TO: San Diego Fire Recovery Network
FROM: CJ Fotheringham, Research Scientist
RE: Mitigation Strategies for Reducing Wildland Fire Risks report
DATE: 19 January, 2004

I am a doctoral candidate at University of California, Los Angeles and have been actively involved in research of fire in southern California shrublands as well as in other mediterranean climate regions of the world for the past 10 years. I have published papers in peer-reviewed scientific journals and have detailed knowledge of fire ecology and fire regimes in southern California. A number of the papers I've published specifically address issues the Board of Supervisors is currently grappling with in order to improve public safety and decrease the loss of human life and property during large fire events.

I have reviewed the "Mitigation Strategies for Reducing Wildland Fire Risks" report and find it lacking, if not outright misleading, in a number of key areas. The report is poorly researched and on the face appears heavily biased toward influencing the San Diego Board of Supervisors and Planning Department toward a decision of managing large fires in San Diego County by control burning of remote wildland areas. I have attached a more detailed review.

It is my belief, based on my own and other's extensive research, that Santa Ana driven fires are infrequent but not unnatural events. As such, I believe that a productive way of viewing the issue in regards to public safety would be addressing this in a similar context as 100 year flood events. Like 100 year floods, the probability of a Santa Ana driven fire is low at any given time but highly probable to occur at some point. A management and planning policy that focused on strategic fuel manipulations at the urban/wildland interface coupled with planning ordinances that mandated buffer zones around new communities would have the greatest success of decreasing loss of property and life during even extreme fire events.

If I can be of further assistance, please do not hesitate to contact me.

CJ Fotheringham
Department of Organismic Biology, Ecology, and Evolution
University of California, Los Angeles 90095-1786
seajay@ucla.edu
818-231-9478

This critique pertains to "Mitigation Strategies for Reducing Wildland Fire Risks" report submitted to The San Diego Board of Supervisors on 13 August 2003

Page 4; The Natural Fire Regime
While the historical fire regime is of academic interest, it is a debatable whether it is relevant to the issue at hand, specifically how to minimize impacts of wildland fires to human property and lives. That said, this section brings up an issue that is apparent throughout the report-the lumping of chaparral and coniferous fire regimes as one phenomena. While these two systems occur in juxtaposition to one another in San Diego County and fires spread from one to another, fire regimes and fire behavior is very different in the two systems. To adequately address the problem of protecting human life and property, management of these systems needs based on the unique characteristics of each.

For further discussion of southern California historic fire regimes :
Keeley, J.E., and C.J. Fotheringham. 2001a. Historic fire regime in Southern California shrublands. Conservation Biology 15:1536-1548.
Keeley, J.E., and C.J. Fotheringham. 2001b. History and Management of crown-fire ecosystems: a summary and response. Conservation Biology 15:1561-1567.
Conard, S. G., and D. R. Weise. 1998. Management of fire regime, fuels, and fire effects in southern California chaparral: lessons from the past and thoughts for the future. Tall Timbers Fire Ecology Conference Proceedings 20:342-350.
Moritz, M. A. 1997. Analyzing extreme disturbance events: fire in the Los Padres National Forest. Ecological Applications 7:1252-1262.
Moritz, M. A. 1999. Controls on disturbance regime dynamics: fire in Los Padres National Forest. Ph.D. dissertation. University of California, Santa Barbara.

Page 4; Fire Exclusion Practices
While it appears that fire suppression has been effective at eliminating fires from many western coniferous systems, there is evidence that this is not the case in chaparral. Additionally, many studies indicate that infrequent large fires were the norm long before arrival of Europeans.

In addition to the above cited literature see also:
Mensing SA, Michaelsen J, Byrne R 1999. A 560-year record of Santa Ana fires reconstructed from charcoal deposited in the Santa Barbara Basin, California. Quaternary Research 51 (3): 295-305
Keeley J. E. 2002. Native American impacts on fire regimes of the California coastal ranges Journal Of Biogeography 29:303-320

Page 5; Fire Exclusion Practices Figure 1
The graph presented contradicts earlier statements by the authors that fire suppression has been effective in San Diego County. Additionally, other reputable publications are widely available that support fire suppression has not led to fire exclusion. These studies also indicate that average fire size in San Diego County shows a significantly decreasing trend since the beginning of the century. The authors of these studies concluded that fire suppression not led to fire exclusion but also that fire suppression is absolutely necessary to minimize the impact of increased anthropogenic ignition.

