SOUTHERN ROCKIES
Landscape Conservation Cooperative

Vegetative and Geomorphic Complexity on the Colorado and Dolores Rivers: A Blueprint for Riparian Restoration

MEG WHITE

The Nature Conservancy

Vegetative and Geomorphic Complexity at Tributary Junctions on the Colorado and Dolores Rivers:
A Blueprint for Riparian Restoration

Meg White, Christine Rasmussen, Brian Tavernia,
Pat Shafroth, Teresa Chapman, John Sanderson

The Nature Conservancy
Protecting nature. Preserving life.

USGS
science for a changing world

TALK OUTLINE

- Riparian Ecosystems & Habitat Complexity
- Research Questions and Hypotheses
- Methods and Analysis
- Results
- Discussion
- Management and Restoration Implications

HABITAT COMPLEXITY

- Declining peak flows → narrower & simpler channels, fewer off channel and low velocity habitats
- Tributary junctions have been shown to support greater physical complexity, particularly in aquatic habitat.
- Is there an influence in the riparian zone?

RIPARIAN ECOSYSTEMS, REGULATED RIVERS

- Little is known about riparian habitat structural complexity and species diversity at tributary junctions in regulated river systems
- Areas like tributary junctions may provide more ecological niches for members of a community due to increased complexity, thereby promoting diversity



RESEARCH QUESTIONS

Q1. Does riparian habitat diversity change at tributary junctions along regulated reaches of the Colorado & Dolores Rivers?

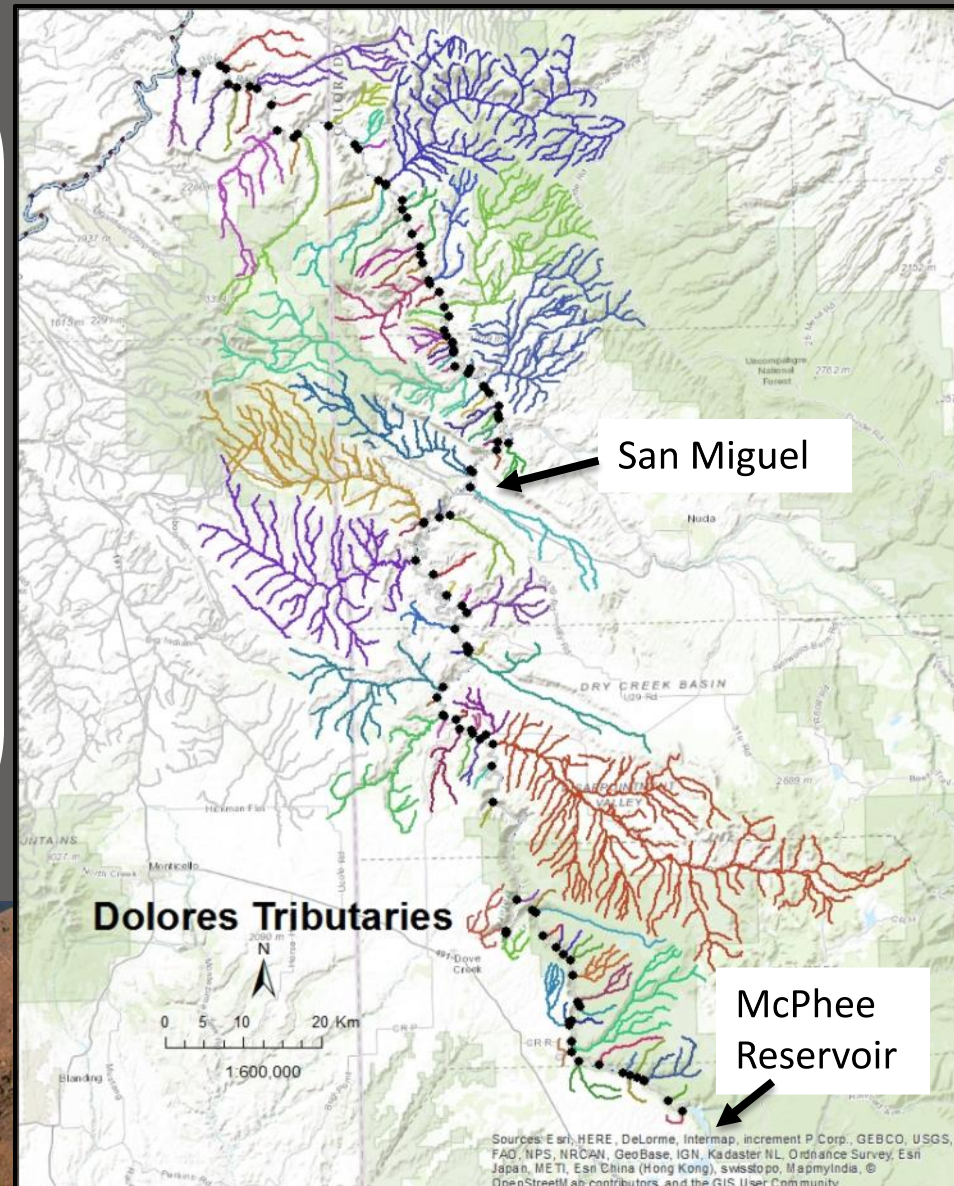
Q2. How do patterns change with changes in scale?

