Innovative Tools to Monitor Invasive Grasses and Restore Dryland Ecosystems

Seth Munson, Miguel Villarreal,

Tara Bishop, Adam Wells

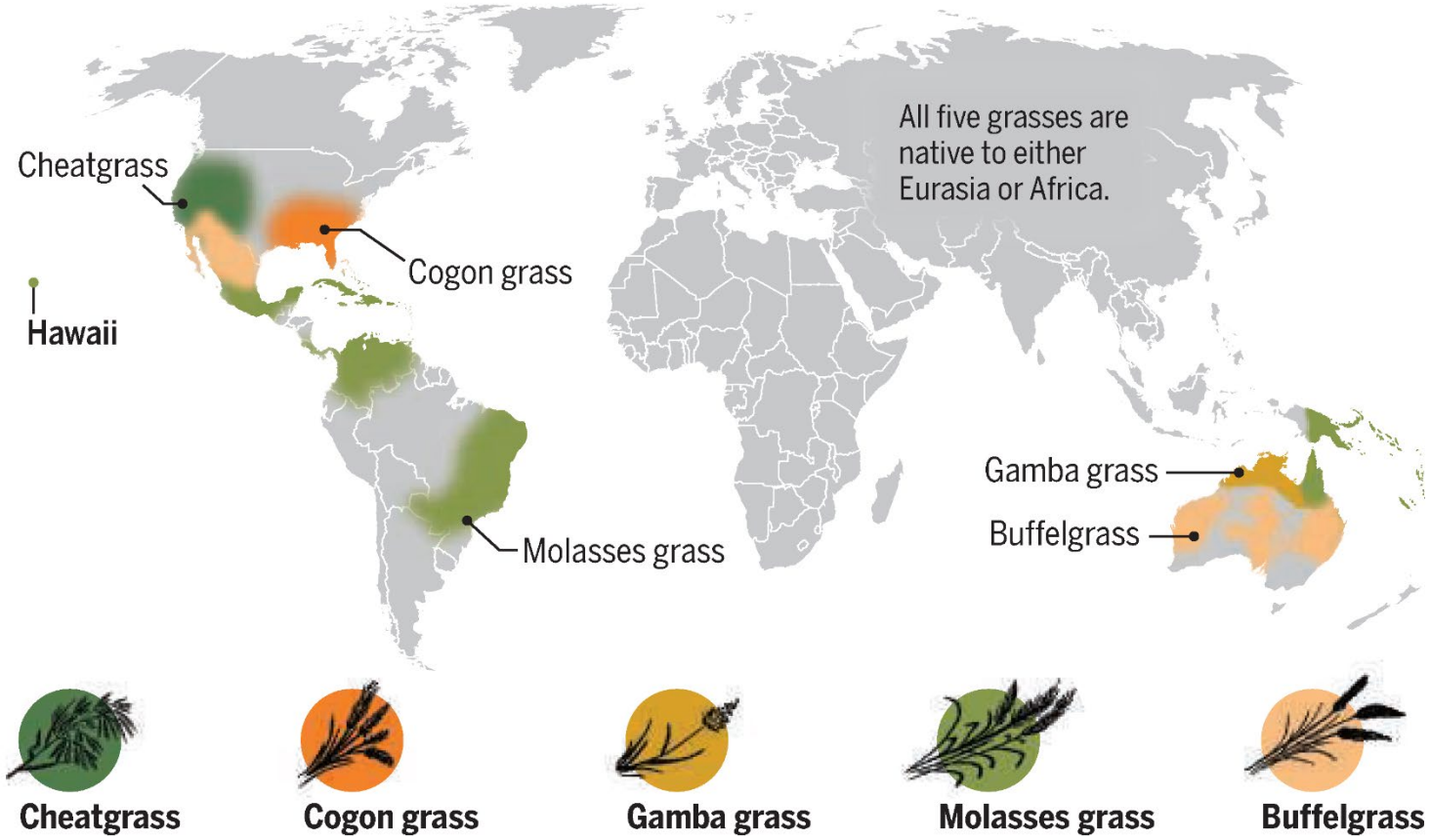
U.S. Geological Survey

15 April 2024

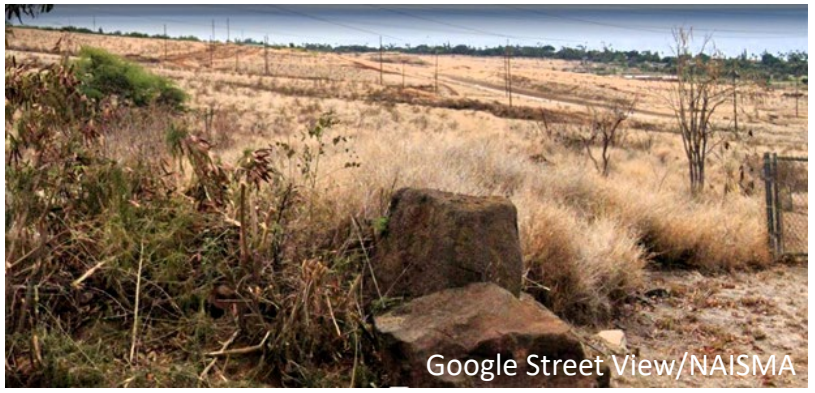
National Conference on Ecosystem Restoration

USGS science for a changing world

Invasive Grasses are a Global Threat



Cornwall. 2022. *Science 377*



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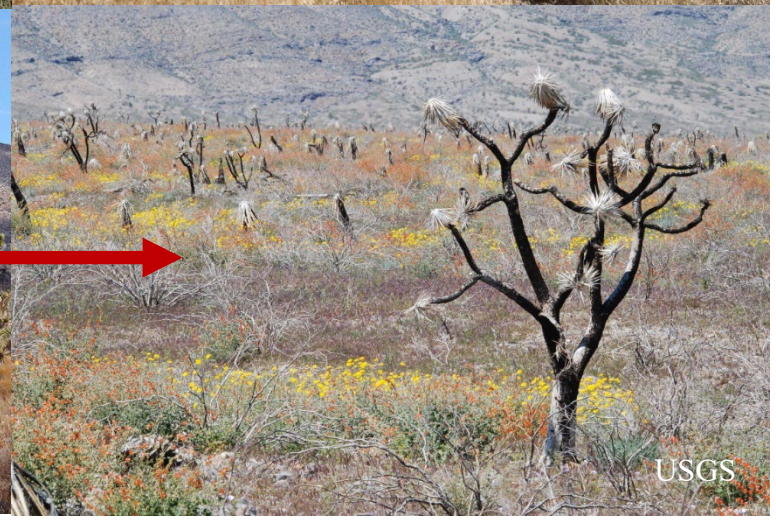
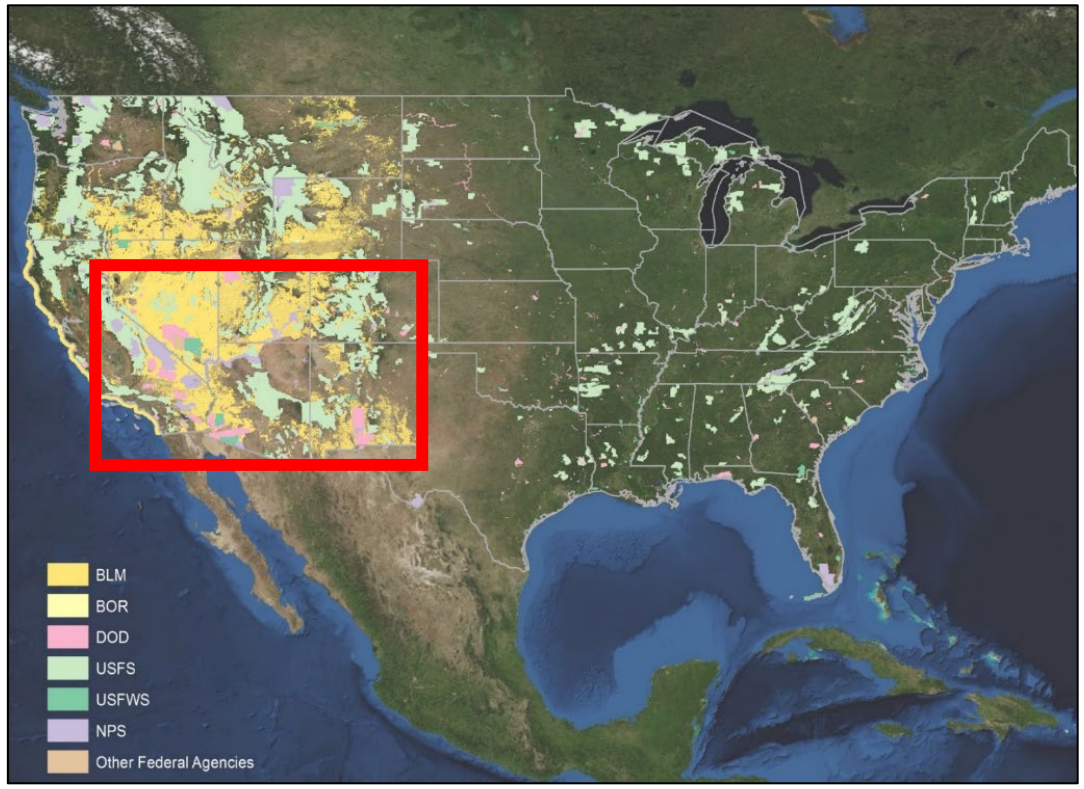
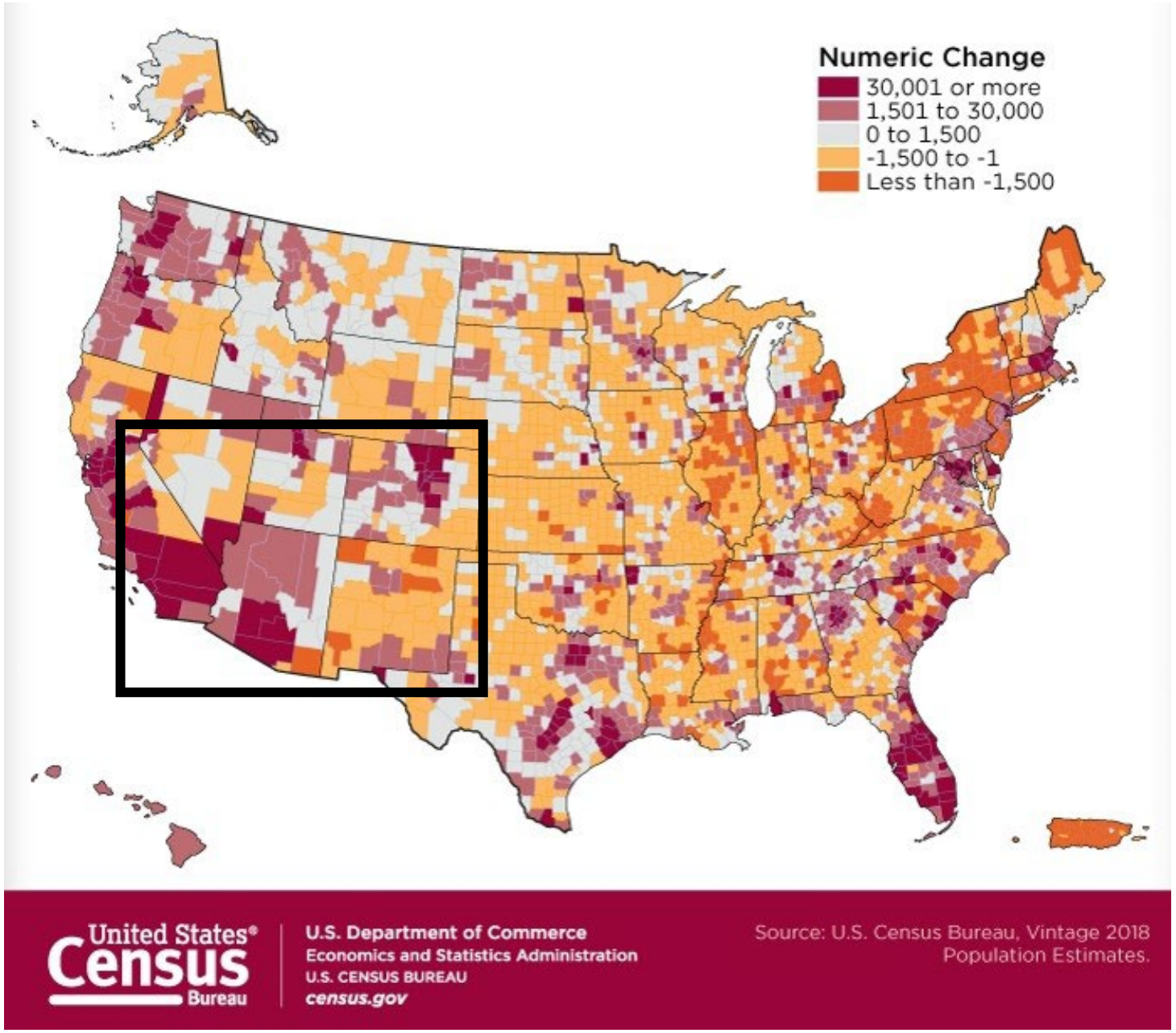


Federal Lands in the Southwest U.S.

