Monitoring of Sea Otters (*Enhydra lutris*) to Inform Future Population Management Actions on the Coast of Vancouver Island

By

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Abstract

Mayer, M. C. (2022). Sea Otter Monitoring to Inform Future Population Management Actions on the Coast of Vancouver Island [graduate project]. Halifax, NS: Dalhousie University.

Sea otter populations on the coast of Vancouver Island in British Columbia (BC) have been greatly impacted by human actions spanning centuries. Historical records suggest that sea otters were abundant in the region prior to the Maritime Fur Trade that drove sea otter populations to near extinction. Protection measures over the last 60 years have facilitated sea otter population increase in BC and allowed some populations to re-occupy areas of their historical range. However, increased sea otter presence in the region can create tensions between various stakeholder and rightsholder groups over access to valuable marine resources. Previous research conducted in other regions of BC demonstrates that sea otters may continue to expand their range to include the Port Renfrew area. This research project focused on the status of sea otter range expansion in this region, encompassing the western and central Juan de Fuca Strait and explored insights into appropriate management tools if sea otter densities increase in this area. Consideration was given to measures that can be brought into place to ensure continued expansion of sea otters while minimizing the potentially negative impacts to the socio-economic activities in the region. Information and insights obtained through sea otter monitoring, semi-structured interviews, an online survey interview questionnaire and a literature review on sea otter expansion can be used to inform an environmentally, economically, and socially sound plan to facilitate increased distribution of sea otters with minimal conflict.

Keywords: sea otter population management; coastal resource management; Vancouver Island; stakeholder perspectives; coastal communities.

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To start, I would like to thank the Indigenous Peoples who have been stewards of the lands and waters in what we know as Canada since time immemorial. This work was conducted on lands and waters of Pacheedaht territory and the unceded territory of the Mi'kmaq peoples.

Thank you to my co-supervisor Dr. Anna Hall for your unwavering support, advice, and warmth. Thank you for hosting me on Vancouver Island and providing me with the internship opportunity of a lifetime. I am immensely grateful to have experienced the joy of working at sea.

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Positionality Statement

As a settler of European descent living and working in Mi'kma'ki the unceded territory of the Mi'kmaq people and attending Dalhousie University, I understand that my beliefs and experiences have influenced the totality of the research I have conducted. As part of the Master of Marine Management degree, I was fortunate to be able to participate in a four-month internship working in the territory of the Pacheedaht. I am deeply grateful to have been given the opportunity to conduct research on Indigenous lands and waters as a non-indigenous researcher. I understand that as a researcher, I approach this research with my own ontological and epistemological understanding rooted in my western upbringing and inherently Eurocentric worldview. My hope is that this work will be a vessel for knowledge sharing incorporating elements of my worldview and western ideologies of science and social science and the expertise and Indigenous knowledge systems that have been graciously shared with me along this journey.

Chapter 1 Introduction

Throughout history, human civilizations have settled in coastal regions to gain access to the marine environment and valuable resources. However, human reliance on marine resources is universal in that both coastal and inland communities experience improved well-being from the nutritional, economic, cultural, and protective goods and services provided by the oceans and other waterways (Selig et al., 2019). Humans are one of the most coastally dependent species existing today and our reliance on the marine environment is imposing unprecedented pressures on the resources on which we depend for survival (Weinstein et al., 2007). For this reason, people who sustain their livelihoods by extracting marine resources can be greatly affected by changes in trophic interactions and environmental conditions (DFO, 2021).

Greatly affected by human activities and increased presence in the coastal environment are the marine mammals, consisting of 121 species of cetaceans, pinnipeds, mustelids (sea otters), and sirenians (Committee on Taxonomy, 2022). The life history and movement patterns of these animals can be affected by a range of human activities that may result in acute or chronic impacts (Marine Mammals Management Toolkit, 2022). From noise pollution to prey depletion, anthropogenic impacts are so prevalent in the marine environment that there are no marine mammal populations today which are unaffected by human impacts (Brakes & Dall., 2016). For example, between the years 2019 and 2020 there were 714 incidents reported to Fisheries and Oceans Canada (DFO) involving marine mammals in the Pacific Ocean, including 333 for species listed in the Species at Risk Act including various whale taxa and other marine species (DFO, 2021). Such incidents and interactions between people and animals inhabiting the marine and coastal environment can affect the survival of the animals, likely resulting in local extirpations and species-level extinctions if changes to human behaviour are not made (DeMaster

et al., 2001). Reversing trends of exploitation will require ecologically, socially, and environmentally sound marine management decisions.

1.1 Context

In the rugged wilderness of the Pacific Northwest, the west coast of Canada extends 1,000 km along the coast of British Columbia (BC), however, including headlands and inlets, the coastline of this province extends over 25,000km (DFO, 2021). Coastal residents have established communities for millennia along the BC coastline bordering the Pacific Ocean (Travel Media, 2019). This province is home to more than 200 First Nations including Pacheedaht First Nation on the southwest coast of Vancouver Island (Travel Media, 2019) and others which contribute a cultural richness to the region rooted in strong connections to the lands and waters. The Pacheedaht First Nation governs a large marine and terrestrial territory (Figure 1) along the coast of Vancouver Island spanning from Bonilla Point to Sheringham Point (British Columbia Assembly of First Nations, 2022).

As a coastal peoples, the historical and contemporary lives of the Pacheedaht is closely tied to the coastal environment and the marine mammals in the region. In a 2019 Pacheedaht First Nation Traditional Use and Occupancy Study Report, the extensive harvest and trading of marine resources by the nation is described as historically unrestricted but more limited post contact with the colonizer (Pacheedaht Heritage Project, 2019).

Figure 1 Map of Pacheedaht Territory adapted from the figure by Samantha Leigh Smith obtained from the Narwhal at https://thenarwhal.ca/pacheedaht-fairy-creek-bc-logging/.

Historical accounts suggest that the Pacheedaht economy was closely tied to the hunt of marine mammals as well as fishing and gathering of plants and berries, practices which continued into the colonial periods until the desired resources became depleted due to the commercialization of marine resource exploitation (Pacheedaht Heritage Project, 2019).

Despite a common theme of appreciation towards marine mammals in human society, various species of such animals have been the target of exploitation throughout history and as such almost all species or marine mammal is exposed to at least one threat (Avila et al., 2018). When interacting with marine mammals, people have shown a tendency to value their own wants and needs over the best interests of the animals. Examples of the commercial whaling industry and the maritime fur trade highlight the human ability to prioritize economic gain over the lives

of marine mammals. A deep dive into the story of sea otters exemplifies how human greed has impacted the history, present and future of this species in BC.

1.2 BC Sea Otter Population

The sea otter (*Enhydra lutris)* is the smallest species of marine mammal and is commonly found in coastal environments that are 1-2 km offshore (DFO, 2020). These "seagoing weasels" are the only member of the Mustelidae, or weasel family of whom are adapted to live their lives exclusively at sea (Cannings & Cannings. 2015). Credited with being the most specialized member of the family, sea otters coexist with other marine mammals such as Pinnipeds and Cetaceans in the marine environment (Kenyon, 1969). They have developed the following adaptations including flippers for aquatic locomotion, flat molars to crush shells, and kidneys adapted to process the sea salt they ingest (Riedman & Estes. 1990). Typically, they weigh under 100 lbs and can grow to be a maximum length of 58 inches (Kenyon, 1969).

Sea otters are voracious predators who consume 25% of their body weight daily (Gregr et al., 2020). Further, they are keystone predators and ecosystem engineers meaning they have an ability to influence changes in community structure and trophic interactions within an ecosystem through their dietary preferences and feeding behaviours (Hughes et al., 2013). Their ability to influence change in coastal environments can be beneficial or problematic for the socio-economic conditions in coastal communities. In the pacific northwest, sea otters participate in a well-studied and ongoing trophic cascade or food chain where they contribute to healthy kelp meadows by feeding on sea urchins, but strong sea otter predation on shellfish can decrease shellfish harvest for coastal peoples and negatively impact fisheries (Gregr et al., 2020).

The historically abundant sea otter population on the BC coast was severely impacted by the maritime fur trade in the 1700s where explorers from Europe gathered and sold the highly

valuable pelts of sea otters in foreign markets, an industry that resulted in the commercial extirpation of this species in Canada (Kenyon, 1969). The historical range of the sea otter spread along the coast of the Pacific Ocean from Japan to Mexico with a population in Canada off the BC coast (Blood, 1993). The historical population was estimated to be between 150,000-300,000 individuals worldwide (Blood, 1993). The arrival of European explorers in North America is traced back as early as 1733 when Spanish missionaries reached the coast of California and later when Russian explorers began to exploit the population of sea otters in the Aleutian Islands, Alaska (Kenyon, 1969). In the year 1779, members of Captain James Cook's expedition sold sea otter pelts that they obtained off the coast of Vancouver Island, in Canton China, sparking international interest in the plush and luxurious pelts provided by this species (Kenyon, 1969). The fur trade, spanning a 150-year period of heavy exploitation, had devastating impacts on sea otter populations on the pacific coast (Blood, 1993).

Few populations remained after the violence of the fur trade concluded. Populations survived only on the Kamchatka coast, the Kuril, Aleutian, and Commander Islands, in the Queen Charlotte Islands of BC, Point Sur California, Cedros Island and San Benitos Island, Mexico (Jameson et al., 1982). The fur trade is a complicated and violent tale of interconnectedness between people and sea otters that marks a key period in the shaping of the world economy (Loshbaugh, 2021). The exploitation of sea otters spanned centuries until the disappearance of the sea otter was observed, and society shifted in favour of the conservation of marine biodiversity. In the early 1900s after centuries of exploitation, there was widespread fear that the commercially extirpated and nearly extinct sea otter would not survive in North America, sparking government protection and management actions (Kenyon, 1969). This marked the beginning of sea otter conservation in North America. In 1929, the last sea otter was recorded

in Canada off the coast of Vancouver Island (Blood, 1993). Through legal protection and management actions such as re-introduction programs that translocated sea otters from Alaska to regions of historical sea otter territory on the Pacific Coast, the sea otter has returned to Canadian waters.

Sea otters were absent from the BC coast for a century until the reintroductions and conservation measures taken for their protection over the last 60 years and have allowed some populations of sea otters on the BC coast to re-establish regions of their historically occupied range (Davis et al., 2019). The return of the sea otter to BC waters initiated by a program in the 1960s where 89 sea otters from Alaska were reintroduced to the BC coast in Checleset Bay on Vancouver Island to repopulate the region (DFO, 2014). During the years 1969-1972, the Arctic Biological Station, Pacific Biological Station, British Columbia Fish and Wildlife Branch and Alaska Department of Fish and Game captured the animals in Alaska and relocated them to BC (Bigg & Macaskie. 1978). Interestingly, the animals dispersed widely post relocation with some individuals travelling as far as 220km south along the coast of Vancouver Island and others travelling 320km north towards the Queen Charlotte Islands and mainland BC (Bigg & Macaskie. 1978). Like other species of marine mammals, sea otter populations have travelled and fluctuated significantly over the last few hundred years. Sea otters have grown from a global population of a few thousand individuals to approximately 150,000 individuals today (Davis et al., 2019).

In 2014, Fisheries and Oceans Canada (DFO) estimated that sea otters in the North Pacific inhabited roughly one half to two thirds of their historical range (DFO, 2014). In 2017, the sea otter population count circulated in Science Advisory Report 2020/036 was approximately 8,110 individuals in BC (DFO, 2020) representing a significant population

increase from the 89 translocated individuals from Alaska only 60 years ago. However, with this population increase and recovery in some regions of the BC coast, changes to nearshore ecosystems have been observed which left unaddressed, could pose challenges for marine managers (DFO, 2021).

1.3 Management Problem

On the Southwest coast of Vancouver Island, there is a community called Port Renfrew on Pacheedaht Territory. The Port Renfrew and Pacheedaht communities are situated on regions of the western and central Juan de Fuca strait, the portion of the Pacific Ocean connecting Vancouver Island to Washington in the United States. Many coastal First Nations on Vancouver Island have a relationship with the natural environment which is central to their identity consisting of strong connections which have existed and continue to exist today between the people and marine life in the territory (DFO, 2021).

Historical documents illustrate the presence of a population of sea otters residing in the territory prior to the 1700's and connect the species to elements of Pacheedaht culture (Pacheedaht Heritage Project, 2019). Sea otters are no longer present in large numbers in the region. However, sea otter range expansion into Pacheedaht territory is anticipated by the nation and if the restoration efforts by the Makah in Neah Bay, Washington are successful, this could expedite the repopulation process in the territory (Pacheedaht Heritage Project, 2019). If sea otter range is expanding into Pacheedaht Territory from sea otters travelling north from Washington, or sea otters travelling south from Checleset Bay (the original site of translocations from Alaska), this could result in changes for the coastal residents and industries which must be addressed.

The recovery of sea otters is viewed by conservation scientists as a success story since populations have rebounded from critically low population sizes (Boustany et al., 2021). This view fails to reflect the nuances associated with sea otter population recovery in the region and does not acknowledge the opinions of people who may be directly impacted by the return of the sea otter (Levine et al., 2016). As such, insights provided by stakeholders or rightsholders with other perspectives view the success of sea otter recovery as a challenge to navigate, especially in terms of social justice and reconciliation with Indigenous peoples (Pinkerton et al., 2019).

Sea otters evoke strong feelings in coastal residents on the Vancouver Island coast of a negative or positive nature due to their perceived impacts (Martone et al., 2020). This project considers the values of coastal peoples regarding sea otter range expansion and aims to understand the current uses of the marine environment that may be positively or negatively affected by sea otter range expansion into this region. Even though sea otters once resided along the coast of Vancouver Island, they are now returning to a vastly different marine environment and socio-economic climate than they experienced in historical times.

1.4 Research Objectives

To understand the extent of range expansion in the study area and document local perceptions of sea otters and sea otter management in the region, the following research questions were developed. The first question examined "*how do sea otters alter the coastal ecosystem?"* through research and stakeholder and rightsholder perspectives. This question was intended to improve general understanding of the ways the potential reoccupation of historical sea otter territory could alter the coastal fabric in the study area. Consideration was primarily given to environmental changes, such as dietary preference of the sea otter and associated trophic

interactions but a secondary consideration of this specific question was the deeper meaning of ecosystem changes to social and economic dimensions.

The second question "*what is the occupancy rate of historic habitats on Southwest Vancouver Island?"* was posed to connect the monitoring and field research aspects of this project. This question examines sea otter reoccupation from the point of view of people who are interacting with the coastal environment regularly. The intention for this question was to provide an opportunity for inference on the potential of range expansion taking place in the region based on sea otter sightings.

The third question "*could range expansion result in changes for stakeholders and rightsholders, and if so, what management tools could be used to minimize conflict?"* unfolded in two parts. The first part of this question touched on the benefits or impacts felt by the people who live and work in the region and interact with the coastal space. The second layer of this question aimed to determine the tools or strategies which stakeholder or rightsholder group participants deemed as appropriate in the management of this species. This question was accompanied by a list of potential management tools which could be applied to the sea otter. Insights elucidated from this question may be used to construct a series of informed recommendations to improve sea otter management strategies moving forward. These three questions guided the research project through the study period to ensure the scope and goals of the research were inherent to the process.

1.5 Document Layout

The report consists of five chapters. Chapter 1 provided introductory and contextual information which forms the background for this research and a high-level overview of sea otter population dynamics in BC. Chapter 2 outlines details of the research methods utilized in this

study. Chapter 3 illustrates the results of the study with a separate section pertaining to each element of the multi-source data set. Chapter 4 synthesizes the information outlined in the results section to explore and understand what sea otter range expansion could mean for future management plans in coastal communities. Finally, Chapter 5 provides concluding remarks and future considerations.

Chapter 2 Methods

This chapter will describe the approach taken to examine the management problem of sea otter range expansion. The elements which form the multi-source data set will be explained. This chapter will begin with a description of the objectives of this research followed by further detail on the study area and an overview of the multi-source data set.

