



Riparian Vegetation Science & Management

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*Presenting

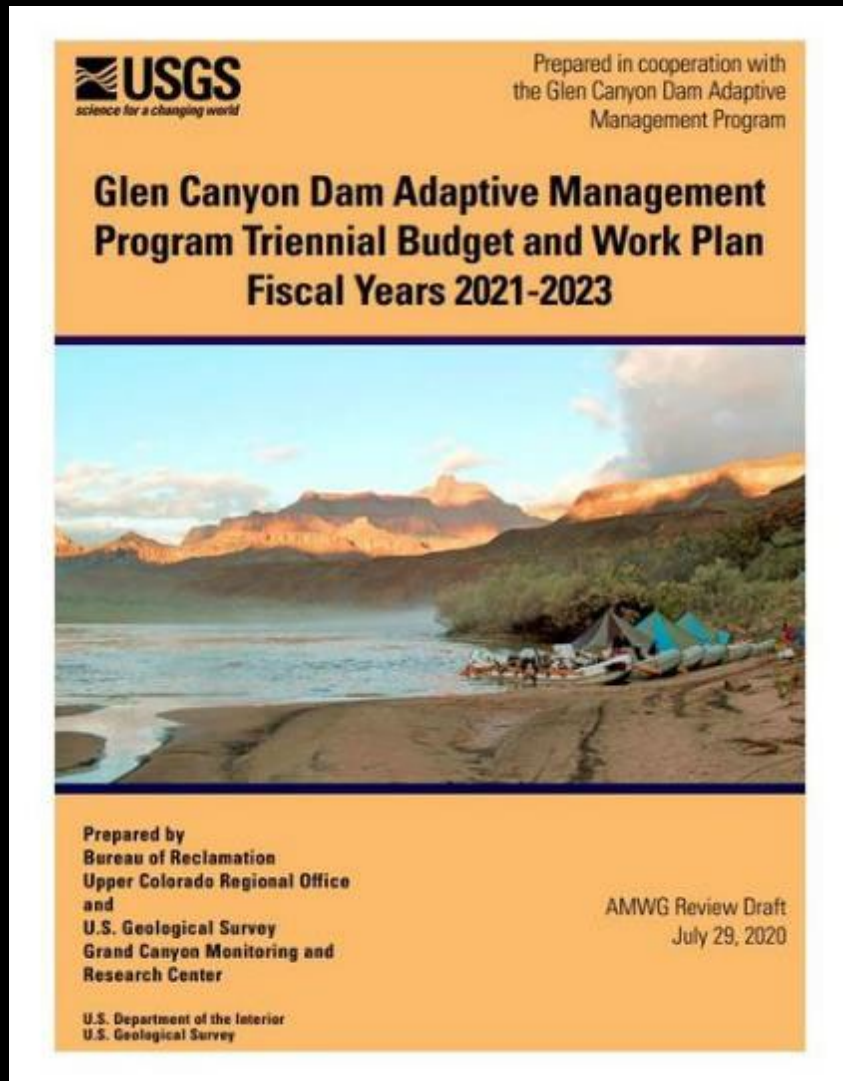




Riparian Vegetation Management, Monitoring, Research

- *LTEMP Goal 11. Riparian Vegetation. Maintain native vegetation and wildlife habitat, in various stages of maturity, such that they are diverse, healthy, productive, self-sustaining, and ecologically appropriate.*

Riparian Vegetation Science & Management 2021 - 2023



- Bureau of Reclamation Triennial Budget and Work Plan
 - C.7. – C.8. GRCA and GLCA Experimental Vegetation Treatment
 - Related Grand Canyon Wildlands Council work
- GCMRC Triennial Budget and Work Plan
 - Project C. Riparian Vegetation Monitoring and Research
 - Project D. Effects of Dam Operations and Vegetation Management for Archaeological Sites
 - Project L. Overflight Remote Sensing

BOR Project C.7. and
C.8. GRCA and GLCA
Experimental
Vegetation
Treatment



Control nonnative plant species affected by dam operations;
including tamarisk and other highly invasive species



Develop native plant materials for replanting through partnerships and the use of regional greenhouses