Keeley, J. E., C. J. Fotheringham, M. Morais. 1999. Reexamining fire suppression impacts on brushland fire regimes. Science 284:1829-1832.

Page 5; Fire Exclusion Practices Figure 2

These data, while minimal, bring up some important points that should be pursued further; specifically structure loss per unit area burned is an order of magnitude greater under Santa Ana driven fires. This is an important observation for policy makers as it indicates that these extreme fire conditions are the ones that need to be addressed in order to affect the greatest decrease in loss to human life and property.

Fire	Condition	Structures lost/1000 ac burned
Laguna	Santa Ana	2
Harmony	Santa Ana	14
Viejas	Santa Ana	2
Gavilan	Santa Ana	7
La Jolla	Heat wave	0.2
Pines	Heat wave	0.7

Page 6; Weather, paragraph 1

This is a mis-statement of the findings. Brushland fire *regimes* in southern California are largely driven by the occurrence of wind driven fires. The difference is more than just a matter of semantics. What drives an individual fire is dependent on the conditions prevalent at the time–*ie* under moderate weather and terrain conditions, fuel is probably the most important factor but under high wind conditions such as Santa Anas then the impact of wind can override the importance of fuels and similarly in rugged terrain, topography may be the limiting factor to fire spread. However, the fire *regime* in southern California is dominated, in terms of both acreage burned and structure/life loss, by wind-driven (primarily Santa Ana) fires.

Page 6; Weather, paragraph 2

While fires under drought conditions can and do get large, they account for less area over all and cause less structure loss. Again, it is important to separate what plant community these fires are occurring in (See discussion above).

Page 6; Figure 3

Why was the Harmony fire not included in this table? A skeptic would think it was to balance the ratio of Santa Ana : Non-Santa Ana fires.

Page 7; Topography

Agreed topography is an important factor in determining structure loss. In addition, planning should include the direction from which a wind driven fire is likely to occur and additional precautions taken along this margin.

Page 7; Fuel, paragraph 1

See above discussion for clarification of fire vs. fire regime.

Page 7; Fuel, paragraph 2

The authors of the report are again confusing individual fires with fire regimes. Dr. Keeley has conducted research and commented on fire *regimes* not individual fires *per se*.

While Minnich and Bonnickson speculate about the historic fire regime, neither author has offered anything that would qualify as "proof" to support their contentions of the historic fire regimes. Indeed, a number of papers have cast serious doubt both on the methodology and the conclusions of studies conducted on southern California shrubland fire regimes by above authors. In regards to studies comparing southern California to Baja California, the methodology has been criticized as there are a number of large fires recorded in Baja California that appear to be lacking from the data set used by Minnich. Also, there were no blind tests conducted to test the accuracy of fire boundary delineation. In regards to conclusions, the study attributes all purported differences in fire regimes to one

factor (fire suppression) without addressing other differences such as climate, topography, land use, etc. that also influence fire regimes.

In addition the authors of the report fail to distinguish between shrubland or coniferous fire regimes. While fuels are likely the dominant factor in fires of coniferous forests (where fire suppression policy has been effective and led to fire exclusion) there is strong evidence this is not the case in southern California shrublands and there is no indication that there is an abnormal accumulation of fuels in shrublands-see figure 1.

For further discussion see:
Keeley, J.E., and C.J. Fotheringham. 2001a. Historic fire regime in Southern California shrublands. Conservation Biology 15:1536-1548.
Keeley, J.E., and C.J. Fotheringham. 2001b. History and Management of crown-fire ecosystems: a summary and response. Conservation Biology 15:1561-1567.
Conard, S. G., and D. R. Weise. 1998. Management of fire regime, fuels, and fire effects in southern California chaparral: lessons from the past and thoughts for the future. Tall Timbers Fire Ecology Conference Proceedings 20:342-350.
Keeley, J.E. and C.J. Fotheringham. 2003. Historical fire regime in southern California. Fire Management Today 631:8-9
Keeley, J.E. and C.J. Fotheringham. 2002. Impact of past, present, and future fire regimes on North American Mediterranean shrublands, pp. 214-258. In T.T. Veblen, W.L. Baker, G. Montenegro, and T.W. Swetnam (eds), Fire Regimes and Climatic Change in Temperate and Boreal Ecosystems of the Western Americans. Springer-Verlag, New York.