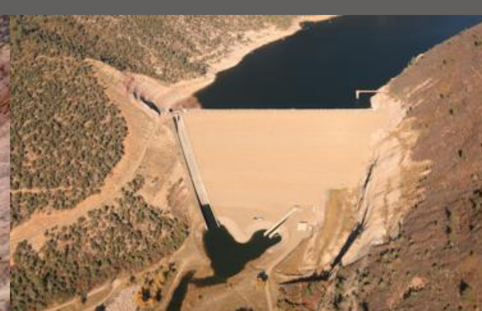
HYPOTHESES

- *Riparian habitat complexity, measured as geomorphic and vegetation response, peaks at or downstream of tributary junctions.*
- *More specifically, geomorphic complexity is higher closer to tributary junctions while vegetation cover complexity increases further downstream.*
- *The influence of tributaries and patterns in riparian and geomorphic response varies with grain size, or across scales laterally and longitudinally.*

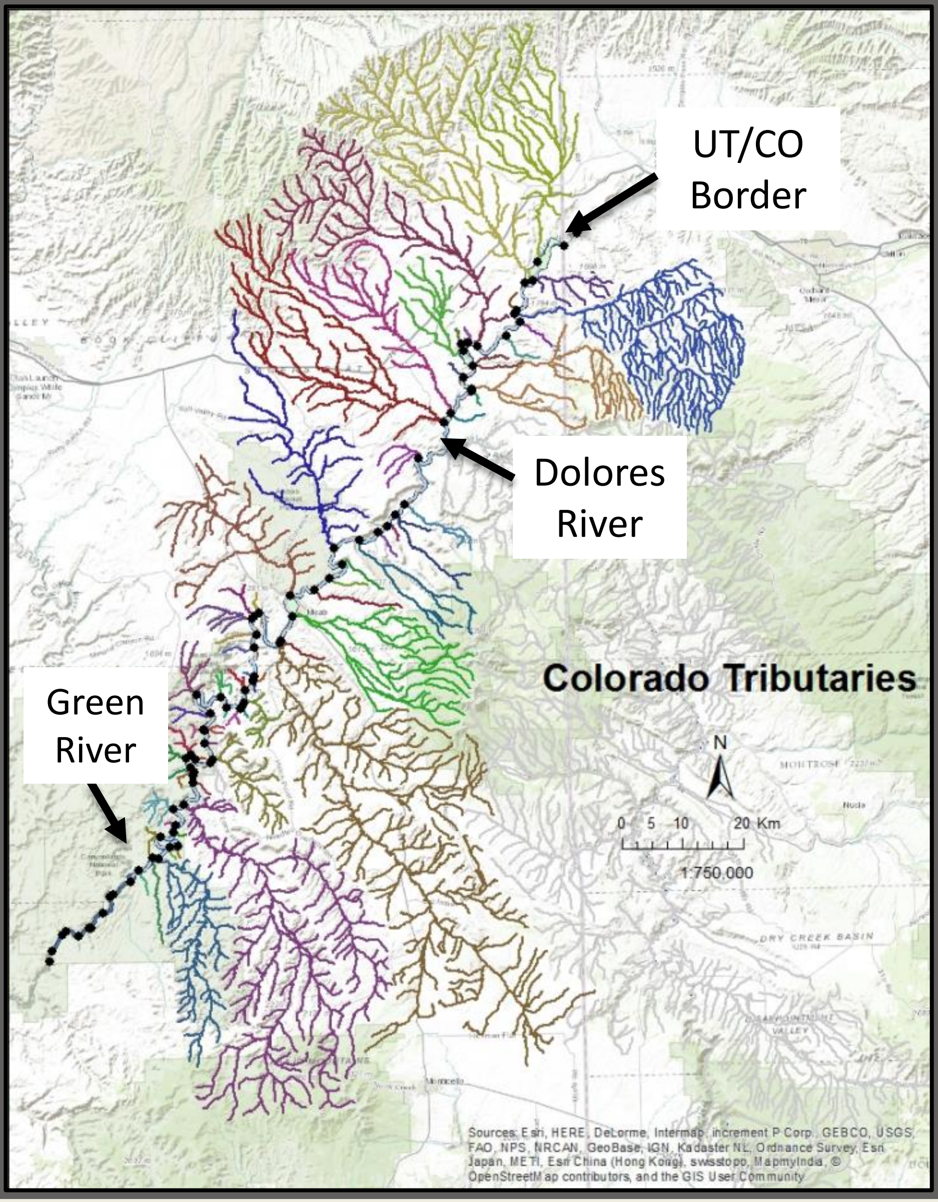
DOLORES RIVER

- *Watershed = 11,965 km^2*
- *~280 km, from McPhee Dam down to confluence with Colorado River*
- *103 tributaries*
- *Upstream of San Miguel, peak flows have been reduced by ~ 50%*



