



Analysis

The effects of wildfire and environmental amenities on property values in northwest Montana, USA

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ABSTRACT

This study employed the hedonic price framework to examine the effects of 256 wildfires and environmental amenities on home values in northwest Montana between June 1996 and January 2007. The study revealed environmental amenities, including proximity to lakes, national forests, Glacier National Park and golf courses, have large positive effects on property values in northwest Montana. However, proximity to and view of wildfire burned areas has had large and persistent negative effects on home values. The analysis supports an argument that homebuyers may correlate proximity to and view of a wildfire burned area with increased wildfire risk. Indeed, when a burned area is not visible from a home, wildfire risk appears to be out of sight and out of mind for homebuyers. Findings from this research can be used to inform debate about efficient allocation of resources to wildfire preparedness, including public education programs, and suppression activities around the wildland–urban interface.

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1. Introduction

The United States, Canada and Australia, have growing wildland–urban interface (WUI) communities, with new residents attracted to environmental amenities, including aesthetics, wildlife, forests, lakes, streams and recreational access to public land (Beringer, 2000; Rasker and Hansen, 2000; Frentz et al., 2004; Hunter et al., 2005; McGee, 2007). As a result, human life and property is increasingly threatened by wildland fire in these nations, and government land management agencies and fire departments are increasingly faced with the challenge of their protection (McCaffrey, 2004; Handmer and Tibbitts, 2005; McCool et al., 2006; Hammer et al., 2007; McGee, 2007). Tragedies, like the Victorian bushfires of 2009 (Stewart et al., 2009), are likely to be repeated.

Presently, the management of wildfire and the WUI is one of the most complex and politically charged natural resource management challenges in the United States. The United States Department of Agriculture Forest Service (Forest Service) has spent more than US \$1 billion managing wildfires during seven of the past 10 wildfire seasons to 2009 (unpublished data compiled and maintained by the Forest Service Rocky Mountain Research Station). Several factors are believed to have contributed to the high level of suppression expenditures, including: fuel accumulation due to past successful fire suppression activities; a more complex fire fighting environment

due to increased private development in the WUI; climate change; limited economic accountability among fire managers; and a fire management incentive system that makes fire managers more risk averse than may be socially optimal (National Academy of Public Administration, 2002; USDA Forest Service et al., 2003; Calkin et al., 2005; Maguire and Albright, 2005; Running, 2006; Westerling et al., 2006; Liang et al., 2008). The United States Federal Government is concerned that fire suppression resources are not being employed in an economically efficient manner and the Forest Service is under substantial pressure to reduce fire suppression expenditures.

In response to escalating wildfire management costs and recognition of the beneficial role of fire as an important ecological process, wildfire and fuel management policy in the United States has shifted from one based primarily on wildfire suppression to one that integrates suppression, hazardous fuels reduction, restoration and rehabilitation of fire adapted ecosystems and community assistance (USDI and USDA, 2000; USDI et al., 2001; Western Governors' Association, 2001; USDA et al., 2002; USDI et al., 2005). Nevertheless, effective implementation of these policies has been limited (Dale, 2006; Steelman and Burke, 2007). There is also acknowledgement of the need for improved accountability of wildfire management expenditures (USDA OIG, 2006). To support economically efficient management of wildfires, fire managers need decision support tools capable of identifying areas where negative resource value change due to fire suggests aggressive suppression and those areas where beneficial fire effects or excessive suppression costs would suggest 'let burn' strategies. However, existing fire budget and planning models used by U.S. federal agencies are inadequate in this regard (Review Team, 2001), which is partly due to challenges in evaluating welfare

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change arising from wildfires and the limited number of studies performed to date (Venn and Calkin, 2009).

There is an obvious impact to homeowners within burned areas related to whether structures survive; however, there is limited information related to the welfare impacts on homeowners adjacent to, but not directly within a wildfire's perimeter. This study contributes to the limited literature examining wildfire effects on human welfare by assessing how wildfire induced changes in environmental amenities and perceptions of wildfire risk are capitalized into home values in northwest Montana. There is evidence from hedonic studies of other types of natural disasters that recent experience with a disaster tends to increase perceived risk to private property (Bin and Polasky, 2004; Morgan, 2007). This research estimates these indirect effects of wildfire on homeowner welfare (home sale price), which is important for full economic accounting of the cost of wildfire. Current wildfire management policy calls for protection of private property commensurate with the value of the assets at risk (USDI et al., 2001). Empirical evidence suggests private assets near wildfires burning on public land are statistically significant drivers of wildfire suppression costs (e.g. Liang et al., 2008) and the Forest Service has been criticized for overemphasizing protection of private property when managing wildfire (OIG, 2006). Estimates of values at risk from this study can be used to support more efficient allocation of resources to wildfire preparedness (including public education programs) and suppression activities, particularly near WUI areas in the northern Rocky Mountains.

There are several characteristics of this hedonic study of wildfire effects that make it unique. First, existing studies have been performed in areas where wildfires are infrequent, but often large and severe. This study was set in a region that frequently experiences wildfire, including large, severe conflagrations. Second, existing studies have focused on a single wildfire or wildfire complex. This study examined the effects of 256 wildland fires larger than 4 ha (10 ac) that burned roughly 303,690 ha over 17 years in a 4 million ha study area. Third, homes from which residents and homebuyers could see a wildfire burned area were identified. Fourth, several environmental amenity variables, including proximity to lakes, golf courses and a ski resort have been accommodated in the hedonic model to more completely explain property values.

The paper continues with a review of existing literature about the effects of wildfire on property values. Next, the study area in northwest Montana is described. Data collection and research methods are presented, and then findings are reported. Policy implications and concluding comments follow.

2. Effects of Wildfire on Private Home Values

Internationally, surprisingly few studies have been conducted to estimate welfare change as a consequence of wildfire. Glover and Jessup (1999) estimated the short-term health costs of the 1997 forest fires in Kalimantan and Sumatra, Indonesia. The social costs of fire use in the Amazon, including carbon emissions and impacts on human health, have been examined by de Mendonça et al. (2004). In Victoria, Australia, Bennetton et al. (1998) assessed the market and non-market benefits of wildfire prevention and suppression, while Spring and Kennedy (2005) determined optimal rotations in a flammable multistand forest when fires degrade timber and habitat of an endangered species. Most of the limited research on the effects of wildfire on social welfare has been conducted in North America, where the focus has been on recreation values (Boxall et al., 1996; Englin et al., 2001; Loomis et al., 2001; Hesseln et al., 2003), the willingness of households to pay for fuel reduction programs that reduce the risk of damage to homes and natural amenities (Fried et al., 1999; Kim and Wells, 2005; Loomis et al., 2005; Kaval and Loomis, 2007; Kaval et al., 2007; Walker et al., 2007), and environmental

amenity and wildfire risk capitalized into private property values in the WUI.

