

DISSERTATION

MEASURING CITIZENS' PREFERENCES FOR PROTECTING ENVIRONMENTAL
RESOURCES: APPLICATIONS OF CHOICE EXPERIMENT SURVEYS, SOCIAL
NETWORK ANALYSIS AND DELIBERATIVE CITIZENS' JURIES

Submitted by

Solomon Geleta

Department of Agricultural and Resource Economics

In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Spring 2017

Doctoral Committee:

Advisor: John Loomis

Co-Advisor: Johannus Janmaat

Stephen Davies

Stephan Kroll

Brett Buyere

Copyright by Solomon Geleta 2017

All Rights Reserved

ABSTRACT

MEASURING CITIZENS' PREFERENCES FOR PROTECTING ENVIRONMENTAL RESOURCES: APPLICATIONS OF CHOICE EXPERIMENT SURVEYS, SOCIAL NETWORK ANALYSIS AND DELIBERATIVE CITIZENS' JURIES

Many reasons have been suggested as explanation for observed differences in citizens' environmental conservation projects policy choices and willingness-to-pay (WTP) values. Some people attribute this distinctive decision behavior to contrasts in the overall policy outcome expectations (preference heterogeneity) and/or differences in reactions to the changes in the environmental attributes (response heterogeneity). Others attribute this to differences in individual choice rationales, personalities, encounters, and past and present experiences. In other words, regardless of the possibility that outcomes are the same, people do not have the same emotions, convictions, disposition, or motivations.

In three separate essays, I investigate the possible reasons for the observed differences in citizens' environmental conservation policy choices and examine how preference and response heterogeneity arise. In the first essay, I ask if a priori environmental damage perception is a source of heterogeneity affecting conservation option choice decisions. In the second, I investigate if social networks (interactions among decision-making agents) affect choice decisions. In the third, I investigate if preferences change when decision making agents are allowed to deliberate among peers.

For the first essay, I conducted an on-line choice experiment (CE) survey. The survey asked questions that help measure citizen preference for protecting environmental public goods, ascertain the value local residents are willing-to-pay (WTP), and determine how preference heterogeneity arises. CE attributes included groundwater use (measured by share of total water use from groundwater), aquatic habitat (measured by count of spawning kokanee salmon return), natural habitat health (measured by the sensitive ecosystem area reclaimed), and rural character (measured by a decrease in urban sprawl and/or a decrease in population density in rural areas). I used a special property levy as the vehicle of

payment. Random parameter logit (RP) and latent class (LC) models were estimated to capture response and preference heterogeneity. The results suggest that (1) both preference and response heterogeneities were found for the choices and all environmental attributes respectively (2) respondents who have a higher value for one environmental good will have a higher value for other environmental goods, and (3) a priori damage perception could be one of the sources of response and preference heterogeneity.

In the same survey, I included people's egocentric networks, interactions, environment related activities and perceptions to empirically evaluate whether social network effect (SNE) is a source of systematic differences in preference. I estimate consumer preferences for a hypothetical future environmental conservation management alternative described by its attributes within a Nested Logit Model: nesting broader and distinct conservation options within choices impacted by individuals network structure. The results show that some network centrality measures capture preference heterogeneity, and consequently the differences in WTP values in a systematic way.

Third, I compare the value estimated based on the traditional choice experiment (CE) with the results obtained using the citizen jury (CJ) approach or a group-based approach or also called the "Market Stall" in some literature. I estimate the effect of deliberation on conservation choice outcomes by removing any significant differences between the people who participated in the CJ (people who volunteered to be contacted again after deliberation treatment) and those people who did the survey twice but did not volunteer for CJ (control group) in terms of their socioeconomic status and be able attribute the changes in preferences to deliberation treatment only. CJ approach involved two 90 minute deliberations held over two days to discuss and consider their preferences and WTP values with other household members. Results show that deliberation improves individuals' valuation process and there is observed difference in choice outcomes between the deliberation treatment and control groups. Both preference and response heterogeneity relatively vanish when people were given more time and allowed to deliberate among peers.

ACKNOWLEDGEMENTS

Completing this dissertation would not have been possible without the support of several people and institutions. First and foremost, I hold immense gratitude for the Agricultural and Resource Economics Department for giving me the opportunity to study at Colorado State University and for funding my study all along. I would like to thank all of my professors, a number of friends and colleagues who contributed to my PhD adventure.

I thank my main advisor Dr. John Loomis for his guidance and persistent encouragement, inspiring and always enriching comments, and immense hard work editing my drafts and securing funding that allowed me to finish this work. I am extremely honored to have him as my advisor. His comments gave this dissertation life.

I would like to thank my co-advisor, Dr. John Janmaat, for trusting me to work on this project; extending the funding required for this research; helping me to build the online survey tools; sitting with me for many hours discussing, editing, and rewriting questionnaires, letters, models; and letting me vent my frustrations during my stay at University of British Columbia (UBC) at Okanagan. I cannot thank him enough for his professional help.

I also wish to thank Dr. Stephen Davies not only for serving as my committee member but also for helping me with my teaching and research assistantship positions during his stay at Colorado State University as the Agricultural and Resource Economics Department Chair. I also thank my committee members, Dr. Stephan Kroll and Dr. Brett Bruyere, for their help, comments, and great questions that refined my thoughts on many issues, especially during my dissertation defense.

I am grateful to the University of British Columbia, at Okanagan, Irving K. Barber School of Arts and Sciences, where I spent two years as a researcher and sessional lecturer. They provided me with conducive and stimulating work environments. I am also thankful to the Social Sciences and Humanities Research Council (SSHRC), Canada, for funding this project. A special thank you goes to Regional District of Central Okanagan District (RDCO) for helping me work in the region with full support from the very start of issue

identification to the final deliberation session. Margaret Bakelaar, in particular, provided extraordinary help. I would say she owned this project doing innumerable tasks for me. I also thank Darwin Horning for helping me with facilitating the deliberation sessions. I owe a thank you to all expert witnesses for being enthusiastic about the project and making themselves available for any questions raised by our survey participants. I would also like to thank Matthew Flyr for reviewing, editing, and suggesting important changes.

I would like to sincerely thank my family for their patience for about 5 years. I admit that I was selfish and required my kids, Ayan and Gelan, had to do many things difficult for their age. I could not be any prouder or happier to see you become such a capable and independent individuals regardless of what you both went through. I also thank Emebet Lema for being such a selfless and responsible mother.

Last but not least, I thank my very good friend Dr.Bekele Debele for his extraordinary help whenever and wherever I needed. “A friend in need is a friend indeed.”

This dissertation is typeset in L^AT_EX using a document class designed by Leif Anderson.

TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS	iv
LIST OF TABLES	x
LIST OF FIGURES	xii
CHAPTER 1. INTRODUCTION	1
CHAPTER 2. INCORPORATING PREFERENCE AND RESPONSE HETEROGENEITIES INTO A CHOICE EXPERIMENT: VALUING WATERSHED PROTECTION	3
2.1. INTRODUCTION	3
2.2. REGIONAL CONTEXT	6
2.3. LITERATURE REVIEW	9
2.4. VALUATION SCENARIO	12
2.5. EXPERIMENTAL DESIGN	16
2.6. SURVEY INSTRUMENT: ON-LINE SURVEY AND SAMPLING	17
2.7. METHODOLOGY	20
2.8. ECONOMETRIC MODEL AND ESTIMATION	22
2.8.1. CONSERVATION OPTION-SPECIFIC INTERCEPTS: PREFERENCE HETEROGENEITY	23
2.8.2. CONSERVATION ATTRIBUTES WITH RANDOM COEFFICIENTS: RESPONSE HETEROGENEITY	24
2.8.3. ESTIMATION PROCEDURE	25
2.9. DATA AND EMPIRICAL RESULTS	27
2.9.1. STANDARD CONDITIONAL FIXED EFFECT LOGIT MODEL	28
2.9.2. RANDOM ALTERNATIVE-SPECIFIC INTERCEPTS: PREFERENCE HETEROGENEITY	30

2.9.3.	RANDOM ALTERNATIVE-SPECIFIC COEFFICIENTS: RESPONSE HETEROGENEITY	31
2.9.4.	LATENT CLASS MODEL	41
2.10.	MEAN WILLINGNESS TO PAY (MWTP) AND WELFARE ESTIMATES .	54
2.11.	CONCLUSION	59
 CHAPTER 3. ON MEASURING SOCIAL NETWORK EFFECT IN CONSERVATION OPTION CHOICES: THE RANDOM UTILITY MAXIMIZATION NESTED LOGIT APPROACH		
3.1.	INTRODUCTION	60
3.2.	LITERATURE REVIEW: SOCIAL NETWORK THEORIES	62
3.3.	SOCIAL NETWORK MODEL.....	64
3.4.	THE SURVEY: SOCIAL NETWORK DATA.....	70
3.5.	EGOCENTRIC NETWORK MEASURES	76
3.6.	ECONOMETRIC MODEL: NESTED LOGIT MODEL	79
3.7.	RESULTS AND DISCUSSION.....	84
3.8.	CONCLUSION	98
 CHAPTER 4. ON USING DELIBERATIVE/CITIZENS JURIES APPROACH TO MEASURE PREFERENCE HETEROGENEITY WITHIN CHOICE EXPERIMENT SURVEYS.....		
4.1.	INTRODUCTION	99
4.2.	LITERATURE REVIEW	102
4.3.	THEORETICAL METHODOLOGY.....	105
4.4.	EMPIRICAL METHODOLOGY: CJ PROCEDURES.....	109
	DISCUSSION AND MOTIVATION TOPICS.....	114
4.5.	ECONOMETRIC MODEL.....	116
4.6.	RESULTS	118
4.6.1.	CITIZEN JURY (CJ) DELIBERATION TREATMENT.....	118

4.6.2. RANDOM PARAMETER MODEL RESULT.....	121
4.6.3. CJ GROUP RESULT	129
4.7. CONCLUSION	133
CHAPTER 5. CONCLUSION.....	134
BIBLIOGRAPHY	139
APPENDIX A. DATA SUMMARY.....	162
APPENDIX B. QUESTIONNAIRE.....	167
B.1. INTRODUCTION.....	167
B.2. ABOUT THIS SURVEY	167
B.3. PART ONE: BACKGROUND.....	168
B.4. YOUR VIEWS ABOUT THE OKANAGAN ENVIRONMENT.....	168
B.5. HOW ENVIRONMENTAL RESOURCES HAVE BEEN CHANGING.....	170
B.6. MANAGEMENT OPTIONS.....	171
B.7. PAYING FOR IT	171
B.8. PART TWO: COMPARING OUTCOMES/YOUR CHOICE.....	172
B.9. MANAGEMENT SCENARIOS.....	172
B.10. FOLLOW UP.....	180
B.11. PART THREE: YOUR COMMUNITY/NETWORK.....	182
B.12. PART FOUR: ABOUT THE INFORMATION PROVIDED.....	187
B.13. WE WOULD LIKE TO KNOW MORE.....	188
B.14. PART FIVE: ABOUT YOU.....	189
APPENDIX C. LETTER OF INVITATION FOR PILOT TEST.....	194
APPENDIX D. PILOT TEST REMINDER.....	196
APPENDIX E. INVITATION LETTER.....	198
APPENDIX F. REMINDER LETTER.....	200

APPENDIX G. PROJECT OVERVIEW FOR EXPERT WITNESSES..... 202

APPENDIX H. EXPERT OPINION: ISSUE IDENTIFICATION STAGE:
TRANSCRIPT 204

APPENDIX I. CONTROL SAMPLE: INVITATION LETTER..... 224

APPENDIX J. INVITATION TO PARTICIPATE IN A CITIZENS' JURY..... 225

APPENDIX K. DELIBERATION WORKSHOP PROTOCOL..... 227

APPENDIX L. PARTICIPATION IN A CITIZENS' JURY: CONSENT FORM.... 230

APPENDIX M. QUESTIONS FOR EXPERT WITNESSES..... 233

APPENDIX N. DEBRIEFING QUESTIONS..... 239

LIST OF TABLES

2.1	ATTRIBUTE LEVELS AND DESCRIPTIONS	14
2.2	ALTERNATIVE AND INDIVIDUAL SPECIFIC COVARIATES	29
2.3	PREFERENCE HETEROGENEITY AND RESPONSE	32
2.4	ANOVA: ATTRIBUTES BY OPTIONS.....	34
2.5	CORRELATED NORMALLY DISTRIBUTED COEFFICIENTS	38
2.6	LATENT CLASS SELECTION CRITERIA	42
2.7	A PRIORI ENVIRONMENTAL VIEWS	43
2.8	LATENT CLASS MODEL (LCM) WITH 5 CLASSES	45
2.9	PARAMETRIC ESTIMATES BY PERCEPTION GROUP	47
2.10	PROPORTION OF CHOICES BY PERCEPTION CLASSES AND OPTIONS CHOSEN	48
2.11	MEAN WILLINGNESS TO PAY (MWTP) ESTIMATES.....	55
2.12	WILLINGNESS TO PAY ESTIMATES (MWTP) BY PERCEPTION CLASS .	56
2.13	WELFARE ESTIMATES UNDER PERCEPTION GROUPS INFLUENCING POLICY IMPLEMENTATIONS (NOT DISCOUNTED AND IN \$ 000'S CAD)	58
3.1	SOCIAL NETWORK PARAMETERS SUMMARY	79
3.2	TREE STRUCTURE SPECIFIED FOR THE NESTED LOGIT MODEL	85
3.3	DEGREE CENTRALITY MEASURE.....	90
3.4	CLOSENESS CENTRALITY MEASURE	91
3.5	TRANSITIVITY MEASURE.....	92
3.6	LOCAL CLUSTERING COEFFICIENT MEASURE.....	93
3.7	EIGENVECTOR CENTRALITY MEASURE	94
3.8	WTP VALUES WITH AND WITHOUT NETWORK EFFECT.....	97

4.1	ESTIMATED PROPENSITY SCORE	120
4.2	BASELINE CHARACTERISTICS	123
4.3	CHANGE IN PREFERENCE AFTER CITIZEN JURY	124
4.4	DELIBERATION TREATMENT SAMPLE CORROLATED COEFFICIENTS	125
4.5	CONTROL SAMPLE CORRELATED COEFFICIENTS	126
4.6	MAIN SURVEY SAMPLE CORRELATED COEFFICIENTS	127
4.7	LIKELIHOOD RATIO TESTS	127
4.8	CHANGE IN PREFERENCE BEFORE AND AFTER DELIBERATION	129
4.9	SCENARIO 1 ALLOCATION: 60 MILLION CAD	130
4.10	SCENARIO 2 ALLOCATION: 120 MILLION CAD	130
4.11	WTP VALUES AFTER CONTROLLING FOR DELIBERATION EFFECT ...	132
4.12	BENEFIT-COST (B/C) ESTIMATES IN CAD	132
A.1	VARIABLES BY FUTURE ENVIRONMENTAL MANAGEMENT OPTION CHOSEN	162
A.2	VARIABLES BY FUTURE ENVIRONMENTAL MANAGEMENT OPTION CHOSEN	163
A.3	VARIABLES BY FUTURE ENVIRONMENTAL MANAGEMENT OPTION CHOSEN	164
A.4	A PRIORI ENVIRONMENTAL PERCEPTION BY OPTIONS CHOSEN	165
A.5	PARTIAL DATA LIST	166
N.1	DEBRIEFING QUESTIONS	239

LIST OF FIGURES

2.1	REGIONAL DISTRICT OF CENTRAL OKANAGAN	7
2.2	ENVIRONMENTAL ATTRIBUTE INDICATORS	13
2.3	SAMPLE STATED CHOICE SCREEN	18
2.4	MEAN ATTRIBUTE LEVELS BY OPTIONS	35
2.5	MEAN ATTRIBUTE LEVELS BY OPTIONS	36
2.6	MEAN COST LEVEL BY OPTIONS	37
2.7	COEFFICIENT VARIATIONS KERNEL DENSITY	40
2.8	PERCEPTION DISSIMILARITY (MDS) PLOT	44
2.9	OPTION CHOSEN BY PERCEPTION CLASSES	49
2.10	OPTION CHOSEN BY PERCEPTION CLASSES	50
2.11	OPTION CHOSEN BY PERCEPTION CLASSES	51
2.12	OPTION CHOSEN BY PERCEPTION CLASSES	52
2.13	OPTION CHOSEN BY PERCEPTION CLASSES	53
3.1	COMPLETE EGOCENTRIC NETWORK	74
3.2	UNDIRECTED EGO-ALTER AND ALTER-ALTER TIES	75
3.3	CORRELATION PLOT FOR ALTERNATIVES CHOSEN AND CENTRALITY MEASURES	87
3.4	CORRELATION PLOT FOR ALTERNATIVES CHOSEN AND CENTRALITY MEASURES	88
3.5	CORRELATION PLOT FOR ALTERNATIVES CHOSEN AND CENTRALITY MEASURES	88
4.1	DECISION CHALLENGE: SCENARIO 1	112
4.2	DECISION CHALLENGE: SCENARIO 2	114

4.3	TREATMENT AND CONTROL GROUP OVERLAP	121
4.4	ESTIMATED PROPENSITY SCORE DISTRIBUTION	122
4.5	PROPENSITY SCORE DISTRIBUTION DENSITIES	122
B.1	ATTRIBUTE DESCRIPTION	173
B.2	CHOICE CARD-1.1	176

CHAPTER 1

INTRODUCTION

This dissertation includes three separate essays that empirically measure citizens' preference for conserving environmental natural resources using three interrelated and widely used methods in natural resource and environmental economics. The data utilized in these essays comes from the Choice Experiment (CE) survey conducted in the Regional District of Central Okanagan (RDCO) in the Province of British Columbia, Canada, between January - May, 2015.

The first essay, *Incorporating Preference Heterogeneity into a Choice Experiment: Valuing Watershed Protection*, investigates the source of preference heterogeneity using Random Parameter (RP) and Latent Class (LC) models. Random Parameter (RP) and/or Latent Class (LC) models are state-of-the-art econometric methods commonly used to capture unobserved heterogeneity, incorporating variables that are believed to be correlated with preferences (taste parameters) and responses (choice attributes). Preference and response heterogeneity are commonly mentioned as reasons for the observed differences in policy choices and the willingness-to-pay (WTP) values in the literature. The results show that households with the same demographic and socioeconomic characteristics display different choice decisions, likely due to the overall policy related outcome expectations, personalized reactions to the changes in the environmental attributes, and a priori perception about environmental damage.

The second essay, *On Measuring Social Network Effect in Conservation Option Choices: The Random Utility Maximization Nested Logit Approach*, explores people's choice decisions for a hypothetical future environmental conservation management alternative, introducing social network centrality measures into the model. The results show a significant interaction effect comparable to the traditional choice experiment result. Here, it was possible to measure citizens' preference for conservation options using a Nested Logit Model (NLM): nesting broader and distinct conservation options within choices impacted by an individual's

egocentric network structure. The clustering coefficient and closeness centrality performed better than the degree, transitivity and eigenvector centrality measures, implying that if two people in a social network have a friend in common, then information spreads fast from a given node to other reachable nodes in the network and that there is an increased likelihood they all will become friends themselves at some point in the future and their decisions and future choices will most likely be interdependent.

The third essay, *On Using Deliberative/Citizens Juries Approach to Measure Preference Heterogeneity within Choice Experiment Surveys*, compares the values estimated in the traditional choice experiment (CE) approach with the results obtained using the citizen jury (CJ) experiment within the same hypothetical conservation option scenarios. The experiment involved two 90 minute sessions of CJ deliberation held over two days. Participants were recruited from those volunteers who showed interest in participating after completing the original choice experiment survey. During the deliberation, participants were given more time to consider their preferences and to discuss their WTP values with other household members. The result shows that CJ deliberation improves individuals valuation process and the WTP amounts reflect community values compared to the traditional choice experiment results.

CHAPTER 2

INCORPORATING PREFERENCE AND RESPONSE HETEROGENEITIES INTO A CHOICE EXPERIMENT: VALUING WATERSHED PROTECTION

2.1. INTRODUCTION

Preference and response heterogeneities are often important reasons for the observed differences in environmental conservation project policy choices and the willingness-to-pay (WTP) values. Households with the same demographic and socioeconomic characteristics and facing similar choice decision scenarios might show distinctive decision behavior because of contrasts in the overall policy outcome expectations (preference heterogeneity), and differences in their reactions to the changes in the environmental attributes (response heterogeneity).

In environmental economics, random parameter (RP) and/or latent class (LC) type models have been utilized widely to capture these unobserved heterogeneities by incorporating variables that are believed to be correlated with preferences (taste parameters) and responses (choice attributes). Other studies have investigated many other econometric methods in the estimation procedure within Daniel McFaddens utility-maximization based multinomial response models (Train, 2009, Morey et al., 2008, Adamowicz et al., 1998a, Álvarez-Farizo and Hanley, 2006b, Boxall et al., 1996, Louviere et al., 2000, Hanley et al., 2006, Bennett and Blamey, 2001, Hanemann, 1989, Dissanayake and Ando, 2014).

One of the survey methodologies employed is choice experiment.¹ It is a survey method used for modeling preferences for a good, where the good is described in terms of its attributes and the levels that these attributes take (Powe et al., 2005, Adamowicz et al., 1998b, Álvarez-Farizo and Hanley, 2006b, Boxall et al., 1996, Louviere et al., 2000, Hanley et al., 2006,

¹In the context of environmental valuation methods, its essential elements include: the presentation of the scenario and good valued; the payment vehicle; and the transaction method (Powe et al., 2005).

Bennett and Blamey, 2001). Unlike the contingent valuation method², where respondents are required to express the maximum willingness-to-pay or the minimum willingness-to-accept for a hypothetical change in the level of provision of a good in its totality, respondents are required to repeatedly choose the best option from a few hypothetical choices described in terms of their individually valued attributes (Powe et al., 2005, Hanley et al., 2001, Dissanayake and Önal, 2011). Within this model, policy specific attributes are allowed to vary systematically to uncover unobserved heterogeneity from parameter estimates. To recover WTP from peoples choices, price (cost) is included as one of the attributes (Adamowicz et al., 1998a, Hanley et al., 2001, Hensher and Greene, 2003, Adamowicz et al., 1994b).

Experimental design techniques are used to identify combinations of attributes and levels to create the question sets appearing on each survey. The design objective is typically to find a small set of choice combinations that provides enough coverage to identify the influences of changes in the levels of each included attribute. However, all valuation studies are limited by the accuracy with which they represent the preferences of those included in the study. There is a trade-off between parsimony and data collection cost on the one hand, and the risk of omitting important variables on the other.³

Moreover, individual choices are based on numerous rationales, personalities, encounters, and past and present experiences. People do not have the same emotions, convictions, or disposition, and even if decisions are the same, people have different motivations (Fishbein and Ajzen, 1975, Koundouri et al., 2014). In particular, there are similarities and differences in individuals perception of the economic, human health, and ecosystem consequences of these environmental issues (Farizo et al., 2014).

²See Adamowicz et al. (1994b), Boxall et al. (1996), Adamowicz et al. (1998a), Hanley et al. (1998), Blamey et al. (1999), Bateman et al. (1994), Hausman (2012) for comparisons between contingent valuation and choice experiment.

³ See Farber et al. (2002), Hanley et al. (2001), Hensher et al. (2005), Hoyos (2010), Carson et al. (2014b,a), Carson and Louviere (2010) for reviews of the choice experiment methodology and for some discussion of the wider context within which stated preferences can be used in environmental valuation.

The goal of this chapter is to show how a choice experiment survey technique can likewise be utilized to quantify individuals trade-offs among conservation attributes considering individuals socio-economic differences and a priori heterogeneous subjective evaluations of the degree or level of environmental damage. I specifically inquire whether individuals level of concern matters in the trade-off among conservation options and in the amount of stated WTP for the attributes. I do this by estimating consumer preferences for environmental conservation options described by multiple environmental attributes within random coefficients and latent class models.⁴ Within these frameworks, “it is possible to incorporate additional individual difference measures to capture observable heterogeneity in systematic (deterministic) utility components, instead of leaving them to random components exclusively (Farizo et al., 2014)”. I use data from a choice experiment survey I conducted in the Regional District of Central Okanagan (RDCO) between January - May, 2015. In this survey, respondents were asked to state their preferences for a hypothetical policy alternative targeting environmental conservation.

The remainder of the chapter is organized as follows. Section 2 provides a regional context. Part 3 reviews the literature. Part 4-6 addresses the valuation scenario, experimental design and survey instrument. In parts 7 and 8, I discuss the econometric and estimation methodology: the Mixed Logit (RP) and Latent class (LC) models used to obtain parameter estimates. Part 9 reports and discusses the results of my analysis. I draw some conclusions and reflect on limitations of this study in part 10.

⁴see Farizo et al. (2014), Hanley et al. (2001), Dissanayake and Önal (2011), Lundhede et al. (2015) and many others for similar analysis.

2.2. REGIONAL CONTEXT

The Regional District of Central Okanagan (RDco), part of the southern interior of British Columbia, Canada, is located approximately 400 kilometers east of Vancouver in British Columbia's interior plateau. It is largely defined by its mix of mountains, lakes, wetlands, watercourses, forests, grasslands, vineyards and orchards (Okanagan Water Stewardship Council, 2008). It includes an area extending from Oyama in the north to Peachland in the south and easterly and westerly to the Okanagan basin watershed boundary.⁵ Okanagan Lake is the main central feature in the Central Okanagan, providing a unique and beautiful landscape as well as the basic sustenance needed for a vibrant community and economy (Okanagan Water Stewardship Council, 2008). Valleys of the Okanagan Lake chain run north and south between high plateaus, which contain the source of many streams draining into the Okanagan lakes. The climate of the Okanagan Basin is somewhat less continental than the rest of the interior of the province (Okanagan Water Stewardship Council, 2008). It is characterized by cool humid air and cloudy skies in winter and by dry air with bright skies in summer. The warm summers with fairly low humidity and the relatively mild winters provide an attractive environment for agriculture and recreation (Wikipedia, 2012, Regional District of Central Okanagan, 2012, 2013).

Population growth, about 1.8% annualized change between 2001-2015 (BCstats, 2012), regional economic growth, and climate change are placing pressure on environmental resources of the Okanagan. Some of the highly impacted environmental resources include foreshore areas, groundwater resources, aquatic species, natural habitats and rural character. Most worrisome is the shoreline of Okanagan Lake which contains habitats that are critical for wildlife, rare plants and terrestrial communities, and fish populations (e.g. Kokanee, rainbow trout, etc.) (Regional District of Central Okanagan, 2005, 2011). Aquatic health is threatened by shoreline development, invasive species, pollution, etc. For instance, the Biophysical Characteristics of Okanagan Lake Foreshore Inventory and Mapping which was

⁵see map 1 RDco (2016)

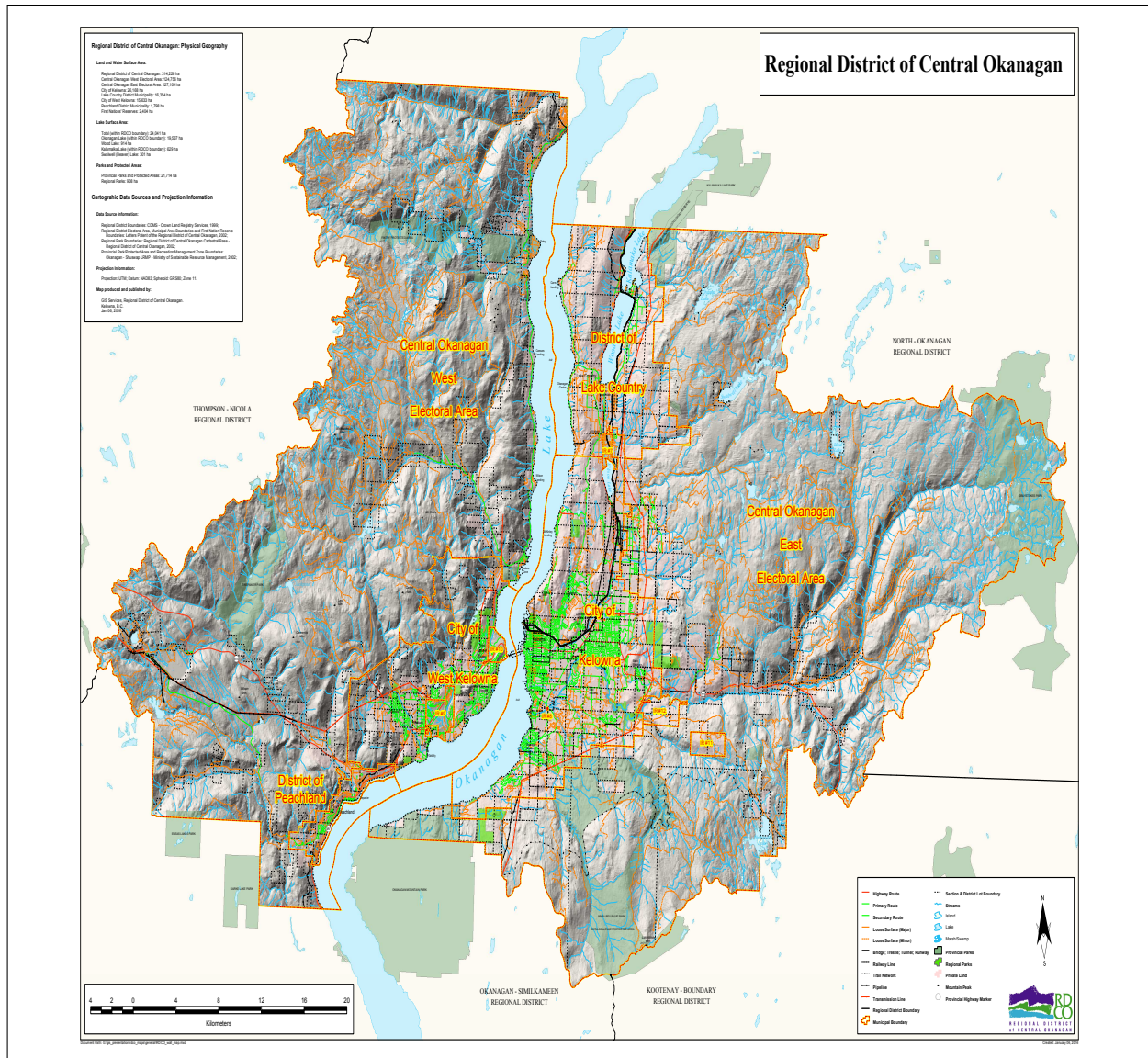


FIGURE 2.1. Regional District of Central Okanagan.
 Source: http://www.regionaldistrict.com/media/192361/rd_map_small.pdf, 2016.

completed on 289 km of shoreline on Okanagan Lake showed that the total length of disturbed shoreline was 164 km, which represents 57% of the total natural shorelines length (Regional District of Central Okanagan, 2005, 2011). The single family residential, transportation, agriculture, recreation (i.e., campgrounds, etc.), and urban parks are the major land use type significantly contributing to the disturbance of the shoreline ecosystem (Regional District of Central Okanagan, 2005, 2011). The riparian vegetation have been completely removed or replaced with non-native species (Regional District of Central Okanagan, 2005,

2011). Modifications to the foreshore are extensive and likely continuous and include a large number of docks (Regional District of Central Okanagan, 2005, 2011). A review of the natural and disturbed areas within the Okanagan Large Lakes protocol shows that Kokanee shore spawning areas are substantially disturbed (Regional District of Central Okanagan, 2005, 2011, Shepherd, 1999). Spawning kokanee numbers have fallen from over 1 million to about 40,000 between 1973 and 2010, a decrease of 90% (Shepherd, 1999). In addition to a variety of other factors that may have contributed to the situation, the introduction of an exotic species, the opossum shrimp (*Mysis relicta*) is likely to have aggravated the decline (Shepherd, 1999). Currently, only 43% of this shoreline lake is estimated to remain natural. Much of these natural shorelines occur in rural areas that are prone to future development (Regional District of Central Okanagan, 2005, 2011).

Moreover, the total annual hectare decline of permanent wetlands, old growth forests, foreshore ecosystems has been tremendous. Most surface sources of water in the Okanagan are fully allocated and there is an increasing groundwater use to the extent that threatens springs and wetlands that are important for natural habitats. For example, more than 90% of the wetland area and 73% of foreshore area has been either lost or disturbed in the Okanagan Valley since 1800 (Okanagan Collaborative Conservation Program, 2014). In addition, growth and development combined with urban expansion contributed to rural areas losing their unique “country character”, history, and close ties to the land. The amount of open space and farm land is shrinking and conflicts between farmers and non-farm residents is on the rise. The context shown above highlights the importance of implementing long term projects to conserve remaining important natural areas and prioritizing habitat improvements where feasible. Local governments have a number of choices they can make to balance the demands for development against the environmental impacts. These include: undertaking research to better understand impacts on the environment and identifying protection strategies; modifying local building requirements to control groundwater pumping and potential contamination sources; investing in better monitoring of water quality, habitat health, groundwater levels, etc.; strengthening regulations and increasing enforcement to

limit development on agricultural and rural lands; pursuing easements, covenants and similar arrangements with property owners to protect sensitive habitats and rural character; acquiring properties important for protecting habitats and/or providing recreational opportunities; and tightly enforcing zoning to limit development that harms the environment and/or changes rural character.

2.3. LITERATURE REVIEW

The literature in the field of non-market valuation is numerous and cannot be exhaustively listed here. Some samples from studies over the years include: the reduction of old growth timber harvests (Knowler and Dust, 2008), preserving the northern spotted owl (Rubin et al., 1991), benefits of phosphorus pollution reductions (Mathews et al., 2002), valuing water quality improvements (Van Houtven et al., 2007, Stumborg et al., 2001), the values of restoring an impaired river basin (Loomis et al., 2000), the value of preserving urban open space (Kovacs and Larson, 2008), total economic value of restoring ecosystem services (Zhongmin et al., 2003), benefits of woodland restoration in native forests (MacMillan and Duff, 1998), benefits of riparian wetland restoration (Meyerhoff and Dehnhardt, 2007), and benefits of mangrove restoration (Stone et al., 2008), among others.⁶⁷

However, not much of the literature has examined the non-monetary motives of heterogeneity in eliciting willingness to pay amounts. Some have considered social-psychology techniques in the CV method (Spash, 2008, Kotchen and Reiling, 2000). Kellert and Berry

⁶see Hanley et al. (2001), Adamowicz et al. (1998a), Álvarez-Farizo and Hanley (2006b), Boxall et al. (1996), Louviere et al. (2000), Hanley et al. (2006), Bennett and Blamey (2001), Meldrum (2015), Meyerhoff (2006), Breffle et al. (2011), Choi and Fielding (2013), Bujosa et al. (2010), Scholte et al. (2015), Dissanayake and Ando (2014), Haan and Uhendorff (2006), Dissanayake and Ando, Csuti et al. (1997), Ando et al. (1998), Önal (2004), Kharouba and Kerr (2010) for many more illustrations.

⁷Quite a bit of these literature focuses on single measure of conservation successes using CV methodology and consequently is not able to identify the sources of citizens' preference heterogeneity. Exceptions are studies by Loomis and Larson (1994) and Dissanayake and Ando (2014) which goes beyond single conservation success and show that wildlife population density is also an important variable affecting the public's WTP for habitats. Christie et al. (2006) study public preferences and WTP for biodiversity in general, and Meyerhoff et al. (2009) find that the species richness is a significant attribute that determines the WTP for forest conservation.

(1980) suggested affection as one of the motivational considerations; Serpell (1996) identified affection and sympathy for animals as drivers; others identified species size (Bitgood et al., 1988) or morphology (Lorenz, 2013, Martín-López et al., 2007) influencing human preferences, and others focused on perceptions affected by past and present interactions with particular species, including cultural factors, such as religiosity or traditional practices, and social factors, such as property relationships or recreational use (Martín-López et al., 2007).

Several other studies have demonstrated the influence of socioeconomic variables in attitudes towards non-human species. For instance, women tend to show stronger affective and weaker utility orientations than men (Kellert and Berry, 1980), other studies have discussed urban versus rural residents, more educated versus lower educated (Kellert and Berry, 1980) and peoples knowledge of species influencing attitudes (Martín-López et al., 2007) such as experience with the good. For example, Carson et al. (2001) discuss how marginal WTP will decrease with experience or as more of a public good is provided. This follows from the idea of a downward sloping demand function. That is, the presence of an environmental public good can lead to learning, experience, and appreciation such that agents who currently experience high levels of the public good may have a higher WTP for more of that good (Cameron and Englin, 1997, OHara and Stagl, 2002). This was explained using endogenous preference theory, which argues that consumers who are familiar with a good may be willing to pay more than consumers who are unfamiliar with the good (Bowles, 1998, OHara and Stagl, 2002, Zizzo, 2003, Gowdy, 2004). Cameron and Englin (1997) confirm this that experience can lead to higher resource values using a CV study of WTP for trout fishing. They find that experience, measured by the number of years in which the respondent has gone fishing, has a significant positive impact on the WTP. A related theory of planned behavior proposed by Ajzen (1991) states that WTP is expected to increase with a more favorable attitude toward paying for a good.

However, none of the above studies include a priori perception and subjective individual assessment of the degree of environmental damage as a source of preference and response

heterogeneity. This makes it difficult to understand why respondents with the same demographic and socioeconomic characteristics and facing similar choice decision scenarios choose the alternative associated with a change or no change from the “no action” status quo situation distinctly. This is an important issue because if such a priori individual damage appraisal exists, then it should be expressly addressed in the empirical model.

In this chapter, I use mixed logit, also called Random Parameter (RP) and Latent Class Models (LC)⁸ to measure preference and response heterogeneity and to see if they are related to individual a priori subjective appraisal of environmental damage. To the best of my knowledge, no past study has examined endogenous preferences in the context of respondents a priori subjective evaluation of damages applied to many environmental goods at a time. Methodologically, it is an extension of previous stated preference based environmental valuation literature attempting to address sources of preference heterogeneity. The most closely related studies are papers by Morey et al. (2008), Boxall and Adamowicz (2002), and Lundhede et al. (2015). Morey et al. (2008) examined the likelihood of heterogeneity in preferences for landscape preservation in the context of a latent class model under the assumption of the existence of some finite number of preference classes/groups. Here, class probabilities were a function of observable characteristics of individual attitude related to the importance of preservation and why they think that preservation is (or is not) important. Their results show four distinct preference classes varying in the level of importance attached to preservation and the motivation for preservation (e.g. use vs non-use motivations). Boxall and Adamowicz (2002) examined welfare measures of some hypothetical policy changes using finite mixture conditional logit models (RP) in which latent classes (LC) was used to identify systematic heterogeneity. The model was applied to wilderness recreation in a branded choice experiment involving the choice of one park from a demand system, and was administered to a sample of recreationists. Attitudinal measures of motivations for taking a trip, as well as their stated preferences over wilderness

⁸see Train and Weeks (2005), Dissanayake and Ando (2014), Morey et al. (2006), Johnston et al. (2007), Munizaga and Alvarez-Daziano (2001) for RP and LC applications among many others.

park attributes, determined class membership. A paper by Lundhede et al. (2015) considers respondents a priori assessments of outcome uncertainty in a choice experiment eliciting respondents preferences for conservation policies under climate change. Their findings show that higher outcome uncertainty reduces utility and that prior beliefs play a significant role in the cost of uncertainty.

2.4. VALUATION SCENARIO

Households were required to compare the various possible consequences and trade-offs that could result from the local government’s environmental conservation policy menu. The policy menu presents three hypothetical alternative conservation measures. It includes the “no action” status quo option which reflects the continuation of the prevailing environmental condition to 2045. The other two options involve additional management actions that would lead to different environmental goods and services outcomes by 2045. The alternatives were presented in the form of choice cards with sets of three future scenarios to compare, described by a short list of environmental attribute and attribute levels. Indicators were used for each attribute to provide a sense of how well their choices would achieve environmental conservation goals. The environmental attribute indicators were chosen in conversation with local experts, and all were field tested for relevance. All attributes and levels were illustrated using images where the number of images shows the direction of the change. Figure 2.2 presents the attributes and attribute indicators used in the survey. Each attribute has three levels and the levels are presented in the order of presumed value, with the highest-valued level presented first for all attributes (See table 2.1). For example, for the share of total water use from groundwater, the best level is 10%, which is a 50% reduction in the share of total water use from groundwater; levels 15% and 20% are the next best and current groundwater uses, respectively. All other attributes and attribute levels are interpreted similarly, demonstrating how environmental attributes change over the planning period.

The part of the environmental costs that cannot be acquired through other channels-such as development cost charges-will need to be paid for through household annual payments.






	ATTRIBUTE DESCRIPTION
<p>Share of Total Water Use from Groundwater</p> 	<p>GROUND WATER USE: Groundwater is an important source of water we use and supports springs and wetlands that are important natural habitats. Increasing ground water use threatens these habitats. Most surface sources in the Okanagan are fully allocated. Increasing the share of total use from groundwater also reflects an increase in overall water use and in the amount of groundwater used.</p>
<p>Count of Spawning Kokanee Salmon</p> 	<p>AQUATIC HABITAT HEALTH : Aquatic health is threatened by shoreline development, invasive species pollution, etc. Species such as Kokanee salmon are sensitive to the overall health of the aquatic environment. Since the 70's, spawning Kokanee numbers in Okanagan lake have fallen from over 1 million to about 40,000.</p>
<p>Sensitive Ecosystem Area Lost</p> 	<p>NATURAL HABITATS: Natural habitats, such as wetlands, forests, natural grasslands, etc. provide a range of environmental goods and services. These environmental resources and services are largely lost if the land is developed.</p>
<p>Population Density in Rural Areas</p> 	<p>RURAL CHARACTER: Rural areas have a unique character that reflects their history and close ties to the land. Increasing development and population growth in rural areas increases traffic, reduces the amount of open space, increases conflict between farmers and non-farm residents, and impacts natural habitats.</p>
<p>Special Property Levy</p> 	<p>COST: The tools that can reduce groundwater use, improve aquatic health, limit loss of natural habitats and reduce population growth in rural areas do have a cost. However they are paid, they will leave your household with less money to spend each year.</p>

FIGURE 2.2. Environmental attribute indicators and attribute descriptions.

Therefore, cost is the most important attribute. Unlike utility charges most studies use, property tax was chosen for the payment vehicle. It was picked in light of the fact that property taxes have been utilized in the region as a method of raising cash in many jurisdictions for many environmental activities and projects. For example, the H_2O aquatic

center in Kelowna was funded in part by a levy on Kelowna properties of about \$0.21 per \$1,000 value for twenty years, and ongoing activities to control Eurasian Milfoil in valley lakes is paid for by a \$0.057 per \$1,000 collected for Okanagan Basin watershed issues. This latter levy has been adjusted as needed, and was as low as \$0.21 per \$1,000 in the 70s, when valley waste water collection and treatment systems needed upgrades to protect Okanagan Lake water quality. In the 70's, community leaders in the Okanagan also opted to implement a levy on all properties in the Okanagan basin to fund waste water treatment upgrades, upgrades that have successfully improved lake water quality. Therefore, in all the scenarios, two different increases in a special levy on property values were proposed, with the money collected to be directed to achieving the environmental changes described. These increases are \$0.05 per \$1000 and \$0.10 per \$1000 property value. Per property, the average additional charge would be about \$20 or \$40 per year, respectively. This levy will be in effect starting 2015 and continuing into the future for 30 years. Each section of the survey questionnaire started with clear instructions that sets out

TABLE 2.1. Attribute Levels and Descriptions

Variable	Attribute Levels	Description
β_2 [<i>Groundwater</i>]	(10%, 15%, 20%)	Share of total water use from groundwater
β_3 [<i>Aquatic Health</i>]	(60, 000, 50, 000, 40, 000)	Count of spawning Kokanee Salmon return
β_4 [<i>Habitat Loss</i>]	(0, 50, 100km ²)	Sensitive ecosystem area lost
β_5 [<i>Rural Character</i>]	(60, 70, 75persons/km ²)	Population density in rural areas
β_6 [<i>Cost</i>]	(0.00, \$20/\$400, 000, \$40/\$400, 000)	Special property levy

the context very carefully. First was a short introduction followed by an environmental status description, basic prior subjective damage assessment questions, then the valuation tasks, elicited discrete choice experiment(CE) values, and follow-up questions. The final section asks demographic questions.

Each respondent was told what the consequence of their choice would be related to household income specifically. That is, property and other taxes and household expenses

may increase in the future for reasons unrelated to this conservation project. In addition, respondents were informed of the possible ways the local government could spend the money. These include: undertaking research to better understand impacts on the environment and identifying preservation strategies; modifying provincial regulations to control groundwater pumping and potential contamination sources; investing in better monitoring of water quality, habitat health, groundwater levels, etc.; strengthening regulations and increasing enforcement to limit development on agricultural and rural lands; pursuing covenants, incentives, and other voluntary arrangements with property owners to protect sensitive habitats and rural character; acquiring land with important habitats and/or that provides recreational opportunities; tightly enforcing official community plans and zoning to limit development that harms the environment and/or changes rural character. Finally, respondents were walked through an example choice card before moving on to the choices. See Appendix “B” for the complete survey questionnaire.

2.5. EXPERIMENTAL DESIGN

The standard approach to designing choice experiments is to hold the status quo situation constant at the baseline attributes and zero cost level over all the choice sets.⁹ Similarly, efficient designs in contrast to orthogonal designs was used, keeping the status quo situation at the baseline level over all the choice sets. Efficient design is widely used mainly because it is good at maintaining attribute level balance and that an attribute occurrence is equally likely exact number of times.¹⁰ According Rose et al. (2009), “experimental design is efficient if the design yields data that enables estimation of the parameters with as low as possible standard errors. These standard errors can be predicted by determining the Asymptotic Variance-Covariance Matrix (AVC) based on the underlying experiment and some prior information about the parameter estimates. Efficient designs do not merely try to minimize the correlation in the data for estimation purposes, but aim to result in data that generates parameter estimates with as small as possible standard errors.”

This survey design is a 60 profile in 30 choice situations. All were generated from the prevailing “no action” status quo condition using Ngene software (Metrics, 2014). Ngene software is one of the stated choice (SC) experimental design software widely used with extensive range of features, outputs and flexibility. The Ngene design syntax comprises three elements: alts (for alternatives), rows (the number of choice profiles) and model (utility functions). The alts property defines which alternatives are present in the choice model. The rows property defines how many choice situations need to be generated. The model property defines the choice model by describing the complete utility function for each alternative (Metrics, 2014).¹¹ Essentially, it pivots the baseline initial quantity or low quality of the attributes up or down by a predetermined amount, say 10%. That gives us 60 treatment combinations of choice tasks, which were blocked into 10 designs of 6 choices,

⁹ A novel approach is to incorporate heterogeneity into the design of the status quo scenario alternative. See Dhar (1997), Kontoleon and Yabe (2003), Street et al. (2005), Domínguez-Torreiro and Soliño (2011) for the details.

¹⁰see Rose et al. (2009) for more on this.

¹¹See Metrics (2014) for basic syntax structure and the choice generating functions for any number of attribute and attribute levels.

out of which 30 treatment combinations were randomly chosen and blocked into 5 designs of 6 choice tasks similar to Sandor and Wedel (2001), Ferrini and Scarpa (2007), Rose and Bliemer (2009). Here, the alternative that clearly dominates was avoided because it will not give us useful information about the trade-offs. For example, in a choice situation where one of the alternatives has both better or the same environmental condition as all other alternatives, and a lower levy (cost) makes it clearly the preferred alternative and we exclude it. In other words, in all choice situations, there is no strictly dominant alternative and the respondent has to make a trade-off between environmental management options considering each attribute levels and property levy, which will affect the household budget. This will compromise the efficiency of the choice sets to some degree but it is what is called “balancing the utilities of alternatives (i.e., having no alternatives that are clearly dominating the others)” in the literature (Hensher and Greene, 2003, Rose et al., 2009).¹² Crabbe and Vandebroek (2012) suggests the use of prior information to avoid choice sets with a dominant alternative from statistically efficient designs. Moreover, within each version, the order of the choice situations has been randomized to control for order effect (Hensher and Greene, 2003). For example, the levels appearing for alternative 2 in choice card one should always be different from those of alternative 2 appearing in choice card 3 for the same respondent. See the sample choice card in figure 2.3 and all cards including respondent’s choice options amongst the three stated choice alternatives in Appendix “B”.

2.6. SURVEY INSTRUMENT: ON-LINE SURVEY AND SAMPLING

Survey participants were randomly recruited from a list of Central Okanagan addresses using directories available on the Internet (Canada 411). Households were chosen over individuals as the target population, mainly because budgetary consumption decisions are

¹²Note that, “this could lead to the understanding that in the most efficient design, all the choice situations are perfectly utility balanced. If all alternatives have an equal observed utility, then the random unobserved component dominates. In other words, then the respondent has no clear preference for any of the alternatives and randomly selects one. This too does not give information. Therefore it can be concluded that an efficient design has some degree of utility balance, but not too much, and not too little. Utility balance of a choice situation and a whole design can be expressed in a percentage (Rose et al., 2009).”

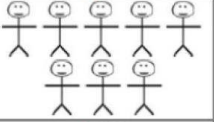
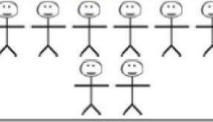
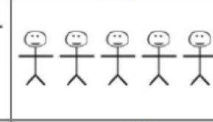
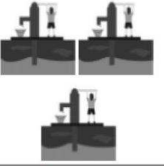







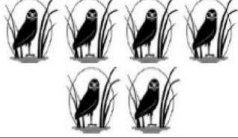



ENVIRONMENTAL RESOURCES INDICATOR	STATUS QUO	OPTION 1	OPTION 2
Density:	75 ppl/km²	75 ppl/km²	60 ppl/km²
RURAL CHARACTER (population density in rural areas)			
Share:	20%	10%	20%
GROUND WATER USE (Share of total water use from groundwater)			
Returns:	40,000	50,000	50,000
AQUATIC HABITAT HEALTH (Count of spawning Kokanee Salmon)			
Loss:	100 km²	100 km²	0 km²
NATURAL HABITATS (Sensitive Ecosystem Area Lost)			
Levy:	\$0.00	\$0.05 per \$1000	\$0.10 per \$1000
COST (Special Property Levy)	 \$0.00	 \$20 on \$400,000 house	 \$40 on \$400,000 house
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your preferred option without status quo		<input type="radio"/>	<input type="radio"/>

FIGURE 2.3. Sample Stated Choice Screen

often made at a household rather than an individual level and property taxes are paid at the household level rather than the individual level. The survey was conducted online, with face-to-face interviews left open given the complexity of the survey instrument and its length and for those individuals unable to do the online survey using computers.

Since engaging with residents has an important impact on how people relate to the environment, we extensively communicated and, consulted with residents and advised

experts to identify and prioritize important local environmental issues. The first step was introducing the project to regional stakeholders so that proper information would be available and issue identification could be performed. Hence, we sent a letter to the Regional District of Central Okanagan officials (RDCO). In the letter we outlined the objectives, stated who is funding and supporting the project, who the research team comprise, and what exactly the survey would look like and want to achieve. Five broad issue areas were identified, discussed, and ranked in terms of local sustainability, importance to local residents and motivated by our intent to explore endogenous preferences regarding common measures of conservation success.

The second step was a pre-test of the draft questionnaire. Prior to the main online survey, a pre-test of the questionnaire was conducted with a sample of residents both face-to-face and online. This led to the final adjustments to the presentation and wording of the questionnaire so that respondents could fully understand the questions. Then, the letter of invitation together with the link and access code to the online survey was sent to the general public sample participants. The online survey was made available from January to May, 2015. See Appendix C to F for the sample invitation and reminder letters.

The online survey was deemed to be an appropriate and cost-effective tool on the conviction that the use of computers and internet among RDCO residents is high.¹³ Similar online Discrete Choice Experiment (DCE) survey was administered by Breustedt et al. (2008) in Germany to explore the factors affecting farmer' willingness to cultivate genetically modified oilseed rape. Schulz et al. (2014) applied a similar online DCE approach to investigate farmers preferences for alternative greening provisions. We executed some laptop-based face-to-face and over the phone interviews at interviewee request. In these cases, each respondent was asked to complete the survey in the presence of an interviewer at their residence or over the phone with the help of employed student.

¹³According to Paul Budde Communication Pty Ltd (2016) "Canada has one of the highest broadband penetration rates among the OECD nations. Government policy has encouraged widespread broadband availability, particularly in rural and regional areas, resulting in 98% of Canadians being able to access broadband services."

Accordingly, each sampled respondent evaluated 6 stated choice situations, making two choices: the first involving choosing amongst three labeled stated choice alternatives including the the “no action” status quo alternative, and the second involving choosing amongst the two stated choice alternatives (Options 1 and 2), status quo alternative excluded. A total of 3000 households were invited, 550 started the on-line survey, which yielded 468 completed questionnaires (16% response rate), producing 2808 observations for model estimation (i.e. 468×6 choice situations). Although, administering the survey online resulted in a lower response rate compared to the total number of invited households, the sample’s demographic characteristics are not statistically different from region’s population profile. For example, in 2015, 81% of the province’s population is 19 years and above old; 45 years and above old make up greater than 50%. Similarly, our respondents age group is 19 years and above old; 75% are 45 years and above old. The proportion of males and females in the province is 50% while our data comprise about 65% male and 35% female respondents. Therefore, this data is fairly representative and the sample size is comparable to Espinosa-Goded et al. (2010), who interviewed 100 farmers in the region of Andalusia and 200 farmers in the Aragon region of Spain with similar demographic profile. However, this survey is not free of some of the undesirable respondent behaviors faced in online surveys: speeding, random responding, and survey fatigues or premature termination. Moreover, the use of mobile phones, which are mostly private and inaccessible through public directories such as Canada 411, and other technical glitches could have contributed to lower response rate.

2.7. METHODOLOGY

The theoretical premise of individual or homogeneous population choice behavior in the choice experiment approach comes from Lancaster’s model of consumer choice (Lancaster, 1966). The technical novelty of Lancaster (1966)’s approach “lies in breaking away from the traditional approach that goods are the direct objects of utility and, instead, supposing that it is the properties or characteristics of the goods from which utility is derived.” Hence,

a good can be described by the attributes that generate utility or disutility to individuals (McFadden et al., 1973, Ouma et al., 2007, Thiene et al., 2014). In other words, consumers get satisfaction not from goods themselves but rather from its attributes. In this way, it utilizes the random utility model concept to explain individual’s choice decisions making functional assumptions for the utility derived from the available alternatives (Thiene et al., 2014, Ouma et al., 2007, McFadden et al., 1973).

