# Preliminary Field Report from the April High-Flow Experiment

GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM, ADAPTIVE MANAGEMENT WORK GROUP MEETING, AUGUST 17, 2023


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**GCMRC Project D: Effects of Dam Operations and Vegetation Management for Archaeological Sites**

**Reclamation Project C.7: Experimental Vegetation Treatment - GRCA**



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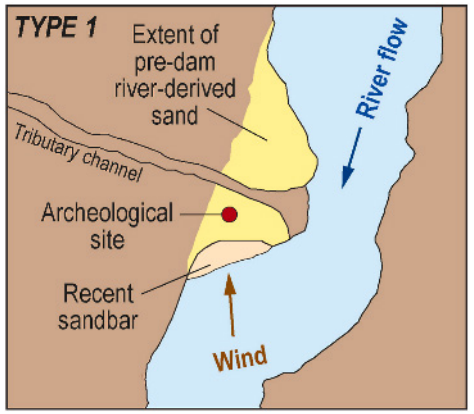
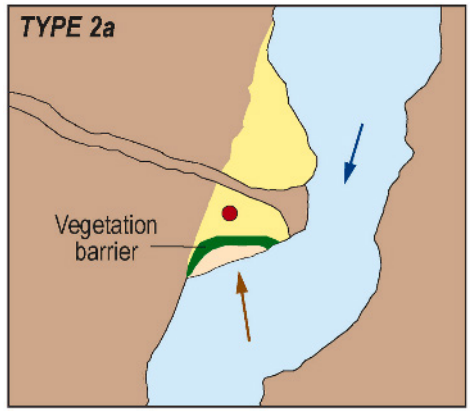
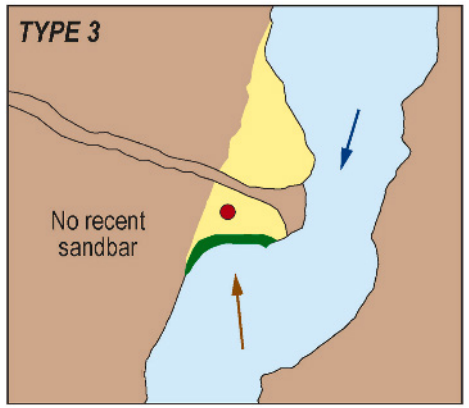
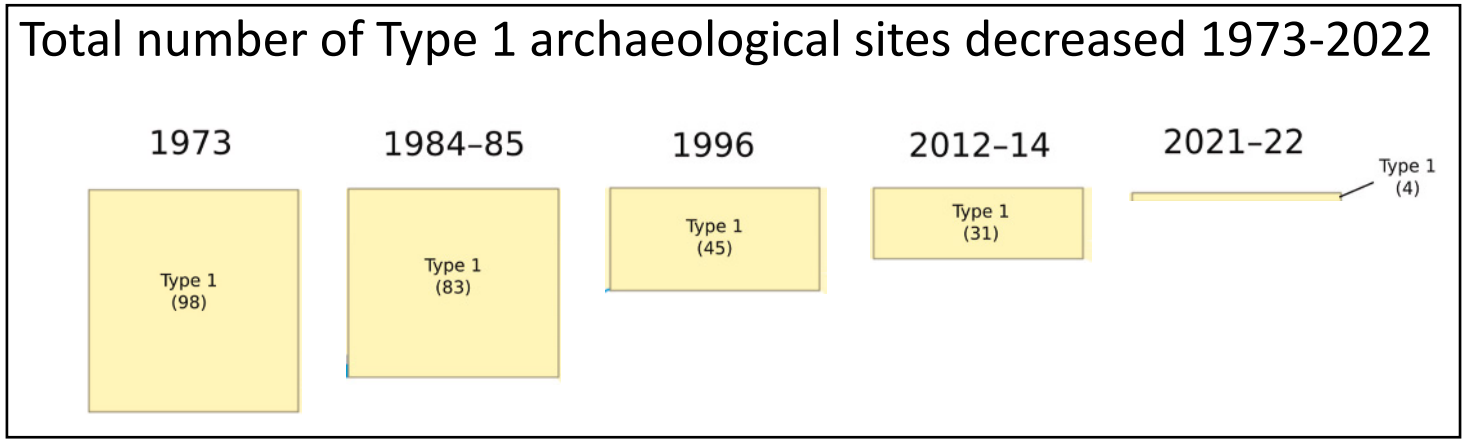
# River sediment, riparian vegetation, & archaeological site preservation

- Burial by river-sourced aeolian (windblown) sand is an important mechanism for archaeological site preservation
- Long term reduction in sediment supply and increase in riparian vegetation since closure of Glen Canyon Dam decrease site preservation potential




