Riparian vegetation monitoring with remote sensing

AMWG Meeting, August 24, 2016

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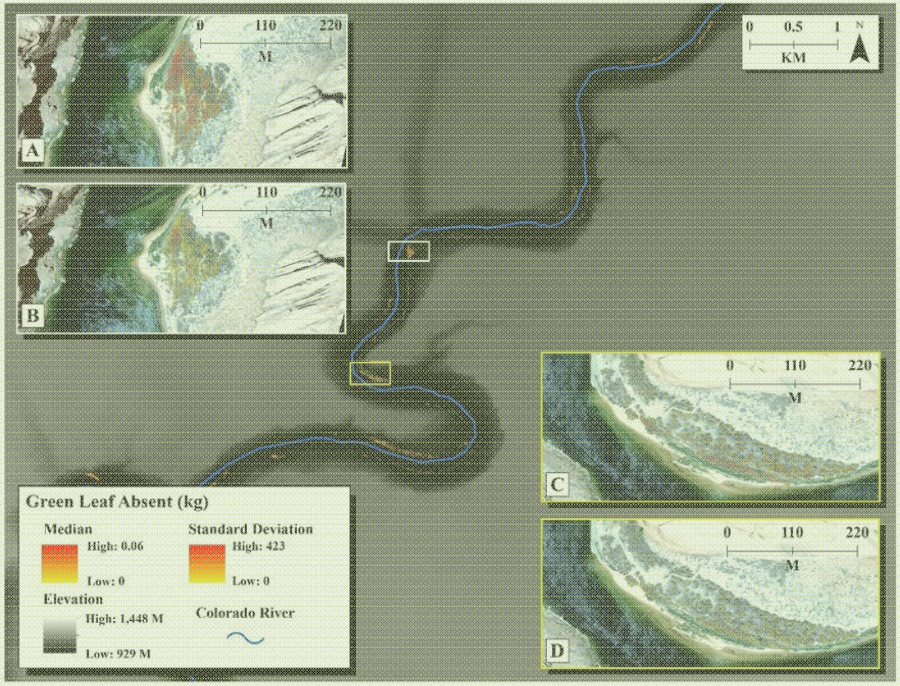

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NORTHERN ARIZONA UNIVERSITY

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NASA

Talk Outline

- 2013 Overflight image mosaic
- Monitoring long-term riparian vegetation changes 1964 to 2013
- Monitoring tamarisk changes and tamarisk beetle impacts 2009 to 2013

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2013 Overflight Image Mosaic

Timeline:

- Acquisition – Memorial Day weekend 2013
- Image mosaic complete – December 2015
- Image mosaic dataset publication – 2016
- Riparian vegetation mapping and other analyses of data mosaic for Triennial Workplan studies – Fiscal years 2015, 2016, & 2017

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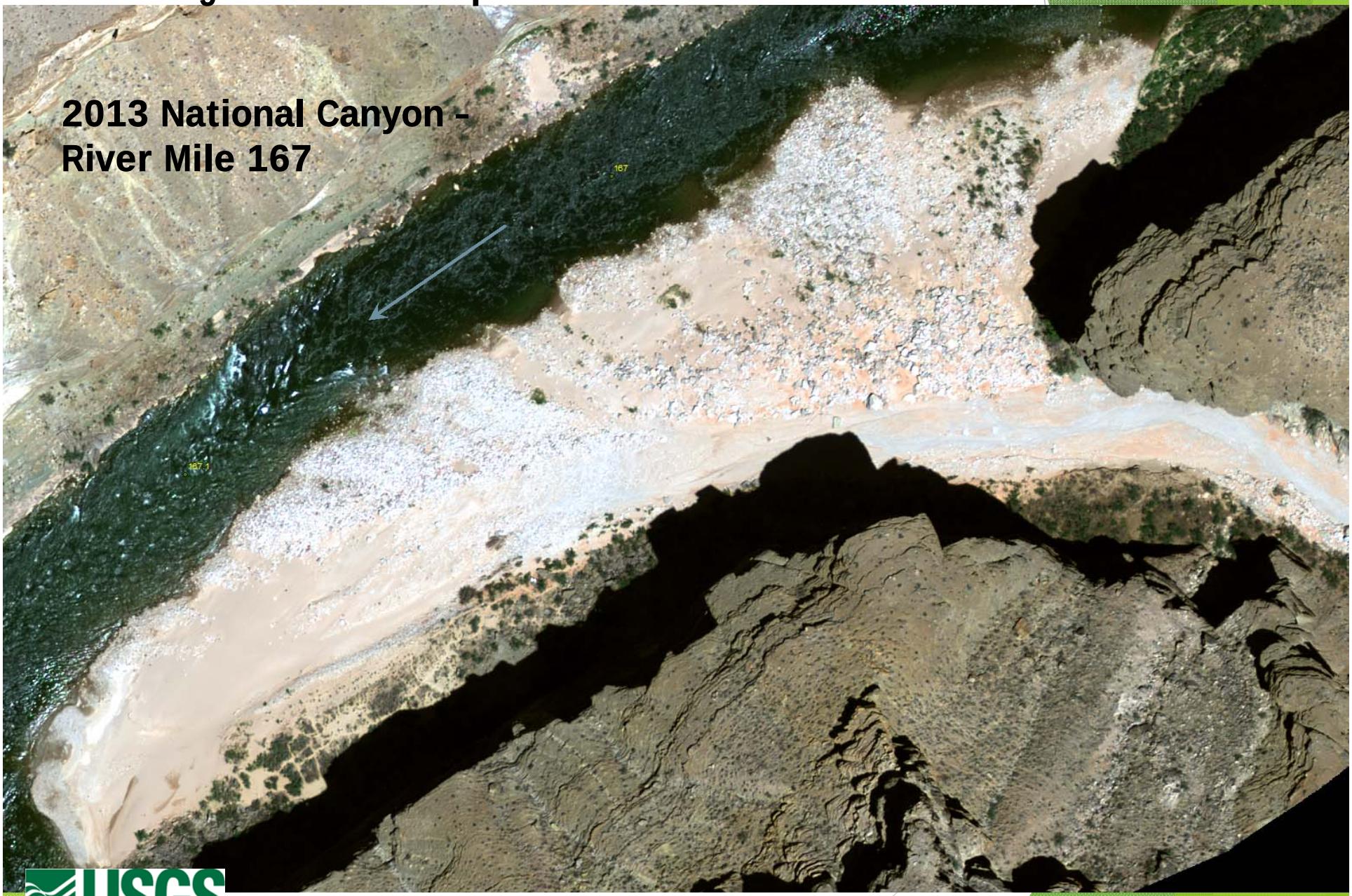
2013 Image Mosaic Examples



