Riparian Vegetation Science and Management

AMWG February 10, 2021

Brad Butterfield[1], Helen Fairley[2], Alan Kasprak[3], Emily Palmquist[2] , Lonnie Pilkington[4], and Joel Sankey[2*]

[1]Center for Ecosystem Science and Society (ECOSS), Northern Arizona University; [2]Grand Canyon Monitoring and Research Center, Southwest Biological Science Center, USGS, Flagstaff; [3]Fort Lewis College, Durango; [4]National Park Service, Grand Canyon; *Presenting

Collaborators and Partnerships

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NATIONAL PARK SERVICE

USGS
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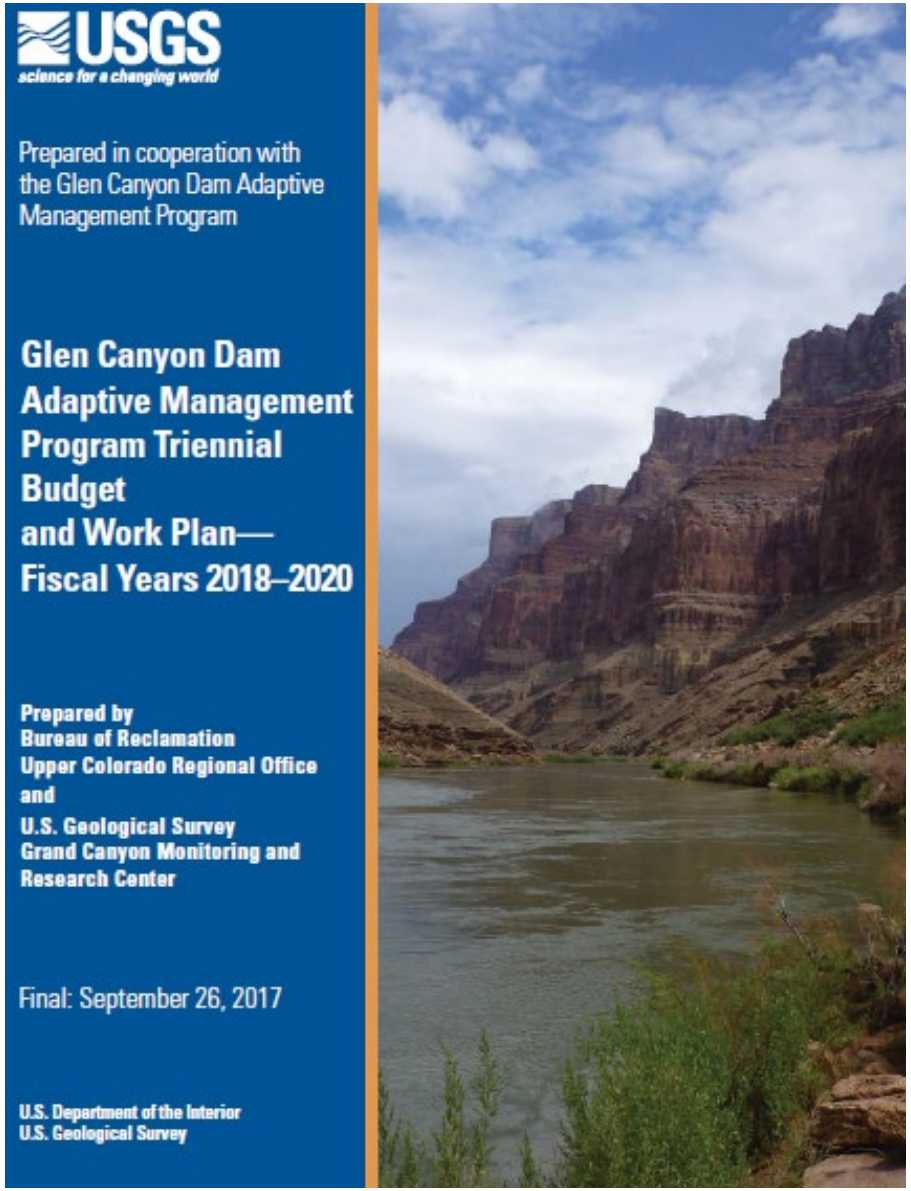
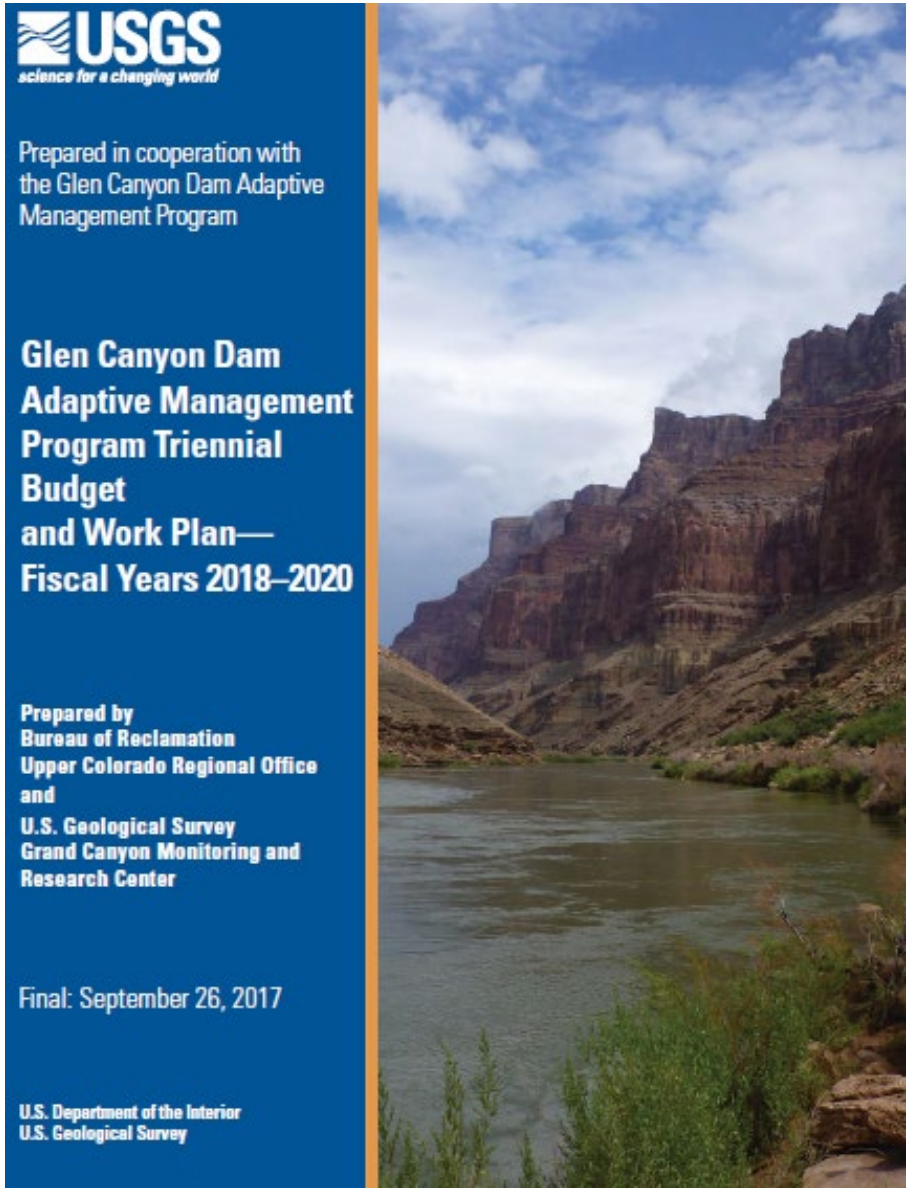
Riparian Vegetation Science and Management Projects 2018-2020 (1)



- Bureau of Reclamation Triennial Budget and Work Plan
  - C. Program Administration, ESA Compliance, and Management Actions
    - C.7. Experimental Vegetation Treatment
- GCMRC Triennial Budget and Work Plan
  - Project C. Riparian Vegetation Monitoring and Research
    - C.1. Ground-based riparian vegetation monitoring
    - C.2. Imagery-based riparian vegetation monitoring at the landscape scale
    - C.3. Vegetation responses to LTEMP flow scenarios
    - C.4. Vegetation management decision support
  - Project D. Geomorphic Effects of Dam Operations and Vegetation Management for Archaeological Sites
    - D.1. Geomorphic effects of dam operations and vegetation management

Riparian Vegetation Science and Management Projects 2018-2020 (2)



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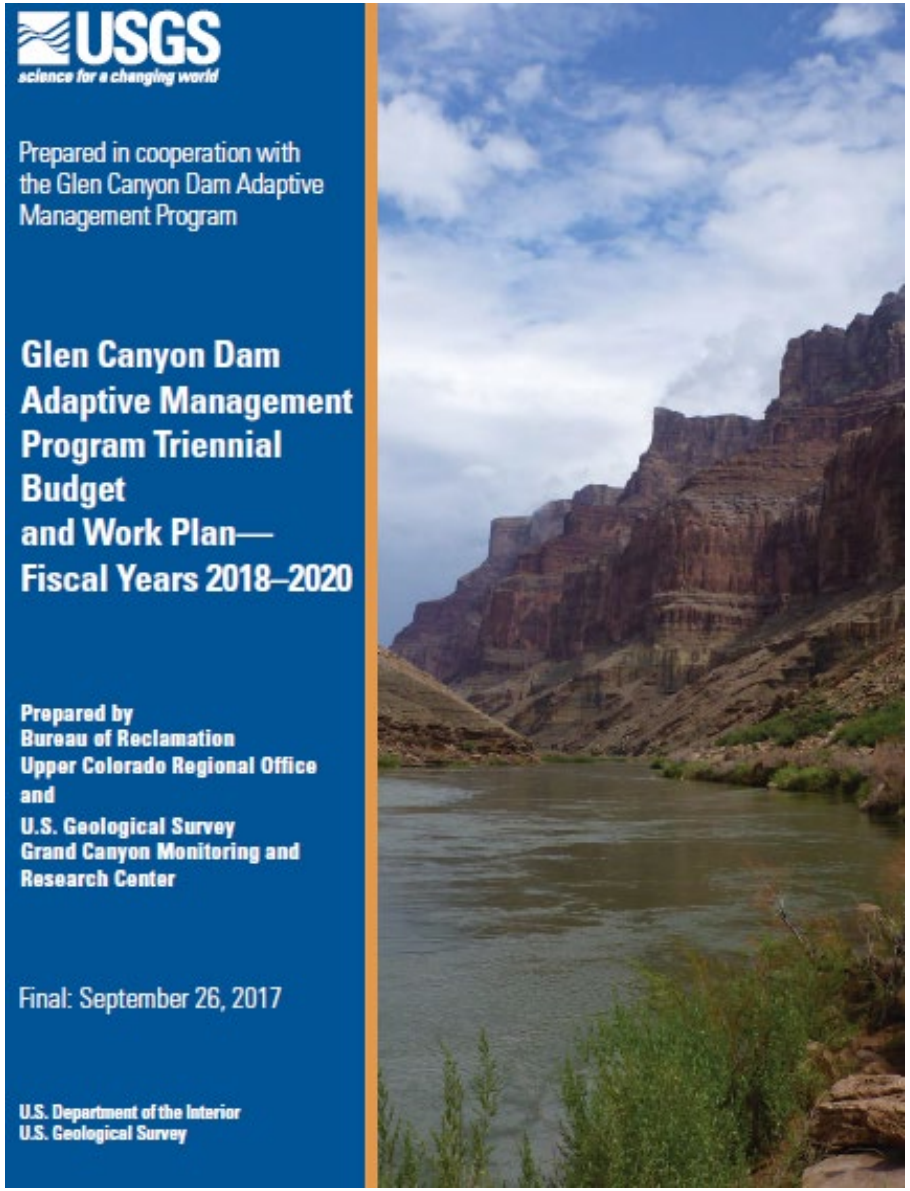
Riparian Vegetation Science and Management Projects 2018-2020 (3)



