Recreation and Protection Values of Port Renfrew Old-Growth Forests

by

Colleen Dupont

B.Sc., University of Victoria, 2017

Project Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Resource Management (Planning)

in the
School of Resource and Environmental Management
Faculty of Environment

SIMON FRASER UNIVERSITY
Summer 2022

Declaration of Committee

Name:	**Colleen Dupont**
Degree:	**Master of Resource Management (Planning)**
Title:	**Recreation and Protection Values of Port Renfrew Old-Growth Forests**
Committee:	**Chair:** **Phillip Bradshaw** PhD Candidate, Resource and Environmental Management
	Duncan Knowler Supervisor Professor, Resource and Environmental Management
	Thomas Gunton Committee Member Professor, Resource and Environmental Management

Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

a. human research ethics approval from the Simon Fraser University Office of Research Ethics

or

b. advance approval of the animal care protocol from the University Animal Care Committee of Simon Fraser University

or has conducted the research

c. as a co-investigator, collaborator, or research assistant in a research project approved in advance.

A copy of the approval letter has been filed with the Theses Office of the University Library at the time of submission of this thesis or project.

The original application for approval and letter of approval are filed with the relevant offices. Inquiries may be directed to those authorities.

Simon Fraser University Library
Burnaby, British Columbia, Canada

Update Spring 2016

Abstract

In recent years, there has been intense pressure for alternative old growth management that better reflects diverse public interests. To make equitable decisions regarding old growth management, information is needed about how the public values the services provided by the forests. This research aims to provide dollar estimates of public values for changes in old growth recreation opportunities, old growth protection, and jobs at a Port Renfrew study site on Vancouver Island. A discrete choice experiment administered with a web survey elicited public preferences for alternative old growth management at the study site. Multinomial logit and latent class models of the survey data demonstrate the public has positive and statistically significant values for increases in old growth protection, recreational sites in old growth forests with giant trees, and study area jobs. The results are expressed as both public willingness to pay (in dollars) for the increases as well as public support for hypothetical alternative management programs.

Keywords: old-growth forests; nonmarket valuation; stated preference; discrete choice experiment; old growth protection; old growth recreation

Acknowledgements

I first want to acknowledge my supervisor, Dr. Duncan Knowler. Thank you for taking me on and for all the wisdom and encouragement you provided throughout this project. You challenged me when I needed it and guided me towards the bigger picture when I couldn't see the forest for the trees. Thank you to Sergio Fernandez Lozada for your unwavering support and enthusiasm throughout this project. You made data analysis fun and exciting where I otherwise would have been frustrated and overwhelmed. Thank you to Paulus Mau for your help with programming the web survey; you made the process enjoyable and manageable for me. Although we never met, I want to acknowledge the late Dr. Wolfgang Haider. His legacy at REM has lived on through his students and made this work possible. Finally, I extend a warm thanks to my mom, Marianne. Nothing has come easily for you, but you have opened every door that has led me here.

Table of Contents

List of Tables

List of Figures

List of Acronyms

BC	British Columbia
CBA	Cost Benefit Analysis
CS	Compensating Surplus
CVM	Contingent Valuation Method
DCE	Discrete Choice Experiment
DST	Decision Support Tool
FRPA	Forests And Range Practice Act
ha	Hectares
IIA	Independence of Irrelevant Alternative
LC	Latent Class
MNL	Multinomial Logit Model
PCA	Principal Components Analysis
SI	Site Index
WTA	Willingness to Accept Payment
WTP	Willingness to Pay

Chapter 1. Introduction

1.1. Problem Statement and Purpose

The two largest acts of civil disobedience in Canadian history, the 1993 Clayoquot Sound protests and the 2021 Fairy Creek protests, were both in response to old growth logging on Vancouver Island. Throughout the Fairy Creek protests, the phrase “worth more standing” appeared in social media hashtags, protest signs, and book titles (e.g., (Lowther, 2021). The slogan captures the perspective that standing old-growth forests provide values to society that are greater than the values from logging them. Meanwhile, logging old-growth forests makes up about half of all logging on Vancouver Island (Province of BC, n.d.-b), providing revenue to the province and some First Nations, as well as direct, indirect, and induced employment. The challenge for policy makers is to balance the trade-offs in old growth management to ensure equitable management of public resources.

The societal value of old-growth forests comes from their diverse ecosystem services including biodiversity, carbon storage, recreation opportunities, and timber products. When the values of the diverse ecosystem services of old-growth forests are expressed in common terms, their respective gains and losses from policies can be compared to balance trade-offs. Dollar values offer a common measure to enable direct comparisons in policy-making tools like cost benefit analysis (CBA). Some provisioning ecosystem services, such as timber products, are traded in markets and have obvious dollar values. Other services, such as non-commercial recreation opportunities, are not traded in markets and do not have obvious dollar values. Those nonmarket goods and services provide value to society that can be accounted for to promote equitable policy. With nonmarket valuation, their values can be expressed in dollars to allow for commensurability and inclusion in policy tools like CBA.

Recent efforts to compare trade-offs in old growth management with CBA have been confounded by missing data (Morton, Trenholm, Beukema, Knowler, & Boyd, 2021). Notably, there is very limited data on the recreational value of old-growth forests in British Columbia (BC). To address this data gap, the purpose of this research is to provide primary data on multiple old growth values, including recreation. The broader

purpose of this work is to support old growth management decisions that consider the full range of ecosystem service values.

It is not the intent of this research to interfere with, detract from, or contend with the stewardship and resource planning of the Pacheedaht, Ditidaht, Huu-ay-aht, T'Sou-ke and WSANEC Nations and the Hul'qumi'num Treaty Group. This research presents general public values for old growth but does not suggest that general public values are a priority in the stewardship and resource planning of First Nations' territories. This research is limited by only providing the perspective of the general public and I ask anyone reading this research to keep the context and limitations in mind.

1.2. Research Objectives

The objectives of this research are:

1. Estimate public values, in dollars, for changes in old growth protection at a candidate study site.

2. Estimate public values, in dollars, for changes in old growth recreation opportunities at the same site.

3. From the results of objectives 1 and 2, consider the trade-offs in old growth management and make policy recommendations.

Chapter 2. Background

2.1. Old-Growth Forest Definitions and Characteristics

"Old-growth forest" is a generic term that describes forests with old trees but does not have a universal definition (Issekutz, 2020). For management purposes, the Province of BC defines old-growth forests as those with a stand-age older than 250 years on the coast and 140 years in the interior (Province of BC, n.d.-b). The general public, however, often have an impression of old-growth forests that includes majestic trees and diverse plants, fungi, and wildlife – characteristics that are not always present in forests with old trees (Wirth, Messier, Bergeron, Frank, & Fankhanel, 2009). A 2019/2020 survey of 18,523 British Columbians elicited what the term "old growth" means to them and found themes defining old growth based on its unique physical and ecological characteristics, its environmental, social, and economic values, and the maturity, size, and age of trees (Gorley & Merkel, 2020a).

To illustrate the difference in definitions, consider low productivity old growth. These forests, such as those at high altitude and/or steep incline, may contain trees that are hundreds of years old but have not grown to large sizes. While the provincial definition may classify those forests as old growth, the public may not perceive them as such, and the forests provide different ecological functions than high productivity old growth. To overcome the limitations of a stand-age definition, previous research has classified old growth based on stand age and productivity levels (e.g., Price, Holt, & Daust, n.d.).

Given that there is no standard definition of old growth and that forests vary between locations, there are no definitive characteristics of old-growth forests. However, there are some common qualities that generally separate old-growth forests from younger forests. Compared to younger forests, old-growth forests often have larger trees, more standing dead trees, more decomposing wood, and a layered canopy with openings that allow more light to reach understory vegetation (Province of BC, n.d.-b).

Some, but not all, old-growth forests have large, monumental ("giant") trees. Giant trees are found in forests at low elevation with minimal incline, long growing seasons, and high precipitation. In BC, these conditions are characteristic of coastal valley bottoms. Giant trees have also either avoided or survived disturbance (e.g., fires, landslides). Although

any area can experience disturbances, a lower frequency of forest fires on the coast compared to the interior is an additional factor that make coastal valley bottoms ideal for growing giant trees in BC.

2.2. The State of Old-Growth Forests in BC

2.2.1. Old Growth Extent and Protection in BC

The ambiguity in defining old growth has created conflicting portrayals of how much old growth remains in BC (Price, Holt, & Daust, 2020). Prior to European colonization and the industrialized logging that followed, BC had approximately 25 million hectares (ha) of old-growth forests (Old Growth Technical Advisory Panel, 2021). In 2020, based on the stand-age definition of old-growth forest, there was approximately 11.1 million ha of old growth, or 44% of the historical amount. Of the remaining old growth, only some forests can support giant trees. As defined by Site Index, which is a measure of productivity, a study by Price et al. (2020) estimates only 35,000 ha of old growth capable of growing very large trees remained in 2020 (Price et al., 2020).[1]

Of the 11.1 million ha of old growth remaining in BC, 3.5 million ha are protected either provincially or federally (Province of BC, 2021). However, low productivity forests are overrepresented in protected old growth, and high productivity forests are underrepresented (Price et al., 2020). A recent study estimates that ~65% of old-growth forests that are ancient, “big-treed,” or remnant ecosystems are unprotected (Old Growth Technical Advisory Panel, 2021).[2] There are also 2.6 million ha of old growth in deferral areas, a temporary (2-year) form of protection intended to preserve the forests while changes to their management are considered.

With 3.5 million ha of protected old growth in BC, is there a need for change? Regarding old growth protests, it is clear that some portions of the public are demanding more

[1] Based on Site Index (SI) is a measure of how many meters trees in a stand are expected to grow after 50 years. Forests capable of growing very large trees were defined by Price et al. (2020)as those with a SI greater than 24.

[2] In that analysis, ancient was defined as forests older than 400 years, and “big-treed” was defined as high-productivity forests within each biogeoclimatic variant (i.e. forests with trees that are big for the type of forest they are), and remnant was defined as areas where 10% or less of the forested ecosystem remains.

protection. Additionally, in the 2019/2020 old growth Strategic Review survey, 38% of respondents provided comments calling to protect *all* old growth in the province (Gorley & Merkel, 2020a). Conversely, in response to the protests, there have been reports and media releases providing counter perspectives on the extent of old growth protection in BC, such as a report commissioned by the Canadian Forest Industries (Brown, Hachey, Wood, Thrower, & Walton, 2021). Further, in the broader engagement for the Strategic Review, there were at least 42 comments calling to not increase old growth protection (e.g., "BC has enough parks.") (Gorley & Merkel, 2020a).[3]

2.2.2. Old Growth Recreation in BC

Old-growth forests support and enhance diverse forms of recreation that occur in formally designated parks and recreation sites and outside of these areas on public or private land. For some recreationists, viewing the trees is the primary activity. For other recreationists, walking, hiking, nature photography, or other forms of recreation may be the primary activity, enhanced by the old-growth forests. Tourists may also share these same experiences in old-growth forests and may travel specifically to witness the forests. Breathtaking forests are a part of the "super, natural, British Columbia" branding to promote tourism (Destination BC, 2022). In economic welfare studies like this one, tourism and recreation are considered separately because the activities of tourists have market values (e.g., accommodation, food, tour guides, etc.), whereas recreationists may partake in outdoor recreation with low or no market costs. Further, the welfare measurement is different between tourists and recreationists. When considering the state of old-growth forest recreation opportunities in BC, it is difficult to separate recreation opportunities from tourism opportunities. As such, the opportunities described here support both recreation and tourism, although this research only estimates recreation values.

Throughout the province, there are many formal and informal old growth recreation opportunities. Cathedral Grove, a stand of giant old growth trees in MacMillan Provincial Park on Vancouver Island receives roughly 500,000 annual visitors (Minstry of Transportation and Infrastructure, 2019), Also on Vancouver Island, the community of

[3] From what was shared in the engagement summary, there were no survey questions directly asking whether or not to increase old growth protection, so these insights are provided from comments.

Port Renfrew has branded itself as the Tall Tree Capital of Canada in reference to several remarkable giant trees and groves of old growth, including the world's largest Douglas-fir tree, giant spruce and Sitka trees, and Avatar Grove, which is a recreation site with boardwalks through giant old-growth trees (Ancient Forest Alliance, n.d.). Some of the giant trees near Port Renfrew are in formal recreation areas, like Avatar Grove, whereas others, like a towering Douglas-fir named Big Lonely Doug, are not. Many other examples of old growth recreation areas exist throughout the province, such as Carmanah Walbran, Meares Island, and the Kokanee Old Growth Cedars Trail.

With the many old growth recreation opportunities throughout the province, is there a need for more? At Cathedral Grove, traffic congestion and overflowing parking indicate the high demand for old growth viewing opportunities (Ministry of Transportation and Infrastructure., 2019). Other than Cathedral Grove, there are few insights into demand for old growth recreation specifically, but there is a lot of information available regarding demand for outdoor recreation more generally. Between 2014 and 2019, BC Parks experienced a 23% increase in visitors (Government of BC, 2021b). Throughout the COVID-19 pandemic, there is widespread anecdotal evidence that the demand for outdoor recreation increased at an even more rapid rate (Government of BC, 2021a; Outdoor Recreation Council of BC, 2021).

2.2.3. Old Growth Logging in BC

Provincially, three million ha of the remaining 11.1 million ha of old-growth forest make up about 15% of the Timber Harvesting Land Base, which is the portion of the publicly managed forest that is available for harvest.[4] Between 2014 and 2018, approximately 27% of the harvested area in the province came from old growth (Province of BC, n.d.-b). On Vancouver Island during the same period, approximately 50% of the harvested area was old growth (Province of BC, n.d.-b). Timber from old-growth forests harvested in BC is used for lumber and high-end specialty items such as musical instruments, and pulp is made from the wood waste (Province of BC, n.d.-b).

The economic impact of old growth logging in BC is not available, but the economic impact of forestry in general is. In 2020, forestry-related activities employed almost

[4] Based on the stand-age definition of old-growth forests in BC (250 years on the coast, 140 years in the interior)

50,000 people and made up $11.5 billion of provincial exports (Province of BC, n.d.-b). In 2019, 5,300 Indigenous people were directly employed in forestry (BC Council of Forest Industries, 2019). Further, the forest sector is the primary employer in several parts of the province (Province of BC, n.d.-b).

Is there a need to make changes to old growth logging? In some respects, demand to change old growth logging is captured by the calls for changes in old growth protection. However, there are other considerations as well. The Old Growth Strategic review process also identified public interests related to the logging process in BC. For example, 13% of survey respondents called for selective logging practices (Gorley & Merkel, 2020a). In general, the current provincial effort on forestry policy reform as well as intense public pressure indicate the demand for changes to old growth logging.

2.3. Old Growth Protests and Blockades

Contention over old growth management has resulted in various protests on the west coast of Vancouver Island. The Clayoquot Sound protests, "*the War in the Woods,"* occurred between 1980 and 1994 on the territories of the Nuu-chah-nulth Nations. Several protests and blockades opposing old growth clearcutting culminated in mid-1993, when over 800 protesters were arrested. This mass arrest remained the largest act of civil disobedience in Canadian history until the 2021 Fairy Creek protests.

The Fairy Creek watershed, within the territories of the Pacheedaht First Nation, Ditidaht First Nation, and Nuu-chah-nulth Nations, has been the focal point of old growth logging protests and blockades between 2020 and 2022. The Fairy Creek site was continuously occupied by protesters for over 500 days and resulted in over 1,100 arrests and widespread conventional and social media coverage (CBC, 2022).

2.4. Old Growth Management Changes

The past few years have seen a lot of planning and policy dialogue from the Province regarding old growth management. Throughout 2019 and 2020, the Province secured an independent panel to undertake an Old Growth Strategic Review. The process included engagement which gathered input on old growth management from tens of thousands of British Columbians, including forestry professionals, advocacy groups, industry groups,

and academics. The resulting report, *"A New Future for Old Forests"* provides 14 recommendations to improve old growth management in BC (Gorley & Merkel, 2020b). Following the Old Growth Strategic Review, and building on ongoing work, the Province has reported progress on engaging Indigenous leaders regarding old growth within their territories, improving old growth public information and reporting, and protecting 1,500 large trees under the Special Tree Protection Regulation (Province of British Columbia, n.d.). The Province has also announced 2.6 million ha of old growth deferrals, which are intended to temporarily suspend old growth logging in specified areas (Province of BC, n.d.-a).

In recent years, there have also been changes to the legislation that governs old growth management. The *Forest and Range Practices Act* (FRPA) which governs forestry activities on public lands in BC, received amendments in 2019 and 2021. The amendments apply to forestry activities in general but have relevance to old-growth forestry as well, such as aligning FRPA with the *Declaration on the Rights of Indigenous Peoples Act* ("*the Declaration*").

Additionally, there are recent changes to Provincial ministries that deal with forestry, natural resource management, parks, and recreation sites. As of early April 1, 2022, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development is no longer active. Now, there is a Ministry of Forests and a separate Ministry of Lands, Water and Resource Stewardship (Office of the Premier, 2022). While the Ministry of Forests deals with forestry and is taking on a modernization of forest practices, the Ministry of Lands, Water, and Resource Stewardship is responsible for working with First Nations to co-manage land and resources more broadly (Office of the Premier, 2022). Further, Recreation Sites and Trails is now under the responsibility of the Ministry of Environment.

Chapter 3. Literature Review

3.1. The Total Economic Value of Old-Growth Forests

The societal benefits of old-growth forests ecosystem services are broad and range from providing jobs and revenue, to supporting a healthy environment for wildlife and humans, and offering aesthetic value and recreation opportunities. The values associated with each benefit make up the total economic value (TEV) of old-growth forests, which is the sum of all direct use values, indirect use values, and non-use values (Figure 1). Direct use values are derived from using the old-growth forests directly, such as with recreation. Indirect use values are those from services that indirectly create conditions that benefit people, like regulating water. Non-use values are those that are not derived from use of the forests, for example the satisfaction we gain from knowing that biodiversity is supported by the forests. Also called existence values, non-use values are distinct from intrinsic value, which is an entity's value in and for itself, without consideration of how humans value the entity.

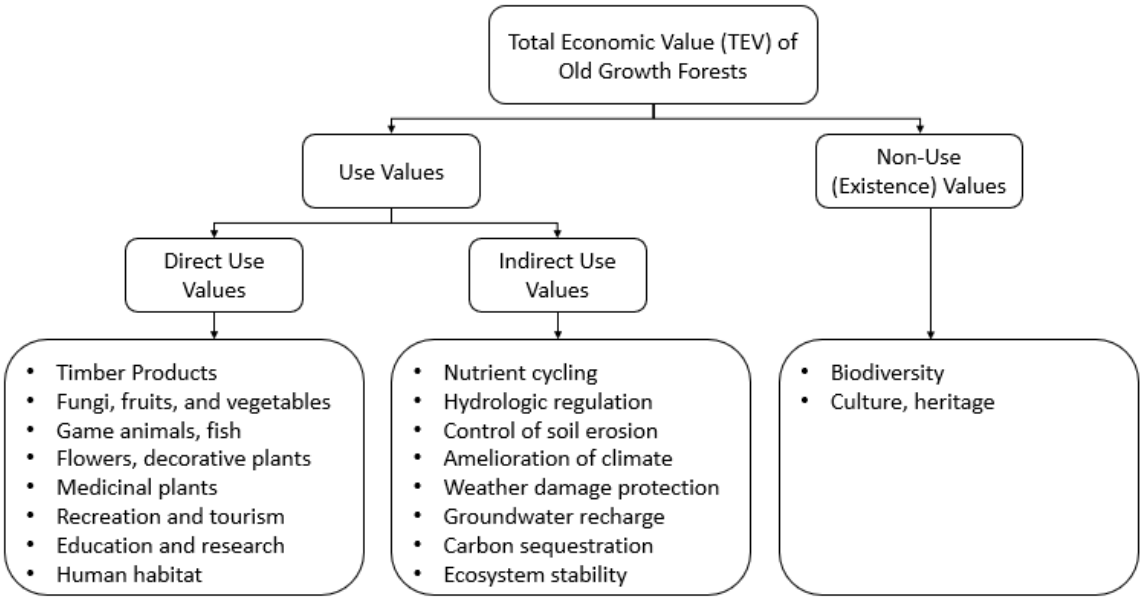


Figure 1. Total economic value (TEV) of old-growth forests adapted from Morton et al. (2021) and Knowler & Dust (2008)

3.2. Non-market Environmental Valuation Techniques

Many of the use and non-use values that make up the TEV of old-growth forests are not traded in markets, but still provide value to society. Therefore, unlike market goods such as timber and mushrooms, these use values are not revealed in market prices and their valuation must be undertaken with non-market ecosystem valuation.

A variety of non-market valuation techniques exist to elicit willingness-to-pay (WTP) or willingness-to-accept payment (WTA) for a change in the number of units of a service (Table 1). Willingness to pay is the amount of money a person would be willing to pay for a positive change or to forego a negative change, while WTA is the amount of money a person would be willing to accept for a negative change or to forego a positive change. In practice, WTP and WTA are more complex, and the choice of measuring WTA or WTP affects the results of valuation studies (Knetsch, 2007).

Most non-market valuation techniques are either stated or revealed preference. In stated preference studies, survey participants state their WTP or WTA for changes to a good or service a hypothetical market presented within the study . Revealed preference methods derive the value of the service from the behaviors of people within markets related to the non-market service.

Table 1. Non-market valuation techniques

	Technique	**Description**
Stated preference	Contingent Valuation Method (CVM)	Directly asks survey respondents for their WTP or WTA for changes to an environmental service in a hypothetical market
	Discrete Choice Experiment	Elicits WTP or WTA for changes to an environmental service by asking survey respondents to choose between a set of alternate scenarios that vary in their levels of multiple attributes
Revealed preference	Travel Cost Method	Estimates WTP to visit a site from the cost individuals have spent to travel to the site
	Hedonic Pricing	The value of the non-market service is evidenced by its effect on real estate prices
Production Function	Production Function	Changes to an environmental service are related to changes in a good or service that is traded in markets

Table adapted from Hanley & Barber (2009)

3.3. Consideration of Use and Non-Use Values

Given that the TEV of old growth is composed of both use and non-use values, eliciting both types of values is beneficial for planning and policy. Assessing use and non-use values with the same instrument can be an efficient way to address multiple data gaps, but there are several concerns with eliciting the two types of value together. First, the attributes that are relevant to users of a resource may be different than the attributes that non-users derive non-use benefits from (Hanley, Mourato, & Wright, 1998). Second, preferences underpinning stated preference responses may reflect use and non-use values and are influenced by substitution possibilities (Day, Bateman, Binner, Ferrini, & Fezzi, 2019). Third, separating use and non-use values is complex due an individual's preferences being driven by overlapping motivations that they themselves may not be able to separate (Marre et al., 2015).

Numerous studies have differentiated between use and non-use values by combining revealed preference techniques with stated preference techniques (Day et al., 2019; Eom & Larson, 2006). Alternatively, Marre et al. (2015) elicited use and non-use values for protection of coral reef by identifying WTP for protection beyond one's life expectancy. The researchers used WTP for preservation within life expectancy as a measure of use and non-use values and WTP for preservation beyond life expectancy as a measure of non-use value.

3.4. British Columbia Old Growth Valuation Studies

As previously mentioned, no recent primary data on the value of recreation in old-growth forests in BC has been collected. However, several studies exist on the valuation of ecosystem services provided by old-growth forests in BC and Alberta more generally (Table 2). This section briefly overviews the methods and results of these studies in chronological order. The studies in Table 2 that include recreation values have not used primary data and have relied on benefits transfer of general forest recreation.
The benefit transfer method estimates values for ecosystem services by transferring available information from previous studies and does not include primary data.

