Cultivating Solutions: Oyster Farmers' Responses to Environmental Change in British Columbia

by

Catriona Joelle Mallows
Master of Arts (Honours), The University of Edinburgh, 2016

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We acknowledge with respect the Lək̓ʷəŋən peoples on whose traditional territory the university stands and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day.

Supervisory Committee

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Abstract

Climate change is already impacting many coastal ecosystems and the communities that depend upon them. Efforts to mitigate and adapt to it will likely further strain these socio-ecological systems. This points to the need for research that explores the socio-ecological dynamics of environmental change, in order to better understand how community resilience can best be supported during a period of rapid global environmental change. This research uses a case study of the oyster farming industry on the West Coast of British Columbia (B.C.). This thesis explores two interrelated clusters of questions:

1. *How are oyster farmers on the B.C. coast perceiving and responding to environmental change, and what are the implications of this for the governance of the industry?*
2. *What role does—and might—the oyster farming industry play in supporting coastal sustainability in B.C., and how can researchers better support the efforts of those in the industry to solve the challenges they—and coastal communities more generally—face?*

Drawing on field research, including participant observation and sixteen interviews with oyster farmers and industry representatives across the region, this research finds that navigating broader social, political and economic changes is at least as important to farmers as the specific ecological changes with which they are grappling. As these findings suggest, environmental change needs to be understood within the context of the industry and culture on the coast; it should be nested within broader reforms to support the sustainability of the industry and the resilience of coastal communities to which it contributes. Furthermore, despite the myriad challenges facing oyster farmers, this research finds that they are actively seeking solutions to ameliorate the difficulties they face. In turn, environmental research and communication should consider how to better support the cultivation of environmental solutions. In summary, the research integrates the need for socio-political reform and solutions-based research and communication. It contributes to a more comprehensive understanding of how to support people and places during periods of rapid change.

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List of Acronyms

AAA – Aboriginal Aquaculture Association

B.C. – British Columbia

BCSGA – British Columbia Shellfish Growers Association

BCMOA – British Columbia Ministry of Agriculture

DFO – Department of Fisheries and Oceans Canada

FAO – Food and Agriculture Organisation of the United Nations

GHG – Greenhouse Gas

IPCC – Intergovernmental Panel on Climate Change

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Sláinte – to good health.

Dedication

To coastal people who hope for a healthier future.

Chapter 1: Introduction

1. Introduction: Oysters and Environmental Change

Oysters line the coast of what is now known as British Columbia (B.C.) in what is now the settler-colonial state of Canada. Empty shells attest to meals devoured by passing birds. Floating farms in gorges and inlets indicate the pivotal role this marine animal plays in supporting local livelihoods. Indeed, the oyster is a staple in the culture of many coastal communities.

In recent years, however, national newspapers have described increasing mortality rates in shellfish. A headline states, "increase in shellfish deaths causes 'full-scale panic' for B.C." (Luymes, 2015). The industry has been described as 'shell shocked,' unsure if it can weather climate change impacts (Baker, 2020). Roberta Stevenson, a previous executive director of the B.C. Shellfish Growers Association (BCSGA), attributes the animal's fatality to "ocean warming, urban run-off, acidification—it all has an impact" (Luymes, 2015). Similarly, researchers outline stressors, including marine heatwaves, ocean acidification and toxic algae blooms (Baker, 2020).

These changes have significant ramifications. Ecologically, oysters are important for coastal ecosystems: they filter algae, improve water quality, regulate concentrations of microorganisms and plankton, and can promote nutrient cycling (Coen et al., 2007; Jacobsen, 2009; Lemasson et al., 2017; McAfee et al., 2018; Shumway et al., 2003). Sustainable marine ecosystems, which oysters can play a crucial role in, can contribute to carbon sequestration (Ahmed et al., 2017; Fodrie et al., 2017; Luisetti et al., 2014).

Additionally, when oysters are threatened by environmental changes, so are the livelihoods of people who depend on them. As humans and the natural world constantly interact in a 'social-ecological system' (Berkes and Folke, 1998), changes in marine systems also affect people whose lives are closely interwoven with the ocean's activity. Bennardo's (2019) work illuminates that those whose livelihoods are deeply connected to the natural world are most aware of, and at the most risk from, environmental change—

understood throughout this research as changes to the environment, of which climate change is but one example.[1]

This thesis seeks to unpack how environmental changes are affecting oyster farmers on the coast of B.C.[2]—yet it does so in a way that opens up possibilities to explore a nexus of change affecting their livelihoods and their communities. Ultimately, the thesis argues that environmental change has significant ramifications for the industry, but these changes are not the only challenges oyster farmers face. Farmers advocate for more attention to the socio-political dynamics that are affecting both ecosystems and their industry. Furthermore, although many farmers are struggling, they are resilient, hopeful and devoted to their practice. They are cultivating solutions just as they are cultivating oysters. This research highlights the need to simultaneously explore the solutions they are building and how these can be better supported by environmental research and communication.

This chapter provides essential context for the research. I demonstrate the need for analysis of this kind and introduce the methodology and methods used to explore this topic. I offer supplementary context, including attention to aquaculture development and the rise of shellfish farming in B.C. I then conclude with an example of an area in B.C. which has a deep history with the industry. I use this to illustrate how this bivalve is interwoven into the fabric of many coastal communities—implicitly highlighting that the challenges facing this creature may implicate the livelihoods of those linked with its cultivation.

1.1 Environmental Change in British Columbia

Environmental change is not a new phenomenon; it has affected communities for thousands of years—Indigenous peoples have navigated a changing climate for millennia (Turner and Clifton, 2009). However, the pace and scale of human-induced climate

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[1] Ensuring consistent terminology throughout this research was a challenge because there is substantial literature on 'climate change,' but less on 'environmental change;' the two terms are often conflated, yet in my view, they are not interchangeable: climate change is but one facet of environmental change.

[2] Although I chose not to precede every colonial place name with 'what is now known as,' this is implicit throughout this thesis; the places I speak about are the traditional territories of Indigenous communities. Names such as 'British Columbia,' 'Canada,' and Vancouver Island' are colonial constructs.

change[3] is transforming the Earth's climatic systems and ecosystems at rates faster than ever recorded in history. Human societies' pursuit of economic growth and consumption, compounded by colonialism and imperialism, has depleted natural resources, created rising inequalities, and caused a climate crisis (Baer and Singer, 2018; Holthaus, 2020; Klein, 2014). The most recent Intergovernmental Panel on Climate Change report (IPCC, 2018) warned that there is only a 12-year window for serious action to meet the targets agreed upon in the 2015 Paris Accord. As of 2021, there are only nine years left to make the needed changes. By 2050, global emissions must be 45% less than pre-industrial levels to have a hope of remaining under 1.5 degrees Celsius of warming.

As a result of the growing release of greenhouse gases into the atmosphere, ecosystems are already bearing the brunt of local impacts. Globally, marine environments are significantly affected by warmer temperatures, increased salinity, coral die-off, ocean acidification, storm surges and sea-level rise (Talloni-Álvarez et al., 2019). Marine degradation is of particular concern for Canada, as it has one of the most extensive coastlines on the planet (Ecotrust Canada and T. Buck Suzuki Foundation, 2018). The country's West Coast is highly susceptible to the effects of environmental change (Turner and Clifton, 2009). In fact, one-third of this coastline has a moderate to high sensitivity to sea-level rise (Dolan and Walker, 2006). Sea surface temperatures in B.C. have increased 0.56 degrees Celsius per decade since 1935, and if current conditions persist, they are expected to increase by 3 degrees Celsius by the end of the 21st century (Talloni-Álvarez et al., 2019, p. 166). Furthermore, areas in the province which are used by the shellfish farming industry are among the most vulnerable to climate change (Bush and Lemmen, 2019; Okey et al., 2014, 2015).

'Ocean acidification,' one outcome of anthropogenic climate change, is the decrease in seawater's pH (Caldeira and Wickett, 2003; Drope, 2019). It is particularly noteworthy here as it demonstrates the effects of burning GHGs. This change in pH

[3] Although I recognise there are many other terms to describe the current epoch of anthropogenic interference with the Earth's systems, such as 'climate breakdown,' 'climate emergency' and the 'climate crisis,' I use the term 'climate change' as that was the language which felt the most comfortable to use during interviews. I am, however, of the belief that this is an emergency and radical transformations are required.

occurs as the ocean absorbs increasing amounts of atmospheric carbon dioxide and this process severely impacts ecological and physiological properties and processes across various taxa (Boyd et al., 2018). These chemically corrosive conditions negatively impact shell-forming organisms, such as oysters (Drope, 2019; Feely et al., 2016; Gazeau et al., 2013; Haigh et al., 2015; Holden et al., 2019). As outlined by Drope (2019, p. 5-6), when CO_2 concentrations increase in ocean water, there are fewer carbonate ions (an important part of calcium carbonate), which means it is more difficult for calcifiers, such as shellfish, to develop and maintain their skeletons or shells. This is a particular challenge for young oysters beginning their lifecycle.

B.C.'s nearshore and coastal waters are particularly vulnerable to ocean acidification: freshwater inputs from rivers, glacial meltwater and sea-ice melt decrease the ability of coastal waters to buffer CO_2 (Bush and Lemmen 2019, p. 399). Furthermore, this coastline has oceanic currents that cause upwelling events (the movement of deep, acidified water to the surface). These events can acidify (reduce the pH) at shallow depths (Kroeker et al., 2010). While many other environmental challenges are occurring as a result of GHG emissions, some of which are explored later in this thesis, ocean acidification emphatically highlights the extent of human impact on Earth's processes, and its immediate threat to the industry has received significant media attention (see Drope, 2019).

1.2 Research Need

It is well understood that anthropogenic activities threaten human lives and ecosystems: people are bearing witness to the dramatic impacts of climate change and biodiversity decline across the globe. Scientific consensus holds that burning fossil fuels can contribute to an uninhabitable planet for human life. Further still, people and places disproportionately feel the effects of environmental change; climate injustice is a deeply political process (Sundberg and Dempsey, 2013).

Following Stensrud and Eriksen's (2019, p. 17) argument, there is clear evidence to support the existence of climate change, to demonstrate its detrimental impact and to determine how long societies have to act. Stensrud and Eriksen (2019) posit that

researchers need now to continue asking questions about the appropriate courses of action. This is what I seek to do in this research.

In order to ask these questions, many scholars are proposing new approaches to researching and communicating on issues of environmental change. A problem identification lens has—and continues to—dominate environmental research, and environmental communication replicates this focus by taking a 'doom and gloom' approach, focusing on the magnitude and diversity of environmental problems in an effort to motivate action (Kelsey, 2020). Yet this has largely failed to encourage effective action (Gornish, 2017; Kelsey, 2016, 2020; Nerlich et al., 2010) and actually contributes to rising eco-anxiety (Ray, 2020). In this thesis, I consider whether and how scholars should alter research and communication approaches to environmental change.

Political ecology has shaped the formation of this research project. This is a field of study which examines how power structures contribute to environmental degradation—a point I later explore. Bennett (2019) highlights that less than 10% of political ecology research focuses on marine or maritime political ecology. Various scholars have explored the privatisation of resources and coastal commons in fisheries governance (Andriamahefazafy, 2020; Joyce and Satterfield, 2010; Mansfield, 2001), environmental discourses (Campbell, 2007) and the use of knowledge and science (St Martin et al., 2007). Several have turned their attention to the 'blue economy' (Childs and Hicks, 2019; Silver et al., 2015). Despite having a contested definition (Silver et al., 2015), the World Bank understands this broadly as that which "promote[s] economic growth, social inclusion, and the preservation or improvement of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas" (World Bank, 2017, p. 6, cited in Adriamahefazafy, 2020, p. 18). Further still, some scholars (Hadjimichael, 2018; Kallis, 2017) have engaged with 'blue de-growth:' the "equitable downscaling of production and consumption that increases human well-being and enhances ecological conditions" (Kallis, 2017, p. 10).

Several political ecologists have researched shellfish aquaculture across Canada and specifically in B.C. Some have explored private property and Indigenous sovereignty (Joyce, 2008; Joyce and Canessa, 2009; Joyce and Satterfield, 2010). Others have more

specifically researched the muted politics of shellfish aquaculture expansion: how its development has garnered little critique, and how this impacts First Nations' territorial rights and title (Silver, 2010, 2013, 2014a, 2014b). Furthermore, D'Anna and Murray (2015) and Flaherty et al. (2019) have examined public perceptions of the industry in B.C.

Despite these noteworthy studies, however, the need for a community-based study on environmental change remains. In their global perspective on the vulnerability of aquaculture-related livelihoods, Handisyde et al. (2017) recommend more community-level studies to understand local climate impacts. Steeves and Filgueira (2019) also advocate studies of this kind. Focusing their attention on Prince Edward Island and Nova Scotia, they recommend that further research consider how farmers, researchers and regulators perceive the relationship between bivalve aquaculture and climate change. They argue that this work should focus on key stakeholders in the industry rather than consumers and public groups. Further still, in their review of climate change impacts on the Pacific coast, Talloni-Álvarez et al. (2019) argue for more knowledge regarding the socio-economic consequences that climate change may have on fisheries, fishers and local communities. Closer to this research's site of study, Whitney and Ban (2019) advocate for more community-based research which explores local perceptions of climate change impacts, risks, and opportunities in B.C. Closer still, Morin's (2020) study on environmental change and die-off events within the oyster farming industry indicates the need for further in-depth studies of environmental change and the broader challenges facing the industry.

This thesis seeks to contribute to this growing body of literature and to respond to this research need. As the studies above reveal, researchers do not know enough about environmental change at a community-level, how it comes to bear on local people and practices, and how to effectively communicate about it to galvanise support.

1.3 Research Questions

This research addresses a central question: how can community resilience best be supported during a period of rapid global environmental change? My research focuses

this broad question by engaging the specific example of oyster farming on the B.C. coast. The thesis specifically addresses the following research questions:

Chapter 2*: How are oyster farmers on the B.C. coast perceiving and responding to environmental change, and what are the implications of this for the governance of the industry?*

Chapter 3: *What role does—and might—the oyster farming industry play in supporting coastal sustainability in B.C., and how can researchers better support the efforts of those in the industry to solve the challenges they—and coastal communities more generally—face?*

Following suggestions from academic literature, I have identified a significant need to further explore the nuances and intricacies of environmental change at a local level. These particular questions are important as they seek to identify not only the specific challenges facing farmers, but how to understand these issues more broadly to respond and better support farmers and coastal communities into the future.

1.4 Thesis Structure

This thesis has four chapters. It has been written with the intention to eventually publish Chapter 2 and Chapter 3 as stand-alone pieces. As a consequence, there is some repetition in these chapters to ensure they can be read independently.

This introductory chapter provides a brief overview of the research project, my research questions and the methodologies and methods that have shaped my work. I provide critical context to understand this research and explore some literature that has framed the research design. I also include an illustrative example of how the industry is embedded within particular communities on the coast, focussing specifically on Cortes Island.

Chapter 2 is an ethnographic account of environmental change as experienced by oyster farmers across several areas in B.C. It argues that environmental change has socio-political impacts, and therefore demands socio-political responses. Intended for

publication in an academic journal, such as *BC Studies* or *Anthropology and the Environment,* it targets policymakers and the scholarly community.

I had intended for Chapter 3 to build upon the arguments outlined in Chapter 2 and interrogate the problem in more depth, explicitly examining environmental change and how it impacts community relations on the coast.[4] However, through my interviews I discovered farmers were operating in a solutions orientation: they were advancing solutions to problems and were overwhelmingly hopeful in the face of adversity. This is a research finding I will describe in more depth in Chapter 3 as I reflect on the tension between problem-identification and solutions-orientations to environmental research. Indeed, problem-identification approaches to environmental issues are taken for granted norms within environmental research and communication research (Kelsey, 2020). However, an emerging body of research now shows that this form of research and communication has mostly failed with respect to motivating effective action (Gornish, 2017; Kelsey, 2016, 2020; Nerlich et al., 2010; Ray, 2020). Recent scholarship proposes an alternative: being attentive to, and mindful of, solutions. This change in focus has been shown to support greater resilience in the face of rapid change, to help remedy a surge in eco-anxiety, and to encourage collective action more effectively (Ciszek, 2018; Kelsey, 2016, 2020; Knowlton, 2020).

In this context, Chapter 3's overall argument is that research and communication should better consider how to foster, identify and support solutions. Given the challenges facing society, what is needed is not merely an issue of framing and changing our narration on environmental change: in fact, a greater methodological change is required. I critically interrogate the path of my research to argue this point. This chapter targets scholars and communicators, and it is hoped that elements of this work will be published in media outlets such as *The Tyee, The Narwhal,* or *Hakai Magazine* to reach public audiences.

[4] Although I explore this theme throughout the thesis, it warrants further research.

To conclude the thesis, Chapter 4 pulls together my findings to consider the broader implications of this work. It also details the limitations of this line of enquiry and provides recommendations for further research.

1.5 Implications of COVID-19

Before I outline the methodologies used for this research, I wish to draw attention to the implications of COVID-19. Although I conducted research before the pandemic, I wrote much of the thesis during the midst of it. While my data does not speak to managing the ramifications of COVID-19, it does broadly tackle what it means to respond to sudden changes and support innovation and resilience during challenging periods. As a farmer indicated during a follow-up discussion, "nobody buys oysters in a crisis, but that doesn't mean they stop growing!"

As cited in Beer (2020), Seth Klein's words resonate with my understanding of this era. He states:

> But it [COVID-19] can also be an incredible springboard to a decarbonized, more fair economy. Everyone now gets the role and value of ambitious government action. Everyone now gets that you look after the more vulnerable, or we're all vulnerable. There's a new collective understanding that the more an economy is localized, the more resilient we are to disruptions.

There is an urgent need for a just, green and sustainable economy. Recovering from this global pandemic may provide the opportune moment to tackle the climate emergency and repair past injustices to create equitable, healthy communities and ecosystems. This research seeks to contribute to that transition.

I also wish to document the implications of COVID-19 on the research process itself. My work has been inherently place-based, using the case study of oyster farming on the coast of B.C. to explore and understand environmental change. As I will later outline, I was grateful to spend time in particular communities conducting this research. Yet during the outbreak of COVID-19, I returned to my home in Scotland. Although a personal choice—which I am privileged to have had— this posed a significant challenge to me as a researcher: I was writing intimately about places and people, yet doing so from

a completely different coastline, in another place, at another point in time, in a whole other nexus of complex relations. At first, I struggled to situate this work in place as much as I had wished to do so.

Fortunately, although they are adjacent to completely different oceans, there are similarities between my home coastline and those areas where I spent time in B.C., which helped me think through certain issues: for example, the ebb and flow of the ocean typifies much activity in both places. Furthermore, both areas are subject to the boom-and-busts of specific industries, and they also share considerable challenges from climate change. Yet, these two geographies are also typified by stark differences, not least of which is that vast expanses of land and water separate them. To write from these different places, in a different set of relations, placed a significant onus on feeling comfortable with discomfort, managing what felt like a liminal space between two coastlines and multiple ontologies. I often felt neither here, in this place, nor there, where these oyster farmers worked.

To resolve some of these challenges, I checked in with several research participants via phone calls and emails as the research developed. I also relied on academic and media articles, grey literature—such as community forums (for example, Cortes Island's community website: Tideline)—and government reports (see Reid, 2020). Finally, I constantly referred back to data from interviews and field notes to remind me of the intricacies of these changes and what I had heard and witnessed during fieldwork.

2. Methodologies and Methods

This section outlines the methodologies and methods I used to conduct this research. 'Methodologies' refer to the ways that I approached, framed and systematically designed the research questions. 'Methods' are the tools used to collect data and answer research questions.

2.1 Political Ecology

As noted, the field of political ecology has informed this research. This is a diverse and interdisciplinary field of study which uses the lens of power to examine the socio-political, economic and cultural relations which shape and drive environmental problems

(Bishop, 2020; Bryant, 1992; Leff, 2015; Peet and Watts, 2004; Peluso, 1993; Robbins, 2011; Sundberg and Dempsey, 2013). Drawing on disciplines such as sociology, anthropology, geography, feminist theories, and political economy, it analyses systems of power to explore how social, political and economic structures fundamentally drive ecological degradation and breakdown. Sundberg and Dempsey (2013, p. 178) state:

> While an apolitical ecology ignores power relations, policy structures and the market economy, a political ecological approach includes them. This means that political ecology necessitates methodologies to examine phenomena that may be difficult to fully observe—colonialism, globalization, racism, sexism—but which leave their marks on bodies, landscapes and soils.

This quote showcases that political ecology takes a particular methodological approach to research: it considers phenomena often difficult to see. While it is paramount to better understand the ecological impacts of environmental changes, this field suggests that research be attentive to the nuances of environmental change and its drivers. In other words, if environmental degradation is political, then understanding its construction and providing solutions should be situated in a broader context that envelops social and political processes. I sought to do this in my research by being open to hearing and considering broader socio-political issues within the context of these specific ecological changes.

Furthermore, scholars sometimes view political ecology as a 'community of practice' rather than a field (Robbins, 2011). With this in mind, I used political ecology as a reference point. Without undermining its critical contributions to academic literature and policy, I also utilised it as a reference point to ensure my research was attentive to power dynamics, socio-political processes and the invisible phenomena, to which Sundberg and Dempsey (2013) allude above.

