Supporting the cultural use and stewardship of Large Cultural Cedar in Kwakwaka'wakw territories

by

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Abstract

Indigenous peoples in many parts of the world are regaining control of biocultural resources critical to their culture, spirituality, subsistence, and livelihoods. Some Indigenous groups have asserted their rights by developing intergenerational stewardship strategies for such resources, to ensure the continuity of cultural practices and maintain ecosystem health. In this thesis, I describe research conducted in partnership with an Indigenous organization representing six Kwakwaka'wakw First Nations whose traditional territories cover a portion of the south-central coast of British Columbia (BC), Canada, including part of the region known as the "Great Bear Rainforest." I use a mixed-methods approach that bridges disparate knowledge systems to coproduce knowledge and tools for a Kwakwaka'wakw stewardship strategy for western redcedar (*Thuja plicata*), a cultural keystone species. First, I interview Kwakwaka'wakw carvers about carving practices and the availability of large redcedar trees now and in the past. I show that enduring legacies of colonial policies and institutions, and more recent colonial forces, have shaped historical and contemporary cedar carving practices. Despite these pressures, some carvers have used their knowledge and practices to foster a revival of cultural carving and resistance to colonial legacies. Second, I review and synthesize scientific literature about factors associated with decay in redcedar, and discuss the implications of this knowledge for Indigenous stewardship. Third, I draw on carvers' interviews to inform an ecological field study of site conditions and tree characteristics associated with heartwood decay in large cultural redcedar trees. I identify a set of external environmental and biological indicators of decay, for use in Indigenous stewardship. Last, I develop a policy evaluation framework based on the United Nations Declaration on the Rights of Indigenous People and the Calls to Action of the Truth and Reconciliation Commission of Canada. I use the framework to evaluate and reveal deficiencies in the BC government's main regulatory policy governing large cultural redcedar in the Great Bear Rainforest. I show that the self-declared Kwakwaka'wakw large cultural cedar stewardship policy addresses most of these deficiencies and can serve as a model for Indigenous stewardship. Collectively, this research supports Indigenous-led stewardship by partnering with Indigenous groups to develop new analytical and technical tools and uncover social-ecological and traditional knowledge that advances scholarship and informs cultural cedar stewardship.

Keywords: Western redcedar; Great Bear Rainforest; biocultural resource stewardship; heartwood decay; carving practice; Indigenous rights

Dedication

I dedicate this thesis to all the Indigenous cedar carvers who keep the carving practice alive by pursuing their passion and fulfilling their cultural obligations to pass down their knowledge and give back to that which made them who they are. It is not easy to live between two worlds, as I have been told, but the carvers I have come to know through this research do it with strength, conviction, and respect. They create magnificent art with the cedar tree—the Tree of Life—and as one of them said, “give the tree its final shape.”

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My PhD journey began nearly a decade ago, when I sat down for coffee with my (then potential) senior supervisor, Murray Rutherford, at SFU's Burnaby campus. I knew that day I would have the privilege of pursuing a PhD in the School of Resource and Environmental Management while working under the guidance of the best and brightest in their fields. I would like to thank these people—my committee members—for all their support, encouragement, and wisdom they provided over the multiple years of study design, field work, data analysis and writing. I thank Murray for holding my work up to his high standards while giving me the direction and support I needed to reach my full potential. I also thank Murray for our long conversations over Zoom about all things Indigenous rights and forest policy related and, for helping me to become a more concise writer. I am grateful for the distinct contributions my other two committee members, Ken Lertzman and Lori Daniels, provided to my research and overall PhD experience. Thank you, Ken, for ensuring that my field research, First Nation community partnerships and course teaching went as planned, and for the adventures on Lasqueti. Thank you, Lori, for providing all that was necessary to conduct my LCC decay field study and for making me feel at home in the University of British Columbia Tree Ring Lab. I am most grateful for the lifelong relationships I have built with this exceptional, kind and giving group of people from whom I have learned so much.

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Notification

This dissertation includes content on the impacts of colonialism and the Indian Residential Schools system in Canada. The Indian Residential Schools Crisis Line is available 24-hours a day for anyone experiencing pain or distress as a result of their Residential School experience. Hotline number: 1-800-721-0066.

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Chapter 1. Introduction

Biocultural resources, and in particular plant species of cultural importance to Indigenous peoples and other sociocultural groups, are under increasing threat due to intensified anthropogenic extraction and transformation of natural resources (Maffi 2007, Reyes-Garcia et al. 2023). An important trend that may help to counter this threat is the increased legal authority that Indigenous peoples in many places in the world are regaining over their traditional territories and biocultural resources (Borrows, 2017; McGregor et al., 2010; UNGA, 2007). As they recover control of lands, waters and resources, many Indigenous groups are developing and implementing intergenerational stewardship strategies, with a fundamental aim of ensuring that biocultural resources are available to fulfill future generations' needs (Bowcutt, 2013; McGregor et al., 2010). Such strategies may be grounded in the concept of guardianship over lands and resources, which "requires careful management and conservation by the present generation for the benefit of future generations" (Turner et al. 2000). Indigenous strategies, protocols and policies governing resource use and stewardship are a crucial part of cultural self-determination (Caston 2013, Gilbert and Lennox 2020) and may include the assertion of other inherent rights pertaining to the guardianship and use of lands and resources (Watts 2013). Indigenous approaches to biocultural resource stewardship, therefore, may serve as exemplars of governance that upholds Indigenous rights and supports the sustainable use and conservation of resources.

To support the continuity of traditional practices into the future, Indigenous groups are not only demanding respect for their laws, protocols and rights, but are also advancing resource stewardship strategies that integrate Indigenous and Western knowledge systems (McMillen et al. 2020, Housty et al. 2014). Indigenous resource stewardship strategies that integrate cultural knowledge and belief systems with science-based knowledge have the potential to enhance social-ecological systems and foster resilience and environmental sustainability (McMillen et al., 2020; Rayne et al., 2020; Tengö et al., 2014). There is a substantial body of research about Indigenous-led biocultural resource stewardship, and about cross-cultural integrative and collaborative research as a method of advancing stewardship while contributing to scientific scholarship (e.g., Housty et al. 2014, McMillan and Prosper 2016, McMillen et al. 2020). However, there is little work that also investigates the associated need for Indigenous

decision-making authority, to adopt and enforce stewardship strategies in colonial land management contexts (for exceptions, see Hill et al. 2020, Kamelamela et al. 2022, Pert et al. 2020).

In this thesis, I investigate and contribute to the efforts of a group of First Nations (Indigenous peoples) on the west coast of Canada to advance their stewardship of western redcedar (*Thuja plicata*). I collaborated in this study with the Nanwakolas Council and its Member Nations, the Wei Wai Kum, Wei Wai Kai, K'omoks, Tlowitsis, Mamalilikulla, and Da'naxda'xw/Awaetlala. The Nanwakolas Council serves as a collective voice for these six Kwakwaka'wakw First Nations regarding decision-making and responsibilities related to Indigenous rights and the stewardship of lands and waters (Nanwakolas Council 2020a). The Nanwakolas Council has recently developed a stewardship strategy for redcedar (or "*wilkw*", in the Kwak'wala language)—a species which serves fundamental roles in the material culture of clothing, housing, transportation, tools, and art, and in spiritual and ceremonial practices (Hebda and Mathewes, 1984; Stewart, 1995; Turner, 2014). My research focuses on "Large Cultural Cedar" (LCC), large old redcedar trees with high-quality wood that makes them suitable for carving by First Nations people for cultural purposes. My study includes: i) eliciting the knowledge, wisdom and experience of traditional knowledge holders about the availability and use of redcedar for cultural carving; ii) using an integrative knowledge systems approach to develop a science-based tool for predicting decay in large redcedar trees; and iii) evaluating a provincial policy governing the harvesting, cultural use and conservation of LCC trees on Indigenous traditional territories, and comparing that policy with an Indigenous stewardship policy for LCC.

1.1. Cedar stewardship and governance on the south-central coast of British Columbia

The study system for my research is a portion of the south-central coast of British Columbia (BC), Canada that is home to more than 25 First Nations (Allen 2005, Price et al. 2009). Like most other Indigenous groups in BC, these First Nations were displaced from most of their traditional territories by colonial settlers and governments, without ceding rights to their lands or entering into treaties (Reynolds 2018). However, the BC provincial government asserts ownership and authority over these lands as "Crown" lands. Under its assumed sovereignty, the BC government has regulated forestry in the

province for more than a century, based on a forest management paradigm driven largely by an economic agenda (e.g., see Ekers 2019). Industrial logging under this management regime has degraded and destroyed biocultural resources across the territories of First Nations (Turner and Turner 2007, Turner et al. 2008).

Western redcedar trees in coastal regions of the province, and especially those trees of large dimensions and with high-quality wood, have been targeted by the forest industry due to their high value as timber (Green 2007, Nelson 2004). As a result of industrial timber harvesting, LCC are now scarce across the coastal region of BC (Benner et al. 2019, Benner et al. 2021, Sutherland et al. 2016). The scarcity of LCC is of great concern to First Nations, given that these trees require several centuries to develop not only the size (Daniels 2003), but also the wood characteristics desired for the traditional practice of cedar carving (Benner et al. 2021). In response to this scarcity, the Member Nations of the Nanwakolas Council recently declared their own intergenerational cedar stewardship strategy and a LCC Operational Protocol, exercising their rights and authority to steward this biocultural resource on their territories and uphold their responsibilities to future generations (Nanwakolas Council 2020a; 2020b).

The traditional territories of the Nanwakolas Member First Nations overlap with the unique social-ecological and institutional region known as the Great Bear Rainforest (GBR). The GBR is one of the last and largest undeveloped regions of coastal temperate rainforest in the province of BC and in the world (Allen 2005). Unlike most of the province of BC, forestry practices and other land uses in the GBR are guided by the outcomes of a progressive collaborative planning process that involved First Nations, the forest industry, environmental groups, and the BC provincial government (Raitio and Saarikoski 2012, Price et al. 2009). That planning process, which began in 1996, included government-to-government negotiations and agreements between the province and First Nations that established shared provincial-First Nations decision-making for the GBR region (McGee et al. 2010). The new institutions and agreements for collaborative planning and shared decision-making in the GBR have been touted as models for reconciliation (Curran 2017). Moreover, the GBR has gained recognition as a radical example of a paradigm shift in forest policy and management, given that 85% of its forests are designated for conservation under an ecosystem-based management (EBM) framework (Price et al. 2009). The EBM framework adopted for the GBR prioritizes the maintenance of ecosystem integrity and the improvement of human well-being.

According to the provincial Ministry of Forests, Lands and Natural Resource Operations, the latter includes the protection and conservation of First Nations cultural values and forest resources, and broad economic goals related to forestry (Ministry of Forests, Lands and NRO 2016a).

The unique physical, cultural and governance attributes of the south-central coast of BC make this region an ideal system for conducting research that contributes to Indigenous cedar stewardship and assesses the performance of policy affecting such stewardship. The Nanwakolas Member First Nations are committed to advancing their cedar stewardship strategies to support the revitalization and decolonization of the cultural practice of cedar carving in their communities (Nanwakolas Council 2020a). People worldwide visit the region to see the tangible cultural heritage that is created by First Nation carvers, such as totem poles and traditional "big houses," which are recognized globally as iconic symbols of First Nation culture (Mawani 2005). Thus, this study system provides an ideal context for conducting applied research that is of value to First Nations and that will advance scholarship in various disciplines, such as natural resource policy, ecology and ethnography.

1.2. Collaborative research with Indigenous partners

To collaborate with First Nations whose territories overlap the Great Bear Rainforest, I developed a research partnership with the Nanwakolas Council and built working relationships with its Member First Nations. These First Nations have occupied various coastal areas of BC since time immemorial—at least 15,000 years ago (Turner, 2020). Despite the Canadian government's attempted elimination of Indigenous traditional practices through assimilation and genocide (TRCC 2015), these Nations have maintained their practices of cedar carving for cultural and other purposes. To ensure the continuity of carving and other cultural uses of cedar into the future, these Nations are dedicated to advancing their cedar stewardship strategies by developing their knowledge and planning tools through collaborative research partnerships. I began by working as a forestry consultant for the Nanwakolas Council, and my ongoing discussions and work with them served to catalyze a research partnership that led to the development of my research questions and the overall direction of each chapter of my thesis. My research partnership with the Nanwakolas Council helped to ensure that the priorities, values, and knowledge of the Nanwakolas Member Nations are reflected in

this research, and that my thesis will contribute to the Nations' cedar stewardship priorities as well as to scientific scholarship.

1.3. Overview of the remaining chapters of the thesis

In the research described in Chapter 2, I conducted interviews with practicing cedar carvers belonging to the Nanwakolas Member Nations, seeking knowledge to address: 1) the Nations' interest in better understanding the ways in which cedar stewardship can support community cultural revitalization initiatives and the practice of carving over the long-term; and 2) a lack of coverage in the scholarship about the dynamics of cedar carving over time in the region, and the factors responsible for key changes and trends in carving practices and access to suitable trees or logs. Carvers' views, experiences, and knowledge are important for advancing LCC stewardship initiatives and policy, given that these knowledge holders have the greatest need for LCC and access it regularly for their practices. I use such social-ecological knowledge to bring awareness to interrelated historical and contemporary injustices that have shaped the carving practice over time. I also highlight how inclusive efforts of Indigenous resistance and cultural revitalization have facilitated recent trends in the carving practice that demonstrate the roles that carvers and the practice of carving serve in the resistance social movement.

In Chapter 3, I draw from the knowledge carvers shared in interviews about characteristics of cedar and cedar habitat, and conduct a literature review about pathogenic heartwood decay in western redcedar. Tree size together with decay volume in LCC trees dictate the suitability of a tree for various cultural carving purposes. Internal bole (heartwood) decay is prevalent in old growth redcedar, and extensive decay can limit the suitability of a tree for carving. However, it is difficult to accurately detect and predict the extent of decay in living LCC. Thus, the determination of tree morphological and environmental (site) correlates of decay that could be used to improve predictions of decay in LCC is a stewardship priority for the Nanwakolas Member Nations. To better understand the factors that contribute to heartwood decay in redcedar (and thus LCC), and to identify knowledge gaps in the scholarship related to correlates of decay, I conducted a systematic search and in-depth review of the literature pertaining to decay and tree morphology, decay resistance, fungal pathogens, and environmental site conditions.

In Chapter 4, I apply the findings from Chapter 3, together with knowledge from carver interviews about potential indicators of heartwood decay in redcedar, to inform a study of environmental (site) and morphological (tree) correlates of decay in LCC that will help to visually predict the severity of decay in living LCC. To do so, I use the traditional ecological knowledge of carvers to better understand the relationships between site conditions, tree characteristics, and decay, and to inform my field study design. To examine the relationships between decay in living LCC and various site conditions and tree characteristics, including tree age, I conducted a field study on Nanwakolas Member Nations' territories. I applied this mixed-methods approach to develop a set of environmental and biological indicators that can be used to predict the occurrence of decay and, to some degree, the extent of decay, in the boles of living LCC. The study uses both Indigenous knowledge and western science to contribute to broad scientific scholarship in the field of tree ecology, and to LCC stewardship planning, with a particular focus on the Nanwakolas Member Nations' cedar stewardship strategy.

In Chapter 5, I evaluate the main BC provincial regulatory policy governing LCC conservation and harvest in the GBR: the GBR Land Use Objectives Order (the "GBR Order") (Ministry of Forests 2023a). I begin by developing a policy evaluation framework based on principles and standards of practice drawn from the United Nations Declaration on the Rights of Indigenous People (UNDRIP) and the Calls to Action of the Truth and Reconciliation Commission of Canada. I use this framework to evaluate the GBR Order, focusing on Indigenous rights and the control and management of LCC. I then consider whether, and if so, how, the Nanwakolas LCC Operational Protocol – a policy declared by the Nanwakolas Council to ensure that LCC are conserved for both current and future cultural use in the territories of its Member Nations (including parts of the GBR) – addresses gaps and deficiencies revealed in the evaluation of the GBR Order.

In the final chapter (Chapter 6), I summarize and draw conclusions based on the collective findings in this thesis.

1.4. Research products and contributions

The chapters in this thesis are all connected by the theme of Indigenous cedar stewardship. Three of these chapters are written as individual papers to be submitted to academic journals, while one (the literature review on decay in redcedar) is intended to

be published as a government report. Some of these chapters involve collaborations with co-authors and are thus written in the first-person plural form. These co-authors, some of whom are the cedar carvers I interviewed, and my research partners at the Nanwakolas Council, made significant contributions to this research throughout the entire process. Nonetheless, I am the primary author of each chapter and carried out the work of scoping the research questions, designing each study, conducting fieldwork (data collection) and data analysis, and writing. In addition, I contributed to related research over the course of my PhD that is not reported in this thesis, including two published journal articles for which I was a co-author.

1.5. Statement of Interdisciplinarity

Aligning with one of the pillars of the School of Resource and Environmental Management, my thesis is an example of interdisciplinary research that bridges aspects of ethnography, forest ecology and resource policy and planning. I found it necessary to weave together these different disciplines to address my research questions and the interests of my First Nation partners. Moreover, I found it necessary to integrate both qualitative and quantitative data and aspects of an Indigenous knowledge system with Western science to conduct this research in an ethical and robust manner.

1.6. Statement of Positionality

Writing as a white settler woman with a background in forestry who has worked as a consultant for the Nanwakolas Council since 2017, I do my best to present an unbiased and transparent thesis. My consulting role for the Nanwakolas Council over the course of this research consisted of providing feedback on draft versions of the Nanwakolas LCC Operational Protocol, helping to develop the Nanwakolas LCC survey manual, conducting LCC inventory field surveys for the Nanwakolas Member Nations, and supporting the development of the Nanwakolas Cultural Wood Program to facilitate access to LCC harvested under the regulations of the LCC Protocol.

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Chapter 2. Kwakwaka'wakw carvers' experience with *wilkw* (western redcedar): practices, historical injustices, repercussions, and cultural revitalization

2.1. Introduction

> *Without the carving there is no culture, yet the carving is just a component of something*
>
> *Greg Henderson, Wei Wai Kum First Nation*

Traditional artisanal practices of Indigenous peoples are essential to the ongoing creation of tangible cultural heritage and the maintenance of intangible cultural heritage (UNESCO 2003). Traditional practices and their associated material culture are important cultural expressions of identity (Turner et al. 2008) and mechanisms for the intergenerational transmission of knowledge, values and beliefs (e.g., see Turner et al. 2000, Turner 1998). Indigenous peoples' connection to place and their responsibilities for resource stewardship provide a foundation for the continuance and resilience of traditional practices and the knowledge and beliefs that underlie the practices (Johnson et al. 2021, Throsby and Petetskaya 2016).

In colonized settler states, the elimination of the traditional practices of Indigenous peoples was a central goal of colonial assimilation policies, which aimed to erase Indigenous peoples' worldviews, cultures and identities (e.g., see Ellinghaus 2009, MacDonald and Steenbeek 2015, Thom and Grimes 2022). Colonial land dispossession and alienation programs also detrimentally affected traditional practices by preventing or impeding Indigenous people from controlling, accessing and stewarding their lands and resources (Turner et al. 2013). The legacies of these colonial policies and institutions continue to threaten, disrupt and shape Indigenous traditional practices and the knowledge systems of which they are a part (Cámara-Leret et al. 2019, Fernandez-Llamazares et al. 2021, Turner et al. 2013).

Despite these colonial forces, many traditional practices have persisted, often by evolving and adapting to social and ecological change (Norgaard 2014). For instance, in the Pacific Northwest of the United States, Indigenous weavers from various tribes have adopted substitute materials such as reed canary grass (*Phalaris arundinacea*) for

beargrass (*Xerophyllum tenax*) to overcome lack of access to beargrass and loss of legal authority in land management (Hart-Fredeluces et al. 2022). In Guam, the CHamoru people have created new weaving techniques for some textiles and plaited objects to reinvigorate lost tradition (Montón-Subías and Hernando Gonzalo 2022). In some native American communities in the United States traditional regalia—material culture that is often fundamental to ceremony—has evolved to include contemporary aesthetic styles and new forms of expression (He 2023). These examples illustrate the resilience of Indigenous peoples and cultures to ongoing changes in social and environmental conditions induced by colonial forces.

As Indigenous peoples strive to revive their cultures and regain control of their land and resources, the recovery and revitalization of traditional practices can play a key role in combatting on-going colonial pressures (Alfred and Corntassel 2005, Varutti 2015). Traditional practices that produce material culture can strengthen identity and social relations and promote the renewal of cultural values and traditions that have been disrupted or lost (Magnani and Magnani 2018). Some products of traditional practices, such as totem poles, can also assist in the disruption of the political order by asserting Indigenous connection to place (Martineau and Ritskes 2014). As such, Indigenous traditional practices and their associated material culture not only advance, but are foundational to social and political movements of resistance, decolonization, and cultural revitalization. For example, much of the work of Beau Dick, a chief and traditional Northwest Coast wood carver and artist, illustrates how visual art, such as carvings, can serve as a form of resistance to colonial legacies and contemporary colonial forces. Dick used his art together with his cultural wisdom and beliefs to communicate the dangers and destructive impact of modern western consumer culture on Indigenous cultures and the world more broadly (Fazakas 2019).

In the present study, I interviewed practicing Indigenous carvers who belong to the Kwakwa̲ka̲’wakw (“Kwakiutl”) people of the Pacific Northwest Coast of North America. Our specific research objectives were to investigate the knowledge and views of these carvers about: 1) the elements that comprise their carving practices and the practices of other carvers, now and in the past; 2) the changes and trends that have occurred in carving practices over time; and 3) the influences responsible for changes in carving practices. Kwakwa̲ka̲’wakw carvers, or “*k'a̲’enux̲w,”* in the Kwak’wala language, create a wide range of products that are vital to ceremony, cultural identity, and

knowledge transfer, including dugout canoes, totem poles, large ceremonial masks and traditional houses ("big houses") (Benner et al. 2021) (Figure 2.1). Some carving products created by the Kwakwaka'wakw, such as totem poles, are broadly recognized as iconic symbols of First Nation culture (Mawani 2005). In addition to producing objects for ritual use within their communities, Kwakwaka'wakw carvers also carve products for sale to art galleries, museums and commercial markets.

The wood used in Kwakwaka'wakw traditional carving comes mainly from western redcedar trees (*Thuja plicata*, or "*wilkw"* in Kwak'wala), particularly from large old-growth redcedar trees, often referred to as "Monumental Cedar" or "Large Cultural Cedar" (LCC). These LCC trees possess distinct wood qualities that are desirable for carving, such as large boles and tight grain. LCC trees are also targeted by the forest industry, because each tree can potentially yield a large amount of timber of high quality and value (Green 2007, Gregory et al. 2018, Nelson 2004). Industrial logging operations during the last century – conducted mainly by non-Indigenous actors operating on Indigenous traditional territories without Indigenous consent – have depleted LCC to the extent that it is now scarce across the coastal region of what is now British Columbia (BC), Canada (Benner et al. 2019; 2021, Sutherland et al. 2016).

The increasing scarcity of large old trees is a global trend (Lindenmayer et al., 2012; Lindenmayer et al., 2018) that affects many culturally important species (Blicharska and Mikusinski, 2014; Huang et al., 2020). Factors contributing to this trend include harvesting, and mortality due to decay, droughts, wildfires, and insect infestations (e.g., see Anderson 2004, Haberman 2013, and Lyver et al. 2017). In addition to cultural value, various species of large old trees are of particular ecological value given their role as keystone structures in diverse ecosystems (Lindenmayer et al., 2014), and their disproportionate contributions to ecosystem function (Lindenmayer et al., 2012). For instance, one of several ecological roles of very old large redcedar trees is supporting high levels of diversity of epiphytic calicioid species in old-growth forests (Goward and Arsenault, 2018). Despite the significant biocultural values that large old trees around the world hold, conservation efforts have been challenged by a plethora of factors, including the susceptibility of such trees to multiple threats, such as climate change (Lindenmayer and Laurence 2016) and commercial timber harvesting (Lindenmayer et al. 2012).

Our research with Kwakwaka'wakw carvers was conducted at the request of the Nanwakolas Council, a regional organization made up of representatives of six Kwakwaka'wakw nations (self-identified as "First Nations"). The Nanwakolas Council assists its member First Nations ("Nanwakolas Member Nations") in their decision-making and responsibilities concerning Indigenous rights and stewardship of lands and waters. In 2019 the Council issued a strategy for LCC stewardship (the "LCC Stewardship Strategy"), which aims to ensure that a supply of LCC is conserved for the cultural use of current and future generations and to support ecological integrity. The Strategy includes a policy and agreements with industry that regulate forest harvesting practices concerning LCC on Nanwakolas Member Nations' territories (see Benner et al. 2021), along with programs that aim to support carvers' practices, and cultural revitalization initiatives, such as a carving apprenticeship program. This research contributes to various aspects of the LCC Stewardship Strategy.

Although there are other studies that examine dynamics in First Nation cultural practices and stewardship associated with biocultural resources and causal factors of change (e.g., see Dick et al. 2022, Turner and Turner 2008), to our knowledge there is no published literature that explores the recent evolution of the practice of Indigenous cedar carving in northwest North America, and the forces that have shaped it into its contemporary form. Our research contributes to the body of scholarship that examines how cultural practices of Indigenous peoples have changed under the pressures of various pervasive phenomena that are rooted in colonialism (e.g., Bacon 2019, He 2023, Parlee et al. 2018). Our research is also part of a growing body of scholarship that examines the roles of traditional knowledge and practices, and their revival, in efforts of Indigenous resistance and cultural revitalization (e.g., see Daehnke 2019, Martineau and Ritskes 2014, Spencer et al. 2020).

Figure 2.1. Pictures of (a) a LCC tree and various contemporary carving purposes such as, (b) a totem pole being painted by Max Chickite, (c) a bentwood box, (d) Randy Frank and his partially finished small dug-out canoe and, (e) a mask (photo credits Julie Nielsen, Max Chickite).

2.2. Methods

2.2.1. Study System

This study included 13 carvers from the six First Nations of the Nanwakolas Council: the K'ómoks, Wei Wai Kum, Wei Wai Kai, Da'naxda'xw Awaetlala, Tlowitsis, and Mamalilikulla Nations. The unceded traditional territories of the Nanwakolas Member Nations cover part of the east coast of Vancouver Island, several islands between Vancouver Island and the adjacent mainland, and a portion of the region on the mainland of BC known as the Great Bear Rainforest (Figure 2.2). These territories include approximately 29% (21, 604 km^2) of the total area (74, 000 km^2) of coastal temperate rainforest in BC (Benner et al. 2021). The people of the Nanwakolas Member Nations were displaced from most of their traditional territories by colonial settlers and

governments, but these Nations continue to assert their Indigenous rights in these unceded territories. The BC provincial government also asserts ownership and authority over these lands as “Crown” lands, with the exception of small parcels of land (“Indian Reserves”) designated by the Canadian federal government for the exclusive use of First Nations.

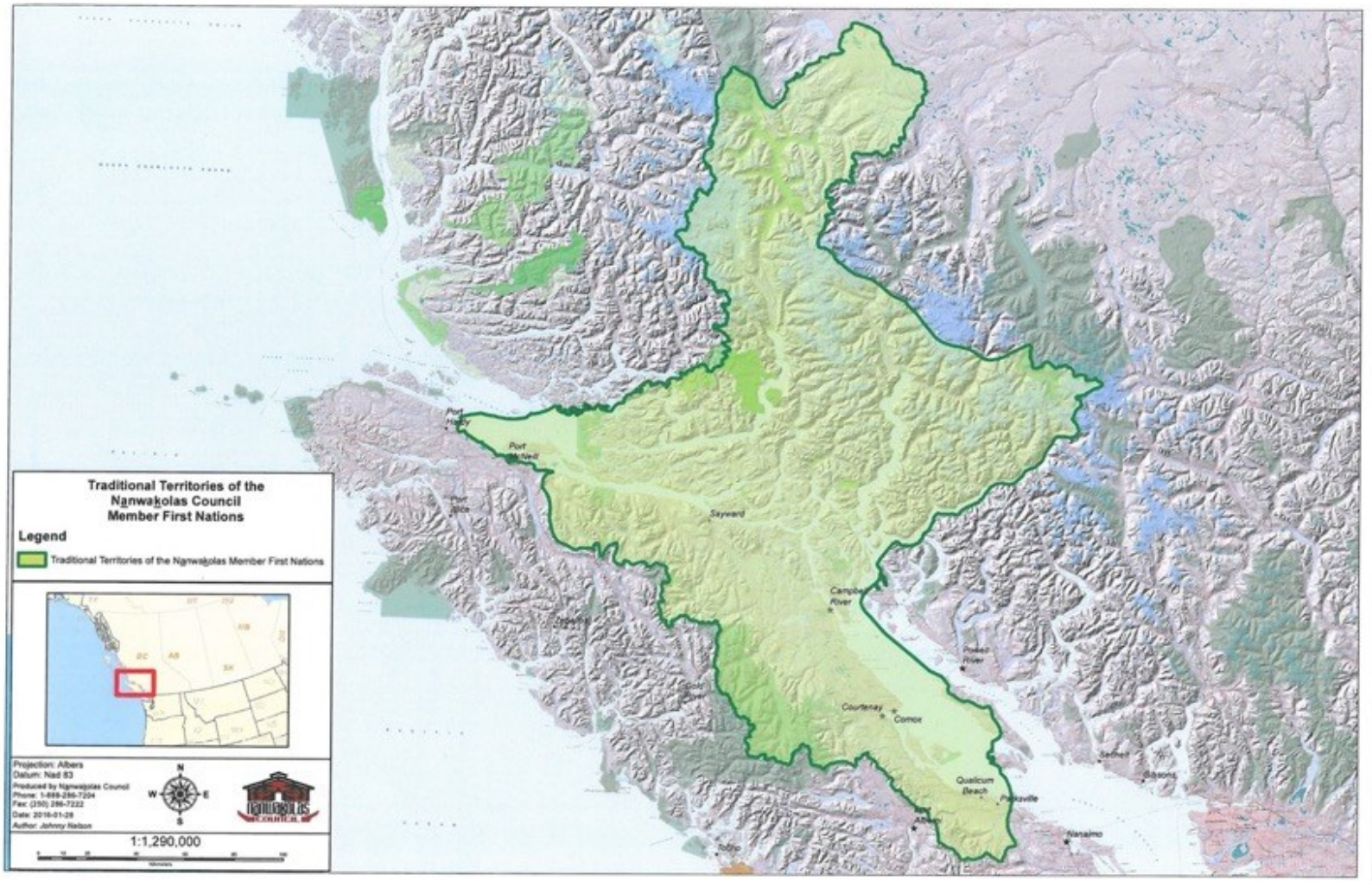

Figure 2.2 **A map of the traditional territories of the Nanwakolas Council Member First Nations (map credit Johnny Nelson).**

Like other Indigenous people in Canada and other colonized states, the people of the Nanwakolas Member Nations have been subjected to programs of colonial assimilation and land dispossession during the last two centuries. The “Indian reserve” system was instituted in the early 1800s in Canada by the British colonial government, ostensibly to protect “Indians” while they were being assimilated into Canadian culture (Leslie 2002). Critical analysts argue that the real objective was to remove Indigenous people permanently from most of their traditional territories and contain them within small “reserves,” so that settlers would have unrestricted access to the remaining land and its resources (Alfred 2009, Joseph 2018). The Canadian government also established the Indian residential school system (~1883-1996), which removed many Indigenous children from their families and cultures and placed them in schools operated by non-Indigenous organizations (TRCC 2015). A primary objective of Indian residential schools was to erode cultural connections and indoctrinate the next generation of Indigenous people into Canadian society (TRCC 2015). Another discriminatory assimilation policy of the Canadian government was the “potlatch ban” (1885-1951), which made it a criminal offence for anyone to participate in a potlatch—an important Indigenous cultural ceremony characterized by feasting, gift-giving, and knowledge and wealth transfer (Deur et al. 2020) (Bracken 1997). All these assimilation programs aimed to “civilize” Indigenous peoples by forcing them to abandon their own cultures and adopt European customs, values, language, government, and health practices (Warry 2008, Joseph 2018).

Approximately 35,000 people of Indigenous, non-Indigenous or mixed ancestry now live on the traditional territories of the Nanwakolas Member Nations, of which approximately 3,400 people belong to one of the Nanwakolas Member Nations. During the last century, industrial forestry, mining, and commercial fishing have been the major forces of economic development in the region (VIEA 2019), but the tourism sector, including nature-based tourism, has grown rapidly over the last decade (Hilsendager et al. 2016). One important draw for tourists is the rich First Nations’ culture in the region (Thimm 2019), which includes tangible cultural heritage such as carved products. First Nations’ artwork and other products are sold in many shops in the area and are on display in local cultural centers and museums (Phillips 1995; Townsend-Gault 2004, Turner and Lepofsky 2013) (Figure 2.3). Another factor that has encouraged a shift in

local economies in recent decades from extraction-based to conservation-based is the criticism from both local and neighboring residents, First Nations, and environmental groups about the harvesting of old growth forests (Riddell et al. 2012, Service Canada 2020). The negative effects of harvesting ecologically productive old-growth forests include losses of biodiversity, forest resilience, carbon storage, and biocultural resources for First Nations (Watson et al. 2018). In response to such criticism and these losses, the BC government and First Nations have established new protected areas and have implemented other policies restricting further harvest of old-growth trees (e.g., see Murray and King 2012, Nanwakolas Council 2020, Stronghill et al. 2015).

Figure 2.3. Various carved artwork pieces on display at (a) a trail head on Hornby Island, K'omoks territory, (b) the Campbell River Museum, (c) a park in Campbell River, and (d) and (e) a shop in Campbell River with Ralph Wilson (photo credits Julie Nielsen).

2.2.2. Carver interviews

In 2017 the Nanwakolas Council entered into a collaborative research partnership with researchers from Simon Fraser University (e.g., see Benner et al.

2020). In 2019, members of the Council suggested that the knowledge, views and experiences of practicing carvers could inform its LCC Stewardship Strategy. To recruit interview participants, staff members of the Nanwakolas Council prepared a list of individuals from Nanwakolas Member Nations who had status in their communities as either experienced or master carvers and who embodied the culture through their work. We invited these carvers to participate in the research, and the Nanwakolas Council paid a monetary honorarium to those who were willing to do so. During 2017 and 2018 we conducted individual semi-structured interviews with each of these carvers (Table 2.2 in Supplementary Material describes the interviewees). All interviews were conducted in accordance with ethics protocols approved by Simon Fraser University and the Nanwakolas Council. All interview participants gave their informed written consent to participate, and only those who consented to have their responses attributed to them are named. This research is part of a broader group of studies using these interview data to examine topics related to redcedar and LCC stewardship and to inform the LCC Stewardship Strategy (see Benner et al. 2021 and Chapter 3).

At least one carver from each Nanwakolas Member Nation was interviewed, but some Nations had more participants than others (see Table 2.2). The disproportionate representation roughly reflected the relative number of established carvers within each Nation at the time of the interviews. Participants' carving experience ranged from five to 50 years, with nine participants having more than 25 years of experience (Table 2.2). Although the knowledge and perspectives of these individuals does not necessarily represent the full range of knowledge and views of all the Kwakwaka'wakw carvers in the region, these participants were selected because of their reputations as carvers and their particular knowledge, skills, and experience.

Interviews typically took two to three hours and were conducted in-person in the participants' communities or in nearby towns. Our interview questions (Section 1 in Supplementary Material) were open-ended and were reviewed for comprehensibility and comprehensiveness by Kwakwaka'wakw artist *Mulidzas* -- Curtis Wilson, of the Nanwakolas Council. The interview questions covered the following general topics:

- The role of carving in Kwakwaka'wakw culture;
- Historic carving practices and protocols of the ancestors;

- The products carved from redcedar logs and wood;
- Cultural traditions of the carving practice;
- Access to redcedar logs;
- Industrial timber harvesting;
- The motivations of carvers;
- Methods of carving;
- Changes in carvers' practices; and
- Influences on carvers' practices now and in the past.

2.2.3. Transcription and data analysis

Interviews were recorded via digital audio and transcribed verbatim, except for one interview that, at the request of the interviewee, was typed *in situ* by Jordan Benner, the forestry advisor for the Nanwakolas Council. We performed thematic content analysis on the interview data using NVivo 12.4.0 for Mac (NVivo qualitative data analysis software 2019) (Richards, 1999; 2005 and Saldana 2013). Using NVivo, we reviewed transcripts to code the main topics and themes that each interview question prompted participants to speak about (Richards 2005; Charmaz 2006). We developed a codebook with a list of these initial codes and their associated descriptions (Rubin and Rubin 2005) (Table 2.3 in Supplementary Material). We validated and expanded the codebook through subsequent iterations of coding. These iterations were performed to allow for continuous comparisons of new findings with previous results to inform subsequent analyses. For example, once all transcripts had been coded, those that were coded first were recoded to analyze text using codes that had been derived in analyses of subsequent transcripts.

During the interviews and the first iteration of coding we realized that two broad periods of time could be distinguished in participants' responses about carving and carving practices:

i) The time period in which they and their fellow living carvers carved (we call this "recent times");

ii) The time period in which the three previous generations of carvers (e.g., parents, grandparents and great-grandparents) carved or had

been told about carving practices and culture by their forebears, and passed this information on to the carvers we interviewed (we call this "historic times").

Thus, recent times refers to approximately the last 50 years (the oldest carver we interviewed had practiced for 50 years), while historic times refers to the period from approximately 50 years ago to approximately 200 years ago. Occasionally a participant also referred to the time before contact with European explorers (which occurred in the late 1700s), but most of the discussion about carving and carving practices focused on historic times and recent times.

Given these temporal distinctions in the responses, we decided to stratify our examination of participants' knowledge and views about changes in carving practices according to time period (recent times and historic times). Using an inductive approach (Rubin and Rubin 2005), we re-analyzed the content of initial nodes to identify emergent themes related to: i) the practice of carving in historic times; ii) the practice of carving in recent times; iii) changes and trends in the carving practice in historic times and recent times, and iv) the influences responsible for causing changes in practices (Table 2.4 in Supplementary Material). The themes that emerged from this analysis became new nodes and sub-nodes, some of which represented concepts expressed by just one or two participants, while others represented concepts that were repeated across several participants.

Our next step was to merge nodes and sub-nodes that had similar content and to delete those that were overly vague or irrelevant to the research questions. Next, we categorized the remaining nodes and sub-nodes according to the main research questions and summarized the content that addressed those questions (Saldana 2013). We also identified quotes in the interview responses that illustrated our interpretation (Ryan and Bernard 2003). To validate our interpretation, we invited all interview participants to review their interview transcripts and a draft of this paper, and to provide their comments, questions, and concerns. The feedback we received from participants included minor suggestions, which we incorporated into the manuscript. At the request of one participant, we removed a direct quote that they did not want to have published.

We emphasize that this is not a comprehensive account of all the carving practices of Kwakwaka'wakw carvers in either historic or recent times, or of all the

changes and potential influences that have affected carving across these time periods. We only interviewed a subset of the greater community of Kwakwaka'wakw carvers in the region. We also stress that the influences identified by respondents in these time periods are not necessarily static phenomena and may have changed over time. Also, while we report each influence in the time period or periods for which it was cited by respondents, the influence may have operated in other time periods as well. For example, some influences associated with recent times in our results were present in historic times, while others associated with historic times continue to exert influence today. Our results represent what the respondents told us about what was important and when it was important.

In addition to the interviews, Julie Nielsen assisted a participant in several of his carving projects and had informal conversations with several participants over the course of this research. Also, during this research both Nielsen and Jordan Benner worked as forestry consultants for the Nanwakolas Council. These relationships provided the opportunity to learn more about carving and the Kwakwaka'wakw culture and worldview, and to gain a deeper and more nuanced understanding of the interview data.

2.3. Results

All participants were willing to share some of their knowledge and experiences as carvers and many were willing to elaborate on what they perceived as changes and trends in their practices and in those of past generations. Most participants were also willing to identify influences that they suggested were responsible for these changes. However, some participants did not answer all the interview questions. The results of the thematic analysis of the interview content are presented below under two main headings: "Historic times" and "Recent times." Additional direct quotes that support some of what participants shared about topics related to historic times and recent times are presented in Section 2 and Table 2.5 in Supplementary Material, respectively.

2.3.1. Historic Times

The Practice of Carving

The practice of carving shaped culture by producing products that allowed not only for a peoples' survival, but also for the creation of distinct ceremonies and traditions connecting *wilkw* to First Nation peoples. Participants explained that prior to European contact and in early historic times, the role of a carver was often revered by those in a village because the practice provided essential products used in daily life and ceremony. Under some circumstances, carvers would be hired by a family or an entire village to create products such as a community canoe or totem pole. Greg Henderson (GH), who came from a long lineage of carvers, explained that carvers would, "*be paid with a wealth of food and roof over their head*," and when the carving was completed, "*the family or village would make sure the carver was treasured somehow*." Carvers were trusted with family stories, cultural teachings and customs, and were respected for their expertise. They created products that were significant to knowledge transfer and commonly used in the potlatch, such as large dancing masks (6 to 7 feet in length), known as "*huk^{w}huk^{w}"* in the Kwak'wala language. GH explained the importance of these masks in historic times: "*We have come from a visual and oral people who [carved] to show the different stories through masks... orally, through singing and dancing. We never had books [...] [so] we brought those dance masks to life."*

Several participants brought up the potlatch system of the ancestors and highlighted the importance of carvers to this ceremony. For example, Bill Henderson (BH), a carver for over 50 years, stressed that, *"[Carvers] just didn't [carve] for nothing,"* and explained that carving was done for the potlatch to continue traditions and pass down knowledge. Participants explained that carvers would provide singing logs, dancing masks, and regalia for the potlatch, all of which were central to knowledge transfer. It was also the responsibility of carvers to provide cedar planks, beams and poles to help in the construction of the big house—a place of gathering where potlatches, various other ceremonies, and living happened. "*We continued that knowledge passed down [with the] carving, dancing, singing, working, and helping in the big house, preparing for potlatches. [Carving] was just part of the culture that you lived back then"* (GH).

Several participants showed knowledge of and interest in the purposes of carved cedar products in pre-contact and historic times. For instance, territorial (totem) poles served as markers indicating a people's claimed area of land and were placed strategically across territories. Territorial poles told the history of a people, whereas house poles, erected at the front of family big houses, told the history of a family. In addition, poles could be part of matrimonial and death ceremonies, the latter requiring the carving of a memorial pole to represent the deceased. BH recounted how a pole was part of his granny's wedding dowry, "*When they married, Chief Billy Assu [lowered] one of his totem poles and paddled it [across the straight] and the dowry came, that totem pole came with my granny."* Canoes served as the main form of transport in historic Kwakwaka'wakw society and were also central to food gathering and goods trading, according to a few participants. BH said, "*Every house would have had at least one [...] up to three, canoes, and the beaches were full of canoes, for clam digging or going trading or traveling*."

Changes, Trends and Influences in Carving Practices and Kwakwaka'wakw Culture

Participants spoke of several trends in the practice of carving in past generations and changes in the Kwakwaka'wakw culture and people over time. Many participants also shared what they perceived to be the influences responsible for such trends and changes. Several participants mentioned that they felt a duty to speak about the past and the damage inflicted on their culture and people. For example, *SeeWees* Max Chickite (MC), who had approximately 50 years of carving experience, said, "*I have to say some of those things that have been done in the past, right*?" Similarly, GH explained why he felt compelled to share what happened in the past: "*We are not really here to blame and shame, we're here just to tell you what happened to our people and how our people almost got wiped off the face of the earth with their culture and language. We are just regaining all that strength back now*."

Many participants brought up colonial assimilation policies—what many referred to as the "banning" of culture, and what Junior Henderson (Junior H.), known for his carving skills using a chainsaw, called, "when everything was taken away," by the government and church. A few participants spoke of the loss of material culture, including carved products, when villages were destroyed and people were forced to live on Indian reserves. Several participants mentioned that the practice of carving was

prohibited during the time when their culture was banned, which prevented carvers from creating products and passing down their knowledge to the next generation of artists. Harry Glendale (HG), who enjoyed carving totem poles, explained the effects of cultural bans and (Indian) residential schools on the carving practice; "*I think [the carving practice] would be quite a bit different today. There would be a lot more [carvers and carved products]. I think, because more of our young people would have grown up carving and not just picked it up later on in life."*

A few participants mentioned that residential schools, disease epidemics, and warfare significantly disrupted the carving practice and contributed to a lack of practicing carvers in their First Nation today. A few other participants noted that cultural bans gave rise to a loss of use of carved products, including use in ceremony and in community, and personal use. However, two participants noted that not all cultural teachings, family practices and the use of products were affected by residential schools or cultural bans. As Bert Smith (BS), who carved various products for ceremony, said, "*My family, sure, some of them went to residential school, but their practices never changed. Like the big house, potlatching, it never changed ever, everything is still intact [...] which makes my [Nation] a little unique, I guess."* Most participants mentioned that a widespread revitalization of the carving practice and of the use of carved products ensued after the lifting of (some) cultural bans, such as the potlatch ban. In addition, a few participants highlighted how the growth of the settler trade economy and widespread advancements in technology resulted in some products being carved less or to fulfill different purposes than in the past, due to declines in demand, and even obsolescence. As Richard Sumner (RS), carver and former elected Chief of the Mamalilikulla Nation, shared, "*The whole [canoe-carving] culture sort of died when gas boats came into play. It wasn't efficient to have an old canoe clunking around."*

Randy Frank (RF), who was one of only two practicing K'omoks carvers, explained how the appropriation of Indigenous peoples' ancestral lands and the allocation of forest land to tenure holders by colonial governments was a turning point in access to redcedar; "*That's when I think access and [traditional] practices started to change. [In the time of] residential school and when they started giving us reserves [...]. The government is like, you get this chunk [of land] here and that chunk there and we are taking all the other nice [forest]*". A few other participants acknowledged that the traditional way of accessing cedar, which was to harvest a tree from the forest, became

a lost practice because of diminished access to ancestral lands that had become, as RF said, “owned” by the provincial government.

2.3.2. Recent Times

Carving Products and What They are Carved For

Participants cited several distinct products that are carved within their communities and acknowledged that not everyone who carves can or should create all products associated with their culture. Poles, dugout canoes, big houses, large dancing masks (*huk^{w}huk^{w})* and large bentwood boxes are all products that require large whole logs and considerable skill, training, and experience. A participant, who preferred to remain anonymous, stressed that, “*Not everyone can do totem poles, you got to have so many years’ experience, in my eye, in order to even touch one. Then you have to learn how to do it all. You have to earn that, it’s earned*.”

Participants identified three main purposes for their carving products: i) ceremonial and family obligations, such as carving for potlatches, memorials, or gift-giving; ii) projects for the First Nation community or the community at large; and iii) sales (i.e., to sell for income). Sometimes these purposes overlap. For example, a product may be carved for sales, with the revenue donated to a ceremonial event. Several participants stressed that ceremonial obligations occur infrequently, which allows them to spend a lot of their time carving for sales and community requests. Carving for ceremony is regarded as an honour and a duty that should come before sales or even community requests. For example, GH explained that, “*If you are going to be a carver, you [have] got to pay back by contributing to the potlatch system [...] It’s a privilege and an honour when you get asked to carve for potlatches and for families who are preparing for [ceremony]*.” However, contributing to community initiatives can also be a way to, as Junior H. says, “pay back,” either by donating products to local institutions (e.g., charities) or by fulfilling project requests from First Nations or the community at large. RF highlighted the importance of carving for community when he recounted carving his first pole 10 years ago at the request of his First Nation; “*It was over 100 years before a K’omox carver stood up a pole here. There's just been no carvers in this [community]*.”

Participants mentioned several changes within their carving practices and the practice in general, concerning the products they carve or their purpose. Several

participants attributed these changes to the dynamics and growth over time of factors that affect sales, such as clients, the commercial artwork market and, in part, community carving initiatives. Participants brought up how carving for sales has influenced what products they carve, which now include non-traditional items such as furniture. Further, some participants who had been carving for more than 25 years said that in recent times fewer carvers prioritize ceremonial projects because of the money carving for sales can bring. Several participants observed that the carving practice has become more commercialized during their careers. As RF said, "*Everybody is just doing it for sales. So, carving has changed, and the people [learning the practice] are looking at it differently than the people 25 or 30 years ago when it was done more for dance purposes and the big house."* Some participants who had been carving for more than 40 years stressed that although the option to carve for monetary gains existed before they began their practice, it was only in the last two decades or so that they perceived that many carvers were prioritizing sales over ceremony and community projects. GH provided an example of this trend when he said, "*Carving went in a direction of greed, there are some [carvers] that are greedy and some that just make you ask, why [do you carve]? But that's no different than commercializing anything right*?" However, a few participants spoke of how a recent revival of culture in many First Nation communities has contributed to the creation of more community carving initiatives.

