Project 2. Stream Flow, Water Quality, and Sediment Transport in the Colorado River Ecosystem

- Continuing core monitoring of stage, discharge, water quality (temperature, dissolved oxygen, turbidity, salinity), sediment transport, and sand budgeting in the Colorado River ecosystem (CRe)
- Project collects and serves the fundamental physical data used to evaluate the status of the CRe with respect to the DFCs approved by the Secretary of the Interior in April 2012
- Projects collects the data and serves the sand budgets used to trigger and evaluate HFEs under the 2012-2020 High Flow Protocol approved by the Secretary of the Interior in May 2012
- Project collects and serves the physical data to be used to evaluate the preferred alternative from the LTEMP EIS
- Measurements from this project are the data that directly link dam operations to to the physical, biological, and sociocultural resources of the CRe, and are used in virtually all other physical, ecological, and socio-cultural resource investigations funded by the Glen Canyon Dam Adaptive Management Program

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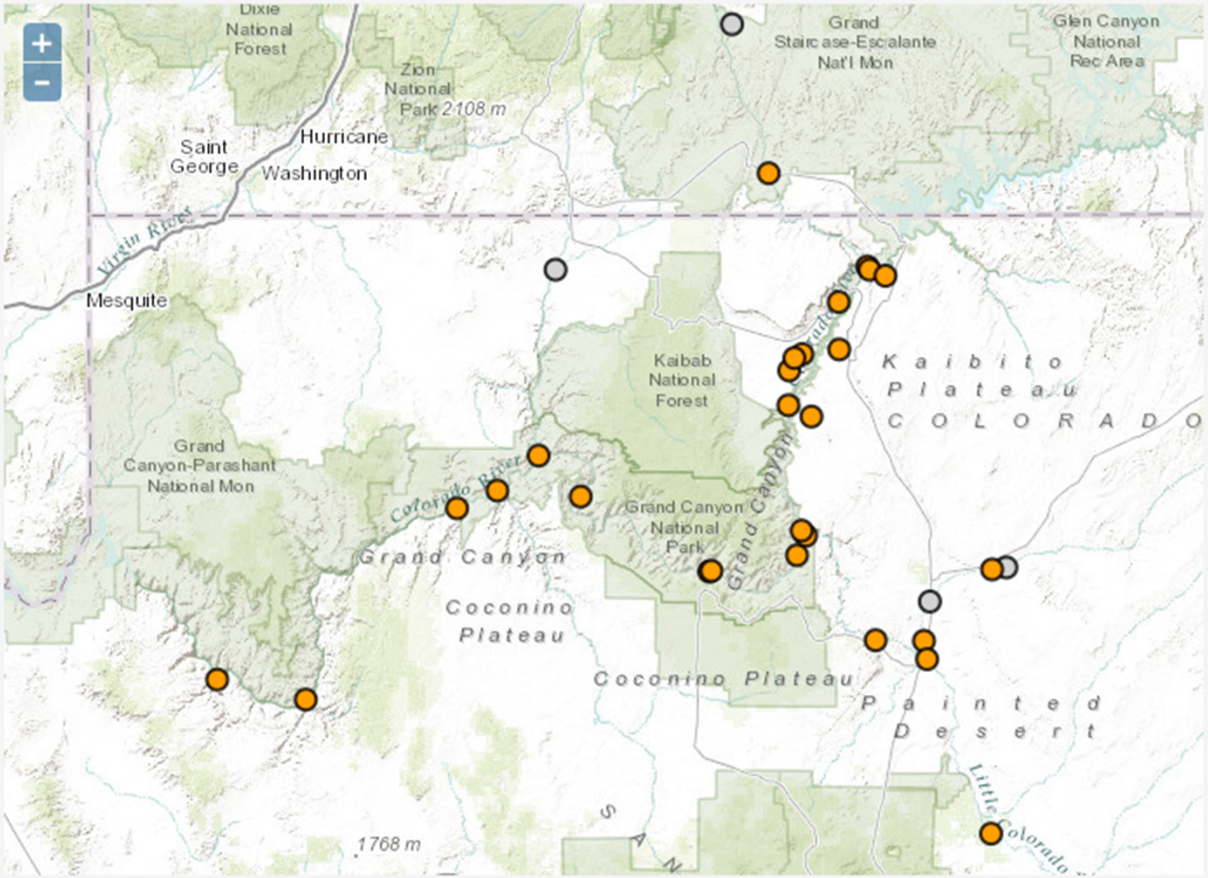
http://www.gcmrc.gov/discharge_qw_sediment/