Page 8; Fuel (cont.), paragraph 3
Again the authors of the report fail to separate coniferous forest from shrublands. While there is evidence of coniferous forests having longer fire free intervals than historically was the case there is no reliable evidence for this being the case in shrublands. In addition, increasing age of wildland fuels is contradicted by the authors own figure 1 (see comments above).

Page 8; Fuel (cont.), paragraph 4
The recent Cedar fire burned through the 10,000 Ac Viejas fire from Jan 2002. Not only was the fire able to propagate in this 1 ½ year old stand, it was able to jump 8-lanes of the freeway at Viejas grade. Clearly, under appropriate conditions chaparral of any age can burn and young age classes cannot be a reliable prevention of fire spread.

Recent studies also indicate that age is not a reliable predictor of fuel load or dead to live ratio.

For further information see:
Conard, S. G. & J. C. Regelbrugge. 1994. On estimating fuel characteristics in California chaparral. Pages 120-129 in Proceedings of the 12th conference on fire and forest meteorology. American Meteorology Society, Boston.

Page 8; Fuel (cont.), paragraph 5
This is a complete mis-representation of studies involving these researchers and borders on outright dishonesty

1. They did not study fuel *per se* but age class (see comments above about age as a fuel predictor)
2. They found that age was a reliable predictor of probability of burning only up to ~28 years.
3. While aware of the debate of the relative role of wind vs. fuel in chaparral fire regimes they do not address the role of wind. Their studies only addressed the probability of stands of a certain age class burning.

However, the authors of the report do not list which of the studies Schoenberg and Peng have published that they are referring to (they are not listed in the bibliography) so it is hard to be more specific than the above comments.

For Schoenberg and Peng's recent work see:

Schoenberg, F.P., Peng, R., Huang, Z., and Rundel, P. (2003). Detection of nonlinearities in the dependence of burn area on fuel age and climatic variables in Los Angeles County, California. Int. J. Wildland Fire 12(1), 1--10
Schoenberg, F.P., Peng, R., and Woods, J. (2003). On the distribution of wildfire sizes. Environmetrics, in review. Available for download at http://web.stat.ucla.edu/~frederic/papers/firesize.pdf
Peng, R. D., Schoenberg, F. P., Woods, J. (2003). Multi-dimensional point process models for evaluating a wildfire hazard index. JASA, in review. Available for download at http://web.stat.ucla.edu/~frederic/papers/fireinterval.pdf

Statements in the second half of the paragraph borders on plagiarism. Peng and Schoenberg never studied Baja California and the figure presented (with modifications? Sub-title is unclear) has been published by Minnich and Chou, 1997. The figure itself has been questioned as misleading on a number of grounds and should be viewed skeptically.

Again, the studies of Baja California vs. southern California have been heavily criticized both on the basis of their methodology and conclusions.

Page 8; Fuel (cont.), paragraph 6
There is no data presented indicating how much of what burned in these fires was 1) older age classes, 2) chaparral or coniferous forest. The fact that Santa Ana conflagrations can and do occur begs the question as to whether maintaining an age mosaic on the landscape is even possible, *ie* when large areas burn the entire footprint of the fire is effectively set back to zero and any previous (expensively obtained) age mosaic is lost across the entire area.

Additionally, the authors do not indicate where these older classes are located. Are they in chaparral or coniferous forests? Near or far from developments? Where they occur is important to making policy and management decisions. Figure 7 would seem to indicate that these older stands are largely coniferous and/or remote from high density population centers.

Page 11; San Diego Wildland-Urban Interface Fire Issues
This section of the report again indicates wind was a dominant factor in structure loss during catastrophic fires. The authors fail to acknowledge this. As indicated earlier, it appears that the greatest losses to human life in property due to fire in southern California is during Santa Ana driven fires. Not all large fires are equal and the order magnitude greater loss under Santa Ana driven fires indicate that these are the fires on which planning should focus in order to maximize the effectiveness of management funds and efforts. Therefore, it would seem that planning for these, infrequent but highly destructive, fires would be a top priority for zoning and planning boards-much in the same way that ordinances are established to cope with the possibility of a 100 year flood.

Bibliography
I'm not sure what to say about this but 'appalling' comes to mind. There is at least one fictional citation when the authors have reputable publications. Most cited articles cannot be verified due to mis sing information such as year and/or journal/media. The number of op-ed pieces included, which are just peoples opinions and they do not generally provide support for their arguments, is inappropriate for a document that purports to be a review of the scientific literature. Particularly in light of what wasn't, and should have been, included.

