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# Understanding Ecosystem Service Preferences across Residential Classifications near Mt. Baker Snoqualmie National Forest, Washington (USA)

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**Abstract:** Ecosystem services consistently group together both spatially and cognitively into "bundles". Understanding socio-economic predictors of these bundles is essential to informing a management approach that emphasizes equitable distribution of ecosystem services. We received 1796 completed surveys from stakeholders of the Mt. Baker-Snoqualmie National Forest (WA, USA) using both in-person workshops and an online platform. Survey respondents rated the importance of 26 ecosystem services. Subsequent analysis revealed six distinct preference bundles of these services: environmental quality, utilitarian values, heritage values, two types of recreational values, and access and roads. Results suggest that the conceptualizations of these bundles are consistent across socio-demographic groups. Resource agencies that seek to frame dialogue around critical values may want to consider these broadly representative bundle sets as a meaningful organizing framework that would resonate with diverse constituents.

**Keywords:** ecosystem services; forest management; values; preferences; urban; rural

## 1. Introduction

### 1.1. Forest Management and Ecosystem Services

The ecosystem services (ES) framework has increasingly been adopted for managing natural resources on state lands, such as national parks, forests, reserves, or refuges. As conceptualized in the Millennium Ecosystem Assessment (MA), ES provide a classification system for forest managers to consider a breadth of ecosystem benefits as well as a framework for discussing tradeoffs among benefits [1]. As such, ES can serve as a useful tool to help forest managers define and evaluate progress toward both social and ecological objectives [2,3].

The U.S. Forest Service (USFS) is responsible for overseeing 154 national forests and 20 national grasslands throughout the United States and its territories [4]. Although originally established as forest reserves to supply timber in support of US military efforts and national emergency needs, the Multiple Use-Sustained Yield Act of 1960 (Public Law 86-517) established that national forests be managed based on the principle of 'multiple use', which initially acknowledged five major uses: timber, water, range, recreation, and fish and wildlife habitat, [5]. In practicality, the five uses were expanded to include many more, such as minerals, air quality, wilderness quality, biodiversity, and heritage, among others. Through the act, forest managers are encouraged to consider a full suite of uses and balance local and national priorities and conditions while establishing target outputs [6,7].

An increased understanding of new threats to forest ecosystems, such as wildfire, insect infestations, population growth, and a warming climate have led the agency to explore new models to consider an increasingly diverse range of benefits [8]. The 2012 Forest Service Planning Rule added the ES concept to its guiding principles at the national level. In so doing, forest planners were tasked with utilizing ES in planning and assessment efforts to help the agency restore and enhance ecosystem health while acknowledging the diverse benefits that public lands offer [9]. As a result, some national forests have used ES as a framework for involving stakeholders and communities in identifying services of particular importance [10,11] and others have added a spatial component to the discussion by mapping ES within management areas [12].

At its core, the Forest Service Planning Rule addresses the concepts of social and environmental justice in natural resource access [9]. The rule stipulates that planning efforts be designed to engage groups and communities that have been under-represented, including youth, low-income, and minority communities. The rule also requires planning teams to consider a balance of local and non-local interests and to adopt an all-inclusive approach to outreach. Forest officials often use tools such as stakeholder analyses and situation assessments to identify the variety of stakeholders and constituents that should be engaged in the planning process. A range of recruitment strategies are then used to bolster participation, particularly for traditionally under-served groups. These expanded efforts to recognize and embrace multiple perspectives have sometimes led to the emergence of community-based collaboratives, which incorporate multiple interests and beneficiaries. The USFS's willingness to work with the collaborative process is an additional model for integrating the diversity of beneficiaries and their interests in forest planning.

### 1.2. Ecosystem Service Bundles

The way that ES consistently group together has been described as "bundling". This term, however, has often conflated whether services are bundled on the supply side or the demand side (e.g., [13]), although some have acknowledged the two types of bundles (e.g., [14]). Most studies are spatial analyses of ES supply, identifying which service or categories of services (such as cultural, provisioning, or supporting services) appear consistently together in space (e.g., [3,15–18]). The other way that services can be bundled is cognitively, according to the preferences, or demand, of beneficiaries (e.g., [14,19,20]). Analyses of these types of ecosystem service bundles specifically look at whether there are common preferences among human populations for groups of ecosystem services. We will call these preference bundles. Unlike the spatially-oriented bundles, preference bundles identify whether stakeholder groups give priority to specific combinations of ecosystem services. The existence of these preference bundles may be due to socio-demographic characteristics, although this research is still nascent. Understanding these linkages is critical to inform the USFS strategies aimed at ensuring multiple use and environmental justice.