Table 2. Summary of old growth valuation studies within BC

Study	Study Area	Values Considered	Valuation Methods
Van Kooten & Bulte (1999)	Coastal BC	Timber, non-timber forest products, carbon capture, recreation, existence	Market prices, benefit transfer
Knowler & Dust (2008)	Fraser timber supply area (lower mainland BC)	Timber, non-timber forest products, recreation, and carbon sequestration	Benefits transfer
Bradshaw (2009)	Fraser timber supply area (lower mainland BC)	Timber, recreation, existence of Spotted Owls	Discrete choice experiment
Knowler, Page, Cooper, & Araujo (2017)	Fraser timber supply area (lower mainland BC)	Water purification	Production function
Knowler, MacGregor, Bradford, & Peterman (2003)	Coastal and interior BC	Salmon habitat	Production function
Morton et al. (2021)	Port Renfrew, BC	Carbon sequestration, timber, recreation, tourism, non-timber forest products, real estate, education and research, salmon habitat	Market prices, benefits transfer

Van Kooten and Bulte (1999) estimated the optimal amount of coastal old growth to retain in order to maximize the benefit to society. They estimated the value (in dollars per ha of mature forest) of ecosystem services including timber, non-timber forest products (e.g. mushrooms), recreation, carbon sequestration, and existence. The researchers estimated non-market values with benefits transfer of data from previous research. The recreation value was estimated to be $105.51 per ha annually and the existence value was $99.71 per ha annually. The results of this study indicate that the optimal amount of primary coastal forest to retain in BC is approximately 25%.

Knowler and Dust (2008) modelled different management scenarios for old growth in the lower mainland of BC to examine the benefits and costs of protecting Spotted Owl habitat. The researchers included timber, non-timber forest products, recreation, and carbon sequestration values in their modelled scenarios. Knowler and Dust used the benefits transfer technique to apply value estimates from previous research to their study site. Notably, they started with the recreation data from the 1989/1990 Outdoor Recreation Survey and adjusted the value to suit the study site, resulting in a recreation value estimate of $79.19 per ha annually. The overall results of Knowler and Dust (2008) are that for most scenarios considered within their model, increasing the area of protected old growth produces a net benefit to society.

Bradshaw (2009) valued protection of old-growth forests for conservation of Spotted Owl habitat in the lower mainland of BC using a DCE. Bradshaw included number of Spotted Owl breeding pairs, harvestable timber, and ratio of motorized to non-motorized recreation area as attributes within the DCE. Results of the DCE indicate that the value provided by old-growth forests to society is maximized when just over half of old-growth forest in BC is preserved.

Knowler et al. (2011) used a production function approach to value the water purification service of forests in the Fraser timber supply area. Unlike the valuation methods overviewed thus far, production function does not estimate WTP/WTA for a change in a service, but rather models the relationship between the environment as an input to a production of a valued good or service. As such, production function approaches are useful for services that produce or affect a market good. Knowler et al. (2011) used this approach to relate utility costs faced by a municipality to purify water with increased sedimentation caused by forest roads. Then, the relationship between forest roads and purification costs was used to estimate the benefits of shifting from forestry to conservation for water purification and found the benefit to be $0.28 per ha per year.

Morton et al. (2021) conducted a CBA of alternative old growth management scenarios in the Port Renfrew area to compare their respective societal welfare gains and losses. the benefits transfer method, Morton et al. estimated the value of old growth services including recreation, nontimber forest products, salmon habitat, real estate, and education and research. The researchers estimated timber values and carbon sequestration values with market prices and the social cost of carbon, respectively. The

analysis included 17 modelled old growth protection scenarios to assess the economic value of these services over a 100-year time horizon. Of the modelled scenarios, the one that provides the highest estimated value over the time period gradually protects 100% of old growth over a 4-year period, resulting in 43.8 million dollars more than the base case.

The studies in Table 2 each provide a unique contribution to understanding of the value of old growth forests in BC. The strengths and limitations of each study are highlighted by the study areas, the range of ecosystem services considered, and the valuation methods employed. Strengths of Van Kooten and Bulte (1999), Knowler and Dust (2008), and Morton et al. (2021) are the range of ecosystems services each study considered. However, these studies are limited by benefits transfer which does not include site-specific primary data. Knowler et al. (2017) and Knowler et al. (2013) do include site-specific data but are limited by only considering water purification and salmon habitat, respectively. Finally, Bradshaw (2009) includes site-specific primary data for a range of ecosystem services but, like the other studies, is limited to the study area considered. In the reviewed studies, the lower mainland of BC is the most common study area, and as such, there is a data gap for site-specific old growth services valuation with primary data for areas outside of the lower mainland. Most prominently, there is limited data for Vancouver Island where old growth management is highly contentious, as evidenced by protests.

Chapter 4. Methods

4.1. Study Area

This project builds on the work of Morton et al. (2020) and Morton et al. (2021) in communicating old growth values at a candidate study site. The intention of choosing a candidate site is to first conduct an in-depth assessment at that site, and then in future research expand the study to other areas.

Morton et al. (2020) considered Port Hardy, Tahsis, and Port Renfrew as candidate sites due to their prevalence of old-growth forests and local economies involved in forestry. From the three candidate sites, Morton et al. (2020) selected the Port Renfrew site because it has more available data, greater potential for transferability, many ecosystem services, and contains a sufficient amount of old-growth forest. Notably, this decision was made prior to the Fairy Creek protests which may have affected the transferability of the results to other areas due to the unique context.

Consistent with Morton et al. (2021), the Port Renfrew study site was also selected for this research and was defined to all land within 35 km of Port Renfrew (Figure 2). The study area is on the unceded territories of the Pacheedaht, Ditidaht, T'Sou-ke, and WSANEC Nations, and the Hul'qumi'num Treaty Group. The study area contains approximately 64,951 ha of old growth which is about 32% of the historical amount prior to harvest disturbance. Of the remaining old growth, approximately 36% (923,599 ha) is protected either provincially or federally. The area has several recreation sites and parks within or partially within old-growth forests, including the West Coast Trail, the Juan de Fuca trail, and Avatar Grove. The study area also includes the Fairy Creek watershed, the site of old growth logging blockades that lead to the largest act of civil disobedience in Canadian history in 2020 and 2021.

Figure 2. The study site for this research, which includes all land within 35 km of Port Renfrew, BC (bold line), on the unceded territories of the Pacheedaht, Ditidaht, T'Sou-ke, and WSANEC Nations, and the Hul'qumi'num Treaty Group.

The majority of the study area is on the unceded territory of the Pacheedaht Nation, whose main community settlement is near Port Renfrew. In the past 20 years, the Pacheedaht Nation has gone from being excluded from forestry in their territory (apart from employment), to now having some benefits of forestry going into their community (Galimski, 2021). The Pacheedaht Nation owns, manages, or co-manages forestry operations that produce 140,000 m^3 of timber annually and have revenue sharing agreements for other operations (Galimski, 2021; Haynes, 2021). The Nation also owns and operates a log sorting facility and a sawmill that processes old-growth cedar into high value specialty products. In July 2021, the Pacheedaht Forestry Manager estimated 20 Pacheedaht members were employed either directly or indirectly in forestry, and

stressed the importance of forestry to their community in providing employment and revenue (cited in Galimski, 2021).

The Pacheedaht take a long-term approach to their forestry planning. In 2005, the Pacheedaht Nation created a long term stewardship plan which considered their needs for old growth cedar for traditional purposes for the next 400 years, as that is the time it takes to regrow (Haynes, 2021).

On June 4, 2021, the Pacheedaht, Ditidaht, and Huu-ay-aht Nations signed the Hišuk ma c̓awak Declaration to take back their power over their ḥahahuuɬi (territories). The three nations, already involved in creating extensive stewardship plans, gave formal notice to the Province on June 5, 2021 to defer old growth logging for two years in the Fairy Creek and the Central Walbran areas while the Nations prepare their stewardship plans (Huu-ay-aht.org, 2021).

4.2. Indigenous Engagement

Early in the project, I emailed Chiefs, Administrators, and/or Band Managers of the Pacheedaht, Ditidaht, T'Sou-ke, and WSANEC Nations, and the Chief Negotiator of the Hul'qumi'num Treaty Group (see Appendix A for a sample email). The intention of the emails was to provide information about my research and open the opportunity for dialogue and collaboration.

I received replies from T'Sou-ke, and WSANEC Nations expressing interest in the subject matter of the project. I did not receive any replies with interest in further engagement other than looking forward to seeing the results. I then proceeded without further engagement.

Given the extreme circumstances these Nations and the Treaty Group were facing during the COVID-19 pandemic and the Fairy Creek protests, I did not want to add to any engagement fatigue, and I especially did not want to detract from the government-to-government collaboration and negotiations occurring simultaneously to this project.[5]

[5] Such as the the Pacheedaht, Ditidaht, and Huu-ay-aht Nations collaborating on the Hišuk ma c̓awak Declaration, the Pacheedaht and Ditidaht Nations both being in the final stage of Treaty negotiations with the Province, the Hul'qumi'num Treaty Group being in stage 5 Treaty

As a result, I recognize a limitation of this project due to the absence of formal collaboration with the Nations and Treaty Group.

4.3. Choice of Valuation Method

To estimate public values for old growth recreation and old growth protection, which are not revealed in markets, requires a nonmarket valuation technique. To determine which nonmarket valuation technique to apply, I considered all techniques in Table 1. First, benefits transfer can be ruled out as it is not concerned with primary data, which is required in this study to address the data gaps in the current literature (e.g., site-specific primary data for Vancouver Island are limited, as discussed in Section 3.4.). Next, because an objective of this study is to value increased protection of old-growth forests, travel cost, hedonic pricing and production function are all inadequate because they cannot estimate non-use values (Turner, Morse-Jones, & Fisher, 2010). Finally, due to the trade-offs between various old growth services, a DCE is preferable to CVM because of its ability to value multiple attributes and the trade-offs between them (Hanley, Mourato, & Wright, 2001).

4.4. Discrete Choice Experiment Development

The methods for developing the discrete choice experiment are based largely on the guidance provided in Champ, Boyle, & Brown (2017), Johnston et al. (2017), Hanley, Wright, & Adamowicz (1998), Hoyos (2010), and Mariel et al. (2021). Developing and refining the DCE was an iterative process that involved three focus groups, pre-testing, and pilot testing.

4.4.1. Choice of Hypothetical Market

Stated preference studies elicit respondent's WTP or WTA for changes in a good and/or service by creating a hypothetical market where respondents could realistically be expected to pay (or accept payment) for the changes. A typical hypothetical market in environmental valuation presents respondents with a policy or program that would come

negotiations with the Province, and the relations between the Nations and the Province regarding old growth deferrals.

with a tax increase. An alternative hypothetical market in recreation valuation studies presents respondents with improvements to recreational opportunities that would come with increases in user site fees. Through focus group testing, I found that members of the target population found the tax increase option more realistic because user site fees are not collected at BC parks or recreation sites. Further, since the values this research considers include both use and non use values, a tax increase is more appropriate because it is something both users and non-users of the forests would pay. In the survey, the hypothetical market was introduced to respondents along with an introduction of the attributes prior to the DCE (Figure 3).

Figure 3. Hypothetical market presented to survey respondents

The hypothetical market asserts that the program would include consultation *and* partnerships with local First Nations. The decision to include this clause is based on the

Declaration Act, and the associated changes to *FRPA* discussed above. Additionally, focus group participants confirmed that Indigenous involvement was relevant to their decisions in the DCE. An important caveat is that the hypothetical market is describing a precondition that did not exist in creating the hypothetical alternatives and had they been created with Indigenous collaboration, the attributes and their levels may have been completely different.

4.4.2. Selection of Attributes

I selected attributes following guidance that they should reflect the actual choice context as much as possible and they should also include the main attributes viewed by most respondents as relevant (Hoyos, 2010). Based on the research objectives, I knew that the DCE must include at least one attribute related to old growth protection, and at least one related to old growth recreation. Based on the hypothetical market, I knew that a tax increase attribute was necessary. I decided to also include an attribute related to jobs because it was relevant to focus group participants and to create an additional trade-off so that tax increases are not the only changes that cause utility losses. Also, by including a jobs attribute, my hope was that respondents would not conflate old growth protection with job changes.[6]. I tested possible attributes for protection, recreation, jobs, and payment in focus groups. I asked participants how important the potential attributes would be in their decision between alternatives and how realistic they are. From the focus groups and additional research, I selected the most relevant and realistic attributes (Table 3).

Table 3. Rationale for selecting attributes

Category	Potential Attribute	Decision	Rationale
Recreation	Number of old growth sites with trails through old growth	Combined and included	Number of sites and presence of giant trees were of interest to focus group participants who desire stationary recreation near the trees, those who want active recreation on trails, and those who desire unique and novel giant tree viewing experiences.
	Presence of giant trees at sites		

[6] The idea of whether or not changes in old growth protection necessarily come with changes in jobs is contested. By keeping old growth protection and local jobs independent of each other, I assume that they can feasibly be independent in the real world.

	Length of trails through old growth	Excluded	Through focus groups, I found that length of trails is not relevant to recreationists who want to spend stationary time near the trees.
	Area of old growth developed for recreation	Excluded	Excluded because focus group participants care more about trails and sites than the total area for recreation, and some found the concept confusing.
	Recreation facilities	Excluded	Excluded as an attribute due to low interest from focus group participants
Protection	Area of protected old growth	Included	Focus group participants unanimously indicated that this attribute would greatly affect their decision.
	Type of protection	Excluded	I tested two types of protection in the focus groups: provincial park and ecological reserve. Some participants did care about this, but less than the area of protection.
	Years of protection	Excluded	Excluded because it lacks policy relevance and could reduce credibility of the survey as it challenges common knowledge of the meaning of protection.
	Visual surroundings	Excluded	Excluded because it would be confounded with area of protected old growth and would be challenging to portray in the survey.
Jobs	Local jobs in general	Included	Focus group participants expressed the most interest in protecting and promoting local jobs, especially Indigenous employment. In order to allow for independence between the protection attribute and the jobs attribute, all forms of employment are considered.
	Vancouver Island jobs in general	Excluded	Excluded because focus group participants expressed less interest in Vancouver Island jobs as compared to local jobs.
	Local jobs in forestry	Excluded	Excluded because it is not independent from protection.
	Vancouver Island jobs in forestry	Excluded	Excluded because it is not independent from protection.
Payment vehicle	Tax increase	Included	Included because a tax increase seemed realistic to focus group participants and is relevant to both visitors and non-visitors of the sites.
	Recreation site fees	Excluded	Excluded because paying for recreation sites is not realistic in BC, and because this payment vehicle is not relevant to people who do not visit the sites.

4.4.3. Attribute Levels

My approach for determining attribute levels was to include a range of levels that are feasible, believable, and have policy relevance. Selection of the final levels (summarized in Table 4) was simple for some attributes and challenging for others.

Levels for the recreation attribute needed to reflect the structure of the attribute from the combination of two attributes, the number of new sites and whether or not those sites have giant trees. The range of numbers is intended to be realistic for the study area. The presence of giant trees is nominal. Combining the number of sites with the nominal presence of trees resulted in eight levels.

Levels for the protection attribute are based on what is possible for the study area, ranging from the current level of protection to all old growth being protected. Levels are expressed as both additional km^2 of protection and the overall percentage of protected old growth in the area, following focus group suggestions.

Determining the levels for the change in jobs was a challenge. The premise of the jobs attribute is that the program would result in changes in jobs due to broader changes in forest related sectors (i.e. independent of the amount of old growth protected and the amount of recreation sites) (Figure 3). With this premise, I wanted to include both losses and gains in jobs because both possibilities have policy relevancy. Through focus groups and pretests, I refined the range to be a loss of 40 jobs up to a gain of 20 jobs.

Determining levels for the tax attribute was also a challenge. I first began exploring appropriate payment levels in focus groups and found that willingness to pay varied greatly between participants.[7] Next, I did a pre-test survey and found that some participants are willing to pay $1000 annually for 10 years, while others were choosing the status quo frequently and indicating in follow up questions that the taxes were too high for them to choose the program. Following these results, I chose four tax levels below $100 and the remainder spread out up to $1500. I split the upper level in two

[7] Prior to having shown any cost variables (to avoid anchoring bias), I asked respondents how much they would be willing to pay annually for 10 years for a hypothetical program that had moderate levels of protection, recreation, and job attributes. Responses ranged from $10 to $400. I then presented a different program with higher protection, recreation, and jobs attributes and went through a simple CVM exercise and found annual willingness to pay for 10 years ranged from $150 to $600.

($1000 and $1500), so that for experimental design purposes, there are eight levels. I did this so that the highest tax levels could be included in the survey while being less frequent than the lower tax levels, given that few people are willing to pay $1500.

Table 4. DCE attributes and levels

Attribute	Levels	
New recreation areas with trails in old growth[8]	No change (status quo) 2 new sites, none have giant trees 4 new sites, none have giant trees 6 new sites, none have giant trees 8 new sites, none have giant trees	2 new sites, all have giant trees 4 new sites, all have giant trees 6 new sites, all have giant trees
Increase in old growth protection	No change (36% protected) (status quo) + 90 km^2 (50% protected) + 255 km^2 (75% protected) + 415 km^2 (100% protected)	
Change in jobs in the study area	- 40 jobs - 20 jobs No change (status quo) + 20 jobs	
Extra annual tax per household for 10 years	$0 (status quo) $25 $50 $75 $100 $200 $500 $1000, $1500	

4.4.4. Experimental Design

After establishing the attributes and their levels, the next step was to arrange them into choice sets and versions of the survey. One option is a complete factorial design that would use all possible combinations of attribute levels, but that would lead to an impractical number of choice sets. Instead, a fractional factorial design was chosen because these designs maintain orthogonality. The fractional factorial design resulted in

[8] Focus groups revealed that whether or not a recreation site within an old-growth forest has 'giant trees' is more important to the target population when choosing between alternatives than other typical recreation site measures such as length of trails or types of recreational facilities.

60 different choice sets.[9] Each choice set includes two alternatives made up of different combinations of the attribute levels as well as a status quo option (Figure 4). The 60 choice sets were divided into ten versions of the survey, each with six different choice sets. Because the highest tax level is split, I manually changed half of the instances of $1000 to $1500.

Which of these options do you prefer for the Port Renfrew area? *[Please select one]*				
	Program Characteristics	**Program A**	**Program B**	**No Program**
?	New recreation areas with trails in old growth 	**6 new** sites, **none** have giant trees	No change	No change
?	Increase in old-growth protection 	+**255**km2 (**75%** protected)	+**90**km2 (**50%** protected)	No change (**36%** protected)
?	Change in jobs in the area 	Overall **loss** of 40 jobs	Overall **loss** of 20 jobs	No change
?	Extra annual tax paid by your household for 10 years 	$0	$100	$0
	Choose one →	○	○	○

[9] The experimental design was prepared by Sergio Fernandez Lozada

Figure 4. Sample choice set

4.4.5. Status Quo Treatment

It is important to include a status quo or opt-out opportunity in choice sets so that the choice better mimics the real-world choice context (Champ et al., 2017). In this study, because all of the attributes are expressed as a change, the status quo is simply presented as an option in the choice sets, called “No Program” that provides no changes (Figure 3Figure 4). It is still important to ensure respondents know what the status quo conditions are so they can make an informed choice about whether they want more or less of the attributes. To inform respondents of the status quo situation, prior to the introduction of the hypothetical market, there was information provided describing the current levels of each attribute (Figure 5).

Figure 5. Example of the status quo descriptions provided for each attribute

4.5. Valuation Scope

Considering the TEV of old growth forests (Figure 1), there are many ecosystem services that could be included in a valuation study. Given the attributes chosen for the DCE, my research relates to some, but not all, use and non-use values that make up the TEV. Naturally, the recreation sites attribute relates to the recreation component of TEV

which is a use value (but users may express non use value for the existence of recreation sites for others and future generations). The study area jobs attribute relates to timber harvest products and other use values associated with employment such as tourism, recreation, and fungi. The old growth protection attribute relates to many of the use and non-use values. For example, protecting old growth forests may protect carbon sequestration, biodiversity, and medicinal plants. However, my research does not explicitly consider any of those values directly. As such, while the TEV framework is useful for understanding the range of use and use values of old growth, the scope of this valuation does not explicitly consider the full range. Rather, my research considers some components, and the results can be integrated with other research to consider the full TEV.

As introduced in Section 3.2, stated preference studies elicit respondents WTP or WTA for changes from a reference state. The choice of valuation measure (WTP or WTA) requires careful consideration as both positive and negative changes can be valued with either WTP or WTA, depending on the nature of the change and reference state (Zong & Knetsch, 2013). The reference state may be either the present conditions or future assumed conditions. For a positive change, studies can measure respondents' WTP for the improvement, or if there is an assumed positive change in the future that is anticipated by respondents, WTA to forego that future improvement can be measured (Table 5) (Zong & Knetsch, 2013). For a negative change, respondents may be WTA a payment to accept the deterioration, or if there is an assumed negative change in the future, respondents may be WTP to avoid the deterioration (Zong & Knetsch, 2013).

Table 5. The reference state and measures of the value of changes (adapted from Zong & Knetsch (2013).

	Valuation Measure	
Reference State	Positive Change	Negative Change
Present	WTP for improvement	WTA to accept deterioration
After Change	WTA to forego improvement	WTP to avoid deterioration

For the attributes of my DCE, I chose to measure WTP. For recreation sites, the measure is WTP for improvement to the present conditions. For protection, the measure is WTP for improvement to the present conditions. Changes in protection may be perceived by some as WTP to avoid deterioration if future logging of the unprotected old

growth is assumed. However, unprotected old growth forest may not necessarily ever be logged as it may not be harvested for other reasons. As such, WTP for an improvement is more straightforward than WTP to avoid deterioration. Either way, however, WTP is the appropriate measure. The levels of the jobs attribute range from a loss of 40 jobs to a gain of 20 jobs. For jobs, respondents may be WTP for improvements for increases in jobs or WTP to mitigate job loss.

As discussed above, my research estimates public values for improvements and is therefore constrained to estimating the benefits of potential changes while not explicitly considering the costs. The valuation results are expressed as WTP for potential changes to old growth protection, old growth recreation, and study area jobs. My valuation does not consider how those changes may affect values such as timber harvest revenue. Therefore, my research is not a CBA of old growth management alternatives because it only considers benefits. Instead, the scope of this valuation produces estimates for the benefits of alternative management, which could be used as inputs into a CBA that does include costs.

4.6. Survey

4.6.1. Survey Questions

I designed the survey to prepare respondents to make informed decisions in the DCE, provide their DCE responses, and provide additional information regarding their motivations for their DCE responses, demographics, attitudes, recreational behaviour, the COVID-19 pandemic, the 2021 wildfire season, and the old-growth protests. For environmental attitudes, I included a modified version of the New Environmental Paradigm (NEP).[10] Following the DCE, I included a contingent behaviour question that elicited how many more or fewer trips respondents would make to the study area if the programs they selected in the DCE were selected. After the contingent behaviour

[10] The NEP was developed in 2000 (as a revision of a 1978 version) as a measure of environmental worldview. The NEP scale consists of 15 statements regarding the relationship between humans and the environment. The modified scale used in this survey was shortened to six questions in the interest of time.

question, two follow-up questions attempted to identify protest responses and free-riders. The full survey is provided in Appendix B.

4.6.2. Target Population

The target population includes everyone who is 18 years or older and lives within an approximately 5-hour drive from Port Renfrew (Figure 6).[11] I chose this target population to include current and potential recreational users of the study area old growth, assuming people who live close to Port Renfrew are more likely to visit than those who live further away. I considered excluding people who do not visit the study area and/or who do not participate in outdoor recreation; however, I decided to include them because they may still have non-use values for the forests in the study area. Additionally, even in studies that only consider use values, excluding current non-users excludes people who may use the resource if the changes presented in the study were implemented.

[11] I estimated driving distance from all Vancouver Island forward sortation areas with GIS analysis and excluded those which were further than a 5-hour drive from Port Renfrew.

