

MT AWRA Conference | October 10, 2025



Understanding social learning in collaborative water resources research

A case study of the Upper Clark Fork Working Group

Madison Boone & Dr. Sarah P. Church

PeoplePlacesWater Lab | Science Math Resource Center

Montana State University

BACKGROUND

COLLABORATIVE WATER RESOURCE RESEARCH

- Collaboration promoted in knowledge production models

BACKGROUND

COLLABORATIVE WATER RESOURCE RESEARCH

- Collaboration promoted in knowledge production models
- Collaboration supports:
 - Shared understanding
 - Trust
 - Adaptive capacity
 - Social learning
 - Useful and usable research

BACKGROUND

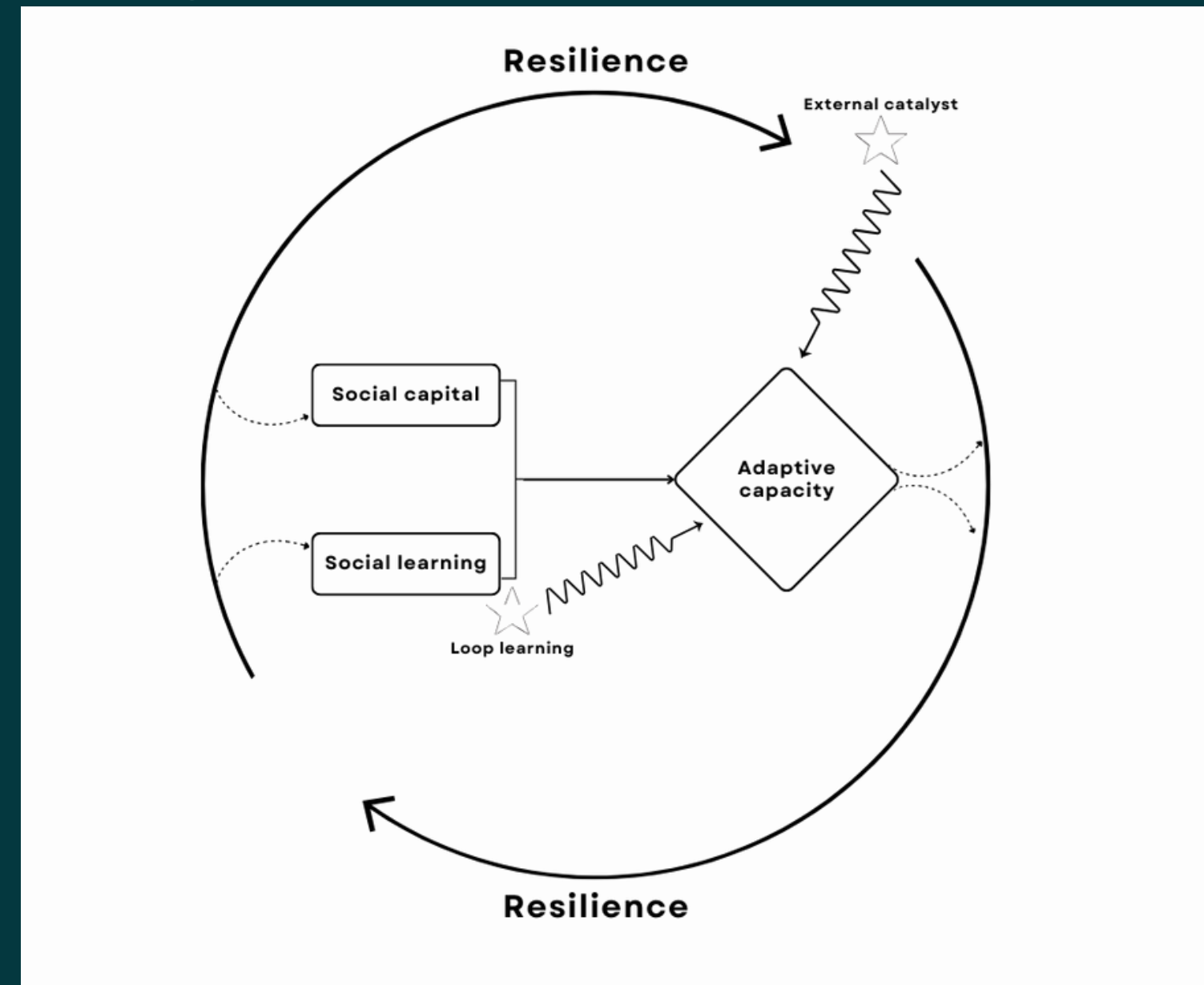
COLLABORATIVE WATER RESOURCE RESEARCH

- Gaps remain in understanding:
 - Context
 - Processes
 - Outcomes

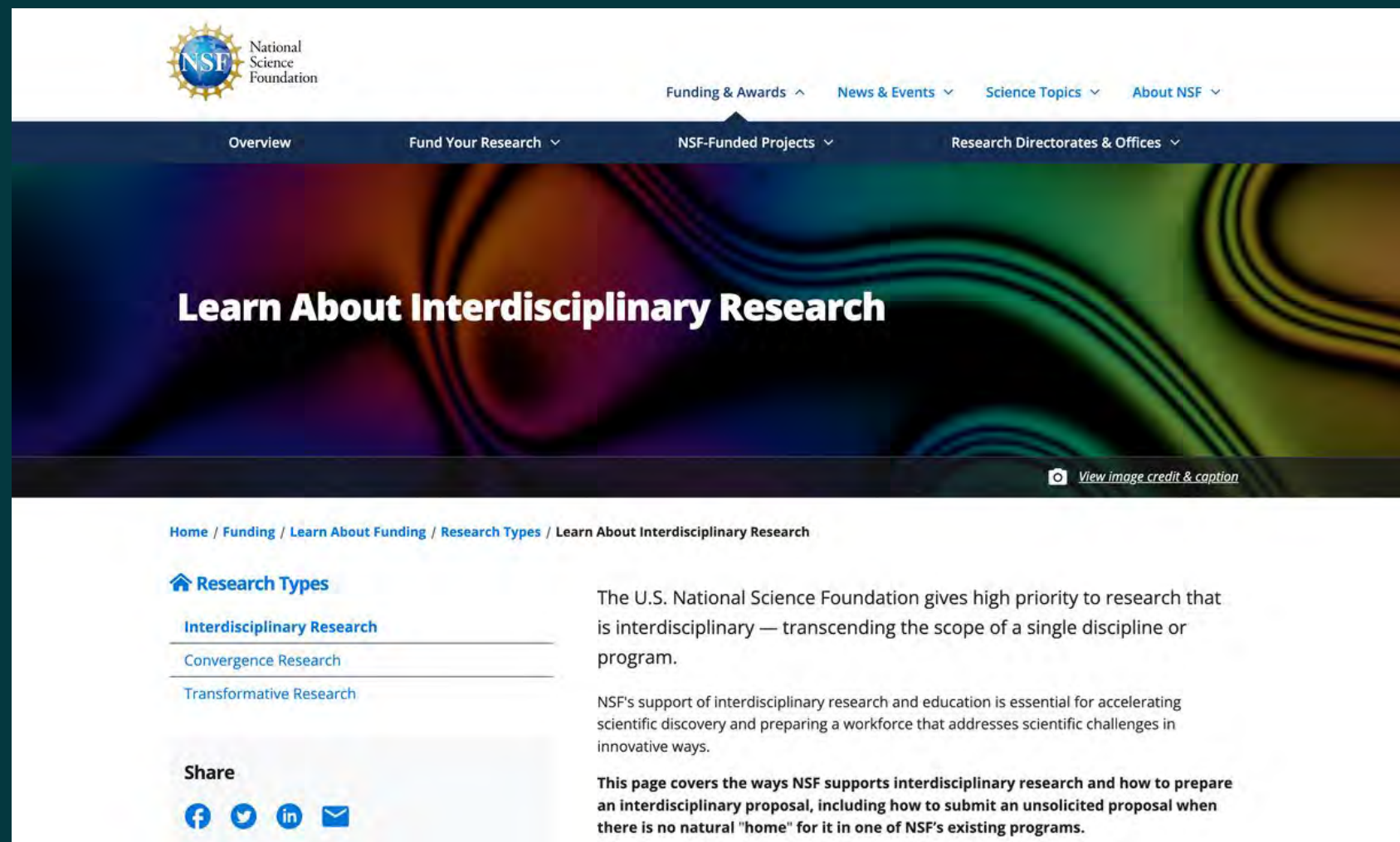
BACKGROUND

COLLABORATIVE WATER RESOURCE RESEARCH

- Gaps remain in understanding:
 - Context
 - Processes
 - Outcomes
- How social learning contributes to adaptive capacity



BACKGROUND



The screenshot shows the NSF website's navigation and content for the 'Learn About Interdisciplinary Research' page. The NSF logo is in the top left. The main navigation bar includes 'Funding & Awards', 'News & Events', 'Science Topics', and 'About NSF'. A secondary navigation bar includes 'Overview', 'Fund Your Research', 'NSF-Funded Projects', and 'Research Directorates & Offices'. The main content area features a large banner with the title 'Learn About Interdisciplinary Research' and a colorful abstract background. Below the banner is a breadcrumb trail: 'Home / Funding / Learn About Funding / Research Types / Learn About Interdisciplinary Research'. A 'Research Types' section lists 'Interdisciplinary Research', 'Convergence Research', and 'Transformative Research'. A 'Share' section includes social media icons for Facebook, Twitter, LinkedIn, and Email. The main text explains that the NSF gives high priority to interdisciplinary research and provides information on how to prepare and submit proposals.

NSF National Science Foundation

Funding & Awards ^ News & Events v Science Topics v About NSF v

Overview Fund Your Research v NSF-Funded Projects v Research Directorates & Offices v

Learn About Interdisciplinary Research

[View image credit & caption](#)

Home / Funding / Learn About Funding / Research Types / Learn About Interdisciplinary Research

Research Types

- [Interdisciplinary Research](#)
- [Convergence Research](#)
- [Transformative Research](#)

Share

[f](#) [t](#) [in](#) [✉](#)

The U.S. National Science Foundation gives high priority to research that is interdisciplinary — transcending the scope of a single discipline or program.

