# Historical Changes to Culturally-Important Riparian Plants along the Colorado River:

## a progress report on a pilot study integrating science and traditional ecological knowledge

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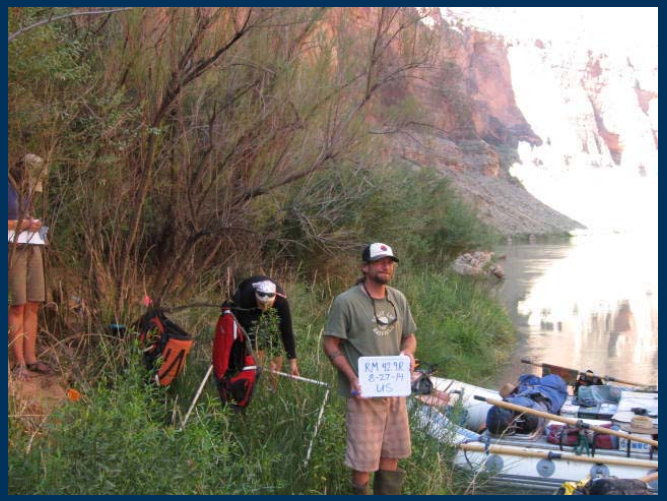
# Linking TEK and western science

**Project seeks to link traditional ecological knowledge with western science through documenting changes to the abundance and distribution of culturally-important riparian plants of mutual interest to multiple tribes and scientists**



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# Desired Future Conditions

- GCDAMP stakeholders have expressed desire for:
  - Native riparian systems that are diverse, healthy, productive, self sustaining, and ecologically appropriate
  - Native, self-sustaining riverine wetlands
  - Riparian vegetation and habitat with appropriate mix of ages
  - Habitat for sensitive species
  - Habitat for neotropical migratory birds, waterfowl, native birds
  - Healthy, self-sustaining populations of native riparian fauna (both resident and migratory)
  - A river corridor landscape that matches natural conditions as closely as possible
  - Attributes of Traditional Cultural Properties and their culturally appropriate conditions are maintained

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# Why this study?

- Plants have cultural value –- as food, traditional medicine, wildlife habitat, biodiversity, etc.

  (all are culturally-determined values)

- Dams change riparian plant communities by altering the hydrology, nutrient supply, sediment supply, and disturbance regime of the natural system

- Many existing studies discuss effects of dams on vegetation but few examine effects to culturally-important plants (or to TCPs and cultural landscapes)

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# Why this study? (continued):

- Cultural values influence why we care about plants and also why and how we study plants
- Plants contribute value to Traditional Cultural Places--so changes in plant communities can affect TCPs and alter cultural/historical significance
- GCMRC vegetation monitoring data driven primarily by biological science questions, not cultural concerns
- Tribal ethnobotanical inventories and monitoring data not well integrated with other GCDAMP studies

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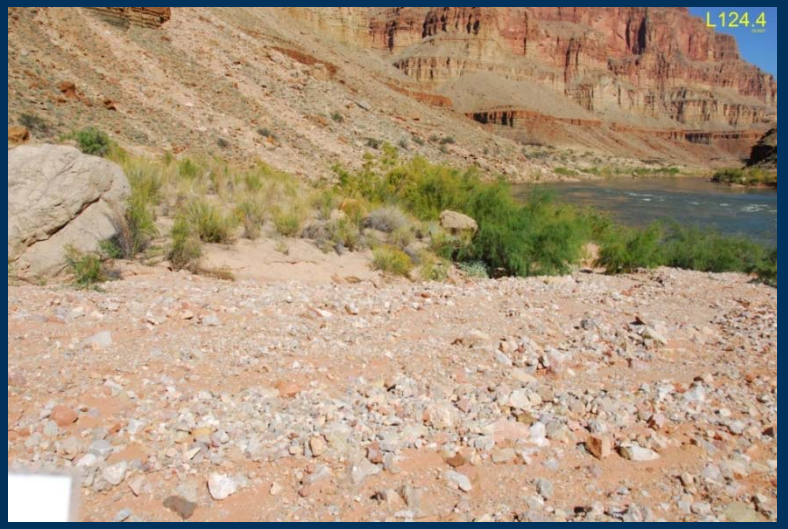
# Many drivers of vegetation change

