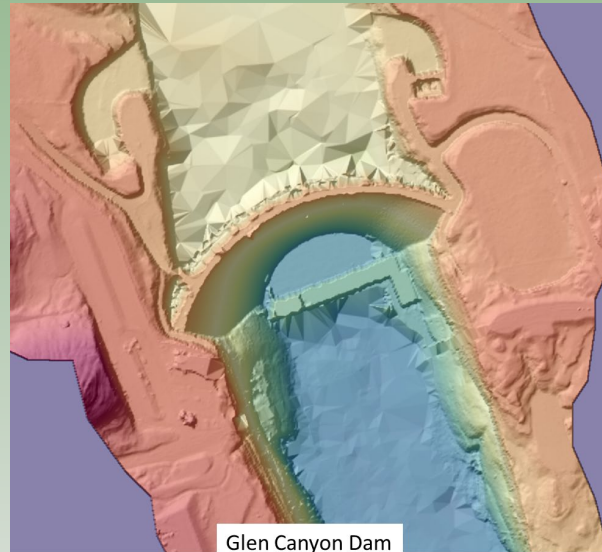


Overflight Remote Sensing in Support of Long-Term Monitoring and LTEMP



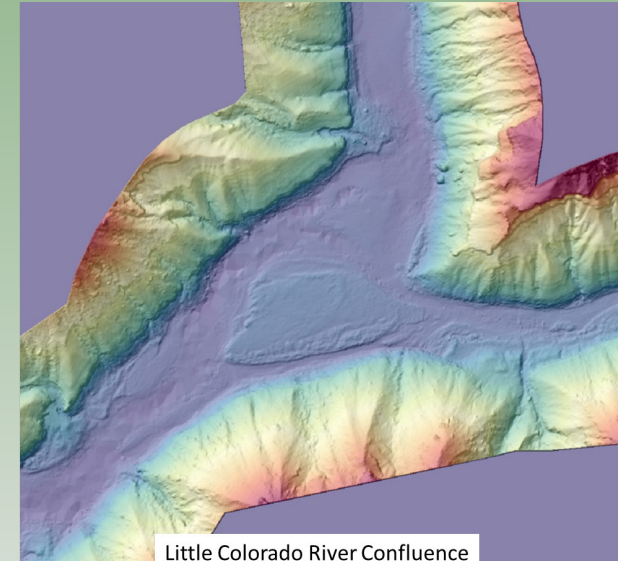
Glen Canyon Dam



Glen Canyon Dam



Lower Colorado River Confluence



Little Colorado River Confluence

Glen Canyon Dam Adaptive Management Work Group Meeting
February 28-29, 2024, Phoenix, AZ

Joel B. Sankey, US Geological Survey (USGS), Southwest Biological Science Center (SBSC),
Grand Canyon Monitoring and Research Center (GCMRC)

Nathaniel Bransky, Northern Arizona University (NAU)

Thomas Gushue, USGS, SBSC, GCMRC

Keith Kohl, USGS, SBSC, GCMRC

Lori Pigue, USGS, Astrogeology Science Center (ASC)

Project Goals and Objectives

GCMRC Triennial Workplan (TWP)

