Do Cultural Differences Affect Support for Alternative Wildland Fire Mitigation Strategies: Native Americans in Montana, USA

A. González-Cabán[1], J.B. Loomis[2], H. Hesseln[3]
[1] USDA Forest Service, Riverside, CA, USA
[2] Colorado State University, Fort Collins, CO, USA
[3] University of Montana, Missoula, MT, USA

Abstract

Responses of Montana residents and members of two tribes, living on and off of Reservations in Montana, are compared on survey response rates, protest responses and willingness to pay for two forest fire prevention programs. A combination phone interview with respondents following along with a previously mailed information booklet is used to convey the prescribed burning and mechanical fuel reduction program. The comparison indicates the survey response rates of Native Americans and other Montana residents were similar on the initial contact phone interview, but fell significantly for Native Americans for the follow up in depth interviews. In addition the individual reasons for voting against the two programs were asked in an open-ended format and then post-coded to compare the types of reasons given for voting against the program. The protest rates for the prescribed burning program were 7% for Native Americans and 9.6% for Montana residents, not a statistically significant difference. The protest rate for the mechanical fuel reduction program was much higher for both groups as 22% for Native Americans and 32% for Montana residents and the difference is significant at the 0.05 level. Several statistical tests of the logit coefficients in the WTP function were conducted. A simple pooled model found the Montana general population's intercept and bid slope interaction variables were not significantly different from zero, implying no significant differences in these variables between Native Americans and general Montana households for the prescribed burning or mechanical fuel reduction program. A likelihood ratio test indicated that overall coefficients of the Native American and Montana general populations were statistically different for the prescribed burning at the 0.01 level and the 0.05 level for the mechanical fuel reduction program. Finally, the mean willingness to pay of Native Americans was nearly twice that of Montana residents for prescribed burning and mechanical fuel reduction, but the large variances around the Native American mean WTP estimates suggests this differences in mean WTP for the two groups of residents is not significantly different.

Introduction

In the United States Native American communities have not enjoyed the economic boom sustained by the country for over the last 100 years. The impact of government programs on their communities by and large has not been studied in depth. In 1994, pressured in part by the social justice movement, President Clinton enacted Executive Order 12898 requiring federal agencies to evaluate the social justice of federal actions on minority populations. The Order requires policy makers to understand the impacts of their projects and policies on different cultural groups and to make sure that these groups do not shoulder the brunt of possible negative impacts of proposed programs or actions. Generally agencies use surveys to ascertain the potential impact of their actions on households. When valuing non-market effects of forest management contingent valuation method (CVM) surveys are often used. To

the best of the authors' knowledge to date there have been no published comparisons of CVM responses of Native Americans and US general population households.

The objective of this study was to determine the level of support by Native American communities in Montana as compared to Montana's general population for two alternative wildland fire mitigation strategies. In addition we wanted to test how well the CVM works in Native American communities to determine the applicability of the method and how well it captures Native Americans' WTP for non-market products and/or services. This research may help policy makers and natural resource managers understand how respondents' cultures may influence participation and response rates in CVM surveys. If cultural differences are found between Native Americans in Montana and the Montana general population this may suggest the need to add culture-specific material to CVM surveys in the future.

Methods

CVM is based on survey techniques to elicit values for non-market goods or services. CVM uses stated preferences by respondents based on a contingent market for the good or service evaluated. This elicitation process is necessary because there is a lack of observable market prices for services such as wildland fire risk reduction. CVM permits the calculation of WTP for goods or services that can then be compared to management costs.

The three steps in producing a valid CVM survey are: (a) providing information about the good or service to be evaluated; (b) including a section for the elicitation of value; and (c) the collection of demographic information (Mitchell and Carson 1989). Although there are still some concerns about the reliability and validity of CVM results (see Carson et al. 1996), empirical test-retest studies have demonstrated CVM results to be reliable (Loomis 1989; Reiling et al. 1990). CVM is an accepted tool to obtain values for non-market goods and/or services. A "blue ribbon panel" co-chaired by two Nobel laureates has indicated that well designed and carefully conducted CVM studies can provide useful information for administrative and judicial decisions (Arrow et al. 1993).

A logistic regression is used to derive WTP from a dichotomous choice question format used in the survey. Because the dollar amount households are asked to pay varies across the sample, the dichotomous choice format allows the analyst to statistically trace out a demand-like relationship between the probability of a "yes" response and the dollar amount (Hanemman 1984). The basic relationship is

$$(1) \qquad \text{Prob(yes)} = 1 - \left\{1 + \exp\left[\beta_0 - \beta_1(X_1) + \beta_2(X_2)\right]\right\}^{-1}$$

where β s are the coefficients to be estimated using logit regression techniques, X_1 is the dollar amount the household is asked to pay, and X_2 is a demographic variable.