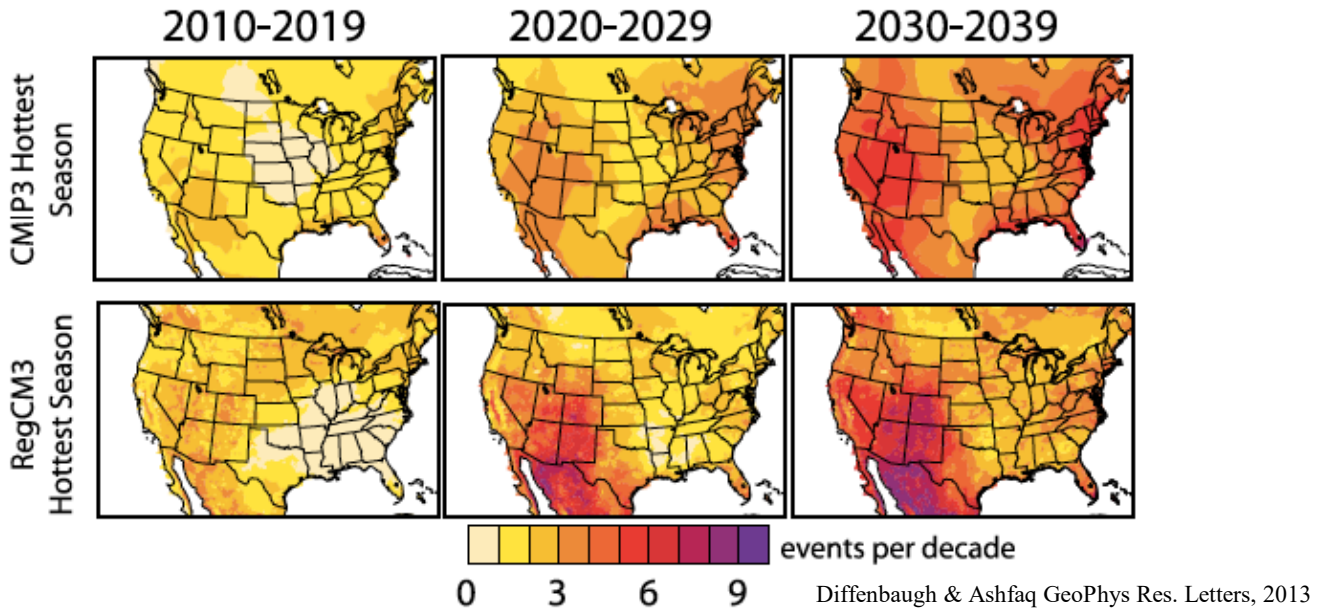


State	BLM	BOR	DOD	FS	FWS	NPS	Other
Arizona	7%	4%	11%	5%	12%	9%	0%
California	8%	5%	16%	11%	5%	29%	0%
Colorado	5%	1%	2%	8%	1%	3%	1%
Nevada	27%	19%	10%	3%	18%	2%	33%
New Mexico	8%	3%	11%	5%	3%	1%	8%
Utah	13%	7%	8%	4%	1%	7%	0%
SOUTHWEST TOTAL	**68%**	**39%**	**58%**	**36%**	**40%**	**51%**	**42%**

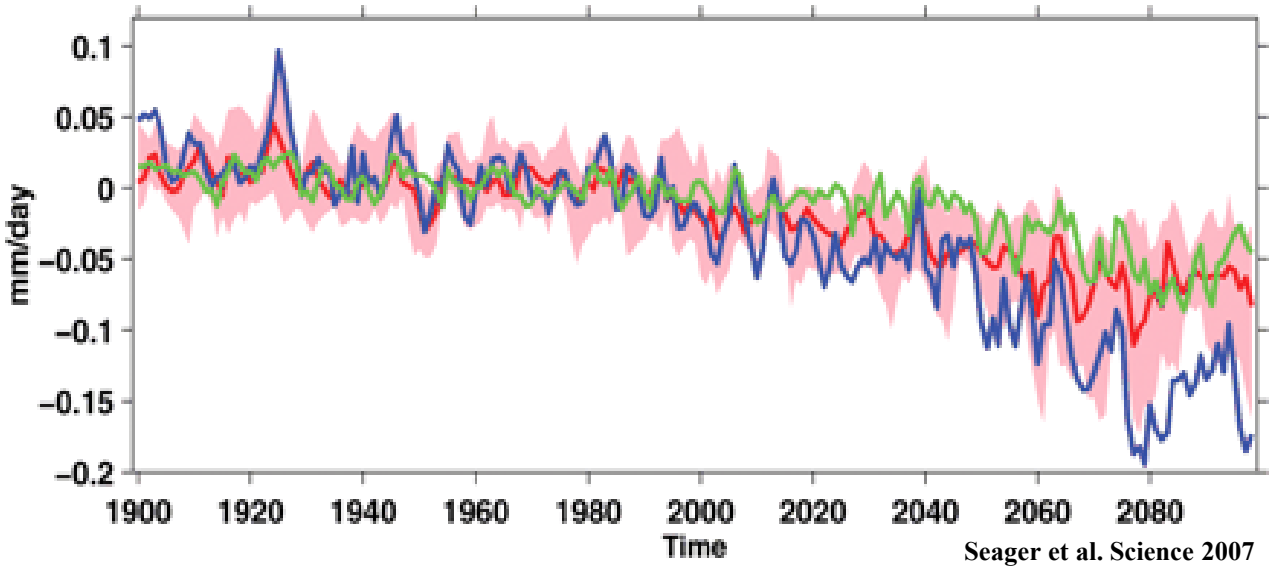
The Southwest is experiencing rapid growth



