Preferences for Hazardous Fuel Treatments: Evidence from a Survey of Forest Service Personnel and the General Public Pre-Anlaysis Plan

Overview and Research Questions

The goal of this research is to assess the preferences of the public and United States Forest Service Personnel for Hazardous Fuel Treatments in National forests. The primary research question asks: What are the preferences of USFS managers and the public for hazardous fuel treatment options when allocating a public budget, and how are allocation preferences affected when budgetary changes are presented as a loss or a gain?

Experimental design

Two surveys were designed to address the research questions. The surveys follow a 2x2 between-subject design and were designed, and will be administered, through Qualtrics, an online survey platform. One survey sample will be comprised of United States Forest Service (USFS) personnel and will be obtained by sending the survey internally to all USFS employee email addresses. The sample size is currently unknown and will depend upon participation among USFS personnel. The second survey will be sent to a representative sample of the public residing in Colorado and Utah. The sample size will be 700, with 420 coming from Colorado and 280 from Utah to reflect the difference in population size between the two states.

Both surveys are comprised of questions that address the participant's experience with wildfire. The survey of USFS personnel focuses more on their professional experience, while the public will be asked about their personal experience. The primary mechanism for analysis in both surveys is a budget allocation exercise and will be the same for USFS personnel and the public. Participants will be asked to allocate a portion of the USFS hazardous fuels treatment budget between prescribed fire and mechanical treatments. Two treatments will be tested through the budget allocation exercise. In the "gain" treatment, participants will be asked how they would allocate an additional $100 million in the USFS hazardous fuel budget among the management options. In the "loss" treatment, participants are asked how they would decrease funding among the management options if $100 million were to be cut from the hazardous fuel management budget.

After responding to questions regarding their experience with wildfire and completing the budget allocation exercise, participants will be asked about the factors they considered when allocating the budget. Additionally, they will complete standard demographic questions, including questions about their current residence.

Power Analysis

Due to funding constraints, the public sample will be capped at 700 participants. A power analysis was completed to ensure this restriction will not severely limit the ability to perform statistical analysis on the data.

A power analysis was completed to assess the minimum detectable effect that can be achieved with the fixed public sample size. This MDE was calculated at 80% and 90% power, with a 0.05 significance level and 3 estimates of the standard deviation. The statistical analysis will utilize the mean dollar value allocated to prescribed fire or mechanical treatments to compare the preferences of USFS personnel and the public. This value will be a number between 0-100 million dollars.

It is assumed that a notable percentage of responses will be clustered around the provided status quo budget allocation, which represents past USFS spending. Three standard deviations were estimated to evaluate how the MDE might change depending on how much of the data is clustered around this point and how variable the rest of the data is. The standard deviations utilized are 20, 22.7, and 25. The following table displays the results of this power analysis:

Power Level	SD = 20	SD = 22.7	SD = 25
80% Power	MDE = 4.24	MDE = 4.81	MDE = 5.30
90% Power	MDE = 4.91	MDE = 5.57	MDE = 6.13

Table 1: Minimum Detectable Effects (MDE) for different standard deviations and power levels

The MDE values represent millions of dollars. If the true effect is greater than the MDE values displayed above, there is an 80% or 90% chance (depending on the power level) this difference will be detected as statistically significant a the 5% level.

Analysis plan

There are several relationships that can be examined through the collection of this data. To test these relationships, the investigators have developed two general research questions: What are the preferences of USFS managers and the public for hazardous fuel treatment options when allocating a public budget, and how does the framing of treatment information impact these preferences?

It is of particular importance to understand what each group prefers in relation to one another and in relation to previous USFS management decisions. Answering these questions can inform the USFS if their decisions align with those of the public and if past management decisions have been favorable among each group.