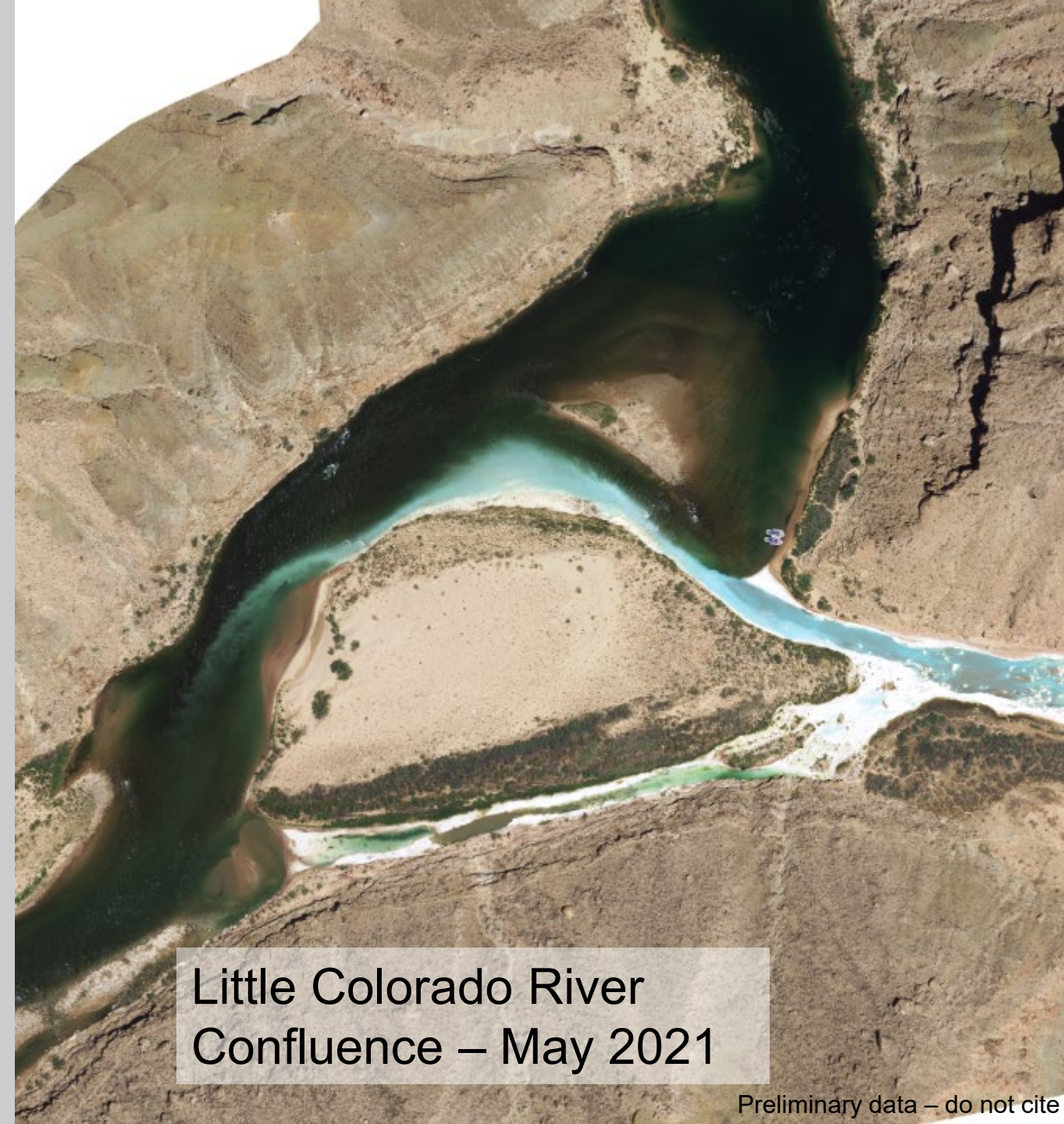
Project L FY2021/2022/2023/2024

Budget \$892k/\$284k/\$316k/\$352k

Imagery and derivative data products from overflight remote sensing are used either directly or indirectly by every science project proposed in the TWP to address every resource goal of the LTEMP

Science Questions:

- How has landcover changed in the Colorado River Ecosystem (CRe) at decadal timescales?
- How are observed landcover changes related to dam operations, other land use and management activities, as well as climate and other environmental factors in the ecosystem?



Little Colorado River
Confluence – May 2021

Airborne Remote Sensing in Grand Canyon

The high-resolution image collection from GCDAMP's May 2021 overflight is the most recent in a rich archive of aerial imagery that is used to track changes of the Colorado River in the Grand Canyon.

