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Report Title: Valuing the contribution of private woodlots to society: a focus on riparian areas in a New Brunswick watershed

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Valuing the contribution of private woodlots to society: a focus on riparian areas in a New Brunswick watershed

By:

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Final Report

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Executive Summary

- The goal of this research was to shed light on the value of ecological goods and services (EG&S) provided by private woodlots to society and to examine the potential mechanisms that can be used to facilitate their delivery.
- Our research specifically focused on riparian areas of the Canaan-Washademoak watershed region in New Brunswick, as a case-study.
- There were four specific objectives associated with this research: (i) To examine private riparian-area forest owner characteristics, forest values, forest management activities, attitudes about environmental stewardship, and perspectives about the current state of the watershed; (ii) To quantify the opportunity costs of protecting private riparian-area forests in the watershed for water, wildlife, and aesthetic benefits in riparian buffers; (iii) To estimate society's willingness to pay for EG&S benefits provided by private riparian-area forests in the watershed, and to estimate private forest owner's willingness to accept compensation for the provision of riparian buffers; and (iv) To assess the main impediments to market exchanges of private forest EG&S in the watershed.
- A wide array of methods were used to achieve the above objectives, including extensive literature reviews, mail surveys of the public and woodlot owners, focus group meetings, and wood supply modeling.
- This report is organized using a number of independent, but related, chapters that are focused on achieving one of the above objectives.
- In Chapter 2, we discuss the results of a mail survey aimed at examining the social and ecological characteristics of riparian landowners within the Canaan-Washademoak watershed. Based on a random sample of 595 landowners and a response rate of 53%, survey statistics revealed that the riparian zone landowners consist of mostly seasonal residents (at 70%), who spend time in the region mainly in the summer months each year. The population is predominately older, retired or pre-retired males with both relatively high education and income levels, owning one parcel of property 1 acre in size.
- Landowners reported multiple values for the region. They benefit from the aesthetics and the recreational opportunities provided by the area, and enjoy the abundant, diverse wildlife and the slow pace of life;
- The majority of riparian land owners indicated that they did not know much about the quality of the water or fish populations in the watershed, however, they tended to believe that industrial forestry and agricultural operations are the largest threats to local water quality;
- All landowners had high levels of self-reported land stewardship, indicating that they may be under-estimating the negative consequences of their own activities. This possibility is emphasized by the fact that relatively few woodlot owners in the region (about 30% in a sample of 83 owners) had forest management plans. While many (54% of the sample) didn't believe they need one, some (18% of the sample) never gave much thought to it in the past.

- In Chapter 3, we estimated the opportunity costs of providing 30 meter (m) and 60m riparian buffers on private forestland, agricultural land, and residential land within the Canaan River and Washademoak Lake sections of the watershed.

- For private forestland, a wood supply model (Spatial Woodstock) was developed with the objective of maximizing the net present value of stumpage (at a 5% discount rate) over an 80-year time horizon under different buffer scenarios and harvesting intensity constraints. The opportunity cost of 30m and 60m buffers on forestland in the River section were estimated at $3,991,467 and $7,636,902, respectively. These values were lower in the Lake section at $2,815,863 and $5,310,818, respectively.

- Considering the forestland area in the region, per acre opportunity costs for 30m and 60m buffers were estimated at: (i) $678/acre and $675/acre on forestland in the River section, respectively; and (ii) $953/acre and $939/acre on forestland in the Lake section, respectively.

- For agricultural and residential land, the total opportunity costs of 30m and 60m buffers were calculated using estimates of per acre land values at $300/acre for agricultural land throughout the watershed, $1,723/acre for residential land in the River section, and $11,592/acre for residential land in the Lake section. Applying these per acre estimates to the total acres under each land classification results in total opportunity cost estimates for 30m and 60m buffers of: (i) $432,900 and $855,900 on agricultural land in the River section, respectively; (ii) $169,800 and $357,300 on agricultural land in the Lake section, respectively; (iii) $139,748 and $285,139 on residential land in the River section, respectively; and (iv) $1,967,431 and $3,865,352 on residential land in the Lake section, respectively.

- In Chapter 4, we discuss the results of two contingent valuation method (CVM) mail surveys aimed at estimating the publics' willingness to pay, and landowners' willingness to accept compensation, for the benefits and costs of riparian buffers along the Canaan River and its main tributaries, respectively.

- The public CVM survey was mailed to three random samples of households: (i) within the riparian area of the watershed; (ii) within the remainder of the watershed; and (iii) within the remainder of southern New Brunswick. A total of 1702 surveys were mailed out, and a response rate of just under 30% was achieved.

- On average, members of the general public were each willing to pay: (i) $32.96 per year for a 30m riparian buffer on all woodlots; (ii) $39.02 per year for a 60m buffer on all woodlots; (iii) $47.64 per year for a 30m buffer on all woodlots, agricultural lands, & residential land; and (iv) $58.89 per year for a 60m buffer on all woodlots, agricultural lands, & residential land. Three EG&S (water quality, wildlife habitat, and forest scenery) flowing from riparian buffers were also valued. Average per person benefits ranged from $15.45-$27.21 per year for water quality, $12.68-$23.19 per year for wildlife habitat, and $4.23-$7.26 per year for forest scenery, depending on the size and scope of buffer protection.

- Per acre benefits from EG&S in buffer areas ranged from $915.27-$1,431.37, depending on the scale and scope of buffer protection. Per acre benefits from specific EG&S ranged from: (i) $97.48-$185.94 for forest scenery; (ii) $347.19-$663.87 for water quality; and (iii) $308.98-$549.72 for wildlife habitat.

- The landowner CVM survey was sent to a random sample of 618 riparian landowners, and a response rate of 53% was achieved.
- On average, woodlot owners were willing to accept $530.25 per acre each year for a 30m buffer, while non-woodlot owners were willing to accept $2,615.38 per acre each year. In the case of a 60m buffer, woodlot owners and non-woodlot owners were willing to accept $1,030.79 and $2,860.23 per acre each year, respectively.
- A benefit-cost analysis of riparian buffers along the Canaan River and its main tributaries revealed that 30m buffers on woodlots, agricultural, and residential land produce positive net present values (i.e. stated willingness to pay was greater than stated willingness to accept compensation). Sixty meter buffers produced negative net present values. However, if the previously determined per acre opportunity cost (estimated in Chapter 3) were used in place of the stated willingness to accept compensation, a positive net benefit would occur for 60m buffers on woodlots.
- In Chapter 5, we discuss the results of a mail survey that examined the impediments to market exchanges of EG&S on woodlots in and outside the Canaan-Washademoak watershed. A total of 1700 surveys were mailed out to landowners throughout the region, with a response rate of 17%. A focus group meeting was also held with 14 woodlot owners in the region to gather further information on opportunities that exit for solving impediments to market exchanges of EG&S.
- Survey results revealed that some EG&S exchanges have already taken place. Four landowners indicated that they have experience selling some combination of access for fishing, hunting, hiking trails, snowmobiling, bird/wildlife watching, camping, and forest viewing (aesthetics) on their land.
- The potential for EG&S exchanges in the watershed could be increased with institutional developments such as intermediaries to reduce transaction costs. Legal sanctions for trespassing and breached exchange agreements, and reduced policy restrictions for fishing and hunting may also be valuable for allowing market exchanges of EG&S.
- The results of this research have important implications specifically for woodlot policies in the province of New Brunswick. Specifically:
  - Woodlot owners provide important EG&S to the public in the province, and increased efforts should be directed toward informing these owners about the benefits of management planning;
  - Thirty meter riparian buffers around major watercourses in the case study region provide a positive net benefit to society, and governments/individuals should consider incentives along with existing legislation to help support these and other ecologically important areas;
  - Increases in riparian buffers up to 60m on woodlots may be supported in net benefit terms for the case study region, depending on the procedure used for estimating costs. Incentives for such protection in these and other ecologically important areas should also be considered;
  - Much potential exists for facilitating market exchanges of EG&S through the reduction of institutional impediments.

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CHAPTER 1

INTRODUCTION

Increasing attention is being paid to the important role that private forests play in maintaining ecosystems across Canada. Organizations such as the Canada Model Forest Network have begun actively encouraging the recognition of private forest contributions to society through their Private Woodlot Strategic Initiative. This initiative complements one of the National Forest Strategy Coalition's priority action areas that emphasizes the need to find mechanisms to compensate landowners for provision of ecological goods and services (EG&S) such as watershed health and clean water, wildlife habitat, aesthetics, carbon sequestration, recreation, and others. The Canadian Federation of Woodlot Owners has also expressed particular interest in valuing water, wildlife, and aesthetic services provided to the public.

In order to recognize and find mechanisms to compensate private forest owners for the EG&S they provide, a significant amount of information is required. This includes: (i) an identification of the EG&S provided by private forests at specific scales (e.g. individual woodlot or watershed-level) and the activities required to provide them (e.g. for clean water services, activities might include managed steam buffers, etc.); (ii) a quantification of the extent to which these EG&S/activities are currently being provided; (iii) an estimation of the costs involved with maintaining and/or improving the EG&S; (iv) an estimation of the social benefits associated with the maintenance and/or improvement of the EG&S provided; and (v) an exploration of the mechanisms and conditions required to effectively recognize and/or compensate private forest owners for providing the environmental services to society.

The goal of this report was to shed light on the value of EG&S provided by private woodlots to society and to examine the potential mechanisms that can be used to facilitate their delivery. This research specifically focused on the Canaan-Washademoak watershed region in New Brunswick as a case-study. The watershed scale was chosen because it tends to be most appropriate for examining the particular EG&S focused on in this research, which include water quality, wildlife habitat, and forest aesthetics. Since riparian areas have been cited as one of the most influential on the quality of these EG&S, we also focused on these areas in our analysis.

There were four specific objectives associated with this research:

Objective #1: To examine private riparian-area forest owner characteristics, forest values, forest management activities, attitudes about environmental stewardship, and perspectives about the current state of the Canaan-Washademoak watershed.

Objective #2: To quantify the opportunity costs of protecting private riparian-area forests in the Caanan-Washademoak watershed for water, wildlife, and aesthetic benefits.

Objective #3: To estimate society's willingness to pay for EG&S benefits provided by private riparian-area forests in the Caanan-Washademoak watershed, and to estimate private forest owner's willingness to accept compensation for the provision of such services.

Objective #4: To assess the main impediments to market exchanges of private forest EG&S in the Caanan-Washademoak watershed.

A wide array of methods were used to achieve the above objectives, including extensive literature reviews, mail surveys of landowners, a woodlot owner focus group meeting, and wood supply modeling. These methods, used to shed light on the value, recognition, and compensation of EG&S provided by private forest owners to society in the Caanan-Washademoak watershed case-study, can be replicated in other regions in the future.

This report is organized using a number of independent, but related, chapters. Each of Chapters 2-5 have their own introductions, methods, results and conclusions sections and are respectively focused on achieving one of the above objectives. Chapter 6 provides an overall synthesis of the independent chapters and discusses possible courses of action to be taken in the future to facilitate the value, recognition, and compensation of EG&S provided by woodlots to society.

CHAPTER 2

A CHARACTERIZATION OF PRIVATE RIPARIAN AREA LANDOWNERS IN THE CANAAN-WASHADEMOAK WATERSHED

Principle Researcher: Stephanie E. Merrill

2.1 Introduction

In recent years, the riparian zone of the Canaan River and Washademoak Lake has been under tremendous development pressure. Most recently, the watershed, particularly the lower reaches and the Lake, has become increasingly popular for summer homes, water based recreation and tourism; attracting people to the scenic beauty and relaxing atmosphere which the region provides. The influx of people, and a transition from farming and agricultural communities to ones comprised of retreating retirees and their recreating families, has great implications for the structure and function of the riparian zone and perhaps subsequently the quality and quantity of the adjacent water. New developments taking place along the river and lake may be threatening the aquatic resources and the human activities that depend on them; the qualities that most likely attracted people to the area in the first place.

The purpose of this research was to better understand the relationships between the people who live, work and play in the watershed, and the resources that are simultaneously affected by and depended upon to support their lifestyles and livelihoods. Specifically, the objectives of this chapter are to: (i) introduce the study site watershed and its ecological and social characteristics; and (ii) to examine private riparian ownership patterns and values and perceptions relating to the landowners' experience in the watershed. Knowledge of the structure and function of the multiple communities, the biophysical condition of the watershed, and the reciprocal relationships between the people and these resources can lead to: (i) a better understanding of the processes that have contributed to the current conditions; (ii) lead to an assessment of desired future conditions; and (iii) a plan for achieving them.

2.2 Research Methods

2.2.1 Sampling Design

This study targeted woodlot and agricultural, residential and recreational riparian zone landowners. Riparian zone properties were defined as any property abutting the main-stem and major tributaries (any double-lined watercourses on a 1:50,000 scale NB topographic map) of the Canaan River and Washademoak Lake. All the riparian properties (approximately 1400), with landowners' names and mailing address, were obtained from the Service New Brunswick Real Property Mapping and Land Assessment databases (Service New Brunswick 2006). All non assessed residential and recreational properties (such as commercial, institutional, public, etc.) were removed as were duplicate owners, to reduce the sample bias generated through the inclusion of multiple-property owners. Husbands and wives (assumed by same last name and mailing address) listed as separate owners on separate parcels were left in the database. The total sample frame remaining equaled 911. Dillman's (2000) sample size equation was used to determine the required sample within the watershed:

$$(2.1) \qquad Ns = \frac{(Np)\,(p)\,(1-p)}{(Np-1)\,(B/C)^2 + (p)\,(1-p)}$$

where Ns = completed sample size needed; Np = size of population; P = 50/50 split in variation of population; B = sampling error; C = confidence level.

The sample size required for a 50/50 split in a population frame of 911 people to be 95% confident that the sample estimate will be within plus or minus five percentage points of the true population is 271.

The sample frame (911 properties) was sorted by last name and each entry was assigned a random number from 10010 to 19110 (using Microsoft Excel 2003). Entries were then sorted by that random assignment number and the first 611 properties were chosen as the survey sample (this assumed a response rate of around 45% would be achieved).

2.2.2 Survey Development

The survey instrument used in this research was developed by firstly gathering questions from similar surveys and questionnaires found in the literature. Interesting and useful questions were adapted and built-upon while new questions were added. Data was collected using numerous question types: simple "fill in the blank"; 4- and 5-point likert scales with multiple items; option boxes; and open ended questions.

The survey underwent numerous rounds of editing; question development, wording, and format were carefully critiqued. In addition, a pre-test was conducted with seven residents of the Canaan-Washademoak watershed. They were asked to fill out the survey while evaluating each question for clarity, format and length. Several comments were received and the survey was edited to reflect their concerns.

2.2.3 Survey Administration

The Tailored Design Method (Dillman 2000) was followed when administering the survey. The surveyed landowners were contacted four times in order to boost the response rate. An introduction letter was sent to each recipient explaining the purpose of the research and asked for their participation. The letter indicated that the survey package itself would be arriving in approximately one week. One week after the introduction letter, the survey package, including a pre-stamped return envelope, was mailed. The return envelope also included each landowner's random assignment number in brackets following the researcher's name, in order to track survey returns. Two weeks following the first survey package, a thank you/reminder post card was sent to all the sample population to thank those who had already completed and returned the survey and to also remind those who had not yet, to please do so as soon as possible. Two weeks following the postcard, a replacement questionnaire package was sent to those landowners who had still not replied (as indicated by a respondent tracking database).

The survey sample included four international (other than United States) landowners (from Germany and the United Kingdom). These landowners were first contacted by telephone to ensure that they could both read and write in English. They were then sent an introduction

letter, the survey package (including international postage coupons to trade for appropriate postage), and a thank-you/reminder postcard; however no replacement survey was sent.

2.2.4 Analysis

A Microsoft Access database was designed to enter and house survey responses. Access tables were then imported into the Statistical Package for Social Sciences v.14.0 for analysis. Cleaning of the data was preformed by running frequency tests and looking for missing values and outliers (extreme or impossible values). Descriptive statistics (frequency, mean, median, mode, etc.) were used to describe the respondents' responses.

2.3 Survey Results

2.3.1 Response Rate

Of the initial 611 surveys mailed, 9 were returned as undeliverable (unknown address), 7 were returned indicating they were sent in error (do not own property in C-WW), 29 were returned blank (and considered non-respondents) and two were returned incomplete (Table 2.1). The final sample population was 595 and the number of respondents 316, generating a response rate of 53%. Twenty-one percent were returned immediately, 24% after the reminder postcard and an additional 8% after the replacement survey.

Table 2.1: Summary of returned surveys

Survey Returns	Number, or % where identified
Returned Completed	316
Returned Partially Completed	2
Returned Completely Blank	29
Sent in Error	7
Undeliverable	9
Unreturned	248
TOTAL Delivered	595
Response Rate	53.1%

2.3.2 Socioeconomic Characteristics

Landownership in the Canaan-Washademoak watershed is very much skewed by gender; 77% males compared to just 23% females (Fig. 2.1). The mean age of the survey population is 60 years old (Table 2.2); however, there exists a wide distribution of age, from 27 to 90 years (Fig. 2.2). The mean 2005 household income (before taxes) was reported to be between $60,000 and $69,999; however the mode was between $100,000 and $249,999 (Fig. 2.3). Respondents reported a relatively high level of education with 43% having at least completed post secondary education (24% post secondary, 19% graduate or professional training) (Fig. 2.4).

Table 2.2: Measures of central tendency for respondent demographics

	Mean	Median	Mode	Min	Max
Age	60	59	58	27	90
Education	3.15	3.0	3.14	1	5
Income	7.09	7.0	11	1	12

Figure 2.1: Gender distribution of respondents.

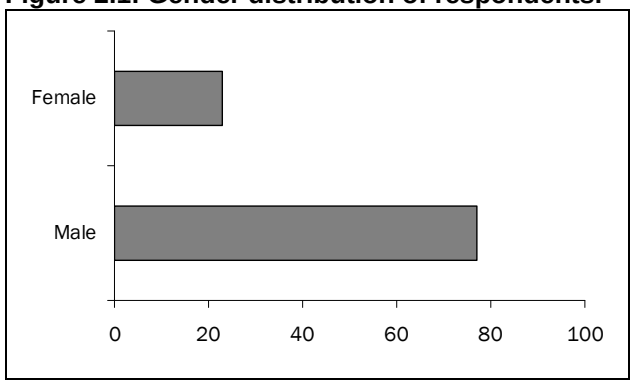


Figure 2.2: Age distribution of respondents.

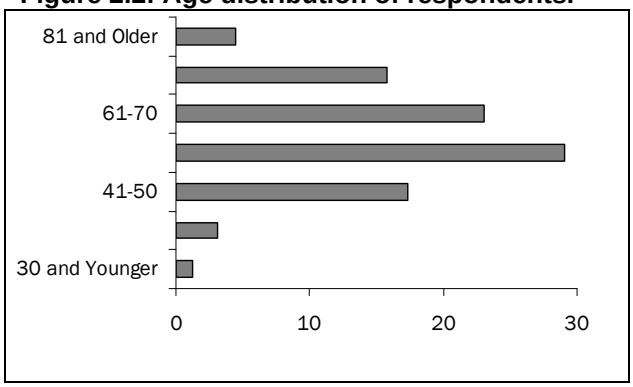


Figure 2.3: Income distribution of respondents.

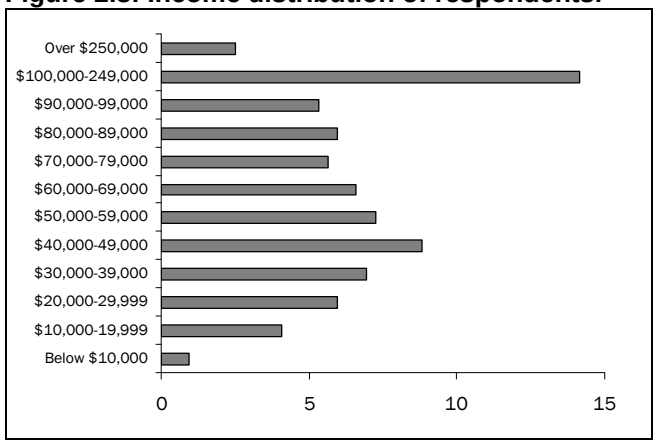
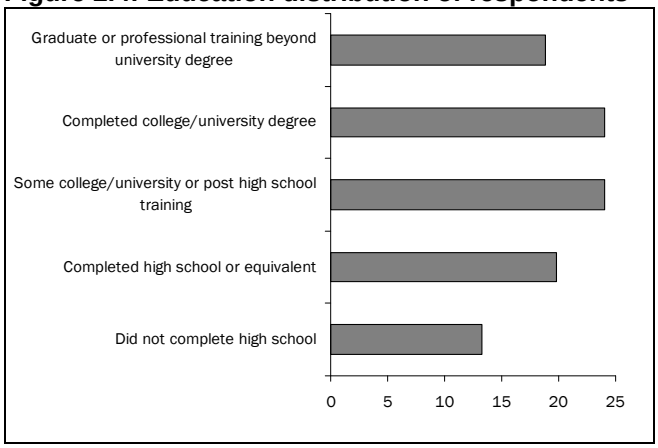


Figure 2.4: Education distribution of respondents



2.3.3 Ownership and Property Patterns

The majority of property owners surveyed owned just one parcel of land in the Canaan-Washademoak Watershed (Fig. 2.5). However, a number of respondents own multiple properties; one owning 16 separate parcels of land. The average total landholding of these parcels is just over 40 acres (Table 2.3), however more representative, is the mode with the majority of properties being 1 (21.5%) or 2 (15.9%) acres in size (Fig. 2.6). Participants were asked to choose one riparian property (of largest water frontage) to refer to when completing the questionnaire. This property has an average size of just over 26 acres, but once again, almost 41% of those were 1 (22.6%) and 2 (18%) acres (Fig. 2.7). Fifty-nine percent of landowners own their land jointly, presumably with their spouse, while another 39% consider them the sole proprietor (Fig. 2.10). The average length of property ownership is just over 18 years (Fig. 2.8), though most respondents have been familiar with the region for much longer; on average, 35 years (Fig 2.9).

Table 2.3: Measures of central tendency for ownership variables.

	Mean	Median	Mode	Min	Max
Number parcels	1.45	1.0	1	1	16
Total holdings (A)	41.62	4.0	1.0	0.25	900
Riparian holding (A)	26.24	3.0	1.0	0.25	360
Ownership time (yr.)	18.5	15.0	20.0	0.25	85
Familiarity (yr.)	35.4	35.0	40.0	0.25	89.0
Ownership type	1.65	2.0	2	1	5

Figure 2.5: Total number of properties owned

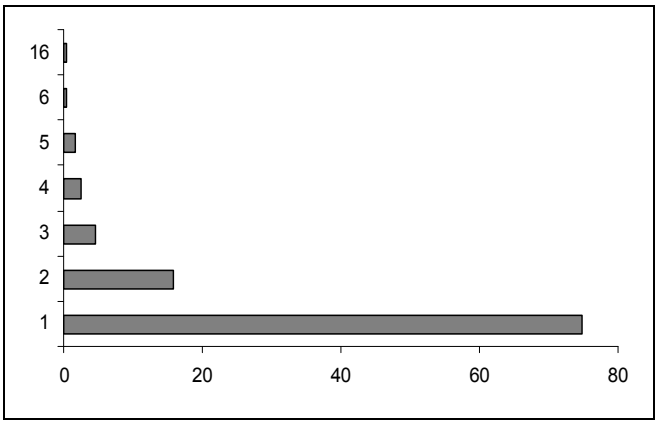


Figure 2.6: Total land holding (A)

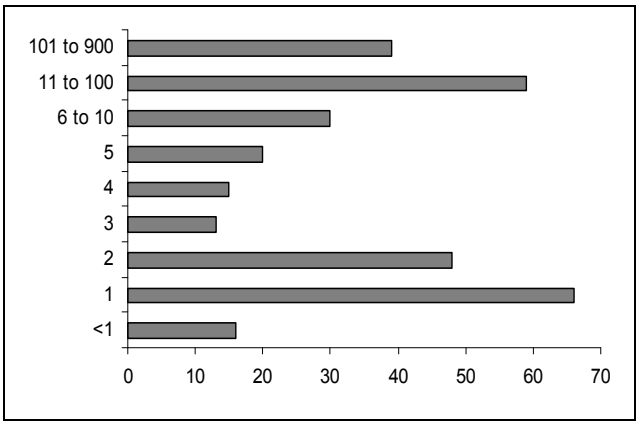


Figure 2.7: Landholding of riparian property (A)

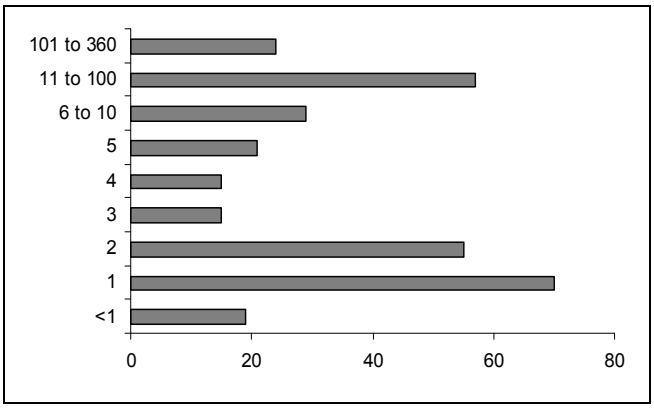


Figure 2.8: Ownership time (yrs.)

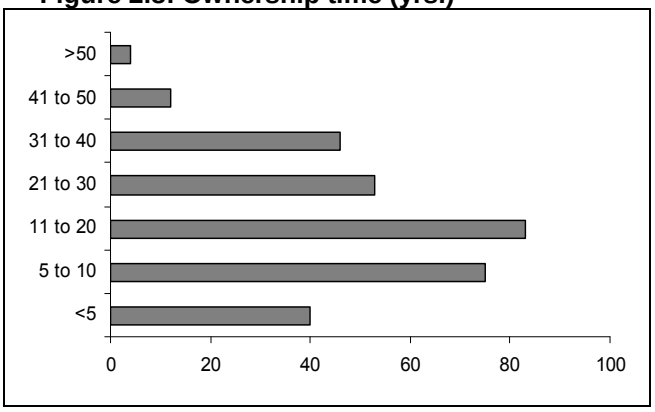


Figure 2.9: Familiarity with region (yrs.)

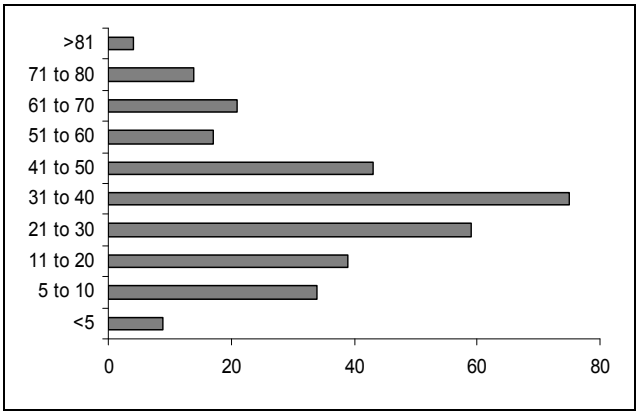
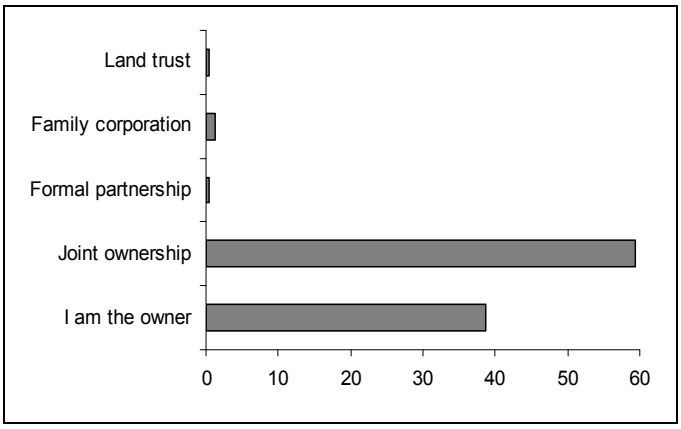


Figure 2.10: Ownership type

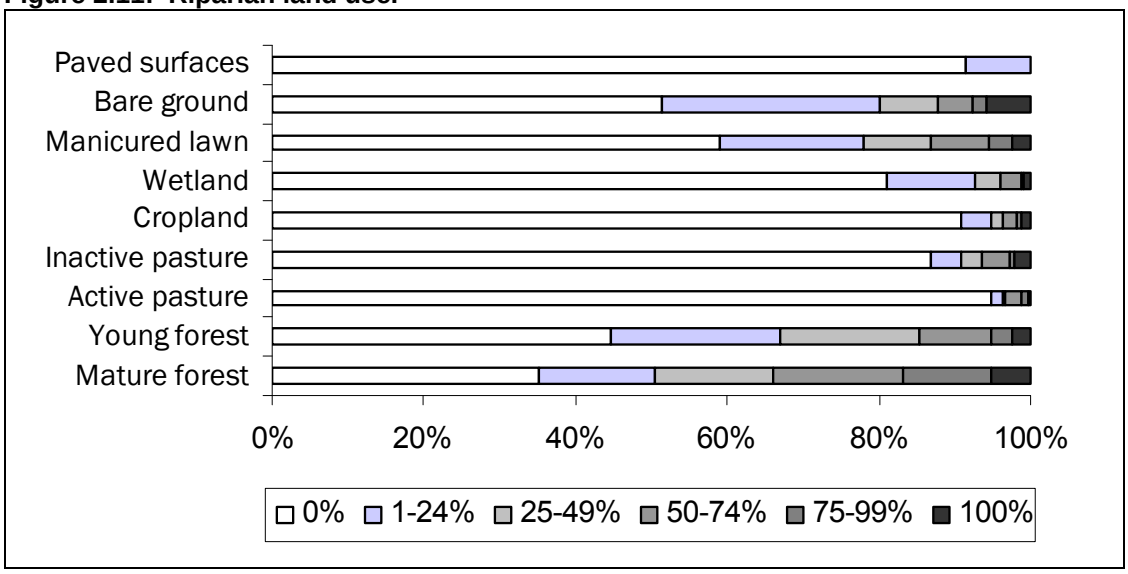


2.3.4 Property Characteristics

Landowners were asked to indicate the percent of each land cover type "along the waterway" on their property in order to roughly determine the current state of the riparian zone. The following figure shows the percent of landowners in each range of coverage (0-100%) for each of the land cover types. Very little riparian land is reported to be paved (e.g. roads or buildings), wetland, cropland (including hay), or pasture (neither active nor inactive) (Fig. 2.11). Most respondents report having a riparian zone of mixed land cover; namely mature forest (older than 30 years), young forest (younger than 30 years), bare ground (e.g. dirt roads,

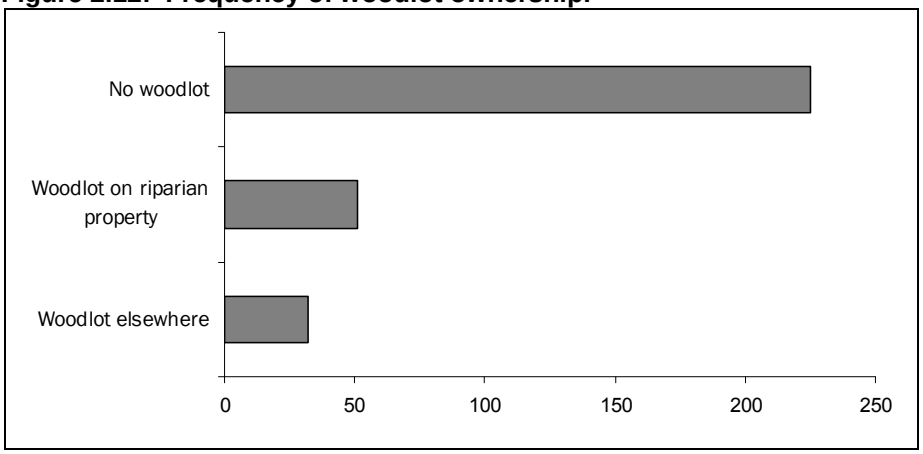
beach), and manicured (landscaped) lawn. Very few indicate 100% coverage of any land cover category.

Figure 2.11: Riparian land use.



Eighty-three respondents (27%) own a woodlot (defined as wooded property 25 acres or more in size); 51 of these woodlots is located on their riparian property while the other 32 are located elsewhere (Fig. 2.12).

Figure 2.12: Frequency of woodlot ownership.



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Landowners were also asked to indicate the dwellings and other structures on their property as well as their location with respect to the water front; within and further than 100 feet (the legislated riparian butter in New Brunswick). Of those who responded, 85 indicated that their main dwelling was located in the riparian zone (within 30 meters of the water's edge). Thirty-nine were summer cottages, 22 hunting/fishing camps, 13 permanent residences, 8 second homes, 2 trailers, and 1 rental property (Table 2.4a). Forty-three people (13%) added that there was no dwelling on the property although "none" was left off the list of options (in error). In addition to the main dwelling, there are 165 other structures associated with the property that are located within the 30m riparian zone. Fifty-eight of those include docks and/or wharves, 33 sets of stair cases (providing access to the water), 20 roads without culverts, 15 roads with culverts, 15 outbuildings (garage, shed, boat house, barn), 8 both boat launches

(made or either concrete, wood, gravel or rock) and trails (ATV, snowmobile, rail line), 3 bridges and 5 classified as "other" (Table 2.4b). One-hundred and eighty-six indicated that there were no structures within 100 feet of the water front.

Table 2.4: The number of dwellings (a) and other structures (b) located within 100 and 200 feet of the waterway on property

(a) Dwellings.

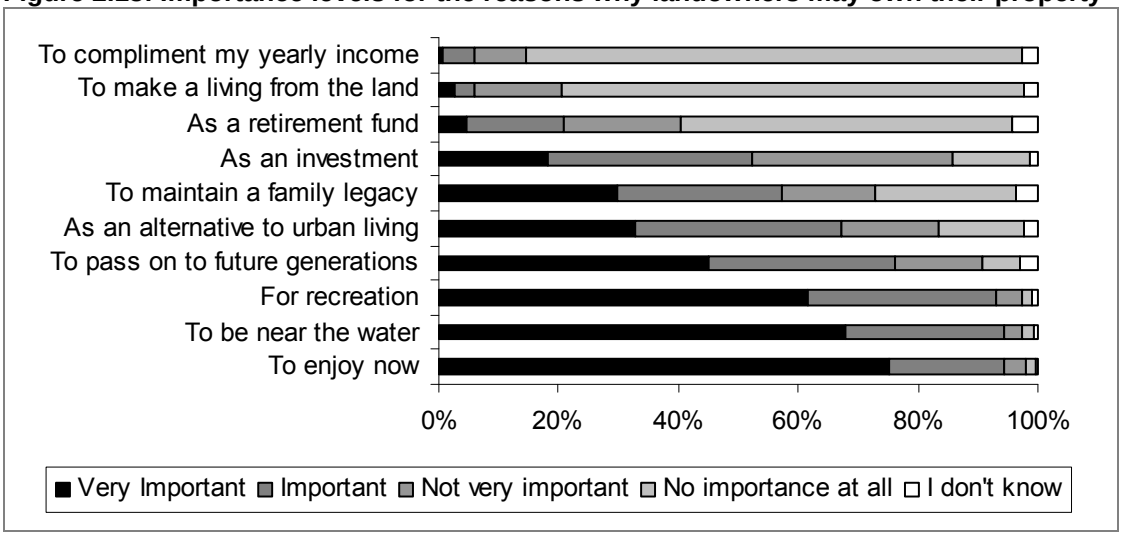
Dwelling Type	Within 100 ft	Further than 100 ft
Second home	8	34
Summer cottage	39	91
Permanent year-round home	13	73
Hunting/fishing Camp	22	21
Rental property	1	9
Other (trailer)	2	3
NONE	43	

(b) Other structures.

Structure Type	Within 100 feet	Within 200 feet
Boat launches	8	2
Dock/wharfs	58	2
Stair cases	33	4
Roads with culverts	15	11
Roads without culverts	20	13
Trails	8	2
Bridges	3	1
Outbuildings	15	16
Other	5	1
NONE	186	

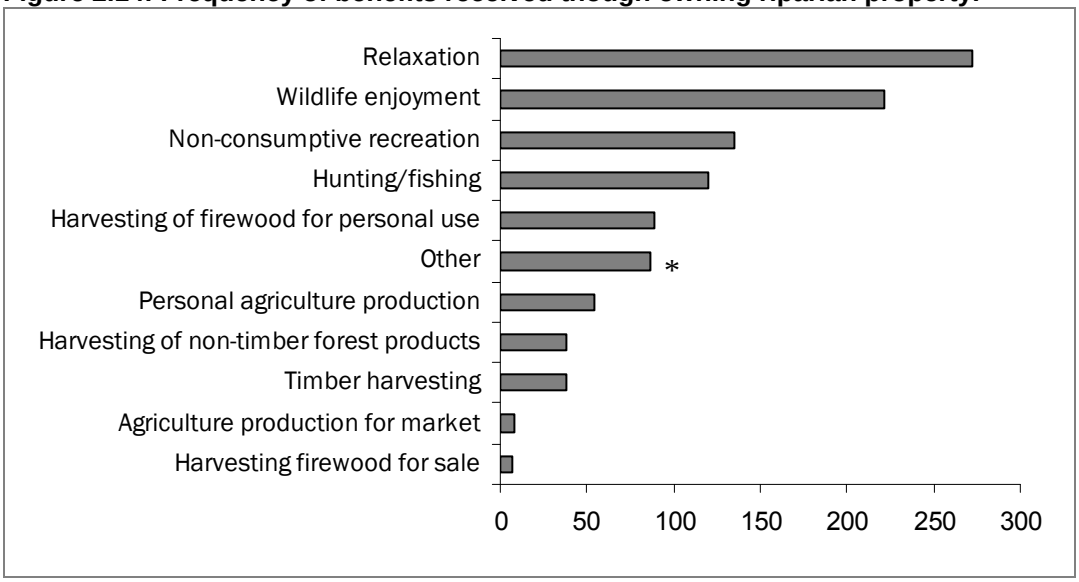
Respondents indicate multiple reasons for owning their property. However, when given the opportunity to rate the importance of a number of reasons why individuals own property, a clear split emerged between more social and environmental factors and economic ones: *"to be near the water"*, *"to enjoy now"*, *"to pass onto future generations"*, *"for recreation"*, *"to maintain a family legacy"*, and *"as an alternative to urban living"* were generally considered to be important (on the positive side of a 4-point likert scale) to the landowner, whereas the items *"as an investment"*, *"as a retirement fund"*, *"to make a living from the land"*, and *"to compliment my yearly income"* were generally considered to be not as important (on the negative side of a 4-point likert scale) (Fig. 2.13).

