Int. J. Wildland Fire 4(4): 209-216, 1994

Estimating the Value of Reducing Fire Hazards to Old Growth Forests in the Pacific Northwest: A Contingent Valuation Approach

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Abstract. To expand the scope of natural resource values included in USDA Forest Service fire management analysis system, a mail survey of Oregon households regarding their willingness to pay for a fire prevention and control program on northern spotted owl critical habitat units in Oregon was performed. Using the voter referendum format, annual willingness to pay of $77 per Oregon household was estimated. This translates into a value of $28 per acre protected. The contingent valuation method may provide a promising avenue for incorporating society's broadening concern about biodiversity and natural values into public land management agencies fire management decisions.

Keywords: Amenity benefits; Survey; Spotted owls.

Introduction

Current Federal fire management policies take into account the economic values of several multiple uses such as timber, range, water, game wildlife and recreation in decisions about the type and level of fire suppression. However, many other important forest values including preservation of biodiversity and related non-game animals are not formally included as part of the USDA Forest Service's National Fire Management Analysis System (NFMAS). There has been a growing recognition within the USDA Forest Service that protection of natural values beyond recreation needs to be incorporated into fire decision making (Gonzalez-Caban and Chase, 1992; Gonzalez-Caban, 1993). These values often reflect peoples' desire to know that rare and unique ecosystems exist (e.g., existence value, first proposed by Krutilla, 1967) and will be protected for future generations (bequest value) and that they will be available for visits at future times (option value). The existence and bequest values have been quantified (in dollar terms) for preservation of old growth forests in Washington (Rubin, et al., 1990) and Colorado (Walsh, et al., 1984), but not for protecting these ecosystem types from fire. The protection of old growth forests was identified as a major concern at a workshop on defining what fire managers thought were the major fire management issues in the Pacific Northwest (Gregory, von Winterfeldt and Gonzalez-Caban, 1992).

In the Pacific Northwest only a small percentage of the old growth ecosystem remains on National Forest lands. About 7 million acres of these old growth forests have been designated by the U.S. Fish and Wildlife Service as Northern Spotted Owl Critical Habitat Units. This designation eliminates clear cutting and severely restricts the logging that can be done. However, for these areas one significant threat to preservation of habitat stems from possible catastrophic fires. Fire management policies can reduce the frequency of fires caused by humans and the extent and severity of all fires. The main objective of this research is to use the contingent valuation method (CVM) to measure the sum of recreation use, option, existence and bequest values (called total economic value, see Randall and Stoll, 1983) for a program to reduce the number and extent of catastrophic fires in old growth forests in Oregon.

Past Efforts at Expanding Scope of Fire Decision Criteria

Vaux, Gardner and Mills (1984), in one of the first studies of the perception of fire influenced landscapes and its effect on recreation quality, stated that "Both economic and psychological methods could be used to evaluate the effects of fire on forest recreation. These methods rely on direct and inferential means to assess the values of outdoor recreation. The most suitable of these approaches appears to be contingent market valuation-a direct economic technique that uses personal interviews. A hypothetical market transaction environment is set up within which values are estimated. This approach has been used to assess the impact of insect

infestations and timber cutting on forest environments. The effects of such infestations and cuttings are similar to the effects of fire. " (Vaux, et al., 1984:1). The authors go on to state, "Willingness-to-pay is an appropriate measure for valuing the effects of fire on forest recreation" (Vaux, et al., 1984:1). Their particular study involved about 70 students rating photographs of burned and unburned forest scenes and then expressing a willingness to pay for the preferred scene. The primary objective of their research was to demonstrate the viability of such an approach.

Our research advances the Vaux, et al., (1984) study in several directions. First, the sample is much larger in size and is representative of the general population rather than focusing on college students. Second, we are interested not only in how fire affects recreational benefits of the forest over time but also the magnitude of the non-use or preservation component of the total value of maintaining old growth forest in its current condition. In this study we also emphasize the ecosystem and critical habitat benefits that old growth forests provide for non-game wildlife such as spotted owls, salmon and steelhead, as well as scenic beauty and water quality. Third, we explicitly include the concept of opportunity costs in that we ask participants to state their willingness to pay in dollars of personal income in order to receive the specified benefits.