Access to Redcedar Trees and Logs

> *Accessing wood was always difficult for us over the years*
>
> *John Henderson*

The wood John Henderson (JH) was speaking of in the quote above is LCC logs, which participants have accessed in a variety of ways over their careers (i.e, in recent times) (Table 2.1). Participants described the ways they have accessed logs in the last approximately 15 years, and in the period approximately 15 to 50 years ago (Table 2.1). Most methods of log access that involve either licensees or salvage of logs previously cut or naturally fallen were practiced in both of these periods of time (Table 2.1). For instance, participants with several decades of carving experience described salvaging logs from the forest, beach, or ocean as a common method they used to access logs earlier in their careers, but only use occasionally today. Some participants attributed the decline in log salvaging to a reduction in harvesting operations within the region that

occurred after the logging boom of the 1980s and '90s. Participants explained that industrial forestry within their territories brought about significant changes to their access to LCC logs over the last 50 years. Forestry created roads that gave carvers access into the forest to salvage fallen trees, but also facilitated the natural movement of fallen trees from steep harvested slopes to the beach or ocean. Roads and clearcut logging were historically associated with an increased incidence of slope failures and debris slides (Guthrie 2002, Slaymaker 2000). Fallen trees would be transported by slope failures and debris slides and in rivers to beaches, often during storm events. As well, industrial logging companies often towed log booms of raw redcedar logs along the coastline by tugboats, which resulted in drift logs being available (boom logs that floated free of their bundles). Carvers salvaged these drift logs using boats in earlier recent times (15 to 50 years ago), but it is more difficult for them to find such logs today.

Table 2.1. Ways that participants have accessed LCC logs and both redcedar and yellow cedar wood for their carving practices in recent times. Ways of obtaining logs are presented together with specific 'requirements' associated with a method of access, according to participants.

Method of log or wood access	Era of method use	Requirement(s) to obtain access
Licensee		
Carver selects a tree on a licensee's tenure. Licensee will harvest tree to sell or donate to carver	Recent Times (0 to 50 years)	Log donation formal application process
Carver or licensee selects a log from a licensee's dryland log sort. Licensee will sell or donate log to carver	Recent Times (0 to 50 years)	Log donation formal application process
Salvage		
Carvers search for fallen logs or wood in the forest or in areas that have been harvested	Recent Times (0 to 50 years)	Provincial government permit and truck for log transport
Carvers search for logs and wood in historic First Nation village sites	Earlier Recent Times (15 to 50 years)	Truck for log transport
Carvers search for logs on the beach or 'drift logs' in the ocean	Recent Times (0 to 50 years)	Truck and boat for log transport
Other		

Carvers request a log by donation through their First Nation	More Recent Times (0 to 15 years)	Band Chief and Council approval letter (no approval required from licensee)
Carvers obtain logs or wood from a contact in industry by an in-kind donation	Earlier Recent Times (15 to 50 years)	Truck for log transport
Carver harvests a tree from their traditional territory	Earlier Recent Times (15 to 50 years)	Machinery and truck for log transport

Nearly all participants spoke of how several decades ago industrial logging also facilitated less labour-intensive methods to access logs. A few participants mentioned that in earlier recent times, they would harvest a tree from their traditional territory without a government permit, but that to harvest a tree this way today is prohibited by provincial law, despite their Aboriginal right to redcedar for cultural use. In more recent times, the most common way to acquire logs, according to participants, has been to be given a log by a licensee from a dryland log sort. Sometimes the licensee will allow the carver to select the log. Using licensees is the most practical and convenient way to acquire a log today, as several participants shared how they lack the ability and equipment to harvest and transport a LCC.

While log access through licensees has been common, respondents expressed both gratitude and resentment about the opportunity to access logs this way. For instance, RS shared his view about receiving logs donated by licensees: "*I certainly do appreciate the effort they took to cut that tree down, put it on a truck and transport it down to the dryland sort* [...] *but on the other hand*, *it's kind of the case how we as First Nations feel that we are asking big brother for our own wood. Can we have a log please?*" According to participants, industry regulations governing log donation to carvers became more stringent over time, which resulted in a formal log donation process that carvers now use (Table 2.1). Using this process, licensees may donate a log to a carver and in return receive an exemption from paying a "stumpage" fee to the provincial government for harvesting that tree. Many participants recounted that they have produced carvings for licensees as in-kind donations to express their gratitude for receiving donated logs. However, participants also indicated that this system of log access, in which licensees have the authority to deny carvers a log, infringes upon their Aboriginal rights.

Some participants expressed that a licensee's decision to donate a log is likely contingent upon the number of LCC being harvested at any one time from the carver's traditional territory. A few participants spoke of the highly discretionary and lengthy nature of the log donation process and pointed out that licensees will tend to deny a carver a log if they are carving for monetary gain. Participants mentioned that because of these issues with the licensee log donation process, the carver may request a log through their First Nation. However, participants said this is not commonly done.

A key factor that nearly all participants identified as important to success in obtaining a log from a licensee is the ability to develop a good relationship with the licensee. A few participants shared what they thought to be important in building such a relationship, such as being respected carvers within their community and providing in-kind donations to licensees. However, other participants described difficulties they had encountered with the log donation process and trying to form relationships with licensees, despite fulfilling such expectations. For example, RF had tried to directly engage and build relationships with licensees for several years, yet his requests for logs were denied on numerous occasions, with the result that he had, "*Gotten three logs in total [from licensees] in 25 years*" (RF).

In addition, participants described receiving poor-quality logs and second-growth logs from licensees in more recent times due to the over-harvest of redcedar in their territories. Several participants expressed an awareness of the growing scarcity of LCC trees across their territories because of industrial logging. Many participants noted that although the harvesting of LCC by licensees has facilitated various ways to access logs that are more efficient and affordable than harvesting a tree themselves, logging has depleted their territories of LCC large enough to create products such as poles and community canoes. As BH said, "*The times have changed and you can't find the wood to do a big canoe anymore."* RF also explained that fewer LCC are being harvested today, which makes licensees reluctant to donate any of the few LCC they harvest to carvers: "*It is a competition between [licensees] and us [...] but [licensees] say they are going to compromise, but then say, you are not going to get that big beautiful [tree], we are going to give you the next grade down. It is basically [...] we are keeping the beautiful cedar and selling it."*

How Carving is Practiced

> *We don't have this whole yard all full of cedar trees here, it is nothing like that. When we use [cedar], it is used to an extent where nothing ever gets wasted because it is such a cherished wood*
>
> *Greg Henderson*

Several participants discussed how the purpose of a product will determine their style of carving, or how they choose to carve a product. For example, RF described how a mask used in ceremonial dance is carved differently from a "wall mask" carved for sales; "*If you are carving a mask that's going to hang on the wall, you don't put holes in the nostrils or the eyes. But, if you are carving a mask that will be danced in the big house, you thin it right out, you carve the nostrils out, you carve the eyes out, so you can see through the holes when it is being worn."* A few participants also noted that various products they carve for sales are typically created with additional materials to make them look more elaborate or attractive, often at the request of a client. For instance, copper and abalone are frequently added to masks, in addition to the customary redcedar bark and paint. As Junior H., explained, "*You got to keep up with your [competition] and be a little bit fancy today too*."

Participants spoke of rituals they routinely perform, regardless of the purpose of the product they are carving, which they have learned from knowledge that has been passed down from previous generations. Most participants mentioned how their carving process begins with blessing the log and a process that MC called, "listening to the wood." MC explained how he listens to the wood; "*I create what the wood wants me to create. I spend time looking at [a log], studying its qualities and whatever I see in the wood, [that is] what's good for that piece of wood."* Blessing a log is performed to honour the tree and ward off negative spirits that could bring harm to a carver while carving. Participants explained that today they bless the cut log rather than the standing tree, because it is rare to have the opportunity to bless a tree while it is standing in the forest. Participants also mentioned that, although they perform these rituals of their ancestors, they knew little about how their ancestors would have performed a variety of processes and tasks associated with carving practices, such as tree felling and transport.

While smaller old-growth logs and those with defects have been utilized by participants in their practices for decades, many participants described how in recent

years they have had to fine-tune their carving style and methods to make use of logs from second-growth trees. Many participants explained that second-growth wood is challenging to carve because of its wide growth-rings and the prevalence of knots and spiral grain. Several participants have learned to incorporate wood irregularities and defects associated with grain and knots into their work to make use of smaller second-growth logs of poor quality.

Most participants spoke of frequently using power tools, such as chainsaws, other power-saws, drills and dremels, in their practice. While traditional hand tools are still the primary tools of the trade according to participants, carving wide-grained wood with traditional knives, adzes and chisels is an arduous task (Figure 2.4). JH commented on this when he reflected on the carving practices of his ancestors: "*I know the tools they were using, they would have had a hard time [carving second-growth], the wood would just break right off using those tools* [...] *I don't know if the old-time carvers would even carve the wood that we are carving today*."

Figure 2.4. Pictures of (a) Karver Everson holding traditional adzes, and (b) and (c) other traditional hand tools made and used by carvers in their practices today. The use of such tools is the most efficient and effective on old growth LCC with tight grains, shown in (d) (photo credits: Julie Nielsen).

One of the most distinct changes in carving methods, according to participants, is the divergence between products carved for sales and those carved for ceremony. While participants said they have always carved products to be physically and aesthetically different depending on their purpose, they indicated that as carving for sales became more prominent, the style and form of products carved for sales (e.g., masks and paddles) diverged farther from those same products carved for ceremony or traditional practices. In addition, participants explained that the purpose of a product has also become a significant consideration in their log selection process because of greater variability in the quality of logs they receive now.

Advances in carving tools and marketing have also been highly influential on how products have been carved over the last 50 years and have led to considerable changes in participants' carving methods. Most notably, the adoption of chainsaws has brought

about the development of new carving skills and techniques and greater efficiency in participants' practices. As GH pointed out, "*With a big chainsaw you can take out literally a week's worth of work [done with an adze] [such as] taking all the outer bark off and [...] the sapwood."* In addition, technological developments such as the online marketplace, including personal websites, social media and virtual stores, have made the option to market carvings online more available. Several participants spoke about the general trend of carvers, particularly those who are younger or still establishing themselves, moving away from selling their carvings in galleries and stores, to advertising online. GH recounted how most carvers, including himself, would try to sell their artwork 30 years ago: "*We called it, nicknamed packing our artwork, brown-bagging it. Because you would actually be packing your stuff in a bag from gallery to gallery, selling yourself."*

Why Carving is Practiced

Some participants described a personal experience that was influential in their decision to become a carver. For example, Junior H. recounted how a school project connected him with First Nation carvers in his community and provided an opportunity to work on a canoe; "*I had the privilege of working on our local canoe, when I was still in high school. That is kind of where I got my drive and my avenue to want to be a carver. That helped me become a carver*." MC explained that as a school-aged child he felt conflicted about his identity, but as he learned about the meanings of the carvings in his home, he was inspired to carve: "*My grandmother caught me in the bathroom one time sanding my skin, [so] she says, what are you doing grandson? [I said] I don't like my colour. And she took me to the bedroom and showed me all the masks they had [and said] this is who you are. That's why I became an artist*." Other participants described how they were introduced to carving as children, growing up with a mentor in their family who encouraged and taught them to carve.

Several participants shared their motivations for carrying out their practice today. Most participants relied on other types of work to earn a living and carved for sales to supplement their income. In an average year, most participants said they carved approximately three quarters of their work for sales (including commissioned community projects) and approximately one quarter for donation (to family, ceremony or the community). However, participants explained that their desire to carve came less from

earning income and more from a passion for carving and honouring the spiritual part of themselves and their cultural heritage.

In addition, a few participants noted that their concerns about keeping the carving practice alive within their family and First Nations communities motivated them to continue with their practice. For instance, a participant who preferred to remain anonymous explained why he carves today: "*I started carving for a reason, I don't want my son to learn from just anyone, I want my son to learn from me*." Several participants spoke about the responsibility they have of passing on their knowledge of carving to the next generation. As Junior H. said, "*Being able to pass my knowledge on is my biggest concern. To carry [my practice] on and love and care for what I am doing is for the purpose of the next generation, not for me."* While participants indicated there is a lack of formal teaching initiatives in their communities, such as carving apprenticeship programs in schools, they remained optimistic that opportunities for younger generations to learn carving will develop through student-mentor relationships with carvers like themselves who are willing to teach.

Participants indicated that the most significant changes concerning why they carve the products they do and why they, and carvers in general, carry out their practices are a result of dynamics in the market economy and an overshadowing of cultural values and responsibilities. Several participants stressed that the growth of the sales market has overshadowed other motivations and responsibilities of carvers, such as teaching. RF illustrated this when he said, "*A lot of guys are scared that, well, if I teach this person, it's just taking money out of my own pocket. I think that's the worst thing I have ever heard another carver say."* Some participants noted that in previous decades there was a decline in apprenticeships and mentoring within the carving community. Similarly, a few participants expressed the view that some carvers have neglected to learn the cultural knowledge and familial history that connects the stories and legends with the art, because their sole intention is to make money from carving. As JH expressed, "*A lot of artists out there that are carving, are just carving for money, they don't have any values. [...] they don't know nothing about our history and where [the art] comes from—the stories and the legends."*

In contrast to the trends in practices that participants associated with a growing commercial artwork market, a few participants described how a revival and resurgence

in cultural practices in their communities in recent years is catalyzing a revitalization in carving for ceremonial and community purposes and has inspired carvers to include teaching and mentoring in their practices. For example, RF shared, "*I think it's changing now, where a lot more carvers are willing to teach what they know [...]. The [culture] is coming back now."* Junior H. explained that he believes that reconciliatory relationship building between First Nations and settler colonists is supporting a revival of carving for the broader community. A few participants also said that more recently there is a growing emphasis on cultural responsibilities at the individual and (First Nation) community levels, which has facilitated an increase in carving for ceremony and other traditions.

2.4. Discussion

In this study we recorded the knowledge and views of Kwakwaka'wakw carvers about the elements that comprise their carving practices and the practices of other carvers, now and in the past. We also asked them about changes over time, and the influences responsible for those changes. Our results highlight the role of colonial policies and institutions in forcing or inducing change (Figure 2.5). Our results also highlight the importance of resistance, decolonization, cultural revitalization, and adaptation in fostering a revival of cultural carving practices in First Nations' communities and the transfer of carvers' knowledge to new generations. Kwakwaka'wakw carvers and Kwakwaka'wakw culture have been resilient, despite the enduring legacies of historic influences, such as residential schools and land dispossession, and the effects of more recent colonial forces, such as industrial forest management. Similar adaptations by Indigenous resource users that foster the resilience of traditional practices in the face of environmental, social and economic changes is well documented around the globe (e.g., see Walshe and Argumedo 2016, Brinkman et al. 2009).

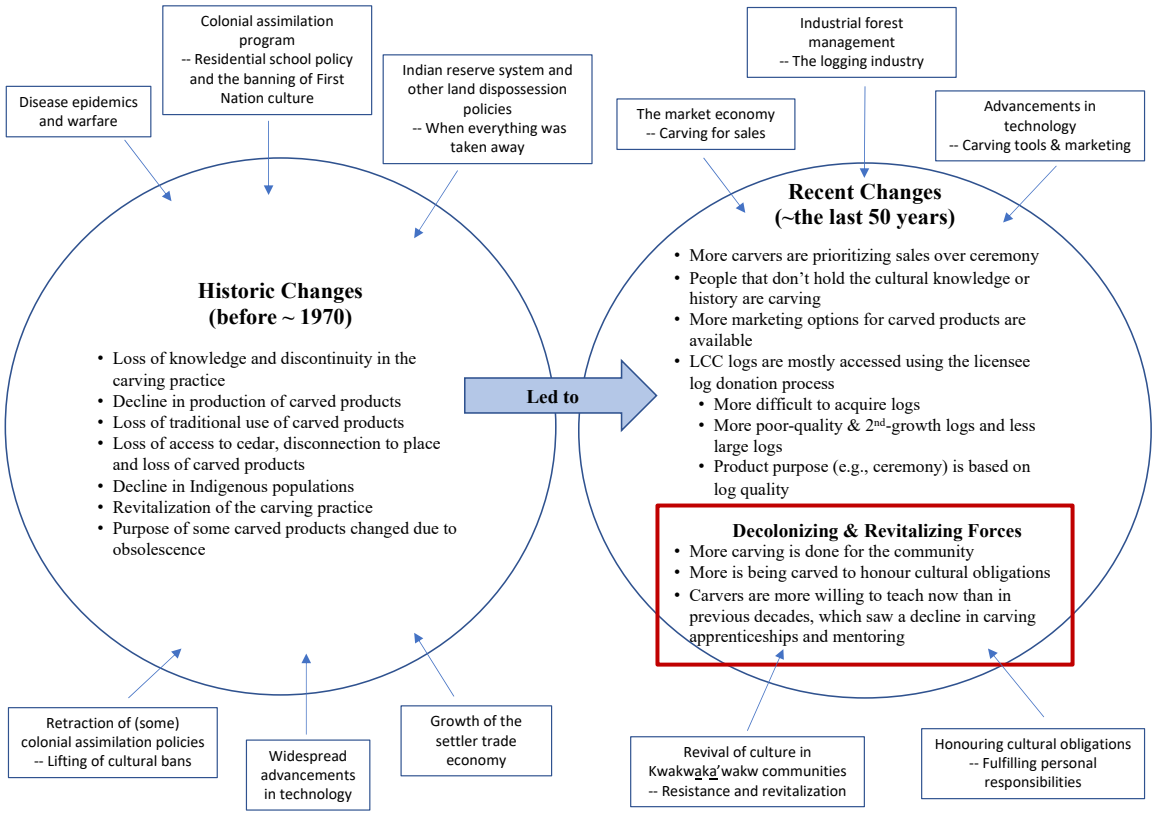

Figure 2.5. Influences, including policies and institutions, (blue boxes) and the changes they have incited in the carving practice and Kwakwaka'wakw culture in historic and recent times (blue bubbles), according to study participants. The phrases following a dashed line in some of the blue boxes are how participants referred to the influence stated above. The thick blue arrow indicates that influences that incited change in historic times are connected to contemporary influences and that historic changes have played a significant role in the occurrence of changes over the last 50 years. The red box captures recent changes that act as a counter force against colonial forces.

2.4.1. Colonial policies and institutions shaped historical and contemporary carving practices

The policies and practices of settler colonialism have shaped and endangered the cultural practices of Indigenous peoples in colonized states (e.g., Bacon 2019, He 2023, Parlee et al. 2018). Many colonial states attempted to eradicate Indigenous peoples culturally, politically, and physically (Alfred and Corntassel 2005). The legacies of colonial policies and practices continue to have both intended and unintended

negative repercussions for the cultures and well-being of Indigenous groups (e.g., see Fernández-Llamazares et al. 2021).

In our interviews, Kwakwaka'wakw carvers identified three main factors associated with colonialism that influenced carving practices in historic times: 1) the colonial assimilation program and the explicit banning of specific aspects of First Nation cultures, 2) the Indian reserve system and other land dispossession policies, and 3) growth of the settler trade economy. The carvers also discussed the consequences of these legacies of colonialism for carving practices in more recent times (see Figure 2.5). Despite these pressures, some Kwakwaka'wakw carvers have sustained carving knowledge and practices, which enabled a revival of cultural carving as colonial policies and prohibitions were partially rescinded in recent decades. Our interviewees also explained how changes in the markets for carving products (the market economy), and changes in the tools and technology available for carving and marketing products (advancements in technology), influenced the evolution of carving practices (Figure 2.5).

Although the carvers we interviewed did not say much about the impacts of disease epidemics and warfare on Kwakwaka'wakw communities since contact with Europeans, it is important to be aware of these impacts when considering the effects of colonialism and other factors. Deaths from smallpox, measles and influenza decimated First Nation populations in BC starting in the late 1700s (Boyd 1994). This population decline was exacerbated by tribal warfare (Davy 2017, Jacknis 2013) and bouts of conflict between colonial traders and settlers and Indigenous groups over land (Dick et al. 2022). In the 1850s and '60s, Kwakwaka'wakw populations precipitously declined due to the smallpox epidemic, although warfare and the availability of alcohol were also likely contributors (Harris 1997, Masco 1995).

The colonial assimilation program and the banning of First Nation cultures

One colonial factor emphasized by the carvers in our interviews was the colonial assimilation program of the Canadian government, including its residential school policy and the "banning" of First Nation cultures. Colonial assimilation policies began before the confederation of Canada and they impeded, prohibited, and criminalized cultural practices (Duffek et al. 2021). The Indian residential school program, a notorious assimilation policy ending only in 1996, removed many Indigenous children from their families and cultures to be taught in government-funded schools operated mainly by

non-Indigenous religious organizations (TRCC 2015). These institutions not only prevented many First Nations children from learning cultural practices and customs directly from their communities, but also prohibited children from communicating in their language, using traditional medicines, and participating in ceremony (MacDonald and Steenbeek 2015). The summary report of the Truth and Reconciliation Commission of Canada calls the establishment and operation of residential schools and other assimilation policies “cultural genocide” (TRCC 2015, p.1).

In 1885 the Canadian government enacted a law that made it a criminal offence for anyone to participate in a potlatch ceremony (Bracken 1997). The word “potlatch” means “to give,” and at a Kwakwaka’wakw potlatch, occasions such as the naming of children, marriages, and mourning deaths, are witnessed by guests who are given gifts for their witnessing of the event (umistapotlatch.ca). The potlatch and other cultural ceremonies and practices, including carving, were and remain ways of teaching cultural values, beliefs, views, stories, and technical knowledge and wisdom through material culture (Davy 2017, Tabor et al. 2023). Thus, the prohibition of the potlatch under Canada’s Aboriginal policy (TRCC 2015) resulted in the reduction or elimination of important mechanisms of intergenerational knowledge transfer and the erosion of Indigenous knowledge systems and self-identity (Turner et al. 2008).

The long-lasting effects of Canada’s assimilation program are evident in our findings about changes in the carving practice in historic and recent times. Assimilation policies influenced the purposes for which carvers carved, and the products they created. After contact, some Indigenous carvers chose to produce artwork for the market economy and, specifically, the souvenir market, which was a safe way to continue carving and make a living during cultural bans without suffering reprisal from colonial authorities (Worl 1990). Our interviewees described an increase in recent times in the number of carvers who prioritize selling their products in the market economy rather than carving for ceremony or teaching mentees, or who carve without knowing or understanding the cultural knowledge or history associated with carving. This trend may, in part, be a legacy of the significant interruption that took place in cultural mechanisms of knowledge transfer including the family and the performing of practices, rituals and ceremonies. Carving for sales in recent times also continues a pattern established in the past when carvers were forced to carve as part of the wage economy if they were to continue their practices.

The Indian reserve system and other land dispossession policies

The Indian reserve system and other land dispossession policies are a second colonial factor that, according to our interviewees, substantially changed carving practices in historic times and continues to influence practices today. Alienation of Indigenous peoples from their territories under the reserve system, together with other forms of land dispossession, constricted or denied access to lands and resources by Indigenous people, thereby impeding cultural practices and contributing to a loss of place-based knowledge and skills associated with land-based practices and spiritual activities (McGillivray 2000, Thom and Grimes 2022, Turner et al. 2008). Similar processes occurred in other colonized states. For instance, the establishment of Indian reservations in the United States, which sometimes removed Native Americans from the entirety of their territories, denied Native people access to cultural resources such as plants, fish and wildlife, impeding their traditional subsistence practices and well-being (Spores 1993). In BC, historic and contemporary forest management is founded on land dispossession (Ekers 2019, Rossiter 2008): the provincial government has granted tenures to the logging industry to conduct industrial forest management on lands from which First Nations were displaced.

In our interviews, carvers told us about a variety of changes in historic and contemporary carving practices due to land dispossession and industrial forestry, such as the trends in access to LCC and other wood suitable for carving. While loss of access to and control over LCC has had negative impacts on the carving practice in both recent and historic times, there have also been times of easier access because of logging roads, increased opportunities to salvage wood, and the licensee log donation process, all consequences of industrial forestry.

In some cases, the adaptations of carvers to the conditions brought about by industrial forestry, such as relationship-building with licensees, seem to have provided carvers easier access to LCC logs. Researchers in other regions of study have noted similar adaptability of Indigenous resource users to changes in access and other factors brought about by contemporary forest management (e.g., see Brinkman et al. 2009, Toledo et al. 2003). Johnson et al. (2021) argue that the implementation of adaptive strategies and knowledge of Alaska Natives in industrial forest planning is imperative to improving their access to and supply of trees for use in cultural activities. However, in

our study carvers told us that more recently it has become more difficult to access an LCC to make a canoe, a trend that has also been documented in other studies (e.g., see Dick et al. 2022, Johnson et al. 2019). LCC of the largest dimensions have been dramatically depleted by logging and are now the rarest type of LCC in the Nanwakolas Member Nations' territories (Benner et al. 2021). Such scarcity of LCC due to industrial logging is consistent with the decline and rarity of large old trees worldwide (e.g., see Lindenmayer et al. 2012, Lindenmayer and Laurence 2016). For example, various tropical "mega-tree" species, several of which hold cultural value (e.g., the Maya Ceiba [*Ceiba pentandra*]), are locally rare owing to their endemism and vulnerability to timber exploitation (Pinho et al. 2020).

Growth of the settler trade economy

Growth of the settler trade economy is a third colonial factor that carvers discussed in our interviews. Their observations about the effects of the trade economy on the carving practice in historic times are consistent with other scholarship that explores the effects of the integration of Indigenous peoples into colonial settler trade and wage economies. In Northwestern North America, the trade economy introduced new products into Indigenous society (Turner 2016). As our findings illustrate, the demand decreased for some carved products, such as the dugout canoe, due to substitute products acquired in trade, such as more efficient gas-powered boats (see Johansen 2012). In the American West, the advent of the wage economy, alongside environmental change and territory loss, negatively impacted the cultural practices of Native American peoples and their lifeways for generations (Sunseri 2017). For First Nations people in Canada, the wage economy diminished the role of dugout canoes in traditional life, as did the prohibition of ceremonies like the potlatch, which were tied to canoe travel (Daehnke 2019). As a consequence, the practice of canoe-carving dwindled, which resulted in not only a loss of practice-based skills and knowledge (Dean 2013, Johansen 2012, Neel 1995), but also a decline in cultural values, like reciprocity, which are embodied in the spiritual connection associated with canoe making and travel (Daehnke 2019, Sarvis 2003). Our interviewees talked about the loss of skills, knowledge and values in the carving practice in recent times, such as a lack of in-depth knowledge about the procedures their ancestors would have used for tree felling, carving a log in situ and transporting a carved product, such as canoe, from the forest. In addition, trends such as a decline in mentoring (in the recent past), and the observation

that some carvers are carving less for ceremony and not giving back to the culture, reflect a loss of values like reciprocity. However, as GH remarked in relation to carvers who carve "strictly for the dollar" today, "*If [carving] puts food on their plate for that day I can't take that away from you*."

Gas-powered boats and other widespread advancements in technology in historic times also decreased the use of some carved products, including dugout canoes. As RS explained, "*You [didn't] see canoes lined up on the beach anymore because of a lack of logs, it was because of a lack of need*." In recent times, advancements in technology such as the creation of the online marketplace and the widespread availability of power tools (e.g., the chainsaw) also influenced carving practices in combination with colonial factors (Figure 2.5). According to participants, such advancements improved carving efficiency and enabled carvers to reach a wider audience, thereby increasing carvers' potential to earn money and contribute to the commercialization of First Nation artwork. Power tools also enabled carvers to work with wider-grained and lower quality wood.

The retraction of some colonial assimilation policies

The retraction of some colonial assimilation policies, which began in the 1950s, was identified by carvers as another influence that has shaped carving practices. In 1951 the federal government repealed the Potlatch Law. In 1952, Kwakwaka'wakw hereditary Chief Mungo Martin hosted the first legal potlatch in Canada since 1885, in Victoria, BC (Siegel, n.d.). Other federal policies instituted under the *Indian Act* (1876) in the 1870s and '80s remained in force for much longer, such as the residential schools program, which ended in 1996 (Warry 2008, Joseph 2018). The lifting of cultural bans initiated a period of recovery that revitalized traditional artistic practices and catalyzed an alteration and re-discovery of technical practices and styles (Vastokas 1977).

In our interviews, carvers attributed changes in their artform, such as carving non-traditional animals or creatures and creating products for sales differently than those for ceremony, to the expansion of the market economy and the widespread commercialization of Indigenous art, both of which occurred in this period of re-discovery. In the 1950s, a shift in non-Indigenous peoples' perceptions of the material culture of First Nations of the Northwest Coast occurred, facilitating its mainstream popularity and acceptance as Canadian culture and art (Hawker 2007). Contemporary

Indigenous artists creating pieces for the commercial artwork market have continued to alter their products using new artistic styles alongside traditional forms (Jonaitis 2006). It is of little surprise that First Nations' styles of art are continuously evolving through the adoption of new technologies (Corbet 2022) and under the influence of non-Indigenous forces (Brown 1998). As Junior H. said, "[*The artwork] changes, the more people that want it, the more we changed it and evolved to what it is, to selling it on everything today*."

2.4.2. Recent changes in the carving practice reveal resistance to colonial legacies

Carvers explained to us that in recent times a revival of culture in their Kwakwaka'wakw communities and an increased focus on honouring cultural obligations in the carving practice have helped to reinvigorate the practice and move it in a direction that may preserve core teachings, beliefs, and knowledge for generations to come (Figure 2.5). The revival of cultural practices and protocols that produce or use material culture, such as carving, is fundamental to the ongoing social and political movements of Indigenous peoples worldwide that are grounded in resistance, decolonization, and cultural revitalization (Magnani and Magnani 2018). The revitalization of Indigenous plant-based arts, including carving and basket weaving, began approximately 50 years ago in BC and the surrounding regions (Turner and Lepofsky 2013). As our findings illustrate, this revitalization continues today in the relatively recent increase in the production of carved products for use in cultural contexts. The words of Junior H. reflect on this revival and connect it to broader processes of reconciliation; "*For the most part, I have seen more and more [carvings] being created in communities as relationships get better with people of this land and people that have come to borrow this land. [These] relationships have helped people want to stand poles up to say this is the land of the Laich-kwil-tach people.*" Cultural revitalization is central to Indigenous people regaining their strength and, thus, is necessary for the reconciliation process (Scott and Fletcher 2014). Junior H.'s comment highlights that relationship-building also supports the revitalization of cultural traditions and a renewal of the identity of Indigenous peoples, including their relationship with and sovereignty over ancestral lands.

The increased presence of carvings, such as totem poles, in Indigenous communities in recent times demonstrates the resilience of such cultural practices and

their role in asserting and reinforcing Indigenous connections and continuity on unceded territories through “visual sovereignty” (Martineau and Ritskes 2014). Visual sovereignty, a concept that can be understood as an approach to diversifying political sovereignty through Indigenous art (Rickard 2017), is an important form of resistance to colonization and, specifically, land dispossession (Adese 2015). Similarly, Cobb (2005) argues that while museums have been instruments of colonization and dispossession, they are now being transformed into vehicles for cultural revitalization and sovereignty, because Indigenous groups are using such spaces to self-define their culture and assert their continuity to place. Arguably, acts of visual sovereignty and the shift in the roles of museums, contribute to decolonizing colonial spaces. Similarly, Daehnke (2019) argues that the recent resurgence of canoe-carving, and the use of carved canoes in Tribal Canoe Journeys—a social event that unites Indigenous groups from neighbouring ancestral territories through canoe travel (Daehnke 2019, Johnson et al. 2019, Johansen 2012)—are acts of decolonization. Over the course of our research, two of the participants undertook a canoe-carving project at a high school in their community to raise awareness of First Nations’ traditional practices with LCC and expose the younger generation to the carving practice (Figure 2.6).

Figure 2.6. Pictures of various stages of the community canoe revitalization project at Carihi High School in Campbell River (photo credits: Max Chickite and Junior Henderson).

This canoe-carving cultural revitalization project used an LCC that became available to the carvers because of the Nanwakolas LCC Stewardship Strategy. In 2020, a policy agreed to by the Nanwakolas Member Nations and several forest licensees was implemented under the LCC Strategy that enables carvers to access LCC through their Nation using a standardized process (Nanwakolas Council 2020). This policy addresses issues carvers have experienced accessing LCC through licensees. As Junior H. stressed, "*Instead of us going out there to crumb around for logs [...] our leaders need to make sure that there [are trees] there for us*." On the BC coast, the Haida First Nation was the first in the province to create an intergenerational strategy to steward LCC on their traditional territory and assert their authority to intervene in provincial forest management and planning (Heritage and NRDC of the Haida Nation 2016). The revival and maintenance of carving practices relies in part on the ability of First Nations to steward LCC in their territories, as well as the individual efforts of carvers who choose to prioritize ceremony, community and passing down their knowledge to the next

generation. As Alfred and Corntassel (2005) remark, “the process of decolonization begins with the self [...] [with] shifts in thinking and action [of individuals].” Carvers often play a cultural leadership role in their communities and are a driving force helping to counteract colonial legacies (Figure 2.5) and revitalize First Nation culture. Indeed, the adaptive responses of carvers to the legacies of colonial forces illustrate mechanisms of ongoing resilience in their communities.

2.4.3. A concluding comment on the role of the buyer of Indigenous art

In this era of contemporary colonialism and decolonial struggle, Indigenous art within the mainstream market economy can serve as “a site for articulating Indigenous resistance and resurgence” (Marineau and Ritskes 2014). On the other hand, it can also be an opportunity for ongoing exploitation and cultural appropriation. Our results prompt reflection on the important role that buyers of Indigenous artwork have in the on-going processes of decolonization and cultural revival. Buyers who knowingly or unknowingly purchase illegitimate or inauthentic artworks that purport to represent Indigenous cultural heritage are perpetuating the misappropriation of tangible heritage and devaluation of Indigenous peoples’ culture and identity. The production of forgeries or fake Indigenous art is a pervasive form of cultural appropriation that has persisted for decades in colonist states such as Canada and Australia (Bowden 2001). Although the production of forgeries and fakes was not brought up in our interviews, interviewees did highlight the issue that the exigencies of the marketplace feedback to drive change in carver practices and attitudes, especially when artwork is being created for the mainstream market by carvers who do not hold or understand their cultural knowledge or history. As Karver Everson (KE), one of two K’omoks carvers, said, “*You have to be part of the culture to really be a carver. You have to have that investment [in culture] and [carving] has to be your life*.” While this issue is distinct from that of the production and sale of forgeries or fakes, both involve the production of art that is not grounded in the culture.

Forgeries and fakes are replicas of authentic pieces that hold no cultural meaning or, in other words, they have little connection to the history, values or principles that are interwoven with the art form and style (Hamilton 2019). Thus, it is an obligation of buyers to ensure the authenticity of art being sold commercially by asking questions to clarify who the artist is, the Indigenous nation(s) they come from, and their connection to

their traditional territory (Fionda 2018). Buying authentic Indigenous artwork is a form of cultural appreciation which can help to counter settler ignorance, discrimination and other colonial forces that continue to oppress Indigenous peoples. As RF stressed, "*As long as there are more people that understand our culture and knowledge, the more they are going to respect it right? And they will hand down that [respect] to their kids and their friends, so [the culture] just gets bigger and better*."

2.5. Acknowledgements

We would like to thank and extend our gratitude to the Nanwakolas Council and its Member Nations—the K'omoks, Wei Wai Kai, Wei Wai Kum, Tlowitsis, Mamalilikulla, and Da'naxda'xw/Awaetlala First Nations—as well as to several individuals such as Curtis Wilson, who provided important information for the interview process. We would also like to thank the cedar carvers for their willingness to participate in this research and welcoming us into their carving sheds at any time. Finally, this project would not have been possible without the support from the Social Sciences and Humanities Research Council of Canada.

2.6. Supplementary Material

2.6.1. Table 2.2

Table 2.2. Interview participants and the personal information they provided during interviews.

Participant English Name and initials	Current Nation(s) of belonging	Approximate Years Carving	Place of Residence (English name)
Anonymous		13	
Anonymous		45	
Max Chickite (MC)	Wei Wai Kai	50	Campbell River, BC
Karver Everson (KE)	K'omoks	5	Comox, BC
Randy Frank (RF)	K'omoks	26	Comox, BC
Harry Glendale (HG)	Da'naxda'xw Awaetlala	15	Alert Bay & New Vancouver (*Tsatsishukwomi*), BC
Bill Henderson (BH)	Wei Wai Kum	45	Campbell River, BC
Greg Henderson (GH)	Wei Wai Kum	50	Campbell River, BC

Participant English Name and initials	Current Nation(s) of belonging	Approximate Years Carving	Place of Residence (English name)
John Henderson (JH)	Wei Wai Kum	50	Campbell River, BC
Junior Henderson (Junior H)	Wei Wai Kum	25	Campbell River, BC
Bert Smith (BS)	Tlowitsis	26	Campbell River, BC
Richard Sumner (RS)	Mamalilikulla	40	Victoria, BC
Ralph Wilson (RW)	Wei Wai Kai	20	Campbell River, BC

2.6.2. Table 2.3

Table 2.3. Initial codes, or 'nodes', that were predetermined by the interview topics and questions are in bold plain font. Emergent nodes, also in bold, and sub-nodes, the latter of which are indented, are in italics and were created using an inductive approach following the first iteration of coding. Initial and emergent nodes are presented in alphabetical order and a general definition or description of each is provided.

Initial nodes, emergent nodes and sub-nodes	Definitions and descriptions
Biggest influence moving forward *Ability to pass on teachings* *Access to logs* *Unique concerns*	Thoughts about what the most influential factors to carvers' practices and the carving practice in general are, moving forward. Also, comments about factors influencing future generations' practices.
Carver identification *Carved in two places* *People in family carved* *Residential school survivor*	Basic personal information: Name(s), Nation(s) of belonging, locations (towns) where carving practices occurred/occur, relevant family history.
Carving practices *Products carved* *Client-driven products* *The practice of carving* *Tree species carved* *Who carved large whole logs* *Why redcedar is carved*	Products carved with redcedar, why redcedar is used, and other species used in carving practices. Any aspect of the carving practice related to products, and beliefs about the meaning of carving in the culture and to carvers. An overall explanation of the practice.
Cedar stewardship planning *Access to LCC in future* *Industrial harvesting practices* *People initiatives* *Preserve forest land* *What trees to protect or harvest*	The most important considerations for Nations developing a LCC stewardship plan/strategy.

Changes in number of people learning to carve *Less people* *Decrease in interest* *Decrease in market demand* *Less investment in culture* *More people* *Larger population* *Revival of culture*	Perspectives on the dynamics in people interested and/or learning the practice of carving today compared to when participants began their practice (50 years ago). Opinions about the revival of carving within the culture.
Changes to log quality *How wood is different* *Wood is different now* *Changes in wood quality affect carving* *Wood quality is the same*	Changes in the morphological characteristics of cedar logs that carvers desire for carving distinct products, over time. Opinions about carving second-growth cedar.
Changes to carvers' practices *Changes in carving methods* *Changes in who you carve for or why you carve* *Commercial clients* *Foreseen changes* *Changes in products carved and why*	Changes carvers have made in their individual practice. Any change related to log access, products carved, time spent carving or who/what they carve for.
Community carving traditions *Influences on traditions* *Traditions and their meaning* *Trends in traditions*	Changes in the creation of products over time in communities, from past to present. When and why these changes occurred.
Finding redcedar in the forest *Knowledge of places* *Looked for trees but never harvested* *Place names* *Site characteristics associated with LCC traits*	Opinions or knowledge about where to find LCC in the forest, including place names, forest stand or landscape characteristics. Descriptions of places where they have found cedar and if they still can find cedar there.
Getting a log *Ability to get logs* *Distribution of logs-carvers' opinion* *Early ability* *Recent ability* *Getting logs overtime* *Preferred way to get logs* *Ways of getting logs* *Common ways in past* *Common ways recently* *Free Use Permit*	Process of acquiring logs, including how logs are typically acquired, all ways logs have been acquired and preferred way to get logs. Changes in ways of getting logs and why those changes occurred.
Harvesting and LCC numbers *Opinions about harvesting practices* *How harvesting has affected LCC numbers* *How harvesting practices should change*	Perspectives about harvesting practices affecting the quantity of cedar and LCC available for carving practices currently, and into the future. Suggestions about how harvesting practices should change to protect cedar and old-growth forests.
Harvesting and receiving logs from licensees *Felling of LCC*	Perspectives about how licensees facilitate or hinder carvers' ability to get logs (both in the past and

Quality of logs given *Thoughts about getting logs*	today). Comments about the quality of logs received from licensees.
Importance of Tree of Life *Value of cedar* *Uses of cedar*	The importance of redcedar, the Tree of Life to carving and *Kwakwaka'wakw* culture and uses of cedar beyond carving.
Influences to carving *Commercialization* *Cultural revitalization* *Early influences and catalysts* *Giving back and tradition* *Historic events* *Personal* *Wood quality and access*	Perspectives about all things (influences) that have influenced or brought about change in the practices of carvers over their careers, the practice in general, and the practices of past generations (prior to 50 yrs ago). Knowledge about the factors that have influenced carving practices, including beliefs about historic influences.
LCC i.d. for licensees *Have not identified LCC for industry* *Receiving LCC from i.d. process* *Type of LCC tagged*	Identifying if carvers have tagged LCC for licensees during cutblock preparation and reasons for tree tagging.
No category responses *Indigenous history and the past* *Carving practices and traditions* *Cedar* *Comments about the future* *Kwakwaka'wakw culture* *Personal accounts*	Participant responses that warranted a unique node and ranged across a variety of topics.
Opinions about LCC stewardship *Alternative ways to access LCC* *Grateful remarks about LCC research* *Opinions about Nations' management of cedar* *Yellow cedar considerations*	Perspectives about Nations' LCC planning strategies and initiatives for cedar stewardship. Suggestions for improving cedar stewardship.
Traditional carving protocols *History of carving* *Opinions about historic practices* *Traditional historic practices*	Knowledge about historic carving practices (traditional practices of the ancestors) with respect to tree harvesting and carving protocols. Opinions about historic practices and why they are or are not practiced today.
Where logs come from *Carving off Vancouver Island* *Great Bear Rainforest* *Unsure* *Vancouver Island*	The area, place (e.g., log sort) or traditional territory where carvers believe their carving logs come from.
Who or what carvers carve for *Ceremony and family* *Commercial clients* *Greater community*	The reasons, people, and institutions carvers carve products for.
Why carvers carve *Culture and family* *Income* *Lifestyle and enjoyment*	The niches carving fulfills in carvers' lives. Opinions about carving as a sole source of income or as an avocation.

2.6.3. Table 2.4

Table 2.4. Categorization of nodes and sub-nodes according to emergent research questions and those that were developed in an inductive manner following the first few interviews with participants. Initial nodes are in plain font, while emergent nodes and sub-nodes are in italics. Sub-nodes of sub-nodes are indented. These nodes and sub-nodes were analyzed to abstract interview text segments or quotes that supported our interpretation of participant responses to research questions.

Emergent research question	Supporting initial and emergent nodes	Corresponding sub-nodes
What is known of the practice of carving in historic times—dating back ~200 years from today, excluding the most recent 50 years?	Community carving traditions	*Influences on traditions* *Traditions and their meaning* *Trends in traditions*
	Getting a log	*Ways of getting logs* *Common ways in past*
	Importance of Tree of Life	*Value of cedar* *Uses of cedar*
	No category responses	*Indigenous history and the past* *Carving practices and traditions* *Kwakwaka'wakw culture*
	Traditional carving protocols	*History of carving* *Opinions about historic practices* *Traditional historic practices*
How would carvers describe the practice of carving in recent times—the last 50 years?	Biggest influence moving forward	*Ability to pass on teachings* *Access to logs* *Unique concerns*
	Carving practices	*Products carved* *Client-driven products* *The practice of carving* *Tree species carved* *Who carved large whole logs* *Why redcedar is carved*
	Changes in number of people learning to carve	*More people* *Larger population* *Revival of culture*
	Changes to log quality	*How wood is different* *Wood is different now*

		Changes in wood quality affect carving *Wood quality is the same*
	Community carving traditions	*Influences on traditions* *Traditions and their meaning* *Trends in traditions*
	Getting a log	*Ability to get logs* *Distribution of logs-carvers' opinion* *Early ability* *Recent ability* *Getting logs overtime* *Preferred way to get logs* *Ways of getting logs* *Common ways in past* *Common ways recently* *Free Use Permit*
	Harvesting and LCC numbers	*Opinions about harvesting practices* *How harvesting has affected LCC numbers*
	Harvesting and receiving logs from licensees	*Felling of LCC* *Quality of logs given* *Thoughts about getting logs*
	Influences to carving	*Commercialization* *Cultural revitalization* *Early influences and catalysts* *Giving back and tradition* *Historic events* *Personal* *Wood quality and access*
	No category responses	*Carving practices and traditions* *Cedar* *Comments about the future* *Kwakwaka'wakw culture* *Personal accounts*
	Who or what carvers carve for	*Ceremony and family* *Commercial clients* *Greater community*
	Why carvers carve	*Culture and family* *Income* *Lifestyle and enjoyment* *Giving back*
What are the changes and trends that have occurred in carvers' practices in recent times?	Changes in number of people learning to carve	*Less people* *Decrease in interest* *Decrease in market demand* *Less investment in culture*

		More people *Larger population* *Revival of culture*
	Changes to log quality	*How wood is different* *Wood is different now* *Changes in wood quality affect carving* *Wood quality is the same*
	Changes to carvers' practices	*Changes in carving methods* *Changes in who you carve for or why you carve* *Commercial clients* *Foreseen changes* *Changes in products carved and why*
	Getting a log	*Ability to get logs* *Distribution of logs-carvers' opinion* *Early ability* *Recent ability* *Getting logs overtime* *Preferred way to get logs* *Ways of getting logs* *Common ways in past* *Common ways recently*
	Harvesting and receiving logs from licensees	*Quality of logs given* *Thoughts about getting logs*
What influences have contributed to the changes and trends in carvers' practices or the practice in general?	Biggest influence moving forward	*Ability to pass on teachings* *Access to logs* *Unique concerns*
	Changes in number of people learning to carve	*Less people* *Decrease in interest* *Decrease in market demand* *Less investment in culture* *More people* *Larger population* *Revival of culture*
	Changes to log quality	*Changes in wood quality affect carving*
	Community carving traditions	*Influences on traditions*
	Harvesting and LCC numbers	*Opinions about harvesting practices* *How harvesting has affected LCC numbers*

	Harvesting and receiving logs from licensees	*Felling of LCC* *Quality of logs given* *Thoughts about getting logs*
	Influences to carving	*Commercialization* *Cultural revitalization* *Early influences and catalysts* *Giving back and tradition* *Historic events* *Personal* *Wood quality and access*
	Who or what carvers carve for	*Ceremony and family* *Commercial clients* *Greater community*
	Why carvers carve	*Culture and family* *Income* *Lifestyle and enjoyment* *Giving back*
Additional research questions	**Supporting initial and emergent nodes**	**Corresponding sub-nodes**
What trends and changes occurred in the carving practices of past generations and in the *Kwakwaka'wakw* culture more than 50 years ago?	Community carving traditions	*Traditions and their meaning* *Trends in traditions*
	No category responses	*Indigenous history and the past* *Carving practices and traditions* *Kwakwaka'wakw culture* *Personal accounts*
	Traditional carving protocols	*History of carving* *Opinions about historic practices* *Traditional historic practices*
What are the influences responsible for the trends and changes in the carving practices of past generations and in the *Kwakwaka'wakw* culture more than 50 years ago?	Community carving traditions	*Influences on traditions*
	Influences to carving	*Cultural revitalization* *Early influences and catalysts* *Historic events* *Personal*
	No category responses	*Indigenous history and the past* *Kwakwaka'wakw culture* *Personal accounts*
	Traditional carving protocols	*Opinions about historic practices*

2.6.4. Table 2.5

Table 2.5. Additional direct quotes of participants that support some of what participants shared in interviews about influences and resulting changes in their carving practices or the practice in general in recent times. Influences are bolded and contained within a single row. Phrases in parentheses following an influence are how most participants described that influence.

