ABSTRACT. This study uses a choice experiment framework to estimate Oregonians’ willingness to pay (WTP) for changes in levels of biodiversity protection under different conservation programs in the Oregon Coast Range. We present biodiversity policy as an amalgam of four different conservation programs: salmon and aquatic habitat conservation, forest age-class management, endangered species protection, and large-scale conservation reserves. The results indicate substantial support for biodiversity protection, but significant differences in WTP across programs. Oregonians indicate the highest WTP for increasing the amount of forest devoted to achieving old-growth characteristics. On average, respondents indicate an annual household WTP of $380 to increase old-growth forests from 5% to 35% of the age-class distribution. Conversely, WTP for increasing conservation reserves peaks at $45 annually to double the current level to 20% of the landscape, whereas WTP is negative for any increase over 32%. We also find resistance to any change in conservation policy, which substantially offsets WTP for increases in all four conservation programs. FOR. SCI. 50(5):589–602.

Key words: Choice experiment, conjoint analysis, ecosystem management, willingness to pay, Oregon forests.

INCREASED RECOGNITION OF NATURAL RESOURCES’ noncommercial values has sparked a shift toward ecosystem management of forest land in the Pacific Northwest. Examples include the USFS Northwest Forest Plan, the Oregon Plan for Salmon and Watersheds, Washington State’s Timber, Fish, and Wildlife Agreement, and the current emphasis on sustainability in federal land policy. A principal objective of ecosystem management is biodiversity conservation.

However, biodiversity is difficult to define (Baydack et al. 1999, Haufler 1999), and, because limited budgets require land managers to set priorities in a milieu of close public scrutiny, even more difficult to implement. Although the public broadly supports biodiversity conservation, designing specific policies that invite public support and participation requires more understanding of preferences over management alternatives. In this article, we use a welfare economics framework to measure public preferences and willingness to pay (WTP) for four biodiversity conservation programs in the Oregon Coast Range (OCR), including: (1) area and distribution of different age classes of trees, from young stands to old growth; (2) protection of coastal salmon and aquatic and riparian habitat; (3) protection of threatened and endangered species’ habitats on public and private land; and (4) designation of reserves managed for biodiversity and ecological functions.

Background and Objectives

identifies four broad approaches to ecosystem management: (1) species-based (“fine filter”) approaches: focus on protection of umbrella and keystone species as indicators of ecosystem health and biodiversity; (2) reserve-based (“coarse filter”) approaches: focus on networked reserves within which ecological processes, including natural disturbance regimes, are allowed to function largely free from commercial constraints; (3) freshwater and riparian zone protection: focus on protection of corridors, for both connectivity to facilitate species dispersion over the landscape, and for protecting diversity “hotspots” given characteristics of riparian zones as steep environmental gradients and loci of disturbance processes; and (4) integrated structure-based management of unreserved land: focus on integrating diversity objectives into management of developed and semi-developed land to increase resident diversity and improve connectivity functions of managed portions of landscapes.

Each approach is discussed in the literature largely in terms of its scientific attributes. However, each also defines the core element of an institutional response to conservation and is represented by management initiatives currently being implemented within the OCR. Both the federal and state endangered species processes exist and federal recovery plans for listed species have been adopted as well as numerous Habitat Conservation Plans (US Fish and Wildlife Service 1982, 1983, 1986, 1991, 1992, and 1997). The reserve-based approach is represented by the network of designated Wilderness Areas, administratively withdrawn areas, and late successional reserves designated under the Northwest Forest Plan (NWFP) (USDA Forest Service 1994). Other elements of the NWFP include riparian zone management and integrated management of unreserved land. The Oregon State Plan for Salmon and Watersheds (Oregon Coastal Salmon Restoration Initiative 1997) focuses on aquatic and riparian habitat in the OCR. Finally, the structure-based management approach being taken by the State of Oregon northern OCR lands (Oregon Department of Forestry 2001) focuses on maintaining a diversity of forest age classes and structures, including late seral conditions, on land actively managed for timber production.

The process of defining a landscape scale strategy for conserving biodiversity is complex and demanding in terms of required time, expertise, and public expenditure. Although different approaches are advocated by the authors cited above, all advocate integrated approaches using a variety of methods, and all advocate clear definition of goals and objectives. It seems essential, then, that Noss’s (1993) first step—setting priorities and identifying objectives—incorporates the interests of stakeholders if the outcome of planning efforts is to be useful in terms of managing resources in the public interest. In discussing ten key “themes” of ecosystem management, Grumbine (1997) concludes by emphasizing the need for scientists and resource managers to step away from purely technical considerations and confront the nature and variety of human values that principally drive management decisions. The research documented here is intended to provide one measure of (public) stakeholder preferences to assist policy makers in setting objectives for management in the OCR.

We estimate demand curves for Oregon residents measuring WTP for incremental changes in distinct programs or attributes of OCR biological conservation plans. We provide continuous measures of public values for biodiversity conservation actions to integrate with value estimates for other resources in evaluation of policy and management scenarios in the Coastal Landscape Analysis and Modeling Study (CLAMS) [1] simulation model of the OCR. To estimate demand curves for attributes of conservation plans, we use the choice experiment valuation approach, combining the multiattribute approach of conjoint analysis with the utility theoretic foundation of dichotomous choice contingent valuation. In a broader context, the study provides information on public preferences for competing objectives of the NWFP. This is of particular relevance given recent initiatives to increase timber production on federal forests covered by NWFP (Seattle Post-Intelligencer 2003).