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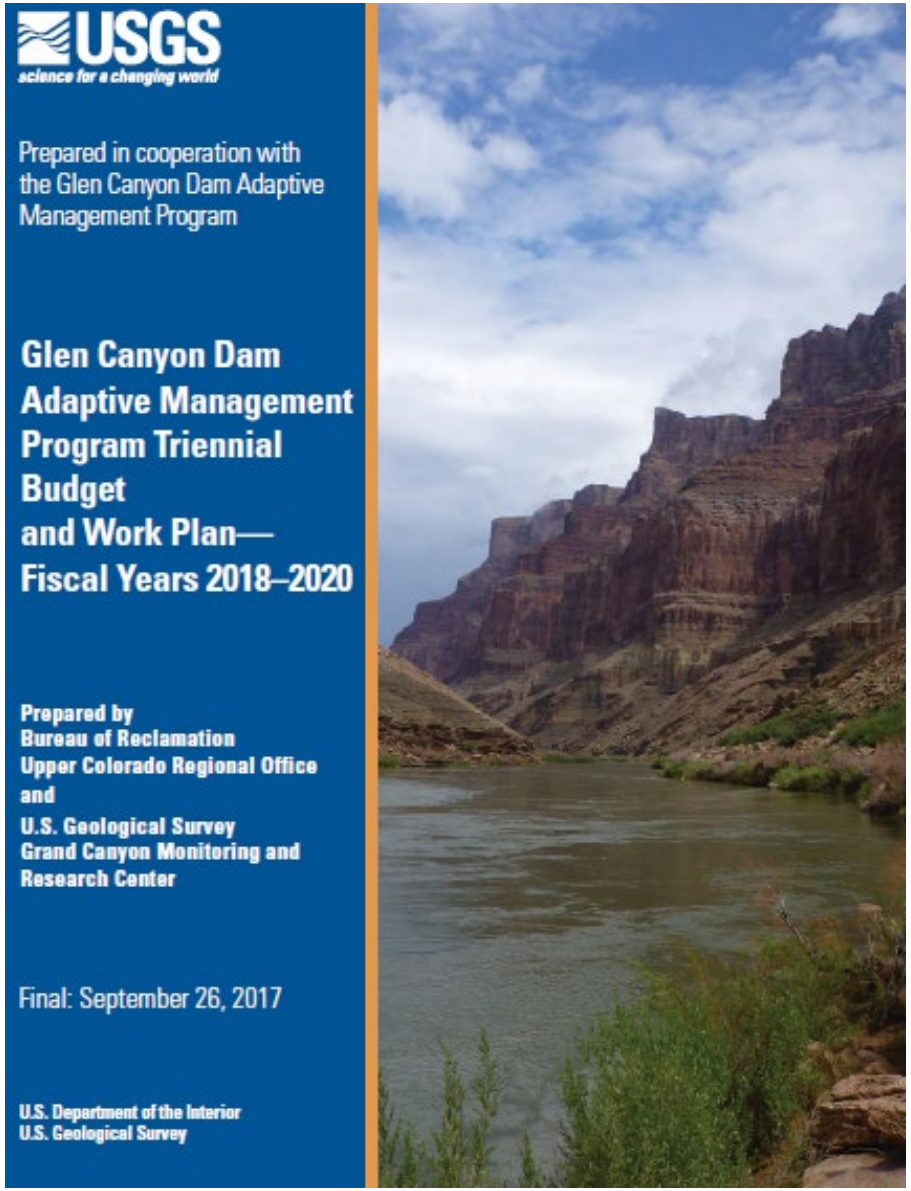
Riparian Vegetation Science and Management Projects 2018-2020 (4)



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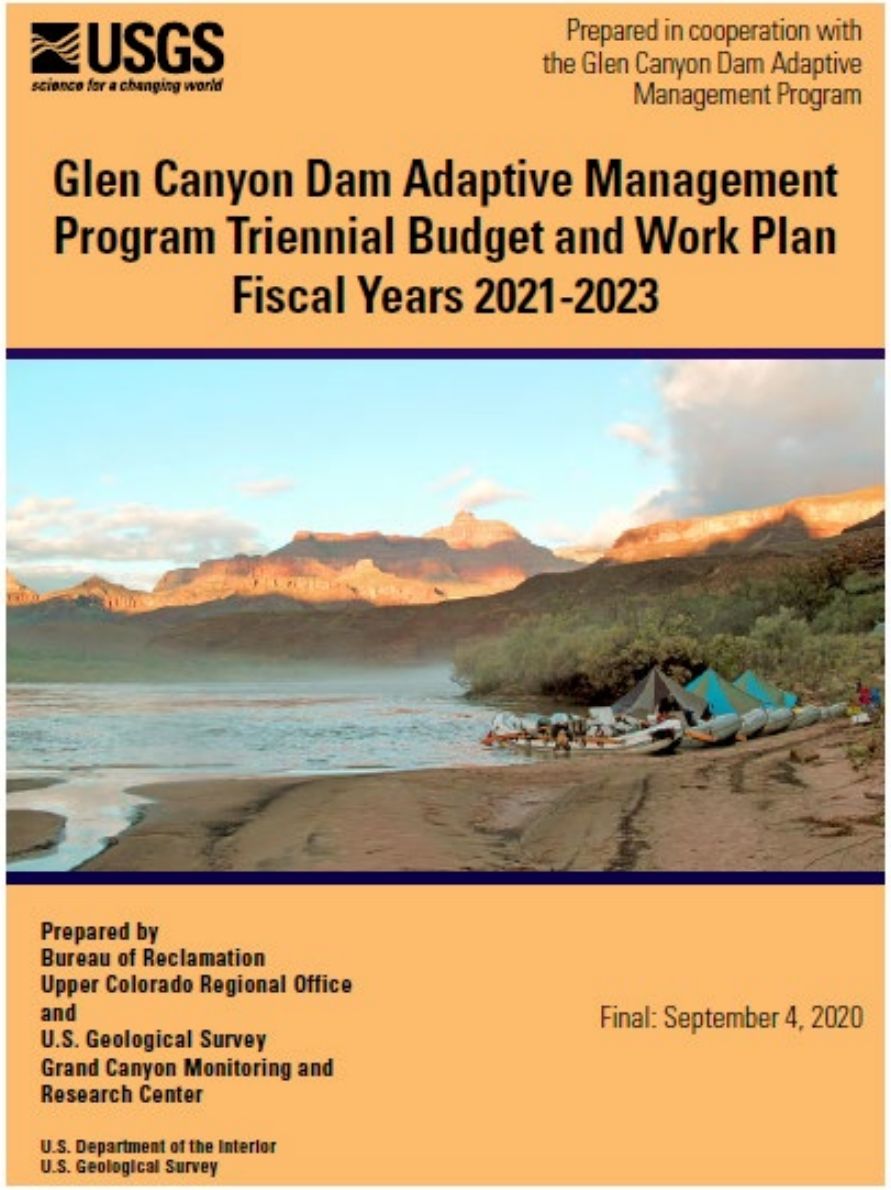
Riparian Vegetation Science and Management Projects 2021-2023 (5)



- Bureau of Reclamation Triennial Budget and Work Plan
  - C. Program Administration, ESA Compliance, and Management Actions
    - C.7. GRCA Experimental Vegetation Treatment
    - C.8. GLCA Experimental Vegetation Treatment
- GCMRC Triennial Budget and Work Plan
  - Project C. Riparian Vegetation Monitoring and Research
    - C.1. Ground-based riparian vegetation monitoring
    - C.2. Determining Hydrological Tolerances and Management Tools for Plant Species of Interest
    - C.3. Predictive Models and Synthesis
    - C.4. Vegetation management decision support
  - Project D: Effects of Dam Operations and Vegetation Management for Archaeological Sites
    - D.1. Dam Operations, Vegetation Management, Archaeological Sites
    - D.2. Monitoring Landscape-scale Ecosystem Change with Repeat Photography

Repeat photography documents long-term historical dam operation effects on sand supply, riparian landscapes, and associated archaeological sites in the Colorado River ecosystem