The Contingent Valuation Method (CVM) is a standardized and widely used method for obtaining willingness to pay for recreation, option, existence and bequest values (Mitchell and Carson, 1989). CVM uses a questionnaire or survey to create a hypothetical market or referendum and then allows the respondent to use the hypothetical market to state or reveal their willingness to pay. The first part of a CVM survey describes the current and proposed quantity or quality of the resource in words and graphics. Next, the respondent is informed of how they will pay for the proposed quantity. For example, will they pay in the form of higher taxes, higher prices for products made from the resource, or a higher utility bill? The appropriate payment mechanism is the one that has a realistic link to provision of the good and is perceived as fair by the respondent. Then the provision rule is made clear: if you agree to pay you get the proposed quantity/quality, if you do not agree to pay, you remain at the current quantity/quality level. There are several question formats that can be used to ask willingness to pay (WTP). The simplest question format is to directly ask the respondent to state or write down their maximum WTP. Since this can be a difficult task for respondents who do not have well thought out values for the good, more recent CVM surveys have respondents state whether they would pay a specific dollar amount. The dollar amount varies from respondent to respondent. This closed-ended question format can be used in a voting format similar to a typical public goods referendum: would you vote in favor of Program B if it cost your household $X per year in higher federal taxes?

Using statements of values from a survey as a measure of WTP is not without its critics. The obvious concern is validity: whether respondents would actually pay the dollar amounts they state or agree to pay in the survey. There have been several approaches to testing the validity of stated willingness to pay including comparison of values derived from CVM surveys with values obtained using actual behavior valuation methods such as travel cost method (Bishop and Heberlein, 1979), property values (Brookshire, et al., 1982) and actual cash (Bishop and Heberlein, 1979). These studies indicate that when surveying users of the resource, that CVM values can be equal to or at least not more than 25% greater than actual willingness to pay. Evaluating validity of survey responses for people that do not use the resource and hence have no easily observable valuation behavior toward the resource in question is much more difficult and definitive experimental designs have yet to be formulated. At present, CVM is the only method capable of quantifying, in dollar terms, the existence and bequest values to the non-visiting general public. While there are legitimate concerns about the degree of accuracy of CVM estimates of WTP for natural resources the public is unfamiliar with, the method has been shown in empirical studies to be reliable (Kealy, et al., 1988, and Loomis, 1989, 1990).

CVM is recommended for use by Federal agencies for performing benefit-cost analysis (U.S. Water Resources Council, 1983), for valuing natural resource damages (U.S. Department of Interior, 1986), and was upheld by the Federal courts (U.S. District Court of Appeals, 1989). Recently, a "blue ribbon panel" including two Nobel laureate economists, an environmental economist and a survey research specialist concluded that CVM can produce estimates reliable enough to be the starting point for administrative and judicial determinations (Arrow, et al., 1993). We were able to follow some, but not all of the "blue ribbon panel's" recommendations. As discussed below we utilized their recommended willingness to pay question format, focus groups and pre-tests were performed, probability sampling was employed and we tested for whether reminders of budget constraints and substitute resources mattered. However, due to limits of our research budget we were not able to perform in-person interviews but rather relied upon mail surveys.

Survey Development

Development of Technical Information on Fire

Prior to actually beginning the survey, the authors met with USDA Forest Service fire management specialists and wildlife biologists in Oregon to obtain an understanding of the natural resources at risk from fire in old growth forests and spotted owl habitat areas. The results of this discussion were used to describe to respondents the likely effects of fire. In addition, this meeting provided information on the frequency and extent of actual fires under current management effort. We obtained this information in both tabular and map overlays from the Forest Service on fire frequency and from the U.S. Fish and Wildlife Service on spotted owl Critical Habitat Units.

From these overlays, we developed our statistics on frequency and extent of fire in spotted owl Critical Habitat Units. From discussion with fire management staff we developed a list of additional fire management actions that could be undertaken by the Forest Service and Bureau of Land Management (BLM) to reduce the frequency and extent of fire in the Critical Habitat Units. We titled this the Fire Prevention and Control Program. After discussion with fire management officials, three main categories of this program were identified: (i) "greater fire prevention efforts", (ii) "earlier fire detection", and (iii) "quicker and larger fire control response". The one sentence elaborations of each of these three management actions given to respondents in the questionnaire are provided below.

