Evaluating Conserved Consumptive Use in the Upper Colorado

Presentation to the Colorado River District Board

July 16, 2025





...also known as **Paul's Project**

Research Questions:

1. How can we accurately and cost-effectively estimate water use and conservation at scale?
2. What are the impacts of reduced irrigation on perennial grass fields and how do they recover under normal irrigation?
3. What does participation in a water conservation project mean for producers' bottom lines?
4. How do water conservation projects impact river flows and wildlife habitat?
5. How do producers in the area feel about the project?

Partners (in addition to the Bruchez family)

Project Team

Perry E. Cabot, Extension Professor, Colorado Water Center, CSU Extension, CSU AES

Aaron Derwingson, Water Projects Director, Colorado River Program, The Nature Conservancy

Matt Bromley, Research Scientist, Desert Research Institute

Alfonso Torres-Rua, Associate, Professor, Civil and Env. Engineering, Utah State University

Jenny Beiermann, Agriculture & Business Management Specialist, CSU Extension

John Ritten, Professor, Department of Ag and Resource Economics, Colorado State University

Larry Hipps, Professor, Plants, Soils, & Climate (PSC), Utah State University

Hannah Holm, Associate Director for Policy, Southwest Region, American Rivers

Mely Whiting, Legal Counsel, Trout Unlimited

Jesse Kruphaupt, Trout Unlimited

Martin Schroeder, Senior Researcher (Eddy Covariance), Utah State University

Paul Bruchez, Colorado River Basin Roundtable, Colorado Water Conservation Board

Seth Mason and Alex Brooks, Lotic Hydrological

William Vetter, Precision Wildlife Resources

Kelsea MacIlroy, Project Manager, The Langdon Group

WATER USE & FORAGE RECOVERY QUESTIONS

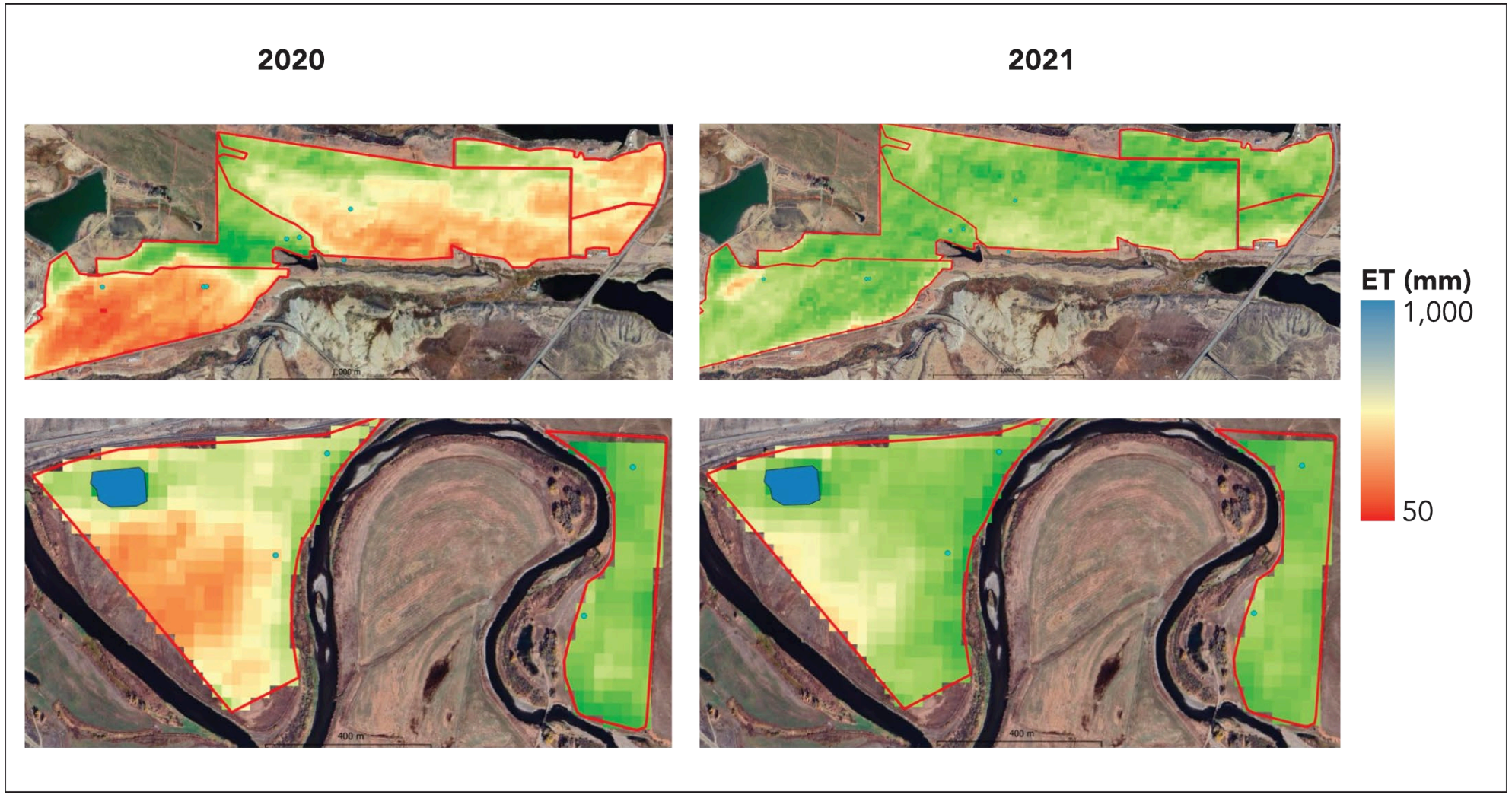
1. What is the CU and CCU on large irrigated high-elevation pastures during and after irrigation withdrawal for a year?
2. What are the forage recovery patterns resulting from these practices?