E. C. La Rue
08/02/1923

Stake 672
RM 10.6 L

A. H. Fairley
05/05/2017

Project D.2

Many former sand bar camps are unavailable today due to vegetation encroachment

E. C. La Rue
08/10/1923

Stake 678
RM 43.9 L

A.H. Fairley
05/06/2019

The original President Harding Camp

Project D.2

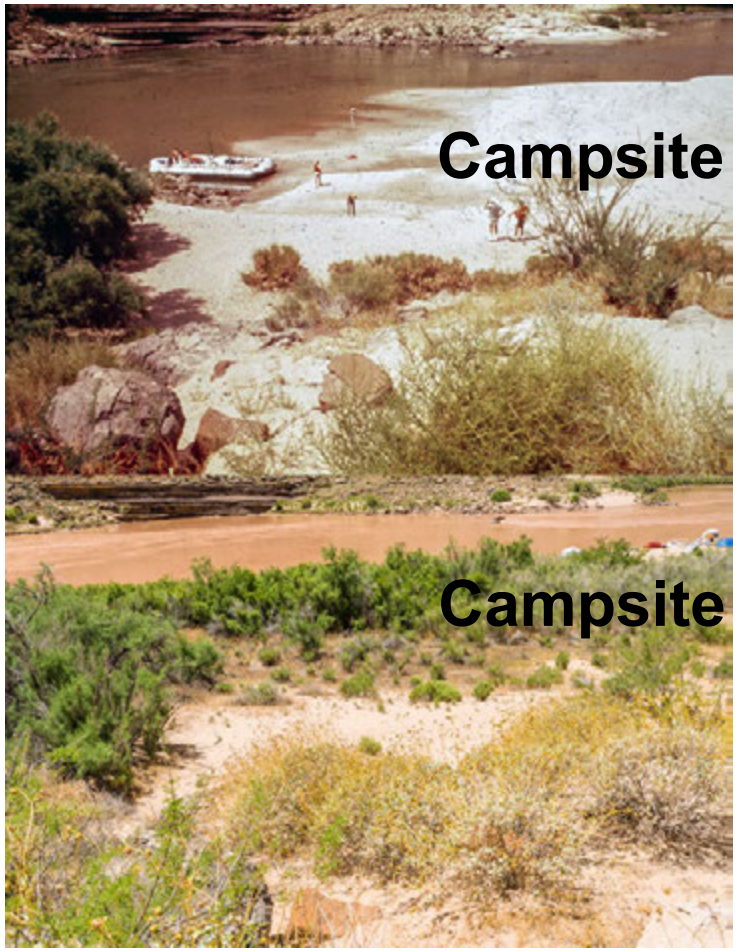
Increased vegetation reduces sediment transfer, negatively impacting campsite area and quality as well as archaeological site integrity

1973

2019

Sand Transfer

Dune is deflated, more vegetated, more bio-crusted



Upper Area (Dune)

Lower Area (Sand Bar)

122 Mile Camp (Project C.7 and D.1 Study Site): Top: Borden-Weeden photos, July 1973; Bottom: A. H. Fairley, May 12, 2019

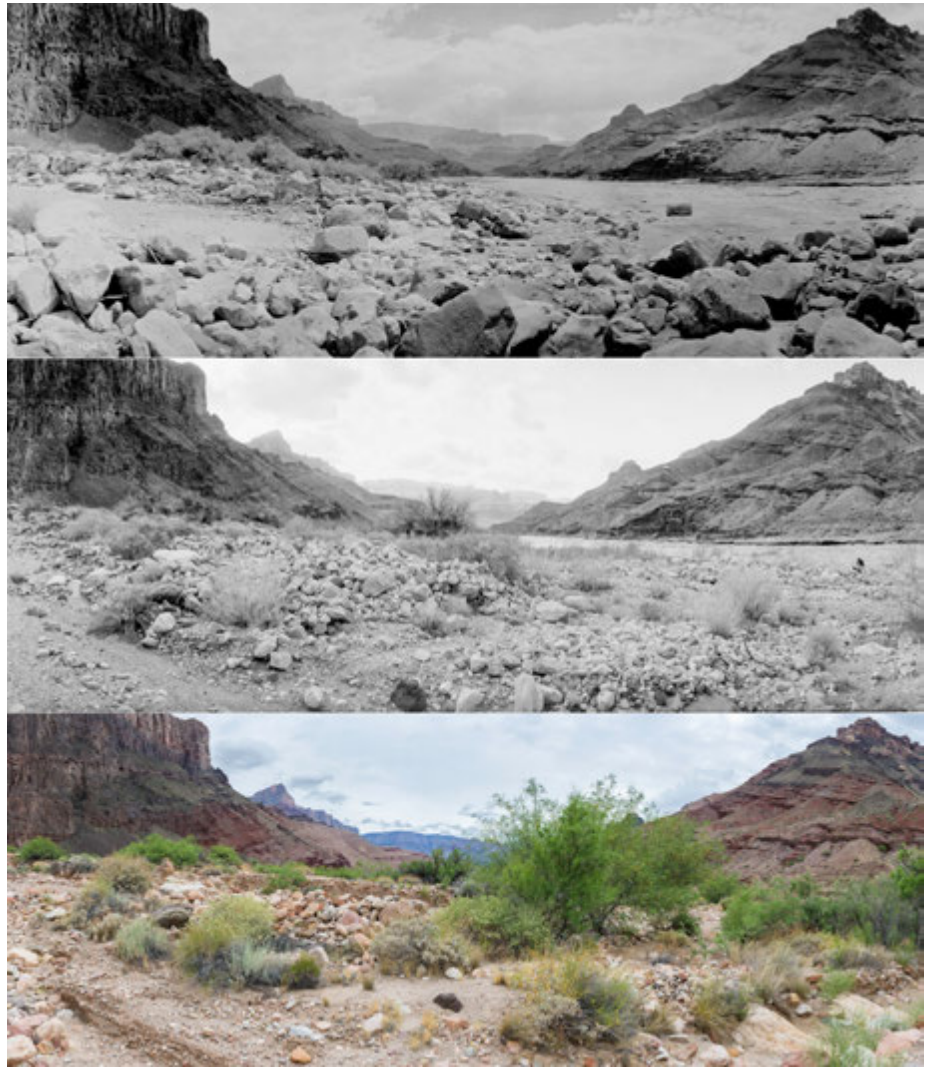
Project D.2

All photo matches document vegetation increases, including those from early 1990s to present day

E. C. La Rue
08/14/1923

E. Hymans
02/24/1993

A. H. Fairley
05/10/2017

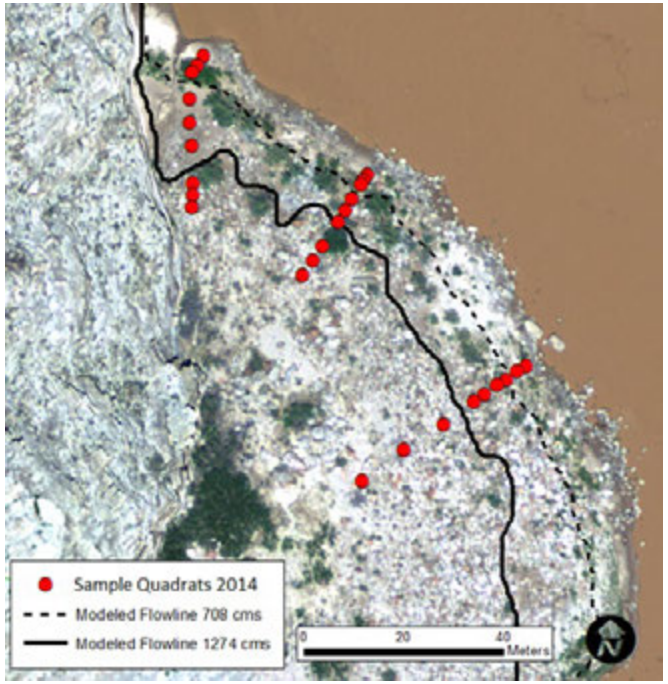


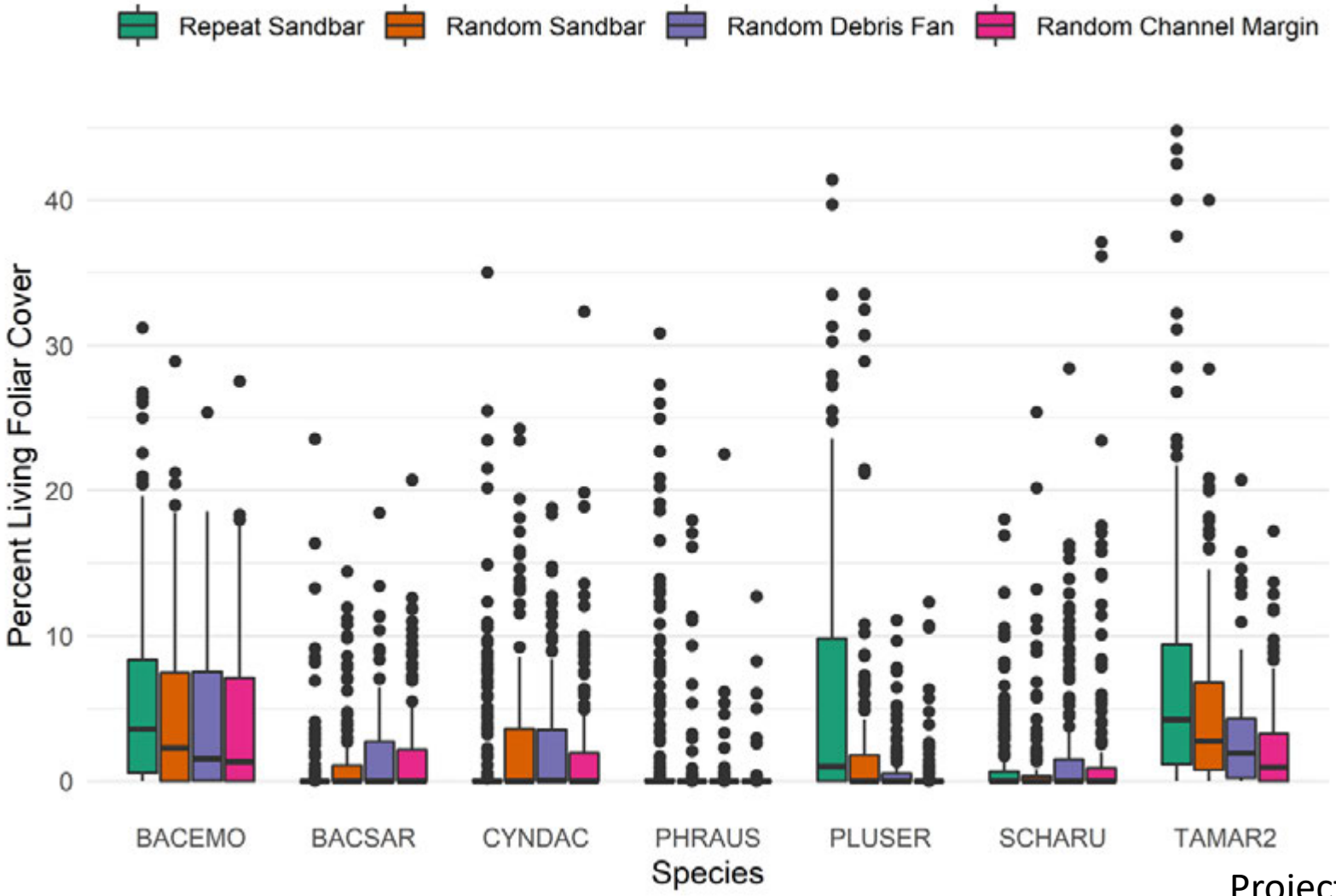
Stake 1707a, RM 66.0 L

Project D.2

Ground-based riparian vegetation monitoring and research documents the current species assemblages