Focus Groups and Pre-testing

Two focus groups were held with small groups of Oregon residents. The purpose of these focus groups included discussion of what terms such as old growth forests meant to members of the general public and their perceptions of the effects of fire on old growth forests. One of the primary objectives was to determine if our basic Fire Prevention and Control Program was understandable and realistic. We also sought to explore alternative ways to describe the extent or amount of area burned each year. Another objective was to discuss acceptable ways this program could be funded. In addition the focus groups provided us with a better understanding of the language that participants normally used to describe forest fire related events.

Following these focus groups, a complete survey was pre-tested on a small sample of Oregon residents. Each individual participating in the pre-test was asked to answer a follow-up checklist where we examined several items that have been problems for past CVM surveys. For example we checked to see if individuals understood that the fire control program protected just spotted owl areas in Oregon. Several modifications were made to the questionnaire based on these results (e.g., bolding or underlining was added for emphasis or layout of the questionnaire was changed). Finally the pre-test was used to establish an appropriate range of bid amounts for the dichotomous choice question.

Survey Structure

Non-Monetary Measures of Relative Importance

Before directly asking how much respondents would pay for a fire protection program for old growth forests, it is important to allow the respondents an opportunity to reflect on why they might care about these forests. Cummings, et al. (1986) call this "researching their preferences", or in other words, collecting your thoughts on the topic. Certainly residents of Oregon have been exposed to large and repeated media coverage about old-growth forests and spotted owls. In the weeks prior to the first mailing of our survey, the President and Vice-President and nearly half of the President's cabinet and came to Portland, Oregon for an "Owl Summit". This event was highlighted, in one way or another, in every local newspaper and received extensive TV network coverage. Thus we believe, that Oregon residents have some knowledge about the natural resources present in old growth forests and have had much opportunity to reflect on what these resources mean to them.

The first set of questions asked about the relative importance of old growth forests for recreational use, providing timber, as habitat for plants and wildlife, providing jobs, and providing scenic beauty in Oregon. A five point Likert scale allowed individuals to rate the relative importance of these various reasons for valuing old growth forests in Oregon. This neutral response format (that precedes the dollar valuation questions) will also aid in understanding the WTP amounts respondents provide later in the survey.

Steps in Developing a Contingent Valuation Method Survey

Any CVM survey design involves three elements: (a) portrayal of the resource to be valued; (b) description of the particular mechanism to be used to pay for the resource; and (c) the question format used to elicit the respondent's dollar amount of WTP.

In this case, the resource to be valued was a fire prevention and control program for 3 million acres of

old growth forests in Northern Spotted Owl Critical Habitat Units (CHU's) in Oregon. This point was emphasized by the half page map of western Oregon showing the CHU's that was located directly across from the WTP question. Below the map we described the current number and size of fires in Oregon's Old growth forests. Specifically we stated:

Currently, Federal forest management agencies spend several million dollars each year for fire prevention and control in Oregon's old growth forests. Even with this effort, an average of 300 fires occur per year in the Critical Habitat Units shown above (in the map). These fires burn about 7,000 acres of public owned Critical Habitat Units. The area burned each year is equal to about 1,200 city blocks or 11 square miles, equivalent to an area 2 miles wide by 5.5 miles long. About half these fires are natural and half are caused by humans.

We had developed the examples of alternative ways to view 7,000 acres after discussions in our focus group on how to make such large acreages meaningful.

After the focus groups we refined the elements of the Fire Prevention and Control Program that were listed and described to respondents on the page with the WTP question as follows:

1) Greater Fire Prevention: This includes more fire patrols, maintenance of existing firebreaks surrounding these old growth forests, fire safety education and enforcement of fire regulations.
2) Earlier Fire Detection: This includes more fire lookouts and fire detection airplane flights.
3) Quicker and Larger Fire Control Response: This requires having more firefighters and equipment located closer to old growth forests in Oregon.