According to this framework, the rational choice for the subject i is to choose the alternative for which his or her utility is the highest (Rabe-Hesketh and Skrondal, 2012, Adamowicz et al., 1998a). That means, alternative j is chosen by subject i if the utility of this alternative is greater than the utility of any other alternative k :

$$(1) \quad U_i^j > U_i^k \text{ for all } j \neq k$$

Assuming the utilities U_i^j are a linear functions of subject-specific covariates x_i and alternative specific covariates z_i^j , it can be formalized as:

$$(2) \quad U_i^j = \beta_1^j + \beta_2^j x_i + \beta_3 z_i^j + \epsilon_i^j$$

Equation (2) can be decomposed into the deterministic part, defined by linear-in-parameters functions $V_i^j = \beta_1^j + \beta_2^j x_i + \beta_3 z_i^j$ of observable characteristics x_i of the decision-making individual and observable attributes z_i^j of the choice alternative for a given decision-making individual, and the stochastic part ϵ_i^j , that varies over both alternatives and subjects. This stochastic part represents the unobservable influence on individual choice (unobserved heterogeneity) (Rabe-Hesketh and Skrondal, 2012, Adamowicz et al., 1998a). “Such unobserved heterogeneity may arise from unobserved attributes of the choice alternatives, unobserved characteristics of the decision-making entities, or simply measurement errors in observed characteristics and/or attributes (Adamowicz et al., 1998a).”¹⁴

¹⁴Also, in the case where instrumental variables are used as a proxy for variables which are not observable, the error term is relevant for capturing unobserved heterogeneity (Adamowicz et al., 1998a, Dugundji and Gulyás, 2008)

Therefore, the probability of choosing an alternative, say status quo [1] given the covariates becomes:

$$\begin{aligned}
(3) \quad Pr(y_i = j^{[st. Quo]} | x_i, z_i^j) &= Pr(U_i^{[st. Quo]} > U_i^{[Opt. 1]}, U_i^{[st. Quo]} > U_i^{[Opt. 2]}) \\
&= Pr(U_i^{[st. Quo]} - U_i^{[Opt. 1]} > 0), \dots \\
&= Pr(\epsilon_i^{[st. Quo]} - \epsilon_i^{[Opt. 1]} > V_i^{[st. Quo]} - V_i^{[Opt. 1]}), \dots
\end{aligned}$$

where:

$$\begin{aligned}
(4) \quad V_i^{[st. Quo]} - V_i^{[Opt. 1]} &= \beta_1^{[st. Quo]} - \beta_1^{[Opt. 1]} + (\beta_2^{[st. Quo]} - \beta_2^{[Opt. 1]})x_i + \dots \\
V_i^{[st. Quo]} - V_i^{[Opt. 2]} &= \beta_1^{[st. Quo]} - \beta_1^{[Opt. 2]} + (\beta_2^{[st. Quo]} - \beta_2^{[Opt. 2]})x_i + \dots
\end{aligned}$$

Similar procedure apply if any of the other alternative is chosen.¹⁵ Only the difference between intercepts $(\beta_1^{[st. Quo]} - \beta_1^{[Opt. 1]})$ and subject-specific coefficients $(\beta_2^{[st. Quo]} - \beta_2^{[Opt. 1]})$ are identified. However, the intercepts and subject-specific coefficients are identified once we fix the intercepts and coefficients for a base or reference category (status quo alternative to zero in this case) (Rabe-Hesketh and Skrondal, 2012, Adamowicz et al., 1998a).¹⁶

2.8. ECONOMETRIC MODEL AND ESTIMATION

The assumption of conditional logit models (CL) that conservation option choices are independent over choice repetition, given all the attributes and individual characteristics is unrealistic. Individuals make repeated choices and there is longitudinal dependence. To accommodate this dependence, we introduce household and choice specific random effects similar to Rabe-Hesketh and Skrondal (2012). In the random effects specification, the micro-level parameters are assumed to be randomly distributed across households following

¹⁵The term $\beta_1^{[j]}$ is an alternative specific constant included to explicitly account for any underlying bias for one over another alternative.

¹⁶The assumption in the rational Choice framework is that choices are independent over choice occasion, choice repetitions and households. That means, the Status Quo alternative is chosen by household i at choice occasion t if the utility is higher than the utilities of conservation option 1 and 2: $U_{it}^{[st. Quo]} > U_{it}^{[Opt. 1]}$ and $U_{it}^{[st. Quo]} > U_{it}^{[Opt. 2]}$. Similarly if conservation option 1 is chosen, $U_{it}^{[Opt. 1]} > U_{it}^{[st. Quo]}$ and $U_{it}^{[Opt. 1]} > U_{it}^{[Opt. 2]}$ and if conservation option 2 is chosen, $U_{it}^{[Opt. 2]} > U_{it}^{[st. Quo]}$ and $U_{it}^{[Opt. 2]} > U_{it}^{[Opt. 1]}$.

a multivariate probability distribution (Rabe-Hesketh and Skrondal, 2012, Jain et al., 1994, Rossi and Allenby, 1993).

Therefore, the random effects represent unobserved heterogeneity related to individuals preference for one conservation option over the other or household specific responses to conservation attributes related to one's experience such as interaction with local environment, available information, occupation, perceptions and/or other effects and variations.

2.8.1. CONSERVATION OPTION-SPECIFIC INTERCEPTS: PREFERENCE HETEROGENEITY. Closely following Rabe-Hesketh and Skrondal (2012) and considering the status quo option as reference category, I use the following logit formulation for conservation option choice behavior, where superscripts [1,2,3] stand for status quo, option 1 and option 2 respectively:

$$(5) \quad P(y_{it} = j | z_{kt}^1, z_{kt}^2, z_{kt}^3) = \frac{\exp \left\{ \beta_1^2 \phi_2^j + \beta_1^3 \phi_3^j + \sum_{k=1}^K \beta_k z_{kt}^j \right\}}{\sum_{j=1}^3 \exp \left\{ \beta_1^2 \phi_2^j + \beta_1^3 \phi_3^j + \sum_{k=1}^K \beta_k z_{kt}^j \right\}}$$

where $P(y_{it} = j)$ is the probability that the i^{th} household chooses alternative j in the choice occasion t , $i = 1, 2, \dots, N$; z_{kt}^j is a vector of attributes faced by household i under conservation option j in the t^{th} choice occasion; β_1^j is the alternative specific intercept terms included using the dummy variables ϕ_1^j and ϕ_3^j for conservation options 1 and 2 and representing the preference of the household i for conservation option j , and β_k is the response coefficient of household i for the k^{th} attribute (covariate), ($k = 1, 2, \dots, K$). The logit model formulation above is equivalent to the linear model for the utility U_{it}^j of alternative j for household i at the t^{th} choice occasion.

$$(6) \quad U_{it}^j = \beta_1^2 \phi_2^j + \beta_1^3 \phi_3^j + \sum_{k=1}^K \beta_k z_{kt}^j + \epsilon_{it}^j$$

Equation 5 takes the following form when preference heterogeneity or conservation option specific random intercepts ξ_{1i}^j is introduced :

$$(7) \quad P(y_{it} = j | z_{kt}^1, \dots, \xi_{1i}^2, \xi_{1i}^3) = \frac{\exp \left\{ (\beta_1^2 + \xi_{1i}^2) \phi_2^j + (\beta_1^3 + \xi_{1i}^3) \phi_3^j + \sum_{k=1}^K \beta_k z_{kt}^j \right\}}{\sum_{j=1}^3 \exp \left\{ (\beta_1^2 + \xi_{1i}^2) \phi_2^j + (\beta_1^3 + \xi_{1i}^3) \phi_3^j + \sum_{k=1}^K \beta_k z_{kt}^j \right\}}$$

The term $\beta_1^j + \xi_{1i}^j$ is the total alternative-specific intercepts for alternative j , composed of the sum of the fixed alternative-specific intercepts β_1^j and random deviation ξ_{1i}^j for household j . This formulation is equivalent to the linear model for the utility U_{it}^j of alternative j for household i at the t^{th} choice repetition (Rabe-Hesketh and Skrondal, 2012).

$$(8) \quad U_{it}^j = (\beta_1^{[2]} + \xi_{1i}^2) \phi_2^j + (\beta_1^3 + \xi_{1i}^3) \phi_3^j + \sum_{k=1}^K \beta_k z_{kt}^j + \epsilon_{it}^j$$

Equation 7 states that utilities are no longer independent and the assumption of independence of irrelevant alternative (IIA) is relaxed and $\xi_{1i}^{[j]}$ is the random alternative-specific intercepts that are shared among conservation choice options over choice occasions of a household. The error term has a Gumbel distributions (with Variance $\pi^2/6$) that are independent over alternatives, choice occasions, and households (Rabe-Hesketh and Skrondal, 2012).¹⁷

2.8.2. CONSERVATION ATTRIBUTES WITH RANDOM COEFFICIENTS: RESPONSE HETEROGENEITY. The effects of environmental attributes may also vary over households. For instance, some households may be more concerned about groundwater than natural habitats and others may be more or less responsive to policy that affect natural habitats. This allows the coefficients to vary randomly over households i , but not over alternatives j . Following Rabe-Hesketh and Skrondal (2012) again and treating the alternative specific-intercepts as fixed, the logit formulation with random coefficients would take the following form considering the status quo option a reference category.

¹⁷See Rabe-Hesketh and Skrondal (2012) for the exposition of the covariances between the random intercepts for conservation options pair and correlation between utility differences.

$$(9) \quad P(y_{it} = j | z_{kt}^j, \dots, \xi_{2i}, \dots) = \frac{\exp \left\{ \beta_1^2 \phi_2^j + \beta_1^3 \phi_3^j + \sum_{k=1}^K (\beta_k + \xi_{ik}) z_{kt}^j \right\}}{\sum_{j=1}^3 \exp \left\{ \beta_1^2 \phi_2^j + \beta_1^3 \phi_3^j + \sum_{k=1}^K (\beta_k + \xi_{ik}) z_{kt}^j \right\}}$$

The logit model formulation above is equivalent to the linear model for the utility U_{it}^j of alternative j for household i at the t^{th} choice repetition as before.

$$(10) \quad U_{it}^j = \beta_1^2 \phi_2^j + \beta_1^3 \phi_3^j + \sum_{k=1}^K (\beta_k + \xi_{ik}) z_{kt}^j + \epsilon_{it}^j$$

Similarly, the random coefficients have a bivariate distribution and the assumption of the distribution of the error term is the same as section 2.8.1 and independent over alternatives, choice occasions, and households.

Both preference and response heterogeneity models allows us to capture the possible observed and unobserved heterogeneity which is shared among the elemental alternatives. A shared attribute not observed in the data, for example, might be that some individuals are more concerned about groundwater use than aquatic habitat health, natural habitats or rural character based on occupation, place of residence, affiliation with other groups concerned with groundwater use, and a priori perception. This is the context of my hypothesis “that a priori subjective damage assessment of a citizen affect choice preferences, and consequently WTP/WTA” values. I expect that the higher the degree of individual concern (or environmental damage assessment), the more the possibilities for a respondent to choose an option other than the ”no action” status quo alternative.¹⁸

2.8.3. ESTIMATION PROCEDURE. I use the maximum likelihood adaptive quadrature approach for estimating the model parameters. The adaptive quadrature approach starts

¹⁸In conditional logit models, the covariates characterize the alternative instead of characterizing subjects as in the multinomial logit models. The covariates are often called the attributes of the different alternatives. A change in any of the attributes, such as share of total water use from groundwater, aquatic and natural habitats health, population density and the cost are assumed to have the same effect β for all alternatives and there are no alternative-specific coefficients for the attributes. Therefore, prediction of marginal probability for a hypothetical alternative is straight forward.¹⁹ In contrast to the multinomial logit models, where the covariate x_i has alternative specific effects β^j , the covariate z_i^j (attributes) has a coefficient β that does not vary over alternatives j .

with a set of initial or starting values of the parameters and updates the parameters until the likelihood is maximized, adapting data to the individual clusters (Rabe-Hesketh et al., 2004). It is computationally more efficient than Gauss-Hermite quadrature to evaluate and maximize the marginal log likelihood since it requires fewer quadrature points to achieve the same precision. Therefore, it provides unbiased estimates for random component models such as random coefficients and random intercepts (Rabe-Hesketh et al., 2005, 2004).

As shown in the econometric specification Equation (7) above, I incorporate preference heterogeneity in such a way that alternative-specific intercept β_1^j are randomly distributed, ξ_{1i}^j ($i = 1, 2, \dots, N$), across households while the response coefficients β_k , ($k = 1, 2, \dots, K$) are treated as fixed and identical for all households. In equation (9), the response heterogeneity is incorporated as random variables distributed across households following some form of joint distribution, while alternative-specific intercepts are treated as fixed.

To see this, I follow Rabe-Hesketh and Skrondal (2012), Jain et al. (1994), Rossi and Allenby (1993) and construct the marginal likelihood for a random intercept logistic regression model with one covariate z_{kt}^j . The responses are assumed conditionally independent given the random intercepts, random coefficients ξ_{ik}^j and the covariates z_{kt}^j . Therefore, the joint probability of all the responses $P(y_{it} = j)$, $i = 1, \dots, N$, given random intercepts, random coefficients and covariates is simply the product of the conditional probabilities of the individual responses:

$$(11) \quad P(y_{it} = j | z_{kt}^j, \xi_{1k}^j) = \prod_{i=1}^N P(y_{it} = j | z_{kt}^j, \xi_{1k}^j) = \prod_{i=1}^N \frac{\exp \left\{ (\beta_1^j + \xi_{1k}^j) + \sum_{k=1}^K \beta_k z_{kt}^j \right\}^{y_{it}}}{1 + \exp \left\{ (\beta_1^j + \xi_{1k}^j) + \sum_{k=1}^K \beta_k z_{kt}^j \right\}}$$

To obtain the unconditional marginal joint probability of responses, we integrate out the random intercepts and coefficients (Revelt and Train, 1998):

$$(12) \quad P(y_{it} | z_{ik}^j) = \int P(y_{it} = j | z_{kt}^j, \xi_{1k}^j) \Delta(\xi_{1k}^j; 0, \varphi) d\xi_{1k}^j$$

and ;

$$(13) \quad P(y_{it}|z_{ik}^j) = \int P(y_{it} = j|z_{kt}^j, \xi_{1k}) \Delta(\xi_{1k}; 0, \zeta) d\xi_{1k}$$

where, $\Delta(\xi_{1k}^j; 0, \varphi)$ and $\Delta(\xi_{1k}; 0, \zeta)$ are the normal density of ξ_{1k}^j and ξ_{1k} with mean 0 and variance φ and ζ respectively. However, we do not have a closed form expression for the integral and therefore the likelihood function is estimated/approximated with initial guesses using adaptive quadrature technique. The marginal likelihood is the joint probability of all observed responses given the covariates. The joint responses are assumed to be mutually independent and the likelihood is given by the product of the marginal joint probabilities for all individuals conditional on the value of the vector ξ_{1k}^j for all (Revelt and Train, 1998, Rabe-Hesketh and Skrondal, 2012):

$$(14) \quad L(\beta_1^j, \beta_k; \varphi) = \prod_{i=1}^N P(y_{1t}, \dots, y_{nt}|z_{kt}^j).$$

Equation 14 is a function of the parameters and estimated by finding the values $\beta_1^j, \beta_{ik}, \varphi$ that maximizes the likelihood. The search for the maximum is iterative using the Newton-Raphson or expectation maximization (EM) algorithm (Rabe-Hesketh and Skrondal, 2012, Jain et al., 1994, Rossi and Allenby, 1993).

2.9. DATA AND EMPIRICAL RESULTS

Using a choice experiment survey conducted in the Regional District of Central Okanagan (RDCO) between January - May, 2015²⁰, I estimate standard conditional logit, random effects mixed logit and latent class models to see if one better fits the data than the other. I use Log-likelihood function (LLF), Akaike information criterion (AIC), Bayesian information criterion (BIC) and Consistent AIC (CAIC) values to determine the number of latent classes needed for the latent class model estimation. Latent classes are defined and characterized based on respondents' response scores to a priori environmental damage perception questions.

²⁰See Appendix A for the data summary

All coefficients were assumed to be independently normally distributed and vary in the random effects models. The willingness to pay for each attribute (the ratio of the attributes coefficient to the levy coefficient) is also assumed to have normal distribution, which is convenient for interpretation.²¹

2.9.1. STANDARD CONDITIONAL FIXED EFFECT LOGIT MODEL. Table 2.2 presents the standard alternative-specific conditional logit model coefficient estimates and standard errors for the parameters. The two fixed coefficients (alternative-specific intercepts) represent the estimated likelihood of choosing “Option 1” and “Option 2” versus the “no action” status quo option when alternative-specific attributes and individual-specific covariates are kept constant. We see that the coefficient on “Option 2” is statistically significantly different from zero and has a negative sign, implying that on average people will not prefer Option 2 (much improved conservation alternative) compared to the base outcome “no action status quo option.

Alternative-specific attributes regression coefficients do not vary over alternatives while individual specific covariates do. That means, only the changes in the levels of the attributes matter (Revelt and Train, 1998, Rabe-Hesketh and Skrondal, 2012). Hence, the coefficients on aquatic habitat health and natural habitat loss are statistically significantly different from zero and have the expected sign, implying that respondents would prefer to choose any of the options that involve a greater return in Kokanee Salmon (indicator of aquatic habitat health) and a decrease in the sensitive ecosystem area lost (indicator of natural habitat loss). In other words, the likelihood of choosing “Option 1” or “Option 2” (both are better options) for a unit change in those attribute levels compared to the “no action” option will be higher. For example, controlling for other household specific factors, increasing the return of the Kokanee Salmon by 10,000 and decreasing the natural habitat loss by 50 km² every year over the planning period, would increase the odds of choosing any of the alternatives by an estimated 113% $[(2.129 - 1) \times 100\%]$ and 170% $[(2.702 - 1) \times 100\%]$ for higher income group

²¹See Revelt and Train (1998) for more on this.

TABLE 2.2. Alternative and Individual Specific Covariates

Covariate	Option	Conservation Options	
		Option 1	Option 2
Alternative-specific intercepts [Fixed]			
β_1 [<i>Options 1 & 2</i>]		0.0862 (0.58)	-0.461** (-2.87)
Alternative-specific covariates [Fixed]			
β_2 [<i>Groundwater</i>]		-0.00572 (-0.85)	
β_3 [<i>Aquatic Health</i>]		0.0000129** (3.25)	
β_4 [<i>Habitat Loss</i>]		-0.00481*** (-6.93)	
β_5 [<i>Rural Character</i>]		-0.00855 (-1.72)	
β_6 [<i>Cost</i>]		0.000620 (0.19)	
Individual-specific covariates			
β_7 [<i>Lower Middle Income</i>]		0.145 (0.99)	0.361* (2.23)
β_8 [<i>Upper Middle Income</i>]		0.145 (0.96)	0.595*** (3.63)
β_9 [<i>High Income</i>]		0.756*** (3.81)	0.994*** (4.68)
χ^2 (df_m)		113.4 (11)	
N		8424	
t statistics in parentheses			
* $p < 0.05$		** $p < 0.01$	*** $p < 0.001$

compared to the lower income group, respectively. That means individual’s willingness to pay depends on utility which is a function of these attributes and households overall budget and other factors and “ Options 1 and 2” constitute environmental attributes which are normal goods from the perspective of the respondent. Only income dummy coefficients are reported and interpreted from among the individual-specific covariates because other covariates are statistically insignificant.

2.9.2. RANDOM ALTERNATIVE-SPECIFIC INTERCEPTS: PREFERENCE HETEROGENEITY. In contrast to the estimates of the standard conditional logit model shown in tables 2.2, which are the marginal or population-averaged coefficients, the estimates in table 2.3 are based on the assumption of dependence of alternative choices across choice occasions by households. That means, there are random-alternative specific intercepts shared among different alternative choice occasions that have conditional or household-specific interpretation. Table 2.3 presents estimated standard deviations [SD] of the random alternative-specific intercepts and covariates. The estimated coefficients in the upper part of the output represent conditional or household-specific effects on the likelihood of choosing any of the alternatives compared with the “no action base outcome status quo alternative. Model 1, the preference heterogeneity only model, shows the total alternative-specific intercept for each conservation option. It is composed of fixed alternative specific intercepts (Mean) and the random intercepts (SD). The SD measures the degree of deviation from the population average and the coefficient estimates have a citizen-specific preference interpretation. We see that the random effects, measured by the standard deviation (SD), are statistically significant, providing a strong evidence for the presence of citizen specific preference “preference heterogeneity” in contrast to the marginal or population-averaged estimates of the standard conditional logit model. From the magnitudes of the standard deviations relative to the mean coefficients, 39% prefer “Option 1” (improved conservation option) and 46% prefer

“Option 2” (much improved conservation option), compared to the “no action” status quo condition, respectively.²²

Intuitively, people would prefer an option that offers relatively better environmental attributes, implying individuals willingness to trade-off higher payment for better environmental condition, keeping all other determinants of demand such as income constant. Further, the presence of preference heterogeneity could be justified based on the fact that “Options 1 and 2” seem to be similar in terms of the absolute attribute levels and therefore utilities could be dependent. The more similar the alternatives seem, the more correlated their utilities would be expected to be (Revelt and Train, 1998). That means, the assumption of conditional logit model that choices are independent over choice occasions fails. Such unobserved heterogeneity could be because of the variation in the household specific characteristics, differences in understanding of an option’s attribute levels, differences in preferences depending on an individual’s perception or household-specific interaction with the environment, and etc. Moreover, a likelihood-ratio test for the joint significance of the standard deviations of the random intercepts (SD), reported in the lower row of table 2.3 ($Prob > \chi^2$), shows that the associated p-value is very small, implying that we can reject the null hypothesis that there is no preference heterogeneity.

2.9.3. RANDOM ALTERNATIVE-SPECIFIC COEFFICIENTS: RESPONSE HETEROGENEITY. The degree of the changes and effects of environmental attributes may vary over households. For instance, some households may be more concerned about groundwater than natural habitats and others may be more responsive to a policy that affects the natural habitat. Therefore, I allow the coefficients to vary randomly over households (Model 2) (i.e. the random deviation from each fixed effect coefficients of the attributes) but not over alternatives and treat the alternative specific-intercepts as fixed in contrast to the random intercept model (Model 1). This random deviation captures response heterogeneity. Similar to the random intercepts model, the random coefficients are shared for different choice

²²These figures are given by $100 \times \Phi(-\beta_j/\sigma_j)$, where Φ is the cumulative standard normal distribution and β_j and σ_j are the mean and standard deviation, respectively, of the j^{th} coefficient (Hole, 2007)

TABLE 2.3. Preference Heterogeneity and Response Heterogeneity

Covariate	Model 1		Model 2		Model 3	
	Mean	SD	Mean	SD	Mean	SD
Random Intercepts [Mean + SD]						
β_1 [Option 1]	0.697*** (3.73)	2.477*** (15.97)	2.878*** (14.54)		2.857*** (11.40)	1.292*** (-4.78)
β_1 [Option 2]	0.226 (1.19)	2.579*** (15.23)	2.396*** (12.82)		2.200*** (8.84)	1.742*** (-8.71)
Random Coefficients [Mean + SD]						
β_2 [Groundwater]	-0.0121 (-1.32)		-0.0147 (-1.25)	0.0736*** (-3.70)	-0.0113 (-0.75)	0.118*** (-4.81)
β_3 [Aquatic Health]	0.0000258*** (4.81)		0.0000210** (3.16)	0.0000441*** (4.59)	0.0000281*** (3.67)	0.0000347* (-1.96)
β_4 [Habitat Loss]	-0.00750*** (-8.05)		-0.00803*** (-5.57)	0.0168*** (-9.18)	-0.00958*** (-5.31)	0.0205*** (9.19)
β_5 [Rural Character]	-0.0122 (-1.83)		-0.0155 (-1.60)	0.112*** (8.17)	-0.0175 (-1.67)	0.0948*** (5.40)
β_6 [Cost]	-0.00144 (-0.33)		-0.0397*** (-4.61)	0.136*** (15.98)	-0.0408*** (-3.91)	0.146*** (13.93)
χ^2 (df.m)	898.7 (2)		1456.3 (5)		1625.6 (7)	
$Prob > \chi^2$	0.0000		0.0000		0.0000	
N	8424		8424		8424	
t statistics in parentheses						
$*p < 0.05$	$**p < 0.01$		$***p < 0.001$			

occasions and the utilities are no longer independent and the assumption of IIA is relaxed (Hensher and Greene, 2003, Rabe-Hesketh and Skrondal, 2012, Revelt and Train, 1998).

Estimated coefficients and standard errors are presented in Table 2.3 under Model 2 (Response heterogeneity fixed intercept). The mean coefficients on both fixed and random effects are statistically significant and all have the right sign. On average, respondents prefer a conservation option that provides a decrease in the share of groundwater use, more salmon return, a decrease in natural habitat loss and a decrease in rural density. From the magnitudes of the standard deviations relative to the mean coefficients, 54% of the respondents prefer a decrease in the share of groundwater use, 32% prefer an increase salmon return, 32% prefer an option that provides protected natural habitat, and 56%

prefer an option which provides a better rural character. The likelihood ratio test for the joint significance of the standard deviations yields a very small p-value, implying the null hypothesis that all the standard deviations are equal to zero is rejected and providing clear evidence for preference heterogeneity in the model.

Model 3 (preference and response heterogeneity) in table 2.3 presents the combined estimated coefficients of preference and response heterogeneity (random-intercepts and random-coefficients) models. Here it is noticeable that mean coefficients of the random variables are consistently larger than the fixed coefficients in the standard logit model. This reflects the fact that the mixed logit includes the unobserved portion of utility and normalizes parameters based on part of the unobserved portion.²³ Further, the coefficients on the standard deviations are highly statistically significant as expected and as we move from standard logit to the preference and response heterogeneity only to a model which combines both, providing strong evidence for preference and response heterogeneity and that choices in fact vary in the population. The likelihood ratio test on a combined estimate confirms that the joint standard deviations are not equal to zero and we reject the null that there is no heterogeneity in the model.

The test conducted so far in all models above is the likelihood ratio test on a separate and a combined estimate and the standard deviations. We can also evaluate if the means of each attribute across the three alternative choices which I coded 0, 1 and 2 (for Status quo, Option 1 and Option 2 respectively) are significantly different from each other. To do this, I conduct One way Analysis Variance (ANOVA). I present the result in Table 2.4 and figures 2.4-2.8.

²³see Revelt and Train (1998) for more on this

TABLE 2.4. Oneway Analysis of Variance (ANOVA): summary of fit of attributes by Options

Attribute	Level	Number	Mean	SE	Lower 95%	Upper 95%	SS	MS	F Ratio	Prob > F
β_2 [Groundwater]	High	4686	0.60	0.01	0.59	0.62	1647.8	823.9	1748.5	< .0001*
	Low	1878	1.49	0.02	1.46	1.52				
	Moderate	1860	1.50	0.02	1.47	1.53				
β_3 [AquaticHealth]	High return	1861	1.52	0.02	1.48	1.55	1742.5	871.2	1894.0	< .0001*
	Low return	4673	0.59	0.01	0.57	0.61				
	Medium return	1890	1.50	0.02	1.47	1.53				
β_4 [HabitatLoss]	High Loss	4668	0.60	0.01	0.58	0.62	1655.2	827.6	1759.5	< .0001*
	Low Loss	1859	1.49	0.02	1.46	1.52				
	Medium Loss	1897	1.50	0.02	1.47	1.53				
β_5 [RuralCharacter]	Above Average Density	4575	0.59	0.01	0.57	0.61	1695.8	847.9	1821.3	< .0001*
	Average Density	1711	1.45	0.02	1.42	1.48				
	Below Average Density	2138	1.52	0.01	1.49	1.55				
β_6 [Cost]	High Cost	2808	1.47	0.01	1.45	1.48	4218.4	2109.2	12709.0	< .0001*
	Low Cost	2808	1.53	0.01	1.52	1.55				
	No Cost	2808	0.00	0.01	-0.02	0.02				

The ANOVA summary of fit reported in Table 2.4 provides overall information about the analysis including the mean, sample size, and standard error (SE) for each attribute. It shows that the $Prob > F$ (the p-value) is 0.0001* for all attributes, which implies that there are significant differences in the mean level of the attributes that constitute each options. In other words, the mean groundwater level, aquatic habitat, habitat loss, rural character, and cost that constitute “Option 1” are statistically significantly different from the mean levels that constitute the “no action” status quo and “Option 2” alternatives. Same information is demonstrated in figures 2.4-2.8. The diamond represents mean attribute levels. The vertical span of each diamond represents the 95% confidence interval for the mean of each attribute level across the three alternatives. The line near the center of each diamond represents the group mean. The length between the ticks is proportional to the number of observations for each attribute level. At a glance, we can see that the mean for each attribute levels over the choice options looks significantly different. The mean attribute value for “Option 2”, for instance (higher option score close to 2), is either equal in some and better in others compared to the other better alternative, “option 1”. The mean attribute level is consistently low for the “no action” status quo alternative supporting the same conclusion as the $Prob > F$ (the p-value) visually.

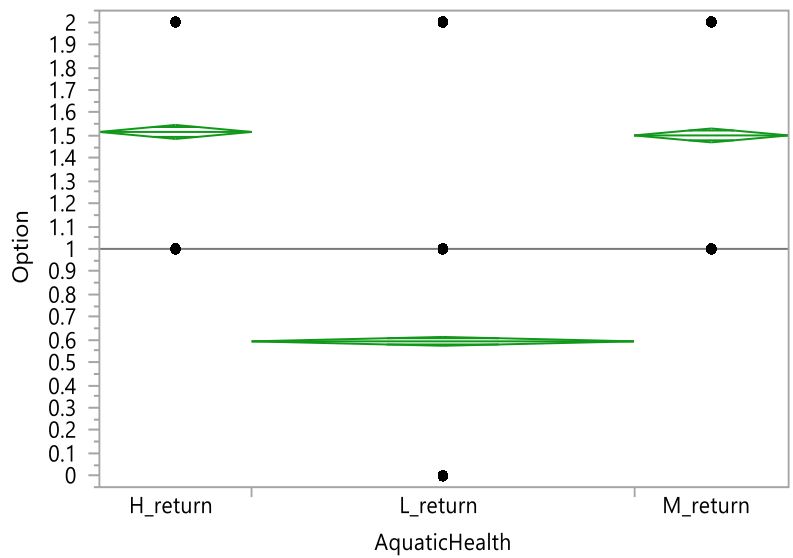
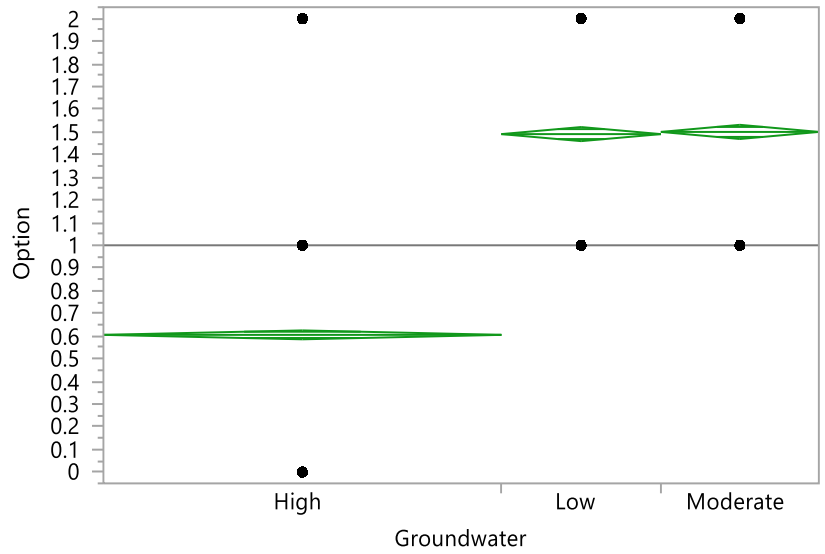


FIGURE 2.4. Mean attribute levels by Options. The diamond represents mean groundwater aquatic health levels. The vertical span of each diamond represents the 95% confidence interval for the mean across the three alternatives. The line near the center of each diamond represents the group mean. The length between the ticks is proportional to the number of observations.

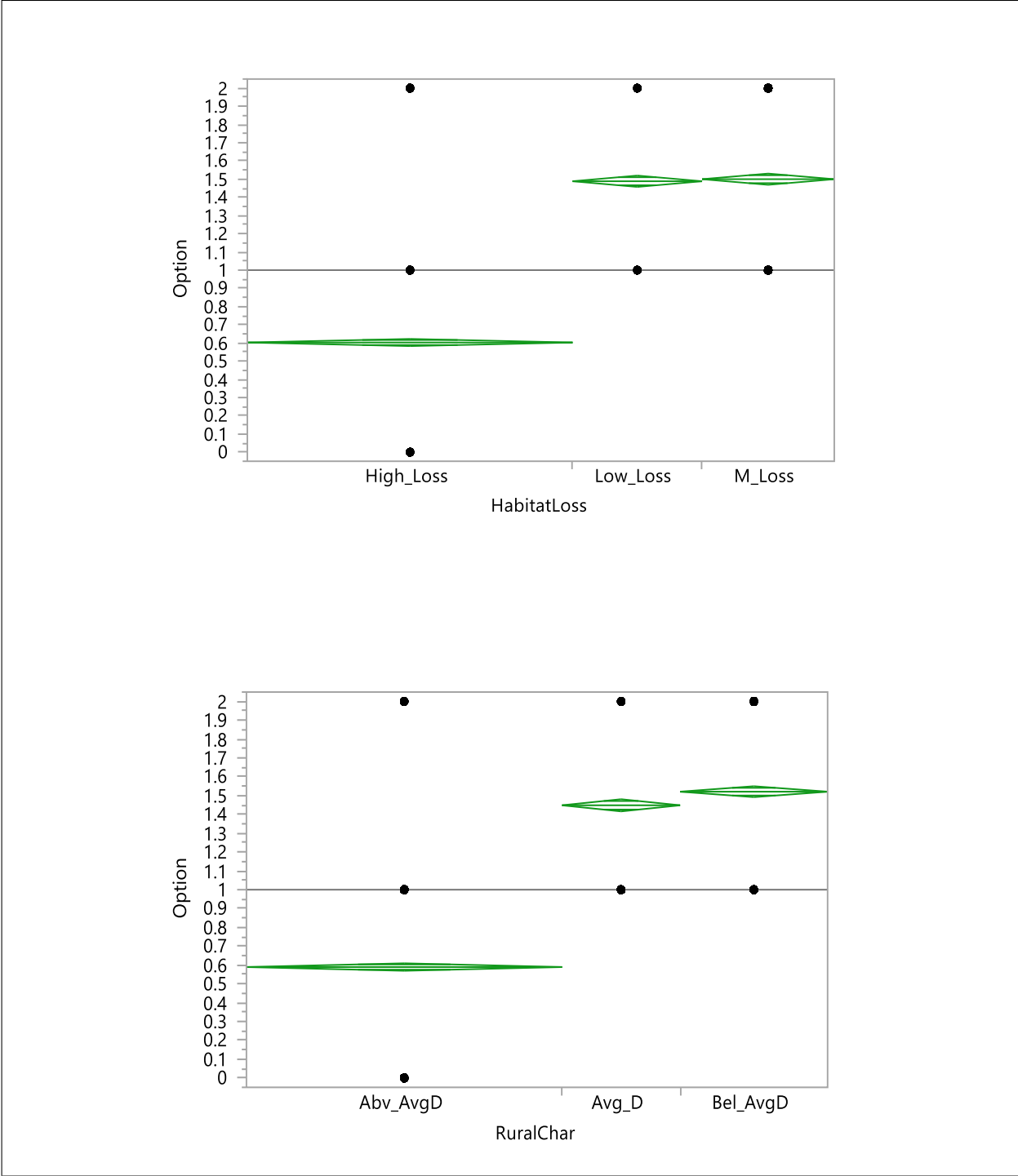


FIGURE 2.5. Mean attribute levels by options. The diamond represents mean habitat loss and rural character levels. The vertical span of each diamond represents the 95% confidence interval for the mean across the three alternatives. The line near the center of each diamond represents the group mean. The length between the ticks is proportional to the number of observations.

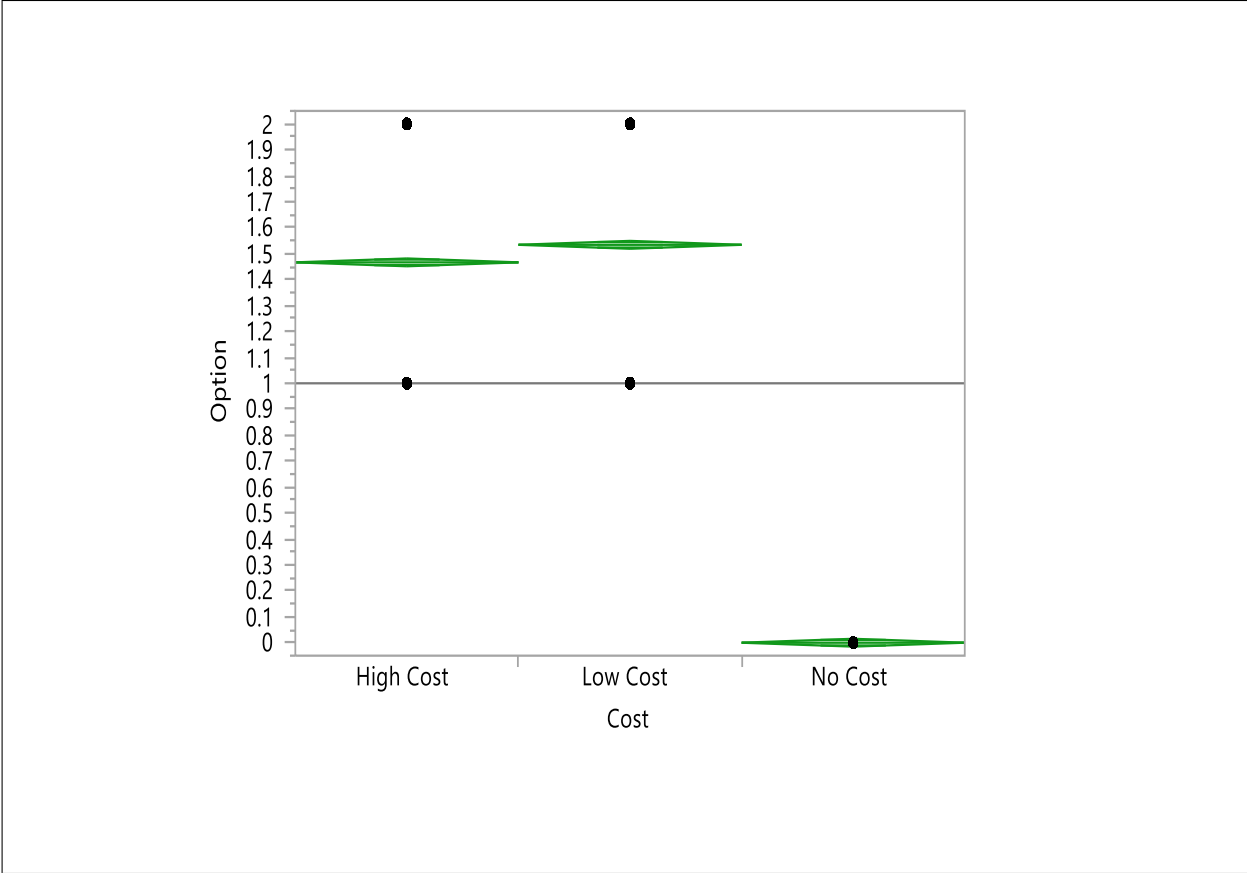


FIGURE 2.6. Mean cost level by options. The diamond represents mean cost levels. The vertical span of each diamond represents the 95% confidence interval for the mean across the three alternatives. The line near the center of each diamond represents the group mean. The length between the ticks is proportional to the number of observations.

TABLE 2.5. Correlated normally distributed coefficients

	Groundwater	Aquatic	Habitat	Rural	Cost
β_2 [<i>Groundwater</i>]	0.134*** (6.54)				
β_3 [<i>AquaticHealth</i>]	-0.0000165 (-1.29)	0.0181*** (6.03)			
β_4 [<i>HabitatLoss</i>]	-0.000924 (-0.06)	0.0280* (2.41)	-0.0000603*** (-6.31)		
β_5 [<i>RuralCharacter</i>]	0.0144*** (5.33)	-0.0247 (-1.39)	0.00341 (0.34)	-0.0116*** (-3.62)	
β_6 [<i>Cost</i>]	-0.0731* (-2.53)	0.00488 (0.42)	0.0780* (2.50)	-0.0182 (-1.06)	0.0868*** (12.38)

t statistics in parentheses
 * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

In addition, it worth looking at whether there is any correlation in the random parameters of the attributes implying that individuals consider more than one attribute in making choice decisions. Table 2.6 shows covariance matrix for the random coefficients and the elements of the lower-triangular matrix (L), where the covariance matrix for the random coefficients is conventionally given by $\Sigma = LL'$, the Cholesky factorization of the covariance matrix V (Hole, 2007, Hensher and Greene, 2003). Diagonal values are the variances of the variables and the off-diagonal elements are the covariances. For example, the covariance on natural habitat and aquatic health is positively correlated and statistically significantly different from zero, implying that a respondent who prefers an option with higher salmon return would also prefer more natural habitat protected. The covariance on natural habitat and rural character is negatively correlated and statistically significant, implying a respondent who prefers an option with less population density or better rural character also prefers more natural habitat protected and vise-versa. The covariance on natural habitat and groundwater is positively correlated, implying that a respondent who prefers a natural habitat protected also prefers an option which offers a lower share of total water use from groundwater and vise-versa. Moreover, the magnitudes on the coefficients of the covariances are relatively higher, reflecting the fact that allowing for covariances capture more variance

in the unobserved portion of utility, such that error term ϵ_{ij} has less variance and therefore raises the parameters. Following Hole (2007) , we can test the joint significance of the off-diagonal elements of the covariance matrix using the likelihood ratio test. The test statistic is chi-squared distributed with 10 degrees of freedom under the null of uncorrelated coefficients, and it is given by $2 \times (2322.7199 - 2300.2773) = 44.8852$, implying rejection of the null hypothesis. Individual coefficient variations kernel density estimators confirm that the joint significance of the off-diagonal elements of the covariance matrix are significantly different from each other. An estimate of the individual coefficient variations density of the parameters in our sample is presented in Figure 2.10.²⁴ Given the fact that kernel density estimators are spread over some interval, we conclude that there is substantial explained variation in the individuals choice decisions in the sample.

²⁴see Greene and Hensher (2003) for the formula on how the kernel density function for a single attribute is computed.

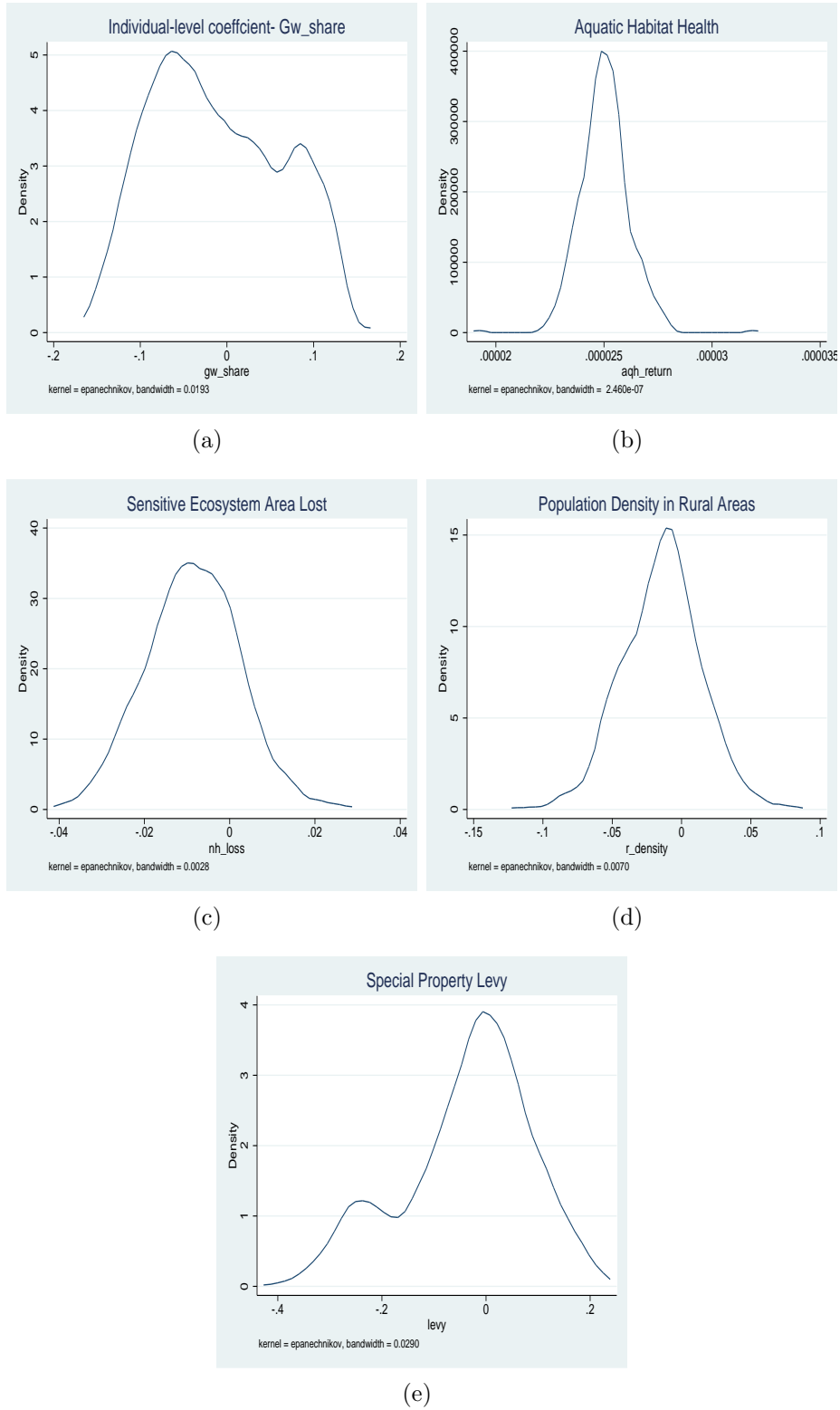


FIGURE 2.7. Coefficient variations kernel density. The kernel density estimators are spread over some interval, and that there is substantial explained variation in the individuals choice decisions.

2.9.4. LATENT CLASS MODEL. In all models above, I assumed that the distribution of the coefficients was continuous.²⁵ However, the coefficients may be discrete, which leads to the latent class model where each respondent is assumed to belong to a class and preferences vary across, but not within, classes. We know that class membership is unknown and is latent from the perspective of the researcher, not the individual, and the probability that an individual belongs to class is estimated as a function of characteristics of the individual's covariates (Greene and Hensher, 2003). According to Greene and Hensher (2003), "the underlying theory of the LCM posits that individual behavior depends on observable attributes and on latent heterogeneity that varies with factors that are unobserved by the analyst. Thus, individuals are implicitly sorted into a set of different classes, but which class contains any particular individual, whether known or not to that individual, is unknown to the analyst."

Hence, I follow the conventional maximum-likelihood method of estimating latent classes to determine class-membership probabilities, and the probability that an individual in a given class will have specific a priori environmental damage perception. This is possible in the latent-class model in the sense that the sample consists of random draws from a mixture of population density functions, one for each class (Magidson and Vermunt, 2002). The first step in this direction would be determining the optimal number of latent classes. Based on Log-likelihood function (LLF), Akaike information criterion (AIC), Bayesian information criterion (BIC) and Consistent AIC (CAIC) model selection criterion, five latent classes are needed as the best fit from 2, 3, 4, 5, 6 and 7 classes. Table 2.6 presents latent class selection criterion.²⁶ Higher LLF value and lower values of AIC, BIC and CAIC indicate better fits.

²⁵see Hole (2007), Danthurebandara et al. (2013) for more on this

²⁶See Porcu and Giambona (2016) for the introduction to latent class analysis with applications.

TABLE 2.6. Latent Class Selection Criteria

Classes	LLF	Nparam	AIC	CAIC	BIC
2	-2368.136	12	4760.272	4822.053	4810.053
3	-2308.114	19	4654.229	4752.05	4733.05
4	-2266.599	26	4585.198	4719.058	4693.058
5	-2232.72	33	4531.44	4701.339	4668.339
6	-2227.248	40	4534.497	4740.436	4700.436
7	-2279.943	47	4653.887	4895.865	4848.865

Before estimating the LCM, I will explore the inherent characteristics of the data based on answers to the a priori environmental damage perception questions. I do this to find out if an individual in a given class behaves specific to a priori environmental damage perceptions in line with my hypothesis that “a priori environmental damage perception actually matters in people’s conservation options choice decisions.” I use the attitudinal a priori environmental damage perception data based on answers to Likert-scale questions 2-7 in the main survey (see Appendix B for a priori environmental damage perception questions 2-7). These questions are easy to relate to from the perspective of the respondents and indirectly ask their perceived perception about the degree of environmental damage. The answers to these questions range from yes/no type to a 5-6 level likert-scaled answers. These answers were clustered into five latent classes based on model goodness of fit using Bayesian information criterion (BIC), binning likert-scaled answers of question 3-7 together into three a priori damage perception categories above and below some threshold value. Then each answer was assigned a score of 0, 1 and 2 for latent class definition according to the degree of damage perception, 0 being “no damage” and 2 being “high damage” (see table 2.9 for class definition and analysis summary). For instance, “Panel A” presents perception question 1 and its associated answers. Class 1 has more “No” answers (81%) and it gets a score (LCS) of 0; more answers for “sometimes” in “Panel B” (50%) and it gets a score of 1; more answers for “disturbed” in “panel C” (45%) and gets a score of 1. I do the same for all perception questions for each class. Then, I renamed the classes:

“unconcerned”, “concerned”, “very concerned”, “worried” and “very worried” based on the total class proportions score or column sum.

TABLE 2.7. A Priori Environmental Views and Damage Perception based Classes

Category	LCS	Unconcerned Class 4	Rank	Concerned Class 1	Rank	Very Concerned Class 3	Rank	Worried Class 2	Rank	Very Worried Class 5	Rank
Panel A: Were you aware of the pressures on environmental resources in the Okanagan?											
No	0	0.8127	0	0.0727	1	0.0664	1	0.0001	1	0.1014	1
Yes	1	0.1873		0.9273		0.9336		0.9999		0.8986	
Panel B: How often can you remember having heard or read about environmental issues in the Okanagan?											
Sometime	1	0.4984		0.9771		0.0052		0.4355		0.5954	
Never	0	0.4546	1	0.0223	1	0.0004	2	0.0197	2	0.1293	1
All the time	2	0.047		0.0005		0.9944		0.5448		0.2754	
Panel C: What share of the shoreline around the major valley lakes do you think is undisturbed?											
Disturbed	1	0.4496		0.4245		0.2478		0.2098		0.2365	
Undisturbed	0	0.3179	1	0.124	2	0.1561	2	0.1557	2	0.2234	2
Very Disturbed	2	0.2324		0.4515		0.5961		0.6344		0.5401	
Panel D: What share of the original wetlands in the Okanagan remain?											
Few	1	0.3335		0.2615		0.1309		0.3063		0.1519	
No Original	2	0.6304	2	0.6989	2	0.869	2	0.6631	2	0.7029	2
More	0	0.0361		0.0396		0.000		0.0306		0.1452	
Panel E: What share of Okanagan households rely on groundwater (own wells or from water utilities)?											
More	1	0.3224		0.2046		0.1548		0.2084		0.2857	
All	2	0.2199	0	0.3841	0	0.4125	0	0.0027	0	0.714	2
Few	0	0.4577		0.4113		0.4326		0.7889		0.0002	
Panel F: What share of jobs in the Okanagan are in tourism and related sectors?											
All	2	0.2382		0.1285		0.3001		0.0586		0.4669	
Few	0	0.2425	1	0.1483	1	0.1764	1	0.1741	1	0.0003	2
Many	1	0.5192		0.7232		0.5235		0.7673		0.5329	
Panel G: Development and growth impacts have been ?											
Negative	2	0.2842		0.1874		0.0007		0.9091		0.9991	
Neutral	1	0.3826	1	0.0969	0	0.0777	0	0.0901	2	0.0002	2
Positive	0	0.3332		0.7158		0.9215		0.0008		0.0007	
Total LSC			6		7		8		10		12

The above perception analysis is demonstrated in Figure 2.11 using Multidimensional Scaling (MDS) plot.²⁷ It is also called “perception configuration map”, with each group represented as points. The points are arranged in such a way that their distances correspond to perception similarities: similar people in a priori perception are represented by points that are close to each other, dissimilar people by points that are far apart.

What we see here is that “distance is nonmetric and therefore MDS only assumes that the order of the proximities is meaningful. In nonmetric MDS, only the ordinal information

²⁷Multidimensional scaling (MDS)“ is a statistical approach of determining the perceptual space of subjects to the problem of finding underlying attributes or dimensions, which influence how subjects evaluate a given set of options (Wickelmaier, 2003).”

in the proximities is used for constructing the configuration. The order of the distances in a nonmetric MDS configuration reflects the order of the proximities as good as possible while interval and ratio information is of no relevance (Wickelmaier, 2003).” Therefore, the three points “concerned”, “unconcerned”, and “very concerned” seem to be similar and closer in perception, since they are closer to each other than “very worried” and “worried” looked at from the Latent Class Analysis MDS 2 (LCA MDS 2) dimension. The “very worried” and “very concerned” seem to be two very distant groups looked at from dimension LCA MDS 1, but rather closer/similar in perception on dimension LCA MDS 2.²⁸ The next step

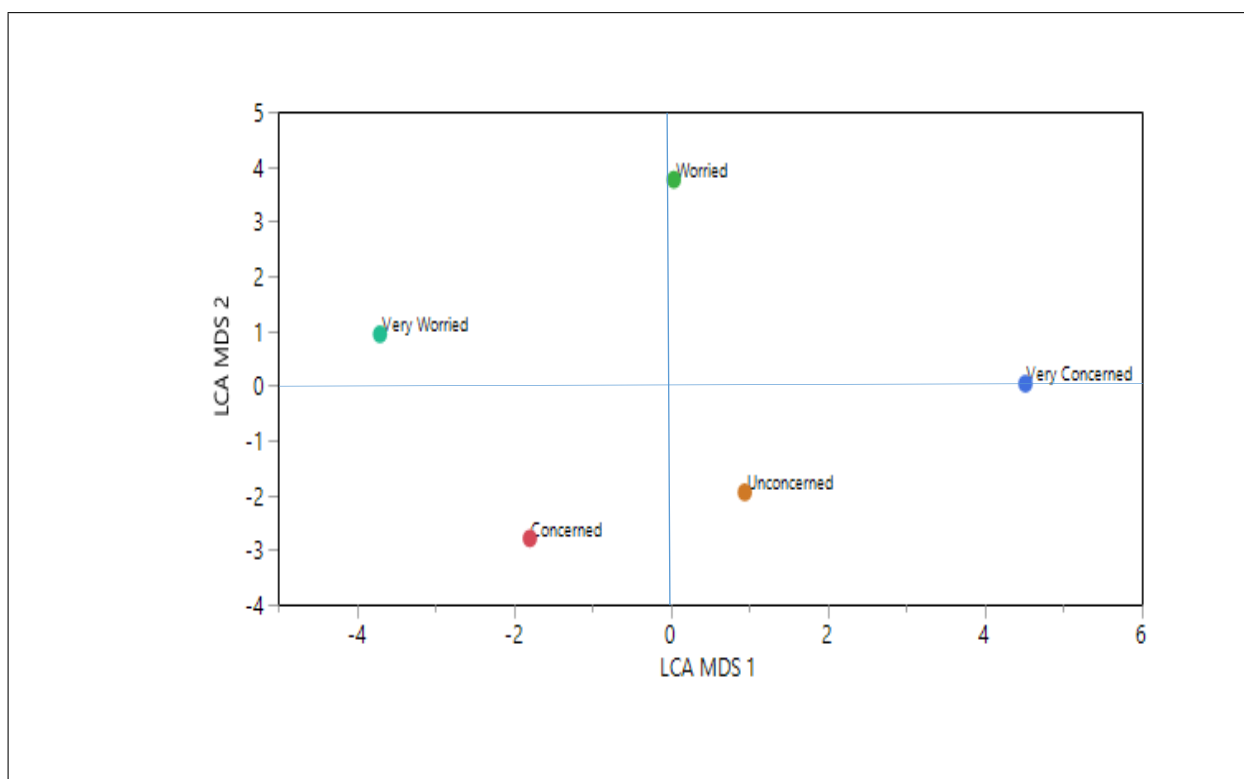


FIGURE 2.8. Perception Dissimilarity (MDS) plot. It is also called “perception configuration map”, with each group represented as points. The points are arranged in such a way that their distances correspond to perception similarities: similar people in a priori perception are represented by points that are close to each other, dissimilar people by points that are far apart.

would be estimating class membership and model coefficients jointly (the standard Latent Class Model (LCM)) and matching each latent class with class characteristics from Table 2.7. Table 2.8 shows the LCM estimated based only on alternative specific attributes or

²⁸See (Wickelmaier, 2003) for more references on this concept.

covariates. Matching the two tables on class membership, it should be the case that “class 4”, defined based only on attitudinal data consisting answers to Likert-scale questions from table 2.8 is the same as “class 4” estimated using LCM based only on alternative specific attributes. Then, I rename each class in LCM by its corresponding class match from Table 2.7. For instance, class 4 has a low class score (LCS) of 6 and is “unconcerned” group and its corresponding Maximum Likelihood LCM based estimates is class 4 in table 2.8 and should also be characterized as the “unconcerned” group.