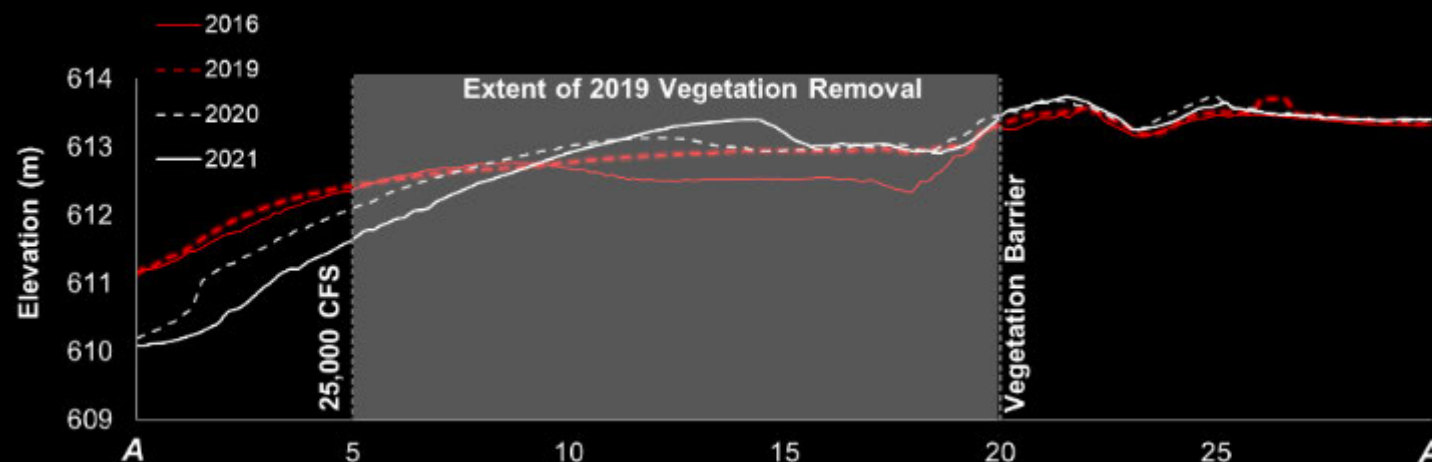
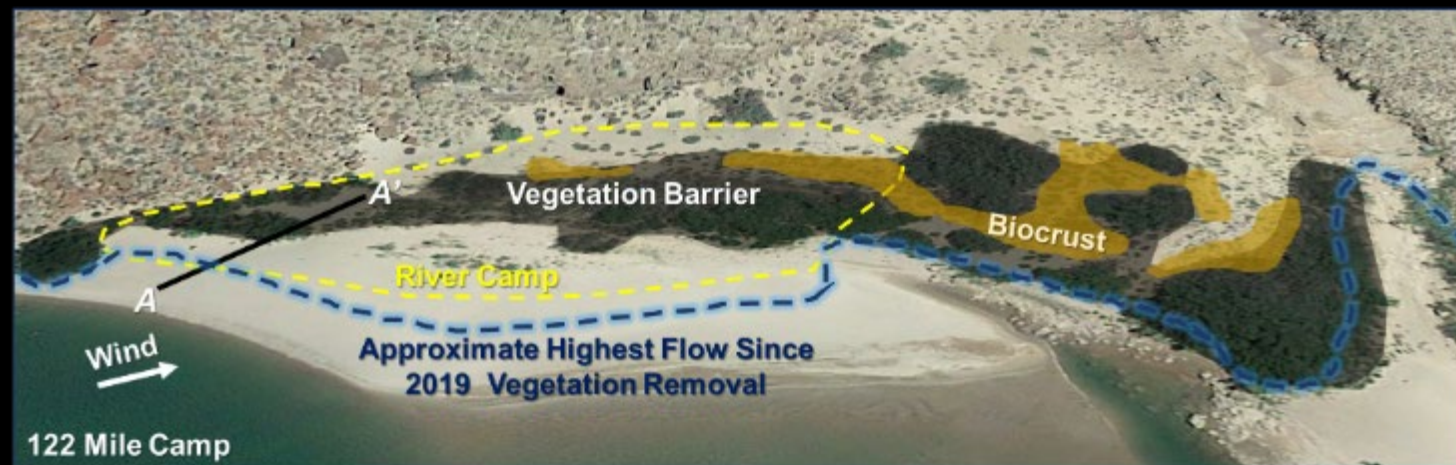
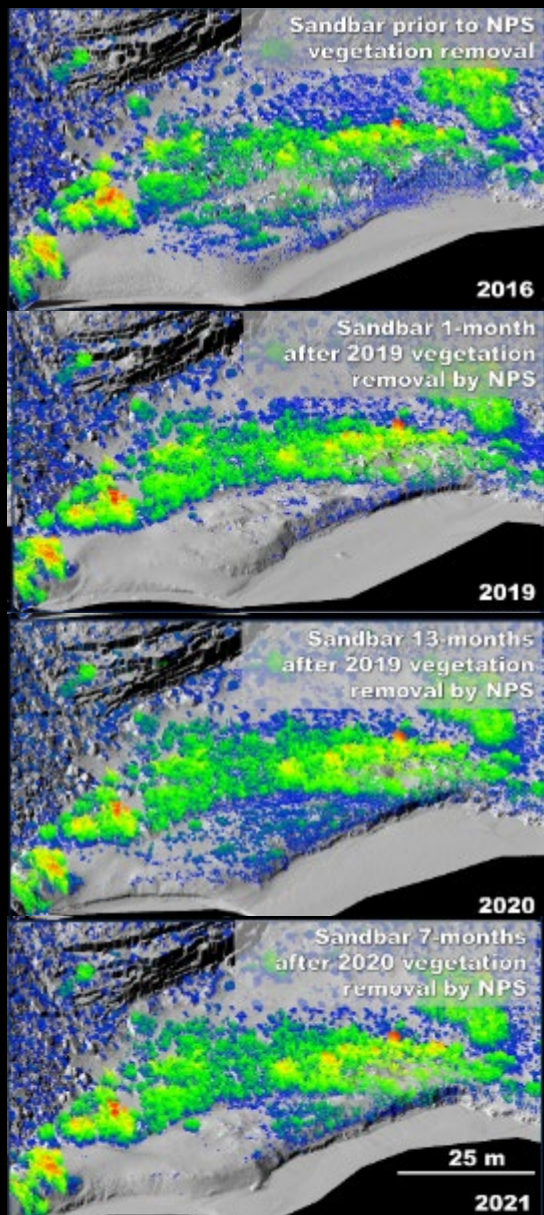




Remove vegetation encroaching on campsites



Preliminary Results: Effects of vegetation removal on campsite condition



Preliminary results, do not cite

Remove Vegetation Encroaching on Campsites and Manage vegetation to assist with cultural site protection

