Supporting Indigenous marine conservation planning:
a case study of the Songhees Nation

by

Elena Buscher
B.Sc., Maastricht University, 2013

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

Supervisory Committee

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Abstract

Worldwide marine ecosystems are facing unprecedented threats, and the biodiversity crisis is paralleled by a decline in Indigenous cultures and languages. Increasingly, Indigenous peoples' abilities to practice their traditional livelihoods and cultures are reduced, but there are many examples of cultural resurgence. My thesis was based on a collaboration for marine conservation planning for *Tl'ches* between the Songhees Nation and researchers from the University of Victoria.

The primary objectives for my thesis were to 1) to document the Songhees marine conservation planning process, and compare it to systematic conservation planning to outline the similarities, differences, and highlight the uniqueness of an Indigenous-led planning approach and 2) to systematically document and integrate culturally significant species and their habitats into the Songhees stewardship vision for the marine use plan.

I achieved my first objective by systematically documenting and showcasing the Indigenous-led marine conservation planning process of the Songhees Nation to reclaim and further stewardship over the *Tl'ches* archipelago near Victoria, BC. I ascribed process steps to the Songhees marine conservation planning approach and compared these steps to the traditional systematic conservation planning (SCP) steps as laid out by Pressey and Bottrill (2009). The Songhees approach showed similarities to SCP in the initial scoping phase of the marine conservation planning, in the review and compiling of existing data prior to the collection of data as well as the focus on focal species such as culturally important species. My second objective was accomplished by applying and evaluating the remotely operated vehicle (ROV) Trident OpenROV as part of the Songhees marine conservation planning process around *Tl'ches*. This objective had three main outcomes: 1) I evaluated the marine ecological data collection capabilities for the Trident and 2) my surveys resulted in a systematic benthos classification and documentation of the algal community as well as a baseline of Songhees culturally important species. 3) I evaluated the ability of the Trident to provide high resolution ecological data to inform a marine use planning process. I found the Trident to be a capable tool to conduct systematic marine surveying despite some limitations such as low

maneuverability in moderate to high current environments and dense kelp areas. I was able to document 14 of 25 culturally important species and 28 species of algae and seaweeds. I was also able to establish highly stressed environments suited for future restoration efforts.

My research saw the creation of the Songhees Nation Marine Use Plan. The plan, along with the associated permanent data collection and compilation, can serve as a basis and guide to the Songhees Nation to initiate a monitoring program. Given the complicated jurisdictional landscape over the archipelago, the Songhees Nation Marine Use Plan could help strengthen assertions to exclusive stewardship and aid in creating a basis for dialogue between other stakeholders such as the Province of British Columbia. My collaboration fills a gap in the marine conservation planning literature by providing an example of an Indigenous-led marine conservation planning process according to the priorities of the Songhees Nation.

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Acknowledgments

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To Joan Morris — Sellemah — *Tl'ches* is your home and I know you want to see it protected and healed. "So long as you have the land, you're rich. But you give that up and you're gonna be dirt poor." Thank you for your extraordinary and generous friendship and support. I think fondly of all the lunches we have and all the jokes we share as well as unanticipated shopping trips to Tillicum Mall or the bingo place. Hy'chka!

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Dedication

I dedicate this thesis to the Songhees Nation and the strong and resilient Indigenous people worldwide reclaiming what is rightfully theirs.

Chapter 1 – Introduction

Introduction

“So long as you have the land, you’re rich. But you give that up and you’re going to be dirt poor.” - Sellemah

The continued degradation of marine ecosystems affects biodiversity and people (Ceballos et al. 2015; Lester and Halpern 2008; Myers and Worm 2003; Ommer 2007; Worm et al. 2006) and requires solutions to protect, restore, and manage for ecocultural health (Rapport and Maffi 2010, 2011). *Ecocultural health* can be defined as the “dynamic interaction of nature and culture that allows for co-evolution of both without compromising either critical ecosystem processes or vitality of cultures” (Rapport and Maffi 2010, 2011). Increasingly, research shows that addressing this degradation requires integrated solutions to marine management and conservation, recognizing and utilizing the existing dependence of humans on a healthy marine environment (Berkes 2015; Ommer 2007; Ostrom 2009; Perry et al. 2011). Developing and implementing solutions is oftentimes also a matter of social justice (Nursey-Bray, Wallis, and Rist 2009; Salomon et al. 2018).

My thesis is based on a collaboration of researchers between the Songhees Nation and the University of Victoria, Canada. The idea for this work originated from conversations with Sellemah (Joan Morris) and Darcy Mathews (a professor at the University of Victoria) about the apparent disappearance of x̣íxʷə (purple urchin; *S. purpuratus*) from the waters around *Tl’ches* (see below) in 2012. Sellemah remembers being able to harvest x̣íxʷə as a young girl from rocks around *Tl’ches* at low tide with her grandparents and was curious about the reasons for the x̣íxʷə disappearance. Further conservations between Darcy Mathews and then Songhees Lands Manager, Cheryl Bryce, set the stage for the collaboration which is laid out in this thesis. My thesis documents and contributes to the Songhees Nation's Indigenous-led marine conservation planning process. This research is one of the first documented Indigenous-led marine conservation planning processes in the literature without the involvement of other levels of government. The product of the conservation planning saw the successful output of the *Songhees Nation Marine Use Plan*. This introduction situates my thesis in literature that helped to inform this research throughout our collaboration over the last two years, and helped to shape the idea for the *Songhees Nation Marine Use Plan* with the Songhees Nation. The literature relevant to this research included social-ecological systems, governance and resource management, marine protected area and systematic conservation planning, traditional ecological knowledge, as well as Indigenous rights and resurgence.

My research is centered on an archipelago off the southern tip of Vancouver Island. The Lekwungen name for this is *Tl'ches*, and this network of small islands, reefs, and adjacent waters (Fig. 1) is the focal point of the Songhees Nation's marine planning and stewardship efforts. It is also an example of an archetype cultural keystone place (Cuerrier et al. 2015). My work aims to support their efforts by integrating data from marine subtidal surveys and Songhees community member interviews (the latter led by Songhees collaborators), thereby ensuring that the project was culturally meaningful and relevant to the Songhees Nation whilst scientifically sound. Through ecological fieldwork and semi-structured interviews, I hoped to accurately capture the Songhees' community objectives and priorities for marine stewardship and conservation, which will help to strengthen Songhees efforts of sovereignty over *Tl'ches*. *Tl'ches* is an archipelago, which is part of the Songhees territory and is featured in one of the most important creation stories to the nation about "*The Origin of Salmon*" (Jenness 2016; Turner and Berkes 2006). Although only preliminary archaeological work has been done, inhabitation likely extends back several millennia at least, and Songhees people only recently stopped living on the islands around 1953 (D. L. Mathews, pers. comm. to EB, May 2017).

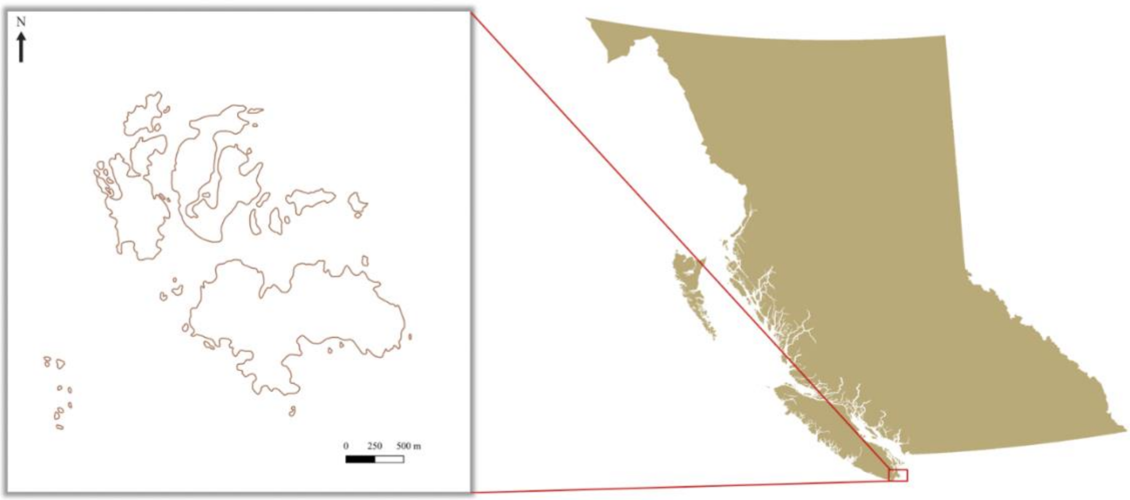

Figure 1. Outline and scale of the *Tl'ches* archipelago and location of *Tl'ches* on the British Columbia coast.

Social-ecological systems

The looming environmental crises, including climate change, overfishing, ocean acidification and others, cannot be solved if we consider the biosphere as separate from the human world (Berkes 2015; Folke et al. 2011; Ommer 2007; Ostrom 2009). All humanly-used resources are entrenched in complex social-ecological systems (SES) (Ostrom 2009). SES are composed of many nested social systems and ecosystems (Folke et al. 2007; Ostrom 2009). Many linkages exist between the nested systems in a horizontal and vertical manner across spatial and temporal scales, impacted by feedbacks between the nested systems (Ban et al. 2017; Ostrom 2009). For example, a nested system could encompass local, single ecosystems (e.g. coral reefs; kelp forests), which are typically managed on the local scale (e.g. municipality; villages). The nested system can be impacted and affected by large-scale ecological change such as climate change and nationally mandated ocean-related policies (Ban et al. 2017). Only when SES are regarded and managed as linked natural and social systems will it be possible to achieve sustainability in managing subsystems such as coastal fisheries (Berkes 2015; Folke et al. 2011; Ostrom 2009).

In addition to the academic view of SES, many Indigenous perspectives encompass the idea of linked SES through kincentric worldviews and ethics, which have commonly led to sustainable, integrated stewardship and management of their territories (Berkes 2012; Mathews and Turner 2017). Kincentric views regard other lifeforms, such as plant and animals, as well as non-living things such as mountains, the sun, the moon, water and winds, as relations (Salmon 2008; Turner and Clifton 2009). Many Indigenous societies have existed in wholesome SES, managing resources for subsistence and cultural purposes (Berkes 2012; Eckert, Ban, Tallio, et al. 2018; Mathews and Turner 2017; Preuss and Dixon 2012; Turner and Berkes 2006; Turner, Lepofsky, and Deur 2013), although there are also examples where management has not been sustainable (Johannes 2002a; Nadasdy 2005). Collaborations with researchers and Indigenous communities — such as through this thesis — will add to the body of literature of Indigenous governance and management of ancestral homelands and ecoculturally important resources in a coupled social-ecological system.

Governance and resource management

Governance denotes the structures and processes by which people in societies make decisions and share power (Lebel, Garden, and Imamura 2005). As Elinor Ostrom wrote, “Governance in SES involves the crafting of rules in an effort to improve incentives to do something, people’s behavior, and outcomes over time, such as achieving sustainable resource use or establishing a protected area” (Ostrom 2015, 22). Sustainable resource management — whether it is community or state driven — can be facilitated by devolution of power from governments higher up the institutional scales to local communities to allow for quick responses to changing environmental conditions (Berkes 2010; Folke et al. 2007). However, devolution requires power sharing and time for feedback and learning, amongst other things (Berkes 2010, 2015; Hill 2011; Preuss and Dixon 2012; Verschuuren et al. 2015). Successful devolution can help sharpen the vision for governance and make the resulting management outcomes more meaningful for the communities impacted (Berkes 2010, 2015; Preuss and Dixon 2012; Hill 2011; Verschuuren et al. 2015). Indeed, depending on the size of the resource system, collective choice rules, leadership and the importance of the resource to users amongst others, might mean smaller communities are better adapted to managing resource units more sustainably (Ostrom 2009). The rules and resulting policies of governance of a certain system are oftentimes a result of a combination of different knowledge systems and experiences of a variety of actors (Folke et al. 2005). Recently, new ideas and systems for resource governance of smaller communities have gained traction (Carroll 2014; Hill 2011; Mills et al. 2010; Nursey-Bray and Rist 2009; Preuss and Dixon 2012).

This thesis draws on the expertise of researchers of the University of Victoria and the Songhees Nation to combine their knowledge systems and experiences to develop a vision for the governance and stewardship of *Tl'ches*. Further, the research during this collaboration helped create the *Songhees Nation Marine Use Plan.* It thus helped to advance the vision for governance of the Songhees ancestral homelands by assisting the Songhees to shape clear formulations for the vision and future management of *Tl'ches*.

Marine protected area and systematic conservation planning

The current threats to the marine environment — e.g., climate change, overfishing, sea level rise, ocean acidification and increased shipping traffic (Ban, Alidina, and Ardron 2010; Cheng et al. 2019; Kroeker et al. 2013; Myers et al. 2007; Worm et al. 2006; Seebens, Gastner, and Blasius 2013) — are serious and are threatening the existence of many coastal peoples (Ommer 2007). Solving them requires integrative, long-term solution-oriented approaches involving actors across many biophysical and organizational scales, potentially through *systematic conservation planning* (SCP). "SCP is an explicit framework for locating and designing [conservation] actions in space and time to promote the conservation of biodiversity and sustainable use of natural resources" (Mills et al. 2010, 291). SCP's two main goals are typically to protect or ensure the (1) representation and (2) persistency of biodiversity in a given area (Margules and Pressey 2000; Pressey and Bottrill 2009).

In the context of marine environments, SCP actions, such as the establishment of networks of marine protected areas (MPAs) and/or locally managed marine areas (LMMAs), can mitigate some of the effects of these threats (Govan et al. 2009; Mills et al. 2010). In addition, MPA establishment can be seen as a potential avenue to recognize and strengthen Indigenous rights (Ban and Frid 2018; Frid, McGreer, and Stevenson 2016). MPAs have been shown to increase marine biodiversity, average size of individual fish and invertebrates, population size and total biomass within them (Lester and Halpern 2008; Lester et al. 2009). MPAs also help preserve ecosystem services such as food production, recreational uses and existence values rendered to humans (Costanza et al. 2014). As such, MPAs are a primary tool for ecosystem-based management and marine conservation.

The Convention on Biological Diversity (CBD) Aichi Biodiversity Target 11 sees at least 10 per cent of coastal and marine areas worldwide protected by 2020 (Convention on Biological Diversity 2010). This target is part of the CBD treaty signed by 168 countries with three main goals: 1) conservation of biodiversity, 2) sustainable use of biodiversity and 3) the fair and equitable sharing of the benefits arising from the use of genetic resources (Convention on Biological Diversity 2010). As part of the CBD, 20 so-called Aichi targets - including Target 11 - were developed in the late 2000s to be implemented by 2020. LMMAs and marine conservation planning initiatives like the *Songhees Marine Use Plan* present timely examples to achieve biodiversity outcomes whilst strengthening Indigenous rights through the establishment of Indigenous Protected and Conserved Areas (IPCAs) in Canada (The Indigenous Circle of Experts 2018) and worldwide (Borrini-Feyerabend and Hill 2015; Borrini-Feyerabend, Kothari, and Oviedo 2004; Ban and Frid 2018).

Currently, there are few documented examples of Indigenous involvement in the governance and management of MPAs in the academic literature (Ban and Frid 2018). In

Australia, Indigenous peoples in conjunction with government officials have created plans as a basis for collaboration and co-management of marine areas through the Indigenous Protected Area framework (Ens, Scott, Rangers, Moritz, and Pirzl 2016; Godden and Cowell 2016; Hill 2011; Preuss and Dixon 2012). In Canada, 17 Indigenous nations collaborated with the Province of British Columbia to spatially zone the north coast of Vancouver Island, the central and north coast as well as Haida Gwaii for many different uses, including protected areas (Diggon et al. 2019). In the Southeast Pacific, Indigenous peoples have been revitalizing spatial closures to manage fish populations on a local scale (Johannes 2002b; Ruddle, Hviding, and Johannes 1992). In Aotearoa New Zealand, the government has legally recognized Maori peoples' inherent rights to steward their resources via three different tools for resource management including spatially managed areas (Stephenson et al. 2014). Thus, the MPA literature lacks documentation of Indigenous-led documented marine conservation planning processes where the vision and goals for spatial protection were determined exclusively by an Indigenous people without the involvement of other levels of government or other stakeholders.