Theoretical Model of Preferences for Biodiversity Conservation Programs

Consumers signal their preferences for marketed goods through prices paid and quantities bought. These signals are used by private and public entities to make resource-allocation decisions. Unfortunately, consumers holding preferences for nonmarketed goods often do not take actions resulting in meaningful market signals. Still, there is little doubt that consumers derive value from nonmarketed goods from three sources: direct use (e.g., recreation), indirect use (e.g., ecosystem services such as waste assimilation), and nonuse. Nonuse values stem from preferences for a good’s existence or from fulfilling the perceived responsibility of preservation for future generations. Of these sources of value, measuring nonuse values presents the greatest challenge. Motivated in part by the directed use of cost benefit analysis, economists have developed survey-based “stated preference” methods to measure nonuse values in terms comparable to market prices. These methods create hypothetical markets for nonmarketed goods and elicit values from responses to WTP questions or stated choices in hypothetical decision scenarios [2].

In this article, we use random utility theory to estimate continuous demand functions for biodiversity programs based on discrete choice observations (McFadden 1974, Ben-Akiva and Lerman 1985). We present individuals with sets of alternative biodiversity plans and ask them to choose the plan they most prefer. Given a set of alternatives, $A_n$, presented to individual $n$, the random utility model posits that the probability that individual $n$ chooses alternative $i$ is

$$P_n(i|A_n) = \Pr(U_{in} \geq U_{jn}, \forall j \in A_n), i \neq j,$$  

where $U_{in}$ is the utility (i.e., satisfaction) that $n$ obtains from alternative $i$ in set $A_n$, and similarly for $U_{jn}$. The utility function is known to the individual but stochastic to the investigator because of unmeasured attributes of the good being valued and other measurement errors (Ben-Akiva and Lerman 1985). So, for analytical purposes,
where \( V_{ia} \) is mean utility and \( e_{ia} \) is a random error. \( V_{ia} \) includes a vector, \( X_{ia} \), of the extent of the biodiversity conservation programs and associated costs, and a vector, \( R_n \), of individual characteristics of the respondent,

\[
U_{ia} = V_{ia} + e_{ia},
\]

where \( f(\cdot) \) is a single valued function and \( \beta \) is a vector of unknown parameters.

The individual chooses the alternative providing the greatest utility, such that Equation 1 can be written as

\[
\Pr(\beta f(X_{ia}, R_n) + e_{ia} \geq \beta f(X_{ja}, R_n) + e_{ja}) = \Pr(\beta f(X_{ia}, R_n) - \beta f(X_{ja}, R_n) \geq e_{ja} - e_{ia});
\]

\[
i, j \in I_n, i \neq j.
\]

Specification of the errors’ distribution allows estimation of \( \beta \). We assume that \( e_{ia} \) and \( e_{ja} \) are independently and identically extreme-value distributed, so \( e^* = e_{ia} - e_{ja} \) is logistically distributed (Ben-Akiva and Lerman 1985) and use the multinomial logit regression model, as presented below.

To obtain information on \( X_{ia} \) and \( R_n \), we used the conjoint method (Louviere 1988). This survey-based method, originally used in marketing and transportation, is increasingly used to simultaneously investigate preferences for complex resource-management options where alternative scenarios encompass multiple attributes or programs (Boxall et al. 1996, Li et al. 1996, Adamowicz et al. 1999, Xu et al. 2003). In a conjoint survey, survey respondents are asked to state their preferences between alternative specifications of a composite good, often framed as consumer goods with associated prices. In the present case, the specifications are framed as conservation plans, which vary in the spatial extent to which conservation programs are applied on the OCR landscape and with associated costs specified as annual household income taxes paid into a biodiversity trust fund to support a given plan.

We use choice experiment analysis (CEA), a variant of conjoint analysis. CEA asks survey respondents to indicate the single most preferred composite rather than rankings of all composites. CEA has the advantage of being a more general case of the choice model that provides the foundation of the commonly used dichotomous choice contingent valuation method (see, for examples, Loomis and Gonzalez-Caban 1997, and Winter and Fried 2001). Although controversial, the dichotomous choice contingent valuation method has well-developed theoretical foundations linking CEA with the valuation literature (Mitchell and Carson 1989, Bateman and Willis 1999).

Observing respondents’ choices over alternative composites, the analyst can statistically estimate the relative importance of each program and compute estimates of WTP for program changes (Hanemann 1984). The results provide estimated aggregate and marginal demand curves for each biodiversity program, depicting the public’s desire for incremental increases in conservation programs as incremental costs change.

Survey Design and Administration

In planning the valuation survey, we identified a list of biodiversity indicators produced by CLAMS models for which economic values were desired. Following discussions with CLAMS scientists and the results from several layperson focus groups held throughout Oregon, we determined that the salient biodiversity indicators could be nested within four programs: aquatic habitat and anadromous fish, threatened and endangered species’ habitats, forest structural and age-class diversity, and biological reserve networks. We also determined that CEA allowed us to address the need for continuous value estimates rather than point estimates of value, especially given the multiattribute nature of the valuation problem [3].