The Southwest is becoming more arid



Diffenbaugh & Ashfaq GeoPhys Res. Letters, 2013



Precipitation

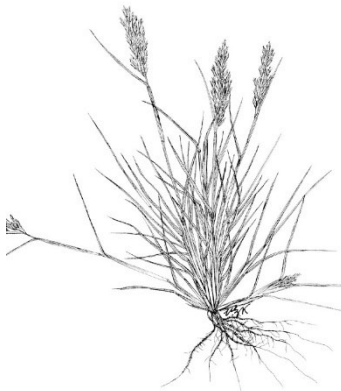
Evaporation

Precitation – Evaporation

Seager et al. Science 2007

Southwest Invasive Grasses

Winter annuals



Schismus arabicus

Schismus barbatus

Mediterranean grass

Bromus tectorum

cheatgrass

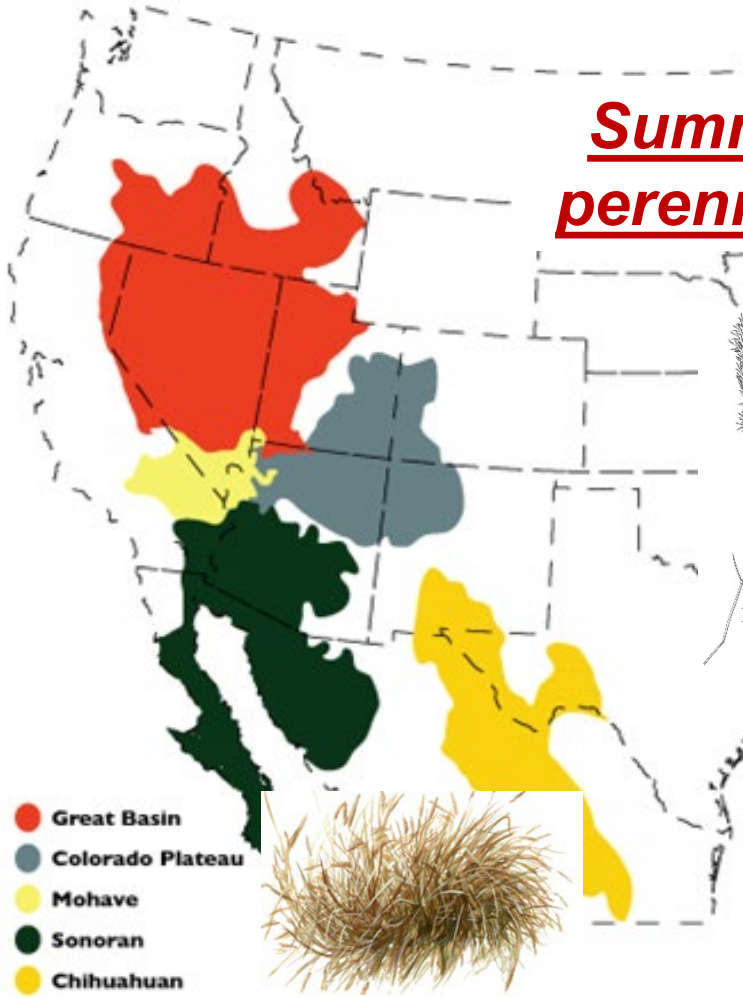
Taeniatherum caput-medusae

medusahead

Bromus rubens

red brome

Summer perennials



Eragrostis lehmanniana

Lehmann lovegrass

Pennisetum ciliare

buffelgrass

Betancourt et al. 2009

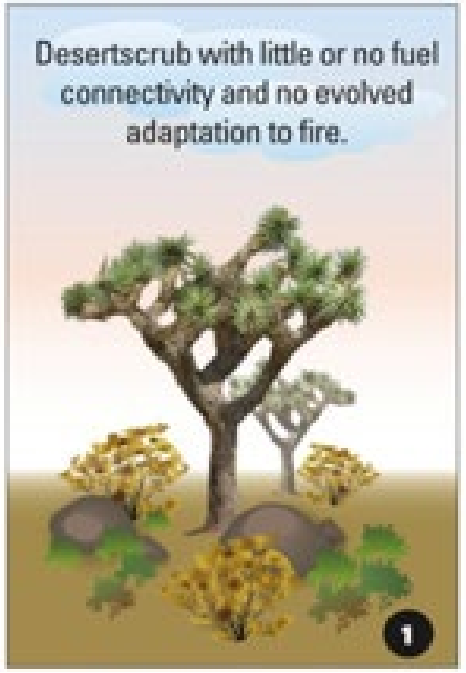
NPS

Audobon Rockies

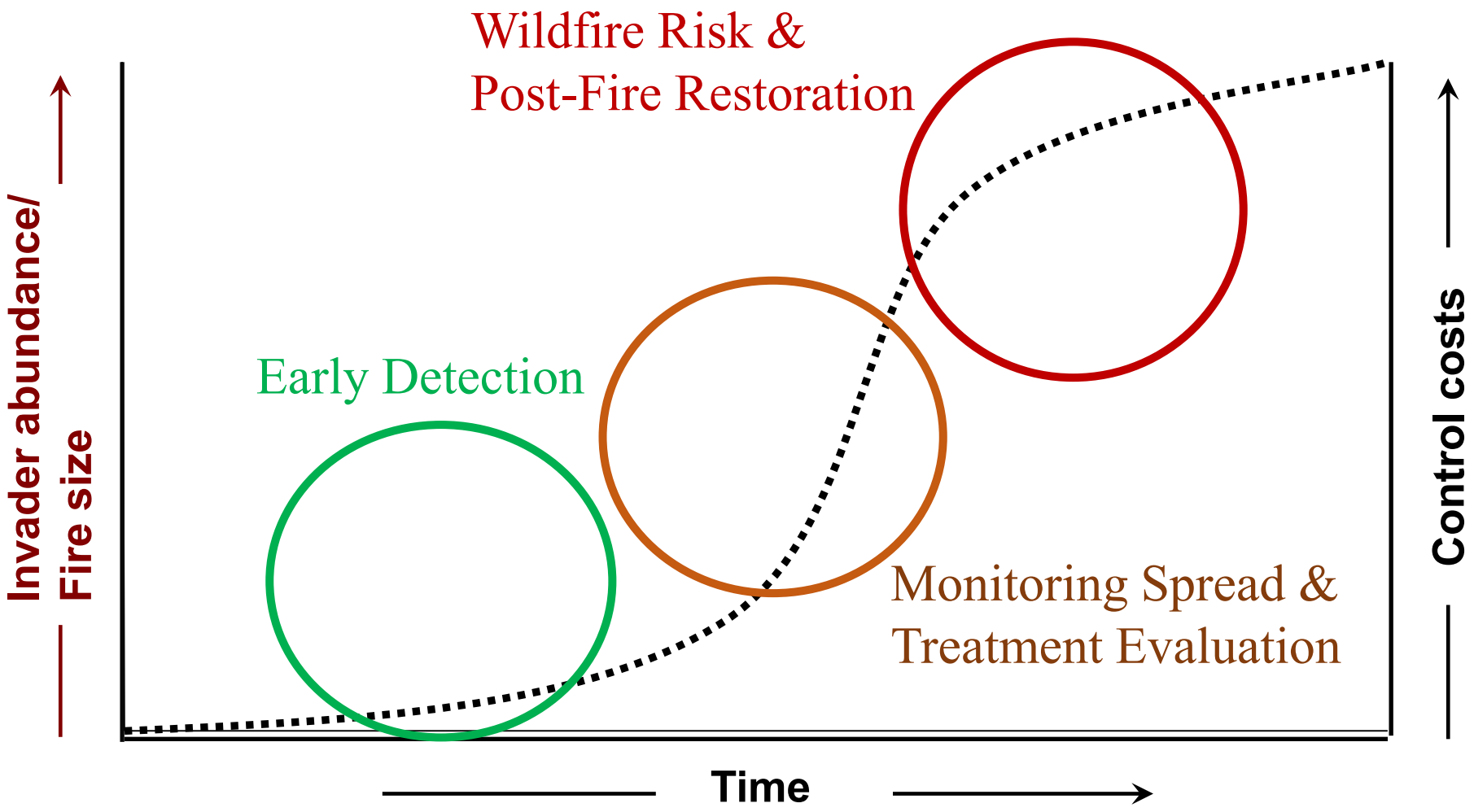
Arizona Daily Star

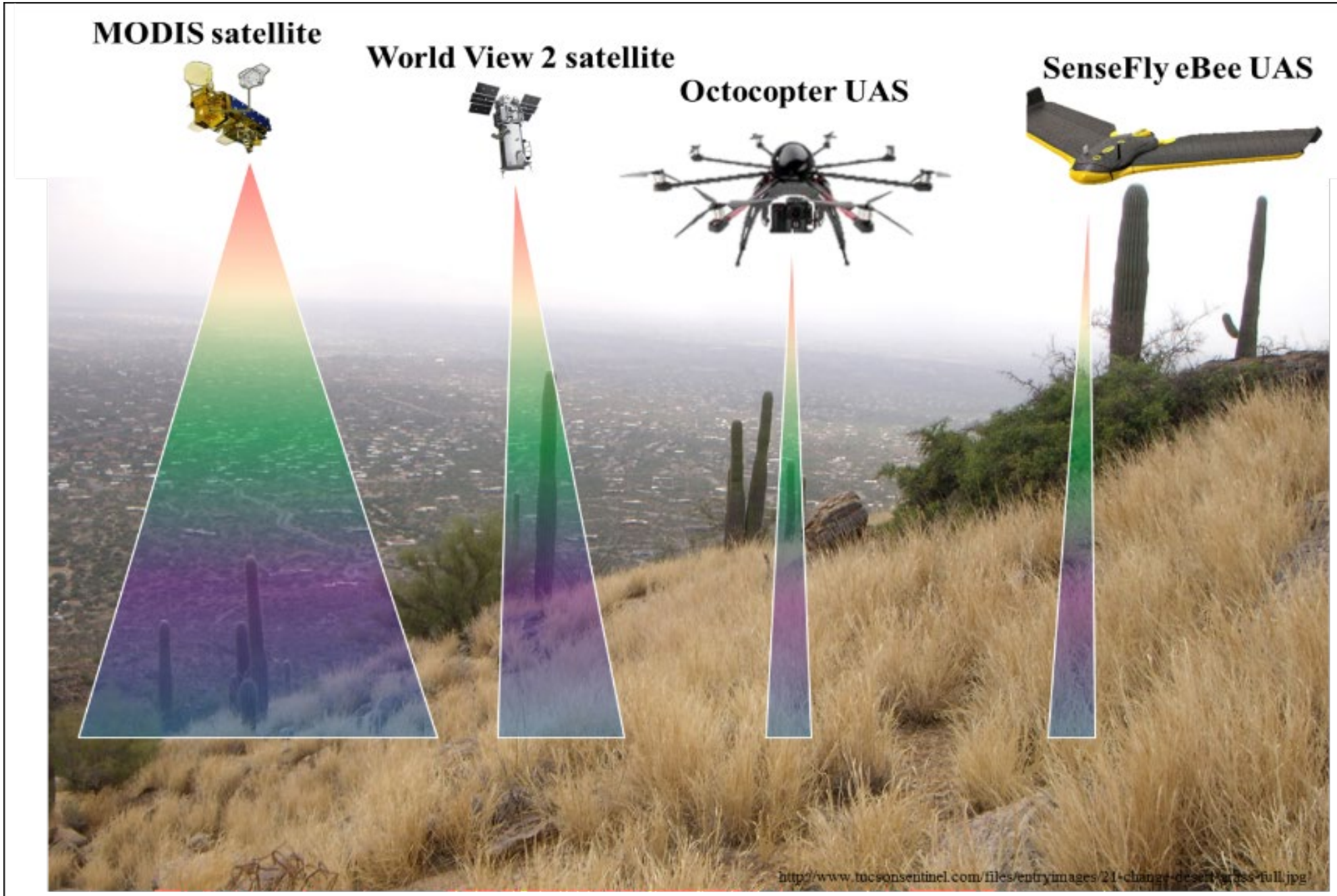
Denver Post

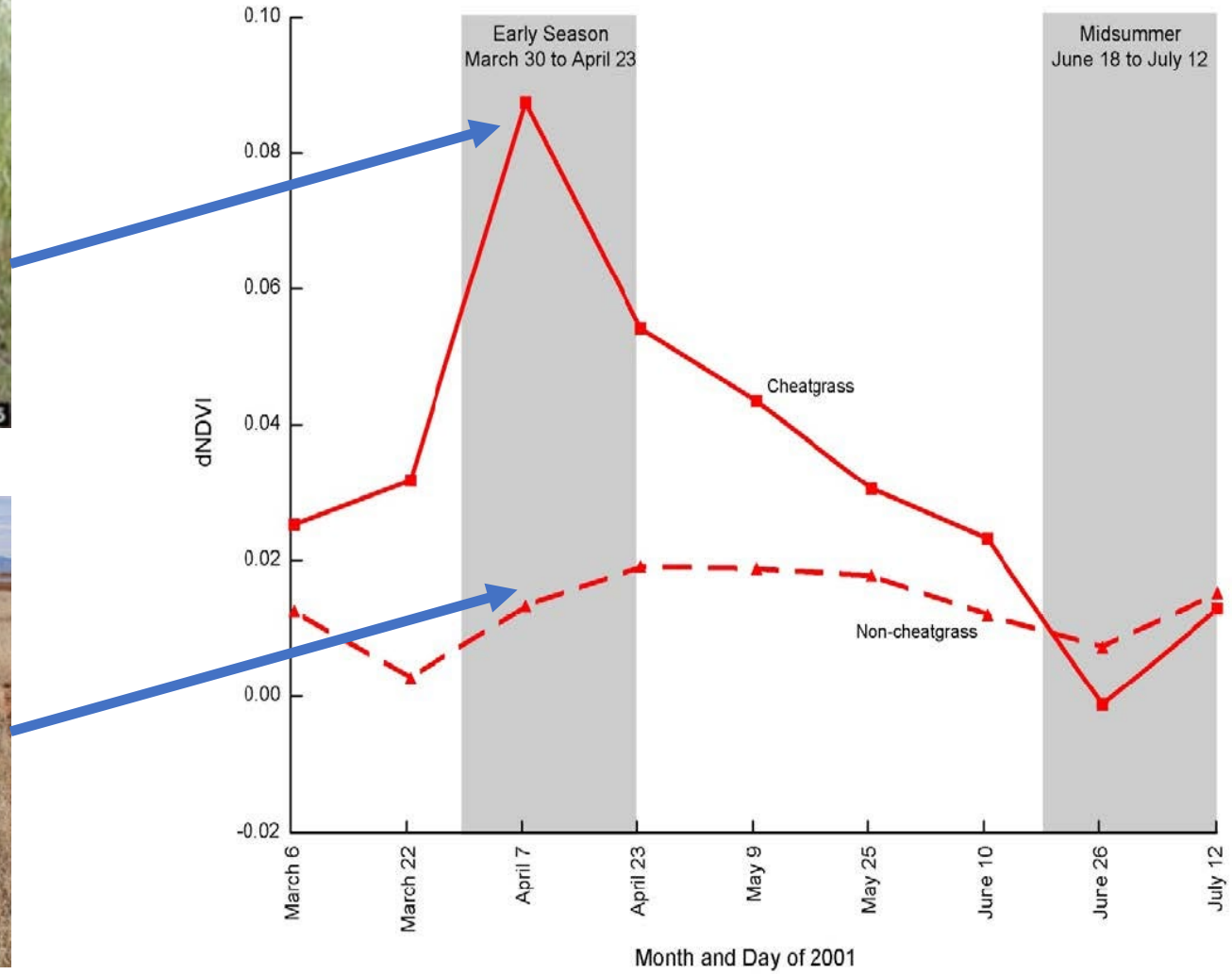
Invasive non-native grasses have introduced fire in desert ecosystems that have previously experienced little or no fire.