Traditional ecological knowledge

This thesis also draws upon traditional ecological knowledge (TEK) to inform the Songhees marine conservation planning process, and explains the uniqueness of their Indigenous-led approach. TEK provides researchers with a rich and diverse multi-disciplinary source of information. SCP and marine protected area planning require data; however, data can be scarce or their resolution insufficient (Ban, Bodtker, et al. 2013; Ban, Mills, et al. 2013; Mills et al. 2010). Alternative sources of data or knowing are therefore being utilized to help inform SCP exercises, such as through historical marine ecology or TEK interviews with resource users (Berkes 2012; Eckert, Ban, Frid, et al. 2018; Fraser et al. 2006; Moller et al. 2009). Indigenous peoples who have stewarded their lands for millennia have intricate environmental knowledge of small and larger scale ecological processes (Berkes 2012). This mostly comes in the form of TEK. TEK is defined as "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission about the relationship of living beings (including humans) with one another with their environment" (Berkes 2012, 7). TEK has contributed insights of how Indigenous populations have sustainably managed their local ecosystems over millennia, and has given greater insight into the size, distribution and behavior of fish, amongst many other contributions (Fraser et al. 2006; Johannes 1998; Moller et al. 2009; Johannes 2002b; Berkes 2012). Previous work has shown that TEK can serve as a proxy for the selection of sites with high conservation priority when compared to areas selected through a conservation planning program in the marine environment (Ban, Picard, and Vincent 2008). Utilizing a combination of TEK and existing ecological data is gaining popularity in the planning and establishment of Indigenous protection areas (IPAs) in Australia (Hill 2011; Preuss and Dixon 2012).

Indigenous rights and resurgence

Many countries have affirmed the rights for Indigenous peoples through the United Nations Declaration on the Rights of Indigenous People (UNDRIP)(United Nations 2007). Others have made explicit the rights of Indigenous peoples in their constitution

(Tran, Ban, and Bhattacharyya, in press). The CBD also includes benefit-sharing rights of Indigenous communities and other rural communities (Convention on Biological Diversity 2010). Despite these rights, the effects of colonialism in many countries have seen Indigenous peoples marginalized and their rights ignored.

In Canada, colonization and its policies focused on assimilating the Indigenous population have been devastating. The Truth and Reconciliation Commission has documented the cultural genocide perpetuated by the government of Canada through policies such as the residential school system, forced sterilizations and the Sixties Scoop (Sinclair 2007; The Truth and Reconciliation Commission of Canada 2015). Despite all of this, Indigenous peoples are aspiring to transcend the colonial oppressive politics and policies. Indigenous resurgence aims to reverse the effects of colonialism, and is the practice of “reconnecting with homelands, cultural practices, and communities, and is centered on reclaiming, restoring and regenerating homeland relationships” (Corntassel & Bryce 2012, 153). Resurgence efforts also re-center Indigenous nationhood in political movements. Examples are the conflict over the herring fisheries on the Central Coast of British Columbia (von der Porten, Corntassel, and Mucina 2019) or the “war in the woods” protests and the subsequent restricting of logging of old growth forest on west Vancouver Island (Murray and Burrows 2017). This research is part of a suite of new opportunities for Indigenous resurgence through collaboration for purpose of ecocultural research and revitalization.

The Lekwungen peoples and the Songhees Nation

The Songhees peoples are part of the Coast Salish peoples, who have occupied their territories for millennia distributed along the shores of the Pacific Northwest down to Washington state. Their Lekwungen language is a dialect of Straits Salish, spoken by Coast Salish peoples. The name Songhees is an anglicization of the word Stsâ/ñges (Suttles 1974). The Songhees Nation is located in South-Western British Columbia on the Southern tip of Vancouver Island in Canada (Figure 1). They are a First Nation with approximately 528 registered members (Indigenous and Northern Affairs Canada 2019), which has seen extensive development throughout its traditional territory. This includes the greater Victoria area. The Songhees' main residential reserve is located in the municipal boundaries of Esquimalt. The reserve land, which includes multiple areas including *Tl'ches*, spans approximately 138 hectares (Indigenous and Northern Affairs Canada 2019). *Tl'ches* is the only non-urban part of the Songhees reserve and, unlike the other parts of the reserve, has not seen extensive development. The Lekwungen peoples are traditionally marine harvesters with some anthropologists referring to them as the "Salmon people" (Jenness 2016). Harvesting took place between the months of March - October, whereas winter was a time for cultural events, such as potlatches and dancing (Jenness 2016).

The research conducted for this thesis focused on Discovery and Chatham Islands off South Vancouver Island, British Columbia, Canada. The Lekwungen name of *Tl'ches* means "one island," which may refer to a time when the sea level was lower and people could cross between the islands on a low tide (Suttles 1974). *Tl'ches* has a longstanding importance in the history of the Lekwungen peoples. Further, *Tl'ches* has been mentioned as a possible location for the traditional reefnet fishery (Turner and Berkes 2006) and salmon camps for the various species of Pacific salmon (*Onchorhynchus* spp.) that migrated back to their birth rivers to spawn, passing *Tl'ches* from early spring until mid-fall. Intertidal eco-cultural uses such as clam enhancement areas and coastal root garden remains have also been located around *Tl'ches* (D. L. Mathews, pers. comm. to EB, May 2017). There is further evidence of burial cairns and as a result of this research, possible reefnet anchors have been located. The Songhees Nation have witnessed the damage to parts of their ecocultural landscape and seascape over the past century due to cumulative impacts of transport, trespassing, invasive species and climate change. In addition, the reduction of traditional management of *Tl'ches* has rendered the archipelago more susceptible to these stressors.

Research objective, questions and thesis structure

This research was initiated by the Songhees Nation, who reached out to researchers from the University of Victoria to assist with the process of marine conservation planning for *Tl'ches*. The Songhees Nation have been worried about the health of their traditional territory. As a result of the increased development on traditional Songhees territory and colonial policies from both the federal and provincial government, Songhees members' ability to practice their Aboriginal and Douglas Treaty rights and culture has been severely diminished. The idea of assisting in and developing the *Songhees Nation Marine Use Plan* was conceived between Songhees Nation and the University of Victoria researchers in early 2017 in response to those concerns. Songhees Nation had received funding from Tides Canada for two years for the purposes of creating data for *Tl'ches* that would result in a marine use plan. Tides Canada is a not for profit organization dedicated to fostering a healthy planet and creating a just Canadian society ("Our Story" 2019).

The primary goal of this thesis was to conduct marine conservation planning to support the Songhees Nation's efforts to protect and steward *Tl'ches*. The objectives were:

1) to document the Songhees marine conservation planning process, and compare it to systematic conservation planning to outline the similarities, differences, and highlight the uniqueness of an Indigenous-led planning approach; and
2) to systematically document and integrate culturally significant species and their habitats into the Songhees stewardship vision for the marine use plan

This thesis has been written in individual chapter/manuscripts meant for publication. Hence some sections might be repetitive.

Outline of my thesis

My first chapter outlines the themes and topics that occurred during the past two years whilst conducting this research. It introduces the Songhees Nation and the location of my research, *Tl'ches.* I outline my research objectives, describe my methodological approach and my position in this research.

My second chapter explores and compares the Indigenous led approach to marine planning by the Songhees Nation to systematic conservation planning initiatives, and thereby addresses objective 1. First, I outline the steps to marine planning undertaken by the Songhees Nation. I then discuss and compare the unique approach that Songhees Nation took in comparison to other indigenous led and systematic conservation planning approaches.

My third chapter addresses objective 2 by describing the application of a small remotely operated vehicle (ROV) to survey the benthos around *Tl'ches* and systematically document the culturally important species, which were identified through a literature review and interviews with Songhees Nation members. This enabled us to establish a baseline of culturally important species, the benthic composition and algal communities around *Tl'ches.*

My last chapter summarizes my findings, as well as shows how I achieved the objectives for this research. It also highlights the limitations of my research and gives suggestions for other nations undertaking marine conservation planning as well as directions for future research.

Methodological approach

My research aimed to support the Songhees Nation in their efforts to enhance stewardship and management over the archipelago *Tl'ches.* To lay out the foundation of our working relationship and to clarify responsibilities in data creation, gathering, sharing and management, a research agreement was created between the Songhees Nation and the University of Victoria researchers (as recommended by Adams et al. 2014). We aimed to gather qualitative data that underscores the ecocultural importance of *Tl'ches* to Songhees

Nation whilst allowing the Songhees to document an ecological baseline through a quantitative approach.

Overall my thesis involved combining a social science approach - gathering traditional ecological knowledge through interviews (Huntington 2000) - and a natural science approach - the collection of ecological data by using a small remotely operated vehicle - and applying it to Indigenous-led systematic marine conservation planning in an ecocultural seascape. This methodological approach allowed me to approach my thesis and this collaboration in a social-ecological systems fashion, recognizing the importance of collecting data from the intricately linked natural and social subsystem that represents the Songhees people and their territory.

Positionality

This research was an incredibly humbling opportunity to examine the privileges that I have been privy to, growing up in Europe and moving to North America as a settler. I am a non-indigenous researcher conducting research in the Lekwungen territories, which have never been ceded. This position required me to be aware and grow my understanding of decolonizing methodologies (Smith 2012) throughout the whole research process. It also carries responsibilities to continue educating myself and share with others the awareness of my privilege as a settler as well as supporting decolonization through whatever means possible. I am aware of the suffering and atrocities perpetuated throughout the history of colonization of what is now known as Canada. My position as a “cultural outsider” means that I am a continuous learner who might never be able to grasp the extent of the relationship between First Peoples and their lands, their culture and their traditional ecological knowledge. I am incredibly grateful and humbled that I was able to participate in this research and am forever grateful to the generosity, patience and wisdom that Songhees Nation, particularly Sellemah (Joan Morris), Cheryl and Kathleen Bryce and Darlene Joseph, have shown me. The work and relationships do not stop with the submission of this thesis. We have a long way to go to achieve meaningful reconciliation.

Chapter 2 – Indigenous and conventional marine conservation planning

Introduction

The biodiversity crisis (Ceballos et al. 2015; Worm and Tittensor 2011) is paralleled by a decline in Indigenous cultures and languages (Maffi 2005; Rapport and Maffi 2010, 2011) These declines are linked, as the biodiversity crisis reduces the ability of Indigenous peoples to sustain and practice their traditional livelihoods, languages and cultures (Cornell 2006; Corntassel and Bryce 2012; Maru, Fletcher, and Chewings 2012; Ommer 2007; von der Porten, Corntassel, and Mucina 2019). For instance, in Canada and New Zealand, overfishing and aquaculture development have made it more difficult to sustain Indigenous peoples' fisheries (Frid, McGreer, and Stevenson 2016; McGreer and Frid 2017; Turner et al. 2013). The cumulative effects of ongoing environmental damage (Castello and Macedo 2016; Teichert et al. 2016), as well as the ongoing effects of colonization and continued dispossession of land and sea (Hill 2011; Nursey-Bray, Wallis, and Rist 2009; The Truth and Reconciliation Commission of Canada 2015; Turner et al. 2013), further compromise the long-term relationships of Indigenous peoples to their territories. These combined effects are in some cases leading to loss of culture and lifestyle, language, identity, health, self-determination, traditional ecological knowledge, sense of place and belonging as well as indirect economic losses (Berkes 2012; Turner et al. 2013, 2008).

The world's oceans are faced with many threats that affect both ecosystems and coastal communities, including climate change, sea level rise, ocean acidification, overfishing and increased shipping traffic (Ban, Alidina, and Ardron 2010; Cheng et al. 2019; Kroeker et al. 2013; Myers et al. 2007; Myers and Worm 2003; Ommer 2007;

Seebens, Gastner, and Blasius 2013). These threats and the cumulative effects of the interactions between them require integrative and innovative solutions as well as research to understand them. Systematic conservation planning (SCP) represents a possible way to reach solutions towards reducing these threats and ultimately aims for the establishment of conservation areas (Margules and Pressey 2000). SCP initially was informed by the natural sciences (Margules and Pressey 2000) but more recently the importance of including the social and political dimensions have been highlighted (Ban, Bodtker, et al. 2013; Ban et al. 2019; Bennett et al. 2019; Pressey and Bottrill 2009). Two common goals typically underlay SCP: representation and persistence of biodiversity (Pressey and Bottrill 2009; Margules and Pressey 2000). Eleven steps have been identified for standard SCP, with many steps occurring simultaneously and providing feedback to each other at various points in time (see Table 1; Pressey and Bottrill 2009). The SCP framework from Pressey & Bottrill (2009) provides useful steps to compare and contrast other conservation planning processes such as this research. Marine systematic conservation planning (hereafter: marine conservation planning) aims to establish protection measures, such as marine protected areas (MPAs), fisheries management or restoration (Ban, Picard, and Vincent 2009, 2008; Halpern, Lester, and McLeod 2010; Lester and Halpern 2008; Pasnin, Attwood, and Klaus 2016). In the context of SCP, marine conservation planning is particularly relevant because many countries have committed to protecting 10% of their marine areas as part of the Convention on Biological Diversity's Aichi target 11 (Convention on Biological Diversity 2010).

1. Scoping and costing the planning process
2. Identifying and involving stakeholders
3. Describing the context for conservation areas
4. Identifying conservation goals
5. Collecting data on socio-economic variables and threats
6. Collecting data on biodiversity and other natural features
7. Setting conservation objectives
8. Reviewing current achievement of objectives
9. Selecting additional conservation areas
10. Applying conservation actions to selected areas
11. Maintaining and monitoring conservation areas

Table 1. Systematic conservation planning steps by Pressey and Bottrill (2009).

Given the coupled effect of declines in biodiversity and the ability of Indigenous cultures to practice traditional livelihoods, culture and language (Gorenflo et al. 2012; Maffi 2005), marine conservation planning efforts could potentially align with Indigenous resurgence efforts to maintain and grow ecocultural health (Ban and Frid 2018; Diggon et al. 2019; Tran, Ban, and Bhattacharyya, n.d.). Likewise, Indigenous stewardship over land and seascapes could improve outcomes for biodiversity (Blackman et al. 2017; Frid, McGreer, and Stevenson 2016; Schuster et al. 2019; Tran, Ban, and Bhattacharyya, in press). *Ecocultural health* can be defined as the "dynamic interaction of nature & culture that allows for co-evolution of both without compromising either critical ecosystem processes or vitality of cultures" (Rapport and Maffi 2011, 1044). Indigenous stewardship strategies are highly complex, place- and context-specific, and adaptive to allow for quick responses to fluctuations in natural systems (Artelle et al. 2018; Berkes 2012; Stephenson et al. 2014; Turner and Berkes 2006; Lepofsky and Caldwell 2013). However, sometimes conservation measures have been established in areas stewarded and occupied by Indigenous peoples with little or no consultation by non-Indigenous planners, such as during the creation of the Yellowstone National Park (Dowie 2011; Stevens 1997). Some of these measures exclude Indigenous peoples from traditional fishing grounds or from their traditional lands (Stevens 1997; Turner et al. 2013). This directly violates the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which affirms individual and collective Indigenous peoples' rights in article 43 by setting "minimum standards for the survival, dignity and well-being of the Indigenous peoples of the world" (United Nations 2007).

One strategy of Indigenous resurgence (see below) is to declare Indigenous-led protected or conserved areas (IPCAs) and assert stewardship and title over traditional territories (Carroll 2014; Hill 2011; Nursey-Bray and Rist 2009; Tran, Ban, and Bhattacharyya, n.d.). IPCAs and Indigenous managed land- and seascapes can safeguard ecocultural health by revitalizing traditional management practices, monitoring and protecting overharvested species (Berkes 2012, 2015; Moller et al. 2009; Preuss and Dixon 2012; Stephenson et al. 2014). Examples include the tribal park *Wanachis-hilth-hoo-is* on Vancouver Island, BC, Canada, governed and managed exclusively by the Tla-o-qui-aht First Nation (Murray and Burrows 2017; Murray and King 2012). The Indigenous Protected Area *Edéhzhíe,* created by the Dene people in Northern Canada, is co-managed by equal numbers of representatives of Environment and Climate Change

Canada and the Dehcho First Nations (Environment and Natural Resources Northwestern Territories 2019). A recent study found that Indigenous-managed lands had a slightly higher species richness of vertebrates compared to protected areas in Canada, Australia and Brazil (Schuster et al. 2019). Indigenous titled lands have shown the clearing of forests to be reduced by 75% and decreased forest disturbance by 66% over the span of two years in Peru (Blackman et al. 2017). In Australia, Indigenous Protected Areas can be declared by Indigenous peoples on aboriginal-owned lands, which initiates a voluntary agreement for the management and conservation of their lands in cooperation with the Australian government (Ens et al. 2016; Godden and Cowell 2016; Hill 2011; Preuss and Dixon 2012). Currently, Indigenous Protected Areas account for almost 50% of the Australian National Reserve System (Ens et al. 2016). In New Zealand, the Maori have attained legal rights to co-manage conservation areas (Stephenson et al. 2014). In Namibia, conservancies have been created to devolve rights for wildlife management to local communities (Hoole and Berkes 2010). However, most IPCAs that have been documented are from terrestrial areas; the academic literature lacks documentation of Indigenous-led processes for marine conservation planning (Ban et al. 2018; Ban and Frid 2018; Godden and Cowell 2016).

