Managed Wildfire Effects on the Drought Resilience of Yosemite's Illilouette Creek Basin

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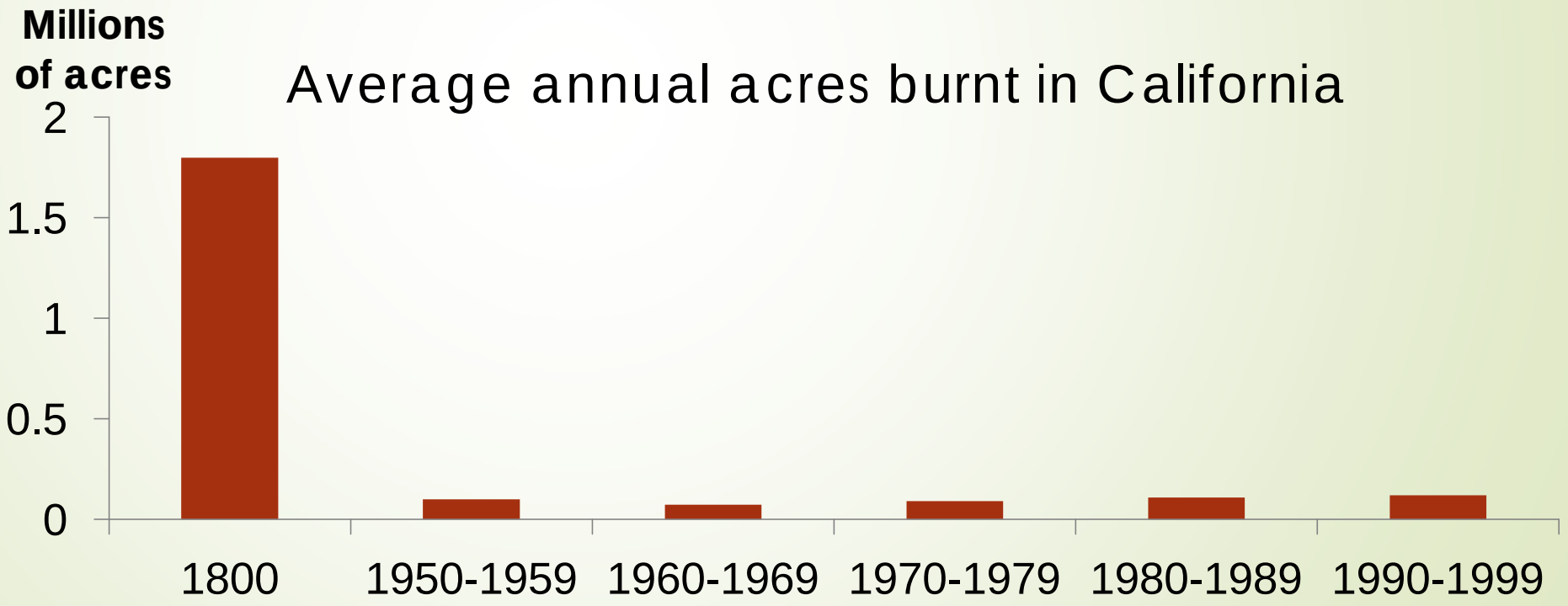
Outline

- Fire in Western mountains
- The Illilouette Creek Basin's unusual fire history
- Effects of fire on the landscape
- Effects of fire on the Basin's hydrology
- Effects of fire on forest health

Fire in Western Mountain Watersheds

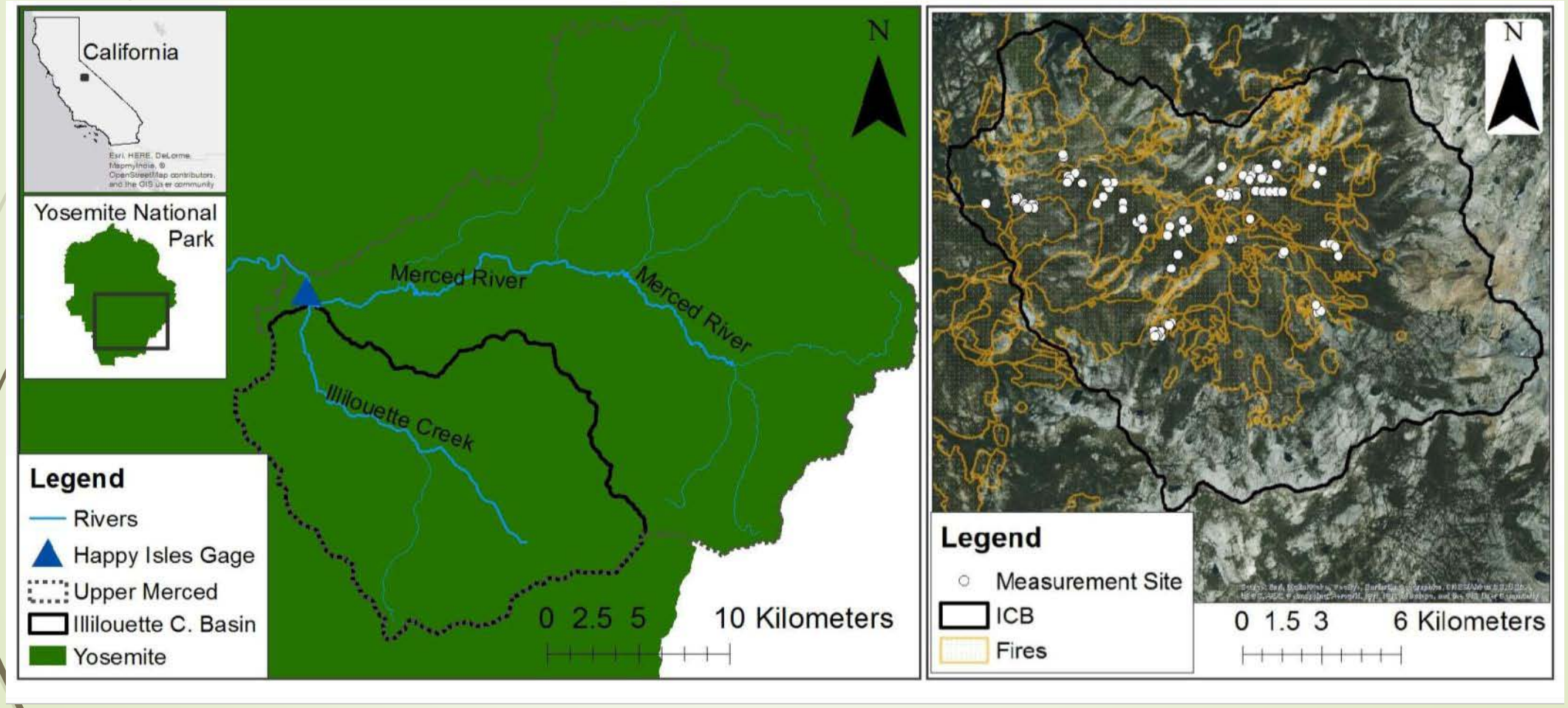
- Historically, fires were frequent, small, and mixed severity.
- Suppression alters forests adapted to frequent fires and allows fuel build-up.



