Picture

Burn Severity and Daily Areas Burned on Three Large, Multiday Wildfires Across Central Idaho and Western Montana, 2005 to 2007

Donovan S. Birch[1], Penelope Morgan[1], Alistair Smith[1], Andrew T. Hudak[2], Crystal A. Kolden[3], Greg K. Dillon[4]

[1] Dept. of Forest, Rangeland, and Fire Sciences, College of Natural Resources, University of Idaho, Moscow, ID
[2] Rocky Mountain Research Station, USDA, Forest Service, Moscow, ID
[3] Dept. of Geography, College of Science, University of Idaho, Moscow, ID
[4] USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT

University of Idaho
College of Natural Resources

Abstract

We evaluated the proportions of burn severity for areas of daily fire growth that occurred on three large forest fires of central Idaho and western Montana: Signal Rock (2005), Red Mountain (2006) and Rattlesnake (2007). We used infrared perimeter (IR) maps and remotely sensed burn severity data from the Monitoring Trends in Burn Severity project using classified differenced Normalized Burn Ratio (dNBR, 30-m satellite imagery). By using the IR perimeter maps we were able to isolate areas of fire growth for periods of 24 hours. We limited the analysis to five or more consecutive days with IR data. We compared proportions of burn severities for 1402 individual areas of daily fire growth (18,394 ha) for 25 days of IR data for the three fires. We found no correlation between daily area burned size and proportions of burn severity. More specifically we found that large fire runs do not result in a disproportionate amount of high burn severity.

Introduction

- Recent climate-induced increases in the extent and frequency of wildland fires in the western United States (Littell et al. 2009; Westerling et al. 2006)
- High severity fires consume large amounts of biomass (Keeley 2009) and have long-term ecological effects on vegetation structure and composition (Holden et al. 2006; Lentile et al. 2007)
- When more area burns, more area burns severely (Holden et al. 2011) but does that really mean a higher proportion of burn severity?
- Burn severity can be seen as the degree of change one year post fire (Lentile et al. 2006)
- Differenced Normalized Burn Ration (dNBR) provides an accurate detection of burn severity

Question – Do large fire runs cause a disproportionate amount of high burn severity?

Methods

- Infrared (IR) perimeter mapping data was downloaded from the National Interagency Fire Center (NIFC) FTP site
- We set a limit of > five consecutive days of perimeter mapping for analysis
- Subtracted 'day 1' from 'day 2' and then 'day 2', etc. to find specific areas of growth per day (**Daily Areas Burned, DAB**)
  - See blue highlighted areas of the three fires in Figure 1
- Some loss of data due to bad IR areas (407 ha)
- Total area analyzed was 18,401 ha over 25 consecutive dates
  - Signal Rock– 9/1-9/8/05
  - Red Mountain– 8/31-9/4/06
  - Rattlesnake– 7/18-7/22/07 and 8/9-8/15/07
- Analyzed 1402 DAB > 0.009 ha
- Areas smaller than 0.009 ha resulted in removal of .77 ha over the three fires (263 DAB)
- Proportions of other, low, moderate, and high burn severities for every daily area burned were calculated from dNBR
  - dNBR data retrieved from the MTBS project

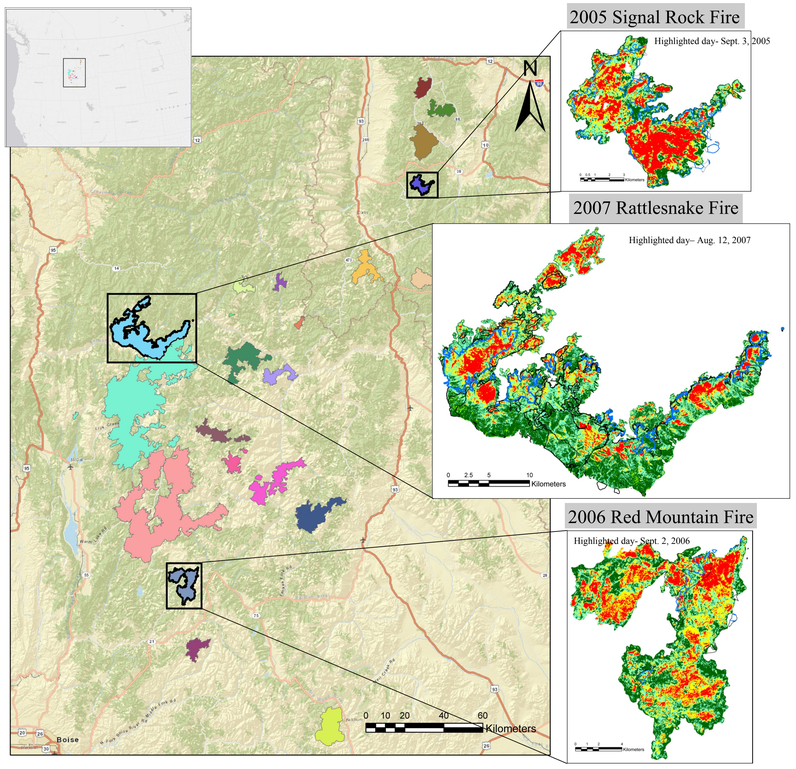

Figure 1. Study area. Includes 27 other fires that will be used for further study of burn severity. The three highlighted fires were chosen based on representing the larger project by covering across the study area and study years. Blue highlighted areas indicate specific daily areas burned.