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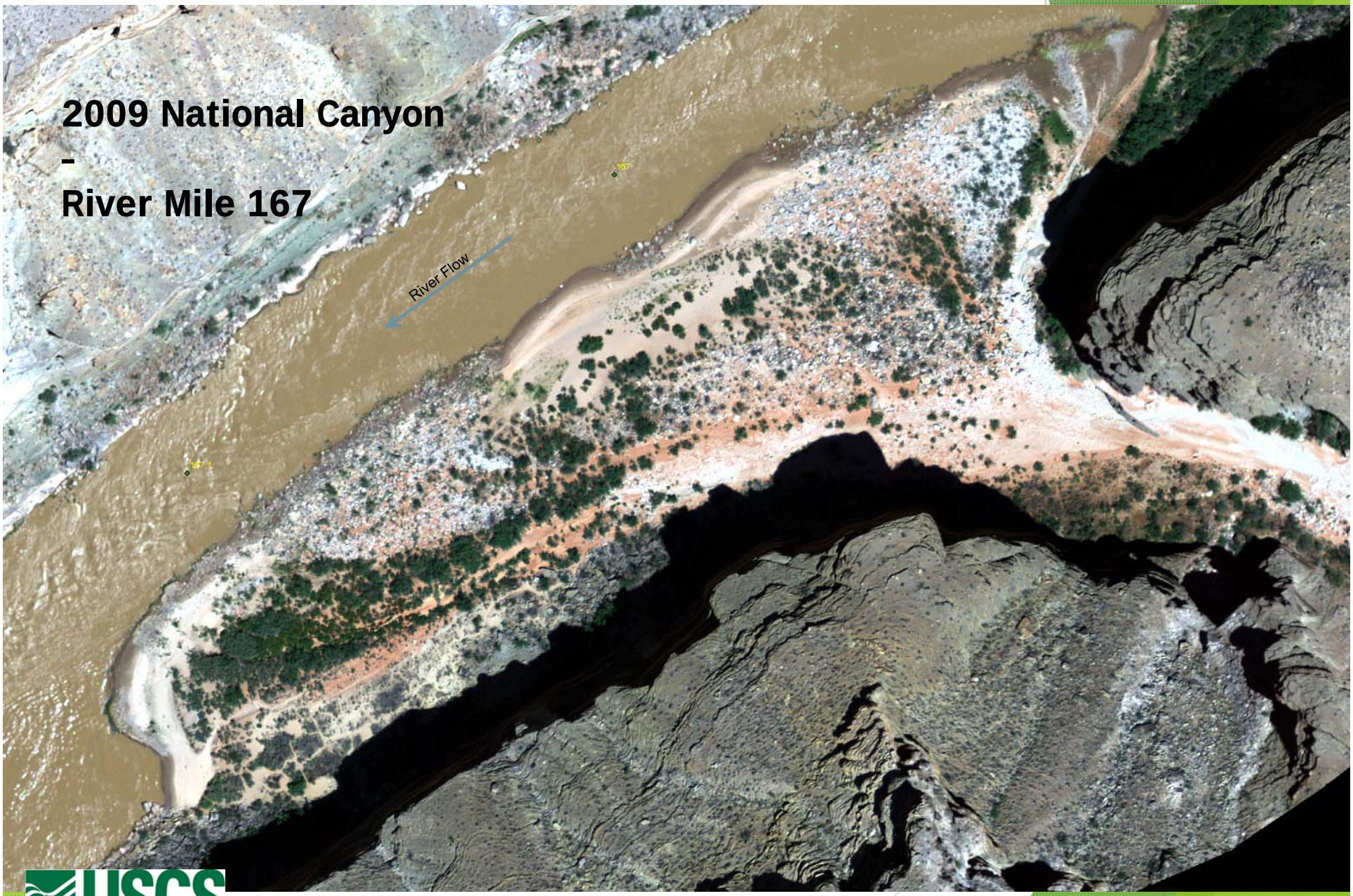
2009