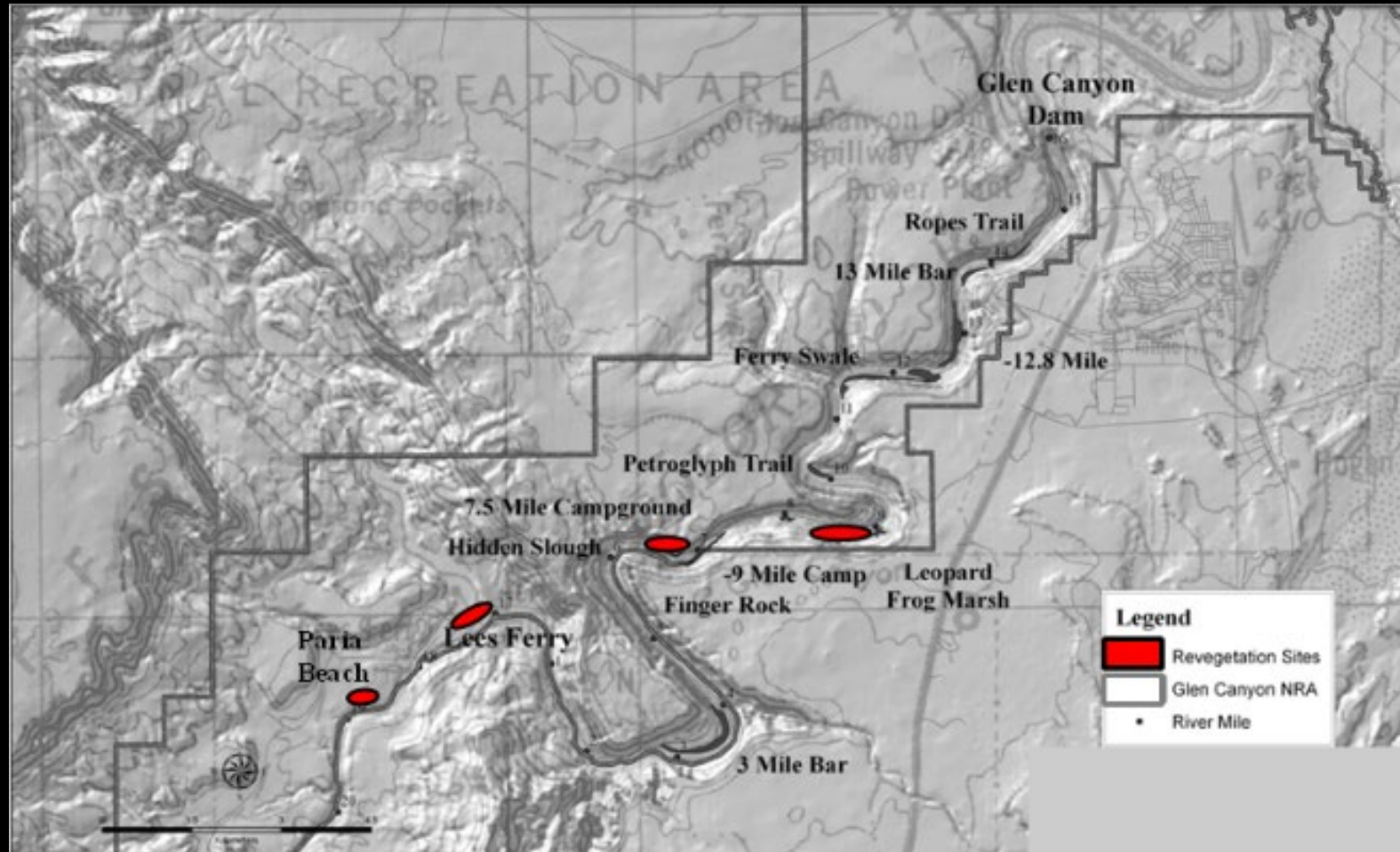
NPS has worked with USGS to conduct experimental vegetation removal treatments on sandbar campsites in Grand Canyon to increase the supply of HFE sediment via aeolian processes for in-situ preservation of archaeological sites in dunefields.

Initially Implemented: April 2019

Repeated: September 2020, October 2021, & 2022...



Riparian Habitat Restoration in Glen Canyon by Grand Canyon Wildlands Council, 2000-Present: Stevens, Burke, GLCA Staff



Lees Ferry Rehabilitation



- Plant diversity increased after second year, survivorship >75%
- Arrowweed and Sueda took over upper terraces
- Invertebrate diversity abundance increased in second year
- Reptile diversity and abundance increased in first year
- Bird diversity exceeded pre-treatment within 3 years
- Rodent abundance increased, but diversity remained low after 10 years