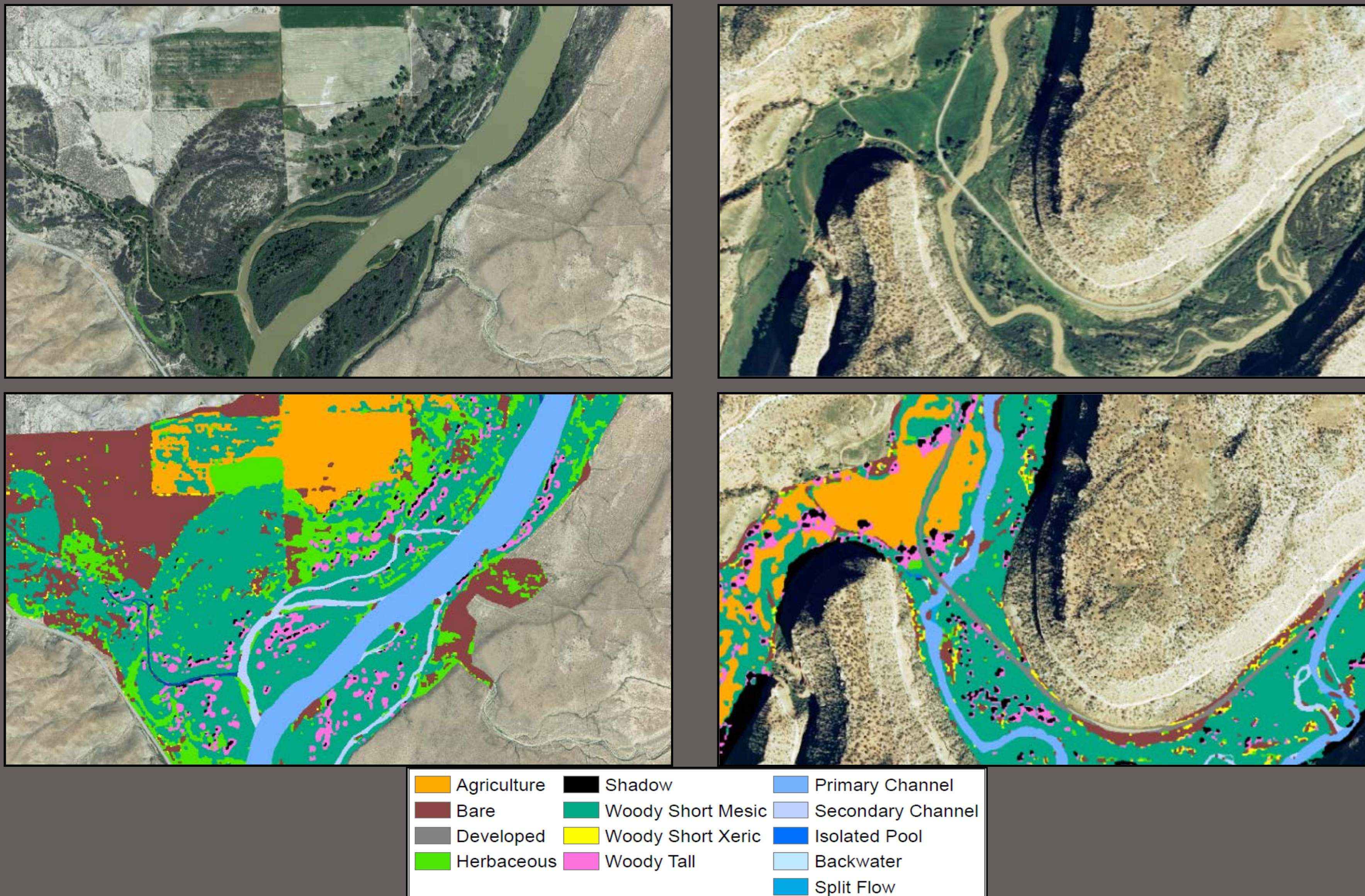


COLORADO RIVER



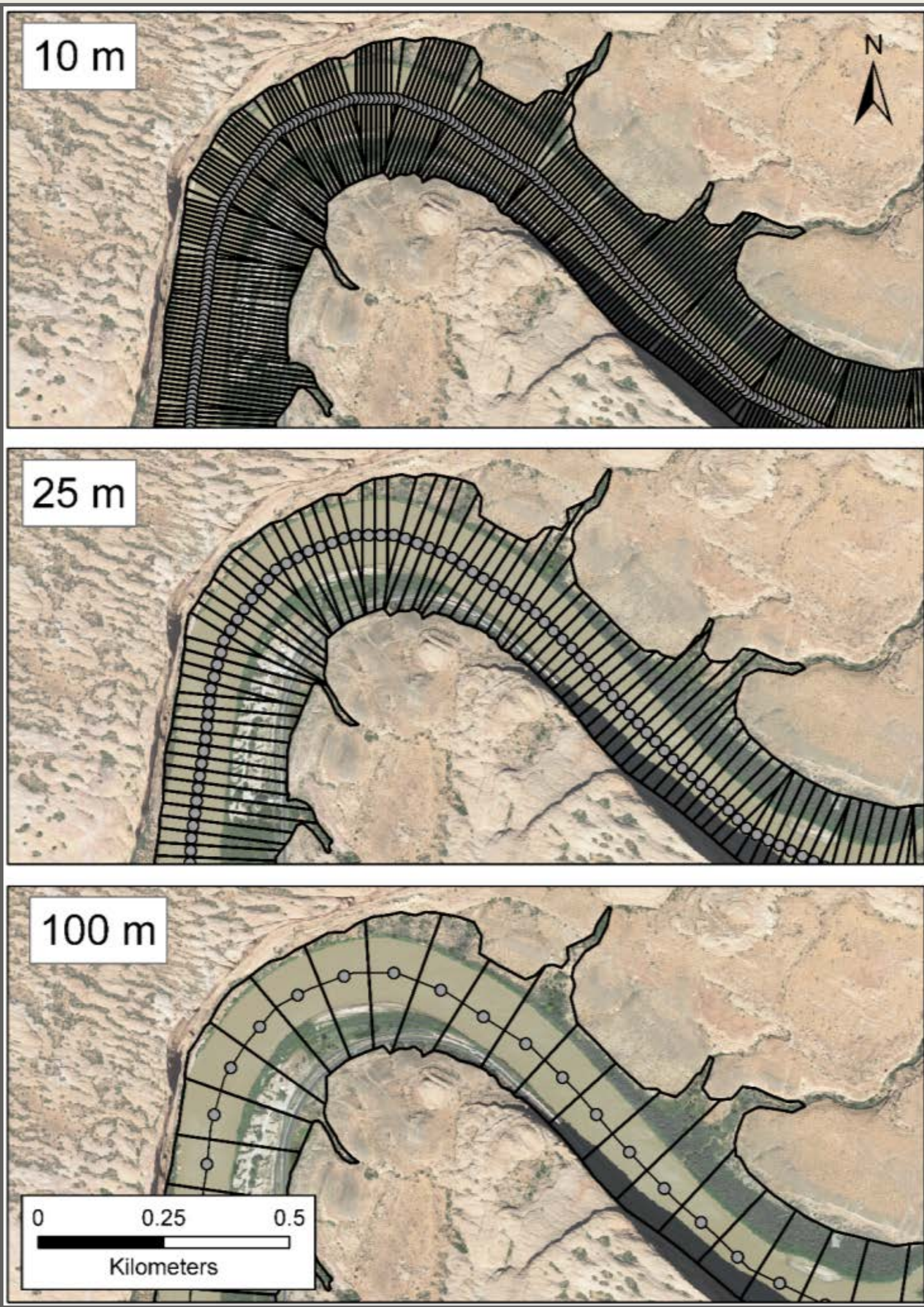
- *Watershed (excluding Green) = 67,800 km^2*
- *~215 km from Utah/ Colorado to confluence with Green River*
- *70 tributaries*
- *Spring peak flows have been reduced by 30-40%*