Despite its potential nonresponse problem (Arrow et al. 1993), a mail survey was necessary, given the combination of time and budget limitations, which precluded personal interviews, and the need to present survey respondents with a large amount of information accompanied by visual aids. The survey instrument was carefully designed, tested, and administered to minimize problems of nonresponse and other sources of bias.

The 16-page survey instrument contained five sections. Section 1 provided background information, the survey’s purpose, introduced the concept of biodiversity, and asked respondents to identify the personally important benefits of OCR forests. Section 2 described the four biodiversity conservation programs, discussed causal factors for the decline of some species and habitats, and current state, federal, and private actions to improve their status. Each program was described in terms of a management approach for protecting one of the elements of biodiversity and specified the current or baseline level of implementation (as of the time of the survey). Graphic icons visually depicted quantitative program changes by incorporating either a pie chart or histogram with a representative icon for the program. The icons were used in the subsequent choice questions to present variation in the program levels in visual and textual terms. Extensive color graphics helped maintain respondents’ interest and condense information. Throughout section 2, attitudinal questions were posed to maintain respondents’ interest and prepare them for the choice experiment questions. Section 3 contained a summary in which the four biodiversity programs were contrasted, and the choice situation motivated (see Figure 1). The survey set up a hypothetical biodiversity trust fund to finance biodiversity improvement, funded by general income taxes and fees paid by industrial and recreational forest users. To motivate serious consideration, respondents were asked to rank the four programs and then to compare the biodiversity programs’ importance to other social programs, including education, crime prevention, and rural development. Respondents were reminded to consider trade-offs to biodiversity conservation...
Making a Biodiversity Plan

Each of the four programs on the previous pages is one part of a possible overall conservation strategy. The four programs overlap somewhat, but each has different advantages and no single approach is adequate to protect all of the elements of biodiversity.

Public agencies, working with private landowners, are discussing long range plans for conservation of species and ecosystems in our State. Each of the four programs discussed above could be part of the overall plan, but how to combine them is a difficult question.

Scientists and experts can provide some of the answers, but the most important input comes from you and other Oregonians.

On the next few pages, we ask that you consider the four conservation programs and decide which ones you prefer. All of the programs require public funding and some limitations on other forest uses. One way to pay for these programs would be to establish a biodiversity trust fund that would be paid into by the general public through income taxes. Forest users such as the timber industry and recreationists would also contribute through user fees. This money would only go to pay for protection of species and habitats in the Coast Range through some combination of the four biodiversity programs.

Program I: Salmon Streams
This program focuses on protecting and restoring salmon habitat in Coast Range streams. This would improve conditions for endangered salmon, and would focus on bringing all populations of salmon to greater levels of abundance.

Program II: Forest Age Management
This program focuses on changing the average age of the working forests of the Oregon Coast Range. This would improve species and habitat diversity on lands managed mainly for timber production.

Program III: Biodiversity Reserves
Instead of modifying land uses over the entire Coast Range to protect individual species, this approach reserves large patches of land from most human uses in order to protect whole ecosystems and retain natural processes.

Program IV: Endangered Species
This program focuses protection on the most severely threatened species. This approach gives some protection to other species using the same habitat, but generally doesn’t become effective until a species is at extreme risk.

Each of the programs above addresses important concerns. In order to proceed with a conservation plan, it is necessary to prioritize. Please rank the following in terms of their importance to you, with the most important ranking 1 and the least important ranking 4: (do not rank any the same)

- Increase the number of miles of stream habitat managed at the highest level of protection for coastal salmon.
- Increase endangered species recovery on non-federal land.
- Increase the amount of forest in mid-age and old stages.
- Increase the number of Biodiversity Reserves in the Coast Range.

Figure 1. Conservation programs.
and household spending constraints before proceeding to the choice experiment questions [4].

In section 4, each respondent was presented with four choice questions, potentially yielding four observations from each respondent. The choices were described as hypothetical Oregon ballots and the income tax and fee payment was reiterated. Each of four choice sets (an example of which is shown in Figure 2) asked the respondent to indicate his or her first choice of three alternatives: a status quo alternative and two alternative conservation plans with various levels of the four programs and “bid levels” described as an annual household cost. Table 1 gives the bid levels, the descriptions used in the survey for each program, and the four different levels of application for each program [5]. An asterisk indicates the current OCR baseline level of each program.

Section five concluded the survey with questions regarding respondents’ demographic characteristics, including age, sex, length of residency, occupation, environmental group membership, political alignment, years of education, household size, and income. Mean values for selected demographic variables are provided by strata in Table 2.

We used a stratified random sample of 3000 Oregon households drawn by Affordable Samples, Inc., with 1000 addresses each from the OCR, Willamette Valley (WV), and Southern, Central, and Eastern Oregon (EO). Following Dillman (1978), the survey booklet was mailed in June 1999, accompanied by a cover letter and a $1 bill. After 10 days, nonrespondents were sent a postcard and a second survey one month later. Seventy-nine percent of the returned surveys were received before the mailing of the second survey. Of the 2,540 deliverable surveys (460 mailings were returned by the post office as undeliverable), 1,372 were ultimately returned, for an effective response rate of 54%. Of these, 1,090 surveys yielded usable results, with 20% of respondents failing to complete the valuation questions or providing unusable responses.