2.1 Objectives

This research seeks to answer the overarching question: Are sea otters re-occupying the region of their historical habitat in Pacheedaht territory and if so, could their presence alter the coastal ecosystem and result in changes for stakeholders and rightsholders in the region? To answer this question, this study considers:

- How sea otters alter the coastal ecosystem
- To what extent the occupancy rate of sea otters in Pacheedaht territory on the Southwest coast of Vancouver Island is increasing
- How range expansion of sea otters could result in changes for stakeholder and rightsholders in the region
- Which management tools could be used to inform an environmentally, economically, and socially sound plan to facilitate increased distribution of sea otters with minimal conflict

Through answering these questions, the goal of this study was to compile information and insights through semi-structured interviews (SSI), an online survey interview questionnaire (SIQ) and a focused literature review on sea otter expansion.

2.2 Study Area

Canada's westernmost province, British Columbia is home to Vancouver Island. As illustrated in the yellow portions of the map below (Figure 2), BC occupies a significant portion of the Coastline bordering the Pacific Ocean. On the southwest coast of Vancouver Island there is a town called Port Renfrew situated in the territory of the Pacheedaht First Nation.

Figure 2 Map of Canada and British Columbia obtained from Wikimedia commons by NordNordWest illustrating the province of British Columbia in red on the bottom left and yellow on the larger map image shown on the right. Pacheedaht Territory, the study area is indicated on the map by a red circle and label.

2.3 Overview of Multi-Source Data Set

To form a multi-source data set, a mixed-methods approach was used involving the collection of both direct and indirect data. This graduate project consisted of sea otter monitoring in the field on Vancouver Island, semi-structured interviews (SSI) conducted over the phone, an online survey interview questionnaire (SIQ) and desktop research in the form of a targeted literature review, as illustrated in the table below (Table 1). Direct research conducted on

Vancouver Island provided quantitative data on sea otter sightings in the study area and more broadly.

Table 1. Summary of the methods used to address the research questions in this study.

Method	Research Question	Quantitative / Qualitative	Materials	Time Requirement	Location and dates
Literature review, semi-structured interviews (SSI), and survey interview questionnaire (SIQ)	Research questions 1,2,3	N/A	Interview guide in Appendix A1	Literature review will span the study period and interviews from August-November 2022	N/A
SSI and SIQ	Research Question 2	Semi-Quantitative	Interview guide in Appendix A1	Answer questions: 30-45 minutes for SSI or 10-15 minutes for SIQ	Interviews conducted from August-October 2022. SIQ from October-November 2022
SSI and SIQ	Research Question 1	Qualitative	Interview guide in Appendix A1	Answer questions: 30-45 minutes for SSI or 10-15 minutes for SIQ	Interviews conducted from August-October 2022. SIQ from October-November 2022
SSI and SIQ	Research Question 3	Qualitative	Interview guide in Appendix A1	Answer questions: 30-45 minutes for SSI or 10-15 minutes for SIQ	Interviews conducted from August-October 2022. SIQ from October-November 2022

The identified implications were explored in detail to allow recommendations to be made to minimize conflict in the study area should sea otter expansion occur. The second section used sea otter sightings from a variety of data sources to assess the extent of sea otter range expansion in the study area. The third section formed the bulk of the data collection for this study as it was comprised of two methods to learn stakeholder and rightsholder perspectives. Finally, a focused

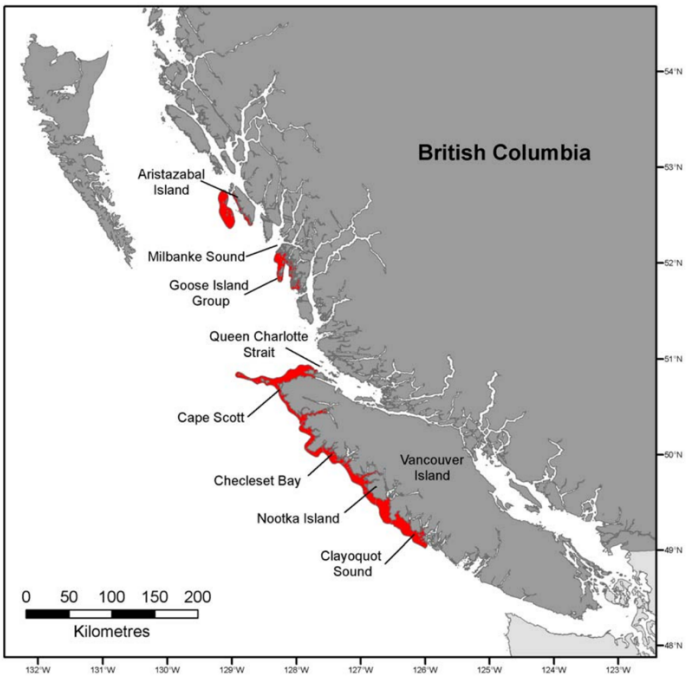
literature review provided the context needed to interpret the results from this multi-source data set and make meaningful connections to the body of literature on this topic. Together, this report will present an overview of the complexities between people and sea otters on Vancouver Island due to the population growth and range expansion of this species.

2.4 Sea Otter Monitoring

Between May and August 2022, the researcher was on Vancouver Island conducting direct research to add a layer of field research to the multi-source data set. During this time, the researcher served as the Research Team Lead on a Southern Resident Killer Whale (SRKW) Study conducted by Pacheedaht First Nation with Sea View Marine Sciences and SMRU Consulting. The researcher spent approximately 100 hours at sea travelling 1,250 nautical miles in the study area. The study area of the SRKW survey spanned Pacheedaht marine territory from Bonilla Point (heading northwest from Port Renfrew towards Bamfield) to Sheringham Point (heading southeast from Port Renfrew towards Sooke) and out to the Canadian border with the United States near the shipping lanes. Transect lines were designed to take 15-20 minutes to complete and a typical survey day would involve the completion of 10-15 transect lines depending on the marine weather and vessel traffic in the study area. The vessel used to conduct the surveys was a 32’ RH Aluminum Hull Offshore XL.

Participating in this systematic line-transect study provided an opportunity to live and work in the historic range of sea otters and gave direct access to prospective participants in semi-structured interviews for this research. During this period, sea otter sightings were recorded from the researcher and the crew of the SRKW study. Reports of sea otter sightings from interview and survey participants and the Pacific Whale Watching Association (PWWA) also contributed to this data set.

Figure 3. Range of sea otters in BC as of 2008 marked with red obtained from DFO. 2014.



Spatially, this study was focused on the regions of Vancouver Island not currently designated as regions of sea otter habitat as designated by DFO (Figure 3). Therefore most of the sightings reported in this study were in the southwest and southern regions of the island.

2.5 Survey Instruments

Important elements to consider when aiming to capture information through surveying respondents include design considerations, sampling plans, data collection strategies and the development of clear and understandable evaluation questions (Newcomer et al., 2015). The considerations have been incorporated in the data collection for this research project.

Interviews with stakeholders were used to document observed changes in the frequency of sea otter sightings in their region. Interviews also addressed the policy actions and management tools that would enable stakeholders in controlling sea otter populations should they re-occupy areas of historical range. The interview process involved documentation and analysis of a variety of perspectives to gain a greater understanding of the socio-economic implications of

sea otter range expansion. The sea otter study questionnaire is illustrated in Appendix 4. Where the survey involves two sections, one pertaining specifically to sea otter sightings in terms of location, frequency, group size, etc. and the impacts of sea otter range expansion and the possible management tools which could be used to minimize conflict between people and sea otters in the future.

From August-November 2022, interviews were conducted by telephone. This work examined the relationship between people and sea otters in known areas of overlap in the coastal environment. The goal was to unearth activities that are compatible, neutral, or conflicting between user groups in the marine environment to provide recommendations based on local perspectives on the tools required to manage sea otters on Vancouver Island.

Surveying by telephone allowed for surveys to continue coast-to-coast when the researcher returned to Halifax and had scheduled interviews with participants on Vancouver Island. Interviews over the phone allowed the respondents to provide complete answers and natural conversation to flow throughout the interview. Following this procedure was advantageous in gaining additional insights from participants outside the realm of the questionnaire. Some interviews exceeded the 30-minute time allotment and extended to 45-60 minutes due to conversation flow and interest in the subject matter.

2.6 Sampling Plan

The target population of this research was adults over the age of 18 years who are stakeholders in the coastal environment and may or may not have an interest in sea otter range expansion. These stakeholder groups included those who were perceived to be the most affected by sea otter presence or absence in a coastal community. Some familiarity with the coastal environment was preferred. This work was limited geographically with a strong emphasis on

respondents who live on or visit Vancouver Island and have experienced sea otter sightings along the coast of Vancouver Island. The only other intentional exclusion was people under the age of 18 for the purposes of informed consent as stipulated by the Marine Affairs Ethics Standing Committee approval for this research.

Initially, the stakeholder groups for this study were participants belonging to the following sectors: government, industry, academia, non-governmental organizations, and community members. However, over the course of the study period and once a greater understanding of the ideal stakeholder and rightsholder groups was developed, the groups evolved (Table 2). The process of finding willing participants for a research study proved to be more challenging than anticipated. It was further complicated by the necessity to conduct interviews by telephone with a four-hour time difference from Halifax to Vancouver Island under the constraints of time and scheduling. The decision to leave interviews to the end of the summer and early fall resulted in a lower than anticipated sample size and subsequent difficulties. This served as a learning opportunity for future research to maximize time in communities by conducting interviews on the spot rather than postponing the interviews to a later time as communications over email can be more challenging to navigate than in-person relations.

Table 2. Number of respondents in each stakeholder and rightsholder group.

Participants	Respondents
First Nations Rightsholders	5
Non-Governmental Organizations	2
Marine Researchers	5
Government Regulators	5
Recreational Ocean Users	4
Whale Watching Industry	4
Fishers	4
Total	29

There is a delicate balance between the relationship-building process with prospective interview participants, and the necessity to complete interviews despite external factors. For example, the researcher intentionally avoided conducting interviews while at sea to avoid mixing personal research efforts with the SRKW work to remain focused and develop a professional rapport with the marine crew. However, in retrospect, the time spent transiting between lines or during a break period while at sea would have been an ideal time to conduct interviews with the crew. This represents a missed opportunity for additional data collection. A total of eleven 30–45-minute interviews were conducted by telephone over the course of the study period. If time permitted, efforts would be made to acquire participants from the aquaculture, shellfish and kelp harvesting industries, and additional coastal community residents. Similarly, a more complete representation of fishers beyond the sportfishing and recreational sectors would be recruited including representatives from commercial and Food, social and ceremonial (FSC) fisheries.

2.7 Survey Interview Questionnaire

By mid-September 2022, the number of participants in the interview portion of this research was 11 which was below the intended sample size of 50 participants. The coursework requirements in the fall semester of 2022 and factors external to school resulted in a backlog of emails and delays in email correspondence relating to interviews. To increase the sample size of this study under time and capacity constraints, the interviews were shifted to an online survey hosted by Dalhousie University's Opinio software. On Tuesday, October 11th, Debany Fonseca Pereira Batista from the Department of Oceanography at Dalhousie University kindly provided guidance on the process of creating an online survey on Opinio using the existing semi-structured interview guide. By October 12th, the Sea Otter Survey was active online enabling data to be collected without the time commitment of 30-minute interviews over the phone and interested participants could provide their insights.

The advantage of this survey method was the ability to collect data from 18 additional participants without interviewer bias. Since each participant was accessing the exact same survey, the tone of voice, phrasing, or human error associated with interviews over the phone were eliminated. Prospective participants were notified of the shift from interviews by telephone to an online survey via email and sent the message in Appendix 2. To combine the data from interviews and the online survey portions of this research, all participant responses were inputted into the Opinio online survey to form one cohesive dataset.

2.8 Desktop Research

To address the three research questions: *How do sea otters alter the coastal ecosystem? What is the occupancy rate of historic habitats on Southwest Vancouver Island? Could range expansion result in changes for stakeholders and rightsholders, and if so, what management*

tools could be used to minimize conflict? From January to May 2022, the researcher was enrolled in three graduate level courses at Dalhousie University, researching sea otters to fulfill the coursework requirements for each course. This provided an opportunity to build a foundation of knowledge on the research topic before beginning to formally write this report.

The targeted literature review provided a comprehensive look at sea otter population dynamics and range expansion in BC but did not provide an all-encompassing review of the current body of literature. This review began in January 2022 as desktop research was required to fulfil the coursework and major paper requirements for the following graduate level courses at Dalhousie University, The Politics of the Sea, Marine Science and Technology, and Information in Policy and Decision-Making. The topic of the major papers in each course was tailored to the sea otters in the North Pacific Ocean to allow ample time to review the available literature and explore the topic in greater detail commencing on-the-ground research.

The preliminary period of literature review provided information and research-based evidence that formed the bulk of the introduction and potential methods for conducting field research on the species of interest. From March-August 2022, research evolved into a more specialized exploration into the topics that were pertinent to this study and the specific details of sea otter range expansion. The outcomes of this phase of desktop research informed the results and discussion portions of the project. Research continued into the fall of 2022 into the implications of sea otter range expansion and the community or region-specific context of the study area.

Chapter 3 Results

This chapter presents the findings of the research by first describing the results of the sea otter monitoring study and sea otter sightings off the coast of Vancouver Island. Next, perspectives and insights provided by interview and survey participants will be explained, and finally an overview of the focused literature review will be presented.

3.1 Sea Otter Monitoring

The sea otter sightings presented in this section have been obtained from direct research involving boat-based counts, observations from the Pacific Whale Watching Association, and accounts from interview and survey participants.

This section does not present an exhaustive list of sea otter sightings on Vancouver Island (Table 3). What it represents is an overview of the sightings provided to the Pacific Whale Watching Association (PWWA) by whale watching vessel operators and other mariners and sightings made by the crew of the Seafoam Spirit from Pacheedaht First Nation. One sighting was provided by the Friends of the Victoria Harbour Migratory Bird Sanctuary.

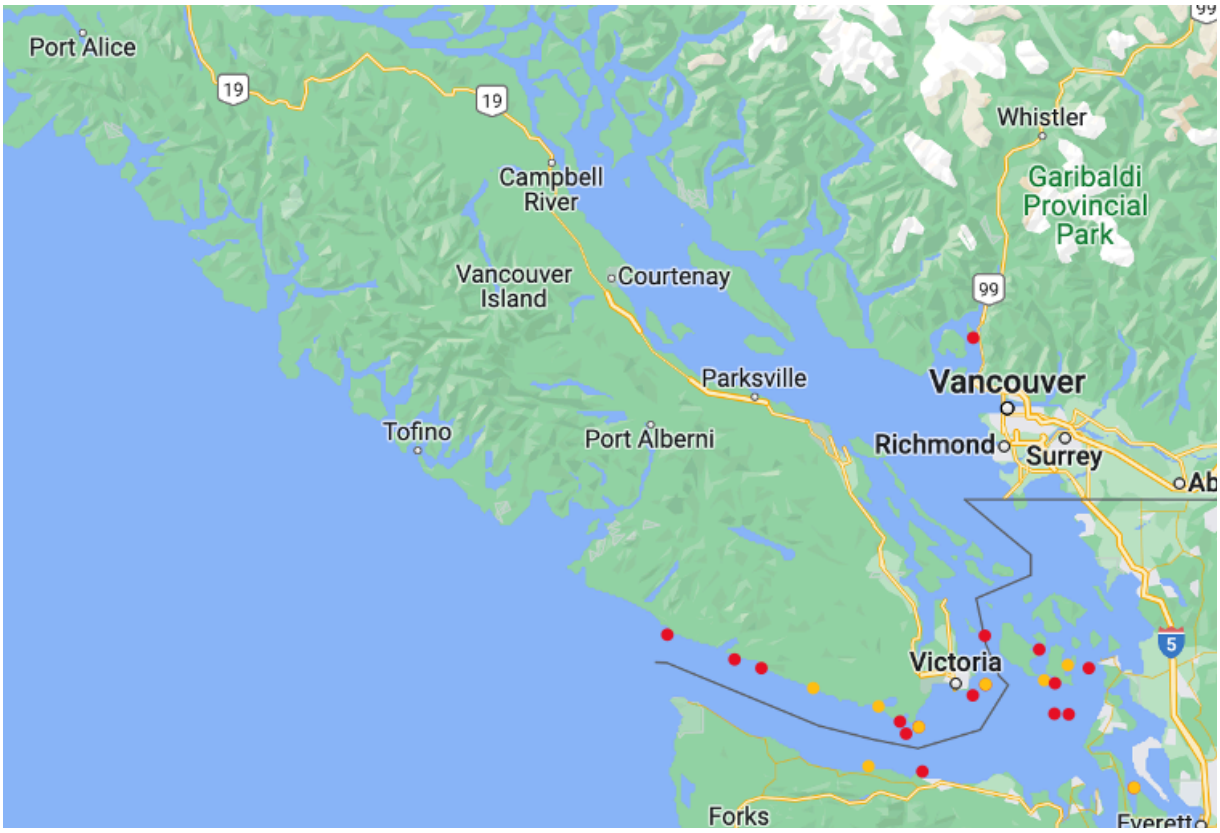
Pertinent to this section is the acknowledgement of research limitations. This sea otter monitoring aspect of the research project was limited by both temporal and spatial constraints. The study conducted by the Seafoam Spirit crew spanned the months of May to October 2022. If the study had continued, perhaps this would have resulted in additional sightings. Furthermore, the PWWA provided their list of sightings in August 2022 therefore if any sightings were reported to them after that point, they were not included in this project. This exhibits a potential gap in the findings as additional sightings are expected to have been reported from August 2022 onward which were omitted from this study due to the scope of the paper and the timeline of the Master of Marine Management Degree at Dalhousie University. It should also be noted that sea

otters are a difficult species to monitor by boat in Southwest Vancouver Island as they can be elusive, they are competent divers, and they could be mistaken for other species such as harbour seals, river otters, or other marine mammals who are common in the study area.