History of aerial remote sensing in Grand Canyon:

- Earliest air photos are black and white prints acquired from an airplane in 1935
- First set of air photos acquired after Glen Canyon Dam was completed are black and white prints from May 1965
- First color and color-infrared air photos were acquired during flights in the 1980s
- First digital multispectral images were acquired in the late-1990s
- First acquisition similar to the May 2021 overflight (high spatial resolution digital multispectral imagery and digital topography) occurred in May 2002, and then again in 2004, 2005, 2009, 2013, 2021

USGS
science for a changing world

SOUTHWEST BIOLOGICAL SCIENCE CENTER SCIENCE

Airborne Remote Sensing in Grand Canyon

By Southwest Biological Science Center May 10, 2021

Sandbar vegetation changes since 1963

2002 2005 2009 2013

Overview Science Data Publications Partners

A high-resolution image collection in 2021 will be the most recent in a rich archive of aerial imagery that is used to track changes of the Colorado River in the Grand Canyon. Imagery will be acquired from an airplane in Grand Canyon National Park along the Colorado River corridor and the Little Colorado River starting Memorial Day weekend and continuing through the first week of June 2021. This imagery will be used by the USGS and partners from the Glen Canyon Dam Adaptive Management Program (GCDAMP) to monitor changes in the Colorado River and riparian ecosystem in Grand Canyon and impacts of management including Glen Canyon Dam operations. Water released from Glen Canyon Dam will be reduced to a steady discharge of 8,000 cubic feet per second (cfs) in the Colorado River for the duration of the image collection mission. The low river discharge is required because consistent water levels are necessary for remote sensing image analyses that compare this new image dataset to historic datasets which also were collected with a constant steady discharge of 8,000 cfs.