We designed the survey to present a balanced view of resource management and the relative trade-offs required in identifying OCR conservation plans. Oregonians have a long history of controversy over natural-resource use and several recent state ballot measures concerning resource policy have attracted extensive media coverage and public debate. Thus, Oregonians are familiar with these issues [Vaidya 1999], and respondents are unlikely to regard the choice scenarios as purely hypothetical (a common criticism of survey-based economic studies, e.g., McKillop 1992) [6].

Analysis

Using the survey data, we estimated numerous alternative multinomial logit. Equation 5 gives the model specification that appeared to achieve the best fit to the data [7]:

$$P_{ij}(A_n) = \frac{\exp(\beta X_{ni} + \alpha C_{ni} + \tau Q_{ni} + \gamma' R_{ni} X_{ni})}{\sum_{j \in A} \exp(\beta X_{nj} + \alpha C_{nj} + \tau Q_{nj} + \gamma' R_{nj} X_{nj})},$$

(5)

where $X_{ni}$ is the vector of linear and quadratic terms for the four conservation program levels; $\beta$, $\alpha$, and $\gamma$ are the vector of associated regression coefficients; $C_{ni}$ is the plan cost and $\alpha$ is the cost coefficient; $Q_{ni}$ is an alternative-specific term with value set to zero for the status quo alternative and unity for the other two alternatives, and $\tau$ is the associated parameter; $R_{ni}$ is a vector of demographic variables and $X_{ni}$ is the linear component of the vector $X_{ni}$, so that $R_{ni} X_{ni}$ is a vector of interactions between the demographic terms and the program attributes, and $\gamma$ is the associated parameter vector.

Results

Table 2 presents the parameter estimates for each region. These generally have expected signs and high degrees of significance [8]. The conservation program level coefficients are significant, with the exception of the linear effects of salmon and old-growth forest among OCR residents, and the linear effect of reserves across all three regions. All quadratic-term coefficients are significant at the 95% level or above. The cost coefficients are negative and highly significant for all three regions. The coefficient ($\tau_{i}$) is also negative and significant for all regions. This status quo effect (SQE) indicates a tendency for respondents to refuse any of the actions offered as alternatives for increasing or decreasing biodiversity conservation, regardless of cost or the degree of increase or decrease. Interpreting this effect raises technical questions and is discussed below. All quadratic terms for the program levels are negative, and with the exception of the salmon habitat program among OCR residents [9], all of the linear effects are positive.

We performed experiments with additional demographic terms, including income and length of regional residence, but found insignificant estimates and dropped them from the final model. Note also that variables for the forest age management program (F and F2 in Tables 1 and 3) describe the proportion of old-growth forest in the OCR forest age class distribution. The survey descriptions included the proportions of young and mid-age forest, but collinearity and insufficient degrees of freedom dictated that we include only old-growth proportion in the final model.

Validity and Reliability

We conducted several statistical tests for potential biases. Context effects, such as the specified scale of decision variables (anchoring) and the order in which the survey presented information and key questions, may result in biased estimates (Tversky and Kahneman 1974, Mitchell and Carson 1989, Payne et al. 1992, Schkade and Payne 1994). The results of three statistical tests indicate that respondents display no significant anchoring or order biases [10].

Though a direct test for nonresponse bias (i.e., where survey nonrespondents hold systematically different views than respondents) was infeasible, we performed an indirect test by including a dummy variable for late responders and interacting this with terms for the four program levels. The implicit assumption is that late responders, defined as those who responded after the third mailing (consisting of a
Suppose that Oregon voters are presented with only the following ballot and that no other conservation plans are being voted on. Compare the three alternatives and consider which one you would vote for.

**Figure 2. Choice scenario.**
response. In only one of the tests did we reject the null at the
12% level. However, this estimated effect was miniscule and we do not include it in the WTP calculations.

To address the potential that the respondents were not representative of the populations of the respective sample strata, sample mean values for key demographic variables were compared to mean demographic values from more broad-based sources (see Table 2). These comparisons indicate that survey respondents tend to be more educated and have a higher level of environmental group affiliation, both associated positively with environmental preference but also having a higher level of timber sector employment, average age, conservative political alignment, and average length of residence, all of which were associated with lower likelihood of choosing higher levels of conservation. To render results more representative of public values, WTP results reported below were calculated using means of demographic variables from the more broad-based sources rather than from the survey sample.

### Calculation of Willingness to Pay for Conservation Programs

Using the estimates in Table 3, mean total willingness to pay (TWTP) for the four conservation programs is given by

\[
TWTP(X_i) = -\frac{1}{\alpha} \left[ \tau + \sum_i \gamma_i \tilde{R}_i (X_{ij} - X_{ij}) + \beta X_i (X_{ij} - X_{ij}) \right],
\]

where \(\tau\) is an alternative specific constant for the status quo choice, the \(\beta\)'s control for positive and negative variation in the levels of the conservation programs between the three choice set alternatives; \(X_i\) denotes the conservation programs \(k = 1, \ldots, 4\); \(i\) subscripts denote program levels where \(i\) identifies the baseline level; and \(\tilde{R}_i\) denotes the regional “population” mean values of demographic covariates \(i = 1, \ldots, 7\) from Table 2 (see Hanemann [1984] for derivation; see also Beenstock et al. [1998], Hanemann [1989], and Li et al. [1996] for further notes on calculating demand curves based on discrete observations).