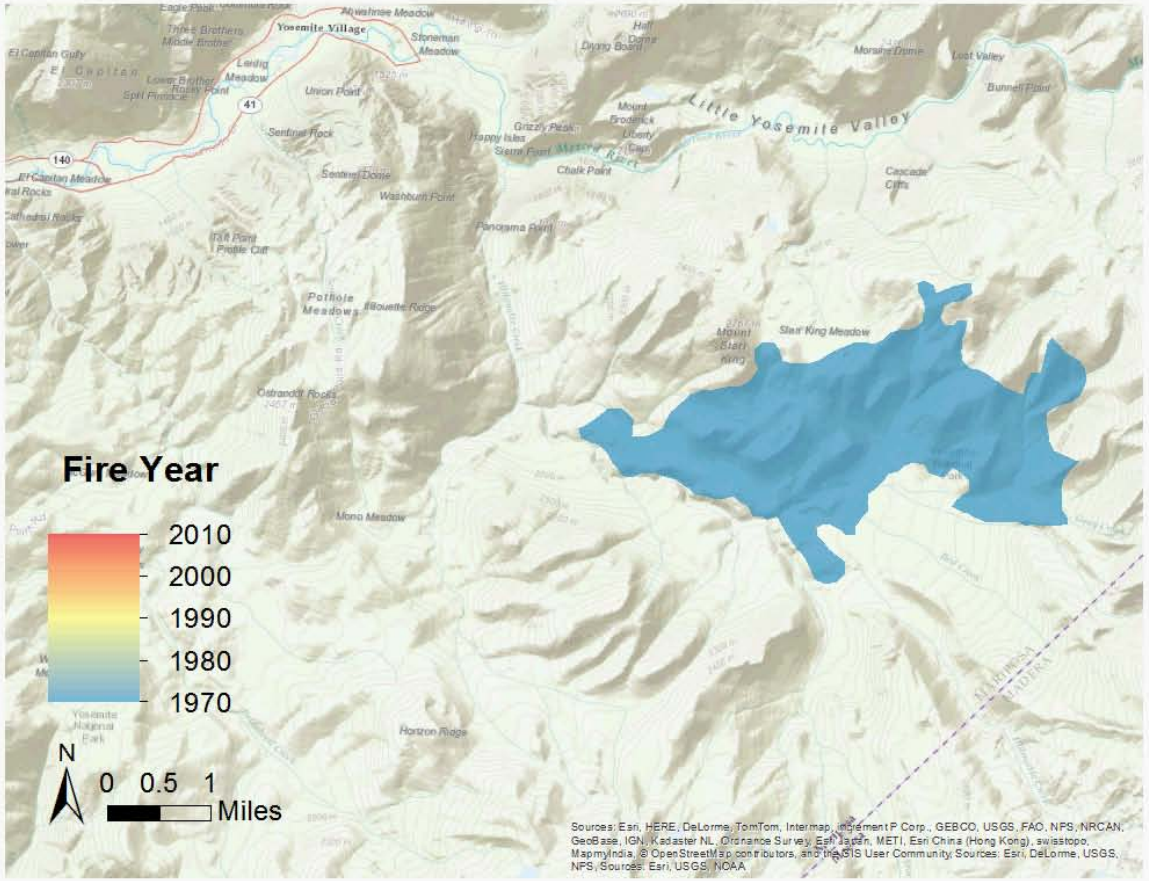
Adapted from S. L. Stephens, R. E. Martin, N. E. Clinton, Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands. *Forest Ecology Management* **251**, 205 (2007).

The Illilouette Basin

- Rare example of natural fire regime (suppression ended 1973).
- How have these fires affected response to drought?