The mean and the median WTP (equations 2 and 3) are calculated using information from the logistic regression through a series of equations derived by Hanemman (1984, 1989), where WTP must be greater than or equal to zero.

$$(2) \qquad \text{Mean WTP} = \left(1/\beta_1\right) * \ln\left(1 + \exp^{\beta_0 + \beta_2 X_2}\right)$$

(3) Median WTP $= \left(\beta_0 + \beta_2 \overline{X}_2\right) / \beta_1$

Demographic variables are included as independent variables in the logistic regression. The expected significant variables are formulated from past survey material and economic theory. The development of a model with expected significant variables helps in the design of the survey instrument.

Survey Design

The principal source of information for development of the survey instrument used in Montana was USDA Forest Service wildland fire management personnel at the regional and local levels. Agency personnel provided technical information on how the prescribed burning and mechanical fuels reduction projects are conducted and the possible environmental effects associated with each activity. They also reviewed the survey instrument to assure the correct representation of the wildland urban interface problem in Montana[1].

Focus Groups

Two focus groups were conducted in February of 2001 to test the comprehensibility to the Native Americans populations. The focus groups were conducted one each on the Confederated Salish-Kootenai reservation, Pablo, MT, and the Blackfeet reservation, Browning, MT. The Tribal Councils of both tribes graciously approved the participation of tribal members in this research effort. Both focus groups consisted of about 18 to 20 people. There was no problem in the interpretation or comprehension of the information provided on the survey instrument. Following the focus groups a complete mail booklet and survey script was developed. No focus groups were conducted for Montana's general population because the survey was the same as used in Florida and California general populations for a similar study. The final survey was an 8-page color booklet.

The willingness to pay question used a voter referendum format. The payment vehicle was an increase in state income taxes for the program. In order to begin to assess protest responses, any respondent that indicated they would not pay their initial bid amount was asked a follow-up question at $1 cost. Those that said no to $1 were asked an open-ended question as to why they voted no. These responses were recorded verbatim by the interviewer and then post-coded by the author who conducted the focus groups.

Sample Design and Survey Mode

The final target sample size to achieve our desired objectives was 500 completed interviews. The data collection was divided into two groups: (a) Native Americans and (b) Montana's general population. The Native Americans were further divided into two groups: (a) the Confederated Salish-Kootenai Tribe and (b) the Blackfeet Tribe. The target sample size for each of the two tribes was 125 completed interviews for a total of 250 Native American households. The target sample for Montana's general population was 250 households as well. The final sample size was 502 completed interviews; 21 interviews fewer for the Native American population and 23 greater for the Montana general population.

[1] The survey instrument is available from the senior author

Random digit dialing of the population was used to obtain a representative sample of each area. The initial contact was used to secure participation from the household and to agree to an appointment for a detailed follow-up interview using a typeset, color booklet that would be mailed to respondents. The booklet contained questions and scenarios about the two different fire management policies (prescribed burning and mechanical fuels treatment), as well as two illustrations contrasting wildland fires and prescribed fires. Participants were asked to read the booklet prior to the agreed upon phone interview.

Results and Discussion

The Montana general population residents and Native American residents were surveyed from spring 2001 to spring 2002. The final dataset was received for analysis in April 2002. The initial response rate to the screening protocol (**First Wave**) for Montana's general population was 67.6 %, and 73.9 % and 73.8 % for the Blackfeet and the Confederated Salish-Kootenai tribes. A Chi-Square test showed no significant differences in the response rate between the three populations for the screening protocol[2].

Those individuals not interviewed because of an incorrect phone number or who did not have appropriate respondent qualifications, such as being over 18, were not included in the final calculated response rate. Those participants who refused to complete the interview or rescheduled without future contact (Callback) were included in the response rate as unit non-responses. Likewise, any individual contacted but not interviewed was included in the response rate as non-response. The unit non-response category also included respondents who completed the screener but did not follow through with completion of the entire survey process. Taking all these factors into account produced a net sample size for the second interview of 273 individuals for Montana's general population, and 109 and 125 for the Blackfeet and the Confederated Salish–Kootenai tribes. The final response rate for Montana's general population, the Blackfeet tribe and the Confederated Salish-Kootenai tribe were 73.2, 48.1, and 57.6 percent respectively. A Chi-Square test showed that the response rates of the net sample (**Second Wave**) for these three populations are significantly different from each other at an alpha level of 0.05[3]. A possible explanation for the lower response rate of Native Americans could be that if they opposed the program they avoided answering the survey. People familiar with the behavior of Native Americans suggest that their way of avoiding saying "no" or disagreeing, is simply to abstain. Another possible explanation is that their treatment of time commitments is different from the general population.