2.2 Anthropology and Ethnography

Concerned with how humans have changed over time and space, anthropology is well-positioned to explore the implications of environmental change and potential local and regional solutions. Various scholars have explored this through a range of case

studies (Crate and Nuttall, 2009, 2016; Cruikshank, 2000; Doolittle, 2010; Hastrup, 2013, 2018; Rudiak-Gould, 2013; Strauss and Orlove, 2003). Although varying in arguments and content, their work predominantly explores lived experiences and understandings of environmental change.

Given the scale of change needed to respond to the climate crisis, some anthropologists demand that further attention is paid to its structural roots to propose better alternatives. As explained by Baer and Singer (2018, p. 39):

> Anthropologists need to examine more closely structural causes of climate change and the anthropology of the future, in order to transcend the existing global political economy into an alternative world system based on social justice, democratic processes, environmental sustainability, and [a] safe climate for all of the peoples living on our fragile planet.

A specific industry, explored through a local study, provides a helpful lens through which to examine climate change, giving rise to a deeper understanding of socio-economic, political and cultural contexts that shape people's lived experiences (Brown and Purcell, 2005; Crang and Cook, 2007; DeLyser et al., 2010; Silver, 2010). I was intrigued by the opportunity to explore a global industry, such as oyster farming, at a local scale.

I engaged in community-based research using ethnography, the study of a particular group of people in their 'natural' surroundings (Burawoy et al., 2000). As anthropology's primary method, ethnography can investigate and affirm the "complexity of change affecting rural livelihoods" (Crate and Nuttall, 2016, p. 151). It has methodological importance; firstly, it emphasises "being there" (ibid, p. 143). This is important to gain insight into the perceptions of environmental change from farmers themselves. Secondly, ethnography can bridge understandings beyond the local to reach global audiences (ibid, p. 143). Through fieldwork, ethnographers can: "acquire a keen sensitivity to change and can identify the various mix of changes at work… Local studies highlight how a global phenomenon such as climate change is having ecosystem and culture-specific effects" (ibid, p. 155). The issues may be particular to that community, but these concerns are not uncommon to a vast array of communities world-wide that face changes in their environments (Armitage et al., 2017; Baztan, 2015; Bennett and Dearden, 2013).

It is important to emphasise that anthropology has deeply-rooted inadequacies, of which contemporary scholars—and the communities subject to the discipline's gaze—are acutely aware. Smith (2012, p. 130) states that "of all the disciplines, anthropology is the one most closely associated with the study of the Other and with the defining of primitivism." I recognise that this discipline was born out of imperialism and colonial hegemony (Huizer and Mannheim, 2011; Lewis, 1973; Pels, 2008). There is a nebulous history between anthropologists and Indigenous communities across what is now known as Canada. Although the discipline is in an ongoing process of reflexivity, there are still ethical tensions. These are particularly pertinent for non-Indigenous researchers working with Indigenous communities. I speak more about this in section 2.4 and 2.5.

2.3 Methods

To explore the case study of shellfish farming, particularly oyster farming, I used qualitative methods. I spent seven weeks conducting fieldwork, holding 14 semi-structured interviews with oyster farmers and two interviews with industry representatives. Upon receiving approval from the University of Victoria Human Research Ethics Board (19-0117),[5] I contacted one farmer, who then put me in touch with others. I also received recommendations from B.C. Shellfish Growers Association (BCSGA) and the Aboriginal Aquaculture Association (AAA) to contact farmers.[6]

Interviewees were from five different locations across Vancouver Island, each of which contains many aquaculture leases. As Figure 1 illustrates, I spoke with folks from Baynes Sound, Bamfield (Barkley Sound), Lemmens Inlet (Clayoquot Sound), Cortes Island, and Quadra Island[7]. The process of interviewing farmers across different areas emerged organically, as farmers recommended certain individuals from different areas and connections grew from there. I was encouraged by this as I believed that hearing

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[5] See Appendix A for Certificate of Approval.
[6] This thesis refers to interviewees predominantly as 'oyster farmers,' though some farmers occasionally identified themselves interchangeably as 'growers' or 'shellfish farmers.'
[7] These are the overlapping traditional territories of many First Nations: respectively, K'ómoks Nation (Baynes Sound), Huu-ay-aht Nation (Bamfield), the Ahousaht, the Hesquiaht and the Tla-o-qui-aht Nations (Clayoquot Sound), the Klahoose Nation and the We Wai Kai Nation (Cortes and Quadra Islands) (British Columbia Assembly of First Nations, n.d.).

from interviewees farming in diverse locations potentially strengthened the research; it offered some diversity in environmental variability and experiences with the industry. I briefly summarise some key characteristics of these different growing areas and then elaborate on how these sites played into my analysis.

Baynes Sound is home to many of the largest oyster farms in the region. Morin (2020, p. 12) states that 47% of the area's farms are medium-sized, meaning they have four to eight employees or produce around 50,000 dozens of shellfish per year. Another 47% of farms in this area are large and extra-large (with eight or more employees or 175,000 dozens or more shellfish produced per year). Approximately 50% of all B.C. farmed shellfish is grown in this area (Fisheries and Oceans Canada, 2017).

The Discovery Islands, which notably include Cortes and Quadra Islands, are home to many smaller farms (Morin, 2020, p. 12) in that they have one to three employees or produce approximately 25,000 dozen shellfish per year. Many of these farms are the oldest in the province (Morin, 2020, p. 12). This area generates 30% of all farmed shellfish in B.C. (Drope, 2019, p. 20).

Farms located on the West Coast of Vancouver Island are also small in size and are some of the youngest in the province (Morin, 2020, p. 12). I was particularly interested in hearing from farmers in these locations to potentially identify similarities and differences in the experiences of farmers on the east and west of the island. Furthermore, there is also a complex history of environmental conflict in this region (see Shaw and Magnusson, 2002). I was curious to hear whether this context had influenced the development of oyster aquaculture in the area.

Although there are some farms on the North Coast of B.C., I did not interview folks in this area. This is because I did not receive any connections to those farming there, and there may not have been enough respondents from this region to ensure participant anonymity.

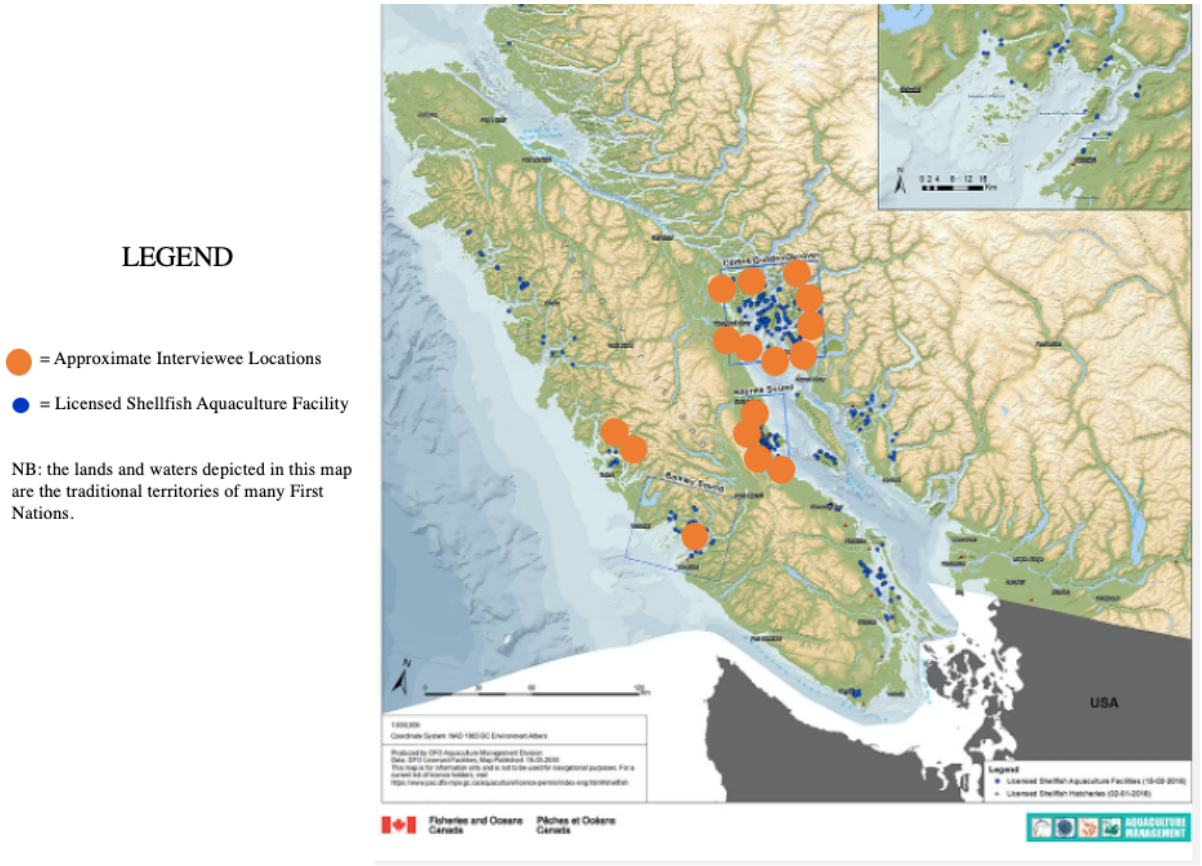

Figure 1: Interviewee Locations (Adapted from Department of Fisheries and Oceans Canada, 2018)

I chose to conduct semi-structured interviews because I wanted to carve out space in the conversation for farmers to identify and discuss issues that were important to them. According to Mason (2004, p. 2), interviews reflect "an ontological position that is concerned with people's knowledge, understandings, interpretations, experiences and interactions." I thought it was essential to embody an "interactional exchange of dialogue" in this research, where the role of the interview is to "ensure that relevant contexts are brought into focus so that situated knowledge can be produced" (ibid, p. 2). I engaged participants as agents who were active in knowledge production, rather than subjects of study from whom knowledge is extracted.

Unfortunately, there is a lack of substantial data regarding the industry's demographics but the sample of farmers I spoke to points to its potential diversity.[8] Participants' ages spanned from thirty to eighty years old and they had a range of experience in the industry. Some were the owners of large companies employing fifty or more people, while others were small-scale farmers employing one to two people. Some participants had been farming for three years, whereas others had worked in the industry for over three decades. The sample of farmers I spoke to include both men and women and racialised minorities. Most of my participants were non-Indigenous, a significant limitation that I discuss further below.

Whilst I sought to ensure I interviewed as diverse[9] a group of participants as possible, I did mostly interview men: only four of those interviewed were women. This bias may stem from heteropatriarchy and relate to broader gender disparities in industries such as fishing and aquaculture (see Gustavsson, 2020; Weeratunge et al., 2010). However, I did hear from many participants that women have played a central role in this practice and continue to do so. Given this, it might be interesting to examine gendered relations within this industry in further research.

Interview questions[10] were structured to gain an understanding of: (1) the environmental changes farmers had noticed; (2) how they felt about them and were responding to them; and (3) the challenges facing the industry and coastal communities more broadly. Interviews averaged sixty minutes in length, with some as short as thirty minutes and others more than one hundred minutes. All interviews were conducted with informed consent and were audio-recorded. I transcribed interview transcripts verbatim and then coded them using the textual analysis software Nvivo 12.

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[8] It may be helpful to include more information about the farmers I spoke with, particularly given the section that follows about my own positionality. However, I chose not to do so as I wanted to ensure participants' anonymity as per the research's Research Ethics Approval. Despite this, I do occasionally expand—where it felt necessary to do so without compromising anonymity—on some farmers' characteristics.

[9] In most cases throughout this thesis, I refrain from using gendered pronouns unless they were made clear to me.

[10] See Appendix B for interview questions.

In line with Thomas (2006), I took an inductive approach to analysing data; I allowed research findings to emerge from significant themes in the raw data, developing an analysis of the structure of experiences that became evident. As I started to analyse the data, it became clear that farmers generally shared similar experiences rather than having isolated or conflicting ideas or perceptions. This then influenced further analysis. Instead of comparing how changes were being perceived differently across the region, as others have done (see Morin, 2020), I aggregated the location-specific experiences of farmers. The research's aim was not to quantitatively analyse the differences between farmers' experiences. Instead, it sought to be attentive to the dynamics of this industry and how—as a community—farmers across B.C. are navigating unprecedented challenges.

However, where relevant, I do add nuance to farmers' particular experiences in different areas. Although participants remain anonymous, I have coded direct quotes to ensure that the reader can track comments:

> **CI 1-9** represent interviewees from around Cortes and Quadra Islands, with each interviewee receiving a number between 1 and 9
>
> **BS 1-4** represent four interviewees from around Baynes Sound
>
> **WC 1-3** represent three interviewees from the West Coast of Vancouver Island
>
> **CM** represents me as the interviewer.

Further to conducting interviews, I also chose to engage the method of participant observation. Often referred to as "deep hanging out" (Geertz, 1973), this involves both observing and interacting with participants and engaging in their activities (Spradley, 1980). I specifically spent time with five farmers from Cortes Island and assisted in grading and moving oysters, collecting beach oysters, and manoeuvring equipment. I also attended community events and festivals. During these activities, I took field notes of conversations, experiences and reflections from my perspective. Due to time constraints, I was only able to pursue participant observation with farmers on Cortes Island, which nonetheless is a particularly illuminating site and offered rich insights into the industry and its challenges. I further elaborate on this in Section 4.

I analysed field notes from participant observation in tandem with my analysis of the interview transcripts, inductively allowing significant themes to emerge from the raw data. Again, I aggregated the experiences of farmers across different geographic locations to present a comprehensive study of farmers' perceptions of environmental change.

Whilst the thesis is peppered with ethnographic details, this data influenced the research and writing more implicitly than explicit data derived from interviews. Indeed, most of the arguments I present specifically use direct quotes from farmers, centring their views and using their words as much as possible.

2.4 Positionality: Locating Myself

Sundberg and Dempsey (2013, p. 176) state that "who we are and where we stand has profound implications for the knowledge we produce." I write as a white woman from the Scottish Highlands. I am cis-gendered and able-bodied. My life, worldview and ability to conduct this research are shaped by, and nested within, structures of colonialism, heteronormativity and privilege. As half of my family are Gaels and half are English, my ancestry straddles people who were colonised and who were colonisers. This is a tension I have thought much about as a Scot living and learning on stolen lands.

The Gaelic poet, Sorley Maclean, speaks about the Highland Clearances—the forced emigration of many Gaels to lands overseas. Whilst I greatly appreciate the following quote, I also find some discomfort in it: Maclean speaks about a process which greatly altered the lands, waters and people across what is now known as Canada. Cited in Ross (2018, p. 62), Maclean states:

> … the thousands of families forced from their homes in the Highlands and Islands. Why was all that? Famine? Overpopulation? Improvement? The Industrial Revolution? Expansion overseas? You see, not many of these people understood such words—they knew only Gaelic. But we now know another set of words: clearance, empire, profit, exploitation; and today we live with the bitter legacy of that kind of history. Our Gaelic language is threatened with extinction, our way of life besieged by the forces of international big business, our countries beggared by bad communication, our culture is vitiated by the sentimentality of those who have gone away. We have, I think, a deep sense of generation and community but this has in so many ways been broken.

Maclean's words starkly show that many people were forced from their homes during the Highland Clearances in favour of "profit and progress." However, this relocation is also a story of colonisation in Canada; many Scots went to what is now known as Canada, and some went to an area of land now known as British Columbia. They uprooted Indigenous ways of living, the repercussions of which are pervasive today in visible and invisible ways. Indeed, settler colonialism is an "ongoing and persistent invasion," write Larsen and Johnson (2017, p. 4).

I am continuously learning and unlearning what it means to have privilege and what my responsibilities are to people and places. I am an uninvited guest to what is now known as Canada, and to the lands and waters of the Lək̓ʷəŋən speaking peoples, on whose territory the university stands and where I have been grateful to live in and study. I was an uninvited guest to the lands of the Klahoose Nation, where I conducted most of my fieldwork. I had no relationships with Indigenous peoples in Canada. Whilst I identify as an ally to Indigenous communities demonstrating their right to self-governance, it is important to recognise my whiteness, the destructive practices I have benefitted from, and the ongoing injustices people like me contribute to every day.

I am appreciative of Māori scholar Linda Tuhiwai Smith's (2012, p. 2) helpful sentiment for non-Indigenous scholars that research is a significant site of struggle. Many people have offered support during the research process, for which I am grateful. One instance was particularly helpful: during the Corporate Mapping Project Summer Programme 2019, in the warm month of June, a group of students sat in a brightly lit classroom and heard a powerful presentation from Caleb Behn, an activist from the Dene Nation. Throughout the talk, Caleb spoke about colonialism, resource extraction, and privilege, before finishing with some helpful advice: as a group of educated students, we *must* use our skills for good. He said, "we need more poets, more writers."

2.5 Research as a Significant Site of Struggle: Limitations

There are significant limitations to this research. Primarily, this research is not able to speak to the experiences of Indigenous[11] communities despite the shoreline being a site of spiritual, cultural and community importance for many First Nations (Hunt, 2021). There is an adage among many Coastal Salish peoples that "when the tide is out, the table is set" (Charles et al., 2004; Donatuto et al., 2011; Hunt, 2021; O'Neill, 2019). For example, clams were—and still are—an essential part of many diets, providing stability and food security to many communities (Deur et al., 2015; Lepofsky et al. 2015). Their production has been managed by Indigenous peoples for over 10,000 years (Groesbeck et al., 2014; Lepofsky et al. 2015).

Despite this, however, Indigenous communities' ongoing relationships to and with the shoreline were not the focus of my analysis. This is a considerable limitation, which I would have liked to address. I did not, however, feel able to do so. Given the time constraints, the lack of research experience, and the lack of relations I had with Indigenous peoples, it was not possible to build adequate, appropriate and respectful relationships with these communities. Increasingly aware of the ways in which Western scholars have conducted research in Indigenous communities in precarious ways (Brant-Castellano, 2004; Smith, 2012), I did not wish to be a 'parachute' researcher, as also outlined by Bishop (2020, p. 18), and so steered away from the possibility of collecting data which suited my needs and then leaving a community (Brant-Castellano, 2004).

The lack of Indigenous perspectives is a particularly stark limitation as shellfish farming provides a very rich site for future research that centres Indigenous peoples and their knowledge of lands and waters, food systems, and climate solutions. Engaging with First Nations would have greatly altered the project, so I hope further research on shellfish farming, environmental change, and coastal relations appropriately centres Indigenous communities and their knowledge.

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[11] I use the term 'Indigenous' throughout this thesis when broadly referring to Indigenous peoples in Canada. 'First Nation' is used to describe Indigenous groups in British Columbia. My use of language is notably guided by UBC's Indigenous Peoples: Language Guidelines (2018) and Johnson and Wilkinson (2020).

Another limitation is that I spoke predominantly with advocates of the shellfish farming industry. I therefore interacted with an echo chamber of knowledge regarding the ways this industry supports coastal communities, interviewing many people who were sympathetic towards the industry and its future. There are significant tensions on the coast with regards to aquaculture development, but due to the time constraints of completing a Master's project, I was unable to contend with these. Some of these tensions did, however, influence my participants' experiences and insights—this was evident in our conversations and engagements. D'Anna and Murray's (2015) research, which explores community perceptions of shellfish farming, was also constructive in adding nuance to my understanding of this industry.

There are also limitations with this work as I had a relatively small sample size given that around 40 to 60 people participate annually in commercial shellfish aquaculture in the province (Reid, 2020, p. 2). Further to this, some conversations with farmers lasted less than an hour yet these dialogues have become entrenched in my thinking about environmental change, coastal communities and livelihoods. In this context, it is paramount to acknowledge that this is one story where there are others to be told and it is specific to my research participants. It should then be understood as a snapshot of a story—one that necessitates further research.

3. Critical Context

In this section, I speak to the development of aquaculture in the province, particularly of the rise in salmon and shellfish farming. The history I outline is just one story where there are many others to tell. Finally, I introduce Cortes Island, where I conducted most of my fieldwork.

3.1 Aquaculture

Nearly 90% of the world's marine fish stocks are now fully exploited, overexploited or depleted (Kutuyi, 2018). Demand for seafood continues to rise, but further production is challenged by changing ecological conditions, pollution and overfishing (Christensen et al., 2014; Costello et al., 2016; Pauly and Zeller, 2016). Aquaculture—the farming of sea organisms such as fish, shellfish and seaweed—is often

posed as a solution to this problem. The sector currently produces one half of all fish consumed by humans (D'Anna and Murray, 2015; FAO, 2014). Many governments and agencies propose that it can further develop to meet global demands (FAO, 2016; Flaherty et al., 2019; Kobayashi et al., 2015). A "blue revolution" is frequently touted, based precariously on the perceived—and now contested—successes of the green revolution in intensifying food production (Volpe, 2008). However, myriad issues constrain its growth, including environmental conditions, the declines of wild fish to feed the farmed animals, diseases, the externalities of natural stocks and the habitats of local areas (FAO, 2016; Smith et al., 2010). In Chapter 2, I argue social and political processes also inhibit its development.

3.1.i Aquaculture in British Columbia

With approximately 25,725 kilometres of shoreline, B.C.'s coastline boasts sheltered inlets and temperate coastal waters (Sebert and Munro, 1972). Much of this rugged area is remote and lacks road access. Given that aquaculture thrives in clean environments, many companies saw these coastal areas as desirable for aquaculture expansion.

Yet it is not just B.C.'s coastline that greatly determined the industry's expansion. Governmental support and neoliberal policies gave the industry vast room to expand: the provincial and federal government bolstered it as an economic development opportunity to remedy some of the repercussions from boom-and-bust industries (Belton and Little, 2011; D'Anna and Murray, 2015; Markey et al., 2012; Time Magazine, 2011). In B.C., there are different aquaculture operations, including both finfish (notably salmon) and shellfish.