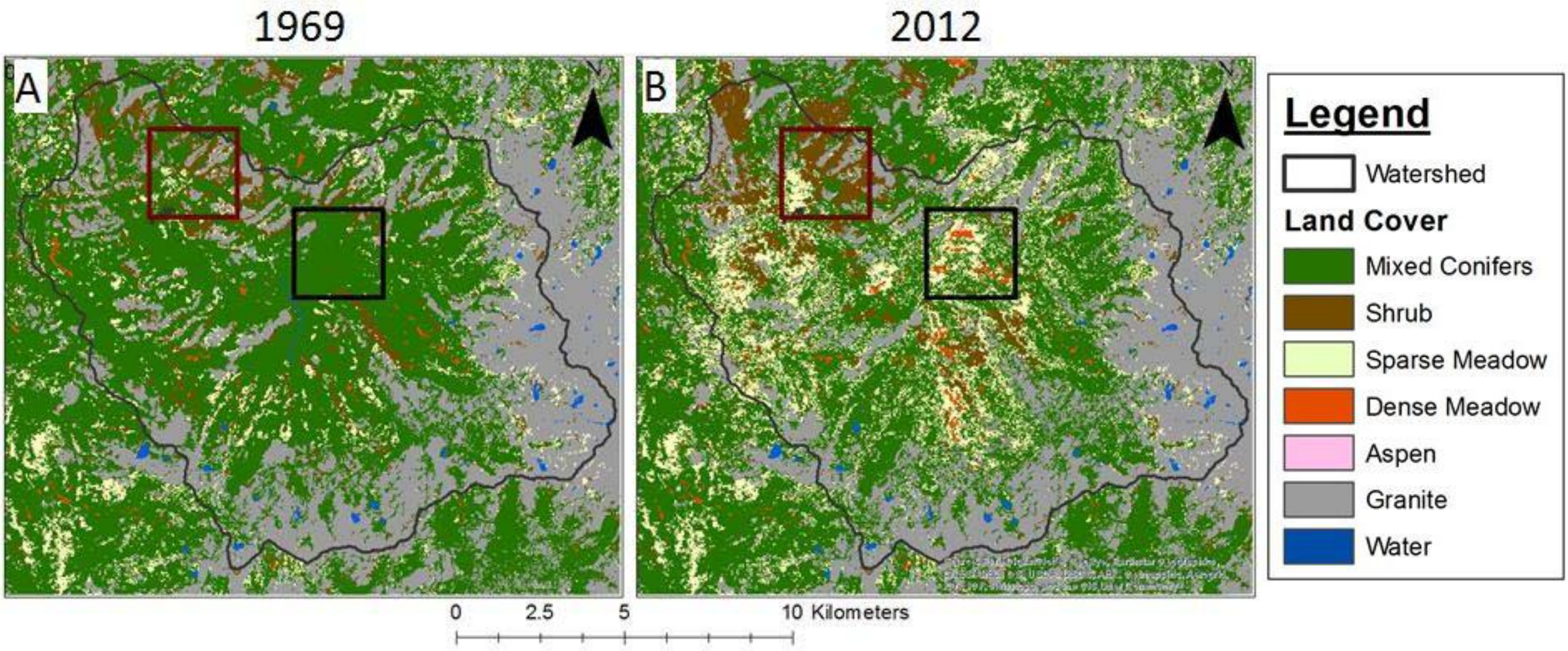


Jigsaw Puzzle of Fires

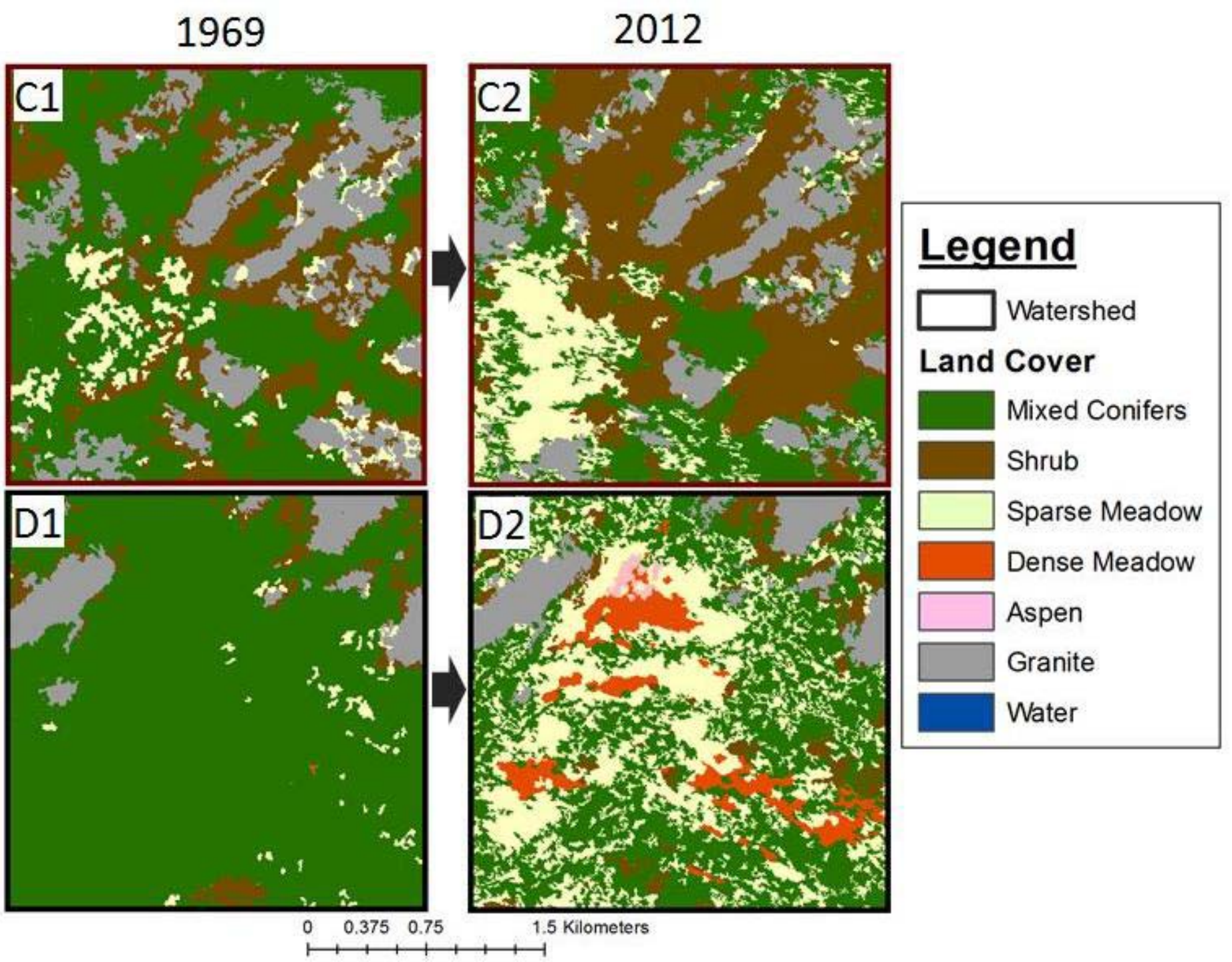


Video by Kate Wilkin and Shane Fairchild.