Change(s) in Participant's Carving Practices or the Practice in General	Direct Quote
The market economy (Carving for sales)	
Carving of non-traditional products and animals/creatures at the request of clients	*Who is to think that you would be making tables and chairs and all kinds of things like that. There was masks and plaques, and it has changed* (JH)
Some products are carved physically and aesthetically different for sales than for ceremonial or other traditional uses	*Now there are different practices for your sales masks and then your dance masks and I think a lot of that has changed for us over the years* (RF)
Fewer carvers prioritize ceremonial projects because of the money that can be earned carving for sales	*I have based [my career] on, if I make a bit of money [from carving], then I look for an avenue with [my carving] where I can give back somewhere [...] I hope that other [carvers] realize that balance in their practice. To pay back what they are taking from. Their families went to jail for keeping this stuff alive and we have to remember and respect that* (Junior H)
Industrial forest management (The logging industry)	
Logs are generally accessed through licensees now via the formal log donation process	*The romantic notion is you go up in the forest and size a tree up and you are going to [find a log] and do this personally, but the reality is, none of these carvers are going out into the bush [...] they are just going to the log sort* (RS)
It is more difficult to acquire donated logs from licensees now and in a timely manner	*Now you need a letter from Chief and Council [to get a log]. You got to go to the Ministry and they sign off, you got to go the forest company and they sign off and by the time you get [to the log sort] you got four letters in hand just to get the logs! And yet we go through a bunch of bureaucratic bullshit, that's what I call it, when the wood is ours!* (JH)
More poor-quality logs and second-growth logs are being received from licensees	*But for this specific [licensee] that [BH] has been dealing with for this long, why do they try to even offer this [small, poor-quality] log to him? Is that all there is? Do you mean to tell me there isn't anything else? I don't think so* (GH)
High quality logs received from licensees are sought for ceremonial and community projects while those with more defects are generally carved for sales	*If it is a [carving project] for the [First Nation] Band, I'll go fight for a really nice log, and then you have a blessing afterwards. You are fighting for something that you believe in, something that's family, that's community* (RF)
Advancements in technology (Carving tools and marketing)	

More options exist now to market products because of the internet	*Marketing. We have learned to develop, well, a lot of the young artists are developing web pages and selling themselves online and going out to the market that way. I still don't hardly ever do that* (JH)
Honouring cultural obligations (Fulfilling personal responsibilities)	
More is being carved as First Nation communities prioritize reviving cultural practices	*[Carving and ceremonies] are picking up quite a bit more now. A lot of the villages and families are getting together, [having] gatherings [...] so building big houses is pretty important to carvers nowadays, because a lot of the [First Nation] Bands are trying to get back to the traditional ways* (MC)
Revival of culture in Kwakwaka'wakw communities (Resistance and revitalization)	
More opportunities to create products for the community are available, inciting a resurgence in carving	*There is a lot of re-identifying of who we are and looking back into history, with these community projects now, like the [K'omoks] Guardian poles* (KE)

2.6.5. Section 1 Open-ended interview questions

If a carver did not offer knowledge or information that the first author was seeking once an interview question was asked, subsequent questions were asked as prompts (see indented questions).

Introductory questions: Carver background

-Can you tell me your full name, what Nation you are a member of and where you grew up?

-Where do you usually live?

-Is this where you typically do your carving?

-Do you know where, the area or traditional territory, your cedar logs/trees you carve with come from?

-What is your carving practice, or what do you carve or make, with redcedar?

-Do you also carve yellow cedar?

-Other tree species for carving?

-What/who do you carve for?

-Community or ceremony?

-For yourself or family, or commercial clients?

-Is carving your primary way of earning a living?

-Would you just want to carve to make a living if you could?

-Do you think that carving for commercial clients has changed your carving practice or practices in general?

-How long have you been carving with cedar? Tell me about your practice…

-Still carve cedar now/in recent years?

-Were there periods when you stopped carving? When was this and why?

-Why did you start carving again?

-When have you carved the most and why?

-Do you think the number of people learning to carve now or in the last decade is different than from past decades? From when you were learning?

-When (actual years) did you learn?

-Why do you think [more/less] people learning now?

-Will the next generation see more/less people carving or wanting to carve?

-Have you ever changed your carving practice, for example, where you get cedar logs, what you carve, or how often you carve certain things, or for who you carve for? Tell me about it…

-When did you make changes? (what years)

-Why?

-Do you think you will make changes to your carving practice moving forward?

-What are these changes and why?

-Do you think paying clients influence carving practices?

Questions related to accessing cedar in the forest, cedar habitat and industrial harvesting with respect to carving practices

Questions with a * beside them were asked to inform Benner et al. (2021) and Chapter 4).

-What is your process for finding, harvesting, transporting and carving a cedar log? Tell me your process step by step…

-Do you scavenge for logs on the beach? On old logging roads or in clearcuts?

-Has length of time spent on finding a log changed? Why & when?

-Any step(s) of your process changed?

-How do you get to areas to find cedar?

-Have you removed a plank from a standing tree?

-Have you began your carving process in the forest?

*If a carver has searched (in past/recent times) for a tree in the forest, ask; or skip to ^ below

-How have you known where to look for cedar in the forest?

-Have you ever changed the area(s) where you go to look for cedar? Why?

-Where is this?

-When did you start looking in different areas?

*-What do you consider, other than tree characteristics (such as tree diameter, knots, rot), when you are looking for a cedar?

-How to access/remove tree or log?

-Breakage from falling?

-Leave tree standing for future generations?

-Number of other suitable trees close by?

*-Can you describe the type of area in the forest where you would find a tree for carving? Tell me about these places (perhaps from knowledge passed down to you)…

-Close to streams/water body

-Close to coastline

-In dense forest with many trees, OR, open forest with lots of brush

-Forest with other big, tall trees

-Close to openings

-Wet or swampy ground, OR, well drained

-Type of soil

-Bottom, middle or upper slope

-Direction slope is facing

-Steep slopes or flat ground

-High, or low, or mid elevations

-Types plants, shrubs or trees that are close by

*-Can you show me [on a map] where you have gone to find cedar or where cedar was found by your mentors or carvers of past generations?

-When did you go to find cedar in those places?

-If locations changed overtime, why?

-Since you first started looking for cedar (in the forest), has it become easier or more difficult to find a log for carving? Tell me about this…

-How is it easier/more difficult?

-When did it start to become more easy or difficult?

-What territory or area was this in?

-Are there traditional rules or protocols carvers have followed to access and harvest cedar in the forest?

-Can you explain them to me?

-Do carvers (if not yourself) still follow these rules? Why/why not? (Who?)

-When did (most) carvers stop following traditional protocols?

^-What are <u>all</u> the ways that you have gotten a cedar log for carving?

-What is the most common way for you? Is this your most preferred way?

-If you changed how you get a log, when did you change your method? Why?

-Does it matter to you how you get a cedar log to carve? Why?

-Are there traditional/ceremonial protocols that are still done today associated with carving, regardless of how and where a log was accessed?

-If part or all of these ceremonial protocols are not practiced anymore, why do you think that is so?

-Have you ever identified large cedar that would be good for carving (for a licensee), in the forest before that area is logged?

-Have you received a cedar, for carving, by doing this?

-Have you ever used a “Free Use Permit” to harvest a cedar for carving?

-When (what years a FUP has been used)?

-Why did you get a FUP? (What changed if you were not using a FUP before)

-Do you think current forestry or logging practices affect the numbers of large high-quality cedar available for carving?

-How so?

-Do you think logging practices influence/have influenced your ability to get a cedar log for carving?

-Do logging practices help/facilitate with accessing cedar? How?

-Have logging practices affected your carving practice in ways others than access to logs?

-How?

-In the future, over the next 300 years, do you think will there be enough cedar for First Nations (Bands) and carvers to access across Traditional Territories for carving purposes?

-How will the availability of cedar change?

-Do you think logging companies will help with accessing logs into the future?

Questions related to factors influencing access to cedar and carving practices overtime (that are not industrial harvesting)

-Since you started carving, has it become easier, more difficult or stayed the same, to get a cedar log for carving? Tell me about this…

-How is it easier/more difficult?

-When did this change occur?

-Are you concerned about being able to access high quality cedar logs into the future? Why or why not?

-Since you have started carving, has the quality of logs/wood (number knots, colour, tight grain, straight grain…) changed over time? Tell me about this…

-Have you ever carved had to carve cedar logs that came from second-growth trees instead of old-growth?

-Why and when did you start carving second-growth?

-How has carving second-growth affected your practice?

-What has affected/influenced your carving practice?

-Has what you carve, who you carve for, when you carve, why you carve and how you carve changed in any way overtime?

-Has the carving of certain purposes (canoes or totems for example) changed in your community over time?

-Tell me a bit about what used to be carved or is still carved a lot?

-When did changes happen?

-What would you tell your Nation is important for their cedar stewardship planning?

-What should they know about issues concerning access to cedar, trends in the carving of certain purposes or the quality of logs being carved?

-What do you think will be the biggest influence to your carving practice moving into the future?

-What things might have the biggest influence on the carving practices of future generations?

-What, if anything, would you like to see change in relation to your carving practice?

-I have asked you what I wanted to ask, but is there anything you would still like to share with me, or something that I missed about your experience carving with cedar that you think I should know about?

2.6.6. Section 2 Additional direct quotes of participants (historic times)

Additional direct quotes of participants that support some of what participants shared in interviews about changes, trends and influences in carving practices and the Kwakwaka'wakw culture in historic times.

Deaths from disease epidemics and warfare resulted in fewer people belonging to the First Nation community and fewer carvers to pass down their knowledge. As Karver Everson (KE) highlighted, *"K'omoks [First Nation] at one point was 10 or 20 thousand people who lived here in the Pentlatch territory [...]K'omoks [peoples] were pushed down [island] through warfare in 1850 and a lot here was wiped out with famine and disease [...] Now we are 300 K'omoks [people*]. *There are only two carvers on our reserve now."* Greg Henderson (GH) captured the significant decline in the production of material culture, including carved products, resulting from the residential school policy and cultural bans when he said, *"The residential school and the government, and our [cultural objects] and villages being taken away and torn down. Literally, driving the culture out of a person. It was here once upon a time, but after some of that devastation, culture and [carving] was next to nothing."* Similarly, Junior Henderson (Junior H.) described the degree of loss of material cultural when he said, *"If we had the option to re-build and re-create all the [carvings] that were taken away and all the carved [products] that were burned and demolished and destroyed, we would need a whole lot of logs. All the big houses were torn down [...] and the totem poles taken away, masks taken away, burned, [...] canoes that were just destroyed, there is probably hundreds!"* Max Chickite (MC) provided a fitting example of the loss of traditional use of carved products for personal use as a result of cultural bans when he said, "*Since the banning of culture, we weren't allowed to use masks. Like when my grandparents were alive [the culture] was all stripped [from us] right? It got taken all away, so when I [carved] this mask and gave it to my grandparents for Christmas, they went and hid it. Because [they] didn't know who was coming through the door, they were scared of the suits."*

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Chapter 3. A literature review on heartwood decay in western redcedar (*Thuja plicata*): Implications for Indigenous cedar stewardship on the coast of British Columbia

Cedar is the tree of life, what we call the tree of life, it gave us everything from clothing to transportation to housing, pretty much everything

Richard Sumner, cedar carver, Mamalilikulla First Nation

3.1. Introduction

Large old trees provide important social-cultural benefits to societies worldwide, including symbolic and cultural heritage value (Blicharska and Mikusinski 2013, 2014). These trees also serve as keystone structures (Lindenmayer et al., 2014) that contribute disproportionately to ecological function of diverse terrestrial ecosystems (Lindenmayer et al., 2012a; Lindenmayer et al., 2012b). As such, the scarcity of large old trees around the globe (Lindenmayer et al., 2012; Lindenmayer et al., 2018) is of concern to the people for whom such trees hold direct cultural, religious, spiritual, symbolic and utilitarian value (Blicharska and Mikusinski 2013), and those who benefit from the ecosystem services these large old trees provide.

A variety of mortality factors contribute to the rarity of large old trees, including timber harvesting, decay, droughts, wildfires, and insect infestations (Lindenmayer et al. 2012; Lindenmayer et al., 2018). While some species of large old trees are more susceptible than others to these threats, decay is common in old individuals of any species, because old trees sustain mechanical damage and are exposed to fungal pathogens over long periods of time, resulting in the persistent decay of heartwood (Hennon, 1995). As a result, internal bole decay is a substantial contributor to the mortality rates of large old trees (Lindenmayer et al., 2018). Decay also contributes to other important ecological processes, such as nutrient cycling (Lindenmayer et al., 2012a) and forest regeneration (Lonsdale et al., 2008; Radu, 2006), and to the structure of mature resilient forests (Blicharska and Mikusinski, 2014; Lindenmayer and Laurence, 2017).

Despite the social, cultural, economic, and ecological implications of decay-caused mortality of large old trees, and the important roles of decay in ecosystem productivity and resilience, most research about decay dynamics focuses on impacts related to the economics of merchantable tree species (Bergin, 2000; Sturrock et al, 2017). Relatively few studies assess the influences that plant diseases, such as pathogenic decay, have on the culture and cultural identity of Indigenous peoples (the few exceptions include Boyd et al., 2013; Voggesser et al., 2013; and Lambert et al., 2018). In this literature review, I focus on decay in western redcedar (*Thuja plicata*; hereafter "redcedar") and consider the implications of such decay for Indigenous forest stewardship and culture.

Redcedar is a cultural keystone species for the Indigenous peoples of British Columbia (BC), Canada (self-identified as "First Nations")[1] (Garibaldi and Turner, 2004). Cultural keystone species are those that Indigenous and local peoples rely upon most extensively to fulfill their needs, and as such, become embedded in a people's cultural traditions and stories (Garibaldi and Turner 2004). Redcedar is known for its large old specimens, which can live well beyond 1000 years (Franklin and Hemstrom 1981, Keenan 1993, Chapter 4). Large old redcedar trees tend to possess large volumes of heartwood with narrow growth rings and fewer knots than second-growth trees (Antos et al. 2016). These characteristics make these large old trees desirable for carving in First Nations' culture, and also potentially highly profitable for the logging industry. However, old redcedar trees frequently develop heartwood decay, often extensively, despite possessing a high resistance to decay (Buckland, 1946; van der Kamp 1975, 1986). The natural decay resistance of redcedar is associated with the presence of numerous fungitoxic extractives in the heartwood (Stirling and Morris 2015), but various species of fungal pathogens can tolerate and overcome these defensive compounds and cause considerable decay (e.g., see Sturrock et al. 2017).

Large old redcedar that have wood qualities and other characteristics that make them suitable to carve for Indigenous cultural purposes – such as dugout canoes, totem poles, large ceremonial masks, bentwood boxes, and traditional buildings – are known as "Large Cultural Cedar" (LCC), or "Monumental Cedar" (Figure 3.1). Decay can

[1] The Indigenous peoples of Canada are First Nations, Métis or Inuit. Section 35 of the Canadian *Constitution Act, 1982* refers to these peoples collectively as "Aboriginal peoples" (*Constitution Act*, 1982, s 35).

severely reduce the potential supply of LCC (Benner et al., 2019; 2021), and can impact the suitability of an individual tree for carving (Benner et al. 2021). Because of the high incidence of decay in large old redcedar, and the forest industry targeting these trees for more than a century in British Columbia (Green 2007, Nelson 2004), trees that possess wood traits that make them suitable for cultural carving are now rare across the landscape (Benner et al., 2021; Sutherland et al., 2016).

Decay has become a key consideration in the intergenerational LCC stewardship planning and practices of some First Nations. For example, some First Nations have established a maximum threshold for decay as one of several criteria used to determine if a redcedar tree qualifies as a LCC (Benner et al. 2021). They have also identified the need for a set of tree morphological and environmental indicators to help visually predict decay occurrence and amount in living LCC. Knowledge about other factors contributing to pathogenic decay in redcedar, such as the role of fungal pathogens, may be useful for predicting decay occurrence in LCC at the landscape scale. For instance, fungal species distribution models can be used to identify forest stands most likely to harbor fungal species that infect redcedar (e.g., see Hao et al. 2020).

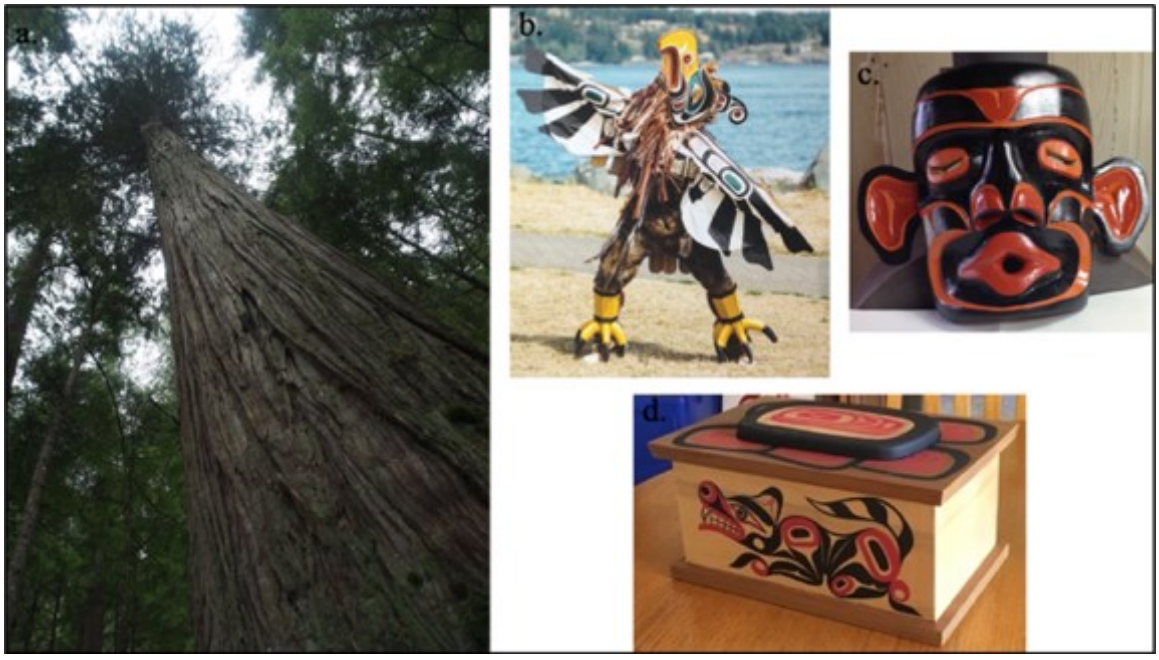

Figure 3.1. Pictures of (a) a LCC tree, (b) a ceremonial dancing mask adorned with redcedar bark strips, (c) a ceremonial mask, and (d) a bentwood box, each of which were carved from redcedar (photo credits: Julie Nielsen).

In this paper, I review and synthesize literature about the main factors that indicate pathogenic heartwood decay in redcedar and influence its development. I focus on knowledge that is relevant to and supports Indigenous redcedar stewardship, some of which overlaps with the management of redcedar in an industrial context (Table 3.2 in Supplementary Material summarizes knowledge gaps and research questions that are important for Indigenous LCC stewardship). To establish the scope of this literature review, I started with morphological attributes that indicate decay in redcedar, then considered the three interrelated causes of disease in trees that make up the "disease triangle" (Figure 3.2): the susceptibility of a host species; a virulent pathogen; and habitat conditions (environmental or climatic) favourable for disease (Klopfenstein et al., 2009; Sturrock et al., 2011). I reviewed research that relates directly to the causal factors of disease in redcedar trees: host tree decay resistance; fungal pathogen species; and environmental site conditions. While these causal factors are the subject of much scholarly research, I found only one report—Sturrock et al. (2017)—that reviewed the literature on redcedar morphology and all three factors in relation to the decay of living redcedar. However, Sturrock et al. (2017) focus on knowledge to assist forestry professionals in developing strategies for genetic selection and industrial silvicultural initiatives to plant and grow decay-resistant redcedar to be harvested in less than 100 years. In contrast, I reviewed and synthesized knowledge about tree morphology and key causes of decay in living redcedar to inform Indigenous LCC stewardship. Knowledge of value to Indigenous redcedar stewardship is applied to help identify and conserve first growth redcedar trees and forest stands for their cultural use and ecological value (e.g., those with little decay), and to develop silvicultural strategies that promote the development of redcedar into LCC.

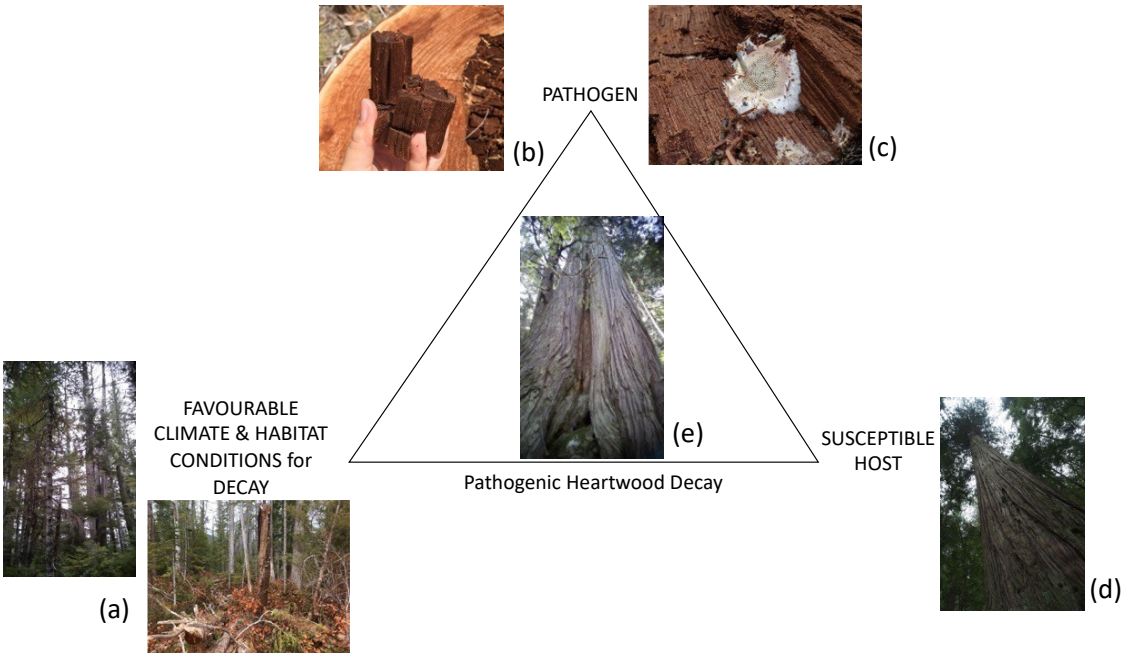

Figure 3.2. A diagrammatic representation of the 'disease triangle', adapted from Klopfenstein et al. (2009), as it pertains to pathogenic heartwood decay in redcedar (photo credits: Krys Stone, Julie Nielsen). Pictures (a) through (d) represent the three interrelated causes of disease in trees, while picture (e) shows heartwood decay in a redcedar tree. Pathogenic heartwood decay is the result of the interactions amongst the three causes of the disease.

My objectives in this literature review are to:

1) review and synthesize existing knowledge about morphological indicators of decay and three causal factors influencing decay in living redcedar (tree decay resistance, fungal pathogens and environmental conditions) that could be useful for Indigenous LCC stewardship; and

2) discuss the implications of this knowledge for Indigenous LCC stewardship, and identify the knowledge gaps relevant to LCC stewardship that should be addressed though future research.

I begin the paper by discussing the importance of knowledge about indicators and causes of decay in redcedar in relation to Indigenous LCC stewardship (the rationale for the literature review), and then turn to the methods, results and discussion.

3.1.1. Rationale for the literature review: Why knowledge about the main factors that influence decay in redcedar is important for Indigenous LCC stewardship strategies

Morphological characteristics associated with decay in redcedar

Indigenous policy and practices aimed at protecting LCC to fulfill the cultural needs of current and future generations rely on knowledge about LCC abundance and community needs, and the dynamics of each over time (Benner et al. 2021). The identification of morphological tree characteristics that could serve as potential indicators of decay would enhance LCC field inventory survey techniques for identifying the incidence, and to some degree, extent of decay in trees. While minimally invasive technologies such as tomography and resistance micro-drilling can be used to detect and quantify decay in trees (Ouis, 2003; Wang and Allison, 2008), these techniques are often costly and time consuming, and may be logistically infeasible in steep terrain (Monk, 2011; Brazee et al., 2011). The use of visual indicators such as distinct tree morphologies to predict decay in LCC could improve the accuracy and efficiency of decay prediction. Predictions of decay amount in LCC boles and measures of bole size are important to building an LCC inventory because decay and size thresholds are used along with other criteria to determine whether or not a tree can be classified as an LCC (Benner et al. 2021).

Decay resistance in redcedar

The forest industry in the Pacific Northwest continues to influence the direction of studies on the decay resistant properties and processes of trees, including redcedar. Much of the recent work in this field is funded by industry and is aimed at developing genetic breeding initiatives to improve the resistance of trees to pathogenic decay (Russell and Daniels, 2010; Russell and Yanchuck, 2012). While this research is intended to assist industry in reducing the occurrence of decay in planted redcedar (Antos et al., 2016), it can also benefit First Nations developing intergenerational LCC stewardship strategies. Such strategies are based on timelines of 300 years or more (e.g., see Nanwakolas Council 2021 and Quintry 2009), given that it takes many centuries of growth for redcedar to develop the wood qualities and reach the dimensions that characterize LCC (Benner et al. 2021). Knowledge about the factors that affect decay resistance in redcedar, and the application of such knowledge to genetic tree

breeding strategies aimed at enhancing decay resistance, may be useful to First Nations in developing silvicultural initiatives for redcedar that support the development of younger redcedar into LCC over time.

Fungal pathogens that infect living redcedar

Knowledge that helps to identify fungal pathogen species that infect living redcedar could improve LCC field inventory techniques by helping to detect decay in trees based on the identification of fungal species living on candidate LCC trees. Such knowledge could also contribute to silvicultural initiatives in Indigenous LCC stewardship strategies. For instance, through the identification and quantification of fungal species across different forest stands, it is possible to identify and manage stands that are more likely to support a developmental pathway in young redcedar that enables trees to develop the traits that characterize LCC, such as a relatively sound bole. In addition, knowledge about how fungal pathogens enter redcedar trees and spread within forest stands, and about the modes of survival of such pathogens across different site and seasonal conditions, could inform stewardship decisions about pre- and post-harvesting practices.

Environmental site conditions associated with fungal pathogens and decay in redcedar

A better understanding of the relationships between decay in redcedar and environmental conditions, including those that may facilitate or inhibit fungal pathogens, would improve the accuracy of field survey techniques for predicting decay in LCC, and could inform decisions about protecting areas on the landscape where the conditions are the most suitable for the recruitment of younger redcedar into LCC over time. For example, an understanding of the habitat types that support the survival of different pathogens could help LCC field surveyors in detecting decay in LCC and contribute to identifying spatial envelopes of ideal growing conditions for LCC. In addition, knowledge about environmental correlates of LCC and decay in LCC can be applied in species distribution models to predict the geographical distribution of candidate LCCs (Benner et al. 2019) and their quality relative to the potential of decay incidence.

3.2. Methods

I conducted a systematic search for published works on decay in redcedar, and specifically on the main factors that indicate or are associated with decay in relation to redcedar—tree morphology, decay resistance, fungal pathogens, and environmental site conditions. I searched the academic literature and grey literature, including published and unpublished reports by Indigenous, industry, and government groups that focused on decay in redcedar. I did not limit the online search with a date of publication. I conducted searches in each of the following databases: ISI Web of Science, Google Scholar, Canadian Research Index (Canadian Government database), EcoCat (Ecological Reports Catalogue, BC Ministry of Environment database), and ScienceDirect. I searched each database twice, first during the period from September 2017 to March 2018, and then again during the period from May 2019 to July 2019. I completed the first database search prior to commencing writing of this literature review, and conducted the second database search to update the literature review prior to writing, which I began in July 2019. I conducted a final search using Google Scholar in March 2024 to identify relevant literature that was published after July 2019.

In each of my database searches I used the keyword search term “western redcedar,” in combination with either “heartwood decay” or “typical tree decay” or “tree rot.” Next, I searched the resulting set of documents for those that included at least one of the terms “environmental correlates,” “ecological conditions,” “pathogen,” “fungal,” “microbial activity,” “decay resistance,” “extractives,” “tree architecture,” or “morphology.” Within this subset I deemed documents appropriate to review if they discussed or contained findings about decay in redcedar in relation to one of, (1) morphological tree characteristics, (2) decay resistance, (3) fungal pathogens, and (4) environmental site conditions. For such documents, I performed an in-depth review (complete reading) (Torraco 2005) and included findings in the results that could be relevant to the Indigenous stewardship of redcedar.

3.3. Results

3.3.1. Morphological tree characteristics associated with decay in redcedar

Redcedar can possess various external indicators of internal heartwood decay (Figure 3.3). Distinct forms of tree architecture such as dead spike crowns (or tops), as well as alterations to boles, branches and roots resulting from damage, can signify internal bole decay, although their presence may not always confirm substantial decay. Important morphological indicators of decay in trees may be part of natural tree morphology, or be caused by wounding resulting in architectural defects, such as broken tops or branches, bole cavities and bole scars. Fungal pathogens can enter living trees through infection courts that are either a result of damage and scarring, or natural growth processes. Infection courts that develop from natural growth processes can include dead branch stubs and small twigs, cankers, frost cracks, crooks and seams (Zeglen, 1997). Thus, the common morphology of deep fluting seams caused by extensive buttressing in redcedar serves as a natural infection court.

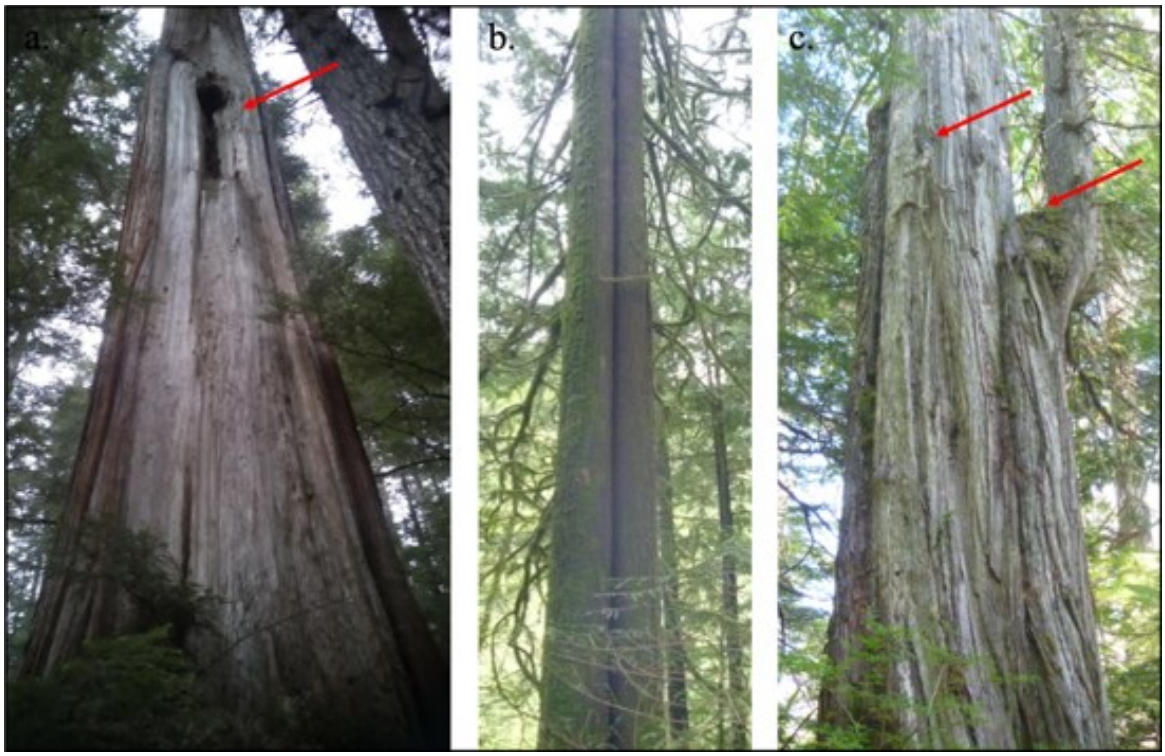

Figure 3.3. Pictures of some potential visual indicators of heartwood decay in redcedar (photo credits: Julie Nielsen). Picture (a) shows a bole cavity in a large old redcedar. Picture (b) is of a deep and extensive seam in a redcedar bole. Picture (c) shows a large dead branch stub indicated by the left-sided arrow and a crook between the tree bole and candelabra, indicated by the right-sided arrow.

Spike crowns, where more than half of the crown is dead (Sturrock et al., 2017) are characteristic of many large old redcedar trees. Tree crown health is used by Indigenous cedar carvers as a gauge of potential “inner rot” within a tree (Sutherland et al., 2016). Conversely, crown die-back observed in redcedar, reflected in a spike top, spike forked top, or broken top were assessed in early seminal studies as innately occurring traits which “did not appear to indicate appreciable decay” (Buckland, 1945; Kimmey, 1956). Spike crowns are thought to result from apical crown dieback, where the main leader and often several lateral leaders have died, possibly owing to cavitation in the upper hydraulic conduits of the stem (Lori Daniels, personal communication, June 26, 2019). Crown dieback may also result from calcium deficiency in redcedar (D’Amore et al., 2009; Egan, 1999; Trant et al., 2016), although little is known about this potential mechanism. Regardless of cause, dead spike crowns may serve as predisposing, inciting, or contributing factors to decay (Manion 1991; Sturrock et al., 2011). Predisposing factors cause long-term or slow change, whereas inciting factors cause

short-term, acute stress (Sturrock et al., 2011). Contributing factors kill trees already affected by a long- or short-term factor (Sturrock et al., 2011). It is reasonable to assume that, relative to trees with healthy live leaders, spike crowns and spike forked crowns are more likely to develop cracks and crooks, with the potential to break. Consequently, spike crown morphology likely serves as a natural infection court for pathogen entry.

Another natural feature often observed in large, old redcedar associated with the presence of bole decay is colloquially referred to as a ‘catface’, historically known as “dry-side” (Sturrock et al., 2017; van der Kamp, 1988) (Figure 3.4). Catfaces in redcedar have been associated with the fungal pathogen Armillaria ostoyae, which is suspected of killing an area of bark in the lower bole above an infected root(s) (van der Kamp, 1988). Over time, a pocket of decay develops inside the bole, resulting in approximately one third of the surface of the tree circumference becoming flat or sunken (Buckland, 1946; van der Kamp, 1988). Catfaces serve as visual cues to the potential presence of heartwood decay or damage to the root system or lower bole of a tree because decay fungi frequently enter trees via basal stem and root tissues (Buckland, 1946 in Sturrock et al., 2017).

Figure 3.4. A picture of redcedar tree with a catface (photo credit: Julie Nielsen). The picture shows a catface on the left side of the tree that extends approximately 5 m up the bole.

Anthropogenic modifications, such as those characterizing culturally modified trees (CMTs), also provide entryways for pathogens, if damage extends to the inner bark and wood tissues. Indigenous peoples of the Pacific Northwest of North America modified redcedar through activities such as stripping bark, removing planks, and boring test holes (Earnshaw, 2019; Mobley and Eldridge, 1992). Such cultural modifications cause morphological defects that injure and expose the inner bark, serving as a catalyst of the decay process. Although such modifications can serve as indicators of decay, identifying those that were made many decades to centuries ago on old redcedar can be a difficult task because trees produce healing lobes that obscure scars over time (Figure 3.5) (Earnshaw, 2019).

Figure 3.5. Pictures of redcedar stumps showing healing lobes of scars that were produced by past cultural modifications (photo credits: Krys Stone). Picture (a) shows a plan-view of the stump that is characterized by two healing lobes ("HL") growing inwards, beginning to obscure the scar. Picture (b) shows a stump with four healing lobes.

Other distinct bole characteristics likely to serve as infection courts are mechanical wounds from natural disturbances. For example, swollen or rotten knots, rotten burls and cankers may originate from mechanical damage, whereas scars from fire, a breakage in the tree stem or branches, or frost cracks occur as a result of natural stochastic events (Aho, 1982; Farr et al., 1976 in Sturrock et al., 2017; Kimmey, 1956). Manning (2001) examined external defects and their relationship with the internal condition of trees across 15 species and reported bole damage to be the most common indicator of heartwood decay in redcedar. Similarly, Buckland (1946) concluded that fire scars and basal wounds of the bole are important infection courts for decay organisms in living redcedar. In a study of redcedar of coastal BC, van der Kamp (1975) also found that extensive bole and butt decay was common and was most often accompanied by basal scars.

Tree age, although not a morphological characteristic of trees, may help to estimate the extent of decay in large trees, given that age is an important correlate of decay. In the absence of dendrochronological methods, tree diameter at breast height (DBH) can be used as a proxy for age, given that redcedar DBH and age are significantly correlated, although the relationship is weak due to high variance (Daniels et al., 1995). Buckland's (1946) study of decay in 615 redcedar revealed a positive relationship between decay volumes and tree age. In a comparable study, Kimmey (1956) found that decay, as "cull volume", in redcedar (n = 111) and associate trees

increased dramatically with age, such that at 400 years nearly 70% of stem volume was cull. Sturrock et al. (2017) determined that in both of these early studies the fraction of redcedar with incidence of decay increased precipitously at approximately 50 years of age and continued until 450 years, when all trees studied displayed some decay. However, inconsistencies have been reported that do not correspond to the positive relationship between age and decay in redcedar found in these studies. For example, Earnshaw (2019) discovered a very large, ancient (approximately 1,165 years old) redcedar with fully intact (sound) heartwood at the tree pith. Furthermore, field observations of large old redcedar with sound heartwood from the pith outward have been made across several stands in coastal BC (Jacob Earnshaw, personal communication, May 22, 2017; Personal observation, Julie Nielsen).

While visible wounds are likely the most reliable morphological indicators of decay in trees, their capacity to indicate the extent of decay within the bole is limited. Additional factors such as tree vigour, decay resistance and the virulence and species of fungal pathogens are instrumental to the rate of fungal colonization of wood (Mike Cruikshank, Canadian Wood Fibre Centre, personal communication, Sept. 18, 2017; Sturrock et al., 2017). Although assessing these factors in the field can be difficult or impossible, they are important considerations which can skew estimates of decay that rely solely on morphological indicators.

3.3.2. Decay resistance in redcedar

Host tree susceptibility or, conversely, resistance is a key component of the disease triangle (Klopfenstein et al., 2009; Sturrock et al., 2011). The decay resistance of individual redcedar trees plays a vital role in the processes involved in progressive heartwood decay through time. Decay resistance in living trees is a measure of an individual tree's susceptibility to invasion and colonization by fungal pathogens (Zabel, n.d.). Fungi are the pathogens that most commonly attack living redcedar, overcoming the constitutive (pre-existing or passive) defense system of the tree to invade heartwood and cause decay (Shain, 1995). Depending on the mode of entry into the tree, fungi can be countered with a suite of induced (active) defenses, involving physical changes to structural wood cells and the release of several chemicals (Sturrock et al. 2017). Although several induced responses exist in redcedar, their mechanisms are multifaceted (see Cleary and Holmes, 2011 and Cleary et al., 2012a,b) and much is still

unknown (Sturrock et al., 2017). Past research has focused on the capacity of specific compounds, also known as extractives, to inhibit enzymatic activities of fungal species (e.g. see Chedgy et al., 2009; Lim et al., 2005; Lim et al., 2007; Stirling and Morris, 2016), although it is still unknown if a single extractive or a suite of extractives is most responsible for inhibiting fungal colonization of redcedar heartwood (Stirling et al., 2017).

Conversely, the activities of fungal pathogens have received much attention in the literature, which indicates that a succession of microorganisms are involved in the decay process (Shigo, 1967; Shigo and Hillis 1973; van der Kamp, 1975 & 1986). Working together, microorganisms have the ability to bypass induced and constitutive defense mechanisms in trees. Early research on defense mechanisms in redcedar determined that pioneer invading organisms did not deteriorate wood tissues but instead altered defensive compounds found in heartwood (Barton and MacDonald, 1971; van der Kamp, 1975 & 1986). Through alteration of these compounds, invasion by subsequent (secondary) fungal and microorganism species is possible (van der Kamp, 1975). While there has been interest in the ability of fungal species to detoxify extractives (e.g. see Jin et al., 1988 and Lim et al., 2005), the research has not yet determined which fungal species can tolerate or degrade which extractives in redcedar (Stirling et al., 2017).

The majority of what is known about decay resistance in redcedar comes from an extensive body of research that focuses on extractive compounds (e.g., see Eades and Alexander 1934; Frietag and Morrell, 2001; Jin et al. 1988; Kirker et al., 2013; Nault 1988; Rennerfelt 1948; Roff et al. 1962; Southam and Ehrlich 1943). The production of extractives, which are classified as secondary metabolites (Southam and Ehrlich, 1943), is thought to be under strong genetic control (DeBell et al., 1999; Ericsson et al. 2001; Fries et al., 2000; Nault, 1988). The suite of unique extractives in redcedar is considered to be the largest contributing factor to the decay resistance and wood durability of the species (Sturrock et al., 2017), which is very high in comparison to other softwood species (Sowder, 1929; Stirling and Morris, 2011). Twenty-one extractives have been identified in redcedar heartwood (Gardner and Barton 1958; Gardner 1963; Stirling and Morris 2011). Several of these have been identified as fungitoxic (DeBell et al., 1999), but their role in overall decay resistance is still not fully understood (Sturrock et al. 2017; Taylor et al., 2002).

Contemporary studies are beginning to elucidate the roles of individual extractives in the susceptibility of redcedar to decay organisms. Earlier work describes the suite of extractives identified for redcedar as a composition of thujaplicins (terpene tropolones) together with lignans (phenols and polyphenols) and other terpenes, all of which are constitutes of resin (Haack and Slansky, 1987; Nault, 1988; Russell and Daniels, 2010). The lignans plicatic acid and plicatin may contribute to redcedar decay resistance not as fungicides but indirectly by scavenging radicals and chelating ferrous iron (Schultz and Nicholas, 2000; Schultz et al., 2005). For several decades the thujaplicins were thought to play the most significant role in the ability of redcedar to defend against multiple pathogenic microorganisms (Erdtman and Gripenberg, 1948; Nault, 1988). More recent research suggests otherwise: thujaplicins can biodegrade (Jin et al., 1988) and a poor correlation exists between thujaplicins and decay resistance under different lab and in-ground wood testing scenarios (Morris and Stirling, 2012; Taylor et al., 2006b). Taylor et al. (2006b) suggest that a single heartwood extractive in redcedar is not fully responsible, nor can it fully elucidate, natural heartwood durability, particularly when multiple agents of decay are being considered.

The susceptibility of a tree to fungal infection and spread depends on several factors, given that the traits of both pathogens and trees will be unique in any single incidence of attack. Decay resistance of trees, which has significant inter- and intraspecies variation (Zabel and Morrell 1992), is thought to be a product of both environmental and genetic factors (Yu et al. 2003; Bush et al. 2011; Partanen et al. 2011). Intraspecies differences in decay resistance can be prominent (Hillis, 1985; Scheffer and Cowling, 1966), and are more apparent in older trees (Zobel and Jett 1995). Nault (1988) reported a high variation in the level of thujaplicins among redcedar trees within a stand and proposed that extractive concentrations are under genetic control and related to tree age.

The inherent variation in decay resistance between individual trees becomes a confounding factor when examining the incidence of decay across a breadth of environmental conditions (Scheffer, 1957). Changes in environmental conditions, whether long-term or short in duration, can promote physiological stress in trees, subsequently serving as pre-disposing or inciting factors to pathogenic disease (Franklin et al., 1987; McDonald et al., 1987). Trees under physiological stress will reallocate resources, which can weaken a tree's defense responses (Hobbs and Partridge 1979).

Yet, the relationship between the production of extractives and dynamics in environmental conditions remains unclear. Nonetheless, it is reasonable to suggest that the production of extractives, and therefore decay resistance, is affected by environmental conditions that promote stress in trees, in addition to genetic controls, to some degree.

The relationship between forest site conditions and extractive properties continues to be a subject of interest in the literature. Research has indicated that the levels of extractives within individual trees are dependent upon environmental conditions (Taylor et al., 2003), such as carbon dioxide concentrations, air temperature and soil moisture (Turtola et al., 2003; Kilpelainen et al., 2005). Relationships between properties of extractives and environmental conditions have been studied in other tree species such as *Picea abies* (Rhen, 2004), eucalyptus spp. (Kilulya et al., 2014) and *Pinus radiata* (Woollons et al., 2008). Recent research concludes that concentrations of secondary extractives (those specific to a species) in fact “depend on site as well as on genetic factors and growth conditions” (Roffael, 2016). Conversely, site factors such as geographic location and elevation have been weakly correlated or not correlated at all to extractive properties (Caron et al., 2013; Kim et al., 1989). The relationship between extractives in living redcedar and environmental conditions is understudied; to date, only Taylor (2004) and Taylor et al. (2006a) have examined this relationship.

While prior research has inferred a positive relationship between the production of extractives and decay resistance in redcedar, these dynamics are still poorly understood. In living redcedar, extractives are generally found in highest concentration in the outer, youngest heartwood layers, closest to the sapwood boundary (Daniels and Russell, 2007; DeBell et al., 1999; Hillis, 1987; MacLean and Gardner, 1956; Nault, 1988; Scheffer, 1957; Scheffer and Cowling, 1966). Thus, older heartwood, closest to the pith, is likely more vulnerable to attack by fungal agents. Field observations indicate the pattern of decay generally observed in old-growth redcedar trees is from the pith outward, supporting the proposition that older heartwood is less decay resistant. While overall extractive concentrations in redcedar heartwood increase with tree age (Nault, 1988; Daniels and Russell, 2007), fungistatic and toxic extractives degrade over time (Wagener and Davidson 1954). The greater amounts of heartwood decay that are found in older trees relative to younger individuals (Buckland, 1946; Hennon, 1995; Kimmey, 1956), could be, in part, a result of the degradation of extractives over time. However,

several studies report an inconsistent and often weak relationship between decay resistance in redcedar and the content and concentrations of extractives (DeBell et al., 1999; Hillis, 1987; Taylor et al., 2002; Taylor et al., 2006b). In addition, as trees age, their exposure time to microbial and fungal activity increases (Hennon, 1995), and mechanical damage producing infection courts can accumulate over time (Hennon, 1995), contributing to higher decay volumes in older trees.

3.3.3. Fungal pathogens that infect living redcedar

Wood decay fungi that invade living redcedar are mostly of the phylum Basidiomycota (Sturrock et al. 2017), which produce either bole and butt decay or root rot in trees (Arnstadt et al., 2016; Sturrock et al., 2017). Species that contribute to advanced decay of redcedar heartwood are classified as either white or brown rot fungi, distinguished by the rate at which different species degrade cellulose, hemicellulose and lignin (Sturrock et al., 2017; Tuor et al., 1995). They are visually differentiated by the colour and texture of the resulting decayed wood. White rot fungi transform heartwood into a white to yellowish colour, with spongy to string-like texture that appears laminated to pitted, depending on the stage of decay (Sturrock et al. 2017) (Figure 3.6). Brown rot fungi leave wood dark brown, with a cubical appearance (Figure 3.6). While white rot species can decay wood completely (Ryvarden, 2001), brown rot fungi decay wood into a substrate still containing lignin, which becomes a key constituent of forest soils (Gilbertson and Ryvarden, 1986).

Figure 3.6. Pictures of redcedar heartwood that has been decayed by white rot and brown rot fungal species (photo credits: Krys Stone). Pictures (a) and (b) show heartwood characteristic of decay caused by brown rot fungi. Picture (c) shows heartwood characteristic of decay caused by white rot fungi.

Two other groups of decay fungi that infect living redcedar are true heart rots and wound parasites (Sturrock et al. 2017, Etheridge 1973, Hunt and Etheridge 1995). True heart rots enter trees through infection courts that develop from natural growth processes and typically produce decay that is confined to the heartwood of a living tree (Hunt and Etheridge, 1995). True heart rots are presumed to have evolved with first-growth forest ecosystems through time and are suspected of exclusively infecting old ageing boles (Vasaitis, 2013). Conversely, most fungal wound parasites require wood to be colonized by other microorganisms in order to infect heartwood cells, although they can also attack living tissues (i.e. sapwood) and serve as pioneer colonizers (Sturrock et al., 2017).

Most research on the epidemiology of tree species of temperate coastal rainforests has been conducted in the context of the economic impacts on the forest industry by decay-causing pathogens that attack merchantable tree species. The economic importance of redcedar has played a large role in identifying its principal decay fungi, yet substantial knowledge gaps exist concerning the infection biology and survival mechanisms of fungal agents. Over 200 pathogens have been identified on redcedar (Minore, 1990), with approximately 30 considered principal white rot or brown

rot species that infect living trees (Sturrock et al., 2017). Sturrock et al. (2017) succinctly describe six of these species[2], which are considered to have the greatest impact on living redcedar in terms of wood volume decayed and frequency of occurrence. Of the six principal decay fungi of redcedar, all produce fruiting bodies, yet for reasons still unknown, fruiting bodies, and in particular bole conks, are rare on living trees (Buckland, 1946; Patton, 1942). For example, *Postia balsamea* (brown cubical butt rot) produces shelf-shaped fruiting bodies which have been detected on *Crataegus* spp., but not yet reported on redcedar (Sturrock et al., 2017). Allen et al. (1996) suggest that for *Perenniporia subacida* (stringy butt rot), the existence of fruiting bodies on living trees indicates decay up to 3-4 m longitudinally within the bole, although this has not been confirmed for redcedar. In the case of *P. weirii,* decay is typically found to extend 2-3 m up the bole from the base of the tree, but can extend 10 m or more (Hagle, 2006).

