WESTERN WILDFIRES – ADAPTING TO A FUTURE WITH MORE FIRE

Susan Prichard
School of Environmental and Forest Sciences, University of Washington

March 2, 2022
Washington Botanical Symposium

INVITED FEATURE: CLIMATE CHANGE AND WESTERN WILDFIRES

Ecological Applications, 0(0), 2021, e02433

Adapting western North American forests to climate change and wildfires: 10 common questions

Susan J. Prichard,[1,19] Paul F. Hessburg,[1,2] R. Keala Hagmann,[1,3] Nicholas A. Povak,[4] Solomon Z. Dobrowski,[5] Matthew D. Hurteau,[6] Van R. Kane,[1] Robert E. Keane,[7] Leda N. Kobziar,[8] Crystal A. Kolden,[9] Malcolm North,[10] Sean A. Parks,[11] Hugh D. Safford,[12] Jens T. Stevens,[13] Larissa L. Yocom,[14] Derek J. Churchill,[15] Robert W. Gray,[16] David W. Huffman,[17] Frank K. Lake,[18] and Pratima Khatri-Chhetri[1]

"The polarization and politicization of scientific evidence impedes implementation of effective land management plans, policies, and management by raising the volume of the disagreement; obscuring the line between facts, opinions, and legal requirements; creating the impression that knowledge is more uncertain than it is; and increasing the time to resolution."

Hessburg et al. (2021)
doi: 10.1002/eap.2432

10 COMMON QUESTIONS

1) Are the effects of fire exclusion overstated? If so, are treatments unwarranted and even counterproductive?

2) Is forest thinning alone sufficient to mitigate wildfire hazard?

3) Can forest thinning and prescribed burning solve the problem?

4) Should active forest management, including forest thinning, be concentrated in the wildland urban interface (WUI)?

5) Can wildfires on their own do the work of fuel treatments?

6) Is the primary objective of fuel reduction treatments to assist in future firefighting response and containment?

7) Do fuel treatments work under extreme fire weather?

8) Is the scale of the problem too great? Can we ever catch up?

9) Will planting more trees mitigate climate change in western North American forests?

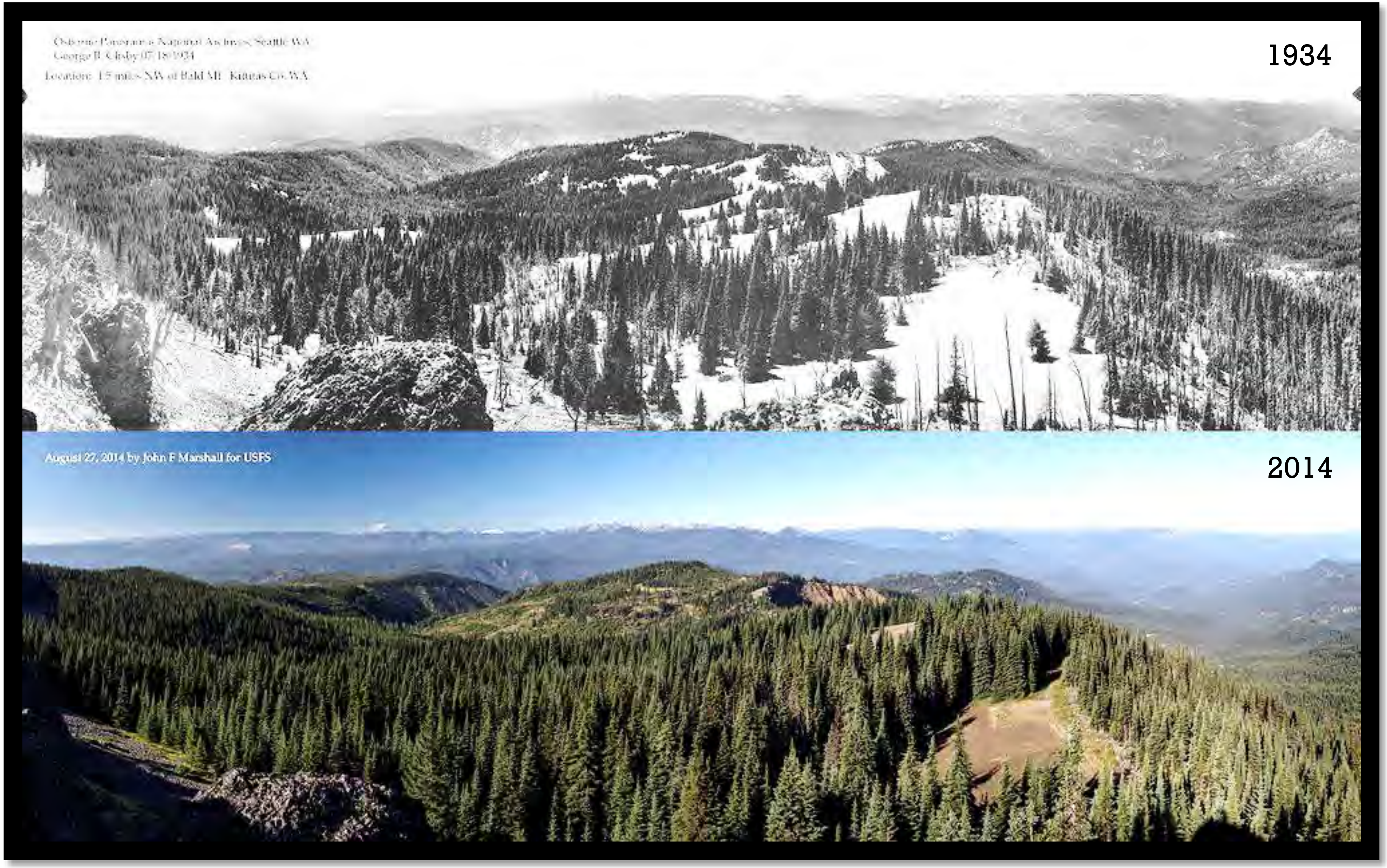
10) Is post-fire management needed or even ecologically justified?