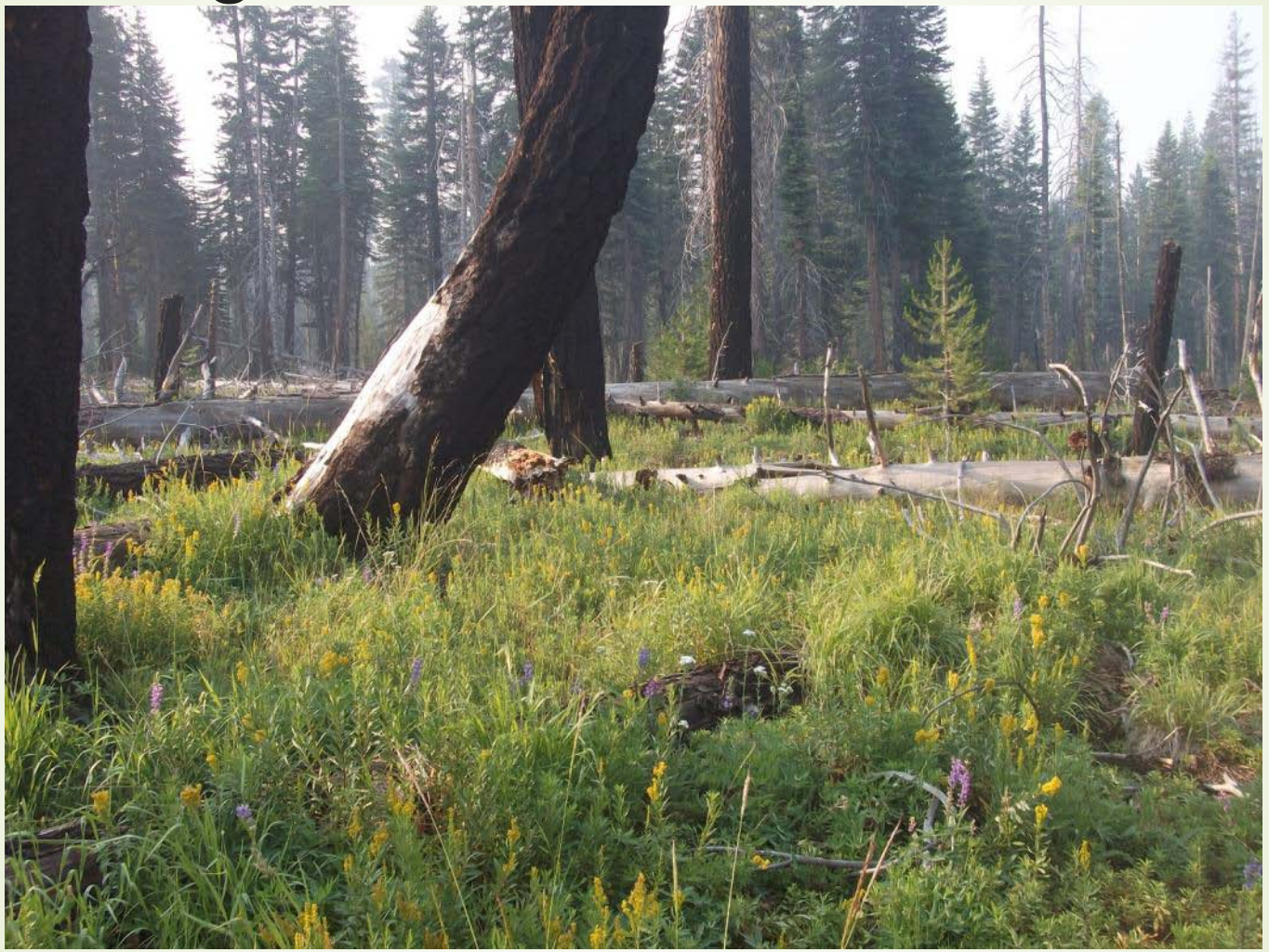
Changes in Land Cover



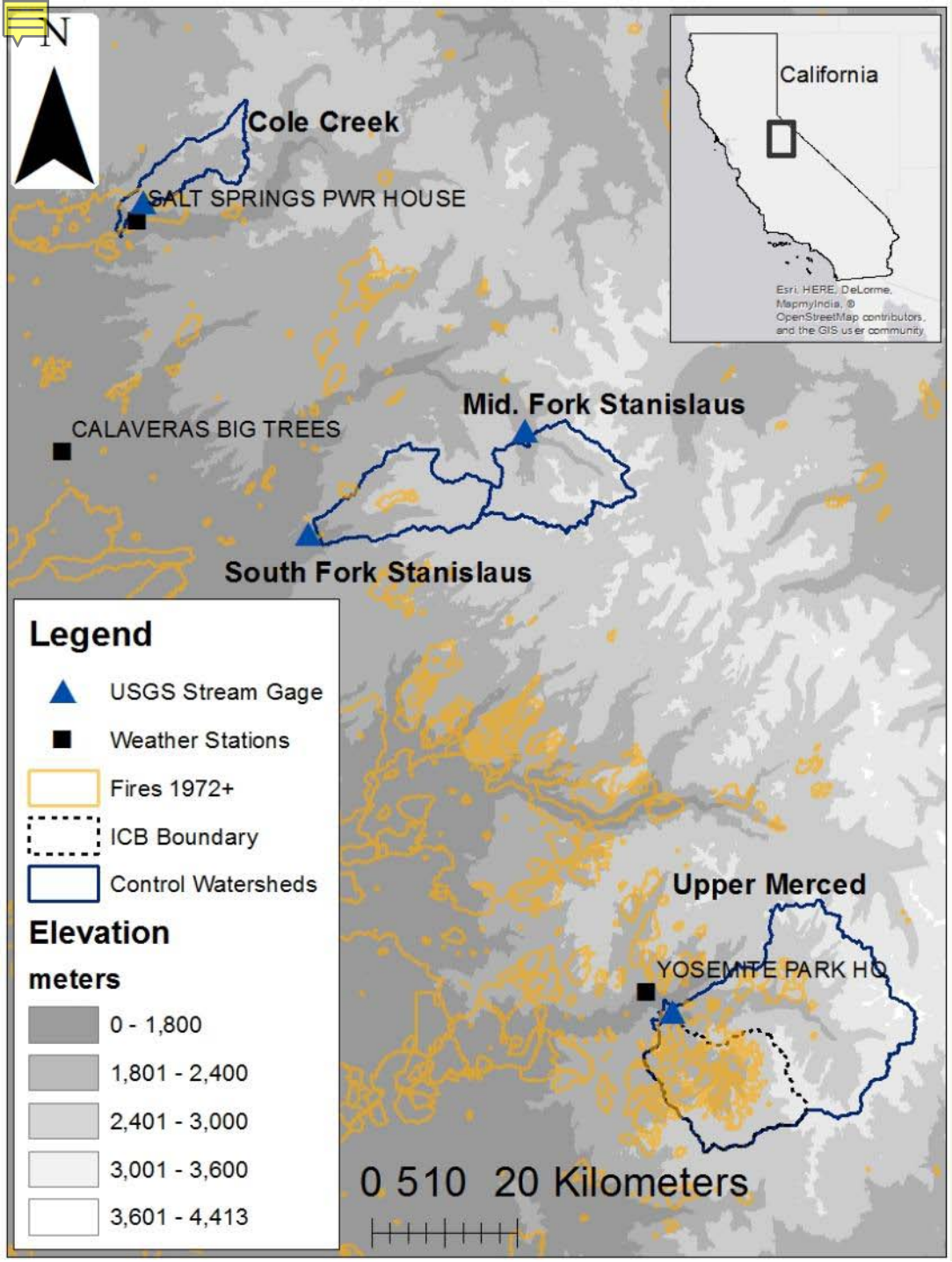
Source: Boisramé et al. Managed wildfire effects on forest resilience and water in the Sierra Nevada. *Ecosystems*. In Press. DOI: 10.1007/s10021-016-0048-1


1969
2012
C1
C2
D1
D2
Legend
Watershed
Land Cover
Mixed Conifers
Shrub
Sparse Meadow
Dense Meadow
Aspen
Granite
Water
0
0.375
0.75
1.5 Kilometers

Seeing the Forest Without the Trees



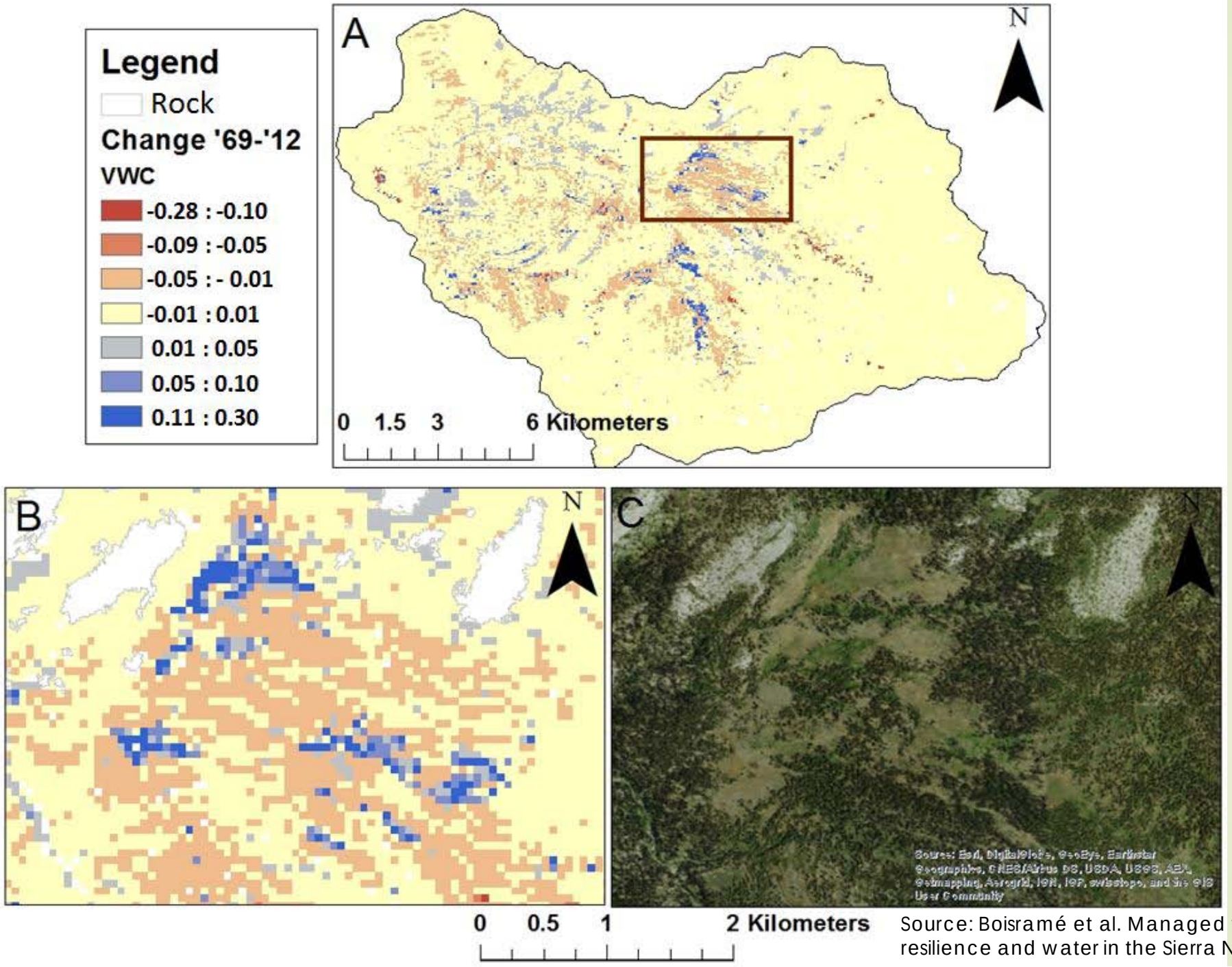
Diverse post-fire vegetation and drought-resistant wetlands.



