On-Site Experience Effect on Stakeholders’ Preferences of Forest Management

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Received: 16 August 2020; Accepted: 18 September 2020; Published: 23 September 2020

Abstract: An understanding of how public preferences vary among different stakeholders toward forest management policies would be helpful in the forest policy design and administration process. In this study, we investigate the preferences toward forest management policies of three stakeholder groups—woodlot owners, environmentalists, and the general public. We used a stated-preference survey to elicit information about stakeholder preferences for forest management practices at Holt Research Forest in Maine. The survey was administered to each group both before and after an on-site experience at the forest. We specifically investigated how information and experience acquired through the on-site experience would influence the preferences of each group. We also conducted a latent class analysis to further explore the preference heterogeneity among survey participants. The results show differences in preferences for forest management policies between stakeholders with the preferences of woodlot owners differing substantially from environmentalists and the general public both before and after the on-site experience. The on-site experience did not have a substantial impact on woodlot owners. In contrast, it increased the consistency of choice decisions among environmentalists and the public.

Keywords: on-site experience; forest management; stakeholders; choice experiment; latent class analysis

1. Introduction

The growing concern about the health of forest ecosystems is creating an increased demand for forest policies and management strategies to promote forest conservation and health. Over the years, forest professionals have proposed sustainable forest management practices designed to simultaneously provide consistent timber production and other important forest benefits [1]. These sustainable forest management practices are promoted as ways to maximize the production of high-quality timber, enhance wildlife diversity and abundance, and maintain forest aesthetics [2–4]. Policy makers often pursue legislation and other policy mechanisms to regulate timber harvesting and incentivize forest owners to undertake these sustainable forest management practices [5,6].

An understanding of public attitudes and values toward private forest land management policies would be helpful in the forest policy design and administration process. Woodlot owners and environmentalists are two prominent stakeholders that have clearly stated interests in forest management decisions and often actively influence the design of relevant policies [7]. The attitudes and values of these stakeholders should be jointly considered by policy makers [3,8,9]. However, as stakeholders have diverse opinions on forest values, their preferences may not align with each other nor represent the preferences of the general public [10,11].

The preferences of stakeholders toward forest management policies have been investigated fairly extensively [12–15]. The results have shown differences in preferences between interest groups [16,17].
For instance, Kumar and Kant [10] showed that foresters in Ontario, Canada had a stronger preference for the economic use of forests compared to aboriginal groups, environmental non-government organizations, and the Ministry of Natural Resources. Specialist forest users, such as cyclists and horse riders, have been found to be more bio-oriented and exhibit higher values for improvements in recreation facilities in forests than general users [18]. These differences in preferences between interest groups are shown to be larger in intensively managed forest regions compared to little managed areas [16]. Whitehead [19] conducted a contingent valuation mail survey and found that environmentalists are expected to value environmental goods more highly than the general population.

There have also been studies showing similar attitudes among different stakeholders to certain specific forest management attributes. For example, the results of several studies found that the attitudes of the general public were not significantly different from non-industrial private forestland owners for timber harvesting [12,20,21]. In another study, campers and the public were found to share common bio-centric attitudes toward forest values [14]. The values of open access rights and forest ownership have also been found to be broadly shared among different stakeholders [13].

Preferences toward forest management policies are influenced by many social and culture factors, such as age, gender, education, income, religion and ethnicity [10,21,22]. In addition, knowledge of forest management and forest use experience have also been shown to impact people’s opinion toward environmental resources management [23–25]. Research has shown that increased knowledge can raise the public’s acceptability of clear cutting [20]. Broussard et al. [26] provided a series of educational experiences to American urban youth and found that, as a result, the participants changed their attitudes about timber harvesting and agreed that it could be beneficial. However, in another study, McFarlane and Boxall [27] used the number of correct responses to forest-related facts as an index for knowledge, and found that knowledge did not influence campers’ and hunters’ attitudes about forest management. There could exist a cultural value for nontimber forest resources independent of knowledge of their management [28,29].

As stakeholders, woodlot owners and environmental activists are expected to be more familiar with the functioning of forest ecosystems and have stronger preferences regarding forest policy, relative to the general public [29,30]. They are also familiar with local policy issues and may have more practical experience regarding forest policy [31]. These differences of prior knowledge and experience between different stakeholder can create subcultures that lead to group-specific preferences related to forest management [11].

Even though the differences in prior knowledge or experience between stakeholders and the general public are recognized, there has been limited research which investigates whether acquiring tangible experience about forest management would influence perceptions toward forest ecosystems and management. It would be useful to know whether stakeholders, such as woodlot owners and environmentalists have similar perceptions and preferences with the general public if they shared similar experience. Our study was specifically designed to provide all respondents with a similar on-site experience of forest management. The objective was to allow participants to acquire information through a tangible experience rather than only through texts or photographs as was typical in previous research.

We randomly recruited study participants from three groups of individuals, an organization of small woodlot owners, an environmental group actively attempting to influence forest management policy, and the general public. Subjects completed a survey on forest management practices when they arrived at the site (pre-test), and also after their walks through the forest (post-test). We used a discrete choice experiment to elicit the preferences of participants about alternative forest management programs for both the pre-test and post-test surveys. Latent class analysis was also conducted, which allowed us to further explore the preference heterogeneity not only between respondent groups but also within each group.