### 1.3. Linking Ecosystem Services to Values and Residential Classification

Recent research in ecosystem services has identified that preferences for different services are based on individually-held values [20,21]. This begs the question of whether prior research on the determinants of environmental values is relevant to understanding ES preferences. For example, environmental values and attitudes toward natural resource management may vary across demographic groups, especially between rural and urban populations [22–25]. Social forestry research has found that residents of timber-dependent (often rural) communities tend to be more supportive of policies that favor resource extraction and instrumental (provisional) values, and less likely to be concerned with intrinsic values or ecological (regulating and supporting) values. Residents of communities not dependent on natural resource commodities (often urban or rural amenity destinations) tend to favor resource protection [26–30]. Rural communities that are forest-dependent are more likely to support policies favoring resource production than rural communities that are far from public lands where resource production takes place (i.e., logging, mining, grazing) [25]. Although

environmental values, concerns and behaviors are related to residential classification (urban, suburban, rural), research on ES preferences by residential classification remains unexplored.

Moreover, research has revealed the social complexity existing along the urban-to rural gradient [31]. In previous studies, environmental values and perceptions of suburban and exurban (those living on the fringes of the metropolitan area) residents are rarely different from urban residents; this suggests that more information is needed to differentiate among residential types. For natural resource managers, understanding the link between diverse types of residential classifications and ES preferences is a critical component to managing for equitable distribution of ecosystem services. As discussed in the book 'Getting to Yes', knowing people's interests is more important than understanding people's positions if we want to resolve any type of conflict [32]. Considering that the overwhelming evidence suggests that competing ES (e.g., aesthetic and economic services based on extraction) occur in the same place on the landscape, understanding the cognitive bundling of preferences across diverse stakeholders can facilitate a more socially-just trade-off assessment for managing ES.

This paper explores the preference bundles for diverse stakeholders near a U.S. national forest and whether socio-demographic variables predict these trends. Specifically, considering the current climate between rural and urban communities in the U.S., we wanted to test whether residential classification correlated with preference bundles. Our research questions were:

(1) What are the primary bundles of ES preferences for residents and stakeholders (or constituents/beneficiaries) of an urban-proximate national forest?
(2) Does residential classification predict preferences for these ES services bundles?

## 2. Materials and Methods

### 2.1. Study Area

This study took place in Northwest Washington (USA) on the western slope of the Cascade Mountain Range (Figure 1). The study was part of a public engagement effort for sustainable roads planning on the Mt. Baker-Snoqualmie National Forest (MBSNF), which encompasses 1.7 million acres (2694 square miles) across five counties and extends from the Canadian border to Mt. Rainier National Park 145 miles south. The eastern border touches the Cascade crest. The MBSNF is within 70 miles of 3.6 million people in the greater Seattle metropolitan area. The urban proximity to natural attractions (glacier lakes, alpine peaks, old growth forest, and alpine ski venues) makes the MBSNF one of the most frequently visited national forests in the United States, with about 1.6 million annual visitors [33]. The socio-economic fabric of the region is also comprised of rural communities with a long history of reliance on resource industries and 11 recognized Native American tribes whose members rely on the salmon runs and access the forest for food and cultural materials. The MBSNF also includes many culturally significant sites for tribes.