Runoff ratio changes before and after 1973:

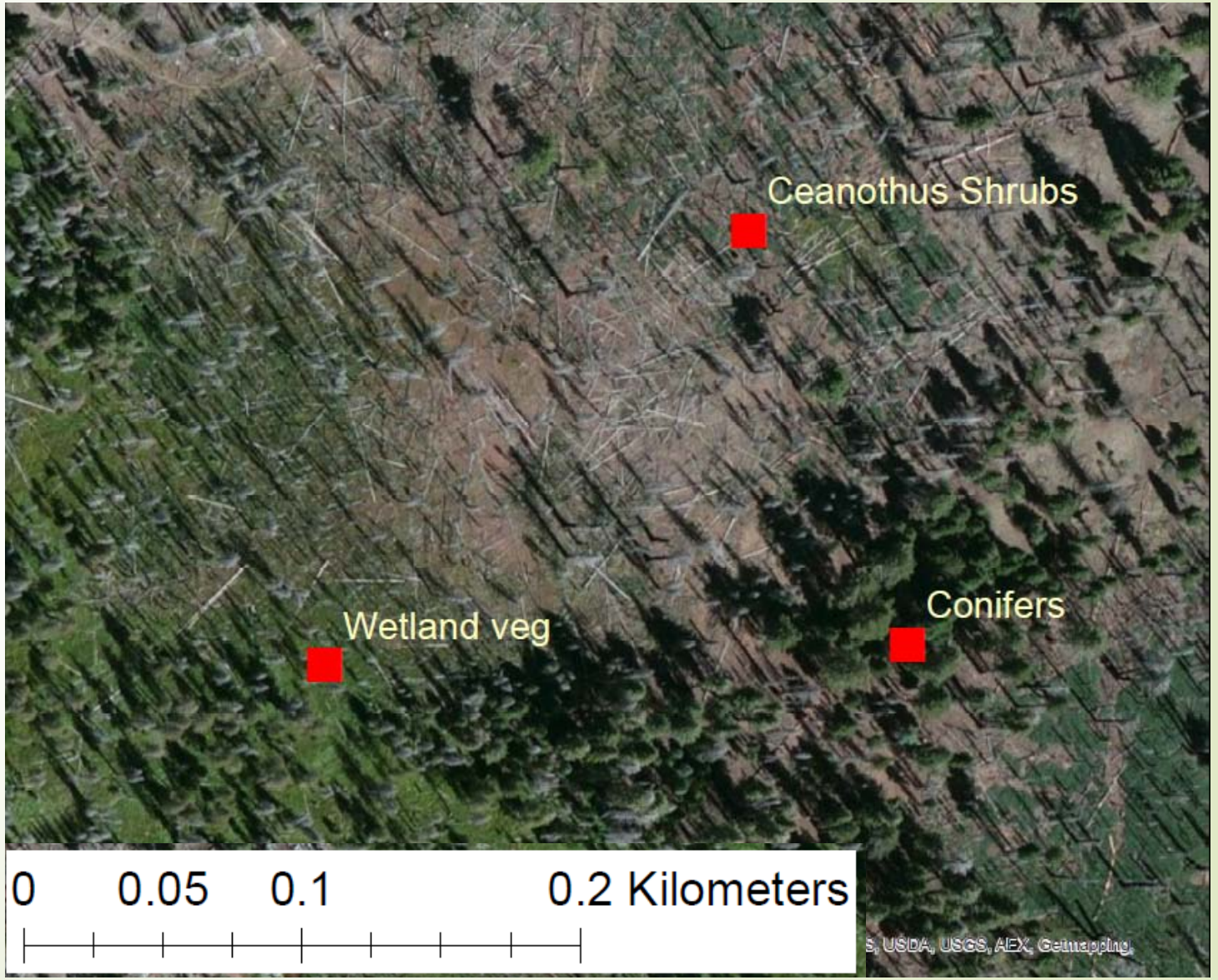
Watershed	Difference	P-Value
Upper Merced	**0.0%**	**0.65**
MF Stanislaus	**-6%**	**0.05**
SF Stanislaus	**-9%**	**0.06**
Cole Creek	**-12%**	**0.02**

Source: Boisramé et al. Managed wildfire effects on forest resilience and water in the Sierra Nevada. *Ecosystems*. In Press. DOI: 10.1007/s10021-016-0048-1

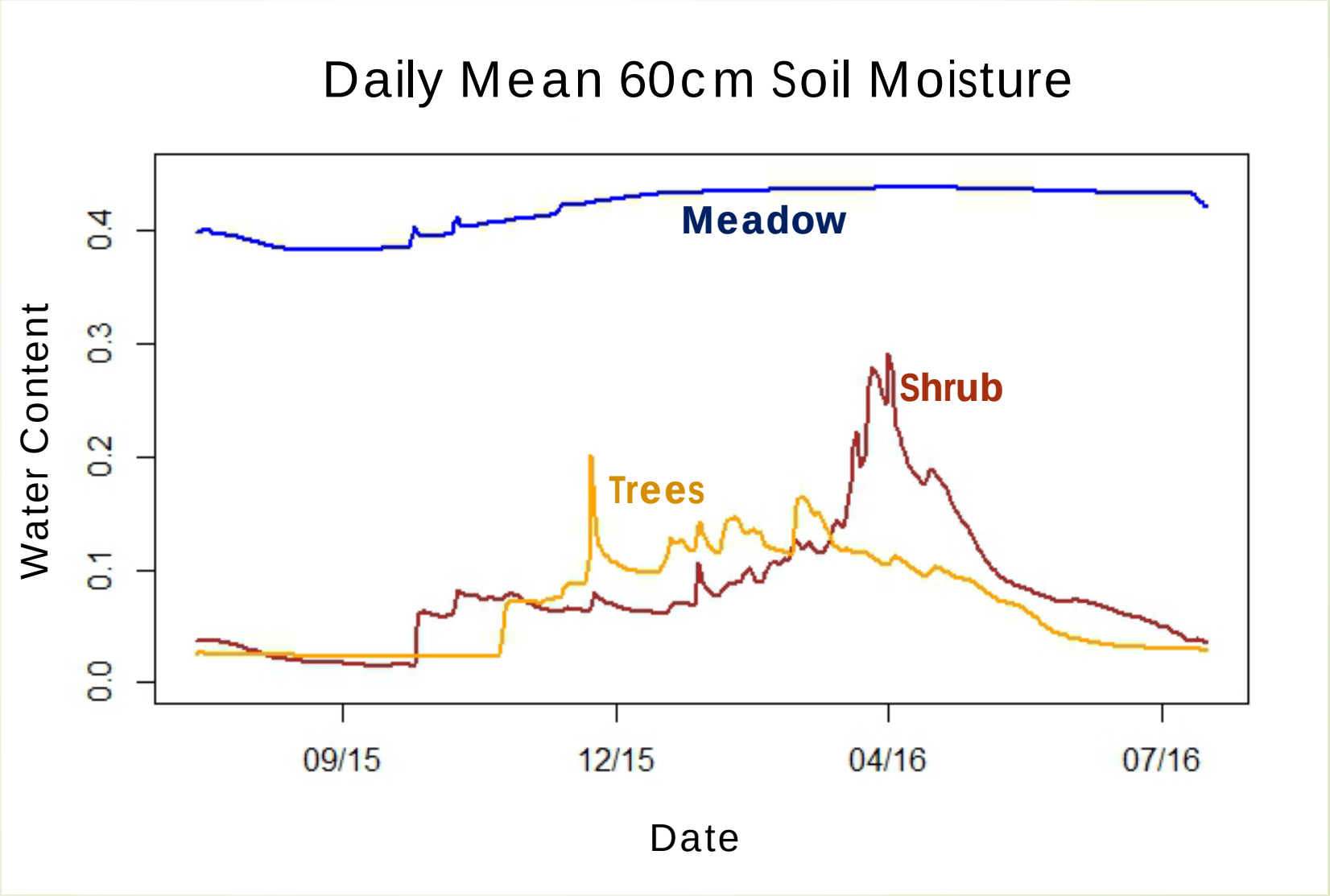


Source: Boisramé et al. Managed wildfire effects on forest resilience and water in the Sierra Nevada. *In Press.*