Table 3. Sea Otter Sightings from 2014-2022 around Vancouver Island.

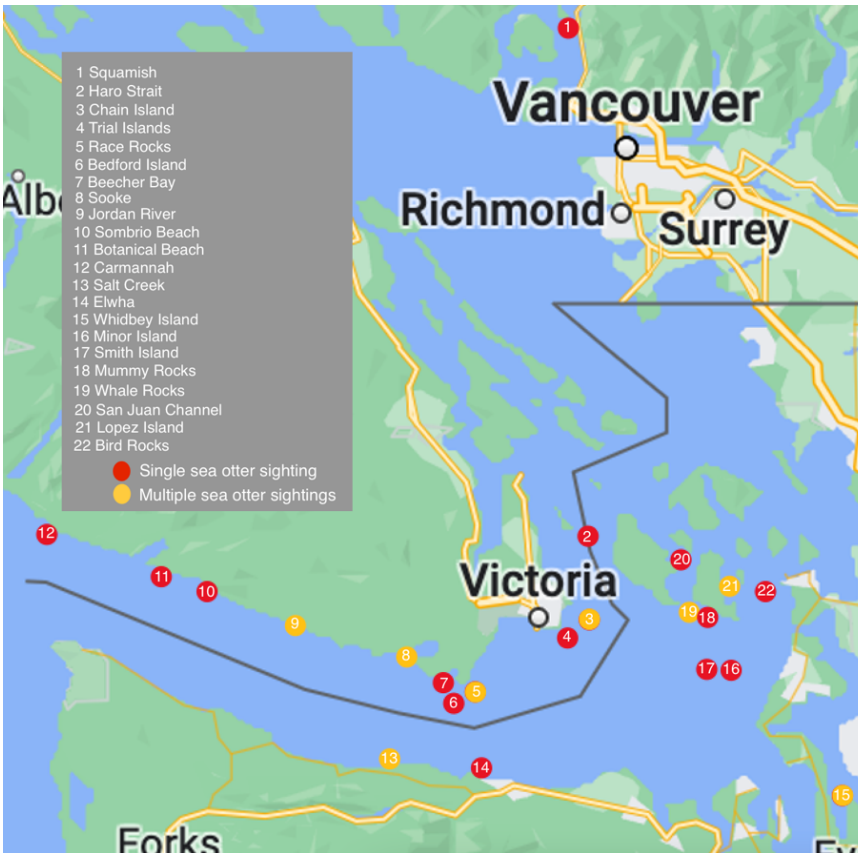
Month	Year	Name	Location	Source
September	2014	Sea Otter	Trial Islands	Friends of Victoria Harbour Migratory Bird Sanctuary
January	2015	Ollie	Race Rocks	Pacific Whale Watching Association
April	2015	Sea Otter	Tongue Point (Salt Creek)	Pacific Whale Watching Association
August	2015	Sea Otter	Lopez Island	Pacific Whale Watching Association
August	2017	Sea Otter	Haro Strait	Pacific Whale Watching Association
October	2017	Sea Otter	Minor Island	Pacific Whale Watching Association
June	2018	Odin	Whale Rocks	Pacific Whale Watching Association
July	2018	Sea Otter	Elwha	Pacific Whale Watching Association
November	2018	Sea Otter	Whale Rocks	Pacific Whale Watching Association
June	2019	Sea Otter	Beecher Bay	Pacific Whale Watching Association
July	2019	Sea Otter	Chain Island	Pacific Whale Watching Association
August	2019	Sea Otter	Whale Rocks	Pacific Whale Watching Association
August	2019	Sea Otter	Mummy Rocks	Pacific Whale Watching Association
November	2019	Pair of Otters	East Sooke	Pacific Whale Watching Association
February	2020	Sea Otter	Whale Rocks	Pacific Whale Watching Association
July	2020	Sea Otter	Smith Island	Pacific Whale Watching Association
April	2021	Odin	Whale Rocks	Pacific Whale Watching Association
April	2021	Sea Otter	Salt Creek	Pacific Whale Watching Association
May	2021	Sea Otter	Whale Rocks	Pacific Whale Watching Association
August	2021	Sea Otter	Whidbey Island/Puget Sound	Pacific Whale Watching Association
September	2021	Sea Otter	Sooke	Pacific Whale Watching Association
October	2021	Sea Otter	South Lopez Island	Pacific Whale Watching Association
November	2021	Sea Otter	Whidbey Island/Puget Sound	Pacific Whale Watching Association
May	2022	Sea Otter	Chain Island	Pacific Whale Watching Association
May	2022	Sea Otter	Squamish (Howe Sound)	Pacific Whale Watching Association
June	2022	Ollie	Race Rocks	Personal
July	2022	Sea Otter	San Juan Channel	Pacific Whale Watching Association
July	2022	Sea Otter	Carmannah	Personal
July	2022	Sea Otter	Sombrio Beach	Seafoam Spirit Crew
July	2022	Sea Otter	Botanical Beach	Seafoam Spirit Crew
August	2022	Sea Otter	Bird Rocks (Rosario Strait)	Pacific Whale Watching Association
August	2022	Sea Otter	Bedford Island	Pacific Whale Watching Association
August	2022	Sea Otter	Jordan River	Seafoam Spirit Crew
August	2022	Sea Otter	Jordan River	Seafoam Spirit Crew

Figure 4. Map obtained from Google Maps illustrating sea otter sightings in Southern Vancouver Island marked by red dots (single sightings) and yellow dots (multiple sightings) between the years 2014-2022.



Sightings were mapped on the southwest coast of Vancouver Island to provide a visual overview of the reports provided in Table 3. Locations with multiple sightings reported are indicated by a yellow dot whereas locations with only a single sea otter sighting have been marked with a red dot (Figure 4). The map has been expanded in Figure 5 to allow a clearer view of each sighting. Additionally, a key has been included to connect each dot to the precise location on the map for clarity. Ten sightings of sea otters in the United States jurisdiction have been included in both figures 4 & 5. Sea otters do not obey transnational border rules. Known individuals have been reported by name in Table 3, while sea otters without known identities are referred to as “sea otter”.

Figure 5. Map obtained from Google Maps illustrating sea otter sightings between 2014-2022 in Southern Vancouver Island marked by red dots (single sightings) and yellow dots (multiple sightings) expanded to show the location more precisely with location key in the top left in grey.



3.2 Interviews

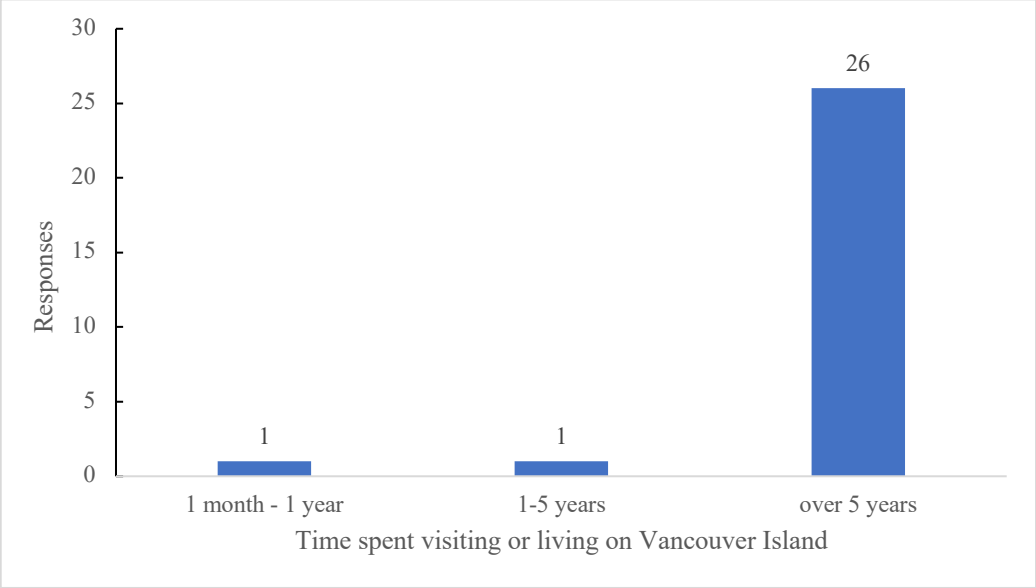
This section will present the data obtained from the 29 interviews and questionnaires combined to form one dataset. Participants responded to the same 22-questions pertaining to sea otters on Vancouver Island illustrated in Appendix 4. Participants had a diverse set of experiences interacting with the coastal environment in the region and the time spent living on or visiting Vancouver Island was varied. Similarly, awareness of environmental changes and potential interactions between sea otters and different facets of society varied greatly between participants. Many participants, specifically (93.1%) of the sample, live on Vancouver Island.

Two participants live in the Vancouver area of mainland BC but have spent time on Vancouver Island and are familiar with the sea otters in the region.

Question 1- Time spent living on or visiting Vancouver Island

Respondents were asked how long they have been living on or visiting Vancouver Island and the overwhelming majority selected the option of over 5 years (92.8%), however, responses were varied with significantly less selecting 1-5 years (3.5%), and 1 month-1 year (3.5%) in equal percentages (Figure 6). The consistent response of more than 5 years living on or visiting Vancouver Island implies a sample of participants with experience and some level of background knowledge of the presence or absence of sea otters in the region.

Figure 6. Interview and survey participant responses to Question 1: How long have you been living on or visiting Vancouver Island?



Question 2- Sea otter sightings by location

Participants were provided a map of Vancouver Island with the regions distinctly marked and colour-coded and asked in which regions they have observed sea otters (Figure 8). This question evoked variation in responses which may have arisen due to the selection of a diverse

group of participants hailing from different regions of Vancouver Island (Figure 7). The Northern (48.2%), Northern central (37.9%), and regions of the Pacific Rim (41.3%), areas of known sea otter habitat were the most common responses (Figure 7). The South Island (31%), Cowichan (17.2%), Central Island (10.3%), and Gulf Islands (3.4%) were less commonly selected, however, many people who are unaware of the prospect of sea otter range expansion may be shocked to see the selection rate of the South Island region as the location of sea otter sightings (Figure 7). The observations of sea otters in regions outside known range will be discussed in further detail in the coming chapters. Those who selected other, did not provide additional information on where else they have observed sea otters (Figure 7).

Figure 7. Interview and survey participant responses to Question 2: In which regions of Vancouver Island have you observed sea otters?

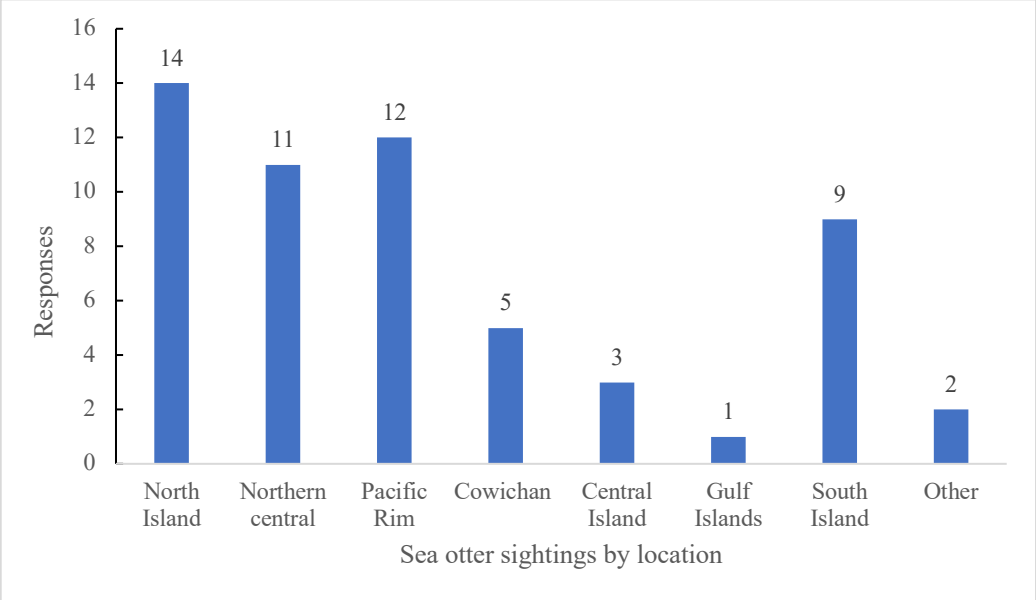
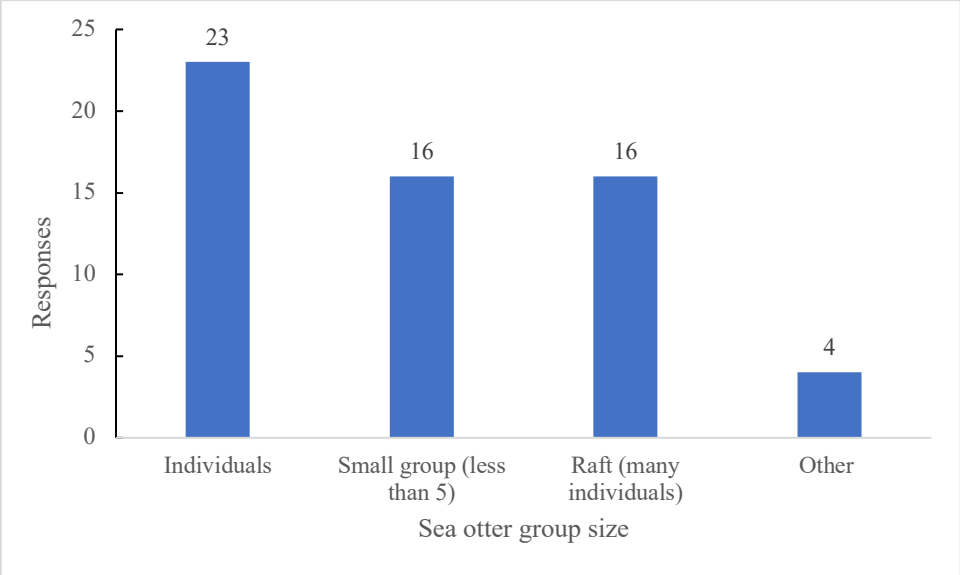


Figure 8. Image of Vancouver Island regions obtained from Wikipedia provided to respondents to accompany Question 2.

Question 3- Sea otter group size

When asked about the group size of the sea otters at the time of their most recent sighting, the most common response was individuals (79.3%), then small group (55.1%), raft (55.1%) and other (13.7%) including the custom responses of none, a pair, a raft of 200+ sea otters and sea otters spotted surprisingly far offshore (Figure 9).