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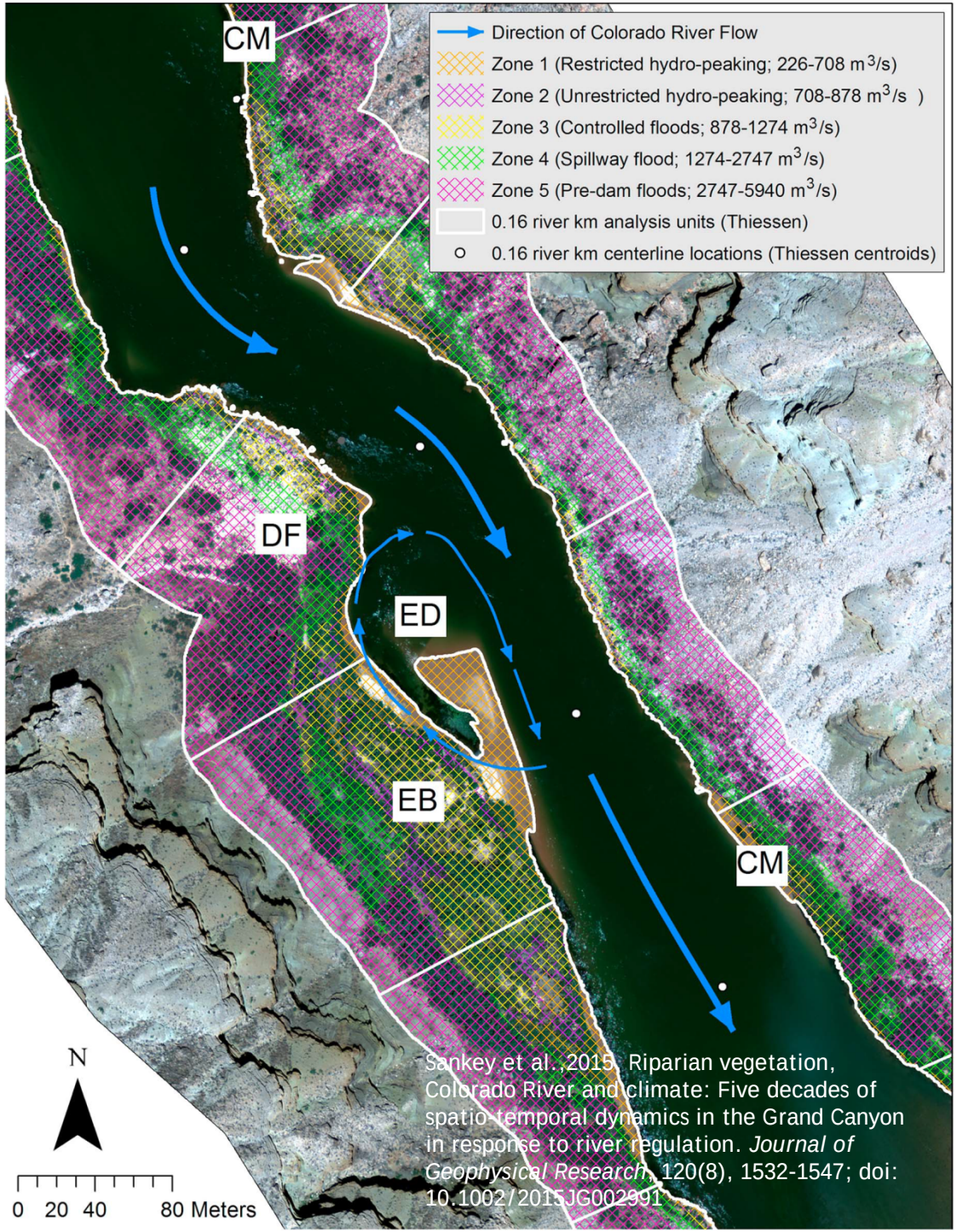
Monitoring long-term riparian vegetation changes

- Analyze by 5 “zones” of the historical riparian area inundated by discharges:
  - 8,000 to 25,000 ft^3/s
  - 25,000 to 31,000 ft^3/s
  - 31,000 to 45,000 ft^3/s
  - 45,000 to 97,000 ft^3/s
  - 97,000 to 210,000 ft^3/s



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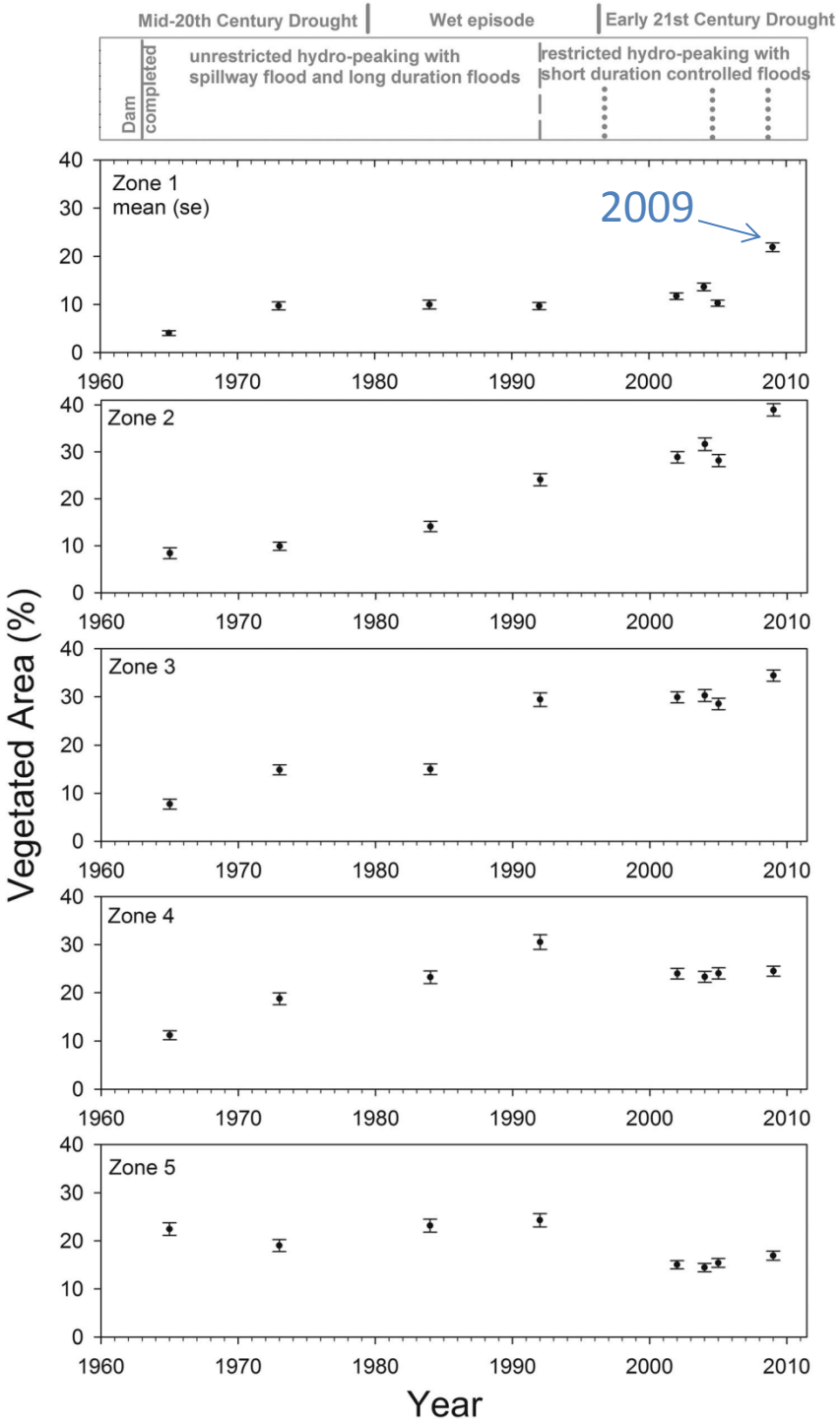
Monitoring long-term riparian vegetation changes 1964 to 2009