VEGETATION CLASSIFICATION

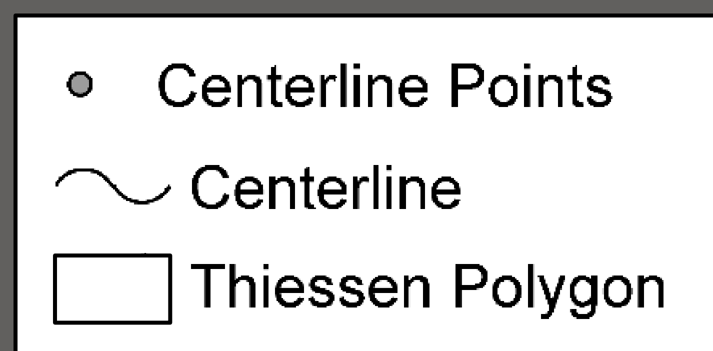


CHANNEL TYPES

THIESSEN POLYGONS



Each Thiessen polygon defines an area of influence around its sample point, so that any location inside the polygon is closer to that point than any of the other sample points.



DATA ANALYSIS

- Thiessen polygons = continuous spatial series of habitat measures:
  - Bare ground percentage
  - Tall woody percentage
  - Cover class richness density
  - Channel class richness density
  - Cover + channel class richness
- Tributaries included = 2 km buffer (1 km up/downstream)
- Pettitt test (change point analysis)
- Randomization test

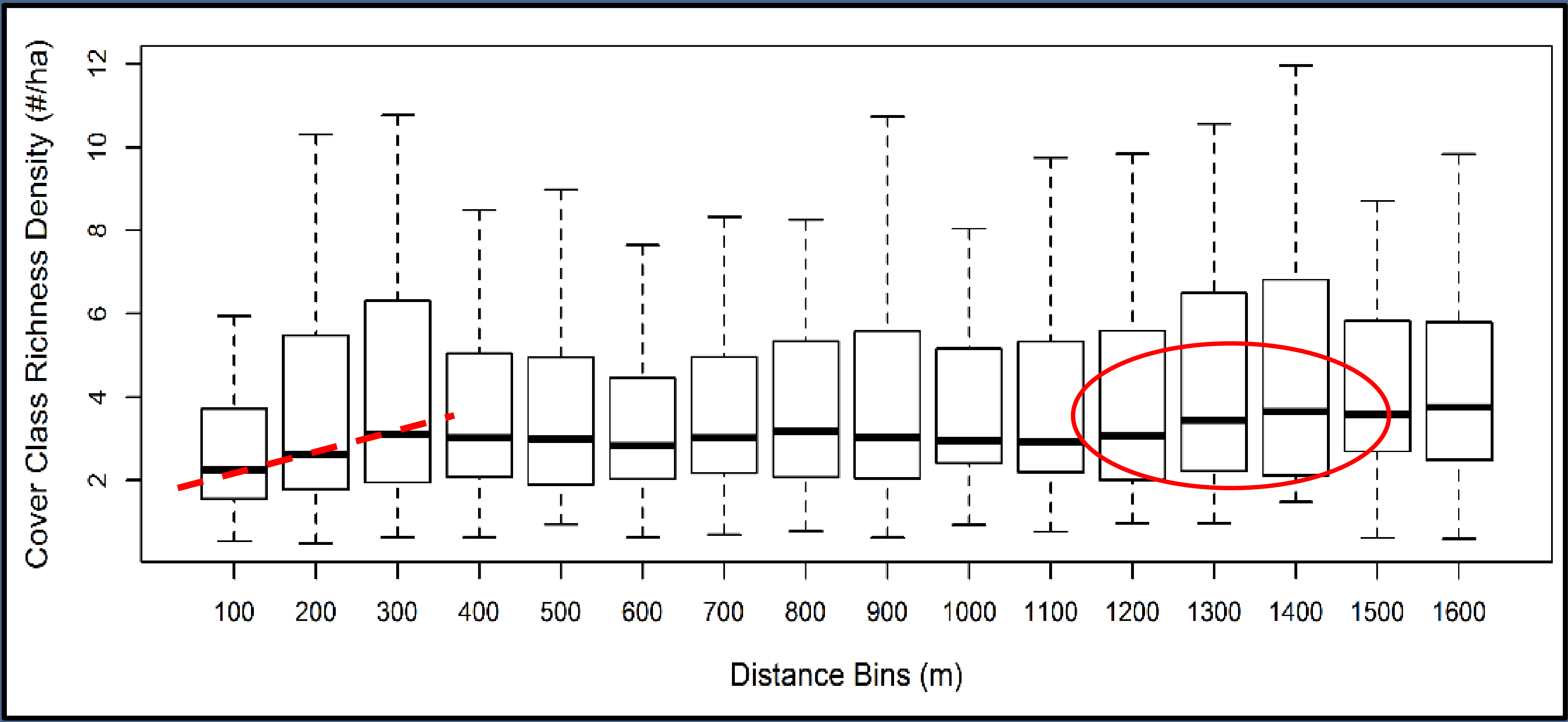
RESULTS: RANDOMIZATION TEST (P VALUE)