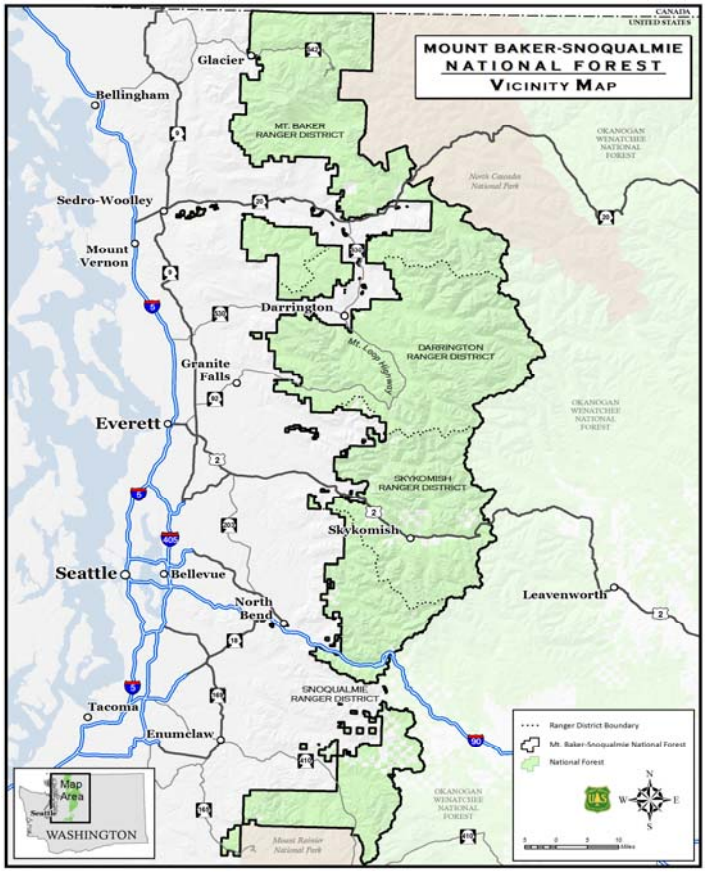


**Figure 1.** Location of Mt. Baker Snoqualmie National Forest in WA, USA.

### 2.2. Methodological Approach

The USDA Forest Service follows the Federal Policy for the Protection of Human Subjects ('Common Rule') and these protocols were followed as required by the U.S. government. The U.S. Forest Service organized the public engagement effort in cooperation with a stakeholder coalition known as the Sustainable Roads Cadre [34,35]. Member organizations of the Sustainable Roads Cadre included conservation groups; specialized recreation user groups, such as hiking, equestrian, and motorized vehicle users; outdoor entrepreneurs; and forest industry representatives, among others. Two concurrent public engagement approaches were conducted to promote dialogue and gather public input on the forest road system. The first approach included a series of public meetings held in urban and rural communities adjacent to the national forest in 2013. The intent of community meetings was to engage local stakeholders in dialogue and to build trust while gathering information about public use of forest roads. The second approach was an online survey designed to mirror the community meeting protocol. The survey allowed for non-local participation as well as participation by those who could not attend the workshops. The online survey was active for six months in 2013.

#### 2.2.1. Community Meetings

Meeting participants were recruited by the U.S. Forest Service and the Sustainable Roads Cadre, as well as by press releases on media outlets in the area. Cadre members actively recruited participants from within their ranks to attend the workshops or participate online. In addition, the meetings attracted unaffiliated citizens, particularly in the rural meetings. Eight public meetings were held in both urban and rural communities, resulting in 285 participants. The number of participants ranged from 22 to 52 per meeting (average: 31). The public meetings were organized around three activities: (1) a participatory mapping exercise; (2) a brief paper survey and (3) a facilitated discussion about

the national forest road system and the implications of potential changes in that system. The survey included questions about demographics, forest visitation patterns, resource uses, and a Likert-type scale exercise eliciting perceptions of forest benefits. Respondents rated how they valued 26 ES provided by the MBSNF (Appendix A) on a 5-point Likert-type scale, with answer choices ranging from 1 "not important" to 5 "extremely important". Substantial qualitative research in the region and across the country has identified the most common ES for forest areas (e.g., [18,36–38]). Many of these projects, however, have found that respondents identify fewer ES when elicited via an open-ended question as opposed to a pre-defined list. Since the goal of this study was to identify common groupings of ES across a large population, we chose the categorical response to prevent the biases associated with coding and the potential for incomplete responses associated with open-ended response options.

#### 2.2.2. Online Questionnaire

The Sustainable Roads Cadre worked with a team of agency scientists and Portland State University researchers to develop the online survey hosted by a cadre core member organization. The online survey was designed to engage people who could not attend a community meeting, as well as non-local stakeholders. There were 1548 respondents to the questionnaire (1776 initially logged on). The questionnaire could be accessed from an IP address multiple times; we estimate 90 instances of this occurring, but since the respondents may have been different individuals using the same computer, we treated them as distinct cases. In this iteration, respondents rated how they valued 26 ecosystem services provided by the MBSNF on a 3-point Likert-type scale, with answer choices ranging from 1 "not important" to 3 "extremely important". To combine workshop data to the online questionnaire, workshop responses were recoded into a 3-point scale with responses of 1 & 2 becoming a 1 ("not important"); 3 becoming 2; and 4 & 5 becoming a 3 ("extremely important").