NSF's support of interdisciplinary research and education is essential for accelerating scientific discovery and preparing a workforce that addresses scientific challenges in innovative ways.

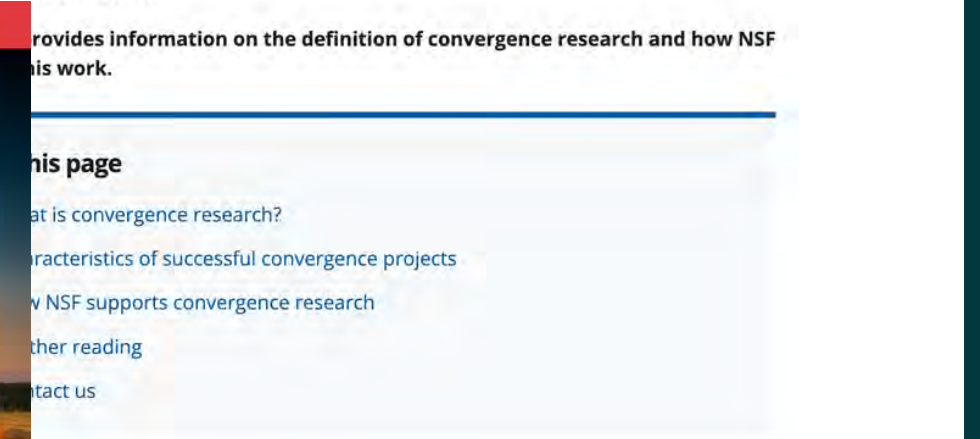
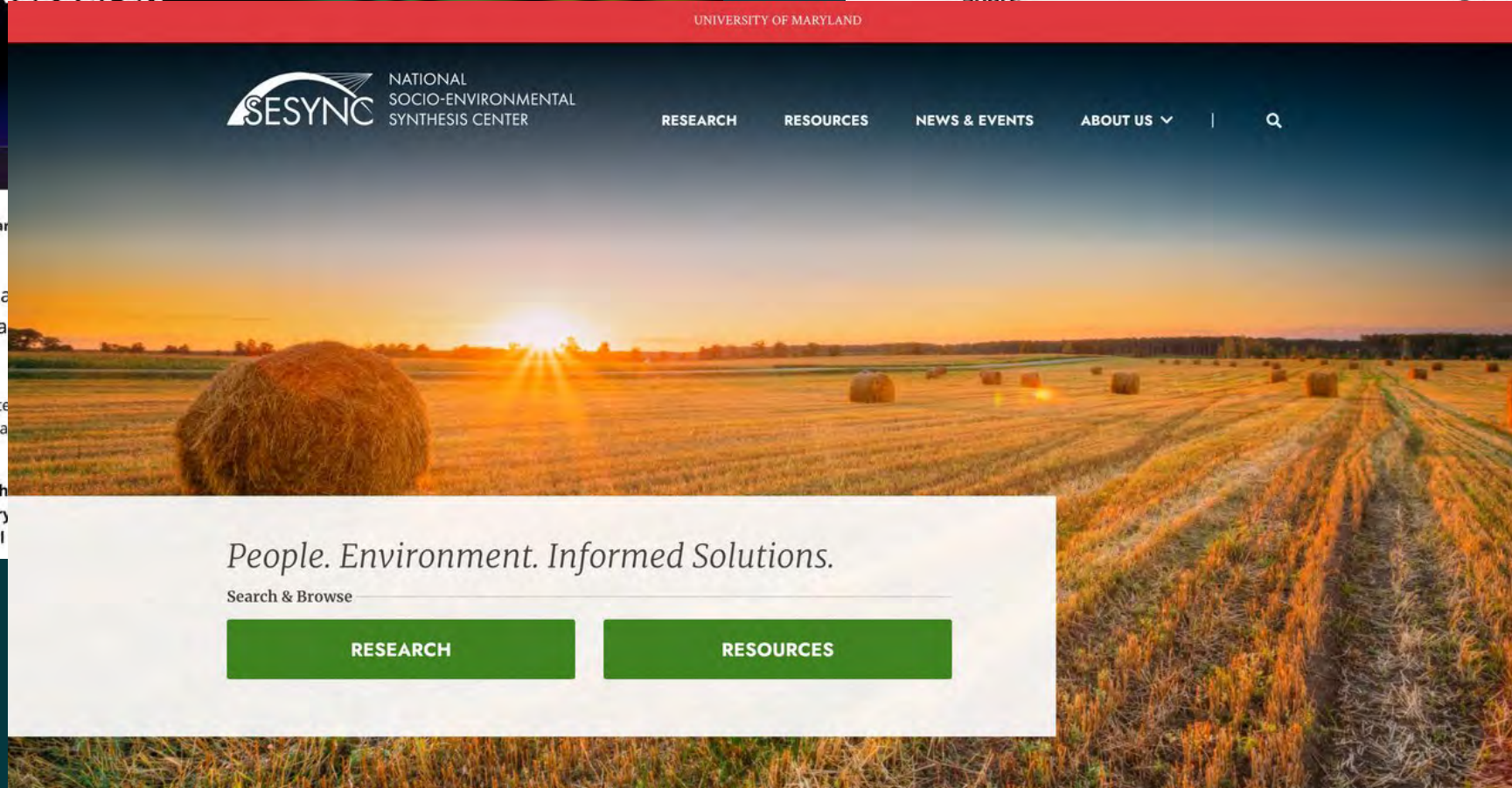
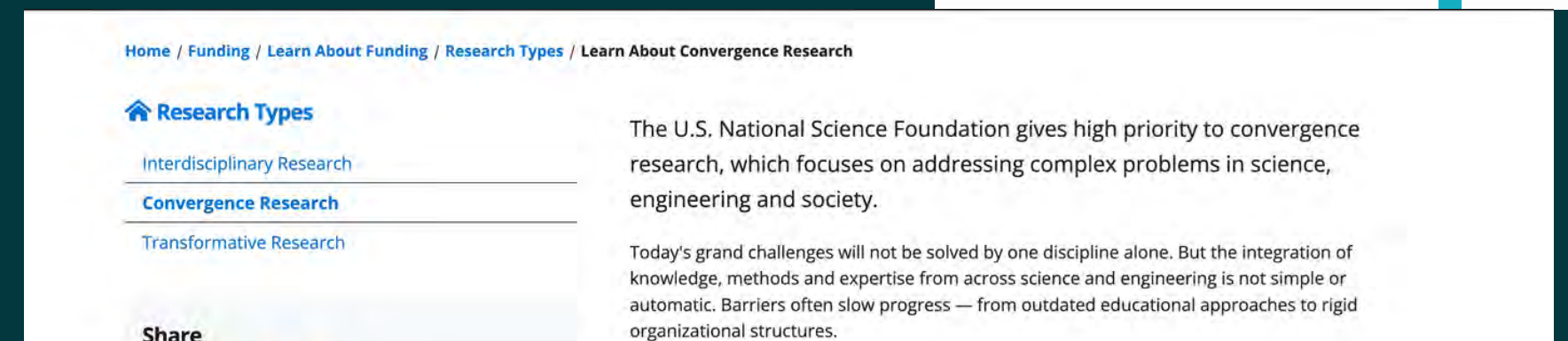
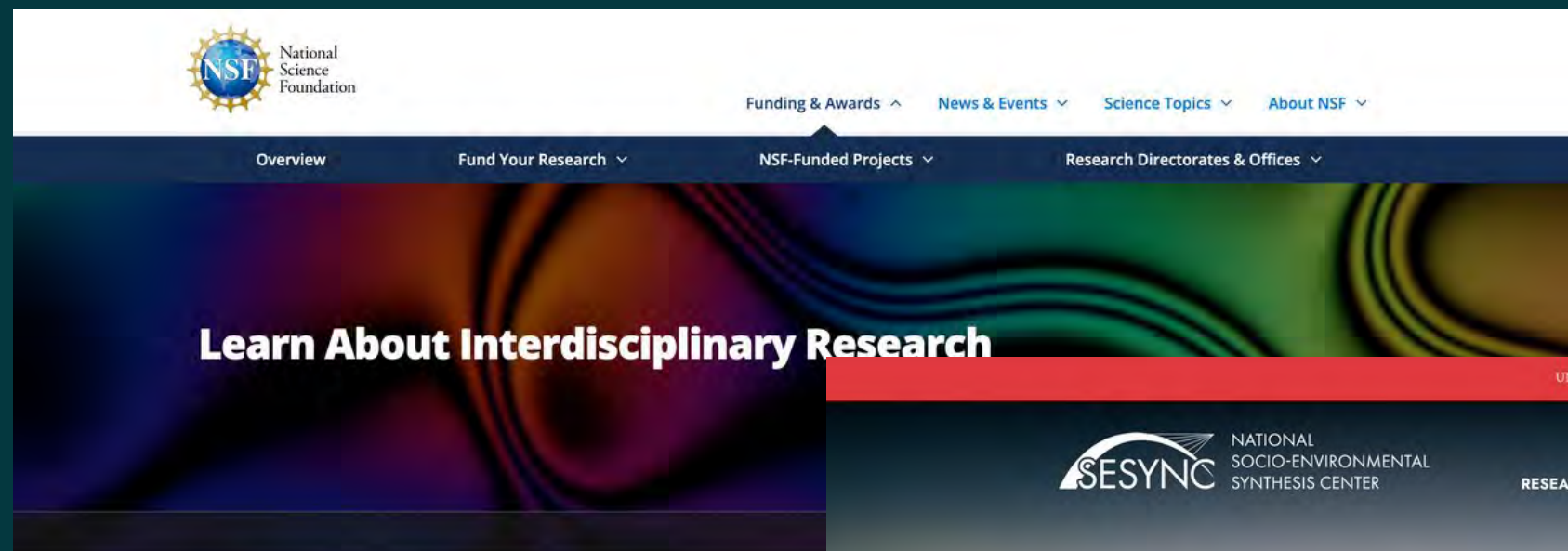
This page covers the ways NSF supports interdisciplinary research and how to prepare an interdisciplinary proposal, including how to submit an unsolicited proposal when there is no natural "home" for it in one of NSF's existing programs.