*Sankey et al., 2023,* Archaeological sites in Grand Canyon National Park along the Colorado River are eroding owing to six decades of Glen Canyon Dam operations, *Journal of Environmental Management*

# Dunefield Archaeological Site Management Experiments

Three ways to increase wind transport of river-sourced sand to higher-elevation dunefields where most archeological sites are located to help increase potential for site preservation

Increase aeolian supply of upwind bare sand by:
1. High flow experiments (HFEs) to rebuild river sandbars (*Sankey et al., 2018, Aeolian Research*)
2. Lowering dam releases to expose sand that is normally underwater in the river channel & eddies (*Sankey et al., 2022, JGR*)

Minimize vegetation on sandbar blocking wind transport of sand:
3. Vegetation-management experiments to remove the barrier of riparian vegetation on sandbars

**2. Channel and eddy sand**

**1. Sandbar sand**

**3. Vegetation**

WIND TRANSPORT

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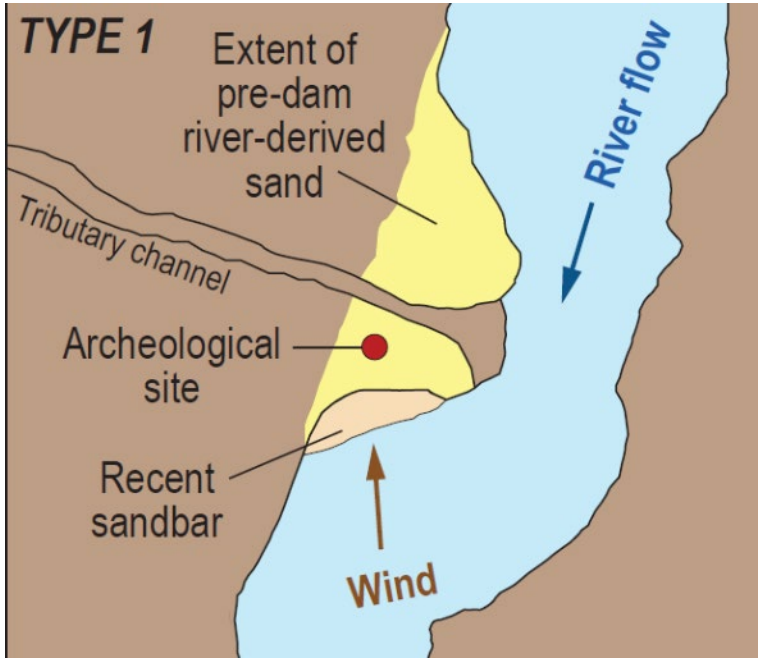
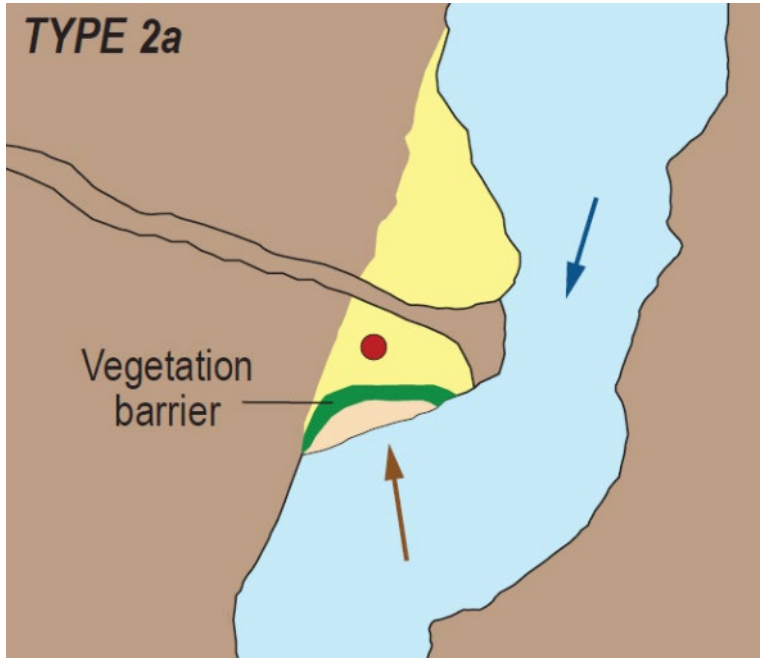
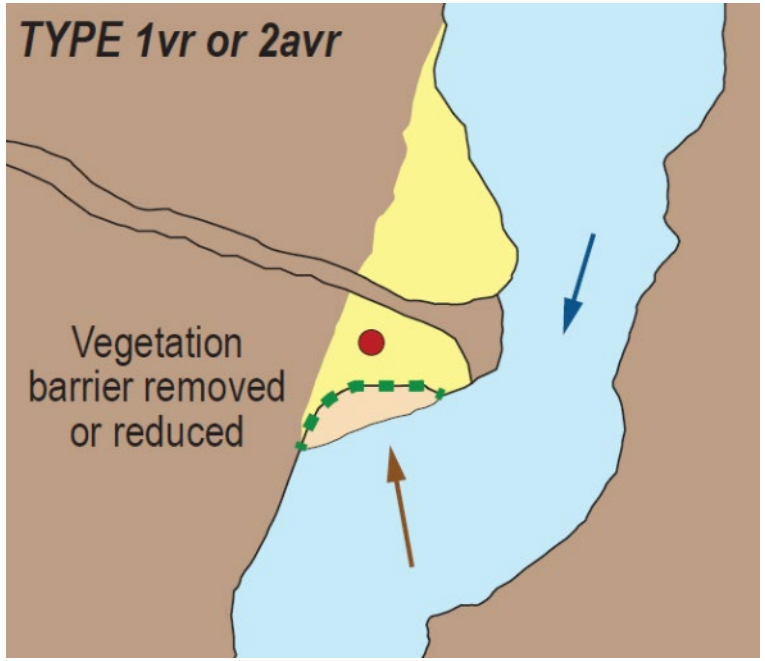
# Experimental management of aeolian transport of river sourced sand for archaeological sites in Grand Canyon

