

On-the-ground tools for climate adaptation in sagebrush steppe, *focus on breaking grass-fire cycle, either preemptively or reactively.*

Main strategy: protect or build resistance to invasion; resilience to disturbance with emphasis on promoting resprouting perennials.

Themes: **Risk vs. reward.** Consider soil stability, risk of action vs. no-action.
 There is no “easy button” – plan for extended hard work, might get lucky in some cases.

Passive action:

Grazing management, focus is on minimizing impacts to resprouting perennials

Active action:

Soil-surface treatments including discing, plowing, chaining, harrowing;

Mechanical treatments including mowing, or selective hand-cutting of wood species

Herbicides including pre- and post-emergent; specific to grasses, dicots, or all plant taxa

Seeding or planting perennials

Grazing:

- Regulatory/administrative actions
- Timing/placement with virtual or wire fences, water, salt
- Season and intensity of use
- Post-fire rest, requires decision-support tools especially regarding “bunchgrass maturity”
- How much rest after active restoration treatments?



Soil surface treatments:

- Generally done to facilitate herbicide or seed contact with soil, usually to address litter or crusty/hard soils.
- Chaining, harrowing, ripping, discing, sometimes limited stabilization covers with tackifiers or erosion baffles.
- Very weather dependent, which means linked to climate.
- Biological soil crusts are key.



Mechanical treatments of standing vegetation:

- To facilitate equipment or reduce fuels
- Mowing whole community
- Selective cutting of woody plants



Herbicides:

- Workhorses are pre-emergent, imazapic and now indaziflam (Plateau, Rejuvra)
- Broad-spectrum post-emergents e.g. glyphosate used in past, less common recently.
- Exotic forbs complicate outcomes; requires broadleaf-specific chemical
- Bioherbicides are currently deemed ineffective, biocontrol insects are key.
- Target vs. non-target impacts
- Issue of how to apply: aerial, vehicle, or backpack sprayer
- VERY weather and thus climate dependent.
- Off-site drift and downwind impact are a serious concerns.



Seeding, planting:

- Aerial seeding useful for some species, e.g. sagebrush and forbs, generally done for lower-cost seeds and large aerial extents
- Planting is effective for smaller areas, examples of >1M planted; appropriate plant prep is key, mycorrhizae etc.
- Seed source:
 - what is “local” and “native”,
 - where/when does seed zone guidance work?

Where does climate-transfer zone guidance come from, and what does it mean for seed selection?

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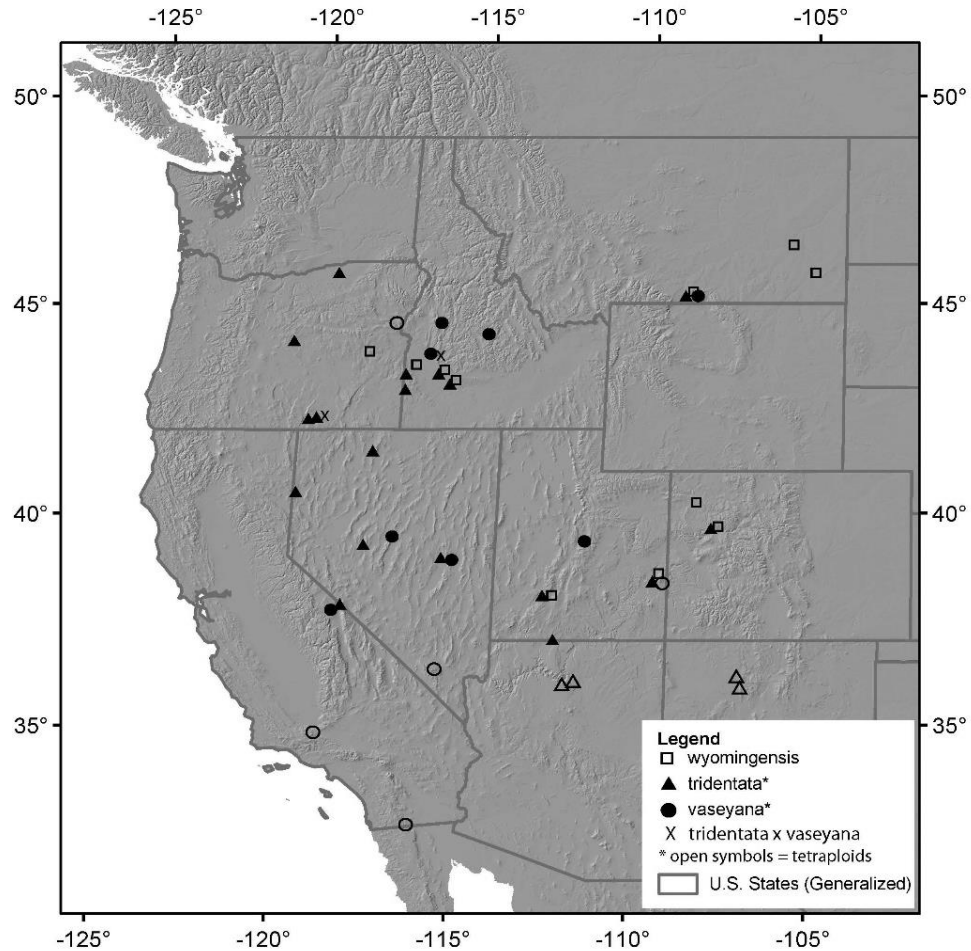
DOI: 10.1002/ece3.6651

ORIGINAL RESEARCH

Ecology and Evolution Open Access WILEY

Spatial grain of adaptation is much finer than ecoregional-scale common gardens reveal