Through this survey design, the study intends to: (1) compare the perceptions of different groups for forest ecosystem attributes based both on their prior knowledge and knowledge acquired after the
walk through the forest; (2) investigate preference heterogeneity among different groups for forest management policies; (3) investigate whether the onsite experience affected each group’s preferences for forest management policies. Providing an on-site walk experience allows us to evaluate such an experience, which could be a significant factor that influences different groups’ attitudes toward forest management policies.

2. Survey Design

The research reported here uses a stated-preference survey to elicit public preferences for a hypothetical forest management program that would provide an incentive, through property tax rebates, to owners of forestlands who agree to use low-impact timber harvesting practices and/or set a portion of their private forestland aside from timber harvesting. The on-site survey took place at Holt Research Forest, which is managed by the University of Maine. The forest has two sections: one half of the forest is managed via low impact timber harvesting (harvest section) and the other half is set aside from timber harvesting (no-harvest section). The trees in the research forest were mature with low impact harvesting being conducted over the past five years. Therefore, respondents’ visits to this forest could provide suitable information of the effects of low impact timber harvesting.

To test the logistics of the on-site survey and forest walk, the pre- and post-treatments were tested in two on-site focus groups at the Holt Research forest. One group consisted of Bowdoin college students, and a second group consisted of a random sample of the general public. Based on these tests, modifications to the survey were made.

2.1. Sample Recruitment

The recruitment of the on-site sample was conducted through phone calls. The sample of the small landowner group was drawn from the membership of Small Woodlot Owners of Maine (SWOM) or from landowners who had their land registered in the Maine’s Tree Growth program. Only those owning more than 10 acres of land were selected. The environmentalist sample was drawn from the membership of Maine Audubon’s Activist (MAA) group. MAA is a wildlife conservation organization which connects people to nature through conservation, education, and advocacy. Only those who did not also belong to the small landowner group were selected. The general public sample was drawn from Maine citizens via random digit telephone dialing. Again, only those that did not belong to the two groups above were selected.

The sample of forest landowners and the general public were chosen from communities within a one hour driving distance from the Holt Research Forest. Due to fewer potential subjects available, the environment activists were chosen from communities within a 1.5-h driving distance from the forest. In addition, subjects for the on-site survey were limited to individuals aged 65 or younger due to the potential rigor of the walk through the forest. Subjects were paid a USD 40 incentive to compensate for their travel time to the study site.

A total of 100 people participated in the study; 35 were owners of small forest holdings and members of SWOM, 34 were members of Maine Audubon, and 31 were from the general public. The on-site sample was limited due to the available budget, but mostly due to the logistics of on-site administration and the desire of the forest researchers that our experiment have minimal impact on the forest and on-going research.

2.2. Survey Administration

All three groups responded to the same survey instrument, but the survey was administered to each group on a different day over three weekends. The on-site subjects completed a pre-test administration of the survey when they arrived at the forest. They were then led by two graduate students on a 45-min walk through the forest.

The walks followed transect lines that divided the forest into research plots. It was necessary to have someone lead subjects through the forest so both groups would follow the same routes and not
walk across research plots. There were no visible signs of ongoing research that participants could observe during their walks through the forest. Transects were selected that avoided any flagging or other identification of research activities. The two graduate students that led the groups stopped at designated sites in the forest so that participants could observe forest conditions. There were also cards for participants to read, which described the characteristics of the forest and the effects of harvesting. Stops included a harvest opening in the harvest section, a natural clearing in the no-harvest section, a skidder path across an ephemeral stream in the harvest section, an uninterrupted ephemeral stream in the no-harvest section, wildlife habitat in the harvest section (slash—piles of brush and limbs left from harvesting), and wildlife habitat in the no-harvest section (snags—standing dead or dying trees).

Respondents assigned to conduct the walk were provided with sets of numbered cards with descriptions of forest attributes on each. The forest guide stopped at designated spots on the walk and instructed participants to read from the appropriate card and observe the forest around them. The cards identified key features in both the harvested and unharvested portions of the forest. The purpose of the cards was to convey information about features of the forest, while the stops gave people time to look around and rest. The total time spent on the walk was approximately 45 min. After the walk, all participants took the post-test survey, which was identical to the pre-test survey.

2.3. Stated-Preference Survey

The survey was designed and implemented following the guidelines outlined in Dillman [32]. The first section of the survey consisted of questions asking respondents about their interest in Maine forest issues. The second section of the survey contained a page of information about the amount of land that is forested in Maine, the amount of forestland owned by woodlot owners and a definition of healthy forest ecosystems. This was followed by opinion questions on forest ecosystems, timber harvesting, harvesting regulations, and the importance of services provided by forests.

The third section contained questions intended to determine respondent’s perceptions of attributes for alternative forest management practices (Figure 1). In the survey, we let the respondents compare the forest attributes in harvested and unharvested areas. The attributes included healthy trees, fertile soil, clear streams, and native species, which are generally the indicators for forest ecosystem health. Songbirds, small mammals, reptiles and amphibians were also included in the survey as they are species populations being monitored by researchers at the Holt Research Forest. We also added forest attributes of large mammals and game birds as previous research has shown that the public is most interested in these particular species [33].