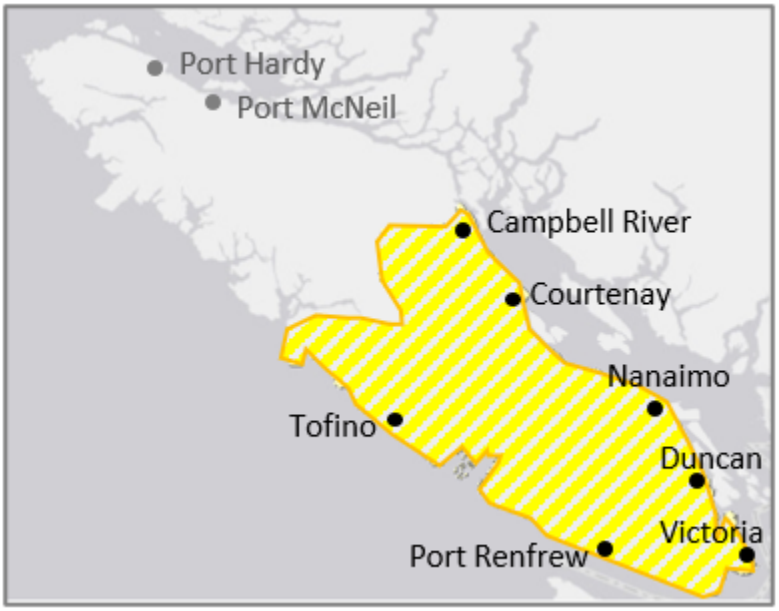


Figure 6. Target population area of residence

4.6.3. Data Collection

The web survey was administered by a marketing company, Léger 360, who invited panelists from the target population to complete the survey by computer or mobile smart phone in exchange for prizes. Data collection was phased over two pilot tests and the final survey between August 2021 and December 2021. Throughout the collection, I regularly monitored the sample for age, gender, and income representativeness, and had the marketing company adjust their invites accordingly.

4.7. Data Analysis

The data analysis included data preparation, choice modelling, and creating a decision support tool. I used IBM SPSS, Latent Gold, and QGIS software in the analysis.

4.7.1. Data Preparation

Removing Invalid Responses

To prepare the data for analysis, I first removed invalid responses from the sample for being repeat responses, for taking too little or too much time to complete the survey,[12] and for being suspected protest responses. A protest response occurs when the DCE responses reflect something other than the respondent's values for the attributes. Following Meyerhoff & Liebe (2008), I identified protest responses with DCE answers and follow-up questions.[13] Every survey respondent who chose the status quo at least one time was asked at the end of the DCE to select the reason(s) for choosing the status quo. Of the respondents who chose the status quo every time, those who selected "I don't trust the government to make these changes" and/or "there was not enough information to decide" and were removed from the analysis.

Alternative File Preparation

Next, to prepare the DCE data for analysis, I prepared multiple alternative files that varied in their coding of the attributes.[14] One set of alternative files kept the recreation sites attribute as one attribute, while another set of alternative files separated the recreation attribute into two attributes (the number of sites with giant trees and the number of sites without giant trees). For the two sets of alternative files, I made versions that coded the attributes as nominal (dummy-coded), numeric with the attributes linearized and centered around zero, and numeric with the attributes centered around zero and squared. The purpose of multiple alternative files was to find a model with utility functions that best fit the data.

---

[12] The median time to complete the survey was 14 minutes and the mean time to complete the survey was 24 minutes, with a standard deviation of 63 minutes. Six minutes and 60 minutes are the cut-offs to ensure respondents were diligently responding to survey questions. Ten responses were removed for being under six minutes and 17 responses were removed for being over 60 minutes.

[13] In some studies, all respondents that select the status quo every time are removed from the analysis to exclude protest responses. This approach removes potential non-protest responses that have a true zero WTP for the attributes and can lead to overvaluation. Given the polarizing topic of old growth management, I wanted to ensure people who had a true zero WTP for the attributes were included.

[14] Alternative files are one of the three files required for choice modelling with Latent Gold Choice. In an alternative file, each row defines an alternative in terms of its attributes and specifies a unique label for the alternative.

Data Digestion

I digested the demographic, attitudinal, and recreation behaviour responses into variables to include as covariates in the choice models. This included principal components analysis (PCA) of the environmental attitude responses, as well as creating binary variables out of some of the continuous variables and creating variables out of the interaction of two or more responses. Additionally, I extracted coordinates from postal codes, and used GIS analysis to create a new variable of driving distance to the study area.

Correlation Analysis

To explore consistency in survey responses, identify patterns, and flag concerns, I created various correlation matrices between responses in the choice experiment and responses elsewhere in the survey that elicited preferences for attributes. For example, I considered the correlation between the attribute levels of respondents' selected alternatives and their recreation behaviour (i.e., is higher participation in outdoor recreation correlated with choosing programs with more recreation sites?). The correlation matrices are reported in Appendix E.

4.7.2. Choice Modelling

Choice Modelling Theory

Choice experiments are grounded in the Characteristics Theory of Value (Lancaster, 1966) and Random Utility Theory (McFadden, 1973). The Characteristics Theory of Value states that the value of any good consists of the utility from characteristics or attributes that make up the good and their levels (Lancaster, 1966). The Random Utility Theory states that the utility derived from a particular good is composed of a deterministic element (V) based on the attributes of that good and a random, unobservable element ($\mathcal{E}$) (Adamowicz, Boxall, Williams, & Louviere, 1998; McFadden, 1973). With this approach, the utility (U) from choosing option j for individual i is:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad (1)$$

An individual *i* will choose alternative *j* over alternative *k* if $U_{ij} > U_{ik}$ for all $j \neq k$. Applying this to a DCE context, where individuals decide between multiple alternatives, the probability that an individual will choose alternative *j* is:

$$Prob\{j\ is\ chosen\} = Prob\{V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik}\ ; for\ all\ k\ \varepsilon\ C_i \quad (2)$$

Given that $\mathcal{E}$ is unobservable, we can make assumptions to remove it from the model. A common assumption is that $\mathcal{E}$ is independently and identically distributed across all individuals, with a Type 1, extreme value distribution. With those assumptions, we can define a model for the probability that *j* is chosen:

$$Prob\{j\ is\ chosen\} = e^{V_{ij}} / \sum_k e^{V_{ik}}\ ; for\ all\ k\ \varepsilon\ C_i \quad (3)$$

Following the Characteristics Theory of Value, the deterministic element of utility (V_{ij}) can be estimated from the attributes and levels of alternative *j*, and the functional form of V_{ij} can be expressed as:

$$V_{ij} = \beta_1 x_{ij1} + \beta_2 x_{ij2} + \cdots + \beta_n x_{ijn} \quad (4)$$

Where x_{ijn} is the value of the n^{th} attribute of alternative *j* to individual *i* and β_n is the utility coefficient of the n^{th} attribute value to be estimated. From the utility coefficients, WTP can be derived if payment is one of the attributes.

Multinomial Logit Model

Following the theory of choice modelling described above, I created a multinomial logit (MNL) model using the statistical software Latent Gold Choice. The MNL model, shown in equation 3, equates the probability of choosing an alternative to a function of the attributes. Responses in the DCE reveal the probability that the alternative is chosen based on how often that alternative is selected, which determines the left side of equation 3. Then, equation 4 is substituted into equation 3, and coefficients of each attribute are estimated using maximum likelihood methods. The coefficients are

measures of how each attribute affects the selection of an alternative. I ran multiple iterations of the MNL model with the alternative files described in Section 4.7.1.

Although useful for their computational simplicity, MNL models are limited by their assumptions. Assumptions of the MNL include the independence of irrelevant alternatives (IIA), that the error term is is independently and identically distributed across all individuals, with Type 1 extreme value distribution, and that respondent preferences are homogeneous (McFadden, 1986).

Latent Class Model

To overcome the MNL assumption of homogeneous preferences and IIA, I developed a latent class (LC) model. Latent class models are an expanded, mixed logit version of the MNL (Train, 2009). A key difference between LC and MNL models is that instead of assuming the whole sample is homogeneous, LC models assume that the sample is heterogenous but made up of a number of homogeneous classes. Latent class models group respondents together into classes that are otherwise not observable to the researcher (Horne, Boxall, & Adamowicz, 2005). In LC models, the probability *P* that an individual *i* chooses alternative *j* is the product of the probability that the individual belongs to class *x* and the probability that the individual will choose alternative *j* given that they are a member of class *x:*

$$P_{ij} = (P_{ix})(P_{i|x}) \tag{5}$$

If the probability distributions in equation 5 both follow the random utility model and assuming the error term in both distributions is independent and identically distributed among individuals with a Type I extreme value distribution, then equation 5 can beexpanded to:

$$P_{ij} = \sum_{x=1}^{x} \left[\frac{e^{\alpha_x S_i}}{\sum_{x=1}^{x} e^{\alpha_x S_i}}\right] \left[\frac{e^{\beta_{xj}}}{\sum_{x=1}^{x} e^{\beta_x Z_h}}\right] \tag{6}$$

Where α_x is the parameter associated with covariate effects *S* of group *x* and β_{xj} is the class *x* parameter for alternative *j*, selected from all alternatives *h* in choice set *C*.

Following the theory presented above, I used Latent Gold Choice to create a LC model that grouped respondents into classes and estimated their respective utility coefficients. I included covariates in the LC model to study the demographic, attitudinal, and behavioral differences between classes. I tried many different covariates and retained those that were significantly different between classes. Like the MNL model, I ran multiple iterations of the LC model with the alternative files described in Section 4.7.1. I also varied the number of classes (up to five classes). Finally, I made the recreation sites without giant trees attribute class-independent because it was not significant in the MNL model or the LC model. Of all the iterations of the LC model I ran, I chose to keep the model that resulted in the lowest Bayesian Information Criterion (BIC) while still being stable across repeated runs (i.e., achieving the same model results repeatedly).[15]

Known Class Models

To explore use and nonuse values, check my assumptions, and look for inconsistencies, I performed several known class choice models. In these models, I divided the sample into classes based on specific survey responses, such as whether they visit the study area. By comparing the classes, I found insights into how the parameter(s) that determined the known classes influenced choices in the DCE.

4.7.3. Willingness to Pay Calculations

To derive WTP for changes in the DCE attributes, I considered compensating surplus (CS), which is the amount of income an individual could give up in exchange for a change in an attribute to remain at the same level of utility. By assuming that CS is the individual's WTP, and the attributes are continuous and numeric, then WTP can be expressed as:

$$WTP = -\beta_{attribute}/\beta_{payment\ vehicle} \tag{5}$$

[15] The BIC penalizes models as the log likelihood od the classes increase; therefore, lower BIC values indicate a better fit model. In addition to BIC, I also considered Akaike Information Criterion (AIC and AIC3) secondary to BIC.

4.7.4. Decision Support Tool

From the utility estimates of the MNL and the LC models, I created a decision support tool (DST). The purpose of the DST is to estimate public support for a hypothetical program. The program would be funded with a tax increase and impact old growth protection, recreation opportunities, and jobs in the Port Renfrew area. The DST calculates the total utilities that the full sample and each latent class would receive from the hypothetical program input into the DST and the status quo based on a summation of the part-worth utilities for each attribute. Based on the comparison between the total utilities of the hypothetical program and the status quo, the DST outputs estimates of the proportion of the population who would support the hypothetical program. An important note is that in addition to the utility coefficients for the attributes, the constant coefficients are also included in the DST, so that preferences for retaining or moving away from the status quo are reflected in the DST as well.

Chapter 5. Results

5.1. Survey Response

In total, 1713 participants opened the survey during the two pilot tests and the final survey. Due to changes to the survey after the first pilot test, I only included responses collected during the second pilot test and the final survey.[16] A total of 1056 participants opened the survey during the second pilot test and final survey, of which 673 completed it (64% completion rate). Of the participants who dropped out of the survey, 87% dropped out before the DCE, 11% dropped out during the DCE, and 2% dropped out after the DCE. The median time to complete the survey was 14 minutes and the mean time to complete the survey was 24 minutes, with a standard deviation of 63 minutes. I removed 84 invalid responses from the sample (section 4.7.1), which left 589 usable responses for the analysis.

5.2. Sample Characteristics

This section reports pertinent descriptive statistics from the non-DCE survey responses. For a full summary of survey results, see Appendix C.

5.2.1. Socio-Demographics

After the DCE, respondents provided socio-demographic information. Overall, the sample is representative in gender, age, income, and regional district of residence, but the sample is less educated than the target population (Table 6).[17]

[16] After the first pilot test, the attribute descriptions, tax attribute payment levels, and DCE follow-up questions were all adjusted. Between the second pilot test and the final survey, only minor changes to the DCE follow-up questions were made. I tested the effect of the difference between the second pilot test and the final survey by creating known classes of respondents in Latent Gold. I found no significant differences between the two classes, so respondents from the second pilot test are included in the analysis.

[17] Socio-demographics of the target population are the weighted averages of 2016 Statistics Canada census data of the five regional districts of the target population.

Table 6. Socio-demographics of the sample and target populations

		% of target population	% of sample	Absolute difference
Gender	Female	52%	56%	4%
	Male	48%	43%	5%
	Nonbinary	0%	1%	1%
Age	18-29	15%	15%	0%
	30-39	14%	13%	1%
	40-49	15%	13%	2%
	50-59	19%	19%	0%
	60-69	19%	20%	1%
	70-79	11%	15%	4%
	80+	7%	6%	1%
Annual Household Income	< $10,000	3%	1%	2%
	$10,000-$19,999	7%	7%	0%
	$20,000 - $39,999	18%	17%	1%
	$40,000 - $59,999	17%	18%	1%
	$60,000 - $79,999	14%	17%	3%
	$80,000 - $99,999	12%	17%	5%
	$100,000 - $149,999	17%	16%	1%
	$150,000 - $199,999	7%	3%	4%
	$200,000 and over	5%	3%	2%
Highest Level of Education Completed	No certificate; diploma or degree	1%	14%	13%
	Secondary (high) school diploma or equivalency certificate	22%	29%	7%
	Apprenticeship or trades certificate or diploma	7%	10%	3%
	College/non-university certificate or diploma	25%	20%	5%
	University certificate or diploma below bachelor level	6%	3%	3%
	Bachelor's degree	20%	15%	5%
	University certificate or diploma above bachelor level	5%	2%	3%
	Master's degree	9%	5%	4%
	Earned doctorate	3%	1%	2%

	Degree in medicine; dentistry; veterinary medicine or optometry	1%	1%	0%
Regional District of Residence	Alberni-Clayoquot	3%	4%	2%
	Capital	48%	53%	5%
	Comox	13%	9%	4%
	Cowichan	14%	12%	2%
	Nanaimo	22%	22%	0%

5.2.2. Recreation Behaviour and Preferences

The survey elicited the number of days respondents participated in outdoor recreation and outdoor forested recreation in a typical year before the COVID-19 pandemic and in the 12 months before April 1, 2021. In a typical year, respondents spent an average (mean) of 80 days or portions of days participating in outdoor recreation, of which 48 were spent within forests. After the onset of the pandemic, overall outdoor recreation decreased, but the proportion of outdoor recreation within forests increased; in the 12 months before April 1, 2021, respondents spent an average of 64 days or portions of days participating in outdoor recreation, of which 43 were spent within forests.

Survey respondents selected which forms of outdoor recreation they have participated in within forests in the last five years (Figure 7). Hiking and nature viewing/scenic photography are the most popular activities among respondents, with 72% and 55% having participated, respectively.

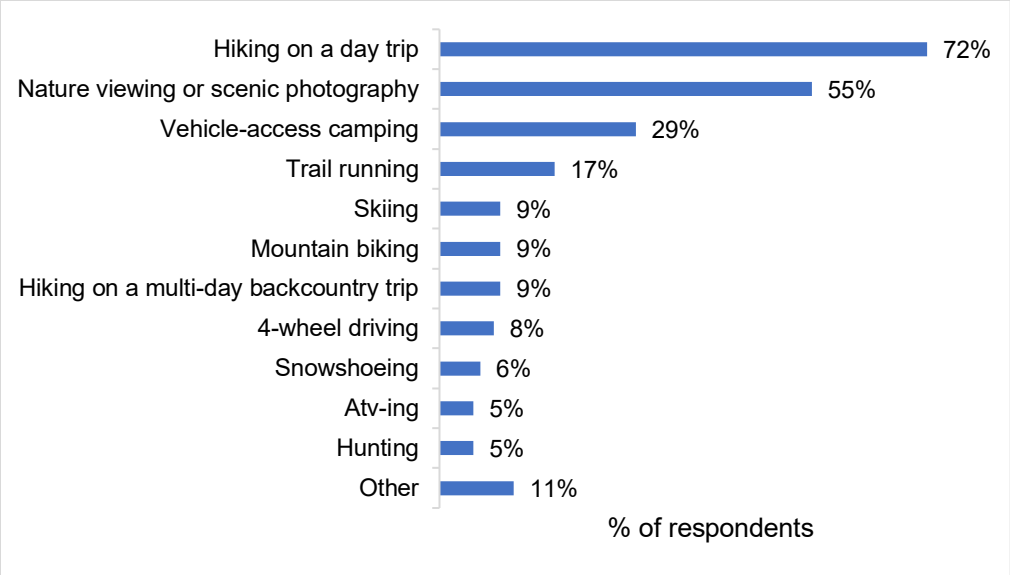


Figure 7. Recreational forest activities respondents have participated in within the last 5 years

The survey elicited respondents' experiences with and preferences for old-growth forests with giant trees. Ninety percent of respondents have visited giant trees within old-growth forests and 35% prefer old-growth forests with giant trees for recreation. In contrast, 23% of respondents prefer old growth irrespective of giant trees, 1.5% prefer young forests, and 39% do not have a preference.

5.2.3. Use of the Study Area

In a typical year before the COVID-19 pandemic, 46% of survey respondents would visit the Port Renfrew area, compared to 23% in the 12 months before April 1, 2021. The mean number of annual visits respondents made to the Port Renfrew area in a typical year was 11.9, compared to 17.6 in the year before April 1, 2021. Respondents visit the area for a variety of reasons, with recreation being the most common (Figure 8).

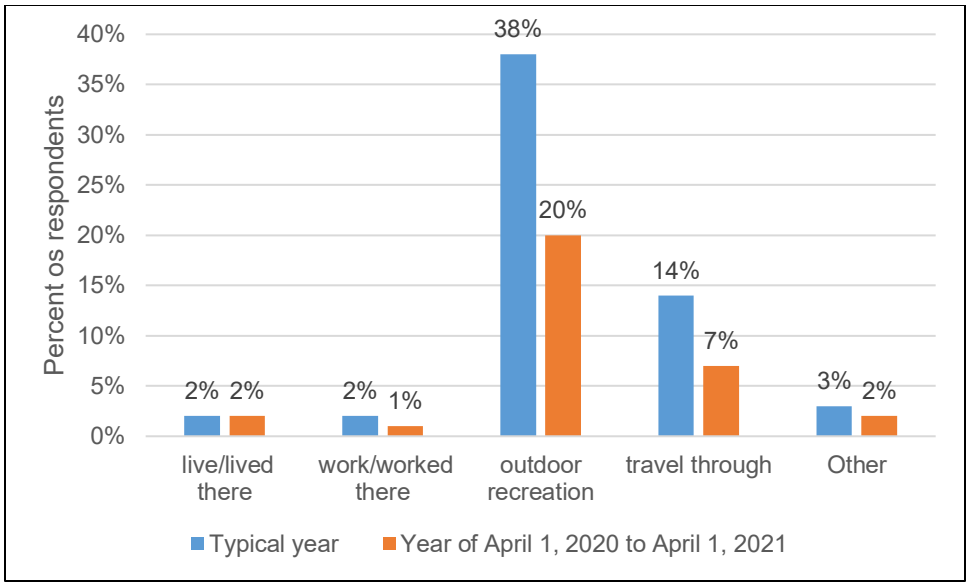


Figure 8. Reasons respondents visited the study area in a typical year and in the year between April 1, 2020, and April 1, 2020

A total of 39% of respondents have visited old-growth forests in the Port Renfrew study area in years either before or during the pandemic. In a typical year, among respondents, the mean number of recreational visits to old-growth forests within the study area was 2.5, which decreased to 1.5 in the 12 months before April 1, 2021. In a typical year, 64% of respondents do not visit old growth in the study area, compared to 82% in the year between April 1, 2020 and April 1, 2021 (Figure 9; Figure 10).

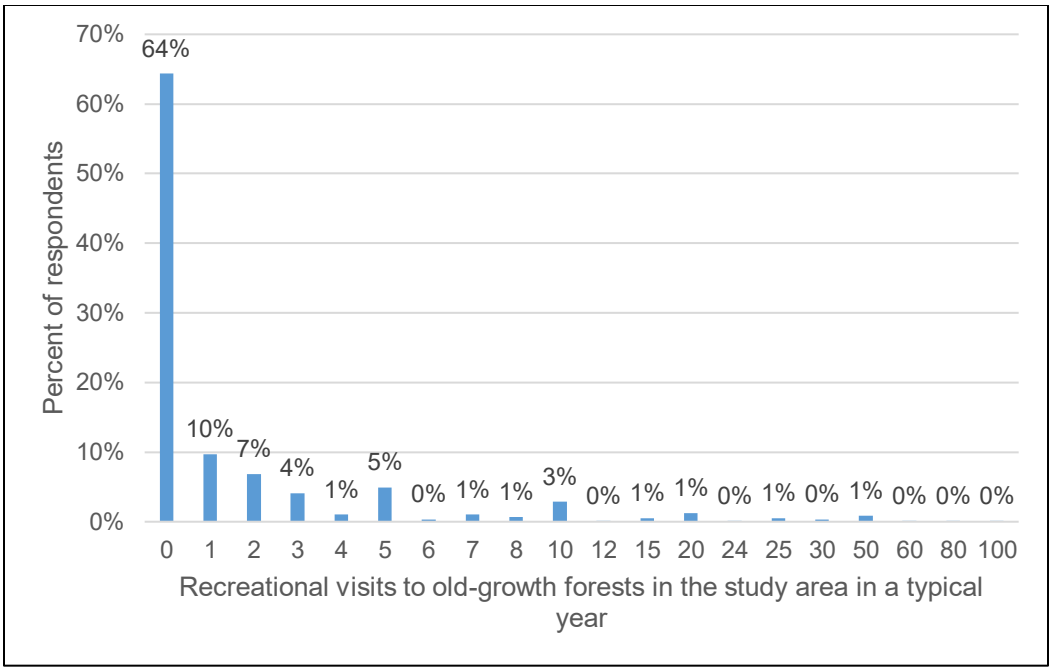


Figure 9. Number of recreational visits respondents made to old growth forests in the study area in a typical year

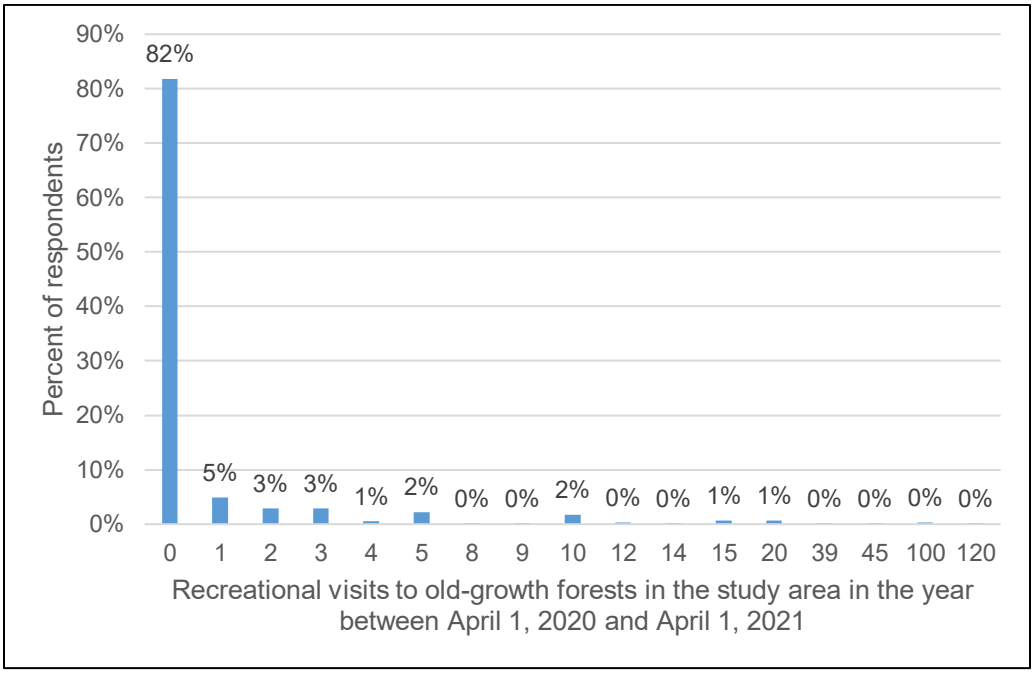


Figure 10. Number of recreational visits respondents made to old growth forests in the study area between April 1, 2020 and April 1, 2021

5.2.4. Importance of Study Area Attributes

Respondents indicated how important old growth recreation areas, old growth protection, and jobs in the study area are to them (even if they don't visit or work in the area). Old growth protection received the highest mean importance rating, while study area jobs received the lowest mean importance rating (Table 7).