Betancourt et al. 2009


Wildfire Risk &
Post-Fire Restoration
Early Detection
Monitoring Spread &
Treatment Evaluation
Invader abundance/
Fire size
Control costs
Time


MODIS satellite
World View 2 satellite
Octocopter UAS
SenseFly eBee UAS
http://www.tucsonsentinel.com/files/entryimages/21-change-desert-grass-full.jpg



Kokaly 2011

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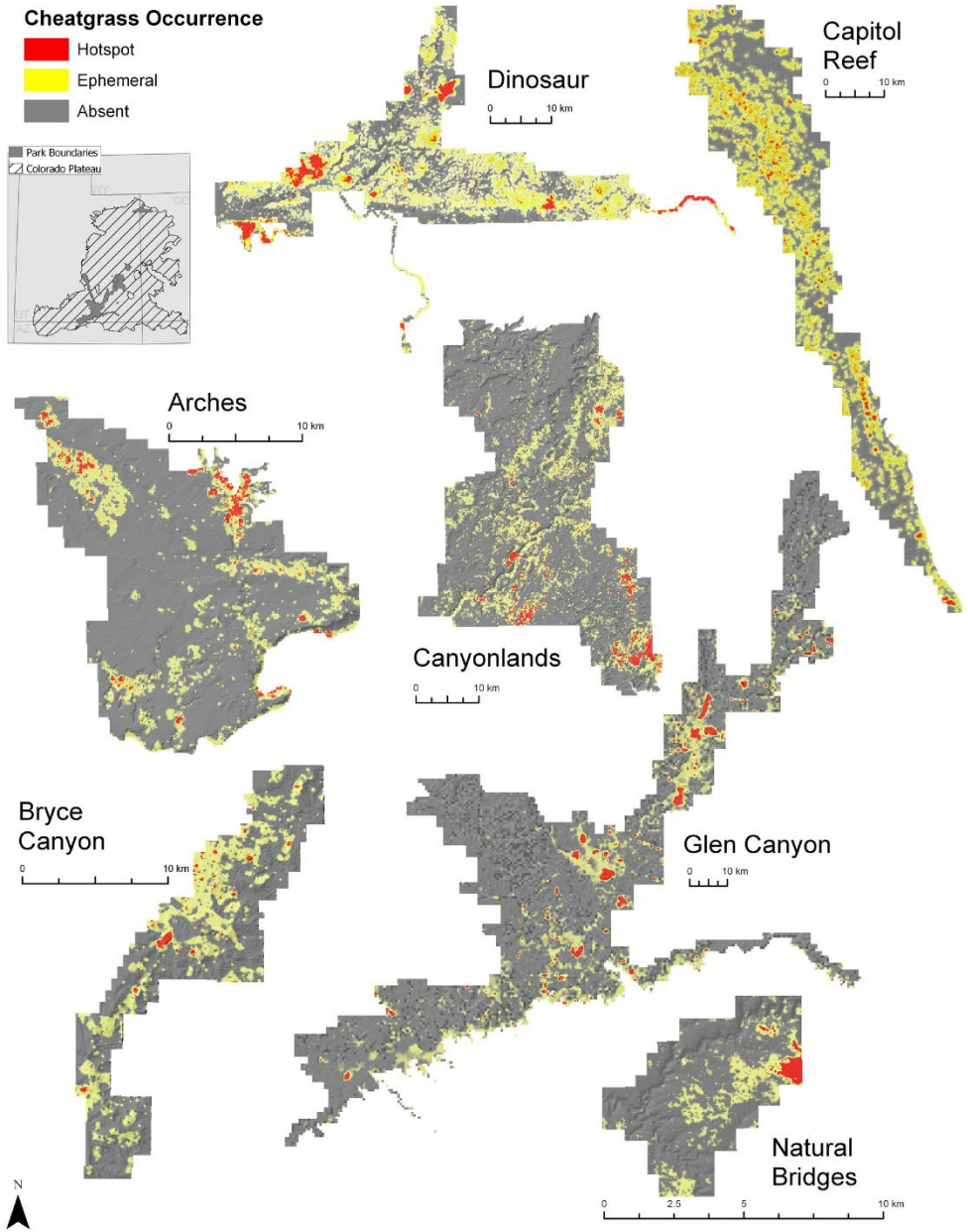
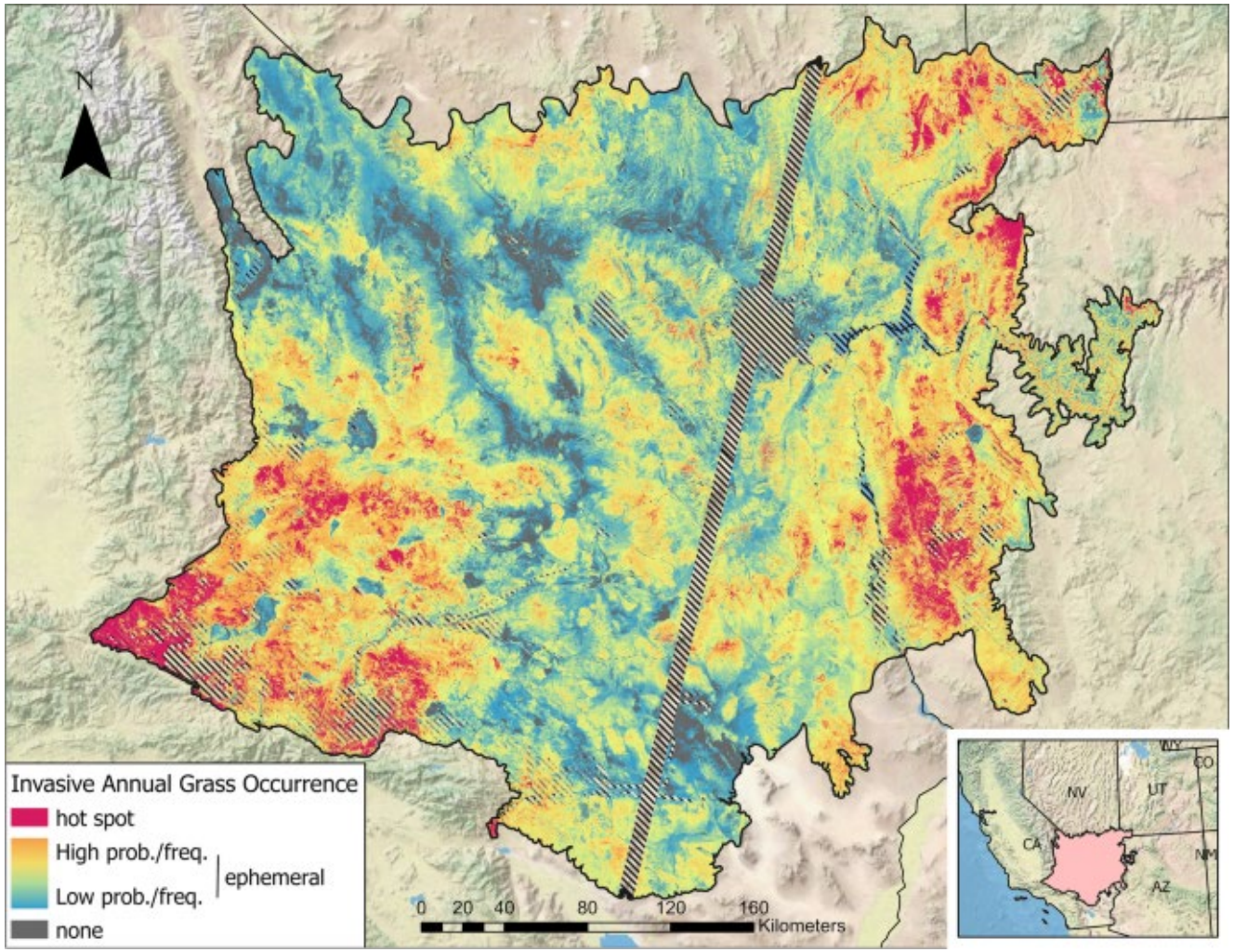


Bishop et al. 2019 Landscape Ecology



Smith et al. 2023 Biological Invasions

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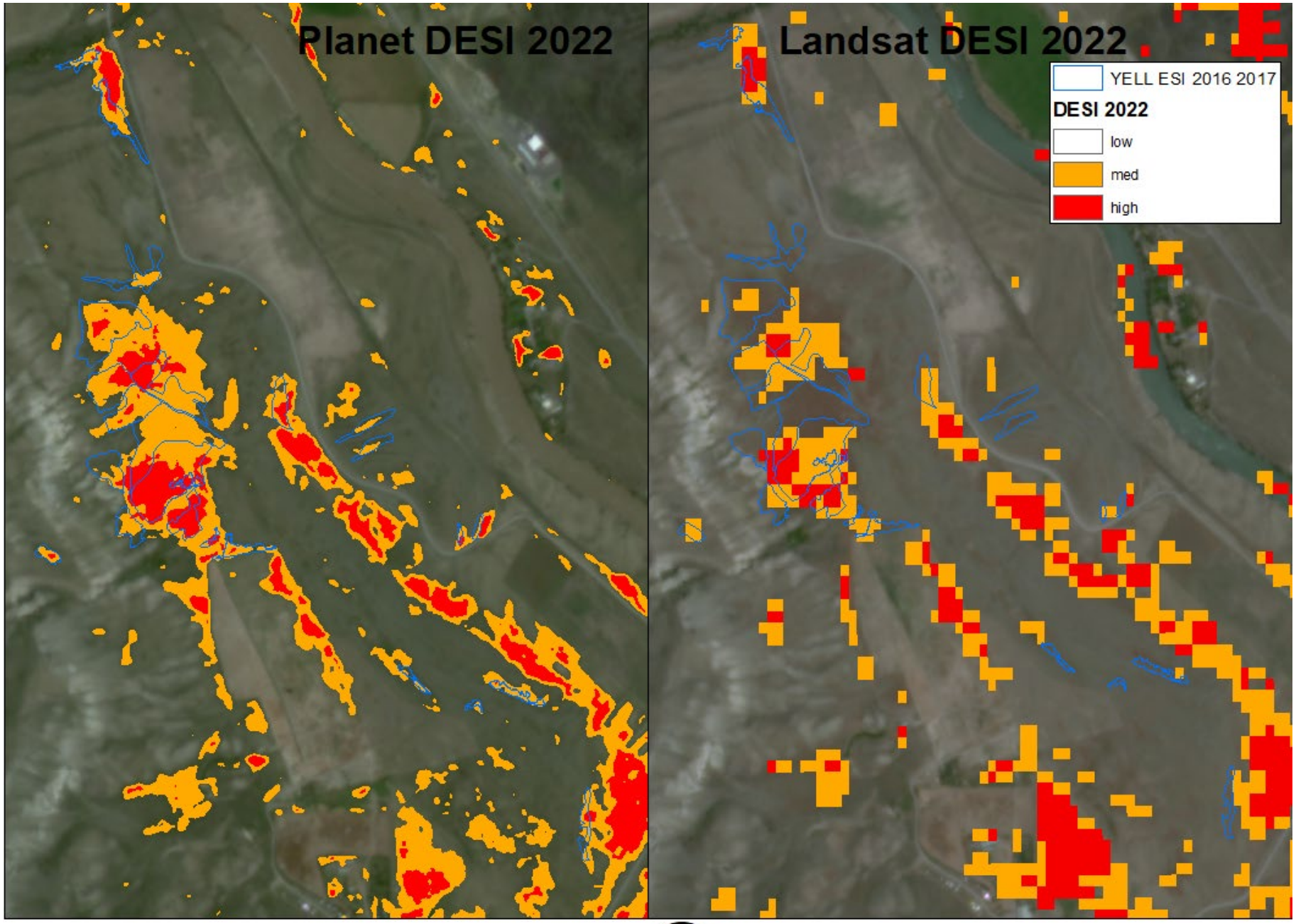

