

Floodplain response 14 years after invasive removal in Canyon de Chelly National Monument, AZ



Colorado
State
University

Lindsay Reynolds

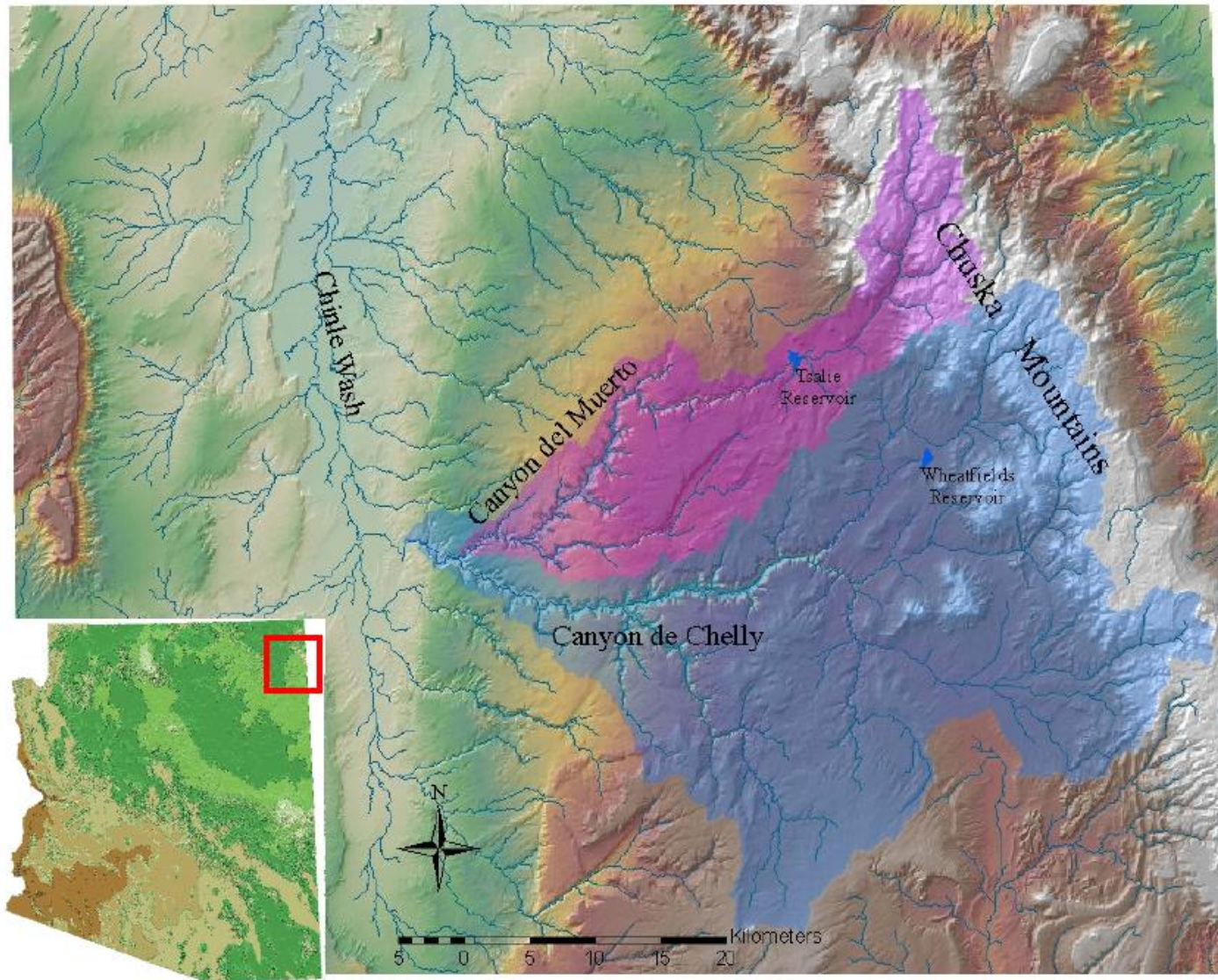
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Canyon de Chelly, Arizona