- Research and Management Question
  - Does removal of riparian vegetation barriers located between river sand bars and archaeological sites increase the resupply of windblown river sand to archaeological sites & thus increase the probability of achieving the Long-term Experimental and Management Plan (LTEMP) goal of preservation in place?



# Vegetation Management and HFE: Basalt Camp example 2018 - 2023

- National Park Service (NPS) with Ancestral Lands Conservation Corps tribal crews have worked to remove invasive plants annually on sand bars since 2019

- 2023 is first HFE since the effort began
- First of a kind management experiment in a river ecosystem in the world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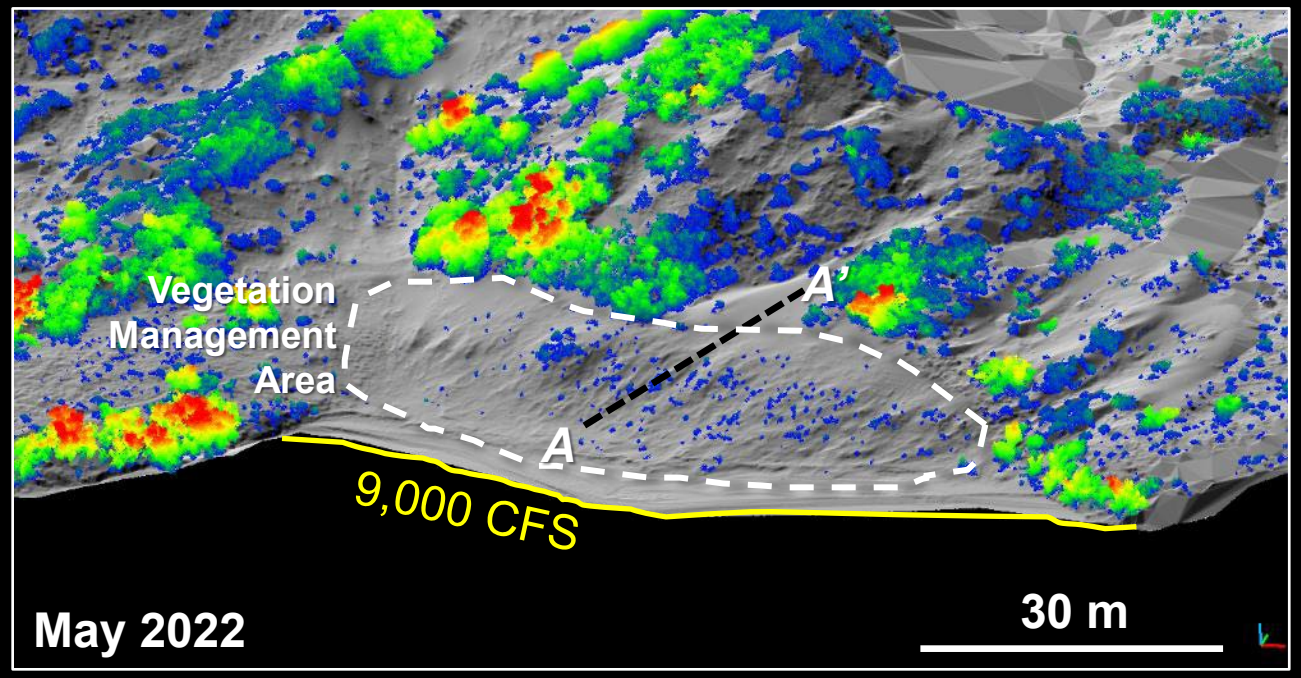
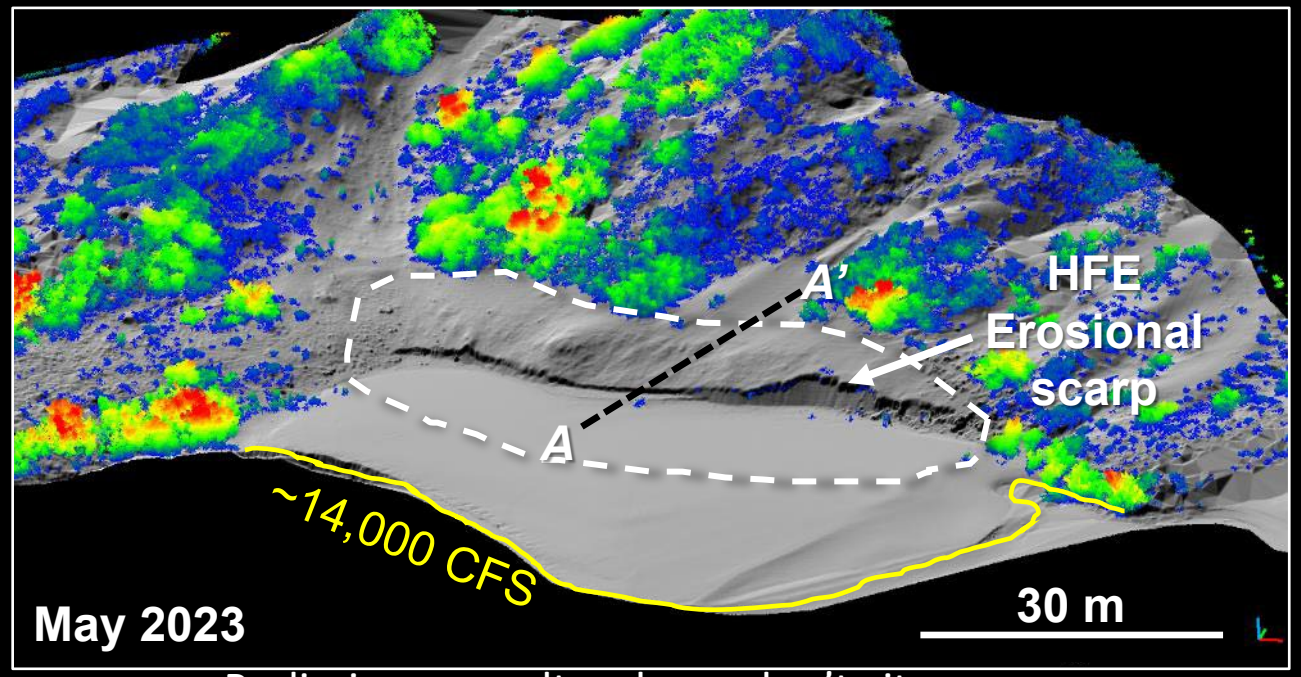
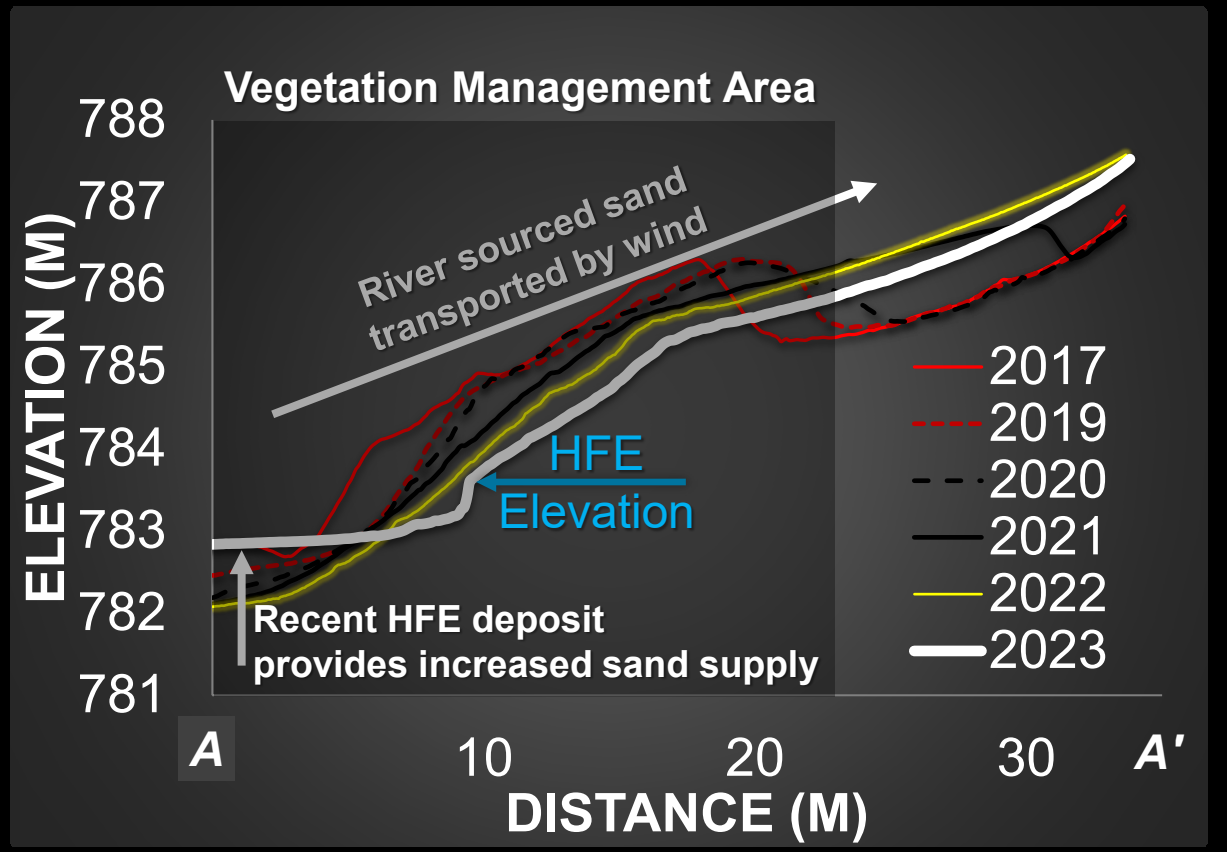
Preliminary results, please don't cite