Over the course of Canada's history, successive governments instituted policies designed to erode Indigenous cultures and traditions and assimilate Indigenous peoples into settler culture. Some of the most well-known examples include the implementation of the *Indian Act,* the banning of the potlatch and reef net fishing traditions, the creation of the reserve system, the Indian Residential School system, the Sixties Scoop, and many others (Sinclair 2007; The Truth and Reconciliation Commission of Canada 2015). The legacies of these policies, including intergenerational trauma, continued to affect Indigenous communities across Canada. Over the last centuries, colonial policies, and the degradation of ecosystems, have impeded Indigenous stewardship in land- and seascapes (Berkes 2012; Turner et al. 2013). Indigenous resurgence, the practice of "reconnecting with homelands, cultural practices, and communities" aims to reverse the effects of colonial politics by "reclaiming, restoring, and regenerating homeland relationships" (Corntassel and Bryce 2012, 153). Indigenous peoples are rights holders, "actors socially endowed with legal or customary rights with respect to land, water and natural resources" (Borrini-Feyerabend and Hill 2015, 180), yet these rights are often disregarded by federal governments (Carroll 2014; Nepal 2002; Turner et al. 2008). This continued disregard and the ongoing environmental damage to parts of their traditional territory inspired an Indigenous people from Victoria BC, Canada—the Songhees Nation—to conduct marine conservation planning to assert sovereignty and further stewardship over an ecoculturally important seascape.

The objective of this research was to design, assist and document the process of marine conservation planning around *Tl'ches* (the Chatham & Discovery Island archipelago, BC, Canada; Figure 1) to support the Songhees Nation in their stewardship efforts. This research was a collaborative effort and was initiated by the Songhees Nation, who reached out to researchers from the University of Victoria to assist with this marine conservation planning process. Our research aims to 1) provide a detailed account of an Indigenous-led marine conservation planning approach, and 2) compare it to systematic conservation planning approaches to yield new insights into the similarities, differences and uniqueness of an Indigenous-led approach.

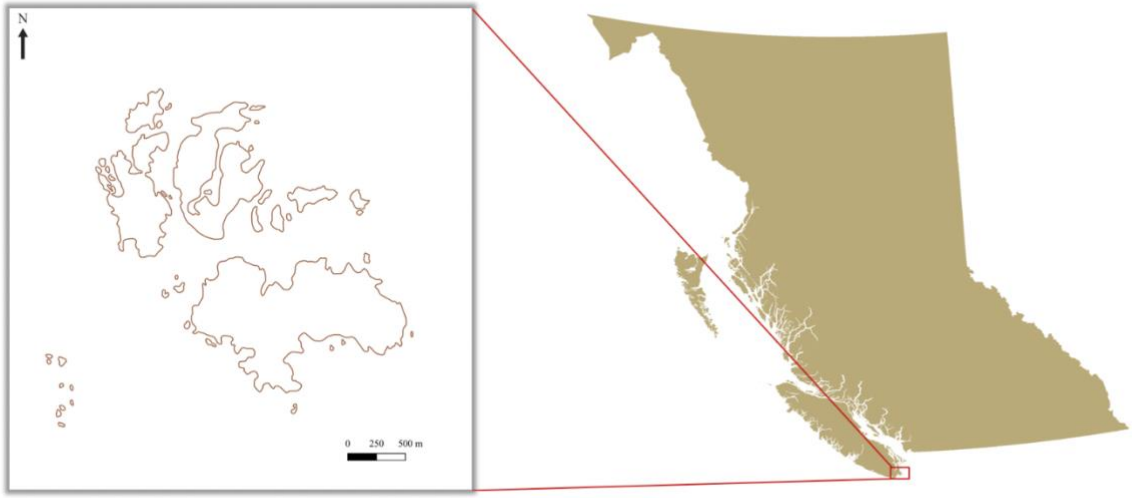

Figure 1. Outline and scale of the *Tl'ches* archipelago and location of *Tl'ches* on the British Columbia coast.

Case study – *Tl'ches*

The study area for the Songhees marine conservation planning effort was focused on the Discovery and Chatham Island archipelago off South Vancouver Island. The islands are known as *Tl'ches* ("one island") in *Lekwungen*, the Songhees dialect of Straits Salish, a linguistic subdivision of the Coast Salish language (Suttles 1974). The islands have longstanding importance for the Songhees people. It is considered a cultural keystone place for the Songhees peoples (Cuerrier et al. 2015). Archaeological evidence of occupation of *Tl'ches* likely dates back millennia, however no systematic archeological research has been conducted to date (D. L. Mathews, pers. comm. to EB, October 2019). In more recent history *Tl'ches* served as a refuge for several families during the smallpox epidemic in the late 1800s (Suttles 1974). Songhees people lived on *Tl'ches* until the 1950s, when the last inhabitants of the islands moved away because the only freshwater source dried up (C. Bryce, pers. comm. to EB, May 2017). *Tl'ches* features in an important creation story of the Songhees peoples as "*The Origin of Salmon*" (Jenness

2016). It has been mentioned as a location for the traditional reefnet fishery (Turner and Berkes 2006) and as a location for salmon harvesting camps for the various species of Pacific salmon (*Onchorhynchus* spp.) that pass *Tl'ches* on their migration route to spawning streams (C. Bryce, pers. comm. to EB, June 2017).

The Songhees people are governed by an elected chief and council. The current governing structure as required by the federal Indian Act sees one Chief and five Council members elected on a four-year term basis. They are the decision makers on projects that Songhees takes on, such as the provision of healthcare to the nation's members, permission as well as budgeting for projects, education and childcare (C. Bryce, pers. comm. to EB, June 2017). Chief and council in the context of this project were the final decision makers on the contents, outcome and implementation of the *Songhees Marine Use Plan*.

The jurisdiction over the sea- and landscape *Tl'ches* is complicated. On land, parts of *Tl'ches* are federally designated Songhees Nation Indian Reserve and the Southern portion of Discovery Island is designated as the Discovery Island Marine Provincial Park. One small parcel on Discovery Island is privately owned. The archipelago sits near a highly populated area on Southern Vancouver Island in BC, Canada. Cumulative impact assessment has shown the area as highly impacted (Ban, Alidina, and Ardron 2010). The shorezone and sea bottom is under provincial jurisdiction, and the water column (and hence all fisheries) is under federal jurisdiction. However, the Songhees affirm their stewardship rights over land and sea. There is also a Rockfish Conservation Area (federal designation) around the perimeter of the archipelago, and *Tl'ches* lies within the federally designated critical habitat for the Southern resident population of Orca whales (*Orcinus orca*).

Current non-Indigenous uses of the *Tl'ches* archipelago and surrounding waters include commercial fisheries, recreational activities such as fishing and kayaking around the islands, and hiking by visitors in the BC Marine Park on South Discovery Island. Songhees uses include but are not limited to traditional harvesting of marine resources around the islands, Camas bulbs (*Camassia quamash* & *Camassia leichtlinii*) and medicinal plants, working with academic researchers, and educational trips for the Songhees Academic Youth League and community members. Historically, a log boom used to be tied to a beach between the Chatham Islands. A set of rails to move heavy equipment onto Discovery Island was also left abandoned in the intertidal zone. In addition, other users scraped paint off their sailboats near Discovery Island in proximity of the now abandoned boat house (I. Cesarec, pers. comm. to EB, March 2018). Fires set by recreational users are a constant threat. Whilst *Tl'ches* represents an important Indigenous spiritual and cultural area, Songhees Nation have not been able to practice some aspects of their culture due to the degradation of the ecocultural seascape and the lasting effects of colonialism impeding the accessibility of *Tl'ches* to community members.

Tl'ches is an ecologically and culturally rich archipelago. It is located in the Coastal Douglas fir biogeoclimatic zone of British Columbia. *Tl'ches* is populated by Douglas-fir (*Pseudotsuga menziesii),* arbutus (*Arbutus menziesii*) and the occasional Western yew tree (*Taxus brevifolia*). There are 129 observed species of birds (Ebird, n.d.). There is evidence of the occupancy of river otters (*Lontra canadensis*) and a gray wolf (*Canis lupus*). The intertidal environment ranges from high exposure rocky channels and platforms, to sand and gravel beaches, to intertidal mudflats (Howes, Harper, and Owens 1994). There are exposed as well as sheltered beaches, and exposed and submerged rocks scattered between the islands provide dangers to unskilled boaters. *Tl'ches* contains a number of culturally significant sites for the Songhees people and their legacies of use are reflected in the landscape. Individual trees bear witness (in the form of char and fire scars) to controlled burning practices by Indigenous Coast Salish peoples including the Songhees peoples until the last century. There is further evidence of culturally modified trees (D. L. Mathews, pers. comm. to EB, May 2017). Portions of the islands are partially ringed by shell middens, bearing further evidence of long-term occupation of *Tl'ches* (D. L. Mathews, pers. comm. to EB, June 2017). Culturally significant sites also extend to the intertidal and include coastal root gardens and clam beds created and/or enhanced by previous Songhees occupants of *Tl'ches* (D. L. Mathews, pers. comm. to EB, June 2017). Root gardens were used to cultivate traditionally important foods such as Pacific silverweed (*Potentilla anserina*) and springbank clover (*Trifolium wormskioldii*) (Deur 2005).

Other marine species of importance include kelp forests, which surround parts of *Tl'ches*, and eelgrass (*Zostera marina*) found mostly between the islands of the archipelago. The most conspicuous culturally important species is the Pacific harbor seal (*Phoca vitulina*), which basks on rocks all around *Tl'ches* and was hunted by the Songhees people for meat (Sellemah (Joan Morris), pers. comm. to EB, July 2017). Previous dive surveys in the waters off *Tl'ches* have noted the occurrence of 39 marine vertebrate and 42 invertebrate species (Reef Environmental Education Foundation 2017c, 2017a, 2017b). Whilst there is some data on the presence of marine species, there has been no comprehensive, systematic mapping of the seafloor, and no ecological baseline inventory of Songhees culturally important species has been conducted to date.

Methods & Results - Description of the Songhees marine conservation planning process

The Songhees vision for Tl'ches is to maintain our close community ties by protecting, and preserving the land, water and resources at Tl'ches for future generations to enjoy its natural beauty, experience its original state, and recall and participate in its storied past.
(Songhees Nation 2019)

Overview

The Songhees people have been stewarding *Tl'ches* for millennia, but increasing outside use is resulting in damage to the seascape. The degradation of this culturally important place motivated them to comprehensively assert their authority over the seascape, with the goal of long-term enhancement of the ecocultural health of the area. The Songhees Nation invited a partnership with University of Victoria (UVic) to build personnel capacity, such as to provide training and educational opportunities to the Songhees members of the marine planning team. The collaboration and planning conception between the Songhees Nation and UVic for the marine conservation planning of *Tl'ches* commenced in early 2017. This research presents an opportunity to showcase an Indigenous-led approach to marine conservation planning. It also provides a guide to other Indigenous communities interested in conducting their own marine conservation planning.

Our focus is on describing the Songhees marine conservation planning approach. Due to confidentiality of the *Songhees Nation Marine Use Plan*, which is currently being implemented, the specific contents of the plan will not be described. The headings that follow describe the seven marine conservation planning steps as they have been undertaken by the Songhees Nation (see Figure 2): *Scoping the Songhees marine conservation planning process; Reviewing existing data and materials; Songhees community engagement; Traditional knowledge and ecological data collection; Data analysis and synthesis for the Songhees Nation Marine Use Plan; Marine conservation planning process outcome – drafting the Songhees Nation Marine Use Plan and implementation*. Hereafter tasks undertaken by Songhees members only are referred to as having been completed by the Songhees planning team. Collaborative tasks which included Songhees members as well as UVic researchers will be referred to as having been completed by the marine planning team. Tasks completed by UVic researchers only will be referred to as having been completed by the researchers.

Figure 2. The Songhees Nation's marine conservation planning process steps. Note: There are feedbacks between the different steps e.g. The Songhees community engagement and Traditional ecological knowledge and ecological data collection part informed each other at various points in time.

1. **Scoping of the Songhees Nation marine conservation planning process**

This first planning step — scoping — served to determine the bounds of the process, and how it would be carried out. The overall initial goal for creating the *Songhees Nation Marine Use Plan* was to establish stronger governance and stewardship over the seascape *Tl'ches,* and the marine conservation planning process focused on creating a general strategy towards achieving this goal. The Songhees Nation Lands Manager (and coauthor of this paper), Cheryl Bryce, conceived the idea for creating a marine plan in order to protect the islands from continued degradation and misuse, and, with others obtained funding (Feb. 2017) to create the *Songhees Nation Marine Use Plan*. Important scoping decisions included focusing this process on input from Songhees people (thereby excluding settler stakeholders) so that it would reflect their vision; delineating the initial outer boundary of the area to be planned; and focusing only on the marine area because it is managed separately from land by federal jurisdiction, whereas the Songhees consider the land and sea as a continuum. Other aspects of the scoping step included developing a research agreement to lay out shared responsibilities of the collaboration between Songhees and the University of Victoria; budgeting; hiring additional Songhees staff for the marine conservation planning process; and outlining the steps and timeline for the process. Once the initial scoping and timeline was developed, the Songhees Nation chief and council approved the project to proceed.

2. Reviewing existing data and materials

This step involved compiling existing biological, environmental, cultural and historical data to inform the Songhees Nation marine conservation planning process. Data were compiled by the marine planning team through digital searches and additional data recommended after interviews with experienced users of the local marine environment, other researchers and/or Songhees Nation knowledge holders (see #4; *Traditional knowledge and ecological data collection*). The data we reviewed are described in Table 2. Reviewing existing data and materials also determined a system to organize the data that would be generated throughout the marine conservation planning process and source data as well as how to design and maximize community engagement (see #3; *Songhees community engagement*).

Another source of data was existing Songhees Nation traditional use and occupancy data for *Tl'ches* and other important places, which was stored in the Songhees Nation Wellness Centre, the head office for Songhees Nation. For example, one of these use studies was conducted between 1998 and 2003 for the Te'mexw Treaty Association (TTA), of which the Songhees Nation is a member. The TTA is an organization of five First Nations negotiating a modern treaty with BC and Canada through the BC Treaty Process. Elders from five First Nations, including the Songhees, participated in the study to locate harvesting locations and relay other harvesting related knowledge for the marine realm surrounding Victoria, BC. The TTA asked interview participants about consistency and abundance in the past and present of harvest species, the gear used, the years they harvested, and other relevant data. The interviewers videotaped the interview and asked the elders to locate and draw known harvesting locations on maps. The interview data was processed, entered into a database and maps were digitized by the TTA interviewers. These data were also helpful in informing the *Songhees Nation Marine Use Plan* (see Table 2).

Data sources (type)	Relevance	Benefits	Drawbacks
EBird surveys (Species occurrence data)	High.	Terrestrial birds and seabirds listed including species hunted traditionally.	Not systematically surveyed (good for presence; not absence).
Shorezone (GIS data)	High.	High resolution data on habitat zones, documented species; commercial fisheries (urchin), exposure, tides, low water mark, substrates.	Information on biobands does not appear to be complete. Some GIS layers appear non-continuous.

Songhees Nation existing interview data (transcripts and GIS data)	High.	These data included traditional use and occupancy studies; previous interviews with traditional knowledge holders of activities, songs and harvesting locations around *Tl'ches*.	Interview information was useful; GIS information on marine environment was rather coarse however provided locations for fishing activities of culturally important species.
CHS charts (Bathymetry)	Moderate.	Resolution of surrounding bathymetry good. Some information on kelp forests.	No geological features of seascape around *Tl'ches*.
Existing academic literature	Moderate.	Good for background information on *Tl'ches*.	Few sources that provide information to be utilized directly in the *Songhees Nation Marine Use Plan*.
REEF (Citizen Science; species occurrence data)	Moderate.	Recent marine vertebrate and invertebrate species occurrence data for the Southern side of Discovery Island BC Marine Park.	Good for presence, not absence.
BCMCA (utilized GIS data for this research)	Low.	Better applied for larger scale conservation planning or if/when networks of protected areas are created.	Resolution too low; not informative enough to inform marine use planning for *Tl'ches*.
Capital Regional District Atlas (orthographic)	Low.	Informative for the terrestrial environment.	Low applicability for marine use planning for *Tl'ches*.
Department of Fisheries & Oceans Canada Invasive Species (*C. maenas* assessment)	Low.	Songhees can do their own assessment since this species is noted as being present in the general fisheries management area 19.	No data pertaining to *Tl'ches;* however, it was noted that *C. maenas* (Green crab) was noted as present in general fisheries management area 19.
Fisheries and Oceans Canada - (Commercial fisheries data)	Low.	Lists commercial fisheries activities as well as estimated total catch of several culturally important species (e.g. urchin and halibut).	Spatial resolution of the data too coarse given the size of the planning region.
LIDAR (lidar data)	Low.	Informative for the terrestrial environment.	Low applicability for marine use planning for *Tl'ches*.
Registered interests (GIS data)	Low.	Informs on terrestrial activities and registered interests; indirectly relates to potential pressures on local aquatic ecosystem.	No direct information on potential pressures.
SARA data for *Tl'ches*	Low.	Focused on the terrestrial side of *Tl'ches*.	No data on marine species at risk.