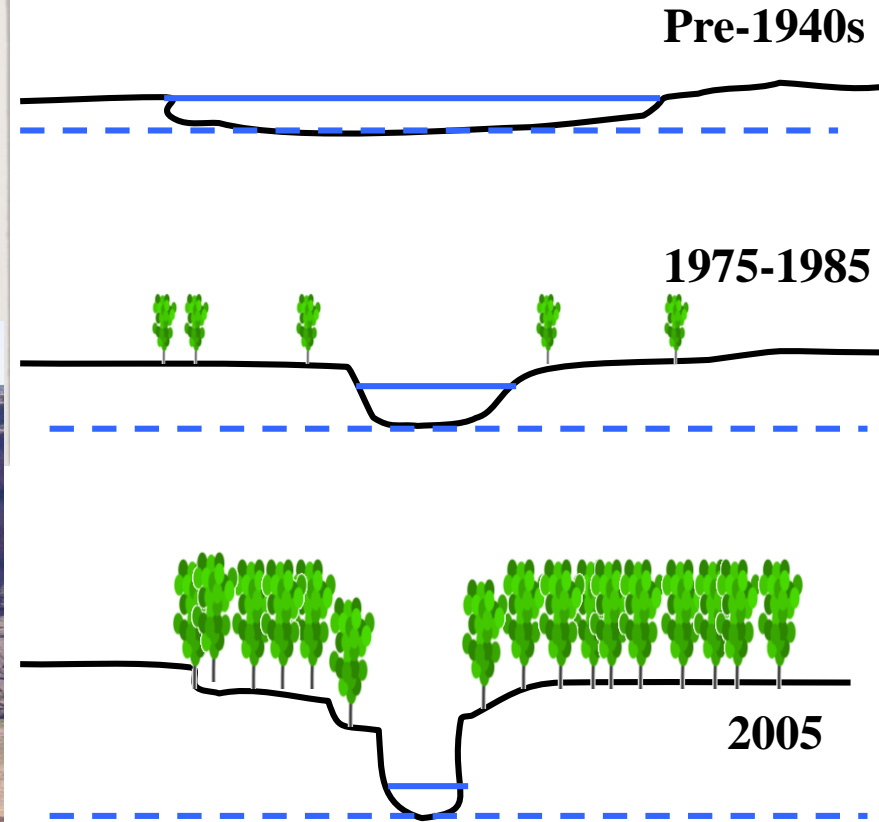
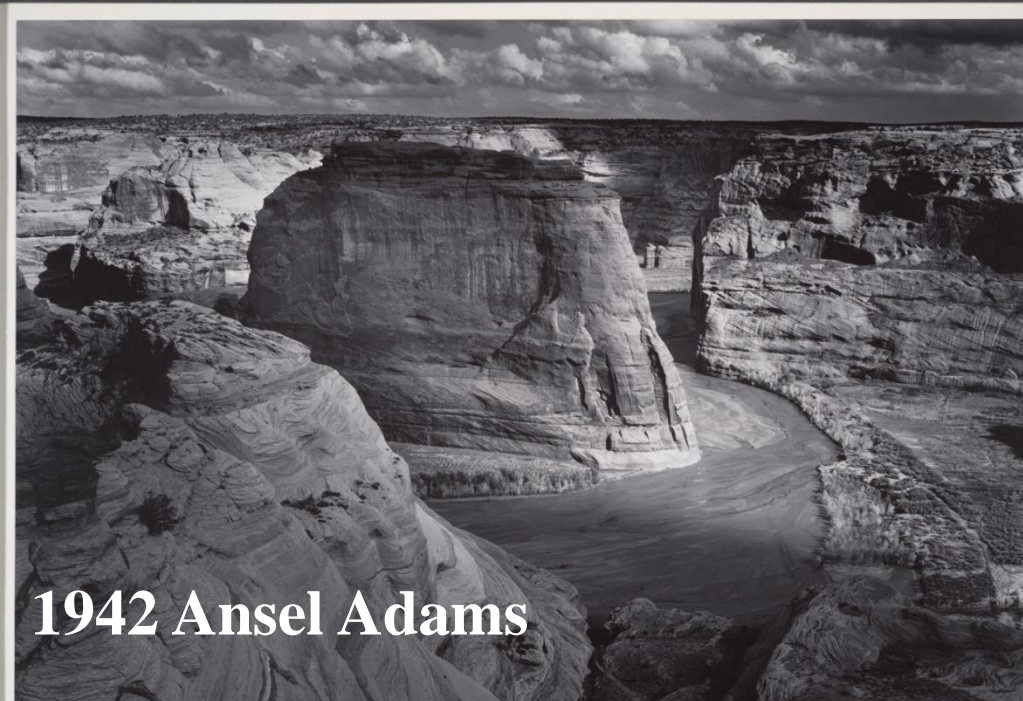


Historic canyon land use

- Farming
 - Fruit and grains
- Grazing
- Residence
- Navajo and Hopi ceremonial sites



Floodplain changes 1930s-2005



*Native cottonwood, exotic tamarisk
and Russian olive riparian forest

Tamarisk and Russian olive

Tamarix ramosissima Ledebour,
T. chinensis Loureiro,
T. pentandra Karst,
and hybrids of these taxa

Elaeagnus angustifolia L.
(Russian olive)



Canyon de Chelly restoration

- National Park Service interest
 - Watershed restoration
 - Viewshed restoration
- Navajo interest
 - Historic farming practices
 - Viewshed restoration