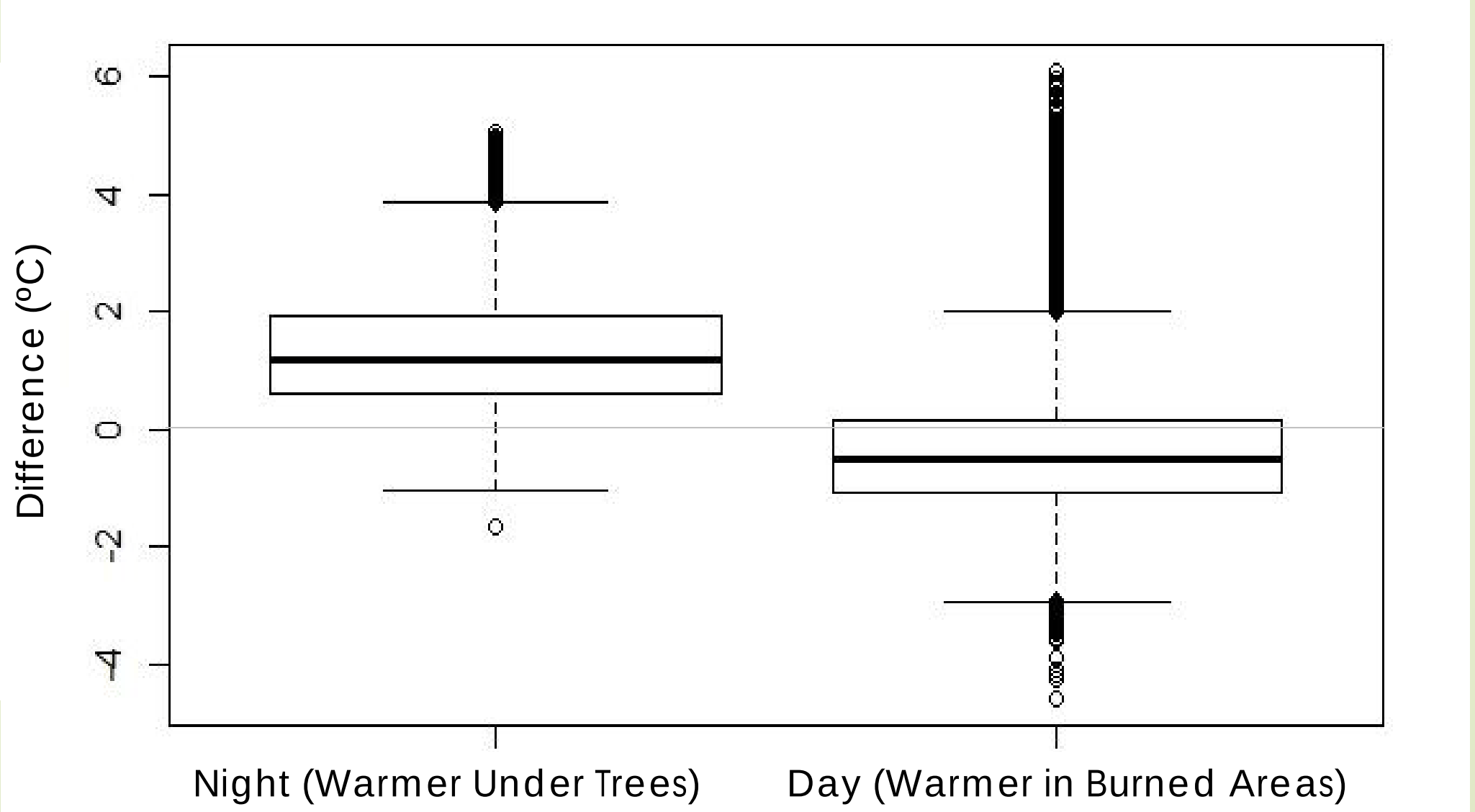
Microclimate Effects of Fire



Microclimate Effects of Fire



Temperature Difference Between Forest and Shrub Sites



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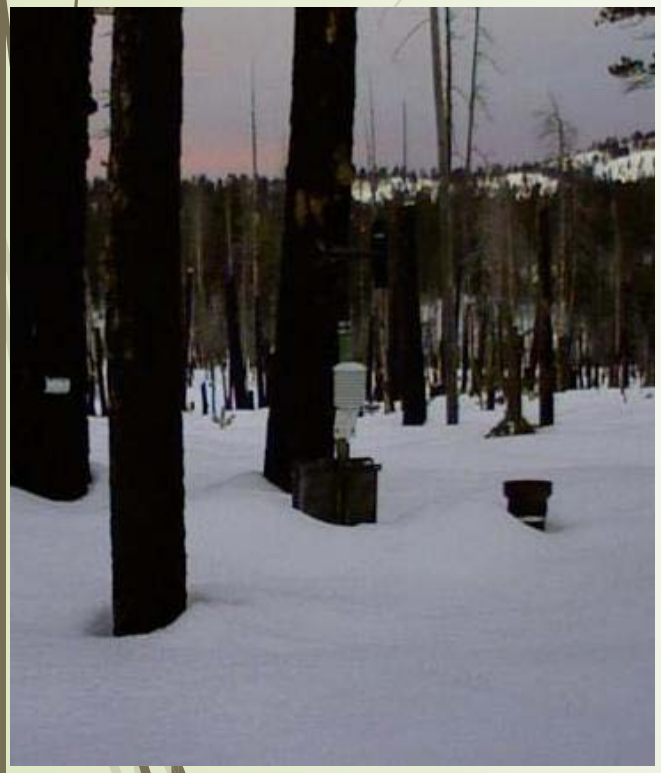