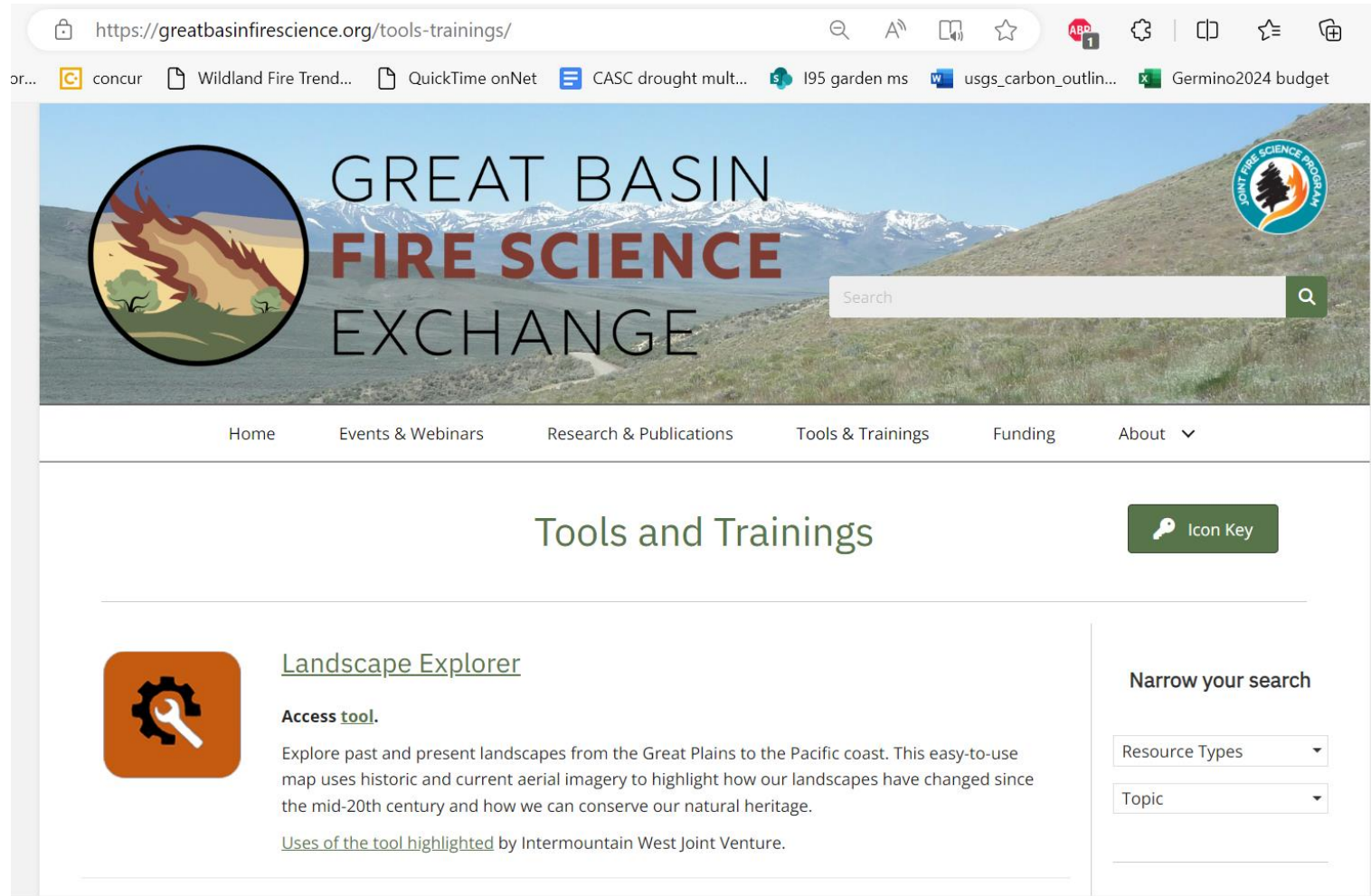
Bill E. Davidson  | Matthew J. Germino 



Successful use of on-the-ground tools:

- What is success? SMART criteria
- Doesn't come easily in sagebrush steppe!
- Previous literature point a negative picture on treatment success, but newer evaluations are changing that picture.
- Bias is hard to escape in monitoring and evaluation:
 Applestein, Kluender, Simler et al. papers.
- Multiple interventions typically required
- Best tool?: *Adaptive management*. Why? –imperfect knowledge.

Some digital resources



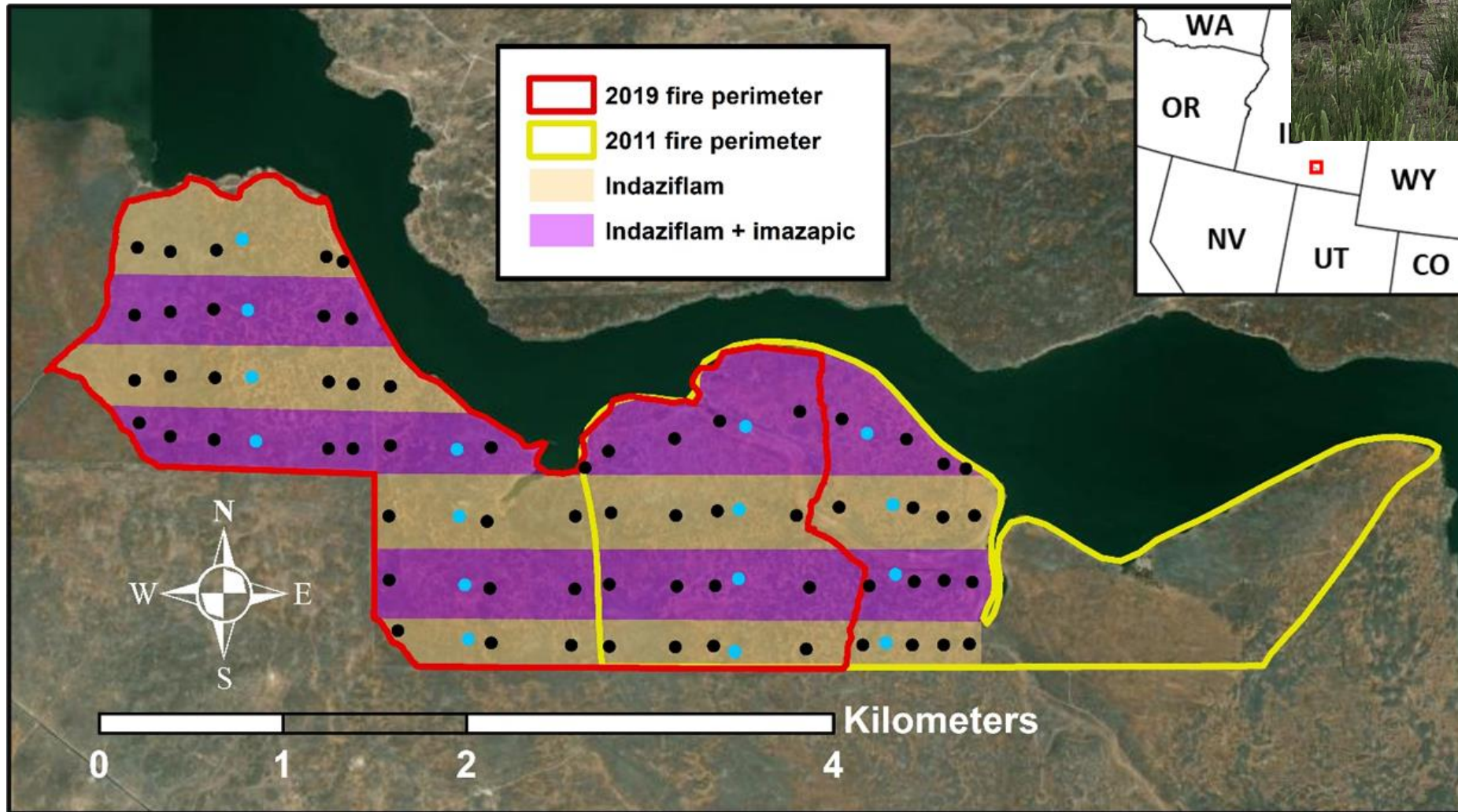
The screenshot shows the website <https://greatbasinfirescience.org/tools-trainings/>. The header features the Great Basin Fire Science Exchange logo and a search bar. The navigation menu includes Home, Events & Webinars, Research & Publications, Tools & Trainings, Funding, and About. The main content area is titled 'Tools and Trainings' and includes an 'Icon Key' button. A tool card for 'Landscape Explorer' is visible, featuring an icon of a gear and a magnifying glass. The card text reads: 'Landscape Explorer', 'Access tool.', 'Explore past and present landscapes from the Great Plains to the Pacific coast. This easy-to-use map uses historic and current aerial imagery to highlight how our landscapes have changed since the mid-20th century and how we can conserve our natural heritage.', and 'Uses of the tool highlighted by Intermountain West Joint Venture.' To the right of the tool card is a 'Narrow your search' section with dropdown menus for 'Resource Types' and 'Topic'.