To empirically test these questions, three t-tests will be conducted. First, a comparison of means will be conducted to determine if the preferences of USFS personnel and the public are statistically different from one another. The mean allocation to each treatment option, prescribed fire and mechanical treatments, will be calculated for each group, and the following

hypotheses will be tested:

Prescribed Fire

$$H_0: \ \mu_{PF,USFS} = \mu_{PF,Public}$$
$$H_a: \ \mu_{PF,USFS} \neq \mu_{PF,Public}$$

Mechanical Treatments

$$H_0: \ \mu_{MT,USFS} = \mu_{MT,Public}$$
$$H_a: \ \mu_{MT,USFS} \neq \mu_{MT,Public}$$

Where μ_{PF} is the mean dollar value allocated to prescribed fire, and μ_{MT} is the mean dollar value allocated to mechanical treatments.

Next, a one-sample t-test will be used to determine if each group's preferences are significantly different from the status quo allocation presented to them during the study. The following hypotheses will be used to compare the mean allocation of each group to the status quo value:

USFS Personnel
  Prescribed Fire

$$H_0: \ \mu_{PF,USFS} = SQ_{PF}$$
$$H_a: \ \mu_{PF,USFS} \neq SQ_{PF}$$

  Mechanical Treatments

$$H_0: \ \mu_{MT,USFS} = SQ_{MT}$$
$$H_a: \ \mu_{MT,USFS} \neq SQ_{MT}$$

Public
  Prescribed Fire

$$H_0: \ \mu_{PF,Public} = SQ_{PF}$$
$$H_a: \ \mu_{PF,Public} \neq SQ_{PF}$$

  Mechanical Treatments

$$H_0: \ \mu_{MT,Public} = SQ_{MT}$$
$$H_a: \ \mu_{MT,Public} \neq SQ_{MT}$$

Where SQ_{PF} and SQ_{MT} are the status quo dollar values allocated to prescribed fire and mechanical treatments, respectively.

A final t-test will be conducted to test the effect of informational framing on the preferences of each group. A statistically significant difference between the mean allocation to either hazardous fuel management option could indicate that the framing of information has an effect on allocation preferences. The following t-test will test this relationship:

USFS Personnel

$$H_0: \ \mu_{PF,USFS\_loss} = \mu_{PF,USFS\_gain}$$
$$H_a: \ \mu_{PF,USFS\_loss} \neq \mu_{PF,USFS\_gain}$$

Public

$$H_0: \ \mu_{PF,Public\_loss} = \mu_{PF,Public\_gain}$$
$$H_a: \ \mu_{PF,Public\_loss} \neq \mu_{PF,Public\_gain}$$

In addition to running t-tests, the researchers will further examine the data through multivariate regression analysis. Regression analysis will be used to assess the effect of respondent characteristics on allocation preferences. Previous research suggests that characteristics such as previous experience with wildfire and distance of residence from a forested area can influence public preferences. Evidence also suggests that characteristics such as years of job experience and experience with wildfire can influence the preferences of land managers.

A standard OLS regression will be run to identify the effect of relevant variables on the amount of money allocated to prescribed fire. Additionally, a logit model will be used to evaluate factors that may have influenced the choice to maintain the status quo budget allocation, or choose a new allocation.

The following model will be used to investigate the allocation preferences of the public:

$$Y_{\text{pf},i} = \beta_0 + \beta_1 \text{Age}_i + \beta_2 \text{Gender}_i + \beta_3 \text{OwnHome}_i + \beta_4 \text{ConcernWildfire}_i + \beta_5 \text{WUI}_i$$
$$+ \beta_6 \text{RiskToHome}_i + \beta_7 \text{Children}_i + \beta_8 \text{Elderly}_i + \beta_9 \text{RespIssues}_i + \beta_{10} \text{Income}_i + \varepsilon_i$$

Where *Age* represents the participants chosen age category, *Gender* is a dummy variable that is 1 if the participant is female, *OwnHome* is a dummy variable that is 1 if the participant owns their home and 0 if they rent, *ConcernWildfire* is a variable that indicates the level of concern the participant has in regard to wildfire, *WUI* is a dummy variable that is 1 if the participant states that they live in the wildlife urban interface, *RiskToHome* is a variable that indicates the level of risk the participant perceives their home faces, *Children* is a dummy variable that is 1 if there are children living in the participant's residence, *Elderly* is a dummy variable that is 1 if there are adults over the age of 65 living in the participant's

residence, *RespIssues* is a dummy that is 1 if there are individuals with respiratory illnesses living in the participant's residence, and *Income* is a variable that indicates the participant's household yearly income.