Grand Canyon Stations

Home > Discharge, Sediment and Water Quality > Grand Canyon Stations



Stations

Active | Inactive

Water Holes Canyon above the mouth
GCMRC-GCLT1

Colorado River at Lees Ferry, AZ
09380000

Paria River near Kanab, UT
09381800

Paria River at Lees Ferry, AZ
09382000

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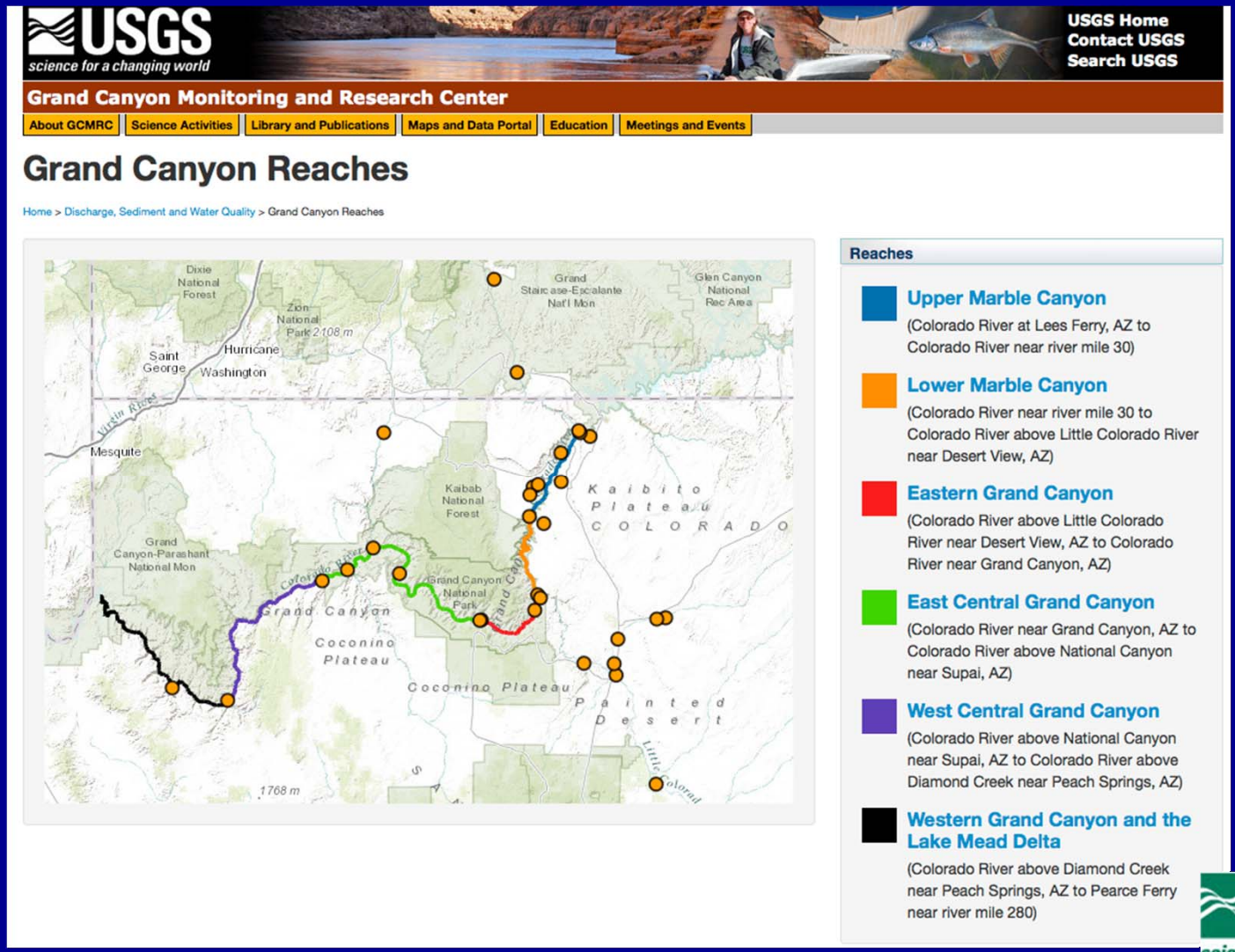
User-interactive sand budgets for 6 reaches used to evaluate DFCs, trigger and evaluate HFEs, and evaluate the preferred alternative from the LTEMP EIS



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Project 3. Sandbars and Sediment Storage Dynamics: Long-term Monitoring and Research at the Site, Reach, and Ecosystem Scales.

- 3.1. Sandbar Monitoring
  - 3.1.1. Monitoring sandbars using topographic surveys and remote cameras (Annual monitoring of area and volume at 47 sandbars, campsites at 37 sites, and daily photos at 44 sites. Advance methods for analyzing remote camerea images)
  - 3.1.2. Monitoring sandbars and shorelines above 8,000 ft^3/s by remote sensing (Analysis of images collected in 2013 overflight to measure sandbar area at 1300+ sites between dam and Lake mead)

New

  - 3.1.3. Surveying with a camera: Rapid topographic surveys with digital images using structure-from-motion (SFM) photogrammetry (Evaluation and development of method to "survey" sandbars using a hand-held digital camera. Will be tested at current monitoring sites on annual monitoring trips. If successful, would use to increase number of monitoring sites at minimal added cost.)
  - 3.1.4. Analysis of historical images at select monitoring sites (Create digital elevation models from 1984 air photos for sandbar monitoring sites. Analyze 3 to 6 sites/year, as budget allows. The comparison of bar size following 1983-84 floods provides context for bar size following controlled floods)

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- 3.2. Bathymetric and Topographic Mapping for Monitoring Long-term Trends in Sediment Storage
  - Will provide robust measure of changes in sandbars and in sand storage on bed over time periods of HFE Protocol and LTEMP.
  - Provides map of channel and bed texture for fish and food base studies in Glen Canyon in 2015.

