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Improving Fire Hazard Assessment at the Urban-Wildland Interface: Case Study in South Lake Tahoe, CA

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Abstract

A fire hazard assessment was conducted on private, developed lots in South Lake Tahoe, a high fire hazard urban-wildland interface community in Northern California. Fire hazard was assessed in terms of the minimum standards set forth in the National Fire Protection Association's (NFPA) Standard 299 and homeowner practices such as compliance with the fire safety law PRC 4291, construction materials of the home, and irrigation. In addition, the influence on small parcel fire hazard by neighbors was assessed.

Results indicated that the overall fire hazard rating for the city was relatively low because of its good roads, water, signage, and firefighting resources. However, the citywide non-compliance rate for property maintenance was 66%, the citywide non-compliance rate for defensible space was 86% when adjusted for small parcel size, and 57% of the parcels were non-compliant for both defensible space and maintenance.

Clearly, homeowners in South Lake Tahoe rarely choose for fire safety even though the city's infrastructure is good. Furthermore, results demonstrate that assessing the city's fire hazard using NFPA 299 alone will underestimate a parcel's fire hazard. Including an analysis of compliance rates and homeowner practices will provide a more accurate estimate of individual fire hazard.

Introduction

The matrix of homes and landscaping that make up the urban forest of urban-wildland interface (UWI) communities is defined as a fuel matrix by the National Fire Protection

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Association (NFPA 299). In contrast to wildland areas, this fuel matrix requires active homeowner involvement in fire hazard mitigation. This necessity has resulted in regulations governing the landscaping practices by private landowners in the high fire hazard areas of California (CA PRC 4291). Designed with the importance of fuels reduction and structure survivability in mind (Brown 1994, Cohen 1995, Tran 1992, Foote 1991), PRC 4291 requires defensible space for at least 10 meters around the home. It limits a homeowner's choice of plant species, density, and placement and regulates maintenance practices such as pruning trees and removing ladder fuels.

Though compliance with PRC 4291 may increase fire safety, the law does not recognize (1) the variability in the individual landscaping preferences that people have, or (2) the impact of neighboring parcels on a homeowner's fire hazard. Residents at the UWI have unique, individual sets of values and preferences that are reflected in the landscapes they create and maintain around their homes. These values often conflict with the principles of fire safety but property owners resist fire-safe regulations if they detract from what is valued in the landscape (Manfredo 1990, Abt 1991, Bailey 1991, Cortner 1991, Foote 1991, Smith 2001, Hodgson 1993, Winter 2000). In some communities, the combination of these two problems – small lot size and landscape preferences – poses a significant barrier to effective individual and community fire hazard mitigation.

This report describes a fire hazard analysis conducted on private, developed lots in South Lake Tahoe, California. South Lake Tahoe is a high fire hazard UWI community in Northern California where many of the developed lots are noncompliant with PRC 4291 even though there is active agency outreach and public support of fuels reduction on undeveloped lots (Garrett, pers. comm., Harcourt, pers. comm.). Fire hazard was assessed according to the standards in NFPA 299, compliance with PRC 4291, construction materials of the home, irrigation practices, and the influence on a parcel's fire hazard by its immediate neighbors.

Results indicated that the overall fire hazard score for the city was relatively low because of infrastructural components such as good roads, water availability, signage, and firefighting resources. Analysis of the components that involve homeowner choice only (e.g. defensible space, maintenance, irrigation, and construction materials) indicated limited individual, parcel-scale fire hazard mitigation efforts.

Study site

South Lake Tahoe has approximately 24,000 inhabitants and is located on the south shore of Lake Tahoe, adjacent to the Nevada border. The greater Lake Tahoe Basin extends across 88,000 hectares in two states (California and Nevada) and four counties (El Dorado, Placer, Douglas and Nevada). Its elevation ranges from approximately 1900 m at the surface of the lake to about 3300 m at Freel Peak.

Historically, fires in the Tahoe Basin were probably low and medium intensity surface fires, occurring every 15 – 25 years and consuming mostly light surface fuels, rarely becoming stand-replacing events (Skinner and Chang 1996). Eighty-five years of fire suppression in the basin (Murphy and Knopp 2001) combined with recent, prolonged drought conditions and extensive bug-kill have led to a build up of highly flammable, hazardous fuel conditions throughout the area.