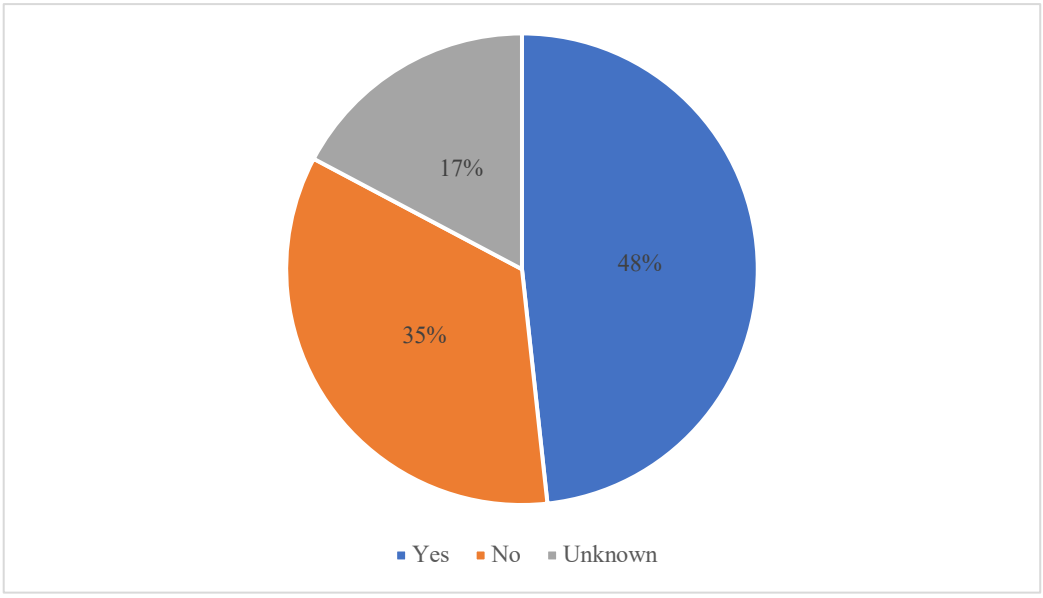
Figure 9. Interview and survey participant responses to Question 3: When you observed sea otters, what was the group size?



Question 4- Sea otters vs River otters

When asked if they have observed river otters in the same areas where they have observed sea otters, respondents most frequently selected yes (48%), then no (35%), and finally unknown (17%) (Figure 10). In the open-ended response textbox, the comments provided by respondents varied greatly but provided interesting insights on the interactions between river otters and sea otters in the coastal environment. One participant noted that they have observed sea otters and river otters in the Tofino Harbour simultaneously, but the two species were not interacting. While another participant described reports of gruesome interactions between the two species in the South Island region. Such insights will be explored in greater detail in the discussion section of this paper.

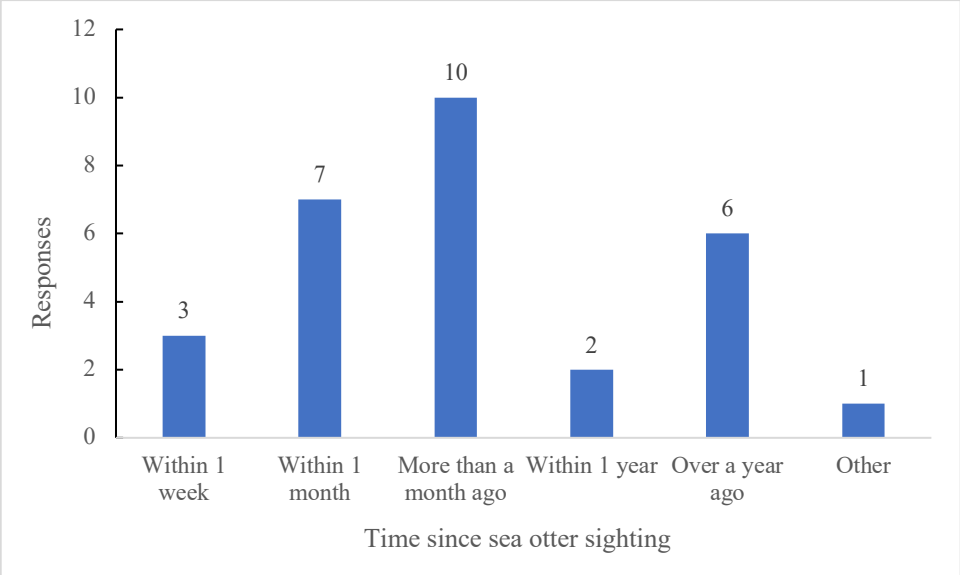
Figure 10. Interview and survey participant responses to Question 4: Have you also observed river otters where you have observed sea otters?



Question 5- Sea otter sightings

When asked to report the timing of their last sea otter sighting, respondents most recalled it being more than a month from the time of the interview (34.4%), with some occurring within one month (24.1%), and slightly fewer over a year before the interview (20.6%) (Figure 11). Fewer participants recalled their most recent sighting taking place within one week (10.3%), or within one year (6.9%) from the time of the interview with one participant who selected other, never having seen a sea otter except for in an aquarium (Figure 11).

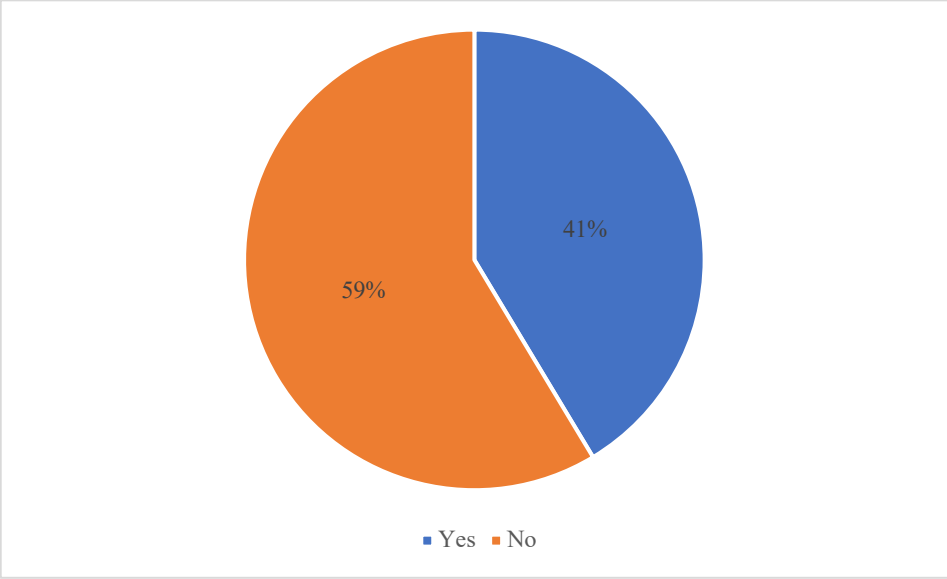
Figure 11. Interview and survey participant responses to Question 5: When was your last sea otter sighting?



Question 6- Regularity of sightings

Participants were asked to report whether they observe sea otters regularly and (58.6%) selected no, while (41.3%) selected yes (Figure 12). With sea otters, the frequency of sightings is highly dependent on the region where one is making observations and current sea otter range.

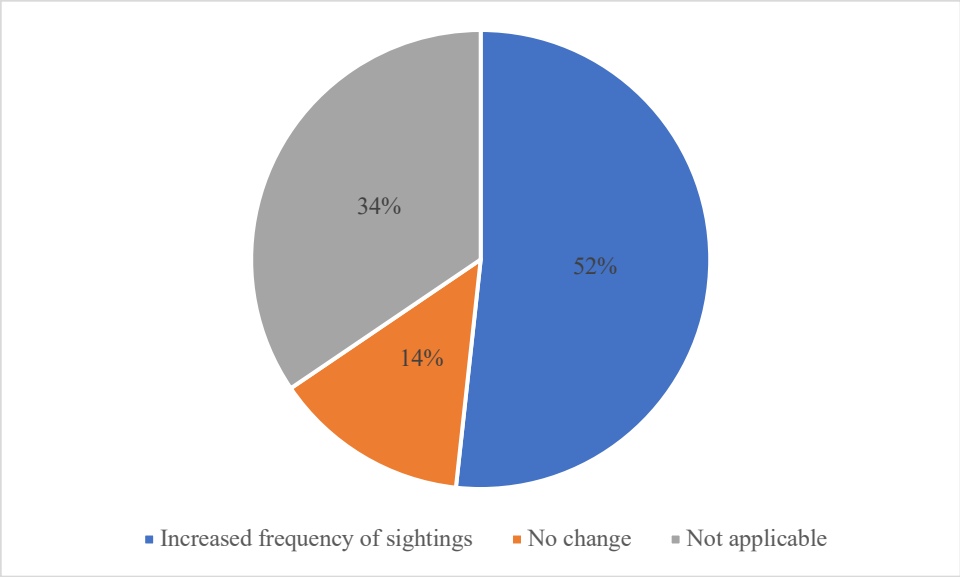
Figure 12. Interview and survey participant responses to Question 6: Do you observe sea otters regularly?



Question 7- Frequency of sea otter sightings

When asked to describe the pattern of sea otter sightings over time in terms of frequency, respondents were divided (Figure 13). The most common response was an observed increase in the frequency of sightings (51.7%), then the response of not applicable (34.4%) for respondents without sufficient information to make an inference, and finally no change observed (13.7%) (Figure 13).

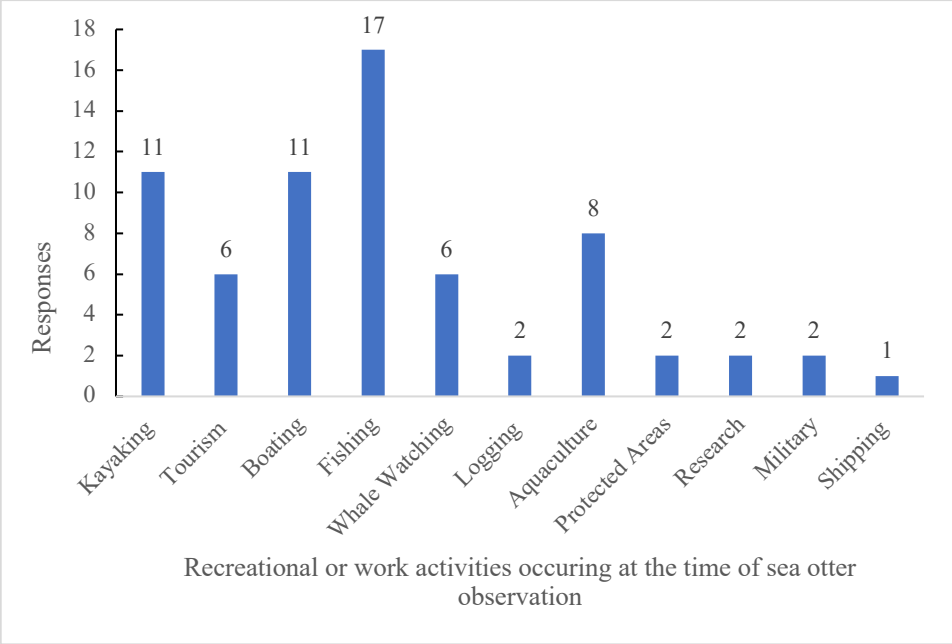
Figure 13. Interview and survey participant responses to Question 7: Have you noticed a change in the frequency of sea otter sightings over time?



Question 8- Identification of activities of overlap

Respondents were asked to identify recreational or work activities occurring simultaneously while they observed sea otters. Respondents identified six main overlapping activities with sea otters including fishing (58.6%), kayaking (37.9%), boating (37.9%), aquaculture (27.5%), whale watching (20.6%) and tourism (20.6%), more broadly (Figure 14). The remaining areas of overlap observed in lower proportions included logging (6.8%), sightings in protected areas (6.8%), marine research (6.8%), military activity (6.8%), and shipping activity (3.4%) (Figure 14).

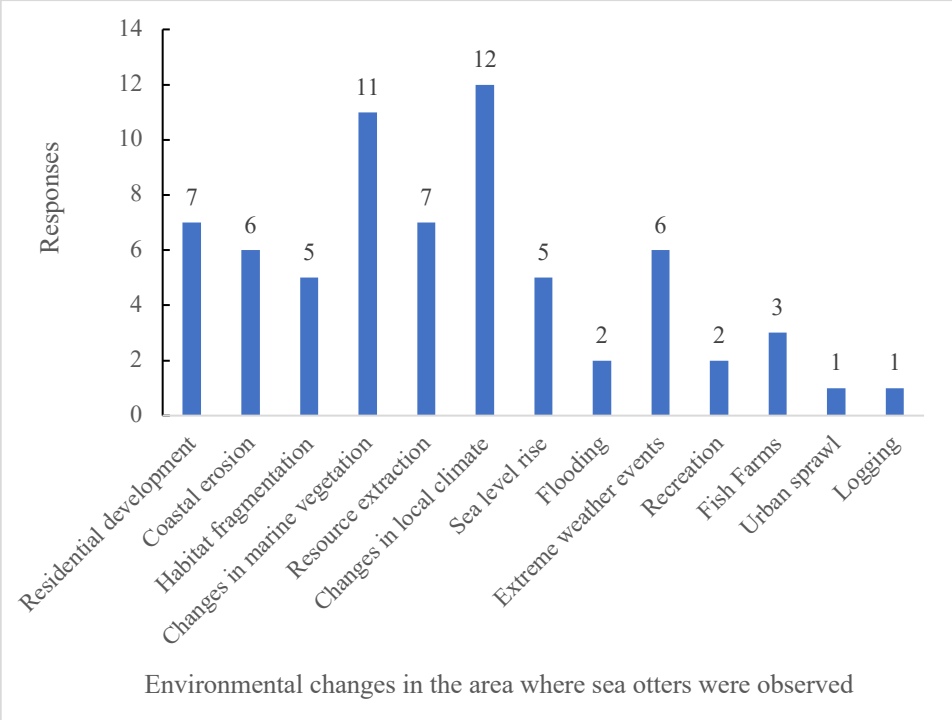
Figure 14. Interview and survey participant responses to Question 8: What kinds of recreational or work activities occur in the areas where you have observed sea otters?



Question 9- Environmental changes

Respondents were asked to select from a series of prompts to describe changes in the local environment which they have observed in the same locations where they have observed sea otters. Respondents identified two main changes in environmental attributes including changes in local climate (54.4%) and changes in marine vegetation (50%) (Figure 15), in the regions where they have observed sea otters. Additional environmental changes observed by participants included residential development (31.8%), resource extraction (31.8%), coastal erosion (27.2%), extreme weather events (27.2%), habitat fragmentation (22.7%), and sea level rise (22.7%) (Figure 15). Changes observed in lower proportions included, fish farms (13.6%), recreation (9%), flooding (9%) urban sprawl (4.5%), and logging (4.5%) (Figure 15).

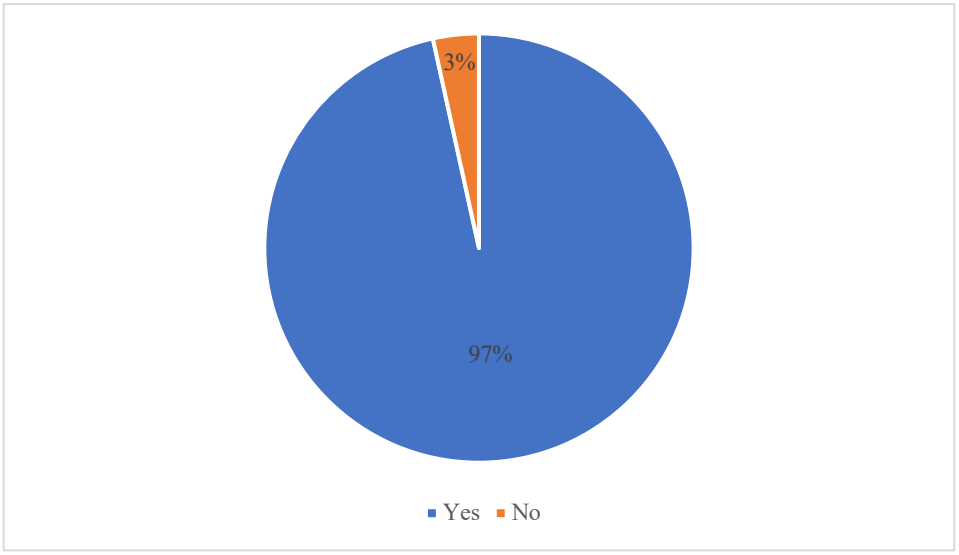
Figure 15. Interview and survey participant responses to Question 9: Are you aware of any changes in the environment in the areas where you have observed sea otters?