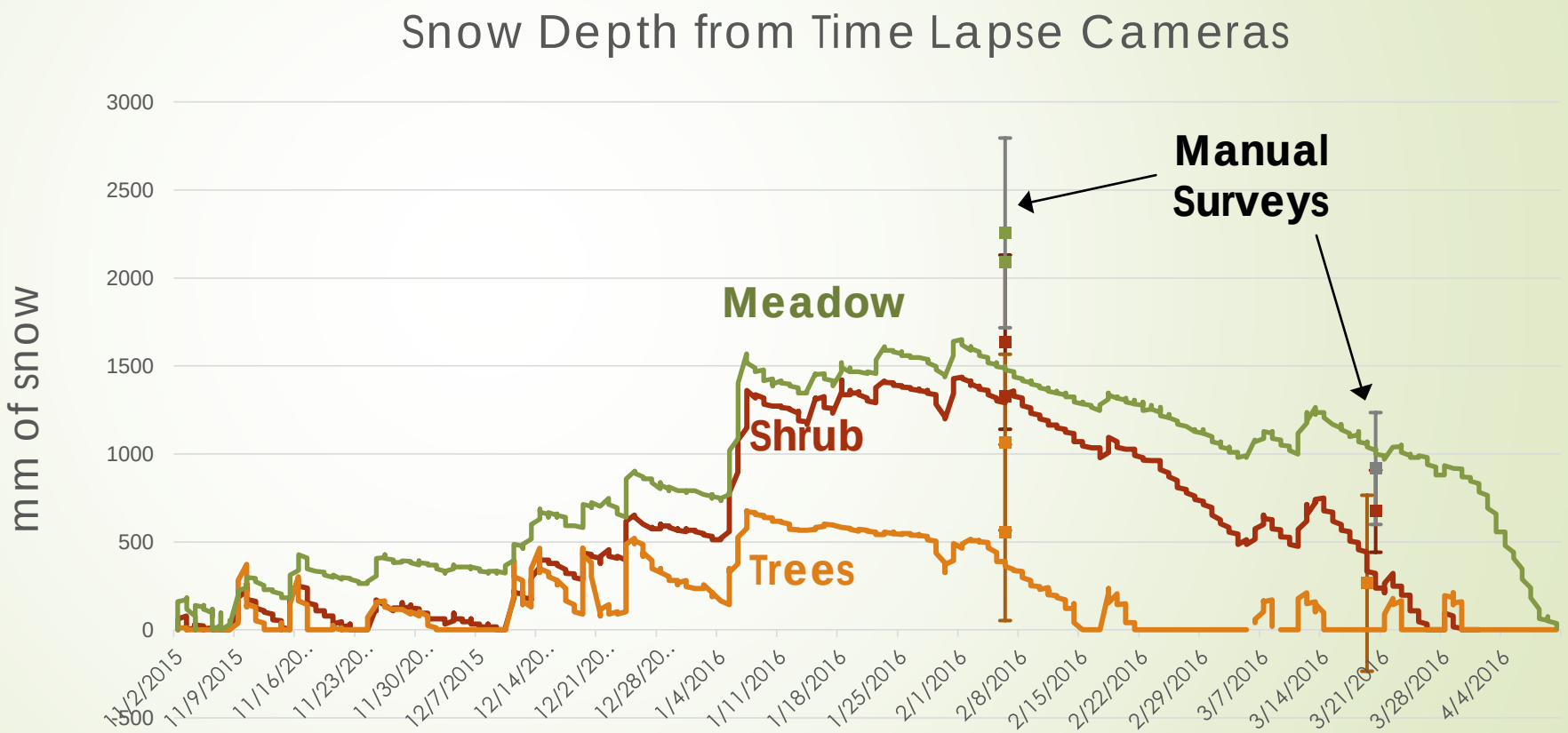
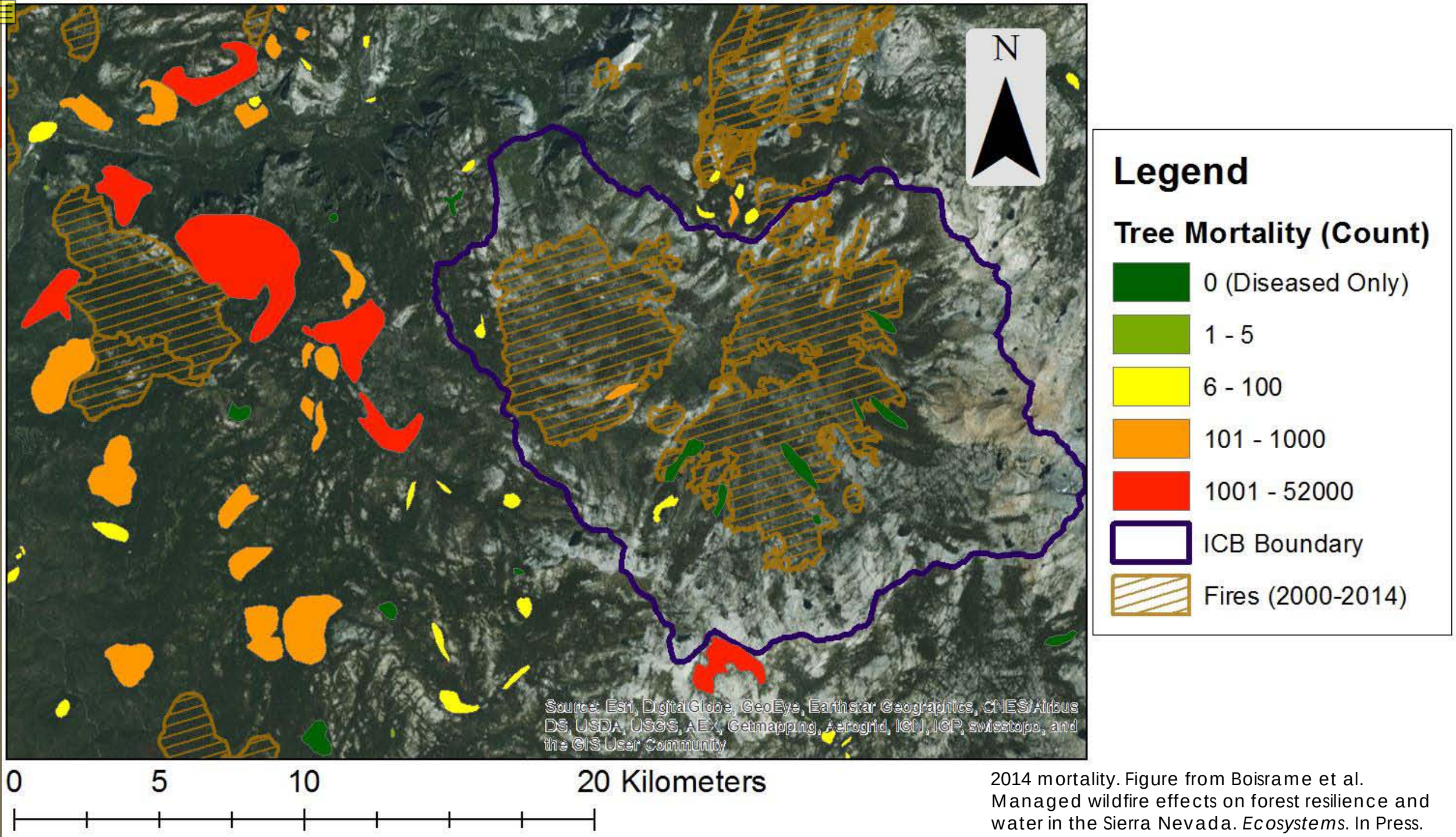




Impacts on Drought Mortality

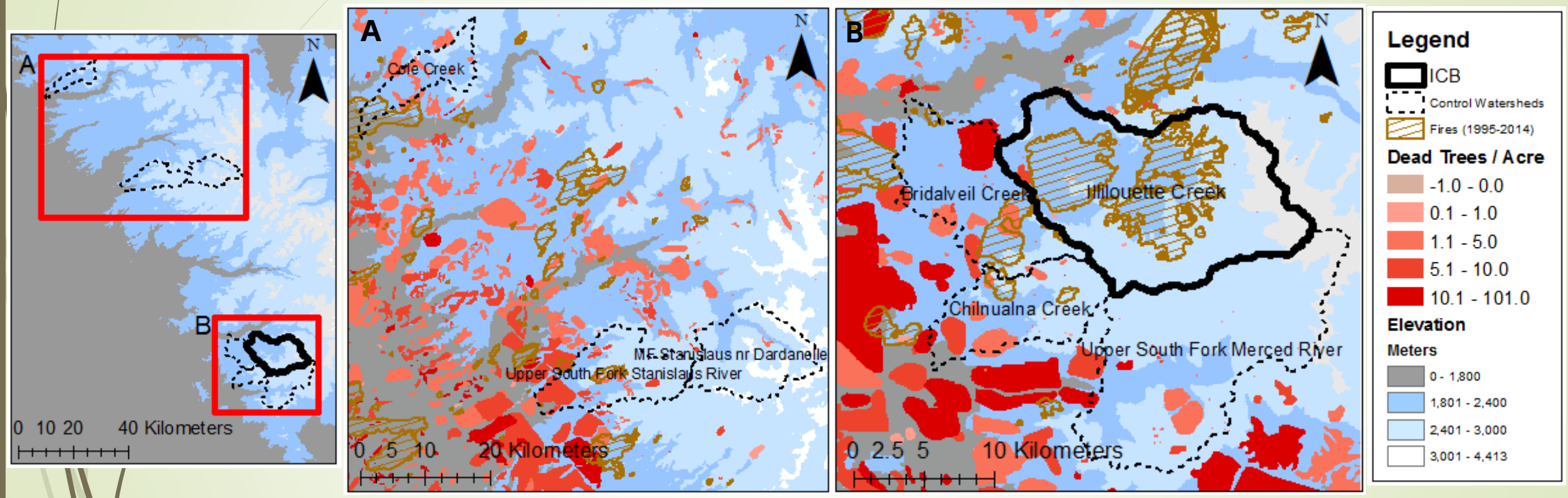
- USFS aerial surveys map tree mortality each summer.
- Unusually high mortality in 2015 throughout Sierra Nevada.