Goals

1. History of invasion
2. Response to removal
 - Channel
 - Floodplain plant communities

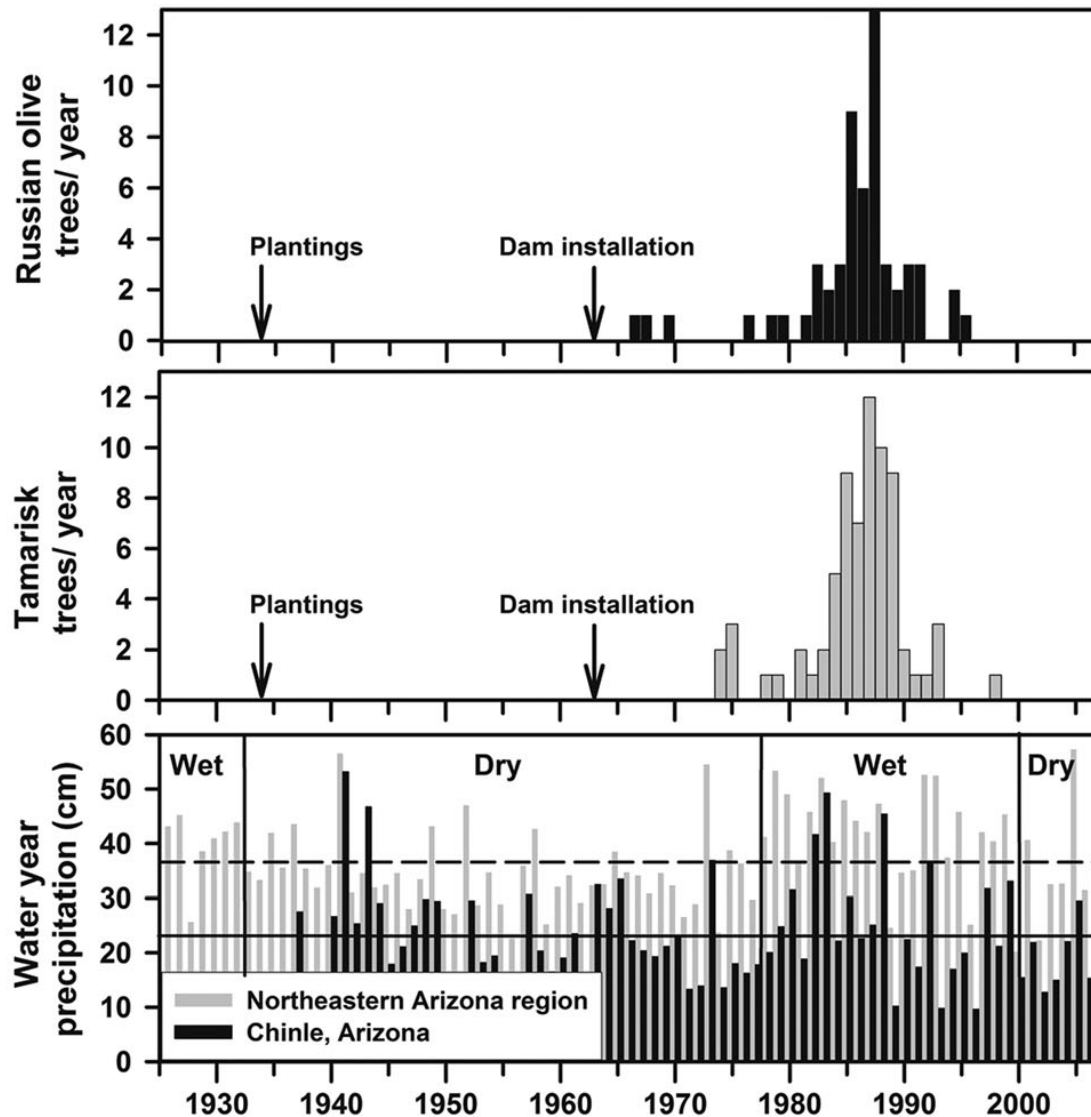


History of Invasion

- Extract plants 2005-2006
- Slice, find germination points, and age plants
- Tree ring aging
- Climate reconstruction



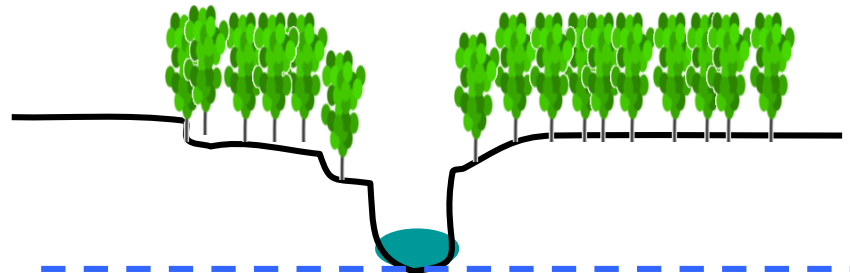
History of Invasion



Reynolds, L.V., Cooper, D.J. and Hobbs, N.T. (2014), Driver of riparian tree invasion on a desert stream. **River Research and Applications**, 30: 60-70. doi:[10.1002/rra.2619](https://doi.org/10.1002/rra.2619)

History of Invasion

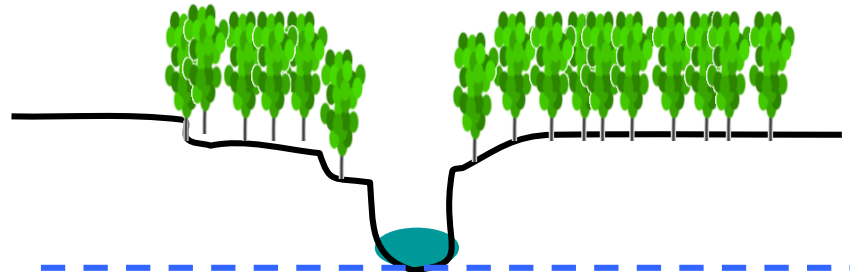
- 1980s: Wide-spread invasion (late! – compared to region)
 - Invasion occurred on an active floodplain that then was abandoned.
 - Establishment driven by wet years and interacted with channel change
 - Establishment facilitated channel change (incision)
- ~OR~
- Channel change (incision) facilitated seedling survival



History of Invasion

Cadol, D., Rathburn, S.L. and Cooper, D.J. (2011), Aerial photographic analysis of channel narrowing and vegetation expansion in Canyon De Chelly National Monument, Arizona, USA, 1935–2004. **River Research and Applications**, 27: 841-856. doi:[10.1002/rra.1399](https://doi.org/10.1002/rra.1399)