BACKGROUND

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BACKGROUND



PROJECT CONTEXT

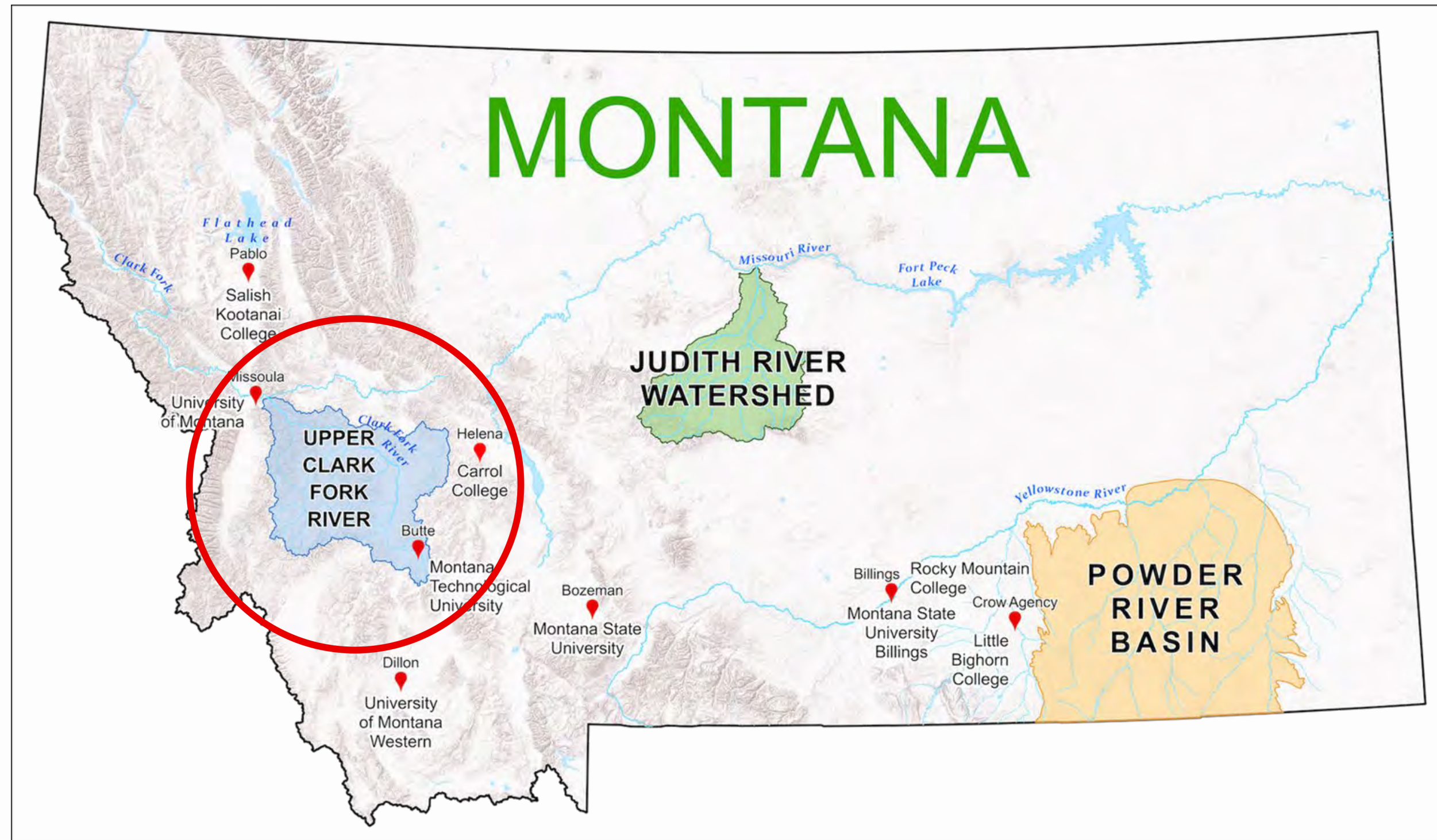


Figure 1. Map illustrating CREWS research sites and participating academic institutions

PROJECT CONTEXT

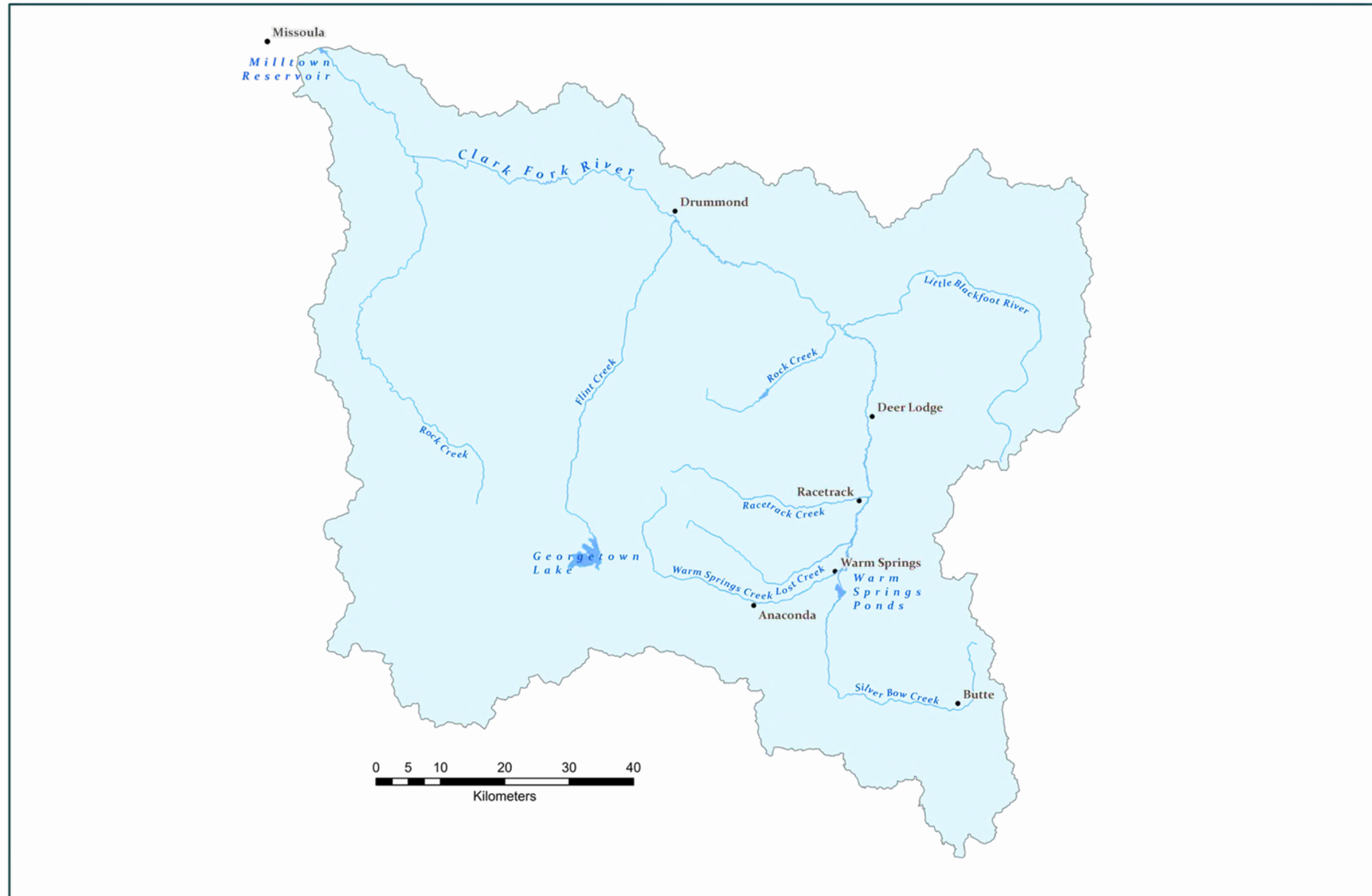


Figure 2. Map illustrating the Upper Clark Fork River watershed Source MTNSFEPSCoR