In addition, both workshop and online respondents were asked to provide their zip code, income range, education level, birth year, race/ethnicity, sex, and frequency of visiting the forest.

### 2.3. Analysis

To prepare the demographic data, we coded the open-ended race responses using U.S. Census Bureau/Office of Management and Budget guidelines [39]. Zip codes were coded into three categories based on proximity to MBSNF: within 25 miles of the MBS was coded as "close"; farther than 25 miles but still within Washington state was coded as "far"; and outside of Washington state was coded as "very far". Similarly, each zip code was coded as "urban", "suburban", or "rural", as classified by the Washington State Department of Health's Rural-Urban Commuting Area system [40]. This system classifies urban areas as "contiguous built-up areas of 50,000 people or more", suburban areas as "areas, often in metropolitan counties, with primary high commuting flows of 30–49% of the population to urban cores", and rural areas as "towns with populations <10,000 and surrounding commuter areas with more than a one-hour driving distance to the closest city".

Significant difference among individual ES preferences were tested across residential classification using one-way ANOVA. To investigate the presence of ecosystem service bundles, we conducted a principal components factor analysis (PCA) on all ecosystem service responses using IBM SPSS 20. PCA is a commonly use statistically tool to determine trends in data responses across respondents, maximizing the amount of variance explained [41,42]. We used Varimax rotation and included all items with minimum factor loadings of 0.5. Internal consistency of each ecosystem service bundle was then tested using Cronbach's alpha. Respondents' loading on the resulting six factors were entered into a regression model using the demographic variables (sex, age, ethnicity, education level, and income), number of years lived in Washington, frequency of visiting MBSNF, proximity to MBSNF, and rural-urban classification as independent variables. For each factor, we selected the model that was most parsimonious while also retaining the highest $R^2$ value.

## 3. Results

### *3.1. Demographics and Frequencies*

Respondents largely lived in urban areas (71.5%), with 22% living in suburban areas and 6.6% living in rural areas. The majority (71.5%) of respondents were male. The median respondent age was 55 years old, and 87.6% of respondents were white. Our respondents were highly educated; 67.8% had completed at least a 4-year degree. Nearly two-thirds (62.4%) of respondents made between $50,000 and $149,999 per year.

The ecosystem services most frequently rated as "extremely important" by all residential classifications were water quality, wildlife habitat, clean air, water quality and human-driven recreation. Over 80% of all respondents selected this ES as extremely important in the MBSNF. Conversely, the ecosystem services most frequently rated as "not important" for all respondents were providing minerals, oil, and fossil fuels; rangeland for grazing; food, wood, fuel, material for household use; and non-timber forest products. Fewer than 60% of all respondents rated these ES as very important (Figure 2).

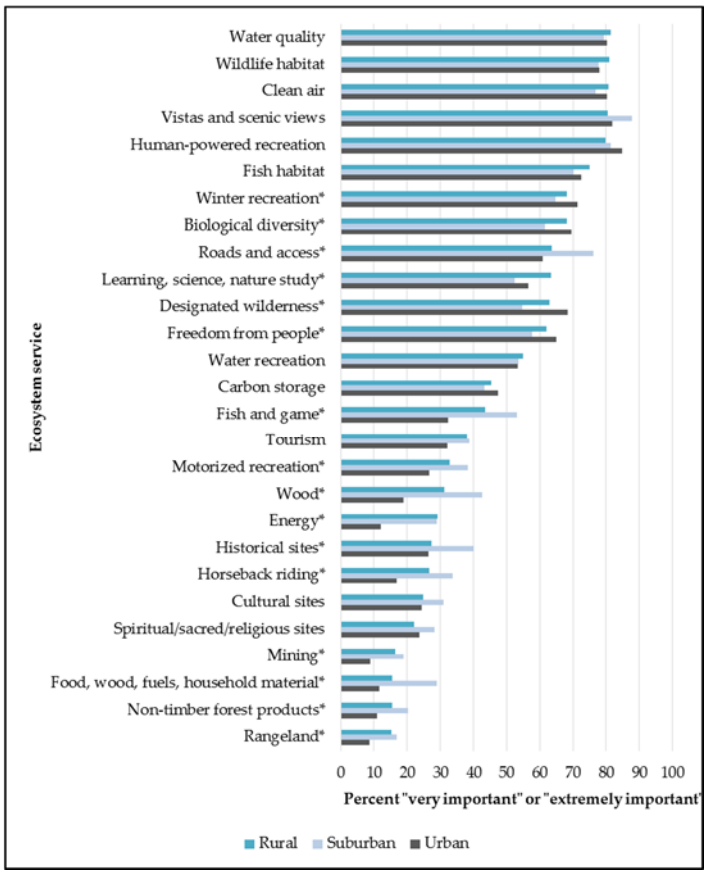


**Figure 2.** Distribution of respondents rating each ecosystem service as very or extremely important by residency classification. Asterisks indicate that means differ at the $\alpha = 0.05$ level based on one-way ANOVA results.