#1 ARE THE EFFECTS OF FIRE EXCLUSION OVERSTATED?

"Our analysis suggests that repeated prescribed burning of large areas of ponderosa pine forests at short intervals (e.g., less than 20 years) lacks a sound basis in science and should not be done at the present time if the goal is restoration. In most parts of the western United States there is also insufficient evidence to support the idea that mixed- or high-severity fires were or were not absent or rare in the pre-EuroAmerican fire regime. Thus, programs to lower the risk of mixed- or high-severity fires in ponderosa pine forests … have ***insufficient scientific basis if the goal is restoration****."*

Baker and Ehle (2003)

CHANGES IN LANDSCAPE PATTERNS



INVITED FEATURE: CLIMATE CHANGE AND WESTERN WILDFIRES

Ecological Applications, 0(0), 2021, e02431

Evidence for widespread changes in the structure, composition, and fire regimes of western North American forests

R. K. Hagmann,[1,2,27] P. F. Hessburg,[1,3] S. J. Prichard,[1] N. A. Povak,[3,4] P. M. Brown,[5] P. Z. Fulé,[6] R. E. Keane,[7] E. E. Knapp,[8] J. M. Lydersen,[9] K. L. Metlen,[10] M. J. Reilly,[11] A. J. Sánchez Meador,[12] S. L. Stephens,[13] J. T. Stevens,[14] A. H. Taylor,[15] L. L. Yocom,[16] M. A. Battaglia,[17] D. J. Churchill,[18] L. D. Daniels,[19] D. A. Falk,[20,26] P. Henson,[21] J. D. Johnston,[22] M. A. Krawchuk,[22] C. R. Levine,[23] G. W. Meigs,[18] A. G. Merschel,[22] M. P. North,[24] H. D. Safford,[25] T. W. Swetnam,[26] and A. E. M. Waltz[12]

Forests are denser today than they were historically across much of the interior West.

Evidence that suggests otherwise has been consistently refuted.

Table 3. Publications presenting (1) counter-evidence asserting that forests were denser than previously thought and (2) evaluations of methods and inferences in counter-evidence publications.