- **Regional climate change (e.g., drought, frosts)**
- **Specific weather events (e.g., debris flows)**
- **Diseases, pathogens**
- **Non-native invasions**
- **Direct human impacts (e.g., trampling, selective removal)**
- **Human alteration of natural disturbance regime (e.g., fire, grazing, dam operations)**

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# Project Goals: Link TEK (ethnobotany) with western science to answer the following questions:

- **Question 1: How have attributes* of culturally-valued riparian plants changed since closure of Glen Canyon Dam?**
  - **Abundance, distribution, density, diversity, size**

- **Question 2: Have changes in the abundance and distribution of culturally-valued plants affected TCPs / cultural values important to GCDAMP Tribes? If so, how?**


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# Project 12 Plan

- Element 12.1 – Data Compilation
  - Workshop to review information sources and identify focal species for pilot study
  - Historical imagery analysis
  - Literature reviews, analyze existing data
  - Identify changes associated with specific culturally-important areas for individual tribes

- Element 12.2 – Tribal monitoring
  - Second workshop to review Year 1 results; discuss applications for tribal monitoring
  - Pilot use of historical photographs & data to elicit tribal perspectives on landscape changes


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# First Step: Identify subset of plants for the pilot study (February 2015)

- **Identify valued species common to multiple tribes** (compare existing ethnobotanical inventories)
- **Focus on riparian and "beach zone" plants**
- **Identify species with restoration potential**

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# Pilot Study Focal Species

- Goodding willow (*Salix gooddingii)*
- Cottonwood (*Populus fremonti*)
- Netleaf Hackberry (*Celtis reticulata)*
- Honey Mesquite (*Prosopis glandulosa*)
- Coyote willow (*Salix exigua*)
- Seep willow (*Baccharis emoryi, B.salicifolia*)
- Apache plume (*Fallugia paradoxa*)
- Arrow weed (*Pluchea sericea*)
- Common reed (*Phragmites australis)*
- Cattail (*Typha sp*.)
- Horsetail (*Equisetum sp*.)
- Dropseed (*Sporobolus* sp.)
- Indian Rice Grass (*Achnatherum hymenoids*)

Trees

Shrubs

Grasses & Grass-like Plants

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- Also Prince's plume (Stanleya pinnata), Globemallow (Sphaeralcea ambigua), and Canyon Grape (Vitis arizonica)

# Potential Sources of Information

- Published articles and reports (botanical, archaeological, etc.)
- Vegetation monitoring program data
- Historical photography: photo matches by RH Webb and others (Stanton -1889/90, Birdseye-1923, Weeden-1973, etc.)
- Historical journals (Clover, Nevills, etc.)
- Oral traditions

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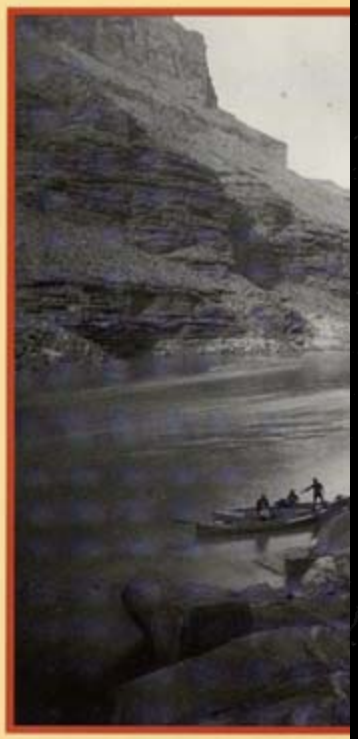
Grand Canyo

Rephotography of

R O B E



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Prepared in cooperation with the
GRAND CANYON MONITORING AND RESE

