The Effects of Fire on Recreation Demand in Montana

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ABSTRACT: *Wildfire and prescribed fire have the potential to affect user demand and value for recreation, making such information important to the decision-making process for fire managers. However, such information is not always readily available. We conducted surveys on 22 sites within four national forests in western Montana to determine fire effects on recreation demand for hiking and biking, and net economic benefits to visitors. Net value per trip for hikers was $37. There was no statistical difference for consumer surplus between hiking and biking. Although there were differences in existing visitation between hikers and bikers, there were no statistical differences between the two groups as a result of fire effects. We found that hikers' demand decreased slightly in areas recovering from crown fire and increased in areas recovering from prescribed fire. Bikers' response to both types of fire was the opposite of hikers; for example, bikers showed a slight decrease in annual trips as areas recovered from prescribed fire. Individual value per trip was unaffected by both wild and prescribed fire for both activity groups. Although our recreation demand shifts in response to fire were statistically significant, the magnitude of the predicted changes in demand were not substantial from a managerial perspective suggesting that recreation users in Montana are not affected by fire characteristics resulting from prescribed burns or crown fires. Demand, however, decreased by both user groups as area burned increased and the amount of burn viewed from trails increased, suggesting that the size and extent of burns do affect visitation. West. J. Appl. For. 19(1):47–53.*

Key Words: Recreation demand, travel cost method, wildfire, prescribed fire.

Wildfire is becoming a heightened concern for the public, scientists, and policy makers throughout the western states as fuel loading increases to unnaturally high levels, giving rise to more frequent fire occurrence and greater severity (Arno and Brown 1991). Because social values can be affected by fire and are an important economic component of the decision-making process, it is important for fire managers to have an understanding of the magnitude and extent of such effects. For example, although prescribed burning may appear to be more cost-effective than mechanical fuels treatments, fire use may diminish social values as a result of smoke and nonaesthetically pleasing landscapes. When these social values are included in the decision-making process, mechanical fuels treatments may prove to be more economical.

Although such values are important to include, there is a dearth of information with respect to the effects of fire on recreation values and demand. Notwithstanding, several scientists have made important inroads into assessing values. Vaux et al. (1984) used a contingent value approach to estimate the economic effects of burned areas on recreation demand. Results indicated that higher intensity fires negatively affected recreation values. Flowers et al. (1985) conducted similar research with respect to the northern Rocky Mountains and determined that there was no clear consensus regarding the treatment of fire duration. Englin et al. (1996) and Boxall et al. (1996) used the travel cost method (TCM) to assess changes in canoeing value in Manitoba, Canada as a result of fire. Finally, the TCM was used by Loomis et al. (2001) to evaluate fire effects on hiking and mountain biking in Colorado. They found that there were differential effects on hiking and mountain biking visitation as a result of different fire ages and the presence of crown fires. Similarly, net benefits were also affected by crown fire and prescribed fire.

To assess the effects on value and demand for hiking and biking in Montana, we replicated the Colorado survey in Montana (Loomis et al. 2001). Because the survey was designed to estimate demand for recreation in National Forests, we focused on recreation demand for hiking and biking on the Lolo, Bitterroot, Flathead, and Helena

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National Forests. We provide an overview of the methodology, followed by a discussion of the model and our hypotheses. Lastly, we present the results of the regression models and our conclusions.

Methodology

Loomis et al. (2001) conducted a travel cost survey in Colorado to determine how fire affected hiker and mountain biker demand in burned areas. We use the same survey and travel cost methodology to estimate the demand for recreation in Montana. The travel cost method is a statistical technique that uses variations in visitors' travel costs as a measure of price and trips taken as quantity to trace out a demand curve. From the demand curve, individual benefits, or consumer surplus, are calculated as the area under the demand curve between visitors' current price and a price that would drive visits to zero (i.e., the choke price). TCM, which is a federally recommended technique, is widely used by federal agencies (U.S. Water Resources Council, 1979).

We measure actual and intended trips as a function of actual site attributes such as elevation, trail length, and elevation gained. We look at fire characteristics, including fire age, percentage of burn observable from the trail, presence of a crown fire, and demographics and travel cost information. Respondents were asked to provide travel cost data including gas costs, camping costs and other travel related expenditures.