The dominant conifer species in the lower montane zone is ponderosa pine (*Pinus ponderosa)*, with some white fir (*Abies concolor*), incense cedar (*Calocedrus decurrens*), and sugar pine (*P. lambertiana*). The upper montane zone (approx. 2000 – 3000 m) is dominated by Jeffrey pine (*P. jeffreyi*) and also contains red fir (*A.*

magnifica), white fir, western white pine (*P. monticola*) and some pure stands of lodgepole pine (*P. contorta*). In the subalpine zone (above 3000 m) species include whitebark pine (*P. albicaulis*) and mountain hemlock (*Tsuga mertensiana*) (Manley and Schlesinger 2001).

The average January temperature for the basin is slightly below 0° C, the average July temperature is approximately 16° C, and the average annual precipitation is 74 cm. Average annual snowfall ranges from 2.5 m at the elevation of the lake to almost 9 m in the mountains. At lake level, there are on average only 70 – 100 frost-free days per year (U. S. Environmental Data Service 2000).

Archaeological evidence suggests that human habitation of the Tahoe Basin began with the ancestors of the Washoe Native Americans, who entered the Basin after the Sierran glaciers retreated 8,000 to 9,000 years ago. The first non-Native settlers arrived in the basin after the discovery of gold and silver in nearby Virginia City, Nevada. Early industry included logging, ranching, grazing and fishing. By the early twentieth century, less than half of the pre-settlement forest in the Tahoe Basin remained. While timber harvesting decreased, grazing and ranching continued because of the need for farm products for the basin's expanding population.

Management agencies and consortiums were developed in the Lake Tahoe Basin to mitigate the negative ecological impacts of the basin's growing population. Among the most visible are the Tahoe Regional Planning Agency (TRPA), the USDA Forest Service's Lake Tahoe Basin Management Unit (LTBMU), and Tahoe Re-Green. The TRPA is a powerful regulatory organization whose primary objective is to develop land use and management standards that maximize environmental health and mitigate negative environmental impacts from development (Murphy and Knopp, eds. 2000). Since the early 1970s, TRPA has prohibited development on environmentally sensitive parcels and has regulated private landowners' management of their own parcels. To compensate landowners, the LTBMU and the California State Tahoe Conservancy have purchased many of these lots. The LTBMU also plays an active role in fuel management on the undeveloped urban lots owned by the Forest Service. Tahoe Re-Green is an interagency consortium that aims to educate residents and help them reduce fire hazard by removing fuels on privately owned land.

Methods

Sampling sites were chosen from a population of approximately 6,500 single-family residential parcels. These parcels were stratified into low, medium, and high canopy cover and into low, medium, or high density residential. A proportional allocation method was used to determine the number of parcels to be sampled within each stratum. In total, 102 parcels across the city were sampled. The vegetation and structural characteristics of each parcel were measured and mapped.

The city was divided into six neighborhoods based on observed differences in vegetation, lot, and building characteristics (Fig. 1) (de Jong, in review). The initial ocular classification was refined through statistical analysis for homogeneity in each of the defined neighborhoods. The boundaries of each neighborhood encompass built areas within city limits and exclude unbuilt areas such as parks and golf courses. Major roads defined the boundaries between adjacent neighborhoods.

Neighborhood 1 was the Tahoe Keys, characterized by wide streets, canals, large, new homes and planted exotic vegetation and turf grass. There was no significant slope on any of the parcels found in this neighborhood. Neighborhood 2 – 5 were similar to one another in terms of small parcel and home size. Their vegetation was

dominated by native conifer species with a sparse assortment of exotic shrubs and other plants, though the species composition and structure differed between neighborhoods. Some parcels were slightly sloped. Neighborhood 2 encompassed a large area surrounding the "Y," or the junction of Highways 50 and 89, including the tracts of Gardner Mountain, Tahoe Vista, Tahoe Island, State Name streets, and the area around the hospital. Neighborhood 3 was the tract consisting of the north-central part of the city. Neighborhood 4 was the Sierra Tract. Neighborhood 5 contained the Bijou and Al Tahoe tracts. Neighborhood 6 was the affluent area of Heavenly Ski Resort and was characterized by large, new homes, large lots, and dominance of native conifer species. Slopes in this neighborhood were significant.