Hidden Slough (-6.5 R): Rehabilitation Success at a Remote Site



Cut Tamarisk by Hand,
Burn Slash,
Treat Cut Stems with
Herbicide

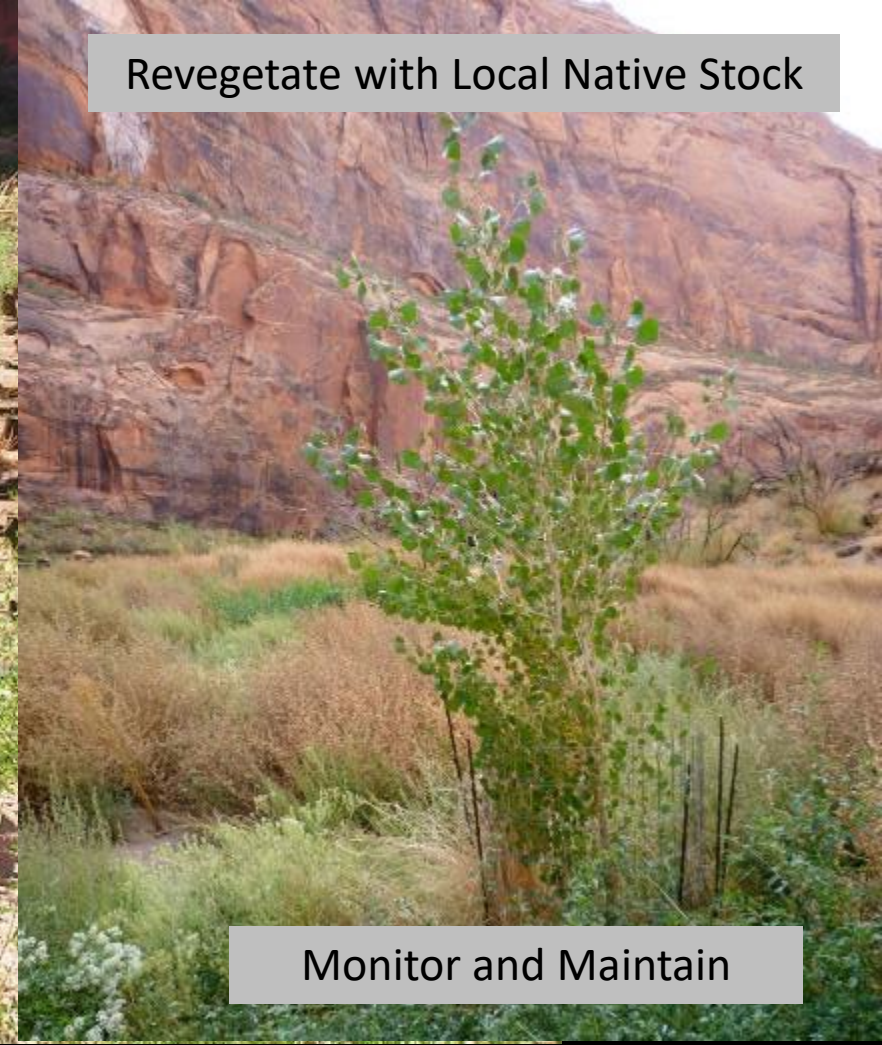


Rely on Tamarisk Leaf
Beetle to Prevent
Tamarisk Regrowth



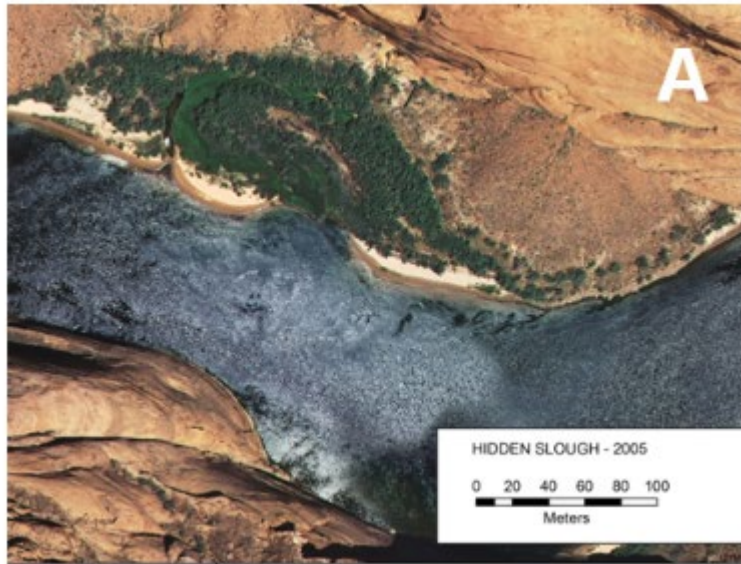
**Tamarisk Leaf Beetle
Larva**

Revegetate with Local Native Stock

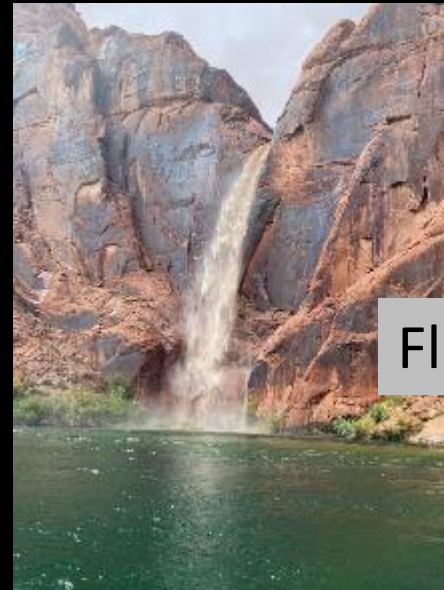


Monitor and Maintain

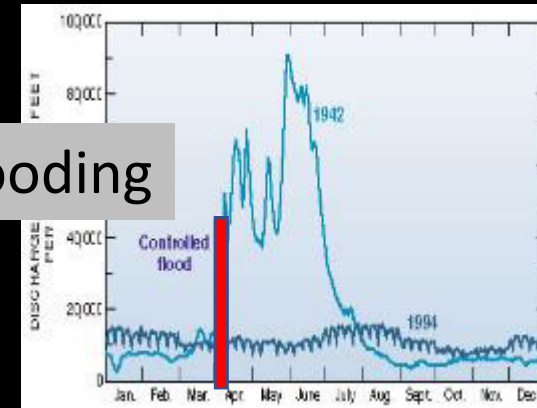
Hidden Slough Process and Unanticipated Challenges