Figure 2.13: Importance levels for the reasons why landowners may own their property



A similar split is evident with regards to the benefits landowners indicated that they receive through owning property in the watershed. Landowners primarily engage in relaxation, wildlife enjoyment, and recreation (both consumptive and non-consumptive) (Fig. 2.14).

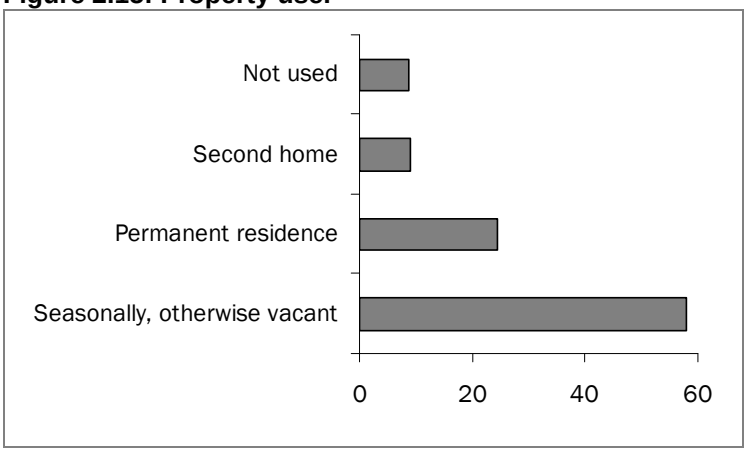
Figure 2.14: Frequency of benefits received though owning riparian property.



*The majority of the "Other" category consists of recreational activities (28 water based recreation, 16 motorized recreation) and ownership (35 home/cottage/place to share with family/friends) benefits.

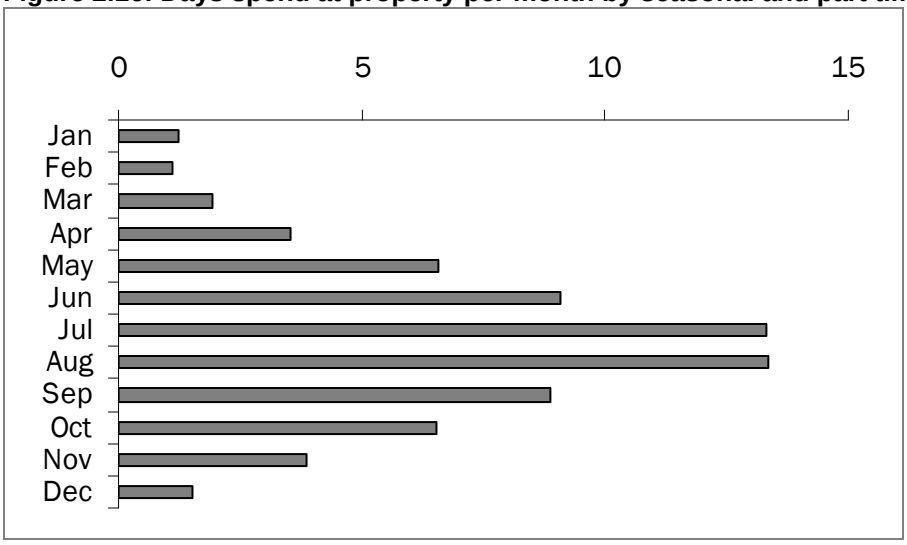
When asked how they would describe how their property is used, 58% indicated that use is on a seasonal basis at which other times the property is vacant (Fig. 2.15). Twenty-four percent of respondents live on their property permanently, or year-round; 9% consider their riparian property a second home (includes most weekends and part-time year-round), while another 9% do not use their property at all, or very rarely (vacant properties and woodlands) (Fig. 2.15).

Figure 2.15: Property use.



Although the "seasonal residents" spend time at their property throughout the different seasons of the year, the summer months of July and August have the highest average days spent (13 days each) when compared to the other months of the year (Figure 2.16).

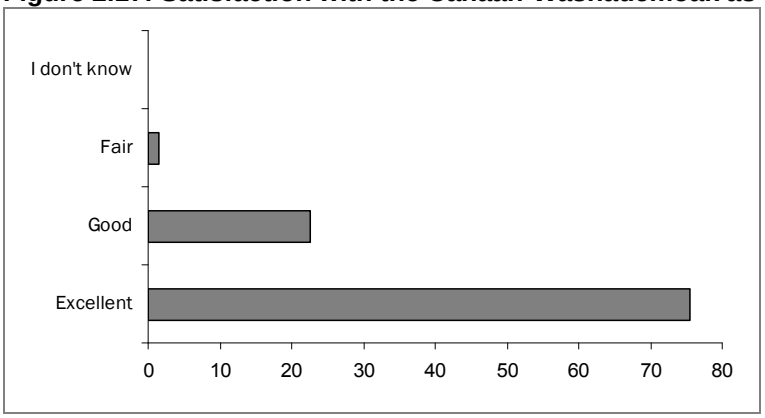
Figure 2.16: Days spend at property per month by seasonal and part time residents.



2.3.5 Quality of Life in the Canaan-Washademoak Watershed

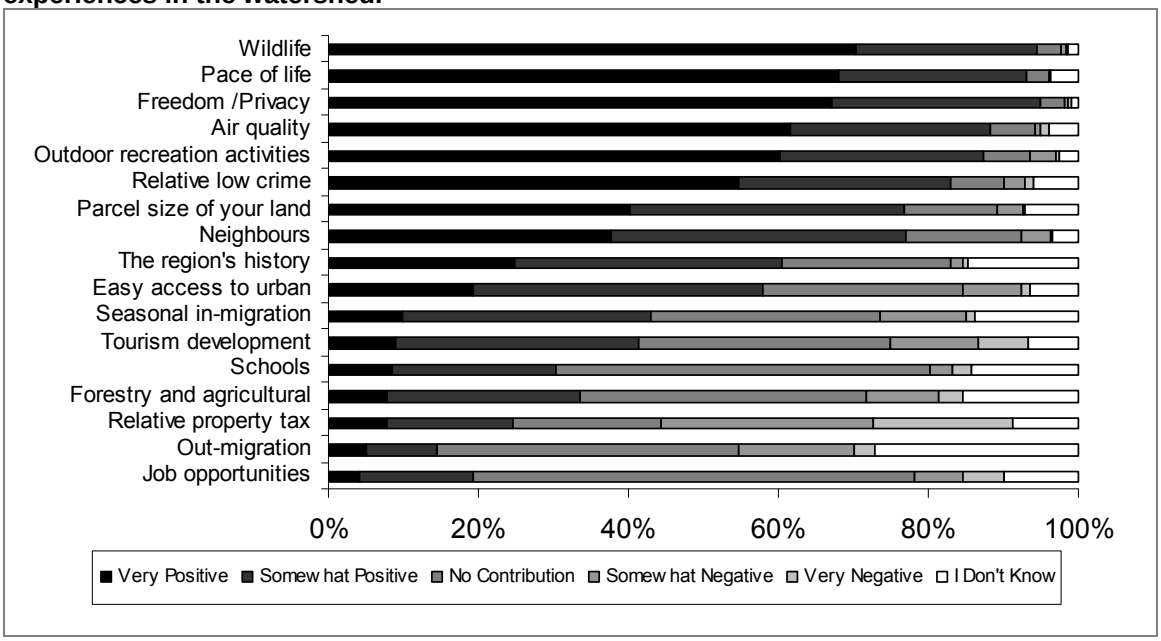
Just over 75% of respondents consider the Canaan-Washademoak watershed an excellent place to live, visit, or spend time (on a 4-point scale from excellent to poor) (Fig. 2.17). In order to gain an understanding of the factors that contribute to their quality of life, respondents were asked to determine how items on a comprehensive list contributed (5-point likert scale from very positive to very negative) to their experience in the Canaan-Washademoak watershed. The items and their contribution to landowners' quality of life are displayed in Figures 2.18 and 2.19. Figure 2.18 includes socially and environmentally related items while figure 2.19 includes potential land use and landscape related items.

Figure 2.17: Satisfaction with the Canaan-Washademoak as a place to live, visit or spend time.



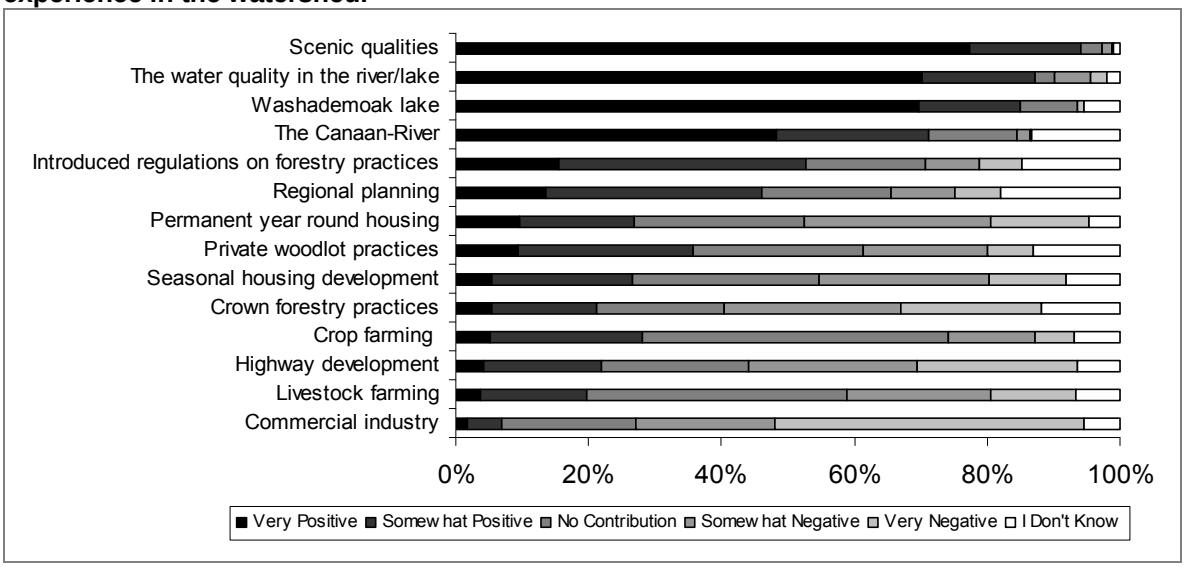
It is clear that landowners consider environmental and personal (physical and mental) wellbeing as the most important factors contributing to their high quality of life in the Canaan-Washademoak watershed. Items such as the wildlife they encounter, the slow pace of life, the freedom and privacy they feel, the outdoor recreation opportunities available, and the relatively low crime rates, top the list as having the most positive affect on their experience in the region (Fig. 2.18). More economically orientated indicators such as job opportunities, schools, forestry and agricultural economies and out-migration, are generally reported to have no contribution. Relative property tax rates have the highest negative contribution to the quality of life for respondents.

Figure 2.18: Social and environmental indicators and their contribution to landowners' experiences in the watershed.



With regard to other land use issues that could potentially have an effect on one's quality of life, the scenic qualities afforded by the region, the water quality of the river and lake, and the River and Lake themselves are overwhelmingly the most positive factors (Fig. 2.19). Crop and livestock farming seem to have no contribution while all types of development (permanent, year round housing, commercial industry, highway, and seasonal housing) are viewed as contributing somewhat to very negatively to landowners' experience in the watershed.

Figure 2.19: Land use and landscape level indicators and their contribution to landowners' experience in the watershed.



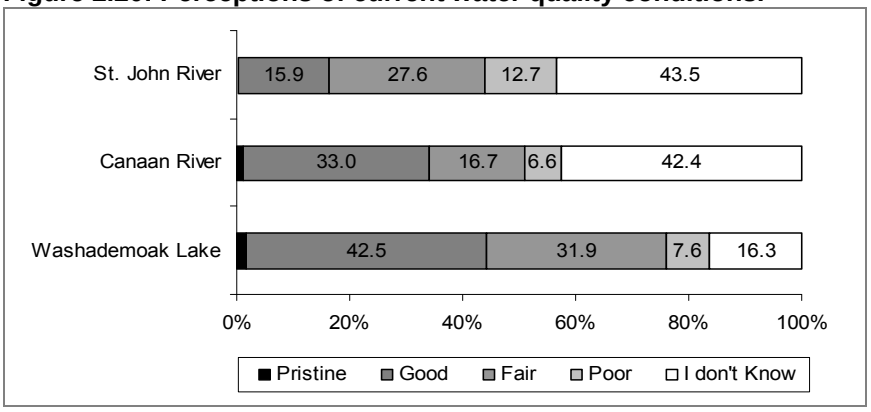
An open ended question gave respondents an opportunity to describe what it is that they value about their experience in the watershed (with regard to the region in general and their property in particular). They were encouraged to include specifics about such aspects as land type, activities, biology, aesthetics, community, economics, people and culture that may hold some value to them. The items mentioned by respondents mirror closely the opinions expressed in the previous questions regarding the quality of life variables. The most commonly reported values include (in no particular order or worth):

- Peace and quiet
- Beautiful
- Privacy
- Air and water quality
- The view
- Sharing with family and friends
- Wildlife
- Swimming, boating
- The Lake
- Relaxing
- Proximity to the water
- Family legacy

2.3.6 Perceptions of Aquatic Quality and Threats to the Resource

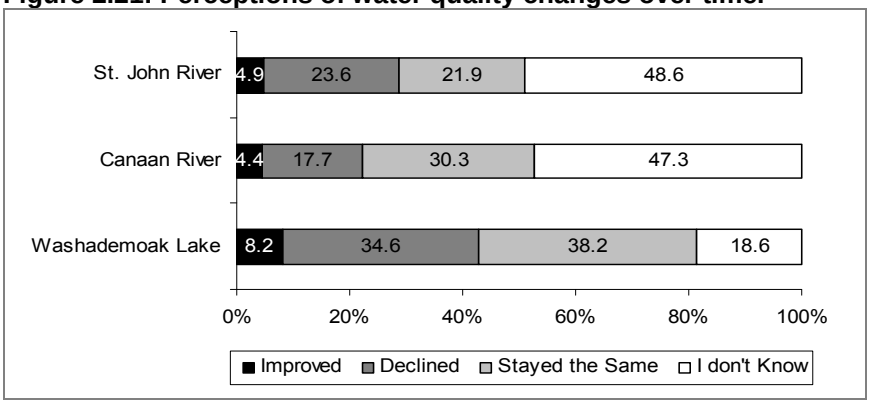
A large number of respondents indicated that they know little about the current quality of water in the Washademoak Lake, Canaan River or the St. John River (downstream of Fredericton) (Fig. 2.20). However, almost 43% believe that the water quality in Washademoak Lake is good, compared to 40% who believe it is fair. Fifty percent of respondents believe that the water is of good or fair quality in the Canaan River. Twenty-eight percent of respondents believe that the water quality in the St. John River (downstream of Fredericton) is good, 15% believe it is fair and 13% believe it is poor.

Figure 2.20: Perceptions of current water quality conditions.



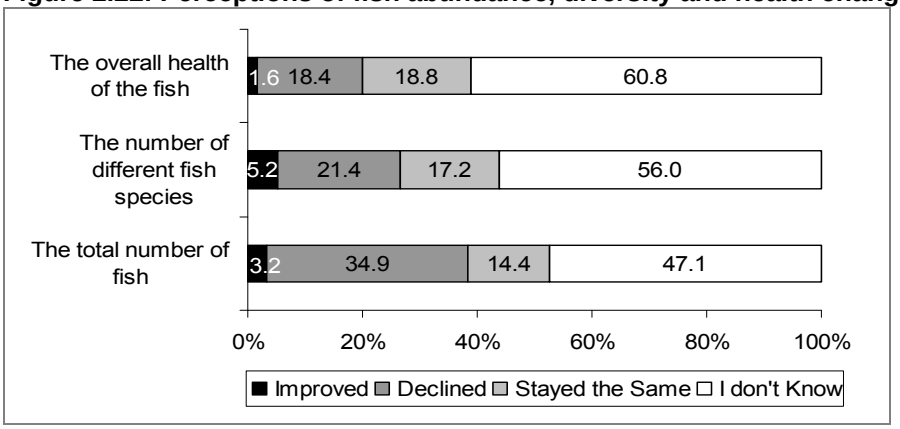
Forty and 30% believe that the quality of Washademoak Lake and the Canaan River, respectively, has stayed the same for as long as they have been familiar with the region (Fig 2.21). Another 35% and 18% indicate declines in water quality in these two section of the watershed over time, respectively, while 8% and 4% say they have witnessed an increased in water quality in these sections, respectively. With respect to the St. John River downstream of Fredericton, 23% believe that the water quality has declined while another 22% say it has stayed about the same. A small portion (5%), believe that the St. John River has improved for as long as they have been familiar with the region.

Figure 2.21: Perceptions of water quality changes over time.



An even larger gap exists in terms of the knowledge of abundance, diversity and health of the fish communities in the Canaan-Washademoak system (Fig. 2.22). For those who did feel they had some knowledge, the majority believe that abundance and diversity have declined for as long as they have been familiar with the region. About half of those responding believe that the health of the fish has declined while the other half believes fish health has not changed.

Figure 2.22: Perceptions of fish abundance, diversity and health changes over time

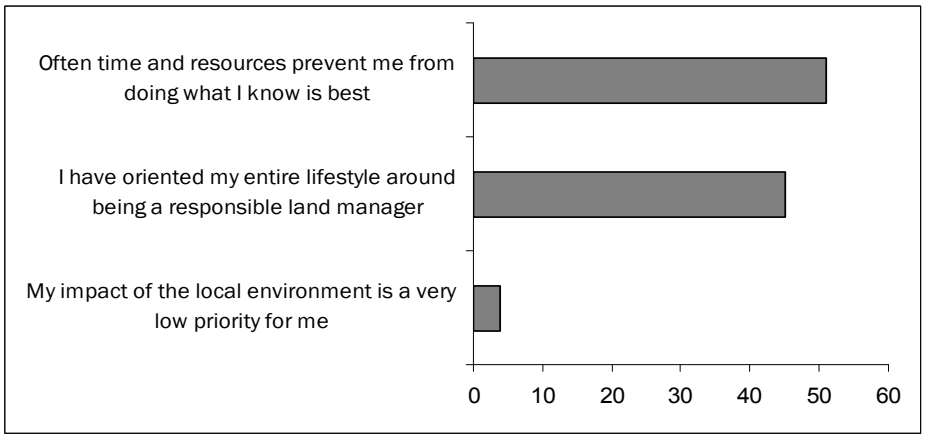


2.3.7 Land Stewardship

The landowner versus thy neighbour

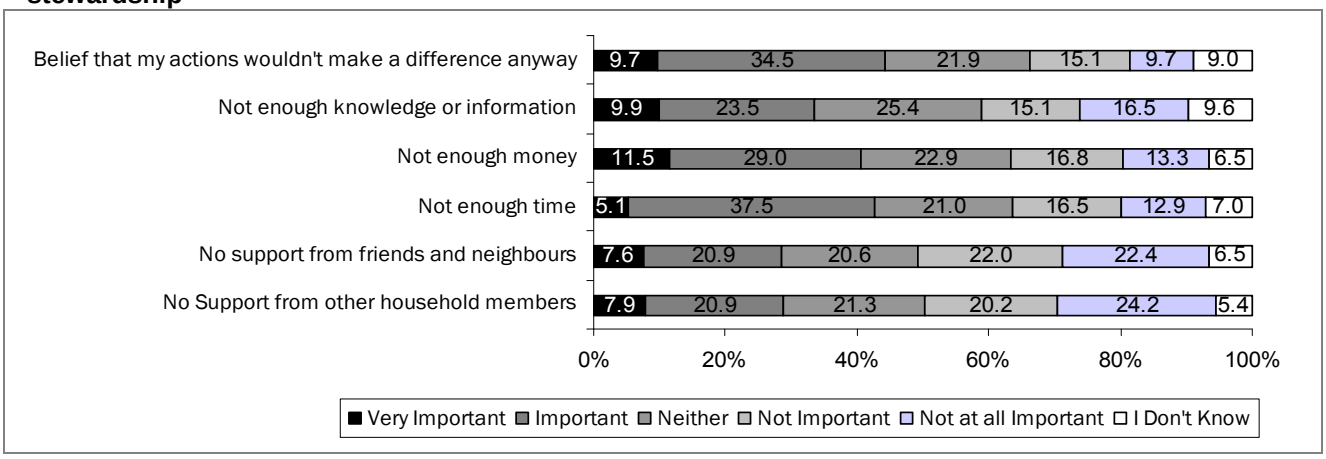
For the purposes of this research, "land stewardship" was defined as being a responsible land manager; practicing responsible property management. Respondents' perceptions of their stewardship were measured through questions that investigated their degree of stewardship and their relative stewardship. When asked to indicate the degree to which landowners considered stewardship in their daily lives, 51% acknowledged that they always considered their impact on the local environment, however, often time and resources prevent them from doing what they know is best. Forty-five percent felt that they have oriented their entire lifestyle around being a responsible land manager, while only 4% admit that their impact on the environment is a very low priority for them (Fig. 2.23).

Figure 2.23: Landowner perceptions regarding the degree to which they consider stewardship in their daily lives.



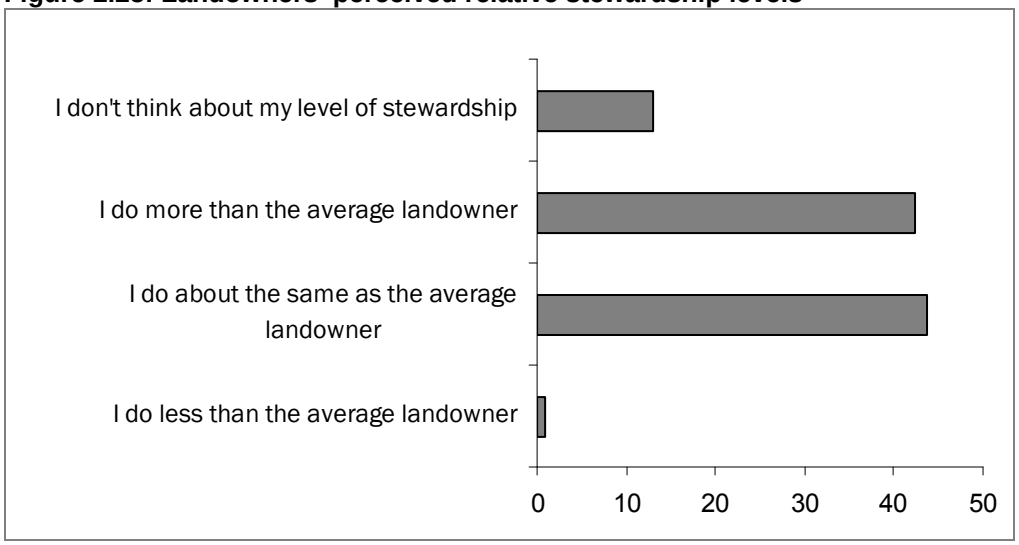
To delve further into the barriers to stewardship for those who felt they were constrained from doing what they felt was the best management, respondents were asked to rate the importance of a list of items that could potentially prevent landowners from engaging in beneficial land management practices. A lack of time (43%) and money (41%) and a belief that their actions would not make a difference anyway (44%) were rated as the most important factors preventing these landowners from (sometimes) acting as responsible land managers (Fig. 2.24).

Figure 2.24: Landowner perspectives on the importance of common barriers to land management stewardship



Landowners were also asked about their relative level of stewardship; how they perceived they compared to other landowners in the region in terms of practicing responsible land management (Fig 2.25.). Forty-four percent believe that *they "do about the same in terms of stewardship as the average landowner"* in the region while 42% say they *"do more"*. Thirteen percent *"don't think about their level of stewardship"* and 1% report that they *"do less in terms of stewardship that the average landowner".*

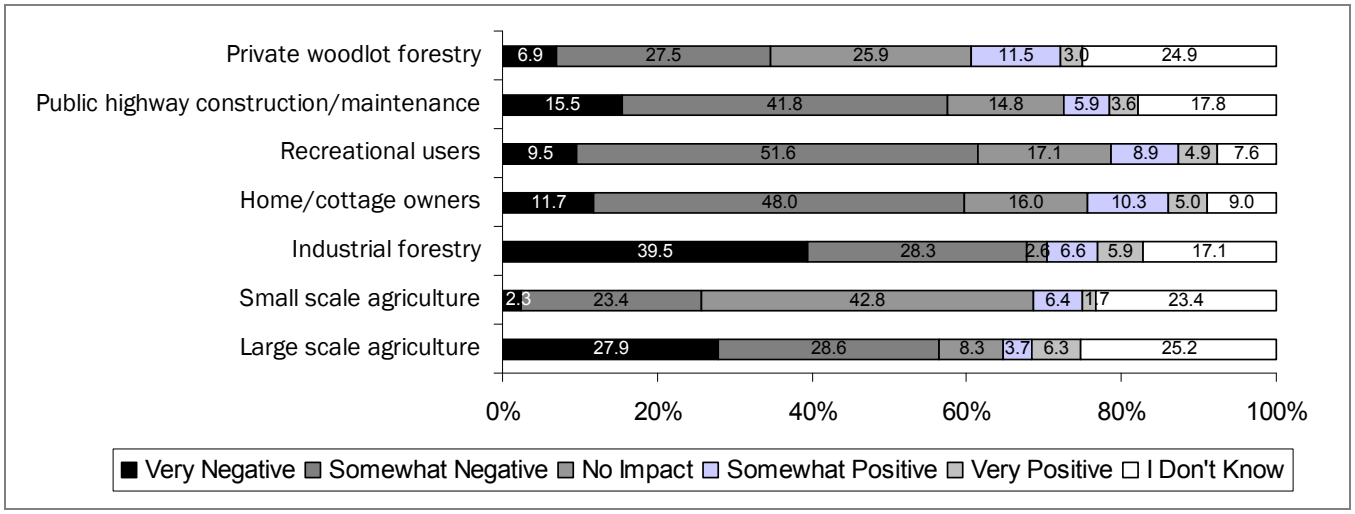
Figure 2.25: Landowners' perceived relative stewardship levels



In addition to asking landowners about their own stewardship levels, they were asked to indicate how they felt a number of different users contributed to water quality in the watershed. On a 5-point likert scale, landowners were asked to give their impression of whom and/or what has the greatest impact on water quality in the Canaan-Washademoak system (Fig. 2.26). Industrial forestry is perceived to have the largest negative effect on the local water quality with 40% of respondents believing it to "very negative". Another 28% say industrial forestry has a "somewhat negative" effect. Twenty-eight and 29% say that large scale agriculture has a very negative and somewhat negative impact on water quality, respectively. Fifty-two percent, 48% and 42% think that recreational users, home and cottage owners, and public highway construction and maintenance have somewhat negative impacts. Private woodlot forestry is perceived to be

somewhat negative for 28% but is considered to have no impact by 26%. Small scale agriculture is believed by 43% of respondents to have no impact on water quality. Despite the widespread perceptions that the users listed had at least a somewhat negative impact (with the exception of small scale agriculture) on water quality in the Canaan-Washademoak system, some respondents believe that they have a positive contribution: private woodlot forestry (15%), home and cottage owners (15%), recreational users (14%), industrial forestry (13%), public highway construction and maintenance (10%), large scale agriculture (10%), and small scale agriculture (8%). Over 20% of respondents indicated that they didn't know how large (25%) or small (23%) scale agriculture or private woodlot forestry (25%) affects water quality.

Figure 2.26: Landowner perceptions of the impacts by user groups in the Canaan-Washademoak watershed.



Similar to the previous perceptions, when landowners listed three specific activities (ranked in order of potential negative impact) that they felt have the highest negative impact on water quality, the majority of respondents ranked the top three negative users as some combination of industrial forestry, large scale agriculture, home and cottage owners and recreational users. Table 2.5 shows the frequency that each user/activity was ranked as number 1, 2 and 3 with regards to their potential impact on water quality in the Canaan River and/or Washademoak Lake. The forestry sector and their associated activities (industrial forestry + private woodlot forestry + clearcutting/landclearing + general forestry practices) makes up approximately 42% of all the number one ranked negative contributors to water quality.

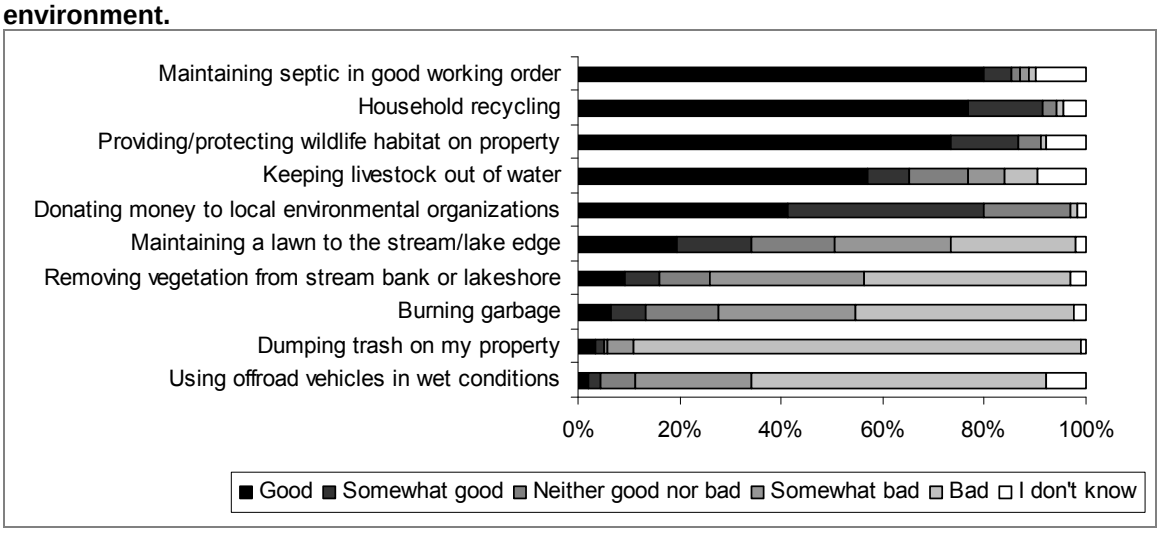
Table 2.5: Frequencies of the ranked top three negative contributors to water quality by landowners.

Perceived Negative Contributors to Water Quality	Ranked #1	Ranked #2	Ranked #3
Users			
Industrial forestry	73	40	16
Large scale agriculture	55	30	17
Home/cottage owners	31	30	33
Recreational users	30	42	36
Highway construction and maintenance	7	19	36
Private woodlot forestry	1	8	11
Small scale agriculture	1	1	2
Campgrounds	1	1	3
Specific Activities reported in 'Other' category			
Sewage	3	14	5
Clear cutting/land clearing	27	16	6
Forestry (general)	10	6	4
Agriculture (general)	10	13	8
Others	14	12	13

Beneficial Management Practices

A number of common beneficial management practices (BMPs) were taken from the literature and used as measures of environmental behaviour; half were rewritten as the opposite (negative) behaviour (e.g. BMP: not using off-road vehicles in wet conditions was rewritten as using off-road vehicles in wet conditions) as to increase the transparency of the question being asked. Respondents were first asked to indicate how they perceive each activity effects the environment (5-point likert scale) then how often they engage in each activity (5-point likert scale). Generally, the positively written behaviours were seen as good and somewhat good for the environment and the negatively written questions were seen as somewhat bad and bad for the environment (Fig. 2.27). "Maintaining a lawn to the stream/lake edge" received the most diverse answers with 18% believing that it was good, 13% believe it is somewhat good, 15% believe is neither good nor bad, 21% believe it is somewhat bad and 22% believe that it is bad.

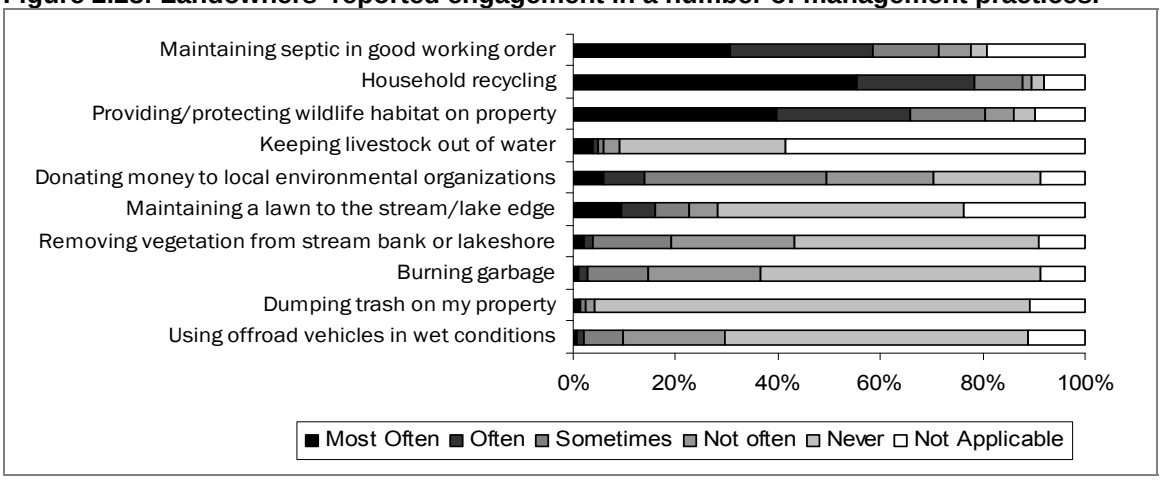
Figure 2.27: Landowner perceptions of the effects of a number of management practices on the local environment.



Landowners report a high engagement level in almost all the BMPs (Fig. 2.28), with the exception of donating money to local environmental organizations and keeping livestock out of waterways.

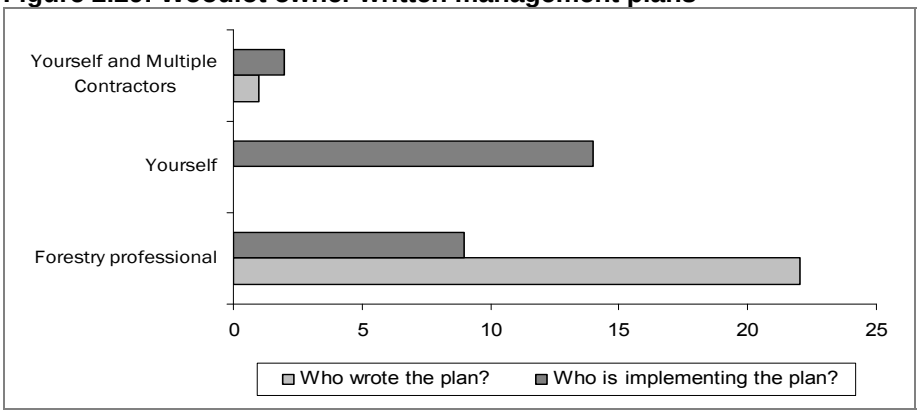
The later however, is likely to be the result of a misunderstanding of the statement. Over 70% of landowners engage (most often, often, or sometimes) in all the BMPs (excluding keeping livestock out of watercourses). Although statistical analysis has not been preformed, at a glance, there seems to be a correlation between how the landowner perceives the activity impact the environment and how often they engage in that specific activity; the more one believes an activity is good for the local environment, the more likely they are to engage in that activity.

Figure 2.28: Landowners' reported engagement in a number of management practices.



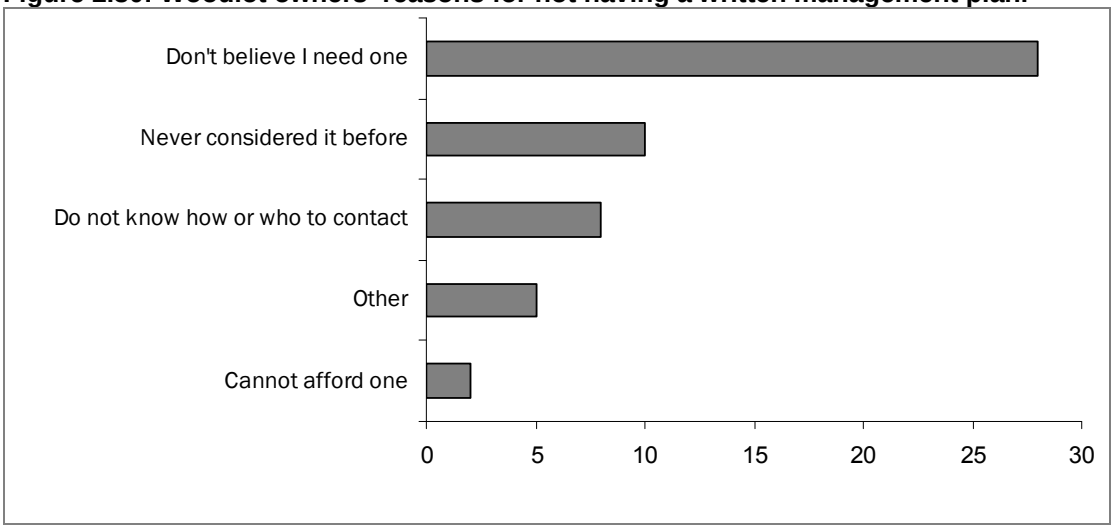
Of the 83 landowners who also own a woodlot (either on their riparian property or elsewhere), 25 of them have a written management plan for the woodlot (Fig 2.29). Of these management plans, 22 (88%) of them were written by a forestry professional (including a marketing board or Co-op). Fourteen management plans have been implemented by the landowner (or their family), 9 are implemented by forestry professionals (including marketing board or Co-op) and 2 as a partnership between the landowner and a contractor(s). Fifty-eight woodlot owners indicated that they do not have a written management plan for their land.

Figure 2.29: Woodlot owner written management plans



Twenty-nine (54%) woodlot owners don't believe they need a forest management plan while another 10 (18%) say that they just hadn't considered it (Fig. 2.30). Eight woodlot owners don't know how to get started on a management plan (don't know how or who to contact about it) and 2 simply cannot afford to pay to have a management plan written for them. Five indicated other reasons including the fact that they just haven't done it yet or the process is right now underway.