- Monsen et al. 2004, 3 volumes
- Native forb restoration manual
- Fire info links
- USGS SampleRange
- Oregon Monitoring program

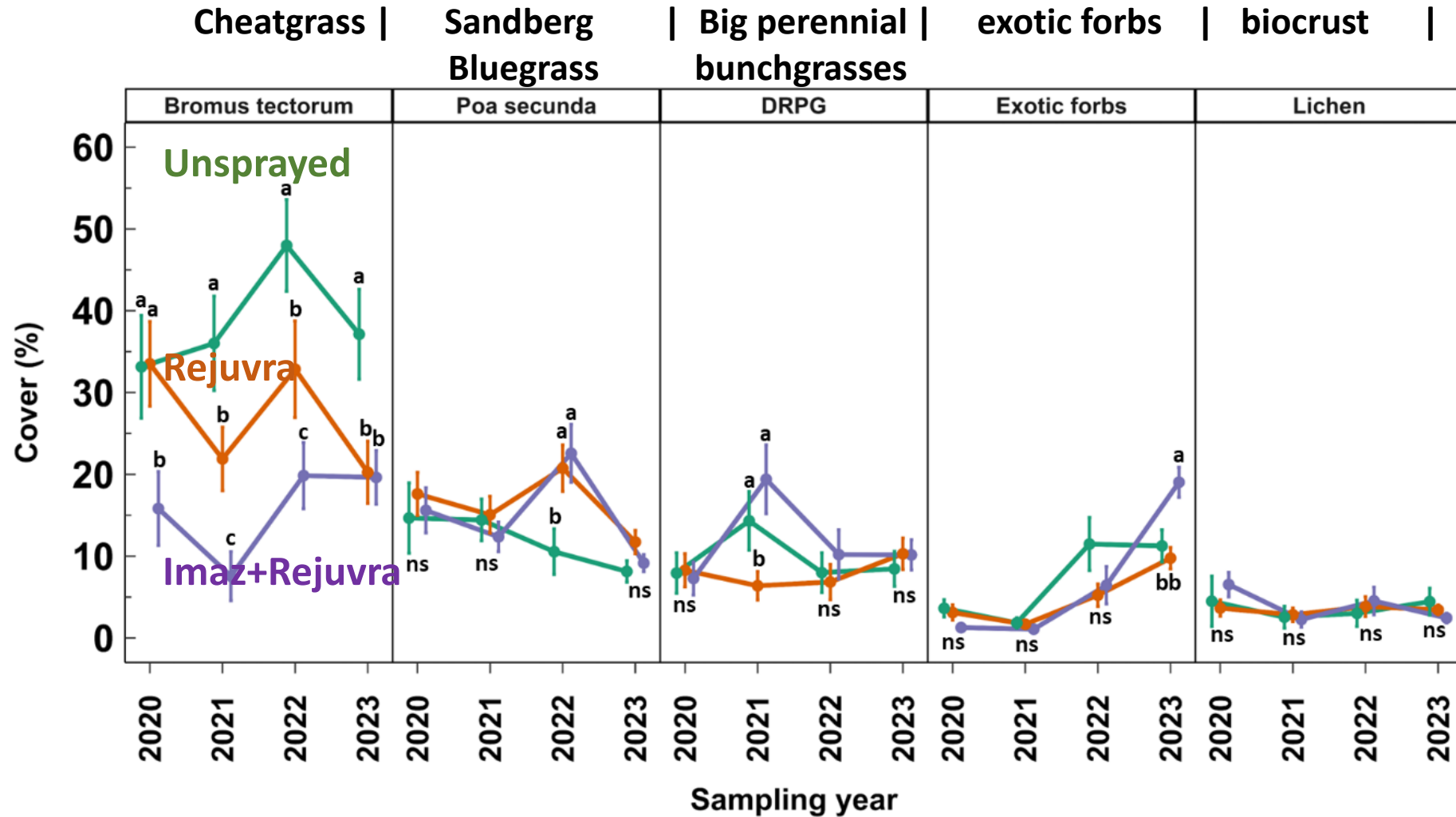
Some real and relevant examples



Minidoka NWR:

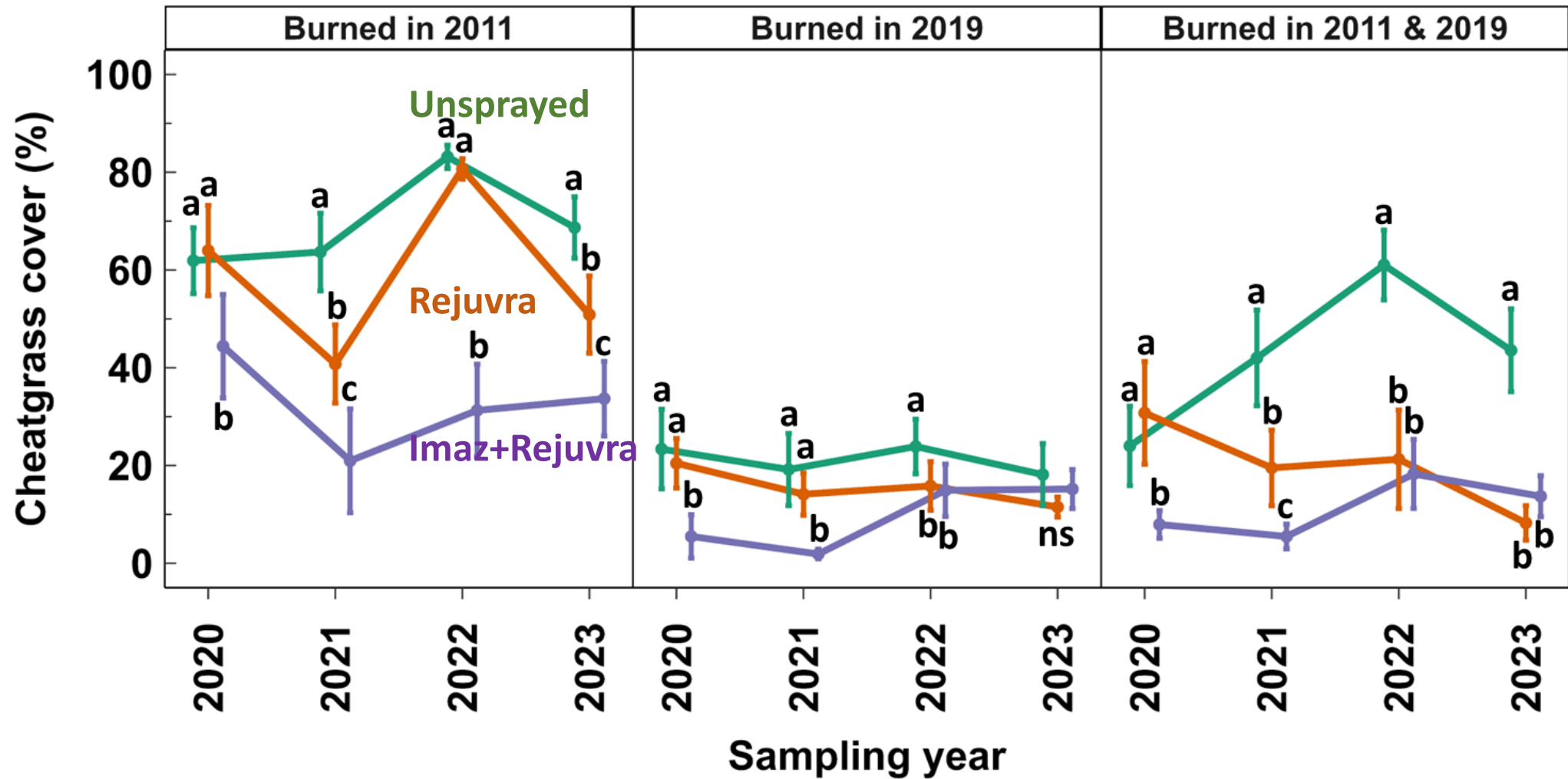


Minidoka NWR, Kluender et al. In review.



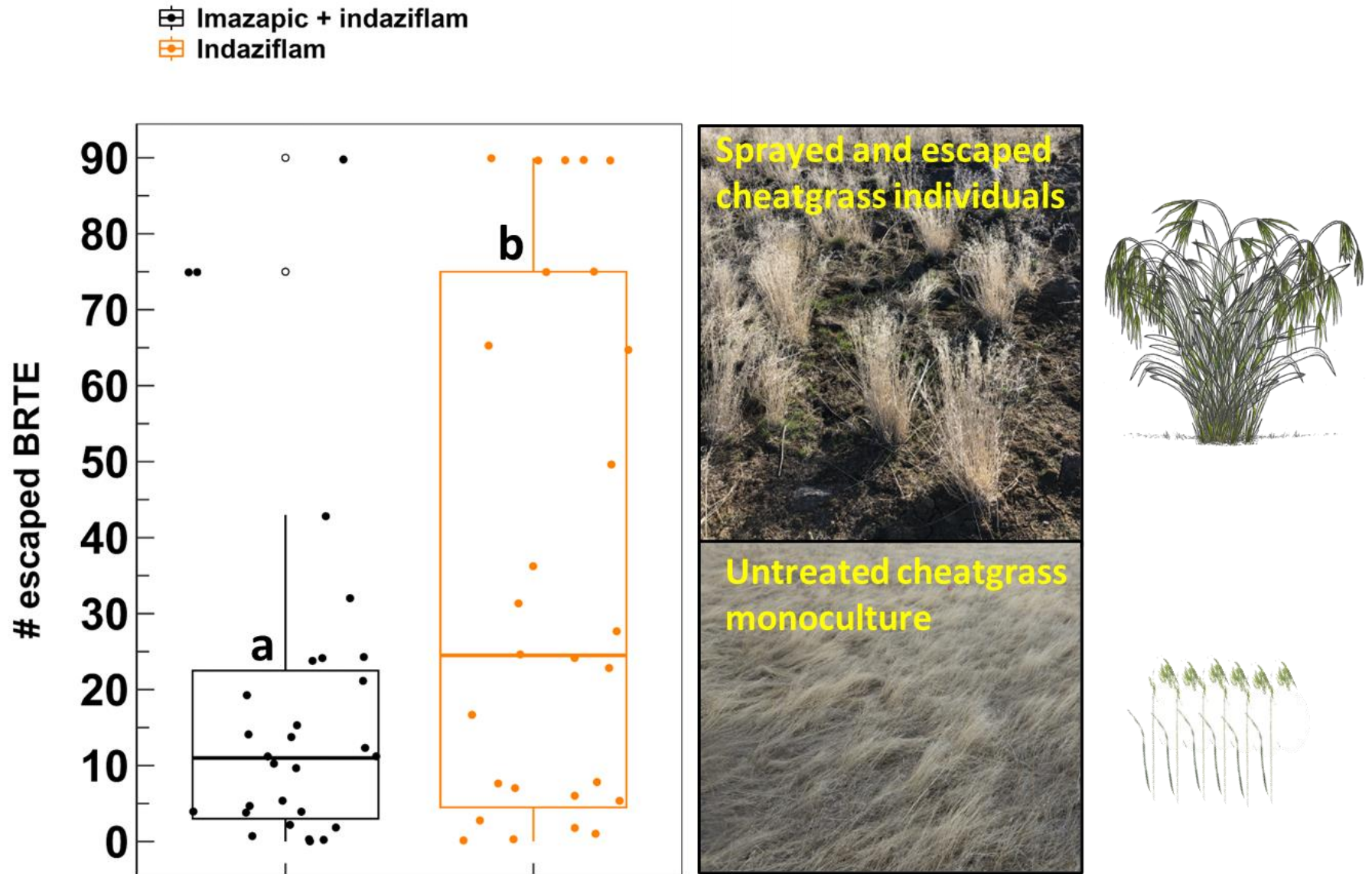
This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.

Minidoka NWR: Treatments exemplify **variability** and need for adaptive & programmatic attack.



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Minidoka NWR:

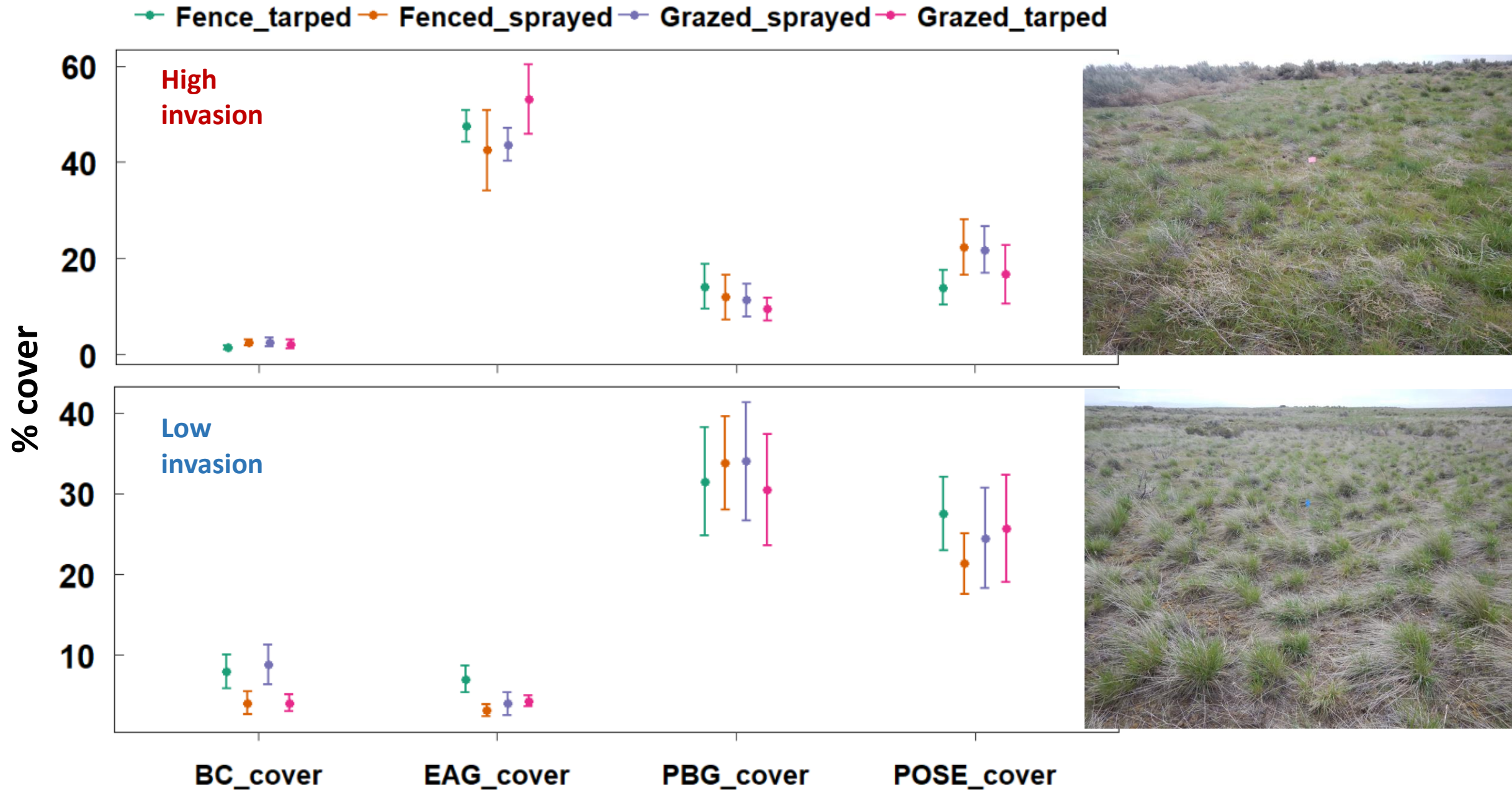


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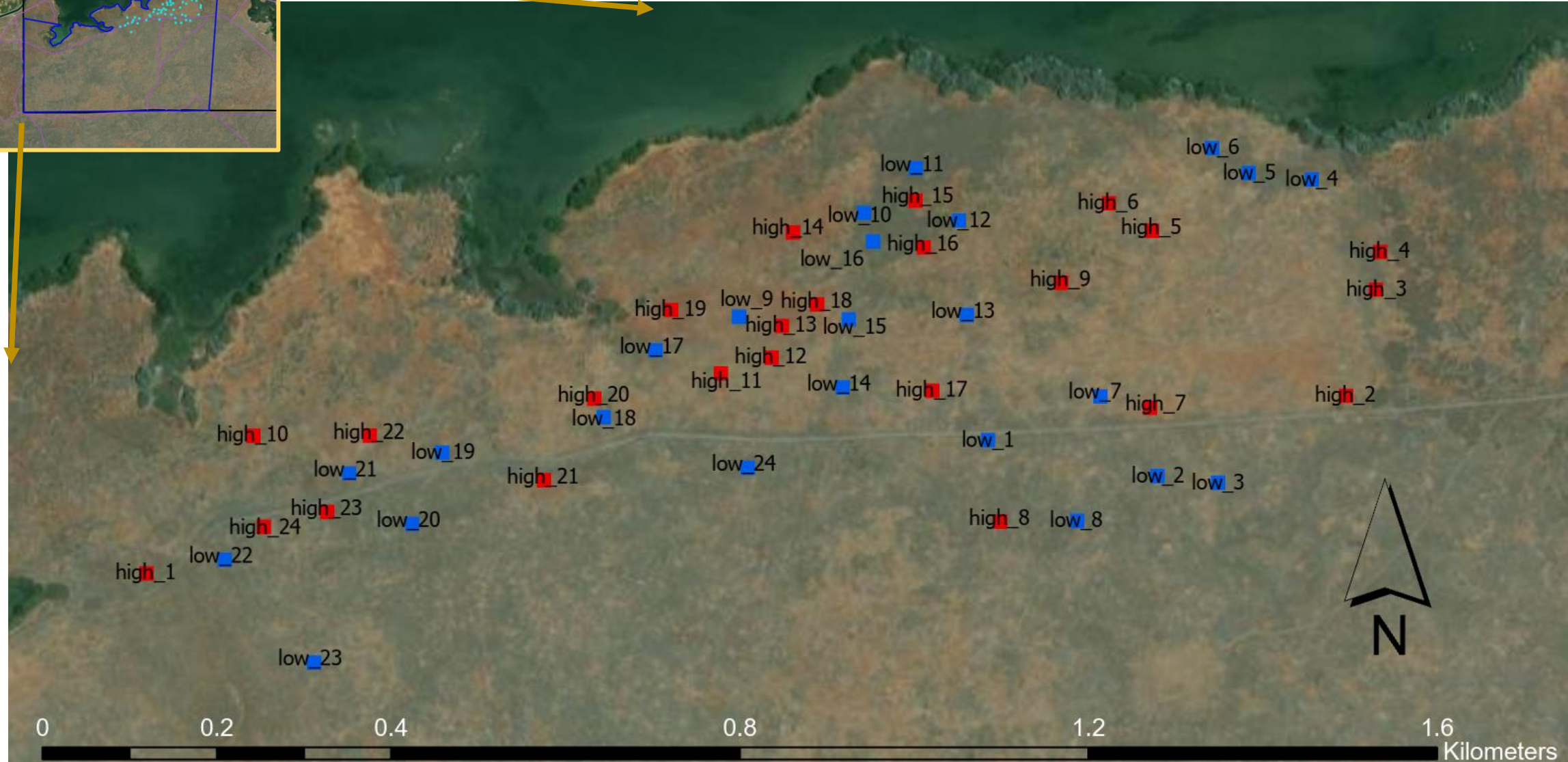