Sixteen of these services were rated significantly differently by participants from different residence classification. These included wood ($F(2, 1660) = 36.59$, $p < 0.01$), mining ($F(2, 1633) = 13.83$, $p < 0.01$), energy, ($F(2, 1636) = 30.24$, $p < 0.01$), rangeland ($F(2, 1624) = 8.76$, $p < 0.01$), non-timber forest products ($F(2, 1627) = 11.38$, $p < 0.01$), motorized recreation ($F(2, 1644) = 10.41$, $p < 0.01$), winter recreation ($F(2, 1670) = 4.13$, $p = 0.02$), horseback riding ($F(2, 1617) = 17.68$, $p < 0.01$), fish and game

($F(2, 1632) = 21.21$, $p < 0.01$), food, wood, fuels, and household materials ($F(2, 1611) = 33.11$, $p < 0.01$), roads and access ($F(2, 1622) = 13.29$, $p < 0.01$), freedom from people ($F(2, 1653) = 7.12$, $p < 0.01$), places for learning, science, and nature study ($F(2, 1649) = 4.47$, $p = 0.01$), historical sites ($F(2, 1641) = 9.71$, $p < 0.01$), designated wilderness ($F(2, 1657) = 11.76$, $p < 0.01$), and biological diversity ($F(2, 1643) = 4.40$, $p = 0.01$) (Figure 2).

### 3.2. Preference Bundles

The ratings for these ecosystem services were entered into a principal component analysis using Varimax rotation. Items with factor loadings under 0.5 were suppressed. Six factors (what we will henceforth refer to as "preference bundles") emerged that explained 63.1% of the variance (Table 1). Several ecosystem services did not load strongly enough on a factor to be retained. Those items were "learning, science, and nature study", "motorized recreation (ATV/motorbikes)", "food, wood, fuel, household materials", and "undeveloped areas to be free from other people".

**Table 1.** Principal component analysis for preference bundles.

| Items | Factor Loadings [1] | | | | | |
|---|---|---|---|---|---|---|
| | Environmental Quality | Utilitarian | Heritage | Specialized Recreation | General Recreation | Roads & Access |
| Wildlife habitat | 0.87 | | | | | |
| Fish and aquatic species habitat | 0.86 | | | | | |
| Water quality | 0.83 | | | | | |
| Biological diversity | 0.82 | | | | | |
| Clean air | 0.79 | | | | | |
| Carbon storage | 0.63 | | | | | |
| Designated wilderness | 0.62 | | | | | |
| Source of energy/biofuels/firewood | | 0.83 | | | | |
| Wood products | | 0.81 | | | | |
| Minerals, oil, fossil fuels | | 0.80 | | | | |
| Rangeland for grazing | | 0.73 | | | | |
| Non-timber forest products | | 0.72 | | | | |
| Tourism | | 0.52 | | | | |
| Cultural heritage sites | | | 0.85 | | | |
| Spiritual, sacred, or religious sites | | | 0.79 | | | |
| Historic building/gravesite/homestead | | | 0.75 | | | |
| Water recreation | | | | 0.72 | | |
| Fish and game | | | | 0.68 | | |
| Horseback riding | | | | 0.54 | | |
| Winter recreation | | | | 0.54 | 0.52 | |
| Human-powered recreation | | | | | 0.67 | |
| Vistas and scenic views | | | | | 0.50 | |
| Road systems | | | | | | 0.79 |
| Food, wood, fuel, household material * | | | | | | |
| Learning, science, nature study * | | | | | | |
| Motor recreation (ATV/motorbikes) * | | | | | | |
| Undeveloped areas free from people * | | | | | | |
| Eigenvalue | 5.07 | 4.07 | 2.66 | 2.12 | 1.89 | 1.22 |
| Percent of total variance explained [2] | 18.76 | 15.07 | 9.87 | 7.85 | 7.01 | 4.53 |

[1] Principal components factor analysis with Varimax rotation. Only factors with eigenvalues greater than 1 and items with factor loadings greater than 0.5 were retained in final factor structure; [2] Total cumulative percent of variance explained = 63.10%; * These items did not significantly load onto any factor.