Counter-evidence		Evaluation of counter-evidence	
Citations	Counter-premise	Citations	Implications of evaluation
Williams and Baker (2011) Baker and Williams (2018)	Novel methods provide estimates of tree density from point data, *i.e.*, General Land Office (GLO) records of bearing trees.	Levine et al. (2017, 2019)	Multiple existing plotless density estimators (PDE) provided less biased estimates than the PDE developed by Williams and Baker (2011), which overestimated known tree densities by 24–667% in contemporary stands.
		Knight et al. (2020)	Methods supported by PDE sampling theory and multiple accuracy assessments further demonstrate the potential for misrepresentation of historical tree density by biased estimators used at resolutions substantially smaller than the minimum recommended for ~50% accuracy.
Williams and Baker (2012)	Historical forests were denser than previously documented.	Johnston et al. (2018)	Existing methods for estimating tree density from point data (Morisita 1957, Warde and Petranka 1981) yielded densities more consistent with tree-ring reconstructions and less than half as large as estimates using Williams and Baker (2011) methods.
Williams and Baker (2012) Baker (2015*a*, *b*, 2012, 2014)	Historical forests were denser than previously documented.	Hagmann et al. (2013, 2014, 2017, 2019), Collins et al. (2015), Stephens et al. (2015, 2018*c*), Battaglia et al. (2018), Johnston et al. (2018)	Consistent with the finding that Williams and Baker (2011) methods overestimate tree density (Levine et al. 2017, 2019, Johnston et al. 2018, Knight et al. 2020), early timber inventory records and tree-ring reconstructions for the same study areas documented substantially lower tree densities than those estimated using Williams and Baker (2011) methods.
Hanson and Odion (2016)	Managing for dense, old forest and high-severity fire is consistent with historical conditions.	Collins et al. (2016)	Fundamental errors compromise assertions about historical conditions, including: (1) inappropriate use of coarse-scale habitat maps and (2) inaccurate assumption that areas lacking timber volume in early inventories indicate past high-severity fire.
Odion et al. (2014), Baker (2015*a*, *b*) Baker and Hanson (2017)	Spatially extensive early timber inventories and bias in their use and interpretation misrepresent historical conditions.	Stephens et al. (2015), Collins et al. (2016), Hagmann et al. (2017, 2018, 2019)	Fundamental errors compromise conclusions, including: (1) use of previously discredited methods (Williams and Baker 2011) to estimate tree density from GLO data as a baseline comparison; (2) incorrect assumptions about the methodological accuracy of early timber inventories; (3) inappropriate comparisons of studies of vastly different spatial scales, forest types, and diameter limits; (4) unsubstantiated assessment of bias in the locations of early timber inventories; and (5) unwarranted assumptions about vegetation patterns as indicators of fire severity.

Fire size and severity are increasing and departed from historical fire regimes.

Evidence to the contrary has been consistently refuted.

INVITED FEATURE: CLIMATE CHANGE AND WESTERN WILDFIRES

Ecological Applications, 0(0), 2021, e02431

Evidence for widespread changes in the structure, composition, and fire regimes of western North American forests

R. K. Hagmann,[1,2,27] P. F. Hessburg,[1,3] S. J. Prichard,[1] N. A. Povak,[3,4] P. M. Brown,[5] P. Z. Fulé,[6] R. E. Keane,[7] E. E. Knapp,[8] J. M. Lydersen,[9] K. L. Metlen,[10] M. J. Reilly,[11] A. J. Sánchez Meador,[12] S. L. Stephens,[13] J. T. Stevens,[14] A. H. Taylor,[15] L. L. Yocom,[16] M. A. Battaglia,[17] D. J. Churchill,[18] L. D. Daniels,[19] D. A. Falk,[20,26] P. Henson,[21] J. D. Johnston,[22] M. A. Krawchuk,[22] C. R. Levine,[23] G. W. Meigs,[18] A. G. Merschel,[22] M. P. North,[24] H. D. Safford,[25] T. W. Swetnam,[26] and A. E. M. Waltz[12]

Table 5. Publications presenting (1) counter-evidence asserting that modern wildfires are not unlike historical fires because severity of historical fires is underestimated and (2) evaluations of methods and inferences in counter-evidence publications.