We use a count data TCM model because the number of trips taken is a nonnegative integer, and statistical efficiency is improved by using such a specification (OLS regression does not). To account for the possibility that the mean of visitor trips is not equal to its variance, we use a negative binomial count model.

Fire Effects TCM

We specify the fire effects model by Equation (1):

$$\begin{aligned}\mathbf{TTRIPS} = {} & \beta_0 + \beta_1(\mathbf{BURNOBS}) + \beta_2(\mathbf{ACRES}) + \\ & \beta_3(\mathbf{AGE}) + \beta_4(\mathbf{CROWN}) + \beta_5(\mathbf{CROWNFIREAGE}) + \\ & \beta_6(\mathbf{ELEV}) + \beta_7(\mathbf{FIREAGE}) + \beta_8(\mathbf{TCOST}) + \\ & \beta_9(\mathbf{TCOST^2})\ \beta_{10}(\mathbf{GENDER}) + \beta_{11}(\mathbf{GROUPSIZE}) + \\ & \beta_{12}(\mathbf{HYPAC}) + \beta_{13}(\mathbf{INC}) + \beta_{14}(\mathbf{LP}) + \beta_{15}(\mathbf{MILEDIRT}) \\ & + \beta_{16}(\mathbf{TCCROWN}) + \beta_{17}(\mathbf{TCFIREAGE}) \\ & + \beta_{18}(\mathbf{TRAVTIME}) + \beta_{19}(\mathbf{TTBUD}) + \beta_{20}(\mathbf{BIKE}) + \\ & \beta_{21}(\mathbf{BIKETC}) + \beta_{22}(\mathbf{BIKECROWN}) \\ & + \beta_{23}(\mathbf{BIKECROWNFIREAGE}) + \beta_{24}(\mathbf{BIKEFIREAGE}) \\ & + \beta_{25}(\mathbf{BIKETCCROWN}) + \beta_{26}(\mathbf{BIKETCFIREAGE}) \end{aligned} \qquad (1)$$

with model variables and definitions given in Table 1.

Benefit Calculations

The model is designed to calculate consumer surplus and to indicate whether fire effects have an influence on visitation and value of trips taken. Consumer surplus is the area under the demand curve between the current price and choke price. We calculated consumer surplus as $1/((\beta_8 + \beta_9)$ because we use a count data model which is equivalent to a semi-log demand function (Loomis et al. 2001).

Table 1. Model variables and descriptions.

Variable	Description
TTRIPS	Total number of trips taken.
BURNOBS	Percentage of fire observable on trail.
ACRES	Number of acres burned.
AGE	Respondent's age (yr).
CROWN	Dummy variable, 1 = crown fire.
CROWNFIREAGE	Interaction between crown fire and fire age.
ELEVATION	Trailhead elevation above sea level (ft).
FIREAGE	Age of fire—negative values: –10 is 10-yr-old, –20 is a 20-yr-old fire.
TCOST	Individual share of travel costs ($).
$TCOST^2$	Travel cost squared.
GROUPSIZE	Number of people in the group.
GENDER	Dummy variable: 1 = mile
HYPAC	Dummy variable: 1 = hypothetical response to contingent scenario, 0 = actual trip taken.
INC	Household income of survey respondent ($).
LP	Dummy for presence of lodgepole pine (1 = lodgepole pine).
MILEDIRT	Miles of dirt road traveled to site.
TCCROWN	Interaction variable between total cost and crown to test the effects of crown fires on consumer surplus.
TCFIREAGE	Interaction between travel cost and fire age to test whether value per trip changes with fire age.
TRAVTIME	Travel time to the site (hr).
TTBUD	Total time budget available for nonwinter vacation; weekends plus paid vacation (days).
BIKE	Dummy variable for bikers (1 = biker).
BIKETC	Interaction between travel cost and bikers.
BIKECROWN	Interaction between crown fires and bikers.
BIKECROWNFIREAGE	Interaction between bikers and aging crown fires.
BIKEFIREAGE	Interaction between bikers and fire age.
BIKETCCROWN	Interaction to measure the effects of crown fires on bikers' consumer surplus.
BIKETCFIREAGE	Interaction to measure the effects of fire age on bikers' consumer surplus.