The results suggest that, in general, Oregonians have a positive WTP for moderate increases in conservation programs, with declining marginal (incremental) values as program levels increase [11]. At the same time, respondents tend to reject changes in any of the four programs, choosing instead the status quo alternative regardless of the changes of any program or costs. Although the WTP results produce continuous WTP curves for changes in the four programs, this status quo result produces a discrete shift in WTP that partially offsets the estimated benefits of changing conservation levels.

Figure 3 depicts the population-weighted estimated mean TWTP of Oregon households for each of the four conservation programs, adjusted and unadjusted for the SQE. With the WV stratum representing 75% of Oregon’s population, the weighted average values are largely representative of the preferences of this most populous region. At current levels,
Table 2. Population and survey sample mean values for selected demographics.

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Coast range Population</th>
<th>Coast range Sample</th>
<th>Willamette Valley Population</th>
<th>Willamette Valley Sample</th>
<th>E. Oregon Population</th>
<th>E. Oregon Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of residence*</td>
<td>20.0355</td>
<td>38.1890</td>
<td>19.4480</td>
<td>35.2108</td>
<td>19.8179</td>
<td>33.9482</td>
</tr>
<tr>
<td>Environmental group membership‡</td>
<td>0.0400</td>
<td>0.1024</td>
<td>0.1065</td>
<td>0.1325</td>
<td>0.1115</td>
<td>0.0986</td>
</tr>
<tr>
<td>Political alignment‡</td>
<td>-0.0687</td>
<td>0.1457</td>
<td>-0.0474</td>
<td>0.0476</td>
<td>0.0427</td>
<td>0.0522</td>
</tr>
<tr>
<td>Age‡</td>
<td>40.6737</td>
<td>56.0299</td>
<td>35.7637</td>
<td>51.1735</td>
<td>37.6606</td>
<td>54.8546</td>
</tr>
<tr>
<td>Forest products employment‡</td>
<td>5.97%</td>
<td>17.23%</td>
<td>3.51%</td>
<td>0.06%</td>
<td>7.78%</td>
<td>12.00%</td>
</tr>
</tbody>
</table>

* Oregon Progress Board (1998, Table All-R1).
† Oregon Progress Board (1998, Table All-EL1).
‡ Oregon Forest Resources Institute (1999).
§ Oregon Secretary of State Office (1998). These figures were compared to data from a Likert scale of political alignment coded to −1 for liberal and +1 for conservative.
|| Oregon Employment Department (1999).

TWTP is zero by definition. For changes decreasing the level of a program (left of lower x-intercept), mean TWTP is negative, indicating that Oregonians would pay to avoid reductions in the current levels of conservation programs. Negative WTP in this context is typically interpreted as willingness to accept economic compensation, or the amount of compensation required to offset the perceived loss in benefits relative to the baseline [12]. For above-baseline changes, respondents on average indicated positive WTP up to a threshold level, represented by the peaks of the

Table 3. Regression analysis results.

<table>
<thead>
<tr>
<th>Term</th>
<th>Coefficient</th>
<th>Coast range</th>
<th>Willamette Valley</th>
<th>E. Oregon</th>
</tr>
</thead>
<tbody>
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<td>$C$</td>
<td>$\alpha$</td>
<td>$-0.003214^{**}$</td>
<td>$-0.002153^{**}$</td>
<td>$-0.004297^{**}$</td>
</tr>
<tr>
<td>$S$</td>
<td>$\beta_S$</td>
<td>$-0.006982$</td>
<td>$0.016116$</td>
<td>$0.034209^{**}$</td>
</tr>
<tr>
<td>$S^2$</td>
<td>$\beta_{S^2}$</td>
<td>$-0.000278^{**}$</td>
<td>$-0.000193^{**}$</td>
<td>$-0.000226^{**}$</td>
</tr>
<tr>
<td>$E$</td>
<td>$\beta_E$</td>
<td>$0.037968^{**}$</td>
<td>$0.058958^{**}$</td>
<td>$0.044707^{**}$</td>
</tr>
<tr>
<td>$E^2$</td>
<td>$\beta_{E^2}$</td>
<td>$-0.000251^{*}$</td>
<td>$-0.000638^{**}$</td>
<td>$-0.000415^{**}$</td>
</tr>
<tr>
<td>$F$</td>
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<td>$0.026838$</td>
<td>$0.06135^{**}$</td>
<td>$0.037894^{*}$</td>
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<tr>
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<td>$-0.002281$</td>
<td>$-0.00102$</td>
</tr>
<tr>
<td>EXOCCN</td>
<td>$\gamma_{eO}$</td>
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<td>$-0.00103$</td>
<td>$-0.00747$</td>
</tr>
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<td>$\gamma_{fO}$</td>
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<td>$-0.014782$</td>
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<td>EXLOR</td>
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<td>SXPOL</td>
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<td>$-0.001983$</td>
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<td>EXPOL</td>
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* Significant at $S$ 95% level; **significant at $S$ 99% level.
respective curves. Beyond these thresholds, additional increments in the level of resources devoted to the programs have negative value, decreasing the TWTP. Ultimately, the perceived cost of allocating more land and resources to conservation overwhelms the gains and TWTP again becomes negative.