Below is a list of some papers that may be considered relevant to Southern California fire regimes and planning issues.

Amaya, S. 1991. Discussion. Page 21 in Memorias de la Conferencia internacional sobre el potencial de la cordillera peninsular de las Californias como reserva de la biosfera. Centro de Investigacion Cientifica y Educacion Superior, Ensenada, Mexico.

Barrett, L. A. 1935. A record of forest and field fires in California from the days of the early explorers to the creation of the forest reserves. U.S. Forest Service, San Francisco.

Biswell, H. H. 1989. Prescribed burning in California wildlands vegetation management. University of California Press, Los Angeles.

Bolton, H. E. 1927. Fray Juan Crespi, missionary explorer on the Pacific Coast, 1769-1774. University of California Press, Berkeley.

Bonnicksen, T. M. & R. G. Lee. 1979. Persistence of a fire exclusion policy in southern California: a biosocial interpretation. Journal of Environmental Management 8:277-293.

Bradshaw, T. D. 1987. The intrusion of human population into forest and range lands of California. Pages 15-25 in J. B. Davis and R. E. Martin, editors. Symposium on wildland fire 2000. General technical report 101. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Brown, W. S. 1945. History of the Los Padres National Forest, 1898-1945. U.S. Forest Service, Goleta, California.

Brown, W. S. & S. B. Show. 1944. California rural land use and management. U.S. Forest Service, California Region, Berkeley.

Bradstock, R. A., M. Bedward, B. J. Kenny, J. Scott. 1998a. Spatially-explicit simulation of the effect of prescribed burning on fire regimes and plant extinctions in shrublands typical of south-eastern Australia. Biological Conservation 86:83-95.

Bradstock, R. A., A. M. Gill, B. J. Kenny, J. Scott. 1998b. Bushfire risk at the urban interface estimated from historical weather records: consequences for the use of prescribed fire in the Sydney region of south-eastern Australia. Journal of Environmental Management 52:259-271.

Chandler, C. C. 1963. A study of mass fires and conflagrations. Research note 22. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Chou, Y. H., R. A. Minnich, R. J. Dezzani. 1993. Do fire sizes differ between southern California and Baja California? Forest Science 39:835-844.

Clar, C. R. 1959. California government and forestry from Spanish days until the creation of the Department of Natural Resources in 1927. California Division of Forestry, Sacramento.

Coleman, R. J. 1996. A historical perspective. Pages 12-17 in R. Slaughter, editor. California's I-Zone. State of California, Sacramento.

Conard, S. G. & J. C. Regelbrugge. 1994. On estimating fuel characteristics in California chaparral. Pages 120-129 in Proceedings of the 12th conference on fire and forest meteorology. American Meteorology Society, Boston.

Conard, S. G., and D. R. Weise. 1998. Management of fire regime, fuels, and fire effects in southern California chaparral: lessons from the past and thoughts for the future. Tall Timbers Fire Ecology Conference Proceedings 20:342-350.

Cooper, W. S. 1922. The broad-sclerophyll vegetation of California: an ecological study of the chaparral and its related communities. Publication 319. Carnegie Institution, Washington, D.C.

Countryman, C. M. 1974. Can southern California wildland conflagrations be stopped? General technical note 7. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

D'Antonio, C.M. 2000. Fire, plant invasions, and global changes. Pages 65-93 in H. A. Mooney and R. J. Hobbs, editors. Invasive species in a changing world. Island Press, Covelo, California.

Davis, L. S. 1965. The economics of wildfire protection with emphasis on fuel break systems. California Resources Agency, Sacramento.

Davis, D. F. 1977. California: summer under fire. American Forests 83(10):8-12.

Davis, J. B. 1989. Demography: a tool for understanding the wildland-urban interface fire problem. Pages 38-42 in N. H. Berg, editor. Proceedings of the symposium on fire and watershed management. General technical report 109. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Davis, M. 1995. The case for letting Malibu burn. Environmental History Review 19(summer):1-36.

Dodge, J. M. 1975. Vegetational changes associated with land use and fire history in San Diego County. Ph.D. dissertation. University of California, Riverside.