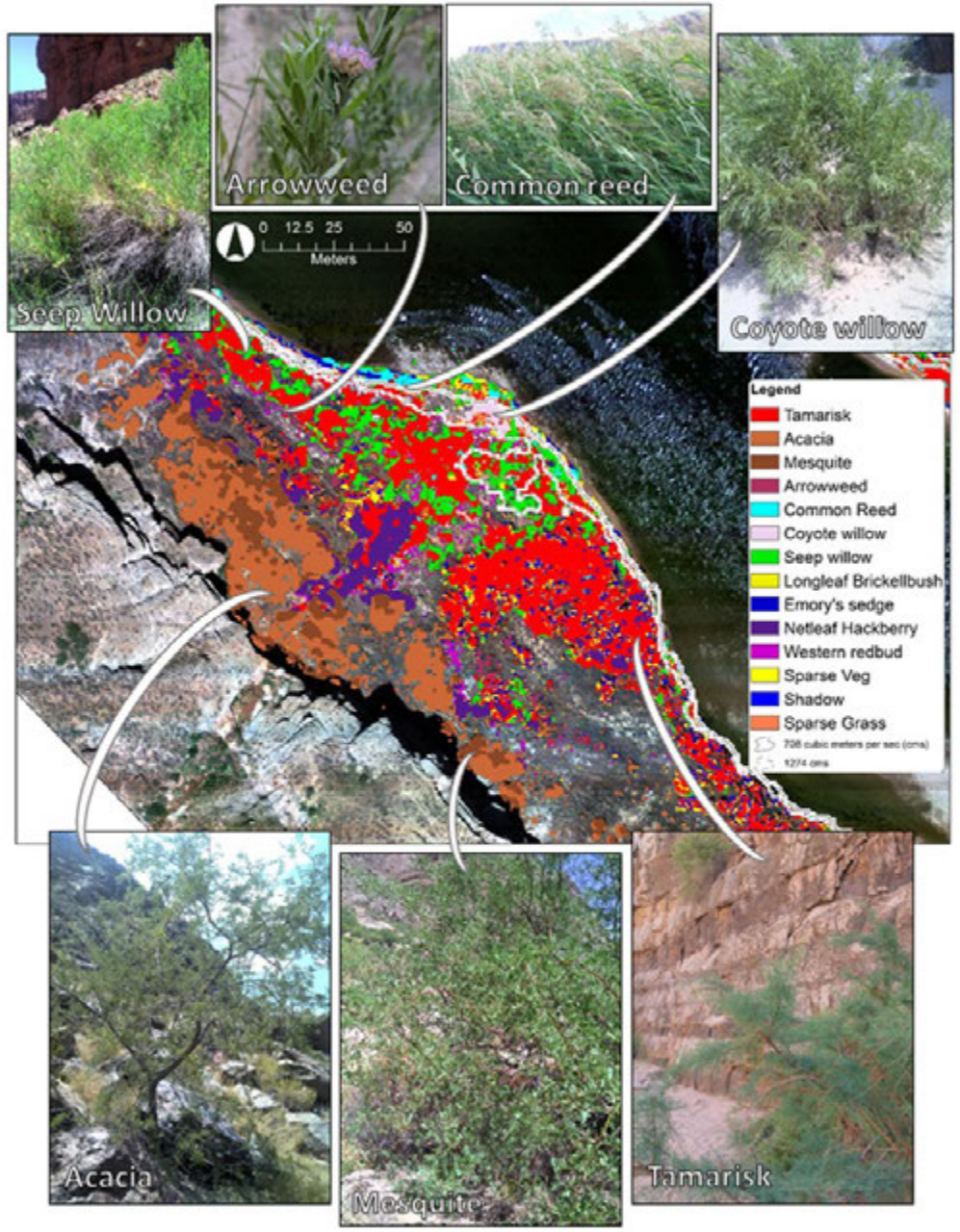
Species cover differs by geomorphic features

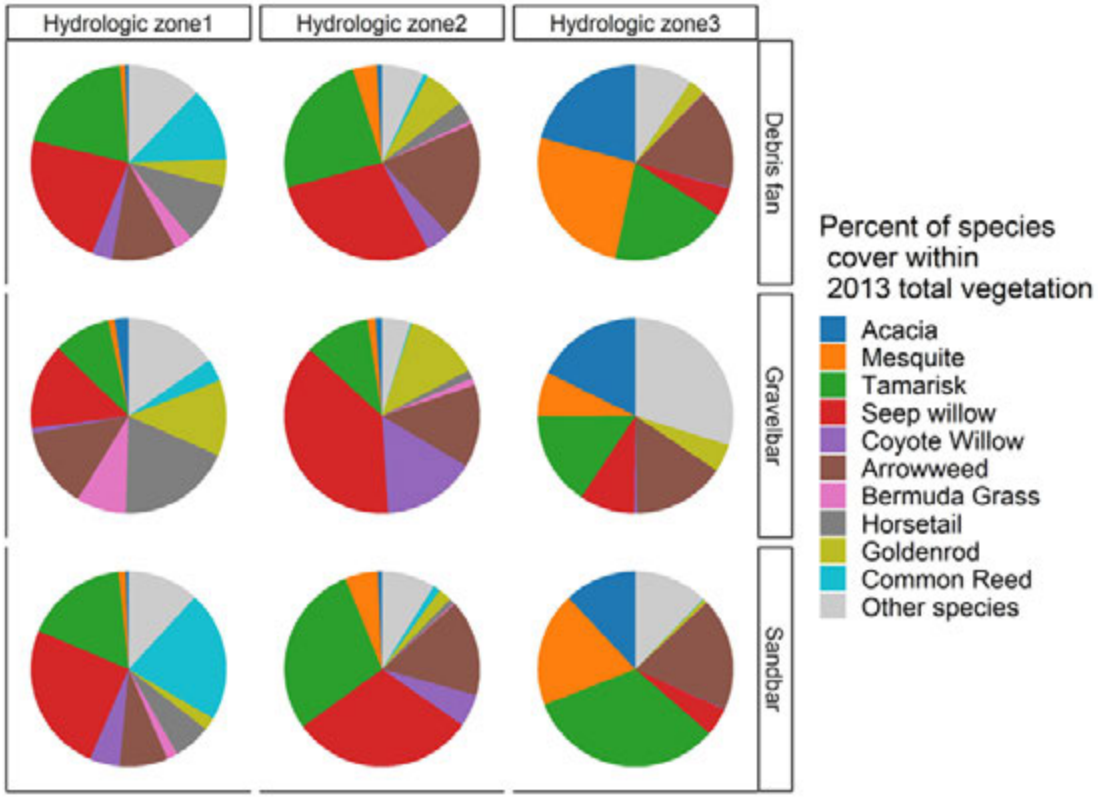




Project C.1

Remote sensing riparian vegetation monitoring and research extends the spatial resolution and geographic extent of ground-based observations

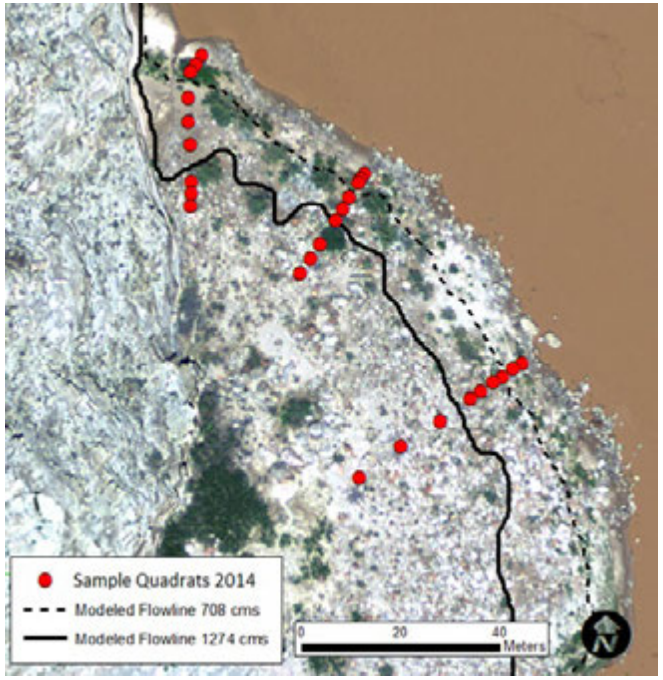


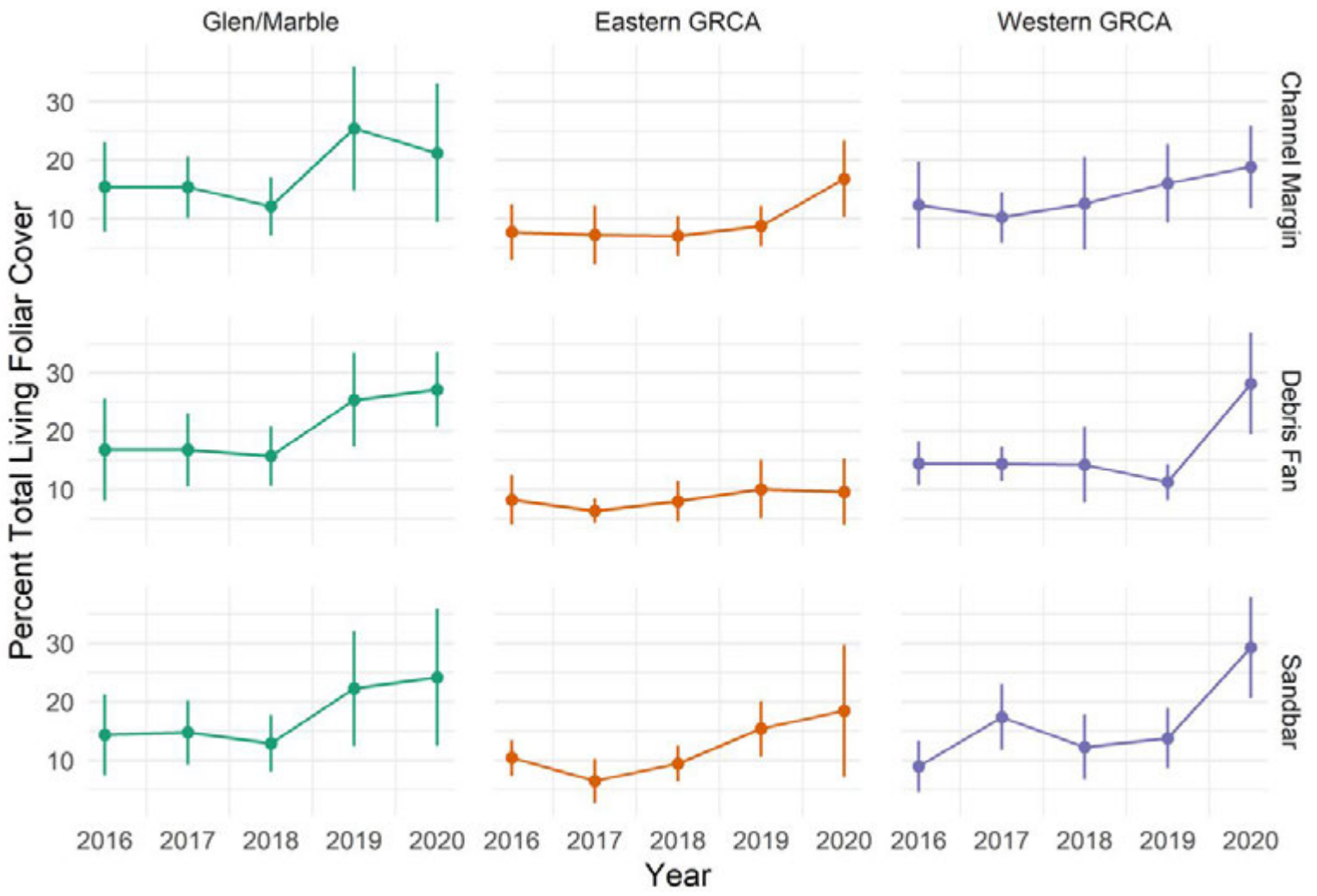


Project C.2

Ground-based riparian vegetation monitoring and research quantify recent changes relevant to LTEMP