Counter-evidence		Evaluation of counter-evidence	
Citations	Counter-premise	Citations	Implications of evaluation
Shinneman and Baker (1997)	Based on early forest inventory age data sets, "nonequilibrium" areas of extensive, high-severity fires in the Black Hills led to landscapes dominated by dense, closed-canopy forests.	Brown (2006)	Tree-ring reconstructions of ponderosa pine forest age structures and fire regimes across the Black Hills found synchronous regional tree recruitment largely in response to pluvials and longer intervals between surface fires, especially during the late 1700s/early 1800s, which is when early inventory data report similar patterns of recruitment. No evidence of crown fires was found in relation to past fire dates.
Baker et al. (2007)	Most ponderosa pine forests in the Rocky Mountains were capable of supporting high-severity crown fires as well as low-severity surface fires.	Brown et al. (2008)	Tree-ring reconstruction of ponderosa pine forests in the Black Hills of South Dakota (included in Baker et al. 2007) demonstrated that roughly 3.3% of the study area burned as crown fire between 1529 and 1893; however, tree density in most stands in 1870 could not have supported crown fire.
Williams and Baker (2012), Baker (2012, 2014)	Fire severity inferred from tree density by size class estimated from GLO bearing trees (Williams and Baker 2011) and surveyors' descriptions suggests low-severity fire dominated only a minority of ponderosa and mixed-conifer forests.	Levine et al. (2017, 2019)	Plotless density estimator used by Williams and Baker (2011) overestimated known tree densities due to a scaling factor that does not correct for the number of trees sampled and therefore systematically underestimates the area per tree relationship.
		Fulé et al. (2014), Merschel et al. (2014), O'Connor et al. (2017)	Substantial errors of method and interpretation invalidate inferences about historical fire severity. These include (1) tree size is an ambiguous indicator of tree age; (2) tree regeneration is an ambiguous indicator of disturbance severity, particularly in dry forests where climate conditions strongly influence regeneration; and (3) lack of direct documentary evidence (e.g., primary observation) of extensive crown fire in historical ponderosa pine forests has been widely noted for nearly 90 yr.
		Stephens et al. (2015), Huffman et al. (2015), Miller and Safford (2017), Hagmann et al. (2019)	Multi-proxy records documented substantially lower levels of high-severity fire in ponderosa and Jeffrey pine and mixed-conifer forests in overlapping study areas.
Baker (2012), Baker and Hanson (2017)	Estimates of area burned at high severity in Hessburg et al. (2007) validate estimates derived using Williams and Baker (2011) methods.	Hagmann et al. (2018), Spies et al. (2018*a*)	Inappropriate comparisons are not validation. Baker (2012) limited assessment of high-severity fire to tree mortality in dry forests whereas Hessburg et al. (2007) estimated high-severity fire in the dominant cover type whether that be grass or tree for "moist and cold forest" type, with lesser amounts of dry forests
Odion et al. (2014)	Modern, high-severity crown-fires are within historical range of variation. Inferred fire severity from current tree-age data for unmanaged forests in the U.S. Forest Service Inventory and Analysis (FIA) program. Compared inferences about modern fire severity to estimates of historical forest conditions and fire severity inferred using Williams and Baker (2011) methods.	Fulé et al. (2014), Levine et al. (2017, 2019), Knight et al. (2020)	Overestimation of historical tree density and unsupported inferences of fire severity from GLO records weaken conclusions based on Williams and Baker (2011) methods.
		Stevens et al. (2016)	Substantial errors of method and interpretation invalidate inferences about historical fire severity. These include (1) FIA stand age variable does not reflect the large range of individual tree ages in the FIA plots and (2) recruitment events are not necessarily related to high-severity fire occurrence.
		Spies et al. (2018*a*, *b*)	In contradiction of the counter-premise, Odion et al. documented only three patches of high-severity fire larger than >1,000 ha in Oregon and Washington in the early 1900s, which account for 1% of the area of historical low-severity fire regime managed under the Northwest Forest Plan.

#2 CAN THINNING ALONE MITIGATE WILDFIRE SEVERITY?

"Unless you plan to rake and bag millions of acres of national forests, fire is the only way to reduce the so-called fine fuels on the forest floor that help wildfire spread. And if that's not going to occur, there's no way you're ever going to log your way out of the problem. You're probably going to make it worse," [Jim] Agee said. "Thinning by itself is not good."

https://www.opb.org/news/article/west-wildfire-risks-fuels-treatment-thinning-burning/

News > World > Americas > US politics

Trump issues executive order to increase logging and deforestation in bid to tackle wildfires

US president launched order that expands logging on grounds it will curb wildfires

Darryl Fears, Juliet Eilperin | Tuesday 15 January 2019 10:03

Logging and Thinning Helps Reduce Wildfire Risks

healthyforests July 21, 2021 News

Active forest management, including thinning fire-prone forests, is a good way to reduce the risk of forest fires.

Decades of lack of management have left federal forests overstocked with disease and insect ridden trees and standing dead timber that fuel catastrophic wildfires.