Question 10- The Fisheries Act

Survey participants were asked to divulge their awareness of the *Fisheries Act* by selecting from the options yes (96.5%) or no (3.4%) (Figure 16). Only one respondent was unaware of this regulatory document.

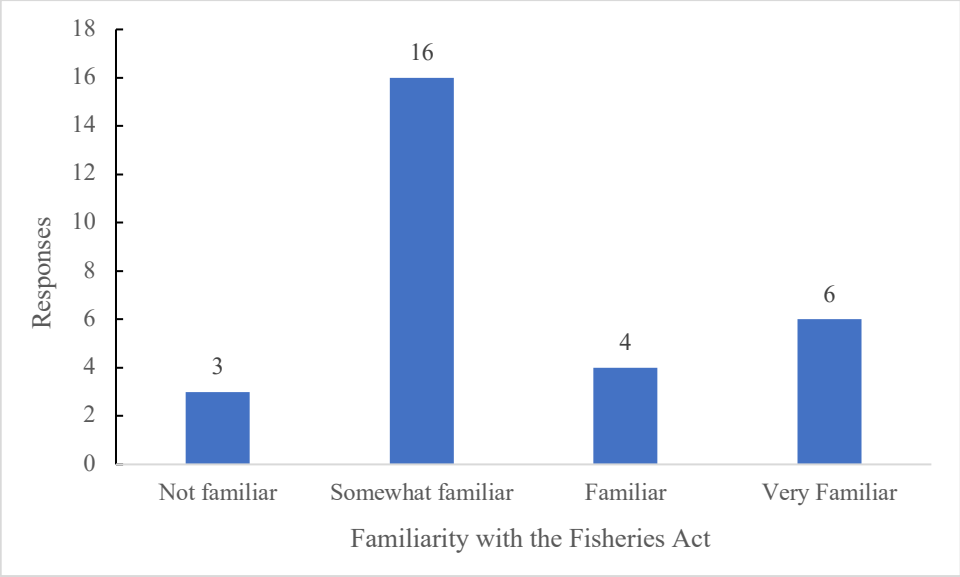
Figure 16. Interview and survey participant responses to Question 10: Do you know what the *Fisheries Act* is?



Question 11- Familiarity with the Fisheries Act

When asked to rate their familiarity with the *Fisheries Act* by selecting one of the following options, not familiar (10.3%), somewhat familiar (55.1%), familiar (13.7%), or very familiar (20.6%), participants responded most frequently with having some familiarity with the regulatory document (Figure 17).

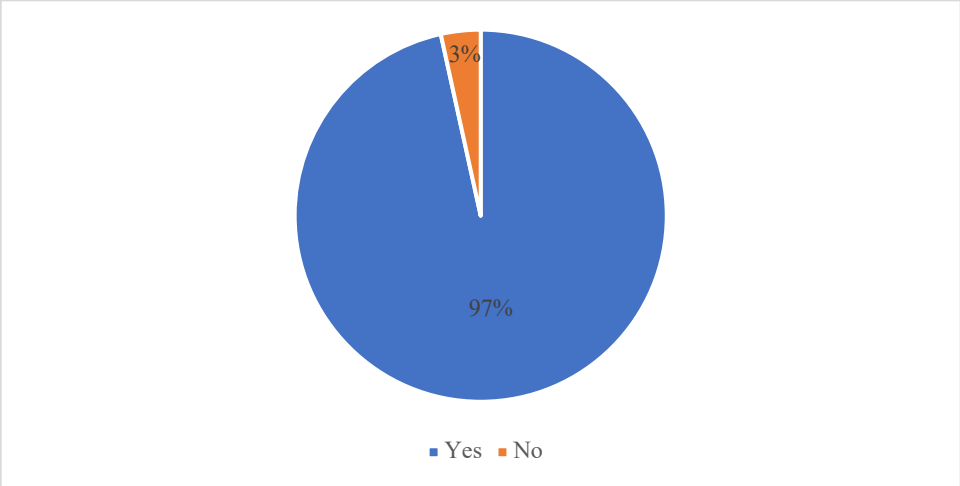
Figure 17. Interview and survey participant responses to Question 11: How familiar are you with the *Fisheries Act*?



Question 12- The Species at Risk Act

Survey participants were asked to divulge their awareness of the *Species at Risk Act* by selecting from the options yes (96.5%) or no (3.4%) (Figure 18). Like the same question regarding the *Fisheries Act*, only one respondent was unaware of this regulatory document.

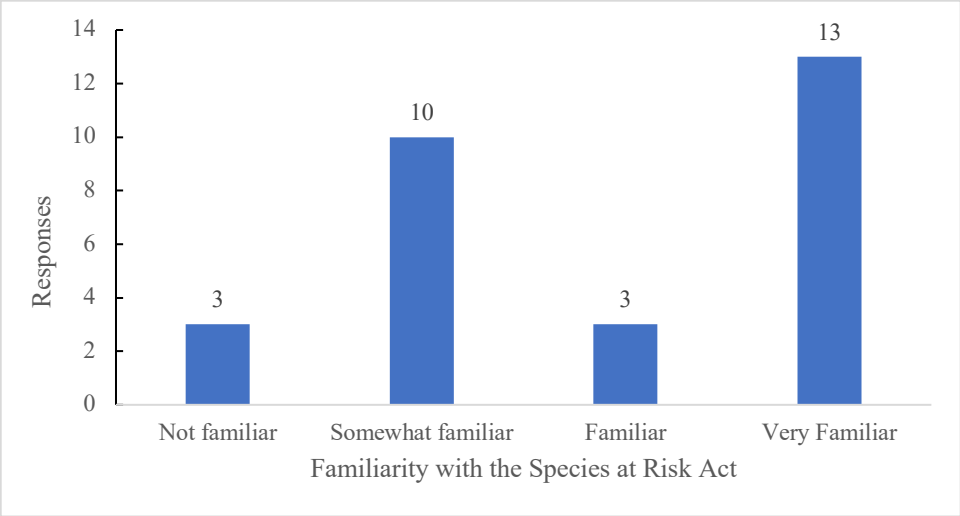
Figure 18. Interview and survey participant responses to Question 12: Do you know what the *Species at Risk Act* is?



Question 13- Familiarity with the Species at Risk Act

When asked to rate their familiarity with the *Species at Risk Act* by selecting one of the following options, not familiar (10.3%), somewhat familiar (34.4%), familiar (10.3%), or very familiar (44.8%) (Figure 19), participants responded most frequently with having familiarity with the regulatory document rather than just some familiarity, illustrating the potential for a greater general understanding of the *Species at Risk Act* than *the Fisheries Act* within the general public.

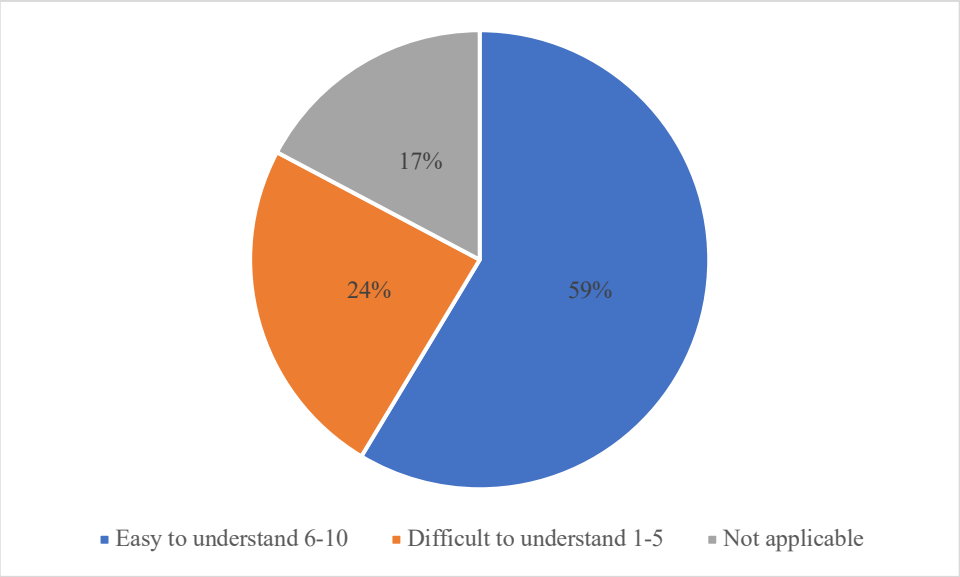
Figure 19. Interview and survey participant responses to Question 13: How familiar are you with the *Species at Risk Act*?



Question 14- How would you describe the government rules used to protect sea otters in terms of understandability (on a scale from 1-10)?

When asked to rank the government rules in place for the protection of sea otters from one to ten, with one being difficult to understand and ten being easy to understand, participants most deemed them as easy to understand (59%) by providing a score of 6-10 (Figure 20). Other responses included difficult to understand (24%) or not applicable (17%) for respondents who are unaware of the rules in place for the protection of the sea otters, or who have never accessed this information (Figure 20).

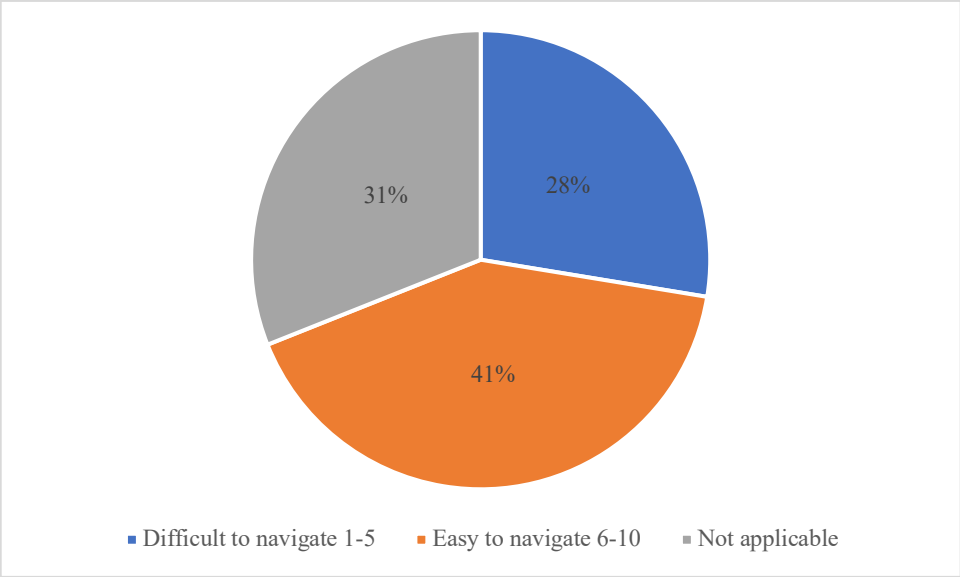
Figure 20. Interview and survey participant responses to Question 14: How would you describe the government rules used to protect sea otters in terms of understandability (on a scale from 1-10)?



Question 15- How would you describe the government resources such as websites used to provide information on sea otters (on a scale from 1-10)?

Using a similar grading scale as Question 14 (Figure 20), this question pertained to the specific Government resources used to educate Canadians about sea otters (Figure 21). Respondents found such resources easy to access or navigate and ranked this question from a 6-10 on the scale (41%), with others responding as not applicable (31%) perhaps not having ever accessed this information, and finally, difficult to access or navigate (28%) (Figure 21).

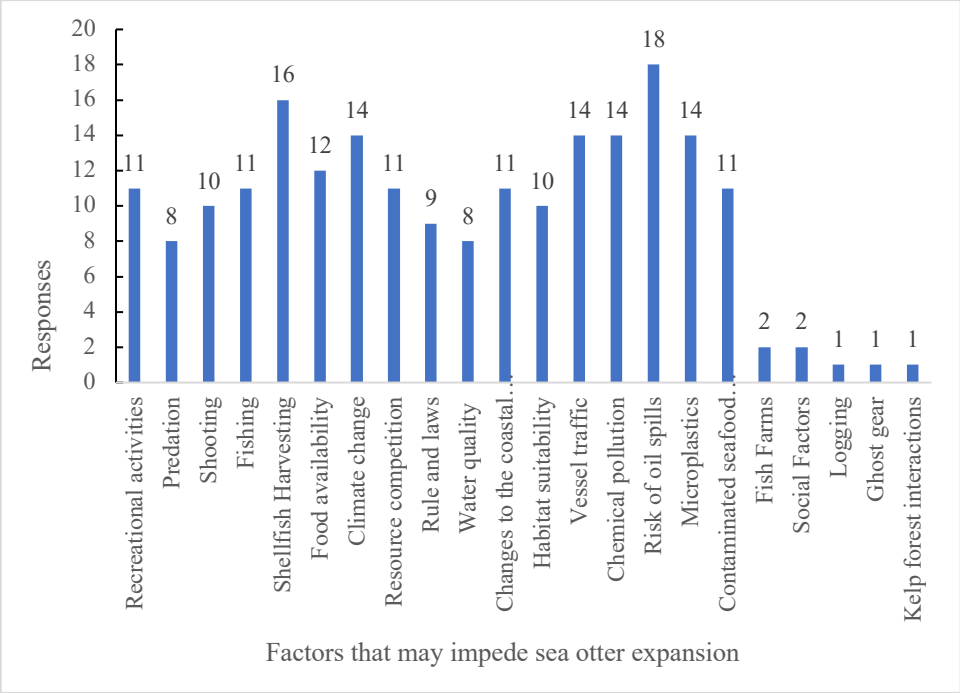
Figure 21. Interview and survey participant responses to Question 15: How would you describe the government resources such as websites used to provide information on sea otters (on a scale from 1-10)?



Question 16- Are you aware of any factors that may impede sea otter expansion into the area where you have observed them?

Respondents were asked to describe which factors they believe could impede the range expansion of sea otters. Respondents identified six main factors including risk of oil spills (78.2%), shellfish harvesting (69.5%), climate change (60.8%), vessel traffic (60.8%), chemical pollution (60.8%) and microplastics (60.8%) (Figure 22). Additional factors described by participants include food availability (52.1%), recreational activities (47.8%), fishing activities (47.8%) resource competition (47.8%), changes to the coastal environment (47.8%), contaminated seafood (47.8%) (Figure 22). The remaining factors observed in lower proportions included, habitat suitability (43.4%), shooting (43.4%), rules and laws (39.1%), predation (34.7%), water quality (34.7%), fish farms (8.6%), social factors (8.6%) and logging (4.3%), ghost gear (4.3%) and finally kelp forest interactions (4.3%) (Figure 22). The implications of the factors which could potentially impede sea otter range expansion require further consideration but due to the scope of this paper, they will not be examined in greater detail.

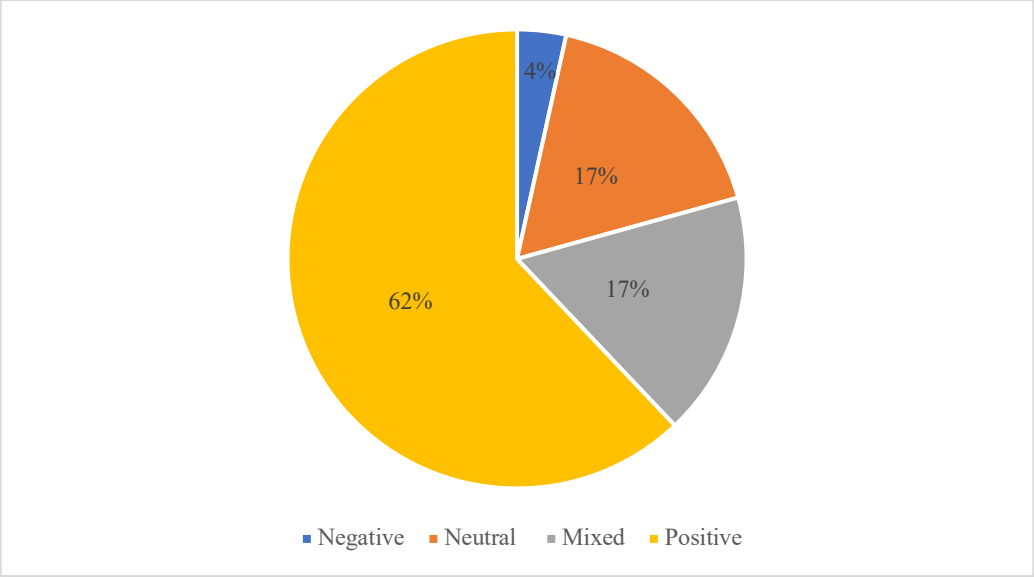
Figure 22. Interview and survey participant responses to Question 16: Are you aware of any factors that may impede sea otter expansion into the area where you have observed them?