Table 7. Importance of old growth recreation areas, old growth protection, and jobs in the study area to survey respondents

	Responses (% of respondents)					Mean
	Not important at all (1)	Somewhat important (2)	Important (3)	Very Important (4)	No opinion	
Importance of old growth recreation areas in the study area	2%	16%	22%	56%	3%	3.3
Importance of old growth protection in the study area	3%	14%	16%	65%	3%	3.4
Importance of jobs in the study area	10%	27%	34%	24%	5%	2.6

5.2.5. Old Growth Management Awareness and Attitudes

More than half (52.3%) of the respondents indicated they are only slightly familiar or not familiar at all with old growth management practices in BC, and only 20% indicate that they trust the government to make good decisions about old growth management. Respondents indicated that citizens of BC should have more say in old growth management (70% either agree or strongly agree). Respondents also believe the First

Nations should have more say in old growth management (65% either agree or strongly agree).

Regarding changes to old growth logging, 53% of respondents would support an end to old growth logging on Vancouver Island, compared to 4% who would support an increase. For province-wide management, 39% would support an end to old growth logging, compared to 4% who would support an increase. Twelve percent of respondents would not support ending or increasing old growth logging on Vancouver Island or provincially.

5.2.6. Environmental Attitudes

In addition to attitudes towards old growth management, the survey also elicited environmental attitudes more broadly. Eleven percent of respondents indicated that they are members of and/or donors to an environmental organization, while 13% have attended an environment-related meeting, lecture, protest, or other environmental event in the last two years. Responses to the NEP questions reveal pro-ecological worldviews; for example, 81% of respondents agree or strongly agree that plants and animals have as much right to exist as humans (Table 8).

Table 8. New Environmental Paradigm survey responses

	Responses (% of respondents)					**Mean**
	Strongly agree (1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly Disagree (5)	
"Humans have the right to modify the natural environment to suit their needs"	5%	17%	30%	34%	14%	3.4
"When humans interfere with nature, it often produces negative consequences"	37%	45%	14%	4%	1%	1.9
"Humans are severely abusing the environment"	47%	38%	10%	4%	1%	1.8

"Plants and animals have as much right to exist as humans"	47%	34%	14%	4%	1%	1.8
"Nature is resilient enough to cope with the impact of modern industrial nations"	4%	10%	20%	45%	23%	3.7
"If things continue on their present course, we will soon experience a major ecological catastrophe"	45%	33%	16%	4%	2%	1.9

5.2.7. Principal Components Analysis

The NEP responses were transformed with PCA, which resulted in one component with an Eigenvalue greater than one. The one component explains 53% of the variance (Table 13 in Appendix D). As such, for each survey response, the responses to six NEP responses were reduced into one continuous variable, while losing 47% of the variance. In general, higher values of the principal component are associated with a less pro-ecological worldview (Table 14 in Appendix D). The NEP principal component was included in the LC model as a covariate.

5.2.8. Context Considerations

Given the context of the old growth logging protests and blockades, the COVID-19 pandemic, and the extreme wildfires in BC in 2021, the survey asked respondents about how these circumstances have affected their lives and opinions.

Considering the COVID-19 pandemic first, in the 12 months before April 1, 2021, outdoor recreation overall decreased and the proportion of forested recreation increased compared to years before the pandemic (see section 5.2.2). During the same time period, visits to the study area in general and visits to old-growth forests in the study area both decreased (see section 5.2.3). Between 2019 and 2020, 13% of respondents reported a decrease in household income, while 11% reported an increase. Additionally,

12% of respondents reported becoming unemployed due to the pandemic, and 13% reported someone else in their household becoming unemployed.

Regarding the old growth protests and blockades, 94% of respondents were at least slightly familiar with the events. Of those respondents, 45% reported that since the protests and blockades, old growth protection is at least slightly more important to them. Similarly, regarding the extreme wildfire season of 2021, 60% of respondents indicated that old growth protection is now at least slightly more important to them.

5.3. Model Estimates

5.3.1. Utility Estimates

The final MNL and LC models have two numeric recreation attributes derived from the nominal recreation site attribute shown in the survey because the numeric variables resulted in a better model fit than the nominal attribute. Both models assume linear relationships between all attributes and their utilities, as a linear utility function fit the data better than a quadratic relationship. The LC model has three classes, which fit the data better than 2, 4, and 5 class models (Table 19 in Appendix E). The model has demographic, behavioural, and attitudinal covariates, and the recreation sites without giant trees attribute is class independent. Adding covariates and making sites without giant trees class independent both improved the fit of the LC model (Table 19 in Appendix E).

The utility coefficients of the MNL model are all significant other than recreation sites without giant trees (Table 9). The constants are also significant in the MNL model, indicating that overall respondents prefer moving away from the status quo. The MNL model indicates respondents have strong, positive values for increasing protection, less strong, positive values for increasing jobs, weakly positive values for increasing recreation sites with giant trees, and strong, negative values for tax increases.

Table 9. Utility coefficient estimates from the MNL and LC models

Parameter	MNL (100% of sample) Estimated Coefficient	LC Class 1 (50% of sample) Estimated Coefficient	LC Class 2 (25% of sample) Estimated Coefficient	LC Class 3 (25% of sample) Estimated Coefficient
Constants				
1 (Program A)	0.0909 (0.0270)***	**0.5208 (0.1145)*** **	**2.4545 (0.7302)*** **	**-2.7667 (0.5799)*** **
2 (Program B)	0.0880 (0.0288)***	**0.3106 (0.1060)*** **	**5.0841 (1.8601)*** **	**-2.4721 (0.5672)*** **
3 (Status Quo)	-0.1789 (0.0378)***	**-0.8314 (0.2032)*** **	**-7.5386 (2.5263)*** **	**5.2388 (1.1099)*** **
New recreation areas with trails in old growth with giant trees	0.0545 (0.0143)***	**0.1272 (0.0305)*** **	**0.6769 (0.2636)** **	**0.0129 (0.0750)**
New recreation areas with trails in old growth without giant trees	-0.0340 (0.0219)	-0.0564 (0.0339)*	-0.0564 (0.0399)*	-0.0564 (0.0399)*
Increase in old-growth protection	0.3425 (0.0231)***	**0.1204 (0.0696)***	**7.8675 (2.8484)*** **	**0.0651 (0.1301)**
Change in jobs in the study area	0.1624 (0.0247)***	**0.2867 (0.0532)*** **	**-0.1723 (0.2442)**	**0.5922 (0.1333)*** **
Extra annual tax per household for 10 years	-0.2426 (0.0181)***	**-0.3391 (0.0421)*** **	**-1.3522 (0.5234)*** **	**-3.6292 (0.8507)*** **

***significant between attributes at 0.01
**significant between attributes at 0.05
*significant between attributes at 0.1
Bold denotes significant differences between classes at 0.05
() denotes standard error
[a] Recreation sites without giant trees was specified as class-independent in the LC model

Following Mariel et al. (2021), piecewise utility graphs from MNL and LC models with dummy-coded attributes provide a visual test of the suitability of linear utility functions (Figure 11; Figure 12).

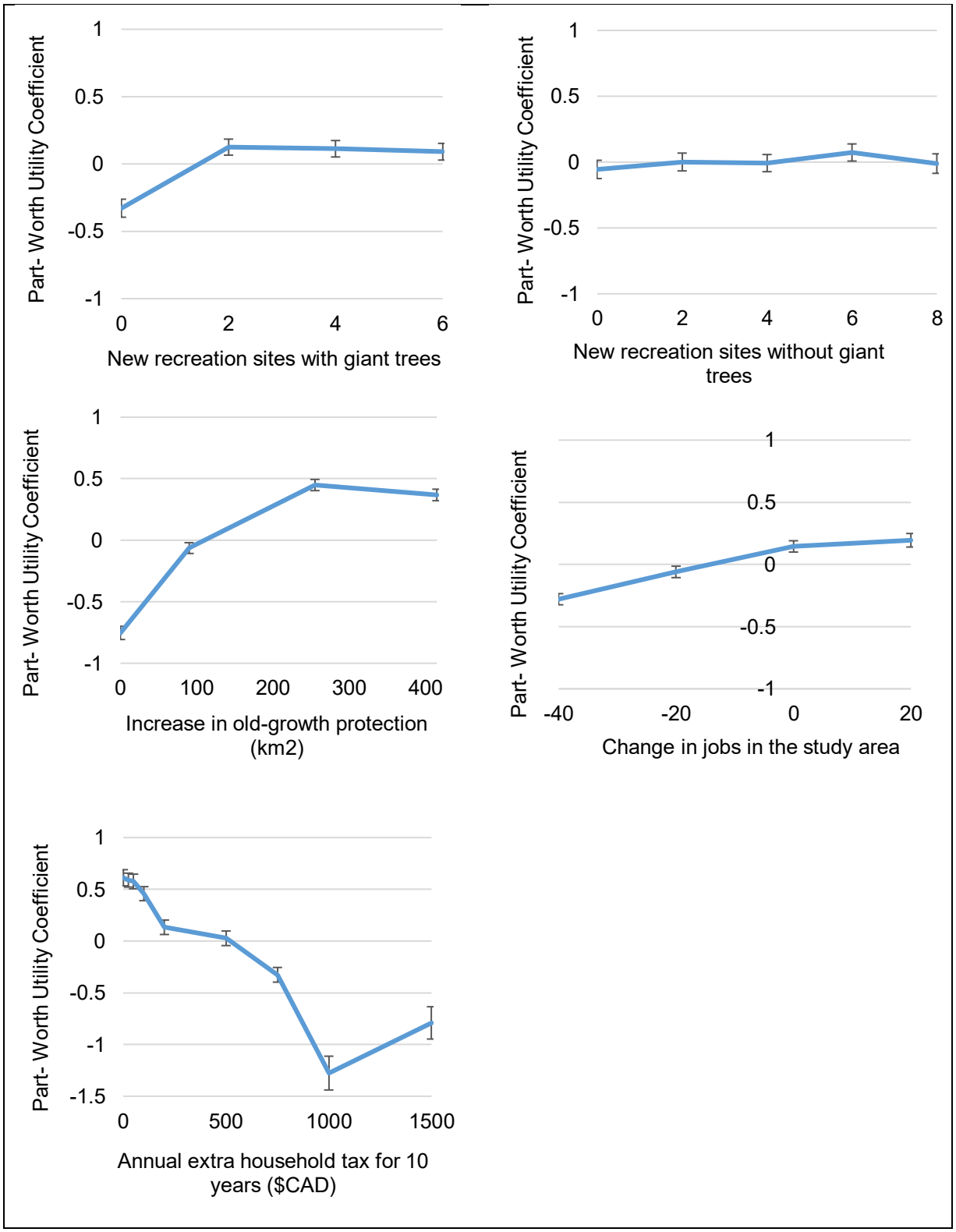


Figure 11. Utility coefficients and standard errors from the MNL model with dummy-coded attributes

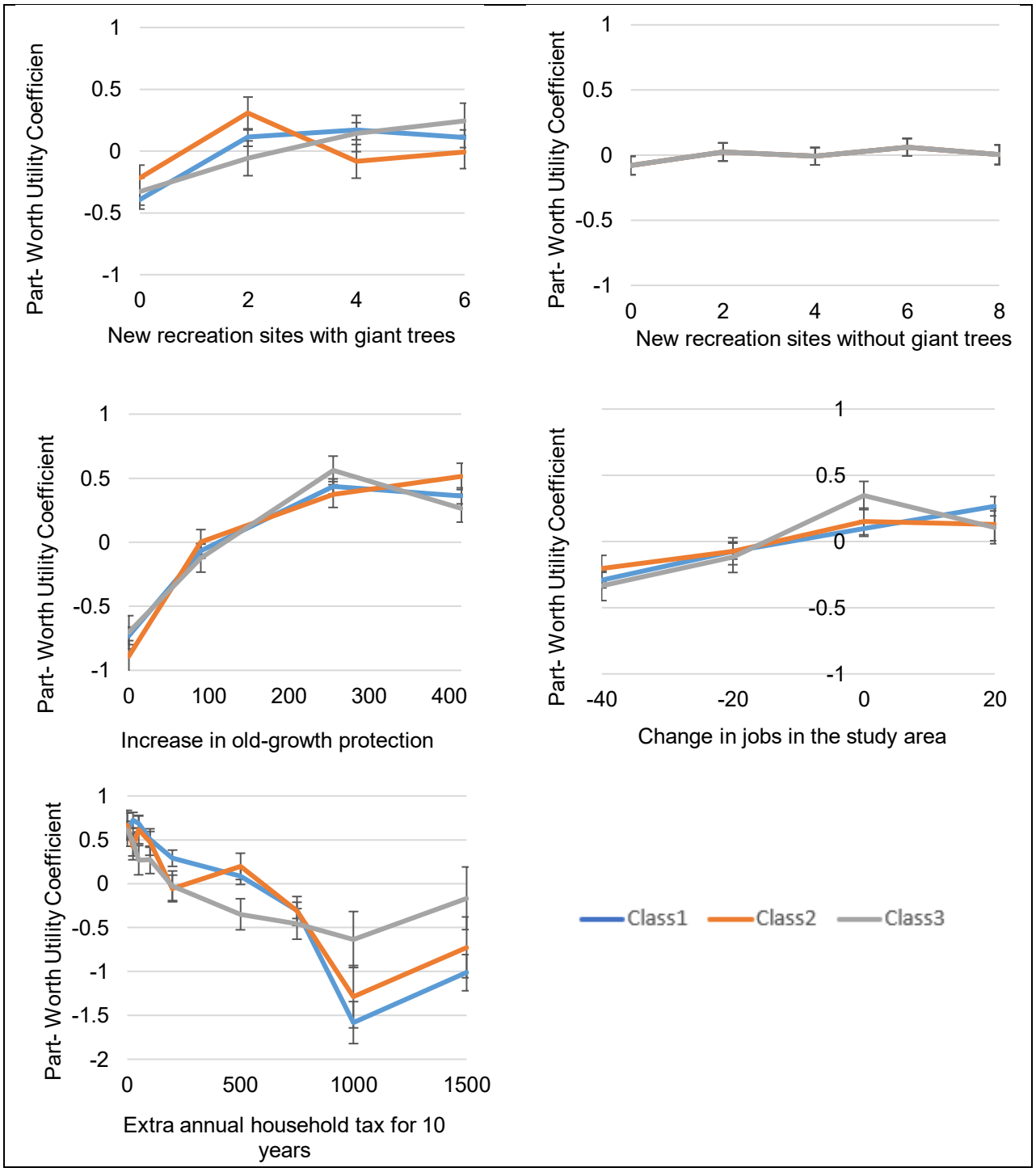


Figure 12. Utility coefficients and standard errors from the LC model with dummy-coded attributes. The class membership is identical to the linear model (made possible with the use of known classes)

5.3.2. Latent Class Profiles

The LC model outputs include utility coefficients (Table 9) and covariate coefficients (

Table 10). Together, the utility and covariate coefficients describe the three latent classes and their preferences. Because the recreation sites without giant trees attribute was insignificant in the MNL model, and set to be class independent, all latent classes have the same coefficient estimate for this attribute, so it is left out of the class descriptions. There are additional relevant variables, including income, that were not included in the model because they were not found to be significant as covariates. Descriptive statistics for each class are provided in Appendix C. Class descriptions based on model parameters are as follows.

Class 1 makes up 50% of the sample and can be described as "moderates." They have a slight preference for moving away from the status quo, they value increases in jobs the most, and also have positive values for increases in recreation sites with giant trees and increases in protection. They are the least tax conscious of the three classes, but still have negative values for tax increases. Most of the covariate coefficients for Class 1 are not significant and are in between the estimates for Class 2 and Class 3. One covariate that is significant for class one is the nominal age variable, which indicates that they are more likely to be under 40 than over 40.

Class 2 makes up 25% of the sample and can be described as "environmentally conscious." They have a strong preference for moving away from the status quo, and have a very strong, positive value for increasing old growth protection, as well as positive values for increases in recreation sites with giant trees. They have statistically insignificant negative values for increases in jobs and statistically significant and negative values for increased in tax. Based on the significant covariates for Class 2, they are more environmentally conscious as determined by the NEP principal component.[18] They are more likely to have participated in non-motorized forest recreation (excluding hunting), more likely to be under 40, and less likely to visit the Port Renfrew area.

Class 3 makes up 25% of the sample and can be described as "economically conscious." They have a strong preference for keeping the status quo, they have positive values for jobs, and statistically insignificant, slightly positive values for

[18] Higher values in the principal component are associated with less environmentally conscious NEP responses (Table 14 in Appendix D). As such, a negative coefficient in Table 10 indicates members of that class are more likely to be more environmentally conscious.

recreation sites with giant trees and old growth protection. They have a significant, strong, negative value for tax. Based on the covariates, Class 3 stands out from the other two classes. They are the least environmentally conscious based on NEP, the least likely to be aware of the protests, less likely to have participated in non motorized recreation (excluding hunting), more likely to be over 40, more likely to visit the Port Renfrew area, more likely to live in Nanaimo, and more likely to prefer recreating in young forests over old-growth forests.

Table 10. LC model covariate coefficient estimates

Covariate Description	Covariate	Class1 (50% of sample) Estimated Coefficient	Class2 (25% of sample) Estimated Coefficient	Class3 (25% of sample) Estimated Coefficient	Wald p-value
New environmental paradigm (NEP) principal component (PC) (numeric)		0.0686	-0.8214***	0.7529***	1.80E-17
Aware of the recent old-growth protests (nominal)	No	0.2022	-1.018	0.8158***	4.00E-05
	Yes	-0.2022	1.018	-0.8158***	
Participated in non-motorized forest recreation (excluding hunting) in the past 5 years (nominal)	No	-0.0822	-0.1691*	0.2513***	0.0008
	Yes	0.0822	0.1691*	-0.2513***	
Is 40 years of age or older (nominal)	No	0.1558***	0.1773***	-0.3331***	0.00021
	Yes	-0.1558***	-0.1773**	0.3331***	
Visits the Port Renfrew area in a typical year and participates in forest recreation (nominal)	No	0.0843	0.0985*	-0.1828***	0.009
	Yes	-0.0843	-0.0985*	0.1828***	
Lives in Nanaimo (nominal)	No	0.115	0.1335	-0.2484***	0.0013
	Yes	-0.115	-0.1335	0.2484***	
Preference of type of forest for outdoor recreation (nominal)	Don't know	-0.6902*	0.0224	0.6678**	8.80E-06
	No preference	-0.0904	0.006	0.0845	
	Old-growth forests whether or not they have giant trees	0.2517	0.4336	-0.6854***	
	Old-growth forests, especially if they have giant trees	0.2846	0.3542	-0.6388***	
	Young forests	0.2443	-0.8162	0.5719	

***significant at 0.01 **significant at 0.05 *significant at 0.1

5.3.3. Known Class Models

I developed several known class models to test the effectiveness of identifying free-riders and protesters, and to compare how users, non-users, and potential users differ in their preferences.

The model that considered free riding is based on a follow-up question to the DCE which asked respondents why they chose the program with the highest tax that they selected. The known class analysis indicates that including vs. excluding respondents for their answers to that question does not result in significant differences in the model (Table 22 in Appendix I). This finding, although not a robust assessment, supports my method of retaining respondents regardless of their response to that follow-up question.[19]

The model that considered protest responses compared two different samples each with different methods of identifying and removing protest bids. In the first class, I removed respondents who chose the status quo every time and, in a follow-up question about why they chose the status quo, indicated that they either do not trust the government to implement the changes or did not have enough information to decide. In the second class, I removed all respondents who chose the status quo every time. The known class model output did not find any significant differences between the two classes (Table 23). This finding supports my decision to remove respondents for protests based on choosing the status quo and their responses to follow up questions.

In the known class model that compared study area old growth users, nonusers, and potential users, class 1 is everyone who has been to the study area in a typical year, and/or during the year between April 1, 2020, and April 1, 2021. Class 2 is everyone who has not been to the study area but indicated that they would travel to the study area under changed conditions. Class 3 is everyone who has not been to the study area and who did not indicate that they would make trips to the study area under changed conditions. Classes 1, 2, and 3 can be considered users, potential users, and non-users

[19] The DCE follow-up question that was intended to identify free riders was added to the survey after data collection had already started, so hundreds of respondents did not answer this question. Therefore, I could not use this question as a basis for removing respondents from the analysis without also excluding hundreds of respondents who were not asked the question. Ideally, I wanted to identify and remove free riders, which was ultimately not possible in this research. Some reassurance is provided by the known class analysis which demonstrates that respondents behave comparably regardless to their responses in the DCE follow.

of the study area old growth, respectively. Interestingly, there are statistically significant differences between the classes for protection, with users and potential users deriving more utility from increases in protection than nonusers. Following this finding, I created additional known class models; one that grouped the potential users in with the users, and one that grouped them in with the nonusers. I found that potential users show preferences that are more similar to users than non-users and the users and potential users combined compared to non-users have statistically significant differences in utility from protection and sites with giant trees. These findings highlight the importance of identifying potential users of a resource rather than assuming all nonusers with remain nonusers. This supports my decision to include current nonusers in this study.

5.4. Willingness to Pay Estimates

From the MNL and LC model utility estimates, I derived WTP estimates for changes in old growth protection, recreation sites, and local jobs. The WTP estimates from both models are expressed as the annual WTP for 10 years, in Canadian dollars, for one unit change in the attribute (Table 11). In the DCE, changes in jobs was negative in some alternatives, and positive for other alternatives. Nonetheless, the measure is still WTP rather than WTA for changes in jobs (i.e., WTP for increases in jobs, or WTP to reduce or avoid job loss). Note that even though utility estimates for recreation sites without giant trees are equal across latent classes, the WTP vary because the utility estimates for taxes vary across classes.

Table 11. WTP estimates derived from the MNL and LC models

Attribute	Unit	MNL (100% of sample) Annual WTP for 10 years	Class 1 (50% of sample) Annual WTP for 10 years	Class 2 (25% of sample) Annual WTP for 10 years	Class 3 (25% of sample) Annual WTP for 10 years
New recreation areas with trails in old growth with giant trees	Per new site	$0.22***	$0.38***	$0.50**	$0.00
New recreation areas with trails in old growth without giant trees[a]	Per new site	-$0.14	-$0.17*	-$0.04*	-$0.02*

Increase in old-growth protection	Per additional km^2 of protection	$1.41***	$0.36*	$5.82***	$0.02
Change in jobs in the area	Per job	$0.67***	$0.85***	-$0.13***	$0.16***

***significant at 0.01 **significant at 0.05 *significant at 0.1

[a] Recreation sites without giant trees was specified as class-independent in the LC model

5.5. Decision Support Tool

I developed a DST that estimates public support for a user-entered hypothetical program. The inputs of the tool can be modified to test hypothetical programs. Here I present model inputs and outputs for several different hypothetical programs. The programs represent relatively low (Scenario A), medium (Scenario B), and high (Scenario C) changes in protection, recreation sites, and jobs. Public support for each program is estimated for three different tax levels: $0.00, $25.00, and $50.00 annually for 10 years.