3.1.ii Salmon Farming

Salmon farming began in the province during the 1970s. Its development was touted on three promises (Volpe and Shaw, 2008). Firstly, the government promised that the industry would provide economic development to rural areas that had previously been hit by the downturn of resource-based industries. With the downturn in logging and the increasing instability of the wild salmon fishery, the promise of jobs and economic

development was enticing for both communities and governments. Secondly, it was promised that it would help feed the world through the production of protein. Finally, it would relieve pressure on wild salmon stocks.

In the 1970s, two Pacific salmon species (Chinook and Coho) were initially farmed in B.C. However, the non-native Atlantic salmon soon replaced them. This was because Atlantic salmon can grow much faster and can adapt to higher stocking densities (Salmon Aquaculture Review, 1997). Over the course of two decades, the salmon farming industry in B.C. grew. In 1988, there were 101 salmon farming operations, most of which were small scale. However, in the 1990s the industry consolidated, partly in response to market challenges and difficult environmental conditions (Flaherty et al., 2019). What is particularly important in this instance is that Norway, a country which had played a considerable role in growing the industry, had experienced major wild fish declines due to the farm-borne parasite *Gyrodactylus* in the early 1980s (Volpe and Shaw, 2008). Norway subsequently reconfigured its regulations, forcing companies to either adapt or find alternative venues. This coincided with significant political decisions in Canada: the prime minister at that time, Brian Mulroney, had replaced the *Foreign Investment Review Act* with the *Investment Canada Act*. This stipulated that Canadian registered companies did not need to be majorly owned by Canadian citizens (Volpe and Shaw, 2008, p. 5). Suddenly, Canada's coastline was enticingly open to Norwegian-owned salmon companies. These companies quickly moved their operations halfway across the world to B.C. waters.

Problems, however, soon bubbled to the surface. These include, but are not limited to: salmon escapes, the hybridisation of wild and farm salmon, increased competition for wild salmon, increase in sea lice and other parasites, the transmission of infections, pollution on the seafloor and the decimation of smaller fish stocks for fishmeal (Bateman et al., 2016; Krkosek et al., 2006; Lafferty et al., 2015; Volpe, 2008). These challenges continue to date, with many land-defenders and protestors taking a stand against the industry—see, for example, the Dzawada'enuxw Nation who have taken the federal government to court over fish farms in their territory (Cox, 2019; Gilpin, 2019). Resistance to the industry is perhaps made more poignant in that three Norwegian

companies now own around 90% of salmon farms in B.C. (Findlay, 2018). There have been huge criticisms about this structure of business ownership, whether these companies care for the environment where their farms operate, and whether this actually offers a sustainable economy for rural areas (Campbell, n.d.; Salmon Nation, 2020).

The above may seem tangential to the farming of shellfish. However, this information is integral to better comprehend the shellfish industry in B.C. Both industries (salmon and shellfish) share similarities and are frequently connected in the public mind: animals are farmed in marine environments; infrastructure is needed on the water to contain these animals; most activities take place in coastal areas ideally away from large urban centres; and both practices can offer year-round work in rural areas. However, the industries are also starkly different, and this points to a potential need for the shellfish industry to overcome some detrimental press coverage—a point further expanded upon in Chapter 3. It is important to note that shellfish farming uses different agricultural practices and is generally considered to be more sustainable than carnivorous fish farming (Naylor et al., 2000). For example, shellfish are filter feeders. They do not require exogenous feed (from farmers) as they sieve and digest phytoplankton and zooplankton in the water column. They also generate fewer waste products, and require less energy per unit of biomass than higher trophic-level species such as finfish (Joyce and Canessa, 2009, p. 586). Furthermore, the shellfish industry encompasses 300 producers in B.C. (DFO, 2017). These businesses vary in size and many are rooted in communities and form part of the culture on the coast—an idea I explore later in the case of Cortes Island. The socio-economic scenario of shellfish farming is therefore vastly different from the overseas corporations' domination found within the salmon farming sector.

In light of the above, the next section provides a brief history of shellfish farming in B.C. It includes important contextual information needed to understand the practice, its vulnerability to environmental changes and its potential role in supporting coastal communities.

3.1.iii Shellfish Farming

In what is now known as B.C., intertidal and nearshore zones support approximately 180 different bivalve species (estimate by Neil Bourne in Broadley et al., 1988, p. 7 cited in Silver, 2010, p. 13). Many of these are essential sources of food for local communities (Parrish et al., 2006; Silver, 2010, p. 13; Uu-a-thluk, 2008). Yet some are also invasive species that have colonised the area. The only native oyster in British Columbia is the Olympia (*Ostrea conchaphila*) oyster. They grow slowly, are between 6 and 9 centimetres long, and have been harvested by First Nations for time immemorial (Harris, 2008; Mos et al., 2004; Uu-a-thluk, 2008). They were first commercially harvested in B.C. in 1884 (Gillespie, 2009). This continued until 1936 when stocks collapsed due to overfishing, winter mortalities, and the increasing competition with invasive, newly colonising species, the Eastern/American oyster (*Crassostrea virginica*)[12] and the Pacific oyster (*Crassostrea gigas*) (Ketchen et al., 1983). The Olympia was then listed as a 'species of special concern' in 2003, under the Canadian Species at Risk Act (Species at Risk Public Registry, n.d.). It is rarely seen on beaches now given predation from invasive species, pollution, limited habitat and competition with the Pacific oyster (Trimble et al., 2009; White et al., 2009). However, efforts to build its population are underway (see Native Olympia Oyster Collaborative, n.d.).

The non-native Pacific oyster, *Crassostrea gigas,* is now the most prolific oyster in B.C. Endemic to Northeast Asia, these cupped bivalves grow in temperatures ranging from 3-35°C and a range of salinities (Strand and Lindegarth, 2014; Quayle, 1988). Adult oysters grow to 10-15cm in length and have two greyish white exterior shells joined at one edge by a flexible ligament (Cowan, 2020; Galstoff, 1964; Quayle, 1988).

This species was first introduced in the early 1900s to areas around Ladysmith in lower Vancouver Island (Ketchen et al., 1983). Between 1929 and 1932, four million small oysters (known as 'seeds') were imported from Asia and placed in southern areas of the island (Ketchen et al., 1983). The Second World War halted further shipments, but

[12] The Eastern oyster was introduced to B.C. in the early 1880s, but its colonisation was limited: it now only resides in a small area near the mouth of the Nicomekl River (Gillespie, 2007; Ketchen et al., 1983).

by then, oysters were naturally reproducing in the waters; the first widespread spawning event occurred in 1942 as the warm temperatures in the Strait of Georgia facilitated faster growth than elsewhere in B.C. (Ketchen et al., 1983; Silver, 2010, pp. 120-125).

The Province implemented new regulations to curb the over-consumption of this new resource. For example, in the 1950s, only those with a permit to harvest wild oysters could do so (Ketchen et al., 1983). These licensed farmers had permission to collect juvenile oysters and 'set' them onto structures, where they were then grown to size in dedicated intertidal areas and sold as 'shuck' (where the meat is taken out of the shell before selling or further processing) (Silver 2010, p. 124). This was the first step of many by the provincial government to regulate the resource and further govern the shoreline and ocean—areas I understand in this thesis as 'watery spaces,' drawing from Larsen and Johnson (2017, p. 57).

By the 1970s, farmers changed their growing techniques as market demands grew for more oysters served in half of their shells (the half shell market) (Silver, 2014a, p. 5). To grow oysters with a more desirable shape and size, farmers began moving their oysters from the intertidal zone to suspending nets and trays in deeper water (Clayton, 2002). Colloquially referred to as 'off-bottom techniques,' this is commonly seen today in B.C., where plastic trays are anchored on long-lines or floating rafts. As the oysters are suspended in deep water, they feed on phytoplankton constantly, rather than only when the tide is high; essentially, they can grow three times faster than at the intertidal zone (Mamoser, 2011, p. 37). Farmers can also densely stock them, and protect them from predators, reducing overall mortality rates. However, this practice means that oysters' shells are softer, given they have not had the opportunity to harden as they would when they bashed around on the beach. Many farmers still require access to an intertidal site for the shells to harden before selling.

As markets continued to grow in the 1980s, the provincial government expressed considerable interest in further developing the industry; they often heralded the economic opportunities for rural, coastal communities and the ability to grow what was perceived to be as a 'sustainable resource' in local waters (see Silver, 2010, 2013, 2014a, 2014b). Following a government funded report in 1997 which estimated the sector would grow

from $12 million to $100 million over ten years (Coopers and Lybrand Consulting, 1997), the provincial government launched the 'Shellfish Development Initiative' in 1998 (Silver, 2014b, p. 110). Its main goal was to double the area of private tenure space for shellfish aquaculture; consequently, between 1998 and 2009, up to one hundred new tenures were allocated, comprising just over twelve hundred hectares of coastal space (Silver 2014a, p. 4).

Between 1995 and 2005, the total area devoted to shellfish aquaculture increased by 42% (Joyce and Satterfield, 2010, p. 109). As of 2017, shellfish leases occupy 3,800 hectares of watery spaces in B.C. (DFO, 2017). This has, however, not been without conflict. Joyce and Canessa (2009) and Joyce and Satterfield (2010) argue that shellfish aquaculture expansion creates competition for marine habitat and results in far fewer productive beach areas for wild shellfish. Furthermore, Pinkerton and Silver (2011) show that the paradigm for shellfish aquaculture expansion, rooted in economic development and market-based terms, has been incompatible with local understandings and community-based approaches. Many communities are unhappy with the industry's mechanisation and have concerns about plastic waste debris, noise pollution and local ecosystem impacts (Bendell, 2019; D'Anna and Murray, 2015).

An important part of this narrative is how First Nations have engaged with aquaculture expansion. As noted, First Nations have engaged in shellfish harvesting for millennia and shellfish aquaculture currently provides socio-economic benefits to rural and coastal Nations (Aboriginal Aquaculture Association, n.d.). A recent article in *The Narwhal* showcases Coastal Shellfish as an example (Simmons, 2020). This company grows 'Great Bear scallops,' is Indigenous-owned and operates out of a former fish-processing plant. Yet some scholars recognise the tensions inherent within colonial ideas of watery spaces vis-à-vis Indigenous sovereignty. Joyce and Canessa (2009, p. 601) argue that "non-First Nations aquaculture development was seen as a potential risk to territorial sovereignty and First Nations rights to access traditional resources." Silver (2014a, p. 7) also takes issue with how the state has rationalised the sector's growth based on the idea that the industry carries forward First Nations' human-shellfish relations in the present. Throughout their critical work (Silver 2010, 2013, 2014a, 2014b),

they show that many First Nations still have limited access to their territorial lands and waters.

Further to the complexities outlined above, there are ecological impacts from farming oysters. For example, although oysters do need any 'feed inputs' from farmers (unlike salmon, for example), they remove nutrients—such as phytoplankton—from the pelagic habitat when they feed (Grant et al., 2007). Farming these creatures can also cause eutrophication—characterised as an increase in the amount of plant and algae growth (Cranford et al., 2009), can promote heightened competition with other filter feeders (Pietros and Rice, 2003) and may potentially disturb habitat and prey for other species such as shorebirds and juvenile fish (Bendell-Young and Ydenberg, 2001; Bendell-Young, 2006; Gibbs, 2007). Furthermore, shellfish are broadcast spawners—this is problematic given the Pacific oyster is an invasive species (Mamoser, 2011, p. 20; McKindsey et al., 2006). Finally, there are concerns about the industry's contributions to plastic pollution.[13]

Yet, shellfish farming has supplied an income and way of life for hundreds of people. There are now approximately 467 shellfish aquaculture licenses around the Georgia Basin, specifically Okeover Inlet, Cortes Island, Baynes Sound, and the West Coast of Vancouver Island (DFO, 2017).

[13] It is useful to note that scholars have recently shown that the concentration of microplastics in B.C. farmed shellfish is low—at less than 1 particle per shellfish on average. Further still, the plastic equipment used in shellfish farming is not a significant source of that microplastic (Covernton n.d.; Covernton et al., 2019).

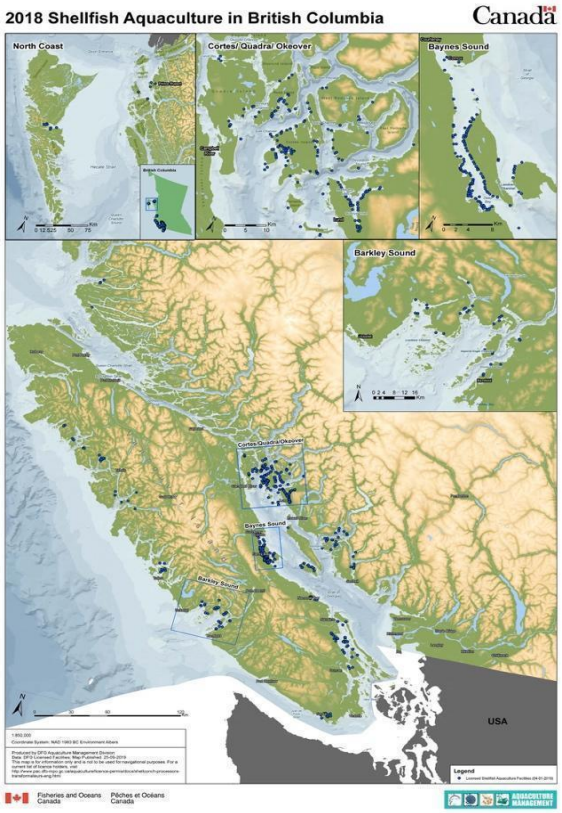

Figure 2: Map of Licensed Shellfish Aquaculture Facilities (DFO, 2018)

The value of the industry has continued to increase. In 2010, the shellfish sector's wholesale value was $32.5 million, with oysters accounting for $14.5 million (British Columbia Ministry of Agriculture [BCMOA], 2010, p. 3). In 2017, it increased to $61.9 million in wholesale value, with oysters' wholesale value accounting for $28.5 million (BCMOA, 2017, p. 12). Unlike salmon farming, the ownership structure of the shellfish sector is more diverse, with 'mom and pop' operations, sole proprietorships, cooperatives and—at the time of writing—one multinational company (Vancouver Island University, 2019).

In sum, the history of shellfish farming in B.C. is complex, with oysters deeply entwined into the lifestyles, history and culture for many people and ecosystems in both past and present times.

4. A History of Oyster Farming in One Locality: Cortes Island

With a history of resource-based industries, including fishing and logging, Cortes Island is not dissimilar to many other places in B.C. As noted by Ommer (2007, p. 23), the coastline of B.C. is "an interface between First Nations and the dominant culture, between industrial and post-industrial economies, between hinterlands and metropoles, rural and urban." However, an excerpt by journalist Ian Ross (2016, p. 1), showcases the particular importance of shellfish to this island:

> To call the harvesting of shellfish an Indigenous activity here on Cortes—rising as it does from the northern waters of the Strait of Georgia—is to make a statement even Huckleberry Finn would say 'warn't much of a stretch.' Imagine Canada without hockey, the States without power, this coast without its sea, and you may begin to imagine life here on Cortes without the harvesting of clams and oysters. Long before Europeans made their way to these waters, Coast Natives [sic] organized their lives around the sea and its wild bounty. Much has changed between those days then and these days now, yet much remains the same: for now, as then, the harvest of the sea is once again a central organizing fact in the lives of many local men and women.

As this island has a deep history with shellfish farming, I trace its relationship to—and with— oyster aquaculture. This is to paint a richer picture of this industry and how it has evolved in specific localities. The details that follow also provide nuance to some farmers' experiences, particularly those coded CI 1-9 who were farming in this region.

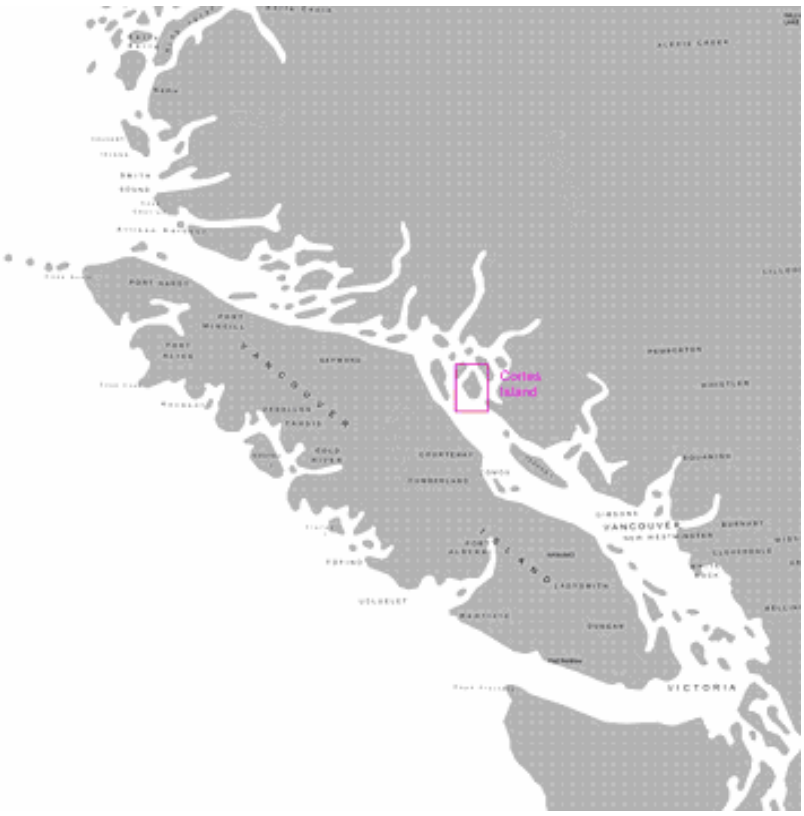

Figure 3: Cortes Island, from Cortes Island Coastal Plan for Shellfish Aquaculture (2003)

The island is located to the east of Campbell River and Quadra Island, lying at the northern end of the Strait of Georgia. It is 25.5 kilometres long, and approximately 13.5 kilometres wide from east to west, and in 2011 had a population of 1007 people (Cortes Island Official Community Plan [CIOCP], 2012). The Klahoose Nation has managed the island for millennia, and still has a significant settlement there and ongoing relations with the coastline. The Sliammon Nation had territorial lands and waters on the island's West Coast, but has not re-established a settlement there since colonisation. Furthermore, the Homalco occupied a village site near the Bute Inlet, but now live on the mainland and reserve lands in Campbell River.

Cortes Island has a rocky shoreline with protected bays and deep channels. There are several settlements and services, including a health centre, library, school

and community halls. Campbell River, however, is the regional centre for goods and services. Travelling there from Cortes Island involves taking two ferries.

Even though the first known Pacific oyster lease developed in the north end of the island in 1938, oyster farming did not significantly arrive on the island until the 1950s. At the time, commercial fishing and logging offered the most lucrative jobs in the area. However, as oysters began repopulating on local beaches, community members soon braced the winter storms to harvest them. People started to work on the beach over a 12-month cycle, picking the largest oysters and leaving small ones to grow. Boats then transported the oysters to shucking plants in Okeover, Sooke and Baynes Sound. In 1978 a processing plant was built in Manson's Landing, on the west of the island, recognising the need to support local jobs. This plant processed "just about everything you could eat from the sea" (Ross, 2016, p. 3). In 1979, Redonda Sea Farms also started operating in Refuge Cove on West Redonda Island. Innovating with new culturing techniques and seed supply in the mid 80s, the company was one of the largest shellfish companies on the B.C. coast and a large employer in the area.

The company's growth continued until 1997, when Fanny Bay Oysters bought them over. This prompted the permanent closure of Cortes Island's processing plant. Many people lost their jobs. Ross (2016, p. 4) explains:

> The industry (though a strange name for work that relies almost wholly on nothing more mechanized or modern than the human back) was by now the mainstay of life for many, many people on Cortes and so the 64 dollar question of 1997 was not whether the local industry would survive, but what it might look like without the central organizing power of… Redonda Sea Farms? And the answer was classic Cortes: rather than becoming bigger, it grew smaller.

In response to this closure, local farmers attained their own leases. Ross (2016, p. 4) notes that "farmers world-wide are being bought out; farmers here are buying in." In 2021, the industry is still important to Cortes Island, albeit much smaller than it had once been. The Cortes Island Official Community Plan in 2012 (CIOCP, 2012, p. 51) recognises its importance; a section devoted to aquaculture celebrates the industry and notes its economic importance to the community.

In conclusion, Cortes Island has a unique relationship with oyster farming, yet my research found that farmers are experiencing unprecedented changes. The next chapter explores how farmers across several areas in B.C are experiencing and responding to environmental change, and how their efforts to find solutions to the challenges it is posing can be better supported.

Chapter 2

This chapter is intended for publication in *BC Studies* or *Anthropology and the Environment.*

1. Introduction

Our pursuit of economic growth and consumption has resulted in the depletion of natural resources and the creation, and continual worsening, of the environmental crisis (Baer and Singer, 2018; Klein, 2014; Parr, 2014). What the future looks like for many local ecosystems and communities is undetermined. This level of change has the potential not only to impact ecosystems but to disrupt local economies and communities, making people and places less resilient. As noted by Baer and Singer (2018, p. 20):

> Human abilities to depend on environmental resources and conditions, feel safe in environmental settings, and plan for the future are threatened by the gradual changes and sudden ruptures of climate turmoil and pluralea[14] interaction.