**Observations of Er**
**in Grand Canyon, A**

Water-Resources Investigation

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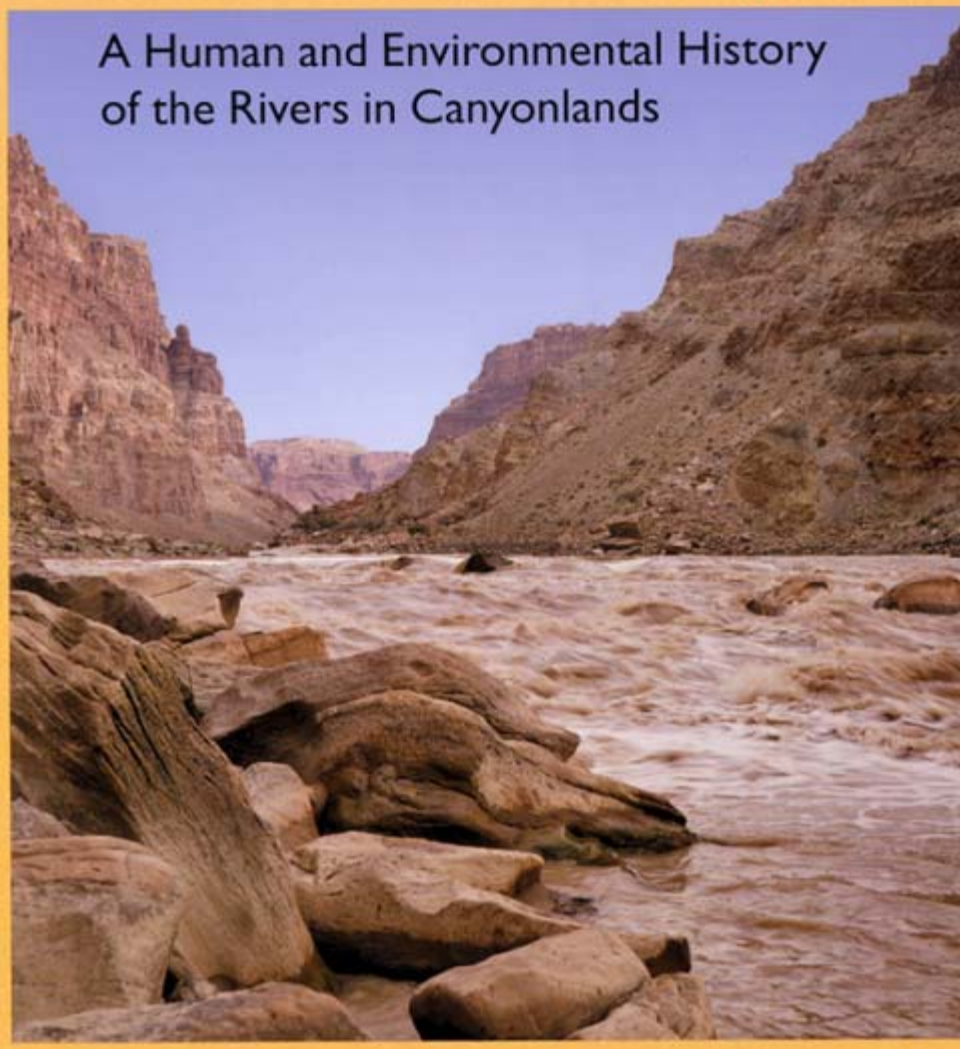
# Cataract Canyon

## A Human and Environmental History of the Rivers in Canyonlands



Robert H. Webb
Jayne Belnap
John S. Weisheit

# Photo Matching

1. Relocate historical view
2. Relocate exact position of original photographer
3. Replicate the view
4. Compare identical views at different time periods
5. Record plant differences between the two images
6. Document differences across multiple images
7. Summarize changes throughout river corridor

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Top Image: RB Stanton, 1890
Bottom Image: RH Webb, 1990

# Limitations of historical image matching

- quality of imagery
- ability to identify species
- seasonal differences
- representativeness
- obtaining high-quality photo matches requires large time investment
- methods for quantifying change difficult to apply (except for large distinctive species, e.g., barrel cactus)


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# Progress report

- 128 of 456 existing Stanton images examined (28%)
- Total of 256 matched pairs analyzed (1889/1890 with 1990s and 1990s with 2010/2011)
- Base of Glen Canyon Dam to Little Colorado River (~77 miles = approximately 32% of river corridor)
- Noticeable increases in riparian vegetation in both sets of matches (1890-1990s and1990s-2010/11)
  - Where riparian change can be reliably seen (n=116),

  only 7 matches (6%) did not show increase from 1890s to 1990s and only 5 matches (4%) did show increase from 1990s to 20101