Zone 1: 8,000 to 25,000 ft^3/s

Zone 2: 25,000 to 31,000 ft^3/s

Zone 3: 31,000 to 45,000 ft^3/s

Zone 4: 45,000 to 97,000 ft^3/s

Zone 5: 97,000 to 210,000 ft^3/s

Sankey et al.,2015. Riparian vegetation, Colorado River and climate: Five decades of spatio-temporal dynamics in the Grand Canyon in response to river regulation. *Journal of Geophysical Research*, 120(8), 1532-1547; doi: 10.1002/2015JG002991

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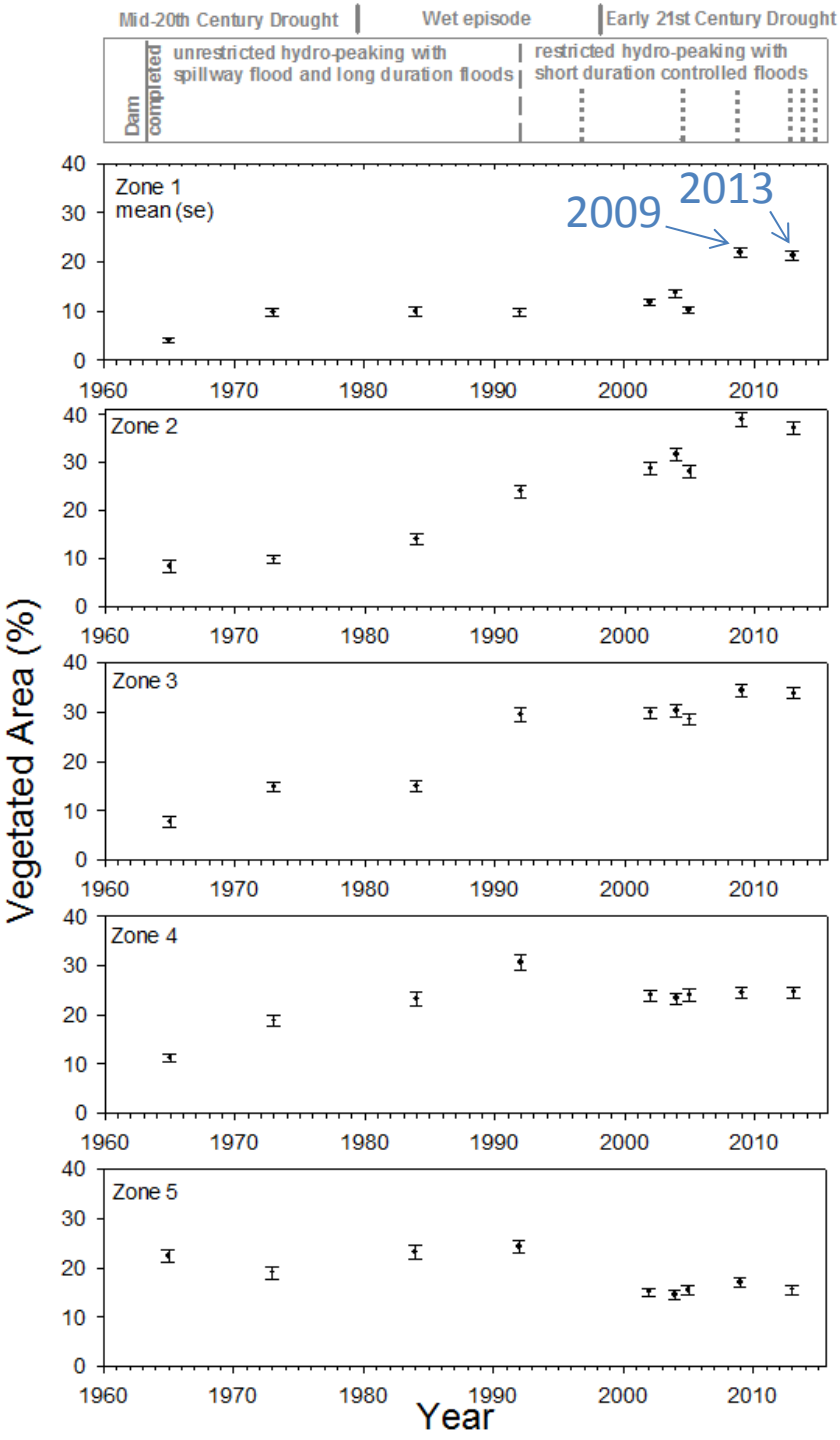
Monitoring long-term riparian vegetation changes 1964 to 2013

- new results



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Preliminary results, do not cite