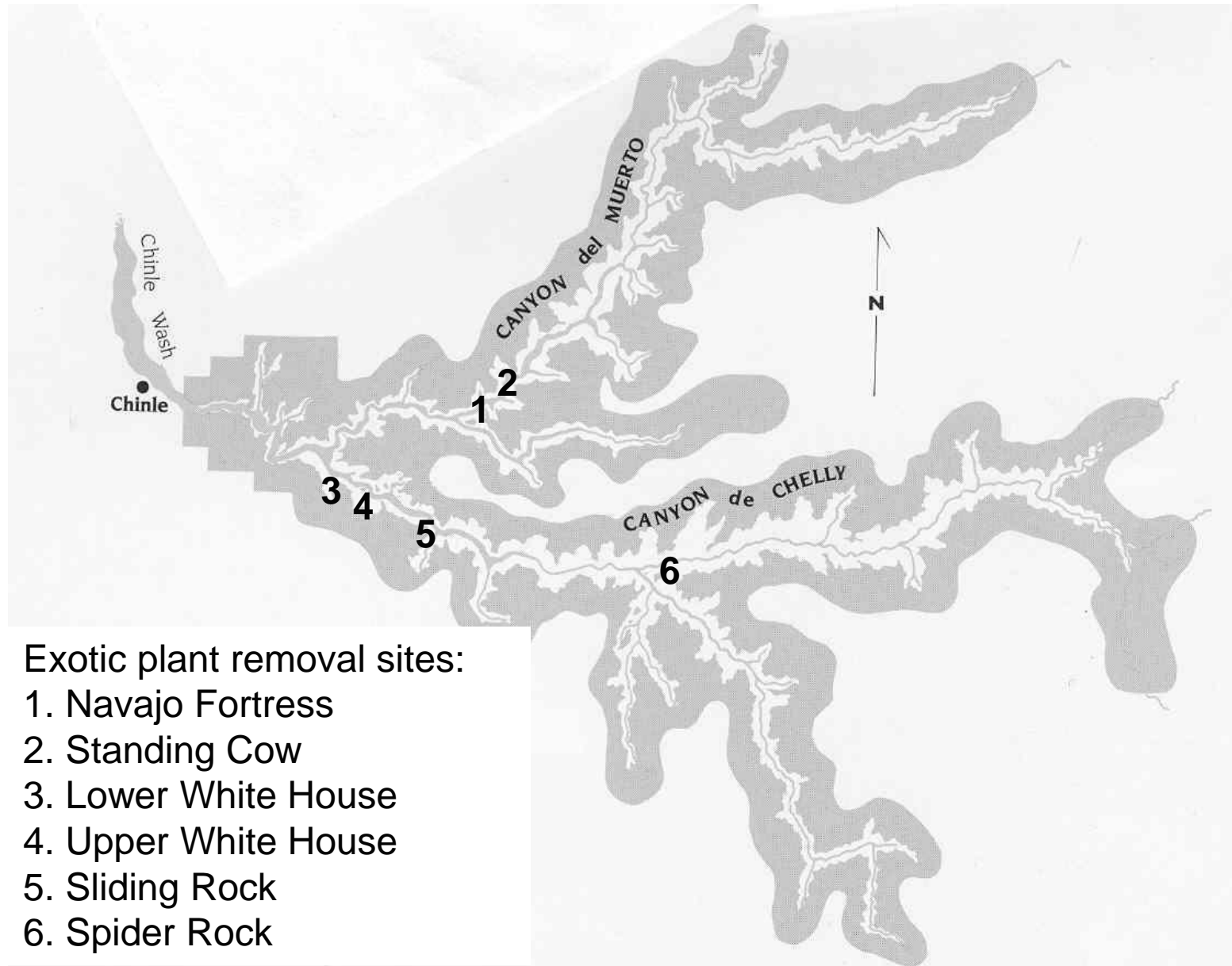
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2005



Study Sites

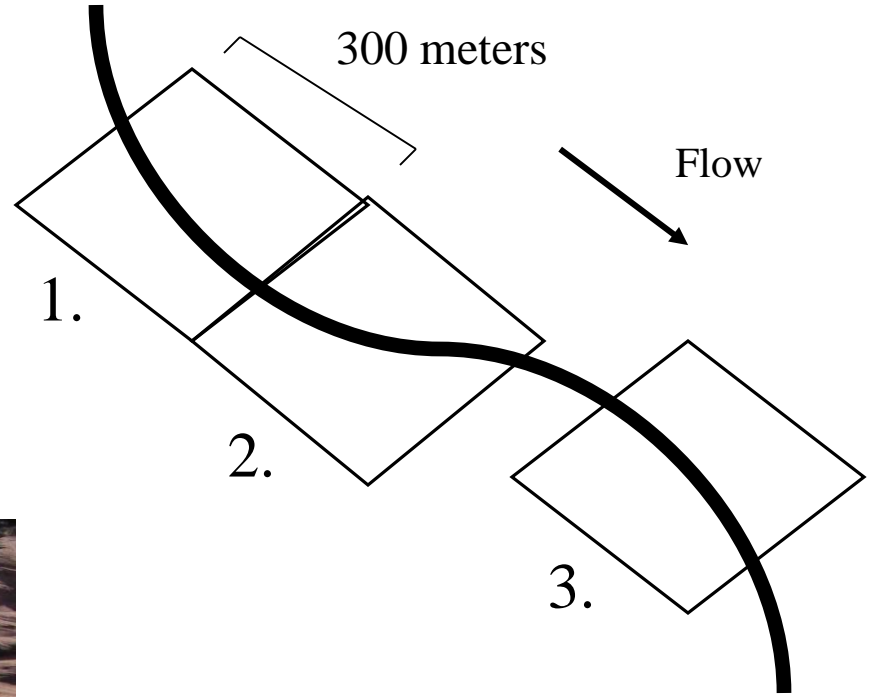


Exotic plant removal sites:

1. Navajo Fortress
2. Standing Cow
3. Lower White House
4. Upper White House
5. Sliding Rock
6. Spider Rock

Removal Sites

1. Control
2. Above-ground removal w/ herbicide
3. Whole plant removal

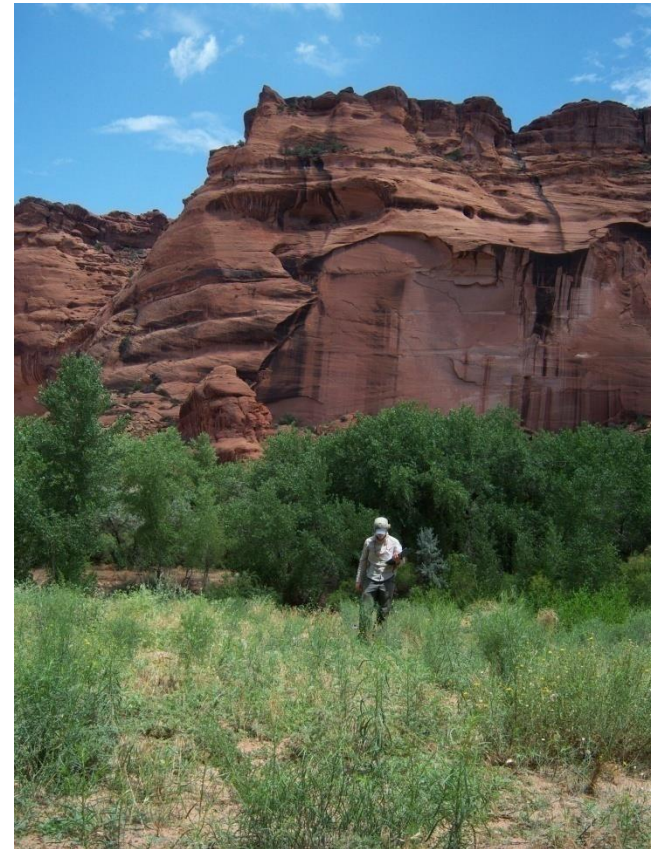


Removals 2005-2006

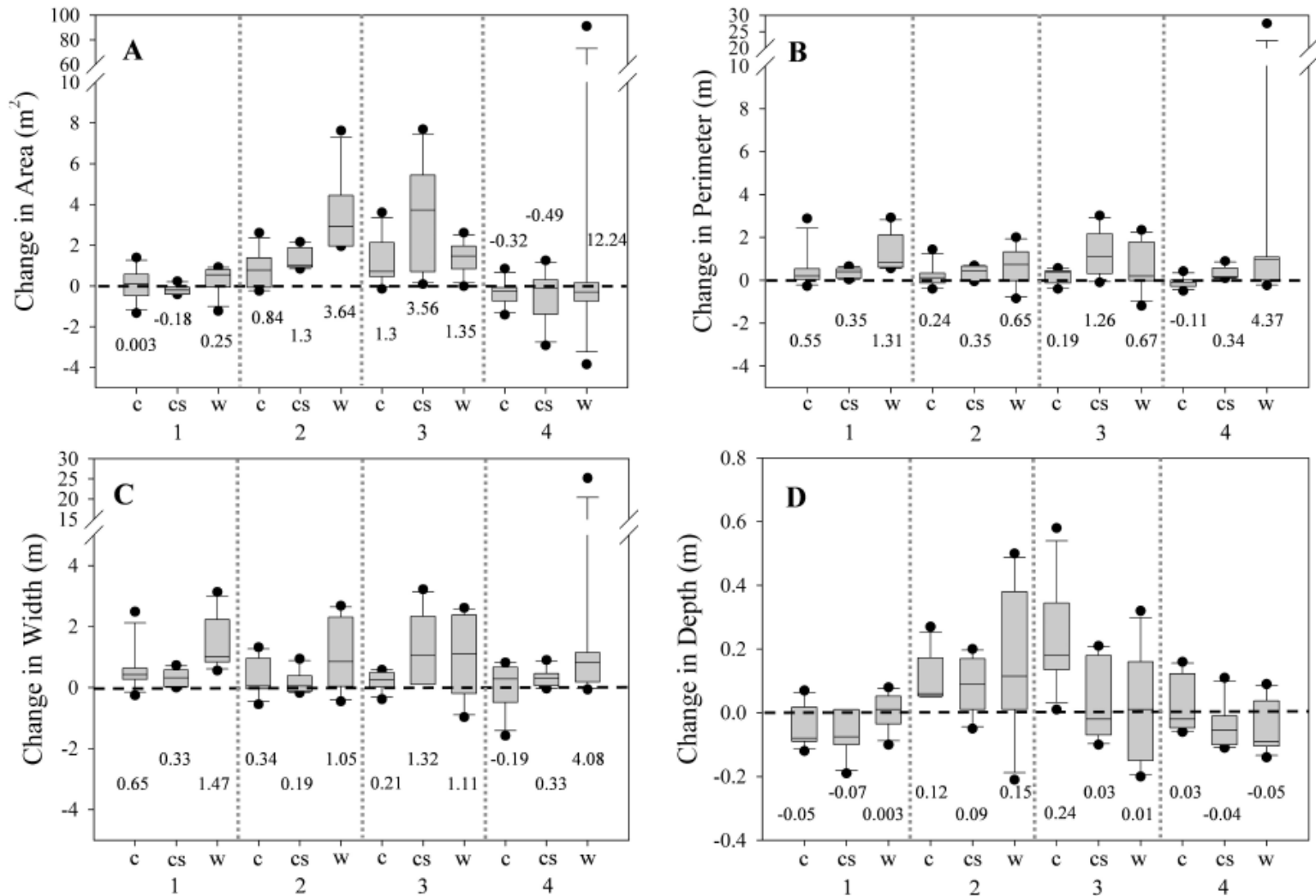


Response to invasive plant removal 2005-2019

- 1) How has the **stream channel** responded?
- 2) How do removal methods affect resulting **plant communities**?
(3 yrs and 14 yrs post treatment)