To test whether the age of a fire (e.g., FIREAGE) has a statistically significant effect on net benefits, we interacted FIREAGE with the travel cost variable TCOST to create a term called TCFIREAGE. Specifically, if fire age has an effect on the price slope of the demand curve, the coefficient β_{17} will be significantly different from zero. Using the same logic, we constructed an interaction term of travel cost and the dummy variable for crown fire to test whether the presence of a crown fire has a statistically significant effect on consumer surplus. The effects of crown fires and fire age on the consumer surplus calculations for hiking trips are given by Equations (2) and (3):

$$1/(\beta_8 + \beta_9 + \beta_{16}) \qquad (2)$$

$$1/(\beta_8 + \beta_9 + \beta_{17} * \boldsymbol{FIREAGE_t}) \qquad (3)$$

Similarly, we tested the effects of crown fire and prescribed fire on bikers' net benefits by interacting the dummy variable for bike (BIKE) with crown fire (CROWN) and total cost (TCOST) to create the term BIKETCCROWN. We also tested the effects of prescribed fire over time on biker consumer surplus (BIKETCFIREAGE). Consumer surplus calculations for bikers as affected by crown fires and prescribed fires are indicated by Equations (4) and (5).

$$1/(\beta_8 + \beta_9 + \beta_{16} + \beta_{21} + \beta_{25}) \tag{4}$$

$$1/(\beta_8 + \beta_9 + \beta_{17}*\boldsymbol{FIREAGE} + \beta_{21} + \beta_{26}*\boldsymbol{FIREAGE_t}) \tag{5}$$

Hypothesis Tests

Using *t*-tests on each of the variables in Equation (1), we tested for the significance of the fire effects variables. Specifically, we tested whether FIREAGE, CROWN, and CROWNFIREAGE were significantly different from zero. Similarly, we tested for differences between bikers and hikers using BIKEFIREAGE, BIKECROWN, and BIKECROWNFIREAGE. Finally, we used regression results to estimate the effects of fire on value per day, and the number of trips taken over time. Hypotheses are listed in Equations (6a)–(6f):

$$H_0 = ß_7\ (\text{FIREAGE}) = 0, \text{ vs. } H_a = ß_7\ (\text{FIREAGE}) \neq 0 \tag{6a}$$

$$H_0 = ß_4\ (\text{CROWN}) = 0, \text{ vs. } H_a = ß_4\ (\text{CROWN}) \neq 0 \tag{6b}$$

$$H_0 = ß_5\ (\text{CROWNFIREAGE}) = 0, \text{ vs. } H_a = ß_5\ (\text{CROWNFIREAGE}) \neq 0 \tag{6c}$$

$$H_0 = ß_{24}\ (\text{BIKEFIREAGE}) = 0, \text{ vs. } H_a = ß_{24}\ (\text{BIKEFIREAGE}) \neq 0 \tag{6d}$$

$$H_0 = ß_{22}\ (\text{BIKECROWN}) = 0, \text{ vs. } H_a = ß_{22}\ (\text{BIKECROWN}) \neq 0 \tag{6e}$$

$$H_0 = ß_{23}\ (\text{BIKECROWNFIREAGE}) = 0, \text{ vs. } H_a = ß_{23}\ (\text{BIKECROWNFIREAGE}) \neq 0 \tag{6f}$$