Boxes on the respective curves in Figure 3 indicate the levels specified in the experimental design. Portions of the curves extending beyond the endpoints of the design represent extrapolation, are not fully supported by the data, and should be viewed with caution. With the exception of biodiversity reserves, TWTP is positive at all above-baseline levels included in the design [13]. But because the slope of the TWTP curve corresponds to the marginal WTP, i.e., the WTP for the marginal percentage-point increase, the corresponding marginal WTP is negative for the highest levels of each program included in the experimental design. This suggests that, at very high levels of increase in the conservation programs, respondents on average impute additional costs above the annual household costs specified in the survey instrument.

The WTP calculation of the SQE is $\sigma/\alpha$, with values $-242, -140$, and $-173$ annually for the OCR, WV, and EO regions [14], with a population-weighted average of $-153$. This should be deducted from the summed TWTP for any conservation alternative that deviates from current program levels. Ideally, we would be able to associate a fraction of the SQE with each of the programs. However, there is insufficient information to associate the SQE differentially. In considering an isolated change in any one conservation program, a downward vertical shift of the respective TWTP curve in Figure 3 by the amount of the SQE value is a conservative interpretation of preferences and may be a lower bound on WTP.

**Discussion**

Comparison of the four TWTP curves in Figure 3 provides information on the relative value Oregonians place on the four conservation programs. On average, Oregonians indicate the highest WTP for increasing the amount of forest devoted to achieving old-growth characteristics (i.e., >150-year-old trees and more complex structure). The survey explained that this could not be achieved in the short run and would require an extended period to accomplish, given current conditions. On average, respondents indicated an annual household WTP of $380 (not including the SQE) to increase old-growth forests from 5% to 35% of the age-class distribution. In attitudinal questions preceding the survey’s choice experiment, respondents were asked to select a preferred age-class distribution. Sixty percent of respondents indicated that they preferred a distribution that
evenly split forest between young, mid-age, and old forest age classes. Apart from this high level of support for increasing old-growth forest to roughly one-third of the age-class distribution, there is little information to explain the apparent preference for this program over the other three. A possible explanation, discussed further below, is a strong tendency to reject the below-baseline level of the old-growth program, which eliminated the last 5% of old-growth forest. Because the functional form of the regression does not allow for a discontinuity at the baseline level, the fitted model may overestimate above-baseline WTP and underestimate below-baseline values.

In contrast, the results indicate a much lower WTP for increasing biodiversity reserves, with a peak TWP of $45 annually to double the current level to 20% of the OCR landscape. Any increase over 32% is regarded as worse than the current level, resulting in negative TWTP. The survey described reserve designation as representing a wholesale change of land use on large areas of land (40–180 square miles), sharply limiting logging, road building, grazing, residential development, and other intensive uses, and leaving low-impact recreation as the principal direct-use benefit. The other three programs are more mitigative in nature, at least in principle, and are intended to protect elements of biodiversity on land that is otherwise intensively used. This may explain why respondents would view greater than 20% of the OCR in reserves as excessive. Apart from the range of increase that respondents regard as acceptable, it is also notable that, at any given level, reserves appear to be the least preferred conservation mechanism. This is a significant implication, given the scientific support for “coarse filter” reserve-based approaches to conservation and their role in maintaining ecological processes (Noss et al. 1997). These results suggest that management approaches that emphasize large-scale reserves may meet a greater degree of public resistance than more “fine filter” approaches.

The WTP for the endangered species habitat program is intermediate relative to the old-growth and reserve programs, with a maximum TWTP of $250/yr/household to increase habitat protected from 15% to 47%. The curve for salmon habitat is somewhat flatter, peaking at a maximum TWTP value of $144/year/household to increase protected habitat from 15% to 60%, but with positive WTP up to nearly 100% of habitat streams protected. Although the analysis indicated that there was no significant difference in response to program levels across the three regional strata [15], it is notable that WTP for moderate increases in salmon habitat protection was substantially higher among OCR residents than in the other two regions, and was also the preferred conservation program among residents of the region. This is consistent with a strong association of OCR residents with salmon, both as a cultural icon and as a commodity and recreational resource.

The SQE is represented in the choice modeling as an alternative-specific constant. Interpreting this as an aversion to changing current conservation policy may oversimplify. There are also three instrumental effects that may contribute to the magnitude of the SQE. First, the status quo alternative may be chosen as a proxy for a “don’t know” response by some respondents who felt that their understanding or the information provided was insufficient. Second, respondents reject alternatives to the baseline policy to protest elements other than cost or changes in program levels. Examples include a distrust of public land managers or general opposition to tax increases [16]. In other valuation studies, protest responses are typically censored with the justification that they reveal nothing about preference for the good being valued. In the context of this study, however, the goods being valued are inseparable from policy mechanisms, and such responses do reveal something about relevant preferences. Third, respondents may choose the status quo as a proxy for another preferred alternative known to be in the respondent’s choice set, but is not offered (DeShazo et al. 2001). However, this is unlikely in the public-referendum context used in this survey, because voters are typically required to vote either for or against a referendum, rather than choose among many alternatives [17].