PROJECT CONTEXT



Source ClarkForkCoalition

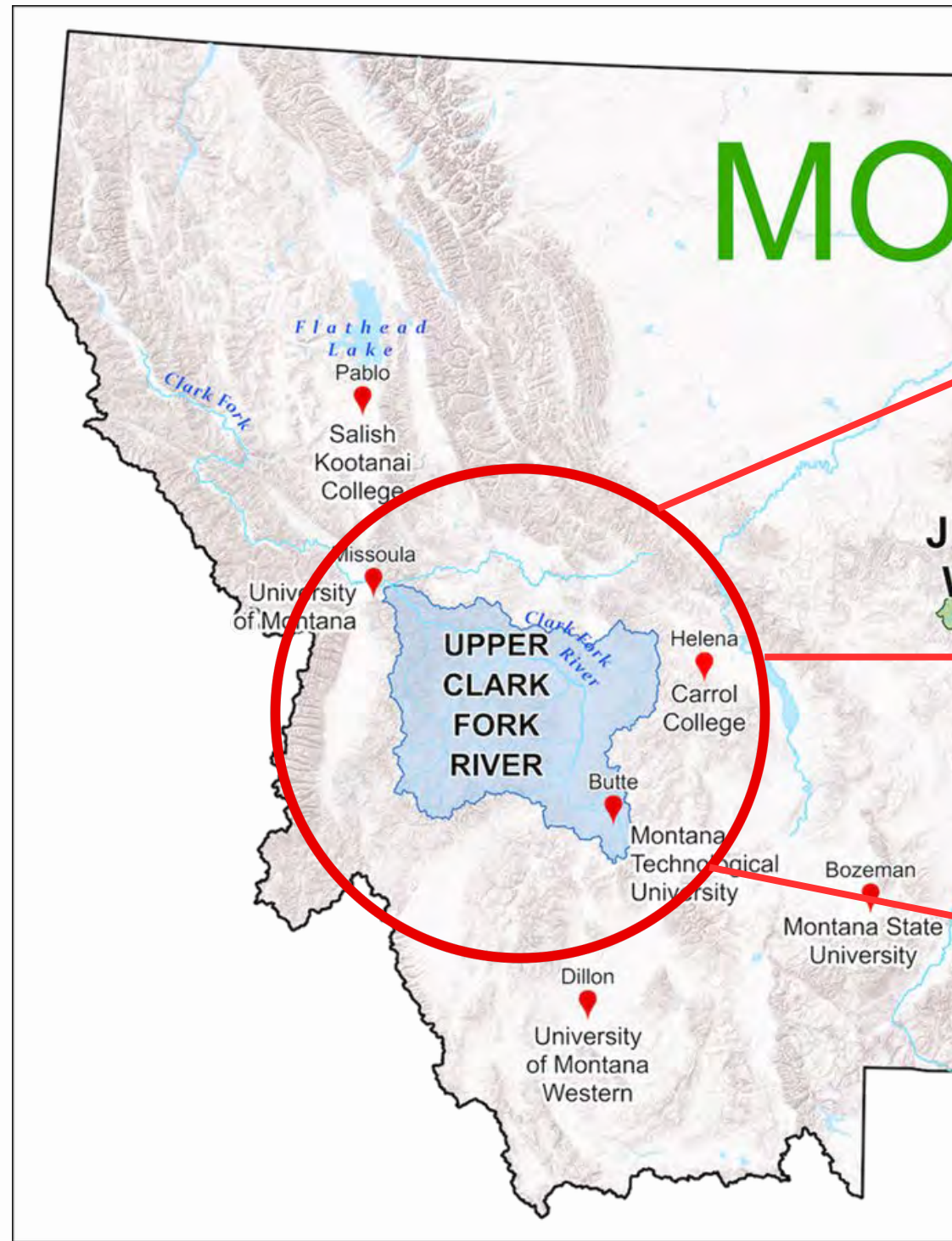


Source ClarkForkRiverTechnicalAssistanceCommittee

PROJECT CONTEXT 2018-2023

- Upper Clark Fork Working Group (UCFWG)
 - Funding from CREWS project - 2018-2023
- Mission:
 - “The UCFWG’s mission is to **facilitate, produce, analyze, and share sciencebased knowledge** among key participants involved in the **remediation, restoration, research, and monitoring** of the Upper Clark Fork River and its tributaries.”

PROJECT CONTEXT 2018-2023



PROJECT CONTEXT 2025


- UCFWG → Clark Fork Science Forum

Please join us:

Clark Fork Science Forum – Lunchtime Science Seminar Reboot!

Hello Friends of Clark Fork River Science!

You are receiving this email because you have previously engaged with either the *Clark Fork Science Forum* or the *Upper Clark Fork Working Group*. I am pleased to announce that both of these venues for the exploration, discussion, and sharing of Clark Fork River science **will continue** into the future under the name **Clark Fork Science Forum**! The [Clark Fork Science Forum](#) (“CFSF”) in-person, conference-style event that you’ve come to know and love will now take place every two years, with the next iteration in spring 2026. In the meantime, CFSF will continue to host the webinar-style science presentations previously hosted by the Upper Clark Fork Working Group (UCFWG); we envision this as a venue to continue important Clark Fork River science discussions during the months and years when there is not an in-person event. We hope to also engage you with occasional field trips, happy hours, and other opportunities to engage your colleagues in emerging Clark Fork River science!



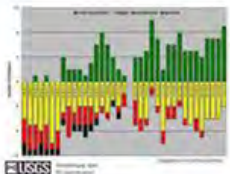
Clark Fork Science Forum

by clarkforkcoalition

Playlist • 3 videos • 37 views


The Clark Fork Science Forum (CFSF) is a coalition of experts from the Montana University System, [key](#) ...more

▶ Play all

- 


Lunchtime Seminar: Clark Fork Monitoring & New Interpretation

clarkforkcoalition • 35 views • 5 months ago

52:31
- 

Lunchtime Seminar: State of the Upper Clark Fork Fishery

clarkforkcoalition • 61 views • 6 months ago

53:14
- 

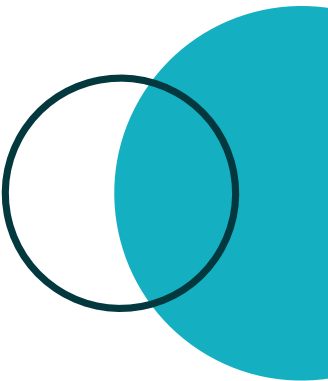
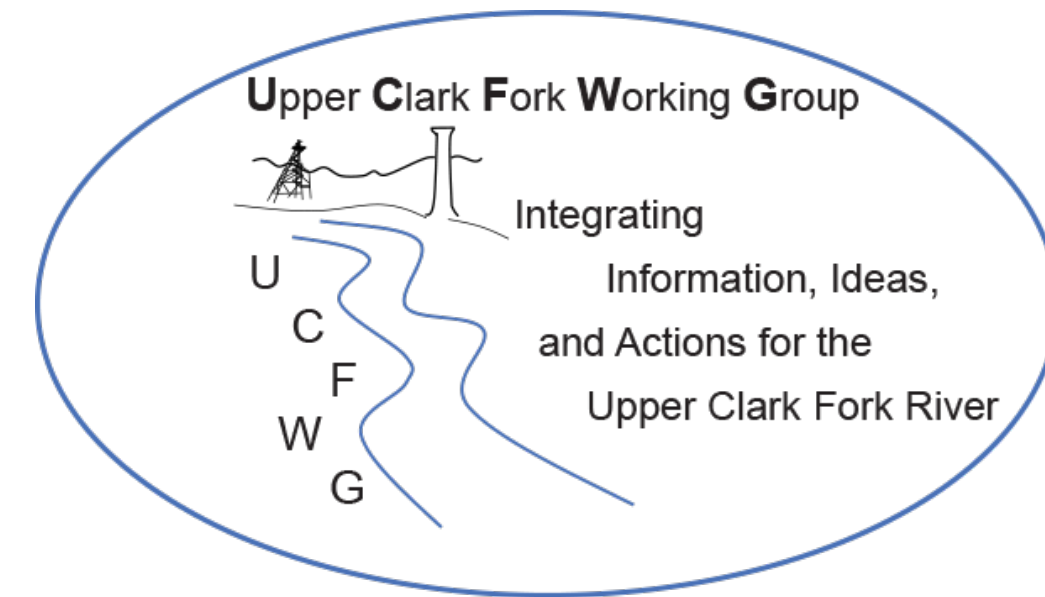
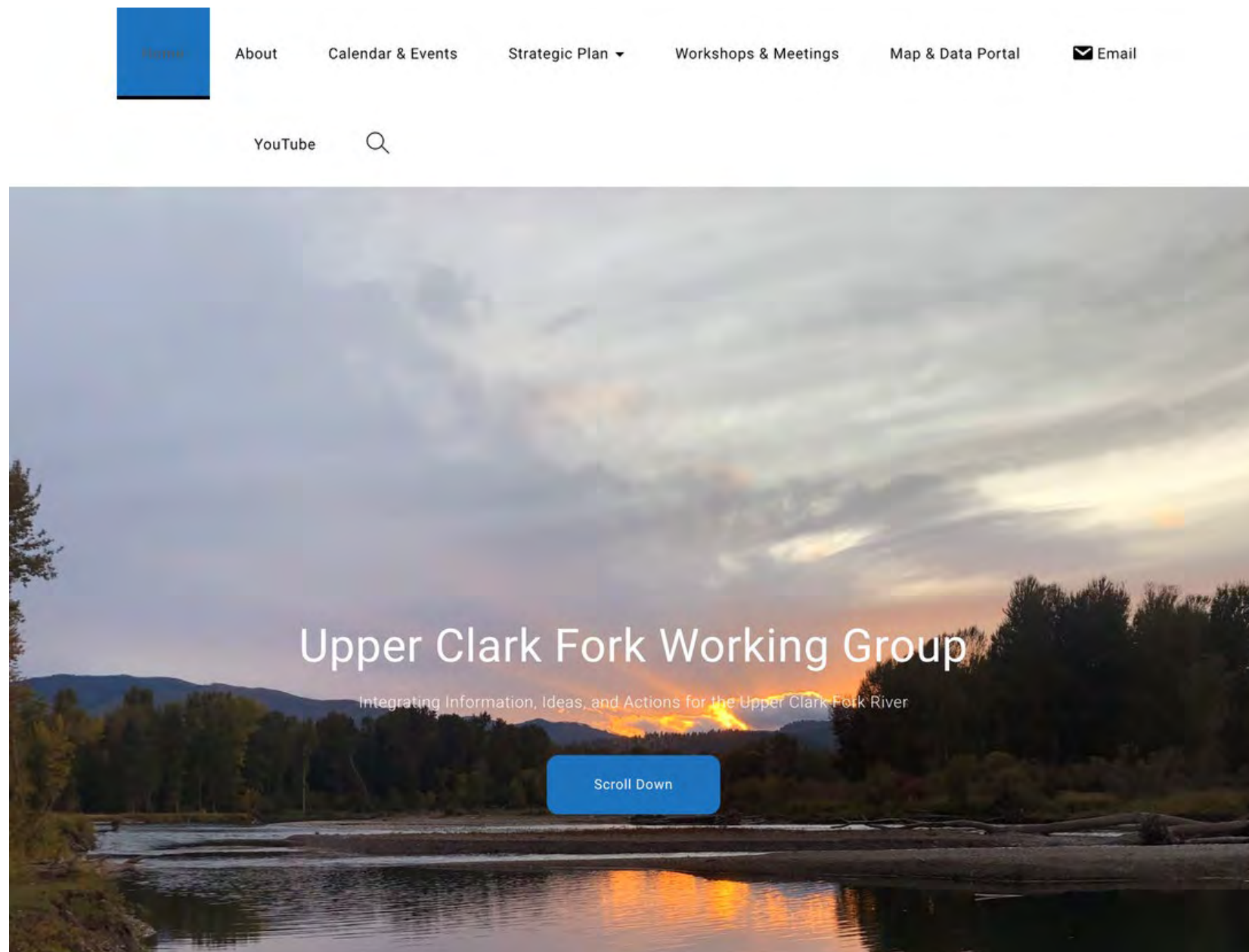
Lunchtime Seminar: Estimating Groundwater Gain and Loss