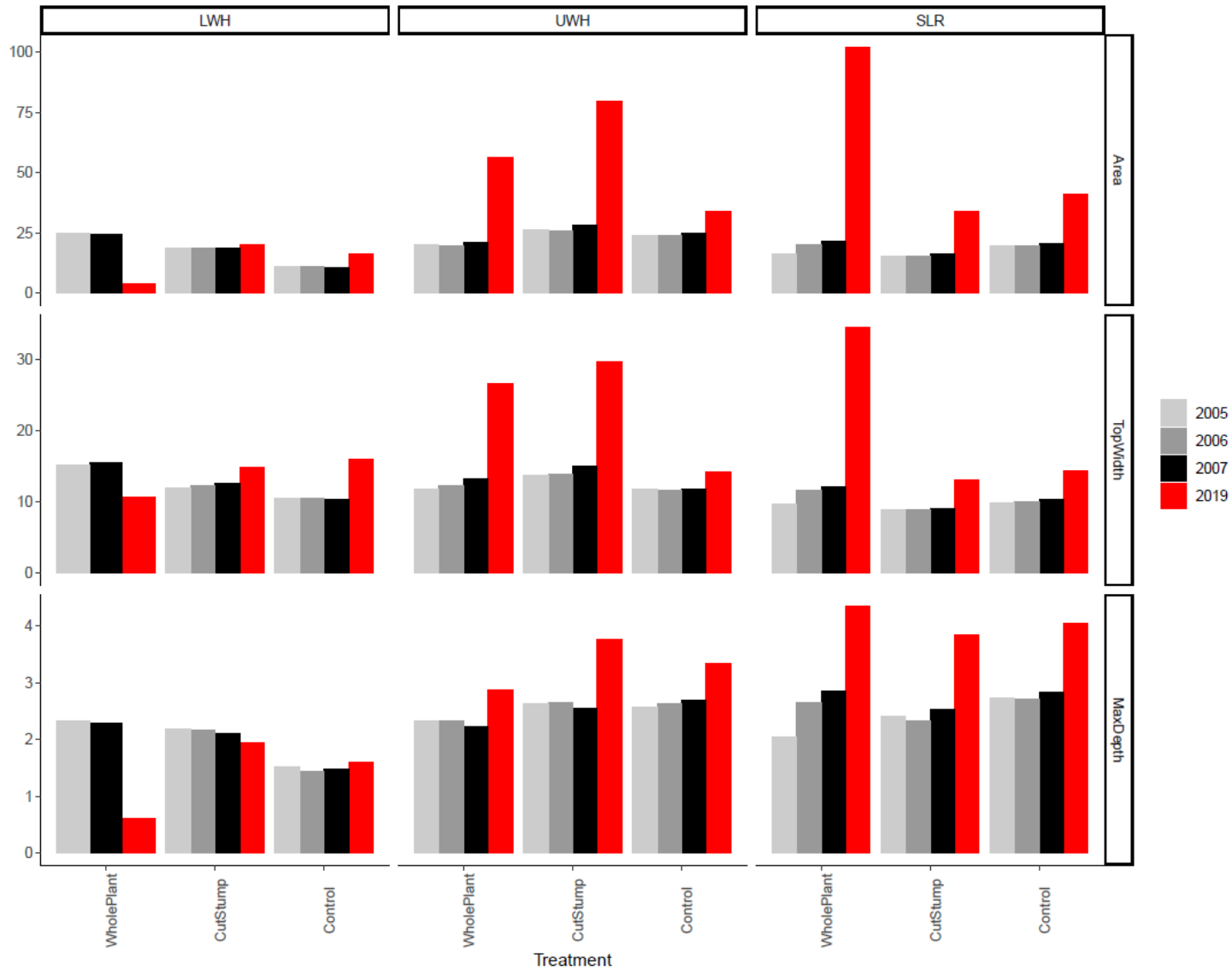


Channel form pre-post removal 2007



Jaeger, K. L., and E.E. Wohl. 2011. *Channel response in a semiarid stream to removal of tamarisk and Russian olive*, Water Resources Research, 47 (2). W02536, doi: 10.1029/2009WR008741

Channel form 2005-2019



Downstream



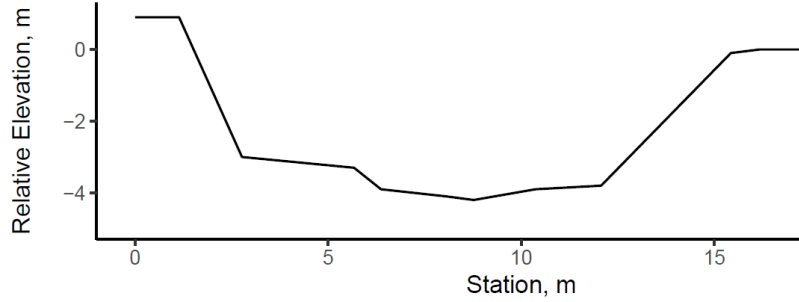
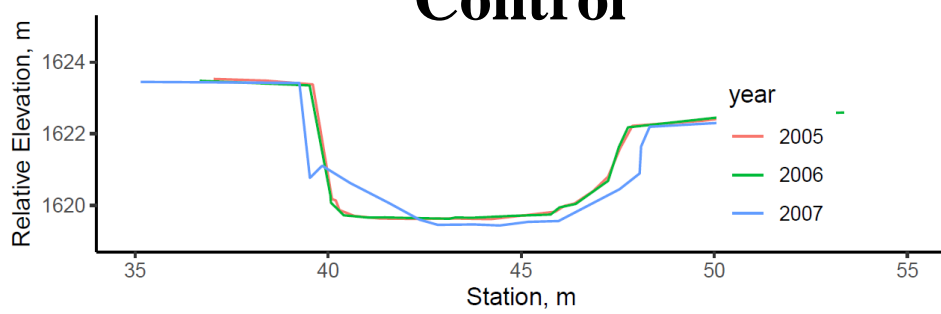
Upstream