Preliminary Information-Subject to Revision.
Not for Citation or Distribution

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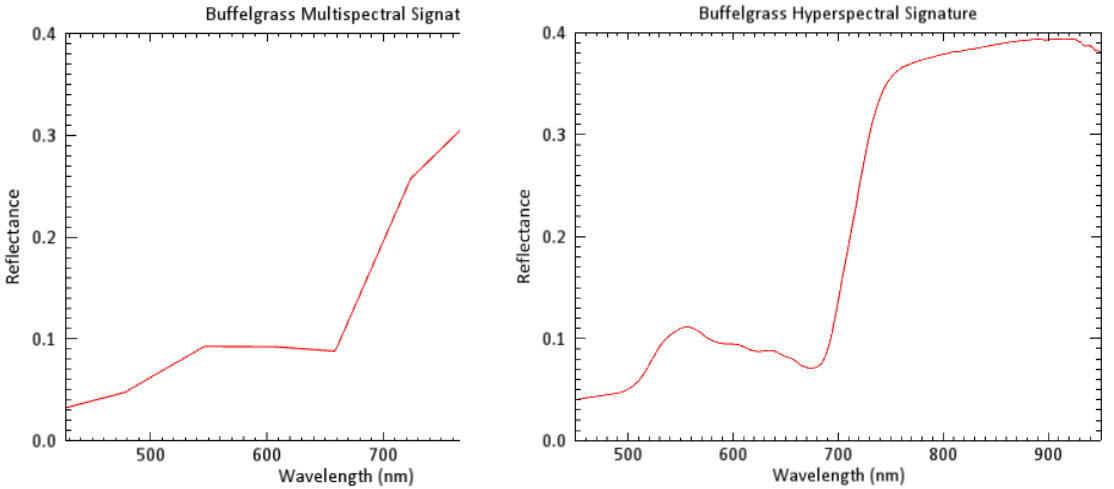
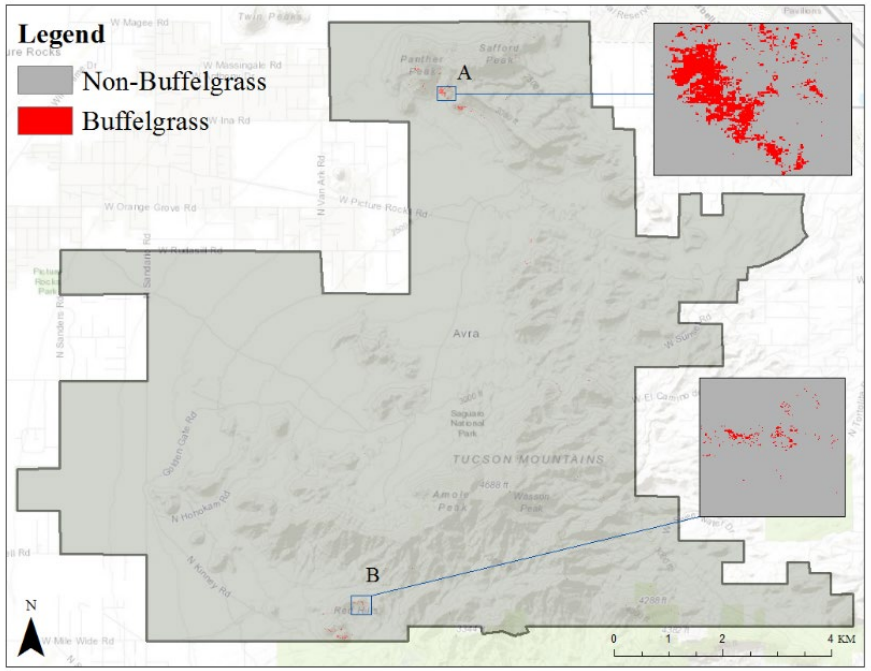
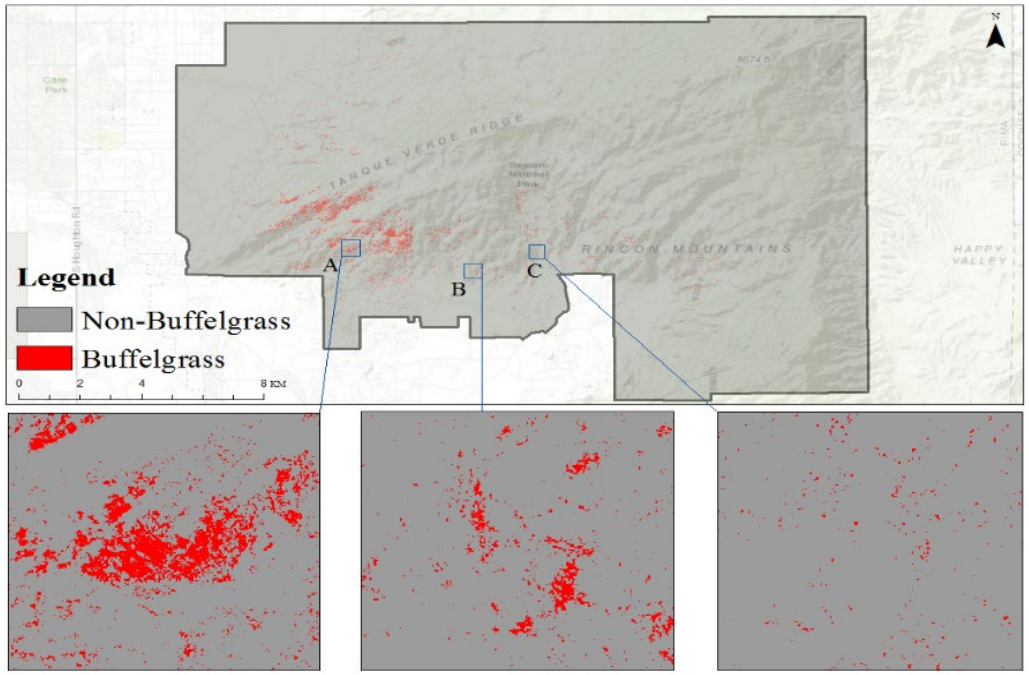
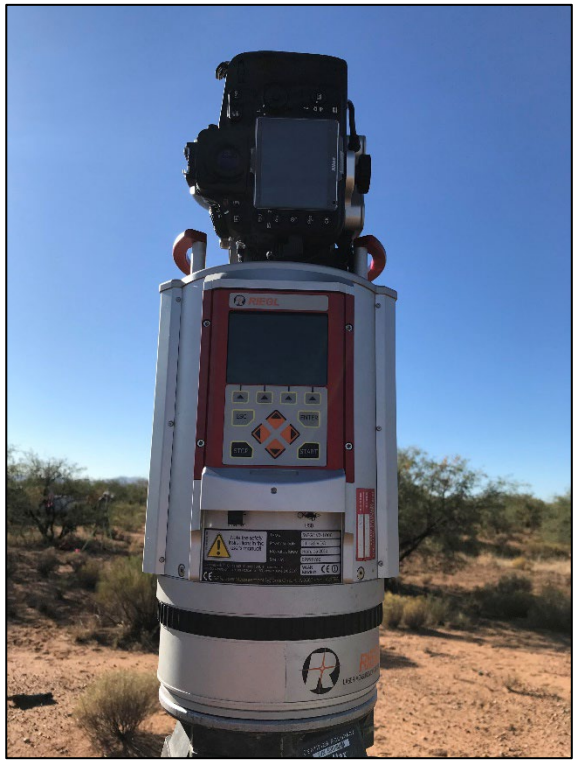