While the literature reports the infection biology and means of spread of some fungal species known to attack living redcedar, there is a dearth of knowledge in this area of study. Early studies established that several fungal species that attack living redcedar can live as saprophytic organisms in dead boles and roots for decades or longer and can also persist in slash and woody debris on the forest floor (Etheridge, 1973). Gilbertson (1980) reports several root and butt rot fungi, including *P. weirii*, can survive in dead root systems for more than a century. The persistence of fungi in dead boles, roots and slash may perpetuate the infection of redcedar trees in a stand over time because these dead components, and in particular roots, act as reservoirs and transport pathways of inoculum. According to Sturrock et al. (2017), only two of the six principal decay fungi of redcedar have confirmed modes of spread. *Perenniporia subacida* spreads using mycelia through root contact, while *P. pini* is transported via spores. Spread through spores has also been proposed as a possible mode of spread for the five other species, including as an additional mode for *Perenniporia subacida* (Sturrock et al. 2017). Cruickshank et al. (2018) acknowledge that a knowledge gap exists concerning the mechanisms decay fungi use to enter roots of redcedar. For example, it is unknown whether spores of butt decay fungi, such as *A. ostoyae,* can infect roots through direct physical contact (Cruickshank et al., 2018). For at least some fungal decay species, including the three principal white rots of redcedar, entry into the

[2] Principal decay fungi of living redcedar; *Obba rivulosa, Perenniporia subacida, Phellinus weirii, Porodaedalea pini, Postia balsamea* and *Postia sericeomollis* (Sturrock et al. 2017)

tree can be through surface mycelium which can penetrate small roots (Cleary et al., 2013; Cruickshank et al., 2018). Mycelium infected with *P. weirii* was found to penetrate roots from colonized wood inoculum (Sturrock and Pellow, 2013). However, this mode of spread and colonization would be considerably slower than microorganisms entering the tree through wounds caused by mechanical forces or other pathogenic species (e.g., lesions formed by *A. ostoyae*) (Cruickshank et al., 2018). Further research is needed to confirm how principal fungal species of decay gain entry into redcedar boles.

3.3.4. Environmental site conditions

The literature on fungal pathogens includes a large amount of research on the environmental conditions associated with infection by, and survival of, these fungal pathogens. While this research overlaps with the literature discussed in the previous section of this paper, I review it under the first subheading below because it also overlaps with the broad literature on environmental site conditions and susceptibility to decay in redcedar (reviewed under the second subheading below). Environmental site conditions and characteristics, such as elevation and soil moisture, are an important focus in LCC stewardship strategies.

The impacts of environmental site conditions on fungal pathogens known to infect redcedar

Principal white and brown rot fungal species occurring on living redcedar have been the subject of several studies linking environmental site conditions to fungal distributions. In particular, in comparison with the other factors discussed in this literature review, there is an abundance of scholarship examining the effects of site conditions related to temperature and moisture on fungal pathogen incidence and richness and/or decay occurrence in trees. While much of this work has sampled host tree species other than redcedar, the studies examining associate tree species of redcedar, such as western hemlock (*Tsuga heterophylla*) and Douglas fir (*Pseudotsuga menziesii*), or conifer species susceptible to infection by fungal pathogens associated with redcedar (Table 3.1), offer insight into the possible dynamics among fungal species that infect redcedar, environmental site conditions and decay. In general, it seems likely that combinations of site factors, such as temperature, soil moisture and soil pH, act synergistically to influence the occurrence and frequency of different species of decay fungi, as suggested for *P. weirii* by Thies and Sturrock (1995).

Table 3.1. Published works that examine relationships between environmental site conditions related to temperature and/or soil moisture and (a) heartwood decay in living trees, or (b) the occurrence or abundance of fungal pathogens associated with redcedar. Only studies examining redcedar, associate tree species of redcedar, or conifer species susceptible to infection by fungal pathogens associated with redcedar are included.

Reference	Tree host species	Environmental site attributes related to temperature and moisture	Study conclusions related to soil moisture and temperature and fungal decay species[a] and/or decay in trees
Aho (1982)	*Pseudotsuga menziesii/* Douglas fir, *Tsuga heterophylla/* western hemlock, *Pinus monticola/*western white pine	Slope incline, stand age[b] and soil depth/type	Occurrence of *Porodaedalea pini* was positively correlated with slope and stand age and increased in shallow soils.
Bernier and Lewis (1999)	*Picea* spp./ spruce genus	Site series, soil moisture, soil coarseness, slope position, humus form and soil texture	In the area studied, only relatively wet to very wet sites have a negative influence on the incidence of *Inonotus tomentosus (Onnia tomentosa).* Soil moisture, as influenced by slope position and soil texture, is the most important site variable influencing the incidence of *I. tomentosus.*
Bouslimi et al. (2013)	*Thuja occidentalis/* northern white-cedar	Site moisture and stand age	Incidence of brown rot decay increased relative to increasing site moisture and stand age.
Cruickshank et al. (1997)	*Pseudotsuga menziesii*	Soil moisture regime (according to Klinka and Brisco, 2009)	*Armillaria ostoyae* occurred more often in fresh and slightly dry soil moisture regimes than in moist soil conditions (in coastal sites in BC).

Reference	Tree host species	Environmental site attributes related to temperature and moisture	Study conclusions related to soil moisture and temperature and fungal decay species[a] and/or decay in trees
Etheridge (1956)	*Picea spp.*	Dry and moist sites classified using plant associations and tree age	Incidence of butt and bole decay of several white rot and brown rot species was higher on moist sites, where it appeared faster-growing trees may be more prone to fungal infection than slower-growing trees.
Hobbs and Partridge (1979)	*Pinus ponderosae/* Ponderosa pine, *Pseudotsuga menziesii, Larix occidentalis/*western larch, *Pinus contorta/*lodgepole pine, *Abies grandis/*grand fir, *Pinus monticola*, *Thuja plicata*/western redcedar, *Tsuga heterophylla*, *Picea engelmannii*/Engelmann spruce, *Abies lasiocarpa*/subalpine fir, *Tsuga mertensiana*/mountain hemlock, *Pinus albicaulis/*whitebark pine	Elevational gradient (altitude used as a proxy for heat/temperature and moisture regimes)	*Postia sericeomollis* and *Phellinus weirii,* primarily found on *Thuja plicata,* were found in lower elevation stands. Overall, temperature and moisture regimes at lower elevations may inhibit the enzymatic activities of some fungal species.
Hofmeyer et al. (2009)	*Thuja occidentalis, Abies balsamea/*Balsam fir, *Picea rubens* Sarg./red spruce	Soil drainage or soil site class (measured as a gradient ranging from well-drained to very poorly-drained)	Decay incidence was highest on well-drained mineral soils and increased as drainage improved from poorly-drained, wet soils to well-drained soils, in outwardly sound trees.
Kim et al. (2010)	*Abies grandis*, *Tsuga heterophylla, Thuja plicata*	Plant associations (representing combined temperature-moisture regimes)	*Armillaria* spp. occurred more frequently in relatively wet sites than in drier sites to a significant degree.
Kimmey (1956)	*Thuja plicata*	Elevation	No relationship between decay volumes and elevation was determined.
Korhonen and Stenlid (1998)	*Picea abies/*Norway spruce	Soil moisture content, water table dynamics	*Heterobasidion annosum* had a higher frequency of occurrence in mineral soils having a lower moisture content or with a fluctuating water table.

Reference	Tree host species	Environmental site attributes related to temperature and moisture	Study conclusions related to soil moisture and temperature and fungal decay species[a] and/or decay in trees
Mattila and Nuutinen (2007)	*Picea abies*	Elevation, temperature (sum of daily average), mineral soil site type (field data for each variable was used to train a logistic regression model)	Probability of decay damage from *Heterobasidion annosum* root and butt decay was inversely related to elevation and increased with temperature. Decay damage was more frequent on fertile sites and less in peatlands.
McDonald et al. (1987)	"*Tsuga mertensiana* & *Pseudotsuga menziesii* stand-type" and "*Abies grandis* & *Thuja plicata* & *Tsuga heterophylla* stand-type"	Temperature-moisture transitional zones (cold-dry to cool-moist and warm-dry to warm-moist)	Undisturbed transitional zones exhibited a high incidence of *Armillaria spp*. (in a pathogenic state) relative to disturbed areas outside of temperature-moisture transitions.
Robison (2000)	*Thuja plicata*	Elevation	Decay volumes were inversely related to elevation.
Whitney (1995)	*Picea glauca*/white spruce, *Picea mariana*/black spruce, *Abies balsamea*	Tree age, soil moisture regime and soils texture	*Armillaria ostoyae* infected significantly more *P. mariana* and *A. balsamea* on dryer sites than wet sites.

a Current common names of fungal decay species can be found in the body of this paper
b Stand age may affect site temperature and soil moisture through canopy closure at various seral stages

Several studies have linked soil moisture to the incidence and abundance of fungal decay species found on redcedar (Table 3.1). For instance, Bernier and Lewis suggest soil moisture, as influenced by slope position and soil texture, is the most important site variable influencing the incidence of *O. tomentosa*. In general, the majority of studies suggest wet to very wet soils tend to negatively impact the incidence of various fungal pathogens (Table 3.1). Cruickshank et al. (1997) suggest that anoxic conditions, which are characteristic of saturated soils, could inhibit fungal colonization and enzymatic activity. Nonetheless, pathogens such as *Armillaria ostoyae* have the capacity to survive in diverse environments, such as dry or wet soils (Klopfenstien et al., 2011) (Table 3.1).

Site conditions at different phases of the lifecycle of a pathogen play a role in determining the habitat conditions of fungal species. For example, the formation of basidiocarps, responsible for spore production, are affected by changes in edaphic moisture content and air temperature, thereby influencing fungi dispersal (Gilbertson, 1980). Some species require an optimum temperature for spore germination, such as *Rhizina undulata*, a root rot of living redcedar (Allen et al., 1996). Hardison (1976) speculated *R. undulata* may rely on fire to create site conditions such as exposed mineral soil, acidic soil and optimum temperatures that promote spore germination.

Environmental site conditions that influence redcedar's susceptibility to decay pathogens

Tree resistance to pathogenic decay depends on stochastic genetic variation, evolved immunity, plasticity and environmental conditions (Cruickshank et al., 2010; Liu and Ekramoddoullah, 2003; Yanchuk et al., 1988). This combination of factors makes determining a set of environmental conditions that promote decay in living redcedar a complex task. Further, the plastic nature of redcedar (El-Kassaby, 1999), which allows it to survive and often thrive across a wide spectrum of soil moisture and fertility (Antos et al., 2016), makes assessing the influence of environmental conditions on decay dynamics an even greater challenge.

Environmental conditions that elevate physiological stress likely increase tree susceptibility to pathogenic infection. For example, trees experiencing perpetual drought stress are more susceptible to invasion by primary and secondary pathogens (Desprez-Loustau et al., 2006; Haughian et al., 2012; Kliejunas et al., 2009). In general, colonization by root pathogens and wound decay fungi, such as *Armillaria spp*., is facilitated by stress in host trees (Lonsdale and Gibbs, 2002; Desprez-Loustau et al., 2006). Host trees may experience different levels of stress brought about by drought, temperature extremes, and reduced site quality (Wargo and Harrington, 1991; Goheen and Otrosina, 1998 in Sturrock et al., 2011). Locales which are more likely to promote stress in redcedar may display prolonged water deficits or continual very wet [3] soils (Klinka and Brisco 2009), a history of fire or insect disturbance, or a high exposure to

[3] Very wet soils are classified in Green and Klinka (1994) 'A Field Guide for the Site Identification and Interpretation for the Vancouver Forest Region, Land Management Handbook Number 28', as part of the Soil Moisture Regime (SMR) classes that contribute to the identification of site series.

wind. While extremes in edaphic conditions may incite physiological stress in redcedar, or pre-dispose trees to it, nutrient-poor soils and those that are classified as wet (Klinka and Brisco 2009) actually constitute productive habitat throughout the range of redcedar (Klinka and Brisco, 2009; Minore, 1990).

While habitat quality thresholds for redcedar can be used to assess stress levels in trees, such thresholds mostly relate to seedling and sapling life stages of the species (e.g., see Drever and Lertzman, 2001; Fan et al., 2008; Grossnickle and Russell, 2006; Klinka and Brisco, 2009; Minore, 1983; Presecott et al., 1993). As such, these habitat quality thresholds may not be suitable for assessing stress in large old trees. Although there is less documentation of the conditions associated with physiological stress responses in older redcedar trees, the phenomenon of apical crown dieback in areas of coastal BC may reveal more about this relationship. Drought stress is responsible for reduced radial growth over approximately the last 50 years, and for recent canopy dieback and mortality in coastal redcedars growing in the Pacific Northwest that were of similar diameter to small LCCs (Andrus et al. 2023).

Stand disturbances and fluctuations or persistent change in environmental conditions can influence the incidence and amount of decay in trees by enhancing or degrading habitat and requirements for tree growth. McDonald et al. (1987) suggest tree species inhabiting natural transitional zones within their ranges, and those in disturbed sites, may experience higher physiological stress, hampering the ability of trees to defend against pathogens. Likewise, the findings of Taylor et al. (2003) indicate how changes in site conditions can influence decay resistance within trees and thus, decay volumes. In their study of *P. menziesii*, Taylor et al. (2003) found a positive relationship between radial growth rate and heartwood extractive content, and a coupling between changes in ring width and extractive content. These findings indicate a potentially significant relationship between environmental conditions affecting growth rate and the efficacy of a tree's defensive response to fungal attack.

Geographic location may also influence the effect of local site conditions on decay development in trees. The research suggests that populations of redcedar in the dryer, warmer interior region of BC experience higher incidence and greater volumes of decay than do coastal BC populations (Buckland, 1946; Daniels and Russell, 2007). Daniels and Russell (2007) suggest this may result from interior trees containing lower

amounts of the extractive beta-thujaplicin than coastal trees. Scheffer (1957) concludes that redcedar can show variation in “durability” (decay resistance) with geographic location, although the natural variation in decay resistance between trees can mask site or regional differences. It is also plausible that disparate site conditions associated with coastal and inland areas could either promote or hinder the distribution, survival and virulence of fungal pathogens (as discussed in the preceding subsection of this review).

At the landscape and local scales, studies examining the relationship between site conditions and decay incidence in redcedar are limited. Broad studies discuss the use of site characteristics, such as slope angle, elevation and aspect (i.e. solar radiation), in assessing disease expression in conifers, because of the direct effects of these characteristics on pathogens and host susceptibility (Holdenrieder et al., 2004). Overall, broad coarse-scale studies have found pathogen and disease incidence across tree species to be mostly limited by elevation, solar radiation and soil moisture (McDougall et al., 2002; Wilson et al., 2003). Relative to redcedar, earlier studies assessed elevation in relation to decay volumes (Kimmey, 1956) and the presence of fungal species (Hobbs and Partridge, 1979) (Table 3.1). Kimmey (1956) found no relationship between decay volumes and elevation in trees ranging from 30-230 cm in diameter at breast height (n=98) in southeast Alaska. More recently, Robison (2000) studied redcedar in the interior region of BC and found decay volumes were inversely related to elevation (Table 3.1), which could relate to higher site productivity and larger tree sizes. Productive sites, which are often defined by the specific soil moisture and nutrient requirements of different tree species, have been correlated to higher volumes of decay (Foster et al., 1954; Thomas and Thomas, 1954), although this was reported for species other than redcedar.

With the potential for climate change to alter feedbacks among climate, site factors, fungal pathogens and trees into the future (Jactel et al., 2012), changes in the distributions of decay organisms and subsequent changes in stand and landscape patterns of tree decay become more likely. Increasing temperatures resulting from climate change are expected to coincide with an increase in the occurrence of forest pathogens and the duration of their infections (Sturrock et al., 2011; Woods et al., 2010). Temperature and soil moisture are sensitive to seasonal fluctuations and disturbance events, making climate change a key factor in the spatial and temporal dynamics of fungal pathogens, which are presumably most directly affected by moisture (Agrios,

2005; Woods et al., 2010). Rapid and unprecedented changes in temperature and precipitation regimes may bring about more favourable conditions for some species of heart-rot fungi, many of which can persist in dry heartwood for decades prior to catalyzing the decay process (Kliejunas et al., 2009; Wright, 1934). Klopfenstein et al. (2009) conclude that as temperatures increase and precipitation decreases in some climates, occurrence of *A. ostoyae* will increase. Sturrock et al. (2017), however, suggest that the frequency of some decay fungi, such as *Armillaria spp*., could either increase or decrease depending on their preference for either drier or wetter conditions. Ayres and Lombardero (2000) and Sturrock et al. (2011) predict even modest climate change could alter distribution patterns of *Heterobasidion annosum* and *Armillaria spp*.

While there appears to be a consensus in the literature that global warming will generally improve conditions for several forest pathogens and increase tree mortality (Allen et al., 2015; Ayres and Lombardero, 2000; Daniels et al., 2011; Desprez-Loustau et al., 2006; Kliejunas et al., 2009; van Mantgem et al., 2009), the interactions among climate, fungal pathogens and trees can be difficult to assess, even without considering climate change (Allen et al., 2010). Uncertainty in predicting future climate-pathogen-tree interactions stems from a difficulty in modeling changes in precipitation patterns (IPCC, 2007). The future of redcedar and its relationships with fungal pathogens under climate change are uncertain (Sturrock et al., 2017) and will be difficult to accurately forecast into the future (Woods et al., 2010).

3.4. Discussion: Implications for Indigenous LCC stewardship

Research on decay in trees tends to focus on economically-valuable species, with applications to forest management practices (Bergin, 2000; Sturrock et al, 2017). Western redcedar is a species of economic importance that is also significant to Indigenous culture and, in particular, to cultural carving practices (e.g., see Benner et al. 2021). Here, I reviewed knowledge about tree decay that is relevant for Indigenous stewardship, to support cultural practices and enhance the conservation of LCC over time. In the following paragraphs I discuss the implications of the knowledge collated in this review for intergenerational LCC stewardship strategies.

3.4.1. Morphological tree characteristics associated with decay in redcedar

The morphological characteristics associated with redcedar that are likely the most reliable indicators of decay include catfaces (Buckland, 1946; van der Kamp, 1988), healing lobes characteristic of CMTs, and bole scars such as those resulting from fire or mechanical damage (Manning 2001). While dead spike tops, spiked forked tops and broken tops are natural infection courts for pathogens, they do not always confirm the presence of decay (e.g., see Buckland, 1945; Kimmey, 1956). For Indigenous LCC stewardship, catfaces, healing lobes and boles scars are important visual cues that may serve as LCC field inventory criteria to help surveyors gauge the occurrence and possible extent of decay within the bole of a LCC. Surveyors could also consider tree top condition when predicting decay in LCC, with an understanding that the presence of a spike top or broken top in the absence of a catface or healing lobes or scars on the bole is insufficient to confidently predict decay within the bole. The application of these characteristics as field survey criteria could contribute to building a more accurate LCC inventory given that robust predictions of decay are needed to classify trees as LCC. Moreover, a description of these characteristics, including tree top condition, in LCC inventories could help cedar carvers to select a tree that best suits their carving needs.

Future research on the relationship between decay and natural infection courts on redcedar, including spike tops, forked spike tops and broken tops, could further enhance field inventory techniques for predicting decay. For instance, while spike tops, dead branch stubs, cankers, frost cracks, crooks and bole seams serve as natural entry ways for pathogens (Zeglen, 1997), little is known about the significance of the role of each in the decay process in redcedar. Another knowledge gap relevant to LCC stewardship is what influence climate change will have on the frequency of occurrence of the drivers of specific redcedar morphologies such as catfaces, spike and forked tops, and bole scars resulting from natural events. While the effects of climate change on some natural stochastic events that affect the scarring of boles, such as fire and storm events, are the subject of much research, it is unknown how specific morphologies common to redcedar such as catfaces and spike and multiple-fork tops will change with global warming. Given that the primary potential mechanism for the development of catfaces in redcedar is a pathogen (van der Kamp, 1988), and for spike tops is cavitation in hydraulic conduits of the bole (Lori Daniels, personal communication, June 26, 2019)

or calcium deficiency (D'Amore et al., 2009; Egan, 1999; Trant et al., 2016), research about the effects of climate change on specific pathogens and soil moisture and nutrients will be important for LCC stewardship.

3.4.2. Decay resistance in redcedar

It is unknown if a single extractive or a suite of extractives is most responsible for inhibiting the fungal colonization of redcedar heartwood (Stirling et al., 2017); however, it is likely that multiple extractives explain the natural resistance of redcedar to decay (Taylor et al., 2006b). Moreover, there is an inconsistent and often weak relationship between the content and concentrations of extractives in redcedar and decay resistance (DeBell et al., 1999; Hillis, 1987; Taylor et al., 2002; Taylor et al., 2006b). In redcedar, both the production of extractives and their concentrations are thought to be under strong genetic control, and the latter is thought to be related to tree age (Nault 1988). In addition to genetic controls, it is likely that the production of extractives is correlated to some degree with environmental conditions that promote stress in trees (e.g., see Taylor et al., 2003; Roffael, 2016).

Research on several tree species indicates the amount of extractives depends on environmental conditions, such as carbon dioxide concentrations, air temperature and soil moisture (Turtola et al., 2003; Kilpelainen et al., 2005). Thus, it is likely that the decay resistance of redcedar will be affected by global warming, although the mechanism and degree is not yet known. Despite these significant knowledge gaps, LCC stewardship silvicultural initiatives can benefit from existing knowledge about the mechanisms of decay resistance of living redcedar. For instance, First Nations may delineate forest stands to serve as recruitment areas for LCC based on the knowledge that the production of extractives is correlated to genetic controls and, to some degree, environmental conditions. Stands where abundant and relatively sound LCC are growing may provide the niche environmental conditions required for the optimum production of extractives and extractive concentrations, while LCCs growing in these stands are likely to serve as parent trees that possess strong decay resistance. Tree breeding strategies could use the seeds of these parent trees to breed redcedar seedlings with enhanced decay resistance that could be planted in LCC recruitment stands.

Future research exploring the relationship between decay resistance and extractives profiles and concentrations in redcedar could contribute to more effective LCC tree breeding strategies. LCC stewardship could also benefit from research that examines the tolerance of various fungal pathogens to the suite of extractives found in redcedar, which could help to identify candidate stands for LCC recruitment based on the incidence of distinct fungal pathogens within a stand. Lastly, research aimed at elucidating the effects of changes in environmental conditions, such as carbon dioxide concentrations, air temperature and soil moisture, on extractive production in redcedar is important not only to silvicultural initiatives in intergenerational LCC strategies, but also to approaches to LCC conservation. LCC growing in forest stands most affected by rapidly changing environmental conditions, such as those already experiencing soil moisture deficits, could be more vulnerable to having decay resistance compromised, and thus, may not be ideal candidate stands for LCC conservation.

3.4.3. Fungal pathogens that infect living redcedar

While the fruiting bodies, including bole conks, of the six principal decay fungi of redcedar are rare on living trees (Buckland, 1946; Patton, 1942), the identification of fungal species as either white or brown rot fungi is possible because of the distinct appearance of the infected wood of each (Sturrock et al. 2017). However, there is only limited knowledge about the six principal fungal species that attack redcedar (as described by Sturrock et al. 2017), and, in particular, about their infection biology, survival mechanisms and means of spread. Several fungal species known to attack living redcedar can live as saprophytic organisms in dead boles and tree roots for decades or longer and can also persist in slash and woody debris on the forest floor (Etheridge, 1973). In addition, the three principal white rot species of redcedar can gain entry into trees though surface mycelium that penetrates small roots (Cleary et al., 2013; Cruickshank et al., 2018).

For LCC stewardship, distinguishing between white and brown rot species on LCC is important for calculating the trade-offs between harvesting LCC for current cultural use and protecting them for future generations and to promote ecological integrity. Given that brown rot species decay wood into a substrate that becomes an important constituent of forest soils (Gilbertson and Ryvarden, 1986), while white rots can decay wood completely (Ryvarden 2001), LCC infected by brown rot species may

better serve as trees in long-term retention in harvested areas for ecological goals, contributing to soil development and ecosystem structure. Knowledge about the presence of fungal species in snags (dead standing trees), dead tree roots and slash and woody debris is also important, to inform LCC pre-harvest planning and post-harvest stewardship practices. Because the persistence of fungal pathogens in such reservoirs can perpetuate the infection of living redcedar, the identification of pathogen incidence could help to eliminate stands with high likelihood of decay in LCC, but also inform post-harvest stewardship practices aiming to mitigate the infection of retained trees, such as stump and slash removal.

Indigenous stewardship approaches also aim to mitigate the infection of younger redcedar that could develop into LCC over time. More nuanced knowledge about fungal species may contribute to the ability of First Nations to identify candidate stands for LCC recruitment. Characteristics of candidate stands that could make them less conducive to the survival and spread of pathogens might include fewer trees per hectare, if fungal spread is through roots, or minimal slash and woody debris on the forest floor, which would reduce inoculum sources. Moreover, climate change could make environmental conditions more conducive to fungal pathogen growth and survival (Kliejunas et al., 2009; Sturrock et al., 2011; Woods et al., 2010), making the current state of knowledge about fungal species of even greater concern to First Nations developing intergenerational stewardship plans for LCC.

3.4.4. Environmental site conditions associated with fungal pathogens and decay in redcedar

It is most likely that specific combinations of site factors, including temperature, soil moisture and soil pH, act synergistically to influence the incidence and survival of fungal pathogens (e.g., see Thies and Sturrock, 1995), and thus, decay in trees. Environmental conditions that elevate physiological stress in redcedar, such as prolonged drought or continually saturated soils (Klinka and Brisco 2009), are likely to increase the susceptibility of trees to pathogenic infection. In particular, drought stress can cause crown mortality and a reduced radial growth in coastal redcedar trees (Andrus et al. 2023). While dead crowns can serve as infection courts to true heart rot fungi, a reduced radial growth-rate can reduce the production of extractives (Taylor et al. 2003), potentially decreasing the efficacy of a tree's defensive response. Redcedar growing in

transitional zones within their natural range or in disturbed sites (such as harvested sites) may also have weaker defense responses because of elevated physiological stress (McDonald et al., 1987). For Indigenous LCC stewardship, knowledge about extremes in soil moisture conditions and their effects on redcedar physiology can inform predictions of decay in LCC in field surveys, when considered together with tree morphological characteristics. Similarly, knowledge about topographic conditions, such as transitional zones, and landscape disturbance history can be applied in LCC mapping and modelling approaches to predict the potential decay incidence in predicted or known distributions of LCC.

Future research is needed to uncover both the basic relationships between site conditions and the principal fungal species that infect redcedar, and the nuanced relationships between various topographic, edaphic and ecological conditions and decay in redcedar. For example, the findings of research on the relationship between elevation and decay in redcedar are inconclusive, while the correlation between site productivity and decay remains to be examined in research. Chapter 4 of this thesis examines the relationship between several site conditions and decay in LCC, to enhance decay prediction techniques in LCC. The ability of fungal decay species to adapt to changing temperature and moisture conditions should be greater than that of long-lived tree hosts (Sturrock et al., 2011), so future research connecting habitat conditions to the incidence and virulence of principal fungal species known to infect redcedar will be important, to inform redcedar and LCC stewardship strategies under different climate change scenarios.

3.5. Conclusion

This literature review highlights the complex nature of the development of heartwood decay in redcedar, the associated morphological characteristics and the complexity of the interactions among the three key factors that contribute to the development of heartwood decay in trees. It also reveals important knowledge gaps. Future research examining the factors contributing to decay in redcedar and their interactions could benefit both Indigenous stewardship and the management of redcedar in industrial forestry. For example, studies aimed at narrowing the knowledge gap about the relationships between redcedar, its principal pathogens, and environmental conditions would help to better forecast redcedar-pathogen-climate interactions given

climate change projections. Such information is important to both Indigenous LCC stewardship and forestry management practices for redcedar.

Most LCC will develop substantial volumes of decay over time, which could severely impact the availability of trees for future generations and the suitability of those trees for cultural use such as carving. In addition, there is a possibility that climate change could hasten the development of decay in redcedar by making environmental conditions more conducive to the survival of fungal pathogen species, which could increase their occurrence and virulence. This review serves as a starting point to guide future research about decay in redcedar to support Indigenous LCC stewardship.

3.6. Acknowledgements

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3.7. Supplementary Material

3.7.1. Table 3.2

Table 3.2. A summary of knowledge gaps, including research questions, associated with four main factors that influence decay in western redcedar that are relevant to informing both Indigenous cedar stewardship and the management of redcedar in an industrial context.

Knowledge gaps and research questions
Tree morphology
To develop a greater understanding of morphological tree characteristics as visual indicators of decay in redcedar;
1. The relationship between the visual attributes of a catface and the incidence and extent of decay within a tree.

2. Is there a consistent relationship between crown health and the incidence and volume of decay in large old redcedar?
-Are spike tops, including dead forked tops and dead candelabra tops, reliable indicators of heartwood decay in older trees?

3. Do morphological tree indicators, other than those identified in this review, exist as visual indicators of appreciable heartwood decay in living redcedar?
-Is tree bole shape (e.g. oval or cylindrical) associated with heartwood decay?
-Can bark shade, colour or texture indicate bole decay?
-Can depth of bark seams within flutes/buttresses indicate decay in the lower bole?

4. Infection courts as indicators of decay
-What (known) infection courts provide entry to the greatest number of pathogenic species?
-Which of the known infection courts are most associated with significant decay volumes in first-growth redcedar?
-What are the visual characteristics used to identify culturally modified trees (CMTs) markings/wounds of Indigenous origin?
-Is there Indigenous knowledge about the relationship between characteristics of CMTs and decay in living redcedar?

Decay resistance in living redcedar

To gain a nuanced understanding of decay resistance in redcedar to better understand factors influencing decay dynamics;

1. The relationship between extractive concentrations and overall decay resistance in trees.
-What is the relationship between single extractive compounds or groups (e.g. terpene tropolones) and the level of decay resistance in living redcedar?
-What is the relationship between extractive content and decay resistance and extractive properties (composition) and decay resistance?
-Does geographic location impact decay resistance &/or extractive content/properties in trees? (e.g. coastal vs. inland populations)

2. The influence of environmental conditions on extractive production, amounts (content) and properties in trees.
-Do environmental conditions (i.e. different habitat types of redcedar) affect decay resistance &/or extractive production and properties in living redcedar?

Fungal pathogens

To expand the knowledge base about the fungal agents of decay that are found on living redcedar;

1. Life history and survival requirements of the known and unidentified fungal species associated with the decay process in redcedar
-What is the infection biology of the fungal species that attack living redcedar?
-What environmental site conditions are most associated with the frequency and abundance of pathogenic fungal species?
-Can a better understanding of the life-history of fungal decay species help to identify fruiting bodies on living redcedar?

2. The identification of new/unknown fungal species that are associated with heartwood decay in living redcedar
Environmental site conditions
To use environmental conditions and site attributes as indicators of decay in living redcedar; 1. Environmental site conditions most associated with the incidence of appreciable decay in redcedar -What habitat types/environmental conditions are associated with heartwood decay in living redcedar? -Are certain habitat types/environmental conditions associated with greater volumes or a more rapid rate of spread of decay within trees and/or across stands? 2. Effects of future climate change to decay dynamics in redcedar -Will changes in environmental conditions (e.g. temperature and moisture) resulting from climate dynamics make first-growth redcedar more vulnerable to fungal infection and decay processes? 3. The incidence and impact of decay on living redcedar across operational forest management areas -Do certain harvesting methods &/or stand management practices promote the incidence &/or extent of decay in living redcedar?

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Chapter 4. Using Indigenous knowledge and western science to identify indicators of heartwood decay for western redcedar, a tree of cultural importance

4.1. Introduction

For millennia, many Indigenous peoples have been judicious users as well as managers and stewards of the resources that sustain their populations and shape their cultures (Ban et al., 2018; Mathews and Turner, 2017; Minnis and Elisens, 2001). Intergenerational place- and value-based knowledge, together with Indigenous practices and beliefs characterized by a strong sense of responsibility towards the local environment, form the foundation of biocultural resource stewardship for many Indigenous groups (Artelle et al., 2019; Curran et al., 2020; Lepofsky, 2009; Sherman et al., 2010; Turner and Berkes 2006; Turner et al., 2013). As Indigenous peoples gain increased legal authority over their traditional territories and resources (Borrows, 2017; McGregor et al., 2010; UNGA, 2007), many seek to steward biocultural resources using their traditional knowledge and worldviews, along with knowledge produced using western scientific principles and methodologies (Adams et al., 2014; Rayne et al., 2020). For example, the Haíłzaqv (Heiltsuk) First Nation of British Columbia (BC), Canada, successfully integrated methods of applied conservation science into a cultural stewardship initiative for grizzly bear (*Ursus arctos horribilis*) monitoring and conservation (Housty et al., 2014). Indigenous stewardship initiatives often take a biocultural approach to conservation by prioritizing both biological and cultural diversity, values and needs (Gavin et al., 2015, Sterling et al., 2017). Indigenous-led resource stewardship strategies that integrate cultural knowledge and belief systems with science-based evidence have the potential to enhance the resilience and sustainability of social-ecological systems and environmental sustainability and resiliency (McMillen et al., 2020; Rayne et al., 2020; Tengö et al., 2014).

A fundamental aim of Indigenous stewardship is often to ensure that a sufficient quantity and quality of biocultural resources, such as large trees of cultural significance, is available to future generations to fulfill their needs and responsibilities (Atleo, 2018; Bowcutt, 2013; McGregor et al., 2010). Trees of exceptionally large sizes are desired by

many Indigenous groups for unique cultural purposes that no other growth forms can fulfill. The Maori peoples of Aotearoa (New Zealand), for example, can only use matai (*Prumnopitys taxifolia*), totara (*Podocarpus totara*) and kauri (*Agathis australis*) trees of extreme girth and height to construct traditional houses (Lyver et al., 2017) and create ocean-going canoes and totems (Boswijk and Johns, 2018; Brooker et al., 1981; Simpson, 2017). Unfortunately, large trees of all species are becoming rare across the globe (Lindenmayer et al., 2012; Lindenmayer et al., 2018), including culturally important species (Blicharska and Mikusinski, 2014; Huang et al., 2020; Sutherland et al., 2016; Benner et al., 2019). Very old large trees of cultural significance are likely to be very rare, given the several centuries such trees require to develop the size (Daniels 2003; Blicharska and Mikusinski, 2014) and wood characteristics desired for cultural use (Benner et al., 2021). As such, factors that influence the rarity of culturally significant tree species, including tree age, size and wood characteristics, are salient considerations in stewardship.

Western redcedar (*Thuja plicata*) (hereafter “redcedar”) is a cultural keystone species known as the “Tree of Life” (Garibaldi and Turner, 2004; Zahn et al., 2018) to Indigenous groups in the Pacific Northwest of North America (referred to as First Nations in Canada). This name for redcedar arises from its extensive and diverse uses within First Nation culture, where it serves fundamental roles in the material culture of clothing, housing, transportation, tools, and art, and in spiritual and ceremonial practices (Hebda and Mathewes, 1984; Stewart, 1995; Turner, 2014). Traditional carved items that require large old redcedar trees, such as dug-out canoes, totem poles, traditional houses (hereafter “big houses”), and masks worn while dancing (“dancing masks”), fulfill important purposes in contemporary Indigenous culture (Benner et al., 2019; Sutherland et al., 2016) (Figure 4.1). Indeed, carving remains vital to ceremony and cultural identity, and is prominent in diverse practices and knowledge transfer (Benner et al., 2021; Chapter 2). However, large old redcedar trees have become increasingly scarce in the last century because industrial forestry operations have targeted these trees due to their high value as lumber (Green, 2007; Gregory et al., 2018; Nelson, 2004). This combination of high cultural value and scarcity makes the stewardship of large old redcedar trees a priority for many First Nations.

Figure 4.1. Pictures of (a) a large old redcedar tree that is suitable for creating traditional carving purposes such as, (b) a totem pole, (c) a dug-out canoe, and (d) a dancing mask (photo credits: Max Chickite and Julie Nielsen).

On the south coast of British Columbia (BC), Canada, the Nanwakolas Council (hereafter "Nanwakolas") serves as a collective voice for six Kwakwaka'wakw First Nations ("Member Nations") regarding decision-making and responsibilities related to Indigenous rights and the stewardship of lands and waters (Nanwakolas Council 2020a). Nanwakolas has recently developed a stewardship strategy for redcedar (or "*wilkw*", in the Kwak'wala language). The Nanwakolas Large Cultural Cedar Stewardship Strategy (the LCC Strategy) is an intergenerational forest stewardship initiative developed by Nanwakolas and the Member Nations (Nanwakolas Council 2020a). "Large Cultural Cedar" [4] (LCC), sometimes called "Monumental Cedar" in other regional contexts (Benner et al., 2019), are first-growth redcedar trees of at least 250 years of age ("old growth" (BC Ministry of Forests, 2003)) that possess wood qualities that make them desirable for carving (see Benner et al., 2021). The Nanwakolas Member Nations view LCC as a scarce non-renewable resource that is profoundly different from second-growth redcedar. The guardianship of existing first-growth trees, or "*k̓wa'x̱tłu*" (large redcedar trees in Kwak'wala), is a priority of LCC stewardship planning (Benner et al. 2021).

Heartwood decay in living redcedar trees is a key consideration for Nanwakolas Member Nations' LCC stewardship planning. Trees with extensive decay are not suitable

4 The term "Large Cultural Cedar" also includes yellow cedar (*Callitropsis nootkatensis*), according to the Nanwakolas Council in their Operational Protocol for Large Cultural Cedar (Nanwakolas Council 2020b).

for cultural carving and first-growth redcedar trees frequently possess heartwood decay, which can be extensive (Buckland, 1946; Sturrock et al., 2017; van der Kamp, 1975; 1986). Historically, First Nation peoples assessed living redcedar for internal decay using destructive methods that involved making a “test hole” in trees (Figure 4.2) (Earnshaw, 2019; Mobley and Eldridge, 1992). Today, minimally invasive technologies such as tomography and resistance micro-drilling can be used to detect and quantify decay in trees (Ouis, 2003; Wang and Allison, 2008), but most of these techniques are costly, time consuming and logistically infeasible in remote, coastal, and mountainous terrain (Monk, 2011; Brazee et al., 2011). Research on tree characteristics and their relationship with internal decay in redcedar is inconclusive (e.g., see Buckland, 1945; Manning 2001 and Sturrock et al. 2017). Also, there is very little scholarship that examines environmental factors in relation to decay dynamics in redcedar (see Daniels and Russel 2007, Kimmey 1956, and Robison 2000 as exceptions). A diagnostic method to predict the amount of decay in redcedar using environmental (site) conditions and externally observable tree characteristics is not available (Sturrock et al., 2017).

Figure 4.2. A picture of a first-growth redcedar showing a “test hole” (photo credit: Amanda Girard).

The Nanwakolas Member Nations wish to develop an accurate inventory of the abundance and distribution of LCC in their territories suitable for cultural carving over the next 300 years. Working together with Nanwakolas, we identified the need for a set of environmental and biological indicators of decay that can be applied in field and digital mapping applications as a key issue in achieving the goal of intergenerational LCC stewardship planning. An unreliable inventory would compromise the capacity of Member Nations to make decisions that support a sustainable carving practice into the future. In addition, existing research about decay in biocultural species tends to focus on economic impact (Bergin, 2000; Sturrock et al, 2017) rather than cultural resource stewardship and practices (Alexander et al. 2017, D'Amato et al. 2023, Chapter 2). We aim to address the issue of decay in LCC inventories and planning by synthesizing the knowledge of Indigenous carvers about decay in LCC and its relationship to the practice of cedar carving and then conducting a field study of decay in relation to readily observable environmental conditions.

We took a collaborative research approach, which integrated two distinct knowledge systems. Our first objective was to document the knowledge of Indigenous carvers about: i) site conditions and tree characteristics and their association with decay in LCC and redcedar more generally; and ii) the suitability of trees with varying amounts of decay for different carving purposes (e.g., canoes or totems). This carvers' knowledge informed the design of a subsequent field study addressing our second objective: to examine heartwood decay in living LCC and its relationship to: i) ecological, topographical, and edaphic site attributes; and ii) readily observable characteristics of tree morphology, size and age.

4.2. Methods

4.2.1. Political Study System

The Member Nations of the Nanwakolas Council are the K'ómoks, Wei Wai Kum, Wai Wai Kai, Da'naxda'xw Awaetlala, Tlowitsis, and the Mamalilikulla, whose combined territories cover a terrestrial area of 21,604 km^2 spread over several islands and adjacent mainland regions of the BC coast on and near northeastern Vancouver Island (Figure 4.3). These First Nations assert Aboriginal rights, including title, over their unceded territories, which are now also home to ~ 35,000 people of Indigenous and non-

Indigenous heritage. The Nanwakolas Member Nations strive to fulfill their stewardship obligations to *Aweenak'ola,* "the lands we are on" (in Kwak'wala), by continually learning about the forests and their biocultural resources using knowledge founded in western science and Indigenous systems (Nanwakolas Council 2020a). First Nations have occupied *Aweenak'ola* since "time immemorial," which according to archaeological findings is at least 10,000 (Fedje et al., 2018) to 15,000 years ago (Turner, 2020). During the past century, industrial forest management carried out mainly by non-Indigenous actors has depleted Nanwakolas Member Nations' territories, often in ways at odds with First Nations' traditional cultural values and philosophy about forest stewardship (Booth and Skelton, 2011). As a part of the Nanwakolas Member Nations' responsibility to uphold and protect their Aboriginal rights to *Aweenak'ola,* they have agreed to steward LCC through the LCC Strategy.

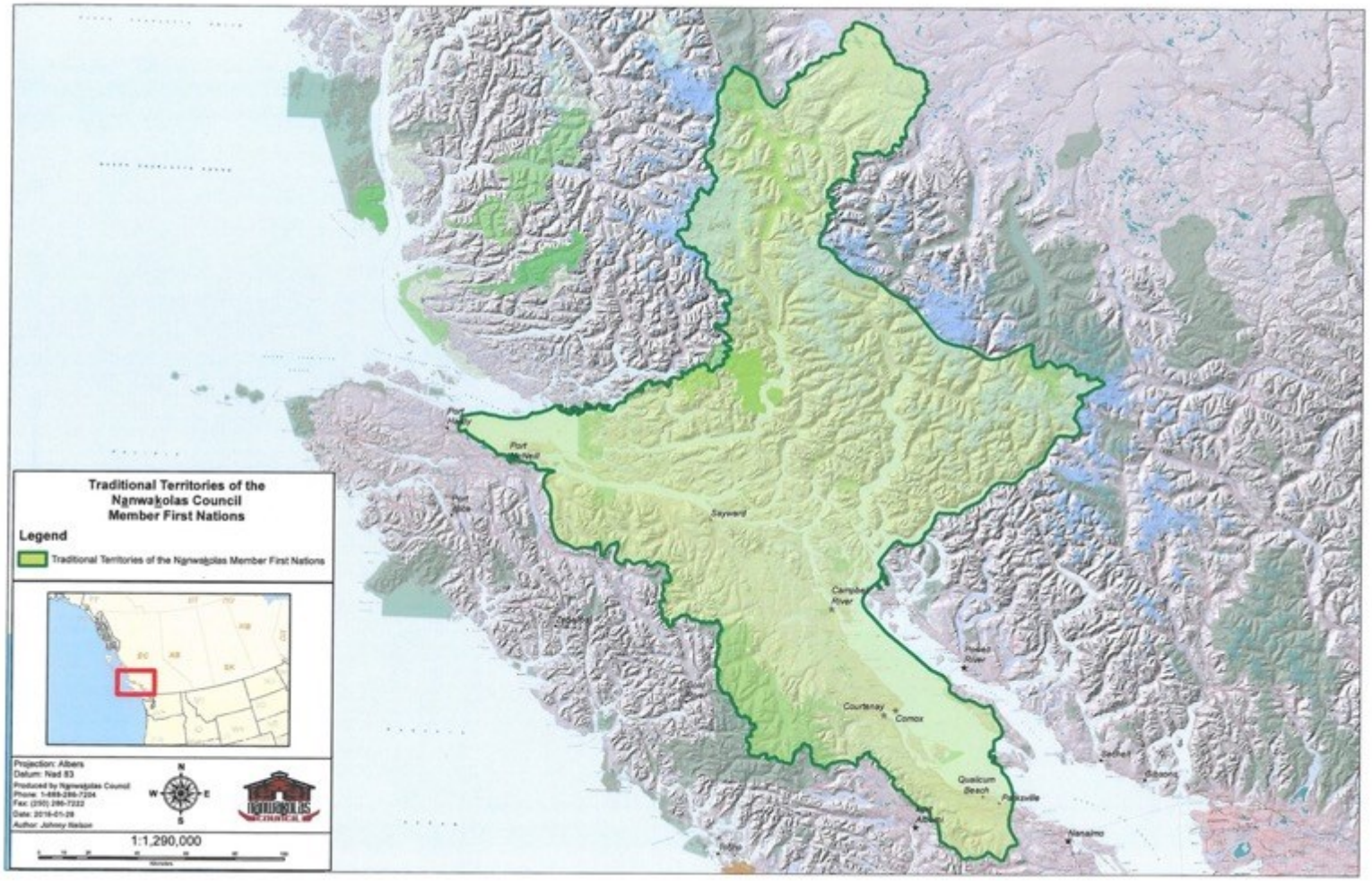

Figure 4.3. A map of the Nanwakolas Member First Nations' traditional territories which cover a portion of the south-central coast of BC, including a region of the mainland known as the Great Bear Rainforest (map credit Johnny Nelson).

4.2.2. Community-based Research

Our co-produced study aims to explore questions rooted in science and cultural knowledge. We developed our research questions with our Nanwakolas partners, and discussions throughout the study ensured the priorities, values and knowledge of the Nanwakolas Member Nations were reflected in all aspects of this research. In addition to approval from Nanwakolas, we obtained ethics board approvals from Simon Fraser University and the University of British Columbia to collect qualitative and quantitative data.

4.2.3. Qualitative Data Collection and Analysis

From spring 2017 to summer 2018, I conducted 13 semi-structured interviews with experienced cedar carvers from the Nanwakolas Member Nations. Interviews typically were 2–3 hours and were conducted individually with each carver in their community. We transcribed the interviews and performed thematic content analysis using the program NVivo 12.4.0 for Mac (Richards 1999; 2005; Saldana 2013). We organized carvers' responses into two distinct themes: (1) site conditions and tree characteristics considered when assessing decay, and their relationship with decay in redcedar/LCC, and (2) the relationship between the amount of decay in a LCC tree and cultural uses. The knowledge carvers shared in theme 1 provided important visual indicators of decay and contributed to our selection of site and tree characteristics to assess in the field. Theme 2 broadened our discussion about indicators and their application and value in LCC stewardship.

4.2.4. Physical Study Area and Sample Sites

Our study area is located on northeastern Vancouver Island, BC, on the Nanwakolas Member Nations' territories (Figure 4.3), in a part of the coastal temperate rainforest where industrial forestry occurs. Ecologically, the Coastal Western Hemlock (CWH) zone of the Biogeoclimatic Ecosystem Classification system (Meidinger and Pojar, 1991), dominates the region. We surveyed first-growth forests (hereafter "sample sites") mostly in the Southern Very Wet Maritime variant of the CWH zone (CWH_{vm1}), which has an average annual temperature of 8°C and average annual precipitation of 1550 to 4400 mm, depending on elevation (Green and Klinka, 1994). Forested

floodplains, treed swamps, bogs, riparian corridors, lacustrine fringes, rock outcrops and steep mountain slopes categorize some of the physiographic features scattered throughout sample sites. Common native tree species include redcedar, western hemlock (*Tsuga heterophyla)*, amabilis fir (*Abies amabilis*), Sitka spruce (*Picea sitchensis*), yellow-cedar (*Xanthocyparis nootkatensis*) and Douglas-fir (*Pseudotsuga menzeisii*).

4.2.5. Field Data Collection

Pre-harvest Data Collection: Tree Characteristics and Site Conditions

Sample sites were located in large areas (>50 ha) scheduled for industrial harvest in 2018 (hereafter “cutblocks”). To delineate forest polygons (spatial areas delineated in a Geographic Information System or GIS) within cutblocks that could be surveyed on foot and serve as sample sites, we queried the Vegetation Resource Inventory (VRI) spatial layer data (Data BC; www.data.gov.bc) using a set of criteria specified by Benner et al. (2019) to exclude areas unlikely to support LCC. Areas that met the criteria and supported either >5% redcedar by relative density or contained high value merchantable redcedar were selected as sample sites if they were <500 m to a road. We used data previously collected in the field to verify species composition and/or the presence of high value redcedar within selected sample sites. This purposive research design ensured LCCs were present and that, after harvest, stumps would be available to assess decay and collect samples for dendrochronological analyses.

In the summer of 2018, we located 88 LCC across 11 sample sites (Figure 4.4). Surveys were conducted by the first author and a cedar carver from the Tlowitsis Nation. In each site, we systematically searched for potential LCC by walking linear belt-transects to visually survey as close to 100% of the area as possible. We assessed all potential LCC by evaluating eight distinct morphological characteristics in the field, following the protocol detailed in Benner et al. (2021) and the Nanwakolas LCC Survey Manual: tree diameter at breast height (DBH), height, sweep of the stem, plus the length, knot class, spiral in the grain, taper, and presence of scars in each “log” or vertical section of the bole that was ≥5m long and usable for carving (see figure 3 in Benner et al. 2021). Redcedar trees that met all eight criteria of an LCC were included in our study. Tree DBH, height and knot class were included in quantitative analyses, together with

three additional tree morphological attributes that were assessed in the field: crown condition, bole scars and bole shape (Tables 4.4 and 4.5 in Supplementary Material). We tagged each tree at the base and recorded its location, with a level of accuracy to 3 m, to relocate stumps after harvesting.