clarkforkcoalition • 27 views • 6 months ago

1:00:55

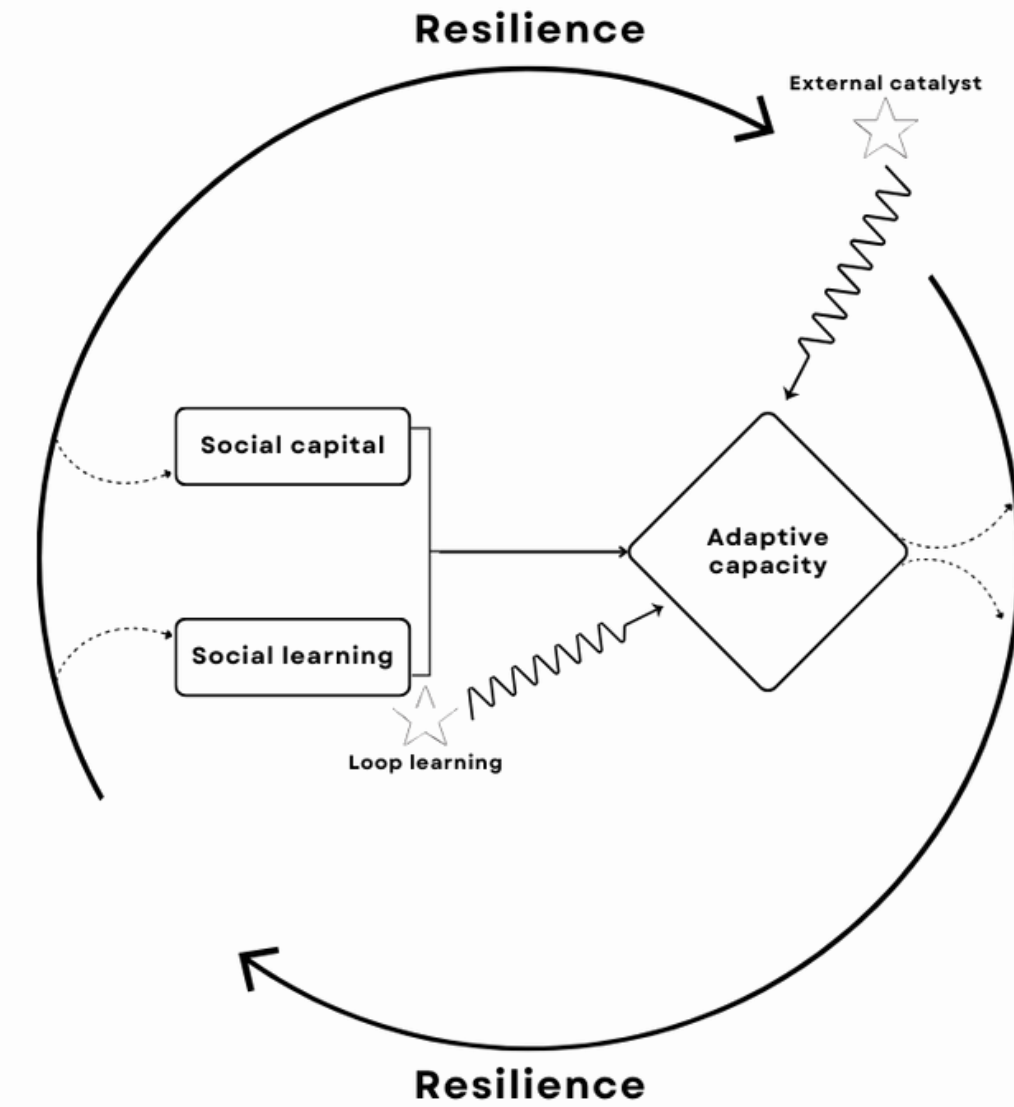
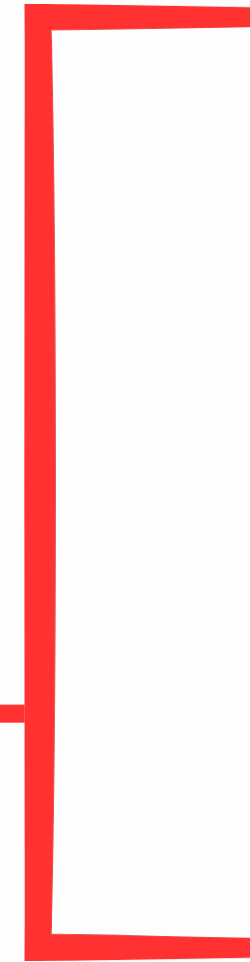
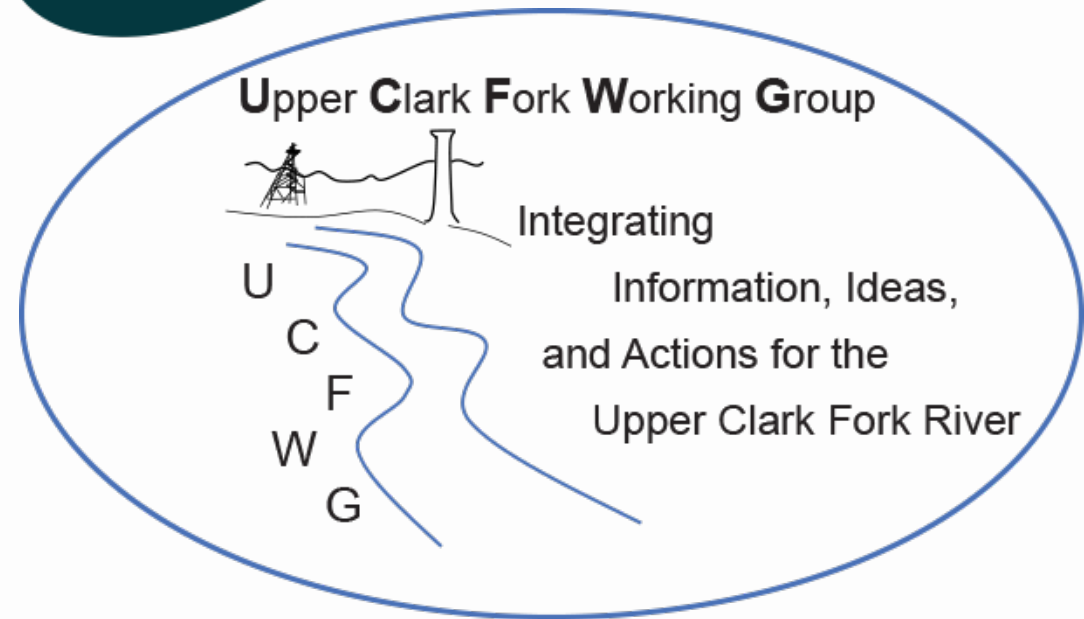
RESEARCH PROJECT