Dombeck, M. 2001. How can we reduce the fire danger in the interior West? Fire Management Today 61(1):5-13.
Dunn, A. T. 1989. The effects of prescribed burning on fire hazard in the chaparral: toward a new conceptual synthesis. Pages 23-29 in N. H. Berg, editor. Symposium on fire and watershed management. General technical report 109. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Edinger, J. G., R. A. Helvey, D. Baumhefner. 1964. Surface wind patterns in the Los Angeles Basin during "Santa Ana" conditions. Research project 2606. Department of Meterology, University of California, Los Angeles.

Forstall, R. S. 1998. Population of counties by decennial census: 1900 to 1990. U.S. Bureau of the Census, Washington, D. C., Available from http://www.census.gov/population/cencounts/ca190090.txt (accessed 11 November 1998).

Fosberg, M. A., C. A. O'Dell, M. J. Schroeder. 1966. Some characteristics of the three-dimensional structure of Santa Ana winds. Research paper 30. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Franco-Vizcaíno, E. & J. Sosa-Ramirez. 1997. Soil properties and nutrient relations in burned and unburned mediterranean-climate shrublands of Baja California, Mexico. Acta Oecologica 18:503-517.

Frank, E. C. & R. Lee. 1966. Potential solar beam irradiation on slopes. Research paper 18. U.S. Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

Freedman, J. R. 1984. Uncontrolled fire and chaparral resilience in the Sierra Juarez, Baja California, Mexico. M.S. thesis. University of California, Riverside.

Green, L. R. 1981. Burning by prescription in chaparral. General technical report PSW-51. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Greenlee, J. M. & A. Moldenke. 1982. History of wildland fires in the Gabilan Mountains region of central coastal California. National Park Service, Pinnacles National Monument, Paicines, California.

Greenlee, J. M. & J. H. Langenheim. 1990. Historic fire regimes and their relation to vegetation patterns in the Monterey Bay area of California. American Midland Naturalist 124:239-253.

Haidinger, T. L. & J. E. Keeley. 1993. Role of high fire frequency in destruction of mixed chaparral. Madro? o 40:141-147.

Haiman, R. L. 1973. The biological environment and its modification by man in the Sierra de Juarez, Baja California, Mexico. Ph.D. dissertation. University of California, Los Angeles.

Henderson, D. A. 1964. Agriculture and livestock raising in the evolution of the economy and culture of the state of Baja California, Mexico. Ph.D. dissertation, University of California, Los Angeles.

Keeley, J. E. 1982. Distribution of lightning and man-caused wildfires in California. Pages 431-437 in C. E. Conrad and

W. C. Oechel, editors. Symposium on dynamics and management of Mediterranean-type ecosystems. General technical report 58. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Keeley, J. E. 1990. The California valley grassland. Pages 2-23 in A. A. Schoenherr, editor. Endangered plant communities of southern California. Special publication 3. Southern California Botanists, Fullerton.

Keeley, J. E. 1992. Demographic structure of California chaparral in the long-term absence of fire. Journal of Vegetation Science 3:79-90.

Keeley, J. E. 1995. Future of California floristics and systematics: wildfire threats to the California flora. Madrono 42:175-179.

Keeley, J. E. 1998. Postfire ecosystem recovery and management: the October 1993 large fire episode in California. Pages 69-90 in J. M. Moreno, editor. Large forest fires. Backhuys, Leiden, The Netherlands.

Keeley, J. E. 2001. We still need Smokey bear! Fire Management Today 61(1):21-22.

Keeley, J. E. & C. J. Fotheringham. 2001. Historic fire regime in Southern California shrublands. Conservation Biology 15:1536-1548.

Keeley, J. E., P. H. Zedler, C. A. Zammit, T. J. Stohlgren. 1989. Fire and demography. Pages 151-153 in S. C. Keeley, editor. The California chaparral. Series 34. Los Angeles County Natural History Museum, Los Angeles.

Keeley, J. E., C. J. Fotheringham, M. Morais. 1999. Reexamining fire suppression impacts on brushland fire regimes. Science 284:1829-1832.

Kinney, A. 1887. First biennial report. California State Board of Forestry, Sacramento.

Kinney, A. 1900. Forest and water. Post Publishing, Los Angeles.

Knight, R. & G. Gappert, editors. 1989. Cities in a global society. Sage Publications, Newbury Park, California.

Knowles, C. 1953. Vegetation burning by California Indians as shown by early records. Fire volume 28. University of California, Berkeley.

Krausmann, W. J. 1981. An analysis of several variables affecting fire occurrence and size in San Diego County, California. M. A. thesis. San Diego State University, San Diego.