New
- 3.3. Characterizing, and Predictive Modeling, of Sandbar Response at Local and Reach Scales
  - Develop a model for sandbar response to dam operations and sediment supply conditions. Will use detailed 3-dimensional model at a few sites and generalize to many sites.

New
- 3.4. Connecting total sand transport, bed morphodynamics, and sand budgets in Grand Canyon
  - Study movement of sand as bedload. Provide better estimate for rate of bedload sand transport.
- 3.5. Control Network and Survey Support
  - Maintain and improve capability to provide accurate spatial referencing for all geospatial research and monitoring.

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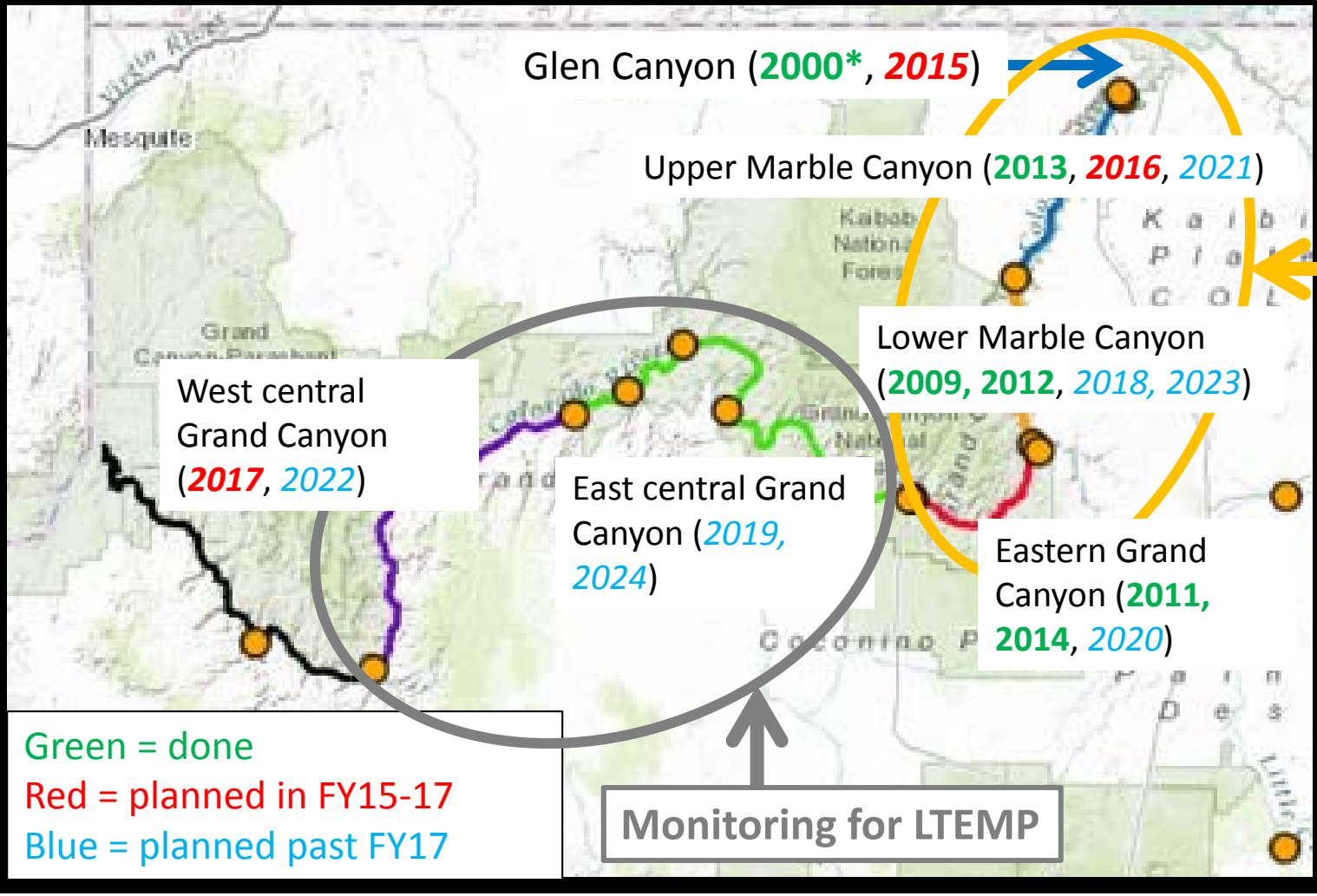
- 3.2. Bathymetric and Topographic Mapping for Monitoring Long-term Trends in Sediment Storage
  - Will provide robust measure of changes in sandbars and in sand storage on bed over time periods of HFE Protocol and LTEMP.
  - Provides map of channel and bed texture for fish and food base studies.