TABLE 2.8. Latent Class Model (LCM) with 5 classes

Variables	RP Model	Latent Class Model (LCM)				
		Class 4 Unconcerned	Class 1 Concerned	Class 3 Very Concerned	Class 2 Worried	Class 5 Very Worried
β_2 [<i>Groundwater</i>]	-0.0113 (-0.75)	0.594* -2.47	-0.0347* (-2.30)	-0.0917*** (-4.26)	0.131** -3.12	-0.0867** (-3.08)
β_3 [<i>Aquatic Health</i>]	0.0000281*** (-3.67)	-0.000106* (-2.16)	0.0000630*** -6.22	0.0000391** -3.12	-0.000039* (-2.02)	0.0000163 -1.13
β_4 [<i>Habitat Loss</i>]	-0.00958*** (-5.31)	0.0132 -1.37	-0.0171*** (-8.61)	-0.0208*** (-6.11)	0.0265*** -4.41	-0.00239 (-0.69)
β_5 [<i>Rural Character</i>]	-0.0175 (-1.67)	0.0213 -0.55	0.027 -1.69	-0.214*** (-5.17)	-0.0826*** (-3.57)	-0.0298 (-1.85)
β_6 [<i>Cost</i>]	-0.0408*** (-3.91)	-0.0346 (-0.85)	0.0304*** -4.00	-0.0466** (-3.18)	0.118*** -5.42	-0.0373** (-2.89)
Class Share		0.12	0.32	0.15	0.26	0.15
N		8424	8424	8424	8424	8424
t statistics in parentheses						
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$						

Therefore, in table 2.8, we see LCM estimates and each class characterized by corresponding a priori environmental damage perception class categories. We also see that the mean estimates of the coefficients of perception class do not vary much but mostly statistically significant. The individual level of significance is also relatively higher among the concerned, very concerned and worried group compared to the coefficients in the unconcerned and very worried group. The most important conservation options choice decision attribute for the “unconcerned group” is groundwater and aquatic habitat. All attributes

are important decision variables for the “concerned” group except rural character. All environmental attributes are important decision variables for the “very concerned” and “worried” groups. Groundwater and cost matters among the “very worried” group. Otherwise, all the coefficients have the expected sign except for the “concerned” and “worried” groups for the payment vehicle (cost). Therefore, we can conclude that most coefficients vary within perception latent classes and across models suggesting that heterogeneity could probably be attributed to the difference in people’s a priori damage perception about the environment. Moreover, the parametric estimates for each perception latent classes are clearly significant and capture heterogeneity in preference (see Table 2.9). Compared to the random effects model presented in Table 2.3, the magnitude of variances or random effect (RE) relatively decreased implying that a larger share of variance is captured when choices are evaluated considering people’s a priori damage perception. The “RP Model” in table 2.8 is the combined random intercepts and slopes estimates.

Otherwise, people among all perception groups want a better environment because at least one or more better environmental attributes are considered important in their choice decisions. That means the better conservation option is favored over “no action” status quo option regardless of cost in all perception groups contrary to the theoretical expectation.

We can explore this conclusion further by investigating whether a priori perception based choice is mainly composed of those choosing the status quo, as this may mean that people are only interested in the “no action” status quo option or the improved options. I demonstrate this in table 2.10 which shows the proportion of options chosen by each perception classes. We see that the proportion of people choosing the “no action” status quo option decreases with the decrease in the degree of concern, and the proportion of people choosing improved and much improved options “Options 1 and 2 ” relatively increase with the increase in level of concern as expected. For example, 26% and 19% of “unconcerned” and “very worried” groups choose the “no action ” status quo option and 45% and 46% choose “Option 1” respectively.

TABLE 2.9. Parametric Estimates by Perception Group

Variable	Unconcerned		Concerned		V/Concerned		Worried		V/Worried	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
β_2 [<i>Groundwater</i>]	-0.049 (-1.69)	0.0321 (0.39)	-0.026 (-1.21)	0.109*** (3.33)	-0.094** (-3.07)	0.0281 (0.43)	-0.055* (-2.11)	0.143*** (4.29)	-0.025 (-0.77)	0.154*** (3.90)
β_3 [<i>Aquatic Habitat</i>]	0.00004* (2.53)	0.00002 (0.41)	0.00004** (3.24)	0.00006*** (3.75)	0.000008 (0.46)	0.00004 (-1.34)	0.00005*** (3.61)	0.00007*** (3.44)	-0.000002 (-0.07)	0.00002 (0.53)
β_4 [<i>Habitat Loss</i>]	-0.0029 (-0.79)	0.014*** (3.51)	-0.009*** (-3.43)	0.020*** (5.73)	-0.009* (-2.56)	0.0136** (-2.88)	-0.018*** (-5.26)	0.0211*** (5.45)	-0.0092* (-2.52)	0.019*** (-4.44)
β_5 [<i>Rural Character</i>]	-0.036 (-1.46)	0.099** (2.89)	-0.037* (-2.32)	0.110*** (4.73)	-0.068* (-2.52)	0.142*** (3.91)	-0.067*** (-3.71)	0.108*** (-3.99)	-0.075*** (-3.65)	0.071 (-1.76)
β_6 [<i>Cost</i>]	-0.025 (-1.17)	0.108*** (5.83)	-0.0068 (-0.57)	0.0789*** (8.04)	-0.0184 (-0.87)	0.123*** (-6.12)	0.0015 (0.11)	0.0815*** (7.05)	0.014 (0.85)	0.083*** (6.20)
$\chi^2(df,m)$	172.2 (5)		356.4 (5)		245.2 (5)		261.2 (5)		173.5 (5)	
N	1008		2664		1242		2211		1296	
t statistics in parentheses										
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$										

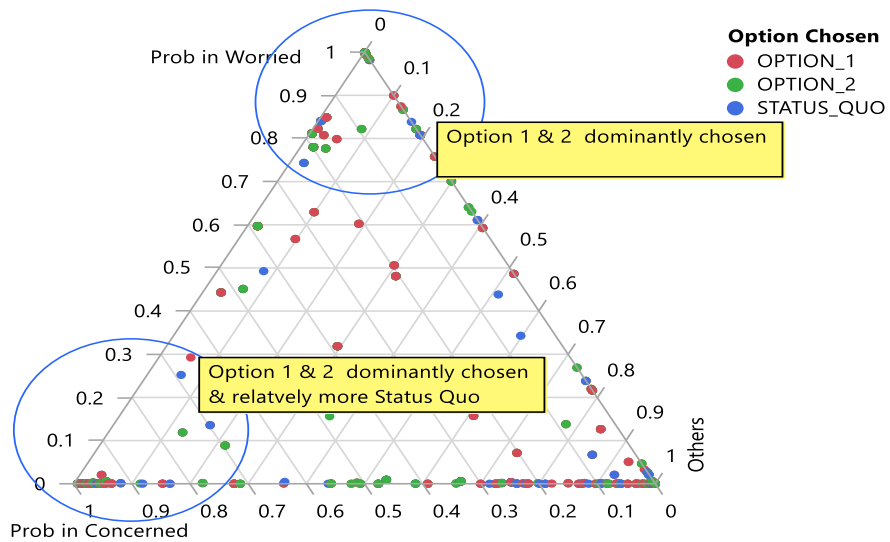
This same information can demonstrably captured using ternary plot. The ternary plot is handy to compare each perception group individually. We see that each ternary figure 2.9-2.15, display the distribution and variability of three-part perception groups and options chosen. The blue, red and green dots represents how one individual’s conservation options choice given his/her a priori perception about the environment varies. Eyeballing only the blue dots that identify percentage of the “no action” status quo option chosen, say in figures 2.9 (a), the proportion of people choosing the “no action” status quo option is higher among the “Concerned” group compared to the “Worried group” keeping the other perception group constant. Similar to the conclusion made above, this also is in line with our hypothesis and expectation that “less concerned individuals most likely choose the “no action” status quo option.” Similar results are displayed in figures 2.9 (b)-12.15 where those less concerned are choosing the “no action” status quo option more often than not.

In summary, society’s conservation option choice decision and motivations in the latent class model are better characterized by a priori perception damage. These five distinct classes highlight homogeneity within the heterogeneity of society in general and individuals’ trade-

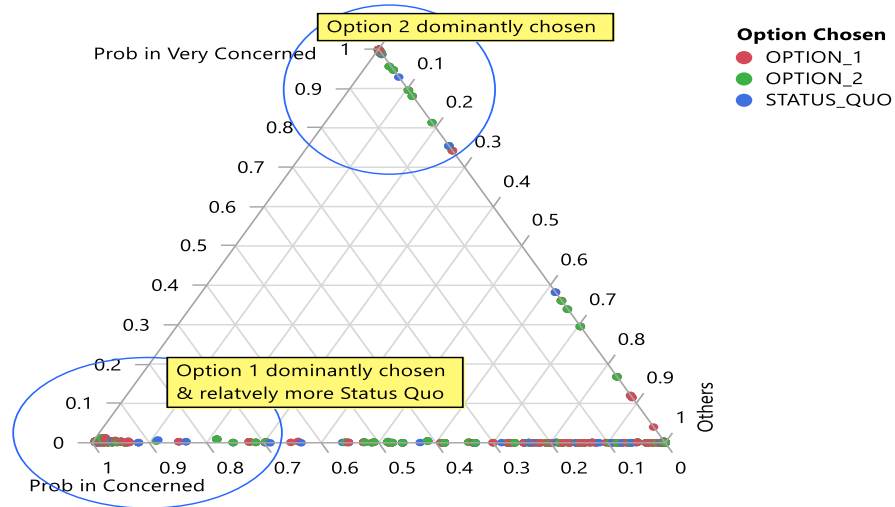
TABLE 2.10. Proportion of Choices by Perception Classes and Options Chosen

Perception Probability		OPTION 1	OPTION 2	STATUS QUO
Prob in Unconcerned	Mean	0.13214637	0.11050384	0.169073535
	Std Dev	0.28369248	0.25239946	0.32327707
	Min	0.00036217	0.00036217	0.000379354
	Max	0.99954026	0.99954026	0.999684737
	% of Total	44.87%	28.69%	26.43%
Prob in Concerned	Mean	0.33709525	0.36104842	0.337657894
	Std Dev	0.39843135	0.39922659	0.392535781
	Min	2.7771E-05	2.7771E-05	8.02407E-05
	Max	0.99335077	0.99335077	0.993350768
	% of Total	43.86%	35.92%	20.22%
Prob in Very Concerned	Mean	0.16000249	0.10847962	0.195271951
	Std Dev	0.35675297	0.29881608	0.389091255
	Min	9.22E-11	2.35E-10	6.40E-10
	Max	0.99907244	0.99907244	0.998912948
	% of Total	48.07%	24.92%	27.01%
Prob in Worried	Mean	0.23479019	0.28751599	0.174495784
	Std Dev	0.37155628	0.39458614	0.321003557
	Min	3.30E-11	2.02E-10	3.30E-11
	Max	0.99933005	0.99933005	0.999330048
	% of Total	43.89%	41.10%	15.02%
Prob in Very Worried	Mean	0.13596571	0.13245214	0.123500836
	Std Dev	0.29343298	0.28613514	0.265423147
	Min	2.62E-11	7.49E-11	6.65E-12
	Max	0.99579583	0.99595174	0.994121894
	% of Total	46.23%	34.44%	19.33%

offs among conservation attributes could be explained by perceived a prior heterogeneous subjective evaluations of the degree of environmental damage.

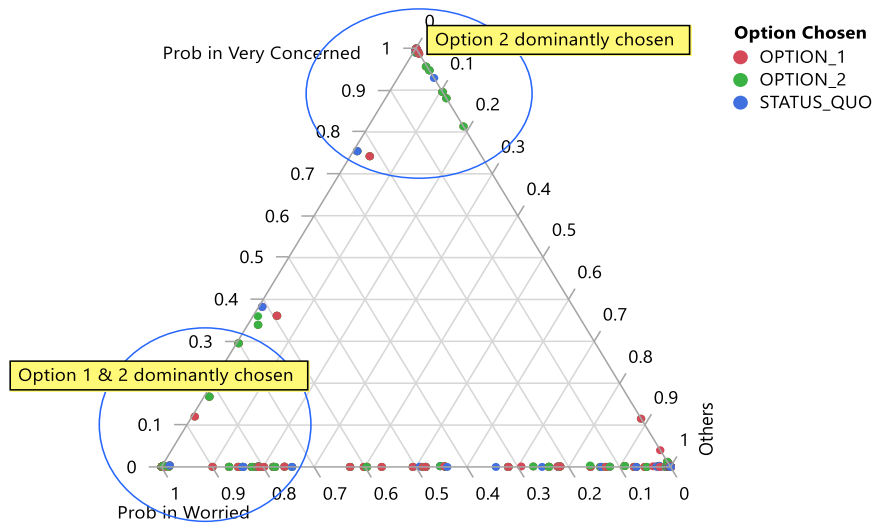


(a)

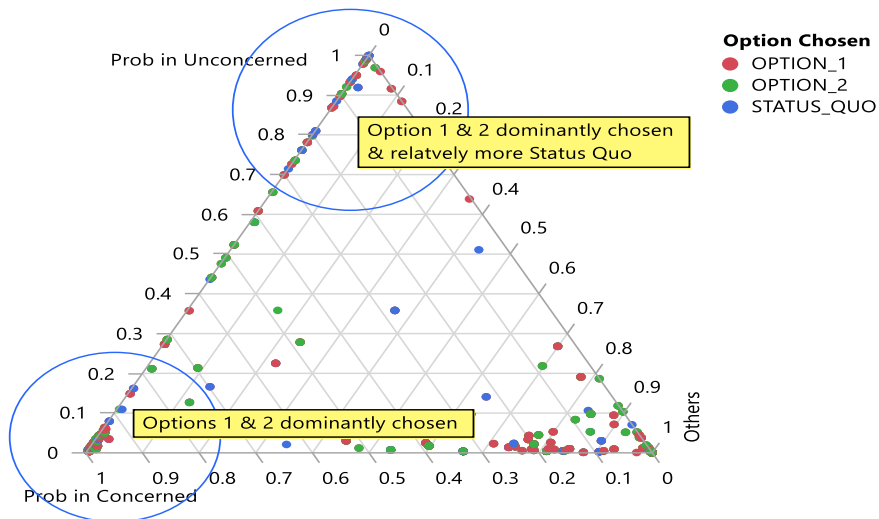


(b)

FIGURE 2.9. Options chosen by classes: “worried” vis-à-vis “concerned” and “very concerned” vis-à-vis “concerned” groups compared.

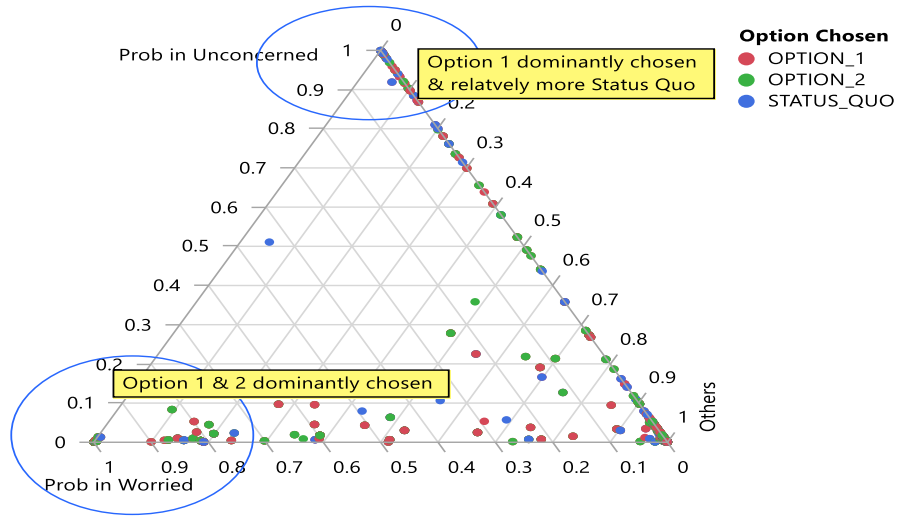


(a)

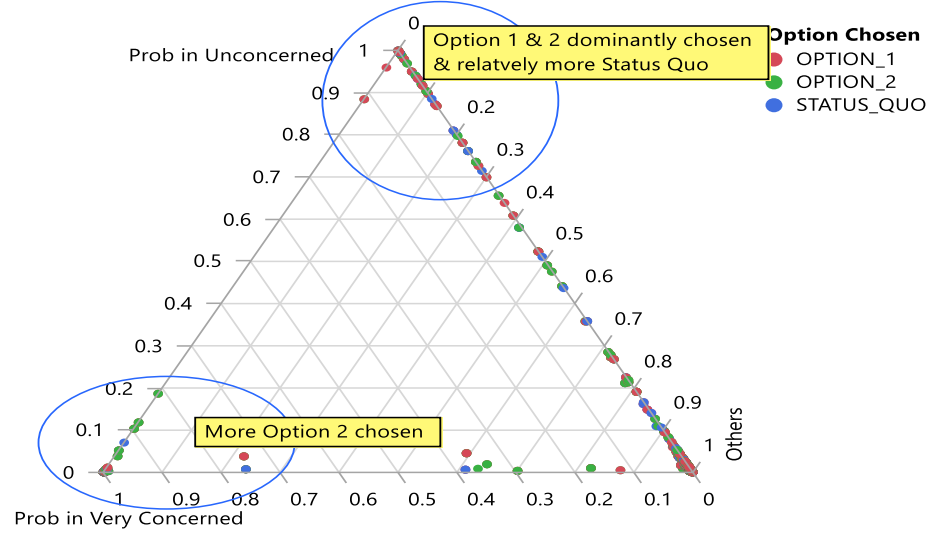


(b)

FIGURE 2.10. Options chosen by classes: “very concerned” vis-à-vis “worried” and “very concerned” vis-à-vis “concerned” groups compared

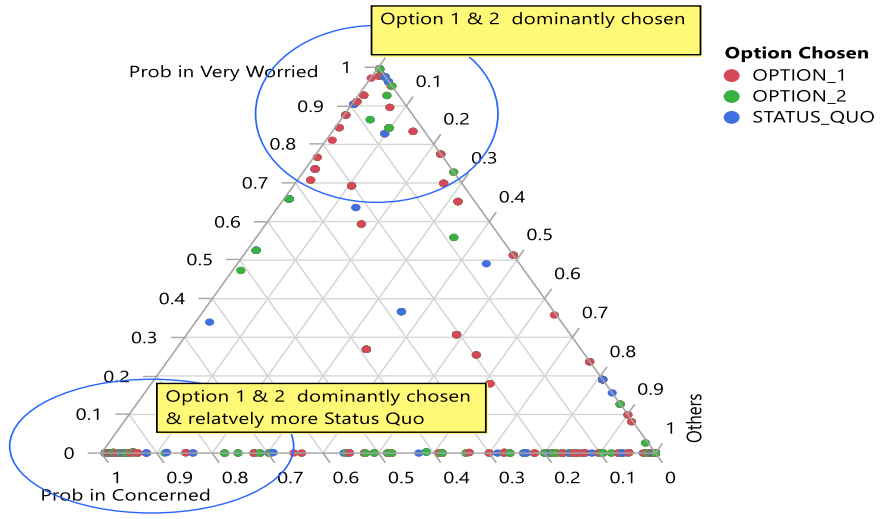


(a)

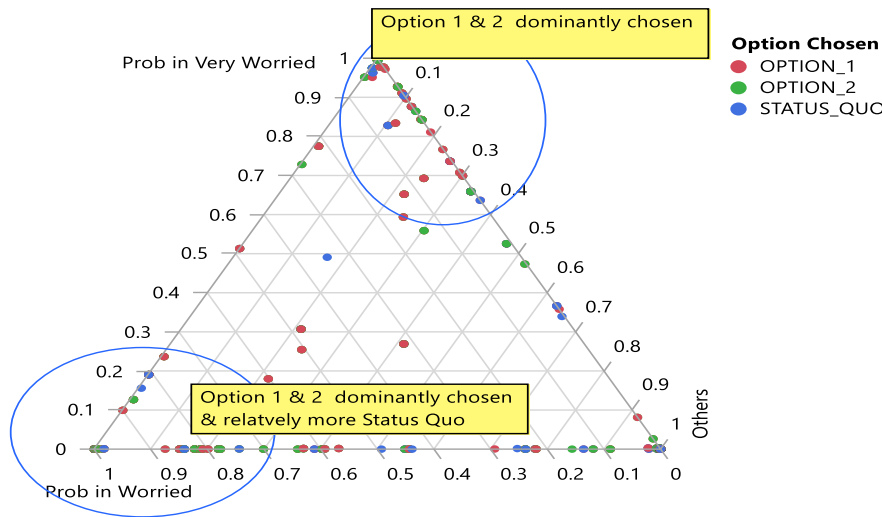


(b)

FIGURE 2.11. Options chosen by classes: “unconcerned” vis-à-vis “worried” and “unconcerned” and “concerned” groups compared.

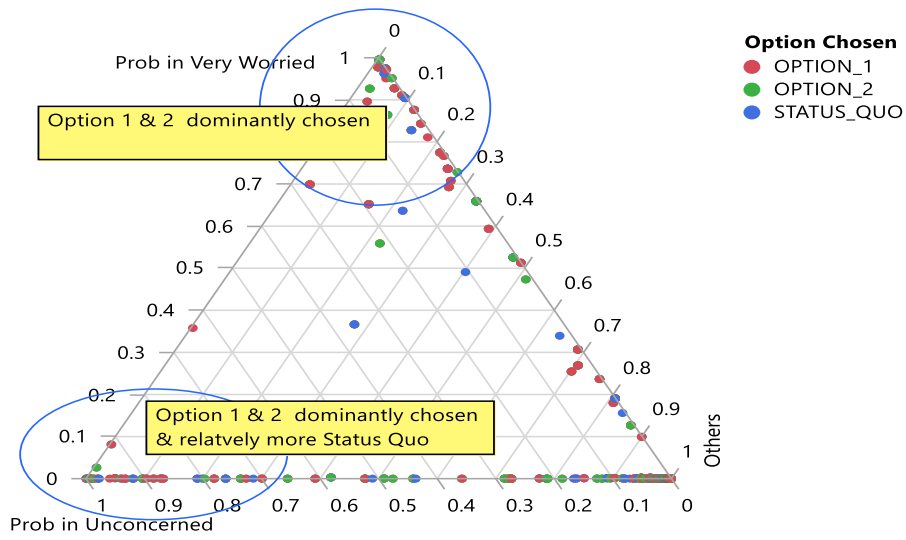


(a)

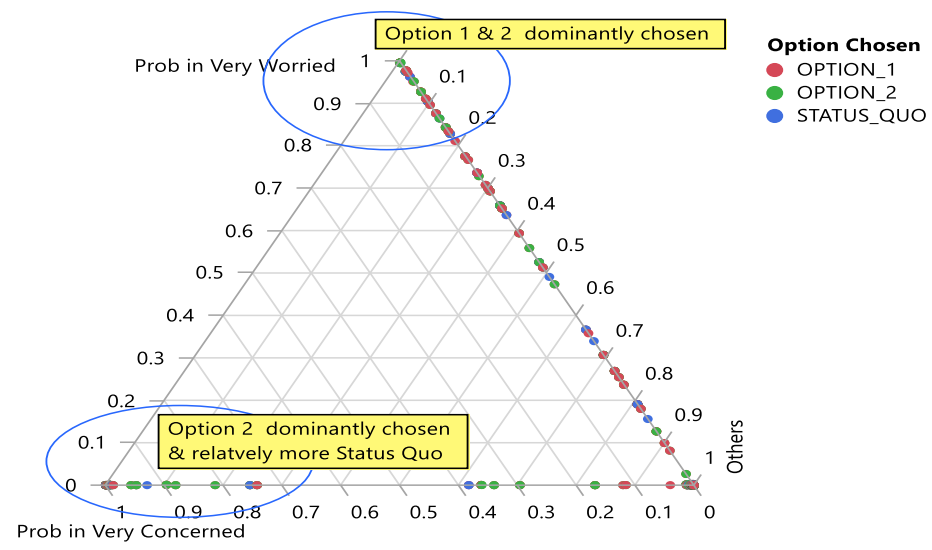


(b)

FIGURE 2.12. Options chosen by classes: “very worried” vis-à-vis “concerned” and “very worried” vis-à-vis “worried” groups compared



(a)



(b)

FIGURE 2.13. Options chosen by classes: “very worried” vis-à-vis “unconcerned”, “very worried” vis-à-vis “very concerned” group compared

2.10. MEAN WILLINGNESS TO PAY (MWTP) AND WELFARE ESTIMATES

As stated above, I applied a choice modeling approach to value the benefits placed on the environmental conservations options chosen and changes in environmental attributes. Here I focus on the implication of preference and response heterogeneities on welfare, since heterogeneity impacts the willingness to pay which is used to quantify gains (or losses) of the environmental conservation policy options. Given the cost coefficient, I estimate the willingness to pay values for each attribute. I calculate WTP values following from Hole (2007) as before:

$$(15) \quad E(WTP^j) = -\frac{E(\beta^j)}{(\beta^{Levy})}$$

Then, I quantify gains or losses by multiplying the average estimated value obtained from these estimations (willingness to pay) by the population of the study region. I assume RDCO's population to be about 100,000 households on average over the planning period. In Tables 2.11 and 2.12, I present the willingness to pay estimates for conditional logit (CL), random parameter (RP) and each perception category latent class models respectively.

TABLE 2.11. Mean Willingness to Pay (MWTP) Estimates

WTP	Groundwater	Aquatic habitat	Natural Habitat	Rural Character
Panel A: Standard Conditional Logit				
Mean WTP	9.2299834	-0.02088377	7.7683167	13.802641
Lower 95%	-98.756915	-0.24446358	-73.349563	-131.95045
Upper 95%	117.21688	0.20269603	88.886197	159.55573
Panel B: Random Intercept Only				
Mean WTP	-8.3463145	0.0178702	-5.1942633	-8.4604849
Lower 95%	-52.040483	-0.08329984	-35.332202	-57.98559
Upper 95%	35.347854	0.11904024	24.943675	41.06462
Panel C: Random Coeffients Only [Suppressed constant]				
Mean WTP	-8.5122388	0.00646589	-2.1216184	-10.979478
Lower 95%	-29.348336	-0.00952953	-7.5759369	-39.71365
Upper 95%	12.323859	0.02246132	3.3327002	17.754694
Panel D: Random Intercepts and Random Coeffients				
Mean WTP	-0.3010169	0.00067951	-0.23291638	-0.45936837
Lower 95%	-0.96563178	0.00030334	-0.34812454	-0.9898203
Upper 95%	0.36359797	0.00105567	-0.11770822	0.07108356

We see that the mean willingness to Pay (MWTP) estimates in both cases differ a great deal across the models and perception groups. It ranges from \$0.3 to \$9.00 per \$1000 in property value for the decrease in the share of total water use from groundwater; from \$7 to \$208 per \$1000 in property value for each 10,000 salmon return; from \$0.2 to \$8.00 less per \$1000 in property value for a km^2 loss in natural habitat; from \$0.45 less to \$13 more per \$1000 in property value for preserving rural character. However, the coefficients on property levy (cost) in the standard conditional logit (CL) and the random intercepts only models are not statistically significant and the MWTP amounts are not statistically different from zero at 95% level of confidence. The combined random coefficients and intercepts and the random coefficients with fixed intercepts models are statistically significant (see Table 2.3) and the MWTP values are statistically different from zero at 95% level of confidence. We

TABLE 2.12. Willingness to Pay Estimates (MWTP) by Perception Class

Perception Class (LC)	MWTP	Groundwater	Aquatic Health	Habitat Loss	Rural Character
Unconcerned	Mean wtp	-1.9907101	0.0016321	-0.11674358	-1.4519163
	Lower 95%	-5.070944	-0.00074366	-0.39054717	-4.076423
	Upper 95%	1.0895239	0.00400785	0.15706	1.1725905
Concerned	Mean wtp	-3.7794399	0.00601769	-1.3449238	-5.4631187
	Lower 95%	-14.929722	-0.01263812	-5.6868945	-23.497461
	Upper 95%	7.3708422	0.0246735	2.9970469	12.571223
Very Concerned	Mean wtp	-5.1224926	0.00042853	-0.51063972	-3.7174741
	Lower 95%	-15.524185	-0.00121883	-1.5745633	-12.012697
	Upper 95%	5.2791996	0.00207589	0.55328386	4.5777483
Worried	Mean wtp	38.150655	-0.03348635	12.363005	46.314221
	Lower 95%	-636.34881	-0.61979144	-202.23106	-756.34234
	Upper 95%	712.65012	0.55281874	226.95707	848.97078
Very Worried	Mean wtp	1.8609225	0.00008392	0.67550404	5.492792
	Lower 95%	-5.9178773	-0.00206085	-1.158074	-8.1843092
	Upper 95%	9.6397223	0.00222868	2.5090821	19.169893

also see that willingness to pay values are statistically significant for aquatic habitat and natural habitat under random intercepts and random coefficients models, implying that scarce resources should be directed to these environmental attributes (see Table 2.11).

Similarly, the mean MWTP differs a great deal across the perception groups. It ranges from \$2 less for the “unconcerned” to \$38 more for the “worried” per \$1000 in property value for the decrease in the share of total water use from groundwater; from \$16 for the “unconcerned” to \$335 for the “worried” group per \$1000 in property value for each 10,000 salmon return; from \$0.10 less for “unconcerned” to \$12.00 more per \$1000 in property value per a km^2 for natural habitat protection; and from \$2 less for the “unconcerned” to \$46 more for the “worried” group per \$1000 in property value for the protection of rural character. Similar to the CL and RP models, the coefficients on property levy (cost) for the perception groups are not statistically significant and the WTP amounts are not statistically different from zero at 95% level of confidence (see Table 2.9).

I use these WTP estimates for the welfare analysis since heterogeneity of affects MWTP estimates which is important for the quantification of gains or losses of the conservation

policies in achieving the goals by 2040. Latent class perception groups allow us to differentiate between groups of people with varying levels of concern about the environment and what each proposed conservation options would mean to them. The fact that at least one or more attributes are important decision variable for all perception group, improved conservation option will allow people to enjoy higher benefit and quality environment by 2040. Even the extreme case class members, the “unconcerned,” consider aquatic habitat as an important decision attribute and are willing to pay for it. It is in the interest of the other environmental damage perception groups to pay for improved environmental quality regardless of the level of payment. we also note that cost is not important in all cases (if only figures in Table 2.9 is considered).Farizo et al. (2014) suspects this kind of result could be a form of “rejecting paying for improvements (as a protest), or that the amounts required to achieve these improvements are not important enough compared with the benefits pursued.”

Therefore, considering the perception group class share (class share row in Table 2.8), I calculate aggregate welfare estimates (not discounted) under five possible scenarios, assuming that each perception group could influence proposed environmental policy implementation. I specifically consider the following scenarios: the “unconcerned” group influences environmental policy implementation; “concerned” group influences environmental policy implementation; the “very concerned” group influences environmental policy implementation; the “worried” group influences environmental policy implementation; and the “very worried” group influences environmental policy implementation. In Table 2.13, I show welfare gains/loss using MWTP amount from the CL and RP models estimates (Table 2.11) and LCM perception groups (Table 2.12) considering only the maximum MWTP values and ignoring the signs. Assuming that there are 100,000 households in RDCO at the end of the planning period, the cost/benefit would range from 85 million to 180 million under the CL & RP models and from 4 million to 300 million among different perception groups. The worried group, for instance, would definitely benefit more if they happen to be the group influencing the proposed conservation policy option implementation. For that matter, all perception groups would benefit from improved conservation policy options as at least

TABLE 2.13. Welfare Estimates under perception groups influencing policy implementations (Not discounted and in \$ 000's CAD)

Scenario	Variables	MWTP(\$CAD)		Prop(%)	Pop. Size	CL& RP Models		LCM	
		Cl & RP	LCM			Benefit/yr	Benefit/30 yrs	Benefit/yr	Benefit/30 yrs
Unconcerned	Ground Water	9	2	0.12	100000	108	3240	24	720
	Aquatic Habitat	208	16	0.12	100000	2496	74880	192	5760
	Natural Loss	8	0.12	0.12	100000	96	2880	1.44	43.2
	Rural Charcter	13	2	0.12	100000	156	4680	24	720
	Total Benefit					2856	85680	241.44	7243.2
Concerned	Ground Water	9	4	0.32	100000	288	8640	128	3840
	Aquatic Habitat	208	60	0.32	100000	6656	199680	1920	57600
	Natural Loss	8	1	0.32	100000	256	7680	32	960
	Rural Character	13	6	0.32	100000	416	12480	192	5760
	Total Benefit					7616	228480	2272	68160
Very Concerned	Ground Water	9	5	0.15	100000	135	4050	75	2250
	Aquatic Habitat	208	4	0.15	100000	3120	93600	60	1800
	Natural Loss	8	0.51	0.15	100000	120	3600	7.65	229.5
	Rural Character	13	4	0.15	100000	195	5850	60	1800
	Total Benefit					3570	107100	202.65	6079.5
Worried	Ground Water	9	38	0.26	100000	234	7020	988	29640
	Aquatic Habitat	208	335	0.26	100000	5408	162240	8710	261300
	Natural Loss	8	12	0.26	100000	208	6240	312	9360
	Rural Character	13	46	0.26	100000	338	10140000	1196	35880
	Total Benefit					6188	185640	11206	336180
Very Worried	Ground Water	9	2	0.15	100000	135	4050	30	900
	Aquatic Habitat	208	0.83	0.15	100000	3120	93600	12.45	373.5
	Natural Loss	8	0.68	0.15	100000	120	3600	10.2	306
	Rural Charcter	13	6	0.15	100000	195	5850	90	2700
	Total Benefit					3570	107100	142.65	4279.5

one environmental attribute is considered important in their choice decisions and they are willing to pay. This is an important observation in the sense that people have different motivations and convictions in choosing conservation options and this approach could be used by policy makers as one of the many ways to estimate benefits/costs of conservation polices proposals. These benefit/cost figures could also be used as starting point toward the ideal of benefit evaluations of policies much more tailored to the many and varied local conditions.

2.11. CONCLUSION

Continuing growth and development is placing increasing pressure on environmental resources, such as ground water, aquatic habitats, natural habitats and rural landscape. These resources provide environmental services that can undoubtedly be underestimated and overlooked. I believe that individuals' subjective damage perceptions about how growth and development impact the environment mirrors the value they put on these environmental goods and services.

The latent class analysis and characterization of the underlying reason for heterogeneity is appealing in the sense that individuals level of concern matters in the trade-off among conservation options. It was possible to distinctly show respondents dissimilarity in terms of the degree of concern for the environment. This is interesting and one of the many ways both preference and response heterogeneity could elegantly be explained. The proportion of people choosing the "no action" status quo option is higher among the less "concerned" group compared to the relatively "worried" group. This finding is in line with our hypothesis and expectation that "less concerned individuals most likely choose the "no action" status quo option. The fact that at least one or more attributes are important decision variable for all perception group, improved conservation options are opted for and that would allow people to enjoy higher benefit and quality environment. Therefore, contrasting the willingness to pay values along this line is more informative and persuasive for policy recommendations.

In a nutshell, the probability that an individual in a given class behaving specific to a priori environmental damage perceptions is in line with our claim that a priori environmental damage perception actually matters in people's conservation options choice decisions.

CHAPTER 3

ON MEASURING SOCIAL NETWORK EFFECT IN CONSERVATION OPTION CHOICES: THE RANDOM UTILITY MAXIMIZATION NESTED LOGIT APPROACH

3.1. INTRODUCTION

While Choice Experiment (CE) is generally one of the toolkits used for eliciting individual preferences over hypothetical alternative scenarios, it assumes that every individual makes autonomous choices, without considering the social impact. However, empirical studies show that choice is social; people inhabit and are influenced by complex and evolving social relationships and influenced by many factors beyond the attributes of the good (He et al., 2014, Knoke and Yang, 2008, Faust et al., 2002, He et al., 2014).

The idea of social interactions as a determinant of behavior, while relatively recent in the context of economic theory, is of course not new in fields such as sociology (Brock and Durlauf, 2003). But, “connectedness” as a lingua franca of interaction of modern society is only a few decades old (Easley et al., 2012). The basis of the network analysis comes from human nature as social animal and from the relationships between people who recognize each other as part of the network system (Diani, 2003; Diani and McAdam, 2003; He et al., 2014, Golub and Jackson, 2010). Its strength lies in its ability to analyze both the behavior of individual actors and the behavior of the whole network (Watts and Witham, 2012; Emirbayer and Goodwin, 1994).

Formally, a social network is defined as “a group of people who are connected to some or all of the others following a random or particular pattern in network system (He et al., 2014).” In network language, this translates into links between nodes in a graph (Watts and Strogatz, 1998; Watts and Witham, 2012). Nodes show the position of different actors in a network and links measure how involved an actor is, how connected the actor is (Diani

and McAdam, 2003) and represent a flow of potential information and interaction between those ‘nodes’ of individuals (Burt, 1984, Carrasco et al., 2008). Network positions could facilitate or constrain actors (Diani and McAdam, 2003), and this can be measured by their degree and other centrality measures (Freeman et al., 1979). Actors with high betweenness centrality, for instance, have greater possibility to control the flow of resources (Watts and Witham, 2012). This could increase the potential to locate and gain resources from the network, but also increase direct influence - for example, in face-to-face meetings which creates the ability to shape actions and priorities (Watts and Witham, 2012).¹ Thus, we can utilize social network analysis to describe, summarize and visualize individual interactions and connections and their implications for decision making.

In this chapter, I investigate the role of interaction in people’s decisions in the context of environmental conservation policy choices by introducing a social network centrality measure into a traditional utility functions. I estimate individual’s choice coefficients and parameters for hypothetical conservation choice options described by multiple environmental goods attributes within a Nested Logit Model (NLM): nesting distinct conservation policy options within broader and composite level environmental conservation policy outcomes. The question I specifically examine is whether social networks influence choice decisions and explains the variations in observed willingness to pay amounts among individuals for environmental goods in a systematic way. The closest study utilizing the method employed here is a paper by He et al. (2014) that examined the impact of social networks on consumer preferences and choice behaviors in the adoption of new products. Their result illustrates the need for considering social impact in forecasting new product adoption. To my knowledge, no study empirically evaluated social network effect as source of systematic preference heterogeneity in the context of environmental conservation.

The remainder of the chapter is organized as follows. Section 3.2 reviews the literature on social network theories and choice experiments. Section 3.3 outlines the theoretical model.

¹For further reviews of the paradigm and techniques, see Scott (2011), Jackson et al. (2008), Carrington et al. (2005), Wasserman and Faust (1994), Wellman and Berkowitz (1988), Carrasco and Miller (2009).

Section 3.4 describes the survey methodology and the structure of network data. Section 3.5 outlines the NLM method and its appeal for analyzing data that has a hierarchical structure. In section 3.6, I present results and discussions on choice decisions and the interdependence of preferences in a network. Section 3.7 offers brief concluding remarks.

3.2. LITERATURE REVIEW: SOCIAL NETWORK THEORIES

The importance of interpersonal interaction on decision behavior has been studied by numerous researchers (McFadden, 2010, Lobel and Sadler, 2015, Bramoullé et al., 2014, He et al., 2014, Jackson, 2010, Jackson and Wolinsky, 1996, Zhang et al., 2013, He, 2012). McFadden (2010), specifically notes that “models that neglect to incorporate sociality will not predict well in situations where individuals utilize their social network to define their perceptions and preferences.” Manski (1993), Banerjee (1992), and Samuelson (2004) highlight the importance of information obtained from social networks in influencing preferences and choice decisions. Brock and Durlauf (2002) demonstrate interdependence of choices and social interaction using a binary logit model. Stopher (1980) and Williams and de Dios Ortuzar (1982) empirically test the inconsistent parameter estimates that can arise when the choice set is considered by individual decision maker in social isolation.² Narayan et al. (2011) demonstrate peer influence on product attribute preference and show that peer influence changes attitude. Dugundji and Gulyás (2008) shows consumer interdependence by demonstrating that a given consumer’s choice is dependent on the overall market share. Struben and Sterman (2008) illustrate a word-of-mouth effect in alternative fuel vehicle choices. Tran (2012) demonstrates the important role that network influence plays in accelerating energy innovation diffusion. Dugundji and Walker (2005) demonstrate the impact of local social network effects on intercity travel mode choice behavior by introducing local social network effects into the choice utility with varying network densities. Páez et al. (2008) study residential location choice using simulated network data with varying degrees of distributions and clustering parameters. Rasouli and Timmermans (2016) show

²see Chandrasekhar and Lewis (2011) and Swait and Ben-Akiva (1987) for more on this.

the effects of vehicle, contextual, and social network attributes on the latent demand for electric cars using fixed and random mixed logit models.

Applications of social network analysis to natural resources and non-market valuation are also evolving recently. Some studies that incorporate social interactions into non-market valuation include Bramoullé and Kranton (2007, 2003), Crona and Bodin (2006), Ostrom (2015), Pretty and Ward (2001), Prell et al. (2009), Neilson and Wichmann (2014), Bouma et al. (2008). Key results include the increase in the likelihood of collective action, opinion formation, cooperation, resource sharing and social influence. For instance, Granovetter (2005) demonstrates that overcoming the free-rider problem is more likely in groups with a dense and cohesive social network. He argue that, “actors in dense networks typically internalize norms that discourage free riding and emphasize trust and norms (shared ideas about the proper way to behave) are clearer, more firmly held and easier to enforce the more dense a social network is.” Bramoullé and Kranton (2007) show how social networks can influence some individuals to contribute and others to free-ride. Neilson and Wichmann (2014) argue that “social network structure with strong connection of individual members with higher private values for the public good produces higher aggregate valuation.”³ They show that aggregate willingness to pay is related to network centrality. That is, societies are willing to pay more in aggregate for a public good when that public good provides more benefit to people more central to the society (Watts and Witham, 2012). In addition, Watts and Witham (2012) claim that willingness to pay or willingness to accept are influenced by the position of actors (opinion leaders) in a network. Newton (2010) analyzes the effect of coalitional behavior on local public goods provision. ODea (2010) examines the relationship between local public good provision and social network formation. Cho (2010) studies

³They highlight on many reasons why social network structure might impact valuation. “One is that individuals may be altruistic and care about public goods that benefit their friends even if they do not benefit themselves. For instance, the presence of a park might not generate any private utility for the individual, but if the park gives her friends utility and she values those friends’ utility, she might have positive willingness to pay for the park due to social utility. Second, people might use the public good in groups. For instance, someone might like going to a park, but not alone, so to get enjoyment from the park her friends must also like the park. She gets utility from going to the park with friends, but might also get utility from going with friends’ and the utility of friends of friends may affect friends’ utility and so on. This leads to network effect (Neilson and Wichmann, 2014).”

endogenous formation of networks for local public goods in sequential bargaining games. Chih (2010) incorporates interactive costs and social perception of free-rider behavior in a model of local public goods and network formation. The overarching message addressed by this literature is that social interactions generate variations in overall valuations of non-market goods, and that treating individuals as independent units of analysis, as traditionally done in economic science, overlooks this fact and that behavior is explained not only through personal attributes but also through social structural attributes (Carrasco et al., 2008, Neilson and Wichmann, 2014). Thus, in this chapter I investigate how individual's personal community networks (Egocentric network) affect conservation choice decisions and the willingness to pay values. As Neilson and Wichmann (2014) say, "low marginal utility agents are willing to pay more under social interaction because they benefit from the higher marginal use values of socially connected agents. If agents are equally "important" in the social network (i.e. they receive the same intensity of social connections), network effects may alter individuals utility but overall welfare remains at the same level it would be under complete social isolation. In this case, the network only works as a re-distributor of benefits."

None of the studies above have empirically evaluated the impact of social network on public good conservation projects/options valuation. Therefore, this work is not only an extension of the previous literature but a contribution in a sense that it illustrates the procedure of social network data collection and application, social influence evaluation, and choice model estimation using a choice experiment which incorporates social network questions into non-market valuation surveys.

3.3. SOCIAL NETWORK MODEL

In Egocentric Network (ENW), we are concerned with how people's patterns of interaction shape their individual-level outcomes (e.g. conservation option choices). Therefore, I consider a model in which an individual's discrete conservation option choice is influenced by the number of ego's network (alters) who usually interact with each other and discuss issues

that matter the most to all of them. ENW is the local social network around an individual consisting of a focal node (“ego”) and the nodes to whom ego is directly connected to (these are called “alters”) plus the ties, if any, among the alters. Each alter in an ego network has his/her own ego network, and all ego networks interlock to form the human social network (Borgatti et al., 2013, Hanneman and Riddle, 2005). Most of the analysis of ego networks uses “simple graphs (i.e. graphs that are symmetric, and show only connection/not, not direction). If we are working with a directed graph, it is possible to define different kinds of ego-neighborhoods. An “out” neighborhood would include all the actors to whom ties are directed from ego. An “in” neighborhood would include all the actors who sent ties directly to ego. We might want to define a neighborhood of only those actors to whom ego had reciprocated ties (Hanneman and Riddle, 2005). Therefore, in this choice experiment survey, “Ego” is the individual respondent and “Alters” are his/her contacts and we have as many egos as the number of total choice experiment survey completed.

Formally stated, an ego network may consist of $n \geq 2$ agents. Let these agents indexed by $i = 1, \dots, N$. Following Neilson and Wichmann (2014), I assume that people in the ego network value each others’ utility not only from the consumption of a private good Y but also improved public good Ψ that depends on new conservation policy outcomes. Then, individual utility associated with choosing new conservation policy may take the following form:

$$(16) \quad V_i^C = F_i(V_i(Y_i, \Psi), V_e^i(\Psi))$$

This could be assumed to take additively separable interdependent functional form:

$$(17) \quad V_i^C = V_i(Y_i, \Psi) + \sum \Upsilon_{ij} V_e^i(\Psi)$$

where $V_i(Y_i, \Psi)$ is the egocentric private utility associated with choosing environmental conservation option “C”, $V_e(\Psi)$ is ego’s social utility associated with his/her conservation option choice and improved public goods that alters also benefit from its consumption, Ψ is

exogenously provided but conservation policy dependent environmental goods (measured by key environmental indicators/attributes), $\Upsilon_{ij} \geq 0$ for all i and j is the relational ego-alter and alter-alter tie, measured on each ordered pair of $i, j = 1, \dots, N$.⁴ We can use actor-by-actor adjacency matrix to represent ego-alter and alter-alter networks:

$$(18) \quad \Upsilon_{ij} = \begin{cases} 1, & \text{if there is ego-alter and alter-alter tie} \\ 0, & \text{otherwise} \end{cases}$$

Υ_{ij} represent the tie that may be reciprocated or not in a sense that Υ_{ij} may be different from Υ_{ji} . In other words, the adjacency matrix could be asymmetric (Υ_{ij} is not always equal to Υ_{ji}) and row stochastic matrix with dimensions $n \times n$. A matrix is row stochastic if it is a square matrix of nonnegative real numbers, with each row summing to 1 (Neilson and Wichmann, 2014).

Social utility in egocentric network is assumed to be the average of alters utility. Neilson and Wichmann (2014) formally states it as follows:

$$(19) \quad V_e^i(\Psi) = (1 - \zeta)v_e^i(\Psi) + \zeta \sum \Upsilon_{ij}v_e^j(\Psi)$$

Where, $V_e^i(\Psi)$ is ego i 's social utility, $\zeta \in [0, 1]$ is a parameter that reflects the extent to which social utility of alters is relevant to ego's. The term $(1 - \zeta)$ is the weight ego puts on own private satisfaction $v_e^i(\Psi)$ by choosing conservation option "C". In the network language, ζ represents ego's degree of social interaction measured by one of the network centrality measures (i.e. degree, closeness, transitivity, clustering coefficient and/or eigenvector). Ego i is said to be socially isolated if ego's conservation option choice decision is independent of alters. According to Neilson and Wichmann (2014), "when $\zeta = 0$, ego i 's social utility $V_e^i(\Psi)$ is equal to his/her own private utility $v_e^i(\Psi)$. Social isolation shuts down the social

⁴Neilson and Wichmann (2014) explains two venues through which the provision of Ψ can affect ego's social utility $V_e(\Psi)$. "First, ego i obtains private utility $V_i(\Psi)$ from the consumption of Ψ . This is the component of social utility that is obtained from own consumption of Ψ and is independent of social effects. Second, ego i may care about the enjoyment of her friends and, as a result, may obtain social utility."

channel through which the provision of Ψ affects ego's utility and the model simplifies to a standard utility model without network effects.”

Equation (19) shows interdependent utility and it can be rewritten in matrix notation as⁵:

$$(20) \quad \begin{aligned} \mathbf{V} &= (\mathbf{I} - \zeta)\mathbf{v} + \zeta\mathbf{M}\mathbf{V} \Rightarrow \mathbf{V} - \zeta\mathbf{M}\mathbf{V} = (\mathbf{I} - \zeta)\mathbf{v} \Rightarrow \mathbf{V}(\mathbf{I} - \zeta\mathbf{M}) = (\mathbf{I} - \zeta)\mathbf{v} \Rightarrow \\ \mathbf{V} &= (\mathbf{I} - \zeta\mathbf{M})^{-1}(\mathbf{I} - \zeta)\mathbf{v} \end{aligned}$$

where \mathbf{I} is the identity matrix, \mathbf{M} is a diagonal matrix with m_{ij} in the i^{th} row.⁶ Similar to Neilson and Wichmann (2014) and Friedkin (1991), let $\Theta = (\mathbf{I} - \zeta\mathbf{M})^{-1}(\mathbf{I} - \zeta) \Rightarrow \mathbf{V} = \Theta\mathbf{v}$.⁷ Θ represents ego-alter and alter-alter links capturing social utility and network effects on choice decisions. Specifically, the ego-alter and alter-alter interaction and egocentric social utility is determined by the matrix $\zeta\mathbf{M}$. Bramoullé (2001) calls it “primary network effect” and Neilson and Wichmann (2014) refers to Θ as the “induced network”. They argue that the circuitous links between agents emerging from links in the primary network induce further ego-alter and alter-alter interaction impacting ego i 's social utility. They note that this arises from Neumann infinite series approximation, further explained in Meyer (2000)⁸:
 $(\mathbf{I} - \zeta\mathbf{M})^{-1} = (\mathbf{I} + (\zeta\mathbf{M}) + (\zeta\mathbf{M})^2 + \dots)$

For illustration, I borrow Neilson and Wichmann (2014) three-person population example:

$$\mathbf{M} = \begin{pmatrix} & Ego & Alter_1 & Alter_2 \\ Ego & 0 & 0.5 & 0.5 \\ Alter_1 & 1 & 0 & 0 \\ Alter_2 & 1 & 0 & 0 \end{pmatrix}$$

⁵see Bergstrom (1999), Neilson and Wichmann (2014) for the derivation and further details.

⁶See Bergstrom (1999) and Neilson and Wichmann (2014) for the detailed explanation.

⁷ Friedkin (1991) refers to Θ as “the total interpersonal effects matrix and which bases several measures of centrality on it”

⁸See Friedkin (1991) for similar argument.

$$\zeta = \begin{pmatrix} & Ego & Alter_1 & Alter_2 \\ Ego & 0.8 & 0 & 0 \\ Alter_1 & 0 & 0.5 & 0 \\ Alter_2 & 0 & 0 & 0.2 \end{pmatrix}$$

$$\Theta = \begin{pmatrix} & Ego & Alter_1 & Alter_2 \\ Ego & 0.28 & 0.28 & 0.44 \\ Alter_1 & 0.14 & 0.64 & 0.22 \\ Alter_2 & 0.06 & 0.06 & 0.88 \end{pmatrix}$$

From \mathbf{M} , we see that ego interacts with both alters with a positive weight of 0.5 each. However, here is no alter-alter interaction. Even though the alters may not even know each other, both alters interact with the ego and their utility may depend on ego's utility leading to interdependent utility. The resulting ego-alter and alter-alter utility may look like Θ matrix. Element-wise, from Θ matrix, we see that $\Theta(Alter_2 Alter_1)$ have a positive utility of 0.06, even though they do not know each other, 0 weight from matrix \mathbf{M} . We also see that social utility is not reciprocated such that $\Theta(Alter_1 Alter_2)$ is greater than $\Theta(Alter_2 Alter_1)$ ($0.64 > 0.06$) because, from ζ matrix, the weight $\zeta_{Alter_1} = 0.5$ and $\zeta_{Alter_2} = 0$.

From equation (20), $\mathbf{V} = (\mathbf{I} - \zeta\mathbf{M})^{-1}(\mathbf{I} - \zeta)\mathbf{v}$, ego's "total social utility can be formalized as a function of alters private utility profile (Neilson and Wichmann, 2014)."

$$(21) \quad \mathbf{V} = \Theta\mathbf{v} \Rightarrow V_e^i(\Psi) = \sum_j \theta_{ij} v_e^j(\Psi)$$

where θ_{ij} is an element of the square matrix Θ .⁹ Substituting equation (21) into equation (16) for social utility, gives us ego i's overall utility function, which we can use measure ego's willingness to pay amount for a change in public good as a consequence of choosing

⁹See Neilson and Wichmann (2014) for all the proofs that "agent i's social utility is a convex combination of the private utilities of all agents"

any conservation option (Neilson and Wichmann, 2014, Bergstrom, 1999).

$$(22) \quad V_i^C = F_i(V_i(Y_i, \Psi), \sum_j \theta_{ij} v_e^j(\Psi)) \Rightarrow V_i(Y_i, \Psi) + \sum_j \theta_{ij} v_e^j(\Psi)$$

Egocentric willingness to pay values and the associated benefit associated with the change in level of environmental attributes under prosocial conservation option chosen can be determined using equation (22). That is, the amount of levy associated with a particular conservation option that results in a discrete change in the levels of environmental attributes Ψ from Ψ^0 to Ψ^1 could be Γ_i amount that solves the following equation:¹⁰

$$(23) \quad V_i^C(\text{Income}^i, \Psi^0) = V_i^C(\text{Income}^i - \Gamma_i, \Psi^1)$$

From equation (22) and normalizing $V_i(Y_i, \Psi)$ to 1, the compensating welfare measure associated with the change in the levels of environmental attributes under egocentric network takes the following form (Neilson and Wichmann, 2014):

$$(24) \quad V_i^C = \text{Income}^i + \sum_j \theta_{ij} v_e^j(\Psi^0) = \text{Income}^i - \Gamma_i + \sum_j \theta_{ij} v_e^j(\Psi^1)$$

$$(25) \quad \Gamma_i = \sum_j \theta_{ij} v_e^j(\Psi^1) - \sum_j \theta_{ij} v_e^j(\Psi^0) \Rightarrow \text{WTP}_i^{\text{egocentric}} = \sum_j \theta_{ij} v_e^j(\Psi^1) - \sum_j \theta_{ij} v_e^j(\Psi^0)$$

From equation (21), willingness to pay under egocentric network can be rewritten as a change in total social utility:

$$(26) \quad \text{WTP}_i^{\text{egocentric}} = V_e^i(\Psi^1) - V_e^i(\Psi^0)$$

¹⁰See (Neilson and Wichmann, 2014) for more on this.

Or from equations 25, prosocial willingness to pay can be summarized as the weighted average of private willingness to pay. Formally stated:

$$\begin{aligned}
 (27) \quad WTP_i^{\text{egocentric}} &= \sum_j \theta_{ij} v_e^j(\Psi^1) - \sum_j \theta_{ij} v_e^j(\Psi^0) \\
 &= \theta_{ij} \sum_j (v_e^j(\Psi^1) - v_e^j(\Psi^0)) \\
 &= \theta \sum WTP^{\text{private}}
 \end{aligned}$$

$$(28) \quad WTP_i^{\text{egocentric}} = \theta_{ij} \sum WTP^{\text{private}} \Rightarrow WTP_i^{\text{egocentric}} = \Theta \mathbf{WTP}^{\text{Private}}$$

“The same induced network Θ determines both social utility and willingness to pay under network interaction (Neilson and Wichmann, 2014).”

The influence each member of the egocentric network exert is the row normalized sum of the elements in the induced Θ matrix (Neilson and Wichmann, 2014). Friedkin (1991) states this process that “the total interpersonal effect of one actor on another which is related to the number and length of the various paths and sequences that join them in the network of interpersonal influence.”

I present the application of the model using survey data collected in the Regional District of Central Okanagan (RDCO) of the British Columbia of Canada. In the survey I incorporated network questions with the choice experiment designed to eliciting individual preferences for a hypothetical environmental conservation programmes.