The respondents were then told: Adoption of this improved fire prevention and control program would on average reduce the number of acres of Critical Habitat Units that burn by half, a reduction of 3,500 acres a year (from 11 square miles to 5.5 square miles) on publicly owned old growth forests in Oregon.

Comprehension check questions following the pretest indicated a majority of individuals comprehended that this program pertained only to Oregon's old growth forests.

The means by which all households would pay was framed as a voter referendum in what is also known as closed-ended or dichotomous choice. The dichotomous choice format mimics an actual vote by simply asking if the person would vote (e.g. pay) for the item if it cost the household a particular dollar amount each year. In this case the individual must just decide if the value to him or her is worth at least this price or not. The dichotomous choice format is recommended by the "blue ribbon panel" on CVM (Arrow, et al., 1993).

The exact question was:

Because Oregon's old growth forests are also Federally designated Critical Habitat Units for the threatened Northern Spotted Owl all U.S. households would pay into a special Oregon Old Growth Fire Control Fund. By law this fund could only be used to pay for fire protection in Federally owned old growth forests shown on the map. Adoption of this program would be decided as part of a national election.

Suppose this Oregon Old Growth Fire Prevention and Control Program proposal was on the next ballot. This program would reduce by half the number of acres of old growth forests in Critical Habitat Units that burn in Oregon each year. If it cost your household $X each year would you vote for this program? YES NO.

Federal trust fund approaches such as Pittman-Robertson and Dingell-Johnson have been used for decades to fund wildlife and fisheries improvements through out the U.S. This trust fund is financed with excise tax monies.

Since the printed dollar amount ($X) varies across the sample, the dichotomous choice format allows the analyst to statistically trace out a demand like relationship between probability of a 'yes' response and the dollar amount (Hanemann, 1984). The basic relationship is:

$$\text{Prob(Yes)} = 1-\{1+\exp[B_0 - B_1 (\$X)]\}^{-1} \quad (1)$$

where B's are coefficients to be estimated using either logit or probit statistical techniques and $X is the dollar amount the household is asked to pay.

From equation 1, Hanemann (1989) provides a formula to calculate the expected value of WTP if WTP must be greater than or equal to zero. The formula is:

$$\text{Mean WTP} = (1/B_1) * \ln(1+\exp^{B_0}) \quad (2)$$

where WTP≥0

If some respondents view fire as beneficial to the old growth forest ecosystem then their WTP to reduce fire could be negative, i.e., they would need to be compensated for reductions in fire. To allow for this, we used an alternative formula provided by Hanemann (1989) that allows part of the logit curve to fall into the negative quadrant. With a linear logit model this mean WTP allowing for negative WTP of some individuals is equal to the median. Equation 3 provides this alternative formula:

$$\text{Median WTP} = Bo/B_1 \quad (3)$$

Twenty different bid amounts ranging from $2 to $300 were randomly assigned to survey respondents. The range was picked such that at the low end, anyone that thought fire would damage old growth forests or northern spotted owl critical habitat would very likely indicate they would pay $2, while almost no one was expected to pay $300 per year.

To check the representativeness of our returned surveys against the population of Oregon, simple demographic questions such as age, education, membership in environmental organizations and income were asked. The final questionnaire was typeset and bound in a 6 page booklet.

Sample Design

The questionnaire was sent to a random sample of 1,000 Oregon households. The sample was provided by Survey Sampling Inc. The overall survey design and mailing procedure follows Dillman's (1978) Total Design Method (first mailing, postcard, second mailing). Each individual was sent a personalized cover letter on Decision Research letter head with a personal signature. The first mailing was sent out the first week in May, with a reminder postcard four business days later. A second mailing of the survey with a new cover letter was sent to non-respondents the first week in June.

Results

Response Rate

In total, 425 surveys were completed and returned, which after deleting undeliverables and deceased yielded a response rate of 49.4%. The response rate is typical for a general population survey using a first mailing-postcard-second mailing without any financial incentives. In addition, Oregon residents may have become overwhelmed by all the attention to the Northern Spotted Owl controversy and some persons may have lost interest in the issue.