- Case study Upper Clark Fork Working Group



METHODS

- Case study on UCFWG



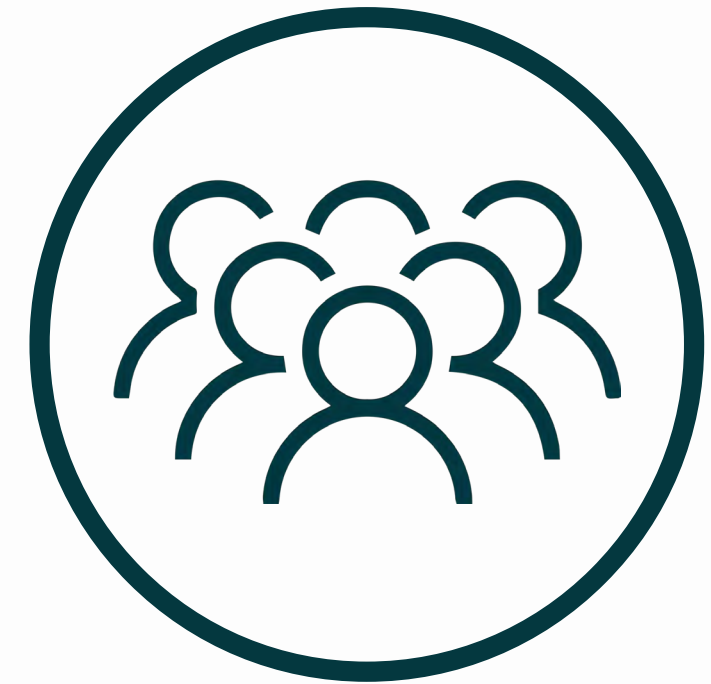
METHODS



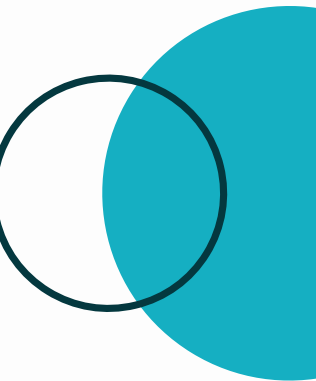
**Semi-Structured
Interviews**



**Document
Analysis**



**Participant
Observation**



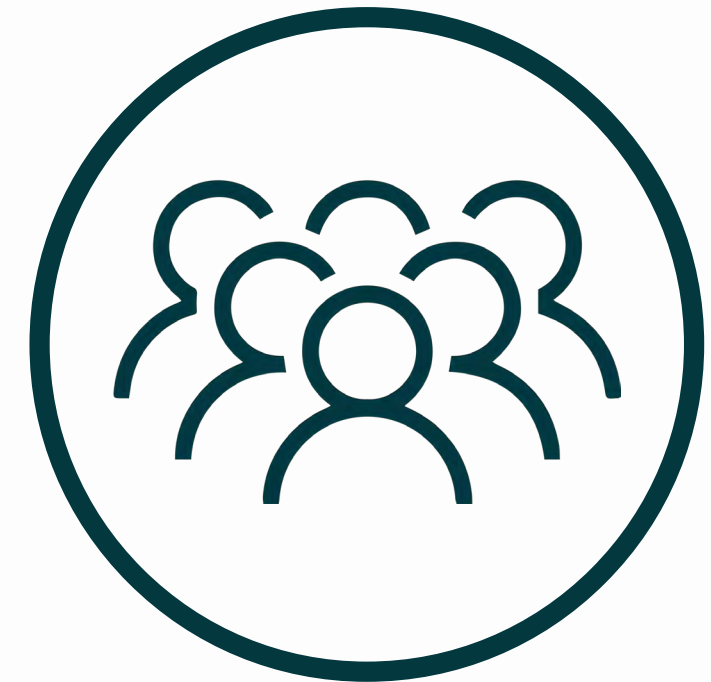
METHODS



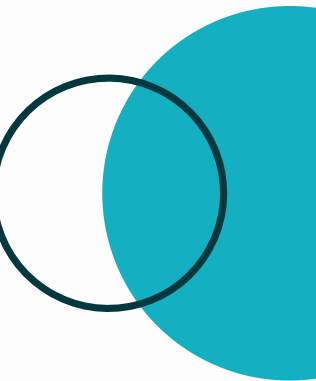
**Semi-Structured
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**Document
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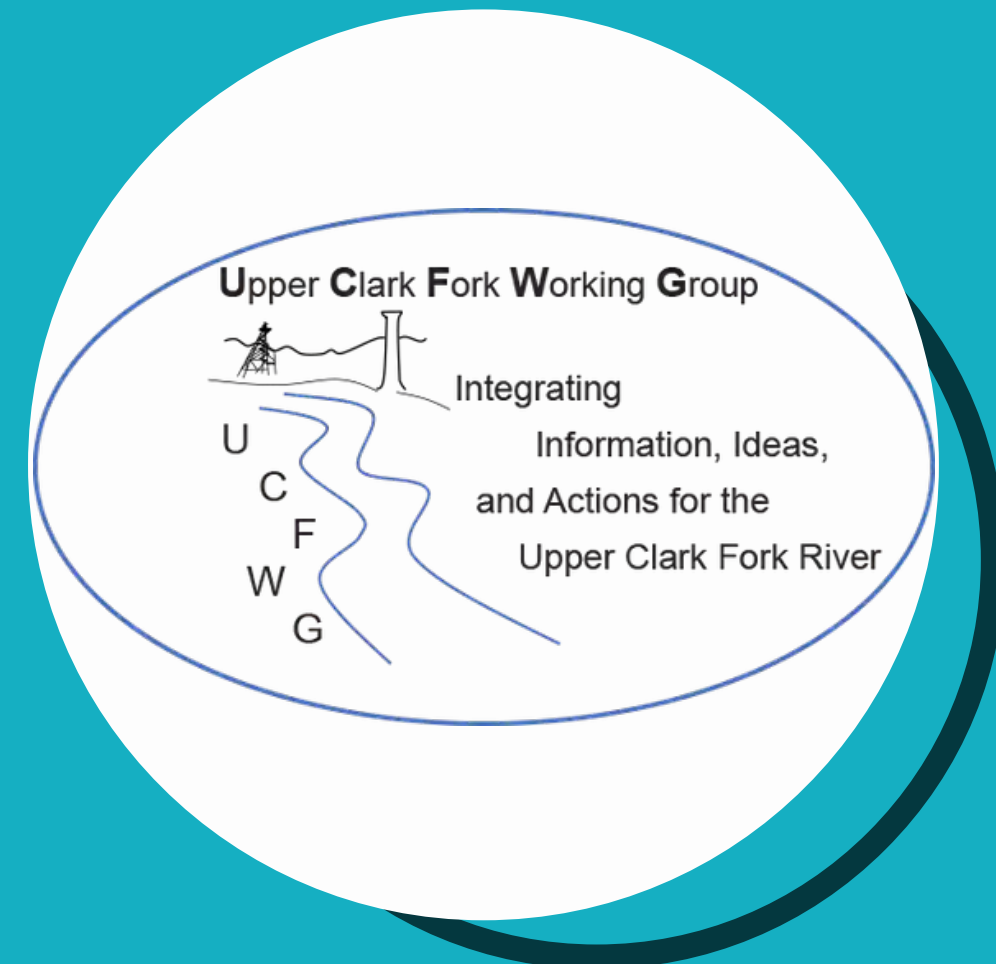


**Participant
Observation**



SEMI-STRUCTURED INTERVIEWS

19
interviews
since May



SEMI-STRUCTURED INTERVIEWS

Interviewees include:

- 6 University researchers
- 5 Federal agency personnel
- 4 State agency personnel
- 3 Private consultants
- 1 NGO personnel

SEMI-STRUCTURED INTERVIEWS

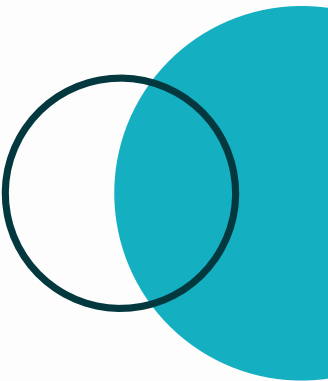
Example interview questions:

- How did you interact and engage with others in the UCFWG?
- Can you describe an instance where you learned something new about water resource issues in the Upper Clark Fork?
- What supported you in learning new information?
- How has your thinking evolved about water resource challenges in the Upper Clark Fork?

DATA ANALYSIS

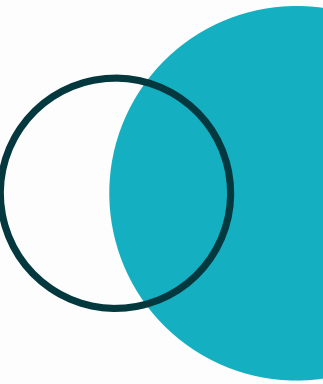
- Codebook development

Name	Description
Trust	Any time an interviewee describes the existence and presence of trust among UCFWG participants.
Group process description	Any description of how the UCFWG functions, including structures, formats, administration, and other logistical and functional processes. Can be coded by itself if needed.
Facilitator/coordinator/leadership	The interviewee describes the leadership and coordination of the UCFWG. May include descriptions of the structures in place that support leadership, facilitation, and coordination, or the specific individuals that hold these roles.
Meeting format/context	Instances where an interviewee describes the format and structure of UCFWG meetings and events.
Communication and dialogue	The interviewee describes how UCFWG participants communicate with each other, including more substantive <u>two-ways</u> communication types like discussion and dialogue among participants. Does not include the platforms, technologies, and processes used in the UCFWG to share information <u>via one-way communication</u> .
Information sharing	Descriptions of how information is shared within the UCFWG. Includes the platforms, technologies, and processes the UCFWG uses to share information with and among participants <u>via one-way communication</u> . Does not include instances of when information is shared outside of the group.
<u>Capacity Resource</u> sharing	Descriptions of <u>when/how</u> resources are shared among UCFWG participants. <u>Specific types of capacityResources</u> can include financial resources, professional resources, and research resources, for example. <u>Will be coded along with capacity code and sub-codes below.</u>
Conflict	Any time an interviewee describes conflict that occurs among UCFWG participants.
Social learning	RQ/Theory code. Social learning codes refer to instances where interviewee talks about how learning in a working group has generated increased understanding or awareness, changed their perspective, or created a novel change or action. Codes are categorized according to loop learning levels, e.g. single loop, double loop, triple loop and defined according to Pahl-Wostl, 2009. Can be coded by itself if needed.
Watershed issue awareness	<u>Interviewee describes</u> their familiarity and understanding of a particular watershed issue or topic.
Familiarity with other groups	Interviewee describes their familiarity and understanding of other groups in the UCFR. Can include other organizations in the UCFWG or groups outside the UCFWG but still in the



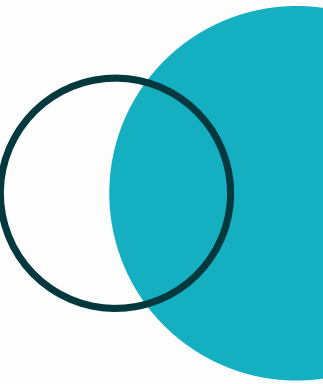
DATA ANALYSIS

- Codebook development
- Intercoder reliability



DATA ANALYSIS

- Codebook development
- Intercoder reliability
- Qualitative coding

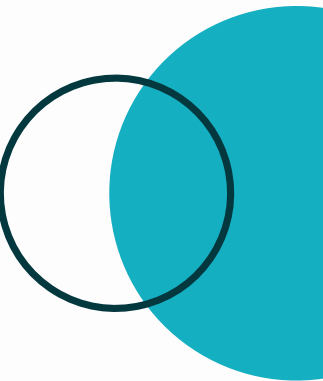


DATA ANALYSIS

The screenshot displays the NVivo software interface for data analysis. The left sidebar contains navigation menus for 'IMPORT' (Data, Files, File Classifications, Externals), 'ORGANIZE' (Coding, Codes), 'Cases', 'Notes', and 'Sets'. The 'EXPLORE' section includes 'Queries' (Query Criteria, Query Results, Coding Matrices) and 'Visualizations' (Maps). The main workspace shows a toolbar with icons for Clipboard, Item, Organize, Visualize, Code, Autocode, Uncode, Collate in View, Quickest Coding, Case Classification, File Classification, and Workspace. A central text document is open, showing a list of codes on the left and a text excerpt in the center. The text excerpt discusses the relationship between osprey and fish, and the importance of in-person meetings. Two sections of the text are highlighted in yellow, with reference coverage percentages: 'Reference 5: 4.86% coverage' and 'Reference 6: 2.71% coverage'. The right sidebar shows 'CODE STRIPES' with a 'Coding Density' chart and a list of codes including 'WC_leadership', 'WC_challenges', 'WC_sustainability', 'Evaluation', 'CREMS_accomplishments', 'CREMS_project', 'CREMS', 'Agency', 'Private company', 'Working Group (WG)', 'UCFR', and 'Interviewee type'.

DATA ANALYSIS

- Codebook development
- Intercoder reliability
- Qualitative coding
- Member checking

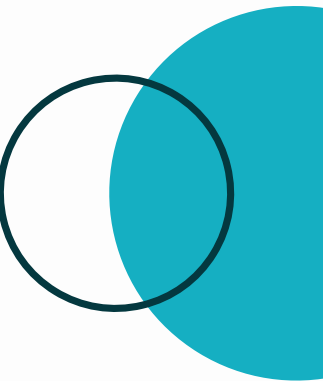


RESULTS



1. How, if at all, does social learning manifest within the UCFWG?

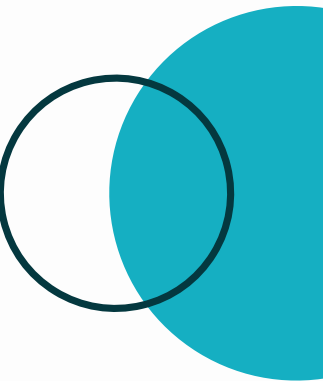
a. What factors influence the emergence of social learning in this group?