The fourth section contained a discrete choice question comprising four dichotomous-choice, contingent-valuation options, each with randomly assigned forest policy attributes. This questionnaire was intended to measure how much individuals are willing to pay for a forest policy that changes forest management practices. The vehicle for payment was a referendum to give owners of small, private forests in Maine a property tax incentive to manage their forestlands for healthy forest ecosystems. This payment vehicle was thought to be the most acceptable means to obtain values and avoid protest responses. In the discrete choice experiment questionnaire, respondents were asked to vote on three alternative forestry referendums with each referendum being differentiated by program attributes (Figure 2). Respondents were informed about current conditions so that they would know what continuing forest management conditions would be if they voted “no”. The levels for each attribute are also listed in Table 1. There were three levels for the “percent of land open for timber harvesting”, 100%, 50% and 0%. The attribute of “Timber harvesting practices” was low-impact harvesting when any of the referendums allow timber harvesting (100% or 50%). The “cost” amounts were based on a prior stated-preference study of forest policy in Maine [34], including USD 1, 20, 40, 60, 80, 100, 120, 160, 180, 200, 400, 800, and 1600. Fractional factorial design was used to assign the attribute levels to each choice situation and there was at least one different attribute between each of the three alternative choice situations.
Figure 1. Perception of Forest Ecosystem Attributes Question as presented in the survey.

|                         | Much more in harvested area | Somewhat more in harvested area | About the same | Somewhat more in unharvested area | Much more in unharvested area | Don't Know |
|-------------------------|-----------------------------|---------------------------------|----------------|-----------------------------------|-------------------------------|------------|
| **TREES**               |                             |                                 |                |                                   |                               |            |
| A. Large, mature trees  | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| B. Small, young trees   | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| C. Softwood trees       | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| D. Hardwood trees       | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| E. Dead, standing trees | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| F. Healthy trees        | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| **WILDLIFE**            |                             |                                 |                |                                   |                               |            |
| G. Songbirds            | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| H. Game birds           | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| I. Birds of prey        | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| J. Large mammals        | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| K. Small mammals        | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| L. Rare animal species  | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| M. Reptiles and amphibians |                     |                                 |                |                                   |                               |            |
| **OTHER FOREST ATTRIBUTES** |                     |                                 |                |                                   |                               |            |
| N. Plants other than trees |                     |                                 |                |                                   |                               |            |
| O. Native plant species | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| P. Open areas           | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| Q. Clean, clear stream  | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| R. Fertile, rich soil   | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| S. Soil erosion         | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
| T. Rare plant species   | 1                           | 2                               | 3              | 4                                 | 5                             | 6          |
How would you vote?

| Referendum Options | Percent of Land Open for Timber Harvesting | Timber Harvesting Practices | Public Access | Percent of Property Tax Rebate to Landowners | Cost to Your Family Per Year (Circle YES or NO) |
|--------------------|------------------------------------------|------------------------------|---------------|---------------------------------------------|-----------------------------------------------|
| Current Condition in Maine | 100 | Forest Practices Act | Voluntary access | 0 | $0 |
| Referendum option 1 | | | | YES NO |
| Referendum option 2 | | | | YES NO |
| Referendum option 3 | | | | YES NO |

**Figure 2.** Stated-Preference Question as presented in the survey. “Percent of land available for timber harvesting” and “Timber harvesting practices” are perfectly co linear. If 50% or 100% of the land is available for timber harvesting in one of the referendums, then “timber harvesting practices” would be low-impact forest practices. In addition, the blank table cells would be filled with randomly assigned referendum attributes when the questionnaires were distributed to each respondent.

**Table 1.** Attributes and Levels.

| Attributes | Levels |
|------------|--------|
| Property tax rebate to participating landowners | 30% |
| Percentage of land available (set aside) for timber harvesting | 0% (All set aside) |
| Public Access to land of participating landowners | Voluntary Required |
| Cost per household | $1, $20, $40, $60, $80, $100, $120, $160, $180, $200, $400, $800, $1600 |

Now, we would like to know how you would vote on each of the referendum options if they were put on the Maine election ballot next year. Please tell us if you would vote YES to approve or NO to reject each option. You can vote YES for more than one option. (CIRCLE YES OR NO FOR EACH OPTION).

In the last section, the survey participants were asked to provide information regarding their socioeconomic background including respondents’ age, education, income, gender, landownership, and forest interest group affiliation.

3. Model Specifications

3.1. Comparison between Interest Groups

We first employed the t test, z test and Chi-square test to identify whether the groups of respondents have the same socioeconomic characteristics, including age, gender, household income, education levels, and voting participation.

To assess whether respondents perceived forest ecosystem attributes in the harvested and unharvested sections as different, the answers were recoded as follows: “About the same” was recoded as 0, “Much more in the harvested area” as −2, “Somewhat more in the harvested area” as −1, “Somewhat more in the unharvested area” as 1, and “Much more in the unharvested area” as 2. Mean scores of each attribute were tested to see if they were significantly different from 0, “About the same”. If the mean is significantly less than 0, then the respondents perceive attributes to be in the harvested...
area. If the mean is significantly greater than 0, then the respondents perceive attributes to be in the unharvested area (Respondents who answered “Don’t know” were not included in this analysis).