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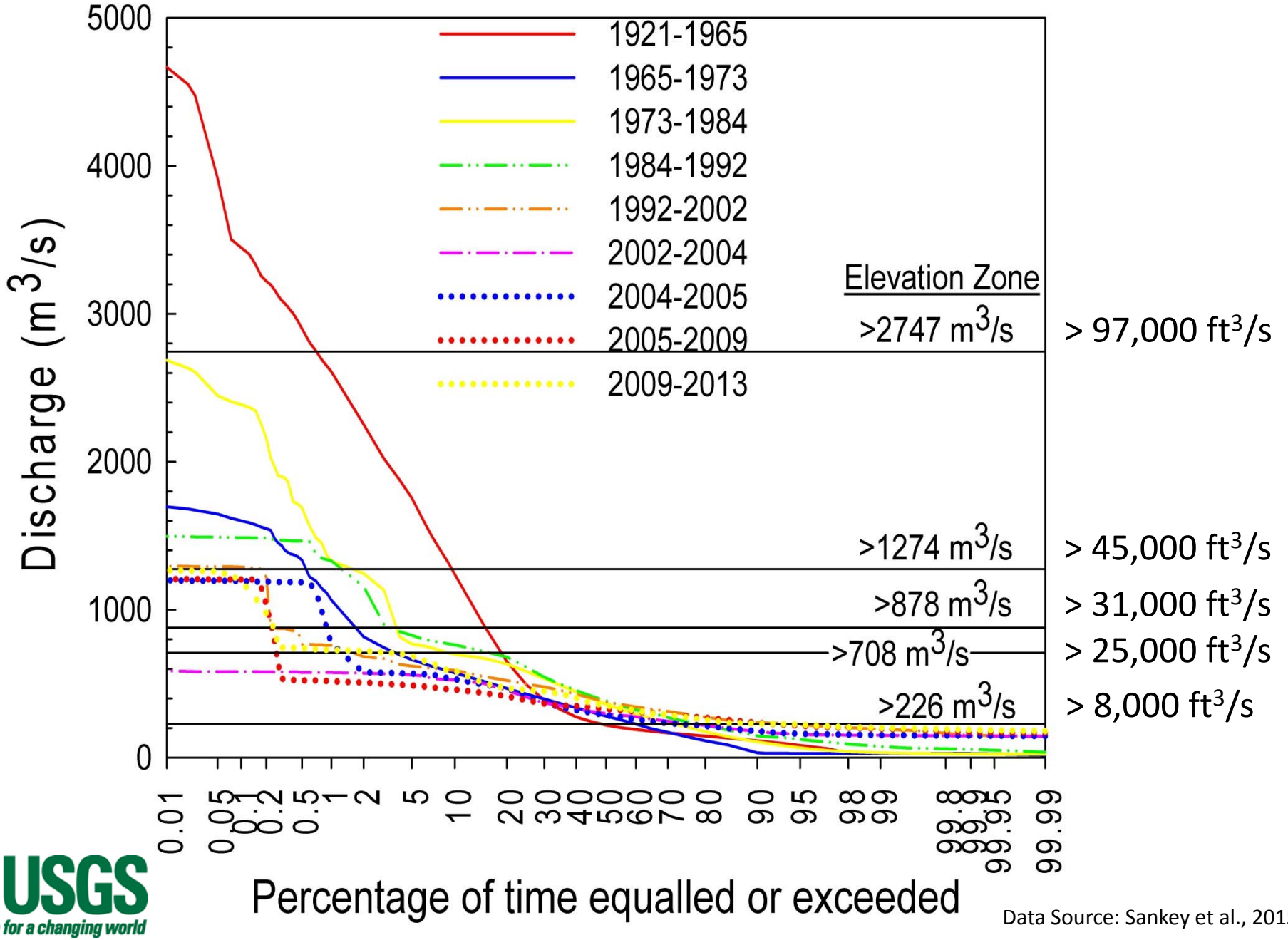

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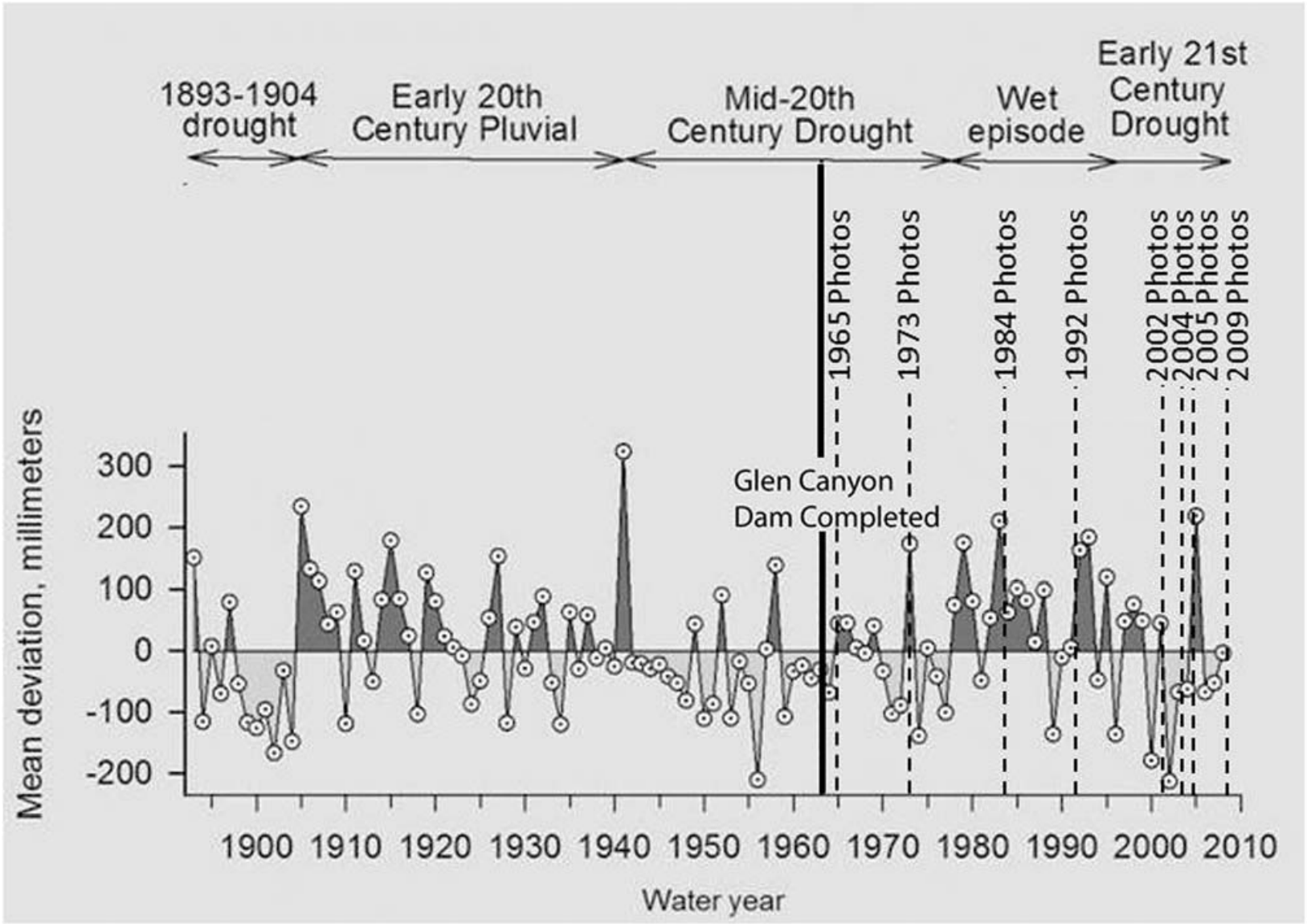
Data Source: Sankey et al., 2015



