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Insights from wildfire science: A resource for fire policy discussions

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Record blazes swept across parts of the US in 2015, burning more than 10 million acres. In recent decades, state and federal policymakers, tribes, and others are confronting longer fire seasons (Jolly et al. 2015), more large fires (Dennison et al. 2014), a tripling of homes burned, a doubling of firefighter deaths (Rasker 2015), and record spending by Federal agencies fighting fires ($2 to $3 billion annually). Here, we highlight key science insights that can contribute to the public discourse on wildfire policy that contains these costs and promotes resilient communities and landscapes facing more fire in the future.

1. Fire size and frequency will increase under a warmer and drier climate

Weather and climate are the primary determinants of the total acreage burned in nearly all western forests, woodlands and shrublands (Littell et al. 2009, Jolly et al. 2015, Jin et al. 2015). As the climate continues to warm, our knowledge of the past tells us that more area will burn across the West. *Because climate's influence on wildfire is so strong, we are facing an inevitable trend of increasing annual area burned, and will need to learn how to adapt to more wildfire.*

2. Fuel reduction on federal lands will do little to reduce acreage burned and homes lost

Fuel reduction treatments (e.g. thinning and/or prescribed fire) can sometimes reduce fire severity and assist tactical firefighting locally (Hudak et al. 2011). But the costs of thinning are high, and the operational challenges are considerable, limiting where, and the extent to which,

federal treatments are feasible (Calkin et al. 2015, North et al. 2015, Boer et al. 2015). *We will never be able to treat enough land to alter the trend of increasing acreage burned, but prioritizing federal fuel treatments around communities and creating better mechanisms for reducing fuels on private land can help reduce home loss and better protect communities.*

3. Not all forests need restoration

The need for forest restoration to undo the effects of past fire suppression is often invoked in fire policy discussions, yet only some landscapes need such restoration (Schoennagel et al. 2004). Restoration is often appropriate in dry forests where logging and fire suppression since the 1950s have shifted open park-like forests to less patchy, dense forests, increasing the risk of high-severity events today (Stephens et al. 2013, Hessburg et al 2015). In contrast to dry formerly open forests, moister and cooler high-elevation forests naturally support high tree densities and fires of mostly high severity, and have changed little from their pre-suppression-era condition. In short, not all forests are equally "out of whack" due to past fire suppression, and the need for restoration is not universal. *Not all western forests need restoration to remedy effects of past fire suppression.*

4. High severity fires often have ecological benefits

High-severity fires are the norm in many systems, such as chaparral, lodgepole pine and spruce-fir forests. While it is easy to understand why humans perceive severe fires as "catastrophic", severely burned landscapes are neither "destroyed" nor "lifeless" in terms of their ecological integrity. Many plant and animal species are highly adapted to severe fires (Bond et al. 2012, Hutto et al. 2015) which often create complex burn patterns where trees and/or shrubs naturally re-establish soon after fire without active post-fire restoration efforts (Turner et al. 1994, Kemp et al. 2015). *Severe fire is not necessarily ecologically catastrophic, but rather a natural mechanism of renewal and diversity.*

5. Insect outbreaks do not necessarily make fires worse

In the last 15 years, native insects called bark beetles have killed trees on more than 47 million acres of forest in the western US. Expensive programs to remove insect-attacked trees have been proposed out of understandable fear that the dead trees will fuel large fires. Weather and climate are the key drivers of the occurrence of large severe fires, however, regardless of beetle outbreaks. *In general, bark beetles have little influence on the occurrence (Hart et al. 2015) or severity of forest fires in at least the first 10 to 15 years after the trees have died (Harvey et al. 2014).*

6. Land-use planning can reduce wildfire risk

Most fire policy and management to date has focused on taming fire risk in relatively undeveloped landscapes, although firefighting risks and costs are directly related to protecting communities from active wildfires (Rasker 2015). There is ample opportunity for land-use planning to play a positive role—84% of Wildland Urban Interface lands in the West do not yet have homes (Gude et al. 2008), and future fire risk greatly depends on how or if such areas get developed. *Better community planning efforts and homeowner practices will keep people and structures out of harm's way* (Moritz et al. 2014, Calkin et al. 2014, Rasker 2015).