Table 2. Data sources consulted, their description and usefulness for the Songhees Marine Use Plan. (Acronyms: BCMCA = British Columbia Marine Conservation Analysis; CHS = Canadian Hydrographic Service; LIDAR = Laser Imaging, Detection And Ranging; REEF = Reef Environmental Education Foundation; SARA = Species at Risk Act)

3. Songhees community engagement

Community engagement was essential to develop the vision and goals for the marine plan. The Songhees Nation planners wanted to include the community's vision for *Tl'ches* by conducting and utilizing interviews to guide the marine conservation planning process and help set conservation objectives. This was considered highly important to maximize transparency and to obtain community approval for the Songhees marine plan. The Songhees Nation put an emphasis on this involvement since the nation considers the marine conservation planning in their territory an act of Indigenous resurgence to project sovereignty and regain exclusive stewardship over *Tl'ches* (C. Bryce, pers. comm. to EB, June 2017).

Community engagement was planned to include an open house, numerous meetings with the Songhees Nation chief and council, and at least one community meeting to schedule interviews with Songhees Nation members to compile traditional ecological knowledge related to *Tl'ches* (see *Traditional knowledge and ecological data collection*). These conversations also included finalizing the extent of geographic boundaries for the Songhees Nation marine conservation planning. The Songhees planning team took advantage of scheduled community meetings to avoid "*meeting fatigue"* (C. Bryce, pers. comm. to EB, August 2017) in the Songhees community. The team also included a community notice about the marine conservation planning process in the Songhees Nation newsletter. In addition, the Songhees planning team produced flyers that were distributed amongst the Songhees community members. During the distribution of flyers, some (n=3) community members were interviewed about knowledge related to *Tl'ches*. The Songhees planning team also presented subtidal survey results as well the preliminary planning results to the Songhees Nation community in October 2018.

4. Traditional knowledge and ecological data collection

This step was to compile ecological and traditional knowledge data to help inform the marine plan on baseline abundances of culturally important species and the type of general benthos, and provided an opportunity to build capacity amongst the Songhees planning team. Prior to commencing data collection, we ensured that permits were in place to conduct ecological research (DFO, BC Parks), and Human Research Ethics approval granted for conducting interviews (UVic ethics # 17-445). Capacity building – "the sum of efforts needed to nurture, enhance and utilize the skills and capabilities of people and institutions at all levels toward a particular goal" (Berkes 2015, 17) – was an important part of data collection. Capacity building for the Songhees planning team included being familiar with GIS software (training was organized by researchers via the UVic Geography department), conducting and coding semi-structured interviews, and assisting with ecological fieldwork.

The first part of fieldwork included interviews (n=35) with Songhees Nation members who hold extensive knowledge of the marine environment. We developed three interview themes: 1) culturally important species, their habitats and their use to Songhees people, 2) important places and/or how they relate to ecocultural identity of Songhees and 3) the interviewees' vision for the ongoing management and future of *Tl'ches*. A stratified snowball sampling approach was used to identify other potential interview candidates. Candidates were contacted by phone or in-person by the Songhees planning team, and all interviews were conducted by Songhees planning team, accompanied by a researcher.

Interviews were transcribed by the Songhees planning team and subsequently analyzed using NVivo *12* (“NVivo” 2018). The planning team conducted local and traditional ecological knowledge interviews (n = 35) in the fall of 2017 and the winter of 2018 to gather knowledge, further community support and gain insight on the type of marine conservation action Songhees Nation members would like to see around *Tl’ches*. The Songhees planning team interviewed 33 Songhees Nation members and two non-Songhees members employed by the nation. As part of this effort, Songhees Nation also decided to utilize *Facebook* to reach out to the community and gather more input on the three themes the planning team identified above, placing a particular emphasis on the community vision for the future of *Tl’ches (see Table 3*).

As part of the marine conservation planning process and to complement the interviews (see fieldwork/data collection), the researchers conducted 45 subtidal surveys with the help of the Songhees planning team to establish a baseline of culturally important species and algal composition as well as survey the benthos. Initial results from subtidal surveys were presented to the marine planning team by the researchers in August 2018. This fieldwork is described in detail in the third chapter of my thesis “*Applying a low cost, mini remotely operated vehicle (ROV) to assess an ecological baseline of an Indigenous seascape in Canada*”.

5. Data analysis and synthesis for the Songhees Nation Marine Use Plan

This step included the analyses of interviews and ecological information gathered. The Songhees planning team conducted the interview analysis, mentored and facilitated by the researchers by providing training and access to *NVivo*. For the ecological surveys, video processing, classification of benthos and baseline counts of culturally important species were conducted by the researchers (see Chapter 3).

The resulting data generated from both interviews and underwater surveys helped to inform the *Songhees Nation Marine Use Plan* for *Tl'ches.* For example, the ecological surveys highlighted extremely stressed areas for restoration around the old rails or the old log boom. These areas showed little to abnormally stunted seaweed growth. The surveys also revealed the importance of protecting habitats of culturally important species at all depth strata surveyed, highlighting the importance of protecting the whole seascape *Tl'ches (*for more detailed information please see Chapter 3). The Songhees planning team utilized NVivo to summarize themes via the interviews and *Facebook* feedback as they relate to the community's preferred conservation measures, traditional harvesting and local biodiversity of the *Tl'ches* seascape.

Due to the sensitivity of data, we cannot report in detail the results of the interviews. Some general trends emerged. For example, the majority of Songhees Nation community members (n =21; 60%) wanted to see *Tl'ches* protected and retained for Songhees Nation community access and use only. Many participants (n = 20; 57%) expressed the desire to restore and protect native plants and foods as well as revitalize cultural customs and traditions, such as clam digging or harvesting of berries and water fowl. A few participants (n = 4) were interested in developing the islands for either ecotourism or by building a hotel. In general, Songhees Nation community members were overwhelmingly interested in restoring and preserving the health of the ecocultural seascape *Tl'ches* for future generations.

6. Marine conservation planning process outcome – drafting the Songhees Nation Marine Use Plan

The outcome of the marine conservation planning for *Tl'ches* saw the completion of the first version of the *Songhees Nation Marine Use Plan* in January 2019. It is a living document and will be adapted and altered with continued research and monitoring. It is also an internal document and will not be made public. The long-term Songhees vision for *Tl'ches* is stated in the plan as: "The Songhees vision for *Tl'ches* is to maintain our close community ties by protecting, and preserving the land, water and resources at *Tl'ches* for future generations to enjoy its natural beauty, experience its original state, and recall and participate in its storied past (Songhees Nation 2019, 17)."

7. Implementation

The outcomes and goals for the *Songhees Nation Marine Use Plan* are currently in the process of being implemented.

Standard systematic conservation planning steps	**Songhees Nation Planning Steps**	**Why these steps were (not) needed for the Songhees marine conservation planning**	**Similarity or difference between the Songhees approach to SCP**
1. Scoping and costing the planning process	Scoping the Songhees marine conservation planning process	To determine the bounds of the Songhees marine conservation planning process and how it would be carried out.	Similarities: This step stressed 1) the importance of multidisciplinary planning teams that included or connected with key people affected; and 2) well-developed lists of planning tasks for the planners to consider when adapting approaches to particular land- or seascapes. Both these steps were part of the Songhees Nation planning approach.
2. Identifying and involving stakeholders	NA.	Not needed explicitly as the focus of the planning process was to establish the Songhees Nation's vision for the area.	Difference: Songhees marine conservation planning process as a rights holder process.
NA.	Reviewing existing data & materials	Compiling existing biological, environmental, cultural to generate overview of what data existed and could be used to inform the *Songhees Nation Marine Use Plan*.	Similarity: This is also done in SCP (steps 5 and 6) but typically this is not an explicit step.
3. Describing the context for conservation areas	NA.	Not needed explicitly as the Songhees community are rights holders who understood the social, economic and cultural background to the area.	Difference: Songhees marine conservation planning process as a rights holder process.
4. Identifying conservation goals	Songhees community engagement	Feedback from Songhees people helped to solidify goal of protection. The vision came from Songhees people themselves.	Similarity: Focus on focal species. Difference: Conservation goals determined after (as opposed to before as in SCP) qualitative and quantitative data collection without any preconceived notion of what the conservation goal would be.

5. Collecting data on socio-economic variables and threats	Traditional knowledge and ecological data collection	The existing threats (e.g. human uses and ecosystem degradation) inspired the Songhees to want to protect the islands.	Similarity: The identification of existing threats enabled Songhees to conduct planning with priorities for protection in mind to make conservation actions more effective as in SCP. In Songhees' case this would mean the exclusion of non-Indigenous user groups.
6. Collecting data on biodiversity and other natural features	Traditional knowledge and ecological data collection	Data collection of ecological traditional data and to establish comprehensive ecological baseline of culturally important species.	Difference: The data collection involved ecological and social data in one step, accounting for and prioritizing the whole social-ecological system *Tl'ches* instead of separating this collection into two steps as done in SCP (Step 5 & 6 by Pressey & Bottrill).
7. Setting conservation objectives	NA.	NA.	Difference: Quantitative conservation objectives not needed as only one protected area for Indigenous-use only was planned on a small scale, with overall focus on achieving ecocultural goals for the long-term.
8. Reviewing current achievement of objectives	NA.	NA.	Difference: No existing other protected areas or legal backing around *Tl'ches* to review objectives; also, no quantitative objectives to be reviewed.
9. Selecting additional conservation areas	NA.	NA.	Difference: Only one area was selected because of the constraint on placement and small study region.
10. Applying conservation actions to selected areas	Marine conservation planning process outcome – drafting the *Songhees*	Comprehensive Songhees Marine Use Plan to further governance and stewardship over *Tl'ches*.	Difference: Songhees jurisdiction in the seascape surrounding *Tl'ches* is unclear as considered by federal or

	Nation Marine Use Plan		provincial governments, whereas in SCP normally multiple levels of governments are involved. The Songhees marine conservation planning was to assert stewardship over *Tl'ches.*
11. Maintaining and monitoring conservation areas	Implementation of the *Songhees Nation Marine Use Plan*	Monitoring to track ecocultural health of the seascape going forward.	Similarity: Currently not much funding allocated to this stage in both SCP and the *Songhees Nation Marine Use Plan*.

Table 3. Comparison of systematic conservation planning (SCP) steps as identified by Pressey & Bottrill (2009) to the Songhees marine conservation planning process steps. The rationale for why Songhees did (not) undertake some of these steps is given and a direct comparison between SCP and the Songhees process is provided.

Discussion – Songhees approach to conservation planning vs SCP

Increasingly, Indigenous peoples are looking to assert their authority to manage and protect their territories (Diggon et al. 2019; Ens et al. 2016; Environment and Natural Resources Northwestern Territories 2019; Hoole and Berkes 2010; Murray and Burrows 2017; Murray and King 2012; Stephenson et al. 2014; Supreme Court of Canada 2014). We showcased an Indigenous marine conservation planning approach that was undertaken by the Songhees Nation. Our research provides an important contribution by detailing the Songhees marine conservation planning process, as to date there are few such examples in the literature (Ban and Frid 2018). Much of the marine conservation literature, however, emphasizes the importance of a systematic approach to planning (Ban et al. 2009; Knight, Cowling, and Campbell 2006; Magris et al. 2014; Margules and Pressey 2000; Mills et al. 2010; Pressey and Bottrill 2009). We use the discussion to compare and contrast the Songhees approach to SCP.

There are many ways in which the Songhees Nation marine conservation planning process converges with systematic conservation planning process (see Table 3): e.g. focus of the ecological surveys on (cultural) keystone species. However, there are also many ways in which the unique situation of an Indigenous peoples asserting self-determination and increased stewardship in their territory differed from these systematic conservation planning examples. The rest of this discussion is structured according to themes that highlight key differences between systematic conservation planning and an Indigenous-led planning initiatives, showcasing the uniqueness of the Songhees approach to marine conservation planning for the *Tl'ches* ecocultural seascape.

1. Community input and shaping of conservation objectives

The Songhees Nation started with the general purpose to protect the archipelago, to stop trespassing and to remediate the erosion of the ecocultural seascape and allow exclusive use by the Songhees people for future generations (see vision statement). The uniqueness of the Songhees approach to marine conservation planning was that the community themselves initiated this project to further stewardship over *Tl'ches* without the involvement of any other potential stakeholders. Other levels of governments are oftentimes involved as stakeholders or co-planners during marine or other systematic conservation planning processes with local and Indigenous peoples (Step 2; Pressey & Bottrill)(Ban and Frid 2018; Borrini-Feyerabend and Hill 2015; Diggon et al. 2019; Green et al. 2009; Hill 2011; Knight, Cowling, and Campbell 2006; Verschuuren et al. 2015). The Songhees community's early and prolonged involvement and their preferences set the marine conservation goals and priorities for the protection of the seascape *Tl'ches.* This occurred without a prior determination of how marine conservation planning around the archipelago might be designed or what the community's, and chief and council's, vision for *Tl'ches* would be. In many ways, the Songhees decision for community involvement is similar to systematic conservation planners involving stakeholders and communities which would be affected by conservation measures (Green et al. 2009; Henson et al. 2009; Knight, Cowling, and Campbell 2006; Margules and Pressey 2000; Pressey and Bottrill 2009). This consultation during both SCP and the Songhees approach can bring benefits to the planners by helping to elicit information on biodiversity and planning opportunities that do not exist in databases, generating trust as well as facilitate conservation actions and maintain conservation actions into the future (Step 2 in Pressey & Bottrill 2009). Other research has shown that early and prolonged involvement of local communities in SCP leads to more sustainable resource management (Gilliland and Laffoley 2008; Ostrom 2009).

Going forward, a consideration for the Songhees Nation might be to identify and involve stakeholders such as other users of the *Tl'ches* marine environment to educate them on the sensitivity, history and fragility of the ecocultural seascape to further protection. This would create dialogue and hopefully some acceptance amongst excluded users to reduce user-to-user and user-to environment conflict (Douvere 2008). Similar initiatives have taken place in the United States where guided ecotourism by local Indigenous peoples lets excluded users still experience the landscape (Carroll 2014).

2. Purpose of data collection for the Songhees Nation Marine Use Plan

One major difference of the Songhees Nation compared to SCP approaches was that the quantitative and qualitative data collection would be utilized to clarify the vision and goals for the *Songhees Nation Marine Use Plan* rather than a vision and goals preceding and determining the data collection as is typically the case in SCP (Ban, Picard, and Vincent 2009; Henson et al. 2009; Margules and Pressey 2000; Mills et al. 2010; Pressey and Bottrill 2009). In SCP, a vision typically precedes the setting of qualitative goals for biodiversity, ecosystem services and livelihoods to identify the need for spatial data and direct subsequent data collection (Step 4 in Pressey and Bottrill, 2009). Following our existing data review, we determined a lack of comprehensive high-resolution data of the marine environment surrounding *Tl'ches,* highlighting the need to gather this information to create an ecological baseline to inform the marine use plan. Some of the existing data provided us with an ability to stratify the ecological surveys by physical shore type to distribute the subtidal survey effort uniformly. The existing data and interviews also highlighted other culturally important features to watch for, such as reefnet anchors.

A major similarity of the Songhees Nation approach to SCP is that the ecological surveys that informed the *Songhees Nation Marine Use Plan* focused on culturally important species as well as benthic data and SCP typically focuses on biodiversity data that range from focal species, representation units (e.g. marine habitat types), special elements (e.g. spawning aggregations) to ecological processes (Didier et al. 2009; Green et al. 2009; Margules and Pressey 2000; Pressey and Bottrill 2009). However, the scale for the data gathering effort was very different. Marine conservation planning focuses on establishing biological connectivity and enhancing the resiliency of a given system through a network of protected areas at a regional scale (Ban, Picard, and Vincent 2008; Green et al. 2009; Magris et al. 2014; Mills et al. 2010). This requires preferably high-resolution data over a wide area, which is oftentimes scarce. High resolution data is mostly produced during the planning process after the need for it has been identified to improve planning decisions (Ban 2009; Ban et al. 2009; Green et al. 2009). This is necessary because objectives need to be quantifiable to use decision support tools that help to map out and identify areas that can achieve the conservation objectives (Ban et al. 2009; Mills et al. 2010). The Songhees ecological surveys were informed and directed by gathering traditional and local ecological knowledge data from the community to fill knowledge gaps and using already available data (see Table 3) but on a small spatial scale (see below). In this circumstance, the Songhees' kincentric view and environmental ethics naturally shaped sustainable choices by wanting to protect the whole archipelago. The goal for protecting the whole seascape was further strengthened by the results of the ecological surveys, showing culturally important species present in every surveyed depth stratum. The successful outcome of this marine conservation planning would see all Songhees Nation community members continue to be able to practice aspects of their Indigenous culture and traditions around the seascape *Tl'ches* for generations to come.