Beaver



Flooding



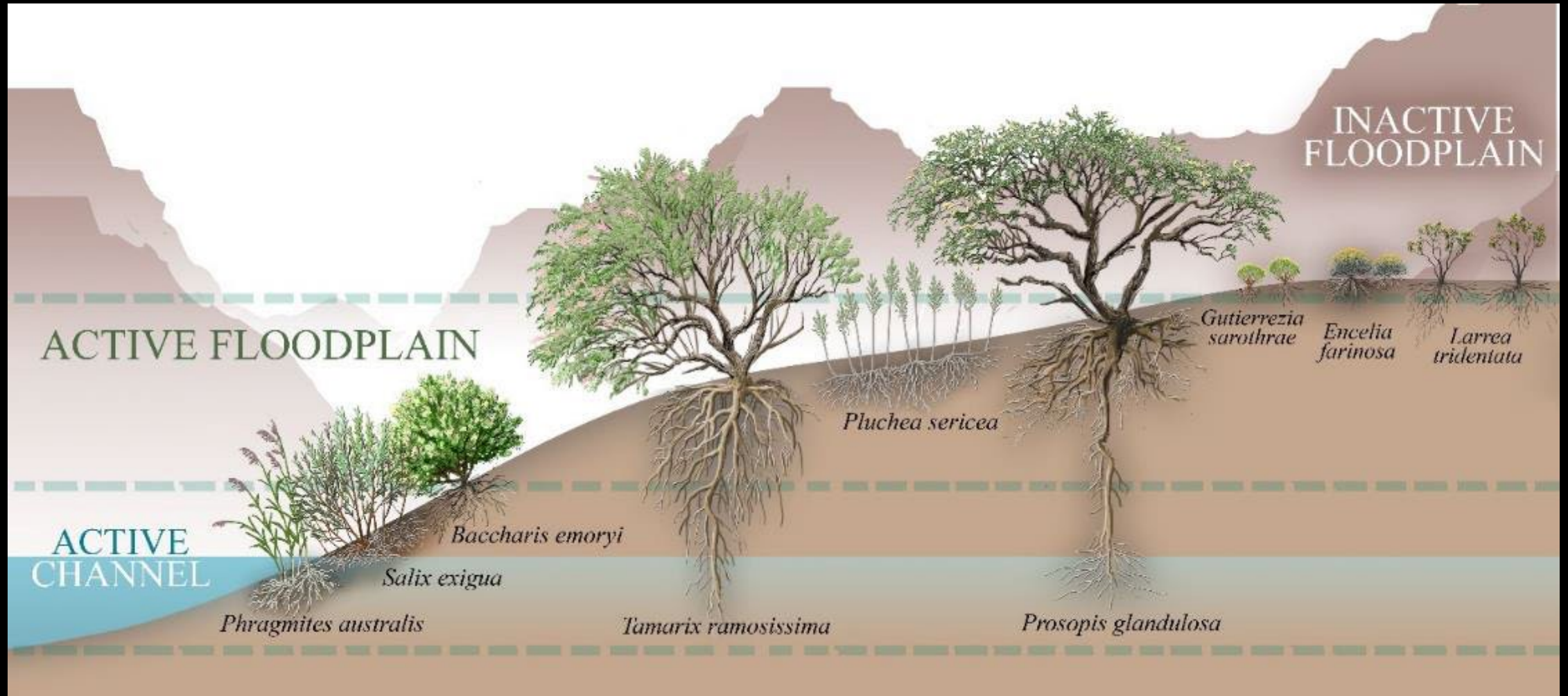
Riparian Rehabilitation Lessons Learned

Hidden Slough Rehabilitation (-6.5R)



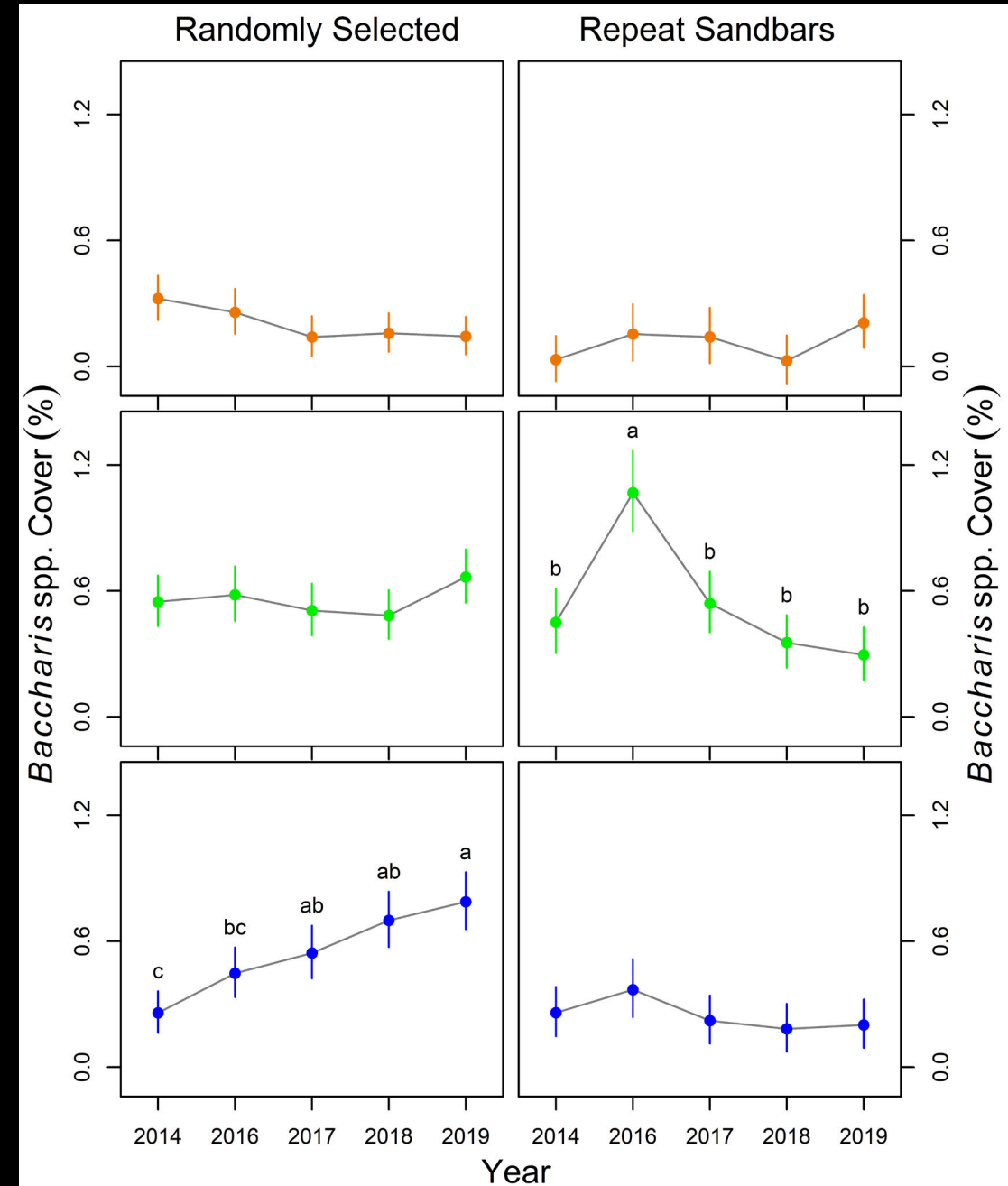
- 1) Establish administrative context, funding, maintain clear relationship with administrators
- 2) Know the landform and disturbance context
- 3) Clearly identify goals, objectives, tasks, staffing, schedule
Overbuild at your own risk
- 4) Accomplish compliance and permitting
- 5) Inventory → Assessment → Planning → Implementation → Monitoring → Feedback
- 6) Contingency planning: “What if...”
- 7) Paria Beach is next rehabilitation site

GCMRC Project C. Riparian Vegetation Monitoring and Research



C1. Ground-Based Monitoring

- Annual random and repeat sampling
- Status and Trends OFR for 2014-2019 in press
- Temporal variation in vegetation metrics by year, hydrological zone and geomorphic setting
- Individual species of interest, e.g. →
- Patterns related to management and climate variability



Palmquist, Ralston and Butterfield. In Press.