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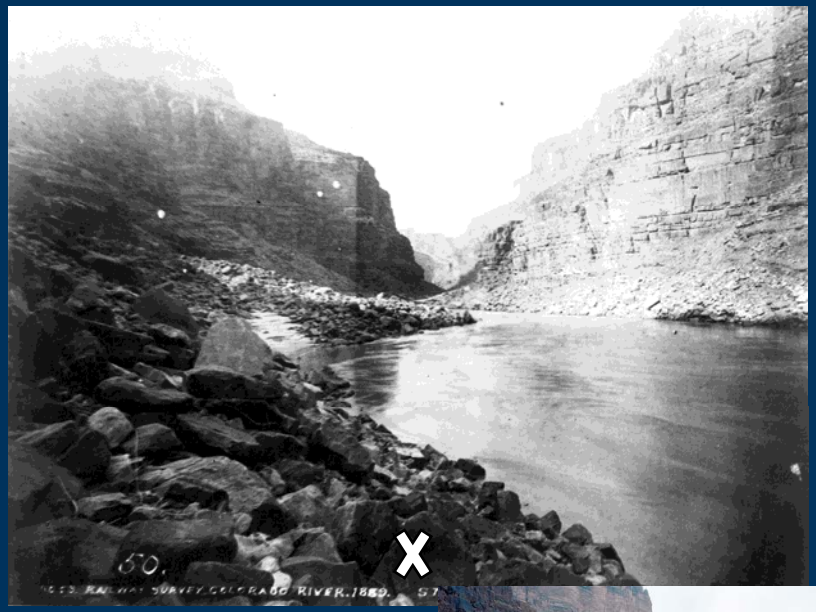
Preliminary Results – Please Do Not Cite

# Example of riparian veg increase



2011

River Mile 22

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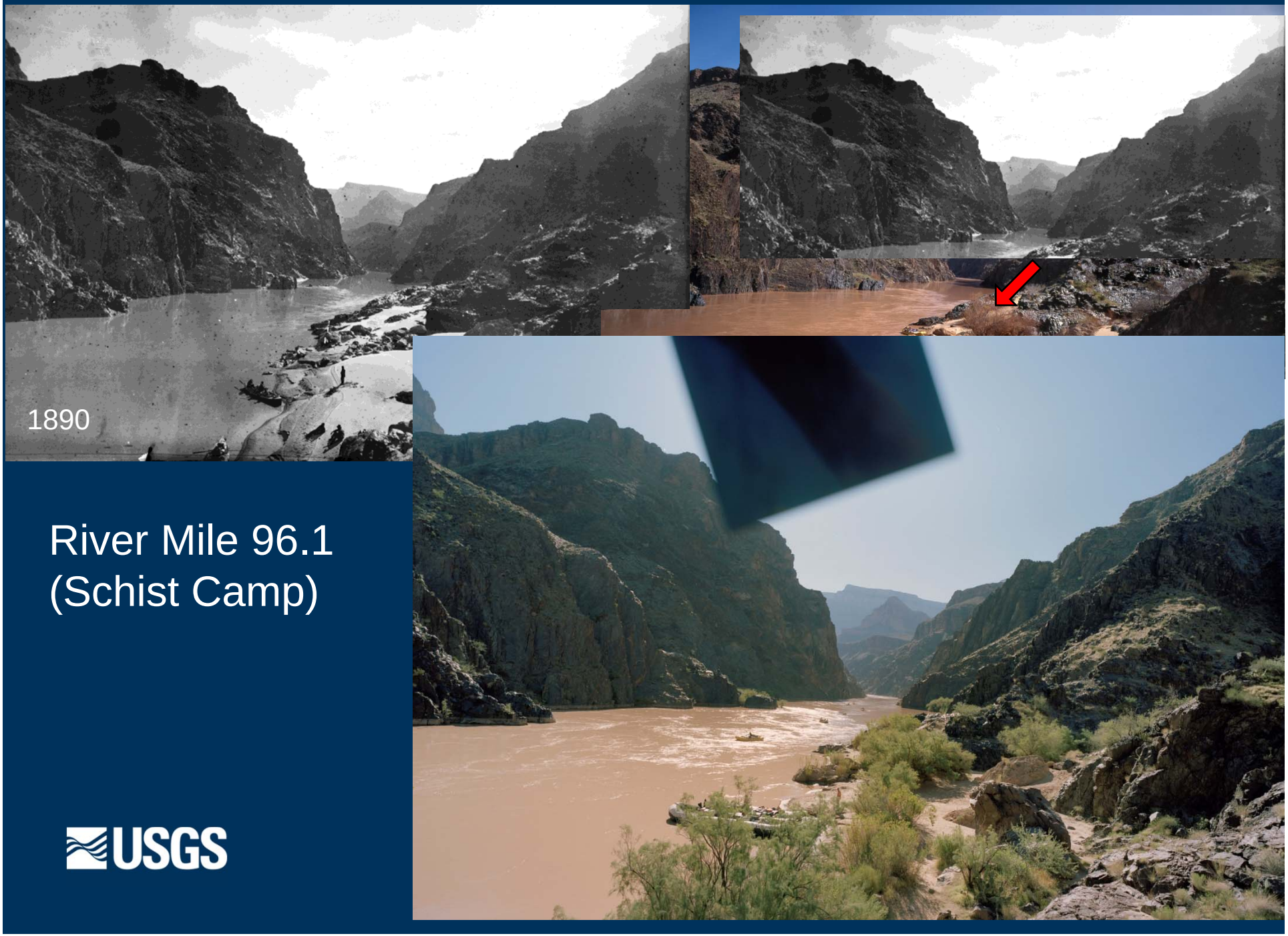