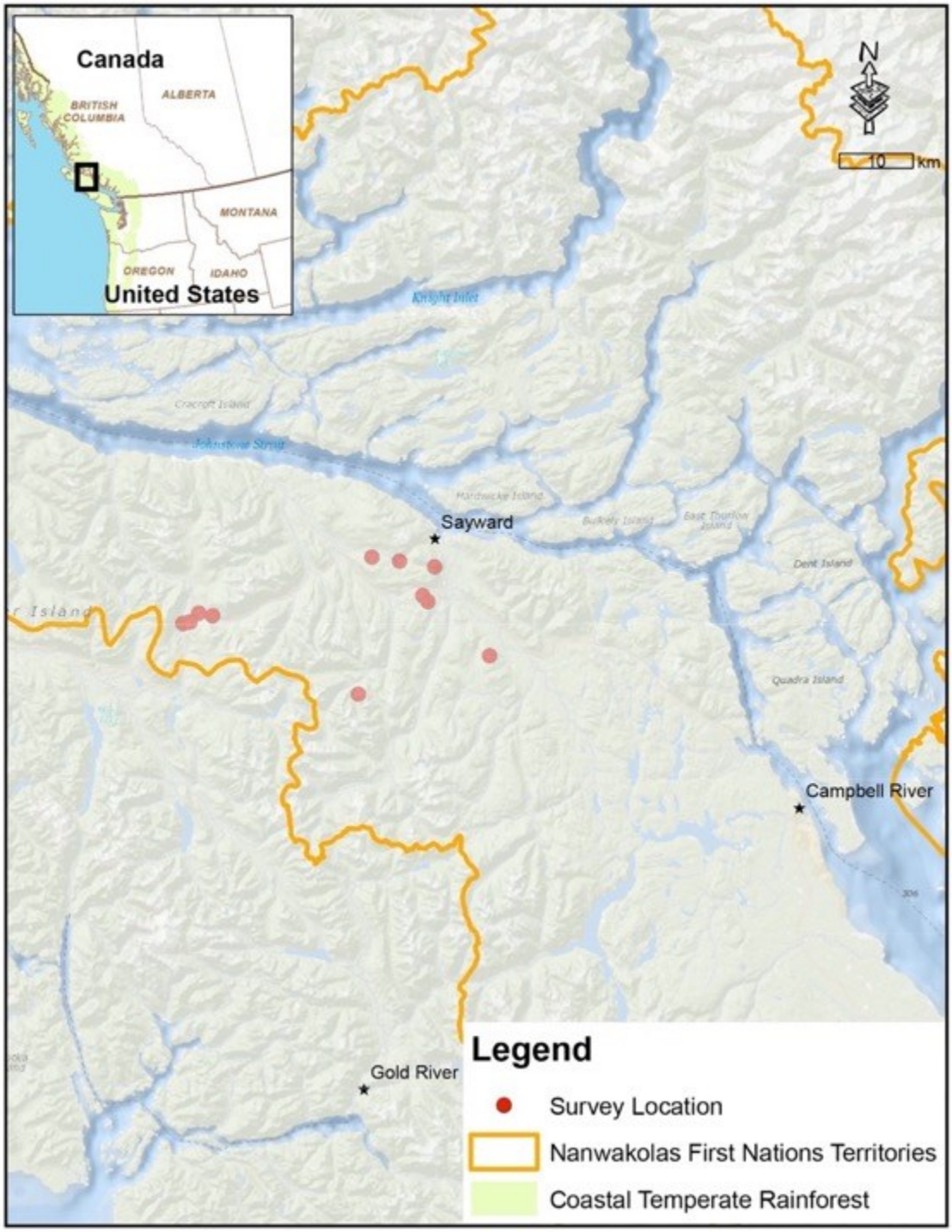

Figure 4.4. **A map of the study area depicting field study locations (map credit: Jordan Benner). Sample sites were located on Vancouver Island, within a portion of Nanwakolas Member Nations' territories. The inset map shows the distribution of the coastal temperature rainforest (based on Wolf et al. 1995).**

We measured or derived 19 environmental attributes to characterize the forest immediately surrounding each LCC and as potential predictors of LCC decay (Tables 4.4 and 4.5 in Supplementary Material). Measured attributes included slope angle and species composition of the dominant and co-dominant trees. To assess edaphic attributes associated with each LCC, we either (a) examined the exposed soil profile along a recently-built road within 10m of the tree or (b) randomly selected one of the four cardinal directions and dug a soil pit ca. 10m from the tree. Soil pits were deep enough to expose the B horizon (average depth = 50cm; range = 10–220cm) and we assessed the soil profile following standard protocols for describing terrestrial ecosystems (BC 2010): texture of the surface materials, subsurface water, particle size in the rooting zone, percentage of coarse fragments, drainage, mycelial abundance, decaying wood abundance, humus form, type of B horizon, soil order, soil moisture regime, soil nutrient regime, and site series. Three additional attributes for each LCC were extracted from the Terrain Resource Information Management (TRIM) data layer using ArcGIS 10.3 software: elevation (metres above sea level, m.a.s.l), solar radiation (WH/m2), and wetness index (WI). The area (ha) of the belt transects that were searched to locate LCCs in each of 11 sample sites was derived using ArcGIS.

Post-harvest Data Collection: Proportion of Decay and Tree Ages

In 2019, after harvesting, we relocated 88 stumps of the LCC surveyed. The proportion of the surface area that is decayed in a stem cross-section (hereafter “proportion decay”) of redcedar has been shown to robustly estimate total percent decay in trees (LeMay, 1992). To quantify the proportion of decay in each LCC stump, we visually assessed the surface of each stump for decayed wood and missing wood due to decay. Decayed heartwood displayed a blocky pattern of fibres, appeared darker than surrounding wood, had a softer texture than sound wood, or showed evidence of fungal decay organisms, such as fungal hyphae or white lamination of wood fibres (BC MoF, 1979). We delineated all areas of incipient and advanced decay and took a plan-view photograph of the entire surface area of each stump. We calculated the proportion decay of each LCC from the ratio of decayed-to-sound heartwood by processing the photograph of the surface area of each stump using the program Affinity Photo (Figure 4.5). Two layers of pixels were extracted, one highlighting the entire surface area and one highlighting all areas with visual decay, including missing wood due to decay.

Proportion decay was calculated as the number of pixels with decay divided by the total surface area.

Figure 4.5. Plan-view pictures of two LCC stump surfaces showing (a) an area of incipient decay delineated in marker and (b) areas of advanced decay with missing wood (photo credits: Krys Stone). Picture (c) illustrates the use of the program Affinity Photo to obtain a ratio of (pixels of) decayed wood, highlighted red, to (pixels of) sound wood, highlighted yellow, for the stump pictured in (b) (photo credit: Krys Stone).

To estimate tree ages, we cut a single radial sample from the top of each stump using a battery-powered circular saw (Figure 4.6) and measured stump height (cm) from mineral soil to stump surface. Radial samples included the bark and sapwood when possible and were oriented perpendicular to the greatest number of visible intact rings that intersected or came close to the pith. Samples were air-dried prior to processing.

Figure 4.6. Pictures of (a) a cross-sectional sample of wood cut from the radius of a LCC stump after sanding and, (b) a radial section of a LCC stump where a sample was removed (photo credits: Krys Stone).

We prepared radial samples using standard dendrochronological procedures (Stokes and Smiley, 1968; Speer, 2010). Each sample was reinforced (glued and mounted) and the surface was sanded with progressively finer sandpaper from 100 to 400 grit, then scanned at high resolution (1200 dpi) (Figure 4.6). Ring-width series were measured to the nearest 0.001 mm using the software program CooRecorder 9 (Larsson, 2011a) and cross dated against an existing chronology from southwestern BC (Stan and Daniels 2010; 2014) using the program CDendro 9 (Larsson, 2011b). Tree ages were estimated from the cross dated inner-ring dates of each sample, with corrections for sampling height and rings missed from stumps with decayed piths, as follows (after Daniels et al., 2017):

Age = 2018 – (inner ring date) + (rings missing at pith) + (stump-height correction) + 1. In this equation, 2018 is the year in which the last complete ring formed before living trees were sampled. Estimating the number of missing years for the 74 samples with decayed or damaged heartwood near the pith required three steps. First, we estimated the length of the missing radius of each stump from the plan-view photographs. From the inner-ring of the radial sample, we estimated the circumference of the decayed area, and geometrically estimated location of and distance to the pith

(i.e., centre of the circle; after Norton et al., 1987). The measured radius in the photograph was rescaled to length in mm. Second, to estimate an initial radial growth rate, we regressed age (years) against cumulative radius (e.g., sum of the ring widths from the pith to bark in mm) of the 14 samples that intercepted the pith. The slope of the linear regression with a y-intercept of 0 indicated trees required 0.8884 years to grow one millimeter (n=14, r^2=0.93). Third, we estimated the number of missing rings (years) as the length of the missing radius (mm) divided by initial growth rate (years mm^{-1}). Lastly, stump heights were grouped into 50 cm increments to derive corrections estimated from the ages of redcedar seedlings of different heights (Daniels et al., 1995).

4.2.6. A generalized linear model of heartwood decay

To determine which tree morphological variables (including tree age) and environmental variables indicate heartwood decay in LCC, we used a model selection procedure for a β-regression model to predict proportion decay (Ferrari 2004). A β-regression is a generalized linear model (GLM) with a logit link function that combines categorical and continuous covariates (Table 4.1). We used a β distribution to calculate model residuals because heartwood decay was measured as a proportion of stump surface area with values between 0 and 1. To estimate model parameters we used the glmmTMB package in R (Brooks et al. 2017).

Table 4.1. Potential predictors of LCC decay stratified as tree or environmental attributes and categorical or continuous variables.

Tree categorical variables	Environmental categorical variables
Proportion decay (Response)	Co-dominant tree species
Knot class	Surface materials texture
Crown condition	Subsurface water
Bole scars	Drainage
Bole shape	Mycelial abundance
	Decaying wood abundance
	Humus form
	B horizon type
	Soil order
	Soil moisture regime

	Soil nutrient regime
	Site series
Tree continuous variables	**Environmental continuous variables**
DBH	Slope
Height	Rooting zone particle size
Tree Age	Coarse fragment percent
	Elevation
	Solar radiation
	Wetness index
	Sample site area

To understand predictor variable strength and the generalized prediction error, we used a cross-validation (CV) approach repeated over 100 Monte Carlo trials (Hastie et al. 2009). The CV approach was nested by randomly splitting the data into two equal sized sets, A and B. Within each set the β-regression model was trained using a forward stepwise regression and a leave-one-out CV. The CV approach required a minimum sample size of four for each level of each categorical variable so that every training and testing set could be constructed to contain one observation of every level. Filtering the data set by this requirement left 79 of the original 88 trees to develop the final models. The model for set A was tested on set B, and vice versa, producing a point estimate of the generalized mean-squared prediction error for each replicate. The results for each replicate were combined to produce a distribution of model prediction errors and estimates of predictor importance, defined as the percentage of Monte-Carlo trials in which each predictor variable was selected by the cross-validation procedure. Variables with a predictor importance >25% were considered indicators of decay in LCC.

Two models were developed. The first model included tree age, which we hypothesized to be an important predictor of decay. The second model included DBH since tree age cannot be obtained non-destructively from large trees (e.g., radius exceeds the longest increment borer), while DBH is easily measured in LCC surveys and commonly used as a surrogate for tree age. Model accuracy was assessed by comparing the measured proportion of decay against values predicted by the models including tree age or DBH.

4.3. Results

4.3.1. Carver Knowledge Shared in Interviews

Tree Characteristics and Site Conditions Associated with Decay

The interview responses of carvers about the tree and site attributes that they use to assess decay in redcedar were highly consistent among carvers. Those responses informed our choices about which tree characteristics and site conditions to measure in the field. Carvers identified multiple morphological characteristics that indicate decay in individual redcedars. Morphologies characteristic of redcedar, such as large, flared buttresses, catfaces (a flat or sunken side of a tree that is associated with decay-causing fungi [Buckland, 1946; van der Kamp, 1988]) and dead spike tops that are free of live branches for several meters' length, were repeatedly mentioned as individual attributes that signal substantial internal decay. Carvers also explained that they consider these tree attributes together with other factors, such as habitat conditions and evidence of bole scars, when estimating volume of decay. We used this information to design our field research, focusing on topographic, ecological and edaphic attributes that influence or reflect soil moisture, and expanded tree characteristics to include bole scars, bole shape (e.g., the presence of a cat face), and crown condition (e.g., a dead spike top).

Drawing from their experience in finding trees for carving, carvers characterized the environmental conditions in which they would most often find redcedar with considerable bole decay. Flat topography together with wet soils were described as the conditions most conducive to the development of decay. Areas with poor drainage, such as the edges of water bodies (e.g., marshes and swamps), characterized by soils rich in nutrients, were repeatedly mentioned as the habitat type most likely to support the development of heartwood decay. Conversely, well-drained, steep slopes at mid-to-high elevations were considered optimal habitat where redcedar trees grow with some decay, but enough sound wood to be considered LCC. As one carver stated, "If [redcedar] are growing in a swampy area, they are going to be [rotten], and [will] have lots of flare. The real solid sound cedars will be up higher, on a slope."

Relationship Between Decay and Carving Purposes

For carvers, the amount of decay in the bole of a redcedar tree is as important as bole size when determining the carving purpose for which a tree is best suited. They described thresholds for decay and size of tree for a variety of carving purposes, referred to as "cultural uses" (Table 4.2). Although tolerances for decay differed among individual carvers, their responses enabled us to create averages and thresholds of decay by cultural use. For instance, for uses that require larger logs, such as canoes, big house posts or beams, and large totem poles, carvers require either sound trees or those with very minimal decay (Table 4.2) (Figure 4.7). However, carvers explained that for uses that require smaller logs, the threshold for decay can be lower. A maximum of one quarter of the tree (visualized in the field as a fraction of tree diameter or a cross-section of the bole at breast height/~1.3 m above ground) can be decayed for carving medium sized totem poles and large masks, while a maximum of one third decayed is considered acceptable for carving uses such as canoe paddles, small masks or small bentwood boxes (Table 4.2) (Figure 4.7).

Table 4.2. LCC characteristics, including thresholds for decay, based on cultural uses according to carvers.

Acceptable heartwood decay (% cross-sectional area at breast height)	Minimum DBH (cm)	Minimum log length (m)	Cultural use
0% (sound wood only)	≥120 ≥150	≥7 ≥12	Chief's dug-out canoe (small size) Community dug-out canoe (large size)
≤3 % (sound to very little)	≥120 ≥150	≥7 ≥12	Big house support posts and beams Big house planks Large totem pole
≤ 25%	≥120	≥7	Medium to large totem pole Large dancing mask
26 – 33%	≥100	≥ 5	Small totem pole Big house planks Medium dancing mask Canoe paddles Small bentwood box Various artwork (e.g., talking stick or wall plaque)
> 33%	--	--	Tree exceeds threshold for decay

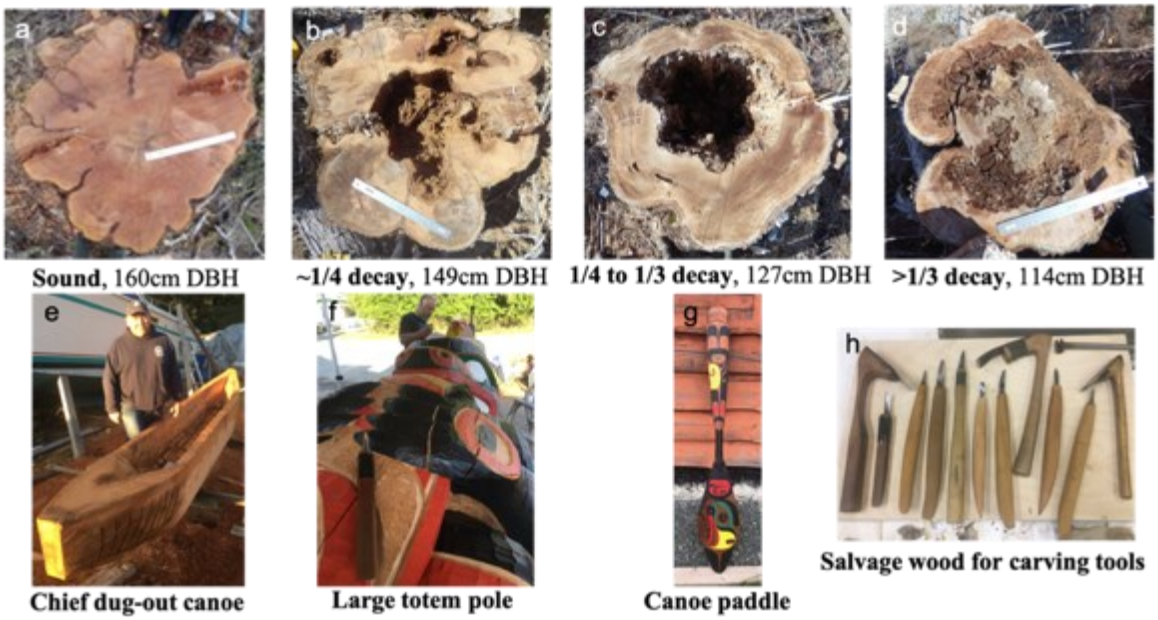

Figure 4.7. A schematic illustrating four of the five decay thresholds for LCC and their relationship to some carving purposes (photo credits: Krys Stone, Jessica Chickite and Julie Nielsen). Pictures (a) through (d) show plan-view photographs of decay in different LCC stumps. Pictures (e) through (h) show different carving purposes that can be created from trees that fulfill the decay threshold represented in the picture directly above.

4.3.2. A Modelling Approach to Establishing Indicators of Decay

LCC and sample site attributes

Figure 4.8 illustrates the relationship between decay and several tree and site attributes. The 79 LCC that we included in the models ranged in DBH from 100 to 255 cm, height from 23 to 42 m, and age from 261 to 1147 years, although 80% (n= 63) were older than 500 years. Most LCC, 73% (n=58), had dead crowns, while only 16% (n=13) had visible scars and 10% (n= 8) had a catface on the bole indicting possible fungal infection. Heartwood decay in the LCCs ranged from 0 to 40% of stump surface area. Relative to the decay thresholds associated with LCC cultural uses (Table 4.2), 27 LCCs were sound or had ≤3% decay, 44 LCCs had 4–25% decay, 6 LCCs had 26-33% decay, and only 2 trees had >33% making them unsuitable for cultural use.

The 11 sample sites ranged in size from 3 to 41 ha. Within the sites, sampled LCCs were located at elevations of 284–692 m.a.s.l. and 43% (n= 34) were on slope angles <11°, but 28% (n= 22) were on angles >27°, up to 51°. Most LCC (70%; n= 55)

were growing at mid-elevations within the 300, 400 and 500 m.a.s.l elevation bands. Most LCCs (70%; n= 55) were on rapidly-draining to well-drained sites with wetness index values of 3–4 (range = 2.86–6.65), representing dry or mesic sites with lower potential soil moisture. Similarly, 72% of the LCCs (n= 57) were in soil moisture regimes of moderately dry to moist. About 60% (n= 48) of LCCs were growing on soils with a moder humus form, and nearly 70% (n= 55) on very poor to medium soil nutrient regimes, which corresponded to 01 (16%; n= 12), 03 (18%; n= 14), or 06 (23%; n= 18) site series.

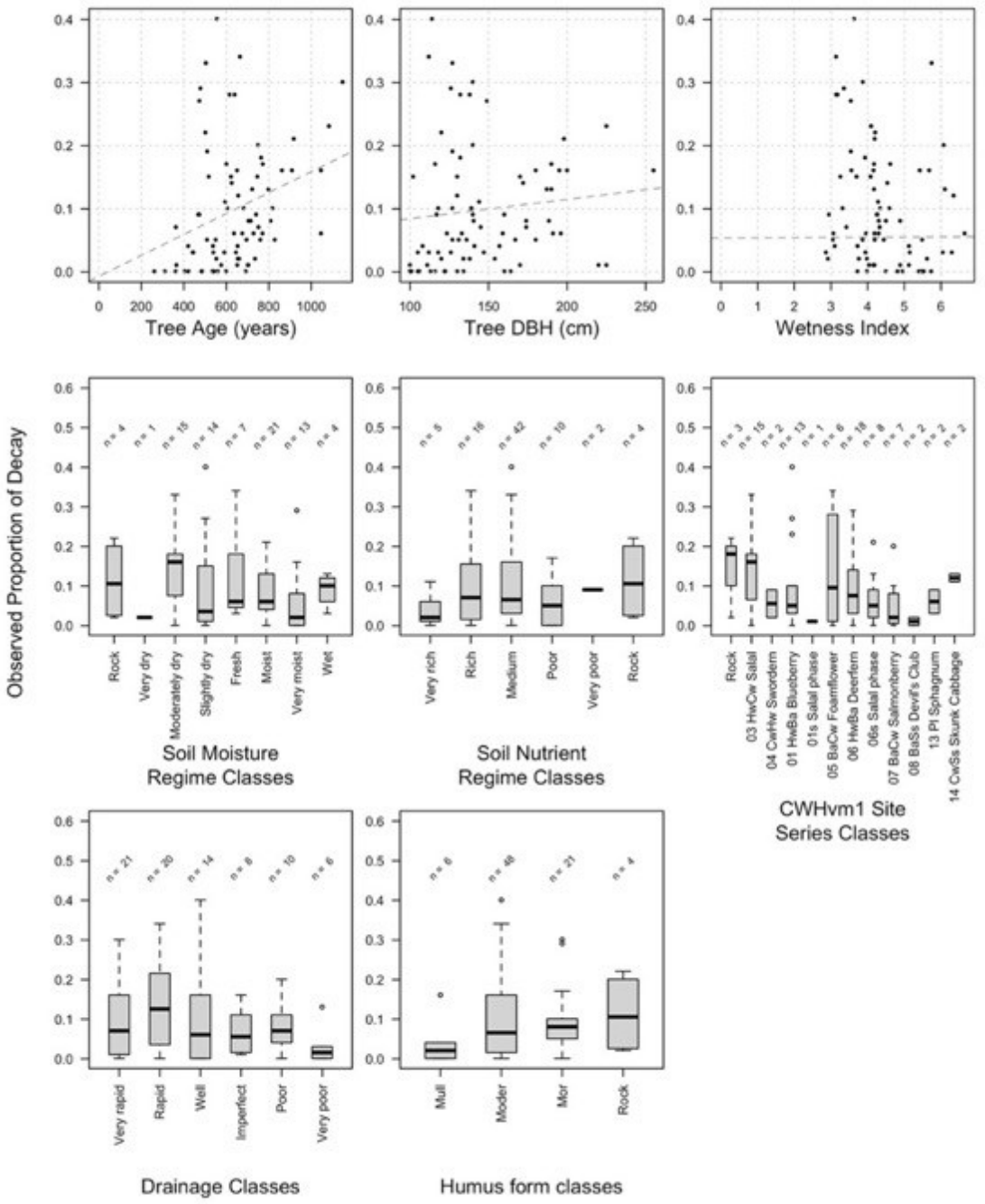

Figure 4.8. Relationship between heartwood decay in 79 LCCs and various tree and site attributes. For continuous variables the trendline depicts a linear regression. For categorical variables the horizontal line is the median, the rectangle represents the 25th and 75th percentiles, and the whiskers are the 5th and 95th percentiles.

Tree and environmental attributes as indicators of decay in LCC

Tree age and DBH were strong, positive predictors of LCC decay, with predictor importance values of 75 and 60%, respectively (Table 4.3). In general, old or large trees tended to have more decayed heartwood. In the model including tree age, five additional predictors of LCC decay with importance values >25% were Wetness index, Humus form, Drainage, Soil nutrient regime (SNR) and Tree crown condition (importance values = 92, 58, 28, 27, and 26%, respectively; Table 4.3). This model predicted higher levels of heartwood decay in old LCCs, commonly with dead spiked tops, that were growing on dry, rapidly-drained soils, often with mor humus forms, or on rock with no humus form, and/or medium to relatively poor nutrient regimes. In the second model substituting tree DBH for age, the four predictors of LCC decay above 25% importance were Wetness index, Humus form, Soil moisture regime (SMR) and Tree crown condition (importance values = 90, 54, 26, and 31%, respectively; Table 4.3). This second model predicted higher levels of heartwood decay in large LCCs, commonly with dead spiked tops, that were growing on relatively dry soils, often with mor humus forms, or on rock (i.e., where no humus form was present). To better understand the relative importance of the independent (predictor) variables selected in each of the models, Tables 4.4 and 4.5 provide a summary of statistics associated with each predictor variable.

Table 4.3. Tree and environmental indicators of LCC decay. Relationship to decay of predictor variables with an importance of >25% in either the model including tree age or size. Predictor variable importance is the percent of 100 Monte Carlo trials in which the variable was selected.

Predictor variable (Indicator)	Relationship to decay	Predictor variable importance in model including tree age (%)	Predictor variable importance in model including tree size (%)
Tree variables			
Tree age	Positive	75	-
Tree DBH	Positive	-	60
Tree crown condition	Inverse	26	31
Environmental variables			
Wetness index	Inverse	92	90
Humus form	Inverse	58	54

Drainage	Positive	28	-
Soil nutrient regime	Inverse	27	-
Soil moisture regime	Inverse	-	26

Table 4.4. A summary of the model including tree age with final selected variables (indicators) fitted to the set of data. Humus form was the only categorical variable for which each class was converted to an ordinal value, thus, the statistics for each Humus form class are reported. Columns show, from left to right, coefficient names, coefficient effect estimates, standard errors, t-values, and p-values.

Variable (coefficient name)	Effect estimate	Standard error	t-value	Pr(>|t|) (p-value)
Tree age	1.536	0.380	4.043	0.000
Tree crown condition	-0.089	0.229	-0.388	0.698
Wetness index	-1.852	0.509	-3.639	0.000
Humus form (Moder)	-8.834	2.741	-3.223	0.001
Humus form (Mor)	-8.998	2.740	-3.284	0.001
Humus form (Mull)	-9.814	2.739	-3.583	0.000
Humus form (rock)	-9.408	2.716	-3.463	0.001
Drainage	0.019	0.064	0.305	0.761
Soil nutrient regime	-0.146	0.162	-0.897	0.370

Table 4.5. A summary of the model including tree size with final selected variables (indicators) fitted to the set of data. Humus form was the only categorical variable for which each class was converted to an ordinal value, thus, the statistics for each Humus form class are reported. Columns show, from left to right, coefficient names, coefficient effect estimates, standard errors, t-values, and p-values.

Variable (coefficient name)	Effect estimate	Standard error	t-value	Pr(>|t|) (p-value)
Tree DBH	1.110	0.432	2.569	0.010
Tree crown condition	-0.306	0.231	-1.329	0.184
Wetness Index	-1.766	0.507	-3.480	0.001
Humus form (Moder)	-4.668	2.393	-1.951	0.051
Humus form (Mor)	-4.559	2.368	-1.925	0.054

Humus form (Mull)	-5.901	2.384	-2.476	0.013
Humus form (rock)	-3.635	2.335	-1.557	0.120
Soil moisture regime	-0.106	0.066	-1.602	0.109

For 44 of the 48 LCCs with <10% heartwood decay, the models tended to over-predict decay (Figure 4.9). In contrast, for the 31 LCCs with ≥10% heartwood decay, the models under-predicted decay (Figure 4.9). We determined the pseudo-R squared values using the Efron Rsquared method for each model. The pseudo-R squared value for the model including tree age is 0.198, and is 0.128 for the model including tree size. Overall, 55.6% of predictions were more accurate by 2% (range = 0 to 7.3%) using the model that included age rather than DBH.

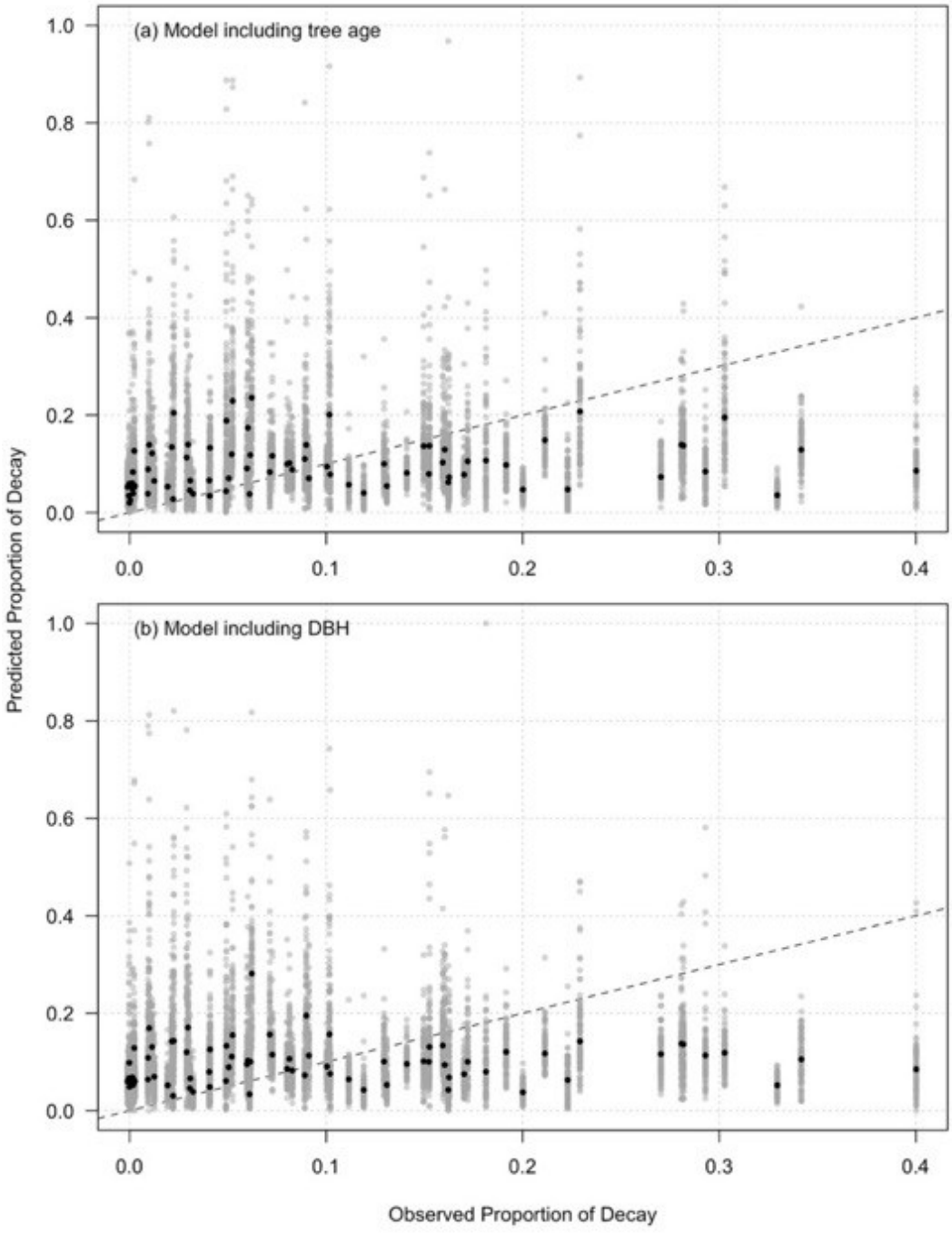

Figure 4.9. The performance of (a) the model including tree age and (b) the model including DBH relative to the relationship between the predicted proportion of decay and the observed proportion of decay for 79 LCCs.

4.4. Discussion

4.4.1. Indicators and their relationship with decay in LCC

Bringing together the Indigenous knowledge of carvers with the output of statistical modelling provided a set of environmental and biological indicators that can be used across a wide range of ecological conditions to predict decay occurrence and, to some degree, decay amount in the boles of living LCC. Carvers' knowledge that site conditions related to soil moisture and nutrients are important considerations when predicting decay in candidate LCCs was reflected in the models, with some key differences. Indigenous knowledge identified wet saturated sites with poor drainage and soils rich in nutrients as site conditions most conducive to decay development in LCC, while the modelling outcomes associated drier sites with rapid drainage and nutrient poor soils with higher decay. Below, we discuss this apparent discrepancy taking into account three factors – the subset of sites available for sampling, degree of decay measured in LCCs, and physiological stress response of redcedar relative to extremes in site moisture. In addition, we highlight two tree characteristics that carvers consider important considerations when assessing decay that were not reflected in modelling outcomes.

The difference between carvers' knowledge and our modelling results likely reflects the range of ecological conditions in which LCCs grow – which represents a wider range of environmental conditions than what were available for us to sample – and which reflects the carvers' broader knowledge and experience in their territories (Figure 4.10). We could only quantify decay on the stumps of harvested trees; thus, our sample sites were restricted to areas where contemporary industrial timber harvesting is operational. This criterion excludes the wettest and driest topo-edaphic sites (Figure 4.10) due to risk of soil compaction and the irreversible damage to sensitive ecosystems caused by ground-based harvesting machinery. The operational landbase for harvesting in our study region excludes most low-elevation sites, riparian zones, and other sites with saturated soils (e.g., 07, 08 and 14 site series in the CWHvm1 zone in Figure 4.10). As well, in the coastal region of BC, much of the productive old growth forests at lower elevations have already been removed by industrial harvesting (Benner and Lertzman 2022, Price et al. 2021), which began over a century ago (Benner et al. 2019; Green, 2007; Pearson, 2010). Although carvers identified the wettest sites as the most

conducive to decay in candidate LCC, less than 30% of the LCC sampled occurred on wet microsites with poor drainage and nutrient rich soils. This issue of remaining LCC occurring on sites that are not representative of their historical ecological distribution also arose in a study comparing the distribution of contemporary LCC in relation to archaeological records of culturally modified trees (Benner et al. 2019).

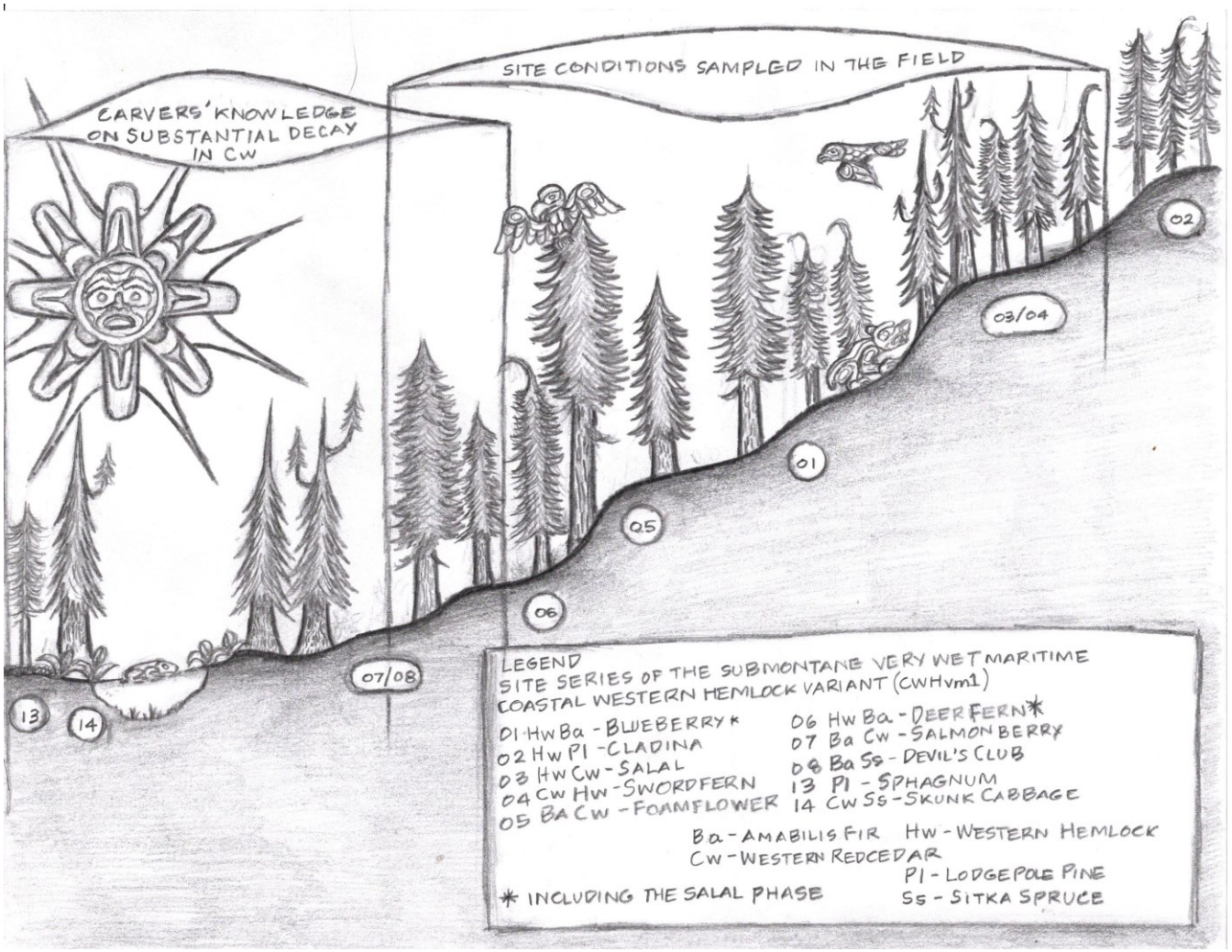

Figure 4.10. A schematic showing the site conditions sampled in the field and those that carvers' knowledge on substantial decay in redcedar reflected using site series of the CWHvm1 biogeoclimatic zone (sketch credits: Karver Everson).

Limited overlap between the environmental conditions that carvers deemed problematic and the sample sites could explain why very few of the LCC we sampled exhibited appreciable decay. Of 79 sampled trees, 71 had low levels of decay and were suitable for most cultural uses (Table 4.2). In contrast, only 6 of 79 LCC exhibited high amounts of decay (26 to 33% of bole cross-sectional area at breast height), while 2 LCC exceeded the critical threshold of 33% decay by only a small amount. Thus, the low degree of decay measured in the sampled LCCs was consistent with carvers' knowledge that redcedar growing on well-drained slopes at mid-to-high elevations are most likely to have enough sound wood to be LCCs. The low degree of decay in our LCCs is also consistent with the finding of Robison (2000) that decay in redcedar growing in the interior region of BC is inversely related to elevation – our sampling sites had an average elevation of 400 m.a.s.l. Conversely, carvers' knowledge that LCC trees growing in very wet, nutrient rich soils tend to have appreciable decay corresponds with the general trend that higher volumes of decay occur in trees on productive sites with moist-to-wet, nutrient-rich soils (Foster et al., 1954; Thomas and Thomas, 1954); however, this relationship has yet to be quantified for redcedar specifically.

Based on carvers' knowledge, one might expect that sampled LCC displaying high amounts of decay (>26%) grew in wet saturated sites that are rich in nutrients, but the eight most-decayed LCCs grew on drier sites characterized by rapid drainage, fresh to dry soil moisture regimes, lower wetness indices, and medium to rich soil nutrient regimes. We hypothesize that physiological stress in LCC potentially explains this disparity. Sites susceptible to prolonged water deficits or continual saturation are more likely to invoke or elevate stress in redcedar (Klinka and Brisco 2009), making trees more susceptible to invasion by fungal pathogens (Desprez-Loustau et al., 2006, Kliejunas et al. 2009) and decay over time. Drought stress is responsible for reduced radial growth over the last ~50 years, and recent canopy dieback and mortality in coastal redcedars, of similar diameter to small LCCs, growing in the Pacific Northwest of North America, the broader region of our study (Andrus et al. 2023). It is likely that the LCC in our study, similar to the redcedar populations studied by Andrus et al. (2023), experienced prolonged warmer and drier climate conditions, given that the coast of BC has experienced an increase in both temperature and spring and summer moisture deficits over the last ~50 years (Parisien et al. 2023). Sampled LCC on drier sites would

experience higher degrees of physiological stress due to moisture deficits during the primary growing season.

The relationships between environmental conditions and tree decay are highly variable (Thor et al. 2005). Various factors and their interactions with tree genetic variation and fungal pathogen virulence contribute to tree susceptibility to pathogenic decay organisms and development of decay (Liu and Ekramoddoullah 2003, Sturrock et al. 2011), confounding relationships between site conditions and decay dynamics in trees. For instance, edaphic moisture content influences the occurrence, spatial distribution, and temporal dynamics of various fungal pathogens (Bernier and Lewis 1999, Cruickshank et al. 1997, Thies and Sturrock 1995, Woods et al. 2010), and is a limiting factor to disease incidence, including pathogenic decay in trees (McDougall et al., 2002; Wilson et al., 2003).

Wetness index was the strongest modelled indicator of decay in our study, and the carvers identified soil moisture as an important consideration when assessing candidate LCC trees for decay. Yet, the relationship between soil moisture and the incidence and extent of decay in redcedar is not well-documented (Sturrock et al. 2017, Chapter 2). Some fungal pathogens that infect living redcedar (e.g., *Inonotus tomentosus, Armillaria ostoyae* and *Heterobasidion annosum*) may be adversely impacted by wet to very wet soils (i.e., saturated soils with anoxic conditions) (Cruikshank et al. 1997, Bernier and Lewis 1999, Whitney 1995), which could, in part, explain why the eight most-decayed LCCs in our study were growing on drier sites. Alternatively, various species of *Armillaria* can occur on redcedar more frequently in relatively wet sites than in drier sites within the broader region of our study (Kim et al. 2010), which supports carvers' knowledge that wet sites support the development of decay in redcedar.

Carvers identified bole shape (i.e., catfaces) and bole scars as important tree characteristics when assessing candidate LCC for decay, but these factors were not significant in the models. A possible explanation for this modelling outcome is that we did not sample enough LCC with catfaces or bole scars; only 8 of 79 LCC had a catface while 17 LCC had scars. Nonetheless, both catfaces and bole scars can negatively impact wood quality (van der Kamp 1988), making each a useful indicator of decay in LCC. Catfaces have been associated with the pathogen *Armillaria ostoyae*, which is

suspected of inciting the development of a pocket of decay inside redcedar boles (Buckland 1946, van der Kamp, 1988). Bole scars serve as entry ways for decay pathogens (Hunt and Etheridge 1995, Sturrock et al. 2017) and are reported to be the most common indicator of heartwood decay in redcedar (Manning 2001).

4.4.2. Applications of Indigenous knowledge and modelling outcomes in LCC stewardship

Indigenous peoples worldwide are using ancestral knowledge and traditions together with western science to develop policy and resource management practices in response to climate warming and forest diseases that threaten cultural keystone tree species (Lambert et al. 2018, Roy et al. 2024). In this study, we found a spatial separation of the applicability of the carvers' knowledge relative to our study sites (Figure 4.10). The indicators selected in the models will be best applied to sites within the range of environmental conditions that we sampled, i.e., that are suitable for contemporary industrial forestry operations. LCC growing in sites characterized by relatively flat slopes at lower elevations and very wet saturated soils rich in nutrients should be assessed using carvers' knowledge. Combining the carvers' knowledge with modelling outcomes will support the Nanwakolas LCC Strategy by enhancing both LCC field survey data and LCC distribution mapping. The former of these two applications would enable the Nanwakolas Member Nations to build a more accurate and reliable LCC field inventory, while the latter would enable mapping that predicts the occurrence and severity of decay in populations of candidate LCC.

To ensure enough LCC are protected from industrial harvesting to allow carving for all cultural uses (Table 4.2) into the future, it is important to build a LCC field inventory that accurately portrays the potential cultural use(s) of any given LCC. To do so, carvers' knowledge and the indicators selected in the model that includes tree DBH should be integrated with existing LCC field survey criteria, which include DBH and log length. Surveyors may assess crown condition, humus form, soil moisture regime, bole shape and scars, and consider wetness index values to make an informed prediction of the decay threshold a LCC is most likely to meet (Table 4.2). Together with DBH and log length, decay threshold predictions can be used to determine the potential cultural use(s) of a LCC (Table 4.2). Connecting LCCs to the cultural use for which they are best suited would enable the Nanwakolas Council to build a LCC inventory that reflects LCC

abundance stratified by tree cultural use. This enhanced inventory would allow the Nanwakolas Member Nations to improve the regulations in the Nanwakolas Operational Protocol for Large Cultural Cedar (hereafter the "LCC Protocol") (Nanwakolas Council 2020b) that guide industry practices for LCC conservation and harvesting in operational areas. The LCC Protocol regulations are designed to ensure that a sufficient quantity and quality of LCC are protected to meet Member Nations' cultural needs over the next 300 years (Nanwakolas Council 2020b).

In addition, an enhanced LCC inventory could support decision-making when individual LCC are selected for harvest to meet a cultural need. For example, when multiple LCC with similar DBHs and log lengths are available for harvest, a prediction of the likely decay threshold of a tree can help to determine which LCC to harvest for a desired cultural use (Table 4.2). Thus, decay predictions can contribute to mitigating the wasteful and ecologically detrimental practice of felling LCCs that fail to meet the requirements for a desired cultural use or are too decayed for any cultural use. As one carver commented, "We cut three big cedars down before we found a tree that wasn't too rotten for [carving] this [community] canoe" (Max Chickite, personal communication, June 9, 2022). Having the additional field-based criteria from carvers' knowledge and the models, plus wetness index values derived using ArcGIS and TRIM data, to predict the level of decay in LCC would help carvers and their Nations to mitigate this risk of harvesting trees that are not suitable for the desired use.

Combining carvers' knowledge about decay, slope angle and elevation together with the modelling outcomes for wetness index and tree age could also enhance LCC distribution mapping and modelling techniques. Spatial data for wetness index, elevation, slope angle, and average stand age (which may be substituted for tree age) can be retrieved from databases such as the Vegetation Resource Inventory or TRIM in BC, or from Light Detection and Ranging scans, and used to assess geographic areas for their potential to support the occurrence and, to a degree, severity of decay in populations of candidate LCC. Species distribution models are one approach to predicting geographic distributions of candidate LCC across the landscape (Benner et al. 2019) and the potential of each distribution to exceed or fulfill various decay thresholds important to tree cultural use (Table 4.2). Species distribution models based on the relationships between environmental conditions and factors that affect resource quality have been used to predict the geographical distribution and quality of culturally or

socially importance resources (e.g., see, Guo et al. 2016, Nielsen et al. 2020). However, the use of Indigenous knowledge in such applications is less common (for exceptions see Mucioki et al. 2022 and Skroblin et al. 2021).

Predictions of decay occurrence and severity in candidate populations of LCC can be used to map and select locations in which to conduct LCC field surveys (i.e., carry out ground-truthing), and delineate areas that are suitable as Cedar Stewardship Areas (CSAs). The establishment of CSAs is a requirement of the BC government's current policy governing forest management in a portion of the Nanwakolas Member Nations' territories—the region known as the Great Bear Rainforest. The 2023 Great Bear Rainforest Land Use Objectives Order specifies that CSAs should be established through First Nation-industry collaborations to conserve LCC and younger redcedar and yellow cedar for cultural tree use (Ministry of Forests 2023). Modelled distributions of candidate LCC that are predicted to have little decay, or less decay than other populations, can provide data for CSA designations to provide for future generations' cultural LCC needs.

4.5. Conclusion

Few studies demonstrate the direct use of research findings based on Indigenous knowledge to enhance and implement Indigenous stewardship policy and practices for culturally significant species (for exceptions, see Benner et al. 2021, Johnson et al. 2021, Taylor et al. 2022). A goal of this research was to support Indigenous stewardship policy and practices by producing study outcomes that could be directly applied in Nanwakolas LCC stewardship initiatives. Thus, this study, co-produced with the Nanwakolas Council and its Member Nations, demonstrates how an integrative knowledge systems approach in resource stewardship can generate new knowledge that is scientifically valid, socially robust, policy relevant, and in-context culturally (see Alexander et al. 2011, Hegger et al. 2012). The knowledge of carvers from Nanwakolas Member Nations informed our field research and our interpretation of our modelling outcomes and measurements of decay in LCC, providing information that otherwise would have been absent from our study. Specifically, carvers' knowledge expanded the range of site conditions at which indicators can predict decay in LCC. By combining carvers' knowledge with modelling outcomes, our novel findings will help Nanwakolas policy and LCC stewardship practices to "maintain the health of our forests

and trees [...to] ensure [the land] is able to maintain us for all time to come" (Nanwakolas Council 2020b) – exemplifying how Indigenous knowledge can form the foundation of research that is socially valid and important to policy development.

4.6. Acknowledgements

We acknowledge the several First Nations of Kwakwaka'wakw heritage whose unceded ancestral lands served as our location to conduct field work—we are grateful for these First Nations' continued stewardship of *Aweenak'ola* and redcedar. We would like to thank and extend our gratitude to the Nanwakolas Council, its Member Nations, and several individuals who allowed us to pursue this collaborative study in a culturally appropriate and respectful manner. As well, we would like to thank Western Forest Products Ltd. and Jack Reynolds of the Campbell River Division for his time and efforts that made our quantitative data collection possible. Further, we are grateful to Dr. Lori Daniels and the Tree Ring Lab at the University of British Columbia for their financial and logistical support which contributed to post-harvest data collection and dendrochronological analyses being performed to the highest standards. We also extend our thanks to Dr. Murray Rutherford for his assistance in the writing of this article and for providing advice and insights that have been invaluable to this work.