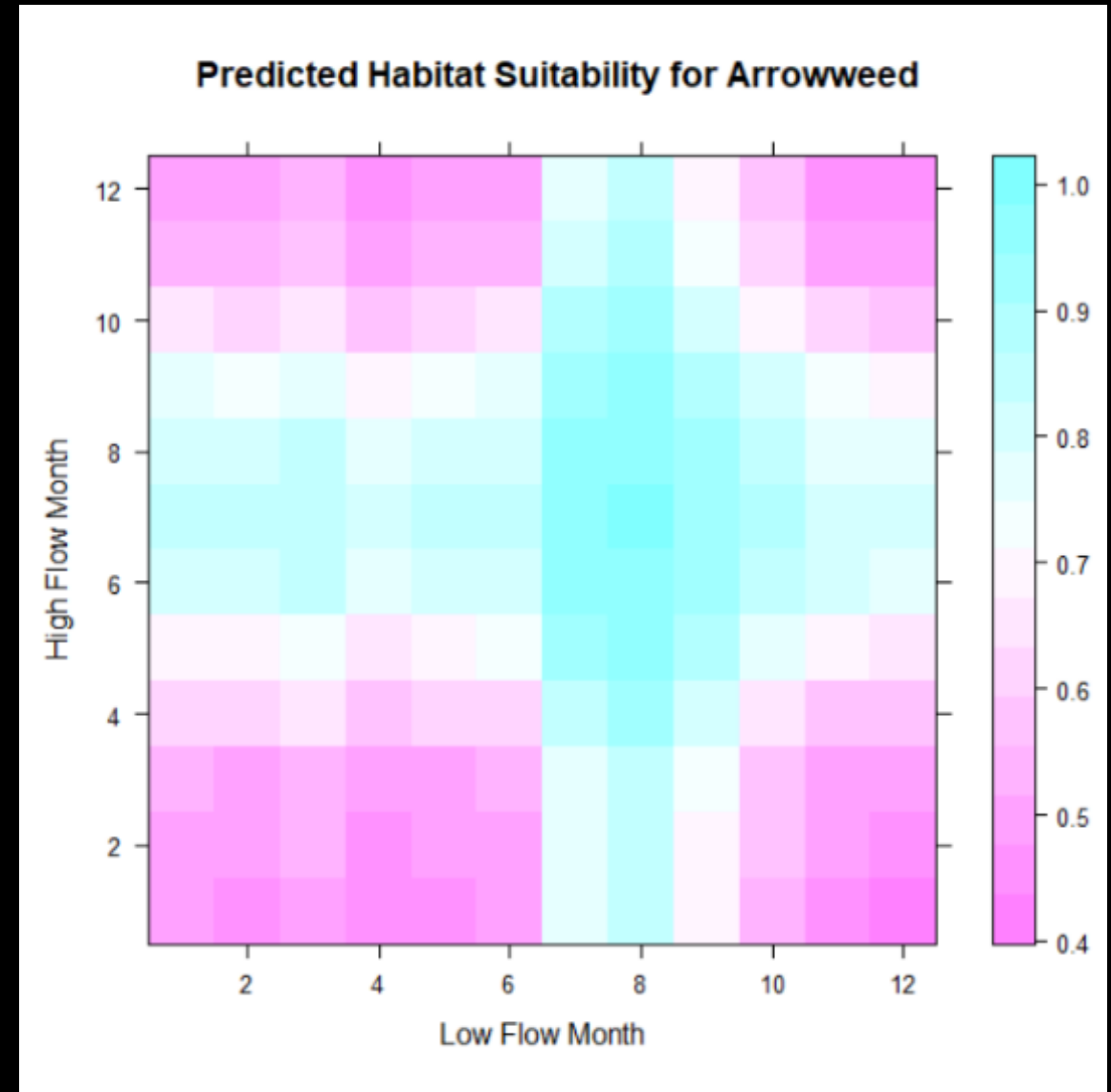
C2. Hydrological Tolerance Experiments

- How do hydrological adaptations of the dominant species in the CRe influence their responses to dam operations?
- Manuscript from 2019 arrowweed experiment nearing submission
- Willow humidity and drought experiment conducted in 2021
- Flood and drought responses in 2022
 - Mesquite, catclaw acacia, hackberry, cottonwood, coyote willow, Goodding's willow, Emory's baccharis, seepwillow, desert broom, arrowweed, tamarisk, common reed, horsetail



C3. Predictive Models and Synthesis

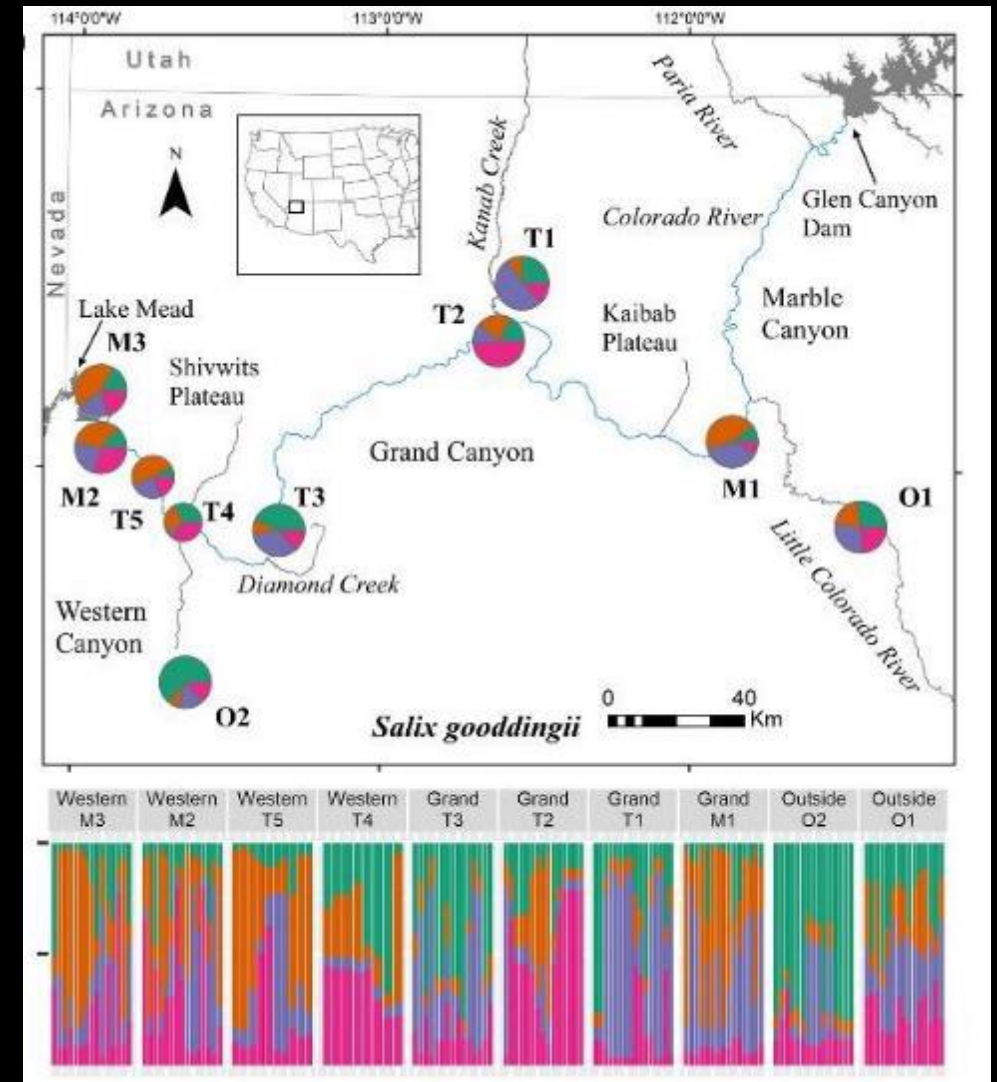
- What are the predicted changes for plant species under current and alternative LTEMP dam operations?
- Examining seasonal timing of base flow variation
- Developing “hydroclimatic” variables
 - model species niches to see if the seasonality of flows can explain who is thriving, and who is not, in the CRe