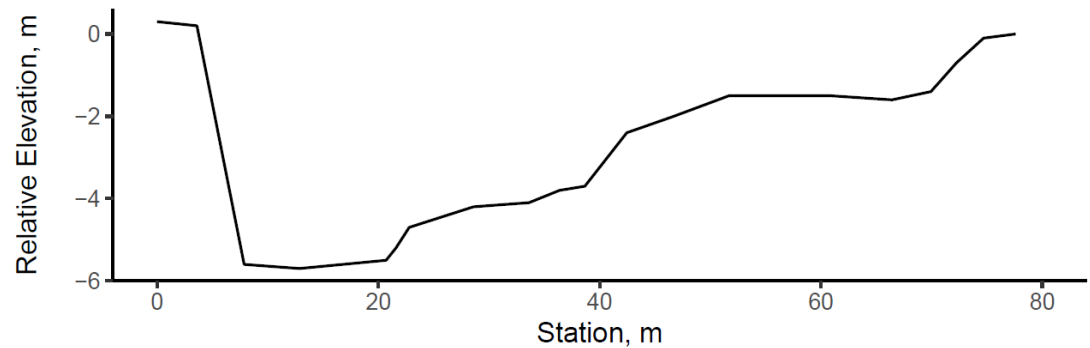
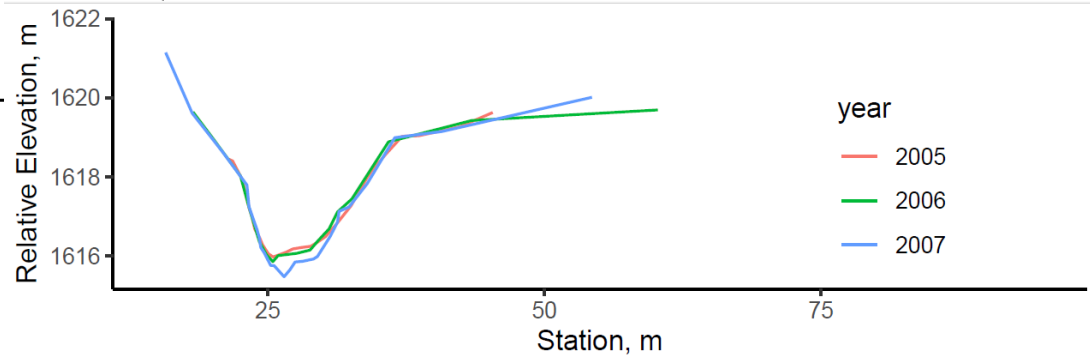
SLR 3.5
Looking
Downstream

Sliding Rock Site (clay)