	Colorado River			Dolores River		
Response Variables	10 m	25 m	100 m	10 m	25 m	100 m
Density of Cover Classes	0.04*	0.24	0.42	0.71	0.5	0.81
Density of Channel Classes	<0.01*	0.02*	0.11	0.58	0.16	0.98
Density of Cover and Channel Classes	0.15	0.78	0.81	0.89	0.7	0.99
Percentage of Bare Ground	0.02*	0.36	0.67	0.83	0.78	0.88
Percentage of Woody Tall	1	0.72	0.19	0.11	0.03*	0.2

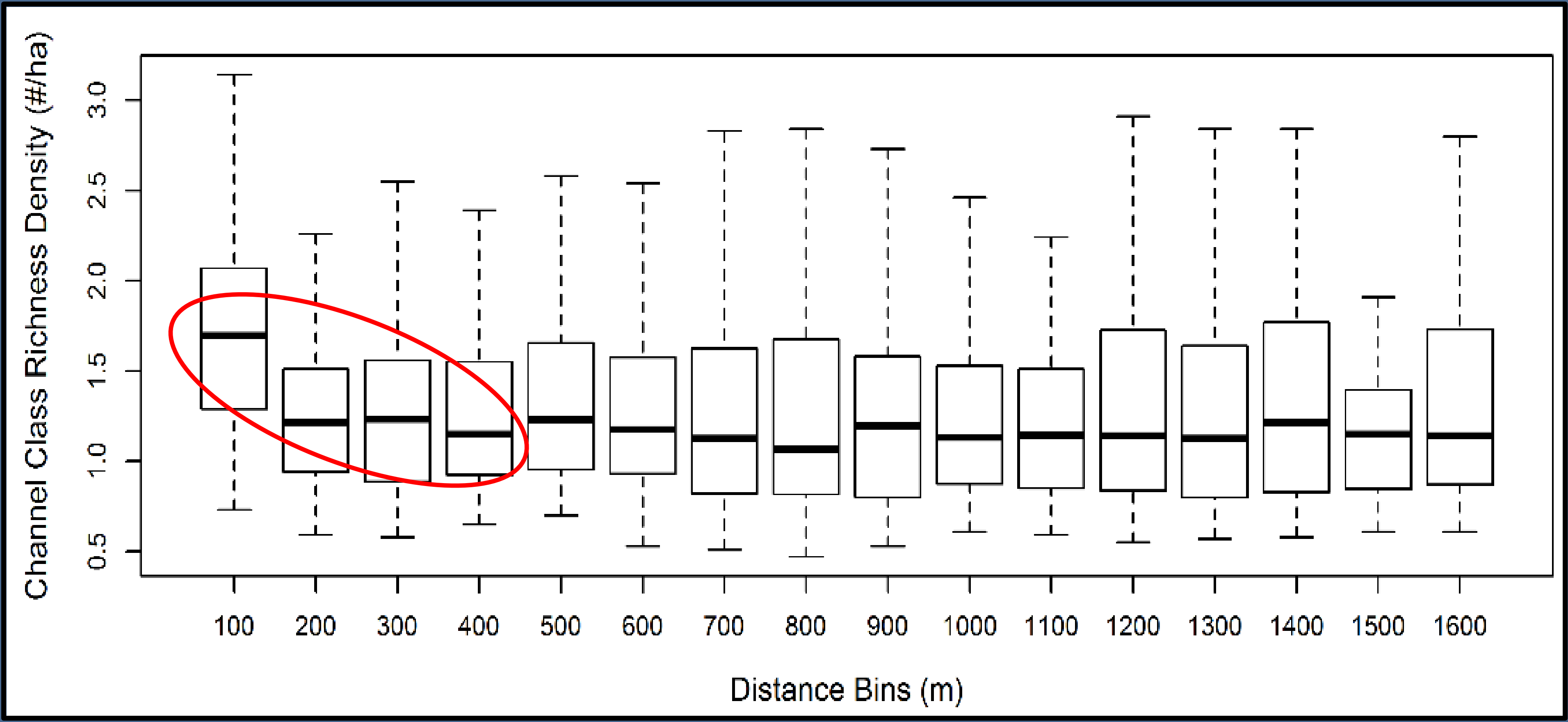
RESULTS: RANDOMIZATION TEST (DISTANCE)