3.4. THE SURVEY: SOCIAL NETWORK DATA

The interest in the data collection effort here is to measure how each ego’s choice decision is influenced by the alters network. In egocentric network, unlike sociocentric social network which use as its sampling frame a census of a particular bounded group, targets unbounded individuals as cases. The focus on individual rather than group outcomes makes egocentric social network analysis superior compared to the sociocentric (i.e. whole) network

analysis (Chung et al., 2005). The boundaries of egocentric networks are defined in terms of each neighborhood or number of alters a ego is directly connected to (Hanneman and Riddle, 2005). The issue in egocentric network approach however is that, tie strength is measured only from the ego perspective, for both ego-alter pairs and alter-alter pairs. This is because it is prohibitively expensive to interview both egos and alters (Carrasco et al., 2008). Otherwise, the potential sampling frames and data collection strategies are relatively easier and flexible in a sense that it can be collected incorporated into large-scale surveys such as choice experiment.

Similarly, I developed a online egocentric network survey instrument integrated with choice experiment, modifying the survey developed by Burt (1984). It covered a variety of aspects about egocentric network's interaction patterns. The main ones include: information on the social structure of individuals (egos) and alters (contacts), socioeconomic and lifestyle attributes, with whom they talk and perform social activities, related communication patterns (e.g. frequency and type of media used), how growth and development are impacting the environment and if they talk with others to learn more about issues like these, and their feeling or opinions on the environment in the Okanagan. Specifically, questions related to network members (name generators), kind of relationship (name interpreter), strength of contact between/among contacts, frequency of contact, length of time knowing each other, reason of connection, political affiliation and what people talk about in general were asked. After prompting the number of network members, further questions included contacts gender, education, income and approximate physical distance. Respondents were only required to provide initials of their contacts making sure that each individuals are unique and mutually exclusive. Specifically, in the name generators section. the question reads:

- i. *During the last six months, who have you talked with about how growth and development are impacting the environment in the Central Okanagan? Please provide us up to 5 people's initials. The initials you*

provide will be used as part of questions later in this survey. Please ensure that each set of initials is unique.

With this type of question we can only measure tie strength between egos and each alter, and between alter-alter pairs.¹¹ After eliciting network members, a second set of questions is the name interpretor which is usually performed to obtain more information about the characteristics of each alter (e.g. socioeconomic status, relationship with ego) and ego-alter relationship (e.g. frequency and characteristics of interaction) (Carrasco et al., 2008). The following questions have been asked in this section:

- ii. *How close (familiar) are you with these people? Choose “very close (very familiar)”, “close (familiar)” or “Acquaintance” for each of the people you have identified;*
- iii. *Please think about the relations between the people you just mentioned. Are they very close (very familiar) to one another, close (familiar) to each other or strangers in the sense that they would not recognize one another if they met on the street. . . . please select as “Very close (very familiar)(VC)”, “Close (familiar)(C)”, “Stranger (S)” to indicate how familiar the person named in the row is with the person named in the column. While in many cases we expect the familiarity to be the same in both directions, it is possible that the familiarity may not be the same in both;*
- iv. *On average, how often do you talk with the people you have identified (text, Twitter, Facebook, visit, phone, email or write)? Daily /Almost daily; at least ; once/week; at least once/month; 3 to 4 times/year; approximately once/year; less than once/year; do not know;*

¹¹ As before, the chosen indicator will affect which tie strength measure is collected, with emotional closeness being the most usual and accepted (Campbell et al., 1986).

- v. *How long have you known these people? less than a year; one to three years; three to six years; six to nine years; more than nine; do not know;*
- Vi. *What is the political affiliation of your contact? (Your best guess if not sure);*
- vii. *Below are some environmental topics that people talk about. Over the last six months, which environmental issues can you recall coming up in your conversations?*

Some of the key challenges in this data collection effort include: that people do not easily recall their network members and need appropriate ‘prompts’ to elicit them; that Networks are very large; that egos and alters may have different importance and priorities depending on their unique individual characteristics; that this questions added to choice experiment overburdens respondents limiting amount of information in a non-tedious, relatively short, and reliable way.¹²

Overall, a total of 3000 households were invited, 550 started the online survey, which yielded 468 completed questionnaires (16% response rate). Each ego named 3 alters on average yielding about 1464 nodes or observations. Figures 3.1 and 3.2 presents the complete undirected egocentric network and ego-alter and alter-alter network separately.¹³

Similar survey was conducted by Carrasco et al. (2008) which they call it “a ‘meso’ approach, since it captures structural features, such as size of the network, approximate density, and aggregated composition according to aspects such as role and gender, and the ego’s characteristics. They claim that their approach contrasts with a ‘micro’ approach mostly adopted in the interviews, which also captures more disaggregated aspects, such as each alters characteristics (e.g gender, spatial location), and each interaction between alters and the respondent.

¹²See Carrasco et al. (2008) for similar issues and problems with ego network surveys.

¹³For similar study, see Carrasco et al. (2008)

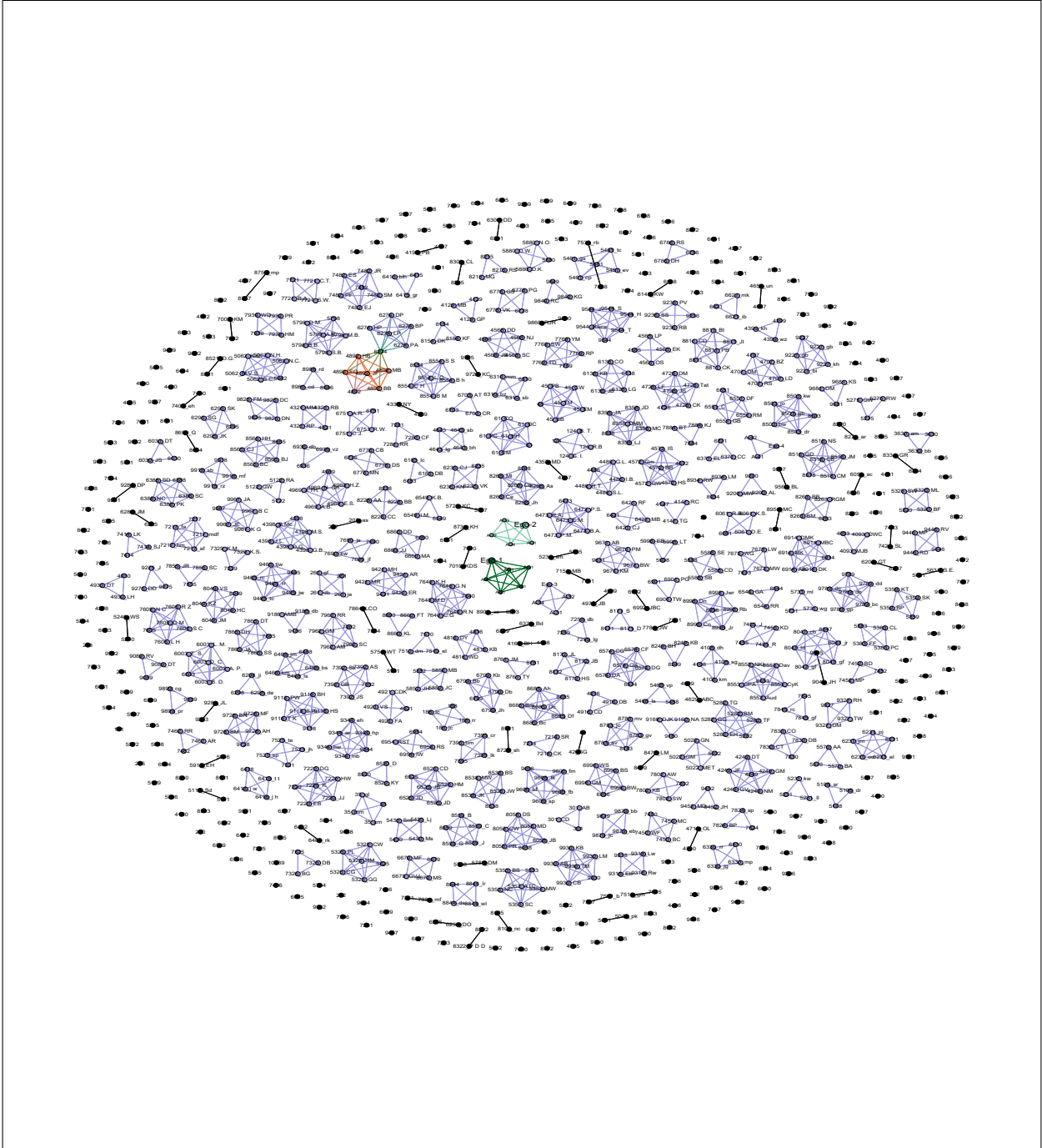


FIGURE 3.1. The figure show complete ego-alter map. It is computed by the author based on survey data using Gephi software (Bastian et al., 2009). Each point represents a person, either an ego or an alter. All nodes are one-step away from ego and all of the ties among all of the alters to whom ego has direct connection. People who did not list or did not talk about these issues are egos with no links.

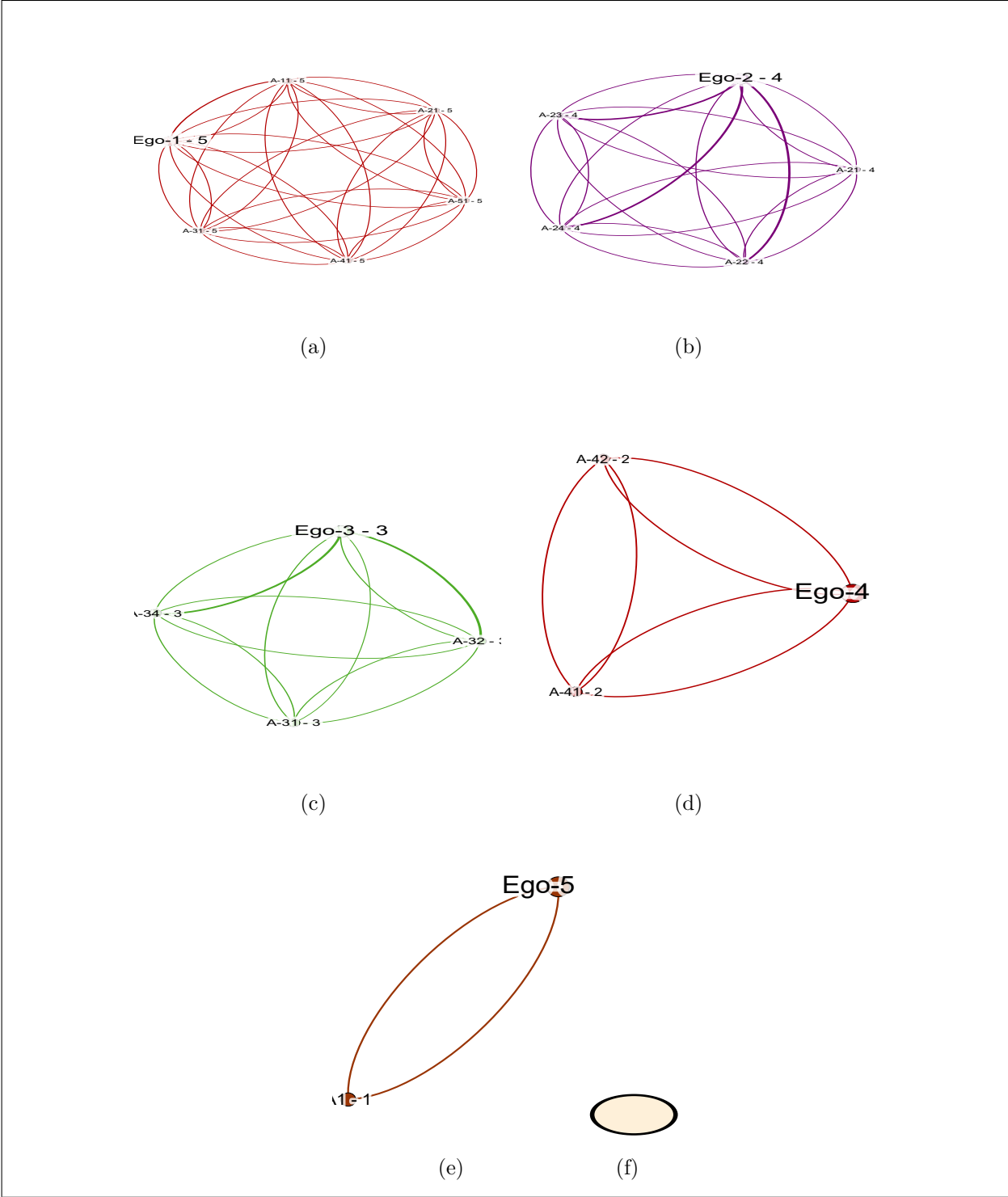


FIGURE 3.2. Egocentric network involving an ego with 5, 4, 3, 2, 1 and 0 alters labeled (a) , (b) , (c) , (d) , (e) and (f). For clarity, all show undirected ego-alter and alter-alter ties. The measures included the number of alters with whom the ego named as having a close relationship (degree), the average strength of these relationships (closeness), and the connectedness of the named alters to each other according to the ego (transitivity).

In the survey, we exhaustively tested for mistakes and relevance and many changes have been made. Researchers who have done similar study were contacted to comment on the first draft and on the improved versions of the whole survey.¹⁴

3.5. EGOCENTRIC NETWORK MEASURES

The most basic metric in network measure of tie strength is degree. It is number of alters or ties a focal node or ego name, ranging from 0 to the maximum 5 (Freeman, 1978, Omalley et al., 2012). Formally, the degree δ on vertex i is:

$$(29) \quad \delta_i = \sum_{j=1}^n \Phi_{ij}$$

Where Φ_{ij} is the adjacency matrix whose elements takes the value of 1 if there is an edge between vertices's i and j and 0 otherwise. It is interpreted as how connected, important, or influential a node is or as the immediate influence of a node for catching whatever is flowing through the network (some information) (Opsahl et al., 2010, Easley et al., 2012). In the case of a directed network (where ties have direction), we usually define two separate measures of degree centrality, namely indegree and outdegree. Indegree is a count of the number of ties directed to the node and outdegree is the number of ties that the node directs to others. When ties are associated to some positive aspect such as friendship, indegree is often interpreted as a form of popularity, and outdegree as outgoing or social (Opsahl et al., 2010, Wikipedia, 2016). The mean average degree in my case is 2-4 persons (see Table 3.2 for the summary statistics). The second important measure is closeness centrality which rely on and length of the shortest paths linking two nodes, either directly or indirectly (Opsahl et al., 2010). This measure can be formalized as follows:

$$(30) \quad \Phi_{i,j} = \min(A_{ik} + \dots + A_{kj})$$

where k is/are intermediary node/s on paths between node i and j . The closeness of an egos relationships is, therefore, the average strengths of their reported ties (Omalley et al.,

¹⁴ See the specific items in part B6 of Appendix B of the questionnaire

2012). Closeness is formally stated by Freeman (1978) as follows:

$$(31) \quad C(i) = \left[\sum (\Phi_{ij}) \right]^{-1}$$

It is believed that closeness have greater discriminatory power than degree (Opsahl et al., 2010). The third important measure in egocentric networks is transitivity. It is defined as “the average value of the relationship between all pairs of alters (Omalley et al., 2012).” It is assumed that relationship in egocentric network is mutual and that the relationship from j to k is the same as that from k to j). Omalley et al. (2012) formally state transitivity T_i as follows:

$$(32) \quad T_i = 2\delta_i^{-1}(\delta_i - 1) \sum_{j < k} I(\zeta_{jk} > 0)$$

Where δ_i is the degree of ego i and ζ_{jk} is the strength of the relationship between alter j and alter k . In the context of egocentric network, transitivity is a local measure specific to an ego and interpreted as “the proportion of pairs of alters for which some form of relationship exists (Omalley et al., 2012).”

The fourth tie strength measure is a clustering coefficient. The basic idea behind a clustering coefficient is that “if two people in a social network have a friend in common, then there is an increased likelihood that they will become friends themselves at some point in the future (Rapoport, 1953).” The clustering coefficient C_L of a node n can be calculated as:

$$(33) \quad C_L = \begin{cases} 0, & \text{if } \delta_n = 0 \\ \frac{E_n}{\binom{\delta_n}{2}}, & \text{if } \delta_n \geq 2 \end{cases}$$

where δ_n the degree of node “n” and E_n is the number of edges in the ego network. Li et al. (2017). The mean clustering coefficient of a ego network with a minimum degree $\delta \geq 2$ is

defined by Li et al. (2017) as :

$$(34) \quad \bar{C}_L = 1/N \sum C_L = 2 \sum E_n / \delta_n (\delta_n - 1)$$

More specifically, if there are three nodes in a network, i , j , and k , and i is connected to j and k , the likelihood that j and k are also connected with each other is greater than the probability of a tie randomly established between two nodes (Opsahl and Panzarasa, 2009). The clustering coefficient of a ego A therefore is the probability that two friends of A are friends with each other (Easley et al., 2012). It quantifies how close neighbors are to being a clique “the friend of my friend is also my friend” (Watts, 1999)

In egocentric network, we deal with the local clustering coefficient which is based on ego’s network density or local density (Scott, 2011, Wasserman and Faust, 1994). it is formally stated “as the fraction of the number of ties connecting i ’s neighbors over the total number of possible ties between i ’s neighbors (Opsahl and Panzarasa, 2009).” It is considered to be an effective measure of the local connectivity or “cliquishness” of a social network Li et al. (2017). It is called “small-world” network if a network has high average clustering coefficient and a small average distance (Watts and Strogatz, 1998). The mean local clustering coefficient for my data is about 30% (See Table 3.1 for the summary statistics).

The fifth important measure is Eigenvector centrality (also called eigenvector centrality). It is a measure of the influence of a node in a network. “Where degree centrality gives a simple count of the number of connections a vertex has, eigenvector centrality acknowledges that not all connections are equal. That means connections to people who are themselves influential will lend a person more influence than connections to less influential people(Newman, 2008)”. Mathematically,

$$(35) \quad \psi_i = \frac{1}{\lambda} \sum_j^n \Phi_{ij} \psi_j$$

where ψ_i is the centrality of vertex i , ψ_j is centralities of i 's network neighbors, and λ is a constant. In matrix notation with $\boldsymbol{\psi}_j = (\psi_1, \dots, \psi_n)$, yields:

$$(36) \quad \mathbf{\Lambda}\boldsymbol{\psi} = \mathbf{\Phi}.\boldsymbol{\psi}$$

where now $\boldsymbol{\psi}$ is the adjacency matrix solved by the eigenvalues and eigenvectors of $\mathbf{\Lambda}$ (Ruhnau, 2000). That means, ψ_i is proportional to the average of the centralities of i 's network neighbors (Newman, 2008). “The eigenvector centrality defined in this way accords each vertex a centrality that depends both on the number and the quality of its connections: having a large number of connections still counts for something, but a vertex with a smaller number of high-quality contacts may outrank one with a larger number of mediocre contacts (Newman, 2008).”

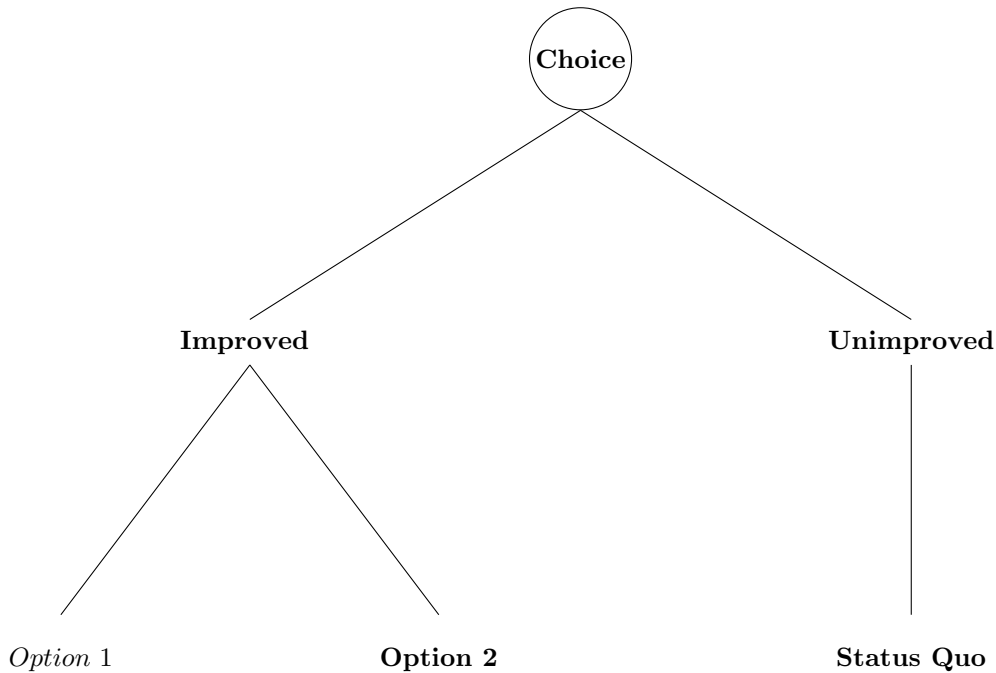
TABLE 3.1. Social Network Parameters Summary

Variable	Mean	Std. Dev.	Min	Max
Degree	2.0894	2.7449	0.0000	9.1667
Indegree	1.0458	1.3748	0.0000	5.0000
Outdegree	1.0436	1.3710	0.0000	5.0000
Closeness	0.2644	0.2999	0.0000	1.0000
Transitivity	0.3915	0.5376	0.0000	2.0000
Clustering Coefficient	0.2898	0.3675	0.0000	1.0000
Eigencentrality	0.0796	0.1972	0.0000	0.8333

3.6. ECONOMETRIC MODEL: NESTED LOGIT MODEL

The logical assumption in this chapter is that conservation options under investigation are similar to each other at least in an unobserved way such that the correlation of error term is expected. NLM also called the “hierarchical logit model” is appropriate in this context in sense that it allows interdependence between the pairs of alternatives in a common group (McFadden, 1978, Ben-Akiva and Lerman, 1985, Börsch-Supan, 1990). In other words, it relaxes the strong assumptions of independently and identically distributed (IID) and the independence of irrelevant alternatives (IIA) inherent in conditional models by clustering similar alternatives into nests (Heiss et al., 2002, Henser et al., 2005). Similarly, I group

each conservation alternative by similarity such that each belongs to exactly one nest: “Improved” conservation alternative comprising *Option 1* and *Option 2* and “Unimproved” conservation alternative comprising the “*no action*” status quo alternative. The tree structure of individual’s decision about which conservation option to choose considering their income may look like:



At the bottom of the tree are the individual conservation options, indicating that there are some random shocks that affect the decision to choose one of the options independently. Above the elemental options are the two groupings, indicating that other random shocks affect the choice between the two composite groups. At the top level is a node, representing the individual making the decision. Hence, in the first level, a composite environmental conservation categories is chosen: the “Improved” or the “Unimproved” conservation option. In the second level, a specific environmental conservation option is chosen : *Option 1*, *Option 2* or *Status Quo*.¹⁵

¹⁵Note: I assume that “all alternatives within an alternative set (levels one and two) are available to someone making a choice at a specific stage. That is, only those that are nested within all higher-level decisions. Moreover, although decision trees in nested logit analysis are often interpreted as implying that the highest level decisions are made first, followed by decisions at lower levels, and finally the decision among alternatives at the bottom level (StataCorp, 2005),” no such temporal ordering is implied here .

The intuitive appeal of nested logit is that the probability of individual i choosing alternative j : $Pr(y_i = j)$, is equal to the product of the probability to choose some alternative in nest Ω : $Pr(Q(j) \in \Omega)$, and the conditional probability to choose exactly alternative j given the alternative is in the same nest $Q(j)$: $Pr(y_i = j|Q(j) \in \Omega)$ (Heiss et al., 2002). Specifically, the probability of choosing *Option 1*: $Pr(y_i = Option\ 1)$ is equal to the probability that “Option 1” is in the “improved” nest: $Pr(y_i = Option\ 1 \in Q(improved))$ times the conditional probability that “improved” environmental condition was chosen. The joint probability that the decision-making entity i chooses elemental alternative j within the nest $Q(j)$ ($P(j|Q(j))$) among all possible alternatives in its choice set Ω is then given by:

$$(37) \quad P(j|\Omega) = P(j|Q(j)) \times P(Q(j)|\Omega)$$

I introduce the social network structure into the utility function in the spirit of Neilson and Wichmann (2014), Dugundji and Gulyás (2008), Brock and Durlauf (2001), and Brock and Durlauf (2002) allowing the systematic utility to be a first-order function, linear in parameters of observable characteristics of the decision-making entity and observable attributes of the public good of the choice alternative. Formally stated:

$$(38) \quad V_{ij} = \beta_a \alpha_{ij} + v_i(c_i(x_{ik}), \psi(z_{ij})) + \sum \alpha_{ij} v_i(\psi(z_{ij})) + \epsilon_{ikj}$$

where $v_i(c_i(x_{ik}), \psi(z_{ij})) + \sum \alpha_{ij} v_i(\psi(z_{ij}))$ is the deterministic or systematic’ (to the modeler) part, composed of private utility from the consumption of private goods x_k which is a function of income c_i , and social utility from the enjoyment of friends or alters well-being $\psi(z_{ij})$, z_{ij} is the attribute of environmental good, and ϵ_{ikj} is an error term and α_{ij} as below.

$$(39) \quad \alpha_{ij} = \begin{cases} 1, & \text{if } i, j \text{ are connected} \\ 0, & \text{otherwise} \end{cases}$$

The error term represents unobserved heterogeneity. Such unobserved heterogeneity may arise from unobserved attributes of the choice alternatives, unobserved characteristics of the decision-making entities, or simply measurement errors in observed attributes and/or characteristics (Dugundji and Gulyás, 2008). The term β_a is an alternative specific constant included to explicitly account for any underlying bias for one alternative over another alternative (Dugundji and Gulyás, 2008). In other words, β_a reflects the mean of the difference in error terms ($\epsilon_{ikn} - \epsilon_{ikj}$); that is, the difference in the utility of alternative n from that of j when all else is equal (Dugundji and Gulyás, 2008). The variable α_{ij} is the interaction patterns variable as demonstrated in the seminal work of Aoki (1995), Brock and Durlauf (2001, 2002). It follows that $\alpha_{ij} \geq 0$ for all i and j is the social utility parameter or interaction parameter capturing interaction effect when decision makers are linked on the basis of social circles. Within NLM framework, I estimate this interaction effect in such away that individual's discrete conservation option preferences is influenced by egocentric social context that emerges from interactions within the network.

Following Ben-Akiva and Lerman (1985) and assuming the Gumbel-distributed disturbances ϵ_{ikj} with a scale parameter θ_I , the probability that agent i chooses alternative j within nest $Q(j)$ ($P(j|Q(j))$), conditional on having chosen that nest, has a convenient closed-form expression:

$$(40) \quad P(j|Q(j)) = \frac{\Delta_j \exp(\theta_I [\beta_a \alpha_{ij} + v_i(c_i(x_{ij}), \psi(z_{ij})) + \sum \alpha_{ij} v_i(\psi(z_{ij}))])}{\sum_{k \in Q(j)} \Delta_k \exp(\theta_I [\beta_a \alpha_{ik} + v_i(c_i(x_{ik}), \psi(z_{ik})) + \sum \alpha_{ik} v_i(\psi(z_{ik}))])}$$

where, Δ_j is an alternative availability indicator defined as 1 if elemental alternative j is available to decision-making entity i and 0 otherwise. θ_I is a scale parameter.

Similarly to Ben-Akiva and Lerman (1985), under the assumption of Gumbel-distributed disturbances ϵ_{ikj} with , the probability $P(j|Q(j))$ that agent i chooses the particular alternative in choice nest $Q(j)$ among the set of Ω nests also has a convenient closed-form expression, given by:

$$(41) \quad P(Q(j)|\Omega) = \frac{\zeta_j \exp(\theta_I [\Gamma_a \alpha_{ij} + u_i(c_i(x_{ij}), \psi(z_{ij})) + \sum \alpha_{ij} u_i(\psi(z_{ij}))])}{\sum_{Q(j) \in \Omega} \zeta_k \exp(\theta_I [\Gamma_a \alpha_{ik} + u_i(c_i(x_{ik}), \psi(z_{ik})) + \sum \alpha_{ik} u_i(\psi(z_{ik}))])}$$

Where j is the elemental alternative (Option 1, 2 and status quo) , $Q(j)$ is the composite alternatives (“improved” and “unimproved”) and Γ_a is a composite alternative specific constant included to explicitly account for any underlying bias for one composite alternative over another. It is the allowance for the possibility of shared unobserved heterogeneity at the nest level which is the unique advantage NLM. However, Dugundji and Gulyás (2008) notes that “without loss of generality, the shared observable attributes at the nest level may be defined at the elemental alternative level and explicit definition of availability at the nest is superfluous.” Moreover, the NLM will reduce to the multinomial logit model if the scale parameter θ_I for the lower nests is equal to the scale parameter ζ for the upper nest (Ben-Akiva and Lerman, 1985, Dugundji and Gulyás, 2008).

The Maximum likelihood techniques are used to estimate parameters of the NLM models. The log-likelihood for discrete outcomes is of the form (Koppelman and Wen, 1998):

$$(42) \quad \ell = \sum_i^N \sum_j^3 \eta_{ij} \ln P_{ij}$$

where η_{ij} is 1 if individual i chooses alternative j and 0 otherwise, P_{ij} is the probability that individual i chooses alternative j . The likelihood function for the two-level conservation options choice is:

$$(43) \quad \ell = \sum_i^N \sum_j \eta_{ij} \ln P_{ij} = \sum_i^N \left(\sum_{\omega=1}^{\Omega} \eta_{(i,Q(j))} \ln P(i, Q(j)|\Omega) + \sum_{\omega \in Qj1}^{\Omega} \eta_{(i,j|Q(j))} \ln P(i, j|Q(j)) \right)$$

where $\eta_{(i,Q(j))}$ is 1 if individual i chooses nest $Q(j)$ and 0 otherwise, $P(i, Q(j)|\Omega)$ is the probability that individual i chooses nest $Q(j)$, $\eta_{(i,j|Q(j))}$ is 1 if individual i chooses alternatives j in the nest Qj and 0 otherwise, and $P(i, j|Q(j))$ is the probability that individual i chooses alternative j in the nest $Q(j)$.

3.7. RESULTS AND DISCUSSION

In this survey, respondents were required to tell us about the people they usually talk to about things affecting the environment in the Okanagan. They were required to name at least 5 and including the following: their contacts' preferences for conservation options; their contacts' socio-demographics (e.g., income, age, education); if the contacts were neighbors, family, co-workers, social clubs, etc.; how they interact (text, Twitter, Facebook, visit, phone, email or write); and the activities they usually undertake that involve the environment (bird watching, hiking, boating etc). A total of 468 survey participants named on average 3 alters (contacts). McPherson et al. (2006) reports similar number of alters for their survey.

Building on the insights obtained from this data and its quantitative analysis, it was possible to measure tie strength (who is linked to whom) between egos (survey respondents) and each alter (contacts) and between alter-alter pairs and determine how each individual's actions have implicit consequences on the actions of everyone else in the egocentric network. Centrality measures were calculated to help identify the most central and prosocial individual with most influence over others. Then, parameter coefficients were estimated on network centrality measures, attributes and other covariates based on full information maximum likelihood (FIML) nested logit model as outlined in the econometric model above.

Essentially, we could fit a conditional logit model but, the conditional logit may be inappropriate. The conditional model assumes that the random errors are independent, and as a result it forces the odds ratio of any two alternatives to be independent of the other alternatives, a property known as the IIA (McFadden et al., 1978, Henser et al., 2005, Heiss et al., 2002). However, assuming that unobserved shocks influencing a decision maker's attitude toward one alternative have no effect on his attitudes toward the other alternatives may seem inappropriate (StataCorp, 2005). For instance, individual would choose say the "no action" status quo option influenced by friends. Therefore, FIML, though an extension

of the conditional logit model, allow groups of alternatives similar to each other in an unobserved way to have correlated error terms (Henser et al., 2005).

The nested tree structure specified for the model using the choice experiment data may take the following form: With these two levels that define the two types of conservation

TABLE 3.2. Tree structure specified for the Nested Logit Model

Conservation Group	N	Option	N	k
Improved Conservation Option	5616	<i>OPTION 1</i>	2808	1262
		<i>OPTION 2</i>	2808	965
No Action (Unimproved Option)	2808	<i>STATUS QUO</i>	2808	581
Total			8424	2808

k = number of times alternative is chosen
N = number of observations at each level

options, I examine how the alternative-specific attributes (share of total water use from groundwater, aquatic health, natural habitat health, rural character, and cost) apply to the bottom alternative set (the three conservation options) and how individual-specific covariates (including social network centrality measures) apply to the alternative set at the higher composite decision level (improved and unimproved conservation options).

The network attributes are characteristics of the individuals and can enter individuals' utility expression at the elemental (bottom alternatives) or composite (upper alternatives) choice levels. I believe it fits well in the composite utility expression level ("improved" and "unimproved") because individual's interaction with his/her network may influence his/her attitude toward the overall conservation option choice at a composite level more than at elemental or specific policy alternatives level. However, I contrast the model result with the elemental utility expression, interacting network centrality measures with environmental attributes and see if people actually talk about individual environmental attribute than the environment in its totality.

Following the nested logit structure outlined above, and incorporating the egocentric social interaction attributes (measured by indicators such as degree centrality, closeness centrality, transitivity, clustering coefficient and eigenvector centrality), I estimate many models with and without social network. The utility function equations for the three “conservation ” options may be formalized as follows:

$$(44) \quad U_{(SQ,Op1,Op2)} = \alpha_1 \Psi_{ij} + \Psi_{ij} [\beta_2(\textit{Groundwater}) + \beta_3(\textit{Aquatic Health}) \\ + \beta_4(\textit{Natural Habitat}) + \beta_5(\textit{Rural Character}) + \beta_6(\textit{Cost})] + \epsilon$$

$$(45) \quad U_{(SQ,Op1,Op2)} = \alpha_1 \Gamma_{ij} + [\beta_2(\textit{Groundwater}) + \beta_3(\textit{Aquatic Health}) \\ + \beta_4(\textit{Natural Habitat}) + \beta_5(\textit{Rural Character}) + \beta_6(\textit{Cost})] \\ + \Gamma_{ij} [\textit{Composite dummy}] + \beta_i(\textit{Income}) + \epsilon$$

Where $U_{(SQ,Op1,Op2)}$ is the utilities associated with the three conservation options. Equation (44) is the utility expression at the elemental (bottom alternatives) and equation (45) is the utility expression at composite (upper alternatives) choice levels. These equations recognize interdependencies between choices. Since alternatives essentially constitute bundles of attributes, the interdependence of alternatives comes from the interdependencies of attributes, some of which are unobserved (Henser et al., 2005, Heiss et al., 2002). “The parameter estimate inclusive value or expected maximum utility (IV index) as the natural logarithm of the denominator of the nested logit model at the elemental alternative level is the statistical test for the relevance of the interdependency (Henser et al., 2005, Heiss et al., 2002)”.

Thus, I evaluated a series of regression models relating individuals’ egocentric network measures to their environmental conservation choice behavior. The strongest result I found is that all environmental attributes including cost are important decision variables when network is introduced at the lower elemental level compared to the “without network” model. In addition, there is association between a respondent’s degree, closeness, transitivity,

clustering coefficient and eigenvector measures and alternatives chosen. The scatter plot matrix in figures 3.3-3.5 below show correlation between alternatives chosen and network centrality measures. We see that “*Options 1*” and “*Option 2*” are positively correlated while the “no action” status quo options is negatively correlated with egocentric network centrality measures. That means individuals with higher centrality measures prefer to choose “*Option 1*” or “*Option 2*”. I call these options, “*prosocial*” conservation options.

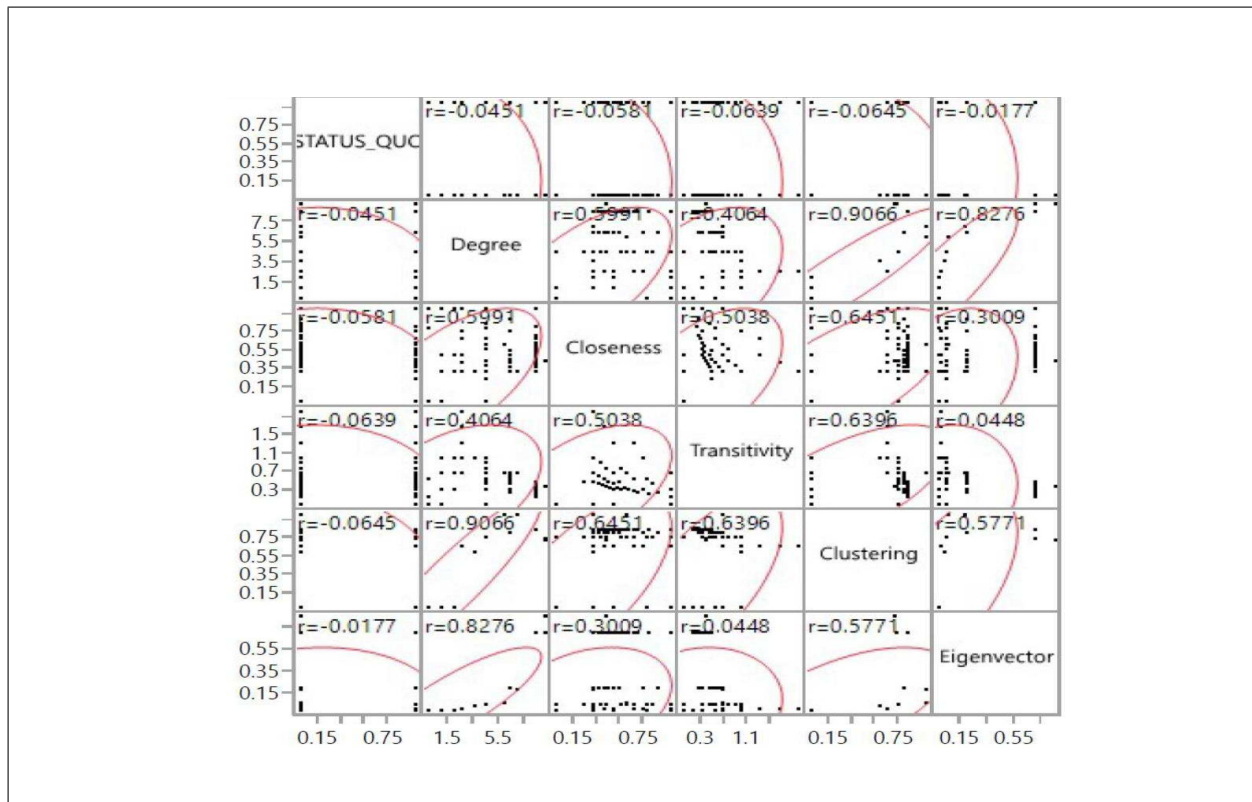


FIGURE 3.3. Correlation Plot for alternatives chosen and centrality measures. We see that the “no action” status quo options is negatively correlated with egocentric network centrality measures.

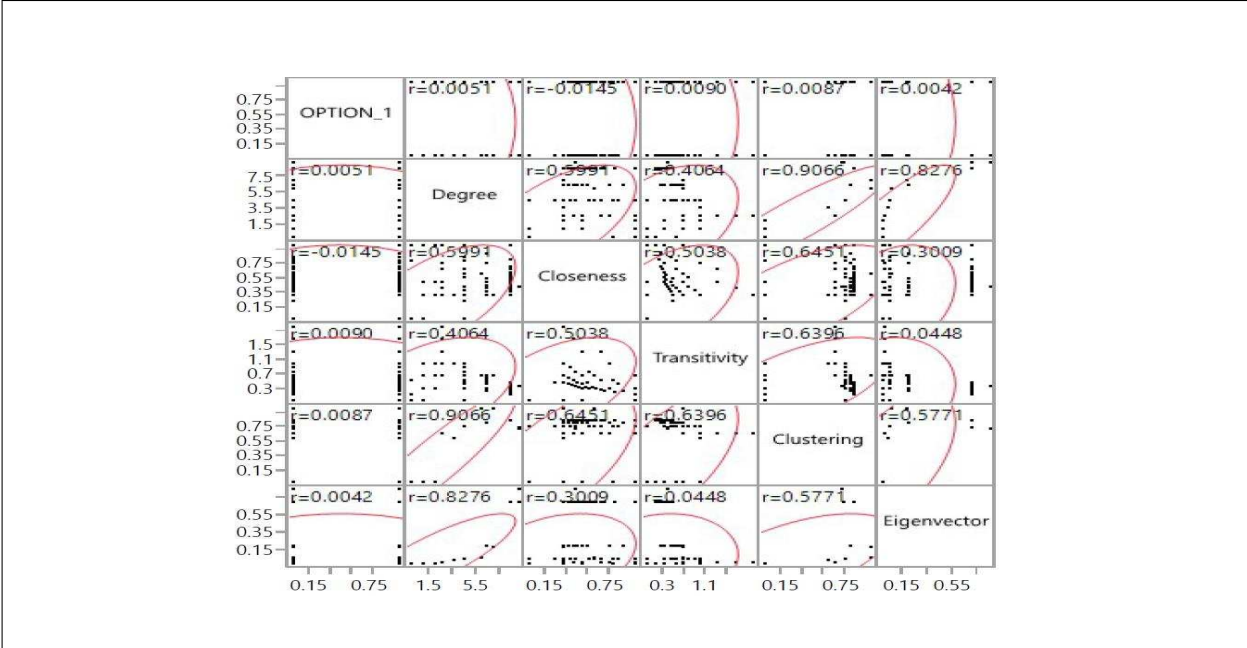


FIGURE 3.4. Correlation Plot for alternatives chosen and centrality measures. We see that “Options 1” is positively correlated with egocentric network centrality measures. Central actors are “prosocial” and prefer prosocial conservation options.

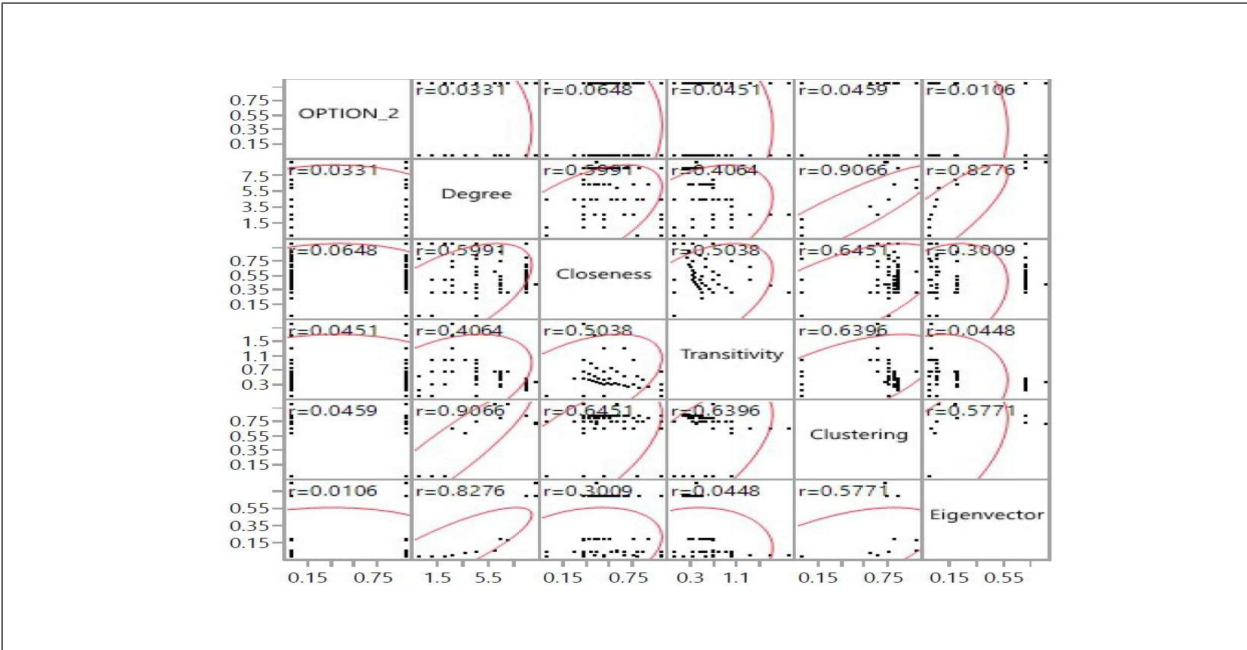


FIGURE 3.5. Correlation Plot for alternatives chosen and centrality measures. We see that “Option 2” is positively correlated with egocentric network centrality measures. Central actors are “prosocial” and prefer prosocial conservation options.

When network is introduced at higher composite level, the likelihood of choosing improved conservation option compared to the “no action” status quo option is higher and this result is statistically significant for all but eigenvector centrality measure. Specifically, both alternative and individual specific estimates for all options (attribute and intercept coefficients): the $[\alpha]$ and $[\beta]$ in the utility equations above, have the right sign and are statistically and significantly different from zero (See tables 3.3-3.7). For instance, degree centrality measure is statistically significant, implying that higher degree is associated with improved conservation option and that the individual is prosocial (see Composite Model in Table 3.2). For high degree individual all attribute except groundwater are important decision attributes compared to the Without Network Model (See Elemental Model in Table 3.2).

On the other hand closeness centrality measure is not statistically significant for more attributes compared to degree centrality at the elemental level, implying that closeness is more discriminatory than degree as a measure of centrality in a sense that how close each actor to all other nodes determine the spread of information (Omalley et al., 2012). That means, “average relationship strength is likely to be lower if degree is higher as the relative frequency of pairs with a non-close relationship increases (Omalley et al., 2012).” It is, however, statistically significantly associated with improved conservation option and that individual’s prosociality manifests at composite conservation options choice level (see Composite Model in Table 3.3).

In egocentric networks, “an ego’s transitivity is the average value of the relationship between all pairs of alters (Omalley et al., 2012)”, which I assumed to be mutual in a sense that if we had a chance to ask the alters to name his/her alters, the ego who name him/her would be one of them (i.e., the relationship from i to j is the same as that from j to i). Hence, transitivity measure is statistically significant, implying that if ego directs a tie to “Alter 1”, and Alter 1” directs a tie to “Alter 2”, then “ego” also directs a tie to “Alter 2” and this natural state toward which triadic relationships tend is associated with people choosing improved conservation option and that the individual is pro-social (see Composite

TABLE 3.3. Degree Centrality Measure

Variables	W/O Network	With Network	
		Elemental	Composite
Alternative-specific: Elemental Options			
β_2 [<i>Groundwater</i>]	-0.00523 (-0.89)	-0.000377 (-0.20)	-0.00495 (-0.90)
β_3 [<i>Aquatic Health</i>]	0.0109*** (-3.970)	0.00219* (-2.39)	0.0102*** (-3.9)
β_4 [<i>Habitat Loss</i>]	-0.00450*** (-6.04)	-0.00111*** (-5.01)	-0.00421*** (-5.77)
β_5 [<i>Rural Character</i>]	-0.00679 (-1.50)	-0.00389* (-2.30)	-0.00651 (-1.52)
β_6 [<i>Cost</i>]	-0.762 (-0.57)	-0.973** (-3.28)	-0.715 (-0.57)
Individual- specific: Composite Options			
β_7 [<i>Middle Income</i>]	0.237 (-1.75)	0.245 (-1.8)	0.227 (-1.67)
β_8 [<i>Upper Middle Income</i>]	0.342* (-2.47)	0.352* (-2.53)	0.332* (-2.39)
β_9 [<i>High Income</i>]	0.859*** (-4.6)	0.852*** (-4.55)	0.835*** (-4.46)
δ_i [<i>Degree centrality</i>]			0.0382* (-2.14)
Alternative-specific: Composite Options			
τ [<i>Constant</i>]	0.955*** (-4.78)	1.359*** (-7.96)	0.893*** (-4.65)
Log likelihood	-2921.5434	-2933.6641	-2919.1828
$\chi^2(df_m)$	261.7 (8)	117.7 (8)	288.3 (9)
N	8424	8424	8424
t statistics in parentheses			
* $p < 0.05$ * * $p < 0.01$ * * * $p < 0.001$			

Model in Table 3.4). Cost and Habitat loss are the most important decision attributes in this case(see Elemental Model in Table 3.4).

Similar to transitivity measure, the local clustering coefficient is based on ego’s local network density. Its main advantage is that it assigns a local score to each node (Scott, 2011, Watts and Strogatz, 1998). The score ranges between 0 and 1; 0 if no ties exist

TABLE 3.4. Closeness Centrality Measure

Variables	W/O Network	With Network	
		Elemental	Composite
Alternative-specific: Elemental Options			
β_2 [<i>Groundwater</i>]	-0.00523 (-0.89)	0.00752 (0.48)	-0.00474 (-0.90)
β_3 [<i>Aquatic Health</i>]	0.0109*** (3.97)	0.0211** (2.88)	0.00973*** (3.85)
β_4 [<i>Habitat Loss</i>]	-0.00450*** (-6.04)	-0.0105*** (-5.58)	-0.00403*** (-5.60)
β_5 [<i>Rural Character</i>]	-0.00679 (-1.50)	-0.0200 (-1.47)	-0.00632 (-1.53)
β_6 [<i>Cost</i>]	-0.762 (-0.57)	-4.518 (-1.90)	-0.689 (-0.57)
Individual -specific: Composite Options			
β_7 [<i>Middle Income</i>]	0.237 (1.75)	0.273* (1.98)	0.227 (1.67)
β_8 [<i>Upper Middle Income</i>]	0.342* (2.47)	0.379** (2.69)	0.332* (2.39)
β_9 [<i>High Income</i>]	0.859*** (4.60)	0.876*** (4.64)	0.835*** (4.46)
$C(i)$ [<i>Closeness centrality</i>]			0.470** (2.90)
Alternative-specific: Composite Options			
τ [<i>Constant</i>]	0.955*** (4.78)	1.238*** (6.96)	0.853*** (4.56)
Log likelihood	-2921.5434	-2929.5012	-2917.2304
$\chi^2(df_m)$	261.7 (8)	143.1 (8)	307.0 (9)
N	8424	8424	8424
t statistics in parentheses			
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$			

between the neighbors, and 1 if all possible ties exists. Hence, we see that the coefficient is positive as expected and statistically significant, implying that higher clustering means an ego's friends are also friends of each and that prosocial options are favored. Aquatic health, natural habitat and cost are important decision attributes (see Elemental Model in

TABLE 3.5. Transitivity Measure

Variables	W/O Network	With Network	
		Elemental	Composite
Alternative-specific: Elemental Options			
β_2 [<i>Groundwater</i>]	-0.00523 (-0.89)	-0.00866 (-0.87)	-0.00493 (-0.89)
β_3 [<i>Aquatic Health</i>]	0.0109*** (-3.97)	0.00944 (-1.93)	0.0102*** (-3.91)
β_4 [<i>Habitat Loss</i>]	-0.00450*** (-6.04)	-0.00735*** (-5.76)	-0.00422*** (-5.82)
β_5 [<i>Rural Character</i>]	-0.00679 (-1.50)	-0.0122 (-1.36)	-0.00655 (-1.52)
β_6 [<i>Cost</i>]	-0.762 (-0.57)	-4.396** (-2.84)	-0.726 (-0.57)
Individual-specific: Composite Options			
β_7 [<i>Middle Income</i>]	0.237 (-1.75)	0.189 (-1.38)	0.184 (-1.35)
β_8 [<i>UpperMiddleIncome</i>]	0.342* (-2.47)	0.295* (-2.11)	0.289* (-2.07)
β_9 [<i>High Income</i>]	0.859*** (-4.6)	0.812*** (-4.32)	0.809*** (-4.31)
T_i [<i>Transitivity</i>]			0.295** (-3.11)
Alternative-specific: Composite Options			
τ [<i>Constant</i>]	0.955*** (-4.78)	1.386*** (-8.27)	0.896*** (-4.67)
Log likelihood	-2921.5434	-2928.5302	-2916.4611
$\chi^2(df_m)$	261.7 (8)	127.0 (8)	290.2 (9)
N	8424	8424	8424
t statistics in parentheses			
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$			

Table 3.5). At the composite level, higher clustering coefficient is associated with improved conservation option and that individuals are prosocial (see Composite Model in Table 3.5).

The other important measure is Eigenvector centrality. We see that the coefficient has positive sign as expected at the composite level, implying that higher Eigenvector centrality is associated with improved conservation option and that individuals are prosocial (see

TABLE 3.6. Local Clustering Coefficient Measure

Variables	W/O Network	With Network	
		Elemental	Composite
Alternative-specific:Elemental Options			
β_1 [<i>Groundwater</i>]	-0.00523 (-0.89)	-0.00345 (-0.25)	-0.00485 (-0.90)
β_3 [<i>Aquatic Health</i>]	0.0109*** (-3.97)	0.0192** (-2.89)	0.00993*** (-3.88)
β_4 [<i>Habitat Loss</i>]	-0.00450*** (-6.04)	-0.0104*** (-5.88)	-0.00411*** (-5.72)
β_5 [<i>Rural Character</i>]	-0.00679 (-1.50)	-0.0212 (-1.74)	-0.00642 (-1.53)
β_6 [<i>Cost</i>]	-0.762 (-0.57)	-6.602** (-3.02)	-0.704 (-0.57)
Individual-specific: Composite Options			
β_7 [<i>Middle Income</i>]	0.237 (-1.75)	0.225 (-1.65)	0.211 (-1.55)
β_8 [<i>Upper Middle Income</i>]	0.342* (-2.47)	0.332* (-2.37)	0.317* (-2.28)
β_9 [<i>High Income</i>]	0.859*** (-4.6)	0.830*** (-4.41)	0.818*** (-4.36)
C_L [<i>Clustering Coefficient</i>]			0.413** (-3.14)
Alternative-specific: Composite Options			
τ [<i>Constant</i>]	0.955*** (-4.78)	1.326*** (-7.81)	0.871*** (-4.62)
Log likelihood	-2921.5434	-2922.4329	-2916.5046
$\chi^2(df_m)$	261.7 (8)	155.6 (8)	300.6 (9)
N	8424	8424	8424
t statistics in parentheses			
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$			

Composite Model in Table 3.6). However, the coefficient is not statistically significant. On the other hand, Eigenvector centrality measure imply that not all connections are equal and that connections to people who are themselves influential will lend a person more influence than connections to less influential people (Newman, 2008). Therefore, prosocial options are highly favored compared to the status quo when network is allowed to impact

elemental decision attributes. Natural habitat, rural character and cost are important decision attributes (see Elemental Model in Table 3.6). In all models, the income dummy

TABLE 3.7. Eigenvector Centrality Measure

Variables	W/O Network	With Network	
		Elemental	Composite
Alternative-specific:Elemental Options			
β_2 [<i>Groundwater</i>]	-0.00523 (-0.89)	0.0162 -0.49	-0.00519 (-0.89)
β_3 [<i>Aquatic Health</i>]	0.0109*** (-3.97)	0.018 (-1.15)	0.0107*** (-3.95)
β_4 [<i>Habitat Loss</i>]	-0.00450*** (-6.04)	-0.00658* (-1.97)	-0.00445*** (-5.99)
β_5 [<i>Rural Character</i>]	-0.00679 (-1.50)	-0.0675* (-2.37)	-0.00674 (-1.50)
β_6 [<i>Cost</i>]	-0.762 (-0.57)	-10.86* (-2.56)	-0.752 (-0.56)
Individual-specific:Composite Options			
β_9 [<i>Middle Income</i>]	0.237 (-1.75)	0.242 (-1.79)	0.236 (-1.74)
β_8 [<i>Upper Middle Income</i>]	0.342* (-2.47)	0.349* (-2.52)	0.341* (-2.46)
β_9 [<i>High Income</i>]	0.859*** (-4.6)	0.861*** (-4.6)	0.852*** (-4.56)
ψ_i [<i>Eigenvector</i>]			0.175 (-0.71)
Alternative-specific: Composite Options			
τ [<i>Constant</i>]	0.955*** (-4.78)	1.465*** (-8.89)	0.944*** (-4.75)
Log likelihood	-2921.5434	-2955.0973	-2921.2871
$\chi^2(df_m)$	261.7 (8)	46.92 (8)	266.1 (9)
N	8424	8424	8424
t statistics in parentheses			
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$			

coefficients are statistically significant and have positive sign, implying that higher income increases the likelihood of choosing prosocial, improved conservation alternatives compared to the lower income group.