RESULTS

WHAT PARTICIPANTS LEARNED

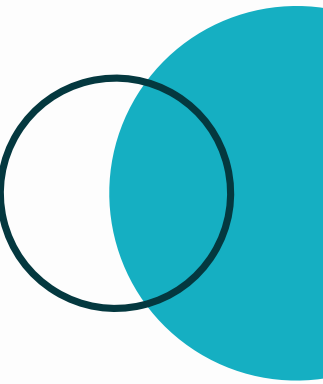
- Example topics:
 - Relationships between physical and ecological factors
 - Superfund governance and decision-making
 - Timescales and change



RESULTS

WHAT PARTICIPANTS LEARNED

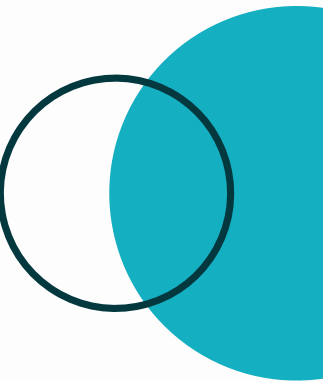
- Reinforcement of existing knowledge



RESULTS

WHAT PARTICIPANTS LEARNED

- Reinforcement of existing knowledge
- System complexity
 - Need for multi- and interdisciplinary approaches



RESULTS

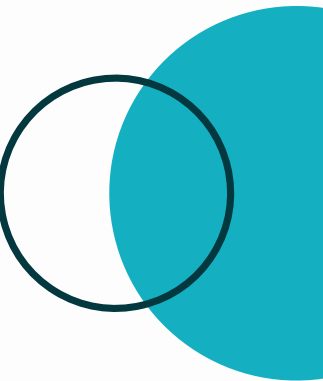
WHAT PARTICIPANTS LEARNED

“And it just reinforces how complex the system is, and there's really no way anybody could understand it well enough to figure out management changes that make sense without there being input from multiple disciplines at the same time.” - Private consultant

RESULTS

WHAT PARTICIPANTS LEARNED

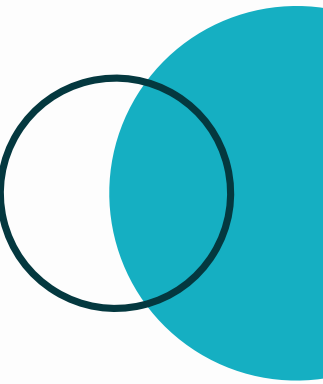
- Reinforcement of existing knowledge
- System complexity
 - Need for multi- and interdisciplinary approaches
- Awareness of people and their work



RESULTS

WHAT SUPPORTS LEARNING?

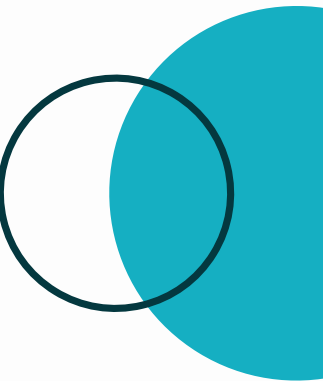
- UCFWG format
 - Online, lunchtime seminars



RESULTS

WHAT SUPPORTS LEARNING?

- UCFWG format
 - Online, lunchtime seminars
- Importance of in-person interactions



RESULTS

WHAT SUPPORTS LEARNING?

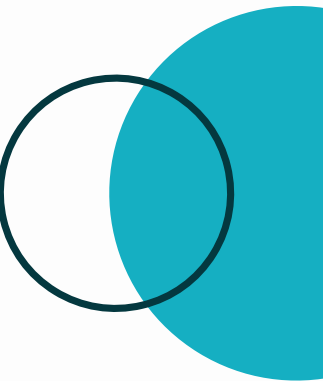
“Because when you go to someone else’s place...you are not just learning their culture . You're saying I am willing to be inside your walls and under your oversight. And so a personal interaction...was a big part of it, rather than just reading a report or having a telephone conversation.. So I think ultimately, that's a mechanism by which trust was built ...personal interaction was one of the critical [factors]. Actually sitting down in the same room and interacting.”

- University researcher

RESULTS

WHAT SUPPORTS LEARNING?

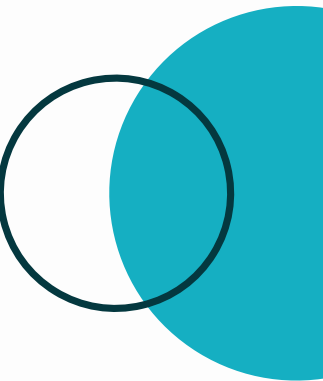
- UCFWG format
 - Online, lunchtime seminars
- Importance of in-person interactions
- Participant attitudes
 - Curiosity, openness, accessibility



RESULTS

WHAT SUPPORTS LEARNING?

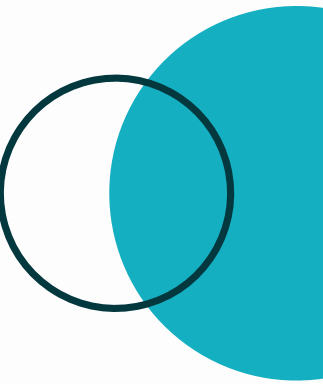
- UCFWG format
 - Online, lunchtime seminars
- Importance of in-person interactions
- Participant attitudes
 - Curiosity, openness, accessibility
- Information-sharing approaches



RESULTS

CHANGES IN PERSPECTIVE

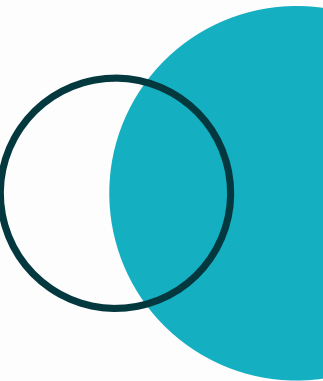
- Gaining holistic awareness of the system



RESULTS

CHANGES IN PERSPECTIVE

- Gaining holistic awareness of the system
- Reinforcement of existing perspectives



RESULTS

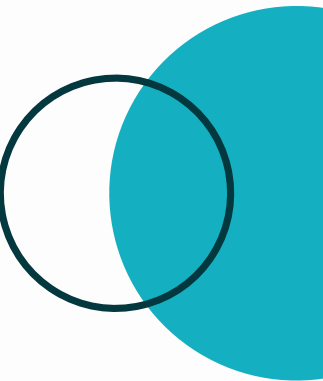
CHANGES IN PERSPECTIVE

- Gaining holistic awareness of the system
- Reinforcement of existing perspectives
- Self-reflection on work and broader implications

RESULTS

CHANGES IN PERSPECTIVE

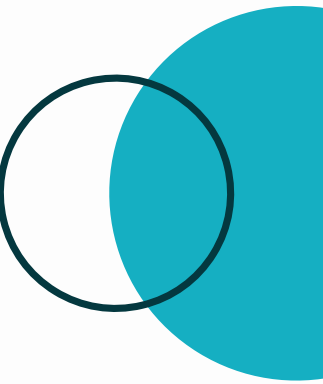
“I guess very fundamentally **instilled a more holistic view** of what's going on there, **and the implications to the various interest groups**...as a scientist you're often **focused on some very narrow things**, and you lose perspective **or the implications of your research and others' research.**”- Federal agency researcher



RESULTS

SYNTHESIS

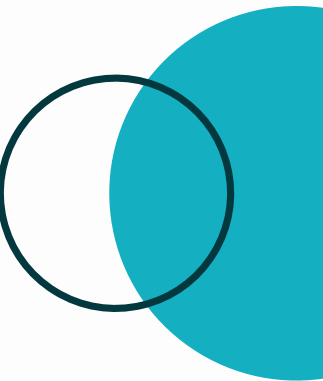
- Systemslevel learning and awareness



RESULTS

SYNTHESIS

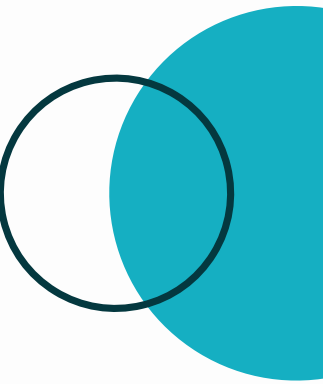
- Systemslevel learning and awareness
- Influence of history and institutional positionality on perspective



RESULTS

SYNTHESIS

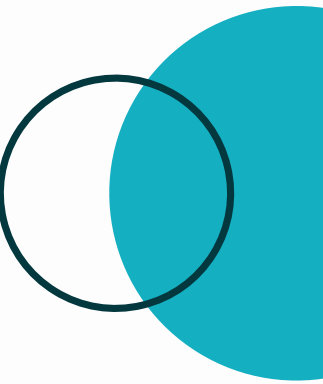
- Systemslevel learning and awareness
- Influence of history and institutional positionality on perspective
- Balancing consistency with capacity