Minidoka NWR, phase II, improving Rejuvra treatment effectiveness



Minidoka NWR: new layout for grazing X herbicide study

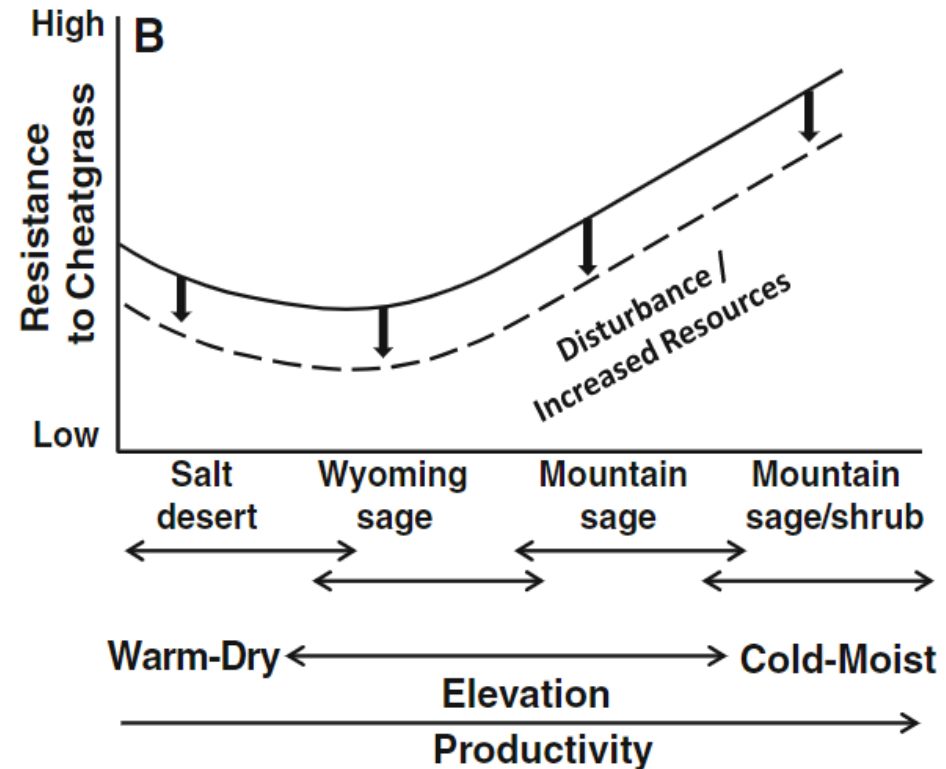
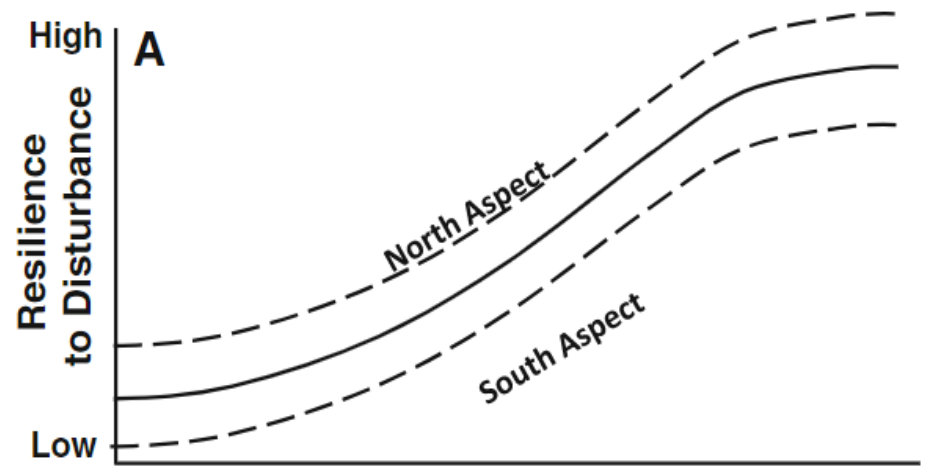
**FINAL PLOT LOCATIONS – 20m² square
buffer around each plot center**



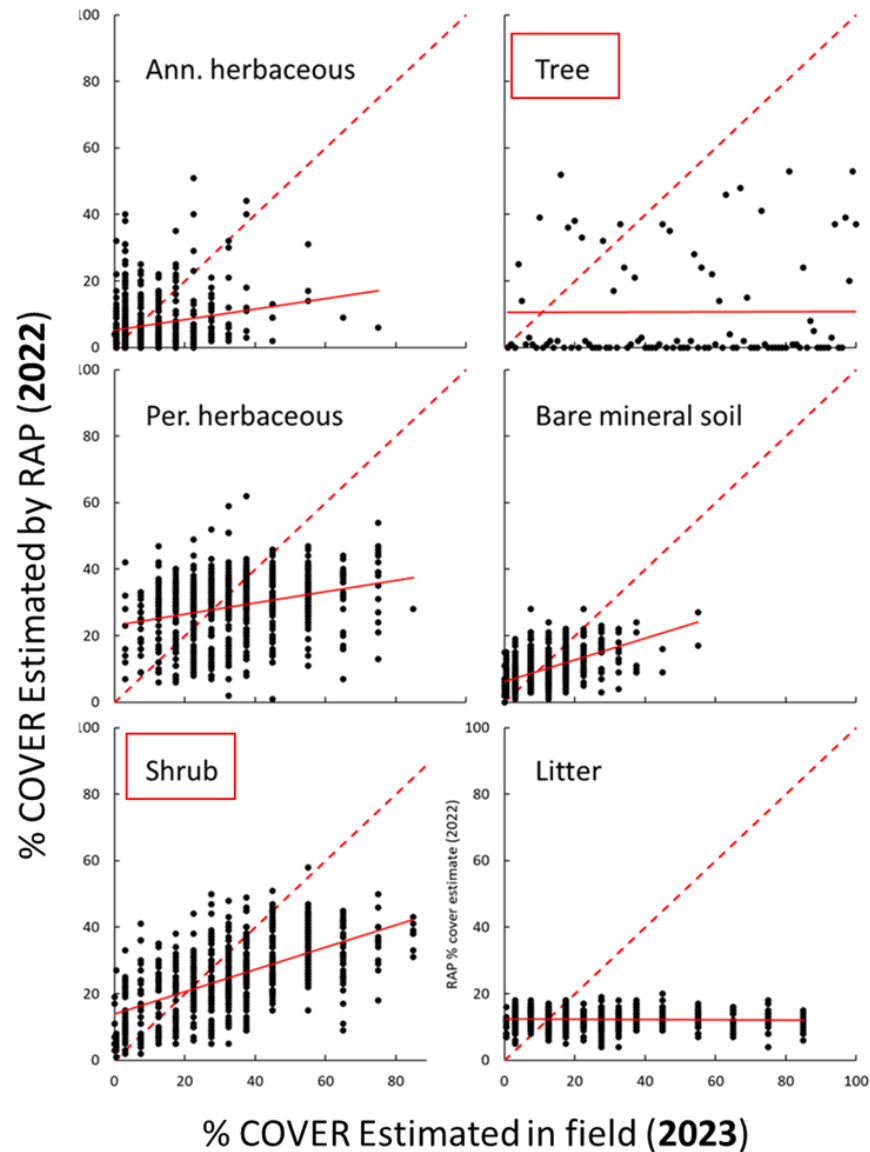
Resilience to Stress and Disturbance, and Resistance to *Bromus tectorum* L. Invasion in Cold Desert Shrublands of Western North America

Jeanne C. Chambers,^{1*} Bethany A. Bradley,² Cynthia S. Brown,³
Carla D'Antonio,⁴ Matthew J. Germino,⁵ James B. Grace,⁶
Stuart P. Hardegree,⁷ Richard F. Miller,⁸ and David A. Pyke⁹

- History of mixed success of restoration points to prioritization need
- Broadscale guidance on prioritization of treatments is climate-based