Table 4 presents estimated household and aggregated TWTP for two hypothetical conservation plans: (1) a 5% reduction from baseline levels of all four programs, including elimination of the last 5% of old-growth forest, and (2) a 10% increase in all four programs (i.e., in absolute terms, not proportion of baseline). Note that these WTP figures are also based on the population demographic values reported in Table 2. In the far right column, which displays weighted average TWTP figures for a 10% increase, with the exception of the old-growth program, an isolated increase in any one program does not achieve sufficiently high WTP to compensate for the SQE, producing negative TWTP for changes in program levels. It is only when other program changes are combined with a 10% increase in old growth that moderate increases in all program levels produce a positive TWTP.

Table 4

The negative WTP values estimated for decreases in the conservation programs’ below-baseline levels are also notable. Assuming that the current baseline levels are supported by law and the current allocation of property rights, the negative WTP values represent the amount by which Oregon households would have to be compensated to make them indifferent between the current level of conservation efforts and the reduced level. This so-called willingness to accept (WTA) can be quite difficult to measure because many respondents reject the notion of accepting compensation, often by stating an infinite WTA value. The CEA offers a certain advantage in this regard. By combining reductions in one or two programs with increases in other programs, respondents are less inclined to reject the valuation scenario. It is a common result of valuation studies that there is a sharp disparity between WTP for increases in a valued resource and willingness to accept compensation for decreases, and there is ample evidence of a discontinuity between WTP and WTA for changes in the provision of public and private goods (Knetsch 1990, Hanemann 1991, Beenstock et al. 1998). Evidence from these and other studies suggests that there may be a kink or vertical shift in the conservation program WTP curves at the status quo.
point [18], with the curve being much steeper for decreases below the baseline. As such, the WTA values in Table 4, particularly if the SQE value is excluded, are probably conservative estimates.

An examination of the TWTP figures in Table 4 reveals that, under the 10% above-baseline scenario, mean TWTP of WV households for increases in all conservation programs is in excess of $500/year. Including the deduction for SQE decreases household TWTP to about $360/year. This is 0.75% of median WV household income. From Figure 3, average Oregon household TWTP for increased old-growth forest alone is almost as high as $280 per year, even when adjusted for the full SQE.

Given the general aversion of Oregonians to income and property tax increases, and numerous competing demands for public funding and private spending, estimates of these magnitudes should be considered carefully. There is evidence that the estimates suffer to some extent from misspecification bias in the regression analysis, which is problematic in most dichotomous choice valuation studies (Creel and Loomis 1997, Haab 1997). Because the smooth parabolic shape of the curves is an artifact of the quadratic specification of the regression model, the magnitude of the estimates may be less with the use of a functional form permitting more complex curvature. Of particular concern is the inability to model the disparity between WTP for increases in program attributes and WTA for decreases below the baseline. The failure to incorporate this discontinuity, if it indeed exists in the data, would likely have the effect of biasing above-baseline estimates upward and below-baseline estimates downward.

Having stated these caveats, however, these estimates are consistent with other evidence. First, the values presented here are not exclusively nonuse values, but most likely also include perceived recreational and other amenity values, apart from the values associated with biodiversity conservation. In a telephone survey of Oregon residents, the Oregon Forest Resources Institute (1999) found that a majority of Oregonians placed the highest value of the state’s forest resources on wildlife protection and ecosystem services (principally protection of water resources). Although 84% of respondents stated that private property rights and financial returns to forest owners were important, these values were attenuated by the public goods values of forests. Forty-eight percent of respondents rated “tax and other (voluntary) incentives” as the best means of promoting environmental protection. Haynes and Horne (1997) estimated that 89% of economic benefits produced on federal land in the Columbia basin in 1995 were environmental amenity values. Also, the scale of benefits measured in this study is similar to that obtained by Xu et al. (2003). In a study similar to ours, these authors estimated average household annual WTP to increase 50-year-old and older forests from 15% to 25% of the forest landscape. Values ranged from $188 among Washington timber rural residents to $502 for urban residents.

Regardless of the absolute magnitude of WTP for biodiversity conservation, the relative values of the conservation programs found in this study provide guidance to policy makers regarding the public acceptability of changes in OCR conservation plans. Current efforts to increase the level of harvest under the NWFP (Seattle Post-Intelligencer 2003), particularly to the extent that this requires reducing the current quantity of late seral forests standing on federal land, should be considered in light of the level of public support for old growth. The methodology used here to estimate public demands for conservation measures surpasses the standards required by the federal government for valuation of nonmarket benefits in cost-benefit analyses (Office of Management and Budget 1996), and is most likely a more conservative valuation technique. Even without submitting increased harvest to a strict cost-benefit test, however, the results here suggest that support for biological conservation in the OCR is high and should be considered in future resource-management decisions.
Conclusions