Trends in vegetation cover differ by river segment and by geomorphic features

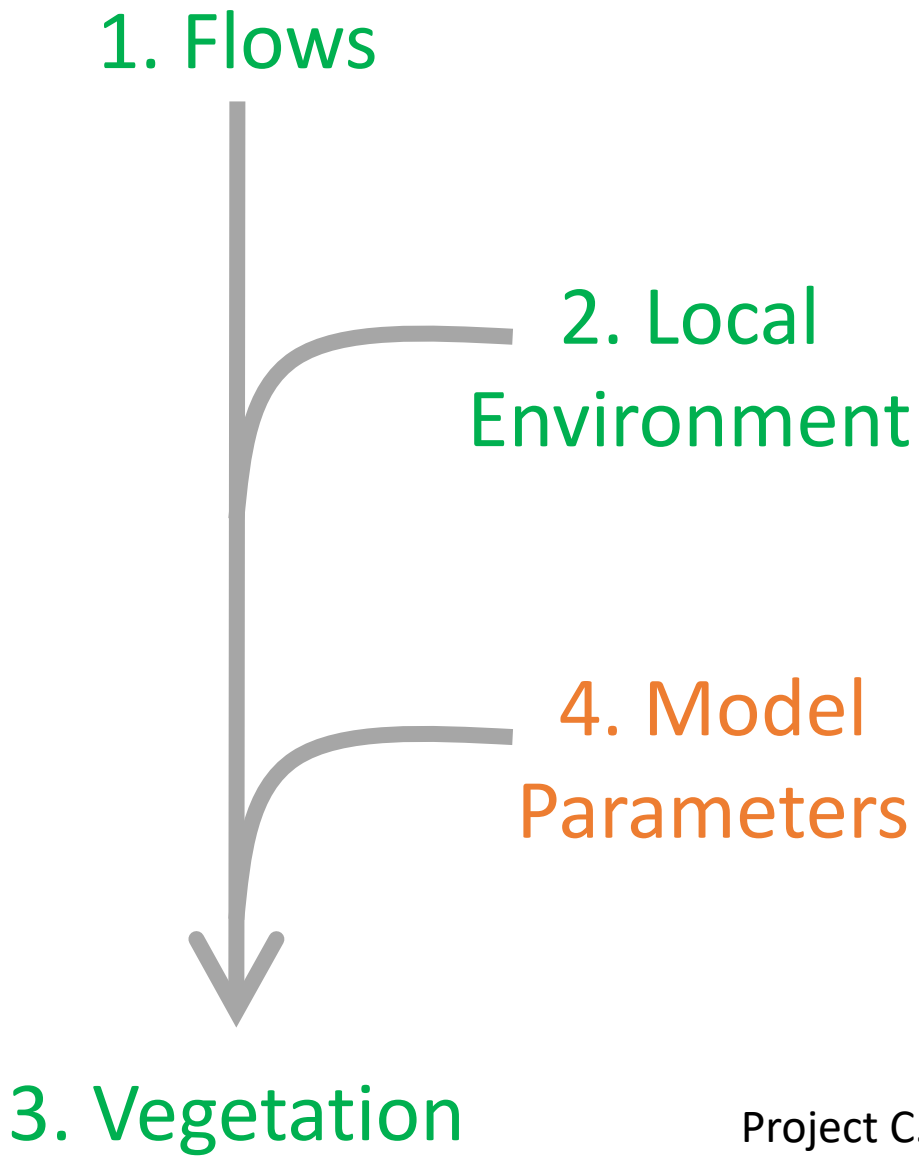




Project C.1

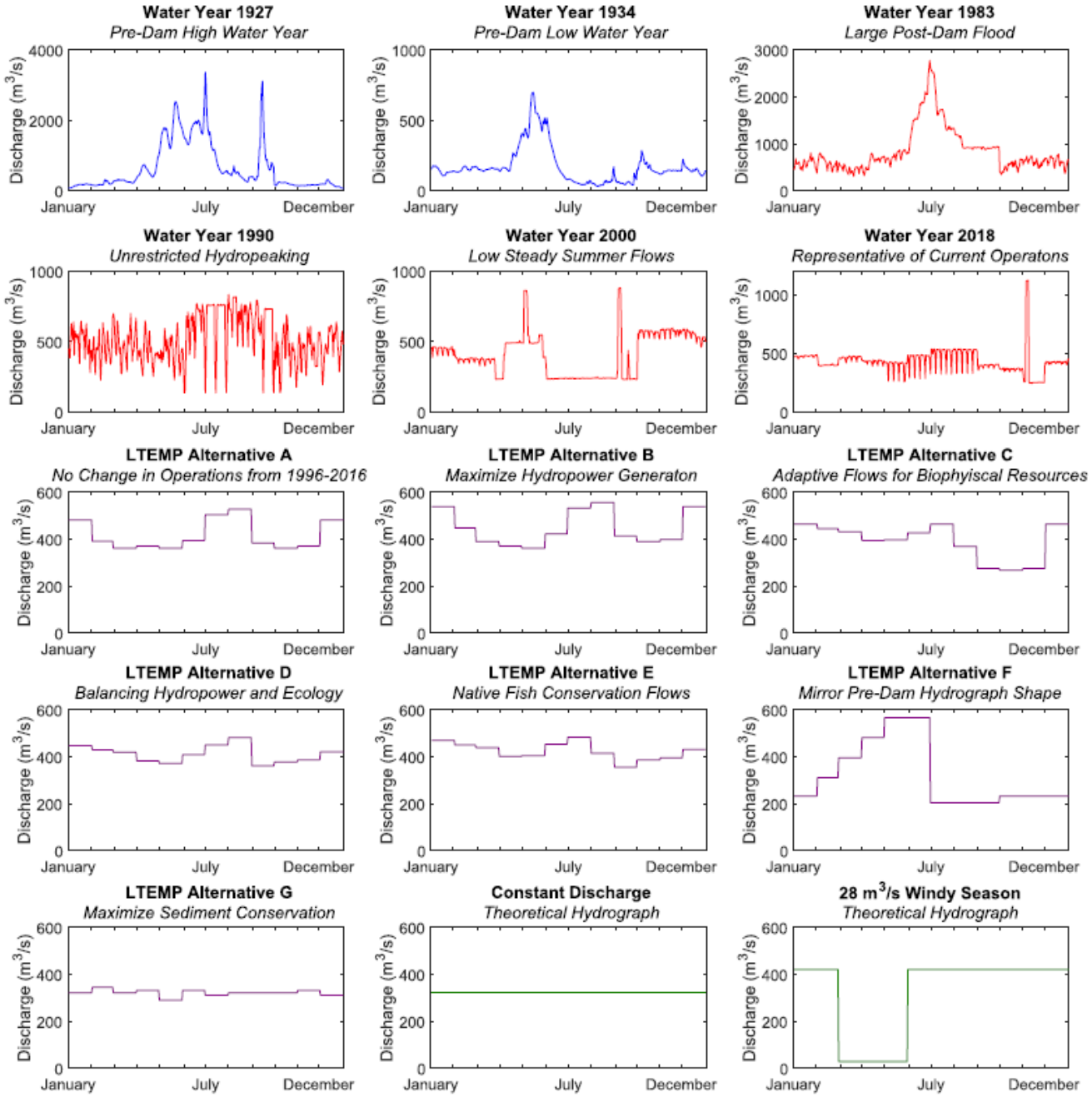
Modelling combines ground and remote sensing observations to predict how LTEMP flows will alter vegetation in the future

- The **local environment** (climate, geomorphology, etc.) modulates **flow** effects on **vegetation**
- Vegetation predictions are influenced by **model parameters**, which are informed by multiple data sources
- We will compare how each of these **variables (1-3)** and **parameters (4)** are treated by the 2014 state-and-transition model and current efforts



1. Flows

- Predict habitat suitability based on 3 variables
  - inundation duration
  - depth to water table
  - time of year
- To predict outside of observed range of hydrological conditions, we rely on
  - Historical CRe and regional studies
  - Greenhouse experiments
  - Expert knowledge



Project C.3

Kasprak, Sankey and Butterfield 2021 *Environmental Research Letters*

2: Local Environment

- Hydrological Zones
  - Vary in frequency of inundation
  - Vary in depth to water table
- Geomorphic Features
  - Repeat monitoring (NAU) sandbars
  - Randomly selected sandbars, channel margins and debris fans
- Climate
  - Existing weather station data
  - Biogeographic distinctions