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Data Source: R. Hereford, USGS

Monitoring long-term riparian vegetation changes - summary

- No significant change in vegetated area from 2009 to 2013
- Long-term trend is vegetation increase in zones inundated by discharges less than 45,000 ft^3/s
- Results of analysis of 1964-2013 data are consistent with 1964-2009 results (i.e., Sankey et al., 2015):
  - Vegetation decoupled from river hydrology in zones inundated by discharges > 97,000 and possibly > 45,000 ft^3/s; vegetated area decreases due to rainfall drought
  - Vegetated area increases in zones below 45,000 ft^3/s with (i) elevated baseflows that make more water available to plant roots, and (ii) lower frequency and magnitude of peak flows/floods

Preliminary results, do not cite

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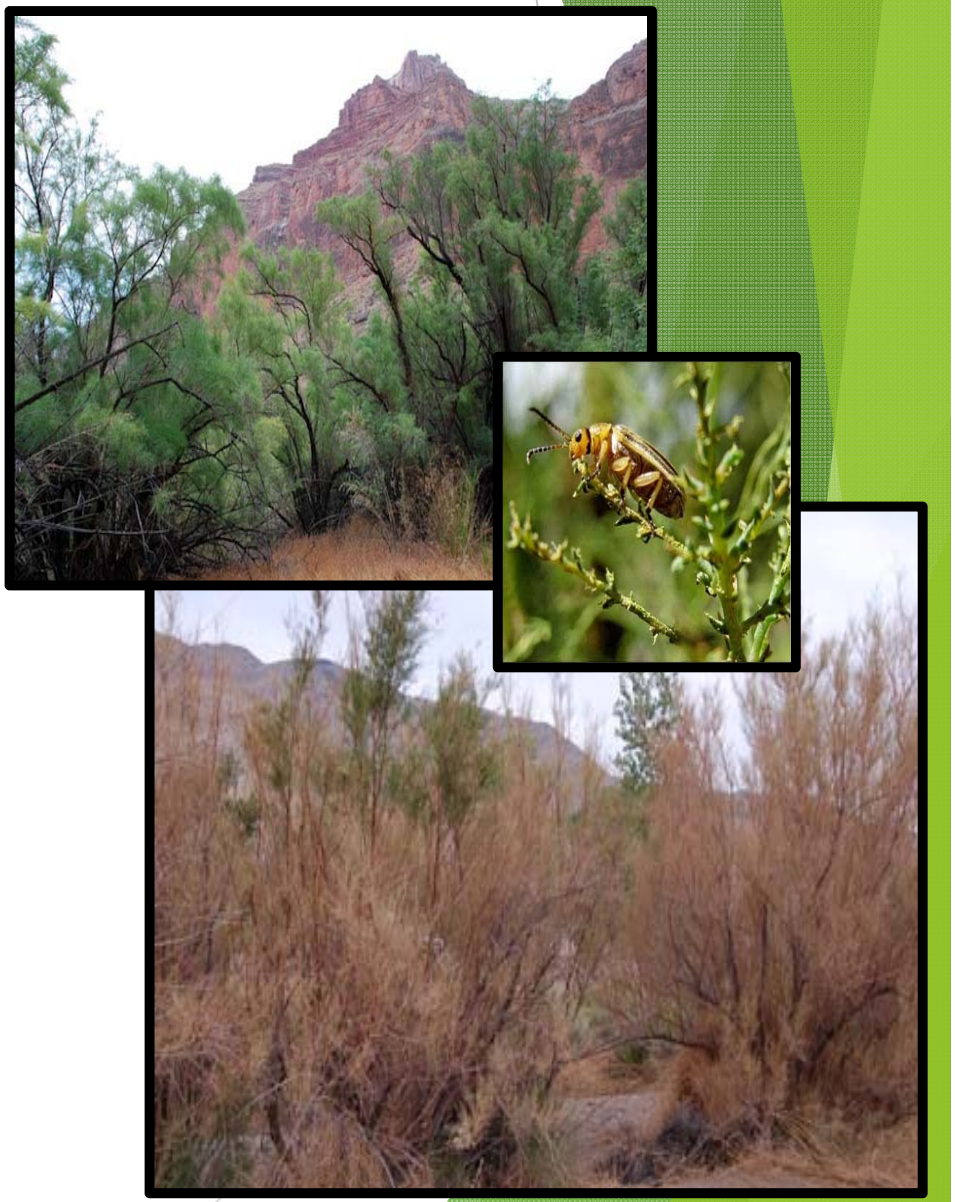
Monitoring tamarisk changes and tamarisk beetle impacts 2009 to 2013

- Tamarisk (*Tamarix spp.*)
  - Invasive riparian shrub
  - In the US since 1800s
- Tamarisk Beetle (*Diorhabda carinulata)*
  - Natural predator
  - Eats the leaves
  - Tamarisk defoliation, mortality
  - In Grand Canyon since 2009