Since 2000, a range of anthropological literature has explored community resilience through case studies that investigate the local impacts of environmental change (see Crate and Nuttall, 2009, 2016; Cruikshank, 2000; Doolittle, 2010; Hastrup, 2013, 2018; Rudiak-Gould, 2013; Strauss and Orlove, 2003; Townsend, 2017). As defined by Edwards (2009, p. 18), resilience is "the capacity of an individual, community or system to adapt in order to sustain an acceptable level of function, structure, and identity." This thesis broadly understands community resilience—following Baker's conception (2013)—as "the ability of a group of people to mobilise their collective skills, knowledge and resources to prepare for and handle the consequence of emergencies and other threats" (cited in Baer and Singer, 2018, p. 22).

As a discipline concerned with how humans have changed over time and space, anthropology is particularly suited to explore the implications of environmental change and the local and regional solutions needed. However, Baer and Singer (2018, p. 39) call

[14] This refers to a litany of changes resulting from other anthropogenic activities including deforestation, coral reef loss, air pollution and water pollution (Baer and Singer, 2018, p. 16).

for further social science engagement with socio-political processes, particularly regarding the structural roots of climate change. They claim anthropologists should:

> examine more closely structural causes of climate change and the anthropology of the future, in order to transcend the existing global political economy into an alternative world system based on social justice, democratic processes, environmental sustainability, and [a] safe climate for all of the peoples…

While this chapter does not research the structural causes of climate change, it is in conversation with Baer and Singer's (2018) recommendations as I look at the ramifications of environmental change on local food producers, and then map how farmers—and their coastal communities—can be better supported.

The B.C. provincial government promotes oyster farming as a response to depleting wild fish stocks and an opportunity for rural economic development. However, mortality and pathogens have negatively affected the industry in recent years (Baker, 2020; Luymes, 2015). Whilst there have been some social studies conducted on shellfish farming in the province, there has been little attention to the ways in which farmers perceive environmental changes and are impacted by them. This is an important line of inquiry as looking at this specific industry, at this scale, speaks to broader dynamics of change in communities.

2. Research Question

My research engages the specific example of oyster farming on the B.C. coast to explore the following research question:

How are oyster farmers on the B.C. coast perceiving and responding to environmental change, and what are the implications of this for the governance of the industry?

3. Methodologies and Methods

I used ethnography—one of anthropology's defining methods—to draw attention to farmers' experiences and situate their concerns in a broader socio-ecological and political nexus. Often typified by participant observation, it emphasises "being there" (Crate and Nuttall, 2016, p. 143), meaning that the research is open to a full range of observation,

interpretation, and contextualisation. I sought to engage participants as agents who were active in the production of knowledge and who had the opportunity to shape the project, rather than as subjects of study from whom knowledge is extracted. This method paves the way for richer engagement with participants and better elucidates the challenges and how these may be overcome. It also helps to prevent "broad-brush food and climate change" policy approaches, a concept outlined by Reay et al. (2020).

Secondly, ethnography is not merely concerned with local interactions in small communities; it can bridge understandings beyond the local to reach global audiences (Crate and Nuttall, 2016, p. 143). Paerregaard (2016, p. 251) explains this well:

> Strategically situated ethnography… can be thought of as a foreshortened multi-sited project that attempts to understand something broadly about the world system and current globalisation processes in ethnographic terms by understanding them in context of the local and its local subjects.

Paerregaard (2016) highlights that if case studies are strategically sited, they speak to more than just the local context. This is pertinent in my approach—I will show that the experiences of oyster farmers are potentially relevant to other food producers and coastal communities. As noted by Crate and Nuttall (2016, p. 143), ethnographers can: "acquire a keen sensitivity to change and can identify the various mix of changes at work… Local studies highlight how a global phenomenon such as climate change is having ecosystem and culture-specific effects." Ethnography can identify local perceptions of change whilst situating concerns and realities in a context of broader socio-ecological and political change.

I spent seven weeks conducting fieldwork in May and June 2019 and interviewed 14 oyster farmers and two industry representatives in five different locations around Vancouver Island. All interviews were conducted with informed consent and were recorded. I transcribed interviews verbatim, then coded them using Nvivo 12. In line with Thomas (2006), I took an inductive approach to data analysis and allowed research findings to emerge from significant themes in the raw data.

I also spent time engaged in participant observation with five oyster farmers around Cortes Island to explore, first-hand, their way of life and farming practices. I took daily

field notes of conversations, experiences and reflections. I analysed these field notes in tandem with interview transcripts, inductively allowing significant themes to emerge from the raw data.

Interviewees remain anonymous, but I have coded quotes so the reader can track their comments. The coding is as follows:

> **CI** 1-9 refers to interviewees from around Cortes and Quadra Islands, with each interviewee receiving a number between 1 and 9
>
> **BS** 1-4 refers to four interviewees from around Baynes Sound
>
> **WC** 1-3 refers to three interviewees from the West Coast of Vancouver Island
>
> **CM** refers to me as the interviewer.

3.1 Chapter Structure

This chapter begins by outlining the environmental changes that were indicated to me by oyster farmers. These local observations speak to both what farmers are noticing and what is important to them. I then discuss the impacts of these changes and their nuances. Finally, I theorise broader structures that condition farmers' responses and play a role in shaping what happens next for coastal communities. I argue that environmental change has myriad effects on oyster farmers in B.C., but it is not the only change that potentially impacts many communities and their futures.

4. Findings

Table 1 summarises the environmental changes farmers had noticed. These are further contextualised as the chapter proceeds.

Table 1 Perceived Environmental Changes

Observed Change	Linked To
Acidification	Climate change, hatcheries, genetics, global seed reliance, political leadership
Mortality	Coastal development, hatcheries, husbandry practices, food mishandling, global seed reliance, pathogens, political leadership, pollution, water temperatures
Pathogens	Coastal development, globalisation, government management, media and public health, political leadership, pollution, regulations
Temperature change, increased storm severity, changing plankton levels, biodiversity changes, weather	Climate change, husbandry techniques, globalisation, natural cycle

4.1 Ecological Changes: Acidification, Mortality, Pathogens, Warming Water

The section below sequentially lists, in order of the frequency at which they appeared in interviews, some of the changes farmers have observed.

4.2 Ocean Acidification

One of the most referenced ecological changes was, in the words of one farmer, "that of ocean water" (CI 1). This refers to the increase in acidity of the oceans. All

participants, except one, mentioned acidification during interviews, expressing concern about its impact on the marine environment and oysters themselves.

As oceans absorb atmospheric carbon dioxide, this acidifies (decreases the pH) of the marine environment. This subsequently reduces the availability of aragonite and calcite—essential compounds needed for bivalve shell formation (Drope, 2019; Feely et al., 2016; Haigh et al., 2015; Holden et al., 2019). Acidification significantly affects shell-forming organisms when they are first developing—and so many farmers understand that this specifically alters oysters at the beginning of their lifecycle when they are the size of grains of sand, which farmers often refer to as "seed."

One farmer I interviewed had been farming on the coast of B.C. for over twenty years. They explained that the changing acidity of the ocean is the biggest ecological threat to oysters and the industry itself:

> The ocean is very complex. It's not like a lake. It's got competing algae, it's got competing bacteria, competing viruses, it's got many trophic levels, and it normally takes care of everything. But we're just overwhelming it, and then things are changing, ok, but environmental changes. The pH! Water temperature is not really gonna do us in… The pH is gonna do us in. The water temperature is easier for everything to work with—the Pacific oyster grows in Brazil, you know, quite happy… But that pH thing—an oyster trying to grow without a shell? It's maybe not gonna work out so good. (CI 9)

Another farmer I interviewed had been very involved in the industry in the 1980s. They told me:

> Well I mean the big issue is the acidification of the ocean. And it's going to affect anything that has got a shell… So how do you stop acidification? I mean we're not talking about a problem that the oyster industry in B.C. has. We're talking about all the oceans in the world. It's huge—it's so gigantic. Yeah, it's very frightening. (CI 7)

They articulated the implications of acidification not only on oysters in B.C. but on oceans across the world.

4.2.i Potential Acidification Causes

After conducting several interviews with farmers, I realised that although they may associate the issues they are facing with climate change, many did not explicitly say this. Instead, farmers spoke about broader environmental, socio-economic and political processes, which I later argue appeared to be more tractable issues. The following quote was one of the few instances where interviewees correlated climatic change directly with the burning of fossil fuels:

> CM: If you could wave a wand, what do you think we should be doing to help mitigate some of these changes that you've mentioned?
>
> CI 5: go to a green economy!
>
> CM: Well whatever you—
>
> CI 6: And get off oil and stop the climate change!
>
> CI 5: Put the price of oil up so far that people have no choice but to go greener. But help provide for the people that are producing food, you know.

Many farmers said acidification had become a significant issue because the industry itself has become so globalised. For example, oyster farmers purchase juvenile shellfish from a hatchery to begin their farming process. These hatcheries are often located far away—such as in Washington, or further south in Brazil. As there was no hatchery in B.C. when the industry was first developing, farmers became dependent on importing oysters from international areas, which were themselves subject to acidified waters. One farmer explained the difficulties inherent in this process: "Seed availability was a big issue for a couple of years. You couldn't get any" (CI 5).

Another farmer explained why this problem arose:

> Something started to arise in the 10-15 year ago bracket. There were some issues down in Washington which is really where the major hatcheries were situated…We never really had a hatchery in B.C. That was one of the things that stifled our growth and our ability to take on different species. So, one of the problems that happened was they were ending up with lots of die-off at post-larval stage, so they are trying to figure that out, and they even thought, 'well maybe our plumbing has gone bad,' so they re-plumbed an entire hatchery in their off season. And next season the same problems

> existed and they started looking more towards water quality issues, and I think it's really—I can't remember exactly what it was that they found but it was related to… you know, water, especially water that was pushed in certain weather conditions. So that was maybe related to shell formation problems, so that might be something to do with the, I mean… it's the chemistry of the ocean…. (CI 1)

Although the government has protected certain areas of the coastline to encourage wild oyster spawning, and hatcheries are slowly developing in the province, farmers are still dependent on other localities. These localities are subject to their own set of challenges:

> Well, one of the things that came from that [is] that Washington, who is the biggest supplier to B.C... for instance, Taylor was selling us 35 million seeds a year and then all of a sudden, they cut back, and they were selling us 3 million. So where are we gonna get this seed from? A couple of things happened: people were getting seed from Guernsey in the UK there, and also from Chile, you know… once you get into the global trade of shellfish, I'm sure there are going to be some issues that come from that. (CI 1)

Whilst interviewees understood acidification as a considerable challenge, other phenomena—such as the industry's globalisation—posed compounding challenges.

4.3 Mortality

Mortality was another issue many farmers told me about. Over 90% of those I interviewed said they had experienced significant mortality events[15] during their time farming, with the last few years being particularly challenging. One farmer who had spent most of their life growing oysters referenced a particular time-scale: "Our mortality over the years has gone from 18% to 75%. For a few years we had 18% mortality—this was 10-15 years ago" (BS 2).

Another told me that "there were hints of it [mortality] in the past couple of years, but nothing compared to what we went through last year" (CI 5). Furthermore, a couple who had been farming oysters for many decades told me:

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[15] Although mortality occurs naturally in oysters, the recent scale of mortality events in oysters across the region is unprecedented (see Morin, 2020, p. 15).

> It [mortality] caught us off guard. What we're experiencing, I think, has been happening everywhere. And we're just the last to get it. We're catching on, so to speak… Because I mean, France had die-off, Australia has had die-off, and Washington State had die-offs, and now we're getting it. (CI 6)

The quotes above showcase that mortality is a huge cause of concern for many farmers I spoke with, regardless of their business size or their location.

4.3.i Potential Mortality Causes

There is substantial research studying the recent causes of mortality in oysters (see Advani, n.d.; Cowan, 2020; Green et al., 2019; Morin, 2020; Vancouver Island University, 2019). For example, Cowan's (2020) work specifically focuses on Baynes Sound. It finds correlations between summer mortality events and elevated water temperature, increased reproductive efforts and the presence of *V. aestuarianus* in the water column. Yet despite these important scientific studies, many farmers are still unsure of the causes:

> So, is it food? Is it genetics? There are the obvious things that you look at: you can say it's climate change, but also… how good are the breeding stocks that we have? And as a farmer, we have no idea. (BS 2)

The above quote exemplifies the concerns farmers have with seed purchasing—they are unsure of hatcheries' practices.

Some farmers agreed that increasing water temperatures contributes to mass mortalities. Others questioned whether certain husbandry techniques might contribute to oyster mortality. For example, some wondered whether "crowding oysters" together in trays had an impact. There was, however, tenuous consensus among farmers about the direct causes. The uncertainty in grappling with this issue makes it increasingly difficult for them to respond in a manner they think is effective.

4.4 Pathogens

As oysters are filter feeders, they can consume viruses, bacteria and chemicals from the water column. These accumulate in the animal's digestive tracts and may make those who consume them ill (Tollefson and Scott, 2006, p. 3). The BC Centre for Disease

Control (n.d.a, n.d.b) links recent outbreaks of *Vibrio parahaemolyticus* and Norovirus to oyster farms in B.C.

One farmer spoke about why their famous oyster festival closed:

> We used to have an oyster festival here… a lot of people got sick. They haven't had it in three years. A lot of people are aware, definitely. Talking to the odd person on the dock that's driving a boat… 'ah, still haven't got over that—still scared to have a raw oyster.' I've finally got over it, but… (WC 1)

This quote demonstrates the devastating impact pathogens can have on human health and community events. Furthermore, pathogens can cause collateral financial repercussions: one interviewee, who managed one of the largest farms in the province, told me their business was closed for three months in 2018 because of a norovirus outbreak.

4.4.i Potential Pathogen Causes

Many farmers attributed an increase in pathogens to increasing water pollution on the coast. One farmer illuminated this rather emphatically: "Really all we gotta do is control the sewage and the noro will go away" (CI 9). From what I heard, farmers believed that the proximity of humans to oyster farms contributes to the presence of harmful pathogens, and this situation is not adequately managed. In other words, it appears that a lack of political will to appropriately manage coastal development contributes to poor public health. The following quote highlights farmers' frustrations:

> Pollution is a growing concern… Increasing population, the reluctance… communities with old infrastructure to upgrade to new infrastructure is a problem. Locally there's a real sanitary issue with wastewater treatment. Places like Cumberland, for example—a booming community. I don't know what the official expansion rate is, but I'd be surprised if it's less than a 50% increase in the number of houses in Cumberland in the last 10 years, and their wastewater treatment plant hasn't changed since the 1950s apparently… you can have raw sewage running into the ocean. We live in a beautiful place that's world-renowned for shellfish and we have a community like Cumberland that has a wastewater treatment plant that overflows into the Trent River and runs down into Baynes Sound. Primary raw sewage during a winter storm! We have septic systems between here and Courtenay that are not functioning or are non-existent. I would be surprised if you couldn't find a house for sale along the water in Union Bay

> that isn't using a rusted out old 45-gallon drum as a septic system. It's disgraceful actually. (BS 1)

This farmer was concerned that there may be more pollution in the marine environment given the area's increasing coastal development. They used Cumberland to showcase this issue, a town which has seen its population rise from 2,700 to 4,000 between 2011 and 2016 (Findlay, 2019). However, even with this expansion, media sources report that the community remains in non-compliance with managing its wastewater (Van der Zwan, 2019).

This farmer continued to express the challenges of coastal development:

> And the desire to fix it or the mechanism to fix it at the regulatory level doesn't appear to be there. As a shellfish grower you can go in and complain at these meetings that things need to happen, and the solution isn't always 'it's just a public health concern… it's not our job to fix it… it's our job to control the safety of shellfish…' So, Environment Canada, for example. The solution is, well, they'll put in a shellfish closure but they won't go out and deal with the pollution coming down the hill. It's not their jurisdiction, well; it's a regional district or it's a provincial issue or what have you. There needs to be a heightened awareness. (BS 1)

Concerned by these events, this interviewee blamed unwieldy and nebulous governance processes. Rather than imposing restrictions on the shellfish industry, farmers suggested governments should be more aware of the root causes of this issue and implement better regulation to prevent the situation at large. Although farmers had different experiences with regards to pathogen outbreaks, they were similarly concerned by coastal development and faulted a lack of political will to manage pollution appropriately and responsibly.

4.5 Summary of Environmental Changes

Overall, farmers were experiencing a litany of environmental changes, which varied from place to place and from farmer to farmer. They were particularly cognisant of ocean acidity, mortality events, pathogens and warmer water temperatures. Much of what they described is unprecedented, unpredictable and little understood.

Farmers' stories were not simply isolated to their local area; they situated their experiences and understandings in the fabric of a globalised world. One farmer, who began picking oysters with their family when they were very young, outlined the global issue of environmental change:

> But what… What happens… How does what happens in India or China affect us here? There's no walls in the sky where the borders of Canada are, or like the borders of B.C. and Alberta... It's a bigger issue, I think. It's a global issue, it seems to me. (CI 5)

Farmers spoke initially about local events and observations. However, their stories often oscillated to a story of global change. Ocean acidity did not just affect oysters in B.C.—it is a global issue. Others spoke of mortality and questioned its causes, noting that other countries have experienced similar issues. Farmers' narratives swung like a pendulum from local instances to global issues.

Furthermore, farmers brought in other stories of change on the coast of B.C. They told me concerns regarding coastal development, rising pollution and a lack of government support for the industry. In sum, environmental changes and their manifestations were important to farmers, yet other socio-political issues permeated the stories they told.

5. Social Implications of Changes

As humans and the natural world constantly interact in a 'social-ecological system' (Berkes and Folke, 1998), changes in marine systems also affect people whose lives are closely interwoven with the activity of the ocean. In this section, I show how this manifested in the lives of those I interviewed.

5.1 Financial Impacts

Farmers mentioned a host of financial difficulties as a result of challenging environmental conditions. Many of these were further compounded by what they believed was poor government management. The Department of Fisheries and Oceans Canada (DFO), a federal body, manages fisheries and aquaculture. Furthermore, oyster

farmers respond to management from the Canadian Food Inspection Agency (CFIA), the federal regulatory agency which ensures the safety of food, animals and places. With the public's health in mind, regulations now require farmers to monitor water temperatures[16] at their lease sites. One farmer explained this process and expressed frustration:

> It's to the point where we're doing 5 tests per week, or a 5-lot sample, so that costs about 250 bucks plus shipping plus your time. It costs 350 a week and the reality is, I argued with them, that we should have a step response to a step level threat. On May 1st when the programme starts, there's no vibrio anywhere in the water in B.C. but I'm spending 350 a week, Joe is spending 350 a week… so is every farmer who wants to sell raw product. And so are all the plants that are having to do tests, so we're spending an enormous amount of money when there's no threat in the water. And then that really takes away from people's enthusiasm about maintaining a clean product because you're just wasting your money, so why not just save that money for when there is a threat and double down then? (CI 1)

Whilst pathogens pose a detrimental risk to public health, this farmer felt that regulation is spurious and overly cumbersome. They suggested the government does not manage the threat adequately, and they expressed frustration at the general lack of advocacy for the industry. One farmer further explained:

> I don't think fisheries know what's going on. Or CFIA… it's just like somebody who has no idea what they are doing and they are just making arbitrary decisions that are really screwing people up… They need to come out and go out to a beach. (CI 8)

Furthermore, farmers told me how the media reports on the link between pathogens and oyster farming. They said that these somewhat simplistic narratives detrimentally impact the sector. For example, one farmer said: "But it affects us all because CBC broadcasts it: 'don't eat shellfish from, you know, anywhere, basically' is what they're saying. So the market dies" (CI 6). Another farmer of a large operation told me that it is difficult to return to business after being forced to close: "People will drop you… for instance, we

[16] The risk of *Vibrio parahaemolyticus* increases when sea water temperatures reach the 12-15°C range (Konrad et al., 2017; Ndraha et al., 2020, Zhang et al., 2014).

were closed a year ago for norovirus. And that resulted in the loss of 25% of our market, and it's taken us the entire year to get it back" (BS 2).

Many farmers explained that all of these issues disproportionately affect small farmers:

> CI 6: You know, it makes you wonder, you know, if all of these things add up… the testing, the unreliable seed, the oyster dying off, the little guy—the little farmers—they're not gonna survive. And we're a little farmer. I mean the big ones… they can probably survive because they have so much capital and so much infrastructure. And they'll keep doing it. But… us, having to carry the burden…
>
> CI 5: Yeah for big companies, the testing and that is nothing. Whereas you know, for us, it's huge, in comparison. And all the fees that we have to pay are the same as what they pay and it's pretty hard to compete.

Finally, farmers were worried that poor governance from local, regional and federal bodies makes them vulnerable to changes.

> So, when you don't have an advocate you just get lost sort of in the shuffle. You know you're somewhere between fisheries and farming. And it's never been defined. If you go into the parliament buildings in Canada, and the main hall foyer, there are four statues: one in each corner.… lumber, farming, fishing, mining. They're the sectors that are represented. That goes right back to the constitution, you know, where these sectors were seen as the backbone of the country. Well no one has ever brought in legislation to protect aquaculture, because it didn't exist. And so it comes in after the fact and no-one's prepared to, for whatever reason—whether it's social issues, perceptions, conflict between wild and farmed, I don't know. (BS 2)

These stories show that farmers were not only feeling pressure because of changing environmental conditions. Regulations, pollution, and poor political support were also challenging their ability to sustain their livelihoods. Section 8 further expands on this.