Hypothetical Program Description:

Attributes	**Program**	**Status Quo**
Increase in old growth protection (km^2)	20.38	0
New recreation areas with trails in old growth with giant trees	2	0
Change in jobs in the Port Renfrew area	-5	0

Program support at different tax amounts (annually for ten years):

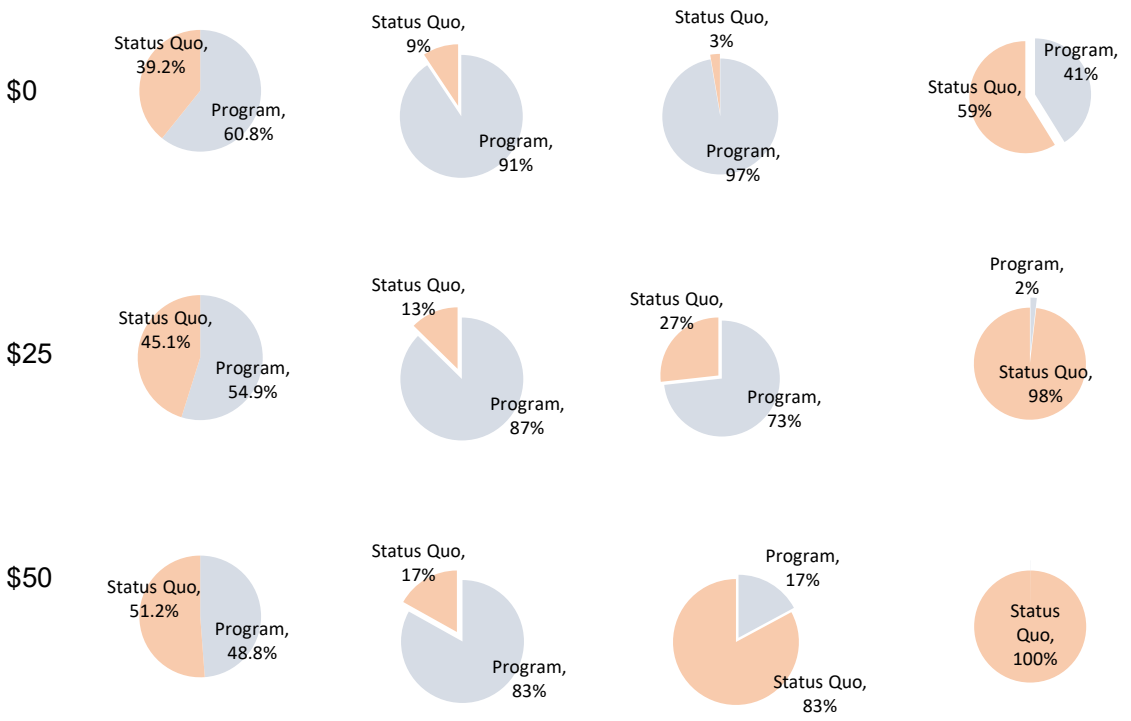


Figure 13. DST Scenario A

Scenario A (

Attributes	Program	Status Quo
Increase in old growth protection (km^2)	20.38	0
New recreation areas with trails in old growth with giant trees	2	0
Change in jobs in the Port Renfrew area	-5	0

Program support at different tax amounts (annually for ten years):

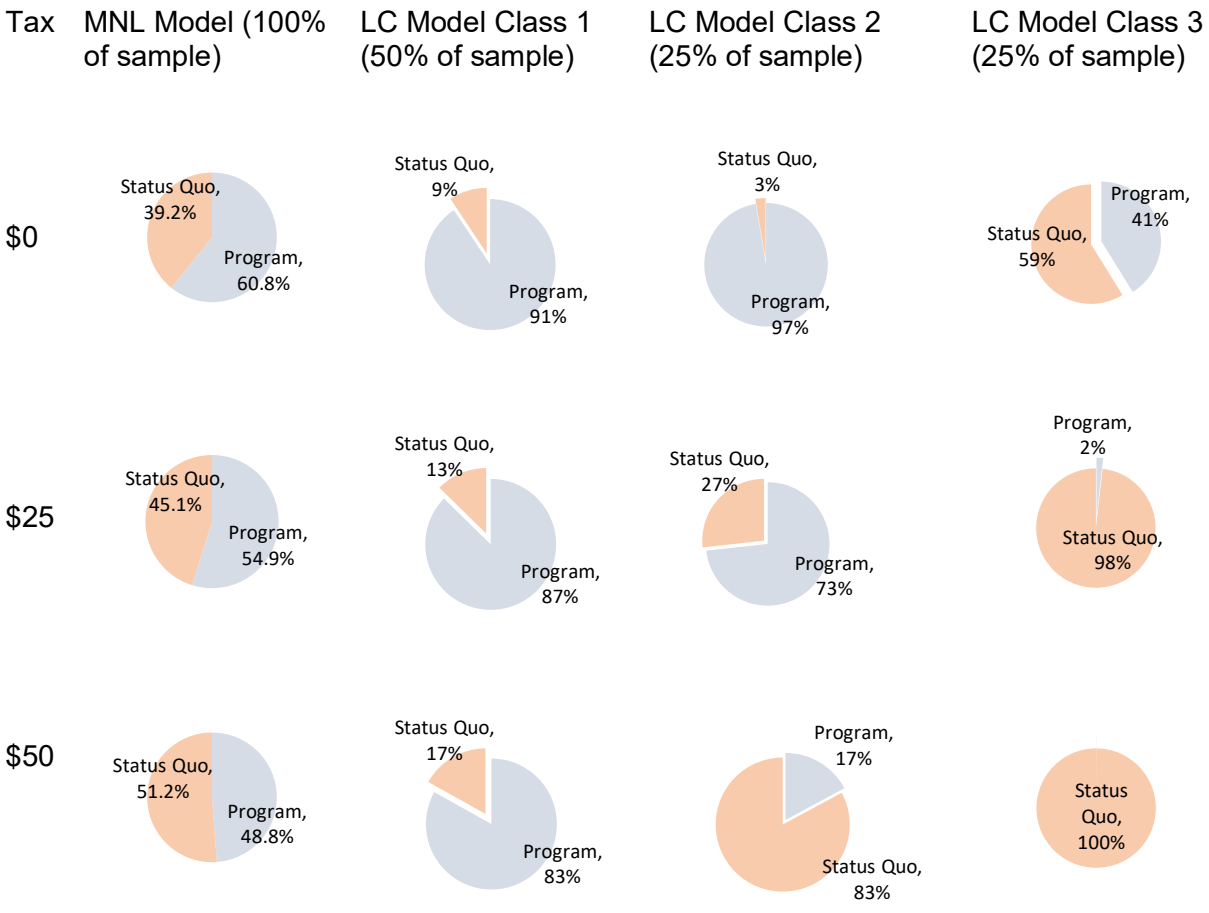


Figure 13) would protect 20.38 km^2 of old growth, create two new recreation sites with giant trees, and result in a loss of 5 local jobs. The rationale for Scenario A is that the area of protection is equivalent to the current old growth deferrals, and the number of

sites is based on three known old growth groves with giant trees: Mossom Grove and Jurassic Grove.[20]

[20] AFA has shared photographs and information about these groves on their website.

Hypothetical Program Description:

Attributes	Program	Status Quo
Increase in old growth protection (km^2)	47	0
New recreation areas with trails in old growth with giant trees	3	0
Change in jobs in the Port Renfrew area	-10	0

Program support at different tax amounts (annually for ten years):

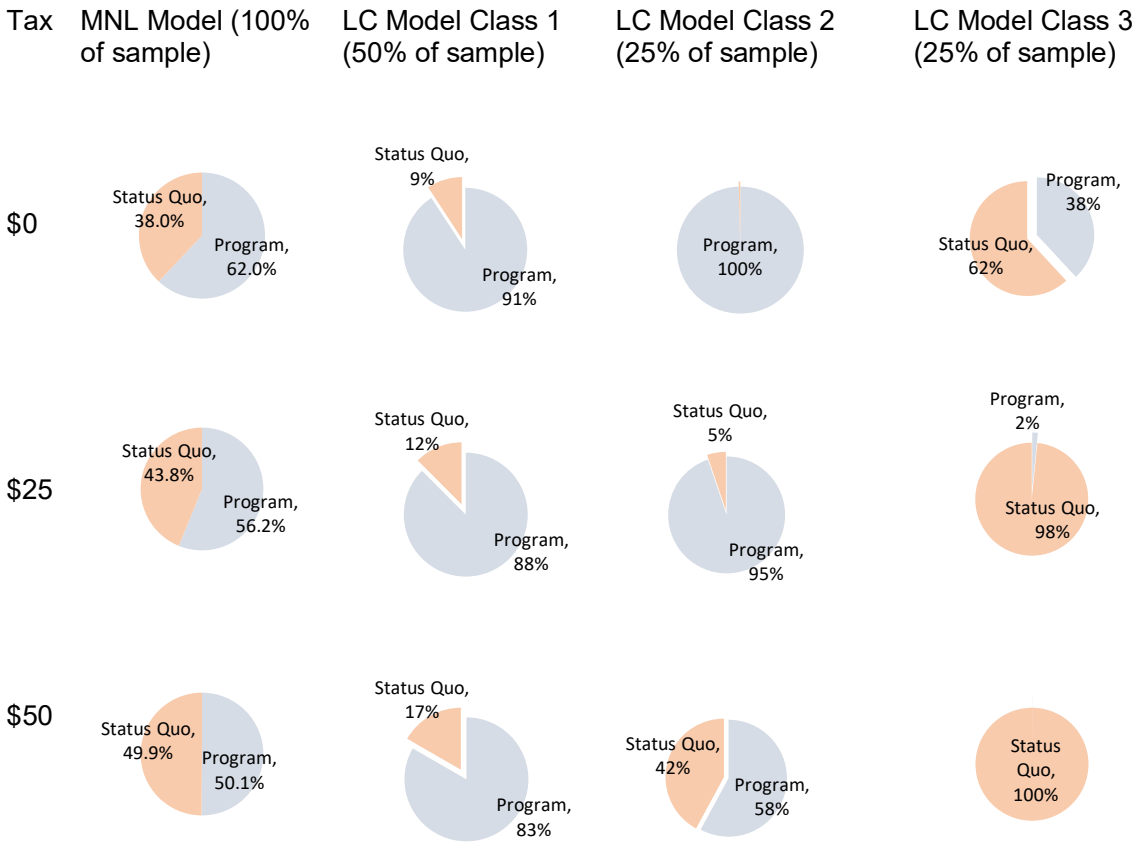


Figure 14. DST Scenario B

Scenario B (Figure 14) would protect 47 km^2 of old growth, create three new recreation sites with giant trees and result in a loss of 10 local jobs. The rationale for Scenario C is protecting all old growth that is currently within the Timber Supply Area and creating recreation sites at three old growth groves identified by AFA in the area: Mossom Grove, Jurassic Grove, and Eden Grove.

Hypothetical Program Description:

Attributes	Program	Status Quo
Increase in old growth protection (km^2)	255	0
New recreation areas with trails in old growth with giant trees	6	0
Change in jobs in the Port Renfrew area	-20	0

Program support at different tax amounts (annually for ten years):

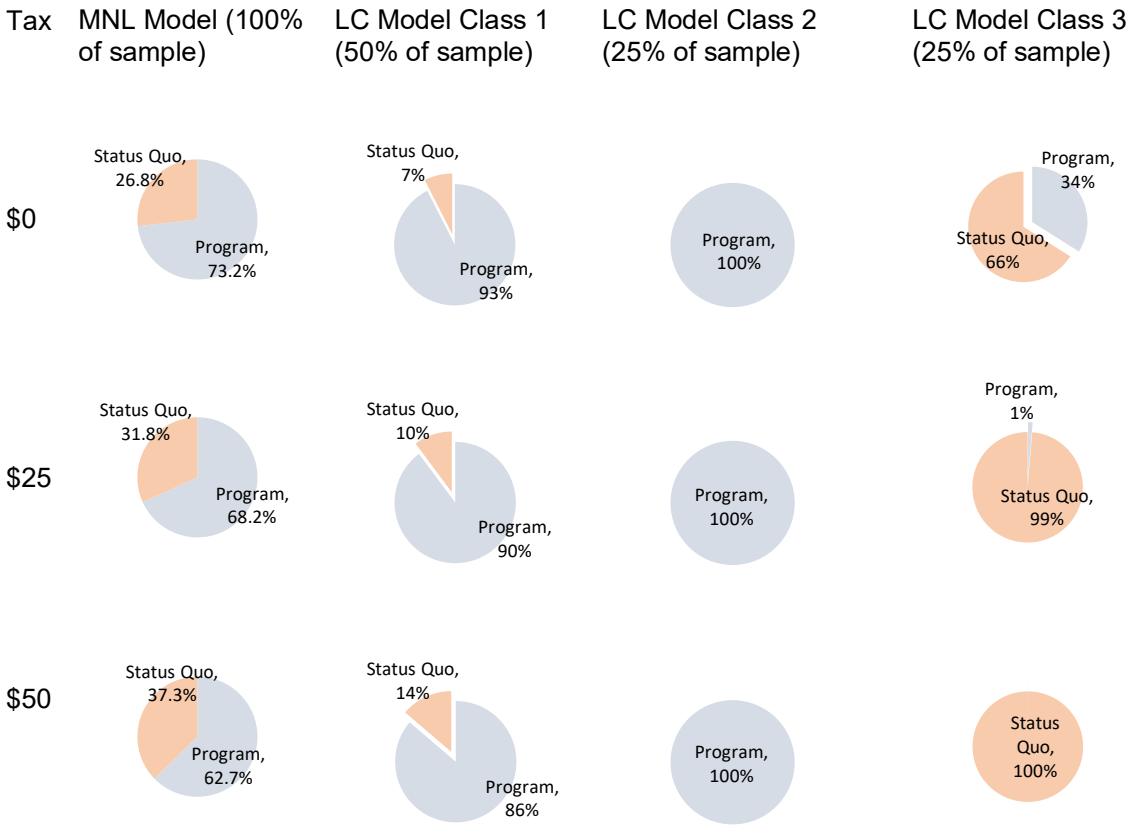


Figure 15. DST Scenario C

Scenario C (Figure 15) would protect 255 km^2 of old growth, create six recreation sites with giant trees and result in a loss of 20 local jobs. The rationale for Scenario C is protecting 75% of old growth, which has the highest measured utility of all protection levels (Figure 11; Figure 12) and creating the maximum amount of recreation sites that the DCE considered.

Chapter 6. Discussion

6.1. Public Willingness to Pay for Alternative Old Growth Management

This research indicates that the public values alternative old growth management in the Port Renfrew area and is willing to pay for improvements. Based on the DCE responses, the MNL and LC models were used to estimate the utility provided by changes in old growth protection, old growth recreation sites and local jobs in the Port Renfrew area. The utility estimates revealed WTP for changes in the attributes, which is the measure of value in my research. Expressed in dollar amounts, WTP estimates allow for utility comparisons when considering alternative policies or programs, such as analyzing these with a CBA. Public WTP estimates from my research vary between models, classes, and attributes (Table 11). In both the MNL and LC models, WTP is generally highest for increases in old growth protection, followed by study area jobs, and finally recreation sites.

In the MNL model, WTP for old growth protection is \$1.41 per km^2 annually. In the LC model, it is \$0.36, \$5.82, and \$0.02 per km^2 annually for classes 1, 2 and 3, respectively. To my knowledge, there are no comparable studies in BC that have valued WTP for old growth protection by area.[21] The MNL and LC models assumed a linear relationship between the amount of old growth protection and utility. However, when considering the stepwise utility models (Figure 11; Figure 12), it is clear that the relationship is not perfectly linear and that utility actually peaks at 75% of old growth protection and is then subject to diminishing returns. As such, WTP also peaks at 75% protection. These results suggest the proportion of old growth protection the public is WTP the most for is higher than in previous research. Bradshaw (2009) found the optimal amount of old growth in southwest mainland BC is 54% and Van Kooten and Bulte (1999) found the proportion of old growth protection in BC that the public is WTP the most for was 23% - 36%, depending on the social discount rate.

[21] Previous research in BC has focused on WTP for improvements related to old growth conservation such as spotted owl habitat (Bradshaw, 2009), but I have not found any studies that have valued old growth protection on its own.

In the MNL model, WTP for Port Renfrew area jobs is $0.67 per job annually. In the LC model, it is $0.85, $-0.13 (insignificant), and $0.16 annually for classes 1, 2 and 3, respectively. These results are comparable to a study by Hynes et al. (2021) that estimated WTP for marine jobs in Canada before and during the COVID-19 pandemic, and found that the public was willing to pay $22.26 annually for an increase of 100 jobs, and $31.41 for an increase of 200 jobs. The results of this research indicate a higher WTP per job than the results of Hynes at al. (2021). However, there is significant heterogeneity as class 2 does not value retaining jobs at all, which class 1 and 3 do.

In the MNL model, WTP for recreation sites in old growth forests with giant trees is $0.22 per site annually. In the LC model, it is $0.38, $0.50, and $0.00 per site annually for classes 1, 2 and 3, respectively. Context factors may contribute to the relatively low WTP for recreation sites in both models. First, the study area already has five old growth recreation areas, four of which have giant trees. As such, the marginal utility of additional sites may be lower than it would be in areas with fewer sites, following the law of diminishing returns. As demonstrated by the importance ratings of the old growth recreation opportunities in the study area compared to jobs and old growth protection in the study area (Table 7), old growth recreation opportunities are almost as important to respondents as protection and more important than jobs. The target population may have high value for existing old growth recreation opportunities, but low marginal utility for additional sites. Second, the timing of this study may also lower the relative importance of recreation sites compared to old growth protection and jobs. With the Fairy Creek protests and blockades and the global pandemic and associated economic uncertainty, respondents may not care as much about old growth recreation sites as jobs and protection. Alternatively, increasing recreation sites may simply provide less utility than protection and jobs, regardless of the timing of this study and existing old growth recreation opportunities.

The WTP estimates for recreation sites in old growth forests without giant trees are insignificant and negative, compared to significant and positive values for recreation sites with giant trees. Although insignificant, the finding that recreation sites in forests with giant trees provide more utility than sites without giant trees is comparable to previous research. With a travel cost approach, Englin, McDonald, & Moeltner (2006) compared the values recreationists have for forests in Jasper National Park, Alberta and found that the value of added trails through ancient forests is greater than the value of

added trails through mature forests by up to an order of magnitude. Although “giant trees” and “ancient” are two different characteristics of old growth forests, they are similar in that they fit with the public perception of old growth described in section 2.1.

The WTP results demonstrate the heterogeneity of public interests regarding old growth management. Based on their respective utility coefficients and covariates, the latent classes provide a moderate perspective (class 1), an environmentally conscious perspective (class 2), and an economically conscious perspective (class 3). When the sample is assumed to have homogeneous preferences (as in the MNL model), the results fail to capture the heterogeneity. For example, for old growth protection (Table 11), the MNL model produced WTP estimates that 75% of the sample in the LC model would not be willing to pay.[22]

6.2. Public Support for Alternative Old Growth Management

The WTP estimates are key outputs of this research and are useful for comparing trade-offs in old growth management with tools such as CBA. However, the application of WTP estimates is limited by the reality that public policies are not necessarily based on public WTP. An alternative application of the MNL and LC utility estimates is estimating public support for potential programs, which has more political relevance. With a DST, I estimated the proportion of the public who would support three hypothetical government programs that propose changes in old growth protection, recreation sites, and local jobs in the Port Renfrew area.

The DST scenarios presented in this report represent programs with low, medium, and high changes in old growth protection, recreation sites, and jobs. For each scenario, I ran the model with high, medium, and zero tax amounts to demonstrate how taxes affect public support for the programs. In the DST, I chose to include the model constants (i.e., alternative specific constants), which indicate the preference for retraining or moving away from the status quo (i.e., the tendency to choose a program vs the tendency to choose the status quo regardless of the attributes). I chose to include the model constants based on the assumption that outside of the DCE, the preferences for keeping

[22] The MNL model WTP for protection ($1.41) is higher than both latent class 1 ($0.36/ha) and class 3 ($0.02/ha) WTP estimates

or moving away from the status quo would persist. The inclusion of the constants means that overall, the sample tends to support the program regardless of the program attributes, while class 3 tends to not support the program regardless of the attributes.

The DST results illustrate what is also apparent in utility and WTP estimates; public support for the programs is most affected by changes in old growth protection and household taxes, followed by changes in jobs, and finally changes in recreation sites. Naturally, public support is maximized when taxes and job loss are minimized, and old growth protection and recreation sites are maximized. Further, the DST results again demonstrate the heterogeneity of public interests and that classes 1 and 2 are generally more supportive of changes in old growth management, whereas class 3 is less supportive.

6.3. Policy Implications

As described in Chapter 2, an independent panel recently completed a strategic review of old growth forest management in BC on behalf of the Province. The resulting report, *A New Future for Old Forests,* presents 14 policy recommendations to improve old growth management. The 14 recommendations are included in Appendix J. This research supports seven of the recommendations, as described below. As such, the key policy recommendation of this research is to fully adopt the seven recommendations of the Old Growth Strategic Review to improve old growth management.

The first recommendation of the Old Growth Strategic Review is to engage the full involvement of Indigenous leaders and organizations in policy reform. This research supports this recommendation. In focus groups and pilot testing, participants indicated the importance of Indigenous involvement and collaboration in the hypothetical programs. Therefore, this research highlights the importance of Indigenous collaboration as a pre-condition for old growth management reform.

The second recommendation of the Old Growth Strategic Review is to prioritize ecosystem health and resilience. Similarly, the seventh recommendation is to bring management of old forests into compliance with existing provincial targets and guidelines for maintaining biological diversity. My research considers old growth forests for all of their social, economic, ecological, and spiritual values and does not focus on

ecosystem health specifically. However, the results still support recommendations two and seven. Based on the relative importance of old growth protection compared to jobs and recreation, the findings imply the public values preserving old growth forests more than developing the forests, which suggests the public values old growth forests for their ecological value.

The fourth recommendation of the Old Growth Strategic Review is to adopt a more inclusive and stable governance model that gives local communities and stakeholders a greater role in forest management decisions that affect them. This research supports that recommendation. The current disparity between the status quo management and the public preferences identified in this research indicates a need for more involvement of local stakeholders in decision making. Further, 70% of respondents either agree or strongly agree that citizens of BC should have more say in old growth management than they do at present.

The tenth recommendation so the Old Growth Strategic Review is to update the targets for retention and management of old and ancient forest, which is directly supported by this research. As evident from the stepwise utility graphs (Figure 11; Figure 12), marginal utility from increased protection is positive until it reaches about 75% of standing old growth protected, indicating the public values greater retention and changed management of old growth.

The eleventh recommendation of the Old Growth Strategic Review is to improve the mapping and classification of old forests to recognize multiple values. The importance of giant trees identified in this research supports this recommendation. As indicated by the WTP for recreation sites with versus without giant trees, the public cares about old growth characteristics that are not captured by stand age classifications.

The fourteenth recommendation of the Old Growth Strategic Review is to support forest sector workers and communities as they adapt to changes resulting from a new forest management system. The public values for local jobs identified in this research support this recommendation. As demonstrated with the WTP estimates and the DST, public utility and support for programs are maximized when changes in old growth management result in higher protection with minimal job loss.

The alignment of this project's findings with the Old Growth Strategic Review recommendations indicates clear policy recommendations. Overall, the policy recommendations of this research are to fully engage Fist Nations in old growth management reform that increases old growth protection while supporting local jobs through the transition. While increasing protection and supporting local jobs are more important to the public than creating new recreation sites, there are still clear recommendations for recreation development from this research: when old growth recreation sites are created, they should be in forests with giant trees. Finally, the importance of giant trees to the public highlights the need for old growth classification systems that capture values beyond stand age.

6.4. Limitations

A fundamental limitation of this research is that it was confined to the assessment of general public values for alternative old growth management and did not involve Indigenous engagement. In the context of ongoing stewardship and resource planning by the Pacheedaht, Ditidaht, Huu-ay-aht, T'Sou-ke and WSANEC Nations and the Hul'qumi'num Treaty Group, general public values may hold little relevance.

Both the COVID-19 pandemic and Fairy Creek protests created challenges for my research. Under these extreme circumstances, public values may be different than they would be otherwise. Therefore, the repeatability and long-term relevance of results may be negatively affected. There is some evidence that the effect of the COVID-19 pandemic on WTP for protection of natural areas and associated employment may not be significant. Hynes et al. (2021) compared DCE results with attributes including marine protected areas and marine employment before and 6 months into the COVID-19 pandemic and did not find statistically significant differences. I explored the effect of the Fairy Creek protests in this research. The vast majority (94%) of respondents were familiar with the Fairy Creek protests, and of those, 45% indicated that since the protests, old growth protection is now at least slightly more important to them.