Question 17- How would you describe your perception of sea otters?

When asked to describe their perception of sea otters, respondents most responded with positive (62%), followed by neutral (17.2%), mixed (17.2%) and finally negative (3.4%) (Figure 23).

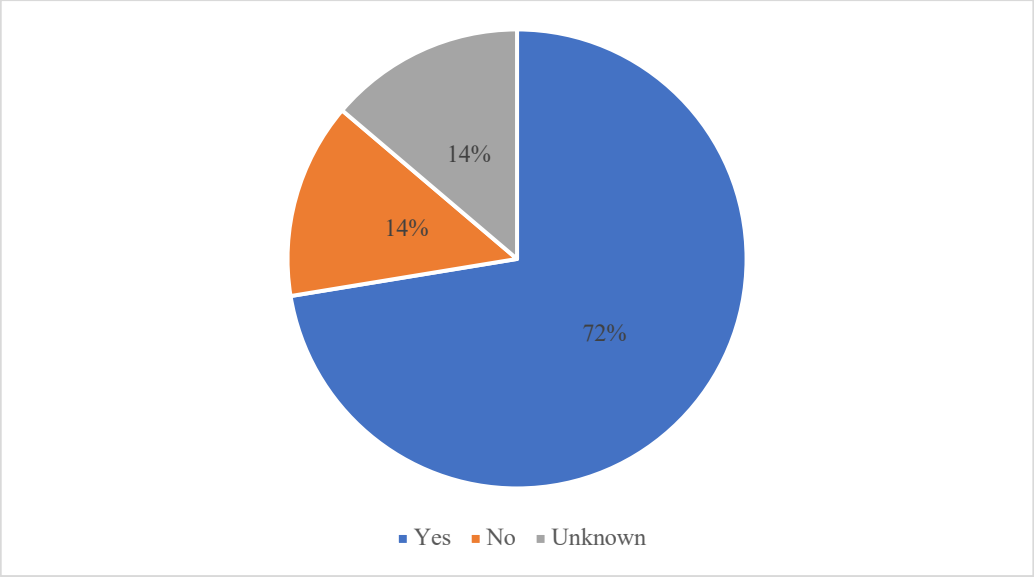
Figure 23. Interview and survey participant responses to Question 17: How would you describe your perception of sea otters?



Question 18- Do you think the public shares your perception?

Participants were asked to compare their perception with that of the public in this question by responding to a prompt regarding a shared perception (Figure 24). Many respondents selected yes (72.4%), indicating their belief of shared views followed by no (13.7%) and unknown (13.7%) (Figure 24).

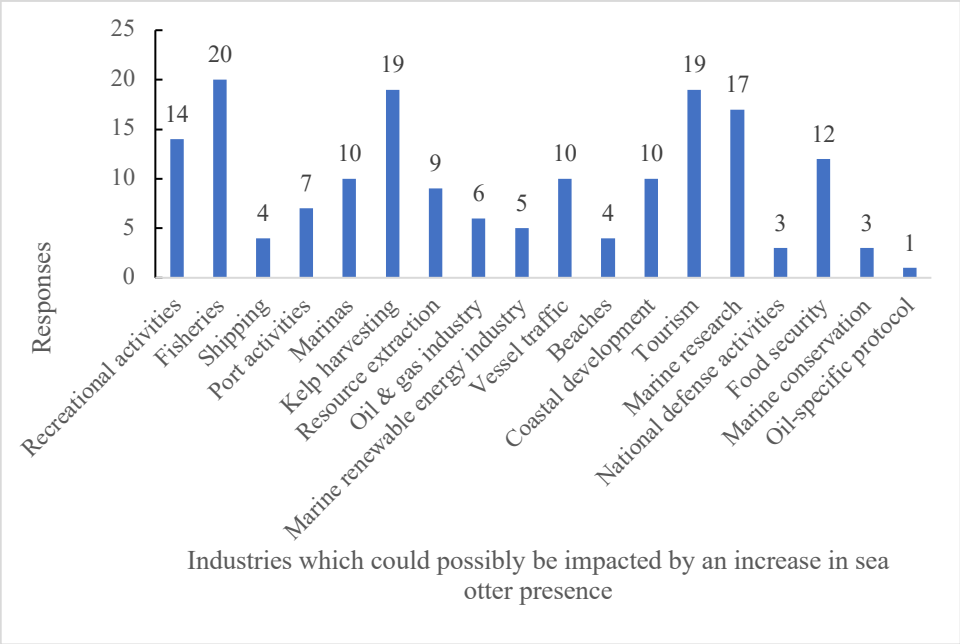
Figure 24. Interview and survey participant responses to Question 18: Do you think the public shares your perception?



Question 19- In your opinion, which of the following industries or coastal attributes could be positively or negatively impacted by an increase in sea otter presence?

Respondents were asked to describe the industries or coastal attributes which they believe could experience interactions and potential impacts due to increased sea otter presence. Respondents identified five main factors including fisheries (83%), kelp harvesting (79%), tourism (79%), marine research (70.8%), and recreational activities (58.3%) (Figure 25). Additional factors include food security (50%), marinas (41.6%), vessel traffic (41.6%) coastal development (41.6%), resource extraction (37.5%), and port activities (29.1%) (Figure 25). The remaining factors observed in lower proportions included, the oil and gas industry (25%), marine renewable energy (20.8%), shipping (16.6%), beaches (16.6%), national defense activities (12.5%), marine conservation (12.5%), and oil specific protocol (4.1%) (Figure 25). The implications of the industries or coastal attributes which could be impacted by sea otter range expansion will be explored in greater detail in the discussion section of the paper.

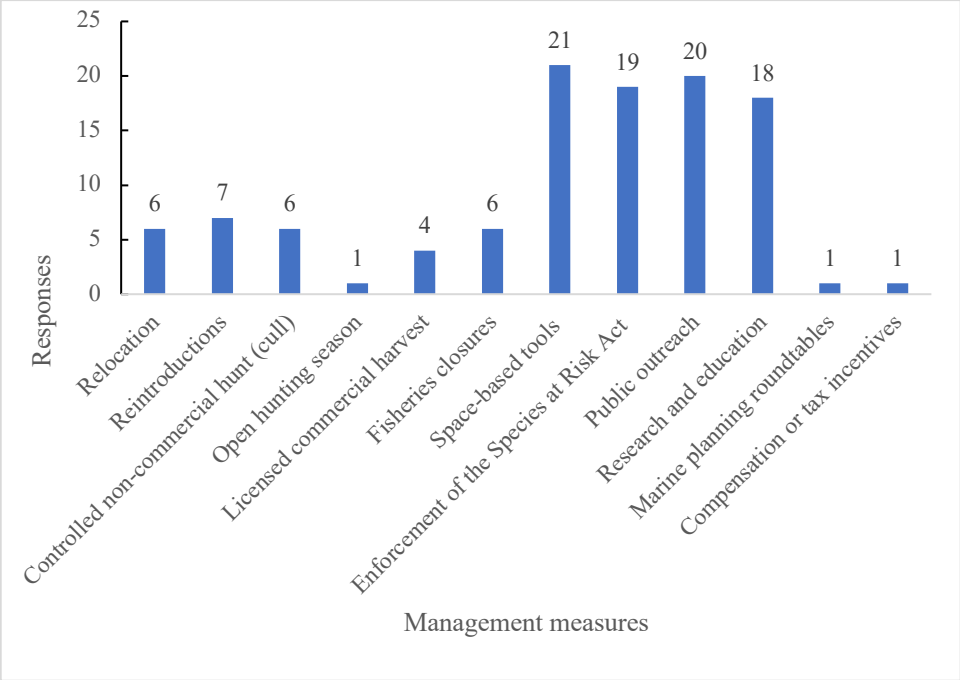
Figure 25. Interview and survey participant responses to Question 19: In your opinion, which of the following industries or coastal attributes could be positively or negatively impacted by an increase in sea otter presence?



Question 20- In your opinion, what measures should we use to manage sea otters in the areas where you have observed them?

When asked to select the management tools they deemed appropriate to be used to manage sea otter populations should they increase in their region, participants most selected four options. The most popular management tools included space-based tools (protected areas, areas of refuge) (75%), public outreach (71.4%), greater enforcement of the *Species at Risk Act* (67.8%), and research and education (64.2%) (Figure 26). Other responses included reintroductions (25%), relocation (21.4%), controlled non-commercial hunt or cull (21.4%), fisheries closures (21.4%), licensed commercial harvest (14.2%), and finally, open hunting season (3.5%), marine planning roundtables (3.5%) and compensation or tax incentives (3.5%) (Figure 26). The management tools will be addressed in the discussion section and more specifically pertaining to the recommendations which will be provided.

Figure 26. Interview and survey participant responses to Question 20: In your opinion, what measures should we use to manage sea otters in the areas where you have observed them?



3.3 Literature Review

The possible changes to the coastal ecosystem because of the return of the sea otter exist in the realm of scientific uncertainty (Levine et al., 2016). This is due to the many interactions between sea otters and their environment, both above and below the surface. To gain a deeper understanding of the ways in which sea otter re-occupation of historical habitat along Vancouver Island could alter the coastal fabric, a focused literature review was undertaken. Explorations into the trophic interactions (Markel & Shurin 2015; Gregr et al., 2020; Smith et al., 2021), socioeconomic implications (Levine et al., 2016; Pinkerton et al., 2019; Salomon et al., 2020; Burt et al., 2020) and future directions of sea otter management (DFO. 2014; Davis et al., 2019), can inform a way forward in sea otter management in BC which is inclusive of stakeholder and rightsholder perspectives.

Literature review topics included sea otter management, sea otter population trends, political implications of sea otters in North America, the role of information in sea otter management, science and monitoring of sea otters, and public perceptions of sea otters and the greater meaning for socially inclusive policy. This interdisciplinary literature review indicated that sea otter management should embrace social dimensions as well as knowledge from First Nations knowledge holders and members of the scientific community. Further, it illustrated the need to approach issues of marine resource management holistically, with a collaborative frame of mind to create an integrated plan which accounts for socioeconomic considerations in addition to environmental considerations.

This research illustrated the complexity of perspectives on sea otters on the west coast in a way that could be described as a wicked problem. One characteristic of a wicked problem is when diverse values are held by groups involved in the situation and a solution for one group is the creation of a new problem for another group (Rittel & Webber. 1973). A notion which is echoed in fisheries and coastal governance work where it was stated that wicked problems have no simple solution and thus, the use of one management tool will not be sufficient (Jentoft & Chuenpagdee. 2009). In the case of the return of the sea otter to the coast of Vancouver Island, the intrinsic diversity of complex interactions between users of the coastal and marine space requires us to proceed with caution and consider a suite of tools rather than a one-size fits all approach (Jentoft & Chuenpagdee. 2009).

Chapter 4 Discussion

Anthropogenic activities in the coastal environment can pose threats to marine life resulting in the decline of wild populations of marine mammals (Boustany et al., 2021). Growing interconnectedness between people and the Pacific Ocean and subsequent increase in human dependence on the marine environment can exacerbate conflicts between coastal residents with divergent values on marine resource conservation (Robards & Reeves., 2011). As such, tensions may arise between those who value the conservation of marine mammals and those who promote sustainable killing and consumption of these animals (Robards & Reeves., 2011). The prospect of sea otter range expansion along the coast of Vancouver Island may be a source of public controversy as a result of divergent opinions on the potential impacts or benefits sea otters bring to coastal regions. For people who live and work in this region and derive their livelihood from the marine resources there is much at stake regarding the potential reoccupation of historical sea otter habitats and the associated gains or losses (Levine et al., 2017). For some, the recovery of the sea otter has caused conflict over the common or shared marine resources (Boustany et al., 2021) a trend which could be intensified by sea otter range expansion.

This chapter will discuss the public perception of sea otters, sea otter sightings, interactions with other species, human activities and the environment, and threats to the sea otter. A final section will provide recommendations for future sea otter management based on the findings of this research supported by advice from the literature.

4.1 Public Perceptions

The tone of public perception plays an important role in the management of charismatic species such as the sea otter. Research conducted on the impact of messaging on public attitudes regarding sea otters found when presented with positive messaging (sea otters as a keystone

species), negative messaging (resource conflicts), or neutral messaging (biological facts), public attitudes towards wildlife shifted (Echeverri et al., 2017). Public perception and messaging can be closely linked to the media but for the purpose and scope of this paper, the role of the media in sea otter perceptions will not be explored. Instead, this section will expand on the insights provided by interview and survey participants which contribute to our understanding of the current perception of sea otters on Vancouver Island shared by stakeholders and rightsholders in the region. Recognizing that the low sample size in this study represents an incomplete view of perspectives on this matter but rather serves as a starting point to begin understanding the diversity of perspectives and commonalities that exist.

Many of the participants who were recruited for this study have spent their careers on the water which has allowed them to make direct observations on the species of interest. With over 92% of participants having spent more than 5 years living on or visiting Vancouver Island (Figure 6), their rich experience interacting with the coastal environment led to an interview data set which was informative. This research illustrated that sea otter perspectives as many other issues pertaining to the marine environment, can be a polarizing force amongst members of the public. Two quotes from participant interviews effectively illustrate the range of perspectives on sea otters unearthed through this work. The first quote was said by a proponent of sea otter range expansion:

> *"As a species once naturally inhabiting the coast of Vancouver Island, the entire ecosystem stands to benefit from [sea otter] reintroduction. As of now, the system is imbalanced and any measures taken to rehabilitate an environment must be positive, especially in this advanced stage of climate change".*

On the other hand, this second quote was said by another interview participant, expressing a more negative view on the species:

"[Sea otters] hurt the environment in which they live then move on. They are a huge problem".

When asked to label their personal perspective of sea otters as positive, negative, neutral, or mixed, 62% of participants selected the positive label while only 4% reported a negative perception (Figure 23). Even though it is known from conversations and the literature that there are people who dislike sea otters and may perceive them as competition over marine resources or as destructive to the coastal environment, Figure 23 suggests that many of the participants in this study have a more positive view on the species. On a similar note, when asked if the public shares their views on sea otters, 72% of participants reported their perception of a shared view on sea otters between themselves and the public (Figure 24).

When implementing conservation and recovery programs, community knowledge is stated as a priority consideration according to the *Species at Risk Act* where it is stipulated that public interests are included in the decision-making process (Species at Risk Act, 2002). The notion the public can influence the choices of decision makers, management measures or policy outcomes is an interesting point to explore as there is a risk the public could lose interest in issues of public concern where they feel they are unheard (Parkins & Mitchell. 2005). In order for public interest to be reflected in the management of the sea otter, public perspectives must be heard, understood and incorporated into management strategies.

Notes taken during telephone interviews were analyzed to reveal themes. During this process, patterns were uncovered regarding the public perception of sea otters (Table 5). Participants commented on the perceived traits of sea otters as charismatic, cute, cuddly, and aggressive as illustrated in Table 5. These findings suggest that this species exhibits both the commonly publicized behaviour of females floating with their pup on their bellies in addition to other behaviours which could be labelled as cute, as well as behaviours existing on the other end

of the spectrum of aggression. One interview participant reported observations of an individual sea otter who was known to display aggressive behaviours and attack beachgoers in the Northwest coast region of Vancouver Island.

Table 5. Examples of perceptions of sea otters unearthed from interview and survey transcripts.

Perceptions	Occurrence
Charismatic	2
Cuddly	3
Cute	2
Aggressive	2
Total	9

Another interesting element of public awareness is the presence of river otters on the Vancouver Island coast and the public perception of this species. The semi-aquatic river otter's habitat frequently overlaps with areas of human activity in the coastal environment such as docks, marinas, and intertidal spaces (BCCSN. 2020). Forty-eight percent of participants in this study reported having observed sea otters and river otters in the same areas (Figure 10). This is meaningful because it demonstrates a large proportion of the participants have enough background knowledge of the two species of otters to distinguish between them in the coastal environment. The two species are easy to confuse since their habitats can overlap and their general appearance could appear to be similar to people who are unfamiliar with the key physiological or behavioural differences. Similarly, it illuminates a need for increased public

awareness as it could mean there is room for confusion among members of the public regarding which species of otter is being observed in the coastal environment.