Lee, R. G. & T. M. Bonnicksen. 1978. Brushland watershed fire management policy in southern California: biosocial considerations. Water resources contribution 172. University of California, Davis.

Leiberg, J. B. 1899a. San Jacinto Forest Reserve. U.S. Geological Survey Annual Report 19(5):351-357.

Leiberg, J. B. 1899b. San Bernardino Forest Reserve. U.S. Geological Survey Annual Report 19(5):359-365.

Leiberg, J. B. 1899c. San Gabriel Forest Reserve. U.S. Geological Survey Annual Report 19(5):367-371.

Leiberg, J. B. 1900a. San Gabriel Forest Reserve. U.S. Geological Survey Annual Report 20(5):411-428.

Leiberg, J. B. 1900b. San Bernardino Forest Reserve. U.S. Geological Survey Annual Report 20(5):429-454.

Leiberg, J. B. 1900c. San Jacinto Forest Reserve. U.S. Geological Survey Annual Report 20(5):455-478.

Markham, C. G. 1972. Baja California's climate. Weatherwise 25:64-76.

Mensing, S. A., J. Michaelsen, R. Byrne. 1999. A 560-year record of Santa Ana fires reconstructed from charcoal deposited in the Santa Barbara Basin, California. Quaternary Research 51:295-305.

Millar, C. I. 1997. Comments on historical variation & desired condition as tools for terrestrial landscape analysis. Pages 105-131 in S. Sommarstrom, editor. Sixth biennial watershed management conference. Water resources report 92. University of California, Davis.

Minnich, R. A. 1978. The geography of fire and conifer forests in the eastern transverse ranges, California. Ph.D. dissertation. University of California, Los Angeles.

Minnich, R. A. 1983. Fire mosaics in southern California and northern Baja California. Science 219:1287-1294.

Minnich, R. A. 1987. Fire behavior in southern California chaparral before fire control: the Mount Wilson burns at the turn of the century. Annals of the Association of American Geographers 77:599-618.

Minnich, R. A. 1989. Chaparral fire history in San Diego County and adjacent northern Baja California: an evaluation of natural fire regimes and the effects of suppression management. Pages 37-47 in S. C. Keeley, editor. The California chaparral. Series 34. Los Angeles Natural History Museum, Los Angeles.

Minnich, R. A. 1995. Fuel-driven fire regimes of the California chaparral. Pages 21-27 in J. E. Keeley and T. Scott, editors. Brushfires in California wildlands: ecology and resource management. International Association of Wildland Fire, Fairfield, Washington.

Minnich, R. A. 1998. Landscapes, land-use and fire policy: where do large fires come from? Pages 133-158 in J. M. Moreno, editor. Large forest fires. Backhuys, Leiden, The Netherlands.

Minnich, R. A. & R. J. Dezzani. 1991. Suppression, fire behavior, and fire magnitudes in Californian chaparral at the urban/wildland interface. Pages 67-83 in J. J. DeVries, editor. California watersheds at the urban interface. Report 75. University of California, Water Resources Center, Davis.

Minnich, R. A. & R. J. Dezzani. 1998. Historical decline of coastal sage scrub in the Riverside-Perris Plain, California. Western Birds 29:366-391.

Minnich, R. A. & E. Franco-Vizcaino. 1998. Land of chamise and pines. Historical accounts and current status of northern Baja California's vegetation. Publications in Botany 80. University of California, Los Angeles.

Minnich, R. A. & E. Franco-Vizcaino. 1999. Letters to the editor. Fremontia 27(3):31-33.

Minnich, R. A., E. F. Vizcaino, J. Sosa-Ramirez, Y. Chou. 1993. Lightning detection rates and wildland fire in the mountains of northern Baja California, Mexico. Atmosfera 6:235-253.

Mitchell, V. L. 1969. The regionalization of climate in montane areas. Ph.D. dissertation. University of Wisconsin, Madison.

Moritz, M. A. 1997. Analyzing extreme disturbance events: fire in the Los Padres National Forest. Ecological Applications 7:1252-1262.

Moritz, M. A. 1999. Controls on disturbance regime dynamics: fire in Los Padres National Forest. Ph.D. dissertation. University of California, Santa Barbara.

Mutch, R. W. 1997. Need for more prescribed fire: but a double standard slows progress. Pages 8-14 in D. C. Bryan, editor. Environmental regulation & prescribed fire. Florida State University, Tallahassee.