To assess whether the perception toward forest ecosystem attributes changed after the walk, the frequency distribution of responses to each forest ecosystem attribute (including response “Don’t know”) were compared between the pre-test and post-test survey for every group using a Chi-square test. When cell frequencies were less than 5, the Fisher’s exact test was employed. Moreover, we also employed the Chi-square test to check whether the perception of forest ecosystem attributes were the same across all groups of respondents, based on the frequency distribution of responses. This test was separately conducted for the pre-test and post-test survey.

3.2. Random Utility Model

The Random Utility Model was employed to analyze the answers to the stated preference question. Respondents were assumed to have a utility function \( U_i \), such that \( V_i \) is the observable component of utility and \( \varepsilon_i \) is the random error \([35,36]\):

\[
U_i = V_i(x) + \varepsilon_i
\]  

(1)

where \( x \) is a vector of attributes from the hypothetical forest management program. Assuming that the utility function is linear in parameters and \( \varepsilon \) has an iid extreme value distribution, we obtain the conditional logit model.

\[
\Delta U_i = \beta \Delta x_i + \Delta \varepsilon_i
\]  

(2)

The attribute variables (\( x \)) are defined in Table 2. The omitted levels for each of the attributes are “0% of land available for harvesting”, “30% property tax rebate to landowner”, and “voluntary access”. We employed the conditional logit model to estimate the preferences for all three interest groups separately in the pre-test survey and the post-test survey.

| Variables | Definitions |
|-----------|-------------|
| Bid       | Negative value of cost per household |
| Access    | 1 if public access is required and 0 otherwise |
| H50       | 1 if 50% of “land available for harvesting” and 0 otherwise |
| H100      | 1 if 100% of “land available for harvesting” and 0 otherwise |
| R70       | 1 if 70% “Property tax rebate to landowner” and 0 otherwise |
| R100      | 1 if 100% “Property tax rebate to landowner” and 0 otherwise |
| Asc       | 1 if the alternative represents referendum conditions and 0 if current condition |

3.3. Latent Class Model

To better understand heterogeneity in preferences, we used a latent class model where respondents were segregated into classes based on their preference and sociodemographic characteristics \([37,38]\). The latent class model can be represented as follows:

\[
Prob_{njt|k} = \sum_{k=1}^{K} \frac{e^{\alpha \gamma_{nit} \sum_{k=1}^{K} e^{\alpha \gamma_{nit}}} e^{\beta_k X_{nit} \sum_{k=1}^{K} e^{\beta_k X_{nit}}}}{\sum_{k=1}^{K} e^{\beta_k X_{nit} \sum_{k=1}^{K} e^{\beta_k X_{nit}}}}
\]  

(3)

where \( \alpha \) is vector of parameters and \( \gamma \) is a vector of sociodemographic variables that determine class membership. Equation (3) represents the probability of individual \( n \) choosing alternative \( j \) in choice situation \( t \) conditional on individual \( n \) belonging to class \( k \). Due to the limited sample size a latent class model with two class was estimated to facilitate convergence and minimize the risk of overfitting.

We conduct the preference estimations for both the pre-test survey and post-test survey.
4. Results

Summary statistics of respondents’ socioeconomic characteristics are reported in Table 3. The environmental activists and the public have the same gender distribution and mean age, while the woodlot owners have more males and are substantially older. The woodlot owners and the environmental activists have higher household income and education levels than the general public. Moreover, woodlot owners and environmental activists are more actively involved in voting for forest management policies than the general public. These differences in socioeconomic characteristics may also affect perception and attitudes toward forest management.

Table 3. Socioeconomic Characteristics of Respondents.

|                          | Woodlot Owner (W) | Environmental Activist (E) | General Public (G) | Test Statistics       |
|--------------------------|-------------------|----------------------------|--------------------|-----------------------|
| Gender                   |                   |                            |                    |                       |
| (male = 1)               | 79% (7)           | 34% (8)                    | 42% (9)            | W&E: $z = 3.62^{***}$ |
|                          |                   |                            |                    | W&G: $z = 3.02^{***}$ |
|                          |                   |                            |                    | E&G: $z = 0.62$       |
| Average Age              | 50 (2)            | 44 (2)                     | 42 (2)             | W&E: $t = 2.72^{***}$ |
|                          |                   |                            |                    | W&G: $t = 3.49^{***}$ |
|                          |                   |                            |                    | E&G: $t = 0.86$       |
| Average Household Income | USD 64,833 (5060) | USD 58,485 (4542)          | USD 43,448 (4459)  | W&E: $t = 0.93$       |
|                          |                   |                            |                    | W&G: $t = 3.17^{***}$ |
|                          |                   |                            |                    | E&G: $t = 2.36^{**}$  |
| Education                |                   |                            |                    |                       |
| High school graduate     | 0% (0)            | 0% (0)                     | 18% (18)           |                       |
| or equivalent            |                   |                            |                    | W&E: $x^2 = 2.37$     |
| Some college, A.S degree | 21% (9)           | 9% (9)                     | 29% (29)           | W&G: $x^2 = 11.63^{**}$|
| or technical school      | 33% (33)          | 30% (30)                   | 39% (39)           | E&G: $x^2 = 18.26^{***}$|
| B.A. degree or equivalent| 33% (33)          | 45% (45)                   | 7% (7)             |                       |
| M.A degree or equivalent | 12% (12)          | 15% (15)                   | 7% (7)             |                       |
| Advanced degree          |                   |                            |                    |                       |
| Voting Participation     | 94% (4)           | 97% (3)                    | 81% (7)            | W&E: $z = 0.56$       |
|                          |                   |                            |                    | W&G: $z = 1.61$       |
|                          |                   |                            |                    | E&G: $z = 2.05^{**}$  |
| Observations             | 35                | 34                         | 31                 |                       |