Estimating Water Use

Remote Sensing: satellite based, cost-effective over large and heterogeneous landscapes, multiple models

Eddy Covariance: site-specific, highly accurate, can be used to compare with estimates from remote-sensing, higher cost to build and maintain

CU Patterns 2020-2021 Visualized Using the eeMETRIC Model in OpenET



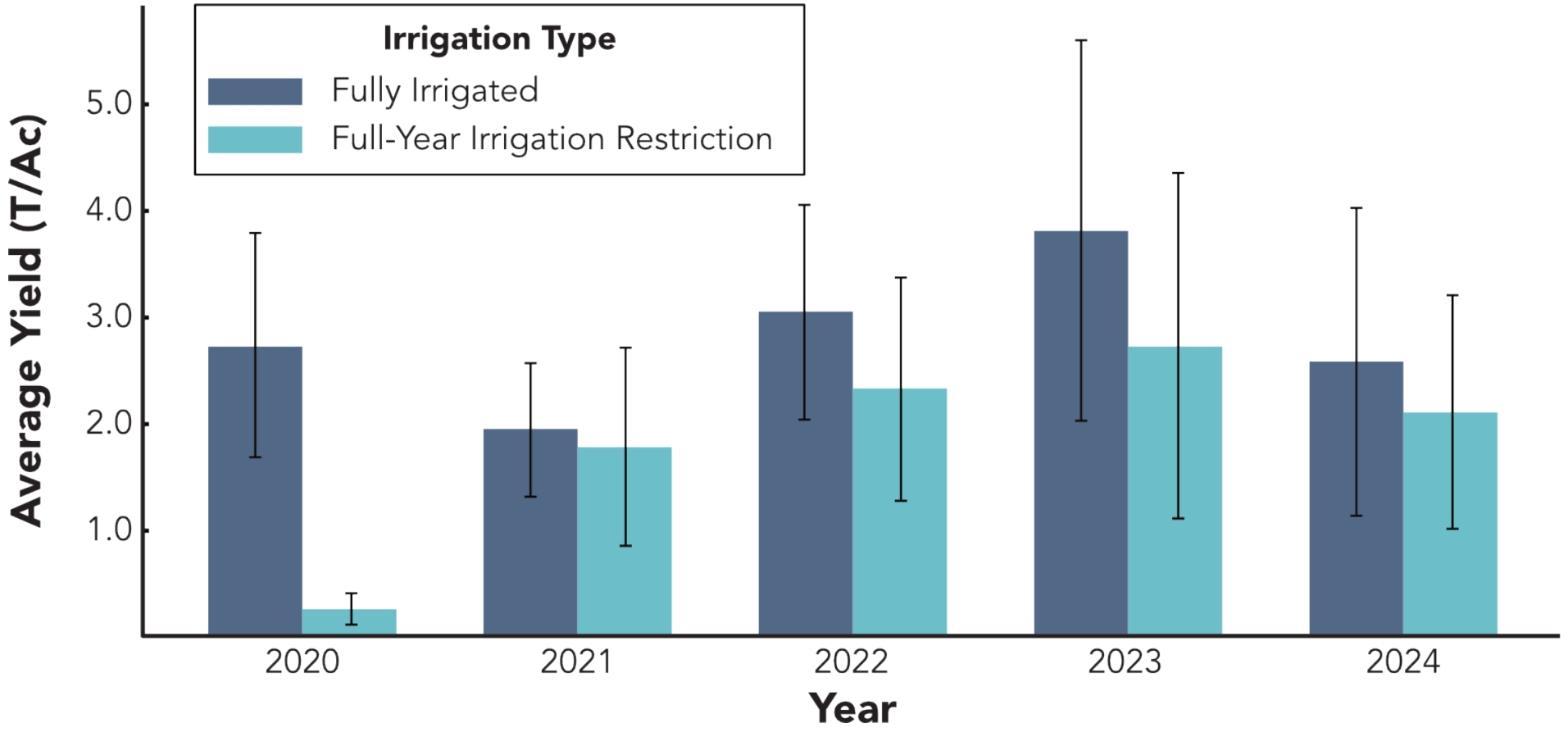
CCU – Historical vs Reference Method

Length of Irrigation Withdrawal	CU Reduction: Reference Field Method				CU Reduction: Historic Baseline Method			
	2020	**2021**	**2022**	**2023**	**2020**	**2021**	**2022**	**2023**
Full season (%)	56%	10%	12%	9%	48%	1%	16%	7%
Partial season (%)	21%	10%	15%	12%	10%	0%	28%	11%
	Total CCU (AF)				**Total CCU (AF)**			
	2020	**2021**	**2022**	**2023**	**2020**	**2021**	**2022**	**2023**
Full season (AF)	940	145	131	87	783	92	288	127
Partial season (AF)	106	30	40	33	-12	11	70	26
Total	**1,046**	**175**	**171**	**120**	**995**	**103**	**358**	**153**

Consumptive Water Use Insights

- **Remote sensing**, particularly using the eeMetric model through OpenET, provides a **practical and scalable** method for estimating consumptive CU and CCU in agricultural systems like this Study.
- Withholding irrigation completely **reduced CU by approximately 50%** during the program implementation year.
- **Water conservation (CCU) persisted** for multiple years, particularly in fields with complete (vs partial season) irrigation withdrawal.
- The CCU calculation is **sensitive to whether it is calculated using "same year" reference conditions or a historical baseline**, making this a critical consideration for future applications.

Forage Recovery



Forage Impact & Recovery Insights

Outcomes in 2020 (Irrigation Withdrawal Year)

- **Full-season withdrawal (no irrigation):**