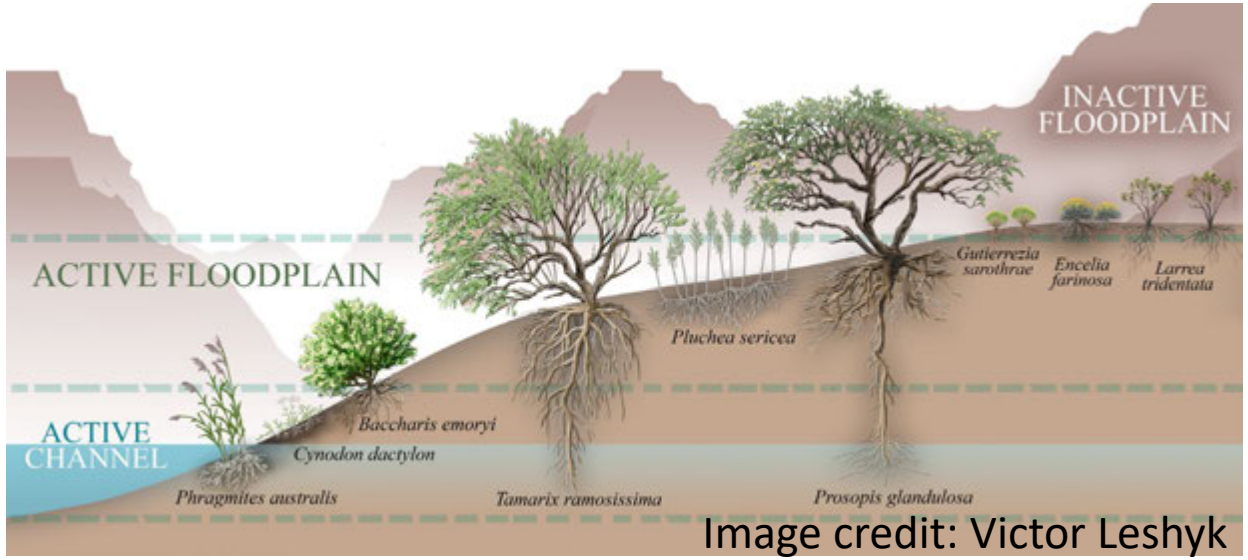
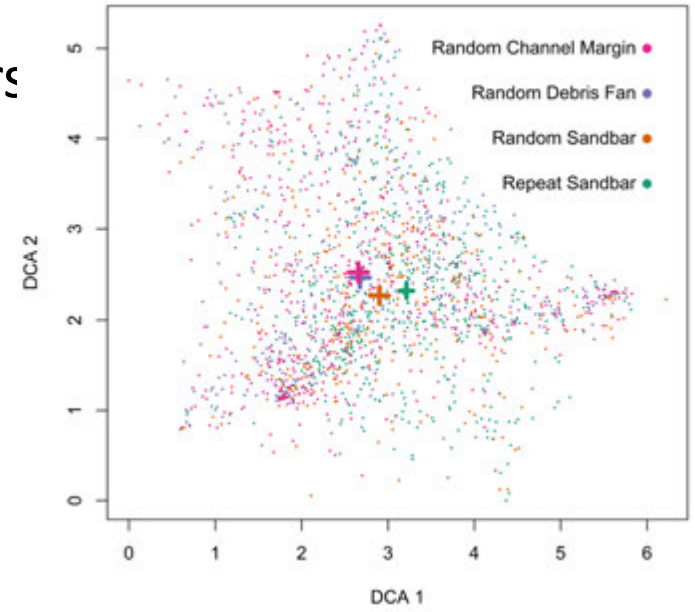
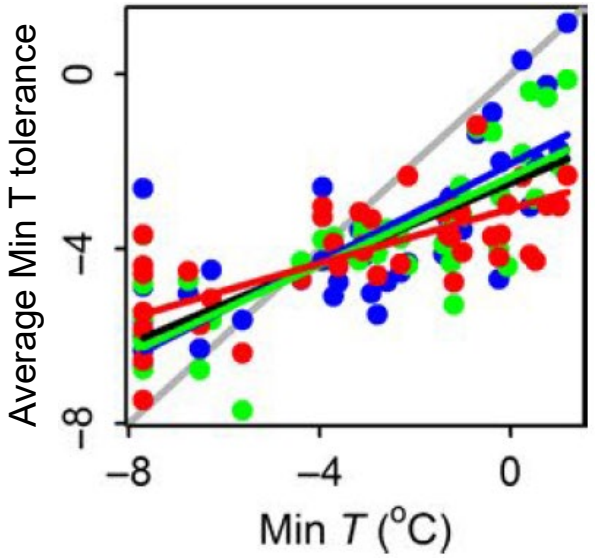


Image credit: Victor Leshyk



Palmquist, Ralston and Butterfield *In prep*



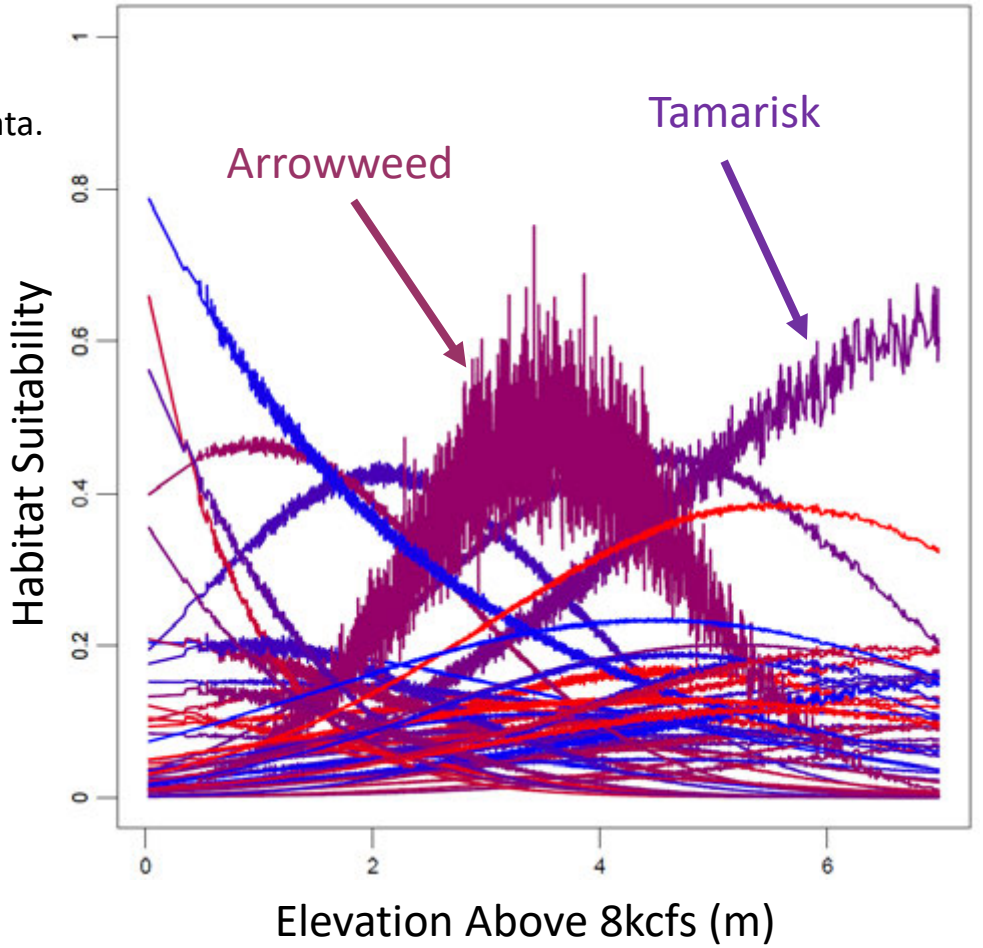
Butterfield, Palmquist and Ralston. 2018. *Applied Vegetation Science*.

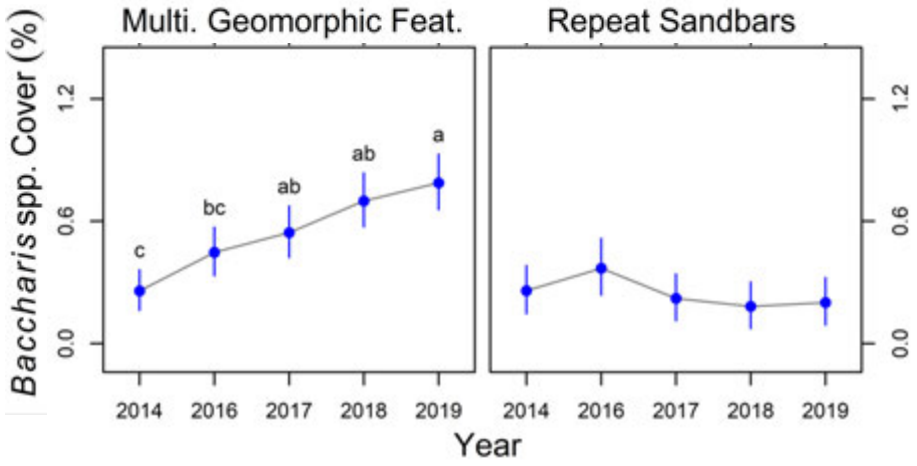
Project C.3

3. Vegetation

- Model habitat suitability for >70 individual species
  - In relation to flows
  - Monitor across different geomorphic features
  - Can aggregate into management-relevant groups

Butterfield and Palmquist, unpublished data.





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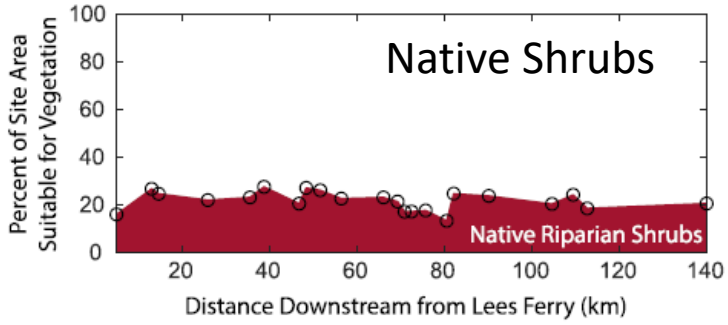
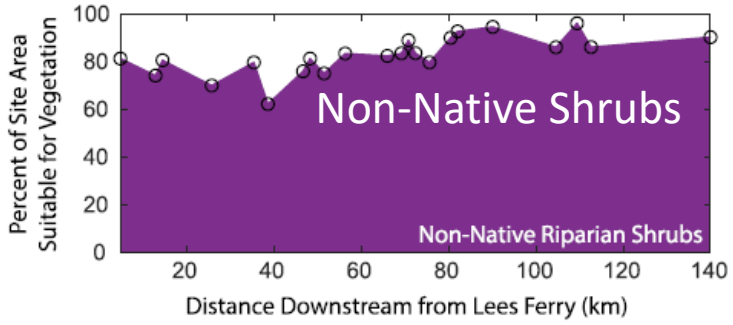