*** Denotes 1% level of significance and ** denotes 5% level of significance. Standard deviations are in parentheses.

W&E represents the comparison between woodlot owner group and environmental activist group while E&G represents the comparison between the environmental activist group and the general public group.

4.1. Comparisons of Responses for Perception of Forest Ecosystem Attributes

In the pre-test survey, all respondents ($n = 100$) answered the forest attribute questions. In the post-test survey, one woodlot owner did not answer most of these forest attribute questions. We excluded his response from the analysis in the post-test. Table 4 shows the mean scores of the questions about forest ecosystem attributes for both the pre-test and post-test survey by interest groups. It appears that participants believed that the unharvested area had more forest attributes that are indicative of forest ecosystem health, such as dead standing trees, and rare plant species. Research scientists at the Holt Research Forest collected scientific biological data in the harvested and unharvested areas for all forest ecosystem attributes except clear clean water and scenic beauty. A comparison of these perceptions with scientific data collected in the harvested and unharvested areas at the Holt Research Forest showed that, for only 4 out of 19 forest attributes, all groups’ perceptions were correct in both the pre-test and post-test survey (small and young trees, plants other than trees, open areas, and soil erosion). Most forest attributes that were perceived to be better in the unharvested area are actually approximately the same as in the harvested area according to scientific data. After the forest walk, the woodlot owner group changed the category of their perceptions for two attributes, while there were three changes for environmental activists and five for the general public. Before the walk, the group of woodlot owners had the greatest number of attributes consistent with the scientific data. However, after the walk, the general public had the greatest number of attributes perceived correct, according to scientific data.
Table 4. Mean Scores of Forest Ecosystem Attributes Questions for interest groups.

| Attributes              | Woodlot Owner | Environmental Activist | General Public | Woodlot Owner | Environmental Activist | General Public |
|-------------------------|---------------|------------------------|----------------|---------------|------------------------|----------------|
| Large, mature trees     | 0.69 *        | 1.03 *                 | 1.16 *         | 0.82 *        | 1.18 *                 | 1.13 *         |
| Small, young trees      | −1.43 *       | −1.44 *                | −1.13 *        | −1.62 *       | −1.12 *                | −1.23 *        |
| Softwood trees          | −0.06         | 0.41 *                 | −0.07          | −0.15         | 0.61 *                 | −0.10          |
| Hardwood trees          | −0.24         | −0.30                  | 0.41           | −0.09         | −0.41 *                | −0.13          |
| Dead, standing trees    | 1.74 *        | 1.67 *                 | 1.32 *         | 1.12 *        | 1.29 *                 | 0.94 *         |
| Healthy trees           | −1.40 *       | −0.52 *                | −0.73 *        | −1.06 *       | 0.03                   | −0.07          |
| Songbirds               | −0.70 *       | 0.12                   | 0.61 *         | −0.61 *       | 0.12                   | 0.26           |
| Game Birds              | −0.97 *       | 0.03                   | 0.62 *         | −0.94 *       | 0.50 *                 | 0.26           |
| Birds of prey           | 0.25          | 0.69 *                 | 0.59 *         | 0.30          | 0.50 *                 | 0.37           |
| Large mammals           | −0.94 *       | 0.12                   | 0.79 *         | −0.76 *       | 0.31                   | 0.60 *         |
| Small mammals           | −0.88 *       | 0.38 *                 | 0.27           | −0.44 *       | 0.41 *                 | −0.07          |
| Reptiles and amphibians | 0.57 *        | 1.48 *                 | 1.31 *         | 0.37 *        | 0.90 *                 | 0.17           |
| Native plant species    | 0.06          | 0.82 *                 | 1.07 *         | 0.09          | 0.94 *                 | 0.79 *         |
| Open areas              | −1.29 *       | −1.35 *                | −1.48 *        | −1.15 *       | −1.03 *                | −0.68 *        |
| Rare plant species      | 0.96 *        | 1.33 *                 | 1.41 *         | 1.08 *        | 1.42 *                 | 1.33 *         |
| Clean, clear stream     | 0.34 *        | 0.82 *                 | 0.97 *         | 0.53 *        | 0.91 *                 | 0.86 *         |
| Fertile, rich soil      | 0.09          | 0.62 *                 | 0.52 *         | 0.39 *        | 0.58 *                 | 0.55 *         |
| Soil erosion            | −0.71 *       | −1.03 *                | −1.20 *        | −0.79 *       | −1.26 *                | −0.71 *        |
| Scenic beauty           | 0.19          | 1.03 *                 | 0.80 *         | 0.78 *        | 0.97 *                 | 0.77 *         |

Pre-test survey n = 100, woodlot owners n = 35, environmental activists n = 34, general public n = 31; Post-test survey n = 99, woodlot owners n = 34, environmental activists n = 34, general public n = 31; * Represents significance at 10% level based on t test statistics.