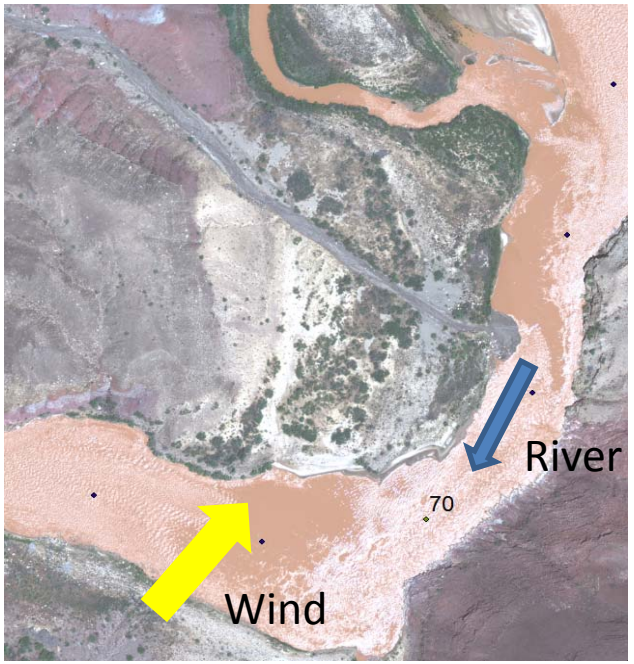


Project 4

Joel Sankey, Amy (Draut) East, Helen Fairley, Joshua Caster

- Element 4.1 *Quantifying connectivity along the fluvial-aeolian-hillslope continuum at landscape scales*
  - Research (ongoing)
    - What controls the transport of HFE sand to upland sites by wind?
      1. Spatial distribution of aeolian sand relative to sandbars, vegetation, topography with data from 2002, 2005, 2009, 2013 overflights (in FY 15-17)
      2. Long-term changes in aeolian sand at archaeological sites using historical oblique photographs from Birdseye, Stanton, Webb, and others (in FY 15-17)
      3. Contrast observations of aeolian sand in Grand Canyon with Desolation and Gray Canyons of the Green River which is a regulated river system with greater sand supply (seeking non-GCDAMP funding)

- Element 4.2 *Monitoring of cultural sites in Grand and Glen Canyons*
  - Monitoring (ongoing)
    - Draft (in FY15) and implement (in FY 16-17) a monitoring plan for GCPA and NHPA section 106 information needs:
      1. Measure effects of wind transported HFE sand for site surface condition and stability
      2. Evaluate other variables related to operations that affect site condition
      3. Integrate non-flow condition variables, as appropriate



Project 5: Food Base Monitoring and Research

5.1 Are aquatic insect diversity and production recruitment limited?

5.1.1 Insect emergence in Grand Canyon via citizen science
Ongoing long-term monitoring 2012-2017

5.1.2 Effects of hydropeaking on oviposition and egg mortality
New research 2015-2017

5.1.3 Synthesis of stressors and controls on EPT distributions
New research 2015-2017

5.1.4 Synthesis of the aquatic foodbase in western US tailwaters
New research 2015-2017

5.1.5 Natural history of oviposition for species in Grand Canyon
New research 2015-2017

5.1.6 Laboratory studies on insect oviposition and egg mortality
New research 2015-2017 (unfunded)

5.1.7 Comparative emergence studies in Upper Basin
New research 2015-2017 (Submitted to Western for funding)

5.1.8 Natural history of oviposition for EPT in the Upper Basin
New research 2015-2017 (Submitted to Western for funding)

Project 5: Food Base Monitoring and Research

5.2 Patterns & controls of aquatic invert drift in Colorado R. tailwaters

- 5.2.1 Characterize and monitor drift, emergence in Glen Canyon
  Ongoing long-term monitoring 2013-2017
- 5.2.2 Drift monitoring in Glen, Marble, and Grand Canyons
  Ongoing long-term monitoring 2013-2017
- 5.2.3 Link drift to channel bed shear stress
  Ongoing research 2013-2017
- 5.2.4 Link drift patterns to substrate in Glen, Marble, Grand Canyons
  Ongoing research 2013-2017
- 5.2.5 Comparative drift in Upper and Lower Basin tailwaters
  New research 2015-2017 (Submitted to Western for funding)

5.3 Primary Production Monitoring in Glen Marble and Grand Canyons

- 5.3.1 Synthesis and publication of Glen Canyon algae production
  Ongoing long-term monitoring 2008-2017
- 5.3.2 Monitoring dissolved O_2 in Glen, Marble, and Grand Canyons
  Ongoing long-term monitoring 2008-2017
- 5.3.3 Developing automated tools for estimating algae production
  Ongoing research 2008-2017

Project 6. Mainstem Colorado River humpback chub aggregations and fish community dynamics

6.1 HBC aggregation relative abundance and distribution
Ongoing long-term monitoring 2010-2017

6.2 HBC aggregation recruitment
Ongoing and new research 2013-2017

6.3 HBC aggregation PIT tag technology
New research 2015-2017

6.4 System Wide Electrofishing (SWEF)
Ongoing long-term monitoring 2000-14, Refine during 2015-17

6.5 Brown trout natal origins through body pigment patterns
New research, defer until completion of otolith microchemistry