This baseline of culturally important species and benthos composition also facilitates the stage for ecological monitoring and adaptive management to occur should Songhees choose to do so. In systematic conservation planning, adaptive management or reviewing the achievement of current objectives is a necessity to ensure successful conservation outcomes (Douvere and Ehler 2011; Pressey and Bottrill 2009). Songhees Nation focuses more on qualitative outcomes such as to restore certain aspects of ecocultural health around *Tl'ches*, i.e. continuing to practice aspects of their culture and harvesting traditions for generations to come. Protecting these types of practices is a common goal for Indigenous peoples when participating in conservation planning and in general (Ban, Picard, and Vincent 2008, 2009; Carroll 2014; Stephenson et al. 2014; Turner et al. 2013; Turner and Berkes 2006; Turner and Clifton 2009; Turner and Turner 2008; Verschuuren et al. 2015).

3. Choosing the conservation area

Another major difference of the Songhees approach was conducting marine conservation planning in a relatively small area, whereas SCP typically uses multiple zones or area networks in which conservation measures are applied to better support connectivity and maintain biodiversity (Step 7 & 9 in Pressey and Bottrill 2009; (Ban et al. 2009; Green et al. 2009; Magris et al. 2014; Mills et al. 2010)). The typical SCP scale signifies common "patterns and processes of biodiversity and human uses" (Pressey and Bottrill 2009, 464). The *Tl'ches* marine conservation planning area, in contrast, was relatively small compared to other conservation planning initiatives. Whilst the Songhees Nation planning team undertook marine conservation planning, it was determined via community consultation that the stewardship goal was to have one protected area only with no allowed resource harvesting uses for non-Songhees members to recover and protect culturally important species. Previous work with Indigenous communities has shown fisheries closures for non-Indigenous users to further recovery of Dungeness crab (Frid et al., 2016), a culturally important species to the Songhees as well. When they are well enforced, spatial closures such as marine protected areas can increase biomass, abundance and diversity of species (Edgar et al. 2014; Lester and Halpern 2008).

Whereas typically placing of conservation measures tries to minimize costs to communities dependent on resources in terms of area or impeding livelihoods (Step 9 in Pressey and Bottrill 2009) whilst selecting areas of high biodiversity priority and value (Ban 2009; Ban et al. 2009; Knight, Cowling, and Campbell 2006), there also was no possibility to consider different areas for conservation measures. The placing is constrained by the location of the archipelago and the ecocultural importance of the whole *Tl'ches* archipelago. The scoping mostly considered the outer boundary of the conservation zone, which could have been larger. Options for conservation measures beyond this are thus fairly limited where 1) only the exclusion of other non-Indigenous users is a possible avenue for recovery of culturally important species and ecocultural conservation as shown by Frid et al. (2016) and/or 2) collaboration with other conservation/user groups/governmental/transboundary initiatives might support this Songhees undertaking further (Gaydos, Thixton, and Donatuto 2015; Gaydos et al. 2008). Smaller protected areas that are locally managed are considered a good precursor to scale up conservation actions across networks such as in Oceania or the Coral Triangle (Green et al. 2009; Mills et al. 2010). *Tl'ches* encompasses many jurisdictions and government, and other stakeholders might make it difficult to gain initial support for this Indigenous marine conservation area.

This also raises the issue of the avenue for implementation. Oftentimes, systematic conservation planning initiatives have recognized laws or policies by the government that can be used to implement the plan (Step 10 in Pressey and Bottrill

2009). In the case of the Songhees Nation marine conservation planning, the creation and implementation of the *Songhees Nation Marine Use Plan* is about asserting and furthering stewardship over parts of the archipelago where the other governments in the area do not (yet) fully recognize it. Thus, having this initial planning initiative and an ongoing monitoring program on the health of the seascape will generate long term data, which in turn can support the Songhees Nation's assertion of stewardship over *Tl'ches*.

4. Capacity building & Indigenous resurgence

Another major difference is that the Songhees Nation's marine conservation planning process focused on the achievement of ecocultural goals to increase Indigenous stewardship over the seascape *Tl'ches* whilst also building personnel and professional capacity amongst the Songhees planning team. Whilst SCP mostly focuses on biodiversity goals, there are examples where developing capacity through leadership training is part of the goals (Henson et al. 2009). However, generally the literature lacks examples of marine conservation planning initiatives that focus on cultural goals (Ban et al. 2019). Capacity building (for definition see introduction) by empowering and employing local community members is of high priority in many Indigenous conservation planning undertakings (Blackman et al. 2017; Carroll 2014; Hoole and Berkes 2010; Parrado-Rosselli 2007; Preuss and Dixon 2012; Caillon et al. 2017). Many SCP initiatives have lacked the continuity of both information flow and personnel, leading to conservation initiatives not achieving their potential outcomes (Pressey and Bottrill 2009). Capacity building and maintaining personnel is also essential to ensure continuance of the Songhees Nation marine conservation initiative around *Tl'ches*. Due to the ongoing effects of colonialism, many First Nations face high barriers to capacity building from limited access to funding to promote education and continual employment (The Truth and Reconciliation Commission of Canada, 2015). The grant received for the marine conservation planning enabled the employment and training of three additional Songhees members for the marine conservation planning process. The researchers as well as the Songhees Nation sought to build additional capacity by organizing and partaking in training opportunities in software used during the marine conservation planning process such as NVivo and QGIS.

The marine conservation planning undertaken around *Tl'ches* is to assert Songhees stewardship and ensure ecocultural health going forward. The initiative of Songhees marine conservation planning around *Tl'ches* is an act of Indigenous resurgence by reclaiming, restoring and regenerating the connection to the *Tl'ches* seascape. Our marine conservation planning process description and considerations of how Indigenous marine conservation planning initiatives may differ from systematic conservation planning provide useful insights to help any First Nation or Indigenous community worldwide to conduct their own marine conservation planning.

Chapter 3 – Applying a low cost, mini remotely operated vehicle (ROV) to assess an ecological baseline of an Indigenous seascape in Canada

Introduction

Marine ecosystems are faced with many threats such as climate change, ocean acidification, overfishing, increased shipping traffic (Ban, Alidina, and Ardron 2010; Cheng et al. 2019; Seebens, Gastner, and Blasius 2013; Kroeker et al. 2013; Myers and Worm 2003; Worm et al. 2006), and therefore resource managers and policy-makers alike need information about the state of a system in order to formulate meaningful management direction and have a baseline against which to assess it (Berkes 2015; Gaydos et al. 2008). Ecological baselines can be established through systematic ecological surveying or through other methods, such as interviews with users of the marine environment (Eckert, Ban, Tallio, et al. 2018; Moller et al. 2004). Baselines of ecological variables are shifting via generational or personal forgetfulness through time (Papworth et al. 2009; Pauly 1995). Despite this, recent marine historical ecology work has shown that baselines can be extended backwards over decades through interviews with knowledge holders and users of the local marine environment (Eckert, Ban, Tallio, et al. 2018), and over centuries and millennia through archaeological means (McKechnie et al. 2014). Ecological baselines are an essential precursor to monitoring programs to be able to judge change in a given ecosystem and subsequently counteract ecological degradation by establishing conservation measures (Magurran et al. 2010).

Marine ecosystems can be assessed through monitoring and mapping benthic habitats to varying scales (Diaz, Solan, and Valente 2004; Van Rein et al. 2009). To assess habitat composition of broadscale marine ecosystems (> 1km), single beam, sidescan or high resolution multibeam sonar are typically used for mapping the physical aspects of the ocean floor at all depths (Diaz, Solan, and Valente 2004; Greene et al. 1999; Lawrence et al. 2015; Pacunski et al. 2008; Rooper and Zimmermann 2007; Tempera et al. 2012). Aerial photography as well as Light Detection and Ranging (LIDAR) are also employed to map physical aspects of the ocean floor. However, such mapping is only possible at shallower depths of up to 40m (Zavalas et al. 2014). In order to supplement physical seascape information with biotic information of the benthos, several techniques can be utilized, such as dredging or trawling to collect samples (Ceia et al. 2013), whilst others have used video taken by remotely operated vehicles (ROVs) to characterize biota (Micallef et al. 2012). To survey smaller areas containing distinct biotic communities and their associated habitats (mesohabitats; 10m – 1000m (Van Rein et al. 2009; Van Rein et al. 2011)), divers typically characterize the benthos and its associated biota along transects or within quadrats by swimming or using diver propulsion vehicles, at times video recording the transect (Brown et al. 2004; Jokiel et al. 2015; Leujak and Ormond 2007). Others have used towed-video or rotating cameras to characterize biological communities (Kenyon et al. 2006; Pelletier et al. 2012). Occasionally, mesoscale surveys include semi-quantitative methods of physical sampling through trawls and dredges (Lathrop et al. 2006). Both broad-scale and mesoscale assessments of biotic benthic communities can also be achieved through video surveying methods with ROVs (Tempera et al., 2012).

Over the past 30 years, rapid technological developments have produced increasingly inexpensive tools for conducting marine surveys, such as low-cost mini ROVs. ROV employment has reduced some of the limitations of SCUBA surveys techniques, such as depth and survey time restrictions. ROVs have the advantage of extending dive time and depth whilst creating a permanent record, and facilitating resampling (Lam et al. 2006; Riegl, Korrubel, and Martin 2001). Marine surveying with an ROV has been done on both a meso- and broad scale (Campos et al. 2009; Cánovas-Molina et al. 2016; Pacunski et al. 2008; Stein et al. 1992), and the initial costs of purchasing and operating ROVs for smaller-scale projects are now feasible (Azis et al. 2012; Pacunski et al. 2008). ROVs are also versatile and fairly easy to operate (Leujak and Ormond 2007; Pacunski et al. 2008). ROVs have now been used in numerous applications, such as characterizing rockfish habitat in California, British Columbia (BC) and Alaska, and surveying biotic communities in Washington and Oregon state (Pacunski et al. 2008; Richards 1986; Stein et al. 1992).

Despite the usefulness of marine habitat assessments, most marine areas have never been surveyed, likely because of the high cost and the intensity of effort and analysis. Furthermore, for those that have been surveyed, many different classification schemes exist that characterize benthos, making comparisons of data or results difficult (Diaz et al. 2004; Van Rein et al. 2011, 2009). One example of a consistent classification schema is the ShoreZone project (www.ShoreZone.org), developed in the 1980s and 1990s. It classifies the intertidal and nearshore habitat for all 37,619 km of shoreline across Oregon, Washington, British Columbia and Alaska. ShoreZone provides biological and geological data of the intertidal and nearshore zones, enabling researchers to compare or complement their own data with the ShoreZone data on various scales. “ShoreZone is a standardized coastal habitat mapping system that follows a certain set of protocols […] for obtaining, analyzing, and distributing coastal habitat information”

(Shorezone 2019b). The overall methodology involves collecting low-tide imagery and completing a shoreline classification with descriptive biophysical attributes. This information is housed in a publicly accessible spatial database and follows the same standard protocols for the nearshore zones from Oregon to Alaska. Shorezone data only extends to the low intertidal, whilst it was used to help guide the surveys this project sought to extend comprehensive physical and ecological data to the subtidal using a mini ROV. Importantly, Shorezone has been used in British Columbia to inform marine spatial planning in waters around Haida Gwaii (Shorezone 2019a).

Marine spatial planning (MSP) is an increasingly common approach used to manage multiple threats and human uses. It is an integrated process allowing for multi-use resource planning through ecosystem-based management (Douvere and Ehler 2011; Ehler and Douvere 2010; Douvere 2008). The intended result is spatial plans, or zones, in the ocean including conservation areas (e.g. marine protected areas, MPAs). Information on the ecological status of marine systems is critical to inform MSP (Bennett and Satterfield 2018; Kittinger et al. 2014; Foley et al. 2010). To assess the ecological health of a system, first one needs to establish a current baseline of the system and its associated biota to then judge ecological change against (Magurran et al. 2010). Continued monitoring of benthos and its associated macrofauna is a common way to gauge the status in coastal ecosystems, which can be a good indicator of ecological health (Magni 2003; Salas et al. 2006). In order to achieve a successful outcome for any monitoring, it is important to formulate clear goals that yield quantifiable data in order to improve the quality of any data that is collected in the future (Legg and Nagy 2006; Field et al. 2007).

ROVs produce easily replicable, high quality data, and recent technological developments and crowdfunding projects have made acquiring and employing ROVs cost-effective. For example, OpenROV (www.openROV.org) is a Kickstarter project that offers a prebuilt ROV, in addition to selling do-it-yourself kits to build your own ROV. The prebuilt Trident ROV made by OpenROV weighs 3.485 kg and is attached to a tether, which lets the pilot livestream the video onto a tablet or controller. The tether is available in lengths of 25m and 100m. Video can be recorded continuously at a resolution of either 720pixels or 1080pixels, and the date and time are automatically recorded. The battery lasts approximately 3.5 hours. Software is continually updated and more advanced features such as flight stabilization or geographic tagging are expected to become available. The acquisition cost for mini ROVs is approximately 0.2 – 12% of the cost of other ROVs currently used for this kind of research. The availability of low-cost ROVs puts the technology within reach of projects with limited resources, but the technology is so new that the ease of operations and quality of the data will be tested and determined through this research.

The Songhees Nation, an Indigenous people whose traditional territory includes what is now known as Victoria, British Columbia, Canada, have been worried about the health of their traditional territory, which has seen significant urban development since European settlements were established in the 19th century. As a result of this development and colonial policies from both the federal and provincial government, Songhees' members' ability to practice their Aboriginal and Douglas Treaty rights and culture has been severely diminished. Songhees has been actively working to protect and preserve the community's way of life and their Aboriginal and Douglas Treaty rights. Inspired by the Marine Plan Partnership's marine spatial plans for BC's North and Central Coast (MaPP; www.mappocean.org)(Diggon et al. 2019) — a collaboration between seventeen First Nations from the Central and North Coast of British Columbia — the Songhees desired to produce their own MSP to support the ecological and cultural health of their traditional territory and to assert and establish exclusive Songhees stewardship.

Songhees members are also keen to see the area protected. For example, Sellemah (Joan Morris), an elder of the Songhees Nation who was raised at Tl'ches, remembers harvesting x̣íxʷə, or purple urchin, along the shoreline fronting their house. No urchin are visible there today, prompting Sellemah to engage the authors to find any remaining x̣íxʷə at *Tl'ches*. In this context, the Songhees Nation specifically wanted to survey the Indigenous seascape that is *Tl'ches*, an island archipelago near Victoria, by documenting a baseline of incidence and occurrence of the culturally important macrofauna necessary to continue practicing aspects of the Lekwungen culture. In addition, other research around *Tl'ches* is being conducted to document other traditional ways of food and subsistence practices such as root gardens (see below) around the archipelago.

To establish a baseline of the Songhees Indigenous seascape, we were interested in applying the new low-cost, mini ROVs for marine surveying of benthos and associated biota. In collaboration with the Songhees Nation, we seek to create this baseline of the Nation's culturally important seascape and species to allow the establishment of an ongoing monitoring system to gauge the seascape's ecological health for future generations. Focusing on culturally important species allowed us to integrate a human dimension into this otherwise scientific undertaking of ecological monitoring (Moller et al. 2009, 2004). The purpose of our research was to (1) to create a present-day ecological baseline of the Songhees Indigenous seascape by documenting the physical substrate, benthic algal communities, and a variety of Songhees culturally important species, (2) test the applicability and capabilities of a low cost mini ROV to gather data to obtain a baseline in a case study seascape and (3) evaluate the ability of ROVs for informing marine use planning by the Songhees Nation in Canada.

Background

This research was initiated by the Songhees Nation Lands Manager, who contacted researchers from the University of Victoria to assist with the process of marine conservation planning for a part of their territory. The study area for the Songhees marine conservation planning effort was focused on Discovery and Chatham Islands off South Vancouver Island in the so-called Salish Sea (Figure 1). The islands are collectively known as *Tl'ches*, or "one island," (Sellemah (J. Morris), pers. comm. to EB, June 2017) in the Lekwungen language, a Straits Salish dialect of the Coast Salish language (Suttles 1974). The islands have longstanding importance for the Lekwungen peoples. Archaeological evidence of occupation of *Tl'ches* dates likely back at least 3500 years but no systematic archaeological research has been conducted to date (D. L. Mathews, pers. comm. to EB, October 2019). In more recent history, *Tl'ches* served as a refuge for several families during the small pox epidemic in the late 1800s (Suttles 1974). Songhees people lived on *Tl'ches* until the 1950s, when the last inhabitants of the islands moved away because the only freshwater source dried up (C. Bryce, pers. comm. to EB, May 2017). *Tl'ches* features in an important creation story of the Lekwungen peoples as "The Origin of Salmon" (Jenness 2016). It has been mentioned as a location for salmon harvesting camps for the various species of Pacific salmon (*Onchorhynchus* spp.) that pass *Tl'ches* on their migration route to spawning streams (C. Bryce, pers. comm. to EB, June 2017).