Over 80 million acres of national forests are at risk of severe wildfire and need active forest management. Proven, science-based forest management tools like logging, thinning, and controlled burns reduce excessive vegetation that fuel catastrophic wildfires. Active management protects the environment by helping forests adapt to changing conditions, reducing massive carbon emissions from wildfire, and creating renewable building materials that store carbon.

REVIEW ARTICLES

Scientific consensus:

Thinning alone can sometimes be effective, but prescribed burning is generally necessary to reduce surface fuels and mitigate future fire behavior and effects.

Forest Ecology and Management 269 (2012) 68–81

Contents lists available at SciVerse ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Review

Do thinning and/or burning treatments in western USA ponderosa or Jeffrey pine-dominated forests help restore natural fire behavior?

Peter Z. Fulé [a,*], Joseph E. Crouse [b], John Paul Roccaforte [b], Elizabeth L. Kalies [b]

[a] School of Forestry, Northern Arizona University, 200 East Pine Knoll Drive, Room 116, Flagstaff, AZ 86011-5018, USA
[b] Ecological Restoration Institute, Northern Arizona University, 200 East Pine Knoll Drive, Room 116, Flagstaff, AZ 86011-5018, USA

United States Department of Agriculture
Forest Service
Rocky Mountain Research Station
Research Paper RMRS-RP-103WWW
June 2013

Fuel Treatments and Fire Severity: A Meta-Analysis

Erik J. Martinson and Philip N. Omi

Forest Ecology and Management 375 (2016) 84–95

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Tamm Review: Are fuel treatments effective at achieving ecological and social objectives? A systematic review

CrossMark

Elizabeth L. Kalies [a,*], Larissa L. Yocom Kent [b]

[a] Ecological Restoration Institute, Northern Arizona University, PO Box 15017, Flagstaff, AZ 86011-5017, United States
[b] School of Forestry, Northern Arizona University, PO Box 15017, Flagstaff, AZ 86011-5017, United States

The Effects of Forest Fuel-Reduction Treatments in the United States

June 2012 / Vol. 62 No. 6 • BioScience 549

SCOTT L. STEPHENS, JAMES D. McIVER, RALPH E. J. BOERNER, CHRISTOPHER J. FETTIG, JOSEPH B. FONTAINE, BRUCE R. HARTSOUGH, PATRICIA L. KENNEDY, AND DYLAN W. SCHWILK

VIRGINIA RIDGE TIMBER SALE

#3 CAN THINNING AND PRESCRIBED BURNING SOLVE THE PROBLEM?

“Fire itself is sacred. It renews life. It shades rivers and cools the water’s temperature. It clears brush and makes for sufficient food for large animals. It changes the molecular structure of traditional food and fiber resources making them nutrient dense and more pliable. Fire does so much more than western science currently understands.”

Bill Tripp, Our land was taken. But we still hold the knowledge of how to stop mega-fires

https://www.theguardian.com/commentisfree/2020/sep/16/california-wildfires-cultural-burns-indigenous-people