7. Managing more fires to burn safely can reduce risk and increase ecological benefit

While firefighters suppress at least 95% of all fires, managing some natural or prescribed fires to burn safely is one important way to reduce future wildfire threat and increase ecological benefit (Prichard et al. 2014, Calkin et al 2015, North et al. 2015, Parks et al. 2015). *Strategic planning for future fires is a crucial part of integrated fire management, where fire can restore and maintain healthy natural systems with minimal threat to people, their homes, and the places they value.*

Conclusion: Learning to live with wildfire

We can live with fire (Moritz et al. 2014, Hessburg et al. 2014) and we must. In the West, wildfire is part of our past and will also be an important part of our future. Relevant wildfire science can help us plan for and adapt to living with wildfire. Policy guidelines such as the National Cohesive Strategy are beginning to recognize fire as fundamental to healthy landscapes. Further integration of relevant insights from wildfire science can lead to more robust policy and practice that promotes resilient communities and landscapes as they face more fire in the future.

References

American Forest Foundation. 2015. Western water threatened by wildfire: it's not just a public lands issue. *American Forest Foundation*. Washington D.C. 28 pp.

Boer, M.M., O.F. Price, R.A. Bradstock. 2015. Wildfires: Weigh policy effectiveness. *Science.* 350 (6263): 920.

Bond, M. L., R. B. Siegel, R. L. Hutto, V. A. Saab, and S. A. Shunk. 2012. A new forest fire paradigm: The need for high-severity fires. *Wildlife Professional.* 6:46-49.

Calder, J.W., D. Parker, C.J. Stopka, G. Jiménez-Moreno, and B.N. Shuman. 2015. Medieval warming initiated exceptionally large wildfire outbreaks in the Rocky Mountains. *Proceedings of the National Academy of Sciences.* 112 (43) 13261-13266.

Calkin, D.E., Cohen, J.D., Finney, M.A., and Thompson, M.P. 2014. How risk management can prevent future wildfire disasters in the wildland-urban interface. *Proceedings of the National Academy of Sciences.* 111(2): 746-751.

Calkin, D.E., M.P. Thompson, and M.A. Finney 2015. Negative consequences of positive feedbacks in US wildfire management. *Forest Ecosystems,* 2:9. DOI 10.1186/s40663-015-0033-8

Dennison, P.E., S.C. Brewer, J.D. Arnold, and M.A. Moritz, 2014. Large wildfire trends in the western United States, 1984-2011. *Geophysical Research Letters.* 41, 2928–2933.

Gude, P., Rasker, R., & Van den Noort, J. 2008. Potential for future development on fire-prone lands. *Journal of Forestry.* 106(4): 198-205.

Hart, S.J., Schoennagel, T., Veblen, T.T., & Chapman, T.B. 2015. Area burned in the western United States is unaffected by recent mountain pine beetle outbreaks. *Proceedings of the National Academy of Sciences.* 112(14): 4375-4380.

Harvey, B.J., Donato, D.C., Turner, M.G. 2014. Recent mountain pine beetle outbreaks, wildfire severity, and postfire tree regeneration in the US Northern Rockies. *Proceedings of the National Academy of Sciences.* 111(42): 15120-15125.

Hessburg, P.F., A.J. Larson, D.J. Churchill, R.D. Haugo, C. Miller, T.A. Spies, M.P. North, N.A. Povak, R.T. Belote, P.A. Singleton, W.L. Gaines, R.E. Keane, G.H. Aplet, S.L. Stephens, P. Morgan, P.A. Bisson, B.E. Rieman, R.B. Salter, G.H. Reeves. 2015. Restoring fire-prone Inland Pacific landscapes: Seven core principles. *Landscape Ecology*. 30:1805–1835.

Heyerdahl, E.K., McKenzie, D., Daniels, L.D., Hessl, A.E., Littell, J.S. and Mantua, N.J., 2008: Climate drivers of regionally synchronous fires in the inland northwest (1651-1900). *International Journal of Wildland Fire*. 17: 40-49

Hudak, A.T, I. Rickert, P. Morgan, E. Strand, S.A. Lewis, and P.R. Robichaud. 2011. Review of fuel treatment effectiveness in forests and rangelands and a case study from the 2007

megafires in central, Idaho. *USA. Gen. Tech. Rep. RMRS-GTR-252*. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 60 p.

Hutto, R. L., M. L. Bond, and D. A. DellaSala. 2015. Using bird ecology to learn about the benefits of severe fire. Pages 55-88 in D. A. DellaSala and C. T. Hanson, editors. *The ecological importance of mixed-severity fires: Nature's phoenix*. Elsevier: Amsterdam. 450 pp.

Jin, Y., M. L. Goulden, N. Faivre, S. Veraverbeke, F. Sun, A. Hall, M. S. Hand, S. Hook, and J. T. Randerson. 2015. Identification of two distinct fire regimes in Southern California: Implications for economic impact and future change. *Environmental Research Letters*. 10:94005-94016.