6.6 HBC translocations to mainstem locations
New research that may lead to management actions 2015-2017

6.7 Rainbow trout early life stage studies (RTELSS)
Ongoing long-term monitoring 2003-2017

6.8 Lees Ferry Creel Surveys
Ongoing long-term monitoring 1981-2017

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Project 7: Chub population dynamics around LCR

7.1 Spring/Fall LCR	Spring -> Adult N; Fall -> resident pop, recruit
7.2 Colorado (JCM)	Juvenile N and survival; Adult N
7.3 Early Life History	Recruit & outmigration
7.4 PIT tag arrays	Adult N - less handling? Trap shy?
7.5 LCR food base	Food limitation (density dependence)
7.6 Substrate limitation	No spring flood -> Few juvenile chub
7.7 CO2 limitation	Can chub produce juvenile in upper reaches?
7.8 Asian tapeworm	Index of infestation over time
7.9 Chub condition	Why don’t wild chub produce eggs like Dexter chub
7.10 Modelling	Trout/temp, adult N & early life history parameters

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Project 8. Management Actions to Increase Abundance and Distribution of Native Fishes in Grand Canyon

Project Elements

- Brown Trout Removal at Bright Angel Creek
- Translocation of Humpback chub
- Protocol Evaluation Panel - New
- LCR Invasive Aquatic Species Surveillance - New
- Genetic Monitoring of Humpback Chub - New

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Project 9. Understanding the Factors Determining Recruitment, Population Size, Growth, and Movement of Rainbow Trout in Glen and Marble Canyons

Project Element 9.1. Rainbow Trout Population Dynamics – Ongoing Modelling and Future Monitoring

Project Element 9.2. Detection of Rainbow Trout Movement from the Upper Reaches of the Colorado River below Glen Canyon Dam/Natal Origins

Project Element 9.3. Exploring the Mechanisms behind Trout Growth, Reproduction, and Movement in Glen and Marble Canyon using Lipid (fat) Reserves as an Indicator of Physiological Condition

Project Element 9.4. Comparative study on the feeding morphology of drift feeding fish

Project Element 9.5. Meta-analysis, and the development of reactive distance relationships for encounter rate models

Project Element 9.6. Evaluation of Turbidity (in terms of TSS) as a potential Glen Canyon Dam operations management tool to constrain rainbow trout populations and reduce predation/competition on juvenile humpback chub

Project Element 9.7. Application of a bioenergetics model in a seasonally turbid river

Project Element 9.8. Mechanisms that Limit Rainbow and Brown Trout Growth in other Western Tailwater Systems

Project Element 9.9. Effects of High Experimental Flows on Rainbow Trout Population Dynamics

Project Element 9.10. Examining the Effects of High Flow Experiments on the Physiological Condition of Age-0 and Adult Rainbow Trout in Glen Canyon

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Project 10 – Melis, Buscombe, Yard, Korman, Grams, Gushue and others

Where does the Glen Canyon Dam rainbow trout tailwater fishery end?

[Integrating Fish and Channel Mapping Data below Glen Canyon Dam]

A New Integrated Research Effort to Bridge Project 3 (Mapping) with Projects 5 & 9 (Trout and Diet & Foodbase)

Q: Why a new integrated project now?