4.7. Supplementary Material

4.7.1. Table 4.6

Table 4.6. Definition and description of tree and environmental attributes used to characterize LCCs. For categorical variables developed in this study or modified from existing classification systems, the classes are described in Table 4.5.

Attributes	Description
Tree attributes	
Diameter at breast height (DBH)	Tree diameter (cm) measured outside the bark at 1.3m above ground at high side (i.e., breast height), using a standard diameter tape.
Tree height	Total tree height (m) measured from tree base at high side to top of live crown or dead spike using a hypsometer.
Knot class*	Categorical variable with nine classes representing knot and branch quantity and size within the four quarters around the circumference of

	each "log" or vertical section of the bole that is usable for carving. The length of a log is measured vertically from breast height and its upper boundary is contingent on a change in knot class. Measured using binoculars and a hypsometer.
Crown condition	Categorical variable with two classes of tree tops differentiating "live" with green foliage, or "dead spike", with a spike top absent of green foliage for a length ≥3m. Assessed using binoculars.
Bole scars*	Categorical variable with three classes representing the presence of one or more scars in one or more quarters of the tree bole and the depth of those scars. A fourth class represents no visible scars on the bole.
Bole shape	Categorical variable with two classes differentiating a tree bole as round or having one flat side considered to be a "catface" associated with decay-causing fungi (Buckland, 1946; van der Kamp, 1988).
Environmental attributes	
Slope angle	Slope angle (degrees) measured with a clinometer.
Co-dominant tree species	Categorical variable with two classes representing *Abies* spp. and western hemlock (*Tsuga heterophylla*). The dominant or tallest trees in the A1 (uppermost) canopy layer were almost exclusively redcedar, so the species of the co-dominant or next tallest trees in the A1 canopy layer was recorded to understand species composition.
Surface materials texture*	Categorical variable with six classes describing the uppermost stratigraphic layer adapted from the Terrain Texture Codes (BC 2010).
Subsurface water*	Categorical variable with three classes representing the presence or absence of seepage or the water table within 50 cm from ground surface. A fourth class represents a ground surface of rock.
Rooting zone particle size*	Categorical variable with seven classes representing particle size distribution of sand, silt and clay in the mineral soil portion of the rooting zone (BC 2010). Classes eight, Folisol, and nine, rock, represent the absence of a mineral soil horizon.
Coarse fragment percent	Percent (%) of mineral soil consisting of gravel, cobble, stones and boulders. Classes described in BC (2010) *Terrain Texture Codes.* Determined by a visual estimate.
Drainage	Categorical variable with seven classes describing the speed and extent to which water was removed from a mineral soil in relation to additions. Classes described in BC (2010) *Soil Drainage Key.*
Mycelial abundance	Categorical variable with four classes representing fungal mycelial presence and abundance in organic soil horizons. Classes described in BC (2010) *Mycelial abundance classes and codes*.
Decaying wood abundance*	Categorical variable with four classes representing decaying wood (duff and coarse wood) presence and abundance in organic and mineral soil horizons. Classes were adapted from BC (2010) *Mycelial abundance classes and codes.*
Humus form	Categorical variable with three classes (mor, moder, mull) representing increasing biological activity and rates of decomposition and nutrient cycling within the organic soil horizons (L, F, H) and the Ah mineral horizon (Green and Klinka 1994). A fourth class, rock, was the absence of a humus form.

B horizon type*	Categorical variable with 10 classes representing the B horizon main constituent(s) which are reflective of soil Great Groups and Subgroups classifications. Classes were developed using BC (2010) *Criteria for classifying soils to the subgroup level*.
Soil order	Categorical variable with three classes representing the Podzolic and Organic soil orders and the Folisol Great Group (Soil Classification Working Group 1998). A fourth class, rock, was the absence of a soil order or great group.
Soil moisture regime	Categorical variable with seven relative soil moisture classes determined using Green and Klinka (1994). An eighth class, "rock," represents the absence of a soil moisture class.
Soil nutrient regime	Categorical variable with five relative soil nutrient classes determined using Green and Klinka (1994). A sixth class, "rock," represents the absence of a soil nutrient class.
Site series	Categorical variable with 15 classes that were derived from relative soil nutrient and moisture classes to represent site productivity determined using Green and Klinka (1994). A 16th class "bedrock" represents the absence of a site series class.
Elevation	Elevation (metres above sea level, masl). Derived using ArcGIS and Terrain Resource Information Management data.
Solar radiation	Global solar radiation (watt hours per square metre, WH m^{-2}) is the global radiation, or total amount of incoming solar insolation, for a given area. Derived using the *Area Solar Radiation* tool in ArcGIS.
Wetness index	Wetness index is a relative value derived using catchment area, elevation, slope, soil wetness and/or saturation data. Larger values represent higher potential soil moisture. Derived using ArcGIS and Terrain Resource Information Management data.
Sample site area	Area (ha) assessed using belt transects to locate LCCs. Derived using ArcGIS.

* See Table 4.7 for descriptions of classes within each categorical variable.

4.7.2. Table 4.7

Table 4.7. Descriptions of classes within categorical variables that are developed in this study or modified from an existing classification system.

Tree or Environmental attribute	Class Names	Description
Tree attributes		
Knot class	Class 1	4 clear (knot free) quarters of the log
	Class 2	1 quarter contains knots < 5 cm in diameter, other 3 quarters are clear
	Class 3	2 quarters contain knots <5 cm, 2 quarters are clear

	Class 4	3 quarters contain knots <5 cm, 1 quarter is clear
	Class 5	4 quarters contain knots <5 cm
	Class 6	1 quarter contains knots 5–10 cm in diameter, other 3 quarters are clear
	Class 7	2 quarters contain knots 5–10 cm, 2 quarters are clear
	Class 8	2 quarters contain knots 5–10 cm, 2 quarters contain knots <5 cm
	Class 9	1 or 2 quarters contain knots >10 cm in diameter, other quarters contain knots <5 cm.
Bole scars	Class 1	Scar(s) <10cm deep in any quarter of the tree bole
	Class 2	Scar(s) >10cm deep in 1 quarter of the tree bole
	Class 3	Scar(s) >10cm deep in ≥2 quarters of the tree bole
	Not visible	No scars visible on the tree bole

Environmental attributes

Surface materials texture	Blocks Boulders	Angular particles > 256 mm in diameter Rounded or subrounded particles > 256 mm in diameter
	Fibric	Well preserved fibre; 40% identifiable after rubbing.
	Mesic	Composition between fibric and humic[a].
	Moss Blanket	>75% of forest floor fully covered in moss
	Wet Organic	>75% of forest floor composed of deep black/brown carbon-rich organics; water-saturated surface
Subsurface water	Water Table	Water table is present within 50 cm of ground surface
	Seepage	Seepage is present within 50 cm of ground surface
	Absent	Water table and seepage are both absent within 50 cm of ground surface
	Rock	Ground surface is comprised of bedrock
Rooting zone particle size	Sandy	More than 75% of particles are sand (.05 to < 2mm) by volume.
	Coarse Loamy	Particles a mixture of 15 to 70% sand and up to 20% clay (<.002 mm) by volume.
	Coarse Silty	Particles a mixture of 0 to 15% sand and up to 20% clay by volume.
	Fine Loamy	Particles a mixture of 15 to 80% sand and 20 to 35% clay by volume.
	Fine Silty	Particles a mixture of up to 15% sand and 20 to 35% clay by volume.
	Fine Clayey	Particles a mixture of up to 65% sand and 35 to 60% clay by volume.
	Very Fine Clay	Particles a mixture of up to 40% sand and 60 to 100% clay by volume.
	Folisol[b]	Indicates forest floor layers overlying bedrock; no mineral soil horizon present (at pit depth).
	Rock	Bedrock or fragmented material.
Decaying wood abundance	None	Decayed wood (coarse woody debris/material and 'duff') is not visible

	Few	Decayed wood is occasionally present, but is scattered and not easily observed
	Common	Decayed wood is commonly observed and distributed either evenly or concentrated in spots throughout the horizon
	Abundant	Decayed wood is observed continuously throughout the horizon and visually takes up more than 85% of the soil volume
B horizon type	Bedrock	Bedrock or fragmented material; mineral soil absent.
	Cemented[c]	A dense layer of soil that obstructs root, air, water movement.
	Folisol	No mineral soil horizons present (at pit depth).
	Eluviat Fe	Iron rich soil deposits in lower depths of B horizon, eluviated from upper horizons.
	Eluviat Organic	Organic rich soil deposits in lower depths of B horizon, eluviated from upper horizons.
	Enrich AlFe	Iron and aluminum deposits or matrix, identified by soil colour of orange/red or white/silvery-gray.
	Enrich Organic	Organic deposits or matrix, identified by soil colour of dark black or brown.
	Gray Mottling	A pattern of mottles gray in colour associated with water transport.
	Organic	Horizon characterized by carbon-rich organics (well-decomposed plant material); often water saturated.
	Organic over AlFe	Carbon-rich organics in the upper layer of the B overtop iron/aluminum deposits or matrix.

a Humic; Decomposed organic material; 10% identified after rubbing.
b Folisol; Well to imperfectly drained upland organic soils composed predominantly of L, F, and H horizons; must be either ≥ 40 cm thick, or ≥ 10 cm thick if overlyingbedrock or fragmental material, or more than twice the thickness of an underlying mineral soil layer that is < 20 cm thick (BC 2010).
c Cemented; Description adapted from van Breeman and Buurman (1998).

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Chapter 5. Evaluating the treatment of Indigenous rights and obligations for reconciliation in the Great Bear Rainforest: Large Cultural Cedar stewardship in Kwakwaka'wakw territories

5.1. Introduction

> *If you want to reconcile with First Nation people, how are you going to do that when all the trees are gone?*
>
> *John Henderson, Wei Wai Kum First Nation*

Indigenous peoples in many parts of the world are regaining control of biocultural resources on lands from which they were displaced by colonizing settler societies (Stephenson et al. 2014). Common colonial practices such as land dispossession and intensive resource exploitation restricted Indigenous peoples from accessing, using and stewarding lands and resources critical to their cultures, spirituality, subsistence and livelihoods (Turner et al. 2013, Fernandez-Llamazares et al. 2021). Recovering control of these lands and resources is an important part of Indigenous self-determination (Nightingale and Richmond 2022), a fundamental right from which other Indigenous rights flow (Gunn 2013).

In the temperate rainforests of coastal British Columbia (BC), Canada, biocultural resources valued by Indigenous communities have been degraded or destroyed by more than 100 years of industrial logging, carried out mainly by non-Indigenous actors sanctioned by the BC provincial government or its colonial predecessors to operate on unceded Indigenous lands (Turner and Turner 2007, Turner et al. 2008). The BC government manages most of the forested land in BC as provincially owned "Crown" land, but this land is in the traditional territories of Indigenous peoples (self-identified as "First Nations").[5] Very few of these First Nations have entered into treaties ceding rights to their territories in BC (Reynolds 2018). However, the BC government claims sovereignty and ownership of these lands and has granted logging rights and other tenures for resource extraction to third parties, often without the consent of the affected

[5] The Indigenous peoples of Canada are First Nations, Métis or Inuit. Section 35 of the *Canadian Constitution Act*, 1982 refers to these peoples collectively as "Aboriginal peoples" (*Constitution Act*, 1982, s 35).

First Nations (e.g., see Ekers 2019). These practices continue despite the explicit recognition and affirmation of “Aboriginal rights” in s.35 of the *Canadian Constitution Act*, 1982 (*Constitution Act*, 1982, s. 35).

For coastal First Nations in BC, the loss of large old cedar trees suitable for cultural carving is of particular concern. “Large Cultural Cedar” trees (LCC), sometimes called “Monumental Cedar,” are old-growth western redcedar (*Thuja plicata*) trees that have special wood qualities and other characteristics that make them suitable for carving for cultural purposes, such as dugout canoes, totem poles, large ceremonial masks, and traditional buildings. Several centuries of growth are required to develop the immense size and other morphological characteristics that make these trees suitable for carving (Daniels 2003, Benner et al. 2021). These large, high-quality trees are also particularly sought by the forest industry for timber products (Green 2007). Industrial logging in BC has targeted such larger trees in productive and accessible areas, leading to depletion of the supply of LCC available to First Nations, and to extreme rarity of LCC of the largest dimensions (Benner et al. 2019, Benner et al. 2021, Benner and Lertzman 2022, Sutherland et al. 2016).

In 2020, the First Nations members of the Nanwakolas Council on the south-central coast of BC directly asserted their authority and control over the harvest and stewardship of LCC in their territories by declaring a Large Cultural Cedar Operational Protocol (the “LCC Protocol”) (Nanwakolas Council 2020). The LCC Protocol is an innovative Indigenous policy that applies strict operational standards to the forest harvesting practices of anyone operating in the traditional territories of these First Nations (Nanwakolas Council 2020a). The standards are designed to ensure that a sufficient quantity and quality of LCC trees are protected to meet First Nations’ needs over the long term, while still allowing some LCC to be harvested to meet First Nations’ current cultural needs and to provide the forest industry with a small number of large high-quality redcedar trees. The Nanwakolas Council is a regional organization consisting of the K’ómoks, Wei Wai Kum, Wei Wai Kai, Da’naxda’xw Awaetlala, Tlowitsis, and Mamalilikulla First Nations. Through the Nanwakolas Council, these Nations (called “Member Nations”) conduct collective decision-making concerning their Indigenous rights and the stewardship of their unceded lands and waters (Nanwakolas Council 2020b). The LCC Protocol is part of a broader LCC stewardship strategy that the

Nanwakolas Member Nations have developed for the 21,604 km2 of land in their traditional territories (the “LCC Stewardship Strategy”).

Much of the land in the territories of the Nanwakolas Member Nations lies in the southern part of the Great Bear Rainforest (the “GBR") (Figure 5.1). The GBR is a region of approximately 64,000 km2 of temperate rainforest on the central and north coast of BC that is globally renowned for its forest values and ecological conservation significance (Clapp 2004, Price et al. 2009). The BC provincial government has established its own regulatory framework governing forestry operations in the GBR, including forestry operations in the portions of the GBR that are within the territories of the Nanwakolas Member Nations. Under this provincial regulatory framework, the BC government establishes “land use objectives” for forest stewardship in the GBR, and forest tenure-holders (mainly large non-Indigenous forestry companies) must then develop stewardship plans with strategies and results that are “consistent with” these objectives (Ministry of Forests 2023a s.1.3). The most recent set of BC land use objectives for the GBR is the 2023 GBR Land Use Objectives Order (the “GBR Order”) (Ministry of Forests 2023a). The stated goals of the GBR Order include, “to protect and conserve First Nations forest and cultural values, improve the long-term stewardship of Indigenous heritage features and Indigenous forest resources in the area, and provide enhanced access to opportunities for forestry-related carbon benefits and commercial forestry” (GBR Order Preamble). The GBR Order also includes specific objectives for "Indigenous Tree Use” (including LCC trees) and for “First Nation information sharing and engagement.”

Figure 5.1. A map showing the traditional territories of the Nanwakolas Council Member First Nations in relation to the boundaries of the GBR (map credit Johnny Nelson).

Thus, the Nanwakolas Member Nations and the BC government have each recently issued an innovative regulatory policy governing the conservation and use of Indigenous bio-cultural resources in the GBR, but these policies are the products of fundamentally different approaches to Indigenous rights and authority, and to the balance to be drawn between Indigenous interests and the interests of colonial governments, the forest industry and other stakeholders. The LCC Protocol was issued directly by a group of First Nations, based on their assertion of authority over their traditional territories. The GBR Order was issued by the BC provincial government as part of its regulatory framework for forestry in BC, which is ultimately based on the BC government's assertion of ownership and sovereignty over lands taken from First Nations during early colonization. However, unlike many laws and regulations issued since colonization under BC's forestry regulation framework, the GBR Order was an outcome of a shared decision-making process between the BC government and First Nations that was established under government-to-government reconciliation protocols and ecosystem-based management agreements.

In this paper, I use widely accepted norms for Indigenous rights and reconciliation to examine and compare these different approaches to Indigenous rights and authority in forest stewardship and cultural resource management in the GBR. More specifically, I evaluate the GBR Order using these norms to understand better the need for a separate Indigenous regulatory policy for LCC stewardship. I begin by developing a new evaluation framework based on principles and standards of practice drawn from the United Nations Declaration on the Rights of Indigenous People ("UNDRIP") (UNGA 2007) and the Calls to Action of the Truth and Reconciliation Commission of Canada ("TRC Calls to Action") (TRCC 2015). I apply this framework to evaluate the GBR Order and the policy processes through which it evolved, focusing on Indigenous rights and the control and management of LCC. I then examine whether, and if so, how, the LCC Protocol addresses gaps and deficiencies revealed in my evaluation of the GBR Order. I am interested in how the approach to cultural resource stewardship in the Indigenous LCC Protocol may address limitations of the GBR Order, thus I do not formally evaluate the LCC Protocol using the evaluation framework. Also, the principles of the UNDRIP that are incorporated in the evaluation framework deal with relationships between states and Indigenous peoples, whereas the LCC Protocol is a declaration by Indigenous peoples.

This evaluation is justified and timely, given that the BC government recently enacted the *Declaration on the Rights of Indigenous Peoples Act* ("*DRIP Act*") (SBC 2019, ch. 44), which establishes the UNDRIP as "the province's framework for reconciliation" (Province of BC, n.d.). The *DRIP Act* requires the BC government "to take all measures necessary to ensure the laws of British Columbia are consistent with the Declaration" (*DRIP Act*, s.3). The BC government has also committed to adopt and implement the TRC Calls to Action (TRCC 2015) (Office of the Premier of BC 2017).

The GBR is one place in BC where it might be expected that the provincial government would be fulfilling its commitments to UNDRIP and the TRC Calls to Action, or at least be well along the way to doing so. The current BC regulatory framework for land use in the GBR is the product of a 15-year collaborative planning process for the region undertaken by the BC government, which included multi-stakeholder planning tables, followed by direct government-to-government negotiations and agreements between the BC government and First Nations (see Low and Shaw 2011, McGee et al. 2010). Some analysts have credited these negotiations and agreements for facilitating a transformation in forest governance in the GBR to the benefit of First Nation communities (Howlett et al. 2009, Low and Shaw 2011, Moore and Tjornbo 2012). Others, including the BC government and some First Nations' leaders, have touted the GBR agreements as a model for reconciliation and a new relationship between Canadian governments and Indigenous peoples (Baker 2023, Curran 2017, Government of BC 2023, Sierra Club BC n.d.).

To my knowledge, my research is the first study to evaluate the GBR Order and policy processes using the norms of the UNDRIP and the TRC Calls to Action. It is also the first to examine an Indigenous protocol for LCC stewardship in the GBR. My research also addresses a gap in the academic literature, in that I develop the first comprehensive set of evaluative principles and practices drawn from the UNDRIP and the TRC Calls to Action that focuses specifically on Indigenous rights in forest stewardship and cultural resource management. Although there are other studies that apply principles or criteria concerned with Indigenous rights and values to natural resource management more broadly (e.g., Caverley et al. 2019, Reed et al. 2022, Smith and Mitchell 2020, and see Indigenous Navigator 2023), the principles and practices in my evaluative framework are tailored specifically to forest stewardship and cultural resource management. I use the term 'forest stewardship' to capture the various terms

that reflect the governance and use of forested lands, such as forestry, forest or natural resource policy, and forest management and practices.

Specifically, the objectives of this research are as follows:

1. Develop a comprehensive framework for evaluating the treatment of Indigenous rights and reconciliation in forest stewardship and cultural resource management policy, based on the norms of the UNDRIP and the TRC Calls to Action;

2. Using this framework, evaluate the treatment of Indigenous rights and reconciliatory obligations under the GBR Order, focusing on the control and stewardship of LCC;

3. Examine and compare the approaches to Indigenous rights and reconciliation under the LCC Protocol with those of the GBR Order;

4. Based on the findings of this evaluation, identify policy shortcomings and discuss the factors underlying these shortcomings and how they can be addressed.

5.1.1. Statement of Positionality

Writing as a white settler woman with a background in forestry who has worked as a consultant for the Nanwakolas Council since 2017, I do my best to present an unbiased and transparent article. My consulting role for the Nanwakolas Council over the course of this research consisted of providing feedback on draft versions of the LCC Protocol, helping to develop the LCC survey manual, conducting LCC inventory field surveys, and supporting the development of the Nanwakolas Cultural Wood Program to facilitate access to LCC harvested under the regulations of the LCC Protocol.

5.2. Methods

5.2.1. Defining a set of evaluative principles and standards of practice based on the UNDRIP and the TRC Calls to Action

To develop the evaluation framework I began by reviewing the academic literature to identify potential principles to use as evaluation criteria. I searched Google Scholar (scholar.google.com) and ScienceDirect (sciencedirect.com) databases in October 2021, using the keyword search term “Indigenous,” in combination with either “principles” or “criteria.” I then repeated this search two times, first replacing the search

term “Indigenous” with “Aboriginal,” then with “First Nation.” Next, I searched the resulting set of documents for those that included the terms “rights,” “policy,” or “decision-making.” Within this subset I identified documents that used any of the following terms: “stewardship,” “management,” “forest,” “environmental,” and “governance.” From the search results, I selected articles that discussed principles for forest or environmental stewardship, and that founded these principles on national or international proclamations concerning Indigenous rights (e.g., the UNDRIP). I found only two articles that satisfied my conditions: Caverley et al. (2019) and Black and McBean (2016).

Caverley et al. (2019) developed an “Indigenous-rights focused” evaluation framework and used it to evaluate forest stewardship in BC under “inclusive development-related policies and practices” (e.g., forest and land use legislation and plans). Their evaluation framework is based on six criteria for meaningful engagement and reconciliation with Indigenous peoples in forest stewardship (Table 5.1). They derived these criteria from the UNDRIP, the TRC Calls to Action, and the ethical principles for meaningful engagement with Indigenous peoples proposed by Kirkness and Barnhardt (1991).

Black and McBean (2016) focus on environmental policy reform to improve health among Indigenous peoples. Using lessons derived from case studies of Indigenous participation in environmental management and the inclusion of traditional knowledge in resource policy, they propose five principles to promote a holistic and equitable approach to addressing health concerns in Indigenous communities (Table 5.1). They discuss how these principles reflect rights and concepts that are described in the UNDRIP and other international instruments concerning Indigenous rights, and conclude that, when applied to environmental management and policy development, these principles can improve the control that Indigenous peoples have in decision-making about environmental issues.

I considered Caverley et al. (2019) and Black and McBean (2016) to be good sources for my framework because both articles discuss principles that support Indigenous rights and aspirations in policy development and decision-making pertaining to the environment and natural resources. In addition, both articles justify the principles by comparing them with relevant provisions of the UNDRIP, and they both apply the

principles in Canadian settings. However, when I compared these principles with the UNDRIP and TRC Calls to Action, I found that, for my purposes, the sets of principles developed by these authors needed further specification and a stronger connection to forest stewardship.

I combined the principles from Caverley et al. (2019) with those from Black and McBean (2016) to form an initial set of five evaluation principles (the first five principles in Table 5.1). To do this, I either adopted a principle directly from Caverley et al. (2019) or Black and McBean (2016), or amalgamated similar principles from the two articles into a single principle, or, in the case of principle (1), amalgamated two principles from Caverley et al. (2019). Next, I reviewed the UNDRIP and the TRC Calls to Action to identify provisions supporting or relevant to each principle, including provisions of the UNDRIP specifically cited by Caverley et al. (2019) or Black and McBean (2016) (Table 5.4 in Supplementary Material). Based on this review, I refined the evaluation principles to clarify the intent and wording, and to align them better with the Articles and Calls to Action. This review also revealed a gap in the coverage of the five principles, which I filled by adding a sixth principle concerning the knowledge and training of policy makers (Table 5.1). Section 1 in the Supplementary Material provides a more detailed explanation and justification of the choices I made in selecting and refining these principles, and explains the importance of each principle in forest stewardship in BC.

Table 5.1. The principles associated with the UNDRIP and the TRC Calls to Action developed in Caverley et al. (2019), in Black and McBean (2016), and used in this research.

Refined principles used in this research	Caverley et al. (2019)	Black and McBean (2016)
(1) Respect, protect and fulfill Indigenous title and rights	(i) Recognizing Indigenous title and rights which includes an economic diversification component (ii) Not diminishing Indigenous title and rights	
(2) Respect, protect and fulfill Indigenous Peoples' rights to self-government and self-determination	(iii) Recognizing Indigenous Peoples' inherent right to self-government	(b) The recognition of Indigenous Peoples' inherent right to self-determination
(3) Create equity and transparency in decision-making processes	(iv) Creating equity in the decision-making process	(d) Reliance on community based participatory approaches

(4) Do not adversely affect Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence and livelihoods	(vi) Reducing forestry's adverse effects on Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence and livelihoods	
(5) Apply Indigenous knowledge, viewpoints and knowledge systems in an integrative fashion and in accordance with Indigenous laws, traditions and customs	(v) Adapting forest policy to include Indigenous knowledge and being informed by Indigenous professionals and institutions	(a) The recognition of Indigenous knowledge (c) The use of inclusive and integrative knowledge systems (e) The use of circular and holistic viewpoints
(6) Ensure policy-makers, managers and practitioners have the requisite knowledge and skills to apply these principles		

I cross checked my principles against the indicators developed by Smith and Mitchell (2020) in their "UNDRIP Compliance Assessment Tool." They designed this tool to assess and monitor state compliance with the UNDRIP, identify areas of non-compliance, and compare the performance of different states. Their tool includes five sets of indicators covering the following themes: self-government and self-governance; consultation and free, prior, and informed consent (FPIC); and land and resource rights. Smith and Mitchell (2020) pilot-tested the tool using the findings of the UN Special Rapporteur on the Rights of Indigenous Peoples' (Anaya 2014) concerning the situation of Indigenous Peoples in Canada. I reviewed Smith and Mitchell's (2020) detailed descriptions of the indicators to ensure that my principles covered the core elements of their indicators, and to identify supporting practices and standards for my principles.

I also considered the Indigenous Navigator (Indigenous Navigator 2023) as a possible source of principles and practices for the evaluation framework, but I decided that it was too broad and generalized for my purposes. The Indigenous Navigator is a framework and free set of tools developed for and by Indigenous peoples "to assess the realisation of Indigenous Peoples' rights." It was designed to be used in assessing the overall performance of governments and communities, and it includes indicators in domains such as cross-border contacts, freedom of expression and media, general economic and social development, and education (Indigenous Navigator 2024).

To make it easier to apply my evaluation framework in practice, I extracted statements from the Articles and Calls to Action that describe practices that will contribute to fulfilling each principle, and added them to the framework. Next, I identified standards that provide more detail about what is required for each practice and principle, again using statements from the UNDRIP Articles and the TRC Calls to Action. Last, I revised the wording of the practices (Table 5.2) and standards to make them more relevant to forest stewardship (Table 5.5 in Supplementary Material). Given that some of the standards described in the Articles and Calls to Action support more than one principle of the evaluation framework, some standards in the framework are similar across principles (Table 5.5).

Table 5.2. The six principles and their practices. The Articles of the UNDRIP and the TRC Calls to Action associated with each principle and from which the practice standards were extracted are also included. Practices are matched with the principle they most closely support.

Principles	Practices and supporting Articles of UNDRIP and/or TRC Calls to Action that relate to each principle
(1) Respect, protect and fulfill Indigenous title and rights	1.1) *Take no actions that dispossess Indigenous peoples of their lands or that use or damage their lands and resources*: Articles: (8.2b), (11.1), (19), (28.1), Calls: (47) 1.2) *Honour Indigenous peoples' rights to own, use, develop, control and steward their lands*: Articles: (26.1), (26.2), (32.1) 1.3) *Honour Indigenous peoples' right to participate in processes that determine their rights to lands and resources:* Articles: (27), Calls: (51) 1.4) *Accept Indigenous title claims that provide evidence:* Calls: (52:i) 1.5) *Collaborate with Indigenous peoples prior to implementing forest policy or practices to develop an arrangement that honours their rights*: Articles: (19), (32.2), (32.3), (37.1) 1.6) *Adopt and implement the UNDRIP and assist Indigenous peoples in achieving the full realization of their rights*: Articles: (38), (39), Calls: (43)
(2) Respect, protect and fulfill Indigenous Peoples' rights to self-government and self-determination	2.1) *Recognize and respect the decisions, actions and processes of Indigenous peoples that contribute to their pursuit of self-determination*: Articles: (3), (4), (32.1), (33.2), (34), (39)
(3) Create equity and transparency in decision-making processes	3.1) *Communicate and conduct decision-making with Indigenous peoples in a way that is fair and free of discrimination*: Articles: (2), (13.2) 3.2) *Include Indigenous peoples in decision-making*: Articles: (18)

	3.3) *Include a mechanism of transparency in the decision-making process to support Indigenous rights and equity*: Articles: (27), Calls: (51)
(4) Do not adversely affect Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence and livelihoods	4.1) *Do not forcibly assimilate or destroy the culture of Indigenous peoples*: Articles: (8.1) 4.2) *Conduct forestry in a manner that honours Indigenous peoples' rights pertaining to their traditional activities, including economic and spiritual activities*: Articles: (8.2b), (12.1), (19), (20.1), (25), (26.1), (26.2), (32.2), Calls: (92:i)
(5) Apply Indigenous knowledge, viewpoints and knowledge systems in an integrative fashion and in accordance with Indigenous laws, traditions and customs	5.1) *Access Indigenous peoples' knowledge and other property in a manner that respects their rights, laws, traditions and customs and supports relationship building:* Articles: (11.2), (31.1), (31.2)
(6) Ensure policy-makers, managers and practitioners have the requisite knowledge and skills to apply these principles	6.1) *Work with Indigenous peoples to develop and implement formal education and training*: Articles: (15.2), Calls: (57), (92:iii) 6.2) *Promote education and public information that speaks truth to Indigenous diversities*: Articles: (15.1)

5.2.2. Applying the Evaluation Framework

GBR Order

The GBR Order (Ministry of Forests 2023a) is a revised and updated version of the BC government's 2016 GBR Land Use Objectives (Ministry of Forests, Lands and NRO 2016a) (hereafter, the 2016 GBR Objectives). The 2016 GBR Objectives were a consolidated and revised version of previous provincial land use orders issued separately in 2007 for the north and south portions of the GBR, and amended in 2009 and 2013 (Ministry of Forests, Lands and NRO 2016a). I evaluated the most recent version of these land use objectives (the 2023 GBR Order), but I also compared the 2023 GBR Order with these previous versions.

To apply the evaluation framework to the GBR Order, I reviewed all the provisions of the GBR Order that apply to the "South Central Coast" region (the portion of the GBR that overlaps with the territories of the Nanwakolas Member Nations). I focused on provisions dealing with cedar, LCC, First Nation cedar stewardship, and First Nation information sharing and engagement, including the following:

1. The legal objectives for Indigenous tree use, stand retention, identification of Indigenous forest values, and Indigenous forest resources

2. The legal objective for First Nation information sharing and engagement,

3. The Preamble and Definitions sections, and

4. Schedule Q of the GBR Order: a map of Cedar Stewardship Areas in the GBR.

In addition, I reviewed the guidance document for the GBR Order developed by First Nations and the BC Government and issued in 2023: Implementing the 2023 Great Bear Rainforest Land Use Order: Ecosystem-Based Management Planning and Practice Guidance (hereafter, "Implementation Guidance Document") (Ministry of Forests 2023b). I also reviewed the previous 2016 GBR Objectives, and the "Background and Intent" implementation guidance document issued by the BC government to support those objectives (hereafter, "2016 Background and Intent") (Ministry of Forests Lands and NRO 2016b).

To investigate the policy processes through which the GBR Order and the previous land use objectives for the GBR were developed, I reviewed peer-reviewed literature on policy and planning in the GBR, including articles on governance, forest practices, ecosystem-based management (EBM), and government-to-government and stakeholder relations (see list after references). Specifically, I sought information from the literature about:

a) the stakeholders and First Nations who were involved in the GBR negotiations and agreements and the roles they played in the policy process;

b) the contributions of those involved (particularly in government-to-government negotiations) with respect to cedar, LCC, First Nation cedar stewardship and First Nation engagement;

c) how such contributions were obtained and subsequently used or represented in decision-making; and

d) the reasoning supporting the decisions made about cedar, LCC and First Nation cedar stewardship and engagement for the GBR Order and previous land use objectives.

Based on my review of the documents described above, I evaluated the performance of the GBR Order on each practice of the evaluation framework. I assigned a qualitative rating for each practice based on the following scale developed by Ellis et al. (2010) (also see Zieger et al. 2018). In the results section I include a narrative explanation of my ratings.

- Fully Met = no deficiencies
- Largely Met = no major deficiencies
- Partially Met = no more than one major deficiency
- Not Met = two or more major deficiencies

A deficiency was deemed to be major if it prevents or substantially impedes fulfillment of the practice. For example, the Indigenous Tree Use (ITU) legal objectives were developed with the objective of providing First Nations with a quantity of LCC that will support their present and future cultural needs, but the GBR Order does not honour First Nations' autonomy to steward LCC on their territories independently of government control and direction. This is a substantial shortfall in comparison with practice 1.2 of the evaluation framework: "Honour Indigenous peoples' rights to own, use, develop, control and steward their lands." Thus, I judged practice (1.2) to be partially met, given that there were no other characteristics of the GBR Order that applied to this practice (in the results section I provide more detail about this example). In contrast, I deemed a minor shortfall of performance in comparison with a practice to be simply a minor deficiency.

I did not have access to the broader suite of government-to-government agreements and protocols between the BC government and First Nations that specify additional procedures for engagement and shared decision making in the GBR. I am aware through my consulting work with the Nanwakolas Council that as a result of these agreements First Nations had a major role in the development of the terms of the GBR Order. I am also aware that in practice under these agreements First Nations have had a more powerful voice in decision making in the GBR than the GBR Order itself may require. Thus, it is possible that First Nations were willing to accept broad wording in the GBR Order with the knowledge that they could rely on the terms of their government-to-government agreements and protocols with the province. However, the BC government's commitment in the DRIP Act is to take measures to ensure "the laws" of British Columbia are consistent with the UNDRIP. While the terms of government-to-

government agreements and reconciliation protocols may constrain provincial actions and provide First Nations with more equal authority in decision making than the GBR Order itself indicates, the terms of the actual laws matter, symbolically and practically. Accordingly, my evaluation of the GBR Order focuses on the legal requirements of the GBR Order itself.

I also acknowledge that the GBR spans the territories of several First Nations that have distinct interests, perspectives, and stewardship objectives. Given this variation, First Nations may have been willing to accept some flexibility in the terms of the GBR Order legal objectives. For instance, some First Nations operate their own forest tenures within the GBR and may prefer to have some flexibility in seeking economic returns from the forest land base.

The LCC Protocol

I relied on the following in my assessment of the LCC Protocol:

1. The LCC Protocol itself. Nanwakolas Member Nations obtain the commitment of forestry licensees to the LCC Protocol by encouraging all major forestry licensees operating on Nanwakolas territories to sign Information Sharing Protocols developed by the Nanwakolas Council, which spell out the terms and conditions for information sharing between the First Nation(s) and a forest tenure holder (licensee), and include a commitment by the licensee to collaboratively implement the provisions of the LCC Protocol. The Information Sharing Protocols are not within the public domain.

2. My immersive participatory research and experience as a forestry consultant with the Nanwakolas Council between 2017 and 2024, which included data collection and assisting in decision-making for the terms of the LCC Protocol.

Based on my review of the materials described above, and my own experience, I assessed whether, and if so, how, the LCC Protocol addresses the gaps and deficiencies revealed in my evaluation of the GBR Order. To do so, I compared the characteristics of the LCC Protocol for each practice of the evaluation framework with my evaluation of the GBR Order.

5.3. Results

In this section, for each principle in the evaluation framework I describe my assessment of the performance of the GBR Order and then compare the relevant provisions of the LCC Protocol. The results of the evaluation of the GBR Order are summarized in Table 5.3. See Table 5.6 in Supplementary Material for a second version of this table that includes a detailed comparison of the characteristics of the LCC Protocol for each practice of the framework with those of the GBR Order.

5.3.1. Principle 1. Respect, protect and fulfill Indigenous title and rights

GBR Order

The GBR Order does not meet the requirements of practices (1.1) and (1.4), and only partially meets the requirements of the other practices for principle 1, with the exception of practice (1.3) which is fully met. The BC government demonstrated deference for the rights and self-governing status of First Nations by participating in government-to-government (G2G) negotiations with First Nations and entering into the GBR agreements (practice 1.3) (Barry 2012; Low and Shaw 2011), but the GBR Order itself is a provincial enactment embedded in a colonial regulatory regime for forestry. In this regime the provincial government wields the ultimate authority (Curran 2017, Howlett et al. 2009). The reconciliation protocols and other agreements that the provincial government has entered into with First Nations in the GBR do establish shared-decision making processes under which First Nations have a major role in the design of forestry policies and in operational decisions in the GBR. However, there are provisions of the GBR Order itself that still allow the possibility that the BC government could exercise its authority in ways that infringe on Indigenous rights and diminish Indigenous cultural resources (practice 1.1). Furthermore, the province has not accepted any Indigenous title claims in the GBR (practice (1.4)) and no treaties have been signed for the region.

The GBR Order does not require free, prior and informed consent for harvesting and actions affecting LCCs (practice 1.2). The first objective in the Order for Indigenous Tree Use (ITU) is to “maintain a volume and quality, *specified during First Nation engagement*, of western redcedar, yellow-cedar and other tree species to support the

Applicable First Nations' present and future Indigenous Tree Use" (GBR Order Part 3, s.8(1); italics added). However, the definition of "First Nation engagement" in the GBR Order requires only "reasonable efforts to communicate, share information, engage in dialogue, and identify and work to resolve issues and concerns brought forward by applicable First Nations" (GBR Order Part 3, s.2(1)). There is no requirement to obtain informed consent from the affected First Nation(s). Under current practices in the GBR, and in accordance with the government-to-government agreements and protocols, First Nations have a much stronger role in decision making about ITU than this objective requires (Jordan Benner, personal communication, April 25, 2024), but the wording of this key provision of the GBR Order has not yet evolved to require informed consent.

The specific objective in the GBR Order for ITU in "development areas" (areas in which harvesting can take place) is to: "retain monumental cedar and cultural cedar stands with windfirm buffers, specified during First Nation engagement, to support the Applicable First Nations' Indigenous Tree Use" (s.8(3)). There are important exceptions to this objective: a licensee may harvest LCC when necessary for road access or other infrastructure, or when there is a safety concern, "and there is no practicable alternative" (GBR Order Part 3, s.8(4)(a)). These exceptions are only available in cases where retention of all the LCC in a cutblock would make harvesting economically unviable, and plans to alter or harvest the LCC(s) have been developed through First Nation engagement (s.8(4)(d) and (e)). However, "economically unviable" is not defined, and presumably would be determined initially by the licensee preparing the stewardship plan and cutting or road permit (at least until challenged). Moreover, First Nation engagement does not include a requirement for consent (as discussed above). This regulatory standard for engagement with First Nations about proposed exceptions to the ITU objectives stands in stark contrast to the higher standards specified for some of the exceptions to other legal objectives in the GBR Order. For example, to qualify for certain exceptions to the objectives in the South Central Coast region of the GBR for "Indigenous heritage features" (Objective 6, ss. 3 &7), or "important fisheries watersheds" (Objective 10, s. 2b), or "aquatic habitat" (Objectives 11, s. 4a, and 12, s. 4a) licensees must have "the support of, or lack of objection from, the applicable First Nations."

The Implementation Guidance Document for the GBR Order does recommend that forest stewardship plan holders (i.e., licensees) "should" engage with First Nations

to “share and discuss information related to the First Nations’ stewardship, harvesting and use of trees,” and develop and implement cedar strategies (s.2.2, p. 22), but such collaboration is not made mandatory by the GBR Order. The Implementation Guidance Document is explicitly structured as a set of guidelines rather than binding rules. For example, the Implementation Guidance Document states (p. 5, italics added): “It is expected that licensees with tenure in the GBR will commit in their forest stewardship plans to *make reasonable efforts* to follow the guidance in this document.” The Implementation Guidance Document also states that licensees should meet with First Nations to “discuss and seek to identify solutions to issues, and then [adjust] planned harvesting, road building, and forest management activities to address the concerns and issues raised by the Nations” (s.2.2, p. 12), but again, this is a suggested approach rather than a requirement.

The combined effect of the ITU objectives and the exceptions for road access, infrastructure and safety is that under the terms of the GBR Order there are a variety of circumstances in which licensees could possibly harvest LCC in development areas without the consent of First Nations, as long as the retention of all the LCC in the cutblock would make harvesting economically unviable, and there are sufficient cedar trees remaining in other areas (e.g., reserve zones) to “support” ITU. There are several fundamental problems with relying solely on LCC outside of development areas to meet the needs of First Nations. First, this ignores the challenges for First Nations of accessing and using LCC outside of development areas. LCC in development areas are typically in more accessible terrain and closer to roads and the communities where the trees will be used. Second, it is important to maintain the genetic diversity of cedar across a range of sites in the GBR (inside and outside of development areas). Third, restricting the spatial distribution of LCC on the landscape would increase the risk that a catastrophic event, such as a fire or landslide, will substantially diminish the stock of LCC in a specific area. Fourth, there is not enough Type 1 LCC (the largest LCC) presently in reserve areas in the southern GBR to meet First Nations’ intergenerational needs, given that the need for Type 1 LCC already exceeds supply in several First Nations’ territories (Benner et al. 2021).

To the credit of the provincial government and First Nations involved in the negotiations that led up to the 2023 GBR Order, the exception for economic viability is much narrower in the 2023 Order than it was in the previous 2016 GBR Objectives. In

the 2016 version, the objectives for “Aboriginal Tree Use” (as they were then called) included a broad exception that allowed licensees to harvest LCC within development areas, after First Nation engagement, if retaining all such trees “would make harvesting economically unviable” (Ministry of Forests, Lands and NRO 2016a). As Curran (2017) points out, that broad exception undermined the overall intent of the objectives. In the 2023 ITU objectives the economic justification only applies as a limitation on other exceptions for specific circumstances (such as cutting trees for access roads and other infrastructure, or safety concerns).

One notable outcome of the GBR negotiations and agreements that supports Indigenous peoples in achieving their rights is the establishment of the Coast Conservation Endowment Fund Foundation (now known as “Coast Funds”). Coast Funds was created to administer C$120 million in donated private and public money to provide First Nations and local communities with resources to oversee and implement EBM and stewardship initiatives in the GBR (Affolderbach et al. 2012, Curran 2017). However, the province has not fully compensated First Nations for the historical and ongoing industrial harvest of cedar and other culturally significant tree species on their territories. Justly compensating Indigenous peoples for forest policy and practices which have adversely impacted environmental, economic, social, cultural, or spiritual aspects of their lives is a component of practice (1.5). Thus, the GBR Order only partially meets practice (1.5).

Turning to practice (1.6), the provincial government has enacted the *DRIP Act*, but, as this evaluation shows, they are still well short of full adoption and implementation of the UNDRIP (see Bankes 2021, JFK Law 2022, Simmons 2021). The Implementation Guidance Document asserts that the GBR Order “represents progress on the *DRIP Act* Action Plan,” in that the BC government developed the Order in collaboration with First Nations and is continuing such collaboration through the GBR Joint EBM Forum (s.1.3, p. 5).

LCC Protocol

In contrast to the GBR Order, the LCC Protocol clearly asserts Indigenous rights rather than potentially infringing on them. In the preamble to the LCC Protocol, First Nations assert their Indigenous title and rights throughout their territories, and state that the UNDRIP “is the framework for reconciliation that states the minimum standards for

the survival, dignity and well-being of Indigenous peoples" (practices (1.1) and (1.6)) (LCC Protocol Preamble). Notably, the LCC Protocol directly advances three of the fundamental rights of Indigenous peoples recognized in the UNDRIP: (i) to "freely pursue their economic, social and cultural development" (Article 3); (ii) "to own, use, develop and control [their] lands, territories and resources" (Article 26 (2)) and, (iii) "to determine and develop priorities and strategies for the development or use of their lands or territories and other resources" (Article 32 (1)) (UNGA 2007).

The LCC Protocol is designed to ensure that an intergenerational supply of LCC is maintained (s. 3) in order to enable cultural uses of LCC to continue, and to support forest health and human well-being now and in the future (LCC Protocol Preamble) (practices (1.1) and (1.2)). The Nanwakolas Council has also developed Information Sharing Protocols to assist in achieving these goals by establishing a process for information exchange during forest management planning. The LCC Protocol specifies forestry operational guidance and standards for areas with LCC. Unlike the First Nation engagement requirements of the GBR Order, if a licensee proposes to deviate from the LCC Protocol due to site conditions, such as concerns about operational access or safety, the licensee must first obtain consent from the affected Nanwakolas Member Nation(s) for the proposed deviation (called an "alternative approach") (practices (1.1), (1.3) and (1.5)). Licensees may propose alternative approaches to the minimum retention requirements for LCCs (ss. 8-11 of the LCC Protocol), the LCC surveys (ss. 4-7 of the LCC Protocol), and the landscape context for the application of the minimum retention requirements (s.12), but in all cases consent from the affected Nanwakolas Member Nation(s) is required.

5.3.2. Principle 2. Respect, protect and fulfill Indigenous Peoples' rights to self-government and self-determination

GBR Order

The GBR Order partially meets the standards of practice (2.1). The GBR Order is part of a larger effort by the province to reconcile First Nations' rights within a colonial framework (Curran 2017). The BC government partially recognized First Nations' assertion of sovereignty and self-governing authority by entering into the G2G negotiations and agreements for the GBR with First Nations as quasi-sovereign governments (Clapp et al. 2016, Price et al. 2009). However, the GBR Order and other

BC policy initiatives in the GBR do not establish a joint decision-making process that is founded on equal authority, because the province still claims underlying authority to the lands (see Bird 2011, Curran 2017). The absence in the GBR Order of an explicit requirement for consent from First Nations for decisions such as the harvesting of LCC in development areas could potentially limit the ability of First Nations to develop and maintain their traditions and practices. The GBR Order does not recognize the authority of First Nations to autonomously pursue cedar stewardship in their territories, but instead encourages them to collaborate with licensees and make shared decisions with the province (Implementation Guidance Document s.2.2, p. 22). The Implementation Guidance Document does, however, cite the LCC Protocol as an example of a cedar strategy that should be considered by licensees in First Nations Engagement (pp. 22-23).

LCC Protocol

The LCC Protocol is a policy instrument through which the Nanwakolas Member Nations directly exercise their decision-making authority in their territories and pursue cultural and economic development (practice (2.1)). The preamble to the LCC Protocol states, “No forestry activity in our territories should take place without first securing [our] consent and ensuring that our title and rights are fully respected.” Thus, the LCC Protocol asserts the rights of the Nanwakolas Member Nations to self-government and self-determination. The cedar stewardship provisions of the LCC Protocol are designed to maintain the Nations’ institutions, customs, spirituality, traditions, procedures and practices (practice (2.1)).

5.3.3. Principle 3. Create equity and transparency in decision-making

GBR Order

Based on the information available to us for this evaluation, the GBR Order largely meets the standards of practice (3.1), but only partially meets the standards of the remaining practices that support principle 3. First Nations participated in the two main tiers of planning that led to the GBR agreements (Henry et al. 2022). At the first tier, First Nations provided input to the Land and Resource Management Planning (LRMP) tables, where they had equal standing to that of non-Indigenous experts (Howlett et al. 2009). At the second tier, they participated as governments in G2G

negotiations with the province. During the policy amendment process that produced the 2023 GBR Order, First Nations participated in negotiations with provincial officials that were, according to Nanwakolas board president Dallas Smith, “the closest I’ve ever seen” to joint decision-making (Baker 2023) (practice (3.2)). I was unable to judge whether the GBR decision-making processes ensured that First Nations fully understood all matters being discussed or that other participants fully understood the input from First Nations (practice (3.1)).

The ITU legal objectives include the limited requirement for First Nation engagement discussed above. Although the Implementation Guidance Document says that a “best practice that should be pursued” by licensees is “the development of a formal protocol or agreement with applicable First Nations that defines and clarifies the working relationship and the processes and procedures that will be followed to share information and address issues” (s.2.2, p.12), this is a suggested action rather than a requirement. Furthermore, the use of undefined terms, such as “economically unviable”, in the ITU and other objectives does not meet standards of full transparency. This does not ensure equity and the protection of Indigenous rights in operational decision-making by licensees. Although the Implementation Guidance Document encourages licensees to provide “a record of efforts made” to “meet, develop processes for engagement, share relevant information, identify and discuss issues, and resolve concerns and issues” (s.2.2, p.12), this is not mandatory, and again it does not guarantee equity or that Indigenous rights will be honoured (practice (3.3)).

LCC Protocol

The Nanwakolas Information Sharing Protocols are designed to establish an information sharing framework that identifies the types of information, data standards, meetings and other communications required for decision-making, to enable all parties to understand the matters under consideration and to be understood by others (practice (3.1)). Further, they encourage open and informed dialogue and authentic relationship building, which may improve comprehension and should discourage discrimination.