The value of private homes in the WUI is a function of many property, neighborhood and environmental attributes, including perceived wildfire risk and environmental amenities (e.g. recreation opportunities and aesthetically pleasing vistas), that may be enhanced or diminished by wildfire. An extensive literature review revealed four studies that have attempted to quantify the effects of wildfire on private home values, and all have been conducted in the United States. The first study that specifically examined the relationship between wildfire and property values followed the Cerro Grande Fire of early June of 2000, which burned 17,400 ha and nearly 230 structures near Los Alamos, New Mexico (Price-Waterhouse Coopers, 2001). This fire received much media attention because it was an escaped prescribed fire. In the aftermath of the fire, Price-Waterhouse Coopers undertook a study on behalf of the federal government to assess “whether the value of residential property that was not physically damaged by the Cerro Grande Fire declined as a result of the fire and if so, which communities and types of housing were most affected” (Price-Waterhouse Coopers, 2001, p. 3). Their analysis found that there was a 3% to 11% decline in single family residence property values in Los Alamos County following the fire. It should be noted that this study had a small dataset of house sales from January 1996 to January 2001 (only 7 months post-fire) and did not employ the hedonic price method (HPM), but rather a pre-fire–post-fire regression analysis of home sale prices. Nonetheless, it was early evidence that wildfire can affect property values.

The first HPM analysis in the context of wildfire was performed by Huggett (2003) and looked at three large fires that together burned over 73,300 ha and destroyed 37 homes and 76 outbuildings during the summer of 1994 in Chelan County, Washington. The model accounted for risk and amenity variables such as distance to fire perimeter, distance to national forest boundary, slope and canopy cover. Huggett (2003) found the housing market did not register a decrease in property values until the first half of 1995, even though the fire was suppressed in September of the previous year. It was hypothesized that this could have been as a result of the fairly lengthy process that one goes through when buying a home, as well as imperfect information. In the first half of 1995 house prices increased by an average of \$156 (0.04%) per kilometer the home was distant from the final fire perimeter. It was also found that, while close proximity to wildfire perimeter reduced home value, close proximity of homes to the forest boundary still positively affected home values after the fires of 1994. Interestingly, the negative effects of the fires on house prices were short-lived, only lasting six to twelve months.

Loomis (2004) published the second HPM study conducted in a wildfire context, examining the town of Pine, Colorado. The 4900 ha Buffalo Creek fire burned in May of 1996, just 2 mi south of Pine. Loomis, like Huggett, was evaluating whether changes in natural amenity levels and perceptions of fire risk had affected property values in town, even though no homes in Pine burned down. Unlike Huggett, Loomis did not include environmental amenities in his model. The study found that five years after the fire, there was a \$17,100 to \$18,500 (15% to 16%) loss in median home value in the study area relative to expected sale prices if there had been no fire. Loomis (2004, p.155) concluded “if this finding is replicated in other areas, the good news is that the housing market in the wildland–urban interface is starting to reflect the hazards of living in these high-amenity forests”.

The third HPM study examined the effect of wildfire risk assessment ratings on property values rather than the direct effect of a wildfire. In 2000, the Colorado Springs Fire Department rated 35,000 structures in the WUI according to their wildfire risk level. Four main factors were used by the Colorado Springs Fire Department to determine the relative risk rating for each home: construction material (roof and siding); proximity to dangerous topography;

vegetation around the house; and the average slope around the home. The risk assessment ratings of each property were then posted on the internet so that homeowners and potential home buyers could access them. Donovan et al. (2007) incorporated the risk factors used by the Colorado Springs Fire Department into a hedonic price model of house sale prices. The risk rating variables contain elements of both amenity and wildfire risk attributes, so it is difficult to determine the specific effects of amenities and wildfire risk separately. Nevertheless, Donovan et al. (2007) found homes that sold before the risk web site was operating had risk rating values that were both positive and significant. This suggested that the amenity benefits outweighed the perceived risks posed by wildfire. However, after the risk assessment rating web site was available to homebuyers, the risk rating values were no longer statistically significant. “This result suggests that post web site creation, the positive amenity effects were offset by the increased wildfire risk associated with such parcels” (Donovan et al., 2007, p. 228).

3. Study Area

The study area for this research is nestled in the northern Rocky Mountains of northwest Montana, comprising Flathead, Lake, Sanders and Lincoln Counties, and the northern portion of Missoula County (excluding the city of Missoula). Illustrated in Fig. 1 and referred to hereafter as northwest Montana, the study area covers 4 million ha and includes three national forests, five wilderness areas and one national park. Table 1 summarizes land holdings in the study area by tenure. Northwest Montana ranges in elevation from 525 m to 3070 m above sea level. The climate in the study area is generally cold and wet in the winter, and warm and dry in the summer. Average annual precipitation of rain and snow varies between 2540 mm at high elevations and 300 mm in the valleys.

Mixed mesic and mixed subalpine forest types are dominant in the study area, although mixed xeric forests can be found on dry southern aspect sites at lower elevation (NRIS c2007). Species found in the

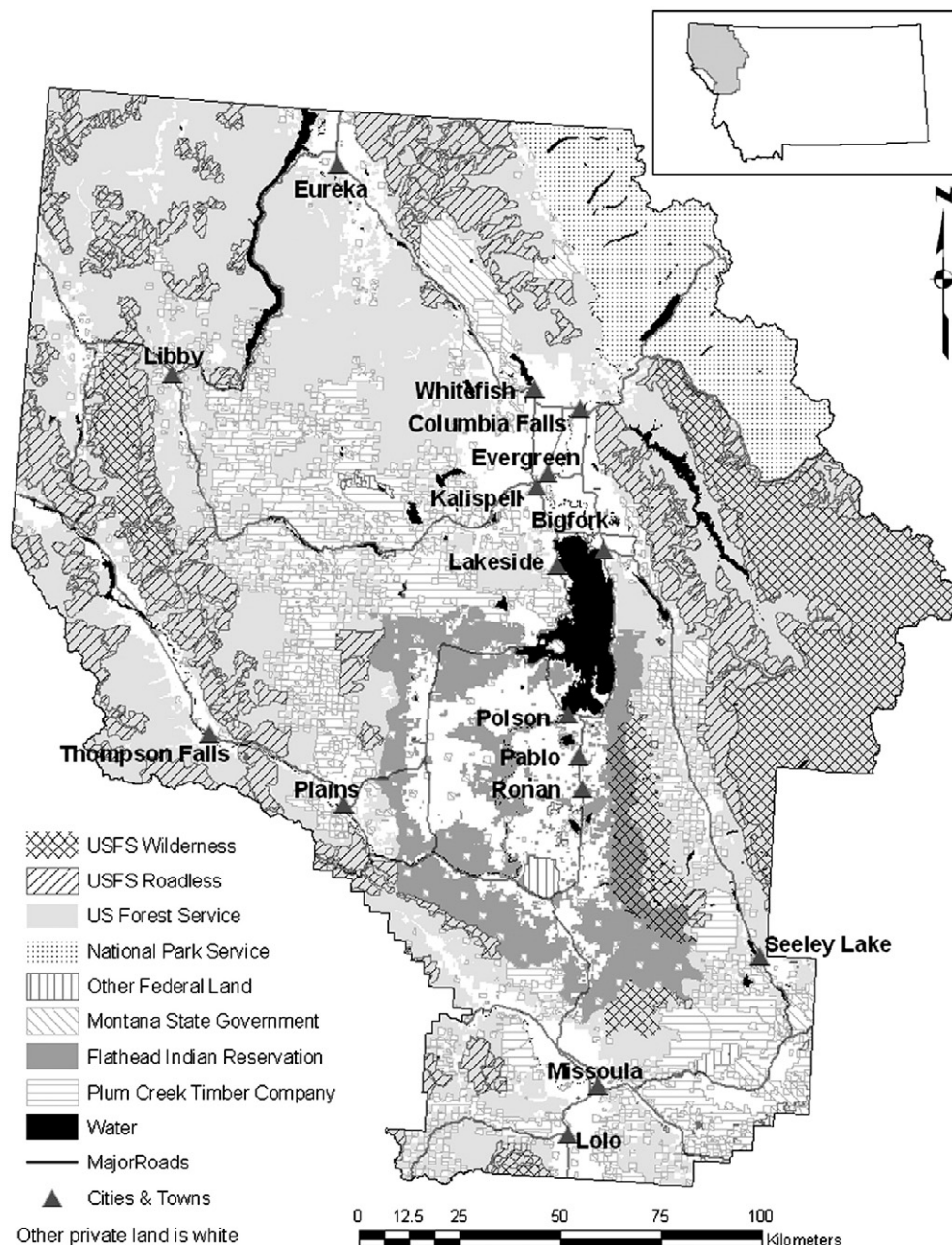


Fig. 1. Land tenure and communities in northwest Montana.