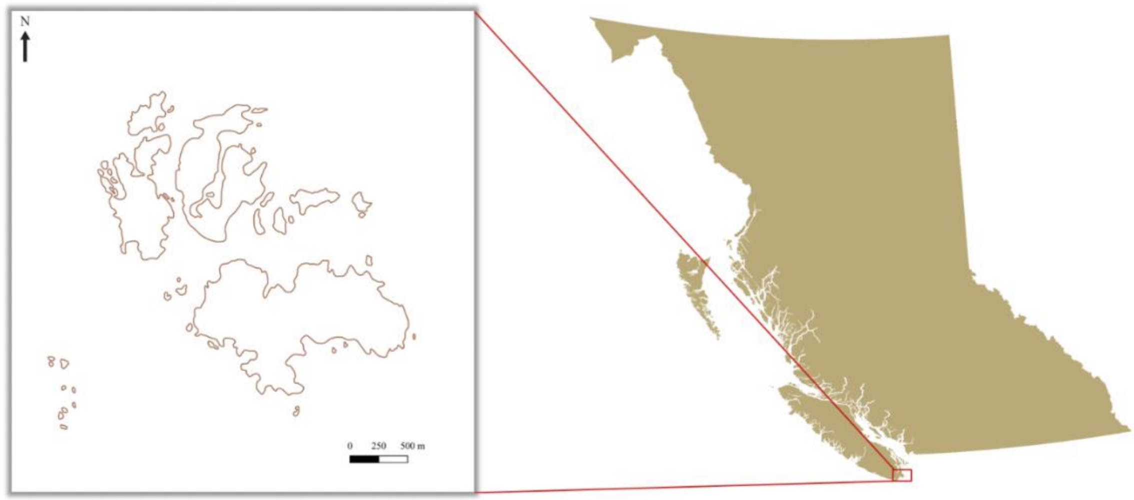

Figure 1. Outline and scale of the *Tl'ches* archipelago and location of *Tl'ches* on the British Columbia coast.

The jurisdiction over the sea- and landscape *Tl'ches* is complicated. The archipelago sits near a highly populated area on Southern Vancouver Island in BC, Canada. Cumulative impact assessment has shown the area as highly impacted (Ban, Alidina, and Ardron 2010). The shorezone and sea bottom is under provincial, and the water column (and hence all fisheries) is under federal jurisdiction. However, the Songhees affirm their stewardship rights over land and sea. There is also a Rockfish Conservation Area (federal designation) around the perimeter of the archipelago, and *Tl'ches* lies within the federally designated critical habitat for the Southern resident population of Orca whales (*Orcinus orca*). On land, most of *Tl'ches* is federally designated Songhees Nation Indian Reserve, and the Southern portion of Discovery Island is designated as the Discovery Island Marine Provincial Park. One small parcel on Discovery Island is privately owned.

Current non-indigenous uses of *Tl'ches* include commercial fisheries, recreational activities such as fishing and kayaking around the islands, and hiking by visitors off the BC Marine Park on South Discovery Island. The Songhees are very concerned about non-members trespassing on *Tl'ches* reserve lands. Songhees uses include but are not limited to traditional harvesting of marine resources around the islands, Camas bulbs (*C. quamash*) on parts of Chatham Islands, as well as for educational trips for the Songhees Academic Youth League around *Tl'ches*. The Songhees Nation has become increasingly concerned with the effects of irresponsible usage of the islands by recreational users, which has been going on for at least four decades. Former Songhees Chief John Albany (radio interview, September 20th 1973) stated: "Chatham Island and the Southern part of Discovery Islands (are) closed to outsiders as some visitors abused the privilege by being careless".

Tl'ches is an ecologically and culturally rich archipelago. In addition, its location affects the islands ecological productivity. For example, the entire tidal volume of the Strait of Georgia drains by *Tl'ches* twice a day. In addition, the wave exposure on the Southeast-facing coast is amongst the highest in the entire Salish Sea with a strong energy gradient from exposed to protected lagoon shores. The seascape environment ranges from high exposure rocky channels and platforms, to sand and gravel beaches, to intertidal mudflats (Shorezone 2019b). There are exposed and submerged rocks scattered between the islands, which provide dangers to boaters unfamiliar with the waters. *Tl'ches* contains a number of culturally significant sites for the Songhees people. These include both large winter villages and summer resources sites, as well as coastal root gardens and clam beds created and/or enhanced by previous Lekwungen occupants of *Tl'ches* (D. L.

Mathews, pers. comm. to EB, June 2017). Coastal root gardens were used to cultivate traditionally important foods such as Pacific silverweed (*P. anserina*) and springbank clover (*T. wormskioldii*) (Deur 2005).

Other marine species of importance include kelp forests, which surround parts of *Tl'ches*, and eelgrass (*Z. marina*) found mostly between the islands of the archipelago. The most conspicuous culturally important species is the Pacific harbor seal (*P. vitulina*), which basks on rocks all around *Tl'ches.* Previous dive surveys in the waters off *Tl'ches* have noted the occurrence of 39 marine vertebrate and 42 invertebrate species (Reef Environmental Education Foundation 2017a, 2017c, 2017b). Whilst there is some data on the presence of marine species, there has been no comprehensive, systematic mapping of the seafloor, and no ecological baseline inventory of Songhees culturally important species has been conducted to date.

Methods

To meet our objectives, our research followed several steps: first, working with Songhees members, we identified culturally important species for the Songhees Nation to be tracked during underwater surveys. Second, we conducted trial transects to train the research team in operating the ROV, and to test the anticipated methods. Third, we conducted underwater surveys to capture video footage of the seafloor and associated biota. Finally, we analyzed the footage to characterize the benthos, and identify and count the culturally important species. We selected the Trident ROV by OpenROV – which we received as beta-testers – as the best current technology and value for money.

We identified the culturally important species through two sources: by reviewing the ethnographic literature concerning Lekwungen marine ethnoecology, and through interviews with Songhees community members (UVic ethics # 17-445). We used the dissertation of an ethnologist (Suttles 1974) to develop the initial list of known harvested marine invertebrate and vertebrate species by the Songhees Nation peoples. The materials we reviewed do not constitute a complete review of the literature on the Lekwungen peoples. For instance, archeological work of additional culturally important species to the Lekwungen peoples has been compiled (D. L Mathews, pers. comm. to EB, Feb 2019). We (led by Songhees team members and co-authors Kathleen Bryce and Darlene Joseph) then conducted semi-structured interviews (Huntington 2000) with Songhees members about the importance of *Tl'ches*, and added additional species mentioned in interviews with Songhees members to those that emerged from the literature review.

For the underwater transect aspect of the project, we used the random points tool in ArcMap 10.6. (ESRI 2011) to generate stratified random starting points. We selected ROV transects so that our surveys included all known substrate types as designated by the ShoreZone project (www.ShoreZone.org) by stratifying by the low water mark habitat classifications. The random points tool created 59 transect points. We supplemented the original transect points with three areas of high disturbance or previous heavy use, resulting in 62 transect locations in total. Transect points were evenly divided amongst the eight shore type classifications assessed by the ShoreZone project. Our team of 3-4 people conducted transects during the daytime at slack tide between March and May 2018 from a 22 ft zodiac that was usually anchored for the duration of the surveys. We started transects at the random points, or the closest safe location. We were unable to complete some transects (n=11) due to the inability of the ROV to withstand the high current flows in certain areas even at slack tide, and due to other physical constraints (e.g., bottom too shallow). Some starting points (n=12) were so close together that we surveyed them in one transect (n = 6). In total, we surveyed 45 transect locations.

Transects ran perpendicular to shore using the integrated compass in the ROV for navigation. Video recording started when the ROV entered the water, and stopped when we reached the end of the tether. Whilst the ROV tether was 100m, due to current movements and depth change we estimate that total transect length was approximately 80 m. We used the OpenROV application and software (Version 2.14) on a Samsung Galaxy Tab S2 tablet to operate the ROV and record videos (OpenROV 2017). We recorded the coordinates of the start of each transect and other observations such as weather conditions, sea conditions, estimated maximum depth and notable sightings. We were unable to document the GPS location for each transect end point. Depth was categorized into three strata: shallow (0 - 10m), medium (11-20m) and deep (>20 m). The classification of depth strata yielded 29 transects in shallow, 13 transects in medium and three transects in deeper waters.

We analyzed videos to characterize the substrate types, or algal cover if benthos was overgrown. Following the benthos classification methodology developed by Stein et al. (1992), we categorized dominant substrates by classifying the stills into primary and secondary benthos. We focused on the three possible categories in line with the ShoreZone low water mark habitat classification for *Tl'ches* – sand, gravel and rock. As in Stein et al. (1992), we ascribed the primary benthos type when substrate cover exceeded 50% of the area viewed, and secondary benthos type when it covered more than

20% of the area viewed. Any transect still that exceeded 80% of one single benthos type did not have a secondary benthos category ascribed to it.

Studies have shown that still photographs yield the same results as video analysis, but with considerably less analysis time for benthic surveying (Cabaitan, Licuanan, and Gomez 2007; Jokiel et al. 2015; Kenyon et al. 2006; Hill and Wilkinson 2004). Therefore, we employed the *screengrab* function of the VLC media player Version 3.0.2 (VideoLAN 2018) to generate stills. Generating stills did not cause any discernable resolution loss. We defined the beginning of each transect as when the ROV showed the substrate and was moving parallel to the benthos (i.e., no longer descending). We slowed down transect videos to about 0.50x speed to determine the starting point for each transect. We then determined the number of seconds of survey time that needed to pass to show a new field of view (so that the benthos and algal community was different for each still), and used that interval for subsequent stills for that transect yielding on average approximately 60 stills per transect.

We quantified percentage cover and composition of the benthos and algae, overlaying a grid onto the substrate of each still (Figure 2) (*sensu* Kenyon et al. 2006). When we were unable to either identify the benthos type due to the instability of the ROV (resulting in images that were too pixelated to identify or did not show any benthos), we assigned a NA (non-applicable) to that screengrab. Many screengrabs had just one category (>80% of the transect as a single category), and thus the proportion of secondary benthos composition was low. We identified algae using the Biodiversity of the Central Coast guide for seagrass and macroalgae (Biodiversity of the Central Coast n.d.). We analyzed each still using the freeware ImageJ (Rasband 2018). When algal coverage equalled 100% of the field of view in stills, we inferred primary substrate type (mostly rock) given the preferred substrate for a given algal species.

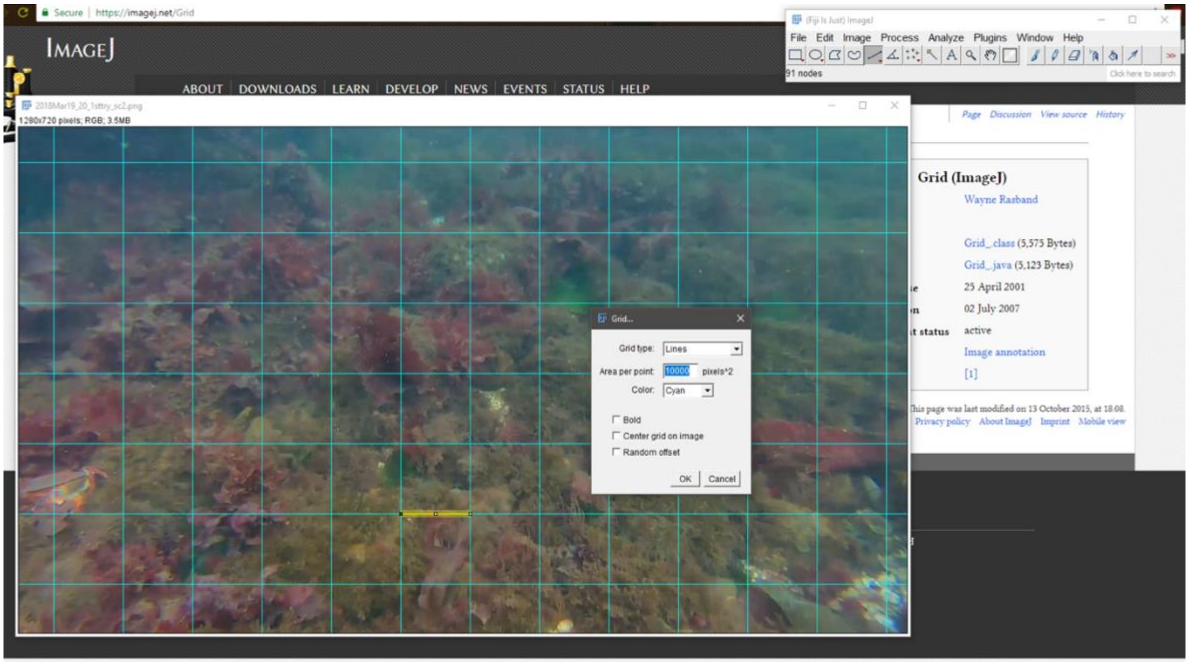

Figure 2. Screen grab showing the classification and estimation of percent of pixels in ImageJ.

To document the incidence and occurrence of the culturally important macrofauna, we viewed the continuous video to identify the culturally important species down to genus and species wherever possible. In contrast to using stills for the benthos classification, we opted to watch continuous video so as to ensure that all occurring species were counted. We counted every individual of a given culturally important species whenever possible. Due to the low stability of the ROV in high flow environments (a common problem for mini to mid-sized ROVs (Pacunski et al. 2008)), and high turbidity or software transmission problems impeding video resolution, we recorded the duration of the transect during which highly abundant species (>10 per still) occurred instead of counting them. We did this to avoid double counting, and to avoid misidentification by failing to distinguish red and purple urchin (*Mesocentrotus* sp. and *Strongylocentrotus* sp.) due to low light levels. Duration was also recorded for the rock scallop (*C. gigantea*) in particular.

We ran a nonmetric multi-dimensional scaling ordination with the *vegan* package (version 2.0-10) in R version 2.15.1 (R Studio Team 2015) to see whether an inference could be made on co-occurring culturally important species, which in turn could highlight important areas for protection. So as not to skew the ordination, we excluded any observation with a count of one. We also ran generalized linear models in *R* to test for which predictors (percentage of algal cover; percentage of primary benthos type cover; percentage of secondary benthos type cover; depth) best explained Songhees culturally important species richness. The model with the least AIC score was determined to be the option that best explained the data (Burnham, Anderson, and Huyvaert 2011).

Results

Our literature review of the Songhees Nation culturally important marine species identified 18 invertebrate species and 6 vertebrate genera (Table 1). Interviews by and with Songhees Nation members mentioned most of these species including two new ones. They also pointed to other traditionally hunted marine species such as waterfowl and seabirds. While these were also mentioned by Suttles (1974), we did not focus on them in our surveys because they are not considered subtidal. Our finalized list contained 24 subtidal culturally important marine species (Table 1).

Common name	Scientific name
Red urchin*	***S. franciscanus***
Green urchin*	***S. droebachiensis***
Purple urchin*	***S. purpuratus***

Keyhole limpets**	***Megathura sp.***
Rockfish**	***Sebastes spp.***
Pacific herring*	***C. pallasii***
Lingcod*	***O. longates***
Pacific Salmon*	***Onchorhynchus spp.***
Giant Pacific Octopus*	***E. dofleini***
Northern Abalone*	***H. kamtschatkana***
Harbor Seal*	***P. vitulina***
Pacific halibut*	***H. stenolepis***
Giant California Sea cucumber*	***A. californicus***
Gumboot chiton*	***C. stelleri***
Native oyster*	*O. lurida*
Blue mussel*	*M. edulis*
Pacific cockle*	*C. corbis*
Butter clam*	***S. gigantea***
Pacific littleneck clam*	*P. staminea*
Bentnose clam*	*M. nasuta*
White-sand macoma*	*M. secta*
Horse clam/Pacific gaper*	*T. nuttallii*
Barnacle*	*Balanus sp.*
Dungeness crab*	***M. magister***
Rock scallop	***C. gigantea***

Table 1. List of Songhees marine culturally important species compiled from Suttles (1974)(*) and interviews with Songhees members(**). The bolded species are predominantly subtidal, whereas the others are considered intertidal. The species with a shaded background represent those found present in our transects (n = 14) and observations (n = 1).

Overall, we found 14 culturally important species or genera to be present. We found nine culturally important species in our most species-rich transect. Rock was the most commonly occurring substrate in the form of boulders, flat rock, and rocky ridges, i.e. continuous rocky benthos (Figure 3a).