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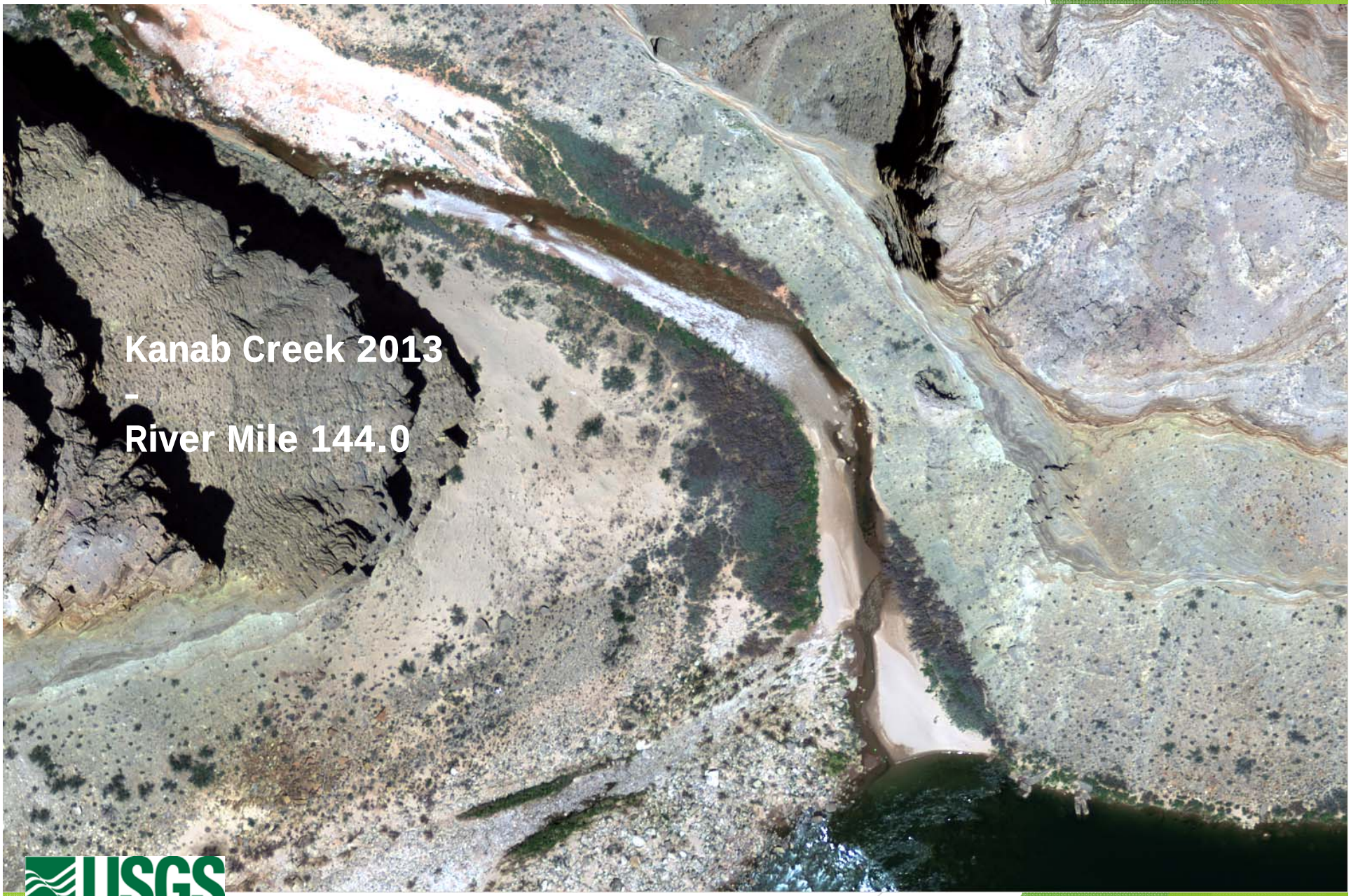
2013 Image Mosaic Examples



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2009

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Monitoring tamarisk

- Map area and biomass of green and defoliated tamarisk – new remote sensing for monitoring tamarisk and beetle impacts
  - Change detection of multispectral imagery
    - What percent of green tamarisk in 2009 was defoliated in 2013?
    - Glen Canyon, Kanab Creek, National Canyon (3 reaches)
    - Bedford, A. "Remote Sensing of Tamarisk (Tamarix spp.) defoliation by the Tamarisk Leaf Beetle (Diorhabda carinulata)along the Colorado River in Arizona " M.S. Thesis. Northern Arizona University, May 2016
  - Fusion of multispectral imagery with lidar data
    - Quantify and map spatial distribution of biomass of total, green-leaf, and defoliated leaf (litter) tamarisk in 2013
    - Glen Canyon (one reach)
    - Sankey, TT, Sankey, JB, Bedford, A, Horne, R, 2016, Remote sensing of tamarisk biomass, insect herbivory, and defoliation: novel methods and applications in the Grand Canyon region, Arizona, USA. *Photogrammetric Engineering and Remote Sensing 82(8), pp. 645-652, doi: 10.14358/PERS.82.8.645*

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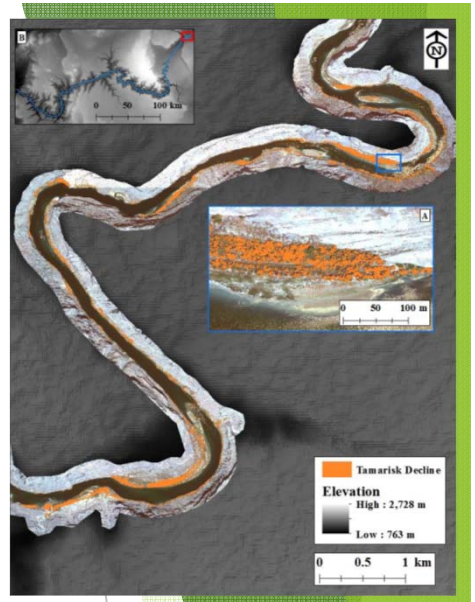
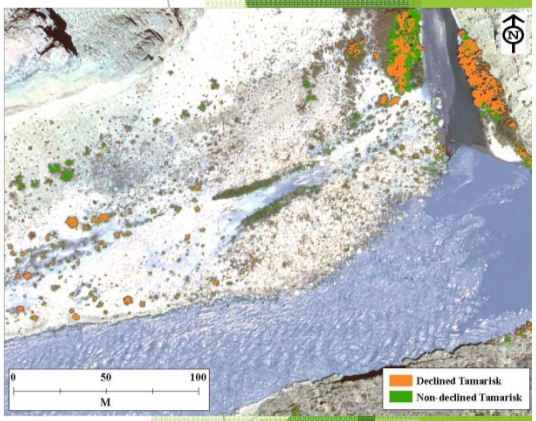
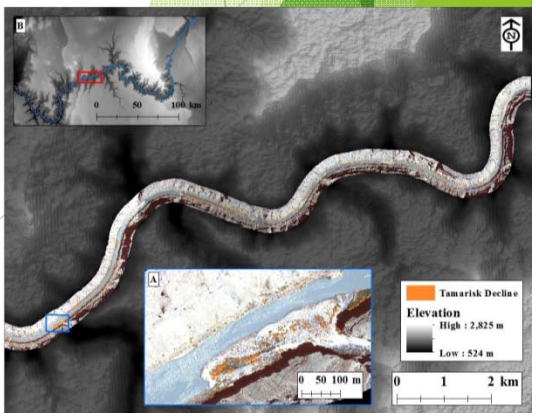
What percent of green tamarisk in 2009 was defoliated in 2013?