5.2 Emotional Impacts

Farmers felt very emotional about the challenges facing them. One farmer told me:

> I don't even know how to describe it [climate change]. It's completely beyond the personal. It's sort of like watching, or hearing… I couldn't even

> bear to watch, but when I heard about the Notre Dame cathedral burn. Just magnify that a thousand fold. That's what it feels like. Now that was an accident. This is wilful. We have been warned, right, like if somebody had spotted that fire in Notre Dame, they would have put it out, right, and they tried with all their hearts, and people threw money at it immediately and everybody watched and stuff like that. I am so ashamed. (CI 2)

This farmer evidently understood the words 'environmental change' as related to 'climate change,' and they correlated this process with the wilful destruction of the Earth's systems. Another farmer explained that the challenges facing their way of life are impacting their personal life: "We certainly didn't make money. It was a big strain on everything… like relationships" (CI 3). Environmental change is not simply concerned with ecological changes in the natural world; it is a highly social phenomenon with emotional impacts, which in turn have broader reverberations[17]. Indeed, this aligns with some issues presented in a recent article on commercial fishers' mental health (Couch, 2021).

5.3 Livelihood Impacts

Many lives have been—and still are—shaped by this bivalve. I heard of family histories and how they are interwoven with the proliferation of this animal. One woman claimed that she was "raised in the industry." Another farmer wore oyster shaped earrings and a necklace at the oyster food festival on Cortes Island. One individual told me that oyster farming was an obsession. Growing oysters was a way of life for many people; it made them feel proud and part of a community.

However, environmental changes and their implications put farmers in precarious positions. One farmer posed the rhetorical question: "How many farmers are just, like, that close [to bankruptcy] all the time? They are just praying that nothing goes wrong." (CI 8).

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[17] The emotional toll of environmental degradation is increasingly recognised by those in the environmental movement, and now—fortunately—receives critical attention from scholars, including Hayes et al. (2018), Kelsey (2016, 2020), Ojala (2012), Pihkala (2020) and Ray (2020). Chapter 3 further focuses on this topic.

5.4 Summary of Impacts

This section illuminates the nuances and complexities of environmental change. The oyster farmers I spoke with were experiencing a multitude of challenges and there are very real consequences to issues such as mortality, acidification and pathogens. Although farmers drew upon a range of different experiences, these findings highlight that there are shared challenges ahead. Indeed, the research reveals that although there are many changes which are ecological in nature, there are underlying socio-political challenges that drive, compound or further complicate farmers' lives and those of their oysters. These issues include the repercussions of globalisation, pollution and poor political support from the state. The following few sections further contend with this line of analysis.

6. So Is It Climate Change?

Climate change is a profoundly complex and wicked[18] problem. A crucial insight that arose from my research was that many farmers were hesitant to name climate change as the primary cause of the environmental changes. All of those I interviewed did acknowledge that the environment was changing. However, some were unsure of the causes. The following quote illuminates their uncertainty in attributing ecological changes to anthropogenic climate change:

> And that's incredibly serious what's going on there [Baynes Sound]—now whether that's climate change or not, or some natural ocean thing, I don't know—but clearly things aren't working as well as they did, even a short time ago… the climate is changing—I'm not against that. It's just that there are other things that are happening on a faster scale and I don't want them tied into this whole climate change when we don't know how fast or what kinda time-scales that is applying to. There are maybe other things going on in the oceans and it is something else—maybe currents changing, which I guess ultimately can be driven by climate but I just feel that some of the

[18] Rittel and Weber (1973) coined the term 'wicked' to refer to policy problems which have no definitive rules, no stopping rules, and no test for solutions. Climate change is now widely understood as a 'wicked' problem as it cannot be separated from issues of values, equity, and social justice (Ludwig, 2001).

> hype out there is not as clean as it gets reported. There are a lot of other things going on. (WC 2)

Other farmers shared similar nuances to the quote above. Although whether farmers believe in climate change is beyond the scope of this analysis, the research did find that there is tension in attributing changing conditions to climate change.

Ray (2020) warns against using polarising language—such as 'climate change'—in her book *A Field Guide to Climate Anxiety*. To do this, she uses Horn's (2016) words from *Rancher, Farmer, Fisherman: Conservation Heroes of the American Heartland*: "people are all talking about it, without talking about it. It's become such a charged topic" (Ray, 2020, p. 103). To further build upon this, Ray (2020, p. 102) draws on Hochschild's (2018) research in Louisiana. Hochschild found that many community members were open to talking about environmental issues when climate change was framed as an issue of freedom or rights, rather than sea-level rise. Finally, Ray (2020, p. 101) draws on Pellow's (2017) work to portray that it might be helpful for those implementing policy to frame climate change as a health problem. This promotes the use of a bipartisan frame that might make people care about it regardless of their political ideologies. In the context of this research, I used the term 'environmental change' rather than 'climate change' to account for other instances of changes that may arise, and to avoid what may be perceived as polarising language.

Norgaard's (2011) work is helpful to understand the possible reluctance for farmers in attributing changes to climate change. She explores the ways in which people understand and respond to climate change in Norway. Although Norgaard (2011) found that people acknowledged that climate change was an issue, community members were apathetic. Her findings illuminated that there was an emotional management system at play among those whom she had interviewed. This system allowed social life to continue as normal amidst climate catastrophe; whilst people acknowledged the severity of climate change and its effects, individuals resist acting on it because of social norms and interactions. Norgaard (2011) termed this 'climate denial.'

My research cannot claim that some farmers I spoke to did not believe in climate change, nor can it state that some are climate deniers using Norgaard's (2011) definition.

What this work can claim is that farmers know they need to act, regardless of the causes. Their responses were not necessarily about curbing carbon emissions but were about surviving in a period of change rippling throughout the coast. Instead of focusing on climate change, they focused attention on socio-economic and political structures and processes they wished to challenge. This is a point I explore further below.

7. Characteristics of Farming and the Industry

Given the range of issues outlined above, this section synthesises some of the key themes that emerged from the research to identify how the industry, and the coastal communities linked to it, might be better supported.

7.1 'Sustainable' Farming

During interviews and participant observation, it was clear that many chose to farm oysters for particular reasons. Some farmers told me they were 'environmentalists' and they praised oyster farming as a relatively sustainable practice.[19] One farmer's words speak to this:

> If you are mindful about it being sustainable, you know, especially beach culture, it can be literally done for thousands of years. And it was by Indigenous people. You know, you don't degrade the environment. (CI 2)

Farmers compared their method of growing protein to other farming practices: "You get the typical 'beef is bad, chicken is bad, large predatory [fish] is not so good, pelagic fish is pretty good.' Shellfish is very good! So there's a lot to be said for it" (BS 1). One

[19] The ecological sustainability of shellfish farming is largely contested, with some scholars arguing it has detrimental ecological impacts on marine systems. This is because it: frequently involves farming an invasive, widely spawning species (McKindsey et al., 2006); can cause eutrophication (Cranford et al., 2009); increase competition with filter feeders (Pietros and Rice, 2003); removes nutrients from the pelagic habitat (Grant et al., 2007); and can disturb habitat and prey for other species (Bendell-Young, 2006; Gibbs, 2007; Mamoser, 2011). Negative interactions between Pacific oysters and native eelgrass have also been recorded (Kelly et al., 2008; Kelly and Volpe, 2007). Despite this, some scholars argue it is a 'green industry' in that marine bivalves do not require outside sources of food and are thus more likely to contribute to food security (Holden et al., 2019). Their cultivation has fewer animal welfare concerns (Knowlton, 2020, p. 8). Many scientists perceive it as a relatively benign method of producing sustainable protein (Stewart-Sinclair et al., 2020; Theuerkauf et al., 2019, p. 2).

farmer told me: “In the three e’s—ecologically, environmentally, economically—I think we come out with a good grade in terms of being food producers and having a positive impact on the community” (CI 1).

Many also told me of their desire to live on the coast and work for themselves. One farmer said: “I could see that you could have your own business instead of working for a large corporation” (CI 6). Some specifically chose it over other resource-based industries, such as salmon farming, oil and gas, and fishing. One farmer, who began growing oysters as the salmon industry was taking off in B.C., told me:

> Well, salmon farming seemed to have its issues back then, and the issues really haven’t gone away and have gotten more pronounced. In the beginning salmon farming wasn’t too bad… one of the ideas I liked was the fact that you could get people back into coastal communities and repopulate some of the area where, let’s say, hand loggers were out living 50 years ago, or more, you know. So I liked the idea of having a positive impact on coastal communities. Oysters, or shellfish in general, were a more natural, you know, food production method as opposed to the feed issues that surround salmon farming. (CI 1)

Several farmers intrinsically valued working for themselves (rather than for larger companies) and all I spoke with believed in the sustainability of their farming practices and product. Many of those I spoke to were deeply devoted to continuing their practice for years to come. The following quote from an industry representative illustrates this:

> [Oyster farmers] seem to be a very practically focused group. They are about solutions so I think they are less looking at what has happened but they’re more looking at what is going to happen and what they are going to do about it. But it’s interesting because when you talk to them about what they are going to do, climate change will continue to move on, water temperatures will continue to rise in this area, so these problems will continue to accelerate so no one is really looking to get out, per se. Some people are, but most people, they are just trying to work with strategies. (BS 4)

Farmers, therefore, showed resilience in their words and actions. However, their livelihoods are under pressure as dramatic and unprecedented environmental changes exacerbate an already dynamic existence. This is a particular concern for smaller operations, an issue I now explore.

7.2 Industry Consolidation

Despite still being a relatively small-scale industry, as detailed above, oyster farming has not developed without businesses merging and expanding. Many farmers expressed concern that the industry would further consolidate; it is becoming increasingly difficult for smaller farmers to conform to the demands of regulations and global markets. The words of one farmer highlight this well:

> It's harder for small growers to participate in the industry and the net effect of government regulation is it's going to tend to consolidate the industry and make bigger players, because the little ones just can't afford to do it. It's not an unusual trend—I've seen the same thing in other industries. But it's the government structure we have tends to encourage that path, rather than discourage it. But it's the way of the world, unfortunately, I think. (BS 1)

Several farmers linked this trend to other resource-based sectors, as the following quote illuminates:

> We are following the predictable pattern that has happened with a lot of resources… With the logging industry that you have on the coast here, it went from ma and pa operations to small companies to larger companies to international companies and the same, that pattern, the fishery… the same pattern. So we are doing exactly the same thing. And from our perspective, we are making exactly the same mistakes again. So, and then, of course, on top of it we have the climate change issue, the environmental, which is adding a whole other level to the challenges. And then responses that are inappropriate, right. (CI 2)

B.C. is extremely reliant on resource extraction. The province's history is permeated with periods of 'booms and busts' (Markey et al., 2012). Whilst these industries 'bust' for complex reasons, the decline of the fishing and logging industries are attributable to trends in overconsumption, increased mechanisation, environmental changes, and—importantly—poor management by the state. A glance at the salmon industry demonstrates this latter point. In 2016, the Canadian Fishing Company closed the last salmon cannery in Prince Rupert. At this time, its owner Jim Pattison—a Vancouver-Based businessman and one of the world's richest individuals (Woods, 2019) —controlled 80 percent of the supply of salmon and herring from B.C. (Pinkerton, 2016).

The cannery's closure resulted in the loss of 600 jobs as the company moved operations overseas to where labour continues to be cheaper, and workers are not unionised (Pinkerton, 2016, 2017).[20]

Whilst the Province of B.C. had, and still has, the power to limit the exports of unprocessed fish, it has not done so. Pinkerton (2017) sums up this process well: "Individuals, communities, and entire provinces are, essentially, losing access whilst a tiny fraction of highly capitalised corporations concentrate economic and political power." The example of the salmon fishery, in my understanding, is an outcome of neoliberal policies. One facet of neoliberalism is a 'rolling back' of the welfare state, and the deregulation and privatisation of the economy (Harvey, 2007; Peck and Tickell, 2002). This is distinct from a 'roll-out' motion, defined using economic, legal, and political regulation that favours industry, the 'free' market, capital, commodification and private property rights (Peck and Tickell, 2002). Though scholars have critiqued the simplicity of these terms (Heynen et al., 2007), they are useful to think about conditions on the coast of B.C. In reference to the salmon cannery, the state rolled back; it favoured private businesses, allowing entities such as the Canadian Fishing Company to own and dictate the market.

Cited in Pinkerton (2017, p. 3), King (2013) ironically states that "government support of big business is capitalism's only hope." Although a public resource, the government has passed fisheries management to quota owners such as Jim Pattison through privatisation and consolidating access. These processes not only decrease coastal communities' access to and control over their fish, but it also impacts the culture of many places (Ecotrust Canada and T. Buck Suzuki Foundation, 2018).

This research warns that not only could environmental changes drastically change the industry; poor governmental policies and mismanagement may be equally as detrimental to oyster farming's future. For example, while it is hugely important to have healthy seafood, poorly designed regulation may have detrimental repercussions. Should it be cumbersome, expensive and process-driven, there is a real risk that larger companies

[20] Most fish caught in Pacific Northwest waters do not land on B.C. soil; fishing vessels deposit their products straight onto offshore ships (Fawcett-Atkinson, 2020).

will hoard production, processing and profit, driving smaller companies who are unable to compete out of the market. The small-scale, locally rooted nature of oyster farming—the reasons why many chose it over other forms of labour on the coast—could be less intrinsic to the industry in the future.

7.3 Local Roots, Global Reliance

Building upon the argument above, farmers continuously told me that oyster farming is an important industry in B.C. One individual who had grown up on the coast and settled on Cortes Island told me:

> We are maybe the one sustainable industry that provides full time employment on the island. When I first started going, I didn't miss an order every week for five years and then we were shut for red tide for the first time in five years. That was the first time. It was like—wow! That's what we do. And no one else can do that. The veggie farmers—they don't cut it. I know this is old data—get a number from the Co-op and ask them how much local produce they buy from islanders. 10 years ago, it was 75,000 dollars. And I thought to myself that's two meagre wages. And I'm sure they are doing a lot more now, but it's pretty hard making a living growing food on land. The other comparison I give when people complain about shellfish is that we could all be carpenters, and there would be 50 of us in the gorge building houses. I can't remember the number we used to use, but in the last 20 years we would have built 150 houses in the gorge, so how would you like it if we were all carpenters? House construction, especially the way we do it for recreation use for wealthy off-islanders, is not a sustainable industry… [it's] not the direction we wanna go. And oyster farming… The 13 people he [another farmer] had working on that site could have had a lifetime on that same footprint: it wouldn't have needed to expand and that would have been their lifetime occupation right there, and there's not many industries that would compare. (CI 1)

As evidenced by this quote, farmers believed that the industry helps to support people to live on the coast of B.C. One farmer, who managed a large company, told me:

> I've heard the argument where people have said 'this is a retirement community!' Well, that's not sustainable! People will die off and there will be a whole bunch of empty houses. You need to have some form of an industry component in order to drive the economy of an area. So that's—I think—what we participated in here. (BS 2)

Farmers emphasised the place-based benefits of oyster farming for the local community and environment. However, whilst the farming itself is innately localised, the industry is highly intertwined in and contingent upon global processes. It thrives, for example, on the provision of international markets to import seed and export products. One farmer laughed and explained: “we are very eco-friendly, even though we’re shipping rocks on airplanes which isn’t the best thing!” (CI 9*).* There is a potential tension between oyster farming's sustainability and the scalar dependencies on global markets to support its economic growth.

Coastal communities are increasingly engaged with international markets, many of which may be unpredictable and inconsistent (Bennett et al., 2016a). Oyster farming in B.C. is dependent on global processes, and this has introduced new vulnerabilities. For example, farmers highlighted the challenges of depending on international seed. Similarly, oyster farmers’ income is highly dependent on global markets; should there be an issue on their farm, there is the potential for the global market to import from elsewhere and leave B.C. farmers without a sale. One farmer said the market can just “drop you” as a result of a pathogen outbreak.

In summary, oyster farmers believe they play a role in supporting coastal communities. However, with erratic and unprecedented challenges facing them, farmers are in precarious positions. The next section summarises my findings and their broader implications.

8. Discussion

On one level, farmers told me about ecological changes in the marine environment. Yet, on another level, their stories were about socio-political change washing through coastal communities in the province.

8.1 Environmental Change Nested in Socio-Political Processes

Conceptualising environmental change in socio-political terms is not new. For example, Smit and Wandel (2006) note that ‘cultural adjustments’ in response to climate change are not simply directed by climate change itself, but are efforts to change broader socio-economic and political forces. By ‘cultural adjustments,’ they broadly mean

adaptation, vulnerability reduction, and adaptive capacity[21] measures. They argue that these are rarely in response to climate change. My findings support this argument, contextualising how this plays out in the case of oyster farming in B.C. This research suggests that environmental change is often not the only—or the most challenging—battle farmers face. If it focuses exclusively on environmental change, research may mask the socio-economic and political structures which are arguably more influential in ensuring viable futures for coastal communities.

8.2 Oyster Farming as Sustainable Development?

Concentrating on the socio-political landscape of Clayoquot Sound, Luke (2002) showcases how the complex contours of commodification in a globalised world make it increasingly difficult for societies, specifically rural communities, to ensure well-paying jobs, realise adequate profits, and conserve productive resources. Luke (2002, p. 95) states: "who gets which jobs, where profits and which resources are conserved for how long are issues behind the struggle to control the natural environment." These three prongs—well-paid jobs, adequate profits and conserving resources—might be perceived as fundamental to sustainable development.[22] Marshall (2002) identifies the foundations which are intrinsic to realising a sustainable fishing industry in B.C.: "successful fisheries—that is, those that are managed sustainably over the long-term, creating healthy local economies—all have similar characteristics. They have local decision-making power, they have a system to share the fish equitably, and access to the fishery is held locally."

Marshall's (2002) ideas are pertinent to the oyster industry given that, as outlined in the previous section, the farmers I spoke to were concerned about industry consolidation. They told me that its future trajectory is contingent on appropriate management.

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[21] Adaptive capacity is helpfully defined by Pelling (2010, p. 58) not as the appropriate fit to current or future threats, "but by the flexibility of people in the face of unexpected as well as predicated hazards, vulnerabilities and their impacts."

[22] 'Sustainable development' is frequently cited as development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).

Smit and Wandel's (2006) work is also helpful in this respect. They show that local initiatives to respond to climate change and enhance livelihoods may be nullified unless decision-makers contend with broader socio-economic and political forces that shape local vulnerabilities. They argue that several schemes to practically address climate adaptation have worked best when measures that address climate change are incorporated into broader decision structures that relate to other socio-economic and political processes, including—and relevant to this research—water resource management. My findings reaffirm the importance of this, showing how this comes to bear on oyster farmers. Unless socio-political dynamics are intimately interwoven with ecological changes and repercussions, working to prevent and mitigate climate change impacts may amount to treating symptoms and ignoring the disease.

8.3 Governance

Rather than solely mapping the ecological effects of climate change, farmers tended to tout the value of their work. Instead of explicitly lobbying for action on climate change, they emphasised the need for changes to the industry's governance and a broader recognition of—and support for—its potential. I use 'governance' as a broad analytical lens that encompasses the management of natural resources (Armitage et al., 2017). A growing body of work links vulnerability, adaptation and resilience to transformational governance processes (for an overview, see Whitney and Ban, 2019). With reference to the shellfish farming industry, Mamoser (2011, p. 76) shows that B.C. uses a multilateral governance approach: jurisdiction is spread across three levels of government (federal, provincial and local) and is under the authority of seven different government agencies. This is not to mention the need to consult with First Nations and local stakeholder groups.

This research did not set out to explore how to better govern the shellfish industry on the coast—specific research is needed to analyse this fully. What this research did find is that farmers want the industry to be better governed to consider and safeguard local ecosystems, public health, and the livelihoods of those who are deeply dependent on this practice. Facilitating and realising this may involve re-thinking the scales at which the

industry is governed, the processes through which it is regulated, and the ways that this governance and regulation shape what is possible in the industry.

9. Conclusion

Social science engagement with environmental change has grown in recent decades, particularly in tandem with scientific reports that demonstrate the scale of climate breakdown. However, in focusing too much on these changes, research may miss other inferences that are more palpable to people's livelihoods.

The case study of oyster farming in B.C. offers one example of how understanding and responding to environmental change encompasses broader socio-political processes. Farmers are asking for governing bodies to recognise the industry on the coast. They want acknowledgement that clean, unpolluted environments are needed for oysters to grow. They wish to have better governance systems in place. They want reliable, safe, high-quality seed.

Paying attention to how individuals are navigating ecological change at a local scale illuminates broader dynamics of change—and possible responses to it—on the coast. This careful approach is integral in making it possible for oyster farming to continue as a mainstay for many people on the coast whilst simultaneously improving the industry's contributions to coastal communities during periods of crisis and rapid change. The central point of this chapter is that environmental change cannot be dealt with on its own or directly—the challenges it poses must be embedded within broader contexts that are responsive to social, cultural and political dynamics.

Chapter 3

1. Introduction

This research explores how one industry is affected by—and is adapting to—changing environmental conditions. Oyster farming on the coast of British Columbia (B.C.) has become increasingly challenging. While perennially at the mercy of the weather and climatic patterns, farmers are particularly noticing increasing oyster mortality, ocean acidification, heightened risks from pathogens, rising water temperatures and more frequent and intense storms. Importantly, as emphasised in the previous chapter, farmers are at least as concerned about—and always situating these environmental changes within—broader socio-economic and political challenges facing their industry. Indeed, farmers tend not to highlight the ecological effects of climate change. Instead, they emphasise the need to grapple with dynamics such as globalisation, regulation and corporatisation.