http://www.sacbee.com/opinion/op-ed/soapbox/article75645627.html



2014 mortality. Figure from Boisrame et al. Managed wildfire effects on forest resilience and water in the Sierra Nevada. *Ecosystems*. In Press.

Impacts on Drought Mortality



2015 mortality. Figure from Boisrame et al. Managed wildfire effects on forest resilience and water in the Sierra Nevada. *Ecosystems*. In Press.

Conclusions

This area's resistance to drought is demonstrated by …

- limited individual fire extent
- increased streamflow and soil moisture
- a diverse landscape
- deeper, more persistent snow
- low disease-related tree mortality

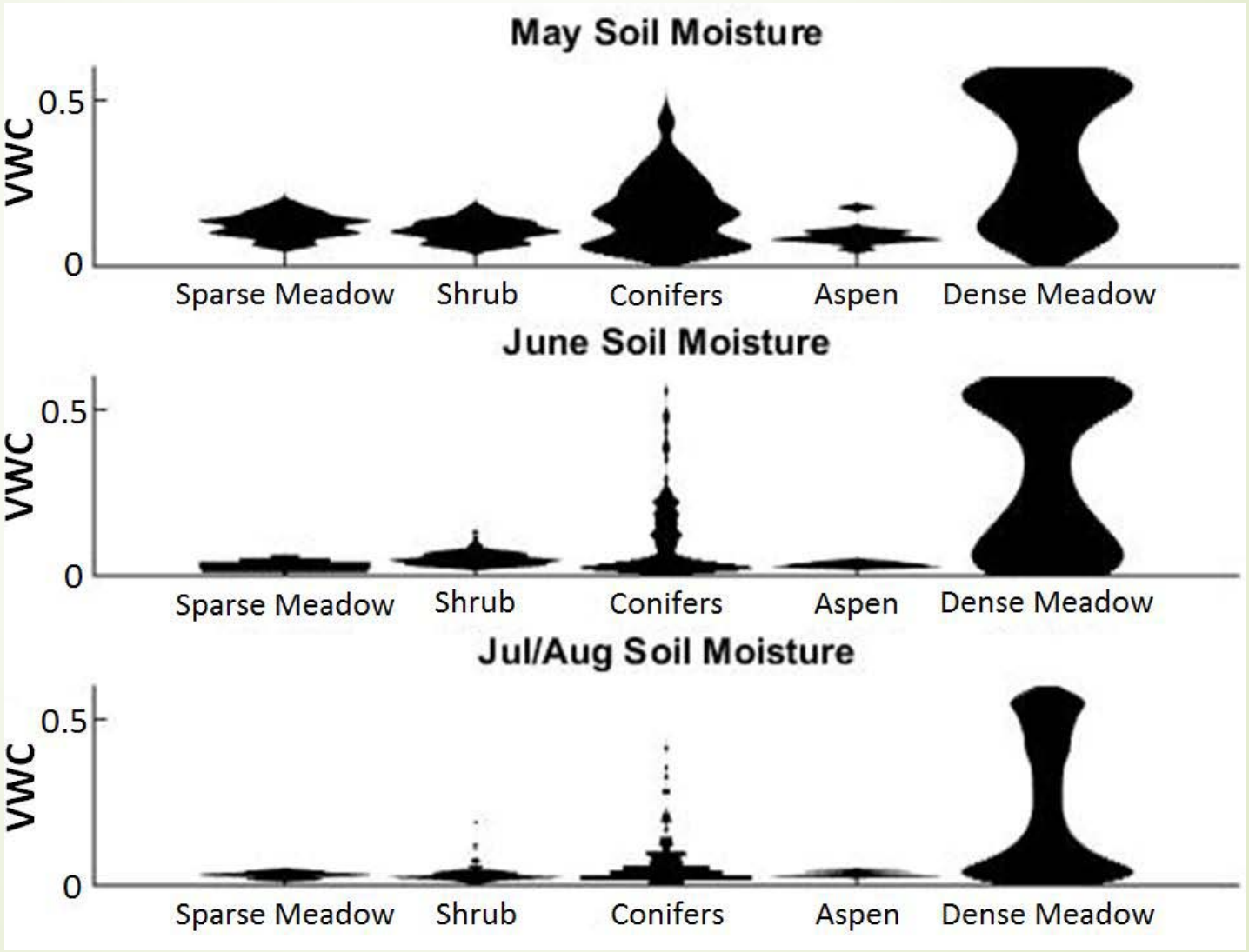
Thank You



- Thank you to Yosemite National Park for creating the amazing place that is the Illilouette Creek Basin, and allowing us to conduct research there.
- This project was supported by the Philomathia Foundation and Joint Fire Sciences Program.
- Field and research assistants: Kate Wilkin, Miguel Naranjo, Andy Wong, Perth Silvers, Jeremy Balch, Seth Bergeson, Amanda Atkinson, Tom Bruton, Diane Taylor, Madeleine Jensen, Isabel Schroeter, Katy Abbott, Bryce King, Zubair Dar, Katherine Eve, Sally McConchie, Karen Klonsky, Yves Boisrame, James Hart, Caroline Delaire, Louis Alexandre-Couston, Catherine Fong, Melissa Thaw, Anthony Everhart, Skye Niles, Lena Nitsan, Chris Phillips, Anthony Ambrose, Wendy Baxter, Chris Phillips, and Lena Nitsan, Julia Cavalli, Melissa Ferriter, Ian McGregor, Kelly Archer, Shahad Jawad, Jingxuan Xiao, and Frank He.
- Valuable guidance provided by Sally Thompson, Scott Stephens, Brandon Collins, and Maggi Kelly.

Questions?

Soil Moisture Differences



Impacts on Drought Mortality

Watershed	Conifer Area (km2)	Dead Trees 2014	Dead/km2 2014	Dead Trees 2015	Dead/km2 2015	Ratio 2014	Ratio 2015
ICB	80.6	325	4.0	1040	12.9	1	1
MF Stanislaus	39.3	351	8.9	540	13.8	**2.2**	**1.1**
SF Stanislaus	71.7	11024	153.8	23352	325.8	**38.1**	**25.2**
Cole Creek	36.0	544	15.1	6294	174.6	**3.7**	**13.5**
Bridalveil	49.5	6094	123.0	33505	676.9	**30.5**	**52.4**
Chilnualna	34.7	306	8.8	10579	304.8	**2.2**	**23.6**
USF Merced	87.6	1787	20.4	5348	61.0	**5.1**	**4.7**

Localized Temperature Differences