With competing demands for resource use in the OCR, there is a clear need to investigate the preferences Oregonians hold regarding priorities for conservation, and commercial use, of resources. This research empirically maps the structure of Oregonians’ preferences for four distinct approaches to conserving biological diversity, and uses an economic model to estimate public willingness to pay (WTP) for changes in conservation policies. The use of a multiattribute valuation framework allows a more accurate and flexible characterization of the policy and management scenario than the more commonly used dichotomous choice-contingent valuation method, and permits more detailed measurement of respondents’ choice behavior. Our key findings are substantial differences in WTP across conservation programs and, to a lesser degree, regional populations. All regions expressed substantial positive WTP for biodiversity conservation at least at intermediate program levels. Despite expressing general approval of conservation objectives, respondents also indicated substantial aversion to policy changes. This reduces the estimated WTP for conservation plans and increases the compensation required for decreases in current protections. The findings will be useful to policy makers in planning for landscape-wide initiatives to improve viability of species and ecosystems in the Oregon Coast Range or, alternatively, to diminish the level of protection currently in place on public lands.

Endnotes

[1] CLAMS (www.fs.orst.edu/clams/first.htm; Spies et al. 2002), an interdisciplin ary project, models the social, economic, and ecological effects of alternative forest management and land-use policies involving the full array of ownership classes on the landscape. CLAMS provides tools for policy analysis and primary research in landscape management and ecological change, using geographic information systems, remote sensing, spatial simulations of landowner behavior, vegetation dynamics, and species–habitat relationships. This article is ancillary to CLAMS and provides measures of economic value for potential biodiversity conservation scenarios, for comparison with values of alternative economic OCR landscape outputs.

[2] Stated preference methods and applications have met with criticism from economists and others in a most vigorous methodological debate (Diamond and Hausman 1993, Portney 1994, Kopp and Pease 1997).

[3] CEA is a more general technique for eliciting and measuring public preferences. It encompasses the more familiar (in natural resource economics) dichotomous choice contingent valuation technique. Methodological advantages of CEA relative to contingent valuation technique are discussed in Adamowicz et al. (1999).

[4] A dichotomous choice valuation question was also included. The results from this question and comparison to the choice experiment are left to a future paper.


[6] Carson et al. (2000) presents evidence that respondents typically take into account the demographic terms with attribute terms to prevent this. An alternative specification of the regression model fit to the $R^2$ measure used in linear regression models (Greene 1993), though it does not measure the proportion of variation in the dependent variable explained by the regressors as the $R^2$ does. Noting, as Hanemann and Kanninen (1999) point out, that there is no standard threshold that indicates a satisfactory model fit, the values derived from our estimation performed in this analysis are relatively high.

[7] Summing the direct linear effect with the demographic interaction terms results in a positive linear effect of salmon habitat protection among OCR residents.

[8] Seventy-six respondents indicated in a follow-up question that they chose the status quo because of distrust of the government, opposition to property rights interference, opposition to taxes in general, or other views that are not known, but the potential for bias could be mitigated by specifying more flexible functional forms for the indirect utility function, with interactions between programs. In doing so, response surfaces could be estimated, so that WTP for one program depends on the levels of the other programs. We attempted this strategy by estimating models with interaction terms between program levels. However, singularity problems precluded us from obtaining meaningful results.


[10] The TWTP curve estimated for old-growth forest conservation among the OCR sample was negatively sloped at both above-baseline design levels. This is obscured when averaged with the results from the other two sample strata.

[11] A likelihood ratio test indicated statistically different status quo effects between regions at a 99% confidence level.

[12] Using terms that interacted program levels with dummy variables for strata, likelihood ratio tests were conducted to test for significant difference between coefficients across strata. Results did not reject the null hypothesis of equal coefficients across strata ($\alpha = 0.10$). Demographic differences between regions, however, give rise to substantial differences in calculated WTP functions.

[13] Seventy-six respondents indicated in a follow-up question that they chose the status quo because of distrust of the government, opposition to property rights interference, opposition to taxes in general, or other views that are not known, but the potential for bias could be mitigated by specifying more flexible functional forms for the indirect utility function, with interactions between programs. In doing so, response surfaces could be estimated, so that WTP for one program depends on the levels of the other programs. We attempted this strategy by estimating models with interaction terms between program levels. However, singularity problems precluded us from obtaining meaningful results.

[14] We thank an anonymous reviewer for referring us to DeShazo et al. (2001). The authors of this article develop a test for the effect of unoffered alternatives on respondent choice of the status quo alternative. The test is developed in the context of a consumer choice experiment wherein alternative real-product choices are available, which may plausibly affect respondent choice behavior. We feel that
this hypothesis is less plausible in the context of public-choice referenda. However, it does point out that further research is needed to fully understand the status quo effect and to better control for the choice behavior that gives rise to it.

[18] A model was tested that included a dummy variable for decreases below baseline for each of the conservation programs. Although the parameters on these terms were highly significant and negative, suggesting a discontinuity in demand at the baseline and proportionately higher WTA for decreases, there were insufficient degrees of freedom to estimate more than one of these terms in the model, and none could be estimated simultaneously with the status quo term.

References Cited


LOOMIS, J.B., AND A. GONZALEZ-CABAN. 1997. Comparing the