Preference bundle 1 (Cronbach's $\alpha = 0.89$) explained 19% of the variance and contained seven items related to the environmental qualities associated with the forest (Table 1). It was named the "Environmental Quality" bundle. Preference bundle 2 (Cronbach's $\alpha = 0.85$), explained 15% of the variance and contained six items reflecting a utilitarian valuation of the forest. We called this the "Utilitarian" bundle. The third preference bundle (Cronbach's $\alpha = 0.85$) explained 10% of the variance and contained three items denoting cultural, spiritual, or historical significance; this was called the "Heritage" bundle. The next two preference bundles were related to recreational uses of the forest. The first (Cronbach's $\alpha = 0.66$) explained about 8% of the variance, contained four items related to a specialized use of the forest, and was called "Specialized Recreation". The second (Cronbach's $\alpha = 0.48$) explained about 7% of the variance. It contained three items related to a generalist use of the forest

and was called "General Recreation". The last preference bundle accounted for 4.5% of the variance and contained only one item, which was "Roads and Access".

### 3.3. Predictors of Preference Bundles

Demographics, including residential classification, explained minimal variance in preference bundles, as evidenced by the low $R^2$ values (Table 2). However, some trends were identified.

**Table 2.** Multiple linear regression analyses of ecosystem services (ES) bundles and demographic predictors.

| Bundle | Variable | B | SE B | β | *t* | *p* | *R* | $R^2$ |
|---|---|---|---|---|---|---|---|---|
| Environmental Quality | | | | | | | 0.29 | 0.08 |
| | Education [1] | 0.19 | 0.03 | 0.21 | 6.25 | <0.01 | | |
| | Gender [2] | −0.38 | 0.07 | −0.16 | −5.08 | <0.01 | | |
| | Income [3] | −0.08 | 0.02 | −0.14 | −4.17 | <0.01 | | |
| Utilitarian | | | | | | | 0.27 | 0.08 |
| | Education [1] | −0.12 | 0.03 | −0.13 | −4.0 | <0.01 | | |
| | Proximity [4] | −0.31 | 0.08 | −0.13 | −3.73 | <0.01 | | |
| | Income [3] | −0.04 | 0.02 | −0.07 | −2.06 | 0.04 | | |
| | Residential Classification [5] | 0.15 | 0.08 | −0.13 | 2.63 | <0.01 | | |
| | Age [6] | 0.001 | 0.001 | 0.07 | 2.30 | 0.02 | | |
| Heritage | | | | | | | 0.28 | 0.08 |
| | Education [1] | −0.08 | 0.03 | −0.09 | −2.59 | 0.01 | | |
| | Gender [2] | −0.52 | 0.07 | −0.22 | −7.06 | <0.01 | | |
| | Income [3] | −0.06 | 0.02 | −0.11 | −3.28 | <0.01 | | |
| Specialized Recreation | | | | | | | 0.24 | 0.06 |
| | Income [3] | 0.07 | 0.02 | 0.13 | 3.87 | <0.01 | | |
| | Education [1] | −0.21 | 0.03 | −0.24 | −7.12 | <0.01 | | |
| General Recreation | | | | | | | 0.16 | 0.03 |
| | Education [1] | 0.11 | 0.03 | 0.12 | 3.98 | <0.01 | | |
| | Gender [2] | −0.21 | 0.07 | −0.09 | −2.93 | <0.01 | | |
| Roads/Access | | | | | | | 0.23 | 0.05 |
| | Education [1] | −0.14 | 0.03 | −0.16 | −4.79 | <0.01 | | |
| | Gender [2] | 0.16 | 0.07 | 0.13 | 2.19 | 0.03 | | |
| | Income [3] | 0.07 | 0.02 | 0.13 | 3.85 | <0.01 | | |
| | Proximity [4] | −0.21 | 0.08 | −0.09 | −2.71 | <0.01 | | |

[1] Item coded from 1 "High school graduate" to 5 "PhD or professional degree"; [2] Item coded from 1 "Female" to 2 "Male"; [3] Item coded from 1 "Less than $25,000" to 8 "More than $200,000"; [4] Item coded from 1 "Near" to 3 "Very Far"; [5] Item coded from 1 "Urban" to 3 "Rural"; [6] Age of respondent in years.