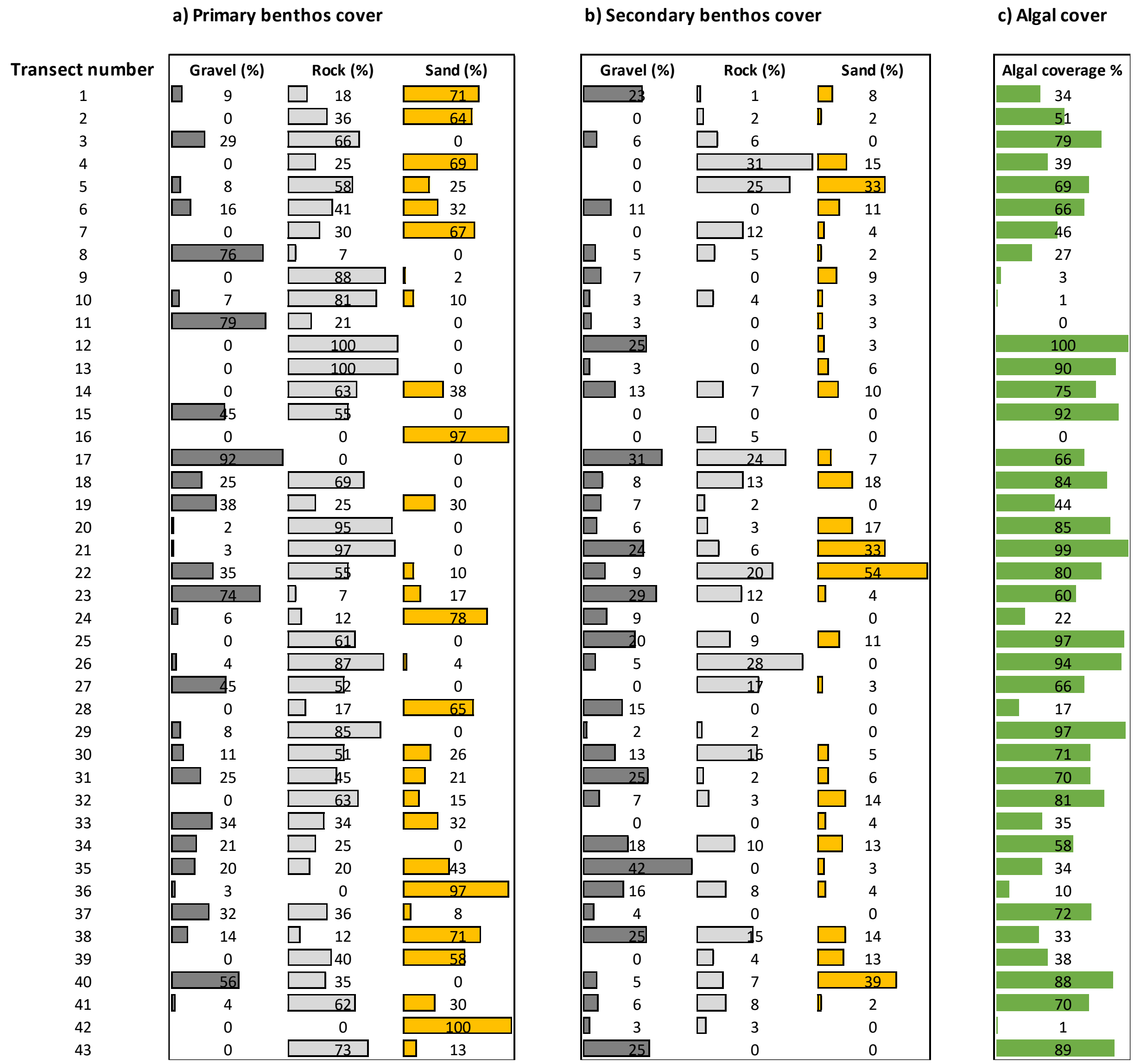

Figure 3. Percentage average of a) primary benthos type composition by transect. Percentage average of b) secondary benthos type composition by transect. c) Percentage of algal cover.

Algal cover (Figure 3c) was present in every but one transect, ranging from 1-100% (average 59%). With the exception of one shallow transect, the deep transects (n=3) showed the least average algal cover (1.33%). Algal cover encompassed all types of algae (red, brown and green), and we were able to confirm the presence of at least 28 species of algae (Table 2).

Common name	**Scientific name**
Sieve kelp	*Agarum sp.*
Ribbon kelp	*Alaria marginata*
Red sea fan	*Callophyllis sp.*
Coralline algae	*Corallinales*
Graceful coral seaweed	*Corralina vancouveriensis*
Five-ribbed kelp	*Costaria costata*
Three-ribbed kelp	*Cymathaere triplicata*
Acid kelp	*Desmarestia spp.*
Feather boa	*Egregia menziesii*
Rockweed	*Fucus sp.*
California limu	*Gracilaria pacifica*
Sea spaghetti	*Gracilaria andersonii*
Southern stiff-stiped kelp	*Laminaria spp.*
Giant perennial kelp	*Macrocystis spp.*
Splendid iridescent seaweed	*Mazzaella spp.*
Sea fern	*Neoptilota spp.*
Bull kelp	*Nereocystis luetkeana*
Frilly red ribbon	*Palmaria sp.*
Broad-ribbed kelp	*Pleurophycus gardneri*
Bleachweed	*Prionitis sp.*
Woody-stemmed kelp	*Pterygophora californica*
Sea felt	*Pylaiella littoralis*
Red islet silk	*Sparlingia pertusa*
Sea cabbage	*Saccharina* sp.
Japanese wireweed	*Sargassum muticum*
Turkish towel	*Chondracanthus exasperatus*
Dark sea lettuce	*Ulvaria* sp.
Eelgrass	*Zostera marina*

Table 2. Documented macroalgae around *Tl'ches*.

We recorded 14 of the 24 listed culturally important species. Apart from rockfish (*Sebastes spp*.), 13 species were invertebrates. While not seen in transects, we observed harbour seals from the surface on several occasions. The generalized linear models revealed that the best model (AIC = 179.18) for culturally important species richness included two significant predictors, shallow depth (0 - 10m) ($p < 0.0005$) and medium depth (11-20m) ($p < 0.002$). The ordination plot revealed certain species to occur more closely together (e.g. S*trongylocentrotus spp.* and *C. gigantea*) but overall did not reveal any other trends (Figure 4).

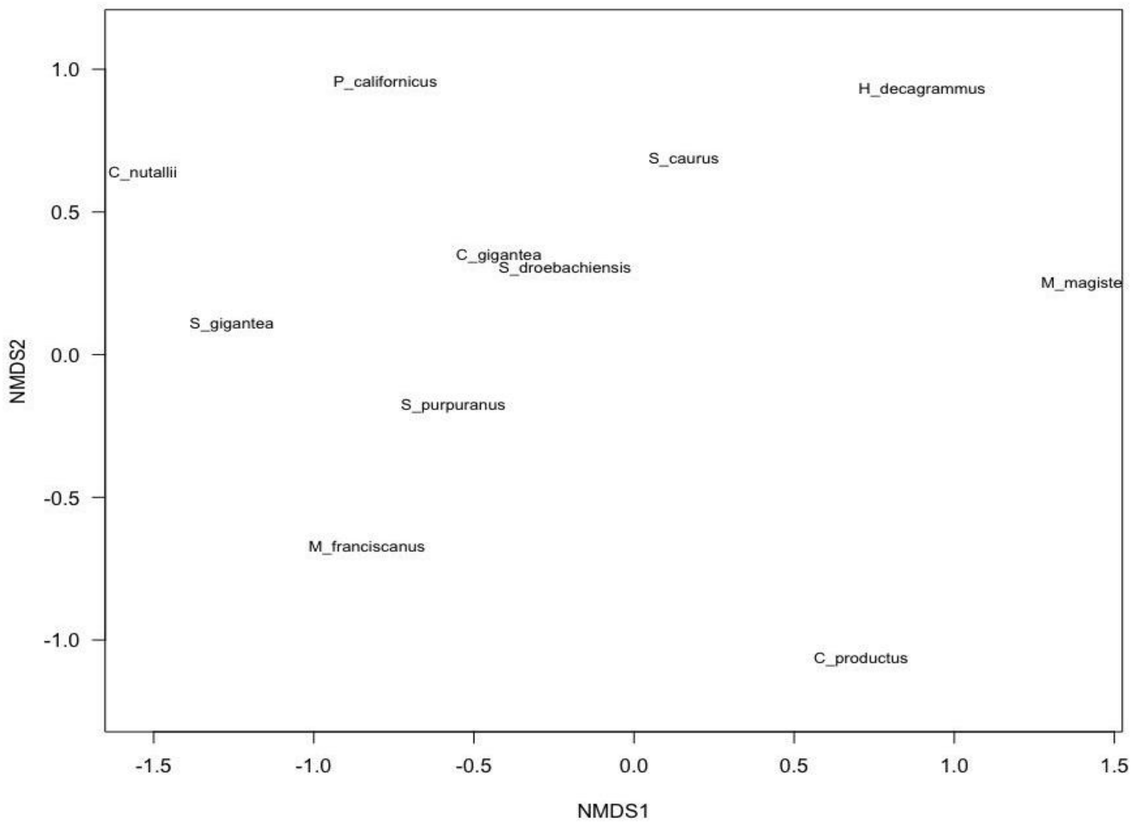

Figure 4. Nonmetric multi-dimensional scaling ordination showing the relationship of species co-occurrence. Stress = 0.25.

Discussion

Ours was the first study that we know of that used the new mini ROV Trident by OpenROV to survey a marine environment. In partnership with the Songhees Nation, we found that the Trident was a useful tool for our purposes, although it had some limitations. We use the discussion to reflect on the objectives of our study: (1) to create an ecological baseline of the Songhees Indigenous seascape by documenting the physical substrate, benthic algal communities, and a variety of Songhees culturally important species, (2) test the applicability and capabilities of a low cost mini ROV to gather data to obtain a baseline in a case study seascape and (3) evaluate the ability of ROVs for informing marine use planning by the Songhees Nation in Canada.

1. Ecological baseline observations

Overall, the Trident worked well to generate baseline observation, although it also had some limitations. Typically, we expect a higher diversity of benthic invertebrate species in marine high flow environments (Palardy and Witman 2011, 2014). However, limitations of the Trident – inability to operate in high-flow environments and kelp beds – means that we were unable to survey some areas near *Tl'ches,* potentially missing culturally important species hotspots and biodiverse areas. Research using other technologies also showed similar challenges, namely difficulty maneuvering ROVs in high rugosity and high flow environments (Benoist et al. 2019; Pacunski et al. 2008). Similar to our methodology, research was conducted around slack tides and other researchers tried to work with surface currents (Pacunski et al. 2008), whereas the Trident was at times completely overpowered by stronger (~ 2.5 knots) surface currents.

When transects have been deployed perpendicular to shore, descending into sublittoral, they have successfully recorded changes in community assemblages with depth at a biotope level (Moore et al. 2006; Parsons et al. 2004; Shears 2007). Our survey could have missed culturally important biota because of kelp dense areas (limiting ROV manoeuvrability) and over substrata with dense algal cover (obscuring understory biota) (Leonard and Clark 1993; Pacunski et al. 2008). Kelp forests as well as eelgrass are highly productive habitats for many species, acting as nurseries as well as refuge for many fish and invertebrate species (Levinton 2013). Finally, whilst this was the first survey to establish an ecological baseline around *Tl'ches,* future monitoring should investigate other technologies (e.g., scuba diving, drop camera) to survey high current environments, since a diverse array of monitoring methods can better address the complexity of ecosystems (Hilty and Merenlender 2000).

While our surveys allowed us to ascertain a baseline, by themselves they do not provide enough information to assess the health of the system. There are many ways of assessing degraded versus healthy ecosystems through environmental monitoring (Diaz, Solan, and Valente 2004; Salas et al. 2006). For initial baseline data, such as species richness, to become meaningful for a monitoring program, it is necessary to consider the species' general life history strategies and tolerances to changes in environmental quality (Carballo and Naranjo 2002). For example, kelp forests in temperate regions are predicted to shift ranges with climatic changes, possibly shifting and altering whole habitats (Marzinelli et al. 2015). Similar potential threats ought to be assessed and life histories and environmental tolerances ought to be considered by the Songhees Nation when developing a monitoring system to evaluate ecological health of the *Tl'ches* seascape. The most notably degraded transects we conducted (with recommendation from our skipper) were typically associated with low biodiversity and stunted growth or complete absence of macroalgae or other biota. Indeed, macroalgae has been shown to serve as an indicator for environmental quality in stressed versus healthy environments, with highly stressed environments showing little to no algal cover (Juanes et al. 2008). We suspect toxic paint and other heavy metals might contaminate these areas as these spots used to serve as a log boom and/or an area were boat paint used to be scraped off (Cesarec 2018). Confirming these areas as highly stressed facilitates Songhees to concentrate restoration efforts in the future.

The ordination plot did not reveal any species that closely co-occurred other than green urchin (*S. droebachiensis*) and rock scallop (*C. gigantea*), which might be explained due to the fact that rock scallop was only recorded at a very small number of transects (n=3) and only in conjunction with echinoids, thus skewing the ordination. While we only found depth to be a significant predictor of number of species, a study conducting similar research in the Celtic Sea found that hard substrates (rock, boulders, gravel) had the highest species diversity and biomass (Benoist et al. 2019). Another result of the same study showed that coarse habitats (gravel and sand) exhibited the lowest species diversity and biomass (Benoist et al., 2019). Our surveys could not confirm nor reject these substrate types as predictors of species diversity statistically, however, qualitatively these species diversity-substrate associations seemed to hold true. In addition, we did not focus on biotope monitoring (surveying the whole species assemblage and benthos (Van Rein et al. 2009)) so these associations could have simply been missed.

Overall, the fact that there is no significant association between species highlights the importance of protecting the whole Indigenous seascape *Tl'ches*. Our models showed the only significant predictors of culturally important species richness as shallow and medium depth. These are also the areas that are most accessible for harvesting of culturally important species.

2. The ROV and its advantages/drawbacks/applicability for marine surveying and monitoring

For communities or organizations that are short of financial or personnel capacity, the Trident offers a comparatively cheap, safe and reliable alternative to conducting dive or towed diver surveys. We were beta testers for OpenROV, allowing us to provide feedback about technological issues such as software glitches. The Trident allows for nearshore and offshore surveying with transect lengths of up to 100m, and possible dive depths of up to 100m. Our surveys took place in nearshore environments with depths of 0-30m, where SCUBA or towed dive surveys are commonly utilized (Kenyon et al. 2006; Leujak and Ormond 2007). Additionally, depending on survey depth, divers are constrained to three dives per day, whereas Trident ROV surveys times can last up to 3 hours without interruption. Depending on the survey technique used, the Trident allows for video recording and possible resampling of the video footage in the future. In addition, although not applicable in our study, surveying in highly polluted environments such as oil spills becomes a possibility with ROVs (Hughes et al. 2010). Overall, utilizing a mini, low-cost ROV such as the Trident can 1) extend dive time and depth, 2) reduce personnel, 3) preparation and overall survey time and 4) be safe and cheaper. As beta testers, we found that the Trident was a cost-effective means of gathering a variety of ecological information.

Learning how to pilot the Trident with a tablet or the controller offered through OpenROV was intuitive. Perfecting to pilot the Trident does, however, require a steep learning curve. The controls are sensitive, where the ROV responds immediately to minor adjustments in direction and/or speed. The Trident dives well and has integrated lights, which were not tested in the context of this research as we did not operate at night. The battery life is around three hours, as advertised. The resolution of the camera and the video output is good, especially at 1080p, which had been temporarily disabled by the developers due to software instability but was enabled again when requested. The transect videos downloaded quite easily. The software, despite some glitches (such as not being able to install the updates without aid of the OpenROV team) was more or less stable and functioning especially with continual updates.

The Trident overall was a very versatile and capable field assistant and allowed for the identification of many of our culturally important target species, but its ability to resolve smaller macrofauna (< 5cm) or buried organisms was turbidity and flow-dependent, as well as ROV velocity dependent, as is the case for other surveys (Cabaitan, Licuanan, and Gomez 2007). Strict species counts might not work in the marine environment due to a typically high flow and turbidity environment; they might however be better suited in low flow lentic environments. Tropical environments such as coral reefs, where visibility tends to be higher than in temperate regions year-round, could also prove to be better suited for ecological surveying using the Trident. Another factor could also be that many ROV cameras are unable to resolve small species due limitations of camera resolution, which is typically set at 1080p (Jokiel et al. 2015; Torquato et al. 2017). Recent work with autonomous underwater vehicles has shown that higher resolution cameras can resolve macrofauna to about 1 cm (Benoist et al. 2019) thus including a higher resolution camera in a newer Trident iteration could improve species identification.

Similarly, the ROV is well built; however minor denting of the outer casing occurred during piloting but did not affect functioning. We also came across an issue of corrosion of the motors within the first two to four weeks (also reported by other beta users) despite a freshwater soak each time post usage. OpenROV resolved this swiftly by replacing this generation of motors.