Table 1

Land tenure in Northwest Montana.

Source: Land tenure estimates made by the authors in ArcGIS with data from NRIS (c2007).

Land tenure	Area (ha)	Proportion of study area
Forest Service non-reserved land	1,157,230	29%
Forest Service Wilderness	404,360	10%
Forest Service Roadless	568,660	14%
Glacier National Park	250,670	6%
Bureau of Land Management	23,700	1%
Other Federal Agencies	14,940	1%
State of Montana	179,250	4%
Flathead Indian Reservation	288,890	7%
Plum Creek Timber Company	494,190	12%
All private land other than Plum Creek	501,440	13%
Water	106,000	3%
Total study area	3,989,330	100%

mixed mesic forest type include Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), ponderosa pine (*Pinus ponderosa*), grand fir (*Abies grandis*) and Engelmann spruce (*Picea engelmannii*) (Fisher et al., 1998). The mixed mesic forest type is characterized as having a 'mixed severity' fire regime and can experience both high frequency, low intensity and low frequency, high intensity fires (Brown et al., 2004). The mixed subalpine forest type includes lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), Douglas-fir, Engelmann spruce and Whitebark pine (*Pinus albicaulis*) (Fisher et al., 1998). The mixed subalpine forest type was historically (and is still predominantly) characterized by low frequency, high severity wildland fire (Brown et al., 2004). Ponderosa pine and Douglas-fir are the two dominant species in the mixed xeric forest type, which historically experienced high frequency, low intensity wildland fire (Brown et al., 2004).

Logging, mining and agriculture dominated the economy of northwest Montana for most of the 20th century, but a dramatic shift in the economic base to service industries has occurred since the 1980s (Swanson et al., 2003; Northwest Economic Development District, 2007). Kalispell is the main regional center in northwest Montana, with a population of about 30,000 in the greater Kalispell area. In 2000, median household incomes in the study area ranged from a high of \$39,885 in Flathead County to a low of \$29,654 in Sanders County, which are low relative to the national median household income of \$44,334 (US Census Bureau, 2008). Northwest Montana has also experienced strong population growth (22% between 1990 and 2000 to 131,500), particularly in the WUI (US Census Bureau, 2008).

Among the predominant factors luring people to northwest Montana are the numerous natural amenities (Power and Barrett, 2001; Swanson et al., 2003). These amenities are primarily located on the 2.6 M ha of public land in the study area, including Glacier National Park (GNP) and large wilderness and roadless areas in national forests. Northwest Montana caters to many types of recreation, including cross-country skiing, downhill skiing, hiking, backpacking, mountain biking, outfitter trips, whitewater rafting and hunting. Flathead Lake, the largest freshwater lake in the western United States, is a major recreation destination as well as summer home location (Flathead Lake Biological Station, 1999; Northwest Economic Development District, 2007).

Between 1990 and 2006, the Forest Service recorded 256 wildfires that each burned at least 4 ha and in aggregate burned 303,690 ha (about 7.3%) of northwest Montana (USDA c.2006). The fires burned principally during the fire seasons of 1994, 2000 and 2003¹ on both public and private land, and ranged in size up to 28,500 ha (USDA c.2006). The larger fires were on the east side of the study area and

around Glacier National Park and the Bob Marshall Wilderness. Residents of northwest Montana have become accustomed to wildfire and smoky days during the summer.

4. Application of the Hedonic Price Method to Northwest Montana

The hedonic price method (HPM) has been in use for at least 80 years (Berndt, 1996), but a solid theoretical foundation for the HPM was not forthcoming until Rosen (1974) empirically demonstrated that goods can be valued on the basis of their characteristics as opposed to merely the good itself. Economic theory suggests that house sale prices can be estimated as a function of vectors of structural characteristics, S , neighborhood attributes, N , and environmental attributes, E . Thus, the hedonic price model for houses takes on the general form

$$\text{House Sale Price} = f(S, N, E)$$

Consumers making a house purchase decision are assumed to maximize their utility, U , from the purchase of a home given the attributes of homes for sale and their budget constraint, Y

$$\text{Max } U = f(S, N, E), \text{ subject to } Y = \text{House Sale Price} + a$$

where a is disposable income spent on all other goods.

4.1. Structural, Neighborhood, Environmental and Wildfire Data for Northwest Montana

House sale prices, structural and neighborhood characteristics for 18,785 transactions in the study area over the period June 1996 to January 2007² were acquired from the Northwest Montana Association of Realtors® (NMAR), a multiple listing service (MLS) group. It is important to note this dataset excludes private transactions not made through a realtor. The MLS dataset includes information about the number of bedrooms and bathrooms, square footage of the house, type of garage, age and style of the home, lot size, type of waterfront access, geospatial data locating the home, asking price, sold price, and list and sold date. Homes in the MLS dataset had also been assigned to one of 80 predetermined 'housing zones' (neighborhoods) defined by realtors according to their expert knowledge about property markets in northwest Montana. For the purposes of this study, five separate dummy variables were derived from these housing zones for homes in the urban areas of Kalispell, Columbia Falls, Whitefish, Bigfork and Polson.

The geospatial data for homes in the MLS dataset were verified with Montana Cadastral data (<http://www.nris.mt.gov/gis/gisdata/lib/gisDataList.aspx>) and 2005 National Agriculture Imagery Program (NRIS c2008) aerial photographs, which highlighted a substantial number of houses with inaccurate geospatial data. The spatial data for these homes were corrected to facilitate spatial analysis of environmental and wildfire attributes. After deleting observations with missing or inaccurate price, structural and geospatial data, 17,693 house sale transactions remained in the dataset. These are highlighted in Fig. 2.

Throughout the study area, homes are typically located in valleys, and the nearest forest and wildfire burned areas are in the surrounding mountains. Neighborhood, environmental and wildfire attributes for homes were derived from spatial analysis with data acquired from the state of Montana Natural Resource Information System website (<http://nris.mt.gov/>), the Forest Service Northern Region Geospatial Library (<http://www.fs.fed.us/r1/gis/>) and the LANDFIRE project (<http://www.landfire.gov/>). Population density around each home was determined by spatially intersecting the homes with a 1 km² resolution population density spatial raster layer for Montana. Straight-line distances of homes to national forest

¹ The fire season in northwest Montana is typically between June and September.

² Approximately half of the transactions in the dataset occurred since January 1, 2003.