Near the bottom of the output are the dissimilarity parameter or inclusive values (IV), which represents the expected utility for the choice of alternatives within the composite nest. It measure the degree of correlation of random shocks within each of the two composite conservation options (improved and unimproved) and the value greater than one imply that the model is inconsistent with random utility parameter NLM (Heiss et al., 2002). The IV parameter τ is within the unit interval and corresponds to a correlation of the two error terms.¹⁶

In addition, I conducted the Likelihood Ratio Test (*LRT*) to see if the models with and without network measures are identical. The test statistic is computed by taking the difference in the log likelihood of the models compared. LRT χ^2 distributed. Using Log Likelihood figures, LTR is $2 \times (-2919.1828 + 2921.5434) = 4.7212$ and $2 \times (-2919.1828 + 2933.6641) = 28.9626$ for the “Composite model” versus ”Without Network Model” and the “Composite Model” versus “Elemental Model” respectively. Therefore, the LR ratio test statistic is above the critical χ^2 value of 3.841 for 1 degrees of freedom at 5% significance level and we can not accept the null hypothesis that the parameters are equal between the models, “With Network” and “Without Network”. The composite and elemental models are also statistically significantly different from each other and all models exhibit similar test results.

Finally, I focus on the implication of network effect on preferences and welfare. It is recalled from the induced network model above that Θ determines both social utility and willingness to pay under network interaction (Neilson and Wichmann, 2014).

$$(46) \quad WTP_i^{\text{egocentric}} = \theta_{ij} \sum WTP^{\text{private}} \Rightarrow WTP_i^{\text{egocentric}} = \Theta WTP^{\text{Private}}$$

Therefore, I use $WTP_i^{\text{egocentric}}$ to quantify gains (or losses) of the environmental conservation policy option, estimated using the estimated cost coefficient With Network” models.

¹⁶see Heiss et al. (2002) and Henser et al. (2005) on this. They discuss in detail that the conditional logit model is a special case of nested logit in which all the dissimilarity parameters are equal to one. Equivalently, the property known as the IIA imposed by the conditional logit model holds if and only if all dissimilarity parameters are equal to one (Hausman and McFadden, 1984).

Table 3.8 display $WTP_i^{\text{egocentric}}$ for each attribute calculated following from Hole (2007) as before:

$$(47) \quad E(WTP^j) = -\frac{E(\beta^j)}{(\beta^{\text{cost}})}$$

We can use these WTP estimates for welfare estimates since network affects WTP estimates which is important for the quantification of gains or losses of the conservation policies in achieving the goals by 2040. We see that the mean willingness to pay (MWTP) estimates with and without network models differ a great deal. All MWTP values for a model that does not accommodate network are not statistically significantly different from zero while some MWTP with network effect are statistically significant. For instance, degree centrality measure MWTP value is statistically significant for all but groundwater, implying that individual's have a statistically significant willingness to pay amount for a unit change in these attributes levels. The amount ranges from \$22.00 to \$46.00 CAD per \$1000 in property value for every 10,000 salmon return, 0 to \$0.23 CAD per \$1000 in property value for every km^2 habitat loss reclaimed and etc.

The fact that at least one or more attributes are important decision variable with models that accommodate network, and that both prosocial options have at least one improved attribute, and that most people prefer these improved options, implying that “network effect is welfare improving”. The most logical explanation is that some central individuals in the network may have greater private values for those conservation attributes and those attributes constitute improved conservation options and the options are prosocial favored by the more egocentrically central individuals. Moreover, it is interesting to see that cost is important decision attribute with models that accommodate network effect (see Tables 3.2-3.6), implying that there is less possibility for “rejecting payment” as a protest which could otherwise be the norm in many non-market valuation literature. In summary, even though the focus on individual rather than group outcomes makes egocentric network better methodological tool and a feasible way of obtaining network information

TABLE 3.8. WTP values With and Without Network Effect

	Mean WTP	Groundwater	Aquatic Health	Habitat Loss	Rural Character
Without Network	Mean WTP	-0.00685735	0.01424591	-0.0059057	-0.0089078
	Lower 95%	-0.04059324	-0.03790537	-0.025491	-0.0427395
	Upper 95%	0.02687854	0.06639719	0.0136797	0.02492387
With Network					
δ_i [<i>Degree</i>]	Mean WTP	-0.00038733	0.00224667	-0.0011446	-0.0039978
	Lower 95%	-0.0042044	0.00009619	-0.0017797	-0.0073168
	Upper 95%	0.00342974	0.00439715	-0.0005095	-0.0006787
C_L [<i>Closeness</i>]	Mean WTP	0.00166376	0.0046706	-0.0023209	-0.0044177
	Lower 95%	-0.00535134	-0.00098593	-0.0044848	-0.0106097
	Upper 95%	0.00867886	0.01032712	-0.0001569	0.00177437
T_i [<i>Transitivity</i>]	Mean WTP	-0.00197078	0.00214794	-0.0016709	-0.0027698
	Lower 95%	-0.00642716	-0.00041124	-0.002682	-0.0065717
	Upper 95%	0.00248561	0.00470712	-0.0006599	0.00103203
$C(i)$ [<i>Clustering</i>]	Mean WTP	-0.00052226	0.00290565	-0.0015709	-0.0032175
	Lower 95%	-0.00456596	0.0003534	-0.002454	-0.0067114
	Upper 95%	0.00352144	0.00545789	-0.0006878	0.00027643
ψ_i [<i>Eigenvector</i>]	Mean WTP	0.00149337	0.00165621	-0.0006061	-0.0062162
	Lower 95%	-0.00488154	-0.00125638	-0.001267	-0.0114263
	Upper 95%	0.00786828	0.0045688	5.491E-05	-0.0010061

on a large-scale (e.g., augmented with other surveys) Omalley et al. (2012), it has several limitations compared to a full sociocentric study. First, the most common survey methods for gathering “sociocentric network data ask respondents to report on their outgoing ties using a recognition format that reminds respondents of all alters deemed to be part of the network under study (Marsden, 1990).” By contrast, typical survey methods for assembling egocentric network data enumerate alters through free recall, and rely on the respondent (the ego node) as an informant about the structure and composition of the entire first-order zone. However, survey respondents do not recall a substantial fraction of their contacts in this case (Burt, 1984, Frank, 2011). In addition, we do not observe alter’s view of relationships and we can not validate the ego self-report, we can not ascertain directionality of relationships Wellman (2007), Omalley et al. (2012). Therefore, other things being equal, egocentric design typically understate degree and centrality measures. Second, there is

uncertainty related to network relation or ties through which actors are influenced (Frank, 2011). It is very difficult to uncover if someone's decision making behavior is influenced by all those with whom they come in contact, or if there are specific types of relations that are more influential for particular behaviors (Frank, 2011). The third limitation is related to formats, in which combining different methods in one survey could be long and sometimes confusing. This results in survey respondents to drop-off or skip questions making it less useful.

3.8. CONCLUSION

In this chapter, it was shown that egocentric approach is a better methodological tool not only to describe, summarize, visualize individual connections and interactions, but also for its flexibility in data collection. The main finding is that egocentric network centrality measure is one of a good predictors of environmental conservation options choices and network effect is welfare improving.

However, this conclusion is over definitive in a sense that it requires further examination fo any causal implication. Specifically, conservation and consumption decisions of many of these goods and services are not only non-excludable along social or geographic links (Bramoullé and Kranton, 2007) but generally are the result of interactions of combinations of social factors (e.g. population, technology, and economic conditions); with huge social consequences that must addressed in the context of citizen preferences interaction, constraint interaction and expectation interaction (Manski, 2000, Brown et al., 2005, Watts and Dodds, 2007) within sociocentric or complete network framework broadly.

CHAPTER 4

ON USING DELIBERATIVE/CITIZENS JURIES APPROACH TO MEASURE PREFERENCE HETEROGENEITY WITHIN CHOICE EXPERIMENT SURVEYS

4.1. INTRODUCTION

Interest in determining monetary values for goods and services provided by the environment has been growing. Some see such values as providing a more convincing way to argue for environmental protection. However, not everyone agrees with this way of putting a value on the environment. Some say that we do not relate to the environment the way we relate to a market basket of goods from a store. The environment affects the whole community, so when we think of the importance of the environment, we may also think about the whole community and hence money can not be a ‘common denominator’ that weighs heavily in the choices people make that have environmental impacts. Therefore, there are disagreements on whether these monetary values reflect private values rather than what would be the community or social value.

Regardless, over the past years, there have been efforts to measure the value that a sample of residents place on some of these environmental goods and services using stated preference environmental valuation techniques. Stated preference environmental valuation techniques assume that the equilibrium prices in a competitive market represent social values.¹ Yet, many environmental goods and services do not have prices that meet this assumption (Dietz et al., 2009).

One of the recently adopted methodological progresses to tackle this issue is Deliberative/Citizen juries (CJ): the use of citizen groups convened to assess the costs and benefits of proposed management options. Although it is relatively new to the field of environmental

¹“Individual responses are aggregated into an estimate of what society as a whole would be willing to pay or accept in the traditional stated preference methodologies (Dietz et al., 2009).”

valuation, participatory techniques have played a role in areas such as multicriteria decision analysis and risk assessment (Howarth and Wilson, 2006, Vargas et al., 2016). The process is believed to enhance citizen participation and improve the effectiveness, perceived quality, and legitimacy of policy decisions and monetary values.

In the standard deliberative valuation, citizen juries (deliberative groups) of roughly fifteen individuals carefully chosen to represent the community from which they are drawn are used to gauge the public's willingness to provide financial resources to support the implementation of proposed environmental policies (Howarth and Wilson, 2006, Brown et al., 1995, O'Hara, 1996, Jacobs, 1997). The jury is convened for a period of several days, during which participants hear expert testimony and deliberate over the facts and values that should guide collective decisions (Howarth and Wilson, 2006, Niemeyer and Spash, 2001).

This method is believed to overcome some of the following critiques directed towards stated preference approaches: that people may not have preformed preferences for environmental goods (Payne et al., 1999); the notions of community rather than individual values (Sagoff, 1988); the problem with the development of a detailed concept description of a resource improvement (Adamowicz et al., 1994a); reliance on the accuracy of the information and completeness of any particular description of the good or service; time constraints (Cummings et al., 1986, Mitchell, 2002, Dixon et al., 2013) ; the protocols to be followed for carrying out surveys and other relevant considerations (Adamowicz et al., 1994a, Ward, 1999); the values people hold towards matters of public policy and their sensitivity to changes in issue framing (Ward, 1999); the sensitivity of respondents' value estimates to survey question context and perceived social importance (Schkade and Payne, 1994, Schuman, 1996); and the opportunity for respondents to ask questions, to discuss questions among themselves, and to get information from a diversity of sources (Ward, 1999). In addition, respondents of surveys in choice experiments may face the following challenges: they may have no predetermined preferences over different levels of the environmental goods (Álvarez-Farizo and Hanley, 2006b); they may believe citizen rather than individual

preferences to be more relevant in social decision making (Álvarez-Farizo and Hanley, 2006b); they may have problems with the presentation of the scenario and good valued, the attributes and the levels taken by these attributes (cognitive burden on respondents) (Blamey et al., 1999, Morrison and Kingsford, 2010); and they may have problems with the payment vehicle and the transaction method (Farber et al., 2002, Adamowicz et al., 1994a, Ward, 1999).

In this chapter, I borrow from these qualitative methodologies (deliberative citizen juries approach (Jefferson, 2016, Street et al., 2014, Brown et al., 1995) and the market stall approach (Macmillan et al., 2002) to aid the survey design and examine the problem of basing policy on “uninformed” individual preferences.² I do this by extending the conventional choice experiment approach and allowing people to deliberate in a citizen jury setting and undertake the choice decision exercises for hypothetical environmental conservation scenarios. I estimate the deliberation treatment effect on conservation choice outcomes by removing any significant differences in terms of their socioeconomic characteristics between the people who participated in the citizen jury (treatment group) and those people who did the survey twice but did not volunteer (control group).

The next sections are structured as follows. In section 4.2, I discuss the existing literature on deliberative and citizen juries related to environment and non-market valuation, giving a context to our findings. Section 4.3 outlines the theoretical grounding of group deliberation and social decision making. Section 4.4 discusses the citizen jury experiment procedures, characteristics, sample, and econometric estimation methods. In section 4.5, I provide choice data sorted and analyzed using propensity score method and environmental conservation option operationalized as a dependent variable, described by attribute levels, and in terms of deliberative and citizen jury processes. In addition, unobserved heterogeneity are captured by estimating a mixed logit model, and WTP values are estimated and compared with group value outcomes. The final section offers a conclusion and a brief discussion on policy implications.

²See for example (Álvarez-Farizo and Hanley, 2006b, Sagoff, 1998) for related issues.

4.2. LITERATURE REVIEW

Howarth and Wilson (2006) firmly emphasize that deliberative valuation approach is rooted in the principles of discursive democracy and social psychology and may be charged with carrying out a variety of tasks, including the generation of narrative evaluations of proposed policy alternatives. Sagoff (1998) introduced the idea of “citizen preferences” where people have a preference for a social arrangement that may disadvantage them as individuals. Such preferences are not captured with traditional valuation techniques (i.e. contingent ranking, contingent choice, choice experiments) (Aldred and Jacobs, 2000; Álvarez-Farizo and Hanley, 2006b; Macmillan et al., 2002). These critics argue that deliberation should be part of the valuation procedure. The presence of lexicographic preferences and protest votes in many valuation studies (Spash and Hanley, 1995), offer support for a deliberative process that allows for the expression of values that cannot be measured using traditional methods (Aldred and Jacobs, 2000, Álvarez-Farizo and Hanley, 2006b, Macmillan et al., 2002, Sagoff, 1998). According to Sagoff (1998), society decides on issues like the environment based on community preferences (rather than on individual preferences).” Howarth and Wilson (2006) claims that “people can both understand the complex issues at stake and carefully consider their preferences and values through reasoned deliberation with others in their community and more informed decision can be achieved. Through such deliberation, new information may be revealed that was not shared beforehand by everyone in the group.” Álvarez-Farizo et al. (2009) consider whether citizen preferences reflect the community objectives as responsible members of the society or personal objectives as self-interested individuals during a traditional valuation exercise of non-market goods. Gregory (2000) claims that “a well-designed deliberative group procedure can increase the likelihood that policy decisions will meet with broad based approval and be viewed by taxpayers and elected officials as a sensible way to spend scarce funds”. Gregory (2000) adds that citizen participation should be involved in: framing decisions, defining key objectives and establishing alternatives.

More recently, deliberation techniques have been extended to stated preference surveys (Powe et al., 2005, Álvarez-Farizo and Hanley, 2006b) and the results have shown improved information, methodological improvements and outputs beyond that of conventional non-market valuation techniques (Schkade and Payne, 1994, Blamey and James, 1999, Brouwer et al., 1999, Clark et al., 2000). Random sampling techniques are usually employed in citizen jury selection (Howarth and Wilson, 2006). Deliberation is added to a valuation study using focus groups at both the design and interpretation stage (Kenter et al., 2011). For instance, Ahlheim et al. (2010) uses focus groups, formed from a sample of respondents in the initial valuation study as “citizen experts” to aid in the design of a second round. Ferreyra and Beard (2007) let the focus groups define success, and relate these definitions to group composition. They find a relationship between group structure and types of successes. Kontogianni et al. (2001) uses stakeholder focus groups to identify key attitudes and opinions, and inform possible scenarios for wetland management on a Greek island. These scenarios are then used in a contingent ranking experiment. They argue that this mixed methodology informs policy options and relative trade offs better than either method alone. Gregory and Wellman (2001) use insights from stakeholder interviews and expert consultations to develop a workbook that is used by small groups of stakeholders to rank policy options. Among other things, they argue that inherent ecological uncertainty renders more sophisticated valuation estimates unreliable. MacMillan et al. (2006) examine the impact of different levels of information, time to think, and deliberation on valuation responses for a familiar (expanding wind power) and an unfamiliar (species introduction) environmental good. Treatments improve value estimates for the unfamiliar good, while not significantly impacting estimates for the familiar one. Urama and Hodge (2006) explore the impact of participatory education on bid values in a contingent valuation study of pollution abatement in a Nigerian river basin. Education increases the perceived severity of the pollution and mean willingness-to-pay. This effect is particularly large among respondents with limited formal education. Álvarez-Farizo and Hanley (2006b) conduct a choice experiment with individuals and in a group setting to assess options for managing

a Spanish river basin. They find that moving from individual to workshop valuation significantly changes the value estimates. Dietz et al. (2009) compares individual responses to an open-ended valuation survey on climate change policy with a carefully-structured group deliberation designed to limit the dominance or group think. Deliberation leads people to consider different issues - thinking like a policymaker rather than a consumer - but willingness-to-pay values are unchanged. Lienhoop and MacMillan (2007) use psychological measures of engagement to compare the behavior of deliberation participants with those individually interviewed in a contingent valuation study related to a hydro development in Iceland. Group participants are far more engaged with the material, and they suggest this improves the quality of valuation estimates.

Similarly, this chapter add to this extensive literature by extending the methodology further. The believe that “people can act as citizens whose primary concern is the public good (i.e. people have values that lie ‘above’ simple self-interest (Howarth and Wilson, 2006)” is shared. The claim that “participatory processes in the form of group deliberation are an improvement from the traditional non-market valuation techniques and help citizens make informed judgment on environmental issues (Christie et al., 2012)” is shared. While some evidence suggests that people have difficulty suspending their self-interest (Niemeyer and Spash, 2001), participatory processes most likely overcome this problem and are seen as a legitimate mechanism for policy development (Howarth and Wilson, 2006). Specifically, the congruity of results from deliberative methods and choice experiment is empirically assessed and the validity of results from CE and CJ methods for eliciting citizen’s willingness to pay for improved environmental goods and services is evaluated. Central to this is an empirical investigation of the impact of deliberative juries on community (citizens’) preference for environmental goods. I believe that integrating deliberative methods within the choice experiment process enhances our understanding of how respondents discuss and conceptualize the good valued, of respondents’ thought processes during the transaction, of motivations for their responses, of adequacy of the valuation process used, and of the public acceptability of the valuation exercise (Powe et al., 2005, Adamowicz et al., 1994a,

Ward, 1999, Álvarez-Farizo and Hanley, 2006b, Lienhoop and Völker, 2016, Rogers, 2013, Schaafsma et al., 2013, Vargas et al., 2016). I test the following hypothesis: A) Participatory processes combined with CE analysis captures community preferences better than CE alone B) Group willingness to pay for enhanced environmental quality is greater than or equal to the sum of individual willingness to pay in line with the claim of (Neilson and Winter, 2008).

4.3. THEORETICAL METHODOLOGY

Howarth and Wilson (2006) notes that “the theoretical concept of group deliberation is similar to a process of social bargaining in which each individual’s conception of the social good feeds into the construction of a mutually acceptable group value function. This helps examine the connections between this value function and measures of willingness to pay for environmental services at the level of both individuals and groups.”

Formally, let us assume that we have a hypothetical deliberative group n of 10 people or more, $n \geq 10$. Suppose this group of people are asked to deliberate among peers and choose from a set of proposed policy options of a given set $(\mathbf{X}_i, \mathbf{G})$, where \mathbf{X} is a private good and \mathbf{G} is a public good. After thorough deliberation, they have to arrive at a collective outcome, which all members support as a matter of mutual agreement or majority voting. The “best outcome” is assumed to be $\Psi_i(x_i^*, g^*) \in \Theta(\mathbf{X}_i, \mathbf{G})$. In the absence of agreement, current (or status quo) policies would remain in force. Hence, it must be the case that each participants value function $\psi_i(x_i^*, g^*)$, summarized by his/her preferences, beliefs, and moral judgments concerning the choice of the options under consideration is less than the group value function $\Psi_i(x_i^*, g^*)$ (Howarth and Wilson, 2006). Formally, this may take the following from:

$$(48) \quad \psi_i(x_i, g) < \Psi_i(x_i^*, g^*), \text{ where } \psi_i(x_i, g) \text{ and } \Psi_i(x_i^*, g^*) \in \Theta(\mathbf{X}_i, \mathbf{G})$$

Technically, “ $\Psi_i(x_i^*, g^*)$ is community utility function (value function) representing what is good for the society and how decisions should be made in the context of public policy.

This doesn't rule cases in which individual i strictly preferring $\psi_i(x_i, g)$ over $\Psi_i(x_i^*, g^*)$ from a personal perspective even though $\Psi_i(x_i^*, g^*) > \psi_i(x_i, g)$. In this event, the person's value function would reflect a willingness to sacrifice her personal interests in support of a social or moral good (Howarth and Wilson, 2006)."

To relate individual valuation to collective outcome, Howarth and Wilson (2006) appeal to a result from the theory of cooperative games (Binmore, 1998), in which a rational individual, seeking to maximize her individual value function through a process of structured negotiation with other group members will arrive at the outcome favored by the group and that would maximize the group value function. This outcome holds if the negotiating process were set up to give each individual equal bargaining power; otherwise, the status quo outcome, $\psi_i(x_i^o, g^o)$, would arise in the absence of agreement (Howarth and Wilson, 2006). The "increase in the value function for each participant i is, therefore, the multiplicative aggregation of the difference in possible valuation functions that could arise as a direct consequence of the structure of the underlying choice problem (Howarth and Wilson, 2006)." Mathematically stated:

$$(49) \quad \Psi_i(x_i^*, g^*) = \prod_i^n (\Psi_i(x_i^*, g^*) - \psi_i(x_i^o, g^o))$$

This result is the "Nash bargaining solution in the game theoretic literature and can be replaced by the more general value function in the case of unequal bargaining power (Howarth and Wilson, 2006)":

$$(50) \quad \psi_i(x_i^*, g^*) = \prod_i^n (\Psi_i(x_i^*, g^*) - \psi_i(x_i^o, g^o))^{\omega_i}$$

where, ω_i , represent bargaining power of individual i .

The grand message of the model is that the negotiated outcome $\Psi(x_i^*, g^*)$ is "pareto-improving and given the chance, each participant would freely choose it over the status quo outcome $\omega_i(x_i^o, g^o)$ (Howarth and Wilson, 2006)." However, in all consent-based

valuation exercises, there is distributional equity issue and it is recommended that representatives/opinion leaders of the affected parties or the community consent or support when social decisions should be made through mutual consent.

Another important message is the existence of trade-offs between group-based decision processes and individual monetary valuation . A key question raised by Howarth and Wilson (2006) is “how a deliberative group’s willingness to pay for environmental quality is related to the underlying values of each individual participant?” In answering this question, they suggest that individuals required to make an incremental tax payment to finance a project that would provide communally shared environmental benefits that would raise the level of environmental quality from the status quo level g^o to the enhanced level $(g^o + \rho)$. The individual i ’s required payment τ_i would thereby reduce the effective income from the status quo level I_i^o to the new level $(I_i^o - \tau_i)$ (Howarth and Wilson, 2006).

It is plausible to assume the individual’s value function takes $\psi_i(x_i(I_i^o - \tau_i), (g^o + \rho))$ is a strictly increasing function of environmental quality ρ and personal income I_i , and that the conservation projects implementation would leave the derivatives of $\psi_i(x_i(I_i^o - \tau_i), (g^o + \rho))$ with respect to each of these variables $\frac{\partial \psi_i}{\partial (g^o + \rho)}$ and $\frac{\partial \psi_i}{\partial (I_i^o - \tau_i)}$ unchanged (Howarth and Wilson, 2006). Under these circumstances, implementing the conservation project would yield the following net change in individual i ’s value function (Howarth and Wilson, 2006):

$$\begin{aligned}
 (51) \quad \psi_i(x_i(I_i^o - \tau_i), (g^o + \rho)) - \psi_i(x_i(I_i^o), g^o) &= \frac{\partial \psi_i}{\partial (g^o + \rho)} \Delta g - \frac{\partial \psi_i}{\partial (I_i^o - \tau_i)} \tau_i \\
 \frac{\partial \psi_i}{\partial (I_i^o - \tau_i)} \left(\frac{\frac{\partial \psi_i}{\partial (g^o + \rho)}}{\frac{\partial \psi_i}{\partial (I_i^o - \tau_i)}} \Delta g \right) - \left(\frac{\partial \psi_i}{\partial (I_i^o - \tau_i)} \tau_i \right) &= \frac{\partial \psi_i}{\partial (I_i^o - \tau_i)} \left(\frac{\frac{\partial \psi_i}{\partial (g^o + \rho)}}{\frac{\partial \psi_i}{\partial (I_i^o - \tau_i)}} \Delta g - \tau_i \right) \Rightarrow \\
 \frac{\partial \psi_i}{\partial (I_i^o - \tau_i)} \left(\frac{\frac{\partial \psi_i}{\partial (g^o + \rho)}}{\frac{\partial \psi_i}{\partial (I_i^o - \tau_i)}} \Delta g - \tau_i \right) &= \frac{\partial \psi_i}{\partial (I_i^o - \tau_i)} (WTP_i - \tau_i)
 \end{aligned}$$

where, following Howarth and Wilson (2006):

$$WTP = \frac{\frac{\partial \psi_i}{\partial (g^o + \rho)}}{\frac{\partial \psi_i}{\partial (I_i^o - \tau_i)}} \Delta g \Rightarrow$$

and $\frac{\frac{\partial \psi_i}{\partial(g^o + \rho)}}{\frac{\partial \psi_i}{\partial(I_i^o - \tau_i)}}$ is what is called the shadow price of environmental quality, or the marginal rate of substitution between environmental quality and income (Howarth and Wilson, 2006).

Equation (51) “represents individual i maximum willingness to pay for project implementation and to measure the monetary value of the project’s benefits, this shadow price is multiplied by the increase in environmental quality. By substituting equation (51) into equation (49), it is possible to rewrite the group value function in the form (Howarth and Wilson, 2006):”

$$\begin{aligned}
 (52) \quad \Psi_i(x_i^*, g^*) &= \prod (\psi_i(g^o + \rho, I_i^o - \tau_i) - \psi_i(g^o, I_i^o)) \\
 &= \prod \left(\frac{\partial \psi_i}{\partial I_i} (WTP_i - \tau_i) \right) \\
 &\equiv \prod_i^n (WTP_i - \tau_i)
 \end{aligned}$$

Equation (52) states the net monetary value that each individual attaches to project (Howarth and Wilson, 2006). Each individual’s share in the deliberative group’s willingness to pay for the hypothetical conservation project would be $\tau_i = \zeta_i WTP$, where the share coefficients ζ_i , are fixed, positive parameters that sum up to unity (Howarth and Wilson, 2006). That is similar to each individual’s payment in actual tax systems, in which the share coefficient reflects one’s taxable income or assets levy such as property. Given this formulation, the group value function may be restated as:”

$$(53) \quad \Psi_i(x_i^*, g^*) = \alpha \prod_i^n (WTP_i - \zeta_i WTP)$$

Equation (53) says that “the deliberative groups’ maximum willingness to pay for increased environmental quality would be a value of zero at level of WTP for which the group would be indifferent between implementing conservation project or maintaining the status quo.

That is, group willingness to pay for enhanced environmental quality is less than or equal to the sum of individual willingness to pay (Howarth and Wilson, 2006).”³

4.4. EMPIRICAL METHODOLOGY: CJ PROCEDURES

Similar to Álvarez-Farizo and Hanley (2006b), the deliberation workshop participants were made up of people who completed the general public survey and who showed interest participating in the deliberation sessions. In the survey, I included a place for people to provide contact information and indicate their willingness to participate in a deliberation workshop. I also indicated that if there were more than 60 such volunteers, workshop participants would be chosen at random to be invited to participate. If there were less than 60, all would be contacted and invited to participate. From 468 questionnaire completed in the general public survey, about 55 people (12%) showed interest and all were invited to the CJ sessions. Only 23 (42%) people actually attended (See Appendix G, H and I for invitation to participate in a citizens’ jury, deliberation workshop protocol, participation in a citizens’ jury consent form respectively).

Step one was grouping volunteer participants into two jury sessions: group 1 and group 2, to meet over two days. Each jury session lasted 90 minutes and was co-ordinated by two facilitators who had experience working with citizens juries. The jury sessions began with a briefing on the format and group norms. During this briefing, participants were reminded that a choice experiment survey was implemented prior to the these jury sessions; that major local environmental issues were identified through discussion with the Regional District of Central Okanagan (RDCO) experts and Okanagan residents; that pilot study results were used to prioritize environmental issues; that a stated choice experimental design software was used to build hypothetical conservation policy scenarios; that the “no action” status quo represents the continuation of the current environmental resources situation to 2040 if it is managed using the existing actions and that this option does not involve any increase in a household’s payment; that options 1 and 2 involve additional management actions that

³See the proof and details in Howarth and Wilson (2006) from which this model and discussion is heavily drawn

would lead to different environmental resources and services outcomes by 2040 and that these options has to be paid for resulting in a reduction of household income available to spend on something else each year for 30 years; and that the money will be saved in an account specific to this conservation project. The facilitator also informed participants that they would be spending some time talking about each of the four environmental indicators they saw on the main survey, now presented differently in the form of decision challenge. Moreover, the confidentiality issues were raised and the “Vegas rules” were explained by the moderators. The “Vegas rules” state that what happens during the session stays in this session. Each participant was required to respect the privacy of all other participants by not revealing the details of the session to any outsiders. All opinions expressed were to be taken as equally valid. Each participant had to treat all others with respect. All questions were to be considered valid and answered in a respectful manner. After the session was over, participants were allowed to continue the discussions with anyone else.

Step two was the information session based on invited expert witnesses recorded interviews. The recorded interviews, while avoiding specific details about the attributes, included experts perspective on the environmental issues that form the basis of the survey and their knowledge of it, and personal histories and their relationship to the environment. The experts were identified from the networks of the research team, from community partners such as the Okanagan Basin Water Board, the Regional District of the Central Okanagan and the city of Kelowna. The two groups then were given the opportunity to prepare up to two questions which were electronically delivered to the experts. The responses from the experts were read to the participants during the second session.⁴ The recoded interviews presentations took about 20 minutes and, each group took 20 minutes to ask questions.

The third step was deliberation and the decision challenge. At this stage, facilitators replayed the answers back to the participants. Jury members were allowed to cross question

⁴The research attempted to include experts from the Okanagan Nation Alliance (ONA) to see if there is any scope for ONA members to describe their perspective on the environmental issues included in the survey but was not successful.

each experts and each other based on expert answers and other issues raised by participants during and in between the two sessions.

The fundamental idea behind the decision challenge is to attempt to combine the desirable features of the Citizen jury (CJ) techniques with the particular requirements of economic valuation and cost-benefit analysis (Macmillan et al., 2002). It is close to “Market Stall” approach (MS) which fundamentally differs from CJ in that it explicitly combines aspects of participatory methods, but still with the primary intention of producing WTP estimates.⁵ Hence, each participant was provided with two decision challenges inspired by the issues raised in the survey. In the main survey, participants faced 6 choice cards for different possible environmental futures with costs of achieving those futures. Here, each participant was asked to vote on a few scenario combinations drawn from those choice scenarios. That is, each participant was asked to consider two possible costs, \$20 or \$40 per household per year for 30 years (the same payment amount they knew from the main survey). The total payment will be about \$60 million if a \$20 levy is collected per household (See figure 4.1), or \$120 million for a \$40 levy per household (See figure 4.2).⁶ These amounts will be collected and spent over 30 years. If \$20 million is spent to enhance Kokanee returns, we expect that returns will increase from 40,000 to 50,000. If \$40 million is spent, returns will increase to 60,000. Therefore, jurors were required, as a group, to tell us how they would divide \$60 million, and how they would divide \$120 million, between four attribute categories. In one possibility, they could spend \$20 million to increase Kokanee returns to 50,000, another \$20 million to reduce natural habitat loss to 50 km^2 , and a further \$20 million to keep rural population density at 70 people/ km^2 , for a total of \$60 million. In another possibility, they could spend \$40 million to increase Kokanee returns to 60,000 and \$20 million to reduce natural habitat loss, with nothing spent to limit rural population growth or groundwater use.

⁵see (Macmillan et al., 2002) for the details on the Market stall approach

⁶These monetary figures were calculated considering the current and projected household size of 80,000 and 120,000 in Central Okanagan over the planning period.

Accordingly, jurors were given 15 minutes to discuss the choices and issues related to the answers given by the experts. They were then given 45 minutes to work with their group to arrive at an agreed way of dividing the budget between the categories. The final decision was done by a showing of hands in line with the majority rule collective decision mechanism used in many CJ exercises (Álvarez-Farizo and Hanley, 2006b, Coote and Lenaghan, 1997).

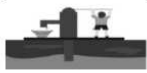



We would divide \$60 million over 30 years as:					
		No improvement	Some improvement	Most improvement	Allocation
	Groundwater share	20%	15% \$20 million	10% \$40 million	\$ _____
	Kokanee returns	40,000	50,000 \$20 million	60,000 \$40 million	\$ _____
	Natural habitat loss	100 km ²	50 km ² \$20 million	0 km ² \$40 million	\$ _____
	Rural density	75 people / km ²	70 people / km ² \$20 million	60 people / km ² \$40 million	\$ _____

FIGURE 4.1. Decision Challenge Choice Card 1. No improvement is an estimate of what things will be like in 30 years if no additional efforts are made to protect or enhance the environment. For groundwater share, natural habitat loss, and rural density, most improvement is like keeping things close to where they are now; for Kokanee returns, most improvement is an improvement over current returns of approximately 40,000. Participants are required to allocate to each category in the allocation column \$0, \$20 or \$40 million for any category. The total of the entries in the column must not exceed \$60 million. Within any category, going from no improvement to some improvement costs \$20 million over 30 years. Within any category, going from no improvement to most improvement costs \$40 million over 30 years.

After the voting was completed, they completed a secret ballot where each could choose differently from the group choice.

The sessions were conducted on February 20th, 21st and 22nd at the RDCO office conference hall. After these sessions were completed, both CJ participants and those who did not participate on the CJ were required to complete a shortened version of the original CE. This will help us understand if the amount people are willing to pay to protect the environment changes when people have a chance to hear from experts with special knowledge and discuss with other people.⁷

⁷One of the unique feature of this exercise is not providing participants with experts who provided information related to decisions. Expert opinions were limited to a set of questions, all information that the group used in the decision challenge came from discussions within the group.

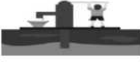



We would divide \$120 million over 30 years as:					
		No improvement	Some improvement	Most improvement	Allocation
	Groundwater share	20%	15% \$20 million	10% \$40 million	\$ _____
	Kokanee returns	40,000	50,000 \$20 million	60,000 \$40 million	\$ _____
	Natural habitat loss	100 km ²	50 km ² \$20 million	0 km ² \$40 million	\$ _____
	Rural density	75 people / km ²	70 people / km ² \$20 million	60 people / km ² \$40 million	\$ _____

FIGURE 4.2. Decision Challenge Choice Card 2. No improvement is an estimate of what things will be like in 30 years if no additional efforts are made to protect or enhance the environment. For groundwater share, natural habitat loss, and rural density, most improvement is like keeping things close to where they are now; for Kokanee returns, most improvement is an improvement over current returns of approximately 40,000. Participants are required to allocate to each category in the allocation column \$0, \$20 or \$40 million for any category. The total of the entries in the column must not exceed \$120 million. Within any category, going from no improvement to some improvement costs \$20 million over 30 years. Within any category, going from no improvement to most improvement costs \$40 million over 30 years.

A debriefing exercise was completed at the end of group voting to see how participants understood the approach as a means of establishing preference and willingness to pay values (See Appendix J for debriefing questions).

DISCUSSION AND MOTIVATION TOPICS. The four attribute indicators faced during the survey were briefly described and discussed. Each were motivated by some kind of emotional questions suggested by participants to relate to the environment around them and

topics to be discussed. Facilitators read the attribute descriptions out-loud and suggested topics for each indicator:

1. *Groundwater*: Groundwater is an important source of water we use and supports springs and wetlands that are important natural habitats. Increasing ground water use threatens these habitats. Most surface sources in the Okanagan are fully allocated. Increasing the share of total use from groundwater also reflects an increase in overall water use and in the amount of groundwater used.

Suggestions for discussions: Need to have a set of facts about springs, how they work, animals that depend on them, and how they have been changing in the Okanagan, particularly in the central Okanagan.

2. *Aquatic Habitat health* : Aquatic health is threatened by shoreline development, invasive species pollution, etc. Species such as Kokanee salmon are sensitive to the overall health of the aquatic environment. Since the 70's, spawning Kokanee numbers in Okanagan lake have fallen from over 1 million to about 40,000. Historic returns were much higher than they are today. The decline is partly due to failed efforts to enhance the kokanee fishery. Protection and enhancement of spawning and rearing areas can help increase returns.

Suggestions for discussion: Why did salmon population fell? Relate to its life cycle, the role it plays in the local ecosystem, reasons that the population has declined, things that can be done to enhance the population, etc.

3. *Natural habitats Loss*: Natural habitats, such as wetlands, forests, natural grasslands, etc. provide a range of environmental goods and services. Loss of these areas threatens the survival of some wild species within the Okanagan, and loss of those areas which allow movement of these species threatens the health of their populations. These environmental resources and services are largely lost if the land is developed.

Suggestions for discussion: Important endangered species in Okanagan, the problem of invasive species, and the loss of natural habitat, particularly valley bottom habitat, the importance of connectivity, and how as we lose more habitat, how we lose options to connect to different areas.

4. *Rural Character*: Rural areas have a unique character that reflects their history and close ties to the land. Increasing development and population growth in rural areas increases traffic, reduces the amount of open space, increases conflict between farmers and non-farm residents, and impacts natural habitats.

Suggestions for discussion: Facts about population growth, land development in rural areas, changes in traffic volumes, etc.

4.5. ECONOMETRIC MODEL

We need to determine whether there is any significant difference in preferences after people have had chances to receive more information and to think collectively as citizens rather than individually as consumers through discussions with the jury, family, and friends (Álvarez-Farizo and Hanley, 2006b, Álvarez-Farizo et al., 2009). This change of preference is examined econometrically by testing whether the CJ system has any influence on the heterogeneity of opinions. In other words, we examine if CJs can be used to elicit community values as opposed to individual values that the traditional choice experiment models produce. Community values are identified when heterogeneity in responses decrease in the citizen jury sessions (i.e. among the treatment group) compared to the control and main survey participants. This may be possible with models such as the Mixed Logit or Random Parameter Logit Models (RP) and Latent Class models (LC) (Álvarez-Farizo et al., 2009). I use the RP model to see if there is a decrease in heterogeneity as we move from traditional CE model to CJ choice formats.

Formalize the RP model following from Revelt and Train (1998), let N represent a sample of respondents with the choice of J alternatives on T choice occasions. Individual i 's ($i = \dots, N$) utility function, from choosing alternative j on choice occasion t takes the

following form:

$$(54) \quad \mathbf{U}_{ijt} = \mathbf{V}_{ijt} + \epsilon_{ijt} \Rightarrow \mathbf{V}_{ijt} = \beta_j \mathbf{x}_{ijt} + \gamma_i \mathbf{z}_{it} + \epsilon_{ijt}$$

where β_j is a vector coefficients of attributes relating to individual i and alternative j on choice occasion t , \mathbf{x}_{ijt} is observable attributes of the alternatives, γ_i is individual specific coefficients relating to individual i 's characteristics, \mathbf{z}_{it} is observable individual specific characteristics and ϵ_{ijt} is a random term that is assumed to be an independently and identically distributed extreme value. The β_i coefficients vary over decision makers with density $f(\beta|\theta)$, where θ are the parameters of the distribution. Assuming that the decision maker knows the value of his own β_i and ϵ_{ijt} for all j , he will choose alternative k if and only if $\mathbf{V}_{ijt} > \mathbf{V}_{ikt}$, $\forall k \neq j$. If the parameter β_i is known, the choice probability would take the standard logit form.

$$(55) \quad P_{ijt} = \frac{\exp(\beta'_i \mathbf{x}_{ijt})}{\sum_{j=1}^J \exp(\beta'_i \mathbf{x}_{ijt})}$$

If the parameter β_i is not known, the mixed logit unconditional choice probability will be the integral of p_{ikt} over all possible variables of β_i and take the following form:

$$(56) \quad P_{ijt} = \int \left(\frac{\exp \beta'_i \mathbf{x}_{ijt}}{\sum_{j=1}^J \exp \beta'_i \mathbf{x}_{ijt}} \right) f(\beta|\theta) d\beta$$

where $f(\beta|\theta)d\beta$ is the density function of β . We know that survey participants are making repeated choices and the probability of a sequence of choices may given by (Hole, 2007):

$$(57) \quad P_{ijt} = \int \prod_{t=1}^T \prod_{j=1}^J \left[\frac{\exp(\beta'_i \mathbf{x}_{ijt})}{\sum_{j=1}^J \exp(\beta'_i \mathbf{x}_{ijt})} \right]^{y_{ijt}} f(\beta|\theta) d\beta$$

where $y_{ijt} = 1$ if the individual chose alternative j in choice situation t and 0 otherwise. These probabilities are approximated by maximizing the θ parameters through simulation of log-likelihood function. Hence, the average simulated probability may take the following

form:

$$(58) \quad P_{ijt} = \sum_{i=1}^N \ln \left\{ \frac{1}{R} \sum_1^R \prod_{t=1}^T \prod_{j=1}^J \left[\frac{\exp(\beta_i^{[r]} \mathbf{x}_{ijt})}{\sum_{j=1}^J \exp(\beta_i^{[r]} \mathbf{x}_{ijt})} \right]^{y_{ijt}} \right\}$$

where R is the number of draws β from from $f(\beta|\theta)$ and where $\beta_i^{[r]}$ is is the r^{th} draw for individual i from the distribution of β . The implication is that we are allowing the fact that different decision makers may have different preferences and the IIA property no longer holds Hole (2007). Equations like 50 and 51 are called the Mixed logit probability (Revelt and Train, 1998). It is the general specification that allows fitting models with both individual specific and alternative-specific explanatory variables (Hole, 2007). The maximum simulated likelihood estimator (MSLE) is the value of θ that maximizes SLL (Revelt and Train, 1998, Hole, 2007).

4.6. RESULTS

4.6.1. CITIZEN JURY (CJ) DELIBERATION TREATMENT. The first task is to remove any significant differences between the people who participated in the CJ (treatment) or those who participated in the CJ sessions and also completed the survey second time and the non-treated (control group) or those who did the survey twice but did not volunteer to be part of the jury, in terms of their socioeconomic characteristics. This allows us to attribute the changes in preferences to deliberation treatment only. The standard approach for estimating the effects of interventions (deliberation treatment) on the probability of choosing conservation outcomes would be randomized controlled trials (RCTs) (Austin, 2011). However, our data is observational. We suspect there is a treatment selection problem (self-selection) and that the result would be influenced by subject characteristics. That means, the baseline characteristics of those who attended the deliberation citizen jury sessions would systematically differ from the control group (those who did not attend). We overcome this issue using propensity score matching method (PSM). The propensity score method forms matched sets of treated and non-treated subjects who share a similar

propensity score value (Rosenbaum and Rubin, 1983).⁸ It is a balancing score in a sense that the distribution of measured baseline observed predictor is similar between treated and non-treated subjects (Austin, 2011). Thus, the effect of deliberation on conservation option choices can be estimated by comparing the outcomes directly between the two subjects (Greenland et al., 1999).

The procedure in the PSM method is to check the overlap and the region of common support between treatment and control group. One of the different ways suggested in the literature is a visual analysis of the density distribution of the propensity score in both groups (Caliendo and Kopeinig, 2008). This is the easier method in a sense that the support problem can be spotted by inspecting the propensity score distribution and we may not need to implement a complicated formal estimator (Lechner, 2000). The more formal approach is comparing the minima and maxima of the propensity score in both groups (Caliendo and Kopeinig, 2008). Then we delete all observations whose propensity score is smaller than the minimum and larger than the maximum in the opposite group (Caliendo and Kopeinig, 2008). For instance, if the propensity score lies within the interval [0.06, 0.84] in the treatment group and within [0.04, 0.90] in the control group, the common support will be given by [0.06, 0.84] (Caliendo and Kopeinig, 2008). “The idea of implementing the common support condition is to ensure that any combination of characteristics observed in the treatment group can also be observed among the control group (Caliendo and Kopeinig, 2008)” Thus, propensity score values in the common support region is interpreted as the predicted probability of the control group being selected into the treatment group. For example, if the propensity score is 0.7 for one of the control group respondent, it means she/he has a 70% chance of being selected to the treatment group. Table 4.1 shows the estimated propensity score result in the region of common support.

⁸Rosenbaum and Rubin (1983) define propensity score as “the probability of treatment assignment conditional on observed baseline covariates: $P_{score} = Pr(M_i = 1|X_i)$, where we observe a $p \times 1$ vector of pretreatment covariates X_i and M_i is the probability of being selected into the treatment. Further, see Rosenbaum and Rubin (1983) and Austin (2011) for the introduction of propensity score model and Abadie and Imbens (2016) for the different methods in which it can be used to estimate treatment effects.

TABLE 4.1. Estimated propensity score

	Percentiles	Smallest		Percentiles	Largest
	1%	0.023415	0.023415	75%	0.292853 0.686780
	5%	0.031324	0.023415	90%	0.419161 0.686780
	10%	0.045892	0.023415	95%	0.559172 0.686780
	25%	0.093343	0.023415	99%	0.671658 0.686780
	50%	0.154178			
Mean					0.20536
Std. Dev.					0.15370
Variance					0.02362
Skewness					1.13088
Kurtosis					3.79120

It lies between $[0.02, 0.70]$, implying that observations which lie outside this region can be discarded from analysis. It is estimated using logistic regression model on the observed predictors listed in Table 4.1., applying stata psmatch package (StataCorp et al., 2013). In the logistic regression model, the deliberation treatment is 1 for the people who volunteered to participate in the jury sessions and 0 for non-treated (control) group.

Hence, from figure 4.3, we see that propensity scores in the treatment group and the control are not overlapping perfectly, implying systematic differences in baseline characteristics between deliberation participants and non-participants. Intuitively, we want the control group to perfectly overlap or look a lot like the treatment group in terms of individual background characteristics or covariates.

Using the estimated propensity score result in the region of common support information $[0.02, 0.70]$ and the groups overlap distribution, I created a new control group which is relatively similar to the treatment group. I used a benchmark of 20% propensity score value to include a respondent in the new control group. Those below 20% were excluded from the analysis. Figure 4.5 shows the propensity score density distribution. We see from the figure that, on average, treated and non-treated participants have similar distributions of measured baseline covariates above a propensity score of 20%. In other words, after matching, observed systematic differences between treated and untreated participants appear to have been greatly reduced (Rosenbaum and Rubin, 1984) and the new control

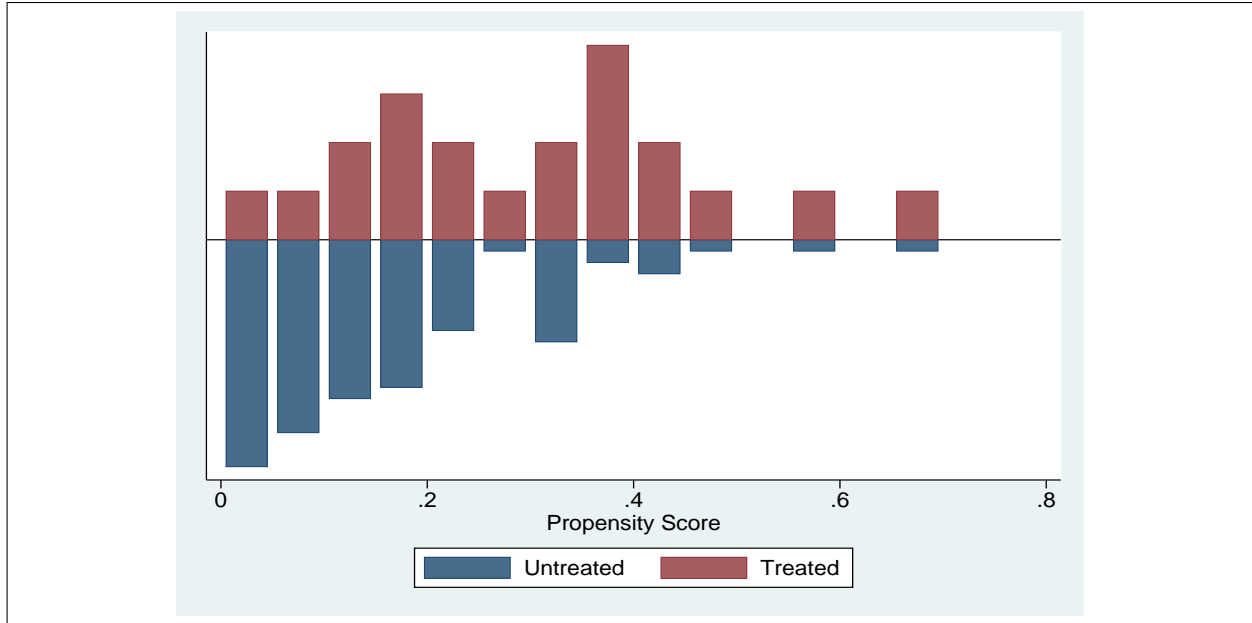


FIGURE 4.3. Treatment and Control Group Overlap

group (after removing participant with a propensity score below 20%.) very much look like the treatment group. Therefore, any significant difference in the conservation options choice outcome must only attributed to the deliberation treatment effect.

4.6.2. RANDOM PARAMETER MODEL RESULT. The multinomial logit models (MNL) do not allow us to test whether the CJ system has any influence on the heterogeneity of choice options. In other words, MNL models cannot show that CJs can be used to elicit community values as opposed to individual values. Community values are identified when heterogeneity in responses decreases in the CJ sessions (i.e. among the treatment group) compared to the control and main survey participants (Álvarez-Farizo et al., 2009). This is possible with models like random parameter models (RP), which can test for heterogeneity in certain attributes. We compare how both preference and response heterogeneity behaves using the mixed logit model estimates for the treated group, the control group, and the main survey group. Table 4.2 displays the mixed logit result.

From the deliberation treatment model estimates in Table 4.2 (columns 2 and 3), we see that the parameter estimate on “Option 1” (alternative specific intercept) is statistically significant and have the expected sign. That means on average, CJ participant prefer

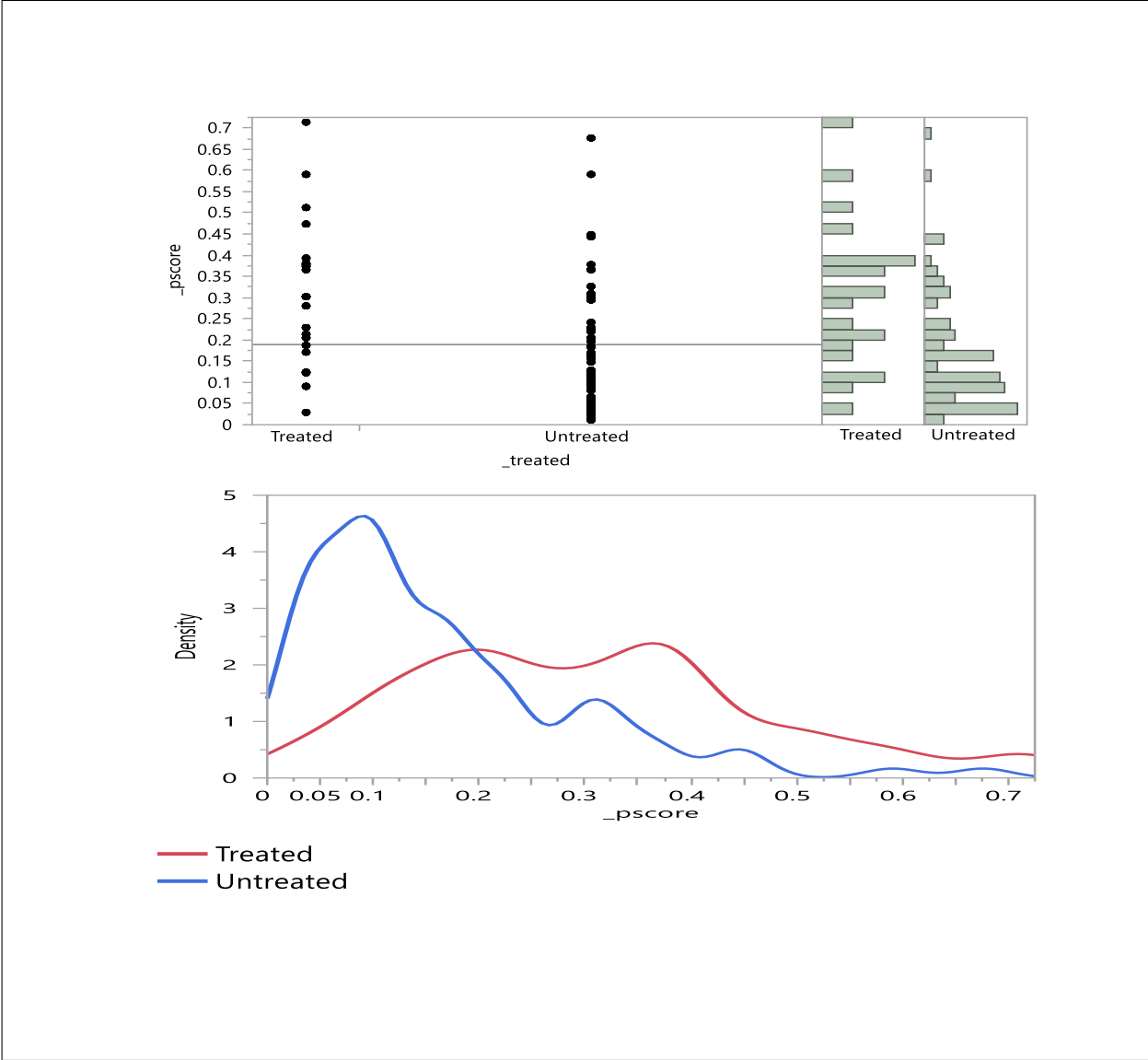


FIGURE 4.5. Propensity Score Distribution Densities

Option 1 compared to the “no action” status quo alternative. The parameters on the alternative specific coefficients (attributes) are not statistically significantly different from zero. However, all have the expected sign. The coefficients on the standard deviation (SD) of the alternative specific intercepts are not statistically significant, inferring that there is no preference heterogeneity in the data and that people have no difference in tests between the two conservation options compared to the “no action” status quo option. From the magnitudes of the standard deviations relative to the mean coefficients, practically all prefer “Option 1” and about 6% prefer “Option 2” compared to the “no action” status quo

TABLE 4.2. Baseline Characteristics of the treatment and control group

Age Group	Frequency	Percent	Cumulative percent
Young	18	0.87	100
Lower Middle Age	396	19.13	19.13
Upper Middle Age	918	44.35	99.13
Senior Age	738	35.65	54.78
Income Group			
Lower Income	216	10.43	19.13
Lower Middle Income	846	40.87	60
Upper Middle Income	828	40	100
High Income	180	8.7	8.7
Education Group			
Completed High School/Below	288	13.91	13.91
Have Diploma/Attended Univ	702	33.91	47.83
University Degree/Above	1,080	52.17	100
Household Characteristics			
Couple with children living at home	504	24.35	24.35
Couple with children who have left home	846	40.87	65.22
Couple with no children	288	13.91	79.13
Group household/Sharing with friends	54	2.61	81.74
Living alone	324	15.65	97.39
Single parent with children living at home	54	2.61	100
Property tax Responsibility			
Jointly or solely	1,980	95.65	100
Not Responsible	90	4.35	4.35
Gender			
Female	684	33.04	33.04
Male	1,386	66.96	100
Dwelling Owner			
Rented	234	11.3	11.3
Own/partner	1,836	88.7	100
Total	2,070	100	

alternative. This figure is given by $100 \times \Phi(-\beta_k/\sigma_k)$, where Φ is the cumulative standard normal distribution and β_k and σ_k are the mean and standard deviation, respectively, of the k^{th} coefficients (Hole, 2007). This is the expected outcome in a sense that the two choices are fundamentally similar in terms of absolute changes in attribute levels.⁹ Therefore, with deliberation, individuals are more informed and “Option 1” is more attractive in terms of

⁹The sign of the estimated standard deviations is irrelevant and interpreted and reported as being positive.