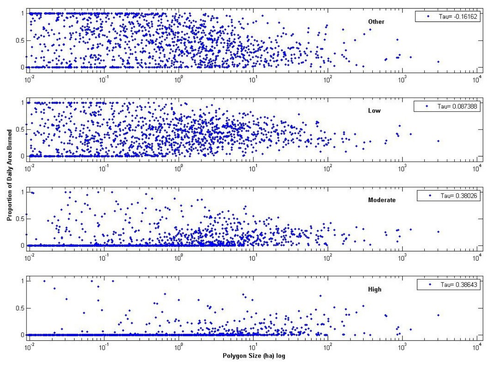

Figure 2. Scatter plots of Daily Areas Burned size and proportion of area burned for the four burn severities. Kendall's Tau correlation (Tau) was measured for the four burn severities.

Conclusion

- Large fire runs did not result in a disproportionate amount of high burn severity
- On days of large fire growth, fire burned across areas of varying topography and fuels under different weather conditions
- Accounting for topography, weather, and fuels may likely explain burn severity patterns within daily areas burned
- This project may help us understand where, when, and why fires burn severely and explain the reasons for large fire runs

Results

- Daily areas burned sizes ranged from 0.009 to 3054 ha
- Burn severity proportions varied greatly among DAB sizes (Figure 2)
- High burn severity did not correlate with DAB size (Tau= 0.386) (Figure 2)
- Proportions of burn severities varied within each burn severity class (Figure 2)
- 86% of all daily areas burned were burned 'Low' or 'Other' (Figure 3)
- Even the largest polygons had all burn severity categories
- Proportion burned severely ranged from 0 to 100% (Figure 3)

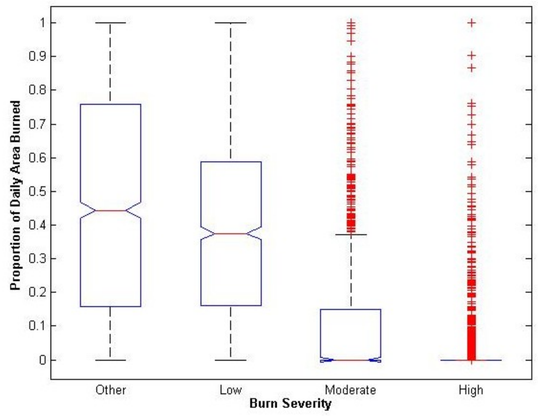

Figure 3. Distribution of proportion of four burn severity classes based on daily areas burned.

Future work

This study is part of larger analysis of 30 fires that burned during the 2005 to 2010 fire seasons in central Idaho and western Montana, which is part of a larger project on the social and ecological consequences of extreme fires. We will use 32 fuel, topography, and weather factors to look at how such factors influence burn severity, daily areas burned, and distance to edge. We will test the hypothesis that local fuels and topography have a bottom-up influence on where fires burn severely, while climate and weather have a stronger top-down effect on daily areas burned.

References- **Holden**,Z.A., P.Morgan, M.G.Rollins, and R.G.Wright. 2006. Ponderosa pine snag densities following multiple fires in the Gila Wilderness, New Mexico. Forest Ecology and Management 221:140–146; **Holden**,Z.A. and W.M.Jolly. 2011. Modeling topographic influences on fuel moisture and fire danger in complex terrain to improve wildland fire management decision support. Forest Ecology and Management [doi: 10.1016/j.foreco.2011.08.002]; **Keeley,**J.E. 2009. Fire intensity, fire severity and burn severity: a brief review and suggested usage. International Journal of Wildland Fire 18:116–126; **Lentile**,L.B., P.Morgan, A.T.Hudak, M.J.Bobbitt, S.A.Lewis, A.M.S.Smith, and P.R.Robichaud. 2007. Post-fire burn severity and vegetation response following eight large wildfires across the western United States. Fire Ecology 3(1):91–101; **Lentile**,L.B., Z.A.Holden, A.M.S.Smith, M.J.Falkowski, A.T.Hudak, P.Morgan, S.A.Lewis, P.E.Gessler, and N.C.Benson. 2006. Remote sensing techniques to assess active fire characteristics and post-fire effects. International Journal of Wildland Fire 15:319–345; **Littell**,J.S., D.McKenzie, D.L.Peterson, and A.L.Westerling. 2009. Climate and wildfire area burned in western U.S. ecoprovinces, 1916-2003. Ecological Applications 19:1003–1021; **Westerling**,A.L., H.G.Hidalgo, D.R.Cayan, and T.W.Swetnam. 2006. Warming and earlier spring increase western US forest wildfire activity. Science 313:940–943;