A fire hazard analysis was conducted on each parcel and then compared qualitatively to the fire hazard of neighboring parcels. The assessment was based on NFPA 299, which assigns a number score for risk factors, compliance with PRC 4291, construction materials, and irrigation. Higher scores reflect higher fire hazard.

Figure 1. -- Neighborhoods and characteristic lots as defined for this study. 1- Tahoe Keys; 2 – The Y; 3- North Central; 4- Sierra; 5- Bijou; 6- Heavenly.

The law (PRC 4291) requires homeowners to prune dead branches, clear needles and other litter from roofs and gutters, cover vents with wire mesh, and clear tree branches for 3 m around chimney outlets. Characteristics known to contribute to structural ignition potential, such as a wood roof and single-paned windows (Foote 1991, White 2000, Quarles 2001, Quarles 2002), were also rated.

Compliance with PRC 4291 was analyzed in terms of the creation of defensible space alone, maintenance alone, and the combination of defensible space and maintenance. Parcels demonstrating little or no defensible space were rated non-compliant. Parcels that were non-compliant with one or more of PRC 4291's maintenance requirements were also considered non-compliant.

Parcels were further assessed for presence of irrigation, construction materials, parcel size, and the presence of hazardous decks. Defensible space ratings were adjusted for small parcels to account for neighboring vegetation that would influence the parcel's fire hazard. Decks were considered hazardous if they were made of wood and greater than 0.5 m high and were open underneath or had flammable material stored underneath them.

Parcels were classified as small and under the direct influence of the fire hazard of immediate neighbors if the distance between the house and the side boundaries of the parcel was less than 7 m on either side, if the difference between the total width of the parcel and the total width of the house was less than 14 m, or if the difference between the total length of the parcel and the total length of the house was less than 14 m. Larger parcels were considered independent of neighboring parcels.

The fire hazard ratings of the individual small parcels were adjusted to include the fire hazard of neighboring parcels. Small parcels with good defensible space and "relatively better" maintenance were rated the same for defensible space as a medium or large parcel with moderate defensible space. Small parcels with good defensible space and "same" relative maintenance were rated the same for defensible space as a medium or large parcel with good defensible space.

Neighborhoods were assigned a mean fire hazard rating based on the fire hazards of the parcels that were sampled within the neighborhoods. The point scoring system is found in Table 1. The range of possible scores is 9 – 80 or more, depending on the number of decks present.

Results

Overall fire hazard rating

The mean citywide fire hazard rating was 30 (s.d. 6), due in large part to the city's infrastructure, including good access (wide, paved roads), the availability of water, and the presence of city and agency fire-fighting resources (Table 2). As expected, the Tahoe Keys exhibited the lowest fire hazard, with a mean fire hazard rating of 24 (s.d. 5), and the Heavenly Ski Area had the highest (38, s.d. 7). The rating for the remaining neighborhoods ranged from 28 to 30.

Lot size

The sampled lots in South Lake Tahoe were small. Mean lot size varied from 585 m^2 in the Sierra tract to 1211 m^2 in Heavenly. The difference in size is explained by the variation in the depth of the lots rather than their width. The mean lot width citywide was 22 m (s.d. 8.5 m). The lot size in the Sierra tract was significantly smaller than any other neighborhood in the city.

Table 1. Point scoring system for risk factors.