# Lidar monitoring at Vegetation Management Sites: Observations at Basalt Camp

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# Vegetation Management and HFE: Mile 122 Camp example 2018 - 2023

- Lidar monitoring occurs at 6 vegetation management sites
  - 2 sites (Basalt and 122 mile camps) are also sand bar monitoring locations
  - Sites respond uniquely to management actions


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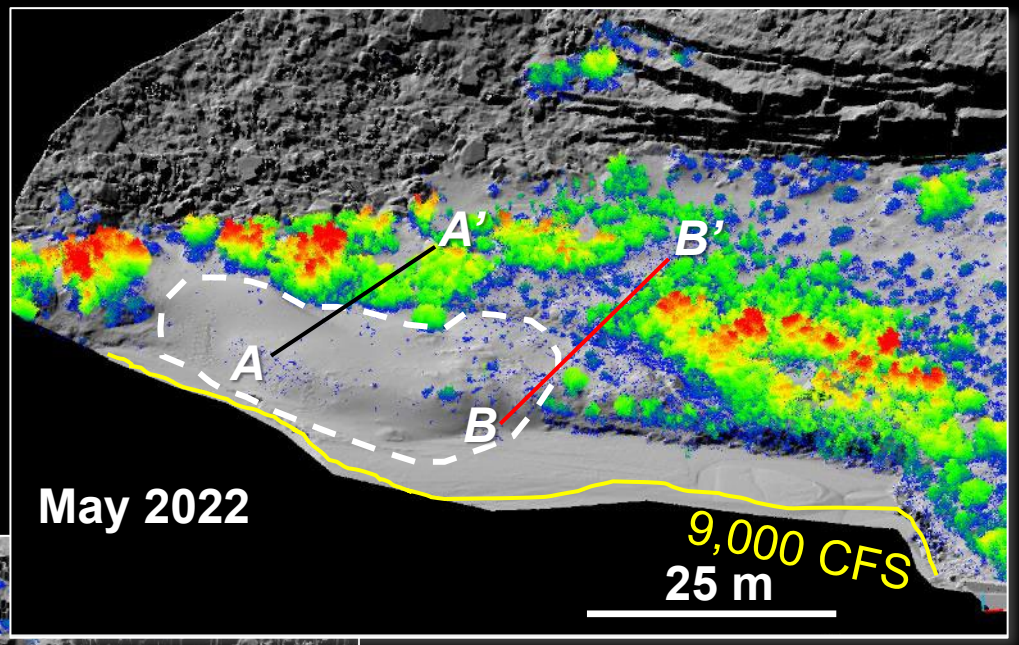
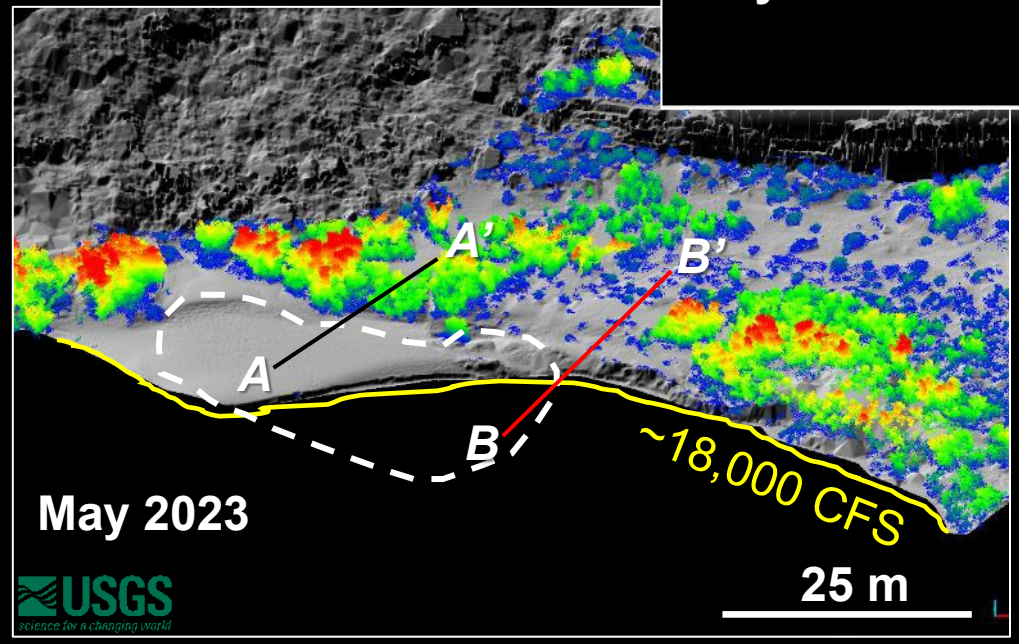
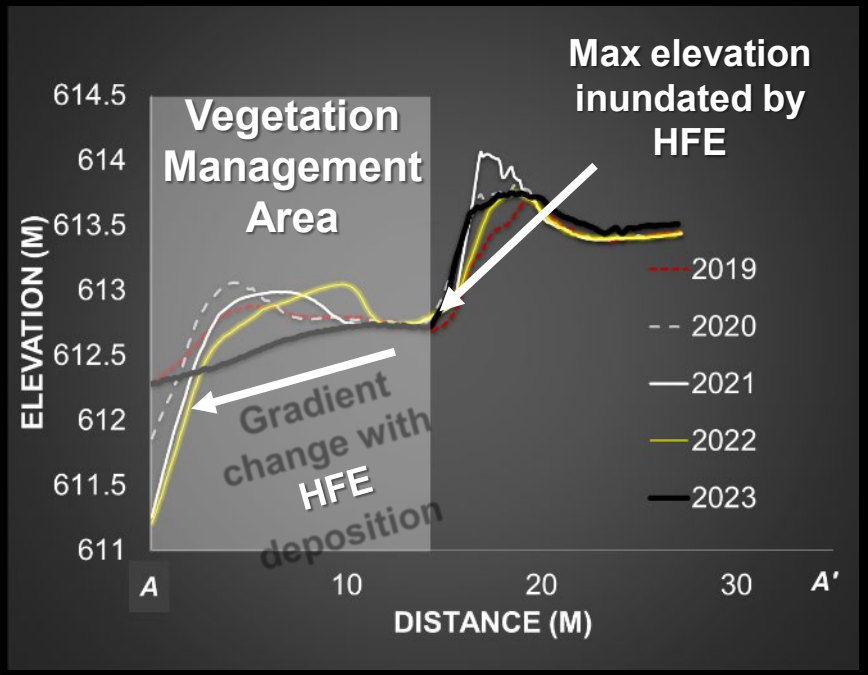
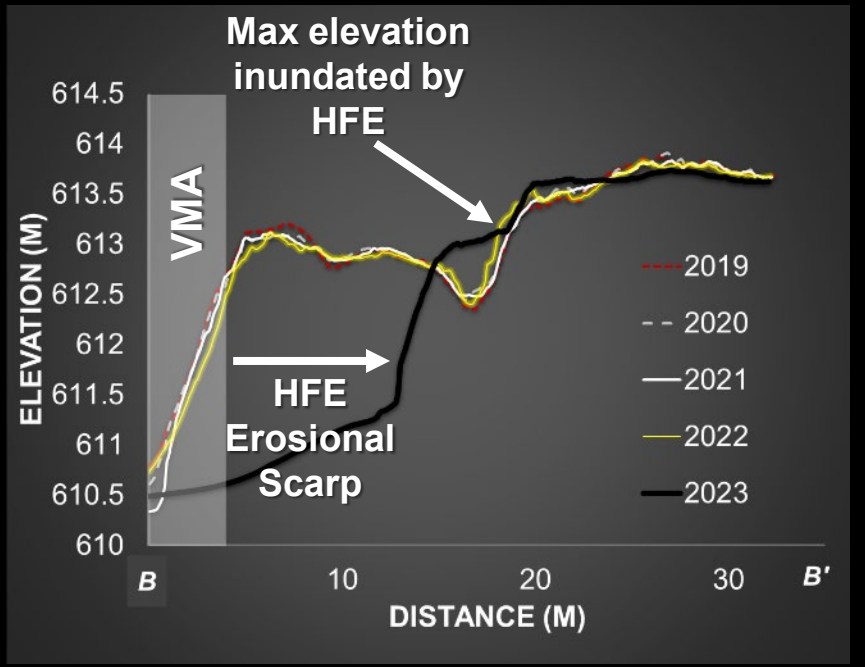
# Lidar Observations at Mile 122 Camp