(Bedford, M.S. Thesis, 2016)

Reach	Percent of Tamarisk Vegetation	Total Area (m^2)
Glen Canyon (Glen Canyon Dam to Lees Ferry)		
Green	70 %	199,000
Defoliated	30 %	87,000
Kanab (RM 134.6 to 155.7)		
Green	79 %	40,000
Defoliated	21 %	11,000
National (RM 158.6 to 180.5)		
Green	88 %	217,000
Defoliated	12 %	29,000







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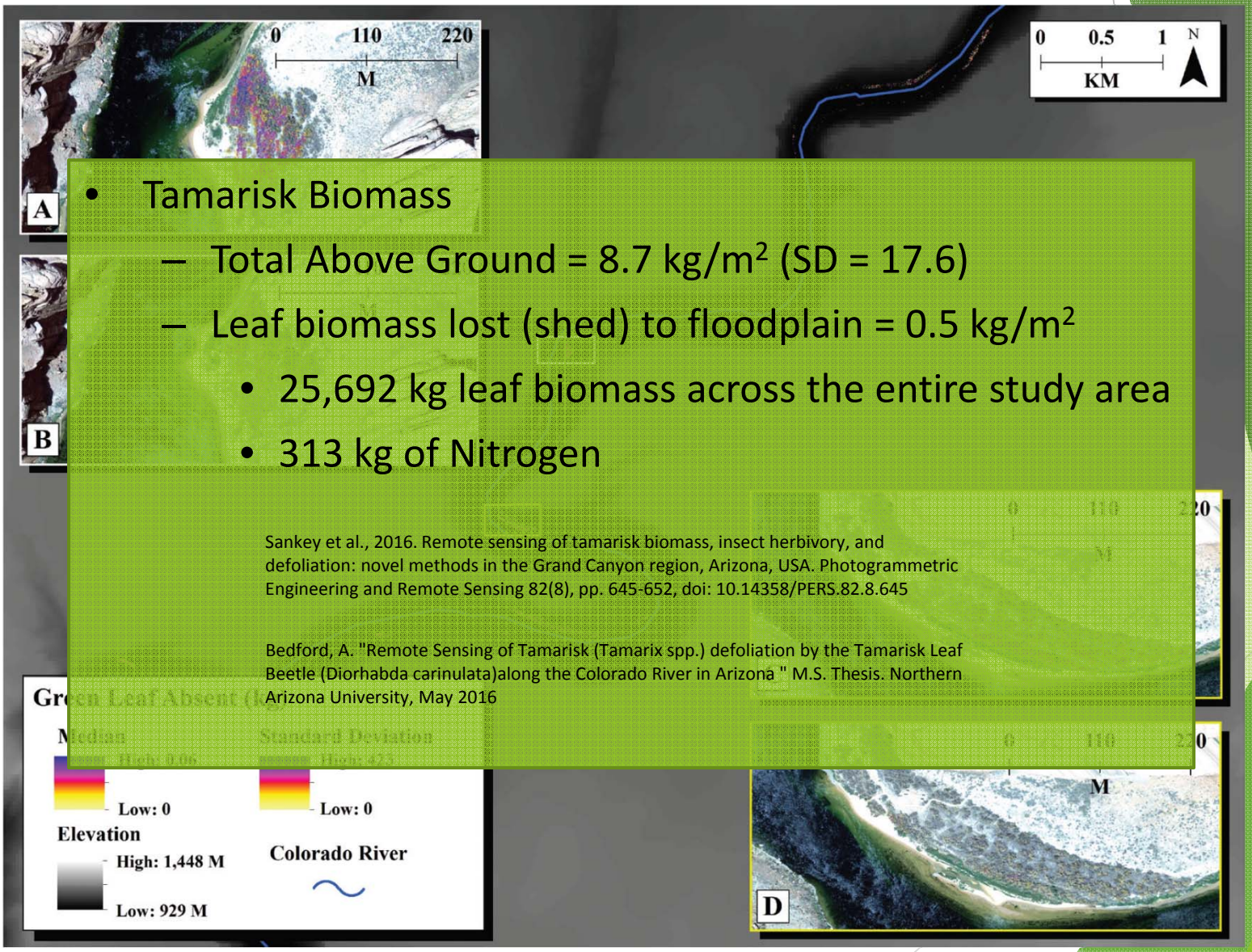
Quantify and map tamarisk biomass



- Tamarisk Biomass
  - Total Above Ground = 8.7 kg/m^2 (SD = 17.6)
  - Leaf biomass lost (shed) to floodplain = 0.5 kg/m^2
    - 25,692 kg leaf biomass across the entire study area
    - 313 kg of Nitrogen

Sankey et al., 2016. Remote sensing of tamarisk biomass, insect herbivory, and defoliation: novel methods in the Grand Canyon region, Arizona, USA. Photogrammetric Engineering and Remote Sensing 82(8), pp. 645-652, doi: 10.14358/PERS.82.8.645

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Monitoring tamarisk changes and tamarisk beetle impacts 2009 to 2013-summary

- Practical utility of the maps and data:
  - Future monitoring of defoliation and beetle impacts
  - Planning for vegetation management
    - Identify locations of widespread defoliation for possible vegetation removal

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Thanks for listening!

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