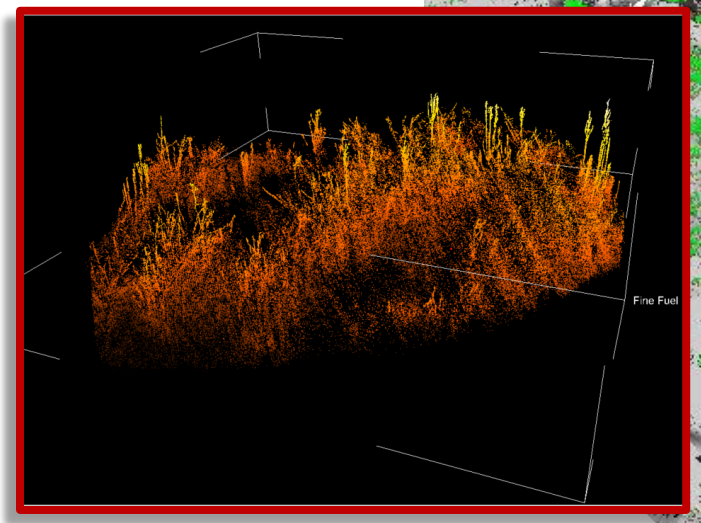


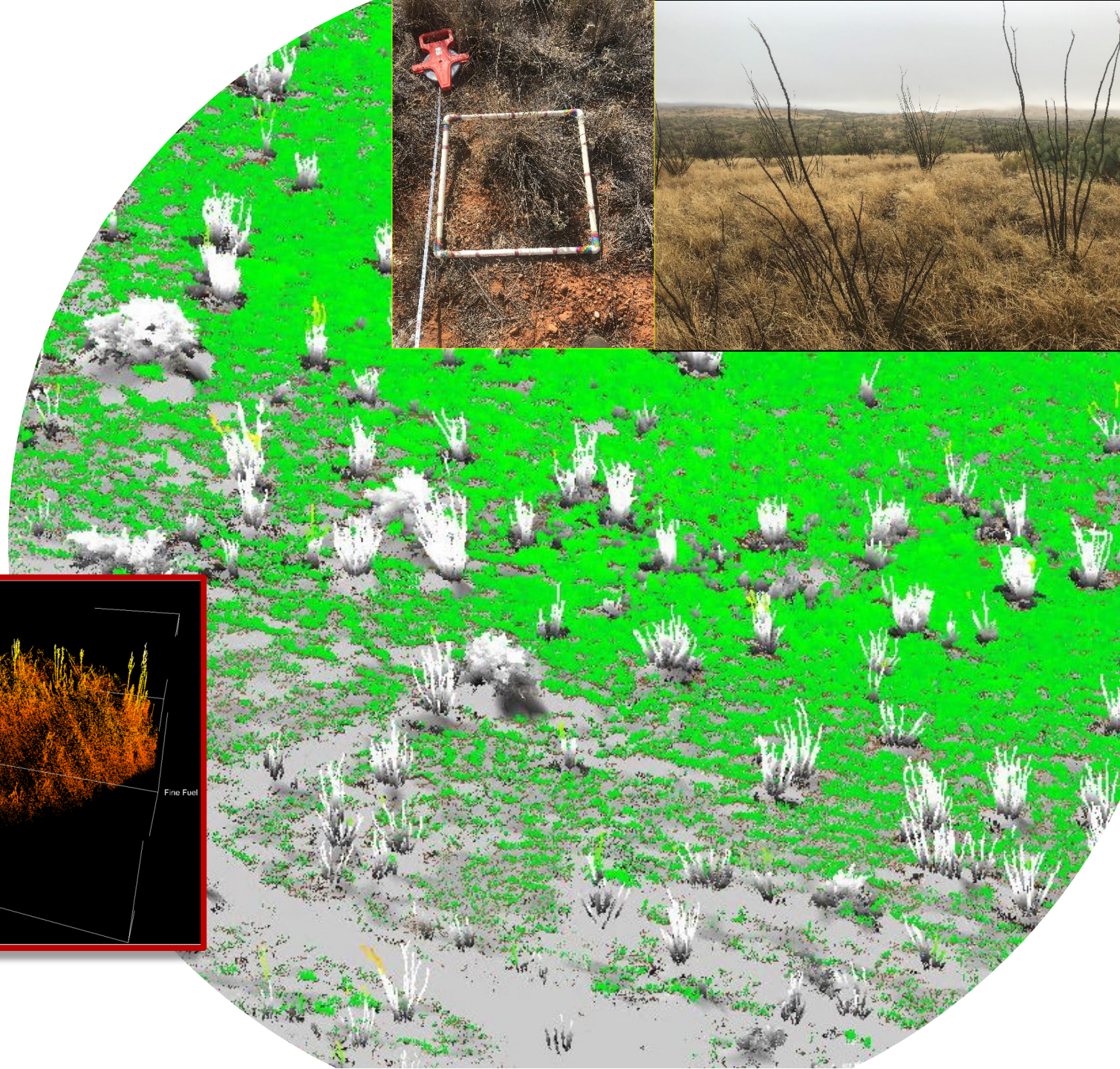


Elkind et al. 2019. Remote Sensing in Ecology and Conservation

Terrestrial Laser Scanning – High-Resolution Fuel







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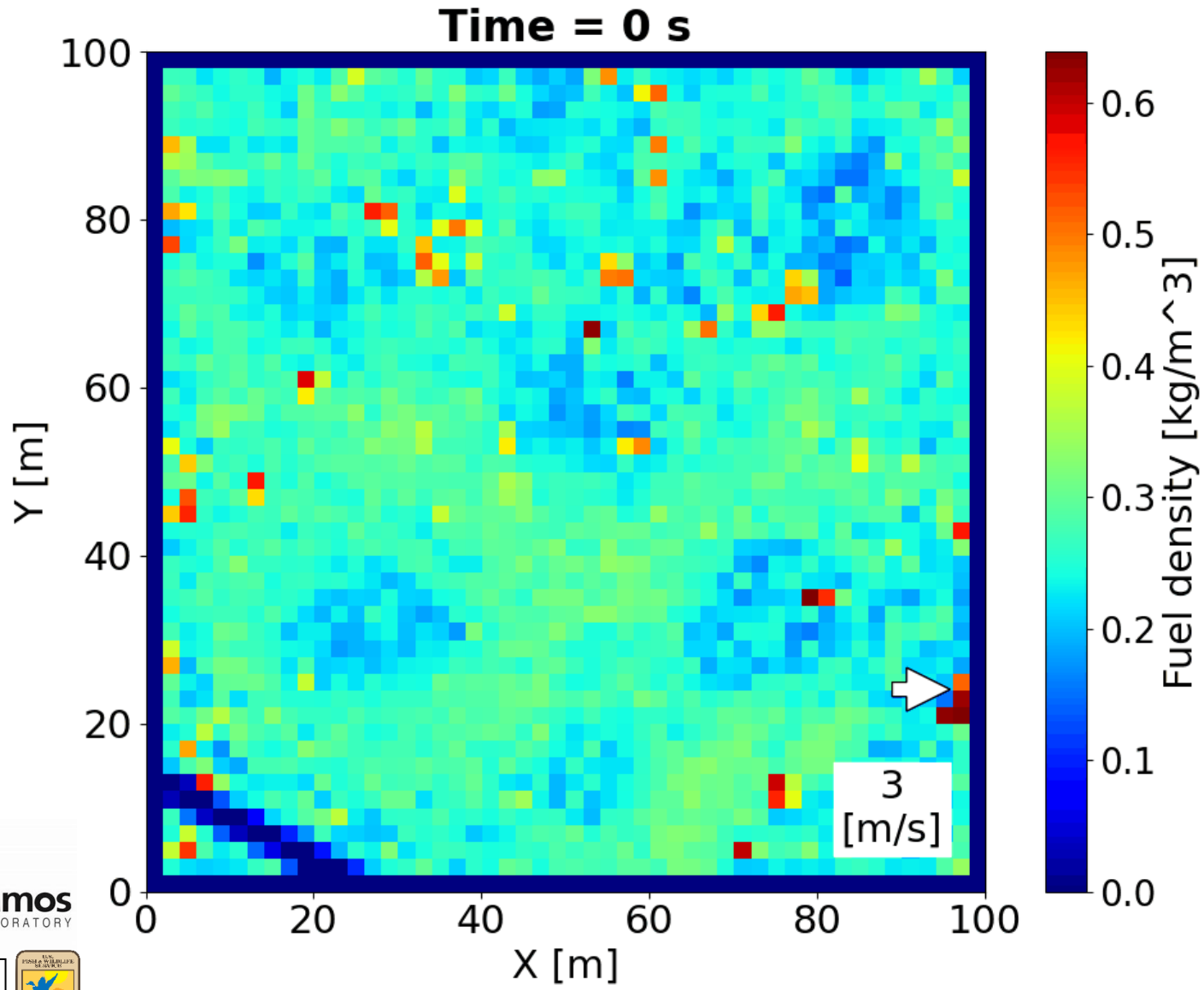
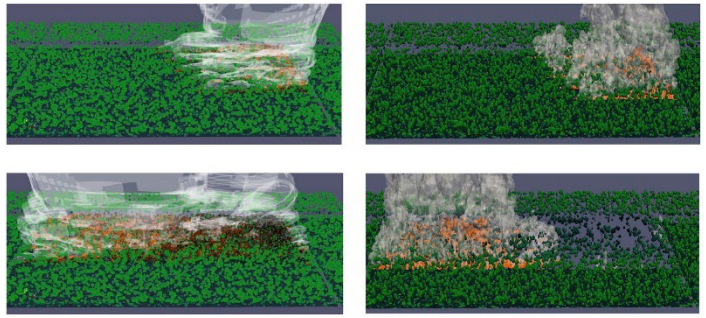
Fire Simulations





Los Alamos NATIONAL LABORATORY

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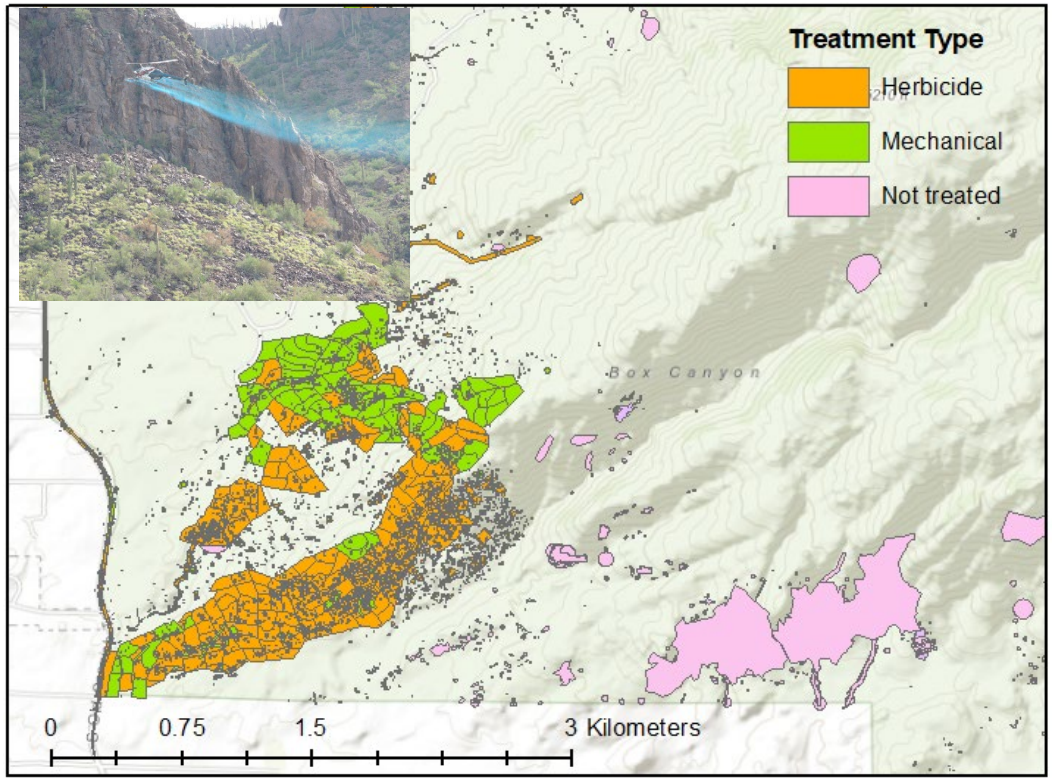
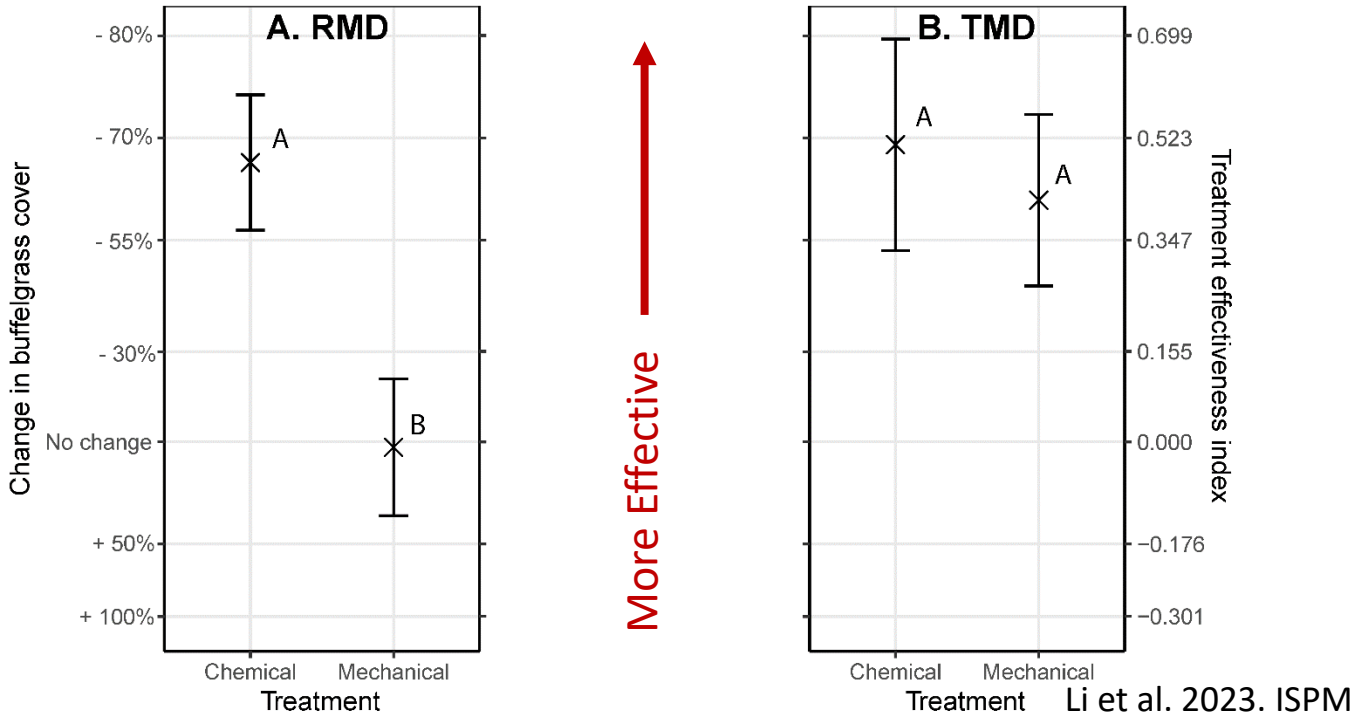




