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Identifying Characteristics of Actionable Science for Drought Planning and Adaptation

Report to the North Central Climate Adaptation Science Center

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Section 1: Administrative Information

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Section 2: Public Summary

Changing climate conditions can make water management planning and drought preparedness decisions more complicated than ever before. Federal and State natural resource managers can no longer rely solely on historical trends as a baseline and thus are in need of science that is relevant to their specific needs to inform important planning decisions. Questions remain, however, regarding the most effective and efficient methods for extending scientific knowledge and products into management and decision-making.

This project analyzed two unique cases of water management to better understand how science can be translated into resource management actions and decision-making, focusing particularly on how the context of how drought influences ecosystems. In particular, this project sought to understand (1) the characteristics that make science actionable and useful for water resource management and drought preparedness, and (2) the ideal types of scientific knowledge or science products that facilitate the use of science in management and decision making.

The first case study focused on beaver mimicry, an emerging nature-based solution that increases the presence of wood and woody debris in rivers and streams to mimic the actions of beavers. This technique has been rapidly adopted by natural resource managers as a way to restore riparian areas, reconnect incised streams with their floodplains, increase groundwater infiltration, and slow surface water flow so that more water is available later in the year during hotter and drier months (Pollock and others 2015). The second case study focused on an established research program, Colorado Dust on Snow, that provides water managers with scientific

information explaining how the movement of dust particles from the Colorado Plateau influences hydrology and the timing and intensity of snow melt and water runoff into critical water sources. This program has support from – and is being used by – several water conservation districts in Colorado.

Understanding how scientific knowledge translates into action and decision-making in these cases is useful to strengthen knowledge of actionable science for drought management. The project team gathered qualitative data through stakeholder conversations and conducted an extensive literature review. In the case of beaver mimicry, the research identified perceived benefits of and barriers to using beaver mimicry structures and considered how these differ between managers and scientists. The dust on snow case results focused on how and why dust monitoring information is used. Findings from these efforts were also incorporated into a broader Intermountain West Drought Social Science Synthesis effort to determine and assess commonalities and differences among socio-ecological aspects of drought adaptation and planning.

Section 3: Project Summary

There is an increasing need to provide actionable science for water management planning and ecological drought preparedness. However, questions remain regarding the most effective and efficient methods for extending scientific knowledge and products into management action and decision-making. This project analyzed two unique cases of water management in the context of ecologically available water to understand the translation of scientific knowledge into management. In particular, the research examined and compared (1) characteristics of the science being assessed and applied and (2) ideal types of scientific knowledge or products that facilitate the translation process towards action, management, and decision-making. The first case, beaver mimicry, is an emerging nature-based solution used to restore riparian areas, reconnect incised streams with their floodplains, increase groundwater infiltration, and slow surface water flow that is rapidly being adopted by the natural resource management community (Pollock and others 2015). The second, Colorado Dust on Snow, is an established research program funded by several agencies and water conservation districts that provides water managers with scientific information regarding how movement of dust influences hydrology and timing of water runoff in critical water sources. For each case, qualitative conversations with scientists and practitioners were used to understand how scientific knowledge translates into action and decision making. Conversations were transcribed and analyzed using thematic analysis. In the case of beaver mimicry, the research identified perceived benefits of and barriers to using beaver mimicry structures and considered how these differ between practitioners and scientists, including how each group may perceive evidence differently. The dust on snow case results focused on how and why dust monitoring information is used.

Section 4: Report Body

Purpose and Objectives

There is an increasing need to provide actionable science for water management planning and ecological drought preparedness. However, questions remain regarding the most effective and efficient methods for extending scientific knowledge and products into management action and decision-making. This project analyzed two unique cases of water management in the context of ecologically available water to understand the translation of scientific knowledge into management. In particular, the research examined and compared (1) characteristics of the science being assessed and applied and (2) ideal types of scientific knowledge or products that facilitate the translation process towards action, management, and decision-making. The first case, beaver mimicry, is an emerging nature-based solution used to restore riparian areas, reconnect incised streams to their floodplains, increase groundwater infiltration, and slow surface water flow, which is rapidly being adopted by the natural resource management community (Pollock and others 2015). The second, Colorado Dust on Snow, is an established research program funded by several agencies and water conservation districts that provides water managers with scientific information regarding how movement of dust influences hydrology and timing of water runoff in critical water sources. Further understanding how scientific knowledge translates into action and decision-making in these cases contributes to conceptual and theoretical knowledge related to actionable science in the context of drought impacts on ecosystems. Better understanding this link allows Federal and State science and land management agencies to more effectively design science that is directly relevant to managers' needs.

Organization and Approach

The case of beaver-related restoration was developed with data from qualitative conversations with scientists (N=12) and practitioners/resource managers (N=14) from throughout the Western US (including Colorado, Wyoming, Montana, Utah, Washington, and Oregon). These individuals are actively involved in research and/or application of beaver-related restoration techniques but were classified by primary job duties; scientists may actively be involved in application and managers may be actively involved in research. "Managers" encompasses individuals primarily tasked with application of beaver-related restoration in a real world setting and may include individuals representing non-governmental organizations (NGO's), watershed groups, Tribes, community organizations, and local or State water and wildlife agencies. Multiple contacts (N=5) did not authorize recording of the conversation; extensive notes of these conversations were taken and considered but they were not formally analyzed. Audio conversations were recorded, transcribed, and coded with NVivo 11 Qualitative Analysis Software using thematic analysis, with themes developed inductively from within the dataset. (Note: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.) Participant observation at beaver-related restoration field days, research sites, and events was also conducted to provide additional background context for interpreting data.