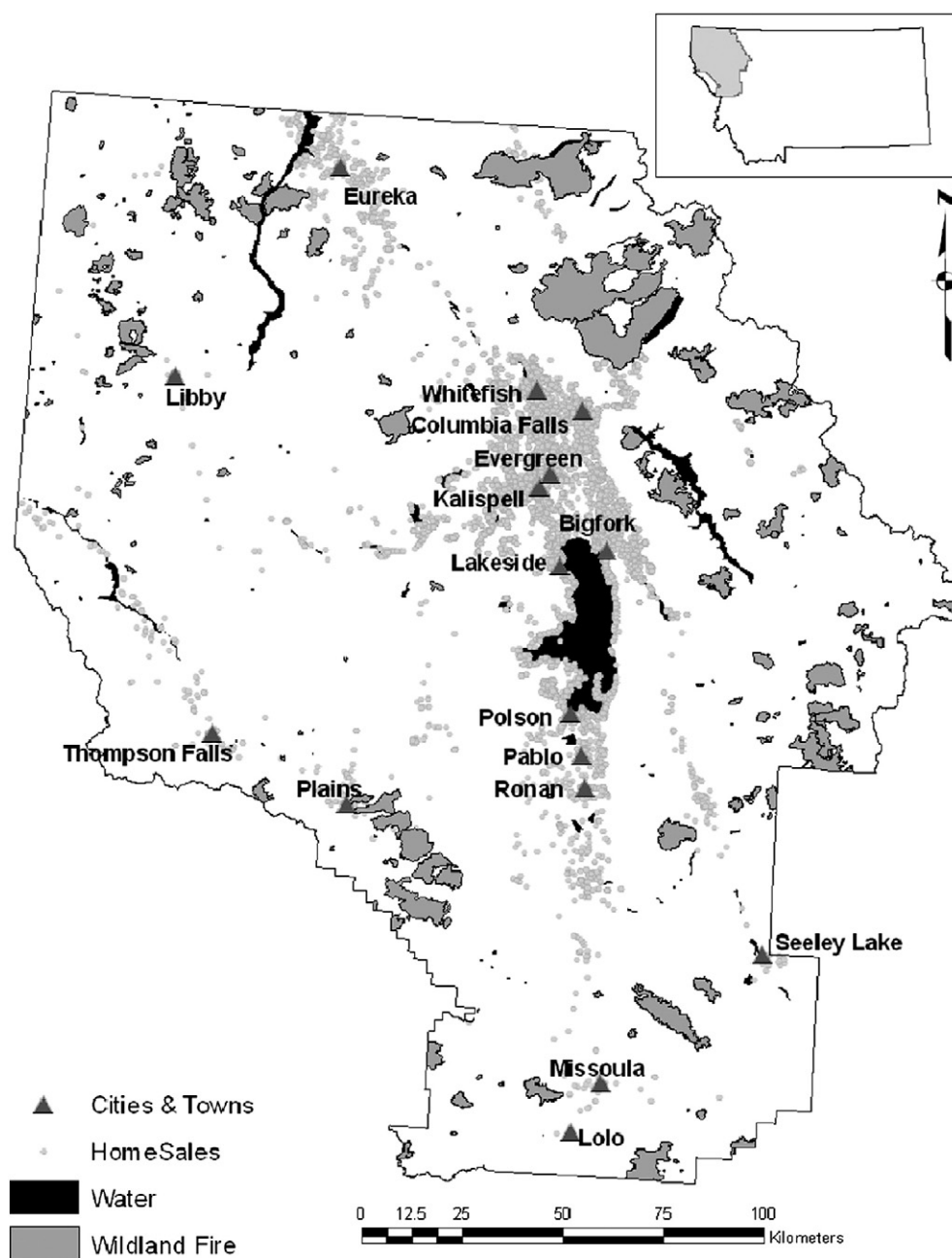


Fig. 2. Home sales (June 1996 to January 2007) and wildfires (May 1990 to October 2006) in northwest Montana.

boundaries, the entrance to GNP, major lakes and rivers (including the large, navigable Flathead and Whitefish lakes), wilderness areas and wildfire burned areas were estimated.³ Homes located on the Flathead Indian Reservation, adjacent to one of the 16 golf courses in the study area, and adjacent to the Big Mountain Ski Resort were identified.⁴

³ Incomplete geographic information system road layers in the study area prevented road distance (travel time) from homes to amenities and disamenities from being estimated. For many amenities and disamenities, including forests and areas previously burned by wildfire, straight-line distance is appropriate because the effect on home sale price is likely to be more related to spatial proximity than travel time.

⁴ In the hedonic price modeling literature, it is common to account for proximity to amenities such as golf courses, parks and rivers with dummy variables that account for properties abutting or within a short distance of these features, because statistically significant effects on property values have been found to decrease rapidly with distance (Leutzenhiser and Netusil, 2001; Shultz and Fridgen, 2001; Mansfield et al., 2005; Snyder et al., 2008). Preliminary analysis in this study revealed that statistically significant positive effects on home sale price of proximity to The Big Mountain Ski Resort and golf courses diminished rapidly with distance.

Wildfires are transient on the landscape, which had to be accommodated in the analysis. Wildfire perimeter data are available for 256 wildfires that burned at least 4 ha in northwest Montana over the period 1990 to 2006 (USDA, 2006), and are illustrated in Fig. 2. A digital elevation model of the study area, combined with the wildfire polygons and home locations, facilitated assessment of distance of each home to the nearest wildfire perimeter and whether areas that had been burned by wildfires could be seen from the home. View of burned areas from homes was determined using the 'Viewshed' tool in ArcGIS 9.2. Above ground obstacles to view of burned areas from the home, such as vegetation and other structures, were not accommodated in the viewshed analysis. Distances from and views of wildfire burned areas were estimated after excluding all wildfires that burned after the sale date of the home, and all fires that burned greater than seven years before the sale of the home. Only the previous seven years of fire history for each home sale was included, because: (a) the nearest wildfire perimeter to almost all homes that

sold prior to the 2000 fire season burned in 1994; (b) the nearest wildfire perimeter for almost all homes that sold since the 2000 wildfire season was a fire that had burned between the house sale date and the 2000 wildfire season; and (c) preliminary analysis revealed that if there were multiple wildfire burned areas within 20 km of a home that burned prior to and during or after the 2000 wildfire season, only wildfires that burned during or after 2000 had a statistically significant effect on house sale price (Stetler, 2008).⁵ Data about the nearest fire to the home, such as fire size and date, were recorded for each home. The wildfire nearest the home was classified as being large if greater than 405 ha (1000 ac). Fire date was used to estimate time since fire, i.e., time between when the fire nearest the home burned and when the house sold.

LANDFIRE percent canopy cover data at 30m×30 m spatial resolution was used to calculate the area of forest by canopy cover categories within 250 m and 500 m of each home (low: 0–40%; medium: 40–70%; high: >70%). As in Kim and Wells (2005), this indicator of stand density was used as a proxy for visual pleasantness and potential wildfire threat. Forest canopy cover around homes is also likely to be a sound proxy for obstacles to view of a wildfire burned area from a home.