While the research identified significant challenges facing the industry, farmers wanted to speak about solutions. They repeatedly highlighted the industry's potential contribution in solving problems facing coastal communities. Their aspirations aggressively stretched the research's analytical frame and forced me to expand my analysis. In this chapter, I take up this challenge and explore the following questions:

1. *What role does—and might—the oyster farming industry play in supporting coastal sustainability in B.C.?*

2. *How can researchers better support the efforts of those in the industry to solve the challenges they—and coastal communities more generally—face?*

I explore these questions in three layers. The chapter begins by presenting the current solutions farmers are already advancing to tackle many of the issues they face. Secondly, it highlights the scope of farmers' desired solutions: not only do farmers wish to rectify the problems the industry confronts, but they also want to reshape the industry so that it contributes solutions to broader issues faced by coastal communities. This then leads to the third layer of analysis, which explores how their ambitions highlight a challenge for researchers, whose work—implicitly or explicitly—shapes understandings of and

responses to the industry. Through this multi-layered analysis, I seek to flesh out the broader implications of farmers' focus on building solutions for and through the industry.

In this way, this chapter explores the challenges of building solutions at multiple levels: on the ground in industry operations, in the broader understanding and governance of the industry and in the approach researchers take to their work. My argument is that the complex nexus of challenges confronting the oyster farming industry, and farmers' ideas about the industry's contributions, has implications not only for the industry itself but for the research process. In particular, it highlights the need for—and the challenges of—solutions-based research.

1.1 Methodology and Methods

My research aimed not to produce generalisable results—it intended to understand farmers' perceptions and understandings of environmental change. To do this, I used ethnography. This is the study of a particular group of people in their 'natural' surroundings (Burawoy et al., 2000). It seeks to investigate and affirm the "complexity of change affecting rural livelihoods" (Crate and Nuttall, 2016, p. 151). This methodology allowed me to follow participants' insights: for example, I engaged in participant observation, referred to as "deep hanging out" by anthropologist Geertz (1973). Ross and Berkes (2014, p. 793) define this as a "holistic and adaptive methodology that opens up new lines of inquiry as it proceeds." Whilst engaged in participant observation, I saw first-hand that oysters were dying and that farmers had to change their practices to remedy this. But I also witnessed and heard of their innovative responses and ideas for solutions to these problems. During 16 semi-structured interviews with oyster farmers and industry representatives located across several areas in B.C., I was able to ask for more information on these solutions and pivot the research slightly to gather data on these insights.

This research mostly used a problem-oriented frame, retrospectively: there was the matter of environmental change, which I had read was impacting farmers, and I sought to explore how they were experiencing and understanding this problem. I had, however, learned of the need to approach environmental issues with a solutions-focus (Kelsey,

2020). Accordingly, I asked the following question during interviews[23] to seek out some solutions: “If you could wave a wand, what do you think we should be doing to help mitigate or respond to these environmental changes?” Yet, as I conducted more interviews and proceeded to analyse them, I realised that asking this kind of question did not mean the research could adequately grapple with and analyse the proposal for solutions. I speak of this pendulum-like movement between problems and solutions throughout this chapter, but it is important to highlight in this context that the research process was iterative; participants were engaged as active agents in the production of this research, which in the end turned the analytical lens back onto the research process itself.

2. Findings

Chapter 2 found that the industry is navigating multiple challenges—at various scales—from water temperature and chemistry to regional development patterns, to the vagaries of global trade. That chapter’s key argument was that environmental change cannot be understood or addressed independently. Instead, it must be located within an analysis of the broader social and political dynamics through which its implications are focused.

The section immediately below (2.1) builds upon these findings to describe farmers’ efforts to navigate contemporary challenges. It focuses specifically on changing industry operations and is divided into sub-themes according to the types of responses I heard. The second section (2.2) addresses specific claims I heard that were beyond the scope of the research frame and analysis. I show that the majority of farmers in this study not only seek to rectify the problems confronting the industry. They also want to advance the idea that oysters are “canaries in the coalmine” and the industry itself is attempting to offer crucial solutions to many issues facing coastal communities.

[23] See Appendix B for Interview Questions.

2.1 What is the Industry Already Doing to Respond to Challenges?

2.1.i Ecological

Several farmers were changing their husbandry techniques to respond to ecological challenges such as rising water temperatures and oyster mortality. For example, one farmer explained their predicament in ensuring the survival of their crop:

> I have two choices in my mind. And that was to try and find a spot within close proximity to where I farm now so it wasn't so difficult, or I could have gone totally overboard and moved everything to the other side: 15.5m, which is colder water… and traditionally has grown poorer quality oysters because it doesn't have as many algae. Colder water. But maybe that's what it takes now. (CI 6)

During participant observation, I worked alongside one farmer who moved their oysters from their deep-water farm to their beach lease. This activity involved removing the oysters from hundreds of plastic trays and placing these animals in mesh bags, which were then dropped off in shallow waters to harden ready for market. What was exceptional about this activity was that they engaged this practice far earlier in the summer than usual to account for the hot weather; this farmer had lost many oysters in trays the year before and so was taking extra precautions.

2.1.ii Economic

As shown in Chapter 2, navigating challenging circumstances has a direct economic impact. Subsequently, farmers are engaged in building more resilient livelihoods in the face of change and are altering how they interact with the industry as a whole. For example, some farmers spoke of diversifying their income to mitigate the financial risk. One farmer started harvesting wild oysters to avoid relying exclusively on the revenue generated from their farmed oysters. Another farmer played a "numbers game" by increasing their farm's production to compensate for potential oyster mortalities.

In addition to mitigating financial losses, farmers are also systematically changing how they interact with the industry. Several farmers, of both small and more extensive operations, spoke of the importance of collaboration and collective learning. Many

praised the BC Shellfish Growers Association (BCSGA) and its work with scientists to gather data on oyster mortality and pathogens. Furthermore, farmers also spoke of their involvement in local cooperatives and shared leases as ways to distribute financial burdens.

2.1.iii Social License

Farmers are also responding to the socio-political challenges facing them. For example, some have sought to improve their social license—"essentially the willingness of others around to allow you to continue to do what you do" (BS 1)—by promoting the industry through festivals or mitigating the industry's impact on the marine environment.

Before outlining their efforts, an explanation of social license in this context is imperative. As with D'Anna and Murray's (2015) research on public perceptions of shellfish farming, my research also found tenuous relationships between farmers and some local community members. There are multiple reasons as to why issues arise, many of which are beyond the scope of this analysis, but a significant cause for concern I heard about was pollution—particularly plastic pollution. I was told by one farmer that:

> One of the large issues locally is debris. Whether it's bad practices or just works of nature or bad design of equipment for whatever reason, we end up with a lot of shellfish [industry] debris washing up on local beaches. (BS 1)

According to Covernton et al. (2019, p. 358), shellfish aquaculture "requires the use of ropes, rafts, floats, and trays that—due to low cost and durability—are usually composed of polystyrene, polypropylene, PVC, or high-density polyethylene." These materials frequently dislodge or break down into smaller pieces and are often not biodegradable. Negatively impacting the local environment in a multitude of ways,[24] the abundance of these materials also contributes to community tensions. For example, one small-scale

[24] Ocean plastics are ubiquitous marine contaminants and studies show their impact on marine ecosystems and human health (Covernton et al., 2019; Ostle et al., 2019). Interestingly, however, a recent study in B.C. concludes that there is "no significant difference in MP [microplastic] concentrations in shellfish or their habitat between shellfish aquaculture and non-aquaculture sites at a local scale" (Covernton et al., 2019, p. 370).

farmer, who had been growing oysters for a long time, told me that living in his community can be arduous: “It can be a tough place to live. If you stay at home and garden in your own garden, then that’s fine. But shellfish farming hasn’t been that easy, politically” (CI 1). As a result of these fragile relationships, farmers recognise the importance of cleaning up their practices if they are to attain a 'social license' to continue. The following quote summarises the importance of this issue for the sector:

> Farmers [should] realise that they need to connect with their community and address the social license issues. That would be a good thing—because I think it’s key. Yeah, we may have our problems, you know, like other parts of the world… the herpes virus and all the rest of it. Mortality. It’s difficult. And that can be a game-changer for farmers, but this other aspect could be just as dangerous. (CI 6)

Given the salience of these concerns, many farmers expressed their desire to resolve them:

> There are things you can do to improve your neighbourly relations or reduce them, and the industry needs to be aware of it and the industry needs to fix the issues that are a problem. So if there’s an issue with microplastics, and we’re seen to be increasing the amount of microplastics in the environment, then we’re in the wrong place—we need to change that. So the industry needs to change what we’re doing. We need to be able to identify social trends and get in line with where things are going…
>
> I spend a lot of time working with the local community group, trying to address that [debris] and put a good face on the industry cleaning up. So we regularly volunteer and go out and do clean-ups. We regularly volunteer staff and equipment to help with other people’s clean-up efforts, and we regularly encourage industry to make some changes. We’re trying to develop some new ideas... (BS 1)

Most of the farmers I spoke with outlined the steps they are taking to address the industry's contribution to ocean plastics. Many organise beach clean-ups. During my time on oyster farms, I saw efforts to both remove polyfoam (Styrofoam™, a material used as a floatation device for deep-water sites) and wrap what remains in plastic[25] to prevent

[25] There are implications to this intervention. Although beyond the analysis of this research, it is noteworthy that the provincial government has initiated the ‘CleanBC Plastics Action Plan’ (British

further degradation. Farmers also highlighted their desire to foster better relations with their local communities. Oyster festivals, such as Seafest on Cortes Island, are one example of how farmers seek to resolve these local tensions. These events highlight and develop pride in the local industry as well as attract tourists to the region who then support other businesses.

2.1.iv Political

Additionally, the industry is also responding to political challenges which constrain its development. For example, farmers are lobbying for better governance and state support. In 2010, the Department of Fisheries and Oceans Canada (DFO)—a federal body—took over responsibility from the Province to regulate and manage aquaculture. One farmer explained this:

> I don't know how many years ago… There was a court case that was to do with salmon farming, and some judge—and I don't really know how this happened—said that it [shellfish farming] was still a fishery, and because it was a fishery it had to be managed by DFO. I don't know how that really happened... to call it a fishery? It's after we've been fighting for the last 15 years trying to hammer it into every regulator's mind that we're farmers, not fishermen, then they finally did say that we were fishermen! It was one of those things that you just shake your head and turn away. Some old man in a black coat who is a judge may have made a mistake… maybe it should have been appealed. So we changed from provincial regulation to federal. And the feds are still adjusting on how to deal with it. And they're maybe less practical than the Province in some ways… There's certainly more burden placed on oyster farmers because of that change. (CI 1)

Another farmer expanded on this nebulous governance structure:

> So, when you don't have an advocate you just get lost sort of in the shuffle. You know you're somewhere between fisheries and farming. And it's never been defined. If you go into the parliament buildings in Canada, and the main hall foyer, there are four statues: one in each corner.… lumber,

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Columbia Ministry of Environment and Climate Change Strategy, n.d.). As part of this, they have announced the 'Clean Coast, Clean Waters Initiative Fund' (2020) to support marine shoreline and derelict vessel clean-ups. Furthermore, the federal government initiated the 'Sustainable Fisheries Solutions and Retrieval Support Contribution Program (Ghost Gear Fund)' (DFO, 2020), and has particular interest in supporting developments in innovative gear technology.

> farming, fishing, mining. They're the sectors that are represented. That goes right back to the constitution, you know, where these sectors were seen as the backbone of the country. Well no one has ever brought in legislation to protect aquaculture, because it didn't exist. And so it comes in after the fact and no-one's prepared to, for whatever reason—whether it's social issues, perceptions, conflict between wild and farmed, I don't know. (BS 2)

Many farmers did not feel they had an advocate in government. Furthermore, they felt that DFO's regulatory approach lacks a grounded understanding of the industry's intricacies. I heard from one farmer that regulators "need to come out and go out to a beach" (CI 8) to understand better how to assist farmers. Another farmer highlighted the importance of keeping industry operations as local as possible:

> When I started there was a shucking plant on this island [Cortes] and a processing plant. And everything was quite small scale but there were local jobs. Right now, to do anything, you have to go quite away, well, quite a distance away to do anything. I think that more than anything—keep everything a bit more local. (CI 8)

The above quotes highlight that farmers want the industry to be better governed—and at a more local scale. Unsurprisingly, they are engaged in bringing this to bear. The following quote indicates their efforts—and their toil:

> CM: The governmental support—how has that changed?
>
> BS 1: I don't know if I'd call it government support… to be honest, it takes too much of my time dealing with government. All I want to do is grow oysters and I probably spend 50% or more of time dealing with government aspects of it, whether it's going to meetings and stick handling new Canadian Food Inspection, or dealing with DFO regulations, or just trying to stay on top with some of the interfaces with government activity.

Many farmers expressed similar sentiments that they spend much of their time dealing with paperwork and regulations. Consequently, they are in constant communication with the provincial and federal government to articulate the support they need. I heard that the BCSGA also plays a significant role in helping them to mobilise action.

In conclusion, the sections above illustrate that the industry is not passively experiencing challenges. Farmers are altering their husbandry techniques, wrapping

Styrofoam™, coordinating beach clean-ups, paying attention to community relationships and lobbying the government. They are innovating, responding and mobilising.

2.2 Cultivating Solutions

Farmers not only wish to rectify the current problems confronting the industry, of which environmental changes play a role alongside socio-economic and political dynamics. The next section highlights that farmers are also working at a deeper level to advance the idea that the industry itself offers meaningful solutions to navigate climate change and other complex issues facing coastal areas.

2.2.i Sustainable Food Production

On a hot summer's day, one oyster farmer told me: "Without climate change, shellfish farming makes sense as a livelihood. With climate change, it makes sense as part of the solution" (CI 2). Describing themself as an amateur environmentalist who sees shellfish farming as a way to "walk the talk,' they told me about their belief in the longevity and sustainability of growing oysters:

> If you are mindful about it being sustainable, you know, especially beach culture, it can be literally done for thousands of years. And it was by Indigenous people. You don't degrade the environment. As long as the climate stays similar and the tide, you know… even if it doesn't, everything adapts. So I mean that was one of the things, when I got involved with shellfish farming, once I realised that, I couldn't believe my luck! Because almost everything unfortunately human beings do has had a negative impact on this planet. But I can do aquaculture, beach aquaculture, my entire life, my children's, like this could go on for thousands of years with no problem whatsoever. (CI 2)

Scientific literature broadly corroborates this sentiment. Often heralded as a 'green industry' with opportunities for coastal communities (Holden et al., 2019), marine bivalves such as mussels and oysters do not require outside sources of food and are thus more likely to contribute to food security (Knowlton, 2020, p. 8). In some cases, they can also help reduce eutrophication in coastal waters, and their cultivation has fewer animal

welfare concerns. Unlike most terrestrial forms of farming, shellfish aquaculture is generally integrated into the marine ecosystem (Cowan, 2020; Theuerkauf et al., 2019).[26]

Other interviewees heralded the practice's ecological benefits. One farmer noted: "they [oysters] provide habitat for other creatures. You know, you don't have to feed them, you don't have to medicate them" (BS 3). Another told me:

> Shellfish are cleaning water. Not making it dirtier. That's an important difference that people need to understand… I think in the three e's—ecologically, environmentally, economically, I think we come out with a good grade in terms of being food producers and having a positive impact on the community. (CI 1)

The quotes above indicate farmers' perceived understanding that growing oysters is a potentially sustainable endeavour, which they felt has the potential to be inherently good for coastal ecosystems—and communities, a point I later explicate. I believe there was an undercurrent of vulnerability embedded within these claims: perhaps farmers were taking pains to point out that what they do is consistent with local community values, an essential endeavour given the need for 'social license' as previously explicated. Additionally, the continuous reminder that their industry is 'green' may also be connected to a deep sensibility many farmers felt as they identified as 'environmentalists.'

2.2.ii Coastal Development

I also heard from farmers that the industry plays a significant role in highlighting and potentially facilitating the mitigation of coastal pollution. This is reflected in an interview with a farmer who remains anonymous in the research but whom I have chosen to call Gerry in the following story. Gerry has been very engaged in the industry for years:

> One of the things that you always felt good about was that an oyster or any bivalve takes in all the goodness and all the badness out of the water column. So it's kind of the canary in the coal mine idea, and as long as you've got a

[26] There are, however, considerable ecological problems that can arise from farming oysters. Farmers did not explicitly raise these issues, but Chapter 1 (Section 3.1) and Chapter 2 (Section 7) draws on scientific literature to provide the reader with an overview.

> healthy oyster, as long as you've got an oyster that isn't being polluted by dioxins… (CI 7)

Gerry began this story by noting that oysters filter feed: they suck in, strain out, and digest phytoplankton and zooplankton in the water column (Silver, 2014a). Whilst this process can improve water quality and eutrophication, it also means oysters are prone to consuming toxins, microorganisms and viruses. This can subsequently pose a harmful risk to human health if eaten.

This 'canary in the coal mine' characteristic played a significant role in swaying political decisions in B.C. For example, during the 1980s, dioxin and furan emissions from pulp mills leaked into many waterways. Animals, such as shellfish, filter-fed on these toxins, raising concerns about the impact on human health. Consequently, the Province closed many seafood areas (Cortes Island Seafood Association, 1993, p. 1). However, during the same timeframe, MacMillan Bloedel—a multi-national private timber company whose mills had been leaking toxins—made net profits of over $575 million (Cortes Island Seafood Association, 1993, p. 1). Concerned by this detrimental profiteering, the shellfish industry mobilised and lobbied political actors. Gerry explained:

> [It] was the pulp mills. We started the first seafood festival… because we were being threatened—the whole coast was being threatened to be shut down, because of the build-up of dioxins in all the bivalves, but, in particular, the oysters.
>
> And just luckily the NDP got in, the New Democratic Party in 19 —oh I can't remember the year, [in 1991], and the very first… we lobbied them, brought them up here, met with them, and the very first piece of legislation that they passed in parliament was to stop the dioxin emissions from the pulp mills. (CI 7)

Indeed, the industry's persistence culminated in the Province introducing the Pulp and Paper Mill Liquid Effluent Control Regulation in April 1992. This regulation legislated that mills must eliminate the discharge of Adsorbable Organic Halogens, the measurement for organochlorines (Hagen et al., 1997; Haigh and Marcus, 1995; Hewitt et al., 2006). The oyster farming industry had, therefore, played a considerable role in determining this result. Gerry told me:

> So there was a huge role environmentally for the industry to play, and it was very successful in that example. And it's also, you know, one of the reasons why we still have relatively clean water, is because of the shellfish. So it's vitally important that the industry continue. It's not just that, you know, it represents so many millions of dollars on an annual basis—it's that it's the canary in the coal mine, and if the canary dies, everything dies. It's game over. (CI 7)

The above quotes illuminate that the industry—and the oysters themselves—shaped ecological and political realities. Both played an important part in protecting coastal waters, people and other living beings.

Gerry also told me that this role continues today. I heard from several farmers about a contemporary contentious issue—raw sewage in waterways. One farmer told me:

> I think there's a huge opportunity in B.C. The coastal environment, the clean waters, the characteristics that the shellfish pick up naturally… It's a really good place. One of the best in the world to grow shellfish. Conditions are just right, nutrient mix is just right, water temperatures are right, water conditions are right, but pollution is a growing concern.
>
> We live in a beautiful place that's world-renowned for shellfish and we have communities that have wastewater treatment plants that overflow primary raw sewage during a winter storm. We have septic systems that are not functioning or are non-existent…
>
> Increasing population, the reluctance of old infrastructure or communities with old infrastructure to upgrade to new infrastructure is a problem. Locally there's a real sanitary issue with wastewater treatment. Places like Cumberland for example—a booming community… I don't know what the official expansion rate is but I'd be surprised if it's less than a 50% increase in the number of houses in Cumberland in the last 10 years, and their wastewater treatment plant hasn't changed since the 1950s apparently. (BS 1)

I heard from many farmers about their concerns regarding sewage pollution, directly linked to coastal development patterns and worsened by a lack of political action to mitigate this issue. In seeking to analyse the claims I heard from farmers, I realised that Gerry's foreboding warning about the canary in the coalmine gives the industry unique political power—and as farmers spoke about pollution and the ecological role of oysters, they implicitly showcased this.

Akin to environmental warning systems, oyster health quite viscerally illuminates the extent to which human activity impacts the coast. Ultimately, what I understood from farmers' responses was that those making decisions about the future of the coast—often those in the role of developers, governments, and policymakers—need to centre the health of these animals. Doing so would have the potential to improve the ecosystem and community health and resilience.

The propositions outlined above suggest that an oyster's unique biology gives it agency in indicating ecosystem health at large. If the concept of a canary in the coalmine is understood seriously, then the oyster farming industry does more than grow oysters—it potentially contributes to food security on the coast, and has proven itself to be an early warning system for other environmental problems, foregrounding solutions that support ecosystem health.