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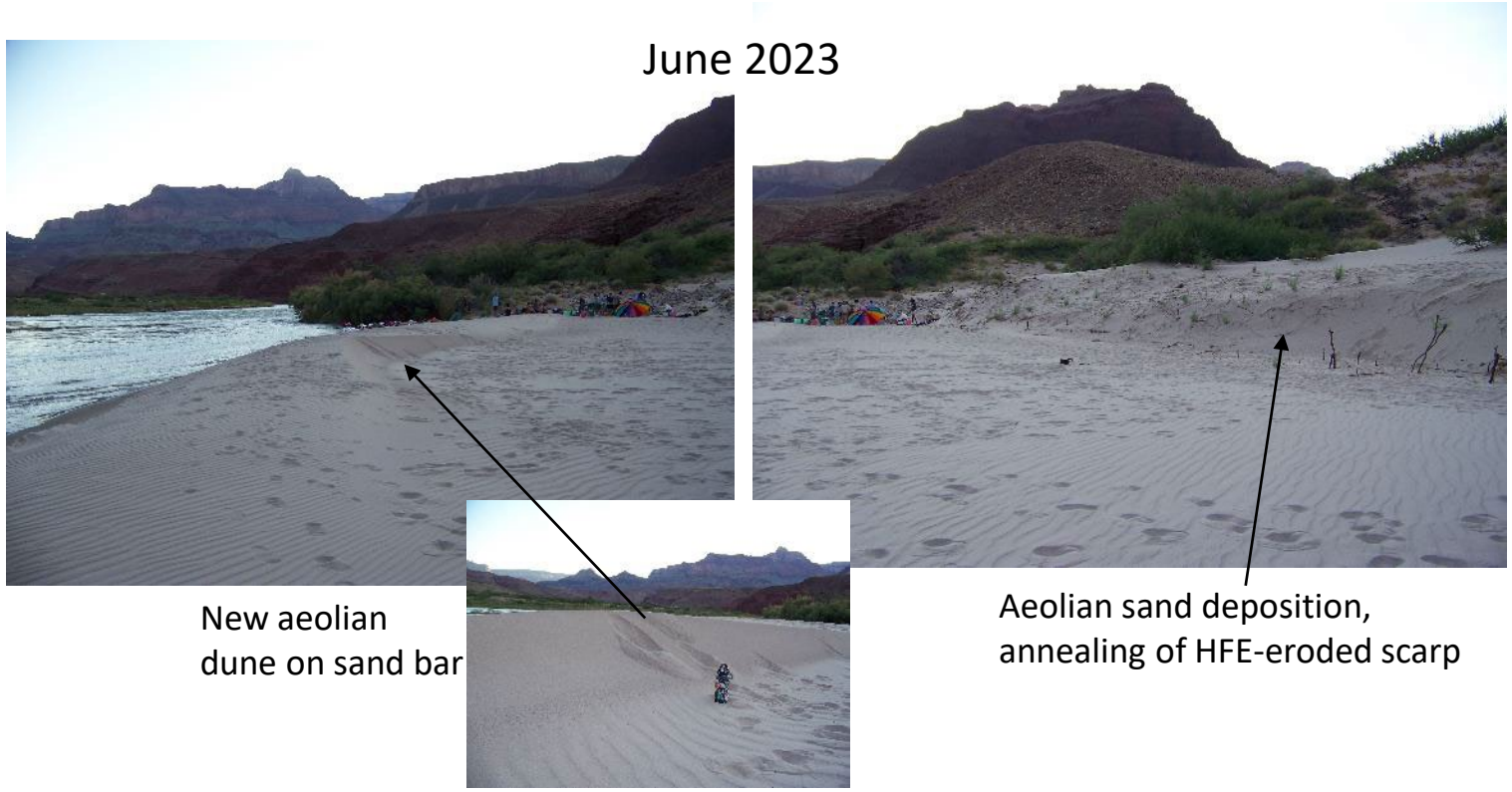
# Summary of preliminary observations