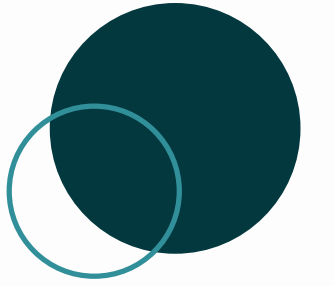
RESULTS

SYNTHESIS

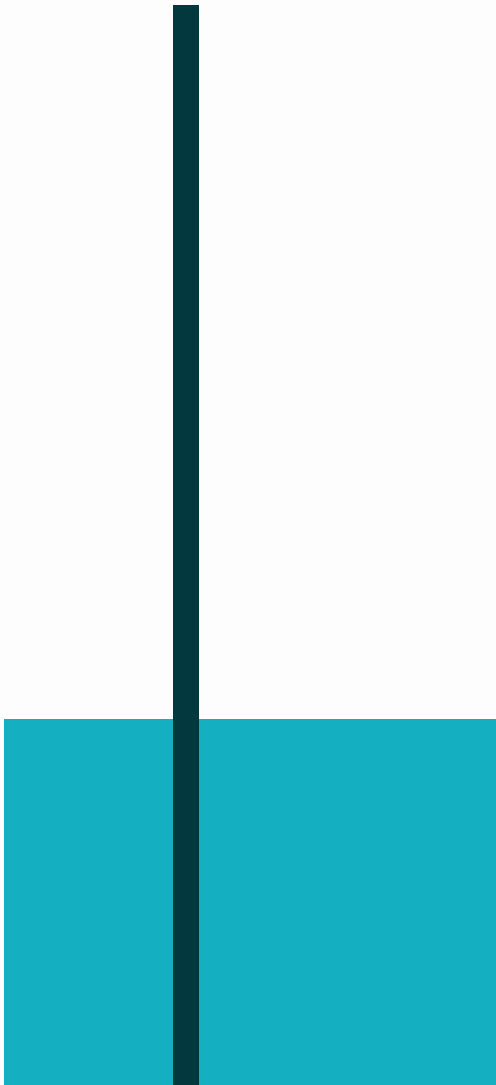
- Systemslevel learning and awareness
- Influence of history and institutional positionality on perspective
- Balancing consistency with capacity
- Learning leads to more questions

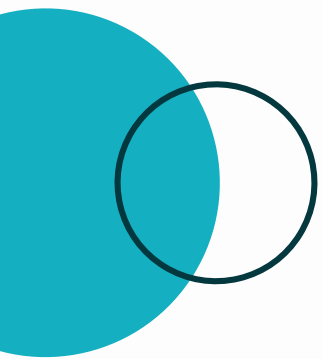


WHAT DO YOU THINK?



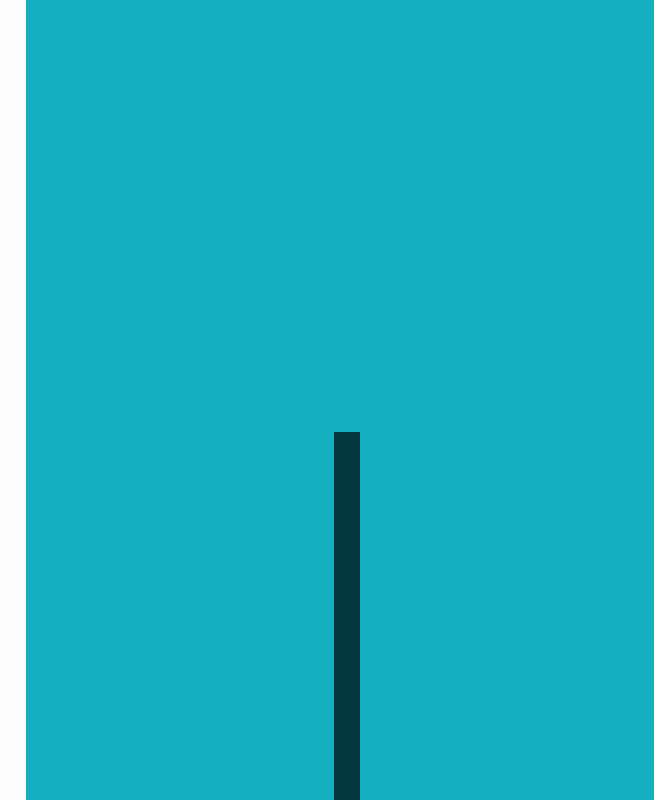
- How does this reflect your collaborative water research experiences?
- What would be most beneficial for you to know in developing a water research collaborative?





THANK YOU!
QUESTIONS?

MADISON.BOONE@MONTANA.EDU

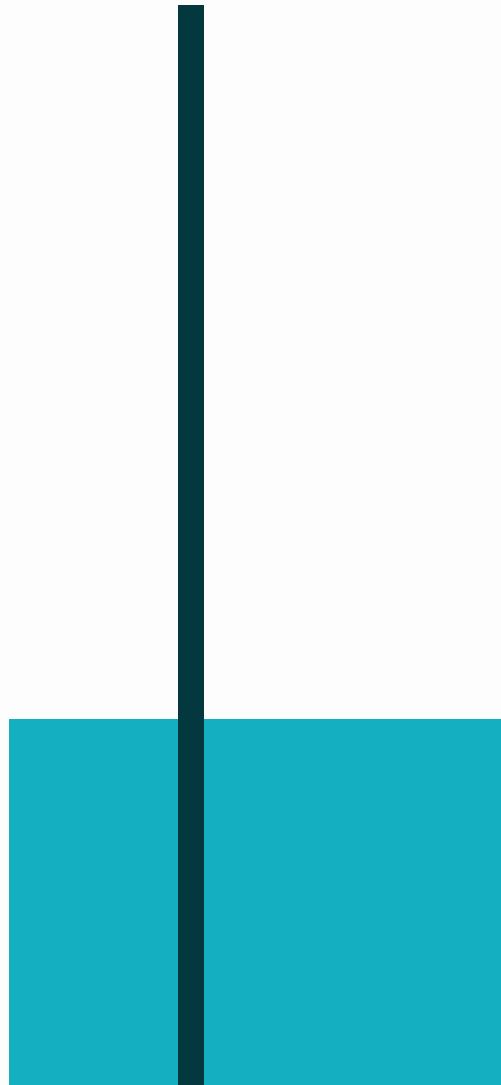


NEXT STEPS



1. PARTICIPANT INTERVIEWS

Complete interviews
with UCFWG
participants (25-30
total)



NEXT STEPS

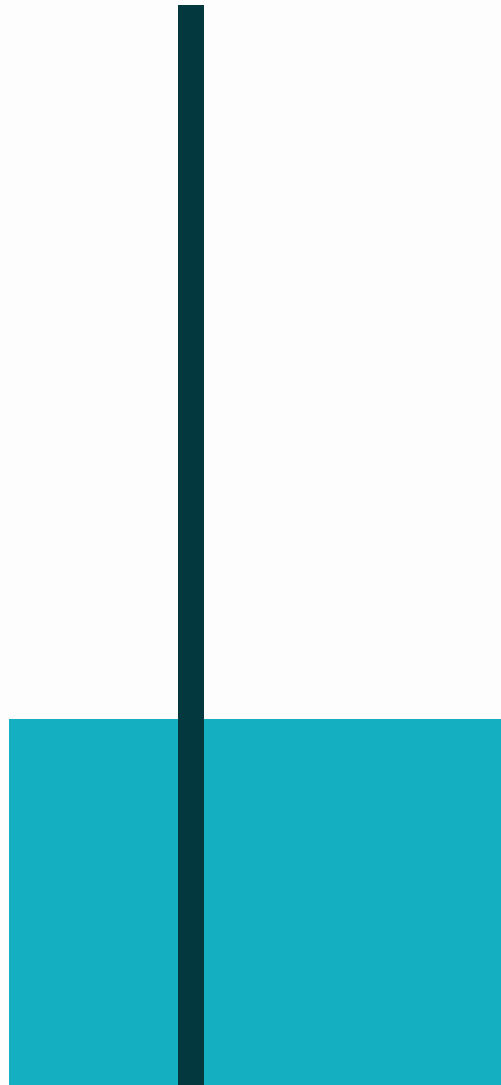


1. PARTICIPANT INTERVIEWS

Complete interviews with UCFWG participants (25-30 total)

2. CODING/ ANALYSIS

Qualitatively code interview transcripts in NVivo software; analysis of theoretical and emergent themes



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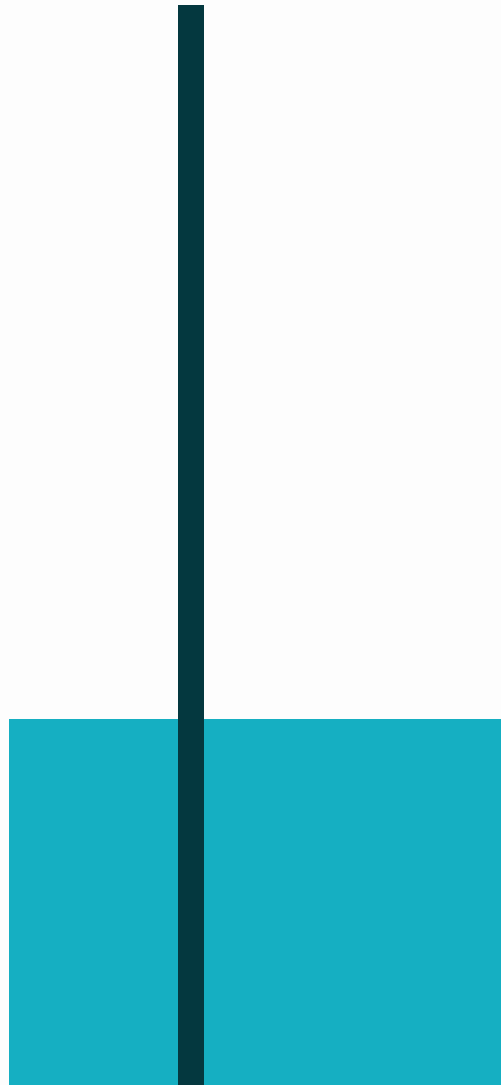
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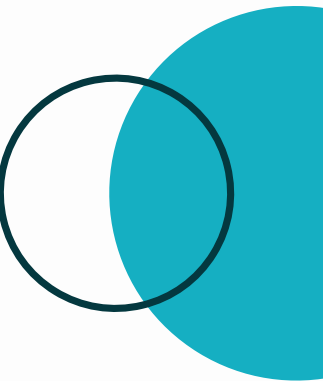
3. SHARE FINDINGS

Participants expressed a desire for synthesis of results and presentations; opportunities in Spring '26



RESEARCH QUESTIONS

1. How, if at all, does social learning manifest within the UCFWG?
 - a. What factors influence the emergence of social learning in this group?
 - b. What other collaborative and non-collaborative processes manifest within the group, if any?



RESEARCH QUESTIONS

2. What conditions support the UCFWG's capacity to develop actionable research and sustained partnerships?
 - a. What other additional capacities are developed in this group, if any?
 - b. How, if at all, does the UCFWG interact with other collaborative groups or efforts in the watershed?