Data Collection

Sample design

Recreation sites were stratified by acres burned and year since fire. We sampled size classes including C (10–99 ac), D (100–299 ac), E (300–999 ac), F (1,000–4,999 ac) and G (5,000+ ac). Fire age was recorded as time since fire, which included zero, representing fires that occurred the year of the survey (2000), and older up to 50 yr. Fire age classes included 1–5, 6–10, 11–20, 21–30, 30 + yr. Equivalent unburned sites were sampled on each of the national forests to provide a control and to represent the sixth age category. Four National Forests in Montana were selected for this study based on these criteria. They include the Bitterroot National Forest, the Flathead National Forest, the Lolo National Forest, and the Helena National Forest. We contacted district rangers, recreation managers, and fire management personnel to locate recreation areas that exhibited evidence of both prescribed and wildfire, as well as areas that did not show evidence of fire to be used as control sites. We focused on recreation activities associated with trail use and were unable to statistically sample sites due to the limited number of recreation trails that were burned by either wildfire or prescribed fire. For this reason, results may not be representative of recreation use on all national forests in Montana. Forest trails were selected based on recreation use (hiking, which includes camping, sightseeing, and biking), fire history (prescribed and wildfire), fire size (classes C–G), and logistical viability. Finally, we sampled areas with heavy, moderate, and light recreation use.

Sites were sampled for a total of 25 days in 2000. Because of fire activity in the Bitterroot Valley, and in Montana in general, all recreation areas were closed across the state for use beginning in August. Prior to closure we sampled 11 days. After fire restrictions were relaxed in September, we sampled an additional 14 days. Final sampling occurred in 2001 over 34 days between June and August inclusively. We sampled on both weekdays and weekends to capture the widest variety of forest recreation users.

Surveyors collected site attributes pertaining to each site, which were verified by Forest Service personnel. Attributes were chosen based on those that were significant in past forest recreation studies (Englin et al. 1996, Loomis et al. 2001). Data collected included: elevation (ft); elevation gained on trail (ft); dirt road access (mi); presence of scenic vistas (1 = yes, 0 = no); presence of water (1 = yes, 0 = no); trail length (mi); and activity use. We verified site characteristics, such as elevation, trail length, and elevation gained using topographical maps and GIS applications.

With respect to fire characteristics, we collected data pertaining to the burn size (acres), the percentage of the burn that could be viewed from the trail, the percentage of the trail affected by the burn, fire intensity (flame length), and fire age (years since fire). Forest Service personnel and GIS applications were used to verify these data. Fire sizes ranged from 15 to 250,000 ac. With respect to fire age, the oldest fire was 24 yr old and the newest, 1 yr. Sites sampled that were not affected by fire were coded as 50 yr old.

Survey Structure

Interviewers intercepted one individual from each group at each trailhead. The interviewer introduced herself and gave her university affiliation and purpose. Respondents were given a questionnaire with a postage paid return envelope. Questionnaires were distributed to individuals 18 yr or older. Respondents were asked to provide their primary recreation activity and attributes of the site that were important to them. They were also asked to provide travel time, travel distance, and travel cost to the site. Travel cost included gas, camping fees, and other travel related costs, such as hotels. Individuals recorded the number of trips taken to the site in the last 12 mo. Finally, respondents were asked to record the number of trips they would take given an increase in trip costs ($3, 7, 9, 12, 15, 19, 25, 30, 35, 40, and 70). This provided additional price variability to supplement the natural variability in travel costs due to different originations.

Stated preference analysis was based on three photos that depicted different fire scenarios and ecological conditions. Each survey booklet included three photographic scenarios depicting areas that had been burned to various degrees. Respondents were asked how their visitation to each site would change if half the trail they were on resembled that of the photo. This enabled us to convey efficiently the effects that high-intensity crown fires, light prescribed burns, and older high intensity burns have on recreation demand. We based the stated preference analysis on three fire scenarios using color photographs of the following: (1) high-intensity crown fire (crown fire)—blackened, standing trees with little greenery where the fire was two years old; (2) light prescribed burn (Rx Burn)—underbrush burned, trees burned on the lower portion of the trunk, reddish needles on lower branches, and green needles on the majority of the trees, where the burn was 2 yr old; and (3) high-intensity 20-yr-old burn (old crown fire)—standing dead trees, white trunks, and downed trees mixed with new greenery.