The comparison of results for perception of forest ecosystem attributes between pre-test and post-test survey is summarized in Table 5. Chi-square test statistics are listed in the table. The group of woodlot owners only had one attribute that changed after the walk. Environmental activists changed their responses for five forest attribute questions, which were mostly related with the growth of trees in the forest. At the same time, the general public had three questions of ecosystem attributes changed after the walk.

The Chi-square Test statistics results for perception of forest ecosystem attributes between interest groups are summarized in Table 6. In the pre-test survey, a total of 11 forest ecosystem attributes were found to have significant differences among groups. In the post-test survey, there were significant differences in responses among groups occurred for 12 attributes. There exist nine forest attributes that are not the same among interest groups for both the pre-test and post-test survey, while there exist seven forest attributes that are same for both the pre-test and post-test survey. There were three attributes that were the same for the pre-test but not for the post-test survey. There were two attributes that were the same in the post-test but not for the pre-test survey. Most of the different responses among the groups are from the questions in the trees and wildlife sections.
Table 5. Chi-square Test statistics of Comparisons between Pre-test and Post-test Survey by Interest Groups for Forest Ecosystem Attributes.

| Attributes                  | Woodlot Owner | Environmental Activist | General Public |
|-----------------------------|---------------|------------------------|----------------|
| Large, mature trees        | 3.55          | 9.97 *                 | 6.62           |
| Small, young trees         | 1.34          | 8.46 *                 | 2.88           |
| Softwood trees             | 2.89          | 14.79 *                | 5.04           |
| Hardwood trees             | 5.35          | 10.21 *                | 5.67           |
| Dead, standing trees       | 22.68 *       | 5.18                   | 22.68 *        |
| Healthy trees              | 5.34          | 10.44 *                | 8.51           |
| Songbirds                  | 3.74          | 4.30                   | 8.51           |
| Game Birds                 | 5.91          | 6.29                   | 4.03           |
| Birds of prey              | 3.18          | 1.97                   | 6.50           |
| Large mammals              | 4.27          | 7.71                   | 1.27           |
| Small mammals              | 5.43          | 1.82                   | 6.99           |
| Reptiles and amphibians    | 3.70          | 0.38                   | 4.00           |
| Native plant species       | 1.75          | 2.91                   | 3.22           |
| Open areas                 | 3.33          | 7.09 *                 | 12.06 *        |
| Rare plant species         | 1.26          | 1.07                   | 4.39           |
| Clean, clear stream        | 4.42          | 0.70                   | 3.78           |
| Fertile, rich soil         | 5.34          | 3.93                   | 1.33           |
| Soil erosion               | 1.35          | 6.26                   | 4.39           |
| Scenic beauty              | 6.32          | 3.15                   | 4.30           |

* Represents significant at 10% level.

Table 6. Chi-square statistics of Comparisons between the Interest Groups before and after the Walk for Forest Ecosystem Attributes.

| Attributes                  | Pre-Test | Post-Test |
|-----------------------------|----------|-----------|
| Large, mature trees        | 21.21 *  | 17.19 *   |
| Small, young trees         | 11.58    | 13.15 *   |
| Softwood trees             | 17.14 *  | 16.21 *   |
| Hardwood trees             | 10.05    | 12.40     |
| Dead, standing trees       | 8.77     | 17.33 *   |
| Healthy trees              | 20.24 *  | 36.30 *   |
| Songbirds                  | 26.65 *  | 17.47 *   |
| Game Birds                 | 30.58 *  | 36.16 *   |
| Birds of prey              | 15.96    | 8.63      |
| Large mammals              | 31.22 *  | 27.97 *   |
| Small mammals              | 23.51 *  | 20.78 *   |
| Reptiles and amphibians    | 19.45 *  | 17.18 *   |
| Rare animals               | 25.21 *  | 20.16 *   |
| Plants other than trees    | 5.68     | 2.89      |
| Native plant species       | 23.75 *  | 12.07     |
| Rare plant species         | 11.52    | 9.25      |
| Open areas                 | 8.99     | 10.25     |
| Clean, clear stream        | 11.20    | 20.26 *   |
| Fertile, rich soil         | 10.03    | 2.21      |
| Soil erosion               | 9.10     | 12.62     |
| Scenic beauty              | 16.16 *  | 10.87     |

Pre-test survey $n = 100$, woodlot owners $n = 35$, environmental activists $n = 34$, general public $n = 31$; Post-test survey $n = 99$, woodlot owners $n = 34$, environmental activists $n = 34$, general public $n = 31$; * Represents significance at 10% level.