2.2.iii Coastal Livelihoods

Finally, farmers spoke about the industry's contribution to increasing the resilience of coastal communities. One farmer told me about the importance of local jobs in the region:

> [People say] 'this is a retirement community.' Well—that's not sustainable! People will die off and there will be a whole bunch of empty houses. You need to have some form of an industry component in order to drive the economy of an area. I hope that's what we do. (BS 2)

Sharp in tone, this farmer proposed that the industry is an integral component to resilient local economies. Another farmer relayed this idea:

> We are maybe the one sustainable industry that provides full-time employment on the island. When I first started going, I didn't miss an order every week for five years and then we were shut for red tide for the first time in five years. That was the first time. It was like—wow! That's what we do. And no one else can do that. The veggie farmers—they don't cut it. (CI 1)

One farmer contrasted the oyster farming industry to the oil and gas sector in Alberta, highlighting the potential for the industry on the coast to support future generations:

> … Rather than people thinking they have to run off to Alberta to grind oil out of the ground to make 100 grand—well, if we can come up with some productive activity, maybe we can get people making 100 grand a year in the oyster industry and they buy a house and live locally. But we need to make a few changes—we need to have some productive changes so the work is more attractive and more lucrative. That's a big part of that. (BS 1)

Farmers emphasised the industry's potential role to support local livelihoods through year-round, local employment.

To conclude this section, the claims I heard illuminate many farmers' passionate aspirations for their industry. Many told me about the industry's unique ability to simultaneously cultivate food and ensure ecosystem health. Several also highlighted that growing these animals may offer local jobs to support local economies. One farmer succinctly told me: "We use salt water and we turn it into delicious food. What could be cooler than that?" (CI 2).

3. Understanding Solutions

Farmers are not only looking for solutions to adapt their farming methods to changing environmental circumstances; their statements showed that they want their industry to be understood, engaged, and supported differently to help them more actively support coastal communities' health and resilience.

It was my wish that this research could help farmers in developing and realising these solutions. I had been prepared for farmers to identify environmental changes and I was interested in their responses to these changes. Yet farmers located environmental change within a much broader complex of dynamics that extended beyond my analytical frame. For example, their aspirations were nested in and linked to multifaceted community relations extending beyond their industry into the wider community. As I only spoke with those involved in the industry, I could not fully engage or analyse these issues. Furthermore, as farmers' comments about pollution were connected to governance issues and development patterns, they stretched the research's analytical frame into substantial policy and governance issues.

This study would have benefited from hearing from a broader diversity of community members to critically analyse how oyster farming is, and might further

contribute to the local economy and the resilience of coastal ecosystems. The research could have consulted with First Nations in order to critically assess and evaluate the desirability of and possibilities for industry expansion. The research could have further analysed policy and legislation to grapple with how to operationalise farmers' proposed solutions in practice. It also would have benefitted from analysing solutions developing in other oyster farming areas around the globe to explore what has been successful and how these approaches might be tailored to this context. In summary, to contend with the complexity of oyster farming as a solution—a potential "bright spot" for coastal ecosystem and community resilience, which I believe farmers were essentially implying—this research would have benefited from exploring: broader community relations; a diversity of perspectives; socio-political governance and policies, and solutions developing in other coastal areas. The scope of the project would have needed to be much larger. This finding is in line with research that demonstrates a solutions-approach demands cross-disciplinary, cross-community framing and research collaboration (see Bennett et al., 2016b; Cinner et al., 2016; Kelsey, 2020; Knowlton, 2020). This is explored in the following section.

This is not to say that this research has not been successful. Despite being unable to fully pivot the research to a solutions orientation, what these research findings—and their limitations—offer is a critical shift in thinking about the research process as a whole. This invites readers to think about cultivating research from the outset that is deeply engaged in understanding how solutions are, and can be, developed. Fortunately, this move is resonant with contemporary research on solutions. Environmental scholars and practitioners are examining the need for, and the challenges of, conducting research that centres solutions. The next section consolidates segments of scholarly literature with learnings from this research process to elucidate why solutions-based research is needed, and how scholars might further take up this approach.

3.1 The Need for Solutions-Based Research

To begin, I outline why solutions-based research is timely and important. This is not to diminish or negate the importance of research focused on problem-definition and

analysis; such research remains essential to focus political attention and to inform how solutions are built. However, I draw upon contemporary research and my own process to showcase the need for research to *expand* its approach and focus to include not only a rigorous analysis of problems, but a rigorous analysis of solutions.

Many scholars highlight the overwhelming focus on problem definition in current environmental research (Balmford and Knowlton, 2017; Kelsey, 2020; Knowlton, 2020). Coleman and Wernberg (2021, p. 1) demonstrate this:

> These [climate stressors and their impacts] are pressing scientific questions and knowledge gaps that need to be tackled. However, choosing to focus only on these negative consequences and questions, rather than acknowledge that there can be silver linings, is an opportunity lost to start the conversation around proactive and novel climate interventions.

Further still, Roth (2019, p. 505) explores the movement of 'environmentalism' and posits that it is "concerned most with the determination and insistent communication of the scale, scope, and urgency of these problems, whereas the development of solutions is given short shrift. Often even the goals and solutions remain in problem mode." These quotes emphasise that research and communication centred on environmental issues is somewhat out of balance—the foundations from which these research projects and narratives begin may need broadening to encompass more than just problems.

There are implicit and explicit consequences when environmental research and communication focuses so pervasively on environmental problems without due attention to solutions. For example, the fixation on problems undermines the possibility for radical change (Kelsey, 2020, p. 24). Arnold (2018) and Knowlton (2020) highlight that concentrating exclusively on the harms and impacts of climate change can create a sense of powerlessness and apathy in individuals. Furthermore, there are increasing mental health problems linked to the continuous focus in the media on the problems which confront us (Hayes et al., 2018; Pihkala, 2020; Ray, 2020). Scholars highlight the rising issue of 'eco-anxiety' (Ray 2020, p. 21), which relates to feelings of sadness, stress or powerlessness about the changing climate and environmental disruption.

Kelsey (2016, 2020) argues that an excessive focus on analysing the environment problems that confront us creates a crisis of hope. In an article on "cultivating[27] hope," Kelsey (2016, p. 31) states that "by leaning so heavily toward environmental problem analysis rather than solutions generation, it appears that academics in a variety of important environmental disciplines are perpetuating a system of research inquiry that manufactures hopelessness." Manufacturing hopelessness itself has become a substantial problem. Kelsey (2020, p. 3) finds it is "damaging to personal health and well-being" and limits "our collective capacity to respond to urgent environmental issues." Essentially, Kelsey argues that hope is integral to building solutions. Whilst its meaning differs between contexts and circumstances, it always innately entails agency—the ability to actively do something. According to Kelsey (2020, p. 44), hope is "what sustains us to keep fighting for social and ecological justice." To hope is, in fact, a political act (Kelsey, 2020).

Hope is therefore an important mobiliser. This research with oyster farmers on the coast of B.C. also fundamentally shows this: in putting forward solutions, I understand that the farmers I interviewed have resolute hope for their future. However, the solutions they spoke about, and the theme of hope that emerged, extended beyond my analytical frame. There was a disjuncture between what farmers were asking for and what the research could do. As previously noted, the research was not structured to fully account for their aspirations, despite my intentions. I now turn to how researchers and practitioners are proposing a better approach.

3.2 Motivating this Shift

For the purpose of this section, I initially focus on how practitioners are approaching solutions. The communication sphere is a particularly ripe site of analysis for this work, considering environmental communication is saturated with problem-oriented stories and pervasive narratives of 'gloom and doom' (Kelsey, 2020). Gornish (2017) finds that 80% of the media coverage on climate change, and 90% of coverage

[27] I have used Kelsey's (2016) concept of 'cultivation' in the title of this thesis, recognising that oysters require careful cultivation, as do solutions.

regarding IPCC reports, frames the subject in terms of "a disaster."[28] What motivates this approach is the assumption that fear motivates action; if people believe the situation is dire enough, they will act. A variation on this is what scholars refer to as the "information-deficit model" (Polk, 2018; Ray, 2020, p. 35). Widely used in documentaries and news reports, it is predicated on the idea that when people understand the problems of the world, they can then fix them (Ray, 2020, p. 12).

Though widely used, a growing body of research challenges its efficacy (Kelsey, 2020; Nisbet and Scheufele, 2009, p. 1768; Yamashita, 2015). Whilst images of climate change can evoke powerful feelings in individuals, O'Neill and Nicholson-Cole (2009) warn against communication predicated on fear as it does not mobilise action. In fact, fear-based strategies about climate change evoke and enhance feelings of fatalism within many individuals, making climate change seem distant in both time and space. Additionally, even when individuals understand the problem at large, they often do not act in ways that would mitigate the problem (Gifford, 2013).

Fortunately, there is a growing movement to change a narrative so heavily concentrated on problems. Solutions Journalism is a burgeoning approach to journalism that emphasises solutions-based reporting, which scholars sometimes refer to as "constructive journalism" (Ciszek, 2018, p. 205). According to Ciszek (2018, p. 205), two pillars for constructive journalism "include the incorporation of positive emotions in negative stories and solutions-based reporting." By providing more hope for the future, this form of reporting may also impact societal well-being and mobilise and encourage action (Ciszek, 2018; Gyldensted, 2015; McIntyre and Lough, 2019).

The Solutions Journalism Network is an organisation that trains journalists to report more holistically on the news. It uses a particular approach when researching and creating

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[28] Victimhood is also a commonly used trope in environmental communication. For example, Arnold (2018) argues that climate change stories in the Arctic are often void of people and concerned mainly with geographical features, polar bears and caribou. Where people do feature, stories focus predominantly on scientists and filmmakers, or are saturated with images of Indigenous communities as victims. This framing fails to provide a more nuanced and holistic narrative, obscuring and even stealing people's right to their own story of agency and resilience; even with all the power of colonisation, capitalism and fossil-fuel extraction, Indigenous peoples still exist and disrupt movements through "grounded normality, radical resurgence and survivance," put well by Barr (2018, p. 15). Stories should be attentive to this.

stories. According to the Network (Learning Lab, n.d.), articles must encompass an in-depth response to a social problem. They must grapple with robust evidence, be attentive to impacts and insights in such a way that helps others, have a strong understanding of the work's limitations, explore where this solution is being developed in other areas or situations, avoid overly-positive good news stories, and adequately analyse the efficacy of what is being proposed.

Bornstein, the Network's co-founder, claims it is not enough to know what is broken. Instead, people should have the opportunity to understand how problems are being responded to and fixed (Arnold, 2018). He advocates reporting that "investigates and explains, in a critical and clear-eyed way, examples of people working toward solutions" in order to "provide valuable insights about how communities may more effectively tackle serious problems" (Solutions Journalism Network, 2017).

The concept of solutions journalism offers crucial insights into my research. I began with a focus on environmental change, implicitly seeking to explore climate change impacts. Yet, my data speaks to broader concerns farmers have about socio-political challenges, solutions, and the restructuring of their industry. Ultimately, solutions permeated farmers' responses and moved beyond the analytical frame of the research. The approach outlined for solutions journalism above has the potential to contend with this analytical shift. It showcases how research *can* move beyond problem-based analyses to situate proposed solutions in a critical context, assessing and evaluating their potential, grappling with what they would require, whether they are plausible, and what other issues would need to be engaged.

Building upon the above, it is also important to highlight that many scholars are also approaching research with solutions in mind. For example, Kelsey (2016, 2020) argues that connecting people with concrete examples of successful responses to conservation issues is critical in amplifying effective, evidence-based strategies. Whilst Kelsey employs this technique throughout her book (2020) and in the many public-facing lectures she gives, she also cites Cinner et al.'s (2016) work as exemplary. Cinner et al. (2016) approached the study of coral reefs by looking at 'bright spots,' which are:

> Places that are performing substantially better than expected, given the socioeconomic and environmental conditions they are exposed to. By their very nature, outliers deviate from expectations, and consequently can provide novel insights into confronting complex problems where conventional solutions have failed. This type of positive deviance, or bright spot analysis has been used in fields such as business, health, and human development to uncover local actions and governance systems that work in the context of widespread failure and holds much promise in informing conservation (ibid, 2016, p. 5)

Working collaboratively—another indicator of the nature of solutions-based research—Cinner et al. (2016) conducted a study of 2,514 coral reefs in 46 countries, states and territories to generate evidence-based management recommendations to coral reef degradation. They situated their work, from the outset, on studying bright spots or outliers. Although their findings are beyond the scope of this analysis, what is important to note here is that their work has been hugely important in informing future strategies for conservation, clearly indicating that focusing on solutions is not trivial nor simplistic: it is a key underpinning to majorly funded, highly impactful research. At the time of writing, Cinner et al.'s (2016) article in *Nature* has garnered much attention and has been widely cited (over 300 times).

Recent studies also showcase that a solutions-based approach does more than simply nurture optimism within readers, as Cvitanovic and Hobday (2018, p. 1) suggest. Using a solutions-based approach can also rectify many complex issues. Gupta et al. (2021) use this 'bright spot' approach in a study on COVID-19 in rural India. They state (2021, p. 2): "we believe that examples of success can lend critical insight into conditions and innovations that can lead to more desirable outcomes, especially in otherwise unfavourable contexts." Perhaps the COVID-19 pandemic typifies this 'unfavourable context,' yet there are promising developments being made in solutions research. For example, epidemiologists are collaborating and sharing data at immense speeds in order to further understand and respond to COVID-19 (Kupferschmidt, 2021). This data-driven approach to solutions demonstrates the potential applicability of solutions research. It also highlights that during times of complex emergency—as in COVID-19 and the environmental crisis—solutions-based research provides helpful offerings. So while these

examples are not only important in changing the narrative on environmental issues and supporting researchers alike to address problems in more optimistic ways, they show that being attentive to solutions can also help to rectify the very core issues themselves. The examples above contend with 'wicked problems'—such as human health—which parallel the complexity and complicated qualities of environmental change issues.

Given the arguments above—that solutions-based research is possible, feasible, rigorous and impactful—I wish to draw attention to one promising solution for the oyster farming industry in B.C. Tim Green is a Canada Research Chair in Shellfish Health and Genomics at Vancouver Island University (VIU). He and his team are several years into a 10-year programme, jointly funded by DFO and National Sciences and Engineering Research Council, to breed oysters which are more resilient to acidity and warming water temperatures (Findlay, 2021). With research experience from Australia, Green is advancing the possibility that oysters might survive in more acidified and warming oceans. An article outlining the project states "there is reason for optimism. In Green's native Australia, the shellfish industry has a good track record breeding Pacific oysters…" (Findlay, 2021). Ultimately, Green and his team at VIU seek to advance scientific research whilst simultaneously working with and helping the industry. Their approach can be identified as solutions-focused and their process indicates the importance of collaboration and the benefits of looking to developments in other countries.

Green's technical approach to solving issues is hugely encouraging. Yet, it is distinct from the socio-political issues this research has also identified as needing direct engagement to support the industry and its farmers. In Chapter 2, I showed that there is an array of issues facing oysters, communities, and ecosystems including globalisation, pollution and governance challenges. This means that there is an array of potential solutions to mitigate many of these issues, and that this may involve more than technical fixes. In other words, Green's work may be completely successful, but the industry could still face challenges. Therefore, cultivating solutions—just as one cultivates oysters—demands rigour, collaboration and multiple approaches.

4. Limitations of this Research

The Solutions Journalism Network ensures that journalists approach matters with rigour and critical analysis. Furthermore, Kelsey's (2020) argument about hope is evidence-based, in-depth, and critical. As such, solutions-based research into socio-ecological systems should similarly be grounded in a rich understanding of the complexity and multiple stakes surrounding an issue, and should not just tell the 'good news.' I offer some learnings from this research process to further accentuate this argument.

Firstly, as I spoke to those sympathetic towards oyster farming and its future, I only heard a small part of what goes on in coastal communities. However, there are significant criticisms of this industry which research should be attentive to—and these criticisms should indicate more broadly that environmental problems are complex, and so are their solutions. For example, one should be careful not to portray oyster farming as inherently good for the environment with little nuance. Many scholars warn of the impacts of farming a non-native species (Mamoser, 2011, p. 20; McKindsey et al., 2006). Joyce (2008), Joyce and Casessa (2009) and Joyce and Satterfield (2010) argue that it contests property rights and prohibits access to the foreshore. Pinkerton and Silver (2011) show that governments have promoted it using a problematic capitalist framework of development, and Silver (2010, 2013, 2014a, 2014b) warns that it complicates and may undermine First Nations' territorial rights. In fact, Silver (2014a, 2014b) argues that marketing of shellfish aquaculture as a sustainable practice has meant it has developed without much criticism.

To fully account for the complexity of shellfish farming, the research would have benefited from hearing from other voices. It would have needed to hear from First Nations and other community members. For example, farmers spoke about their clashes with 'upland owners,' those with private property adjacent and above oyster leases. Some informants used the term 'NIMBYism.'[29] This generally refers to a community's refusal

[29] Literature suggests researchers should refrain from denouncing and dismissing conceptualisations as NIMBYism (Burningham, 2000; McClymont and O'Hare, 2008); concerns over landscape impacts are

of a project based on local or aesthetic impacts, regardless of the project's public good (Shaw et al., 2015). Farmers told me they wished some community members would instead greet shellfish farming with 'SWIMBYism:' 'something wonderful in my backyard.' Analysing this in more detail requires further investigation, but ascertaining the existence of—and further exploring—tenuous relations within communities is integral to this form of research and its efficacy.

In addition, research must be attentive to rapid changes in socio-political dynamics. For example, I conducted research with oyster farmers before the coronavirus pandemic. Whilst relations may have been improving between farmers and community members, changing socio-political circumstances can drastically alter social relations. Gibbs (2009, p. 86) shows that aquaculture support can change quickly—acceptance may change during economic downturns. Knowlton (2020, p. 14) further accentuates this argument, stating that "changing political situations (e.g., due to war and, most recently, the global coronavirus pandemic) can unexpectedly undermine achievements once thought to be settled." Research must be attentive to the dynamic nature of social and political phenomena.

4.1 What Does This Mean for Future Research?

I have identified above a convergence between the focus that emerged in my own research and an emerging emphasis on the importance, and challenge, of researching and writing about solutions much more widely. Engaging in this kind of work is complex. Fortunately, scholars and practitioners are making headway in suggesting, illuminating and undertaking new approaches to solutions.

Upon reflecting on this research process, I have identified several approaches that might rectify and unite the gap between what I heard from farmers and what research can do. I might have begun this research with an evaluation of which oyster farms along the B.C. coast were performing better than might be expected along various indices, such as ecological health, commercial viability, community relationships, and ability to adapt to

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more than aesthetic concerns and can relate to experiences, local histories, and spirituality (Shaw et al., 2015).

environmental challenges. This would loosely pertain to Cinner et al. (2016) and Cvitanovic and Hobday (2018)'s use of 'bright spots,' enabling this particular research to explore what was working well within these specific operations.

Another approach may have been to conduct the research in stages, using a 'cumulative study' methodology as developed by Wilson (2012) and outlined by Ross and Berkes (2014, p. 793). This term refers to successive studies which are designed to build understanding in steps. In the case of this project, this may involve conducting the study in two stages. The first stage may establish the many solutions farmers are working on, via interviews and surveys. This would then necessitate researching these solutions, analysing their efficacies and limitations in conjunction with scholarly and grey literature. The second stage of research would then follow up with more interviews, surveys and/or participant observation to engage farmers specifically on these solutions and how they might be carefully developed. In essence, the two step approach would primarily identify the solutions being proposed, and then further analyse how to operationalise them.

Irrespective of the above, my research journey highlights that any research project operating in the sphere of solutions should be iterative and flexible. Certain methodologies, such as those found within the social sciences, helpfully allow research to evolve and pivot according to what emerges during data collection (see Ross and Berkes, 2014). I suggest that future research should be prepared to alter its trajectory based on participants' needs and understandings. In fact, co-producing and co-creating research materials alongside interviewees and other scholars in a range of disciplines would be enormously beneficial. This would help ensure the research is community-led—and thus responsive to community needs—and that it engages critical and robust analysis, needed to assess and evaluate solutions.

Future research on this topic should also seek to hear from more participants and collect data on broader community perspectives. This is because farmers' propositions are only one segment of the story regarding coastal communities and their futures. Oyster farming is contentious in many communities; it can be ecologically detrimental and—importantly—its development must consider the rights and titles of Indigenous communities on whose land and waters the practice depends. As the adage from the

Environmental Justice movement (Mascarenhas-Swan, 2017, p. 44) states, "no decisions about us without us." If coastal communities are being spoken about, then research must hear their views.

Finally, research of this kind could consider how to better tailor and communicate findings to specific audiences to combat the media's pervasive 'doom and gloom' narrative. Solutions Journalism highlights ways to approach solutions, and many platforms[30] prioritise solutions-based stories. In particular, *The Tyee,* an independent news outlet in B.C., has taken up Bornstein's solutions reporting model. The outlet's founder, David Beers, also says the value of solutions journalism is not to just describe what is going wrong in the world. In fact, it is just as essential to report what is going right (Gunster, 2017). I hope to publish a public-facing, solutions-based article in a news outlet such as *The Tyee* upon completion of this research.

Inevitably, approaching solutions is challenging. However, I have demonstrated that this route is useful if scholars and practitioners in science, social science, communications and other fields wish to seriously grapple with and motivate action on environmental issues. Whilst difficult, this work is necessary. As Kelsey (2020, p. 183) notes in *Hope Matters,* "solutions are not final, perfect end points. They're ongoing processes that require monitoring and adjustment to achieve meaningful results. Solutions are directions that require constant vigilance. But the need for vigilance shouldn't prevent us from forward action." Engaging this line of analysis is complex, and solutions themselves are not straightforward. Yet, grappling with them is fundamental. The words and actions from oyster farmers emphasise that.