Another limitation of this research is the specification of linear functional forms for all attributes in the MNL and LC models. Linear utility functional forms fit the data better

than quadratic forms, however other possible functional forms could be explored.[23] A linear relationship defies the law of diminishing marginal utility which states each additional unit of gain leads to an ever-smaller increase in utility. When considering the piecewise linear utility functions (Figure 11; Figure 12), some limitations of the linear assumption are apparent, such as the drop in utility between 75% and 100% protection. Although there are limitations with linear utility functions, they offer ease of interpretation, maintain tractability, and remain the most common utility functional form in the literature (Mariel et al., 2021).

6.5. Contributions to the Literature and Future Research

As discussed in Chapter 3, previous studies have estimated the value of a range of ecosystem services provided by old growth forests at various study sites in BC (Table 2). The primary motivation for this research was to address data needs that have not been filled by those studies (or others). As highlighted by Morton et al. (2021), site-specific, primary data was needed for the value of ecosystem services provided by old growth forests on Vancouver Island. This research provides primary, site-specific data for the Port Renfrew area, which contributes to the existing literature, broadening the understanding of old growth values.

Where possible, comparisons of the results of this research to other studies are made in Section 6.4. However, comparisons to previous old growth valuation studies in BC (Table 2) are limited because this study measures different types of benefits in different units. For example, Van Kooten and Bulte (1999), Knowler and Dust (2008), and Morton et al. (2021) each estimate WTP for a day of recreation in an old growth forest in their study areas and the per hectare recreational value of the forests from that. My research estimates WTP for an increase in old growth recreation sites, so directly comparing my results to these studies is not possible.

Although comparisons are limited, the results of my research should be considered within the context of previous studies to understand the contribution of my work. Van Kooten and Bulte (1999), Knowler and Dust (2008), and Morton et al. (2021) each estimated old growth values with benefits transfer relying on provincial survey data

[23] Such as logarithmic, Box-Cox, Box-Tukey, or alternative power transformations

collected in 1989/1990 that was not specific to old growth forests. That approach is limited by the age of the dataset (especially when considering changes to forests and recreation demand over the past 30 years) and that the dataset is not specific to the study areas of the researchers and is not specific to old growth forests. The researchers all accounted for these limitations in their benefits transfer approaches to make their estimates appropriate for their study period and study areas. However, the reliance on the 1989/1990 dataset still affects the reliability of the results. Comparatively, the data I collected is specific is current and specific to old growth forests in the Port Renfrew area, which is a strength of my research.

While this research provides much needed primary data on old growth values, there are still gaps that this research did not fill. My research estimates WTP for changes in protection, recreation, and jobs, but does not consider the costs of such changes, such as a reduction in timber harvest revenue. As such, my research is not a CBA on its own and the results may be best understood as inputs into a future CBA. Doing so, such as building on the work of Morton et al. (2021), would require careful consideration. First, WTP for protection is an expression of WTP for preservation of the forests including all of the services they provide, such as wildlife habitat and carbon sequestration. As such, it is important to not double-count ecosystem services by including WTP for protection and WTP for services affected by protection. Second, the recreation results are not the same units as the recreation inputs in Morton et al. (2021). To include the results of my research in a future iteration of the CBA by Morton et al. (2021), analysis of the contingent behaviour data is first necessary.

With the contingent behavior data from this project, future research may explore how recreation behaviour could be affected by changes in old growth management. Such an analysis could model the number of trips respondents would take given changes in the number of old growth recreation sites, old growth protection, and study area jobs. The WTP results of this research can be incorporated into future CBA analyses for old growth management in the Port Renfrew area. For example, a future iteration of the CBA by Morton et al. (2021) could incorporate the public values estimated in this research, and/or future contingent behaviour analyses. As is common in valuation studies, a benefits transfer approach could potentially expand the results of this study to other study areas and populations. However, given the unique circumstances of this research during the COVID-19 pandemic and Fairy Creek protests, expanding these results with

benefits transfer may not be appropriate. Finally, the WTP results of this project can be expanded with future research that extends beyond marginal WTP into nonmarginal WTP with compensating surplus estimations.

Chapter 7. Conclusion

Over the past few years, contention over old growth management has been making headlines. In the wake of historic old growth logging protests and blockades, and while the Province, First Nations, and other stakeholders consider the future of old growth management, this research aims to support old growth management decisions with insights into public values for old growth management. The WTP estimates and DST outputs provide insights into public preferences for the difficult trade-offs in old growth management. Using the models estimated here, it is possible to look at balancing old growth values to avoid creating winners and loser. Some portions of the public (class 1) have moderate perspectives on old growth protection, while others (class 2) have prominent pro-environmental attitudes, and others (class 3) are very tax conscious. Creating policy that serves these diverse public interests is challenging, as demonstrated by the DST. The results demonstrate the heterogeneity of public interests regarding old growth management and the importance of balancing diverse values and support increasing protection of old growth forests and old growth recreation sites in the Port Renfrew area.

References

Adamowicz, W., Boxall, P., Williams, M., & Louviere, J. (1998). Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation. *American Journal of Agricultural Economics*, *80*(1), 64–75. https://doi.org/10.2307/3180269

Ancient Forest Alliance. (n.d.). Port Renfrew Big Trees Map . Retrieved May 29, 2022, from https://ancientforestalliance.org/learn-more/port-renfrew-big-trees-map/

BC Council of Forest Industries. (2019). *2019 Forest Industry Economic Impact Assessment*.

Bradshaw, P. G. (2009). Valuing old-growth forests and related qualities in southwest mainland British Columbia using contingent choice (Simon Fraser University). Retrieved from http://ir.lib.sfu.ca/handle/1892/112

Brown, C., Hachey, J., Wood, J., Thrower, J., & Walton, A. (2021). *Status of BC's Old Forests: The situation in 2021*. Retrieved from https://www.cofi.org/wp-content/uploads/BC_OldGrowth_2021Status-Report_Oct21-2021.pdf

CBC. (2022). Second judge to consider stay of proceedings application for old growth logging protesters in B.C. | CBC News. Retrieved June 6, 2022, from https://www.cbc.ca/news/canada/british-columbia/logging-protest-trial-1.6363292

Champ, P. A., Boyle, K. J., & Brown, T. C. (2017). *The Economics of Non-Market Goods and Resources A Primer on Nonmarket Valuation Second Edition* (2nd ed.). Retrieved from http://www.springer.com/series/5919

Day, B., Bateman, I., Binner, A., Ferrini, S., & Fezzi, C. (2019). Structurally-consistent estimation of use and nonuse values for landscape-wide environmental change. *Journal of Environmental Economics and Management*, *98*, 102256. https://doi.org/10.1016/j.jeem.2019.102256

Destination BC. (2022). *Super, Natural British Columbia*.

Englin, J. E., McDonald, J. M., & Moeltner, K. (2006). Valuing ancient forest ecosystems:

An analysis of backcountry hiking in Jasper National Park. *Ecological Economics*, *57*(4), 665–678. https://doi.org/10.1016/j.ecolecon.2005.05.022

Eom, Y., & Larson, D. M. (2006). *Improving environmental valuation estimates through consistent use of revealed and stated preference information*. *52*, 501–516. https://doi.org/10.1016/j.jeem.2005.11.001

Galimski. (2021). *For Pacheedaht First Nation, forestry is a lifeline, bringing jobs and services to the community - Victoria Times Colonist*. Retrieved from https://www.timescolonist.com/islander/for-pacheedaht-first-nation-forestry-is-a-lifeline-bringing-jobs-and-services-to-the-community-4690768

Gorley, A., & Merkel, G. (2020a). *A new future for old forests: What we heard*. Victoria, BC.

Gorley, A., & Merkel, G. (2020b). *A NEW FUTURE FOR OLD FORESTS A Strategic Review of How British Columbia Manages for Old Forests Within its Ancient Ecosystems*. Retrieved from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/old-growth-forests/strategic-review-20200430.pdf

Government of BC. (2021a). BC Parks pilots plans for managing, promoting access to nature . Retrieved May 29, 2022, from https://news.gov.bc.ca/releases/2021ENV0043-001156

Government of BC. (2021b). Greater access to nature for a healthier, brighter future . Retrieved May 29, 2022, from https://news.gov.bc.ca/releases/2021ENV0027-000723

Hanley, N., & Barber, E. (2009). *Pricing Nature: Cost-benefit Analysis and Environmental Policy*. Retrieved from https://books.google.ca/books?hl=en&lr=&id=Ojg9u-fS9dAC&oi=fnd&pg=PR1&dq=hanley+and+barbier+2009&ots=TL1Pw2xtR8&sig=CwAWJHrcI5_ENQINeKqJwPSrnfM#v=onepage&q=hanley and barbier 2009&f=false

Hanley, N., Mourato, S., & Wright, R. E. (1998). *Choice modelling approaches: A Superior alternative for environmental valuation? 15*(3).

Hanley, N., Mourato, S., & Wright, R. E. (2001). Choice Modelling Approaches: A Superior Alternative for Environmental Valuatioin? *Journal of Economic Surveys*, *15*(3), 435–462. https://doi.org/10.1111/1467-6419.00145

Hanley, N., Wright, R. E., & Adamowicz, V. (1998). Using Choice Experiments to Value the Environment Design Issues, Current Experience and Future Prospects 1. *Environmental and Resource Economics*, *11*(4), 413–428.

Haynes, J. (2021). Pacheedaht First Nation: An example of reconciliation and development - Resource Works. Retrieved May 31, 2022, from https://www.resourceworks.com/pacheedaht-example

Horne, P., Boxall, P. C., & Adamowicz, W. L. (2005). Multiple-use management of forest recreation sites: A spatially explicit choice experiment. *Forest Ecology and Management*, *207*(1-2 SPEC. ISS.), 189–199. https://doi.org/10.1016/j.foreco.2004.10.026

Hoyos, D. (2010). *The state of the art of environmental valuation with discrete choice experiments*. https://doi.org/10.1016/j.ecolecon.2010.04.011

Huu-ay-aht, Pacheedaht, Ditidaht First Nations take back decision-making responsibilities over ẖahahuuɬi – Huu-ay-aht. (2021). Retrieved June 6, 2022, from https://huuayaht.org/2021/06/07/huu-ay-aht-pacheedaht-ditidaht-first-nations-take-back-decision-making-responsibilities-over-ẖahahuuli/

Hynes, S., Armstrong, C. W., Xuan, B. B., Ankamah-Yeboah, I., Simpson, K., Tinch, R., & Ressurreição, A. (2021). Have environmental preferences and willingness to pay remained stable before and during the global Covid-19 shock? *Ecological Economics*, *189*. https://doi.org/10.1016/J.ECOLECON.2021.107142

Issekutz, P. B. (2020). *A Critical Evaluation of Old-Growth Forest Definitions in Canada*.

Johnston, R. J., Boyle, K. J., Adamowicz, V., Bennett, J., Brouwer, R., Cameron, T. A., … Vossler, C. A. (2017). *Contemporary Guidance for Stated Preference Studies*. https://doi.org/10.1086/691697

Knowler, D., & Dust, K. (2008). The Economics of Protecting Old Growth Forest: An

Analysis of Spotted Owl Habitat in the Fraser Timber Supply Area of British Columbia. *Carbon*, (September), 118.

Knowler, D. J., MacGregor, B. W., Bradford, M. J., & Peterman, R. M. (2003). Valuing freshwater salmon habitat on the west coast of Canada. *Journal of Environmental Management*, *69*(3), 261–273. https://doi.org/10.1016/j.jenvman.2003.09.001

Knowler, D., Page, A., Cooper, A., & Araujo, H. A. (2017). Valuing a Logging Externality: Loss of the Water Purification Service of Temperate Coastal Rainforests. *Water Economics and Policy*, *3*(2), 1–29. https://doi.org/10.1142/S2382624X16500326

Lancaster, K. J. (1966). A New Approach to Consumer Theory. *Https://Doi.Org/10.1086/259131*, *74*(2), 132–157. https://doi.org/10.1086/259131

Lowther, C. (2021). *Worth More Standing: Poets And Activists Pay Homage To Trees, Book by Christine Lowther (Paperback) | www.chapters.indigo.ca*. Retrieved from https://www.chapters.indigo.ca/en-ca/books/worth-more-standing/9781773860824-item.html

Mariel, P., Hoyos, D., Meyerhoff, J., Czajkowski, M., Dekker, T., Glenk, K., … Thiene, M. (2021). *Environmental Valuation with Discrete Choice Experiments Guidance on Design, Implementation and Data Analysis*. Retrieved from http://www.springer.com/series/8876

Marre, J. B., Brander, L., Thebaud, O., Boncoeur, J., Pascoe, S., Coglan, L., & Pascal, N. (2015). Non-market use and non-use values for preserving ecosystem services over time: A choice experiment application to coral reef ecosystems in New Caledonia. *Ocean and Coastal Management*, *105*, 1–14. https://doi.org/10.1016/j.ocecoaman.2014.12.010

Mcfadden, D. (1986). *Stated preference methods and their applicability to environmental use and non-use valuations*.

McFadden, D. (1973). Conditional logit analysis of qualitative choice behaviour. In P. Zarembka (Ed.), *Frontiers in Econometrics* (pp. 105–142). Retrieved from https://eml.berkeley.edu/reprints/mcfadden/zarembka.pdf

Meyerhoff, J., & Liebe, U. (2008). Do protest responses to a contingent valuation question and a choice experiment differ? *Environ Resource Econ*, *39*, 433–446. https://doi.org/10.1007/s10640-007-9134-3

Minstry of Transportation and Infrastructure. (2019). *Cathedral Grove Pedestrian and Traffic Safety Study*. Retrieved from https://engage.gov.bc.ca/app/uploads/sites/416/2019/06/Cathedral-Grove-Public-Event-2-Discussion-Guide-FINAL-2019.06.12.pdf

Morton, C., Trenholm, S., Beukema, D., Knowler, D., & Boyd, R. (2021). *Economic Valuation of Old Growth Forests on Vancouver Island Phase 2-Port Renfrew Pilot Study Economic Valuation of Old Growth Forests on Vancouver Island Phase 2-Port Renfrew Pilot Study Economic Valuation of Old Growth Forests on Vancouver Island, Phase*. Retrieved from www.essa.com

Office of the Premier. (2022). New ministers appointed for land stewardship, municipal affairs | BC Gov News. Retrieved June 6, 2022, from https://news.gov.bc.ca/releases/2022PREM0011-000268

Old Growth Technical Advisory Panel. (2021). *Priority Deferrals An Ecological Approach*.

Outdoor Recreation Council of BC. (2021). New investments needed to create improved access to nature . Retrieved May 29, 2022, from https://www.orcbc.ca/blog/need-investments-in-outdoor-recreation

Price, K., Holt, R. F., & Daust, D. (2020). *Conflicting portrayals of remaining old growth: the British Columbia case*. https://doi.org/10.1139/cjfr-2020-0453

Province of BC. (n.d.-a). Old growth deferral areas. Retrieved May 29, 2022, from https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/old-growth-forests/deferral-areas

Province of BC. (n.d.-b). Old growth definitions and values - Province of British Columbia. Retrieved May 11, 2022, from https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/old-growth-forests/old-growth-values#definitions

Province of BC. (2021). Government taking action on old-growth deferrals. Retrieved May 29, 2022, from https://news.gov.bc.ca/releases/2021FLNRO0068-002088

Province of British Columbia. (n.d.). Old growth work underway. Retrieved May 29, 2022, from https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/old-growth-forests/work-underway

Train, K. (2009). Discrete Choice Methods with Simulation . In *Cambridge* . Retrieved from https://books.google.ca/books?hl=en&lr=&id=4yHaAgAAQBAJ&oi=fnd&pg=PR7&dq=train+2009&ots=eF-bDel-gu&sig=BKuNX886LksthaUNk_fQ_F_-AzY&redir_esc=y#v=onepage&q=train 2009&f=false

Turner, R. K., Morse-Jones, S., & Fisher, B. (2010). Ecosystem valuation: A sequential decision support system and quality assessment issues. *Annals of the New York Academy of Sciences*, *1185*, 79–101. https://doi.org/10.1111/J.1749-6632.2009.05280.X

Van Kooten, G. C., & Bulte, E. H. (1999). How much primary coastal temperate rain forest should society retain? Carbon uptake, recreation, and other values. *Canadian Journal of Forest Research*, *29*(12), 1879–1890. https://doi.org/10.1139/x99-173

Wirth, C., Messier, C., Bergeron, Y., Frank, D., & Fankhanel, A. (2009). Old-Growth Forest Definitions: a Pragmatic View. In *Old-Growth Forests* (Vol. 207, pp. 3–9). Retrieved from https://link.springer.com/content/pdf/10.1007/978-3-540-92706-8.pdf

Zong, J., & Knetsch, J. L. (2013). Valuations of changes in risks: the reference state and evidence of differences between the measures. *The Singapore Economic Review*, *58*(01), 1350001.

Appendix A.

Example Indigenous Outreach Email

Hello [redacted for privacy],

I am a Master's student in the Resource and Environmental Management program at Simon Fraser University (SFU) in Burnaby and I am working on a research project concerned with the management of old-growth forests in a study area that includes Pacheedaht Territory. My supervisor is Professor Duncan Knowler.

The project is about old-growth forest values and includes a survey of Vancouver Island residents. The survey asks respondents about their preferences for different hypothetical old-growth management programs. The research will provide insights into the preferences people have for different trade-offs in old-growth management, as well as value estimates (in dollars) for various aspects of old-growth forests. The research will also investigate the number of current and potential recreational visitors from Vancouver Island cities to the study area.

I am working on this project in partnership with the Ancient Forest Alliance. I will be launching the survey soon and analyzing the results over the coming months. I will be happy to share the results of my research with you when they are ready. I hope the research may be useful for the Pacheedaht Nation.

If you would like more information or have any questions or concerns, please contact me anytime. I would be happy to discuss potential ways to align this research with the Pacheedaht Nation's objectives. You can also contact Professor Knowler at djk@sfu.ca.

Thank you,

Colleen Dupont (she/her/hers)
MRM Candidate (Planning) | Simon Fraser University

I am grateful for the opportunity and privilege to live, study, work, and play on the unceded and rightful lands of the Sḵwx̱wú7mesh (Squamish), Səlílwətaʔ/Selilwitulh (Tsleil-Waututh), and xʷməθkʷəy'əm (Musqueam) Nations.

Appendix B.

Full survey

Port Renfrew Old-Growth Forest Survey

Thank you for taking the time to participate in our survey!

We are conducting this survey to better understand the opinions Vancouver Island residents have about old-growth forests and economic opportunities. Your completed survey will contribute to improving old-growth management.

The survey will take approximately **15 minutes** to complete. Please answer the questions in sequence.

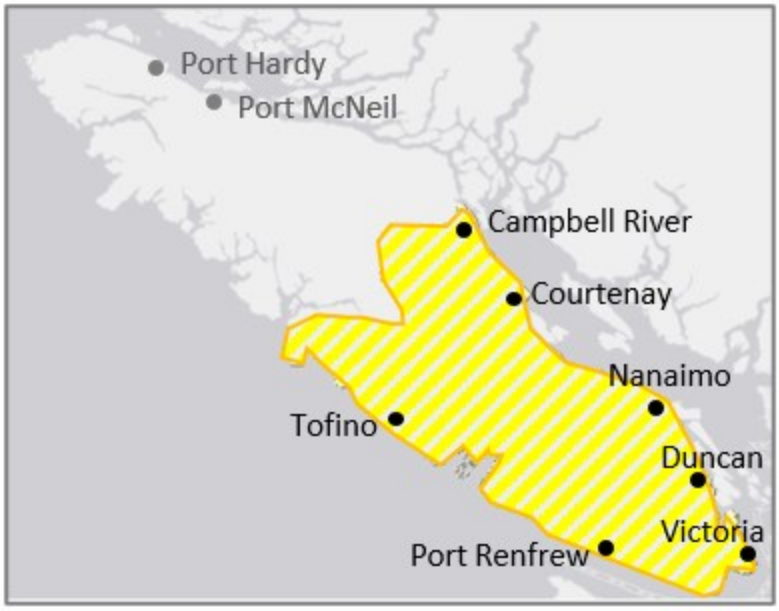
Before starting, please read the privacy policy. By clicking 'Begin', you acknowledge that you have read and agree to the privacy policy.

Begin

1 % Completed

Welcome

Q1 Do you live within the highlighted area on this map?



○ Yes ○ No

4 % Completed

Recreation

Some of the following questions ask about your situation prior to versus during the COVID-19 pandemic.

Q2 • In a typical year, **before the COVID-19 pandemic**, how many days would you spend participating in outdoor recreation? Outdoor recreation takes place in a natural setting.

_____ days

Q3 • In the year between April 1st, 2020 and April 1st, 2021, **during the COVID-19 pandemic**, how many days did you spend participating in outdoor recreation?

_____ days

Next

9 % Completed

Forest Recreation

Q4 • Of the **10** days you would spend participating in outdoor recreation in a typical year **before the COVID-19 pandemic,** how many would be spent **within forests** (areas with at least 50% forest cover)?

_____ days

Q5 • Of the **20** days you spent participating in outdoor recreation between April 1st, 2020 and April 1st, 2021, **during the COVID-19 pandemic**, how many were spent **within forests**?

_____ days

Next

13 % Completed

Forest Activities

Q6 • In the last five years, which of the following recreational activities have you participated in **within forests**? *[Please select all that apply]*

- [ ] Hiking on a day trip
- [ ] Hiking on a multi-day backcountry trip
- [ ] Trail running
- [ ] Nature viewing or scenic photography
- [ ] Mountain biking
- [ ] Vehicle-access camping
- [ ] Hunting
- [ ] ATV-ing
- [ ] 4-wheel driving
- [ ] Snowshoeing
- [ ] Skiing
- [ ] Other, please specify:
- [ ] None of the above

Next

17 % Completed

Young vs. Old-Growth Forests

This survey is about old-growth forests which are distinct from young forests. Here is some information about young versus old-growth forests that will help you answer the next questions.

Young Forests

- Trees are generally less than 70 years old
- Trees may be all the same age and height
- Limited variety of species
- Often contain large stumps, but few (or no) large trees

Old-Growth Forests

- Some trees are hundreds of years old
- Trees of diverse ages and heights
- More variety of species
- Often contain large trees

Q7 • In a typical year, what percentage of the days you spend recreating in forests is spent **within old-growth forests?**

- ◯ 0%
- ◯ 1% - 24%
- ◯ 25% - 49%
- ◯ 50% - 74%
- ◯ 75% - 99%
- ◯ 100%
- ◯ I don't know

Next

21 % Completed

Old-Growth Forests with Giant Trees

Some old-growth forests have ancient, monumental ("giant") trees such as those shown below.

Q8 • Have you ever visited giant trees in an old-growth forest?

- ◯ Yes
- ◯ No
- ◯ I don't know

Q9 • Which type of forest do you prefer to visit for recreation?

- ◯ Young forests
- ◯ Old-growth forests whether or not they have giant trees
- ◯ Old-growth forests, especially if they have giant trees
- ◯ I have no preference
- ◯ I don't know

Port Renfrew Study Area

The next sections refer to a study area around Port Renfrew on the west side of Vancouver Island that is located within the traditional territories of the Pacheedaht, Dididaht, T'Sou-ke, and WSÁNEĆ Nations, and the Hul'qumi'num Treaty Group. The study area includes all land within a 35 km radius of Port Renfrew:

Q10 • In a typical year, **before the COVID-19 pandemic**, would you visit the study area?

- (●) Yes
- ( ) No

Q11 • In a typical year, **before the COVID-19 pandemic**, how many days would you spend within the study area?

[ ] days

Q12 • Why do you spend time in the area in a typical year? *[Please select all that apply]*

- [ ] I live/lived there
- [ ] I work/worked there
- [ ] I go there for outdoor recreation
- [ ] I travel through
- [ ] Other. Please specify: [ ]

Q13 • In the year between April 1st, 2020 and April 1st, 2021, **during the COVID-19 pandemic**, did you visit the study area?

- (●) Yes
- ( ) No

Q14 • In the year between April 1st, 2020 and April 1st, 2021, **during the COVID-19 pandemic**, how many days did you spend within the study area?