In terms of interactions between the two otter species, one specific example in the southern region of Vancouver Island is worth noting as it illustrates the lesser-known dark side of sea otters. One male sea otter who inhabits this region has been known to prey on river otters and carry them around like a teddy bear or pet until it is essentially decomposed. This behaviour is worth noting since sea otters are often illustrated in the media as being cute and cuddly creatures who are nurturing to their pups and sometimes their behaviour in the wild is vastly different than what is expected. Otherwise, interactions between the two otter species were limited according to interview participants.

4.2 Sightings

Sea otters are currently inhabiting some regions of Southwest Vancouver Island including portions of their historical range (Figure 4), however, the extent of their occupation of the region is currently unclear. Potentially, insufficient information on sightings is available or it could be that information exists on the small population of sea otters in the region and it is just not widely available. Regardless, the sightings provided in Figure 4 and Figure 5 suggest that sea otters have returned to some extent, sparking future conversations and research into the prospect of sea otter range expansion along the Pacific Coast. Despite being unable to definitively state that this species is experiencing an expansion, this phenomenon is entirely possible.

Based on the findings in this study, it cannot be determined at this moment if sea otters are expanding their range to include the southwestern coast of Vancouver Island. Additional sightings would have strengthened the research by providing further scientific evidence to support a claim of sea otter range expansion. With that said, this research serves as a vessel of

knowledge transmission from the researcher to a wide array of stakeholders and rightsholders who are interested in knowing the extent of sea otter range expansion in the region. The findings presented in Table 3 could be used as a baseline for future studies reporting on this phenomenon. Or as a platform to document the sightings and refer to them in the future for comparison.

In addition to the sightings provided in the monitoring section of this paper, participants reported 18 sea otter sightings outside known sea otter range (Figure 7) in the regions of Cowichan, South Island, Gulf Islands and Central Island (Figure 8) illustrating the importance of the work which was done in this study in providing a means of documenting this information. One key message to be inferred from the sea otter sightings provided is the connectedness between the Canadian and United States marine border (Table 3). The sea otters which have been reported in American waters may easily travel into Canadian jurisdiction, illustrating the necessity for transnational co-operation and collaboration in the planning of sea otter management programs or future studies.

4.3 Interactions

Sea otter population growth and range expansion can have unintended impacts on the socio-economic and natural environment of coastal communities. For this reason, the trophic level alterations caused by sea otter and the potential economic impacts should be understood. Sea otters have a voracious appetite and therefore can influence widespread ecosystem changes based on their dietary preferences and feeding behaviours (Hughes et al.,2013; Gregr et al., 2020). For some human users of the marine space and resources, this can be problematic or potentially detrimental to businesses rooted in marine resource extraction. However, we must also consider the potential or realized economic benefits brought by sea otter presence in a coastal community. When sea otters are present in a coastal region, they can draw people to

come and visit the region, serving as a means for the community to generate income and benefit from a boost in tourism (Martone et al. 2020). Sea otters are a primary driver of tourists to regions of Southeast Alaska and California where they contribute significantly to the local economy (McLeish, 2018). Continued public support for sea otters can bolster their positive economic impacts on communities as seen in Santa Barbara County, California where this species draws $100 million annually despite financial losses for commercial fisheries due to sea otter presence (McLeish, 2018). Some regions of northwest Vancouver Island have realized the economic benefits of wildlife tours and sea otter ecotourism, however, in regions with unknown or low sea otter presence, the potential benefits of tourism and related industries has not been realized (Martone et al., 2020). For communities on the southwest coast of Vancouver Island including Pacheedaht territory, this could present an opportunity for additional economic benefits related to eco-tourism where sea-lion and harbour porpoise viewing tours in addition to whale watching excursions are currently offered (Pacheedaht Heritage Project, 2019).

4.4 Threats

In the *Management Plan for the Sea Otter*, DFO designated anthropogenic factors into various classes of threats to sea otters including, oil spills, illegal kill, entanglement in ghost gear, bioaccumulating toxins, disease and parasites, boat strikes, general human disturbance, and directed harvest (DFO, 2014). The threats facing sea otters represent areas of opportunity for improvements to the way we manage our interactions with the species and other marine mammals. Sea otter conservation priorities have also been noted: understanding and reducing causes of mortality, boat strikes, pollution, and pathogens emerging from human sources in other regions of the Pacific coast (McLeish, 2018) as areas where improvements should be made.

The threats illustrated in the literature align with the findings from this research where interview and survey participants identified six main overlapping recreational or work activities with sea otter habitat (Figure 14). The overlapping activities could pose threats to sea otters. However, it is important to note that beneficial interactions could also occur as a result of sea otter and human overlap in the marine space. The discussion of activities of overlap serves to illuminate areas for further consideration in the management of this species. Activities which occur in sea otter habitat require effective planning to minimize competition over the coastal space or resources and address the possibility of risks to the health and wellbeing of marine animals. Known threats to sea otters combined with insights provided by interview or survey participants of potential areas of overlap could inform sound management plans. In interviews and surveys, fishing was selected by 58.6% of participants, as well as kayaking (37.9%), boating (37.9%), aquaculture (27.5%), whale watching (20.6%) and tourism (20.6%) (Figure 14).

Another connection between the threats above and the findings of this research pertain to pathogens emerging from human sources and the speculated potential source of aquaculture if projects are not effectively managed and monitored (DFO, 2014; McLeish, 2018). In response to the activities of overlap question, 27.5% of respondents observed aquaculture activities taking place in the same regions where they had observed sea otters (Figure 14). This illustrates a potential risk to both sea otter health and wellbeing and the success of an aquaculture project should a negative interaction take place. The distribution of sea otters in BC includes populations along the central coast of the province and the west coast of Vancouver Island where high wave energy serves to promote a variety of invertebrates and microhabitats (DFO. 2014). Examples of sea otters preferred food species include herbaceous invertebrates such as sea urchins and mollusks, clams, mussels, oysters, among others (Watson and Estes. 2011). The most probable

interactions between sea otters and invertebrate fisheries or aquaculture projects of known sea otter preference could be key information for conflict mitigation. To maintain within the bounds of the scope of this research, the interactions between aquaculture and sea otters will not be examined in further detail. However, this would be an interesting research study to undertake in the future involving a participatory mapping approach to dive deeper into the areas of overlap.

Table 4. Possible threats to sea otters unearthed from interview and survey transcripts.

Potential Threats	Occurrence
Fisheries	10
Vessel traffic	7
Tourism	4
Boat strikes	4
Disturbance	4
Oil spills	4
Competition	4
Climate change	3
Human impacts	3
Total	43

In an analysis of interview transcripts and open-ended questions in the online survey, themes pertaining to possible threats to sea otters were discussed (Table 4). Only themes which were mentioned more than twice by participants were included in Table 4. The topic of human impacts was specifically mentioned three times, but every other theme discussed is a direct or

indirect result of human activity. Other threats discussed include fisheries and competition, tourism, vessel traffic and boat strikes, climate change and oil spills (Table 4).

The proximity of sea otters to heavily populated coastal communities and a wide range of human activities in the coastal environment exacerbates the threat of oil spills for sea otters (DFO, 2014). In BC, the most vulnerable species to spills include Northern and Southern Resident Killer Whales, sea otters, Bigg's killer whales and Steller sea lions (Rosenberger et al., 2017). Sea otters are particularly vulnerable to oil spills since they lack blubber and rely on their dense fur to stay warm in cold pacific waters and stay afloat at sea (McLeish, 2018). A sea otter coat contains approximately 800 million hairs which require that the animals spend significant time and effort grooming to maintain proper function (Cannings & Cannings. 2015). Oil spills threaten sea otters by causing hypothermia in some cases and decreasing their buoyancy and long-term survival in others (McLeish, 2018). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the sea otter as *Special Concern* in 2007 and part of their justification was the species' susceptibility to oil and habitat nearby tanker routes (DFO. 2014).

In 1989, leaders from Alaska, British Columbia, Washington, Oregon, California, and Hawaii signed a Memorandum of Cooperation to form the Oil Spill Task Force as a result of oil spills which threatened the health of the coastal environment and alarmed political leaders (Oil Spill Task Force, 2019). Examples of such spills include the Union Oil Spill in 1969 in the Santa Barbara Channel (McLeish, 2018) and the Exxon Valdez spill which was responsible for the dumping of 42 million litres of crude oil off the coast of Alaska and has been tied to an estimation of 3,000 sea otter fatalities (DFO, 2014). However, this issue is ongoing. From April 1st, 2022, to March 31st, 2021, 4,734 spills (posing varying levels of risk) were reported in BC

with 1,283 being reported in the Vancouver Island region (Bauch et al., 2021). Thus illustrating the importance of effective marine planning and risk reduction strategies to protect marine mammals.

4.5 Recommendations

Stakeholder and rightsholder perspectives are integral to the effective management of this species as the people who live and work in coastal communities are those who may be directly impacted by changes in sea otter range and habitat. To reduce human-wildlife conflicts, managers must decide whether to retain the status quo of management or forge a new path forward using new methods of adaptive management while acknowledging the risks associated with change (Camman et al., 2019). In this section, recommendations will be made to promote a path forward with conflict reduction between users of the marine space in mind. The discussion section was organized by topic beginning with public perceptions of sea otters, followed by sea otter sightings, interactions, and threats to sea otters. From each section, recommendations have been derived based off key findings in this study to advance the management of this species.

Key players such as the stakeholder and rightsholder groups in this study play a role in the future direction of sea otter management in BC. Recommendations which are relevant to this study in the management plan for the sea otter by DFO have been illustrated in Table 6 (DFO, 2014) and will be addressed in the following sections.

Table 6. Key Recommendations for future sea otter management adapted from DFO. 2014.

Recommendations
Support community involvement in sea otter conservation and research
Maintain relationships with stakeholders and rightsholders
Assess the potential of human disturbances and create a mitigation plan
Assess the interactions between sea otters and fisheries in terms of competition
Support the enforcement of regulatory documents pertaining to sea otter management
Develop sea otter specific measures for oil spills
Develop a monitoring plan for First Nations Harvest of sea otters

4.6 Public Perceptions & Outreach

This study supports increased public outreach and public awareness campaigns to promote an improved understanding of the potential benefits and risks of sea otter reoccupation of historical territory on Vancouver Island. As described in the discussion section, stakeholders and rightsholders in the region possess divergent views on the species which can lead to management challenges. Public support is important for the successful management of marine species. The messaging which is provided to the public via the media, government players or non-governmental organization or community groups can influence the public perception of marine species (Echeverri et al., 2017). For issues pertaining to public perception in the management of the sea otter, consistent messaging is required which encompasses the behavioural spectrum of the species and informs the public of the risks of human interactions.

Table 7. Critical Recommendations to improve coexistence with sea otters adapted from Burt et al., 2020.

Recommendations
Strengthen Indigenous governance and decision-making authority
Promote adaptive co-management
Incorporate Indigenous Knowledge and Western science into management plans
Establish learning platforms

Table 7 shows recommendations by Burt et al., 2020, on how people can better coexist with sea otters. Their recommendation to establish learning platforms and improve the systems in place to allow Indigenous decision-making authority are closely tied to this research (Table 7) in that learning platforms could be used to inform the public of both the positive and negative changes to be expected if sea otter densities are to increase in the region. Similarly, this platform could provide resources and management measures to implement in the wake of sea otter range expansion.

In terms of Indigenous decision-making authority, currently the provincial and federal governments in BC are most directly involved in the management of the sea otter on Vancouver Island. Improved Indigenous decision-making authority could provide coastal First Nations with the autonomy to manage sea otters in their territory which could in turn result in a shift in sea otter perspectives. These recommendations align with DFO, 2014, including the support of community involvement, public outreach, research and education, and the inclusion of stakeholder and rightsholder perspectives in future planning which could contribute to relationship building (Table 6).

4.7 Sea Otter Sightings & Research

One of the key recommendations by DFO is to support community involvement in future sea otter conservation and research (Table 6). The idea of community involvement could find practical application in sea otter monitoring on the southwest coast of Vancouver Island where the extent of sea otter habitat reoccupation is not clear. Research programs would benefit from the knowledge and expertise of local peoples and community scientists in the monitoring of sea otters. This recommendation involves a shift towards participatory research and collaborative research with community partners and away from monitoring from a western science lens or monitoring conducted by only one organization.

4.8 Interactions & Space-Based Tools

One of the most salient findings in this work was the identified activities of potential overlap between people and sea otters. More specifically, the work or recreational activities which were observed in regions of sea otter habitat by the participants in this study illustrate an opportunity for spatial planning as a tool to mitigate conflicts in the coastal space. Such activities include fishing, small vessels, charter boats and commercial vessels, boating, including recreational motorboats, kayaking and aquaculture activities.

The use of space-based tools (marine protected areas, areas of refuge, Indigenous protected and conserved areas, etc.) to manage human interactions with sea otters could minimize the risk of interactions which could lead to adverse outcomes. By planning and mapping the uses of the marine space, the designation and delineation of zones could reduce the risk of conflict between user groups and the risk of harm to marine mammals, namely sea otters. This is in alignment with the recommendation by DFO to assess the risks of human disturbance and develop a mitigation plan (Table 6). Spatially based tools could be part of the mitigation plan

for the protection of marine species. An understanding of the complex marine user groups and uses would be necessary in attempting this means of management to effectively protect wildlife while allowing industries and recreational activities to continue where permitted.

4.9 Threats & Enforcement

Threats requiring action include boat strikes and human disturbance to sea otters as well as the interactions between sea otters and aquaculture projects and sea otters and fisheries. Sea otters were observed by interview and survey participants in coastal spaces in the nearshore but also further out to sea than they were expected to be found. This raised concerns of potential threats posed by the shipping industry and the movement of larger vessels along the Pacific coast. On the other hand, one interview participant described an interaction they had with a sea otter while kayaking where they startled a sea otter as the animal could not hear them approaching. Such threats to the sea otter illustrate the necessity for greater enforcement of the rules and regulations in place for the protection of this species such as the *Species at Risk Act*. This recommendation was derived from the insights provided by participants in this study and the information displayed in Table 6 from (DFO, 2014).

Chapter 6 Conclusion

The management of sea otters on the coast of Vancouver Island is complicated due to a wide variety of users interacting in the marine environment and perceived or real competition between humans and sea otters over valuable marine resources. Sea otter populations are established in some regions of the Vancouver Island coast, but the study area of this research is not currently designated as a region of sea otter territory. This study aimed to examine the extent of sea otter range expansion into the study area and gain insights on the environmental, social, and economic implications in the region.

Based on the research conducted through the monitoring and reporting of sea otter sightings, interviews and survey interview questionnaires, and a focused literature review on sea otter range expansion, the following conclusions can be made. Monitoring data suggest that sea otters are inhabiting waters outside the known range designated by Fisheries Oceans Canada. The sea otter sightings outlined in this study are insufficient to definitively determine whether sea otter range is expanding, however, the individual sea otters who currently inhabit said regions could form part of the baseline data moving forward in sea otter range expansion research. Based on the qualitative analysis of interview and survey data n=29, results indicated that perceived activities of overlap between people and sea otters include fishing, kayaking, boating, aquaculture, whale watching and tourism. Similarly, the management measures most frequently selected by participants from various stakeholder and rightsholder groups as appropriate for the management of sea otters included space-based tools, greater enforcement of the SARA rules and regulations, increased public outreach and research and education.

The recommendations provided in this study include public outreach to inform coastal residents of the benefits and risk of sea otter presence, research and education based on a citizen

science and community monitoring approach, the use of space-based management tools to reduce conflict in the marine space, and increased enforcement of rules and regulations to mitigate threats to the sea otter. Effective sea otter management is contingent on community involvement and the incorporation of stakeholder and rightsholder perspectives in future marine planning which could contribute to more successful interactions in the marine environment where environmental conditions are protected, and socioeconomic benefits are achieved in balance.

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Appendix

Appendix 1 Body of Email Template for Prospective Participants

Dear (Name):

I am currently conducting a study and would like to invite you to participate.