  - Average forage yields were 87% lower in fields with no irrigation compared to fully irrigated fields.
- **Partial-season withdrawal (irrigation stopped after June 15):**
  - Average forage yields in 2020 were between 7% below to 27% above yields on reference fields.
  - This suggests early-season irrigation was sufficient to sustain growth into the withdrawal period.

Forage Impact & Recovery Insights

Outcomes in 2021-2023 (Recovery Years)

- **Full-season withdrawal (no irrigation):**
  - Drought in 2021 reduced yields on reference fields, helping to explain the small difference in forage productivity between treatment and reference fields during this time.
  - In the following years (2022–2023), fields that experienced full-season withdrawal continued to have reduced productivity compared to reference fields, despite receiving the same irrigation as their paired reference fields.
- **Partial-season withdrawal (irrigation stopped after June 15):**
  - Some forage yield reduction was observed on these parcels during the recovery years.

ECONOMIC RESEARCH QUESTION

What does participation in a water conservation project mean for producers' bottom lines?

REFERENCE CONDITIONS: HAY ONLY

REFERENCE FIELDS	Average	Max	Min
Gross Receipts	$ 319.61	$ 455.28	$ 66.00
Total Operating + Fixed Costs	$ 313.14	$ 426.74	$ 211.21
Net Receipts Before Factor Payments	$ 7.47	$ 192.82	$ (282.88)
Factor Payments	$203.50	$203.50	$203.50
Return To Management and Risk	$ (196.03)	$ (4.68)	$ (486.38)

ECONOMIC RESULTS: HAY ONLY

TREATMENT FIELDS – Full Season	Average	Max	Min
Gross Receipts	$ 621.00	$ 621.00	$ 621.00
Total Operating + Fixed Costs	$ 220.30	$ 266.18	$ 152.74
Net Receipts Before Factor Payments	$ 400.69	$ 468.26	$ 354.77
Factor Payments	$203.50	$203.50	$203.50
Return To Management And Risk	$ 197.19	$ 264.76	$ 151.27