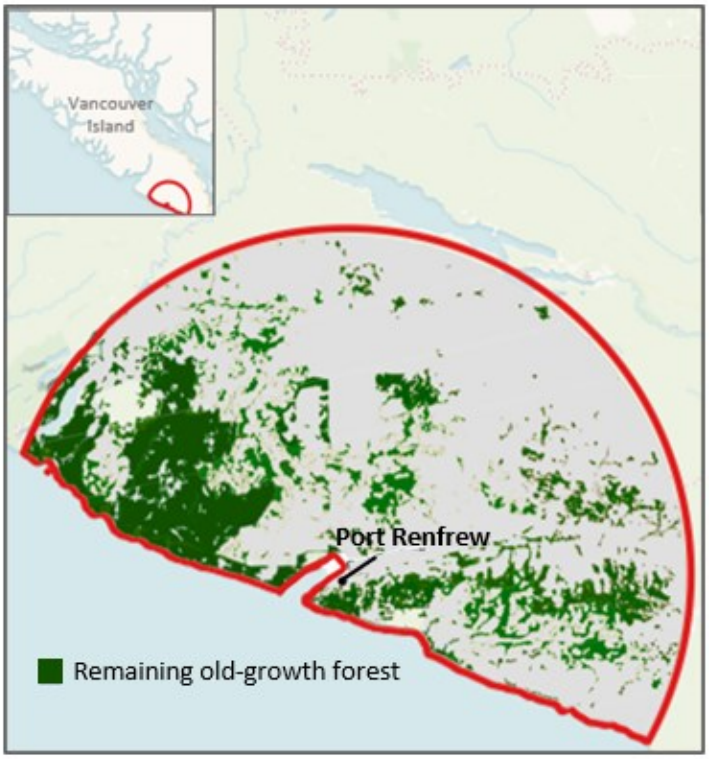
[ ] days

Q15 • Why did you spend time in the area between April 1st, 2020, and April 1st, 2021? *[Please select all that apply]*

- [ ] I live/lived there
- [ ] I work/worked there
- [ ] I went there for outdoor recreation
- [ ] I traveled through
- [ ] Other. Please specify: [ ]

Port Renfrew Old-Growth Forest

Approximately 1/3 of the original old growth in the Port Renfrew study area remains today. The area has many giant trees, including Canada's largest tree.



Q16 • In a typical year, **before the COVID-19 pandemic,** how many days (or portions of days) would you spend recreating **in old-growth forests** within the study area (within 35 km of Port Renfrew)

[ ] days/portions of days

Q17 • In the year between April 1st, 2020 and April 1st, 2021, **during the COVID-19 pandemic**, how many days (or portions of days) did you spend recreating **in old-growth forests** within the study area (within 35 km of Port Renfrew)?

[ ] days/portions of days

The following pages contain additional information about old-growth recreation opportunities, old-growth protection, and forest-related jobs in the study area.

Next

35 % Completed

Port Renfrew Old-Growth Forest Recreation Areas

Currently, there are five recreation areas with maintained trails through old-growth forests in the study area. Four of the recreation areas have giant trees.

Q18 • How important are recreation areas with trails through old-growth forests in the study area to you (even if you don't use them yourself)?

- ◯ Not important at all
- ◯ Somewhat important
- ◯ Important
- ◯ Very important
- ◯ No opinion

Next

39 % Completed

Port Renfrew Old-Growth Protection

Currently, about 36% of the remaining old-growth forest within the study area is protected from future logging. Many giant trees in the area are unprotected.

Q19 • How important is old-growth protection in the study area to you?

- ◯ Not important at all
- ◯ Somewhat important
- ◯ Important
- ◯ Very important
- ◯ No opinion

Next

43 % Completed

Port Renfrew Forest-Related Jobs

Currently, the local economy supports jobs in various forest-related sectors such as forestry, tourism, retail and other service industries. Local First Nations, Port Renfrew residents, and others benefit from these jobs.

Q20 • How important are jobs in the study area to you?

- ◯ Not important at all
- ◯ Somewhat important
- ◯ Important
- ◯ Very important
- ◯ No opinion

Next

47 % Completed

Port Renfrew Program

Imagine a new government program that would address forest management and support forest-related economic opportunities in the Port Renfrew area. The program would involve consultation and partnerships with local First Nations. Such a program might include:

- Creating new recreation areas with hiking trails through old-growth forests. The new recreation areas may or may not have giant trees.

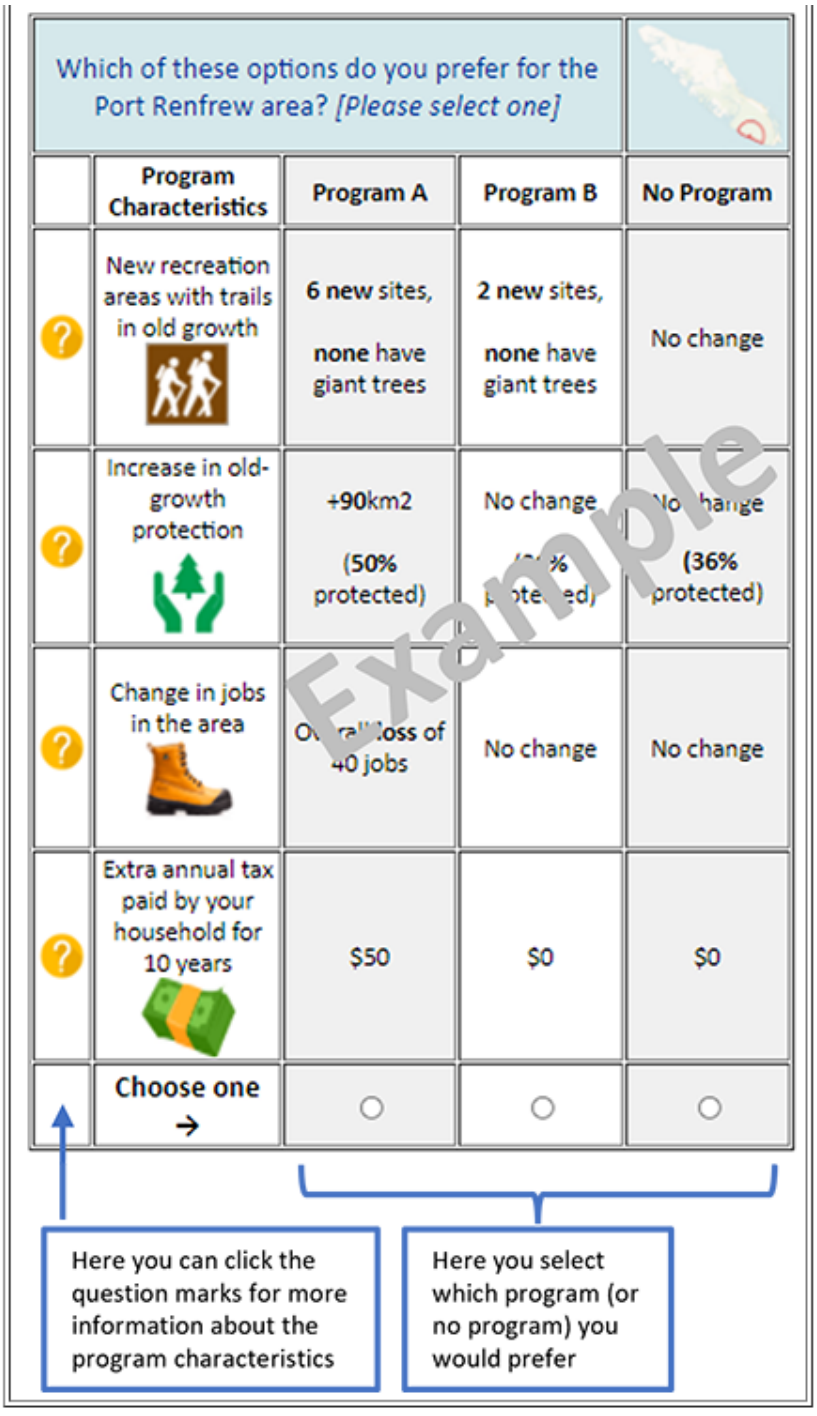
- Increasing protection of old-growth forests by expanding and/or creating parks, protected areas, and reserves.

- Encouraging economic opportunities in forest-related sectors, while also promoting sustainable logging practices. Overall, this could lead to gains or losses in local jobs.

Assume the program would be funded with an increase in annual taxes and would need to be paid from your household budget for the next 10 years.

In the following exercise, you will be asked to choose between potential programs for forest management within 35 km of Port Renfrew.

Here is an example of the exercise:



We will show you six pages like the one above. Please consider each page separately from the previous pages.

Next

Port Renfrew Program - 1 of 6

Which of these options do you prefer for the Port Renfrew area? *[Please select one]*				
	Program Characteristics	**Program A**	**Program B**	**No Program**
?	New recreation areas with trails in old growth 	**6 new** sites, **none** have giant trees	No change	No change
?	Increase in old-growth protection 	**+255**km2 (**75%** protected)	**+90**km2 (**50%** protected)	No change (**36%** protected)
?	Change in jobs in the area 	Overall **loss** of 40 jobs	Overall **loss** of 20 jobs	No change
?	Extra annual tax paid by your household for 10 years 	$0	$100	$0
	Choose one →	○	○	○

Q21 • In a typical year, you spend **no days** in the study area. If the program you selected was implemented, how many days would you spend in the study area in a typical year? *[Please enter a number]*

_____ days

56 % Completed

Port Renfrew Program

Q22a • You chose the 'No Program' option at least once. Why?
[Please select all that apply]

- [ ] I wouldn't be able to afford the tax increase
- [ ] The improvements are not good enough for the tax increase
- [ ] I think there is enough old-growth forest protected already
- [ ] I don't want more recreation development here
- [ ] Those tax dollars could be better spent on other issues
- [ ] I don't trust the government to make these changes
- [ ] There was not enough information provided to decide
- [ ] I'm concerned about the impact on First Nations
- [ ] The reduction in jobs is too great
- [ ] Other, please specify:

Q22b • The most expensive program you chose would include an additional annual tax of **$1000** to be paid by your household for 10 years. Please select the option that best explains why you chose that program:

- ○ My household could afford that tax and the program would be worth it
- ○ Even if other households would pay the tax, I expect that my household would be able to avoid paying it
- ○ I did not consider that the tax would directly affect my household budget
- ○ Other, please specify:

Next

85 % Completed

Tell us about yourself

This section asks for some personal details that are important for statistical analysis. Responses to all questions will be kept strictly confidential.

Q23 • What is your postal code?

Q24 • What is your gender?

- ◯ Male
- ◯ Female
- ◯ Non-binary, gender-fluid, and/or Two-Spirit
- ◯ No response

Q25 • How old are you? *[Please enter a number]*

years

Q26 • What is the highest certificate, diploma, or degree you have received?

- ◯ Secondary (high) school diploma or equivalent
- ◯ Apprenticeship or trades certificate or diploma
- ◯ College or other non-university certificate or diploma
- ◯ University certificate or diploma below bachelor level
- ◯ Bachelor's degree
- ◯ University certificate or diploma above bachelor level
- ◯ Degree in medicine, dentistry, veterinary medicine or optometry
- ◯ Master's degree
- ◯ Doctorate degree
- ◯ No certificate
- ◯ No response

Q27 • How many people are in your household, including yourself? Household includes all family members who share expenses and live with you for at least half of the year, including children. *[Please enter a number]*

_____ persons

Q28 • How many years (in total) have you lived on Vancouver Island? *[Please enter a number]*

_____ years

Q29 • Have you or anyone close to you worked in forestry in the past 15 years? *[Please select all that apply]*

- ☐ Myself
- ☐ My partner/spouse
- ☐ Someone else in my household
- ☐ Someone in my family who does not live with me
- ☐ Someone else (a friend, coworker, etc). Please specify:
  _____
- ☐ No one close to me has worked in forestry in the past 15 years
- ☐ I don't know

Q30 • Have you or anyone close to you become unemployed due to COVID-19? *[Please select all that apply]*

- ☐ Myself
- ☐ My partner/spouse
- ☐ Someone else in my household
- ☐ Someone in my family who does not live with me
- ☐ Someone else (a friend, a coworker, etc). Please specify:
  _____
- ☐ No one close to me has become unemployed due to COVID-19
- ☐ I don't know

Q31 • **In 2019,** what was your annual household income before tax?

- ◯ Under $10,000
- ◯ $10,000 to $19,999
- ◯ $20,000 to $39,999
- ◯ $40,000 to $59,999
- ◯ $60,000 to $79,999
- ◯ $80,000 to $99,999
- ◯ $100,000 to $149,999
- ◯ $150,000 to $199,999
- ◯ $200,000 and over
- ◯ No response

Q32 • **In 2020,** what was your annual household income before tax?

- ◯ Under $10,000
- ◯ $10,000 to $19,999
- ◯ $20,000 to $39,999
- ◯ $40,000 to $59,999
- ◯ $60,000 to $79,999
- ◯ $80,000 to $99,999
- ◯ $100,000 to $149,999
- ◯ $150,000 to $199,999
- ◯ $200,000 and over
- ◯ No response

Next

95 % Completed

Old-Growth Management

Q33 • How familiar are you with old-growth management in British Columbia?

- ◯ Not at all familiar
- ◯ Slightly familiar
- ◯ Somewhat familiar
- ◯ Moderately familiar
- ◯ Very familiar

Q34 • Which of the following changes to old-growth logging in B.C. would you support? *[Please select all that apply]*

- ☐ An increase in old-growth logging across B.C.
- ☐ An increase in old-growth logging on Vancouver Island
- ☐ An end to old-growth logging on Vancouver Island
- ☐ An end to old-growth logging across B.C.
- ☐ I would not support any of these changes
- ☐ I don't know

Q35 • How familiar are you with the recent protests and blockades opposing old-growth logging on Vancouver Island?

- ◯ Not at all familiar
- ◯ Slightly familiar
- ◯ Somewhat familiar
- ◯ Moderately familiar
- ◯ Very familiar

Q36 • How have the recent protests and blockades affected the importance of old-growth protection for you?

- ◯ Protection is now much less important to me
- ◯ Protection is now slightly less important to me
- ◯ No change
- ◯ Protection is now slightly more important to me
- ◯ Protection is now much more important to me
- ◯ I don't know

Q37 • How has the severe wildfire season of 2021 affected the importance of old-growth protection for you?

- ◯ Protection is now much less important to me
- ◯ Protection is now slightly less important to me
- ◯ No change
- ◯ Protection is now slightly more important to me
- ◯ Protection is now much more important to me
- ◯ I don't know

Q38 • I trust the government to make good decisions about old-growth management

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

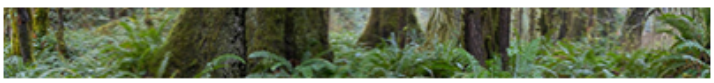
Q39 • Citizens of B.C. should have more opportunities for input into old-growth forest management decisions

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

Q40 • First Nations in B.C. should have more say in old-growth forest management than they do at present

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

Next



97 % Completed

The Environment

Q41 • Are you a member of, and/or a donor to, an environmental organization?

- ◯ Yes
- ◯ No
- ◯ I don't know

Q42 • In the last two years, have you attended an environment-related meeting, lecture, or protest or other environmental event?

- ◯ Yes
- ◯ No
- ◯ I don't know

Q43 • To what extent do you agree or disagree with the following statements? *[Please select the response that best describes your opinion]*

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Humans have the right to modify the natural environment to suit their needs	◯	◯	◯	◯	◯
When humans interfere with nature, it often produces negative consequences	◯	◯	◯	◯	◯

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Humans are severely abusing the environment	○	○	○	○	○
Plants and animals have as much right to exist as humans	○	○	○	○	○
Nature is reslient enough to cope with the impact of modern industrial nations	○	○	○	○	○
If things continue on their present course, we will soon experience a major ecological catastrophe	○	○	○	○	○

Next

98 % Completed

Thank you for participating in our survey!

In 3 seconds, you will be redirected back to Legerweb to register your completion.

If the automatic redirect does not work, please CLICK HERE

If you have any questions or would like to know the results of the survey, please contact Colleen Dupont [redacted]

Photographs used in this survey are by TJ Watt and were retrieved from the Ancient Forest Alliance Website

100 % Completed

Appendix C.

Survey Results

Table 12. Survey results reported for the full sample and for each latent class

Source	Variable description	Full sample (n=589)	Class 1 (n = ~287)	Class 2 (n = ~144)	Class 2 (n = ~141)
Q2	Days spent recreating in a typical year	mean = 80 SD = 99	mean = 76 SD =96	mean =94 SD =105	mean =70 SD =95
Q3	Days spent recreating between April 1, 2020, and April 1, 2021	mean = 64 SD = 94	mean = 61 SD = 88	mean =79 SD =104	mean =55 SD =91
Q4	Days spent participating in forested recreation in a typical year	mean = 48 SD = 72	mean = 44 SD = 67	mean =61 SD =86	mean =41 SD =65
Q5	Days spent participating in forested recreation between April 1, 2020, and April 1, 2021	mean = 43 SD = 71	mean = 38 SD =65	mean =56 SD =87	mean =39 SD =67
Q6	Forest activities participated in within the last 5 years.				
	Hiking on a day trip	72%	73%	44%	58%
	Hiking on a multi-day backcountry trip	9%	9%	5%	8%
	Trail running	17%	19%	10%	11%
	Nature viewing or scenic photography	55%	56%	34%	43%
	Mountain biking	9%	9%	5%	10%
	Vehicle-access camping	29%	29%	18%	23%
	Hunting	5%	6%	1%	7%
	Atv-ing	5%	5%	2%	7%
	4-wheel driving	8%	7%	4%	13%
	Snowshoeing	6%	6%	3%	5%
	Skiing	9%	8%	6%	8%
	Other	11%	8%	8%	10%
Q6*	Participated in at least one non-motorized forested activities other than hunting in the last 5 years	82%	84%	91%	69%

Q7	Proportion of forest recreation spent within old growth				
	don't know/none	26%	24%	19%	40%
	1%-24%	32%	31%	34%	29%
	25%-49%	16%	17%	16%	13%
	50%-74%	16%	18%	15%	12%
	75%-99%	9%	7%	14%	5%
	100%	2%	3%	2%	1%
	Average	29%	31%	34%	22%
Q8	Has visited giant trees in an old-growth forest				
	yes	90%	89%	94%	85%
	no	8%	7%	6%	10%
	don't know	3%	4%	0%	5%
Q9	Preferred forest type for recreation				
	Young forests	1.5%	1.5%	0%	3.5%
	Old-growth forests whether or not they have giant trees	23%	24%	34%	10%
	Old-growth forests especially if they have giant trees	35%	39%	44%	19%
	No preference	39%	35%	22%	35%
	Don't know	1%	0.5%	1%	3%
Q10	Visits the study area in a typical year				
	Yes	46%	46%	50%	45%
	No	54%	55%	50%	55%
Q11	Number of days spent in the study area in a typical year	mean = 11.9 SD = 30.3	mean = 8.6 SD =16.3	mean = 15.0 SD = 43.3	mean = 12.4 SD = 28.7
Q12	Reason(s) for spending time in the study area in a typical year[24]				
	live/lived there	2%	2%	2%	1%
	work/worked there	2%	3%	1%	2%
	go there for outdoor recreation	38%	36%	44%	36%
	travel through	14%	15%	14%	13%
	Other	3%	3%	3%	4%

[24] Expressed as percent of total sample or percent of total class (as opposed to percent of people who visit the study area

Q13	Visited the study area between April 1, 2020, and April 1, 2021				
	Yes	25%	26%	29%	18%
	No	75%	74%	71%	83%
Q14	Number of days spent in the study area between April 1, 2020, and April 1, 2021	mean = 17.6 SD = 51.4	mean = 12.2 SD = 37.6	mean = 22.2 SD = 61.7	mean = 29.4 SD = 69.2
Q15	Reason(s) for spending time in the study area between April 1, 2020, and April 1, 2021				
	live/lived there	2%	2%	2%	1%
	work/worked there	1%	2%	1%	1%
	outdoor recreation	20%	20%	25%	14%
	travel through	7%	7%	8%	5%
	Other	2%	2%	3%	2%
Q16	Days spent recreating in old growth within the study area in a typical year	mean = 6.6 SD = 12.4	mean = 5.6 SD = 10.1	mean = 6.3 SD = 9.4	mean = 9.6 SD = 18.9
Q17	Days spent recreating in old growth within the study area between April 1, 2020, and April 1, 2021	mean = 7.5 SD = 14.4	mean = 5.8 SD = 14.0	mean = 7.3 SD = 14.2	mean = 13.7 SD = 29.7
Q18	Importance of old growth recreation areas in the study area				
	Not important at all (1)	2%	2%	1%	6%
	Somewhat important (2)	16%	14%	10%	29%
	Important (3)	22%	25%	15%	25%
	Very Important (4)	56%	57%	73%	34%
	No opinion	3%	2%	1%	5%
	Mean	3.3	3.3	3.6	2.77
Q19	Importance of old growth protection in the study area				
	Not important at all (1)	3%	1%	0%	11%
	Somewhat important (2)	14%	13%	2%	30%
	Important (3)	16%	18%	5%	23%
	Very Important (4)	65%	66%	92%	30%
	No opinion (0)	3%	2%	0%	5%
	Mean	3.4	3.4	3.9	3.0

Q20	Importance of jobs in the study area				
	Not important at all (1)	9.5%	7%	16%	8%
	Somewhat important (2)	27%	27%	41%	12%
	Important (3)	34%	37%	28%	32%
	Very Important (4)	24%	23%	12%	43%
	No opinion (0)	5%	7%	3%	6%
	Mean	2.6	2.6	2.3	3.0
Q11, Q21*	Change in annual number of days in spent in the study area between current conditions and if the program selected in the DCE was implemented	mean= 4.8 SD= 26.0	mean= 4.2 SD= 17.4	mean= 6.3 SD= 38.5	mean= 1.1 SD= 3.0
DCE*	Selected "no program" at least once	47%	42%	18%	93%
DCE*	Selected "no program" every time	8%	0%	0%	32%
Q22	Reason(s) for selecting "no program"[25]				
	Wouldn't be able to afford the tax increase	41%	40%	46%	40%
	The improvements are not good enough for the tax increase	29%	37%	30%	21%
	There is enough old growth protected already	15%	8%	0%	24%
	Don't want more recreation development here	10%	6%	13%	13%
	Those tax dollars could be better spent on other issues	8%	17%	16%	34%
	Don't trust the government to make the changes	19%	20%	25%	17%
	Not enough information to decide	15%	15%	18%	14%
	Concerned about the impact on First Nations	9%	9%	18%	8%
	The reduction in jobs is too high	30%	27%	14%	36%

[25] Expressed as percent of total sample or percent of class who selected "no program" at least once

	Other	6%	5%	8%	8%
Q24	Gender				
	Male	42%	42%	33%	54%
	Female	56%	57%	65%	44%
	Non-binary, gender-fluid and/or Two-Spirit	1%	1%	2%	2%
	No response	1%	1%	1%	0%
Q25	Age	mean = 52.5 SD = 18.2	mean = 50.8 SD = 18.7	mean = 50.8 SD = 18.2	mean = 56.9 SD = 16.7
Q26	Highest education completed				
	No certificate; diploma or degree	1%	0%	2%	2%
	Secondary (high) school diploma or equivalency certificate	22%	23%	21%	22%
	Apprenticeship or trades certificate or diploma	7%	5%	7%	9%
	College/non-university certificate or diploma	24%	24%	25%	24%
	University certificate or diploma below bachelor level	6%	6%	6%	5%
	Bachelor's degree	20%	19%	20%	20%
	University certificate or diploma above bachelor level	5%	4%	5%	4%
	Master's degree	9%	9%	11%	8%
	Doctorate	3%	5%	1%	1%
	Degree in medicine; dentistry; veterinary medicine or optometry	1%	1%	0%	1%
Q27	Number of people in household	mean = 2.3 SD = 1.6	mean = 2.4 SD = 1.4	mean = 2.4 SD = 1.3	mean = 2.3 SD = 2.2
Q28	Number of years living on Vancouver Island	mean = 27.1 SD = 19.9	mean = 26.0 SD = 19.7	mean = 25.0 SD =18.7	mean = 31.3 SD =21.5
Q29	People they know who have worked in forestry in the past 15 years (% of respondents who selected each option)				
	Respondent themselves	83%	8%	4%	13%
	Someone else in their household	2%	2%	2%	1%