The dust on snow case study involved qualitative conversations with scientists (N=8) and managers (N=10) conducting research or managing water supplies on the western slope of the Rocky Mountains, mainly in Colorado. Participant observation was also conducted at a dust on snow site near the Center for Snow and Avalanche Studies in Silverton, Colorado. Audio conversations were recorded, transcribed, and coded with NVivo 11 Qualitative Analysis

Software using thematic analysis, with themes developed inductively from within the dataset. The dust on snow case results focused on how and why dust monitoring information is used, but the dust on snow conversations did not yield publishable results.

Project Results, Analysis, and Findings

Results from the beaver-related restoration case identified perceived benefits of and barriers to using beaver mimicry structures and considered how these differ between practitioners and scientists, including how each group may perceive evidence differently (see Tables 1 and 2 in Appendix). Managers mentioned more benefits than scientists, who appeared quite skeptical of beaver mimicry structures. Barriers also differed between the two groups, with scientists placing more emphasis on barriers related to ecosystem function and generalizability (e.g. lack of data, annual base flow) while managers focused on more practical barriers (e.g. landowner concerns).

One of the main findings across both groups involved the role of regulations and policy as a barrier. The main constraints imposed on decisions about beaver-related restoration revolve around the complexity of western U.S. water rights, particularly Section 404 of the Clean Water Act, which "establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands" (EPA https://www.epa.gov/cwa-404/section-404-permit-program). Under the prior appropriation doctrine used in most Western States, it is illegal to store or dam water on one's land without a water right that explicitly authorizes one to do so, as this is seen as taking water out of the river that would otherwise be available to the person with the next most senior water right. Most practitioners in the qualitative conversations referenced the U.S. Army Corp of Engineers Nationwide Permit 27, "Aquatic Habitat Restoration, Enhancement, and Establishment Activities," as a way to "permit" the placement of woody debris into stream and wetland systems. But this permit does not guarantee that the individual or organization performing this restoration technique would not potential be liable for water rights violations to downstream water users under State water law. However, in keeping with the longstanding practice of USGS to remain policy neutral, it was decided to focus this project on the physical, biological, and social aspects of beaver-related restoration instead of policy, legal, and regulatory responses.

The second major theme that emerged involved the roles of experiential knowledge and field observations performed and communicated by managers and practitioners. Managers and scientists seem to experience the salience, credibility and legitimacy of information differently; they have varying thresholds to which they will consider data or results to be valid. While a manager or practitioner might be willing to accept the efficacy of beaver mimicry structures after a few seasons of simply seeing how water stayed on the landscape longer, standards of scientific rigor require data proving that the structure was the factor responsible for the observed changes. The benefits of cost effectiveness also emerged in the context of long-term monitoring; the lead researcher found that managers preferred to allocate resources for installation of beaver mimicry structures as opposed to monitoring their effectiveness after installation.

Conclusions and Recommendations

Results from this project emphasize the importance of examining how science is translated into management (or not). The contrast between managers' and scientists' views of beaver mimicry

structures indicates the need to consider how assumptions about evidence and causal inference shape people's conclusions about ecological function and influence the actions they take in response to management challenges like drought.

Outreach and Products

Results of this project were integrated into the Intermountain West Drought Social Science Synthesis Working Group. This ongoing collaboration joins place-based and case study research from throughout the Intermountain West to understand differences and commonalities or social and institutional aspects of drought planning, management, and adaptation.

References

Pollock, M.M., G. Lewallen, K. Woodruff, C.E. Jordan and J.M. Castro (Editors) 2015. The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains. Version 1.0. United States Fish and Wildlife Service, Portland, Oregon. 189 pp. Online at:http://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/Beaver.asp

Appendix

Benefit	# (%) Scientists	# (%) Managers
Cost effective	11 (92%)	14 (100%)
Nature-based	8 (67%)	12 (86%)
Riparian habitat	8 (67%)	11 (79%)
Anecdotal (observed) benefits	2 (17%)	12 (86%)
Materials found on-site	4 (33%)	11 (79%)
Volunteer assistance	2 (17%)	10 (71%)
Drought adaptation	3 (25%)	9 (64%)

Table 1. Perceived benefits of adopting beaver-related restoration strategies.

Barrier	# (%) Scientists	# (%) Managers
Regulations / policy	12 (100%)	14 (100%)
Lack of data / monitoring	11 (92%)	8 (57%)
Generalizing across varying ecosystems	10 (83%)	4 (29%)
Fisheries / water temp	6 (50%)	4 (29%)
Landowner concerns	3 (25%)	12 (86%)
Beaver as nuisance	5 (42%)	2 (14%)
Annual base flow	2 (17%)	0 (0%)

Table 2. Perceived barriers to adopting beaver-related restoration strategies.