Several improvements in the Trident could increase usability for surveying. The current version of the software does not gather data on variables such as temperature, water depth, geographic location and ROV orientation. Information on these variables would be highly advantageous for replicating transects and more information for continued monitoring. Another suggestion to improve the Trident would be to integrate lasers to estimate transect width or species size. Many higher end ROVs or other systems have this capability (Stein et al. 1992; Tissot 2007; Yoklavich, Love, and Forney 2007).

3. Usefulness for the Songhees Nation marine conservation planning

The information we collected with the Trident enabled us to establish a baseline of culturally important species occurring around *Tl'ches*, which will inform the Songhees Nation Marine Use Plan and assist the Nation to negotiate protection for this ecocultural seascape. We did this by establishing the presence of at least 14 of 24 culturally important species and extended the shorezone shore-type information to the subtidal as well as established a systematic and comprehensive benthos classification. High resolution data is a precursor to many conservation planning initiatives (Margules and Pressey 2000; Pressey and Bottrill 2009; Mills et al. 2010). Protecting *Tl'ches* for Songhees cultural, social and ceremonial use only will potentially aid in revitalizing aspects of their culture for generations to come.

We documented the substrate and algal cover composition of the benthos, which could serve as one reference point for the Songhees Nation established monitoring system. Our models identified the shallow and medium depth strata as the only significant predictors explaining culturally important species richness, which shows the importance of protecting the whole archipelago around to a depth of at least 20 m to protect culturally important species. This was in accordance with the general vision and goals that the Songhees Nation established during interviews and consultations with Songhees community members (see Chapter 2 of this thesis). *Tl'ches* continues to be a culturally important place for Songhees peoples and many interviewees mentioned the need to have the islands protected for Songhees use for current and future generations. Indeed, in our interviews with Songhees members mentioned other culturally important species that went beyond the scope of this research, such as seabirds or waterfowl. This highlights another limitation of our research, which is our focus on subtidal species. Therefore, other culturally important species should be included in a monitoring program for *Tl'ches* to more accurately assess the whole ecocultural system that is *Tl'ches*.

Chapter 4 – Conclusion

The current biodiversity crisis (Ceballos et al. 2015; Myers et al. 2007; Myers and Worm 2003) and the parallel decline in many Indigenous cultures and languages (Gorenflo et al. 2012; Maffi 2005; Stephenson et al. 2014; Turner et al. 2013) warrants supporting efforts that try to address these threats in an integrated manner. Integrated and holistic solutions recognizing the linkages between the social-ecological system to address biodiversity loss and its consequences are likely to be more successful than disregarding the various interactions of systems on multiple scales of space and time (Berkes 2015; Ommer 2007; Ostrom 2009, 2015). Interdisciplinary solutions can also strengthen and build ecocultural health (Berkes 2015; Rapport and Maffi 2010, 2011). The goals to increase conservation measures worldwide and strengthen Indigenous rights could align well to achieve positive outcomes for biodiversity whilst recognizing the inherent stewardship rights of marginalized communities (Ban and Frid 2018; Ban et al. 2018; Salomon et al. 2018).

My thesis had the main goal of assisting and supporting the marine conservation planning effort of the Songhees Nation around *Tl'ches*. The collaborative work between researchers of the University of Victoria and Songhees Nation during this process intended to support the nation's efforts to protect and steward the ecocultural seascape *Tl'ches* for generations to come. My objectives were 1) to document the Songhees marine conservation planning process, and compare it to systematic conservation planning to outline the similarities, differences, and highlight the uniqueness of an Indigenous-led planning approach and 2) to systematically document and integrate culturally significant species and their habitats into the Songhees stewardship vision for the marine use plan. In this chapter I summarize how my thesis has achieved its main goal and the objectives, highlight key take-aways of how this thesis has contributed to the Songhees Nation and other Indigenous peoples wanting to undertake marine conservation planning, outline how my research adds to the academic literature, discuss the limitations of my research, and recommend future research directions. In this chapter I use the first person singular to emphasize the contributions I made, although the whole project was collaborative.

Objective 1: Document, compare & contrast the Songhees marine conservation planning approach to systematic conservation approaches

The literature lacks examples that showcase Indigenous-led approaches to marine conservation planning *per se*. In addition, the literature lacks examples where the priorities, vision and goals of the resulting outcome were determined exclusively by an Indigenous nation. I aimed to fill this gap by accomplishing my first objective. I achieved this objective by systematically documenting and showcasing the Indigenous-led marine conservation planning process of the Songhees Nation to reclaim and further stewardship around the *Tl'ches* archipelago near Victoria, BC. I ascribed process steps to the Songhees marine conservation planning approach and compare these steps to the traditional systematic conservation planning steps as laid out by Pressey and Bottrill (2009).

In Chapter 2, I found four intricate differences of the marine conservation planning for *Tl'ches* as it compares to systematic conservation approaches. First, the Songhees Nation applied a combination of quantitative and qualitative data gathering methodologies to determine the vision and goals for the *Songhees Nation Marine Use Plan* for *Tl'ches*, differing from systematic conservation planning where a vision and goals precede and determine the data collection. The data collection was done prior to having set a vision and goals as is typically the case in SCP. Second, the Songhees Nation conducted marine conservation planning as rights holders and without the involvement of other stakeholders whereas systematic conservation planning typically involves other levels of government as stakeholders or co-planners with local and/or Indigenous peoples. Third, *Tl'ches* was zoned for one protected area, which is Indigenous-use only, compared to systematic marine conservation planning where typically a number of protected areas are used to establish networks to better promote biological connectivity and enhance the resiliency of the seascape (Green et al. 2009; Magris et al. 2014; Mills et al. 2010). Finally, undertaking this marine conservation planning process helped building personnel and professional capacity amongst the Songhees planning team. This differed from systematic conservation planning processes, which typically focuses on persistence and biodiversity representation as the two main overarching goals with few initiatives focusing on social or cultural goals (Ban et al. 2019). My research provides useful insights and guidance to help any First Nation or Indigenous community worldwide to conduct their own marine conservation planning.

Objective 2: Systematically document & integrate culturally important species and habitats into the Songhees Nation Marine Use Plan

I accomplished this objective by utilizing new low-cost technology in the form of a mini ROV that enabled me to gather baseline data on the nearshore subtidal environment surrounding *Tl'ches*, for use in the Songhees planning process. I combined the data collection to account for the linked social-ecological system (Berkes, 2015; Ostrom, 2009). I reviewed and compiled existing data, which I used to guide the Songhees community interviews and ecological data collection. For the data collection, we used the Shorezone data to stratify my subtidal surveys from shore type and then conducted 45 transects using the OpenROV Trident to systematically document the benthos and the algal community as well as a baseline of Songhees culturally important species. We also evaluated the ability of the Trident to provide high resolution ecological data to inform the Songhees marine conservation planning process. With the ecological baseline surveys, I was able to identify at least 14 of 24 culturally important species I had identified as part of the data review. In addition, I found culturally important species present in every depth stratum highlighting the need - in accordance with the community's preferences determined through my interviews – to protect the whole archipelago for Indigenous-use only. I was also able to establish the presence of at least 28 species of algae and seaweeds. I was visually able to confirm highly stressed areas that present opportunities for future restoration efforts. The video and screen grab data I collected represent a permanent record and can be accessed for future resampling at any point in time. Overall, data collection and analysis were accomplished with relative ease, low cost and people-power as compared to other ROV studies. The ecological baseline of the algal community and Songhees culturally important species I established can serve as a starting point for future monitoring efforts by the Songhees Nation.

Integrating the data from marine subtidal surveys, as well as the Songhees community member interviews, I ensured that the project was culturally meaningful and relevant to the Songhees Nation whilst scientifically sound. As far as I know my research was the first documented application of the new low cost underwater Trident ROV to survey the benthos and an Indigenous peoples' culturally important species in the academic literature. Further my research showcases the ability to do ecological and benthic surveying utilizing new cost-effective technology and adds to the body of literature on low cost ROVs.

Implications for Songhees stewardship of *Tl'ches* and Indigenous conservation planning

The successful outcome of the Songhees marine conservation planning process is the *Songhees Nation Marine Use Plan*. The *Songhees Nation Marine Use Plan* along with the associated permanent data collection and compilation can serve as a basis and guide to initiate a monitoring program. In addition, further data collection could refine the Songhees stewardship goals for *Tl'ches*. My project was conducted to support and provide evidence to assert the Songhees rights to self-determination and stewardship over their ancestral lands as per the United Nations Declaration on the Rights of Indigenous Peoples (United Nations 2007). Given the complicated jurisdictional landscape over the archipelago, the *Songhees Nation Marine Use Plan* could help strengthen assertions to exclusive stewardship and aid in creating a basis for dialogue between other stakeholders such as the provincial government of British Columbia.

This collaboration has supported the Songhees Nation's pursuit to conduct marine conservation planning, utilizing input and additional professional capacity from the University of Victoria. It also enabled the training of three Songhees members in GIS software, conducting and coding of interviews as well as ecological field methods and data compilation. The product of my research can serve as an inspiration to other First

Nations interested in conducting their own marine conservation planning through a collaboration with researchers. Further, the availability of low cost ROVs could lower barriers to doing ecological surveying for coastal Indigenous communities with little financial means available.

Academic contributions

There are few studies overall documenting Indigenous rights and marine conservation planning initiatives (Ban and Frid 2018; Eckert, Ban, Frid, et al. 2018; Nursey-Bray and Rist 2009; Caillon et al. 2017), a gap I addressed in my thesis. Of those planning processes that exist, few have documented the process of conservation planning according to the sole priorities of an Indigenous People (Ban and Frid 2018; Nursey-Bray and Rist 2009; Stephenson et al. 2014; Turner et al. 2013; Verschuuren et al. 2015; von der Porten, Corntassel, and Mucina 2019). Indigenous peoples are rights holders (United Nations 2007) who oftentimes see their rights and autonomy disrespected (Dowie 2011; Stevens 1997). Our collaboration fills a gap in the marine conservation planning literature by providing a process example of an Indigenous-led marine conservation planning process according to priorities of the Songhees Nation. My thesis also fills a gap by showcasing how an Indigenous marine conservation planning process compares to systematic conservation planning approaches. It highlights the uniqueness of the Songhees Nation's Indigenous rights holder approach to marine conservation planning. The establishment of marine protected areas can be seen as an opportunity to strengthen Indigenous rights (Ban & Frid, 2018), hence my thesis and the *Songhees Nation Marine Use Plan* provide an opening to test this hypothesis. The Canadian government has committed to protecting 10% of coastal and marine areas by 2020 (Convention on Biological Diversity, 2010) implementing the Songhees marine conservation planning around *Tl'ches* could help to achieve this goal.

My thesis contributes to the academic literature in several ways. My thesis further contributes to the body of literature of (Indigenous) governance and management of ancestral homelands and ecoculturally important resources in a coupled social-ecological system (Berkes 2012, 2015; Ens et al. 2016; Turner et al. 2013). Specifically, I describe an example of an Indigenous-led and value-driven marine conservation planning process that other Indigenous peoples can adapt. It also adds to a body of knowledge on researcher and Indigenous peoples' collaborations, combining knowledge systems and experiences to develop an Indigenous peoples' vision for governance (Ens, 2014; Hill, 2011; Preuss & Dixon, 2012; Verschuuren et al., 2015). Whilst many examples exist out of Australia for this type of combining of knowledge systems and collaborating (Ens, 2014; Hill, 2011; Preuss & Dixon, 2012; Verschuuren et al., 2015), my research provides an example of a "two-way" knowledge system combination for conservation planning from Canada. Finally, the contents of my thesis provide an example of Indigenous resurgence (Corntassel and Bryce 2012; von der Porten, Corntassel, and Mucina 2019) of Songhees Nation on the path to self-determination that aims to transcend the oppressive politics of the past by seeking to protect and revitalize aspects of their unique Songhees culture. This research is also part of a suite of new opportunities for Indigenous resurgence by providing an example of a collaborative process with researchers for the purpose of ecocultural research and revitalization.

Finally, the advent of low-cost technology to conduct marine surveying provides new opportunities for anyone interested in utilizing this technology. I add to the literature by providing an example of utilizing and testing a low cost ROV to conduct comprehensive benthic and ecological surveys. Overall, data collection and analysis were accomplished with relative ease, low cost and manpower as compared to other ROV studies (Pacunski et al. 2008; Stein et al. 1992; Tissot 2007).

Study Limitations

My research had several limitations, partly due to scope limitations to make the thesis tractable. I address specific methodological limitations in the respective chapters, and here focus on broader limitations of the thesis. In general, my research has data and information limitations due to the nature of human memory and shifting baselines over large time scales (Pauly 1995) in ecological knowledge studies.

To make the thesis tractable, I was unable to address several aspects of ecocultural health. First, I would have liked to integrate and assess cultural uses around the whole seascape *Tl'ches* during this process. Unfortunately, the scope for this thesis would have been too large, which made it impossible to examine the cultural uses during the short time frame of my graduate school experience. Second, the Songhees marine conservation planning for *Tl'ches* was conducted near a highly urbanized and in a cumulatively stressed environment (Ban et al. 2010) with many different user groups. Whilst I hope the *Songhees Nation Marine Use Plan* will be implemented according to the Songhees priorities, the fact that there are many different stakeholder groups, many competing jurisdictions and also commercial fishing activities will likely make the implementation protracted. Third, whilst the whole archipelago is of cultural importance, this study only focused on subtidal or burrowing species (such as clams). Interviews with the Songhees members specifically mentioned seabirds and waterfowls as other culturally important species, which could be comprehensively surveyed in the future. Despite these limitations, the focus for the *Songhees Nation Marine Use Plan* was strictly subtidal and I was able to comprehensively map the benthos and the associated culturally important species, which is what my research objectives aimed to do.

It should also be stressed that this thesis and research was written by a settler who may never fully be able to grasp the connection of Indigenous peoples and their lands. I have tried to be as sensitive as I can to the colonial forces that still exist in such subtleties that I may never be able to understand.

Suggestions for future research

My research has created multiple opportunities for future research for the Songhees Nation and the broader research community. I will elaborate on both in the following paragraphs. First, having a baseline for the benthos and algal community as well as a subtidal culturally important species assessment around *Tl'ches* is a great basis to commence a monitoring program. Moving forward, the Songhees can expand this data collection to a comprehensive land and sea baseline assessment, which could include waterfowl, seabirds and terrestrial animals to create a joint Songhees Nation Land and Marine Use Plan.

Second, the Songhees Nation could systematically document cultural uses and remnants such as burial cairns on the islands. (Systematic documentation of clam and root gardens is currently underway at *Tl'ches*.) This undertaking could further support the Songhees cultural stewardship and revitalization efforts by providing new information coupled with the envisioned land and seascape protection (such as exclusion of non-Indigenous users). In addition, the establishment of a monitoring system around *Tl'ches* could provide an opportunity to examine whether an Indigenous-led protected area can recover culturally important species near an urban center.

Third, unlike many systematic conservation planning initiatives with clear jurisdiction, because multiple levels of government hold different types of jurisdiction over the marine area surrounding *Tl'che*s, Songhees will explore ways to collaborate with other governments to implement the *Songhees Nation Marine Use Plan*. Songhees could inquire with lawyers or legal scholars to clarify what options and legal tools exist for the nation to further their vision of self-determination of stewardship for *Tl'ches*.

Future academic research should document more instances of Indigenous-led conservation planning approaches as well as researcher collaborations, which could help elevate and inspire Indigenous peoples worldwide. So far, academic literature has not often discussed Indigenous-led marine conservation planning processes (Ban & Frid, 2018). In addition, the goals for conservation and Indigenous stewardship frequently align and more research could clarify how conservation goals and Indigenous stewardship complement one another. In addition, recent work found a higher incidence of vertebrates and one invertebrate species in Indigenous-managed lands and waters (Frid et al. 2016; Schuster et al. 2019) and more research to confirm if this is true for other species, such as plants and fish, should be done. Further research could investigate whether Indigenous-managed seascapes can recover and protect a suit of culturally important species in highly stressed environments such as *Tl'ches.*

Conclusion

Recent studies have shown the benefits to biodiversity (as well as culture) where Indigenous peoples are stewarding lands (Frid, McGreer, and Stevenson 2016; Schuster et al. 2019; Stephenson et al. 2014; Sterling et al. 2017). For example, Indigenous-use only areas can lead to the recovery of Dungeness crab in commercially fished areas (Frid et al. 2016). My research comes at a critical time where the world experiences unprecedented rates of biodiversity declines (Ceballos et al. 2015) and Indigenous-managed areas showed a higher density of vertebrate species than protected areas combined (Schuster et al. 2019). My research helped to assist the Songhees community to assert authority and stewardship whilst protecting the important ecocultural seascape *Tl'ches* according to the community's sole priorities.

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