The wildfire risk and environmental amenity characteristics of homes may be partially explained by whether the home is located within a land management agency-defined WUI. A spatial layer of land parcels that are charged a forest fire protection fee by the Montana Department of Natural Resources and Conservation (DNRC) (along with their regular property taxes) was used to define the variable DNRC WUI.⁶

4.2. Northwest Montana Hedonic Price Model

Early specifications of the hedonic price model (HPM) for northwest Montana included all 17,693 observations; however, prior knowledge suggested structural differences between home-buyer preferences in the Kalispell metropolitan area relative to the rest of small town and rural northwest Montana. A Chow test with a computed F value of 10.05 exceeded the critical F value of 1.24 ($\alpha = 5\%$) and confirmed this structural difference. Therefore, house sale prices are better explained by two separate models: one for Kalispell; and one for the rest of northwest Montana. The latter is relevant for examining the effects of wildfire and environmental amenities on property values, because of the dominating effect of urban amenities in Kalispell.

Stetler (2008) fitted several linear, semi-log and logarithmic HPMs to the 11,833 non-Kalispell observations. Numerous interaction variables were tested, including interactions of forest canopy cover and distance to fire, and time since fire and distance to fire, but none were statistically significant. Total square footage of the home was found to be a better predictor of house sale prices than number of bedrooms and bathrooms, so the latter two variables were excluded from the final model. Following standard practice in hedonic price modeling to account for potential non-linear relationships between house attributes and house sale price (Haab and McConnell, 2003; Taylor, 2003), squared and cubed terms were estimated for quarter since fire, canopy cover and distance variables to wilderness, national forest, entrance to GNP, nearest lake and nearest wildfire burn perimeter. A superior statistical fit was achieved with these terms for the quarter since fire, canopy cover and distance to lake variables,

relative to inclusion of the linear variable only. The effect of distance to nearest wildfire perimeter on home sale price was found to be better explained by discrete distance categories than a continuous distance variable.⁷ After assessing many potential wildfire distance category classifications, houses were assigned to one of the following five categories: 0 to 5 km, 5 to 10 km, 10 to 15 km, 15 to 20 km and greater than 20 km.

The HPM with the greatest explanatory power, hereafter referred to as the 'northwest Montana' model, fitted the independent variables defined in Table 2 to the natural log of sale price of homes by ordinary least squares with robust standard errors to adjust for heteroscedasticity. Robustness tests, including removing individual environmental amenity, canopy cover and fire variables, and increasing the number of neighborhood variables, revealed the statistical significance and coefficient levels of explanatory variables in this model were insensitive to changes in model specification.

It was hypothesized that the explanatory power of particular wildfire variables may be sensitive to whether a wildfire burned area could be seen from the home. This was tested with the alternative model specifications 'with view of fire' and 'without view of fire', which was the northwest Montana model fitted only to home data from which a wildfire burned area could and could not be seen, respectively. A Chow test revealed statistically significant structural differences (computed $F = 3.31$, critical $F = 1.24$, $\alpha = 5\%$) in home-buyer preferences for homes with and without views of wildfire burned areas.

Table 3 lists summary statistics for the dependent and independent variables in the three models. Notably, homes with a view of a wildfire burned area have the highest mean sale price of \$280,000. This can largely be explained by the fact that these homes had larger mean square footage and lot sizes than for northwest Montana as a whole, and that many of these homes have unique architecture and construction materials, and high environmental amenity values (such as sweeping scenic vistas) that are not completely captured by the structural and environmental amenity variables in the HPM. Anecdotal evidence also suggested a substantial number of these homes may have sale price premiums associated with them being out-of-state purchases, although we have inadequate data to support this assertion.

5. Results

The variable coefficients, t -statistics and shadow prices of statistically significant⁸ variables for the 'northwest Montana', 'with view of fire' and 'without view of fire' models are reported in Table 4. Because of space limitations, coefficients for large groups of statistically significant dummy variables for age of the home, style of the home, garage type, and sale quarter are not reported, but are available from the authors. Importantly, the sale quarter variable captures the effects of the property boom in northwest Montana from

⁵ The authors have not analyzed the data to explain point (c), but it may be due to substantially greater average wildfire size in northwest Montana since 2000 (USDA c2006), which increased public consciousness and perception of wildfire risk since the early 2000s.

⁶ Stetler (2008) found the USDA Forest Service defined WUI for northwest Montana was a statistically insignificant predictor of house sale price. Upon inspection, it became apparent that the Forest Service WUI spatial layer is inaccurate for the study area.

⁷ The approach of employing dummy variables to account for homes within particular distance intervals from a landscape feature has precedent (e.g. Kang and Cervero, 2009) and was adopted in this study for two reasons. First, while a variable for actual distance of the home to the nearest wildfire burn perimeter is statistically significant, the coefficient is small. This is not surprising given the mean distance of a home from a wildfire perimeter was 21 km, 52% of homes in our dataset were at least 20 km from a wildfire burned area, multiple wildfires burn annually in northwest Montana, and wildfires are only of concern to homebuyers (and homeowners) when they burn close to homes. When the variable for actual distance to a wildfire perimeter and a dummy variable for homes within 10 km of a wildfire burned area are included in the hedonic model, the former is statistically insignificant (t -stat = 1.29), and the latter has a large, negative and statistically significant coefficient (t -stat = -5.98). This suggests the effect on property values of proximity to a wildfire burned area is high for homes close to a burn and negligible beyond about 10 km. Second, wildfire effects on property values did not follow a systematic linear or non-linear pattern, and measuring wildfire effects in 5 km increments provided a superior statistical fit.

⁸ The level of significance or probability of a Type 1 error has been fixed at 5% in this study.

Table 2
Definitions of dependent and independent variables.

Variable name	Definition
Dependent variable	
ln(sold price)	Natural log of sale price of the home (\$)
Structural variables	
ln(square footage)	Natural log of square footage of the home
Age of home	Nine dummy variables that accounted for age of the home ^a
ln(lot size)	Natural log of size of the lot (ha)
Style of home	Ten dummy variables that represent different home styles ^a
Type of garage	Eight dummy variables that account for different types of garages
Sale quarter	The quarter that the house sold from 1 (June to September 1996) to 44 (January 2007)
Neighborhood variables	
Whitefish	Whitefish town dummy variable: home is within MLS Housing Zones 51A, 51B, 52A, 53A, or 54A
Polson	Polson town dummy variable: home is within MLS Housing Zones 81A, 82A, 81E, 81 W, or 82B
Bigfork	Bigfork town dummy variable: home is within MLS Housing Zones 21, 22, or 41
Columbia Falls	Columbia Falls town dummy variable: home is within MLS Housing Zones 32, 33, 34A, or 34B
ln(pop density)	Natural log of population density in the 1 km × 1 km census block in which the house is located (people/km ²)
Big Mountain ski	Dummy for whether the property is located within 1200 m of The Big Mountain Ski Resort
Golf course	Dummy for whether the property is located within 750 m of a golf course
Reservation	Dummy for whether the property is located on the Flathead Indian Reservation
Environmental amenity variables	
Dist to wilderness	Straight-line distance from the home to the nearest wilderness area boundary (km)
Dist to nat forest	Straight-line distance from the home to the nearest National Forest boundary (km)
Dist to Glacier NP	Straight-line distance from the home to the entrance of Glacier National Park (km)
Nav waterfront	Dummy for whether the property had access to a navigable waterfront
Flathead/Whitefish Lake	Dummy for whether the property had navigable waterfront access on Flathead Lake or Whitefish Lake
Non nav waterfront	Dummy for whether the property had water frontage, but not a navigable waterfront
Dist to lake	Straight-line distance from the home to the nearest lake (km)
Dist to lake ²	(dist to lake) ²
Dist to lake ³	(dist to lake) ³
Wildfire variables	
DNRC WUI	Dummy variable for whether the home is assessed the DNRC forest fire protection fee
View of fire	Dummy variable for whether the home had a view of a wildfire burned area prior to sale.
Big fire	Dummy variable for whether the closest fire to the home was ≥405 ha
0–5 km from fire	Dummy variable for whether the home is 0–5 km from a wildfire burned area
5–10 km from fire	Dummy variable for whether the home is 5–10 km from a wildfire burned area
10–15 km from fire	Dummy variable for whether the home is 10–15 km from a wildfire burned area
15–20 km from fire	Dummy variable for whether the home is 15–20 km from a wildfire burned area
qtr since fire	Time in quarters between the time the nearest fire occurred and the time the house sold
qtr since fire ²	(qtr since fire) ²
250 m med cc	Area of 40–70% tree canopy cover within 250 m of the home (ha)
250 m high cc	Area of 70–100% tree canopy cover within 250 m of the home (ha)
500 m med cc	Area of 40–70% tree canopy cover between 250 and 500 m from the home (ha)
500 m high cc	Area of 70–100% tree canopy cover between 250 and 500 m from the home (ha)
250 m med cc ²	(250m_medcc) ²
250 m high cc ²	(250m_highcc) ²
500 m med cc ²	(500m_medcc) ²
500 m high cc ²	(500m_highcc) ²