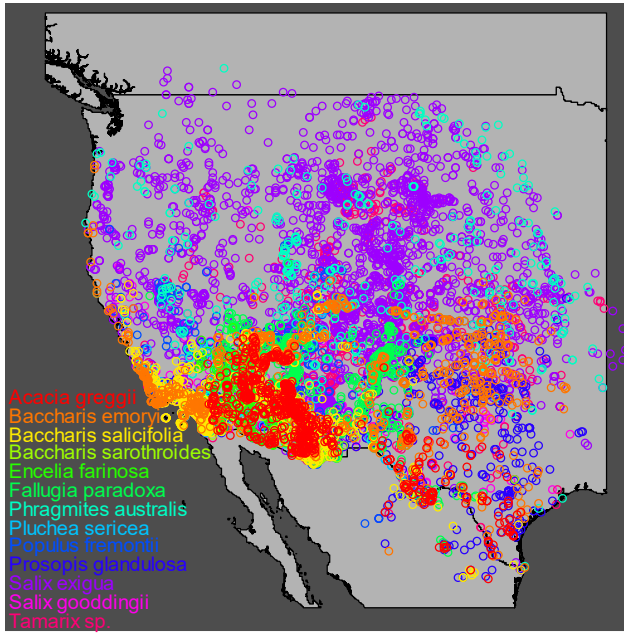


Kasprak, Sankey and Butterfield. 2021. *Environmental Research Letters*

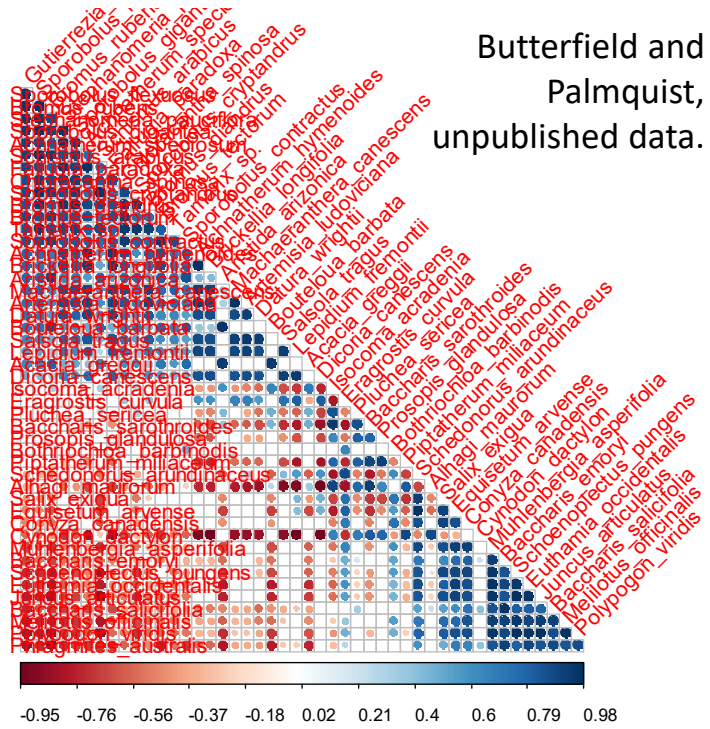
Project C.3

4. Model Parameters

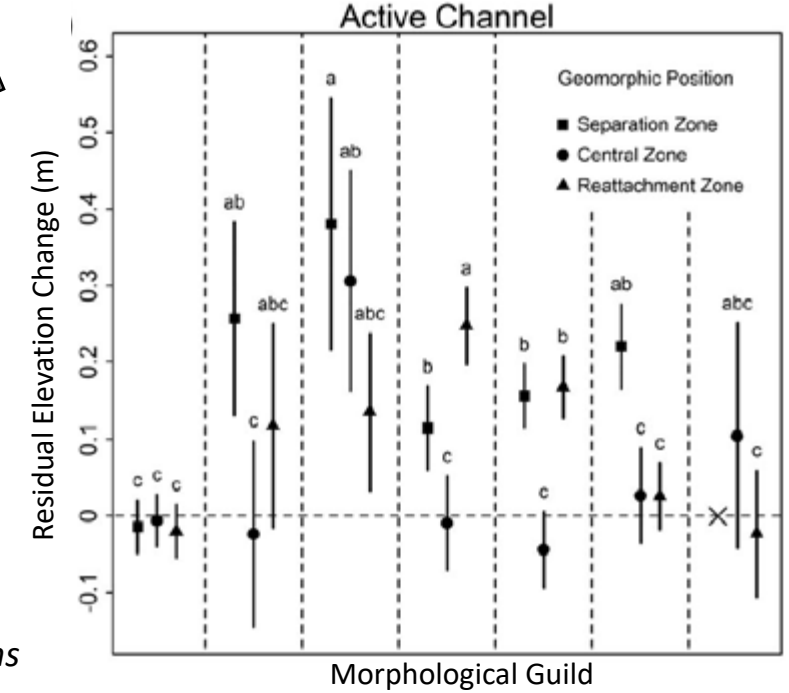
- Biotic Feedbacks
  - Competition and facilitation
  - Sand accretion and erosion
- Mechanistic Experiments
- Big Data



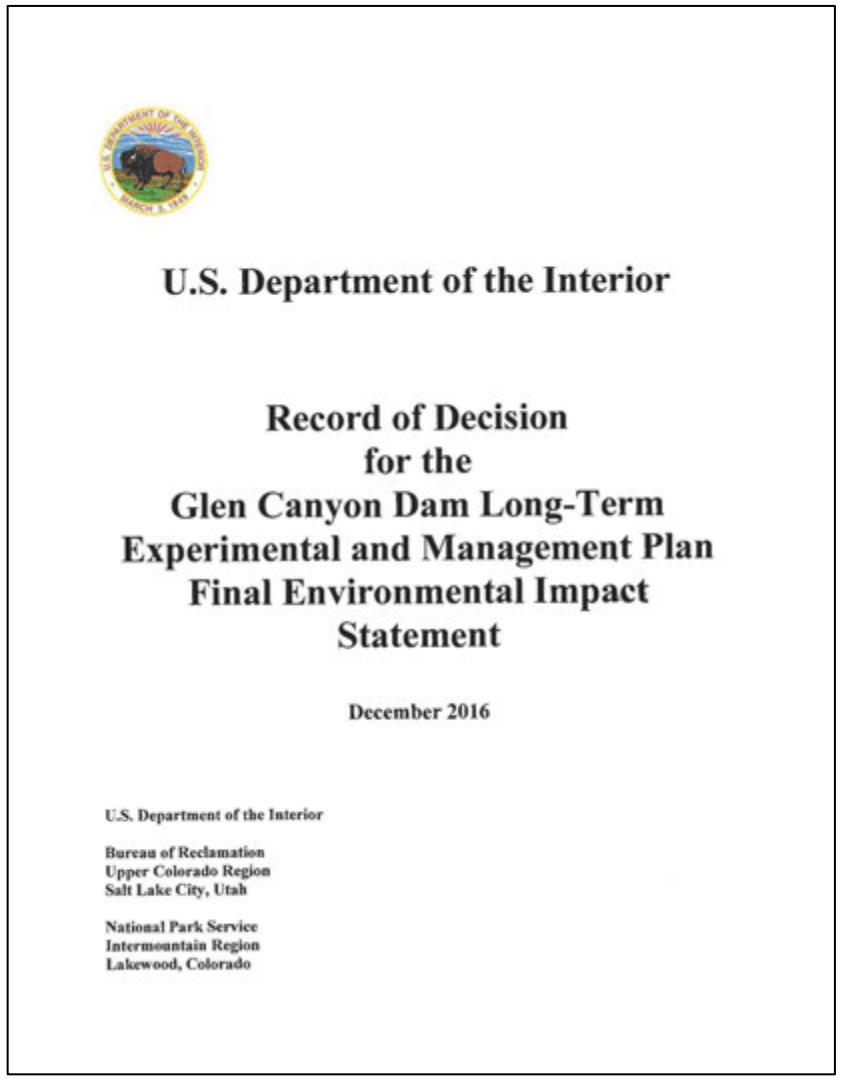
Butterfield and Palmquist, unpublished data.



Butterfield and others. 2020. *River Research and Applications*



NPS implements LTEMP non-flow vegetation management



U.S. Department of the Interior

Record of Decision
for the
Glen Canyon Dam Long-Term
Experimental and Management Plan
Final Environmental Impact
Statement

December 2016

U.S. Department of the Interior

Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

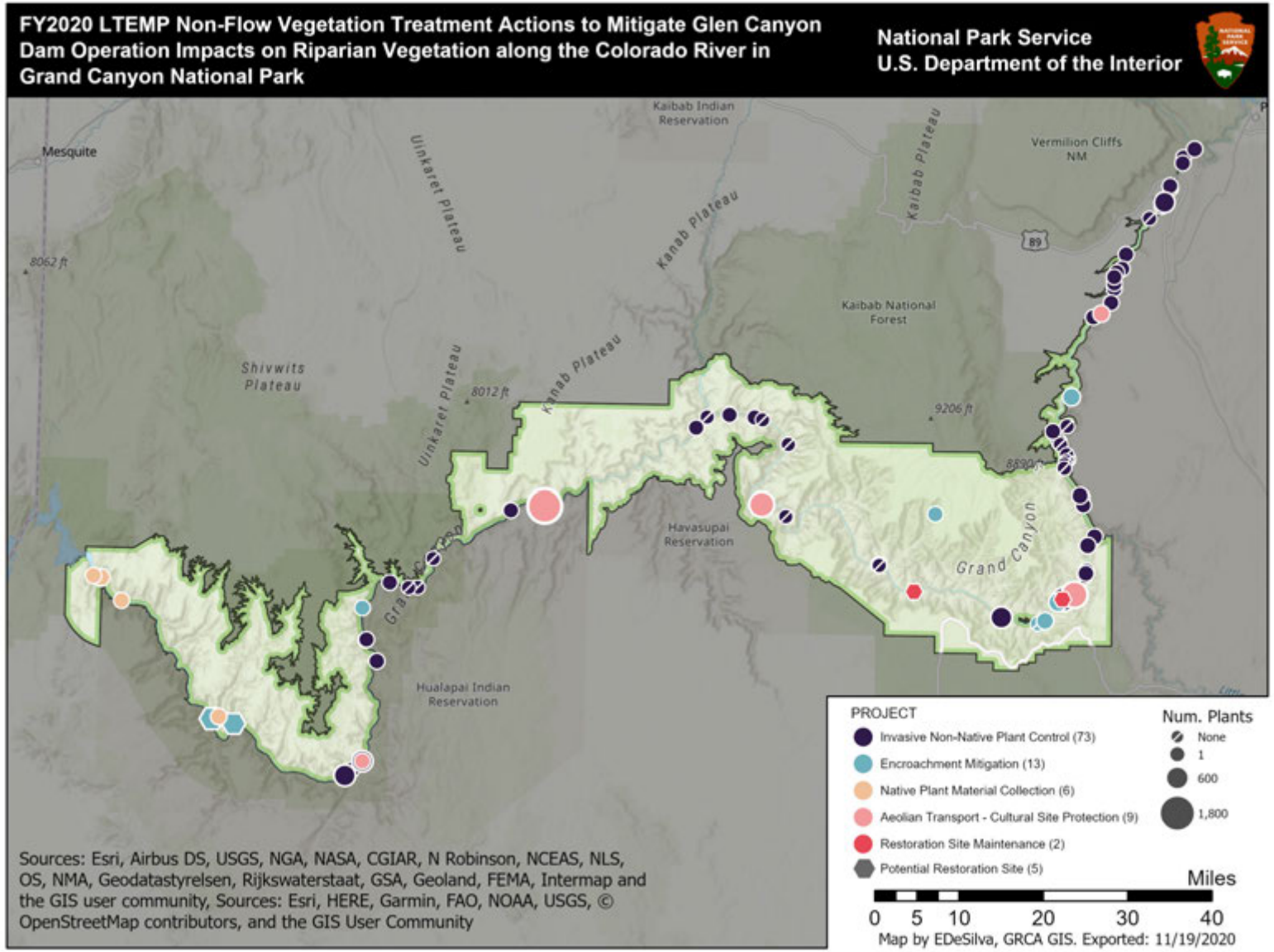
National Park Service
Intermountain Region
Lakewood, Colorado