John F Marshall

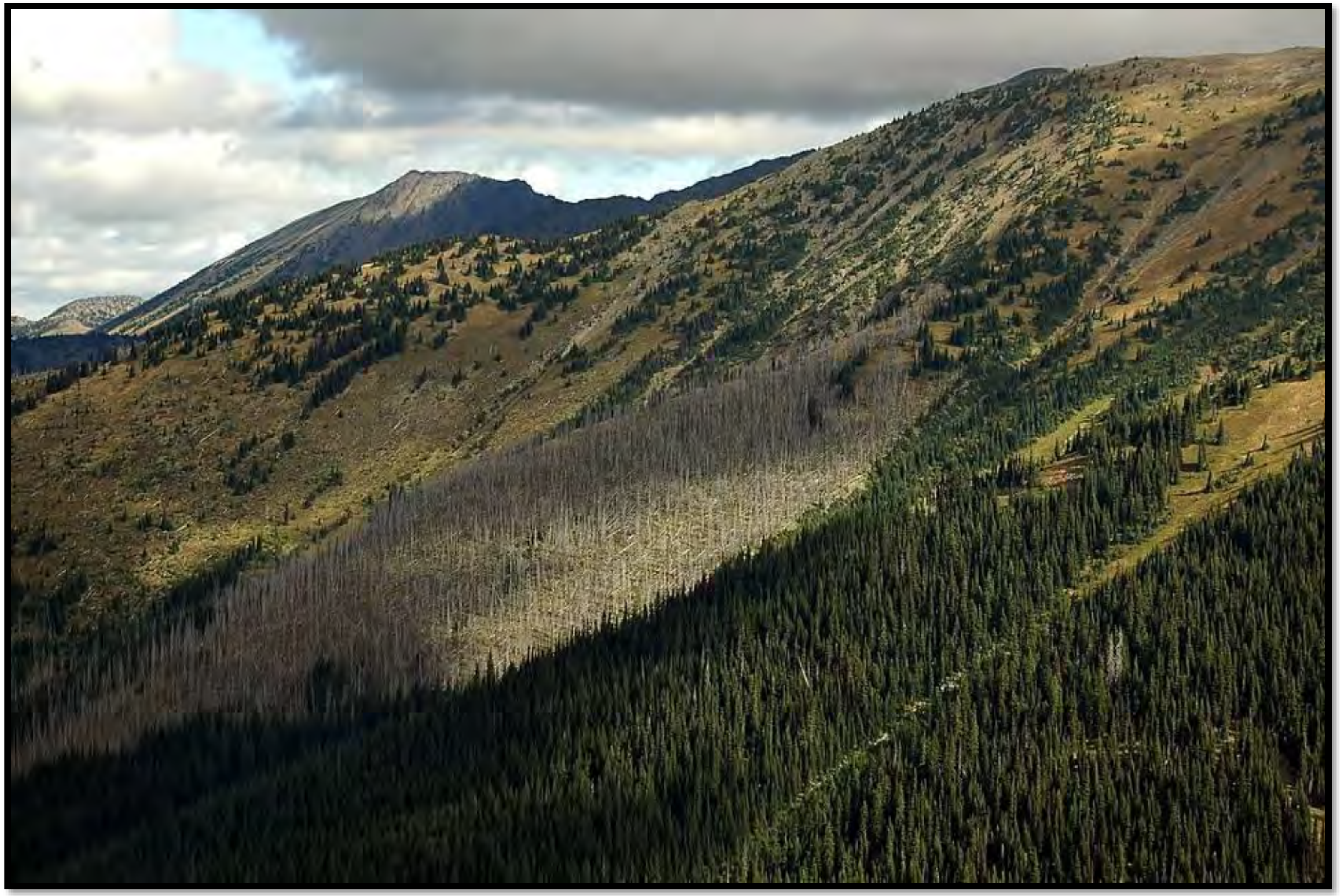

Indigenous Fire Stewardship, Fig. 3 Fire Keeper Pierre Krueger, Penticton Indian Band, conducting a cultural burn in the Nicola Valley, British Columbia." (Photo credit: A.C. Christianson, CFS)

CULTURAL BURNING PRACTICES

https://www.fs.fed.us/psw/publications/lake/psw_2019_lake001.pdf

https://eos.org/features/fire-as-medicine-learning-from-native-american-fire-stewardship

COLD FORESTS WITH INFREQUENT FIRE



#5 IS THE PRIMARY OBJECTIVE OF FUEL TREATMENTS IS TO CONTAIN WILDFIRES?

"It is becoming more and more commonly accepted that reducing fuels does not consistently prevent large forest fires, and seldom significantly reduces the outcome of these large fires."

BARK vs US Forest Service (9th District Court of Appeals ruling against a forest restoration project)

RECENT MEDIA – SACRAMENTO BEE

"This [set of fuel treatments] is not stopping fires, because they're mostly driven by weather and climate," [Chad] Hanson said. "You can't fight the wind with a chainsaw."

"The goal of these treatments is not to stop wildfires in their tracks. It's to change the behavior where we can," said Dan Porter, the California forest program director at The Nature Conservancy, which has worked with the Forest Service on thinning the projects in the Sierra.

Read more at: https://www.sacbee.com/news/california/fires/article254957722.html#storylink=cpy

Photo credit: Ryan Sabalow *RSABALOW@SACBEE.COM*

2015 NORTH STAR FIRE

https://depts.washington.edu/nwfire/ncw/#t2a

#8 IS THE SCALE OF THE PROBLEM TOO GREAT – CAN WE EVER CATCH UP?

"…fuel treatments are unlikely to reduce fire severity and consequent impacts because often the treated area is not affected by fire before fuels return to normal levels."