Reliability of RAP's vegetation cover maps": Craters of the Moon



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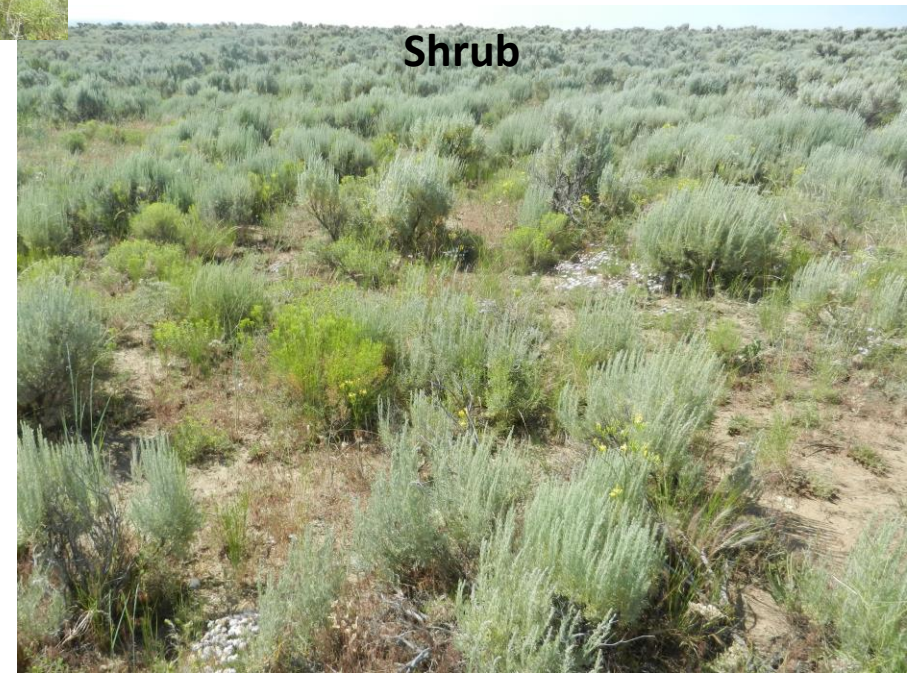
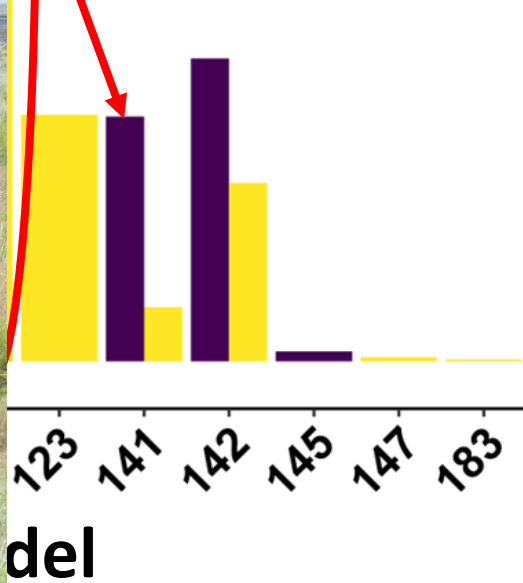
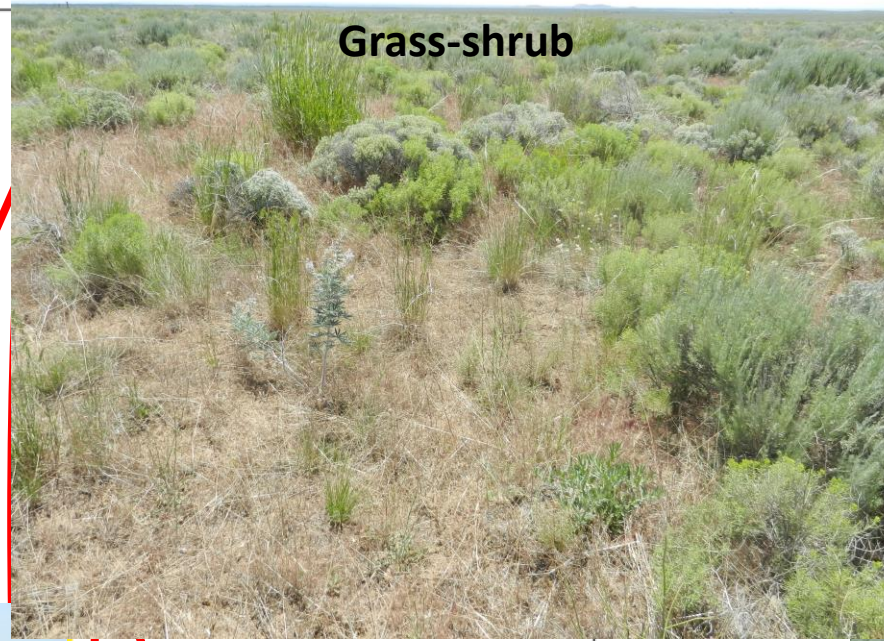
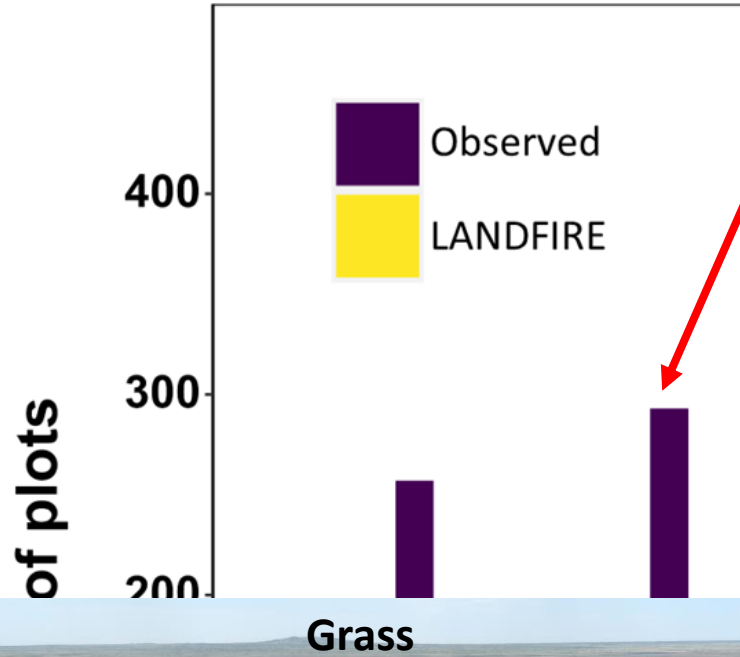


How do accuracy and model agreement vary with versioning, scale, and landscape heterogeneity for satellite-derived vegetation maps in sagebrush steppe?