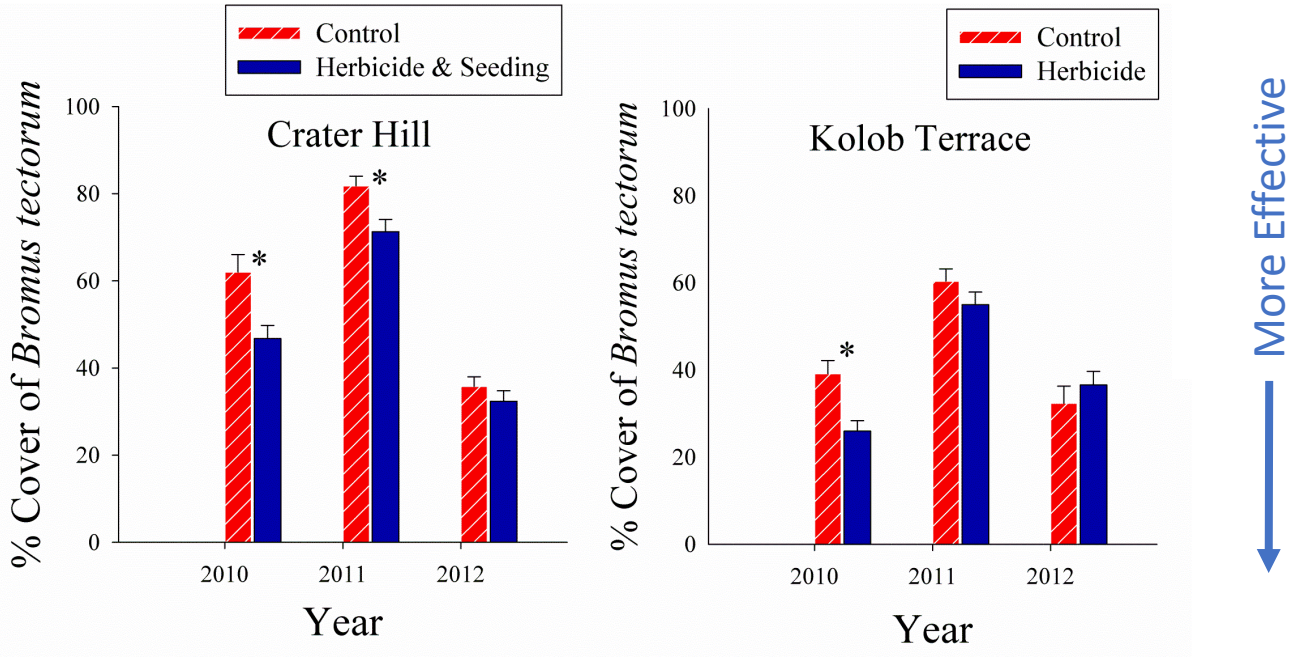
Li et al. 2023. ISPM

Biol Invasions (2015) 17:1915–1926
DOI 10.1007/s10530-015-0847-x

ORIGINAL PAPER

Repeated landscape-scale treatments following fire suppress a non-native annual grass and promote recovery of native perennial vegetation

Seth M. Munson · A. Lexine Long · Cheryl Decker · Katie A. Johnson · Kathleen Walsh · Mark E. Miller



RAMPS: Restoration Assessment & Monitoring Program for the Southwest

Connecting Science and Land Management

Mission

Strengthen restoration outcomes in the southwestern U.S. by providing science and guidance on effective strategies

http://usgs.gov/sbsc/ramps

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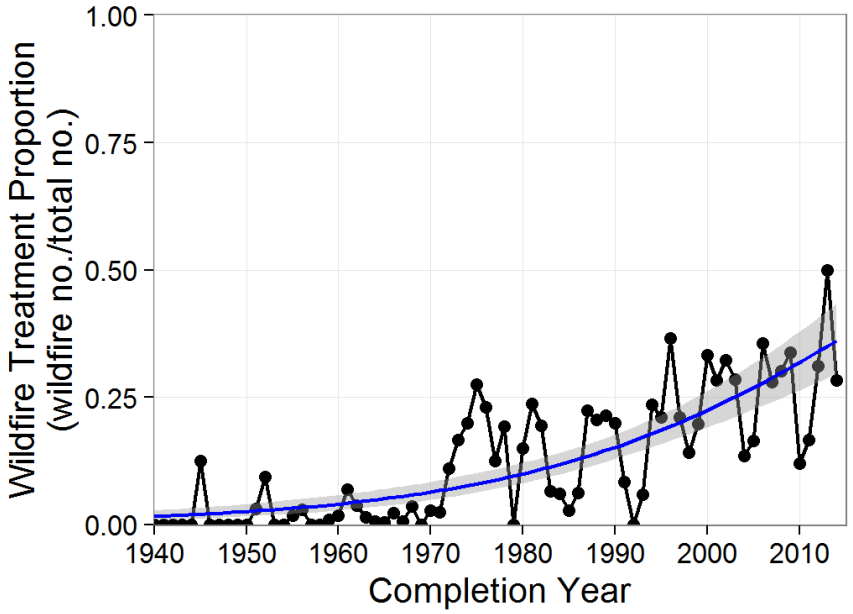
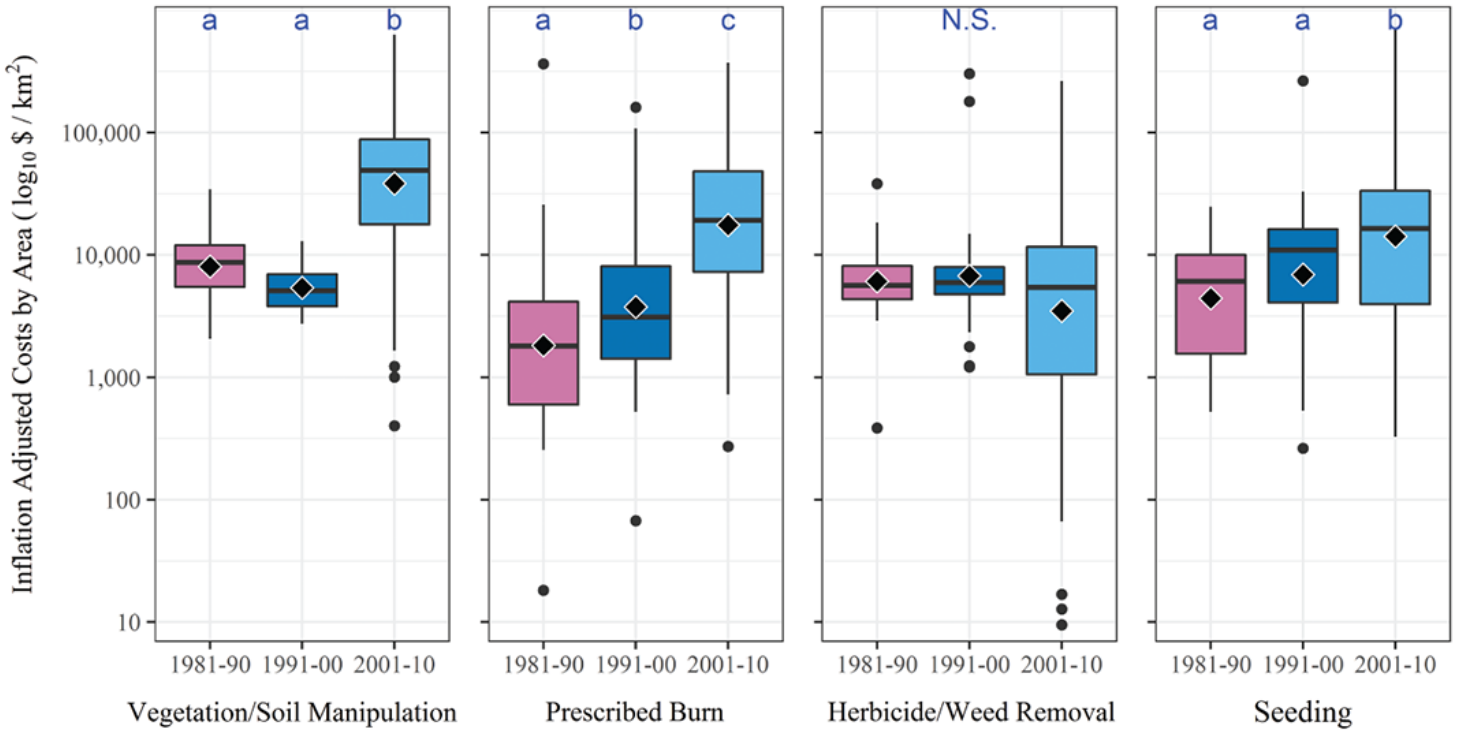
Trends in Land Treatments





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Copeland et al. 2018. Restoration Ecology 26: 311 – 322

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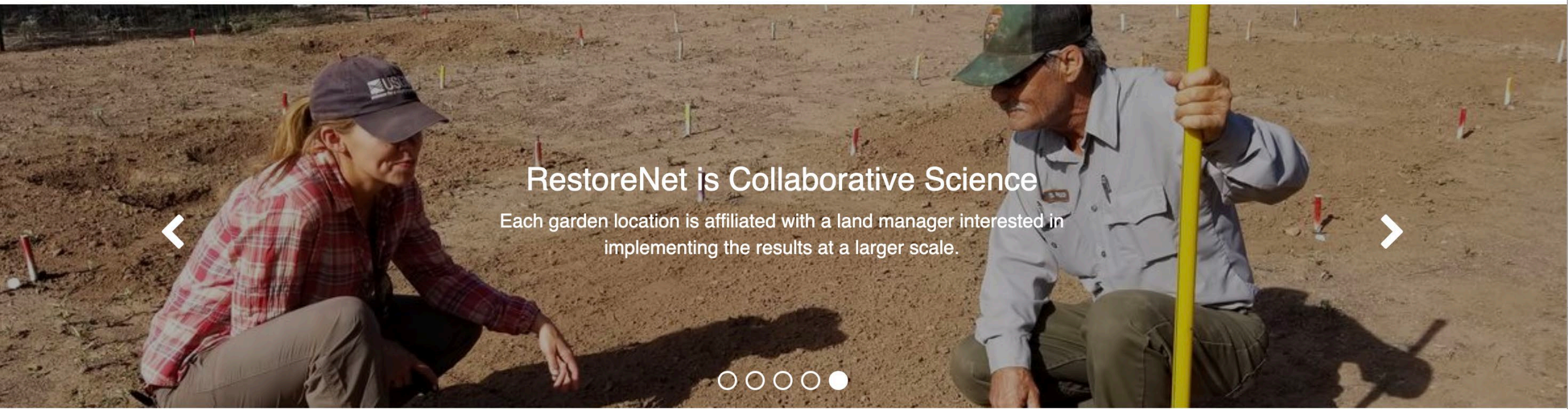
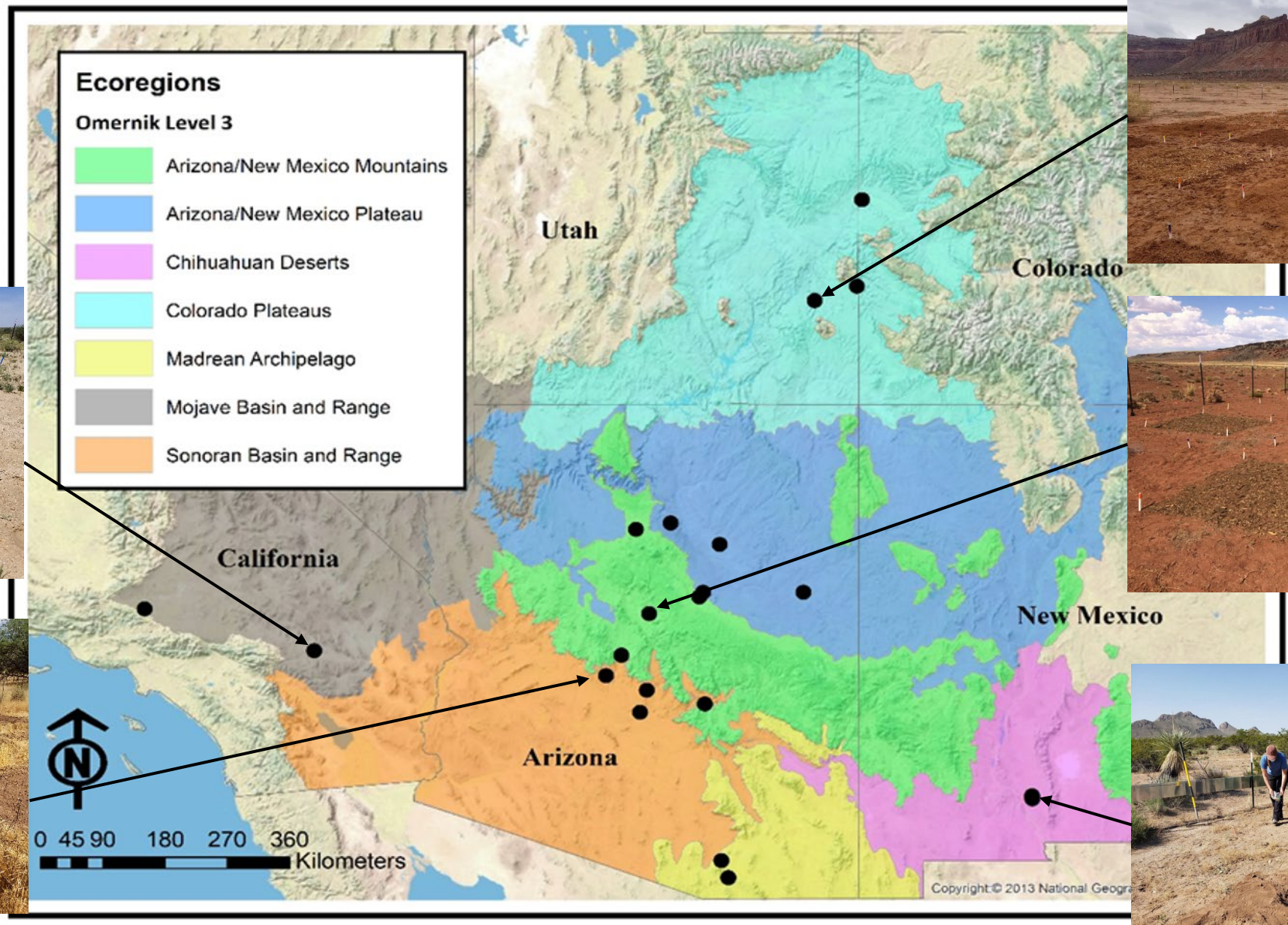
Southwest Biological Science Center