Stated preference and revealed preference data were combined using a panel approach (Englin and Cameron 1996). Given the four scenarios—crown fire, Rx burn, old crown fire, and increased cost per trip—we were able to stack the database into panels. The four scenarios represented stated preference data, while the actual observations collected from the survey respondents represented revealed preference. Therefore, each respondent provided six observations. The first and second panels represented actual trips taken in the previous year and the current year, and were coded with a dummy variable, HYPAC = 0, to reflect observed behavior. For these observations, site data and fire attributes were recorded as actual observations and actual fire history. Panels three through five represented, for each individual, stated preference behavior relating to the three fire scenarios—crown fire, Rx burn, and old crown fire. Site characteristics were recorded as actual site attributes; however, we coded fire history according to fire characteristics relating to each of the three scenarios. For example, fire age for the high intensity crown fire was 2 yr old, the prescribed fire was 2 yr old, and the old crown fire was 20 yr old. In each of these three cases, the percentage burn observable (BURNOBS) was recorded as 50% to reflect 50% of the trail in this condition. Finally, the last panel included contingent behavior based on increased travel costs. In this panel, we used actual fire history and site characteristics. The final four panels were coded as HYPAC = 1 to reflect stated preference.

Results

We made a total of 1,074 visitor contacts of which there were 24 refusals. In total, we distributed 1,050 questionnaires; 559 (53% response rate) were returned after first and second postcard reminders.

Of the visitors to the 22 sites, approximately 78% were hiking, camping, and sightseeing. The next largest categories were biking at 10%, fishing at 7%, and swimming and water related activities at 5%. Group size was approximately three individuals who stayed onsite an average of 12 hr. The average distance traveled onsite was 5.8 mi. The average visitor spent \$12.60 in travel costs getting to the site and traveled a distance of 98.6 mi. Visitors were 51% male with an average age of 39 yr. Average household income was \$55,576, while the average education level was a baccalaureate degree. Averages are summarized in Table 2.

Individuals took an average of 12.3 trips/yr. When respondents were asked to provide the number of trips taken given the three scenarios, the averages reported were 10.6 for the crown fire, 12.9 for the Rx burn, and 11.0 for the old crown fire. Regression results are displayed in Table 3.

Based on the comparison of the restricted and unrestricted log likelihood function, the Likelihood Ratio (LR) statistic is significant at $P < 0.01$ indicating the overall model is significant. The model has an adjusted R^2 value of 0.16 and a Pseudo R^2 of 0.14. The overdispersion parameter is also significant at $P < 0.01$ indicating that overdispersion is present and that the negative binomial count model is appropriate.

The following variables each negatively affected the number of trips taken by individuals and were significant at $P < 0.01$. When lodgepole pine (LP) was present, onsite hikers took an average of 13 trips as opposed to 14 where LP was not present. Bikers took an average of 14 trips in areas with lodgepole present as opposed to 16 without lodgepole. Similarly, increases in respondents' age (AGE), time available for recreation (TTBUD), and income all negatively affected the number of recreation trips taken to these national forests in Montana. While the negative relationship between aging and hiking and biking seems intuitive, the negative relationship between demand and total time budget, and demand and income does not. The sites we sampled were relatively easily accessed and did not necessarily require significant time investments. As

Table 2. Descriptive statistics of travel survey for Montana.

Variable	Montana
Site and visitor statistics	
Travel distance to site (mi)	98.6
Travel time to site (hr)	1.6
Gas cost per individual (\$)	12.60
Time onsite (hr)	11.9
Miles traveled onsite	5.8
Group size (# persons)	3.2
Fire statistics	
Average fire age (yr)	12
Average fire size (ac)	9,344
Contingent behavior	
Total average trips	12.3
Trips for crown fire	10.6
Trips for Rx burn	12.9
Trips if old crown fire	11.0
Demographics	
Percent females	48.8
Respondent age	39
Education (yr)	16
Percent retired	10
% members of environmental organization	30
Years at current residence (yr)	11
Household income	\$55,576

Table 3. Regression results for Montana.