Jolly, W.M., Cochrane, M.A., Freeborn, P.H., Holden, Z.A., Brown, T.J., Williamson, G.J., & Bowman, D.M.J.S. 2015. Climate-induced variations in global wildfire danger from 1979 to 2013. *Nature Communications.* 6: 7537 doi: 10.1038/ncomms8537.

Keeley, J. E., Pausas, J. G., Rundel, P. W., Bond, W. J., & Bradstock, R. A. (2011). Fire as an evolutionary pressure shaping plant traits. *Trends in Plant Science*. *16*(8), 406-411.

Kemp, K.B., P.E. Higuera, and P. Morgan. 2015. Fire legacies impact conifer regeneration across environmental gradients in U.S. northern Rockies. *Landscape Ecology*. doi: http//dx.doi.org/10.1007/s10980-015-0268-3

Kitzberger, T., P. M. Brown, E. K. Heyerdahl, T. W. Swetnam, and T. T. Veblen. 2007. Contingent Pacific-Atlantic Ocean influence on multi-century wildfire synchrony over western North America. *Proceedings of the National Academy of Sciences.* 104: 543-548.

Littell J.S., D. McKenzie, D.L. Peterson, and A.L. Westerling. 2009. Climate and wildfire area burned in western US ecoprovinces, 1916–2003. *Ecological Applications.* 19:1003–1021.

Lubchenco, J. 1998. Entering the century of the environment: A new social contract for science. *Science*. 279 (5350): 491-497.

Marlon, J.R., P.J Bartlein, C. Long, D.G. Gavin, R.S.Anderson, C. Briles, K.J. Brown, D. Colombaroli, D.J. Hallett, M.J. Power, E.A. Scharf, and M.K. Walsh. 2012. A long-term perspective on wildfires in the western U.S. *Proceedings of the National Academy of Sciences*. 109: E535-E543.

Morgan, P., E.K. Heyerdahl, and C.E. Gibson. 2008. Multi-season climate synchronized widespread forest fires throughout the 20th-century, Northern Rocky Mountains, USA. *Ecology.* 89(3):717-728.

Moritz, M.A., E. Batllori, R.A. Bradstock, A.M. Gill, J. Handmer, P.F. Hessburg, J. Leonard, S. McCaffrey, D.C. Odion, T. Schoennagel and A.D. Syphard. 2014. Learning to coexist with wildfire. *Nature.* 515(7525): 58-66.

North, M.P., S. L. Stephens, B. M. Collins, J. K. Agee, G. Aplet, J. F. Franklin, and P. Z. Fulé. 2015. Reform forest fire management. *Science.* 18 September 2015: 1280-1281.

Parks, S. A.; L.M. Holsinger, C. Miller, C.R. Nelson. 2015. Wildland fire as a self-regulating mechanism: The role of previous burns and weather in limiting fire progression. Ecological Applications. 25(6): 1478-1492.

Prichard, S.J. and M.C. Kennedy 2014. Fuel treatments and landform modify landscape patterns of burn severity in an extreme fire event. Ecological Applications. 24:571–590.

Rasker, R. 2015. Resolving the increasing risk from wildfires in the American West. *Solutions.* 6(2): 48-55.

Schoennagel, T., T.T. Veblen, W.H. Romme. 2004. The interaction of fire, fuels and climate across Rocky Mountain forests. *BioScience.* 54(7) 661-676.

Schoennagel, T., C.R. Nelson, D.M. Theobald, G. Carnwath, T.B. Chapman. 2009. Implementation of National Fire Plan fuel treatments near the wildland-urban interface in the western U.S. *Proceedings of the National Academy of Sciences.* 160: 10706-10711.

Stephens, S.L., J. K. Agee,P. Z. Fulé, M. P. North, W. H. Romme, T. W. Swetnam, M. G. Turner, 2013. Managing forests and fire in changing climates. *Science*. 342 (6154): 41-42.

Turner M.G., Hargrove W.H., Gardner R.H., Romme W.H. 1994. Effects of fire on landscape heterogeneity in Yellowstone National Park, Wyoming. *Journal of Vegetation Science.* 5: 731–742. doi:10.2307/3235886.

Whitlock, C., Marlon, J., Briles, C., Brunelle, A., Long. C., and Bartlein, P.J. 2008. Long-term relations among fire, fuels, and climate in the northwestern U.S. based on lake-sediment studies. *Journal of International Wildfire Research.* 17 (1): 72-83.