The decision-making arrangements established by the Information Sharing Protocols and the LCC Protocol honour the right of Indigenous peoples to “participate in decision-making in matters which would affect their rights, through representatives chosen by themselves,” as per Article (18) of the UNDRIP (UNGA 2007) (practice 3.2).

The Protocols also establish transparent procedures to support Indigenous rights and equitable decision-making (practice (3.3)). The LCC Protocol articulates clear expectations about how licensees should conduct forestry operations. It includes rationales for its provisions concerning the retention and harvesting of LCC. For example, it states that the stand retention requirements for LCC are partly based on predictions of the abundance of different types of LCC across traditional territories relative to the cultural need for those LCC types over the next 300 years (s.8). It also explains that LCC retention levels are based on the rarity of LCC type (s.9) and are designed to address both Nanwakolas Member Nations' stewardship objectives and "commercial timber objectives" (s.14).

5.3.4. Principle 4. Do not adversely affect Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence, and livelihoods

GBR Order

The preamble to the GBR Order includes commitments from the provincial government to implement EBM, improve the well-being of First Nations, and protect and conserve First Nations' forest and cultural values. These commitments align with the standards of practice (4.1). An EBM approach, theoretically, should promote ecosystem integrity in a way that allows for the provision of benefits that contribute to maintaining Indigenous cultures (Benner 2020, Lertzman 2010). However, the preamble also states that it provides only "context and background" and is not part of the GBR Order. EBM and Indigenous well-being are not mentioned in the body of the GBR Order. Accordingly, I assessed the GBR Order as only partially meeting the standards of practice (4.1).

The GBR Order fails to meet the standards of practice (4.2). As discussed previously, the ITU objectives could permit the harvesting of LCC in development areas in some circumstances without obtaining First Nations' consent (GBR Order Part 3, s.8(4)(a,)). This would impinge on First Nations' right to the non-consumptive (e.g., spiritual) use of these LCC, and would also diminish the capacity of First Nations to fulfill their obligations to future generations. Although ITU objective (5), when read together with the Stand Retention objectives (GBR Order Part 3, s.18), does require the retention of 15% of the forest within a cutblock to "maintain mature and old western redcedar and yellow cedar representative of the pre-harvest stand," there is no minimum time limit

specified in the legal objectives or implementation guidance for stand retention. The previous 2016 Background and Intent stated that stand retention “is intended to be left for at least an entire [harvest] rotation” (s. 3.3.17). Rotation times for industrial forestry within the operational land base in the temperate rainforests of coastal BC are typically set at 100 years or less, because this time frame allows trees to be harvested at the size expected to maximize the volume of wood extracted over time (Lepage and Banner 2014, Benner et al. 2019). This time frame does not permit the recruitment of “mature” cedar into LCC (Sutherland et al. 2016).

ITU legal objective (2) does require licensees to “maintain and recruit as necessary, monumental cedar, western redcedar and yellow cedar, specified during First Nation engagement, to support the applicable First Nations’ ITU needs” in Cedar Stewardship Areas (GBR Order Part 3, s.8). However, no Cedar Stewardship Areas have been established for the GBR South Central Coast area.

LCC Protocol

A central aim of the LCC Protocol is to ensure the long-term retention of a sufficient quantity and quality of accessible LCC in Nanwakolas territories to meet the needs of current and future generations (s.3 and s.8) (practices (4.1) and (4.2)). The Nanwakolas Member Nations have applied a timeframe of 300 years for LCC retention and recruitment in managed forests (LCC Protocol s.8, s.13). This retention period is much longer than typical rotation times have been in managed forests within the region, because it is designed to protect trees for the time it takes cedar to develop the characteristics of LCC, which is typically more than 250 years (Sutherland et al. 2016). A 300-year retention strategy also provides a longer period for spiritual interaction with trees and contributes to ecological resilience, given that large old trees contribute disproportionately to ecosystem function (Lindenmayer et al., 2012a; Lindenmayer et al., 2012b). In addition, the LCC Protocol’s “minimum retention requirements” require 100% retention for the largest LCC due to their extreme rarity across the landscape (LCC Protocol s.10) (Benner et al. 2021). Cedar trees that are smaller than the minimum 100 cm diameter criterion used to classify LCC may also be protected from harvesting if Nations elect to recruit these trees to become LCC for future use (s.6).

5.3.5. Principle 5. Apply Indigenous knowledge, viewpoints and knowledge systems in an integrative fashion and in accordance with Indigenous laws, traditions and customs

GBR Order

The GBR Order partially meets the standards of principle 5. The collection and dissemination of Indigenous knowledge (IK) at the stakeholder planning tables and in G2G negotiations for the GBR Order occurred collaboratively, with the guidance of First Nations. Prior to and during G2G negotiations, the BC government and First Nations collaboratively developed strategic land use planning agreements, and some First Nations developed "Detailed Strategic Plans." These agreements and plans facilitated the inclusion of IK, Indigenous viewpoints and other aspects of IK systems in the decision-making processes that produced the GBR agreements (Low and Shaw 2011). For example, some First Nations presented their Detailed Strategic Plans at the LRMP tables, which enabled these Nations to share, at their discretion, IK that was specific to distinct land and resource values in their territories (2016 Background and Intent s.1.2.1). All of this indicates that IK was not decontextualized (i.e., extracted and adapted) but rather conveyed and treated according to First Nations' laws, traditions and customs, as required by practice (5.1).

The strategic land use planning agreements also provided an initial set of agreed upon land use objectives that formed the basis for the land use objectives ultimately proclaimed by the province in the GBR Order (Implementation Guidance Document s.1.2, p. 2). This indicates that First Nations' consent was obtained for the acquisition and application of IK associated with these initial objectives. Moreover, these objectives were informed by the work of a multidisciplinary advisory team, the "Coast Information Team" (CIT), made up of scientists, practitioners, First Nation traditional knowledge holders and other local experts (Coast Information Team n.d., Saarikoski et al. 2013). The CIT used Western science together with First Nations' knowledge and views to develop a novel approach to EBM that was accepted by First Nations (Coast Information Team n.d., Clapp and Mortenson 2011). The CIT built trust between First Nations and other team members (Coast Information Team n.d., Saarikoski et al. 2013), contributing to relationship building—a key requirement of practice (5.1). Furthermore, the G2G negotiations were founded on a new, more equal governance relationship between First Nations' leadership and the province (Barry 2012, Low and Shaw 2011).

In addition, the ITU legal objectives were designed to encourage licensees to obtain and apply First Nations' knowledge and expectations in relation to present and future cultural tree use (GBR Order Part 3, s.8(1,)(2,)(3)) and the harvesting of LCC (s.8(4)) through First Nation engagement. The Implementation Guidance Document suggests that this could be achieved in several steps, including meeting with First Nations to discuss "First Nations' stewardship, harvesting, and use of trees" and "applicable Indigenous customs or policies regarding [tree] identification, protection, and management," collaboratively developing a "cedar strategy," and using "agreements with the First Nation(s)" (s.2.2, p. 22). While this stepwise approach provides an opportunity to use IK, Indigenous views and IK systems in an integrative manner with, for example, Western science, in a way that fulfills practice (5.1), this is not mandatory. In addition, the GBR Order objectives are intended to be grounded in an approach to EBM that is holistic (Coast Funds n.d.). However, to compensate for the long history of industrial forest harvesting and depletion of old growth forests, and in particular cedar (Green 2007, Price et al. 2021), a more restrictive approach to LCC harvest may be needed than that established in the ITU objectives. For example, the GBR Order could prohibit the commercial harvesting of the largest LCC, which are the rarest LCC in the region. Instead, objective (4) permits the harvesting of LCC under specific circumstances (described previously) (GBR Order Part 3, s.8).

LCC Protocol

The LCC Protocol provides a means through which licensees can obtain the information required for the ITU legal objectives that depend on the knowledge of individual First Nations (e.g., knowledge about present and future Indigenous tree use and cultural cedar stands (Part 3, s.8(1)(2)(3)). For example, Nanwakolas Member Nations can "prioritize specific LCC [trees] for either long-term retention or current cultural use," despite licensees' preference for retaining or harvesting of such trees (LCC Protocol s.14). In addition, the minimum retention requirements (LCC Protocol s.10) dictate the percentage of LCC that will be retained for future use, regardless of how their retention affects the economic viability of harvesting the cutblock. The provisions of the Protocol are based on Indigenous knowledge as well as knowledge developed by Western scientific methods. These sources of knowledge were used in an integrative manner, fulfilling a key component of principle (5). For example, the minimum retention requirements were derived from Indigenous knowledge about the desired characteristics

and cultural uses of LCC combined with forecasts of the abundance of appropriate types of LCC at a landscape scale, determined using biological survey data and digital modeling techniques (Benner et al. 2021).

This integrative approach to knowledge and knowledge systems used, but did not disclose, confidential knowledge held by Nanwakolas Member Nations about present and future LCC needs. As such, the LCC Protocol honours First Nations' right to "maintain, control, protect and develop their [...] traditional knowledge" as per Article (31.1) of the UNDRIP (UNGA 2007) (practice (5.1)). The LCC Protocol is also explicit about the content of specific provisions that were derived from First Nation's knowledge-keepers. For example, the Protocol states that knowledge-keepers provided the criteria used to identify LCC and characterize trees according to traditional use (s.6), and the knowledge used to categorize LCC into "Types" from which the minimum retention requirements were developed (s.10). These retention requirements also consider the past, present and predicted future effects of industrial harvesting on LCC abundance in the territories of the Nanwakolas Member Nations (Benner et al. 2021, LCC Protocol s.2), given that they protect a percentage of each Type of LCC from harvesting based on the rarity of that Type (LCC Protocol s.10).

5.3.6. Principle 6. Ensure policy-makers, managers and practitioners have the requisite knowledge and skills to apply these principles

GBR Order

The GBR Order does not meet the standards of practices (6.1) and (6.2). The GBR Order and the Implementation Guidance Document do not require, or even recommend, that licensees or the government collaborate with First Nations to develop educational tools or training to ensure that policy-makers, managers and practitioners implementing the legal objectives understand the essential concepts and knowledge listed in principle 6 of the evaluation framework. The GBR Order and the Implementation Guidance Document also do not promote education and public information that reflects First Nations' "right to the dignity and diversity of their cultures, traditions, histories, and aspirations," as specified by practice (6.2). The Implementation Guidance Document does, however, provide a two-paragraph background about the relationship of First Nations' people with cedar and other forest resources and the existence of specific

protocols and practices that guided First Nations' historic forest resource stewardship and use (s.2.2, p.10). The policy processes through which the GBR agreements were developed included positive Indigenous-Crown relations, intercultural collaborations, and conflict resolution (Curran 2017), characterized by a "learning by doing" approach (Low and Shaw 2011) that should serve as an educational example for other settings. Also, the Implementation Guidance Document provisions do draw attention to Indigenous diversity, in that they point out that different First Nations may hold distinct aspirations regarding the quantities of LCC they desire for current and future cultural use (s.2.2, p. 22).

LCC Protocol

The LCC Protocol and the Information Sharing Protocols that Nanwakolas Council has developed promote the UNDRIP as the framework for reconciliation. However, like the GBR Order, there are no requirements or calls for education or training in the areas listed in principle 6.

Table 5.3. Key characteristics of the 2023 GBR Order legal objectives affecting cedar stewardship, in relation to the six principles of the evaluation framework. The examples provided refer to the GBR Order Indigenous Tree Use (ITU) legal objectives unless otherwise stated.

Principles that support Indigenous rights and reconciliation and their practices
2023 GBR Order
(1) Respect, protect and fulfill Indigenous title and rights 1.1) *Take no actions that dispossess Indigenous peoples of their lands or that use or damage their lands and resources* [Not Met] • GBR Order is part of the province's regulatory framework for forestry on "Crown Lands," which infringes on First Nations' sovereignty over their lands and resources • Legal objectives aim to improve protection and maintenance of First Nation forest and cultural values through the implementation of EBM • Prioritizes harvesting over retention of LCC when necessary for roads or infrastructure, or where there is an operational or safety concern, if retaining all LCC would be "economically unviable" (as long as there has been "First Nation engagement") 1.2) *Honour Indigenous peoples' rights to own, use, develop, control and steward their lands* [Partially Met] • ITU objectives were developed to provide First Nations with a quantity of LCC that will support their present and future cultural needs, but the GBR Order and the BC forestry regulatory regime do not recognize First Nations autonomy to steward LCC independent of government control and direction

Principles that support Indigenous rights and reconciliation and their practices	2023 GBR Order
	1.3) *Honour Indigenous peoples' right to participate in processes that determine their rights to lands and resources* [Fully Met] • Formal government-to-government (G2G) negotiations and decision-making about First Nations' rights and title claims included First Nations 1.4) *Accept Indigenous title claims that provide evidence* [Not Met] • The BC government has not accepted Indigenous title claims in the GBR 1.5) *Collaborate with Indigenous peoples prior to implementing forest policy or practices to develop an arrangement that honours their rights* [Partially Met] • Recommends and provides support for collaborative decision-making between First Nations and licensees, but does not require it. In practice, and in accordance with government-to-government agreements and protocols, First Nations have had a much stronger role in decision making about ITU in the GBR than the wording of the GBR Order requires • No compensation to First Nations for the previous and ongoing industrial harvest of LCC (and other tree species) on First Nations' traditional territories 1.6) *Adopt and implement the UNDRIP and assist Indigenous peoples in achieving the realization of their rights* [Partially Met] • Policy process facilitated the creation of the conservation financing structure ("Coast Funds") for the GBR agreements • 2016 GBR Objectives did not refer to the UNDRIP, but 2023 GBR Order declares that it contributes to fulfilling (s.4 of) the *DRIP Act*
(2) Respect, protect and fulfill Indigenous Peoples' rights to self-government and self-determination	2.1) Recognize and respect the decisions, actions and processes of Indigenous peoples that contribute to their pursuit of self-determination [Partially Met] • Does not explicitly provide for First Nations to autonomously develop and implement their own cedar/LCC stewardship strategies on traditional territories, although it does require "First Nation engagement" before many decisions. Government-to-government agreements and protocols establish a stronger role for First Nations in decision making about ITU • The provincial government in G2G negotiations recognized First Nations as governments with decision-making power
(3) Create equity and transparency in decision-making processes	3.1) Communicate and conduct decision-making with Indigenous peoples in a way that is fair and free of discrimination [Largely Met] • Policy process included First Nation land use planning and knowledge contributions in decision-making and recognized both as legitimate and coming from experts 3.2) Include Indigenous peoples in decision-making [Partially Met]

Principles that support Indigenous rights and reconciliation and their practices
2023 GBR Order
• "First Nation engagement" legal objective requires that licensees make "reasonable efforts" to communicate, share information, engage in dialogue, and resolve issues with First Nations, but obtaining FPIC is not required. Government-to-government agreements and protocols establish a stronger role for First Nations • Some First Nations participated in LRMP tables—a consensus-based public planning process—which informed G2G negotiations between First Nations and the province • Policy process was supported by G2G negotiations and agreements between First Nations and the province that gave First Nations enhanced roles in decision-making 3.3) Include a mechanism of transparency in the decision-making process to support Indigenous rights and equity [Partially Met] • Supports decision-making through First Nation engagement but does not require consent or guarantee equitable outcomes. Government-to-government agreements and protocols establish a stronger role for First Nations • No peer-reviewed or other published data available on the authority First Nations held in the establishment of the GBR Order legal objectives or whether such decision-making was equitable
(4) Do not adversely affect Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence, and livelihoods 4.1) Do not forcibly assimilate or destroy the culture of Indigenous peoples [Partially Met] • Goal is to implement EBM to concurrently maintain ecosystem integrity and improve human well-being 4.2) Conduct forestry in a manner that honours Indigenous peoples' rights pertaining to their traditional, including economic and spiritual, activities [Not Met] • ITU legal objective (4) is implemented through First Nation engagement instead of requiring FPIC. Government-to-government agreements and protocols establish a stronger role for First Nations • ITU legal objectives (4) (a), (b,) (c) and (d) support the harvesting of LCC under specified circumstances (as long as there has been "First Nation engagement"), rather than retaining and protecting individual trees or stands for spiritual or future cultural use and ecological integrity • No minimum time limit for stand retention. The previous 2016 Background and Intent specified a minimum of one harvest rotation (approximately 100 years), which is too short for LCC development. • ITU legal objective (2) imposes further restrictions within Cedar Stewardship Areas, but none have been established in the GBR South Central Coast area
(5) Apply Indigenous knowledge, viewpoints and knowledge systems in an integrative fashion and in accordance with Indigenous laws, traditions and customs 5.1) Access Indigenous peoples' knowledge and other property in a manner that respects their rights, laws, traditions and customs and supports relationship building [Partially Met] Integrative use of IKS: • Legal objectives were developed using knowledge provided in First Nations' land use plans and G2G negotiations together with First Nations' knowledge and views that were collected, analyzed and applied by an advisory team

Principles that support Indigenous rights and reconciliation and their practices
2023 GBR Order
Integrative use of Indigenous knowledge: • Strategic land use planning agreements between the provincial government and First Nations, G2G negotiations, and First Nations Detailed Strategic Plans informed decision-making for the GBR Order and other GBR agreements • Implementation of ITU legal objectives requires the acquisition, understanding and application of information and knowledge held by individual First Nations Integrative use of Indigenous viewpoints: • Legal objectives are guided by the concept of ecosystem-based management—a holistic approach to resource management • Does not fully acknowledge the implications of the past and present industrial forest harvesting and policy in the GBR and neighboring jurisdictions
(6) Ensure policy-makers, managers and practitioners have the requisite knowledge and skills to apply these principles 6.1) Work with Indigenous peoples to develop and implement formal education and training [Not Met] • Does not explicitly require education or training, co-developed with First Nations, for government staff or licensees to implement its provisions or provide the knowledge and skills necessary to apply these principles and respectfully collaborate with First Nations • GBR policy process was a complex exercise in Indigenous-Crown relations, intercultural collaborations, Indigenous rights and conflict resolution, which was characterized by a "learning by doing" approach 6.2) Promote education and public information that speaks truth to Indigenous diversities [Not Met] • No example

5.3.7. Broad Problems of Compliance and Enforcement Under the GBR Order: BC's Performance-Based Regulatory Regime for Forest Management

There is one other major set of regulatory issues that potentially impairs the performance of the GBR Order on all of the principles in the evaluation framework. The land use objectives established in the GBR Order are part of a performance-based (also known as "results-based") regulatory regime for forest management on Crown lands in BC. Under this regime, land use objectives are not strict command-and-control rules. The main legal requirement for compliance with these objectives is that forest licensees must develop forest stewardship plans that are "consistent with" the objectives (*FRPA* s.5). Although in practice the standards developed within this results-based regime may

sometimes be quite prescriptive (Hoberg and Malkinson 2013), the requirement that stewardship plans be “consistent with” general objectives is fundamentally weaker than a requirement to “comply with” or “meet” objectives (see WCEL 2004). Thus, there is considerable flexibility given to licensees and their professional staff in designing forest stewardship plans. Indigenous peoples should not have to depend on the interpretations of forestry professionals, government officials, or even the courts, as to what is “consistent with” land use objectives that are supposed to protect Indigenous rights.

There are also substantial problems with monitoring and enforcement under the performance-based regulatory regime for forest management in BC. The BC government has informally delegated effectiveness monitoring to licensees (Hoberg et al. 2016), while compliance monitoring is undertaken by the BC Ministry of Forests and the Forest Practices Board (FPB)—an independent agency that does not have the authority to administer penalties for contraventions (Hoberg and Malkinson 2013). Several FPB reports issued in the last decade (FPB 2013, 2014, and 2019) indicate that the BC government’s compliance and enforcement mechanisms and resources are insufficient to ensure licensee compliance with forestry legislation and to hold licensees accountable for contraventions. For example, in the Board’s 2014 review of the regulation of forest and range practices in BC over the previous decade, it found that under the results-based *Forest and Range Practices Act,* some legal requirements, including licensee forest stewardship plan results and strategies, were not sufficiently clear, and were open to considerable interpretation, making enforcement not possible (FPB 2014). A year earlier, the Board had said that issues with government performance measures prevented the reporting of accurate compliance rates (FPB 2013). The Board has also found that the BC government has not allocated sufficient resources, including personnel, to effectively implement on-the-ground inspections and investigations of forest operations in the province (FPB 2013; 2019). Referring specifically to the GBR, Böhling (2019) argues that the implementation of EBM legal objectives under BC’s performance-based regime requires enforcement at the local level, and that the provincial government has not provided adequate capacity to monitor and enforce forestry regulations at this level.

5.4. Discussion

In this evaluation I showed that the provisions of the GBR Order dealing with Indigenous Tree Use and First Nations engagement do not meet the standards of the UNDRIP and the TRC Calls to Action. The BC government's efforts to engage and reach agreements with First Nations to develop progressive policies for the GBR are laudable, but the regulatory outcomes still fall short of the government's commitment to "ensure the laws of British Columbia are consistent with the Declaration" (*DRIP Act*, s.3). The Nanwakolas Member Nations have adopted their own policy for LCC stewardship in the GBR, which, among other things, modifies the terms of engagement between government, industry and First Nations to include an explicit requirement to obtain consent from Nanwakolas Member Nations. The Nanwakolas LCC Protocol provides a model for addressing the primary shortcomings of the GBR Order revealed in my evaluation, with the exception of the evaluation principle calling for further education and training.

The main shortcomings of the GBR Order can be grouped into three categories: i) failure to recognize and honour Indigenous rights (including Indigenous title and the rights to self-determination and FPIC); ii) failure to prioritize the protection of scarce bio-cultural resources over short-term economic gains; and iii) failure to ensure adequate education and training to support Indigenous rights and foster reconciliation. In this section, I discuss these shortcomings. My results concerning categories i) and ii) are consistent with those of Smith and Mitchell (2020), who found that the treatment of Indigenous rights in Canada in 2013 "did not adequately approach the rights standards set out in the UNDRIP" for self-government and self-governance, consultation and free, prior, and informed consent, and land and natural resources.

5.4.1. Failure to recognize and honour Indigenous rights

The government-to-government negotiations, agreements and reconciliation protocols between the BC government and First Nations have established remarkably progressive shared decision-making processes for the GBR (Curran 2017, Low and Shaw 2011, Moore and Tjornbo 2012). However, the province's legal and regulatory framework for forestry lags behind these progressive agreements. Despite the BC government's widely promoted commitments to comply with the UNDRIP and the TRC

Calls to Action, the GBR Order establishes a structure for planning and operational decision-making that allows the possibility of overriding Indigenous rights, without consent, for economic and operational objectives. Importantly, the GBR Order and the rest of the province's regulatory framework for forestry do not permit First Nations to independently and autonomously steward LCC in their territories, and the province has not accepted Indigenous title claims in the GBR. While I acknowledge the complexity and difficulty of multi-party negotiations with First Nations, sometimes with differing interests and claims—including differing approaches to LCC harvest and stewardship—the UNDRIP clearly requires more than what has been accomplished to date.

The BC government has a long history of espousing good intentions about advancing non-timber values on the forest land base in the province, but limiting actual regulatory changes in order to protect the interests of the forest industry. Examples include biodiversity conservation (Hoberg 2011, Lertzman et al. 1996), and cultural and heritage resources (Mason 2013). The Canadian federal government has taken a similar approach in its policies dealing with forest management (Passelac-Ross and Smith 2013). More broadly, the failure of non-Indigenous governments and private actors to respect title rights is a common problem for Indigenous groups within and outside of Canada (Alden Wily 2019, Otis and Laurent 2013).

The UNDRIP affirms the obligation of states to obtain FPIC from Indigenous peoples before taking any action that may affect Indigenous lands or resources. However, the First Nation engagement process set out in the GBR Order requires only "reasonable efforts to communicate, share information, engage in dialogue, and identify and work to resolve issues and concerns brought forward by applicable First Nations" (GBR Order Part 3, s.2(1)). One possible explanation for this relatively narrow conception of engagement is that the general wording was carried forward from earlier versions of the GBR Order, which were developed before Canada and BC committed to implement the UNDRIP. Notably, the wording of the First Nation engagement provisions in the GBR Order is similar to the "duty to consult" doctrine established by the Supreme Court of Canada for circumstances in which decisions of Canadian governments may infringe on Aboriginal (Indigenous) rights. The Supreme Court has defined the duty to consult as a procedural obligation to consult with Indigenous people, consider their concerns, and potentially provide accommodation for those concerns (Coates and Flavel 2016, Papillon and Rodon 2017). Indigenous leaders, scholars and activists argue that

this duty to consult doctrine represents a minimalist perception of FPIC (Deer 2011, Nagy 2022, Papillon and Rodon 2017), in that it fails to provide Indigenous peoples with the ability to withhold, withdraw or provide consent to proposed activities (Smith and Mitchell 2020). This minimalist standard allows federal and provincial governments to manage land and natural resources in ways that diminish or ignore Indigenous rights (Boutilier 2017, Patzer 2019).

The lack of a requirement for consent in the GBR Order's First Nation engagement process not only potentially infringes on the right to FPIC, but in doing so it diminishes the right to self-determination. The right to self-determination mandates that consent from Indigenous peoples must be obtained in a manner determined by, or with, them, whenever proposed activities could change the conditions of their existence, and that Indigenous peoples are entitled to determine these conditions for themselves (Doyle 2022). Forestry activities such as the harvesting of LCC could significantly alter the conditions of existence for First Nations in the GBR, given that LCC are a scarce resource and western redcedar is a cultural keystone species (Garibaldi and Turner 2004). LCC and other forms of redcedar remain vital to ceremony and cultural identity through their continued use in traditional practices, customs, and knowledge transfer (Benner et al. 2021, Turner 2014).

There is a long-standing imbalance of power in favour of the Crown in the Indigenous-Crown relationship in BC. As Coulthard (2014) notes, the firmly entrenched power imbalance in colonial settings enables Crown governments to limit and submerge Indigenous rights; the Crown tends to recognize these rights only to the extent that they do not threaten the colonial power dynamic (Coulthard 2007). The Crown's power is rooted in its assertion of inviolable sovereignty (Borrows 2002), predicated on illegitimate and oppressive colonial concepts such as the Doctrine of Discovery and *Terra Nullius* (TRCC 2015), and supported by Eurocentric international law principles concerning national sovereignty. Canadian courts have taken the position that they lack the jurisdiction to question the sovereignty of the Canadian Crown, as that sovereignty is the source of the courts' own authority (Reynolds 2018). This position of the courts reinforces the power of the Crown and forces First Nations to argue within the Canadian legal system when they seek remedies from Canadian courts.

If Canada fully implemented the principles of the UNDRIP, including the right of FPIC, Indigenous control over the development of lands and resources could dramatically change (Nagy 2022). However, fear of the potential impacts on non-Indigenous property interests and the Canadian economy (including government resource revenues), deters the Crown from adopting a stronger, self-determination-based interpretation of FPIC (Joffe 2010, Papillion and Rodon 2017). A recent example of this is the BC government's decision to withdraw proposed amendments to the *Land Act* (1996) – which governs the use of Crown land in BC – in response to public and political party backlash (Gage and Clogg 2024). Adoption of the proposed changes would have enabled public land use to be governed using joint or consent-based decision-making agreements between Indigenous governments and the province (Government of BC, n.d.). Instead, the Crown continues to limit the scope of and submerge Aboriginal sovereignty (Burrows 2015). Curran (2017) observes that reconciliation in Canada has often been more about reconciling Indigenous societies and rights with Crown sovereignty than finding ways for Indigenous sovereignty and Crown sovereignty to co-exist.

Another factor deterring Canadian governments from developing engagement processes with an explicit requirement for FPIC is that the precise meaning of FPIC and its basic requirements have not yet been defined in Canadian law (Scott 2016). One critical uncertainty is whether the right to FPIC gives Indigenous peoples a veto power over resource developments. However, despite this uncertainty and the failure of the Canadian and BC governments to incorporate a standardized approach to FPIC, there are several examples of both industry and Indigenous approaches to operationalizing FPIC in environmental stewardship in Canada (e.g., see Guédon 2020), along with collective approaches that involve First Nations, non-Indigenous organizations and the Province of BC (Danesh and McPhee 2019).

5.4.2. Failure to prioritize the protection of scarce bio-cultural resources over economic gains

Another key shortcoming of the GBR Order is that in some circumstances the ITU legal objectives prioritize the economic viability of harvesting a cutblock over the retention of LCC. For example, after First Nation engagement a licensee may harvest otherwise-protected LCC for road access, if the licensee determines that there is no

practicable alternative, and that harvesting the cutblock would otherwise be economically unviable. Environmental journalist Ben Parfitt (2019) called a similar, but broader, exception in the 2016 GBR Objectives a “loophole” in the GBR arrangements, and he described anecdotal reports of unnecessary roads being built intentionally through stands of old-growth forest so that the large old trees could be harvested. In prioritizing economic values, the GBR Order is consistent with previous forest management policies in BC that have focused on timber production and harvesting revenues (Hagerman et al. 2010, Hoberg and Malkinson 2013, Hoberg and Morawski 1997; Benner and Lertzman 2022). Some analysts argue that the BC forest tenures system serves mainly to produce timber harvesting revenues for the forest industry and the provincial government from the lands of dispossessed Indigenous people (see Ekers 2019, Rossiter 2008). The 2023 GBR Order at least partially closes this loophole in the GBR legal framework by greatly restricting the scope of the economic exception.

The emphasis in BC forest policy on revenue generation from the extraction of forest products is in keeping with the Western worldview of nature, in which humans are thought to be separate from nature, and nature is for the sole benefit of and use by humans (Schelbert 2003). In contrast to this worldview, many Indigenous peoples view land and non-human life forms as kin, for whom humans have an obligation of stewardship and care (Atleo and Boron 2022, and see Buergelt et al. 2017, Datta 2018). This divergence between Western and Indigenous worldviews confounds efforts to come to a shared understanding of sustainable and appropriate use of land and resources. Mitchell (2019) argues that Canada’s commitment to “extractive imperialism”— in which land and resources are treated as commodities that can be bought and sold (Klein 2013)– has impeded implementation of the UNDRIP.

5.4.3. Failure to ensure adequate education and training to support Indigenous rights and foster reconciliation

The third major shortcoming of the GBR Order, which is also a weakness of the LCC Protocol, is the absence of a requirement for education and training to ensure that licensees, consultants and government staff members are well-informed about Indigenous rights and related matters (e.g., Indigenous history, Indigenous-Crown relations, intercultural collaboration, and anti-racism). Ignorance of Indigenous peoples’ histories and lived realities, knowledge systems, and Indigenous-settler relations can

hinder relationship building, collaborations and reconciliation (Bohzkov et al. 2020). Collaborative, cross-cultural education and training is necessary to develop strong, genuine working relationships between Indigenous and non-Indigenous peoples (Davis et al. 2016). Such relationships are a crucial element of collaborative policy-making, progressive legislative reform and decision-making that protects Indigenous rights (Lightfoot 2022). Although the TRC Calls to Action call for such education and training for public servants and industry personnel (#57 and #92:iii), these calls remain unfulfilled across Canada (Jewell and Mosby 2019, Numata 2021). Many forest managers are not trained in how to constructively implement Indigenous rights and aspirations in forest management planning (Robitaille et al. 2017).

Althaus (2020) argues that national governments and the public service sector have not emphasized cultural competency education and training because it is costly, complex, and challenging, and because of fear of the potential threat to state authority and control. Education that erodes the resistance and lack of knowledge of non-Indigenous peoples threatens colonial authority because it puts into question settler occupation of land and ownership of resources (Davis et al. 2016). Misconceptions of policy-makers and other public servants about colonization, and resistance to and ignorance of Indigenous history and rights, may also contribute to reluctance to mandate education that teaches the Indigenous counter-narrative. Such ignorance may be rooted in the discomfort of confronting the truth (Regan 2010), in which one's own identity and investments are called into question (Boler and Zembylas 2003). However, from an Indigenous perspective, the co-creation of education and training may be undesirable because Indigenous peoples may regard state-initiated programs as paternalistic and colonial (e.g., see Corntassel et al. 2009).

5.5. Conclusion

I developed an evaluation framework based on principles and practices drawn from the literature and Articles of the UNDRIP and TRC Calls to Action, and I used that framework to systematically examine the treatment of Indigenous rights and reconciliation in BC under the GBR Order. While the GBR Order represents progress in many areas, it did not fully satisfy any of the principles in the evaluation framework. Although the government-to-government agreements and protocols between the BC government and First Nations provide a stronger voice in decision making for First

Nations than the GBR Order prescribes, the Order itself falls well short of the requirements of the UNDRIP. These findings show the need for the BC government to take major additional steps in the GBR to fulfill its commitments to implement the UNDRIP and the TRC Calls to Action.

I also compared the GBR Order to the Nanwakolas LCC Protocol, an Indigenous stewardship policy for LCC that applies in the southern portions of the GBR. The LCC Protocol addressed the major shortcomings of the GBR Order, with the exception of the requirements of principle (6), concerning education and training for policy-makers, managers and practitioners. The comparison highlights the Nanwakolas initiative as a good example of a group of Indigenous Nations effectively instilling their own stewardship requirements for lands and biocultural resources in territories from which they were displaced by colonization.

My findings also demonstrate that the new evaluation framework I developed can be used to identify specific shortcomings and strengths of a policy's performance concerning Indigenous rights and reconciliatory obligations in forest stewardship. In addition, the framework can be used to examine whether and how Indigenous policies address the shortcomings of policies enacted by colonial governments. I recommend further research to apply the evaluative framework to a range of policies governing resource stewardship, in order to: (i) identify common shortcomings among different policies; (ii) better understand the forest governance strategies that are best suited to achieving compliance with the provisions of the UNDRIP and fulfilling the Crown's reconciliatory obligations to Indigenous people; and (iii) learn from other initiatives of Indigenous people to regain control over their biocultural resources.

5.6. Supplementary Material

5.6.1. Table 5.4

Table 5.4. Articles of the UNDRIP and the TRC Calls to Action that support the principles used in this research. Bolded text is used to clarify the portion of the Article or Call to Action that is most relevant to a principle.

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
(1) Respect, protect and fulfill Indigenous title and rights	(8.2b) States shall provide effective mechanisms for **prevention of, and redress for any action which has the aim or effect of dispossessing [Indigenous peoples] of their lands, territories or resources** (11.1) Indigenous peoples have the right to practice and revitalize their cultural traditions and customs. This includes the **right to maintain, protect and develop the past, present and future manifestations of their cultures**, such as archaeological and historical sites, artefacts, designs, ceremonies, technologies and visual and performing arts and literature (19) States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to **obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures** that may affect them (26.1) Indigenous peoples have the **right to the lands, territories and resources** which they have traditionally owned, occupied or otherwise used or acquired	(43) We call upon federal provincial, territorial, and municipal governments to **fully adopt and implement the *UNDRIP*** as the framework for reconciliation (47) We call upon federal, provincial, territorial, and municipal governments to **repudiate concepts used to justify European sovereignty over Indigenous peoples and lands**, such as the Doctrine of Discovery and *terra nullius*, and **to reform those laws, government policies**, and litigation strategies that continue to rely on such concepts (51) We call upon the Government of Canada, as an obligation of its fiduciary responsibility, **to develop a policy of transparency by publishing legal opinions it develops and upon which it acts or intends to act, in regard to the scope and extent of Aboriginal and Treaty rights**

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
	(26.2) Indigenous peoples have the **right to own, use, develop and control the lands, territories and resources that they possess** by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired (27) States shall **establish and implement, in conjunction with indigenous peoples concerned, a fair, independent, impartial, open and transparent process**, giving due recognition to indigenous peoples' laws, traditions, customs and land tenure systems, to **recognize and adjudicate the rights of indigenous peoples pertaining to their lands, territories and resources**, including those which were traditionally owned or otherwise occupied or used. Indigenous peoples shall have the right to participate in this process (28.1) Indigenous peoples have **the right to redress**, by means that can include restitution or, when this is not possible, just, fair and equitable compensation, **for the lands, territories and resources which they have traditionally owned or otherwise occupied or used, and which have been confiscated, taken, occupied, used or damaged without their free, prior and informed consent** (32.1) Indigenous peoples have the **right to determine and develop priorities and strategies** for the **development or use of their lands or territories and other resources**	(52:i) [We call upon the Government of Canada, provincial and territorial governments, and the courts to adopt the following legal principles] Aboriginal title claims are accepted once the Aboriginal claimant has established occupation over a particular territory at a particular point in time

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
	(32.2) States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to **obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources** (32.3) States shall provide effective mechanisms **for just and fair redress** for any such activities, and **appropriate measures shall be taken to mitigate adverse environmental, economic, social, cultural or spiritual impact** (37.1) Indigenous peoples have the **right to the recognition, observance and enforcement of treaties, agreements and other constructive arrangements** concluded with States or their successors and **to have States honour and respect such treaties, agreements and other constructive arrangements** (38) States in consultation and cooperation with indigenous peoples, **shall take the appropriate measures**, including legislative measures, **to achieve the ends of this Declaration**	

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
	(39) Indigenous peoples have **the right to have access to financial and technical assistance from States** and through international cooperation, for the enjoyment of the rights contained in this Declaration	
(2) Respect, protect and fulfill Indigenous Peoples' rights to self-government and self-determination	(3) Indigenous peoples have the **right to self-determination.** By virtue of that right they freely determine their political status and freely pursue their economic, social and cultural development (4) Indigenous peoples, in exercising their right to self-determination, have the **right to autonomy or self-government** in matters relating to their inter-nal and local affairs, as well as ways and means for financing their autonomous functions (32.1) Indigenous peoples have the **right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources** (33.2) Indigenous peoples have the **right to determine the structures and to select the membership of their institutions in accordance with their own procedures** (34) Indigenous peoples have the **right to promote, develop and maintain their institutional structures and their distinctive customs, spirituality, traditions, procedures, practices** and, in the cases where they exist, **juridical systems or customs**, in accordance with international human rights standards	

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
	(39) Indigenous peoples have **the right to have access to financial and technical assistance from States** and through international cooperation, for the enjoyment of the rights contained in this Declaration	
(3) Create equity and transparency in decision-making processes	(2) Indigenous peoples and individuals are free and equal to all other peoples and individuals and **have the right to be free from any kind of discrimination, in the exercise of their rights,** in particular that is based on their indigenous origin or identity (13.2) States shall take effective measures to [...] **ensure that indigenous peoples can understand and be understood in political, legal and administrative proceedings**, where necessary through the provision of interpretation or by other appropriate means. (18) Indigenous peoples have **the right to participate in decision-making in matters which would affect their rights**, **through representatives chosen by themselves** in accordance with their own procedures, as well as to maintain and develop their own indigenous decision-making institutions	(51) We call upon the Government of Canada, as an obligation of its fiduciary responsibility, to develop a policy **of transparency by publishing legal opinions it develops and upon which it acts or intends to act, in regard to the scope and extent of Aboriginal and Treaty rights**

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
	(27) States shall establish and implement, in conjunction with indigenous peoples concerned, **a fair, independent, impartial, open and transparent process,** giving due recognition to indigenous peoples' laws, traditions, customs and land tenure systems, **to recognize and adjudicate the rights of indigenous peoples pertaining to their lands, territories and resources**, including those which were traditionally owned or otherwise occupied or used. **Indigenous peoples shall have the right to participate in this process**	
(4) Do not adversely affect Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence and livelihoods	(8.1) Indigenous peoples and individuals have the **right not to be subjected to forced assimilation or destruction of their culture** (8.2b) States shall provide effective mechanisms for **prevention of, and redress for any action which has the aim or effect of dispossessing [Indigenous peoples] of their lands, territories or resources** (12.1) Indigenous peoples have the **right to manifest, practise, develop and teach their spiritual and religious traditions, customs and ceremonies**; the **right to maintain, protect, and have access in privacy to their religious and cultural sites**; the right to the use and control of their ceremonial objects; and the **right to the repatriation of their human remains**	(92:i) [We call upon the corporate sector of Canada to **adopt *UNDRIP*** as a reconciliation framework and **to apply its principles, norms, and standards to corporate policy and core operational activities involving Indigenous peoples and their lands and resources.** This would include] **Commit to meaningful consultation, building respectful relationships and obtaining the free, prior and informed consent of Indigenous peoples** before proceeding with economic development projects

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
	(19) States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to **obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures that may affect them** (20.1) Indigenous peoples have the **right to maintain and develop their political, economic and social systems or institutions**, **to be secure in the enjoyment of their own means of subsistence and development**, and **to engage freely in all their traditional and other economic activities** (25) Indigenous peoples have the **right to maintain and strengthen their distinctive spiritual relationship with their traditionally owned or otherwise occupied and used lands**, territories, waters and coastal seas and other resources and **to uphold their responsibilities to future generations** in this regard (26.1) Indigenous peoples have the **right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired** (26.2) Indigenous peoples have the **right to own, use, develop and control the lands, territories and resources that they possess** by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired	

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
	(32.2) States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to **obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the develop-ment, utilization or exploitation of mineral, water or other resources**	
(5) Apply Indigenous knowledge, viewpoints and knowledge systems in an integrative fashion and in accordance with Indigenous laws, traditions and customs	(11.2) **States shall provide redress** through effective mechanisms, which may include restitution, developed in conjunction with indigenous peoples, **with respect to their cultural, intellectual, religious and spiritual property taken without their free, prior and informed consent or in violation of their laws, traditions and customs** (31.1) Indigenous peoples have the **right to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions**, as well as the manifestations of their sciences, technologies and cul-tures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games and visual and performing arts. They also have the **right to maintain, control, protect and develop their intellectual property** over such cultural heritage, traditional knowledge, and traditional cultural expressions.	

Principles (that pertain to forest stewardship)	Articles of UNDRIP	TRC Calls to Action
	(31.2) In conjunction with indigenous peoples, States shall **take effective measures to recognize and protect the exercise of these rights**.	
(6) Ensure policy-makers, managers and practitioners have the requisite knowledge and skills to apply these principles	(15.1) Indigenous peoples have the right to the dignity and diversity of their cultures, traditions, histories and aspirations **which shall be appropriately reflected in education and public information** (15.2) **States shall take effective measures**, in consultation and cooperation with the indigenous peoples concerned, **to combat prejudice and eliminate discrimination and to promote tolerance, understanding and good relations among indigenous peoples and all other segments of society**	(57) We call upon federal provincial, territorial, and municipal governments to **provide education to public servants on the history of Aboriginal peoples including the history and legacy of residential schools, the United Nations Declaration on the Rights of Indigenous Peoples, Treaties and Aboriginal rights, Indigenous law, and Aboriginal–Crown relations. This will require skills-based training in intercultural competency, conflict resolution, human rights, and anti-racism.** (92:iii) [We call upon the corporate sector of Canada to **adopt *UNDRIP*** as a reconciliation framework and **to apply its principles, norms, and standards to corporate policy and core operational activities involving Indigenous peoples and their lands and resources**. This would include] **Provide education for management and staff on the history of Aboriginal peoples, including the history and legacy of residential schools, the *UNDRIP*, Treaties and Aboriginal rights, Indigenous law, and Aboriginal-Crown relations**. **This will require skills-based training in intercultural competency, conflict resolution, human rights, and anti-racism**

5.6.2. Table 5.5

Table 5.5. The six principles and their practices and associated standards. The Articles of the UNDRIP and the TRC Calls to Action associated with each principle and from which the practice standards were extracted are also included. Practices are matched with the principle they most closely support.

Principles	Practices and standards and supporting Articles of UNDRIP and/or TRC Calls to Action
(1) Respect, protect and fulfill Indigenous title and rights	1.1) *Take no actions that dispossess Indigenous peoples of their lands or that use or damage their lands and resources*: Articles: (8.2b), (11.1), (19), (28.1), Calls: (47) →Take no actions that have the aim or effect of dispossessing Indigenous peoples of their lands or resources and protect lands and resources traditionally owned, occupied or used by Indigenous peoples. →Reform forest policy by repudiating concepts that justify European sovereignty over Indigenous peoples and lands. →Conduct forest management practices in a manner that (a) maintains, protects, and supports past, present and future manifestations of culture (such as archaeological and historical sites, ceremonies and technologies), and (b) does not confiscate, take, occupy, use or damage Indigenous peoples' lands and resources, without their free, prior and informed consent (FPIC). 1.2) *Honour Indigenous peoples' rights to own, use, develop, control and steward their lands*: Articles: (26.1), (26.2), (32.1) →Honour Indigenous peoples' rights to (a) own, use, develop and control the lands and resources which they have traditionally owned, occupied or otherwise used or acquired, and (b) determine and develop priorities and strategies for the development or use of such lands and resources. 1.3) *Honour Indigenous peoples' right to participate in processes that determine their rights to lands and resources:* Articles: (27), Calls: (51) →Establish and implement with Indigenous peoples, a fair and transparent process to recognize and adjudicate their rights pertaining to their lands and resources. →Honour Indigenous peoples' right to participate in this process. 1.4) *Accept Indigenous title claims that provide evidence:* Calls: (52:i) →Accept and honour title claims once occupation over a territory at a particular point in time has been established.

Principles	Practices and standards and supporting Articles of UNDRIP and/or TRC Calls to Action
	1.5) *Collaborate with Indigenous peoples prior to implementing forest policy or practices to develop an arrangement that honours their rights*: Articles: (19), (32.2), (32.3), (37.1) →Consult, cooperate and collaborate authentically and respectfully with Indigenous peoples to obtain their FPIC before adopting forest policy or implementing practices in traditional territories. →Honour and enforce treaties, agreements, and other constructive arrangements. →Justly compensate them for forest policy and practices which have adversely impacted environmental, economic, social, cultural, or spiritual aspects of their lives. 1.6) *Adopt and implement the UNDRIP and assist Indigenous peoples in achieving the full realization of their rights*: Articles: (38), (39), Calls: (43) →Adopt and implement the UNDRIP and apply its principles, norms and standards to forest policy and management practices. →Provide financial and technical assistance to Indigenous peoples so they may achieve the full realization of their rights.
(2) Respect, protect and fulfill Indigenous Peoples' rights to self-government and self-determination	2.1) *Recognize and respect the decisions, actions and processes of Indigenous peoples that contribute to their pursuit of self-determination*: Articles: (3), (4), (32.1), (33.2), (34), (39) →Recognize and respect the decisions, actions, and processes of Indigenous peoples that (a) help them to freely determine their political status and the structures and membership of their institutions, pursue self-government and their economic, social and cultural development, and (b) promote, develop and maintain their institutions, customs, spirituality, traditions, procedures, practices and judicial systems or customs.
(3) Create equity and transparency in decision-making processes	3.1) *Communicate and conduct decision-making with Indigenous peoples in a way that is fair and free of discrimination*: Articles: (2), (13.2) →Conduct consultation, discussions, collaborations and decision-making in a manner that (a) enables Indigenous peoples to be understood and to understand the matter(s) being discussed, and (b) promotes the equality and freedom of Indigenous peoples and individuals as equal to all other peoples and is free of discrimination. 3.2) *Include Indigenous peoples in decision-making*: Articles: (18)

Principles	Practices and standards and supporting Articles of UNDRIP and/or TRC Calls to Action
	→Honour the right of Indigenous peoples to participate in decision-making that affects their rights through representatives chosen by themselves. 3.3) *Include a mechanism of transparency in the decision-making process to support Indigenous rights and equity*: Articles: (27), Calls: (51) →Establish and implement transparent procedures that include publishing or reporting how Indigenous rights will be honoured and equity will be created in decision-making.
(4) Do not adversely affect Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence and livelihoods	4.1) *Do not forcibly assimilate or destroy the culture of Indigenous peoples*: Articles: (8.1) →Honour the rights of Indigenous peoples not to be subjected to forced assimilation or destruction of their culture. 4.2) *Conduct forestry in a manner that honours Indigenous peoples' rights pertaining to their traditional activities, including economic and spiritual activities*: Articles: (8.2b), (12.1), (19), (20.1), (25), (26.1), (26.2), (32.2), Calls: (92:i) →Prevent and provide redress for any action which has the effect of dispossessing Indigenous peoples of their lands, territories or resources. →Obtain the FPIC of Indigenous peoples prior to adopting and implementing policy that affects them, or, approving any project that affects their lands and resources. →Conduct forest practices in a manner that honours the rights of Indigenous peoples to: (a) manifest, practice, develop and teach their spiritual and religious traditions, customs and ceremonies, (b) maintain, protect and access, in privacy, their religious and cultural sites, (c) the repatriation of their human remains, (d) maintain and develop their political, economic and social systems or institutions, to be secure in their own means of subsistence and development, and to engage freely in all their traditional and other economic activities, and (e) maintain and strengthen their spiritual relationship with their unceded territories and resources and uphold their responsibilities to future generations regarding this relationship.
(5) Apply Indigenous knowledge, viewpoints and knowledge systems in an integrative fashion and in accordance with Indigenous laws, traditions and customs	5.1) *Access Indigenous peoples' knowledge and other property in a manner that respects their rights, laws, traditions and customs and supports relationship building:* Articles: (11.2), (31.1), (31.2)

Principles	Practices and standards and supporting Articles of UNDRIP and/or TRC Calls to Action
	→Access the cultural, intellectual, religious and spiritual property of Indigenous peoples by: (a) honouring and protecting their rights to maintain, control, protect and develop their cultural heritage, traditional knowledge, cultural expressions and intellectual property over such things and the manifestations of their sciences and technologies, (b) building genuine relationships with them, (c) obtaining their FPIC, and (d) using ways that respect their laws, traditions and customs.
(6) Ensure policy-makers, managers and practitioners have the requisite knowledge and skills to apply these principles	6.1) *Work with Indigenous peoples to develop and implement formal education and training*: Articles: (15.2), Calls: (57), (92:iii) →Collaborate with Indigenous peoples to develop and implement formal education and skills-based training programs to assist public servants, forest managers and practitioners in: 1) applying the UNDRIP to forest policy and practices, 2) learning about Indigenous peoples' history, including the legacy of residential schools, Indigenous Peoples' knowledge systems, traditions, customs, and connection to traditional lands, the UNDRIP, the TRC Calls to Action, Indigenous and Aboriginal rights and law, and Indigenous-Crown relations, and 3) fostering skills required to excel in intercultural competency, equitable and transparent decision-making, conflict resolution, and the endorsement of human rights and anti-racism. 6.2) *Promote education and public information that speaks truth to Indigenous diversities*: Articles: (15.1) →Honour Indigenous peoples' right to the dignity and diversity of their cultures, traditions, histories, and aspirations by supporting education and public information that accurately reflects such diversity.