Figure 2.30: Woodlot owners' reasons for not having a written management plan.



2.4 Conclusions

Two main categories of landowners emerged from the data; permanent and seasonal landowners. Furthermore, the two groups are skewed in terms of representation; approximately 70% of respondents are considered seasonal, part-time while 25% live there year-round. Although the results outlined in the previous section is not dissected by ownership type, a largely transient riparian zone ownership has important resource management implications and should be kept in mind for interpretation.

Aside from ownership type, the survey population can be characterized as predominately older, retired or pre-retired males with both relatively high education and income levels. The majority of landowners hold one parcel in joint ownership (assumed with spouse) of approximately 1 acre in size. Although a large number have owned their property for a short time (10 years or less), they have been familiar with the region for much longer; 30, 40, or 50 years and some for their whole lives.

In concert with the ownership type, the respondents report owning their property to enjoy now, while they can. They benefit from the aesthetics and the recreational opportunities provided by the area and enjoy the abundant, diverse wildlife and the slow pace of life.

Although many residents do not view themselves as very knowledgeable about the quality of water or its change over time, those who do indicate that although the water quality is currently good (in both Washademoak Lake and the Canaan-River) it has declined over time. Industrial forestry and agricultural (specifically industrial and large scale) operations are seen as being the largest culprits when it comes to negatively impacting the local water quality. Furthermore, the high self reported levels of individual land stewardship by landowners may indicate that they under-estimate the negative consequences of their own activities.

In conclusion, it is obvious from this research that the Canaan-Washademoak watershed, specifically the riparian zone, has undergone a shift from a primarily forestry and agriculture

dependant society to one depending on and demanding rural amenities relating to tranquility, aesthetics and recreation. With almost 70% of the population transient, the ability to easily retreat to the city in search of peace and quiet, calming vistas and an opportunity to recreate and rejuvenate is the appeal of this large region with a disparate population and all the amenities one could ever want. It is clear that these landowners depend on and are now demanding a pristine environment: a river and lake with boatable, fishable, and swimable waters; fresh, clean air; and intact forests for wildlife and marvelous scenery, all EG&S that lend themselves to the private, relaxing, and quiet quality-of-life (-vacation) that is so highly valued by those who have experienced it.

2.5 References

Dillman, D. A 2000. Mail and Internet Surveys; the tailored design method. John Wiley & Sons Inc. Toronto, Ontario.

Service New Brunswick. 2006. Real Property Mapping database. Obtained from Service New Brunswick, Fredericton, NB.

Service New Brunswick. 2006. Property Assessment database. Obtained from Service New Brunswick, Fredericton, NB.

CHAPTER 3

OPPORTUNITY COSTS OF PROVIDING RIPARIAN BUFFERS ALONG WATERCOURSES IN THE CANAAN-WASHADEMOAK WATERSHED

Principle Researcher: Shawn Little

3.1 Introduction

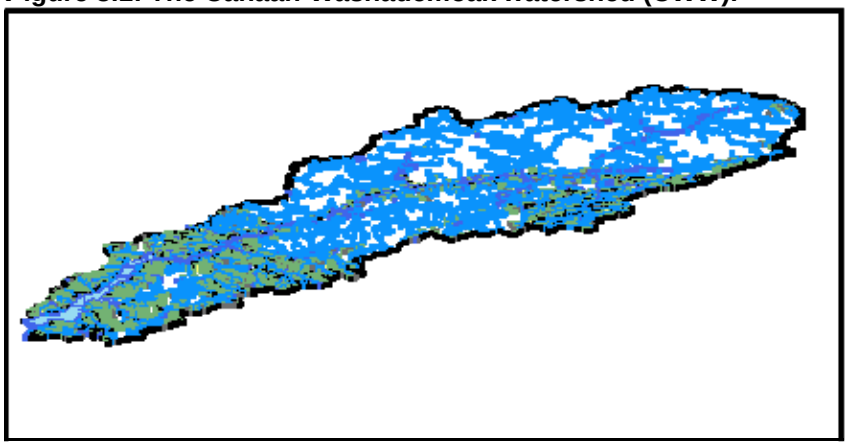
As society begins to realize the importance of ecological goods and services, there is increasing pressure directed toward private landowners to change the way in which they manage their land. Such changes often come at a financial cost to the landowner, as they would have to forego potential income. This financial cost, often referred to as 'opportunity cost', may be significant in cases where land is used for resource extraction such as timber or agricultural products, or is considered being used for residential development.

The objective of this analysis was to examine private landowner opportunity costs associated with providing EG&S in the Canaan Washademoak Watershed (CWW). The specific land management change considered here was the establishment and/or maintenance of 30m and 60m riparian buffers along the Canaan River, Washademoak Lake, and their associated tributaries. Such land management changes are thought to provide a number of EG&S including good water quality, wildlife habitat, and aesthetics. Since private land can be classified into three general land-use classifications in the region (i.e. forested, agriculture and residential), three different opportunity costs are estimated for each of the 30m and 60m riparian buffer considered. The results of this analysis can provide the basis for discussions about compensating landowners for the provision of EG&S.

3.2 Land-use in the Canaan Washademoak Watershed

The CWW is approximately 216,000 hectares (533,520 acres) in size, 32% (69,300 hectares) of which is owned by private landowners. The watershed is illustrated in Figure 3.1, with private land shown in green. The watershed is home to some 91 tributaries of the Canaan River and the Washademoak Lake (Dalton 2005). In total, the major waterways, lakes and wetlands are equivalent to approximately 8500 hectares.

Figure 3.1: The Canaan-Washademoak watershed (CWW).



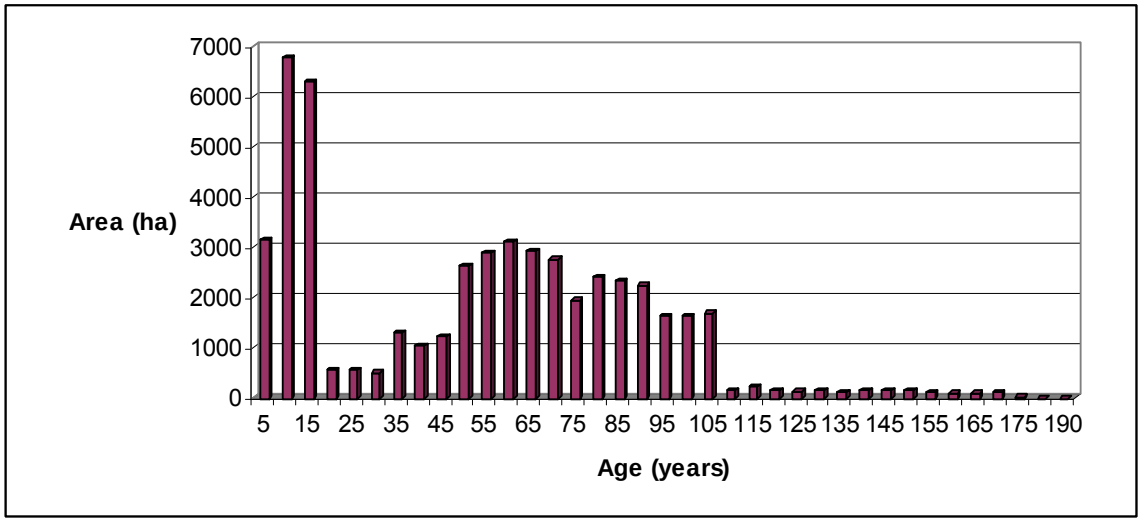
Land-use within the CWW has changed over time, just like most other areas that were inhabited by some of the first settlers to New Brunswick. Development in technology brought about changes in people's fortunes and lifestyles (Dalton 2005). The once flourishing family farms of the years past have been phased out by larger, more mechanical farms, thus causing land use patterns to shift. Today, the watershed is still home to rolling farmland, vast forests and an ever increasing amount of residential areas. Forests are by far the most abundant land cover type within the watershed, followed by agricultural and residential land (Table 3.1)

Table 3.1: The amount of area (ha) for each type of land classification on private land in the Canaan Washademoak watershed.

Land Classification	Area (ha)
Agriculture	8509
Forested	51989
Other	1603
Residential	827
Wetlands/lakes/river	6444
Total	69371

The private forests of the CWW have also changed over time, primarily due to changes in harvesting practices. As time passed, new wood markets emerged which made it possible for smaller timber to become marketable. Therefore the present day private forest land in the CWW contains many young stands. Figure 3.2 shows the amount of area (ha) by age class (5-year periods) for private forest land within the CWW watershed (buffers are included).

Figure 3.2: CWW forest age class structure (2006).



Private forests of the CWW have, like the majority of the Acadian forest in the province, a wide array of tree species and stand types. The type of forest (stand types) on private land in the CWW consists predominately of softwood or softwood mixed stands (Table 3.2).

Table 3.2: Amount of area (ha) by stand type in 2006.

Stand Type	Area (ha)
Hardwood/Softwood	13090
Intolerant Hardwood	8233
Cedar/Hemlock/Pine	1819
Regenerating hw/sw	985
Regenerating hw	641
Regenerating sw/hw	859
Regenerating sw	1278
Spruce Fir	10307
Softwood/Hardwood	8847
Tolerant Hardwood	5613

There is one major piece of legislation that protects watercourses within the CWW, and other watercourses in New Brunswick. The Clean Water Act was introduced into the New Brunswick legislature in 1990. The Act specifies that 30 meter riparian buffers would be required adjacent to all streams, rivers and lakes (outlined on 1:10,000 orthophoto map) (GNB 1990). Riparian buffers are strips of trees or other forms of vegetation which are 30 meters in width and located adjacent to the high water mark of the above mentioned watercourses. The environmental benefits of riparian buffers, such as improvements in water quality, fish and wildlife habitat and recreation have been documented (Lynch 2000). Riparian buffers help prevent soil erosion, and provide shade which in turn keeps the stream bed cool thus providing the proper conditions for certain types of aquatic life. The environmental benefits of each buffer zone depend on whether grass or trees occupy the area, how wide the buffer is, the land use of the adjacent property, and the conditions that exist both up and down stream from the buffer (Lynch 2000). Wetlands have also just recently been added to the Clean Water Act legislation. They too require a 30m buffer around their perimeter.

3.3 Methods

In order to meet the objectives of this study, the relative amounts of area occupied by each land-use was first determined. Then, the delineation of 30m and 60m buffers around all watercourses and wetlands was carried out. Upon the delineation of the watercourse buffers, the cost of riparian buffers on an acre of forest, agriculture and residential land was estimated. This provided the necessary information for understanding the opportunity cost of maintaining riparian buffers within the CWW.

3.3.1 Area by Land Classification

Determining the relative amounts of area of each type of land use was conducted using forest cover maps obtained from the New Brunswick Department of Natural Resources. Forest cover maps outline and identify different forest stands based on aerial photos of the area. Since private land has varying uses, various forest stands as well as various types of agriculture land and residential land exist. The forest cover maps identify all non-forested areas like pastures, abandoned fields, agriculture fields, wetlands, residential areas among many others. Since every forest stand and non forested area were identified and labeled, this enabled these areas to be grouped into four general land classifications: (i) forested area; (ii) agricultural area; (iii) residential area; and (iv) other. The classification ‘other’ refers to transmission lines, roads, railways, gravel

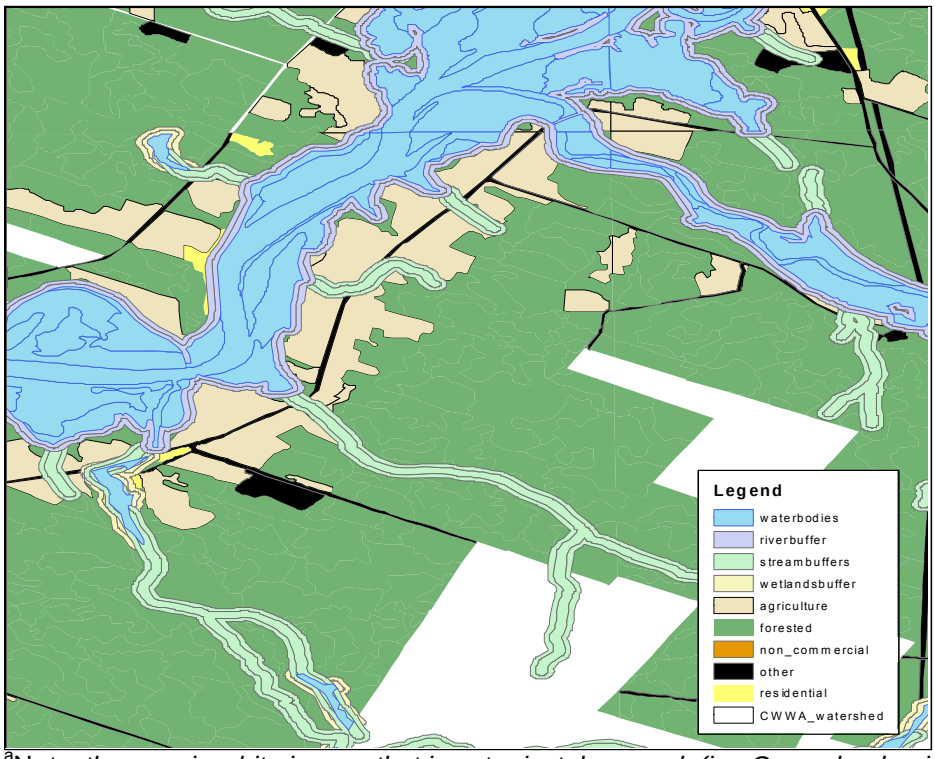
pits etc. We did not pursue any analysis of this last classification because it was either provincially owned or was a form of easement property.

Grouping the forest stands, agriculture areas, residential areas and other unique areas was carried out using ArcMap 9.0. This software allows the user to label different polygons and line features depending on their attributes (ex. 25 year old spruce stands). With all polygon and line features labeled, the areas could then be calculated and summed for each type of land classification.

3.3.2 Delineation of Riparian Buffers

Riparian buffers were created around all watercourses (lakes, rivers, streams and wetlands) at a distance of 30m and 60m. Riparian buffers were created using the buffer tool in ArcMap 9.0. The buffer tool delineates new polygons of any specified distance from the edge of a line (stream) or polygon (lake) feature. The new buffers polygons created can be analyzed separately from the forest cover map polygons which are not located within the "buffer zone." Area within these buffers is to be used only for protecting water quality; no timber harvesting or agricultural use is allowed to occur. Figure 3.3 shows an example of the 30m and 60m buffers around all watercourses and how they overlap or affect different land uses for a portion of the watershed.

Figure 3.3: Example of 30m and 60m riparian buffers around wetlands, streams and the rivers in the CWW[a]



[a]*Note: the area in white is area that is not privately owned. (i.e. Crown land or industrial freehold).*

Using ArcMap 9.0, the watershed was broken into two separate sections: (i) the Lake section; and (ii) the River section. The reason for splitting the CWW into two sections was to analyze the relative opportunity costs around the lake (in the south) and the river (in the north).

3.3.4 Estimating Forested Land Opportunity Costs

In order to understand the opportunity costs of implementing riparian buffers on forest land, the original forest condition (present day forest) must first be identified. Then the allowable forest management activities must be defined, forest growth must be estimated, and harvested values must be determined under different buffer constraints.

Forest condition is characterized by the age, type and amount of forest that is to be analyzed. The forest cover maps (compiled in 2000) identify portions of the forest by stand types which are named based on species composition and species stocking among other attributes. Information such as age, height and development stage (young, immature etc.) is also recorded for each stand. In order to simplify the modeling of the forest, the stand types were stratified into more general names (Table 3.2). These new stand types included in some cases the grouping of 3 to 4 original stand types.

In order to forecast the growth of a stand over time, it is critical to assign an age to each stand. The age of each forest stand was determined using the New Brunswick data dictionary, and in a few minor cases, professional judgment was used. Forest stands were labeled with either a number (2-9) or a letter (I, M, O, R, S and Y), each represents a range of ages. For example, the number 5 represented the ages 41-50. The forest stands were then assigned an age (multiples of 5) using a systematic and unbiased method. Ages and stand types were then labeled accordingly using ArcMap 9.0. The new forest type and its corresponding age and area (ha) produced a representation or model of the current forest condition in the CWW.

The present day forest condition combined with the information gathered from the buffer analysis was then used to conduct an aspatial analysis. This analysis was carried out using Spatial Woodstock, a forest estate modeling software. This software allows the user to effectively model a forested area of any size and forecast its development through time while monitoring numerous other attributes.

Forests develop in numerous ways; of particular concern for this study is stand development, and more specifically, stand yield (m3/ha). Accurately forecasting a stands yield is not always straightforward. Yield curves are generally developed based on some form of field data or forest inventory. Since there is was no inventory collected specifically for this watershed, the yield curves had to be obtained from another source. The yield curves used were those that are currently used to forecast stand yield on adjacent Crown Lands in License 7, obtained from Mr. Adam Dick (Forest Management Senior Technologist, UNB). These yield curves are very representative of the CWW region, as the site, climate and species composition would be similar among similar stand types. The main factor that differs is stand history, resulting from the frequency and method of harvesting used. The yield curves used are those that resemble the stand types that exist in the present day CWW forest.

The objective function within the forest modeling exercise was to maximize the net present value of timber (i.e. stumpage values, discounted at a rate of 5%) harvested in the CWW over an 80-year planning horizon. In order to mimic the forest activities that are carried out within the CWW,

and to investigate the impacts of establishing riparian buffers, a number of constraints needed to be imposed in the model. These include harvesting and silvicultural constraints.

Harvesting constraints are typically imposed within forest modeling exercises in order to mimic the harvesting intensities currently exhibited in the region under consideration. Whether or not the current harvesting intensities will remain the same in the future, however, is unknown. Therefore, we considerd two harvesting intensity constraint cases: (i) No constraint on harvesting intensity; (ii) Harvesting is constrained to current intensity.

Implementing the case where harvesting is constrained to current intensity proved difficult since such intensities within the CWW have not been formally documented. To estimate this intensity, we used information from several marketing boards within New Brunswick. On average, the private land harvest intensity was estimated to be 1.75% of their representative area annually (this is similar to what Erdle 2004 determined). Applying this percentage to the CWW, we calculated that 900 ha of forest land was harvested each year, or 4500 ha harvested over a 5 year period.[1]

Various timber harvesting methods are implemented on private woodlots within the CWW and elsewhere in New Brunswick. Clearcutting and multiple forms of selective harvesting are the most prominent methods. Clearcutting is simply the removal of all merchantable timber during one entry in the forest. Selective harvesting on private woodlots has, according to some, resembled a form of high grading or "take the best and leave the rest" mentality. For the purpose of this analysis, selective harvesting was assumed to be carried out every 30 years. According to the forest cover maps, partial harvesting (or selective harvesting) constitutes 30% of the total area harvest. For the purpose of this analysis, 30% of the annual harvested area was assumed to be selectively harvested.

Forest timber products were the only sources of value considered in this analysis. Revenues received from the sale of forest products on private woodlots are based on stumpage prices for softwood and hardwood logs and softwood and hardwood pulp. Stumpage prices are defined as the value of standing timber minus the costs of harvesting and transporting the product to the point of sale. Essentially stumpage value is what someone is willing to pay the landowner for a quantity of standing timber. The products and their respective stumpage prices used in this analysis are as follows: (i) Softwood logs - $\$20.79/m^3$; (ii) Hardwood logs - $\$24.24/m^3$; (iii) Softwood pulp - $\$8.89/m^3$; and (iv) Hardwood pulp - $\$8.73/m^3$ (SNB Wood Co-op 2007).

Silviculture practices such as tree planting and pre-commercial thinning are also currently being carried out in the CWW, according to the forest cover maps. However, the relative amount of each silviculture practice is unknown, as are the amounts of existing plantations and pre-commercial thinned areas. In order to determine reasonable tree planting and pre-commercial thinning levels, we calculated the average levels conducted in New Brunswick marketing board areas. Accordingly, tree planting and pre-commercial thinning levels of 70 ha per year and 250 ha per year, respectively, were used (similar levels were found by Erdle 2005).

[1] Constraining the harvest level to an area based harvest rather than a volume based harvest level implies the woodlot owners are harvesting over a range of ages and not just when individual forest stands are deemed most optimal, which is realistic to actual woodlot owner harvesting decisions. Using a volume based harvest level would over estimate the actual harvest level in the CWW.

The use of Spatial Woodstock for this project was instrumental in predicting the opportunity costs of riparian buffers on private forest land in the CWW. The cost of maintaining buffers is represented by the value of merchantable trees that cannot be harvested within the forested area. The area located in a riparian buffer is assumed inoperable for harvesting in this analysis.

Using Spatial Woodstock, three water quality protection scenarios were analyzed, they included:

- Scenario 1: No buffers implemented
- Scenario 2: 30m buffers implemented
- Scenario 3: 60m buffers implemented

Scenario 1 analyzed what would be expected if landowners did not maintain any riparian buffers adjacent to watercourses within their woodlots and harvested all merchantable timber products. The purpose of this scenario was to illustrate the maximum net present value attainable from the private woodlots in the CWW. Scenarios 2 and 3 analyzed the effects of maintaining 30m and 60m buffers adjacent to all watercourses and wetlands on net present value, respectively. These latter two scenarios were intended to illustrate the opportunity costs (by means of differing levels of net present value stumpage) that private landowners would experience for maintaining riparian buffers for society.

3.3.5 Estimating Agricultural Land Opportunity Costs

Understanding the costs associated with maintaining riparian buffers on agricultural land in the CWW involves determining the total amount of acres lost to riparian buffers and an estimate of reasonable unit value for agricultural land ($/acre). Agricultural land in the CWW has varying uses, numerous types of crop production, pasture land and abandoned fields just to name a few. Such a diversity of agricultural uses means that a similar diversity is observed in the ranges of expected dollar per acre value of agricultural land.

According to Farm Credit Canada (McFadgen 2007), agriculture land in southern New Brunswick is given an average value of $546/acre for crop land. Assuming that not all of the agricultural land is crop land (i.e. some is pasture land, etc) a minimum value of $300/acre is more representative of the CWW region (McFadgen 2007). This average value per acre was used to represent all agricultural land in the region because the relative amounts of each type of agricultural use have not been officially documented.

It was also assumed that all agricultural land in the CWW would implement riparian buffers next to all watercourses, meaning no agriculture activities would exist. This would likely not be the case, since a majority of agricultural activities occurring on the land existed before the watercourse legislation was introduced. In order to accurately determine the actual buffer distances on agricultural land some sort of inventory would have to be carried out. However, the analysis does show what the financial affect would be if all agricultural land had either a 30m buffer or 60m buffer implemented.

3.3.6 Estimating Residential Land Opportunity Costs

Residential land is comparable to agricultural land with respect to the varying types and the corresponding dollar values. Residential land in the CWW constitutes the smallest amount of area of the three land use classifications analyzed in this study, yet it has the highest value ($/acre).

Since the current analysis examines the Lake section and River section independently, a unique residential land value per acre was estimated for each. Using Service New Brunswick's Property Browser (SNB 2006), 20 vacant lots from both sections (lake and river) were identified and the assessed value and parcel size was recorded. This produced an average $/acre of $1,723/acre for the River section and $11,592/acre for the Lake section.

It should be emphasized that the above estimates are based solely on the assessed value of vacant residential lots in the CWW. Determining the assessed value of a vacant lot eliminates the diversity of structures among properties from the equation and deals only with location. This method provides a representative (conservative) value of residential land in the CWW. It should be noted that the assessed value of residential land and the actual selling price can vary drastically depending on a variety of factors.

3.4 Results and Discussion

The amount of area that is "set aside" as a result of the riparian buffers is about 10,200 acres for 30m buffers, and 21,600 acres for 60m buffers. Table 3.3 depicts the amount of area both within and outside the riparian buffers by land classification. As would be expected the amount of area occupied by the 60m riparian buffers is almost twice that of the 30m riparian buffers.

Table 3.3: Amount of area occupied by buffers under different land classification for each section of the CWW.

Section	Forested area (acres)			Agricultural area (acres)			Residential area (acres)		
	Total	Within 30m buffer	Within 60m buffer	Total	Within 30m buffer	Within 60m buffer	Total	Within 30m buffer	Within 60m buffer
Washademoak Lake (Total area = 60,000 acres)	45799	2954	5654	5401	566	1191	656	170	333
Canaan River (Total area = 95,000 acres)	65660	5884	11300	11576	1443	2853	888	81	165

3.4.1 Forested Land

The Canaan Washademoak watershed as mentioned earlier is heavily forested. If no timber harvesting occurred over the next 80 years and the objective was to maximize the growing stock in the privately owned forest, it would on average produce about 6,000,000 m^3 of wood (Table 3.4 & Table 3.5). Establishment of a 30m buffer and a 60m buffer would utilize on average 11% and 21% of the total growing stock, respectively. As the forest ages over the next 80 years, the growing stock increases, which is due in part to the large amount of younger stands being recruited into older age classes that yield more volume (m^3/ha).

Table 3.4: Projected forest growing stock on private land in the Washademoak Lake over an 80-year horizon (if no harvesting occurred).

Period (5 year)	Total Growing Stock in Watershed (m^3/period)	Growing Stock within 30m Buffer		Growing Stock within 60m Buffer	
		(m^3/period)	%	(m^3/period)	%
5	1,441,676	141,102	10	125,254	9
10	1,515,683	149,956	10	131,053	9
15	1,730,471	162,169	9	143,058	8
20	1,903,170	170,793	9	152,235	8
25	2,423,535	174,566	7	156,210	6
30	2,935,973	180,823	6	162,836	6
35	3,242,930	185,288	6	167,059	5
40	3,516,479	188,628	5	170,727	5
45	3,709,384	183,655	5	166,142	4
50	3,897,204	187,030	5	169,763	4
55	4,030,081	188,810	5	172,208	4
60	4,126,405	190,212	5	173,677	4
65	4,092,220	177,926	4	162,296	4
70	4,108,433	180,024	4	164,037	4
75	4,068,444	180,393	4	164,490	4
80	4,008,043	180,768	5	165,221	4

Table 3.5: Projected forest growing stock on private land in the Canaan River over an 80-year horizon (if no harvesting occurred).

Period (5 year)	Total Growing Stock in Watershed (m^3/period)	Growing Stock within 30m Buffer		Growing Stock within 60m Buffer	
		(m^3/period)	%	(m^3/period)	%
5	1,540,006	202,378	13	182,815	12
10	1,654,621	218,416	13	198,126	12
15	2,048,166	251,400	12	229,454	11
20	2,391,659	277,707	12	254,386	11
25	3,259,173	296,825	9	275,276	8
30	4,113,723	321,715	8	300,408	7
35	4,640,142	338,394	7	316,482	7
40	5,106,979	353,124	7	330,972	6
45	5,439,669	346,795	6	326,995	6
50	5,767,822	360,788	6	340,654	6
55	6,001,352	370,784	6	350,618	6
60	6,169,696	377,303	6	357,709	6
65	6,121,566	350,489	6	333,840	5
70	6,168,848	356,475	6	339,291	6
75	6,140,373	360,069	6	342,275	6
80	6,086,112	363,896	6	345,748	6

Recall that the objective of the forest modeling exercise was to maximize net present value (or stumpage value) of timber harvests under 3 different buffer protection scenarios (no buffer, 30m, and 60m). These 3 scenarios were modeled using 2 harvest intensity constraint scenarios (no harvest constraint, and an area based harvest constraint of 4500 ha/period). Table 3.6 reveals the maximum 5-year present values of stumpage from timber harvests (for each timber harvest scenario) in the Washademoak Lake section of the watershed under different buffer protection

scenarios and harvesting intensity constraints. It is clear that the establishment of riparian buffers negatively affects the present values. Increasing the width of buffers decreases the amount of harvestable forested area, which in turn decreases the merchantable volume available for harvesting, leading to a decrease in present values. Constraining the harvest to 4500 ha/period also negatively affects present values within the Lake section of the watershed. If timber harvesting occurred on a non-sustainable basis or without any area based harvest constraints the present values could be increased significantly.

Table 3.6: Maximum 5-year present value (PV) stumpage ($) from timber harvests on private land in the Washademoak Lake throughout an 80-year planning horizon under different buffer scenarios and harvesting intensity constraints.

Period (5 Year)	PV stumpage ($) without harvesting intensity constraint			PV stumpage ($) with harvesting intensity constrained to 4500 ha/period		
	Scenario1: No Buffer	Scenario2: 30m Buffer	Scenario3: 60m Buffer	Scenario1: No Buffer	Scenario2: 30m Buffer	Scenario3: 60m Buffer
5	20,433,405	19,929,905	19,473,460	4,103,379	4,305,854	4,030,137
10	22,110,476	21,545,230	21,056,398	7,688,249	7,524,826	7,384,997
15	23,668,935	23,066,063	22,550,028	10,425,326	10,118,004	9,922,669
20	24,507,309	23,882,612	23,339,129	12,230,097	12,250,998	11,784,763
25	24,799,200	24,025,617	23,343,332	13,835,075	13,681,108	13,089,028
30	24,949,695	24,149,588	23,448,930	15,158,083	14,912,548	14,385,011
35	25,216,256	24,398,241	23,682,748	15,995,611	15,965,276	15,335,007
40	25,468,959	24,638,779	23,912,065	16,914,795	16,773,012	16,131,128
45	25,646,527	24,748,637	23,960,601	17,698,103	17,401,938	16,720,247
50	25,715,070	24,806,528	24,009,029	18,289,637	17,946,024	17,301,351
55	25,895,844	24,978,087	24,173,316	18,650,111	18,160,427	17,451,893
60	26,289,882	25,359,296	24,543,200	18,775,795	18,407,123	17,676,300
65	26,604,382	25,643,359	24,796,463	19,046,865	18,683,621	18,019,310
70	27,176,767	26,211,639	25,362,614	19,188,952	18,847,215	18,215,213
75	27,953,965	26,984,951	26,132,503	19,374,358	19,021,054	18,405,198
80	28,267,242	27,296,029	26,441,164	19,547,884	19,204,652	18,554,372

Table 3.7 reveals the present values of stumpage from timber harvests in the River section of the watershed over an 80-year horizon under each buffer protection scenario and harvesting intensity constraint case. Similarly to the analysis of the Lake section, increasing the width of buffers decreases the present values of stumpage realized within the River section. The most notable difference between each section is that the River section produces greater present values over the 80 year planning horizon. The reason for this difference is mostly due to the fact that the River section is larger than the Lake section.

Table 3.7: Maximum, 5-year present value (PV) stumpage ($) from timber harvests on private land in the Canaan River throughout an 80-year planning horizon under different buffer scenarios and harvesting intensity constraints.

Period (5 Year)	PV stumpage ($) without harvesting intensity constraint			PV stumpage ($) with harvesting intensity constrained to 4500 ha/period		
	Scenario1: No Buffer	Scenario2: 30m Buffer	Scenario3: 60m Buffer	Scenario1: No Buffer	Scenario2: 30m Buffer	Scenario3: 60m Buffer
5	21,075,277	20,462,943	19,923,344	5,255,204	4,687,804	4,646,240
10	23,461,587	22,790,015	22,210,197	8,291,537	7,928,821	7,644,202
15	25,505,080	24,786,826	24,162,469	10,996,313	10,555,831	10,144,335
20	26,525,971	25,769,878	25,110,822	13,378,346	12,624,199	12,520,750
25	26,943,696	25,978,565	25,128,807	15,324,945	14,504,495	14,440,036
30	27,163,705	26,158,332	25,278,540	16,935,502	16,183,687	15,875,581
35	27,530,735	26,499,173	25,592,870	18,512,794	17,460,255	17,177,087
40	27,818,917	26,767,381	25,840,734	19,516,143	18,554,423	18,171,317
45	28,042,812	26,894,001	25,879,571	20,168,232	19,279,847	18,856,213
50	28,141,784	26,975,658	25,945,331	20,680,420	19,828,438	19,320,102
55	28,553,285	27,374,171	26,330,238	21,219,551	20,497,725	20,039,364
60	29,361,736	28,155,382	27,086,385	21,875,446	20,996,568	20,537,133
65	30,044,054	28,778,785	27,656,251	22,281,273	21,396,512	20,843,359
70	30,758,484	29,486,836	28,359,003	22,692,931	21,771,771	21,165,344
75	31,651,630	30,374,581	29,241,171	22,952,853	22,034,373	21,404,267
80	32,103,459	30,820,298	29,680,692	23,139,868	22,197,195	21,596,257

Table 3.8 shows that the opportunity costs of riparian buffers on forestland, calculated by subtracting the net present value (i.e., the sum of all 5-year present values in a column of Table 3.7) associated with either Scenario 2 (30m buffer) or Scenario 3 (60m buffer) from Scenario 1 (no buffer). As would be expected, the opportunity cost of riparian buffers within the River section is greater than the Lake section because there is more forest area located within the buffers in the former section. Constraining the harvest to 4500 ha in every 5-year period also decreases the opportunity costs of buffers over 80 years.

Table 3.8: Opportunity costs of 30m and 60m riparian buffers on private forested land in the CWW.

Section	Opportunity Cost ($) without harvesting intensity constraint		Opportunity Cost ($) with harvesting intensity constrained to 4500 ha/period	
	30m buffer	60m buffer	30m buffer	60m buffer
Washademoak Lake	2,934,592	5,545,792	2,697,135	5,075,844
Canaan River	4,392,937	8,390,197	3,589,998	6,883,607
Total	7,327,529	13,935,989	6,287,133	11,959,451

Although we cannot predict what level of harvesting will occur in these regions in the future, it may be safe to assume that it will be somewhere in between the 'harvesting intensity constraint of 4500 ha/period constraint' and 'without harvesting intensity constraint' presented in Table 3.8. With this in mind, we provide a 'best-guess' opportunity cost estimate for 30m and 60m riparian buffers on private land in the two sections of the watershed. The 'best-guess' estimate is based on the average opportunity cost between the two harvesting intensity constraint cases, shown in Table 3.8. Table 3.9 shows the "best guess" opportunity cost of 30m and 60m riparian buffers for each section within the CWW.

Table 3.9: 'Best-guess' opportunity cost of 30m and 60m riparian buffers on private forested land in the CWW (mean of the harvesting intensity constraint cases in Table 3.8).

Section	Opportunity Cost ($)	
	30m Buffer	60m buffer
Washademoak Lake	2,815,863	5,310,818
Canaan River	3,991,467	7,636,902
Total	6,807,330	12,947,720

Determining the per acre opportunity cost of maintaining riparian buffers on forested land involved dividing the 'best-guess' opportunity cost for each buffer (Table 3.9) by the total respective area within each buffer (Table 3.3). The results, presented in Table 3.10, show that the per acre opportunity cost within the Lake section is higher than in the River section. This is due to the differences in growing stock and potential products harvested over time in the buffers of each section.

Table 3.10: "Best-guess" per acre opportunity costs of 30m and 60m riparian buffers on private forested land in the CWW.

Section	Per Acre Opportunity Costs ($)	
	30m Buffer	60m buffer
Washademoak Lake	953	939
Canaan River	678	675

3.4.2 Agricultural Land

The area of agricultural land set aside for 30m and 60m watercourse buffers were 566 acres and 1191 acres in the Lake section, respectively, and 1443 acres and 2853 acres in the River section, respectively (Table 3.3). Accordingly, when we applied the previously estimated $300/acre opportunity cost for agricultural land in the watershed region to these areas, the latter section experienced by far the largest opportunity costs (Table 3.11). The total opportunity costs associated with 30m and 60m riparian buffers on agricultural land in the CWW were estimated to be $602,700 and $1,213,200, respectively.

Table 3.11: Opportunity cost of 30m and 60m riparian buffers on agricultural land in the CWW.

Section	Opportunity Cost ($)	
	30m Buffer	60m buffer
Washademoak Lake	169,800	357,300
Canaan River	432,900	855,900
Total	602,700	1,213,200

3.4.3 Residential Land

The area of residential land set aside for 30m and 60m riparian buffers were 170 acres and 333 acres in the Lake section, respectively, and 81 acres and 165 acres in the River section, respectively. Applying the previously estimated values of $1,723/acre for the River section and $11,592/acre for the Lake section, revealed that the former section experienced the largest opportunity costs (Table 3.12). The total opportunity cost associated with 30m and 60m riparian buffers on residential land were estimated to be $2,107,179 and $4,150, 491, respectively.

Table 3.12. Opportunity cost of 30m and 60m riparian buffers on residential land in the CWW.

Section	Opportunity Cost ($)	
	30m Buffer	60m buffer
Washademoak Lake	1,967,431	3,865,352
Canaan River	139,748	285,139
Total	2,107,179	4,150,491

3.5 Conclusion

As would be expected, the opportunity costs associated with establishing riparian buffers in the CWW is substantial. The estimates presented depend on a number of assumptions regarding land value, land-use intensity, and other such factors. Attempts were made in the analysis to reflect the actual conditions in the region, however, these conditions may change in the future.

The opportunity cost of maintaining riparian buffers on private land varies greatly depending on land use. Residential land has the highest opportunity cost per acre in the region at $11,592/acre in the Lake section and $1,723/acre in the River section. However, residential land occupies the smallest amount of area. Forested area has the second highest opportunity cost per acre in the region at $953/acre in the Lake section and $673/acre in the River section, and occupies that largest amount of area. Agriculture land has the lowest opportunity cost per acre at approximately $300/acre, and occupies the second greatest amount of land in the region.

The opportunity costs provided in this study can be thought of as conservative estimates of the value of EG&S provided in riparian buffers by private landowners in the CWW. However, these estimates cannot by themselves form the basis of compensating landowners for the EG&S they provide since this is a supply-side only analysis. To determine the true value of such EG&S, we also need the demand-side of the market equation which is driven from society's perspective. In some cases, the demand-side of the market (society) may place a higher value on the EG&S provided by landowners than the respective opportunity cost, and in other cases they may not. Even if we were able to estimate the demand-side of the market (as we do in Chapter 4), an important issue that remains is whether or not landowners should be paid different compensation amounts based on their land-use classifications. As we have seen in this analysis, opportunity costs vary considerably with land-use classification. If a market exchange for EG&S existed in this context, an equilibrium price would be established, thereby solving this issue. However, whether or not such a market exchange can be created is an issue worth further exploration (this is the topic of Chapter 5).

3.6 References

Dalton, S. and Weatherley, R. 2005. Living With the Land, People and Resources: Canaan Washademoak Watershed. Washademoak Environmentalists.