	Coefficient (SE)	P-value
Consumer surplus		
Travel cost	–0.0270 (0.0072)	0.000
Travel cost squared	4.58E–05 (1.14E–05)	0.000
Bike	0.9722 (0.2785)	0.000
Bike × travel cost	–0.0541 (0.0555)	0.329
Value and fire effects		
Travel cost × crown	0.0035 (0.0047)	0.450
Travel cost × Rx burn	3.60E–05 (0.0003)	0.906
Travel cost × bike × crown	0.0872 (0.0714)	0.222
Travel cost × bike × Rx burn	–0.0003 (0.0067)	0.959
Fire effects		
Fire age	–0.0143 (0.0054)	0.008
Crown fire × age	0.0235 (0.0087)	0.007
Crown fire	2.34E–01 (0.1802)	0.193
Acres burned	–6.56E–05 (2.28E–05)	0.004
Bike × crown fire	–0.1823 (0.4908)	0.710
Bike × crown fire × fire age	–0.0238 (0.0317)	0.453
Bike × fire age	0.0197 (0.0195)	0.312
% burn observable	0.0064 (0.0026)	0.015
Site characteristics		
Elevation	0.0002 (0.0002)	0.317
Dirt road access	0.0346 (0.0319)	0.277
Lodgepole pine	–1.30E+00 (1.99E–01)	0.000
Demographics		
Age	0.0322 (0.0053)	0.000
Gender	–0.5176 (0.1096)	0.000
Group size	0.0038 (0.0233)	0.869
Income	–9.13E–06 (1.60E–06)	0.000
Travel time to site	–0.0013 (0.0004)	0.001
Total time budget	–0.0081 (0.0016)	0.000
Hypothetical vs. actual	–0.0004 (0.1553)	0.997
Overdispersion parameter	1.017 (0.045)	0.00
R^2		0.162
Adjusted R^2		0.143
Probability (LR stat)		0.00
Mean dependent var.		12.98

respondents become more affluent and have more time, they may substitute higher quality recreation sites by traveling farther or spending higher amounts on more expensive recreation activities. Gender (GENDER) was also significant with males taking slightly fewer trips. With respect to recreation activity, bikers take significantly more trips than do hikers. Table 4 shows trip forecasts for significant fire and site related variables.

Table 4. Fire effects on recreation in Montana.

Variable	Hike trips	Bike trips
Crown fire recovery		
No fire	14.0	15.6
20 yr	13.6	15.7
40 yr	13.4	15.7
Prescribed fire recovery		
No fire	14.0	15.6
20 yr	14.3	15.4
40 yr	14.8	15.1
Lodgepole pine		
Not present	14.0	15.6
Present	13.2	13.7
Acres burned		
0	14.0	15.6
10,000	13.5	14.4
100,000	13.1	12.9

Because we used a count model, we estimate consumer surplus as the inverse of the coefficient on total cost β_8 plus β_9 (total cost and total cost squared are significant at $P < 0.01$.). Consumer surplus per day for hiking demand in Montana is \$37/trip. Given a 95% confidence interval, consumer surplus ranges from \$24 to 75/trip. With respect to trip value, neither crown fire nor Rx burn had significant effects on consumer surplus.

Fire characteristics did affect visitor demand however. Significant fire effects include: areas recovering from prescribed fires (FIREAGE); fire size as measured by the number of acres burned; and the areas recovering from crown fires (CROWNFIREAGE) ($P < 0.01$). The average number of trips taken per individual without fire is 14.0 for hikers, and 15.6 for bikers (Table 4). As areas recover from Rx burns over a period of 40 yr, the average number of trips increases for hikers from 14.0 to 14.8. The trips taken in response to fire by bikers were not significantly different from those taken by hikers. The number of trips taken decreases slightly over time from 15.6 to 15.1.

While the coefficient sign for Rx burn was expected, the sign of the coefficient on areas recovering from crown fires was the opposite of what we expected. Given the direct effects of Rx burns on visitation, one would expect similar reactions to areas recovering from crown fires. However, the relationship between demand and the interaction between crown fire and fire age is indirect for hikers. As areas that have been burned by crown fires recover, visitation drops from 14.0 to 13.4 over 40 yr. There was no significant difference between bikers and hikers in terms of response to crown fire and prescribed fire (see Table 4).

Finally, the number of acres burned adversely affected demand for recreation for both hikers and bikers. The negative coefficient for acres indicates that as fires increase in size from 0 ac to 100,000 ac, recreation demand will drop from 14.0 to 13.0 trips for hikers and from 15.6 to 12.9 trips for bikers.