Control



Whole plant removal



2019 - Lower White House Whole Plant Removal



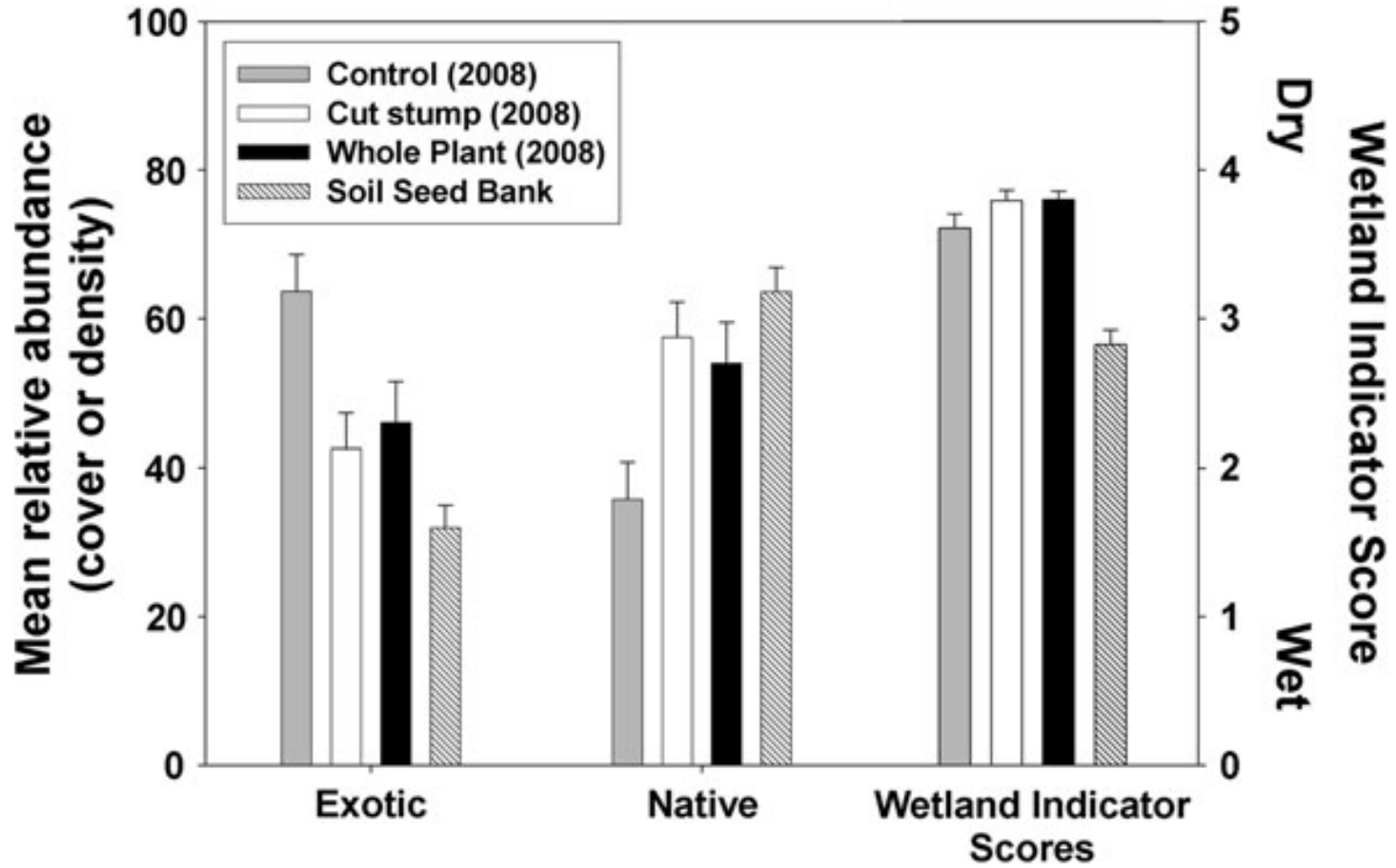
Response to invasive plant removal

Vegetation surveys:

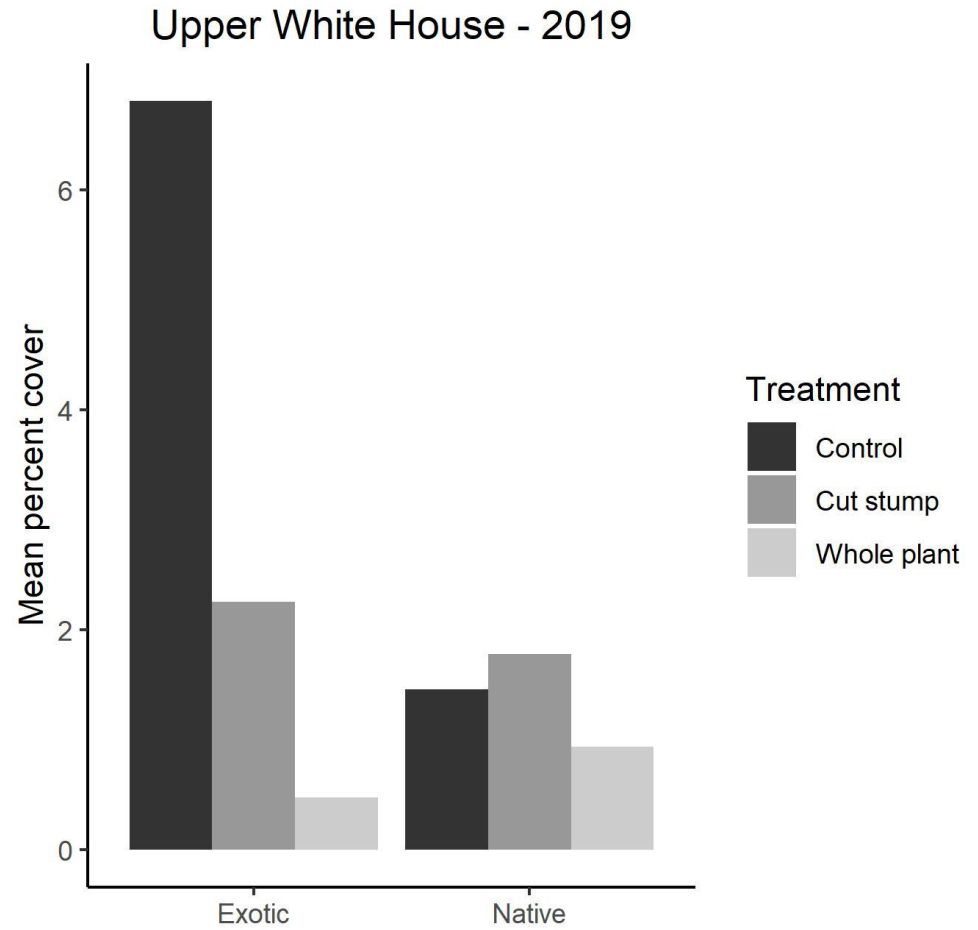
- Summer 2005, 06, 07, 08 and 2019



2008



2019 Upper White House site



Grazing is ongoing



Grazing exclosures, seed additions (2012)





(Ansel Adams, 1942)



(D. Cooper, 6.1.05)



(L. Reynolds, 9.27.06)



June 2015



July 2019



July 2019

Summary



1942

Ansel Adams



2005



2015

- **Tamarisk and Russian olive invasion was driven by:**
 - wet years, large floods -1980s
 - channel narrowing, channel incision – which caused which?
- **After invasive plant removal:**
 - Cohesive banks with clay and prior entrenchment facilitate further channel enlargement (including incision) and does not promote lateral movement: persistent entrenchment

Summary



1942

Ansel Adams



2005



2015

- **Where bank sediments are dominated by sand, widening and channel migration is happening, with sufficient flow**
- **Vegetation in removal sites is dominated by exotic grasses and forbs, return of native plant communities is limited.**
- **Seeding and grazing exclosure are facilitating native grass persistence**

Acknowledgements



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Questions?

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