Erdle, T. and Norfolk, C. 2004. Analysis of Future Forest Condition and Wood Supply for Private Woodlots in New Brunswick. Research Report. Faculty of Forestry and Environmental Management, University of New Brunswick. Fredericton, NB.

GNB. 1990. Clean Water Act Chapter C-6.1. Attorney General. http://www.gnb.ca/0062/acts/acts/c-06-1.htm

Lynch, L., and Tjaden, R. 2000. When a Landowner Adopts a Riparian Buffer – Benefits and Costs. Maryland Cooperative Extension. Fact sheet. 12 pages.

McFadgen, A. 2007. Central NB Agri Environmental Club. Personal Communication.

NBDNR. 2003. New Brunswick Natural Resources and Energy Data Dictionary. New Brunswick Forest Inventory Database. Government of New Brunswick.

SNB 2006. Service New Brunswick Registry and Mapping Services. https://www.planet.snb.ca/PLANET/index.html Accessed March 2007.

SNB Wood Coop. 2006. So Whats Stumpage Going For? SNB Wood Coop Ltd. http://www.snbwoodcoop.com/markets/Stumpage.html Accessed February 2007.

CHAPTER 4

A STATED PREFERENCE APPROACH TO ESTIMATING THE BENEFITS AND COSTS OF RIPARIAN PRESERVATION ALONG THE CANAAN RIVER AND ITS MAIN TRIBUTARIES

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4.1 Introduction

In the past few years, residents of the Canaan Washademoak watershed have noticed a decline in the water quality of the river and lake (declining clarity, water colouring, increased algae growth, increased silting, etc.) (Washademoak Environmentalists 2002). It is thought that the main cause of this decline is silt deposition, mainly caused by commercial forestry and land-clearing associated with recreational properties. Other activities, such as agriculture and improper road maintenance may also contribute to the declining water quality. Clearing riparian areas also contributes to less natural scenic views and decreases the amount of wildlife habitat in the watershed.

One possible solution to these problems is the re-establishment, maintenance, and/or enhancement of existing riparian buffers. The current provincial Watercourse and Wetland Alteration regulations require one to obtain a permit when working within 30 meters (m) of a watercourse or wetland (New Brunswick Department of Environment 2006). Riparian buffers, defined as “the strip of land adjacent to water bodies” (Lee and Barker 2005: 263), are known to provide a number of ecological goods and services (EG&S). Such EG&S include flood mitigation, temporary reservoirs, prevention of bank erosion, habitat creation, water filtration, and aesthetics (Amigues et al. 2002). An important issue that emerges when considering the re-establishment, maintenance, and/or enhancement of existing riparian buffers is the degree to which the societal benefits outweigh the costs. This is not an easy issue to resolve, especially since most of the benefits do not have an established market. To place a value on the non-market benefits, stated preference approaches, such as the contingent valuation method, are typically used. This approach elicits the public’s willingness to pay for the EG&S provided by certain management activities, such as the provision of riparian buffers.

Previous stated preference approach studies have shown that valuation of EG&S is possible, and certain countries such as Costa Rica already have systems in place that pay compensation for the provision of ecosystem services through protection of natural forests and reforestation (Zbinden and Lee 2005). If reliable estimates of the benefits and costs of providing EG&S can be generated, they can be better integrated into policy decisions. Additionally, it may be possible to compensate landowners for their beneficial management activities, ensuring an increased or stable supply of EG&S in the Canaan-Washademoak watershed. In the United States, the Natural Resources Conservation Service (NRCS), a part of the Department of Agriculture, operates several programs that provide technical and financial assistance to landowners who agree to maintain or enhance the environmental quality of their land. One such program known as the Conservation Security Program, provides payments to qualifying agricultural landowners in watersheds across the country “for maintaining and enhancing natural resources” (NRCS 2005: 1).

Recently, much attention has been focused on estimating societal values of EG&S provided in Canada's forests. In 2005, for instance, a study was released that estimated the value of a set of EG&S provided by Canada's boreal forest. The findings of this study place the total non-market value of boreal ecosystem services at $93.2 billion dollars per year—2.5 times greater than the net market value of extractive industries, such as mining and forestry (Anielski and Wilson 2005).

The main objective of this research was to value EG&S provided by landowners along the Canaan River and its main tributaries, in southern New Brunswick. These attributes were chosen in consultation with the New Brunswick Woodlot Owners Association. Each of the above EG&S provided by riparian zones produce human and ecological well-being and their values can only be measured using non-market valuation methods (Holmes et al. 2004).

Two sub-objectives have been specified:

> (i) To estimate society's willingness to pay (WTP) for scenic views (aesthetics), wildlife habitat (terrestrial and aquatic), and water quality (for recreation) benefits provided in riparian buffers on private land along the Canaan River and its main tributaries.
>
> (ii) To estimate private land owners' willingness to accept (WTA) compensation for providing riparian buffers along the Canaan River and its main tributaries.

Once estimates for willingness to pay and willingness to accept are determined, the results can be used to inform policymakers of the potential net benefits (benefits minus costs) of providing riparian buffers in this region. One of the policy implications of this research might be to consider financial compensation to the landowners for providing the EG&S.

4.2 Theoretical Background and Literature Review

4.2.1 Theoretical Background

Economic theory suggests that a properly functioning market system allocates goods and services in such a way that maximizes social welfare (Bateman et al. 2002: 17). However, the values associated with the majority of the EG&S are not reflected in the market.[2] Prices do not exist primarily because these goods and services are public goods. Public goods have two main characteristics. The first and most important is that public goods are non-rival in consumption: one individual's consumption of the good does not negatively affect the consumption of the good by other individuals (Samuelson 1954, Kolstad 2000: 80-82). Second, public goods are non-excludable: if a good or service is provided to one individual for a fee, other individuals cannot be excluded from benefiting from the goods provision (Kolstad 2000: 78-80).

In the absence of a market, benefit-cost analysis can be used to assess the efficiency and welfare implications of resource allocation decisions. This technique sums up the values associated with the benefits and the costs and puts them into a common unit or metric. In economics, the usual metric is money (Condon and White 1994: 2). When money is used as the metric there are two primary measures of welfare, an individual's willingness to pay (WTP) and an individual's willingness to accept (WTA) (Bateman et al. 2002: 17).

[2] Apart from admission fees to parks, there are generally no prices attached to these services and therefore a market cannot exist.

An individual's willingness to pay is the maximum amount they would pay in order to obtain an increase in non-market benefits, or the maximum amount they would pay to avoid a decrease in non-market benefits. On the other hand, an individual's willingness to accept is the minimum amount they would accept in compensation for not getting an increase in non-market benefits, or the minimum amount of money they would accept for a decrease in non-market benefits. Whether one uses willingness to pay or willingness to accept depends on how property rights are assigned—one must ask who is entitled to what (Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems 2005: 49).

4.2.2 A Review of Available Environmental Valuation Methods

Several methods have been developed to evaluate the benefits and costs associated with non-market EG&S. They can be separated into two different groups: stated and revealed preference methods. Stated preference methods gather data on individual preferences through the use of a public survey. There are two widely used stated preference techniques: the contingent valuation method and a group of similar techniques called attribute based methods.

Contingent valuation is the older of the two—it has been applied to a wide array of environmental issues since it was created (Venkatachalam 2004). While this method has been heavily criticized for its hypothetical nature, academic and government studies have shown that it can be used as a valid instrument to estimate changes in welfare. The Comprehensive Environmental Response, Compensation and Liability Act of 1980 in the United States allows for the use contingent valuation damage estimates to determine payments in legal cases (Boyle 2003a: 112-113).

Additionally, a panel convened by the United States National Oceanic and Atmospheric Association (NOAA) to examine contingent valuation concluded that the results of a properly conducted study could be used to assess non-use values. The panel also recommended a set of general guidelines to be used when conducting a contingent valuation study (Arrow et al. 1993: 30-35). They indicate that if a study followed these guidelines, fairly reliable estimates could be elicited.

The panel's conclusions and recommended guidelines led to much debate when the report was released. Among those who supported the report, Carson et al. (1996: 4) found evidence that stated preferences that follow the guidelines yield similar results to those obtained using revealed preferences. Hanemann (1994) claims that the evidence found in the two years after the report backs the panel's conclusions. However, the conclusions of the panel were also criticized. For one, the panel did not offer any reason as to why following their guidelines would generate fairly reliable estimates (Diamond and Hausman 1994). Another criticism is that the panel did not advocate for testing whether a survey that follows the guidelines will result in reliable estimates.

Attribute based methods have not been used as extensively as contingent valuation. Though their foundations can be traced to the middle of the 20th century, attribute based methods have only been applied to the environment in the past few decades—these techniques were initially used in market research (Holmes and Adamowicz 2003: 172-175). The focus of this method is on valuing the attributes associated with a policy change—in the current context, attribute based methods could be used to estimate a value of individual ecosystem goods and services such as aesthetics, water quality, and wildlife habitat. Attribute based methods can be subdivided into 4 main variants: choice experiments, contingent ranking, contingent rating, and paired comparisons (Hanley,

Mourato, and Wright 2001). A review of the literature reveals that choice experiments are the most widely applied of these four techniques for environmental valuation.

There are several revealed preference techniques that have been applied to environmental valuation. A popular revealed preference technique is known as the dose-response method. The dose-response method treats the EG&S as "a factor input into the production of a marketed good that yields utility" (Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems 2005: 113). There are two basic steps involved in the dose response method (Barbier 1994). The first is to quantify the physical effects on an economic activity of a change in the ecosystem good or service. The second step is to value the effect on market activity brought about by the change.

Another revealed preference technique is the travel cost method. The idea behind the travel cost method is that a value can be estimated for an ecosystem good or service based on the travel expenditures and time costs an individual incurs while visiting a site. Travel cost methods are most often applied to recreational sites and activities (Parsons 2003: 269)—for example fishing.

The hedonic method involves observing "the monetary trade-offs individuals are willing to make with respect to the changes" in the characteristics of a good (Taylor 2003: 331). In the majority of cases the monetary trade-off or instrument considered when using the hedonic method for environmental valuation is the price of residential property. In the current context one can examine the effects that differing watershed characteristics (aesthetics for example) have on the price of residential properties.

There are a few other methods that can be used to value the environment: replacement and treatment cost as well as benefit transfers. The replacement and treatment cost techniques estimate a value based on the cost of replacing the EG&S, or the cost associated with treating damages that arise due to loss of the EG&S (Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems 2005: 125). The benefit transfer technique involves using values for EG&S that have already been reported in the literature. Essentially, one transfers value estimates from other sites to the area of interest (Rosenberger and Loomis 2003: 447). The Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems (2005: 10) recommends that replacement and treatment cost methods as well as benefit transfers only be applied if there are no other alternatives available.

Revealed preference techniques have several limitations compared to stated preferences that are relevant to the current study. The first limitation is that revealed preferences are only able to estimate use values, while stated preference methods are able to assess both use and non-use values (Boyle 2003b: 266). Another limitation of revealed preferences is that these methods are unable "to estimate values for levels of quality that have not been experienced" (Boyle 2003b: 266). Based on these two limitations, it is proposed that a stated preference method be used for the study in the Canaan-Washademoak watershed. However, one should recognize that stated preference methods have drawbacks. For example, depending on the quality of the survey design, stated preference techniques are subject to a number of different types of bias (Mitchell and Carson 1989: 236-237).

Though a few studies have applied attribute based methods to watersheds, such as Farber and Griner (2000), contingent valuation is the best option for the valuation of EG&S in the Canaan-Washademoak watershed. The proposed changes in riparian buffer size are highly correlated with

the chosen EG&S. Therefore these management actions cannot differently affect the provision of individual EG&S such as aesthetics, wildlife habitat and water quality services (Kramer et al. 2003: 304; Holmes et al. 2004). Attribute based methods cannot be used when the attributes are not differently affected by the management actions; contingent valuation works best for this type of policy change.

4.2.3 Literature Focusing on Benefits Estimation

Contingent Valuation Literature

A review of the literature identified four recent articles that value the benefits associated with some aspect of riparian ecosystems. The earliest, by Loomis et al. (2000), uses the contingent valuation method to estimate the total economic value of restoring certain EG&S along a 45-mile section of the South Platte River in Colorado. The EG&S included in the study are the dilution of wastewater, natural purification of water, erosion control, fish and wildlife habitat, as well as recreation.

Respondents were asked if they would be willing to pay an additional amount on their monthly water bill that would go towards a river restoration fund. This fund would be used to pay for a management plan consisting of a ten-mile wide conservation easement, restoration of native vegetation (implementation of buffer strips), elimination of cropland and cattle grazing in the buffer strips, and reducing water diversions to agriculture from 75% to 50% of the total river flow. Approximately 100 households participated in face to face interviews. The questionnaire used a closed ended dichotomous choice format; respondents were given one of 12 bid amounts, ranging from $1 to $100, in potential increases in their water bill.

The estimated mean monthly willingness to pay per household was $21 ($252 annually). Three different annual aggregate values were calculated. Two were calculated based on different estimates of the response rate: $18.54 million (applying the mean WTP to 26% of area households) and $29.171 million (applying the mean WTP to 41% of area households). The final estimate resulted from applying the mean willingness to pay to all area households: $71.148 million. The costs of restoration were calculated using the size of the conservation easements and water rental rates. Each of the three aggregate benefit estimates are larger than the calculated costs and therefore there is a positive net benefit.

Amigues et al. (2002) used contingent valuation to estimate the amount that households near the Garonne River in France are willing to pay for the preservation of riparian forests. This project entailed setting aside a riparian buffer approximately 10-50 metres wide along 20 and 70 kilometre sections of the river. Benefits associated with preserving the buffer strip include protecting migrant species reproduction areas, water pollution reduction, limiting soil erosion, and protecting habitat for local species.

Respondents were initially asked if they would be willing to fund the preservation project through higher annual taxes over the next five years. Two different types of valuation questions were asked to two separate population samples—an open ended question and a closed ended dichotomous choice question. Face to face interviews were held with a random and representative sample of 402 survey participants. Only half of the respondents were willing to pay some amount to preserve and restore the riparian area. Half of these respondents indicated that they would pay the same amount for the 20 and 70 kilometre preservation programs, indicating insensitivity to scope.

Six different estimates of WTP using six different statistical methods were calculated for the open ended question (mean in brackets): arithmetic mean ($26 USD), simple linear model ($13 USD), Tobit (expected value of WTP -$2.50 USD), Heckman two-step approach (expected value of WTP $6 USD), semi-log model ($7 USD), and a spike-adjusted model ($13 USD). Two different values of willingness to pay were estimated for the closed ended question. When calculated over the total range of bid values, the estimated mean willingness to pay was $52 USD, while using a spike adjusted model yielded a value of $25 USD. The cost of the project was determined by estimating values for the willingness to accept of riparian landowners (this is detailed in Section 4.3.4). The primary finding of this article is that the benefits are larger than the costs.

Holmes et al. (2004) used contingent valuation to estimate the benefits of restoring the riparian zone of the Little Tennessee River in North Carolina. The main objectives of this study were to develop and test a methodology for valuing the restoration of a set of EG&S and complete a benefit-cost analysis of restoring the riparian area. The EG&S considered in this study include: fish habitat (i.e., abundance of game fish), wildlife habitat (i.e., wildlife habitat in buffer zones), erosion control and water purification (i.e., water clarity), recreational uses, and ecosystem integrity (i.e., an index of ecosystem 'naturalness').

The authors developed four different restoration programs. Each of these programs included the protection of small tributary streams by best management practices. However the amount of restoration along the main branch of the river differed among the four programs: Program One only protected the tributaries, Program Two had two miles of restoration, Program Three had four miles of restoration, and Program Four had six miles of restoration—the final program is considered a complete restoration of the river. Each of the programs had varying effects on the indicators of EG&S (low, moderate, and high). In the status quo, each of the indicators was assigned "low" level—while program four raised each of the indicators to "high".

The questionnaire was administered in a central location to 384 individuals. The survey was computerized in order to simplify its presentation. Respondents were asked to vote on increasing the county sales tax for the next ten years to pay for the restoration project. Questions were phrased in a double bounded dichotomous choice format. Initially a bid was presented for program one. If respondents were willing to pay the amount for Program One, a higher bid was assigned for Program Two. If however, the respondent answered 'no', a lower amount was assigned for Program Two. This process continued until Program Four.

The sample and population median willingness to pay for each program were estimated using standard probit and random probit models—this resulted in four estimates for each program. Using sample means and the standard probit model, the estimated median annual household willingness to pay for each of the programs was: $5.66 USD (Program One), $1.09 (Program Two), $2.30 USD (Program Three), and $53.76 USD (Program Four). The three remaining estimates for each program follow the same pattern as those from the standard probit model (though differing in magnitude). Cost estimates were obtained from previous local restoration projects. The benefit-cost ratios ranged from 3.33 to 15.65; each project had a positive net benefit.

Finally, Colby and Orr (2005) report on a recent contingent valuation study which examined the willingness to pay of visitors to preserve the riparian zone of the San Pedro River Basin in southeastern Arizona. This area, which has been designated the San Pedro Riparian National Conservation area, has one of the most diverse bird populations in the United States. Agriculture

and urban growth are threatening the ecological integrity of the river's riparian area through the diversion of surface water and groundwater depletion.

The survey was administered on-site to 843 respondents, all of whom lived outside the Upper San Pedro River Basin—551 questionnaires were complete and used in the analysis. Respondents were asked whether they would be willing to provide a one-time donation to a fund that would acquire water rights and promote regional water conservation—they could choose from 13 bid categories (ranging from $0 to $1000). The respondents were informed that if they chose not to donate and the program was under funded, the ecosystem could become degraded. The survey made use of photographs depicting healthy and unhealthy landscapes to help with the valuation process.

The estimated mean willingness to pay for the preservation of the riparian ecosystem was $79.31 USD per visitor. The annual aggregate willingness to pay varies depending on the visitor estimate. A high (+25%) visitor estimate yields a benefit of $3.461 million, a medium visitor estimate yields a benefit of $2.769 million, and a low (-25%) visitor estimate yields a benefit of $2.077 million. The study does not estimate the cost of preserving the riparian area and therefore does not complete a benefit-cost analysis.

Table 4.1: Estimated mean willingness to pay (Benefits) from previous literature

Study	EG&S	Scale	Range of Estimated WTP
Loomis et al. (2000)	Dilution of wastewater, purification of water, erosion control, fish and wildlife habitat, recreation	45 Miles	$21 per month/household
Amigues et al. (2002)	Protecting migrant species reproduction areas, water pollution reduction, limiting soil erosion, protecting natural areas for local species	20 and 70 Kilometres	$6 to $26 (Open Ended) $25 & $52 (Closed Ended) *Scale not explicit*
Holmes et al. (2004)	Fish & wildlife habitat, erosion control and water purification, recreation, ecosystem integrity	0, 2, 4, and 6 Miles	0 (& Tributaries): $3.62 to $8.97 2 (& Tributaries): $0.69 to $3.48 3 (& Tributaries): $1.47 to $5.73 6 (& Tributaries): $27.26 to $53.76 *All per year/household*
Colby and Orr (2005)	Main focus is habitat, recreation	San Pedro River Basin	$79.31 per visitor

Other Relevant Literature

There has been little research completed that has applied attribute based methods to estimating the value of preserving or restoring riparian areas of watercourses; though some studies have been published. Collins, Rosenberger and Fletcher (2005) estimate the value of restoring Deckers Creek in West Virginia. The creek is contaminated with trash and sewage; it is also highly acidic and has elevated levels of chemicals. Almost all of the creek's aquatic life has disappeared. The authors used choice experiments to estimate a value of fully restoring three attributes of Deckers Creek: aquatic life, swimming, and scenic quality.

Study participants (n = 257) received the questionnaire through the mail and the internet (e-mail); recreational users of the creek and a trail that passes nearby were also surveyed. A nested logit

model was developed to estimate a value for the three attributes that controlled for respondent characteristics, knowledge of and attitudes toward the creek. The estimated value of fully restoring Deckers Creek ranged from $12 to $16 (USD) annually. When this is aggregated across the relevant population, the total annual benefit of restoration is estimated to be $1,870,000.

Mooney and Esigruber (2001) used hedonic analysis to estimate the change in the value of streamside properties caused by the planting of a treed riparian buffer. Residential property owners situated along watercourses have been encouraged to plant treed riparian buffers by the Oregon Plan for Salmon and Watersheds in order to improve fish habitat. Assessed house values, as well as other structural and neighborhood characteristics were obtained from the department responsible for taxation and assessment in the county. GIS data and aerial photos were used to obtain other environmental, adjacency, and distance characteristics. Results of the regression analysis (n = 153) indicate that a treed riparian buffer causes a decline in property value.

4.2.4 Literature Focusing on Costs Estimation

Kline et al. (2000), examine the willingness of non-industrial private forest (NIPF) owners in Oregon and Washington to adopt harvesting practices that protect or enhance riparian habitat for Coho salmon. Contingent valuation is used to estimate the willingness to accept values that NIPF owners require in order to forego harvesting within a 200 foot buffer zone along streams. They also examine reasons why NIPF owners own their forest land. Based on the answers to a set of questions, the authors categorize forest owners into one of four groups: 1) timber producers (solely interested in timber values), 2) multi-objective owners (interested in timber and non-timber values, 3) recreationists (most interested in recreational values), and 4) passive owners (no specific purpose for owning forest land). This categorization enables an examination of how willingness to accept varies across the four groups of forest landowners.

The questionnaire contained a closed ended discrete choice question, with bid amounts ranging from $25 to $1000/acre/year (USD). A telephone survey, returning 403 useable responses, asked whether non-industrial private forest owners would forego all harvesting within 200 feet of streams in return for a 10 year reduction in federal income tax. The results were analyzed using two different methods in order to ascertain mean willingness to accept for each of the forest owner groups. The first method, using truncated means, yielded mean estimates of willingness to accept for each group of: 1) $128/acre/year (timber producers), 2) $54/acre/year (multi-objective owners), 3) $38/acre/year (recreationists), and 4) $115/acre/year (passive owners). The second method resulted in similar estimates of mean willingness to accept. Median willingness to pay is also reported—they follow the same pattern as the mean values.

Amigues et al. (2002) used the contingent valuation method to estimate the willingness to accept values of property owners to preserve riparian habitat. The owners of relevant properties along the river, used for agriculture and non-agricultural purposes, were sent a mail survey—out of 315 landowners, there were 97 useable responses. The questionnaire included an open ended question which estimated the minimum payment riparian landowners required for them to preserve a buffer strip 10-50 meters wide in a natural state. The landowners were first asked whether they would participate in one of three differing programs for the next 10 years. The programs differed with respect to the responsibilities that the owner has in maintaining the buffer strip. Interested respondents were then asked the minimum compensation required for them to participate in the program of their choice.

Three different statistical methods were used to determine mean willingness to accept values for the whole sample (all USD): 1) $114/hectare (unknown method), 2) $117/hectare (spike-adjusted model), and 3) $125/hectare (Tobit model). The authors note that the mean willingness to accept values reported for the sub-sample of farmers (not shown) appear to be consistent with net revenues generated from crops. They suggest that contingent valuation using willingness to accept may result in more reliable estimates than previously suggested in the literature—particularly when respondents are more familiar with the scenario.

Table 4.2: Estimated mean willingness to accept (perceived costs) from previous literature

Study	EG&S	Scale	Range of Estimated WTA
Kline et al. (2000)	Habitat for Coho salmon	Buffer: 200 feet wide	$38 to $128 per acre/year (Truncated Means)
Amigues et al. (2002)	Protecting migrant species reproduction areas, water pollution reduction, limiting soil erosion, protecting natural areas for local species	Buffer: 10 to 50 metres wide	$114 to $125 per hectare/year

4.2.5 Conclusions Derived from the Literature

There are a few conclusions that can be drawn from the literature and applied to the current study of EG&S provision in the Canaan-Washademoak watershed. The first is that the contingent valuation method can be used successfully to estimate the benefit that society derives from riparian ecosystem services. The second is that this method can also be applied to estimate the cost to landowners of providing these goods and services. The current study uses a similar approach to that used by Amigues et al. (2002). Willingness to pay for an increase in EG&S was used as an estimate of the benefit derived from goods and services provided by landowners and willingness to accept as an estimate of the costs incurred by landowners. A benefit cost analysis was then completed by summing the benefit (WTP) and the cost (WTA). The structure of the contingent valuation scenario used by Holmes et al. (2004) was followed. Four potential riparian management programs were developed—each program having a different effect on aesthetics (forest scenery), water quality (for recreation), as well as fish and wildlife habitat.

4.3 Methodology

A benefit-cost analysis framework was used to examine the welfare implications associated with the provision of EG&S by landowners in the Canaan-Washademoak watershed. In order to assess the relevant benefits and costs, the contingent valuation method—a stated preference technique—was used. The main feature of the contingent valuation method is the creation of a hypothetical market for goods or services—the estimated values are contingent upon the scenario presented in the questionnaire (Condon and White 1994: 8, Bateman et al. 2002: 120). In the past few decades this method has seen extensive use in the valuation of the environment—it was originally proposed in 1947 and first used empirically by Davis (1963) to estimate the value of goose hunting (Venkatachalam 2004).

4.3.1 General Public Mail Survey

The Contingent Valuation Questionnaire

A questionnaire was designed and sent to a random sample of the public. According to Bateman et al. (2002: 117), there are three stages involved in designing a contingent valuation questionnaire: 1) "formulating the valuation problem," 2) developing "additional questions," and 3) "pre-testing the questionnaire." The first stage, developing the valuation problem, involves defining the policy change, designing a valuation scenario, and estimating the monetary values. The policy change that was presented to in the public mail survey was an increase in the size of the riparian buffer along the Canaan River and the river's main tributaries.

The valuation scenario that was presented to respondents is as follows. After being presented with information on the current state of the watershed, respondents were asked how much they would be willing to pay to establish, preserve or enhance a 30 meter (m) riparian buffer on private woodlots along the Canaan River and the river's main tributaries. Then, a second scenario asks how much they would be willing to pay to establish, preserve or enhance a 60m riparian buffer on private woodlots along the Canaan River and its main tributaries. A third program asks respondents how much they would be willing to pay to establish, preserve or enhance a 30m riparian buffer on private woodlots, agricultural and residential land along the Canaan River and its main tributaries. A fourth program asks respondents how much they would be willing to pay to establish, preserve or enhance a 60m riparian buffer on private woodlots, agricultural and residential land along the Canaan River and its main tributaries. The effect that these programs are expected to have on aesthetics, water quality, and wildlife habitat are explained to respondents. See Table 4.3 below for an overview of each program.

Table 4.3 Overview of the valuation program scenarios presented in the household survey

Scenario	Buffer Size	Land Type	Magnitude of Change in EGS
Program 1	30m	Private Woodlots	Slight Improvement
Program 2	60m	Private Woodlots	Slight to Moderate Improvement
Program 3	30m	Woodlots, Agriculture, Residential	Moderate Improvement
Program 4	60m	Woodlots, Agriculture, Residential	Large Improvement

After being presented with a description of each program, individuals were then asked the maximum annual amount of additional income taxes that they would be willing to pay for the next 10 years to achieve the policy change outlined in each program. This amount represents an estimate of how much an individual values the riparian buffer and the EG&S in question. The main feature of this stage is the elicitation format. There are three common response formats used in contingent valuation surveys: open ended, payment card, and dichotomous choice (Boyle 2003a). The particular format used in this study is a variant of dichotomous choice, which is the most widely used format—the variant is known as double bounded dichotomous choice. It is relatively simple for respondents to answer as it closely resembles a real market situation—individuals only need to decide whether to accept the given price for a certain level of EG&S (Condon and White 1994: 9).

The double bounded dichotomous choice format proceeds as follows. Respondents are initially asked whether they would be willing to pay *x* dollars in order to increase the quality and quantity of ecosystem services provided. If the respondent answers 'yes', they are then asked a similar

question but presented with twice (2*x*) the previous value. On the other hand, if the respondent answers 'no' then they are asked the same question at half (1/2*x*) the original value. If the respondent accepts any of these offers, that amount provides an indication of their maximum willingness to pay. Eight initial values for x have been used for Program 1. These values were chosen in consultation with the literature and a focus group and range from $1.00 to $75.00, increasing by approximately 20%-30% from one program to the next. If a respondent was willing to pay any of these amounts, they were asked to allocate the money among forest scenery, water quality, as well as fish and wildlife habitat. This was done in order to estimate a value for the three EG&S and is similar to the approach used by Walsh et al. (1984) to estimate option, existence, and bequest values.

The second stage in designing a contingent valuation questionnaire is developing additional questions. This stage involved the creation of debriefing, follow-up, attitudinal, opinion, and use questions, as well as demographic questions. The third stage in designing a contingent valuation questionnaire was pre-testing the questionnaire. There are several different ways to test the draft questionnaire: focus groups, one-on-one interviews, verbal protocols, and pilot surveys. Focus groups involve an interview done with a small group of individuals. They are the most important part of the design stage of qualitative research (Bateman et al. 2002: 153) and are used to get information on among other things, survey design, wording, and the credibility of the contingent valuation scenario. The current research project held a focus group to test the survey on December 18, 2006.

Sampling and Implementation of the Survey

The survey was administered to three different sample populations of the general public in New Brunswick. The first was a sample of households located in the riparian zone of the Canaan-Washademoak watershed, the second was a sample of the remainder of the watershed, and the third was a random sample of households in the remainder of southern New Brunswick (Albert, Westmorland, Kent, Saint John, Kings, Queens, Sunbury, York, and Charlotte counties). A mail survey was used since this mode is the cheapest way to contact the largest amount of people. Mail surveys also give the respondent more time to complete the questionnaire and allow for the use of maps. Addresses were obtained from Service New Brunswick's Real Property Mapping and Property Assessment database. The process of mailing the surveys roughly followed the steps outlined in Tailored Design Method (Dillman 2000: 27). The selected households were notified with a letter a few days before the questionnaire is sent. The questionnaire was then sent. A few weeks later a replacement questionnaire was mailed to the non-respondents.

4.3.2 Landowner Mail Survey

The Contingent Valuation Questionnaire

The policy change presented to the landowners was similar to the one presented to households in the public mail survey. Landowners along the Canaan River and its main tributaries were asked the minimum annual amount of money they would require per acre within the buffer, in order for them to provide (if no treed buffer exists), maintain or enhance (if a treed buffer already exists) a riparian buffer within 30m of the watercourse for the next 10 years. These landowners were then asked the same question using a 60m buffer instead.

An open-ended elicitation format was used to ask respondents the minimum amount they would accept to adopt the new management policies. Under this format, the respondent is asked how much financial compensation (paid to them by the provincial government) they would require in order to implement the management plans—a blank space is left for them to write the compensation they require. As in the public mail survey, landowners were asked a number of attitudinal, opinion, knowledge, and use questions as well as demographic and socioeconomic questions.

Sampling and Implementation of the Survey

The survey was administered to riparian landowners in the Canaan-Washademoak watershed. The questionnaire was included with the mail survey described in Chapter 2. The addresses for the affected landowners were obtained from Service New Brunswick's Real Property Mapping and Property Assessment databases. The surveys were mailed according the steps outlined in Tailored Design Method (Dillman 2000: 27).

4.3.3 Statistical Analysis

The statistical analysis proceeded in three steps: 1) cleaning the data, 2) estimating willingness to pay and willingness to accept, and 3) examining the reliability of the data. Many of the respondents skipped some of the socioeconomic questions. Two options exist for dealing with this problem: 1) delete the observations with missing data resulting in a reduced sample size or 2) impute the missing data resulting in an increased sample size (Whitehead 2006: 88). This report proceeds with a mixture of the two. Data imputation, which according to Bateman et al. (2002: 181) is the most common solution was used and then all other observations with missing data were deleted.[3] Observations which do not reflect an individuals actual willingness to pay (called protest responses) were also removed based on guidelines that were modified from Bateman et al. (2002: 146).

Mean willingness to pay was estimated using the Kaplan-Meier product limit estimator and Turnbull's self consistency algorithm, a non-parametric method, according to the steps described in Bateman et al. (2002: 225-242). This technique is not subject to the same level of assumptions as parametric techniques and can often be considered a lower bound estimate of willingness to pay (accept). The data on willingness to accept is continuous, and it is therefore sufficient to take the arithmetic mean.

The data was tested for validity and reliability using regression analysis.[4] This analysis examines whether the data conforms to the expected relationships between the independent variables and willingness to pay or accept provided by economic theory (Brown 2003: 104). For example, one expects respondents with higher incomes to have a higher WTP. An additional analysis of data validity is to test for sensitivity to scope—whether respondents are willing to pay more if they are provided with a greater quality or quantity of the EG&S.

[3] Data is imputed by using observed characteristics to predict the missing observations (using regression). The imputation uses the `uvis` command in the ICE program written for Intercooled Stata 8.0.
[4] A parametric approach is required to examine the relationship between willingness to pay and covariates. Imputed data is only used in this model and is not used to estimate willingness to pay or accept.

4.3.4 Calculation of Net Benefit

Once the benefits and costs have been estimated in monetary terms, the welfare analysis can be completed by calculating the net benefit (benefit – cost) using a simple benefit cost analysis. Mean willingness to pay can be calculated from the survey responses and then aggregated for all individuals in the affected population in order to get total annual willingness to pay. These annual values are then discounted and added together to get the present value of total willingness to pay. Discounting is the process of converting future monetary values to current monetary values to account for the effect that time has on the value of money. The same can be done for landowners in the watershed to get the present value of total willingness to accept.

4.4 Results

4.4.1 Response Rates for the Survey

Household Survey

A total of 219 survey packages were sent to owners of property located adjacent to the Canaan River, Washademoak Lake, and their main tributaries. Ten questionnaires were returned as they were not deliverable. Of the remaining 209 survey packages, 90, or 43.1% were returned. Eighty one of these questionnaires were completed to some extent—9 of the questionnaires were returned blank. Therefore, the response rate for the portion of the surveys sent to riparian property owners was 38.8%.

A total of 683 survey packages were sent to owners of non-riparian property located in the Canaan-Washademoak watershed. Twenty seven survey packages were not deliverable and were returned by Canada Post. Of the remaining 656 survey packages, 246, or 37.5% were returned. There were 215 questionnaires completed to some extent—31 of the questionnaires were returned blank. The response rate achieved for the surveys sent to non-riparian property owners in the Canaan-Washademoak watershed was 32.8%.

Also, a total of 800 survey packages were sent to a sample of property owners living in southern New Brunswick. Twenty five survey packages were not deliverable. Of the remaining 775 survey packages, 225, or 29.0% were returned. There were 178 questionnaires completed to some extent—47 questionnaires were returned blank. Therefore, the response rate for surveys sent to property owners residing in southern New Brunswick is 23.0%

Overall, a total of 1702 survey packages were sent out to the three groups of respondents. Sixty two surveys were undeliverable. Of the remaining 1640 survey packages, 561, or 34.2% were returned. There were 474 surveys completed to some extent—87 of the questionnaires were blank. Therefore, the overall response rate is 28.9%.

Landowner Survey

The response statistics for the landowner survey are similar to those presented in Chapter 2 (i.e., the CVM questions used in this analysis were integrated with the survey described in Chapter 2). However, 23 additional questionnaires were mailed to woodlot owners and 12 of these additional questionnaires were returned. Therefore, the landowner survey was sent to 634 individuals and

328 were returned. A final sample of 618[5] landowners resulted, and a response rate of 53% was achieved.

4.4.2 The Benefits of Riparian Buffers along the Canaan River & Tributaries

Estimating Mean Willingness to Pay for EG&S in Riparian Buffer Areas

Of the 474 completed surveys returned, there were 36 respondents who did not completely or properly answer the first valuation scenario (Program 1: 30m Buffer on Woodlots), leaving 438 individuals who answered it correctly. However, many of these responses were protests and did not reflect the actual utility of the respondent. After removing these responses, there were 319 useable observations on the first scenario. Of this total, 103 respondents were not willing to pay anything. This left 216 respondents who were willing to pay one of the amounts which they were presented. Mean annual willingness to pay for the changes in Program 1 was estimated to be $32.96.

Fifty six respondents did not completely or properly answer the second valuation scenario (Program 2: 60m Buffer on Woodlots). This left 418 respondents that did correctly answer the scenario. After removing the responses considered protests there were 310 useable observations. Of this total, 139 respondents were not willing to pay anything—leaving 171 respondents who were willing to pay one of the amounts presented to them. Mean annual willingness to pay for the changes outlined in Program 2 has been estimated to be $39.02.

Sixty one respondents failed to properly complete the third valuation scenario (Program 3: 30m Buffer on Woodlots, Agricultural Land, and Residential Land); 413 individuals answered it correctly. After removing the protests, 296 observations remained to be used in the analysis. Of this total, 127 respondents were not willing to pay anything. Therefore 169 respondents indicated that they were willing to pay one of the amounts presented to them. Mean annual willingness to pay for the changes in Program 3 was estimated to be $47.65.

Fifty nine respondents did not properly complete the fourth valuation scenario (Program 4: 60m Buffer on Woodlots, Agricultural Land, and Residential Land). This left 415 individuals who answered it correctly. After removing the responses that were considered protests there were 245 useable observations. Of this total, 89 respondents were not willing to pay anything, leaving 156 respondents who were willing to pay one of the amounts which they were presented. Mean annual willingness to pay for the changes in Program 4 has been estimated to be $58.89.

Table 4.4: Mean annual per person willingness to pay (WTP) for EG&S under each buffer program[a]

Component	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Mean annual per person WTP ($)	$32.96	$39.02	$47.65	$58.89
95% CI ($)[6]	$28.55 to $37.37	$33.45 to $44.60	$40.26 to $55.05	$48.33 to $69.46
Observations	319	310	296	245

[a] See table 4.3 for a description of each program.

[5] The final sample population of 595 from Chapter 2 plus the 23 additional questionnaires sent to woodlot owners.
[6] The analytical approach described in Bateman et al. (2002: 242) was used to calculate the confidence intervals.

The main finding from the household survey is that respondents positively value riparian buffers along watercourses in the Canaan watershed. Also of note is that mean annual willingness to pay increases as the scope of the programs increase. Mean willingness to pay increases by $6.06 (or 18.4%) from Program 1 to Program 2; it increases by $8.63 (or 22.1%) from Program 2 to Program 3; and it increases by $11.24 (or 23.6%) from Program 3 to Program 4. This suggests the presence of internal sensitivity to scope.