Having a higher education level, being female, and having lower income were weak, but significant predictors of the Environmental Quality bundle. Those who placed greater importance on the use of natural resources for human benefit (the Utilitarian bundle) were more likely to be less educated, have lower income, be older, and be more rural residents living near the MBSNF. Those who valued historic, cultural and spiritual sites (the Heritage bundle) were more likely to have lower incomes, and be less educated females. Neither recreation bundle was strongly predicted by demographics, likely because of their lower internal reliability, although the Specialized Recreation bundle tended to have higher income, less educated respondents, and the General Recreation bundle tended to have higher educated, female respondents. In sum, the Utilitarian bundle was the only bundle to be predicted by residential classification, but even this association was weak.

## 4. Discussion

Our findings demonstrate that aggregate analyses of the MBSNF stakeholder population provide interesting information for how ES preferences bundle into six categories, and that the conceptualization of these bundles varies little by residential classification or other demographics. When we compared the stakeholder-derived preference bundles to those provided in the Millennium Assessment (MA), we noticed that the Environmental Quality values described by all participants mostly align with two of the six MA ES service types: regulating and supporting services [1]. Provisioning services in the MA were most like the Utilitarian bundle expressed in our sample

and cultural services in the MA were represented in two distinct categories of services for our sample: Heritage and Recreation. It was within these last two preference bundles that we noticed a divergence from the established framework in the global literature.

At a U.S. level, the preference bundles from this research also provided a more nuanced perspective for how forest managers might consider multiple uses across diverse stakeholders. The intent of the Multiple Use-Sustained Yield Act of 1960 was to institute a shift in forest management in the post-war era that emphasized instrumental (utilitarian or anthropocentric) values, especially timber. This act acknowledged the range of benefits and required foresters to assess trade-offs and consider all uses in making allocation decisions. While a step forward, the multiple use concept continued to have an anthropocentric flavor, with fish and wildlife being considered important often only for the benefit of human consumption, for example. The preference bundles identified here suggest that public preferences for ecosystem benefits are not entirely aligned with the original multiple use categories. Rather, our participants appeared to acknowledge both instrumental and non-instrumental (biocentric, aesthetic, spiritual) values throughout the preference bundles. The clustering of a range of ecological and human health values into the Environmental Quality preference bundle might suggest a shift away from a wholly instrumental view toward a fuller spectrum that also embraces biocentric functions. Further, the demarcation of cultural or heritage values in the ES preference bundles is something new and unexpected. Foresters typically manage heritage as a subset of recreation. Also, our results show that Recreation encompasses multiple forms and is more nuanced than originally conceived. Finally, the emergence of Access and Roads as a distinct bundle is interesting, suggesting the presence of a shared connection of individuals to the forest via roads, and this transcends or perhaps underlies other benefits.

Unlike prior research that has identified rural communities as prioritizing instrumental values, this study found that there were only modest differences in values related to the highest prioritization of specific ES (recreation for urban participants; vistas for suburban; and wildlife habitat, water quality and clean air for rural). Additionally, the fact that we found only weak, if any, socio-demographic correlates to the perceived relationships of ES within preference bundles is in contrast to our qualitative experiences with planning in the region, where vocal rural residents often associate "human-powered recreation" with urban conservationists, who have to escape the city to enjoy nature's benefits. Based on the rhetorical arguments we overheard from urban and rural constituents engaged in the conflict-laden discussion about roads within a shared national forest, we expected to see strong socio-demographic predictors of the ES bundles. Yet, we were surprised to find that the ES preference bundles were equally identified across urban, suburban and rural classifications. We suggest that the value differences between urban and rural dwellers identified by the social forestry literature [25,26,28] may still be present, but they are certainly not dominant across all residents of those residential classifications.

This consistency of preferences across residential classifications is an important finding that needs further exploration. It is possible that the lack of difference could be due to the opt-in nature of the study. However, this would contradict our experiences in the region. Generally, we find that those who participate in USFS social surveys do so to express their values and positions in response to the concern that they are treated differently from other social groups [43]. As such, differences are often amplified in the voluntary participation approach. In this case, we believe that the large number of respondents, who were recruited through multiple outlets, demonstrated that despite tensions in the region, the majority of respondents held similar conceptualizations of how ES relate to each other.