TREATMENT FIELDS – Split Season	Average	Max	Min
Gross Receipts	$ 467.50	$ 566.00	$ 369.00
Total Operating + Fixed Costs	$ 310.00	$ 325.40	$ 294.59
Net Receipts Before Factor Payments	$ 157.51	$ 240.60	$ 74.41
Factor Payments	$203.50	$203.50	$203.50
Return To Management And Risk	$ (46.00)	$ 37.10	$ (129.09)

ECONOMIC RESULTS: WITH LIVESTOCK

Average Per-Acre across Full and Split Season Curtailment Fields with Livestock					
Additional Income	$550.63			**Additional Costs**	$800.91
Reduced Costs	$262.97			**Reduced Income**	$362.35
Total	**$813.60**			**Total**	**$1,163.26**
			Net Increase/Decrease to Income		**-$349.66**

Insights: Economic Impacts

- Full season participants *growing hay strictly for sale* saw net gains in 2020 on their treatment fields compared to reference fields, with larger gains for those with full-season irrigation withdrawal.

- However, cattle producers experienced losses on their treatment fields, because they had to purchase additional hay and pasture to make up for reduced forage yields.

- Most of the economic impact from irrigation withholding was felt in 2020 but, as with CU changes and forage impacts, producers experienced some economic impacts after that season.

KEY EXTERNAL FACTORS

Drought Conditions
2020 was a particularly bad year

Dynamic System
High elevation, short growing season, harsh winter conditions

Coordination Across Operations
Site specific conditions are important, and we need to consider impacts to all aspects of the operations

STREAMFLOW & HABITAT IMPACTS

1. How does water conservation impact the quantity and timing of water in streams and reservoirs?
2. How do changes in irrigation impact bird species?

Impacts on Streamflow - Results

- Field measurements showed limited ability to detect increased streamflow from water conservation but also did not find impacts from return flows that the research team expected from reduced irrigation.
- Field-based water balance method has limitations.
- Model approach provides insights into impacts on streams and reservoirs.
  - Modest and variable impacts on streams (+/- 10cfs relative to 200-400 cfs flow).
  - Increased early inflow, modest decreases to inflows later. Important for understanding impact to timing and ability to spill/store.
- More data for more years would help but is costly and not transferrable to other areas. Alternative approaches required.

Avian Response

- Irrigated ag lands provide important wildlife habitat for bird species – it's critical to understand how reduced irrigation may influence bird use of these habitats.
- Completed bird surveys on five participating properties in 2020, 2021, and 2022.
- Results were inconclusive: More detections in 2021 than 2020 but.. fewer detections in 2022 than 2020. Why?
- Bird presence impacted by variables outside of the study (e.g., temperature)
- Birds are highly mobile, and the area of the study was relatively small – likely birds are utilizing other habitat areas.

SOCIAL SCIENCE RESEARCH QUESTIONS

1. What factors did producers consider when deciding to participate or not?
2. How did participants' thoughts on the project change over time?

Methods

Qualitative Data

Grounded Theory

Longitudinal

Participation = Location + Timing + Trust

+ Payments

Participation = Location + Timing + Trust

= Local proximity/shared ditches

“Once “Smiths” decided to join up and do the project, everyone below that felt like, 'Well, if they aren't going to be irrigating and they're not going to be turning on the water, that's going to impact our return flows… so we probably should just sign up.’”

Participation = Location + **Timing** + Trust

“We’ve worked hard at developing this [piece of land].”

“Our ground might get more hurt than other people's ground …”

“Most of the people aren't in [ranching] for fun. They're trying to make a living, so, and without water it's just dirt.”

Participation = Location + Timing + Trust

“Well, Paul called me…”

“If you want it done well…”

- Plan for robust engagement with participants
- Adequately fund engagement and local, on-the-ground support

“If the water community wants successful things to occur, you’ve got to have trusted local people that can be around and have the funding available from the beginning.”

Water does not stand alone.

"Everything that's bad in this world starts with a 'W'."

- Water law and policy are not enacted in a vacuum.
- Context impacts how people think and act.

Key Findings

1. Participation = Location + Timing + Trust + *payments*

2. “If you want to do it well…” fund and staff it appropriately.

3. Water Policy *does NOT stand alone*.

WHAT'S NEXT?

- **Final Report** coming soon – email **aderwingson@tnc.org** to see it first!

- Additional work on ag drought resilience:
  - Alternative forage research
  - Homegrown drought resilience strategies (CAWA)