Conclusion

Results suggest that although demand for hiking and biking is influenced by fire effects, individual net values are not. We therefore cannot reject the null hypotheses that crown fire (TCCROWN) and Rx burns (TCFIREAGE) have no affect on the values per trip of these two recreation activities. Similarly, there are no significant differences between the two user groups with respect to crown fires and prescribed burns (BIKETCCROWN vs. TCCROWN, BIKETCFIREAGE vs. TCFIREAGE). This finding is different from that of Loomis et al. (2001) who show that crown fires and Rx burns influence the values for both groups, although less for bikers. For example, in Loomis et al. (2001), hikers exhibit declining value per trip as areas recover from both crown fires and Rx burns. The opposite was true for bikers. These differences in findings suggest that values vary across states, and that results from other states cannot be generally applied to assess recreation value.

With respect to fire effects, we cannot reject the null hypothesis that crown fires have no effect on hiker and biker demand. For both recreation activities, the coefficient on crown fire was not significant (CROWN, BIKECROWN). This is a surprising result given that areas recovering from crown fires do affect demand; both aging Rx burns (FIREAGE) and aging crown fires (CROWNFIREAGE) had an effect on demand. Therefore, we reject the null hypothesis that FIREAGE and CROWNFIREAGE are equal to zero. Rx burns directly affect hiker demand resulting in increased visitation as areas recover. The coefficient on the bike variable (BIKEFIREAGE) indicated that there was no significant difference between hikers and bikers, although bikers were slightly adversely affected (a decrease of less than one trip per individual). As areas recover from crown fire over time, visitation by hikers decreases slightly. Again, the reverse was true for bikers, although the difference between hikers and bikers was not statistically significant. In each case, the absolute change in demand, although statistically significant, is small enough to be inconsequential from a managerial perspective. A comparison of the results to the findings of Loomis et al. (2001) reveals similar patterns. In Colorado, Wyoming, and Montana, areas recovering from Rx burns result in increased demand by hikers and decreased demand by bikers. The opposite is true for areas recovering from crown fires.

The percentage of the burn observable from the trail (BURNOBS), and fire size (ACRES) were both statistically significant. Demand for hiking decreases 1% as fire size increases to 1,000 acres, 4% as fire reaches 10,000 ac, and 7% as fire increases to 100,000 acres and greater. Biking demand decreases 1% as fire size reaches 1,000 ac, 8% as fire size reaches 10,000 ac, and 17% for fires of 100,000 ac and beyond.

As the percentage of burn increased from zero to 50%, hiking demand declined 1.5%, and biking demand declined 4.7%. In both cases, bikers seem to be more sensitive to changes in site characteristics affected by fire. This may be due to downed woody debris and other impediments to bike maneuverability. Because of these differences, fire and recreation planners may want to consider burn size in areas frequented by bikers.

Finally, the presence of lodgepole pine onsite resulted in decreased visitation by both hikers and bikers. The average number of trips taken per individual to sites without lodgepole pine present was 14.0 for hikers, and 15.6 for bikers. When lodgepole pine was present, hikers took 5% fewer trips (13.3) and bikers took 12% fewer trips (13.7). This suggests that recreation users prefer to hike in areas with Douglas-fir, aspen, ponderosa pine, and larch. From a fire management perspective treating lodgepole pine areas with prescribed fire may result in fewer negative impacts to recreation users. Conversely, it could increase recreation demand by reducing the presence of the undesirable species, lodgepole pine.

In general, although respondents in this and the Loomis et al. (2001) study behaved in a similar manner, the degree to which they were affected was dissimilar suggesting that national or regional fire management policies cannot be broadly applied. This is important when considering policymaking and management from a broader than local perspective. Research should be conducted to assess the reason for the difference in demand among states.

Lastly, because the public is becoming more educated in natural resources, particularly with respect to fire through media coverage, local programs, and cooperatives, it would be useful to conduct the same survey in the future to test differences in recreation value for hiking and biking over time. While our results may be used to calculate the opportunity costs of prescribed fires, such costs may fall over time with education and increased knowledge. Lastly, it would be useful to compare respondents engaged in other recreation activities to see how they are affected by fire and how their demands and value compare to hikers and bikers.

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