5.6.3. Table 5.6

Table 5.6. Key characteristics of the Nanwakolas LCC Operational Protocol and the 2023 GBR Order legal objectives related to cedar stewardship in relation to the six principles of the evaluation framework. Characteristics from supporting documentation and policy development processes are included in the examples provided. Examples provided refer to either the LCC Protocol or the GBR Order Indigenous Tree Use legal objectives unless otherwise stated.

Principles that support Indigenous rights and reconciliation and their practices	
2023 GBR Order	**LCC Protocol**
(1) Respect, protect and fulfill Indigenous title and rights	
1.1) *Take no actions that dispossess Indigenous peoples of their lands or that use or damage their lands and resources* • GBR Order is part of the province's regulatory framework for forestry on "Crown Lands," which infringes on First Nations' sovereignty over their lands and resources • Legal objectives aim to improve protection and maintenance of First Nation forest and cultural values through the implementation of EBM • Prioritizes harvesting over retention of LCC when necessary for roads or infrastructure, or where there is an operational or safety concern, if retaining all LCC would be "economically unviable" (as long as there has been "First Nation engagement")	• Was developed to guide forest and resource stewardship obligations bestowed upon Nanwakolas Member Nations by their inherent right to title • Information Sharing Protocol clarifies Nanwakolas Member Nations' assertion of title and that the Nations have never ceded, sold or surrendered their traditional territories
1.2) *Honour Indigenous peoples' rights to own, use, develop, control and steward their lands* • ITU objectives were developed to provide First Nations with a quantity of LCC that will support their present and future cultural needs, but the GBR Order and the BC forestry regulatory regime do not recognize First Nations autonomy to steward LCC independent of government control and direction	• Applies Nanwakolas Member Nations' laws to traditional territories to ensure respect, recognition, and implementation of their title and rights while simultaneously addressing commercial timber objectives

Principles that support Indigenous rights and reconciliation and their practices	
2023 GBR Order	**LCC Protocol**
1.3) *Honour Indigenous peoples' right to participate in processes that determine their rights to lands and resources* • Formal government-to-government (G2G) negotiations and decision-making about First Nations' rights and title claims included First Nations	• Information Sharing Protocol establishes a process for information exchange with licensees and includes provisions that depict Nanwakolas Member Nations' rights in regard to the operational management of LCC
1.4) *Accept Indigenous title claims that provide evidence* • The BC government has not accepted Indigenous title claims in the GBR	• The Nanwakolas Member Nations have never ceded title to their traditional territories
1.5) *Collaborate with Indigenous peoples prior to implementing forest policy or practices to develop an arrangement that honours their rights* • Recommends and provides support for collaborative decision-making between First Nations and licensees, but does not require it. In practice, and in accordance with government-to-government agreements and protocols, First Nations have had a much stronger role in decision making about ITU in the GBR than the wording of the GBR Order requires • No compensation to First Nations for the previous and ongoing industrial harvest of LCC (and other tree species) on First Nations' traditional territories	• Confirms Nanwakolas Member Nations' right to FPIC; Information Sharing Protocol requires their consent be obtained regarding decisions involving LCC • Information Sharing Protocol establishes an information-sharing process between Nanwakolas Member Nations and licensees regarding forestry practices that contributes to the protection of Section 35 rights
1.6) *Adopt and implement the UNDRIP and assist Indigenous peoples in achieving the realization of their rights* • Policy process facilitated the creation of the conservation financing structure ("Coast Funds") for the GBR agreements • 2016 GBR Objectives did not refer to the UNDRIP, but 2023 GBR Order declares that it contributes to fulfilling (s.4 of) the *DRIP Act*	• States explicitly that it is intended to uphold the standards of the UNDRIP and ensure the realization of Nanwakolas Member Nations' rights, which it does through its provisions for LCC harvesting and conservation
(2) Respect, protect and fulfill Indigenous Peoples' rights to self-government and self-determination	

Principles that support Indigenous rights and reconciliation and their practices	
2023 GBR Order	**LCC Protocol**
2.1) *Recognize and respect the decisions, actions and processes of Indigenous peoples that contribute to their pursuit of self-determination* • Does not explicitly provide for First Nations to autonomously develop and implement their own cedar/LCC stewardship strategies on traditional territories, although it does require "First Nation engagement" before many decisions. Government-to-government agreements and protocols establish a stronger role for First Nations in decision making about ITU • The provincial government in G2G negotiations recognized First Nations as governments with decision-making power	• Nanwakolas Member Nations exercise their rights to self-determination and self-government by forming the Nanwakolas Council to take collective action and receive support to steward their lands and waters as independent Nations • Outcome of Nanwakolas Member Nations' pursuit of self-determination • Implementation of the LCC Protocol on traditional territories is an assertion of Nanwakolas Member Nations' self-governing authority to make decisions about how to steward their lands and resources
(3) Create equity and transparency in decision-making processes 3.1) *Communicate and conduct decision-making with Indigenous peoples in a way that is fair and free of discrimination* • Policy process included First Nation land use planning and knowledge contributions in decision-making and recognized both as legitimate and coming from experts 3.2) *Include Indigenous peoples in decision-making* • "First Nation engagement" legal objective requires that licensees make "reasonable efforts" to communicate, share information, engage in dialogue, and resolve issues with First Nations, but obtaining FPIC is not required. Government-to-government agreements and protocols establish a stronger role for First Nations	• Information Sharing Protocol establishes provisions that support equitable decision-making between Nanwakolas Member Nations and licensees • Policy process was consensus-based and involved approval of policy content from each Nanwakolas Member Nation • Nanwakolas Council facilitates collective decision-making about shared matters of interest and does not restrict the participation of Kwakwaka'wakw Nations • Is a product of Nanwakolas Member Nations' collective decision-making about cedar stewardship

Principles that support Indigenous rights and reconciliation and their practices	
2023 GBR Order	**LCC Protocol**
• Some First Nations participated in LRMP tables—a consensus-based public planning process—which informed G2G negotiations between First Nations and the province • Policy process was supported by G2G negotiations and agreements between First Nations and the province that gave First Nations enhanced roles in decision-making 3.3) *Include a mechanism of transparency in the decision-making process to support Indigenous rights and equity* • Supports decision-making through First Nation engagement but does not require consent or guarantee equitable outcomes. Government-to-government agreements and protocols establish a stronger role for First Nations • No peer-reviewed or other published data available on the authority First Nations held in the establishment of the GBR Order legal objectives or whether such decision-making was equitable	• Clearly states Nanwakolas Member Nations' expectations concerning licensee's conduct and how their First Nations' title and rights will be honoured • Provides a clear rationale for the decisions that support regulations governing LCC operational management and surveys
(4) Do not adversely affect Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence, and livelihoods 4.1) *Do not forcibly assimilate or destroy the culture of Indigenous peoples* • Was developed to implement EBM to concurrently maintain ecosystem integrity and improve human well-being 4.2) *Conduct forestry in a manner that honours Indigenous peoples' rights pertaining to their traditional, including economic and spiritual, activities*	• Information Sharing Protocol was developed, in part, to improve communication and relationship-building between Nanwakolas Member Nations and licensees regarding decision-making about forest management practices

Principles that support Indigenous rights and reconciliation and their practices	
2023 GBR Order	**LCC Protocol**
• ITU legal objective (4) is implemented through First Nation engagement instead of requiring FPIC. Government-to-government agreements and protocols establish a stronger role for First Nations • ITU legal objectives (4) (a), (b,) (c) and (d) support the harvesting of LCC under specified circumstances (as long as there has been "First Nation engagement"), rather than retaining and protecting individual trees or stands for spiritual or future cultural use and ecological integrity • No minimum time limit for stand retention. The previous 2016 Background and Intent specified a minimum of one harvest rotation (approximately 100 years), which is too short for LCC development. • ITU legal objective (2) imposes further restrictions within Cedar Stewardship Areas, but none have been established in the GBR South Central Coast area	• A component of a broader cedar stewardship strategy developed to support Nanwakolas Member Nations' cultural, social, spiritual, and economic use of cedar for generations to come • Confirms Nanwakolas Member Nations' right to FPIC while the Information Sharing Protocol requires First Nations consent be obtained regarding forest management decisions that involve LCC • Seeks to ensure an intergenerational supply (i.e., up to 300 years) of living LCC remains within traditional territories for cultural use • Includes "minimum retention requirements" that protect a portion of LCC from industrial harvesting in development areas over sequential harvest rotations
(5) Apply Indigenous knowledge, viewpoints and knowledge systems in an integrative fashion and in accordance with Indigenous laws, traditions and customs 5.1) *Access Indigenous peoples' knowledge and other property in a manner that respects their rights, laws, traditions and customs and supports relationship building* *Integrative use of IKS:* • Legal objectives were developed using knowledge provided in First Nations' land use plans and G2G negotiations together with First Nations' knowledge and views that were collected, analyzed and applied by an advisory team *Integrative use of Indigenous knowledge:*	• Was developed using novel findings from research that was guided by and included both Western scientific methods and Indigenous knowledge, objectives and values

Principles that support Indigenous rights and reconciliation and their practices	
2023 GBR Order	**LCC Protocol**
• Strategic land use planning agreements between the provincial government and First Nations, G2G negotiations, and First Nations Detailed Strategic Plans informed decision-making for the GBR Order and other GBR agreements • Implementation of ITU legal objectives requires the acquisition, understanding and application of information and knowledge held by individual First Nations	• Applies traditional ecological knowledge provided by First Nation's knowledge-keepers and confidential knowledge held by Nations about their needs for LCC over the next 300 years • Was developed, in part, to integrate Nanwakolas member Nations' cedar stewardship knowledge and objectives into provincial forest policy, address deficiencies in the ITU legal objectives, and facilitate relationship building with licensees • Policy process included knowledge-sharing with other First Nations (e.g., the Haida Nation) about developing and implementing a cedar stewardship strategy
Integrative use of Indigenous viewpoints: • Legal objectives are guided by the concept of ecosystem-based management—a holistic approach to resource management • Does not fully acknowledge the implications of the past and present contexts of industrial forest harvesting and policy in the GBR and neighboring jurisdictions	• Is grounded in an Indigenous worldview which embodies a holistic approach to LCC stewardship • Considers past, present and future contexts of industrial forest harvesting and policy in traditional territories • Uses a 300-year timeline aligned with LCC growth and development (i.e., an ecological time frame)
(6) Ensure policy-makers, managers and practitioners have the requisite knowledge and skills to apply these principles	
6.1) *Work with Indigenous peoples to develop and implement formal education and training* • Does not explicitly require education or training, co-developed with First Nations, for government staff or licensees to implement its provisions or provide the knowledge and skills necessary to apply these principles and respectfully collaborate with First Nations	• Does not explicitly require education or training to implement its provisions or provide the knowledge and skills necessary to apply these principles and respectfully collaborate with First Nations

Principles that support Indigenous rights and reconciliation and their practices	
2023 GBR Order	**LCC Protocol**
• GBR policy process was a complex exercise in Indigenous-Crown relations, intercultural collaborations, Indigenous rights and conflict resolution that was characterized by a "learning by doing" approach 6.2) *Promote education and public information that speaks truth to Indigenous diversities* • No example	• Both the LCC Protocol and Information Sharing Protocol adopt and promote the UNDRIP as the framework for reconciliation

5.6.4. Supplementary Material Section 1: Six principles that support Indigenous rights and aspirations in forest stewardship

The following provides a more detailed explanation and justification of the choices I made in selecting and refining the principles and highlights the importance of each principle to forest stewardship in BC. Given that these principles and the concepts within them may be defined according to the norms of various legal institutions and groups, both Indigenous and non-Indigenous, I use definitions provided by various sources to provide an inclusive explanation of each principle. Not surprisingly, some principles are comprised of concepts that are contested in Canadian institutions of law and policy. My objective in developing this policy evaluation framework is to provide a comprehensive and transparent method for measuring the success of forest stewardship policy or practices in upholding Indigenous rights and aspirations in Canadian settings. However, while this framework is explicit to Canada because of its grounding in the TRC Calls to Action, the concepts expressed in it are more broadly applicable to other jurisdictions and contexts of land and resource stewardship where Indigenous rights and sovereignty are asserted.

(1) Respect, protect and fulfill Indigenous title and rights

This principle combines the first two principles of Caverley et al. (2019): (i) "Recognizing Indigenous title and rights which includes an economic diversification component" and (ii) "Not diminishing Indigenous title and rights." I chose the terms

“respect, protect and fulfill,” because these terms are commonly used to describe the duties of states in international human rights law (United Nations 2024), and have been applied to Indigenous Rights as well (e.g., Cernic 2013, Cultural Survival 2023). The obligation to respect means to “refrain from interfering with or curtailing;” the obligation to protect refers to the protection of individuals and groups against rights abuses; and the obligation to fulfill refers to “positive action to facilitate” (United Nations 2024). I do not explicitly state “which includes an economic diversification component” in this principle because this component is inherent in Indigenous title (Law Foundation of BC n.d.) and rights, wherein the Government of Canada supports a renewed economic and fiscal relationship with Indigenous peoples that recognizes their rights, including the right to access their lands and resources to support their traditional economies and to share in the wealth generated from those lands and resources as part of the broader economy (Government of Canada 2018). Also, the “economic diversification component” is further captured in principle (4) “Do not adversely affect Indigenous Peoples’ connection to traditional lands for culture, spirituality, subsistence and livelihoods”. An economic diversification component encourages forest stewardship to support Indigenous peoples’ fulfillment of their subsistence and livelihoods needs, potentially through the provision of forestry-derived fiscal benefits and employment.

The Supreme Court of Canada includes Indigenous title in its spectrum of Indigenous rights, whereby Indigenous title is said to “arise from the prior occupation of Canada by aboriginal peoples” (Haida Nation 2017 para. 52). Canadian common law recognizes two fundamental principles of Indigenous title, one of which is, “The Crown’s interest in the land is subject to existing Indigenous interests in the land” (confirmed in Van der Peet 1996) (God’s Lake 2006 para. 82). One Indigenous perspective of title is that the Creator placed Nations upon their traditional territories and provided them with the laws and responsibilities to care for those territories and as such, Original Title to the lands, water and resources is bestowed upon Indigenous peoples (Law Foundation of BC n.d.). Canadian law supports Original Title by declaring that title includes a right to the land itself, the right to make decisions about the land, the Indigenous laws which have controlled the territory and protected the land, an economic component that evolves to reflect relationships between the Indigenous peoples and their land and economies and, a collective interest in the land which is held by Indigenous Nations (Law Foundation of BC n.d.).

Indigenous rights are collective rights that recognize and protect Indigenous law and custom, the Indigenous relationship to land and the natural environment, Indigenous religious, social and economic practices, Indigenous tangible cultural artefacts and intangible cultural phenomena (Connolly 2016). In addition, Indigenous rights are specific to an Indigenous group and will vary in accordance with that group's distinct culture and traditions (Wewaykum Indian Band 2002 para. 96). I include "Aboriginal rights," which are those confirmed in Sappier (2006) and recognized and affirmed in Section 35 to maintain the distinctive character and ensure the continued existence of Indigenous societies (Reynolds 2018), as part of Indigenous rights in this principle.

This principle is of utmost importance to forest stewardship in BC, where historic land surrender treaties were not generally signed by Indigenous groups and the provincial government has denied that Indigenous title exists after the year 1871 (Reynolds 2018). Consequently, there is an outstanding "land question" in BC which has resulted in continual land claim processes that aim to arrive at comprehensive and specific agreements (Galois 1992). Moreover, the land question has permitted the Crown to grant timber harvesting rights to forest tenure holders on the traditional territories of Indigenous peoples. Thus, industrial forestry in BC, by its nature, has diminished Indigenous peoples' rights pertaining to their lands and resources and dispossessed Indigenous peoples of their title to these lands and resources. Indeed, in Tsilhqot'in (2014), which sets out the current law on Indigenous title (Reynolds 2018), the Court conveyed that the granting of timber licenses would be "a serious infringement on Indigenous rights that would not lightly be justified."

(2) Respect, protect and fulfill Indigenous Peoples' rights to self-government and self-determination

This principle is an amalgamation of Caverley et al. (2019) principle (iii) "Recognizing Indigenous Peoples' inherent right to self-government" and Black and McBean's (2016) principle (b) "The recognition of Indigenous Peoples' inherent right to self-determination". I did not use the term "inherent" to describe these specific rights because the UNDRIP recognizes all rights of Indigenous peoples as inherent (UNGA 2007, pg. 3). I consider these two rights together in one principle because they are interwoven, in that in exercising the right to self-determination, Indigenous peoples have the right to pursue autonomy or self-government, according to Article (4) of the UNDRIP (UNGA 2007). Self-government as a right and a practice carried out by Indigenous

peoples forms part of a broader movement for Indigenous self-determination in Canada (Cornell 2015).

The terms “self-determination” and “self-government” can both refer to the right of Indigenous peoples to govern themselves using laws for which they have passed to have priority over those passed by other governments (i.e., the paramountcy of Indigenous self-government powers) (Reynolds 2018). Given that both the rights to self-government and self-determination are *inherent*, they are rights not derived from anyone else but the group to which the right belongs. Indigenous groups assert that their right to self-government is derived from their powers existing prior to contact (with Europeans) and therefore this right is not a power granted by the Crown or Section 35 (Reynolds 2018). Further, the UNDRIP states that the right to self-government provides Indigenous groups the power to make decisions, based on traditional laws and customs, about how to steward their land and resources and implement those decisions as Indigenous practice (UNGA 2007). Likewise, Article (3) of the UNDRIP states that the right to self-determination allows Indigenous peoples “to freely determine their political status and freely pursue their economic, social and cultural development” (UNGA 2007).

This principle is important to enhancing forest stewardship in BC in particular, because such stewardship is characterized by both Indigenous laws and the province’s centralized legal system for allocating forest rights as a result of the land question in BC. These two governance systems struggle to co-exist as Indigenous policies gain greater recognition by the Crown and industry (Nikolakis and Hotte 2020). This conflict, together with the increasing decision-making authority Indigenous groups now hold over their traditional lands and resources (Lawler and Bullock 2019, Teitelbaum et al. 2019), has arisen from a more inclusive strategy of Indigenous peoples to reassert self-governance (Nikolakis and Nelson 2015, Tindall et al. 2014). This reassertion of self-governance, combined with an increase in collaborative approaches to forest stewardship with Indigenous peoples in BC (Nikolakis and Nelson 2015, Nikolakis and Hotte 2020) highlights a growing need for the adoption of this principle in the current, but also next era, of forestry in the province.

(3) Create equity and transparency in decision-making processes

This principle is taken directly from Caverley’s principle (iv) “Creating equity in the decision-making process”. I consider Black and McBean’s principle (d) “Reliance on

community based participatory approaches" to be a component of this principle (Table 1), given that community-based participatory approaches (CBPAs) can be used to achieve a just decision-making process that does not illegitimize or overlook Indigenous knowledge or contributions (Joshi et al. 2021). However, I do not explicitly refer to CBPAs in this principle since they are but one of several ways of creating equity in decision-making. In contrast, I add "transparency" to this principle because of its importance to fair decision-making. Recent research suggests that transparency is crucial to identifying and addressing systemic discrimination and promoting equality at the negotiating table (Allen and Blackham 2021) and can significantly benefit decision-making that integrates knowledge from diverse sources (Christie et al. 2022).

While the word "equity" translates to "the quality of being fair and impartial" (Oxford English Dictionary 2022), its meaning in decision-making can be described as "a principle and process that promotes fair conditions for all persons to fully participate" (adapted from canadacouncil.ca/glossary/equity). McGregor (2021) acknowledges that the full inclusion and genuine participation of Indigenous peoples in decision-making contributes to a more equitable process in and of itself because of the essential role Indigenous peoples have in transmitting, transforming, protecting and governing their knowledge, values and views. Although, Indigenous peoples may identify with equity—what it means to them and how it may be created—differently than non-Indigenous people. For instance, consensus-based decision-making is a fundamental pillar of First Nations' governance (Wilson-Raybould 2021), and in participatory approaches contributes to a fair decision-making process (Laird 1993).

Transparency in policy decision-making, as it is understood in the public policy sphere, includes, but is not limited to, creating accountability and reducing corruption through open (visible) decision-making (Ball 2009). Further, a policy is transparent if its objective and impact are clear, which is most likely to occur when information about the policy is available and easily obtainable, such as through public disclosure (Ball 2009). According to policy researchers, transparency is a part of each component of the policy process (Ball 2009) and as such, is a way to hold those who possess more power accountable to those with less authority and thus, contributes to a fairer, more democratic process (Richardson and Razzaque 2006).

Indeed, given the imbalance of power and privilege that still exists between both federal and provincial governments and, Indigenous Nations in Canada (Caverley et al. 2019, Coulthard 2007), this principle is of particular importance to decision-making involving Indigenous peoples. In BC, decision-making about forest stewardship inherently affects Indigenous peoples and their rights to lands and resources. Thus, Indigenous Nations have a right to participate in such decision-making, according to Article (3.2) of the UNDRIP (UNGA 2007). However, decision-making processes involving Indigenous peoples that have contributed to the stewardship of forest lands in BC have been marred by inequities in power and privilege and systemic discrimination (Caverley et al. 2019), making this principle a key objective of forest stewardship moving forward.

(4) Do not adversely affect Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence and livelihoods

This principle captures the intent of Caverley's et al. (2019) principle (vi) "Reducing forestry's adverse effects on Indigenous Peoples' connection to traditional lands for culture, spirituality, subsistence and livelihoods". I substituted "Do not adversely affect" in place of "Reducing forestry's adverse effects" to make this principle more inclusive and less ambiguous (Table 5.1). To *not* adversely affect Indigenous peoples' distinctive connection to their lands is the central tenet of this principle, unlike Caverley's principle (vi), which requires that adverse effects, from forestry, only be reduced, although not prevented from occurring. I acknowledge that this principle takes a neutral approach, in that it does not require decisions or actions that contribute to Indigenous peoples' ability to strengthen their connection to their lands. Although, I suggest that preventing or stopping adverse effects from occurring is the first step to a proactive approach that actively contributes to strengthening this connection.

Inherently, Indigenous cultures, ways of life and well-being are grounded in intricate spiritual and cultural connections to nature that Indigenous peoples have developed through the occupation of their territories since time immemorial (Brown and Brown 2009, Henderson 1997). This connection to the land, and waters, is eternal and is fundamental to Indigenous peoples' culture, spirituality, subsistence and livelihoods (Brown and Brown 2009, Johnson et al. 2015). It is Indigenous peoples' distinct and interdependent connection to nature—to the land—that serves as the foundation of

Indigenous culture (Prosper et al. 2011), and thus, to Indigenous laws, knowledge, beliefs, values, customs and practices, all of which guide their resource stewardship.

To adversely affect Indigenous peoples' connection to their lands threatens their ability to steward the land and its resources and as such, express their collective rights and autonomy and fulfill their obligations to future generations (Prosper et al. 2011). Policy and management practices that fail to honour Indigenous peoples' rights to their land and resources, such as their right to "own, use, develop and control the lands and resources which they [possess]", according to Article (26.2) of the UNDRIP, compromise Indigenous peoples' connection to their lands and their ability to maintain their cultural ways of life (Gilbert 2007, UNGA 2007). A crucial component of policy and practices that support this principle is the principle of free, prior and informed consent (FPIC), or more specifically, the element of consent itself. While consent has been the subject of much debate in domestic and international law (Doyle 2022, Papillon and Rodon 2017), recent interpretations of FPIC depict it as a foundational right of Indigenous peoples that characterizes their right to self-determination (King and Pasternak 2019, Papillon and Rodon 2017).

By its nature, industrial forestry and the fragmentation of the landscape that results from harvesting produces adverse effects on Indigenous peoples' connection to their lands, given that many Indigenous peoples' cultural sense of self is inextricably linked to intact forests (Rozzi 2012). As such, this principle is of particular importance to forest stewardship in BC which has facilitated landscape fragmentation and a decline in forest ecosystem resilience over decades because of widespread industrial logging across the province (Hammond 1991, Strittholt et al. 2006). For nearly a century industrial logging in BC has liquidated the original old-growth forests, eroding the capacity of the land to provide cultural, subsistence and economic benefits for Indigenous peoples (Johnson et al. 2015, Pinkerton 1998).

(5) Apply Indigenous knowledge, viewpoints and knowledge systems in an integrative fashion and in accordance with Indigenous laws, traditions and customs

This principle is an amalgamation of Caverley et al. (2019) principle (v) "Adapting forest policy to include Indigenous knowledge and being informed by Indigenous professionals and institutions" and principles (a) "The recognition of Indigenous

knowledge," (c) "The use of inclusive and integrative knowledge systems," and (e) "The use of circular and holistic viewpoints" of Black and McBean (2016) (Table 5.1). I exclude Caverley's wording "adapting forest policy" from this principle because I chose not to limit how IK can be incorporated into or used in policy development or management practices. Indeed, to date, Western policy and decision-making processes do not have the capacity to respect, understand and receive Indigenous knowledge (IK) or the societal systems which are inseparable from it and which produce, maintain, apply and transmit it (Diver 2017, McGregor 2021). Also, I do not explicitly state "being informed by Indigenous professionals and institutions" in this principle because this component is not only implicit in the use of IKS, IK and Indigenous viewpoints, but it is also insufficient on its own to achieve the genuine use and inclusion of each. This is, partly, a result of non-Indigenous decision-makers and managers misconstruing the intent of this component by attempting to include IK shared by Indigenous people by extracting and transforming it into "bits of manageable information" to use to their benefit and without respect for Indigenous rights (McGregor 2014; 2021). As such, I add "in accordance with Indigenous laws, traditions and customs" to this principle to convey that the sharing and integrative use of each of Indigenous knowledge, viewpoints and knowledge systems must occur in a way that protects such Indigenous property from decontextualization and exploitation (McGregor 2021).

In addition, I replace "inclusive and integrative knowledge systems" with "Indigenous knowledge systems" to convey that, regardless of the type of knowledge systems used (e.g., inclusive), at least one must be Indigenous, given that this principle is part of an evaluation framework that is grounded in Indigenous rights. Also, I add "in an integrative fashion" to clarify that Indigenous knowledge, viewpoints and knowledge systems are to be used with other knowledge systems, knowledge and views to engage in respectful, meaningful, and reciprocal learning that is generated from disparate worldviews. Lastly, I replace "circular and holistic" viewpoints with "Indigenous" viewpoints because the former are the foundation of Indigenous worldviews (Dockstator 2014, Little Bear 2012) and, moreover, it would be inappropriate to exclude Indigenous viewpoints from this principle, given the purpose of this framework.

IKS are a way of life that support the creation, renewal and transformation of knowledge and embody the relationships among not only people, but all living things, including those in the past, the future, and the spirit world (McGregor 2021). In addition,

IKS embody political, legal, economic, and cultural systems that afford Indigenous peoples the ability to ensure their well-being (McGregor 2018, Simpson 2004). Thus, IK, which includes knowledge, practices and beliefs, is inseparable from IKS and each are inseparable from the people who hold and live that knowledge and those systems as part of their daily lives (Berkes 1999, McGregor 2021). I distinguish the use of IKS in an integrative fashion from their independent use, because using the strengths of each system together can produce new knowledge for the benefit of all (Marshall and Bartlett 2010). The co-production of knowledge (Lyver et al. 2018, Adelle et al. 2020), co-learning (Wehi et al. 2019) or changing or addressing power imbalances (Varghese and Crawford 2021) are approaches to using IKS with other knowledge systems that promote greater equity for Indigenous peoples.

Indigenous viewpoints, collectively, form Indigenous worldviews which are characterized by a circular and holistic understanding of people's relationship to nature, place and time. Indeed, most Indigenous worldviews are borne from a "systems thinking" concept wherein the whole of a system is more than the sum of its parts (Little Bear 2000, Henderson 2000). The Indigenous belief that "everything is connected" (Castleden et al. 2009) embodies this concept and reflects the central principle of holism—the interdependence of relationship to others, whereby each part affects the whole (Cheung 2008). Further, Indigenous peoples' views about the interdependence of relationships, place and time illustrate the application of a circular viewpoint, wherein time is "manifested in the world around us through the cyclical progression of the seasons [...]" and is grounded by place, which "determines the patterns time manifests" (Dockstator 2014). And, relationships between living and non-living things are understood by Indigenous peoples as the "circle of life" (Martin et al. 2017).

To facilitate the use of IKS, IK and Indigenous viewpoints in forest policy and management in a manner that aligns with Indigenous laws, traditions and customs, decision-makers must work together with Indigenous peoples throughout the decision-making process and build just and meaningful relationships with them. These approaches contribute to preserving the integrity, effectiveness, and purpose of IK and views because a deeper understanding of IK and views and their intimate relationship with IKS can be developed (McGregor 2021).

For more than a century in forest stewardship in BC, a Western approach that overlooks the "socio-cultural services" of forests and focuses on a single entity—the economic value of trees—has been used to achieve economic gain over the short-term (Arias-Bustamante and Innes 2021). However, approaches to forest stewardship in BC have evolved over the last ~40 years into a type of holistic paradigm, while the knowledge of Indigenous peoples has become an essential part of contemporary forest and resource management (Wyatt 2008). As such, this principle is of utmost importance to forest stewardship in BC, not only because land managers and scientists are increasingly recognizing the need to learn from Indigenous peoples (Diver 2017, Rayne et al. 2020, Varghese and Crawford 2021) but there remains a disregard for First Nations' objectives, knowledge, perspectives and values (Castleden et al. 2009, Caverley et al. 2019). Indeed, to achieve a more holistic stewardship approach that considers the social and cultural values of forests and enhances social equity will require the appropriate use of IK and views in forest stewardship (Baumflek et al. 2021, Emery et al. 2014, Wyatt et al. 2011) and, arguably, an understanding and use of IKS together with other knowledge systems. Moreover, if forest stewardship in BC is to uphold Indigenous rights, it is not only the inclusion and use of IKS together with IK and viewpoints in stewardship that is important but the way this is achieved, as this principle conveys.

(6) Ensure policy-makers, managers and practitioners have the requisite knowledge and skills to apply these principles

I created this principle because of its importance to decision-making in forest stewardship in BC and, to adopting and successfully implementing principles (1) through (5) (Table 5.2). To describe the "requisite knowledge and skills" in this principle's practices and standards (Table 5.2) I draw from Calls to Action (57) and (92:iii), which, in part, request that both the government and corporate sectors of society "provide education [...] on the history of Aboriginal peoples, including the history and legacy of residential schools, the *UNDRIP*, Treaties and Aboriginal rights, Indigenous law, and Aboriginal-Crown relations," which "will require skills-based training in intercultural competency, conflict resolution, human rights, and anti-racism" (TRCC 2015).

Implicit in this principle is that education and training will provide policy-makers, managers and practitioners with the requisite knowledge and skills to apply the principles of this framework. An essential facet of such education and training, which is

echoed in Article (15.2) of the UNDRIP (UNGA 2007), is that teaching initiatives be developed in collaboration with Indigenous peoples to support the appropriate and accurate reflection of Indigenous experiences, knowledge and perspectives (Smith 2020, Delbridge et al. 2021). Further, the approach to or meaning of some terms that are described in the practices and standards of this principle (Table 5.2) and what they are comprised of can only be determined in collaboration with or by Indigenous peoples. For instance, the meaning of Indigenous peoples' "history" and "law" in this principle is what any given Indigenous group deems as their law and history and that of Indigenous peoples' more broadly. In addition, regarding the term "Aboriginal rights," I distinguish such rights from the rights of Indigenous peoples by recognizing them as the rights affirmed in Section 35. I also recognize "human rights," including the human rights of Indigenous peoples, as those included in the *Canadian Human Rights Act, 1977* (*Canadian Human Rights Act,*1977, s.1).

This principle is of particular importance to those involved in forest stewardship in BC because of the rights Indigenous peoples hold to their lands and resources. Because of these rights of Indigenous peoples, consultation, collaboration, relationship building and decision-making with First Nations plays a significant role in the work of public servants and those employed by industry. Thus, I ask, how can such relations be conducted in an informed, just, and respectful manner with First Nations if those involved lack the requisite knowledge of, and skills to apply, this principle's practices and standards, which represent matters that are of great significance to Indigenous peoples and the stewardship of their lands and resources? Furthermore, it is not only judicious of public servants and industry personnel to undertake formal education about such concepts and, to receive training to advance knowledge and skills important to relationship-building, but mandatory, pursuant to the *DRIP Act* and the province's commitment to the Calls to Action (TRCC 2015).

Supplementary Material Section 1 References

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5.7.1. Cases

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5.7.2. GBR Order policy and planning literature

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Chapter 6. Conclusion

6.1. Bringing together distinct disciplines and sources of knowledge

Anecdotal evidence reveals that many natural scientists in Canada are unaware of the extent to which research can benefit from Indigenous perspectives and knowledge (Wong et al. 2020). In contrast, many Indigenous groups worldwide recognize the value and utility of using their traditional knowledge and worldviews together with knowledge produced using Western scientific principles and methodologies to steward biocultural resources (Adams et al., 2014; Rayne et al., 2020). An important benefit of bringing together distinct sources of knowledge is the meaningful involvement of Indigenous people in the research process. In addition, knowledge-sharing and knowledge co-creation can shift power relations, as long as Indigenous peoples and researchers are viewed by western researchers as knowledge holders of equal status (Berkes and Berkes, 2009; Armitage et al. 2011). Knowledge sharing and creation can also contribute to advancing reconciliation (Wong et al. 2020). In this thesis, I bring together Indigenous knowledge and knowledge derived from Western scientific principles and methods, including the social and natural sciences, to support an Indigenous stewardship strategy for LCC and produce novel scholarly contributions. It was necessary to involve my research partners and Indigenous knowledge holders in the research process to ensure not only the inclusion of Indigenous knowledge, views and values in a way that supported Nanwakolas stewardship objectives, but also to ensure that their knowledge and views were not decontextualized or exploited.

I also found it necessary to bring together different disciplines to help clarify, prioritize, and ultimately address First Nation stewardship objectives, and conduct research that would contribute to filling knowledge gaps in the scholarship. Not surprisingly, effective biocultural research, given its grounding in social-ecological systems, often engages multiple knowledge systems and bridges disciplinary barriers (Polfus et al. 2017). In this thesis I demonstrate that this is not only possible, but a necessary and important approach to conducting research that explores and aims to support different aspects of Indigenous biocultural resource stewardship. For instance, in Chapter 2, I drew on the principles and methodologies of the field of ethnography to

interview 13 First Nation cedar carvers to understand the evolution of the practice of carving and access to trees and logs over the last 250 years, and the influences responsible for shaping practices and access over time. This rich ethnographic knowledge revealed not only how the legacies of widespread colonial phenomena have shaped the contemporary carving practice, but also how recent trends in carving embody cultural revitalization and Indigenous resistance. While these findings are a unique contribution to scholarship, they will also help the Nanwakolas Member Nations in setting stewardship priorities to support community carving revitalization initiatives and the practice of carving over the long term.

The knowledge, views and experiences that carvers shared in their interviews also highlighted knowledge gaps and cedar stewardship needs that informed my subsequent research questions and the following chapters of my thesis. In Chapter 3, I conducted a literature review of the scholarship pertaining to correlates of heartwood decay in redcedar, given that carvers identified such decay in LCC as a key factor that limits the suitability of trees for various carving purposes. Carvers expressed their concern about harvesting LCC trees for cultural practices that contain considerable volumes of decay, given that this practice neglects the ecological and spiritual importance of conserving such trees and does not contribute to fulfilling carvers' needs. While carvers shared their knowledge about the relationship between decay in redcedar and morphological tree characteristics and habitat conditions, they also explained the difficulty in accurately detecting and predicting decay in living trees. Thus, it became apparent that there was a need for a set of visual indicators of decay in LCC that could be applied in cedar stewardship planning. By conducting a literature review I was able to identify knowledge gaps in relation to redcedar and its relationship with four distinct factors of decay, bridging the disciplines of pathology, ecology and tree physiology. Moreover, I was able to highlight the relationship between decay in redcedar and the cultural practice of carving using Indigenous knowledge.

In Chapter 4, I used an integrative knowledge systems approach to establish a set of environmental and biological indicators of heartwood decay in LCC to address both the knowledge gaps and stewardship needs I identified in Chapter 3. I not only drew from the disciplines of ecology, tree physiology, and dendrochronology, but brought together Indigenous knowledge and views with knowledge and methods grounded in Western science, to conduct a field study to examine the relationship between amounts

of decay in LCC, environmental conditions and morphological tree characteristics. The results demonstrate that the knowledge and views of cedar carvers was essential to informing study design, broadening understanding of, and establishing, a robust set of indictors of decay, and exploring the application of such indicators in Indigenous cedar stewardship.

In Chapter 5, I developed a policy evaluation framework to evaluate the treatment of Indigenous rights in a provincial government policy governing cedar and LCC stewardship, and compared the results with a policy declared by First Nations for LCC stewardship. I conducted this research, in part, in response to carvers' concerns about the capacity of their Nations to support intergenerational access to LCC, and the infringement of their Aboriginal rights that is perpetuated through current provincial forest policy. The results demonstrate that the Nanwakolas LCC Operational Protocol is an assertion of Indigenous rights and protects First Nation cultural values, while various barriers continue to exist that prevent the GBR Order from reaching its full potential relative to Indigenous rights and reconciliation. In this study, I not only addressed an analytical gap in the academic scholarship by developing a novel evaluation framework, but also highlighted how an Indigenous approach to biocultural resource stewardship can contribute to Indigenous self-determination. Collectively, these chapters demonstrate how bringing together disciplines and using knowledge and ways of knowing from Indigenous and Western science can inform and enrich research so that its products are more scientifically valid, socially robust and policy relevant.

6.2. Supporting Indigenous-led stewardship of biocultural resources

Why is support for Indigenous-led biocultural resource stewardship important to land and resource management in settler states, such as Canada? The answer to this question may appear obvious, given the benefits that often come with the return to ancestral traditions, practices and protocols that have sustained Indigenous societies and conserved biocultural resources for millenia. For instance, supporting Indigenous-led governance and stewardship of lands and waters can reduce ecological degradation and increase the spatial scale and effectiveness of ecological and biological conservation efforts (Artelle et al. 2019; 2021, Bandiaky-Badji et al. 2023), and the resilience of social-ecological systems (Salomon et al. 2019). Moreover, Indigenous-led

resource stewardship and governance is driven by distinct cultural values, pedagogy, laws and intergenerational responsibilities, and is, ultimately, an expression of Indigenous peoples' self-determining authority. Thus, to conduct land and resource management in a way that is socially just and that aims to advance the process of reconciliation and uphold inherent Indigenous, as well as human, rights (e.g., those in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)), requires that space and support be created for Indigenous stewardship and governance systems (Artelle et al. 2019). Chapter 5 illustrates this point by showing that the Indigenous Nanwakolas LCC Protocol fills gaps and deficiencies in the BC provincial regulatory framework for cedar stewardship in the GBR.

There are also ethical justifications for resource stewardship being carried out by Indigenous groups on their traditional territories. These justifications are grounded in decolonization, Indigenous resurgence, and the recognition of, and redress for, the injustices resulting from settler colonialism (such as those described in Chapter 2 of this thesis) (e.g., see Artelle et al. 2019; 2021). Relative to the study setting for my research, scholars have recognized the need for Indigenous-led stewardship strategies in the GBR. For example, Bohling (2019) stresses that efforts to implement EBM forestry practices in the GBR in a manner that balances social, cultural, economic and environmental benefits, will rely heavily on First Nation communities and their ability to develop mechanisms that can guide resource management and extraction on their territories. Thus, there is not only an ethical obligation to support Indigenous-led land and resource stewardship strategies in the GBR, but Indigenous approaches carried out under First Nation governing authority are also essential to achieving the basic tenets of EBM, and arguably, First Nations' stewardship objectives. The chapters of my thesis present some of the knowledge and tools that are needed to support the stewardship of LCC in the GBR in a manner that fulfills the Nanwakolas Member Nations' intergenerational stewardship objectives.

Indigenous groups seeking to develop and implement biocultural resource stewardship strategies on their territories require institutional and human capacity, in areas such as training, knowledge development, monitoring, financial and human resources, and time. The Nanwakolas Council provides Kwakwaka'wakw First Nations with the opportunity to expand their self-governing capacity in these areas. Research partnerships are part of the Nanwakolas approach to collaborative decision-making and

serve as a key mechanism through which researchers can provide support to the Nations. It is at this grassroots level of knowledge sharing and knowledge co-creation, and spending time with research partners and community members, that the value and importance of contributions to Indigenous-led stewardship become clear. As I have learned over the course of this research, the value of this collaborative work goes far beyond contributing to the development of a robust stewardship strategy for any given resource. This work is one small way to give back to Indigenous groups that have been restricted from accessing, using, and stewarding lands and resources critical to their well-being and survival by colonizing settler societies. I hope my work supports efforts to honour and advocate for Indigenous self-determination and sovereignty over resource stewardship, to overcome ignorance about Indigenous peoples' history, rights and worldviews, and to create equitable relationships.

The chapters of my thesis provide insights into the approaches the Nanwakolas Member First Nations are taking to develop and implement a biocultural resource stewardship strategy on their territories. Specifically, this thesis shows how these Nations are using their cultural knowledge to guide resource stewardship while also creating new knowledge through the integration of different knowledge systems. It also highlights that Indigenous-led policies such as the LCC Protocol can be an assertion of Indigenous rights pertaining to land and resource stewardship and, as such, an approach to counteracting the infringement of such rights in a colonial land management context. I provide empirical findings that not only advance bodies of scholarship in various disciplines, such as natural resource policy, ecology and ethnography, but support an Indigenous-led stewardship strategy that seeks to fulfill intergenerational cultural needs while upholding the Nations' obligation to care for the land in perpetuity. I also demonstrate the need for the traditional knowledge, views and experiences of Indigenous practitioners and users in research that informs resource stewardship; and show how integrating such knowledge and views with Western science can create tools to better inform operational and landscape level planning that aims to ensure sustainable use of a scarce resource over the long term. Lastly, I show how an evaluation framework composed of principles grounded in the norms of the UNDRIP and the Calls to Action of the Truth and Reconciliation Commission of Canada, can be used to assess the performance of forest or natural resource policy and practices relative to universal Indigenous rights and interests. Broadly, this thesis shows how Indigenous groups are

pursuing biocultural resource stewardship in ways that are adaptive and use the best available knowledge and approaches.

6.3. The importance and challenges of collaborative research with Indigenous groups: Personal reflections

Collaborative research between Indigenous groups and researchers in various disciplines has gained momentum due to the value and benefits it brings to both types of collaborators (Adams et al. 2014, Lepofsky and Lertzman 2018, Salomon et al. 2019, Tondu et al. 2014). Although the need to learn from Indigenous peoples is recognized by many land managers and researchers (Diver 2017, Rayne et al. 2020, Varghese and Crawford 2021), it is still common to disregard Indigenous peoples' objectives, knowledge, perspectives and values in land and resource stewardship (Castleden et al. 2009, Caverley et al. 2019). Collaborative research that integrates the knowledge, values and views of Indigenous groups can produce novel and nuanced knowledge to advance academic scholarship and address practical and applied issues of concern to Indigenous peoples in land and resource stewardship (Adams et al. 2014, Benner et al. 2021). Research partnerships with Indigenous groups are also a way of ensuring that researchers conduct research and mobilize knowledge in accordance with Indigenous laws, traditions and customs, and help to build trust and respect among individuals. For example, through my discussions and planning sessions with N̲anwa̲kolas staff I learned that it is customary to conduct interviews with members of their nations in-person, and it is considered respectful to give a small gift to those sharing their knowledge.

Research that involves Indigenous peoples' traditional lands and resources must meaningfully involve Indigenous groups to be ethical. As McGregor (2018) stresses, research is not exempt from the obligations of reconciliation with Indigenous peoples. I strongly believe that the social license of researchers who wish to carry out studies that require access to Indigenous lands and resources or that focus on matters of interest to Indigenous peoples (e.g., the stewardship of biocultural resources) should be contingent on creating equitable partnerships with Indigenous groups. It was not so long ago that much research "with" Indigenous peoples was conducted from a perspective of settler-colonial superiority, ignorance, and discrimination, which contributed to suffering in Indigenous communities, further eroding trust and respect (Castellano 2004).

While a collaborative approach is necessary in academic work involving Indigenous peoples and their lands and resources, developing strong research partnerships with Indigenous Nations and organizations, such as the Nanwakolas Council, can be challenging, particularly for graduate student researchers (e.g., see Wray et al. 2020). Through my work with the Nanwakolas Council and previous work with another First Nation in BC, I learned that some Indigenous groups may experience "research fatigue" and that despite identifying a meaningful overlap between researcher interests and the needs and values of an Indigenous group, their resources, such as time and funding, may be limited.

In addition, building a research partnership takes time, often more time than is appropriate to complete a PhD program within academic requirements (Wray et al. 2020). It takes time to establish long-term meaningful relationships based on mutual trust, which can include extensive travel to, and stays in, Indigenous communities. I benefitted from a fellow PhD student and colleague's established research partnership with the Nanwakolas Council (see Benner 2020) by building on their relationship with Nanwakolas and its Member First Nations to establish trust and mutually beneficial research objectives. Such collaborative research in my study region, the GBR, has been shown to be important to democratizing conservation science and stewardship practices to achieve ecologically sustainable and socially just outcomes (Salomon et al. 2018). In addition, spending time with community members and research participants outside of conducting research, but within the context of the research (e.g., on the land), are key aspects of relationship building that are valuable to collaborative work and the "research experience." For example, over the span of four years, I was privileged enough to spend several extended periods of time (up to five months) within communities of the Nanwakolas Member Nations, "hanging out" in carving sheds, participating in First Nation community events (e.g., canoe journeys), visiting galleries and museums with carvers to admire their artwork, and conducting and teaching LCC surveys on traditional territories for the Nanwakolas Council. Nonetheless, the time spent on such relationship building activities, combined with the relatively slow pace of academic research, often conflicts with the relatively swift pace of decision-making and planning that is required of Indigenous groups who are working under timelines, often set by other stakeholders, such as industry and government. For instance, to help inform the regulations governing the harvesting of LCC in the Nanwakolas LCC Protocol, I established a set of visual

indicators of heartwood decay in LCC (Chapter 4); however, the LCC Protocol was published before I could complete my LCC decay field study.

Despite these challenges, building research partnerships not only brings practical benefits to Indigenous groups and their communities while enhancing scholarly contributions, but it also provides researchers with unique opportunities to become embedded in their study system and make connections with people and places that would otherwise be out of reach. For instance, by living in the Nanwakolas Member Nations' communities and having on-going discussions with the Nanwakolas Council throughout the research process, I was able to build relationships with some of the chiefs of the Nations, connect with the carvers frequently and build personal relationships with them, and spend time on the land with Nanwakolas staff and local First Nation Guardian Watchman. These opportunities had an immense personal impact and enriched my research, because I was able to gain a deeper understanding of the carving practice, other distinct aspects of the Kwakwaka'wakw culture, and the connection of the people belonging to the Nanwakolas Member Nations to various places of cultural importance within their traditional territories. I found it incredibly rewarding to provide findings to help address some of the issues and concerns carvers voiced (Chapters 2 and 4) and to support LCC stewardship planning, policy, and carving revitalization initiatives. On a personal level, conducting collaborative research has brought unforeseen rewards, such as the cultural knowledge and unique opportunities I have been given, which include helping paint a totem pole and being invited to a potlatch. In addition, I was humbled by the words of several of the carvers I interviewed, who expressed how grateful they were for the research I was doing. For instance, Greg Henderson's words left a lasting impression on me; "*The work you are doing, you are speaking out for us and gaining this knowledge, so you are our voice and our vision, so kudos to you for trying to do something [...] because it's having people like you [who are] able to take this and move forward. Hopefully it will make [an] impact one day*."

6.4. References

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