When making resource management decisions for a particular management area, foresters factor in information from a variety of sources, including the best available scientific information, existing monitoring data, professional expertise, and local and national public sentiment within a broader policy context. Public meetings and other formats provide a way for constituents and stakeholders to weigh in on proposed plans and actions. In many instances, management actions can evoke conflict or tension between rural and urban communities or among various stakeholders with vested interests within the communities. The broad representativeness of these ES preference bundles could help

foresters recognize that despite these tensions, the collective public conscious views the nuanced benefits of public forests similarly. Moreover, the collective conceptualization may not align with agency priorities as reflected by the multiple use policy. In light of this, foresters may want to create space for a fuller spectrum of values in public deliberations and recognize that their management strategies and targets may not align exactly with how people conceptualize their forest. Repeating this analysis on data from a rural forest would be interesting to see whether the ES preference bundles remained consistent.

## 5. Conclusions

U.S. national forest managers are actively embracing the MA-based ES framework for planning decisions. At the same time, the 2012 Planning Rule requires expanding efforts to reach out to traditionally under-represented groups and incorporate their values and preferences. Previous studies have indicated potential for differences in support for federal lands management between urban and residential stakeholders [25–27]. Furthermore, recognition of the social complexity of residents along the urban-to-rural gradient has only recently been contemplated for those considering ecosystem services and forest benefits [44]. We identified a convergence in how stakeholders from different residential categories perceived and preferred ES in the MBSNF. This knowledge can substantially support the dual managerial goals of resource protection and public access. Foresters engaged in planning can use these data-based ES preference bundles to test whether their own conceptualizations of the forest match the public's and whether their deliberation processes are providing space to engage the stakeholders who identify diverse preferences. There is a saying that you "can't see the forest through the trees"; we suggest that you can better see the forest through the public's preference bundles.

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**Author Contributions:** L.C. conceived, designed and coordinated the project and collected data in collaboration with partners; K.B. and L.C. conceived the analysis; K.W. and K.B. analyzed the data; all authors wrote the paper.

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

## Appendix A. Ecosystem Service Questions Asked of Respondents

The following list details functions provided by the Mount Baker-Snoqualmie National Forest. Tell us how important each function is to you.

| Question | Not Important | Somewhat Important | Extremely Important |
|---|---|---|---|
| Providing wood products (lumber, pulp, paper) | ❍ | ❍ | ❍ |
| Providing minerals, oil, and fossil fuels | ❍ | ❍ | ❍ |
| Source of energy, biofuels, firewood | ❍ | ❍ | ❍ |
| Rangeland for grazing | ❍ | ❍ | ❍ |
| Tourism; commercial guiding and outfitting | ❍ | ❍ | ❍ |
| Commercial forest products (floral greens, herbs, mushrooms, ornamentals) | ❍ | ❍ | ❍ |
| Human-powered recreation (camping, hiking, mountain biking, climbing) | ❍ | ❍ | ❍ |
| Motorized recreation (ATV, motorbikes) | ❍ | ❍ | ❍ |
| Winter recreation | ❍ | ❍ | ❍ |
| Water recreation (lakes, rivers) | ❍ | ❍ | ❍ |

| Question | Not Important | Somewhat Important | Extremely Important |
|---|---|---|---|
| Scenery, vistas, outlooks | ❍ | ❍ | ❍ |
| Place to ride horses and pack animals | ❍ | ❍ | ❍ |
| Source of fish and game | ❍ | ❍ | ❍ |
| Source of foods and materials for household | ❍ | ❍ | ❍ |
| Road systems for people to use | ❍ | ❍ | ❍ |
| Undeveloped areas to be free from other people | ❍ | ❍ | ❍ |
| Place for learning, nature study, science | ❍ | ❍ | ❍ |
| Historic buildings, gravesites, homesteads | ❍ | ❍ | ❍ |
| Spiritual, sacred, and religious sites | ❍ | ❍ | ❍ |
| Cultural heritage sites | ❍ | ❍ | ❍ |
| Designated wilderness | ❍ | ❍ | ❍ |
| Clean air | ❍ | ❍ | ❍ |
| Water quality | ❍ | ❍ | ❍ |
| Fish and aquatic species habitat | ❍ | ❍ | ❍ |
| Wildlife habitat | ❍ | ❍ | ❍ |
| Biological diversity | ❍ | ❍ | ❍ |
| Carbon storage | ❍ | ❍ | ❍ |

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