5. Conclusion

I have attempted to map the complexity of shifting from a problem analysis to a solutions orientation by sharing my perspective of this research process. This research has found many hardships for B.C.'s oyster farmers: the environment is changing, just as

[30] See Atlas of the Future (n.d), a digital news outlet which tells 'daily adventures for a better tomorrow,' Solutions Story Tracker (n.d), and hashtags such as #*earthoptimism* and #*oceanoptimism.*

community relations shift and socio-political structures evolve. Farmers are, however, responding to what confronts them and they remain committed to their practice and its future. They seek to ameliorate some of the issues facing them, such as oyster mortalities, community politics, or raw sewage. They are also proposing solutions to more complex challenges on the coast.

To demonstrate the challenge—and importance—of grappling with solutions in research, I have unravelled this chapter in layers. Focusing on my experiences with farmers on the B.C. coast, the first layer shows what farmers are already doing to respond to the problems they face. The second layer highlights farmers' devotion to this industry and showcases their focus on transforming the industry so that it is able to contribute solutions to some of the complex challenges coastal communities are facing. The third layer speaks to the importance of, and challenges inherent in, refocusing research on building solutions.

As Ray (2020, p. 17) states in *A Field Guide to Climate Anxiety*, "we need to desire, not fear, the future." Many of those I spoke with during this research desired a future for their industry. Research can play a role in assisting them in imagining this future. Grappling with the complex landscape of solutions is a robust way to do so.

Chapter 4: Conclusion

1. Introduction: Research Flow

This research explored environmental change, coastal communities, and a small marine animal that lives in B.C's coastal waters. I sought to understand how environmental change—including climate change—impacts people in specific areas and how they are responding to it, hoping that this would provide insights about how to better support community resilience in the face of these changes.

I chose to concentrate the research on oyster farming. Indigenous communities have been harvesting shellfish in the Pacific Northwest for millennia, and since the 1900s the coastal waters have been home to Pacific oysters. This practice has grown into an important industry for many regions, yet it is encountering difficult and complex changes. Subject to a host of unprecedented environmental issues, the oyster has become a new 'canary in the coal mine.'

I used ethnographic methods to conduct the research. During the warm summer months of 2019, I was privileged to interview 14 oyster farmers and two industry representatives in five different locations around Vancouver Island. I also spent extended time with five of these farmers, engaged in the method of participant observation. This included working with them for up to several days and attending oyster festivals and community events.

Chapter 1 began by contextualising this research and reviewing relevant academic literature and its gaps. This was a daunting task; in the words of Dr. James Rowe (2020), scholarly literature may appear to be an expansive desert. This is particularly true with regards to climate change, a vast topic that rightly garners much attention. To address this issue within the realm of a Master's project, Rowe suggests finding a 'sandbank' within the desert in which to situate your work (Rowe, personal communication, September 21, 2020). The first chapter sought to do this, drawing contours around the topic of environmental change as it relates to coastal communities in B.C., with a particular focus on the oyster farming industry.

Building from this, Chapter 2 sought to answer the following question to provide insights into the larger question of the resilience of coastal communities:
How are oyster farmers on the B.C. coast perceiving and responding to environmental change, and what are the implications of this for the governance of the industry?
Based on what I heard, this chapter showcased that environmental change—and climate change—must not be dealt with in isolation. Rather, it needs to be understood within the context of the industry and culture on the coast and should be nested within broader reforms to support the sustainability of the industry and the resilience of the coastal communities.

It soon became clear that the story I was hearing was not solely about the problems of environmental change; my interviewees wanted to talk about solutions. As noted in Chapter 3, the following quote from one farmer illuminates this: "Without climate change, shellfish farming makes sense as a livelihood. Now it makes sense as part of the solution" (CI 2). Despite facing many challenges, farmers were deeply motivated and actively involved in ensuring that their industry had a future and that this future co-existed with—and supported—coastal communities. In response to their urging to focus the research towards solutions, Chapter 3 then evolved into analysing how to better account for and approach environmental solutions both in practice and in socio-ecological and communications research. Throughout this chapter I sought to answer the following questions:
What role does—and might—the oyster farming industry play in supporting coastal sustainability in B.C., and how can researchers better support the efforts of those in the industry to solve the challenges they—and coastal communities more generally—face?
This chapter demonstrated the challenges—and the importance—of solutions-based research.

This concluding chapter, Chapter 4, answers each research question sequentially and reviews the research findings. It then explores the work's broader implications and its limitations. I conclude by setting out ideas for further investigation.

2. Findings and Broader Implications

Question 1. How are oyster farmers on the B.C. coast perceiving and responding to environmental change, and what are the implications of this for the governance of the industry?

Academic literature demands better understandings of localised climate impacts (Handisyde et al., 2017), better analyses of its impacts (Talloni-Álvarez et al., 2019), and more robust studies as to how we support communities through transitions and take the appropriate courses of action (Baer and Singer, 2018; Crate and Nuttal, 2009, 2016; Stensrud and Eriksen, 2019). I sought to contribute to these research needs by exploring one industry that is significantly affected by environmental changes.

Oyster farmers spoke predominantly about ocean acidification, excessive mortality in their oysters, the presence of pathogens, increasing water temperatures and more dramatic weather events. There was consensus that events were unprecedented and posed significant hardships. Importantly, however, farmers contextualised these changes in reference to underlying dynamics concerning broader socio-economic and political processes. For example, concerns about acidification were intimately linked to the globalisation of the industry: as the industry had developed with few local hatcheries, farmers were forced to import seed from international markets, which were themselves subject to their own host of challenges. As a response to this, farmers argued for more hatcheries in B.C. and better political support for the industry at a local level. Unpacking these issues revealed that these events were intricately connected to fears about pollution, coastal development and a lack of political will to ensure clean coastal waters—pointing to environmental changes that are distinct from climate change and require different kinds of responses.

Environmental changes were salient, in other words, but had to be understood within a broader context of socio-economic-political change, including but not exclusively climate change. The shellfish industry is—and has been—changing, even as the climate is changing; and so navigating broader dynamics of social, political and economic changes is at least as important to farmers as the challenges of climate change. In fact, these changes must be dealt with together.

Farmers firmly believed in the industry's potential sustainability, touting its economic, ecological and environmental contributions in supporting local economies. Some emphasised its important role in economic and community development, particularly because it offered year-round local jobs to community members. They appreciated its small scale and locally rooted nature. Others heralded its ecological importance, noting that oysters can improve water quality and are akin to canaries in a coal mine, indicating when ecosystems—and human communities—may be unhealthy. Finally, farmers told me that this practice offers them a way to make a living in places they love.

Yet my findings showcase that these traits are not only threatened by climate change; ill-fitting policies and regulations which come to bear on the industry may further compound issues and may be directly antithetical to farmers' hopes for the future of their practice. To make this argument, I highlight how neoliberal policies have systematically impacted local communities' ability to benefit from local resources. Several farmers speak to this:

> It's harder for small growers to participate in the industry and the net effect of government regulation is it's going to tend to consolidate the industry and make bigger players, because the little ones just can't afford to do it. That's… it's not an unusual trend, I've seen the same thing in other industries. But it's… the government structure we have tends to encourage that path rather than discourage it. But it's the way of the world, unfortunately, I think. (BS 1)

> We are following the predictable pattern that has happened with a lot of resources. Where you have, you know, with the logging industry that you have on the coast here, it went from ma and pa operations to small companies to larger companies to international companies and you know, the same, that pattern, the fishery… the same pattern. So, we are doing exactly the same thing. And from our perspective we are making exactly the same mistakes again. (CI 2)

Farmers were concerned about resource management in the province, recognising some of the damage from boom-and-bust industries in rural areas. To prevent this, they argued that governments need to grapple with the industry's scale and governance before

consolidation and corporatisation made their livelihoods unviable. If governments want to support this industry, they must listen and respond to farmers' concerns and priorities.

Ultimately, they told me they want to continue working at the beach and on the water, knee-deep in gritty mud and clothes crisp with salt-water, and they will navigate tumultuous waters ahead in the hope of continuing their practice. They need help to do so, however. They advocated for certain support, such as more local hatcheries, assistance to manage plastic pollution, and more integrated and robust decision-making to curb coastal pollution and the hidden consequences of coastal development patterns. In sum, many farmers believed they contribute most to their communities when their operations are locally owned, when government regulation supports them and where the locality of place and coastal ecosystems are paramount.

Question 2. What role does—and might—the oyster farming industry play in supporting coastal sustainability in B.C., and how can researchers better support the efforts of those in the industry to solve the challenges they—and coastal communities more generally—face?

A 'problem identification' lens often dominates environmental research, and environmental communications replicates this focus by taking a narrow 'doom and gloom' approach. In both cases, this focus is predicated on the idea that people need more information about what is not working or need to be more fearful in order to act. These strategies, however, create unintended consequences: scholars show that they misunderstand human agency and can immobilise action (Gifford, 2013; Kelsey 2016, 2020; O'Neill and Nicholson-Cole, 2009; Polk, 2018). Environmental research and communication has not effectively galvanised action to address environmental problems (Kelsey, 2016, 2020).

Many scholars are now calling for a change in the way people approach environmental issues. Ray (2020, p. 31) explains that in fact "love" for the planet can be an antidote to despair. This call joins a burgeoning body of literature which shows that people are more motivated to act when tangible solutions are illuminated, and when personal stories—rather than facts—are used (Arnold, 2018; Cvitanovic and Hobday,

2018; Gornish, 2017; Jones, 2014; Kelsey, 2016, 2020; Knowlton, 2020; O'Neill and Nicholson-Cole, 2009; Polk, 2018). This is not to say that facts and rigorous research are not important. It is to instead highlight the need to not only focus on problem-definition, but on how to build evidence-based solutions. In other words: the problem is not facts *per se,* but how to shift from focusing so heavily on the *facts of the problems* to the *facts supporting evidence-based solutions*.

Chapter 3 is a response to both this growing body of work and farmers' aspirations. I showed that farmers point to the potential for oyster farming to support ecosystem and community resilience. For example, they suggested these benefits might be realised if decision-makers link the health of oysters with the health and integrity of ecosystems and human communities. Throughout this chapter, I make the case that the oyster farmers I interviewed on the coast of B.C. are searching for solutions to challenges facing their industry, that these quests for solutions are potentially endeavours that may ameliorate and strengthen relationships with coastal communities, and that this methodological turn towards solutions should be further taken up and critically considered in environmental research and communication more broadly.

3. Broader Implications

Many scholars continue to map the lived experiences of climate change, using case studies to argue for support at local, regional, national and international levels (see Crate and Nuttal, 2009, 2016). My research offers another ethnographic account and is particularly significant because it focuses on an industry that has received relatively little attention from social science researchers interested in climate change. Specifically, it demonstrates that climate change must not dominate the conversation about environmental change. Conversations about how to respond to climate change should be situated in the concerns and challenges of sustainability and environmental justice that all communities are facing. Shellfish farming may have an increasingly important role to play, yet its trajectory in a climate-changed world should be attentive to the socio-political and cultural contours which I have identified throughout this thesis.

Furthermore, this research joins a range of scholars who are demanding more solutions-based approaches in research on environmental issues (Bennett et al., 2016b; Cinner et al., 2016; Cvitanovic and Hobday, 2018; Kelsey, 2016, 2020; Knowlton, 2018, 2020; O'Neill and Nicholson-Cole, 2019; Polk, 2018; Ray, 2020). My research process itself illuminates the importance of grappling with solutions to environmental issues and exploring them with rigour and depth. While significant solutions are being developed to assist the industry in managing threats from ocean acidification and warming water temperatures (Findlay, 2021), more solutions are needed. Given the findings from my ethnographic research, paired with burgeoning approaches in research and communication, future work centred on the oyster farming industry could seriously consider their aspirations towards solutions that not only aid their industry, but communities along the coast too.

4. Next Steps for Research

This work has given a preliminary sense of how best to support oyster farmers and the coastal communities within which they are embedded. It synthesised their perceptions, their solutions, and their hopes for the future, demonstrating a need and desire for better strategies for their industry. This research is a critical piece in exploring the industry's future, yet it merits supplementary analysis. Future research might involve cross-examining current policy and regulations, consulting with community members and grappling with economic development in coastal areas. Ultimately, farmers need—and desire—their solutions coalesced into a strategy for the future of this industry.

Furthermore, First Nations' engagement with shellfish farming deserves more analysis. Future research could build from the work of non-Indigenous and Indigenous scholars, including but not limited to Deur et al. (2015), Joyce and Canessa (2009), Joyce and Satterfield (2010), Lepofsky et al. (2015), von der Porten at al. (2019), Tollefson and Scott (2006), and Silver (2010, 2013, 2014a, 2014b). I hope that this work serves as a humble contribution to research of that nature.

Finally, as noted by Kelsey (2016, p. 28):

> Adhering to a narrative of doom and gloom that leaves its most vulnerable constituents frightened and disempowered clearly needs to change. And the narrative needs to be changed in a way that does not create ethical tensions around the issue of raising false hope.

This work demonstrates the need for more research that is attentive to solutions.

5. Research is Still a Significant Site of Struggle: Research Limitations

There are limitations to this research. I believe the most pressing is that it did not engage with First Nations. It should therefore be understood as a preliminary exploration of what a group of predominantly non-Indigenous oyster farmers are engaged in.

There are also limitations with this work in that I had a relatively small sample size of 16 people. Although this research speaks to broad issues that may affect coastal communities, it tells one story among many and is specific to my research participants. Specifically, I did not engage with community members who oppose shellfish farming. I spoke only to those who were sympathetic towards the industry and its future. It should then be understood as a snapshot of a story, one that necessitates further research. Despite this, I hope my work is still useful in drawing attention to the voices of those who may offer solutions.

Another limitation is that because this research sought to coalesce farmers' understandings of environmental change, it may consequently homogenise their perceptions—particularly across different geographical locations around the province—and over-generalise some facets of environmental change. This was a limitation inherent to some of the methods I chose to use—such as semi-structured interviews—as I did not ask every farmer the same question. Further to this, I did not analyse the interviews with certain specificities in mind, such as how frequently changes were occurring in different areas. Instead, I wanted to draw out a broader landscape of some of the key issues facing farmers, rather than their specific challenges in certain places. Fortunately, however, there is ongoing research conducted by Advani (Advani, n.d.; Advani and Satterfield, personal communication) which seeks to grapple with the specificities of oyster mortality, analysing how different geographic areas experience this issue differently.

Furthermore, this research cannot speak to gendered relations and other aspects of diversity and equity in the industry, despite a potentially interesting site of analysis—particularly given the gendered impacts of climate change (Johnson and Wilkinson, 2020) and an array of feminist theories unpacking and politicising the 'Anthropocene' (see Ebron and Tsing, 2017 for a brief overview). My data speaks predominantly to the experiences of men. There are thus limitations in what it can claim.

Finally, as noted in the introduction, I write as a white woman from the Scottish Highlands, cis-gendered and able-bodied. My life and my worldview have been shaped by structures of colonialism, heteronormativity and privilege. This research is inherently limited because of my positionality.

6. Final Thoughts

The last few years have shone a light on what is possible with regards to transformative change. 2019 and 2020 have been momentous years in unravelling what is achievable with regards to climate action. Global societies have seen the rise of Extinction Rebellion, a UK-based group that demands strategic action on the ecological emergency, and an encouraging popularisation of the Youth Strikes across the world, including across what is now called Canada (Cheung and Mike, 2019). There has also been political momentum around adopting a Green New Deal, implementing policies to support a Just Transition, and ensuring the state 'builds back better' from COVID-19 (Klein, 2020). Furthermore, there have been a myriad of challenging and hopeful discussions surrounding the need to uphold Indigenous rights and title, illuminated by the ongoing struggle faced by Wet'suwet'en land defenders and Mi'kmaw fishers.

We are therefore in the midst of a transition and there is much at stake. Although the intricacies of oyster farming and its challenges on the coast may seem small in comparison to climate change and the quest for social and ecological justice, they matter because they tell us about the politics of coastal communities, the need for healthy people and healthy ecosystems, and the importance of making a living on a living planet.

Bren Smith is a former commercial fisher-turned shellfish farmer. In his book *Eat like a Fish* (2019), he makes a powerful case for a transition to an equitable, blue-green

economy centred around restorative ocean farming. His arguments are a response to what he views as a "historic failure" by environmentalists and politicians to offer alternatives for communities. The lasting effects of overfishing are well documented—less so are forward-thinking opportunities for the future.

Scholars also document the society-wide historical failure to propose future solutions. Peter Senge, a prolific systems-theory academic, highlights this when in conversation with Hoggan (2019). He states that: "the common denominator underlying a lot of these problems—whether the environmental crisis, or social justice or the widening gap between rich and poor—is we don't seem to be able to develop wise, forward-thinking strategies… Our society systematically undervalues the future and is strongly biased toward [the] short term" (2019, pp. 152-153). I agree with this sentiment. Society has been focused on speaking to the scale of the problem and not attentive enough to imagining possible alternatives or creating the conditions for these to come to fruition. My research has attempted to map the complexities of this pendulum-like movement between problem-identification (in Chapter 2) towards the process of cultivating solutions.

Following this line of thought, this research leads me to suggest that the environmental movement—including activists, academics and community organisers—should focus more on possible futures and solutions than they have to date. A farmer told me: "we should campaign for what we are for, not what we are against." Ray (2020, p. 17) puts this extremely well: "we need to desire, not fear, the future." I believe the case of oyster farming presents an illuminative example of this refocus. Oyster farmers are facing hardships, but they continue to innovate. Their devotion to making a living on a living planet prompted the need to frame their story as one of hope. Paying attention to the ways in which they are doing this work highlights broader examples of how to reimagine our world. It is irresponsible to tout shellfish farming as an unbounded solution, but it is important to recognise its potential.

Finally, I wish to finish with the words of Bren Smith, who calls for an ocean farming revolution (2019, p. 12):

> Necessity pushes us to farm the seas, but we can embark on our journey with anticipation and joy. With ocean agriculture still in its infancy, we have an unprecedented opportunity to build a food system from the bottom up. We can avoid the mistakes of industrial agriculture and aquaculture, farm for the benefit of all, not just the few, and weave economic and social justice into the DNA of the blue-green economy, all the while capturing carbon, creating millions of jobs, and feeding the planet.

Perhaps needing to be taken with a pinch of salt, Smith's words are in line with some of the comments from farmers I spoke with. In summary, there is nascent potential for shellfish aquaculture, but supporting the waters, people, and oysters on the coast of B.C. demands a carefully charted route as we navigate these rapidly-evolving times. There are decisions to make as to how to protect the health of these barnacle-covered animals, and how to better support our communities, our ecosystem health, and our shared futures.

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Appendix

Appendix A: Human Research Ethics Board Approval

Certificate of Approval - Annual Renewal

PRINCIPAL INVESTIGATOR	**Kara Shaw** (Supervisor)	**ETHICS PROTOCOL NUMBER** Expedited review - delegated	**19-0117**
PRINCIPAL APPLICANT	**Catriona Mallows** **Master's student**	ORIGINAL APPROVAL DATE	11-Apr-2019
UVIC DEPARTMENT	**Environmental Studies**	APPROVED ON	30-Mar-2020
		APPROVAL EXPIRY DATE	10-Apr-2021

PROJECT TITLE **Understanding the Impacts of Environmental Change in Coastal Communities: An Ethnographic Account of Oyster Farming in British Columbia**

RESEARCH TEAM MEMBERS **None**

DECLARED PROJECT FUNDING **None**

DOCUMENTS INCLUDED IN THIS APPROVAL
Appendix 5.1 Verbal Consent Form.doc - 21-Mar-2019
Appendix 4.1WrittenConsentForm.doc - 21-Mar-2019
Appendix 5 Verbal Consent Form.doc - 21-Mar-2019
Appendix 4 - WrittenConsentForm.docx - 21-Mar-2019
Appendix 2.1 Invitation to Participate Verbal.docx - 20-Mar-2019
Appendix 1.1 Invitation to Participate Written.docx - 20-Mar-2019
Appendix 2 Invitation to Participate Verbal.docx - 20-Mar-2019
Appendix 1 Invitation to Participate Written.docx - 20-Mar-2019
Appendix 3.1 Interview Questions GROUP234.docx - 18-Mar-2019
Appendix 3_Interview QuestionswithGroup1.docx - 18-Mar-2019

CONDITIONS OF APPROVAL

This Certificate of Approval is valid for the above term provided there is no change in the protocol.

Modifications
To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.

Renewals
Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.

Project Closures
When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.

Certification

This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropiate standards of ethcis as outlines by the University of Victoria Research Regulations Involving Human Participants.

Associate VP Research Operations

Certificate Issued On: 30-Mar-2020

Appendix B: Semi-Structured Interview Questions

1. Can you introduce yourself, describe your position and how you are involved with oyster farming?

2. How important is oyster farming to your livelihood?

3. What changes have you noticed in oyster farming since you started farming?

4. What, if any, environmental changes have you specifically noticed since you began oyster farming?

5. When and where do they occur, normally?

6. Based on your experiences, what do you think is causing these changes?

7. How do you feel about these changes (concerned, surprised, unconcerned, welcoming, etc.)?

8. How are you responding to these changes?

9. What outstanding questions do you have about these changes? If you could direct a scientist, what would you like them to look at?

10. What does the future of oyster farming look like to you?

11. If you could wave a wand, what do you think we should be doing to help mitigate or respond to these environmental changes?

12. I am hoping to make a film to help share the results of interviews. Who needs to hear from oyster farmers and what do they need to hear?

13. Is there anything else you'd like to share?