# River Mile 96.1 (Schist Camp)

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River Mile 62.6
Crash Canyon


527


Mile 222 Upstream
(1991)
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science for a changing world

# Example: *Celtis reticulata*

- **Netleaf Hackberry**: Traditional food source (berries); wood used for utilitarian items & fuel

- Appears in 16 of 128 analyzed views (12.5%)
  - 6 photos from 1889/1890 (4.6%)
  - 16 photos from 1990-1992; $\bar{\Delta}$ +7.9%
  - 16 photos from 2010-2011; $\Delta$ = 0%
- 1990s to 2010s: Existing trees continued to grow bigger but few new individuals recruited

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Preliminary Results – Please Do Not Cite



-12.2 Mile
Glen Canyon


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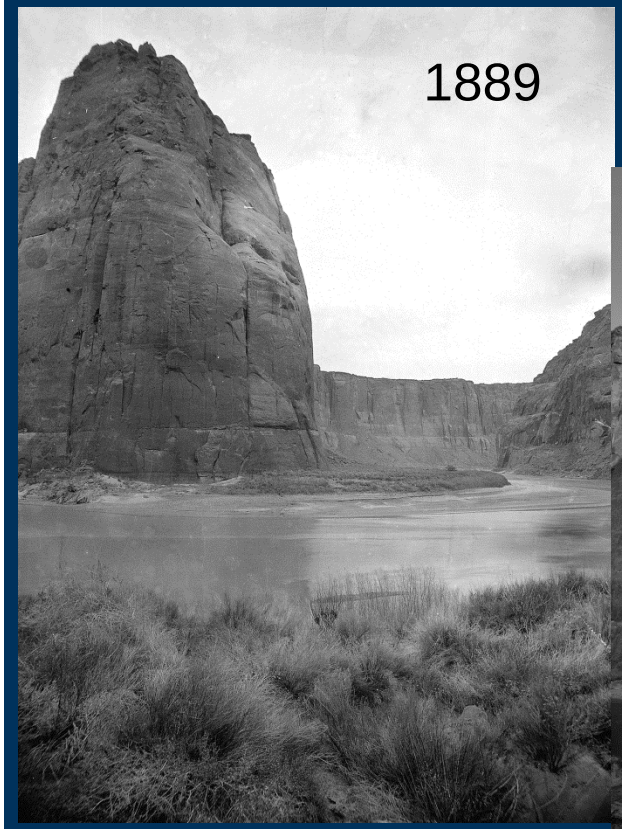




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# Example: *Falugia paradoxa*

- **Apache Plume: used in some basket-making; also used in cradleboard construction**