RISK FACTOR	SCORING
Ingress/egress	1- two or more primary road 3- one road, primary route 5- one way in/out
Primary road width	1- >6.1m 3- <6.1m
Accessibility	1- smooth road, <5% grade 3- rough road, >5% grade 5- other
Cul-de-sacs	1- outside radius >15m 3- outside radius <15m
Turn-arounds	3- dead end road is <60m 5- dead end road is >60m
Street signs	1- present (=10cm and reflect) 5- not present
Water	1- source <20min round-trip 5-source 20 - 45min RT 10- source >45 min RT
Utilities	1- all underground 3- one above-, one underground 5- all aboveground
Maintenance	1-high 3- moderate 5- none
Defensible space	1- high (10+m treatment) 5- moderate (3-7m treatment) 10- no treatment
Roof materials	+3 – wood roof
Branches in chimney	+2 – branches within 2m of chimney outlet
Irrigation	+1 – little or no irrigation
Vegetation	+2 – high canopy cover +1 – medium canopy cover
Slope	+1 - 25 – 40% +2 - >40%
Wall materials	+1 – wood siding
Wall, eave, roof vents	+2 – some present without _ in. mesh cover
Predominant number of window panes	+1 – predominantly single-paned
Deck height	+1 – each deck with height > 0.5m
Open space below deck	+1 – each deck with open space beneath
Storage of flammable materials under deck	+1 – each deck with storage of flammables beneath
Deck materials	+1 – each wooden deck
Parcel size	Adjustments made for small parcels
Relative maintenance	1- parcel is worse than neighbors 3- about the same 5- neighbors are worse than parcel

Table 2. Fire hazard rating, non-compliance rates, and risk factors in South Lake Tahoe neighborhoods.

Risk Factor	City	Neighborhood					
	Total *(n=102)*	Keys *(n=15)*	The Y *(n=22)*	N. Central *(n=13)*	Sierra *(n=22)*	Bijou *(n=21)*	Heavenly *(n=9)*
Mean fire hazard rating (s.d.)	30 (6)	24 (5)	30 (4)	30 (6)	30 (6)	28 (5)	38 (7)
Maintenance non-compliance rate	66	20	68	69	73	76	89
Individual def. space non-compliance rate	75	47	86	85	77	62	100
Individual total non-compliance rate	53	7	59	62	64	48	89
Individual def. space non-compliance rate (adjusted for small parcels)	86	80	91	92	82	81	100
Individual total non-compliance rate (adjusted for small parcels)	57	20	59	62	64	58	89
Irrigation (% of parcels with less than half irrigated)	52	13	45	69	59	58	78
Mean slope % (s.d.)	2 (6)	0 (0)	0 (0)	0 (0)	1 (3)	0 (0)	15 (16)
Wood exterior (% of homes)	96	87	95	100	100	95	100
Wood roof (% of homes)	31	27	18	54	27	29	56
Window hazard (% of homes)	29	27	41	23	32	24	22
Deck hazard (% of homes)	67	60	68	77	73	48	89

Compliance with PRC 4291

Citywide, the majority of parcels had increased fire hazard ratings because they were partially or wholly non-compliant with PRC 4291. Sixty-six percent of the sampled parcels were non-compliant with the law's requirements for maintenance and 75% exhibited little or no defensible space. In total, 53% of the parcels were non-compliant for both maintenance and defensible space.

When taking small parcel size into consideration, i.e. including the vegetation of neighboring parcels in the defensible space analysis, 86% of the parcels were non-compliant for defensible space and 57% were non-compliant for both maintenance and defensible space.

Adjusting the defensible space rating to account for neighboring lots had the greatest effect on the defensible space compliance rates for the Keys and for Bijou. Smaller changes were observed for the Y,

North Central, and Sierra. It had no effect on the 0% defensible space compliance rate for Heavenly.

Irrigation
Over half the parcels citywide had irrigation on less than half of the vegetation found on the parcel. The vegetation in the Keys, which was dominated by turf grass and planted exotics, was well irrigated, while over 75% of the parcels in Heavenly, which were dominated by native conifer stands, showed little evidence of irrigation. Less than one third of the parcels in the North Central neighborhood were irrigated. From 41% - 55% of the parcels in the other neighborhoods were irrigated.

Slope
Most of the parcels that were sampled existed on little or no slope, with the exception of parcels in Heavenly, where the mean was 15% and the range was from 0% to 53%.

Wall material
The preferred building material for homes in South Lake Tahoe was wood. 96% of the homes in the sample had exterior walls that were shakes, logs, or wood siding. Thirteen percent of the homes in the Keys were predominantly brick, stucco, or stone, but from 95 – 100% of the homes in the remaining neighborhoods had wood exteriors.