- Annual removal of riparian vegetation on river sandbars increased aeolian transport and dune migration of river sourced sand: 2019-2023
- HFE (April 2023)
  - Eroded dune and vegetation removal area
  - Rebuilt sandbar deposit that is source area of aeolian sand
- Post-HFE (April-June 2023)
  - Sand bar erosion by fluctuating river flows
  - Aeolian sand transport, dune building on sandbar
  - Aeolian deposition, annealing of eroded vegetation management area


June 2023






Preliminary results, please don't cite

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Research article

# Archaeological sites in Grand Canyon National Park along the Colorado River are eroding owing to six decades of Glen Canyon Dam operations

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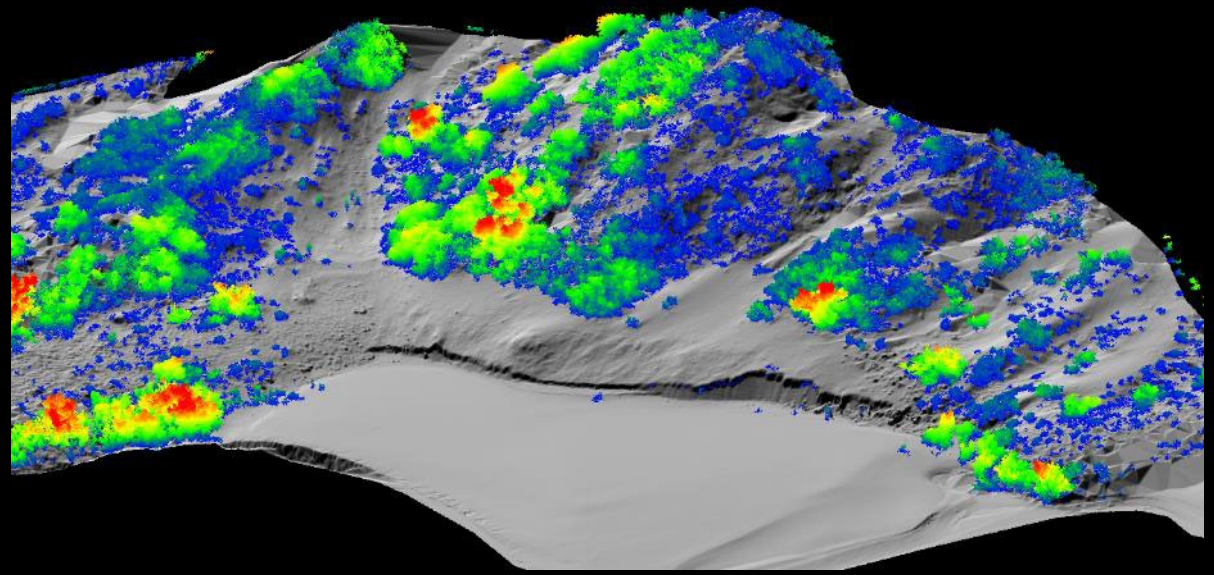
https://doi.org/10.1016/j.jenvman.2023.118036  

## Highlights

- Integrity of 362 Colorado River archaeological sites assessed 60 years after damming.
- River-sourced aeolian sand decreased since 1973, making most sites more erosion-prone.
- Proportion of sites eroding by gully processes has increased since 2000.
- Erosion limits management goal to maintain or improve site integrity *in situ*.
- Environmental management opportunities: floods, low flows, riparian plant removal.



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