	Someone else in their family who does not live with them	12%	13%	11%	13%
	No one	66%	66%	54%	63%
	Don't know	5%	4%	5%	6%
Q30	People they know who became unemployed due to COVID-19				
	Respondent themselves	13%	13%	18%	8%
	Someone else in their household	12%	0%	0%	0%
	Someone else in their family who does not live with them	12%	13%	15%	8%
	Someone else	10%	11%	11%	7%
	No one	60%	59%	54%	66%
	Don't know	5%	3%	5%	7%
Q31	2019 household income before tax				
	< $10,000	1%	1%	1%	0%
	$10,000-$19,999	6%	7%	5%	6%
	$20,000 - $39,999	15%	15%	15%	16%
	$40,000 - $59,999	17%	16%	18%	16%
	$60,000 - $79,999	16%	16%	16%	14%
	$80,000 - $99,999	16%	15%	19%	14%
	$100,000 - $149,999	15%	16%	14%	13%
	$150,000 - $199,999	3%	3%	2%	4%
	$200,000 and over	3%	2%	3%	5%
	Median	$60,000 - $79,999	$60,000 - $79,999	$60,000 - $79,999	$60,000 - $79,999
Q32	2020 household income before tax				
	< $10,000	2%	3%	2%	2%
	$10,000-$19,999	5%	5%	6%	6%
	$20,000 - $39,999	16%	17%	16%	16%
	$40,000 - $59,999	16%	17%	17%	16%
	$60,000 - $79,999	17%	17%	17%	17%
	$80,000 - $99,999	12%	12%	14%	10%
	$100,000 - $149,999	15%	16%	15%	13%
	$150,000 - $199,999	4%	4%	3%	4%
	$200,000 and over	3%	2%	3%	5%
	Median	$60,000 - $79,999	$60,000 - $79,999	$60,000 - $79,999	$60,000 - $79,999

Q31, Q32*	Income increased between 2019 and 2020	12%	13%	13%	9%
Q31, Q32*	Income decreased between 2019 and 2020	13%	14%	15%	9%
Q33	Familiarity with old-growth management in BC				
	Not at all familiar (1)	15.7%	16.2%	10.8%	20.3%
	Slightly familiar (2)	36.6%	38.3%	37.9%	32.8%
	Somewhat familiar (3)	29.6%	30.6%	30.3%	24.8%
	Moderately familiar (4)	13.3%	11.0%	15.1%	16.8%
	Very familiar (5)	4.8%	3.9%	5.9%	5.4%
	Median	2	2	3	2
Q34	Changes to old growth logging they would support				
	An increase in old growth logging across BC	4%	4%	0%	9%
	An increase in old growth logging on Vancouver island	4%	6%	1%	7%
	An end to old growth logging on Vancouver Island	53%	50%	83%	24%
	An end to old growth logging across BC	39%	39%	51%	20%
	Would not support any of these changes	12%	9%	2%	30%
	Don't know	15%	17%	3%	24%
Q35	Familiarity with recent old-growth protests and blockades				
	Not at all familiar (1)	6%	5%	0%	13%
	Slightly familiar (2)	28%	30%	28%	25%
	Somewhat familiar (3)	31%	33%	29%	27%
	Moderately familiar (4)	18%	18%	22%	14%
	Very familiar (5)	17%	14%	20%	21%
	Median	3	3	3	3
Q36	Effect of protests and blockades on the importance of old growth protection				
	Don't know	5%	4%	4%	5%
	Protection is now much less important	4%	2%	0%	13%

	Protection is now less important	5%	5%	0%	9%
	No change	42%	41%	32%	58%
	Protection is now slightly more important	21%	25%	23%	10%
	Protection is now more important	24%	22%	40%	4%
Q37	Effect of severe 2021 wildfire season on the importance of old growth protection				
	Don't know	5%	5%	2%	8%
	Protection is now much less important	2%	1%	1%	4%
	Protection is now less important	2%	3%	0%	4%
	No change	31%	28%	18%	53%
	Protection is now slightly more important	19%	22%	12%	19%
	Protection is now more important	41%	41%	67%	13%
Q38	Trust in the government to make good decision about old growth management				
	Strongly agree	4%	4%	4%	4%
	Agree	16%	19%	7%	18%
	Neutral	32%	35%	25%	37%
	Disagree	29%	28%	36%	26%
	Strongly disagree	18%	14%	28%	14%
Q39	Agreement that citizens of BC should have more say in old growth management than they do at present				
	Strongly agree	33%	29%	54%	13%
	Agree	37%	42%	33%	32%
	Neutral	25%	25%	12%	39%
	Disagree	5%	4%	2%	13%
	Strongly disagree	1%	0%	0%	3%
Q40	Agreement that First Nations in BC should have more say in old growth management than they do at present				
	Strongly agree	33%	29%	53%	18%

	Agree	32%	38%	26%	25%
	Neutral	23%	22%	17%	31%
	Disagree	7%	7%	2%	13%
	Strongly disagree	6%	4%	3%	12%
Q41	Member of and/or donor to an environmental Organization				
	Yes	11%	12%	14%	6%
	No	85%	84%	82%	90%
	Don't know	3%	2%	3%	3%
Q42	Attended an environment-related meeting, lecture, protest, or other environmental event in the last two years				
	Yes	13%	13%	21%	5%
	No	85%	85%	77%	94%
	Don't know	2%	1%	1%	2%
Q43	Disagreement with the following NEP statements (Strongly agree (1), Agree (2), Neutral (3) Disagree (4), Strongly disagree (5))				
	"Humans have the right to modify the natural environment to suit their needs"	mean = 3.4 median = 3	mean = 3.2 median = 3	mean = 3.8 median = 4	mean = 3.0 median = 3
	"When humans interfere with nature, it often produces negative consequences"	mean = 1.9 median = 2	mean = 1.9 median = 2	mean = 1.3 median = 1	mean = 2.3 median = 2
	"Humans are severely abusing the environment"	mean = 1.8 median = 2	mean = 1.8 median = 2	mean = 1.2 median = 1	mean = 2.3 median = 2
	"Plants and animals have as much right to exist as humans"	mean = 1.8 median = 2	mean = 1.8 median = 2	mean = 1.3 median = 1	mean = 2.2 median = 2
	"Nature is resilient enough to cope with the impact of modern industrial nations"	mean = 3.7 median = 4	mean = 3.7 median = 4	mean = 4.3 median = 4	mean = 3.2 median = 3

	"If things continue on their present course, we will soon experience a major ecological catastrophe"	mean = 1.9 median = 2	mean = 1.9 median = 2	mean = 1.2 median = 1	mean = 2.5 median = 3

* Derived from survey responses to the noted questions

Appendix D.

Principal Components Analysis

Table 13. NEP PCA components

Component	Eigenvalues*	% of Variance	Cumulative %
1	3.155959	52.59932	52.59932
2	0.873396	14.55659	67.15591
3	0.733071	12.21785	79.37377
4	0.535467	8.924458	88.29822
5	0.423415	7.056923	95.35515
6	0.278691	4.644853	100

* Eigenvalues measure the amount of variation explained by each principal component.

Table 14. NEP PCA Component 1 loadings

Variable	Component 1
Disagreement with “humans have the right to modify the natural environment to suit their needs”	-0.61823
Disagreement with “When humans interfere with nature, it often produces negative consequences”	0.777438
Disagreement with “humans are severely abusing the environment”	0.82913
Disagreement with “plants and animals have as much right to exist as humans”	0.605732
Disagreement with “nature is resilient enough to cope with the impact of modern industrial nations”	-0.65863
Disagreement with “If things continue on their present course, we will soon experience a major ecological catastrophe”	0.825337

Appendix E.

Correlation Matrices

Table 15. Spearmans's correlation coefficients of the attribute levels in the programs selected by respondents, determined by Spearman's correlation

	Sites w/ giant trees	Sites w/o giant trees	Protection	Jobs	Tax
Sites w/ giant trees	1	N/A	.231**	-0.00873	.355**
Sites w/o giant trees	N/A	1	.303**	-.119**	.141**
Protection	.231**	.303**	1	-.100**	.448**
Jobs	-0.00873	-.119**	-.100**	1	.048**
Tax	.355**	.141**	.448**	.048**	1

Table 16. Spearman's correlation coefficients between importance ratings of study area recreation opportunities, old growth protection, and jobs

	Recreation areas importance rating	Protection importance rating	Jobs importance rating
Recreation areas importance rating	1	.565**	-.043*
Protection importance rating	.565**	1	-.160**
Jobs importance rating	-.043*	-.160**	1

Table 17. Spearman's correlation coefficients between the attributes in the programs selected by respondents and the importance ratings of study area recreation opportunities, old growth protection, and jobs

	Sites w/ giant trees	Sites w/o giant trees	Protection	Jobs	Tax
Recreation areas importance rating	.116**	.069**	.195**	-.050**	.197**

Protection importance rating	.106**	.148**	.291**	-.106**	.267**
Jobs importance rating	-.037*	-.080**	-.183**	.127**	-.120**

Table 18. Spearman's correlation coefficients between the attribute levels in the programs selected by respondents and respondents' recreation and visitation behaviour

	Sites w/ giant trees	**Sites w/o giant trees**	**Protection**	**Jobs**	**Tax**
Annual recreation days in study area old growth	-0.02953	0.033927	0.030367	0.000425	.081**
Annual days in study area	-0.02636	0.004175	0.009717	0.028478	.059*
Annual days participating in forest recreation	0.027065	0.019593	.066**	0.0137	.065**
Annual days participating in old-growth forest recreation	.059**	0.010995	.084**	-0.00016	.117**

Appendix F.

Latent Class Model Goodness-of-Fit Results

Table 19. Goodness-of-fit statistics for LC model iterations

	LL	BIC(LL)	AIC(LL)	AIC3(LL)	$R^2(0)$	R^2
1 Class	-3558.68	7174.542	7131.35	7138.35	0.0956	0.0753
2 Class	-3507.75	7138.056	7045.503	7060.503	0.3588	0.3444
3 Class	-3474.48	7136.865	6994.95	7017.95	0.5023	0.4911
4 Class	-3453	7159.271	6967.995	6998.995	0.8074	0.8031
5 Class	-3432.78	7184.194	6943.557	6982.557	0.8759	0.8731
3 class with covariates	-3099.1706	6548.3999	6284.3413	6327.3413	0.5836	0.5750
3 class with covariates and sites without giant trees set as class independent (final LC model)	-3102.1970	6538.1708	6286.3939	6327.3939	0.5875	0.5789

Appendix G.

Multinomial Logit Model Full Output

Table 20. Full MNL model output from Latent Gold

Model for Choices							
	Class1			Overall			
R^2	0.0753			0.0753			
$R^2(0)$	0.0956			0.0956			
Attributes	Class1	s.e.	z-value	Wald	p-value	Mean	Std.Dev.
Constants							
1	0.0909	0.0270	3.3741	22.5010	1.3e-5	0.0909	.
2	0.0880	0.0288	3.0532			0.0880	.
3	-0.1789	0.0378	-4.7275			-0.1789	.
Protection							
	0.3425	0.0231	14.8425	220.2996	7.8e-50	0.3425	.
SitesGiant							
	0.0545	0.0143	3.8143	14.5488	0.00014	0.0545	.
SitesNoGiant							
	-0.0340	0.0219	-1.5516	2.4073	0.12	-0.0340	.
Jobs							
	0.1624	0.0247	6.5746	43.2252	4.9e-11	0.1624	.
Tax							
	-0.2426	0.0181	-13.3757	178.9097	8.4e-41	-0.2426	.

Appendix H.

Latent Class Model Full Output

Table 21. Full LC model output from Latent Gold

Model for Choices															
	Class1			Class2			Class3			Overall					
R^2	0.1084			0.8455			0.1514			0.5789					
$R^2(0)$	0.2133			0.8850			0.4728			0.5875					
Attributes	Class1	s.e.	z-value	Class2	s.e.	z-value	Class3	s.e.	z-value	Wald	p-value	Wald(=)	p-value	Mean	Std.Dev.
Constants															
1	0.5208	0.1145	4.5494	2.4545	0.7302	3.3614	-2.7667	0.5799	-4.7708	63.3914	9.2e-12	39.9960	4.3e-8	0.2010	1.8699
2	0.3106	0.1060	2.9311	5.0841	1.8601	2.7333	-2.4721	0.5672	-4.3583					0.8314	2.7167
3	-0.8314	0.2032	-4.0920	-7.5386	2.5263	-2.9840	5.2388	1.1099	4.7201					-1.0324	4.5125
Protection															
	0.1204	0.0696	1.7291	7.8675	2.8484	2.7621	0.0651	0.1301	0.4999	10.0055	0.019	7.4837	0.024	2.0615	3.3729
SitesGiant															
	0.1272	0.0305	4.1741	0.6769	0.2636	2.5681	0.0129	0.0750	0.1720	25.9000	1.0e-5	6.3329	0.042	0.2378	0.2593
SitesNoGiant															
	-0.0564	0.0339	-1.6615	-0.0564	0.0339	-1.6615	-0.0564	0.0339	-1.6615	2.7606	0.097	0.0000	.	-0.0564	.
Jobs															
	0.2867	0.0532	5.3890	-0.1723	0.2442	-0.7056	0.5922	0.1333	4.4429	65.7692	3.4e-14	8.6879	0.013	0.2460	0.2728
Tax															
	-0.3391	0.0421	-8.0500	-1.3522	0.5234	-2.5833	-3.6292	0.8507	-4.2662	79.7900	3.4e-17	19.0361	7.4e-5	-1.4030	1.3366
Model for Classes															
Intercept	Class1	s.e.	z-value	Class2	s.e.	z-value	Class3	s.e.	z-value	Wald	p-value				
	0.7163	0.4323	1.6571	-1.6190	0.7220	-2.2425	0.9027	0.3470	2.6013	6.8464	0.033				
Covariates	Class1	s.e.	z-value	Class2	s.e.	z-value	Class3	s.e.	z-value	Wald	p-value				
NEP_PCA															
	0.0686	0.0632	1.0846	-0.8214	0.1031	-7.9708	0.7529	0.0879	8.5635	77.1240	1.8e-17				
protest_aware															
0	0.2022	0.3392	0.5961	-1.0180	0.6218	-1.6371	0.8158	0.3032	2.6908	20.2542	4.0e-5				
1	-0.2022	0.3392	-0.5961	1.0180	0.6218	1.6371	-0.8158	0.3032	-2.6908						
rec_mostaffectedbyOG															
0	-0.0822	0.0714	-1.1514	-0.1691	0.0910	-1.8574	0.2513	0.0675	3.7246	14.2700	0.00080				
1	0.0822	0.0714	1.1514	0.1691	0.0910	1.8574	-0.2513	0.0675	-3.7246						
over_40															
0	0.1558	0.0596	2.6135	0.1773	0.0687	2.5809	-0.3331	0.0812	-4.1010	16.9615	0.00021				
1	-0.1558	0.0596	-2.6135	-0.1773	0.0687	-2.5809	0.3331	0.0812	4.1010						
renfrew_user															
0	0.0843	0.0525	1.6057	0.0985	0.0594	1.6602	-0.1828	0.0598	-3.0570	9.4155	0.0090				
1	-0.0843	0.0525	-1.6057	-0.0985	0.0594	-1.6602	0.1828	0.0598	3.0570						
nanaimo															
0	0.1150	0.0715	1.6082	0.1335	0.0857	1.5571	-0.2484	0.0695	-3.5764	13.2812	0.0013				
1	-0.1150	0.0715	-1.6082	-0.1335	0.0857	-1.5571	0.2484	0.0695	3.5764						
forest_preference															
dont_know	-0.6902	0.4116	-1.6770	0.0224	0.4728	0.0474	0.6678	0.3230	2.0675	37.6215	8.8e-6				
no_preference	-0.0904	0.2039	-0.4435	0.0060	0.3156	0.0189	0.0845	0.1648	0.5126						
old_general	0.2517	0.2106	1.1954	0.4336	0.3175	1.3657	-0.6854	0.2062	-3.3236						
old_giant	0.2846	0.2022	1.4075	0.3542	0.3138	1.1286	-0.6388	0.1802	-3.5441						
young	0.2443	0.6671	0.3662	-0.8162	1.1562	-0.7059	0.5719	0.5431	1.0530						

Appendix I.

Known Class Choice Models

Table 22. Known class model output for testing free-riding

Model for Choices												
	Class1			Class2			Overall					
R^2	0.0969			0.1199			0.1063					
$R^2(0)$	0.1704			0.2028			0.1836					
Attributes	Class1	s.e.	z-value	Class2	s.e.	z-value	Wald	p-value	Wald(=)	p-value	Mean	Std.Dev.
Constants												
1	0.3249	0.0341	9.5156	0.3739	0.0423	8.8449	269.6970	3.7e-57	1.4257	0.49	0.3448	0.0240
2	0.2870	0.0361	7.9549	0.3358	0.0447	7.5119					0.3069	0.0240
3	-0.6120	0.0511	-11.9862	-0.7097	0.0642	-11.0595					-0.6517	0.0480
Protection												
	0.3816	0.0289	13.1945	0.4378	0.0359	12.2039	323.0309	7.2e-71	1.4885	0.22	0.4044	0.0276
SitesGiant												
	0.0779	0.0175	4.4384	0.1015	0.0216	4.6975	41.7655	8.5e-10	0.7205	0.40	0.0875	0.0116
SitesNoGiant												
	-0.0498	0.0266	-1.8698	-0.0353	0.0328	-1.0768	4.6556	0.098	0.1183	0.73	-0.0439	0.0071
Jobs												
	0.1982	0.0307	6.4514	0.2185	0.0378	5.7875	75.1158	4.9e-17	0.1749	0.68	0.2065	0.0100
Tax												
	-0.2408	0.0211	-11.4256	-0.2712	0.0263	-10.3040	236.7150	4.0e-52	0.8142	0.37	-0.2532	0.0149
Model for Classes												
Intercept	Class1	s.e.	z-value	Class2	s.e.	z-value	Wald	p-value				
	0.1888	0.0162	11.6656	-0.1888	0.0162	-11.6656	136.0854	1.9e-31				

In the known class model presented in Table 22, class 1(n=391) is all respondents who answered the DCE follow-up question that attempted to identify free riders (Q22b). I added this question to the survey after data collection began, so only 391 respondents answered this question. Class 2 is the same sample as class 1, but with the respondents who answered that they either thought their household wouldn't need to pay the tax or that they did not consider their household budget excluded, which left 268 respondents. This model resulted in insignificant differences (based on Wald(=) p-values) between classes for all attributes.

Table 23. Known class model output for testing protest responses

Model for Choices												
	Class1			Class2			Overall					
R^2	0.0753			0.0960			0.0874					
$R^2(0)$	0.0956			0.1515			0.1224					
Attributes	Class1	s.e.	z-value	Class2	s.e.	z-value	Wald	p-value	Wald(=)	p-value	Mean	Std.Dev.
Constants												
1	0.0909	0.0270	3.3736	0.2350	0.0287	8.1945	143.5495	4.9e-30	25.0201	3.7e-6	0.1600	0.0720
2	0.0880	0.0288	3.0525	0.2257	0.0304	7.4249					0.1539	0.0688
3	-0.1789	0.0378	-4.7266	-0.4607	0.0420	-10.9688					-0.3139	0.1408
Protection												
	0.3425	0.0231	14.8435	0.3725	0.0244	15.2977	454.3507	2.2e-99	0.7997	0.37	0.3569	0.0150
SitesGiant												
	0.0545	0.0143	3.8146	0.0638	0.0149	4.2910	32.9640	6.9e-8	0.2063	0.65	0.0590	0.0047
SitesNoGiant												
	-0.0340	0.0219	-1.5518	-0.0347	0.0226	-1.5341	4.7617	0.092	0.0004	0.98	-0.0343	0.0003
Jobs												
	0.1624	0.0247	6.5751	0.1816	0.0260	6.9778	91.9224	1.1e-20	0.2864	0.59	0.1716	0.0096
Tax												
	-0.2427	0.0181	-13.3765	-0.2606	0.0187	-13.9082	372.3676	1.4e-81	0.4689	0.49	-0.2513	0.0089
Model for Classes												
Intercept	Class1	s.e.	z-value	Class2	s.e.	z-value	Wald	p-value				
	0.0416	0.0121	3.4220	-0.0416	0.0121	-3.4220	11.7104	0.00062				

In the known class model presented in Table 24, class 1 (n=589) is the full sample that remained after removing invalid responses. In this class, respondents who chose the status quo every time were removed only if they answered that they do not trust the government to implement the program or that they did not have enough information to decide in the DCE follow-up (Q22b). Other respondents who chose the status quo every time were retained. In class 2 (n=542), all respondents who chose the status quo every time were removed. This model resulted in insignificant differences (based on Wald(=) p-values) between classes for all attributes.

Table 24. Known class model output for comparing users, potential users, and non-users of the study area

Model for Choices															
	Class1			Class2			Class3			Overall					
R^2	0.0866			0.1070			0.0505			0.1048					
$R^2(0)$	0.1134			0.1869			0.0579			0.1244					
Attributes	Class1	s.e.	z-value	Class2	s.e.	z-value	Class3	s.e.	z-value	Wald	p-value	Wald(=)	p-value	Mean	Std.Dev.
Constants															
1	0.1199	0.0437	2.7468	0.3409	0.0478	7.1328	-0.2001	0.0553	-3.6187	133.9305	1.9e-26	109.3652	9.9e-23	0.1133	0.2085
2	0.1204	0.0462	2.6061	0.3283	0.0495	6.6296	-0.2062	0.0619	-3.3335					0.1075	0.2062
3	-0.2403	0.0621	-3.8683	-0.6692	0.0707	-9.4658	0.4063	0.0758	5.3620					-0.2209	0.4147
Protection															
	0.3951	0.0370	10.6848	0.3665	0.0401	9.1341	0.2524	0.0465	5.4263	227.0413	6.0e-49	6.0632	0.048	0.3481	0.0580
SitesGiant															
	0.0601	0.0234	2.5696	0.0807	0.0238	3.3841	0.0092	0.0294	0.3121	18.1525	0.00041	3.6451	0.16	0.0540	0.0280
SitesNoGiant															
	-0.0686	0.0360	-1.9027	-0.0276	0.0356	-0.7770	0.0090	0.0449	0.2011	4.2644	0.23	1.8688	0.39	-0.0342	0.0311
Jobs															
	0.1993	0.0393	5.0709	0.1639	0.0424	3.8671	0.1418	0.0508	2.7917	48.4615	1.7e-10	0.8707	0.65	0.1721	0.0235
Tax															
	-0.2153	0.0286	-7.5169	-0.2575	0.0288	-8.9345	-0.3157	0.0449	-7.0327	185.7879	5.0e-40	3.6807	0.16	-0.2560	0.0398
Model for Classes															
Intercept	Class1	s.e.	z-value	Class2	s.e.	z-value	Class3	s.e.	z-value	Wald	p-value				
	0.1816	0.0230	7.8805	0.0530	0.0237	2.2322	-0.2346	0.0256	-9.1695	96.9277	9.0e-22				

Appendix J.

Old Growth Strategic Review Recommendations

The 14 recommendations in Gorley & Merkel (2020a) are:

1. Engage the full involvement of Indigenous leaders and organizations to review this report and any subsequent policy or strategy development and implementation.

2. Declare conservation of ecosystem health and biodiversity of British Columbia's forests as an overarching priority and enact legislation that legally establishes this priority for all sectors.

3. Adopt a three-zone forest management framework to guide forest planning and decision-making.

4. Adopt a more inclusive and stable governance model that gives local communities and stakeholders a greater role in forest management decisions that affect them.

5. Provide the public with timely and objective information about forest conditions and trends.

6. Until a new strategy is implemented, defer development in old forests where ecosystems are at very high and near-term risk of irreversible biodiversity loss.

7. Bring management of old forests into compliance with existing provincial targets and guidelines for maintaining biological diversity.

8. Establish and fund a more robust monitoring and evaluation system for updating management of old forests.

9. Establish a standardized system and guidance that integrates provincial goals and priorities to local objectives and targets.

10. Update the targets for retention and management of old and ancient forest.

11. Improve the mapping and classification of old forests to recognize multiple values.

12. Create a silviculture innovation program aimed at developing harvesting alternatives to clearcutting that maintain old forest values.