Roof material
Citywide, 31% of the sampled homes had a significant increase in susceptibility to ignition because of wood roofs. Neighborhoods where more than half the homes had wood roofs were North Central (54%) and Heavenly (56%). The fewest number were found in the neighborhood of the Y (18%).

Window panes
Citywide, 29% of the sampled homes had increased fire hazard due to the presence of single-paned glass in over half the windows of the home. The highest percentage of homes that had predominantly single-paned windows was in the neighborhood of the Y (41%), while the lowest was in Heavenly (22%).

Hazardous decks
Hazardous decks were found on 67% of the homes citywide. Deck construction and placement was particularly problematic in Heavenly, where slopes were greatest. In that neighborhood, eight of the nine parcels sampled had hazardous decks. In Bijou only 48% of the homes had hazardous decks, while 60 – 73% of the homes in the remaining neighborhoods had hazardous decks.

Discussion

The results of this study clearly indicate that standard city-scale fire hazard rating in South Lake Tahoe will not provide managers and planners with sufficiently detailed information to implement an effective fire hazard mitigation program. While the city's infrastructure is good, individual homeowners in the community rarely choose for fire safety in terms of construction materials, property maintenance, and landscaping or defensible space. The problem of non-compliance is worsened by the fact that many of the city's lots are so small they are influenced by the fire hazard of neighboring lots.

Furthermore, results indicate that fire hazard rating should be improved to account for the fire hazard created by neighboring vegetation and houses in areas dominated by small lots. Also, each component of a fire hazard rating system should produce results than can be used as decision support for fire management, including identifying priority areas for treatment, identifying problematic areas in

terms of non-compliance, and identifying reasons for non-compliance. Each of the six neighborhoods in South Lake Tahoe has a unique profile in terms of the suite of factors that contribute most significantly to neighborhood-scale fire hazard. The neighborhood profiles can be used to direct and focus management and homeowner education efforts. The obvious difference between the Keys and Heavenly, for example, provides managers with a clear set of management objectives, but there are also important, less obvious differences between the other neighborhoods.

For example, results indicated that the Y had an average fire hazard for the city, but compared to the rest of the city this neighborhood was characterized by a low percentage of wood roofs, better irrigation, average compliance with PRC 4291, and an average hazard created by decks. However, the fire hazard rating was the same as the citywide average because these positive factors were offset by its 85% non-compliance rate for defensible space. This figure increased to 91% when adjusted for small lot size. Compared to Sierra, the Y had a lower compliance rate but rated better in terms of construction materials and decks. Compared to North Central, the Y exhibited comparable compliance rates and was slightly better in terms of deck hazards, but the Y rated far worse in terms of the percentage of wood roofs and single-paned windows. These data can guide management decisions, including both fuels reduction programs and outreach and education that focus on the particular needs in each neighborhood.

In addition to the education efforts that focus on defensible space and maintenance, there is clearly a need to educate residents about other practices related to fire hazard. Education is needed in Heavenly and elsewhere about the benefits of irrigation in terms of fuel moisture content and the relationship between drought stress, bug kill, and fire hazard. Most homes already have double-paned windows for better insulation against winter weather, but many residents do not realize that double-paned windows also decrease the risk of structural ignition. Hazardous decks are a chronic problem in Heavenly, where most decks hang over steep slopes covered with continuous surface fuels. In this community, which is characterized by small lots and many seasonal residents, education on the importance of neighborhood-scale cooperation is critical.

In sum, standard fire hazard analysis in South Lake Tahoe and similar communities is likely to underestimate individual fire hazard. First, the city's fire-safe infrastructure is included in the parcel-scale analysis, which offsets the increased individual fire hazard associated with a lack of defensible space and maintenance around the home. Compliance with PRC 4291 is perhaps the most important factor in structure survivability, but the influence of the city's good infrastructure on its overall fire hazard rating obscures the fact that three-quarters of the parcels citywide are non-compliant with defensible space codes and two-thirds are non-compliant with maintenance codes. Second, the hazard on small lots will be further underestimated because of the influence of the fire hazard of neighboring parcels.

A more appropriate approach to fire hazard assessment in South Lake Tahoe is to assess parcels for compliance, lot size, and the individual choices homeowners make in terms of construction materials and irrigation. Analysis of compliance rates and homeowner choices will provide a more accurate estimate of individual fire hazard. The analysis can also serve as decision support for focusing outreach and education efforts and for prioritizing areas that are most in need of homeowner compliance and cooperation.