Contacts
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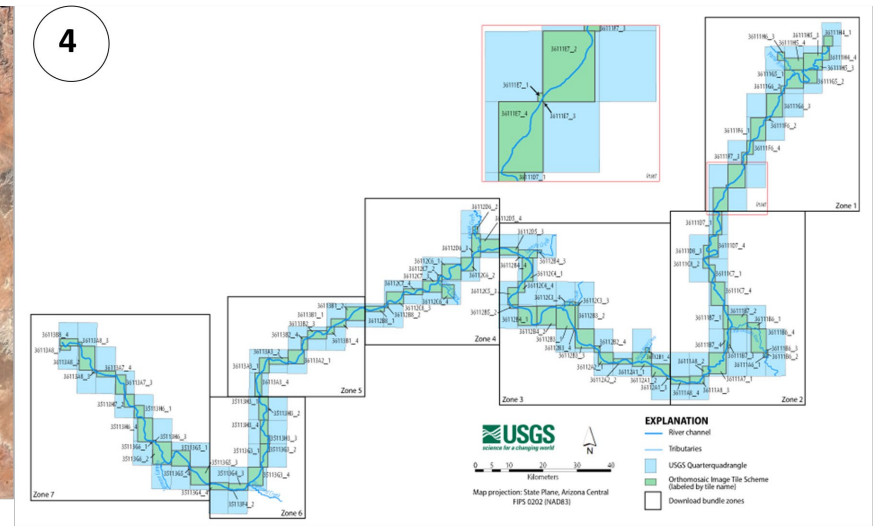
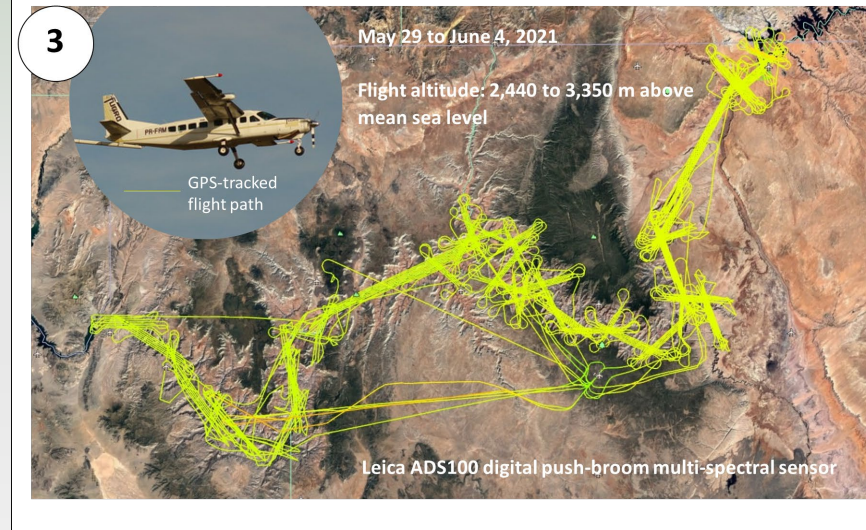
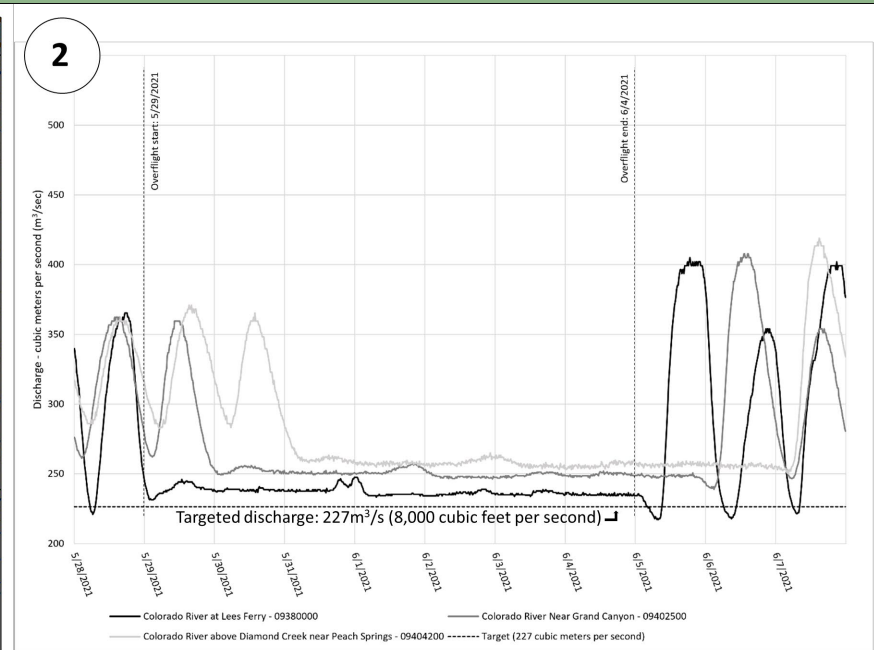
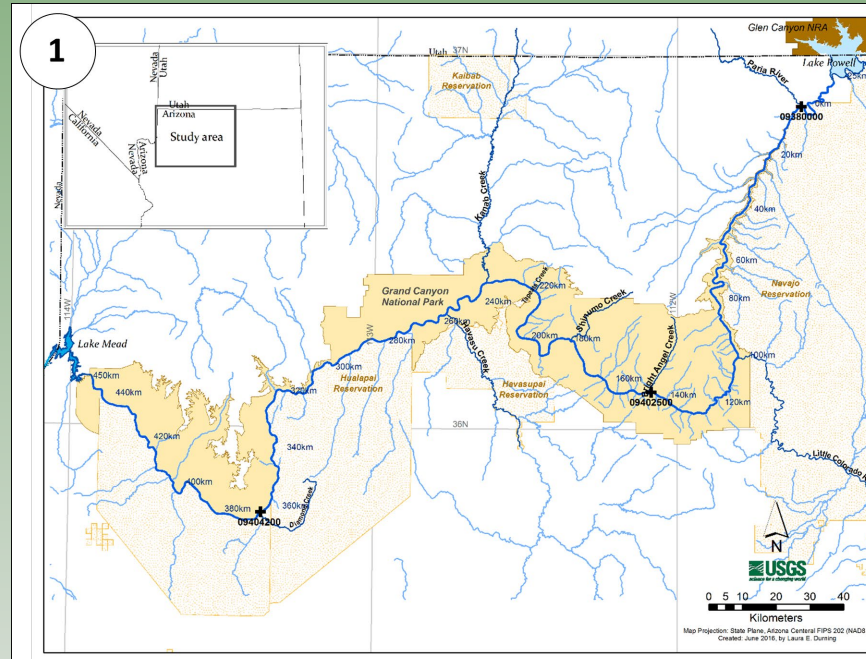
Laura Durning (Former Employee)
Research Specialist
Southwest Biological Science Center