Analysis of Protest Responses

The interviewer recorded open-ended statements of the reason why any respondent voted no to paying the stepped down minimum bid of $1. A "no" response for reasons other than the lack of value for the program, or un-affordability constituted a protest vote. These included reasons such as opposition to government programs, stating that the program will just not work, opposition to taxes, or the program causing environmental damage, etc. In each group, "no" responses were categorized and identified as protest or non-protest responses. This process was completed for each fuels treatment program. Both groups consistently showed a higher preference for the prescribed burning program.

[2] Results are available from the senior author
[3] Results are available from the senior author

To test the hypothesis of whether there is a difference in the protest rate for general Montana households and Native Americans, the protest responses were aggregated to a contingency table. The protest rates for the prescribed burning program were 7 % for Native Americans and 9.6 % for Montana residents. A chi-square test indicates there is no statistical difference between these protest rates ($p = 0.4$)[4]. The protest rate for the mechanical fuels reduction program was much higher for both groups at 22 % for Native Americans and 32 % for Montana residents. Further, the protest rate for Montana general residents is significantly higher than for Native Americans ($p=0.024$)[5]. This result suggests different information may be needed to fully convey the managerial aspects of the mechanical fuels reduction programs such as thinning, or that different a payment vehicle is needed for the more reluctant general residents of Montana.

Logistic Regression Results

The first test to determine if the general population of Montana has a different WTP function from that of the Native American population living in Montana was whether these two groups differ only by an intercept shifter and bid slope interaction term. A statistically significant bid slope interaction term would potentially indicate a significant difference in WTP, as the bid slope has a direct influence on WTP. To be as general as possible we include all the variables that theory or the past literature suggests may be important determinants of WTP. Regression results showed that Montana's general population intercept and bid slope interaction variables were not statistically significantly different from zero for either the prescribed burning program (Bidrx_MTGen01 P=0.4468, MTGenPop P=0.3888) or the mechanical fuels reduction program (BidMec_MTGen01 P=0.2394, MTGenPop P=0.8308)[6]. This suggests there are no simple differences between these two groups with respect to these programs.

To provide a less restrictive test, we performed a likelihood ratio test of whether the coefficient vectors for the entire logit equations are different between Native Americans and general Montana households. The likelihood ratio test for prescribed burning of the pooled versus the individual models yielded a calculated chi square of 40.495, which is significantly different from the critical chi square at the 0.01 level, suggesting that the magnitudes of at least some of the coefficients of variables explaining Native American's WTP and the general Montana population's WTP are statistically different[7].

The calculated chi-square of 38.112 for the mechanical fuels reduction model of the pooled versus the individual models is significantly different from the critical chi-square at the 0.05 level but not at the 0.01[8]. This too indicates different magnitudes between some of the coefficients for Native Americans' WTP and that of general Montana households.

Reduced Logit Models for Calculating WTP

Having estimated the initial model with all the variables thought to be relevant, these preliminary logistic regressions were used to determine the significant variables affecting WTP for each fuels treatment program for each of the two sample groups: Native Americans

[4] Results are available from the senior author
[5] Results are available from the senior author
[6] Results are available from the senior author.
[7] Results are available from the senior author
[8] Results are available from the senior author

and Montana's general population. A reduced model containing only significant variables was used to calculate median and mean WTP, to increase the statistical efficiency and tighten the confidence intervals. Results for only the regressions without the protest responses are reported below.

Native Americans Logistic Regression Results to Calculate WTP for Prescribed Burning

Using the initial model significant variables, only two variables proved significant in influencing the WTP for the prescribed fire fuel treatment program reduced model (table 1). Only the "prescribed fire reduces high intensity fire" (RxRedHiFire) variable and the "dollar amount voted on" (BidRx) variables are significant. The RxRedHiFire variable determines if the respondent feels the prescribed fire program will reduce the chance for future high intensity wildfires. The more effectively respondents think that prescribed fire can achieve this objective, the more likely they are to support the program. The bid amount (BidRx) follows economic theory in that the higher the dollar amount asked of each respondent; the less likely they are to vote in favor of the program.