TABLE 4.3. Deliberation treatment, control group, and main survey results:
Change in Preference after Citizen Jury

Variable	Del.Treatment Group		Control Group		Main Survey	
	Mean	SD	Mean	SD	Mean	SD
β_1^1 [<i>Option 1</i>]	3.950* (-2.45)	0.45 (-0.46)	3.305*** (-3.38)	0.412 (-0.3)	2.922*** (-11.22)	1.436*** (-5.63)
β_1^2 [<i>Option 2</i>]	2.368 (-1.71)	1.512 (-1.81)	2.530** (-2.83)	0.353 (-0.65)	2.224*** (-8.83)	1.728*** (-8.32)
β_2 [<i>Groundwater</i>]	0.0541 (-0.68)	0.164 (-1.55)	0.00307 (-0.06)	0.11 (-1.34)	-0.0098 (-0.63)	0.119*** (-5.23)
β_3 [<i>Aquatic Health</i>]	0.0619 (-1.71)	0.0106 (-0.22)	0.035 (-1.07)	0.06 (-1.04)	0.0000286*** (-3.55)	0.0000459*** (-3.55)
β_3 [<i>Habitat Loss</i>]	-0.00904 (-1.21)	-0.0092 (-0.71)	-0.0083 (-1.38)	0.0186** (-2.66)	-0.0102*** (-5.46)	0.0210*** (-9.21)
β_5 [<i>Rural Character</i>]	-0.0362 (-0.52)	0.222 (-1.63)	-0.0489 (-1.22)	0.0603 (-0.57)	-0.0182 (-1.68)	0.101*** (-5.92)
β_6 [<i>Cost</i>]	-0.0288 (-0.66)	0.119* (-2.51)	-0.0602 (-1.56)	0.173** (-3.15)	-0.0395*** (-3.85)	0.152*** (-13.86)
Log likelihood	-96.41147		-158.54		-2097.9	
χ^2 (df.m)	45.31 (7)		133.2 (7)		1630.8 (7)	
<i>Prob</i> > χ^2	0.0000		0.0000		0.0000	
N	396		648		8424	

t statistics in parentheses
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

cost and is chosen overwhelmingly. Moreover, the variance covariance coefficients on some of attribute are statistically significant (see Table 4.3), implying that the variables are not independent of each other and those who chose an option with a higher salmon return for instance necessarily also want a decrease in the use of groundwater, sensitive ecosystem protected (decrease in habitat loss) and unique rural character sustained.

Columns 4 and 5 in Table 4.2 shows the results from control sample. We see that all the parameter estimates have the expected sign. The coefficients on the alternative specific coefficients (Options 1 and 2) are statistically significant. The coefficients on the standard deviations of these variables are not statistically significant, implying that there is no

TABLE 4.4. Variance Covariance of Normally Distributed Coefficients: Deliberation Treatment Sample

	Groundwater	Aquatic Health	Habitat Loss	Rural character	Cost
β_2 [<i>Groundwater</i>]	0.361* (2.49)				
β_3 [<i>Aquatic Health</i>]	-0.151* (-2.29)	0.0299 (0.80)			
β_4 [<i>Habitat Loss</i>]	0.0521** (2.69)	-0.000208 (-0.02)	0.0156 (1.27)		
β_5 [<i>Rural character</i>]	0.0282 (0.34)	-0.290** (-2.61)	0.0299 (0.32)	0.0787 (0.75)	
β_6 [<i>Cost</i>]	0.0908 (1.78)	-0.0533 (-1.32)	0.0602 (1.40)	-0.0181 (-0.50)	0.0583* (2.33)

t statistics in parentheses
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

statistically significant evidence to support the increase in preference heterogeneity compared to the CJ sample and in contrast to my expectation. However, from the magnitudes of the standard deviations relative to the mean coefficients, people are indifferent between the two improved options unlike the CJ sample who overwhelmingly chose “Option 1” compared to the “no action” status quo alternative. This is probably attributed to cost which is statistically significantly heterogeneous (statistically significant SD on cost), implying that people are more responsive to cost in sense that it is a disutility per my expectation. On the other hand, the standard deviation (SD) coefficients on habitat loss attributes is statistically significant compared to CJ model, suggesting some evidence of response heterogeneity in the data and that people react differently to a change in the levels of the attribute of each option. In addition, unlike the CJ case, attributes do not covary (see Table 4.5), suggesting that people only consider the change in the level of attribute of interest independent of other environmental attributes in their conservation option decision. This is the expected result in sense that private incentive would prevail among the control sample whereas deliberation hampers private incentive and enhances community or group values among the CJ sample.

From the main survey model result in Table 4.2, the mean coefficients on the alternative specific variables (Options 1 and 2) are statistically significant. The coefficients on the attributes are also statistically significant, except for groundwater use and rural character,

TABLE 4.5. Correlated Normally Distributed Coefficients: Control Sample

	Groundwater	Aquatic Health	Habitat Loss	Rural Character	Cost
β_2 [<i>Groundwater</i>]	0.170** (2.58)				
β_3 [<i>Aquatic Health</i>]	-0.0378 (-0.98)	0.0717* (1.98)			
β_4 [<i>Habitat Loss</i>]	-0.00668 (-0.83)	-0.0101 (-1.34)	0.0190* (2.49)		
β_5 [<i>Rural Character</i>]	0.0720 (1.58)	-0.0863 (-1.82)	0.0829 (1.95)	0.0252 (0.48)	
β_6 [<i>Cost</i>]	-0.0478 (-1.59)	-0.0120 (-0.43)	-0.0253 (-1.10)	0.0222 (0.83)	0.0761** (2.65)

t statistics in parentheses
 $*p < 0.05$, $**p < 0.01$, $***p < 0.001$

implying that most are important conservation option choice decision attributes. The coefficients on the standard deviations are highly statistically significant, implying a strong preference and response heterogeneity in the data. That means, people have different tests for conservation options and also react differently for the changes in levels of the attributes compared to both the CJ and control samples. Cost attribute has the right sign (negative) and highly statistically significant in line with a priori expectations that increases in the cost of the conservation options reduces any of the options utility. Cost is not important as a decision attribute in the CJ and control group cases, implying that utility of any of the options does not depend on it. This is expected because discussion enhances deliberative solutions as opposed to private solution. In deliberative exercises, “the common good prevails and predictions of models based on narrow self-interest and negotiation may fail Mendelberg (2002)”.

The variance covariance coefficients on the survey sample attributes are statistically significant, implying that people do evaluate the environment as a whole and the attributes are not independent of each other. This outcome is similar to the CJ case and that environmental attributes are statistically significantly correlated in contrast to the control group outcome. The important question here, motivated by Álvarez-Farizo and Hanley (2006a), who inquired the same question, therefore, is whether “preferences change significantly across CJ, control and main survey samples?” To address this question, I test the null

TABLE 4.6. Correlated Normally Distributed Coefficients: Main Survey Sample

	Groundwater	Aquatic Health	Habitat Loss	Rural Char	Cost
β_2 [<i>Groundwater</i>]	0.134*** (6.54)				
β_3 [<i>Aquatic Health</i>]	-0.0000165 (-1.29)	-0.0000603*** (-6.31)			
β_4 [<i>Habitat Loss</i>]	0.0181*** (6.03)	0.0144*** (5.33)	-0.0116*** (-3.62)		
β_5 [<i>Rural Character</i>]	-0.000924 (-0.06)	-0.0247 (-1.39)	-0.0731* (-2.53)	0.0780* (2.50)	
β_6 [<i>Cost</i>]	0.0280* (2.41)	0.00341 (0.34)	0.00488 (0.42)	-0.0182 (-1.06)	0.0868*** (12.38)

t statistics in parentheses
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

hypothesis of the equality of parameter coefficients across CJ, control and main survey samples. Formally, the null and alternative hypotheses would be Álvarez-Farizo and Hanley (2006b):

$$H_0 = \beta_i \text{ (Deliberation Treatment)} = \beta_i \text{ (Control)} = \beta_i \text{ (Main Survey)}$$

$$H_1 = \beta_i \text{ (Deliberation Treatment)} \neq \beta_i \text{ (Control)} \neq \beta_i \text{ (Main Survey)}$$

The likelihood-ratio test statistic of this hypothesis is the ratio of the likelihood of the simpler attribute only model with fewer parameters and the broader with alternative specific intercepts model.

$$LRT = -2 \log \left(\frac{\mathcal{L}_{\text{attribute only}}(\hat{\theta})}{\mathcal{L}_{\text{attributes+Intercepts}}(\hat{\theta})} \right)$$

Asymptotically, the test statistic is distributed as a chi-squared random variable, with degrees of freedom equal to the difference in the number of parameters between the two models (Greene, 2012, Álvarez-Farizo and Hanley, 2006b). Table 4.6 shows this test statistic.

TABLE 4.7. Likelihood Ratio Tests

	$LL_{\text{Attribute Only}}$	$LL_{\text{Attribute+Intercept}}$	LRT
$LR_{\text{treatment}}$	-103.0855	-96.5566	13.0577
LR_{Control}	-165.3333	-158.3627	13.9412
$LR_{\text{Main Survey}}$	-2322.7199	-2100.4806	444.4786
$LR_{TC} = \beta_T \text{ (Treatment)} = \beta_C \text{ (Control)}$	-165.3333	-96.5566	137.55346
$LR_{TM} = \beta_T \text{ (Treatment)} = \beta_M \text{ (Main survey)}$	-2322.7199	-96.5566	4452.3266
$LR_{CM} = \beta_C \text{ (Control)} = \beta_M \text{ (Main Survey)}$	-2322.7199	-158.3627	4328.71434

Hence, we can not accept the null hypothesis of parameter equality across the different survey samples and choice models as LRT values are above the critical χ^2 value of 11.070 for 5 degrees of freedom at $\alpha = 0.05$ confidence level.

The other important question we may ask is if preferences change significantly within the same sample before and after the deliberation (among the treatment sample) and before and after completing the survey the second time (among the control group). We see from Table 4.8 that there is relatively more heterogeneity in the data before deliberation compared to after in the deliberation treatment data. We observe statistically significant SD on alternative specific intercept (Option 1) and coefficients (groundwater and habitat loss), implying preference and response heterogeneity in the data at 95% confidence level among treatment group before deliberation. Choices are consistent among the control group, implying that completing the survey did not matter or did not change preference for conservation options.

In summary, from the results demonstrated above, both preference and response heterogeneity relatively decreased but did vanish when people were allowed to deliberate among peers and given more time. The overall goodness of fit did not differ considerably and from the likelihood-ratio test for the joint significance of the standard deviations, we can reject the null hypothesis that all the standard deviations are equal to zero (See Table 4.2 that $Prob > \chi^2$). Nonetheless, the CJ result could most likely reflect group (community) values rather than private values for at least two reasons:

1. Both Preference and response heterogeneity decreased relative to the control and main survey samples;
2. Cost is not important conservation choice decision attribute under CJ model.

We see that cost is strongly statistically significant under the main survey sample, suggesting that it is one of the essential choice factors. In contrast, cost is measurably unimportant in CJ sample and not an important conservation options decision variable. This suggests a decrease in dissent or protest to the expansion in property levy (cost) in contrast to most

TABLE 4.8. Change in preference before and after deliberation (Treatment group) and first and second time survey participant (Control)

Variable	Before Deliberation		After Deliberation		Control (First Time)		Control (Second Time)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
β_1^1 [<i>Option1</i>]	2.381* (2.43)	1.608* (2.44)	3.881* (2.31)	-0.637 (-0.68)	2.823*** (3.36)	0.370 (0.82)	3.305*** (3.38)	0.412 (0.30)
β_1^2 [<i>Option2</i>]	1.421 (1.53)	1.782 (1.66)	2.338 (1.61)	1.751 (1.09)	2.223** (2.83)	-0.701 (-1.22)	2.530** (2.83)	0.353 (0.65)
β_2 [<i>Groundwater</i>]	0.0714 (0.95)	-0.164* (-2.24)	0.0582 (0.72)	0.181 (1.19)	0.0205 (0.35)	0.192 (1.96)	0.00307 (0.06)	0.110 (1.34)
β_3 [<i>AquaticHealth</i>]	0.0000329 (0.86)	0.0000850 (1.73)	0.0609 (1.68)	-0.00866 (-0.16)	0.0000731* (2.36)	0.0000375 (0.88)	0.0350 (1.07)	0.0600 (1.04)
β_4 [<i>Habitat Loss</i>]	-0.00772 (-0.87)	-0.0209* (-2.15)	-0.00824 (-1.11)	0.00727 (0.57)	-0.0120 (-1.46)	0.0239* (2.40)	-0.00827 (-1.38)	0.0186** (2.66)
β_5 [<i>Rural Character</i>]	-0.0579 (-1.15)	0.0856 (1.47)	-0.0232 (-0.34)	0.214 (1.42)	-0.0641 (-1.65)	-0.110 (-1.58)	-0.0489 (-1.22)	0.0603 (0.57)
β_6 [<i>Cost</i>]	-0.00684 (-0.20)	0.0211 (0.72)	-0.0181 (-0.45)	0.124* (2.18)	-0.0501 (-1.38)	0.152*** (3.83)	-0.0602 (-1.56)	0.173** (3.15)
$\chi^2(df_m)$	40.17 (7)		45.02 (7)		116.6 (7)		133.2 (7)	
N	396		396		648		648	
t statistics in parentheses								
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$								

non-market valuation outcomes. That means, it is expected that deliberation help build consensus by narrowing the difference in views and entertaining the diversity of opinions among the jurors related to the method of financing conservation options.

4.6.3. CJ GROUP RESULT. Based on the decision challenges inspired by the issues raised in the survey, jurors were required to vote on a few scenario combinations drawn from those six different possible environmental futures considering costs of achieving those futures over the planning period. That is, each participant has to consider two possible costs, \$20 or \$40 per household per year for 30 years (the same payment vehicle they knew from the main survey) and allocate funding for each environmental attribute according to the priority set by the jurors.

Given that there are approximately 80,000 households in the Regional District of Central Okanagan (RDCO) presently, and likely to increase to about 120,000 over the next 30 years,

the payment will raise about \$60 million ($\$0.05 \times (400,000/1000) \times 100,000 \times 30$ years) or if a \$20 CAD levy per property value is collected per household, or \$120 million ($\$0.10 \times (400,000/1000) \times 100,000 \times 30$ years) or if \$ 40 levy is collected per household, where the population is assumed to be the average of 80,000 and 120,000. Tables 4.8 and 4.9 show the result of this hypothetical CJ exercise.

TABLE 4.9. Scenario 1 Allocation: 60 million CAD

Attributes	Level Chosen	Allocation (mil CAD)	WTP/yr/per	WTP/30 yrs/per
Groundwater	Medium use (15%)	20	8.333	250
Aquatic Health	Medium Return (50000)	0.0	0.00	0.0
Habitat Loss	Medium Loss (50 KM^2)	20	8.33	250
Rural Character	Av.Density (70 Per/KM^2)	20	8.33	250
Total		60	25	750

TABLE 4.10. Scenario 2 Allocation: 120 million CAD

Attributes	Level Chosen	Allocation (mil CAD)	WTP/yr/per	WTP/30 yrs/per
Groundwater	Moderate use (15%)	40	16.67	500
Aquatic Health	Moderate return (50000)	20	8.33	250
Habitat Loss	Moderate loss (50 KM^2)	40	16.67	500
Rural Character	Av.Density (70 Per/KM^2)	20	8.33	250
Total		120	50	1500

The result was achieved by the highest votes from among the levels suggested by participants in each option in the choice set. For example, the majority voted for a moderate increase in the share of total water use from groundwater, moderate reduction in habitat loss, and about average population density and allocated \$20 million CAD for each. Aquatic habitat was not given priority under this scenario. Groundwater use and habitat loss were given priority under the second scenario, allocating \$40 million CAD for each over the the planning period. This means, an average person is willing to pay about \$250 CAD over the planning period (\$8 CAD per year) for each of the attributes except aquatic habitat under scenario 1 keeping population constant at 80,000. An average individual would be willing to pay about \$500 CAD each for a policy that promote a decrease in groundwater use and natural habitat loss and \$250 CAD each for a policy that promote

the return of salmon fish or maintain rural amenity under scenario 2 over the planning period. Alternatively, if all environmental attributes are considered together, an average individual would be willing to pay about \$750 CAD (\$25/year) under scenario 1 and about \$1500 CAD (\$50/year) under scenario 2 conservation policy package respectively over the planning period.

This result is expected to conform with the private MWTP outcome discussed in section 4.5.2 above. Table 4.10 shows MWTP values calculated based on deliberation treatment (treatment panel); control and main survey samples outcomes presented for comparison. MWTP values are calculated following from Hole (2007): $E(WTP^j) = -\frac{E(\beta^j)}{(\beta^{Levy})}$ and assuming cost to have fixed coefficient. We see that private MWTP estimates after controlling for deliberation effect differ from group result a great deal and the values are not statistically significantly different from zero at 95% confidence level (it is presented here only for comparison). For instance, private CJ WTP is about \$3.1 CAD less in average additional charge per property per year for the increase in the share of total water use from groundwater, \$2.7 less in average additional charge per property per year for average decline in salmon return, \$0.04 less in average additional charge per year for a km² loss in natural habitat, \$4.7 CAD more in average additional charge per property per year to protect unique rural character. In other words, an average individual who participated in CJ sessions and completed the survey the twice is willing to pay 10% and 40% more in average additional charge per property per year for a decrease in groundwater use, 50% and > 100% more in average additional charge per property per year for a aquatic health (salmon fish return), 30% and 90% less in average additional charge per property per year for a habitat loss, and 36% less and 95% more in average additional charge per property per year to protect unique rural character, compared to the control and main survey samples respectively. However, group MWTP value is approximately higher by more than 160% and 75% in average additional charge per property per year for a decrease in groundwater use and protecting rural character and by extremely large figure to protect natural habitat loss than the treatment sample MWTP values respectively.

The welfare implication is even more huge. It was shown that heterogeneity decreased after deliberation treatment and the decrease in heterogeneity of preferences impacts the willingness to pay which is used to quantify gains (or losses) of the environmental conservation policy option. Hence, the undiscounted gain or losses, calculated using the CJ willingness to pay values for each attribute and for the policy packages if implemented by multiplying it with the average population size of the study region, and assuming population of the region over the planning period to be about 100,000 households, associated with group CJ MWTP is approximately higher by 130% under scenario 1 and 370% under scenario 2 (see the last four columns of Table 4.11) than the private values associated with CJ treatment sample. In conclusion, even though private MWTP values after

TABLE 4.11. Willingness to pay values after controlling for Deliberation Effect, Control and Main Survey

Sample Group	MWTP	Groundwater	Aquatic Health	Habitat Loss	Rural Character
Treatment	MWTP	-3.11163	-2.71404	-0.03986	4.75790
	Lower 95%	-9.72592	-11.05628	-0.72069	-8.29893
	Upper 95%	3.50266	5.62821	0.80040	17.81473
Control	MWTP	-2.82303	-5.92658	-0.93139	7.48737
	Lower 95%	-14.96391	-35.52592	-4.07613	-27.46128
	Upper 95%	9.31784	23.67277	5.93890	42.43601
Main Survey	MWTP	0.07007	-0.00097	-0.60401	2.43389
	Lower 95%	-2.27445	-0.00288	-0.09858	-0.44730
	Upper 95%	2.41459	0.00095	1.30661	5.31508

TABLE 4.12. Benefit-Cost (B/C) Estimates in CAD

Scenario	Variables	Private MWTP After Deliberation	CJ WTP	Av/Pop	Private WTP Based B/C/yr	B/C/30 yrs	CJ WTP based B/C/yr	B/C/30 yrs
Scenario 1	Ground Water	3.11	8.33	100,000	311,000	9,330,000	833,000	24,990,000
	Aquatic Habitat	2.71	0.00	100,000	271,000	8,130,000	0.000000	0.000000
	Natural Loss	0.04	8.33	100,000	4,000	120,000	833,000	24,990,000
	Rural Character	4.76	8.33	100,000	476,000	14,280,000	833,000	24,999,000
	Total Benefit	10.62	25		1,062,000	31,860,000	2,499,000	74,970,000
Senario 2	Ground Water	3.11	16.67	100,000	311,000	9,330,000	1,667,000	50,010,000
	Aquatic Habitat	2.71	8.33	100,000	271,000	8,130,000	833,000	24,990,000
	Natural Loss	0.04	16.67	100,000	4,000	120,000	1,667,000	50,010,000
	Rural Character	4.76	8.33	100,000	476,000	14,280,000	833,000	24,990,000
	Total Benefit	10.62	50		825,000	31,860,000	5,000,000	150,000,000

controlling for deliberation effect is not comparable with group (community) WTP values, it performs better in approximating community values compared to control and main survey samples. This result is in line with many studies that have compared private MWTP with hypothetical stated preference methods MWTP values which found that CJ values usually produce higher welfare by a factor of between 2 and 10 (Macmillan et al., 2002). Intuitively, the treatment sample MWTP and group CJ outcome should have produced close results given that time is not a constraint and that CJ sample participants are completing the survey the second time after participating in CJ sessions. The most plausible explanation and cautionary note would be that deliberation as a group activity forces decisions more to the opinion of those who are more vocal and informed and that MWTP values could be exaggerated.

4.7. CONCLUSION

Mendelberg (2002) states that “not only is deliberation about talk, it is about groups.” We observed differences in control and treatment samples outcome after deliberation treatment. Both preference and response heterogeneity essentially vanished when people were allowed to deliberate more and the willingness to pay values reflect conformity with the group dynamics.

In relation to my central hypothesis and evaluation of data from the jury, deliberation improved individuals’ valuation processes in a way that I believe reflects community values more so than the traditional CE valuation method. Most jurors’ evaluation sheets about the content of the jury and the process of the CJ indicated that their knowledge about the environment increased as a result of participation in the CJ. The majority also viewed the decision-making process as fair and felt that their views were listened to and they believed that they made well-informed and better choices. In summary, group-deliberation markedly affected the kinds of considerations that most mattered to respondents, which consequently affected the choices made and their willingness to pay values.

CHAPTER 5

CONCLUSION

In this dissertation, I investigated unobserved heterogeneity in citizens preferences for conservation option choices in three essays. The results of the first essay show that the random coefficient discrete choice models that allow for correlated errors demonstrate statistically significant preference and response heterogeneity. The latent class model, which allows respondents to belong to a class and preferences varying across, but not within, classes, show a priori environmental damage perception as one of a potential source of these heterogeneities. In addition, models are complementary with each explaining something better than the other when compared to discover if one model performs better in explaining unobserved heterogeneity. For example, while the latent class model capture the possible sources of heterogeneity, the mixed logit model is strong in quantifying unobserved heterogeneity.

In chapter two, I posit social network as another possible source of unobserved heterogeneity. I used egocentric centrality measures for data on a nodes first-order zone similar to Freeman et al. (1979) centrality measures for complete (sociocentric) network data to understand the structure, function, and composition of network ties around an individual. A clustering coefficient was found statistically significant implying two friends of an ego are likely friends with each other, resulting in sets of people among which many links exist (Watts and Strogatz, 1998). A closeness measure is uninformative for egocentric data, since all geodesic distances from ego to other nodes in the first-order zone are 1 by definition (Marsden, 2002). Degree and eigenvector centrality measures are statistically insignificant and uninformative. In principle, the sociocentric (complete network) and egocentric networks yield identical information on degree centrality (Frank, 2011). The eigenvector centrality depends both on the number of neighbors and the quality of its connections and the idea that a highly influential node influences one other node and then that influencing the ego more in the chain does not stand out in the egocentric data. The policy implication

of this finding is that both conservation and consumption of environmental goods generally are the result of interactions of combinations of social factors (e.g. population, technology, economic conditions). Many of these goods and services are non-excludable along social or geographic links (Bramoullé and Kranton, 2007). Decision making in this situation can not be thought as driven by private incentives only. Decisions around natural resources have social consequences that need to be addressed in public policy formulations in the context of citizens preferences interaction, constraint interaction and expectation interaction (Manski, 2000, Brown et al., 2005, Watts and Dodds, 2007). Any policy that ignores these interaction effects would be incomplete. Therefore, a thorough understanding of these interconnections, including how information is exchanged, how residents are influenced by members of their network, and how people choose or select their network could explain citizen conservation program choices and preferences (Frank, 2011). Moreover, egocentric social network analysis (SNA) is a methodological tool used to understand the structure, function, and composition of network ties around an individual is cost effective compared to the sociocentric (i.e. whole) network analysis. Egocentric network analysis share the basic assumption that behaviors, beliefs, attitudes, and values of individuals are shaped through contact and communication with others in unbounded setting unlike Sociocentric SNA which has a limited inference beyond the bounded group. Egocentric SNA assesses individual's personal community networks across any number of social settings using name generators, and is therefore less limited in theoretical and substantive scope. The focus on individual rather than group outcomes. Egocentric SNA is concerned with how people's patterns of interaction shape their individual-level outcomes (e.g. conservation option choices). Flexibility in data collection. Because sociocentric SNA must use as its sampling frame a census of a particular bounded group, data collection is very time-consuming, expensive, and targeted to a specific set of research questions. In contrast, because egocentric SNA uses individuals as cases, potential sampling frames and data collection strategies are virtually limitless. Egocentric data collection tools can easily be incorporated into large-scale or nationally-representative surveys being fielded for a variety of other purposes.

In chapter three, I evaluated the data from the citizen jury deliberation and if that results in the change of preferences and improve individuals valuation process. The results indicate that unobserved heterogeneity significantly declined, suggesting that relying only on the conventional application of valuation in which individuals are asked to express the value they attach to environmental public goods and services in isolation is inadequate. Other researchers have also shown similar and significant difference in value between those based on individual valuation and the more deliberative forms of valuation. Further, “environmental public goods allocation of services directly affects many people and raises normative questions about social equity, and it is argued that carefully designed deliberative methods will help ensure the achievement of social equity goals (Wilson and Howarth, 2002).” Moreover, in contrast to estimates of willingness to pay derived from conventional methods, the estimates from citizen juries would not reflect the budget constraints of the individual participants and the values are social rather than individual (Wilson and Howarth, 2002). In addition, the jurors place more value on programs containing actions related to the preservation of the environment as a whole. This information should be of interest to policy makers aiming to keep the environment alive and protect the ecosystem. Conservation policy options and public investments are also justifiable based on the WTP estimates. Therefore, this method could be used “to determine either a social/civic willingness to pay (“public WTP”) or a social/civic willingness to accept (“public WTA”) for any particular ecological change (Blamey et al., 2000).” O’neill and Spash (2000) notes that “for public WTP values, citizen valuation juries can be asked to determine the highest levy, tax, or other form of payment that the government should pay to obtain a particular ecological benefit. For public WTA values, citizen valuation juries can be asked to determine the highest monetary sum that the government should accept to avoid a particular ecological loss.”

Overall, heterogeneity manifests itself in individual choice decisions. This has implications for both the marginal valuation of attributes and also for predicted changes in conservation program choices. It also suggests a need for future policy design and adoptions

that focus on the following: identifying higher value ecological spots, balancing private property rights with the rights of the public, directing resources towards information and education to ensure residents understand the value of the resource and the need to protect, designing a suitable and realistic adaptive management plan with compliance and enforcement systems, maintaining the local settlements of rural population, preserving the natural open spaces and traditional agricultural and forestry landscapes, among others. Given that growth is likely inevitable, residents need to better understand the challenges and consequences of different growth scenarios.

As a final thought, there are three major limitations in this research. The first two limitations are related to social network analysis. The third is related to the general survey design. First, the most common survey methods for gathering “sociocentric network data ask respondents to report on their outgoing ties using a recognition format that reminds respondents of all alters deemed to be part of the network under study (Marsden, 1990).” By contrast, typical survey methods for assembling egocentric network data enumerate alters through free recall, and rely on the respondent (the ego node) as an informant about the structure and composition of the entire first-order zone. However, survey respondents do not recall a substantial fraction of their contacts in this case (Burt, 1984, Frank, 2011). Therefore, other things being equal, egocentric design typically understate degree and centrality measures. Second, there is uncertainty related to network relation or ties through which actors are influenced (Frank, 2011). It is very difficult to uncover if someone’s decision making behavior is influenced by all those with whom they come in contact, or if there are specific types of relations that are more influential for particular behaviors (Frank, 2011). The third limitation is the length of the survey. Augmenting three different methods in one survey is interesting but created a long, and sometimes confusing, survey for respondents that probably resulted in drop-offs, skipped questions and a low response rate.

Finally, this research contributes to the stated preference environmental economics literature by incorporating social network and citizen jury methods into discrete choice modeling techniques. The choice experiment augmented with social network and deliberation

methods also contributes more broadly to the survey design literature in non-market valuation.

BIBLIOGRAPHY

- A. Abadie and G. W. Imbens. Matching on the estimated propensity score. *Econometrica*, 84(2):781--807, 2016.
- W. Adamowicz, J. Louviere, and M. Williams. Combining revealed and stated preference methods for valuing environmental amenities. *Journal of environmental economics and management*, 26(3):271--292, 1994a.
- W. Adamowicz, P. Boxall, M. Williams, and J. Louviere. Stated preference approaches for measuring passive use values: choice experiments and contingent valuation. *American journal of agricultural economics*, 80(1):64--75, 1998a.
- W. Adamowicz, J. Louviere, and J. Swait. Introduction to attribute-based stated choice methods. *NOAA-National Oceanic Atmospheric Administration, Washington, USA*, 1998b.
- W. L. Adamowicz, P. Boxall, J. Louviere, J. Swait, and M. Williams. *Stated preference methods for environmental valuation*. Department of Rural Economy, Faculty of Agriculture and Forestry, University of Alberta, 1994b.
- M. Ahlheim, B. Ekasingh, O. Frör, J. Kitchaicharoen, A. Neef, C. Sangkapitux, and N. Sinphurmsukskul. Better than their reputation: enhancing the validity of contingent valuation mail survey results through citizen expert groups. *Journal of environmental planning and management*, 53(2):163--182, 2010.
- I. Ajzen. The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2):179--211, 1991.
- J. Aldred and M. Jacobs. Citizens and wetlands: evaluating the eley citizens jury. *Ecological Economics*, 34(2):217--232, 2000.
- B. Álvarez-Farizo and N. Hanley. Improving the process of valuing non-market benefits: combining citizens juries with choice modelling. *Land economics*, 82(3):465--478, 2006a.
- B. Álvarez-Farizo and N. Hanley. Improving the process of valuing non-market benefits: combining citizens juries with choice modelling. *Land economics*, 82(3):465--478, 2006b.

- B. Álvarez-Farizo, J. M. Gil, and B. Howard. Impacts from restoration strategies: Assessment through valuation workshops. *Ecological Economics*, 68(3):787--797, 2009.
- A. Ando, J. Camm, S. Polasky, and A. Solow. Species distributions, land values, and efficient conservation. *Science*, 279(5359):2126--2128, 1998.
- M. Aoki. Economic fluctuations with interactive agents: Dynamic and stochastic externalities*. *Japanese Economic Review*, 46(2):148--165, 1995.
- P. C. Austin. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate behavioral research*, 46(3):399--424, 2011.
- A. V. Banerjee. A simple model of herd behavior. *The Quarterly Journal of Economics*, pages 797--817, 1992.
- M. Bastian, S. Heymann, M. Jacomy, et al. Gephi: an open source software for exploring and manipulating networks. *ICWSM*, 8:361--362, 2009.
- I. Bateman, K. Willis, and G. Garrod. Consistency between contingent valuation estimates: a comparison of two studies of uk national parks. *Journal of the Regional Studies Association*, 28(5):457--474, 1994.
- BCstats. Population estimates, 2012. URL <http://www.bcstats.gov.bc.ca/statisticsbysubject/demography/populationestimates.aspx>.
- M. E. Ben-Akiva and S. R. Lerman. *Discrete choice analysis: theory and application to travel demand*, volume 9. MIT press, 1985.
- J. Bennett and R. Blamey. *The choice modelling approach to environmental valuation*. Edward Elgar Publishing, 2001.
- T. C. Bergstrom. Systems of benevolent utility functions. *Journal of Public Economic Theory*, 1(1):71--100, 1999.
- K. G. Binmore. *Game theory and the social contract: just playing*, volume 2. MIT press, 1998.
- S. Bitgood, D. Patterson, and A. Benefield. Exhibit design and visitor behavior empirical relationships. *Environment and behavior*, 20(4):474--491, 1988.

- R. Blamey, J. Gordon, and R. Chapman. Choice modelling: assessing the environmental values of water supply options. *Australian Journal of Agricultural and Resource Economics*, 43(3):337--357, 1999.
- R. K. Blamey and R. James. Citizens' juries: An alternative or an input to environmental cost-benefit analysis, 1999.
- R. K. Blamey, J. W. Bennett, J. J. Louviere, M. Morrison, and J. Rolfe. A test of policy labels in environmental choice modelling studies. *Ecological Economics*, 32(2):269--286, 2000.
- S. P. Borgatti, M. G. Everett, and J. C. Johnson. *Analyzing social networks*. SAGE Publications Limited, 2013.
- A. Börsch-Supan. On the compatibility of nested logit models with utility maximization. *Journal of Econometrics*, 43(3):373--388, 1990.
- J. Bouma, E. Bulte, and D. van Soest. Trust and cooperation: Social capital and community resource management. *Journal of environmental economics and management*, 56(2):155--166, 2008.
- S. Bowles. Endogenous preferences: The cultural consequences of markets and other economic institutions. *Journal of economic literature*, 36(1):75--111, 1998.
- P. C. Boxall and W. L. Adamowicz. Understanding heterogeneous preferences in random utility models: a latent class approach. *Environmental and resource economics*, 23(4):421--446, 2002.
- P. C. Boxall, W. L. Adamowicz, J. Swait, M. Williams, and J. Louviere. A comparison of stated preference methods for environmental valuation. *Ecological economics*, 18(3):243--253, 1996.
- Y. Bramoullé. Interdependent utilities, preference indeterminacy, and social networks. *Department of Agricultural and Resource Economics, University of Maryland, College Park, MD*, 2001.

- Y. Bramoullé and R. Kranton. A network model of public goods: experimentation and social learning. *LEERNA--INRA, University of Toulouse, and Department of Economics, University of Maryland, April, 2003.*
- Y. Bramoullé and R. Kranton. Public goods in networks. *Journal of Economic Theory*, 135(1):478--494, 2007.
- Y. Bramoullé, R. Kranton, and M. D'amours. Strategic interaction and networks. *The American Economic Review*, 104(3):898--930, 2014.
- W. S. Breffle, E. R. Morey, and J. A. Thacher. A joint latent-class model: combining likert-scale preference statements with choice data to harvest preference heterogeneity. *Environmental and Resource Economics*, 50(1):83--110, 2011.
- G. Breustedt, J. Müller-Scheeßel, and U. Latacz-Lohmann. Forecasting the adoption of gm oilseed rape: Evidence from a discrete choice experiment in germany. *Journal of Agricultural Economics*, 59(2):237--256, 2008.
- W. Brock and S. N. Durlauf. Multinomial choice with social interactions, 2003.
- W. A. Brock and S. N. Durlauf. Discrete choice with social interactions. *The Review of Economic Studies*, 68(2):235--260, 2001.
- W. A. Brock and S. N. Durlauf. A multinomial-choice model of neighborhood effects. *American Economic Review*, pages 298--303, 2002.
- R. Brouwer, I. H. Langford, I. J. Bateman, and R. K. Turner. A meta-analysis of wetland contingent valuation studies. *Regional Environmental Change*, 1(1):47--57, 1999.
- D. G. Brown, S. Page, R. Riolo, M. Zellner, and W. Rand. Path dependence and the validation of agent-based spatial models of land use. *International Journal of Geographical Information Science*, 19(2):153--174, 2005.
- T. C. Brown, G. L. Peterson, and B. E. Tonn. The values jury to aid natural resource decisions. *Land Economics*, 71(2):250--260, 1995.
- A. Bujosa, A. Riera, and R. L. Hicks. Combining discrete and continuous representations of preference heterogeneity: a latent class approach. *Environmental and Resource Economics*, 47(4):477--493, 2010.

- R. S. Burt. Network items and the general social survey. *Social networks*, 6(4):293--339, 1984.
- M. Caliendo and S. Kopeinig. Some practical guidance for the implementation of propensity score matching. *Journal of economic surveys*, 22(1):31--72, 2008.
- T. A. Cameron and J. Englin. Respondent experience and contingent valuation of environmental goods. *Journal of Environmental Economics and Management*, 33(3):296--313, 1997.
- K. E. Campbell, P. V. Marsden, and J. S. Hurlbert. Social resources and socioeconomic status. *Social networks*, 8(1):97--117, 1986.
- J.-A. Carrasco and E. J. Miller. The social dimension in action: A multilevel, personal networks model of social activity frequency between individuals. *Transportation Research Part A: Policy and Practice*, 43(1):90--104, 2009.
- J. A. Carrasco, B. Hogan, B. Wellman, and E. J. Miller. Collecting social network data to study social activity-travel behavior: an egocentric approach. *Environment and planning. B, Planning & design*, 35(6):961, 2008.
- P. J. Carrington, J. Scott, and S. Wasserman. *Models and methods in social network analysis*, volume 28. Cambridge university press, 2005.
- R. Carson and J. J. Louviere. *Experimental design and the estimation of willingness to pay in choice experiments for health policy evaluation*. PhD thesis, Oxford University Press, 2010.
- R. Carson, M. Czajkowski, et al. *The discrete choice experiment approach to environmental contingent valuation*. PhD thesis, Edward Elgar Publishing, 2014a.
- R. T. Carson, N. E. Flores, and N. F. Meade. Contingent valuation: controversies and evidence. *Environmental and resource economics*, 19(2):173--210, 2001.
- R. T. Carson, T. Groves, and J. A. List. Consequentiality: A theoretical and experimental exploration of a single binary choice. *Journal of the Association of Environmental and Resource Economists*, 1(1/2):171--207, 2014b.

- A. Chandrasekhar and R. Lewis. Econometrics of sampled networks. *Unpublished manuscript, MIT.[422]*, 2011.
- Y. Chih. Public sharing networks with free riders. Technical report, Indiana University [mimeo], 2010.
- M. Cho. Endogenous formation of networks for local public goods. *International Journal of Game Theory*, 39(4):529--562, 2010.
- A. S. Choi and K. S. Fielding. Environmental attitudes as wtp predictors: A case study involving endangered species. *Ecological Economics*, 89:24--32, 2013.
- M. Christie, N. Hanley, J. Warren, K. Murphy, R. Wright, and T. Hyde. Valuing the diversity of biodiversity. *Ecological economics*, 58(2):304--317, 2006.
- M. Christie, I. Fazey, R. Cooper, T. Hyde, and J. O. Kenter. An evaluation of monetary and non-monetary techniques for assessing the importance of biodiversity and ecosystem services to people in countries with developing economies. *Ecological economics*, 83: 67--78, 2012.
- K. K. Chung, L. Hossain, and J. Davis. Exploring sociocentric and egocentric approaches for social network analysis. In *Proceedings of the 2nd international conference on knowledge management in Asia Pacific*, pages 27--29, 2005.
- J. Clark, J. Burgess, and C. M. Harrison. i struggled with this money business: respondents perspectives on contingent valuation. *Ecological economics*, 33(1):45--62, 2000.
- A. Coote and J. Lenaghan. *Citizens' juries: theory into practice*. Institute for Public Policy Research, 1997.
- M. Crabbe and M. Vandebroek. Using appropriate prior information to eliminate choice sets with a dominant alternative from d-efficient designs. *Journal of Choice Modelling*, 5 (1):22--45, 2012.
- B. Crona and Ö. Bodin. What you know is who you know? communication patterns among resource users as a prerequisite for co-management. *Ecology and society*, 11(2):7, 2006.

- B. Csuti, S. Polasky, P. H. Williams, R. L. Pressey, J. D. Camm, M. Kershaw, A. R. Kiester, B. Downs, R. Hamilton, M. Huso, et al. A comparison of reserve selection algorithms using data on terrestrial vertebrates in oregon. *Biological Conservation*, 80(1):83--97, 1997.
- R. Cummings, D. Brookshire, and W. Schulze. Valuing environmental goods: an assessment of the contingent valuation method. *Totowa, NJ*, 1986.
- V. M. Danthurebandara, M. Vandebroek, and J. Yu. Integrated mixed logit and latent variable models. *Marketing Letters*, 24(3):245--259, 2013.
- R. Dhar. Consumer preference for a no-choice option. *Journal of Consumer Research*, 24(2):215--231, 1997.
- M. Diani. Leaders or brokers? positions and influence in social movement networks. *Social movements and networks: Relational approaches to collective action*, pages 105--122, 2003.
- M. Diani and D. McAdam. *Social movements and networks: Relational approaches to collective action: Relational approaches to collective action*. OUP Oxford, 2003.
- T. Dietz, P. C. Stern, and A. Dan. How deliberation affects stated willingness to pay for mitigation of carbon dioxide emissions: an experiment. *Land Economics*, 85(2):329--347, 2009.
- S. T. Dissanayake and A. W. Ando. Valuing ecosystem restoration: tradeoffs, experience and design.
- S. T. Dissanayake and A. W. Ando. Valuing grassland restoration: Proximity to substitutes and trade-offs among conservation attributes. *Land Economics*, 90(2):237--259, 2014.
- S. T. Dissanayake and H. Önal. Amenity driven price effects and conservation reserve site selection: A dynamic linear integer programming approach. *Ecological Economics*, 70(12):2225--2235, 2011.
- J. Dixon, L. Scura, R. Carpenter, and P. Sherman. *Economic analysis of environmental impacts*. Routledge, 2013.

- M. Domínguez-Torreiro and M. Soliño. Provided and perceived status quo in choice experiments: Implications for valuing the outputs of multifunctional rural areas. *Ecological Economics*, 70(12):2523--2531, 2011.
- E. R. Dugundji and L. Gulyás. Sociodynamic discrete choice on networks in space: impacts of agent heterogeneity on emergent outcomes. *Environment and planning. B, Planning & design*, 35(6):1028, 2008.
- E. R. Dugundji and J. L. Walker. Discrete choice with social and spatial network interdependencies: An empirical example using mixed generalized extreme value models with field and panel effects. *Transportation Research Record: Journal of the Transportation Research Board*, 1921(1):70--78, 2005.
- D. Easley, J. Kleinberg, et al. Networks, crowds, and markets: Reasoning about a highly connected world. *Significance*, 9:43--44, 2012.
- M. Emirbayer and J. Goodwin. Network analysis, culture, and the problem of agency. *American journal of sociology*, pages 1411--1454, 1994.
- M. Espinosa-Goded, J. Barreiro-Hurlé, and E. Ruto. What do farmers want from agri-environmental scheme design? a choice experiment approach. *Journal of Agricultural economics*, 61(2):259--273, 2010.
- S. C. Farber, R. Costanza, and M. A. Wilson. Economic and ecological concepts for valuing ecosystem services. *Ecological economics*, 41(3):375--392, 2002.
- B. A. Farizo, J. Joyce, and M. Soliño. Dealing with heterogeneous preferences using multilevel mixed models. *Land Economics*, 90(1):181--198, 2014.
- K. Faust, K. E. Willert, D. D. Rowlee, and J. Skvoretz. Scaling and statistical models for affiliation networks: patterns of participation among soviet politicians during the brezhnev era. *Social Networks*, 24(3):231--259, 2002.
- C. Ferreyra and P. Beard. Participatory evaluation of collaborative and integrated water management: insights from the field. *Journal of Environmental Planning and Management*, 50(2):271--296, 2007.

- S. Ferrini and R. Scarpa. Designs with a priori information for nonmarket valuation with choice experiments: A monte carlo study. *Journal of environmental economics and management*, 53(3):342--363, 2007.
- M. Fishbein and I. Ajzen. *Belief, attitude, intention and behavior: An introduction to theory and research*. 1975.
- K. Frank. Social network models for natural resource use and extraction. *Social networks and natural resource management: Uncovering the social fabric of environmental governance*, pages 180--205, 2011.
- L. C. Freeman. Centrality in social networks conceptual clarification. *Social networks*, 1(3): 215--239, 1978.
- L. C. Freeman, D. Roeder, and R. R. Mulholland. Centrality in social networks: Ii. experimental results. *Social networks*, 2(2):119--141, 1979.
- N. E. Friedkin. Theoretical foundations for centrality measures. *American journal of Sociology*, pages 1478--1504, 1991.
- B. Golub and M. O. Jackson. Naive learning in social networks and the wisdom of crowds. *American Economic Journal: Microeconomics*, 2(1):112--149, 2010.
- J. M. Gowdy. The revolution in welfare economics and its implications for environmental valuation and policy. *Land economics*, 80(2):239--257, 2004.
- M. Granovetter. The impact of social structure on economic outcomes. *The Journal of Economic Perspectives*, 19(1):33--50, 2005.
- W. H. Greene. Econometric analysis, 71e. *Stern School of Business, New York University*, 2012.
- W. H. Greene and D. A. Hensher. A latent class model for discrete choice analysis: contrasts with mixed logit. *Transportation Research Part B: Methodological*, 37(8):681--698, 2003.
- S. Greenland, J. Pearl, and J. M. Robins. Causal diagrams for epidemiologic research. *Epidemiology*, pages 37--48, 1999.
- R. Gregory. Using stakeholder values to make smarter environmental decisions. *Environment: science and policy for sustainable development*, 42(5):34--44, 2000.

- R. Gregory and K. Wellman. Bringing stakeholder values into environmental policy choices: a community-based estuary case study. *Ecological Economics*, 39(1):37--52, 2001.
- P. Haan and A. Uhlendorff. Estimation of multinomial logit models with unobserved heterogeneity using maximum simulated likelihood. Technical report, DIW-Diskussionspapiere, 2006.
- W. M. Hanemann. Welfare evaluations in contingent valuation experiments with discrete response data: reply. *American Journal of Agricultural Economics*, 71(4):1057--1061, 1989.
- N. Hanley, D. MacMillan, R. E. Wright, C. Bullock, I. Simpson, D. Parsisson, and B. Crabtree. Contingent valuation versus choice experiments: estimating the benefits of environmentally sensitive areas in scotland. *Journal of agricultural economics*, 49(1):1--15, 1998.
- N. Hanley, S. Mourato, R. E. Wright, et al. Choice modelling approaches: a superior alternative for environmental valuation? *Journal of economic surveys*, 15(3):435--462, 2001.
- N. Hanley, R. E. Wright, and B. Alvarez-Farizo. Estimating the economic value of improvements in river ecology using choice experiments: an application to the water framework directive. *Journal of environmental management*, 78(2):183--193, 2006.
- R. A. Hanneman and M. Riddle. Introduction to social network methods, 2005.
- J. Hausman. Contingent valuation: from dubious to hopeless. *The Journal of Economic Perspectives*, pages 43--56, 2012.
- J. Hausman and D. McFadden. Specification tests for the multinomial logit model. *Econometrica: Journal of the Econometric Society*, pages 1219--1240, 1984.
- L. He. *Usage and Social Context-based Choice Modeling for Engineering Design*. PhD thesis, NORTHWESTERN UNIVERSITY, 2012.
- L. He, M. Wang, W. Chen, and G. Conzelmann. Incorporating social impact on new product adoption in choice modeling: A case study in green vehicles. *Transportation Research Part D: Transport and Environment*, 32:421--434, 2014.

- F. Heiss et al. Structural choice analysis with nested logit models. *The Stata Journal*, 2(3): 227--252, 2002.
- D. Hensher, J. Rose, and W. Greene. Applied choice analysis, 2005.
- D. A. Hensher and W. H. Greene. The mixed logit model: the state of practice. *Transportation*, 30(2):133--176, 2003.
- D. A. Hensher, J. M. Rose, and W. H. Greene. *Applied choice analysis: a primer*. Cambridge University Press, 2005.
- A. R. Hole. Estimating mixed logit models using maximum simulated likelihood. *Stata Journal*, 7(3):388--401, 2007.
- R. B. Howarth and M. A. Wilson. A theoretical approach to deliberative valuation: aggregation by mutual consent. *Land Economics*, 82(1):1--16, 2006.
- D. Hoyos. The state of the art of environmental valuation with discrete choice experiments. *Ecological Economics*, 69(8):1595--1603, 2010.
- M. O. Jackson. *Social and economic networks*. Princeton University Press, 2010.
- M. O. Jackson and A. Wolinsky. A strategic model of social and economic networks. *Journal of economic theory*, 71(1):44--74, 1996.
- M. O. Jackson et al. *Social and economic networks*, volume 3. Princeton university press Princeton, 2008.
- M. Jacobs. Environmental valuation, deliberative democracy and public decision-making institutions. *Valuing nature*, pages 211--231, 1997.
- D. C. Jain, N. J. Vilcassim, and P. K. Chintagunta. A random-coefficients logit brand-choice model applied to panel data. *Journal of Business & Economic Statistics*, 12(3):317--328, 1994.
- C. Jefferson. Citizens juries, 2016. URL <http://jefferson-center.org/>.
- R. J. Johnston, T. W. Campson, and J. M. Duke. The value of farm and forest preservation to residents of mansfield, connecticut. *Dept. of Agr. and Res. Econ. Report, University of Connecticut*, 2007.

- S. R. Kellert and J. K. Berry. Knowledge, affection and basic attitudes toward animals in american society. phase iii. 1980.
- J. O. Kenter, T. Hyde, M. Christie, and I. Fazey. The importance of deliberation in valuing ecosystem services in developing countries evidence from the solomon islands. *Global Environmental Change*, 21(2):505--521, 2011.
- H. M. Kharouba and J. T. Kerr. Just passing through: Global change and the conservation of biodiversity in protected areas. *Biological Conservation*, 143(5):1094--1101, 2010.
- D. Knoke and S. Yang. *Social network analysis*, volume 154. Sage, 2008.
- D. Knowler and K. Dust. *The Economics of Protecting Old Growth Forest: An Analysis of Spotted Owl Habitat in the Fraser Timber Supply Area of British Columbia: Final Report*. School of Resource and Environmental Management, Simon Fraser University, 2008.
- A. Kontogianni, M. S. Skourtos, I. H. Langford, I. J. Bateman, and S. Georgiou. Integrating stakeholder analysis in non-market valuation of environmental assets. *Ecological Economics*, 37(1):123--138, 2001.
- A. Kontoleon and M. Yabe. Assessing the impacts of alternative opt-out formats in choice experiment studies: consumer preferences for genetically modified content and production information in food. *Journal of Agricultural policy and Resources*, 5(1):1--43, 2003.
- F. S. Koppelman and C.-H. Wen. Alternative nested logit models: structure, properties and estimation. *Transportation Research Part B: Methodological*, 32(5):289--298, 1998.
- M. J. Kotchen and S. D. Reiling. Environmental attitudes, motivations, and contingent valuation of nonuse values: a case study involving endangered species. *Ecological Economics*, 32(1):93--107, 2000.
- P. Koundouri, R. Scarpa, and M. Stithou. A choice experiment for the estimation of the economic value of the river ecosystem: Management policies for sustaining natura (2000) species and the coastal environment. In *Water Resources Management Sustaining Socio-Economic Welfare*, pages 101--112. Springer, 2014.

- K. F. Kovacs and D. M. Larson. Identifying individual discount rates and valuing public open space with stated-preference models. *Land Economics*, 84(2):209--224, 2008.
- K. J. Lancaster. A new approach to consumer theory. *The journal of political economy*, pages 132--157, 1966.
- M. Lechner. A note on the common support problem in applied evaluation studies. 2000.
- Y. Li, Y. Shang, and Y. Yang. Clustering coefficients of large networks. *Information Sciences*, 382:350--358, 2017.
- N. Lienhoop and D. C. MacMillan. Contingent valuation: comparing participant performance in group-based approaches and personal interviews. *Environmental Values*, pages 209--231, 2007.
- N. Lienhoop and M. Völker. Preference refinement in deliberative choice experiments for ecosystem service valuation. *Land Economics*, 92(3):555--577, 2016.
- I. Lobel and E. Sadler. Preferences, homophily, and social learning. *Operations Research*, 64(3):564--584, 2015.
- J. Loomis, P. Kent, L. Strange, K. Fausch, and A. Covich. Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey. *Ecological economics*, 33(1):103--117, 2000.
- J. B. Loomis and D. M. Larson. Total economic values of increasing gray whale populations: results from a contingent valuation survey of visitors and households. *Marine Resource Economics*, pages 275--286, 1994.
- K. Lorenz. *The foundations of ethology*. Springer Science & Business Media, 2013.
- J. J. Louviere, D. A. Hensher, and J. D. Swait. *Stated choice methods: analysis and applications*. Cambridge University Press, 2000.
- T. Lundhede, J. B. Jacobsen, N. Hanley, N. Strange, and B. J. Thorsen. Incorporating outcome uncertainty and prior outcome beliefs in stated preferences. *Land Economics*, 91(2):296--316, 2015.
- D. MacMillan, N. Hanley, and N. Lienhoop. Contingent valuation: Environmental polling or preference engine? *Ecological economics*, 60(1):299--307, 2006.

- D. C. MacMillan and E. I. Duff. Estimating the non-market costs and benefits of native woodland restoration using the contingent valuation method. *Forestry*, 71(3):247--259, 1998.
- D. C. Macmillan, L. Philip, N. Hanley, and B. Alvarez-Farizo. Valuing the non-market benefits of wild goose conservation: a comparison of interview and group based approaches. *Ecological Economics*, 43(1):49--59, 2002.
- J. Magidson and J. Vermunt. Latent class modeling as a probabilistic extension of k-means clustering. *Quirks Marketing Research Review*, 20:77--80, 2002.
- C. F. Manski. Identification of endogenous social effects: The reflection problem. *The review of economic studies*, 60(3):531--542, 1993.
- C. F. Manski. Economic analysis of social interactions. Technical report, National Bureau of Economic Research, 2000.
- P. V. Marsden. Network data and measurement. *Annual review of sociology*, pages 435--463, 1990.
- P. V. Marsden. Egocentric and sociocentric measures of network centrality. *Social networks*, 24(4):407--422, 2002.
- B. Martín-López, C. Montes, and J. Benayas. The non-economic motives behind the willingness to pay for biodiversity conservation. *Biological conservation*, 139(1):67--82, 2007.
- L. G. Mathews, F. R. Homans, and K. W. Easter. Estimating the benefits of phosphorus pollution reductions: An application in the minnesota river. *Journal of the American Water Resources Association*, 38(5):1217, 2002.
- D. McFadden. Modeling the choice of residential location. *Transportation Research Record*, (673), 1978.
- D. McFadden. Sociality, rationality, and the ecology of choice. In *Choice Modelling: The State-of-the-Art and the State-of-Practice: Proceedings from the Inaugural International Choice Modelling Conference*, 2010.
- D. McFadden et al. Conditional logit analysis of qualitative choice behavior. 1973.

- D. McFadden et al. *Modelling the choice of residential location*. Institute of Transportation Studies, University of California, 1978.
- M. McPherson, L. Smith-Lovin, and M. E. Brashears. Social isolation in america: Changes in core discussion networks over two decades. *American sociological review*, 71(3):353--375, 2006.
- J. R. Meldrum. Comparing different attitude statements in latent class models of stated preferences for managing an invasive forest pathogen. *Ecological Economics*, 120:13--22, 2015.
- T. Mendelberg. The deliberative citizen: Theory and evidence. *Political decision making, deliberation and participation*, 6(1):151--193, 2002.
- C. Metrics. Ngene 1.1.2 user manual & reference guide. <http://www.choice-metrics.com/documentation.html>, 2014.
- C. D. Meyer. *Matrix analysis and applied linear algebra*, volume 2. Siam, 2000.
- J. Meyerhoff. Stated willingness to pay as hypothetical behaviour: Can attitudes tell us more? *Journal of Environmental Planning and Management*, 49(2):209--226, 2006.
- J. Meyerhoff and A. Dehnhardt. The european water framework directive and economic valuation of wetlands: the restoration of floodplains along the river elbe. *European Environment*, 17(1):18--36, 2007.
- J. Meyerhoff, U. Liebe, and V. Hartje. Benefits of biodiversity enhancement of nature-oriented silviculture: Evidence from two choice experiments in germany. *Journal of Forest Economics*, 15(1):37--58, 2009.
- R. C. Mitchell. On designing constructed markets in valuation surveys. *Environmental and Resource Economics*, 22(1-2):297--321, 2002.
- E. Morey, J. Thacher, and W. Breffle. Using angler characteristics and attitudinal data to identify environmental preference classes: a latent-class model. *Environmental and Resource Economics*, 34(1):91--115, 2006.