Note: a. The actual age of the home was not available for many homes in the dataset; however, age ranges were always available and have been used in this analysis. Home style categories include '1.5–2 story', tri or multiple level', 'cabin', 'log home' and 'condominium or townhouse'. Out of the 90 pair-wise correlation coefficients for all nine age classes and 10 home style categories, 78 had correlation coefficients within the range ± 0.05 , six had correlation coefficients between ± 0.05 and ± 0.1 , five had correlation coefficients between ± 0.1 and ± 0.17 , and one had a correlation coefficient of 0.27. Thus, correlation between age and style of the home is very low.

2002 to the first quarter of 2007, during which the model estimated mean house sale prices rose 164%. Shadow prices are the derivatives of *sold price* with respect to the independent variable of interest. The shadow prices have been estimated at the mean house sale prices of \$260,000 in the 'northwest Montana' model, \$280,000 in the 'with view of fire' model and \$240,000 in the 'without view of fire' model, and are interpreted from the mean level of the independent variable used in the shadow price calculation, with all other variables held constant.

5.1. Contribution of Neighborhood and Environmental Amenities to Property Values in the 'Northwest Montana' Model

Homes in the towns of Whitefish, Bigfork and Columbia Falls have higher sale prices relative to the rest of the study area. Columbia Falls and Bigfork are both recreational hotspots that provide access to Flathead Lake, while Whitefish is a year-round destination town with skiing in the winter and Whitefish Lake recreational opportunities in the summer. Whitefish homes had the largest price premium, with values 28% (\$83,818) higher than homes outside Whitefish, Bigfork

and Columbia Falls. Sale prices of homes on the Flathead Indian Reservation were found to be \$27,172 less than the mean⁹. The dummy variable for the town of Polson was statistically insignificant and is not reported in Table 4.

Environmental amenities are found to have a large effect on property values in northwest Montana. Living further away from national forests, wilderness areas and the entrance to GNP had a detrimental effect on home sale price. Proximity to lakes and waterfront access are important house attributes for home buyers. If the home has a navigable waterfront, this was found to increase mean house sale price by \$214,034. Homes with navigable waterfront access on either Flathead Lake or Whitefish Lake had an additional \$117,295 price premium. Although structural variables have been included in the model, part of the estimated waterfront home sale price increases from the mean is likely to be reflecting particular structural attributes of these homes (e.g. very large home with unique and aesthetically pleasing style and building materials). Homes adjacent to a golf course

⁹ Realtors in northwest Montana advised that there are no restrictions on non-tribal members buying homes inside the Flathead Indian Reservation.

Table 3

Summary statistics for the northwest Montana, with view of fire and without view of fire models.

Variable	Northwest Montana model				With view of fire model				Without view of fire model			
	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.
Sold price	2.60×10^5	3.50×10^5	10,000	1.40×10^7	2.80×10^5	4.20×10^5	10,000	1.40×10^7	2.40×10^5	3.10×10^5	12,000	8.20×10^6
Square footage	1966.39	1022.2	128	15,500	2024	1078.19	150	15,500	1934.92	989.02	128	10,000
Lot size	2.00	6.34	0	147.72	2.42	7.68	0	147.72	1.77	5.47	0	129.5
Whitefish	0.22	0.41	0	1	0.08	0.27	0	1	0.3	0.46	0	1
Bigfork	0.09	0.28	0	1	0.11	0.31	0	1	0.07	0.26	0	1
Columbia Falls	0.12	0.33	0	1	0.15	0.36	0	1	0.11	0.31	0	1
Pop density	834.33	1094.6	0	7010.21	714.67	970	0	7010	899.66	1152	0	6597
Big Mountain ski	0.01	0.12	0	1	0.01	0.11	0	1	0.01	0.12	0	1
Golf course	0.03	0.18	0	1	0.02	0.13	0	1	0.04	0.2	0	1
Reservation	0.06	0.24	0	1	0.12	0.32	0	1	0.03	0.17	0	1
Dist to wilderness	30	15.66	0.49	81.24	29.78	20.26	0.75	81.24	30.12	12.46	0.49	77.46
Dist to nat forest	4.62	4.52	0	28.71	4.88	5.16	0	28.71	4.49	4.13	0	25.23
Dist to Glacier NP	54.05	31.98	0.41	194.42	65.52	37.03	0.41	188.24	47.79	26.86	0.65	194.42
Nav waterfront	0.13	0.33	0	1	0.09	0.28	0	1	0.15	0.35	0	1
Flathead/Whitefish Lake	0.06	0.24	0	1	0.04	0.21	0	1	0.07	0.25	0	1
Non nav waterfront	0.12	0.33	0	1	0.12	0.33	0	1	0.12	0.33	0	1
Dist to lake	5.09	6.53	0	58.07	6.42	7.76	0	51.86	4.36	5.61	0	58.07
Dist to lake ²	68.48	230.82	0	3371.8	101.4	323.07	0	2689.8	50.53	156.45	0	3371.8
Dist to lake ³	1653.78	10,262	0	2.00×10^5	2889	15339.15	0	1.40×10^5	979.69	5752.49	0	2.00×10^5
DNRC WUI	0.55	0.5	0	1	0.49	0.5	0	1	0.57	0.49	0	1
View of fire	0.35	0.48	0	1	NA	NA	NA	NA	NA	NA	NA	NA
Big fire	0.57	0.49	0	1	0.7	0.46	0	1	0.5	0.5	0	1
0–5 km from fire	0.02	0.15	0	1	0.05	0.21	0	1	0.01	0.09	0	1
5–10 km from fire	0.08	0.27	0	1	0.14	0.35	0	1	0.04	0.2	0	1
10–15 km from fire	0.18	0.39	0	1	0.27	0.44	0	1	0.14	0.34	0	1
15–20 km from fire	0.2	0.4	0	1	0.18	0.39	0	1	0.21	0.41	0	1
qtr since fire	10.82	7.58	0	27.85	11.98	7.26	0	27.85	10.18	7.67	0	27.82
qtr since fire ²	174.41	204.39	0	775.43	196.2	199.91	0	775.43	162.54	205.83	0	774.21
250 m med cc	3.14	3.31	0	18	2.77	3.34	0	16.56	3.35	3.28	0	18
250 m med cc ²	20.85	32.94	0	324	18.82	32.29	0	274.23	21.96	33.24	0	324
500 m med cc	9.57	8.79	0	45.09	8.65	9.17	0	44.31	10.08	8.53	0	45.09
500 m med cc ²	168.86	241.01	0	2033.11	158.78	248.39	0	1963.38	174.36	236.71	0	2033.11
Controls	Age of home, style of home, type of garage, sale quarter											

Table 4

Regression estimates and shadow prices for the northwest Montana, with view of fire and without view of fire models.