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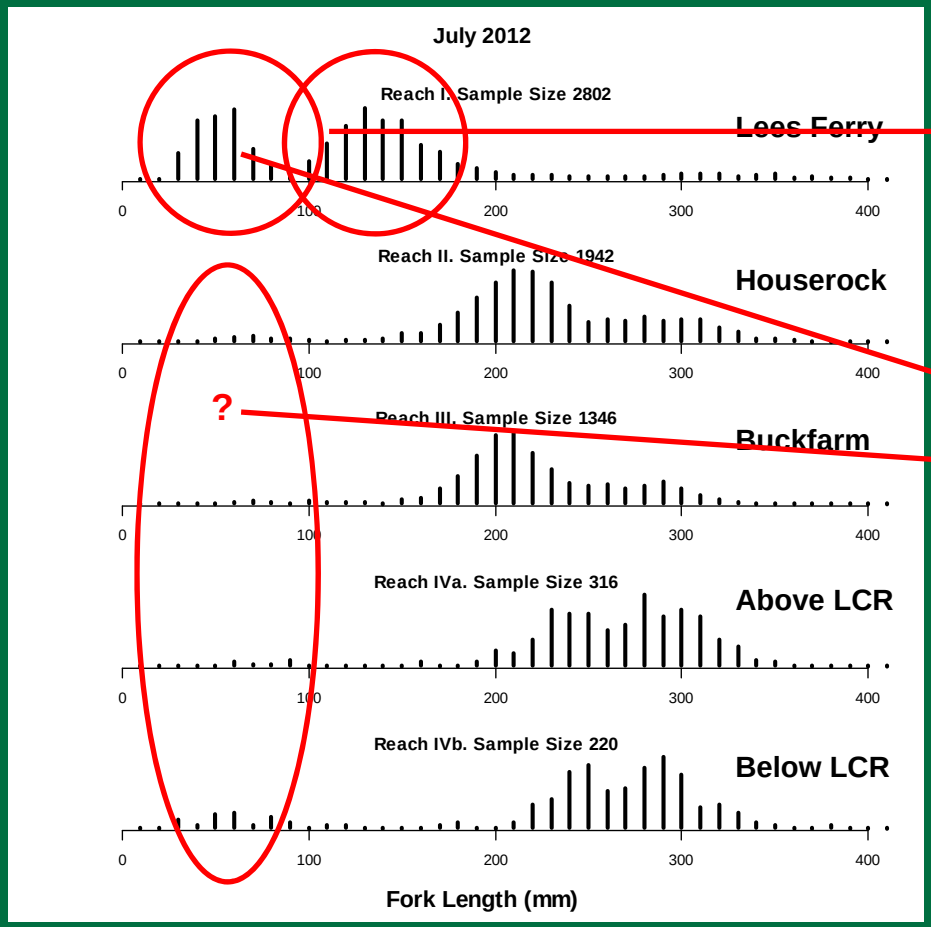
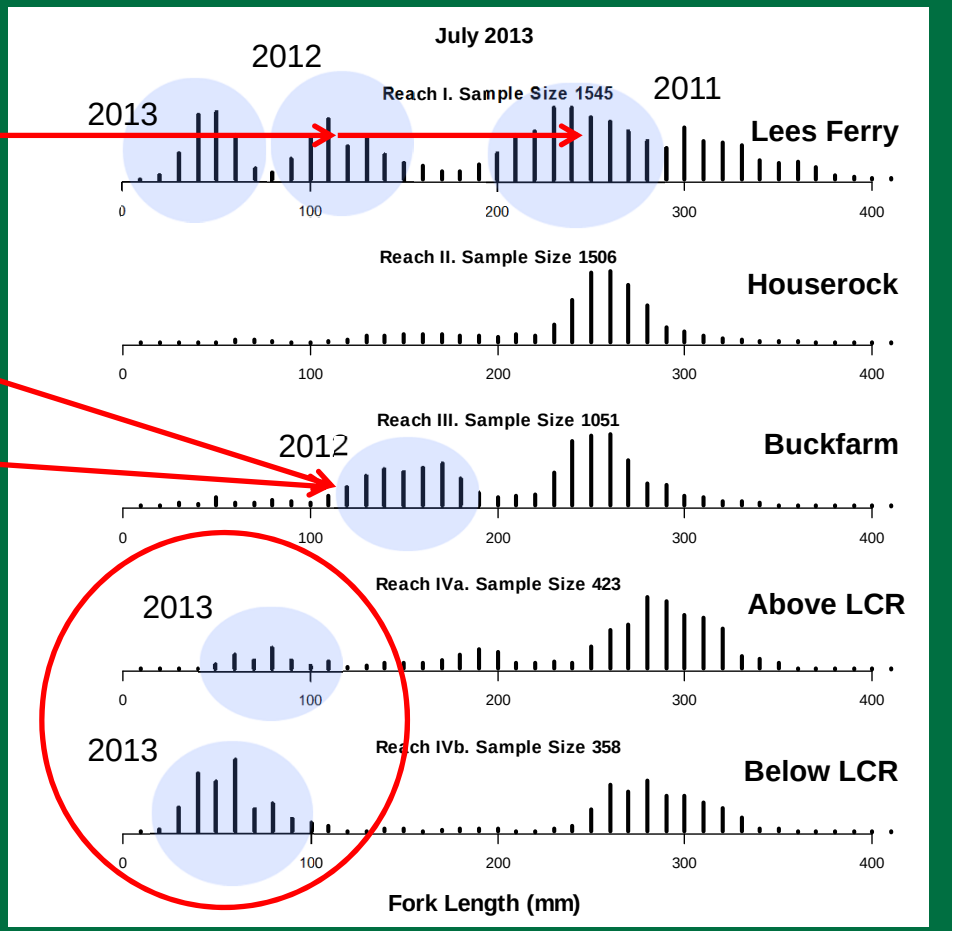
Not All Trout in Marble Canyon Originate from Lees Ferry: Evidence for Local Recruitment

[From Korman and Yard, JAN 2014 AR meeting]





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Preliminary Data, Do Not Cite

Some Questions?

1) Winnowing of Bed Sediments - Are there aquatic resource implications associated with winnowing channel-bed sediments in Marble Canyon (coarsening bed grain size, reduction of bed coverage by fine sediment, reduced turbidity) if bed sediments coarsen there under high flows, as in Glen Canyon in 1965?

2) Frequency & Timing of High-Flow Operations - Do fall-timed high releases also increase rainbow trout populations in GLNRA, and do such releases in either spring or fall support bed sediment conditions that allow local trout production downstream in GRCA?