	Colorado River			Dolores River		
Response Variables	10 m	25 m	100 m	10 m	25 m	100 m
Density of Cover Classes	1126*	1153	1160	1507	1464	1697
Density of Channel Classes	1121*	1100*	947	1480	1347	2484
Density of Cover & Channel Classes	1157	1251	1343	1551	1545	2460
Percentage of Bare Ground	1122*	1178	1261	1533	1565	1826
Percentage of Woody Tall	1488	1281	973	1309	1134*	1213

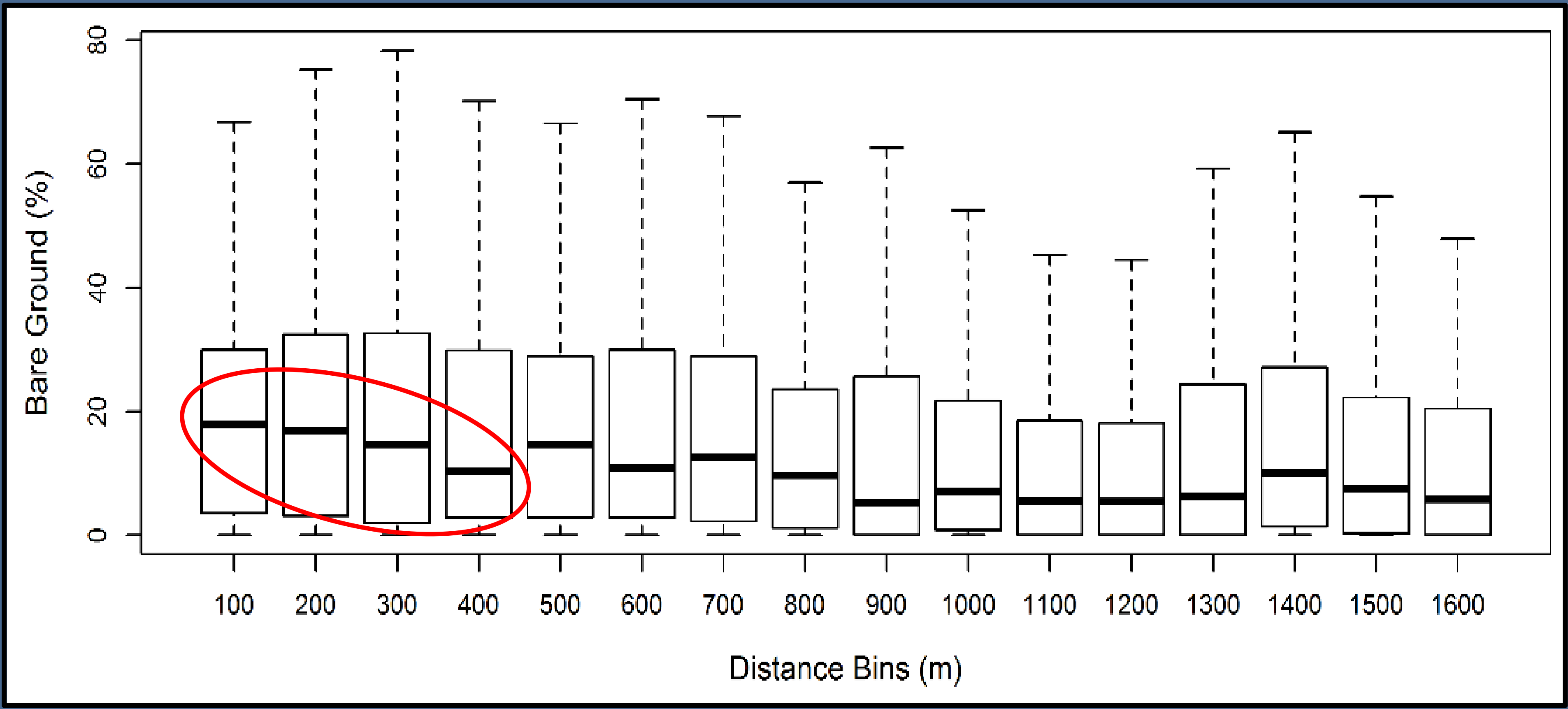
COLORADO RIVER: COVER CLASSES



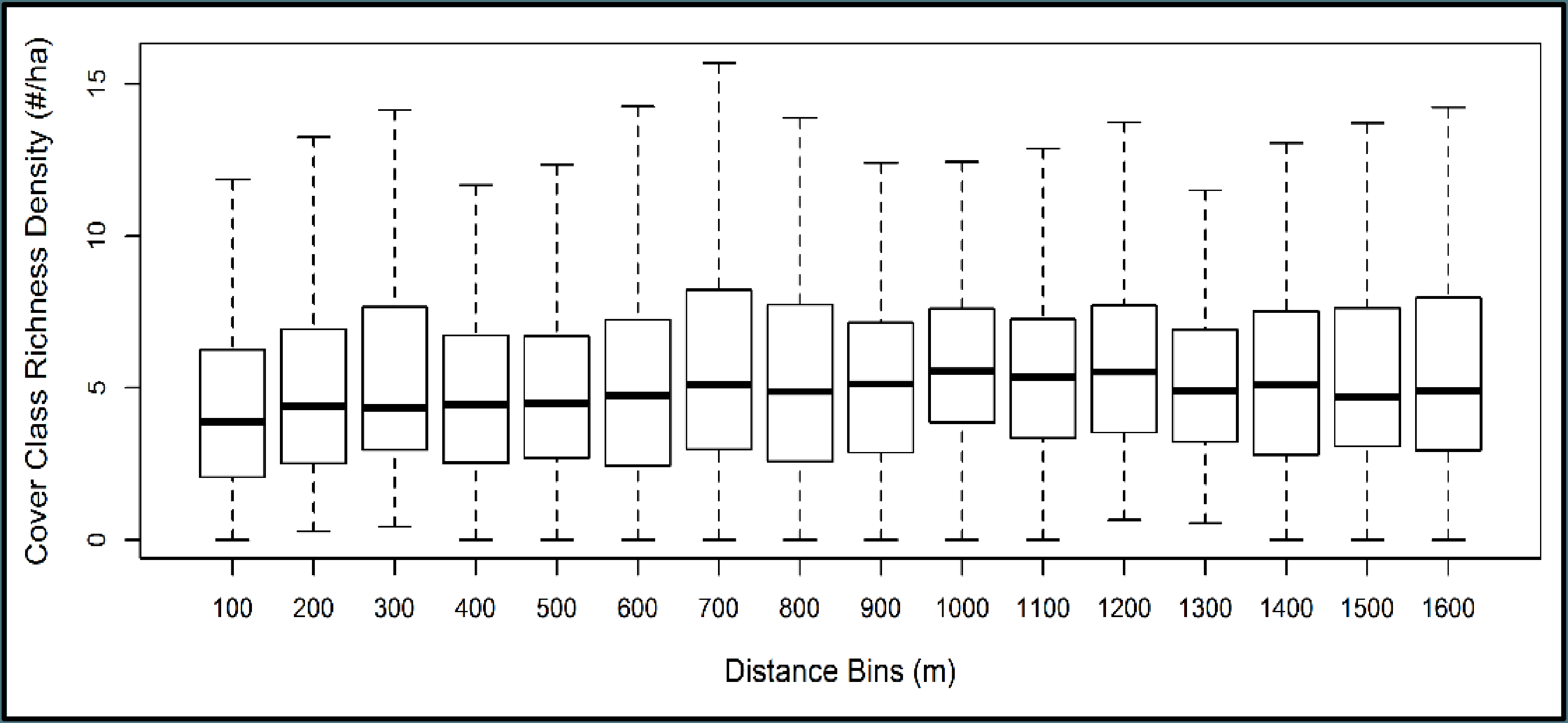
COLORADO RIVER: CHANNEL CLASSES



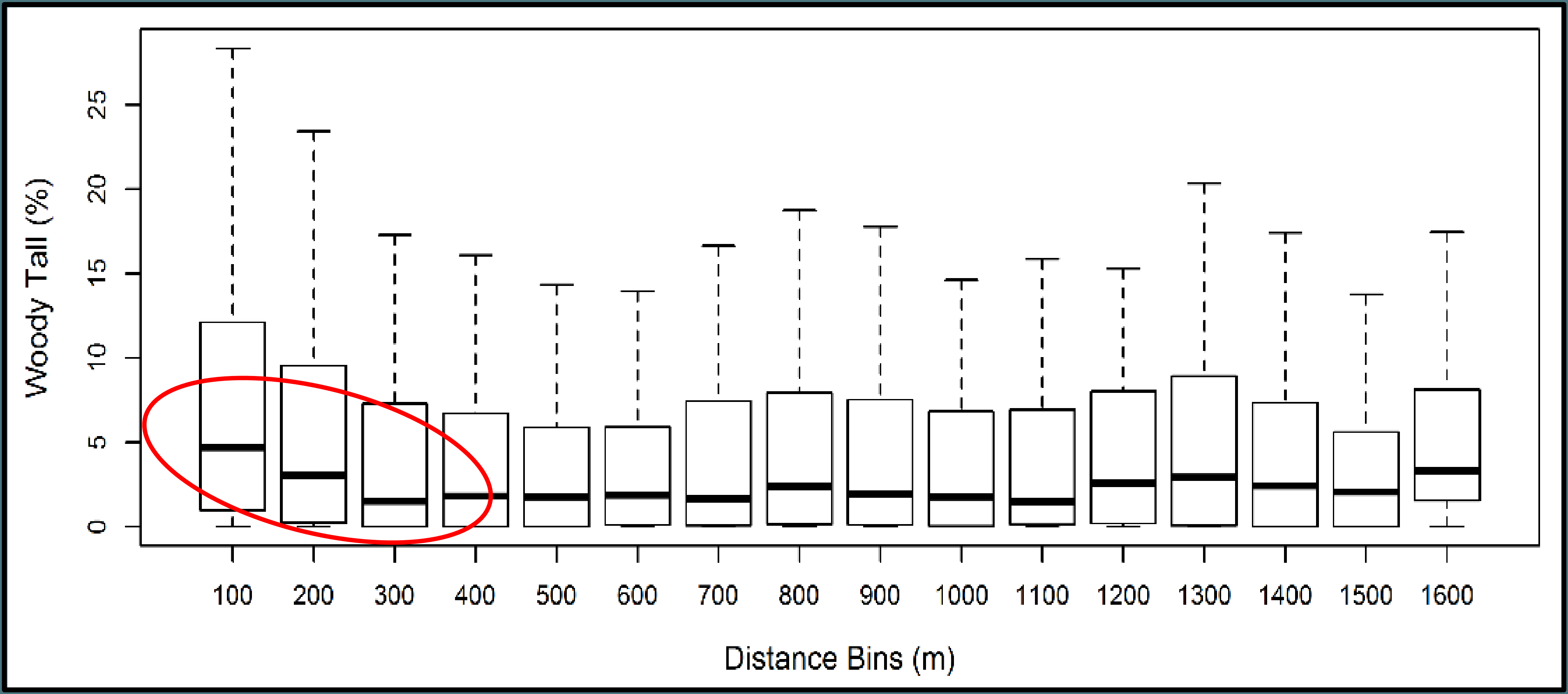
COLORADO RIVER: BARE GROUND



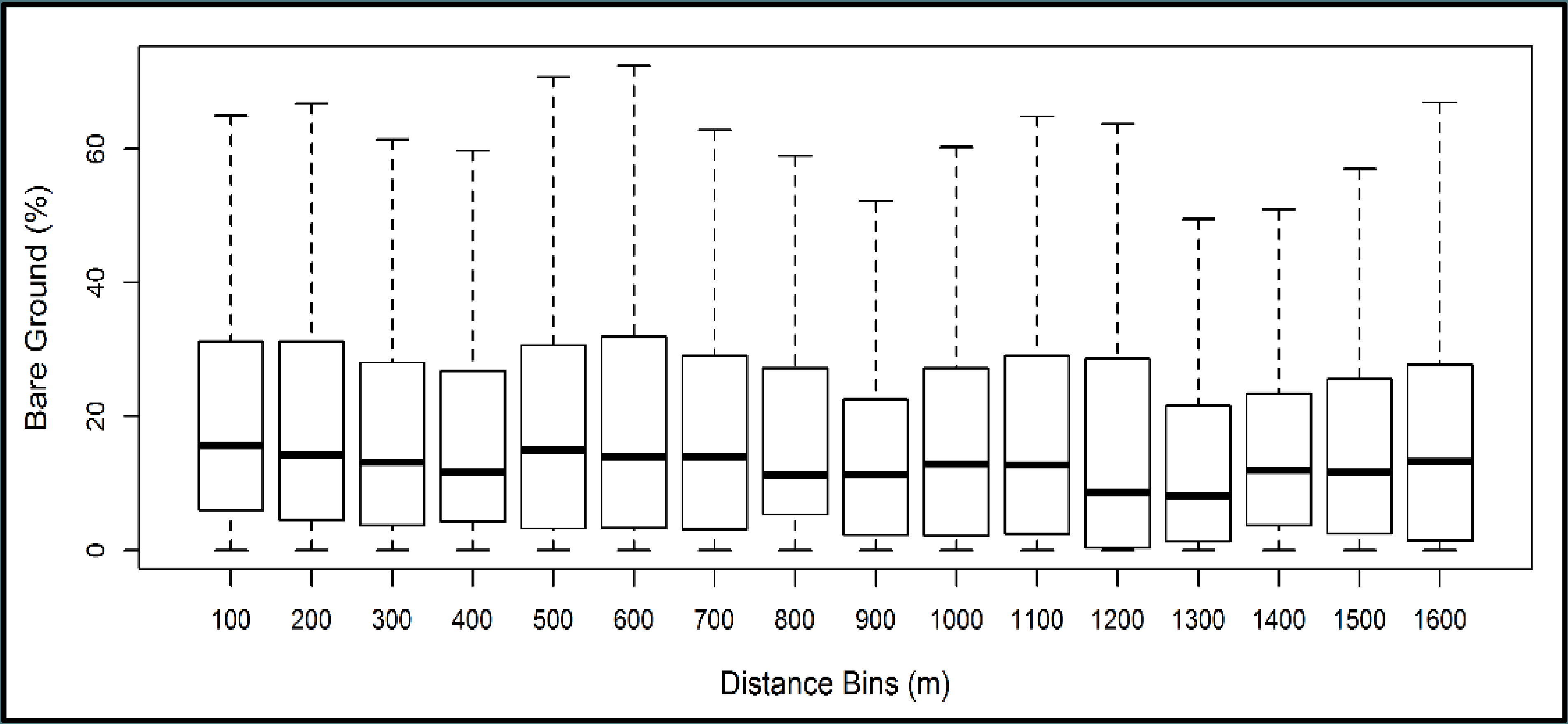
DOLORES RIVER: COVER CLASSES



DOLORES RIVER: WOODY TALL



DOLORES RIVER: BARE GROUND



DISCUSSION

- Patterns differed in the two river systems:
  - On the Colorado, terrestrial cover was low at confluences but increased in the first hundred meters
  - On the Dolores, terrestrial cover was high and continued to increase, but woody cover decreased.
- Differences point to flow variability and size of systems (e.g., size of bottomland)
- Contrasting dynamics driving patterns in riparian habitat complexity

TAKE-AWAYS: TRIBUTARY INFLUENCE

- Increased geomorphic and vegetation complexity in the presence of tributary confluences along these two regulated river reaches.
  - Higher geomorphic complexity closer to tributary junctions; riparian diversity increased with distance.
- Scale matters!
  - Shifts in vegetation cover, channel density and bare ground patterns were detectable at narrower lateral scales near tributaries; riparian forest cover patterns were more strongly detected across the full bottomland environment.

MANAGEMENT/RESTORATION IMPLICATIONS

- Tributaries deliver critical resource inputs and dynamism on regulated rivers that extend into riparian zone.
- May serve as refugia and provide the geomorphic and habitat complexity necessary to achieve riparian restoration outcomes locally and at larger scales.
- Future studies: Investigate how physical and biological characteristics of tributaries (e.g., watershed area, volume of sediment input, degree of vegetation cover) and the mainstem (e.g., sinuosity, width of mainstem and bottomland to tributary size) interact to influence riparian response patterns.

QUESTIONS?

meg_white@tnc.org

Thank you to our funders and partners!

SOUTHERN ROCKIES
Landscape Conservation Cooperative

The Nature Conservancy
Protecting nature. Preserving life.

USGS
science for a changing world