Preliminary Data, Do Not Cite

C4. Vegetation Management Decision Support

- Population genetic structure research being incorporated into NPS materials development
- GMRC scientists from Projects C, D, and B at planning meetings for NPS non-flow experimental veg treatments
 - Three sites (so far) overlap with long-term monitoring sandbar sites



Palmquist and others. 2021. *Restoration Ecology*

Project L: Remote Sensing Overflight in Support of Long-Term Monitoring and LTEMP



Hydrologic and geomorphic effects on riparian plant species occurrence and encroachment: remote sensing of 360 km of the Colorado River in Grand Canyon

Received: 8 February 2021 | Revised: 4 August 2021 | Accepted: 6 August 2021
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RESEARCH ARTICLE

WILEY

Hydrologic and geomorphic effects on riparian plant species occurrence and encroachment: Remote sensing of 360 km of the Colorado River in Grand Canyon

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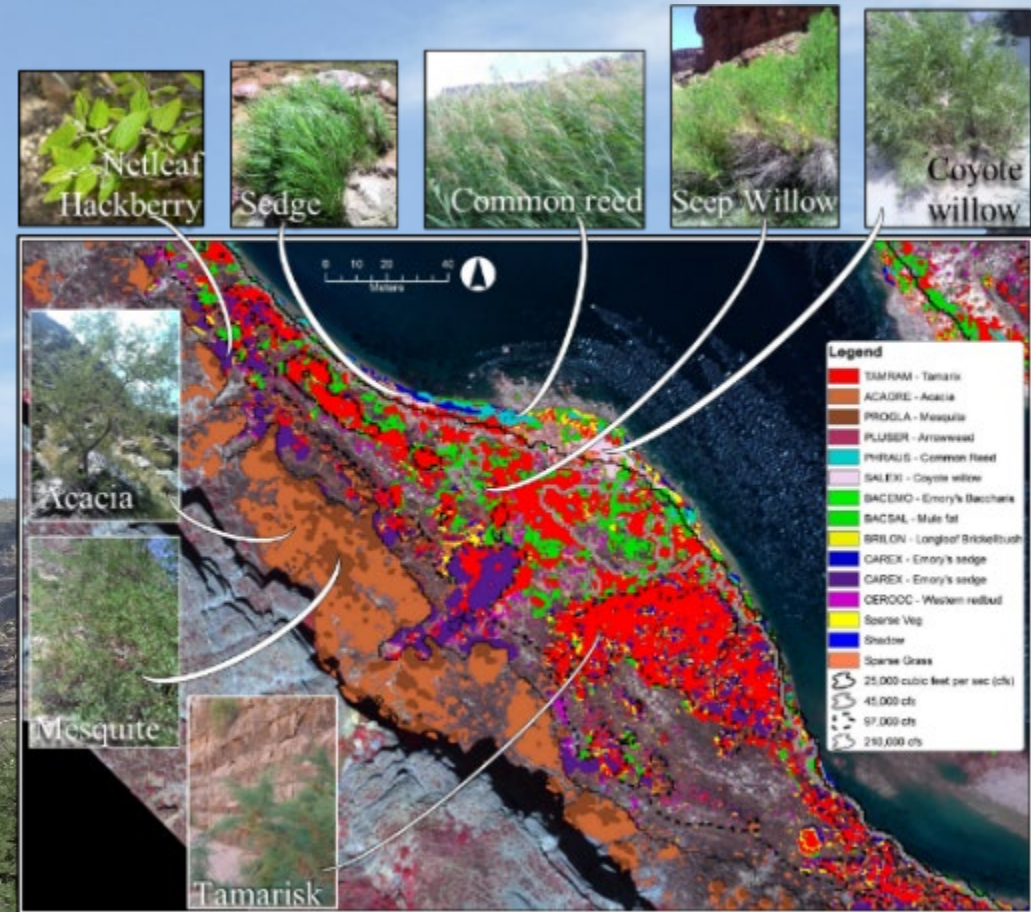
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U.S. Geological Survey; Bureau of Reclamation

Abstract

A common impact on riparian ecosystem function following river regulation is the expansion and encroachment of riparian plant species in the active river channels and floodplain, which reduces flow of water and suspended sediment between the river, riparian area and upland ecosystems. We characterised riparian plant species occurrence and quantified encroachment within the dam-regulated Colorado River in Grand Canyon, Arizona, USA. We mapped 10 riparian species with high-resolution multispectral imagery and examined effects of river hydrology and geomorphology on the spatial distribution of plant species and open sand. Analysis spanned an image time series from 2002 to 2009 to 2013, a period when plant species and sand were spatially dynamic and operations of Glen Canyon Dam included daily hydro-peaking and small episodic controlled flood releases. Plant species occurrence and encroachment rates varied with hydrology, geomorphology and local species pool. Encroachment was greatest on surfaces frequently inundated by hydro-peaking. Seep willow (*Baccharis* spp.), tamarisk (*Tamarix* spp.) and arrowweed (*Pluchea sericea*)