- E. Morey, M. Thiene, M. De Salvo, and G. Signorello. Using attitudinal data to identify latent classes that vary in their preference for landscape preservation. *Ecological Economics*, 68(1):536--546, 2008.
- M. Morrison and R. Kingsford. The management of inland wetlands and river flows and the importance of economic valuation in new south wales. *Wetlands (Australia)*, 16(2):83--98, 2010.
- M. A. Munizaga and R. Alvarez-Daziano. Mixed logit vs. nested logit and probit models. In *5th tri-annual Invitational Choice Symposium: Hybrid Choice Models, Formulation and Practical Issues*. Available from http://www.cec.uchile.cl/~dididet/mmunizaga/mixed_logit.pdf, 2001.
- V. Narayan, V. R. Rao, and C. Saunders. How peer influence affects attribute preferences: A bayesian updating mechanism. *Marketing Science*, 30(2):368--384, 2011.
- W. Neilson and B. Wichmann. Social networks and non-market valuations. *Journal of Environmental Economics and Management*, 67(2):155--170, 2014.
- W. S. Neilson and H. Winter. Votes based on protracted deliberations. *Journal of Economic Behavior & Organization*, 67(1):308--321, 2008.
- M. E. Newman. The mathematics of networks. *The new palgrave encyclopedia of economics*, 2(2008):1--12, 2008.
- J. Newton. Coalitional behaviour and the provision of public goods on networks. *University of Cambridge [mimeo]*, 2010.
- S. Niemeyer and C. L. Spash. Environmental valuation analysis, public deliberation, and their pragmatic syntheses: a critical appraisal. *Environment and Planning C*, 19(4):567--586, 2001.
- D. ODea. Local public goods and network formation. *University of Illinois [mimeo]*, 2010.
- S. U. O'Hara. Discursive ethics in ecosystems valuation and environmental policy. *Ecological Economics*, 16(2):95--107, 1996.
- S. U. OHara and S. Stagl. Endogenous preferences and sustainable development. *The Journal of Socio-Economics*, 31(5):511--527, 2002.

- O. Okanagan Collaborative Conservation Program. A Biodiversity Conservation Strategy for the Okanagan Region keeping nature in our future, 2014. URL http://a100.gov.bc.ca/appsdata/acat/documents/r42389/ABiodiversityStrategyfo_1425071681093_5071573148.pdf.
- O. Okanagan Water Stewardship Council. The Okanagan Sustainable Water Strategy action plan 1.0, 2008. URL http://www.obwb.ca/fileadmin/docs/osws_action_plan.pdf.
- A. J. Omalley, S. Arbesman, D. M. Steiger, J. H. Fowler, and N. A. Christakis. Egocentric social network structure, health, and pro-social behaviors in a national panel study of americans. *PLoS One*, 7(5):e36250, 2012.
- H. Önal. First-best, second-best, and heuristic solutions in conservation reserve site selection. *Biological Conservation*, 115(1):55--62, 2004.
- J. O’neill and C. L. Spash. Conceptions of value in environmental decision-making. *Environmental Values*, 9(4):521--536, 2000.
- T. Opsahl and P. Panzarasa. Clustering in weighted networks. *Social networks*, 31(2):155--163, 2009.
- T. Opsahl, F. Agneessens, and J. Skvoretz. Node centrality in weighted networks: Generalizing degree and shortest paths. *Social Networks*, 32(3):245--251, 2010.
- E. Ostrom. *Governing the commons*. Cambridge university press, 2015.
- E. Ouma, A. Abdulai, and A. Drucker. Measuring heterogeneous preferences for cattle traits among cattle-keeping households in east africa. *American Journal of Agricultural Economics*, 89(4):1005--1019, 2007.
- A. Páez, D. M. Scott, and E. Volz. A discrete-choice approach to modeling social influence on individual decision making. *Environment and planning. B, Planning & design*, 35(6):1055, 2008.
- P. Paul Budde Communication Pty Ltd. Canada-broadband market-insights, statistics and forecasts, 2016. URL <https://www.budde.com.au/Research/Canada-Broadband-Market-Insights-Statistics-and-Forecasts?r=51>.

- J. W. Payne, J. R. Bettman, D. A. Schkade, N. Schwarz, and R. Gregory. Measuring constructed preferences: Towards a building code. In *Elicitation of preferences*, pages 243--275. Springer, 1999.
- M. Porcu and F. Giambona. Introduction to latent class analysis with applications. *The Journal of Early Adolescence*, page 0272431616648452, 2016.
- N. Powe, G. Garrod, and P. McMahon. Mixing methods within stated preference environmental valuation: choice experiments and post-questionnaire qualitative analysis. *Ecological economics*, 52(4):513--526, 2005.
- C. Prell, K. Hubacek, and M. Reed. Stakeholder analysis and social network analysis in natural resource management. *Society and Natural Resources*, 22(6):501--518, 2009.
- J. Pretty and H. Ward. Social capital and the environment. *World development*, 29(2): 209--227, 2001.
- S. Rabe-Hesketh and A. Skrondal. *Multilevel and longitudinal modeling using Stata*. STATA press, 2012.
- S. Rabe-Hesketh, A. Skrondal, and A. Pickles. Gllamm manual. 2004.
- S. Rabe-Hesketh, A. Skrondal, and A. Pickles. Maximum likelihood estimation of limited and discrete dependent variable models with nested random effects. *Journal of Econometrics*, 128(2):301--323, 2005.
- A. Rapoport. Spread of information through a population with socio-structural bias: I. assumption of transitivity. *The bulletin of mathematical biophysics*, 15(4):523--533, 1953.
- S. Rasouli and H. Timmermans. Influence of social networks on latent choice of electric cars: a mixed logit specification using experimental design data. *Networks and Spatial Economics*, 16(1):99--130, 2016.
- RDCO. RDCO - Geographic Information System rdco location map, 2016. URL http://www.rdcogis.com/GIS_App_public/index.html.
- R. Regional District of Central Okanagan. Central okanagan lake foreshore inventory and mapping, 2005. URL https://www.regionaldistrict.com/media/20203/Part_I_State%20of%20the%20Foreshore.pdf.

- R. Regional District of Central Okanagan. Okanagan lake foreshore inventory and mapping, 2011. URL <https://www.regionaldistrict.com/media/20167/PART%204%20-%20DATA%20ANALYSIS%20AND%20RESULTS.pdf>.
- R. Regional District of Central Okanagan. Regional growth strategy water resources, lakes? and streams: Discussion paper, 2012. URL [http://futureok.ca/media/1862/FINAL%20-%20WR%20Discussion%20Paper%20\(final\)%20Oct%2023.pdf](http://futureok.ca/media/1862/FINAL%20-%20WR%20Discussion%20Paper%20(final)%20Oct%2023.pdf).
- R. Regional District of Central Okanagan. Regional District of Central Okanagan Regional Growth Strategy schedule 'a', 2013. URL <http://futureok.ca/media/2227/2013%20RGS%20-%20DRAFT%20-%20June%202013%20-%20FINAL.pdf>.
- D. Revelt and K. Train. Mixed logit with repeated choices: households' choices of appliance efficiency level. *Review of economics and statistics*, 80(4):647--657, 1998.
- A. A. Rogers. Public and expert preference divergence: Evidence from a choice experiment of marine reserves in australia. *Land Economics*, 89(2):346--370, 2013.
- J. Rose, A. Collins, M. Bliemer, and D. Hensher. Ngene 1.0 stated choice experiment design software. *University of Sydney*, 2009.
- J. M. Rose and M. C. Bliemer. Constructing efficient stated choice experimental designs. *Transport Reviews*, 29(5):587--617, 2009.
- P. R. Rosenbaum and D. B. Rubin. The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1):41--55, 1983.
- P. R. Rosenbaum and D. B. Rubin. Reducing bias in observational studies using subclassification on the propensity score. *Journal of the American statistical Association*, 79(387):516--524, 1984.
- P. Rossi and G. Allenby. A new approach to estimating household parameters. *Journal of Marketing Research*, 20:329--340, 1993.
- J. Rubin, G. Helfand, and J. Loomis. A benefit-cost analysis of the northern spotted owl. *Journal of forestry (USA)*, 1991.
- B. Ruhnau. Eigenvector-centrality a node-centrality? *Social networks*, 22(4):357--365, 2000.

- M. Sagoff. *The economy of the earth: Philosophy, law, and the environment*. Cambridge University Press, 1988.
- M. Sagoff. Aggregation and deliberation in valuing environmental public goods:: A look beyond contingent pricing. *Ecological Economics*, 24(2):213--230, 1998.
- L. Samuelson. Information-based relative consumption effects. *Econometrica*, 72(1):93--118, 2004.
- Z. Sandor and M. Wedel. Designing conjoint choice experiments using managers prior beliefs. *Journal of Marketing Research*, 38(4):430--444, 2001.
- M. Schaafsma, R. Brouwer, A. Gilbert, J. van den Bergh, and A. Wagtendonk. Estimation of distance-decay functions to account for substitution and spatial heterogeneity in stated preference research. *Land Economics*, 89(3):514--537, 2013.
- D. A. Schkade and J. W. Payne. How people respond to contingent valuation questions: a verbal protocol analysis of willingness to pay for an environmental regulation. *Journal of Environmental Economics and Management*, 26(1):88--109, 1994.
- S. S. Scholte, A. J. van Teeffelen, and P. H. Verburg. Integrating socio-cultural perspectives into ecosystem service valuation: A review of concepts and methods. *Ecological Economics*, 114:67--78, 2015.
- N. Schulz, G. Breustedt, and U. Latacz-Lohmann. Assessing farmers' willingness to accept greening: Insights from a discrete choice experiment in germany. *Journal of agricultural economics*, 65(1):26--48, 2014.
- H. Schuman. *The sensitivity of cv outcomes to cv survey methods*, 1996.
- J. Scott. Social network analysis: developments, advances, and prospects. *Social network analysis and mining*, 1(1):21--26, 2011.
- J. Serpell. *In the company of animals: A study of human-animal relationships*. Cambridge University Press, 1996.
- B. G. Shepherd. A case history: the kokanee stocks of okanagan lake. In *Proceedings of a Conference on the Biology and Management of Species and Habitats at Risk, Kamloops, BC*, volume 15, page 19, 1999.

- C. L. Spash. Contingent valuation design and data treatment: If you can't shoot the messenger, change the message. *Environment and planning. C, Government & policy*, 26(1):34, 2008.
- C. L. Spash and N. Hanley. Preferences, information and biodiversity preservation. *Ecological economics*, 12(3):191--208, 1995.
- L. StataCorp. *Stata base reference manual*, volume 2. Citeseer, 2005.
- L. StataCorp et al. teffects psmatch propensity-score matching. *Special Edition Release*, 13, 2013.
- K. Stone, M. Bhat, R. Bhatta, and A. Mathews. Factors influencing community participation in mangroves restoration: A contingent valuation analysis. *Ocean & Coastal Management*, 51(6):476--484, 2008.
- P. R. Stopher. Captivity and choice in travel-behavior models. *Transportation engineering journal of the American Society of Civil Engineers*, 106(4):427--435, 1980.
- D. J. Street, L. Burgess, and J. J. Louviere. Quick and easy choice sets: constructing optimal and nearly optimal stated choice experiments. *International Journal of Research in Marketing*, 22(4):459--470, 2005.
- J. Street, K. Duszynski, S. Krawczyk, and A. Braunack-Mayer. The use of citizens' juries in health policy decision-making: a systematic review. *Social Science & Medicine*, 109:1--9, 2014.
- J. Struben and J. D. Sterman. Transition challenges for alternative fuel vehicle and transportation systems. *Environment and Planning B: Planning and Design*, 35(6):1070--1097, 2008.
- B. E. Stumborg, K. A. Baerenklau, and R. C. Bishop. Nonpoint source pollution and present values: A contingent valuation study of lake mendota. *Review of Agricultural Economics*, 23(1):120--132, 2001.
- J. Swait and M. Ben-Akiva. Incorporating random constraints in discrete models of choice set generation. *Transportation Research Part B: Methodological*, 21(2):91--102, 1987.

- M. Thiene, R. Scarpa, and J. J. Louviere. Addressing preference heterogeneity, multiple scales and attribute attendance with a correlated finite mixing model of tap water choice. *Environmental and Resource Economics*, pages 1--20, 2014.
- K. Train and M. Weeks. *Discrete choice models in preference space and willingness-to-pay space*. Springer, 2005.
- K. E. Train. *Discrete choice methods with simulation*. Cambridge university press, 2009.
- M. Tran. Agent-behaviour and network influence on energy innovation diffusion. *Communications in Nonlinear Science and Numerical Simulation*, 17(9):3682--3695, 2012.
- K. C. Urama and I. Hodge. Participatory environmental education and willingness to pay for river basin management: Empirical evidence from nigeria. *Land Economics*, 82(4):542--561, 2006.
- G. Van Houtven, J. Powers, and S. K. Pattanayak. Valuing water quality improvements in the united states using meta-analysis: Is the glass half-full or half-empty for national policy analysis? *Resource and Energy Economics*, 29(3):206--228, 2007.
- A. Vargas, A. Y. Lo, N. Rohde, and M. Howes. Background inequality and differential participation in deliberative valuation: Lessons from small-group discussions on forest conservation in colombia. *Ecological Economics*, 129:104--111, 2016.
- J. K. Vermunt and J. Magidson. Latent gold® choice 4.0 user's manual. *Statistical Innovations Inc., Belmont, MA*, 2005.
- H. Ward. Citizens' juries and valuing the environment: A proposal. *Environmental Politics*, 8(2):75--96, 1999.
- S. Wasserman and K. Faust. Social network analysis: Methods and applications (structural analysis in the social sciences) author: Stanley wasserman. 1994.
- D. J. Watts. Networks, dynamics, and the small-world phenomenon 1. *American Journal of sociology*, 105(2):493--527, 1999.
- D. J. Watts and P. S. Dodds. Influentials, networks, and public opinion formation. *Journal of consumer research*, 34(4):441--458, 2007.

- D. J. Watts and S. H. Strogatz. Collective dynamics of small-world networks. *nature*, 393 (6684):440--442, 1998.
- R. Watts and A. Witham. Social network analysis of sustainable transportation organizations. Technical report, 2012.
- B. Wellman. Challenges in collecting personal network data: The nature of personal network analysis. *Field Methods*, 19(2):111--115, 2007.
- B. Wellman and S. D. Berkowitz. *Social structures: A network approach*, volume 2. CUP Archive, 1988.
- F. Wickelmaier. An introduction to mds. *Sound Quality Research Unit, Aalborg University, Denmark*, 46, 2003.
- Wikipedia. Okanagan, 2012. URL <https://en.wikipedia.org/wiki/Okanagan>.
- Wikipedia. Directed graph, 2016. URL https://en.wikipedia.org/wiki/Directed_graph#Indegree_and_outdegree.
- H. Williams and J. de Dios Ortuzar. Travel demand and response analysis some integrating themes. *Transportation Research Part A: General*, 16(5-6):345--362, 1982.
- M. A. Wilson and R. B. Howarth. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecological economics*, 41(3):431--443, 2002.
- B. Zhang, A. C. Thomas, P. Doreian, D. Krackhardt, and R. Krishnan. Contrasting multiple social network autocorrelations for binary outcomes, with applications to technology adoption. *ACM Transactions on Management Information Systems (TMIS)*, 3(4):18, 2013.
- X. Zhongmin, C. Guodong, Z. Zhiqiang, S. Zhiyong, and J. Loomis. Applying contingent valuation in china to measure the total economic value of restoring ecosystem services in ejina region. *Ecological Economics*, 44(2):345--358, 2003.
- D. J. Zizzo. Empirical evidence on interdependent preferences: nature or nurture? *Cambridge Journal of Economics*, 27(6):867--880, 2003.

APPENDIX A

DATA SUMMARY

TABLE A.1. Data Summary: Variables by Future Environmental Management Option Chosen

VARIABLE NAME	OPTION 1	OPTION 2	STATUS QUO	TOTAL
<i>Family size</i>				
<i>Child at Home</i>	325	276	149	750
<i>No Child/Left Home</i>	882	639	423	1,944
<i>Live in Group household/Sharing</i>	55	50	9	114
<i>Education</i>				
<i>Completed High School</i>	225	140	127	492
<i>Have Diploma/Attended</i>	493	340	246	1,079
<i>University Degree/Above</i>	544	485	208	1,237
<i>Income</i>				
<i>Low Income</i>	189	108	105	402
<i>Lower Middle Income</i>	465	338	223	1,026
<i>Upper Middle Income</i>	410	378	202	990
<i>High Income</i>	198	141	51	390
<i>Age</i>				
<i>Young</i>	56	47	23	126
<i>Low Middle Age</i>	195	169	128	492
<i>Upper Middle Age</i>	620	457	220	1,297
<i>Senior Age</i>	391	292	210	893
<i>Gender</i>				
Female	445	365	198	1,008
Male	817	600	383	1,800
<i>Dwelling Ownership</i>				
<i>Owned</i>	1,149	880	503	2,532
<i>Rented</i>	107	79	72	258
<i>Other</i>	6	6	6	18

TABLE A.2. Data Summary: Variables by Future Environmental Management Option Chosen

VARIABLE NAME	OPTION 1	OPTION 2	STATUS QUO	TOTAL
<i>Property taxes(House rent)</i>				
<i>Solely</i>	41	49	18	108
<i>Jointly</i>	1,062	803	487	2,352
<i>Pressure Before Survey</i>				
<i>Not aware</i>	205	117	116	438
<i>Aware</i>	1,057	848	465	2,370
<i>Past 6 Months read remember</i>				
<i>Not Aware</i>	101	83	68	252
<i>Aware</i>	743	587	320	1,650
<i>Very Aware</i>	418	295	193	906
<i>Shoreline Disturbed</i>				
<i>Very Disturbed</i>	611	495	298	1,404
<i>Disturbed</i>	413	294	205	912
<i>Undisturbed</i>	238	176	78	492
<i>Share of the original wetlands</i>				
<i>Almost No Original</i>	873	700	413	1,986
<i>Few Original</i>	324	223	148	695
<i>More Original</i>	65	42	20	127
<i>% Rely on Groundwater</i>				
<i>Few Depend on</i>	547	466	270	1,283
<i>More Depend on</i>	293	208	129	630
<i>Almost all depend on</i>	422	291	182	895
<i>Share of jobs in Tourism</i>				
<i>Few Jobs</i>	194	146	85	425
<i>Many Jobs</i>	790	643	398	1,831
<i>Almost All Jobs</i>	278	176	98	552
<i>Impact of Development and growth</i>				
<i>Negative</i>	569	498	206	1,273
<i>Neutral</i>	145	92	92	329
<i>No Impact (Positive)</i>	548	375	283	1,206
<i>If Member of First Nation</i>				
<i>No</i>	1,248	955	581	2,784
<i>Yes</i>	14	10	0	24
<i>Involved in Environmental Con.</i>				
<i>No</i>	1,205	913	528	2,646
<i>Yes</i>	57	52	53	162

TABLE A.3. Data Summary: Variables by Future Environmental Management Option Chosen

VARIABLE NAME		Alternative Chosen			Total Res.	Mean	Std Dev
		OPTION 1	OPTION 2	STATUS QUO			
Family size	Child at Home	325 43.3%	276 36.8%	149 19.9%	750	1.7653	0.76007
	Group household	55 48.2%	50 43.9%	9 7.9%	114	1.5965	0.63412
	No Child	882 45.4%	639 32.9%	423 21.8%	1944	1.7639	0.78477
Education	Comp.HS/Below	225 45.7%	140 28.5%	127 25.8%	492	1.8008	0.82289
	Have Diploma/Univ	493 45.7%	340 31.5%	246 22.8%	1079	1.7711	0.79566
	Uni.Degree/Above	544 44.0%	485 39.2%	208 16.8%	1237	1.7284	0.73115
Income Group	High Income	198 50.8%	141 36.2%	51 13.1%	390	1.6231	0.70545
	Low Income	189 47.0%	108 26.9%	105 26.1%	402	1.791	0.8303
	Lower Middle Inc	465 45.3%	338 32.9%	223 21.7%	1026	1.7641	0.78456
	Upper Middle Income	410 41.4%	378 38.2%	202 20.4%	990	1.7899	0.75804
Age Group	Low Middle Age	195 39.6%	169 34.3%	128 26.0%	492	1.8638	0.79954
	Senior Age	391 43.8%	292 32.7%	210 23.5%	893	1.7973	0.79539
	Upper Middle Age	620 47.8%	457 35.2%	220 17.0%	1297	1.6916	0.74361
Gender	Young	56 44.4%	47 37.3%	23 18.3%	126	1.7381	0.75024
	Female	445 44.10%	365 36.20%	198 19.60%	1008	1.76	0.76
Prop.ownership	Male	817 45.40%	600 33.30%	383 21.30%	1800	1.76	0.78
	Owned	1149 45.4%	880 34.8%	503 19.9%	2532	1.74	0.77
	Rented	107 41.5%	79 30.6%	72 27.9%	258	1.86	0.82
Property tax	Other	6 33.3%	6 33.3%	6 33.3%	18	2.00	0.84
	No	41 38.00%	49 45.40%	18 16.70%	108	1.79	0.71
	Yes	1062 45.20%	803 34.10%	487 20.70%	2352	1.76	0.77

TABLE A.4. Data Summary: A priori Environmental Perception by Alternative Chosen

VARIABLE NAME		Alternative Chosen			Total Responses
		OPTION 1	OPTION 2	STATUS QUO	
Environmental Awareness 1	Not Aware	205 46.8%	117 26.7%	116 26.5%	438
	Aware	1057 44.6%	848 35.8%	465 19.6%	
Environmental Awareness 2	Aware	743 45.0%	587 35.6%	320 19.4%	1650
	Not Aware	101 40.1%	83 32.9%	68 27.0%	
	Very Aware	418 46.1%	295 32.6%	193 21.3%	906
	Disturbed	413 45.3%	294 32.2%	205 22.5%	
Environmental Awareness 3	Undisturbed	238 48.4%	176 35.8%	78 15.9%	492
	Very Disturbed	611 43.5%	495 35.3%	298 21.2%	
	Few Original	324 46.6%	223 32.1%	148 21.3%	695
Environmental Awareness 4	Almost No Original	873 44.0%	700 35.2%	413 20.8%	
	More Original	65 51.2%	42 33.1%	20 15.7%	127
	More Depend	293 46.5%	208 33.0%	129 20.5%	
Environmental Awareness 5	Almost All Depend	422 47.2%	291 32.5%	182 20.3%	895
	Few Depend	547 42.6%	466 36.3%	270 21.0%	
	Almost All Jobs	278 50.4%	176 31.9%	98 17.8%	552
Environmental Awareness 6	Few Jobs	194 45.6%	146 34.4%	85 20.0%	
	Many Jobs	790 43.1%	643 35.1%	398 21.7%	
	Negative	569 44.7%	498 39.1%	206 16.2%	1273
Environmental Awareness 7	Neutral	145 44.1%	92 28.0%	92 28.0%	
	No Impact (Positive)	548 45.4%	375 31.1%	283 23.5%	1206

TABLE A.5. Partial Data List

Participant.ID	Alt.	Alternative Chosen	Groundwater	Aquatic Health	Habitat Loss	Rural Density	Levy
7	STATUS QUO	0	High use	Low return	High Loss	Above Average Density	0
7	OPTION 1	1	Low use	High return	High Loss	Below Average Density	40
7	OPTION 2	0	High use	Low return	Low Loss	Below Average Density	20
7	STATUS QUO	0	High use	Low return	High Loss	Above Average Density	0
7	OPTION 1	0	Low use	Low return	Low Loss	Above Average Density	20
7	OPTION 2	1	High use	High return	High Loss	Below Average Density	40
7	STATUS QUO	0	High use	Low return	High Loss	Above Average Density	0
7	OPTION 1	1	Moderate	Medium return	Low Loss	Above Average Density	40
7	OPTION 2	0	Moderate	Medium return	High Loss	Above Average Density	20
7	STATUS QUO	0	High use	Low return	High Loss	Above Average Density	0
7	OPTION 1	0	Moderate	High return	Medium Loss	Above Average Density	40
7	OPTION 2	1	Moderate	Low return	Medium Loss	Above Average Density	20
7	STATUS QUO	0	High	Low return	High Loss	Above Average Density	0
7	OPTION 1	1	High	Medium return	High Loss	Below Average Density	20
7	OPTION 2	0	Low use	Medium return	Low Loss	Below Average Density	40
7	STATUS QUO	0	High use	Low return	High Loss	Above Average Density	0
7	OPTION 1	1	High	High return	High Loss	Above Average Density	20
7	OPTION 2	0	Low	Low return	Low Loss	Below Average Density	40

APPENDIX B

QUESTIONNAIRE

B.1. INTRODUCTION

Thank you for participating in our survey. Your household was randomly selected from a list of Central Okanagan addresses we collected using directories available on the internet.

Continuing growth and development is placing increasing pressure on environmental resources, such as ground water, aquatic habitats, natural habitats and rural landscape. These resources provide environmental services that can easily be taken for granted and ignored. Our choices as a community about how growth and development happens in the Okanagan reflects the value we place on these environmental resources and services. By completing this survey, you will help us understand the balance between development and environmental protection that you and other Central Okanagan residents would like to see.

The survey should take about 30 minutes to complete. As thanks for your effort, we will draw five names from among those who complete the survey and send them a \$250.00 prize. We do not expect more than 600 people to complete the survey.

You will also be invited to participate in a shorter version of this survey in about a month. If you complete the second survey, your name will be entered into the draw a second time. All prizes will be drawn after the second round of the survey is complete.

B.2. ABOUT THIS SURVEY

This survey has four parts:

1. **Information on environmental resources:** we give you some information about environmental resources and the services they provide in the Okanagan.
2. **Your choices:** we ask you to choose among alternative future levels of environmental resources.
3. **Your community:** we ask you questions about the people you talk to about environmental issues.

4. **Follow up** : we ask some qualifying questions about the choices you have made and some details about yourself.

B.3. PART ONE: BACKGROUND

Environmental resources and the services they provide are important in the Okanagan. Some examples include:

- Large valley bottom lakes create recreation and tourism opportunities (boating, fishing, etc.).
- Natural areas along lake shores, streams, and wetlands provide habitat for fish and wildlife, help improve water quality and reduce erosion.
- 48 of the 1,597 identified species at risk in British Columbia are found only in the Okanagan.

These environmental resources are vulnerable to a range of pressures from ongoing growth and development. These include shoreline modification, increasing use of surface and groundwater, invasion by non-native species, land development, and overuse.

B.4. YOUR VIEWS ABOUT THE OKANAGAN ENVIRONMENT

1. Before receiving this survey, were you aware of the pressures on environmental resources in the Okanagan?

- No.
- Yes.

2. In the past 6 months how often can you remember having heard or read about environmental issues in the Okanagan?

- None.
- One or two times.
- Three or four times
- Five or six times.
- Seven or more times.

3. What share of the shoreline around the major valley lakes do you think is undisturbed?

- Less than 10%.
- 10-25%.
- 25-40%.
- 40-60%.
- 60-75%.
- 75-90%.
- Do not know.

4. What share of the original wetlands in the Okanagan remain?

- Less than 10%.
- 10-25%.
- 25-40%.
- 40-60%.
- 60-75%.
- 75-90%.
- More than 90%.

5. What share of Okanagan households rely on groundwater (own wells or from water utilities)?

- Less than 10%.
- 10-25%.
- 25-40%.
- 40-60%.
- 60-75%.
- 75-90%.
- More than 90%.

6. What share of jobs in the Okanagan are in tourism and related sectors?

- Less than 10%.
- 10-25%.
- 25-40%.
- 40-60%.
- 60-75%.
- 75-90%.
- Do not know.

B.5. HOW ENVIRONMENTAL RESOURCES HAVE BEEN CHANGING

Growth and development have transformed the Okanagan environment. Changes include:

- Groundwater use: Groundwater is a growing source of water for both private households and water utilities.
- Aquatic species: Between 1973 and 2010, the shore-spawning Kokanee population had decreased by 90
- Natural habitats: Natural habitats, including wetlands, grasslands, and forests have been extensively modified, particularly on the valley floor.
- Rural character: Rural areas and communities have attracted many new residents and been losing their 'country' character.

7. Development and growth has led to large reductions in natural habitats.

These changes have also brought jobs and improved the standard of living for Okanagan residents. In your opinion, these changes have been:

- Very bad.
- Generally Negative.
- Weakly Negative.
- Neutral.
- Weakly positive.
- Generally positive.

- Very good.
- Do not know.

B.6. MANAGEMENT OPTIONS

There are a variety of ways to balance the demands for development with the environmental impacts. These include:

- Undertaking research to better understand our impacts on the environment and identify protection strategies.
- Modify provincial regulations to control groundwater pumping and potential contamination sources.
- Invest in better monitoring of water quality, habitat health, groundwater levels, etc.
- Strengthen regulations and increase enforcement to limit development on agricultural and rural lands.
- Pursue covenants, incentives, and other voluntary arrangements with property owners to protect sensitive habitats and rural character.
- Acquire land having important habitats and/or provides recreational opportunities.
- Tightly enforce official community plans and zoning to limit development that harms the environment and/or changes rural character.

Over the coming 30 years, the future condition will depend on which of the additional management actions/tools are used, how much and how often the actions/tools are taken, how they are combined and when it is started.

B.7. PAYING FOR IT

Balancing growth and development while protecting the environment also means weighing the value of protecting the environment against how much money your household will have to pay for its protection. Moreover, any method of payment chosen will reduce the amount of money that your household has available to spend each year on other things.

Special levies on property have been used in many jurisdictions to raise money for specific projects. For example, the *H₂O* aquatic center in Kelowna was funded in part by a levy on Kelowna properties of about \$0.21 per \$1,000 value for twenty years, and ongoing activities to control Eurasian Milfoil in valley lakes is one of the things paid for by a \$0.057 per \$1,000 collected for Okanagan Basin watershed issues. This last levy has been adjusted as needed, being \$0.21 per \$1,000 in the 70's, when valley waste water collection and treatment systems needed upgrades to protect Okanagan Lake water quality. In the 70's, community leaders in the Okanagan also opted to use a levy on all properties in the Okanagan basin to fund waste water treatment upgrades, upgrades that have successfully improved lake water quality.

In the scenarios that follow, we are proposing two different increases in a special levy on property values, with the monies collected directed to achieving the environmental changes described. These increases are \$0.05 per \$1000 and \$0.10 per \$1000. Per property, the average additional charge would be about \$20 or \$40 per year. This levy will be in effect starting 2015 and continuing into the future for 30 years.

B.8. PART TWO: COMPARING OUTCOMES/YOUR CHOICE

Like grades on a report card, indicators are often used to assess how we are balancing development and growth with environmental protection. In what follows we will describe several indicators that are related to different important environmental resources.

B.9. MANAGEMENT SCENARIOS

Question 8 is an example of several scenario combinations we would like you to compare. Each scenario combination contains the status quo, option 1 and option 2.

The status quo reflects how we expect the indicators to change if no special policy choices are made. There will also be no additional costs that your household will have to pay. Options 1 and 2 offer improvements in some or all of the indicators, but also involve






	ATTRIBUTE DESCRIPTION
<p>Share of Total Water Use from Groundwater</p> 	<p>GROUND WATER USE: Groundwater is an important source of water we use and supports springs and wetlands that are important natural habitats. Increasing ground water use threatens these habitats. Most surface sources in the Okanagan are fully allocated. Increasing the share of total use from groundwater also reflects an increase in overall water use and in the amount of groundwater used.</p>
<p>Count of Spawning Kokanee Salmon</p> 	<p>AQUATIC HABITAT HEALTH : Aquatic health is threatened by shoreline development, invasive species pollution, etc. Species such as Kokanee salmon are sensitive to the overall health of the aquatic environment. Since the 70's, spawning Kokanee numbers in Okanagan lake have fallen from over 1 million to about 40,000.</p>
<p>Sensitive Ecosystem Area Lost</p> 	<p>NATURAL HABITATS: Natural habitats, such as wetlands, forests, natural grasslands, etc. provide a range of environmental goods and services. These environmental resources and services are largely lost if the land is developed.</p>
<p>Population Density in Rural Areas</p> 	<p>RURAL CHARACTER: Rural areas have a unique character that reflects their history and close ties to the land. Increasing development and population growth in rural areas increases traffic, reduces the amount of open space, increases conflict between farmers and non-farm residents, and impacts natural habitats.</p>
<p>Special Property Levy</p> 	<p>COST: The tools that can reduce groundwater use, improve aquatic health, limit loss of natural habitats and reduce population growth in rural areas do have a cost. However they are paid, they will leave your household with less money to spend each year.</p>

FIGURE B.1. Attributes and Indicators Description

a cost to your household. The number of images in each box shows the direction of the change.












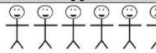



In the example below, option 1 has half as large an increase in groundwater use, 10,000 additional Kokanee spawning returns, and 5,000 less hectares of sensitive habitat lost. The

number of people living in rural areas is no different from the status quo, and your household will face a special property levy of \$0.05 per \$1000 in property value, or about \$20 per year for a \$400,000 house, for 30 years.

Option 2 has the same increase in groundwater pumping and loss of sensitive habitat as for the status quo. However there are 20,000 additional Kokanee spawning returns and a lower rural population density. Achieving these changes will be paid for by a special levy of \$0.10 per \$1000, or for a \$400,000 house, about \$40 per year for 30 years.

In the following pages, we will give you a number of scenario combinations like this example, except with different combinations of changes. We would like you to compare each of the two options with each other and with the status quo. If the improvements in the environmental indicators are, in your opinion, worth the cost of the special levy, select the option that you think is the best value. If you do not think that the improvements justify the cost, then choose the status quo.

8. Please choose the future you like best. Remember that if you choose a future other than the status quo, your household will have less money to spend each year.

Choice Card-Example			
ATTRIBUTE (Indicator)	STATUS QUO	OPTION 1	OPTION 2
Share:	20%	10%	20%
GROUND WATER USE (Share of total water use from groundwater)			
Returns:	40,000	50,000	60,000
AQUATIC HABITAT HEALTH (Count of spawning Kokanee Salmon)			
Loss:	100 km²	50 km²	100 km²
NATURAL HABITATS (Sensitive Ecosystem Area Lost)			
Density:	75 ppl/km²	75 ppl/km²	60 ppl/km²
RURAL CHARACTER (population density in rural areas)			
Levy:	\$0.00	\$0.05 per \$1000	\$0.10 per \$1000
COST (Special Property Levy)	 \$0.00	 \$20 on \$400,000 house	 \$40 on \$400,000 house
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your preferred option without status quo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In Q9-Q14, you will see: A future for the Central Okanagan in 2040 that could occur if no new tools are used to manage growth and development.

Two possible futures that could occur if some new tools are used. The reduction in the amount of money that your household will have to spend each year is also shown with each possible future.

Each of the next six questions offers different combinations of the two futures possible if new tools are used. For these six questions, you choose that future, either the status quo, where no new tools are used, or one of the two other possible futures, which you like best. Remember that if you choose a future other than the status quo, your household will have less money to spend each year.

9. Please choose the future you like best. Remember that if you choose a future other than the status quo, your household will have less money to spend each year.

Choice Card 1.1




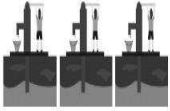
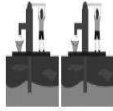
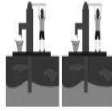



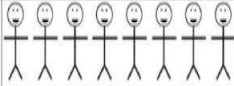
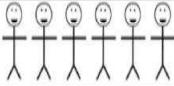
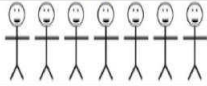




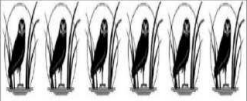

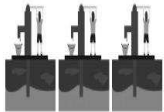
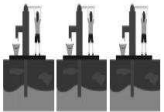




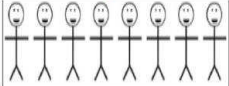
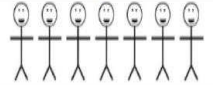
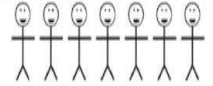



ENVIRONMENTAL RESOURCES INDICATOR	STATUS QUO	OPTION 1	OPTION 2
Returns:	40,000	50,000	50,000
AQUATIC HABITAT HEALTH (Count of spawning Kokanee Salmon)			
Share:	20%	15%	15%
GROUND WATER USE (Share of total water use from groundwater)			
Loss:	100 km ²	100 km ²	0 km ²
NATURAL HABITATS (Sensitive Ecosystem Area Lost)			
Density:	75 ppl/km ²	60 ppl/km ²	70 ppl/km ²
RURAL CHARACTER (population density in rural areas)			
Levy:	\$0.00	\$0.05 per \$1000	\$0.10 per \$1000
COST (Special Property Levy)	 \$0.00	 \$20 on \$400,000 house	 \$40 on \$400,000 house
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your preferred option without status quo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

FIGURE B.2. Choice Card-1.1


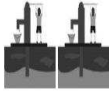
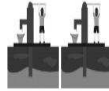






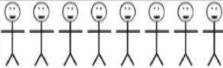
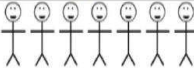
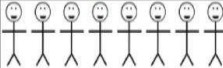



10. Please choose the future you like best. Remember that if you choose a future other than the status quo, your household will have less money to spend each year.

Choice Card 1.2

ENVIRONMENTAL RESOURCES INDICATOR	STATUS QUO	OPTION 1	OPTION 2
Loss:	100 km ²	0 km ²	100 km ²
NATURAL HABITATS <small>(Sensitive Ecosystem Area Lost)</small>			
Share:	20%	20%	10%
GROUND WATER USE <small>(Share of total water use from groundwater)</small>			
Returns:	40,000	40,000	60,000
AQUATIC HABITAT HEALTH <small>(Count of spawning Kokanee Salmon)</small>			
Density:	75 ppl/km ²	70 ppl/km ²	70 ppl/km ²
RURAL CHARACTER <small>(population density in rural areas)</small>			
Levy:	\$0.00	\$0.10 per \$1000	\$0.05 per \$1000
COST <small>(Special Property Levy)</small>	 \$0.00	 \$40 on \$400,000 house	 \$20 on \$400,000 house
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your preferred option without status quo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

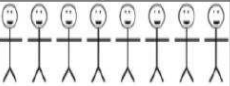
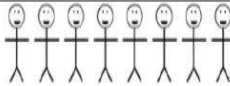
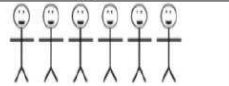
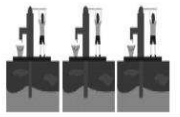

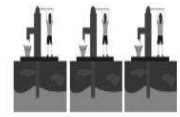





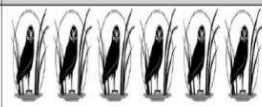



11. Please choose the future you like best. Remember that if you choose a future other than the status quo, your household will have less money to spend each year.

Choice Card 1.3

ENVIRONMENTAL RESOURCES INDICATOR	STATUS QUO	OPTION 1	OPTION 2
Share:	20%	15%	15%
GROUND WATER USE (Share of total water use from groundwater)			
Returns:	40,000	60,000	40,000
AQUATIC HABITAT HEALTH (Count of spawning Kokanee Salmon)			
Loss:	100 km²	50 km²	50 km²
NATURAL HABITATS (Sensitive Ecosystem Area Lost)			
Density:	75 ppl/km²	70 ppl/km²	75 ppl/km²
RURAL CHARACTER (population density in rural areas)			
Levy:	\$0.00	\$0.10 per \$1000	\$0.05 per \$1000
COST (Special Property Levy)	 \$0.00	 \$40 on \$400,000 house	 \$20 on \$400,000 house
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your preferred option without status quo		<input type="radio"/>	<input type="radio"/>

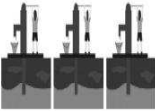
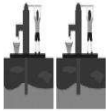
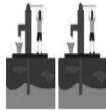






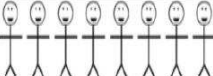
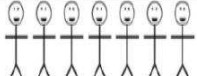
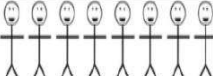



12. Please choose the future you like best. Remember that if you choose a future other than the status quo, your household will have less money to spend each year.

Choice Card 1.4

ENVIRONMENTAL RESOURCES INDICATOR	STATUS QUO	OPTION 1	OPTION 2
Density:	75 ppl/km²	75 ppl/km²	60 ppl/km²
RURAL CHARACTER (population density in rural areas)			
Share:	20%	10%	20%
GROUND WATER USE (Share of total water use from groundwater)			
Returns:	40,000	50,000	50,000
AQUATIC HABITAT HEALTH (Count of spawning Kokanee Salmon)			
Loss:	100 km²	100 km²	0 km²
NATURAL HABITATS (Sensitive Ecosystem Area Lost)			
Levy:	\$0.00	\$0.10 per \$1000	\$0.05 per \$1000
COST (Special Property Levy)	 \$0.00	 \$40 on \$400,000 house	 \$20 on \$400,000 house
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your preferred option without status quo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. Please choose the future you like best. Remember that if you choose a future other than the status quo, your household will have less money to spend each year.

Choice Card 1.5




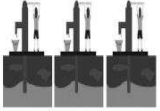
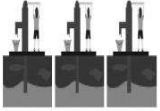




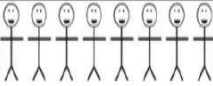
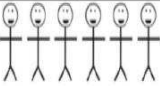
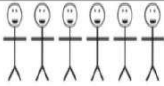



ENVIRONMENTAL RESOURCES INDICATOR	STATUS QUO	OPTION 1	OPTION 2
Share:	20%	15%	15%
GROUND WATER USE <small>(Share of total water use from groundwater)</small>			
Returns:	40,000	50,000	50,000
AQUATIC HABITAT HEALTH <small>(Count of spawning Kokanee Salmon)</small>			
Loss:	100 km ²	50 km ²	50 km ²
NATURAL HABITATS <small>(Sensitive Ecosystem Area Lost)</small>			
Density:	75 ppl/km ²	70 ppl/km ²	75 ppl/km ²
RURAL CHARACTER <small>(population density in rural area)</small>			
Levy:	\$0.00	\$0.10 per \$1000	\$0.05 per \$1000
COST <small>(Special Property Levy)</small>	 \$0.00	 \$40 on \$400,000 house	 \$20 on \$400,000 house
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your preferred option without status quo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. Please choose the future you like best. Remember that if you choose a future other than the status quo, your household will have less money to spend each year.

B.10. FOLLOW UP

The following questions gather some further information about your choices. This information will help us to see whether people who give similar answers to the above questions are also similar in other respects. Please keep in mind that all the information

Choice Card 1.6

ENVIRONMENTAL RESOURCES INDICATOR	STATUS QUO	OPTION 1	OPTION 2
Loss:	100 km²	0 km²	100 km²
NATURAL HABITATS (Sensitive Ecosystem Area Lost)			
Share:	20%	20%	10%
GROUND WATER USE (Share of total water use from groundwater)			
Returns:	40,000	60,000	40,000
AQUATIC HABITAT HEALTH (Count of spawning Kokanee Salmon)			
Density:	75 ppl/km²	60 ppl/km²	60 ppl/km²
RURAL CHARACTER (population density in rural areas)			
Levy:	\$0.00	\$0.10 per \$1000	\$0.05 per \$1000
COST (Special Property Levy)	 \$0.00	 \$40 on \$400,000 house	 \$20 on \$400,000 house
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your preferred option without status quo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

provided here will be kept in the strictest confidence, and nothing will be released which can tie back to you and the specific answers you provide.

15. Which of the following statements most closely describes the main reason(s) why you chose Status Quo, if you did (Please tick all that apply).

- I do not use any of the environmental resources described here?
- I do not particularly care about the environmental resources management outcomes.

- I would like to see some improvement in the condition of resources but I do not have the money to make a payment.
- I already pay enough in taxes and charges.
- I do not think I should be the one paying for any additional management actions.
- It is too long before we would see any changes in the environmental resources.
- The additional management action options did not make sense to me.
- I found making the choices too confusing, so I always chose the existing actions option.
- I think the Government should pay for the initiatives using existing revenues.
- Other [please specify].

B.11. PART THREE: YOUR COMMUNITY/NETWORK

You may talk with other people about how growth and development are impacting the environment in the Okanagan. Sometimes we talk with others to learn more about issues like these. At other times we look for people whose opinions are similar to ours, to share our feelings about these issues. We would like you to tell us a little bit about the people you have recently talked to about how growth and development are affecting the environment in the Okanagan.

Understanding how our conversations with other people can help us find the right balance between development and environmental protection is an important part of our research. We will not be using the information you provide to contact anyone, nor will any information about who you talk to be made available to anyone outside of our research team. Further, we only want initials for those you identify, and those initials are used only to help you answer questions that come up later in the survey.

16. NAME GENERATOR: During the last six months, who have you talked with about how growth and development are impacting the environment in the Central Okanagan? The initials you provide below will be used

as part of questions later in this survey. Please ensure that each set of initials is unique.

Name Generator

	INITIALS	GENDER	EDUCATION (YOUR BEST GUESS IF NOT SURE)	INCOME (YOUR BEST GUESS IF NOT SURE)	PHYSICAL DISTANCE FROM YOUR HOUSE (KM) (YOUR BEST GUESS IF NOT SURE)
1.	<input type="text"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text"/>
2.	<input type="text"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text"/>
3.	<input type="text"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text"/>
4.	<input type="text"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text"/>
5.	<input type="text"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text" value="v"/>	<input type="text"/>

17. **NAME INTERPRETER:** How close (familiar) are you with these people?
Choose “very close (very familiar)”, “close (familiar)” or “Acquaintance”
for each of the people you have identified.

Name Interpreter

	INITIALS	Very Close	Close	Acquaintance
1.	<input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	<input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. **CONTACT BETWEEN/AMONG YOUR CONTACTS:** Please think about the relations between the people you just mentioned. Are they very close (very familiar) to one another, close (familiar) to each other or strangers in the sense that they would not recognize one another if they met on the street. For each row in the table below, please select as “Very close (very familiar)(VC)”, “Close (familiar)(C)”, “Stranger (S)” to indicate how familiar the person named in the row is with the person named in the column. While in many cases we expect the familiarity to be the same in both directions, it is possible that the familiarity may not be the same in both directions.

Contact Between/Among Your Contacts

	INITIALS					
1.			▼	▼	▼	▼
2.		▼		▼	▼	▼
3.		▼	▼		▼	▼
4.		▼	▼	▼		▼
5.		▼	▼	▼	▼	

19. **FREQUENCY OF CONTACT:** On average, how often do you talk with the people you have identified (Text, Twitter, Facebook, Visit, Phone, Email or write)?

20. **LENGTH OF TIME YOU HAVE KNOWN EACH OTHER:** How long have you known these people?

Frequency of Contact

	INITIALS	Daily /Almost daily	At least once/week	At least once/month	3 to 4 times/year	Approx. once/year	Less than once/year	Do not know
1.		○	○	○	○	○	○	○
2.		○	○	○	○	○	○	○
3.		○	○	○	○	○	○	○
4.		○	○	○	○	○	○	○
5.		○	○	○	○	○	○	○

Length of Time You have Known Each Other

	INITIALS	Less than a year	One to three years	Three to six years	Six to Nine years	More than Nine	Do not know
1.		○	○	○	○	○	○
2.		○	○	○	○	○	○
3.		○	○	○	○	○	○
4.		○	○	○	○	○	○
5.		○	○	○	○	○	○

21. REASON OF CONNECTION: Below are some of the ways in which people are connected to each other. Some people can be connected to you in more than one way. For example, a man could be your brother and he could belong to your place of worship and work with you. Please select all that describe your connection with the people you have identified.

Reason of Connection

	INITIALS	Family	Co-worker	Co-member(Environmental club, golf club, volunteer club, etc.)	Neighbour	Friend	Advisor	Other	Do not know
1.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

22. POLITICAL AFFILIATION: What is the political affiliation of your contact? (Your best guess if not sure)

Political Affiliation

	INITIALS	Left	Right	Independent	Refused	Do not know
1.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23. WHAT PEOPLE TALK ABOUT: Below are some environmental topics that people talk about. Over the last six months, which environmental issues can you recall coming up in your conversations? Please tick all that apply.

- Ground water supply.
- Rural landscapes.
- Water quality/quantity.
- Climate change.
- Invasive species.
- Natural foreshore.
- Park visits.
- Bird watching.
- Hunting.
- Fishing.
- Health and environment.
- The Economy and environment.
- Politics (Election) and environment.
- Lake side activities (e.g. picnics, walking).
- Other.
- Do not know.

B.12. PART FOUR: ABOUT THE INFORMATION PROVIDED

Thinking about the information given to you in this survey, please tell us the option that best describes how you found the survey.

24. For each of the following statements, please indicate whether you (1) Strongly agree, (2) Agree, (3) Somewhat agree, (4) Neutral (5) Somewhat disagree (6) Disagree or (7) Strongly disagree

About the Information Provided

	Strong Agree	Agree	Some Agree	Neutral	Some Disag	Disag	Strong Disag
I carefully read all of the information provided.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I understood all of the information provided.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was given enough information to make an informed decision.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I understood the description of the new management option outcomes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I understood the idea of making choices between alternative management outcomes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I thought that the alternative management outcomes described could be achieved by 2040.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It wasn't clear to me when the management outcomes described will happen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I thought that my choices will have an impact on decisions and actions that affect the condition of environmental goods in the Okanagan.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I thought that the environmental resources condition option that receives the greatest support will be implemented.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I thought that every household in Okanagan will have to pay for additional management actions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

B.13. WE WOULD LIKE TO KNOW MORE

25. We are recruiting candidates for four citizens' jury groups composed of about 10 people each. In these juries you will have the opportunity to talk with experts about some of the issues raised here, and to discuss these issues with other people who have also completed this survey. If you are chosen from among those who volunteer and participate in a group meeting, we will give you \$50 as thanks for your participation. We expect that the group meeting will take no more than two hours of your time. Are you willing to participate in one of the citizen juries?

- Yes
- No
- Please provide us with your name and phone number so that we can contact you if you are selected to participate. We will not use this information to contact

you for any other purpose, nor share your contact information with anyone else.
NAME/PHONE NUMBER

B.14. PART FIVE: ABOUT YOU

To better understand how your choices are different from the choices made by other people who have completed this survey, we would like to know some more information about you. We will not share your private information with anyone. Any results from our research will not contain anything that can identify you, and your responses will be combined with those of other people in such a way that individual answers are not available.

26. Are you jointly or solely responsible for paying property taxes or house rent?

- Yes
- No

27. How old are you?

- 19 - 24
- 30 - 34
- 35 - 39
- 40 - 44
- 45 - 49
- 50 - 54
- 55 - 59
- 60 - 64
- 65 - 69
- 70 - 74
- Greater than 75

28. Are you?

- Male.
- Female.

29. What is the highest level of education you completed?

- Didn't complete high school.
- Completed high school.
- Attended college/university
- Have a college diploma
- Have a university degree
- Attended university beyond first degree

30. Which one of the following best describes your household?

- Couple with children living at home.
- Couple with children who have left home.
- Couple with no children.
- Single parent with children living at home.
- Living alone.
- Group household/ Sharing with friends.

31. How many children live in your household? (Please write)

32. Is the dwelling you live in owned by you/your partner?

- Owned by you/your partner.
- Rented.
- Other.

33. How often do you undertake each of the following activities in the Okanagan, if at all? Please answer "Never" if you have never undertaken that activity in the Okanagan.

34. Have you had any formal or informal training in environmental sciences such as in the following disciplines?

- Ecology.
- Biology.
- Other related disciplines.

About the Information Provided

Activities	Never	Did this in years gone by, but not anymore	Roughly once a year	Roughly once every six months	Once a month	Once a week	More than once a week
Park visits	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bird Watching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boating, canoeing, or similar.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hunting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lakeside Activities (beach picnics, walking, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (specify if applicable)	<input style="width: 100%; height: 20px;" type="text"/>						

None of the above.

35. Are you professionally or voluntarily involved in environmental conservation or environmental management?

Yes.

No.

36. Are you a member of first nation?

Yes.

No.

37. What was your total household income last year (total income before tax and any deductions from all wages and salaries, pensions, allowances, and investment)?

Less than \$20,000

\$20,001 - 40,000

\$40,001 - 60,000

- \$60,001 - 80,000
- \$80,001 - 100,000
- \$100,001 - 125,000
- \$125,001 - 150,000
- \$150,001 - 200,000
- \$200,001 - 250,000
- More than \$250,000

Thank you for completing this survey. To be considered for the draw, please provide your contact information. This information will not be used to contact you for any reason beyond informing you that you have won the prize. The draw will take place after the second round of the survey is complete. The contact information you provide here will not be attached to the survey results, and will be removed once the draw is concluded.

1. Name

2. Address 1

3. Postal Code

38. If you have any additional comments you would like to make, please enter them below.

This survey is supervised by Dr. John Janmaat from the University of British Columbia with support and funding from Environment Canada, the Okanagan Basin Water Board,

and the Regional District of Central Okanagan. Our research results will be shared with planners and policy makers across all jurisdictions to assist them in choosing environmental protection and management policies. These results will not contain any information that will link you with the answers you provide in this survey. We do not anticipate any impact on you - positive or negative - as a result of completing this survey. While we hope you will complete the survey, you are under no obligation to do so.

All of the information you give us in this survey is strictly confidential and will be reported only in ways that ensure you remain anonymous. If you have any questions please contact:

Dr. John Janmaat

Regional Innovation Chair in Water Resources and Ecosystem Sustainability.

I.K. Barber School of Arts and Sciences

The University of British Columbia.

john.janmaat@ubc.ca, 250-807-8021.

APPENDIX C

LETTER OF INVITATION FOR PILOT TEST

39. Address

Date

Dear Sir or Madam,

We are developing a survey that will help us understand the value Okanagan residents place on the services provided by the environment. We would be grateful if you help us by completing a pilot test of our survey. Surveys are costly and time consuming to develop. If the survey is poorly designed and not tested, the results may be of little use. Your input will help us make the survey more clear and easy to understand, and thereby helping ensure that we are collecting high quality data. With your input, the results of this research will be more useful to those who make decisions that impact on our environment. We have embedded a number of questions about the survey into the survey itself. As you work through the survey, please bear the following in mind: Invited participants will be randomly drawn from a list of Central Okanagan addresses.

- Are the facts and descriptions clear?
- Is it easy to understand what the questions are asking?
- Are there questions you are uncomfortable with?
- Is there anything in the survey that would make you stop answering it?

To complete and comment on the online survey, please go to: <http://jjanmaat.research.ok.ubc.ca/> and enter the following information exactly as it appears here:

Postal Code: *V1Z 2T7*

Access Code: *22223A*

If you have any problem accessing the online survey or if you do not have internet access, but would still like to help with the pilot, please contact Dr. John Janmaat at 250-807-8021 or john.janmaat@ubc.ca. Note that the data obtained from this pilot will not be used for the analysis. However, your name will be included in the draw to win \$250.00 prize for completing this pilot survey.

Thank you,

APPENDIX D

PILOT TEST REMINDER

40. Address

Date

Dear Sir or Madam,

A couple of weeks ago we sent you a letter with an online link to a survey asking you to help us to test a survey. This survey will help us understand the value Okanagan residents place on the services provided by the environment. If you have completed the survey, we apologize for contacting you again and are thankful that you took the time to complete the survey.

If you have not completed the survey, we would be grateful if you took the time to help us. You should be able to complete the survey in 30 minutes or less. Your input will help make the survey easier to understand, and thereby help ensure that we collect high quality data. The results we generate will then more useful to those who make decisions impacting our environment. We know that it takes time and effort to complete our survey. As a reflection of our gratitude, if you complete the survey, your name will be entered into one of a number of draws for \$250. Here below is the link we sent you to complete or withdraw from the survey online. <http://jjanmaat.research.ok.ubc.ca/>; and enter the following information exactly as it appears here:

Postal Code: V1Z 2T7

Access Code: 22223A

If you wish to help us with pilot survey, but do not want to do so online, please call

Dr. Janmaat at 250-807-8021. We will then arrange a convenient time for you to complete the survey with our help over the phone.

For any questions about this research project, please feel free to contact Dr. John Janmaat at 250-807-8021 or by email at john.janmaat@ubc.ca.