- **Appears in 21 of 128 analyzed views (16.4%)**
- **In 11-13 photos from 1889/1890 (8.5-10.2%)**
- **In 18 photos from 1990-1992; 14.1%, △=3.9%+**
- **In 21 photos from 2010-2011; △ = 2.3%**
- **1990s to 2010s: 12 images show no change. 3 show noticeable decrease, 4 show new growth (downslope), 2 uncertain.**

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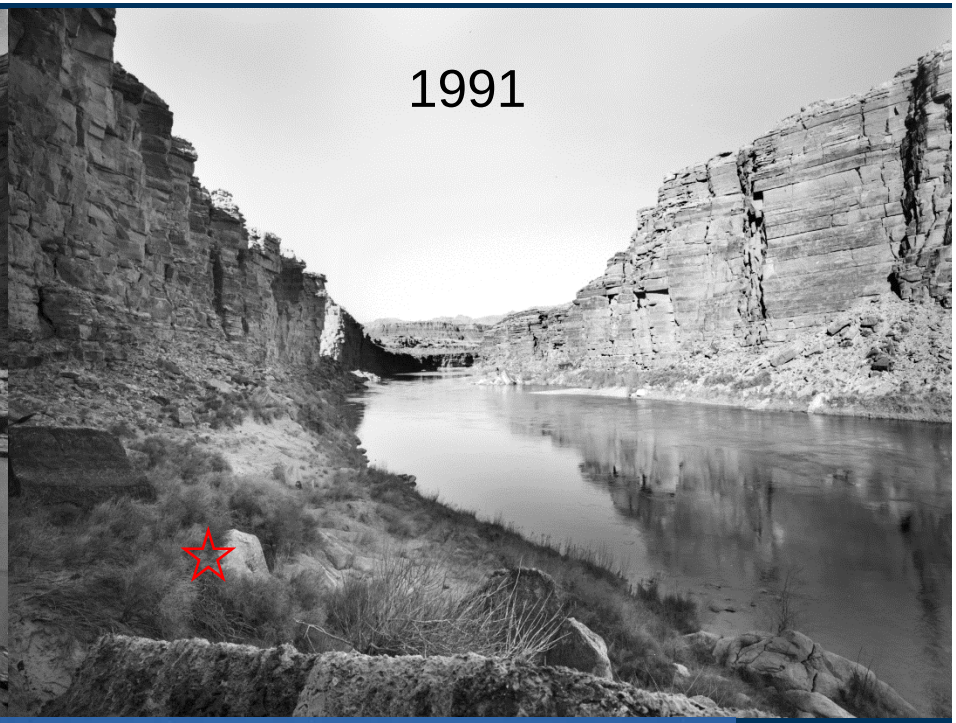