Monitoring *Tamarix* Changes Using WorldView-2 Satellite Imagery in Grand Canyon National Park, Arizona

 remote sensing 

Article

Monitoring *Tamarix* Changes Using WorldView-2 Satellite Imagery in Grand Canyon National Park, Arizona

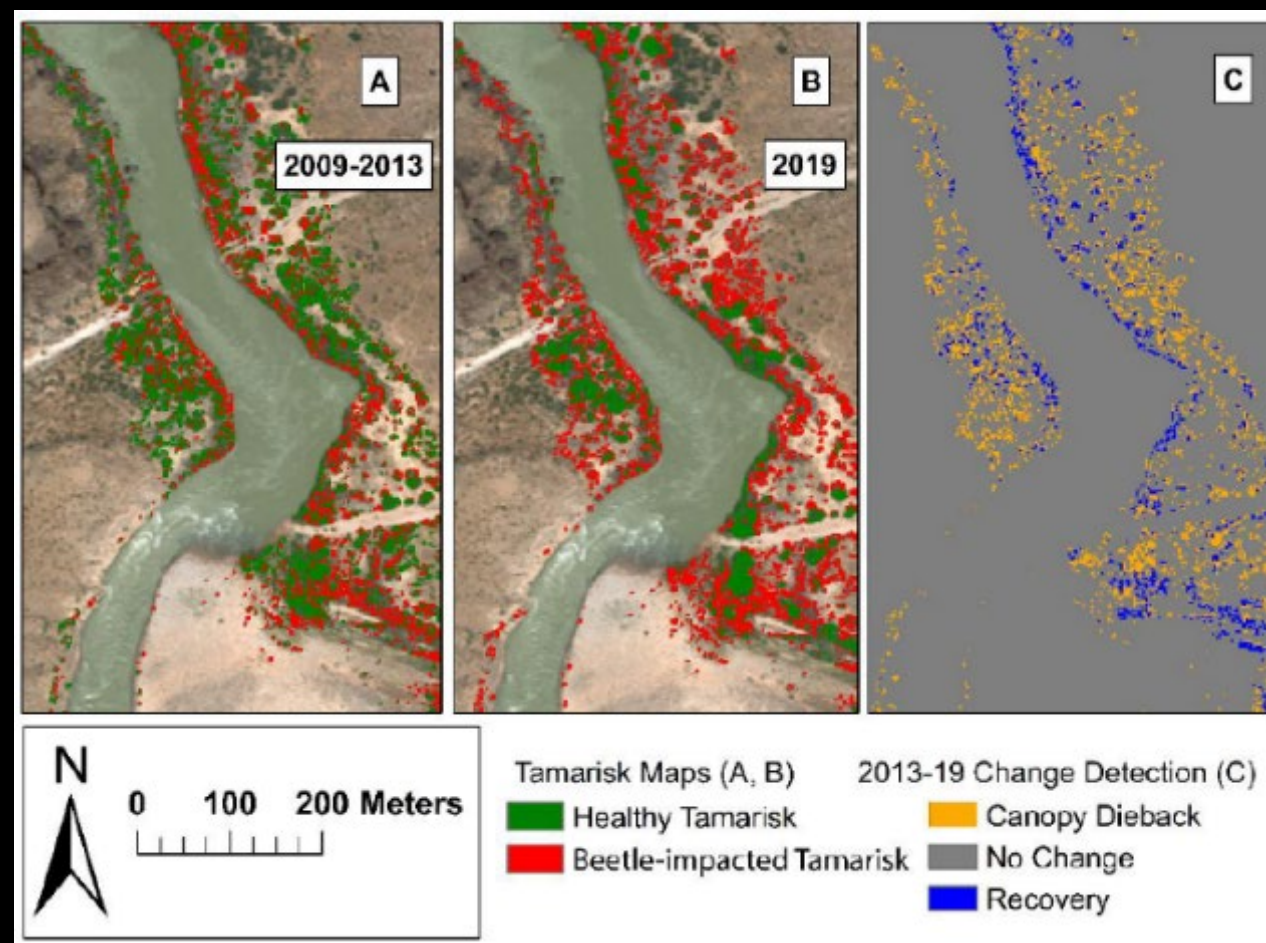
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Abstract: Remote sensing methods are commonly used to monitor the invasive riparian shrub tamarisk (*Tamarix spp.*) and its response to the northern tamarisk beetle (*D. carinulata*), a specialized herbivore introduced as a biocontrol agent to control tamarisk in the Southwest USA in 2001. We use a Spectral Angle Mapper (SAM) supervised classification method with WorldView-2 (2 m spatial resolution) multispectral images from May and August of 2019 to map healthy tamarisk, canopy dieback, and defoliated tamarisk over a 48 km segment of the Colorado River in the topographically complex Grand Canyon National Park, where coarse-resolution satellite images are of limited use. The classifications in May and August produced overall accuracies of 80.0% and 83.1%, respectively. Seasonal change detection between May and August 2019 indicated that 47.5% of the healthy tamarisk detected in May 2019 had been defoliated by August 2019 within the WorldView-2 image extent. When compared to a previously published tamarisk map from 2009, derived from multispectral aerial imagery, we found that 29.5% of healthy tamarisk canopy declined between 2009 and 2019. This implies that tamarisk beetle impacts are continuing to accumulate even though land managers have noted the presence of the beetles in this reach of the river for 7 years since 2012.

 check for updates

Citation: Bransky, N.; Sankey, T.; Sankey, J.B.; Johnson, M.; Jamison, L. Monitoring *Tamarix* Changes Using WorldView-2 Satellite Imagery in Grand Canyon National Park.



Riparian Vegetation Science & Management

- Using research, monitoring, and past and present restoration experiments to support an ecologically appropriate riparian vegetation community



Freshwaters Illustrated/USGS



Grand Canyon Wildlands
Council