WTP for the prescribed fuel treatment program was calculated from the logit model. The mean and the median WTP for the prescribed fuels treatment program for the Native Americans are $674.21 (90% confidence interval $424-2640) and $582.14 per household per year.

Table 1. Logistic regression for the Native Americans for the prescribed fire fuels treatment program corrected for protest responses.

Variable	Coefficient	Std. Error	z-Statistic	Probability
C	-0.4590	1.2058	-0.38	0.7035
BIDRX	-0.0024**	0.0012	-2.01	0.0446
RXREDHIFIRE	1.9092*	1.1856	1.61	0.1073
Mean dependent variable	0.7222	S.D. dependent variable		0.4495
S.E. of regression	0.4400	Sum squared residual		27.2935
Restricted Log likelihood	-85.0813	McFadden R-squared		0.0468
LR statistic (2 df)	7.9577	Probability (LR stat)		0.0187
N	144			

Note: Single and double asterisk (*) denote statistical significance at the 0.10 and 0.05 levels.

Montana's General Population Logit Regression for Calculating WTP for Prescribed Burning

As in the Native Americans' population, using the initial model significant variables, only two variables proved significant in influencing the WTP for the prescribed fire fuel treatment program reduced model (table 2). Only the variables, "fire bothers them both physically and visually" (BotherBoth) and the "dollar amount" (BidRx) are significant. The BotherBoth variable represents how respondents feel wildland or prescribed fire affects them physically and visually. The more they think fire affects them both physically and visually the less inclined they are to support such a program. Thus, the negative sign is intuitively sensible. The bid amount again follows economic theory in that the higher the dollar amount asked of each respondent; the less likely they are to vote in favor of the program.

WTP for the prescribed fuel treatment program was calculated from the logit model. The mean and the median WTP for the prescribed fuels treatment program for the Native Americans are $343.72 (with a 90% CI of $262-558) and $279.61 per household per year.

Table 2. Logistic regression for Montana's general population for the prescribed fire fuels treatment program corrected for protest responses.

Variable	Coefficient	Std. Error	z-Statistic	Probability
C	1.5432***	0.3420	4.51	0.0000
BIDRX	-0.0042***	0.0012	-3.46	0.0005
BOTHERBOTH	-0.7590**	0.3583	-2.19	0.0341
Mean dependent variable	0.6184	S.D. dependent variable		0.4874
S.E. of regression	0.4646	Sum squared residuals		32.1563
Restricted log likelihood	-101.0544	McFadden R-squared		0.0828
LR statistic (2 df)	16.7343	Probability (LR stat)		0.0002
N	152			

Note: Double and triple asterisk (*) denote statistical significance at the 0.05 and 0.01 levels.

Native Americans Logistic Regression Results to Calculate WTP for Mechanical Fuel Treatment

Only two variables proved significant in influencing WTP for the mechanical fuels treatment program reduced model (table 3). The variables "prescribed fire reduces high intensity fires" (RxRedHiFire) and the bid amount (BidMec), or cost of the program, were significant.
The variable RxRedHiFire is difficult to interpret in the context of the mechanical fuels treatment program. This finding suggest that if respondents think that prescribed fire reduces the chance of high intensity fires they would vote for a mechanical fuels treatment program. As with the prescribed fire fuels treatment program, the bid amount asked of each respondent follows economic theory.

WTP for the mechanical fuels treatment program was calculated from the logit model. The mean and the median WTP for the mechanical fuels treatment program for the Native Americans are $409.87 (with a 90% CI of $147-1455) and $214.75 per household per year.

Montana General Population Logistic Regression Results to Calculate WTP for Mechanical Fuel Treatment

Similar to the Native Americans results, only two variables proved significant in influencing the WTP for the mechanical fuels treatment program reduced model (table 4); both the "respondent income" (Inc) and the "bid amount" (BidMec), or cost of the program, were statistically significant. The positive sign of the variable Inc indicates that more affluent respondents would be more inclined to support or vote for the mechanical fuels treatment program. As in the previous models the bid amount asked of each respondent follows economic theory.

Table 3. Reduced mechanical fuels treatment program model—Native American population dataset corrected for protests.