The Relationship between Willingness to Pay and Respondent Characteristics

Logistic regression was used examine the relationship between willingness to pay and certain respondent characteristics such as socioeconomics, use and knowledge of the watershed, as well as attitudes toward land use restrictions. The results of this regression are presented in Table 4.5. Generally, most of the coefficients exhibit the relationships that one might expect based on economic theory. Seven variables are significant across all four programs: 1) being 65 or over; 2) being female; 3) being employed; 4) having a high income (over $85,000); 5) often or sometimes participating in outdoor activities in the watershed; 6) thinking that land use should be restricted to provide or maintain EG&S; and 7) thinking that there should be riparian buffers on woodlots, agricultural lands, and residential lands in order to protect EG&S. Also of note is that distance from the watershed does not significantly affect willingness to pay. Additionally, imputing income has a negative and significant effect on willingness to pay in Programs 1 and 4. This implies that respondents who did not answer the income question were not willing to pay as much as those who did answer this question.

Table 4.5: Regression results relating individual willingness to pay values and respondent characteristics[a.b]

Variable	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
High school diploma	-1.426	61.534**	55.260	511.492
	(14.375)	(29.089)	(33.744)	(26925.840)
University / College graduate	4.212	57.707*	59.509*	494.636
	(15.151)	(29.923)	(34.669)	(26925.840)
Graduate degree	8.950	65.223**	56.587	513.362
	(15.335)	(29.769)	(34.456)	(26925.840)
Age category: 39 to 50	-19.569**	-16.140	-31.792**	-23.093
	(9.962)	(12.552)	(15.125)	(18.365)
Age category: 51 to 65	-13.106	-22.230*	-39.718**	-26.000
	(9.850)	(12.617)	(15.587)	(20.342)
Age category: over 65	-21.914*	-35.323**	-54.610***	-59.837**
	(12.261)	(15.910)	(19.230)	(26.268)
Female	-21.356***	-19.670**	-18.674**	-27.200**
	(6.009)	(8.069)	(9.338)	(12.038)
Household size	-1.746	-3.945	-5.017	-5.377
	(2.680)	(3.345)	(4.174)	(6.273)
Employed	21.219***	22.634**	19.394*	30.024**
	(6.693)	(9.027)	(10.596)	(14.114)
Household income category: $18,001 to $42,000	13.060	11.001	12.974	35.048
	(10.666)	(16.190)	(19.085)	(27.254)
Household income category: $42,001 to $85,000	11.580	9.184	18.898	26.921
	(11.060)	(16.140)	(19.222)	(26.773)
Household income category: $85,001 or more	23.302*	39.389**	38.844*	57.022*
	(12.226)	(17.972)	(21.343)	(29.814)
Member of an environmental organization	-0.274	-8.993	-1.244	-28.734
	(9.095)	(12.182)	(14.627)	(18.146)
Own property in the Canaan-Washademoak watershed	-10.647	-16.267	-14.927	-28.940*
	(7.411)	(10.275)	(11.807)	(15.576)
Familiarity with the Canaan-Washademoak watershed	-8.857	-1.172	1.135	14.647
	(6.499)	(8.789)	(10.339)	(12.640)
Participates in Outdoor Activities in the watershed	22.296***	21.556**	23.076**	32.531**
	(7.527)	(10.349)	(11.742)	(14.748)
Effectiveness of current regulations in watershed	-3.661	11.237	3.492	17.095
	(5.968)	(8.262)	(9.715)	(11.901)
Owns riparian property in the watershed	-0.00393	0.165**	0.0229	-0.0957
	(0.0624)	(0.0811)	(0.0962)	(0.129)
Distance in kilometers from the Canaan watershed	-0.000403	-0.00710	-0.0133	-0.00562
	(0.00557)	(0.00865)	(0.0109)	(0.0128)
Likert: Agreement with land use restrictions	4.612***	8.847***	7.397***	10.795***
	(1.509)	(2.237)	(2.392)	(3.440)
Likert: Agreement with riparian buffers	4.660***	6.0931***	8.345658***	13.391***
	(1.591)	(2.156)	(2.500)	(3.317)
Imputed income	-14.735*	-14.328	-21.818	-49.929**
	(8.555)	(12.375)	(16.500)	(19.754)
Imputed household size	-2.316	-34.463	-19.379	-56.584
	(22.211)	(42.090)	(48.570)	(59.326)
Constant	-86.289***	-226.081***	-206.819***	-767.890
	(26.853)	(46.268)	(52.004)	(26925.93)
Wald chi2(23)	75.43	67.43	58.87	67.79
Prob > chi2	0	0	0.0001	0
Log-Likelihood	-323.12891	-298.10771	-308.14944	-243.88272
Observations	267	261	249	203

[a] See table 4.3 for a description of each program.

[b] Standard errors are in parentheses; * indicates significance at the 0.10 level; ** indicates significance at the 0.05 level; and *** indicates significance at the 0.01 level.

Estimating Mean Willingness to Pay for Specific EG&S in Riparian Buffer Areas

In an attempt to estimate a value for individual EG&S, respondents were asked to divide their willingness to pay (if they were willing to pay) up among forest scenery, water quality, wildlife habitat, and other. One can see in Table 4.6 that on average, the largest allocation went to water quality (around 46%), the second largest to wildlife habitat (around 39%), and the smallest allocation went to forest scenery (around 12%-13%). The allocations were fairly consistent across the four programs. Around 2% of total willingness to pay was allocated to other. This suggests that respondents were placing most of their value on the EG&S on which this report aims to place a dollar value.

Table 4.6: Average per person willingness to pay allocations (% of total) to specific EG&S under each buffer program[a]

Specific EG&S	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Forest scenery	12.84%	12.69%	12.99%	12.34%
Water quality	46.87%	45.17%	46.39%	46.10%
Wildlife habitat	38.46%	40.21%	38.40%	39.37%
Other	1.83%	1.93%	2.23%	2.19%
N	211	162	163	147

[a] See table 4.3 for a description of each program.

Using the figures in Table 4.6 above it is possible to estimate the dollar value that respondents place on forest scenery, water quality, and wildlife habitat. Total mean willingness to pay (from Table 4.4) is multiplied by the relevant percentage that each EG&S was allocated. The results of this calculation are presented in Table 4.7.

Table 4.7: Mean annual per person willingness to pay (WTP) for specific EG&S under each buffer program[a]

Specific EG&S	WTP ($) for Program 1: 30m buffer, woodlots	WTP ($) for Program 2: 60m buffer, woodlots	WTP ($) for Program 3: 30m buffer, all land	WTP ($) for Program 4: 60m buffer, all land
Forest scenery	$4.23	$4.95	$6.19	$7.26
Water quality	$15.45	$17.63	$22.10	$27.21
Wildlife habitat	$12.68	$15.69	$18.30	$23.19
Other	$0.60	$0.75	$1.06	$1.28

[a] See table 4.3 for a description of each program.

4.4.3 The Cost of Riparian Buffers along the Canaan River & Tributaries

Landowners' Willingness to Accept Compensation for providing Riparian Buffers

Landowners were initially asked whether they would be willing to provide, maintain, or enhance a 30m to 60m riparian buffer on their land if they were paid to do so. Twenty eight respondents did not answer this question, leaving a total of 300 useable responses. Of this total, 129 (43.0%) indicated that they would be willing to provide a riparian buffer and 171 (57.0%) indicated that they

would not be willing to do so. Those individuals who indicated that they were not willing to provide the buffer were asked to skip the remaining questions in the valuation scenario.

Of the 129 respondents who indicated that they would be willing to provide the riparian buffer, only 72 indicated the amount annual of compensation they would require per acre for a 30m buffer. The compensation required ranged from $0 to $100,000 per acre. The mean annual willingness to pay, presented in Table 4.8, has been estimated at $2,036.18 per acre.

Sixty three respondents indicated the amount of per acre compensation required for them to implement a 60m buffer. The compensation required by these 63 respondents ranged from $0 to $50,000 per acre. The mean annual willingness to accept was estimated at $2308.49 per acre, a $272.31 (or 13.4%) increase over the amount required for the 30m buffer.

Table 4.8: Mean annual individual landowner willingness to accept compensation (WTA) for providing 30m or 60m buffers per acre of land

Component	30m Buffer		60m Buffer	
	n	Mean WTA ($/acre)	n	Mean WTA ($/acre)
Average landowner	72	$2,036.18	63	$2308.49

Willingness to accept for both buffer sizes was regressed on a set of independent variables using ordinary least squares and a logistic regression. These regressions did not reveal any significant relationships between willingness to accept and landowner characteristics. The lack of significance may be due to the small number of observations. The results of these regressions are not presented in this report.

Comparing Woodlot Owner vs. Non-Woodlot Owners' Willingness to Accept Compensation

There were 293 valid responses to the question about whether the respondent owned a woodlot. Of this total, 53 (or 18.1%) were woodlot owners and 240 (or 81.9%) indicated that they were not. Twenty nine (or 54.7%) of the woodlot owners indicated that they would be willing to provide, restore or enhance a riparian buffer of a size ranging from 30m to 60m. Ninety eight (or 40.8%) of the non-woodlot owners indicated that they would do so.

Twenty woodlot owners answered the question about compensation for a 30m buffer. The payments required by these 20 landowners ranged from $0 to $3,000 per acre. Their mean annual willingness to accept was estimated at $520.25 per acre. Fifty two non-woodlot owners indicated the amount of compensation they would require to implement a 30m buffer. Their annual willingness to accept ranged from $0 to $100,000 per acre. The mean annual compensation required was $2,615.38 per acre.

Nineteen woodlot owners answered the question about compensation for a 60m buffer. The payments required by these 19 woodlot owners ranged from $0 to $5,000 per acre. The mean annual willingness to accept was estimated at $1,030.79 per acre. Forty four non-woodlot owners indicated the amount of compensation they would require for a 60m buffer. The compensation required by these landowners ranged from $0 to $50,000 per acre. Their mean annual willingness to accept was $2,860.93 per acre.

Table 4.9: Average woodlot owner vs. non-woodlot owner willingness to accept compensation (WTA) for providing a 30m or 60m riparian buffer per acre of land

Landowner Type	30m Buffer		60m Buffer	
	n	Mean WTA ($/acre)	n	Mean WTA ($/acre)
Average woodlot owner	20	$530.25	19	$1,030.79
Average non-Woodlot owner	52	$2,615.38	44	$2,860.23

The results suggest that woodlot owners are more likely to provide, maintain, or enhance a 30m to 60m riparian buffer on their land than non-woodlot owners. Additionally, woodlot owners require less compensation than non-woodlot owners. The mean annual willingness to accept for the 30m buffer was $2,085.13 (or 393.2%) larger for non-woodlot owners than for woodlot owners. Non-woodlot owners required $1,829.44 (or 177.5%) more than woodlot owners for the 60m buffer.

4.4.4 A Benefit-Cost Analysis of Riparian Buffers along the Canaan River & Tributaries

Population of Affected Landowners and Households

There are two different groups that comprise the population to which the results of the household survey can be aggregated. The largest group is comprised of households located in a geographic area represented by nine counties[7] in southern New Brunswick. According to the 2006 Canadian Census, there are 222,363 private households located in these counties. The second group is comprised of individuals who own land in the Canaan-Washademoak watershed. According to Service New Brunswick's Real Property Mapping and Property Assessment database, there are 3083 different landowners in the watershed. Approximately 166 of these landowners do not reside in the nine counties which comprise the population of southern New Brunswick. The remaining landowners are already counted in the census data as residents of a household located in one of the nine counties. If one assumes that everyone in the two groups hold a value for the watershed, the total affected population can be estimated by adding the non-resident landowners (166) to the number of households in the southern part of the province (222,531).

Table 4.10: Estimates of the affected population

Population	N	Non-Resident	Affected Population
Riparian landowners	883	62	62
Non-riparian landowners	2200	106	106
Southern New Brunswick	222,363	0	222,363
Total Affected Population			222,531

Number of Acres Involved For Each Program

The total number acres involved for implementing the riparian buffers for each program are shown in Table 4.11 (see Chapter 3 for details).

[7] Albert, Charlotte, Kent, Kings, Queens, St. John, Sunbury, Westmorland, and York counties

Table 4.11: Estimated number of woodlot vs. non-woodlot acres within riparian buffers under each buffer program[a]

Land Type	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Woodlot acres	5,884	11,300	5,884	11,300
Non-woodlot acres	0	0	1,524	3,018
Total acres	5,884	11,300	7,408	14,318

[a] See table 4.3 for a description of each program.

Aggregating the Benefits

Since there was no evidence of willingness to pay declining as distance from the watershed increases, aggregating the benefits is fairly straight forward. One proceeds by multiplying the affected population by the individual benefit estimate (mean willingness to pay) for each program found in Table 4.4. The estimates of the total annual benefit are presented in Table 4.12.

Table 4.12: Aggregating the benefits (willingness to pay, or WTP) of EG&S under each buffer program[a]

Component	Program 1: 30m buffer, woodlots	Program 2: 30m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Mean annual individual WTP ($)	$32.96	$39.02	$47.65	$58.89
Affected population	222,531	222,531	222,531	222,531
Total annual WTP ($)	$7,334,621.76	$8,683,159.62	$10,603,602.15	$13,104,850.59

[a] See table 4.3 for a description of each program.

Aggregating the Costs

The annual cost of each program is aggregated in a similar manner to the benefit. The estimate of affected acres for a 30m and 60m buffer has been estimated for woodlot and non-woodlot owners in Chapter 3 of this report. This area is then multiplied by the estimates of woodlot and non-woodlot owner willingness to accept compensation (from Table 4.9). The annual aggregate cost to woodlot and non-woodlot owners for each buffer size is presented in Table 4.13.

Table 4.13: Aggregating the costs (willingness to accept compensation, or WTA, by landowner) of providing buffers on woodlots vs. non-woodlot

Component	Woodlots		Non-Woodlots	
	30m Buffer	60m Buffer	30m Buffer	60m Buffer
Mean annual WTA ($/Acre)	$530.25	$1,030.79	$2,615.38	$2,860.23
Affected acres	5,884	11,300	1,524	3,018
Total annual WTA ($)	$3,119,991.00	$11,647,927.00	$3,985,839.12	$8,632,174.14

The above estimates of aggregate annual costs were used to calculate the cost of each program using the following calculations (the results are presented in Table 4.14):

- Program 1: Total Annual Cost of a 30m buffer on Woodlots
- Program 2: Total Annual Cost of a 60m buffer on Woodlots
- Program 3: Cost of Program 1 + Total Annual Cost of a 30m Buffer on Non-Woodlots
- Program 4: Cost of Program 2 + Total Annual Cost of a 60m Buffer on Non-Woodlots

Table 4.14: The total annual cost of providing buffers under each buffer program[a]

Component	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Total annual WTA ($)	$3,119,991.00	$11,647,927.00	$7,105,830.12	$20,280,101.14

[a] See table 4.3 for a description of each program.

The Annual Net Benefits Under Each Buffer Program

Now that the benefits and the costs have been aggregated, annual net benefits can be estimated for each program. Since the benefits and costs occur in the same time period the annual net benefit can be calculated by subtracting the total annual cost from the total annual benefit. The results of this calculation are presented in Table 4.15. Here, only Program 1 and Program 3 yield a positive net benefit.

Table 4.15: The annual net benefits of EG&S under each buffer program[a]

Component	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Net benefit ($) (= WTP-WTA)	$4,214,630.76	-$2,964,767.38	$3,497,772.03	-$7,175,250.55

[a] See table 4.3 for a description of each program.

The Net Present Value (NPV) Of Each Program

The NPV is calculated by summing over the life of each program, which was specified as 10 years in the surveys. Since time is involved, future benefits and costs must be discounted. As the benefits and costs are assumed to always occur in the same year, discounting does not affect which program has a positive or negative net benefit—it only affects the magnitudes of the net present value. Results of this analysis are presented in Table 4.16, using a discount rate of 4.5%.[8]

Table 4.16: The net present value benefit from EG&S in buffer areas under each buffer program (over 10 years, using a discount rate of 4.5%)[a]

Component	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Net present value benefit ($)	$37,563,816.18	-$26,424,136.12	$31,174,656.35	-$63,950,986.00

[a] See table 4.3 for a description of each program.

4.4.5 EG&S Benefits Per Acre Of Buffer Area

The benefits associated with providing EG&S can be computed on a per acre basis. Such benefits can be useful for policy-makers when comparing the benefits with the costs of riparian area protection at different scales. Below, we present these per acre benefits for total and specific EG&S within buffer areas on an annual basis. Present value benefits can be estimated if desired using a similar procedure followed in the previous section.

[8] 4.5% was the Bank of Canada Target Overnight Rate on August 15, 2007. (http://www.bank-banque-canada.ca/en/rates/interest-look.html)

Annual Per Acre Benefits From EG&S In Buffer Areas

The total annual benefit per acre can be calculated by dividing the total annual benefit in Table 4.12 by the number of acres involved under each program, shown in Table 4.11. The results, presented in Table 4.17, reveal that Program 1 and Program 3 yield the largest mean benefit per acre. Both of these programs involve implementing 30m riparian buffers. Note that the annual benefits per acre declines by $478.12 (or 38.4%) from Program 1 to Program 2 and declines by $516.10 (or 36.1%) from Program 3 to Program 4—a result that may seem counterintuitive. This occurs since the total annual benefit (Table 4.12) only increases by 18.4% from Program 1 to Program 2 while the number of acres required almost doubles (Table 4.11) from a 30m to a 60m buffer. Another way to look at this is to recognize that an acre of 30m buffer stretches almost twice as far along a waterway than a 60m buffer does. Therefore, there are almost twice as many more acres in the 60m buffer case compared to the 30m buffer case. If the benefits of the 60m buffer are not at least twice as much as the benefits of the 30m buffer, the per acre benefit will be reduced in the 60m buffer case compared to the 30m buffer case (as is what happened here). The same logic applies to explain the decrease in annual benefits per acre from Program 3 to Program 4.

Table 4.17: Annual per acre benefits from EG&S in buffer areas under each buffer program[a]

Component	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Annual per acre WTP ($/acre)	$1,246.54	$768.42	$1,431.37	$915.27

[a] See table 4.3 for a description of each program.

The per acre benefit estimates provided in Table 4.17 can be compared directly with the per acre cost estimates provided in Table 4.9. Results generally confirm the aggregate net benefit results presented previously.

Annual Per Acre Benefits From Specific EG&S In Buffer Areas

The first step in estimating the annual benefits for specific EG&S per acre is to sum the annual willingness to pay for the specific EG&S (Table 4.7) over the relevant population. This process is the same as the one used to estimate the aggregate benefit in Section 4.4.4. These aggregate estimates are presented below in Table 4.18.

Table 4.18: Annual total benefits for specific EG&S under each buffer program[a]

Specific EG&S	WTP ($) for Program 1: 30m buffer, woodlots	WTP ($) for Program 2: 60m buffer, woodlots	WTP ($) for Program 3: 30m buffer, all land	WTP ($) for Program 4: 60m buffer, all land
Forest scenery	$941,306.13	$1,101,528.45	$1,377,466.89	$1,615,575.06
Water quality	$3,438,103.95	$3,923,221.53	$4,917,935.10	$6,055,068.51
Wildlife habitat	$2,821,693.08	$3,491,511.39	$4,072,317.30	$5,160,493.89

[a] See table 4.3 for a description of each program.

The second step involved in the calculation is to divide the estimates in Table 4.18 by the total number of acres required for each program in Table 4.11. The results of this calculation are presented in Table 4.19. The mean total annual willingness to pay per acre for each EG&S ranges

from $97.48 to $185.94 for forest scenery, $347.19 to 663.87 for water quality, and $308.98 to $549.72 for wildlife habitat. Of note here again is the seemingly counterintuitive decline in annual per acre benefits moving from Program 1 to Program 2, and then again moving from Program 3 to Program 4 for all specific EG&S. However, a similar rationale exists in this case as occurred for per acre benefits from the total EG&S in Table 4.17. Basically, the number of acres increased by more than the benefits as we moved from the 30m buffer case to the 60m buffer case.

Table 4.19: Annual total per acre benefits for specific EG&S under each buffer program[a]

Specific EG&S	Program 1: 30m buffer, woodlots	Program 2: 60m buffer, woodlots	Program 3: 30m buffer, all land	Program 4: 60m buffer, all land
Forest scenery	$159.98	$97.48	$185.94	$112.84
Water quality	$584.31	$347.19	$663.87	$422.90
Wildlife habitat	$479.55	$308.98	$549.72	$360.42

[a] See table 4.3 for a description of each program.

4.5 Conclusion

The purpose of this report was to estimate the benefits and costs of riparian buffers in the Canaan-Washademoak watershed. A further objective was to estimate the value that the public places on three EG&S derived from these riparian buffers—water quality, wildlife habitat, and forest scenery. These costs and benefits were estimated using a survey based technique called contingent valuation. In order to estimate the benefit, a questionnaire was developed and sent to a sample of watershed landowner and households in southern New Brunswick. The costs were estimated by sending a questionnaire to riparian landowners in the watershed.

Four different scenarios, each varying the amount of riparian area protected along the Canaan River and its tributaries, were developed. Mean willingness to accept was estimated using a non-parametric technique for each of the scenarios. The estimates of mean annual willingness to pay were: $32.96 per year for a 30m riparian buffer on woodlots; $39.02 per year for a 60m buffer on woodlots; $47.64 per year for a 30m buffer on woodlots, agricultural lands, and residential lands; and $58.89 per year for a 60m buffer on woodlots, agricultural lands, and residential lands.

Of the three EG&S, respondents valued water quality most highly, followed by wildlife habitat, and then finally forest scenery. The resulting mean dollar values being placed on these EG&S ranged from $15.45 per year to $27.21 per year for water quality, $12.68 per year to $23.19 per year for wildlife habitat, and $4.23 per year to $7.26 per year for forest scenery.[9]

The costs of the 30m and 60m riparian buffers were estimated for woodlot and non-woodlot owners. Findings indicate that woodlot owners are more willing than non-woodlot owners to provide, maintain, and enhance 30m and 60m riparian buffers. Additionally, woodlot owners required less compensation. The estimated mean cost of the 30m buffer to woodlot owners was $530.25 per acre and for a 60m buffer $1,030.79 per acre. While the cost to non-woodlot owners was $2,615.38 per acre for a 30m buffer and $2,860.23 per acre for the 60m buffer.

The fact that woodlot owners in particular stated that they would require almost twice as much compensation for an acre of 60m buffer as opposed to an acre of 30m buffer indicates there is a

[9] The range is due to the fact that four different changes in the EG&S were considered.

large ‘inconvenience’ cost associated with the former buffer (even though the total area remains the same). Specifically, many woodlot owners may already be maintaining a 30m buffer (as per regulations), and moving to a 60m buffer would entail significant changes in their forest management practices. Overall, the $530.25 and $1,030.79 per acre compensation required by woodlot owners for 30m and 60m buffers, respectively, ranges around the previously determined per acre opportunity costs of $678 and $675, respectively, estimated in Chapter 3.

The results of the benefit-cost analysis were mixed. When applying estimates of the individual mean benefit to the population, a positive net benefit was observed for 30m buffers on woodlots as well as for 30m buffers on woodlots, agricultural lands, and residential lands. The 60m buffer on woodlots and the 60m buffer on woodlots, agricultural lands, and residential lands resulted in a negative net benefit. However, it is interesting to note here that if the previously determined per acre opportunity costs (estimated in Chapter 3) were used in place of the stated willingness to accept compensation, a positive net benefit would occur for 60m buffers on woodlots.

Some caveats about the benefit cost analysis must be considered. A complication arises when aggregating the benefit: it is possible that individuals living outside of southern New Brunswick value the proposed changes in riparian buffers in the Canaan watershed. It is also likely that mean willingness to accept for the 30m and 60m buffers is higher than estimated. Those landowners who were not willing to participate in the program would likely require a larger amount of compensation if they were forced to implement a 30m or 60m buffer. Finally, it must be noted that the benefit cost analysis was not exhaustive—respondents were only asked to consider three EG&S that flow from riparian buffers. Riparian buffers produce more than water quality, wildlife habitat, and scenic views.

4.6 References

Amigues JP, Boutaloff C, Desaigues B, Gauthier C, Keith JE. (2002). The Benefits and Costs of Riparian Analysis Habitat Preservation: A Willingness to Accept/Willingness to Pay Contingent Valuation Approach. *Ecological Economics*. 43: 17-31.

Anielski M, Wilson S. (2005). Counting Canada’s Natural Capital: Assessing the Real Value of Canada’s Boreal Ecosystems. Pembina Institute.

Arrow K, Solow R, Portney PR, Leamer EE, Radner R, Schuman H. (1993). Report of the NOAA Panel on Contingent Valuation. *Federal Register*. 58(10): 4601-4614.

Barbier EB. (1994). Valuing Environmental Functions: Tropical Wetlands. *Land Economics*. 70(2): 155-173.

Bateman IJ, Carson RT, Day B, Hanemann M, Hanley N, Hett T, Jones-Lee M, Loomes G, Mourato S, Özdemiroğlu E, Pearce DW, Sugden R, Swanson J. (2002). *Economic Valuation with Stated Preference Techniques: A Manual*, Edward Elgar, Northhampton, MA.

Boyle KJ. (2003a). “Contingent Valuation in Practice,” A *Primer on Nonmarket Valuation*, ed. Patricia A. Champ, Kevin J. Boyle and Thomas C. Brown, Netherlands: Kluwer Academic Publishers, p. 111-170.

Boyle KJ. (2003b). “Introduction to Revealed Preference Methods,” A *Primer on Nonmarket Valuation*, ed. Patricia A. Champ, Kevin J. Boyle and Thomas C. Brown, Netherlands: Kluwer Academic Publishers, p. 259-267.

Carson RT, Mitchell RC, Hanemann WM, Kopp RJ, Presser S, Ruud PA. (1992). *A Contingent Valuation Study of Lost Passive Use Values Resulting from the Exxon Valdez Oil Spill*. A Report for the Attorney General of the State of Alaska.

Carson RT, Hanemann WM, Kopp RJ, Krosnick JA, Mitchell RC, Presser S, Ruud PA, Kerry Smith V, Conaway M, Martin K. (1996). *Was the NOAA Panel Correct about Contingent Valuation?* Discussion Paper 96-20, Resources for the Future: Washington, D.C.

Carson R, Mitchell R, Hanemann M, Kopp R, Presser S, Ruud P. (2003). Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill. *Environmental and Resource Economics*. 25: 257-286.

Colby B, Orr P. (2005). Economic Tradeoffs in Preserving Riparian Habitat. *Natural Resources Journal*. 45: 15-31.

Collins A, Rosenberger R, Fletcher J. (2005). The Economic Value of Stream Restoration. *Water Resources Research*. 41: W02017.

Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems. (2005). *Valuing Ecosystem Services: Toward Better Environmental Decision-Making.* Washington, DC: The National Academies Press.

Condon B, White WA. (1994). *Valuation of Nontimber Forest Resources: An Overview.* Edmonton: Natural Resources Canada, Canadian Forest Service, Northwest Region, Northern Forestry Centre.

Diamond PA, Hausman JA. (1994). Contingent Valuation: Is Some Number Better than No Number? *Journal of Economic Perspectives*. 8(4): 45-64.

Dillman DA. (2000). *Mail and Internet Surveys: The Tailored Design Method*, New York: Wiley.

Farber S, Griner B. (2000). Valuing Watershed Quality Improvements Using Conjoint Analysis. *Ecological Economics*. 34(1): 63-76.

Gould W, Pitblado J, Sribney W. (2003). *Maximum Likelihood Estimation with Stata, 2nd Edition*, College Station, Texas: Stata Press.

Haab TC, McConnell KE. (2002). *Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation*, Northampton, Massachusetts: Edward Elgar Publishing.

Hanemann WM. (1994). Valuing the Environment Through Contingent Valuation. *Journal of Economic Perspectives*. 8(4): 19-43.

Hanley N, Mourato S, Wright RE. (2001). Choice Modeling Approaches: A Superior Alternative for Environmental Valuation? *Journal of Economic Surveys*. 15(3): 435-462.

Holmes TP, Adamowicz WL. (2003). "Attribute-Based Methods," *A Primer on Nonmarket Valuation*, ed. Patricia A. Champ, Kevin J. Boyle and Thomas C. Brown, Netherlands: Kluwer Academic Publishers, p. 171-219.

Holmes TP, Bergstrom JC, Huszar E, Kask SB, Orr F. (2004). Contingent valuation, net marginal benefits, and the scale of riparian ecosystem restoration. *Ecological Economics*. 49: 19-30.

Kline JD, Alig RJ, Johnson RL. (2000). Forest owner incentives to protect riparian habitat. *Ecological Economics*. 33: 29-43.

Kolstad CD. (2000). *Environmental Economics*, Toronto: Oxford University Press.

Kramer RA, Holmes TP, Haefele M. (2003). "Contingent Valuation of Forest Ecosystem Protection," *Forests in a Market Economy*, ed. Erin Sills and Kathie Lee Abt, Netherlands: Kluwer Academic Publishers, p. 303-320.

Lee P, Barker T. (2005). Impact of Riparian Buffer Guidelines on Old Growth in Western Boreal Forests of Canada. *Forestry*. 78(3): 263-278.

Loomis H, Kent P, Strange L, Fausch K, Covich A. (2000). Measuring the Total Economic Value of Restoring Ecosystem Services in an Impaired River Basin: Results from a Contingent Valuation Survey. *Ecological Economics.* 33: 103-117.

Mitchell RC, Carson R. (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Washington, D.C.: Resources for the Future.

Mooney S, Eisgruber LM. (2001). The Influence of Riparian Protection Measures on Residential Property Values: The Case of the Oregon Plan for Salmon and Watersheds. *Journal of Real Estate Finance and Economics*. 22(2/3): 273-286.

Natural Resources Conservation Service. (2005). *Conservation Security Program: Program Description*. Retrieved August 17, 2007, from Natural Resources Conservation Service, Conservation Security Program Web site: http://www.nrcs.usda.gov/programs/csp/

New Brunswick Department of Environment. (2006). *Watercourse and Wetland Alteration Package.* Department of Environment, Government of New Brunswick. Fredericton, N.B. Retrieved August 23, 2007, from Department of Environment Web site: http://www.gnb.ca/0009/0373/0001/0004-e.asp

Parsons GR. (2003). "The Travel Cost Model," *A Primer on Nonmarket Valuation*, ed. Patricia A. Champ, Kevin J. Boyle and Thomas C. Brown, Netherlands: Kluwer Academic Publishers, p. 269-329.

Rosenberger RS, Loomis JB. (2003). “Benefit Transfer,” *A Primer on Nonmarket Valuation*, ed. Patricia A. Champ, Kevin J. Boyle and Thomas C. Brown, Netherlands: Kluwer Academic Publishers, p. 445-482.

Samuelson PA. (1954). The Pure Theory of Public Expenditure. *The Review of Economics and Statistics*. 36(4): 387-389.

Taylor LO. (2003). “The Hedonic Method,” *A Primer on Nonmarket Valuation*, ed. Patricia A. Champ, Kevin J. Boyle and Thomas C. Brown, Netherlands: Kluwer Academic Publishers, p. 331-387.

Venkatachalam L. (2004). The contingent valuation method: a review. *Environmental Impact Assessment Review*. 24: 89-124.

Walsh RG, Loomis JB, Gillman RA. (1984). Valuing Option, Existence, and Bequest Demands for Wilderness. *Land Economics*. 60: 14-29.

Washademoak Environmentalists. (2002). *Washademoak Lake – Canaan River Watershed Study: A Summary*. Retrieved August 17, 2007, from Fundy Model Forest Web Site: http://www.fundymodelforest.net/index.php?id=56

Whitehead JC. (2006). “A practitioner’s primer on the contingent valuation method,” *Handbook on Contingent Valuation*, ed. Anna Alberini and James R. Kahn, Northhampton, MA: Edward Elgar.

Zbinden S, Lee DR. (2005). Paying for Environmental Services: An Analysis of Participation in Costa Rica’s PSA Program. *World Development*. 33(2): 255-72.

CHAPTER 5

IMPEDIMENTS TO MARKET EXCHANGES OF EG&S PROVIDED BY WOODLOT OWNERS IN THE CANAAN-WASHADEMOAK WATERSHED

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5.1 Introduction

According to the Christian Farmers Federation, "society wants clean water, clean air, healthy soils and biodiversity" (2005, p. 1). These environmental attributes are often referred to as ecological goods and services (EG&S). Agriculture and Agri-Food Canada (2005) defines EG&S as "the benefits that humans derive from our ecosystems [which] include water supply and regulation, erosion control, climate regulation, food production, raw materials, and recreational activities."

Private rural landowners have the potential to supply many of these environmental amenities. For example, the Alternative Land Use Services (ALUS) program, a pilot project which rewards agricultural producers for providing EG&S, recognizes the potential of "integrating the environmental demands of Canadians into the mainstream of Canadian agriculture" (Stoneman, 2006, p. 7).

Private woodlot owners in New Brunswick are another example of landowners who are supplying EG&S. According to the National Round Table on the Environment and the Economy, many private woodlots in the Maritimes "have ecological significance…encompass river and streamside areas critical for maintaining biodiversity and valuable fish and bird habitat" (1997, p. 4). However, the National Round Table also acknowledges that "there appears to be no clear economic return on an investment toward sustainability for the woodlot owner" (1997, p.12).

According to the Alberta Environmentally Sustainable Agriculture Council, "Canadians' desire and commitment for clean air and water, wildlife habitat, healthy soils and aesthetically pleasing landscapes has resulted in environmental public policy"[10] (2003, p. 6). The government is trying to satisfy the demand for EG&S by forcing rural landowners to comply with certain environmental practices. This policy response constitutes regulatory takings. According to Pilon (1988), a regulatory taking, or police power, involves the taking of property rights without compensation. For example, Species at Risk policy may restrict the use of land by landowners, taking away their property rights. For example, if an eagle nests on a farmer's land, he may be forced to retire that land from agriculture. Other examples of regulations related to the provision of EG&S in Canada, and, more specifically, Ontario, include the Fisheries Act, Migratory Birds Regulation, Provincial Water Rights Legislation, Ontario Nutrient Management Act, Greenbelt Legislation and Provision Water Source Protection Legislation.

These kinds of regulations lead to several problems. First, according to the Council, "the agricultural sector has concerns with using command and control regulation as a policy instrument" (2003, p. 7) since the agricultural producers bear the costs of complying with these regulations. As

[10] For example, the goal of the Agricultural Policy Framework is "to position Canada as the world leader in…environmentally responsible agricultural production" (Agriculture and Agri-Food Canada, 2006).

such, this policy leads to the inequitable distribution of the costs of the provision of EG&S since beneficiaries of this provision do not contribute.

A second problem stemming from policy forcing the provision of EG&S is that such policy offers perverse incentives since it turns assets into liabilities. In other words, landowners are less likely to invest in conservation and more likely to destroy natural capital in order to avoid the restrictions of related policy.

The Canadian Federation of Agriculture (CFA) asserts that EG&S provided by agricultural producers should "be recognized as equally deserving of financial return as traditional commodities" (Stoneman, 2006, p. 7). Norfolk farmer Bryan Gilvesy, a proponent of the Alternative Land Use Services program, agrees that compensation for these EG&S is "a far better concept…than stripping someone of their property rights slowly through legislation" (Stoneman, 2006, p. 7). Furthermore, according to Delta Waterfowl (2005), landowners want to be compensated for the agricultural provision of EG&S since "current economic pressures, such as the recent sharp downturn in the traditional tobacco industry in Norfolk County, the closing of global markets to Canadian cattle, low commodity prices and rising costs of fuel, fertilizer and other inputs, are reducing farm income." Agricultural producers facing a depressed farm income in the crop and oilseed industries could especially gain from compensation for their provision of EG&S.

The Ministère de L'Agriculture, des Pêcheries et de l'Alimentation du Québec (2005, p. 13-16), in its identification of various approaches to increasing output of EG&S, notes that compensating providers of EG&S to increase their output may be more beneficial than forcing their provision. The new Agricultural Policy Framework is one example of policy pursuing the goal of compensating landowners for their provision of EG&S. For example, according to the Canadian Federation of Agriculture (No Date, p. 6), one of the proposals in the Agricultural Policy Framework is the development of decoupled programs to compensate landowners for their environmental contributions. The Canadian Federation of Agriculture cites the Alternative Land Use Services pilot program as an example of such an initiative.

To establish the compensation levels landowners should receive for providing a certain amount of EG&S, governments need to establish the value of these EG&S. This valuation requires the use of willingness-to-pay studies for EG&S and the multiplication of willingness-to-pay per unit of EG&S and the total quantity provided. The result is a total value of the EG&S provided by a landowner or group of landowners, so that these landowners can receive tax-based compensation for the provision. However, the complexity of calculating the value of EG&S is a problem in implementing tax-based compensation policy.

Another problem with tax-based compensation is potential tax fatigue. Compensation for EG&S from tax funds may be placing pressure on the tax system, since these tax dollars are competing with health care and education programs. Furthermore, some landowners may be concerned with government payments coming hand-in-hand with government controls regarding their property rights.

According to the Ministère de L'Agriculture, des Pêcheries et de l'Alimentation du Québec (2005) another approach to the compensation for the provision of EG&S is private landowners and beneficiaries of EG&S participating in private market exchanges of these goods and services. The

private market exchange of EG&S would avoid the problems associated with tax-based approaches to compensating landowners for their provision of EG&S.

According to Buchanan (1964), the market is an embodiment of the voluntary exchange processes that are entered into by individuals, and, since individuals are motivated to move from a less preferred to a more preferred position, exchanges are always efficient. Efficiency, in this context, indicates that both parties are benefiting from the exchange. As such, the market exchange of EG&S ensures that both private landowners and potential beneficiaries of EG&S benefit, implying that neither party is incurring a cost from this approach to compensation.

Some have claimed that the demand for EG&S is strong and growing. Up until now, however, the response to this demand has been policy in the form of regulatory takings. This kind of regulation leads to several problems. First, policy forcing the provision of EG&S entails the inequitable distribution of the costs of this provision. Under the policy scenario, landowners bear the costs of the provision and beneficiaries of this provision do not contribute. Second, such policy offers perverse incentives since it turns assets into liabilities. In other words, landowners are less likely to invest in conservation and more likely to destroy natural capital in order to avoid the restrictions of related policy.

Most of the discussion on EG&S or natural capital has been metaphorical. That is, although these environmental benefits are often described using words such as “goods,” “services,” “capital” or “assets,” implying that they can be exchanged in a market, few good or service markets for these benefits exist. The research problem is that we do not know how to increase the potential of market exchanges of EG&S to eliminate the problems of forced provision of these goods and services.