A logit model will also be run to determine if the list of variables included in the OLS regression influence the decision to maintain the status quo budget allocation or choose a new allocation. The logit model will utilize the same list of independent variables to determine how each variable influences the probability of maintaining the status quo allocation.

$$\text{logit}(\Pr(S_i = 1)) = \alpha_0 + \alpha_1 \text{Age}_i + \alpha_2 \text{Gender}_i + \alpha_3 \text{OwnHome}_i + \alpha_4 \text{ConcernWildfire}_i + \alpha_5 \text{WUI}_i$$
$$+ \alpha_6 \text{RiskToHome}_i + \alpha_7 \text{Children}_i + \alpha_8 \text{Elderly}_i + \alpha_9 \text{RespIssues}_i + \alpha_{10} \text{Income}_i + \epsilon_i$$

A similar strategy will be utilized to investigate the preferences of USFS personnel, but slighlty different independent variables will be included. The following model will be utilized:

$$Y_{\text{pf},i} = \beta_0 + \beta_1 \text{Age}_i + \beta_2 \text{ConcernWildfire}_i + \beta_3 \text{USFSYears}_i + \beta_4 \text{PopRisk}_i + \beta_5 \text{PersonalRisk}_i$$
$$+ \beta_6 \text{Manager}_i + \beta_7 \text{Gender}_i + \beta_8 \text{Income}_i + \beta_9 \text{OwnHome}_i + \beta_{10} \text{Children}_i$$
$$+ \beta_{11} \text{Elderly}_i + \beta_{12} \text{RespIssues}_i + \varepsilon_i$$

Many of the independent variables in this regression match that of the public model. Variables unique to this model are *USFSYears* which represents the number of years the individual has worked for the USFS, *PopRisk* represents the level of wildfire risk that they indicated the primary population they serve faces, *PersonalRisk* represents the level of wildfire risk they personally face, and *Manager* is a dummy variable that is 1 if the individual makes wildfire management decisions in their role.

Similarly, a logit model will be run using the same independent variables:

$$\text{logit}(\Pr(S_i = 1)) = \alpha_0 + \alpha_1 \text{Age}_i + \alpha_2 \text{ConcernWildfire}_i + \alpha_3 \text{USFSYears}_i + \alpha_4 \text{PopRisk}_i + \alpha_5 \text{PersonalRisk}_i$$
$$+ \alpha_6 \text{Manager}_i + \alpha_7 \text{Gender}_i + \alpha_8 \text{Income}_i + \alpha_9 \text{OwnHome}_i + \alpha_{10} \text{Children}_i$$
$$+ \alpha_{11} \text{Elderly}_i + \alpha_{12} \text{RespIssues}_i + \epsilon_i$$

Hypotheses

I assume that USFS personnel and the public will have different preferences for hazardous fuel treatments. Prior literature offers evidence that USFS personnel may seek to maximize some managerial utility when choosing an allocation, while the public will seek to maximize their personal utility. The literature also suggests that the USFS does not fully understand

the preferences of the public, and as such, may not make decisions that align with those of the public.

H1: *There will be a statistically significant difference between the allocation preferences of USFS personnel and the public.*

It is probable that a notable percentage of participants from both the USFS and public samples will choose to maintain the status quo budget allocation. This is a likely result among USFS personnel, who are likely to support decisions previously made by their organization, and the public, who may not have enough information to confidently make an allocation decision. However, the literature suggests that preferences for fuel treatments can vary greatly depending on location, community characteristics, etc. I assume that there will be enough variability in responses that the mean allocation will differ from the status quo allocation.

H2: *There will be a statistically significant difference between the mean budget allocation and the status quo allocation for both the USFS and public samples.*

The literature provides evidence of the idea that the framing of information as a loss or a gain can influence preferences. It is likely that the presentation of budgetary changes as a gain of \$100 million or a loss of \$100 million will influence the preferences of respondents. I assume that there will be a difference between the preferences of individuals assigned to the gain treatment and those assigned the loss treatment for both the USFS and public samples.