RestoreNet: Distributed Field Trial Network for Dryland Restoration



RestoreNet is a co-produced research network that systematically tests restoration treatments and native seed sources across environmental gradients in the southwestern U.S.



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Partner Engagement & Application of Results

- Field site visits and demonstrations
- Partner meetings and workshops
- Information briefs, web content, protocols
- Co-development of local-scale projects

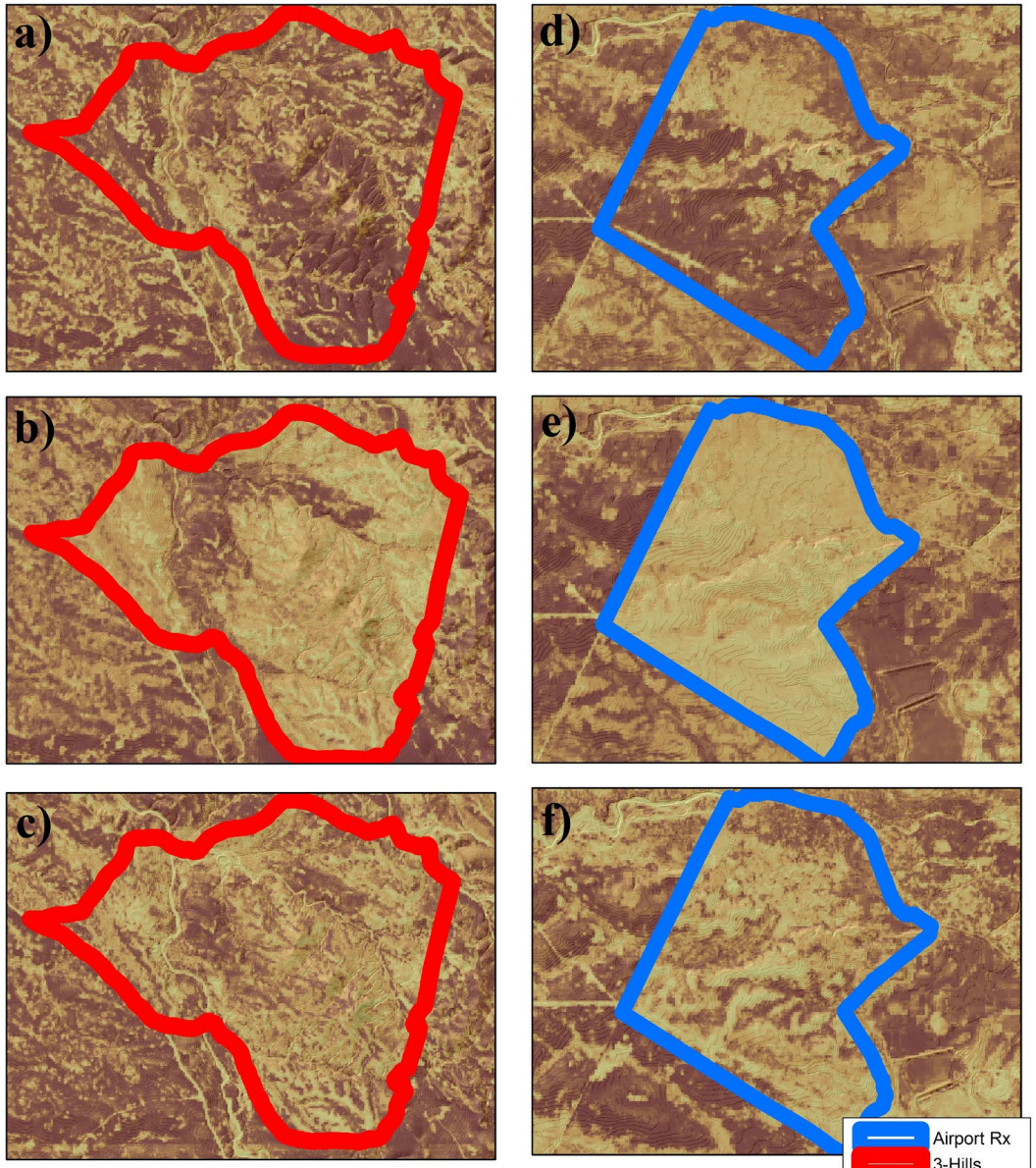
Thank you!
smunson@usgs.gov
https://usgs.gov/sbsc/ramps
Funding Sources:
USGS Invasive Species Program
USGS Wildland Fire Program
DOI Office of Wildland Fire
National Park Service

Wildfire

Pre-fire

1 Year Post-fire

3 Years Post-fire



Prescribed Fire

Pre-fire

1 Year Post-fire

3 Years Post-fire

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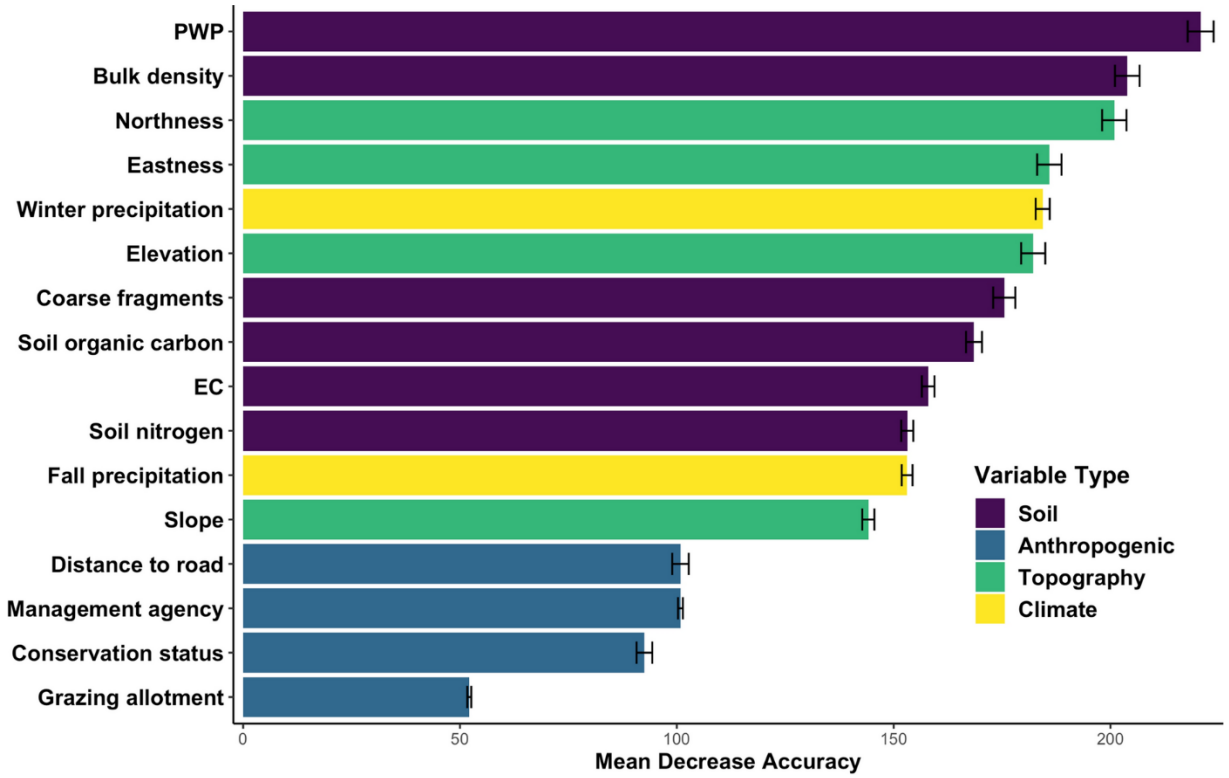
Wells et al. 2021. Fire



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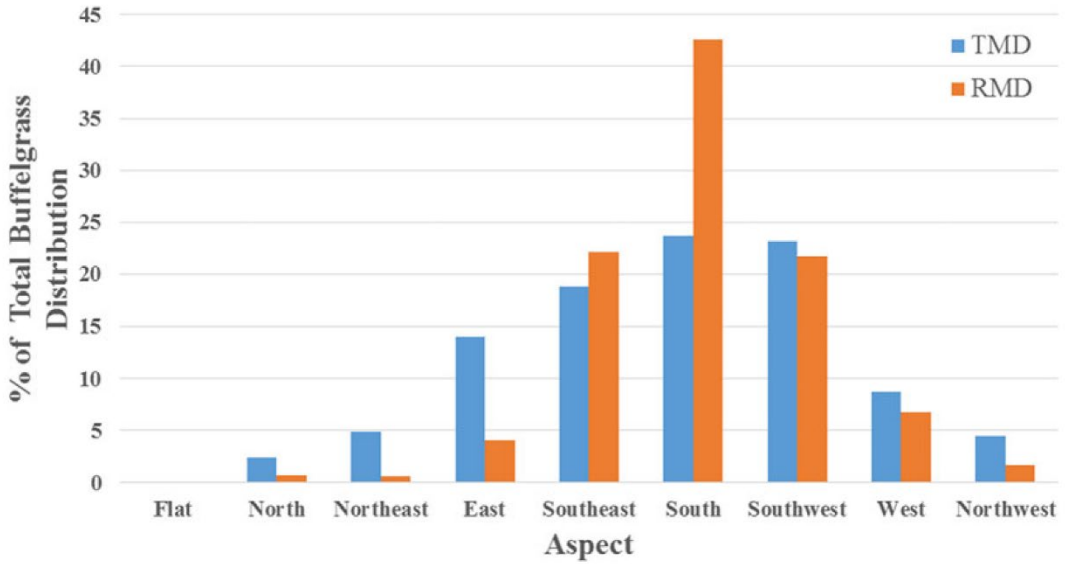

Elkind et al. 2019. Remote Sensing in Ecology and Conservation

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