BARK VS US FOREST SERVICE

SCIENCE-BASED ADAPTIVE MANAGEMENT

- We are currently not treating enough area, but there are many science-based adaptation strategies with proven effectiveness.
- Increasing the pace and scale of adaptive management will require the use of many strategies including:
  - Thinning and/or prescribed burning
  - Support and revitalization of cultural burning
  - Use of managed wildfires
  - Pro-active post-fire planting and silviculture that enhance resilient structure and composition of forests
  - Restoration of resilient patch mosaics
- As with any adaptive management approach, science-based practices combined with active monitoring and adaptation are critical.

CLIMATE CHANGE STRATEGIES

- RESIST – restore resilient structure and composition of western forests
- GUIDE – adapt forests to a warmer, often drier future
- ACCEPT – recognize that some transformations are inevitable

Wildfire-Driven Forest Conversion in Western North American Landscapes

JONATHAN D. COOP, SEAN A. PARKS, CAMILLE S. STEVENS-RUMANN, SHELLEY D. CRAUSBAY, PHILIP E. HIGUERA, MATTHEW D. HURTEAU, ALAN TEPLEY, ELLEN WHITMAN, TIMOTHY ASSAL, BRANDON M. COLLINS, KIMBERLEY T. DAVIS, SOLOMON DOBROWSKI, DONALD A. FALK, PAULA J. FORNWALT, PETER Z. FULÉ, BRIAN J. HARVEY, VAN R. KANE, CAITLIN E. LITTLEFIELD, ELLIS Q. MARGOLIS, MALCOLM NORTH, MARC-ANDRÉ PARISIEN, SUSAN PRICHARD, AND KYLE C. RODMAN

Changing disturbance regimes and climate can overcome forest ecosystem resilience. Following high-severity fire, forest recovery may be compromised by lack of tree seed sources, warmer and drier postfire climate, or short-interval reburning. A potential outcome of the loss of resilience is the conversion of the prefire forest to a different forest type or nonforest vegetation. Conversion implies major, extensive, and enduring changes in dominant species, life forms, or functions, with impacts on ecosystem services. In the present article, we synthesize a growing body of evidence of fire-driven conversion and our understanding of its causes across western North America. We assess our capacity to predict conversion and highlight important uncertainties. Increasing forest vulnerability to changing fire activity and climate compels shifts in management approaches, and we propose key themes for applied research coproduced by scientists and managers to support decision-making in an era when the prefire forest may not return.

Keywords: climate change, ecological transformation, high-severity fire, tree regeneration, tree seedlings, stand-replacing fire, wildfire, vegetation type conversion.

Adapting Communities to Climate Change

Re-learning to Live with Fire

REVIEW

doi:10.1038/nature13946

Learning to coexist with wildfire

Max A. Moritz[1], Enric Batllori[1†], Ross A. Bradstock[2], A. Malcolm Gill[3], John Handmer[4], Pau
Justin Leonard[6], Sarah McCaffrey[5], Dennis C. Odion[7], Tania Schoennagel[8] & Alexandra D.

**The impacts of escalating wildfire in many regions — the lives and homes lost, the e
to ecosystem services — necessitate a more sustainable coexistence with wildfire. C
ment on fire-prone landscapes will only compound current problems. Emerging s
mitigating risks to human communities provide some hope, although greater r
and links is crucial. Without a more integrated framework, fire will never operat
the impact on society will continue to grow. A more coordinated approach to ris
in these coupled systems is needed.**

Fire Adapted Communities

"Fire is a good servant but a bad master"

- * Safe access for emergency workers and exit routes
- * Emergency response & community fire pla
- * Firewise – homes and communities
- * Building codes and zoning (insurance)
- * Managed fuel breaks
- * Smoke management and planning

Traditional Fire Knowledge

Elder ranger Rita Cutter performing 'right way' fire burning. Patch burning is one way to prevent large-scale hot fires. (Photo credit: Annette Ruzicka)

Fire management in southern Europe PM Fernandes *et al.*

Figure 2. *Prescribed burning in fire-adapted pines: (a) maritime pine (Pinus pinaster) in Portugal and (b) Aleppo pine (Pinus halepensis) in France. (c) Prescribed burning in Spartium-dominated shrubland in France. (d) Livestock shepherds discuss the use of prescribed fire with Forest Service officers and researchers in Italy's Cilento National Park.*

Ashland
(lomakatsi.org)

Mid Klamath

CONTACT INFO

Susan Prichard, SEFS Research Scientist
FLAME lab, Precision Forestry Cooperative
https://depts.Washington.edu/flame/
sprich@uw.edu