Table 1 compares the demographics of the sample to all Oregon households. As is typical in mail surveys, the sample education level, income and age is greater than the state level. Due to Survey Sampling Inc., drawing of the majority of names from the phone books, which are traditionally listed under the males name, the sample overrepresented males. Below we provide a statistical adjustment to account for potential non-response bias and less than perfect representation of Oregon's population when generalizing the sample results to the entire state of Oregon.

Table 1. Comparison of Demographic Characteristics of Sample With Oregon's Households.

	Sample	Oregon
Age	52.6	49.0
Education	14.3	13.0
Income	$37,832	$32,336
Percent Male	69	49

Screening of Potential Protest Responses

As is standard, a follow-up check question is asked after the WTP question to determine if those refusing to pay or stating a zero WTP represent a valid representation of their value or reflect a protest about some feature of the simulated referendum (Mitchell and Carson, 1989). This check question had five response categories. The first two categories represent valid refusals or zero's and are considered non-protests. These categories were "the program is not worth anything to me" and "I cannot afford to pay at this time". Fourteen respondents gave the first reason and 32 respondents indicated they could not afford to pay. This latter response is particularly encouraging as it meant they took the commitment to pay seriously.

The third through fifth categories represent what are usually classified as protest or scenario rejection responses. These included "I don't think the program would work" with 32 responses, "it is unfair to expect me to pay" with 23 responses, "I am opposed to any new government programs" with 62 responses and finally "fire is natural and benefits the forest" with 26 responses. These responses are usually not considered valid representations of the individuals willingness to pay, though they do represent valid concerns. These concerns may include a rejection of the basic premise of the CVM market, some feature of the scenario, other concerns about the survey or generalized concerns about the overall issue. These responses are normally not included when WTP is computed (Mitchell and Carson, 1989). Thus, implicitly, the sample average WTP is applied to these individuals when the sample is expanded to the population.

Overall, there is a higher level of protest responses than is desirable and may in part be due to not convincing the respondent that the fire prevention and control program would work. This can perhaps be improved upon in future surveys by including a statement that scientists have demonstrated such a program would work. Alternatively these expressions may represent opinions about government programs in gen-

eral or a feeling that too much attention has been focused on the spotted owl in Oregon. To resolve these motivation behind the responses would take an in-person interview and is an important priority for future research. Regardless of the motivations for these protest responses we perform both a separate logit equation and calculation of WTP including protests (i.e., the full set of returned surveys) to assess the sensitivity of our results to the conventional deletion of protest respondents. When coupled with our allowance that some respondents might hold negative WTP's for reductions in fire, an ultra-conservative lower bound estimate of the fire control benefits is provided.

Statistical Analysis

Calculation of WTP from the yes/no referendum format data requires estimation of a logit or probit equation relating the yes/no response to the bid amount and other independent variables (Hanemann, 1984). Table 2 provides the coefficients and t-statistics for the multivariate logit equation with protest responses removed and protest responses included. As can be seen the pseudo R^2 is 31% and 21%, respectively, for the multivariate logit equations with and without protests removed. All of the coefficients have the expected sign and are significant at the .05 alpha level or higher in the equation without protests and all but one coefficient is significant in the equation with protests included. For example, the higher the dollar amount they were asked to pay, the *less* likely they would vote for the fire program. The more harmful the individual thought fire was to diversity of plants, fish and wildlife (Fire Harm), the more likely they would pay for the program to reduce the number and extent of fires. People who used the forest for recreation were more likely to pay for the fire prevention and control program.

Income, age and gender were not statistically significant. Even excluding education due to its colinearity with income did not result in income having a statistically significant effect. This may be due to the dollar amounts most people in the sample were asked to pay being small compared to their income.

Figure 1, presents the logit curves and benefit estimates derived from the multivariate logit models in Table 2. The distribution when protest responses are removed is relatively symmetric and well behaved. This is supported by the fact that the median (i.e., .5 probability level) is \$81 while the mean, calculated from equation 2, is \$90 per year (with a 90% confidence interval of \$76 to \$111). Thus while this equation includes those that would not pay for the fire reduction program because they received no benefits or could not afford to pay, the zero or potentially negative WTP is relatively small. The same is not true when we include all protest responses. Here those that believe the program would not work or are opposed to any government programs regardless of merit, pulls the logit curve down dramatically, resulting in a wide divergence between mean WTP of \$59 (with a 90% confidence interval of \$47 to \$79) and a median of \$9. If a decision maker wishes to value a program that they and the "professionals" believe will work, then it seems inconsistent to include valuations of respondents which are premised on the program not working. Therefore,

Table 2. Multivariate Logit Equation for Fire Prevention & Control Program.