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Literature Cited

Abt, R. C., M. K. Kupyers and J. B. Whitson. 1991. **Perception of fire danger and wildland/urban policies after wildfire**. USDA Forest Service. GTR SE-69, pp. 257-259.

Bailey, D. W. 1991. **The wildland-urban interface: social and political implications in the 1990's**. Fire Management Notes 52(1): 11-18.

Cohen, J. 1995. **Structure Ignition Assessment Model (SIAM)**.USDA Forest Service. PSW-GTR-158.

Cortner, H. J. 1991. **Interface policy offers opportunities and challenges: USDA Forest Service strategies and constraints**. Journal of Forestry 89(6): 31-34.

de Jong, L. 2002 (in review). **Urban Forestry at the Urban Wildland Interface: Case Study in South Lake Tahoe.**

Foote, E., R. Martin, J. K. Gilless. 1991. **The defensible space factor study: a survey instrument for post-fire structure loss analysis**. Proceedings, 11th Conference on Fire and Forest Meteorology. Society of American Foresters. p. 66 – 73.

Garrett, Brian. Urban Lot Manager, USDA Forest Service Lake Tahoe Basin Management Unit (LTBMU). May 7, 2002.

Harcourt, Steve. Area Forester, California Department of Forestry and Fire Protection. Telephone conversation, February 11, 2002.

Hodgson, R. W. 1993. **Perceptions of Defensible Space: Perceived Characteristics that Influence Wildland-Urban Intermix Residents to Accept or Reject Fire Safe Landscaping**. Prepared for the California Department of Forestry and Fire Protection.

Manfredo, M. J., M. Fishbein, G.E. Haas and A.E. Watson. 1990. **Attitudes toward prescribed fire policies**. Journal of Forestry 88(7): 19–23.

Manley, P. and M. Schlesinger. 2001. **Final Report for the California Tahoe Conservancy and US Forest Service**. April, 2001.

Murphy, D.D., C. M. Knopp, eds. 2000. **Lake Tahoe watershed assessment: Volume I**. Gen.Tech.Rep. PSW-GTR-175. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 736 pp.

NFPA. 1997. **NFPA-299: Standard for Protection of Life and Property from**

Wildfire. National Fire Protection Association. 17 pp.

Quarles, S. 2001. **Testing protocols and fire tests in support of performance-based codes**. California's 2001 Wildfire Conference, Oakland, CA. October 10-12, 2001.

Quarles, S. 2002. **Conflicting design issues in wood frame construction**. 9th Durability Building Materials Conference, Brisbane, Australia. March 2002.

Skinner, C., C. Chang 1996. **Fire regimes, past and present**. In: Sierra Nevada Ecosystem Project: Final Report to Congress, volume II, chapter 38. Davis, CA, University of California, Centers for Water and Wildland Resources.

Smith, E. and M. Rebori. 2001. **Factors affecting property owner decisions about defensible space**. In: Conference Proceedings for Forestry Extension: Assisting Forest Owner, Farmer, and Stakeholder Decision-Making. International Union of Forestry Research Organizations, Lorne, Australia. October 29 -November 2, 2001. p.404-408.

Tran, H. C., J. Cohen, R. Chase. 1992. **Modeling ignition of structures in wildland/urban interface fires**. Proceedings, 1st International Fire and Materials Conference. Arlington, VA. p. 253 – 262.

U. S. Environmental Data Service. 2000. Climatological data analysis annual summary: California.

White, R. 2000. **Wildland/urban interface fire research at the USDA Forest Service, Forest Products Laboratory: past, present and future**. In: Proceedings of the Thirtieth International Conference on Fire Safety, the Twelfth International Conference on Thermal Insulation, the Fourth International Conference on Electrical and Electronic Products. White Sulphur Springs, WV. January 24-27, 2000.

Winter, G. and J. S. Fried. 2000. **Homeowner Perspectives on Fire Hazard, Responsibility, and Management Strategies at the Wildland-Urban Interface**. Society & Natural Resources, 13: 33-49.