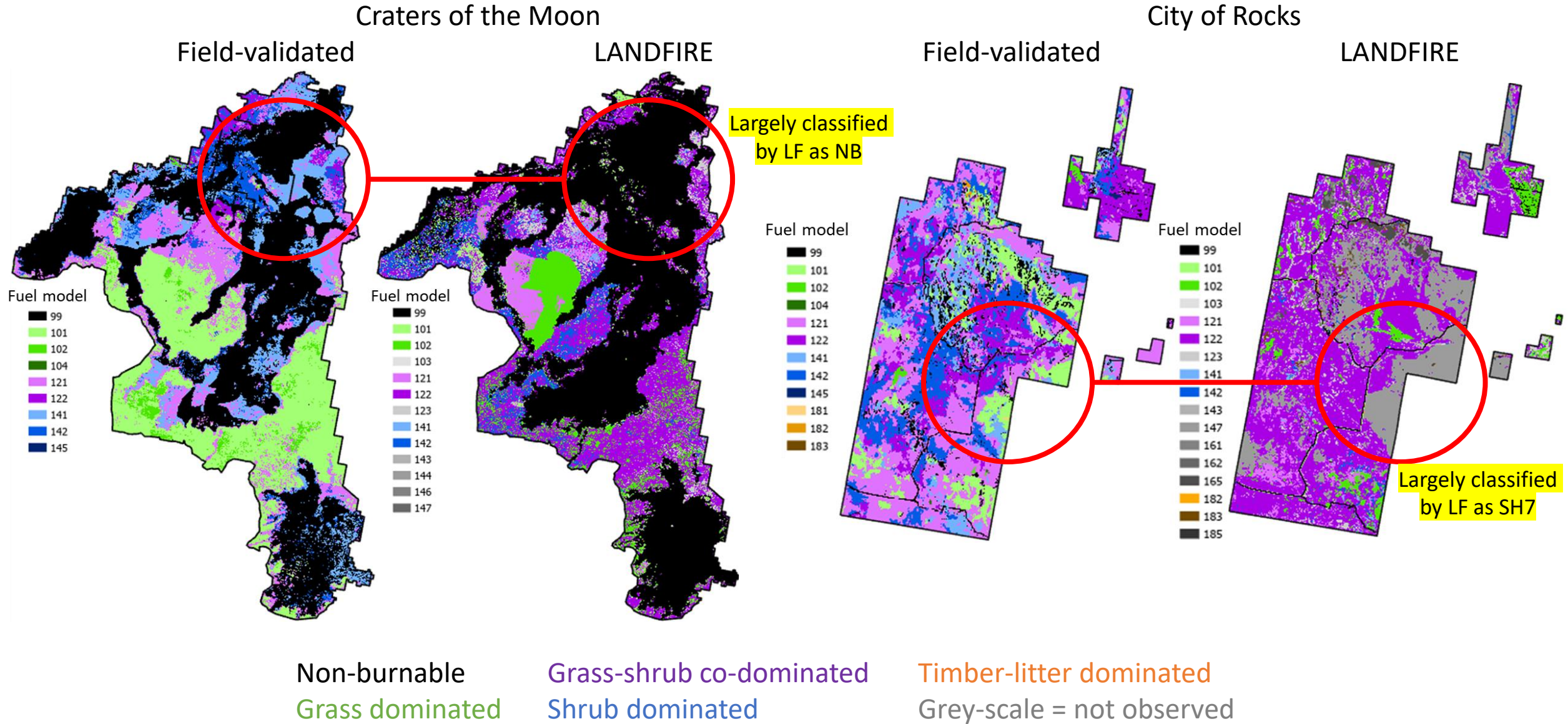
[Cara Applestein](#)  , [Matthew J. Germino](#)

Disagreement between LANDFIRE and field observations

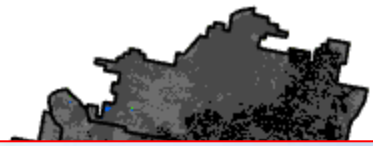
ters of the Moon



Field vs. LANDFIRE: disagreement in spatial layout of fuels models



Applying what was learned: treatment options for EAGs



PBG cover	Area (ha)
≤ 10%	159



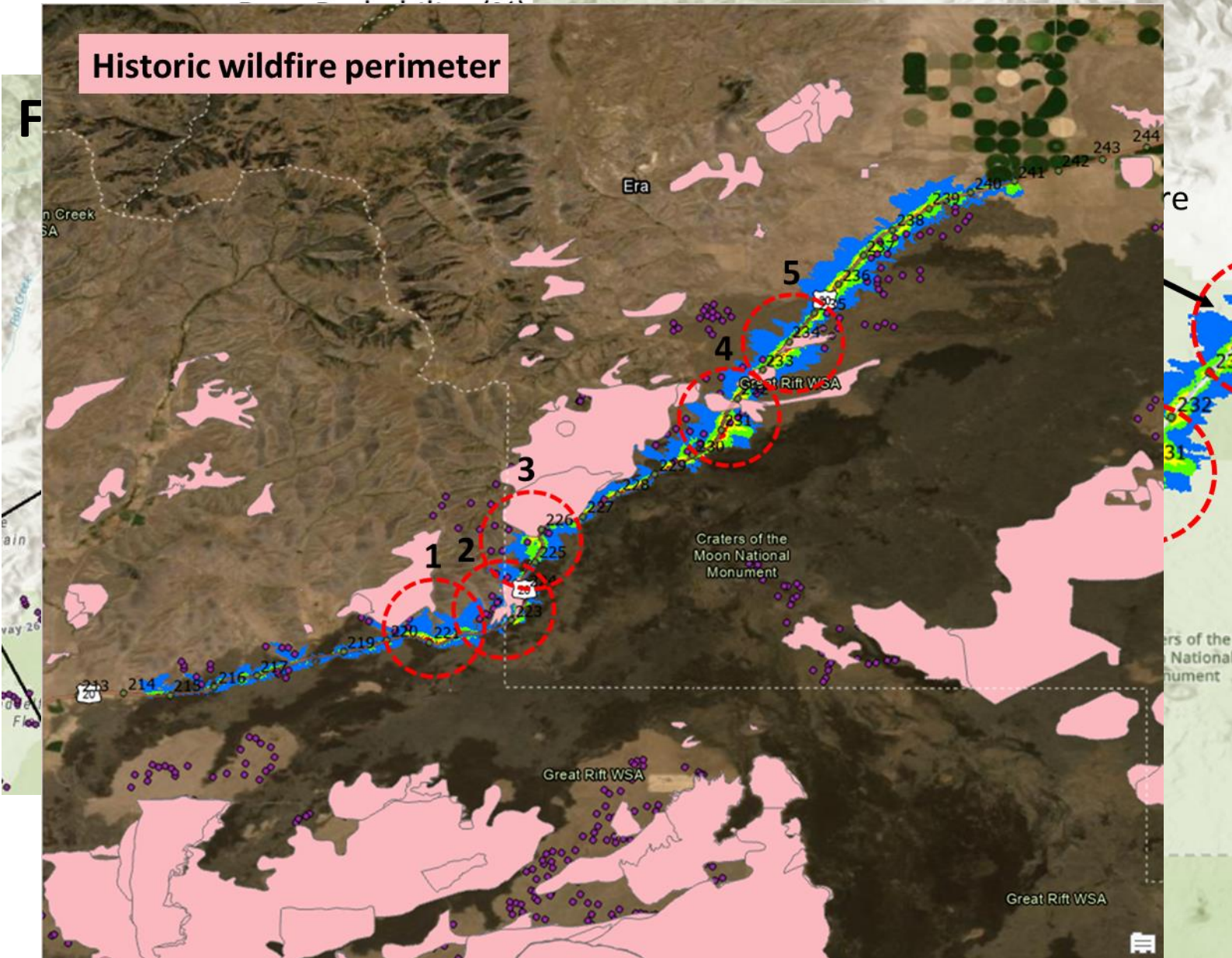
CRMO_10_50, EAG 32.5, PBG 17.5, shrub 15



CRMO_10_63, EAG 32.5, PBG 17.5, shrub 27.5



Applying what was learned: reliably identifying risk



BEST DIGITAL RESOURCE FOR TREATMENTS FOR ANNUAL GRASSES AND PERENNIALS IN SAGEBRUSH STEPPE= emails and phone numbers
mgermino@usgs.gov