This is a study on sea otter range expansion on Vancouver Island and the management measures that can be used to accommodate changing sea otter populations. This work will address the political, socio-economic, and ecological dimensions of sea otter population management and the implications of sea otter range expansion on coastal communities. This study will include population monitoring surveys to determine the presence of sea otters on the Southwest coast of Vancouver Island, and interviews with a variety of stakeholders to learn about their observations on sea otter range expansion and the potential positive and negative impacts.

The extent of your participation would be a 30-minute interview in person, online, or by telephone. Interviews can be scheduled at a day and time that is convenient for you. I am available evenings and weekends.

Thank you for your consideration.

Please call 1(250) 888-8332 if you are interested in participating in this study and do not hesitate to reach out to me with any questions. You can also email me at Michaela.mayer@dal.ca. If you are interested in participating in this study, I will send you a consent form with more information about the project and a signature page.

I hope that you can help me understand more about sea otter range expansion and the potential impacts on the coast of Vancouver Island.

Sincerely, Michaela Mayer

Appendix 2 Shift from Interviews to online survey notification email

Prospective participants were notified of the shift from interviews by telephone to an online survey via email and sent the message below:

Hello X,

We connected in September about the possibility of an interview to contribute to my Graduate research at Dalhousie University on sea otter range expansion along the coast of Vancouver Island.

I have since shifted my methodology from interviews to an online survey in the interest of time. Would you consider participating in my research? The extent of your participation would be the completion of a short online survey consisting of 22 questions.

I hope that you can help me understand more about sea otter range expansion and the potential impacts on the coast of Vancouver Island.

Please email me if you have any questions.

Thank you for your consideration,

Michaela Mayer

Appendix 3 Promotional Poster Disseminated Electronically

Summer 2022

PARTICIPANTS WANTED

STUDY ON SEA OTTER RANGE EXPANSION

Sea otters are on the move!

Participants needed for a short conversation about sea otters

Conducted by Michaela Mayer of Dalhousie University's Marine Affairs Program under the co-supervision of Dr. Anna Hall

REQUIRED

Are you 18 years (or older) and interested in helping me?

BENEFITS

Contribute to understanding the effects of Vancouver Island sea otter range expansion

Let's talk: michaela.mayer@dal.ca, 1(250)883-8332

1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332 1(250)883-8332

Appendix 4 Development of Evaluation Questions

Question 1- *How long have you been living on or visiting Vancouver Island?*

This question was designed to determine whether survey participants have met the requirements of familiarity with study area and able provide insights on the state of sea otter expansion. The goal was for a large proportion of respondents to fill out option stating five or more years spent living on or visiting the Island (Figure 6).

Question 2- *In which regions of Vancouver Island have you observed sea otters?*

This question aimed to provide an overview of the overlap between interview participants and sea otters to better understand the current sea otter range along the coast of Vancouver Island (Figure 7). An image was provided to participants to illustrate the regions of the island to standardize responses (Figure 8).

Question 3- *When you observed sea otters, what was the group size?*

It is known that sea otters travel in groups called rafts, as individuals or in smaller groups of a few individuals. This question aimed to see if any patterns exist in sea otter group size by region (Figure 9).

Question 4- *Have you also observed river otters where you have observed sea otters?*

Through initial conversations with community members and members of the public about sea otters while staying on Vancouver Island, it became quickly apparent that many people confuse sea otters and river otters. To avoid the downfall of potential respondents confusing sea otters and river otters, this question aimed to determine whether interview and survey participants could distinguish between the two species before proceeding through the questionnaire (Figure 10). Another dimension to this question was to hear if participants had

opinions on river otters or if they had observed sea otters and river otters interacting in the coastal environment.

Question 5- *When was your last sea otter sighting?*

The purpose of this question was to determine if the participant has observed sea otters recently and could then provide any insights on whether the presence of sea otters in the region may be changing (Figure 11).

Question 6- *Do you observe sea otters regularly?*

This question was a follow-up to Question 5 to expand on the possibility of changing presence (Figure 12).

Question 7- *Have you noticed a change in the frequency of sea otter sightings over time?*

This question was selected to provide an opportunity for participants to provide their opinions on the frequency of sea otter sightings over time based on their experience in the coastal environment (Figure 13).

Question 8- *What kinds of recreational or work activities occur in the areas where you have observed sea otters?*

This was the first question to touch on threats to sea otters indirectly (Figure 14). Through this question, it was expected that participants could paint a picture of the activities they observed in the field to examine areas and activities of overlap and assess possible compatibilities and conflicts.

Question 9- *Are you aware of any changes in the environment in the areas where you have observed sea otters?*

In this question, a list of options was provided with an option for participants to provide their own examples (Figure 15). The goal was to form a comprehensive list of potential environmental changes that could impact sea otters and vice versa.

Question 10- *Do you know what the Fisheries Act is?*

This question served to determine if participants possess prior knowledge of the *Fisheries Act* (Figure 16).

Question 11- *How familiar are you with the Fisheries Act?*

Through this question, participants could express their familiarity with the regulatory document in question by selecting unfamiliar, somewhat familiar, familiar, or very familiar (Figure 17).

Question 12- *Do you know what the Species at Risk Act is?*

This question served to determine if participants possess prior knowledge of the *Species at Risk Act* (Figure 18).

Question 13- *How familiar are you with the Species at Risk Act?*

Through this question, participants could express their familiarity with the regulatory document in question by selecting unfamiliar, somewhat familiar, familiar, or very familiar (Figure 19).

Question 14- *How would you describe the government rules used to protect sea otters in terms of understandability (on a scale from 1-10)?*

Through this question, the goal was to gain an understanding of whether participants could understand government rules for sea otter protection (Figure 20). The responses to this question could be useful in the recommendations provided in the discussion section of the paper. If participants felt the government rules to protect sea otters were not easily understood, perhaps a recommendation to DFO would be made to clarify the rules.

Question 15- *How would you describe the government resources such as websites used to provide information on sea otters (on a scale from 1-10)?*

The goal of this question was to gain a sense of the accessibility of government resources (Figure 21). The secondary goal was to gauge the interest level of participants to approaching government resources.

Question 16- *Are you aware of any factors that may impede sea otter expansion into the area where you have observed them?*

In this question, a list of options was provided with an option for participants to provide their own examples (Figure 22). The goal was to form a comprehensive list of potential impediments that could impact sea otter range expansion.

Question 17- *How would you describe your perception of sea otters?*

The goal of this question was simply to understand where the participant's perception of sea otters fell along a spectrum from negative, to neutral, mixed, and positive (Figure 23).

Question 18- *Do you think the public shares your perception?*

Through this question, the aim was to see how the participant related their experience with sea otters to the rest of their community (Figure 24). The possible responses to this question included yes, no, and unknown.

Question 19- *In your opinion, which of the following industries or coastal attributes could be positively or negatively impacted by an increase in sea otter presence?*

In this question, a list of options was provided with an option for participants to provide their own examples (Figure 25). The goal was to form a comprehensive list of potential industry or coastal attributes that could be affected by sea otters.

Question 20- *In your opinion, what measures should we use to manage sea otters in the areas where you have observed them?*

This question aimed to determine an appropriate range of management tools for communities to use if sea otters expand their range into coastal regions in the study area (Figure 26). The idea was to provide options of tools and ask participants whether they found each one

appropriate. The responses to this question could inform a portion of the discussion section and recommendations for future sea otter management programs.

Appendix 5 Sea Otter Study Questionnaire

1. How long have you been living on or visiting Vancouver Island?

_Less than a month _1 month-1 year _1-5 years _5+ years

2. In which regions of Vancouver Island have you observed sea otters? (Provide a map for reference)

_North Island _Central Island _South Island _Greater Victoria _Pacific Rim _Gulf Islands _Sunshine Coast Other_____

3. Were they observed an individual, a small group, or as a large group (raft of sea otters)?

_Individual _Small group _Raft

How many sea otters did you observe? _____

4. Have you also observed river otters in the same regions where you observed sea otters?

_Yes _No _Unknown

If so, where did you see them?_____

5. Approximately how recent was your last sea otter sighting?

_Within one week _One month _More than one month _One year _More than one year

6. Do you see them regularly?

_Yes _No

7. If you see sea otters frequently, how has the frequency of sightings changed over time?

_Not applicable _Decreased frequency _No change _Increased frequency

8. What kind of work or recreational activities occur in the areas where you have observed sea otters? _____

9. Are you aware of any changes in the environment in the areas where you have observed sea otters?

_Yes _No

If so, please select all that apply.

_Residential Development

_Coastal Erosion

_Habitat Fragmentation

_Changes in Vegetation

_Mining or Resource extraction

_Changes in local climate

_Sea level rise

_Flooding

_Extreme weather events (Tsunamis, earthquakes, storms)

Other_____

Government Rules

10. Do you know what the Fisheries Act is?

_Yes _No

11. How familiar are you with the Fisheries Act?

_Not familiar _Somewhat familiar _Familiar _Very familiar

12. Do you know what the Species at Risk Act is?

_Yes _No

13. How familiar are you with the Species at Risk Act?

_Not familiar _Somewhat familiar _Familiar _Very familiar

Fisheries Act
Federal protection of sea otters is achieved by the Marine Mammal Regulations under the Fisheries Act. Regulations apply to the management and control of fishing and related activities and the conservation and protection of marine mammals in Canada and in Canadian fisheries waters.

Marine Mammal Regulations

These regulations protect marine mammals from general disruptions and outline the guidelines for fishing license holders and those conducting research to follow. The rules are in place to ensure that people do not disturb marine mammals except when they are carrying out authorized activities in a respectful manner.

Species at Risk Act
Sea otters in Canada are listed as a Species at Risk under Special Concern. Their designation has changed from Threatened (higher risk) to Special Concern (lower risk) since sea otter populations have been increasing over the last few decades. Some populations are expanding along the coast of British Columbia to regions of their historical range. Due to population growth and range expansion, this species is of a lower risk of extinction than it was in the early 2000s.

Management Plan for the Sea Otter (Enhydra lutris) in Canada
This document outlines the rules set out by the Canadian Government and the programs that exist for the protection of the sea otter. Federal, provincial, and territorial governments work together to plan their approach for the conservation of sea otters in British Columbia. Management objectives for this species include monitoring programs, promoting the recovery of sea otters, and limiting threats to their populations.

14. How would you describe the government rules used to protect sea otters (0 being difficult to understand and 10 being easy to understand)?
0 1 2 3 4 5 6 7 8 9 10

15. How would you describe the government resources such as websites used to provide information on sea otters (0 being difficult to navigate and 10 being easy to navigate)?
0 1 2 3 4 5 6 7 8 9 10

16. Are you aware of any factors that may impede sea otter expansion into the area where you have observed them?

_Yes _No

If so, please select all that apply.

_Recreational activities (boating, surfing, kayaking)

_Predator-prey dynamics

_Shooting

_Changes to the coastal environment

_Habitat suitability

_Fishing

_Shellfish harvesting

_Vessel traffic

_Weather events

_Food availability

_Climate change

_Competition over resources

_Rules and Laws

_Water quality

_Chemical pollution

_Plastic pollution

_Risk of oil spills

_Microplastics

_Contaminated seafood resources

17. How would you describe your perception of sea otters in this region?

_Negative _Neutral _Positive_Mixed

18. Do you think the public shares your perception?

_Yes _No _Unknown

19. In your opinion, which of the following industries or coastal attributes could be positively or negatively impacted by an increase in sea otter presence? (Select all that apply)

_Fisheries

_Shipping

_Port activities

_Marinas

_Surfing and diving

_Kelp harvesting

_Marine resource extraction

_Oil & gas

_Marine renewable energy

_Small vessel traffic

_Beaches and recreation

_Coastal development

_Tourism

_Marine research

_National defense work

_Marine conservation initiatives

_Food security

Other_____

20. In your opinion, what measures should we use to manage sea otters in your area or the area where you have observed them?

_Relocation of sea otters (moving sea otters elsewhere)
_Reintroduction of sea otters (bringing sea otters in)
_Controlled non-commercial hunt (cull)
_Open hunting season
_Licensed commercial harvest
_Fishery closures
_Space-based tools (Marine protected areas, marine parks, refuge areas, etc.)
_Increased enforcement for the protection of Species at Risk
_Public outreach or campaigns

21. Is there anything else that you think I should know about sea otters in your area?

_____

22. Do you have recommendations on who else should complete this survey?

Appendix 6 Consent Form

DALHOUSIE UNIVERSITY

CONSENT FORM

Project title: Sea Otter Monitoring to inform future population management actions on the Southwest Coast of Vancouver Island

Lead researcher: Michaela Mayer, Dalhousie University, Master of Marine Management, Marine Affairs Program.
Contact: Michaela.mayer@dal.ca, 1(250) 883-8332

Other researchers
Dr. Anna Hall, Sea View Marine Sciences
Contact: Annahall@shaw.ca
Christopher Milley, Nexus Coastal Resource Management, Dalhousie University
Contact: chris.milley@dal.ca

Introduction
We invite you to take part in a research study being conducted by, Michaela Mayer, who is a master's Student at Dalhousie University. Choosing whether to take part in this research is entirely your choice. The information below tells you about what is involved in the research, what you will be asked to do and about any benefit, risk, inconvenience, or discomfort that you might experience.
You should discuss any questions you have about this study Michaela Mayer. Please ask as many questions as you like. If you have questions later, please reach out via email.

Purpose and Outline of the Research Study
This is a study on sea otter range expansion on Vancouver Island and the management measures that can be used to accommodate changing sea otter populations. This work will address the political, socio-economic, and ecological dimensions of sea otter population management and the implications of sea otter range expansion on coastal communities. This study will include population monitoring surveys to determine the presence of sea otters on the Southwest coast of Vancouver Island, and interviews with a variety of stakeholders to learn about their observations on sea otter range expansion and the potential positive and negative impacts.

Who Can Take Part in the Research Study
For this study, we are seeking individuals over the age of 18 from stakeholder groups from different levels of Government, Non-governmental organizations, members of coastal communities, Industry and Academia to learn about the potential impacts and possible management tools to mitigate the effects of sea otter population growth and range expansion on the coastal ecosystem in the region.

What You Will Be Asked to Do
If you decide to participate in this research, you will be asked to attend one interview with Michaela Mayer in-person, online, or over the phone. The interview will take approximately 30

minutes. During the interview you will be asked to describe observations on the presence of sea otters in the region, the regulatory framework governing sea otters in British Columbia, and answer other questions about sea otter range expansion.

Possible Benefits, Risks and Discomforts
Benefits: Participating in the study might not benefit you, but we might learn things that could benefit others.

Risks: The risks associated with this study are minimal; there are no known risks for participating in this research beyond being bored or fatigued. You will be offered a break during the interview to reduce these risks.

How your information will be protected:
Privacy: Your participation in this research will be known only to Michaela Mayer, Anna Hall, and Chris Milley.

Confidentiality: The information that you provide to us will be kept confidential. Only the research team will have access to this information. The people who work with us have an obligation to keep all research information confidential. All your identifying information (such as your name and contact information) will be securely stored separately from your research information. We will use a participant number (not your name) in our written and computer records so that the research information we have about you contains no names. During the study, all electronic records will be kept secure in an encrypted file on the researcher's password-protected computer.

We will describe and share our findings in presentations, a graduate project report and potentially, publications. We will only report group results and not individual results. This means that you will not be identified in any way in our reports.

Data retention: Once the study is over your data will be stored on a USB protected by encryption for one year from the final submission date of the Graduate Project Report in November 2022. After that time, it will be deleted from storage.

If You Decide to Stop Participating
You are free to leave the study at any time. If you decide to stop participating during the study, you can decide whether you want any of the information that you have provided up to that point to be removed or if you will allow us to use that information. After participating in the study, you can decide for up to September 12th, 2022, if you want us to remove your data. After that time, it will become impossible for us to remove it because it will already be analyzed.

How to Obtain Results
We will provide you with a short description of group results when the study is finished. No individual results will be provided. You can obtain these results by including your contact information at the end of the signature page.

Questions

We are happy to talk with you about any questions or concerns you may have about your participation in this research study. Please contact Michaela Mayer (1(647)-654-6561), Michaela.mayer@dal.ca) or Chris Milley (chris.milley@dal.ca) at any time with questions, comments, or concerns about the research study.

If you have any ethical concerns about your participation in this research, you may also contact the Marine Affairs Program Ethics Review Standing Committee, Dalhousie University, by email at marine.affairs@dal.ca (MAPERSC file #MAP2022-01).