H3: *There will be a statistically significant difference between the mean budget allocation of those assigned to the loss treatment and those assigned to the gain treatment.*

Prior literature suggests that there are many factors that might influence preferences for fuel treatments. The OLS regression models that will be utilized are set up so that the dependent variable represents how many millions of dollars are allocated to prescribed fire. The following hypotheses describe the expected direction of each independent variable included in the analysis:

Public sample:

H4.1 **Gender**: Individuals identifying as female will allocate less money to prescribed fire than those identifying as male.
($\beta_{\text{Gender}} < 0$)

H4.2 **Concern about wildfire**: Higher levels of concern about wildfire will be associated

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with greater prescribed fire allocations.
$(\beta_{\text{ConcernWildfire}} > 0)$

H4.3 **Income**: Individuals with higher income will allocate more money to prescribed fire.
$(\beta_{\text{Income}} > 0)$

H4.4 **Age**: Older individuals will allocate less money to prescribed fire.
$(\beta_{\text{Age}} < 0)$

H4.5 **Homeownership**: Individuals who own their homes will allocate less money to prescribed fire than renters.
$(\beta_{\text{OwnHome}} < 0)$

H4.6 **WUI residence**: Individuals living in the wildland–urban interface (WUI) will allocate less money to prescribed fire.
$(\beta_{\text{WUI}} < 0)$

H4.7 **Perceived risk to home**: Individuals who perceive their home as being at risk from wildfire will allocate less money to prescribed fire.
$(\beta_{\text{RiskToHome}} < 0)$

H4.8 **Children in the household**: Individuals with children in the household will allocate less money to prescribed fire.
$(\beta_{\text{Children}} < 0)$

H4.9 **Elderly in the household**: Individuals with elderly people in the household will allocate less money to prescribed fire.
$(\beta_{\text{Elderly}} < 0)$

H4.10 **Respiratory health concerns**: Individuals with household members who have respiratory issues will allocate less money to prescribed fire.
$(\beta_{\text{RespIssues}} < 0)$

USFS Sample:

H5.1 **Gender**: USFS personnel identifying as female will allocate less money to prescribed fire than those identifying as male.
$(\beta_{\text{Gender}} < 0)$

H5.2 **Years with USFS**: Respondents with more years working for the USFS will allocate more money to prescribed fire.
$(\beta_{\text{USFSYears}} > 0)$

H5.3 **Managerial role**: Individuals who report making managerial decisions will allocate more money to prescribed fire.
$(\beta_{\text{Manager}} > 0)$

H5.4 **Income**: Individuals with higher income will allocate more money to prescribed fire.
$(\beta_{\text{Income}} > 0)$

H5.5 **Concern about wildfire**: Higher levels of concern about wildfire will be associated with greater prescribed fire allocations.
$(\beta_{\text{ConcernWildfire}} > 0)$

H5.6 **Age**: Older individuals will allocate more money to prescribed fire.
$(\beta_{\text{Age}} > 0)$

H5.7 **Risk to the population served**: Respondents who perceive greater wildfire risk to the population they serve will allocate more money to prescribed fire.
$(\beta_{\text{PopRisk}} > 0)$

H5.8 **Personal wildfire risk**: Respondents who perceive greater personal wildfire risk will allocate less money to prescribed fire.
$(\beta_{\text{PersonalRisk}} < 0)$

H5.9 **Homeownership**: Individuals who own their homes will allocate less money to prescribed fire than renters.
$(\beta_{\text{OwnHome}} < 0)$

H5.10 **Children in the household**: Individuals with children in the household will allocate less money to prescribed fire.
$(\beta_{\text{Children}} < 0)$

H5.11 **Elderly in the household**: Individuals with elderly people in the household will allocate less money to prescribed fire.
$(\beta_{\text{Elderly}} < 0)$

H5.12 **Respiratory health concerns**: Individuals with household members who have respiratory issues will allocate less money to prescribed fire.
$(\beta_{\text{RespIssues}} < 0)$