Thank you,

APPENDIX E

INVITATION LETTER

Address 1

Date

Dear Okanagan resident,

We would like to invite you to participate in a survey to help us understand the value Okanagan residents place on the services provided by the environment. From a list of addresses we collected using directories available on the internet, you were randomly chosen to receive this invitation. As you may have noticed, regional economic growth, population growth, and climate change are placing pressure on environmental resources in the Okanagan. These environmental resources provide “services” that we may not be aware of or take for granted. Services like clean air and water, flood control, natural habitats and recreational opportunities. The path of development we choose affects the levels of these environmental services. This survey will help us understand how you and the other Okanagan residents feel about balancing development and environmental services. We know that it takes time and effort to complete our survey. Therefore, if we receive your completed survey, your name will be entered into one of a number of draws for \$250; one draw for each of the most recent 150-200 responses. A number of volunteers will also have the opportunity to participate in a group discussion about the issues in the survey, receiving a \$50 payment for their time. To complete or withdraw from the survey online, please visit:

<http://jjanmaat.research.ok.ubc.ca>

and enter the following information exactly as it appears here:

Postal Code: A1A 1A1

Access Code: 1111111

If you wish to help us with our research, but do not want to do so online, please put the enclosed postage paid card in the mail, or call Dr. Janmaat at 250-807-8021. We will then arrange a convenient time for you to complete the survey with our help over the phone.

For any questions about this research project, please feel free to contact Dr. John Janmaat at 250-807-8021 or by email at john.janmaat@ubc.ca.

APPENDIX F

REMINDER LETTER

Address 1

Date

Dear Sir/Madam

A couple of weeks ago we sent you a letter with an online link to a survey asking you to help us to test a survey. This survey will help us understand the value Okanagan residents place on the services provided by the environment. If you have completed the survey, we apologize for contacting you again and are thankful that you took the time to complete the survey.

If you have not completed the survey, we would be grateful if you took the time to help us. You should be able to complete the survey in 30 minutes or less. Your input will help make the survey easier to understand, and thereby help ensure that we collect high quality data. The results we generate will then more useful to those who make decisions impacting our environment. We know that it takes time and effort to complete our survey. As a reflection of our gratitude, if you complete the survey, your name will be entered into one of a number of draws for \$250. Here below is the link we sent you to complete or withdraw from the survey online. <http://jjanmaat.research.ok.ubc.ca/> and enter the following information exactly as it appears here:

Postal Code: V1Z 2T7

Access Code: 22223A

If you wish to help us with pilot survey, but do not want to do so online, please call Dr. Janmaat at 250-807-8021. We will then arrange a convenient time for you to complete the survey with our help over the phone.

For any questions about this research project, please feel free to contact Dr. John Janmaat at 250-807-8021 or by email at john.janmaat@ubc.ca.

APPENDIX G

PROJECT OVERVIEW FOR EXPERT WITNESSES

Hello Jason, Anna, Todd and Carol

The following is the project overview for expert Witnesses. Interest in determining monetary values for the goods and services provided by the environment has been growing. Some see such values as providing a potentially more convincing way to argue for environmental protection. Money is a “common denominator” that often weighs heavily in the choices we make that have environmental impacts. “Over the past year we have been conducting a study to investigate the value that a sample of Okanagan residents place on some of these environmental goods and services. The participants in our study have completed a survey where they compare several combinations of possible futures for the Okanagan. Each future that has a ‘better’ environmental situation than a ‘business’ as ‘usual case also has a cost. Based on this cost, and with a fair bit of statistics, we can figure out how much our sample is willing to pay to ‘purchase environmental improvements. Not everyone agrees with this way of putting a value on the environment. Some say that we dont relate to the environment the way we relate to a cup of coffee or a new mobile phone. The environment affects the whole community, so when we think of the importance of the environment, maybe we also think about the whole community.’”

In this part of our research, we plan to gather a number of people together who participated in the first part of the work. We will present them with a number of video interviews with people such as yourself, who are knowledgeable about the environment in the Okanagan. In the interview we will ask you to speak a bit about yourself, about your connection to the Okanagan, your views on some of the big threats, and some of the opportunities we have.

We will also present these participants with a couple of decision challenges that involve the environment. After they have had time to consider the videos that they have seen, we

will ask them to put forward up to two questions for each of the people who were interviewed. We will then send these questions by email to each of the people we interviewed. We will relay the answers back to the participants when we meet with them a day or two later. With the answers to their questions, and some more time for discussion, we will then ask the participants to give a solution for their decision challenge.”

We have scheduled these sessions for February 20th, 21st and 22nd, 2015. After these sessions are completed, we will also ask those who participated in these sessions and those who did not to complete a shortened version of the original valuation study. This will help us understand if the amount people are willing to pay to protect the environment changes when they have a chance to discuss these issues with other people, and to listen to the views of people such as yourself with special knowledge.

We will follow up shortly with a telephone call. We can then answer any questions you may have, and if you are able to help us, set up a time to meet. we will also send you the questions that We will ask you during our interview. We expect that the whole interview process should not take more than half an hour.

Thanks again for making the time for our interview. We will be showing the interviews to our participants this afternoon at 4:00 pm. The follow up sessions will take place tomorrow (Saturday) at 10:00 am and 1:00 pm.

APPENDIX H

EXPERT OPINION: ISSUE IDENTIFICATION STAGE: TRANSCRIPT

1. Principal Speaker: Dr. Johannus (John) A. Janmaat: Associate Professor of Economics at University of British Columbia Okanagan
2. Jason Schleppe: President at Ecoscape Environmental Consultants Ltd.
3. Anna Warwick Sears: Executive Director of Okanagan Basin Water Board
4. Todd Cashin: Suburban & Rural Planning Manager at City of Kelowna
5. Carol Luttmmer: Okanagan Collaborative Conservation Program Coordinator

Interview 1: Jason Schleppe

- (John Janmaat) Hello Jason Schleppe. Thanks for agreeing to this interview.
- (Jason Schleppe) No problem

(John Janmaat) First, can you tell us a little bit about yourself. How long have you lived in the Okanagan? Where did you come from before moving here?

(Jason Schleppe) I am actually a fourth generation resident of the Okanagan. So Ive been here for a long time, well my family has been for a long time. I am a registered professional biologist by trade so I did my undergrad at the UBCO. I went to Lethbridge and did my masters in parasitology that was in the early 2000s. I was unable to find a job, so I came back to the college here and took the water quality technology program, which is basic water and waste water treatment, water distribution systems, that kind of stuff. And did all but one semester before I got a consulting gig at a local firm. I was there for a few years and then I decided that I wanted to do things on my own and so with my current business partner, started Ecoscape Environmental in 2006 and thats what Ive been doing since.

(John Janmaat) Okay, so next question here: How would you describe your relationship with the environment here in the Okanagan?

(Jason Schleppe) Well, I believe I'm fairly intimately tied to the environment here. I've mapped all the large lakes, I've mapped a lot of the creeks, I spend a lot of time fishing, those kind of outdoor recreational activities in the valley, whether that's on the valley bottom or up in Okanagan highlands, towards Big White or the other side up in the Bear Lake water shed, I mean I've been to many different areas so I've seen a lot and I'm only 39, but I've seen a lot in my time in the valley, a lot of change. I mean when I was six or seven, Orchard Park was literally an orchard. So it's changed dramatically in my time in Kelowna.

(John Janmaat) Okay, now kind of building on that, what does it mean to you to be connected to the environment?

(Jason Schleppe) Well I think being connected to the environment probably means something different to everybody. To me being connected to the environment is I always see it from a biological side of things because that's where my passion lies. So being connected comes with an understanding of what biodiversity is or what are natural ecosystems, and what it takes to make those ecosystems work. I mean, I'm a fisheries biologist, that's what got me into doing what I do is that I love fish and so for me it's seeing all the connectedness between all those different systems. How food moves through to fish and how fish feed eagles and all those connections. I think that that's what it means to me. It's understanding that the environment is one big web. There's nothing that is independent. You can't do something to one part without having a consequence in another part. So everything is all intimately tied together. Does that get at?

(John Janmaat) Well, I am curious about what your view is, so that's great thank you. Can you describe a natural place in the Okanagan that is or was, if it's not around anymore, special to you, and what made it special?

(Jason Schleppe) For me it would be the Mission Creek Corridor and mostly from the east Kelowna road up so basically the layer cake mountain that area and that's because as a kid and even as an adult I spent a lot of time just walking around down on the trails that exist down there. For me that would be that would be you know definitely a low elevation area that would be of importance after that it would be any lake that has good fishing up

in the highlands around. But, I would say that's sort of a fairly special space just because of what's there. It's an interface of all the different ecosystems; forests, grasslands, arguably one of the more unique rock formations in the valley, all those different things sort of fit into one space well one bigger space.

(John Janmaat) Okay, so How is your job and/or volunteer time related to the environment? You've already given us a chunk of that, so follow along: What inspired you to get involved with this?

(Jason Schleppe) My passion for fishing was what drove me to do what I do.

(John Janmaat) I guess you covered that already too.

(Jason Schleppe) Yeah

(John Janmaat) So what would you say is the most disturbing thing you have noticed about changes in the Okanagan environment?

(Jason Schleppe) The rate at which natural ecosystems are being lost. I'll use Okanagan lake as the example. In 2004, the shoreline of the lake was mapped using something called Foreshore Inventory and Mapping. It was something that the regional district put together in conjunction with the federal department of fisheries and oceans and the province, to map shorelines and it followed a stream mapping protocol that have been developed. After 2004 we worked with DFO and RDCO and sort of revised how that data was collected based upon how it was being used and that data was recollected again in 2009, I believe. Following that assessment, I was able to calculate the rate of loss of natural shoreline on Okanagan lake and the rate of loss ranged anywhere from -0.5 percent to -2.5 percent per year. Which doesn't seem like a big number, but when you look at it from the fact that there's only 44 percent of the lake that's left in the natural condition. If we are losing truly losing 2 percent per year, it could be 20 to 30 years and there's no natural shoreline left. Now obviously that's I'm making a whole bunch of assumptions when I say that and that's not ever going to happen because parks and other things. But, for me that was a big I redid that math multiple times because the rate of loss was staggering. When you looked at it and the amount of time and how fast. So I think it's just a general issue right now, is that

in my belief we are in an exponential population rate of growth across the world as a whole and were also in sort of an exponential rate of loss of everything that is a natural system. Its happening so fast that I dont think we can keep up with managing those rates. Its changing so fast that, its changing faster than we can say: this is whats changing and whats happening. We can even understand whats happening because its so quick. For me that was a big aha moment. It was one that I found disturbing, very disturbing. Again, because Ive been here for such a long time. If Okanagan lake, is the jewel of Okanagan and we are losing that much natural shoreline it has more consequences than just environmental.

(John Janmaat) So, when did you first notice this?

(Jason Schleppe) Well, I noticed when I was doing work on the Okanagan. I was Its not just Okanagan Lake I mapped either, Ive mapped wood, Kalamalka, Skaha, Osoyoos, Mara, Mabel, Shuswap, Cootney. So you know the trends that I saw in the Okanagan, they replicated across the province. Its not just the Okanagan lake, its what happens when land gets developed or land-used changes. So when did I notice this? Well, as soon as you start to pay attention and start collecting data, you go oh wow and you start to see trends. If land is developed as single family residential. So we build one house on one lost on a shore line. Inevitably, 20, 30 years from now after that lot is developed, it will typically remain 10 percent of it will be left naturally if that. That trans replicated across multiple different lakes and jurisdictions. Its not its independent of anything to do with jurisdiction. Its just when people buy lots, the first thing they do is: they cut down the trees and they then put a house on it, and then when they put a house on, and then they want access down to the lake, so then they build their trail down to the lake, and they want to have their dock for their boat, or they want to have their beach area for the kids and with that comes disturbance and with that disturbance comes changing natural to what we believe is more suited to people.

(John Janmaat) What frustrates you about this issue?

(Jason Schleppe) A significant not a significant [Pause] regulatory processes is very slow to catch up. The biggest hurdle were facing these days is the dramatic changes to

the federal fisheries act, and what that means. Environmental regulation tends to follow that of the economy. When economy is high, there's more environmental regulation, and when economy goes down, environmental regulation subsequently decreases and we saw that with the bus bill and the changes in the fisheries act a couple years ago. It was all these changes happened to kick-start oil and gas and get that first streamline on those processes. Those come back to consequences that I don't think people who don't practice fully understand, they don't comprehend what exactly those changes mean. They made it perceive them as being good things which, arguably I'm all for reducing red tape and allowing process to happen having said that I think we do need good public process in order to make good decisions. I don't think that I'm a believer that when government makes decisions they should take all the information and make a decision on whether it's right or wrong, at that point in time based upon the information they have available to them. Versus that of, let's just get rid of all regulatory process and what we don't know won't hurt us. That's what the new fisheries act kind of means in some ways. It's going the root of self-regulation and self-regulation is a scary proposition I think. It's more complicated than that, I'm simplifying it a bit. But it's definitely that would be highly frustrating for anybody that does fisheries type of work.

(John Janmaat) Is there anything that gives you hope for the future of the Okanagan environment?

(Jason Schleppe) I think that younger people are generally in tune with where they want the world to go. I believe that in the good of people and that eventually we maybe will figure things out. I just would hope that we figure it out before it's too late. So rather than a hindsight 2020, I'm looking back and going oh we should've done it this way, maybe we can use a bit of foresight and try and pre-emptively curb some of the things that are bigger challenges. There's a lot of good things going on in the Okanagan. The Okanagan is a leader I believe when it comes to environmental policy. The regional district has the environmental advisory commission a lot of the policy within British Columbia, people look to the Okanagan for examples of how to build policies. So we have good policy here.

Its just a question of with good policy, is it being implemented properly? You know, great policy, but if you dont implement it then it doesnt mean anything anyways. So theres sort of two sides theres policy and I think thats a huge thing that we have to our benefit, its just whether or not it will be actually implemented to make effective change.

(John Janmaat) On the whole, you say youve become more optimistic or pessimistic over the last five years or so?

(Jason Schleppe) Thats six of one, half a dozen of the other. Im optimistic about some things and pessimistic about others. Quite pessimistic about the changes to the fisheries act and maybe what it would take to go back and change some of those policies. Those changes to policies made international news. It was other governments were looking at us saying what are you doing to your fisheries act?, why are you gutting it?. I know lots of people that work within those different agencies and the staff was handcuffed. There was nothing they can do. Thats a very challenging thing for people who cared, have government change legislation and not really understand what is it theyre changing or what those changes mean. Im optimistic in the sense that we do have good policy here and there is people who do care and that environmental issues whether its sustainability, or biodiversity, or theres a whole gambit of different environmental issues. But they are more mainstream. They do hit mainstream media, its not people are aware and as when I went to school, recycling was the name of the game and now everybody does it. So I am optimistic in that sense that people are aware and are becoming more aware with the advent of mass media and the ability to disseminate information. So thats definitely could be good in the long run.

(John Janmaat) Before ending here, given all the stuff weve been talking about, any other thoughts you have that youd like to share?

(Jason Schleppe) Not specifically no, I mean again, Ive been very involved in the Okanagan and different committees and helping young people. Whether its find jobs or mentoring them. Ive seen a lot of change; some for the good, some for the bad. Its a challenging world. I would say that the environment is always on the forefront of peoples minds when its in their backyard, but if it isnt in their backyard, it isnt necessarily on the

forefront of their mind. The environment is always used as the card that people play. Its always about the environment, again, when it affects them directly, but when it doesnt affect them directly its less relevant. I think that thats something of interest its when the environment becomes of relevance to people and how it becomes of relevance. What is their motivation? Is it that theyre truly aware and truly care or is it just a card theyre playing to suit their desires. Thats something that if we could change that perception and build about a societal change that values the environment for what it is and what its worth. This greenspace does have value, it's how to value it thats challenging. But if you could do that, then people understand that that means then that would probably factor into how they carry themselves day to day, or how they perceive different scenarios as they come up. Whether its land development or changes in policy or whatever that may affect the environment. Just because they have a better understanding and perception of what it exactly means. (John Janmaat) Well, thanks so much for your time, it was great!

2 Expert: Anna Warwick Sears (John Janmaat) First, can you tell us a little bit about yourself. How long have you lived in the Okanagan? Where did you come from before moving here?

Interview 2: Anna Warwick Sears

I have lived in the Okanagan for almost nine years and I moved here from California, but I grew up on Cootney lake and coming to the Okanagan was part of my heartfelt, lifelong desire to return to the interior of British Columbia.

(John Janmaat) So how would you describe your relationship with the environment here in the Okanagan?

(Anna Warwick Sears) I think the most important thing for me about the environment and the Okanagan is the lakes. I was going through some old family photos over the weekend and I found a photo of myself and my two sisters and we were playing on a log with my uncle and it was probably about 8 years old. It just really captured my whole childhood for me and how much I loved being in the lake. I was thinking about that picture

and about how when we scattered my fathers ashes a couple years ago, he asked specifically that we scatter them on the beach where he had played as a child. Before my grandmother died, one of the things that she wanted to do with myself and my cousins was, take us to the river where she had played when she was a child. It gave here great happiness to swim the river with us and tell us all the stories about how shed been a young girl and they used to jump off the trestles into the river, and show us those trestles and walk on them with us, and she was quite elderly at that time, but she carried in her heart that memory of being a child and playing in the water. I think that the experience of the lakes and the water itself is really deep in my heart and its definably the most important part of being in the valley for me.

(John Janmaat) I think you may already have answered this but, what would you say it means to be connected to the environment?

(Anna Warwick Sears) I think being connected to the environment is having that deep sense of feeling at home with some aspect to the environment. For some people its being on a mountain; my sisters just like that. For some people its walking down a beach, for some people its being out on a boat, but I think its where you feel really, really calm and soothed and at home and being outside.

(John Janmaat) Can you describe a natural place in the Okanagan that is or was special to you, and what made it special?

(Anna Warwick Sears) I think the most special place for me in the Okanagan is the beach at Cousins Bay on Kalamalka Lake. Its very very calm and beautiful water. Its you have to hike into it, so theres a bit of adventure just to get there. The water is very blue and very clean and its quiet there.

(John Janmaat) Ok so how is your job related to the environment?

(Anna Warwick Sears) I think Im incredibly fortunate in that my job is to work on protecting these things that I love the most and try to help to work with other people to help protect the quality of the water and protect the health of the lakes. Its something that I really care about personally and I feel incredibly fortunate to be able to work on

something that makes such a difference in my life. (John Janmaat) What inspired you to get involved with the work here?

(Anna Warwick Sears) I had worked I got my degree in biology and I always loved natural things not just purely natural. I loved gardening, I loved anything that had to do with living things. Having grown up in the interior and being around lots of beautiful natural areas it always made a lot of sense to me. But, I also was really attracted to the aspect of the work that has to do with working with people because, I think basically I look at how people interact with their surroundings. I know that there is also a lot of people who also really care about water and protecting nature, and keeping the world nice for themselves and their families. But theres also a lot of you know theres politics and theres squabbling, theres people maybe not being as careful as they want to be. I think what inspires me is being able to work with people and find ways that we can all get along and something that we all share common values for. Water is not arguable; everybody loves that water. Everybody want that water to be clean to drink and to enjoy and to be around. So I think this job is a really nice marriage between my own feelings about what make s me happy; being around these big lakes, and also it makes me happy to be able to work with people who also share that love and who want to have the world be a nicer place for themselves and their families.

(John Janmaat) So in terms of things youve noticed changed in the Okanagan. What changes would you say disturbed you the most?

(Anna Warwick Sears) I see a lot good happening in the Okanagan. I see a lot of changes for the better. Particularly with peoples awareness about the water and peoples commitments to personal commitments to wanting to work and help, and volunteer, and the electric representatives acknowledging the importance of doing things like: cleaning up the wastewater and making plans to avoid the impacts of drought, and restoring streams for the salmon and these different things. I think the things in the Okanagan that I think are a challenge are things that have to do with just the natural expansion of impacts as more and more people come to visit the Okanagan more and more people come to live in

the Okanagan, there is a bit of an inevitable slide. There are all the hardscapes that go in when we put in new streets, when we repave them more traffic, pollution coming from the cars, all these things. Its a bit inevitable and I dont think that we its right or even possible to stop people coming to visit or stop people from moving here the world population is growing from seven billion to nine billion over the next 20 years or so and people have to move somewhere. We have some of the nicest places in the world to live and some people are going to want to move here, but at the same time we need to work together to figure out how we can reduce the impacts of all the additional pressures that are just inevitable from more people walking on the beaches, more people swimming in the lakes, more people driving cars and the run off from the streets and all those things.

(John Janmaat) So speaking of those challenges, do you think were making progress?

(Anna Warwick Sears) I think were making progress a really a theres a great deal of more recognition going on at all levels. The personal level where people are looking at their personal use of water and the use of resources and whether or not theyre picking up after their dogs or dumping paint down the storm sewers. People are a lot more contentious than they used to be about things like that. Theres just a much higher level of awareness. Theres also a much higher level of awareness among the local governments who do development permitting and theres a lot of reasons for having low impact development of different kinds. Part of it is just that its much more economical and much easier to have people living closer together so called densification. But if youre trying to figure out how to extend water lines all the way out up the hill, its just going to cost a lot more to put those water lines in, cost a lot more to maintain them over a long period of time. So the whole trend in development is to move people in closer to each other and closer to the services, closer to shopping. Theres a lot of studies that are showing theres a higher quality of life when for the people who are living in those more urban environments. Particularly things like commuting, more ability to support small businesses, because theres more rivalry neighbourhoods. At the senior government level theres a lot more awareness about the importance of taking care of our own potters. The kind of policies that are coming down through the water sustainability

act some of the policies that were here from environment Canada these things, they add up to a change in attitudes at all levels across the country and thats very heartening.

(John Janmaat) So on the whole then, do you say youve become more optimistic or pessimistic about changes related to the environment or management of it in the last five six years.

(Anna Warwick Sears) Ive become more optimistic about our relationship to water and the environment over the last five or six years because I see people changing. I go and speak at a lot of public meetings so the kind of questions that I get asked are much more sophisticated. I am always finding people who are coming up to me, telling me their own stories about water, or being a kid around the lakes, and how important it is for them to protect the environment in the Okanagan and the water in the Okanagan. I think theres a lot of pressures on the world on Canada, British Columbia and on the Okanagan. But I think it comes down to that people making personal commitments and understanding what the situation is and I think thats happening.

(John Janmaat) Okay, well thats the end of my questions, but is there anything that comes to mind to you, over the course of these questions in this interview that youd like to add as we wrap up here.

(Anna Warwick Sears) I just want to say one more time and emphasize that the most important thing is that people coming together and working together on it. People in the Okanagan do really value water, they do really value having clean drinking water, having the agriculture around them with the fresh fruit and vegetables they value the ability to go kayaking and boating and not having to worry about getting diseases. Its a beautiful place to live and I think if we can all tap into that shared value system and learn how to work together to keep the Okanagan beautiful then I think that theres not stopping us.

Interview 3: Todd Cashin

(John Janmaat) Hello Todd Cashin. Thanks for agreeing to this interview.

(Todd Cashin) No problem.

(John Janmaat) First, can you tell us a little bit about yourself. How long have you lived in the Okanagan? Where did you live before moving here?

(Todd Cashin) Sure, well my Im an army brad, my dad was in the military for 30 years, my family is from Nova Scotia. I lived in six provinces Canada and moved to the Okanagan, Kelowna right after I finished school. So I moved here in 1995 and been here ever since.

(John Janmaat) Ok, so how would you describe your relationship with the environment here in the Okanagan?

(Todd Cashin) Well I guess I see it on a number of levels. I mean I moved here because of the environment. My wife and I researched where we wanted to live in terms of weather, climate, politics. We lived in Alberta for a number of years didnt necessarily agree with the politics of the day in southern Alberta in Lethbridge. So were also looking for a place to live that we can raise kids and that we could find work. So on that side of the environment side I guess that we found it to be really great and were both skiers, weve skied quite some times so weve had a lot of winter sports here as well. But then again on the intrinsic side, the minute you drive into this valley it just catches your eye, its spectacular. Then of course theres my wildlife biology environmental planning background this is a very special place in terms of species at risk, in terms of the types of ecosystems we see here so its attractive on many levels. I guess working in environmental planning in the forest sector initially, and then in local government both regionally now and here at the city, I guess its something that I always relate to work. So my kids dont know exactly what I do, but they do know that Im sort of the environment guy. So that word does have a little bit of weight on a number of different levels.

(John Janmaat) What does it mean to you to be connected to the environment?

(Todd Cashin) Well for me, connected to the environment, means understanding the world that you are living in or your surroundings. You know I again relate back to my kids, my kids make fun of me, but I think its a good thing. They understand that like I understand when were going for hikes that what are all the plants are around them and Im always boring them about the plants and what type of tree is that?, what type of

shrub is that?, and it drives them crazy but that to me is being connected, understating the ecosystems and being on a trail and moving from one ecosystem into another. But also I guess on a broader scale understanding how our system is connected to other valleys and so on and so forth, and how what we do can impact the other areas of our community.

(John Janmaat) Ok great. Can you describe a natural place in the Okanagan that is or was special to you, and what made it special?

(Todd Cashin) Well Ive got a number I guess that Im attracted to. I mean Im always I started fly-fishing back in college days in Alberta on the crows nest path, so for me and working again in the forest sector and doing a lot of work around river restoration, and channel assessment and that sort of thing. Im attracted to water, maybe its my nova scotia background, I dont know. But Im always attracted to I cant not stop and look whether its the Okanagan lake or you know if its over on highway 33, driving past the kettle river, or up in Enderby, along the Shuswap and its when I worked in the forest sector all over this province, I was always attracted to the water and trying to understand it and look at it, how it flowed and that sort of thing. Thats the first thing I guess. Secondly its the places that I take my kids, that I hike more regularly now that that really have that attraction to me I live at the bottom of now mountain here in Kelowna and I know it very well. Bear creek provincial park when I worked with BC parks back in my school days I had my first summer job in BC was with BC parks here in the Okanagan. So I got to know a number of the parks as a park interpreter but also I lived at bear creek provincial park for a couple summers so I know that park fairly well as well. So I guess on a local scale, those are the two that and of course getting up into the alpine is also another interest of mine. But its always getting to new places and not necessarily going back to old ones.

(John Janmaat) Ok, so youve described your job a little bit. What inspired you to get involved to get into the kind of work you do?

(Todd Cashin) I dont know if anything inspired me. I think its just the way I was raised. My mum basically was the person that I think instilled the environmental ethic in both my brother and I at a very young age. We joke all the time my mums been gone

now 10 years but, we always joke that she knew she was way ahead of the curve in terms of environmental issues of the day and was and you know when you were a kid just like my kids today, its a bit of a pain to listen to your mom go on about you know protecting the environment. But yeah we reflect back on that regularly and it was something that was instilled with me at a very early age and when I look into going to school it was a no brainer. I was going to be a conservation officer or a wild life biologist or fisheries biologist or an oceanographer or something along those lines thats what I was looking at in grade 9, 10 and 11, looking into those types of things.

(John Janmaat) So, some more specific things. In terms of changes that youve noticed in the Okanagan, what changes have you seen that would be the most disturbing to you about the Okanagan environment.

(Todd Cashin) Theres a few, theres probably two or three. The land use changes has probably been one of the larger ones. In terms of man the influence that I can see on a daily basis with my job. Everybody wants to come to the Okanagan and everyone wants to get their piece of pie, or small plot of land and do something. So the land uses the impacts from the real estate booms and the influx of people thats slowly changing the environment. I think at the same time though that the climate change issues that I see are, a lot more moisture. You know every degree of temperature I think, or every its like seven percent more moisture in the atmosphere for every degree of climate change and weve definitely I think theres probably those out there that say well theres not enough data, but from what Ive seen having walked rivers, Ive walked rivers since the early 90s, doing channel assessments, river restoration projects, the peak flow events that we are now seeing are fairly significant. There are significant rain events or rainfall events. Were seeing here in Kelowna up on the south slopes in particular are starting to have some impact and I think thats one of he bigger issue in the next couple of decades that wed have you keep our eye on.

(John Janmaat) Okay, what would frustrate you the most about these issues?

(Todd Cashin) I think that's a word I used to feel a lot: frustration. I as I get older I recognise it's not worth it to let things frustrate me or because it's very simple this position right now, both on the agricultural planning side and the environmental planning side, anything can be frustrating. But, you I think for me it's trying to identify what our goals and objectives are and pick them one at a time and just move forward and try and be successful at achieving what we've set out in those goals and objectives. I mean not to sound like a bureaucrat, but that's really how you have to look at it because otherwise I think this job could probably chew you up and spit you out if you let things frustrate you or you let things get to you. I used to take my work home with me everyday. Used to be I'd watch wetlands one wetland after another slowly get degraded or slowly get infilled that's slowly coming to an end I think. We've put some pretty good policy and regulations in place it was a tough fight on the front end in terms of stream protection, wetland protection, but I believe that people are starting to understand that. But it's very similar on the agricultural planning side as well that I think we're starting to see a bit of an interest out there in the young farmers and take ownership of some of the farmland out there, and that's where we need to put out energy, is in the young farmers who are going to sort of take it to the next step and protect our farmland and protect it for the generations to come.

(John Janmaat) That kind of leads in to the next question. Is there anything that gives you hope for the future of the Okanagan environment.

(Todd Cashin) Yeah, I mean everyday, I mean I work every single day on different files and applications and we are slowly whittling away at protecting all the sensitive ecosystems in our community. I worked both at the regional district and now at the city and I've seen it at both levels and I think that we are in a better place. Could we be doing a better job? Could we be protecting more? Absolutely, we could always be doing better. But I think that people understand or people that are moving or people that have lived in Kelowna or in the Okanagan valley understand or they're starting to be a better understanding of what it is that we're trying to protect and why you know people love this valley and they

want to protect I think what makes it special so that's the goal. It's to convince people how special these places are and to keep putting them aside for future generations.

(John Janmaat) Okay, so putting this all together. On the whole, are you more optimistic or pessimistic about the future of the Okanagan environment?

(Todd Cashin) It depends on the day of the week. [Laughter]. Yeah I definitely have become more optimistic. I think you know really coming out of school can't speak for all students I guess but I found myself to be very idealistic about how the world should work and it was very frustrating to use that word. Things weren't going as you thought you should or as quickly as you should and I've learned to sort of reflect back on our successes and try and learn from them to sort of accelerate those successes into the future and so you have to be optimistic. Like I said, I don't think you could survive in the environmental planning world these days without being optimistic. I think it'd be tough to be a pessimist and be an environmental planner at the same time.

(John Janmaat) So we are right at the end now. But given the conversation we had, is there anything else that's come up for you that you'd like to share?

(Todd Cashin) No I don't know just that I mean I always wanted a job where, you know excited to get out of bed every morning and come to work and happy to be here and I'd consider myself lucky to be in a position to be able to do that. I mean this can be stressful at times and it can be as you say frustrating at times and but for the most part I'm pretty happy individual. I always say Kelowna is the most beautiful or the best city in the best province in the best country in the world. So I think if you start your day everyday with that type of attitude, and keep working towards protecting agricultural and protecting environmental the sensitive features on the environmental land base I think and you keep reflecting back on all the land and policies and stuff that you put in place that make Kelowna better it's pretty easy to walk away with a smile on your [Video cuts to next interview]

Interview 4: Carol Luttmer

(John Janmaat) Hello, thanks for agreeing to this interview.

(Carol Luttmer) Oh no problem.

(John Janmaat) First, can you tell us a little bit about yourself. How long have you lived in the Okanagan? Where did you live before moving here?

(Carol Luttmer) Well Ive actually only been in the Okanagan a year and a half. I ended up here kind of on a whim. My partner decided to go back to school so we ended up here in the Okanagan. I grew up in Toronto but I actually worked and traveled in every single province and territory in Canada. Ive been on the move a lot doing different projects, different areas and now Im here in the Okanagan.

(John Janmaat) You are with the Okanagan Conservation Collaborative Partnership?

(Carol Luttmer) Yeah its a bit of a twisted that name the Okanagan Collaborate Conservation Program. So it was established in 2007, when several key partners like the Allan Brooks Nature Centre and the Grasslands Conservation Council and several other organizations wanted a better form to work with government and other individuals and first nations, interested in conservation and stewardship in the Okanagan. So it really formed out of a need for different organizations to be able to work together. We have 35 partners that have signed a statement of cooperation to work together on common goal such as: protecting species at risk, balancing regional growth with conservation, and really just trying to use data and information to make wise decisions about land use and land-used planning. So I started as the coordinator for program about a year ago.

(John Janmaat) Okay. How would you describe your relationship with the environment here in the Okanagan?

(Carol Luttmer) Well I think my relationship with the environment stemmed from when I was really young. I grew up on the shores of Lake Ontario and Ive always been and outdoors person. So for me, my relationship with the environment started with recreations. Being able to ski, go for hikes, go sailing, going on canoe trips. Just being outdoors and having that freedom and that space. Because I grew up with a passion for the natural environment, I pursued education in that field. So I actually did an undergraduate degree in

Water Resource Engineering and then I did a masters degree in geography. Then I worked actually the first 15 years of my career, cleaning up environmental messes that we've created in the past. So I did my masters work in California at a site called Owens lakes. What had happened there was that the city of L.A bought up all of the farms on the properties in the Owens valley, diverted the water to Los Angeles because L.A needed water and as a result of all of those water diversions from the early 1900s, the lake that was in that valley is now dry and its full of fine sediment and dust. So the wind was blowing and creating an air pollution problem that was caused by diverting all of this water. So we were researching how could we prevent these errors the dust emissions, which was a health hazard coming off this lake. So sort of an environmental problem that happened. They didn't realize that was going to happen when they started diverting the water. After that I worked for ten years cleaning up contaminated sites in the Arctic. Old military sites and doing research on the transportation of airborne contaminants from major centers in the U.S, Mexico sort of are developed areas in the south that actually get transported by evaporation and through air currents and get deposited in the arctic and so to me I really all those years cleaning up these environmental messes, these military sites in the north, and when I came and moved to the Okanagan and I said I don't want to be cleaning up messes anymore, I want to be working proactively towards preserving the natural environment and how can we plan to do that ahead of time instead of working in reverse and trying to clean things up. So for me coming to the Okanagan and getting the job with the OCCP, the Okanagan Collaborative Conservation Program, it was about trying to figure how we can work together and be collaborative for protecting the Okanagan. I mean its a really unique landscape here. 0.8 percent of the land mass of B.C., but it has 30 percent of the species at risk in the province. We have to recognize how unique it really is here.

(John Janmaat) What does it mean to you to be connected to the environment?

(Carol Luttmer) I think we're all connected to the environment in different ways. I also think we don't realise how much it gives to us emotionally for I don't know If I don't spend half an hour outside everyday, my boyfriend doesn't want to talk to me at the end of the

day. So I think I think its hard to define, but I think that its important for us as a species to spend time outside.

(John Janmaat) Can you describe a natural place in the Okanagan that is or was special to you, and what made it special?

(Carol Luttmer) Probably Ellison Park, because it was the first place that we arrived that we went out and really explored the area. We could ride bikes out there and just hiking along the shore and Im a water person and I just really enjoy the landscape there. The contrast between the water and the rocks and the trees, it was just a really special day.

(John Janmaat) Okay, well you already told us about your job to a degree. So why did you get into what youre doing?

(Carol Luttmer) I think I just really wanted to be proactive in terms of conservation and stewardship and protecting our environment. A big part of the Okanagan Collaborative Conservation Program part of our mandate is: to communicate and to share ideas about protecting the environment and it really meant a lot to me. Ive had a lot of amazing experiences hiking, sailing, camping and I want to be able to continue to do that and I want my children and others to be able to enjoy the natural environment and so it really inspired me when I saw the job opportunity and I think I thought this is a good way to get connected to with community and the environment and to learn about the Okanagan.

(John Janmaat) What things have you seen around or heard about that most concerned you or disturbed you about trends of the environment here in the Okanagan.

(Carol Luttmer) Well I think two of the biggest issues are increasing foreshore development so a lot of development on the foreshore around our lakes protecting that important ecosystem between the lake ecosystem and the upland ecosystems. We all want to live on the water and have our docks and our boats and have that opportunity to live on the waterfront but if we dont the cumulative effects of large developments along the foreshore, we really have a large effect. So I think foreshore development is a big issue. I also think just urban sprawl. So development in areas that are sensitive. So that idea of the Okanagan having some really rare and sensitive ecosystems and how can we develop and grow our

cities in a way that continue to protect those sensitive ecosystems because they're very important. Because if we protect those ecosystems and if we were able to protect the habitats for those species at risk, those are the same things we need to protect for ourselves. So I think that really protecting the unique ecosystems in the Okanagan is really important.

(John Janmaat) You think we're doing much about that?

(Carol Luttmer) I think we are. I actually think we're working a lot with the regional districts and the municipalities and hope to be working more with the province. I think that here in the Okanagan, people come here because of the lakes, because of the mountains, because of the dry arid climate and if we are able to communicate that if we were not responsible about our development, and if we were not responsible with the way we live here, the things that we came here for, aren't going to be here anymore. I think people realise that when you say well, you came here because you want to enjoy the lake, well, if we were not careful, you won't be able to swim in the lake anymore.

(John Janmaat) Is there anything that really gives you hope about the future here in the Okanagan? (Carol Luttmer) Yeah, I think it's that people do really appreciate the natural environment here. They are here because of the mountains and the lakes and the recreation opportunities and the climate. I do think we need to constantly remind ourselves of that. I think we have to act we have to be diligent with we can just say we actually have to do with our actions. I think it's happening but I think it's maybe happening too slow.

(John Janmaat) Would you say that your experience here has overall made you more optimistic for our relationship with the environment as a people or less so?

(Carol Luttmer) I think moving here has really made opened my eyes to the species at risk and understanding the value of protecting species at risk, just because there are so many in the Okanagan. I think that I'm hopeful, but I think we do have a lot of work ahead of us.

APPENDIX I

CONTROL SAMPLE: INVITATION LETTER

A short while back you completed a survey for us that asked you to consider several alternative futures for the central Okanagan environment. Since completing the survey, you may have reflected on the issues posed, looked into the matter more, and talked with other people. You may also have participated in a discussion group that we organized and run February 20-21 at 1450 K.L.O Road, The Regional District of Central Okanagan office. Any of these activities may have reinforced your views or lead you to change your perspective. We would like you to complete a shorter version of the original survey, a version that you should be able to complete in about ten minutes. Even if you do not think your views have changed, we would like to hear from you. We can end up with very slanted results if we only hear from people who have changed their view. If you provide your contact information at the end of the survey, we will again enter your name in a draw for one of five prizes of \$250 that we will make in recognition of the help you are providing us.

To complete or withdraw from the survey online, please visit: [and enter the following information exactly as it appears here \(including the space in the postal code\):](#) Postal Code: PostalCode Access Code: AccessCode

APPENDIX J

INVITATION TO PARTICIPATE IN A CITIZENS' JURY

Address 1

Date

Dear Okanagan resident,

You have been randomly selected to participant in the jury deliberation from among those who showed interest in the main survey and who provided us with their contact details. We believe that your input will play an important role in influencing government policy related to natural resources protection.

A Citizens' Jury is an event at which a panel of citizens from Central Okanagan is given the opportunity to hear experts, discuss and debate those environmental issues of concern you encountered in the main survey and present your views and recommendations.

Unlike juries in the legal system, Citizens Juries make policy recommendations rather than final decisions. The objective is to hear opinions of a cross-section of the general public. This method is getting popularity in many parts of the world as an important tool in the policy-making process.

Therefore, Citizens' Jury will be held in Kelowna on -----, at -----, We will have a welcoming refreshments and all the jury members will be paid \$50.00 as a thank you for participation. If you have any special needs relating to travel, health or other personal issues, please let us know and we will make every effort to meet them.

Please complete the enclosed participation confirmation form and send it to us using the pre-paid envelope enclosed with this letter of invitation before -----.

Your participation and the information you give us will assist our research. All information will remain confidential and will not be passed onto any other organizations. We know that it involves a considerable time commitment, but it is a unique opportunity to take part in our research.

Please do not feel that you need to be an expert in the field. We are interested in the views of all members of the public and would value your input. We very much hope you are able to help us.

We would be grateful if you could send us back the prepaid envelop even if you could not make it. If you have any questions, please do not hesitate to contact Dr. John Janmaat on john.janmaat@ubc.ca, 250-807-8021.

APPENDIX K

DELIBERATION WORKSHOP PROTOCOL

1. **Why deliberative Juries?**

Deliberative juries enhance citizen participation decision making. Using deliberative techniques (the use of citizen groups convened to assess the costs and benefits of proposed management options) can improve the effectiveness of public participation in the policy process, thereby enhancing the perceived quality and legitimacy of policy decisions. In our research we use deliberative juries to provide adequate information to each respondent to judging the environmental management options and the level of change in the provision of environmental resources and services.

2. **Who makes the citizen juries?**

Random sampling technique will used to recruit participants who showed interest in the main survey and who provided us with their contact details.

3. **How we present the valuation exercise and Deliberation Options?**

Jury members will be presented with three environmental resources management options. These Options are the same options completed by general public in the main survey. It is up to the jury to decide which of the three options is most likely to enhance the health of the environment 30 years from now.

4. **How are environmental issues identified?**

Major local environmental issues were identified discussing with the Regional District of Central Okanogan experts and Okanogan residents. Both were asked to prioritize environmental issues based on the degree of their concern.

5. **What are the environmental management options?**

“No action”-Status Quo: Environmental management “No action” is the continuation of the current environmental resources situation to 2040 if it is managed using the existing actions. This option does not involve any increase in household’s payment.

Options 1 and 2: Option 2 and Option 3 involve additional management actions that would lead to different environmental goods and services outcomes by 2040. These options involve each household making an annual payment each year for 30 years starting in 2015.

6. How to provide information?

Experts from the Okanagan Basin Water Board, the Regional District of Central Okanagan and University of British Columbia will make presentations and expert witness the case to the jury related to each environmental resources management options. Jury members will be allowed to cross question expert witnesses after their presentation.

7. How many Jury deliberations?

We will conduct two jury deliberations.

Jury session 1: Jury members will be brought together in a room with a moderator (from the advisory group to be assigned from expert witnesses) taking charge. Step one will be a briefing to participant about the environmental problems facing the Regional District of Central Okanagan in not more than 20 minutes. Step two will focus on a questionnaire to gather data on respondents' general and environmental attitudes and their socioeconomic situation. This questionnaire will also contain the choice experiment, which respondents will complete individually, based on an instruction that will help them to consider their choices from a self-interested perspective, having in mind their income and family situation and the possibility of alternative uses of the resources, and what outcomes they imagined would be best for themselves. The instructions will be identical to those to be used in the main survey. We will collect the individually completed survey. In step three, a debate between group members will be prompted wherein questions and problems arising from the session will be discussed. Participants raising any concerns shall be accommodated related to what they will do by the moderator. Lastly, members will be asked, in the time before the next session, to discuss the issues raised in the meeting with family and friends, and/or to learn more about the issues discussed from their own sources.

Jury session 2: the brief summary of the problems facing environmental resources and services in Regional District of Central Okanagan will be presented. Environmental management options will be reviewed by the moderators and the other participants. Participants could then raise any issues/questions which occurs to them in the period between the two sessions. A debate will be on the consequences the policy alternatives related to participants' perceptions, the community affected, and consequences for the environment itself. Participants will be required to state and discuss what they thought is more important not only for themselves, but for the wider range of their community. In addition, respondents will be reminded that their role in the jury as a part of decision-making process will be to select environmental management options and payment action, if any, which they would choose on behalf of their community and if their decision has been influenced by people in their network . These choices will be made by each individual separately and confidentially. We will record any changes in beliefs, attitudes, or choices between the two sessions.

Finally, a collective-choice experiment will be implemented. Here, participants will be reminded the desirability of having conversations and reaching out to people in their network and discuss on issues including with family and/or friends. The issue of collective responsibility for designing the policy action plan will be raised and discussed, along with the implications for the community of any decisions taken. Participants will be told that this meeting will be a good chance for influencing the policy action plan. Participants will be reminded to make their choices on the basis of what they thought would be best for the community. That is, to express their citizen values, but to make these choices collectively rather than individually.

8. How to reach a Verdict in Jury?

This will be achieved by, for each option in the choice set, choosing that option with the highest votes, but with a condition of not making any jury member unhappy. It is in line with a collective-decision procedure of the majority/unanimity rule adopted in most citizen juries.

APPENDIX L

PARTICIPATION IN A CITIZENS' JURY: CONSENT FORM

1. Who is conducting the study?

The principal investigator is Dr. John Janmaat, Regional Innovation Chair in Water Resources and Ecosystem Sustainability, I.K. Barber School of Arts and Sciences, the University of British Columbia Okanagan. john.janmaat@ubc.ca, 250-807-8021. Solomon Geleta, PhD Candidate in Agricultural and Resource Economics at Colorado State University, USA, Fort Collins, CO 80523-1172, solomon.geleta@ubc.ca, 250-808-5425, is a co-investigator on this project. This survey forms a central part of Solomons doctoral thesis.

2. Who is funding this study?

Funding and additional support are provided by the Social Sciences and Humanities Research Council of Canada (SSHRC), Environment Canada, the Okanagan Basin Water Board, and the Regional District of Central Okanagan.

3. Why are we doing this study?

As elsewhere, each person in the Okanagan has a unique perspective about the right balance between development and protection of environmental resources, such as aquatic habitats and rural landscapes. By participating in our research, you will be helping us to better understand how Okanagan residents feel about these tradeoffs.

4. How is the study done?

You were randomly chosen from among those who volunteered to participate in a citizen jury when completing a survey for us. During the jury session you will have the opportunity to explore issues raised in the survey in greater depth by hearing from experts and discussing with others who also volunteered to participate. This session should last about 90 minutes. The jury session will be digitally recorded and a note taker will make written notes during the session. Written notes will be typed and stored with the digital recording on a secure server at the University of British Columbia. For analysis, recordings will be transcribed

and participants identified as person 1, person 2, etc. Any names or other person identifying information in the recordings will be changed to protect privacy.

5. Is there any way being in this study could be bad for you?

We do not think that participation in this study can be bad for you. Your responses are valuable to us, and we will protect your confidentiality and privacy.

6. What are the benefits of participating?

We do not expect that you will directly benefit from participating in this study. However, we hope that others will benefit from what we have learned, both here in the Okanagan and elsewhere where there is tension between development and environmental protection.

7. How will your privacy be maintained?

Data will be stored on a secure server at the University of British Columbia for at least five years, after which files will be deleted and any physical storage destroyed. Anything that can identify you will be removed from the data before it is used for any analysis, and will likewise be absent from any results that are publicly available. We ask you and all participants in this session to respect the privacy and confidentiality of all those who participate by not sharing what you have heard after this session. In most sessions conducted this way, participants do respect each others privacy. However, we cannot guarantee this and as such please be aware that there is a risk your privacy will not be respected by other participants.

8. Will you be paid for your time/ taking part in this research study?

We understand that participation in a jury session is a considerable time commitment. As a sign of our appreciation, we will give you \$50.00 for participation at the end of the session.

9. Informed Consent

By signing the consent record that we will be circulating at the beginning of the session, you confirm that you are at least 18 years old, are legally able to give informed consent, and are consenting for us to use your responses as we have described. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the

UBC Office of Research Services toll free at 1-877-822-8598 or the UBC Okanagan Research Services Office at 250-807-8832. It is also possible to contact the Research Complaint Line by email (RSIL@ors.ubc.ca).

10. Who can you contact if you have questions about the study?

If you have any questions, please contact Dr. John Janmaat, either by email at john.janmaat@ubc.ca, by phone at 250-807-8021, or by mail, Dr. John Janmaat, Unit 8, I.K. Barber School of Arts and Sciences, The University of British Columbia, 3333 University Way, Kelowna, BC, V1V 1V7.

APPENDIX M

QUESTIONS FOR EXPERT WITNESSES

As described in the overview we sent to you, people will have the opportunity to suggest some questions for experts. We took their questions and distill them down to two or three, which are presented out to you as they were directed at.

1. Expert Witness 1: Jason Schleppe, President at Ecoscape Environmental Consultants Ltd., Kelowna.

The group has four questions for you, which we distilled down to the three below.

- a. What recommendations would you make to maintain natural shoreline while allowing development that incorporates human usage?

Answer: Shoreline maintenance is complicated for the exact reason identified in the question, how do you achieve balance. To me, it means at minimum maintaining the current shoreline condition and preferably improving shoreline function in all areas, but particularly in areas of greater habitat value (e.g., shoreline spawning areas, high value rearing areas, etc.). To reach these goals I think that: 1) Areas of higher value need to be identified, and clear, measurable objectives to maintain or improve the shoreline need to be developed. The challenge is balancing private property rights with the rights of the public because the shoreline and lake are a public resource in many aspects (i.e., it is very likely that a good portion of our economy is derived from the lake and the shorelines natural value but private parcels do have inherent rights of access and protection). 2) ensuring that adequate resources are directed to education. An adequate education system is needed to ensure both lakeside and non-lakeside residents understand the value of the resource and the need to protect it. And, 3) Since education has occurred, a suitable and realistic adaptive management plan with compliance and enforcement systems should be implemented to ensure that management goals are achieved. Finally, I would suggest that all levels of government need to play an active role in shoreline management because it is a public

resource and self regulation without adequate compliance monitoring is not likely to be successful. Once resources are lost, they are much harder and costly to restore and each level of government has some level of responsibility under the current legislative framework.

- b. Is the measurement of shoreline loss based on actual disturbed shoreline or simply based on whether the lot has been developed, and given that much remaining shoreline is in parks, will the rate of loss slow down?

Answer: The measurements of shoreline loss are based upon data for Okanagan Lake and there are many assumptions in the analysis. I define a disturbance as any deviation from natural shoreline character, meaning that any private held, Crown, or municipal parcel (Park or otherwise) can have both natural areas and disturbed areas. These trends have been observed across many lakes in BC. For instance, single family residential areas range in levels of disturbance from as high as 70 to 90% in many cases on many lakes. Generally, as density of development increases, so does the level of disturbance. The rates of loss likely vary spatially, meaning that some areas will have higher rates (e.g., say 2%), while others have lower rates (e.g., say 0 to 0.5%). I would think that as privately held parcels increase in density (i.e., going from rural to single family residential or from large parcel single family residential to multi family, etc.), there is an increase in the observed rate of loss. Once the amount of disturbed shoreline increases to some point (maybe between 70 to 90%, this is just a guess, and likely complicated to calculate, but possible), the rate would slow down simply because there is not as much natural area left. So, is it possible to reduce the rate, I would suggest yes but this will be challenging. Once natural capital is lost it is very challenging to restore it.

- c. How does increasing the population density in the city core affect quality of life?

Answer: I am not sure I am qualified to comment on quality of life, this is likely a matter of preference. The urban versus rural debate has always been and will continue to be challenging. From a biological perspective, I think that densification of previously disturbed areas will concentrate impacts to the environment, and reduce the spread of habitat loss in

natural areas, both shoreline or upland. Further, I believe that densification is a more tax efficient land development strategy than sprawl. However, I can appreciate the desires of those that prefer a more rural character because this is why I am a biologist. Ultimately, I think growth will occur, and local residents need to become involved to help guide and direct how the places they live develops and grows. Given that growth is likely inevitable, residents need to better understand the challenges of and consequences of different growth scenarios. I believe that if the core doesn't develop, it is probable that other areas will and these areas may have very high natural capital value also. So, ultimately, the tradeoff is deciding where and what natural capital is worth protecting and what is worth sacrificing to more dense development scenarios.

2. Expert Witness 2: Anna Warwick Sears, PhD, Executive Director, Okanagan Basin Water Board.

The group came up with questions they would like to put to Anna Warwick Sears.

- a. Can we deal with the pressure that continuing population growth is putting on agriculture and environmental resources by putting a cap on how much more we grow?

Answer: In the near term, say the next several decades, where population growth occurs is more important than how many people move here. For the best use and reuse of resources, people should be concentrated in urban centres, near services. Putting a cap on growth without controlling the form of growth accelerates resource waste and over-inflates property values.

- b. Is wastewater a problem in the Okanagan and are there good methods for disposal and reclamation?

Answer: Wastewater must be constantly maintained and improved to avoid becoming a problem. This is an area where we do NOT want to have deferred maintenance. Right now, there are no major problems, but some systems are nearing capacity and will need to be expanded. Keep in mind that there is very little margin of error. Kelowna Wastewater

treatment plant for example must run near perfectly 24/7/365 as long as there are people living in the city.

c. What part can pricing of environmental resources play in supporting conservation?

E.g. water pricing policy.

Answer: pricing of environmental resources plays a relatively small role in their conservation. It depends somewhat on the price of course. People drive less in Europe because the gas prices are so much higher. But a bigger and more immediate influence for conservation is people's moral and community values and what is seen as the socially responsible right choice. Currently, poor spending choices are socially acceptable, as is excessive water use.

3. Expert Witness 3: Todd Cashin, Agriculture and Environment Services Manager at City of Kelowna.

The group came up with three questions they would like to put to Todd Cashin.

a. What would be the best way to protect farmland for this, and the next, generation?

Answer: It has three parts: Continue supporting the ALC and it's mandate to protect farmland, Continue supporting strict policies regarding farmland loss and fragmentation such as exclusions and subdivisions, Continue to enforce illegal uses, non farm uses and misuse of existing policies that impact agricultural lands or agribusinesses such as industrial and commercial land uses on farmland, soil removal and placement and non-agricultural retail operations (or activities or businesses that become the primary land use over agriculture).

b. How does increasing the population density in the city core affect quality of life?

Answer: Tough question to answer given that quality of life means different things to different people. For example, someone who grew up in rural Manitoba will have had a completely different life experience than someone growing up in Surrey and therefore each individual is going to have a completely different expectations of quality of life impacts or benefits. However, I think that(if planned well) densification can sustain businesses and services downtown which can create a livelier downtown core and therefore create a rich mix

of economic activities, mix of housing stock and mix of employment opportunities in the downtown area. However, if not done correctly, housing supply may see a significant rise in real estate values which can squeeze out activities and residents. Quality of life impacts in downtown Kelowna in the short term (e.g. next 5 years) will include: construction noise, traffic and parking disruption during significant construction projects and increased frustration with parking, traffic and transit.

4. Expert Witness 4: Carol Luttmmer, OCCP Coordinator, Okanagan Collaborative Conservation Program.

The group came up with three questions they would like to put to Carol Luttmmer.

- a. Are you in favour of vertical expansion (high rise buildings) instead of urban sprawl?

Answer: I am in favour of vertical expansion instead of urban sprawl. It allows us to protect natural areas and farmland.

- b. Which is the best venue for protecting foreshore areas - local, regional or provincial?

Answer: All three are important. Jurisdictions for who regulates the foreshore are a result of century old understandings that water-bodies and watercourses are essential for marine commerce and streams are important for potable water and irrigation. Therefore, I am not an expert in the regulations and laws, but my understanding is that the federal government is responsible for navigation and the province, through the Land Act, is responsible for approving any development below the high water mark. Hence, if a landowner wants to build a dock, they have to get approval from the Province. The Okanagan has the Large Lake Protocol which the province uses to and there is also the Riparian Act Regulations which is provincial legislation that requires local governments to protect riparian areas. Local and regional governments can affect foreshore development through zoning and bylaws. I think a coordinated approach from all levels of government is necessary- but also really important is public education. An informed public, that understands the need to protect the foreshore to maintain fisheries and water quality- that will go a long way.

Communities, developers and landowners need to make decisions because they understand and care about the implications of their actions.

c. How does increasing the population density in the city core affect quality of life?

Answer: I think increasing density in the city core increases quality of life. It allows for more services in a smaller geographic area (who doesn't like to be able to walk to their favorite coffee shop or pub?), for residents to have a more sustainable lifestyle, and to protect our natural areas and farmland. I am a firm believer that being connected to the natural environment is critical to quality of life- but this doesn't mean we all have to live on hobby farms or acreages. As we increase density I think that quality of life and connection to nature can be maintained by designing city cores to incorporate natural features, such as boulevards with trees down the center, green spaces and living walls in buildings and by increasing opportunities and access to the natural environment within and on the outskirts of the city core.

APPENDIX N

DEBRIEFING QUESTIONS

Please indicate your level of agreement with the following statements, where 1 is strongly agree and 7 is strongly disagree

TABLE N.1. Debriefing Questions

	1	2	3	4	5	6	7
Environmental problems in the Okanagan will be worse than predicted							
We cannot influence the future of the Okanagan environment							
There are other priorities more important for government spending than the environment							
Government do not listen to the input from the public when making decisions that affect the environment							
This exercise has helped me to better understand different perspectives about the Okanagan environment							
This exercise has helped my views about protecting the Okanagan environment							
This exercise has left me better informed about environmental issues in the Okanagan							