Peng, R. D., Schoenberg, F. P., Woods, J. (2003). Multi-dimensional point process models for evaluating a wildfire hazard index. JASA, in review. Available for download at http://web.stat.ucla.edu/~frederic/papers/fireinterval.pdf

Phillips, C. B. 1971. California aflame! September 22-October 4, 1970. California Division of Forestry, Sacramento.

Pyke, C. B. 1972. Some meteorological aspects of the seasonal distribution of precipitation in the western United States and Baja California. Water resources contribution 139. University of California, Davis.

Pyne, S. J. 1995. World fire: the culture of fire on earth. Henry Holt, New York.

Reap, R. M. 1986. Evaluation of cloud-to-ground lightning data from the western United States for the 1983-84 summer seasons. Journal of Climate 25:785-799.

Rogers, D. H. 1942. Measuring the efficiency of fire control in California chaparral. Journal of Forestry 40:697-703.

Rowe, P. B., O. M. Countryman, H. C. Storey. 1954. Hydrologic analysis used to determine effects of fire on peak discharge and erosion rates in southern California watersheds. U.S. Forest Service, California Forest and Range Experiment Station, Berkeley, California.

Ryan, G. 1996. Downslope winds of Santa Barbara, California. NOAA NWS-WR-240. U.S. National Weather Service, Berkeley, California.

Schoenberg, F.P., Peng, R., Huang, Z., and Rundel, P. (2003). Detection of nonlinearities in the dependence of burn area on fuel age and climatic variables in Los Angeles County, California. Int. J. Wildland Fire 12(1), 1--10

Schoenberg, F.P., Peng, R., and Woods, J. (2003). On the distribution of wildfire sizes. Environmetrics, in review. Available for download at http://web.stat.ucla.edu/~frederic/papers/firesize.pdf

Schroeder, M. J., et al. 1964. Synoptic weather types associated with critical fire weather. AD-449-630. U.S. National Bureau of Standards, Washington, D.C.

Schroeder, M. J. & C. C. Buck. 1970. Fire weather: a guide for application of meteorological information to forest fire control operations. Agricultural handbook 360. U.S. Forest Service, Washington, D.C.

Schuster, E. G., D. A. Cleaves, E. F. Bell. 1997. Analysis of USDA Forest Service fire-related expenditures 1970-1995. Research paper 230. U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Skinner, C. N. 1997. Toward an understanding of fire history information. Pages 15-22 in S. Sommarstrom, editor. Sixth biennial watershed management conference. Water resources report 92. University of California, Davis.

Sommers, W. T. 1978. LFM forecast variables related to Santa Ana wind occurrences. Monthly Weather Review 106:1307-1316.

Strauss, D., L. Dednar, R. Mees. 1989. Do one percent of forest fires cause ninety-nine percent of the damage? Forest Science 35:319-328.

Swetnam, T. W. 1993. Fire history and climate change in giant sequoia groves. Science 262:885-889.

Talley, S. N. & J. R. Griffin. 1980. Fire ecology of a montane pine forest, Junipero Sierra Peak, California. Madro? o 27:49-60.

Timbrook, J., J. R. Johnson, D. D. Earle. 1982. Vegetation burning by the Chumash. Journal of California and Great Basin Anthropology 4:163-186.

Vankat, J. 1989. Water stress in chaparral shrubs in summer rain versus summer drought climates: whither the Mediterranean type climate paradigm. Pages 117-124 in S. C. Keeley, editor. The California chaparral: paradigms reexamined. Natural History Museum of Los Angeles, Science Series No. 34, Los Angeles.

Weide, D. L. 1968. The geography of fire in the Santa Monica Mountains. M. S. thesis. California State University, Los Angeles.

Wickstrom, C. K. R. 1987. Issues concerning Native American use of fire: a literature review. Publications in anthropology 6. Yosemite Research Center, U.S. National Park Service, Yosemite, California.

Zedler, P. H. 1995. Fire frequency in southern California shrublands: biological effects and management options. Pages 101-112 in J. E. Keeley, and T. Scott, editors. Brushfires in California: ecology and resource management. International Association of Wildland Fire, Fairfield, Washington.

Zedler, P. H. & T. A. Oberbauer. 1998. Letters to the editor. Fremontia 26(1):34-35.

Zivnuska, J. A. & K. Arnold. 1950. Wildfire damage and cost far-reaching. California Agriculture 4(9):8-10.