4.2. Preference Estimates for the Stated Preference Questions

In Table 7, we summarize patterns of responses to the hypothetical forestry program referendum questions for the on-site pre-test and post-test survey administrations. For the general public, 9 of 30 respondents changed their votes from “Yes” to “No” or from “No” to “Yes” in at least one forestry
program referendum question after their walk through the forest, while 10 of 91 questions got a different vote answer. For the woodlot owners, 9 of 31 respondents changed their votes for the forestry program referendum question after their walk through the forest, while 11 of 93 questions got a different vote answer. For the environmental activists, 11 of 34 respondents changed their votes after their walk, while 12 of 102 questions got a different vote answer. These patterns of responses suggest that the walk through the forest influenced responses of some survey participants, about a third changed responses to at least one question, but the acquired information from the walk did not have a dramatic effect that changed responses to most of the stated-preference questions. This pattern is the same for all three groups of respondents, even though they share different prior knowledge and experience of the forest.

Table 7. Changes in Votes for Forest Management Referenda between Pre-test Survey and Post-test Survey.

|                       | Number of Questions | Number of People | Total Number of Questions | Total Number of Respondents |
|-----------------------|---------------------|------------------|---------------------------|-----------------------------|
| Woodlot Owner         | 11 (12%)            | 9 (29%)          | 93                        | 31                          |
| Environmental Activist| 12 (12%)            | 11 (32%)         | 102                       | 34                          |
| General Public        | 10 (11%)            | 9 (30%)          | 91                        | 30                          |

Note: the numbers in the bracket represent the percentages of all the questions or respondents.

Results of the latent class model are presented in Table 8. Class 2 was set as the base for interpretation of the coefficients of the sociodemographic variables used to determine class membership. A model using all socioeconomic variables to determine class membership, including age, gender, income, education and interest group, was run. In this model only the variable woodlot owner showed significance at the 10% level in both the pre-test and post-test surveys. The final model thus only used the variable woodlot owner along with choice experiment responses to generate the classes.

Results from the latent class model confirm that there is preference heterogeneity among the survey respondents. As can be seen in Figure 3, the model placed 50% of the respondents in the pre-test into class 1. After acquiring information from the onsite walk, class 1 has 31% of the respondents, while class 2 contains 69%. In the pre-test survey, 64.71% of environmentalists and 61.29% of the general public belong to Class 2, while 74.29% of the woodlot owners belong to Class 1. In the post-test survey, the proportion of woodlot owners that belong to Class 1 is similar with the pre-test survey. However, about 30% of the environmentalists and the general public change from Class 1 to Class 2. Most respondents in these two groups are in Class 2 in the post-test survey.

Figure 3. The proportion of interest groups belong to different classes based on latent class model estimation in both the pre-test and post-test survey.
Table 8. Preference Parameter Estimates for Stated Preference Questions in the Pre-test Survey and Post-test Survey.

|                        | Pre-Test Survey | Post-Test Survey |
|------------------------|-----------------|------------------|
|                        | Class 1         | Class 2          |
| Asc                    | −1.354 * (0.770) | 4.733 *** (1.676) |
|                        | −0.383 (1.315)   | 0.638 (0.536)    |
| Bid                    | 0.0003 (0.0005)  | −0.011 *** (0.003) |
|                        | 0.0006 (0.0008)  | −0.005 *** (0.001) |
| Access                 | −2.194 *** (0.532) | 0.644 (0.857)    |
|                        | −3.467 ** (1.340) | −0.167 (0.396)   |
| H50                    | 0.414 (0.532)    | 8.009 *** (2.466) |
|                        | 2.081 * (1.253)  | 2.624 *** (0.567) |
| H100                   | −0.419 (0.690)   | 4.671 *** (1.683) |
|                        | 3.962 *** (1.520) | 0.623 (0.439)    |
| R70                    | 2.791 *** (0.759) | −4.585 *** (1.683) |
|                        | 2.573 ** (1.254) | −0.063 (0.524)   |
| R100                   | 1.230 * (0.639)  | −3.248 ** (1.537) |
|                        | 2.242 (1.428)    | 0.320 (0.518)    |
| Woodlot Owner          | 1.291 * (0.737)  | 3.521 *** (1.036) |
| Environmentalist       | −0.313 (0.640)   | −0.968 (1.260)   |
| constant               | −0.050 (0.506)   | −1.849 ** (0.868) |
| Class Share            | 50%              | 31%              |
| Log-likelihood         | −153.632         | −134.897         |
| N                      | 588              | 576              |

Note: *** denotes 1% level of significance, ** denotes 5% level of significance, * denotes 10% level of significance. Standard deviations in parentheses.

In the pre-test, the Alternative Specific Constant coefficient was significant for both class 1 and class 2. In class 1 it had a negative coefficient, indicating that respondents in this class generally preferred the status quo or current forest management practices. Class 2 had positive coefficient, indicating that respondents in this class generally preferred alternative forest management practices relative to the status quo. The preferences of Class 1 are significantly influenced by the choice attributes of public access and 70% of tax rebate at 5% level. Requiring public access to private land reduces the probability of choosing an alternative and 70% of tax rebate to woodlot owners increases the probability of an affirmative vote. The preferences of Class 2 are significantly influenced by all of the choice attributes except public access. Regarding cost to households, 70% and 100% tax rebate to woodlot owners have significant negative effects on their choice decision. Both 50% and 100% land open to harvesting increases the probability of an affirmative vote. Comparing Class 1 with Class 2, the preferences of choice attributes show large differences.