	Data with Protests Removed		Full Data	
Variable	Coefficient	T Stat	Coefficient	T Stat
Constant	-3.8395	-3.93	-4.334	-5.47
Fire Harm[1]	0.3081	3.79	0.2759	4.46
Existence Importance[2]	0.4085	2.46	0.5669	4.34
Education[3]	0.2411	3.99	0.1721	3.71
Forest Recreation[4]	0.7165	1.98	0.2638	0.86
Bid Amount[5]	-0.02075	-3.94	-0.0128	4.99
Chi-Square	102.47		93.69	
Pseudo R square	31%		21%	

[1] Fire Harm is a person's perception of whether fire is harmful to diversity of plants and animals, health of trees, muddying of salmon spawning habitat and northern spotted owl habitat.
[2] Existence Importance is the importance of knowing old growth forests exists in Oregon.
[3] Education is education level in years
[4] Forest Recreation is a dummy variable for whether they had visited forests for recreation in the past 12 months.
[5] Bid Amount is the dollar amount they were asked to pay.

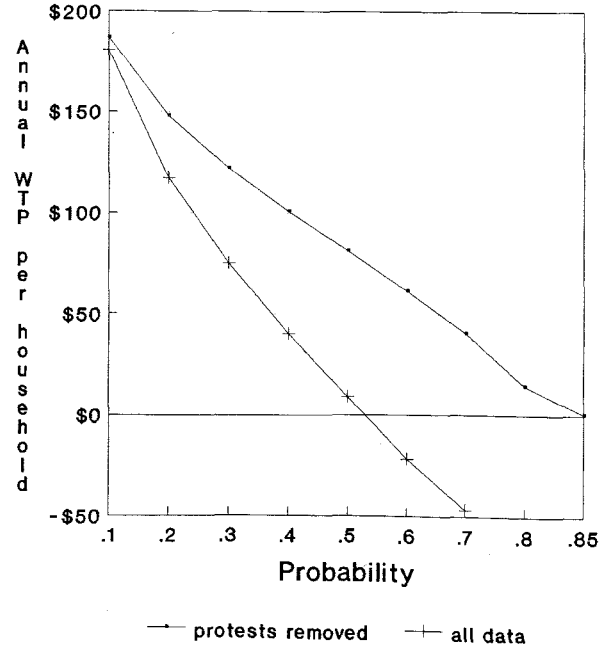

Figure 1. Oregon Household's WTP Function for Fire Prevention in Old Growth Forests.

in the remaining discussion we focus on generalizing and statistically adjusting WTP responses of those that did not reject the basic premise that the fire control program would be beneficial to protection of northern spotted owl habitat and that such a program could achieve the reduction in acreage burned specified in the survey.

Discussion

When expanding the sample to the population one critical concern is the external validity or generalizability of the sample values to the population. This is partly dependent on the representativeness of the sample frame and the survey response rate. While our sample frame was a random sample of Oregon's households, the response rate is a little lower than desirable. The net effect was illustrated in Table 1, where our sample had about 1.3 years more of education than the state of Oregon as a whole.

To correct for the higher education level of the sample and estimate a mean WTP more representative of Oregon's population, the logit equation in Table 2 can be used with the state of Oregon average education level (Schulze, et al., 1983; Loomis, 1987). Using the state of Oregon average education level of 13 years instead of the sample estimate of 14.3 years we obtained an estimated overall state of Oregon WTP of $77 per household. This translates into an annual WTP by Oregon residents of $84.6 million for the old growth forest fire prevention and control program.