Variable	Coefficient	Std. Error	z-Statistic	Probability
C	-1.5402	1.0871	-1.42	0.1566
BIDMEC	-0.0024**	0.0011	-2.28	0.0227
RXREDHIFIRE	2.1631**	1.0887	1.99	0.0469
Mean dependent variable	0.5280	S.D. dependent variable		0.5008
S.E. of regression	0.4874	Sum squared residual		37.5340
Restricted log likelihood	-111.3450	McFadden R-squared		0.0512
LR statistic (2 df)	11.3951	Probability (LR stat)		0.0034
N	161			

Note: Double asterisk (*) denote statistical significance at the 0.05 level.

WTP for the mechanical fuels treatment program was calculated from the logit model. The mean and the median WTP for the mechanical fuel treatment program for the Native Americans are $254.55 (with a 90% CI of $194-410) and $142.49 per household per year.

Table 4. Reduced mechanical fuels treatment program model—Montana general population corrected for protests.

Variable	Coefficient	Std. Error	z-Statistic	Probability
C	0.1735	0.3275	0.53	0.5963
BIDMEC	-0.0040***	0.0011	-3.48	0.0005
INC	9.16E-06*	5.63E-06	1.63	0.1038
Mean dependent variable	0.4833	S.D. dependent variable		0.5011
S.E. of regression	0.4811	Sum squared residuals		40.9690
Restricted log likelihood	-124.6665	McFadden R-squared		0.0652
LR statistic (2 df)	16.2462	Probability (LR stat)		0.0003
N	180			

Note: Single and triple asterisk (*) denote statistical significance at the 0.10 and 0.01 levels.

Willingness-to-Pay Results

The mean WTP for the Native Americans is larger than that of the Montana general population households for both the prescribed burning and mechanical fuels treatment programs, excluding protest votes (table 5).

A simulation technique developed by Park et al. (1991) that uses the variance-covariance matrix was used to develop confidence intervals around the mean WTP for both the Native American and Montana general population groups. An overlapping confidence interval would be an indication that there is no statistical difference between population groups' WTP. For both the prescribed burning and the mechanical fuels reduction program there are no statistical differences between Native Americans' mean WTP and that of the general Montana residents. It is interesting to note that in contrast to Loomis et al. (2002), the Native Americans have a much greater variance of WTP than do the general Montana residents.

Table 5. Native Americans and Montana general populations corrected for protests Mean WTP estimates for the prescribed burning and mechanical fuels treatment programs.

Fuel Treatment Program	Native Americans	Montana general population
Prescribed burning	$674	$344
Confidence Interval (90%)	424-2640	262-558
Mechanical fuels reduction	$410	$255
Confidence Interval (90%)	147-1455	194-410

CONCLUSION

Responses of Montana residents and members of two tribes, living on and off of reservations in Montana, were compared on survey response rates, protest responses and willingness-to-pay for two forest fire prevention programs. A combination phone interview with respondent in conjunction with a previously mailed information booklet was used to convey the prescribed burning and mechanical fuels reduction programs. The comparison indicates the survey response rates for the initial phone interview were not statistically different between Native Americans and other Montana residents, but fell significantly for Native Americans for the follow-up, in-depth interviews. Protest responses for the prescribed burning program were 7 % for Native Americans and 9.6 % for Montana residents which was not statistically significantly different. The protest rate for the mechanical fuels reduction program was much higher for both groups at 22 % for Native Americans and 32 % for Montana residents; the difference between the two groups is significant at the 0.05 level. A simple pooled model found the Montana general populations intercept and bid slope interaction variables were not significantly different from zero, implying no significant differences in these variables between Native Americans and general Montana households for the prescribed burning or mechanical fuels reduction programs.

However, a likelihood ratio test indicated that overall the logit regression coefficients of the Native Americans and Montana general populations were statistically different for the prescribed burning program at the 0.01 level and the 0.05 level for the mechanical fuels reduction program. Finally, while the mean WTP for the programs was nearly double for Native American households, because of the large variance on the Native American WTP, the confidence intervals overlapped suggesting no statistical difference in WTP at the 90% level.

Native Americans had a significantly lower response rate to the follow-up survey that reduced our ability to generalize from the sample of Native Americans to the general Native American population. Future surveys should attempt to see if including a letter from tribal officials or other means of motivating Native Americans might improve the response rate. In terms of support for the forest fire management programs, support for prescribed burning was similar between general Montana households and Native Americans. For the mechanical fuels reduction program, the significantly lower protest rate indicates Native Americans actually supported this program at a higher level than did Montana residents. Willingness to pay for the prescribed fire program was 50% higher and the protest rate about one-third lower than for the mechanical fuels reduction program. This suggests there may be more public support in Montana for prescribed burning than mechanical fuels reductions.

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