River Mile 2.9
Cathedral Wash


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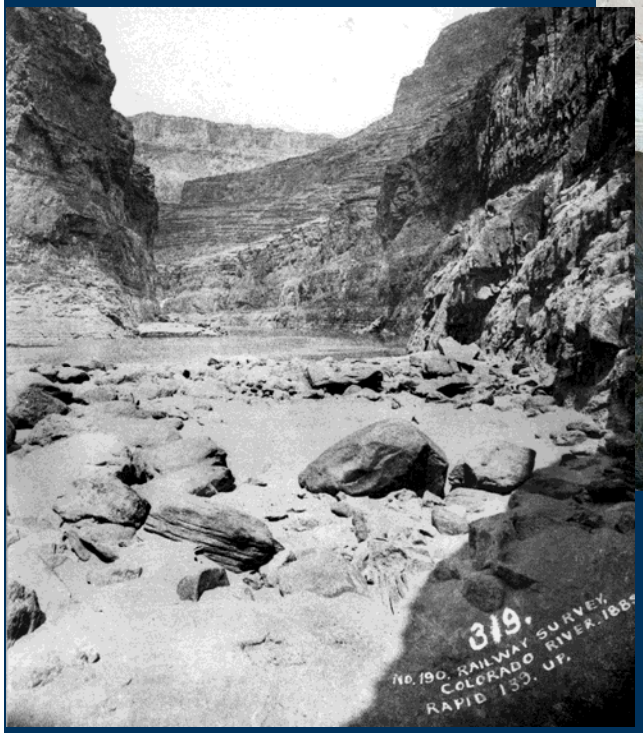
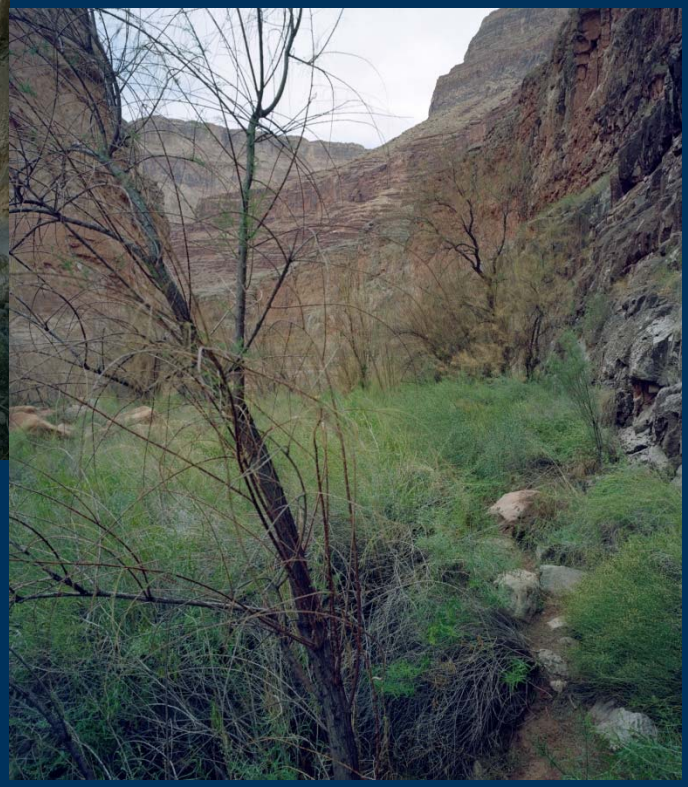
# *Baccharis sp. & Salix exigua* increase noticeably 1990s-2010s




1890

1993

River Mile 29.1
(Shinumo Wash)



2011

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# Journal entries complement photos


**“Black willows are beginning to appear along the banks of the river that afford shade which is very welcome now that there are not high walls close to the river to answer the purpose.” Elwyn Blake, Sept. 24, 1923**

**Journal entries and photos from 1923-1940 document at least 6 previously unrecorded locations of Goodding willow trees between RM ~180-225**

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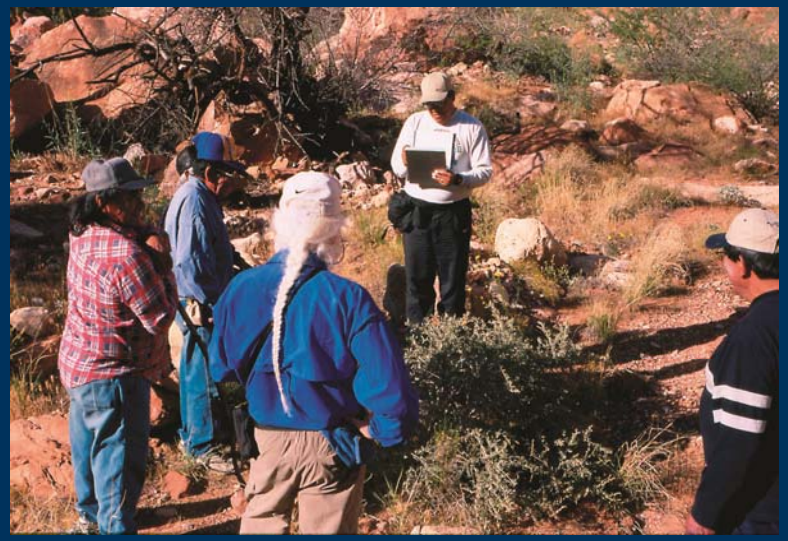
# Next steps:
# Elicit Cultural Meaning of Changes

## Possible methods:

- Choice experiments using photo comparisons
  - "Which of the paired photos do you prefer and why?"
- Semi-structured interviews
- Structured "opinion surveys"
- Focus group discussions
- Other methods?



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Questions?