As Buchanan (1964) notes, market exchanges emerge when both parties stand to gain from the exchange. However, since few markets for EG&S exist, impediments to the gains from such exchanges may exist. To address this research problem, we will answer the following research questions:

1. What factors may impede buyers and sellers from coming together for an exchange of an EG&S?
2. How can we overcome these impediments to market exchanges of EG&S?
3. Which individuals have the most potential to participate in market exchanges of EG&S?
4. What policy and institutional environments offer the most potential for market exchanges of EG&S?
5. What EG&S have the most potential to be exchanged?

The purpose of this research was to investigate the impediments to market exchanges of E&S and to identify possible solutions to facilitate further exchanges. According to Buchanan (1964), the exploration of diverse market arrangements and extensions may facilitate market exchanges by reducing the barriers to these exchanges. Coase (1960) and Dahlman (1979) also propose comparative institutional analysis and exploration of market extensions to facilitate market exchanges. Coase (1960, p. 18) states, for example, “economists need to study the work of the broker in bringing parties together, the effectiveness of restrictive covenants, the problems of the large-scale real-estate development company, the operation of Government zoning and other regulation activities.” His statement reveals some of the factors that may need to be investigated to pursue the purpose of extending market exchanges of EG&S.

Menger (1871/1981) developed a theory to describe why and how commodities differ in their marketability, the facility with which goods can be exchanged. He points to four limiting factors affecting marketability: individuals to whom the commodity can be sold, area within which the commodity can be sold, the quantity of a commodity that can be sold, and the time period in which the commodity can be sold.

Menger's theory motivates the approach to pursuing the purpose of this thesis to increase the potential of market exchanges of EG&S. Menger illustrates the importance of studying the factors affecting the marketability of EG&S in order to facilitate the emergence of markets for these goods and services. His theory is the foundation and impetus for the categorization of impediments to market exchanges of EG&S. This categorization, or taxonomy, is a starting point for the exploration of solutions to overcoming impediments to market exchanges of EG&S in order to fulfill the purpose of this thesis.

The specific objectives of this research were:

1. To clarify and reconcile economic concepts in EG&S literature.
2. To develop a diagnostic taxonomy of impediments and potential solutions to impediments to market exchanges of EG&S.
3. To develop an empirical framework to test the taxonomy of impediments and potential solutions to impediments to market exchanges of EG&S.
4. To apply the empirical framework to test the taxonomy of impediments to market exchanges of EG&S in the case-study region of the Canaan-Washademoak watershed, in Southern New Brunswick in order to:
    a. Identify the individuals who have the most potential to participate in market exchanges of EG&S.
    b. Identify the situations or environments where these individuals have the most potential to participate in market exchanges of EG&S.
    c. Identify what EG&S these individuals have the most potential of providing in a market exchange.
5. To propose policy implications, recommendations for institutional change and recommendations for future research on extending market exchanges to the realm of EG&S.

5.2 Taxonomy of Impediments to Market Exchanges of EG&S

Menger (1871/1981) illustrates the importance of studying the factors affecting the marketability of EG&S in order to facilitate the emergence of markets for these goods and services. His theory is the foundation and impetus for the categorization of impediments to market exchanges of EG&S. This categorization, or taxonomy, is a starting point for the exploration of solutions to overcoming impediments to market exchanges of EG&S in order to fulfill the purpose of this thesis.

The purpose of this section is to develop a diagnostic taxonomy to answer the first two research questions we proposed to address the research problem of how to extend market exchanges to EG&S. These research questions are: What impediments exist to buyers and sellers coming together for an exchange of an EG&S? How can we overcome these impediments to market exchanges of EG&S? Menger's theory of marketability of goods is the economic motivation for this taxonomy.

The purpose of the diagnostic taxonomy is to apply it to diagnose which, if any, of the proposed impediments to market exchanges exist for two case studies in Canada in order to answer the remaining research questions: Who has the most potential of participating in market exchanges? What policy and market environments facilitate these exchanges? What EG&S have the most potential of being exchanged?

The impediments to market exchanges of EG&S that we will discuss include impediments that stem from market failure (public goods, high transaction costs, weak demand and high cost of provision) and impediments that stem from non-market or policy failure (unprotected property rights, policy setting quantity constraint/government ownership of resources, and government provision/subsidization of EG&S).

The first impediment to market exchanges of EG&S in Canada in the taxonomy is the public good classification of these goods and services. The non-excludable nature of public goods implies that the benefits derived from these goods cannot be completely internalized, since the owner cannot exclude non-payers from benefiting from them. As such, the public good impediment results in an underproduction of these goods and services.

The second explanation of a lack of market exchanges in environmental goods and services is that transaction costs exceed the potential gains from exchange. Markets for EG&S are not emerging because transaction costs (the sum of search, negotiation and concluding costs) facing consumers are higher than Consumers' Surplus and transaction costs facing producers are higher than Producers' Surplus. As Buchanan (1964) suggests, exchange would begin when Consumers' Surplus and Producers' Surplus (gain from the exchange) are greater than transaction costs facing consumers and producers, respectively (loss from the exchange). Following Dahlman (1979), the contribution of economic research in this situation would be to identify the factors that influence the level of transaction costs and to examine alternative ways to reduce those transaction costs, thereby extending possibilities for market exchanges.

The third possible impediment to market exchanges of EG&S in Canada is weak demand relative to supply. Here, a weak demand, results in demand being below supply for all quantities of EG&S. No intersection of supply and demand results in no equilibrium price or quantity for this good and service.

The fourth possible impediment to market exchanges of EG&S in Canada is a high cost of provision relative to demand. Again, this impediment results in the situation where there is no intersection of supply and demand and no equilibrium price or quantity for a good or service exists. The impediments of weak demand and high cost of provision are related because the lack of intersection of demand and supply depends on the magnitudes of these relative to each other.

The fifth possible impediment to market exchanges of EG&S is government policy that results in unprotected or uncertain property rights. The specific policy that may be impeding market exchanges of EG&S by making property rights uncertain is the Canadian *Species At Risk Act*. Since this Act dictates management of certain species and their habitat, landowners may have little incentive to establish wildlife habitat on their land, for fear that the *Species at Risk Act* will then apply to this new habitat, and they will no longer have rights to manage this land as they wish. This uncertainty in property rights for landowners may be raising their perceived future costs of

production, raising supply above demand for all quantities of EG&S. As such, no market exchanges are taking place.

The sixth possible impediment to market exchanges of EG&S is a government-imposed quantity constraint or government ownership of natural resources. Specifically, we can imagine that policy prevents the exchange of any amount of the good or service, in which case the quantity constraint lies on the vertical axis (where quantity equals zero). As such, no market exchanges of EG&S are taking place. An example of this situation would be a policy prohibiting fee-hunting. Government ownership would result in a similar situation, since landowners, having no property rights to the resource, would have no rights to exchange these kinds of goods or services and would be facing a market quantity constraint of zero. An example of a government owned resource for which exchange may be restricted is wildlife.

The final possible impediment to market exchanges of EG&S in Canada is the government-subsidized supply of the good or service. The subsidization case undermines the potential of the private provision of EG&S. Individuals are already benefiting from the low-cost or free provision of these goods and services by the government which decreases net demand facing individual potential private suppliers. Examples of this situation in Canada include subsidized entry to and use of national and provincial park recreational areas.

5.3 Overview of Methods

The thesis of this chapter is that market exchanges of EG&S are not emerging in Canada due to one or several of seven impediments to market exchange. In other words, the potential for market exchanges of EG&S in Canada is a function of seven impediments. These seven impediments are: the existence of a public good problem, high transaction costs, weak demand, high cost of supply, the existence of government policy resulting in uncertain property rights, the existence of government policy forbidding exchange of EG&S/government ownership of natural resources and the existence of subsidized government provision of EG&S.

To examine this thesis, we developed and implemented a landowner survey and focus group questionnaire. We developed the survey questions first. However, due to space limitations, we limited the survey questions to two impediments in the taxonomy that we thought, at the time, were very important (high transaction costs and policy causing uncertain property rights). We also used the survey to ask respondents about their experiences with selling EG&S and their opinions on compensation for the provision of EG&S. The aim of these questions was multifold. First, we wanted to test whether the public good characteristic of EG&S, as listed in the taxonomy, existed for these landowners. If landowners have no experience selling EG&S, the public good characteristic could be to blame.

Second, we wanted to gauge landowner receptiveness to market exchanges of EG&S. Asking them about their opinions on compensation approaches for the provision of EG&S aims to fulfill this purpose. We also wanted to distinguish individuals with selling experience from individuals who have not been able or willing to sell EG&S. We did not anticipate that landowners would have experiences, so we did not focus on how we would analyze this distinction. However, this distinction turned out to be a primary component in our analysis.

To gauge experiences with selling EG&S, respondents who were woodlot owners (104 of the 290, or 35.9%, of respondents indicated that that they are woodlot owners) were asked whether they had sold any of the following EG&S related to their woodlots: access to fishing, access to hunting, access to hiking trails, access to snowmobilers, access to birdwatchers, access to campers, access to wildlife watchers, filtering water/clean water benefits, access to scenic views and benefits from trees (carbon sequestration). We also allowed them to indicate if they had sold other EG&S. If the woodlot owner indicated that he or she had sold an EG&S, he or she was asked how many times he or she has sold it.

To gauge respondent receptiveness to market exchanges, we first asked respondents whether landowners should be compensated for providing EG&S. We then asked respondents to indicate their level of agreement, strongly disagree to strongly agree, with different approaches to compensation. Only those respondents who indicated that compensation should be provided to landowners for the provision of EG&S were asked for their opinions on different approaches to compensation. The four approaches to compensation we asked opinions on are community recognition (signage, awards), direct monetary compensation from individuals who benefit (representing a market exchange), property tax breaks and monetary compensation from the government.

Next, we asked respondents to indicate their level of agreement, strongly disagree, disagree, undecided, agree or strongly agree, with the following Likert Scale statements corresponding to impediments to market transactions of EG&S. Statements 1 to 4 correspond to factors affecting transaction costs, while statement 5 corresponds to government policy resulting in uncertain property rights. Only woodlot owners were asked to indicate their opinions on these statements:

1. “It is or would be easy to find a buyer of an EG&S that I could provide”.
2. “It would be easier to find a buyer if a landowner association provided me with information about potential buyers of an EG&S that I could provide”.
3. “I would find it easy to trust someone to follow through on buying an EG&S that I could provide”.
4. “It would be easier to trust someone to follow through on buying an EG&S I could provide if a landowners association provided a template for an agreement”.
5. “I would be wary of providing EG&S because I am afraid that if I invest in conservation, new regulations might restrict the use of my land in the future”.

Finally, survey respondents who own land in the Canaan-Washademoak watershed were asked to indicate how long they have owned their land and how many acres of land they own. Seventy-five percent of woodlot owners who have sold EG&S, 61% of woodlot owners who have not sold EG&S and 40% of non-woodlot owner respondents own land in the Canaan-Washademoak watershed. Since the original aim of University of New Brunswick researchers was to gather opinions on the management of the Canaan-Washademoak watershed, residents of this watershed were targeted in the survey questions. Respondents were also asked about their demographic characteristics, including gender, age, income, employment status, education levels, membership to landowner associations and membership to environmental associations. We used these land characteristic information and demographic information to analyze if relationships to these characteristics differed between sellers and non-sellers.

We sent the survey on views on the management of the Canaan-Washademoak Watershed to 1700 landowners in Southern New Brunswick. The landowners were chosen using a provincial property owner database. The response number was 290 surveys, giving a response rate of 17%.

In addition to the mail survey, we developed a series of focus group questions based on the taxonomy of impediments to market exchanges of EG&S. We did not ask participants about their opinions on compensation or their demographics, but we did ask them about their experiences with selling EG&S, how many acres of land they own, and how long they have owned the land.

Fourteen focus group participants responded to advertising of the workshop. We had two hours with the focus group participants so we used questions to direct discussion. We gauged responses by having participants raise their hands for quantitative or 'yes/no' type questions. Participants also offered detailed responses, which were often followed by discussion and more detailed responses.

5.4 Empirical Analysis

This section tests the taxonomy of impediments to market exchanges of EG&S to determine which, if any, of these impediments are preventing markets from emerging in New Brunswick. Since landowners are in the best position to identify the barriers to selling EG&S and how to overcome these barriers, we developed questions for landowners that offer insight into which impediments they feel are relevant to the sale of EG&S from their land. We applied these questions through a focus group and through surveys.

We use two data collection methods to implement the case study: a landowner mail survey and a focus group meeting. The target respondents for the survey and focus group were woodlot owners within the Canaan-Washademoak watershed. The Canaan-Washademoak watershed is approximately 2163 square kilometers, with 73-86% forest cover. 6116 of 6872 or 89% of the land parcels in the watershed are privately owned (42% of the watershed area) (Canaan-Washademoak Watershed Association, 2007).

We integrated a qualitative and quantitative approach to the analysis of survey data. We used statistical analysis where sample sizes allowed it. Otherwise, we used the survey to gather pieces of evidence on how to increase the potential for market exchanges of EG&S. The focus group was a qualitative approach of data analysis. We used the focus group to gather further evidence on how to increase the potential for market exchanges of EG&S. We also used the focus group to help interpret the survey results.

5.4.1 Survey of New Brunswick Landowners and Potential Beneficiaries of EG&S

A survey on views on the management of the Canaan-Washademoak Watershed was sent to 1700 landowners in Southern New Brunswick. The landowners were chosen using a provincial property owner database. One section of the survey asked questions on landowner experiences with and perceptions on compensation for the provision of EG&S and factors impeding market exchanges of EG&S. The analysis includes 290 returned surveys.

Of the 290 survey respondents, 47.9% own land in the Canaan-Washademoak watershed in southeastern New Brunswick. Of those who owned land in the watershed, 38.1% used their land as permanent residence, 57.6% used the land for seasonal residence or a cottage, 30.9% used

the land for woodlot, 12.2% used the land for agriculture, and 2.9% used the land for other business purposes. Furthermore, 18.0% used their land for recreational purposes.

5.4.1.1 Respondent Experiences with Selling EG&S

We first asked survey respondents about their experiences with selling EG&S. Table 5.1 summarizes these responses for each EG&S. The table shows the percentage of respondents who indicated that they have sold each EG&S zero times, once, twice, three to five times, six to ten times, 11 to 30 times, 31 to 99 times, and 100 or more times.

Table 5.1: Survey responses on experiences with selling EG&S: Number of times woodlot owners have sold EG&S, by percentage of respondents, and total number of exchanges

EG&S Type	Percentage (%) of respondents that have sold EG&S								Total # of exchanges[a]
	Number of times sold								
	Zero	Once	Twice	3-5	6-10	11-30	31-99	100+	
Access to fishing	98%	0%	0%	0%	1%	0%	0%	1%	108
Access to hunting	97%	0%	1%	0%	0%	1%	0%	1%	132
Access to hiking trails	98%	0%	0%	0%	1%	0%	0%	1%	108
Access to snowmobiles	99%	0%	1%	0%	0%	0%	0%	0%	2
Access to birdwatchers	98%	0%	0%	0%	0%	1%	0%	1%	130
Access to campers	98%	0%	1%	1%	0%	0%	0%	0%	5
Access to wildlife watchers	98%	0%	0%	0%	0%	1%	0%	1%	130
Filtering water/ clean water	100%	0%	0%	0%	0%	0%	0%	0%	0
Access to scenic views	98%	0%	0%	0%	1	0%	0%	1%	110
Carbon sequestration	100%	0%	0%	0%	0%	0%	0%	0%	0
All EG&S									725

[a] Total number of exchanges for the particular EG&S was calculated using the exact number of exchanges reported by respondents. Final total is total number of exchanges for all EG&S.

While most of the respondents (97-100%) have not sold any of the EG&S presented to them, a small percentage (3%, representing 4 woodlot owners) have sold most of them (Table 5). The two exceptions were clean water and carbon sequestration benefits. The 4 respondents that have sold EG&S have done so between 2 and 100 or more times. The total number of exchanges of EG&S have been 725[11].

[11] The total number of exchanges is the sum of the number of times each individual has sold each EG&S.

As Table 5.1 shows, access to hunting was the most frequently sold EG&S (132 occasions of exchange), followed by access to birdwatchers and access to wildlife watchers (130 exchanges each), access to scenic views (110 exchanges) and access to fishing and hiking trails (108 exchanges each). As such, these services, in the order listed, may have the most potential to be exchanged.

One explanation for a lack of exchanges of clean water benefits and carbon sequestration is that these services exhibit the public good impediment that we described in the taxonomy of impediments to market exchanges of EG&S. Specifically, these services may be harder to exclude than the EG&S that have been provided in exchanges.

Woodlot owners who have sold EG&S vs. those who have not sold EG&S

Although only four woodlot owners responding to the survey have sold EG&S, the fact that they have had extensive experience with sales, 725 occasions worth of experience, supports the possibility that not all EG&S are public goods that absolutely cannot be marketed. Furthermore, an interesting aspect of these experiences with selling EG&S is that a very large number of exchanges (725) was conducted by only four individuals out of 290. Therefore, among the survey respondents, if an individual sold one EG&Ss he was likely to have sold other EG&S as well. One explanation for this result is that landowners who sold EG&S own land that allows them to market joint product. Another interpretation is that those landowners who have sold EG&S have characteristics that make them able to sell many different kinds of EG&S. Therefore, these characteristics of sellers may be quite general, such as, for example, entrepreneurial alertness.

In order to pursue the objective of this research to evaluate the factors contributing to increasing the potential of the market exchange of EG&S, the next step in evaluating the potential is to analyze the characteristics of these sellers. To do so, we will compare the land and demographic characteristics of those woodlot owners who have sold EG&S (4 of 290 or 1.4% of respondents) to woodlot owners who have not sold EG&S (100 of 290 or 34.5% of respondents) and to non-woodlot landowners (186 of 290 or 64.1% of respondents). This comparison aims to investigate if the sellers have something in common that is not shared with the non-sellers.

We used a two-sample t-test assuming unequal variances to analyze the mean response differences between the three groups. We assumed a significance level of alpha = 0.05 (a 95% confidence interval) and compared the t value to the two-tail critical t to determine if the means of the responses in question were significantly different. Since the sample of sellers is small, statistical analysis of this group (compared to other groups) is less likely to be conclusive due to high variance of the data. Because variance is included in the t-test calculation, small sample means with large variances are unlikely to result in a rejection of the hypothesis that population means are statistically the same, even if means may be different. However, seeing as this is the first analysis of its kind, the exercise may offer some preliminary evidence on landowner characteristics that aid in exchanges of EG&S, regardless of our ability to make confident statistical conclusions.

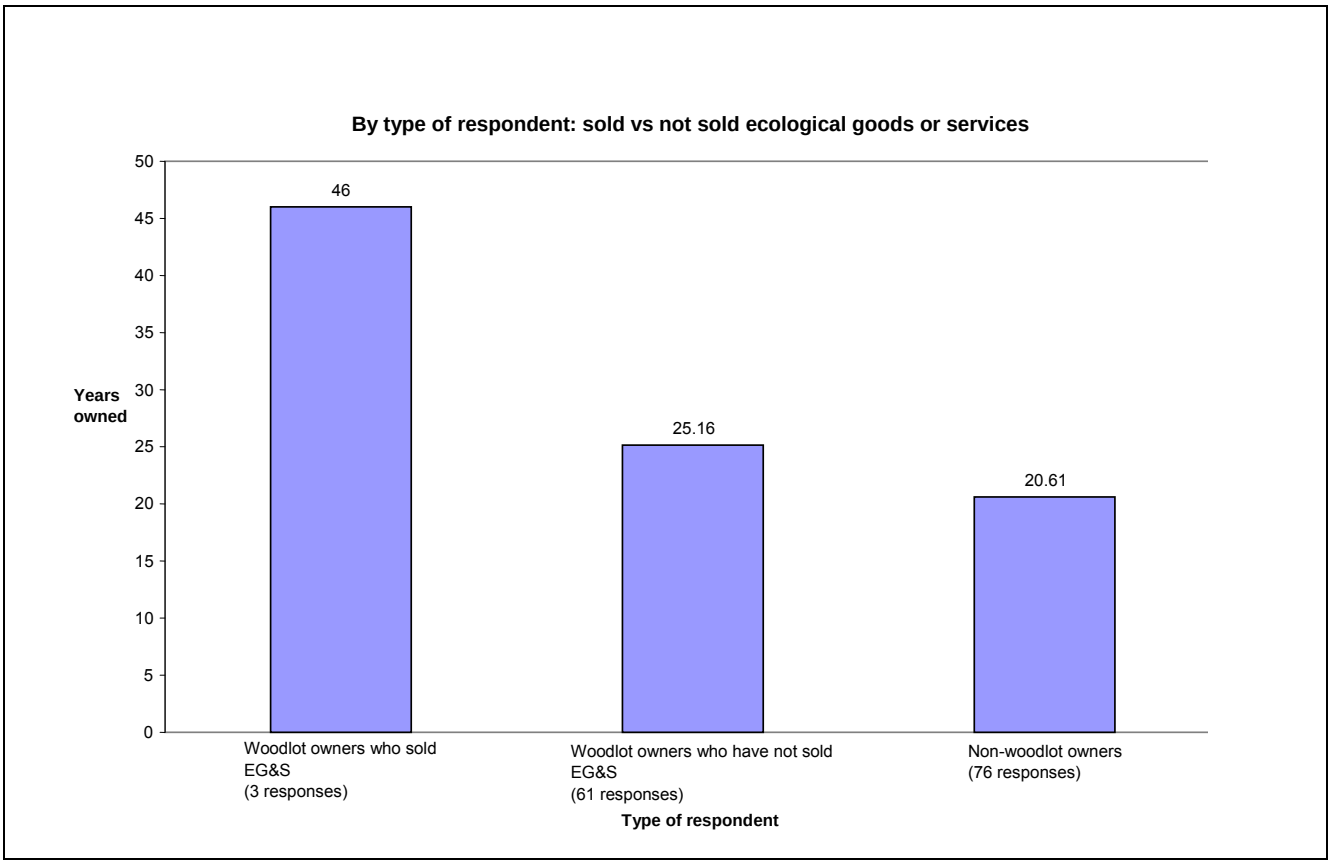
Land characteristics: length of ownership and size of land

The number of years a landowner has owned his or her land and the size of the land he or she owns may affect the potential of his or her selling EG&S. Longer ownership and larger parcels of land could both decrease transaction costs, as compared to shorter ownership and smaller

acreage. Length of ownership could play a role in defining the magnitude of search costs, since it may lead to more knowledge about potential buyers. This potential knowledge could stem from being familiar with the surrounding area and its residents.

Figure 5.1 shows the mean length of time that the three groups of respondents, woodlot owners who have sold EG&S, those who have not, and non-woodlot owners, have owned their land. Woodlot owners who have sold EG&S (three woodlot owners responded to this question) have owned their land for an average of 46 years. Woodlot owners responding to the survey who have not sold EG&S (61 responses) and non-woodlot owners (76 responses) have owned their land for a mean of 25.16 years and 20.61 years, respectively. These means are not statistically different.

Figure 5.1: Mean Responses to Survey Question: "How Many Years Have You Owned Your Land?", by type of respondent.



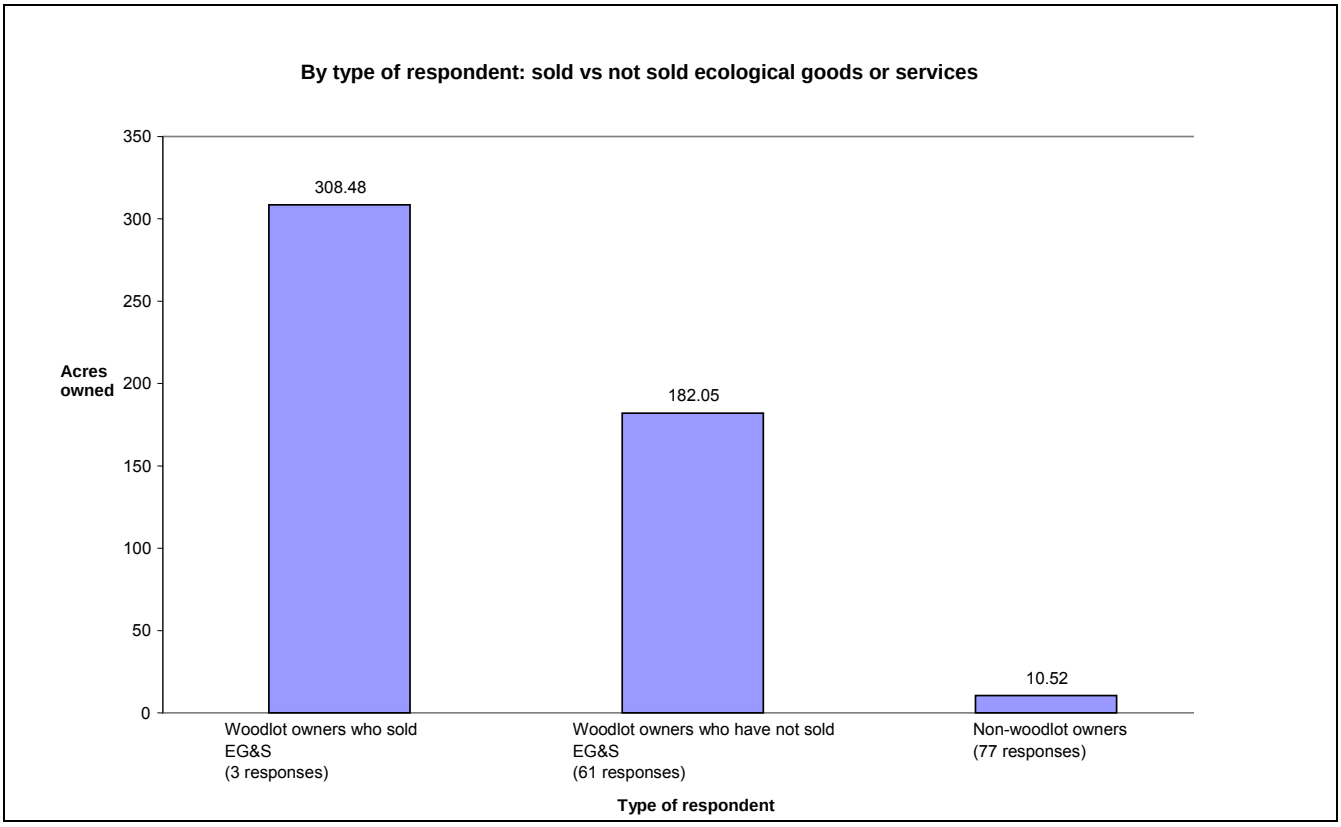
Woodlot owners responding to the survey who have sold EG&S have owned their land for almost twice as long as woodlot owners who have not sold these goods or services or non-woodlot owners. However, we could not reject the hypothesis that the means of these two groups are the same, which is not surprising considering the small sample of woodlot owners who have sold EG&S (n=3 and variance was very high). Regardless, we propose implications of these results assuming a statistical difference in the means of woodlot owners who have sold EG&S and those who have not. These implications may be valuable as a preliminary analysis of factors affecting the potential of market exchanges of EG&S in Canada.

These data are consistent with the theory of transaction costs. Longer ownership may be related to more knowledge of the area, people and woodlots, increasing opportunity for exchange by

decreasing search costs. Furthermore, longer ownership may offer more opportunity and incentive for capital investments, such as fencing of the land perimeter, increasing excludability thereby making the good more marketable.

The size of land owned may also be a factor contributing to the potential of market exchange of EG&S. Figure 5.2 shows the mean size of land owned by woodlot owner respondents who have sold EG&S, woodlot owners who have not sold EG&S and non-woodlot owner respondents. The mean sizes of land owned by these three groups of respondents are 308.48, 182.05 and 10.52 acres, respectively. The sample sizes are three, 61 and 77, respectively. There is a statistical difference between the mean acres of woodlot owners who have not sold EG&S and non-woodlot owners. However, we could not reject the hypothesis that the mean acres owned by the woodlot owners who have sold EG&S and the woodlot owners who have not sold EG&S are the same.

Figure 5.2 Mean Responses to Survey Question: "How Many Acres of Land Do You Own?" by type of respondent.



Although not statistically significant, the large difference in the mean sizes of land between landowners who have sold EG&S and those who have not is an interesting result and we will offer a preliminary analysis for this result.

The woodlot owners responding to the survey who have sold EG&S own almost twice as much land as the woodlot owners who have not sold EG&S, and 30 more times the land of the non-woodlot owner respondents. Again, relating these data to the taxonomy of impediments to market exchanges of EG&S, it is possible that a higher demand exists for access to larger pieces of land. Since a weak demand can be an impediment to market exchanges of EG&S, if demand is too

weak to intersect supply, a strong demand can increase the potential of the market exchange of a particular good or service.

Demand could be higher for EG&S related to large pieces of land because more land offers more opportunity for certain activities and these opportunities lend themselves to the provision of joint products. For example, large parcels of land could have more wildlife habitat than smaller pieces of land, in which case they are more suitable for hunting, fishing or wildlife watching. Large pieces of land may also lend themselves to activities such as hiking, biking, snowmobiling and camping, since they are more likely to have secluded trails and camping areas. Finally, larger pieces of land have potential for longer networks of trails than smaller pieces of land, making them more attractive to hikers, bikers and snowmobilers.

Another explanation is possible about this relationship. Landowners who own larger pieces of land may have lower provision costs for EG&S than landowners who own smaller pieces of land. The decreased cost of provision for landowners with large pieces of land relative to the cost of supply for landowners with small pieces of land could be a result of fewer disturbances to landowners from users of their land. For example, snowmobilers using trails on the outskirts of a landowner's large piece of land may cause less noise disturbance to the landowner and his family than would a snowmobiler racing down a trail on a small piece of land. Another example would involve hunters and fishers who would be able to hunt or fish further away from the permanent residence on the land.

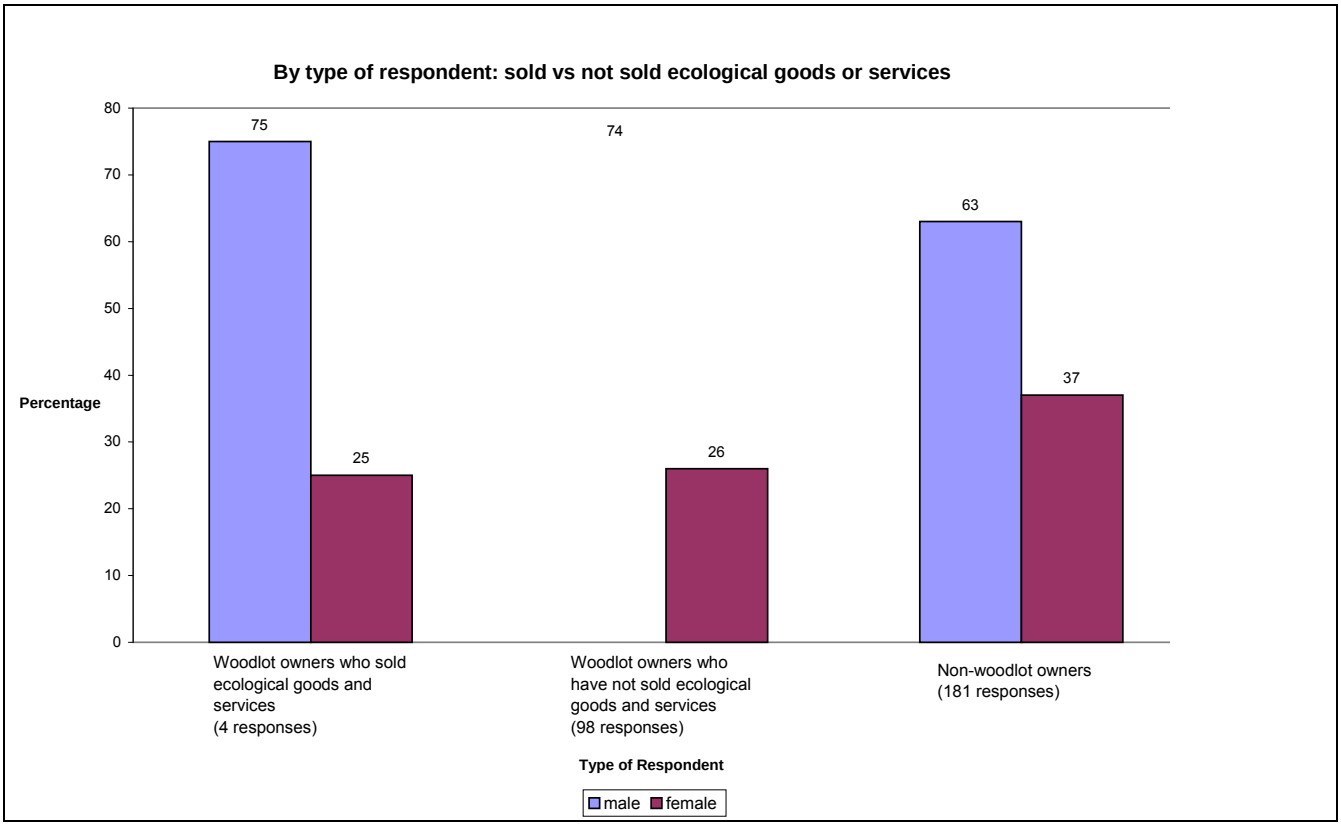
As such, a new impediment to market exchanges that emerges from this analysis is a high cost of provision relative to the demand for a particular EG&S. In this case, supply and demand for this good or service may not intersect, since the supply would be above demand for all quantities of the EG&S, and no equilibrium price or quantity for this good or service would exist. A low cost of provision, therefore, could increase the possibility of supply intersecting demand for an EG&S. This could be the case for landowners owning large pieces of land, especially in the context of access to snowmobilers.

Demographic characteristics: gender, age, education employment status, income, membership to environmental organizations and landowner associations

As Figure 5.3 shows, woodlot owners who have sold EG&S and woodlot owners who have not sold EG&S have very similar proportions of male respondents to female respondents. The first group consisted of 75% males and 25% females, while the second group consisted of 76% males and 24% females. Therefore, gender may not be a factor affecting the market exchange of EG&S in this case.

The non-woodlot owner respondents included 63% males and 37% females, which was a statistically different gender proportion than the group of woodlot owners who have not sold EG&S. This group may have a larger proportion of female respondents because their family dynamics are different than those of woodlot owners'. If males are more likely to manage a woodlot, then their interest would lie in responding to the survey. Possibly, in non-woodlot households, both the male and the female household members work in areas unrelated to their land. Therefore, females may be more likely to respond to surveys than in the case of a woodlot owner household.

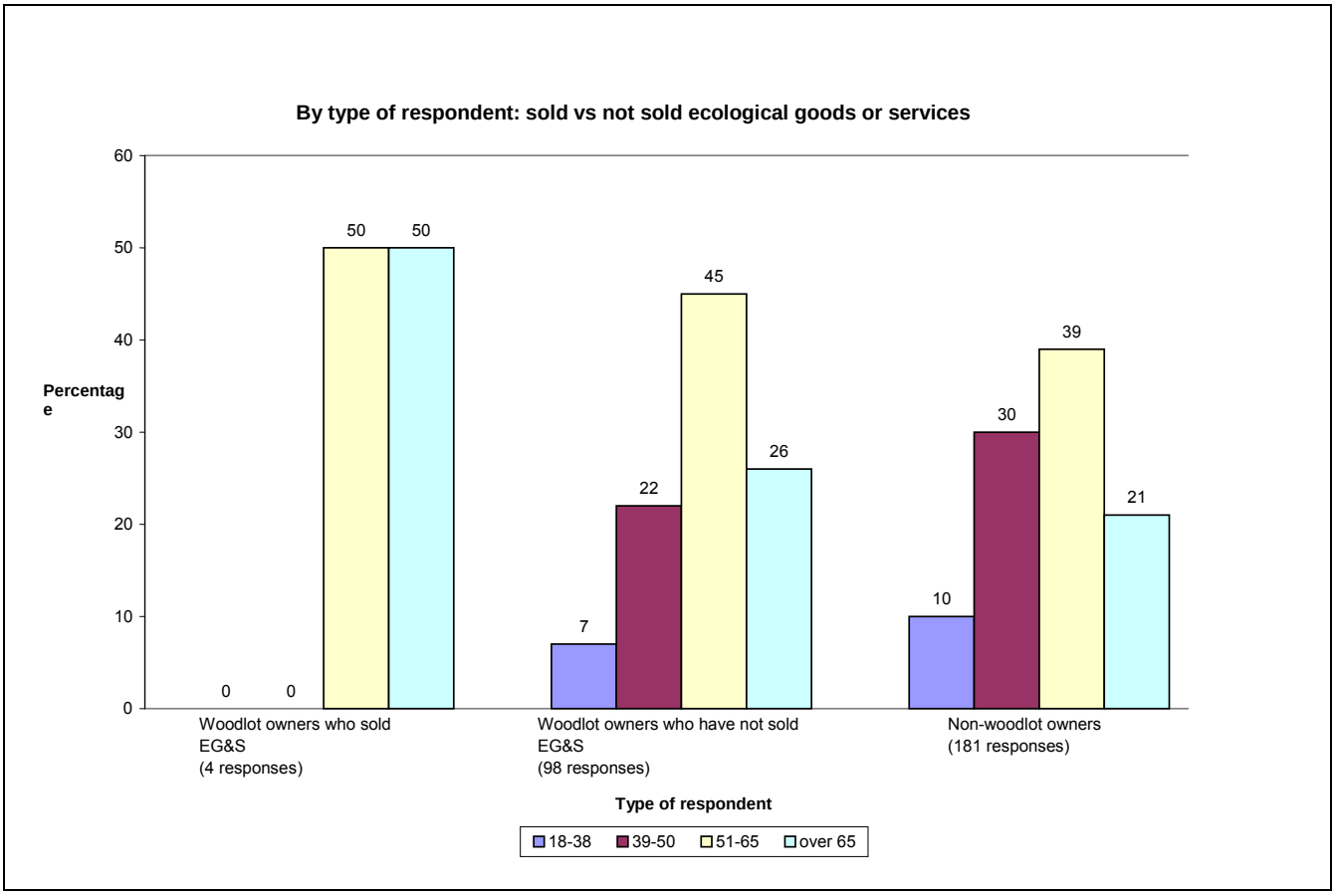
Figure 5.3 Responses to Survey Question: "What is Your Gender?", by type of respondent.