3) Channel-Margin Geometry & Stage Changes - How abundant are low-angle channel margins in Glen, Marble and eastern Grand Canyon, and which NO study sites used by juvenile rainbow trout are most sensitive to river inundation or dewatering in response to hourly varied GCD operations? [re: viability of EXP TMFs]

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Elements:

1) Complete Humminbird® Sidescan Sonar Mapping Methods (2015)

2) Collect Additional Channel-Bed Data in NO Study Segments & Analyze Existing & New Data for Channel Margin Geometry and Bed Sediment Type (2015-16)

3) Synthetic Analysis (workshop) of NO Rainbow Trout/Diet and Channel Map & QW Data (2017)

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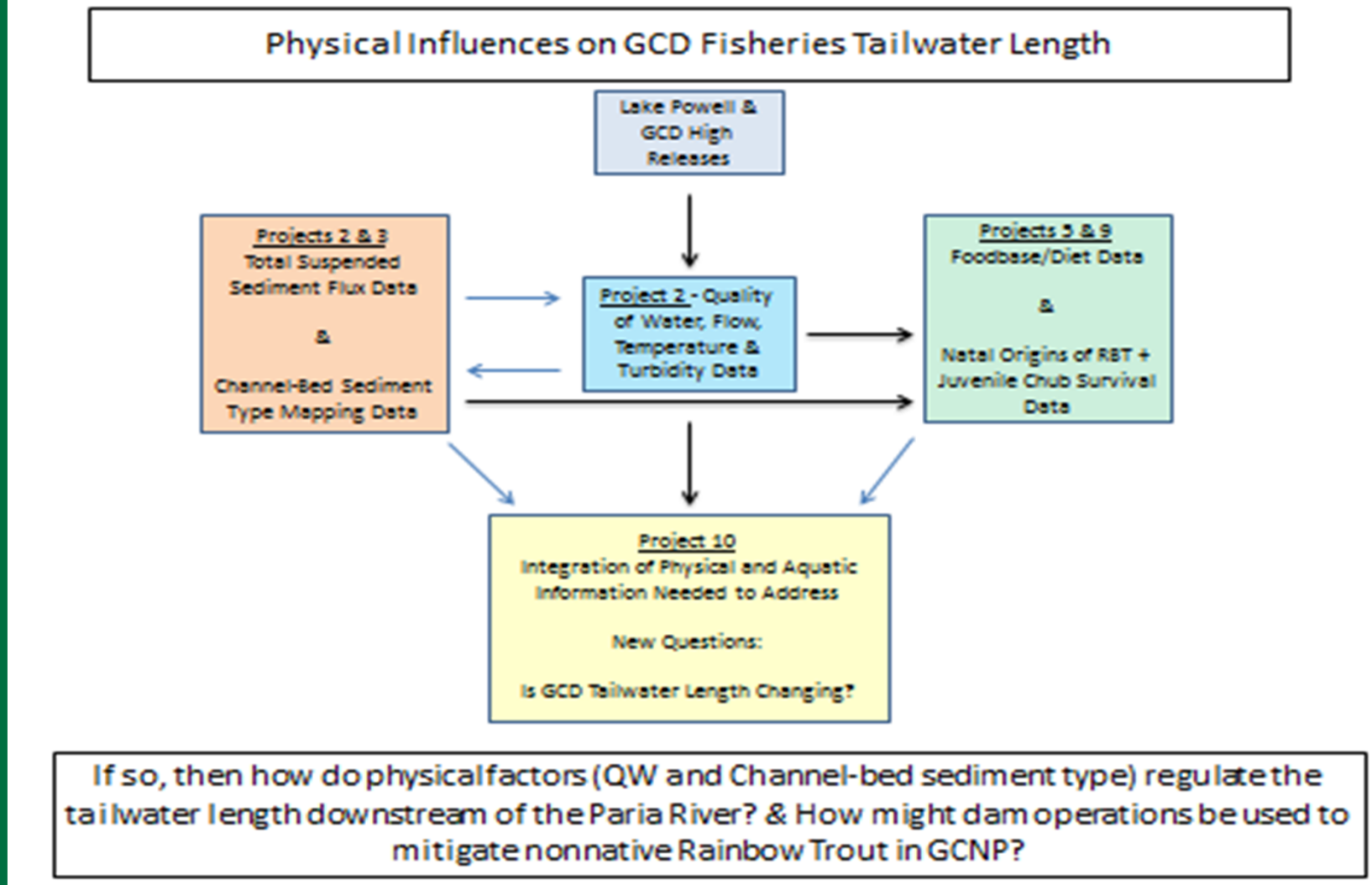