In the post-test, choice was neither significant in Class 1 or Class 2. The preferences of Class 1, mainly woodlot owners, are still significantly influenced by the choice attributes of public access and 70% of tax rebate at 5% level. In addition, Class 1 also strongly preferred 100% of land open to harvesting. For Class 2 (most of the environmentalists, most of the public and some woodlot owners), only cost to households and allowing 50% of the land open to harvesting showed significant effects on choice decisions. Respondents in this class did not think that leaving 100% of land open to harvesting is beneficial.
5. Discussion and Conclusions

The results of this study indicate that there exist substantial differences in forest attribute perceptions between interest groups both before and after the walk. Woodlot owners were more likely to believe that healthy forest attributes were greater in the harvested area or about the same in both areas, while the environmental activists and the public were more likely to believe they were greater in the unharvested area. Additionally, the results show that environmental activists and the general public were more likely to change responses to forest ecosystem attribute questions after the walk in the forest, while the perceptions of woodlot owners were quite stable.

In general, a comparison of the scientific data collected at the Holt Research forest suggests that the woodlot owners’ perceptions were more accurate than the other groups in the pre-test survey. This may be because woodlot owners may have greater experience and knowledge of small woodlots. After walking through the forest, the general public was more likely to perceive forest attributes “about the same” in both areas. This implies the public can make more scientifically reliable decisions when they get more experience and knowledge. However, environmental activists exhibited less change in their preferences after the walk. This result may be because this group had stronger pre-existing opinions regarding forest management or that the walk through the forest did not give participants enough knowledge, especially for the attributes not easily observable during the walk, such as rare animal species or game birds.

This divergence in perceptions may account for the differences in preferences for polices that promote alternative harvesting practices. As the woodlot owners did not perceive harmful impacts from harvesting on the forest attributes, a majority of them preferred the forest management practices with 100% harvesting after the onsite walk. Nearly all environmental activists and the general public preferred the alternative harvesting practices and were willing to pay for their implementation. These results are similar to a previous study by Kumar and Kant [10] which showed foresters emphasized the economic use of forests while the environmental activists were more bio-oriented. In addition, it is important to note that there still exists preference heterogeneity within woodlot owners even after the onsite walk. This result is not surprising as woodlot owners hold their lands for a diversity of reasons, not just for forest harvesting [39]. After acquiring information about forest ecosystem services, the preferences of environmentalists and the general public turn out to be more consistent intra-group, even though their preferences are still different from woodlot owners for forest management practices.

These results also suggest that, in Maine, the public is capable of voting logically on complex forestry referendums and that information regarding the impact of forest management practices may influence their preferences. In addition, the results suggest that, overall, the general public in Maine supports sustainable forest management policies that both allow harvesting and set some land aside from harvesting. This change in forest policy could be brought about by encouraging family forest owners in Maine to participate in stewardship-type programs [40]. The results here indicate that providing subsidies to small woodlot owners, such as tax rebates, would incentivize them to set land aside from harvesting. Restricting open access to the private forest land may also encourage landowners to enroll in the forest management programs, which is consistent with the finding by Rantala and Primmer [13]. From a policy perspective, these results indicate that providing incentives to private landowners consistent with their preferences could be an effective way to increase sustainable forest management.

There exist several limitations with this research. The sample sizes are small due to the logistics of administering the study on-site at the experimental forest. Future research should include larger on-site samples as budgets and study site conditions permit. Individuals may also be self-selected based on the fact that they agreed to participate in the study. Individuals who participated may have more of an interest in forest issues than others who did not agree; however, the USD 40 incentive may have brought some participants on-site who would not normally have come. However, another study using an overlapping sample of the general public compared respondents that did a forest walk with
those that did not and responded via a mail survey [41] showed that stated preferences for timber harvesting attributes are not statistically different between the mail survey and on-site applications of the survey.

It is also important to note that the biological data used in this study are specific for the Holt Research Forest and may vary by forest type and geographical location. For instance, the harvesting at the Holt Research Forest was not recent or intensive. This could be the reason that the forest walk had little effect on perceptions and values about the impact of harvesting. Additionally, the woodlot owners in this study are members from Small Woodlot Owners of Maine (SWOM) who actively engage in forest management. However, private forest landowners own their wooded lands for a diversity of reasons, and many landowners do not actively engage in forest management [42].

**Author Contributions:** Conceptualization, X.L. and G.A.S.; methodology, X.L. and G.A.S.; formal analysis, X.L. and G.A.S.; writing—original draft preparation, X.L.; writing—review and editing, X.L. and G.A.S. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by USDA Forest Service.

**Acknowledgments:** Thank you for Kevin Boyle, Genevieve Pullis LaRouche and Tom Holmes who helped to design the survey and collect research data.

**Conflicts of Interest:** The authors declare no conflict of interest.

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