Variable	Northwest Montana model			With view of fire model			Without view of fire model		
	β	t-stat	Shadow price (\$)	β	t-stat	Shadow price (\$)	β	t-stat	Shadow price (\$)
ln(square footage)	0.588	58.71	78/ft ²	0.584	35.00	81/ft ²	0.585	47.76	73/ft ²
ln(lot size)	0.294	39.81	38,205/ha	0.303	24.51	35,380/ha	0.290	31.98	39,330/ha
Whitefish	0.279	19.90	83,818	0.366	10.06	123,704	0.257	14.66	70,256
Bigfork	0.205	14.80	59,276	0.198	8.44	61,455	0.210	11.48	56,169
Columbia Falls	0.066	4.65	17,850	0.044	1.89	12,577	0.074	3.91	18,367
ln(pop density)	−0.028	−8.96	−9/person/km ²	−0.038	−7.87	−15/person/km ²	−0.017	−4.38	−5/person/km ²
Big Mountain ski	0.522	17.43	178,211	0.538	9.05	199,648	0.497	14.00	154,650
Golf course	0.177	9.70	50,222	0.207	5.55	64,431	0.175	8.29	45,835
Reservation	−0.110	−4.88	−27,172	−0.158	−4.64	−40,924	−0.005	−0.15	−1207
Dist to wilderness	−0.004	−12.01	−949/km	−0.003	−7.65	−952/km	−0.004	−8.81	−952/km
Dist to nat forest	−0.009	−5.49	−2356/km	−0.009	−3.35	−2510/km	−0.009	−4.16	−2226/km
Dist to Glacier NP	−0.002	−8.87	−488/km	−0.002	−5.95	−489/km	−0.002	−5.51	−461/km
Nav waterfront	0.601	31.47	214,034	0.636	15.86	248,836	0.595	27.71	195,047
Flathead/Whitefish Lake	0.372	14.30	117,295	0.438	7.98	153,702	0.359	12.27	103,804
Non nav waterfront	0.127	11.96	35,291	0.142	7.81	42,704	0.124	9.49	31,759
Dist to lake	−0.041	−16.71		−0.031	−6.65		−0.044	−12.18	
Dist to lake ²	0.002	9.34	−6767/km	0.001	3.32	−5130/km	0.002	5.76	−7257/km
Dist to lake ³	$−1.6 \times 10^{-5}$	−6.02		$−9.4 \times 10^{-6}$	−1.89		$−1.8 \times 10^{-5}$	−3.30	
DNRC WUI	−0.028	−3.07	−7076	−0.064	−4.14	−17,389	−0.005	−0.42	−1132
View of fire	−0.026	−2.97	−6610	NA	NA	NA	NA	NA	NA
Big fire	−0.035	−3.45	−9045	−0.056	−2.68	−15,136	−0.029	−2.35	−6854
0–5 km from fire	−0.137	−4.67	−33,232	−0.149	−3.93	−38,836	−0.103	−1.92	−23,498
5–10 km from fire	−0.076	−5.31	−18,924	−0.098	−4.67	−26,127	−0.030	−1.34	−7096
qtr since fire	0.003	1.55	−301/quarter	0.002	0.68	−774/quarter	0.004	1.99	23/quarter
qtr since fire ²	$−1.8 \times 10^{-4}$	−2.81		$−2.1 \times 10^{-4}$	−1.84		$−2.0 \times 10^{-4}$	−2.58	
250 m med cc	0.016	3.46	2708/ha	0.030	3.37	4644/ha	0.006	1.02	1537/ha
250 m med cc ²	−0.001	−2.32		−0.003	−3.33		1.2×10^{-4}	0.26	
500 m med cc	−0.005	−2.97	−982/ha	−0.005	−1.64	−918/ha	−0.003	−1.49	−868/ha
500 m med cc ²	7.8×10^{-5}	1.49		1.1×10^{-4}	1.22		$−1.3 \times 10^{-5}$	−0.19	
Controls	age of home, style of home, type of garage, sale quarter								
R ²	0.817			0.827			0.817		
Adjusted R ²	0.815			0.823			0.815		
N	11,817			4173			7644		

or the Big Mountain Ski Resort also had substantially higher home sale prices relative to other homes.

5.2. Effect of Wildfire and Perceived Wildfire Threat on Property Values in the 'Northwest Montana' Model

Wildfire has had a dramatic effect on home sale prices in northwest Montana. The 'northwest Montana' model suggests sale prices of homes within 5 km of a wildfire burned area were 13.7% (\$33,232) lower than equivalent homes at least 20 km from a fire. Sale prices of homes between 5 km and 10 km from a wildfire burned area were 7.6% (\$18,924) lower than equivalent homes at least 20 km from a fire. Sale prices of homes between 10 km and 15 km, and 15 km and 20 km from the nearest wildfire burned area were not statistically significantly different from homes greater than 20 km from a previously burned area.

Having a view of a wildfire burned area (*view of fire*) decreased the mean sale price of a home by \$6610 relative to a home without a view of a burned area. The statistical significance of *big fire* indicates that proximity to large wildfires negatively affects homebuyer willingness to pay more than proximity to small wildfires. Properties that pay the DNRC WUI fire protection fee have mean sale prices \$7076 lower than homes that do not. Given that these fees are typically less than \$50/household/year, this variable is capturing more than capitalization of the fee into the sale price. The fee is levied only from properties close to large forested areas and may be accounting for several disamenities, including remoteness from urban amenities, and increased perception of wildfire risk.

The variable *qtr since fire* was found to be statistically insignificant; however, *qtr since fire*² was statistically significant and negative. House prices were found to decrease with time since the nearest wildfire to the home burned. This counter-intuitive result is relatively small (\$301/quarter since fire) and suggests recovery of house sale prices with time since fire in northwest Montana takes considerable time (greater than the maximum period of seven years post-fire examined in this study), which is consistent with house sale price trends following wildfire in Colorado (Loomis, 2004). Since seven years is a short period of time relative to the time required for recovery of northern Rocky Mountain forest ecosystems from wildfire, it is perhaps not surprising that the time since fire variables are either statistically insignificant or small.

As in Kim and Wells (2005), medium density canopy cover was found to be statistically significant and positive for house sale prices relative to low canopy density, although only within 250 m of the home. Medium canopy cover is a disamenity between 250 m and 500 m of a home. This suggests that the amenity aspect of trees, including shade, privacy and aesthetic value, outweighs disamenities such as wildfire risk for trees close to a home. However, disamenities associated with medium density canopy cover outweigh the amenity benefits of trees further from the home (250 m to 500 m). The effect of high density canopy cover on property values was not statistically significantly different from low density canopy cover, and the coefficients are not reported in Table 4. This may be due to the small area of high canopy cover forest near homes in the study area (Table 3).