As Figure 5.4 shows, the distribution of ages for the woodlot owner respondents who have not sold EG&S and non-woodlot owner respondents were similar. The former was comprised of 7% in the 18-38 year old age group, 22% in the 39-50 year old age group, 45% in the 51-65 year old age group and 26% in the over 65 year old age group, while the age group proportions for the latter group were 10, 30, 39 and 21%, respectively. We could not reject the hypothesis that the age distributions for the two groups are statistically the same.

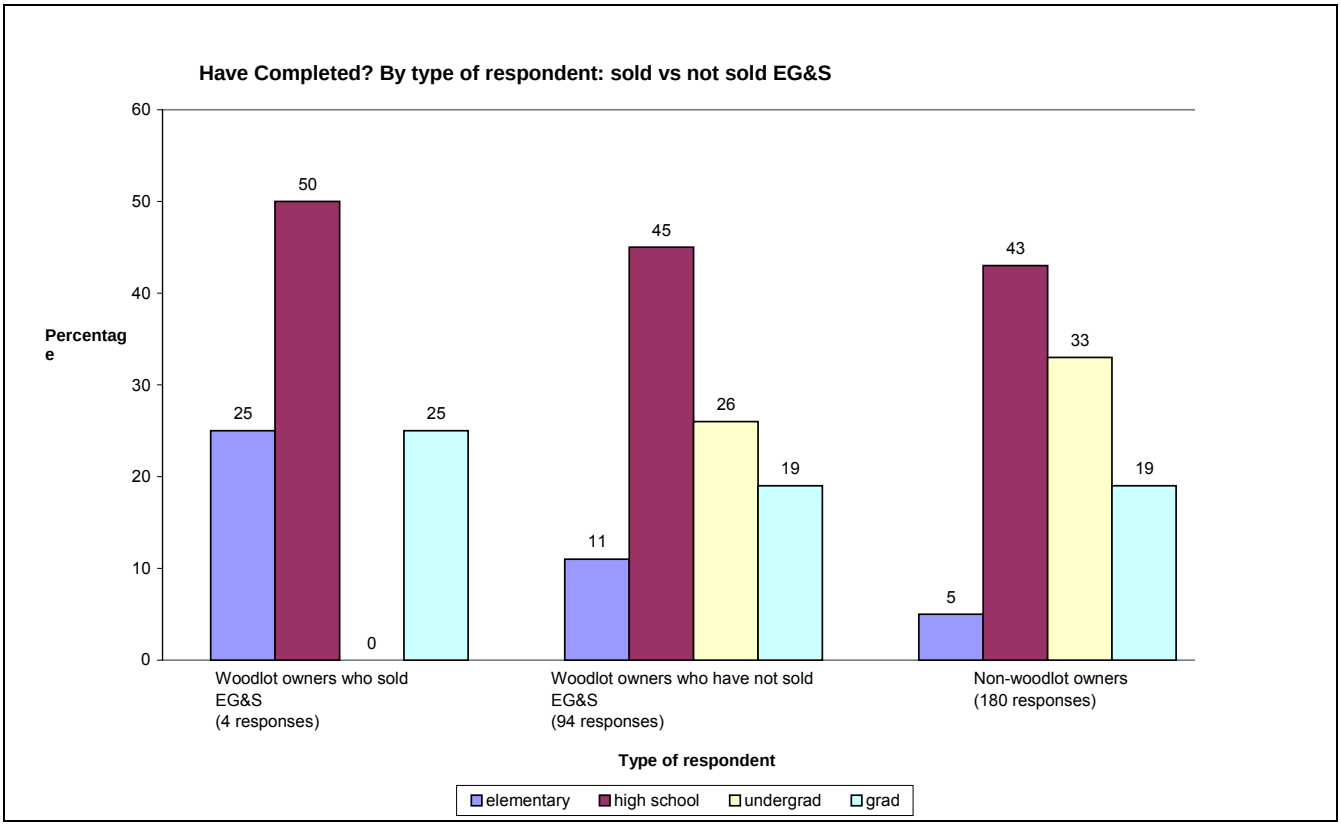
However, the group of respondents who have sold EG&S was older than the other two groups of respondents, with two respondents in the 51-65 age group and 2 respondents in the over 65 age group. Although we could not reject the hypothesis that the mean age distributions of these groups are the same, we will theorize on a possible relationship between ability to sell EG&S and the age of sellers. The age of landowners could have similar consequences to length of land ownership. That is, older landowners may have more knowledge of and experience with the areas they live in, and therefore have lower search costs and a longer opportunity to acquire capital and therefore lower supply costs.

Figure 5.4 Responses to Survey Question: "What Is Your Age?", by type of respondent.



Generally, education levels of the respondents of the three groups are similar. As Figure 5.5 shows, 11% of woodlot owners who have not sold EG&S and 5% of non-woodlot owners have completed elementary as their highest level of education. Forty-five and 43% have completed high school, respectively. Twenty-six and 33% have completed an undergraduate degree as their highest level of education, respectively, and 19% both groups have a graduate degree. The woodlot owners who have sold EG&S have a higher percentage of elementary, high school and graduate degrees as the highest levels of education (25%, 50% and 25%, respectively) than the other two groups of respondents. However, the group of woodlot owners who have sold EG&S did not include any respondents with undergraduate degrees as their highest level of education. We could not reject the hypothesis that the mean education levels of the woodlot owners who have not sold EG&S and those of the non-woodlot owners are statistically the same.

Figure 5.5 Responses to Survey Question: "What Is The Highest Level of Education That You Have Completed?", by type of respondent.



Employment status results were similar. As Figure 5.6 shows, the woodlot owners how have not sold EG&S and non-woodlot owners both had the highest percentages of employed respondents (41% and 45%, respectively), followed by retired respondents (38% and 36%, respectively), self-employed respondents (18% and 12%, respectively), and, lastly, unemployed respondents (3% and 7%, respectively). We could not reject the hypothesis that the mean employment status proportions between these two groups of individuals are the same.

However, the four respondents in the group of woodlot owners who have sold EG&S included two employed and two retired individuals. The fact that two were retired is not surprising due to the fact that we found these respondents to be older than the respondents in the other groups.

Figure 5.6 Responses to Survey Question: "What Is Your Employment Status", by type of respondent.

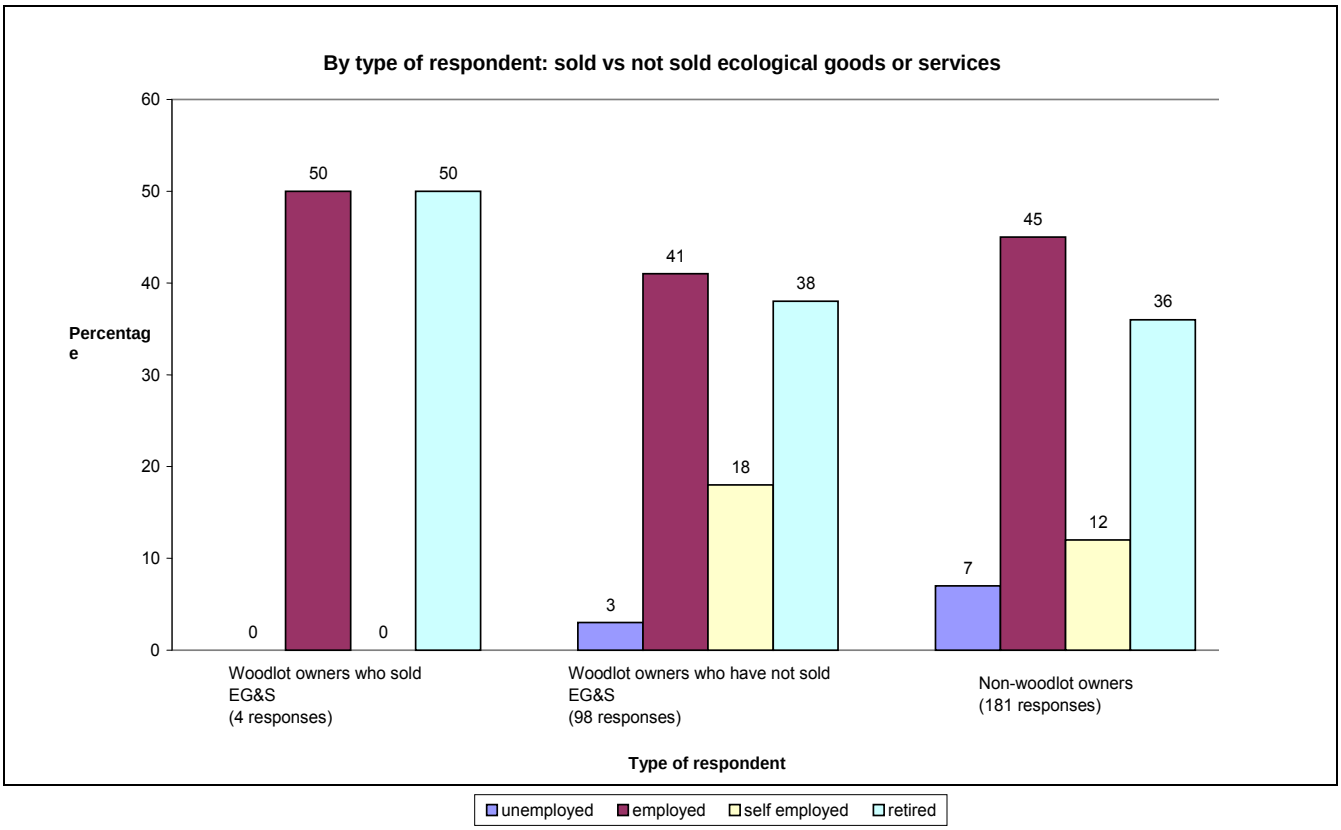
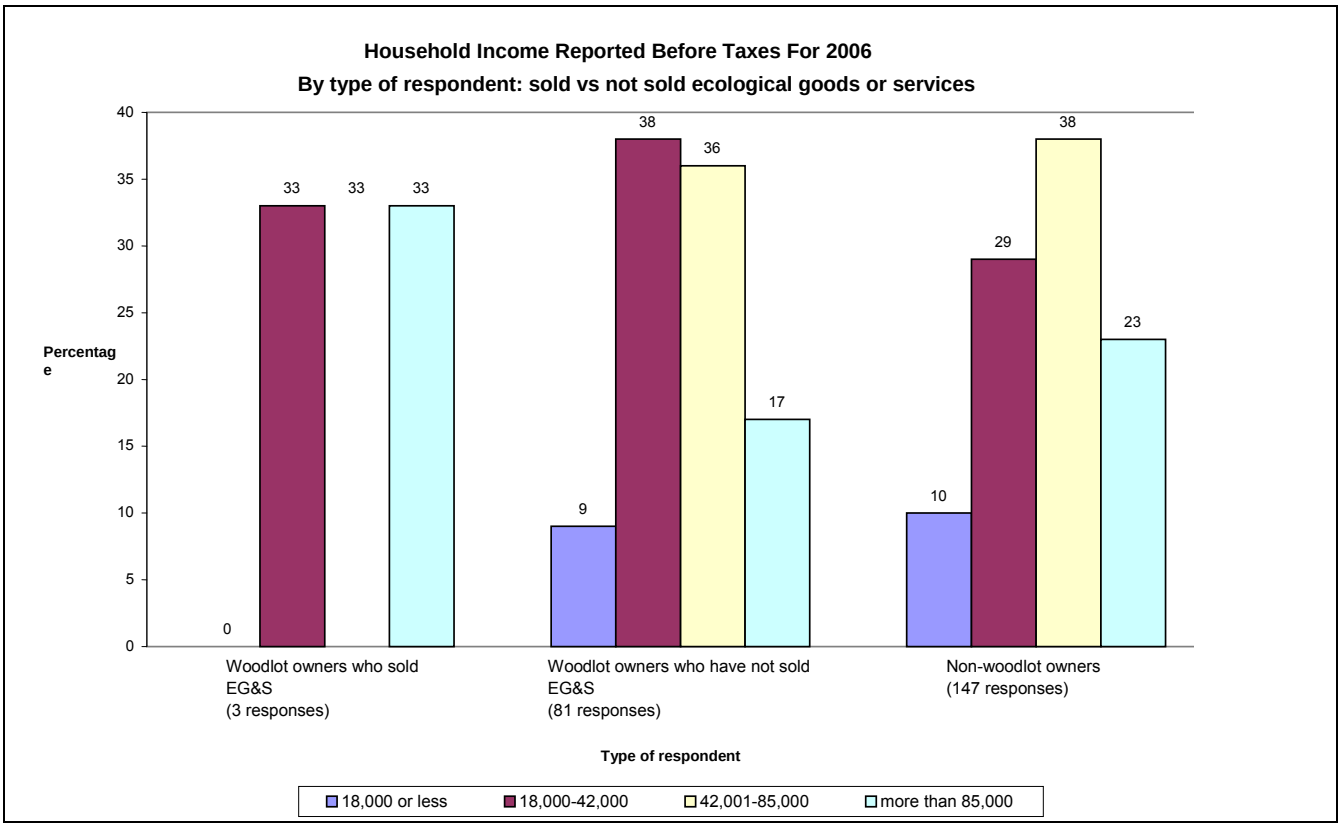


Figure 5.7 shows the approximate level of annual household income of the three groups of respondents, woodlot owners who have sold EG&S, woodlot owners who have not sold EG&S, and non-woodlot owners. The respondents were asked to indicate the category of income in which they belong, $18,000 or less, $18,000 to 42,000, $42,001-85,000 or more than $85,000. A smaller number of individuals responded to this question than to the rest of the survey (three woodlot owners who have sold EG&S, 81 woodlot owners who have not sold EG&S and 147 non-woodlot owners). Nine percent and 10% of respondents in the groups who have not sold EG&S fell into the lowest income category, whereas none of the three respondents who have sold EG&S fell into this group. The incomes of the three respondents who have sold EG&S were distributed among the three other income categories.

The two groups who have not sold EG&S included 17% and 23% of respondents in the highest income group, respectively. However, whereas the highest percentage (38%) of respondents in the group of woodlot owners who had not sold EG&S fell in the $18,000 to $42,000 income range, the highest percentage of non-woodlot owners (also 38%) indicated their incomes were between $42,001 and 85,000. However, we could not reject the hypothesis that the mean levels of income in these two groups are the same.

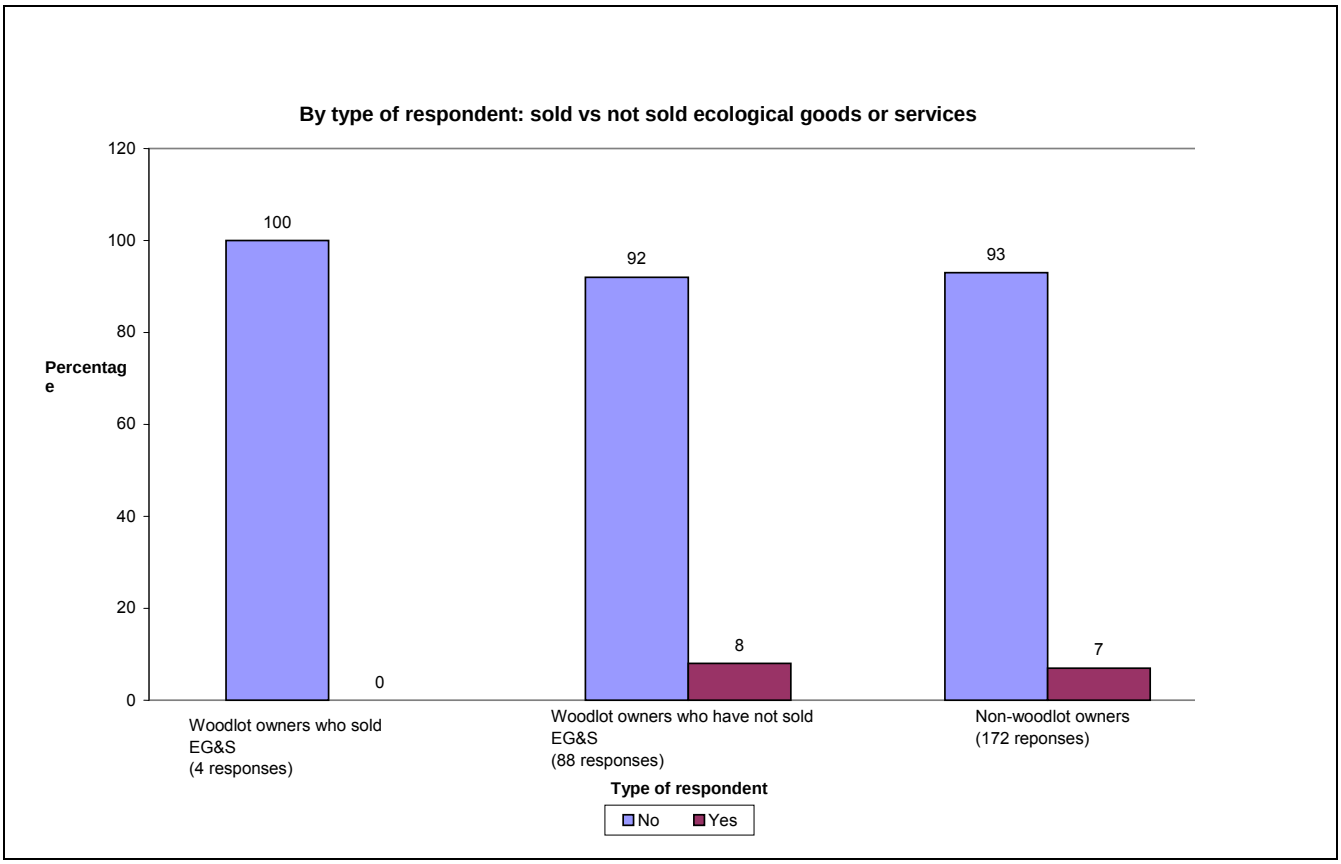
Figure 5.7 Responses to Survey Question: "What Is Your Approximate Level of Annual Household Income?", by type of respondent.



As Figure 5.8 shows, few of the respondents in any of the groups have ever been or are members of an environmental organization. None of the woodlot owners who have sold EG&S have belonged or belong to an environmental organization, and 8% and 7% of the woodlot owners who have not sold EG&S and the non-woodlot owner respondents, respectively, have been or are members. This was not a statistically significant difference. As such, we cannot speculate on the relationship between membership to an environmental organization and ability to sell EG&S.

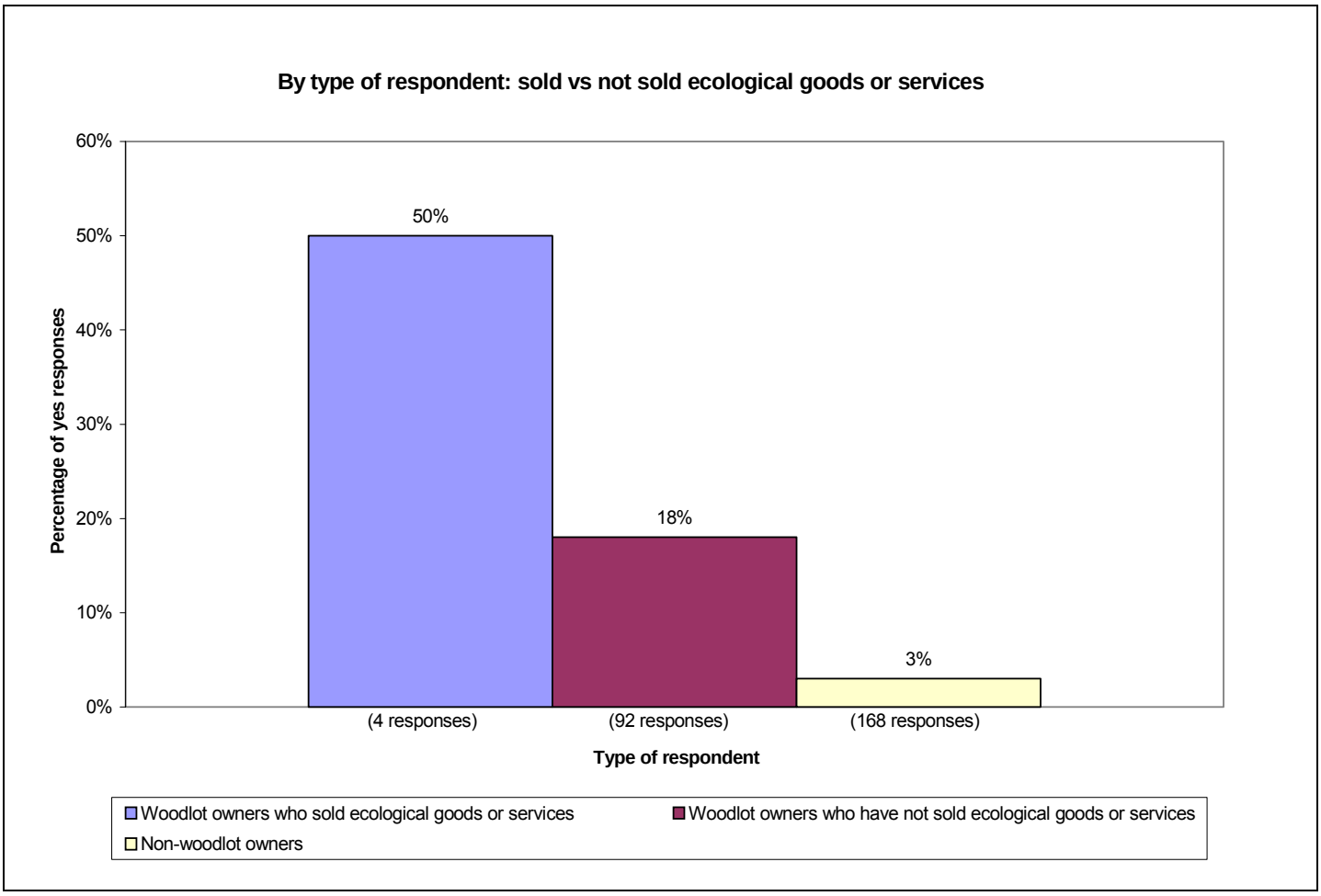
Figure 5.9 shows the percentage of respondents, in each of the groups being analyzed, who are or have been members of a landowner association. Fifty percent of woodlot owners who have sold EG&S, 18% of woodlot owners have not sold EG&S and 3% of non-woodlot owners are or have been members of a landowner association. The difference between the number of woodlot owners who have not sold EG&S and non-woodlot respondents who have memberships to landowner associations is statistically significant.

Figure 5.8 Responses to Survey Question: "Are you (or have you ever been) a member of an environmental organization?", by respondent type.



We could not reject the hypothesis that mean membership to a landowner association is the same between woodlot owners who have sold and who have not sold EG&S, probably due to the small sample of woodlot owners responding to the question. However, assuming a difference, the results are relevant to the question of how to extend markets to EG&S, specifically in the context of the theory of transaction costs. As we discussed in the taxonomy of impediments to market exchanges of EG&S, a middleman such as a landowner association, could reduce transaction costs by helping buyers and sellers come together (reducing search costs), and increasing trust by setting default contracts to help negotiations and sanctions for broken agreements (reducing negotiation and conclusion costs). As such, a landowner association may increase the potential of market exchanges of EG&S by reducing transaction costs. The survey results support this theory, since more of those woodlot owners who have sold EG&S belong or have belonged to landowner associations than any other respondents.

Figure 5.9 Responses to Survey Question: "Are you or have you ever been a aember of a landowner association?", by type of respondent.



*5.4.1.2 R*espondent Opinions on Compensation Approaches to the Provision of EG&S

In order to investigate the factors that affect the ability for individuals to sell EG&S, we examined how land and demographic characteristics differ between three groups of individuals, woodlot owners who have sold EG&S, woodlot owners who have not sold EG&S and non-woodlot owners. An analysis of the opinions of these three groups on whether or not landowners should be compensated for the provision of EG&S and the best approach to compensation is also helpful in revealing the potential of market exchanges of EG&S.

For the compensation analysis, it is helpful to categorize the three groups of respondents into their roles in market exchanges of EG&S. The woodlot owners who have sold EG&S are the successful sellers of these goods and services. The woodlot owners who have not sold EG&S also represent the supply side of this market, as they could potentially provide these goods and services. We are unsure whether these potential sellers want to sell these EG&S but have not succeeded, or whether they are not interested in playing the role of suppliers. However, compensation analysis can help answer this question, since landowners who do not think landowners should be compensated for the provision of EG&S by individuals directly benefiting from these exchanges, or at all, are probably less likely to be interested in taking part in such market exchanges of EG&S.

Finally, we found in the previous analysis of land and demographic characteristics that there are statistically significant differences between non-woodlot owner respondents and woodlot owners who have not sold EG&S. These differences include the number of acres owned, the gender proportions of the respondents, and membership to a landowner association. Therefore, the non-woodlot owner respondents could represent the demand side in the market for EG&S since they have less potential for the provision of EG&S but live in the area where they could benefit from the woodlot owners' provision.

The reasons for this low potential to provide EG&S are twofold. First of all, since the non-woodlot owners own, on average, about ten acres of land compared to the woodlot owners' mean land size of approximately 245 acres, they face a weak demand for the EG&S they could provide. We discussed the details of this theory in the land characteristic analysis. Secondly, they may simply have few or no EG&S related to their land (trees, for example, that serve to provide wildlife habitat and carbon sequestration benefits).

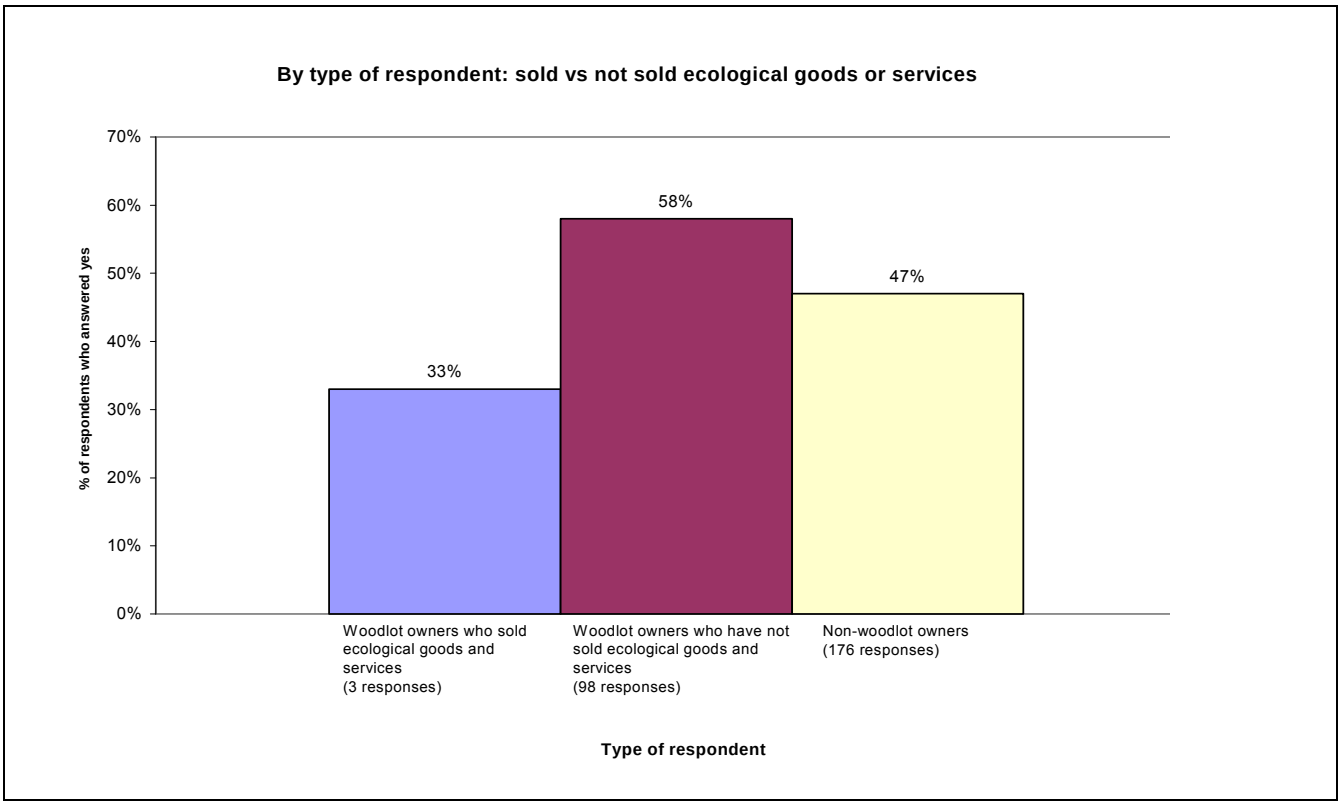
Keeping these three parties to market exchanges of EG&S in mind, comparing the opinions of approaches to compensation for the provision of EG&S of these groups serves two purposes. First, the analysis serves to test the demand of EG&S relative to the supply. We can do this by comparing the opinions of demanders and suppliers on whether or not landowners should be compensated for their provision and their receptiveness to direct compensation from individuals (representing a market exchange). Secondly, the analysis serves to evaluate whether opinions on compensation differ between those landowners who have sold EG&S and those who have not sold EG&S. This evaluation will help determine if opinions towards compensation approaches may be a factor in the ability or willingness to sell EG&S.

As Figure 5.10 shows, 33% of woodlot owners who have sold EG&S indicated that landowners should be compensated for providing EG&S. Fifty-eight percent of woodlot owners who have not sold EG&S and 47% of respondents on the demand side indicated that landowners should be compensated for providing EG&S.

More woodlot owners who have not sold EG&S indicated landowners should be compensated for the provision of EG&S than demander respondents. However, the difference was not statistically significant.

Unfortunately, since the sample of woodlot owners who have sold EG&S is only three, there are few conclusions we can make regarding what role opinions on compensation approaches play in ability to sell EG&S. We could not reject the hypothesis that the mean opinion on compensation is the same for woodlot owners who have sold and those who have not sold EG&S. However, if the small sample of woodlot owners who have succeeded in selling EG&S represent the opinions of other landowners who have sold EG&S, then they have a lower receptiveness to the compensation for the provision of EG&S than those landowners who have not sold EG&S and the potential demanders of EG&S. Maybe landowners who think they should provide EG&S regardless of compensation are more likely to be open to the opportunities of having users on their land, since they already supply these EG&S and since they may feel a responsibility to provide these benefits to the public. On the other hand, landowners who demand compensation may not be willing to invest in conservation activities which offer EG&S without this compensation. Therefore, they are not in a preemptive position to be open to opportunities for exchange.

Figure 5.10 Responses to Survey Question: "Should Landowners Be Compensated for Providing EG&S?", by type of respondent.

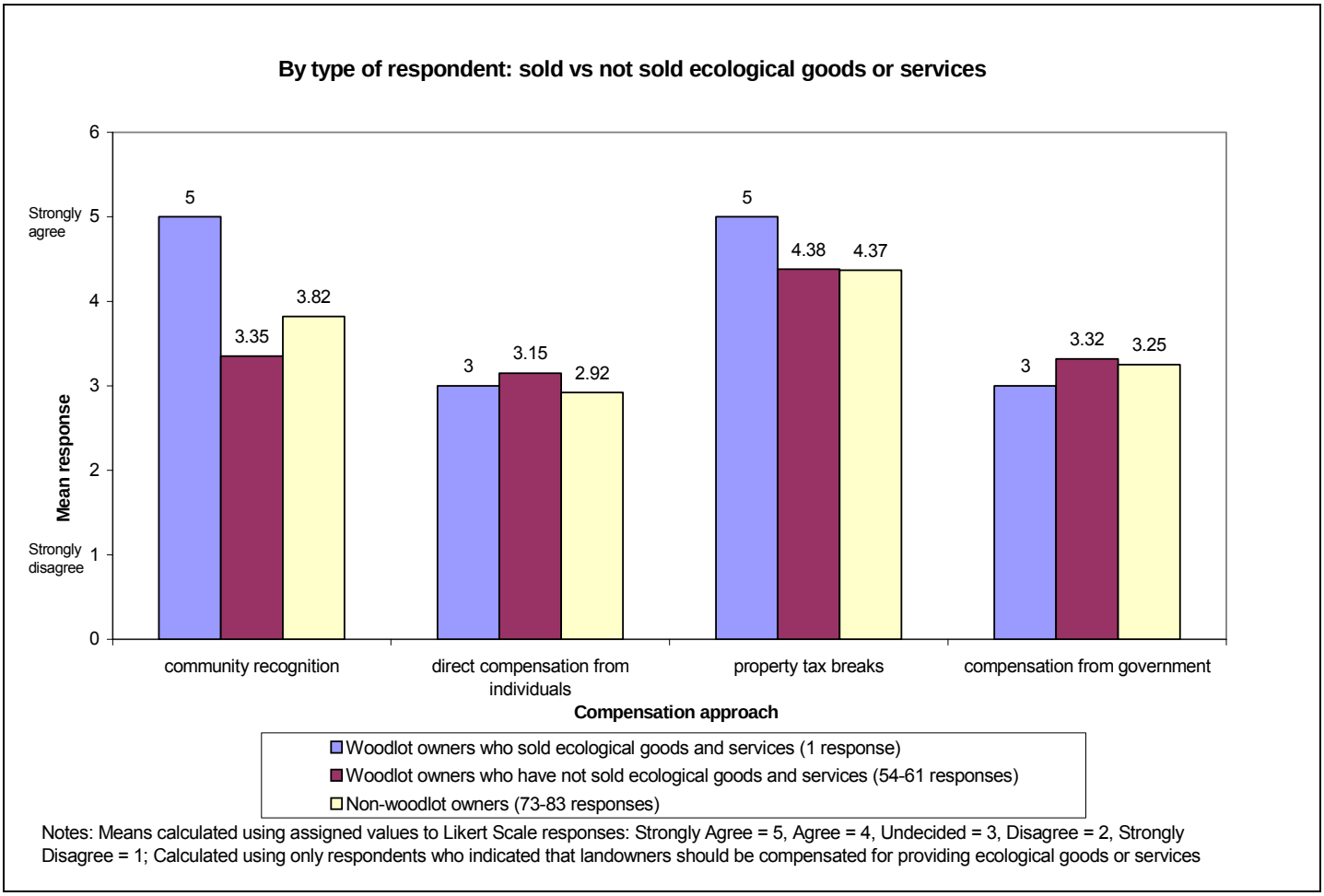


Opinions on different approaches to compensation:

An analysis of the types of compensation approaches these three groups of respondents are most receptive to could offer further insight into the differences between these three groups. Figure 5.11 shows the mean levels of agreement of respondents, on a scale of 1 to 5, strongly disagree to strongly agree, to several types of approaches to compensating landowners for the provision of EG&S. We broke these responses down according to the three groups of respondents.

The responses of the demand side and the supply side of the market for EG&S on the topic of approaches to compensation for the provision of EG&S do not differ significantly for three of the four compensation approaches. Both groups are generally undecided about direct compensation from individuals and government compensation as means of compensation. Furthermore, both groups are equally receptive (the means of 4.38 and 4.37, were slightly above the 'agree' level and not statistically significantly different) to the idea of property tax breaks as a means of compensation for the provision of EG&S. Why are property tax breaks a more favourable approach to compensation than the alternatives? The reasons may be different for suppliers and demanders. Suppliers may see this approach as less convoluted than receiving payments. They must pay property taxes anyway, so paying less is a straight-forward way to add money in their pockets. On the other hand, demanders may favour this approach because they believe that they will not have to pay out of their pockets, and that their taxpayer dollars will not be diverged into compensating landowners. Even if in the end, decreasing property taxes to landowners reduces the overall pool of taxes, individuals may not make this connection immediately.

Figure 5.11: Responses to Survey Question: "How Should Landowners Be Compensated For Providing EG&S?", by type of respondent.



Notes: Means calculated using assigned values to Likert Scale responses: Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2, Strongly Disagree = 1; Calculated using only respondents who indicated that landowners should be compensated for providing ecological goods or services

Agreement with community recognition as a compensation approach was statistically different between the woodlot owners who have not sold EG&S and potential demanders of these goods and services. Demanders were more receptive to the idea of community recognition as a form of compensation than the woodlot owners who have not sold EG&S. Community recognition may be less favourable to woodlot owners than demanders of EG&S because it provides no monetary incentives for the woodlot owners. However, the demanders may prefer this approach because they do not have to provide any financial compensation but benefit from the provision regardless.

The woodlot owners who have sold EG&S have limited response rates to this question making speculation on their opinions of different approaches to compensation impossible. Since only one of the four respondents indicated that he thought landowners should be compensated for the provision of EG&S (two indicated that no compensation was required and one did not respond), his one response represents the mean level of agreement. For the sake of interest, the woodlot owner who has sold EG&S strongly agreed with community recognition and property tax breaks as a form of compensation for the provision of EG&S and was undecided on direct compensation from individuals and from the government.

Analysis of survey respondents who agree with compensation for the provision of EG&S:

Determining the kinds of individuals, both on the supply and demand side of the market for EG&S, who are receptive to the idea of compensation for the provision of EG&S, and specifically to the direct compensation approach, is an important step in determining who is likely to participate in such exchanges, and, therefore, how to increase the potential of these market exchanges. In order to dig deeper into the responses on compensation for the provision of EG&S, we compared the land and demographic characteristic of those individuals who agreed with compensation and those who indicated that landowners should not be compensated for the provision of EG&S.

Of the individuals who agreed with compensation, we also subdivided the respondents into those who strongly agreed and agreed with direct compensation from individuals who benefit from the provision of EG&S and those who strongly disagree and disagree with this approach to compensation. Here we will summarize the highlights of this analysis, by discussing the land and demographic characteristics that had statistical significance in opinions on compensation.