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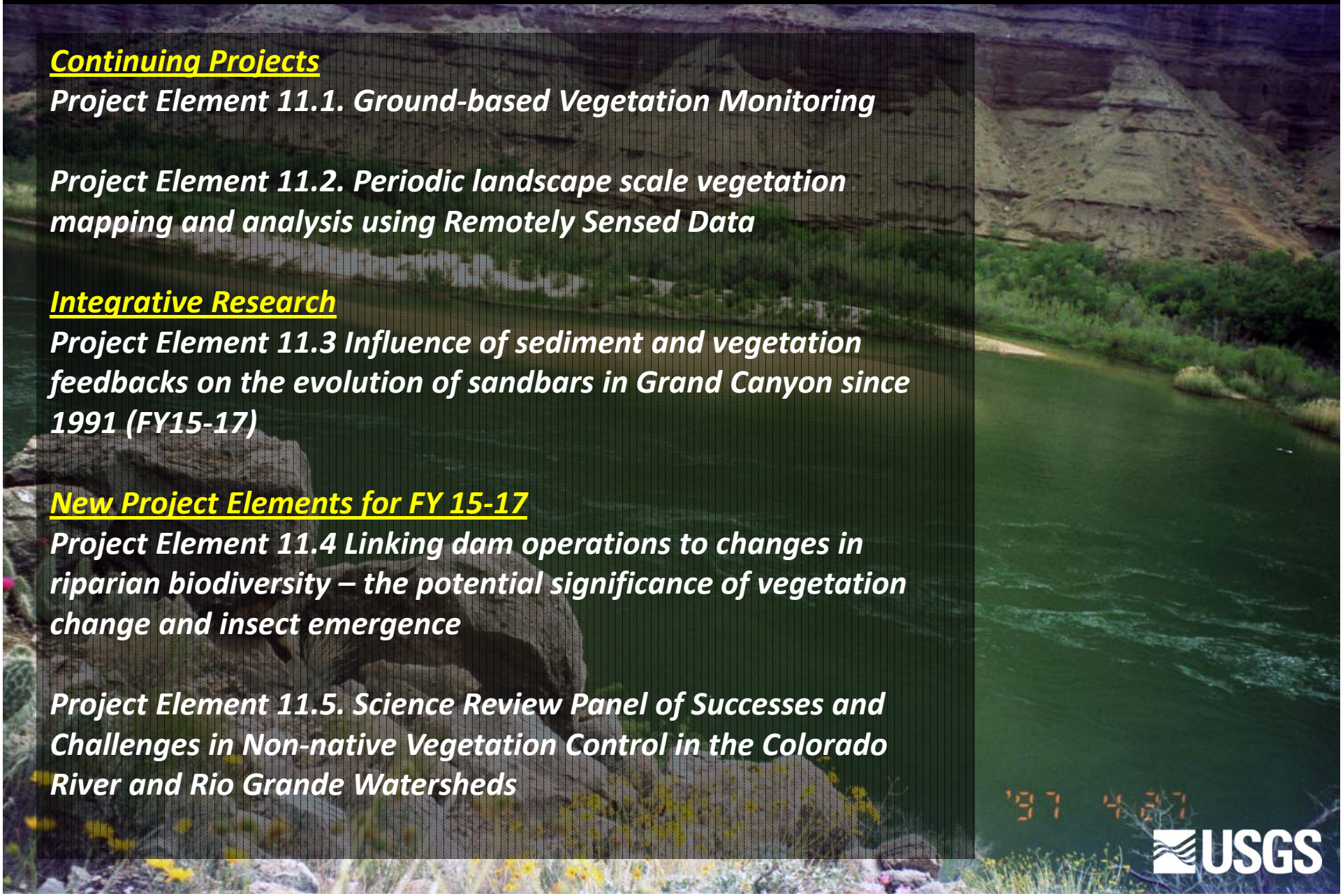
GCMRC sources of existing and (or) new monitoring information to answer questions about GCD operation and questions about co-management of native and nonnative tailwater fisheries of the Colorado River ecosystem in GCNRA and GCNP

Project 11. Riparian Vegetation Monitoring and Analysis of Riparian Vegetation, Landform Change and Aquatic-Terrestrial linkages to Faunal Communities



Continuing Projects

Project Element 11.1. Ground-based Vegetation Monitoring

Project Element 11.2. Periodic landscape scale vegetation mapping and analysis using Remotely Sensed Data

Integrative Research

Project Element 11.3 Influence of sediment and vegetation feedbacks on the evolution of sandbars in Grand Canyon since 1991 (FY15-17)

New Project Elements for FY 15-17

Project Element 11.4 Linking dam operations to changes in riparian biodiversity – the potential significance of vegetation change and insect emergence

Project Element 11.5. Science Review Panel of Successes and Challenges in Non-native Vegetation Control in the Colorado River and Rio Grande Watersheds

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Project 12 (New) – Dam-related Effects on the Distribution & Abundance of Culturally Important Plants in the CRE (Fairley, Bungart, Joe, and Yeatts)

- Element 12.1 – Workshop and analysis
  - Workshop with Tribes to identify focal species of cultural importance to multiple tribes
  - Historical imagery analysis to identify changes in distribution & abundance of focal species
  - Identify changes associated with specific areas of cultural importance to individual tribes
- Element 12.2 – Monitoring
  - Use historical photographs to elicit tribal perspectives on cultural landscape changes
- **Products: Report documenting changes to focal species**
  Journal article (project methods & results)

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Project 13 - Socioeconomic Monitoring and Research

- Element 13.1 – Economic values of recreational resources along the Colorado River
  - Angler values in GCNRA
  - Whitewater floater values in GCNP
- Element 13.2 – Tribal preferences for and values of resource downstream of Glen Canyon Dam
- Element 13.3 – Applied decision methods for the Glen Canyon Dam Adaptive Management Program

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