This $85 million annual value ignores any value that households in the other 49 states in the U.S. would place on reducing the risk of wildfire in Oregon's old growth forest and spotted owl habitat. The U.S. population has about 100 million households and Oregon has about 1 million households. While, we would expect that rest of the U.S. households would hold a much lower value per household toward fire protection in Oregon's old growth forests than Oregon residents, the total value of the rest of the U.S. would likely dwarf the value held by just Oregon's residents.

In terms of putting the values on a per acre basis consistent with how it is used in USDA Forest Service National Fire Management Analyses System (NFMAS) we would divide the $84.6 million by the 3 million acres of old growth forests in northern spotted owl critical habitat units protected. This results in an annual value to just Oregon residents of $28 per acre protected. Protection of public lands for a federally listed threatened species is a national concern and is close to a pure public good. The annual value to the nation of this program could be ten times the $28 per acre figure ($280 per acre) if U.S. households outside of Oregon have WTP values per household just one-tenth those of Oregon households. In any case, this *type* of value can be integrated with other multiple use values of old growth forests in critical habitat areas of the northern spotted owl to recalibrate the economically optimum amount of fire effort justified. To facilitate comparison to timber values which often reflect present values over long rotations, we capitalized these annual values at the USDA Forest Service's 4% discount rate. Doing so yields values to Oregon residents of $700 per acre protected.

Another way to view the Oregon willingness to pay results is that respondents were told in the survey that the fire prevention and control program would reduce by half the number of acres of old growth forests that would burn each year. This represents a reduction of 3,500 acres of old growth forest that would no longer burn each year. If we take the estimate of WTP of $84.6 million annually and divide it by 3,500 acres that would no longer burn, the resulting value per acre saved from fire is $24,170 per year.

Conclusion and Future Research

The contingent valuation method was used to obtain estimates of willingness to pay values for reducing the number and extent of wild fires within northern spotted owl critical habitat units of Oregon's old growth forests. The survey obtained nearly a 50% response rate. Using the dichotomous choice voter referendum format, the annual value per household in the sample was $90. Adjusting for differences between the sample and Oregon's education level, we estimated the population's WTP at $77 per household. This translates into Oregon resident's willingness to pay of $85 million annually. On a per acre of old growth forest protected from fire this is $28. If other U.S. residents hold values even one-tenth as large as Oregon residents, this value becomes $280 per acre for protecting northern spotted owl critical habitat areas in Oregon.

Thus, the contingent valuation method appears to be a promising approach to include a broader range of societal concerns about biodiversity and ecosystems in USDA Forest Service fire management decisions. Numerous improvements in future surveys could be made including more effort to convince the respondent that the fire prevention and control program would work as intended and distinguishing ecosystem types for which fire is beneficial from those where fire is detrimental to increasingly scarce species. A better understanding of respondents answers could be obtained from more expensive in-person interviews. More representative demographics could be obtained in fu-

ture surveys if the sample frame is generated from a more expensive random digit dialing approach of all households. Given the sensitivity of national estimates of protecting old growth forests in Oregon from fire to what the 99 million households outside of Oregon are willing to pay, a national survey regarding this issue is certainly worthwhile. Of course, alternative value elicitation formats such as paired-comparison or multi-attribute decision techniques should also be explored as they may also prove suitable and perhaps complementary to contingent valuation in providing fire management officials with societal concerns about fire in ecosystem management on public lands.

Acknowledgements. We would like to thank Paula Stevens and Sunny Williams, for assistance in survey mailing and data entry. Kari Nelson and Geri Hanson at Decision Research facilitated the mailing and checking of surveys. Dr. Peter Teensma, Bureau of Land Management and Harold Legard and Dean Longrie of the USDA Forest Service provided technical information and guidance on the fire risk to old growth forests and effects on spotted owls. Robin Gregory helped immensely in the survey design and conducted the focus groups and pretest. Lastly, three anonymous reviewers provided numerous suggestions for broadening the statistical analysis and interpretation of the results. The assistance of all of these individuals is greatly appreciated but they bear no responsibility for the contents of this paper. Funding was provided by the USDA Forest Service, Pacific Southwest Station's Forest Fire Lab, under cooperative agreement PSW-92-0044CA. The views expressed represent the individuals and do not reflect any official position of the USDA Forest Service.

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