The only statistically significant relationship between agreement with direct compensation and demographic or land characteristics of individuals was age. The respondents who agreed with compensation were statistically significantly younger, with 13% of them falling into the 18-38 year old age group compared to the non-compensation respondents' 4.5% falling within the same group. The compensation group also had a lower percentage of over 65 year old respondents than the non-compensation group, 17% compared to 27%. The compensation group also had less retired respondents than the non-compensation group, 27.5% versus 42.5%. This makes sense considering the compensation group had younger aged respondents. It is possible that older respondents have a cultural norm mentality about the responsibility to provide EG&S regardless of compensation

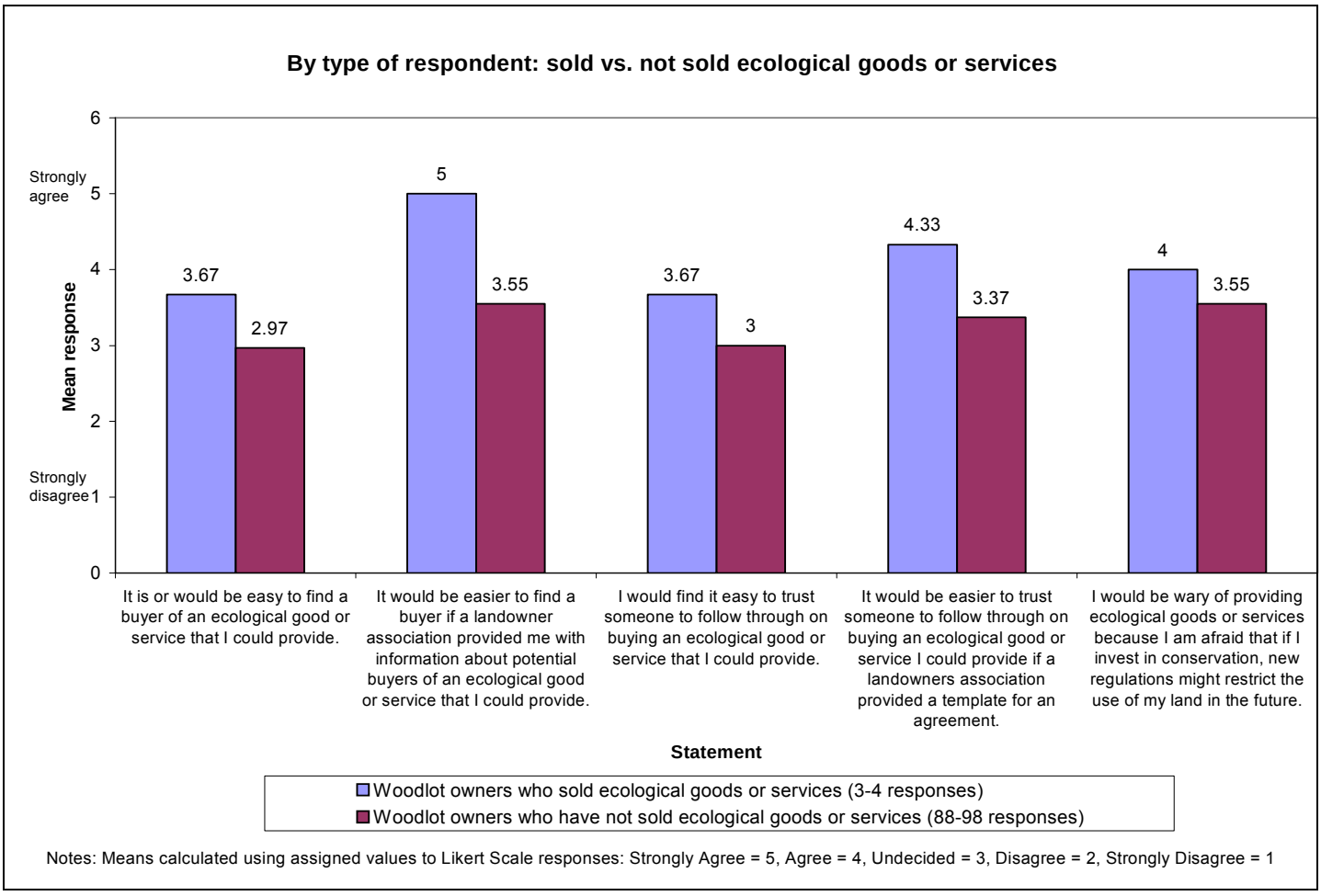
5.4.1.3 Respondent Opinions on Impediments to Market Exchanges of EG&S

The purpose of this survey was to test the factors that may affect the potential for woodlot owners in New Brunswick to sell EG&S. So far, we have done this indirectly by comparing the land characteristics, demographic characteristics and receptiveness to compensation approaches of the landowners who have sold EG&S to those that have not sold EG&S. However, a more direct approach to testing the impediments listed in the taxonomy is to ask landowners directly if these factors play a role in impeding transactions. We asked respondents to indicate their level of agreement with four statements related to factors affecting transaction costs and one statement related to government policy resulting in uncertain property rights, as we described above.

Figure 5.12 shows the mean responses to these statements of woodlot owners who have sold EG&S and woodlot owners who have not sold EG&S. Mean responses were calculated by assigning a value of 5 to strongly agree responses, 4 to agree responses, 3 to undecided responses, 2 to disagree responses and 1 to strongly disagree responses.

As Figure 5.12 shows, woodlot owners who have not sold EG&S were mostly undecided about the five statements. The means ranged from 2.97 to 3.55. Eighty-eight to 98 respondents indicated their opinions on the statements.

Figure 5.12 Survey Responses to Survey Questions related to Opinions on Impediments To Market Exchanges of EG&S, by type of respondent.



Notes: Means calculated using assigned values to Likert Scale responses: Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2, Strongly Disagree = 1

Three of the four woodlot owners who have sold EG&S indicated their opinions on the transaction cost statements. All four indicated their opinions on the new regulations statement. Although this sample is small, it is noteworthy that the woodlot owner respondents who have sold EG&S indicated that their levels of agreement for all statements were higher than those of the woodlot owners who have not sold EG&S. Specifically, all woodlot owners who have sold EG&S strongly agreed with the statement that it would be easier to find a buyer if a landowner association provided them with information about potential buyers of an EG&S that they could provide. They also agreed with the statement that it would be easier to trust someone to follow through on buying an EG&S they could provide if a landowners association provided a template for an agreement.

Both of the statements discussed above are related to the potential of a middleman to reduce transaction costs (search costs for the first statement, and negotiation and concluding costs for the second statement). Their responses indicate that a middleman could increase the potential of market exchanges of EG&S, as we hypothesized in the taxonomy of impediments to market exchanges. They also indicated a mean agreement level of 3.67 (between undecided and agree) for both the statement describing low search costs and the statement describing low negotiation costs (specifically as it relates to trust). As such, the woodlot owners who have sold EG&S responding to this survey are less concerned with these transaction cost impediments to market exchanges than the woodlot owners who have not sold EG&S.

One possible explanation for the fact that woodlot owners who have sold EG&S indicated that transaction costs may not be a concern for them and that solutions to transaction costs are viable is that they are already successfully implementing these solutions (i.e. they are members of a landowner association that may be acting as a middleman). Another explanation is that these landowners have lower search and negotiation costs due to their demographic characteristics. As we have already discussed, these woodlot owners tend to be older and have owned their land for longer periods of time, which may reduce their search costs and increase their trust in community residents.

The woodlot owners who have sold EG&S were also more likely than woodlot owners who have not sold EG&S to agree that they would be wary of providing EG&S because they are afraid that if they invest in conservation, new regulations might restrict the use of their land in the future (this result, however, is statistically inconclusive due to the small sample of sold respondents). If we were to hypothesize, landowners who have sold EG&S may be more concerned about this issue because they are already in the game of conservation, due to the fact that they are providing EG&S. As such, they are more vulnerable to policy restricting property rights because they have more to lose from the restriction of property rights.

5.4.2 Focus Group with Canaan-Washademoak Watershed Landowners

The focus group participants were landowners from the Canaan-Washademoak Watershed and, therefore, can be representative of the resident proportion of the previously discussed survey respondents in the region. Since a focus group is a more informal and qualitative approach to data collection than the survey, we use it as a support tool for the quantitative survey analysis. That is, we use the focus group discussion to answer some of the “why” questions stemming from the survey results, or to explain, more informally but in more detail, why survey respondents may have indicated the answers that they did. These explanations may collaborate some of the theories we proposed in the analysis of the survey results. Alternatively, the discussion may reveal alternative explanations for the survey results which may provide for some interesting findings. Finally, since we asked focus group participants about all the impediments we have in the taxonomy of impediments to market exchanges (unlike in the survey where we had space limitations), we will look for evidence of these impediments and other impediments existing for these landowners.

5.4.2.1 Demographic and Land Characteristics of Participants

The 14 participants responded to advertising of the workshop by the University of New Brunswick. Several women participated, although most participants were male. Most participants belonged to the woodlot owners cooperative, especially those that marketed lumber from their woodlot. We were told that membership was necessary for landowners who marketed wood and owned more than 10 hectares of woodlot.

Participants were asked about the characteristics of their land. The size of land owned ranged from 3 to 500 acres. The watershed landowners in the survey owned between 0.5 and 4000 acres of land. On average, the woodlot owners who have sold EG&S responding to the survey owned about 300 acres of land, and woodlot owners who have not sold EG&S owned approximately 180 acres of land, so the survey participants fell into the range of focus group participants. Most respondents indicated that they use the land for permanent residence, with recreational uses, and sometimes with a cottage also on the land. Many used land for woodlot purposes (25 acres or

more of woodlot), and one respondent indicated that his land was divided between woodlot and agricultural uses.

Most participants indicated that they have owned their land for more than 20 years, and many have owned their land for more than 30 years. One couple owned their land for less than 6 years. This information is consistent with the survey results, in which the average length of land ownership for woodlot owners who have sold EG&S was 46 years and the average length for woodlot owners who have not sold EG&S was about 25 years. The general distance from the nearest urban area of the participants' land was 50 miles from Moncton and 70 miles from Fredericton.

5.4.2.2 Focus Group Participant Experiences With & Receptiveness To Selling EG&S

When asked what EG&S their land could provide, respondents indicated that their lands could provide all the goods and services listed to them (pleasant landscapes, wildlife watching, fishing, hunting, hiking, wildlife habitat, clean water and clean air). Cycling and snowmobiling were the exceptions. Some participants indicated that cycling would be difficult on their land and others indicated that snowmobiling may be difficult on their land (but not to the extent of cycling). Participants also identified another category of EG&S that their land could provide: access to water (docking facilities for boats, canoes etc.).

We asked participants if they have ever sold an EG&S. Although no one had sold a good or service for monetary payment, one participant had exchanged access to property with other landowners, mainly for the purpose of hunting, and another participant had exchanged photographs for access to land (he photographs landscapes). These kinds of exchanges, although more informal than a typical market exchange, still encompass the aspects of successful exchanges. Furthermore, since the focus group size was 14, the percentage of focus group participants who have sold EG&S was 14%.

When asked what kind of EG&S landowners would be interested in providing for payment, participants were unanimous. Although most were willing to provide pleasant landscapes and wildlife watching/photography (with specification of what the photography is used for), the other categories of goods and services were much more controversial. Many participants indicated that they had no control over fishing and hunting, and therefore, could not respond to the question of whether they would be interested in providing these for payment. Conflict arose over the issue of who has the right to fish and hunt on private land. The conclusion was that signage was necessary, according to law, to disallow hunters and fishers on private land. Without signage (indicating that trespassers were not allowed on the land), landowners have no control over hunting and fishing activities on their land. These activities are controlled solely by government licensing. This controversy on the issue of whether landowners are restricted by government to sell access to fishing and hunting reveals that the perception of government policy prohibiting the exchange of these services may be a factor impeding market exchanges of these two goods and services.

The issue of insurance and liability came up for hiking and cycling. Participants claimed that they would be willing to provide the service only if cyclists and hikers waived liability. Otherwise, they were afraid of being sued by users if the users were hurt on their land. The issue of liability could impede the exchange of EG&S by increasing negotiation costs, since waiving liability could add to the complexity of an exchange agreement. Alternatively, liability could raise the perceived costs of

supply for landowners, which could result in supply being above demand for some EG&S and no exchanges taking place.

Landowners were not responsive to the idea of allowing snowmobilers on their land for payment. They stated that snowmobilers caused noise pollution, environmental pollution and, most importantly, left garbage on their land. Many landowners had experienced these problems with snowmobilers on their land. They stated that legal sanctions and hefty fines for littering on private property were necessary to improve this situation. Participants did note, however, that size of land owned is relevant to whether snowmobilers would be welcome. Larger parcels of land mean less noise pollution (or at least noise pollution further from their residences). This discussion offers several explanations for survey responses. First of all, the focus group participants offer an explanation as to why access to snowmobilers was a less often sold EG&S than most of the other EG&S listed to survey respondents. Access to snowmobiling was only sold on two occasions, the lowest number of exchanges except for carbon sequestration and water quality benefits (landowners reported zero exchanges for these two services). Secondly, this explanation is valuable in offering insight into why owners of larger pieces of land are more likely to have sold EG&S.

Landowners stated that they did not require payments to maintain the indirect benefits of clean water and clean air that their lands provided. However, they stated that any improvements to air quality or water quality above the status quo level would require payment. This payment could be in kind (i.e. if tree planting was required to improve air or water quality, the landowners would like the trees for free). The participants did not think that improvements in water and air quality were needed in their area. Air, especially, according to these participants, is of very high quality in the watershed and no action is required on the part of the landowners since the status quo is acceptable to them. This discussion on air and water quality benefits is interesting in illuminating two aspects of the survey responses. Firstly, the participants' point that the provision of water and air quality do not require compensation and that their levels without compensation are adequate may explain why these two services have never been sold by survey respondents. Secondly, and perhaps more importantly, this discussion may explain why almost half of survey respondents indicated that landowners should not be compensated for the provision of EG&S.

An additional comment on the topic of payment for the provision of EG&S was that payment from the land user is associated with the user waiving his responsibility to respect the land or the landowner. The landowners believe that the public is more likely to litter on their land if it pays for using the land. This comment may explain why many survey respondents were not responsive to the idea of direct compensation from individuals who benefit from the provision of EG&S as a means of compensation.

5.4.2.3 Participant Opinions on Trespassers and Exclusion

According to the taxonomy of impediments to market exchanges of EG&S, the public good characteristic, specifically a lack of excludability, of EG&S could be an impediment to their exchange. Although we did not ask survey respondents about excludability of EG&S benefits as a factor in impeding market exchanges of EG&S, we did have an opportunity to discuss this issue with focus group participants. As such, we will use their discussion as a preliminary analysis on the existence of this potential impediment. we will also continue to look for insight into how the focus group discussion may explain survey results.

All participants claimed they have problems with trespassers coming on their land. The trespassers' intentions on the land, according to the landowners, are to enjoy the pleasant landscape, sometimes watch wildlife, fish and hunt. Cycling and hiking are not popular trespasser activities, according to the landowners. Snowmobiling and ATVing, on the other hand, are big trespassing activities. Other trespassers mentioned by participants were airplanes flying low and often above the land, swimming and paintball. The fact that trespassers were common for these focus group participants may indicate that a lack of excludability is a problem that may prevent landowners from charging individuals for EG&S. However, the silver lining in this discussion is that, since trespassers for most of the activities listed to the focus group and survey respondents were common, there is a demand for these EG&S. This demand may explain why woodlot owners responding to the survey have sold almost all the EG&S listed to them. As a matter of fact, they have sold all the EG&S listed to them that involved individuals having direct access and use of their land.

When we asked focus group participants if there is anything they could do to prevent trespassers from using their land for the activities they indicated, they said that confronting trespassers was the best solution. According to the participants, fencing is too expensive and not effective enough to prevent trespassers. They also mentioned that they have no support in excluding trespassers from police.

What does this mean for the potential of market exchanges of EG&S? Firstly, a lack of excludability may be an impediment to market exchanges, especially for some landowners. Since confrontation was listed as effective in increasing excludability, landowners who are willing to confront trespassers may have more potential to sell EG&S. Connecting this information to the survey results yields some interesting perspectives on who these individuals may be. Survey respondents who sold EG&S were older and had owned their land for longer than respondents who had not sold EG&S. We attested their ability to sell EG&S to low search costs as a result of their more extensive knowledge of the community and its residents. This knowledge may also facilitate confrontation of trespassers for these landowners, since their link to the community may give them more confidence about the use of their land.

5.4.2.4 Participant Opinions on Transaction Costs

We asked participants to indicate their level of agreement (strongly agree to strongly disagree) on several statements on the topic of transaction costs. These questions were similar to those presented in the survey. Participants strongly agreed with the statement that it would be easy to find a buyer of an EG&S they could provide. As a matter of fact, they did not think it would be any easier to find a buyer if a landowner association provided them with information about potential buyers. The participants indicted that simple advertising (i.e. a poster) for EG&S they could provide would be sufficient to attract buyers. They added that they did not want to advertise for fear that too many buyers would be interested in coming onto their land.

Participants also strongly agreed that it would be easy to negotiate the terms of an agreement with a buyer for an EG&S. They strongly disagreed with the statement that it would be easier to negotiate an agreement with a buyer of an EG&S if a landowner association provided a template for an agreement. On this topic, they stated that they knew what they expected from users of their land and could relay this information to potential buyers.

The issues brought up by participants on low search costs and negotiation costs are interesting in the context of the survey responses. Although we did not ask focus group respondents for their ages, many of them had owned their land for periods of time in the range of the survey respondents who had sold EG&S. Furthermore, these participants were landowners with close links to the community. Most of them were somehow connected to the researchers and the University of New Brunswick because of their knowledge of the area. As such, their outlook on search and negotiation costs coheres to the survey respondents who have sold EG&S. These respondents indicated lower search and negotiation costs than respondents who have not sold EG&S.

Participants strongly disagreed with the statement that they would find it easy to trust someone to follow through on buying an EG&S they could provide. They indicated that they did not trust buyers to respect the land in a way the landowners would outline in a negotiation. Specifically, participants felt that buyers would leave garbage on their land, regardless of whether the landowner specified against littering in the exchange negotiation. Furthermore, participants strongly disagreed with the statement that it would be easier to trust someone to follow through on buying an EG&S if a landowner association provided a template for an agreement. They justified this response by stating that they knew what negotiations they could make. However, they do not trust buyers to adhere to the negotiated contract or agreement which may mean that they face high concluding costs. On the other hand, they did agree with the statement that it would be easier to trust someone to follow through on buying an EG&S they could provide if they knew legal sanctions existed for those that did not follow through with their agreement. However, they indicated that severe fines were necessary and that precedent for legal sanctions had to be established for them to gain trust for agreement adherence. The overall punch-line from participants was that they did not want to sell an EG&S because buyers would always abuse their property. As such, a lack of trust raising concluding costs may be an impediment to market exchanges of EG&S for these landowners.

5.4.2.5 Weak Demand as Impediments to Market Exchanges of EG&S

We did not ask participants questions regarding demand for EG&S because we felt that they had already indicated in previous discussion that weak demand was not a problem for providing EG&S from their land. Since our time with the focus group participants was limited, we deduced from the discussion that landowners perceived a high demand for the services that their land could provide. Landowners mentioned that a simple poster would likely bring in users, but that they did not want to advertise EG&S on from their land. This, coupled with the fact that trespassers are common on the land of these participants, leads us to believe that weak demand is probably not a factor contributing to a lack of exchange of EG&S for these focus group participants.

5.4.2.6 Participant Opinions on Govt. Policy/Property Rights

Government policy causing uncertain property rights is listed in the taxonomy of impediments to EG&S. The theory behind this impediment is that it raises the perceived future cost of supply of landowners because they are afraid restrictions will limit their use of their land if they invest in conservation. Since conservation activities are related to the provision of EG&S, a lack of these activities prevents the provision, and therefore exchange, of these goods and services. We asked survey respondents about this impediment as well and the loose interpretation of the results was that woodlot owners who have sold EG&S generally agree with the concern whereas woodlot owners who have not sold EG&S are less concerned. We interpreted this to mean that those

landowners who have sold EG&S are already invested in conservation activities and, therefore, have more to lose from these regulations than landowners who have not sold EG&S.

Participants of the focus group strongly disagreed with the statement that they would be wary of providing an EG&S because they are afraid that if they invested in conservation, new regulations such as endangered species policy might restrict their use of their land in the future. They stated that regulations such as clean water policy already protected species such as salmon and this policy does not affect their decision on selling EG&S.

Why the discrepancy in opinions between the survey respondents and focus group participants on the issue of policy causing uncertain property rights? One reason for this discrepancy may be that the focus group participants are not representative of the Southern New Brunswick population, whereas the survey results, encompassing much larger number of these residents, are representative of this population.

5.4.2.7 Participant Opinions on Govt. Resource Policy/Ownership

In the taxonomy of impediments to market exchanges of EG&S, we hypothesized that if landowners thought that government policy forbids the exchange of EG&S, or if landowners perceived that they had no property rights to natural resources because the government owns these resources, they would be less likely to sell these EG&S. However, participants of the focus group strongly agreed that government policy does not forbid them from selling the access to pleasant landscapes, wildlife watching/photography, cycling, hiking, snowmobiling or benefits from wildlife habitat, water quality or clean air. As such, they did not perceive government policy or ownership of natural resources to impede market exchanges of related EG&S. Since we did not ask survey respondents this question, we cannot compare their responses to focus group discussion. However, the fact that the woodlot owners responding to the survey who have sold EG&S sold most of the activities listed to them supports the focus group discussion that government policy forbidding exchange or government ownership of natural resources is not an impediment to the exchange of any specific EG&Ss that may be restricted by policy.

Focus group participants added, however, that the sale of these activities, and all activities not addressed by specific regulations, is restricted by general requirements for sale licenses. The participants strongly agreed that government policy forbids them from providing fishing or hunting for payment, stating that these activities were under the control of government licenses only. Since survey respondents managed to sell access to many activities, including fishing and hunting, these general restrictions did not appear to impede their ability to sell EG&S. However, these restrictions may have played a role in impeding exchanges for the woodlot owners responding to the survey who have not sold EG&S.

When asked for their level of agreement with the statement they own certain natural resources on their land, participants indicated that they strongly disagreed that they own birds, deer, moose and other large mammals, wild fish, streams, and natural ponds. However, they strongly agreed that they own stocked fish, trees, manmade ponds and hiking trails. These opinions would indicate that those EG&S related to birds, deer, moose and other large mammals, wild fish, streams and natural ponds would be less likely to be sold than EG&S related to stocked fish, trees, manmade ponds and hiking trails. The survey results do not readily lend themselves to collaborating this theory since survey respondents who have sold EG&S such as access to fishing may have sold access to stocked fish, for example. Also, even if landowners do not believe they own birds and wildlife,

allowing birdwatchers and wildlife watchers on their land does not entail exchanging all the property rights to this natural resource. Therefore, government ownership may not conflict with this type of service. However, survey respondents did sell access to hunting and this kind of exchange conflicts with government ownership of wildlife. As such, these landowners were not impeded by the perception that the government owns this natural resource.

5.4.2.8 Participant Opinions on Govt. Subsidization/Provision of EG&S

In the taxonomy of impediments to market exchanges of EG&S we listed government subsidized provision of EG&S as a possible impediment to market exchanges of EG&S. This impediment is based on the theory that government subsidized provision undercuts the net demand for EG&S to private suppliers.

In order to test whether government subsidized supply of EG&S could be an impediment to the market exchange of these goods and services for the focus group participants, we asked participants about their level of agreement with the statement that it would not be worthwhile for them to provide certain activities for sale because they are already provided by someone else for a price that they could not compete with. They strongly disagreed with this statement for all activities, stating that they could provide a higher quality or differentiated service and therefore could compete with current provision. For example, one participant stated that he could provide an exclusive and private campsite on his 100 acres of land that would be very attractive to campers. These responses lead us to believe that government subsidized provision of EG&S may not be an impediment for these landowners. As a matter of fact, they have already thought of similar solutions to overcoming this impediment that we thought of when we developed the taxonomy of impediments.

5.4.2.9 General Comments from Participants on Selling EG&S

When we asked participants for any general comments they had on why they are not selling EG&S, one landowner responded “We don’t want to.” The general consensus was that landowners want peace, quiet and privacy, and the potential income from selling EG&S is not important or necessary for them. Participants indicated that providing EG&S would result in the pollution and disrespect of their land and then “you might as well cut every tree down.” They added that landowners have respect for each others’ land, and that they want to keep it the way it is. These comments, again, appear to be on point with the issue of a lack of trust that raises transaction costs to a level that may outweigh the potential producers’ surplus from market exchanges of EG&S.

The participants also indicated that the point of private ownership was to maintain control over the land and the activities on it, and the provision of EG&S to buyers would dissolve this control. When asked if there was any price a buyer could offer for the provision of an EG&S, one landowner said that she would not provide the service regardless how high the price, stating “We like that there is no people here.” This perception that allowing users on land would result in a loss of control over the use of land may be indicative of a high cost of supply, especially in light of the comment that no price would be high enough to induce provision of these services from landowners.

5.4.2.10 Lessons Learned from the Focus Group

The fact that landowners indicated that snowmobilers and ATVers often trespass on their land may indicate a high demand for snowmobiling and ATVing access EG&S. However, landowners were not responsive to the idea of allowing specifically snowmobilers on their land for payment. They stated that such activities cause noise pollution, environmental pollution and, most importantly, left garbage on their land. As such, although demand may be high for these EG&S, the perceived cost of provision may also be very high, making their exchange less likely.

Access to pleasant landscapes, wildlife watchers, fishers, hunters, and other such EG&S may also have a high demand since landowners indicate a high rate of trespassing on their land. Since one landowner has exchanged access to pleasant landscapes and another has exchanged access to hunting, these appear to have potential as marketable EG&S. Furthermore, when asked what kind of EG&S landowners would be interested in providing for payment, participants were willing to provide pleasant landscapes and wildlife watching/photography (if visitors agree to specify what the photography is used for). However, many landowners indicated that they had no control over fishing and hunting (since it is regulated by the government), and therefore, they could not respond to the question of whether they would be interested in providing these for payment. Therefore, hunting and fishing may have less potential as EG&S than, for example, access to pleasant landscapes.

The issue of insurance and liability came up for hiking and cycling. Participants claimed that they would be willing to provide the service only if cyclists and hikers waived liability. Otherwise, they were afraid of being sued by users if the users were hurt on their land. The issue of liability could impede the exchange of EG&S by increasing negotiation costs, since waiving liability could add to the complexity of an exchange agreement. Alternatively, liability could raise the perceived costs of provision for landowners. Furthermore, hiking and cycling were not popular trespassing activities (according to landowners) which could signify relatively low demand for these EG&S. As such, the combination of these issues could result in supply being above demand for cycling and hiking, thereby limiting opportunities for market exchange of these activities. Additionally, since many landowners thought that many of these indirect benefits (i.e. EG&S) should be provided without compensation, they were not receptive to market exchanges of these services.

5.5 Conclusions

The survey revealed that 4 respondents have sold a wide array of EG&S associated with access for various recreational activities, totaling 725 exchanges. Since these respondents had succeeded rather well in selling EG&S, we used the opportunity to examine the characteristics and opinions of these individuals to see if they can provide insight about increasing the potential for market exchanges of EG&S. We also used a focus group meeting to support the analysis of the survey results. Two focus group participants had previously exchanged EG&S in-kind: access to hunting and access to scenic views.

The lessons from the analysis of the Southern New Brunswick case study are as follows:

(i) Woodlot owners who have previously exchanged EG&S, and therefore may have the most potential to participate in future market exchanges: (a) Own more land than non-sellers; (b)

Have owned their land for longer than non-sellers; (c) Are older than non-sellers; (d) Are members of a landowner organization; (e) Are less likely than non-sellers to agree that compensation for the provision of EG&S is required; (f) Are more likely than non-sellers to confront trespassers; and (g) Have close ties to the communities in which they live.

(ii) Woodlot owners require the following to participate in market exchanges of EG&S: (a) Low transaction costs, especially search costs, and negotiation and concluding costs as they relate to trust; (b) Implementation of instruments to reduce transaction costs, such as a middleman who provides information about potential buyers and templates for agreements (including a component on users waiving liability if they are hurt on land) and legal sanctions for broken agreements to reduce concluding costs; (c) Reduction in the perceived costs of supply, especially for the provision of access to snowmobiling (i.e. noise, garbage left on sight, etc); and (d) Less policy restrictions in the area of selling access to fishers and hunters.

(iii) The EG&S that woodlot owners have the most potential of providing in a market exchange include: (a) Access to pleasant landscapes or scenic views; (b) Access to birdwatchers and wildlife watchers; and (c) Access to hunters.

(iv) The EG&S that woodlot owners have the least potential of providing in a market exchange include: (a) Access to snowmobilers; (b) Access to hikers; (c) Access to cyclists; (d) Clean water benefits; and (e) Carbon sequestration.

5.6 References

Agriculture and Agri-Food Canada (AAFC). 2005. News Release: Wildlife Habitat Canada Launches National Survey on EG&S. http://www.agr.gc.ca/cb/index_e.php?s1=n&s2=2005&page=n51012a. INTERNET. Cited: April 22, 2006.

Buchanan, J.M. 1964. “What Should Economists Do?” *The Southern Economic Journal* XXX(3):213-222.

Canaan-Washademoak Watershed Association. 2007. The Canaan-Washademoak watershed. *Living With The Land.* Issue 1: Who We Are. Spring 2007.

Coase, Ronald H. 1937. “The Nature of the Firm.” In *The Nature of the Firm: Origins, Evolution, and Development*, ed. Oliver E. Williamson and Sidney G. Winter. New York: Oxford University Press.

Coase, Ronald, H. 1960. “The Problem of Social Cost.” *Journal of Law and Economics* 3 (Oct.): 1-44.

Dahlman, C.J. 1979. “The Problem of Externality.” *Journal of Law and Economics*, 22(1):141-162.

Deakin, Simon and Jonathan Michie. 1997. “The Theory and Practice of Contracting.” In *Contracts, Cooperation, and Competition. Studies in Economics, Management, and Law*, ed. Simon Deakin and Jonathan Michie. New York: Oxford University Press.

Environmental Defense. 2002. *What is Safe Harbor?* Available online at http://www.environmentaldefense.org/article.cfm?ContentID=156 (accessed on 9/25/06).

Kirzner, Israel. 1973. *Competition and Entrepreneurship*. Chicago: The University of Chicago Press.

Kirzner, Isreal. 1979. *Perception, opportunity, and profit: studies in the theory of entrepreneurship*. Chicago: The University of Chicago Press.

Menger, C. (1871, reprinted 1981), "The Theory of the Commodity" in *Principles of Economics*, New York University Press, New York: 236-256.

Mises, Ludwig. 1949. *Human Action: A Treatise on Economics*. New Haven: Yale University Press.

North, Douglass, C. 1990. *Institutions, institutional change and economic performance.* Cambridge: Cambridge University Press.

The Ministère de L'Agriculture, des Pêcheries et de l'Alimentation du Québec. 2005. Remuneration for EG&S produced by agriculture: elements for a Quebec analysis.

CHAPTER 6

SUMMARY AND CONCLUSIONS

This report investigated the value of ecological goods and services (EG&S) provided by private woodlots in riparian areas of the Canaan-Washademoak watershed region in New Brunswick to society, and the potential mechanisms that can be used to facilitate their delivery. There were four specific objectives associated with this research: (i) To examine private riparian-area forest owner characteristics, forest values, forest management activities, attitudes about environmental stewardship, and perspectives about the current state of the watershed; (ii) To quantify the opportunity costs of protecting private riparian-area forests in the watershed for water, wildlife, and aesthetic benefits in riparian buffers; (iii) To estimate society's willingness to pay for EG&S provided by private riparian-area forests in the watershed, and to estimate private forest owner's willingness to accept compensation for the provision of riparian buffers; and (iv) To assess the main impediments to market exchanges of private forest EG&S in the watershed.

A wide array of methods were used to achieve the above objectives, including extensive literature reviews, mail surveys of landowners, a woodlot owner focus group meeting, and wood supply modeling. In Chapter 2, the results of a public mail survey that was sent to a random sample of riparian area landowners in the watershed to investigate their social and ecological characteristics were discussed. A total of 595 surveys were mailed out, and a response rate of 53% was achieved. Survey statistics revealed that the riparian zone landowners consist of mostly seasonal residents (at 70%), who spend time in the region mainly in the summer months each year. The population is predominately older, retired or pre-retired males with both relatively high education and income levels, owning one parcel of property 1 acre in size. Although a large number have owned their property for a short time (10 years or less), they have been familiar with the region for much longer (30-50 years).

Landowners report multiple values for the region. They benefit from the aesthetics and the recreational opportunities provided by the area, and enjoy the abundant, diverse wildlife and the slow pace of life. The majority of riparian land owners indicate that do not know much about the quality of the water or fish populations in the watershed, however, they tended to believe that industrial forestry and agricultural operations are the largest threats to local water quality.

Landowners have high levels of self-reported land stewardship, indicating that they may under-estimate the negative consequences of their own activities. This possibility is emphasized by the fact that relatively few woodlot owners in the region (about 30% in a sample of 83 owners) have forest management plans. While many (54% of the sample) don't believe they need one, some (18% of the sample) never gave much thought to it in the past.

In Chapter 3, the opportunity costs of providing 30m and 60m riparian buffers for private forestland, agricultural land, and residential land within the Canaan River and Washademoak Lake sections of the watershed were estimated. For private forestland, a wood supply model (Spatial Woodstock) was developed with the objective of maximizing the net present value of stumpage (at a 5% discount rate) over an 80-year time horizon under different buffer scenarios and harvesting intensity constraints. The opportunity cost of 30m and 60m buffers on forestland in the Canaan River section were estimated at $3,991,467 and $7,636,902, respectively. These values were lower in the Washademoak Lake section at $2,815,863 and $5,310,818, respectively. The

estimates may be higher or lower depending on future harvesting intensities in the region and the use of different discount rates. Considering the forest land area in the region, per acre opportunity costs for 30m and 60m buffers were estimated at: (i) $678/acre and $675/acre on forestland in the Canaan River section, respectively; and (ii) $953/acre and $939/acre on forestland in the Washademoak Lake section, respectively.

For agricultural and residential land, the total opportunity costs of 30m and 60m buffers were calculated using estimates of per acre land values at $300/acre for agricultural land throughout the watershed, $1,723/acre for residential land in the Canaan River section, and $11,592/acre for residential land in the Washademoak Lake section. Applying these per acre estimates to the total acres under each land classification results in total opportunity cost estimates for 30m and 60m buffers of: (i) $432,900 and $855,900 on agricultural land in the Canaan River section, respectively; (ii) $169,800 and $357,300 on agricultural land in the Washademoak Lake section, respectively; (iii) $139,748 and $285,139 on residential land in the Canaan River section, respectively; and (iv) $1,967,431 and $3,865,352 on residential land in the Washademoak Lake section, respectively.

In Chapter 4, the results of two contingent valuation method mail surveys sent to the general public and riparian area landowners along the Canaan River and its main tributaries to estimate the perceived benefits and costs of riparian buffers were respectively presented. The results of the first mail survey provided estimates of the average and total willingness to pay of the general public for the benefits of having riparian buffers along the Canaan River and its main tributaries. This survey was sent to three random samples of households: (i) within the riparian area of the watershed; (ii) within the remainder of the watershed; and (iii) within the remainder of southern New Brunswick. A total of 1702 surveys were mailed out, and a response rate of just under 30% was achieved.

On average, members of the general public were each willing to pay: (i) $32.96 per year for a 30m riparian buffer on all woodlots; (ii) $39.02 per year for a 60m buffer on all woodlots; (iii) $47.64 per year for a 30m buffer on all woodlots, agricultural lands, & residential land; and (iv) $58.89 per year for a 60m buffer on all woodlots, agricultural lands, & residential land. The per person benefits for three specific EG&S (i.e., water quality, wildlife habitat, and forest scenery) flowing from riparian buffers were also valued. Average per person benefits ranged from $15.45-$27.21 per year for water quality, $12.68-$23.19 per year for wildlife habitat, and $4.23-$7.26 per year for forest scenery, depending on the size and scope of buffer protection.

Per acre benefits from EG&S in buffer areas were also calculated and ranged from $915.27-$1,431.37, depending on the scale and scope of buffer protection. Per acre benefits from specific EG&S ranged from: (i) $97.48-$185.94 for forest scenery; (ii) $347.19-$663.87 for water quality; and (iii) $308.98-$549.72 for wildlife habitat.

The second CVM survey questioned landowners within the riparian area of the Canaan River and tributaries about their willingness to accept compensation for the cost of providing, maintaining, and/or enhancing riparian buffers. This survey was sent to a random sample of 618 riparian landowners, and a response rate of 53% was achieved. On average, woodlot owners were willing to accept $530.25 per acre each year for a 30m buffer, while non-woodlot owners were willing to accept $2,615.38 per acre each year. In the case of a 60m buffer, woodlot owners and non-woodlot owners were willing to accept $1,030.79 and $2,860.23 per acre each year, respectively.

A benefit-cost analysis of riparian buffers along the Canaan River and its main tributaries revealed that 30m buffers on woodlots, agricultural, and residential land generally produce positive net

present values (i.e. landowner stated willingness to pay is greater than stated willingness to accept compensation), however the opposite is true for 60m buffers. It is interesting to note here that if the previously determined per acre opportunity costs (estimated in Chapter 3) were used in place of the stated willingness to accept compensation, a positive net benefit would occur for 60m buffers on woodlots.

In Chapter 5, the results of a mail survey sent to a random sample of landowners within and surrounding the Canaan-Washademoak watershed that investigated the impediments to market exchanges of EG&S in the watershed were presented. A total of 1,700 surveys were mailed out, and the response rate was 17%. Along with this survey, the results of a focus group meeting held with 14 landowners in the region to gather further information on opportunities that could solve the impediments to EG&S market exchanges were also presented. Results revealed that: (i) some EG&S exchanges have already taken place. Specifically, 4 landowners indicate that they have experience selling some combination of access for fishing, hunting, hiking trails, snowmobiling, bird/wildlife watching, camping, and forest viewing (aesthetics) on their land; (ii) a landowner's ability to sell EG&S in the watershed is positively correlated with knowledge of the community, joint production, 'club good' provision, and product differentiation; and (iii) the potential for EG&S exchanges in the watershed could be increased with institutional developments such as intermediaries to reduce transaction costs. Legal sanctions for trespassing and breached exchange agreements, and reduced policy restrictions for fishing and hunting may also be valuable for allowing market exchanges of EG&S.

The results of this research have important implications specifically for woodlot policies in the province of New Brunswick: (i) woodlot owners provide important EG&S to the public in the province, and increased efforts should be directed toward informing woodlot owners about the benefits of management planning; (ii) 30m riparian buffers around major watercourses provide a positive net benefit to society, and governments/individuals may want to consider incentives along with existing legislation to help support the creation, maintenance, and/or enhancement of these important areas; (iii) increases in riparian buffers up to 60m on woodlots may be supported in net benefit terms depending on the procedure used for estimating costs; and (iv) much potential exists for facilitating market exchanges of EG&S by reducing institutional impediments.