Experimental riparian vegetation treatments as mitigation for dam operations

1. Control nonnative plant species affected by dam operations; including tamarisk and other highly invasive species
2. Develop native plant materials for replanting through partnerships and the use of regional greenhouses
3. Replant native plant species at priority sites along the river corridor; including native species of interest to tribes
4. Remove vegetation encroaching on campsites
5. Manage vegetation to assist with cultural site protection

Project C.7

NPS Project Sites



Project C.7

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

Project C.7

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Project C.7

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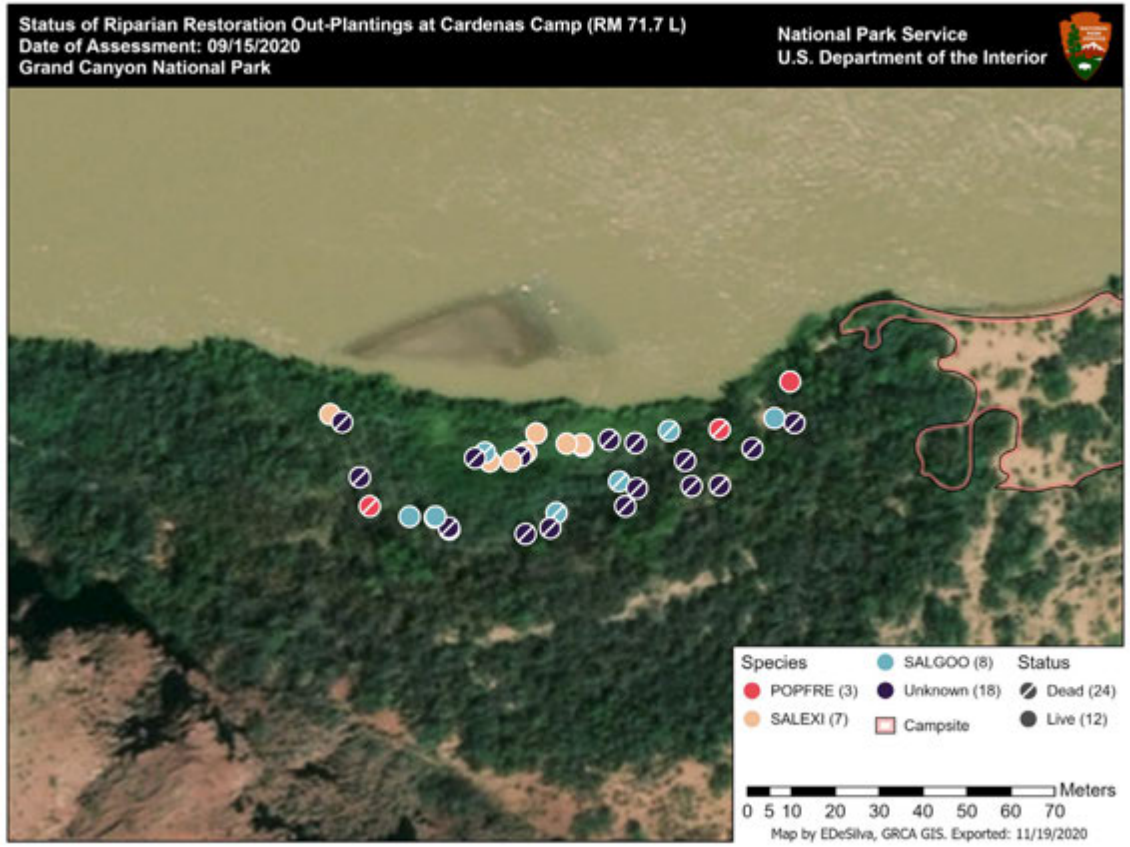


Project C.7

Remove vegetation encroaching on campsites

Project C.7

Manage vegetation to assist with cultural site protection (1)

NPS experimental vegetation removal treatments on sandbars 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 & April 2021 (planned)…

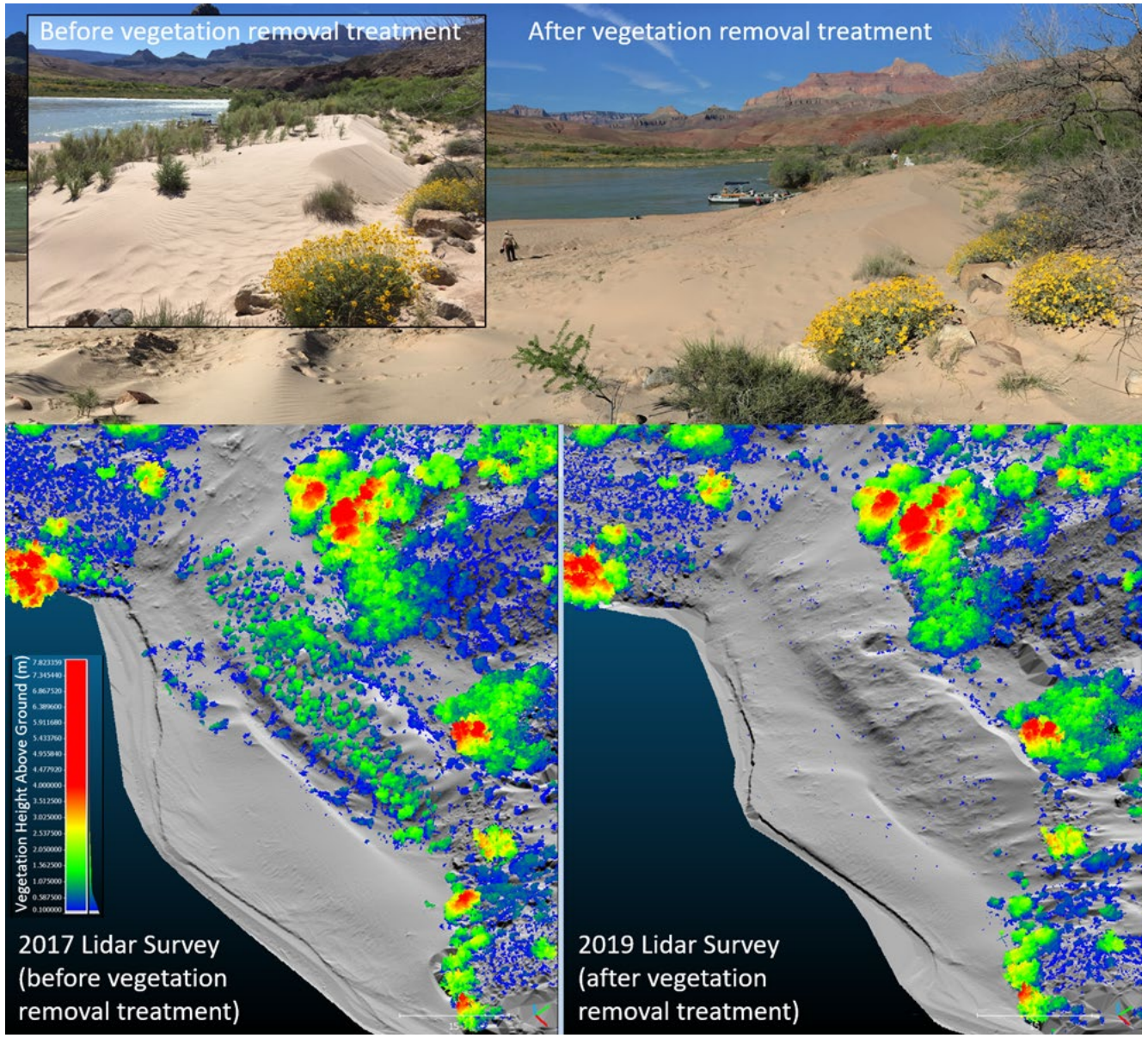
Project C.7 & D.1

Manage vegetation to assist with cultural site protection (2)

GCMRC evaluating whether treatments + HFEs do increase the supply of river sand via aeolian processes to dunefields that host archaeological sites.

Baseline lidar monitoring data: 2010-2018

Post-treatment lidar monitoring: May 2019, June 2020, May 2021 (planned)…



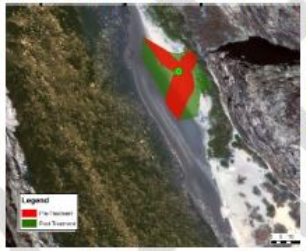
Project C.7 & D.1

Long Term Experimental and Management Plan Riparian Vegetation Project Plan

National Park Service
U.S. Department of the Interior
Grand Canyon National Park and Glen Canyon National Recreation Area

Long Term Experimental and Management Plan Riparian Vegetation Project Plan

FOR THE IMPLEMENTATION OF THE VEGETATION ENVIRONMENTAL COMMITMENTS FROM THE LTEMP ROD IN GLEN CANYON NATIONAL RECREATION AREA AND GRAND CANYON NATIONAL PARK BELOW GLEN CANYON DAM



Authored by NPS in coordination with the Grand Canyon Monitoring and Research Center (GCMRC). Project planned in partnership with the Tribes associated with the Glen Canyon Dam Adaptive Management Program (GCDAMP), and with funding from GCDAMP through the Bureau of Reclamation

August 12, 2020

Project C.7 & C.4

Moving Forward

The End. Thank you for listening!

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