5.3. The 'With' and 'Without View of Wildfire' Models

Structural, neighborhood and environmental amenity variables for the 'with view of fire' and 'without view of fire' models are consistent with the 'northwest Montana' model. The with and without view models highlight the importance of view of wildfire burned areas on environmental amenity values and wildfire risk perceptions, as capitalized into home sale price. The negative coefficients for DNRC WUI, *big fire*, *0–5 km from fire* and *5–10 km from fire* all increased in the 'with view of fire' model. Canopy cover variables also remained

statistically significant. An increase in medium canopy density cover within 250 m of a home is projected to add substantially more to the value of a home with a view of a burned area than in the 'northwest Montana' model. This may be capturing aesthetic and lower wildfire risk perception benefits associated with the view of burned areas being interrupted by tree cover near the home. Both *qtr since fire* and *qtr since fire*² are statistically insignificant in the 'with view of fire' model, indicating that time since fire is not important to homebuyers when a wildfire burned area can be seen from the home.

In the 'without view of fire' model, only *big fire* and time since the nearest wildfire burned remained statistically significant; DNRC WUI, *0–5 km from fire*, *5–10 km from fire* and all canopy cover variables became statistically insignificant. In contrast to the two other house sale price models examined in this study, a small increase in house sale price with time since fire was projected for homes without a view of wildfire. Since the general house sale price trend was captured by the *sale quarter* variable, this result suggests that properties without views of burned areas increased in value at a faster rate than homes with views of burned areas. Being located within the DNRC WUI is statistically insignificant for homes without a view of a wildfire burned area, but is statistically significant and has a large negative effect on the sale price of homes with views of burned areas. This seems to indicate that the DNRC WUI variable is capturing perceptions of wildfire risk and wildfire-related disamenities, rather than remoteness from urban amenities.

6. Policy Implications and Conclusions

Wildfires have had large, persistent and negative effects on property values in northwest Montana, which is consistent with previous research in Colorado (Loomis, 2004). This reduction arises from changes in the quality of environmental amenities (e.g. aesthetics and recreation opportunities) and in perceived wildfire risk. It is impossible to determine the relative magnitudes of these two effects with the revealed preference data available for this study; however, indications from the magnitude of the decrease in home sale price from proximate large wildfires (\$33,232 within 0–5 km of a wildfire) compared to the increase associated with proximity to public lands (\$2355 increase for every kilometer closer to national forest than the average of 4.62 km) indicates that much of the price loss may be associated with increased perception of wildfire risk. Stated preference research is required to resolve this interpretation dilemma and begin to answer questions about how the public would like wildfire and environmental amenities to be managed.

The statistically significant and large negative effects of wildfire variables in the 'with view of fire' model, coupled with the insignificance of the same variables in the 'without view of fire' model does support an argument that homebuyers may correlate view of and closer proximity to burned areas with increased wildfire risk. However, when burned areas are out of sight, wildfire risk appears to be out of mind. This bears similarities with recent studies on the effects of flood hazards on property values, where the price discount for locating within a floodplain was significantly larger after a flood event in the floodplain (Bin and Polasky, 2004; Morgan, 2007). Of course, future flood risk is relatively independent of the timing of previous flood events, whereas due to modification of fuels, a home that is proximate to a recently burned area is likely to have lower future wildfire risk than a similar home located where no wildfire has recently occurred. Thus, misguided wildfire risk perceptions of homebuyers may be increasing demand for WUI homes in areas of greater future wildfire risk. An investigation of how homebuyer willingness to pay is affected by perceived wildfire risk and how closely perceptions compare with actual wildfire risk (as determined by computer simulation or expert opinion) would be interesting avenues for future research and may highlight the desirability of a wildfire risk education campaign.

The out of sight, out of mind mentality of homebuyers in northwest Montana does suggest opportunities for wildfire management authorities to manage wildland fires for resource benefits under suitable fire weather conditions when the fire is outside the viewshed of homes. With homebuyers indicating a preference for medium canopy density stands within 250 m of a home when a wildfire burned area can be seen from a home, it appears that moral suasion and government incentive programs for landowners to perform fuel treatments around their home may be positively received in the study area. This is consistent with a stated preference study that estimated the willingness of Montanan WUI households to pay for prescribed fire and mechanical thinning to reduce fuels on adjacent public land (Loomis et al., 2005). However, *Fire Wise* education campaigns may be necessary to encourage homeowners without views of wildfire burned areas to thin their stands.

Dramatic population increase within Northwest Montana during the period of analysis was largely driven by high quality environmental amenities (Power and Barrett, 2001; Swanson et al., 2003). The importance of these attributes was further confirmed by this study. Public fire management is currently being challenged by the needs to protect communities within the public–private interface and the primary missions of the various land management agencies in protecting natural resource values (including consideration of the beneficial effects of wildfire). USDA OIG (2006) specifically highlighted this challenge and argued that the Forest Service has given default priority to the protection of private property despite policy that recommends equal consideration with natural resource values.

Taken at face value, the results of this study may indicate that increased funding for aggressive suppression of all wildfires within 10 km of residential development is the most economically efficient response, given the large and growing value of the housing stock in these fire prone areas. However, prioritization of aggressive wildfire suppression in all areas proximate to homes poses three dilemmas.

- 1) Fire suppression and exclusion will further exacerbate hazardous fuels conditions and create conditions where future wildfires will be more difficult to suppress (Reinhardt et al., 2008);
- 2) Priority given to manage the natural resources that have been largely responsible for increased migration to northwest Montana would need to be reduced given existing budget constraints; and
- 3) Federal funding of wildfire suppression in the WUI transfers wealth from society at large to a comparatively small number of homeowners.

As Loomis (2004) asserted, building homes in wildfire-prone areas generates substantial negative externalities, because homeowners do not pay the cost of wildfire suppression. Increased suppression of wildfires near residential development will increase moral hazard and reduce disincentives to build in areas of high wildfire risk. The negative effect of wildfire on house prices in northwest Montana suggests that house prices are beginning to reflect the increased hazards of living in the WUI, which is efficient for society at large. However, there is evidence that homebuyers in northwest Montana have a poor understanding of wildfire risk and have substantially reduced their willingness to pay for homes with lower future wildfire risk, relative to homes with higher future wildfire risk. These dilemmas suggest that rather than increasing focus on wildfire suppression, more resources need to be allocated to educate people living in these environments about the threat of wildfire, mitigation opportunities and long-term ecological impacts, and to improve management of residential development patterns.

This study focused on the northern Rocky Mountains of the western United States. Similar studies in other wildfire-prone areas with large and growing WUI communities, including parts of Canada and Australia, are likely to be useful in supporting efficient allocation of resources to wildfire preparedness and suppression activities through: (a) providing an estimate of the magnitude of private home value change due to wildfire effects on the quality of environmental amenities and perceived

wildfire risk; (b) highlighting fuels and wildfire management strategies likely to be more acceptable to residents of the WUI; and (c) identifying misguided wildfire risk perceptions and whether homebuyers prefer home attributes that are positively correlated with wildfire risk.

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