<https://www.usgs.gov/centers/southwest-biological-science-center/science/airborne-remote-sensing-grand-canyon>

2021 Overflight Orthomosaic

Data Collection by Fugro, Inc. under contract with the USGS Grand Canyon Monitoring and Research Center

1. Collected from just upstream of Glen Canyon Dam (in Lake Powell) near Page, Arizona, downstream to Lake Mead's Pearce Ferry, Arizona, for a total length of 475 kilometers (km) at a width of about 500 meters (m) centered on the mainstem of the Colorado River and seven primary tributaries
2. Targeted river discharge of 227 m³/s (8,000 cubic feet per second)
3. For any given section of the river corridor, five or six overlapping linear flightlines were acquired, allowing for the greatest probability of error-free and low-shadow imagery
4. Initial image orthomosaic of overlapping flightlines produced by contractor (Fugro)



Preliminary results, please don't cite

May 2021 Overflight Status

Fiscal Year	Quarter(s)	Activities
2021	1st	<ul style="list-style-type: none"> Write Task Order and negotiate contract with GPSC (USGS Geospatial Products and Services Contracts) and contractor for overflight mission consisting of imagery and digital topographic data acquisition
	2nd	<ul style="list-style-type: none"> Contract awarded to Fugro Earth Data Inc. Coordinate logistics for the overflight mission with GCDAMP agencies and stakeholders Plan GCMRC logistics, including the rim- and river-level operations to be conducted by GCMRC in coordination with the contractor
	3rd	<ul style="list-style-type: none"> Overflight mission Rim-level GPS base station operations River-level accuracy assessment and ground-truthing operations
	4th	<ul style="list-style-type: none"> Monitor image processing performed by Fugro (contractor)
2022	1st	<ul style="list-style-type: none"> Data delivered to GCMRC QA/QC performed by GCMRC in coordination with vendor
	2nd	<ul style="list-style-type: none"> Final modifications to mosaic performed
	3rd & 4th	<ul style="list-style-type: none"> Begin publication process for finalized mosaic
2023	All	<ul style="list-style-type: none"> Image mosaic published Landcover classification maps produced by GCMRC remote sensing staff

- Sankey, J.B., Bransky, N., Pigue, L., Kohl, K., and Gushue, T.M., 2024, Four Band Image Mosaic of the Colorado River Corridor in Arizona--2021, including Accuracy Assessment Data: U.S. Geological Survey data release, <https://doi.org/10.5066/P9BBGN6G..>
- Sankey, J.B., Kohl, K., Gushue, T., Bransky, N., Bedford, A., Durning, L., Davis, P.A., *In Press*, DSMs for Colorado River Corridor in Grand Canyon National Park and Glen Canyon National Recreation Area: 2002, 2009, 2013 and 2021 and DEM for 2021: U.S. Geological Survey data release

Preliminary results, please don't cite



The End and Next Steps

Thanks for listening and remember it is not too early to begin planning for the next overflight which could occur in 2025 or 2026 during the next Triennial Workplan!

