



The Colorado Basin River Forecast Center and the Decision Making Process

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Motivation for study

Consistent with WWA's mission to provide information that can assist decision makers, we wanted to learn:

- Who are CBRFC stakeholders, what do they feel are their current and future vulnerabilities, and how do they cope?
- How can the dust on snow and bark beetle research be useful to CBRFC stakeholders?

Methodology

- Reviewed literature on decision maker use of forecasts. While a variety of factors explain non-use of forecasts, generally a key determinant of forecast use is perception of risk based on previous experience. Forecast skill is generally not as critical to use.
- In consultation with CBRFC, developed a survey covering 3 areas:
 - background information about stakeholders
 - vulnerability (weather and climate events respondents have experienced or expect to experience) and coping mechanisms
 - how stakeholders use forecasts; knowledge of/concern about dust on snow and bark beetle
- Pretested survey with water managers
- Compiled list of current and potential CBRFC stakeholders including CBRFC stakeholder meeting attendees, managers of ~80 reservoirs monitored by CBRFC, NWS forecasters, Bureau of Reclamation roster of water users in the Upper Colorado Region, emergency managers
- Distributed survey to 141 stakeholders via Survey Monkey last summer; 70 stakeholders responded

I. Background information about stakeholders



Survey respondents work for:

- federal agencies (23)
- water conservancy districts (11)
- regional water entities (9)
- municipal water utilities (8)
- flood control districts (3)
- organizations providing either research, consulting, or work on policy issues (3)
- state agencies (2)
- irrigation districts (2)
- electric power providers (2)

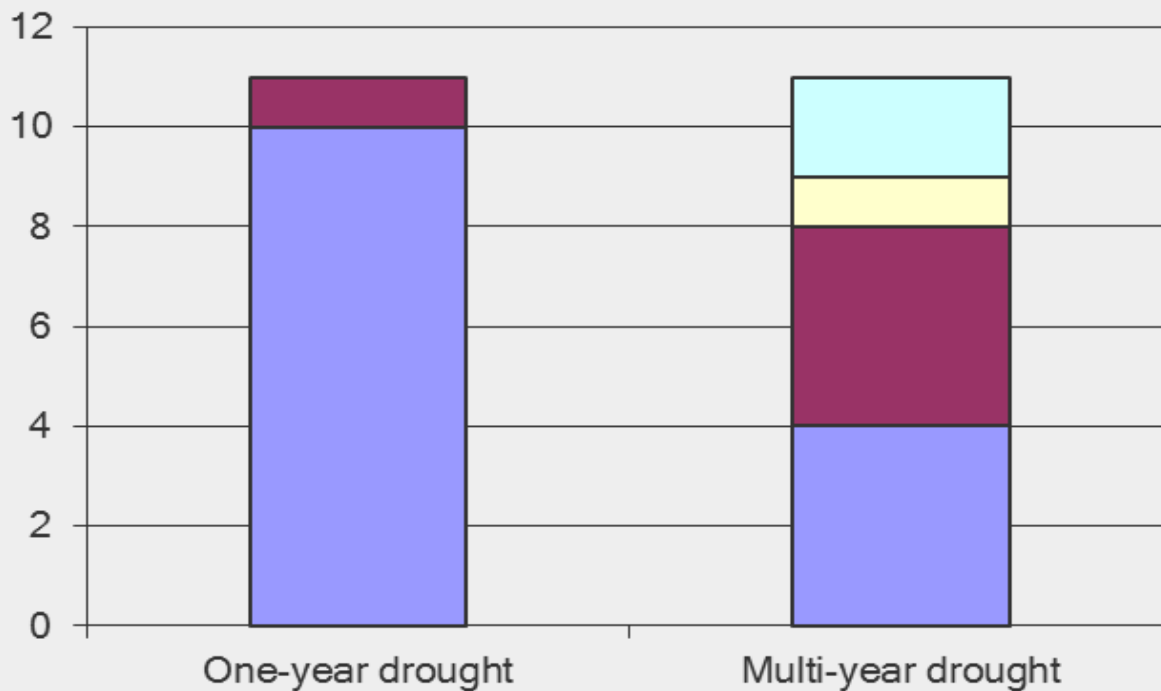
~half describe affiliation as water management, 14% govt forecasting, 8% emergency mgmt/flood control; the remainder scattered among ag, research, energy, water treatment, recreation, environmental, etc.

Service area (select all that apply)	
Colorado, including municipalities and counties within the state	34%
Colorado River Basin	31%
Utah, including municipalities and counties within the state	23%
Other (please specify)	21%
Arizona, including municipalities and counties within the state	18%
Southwest region (Arizona, New Mexico, Colorado, Utah)	13%
Western U.S.	13%
New Mexico, including municipalities and counties within the state	8%
Wyoming, including municipalities and counties within the state	8%
National	3%
U.S.-Mexico border	3%
Global	2%

II. Vulnerability and Coping Mechanisms

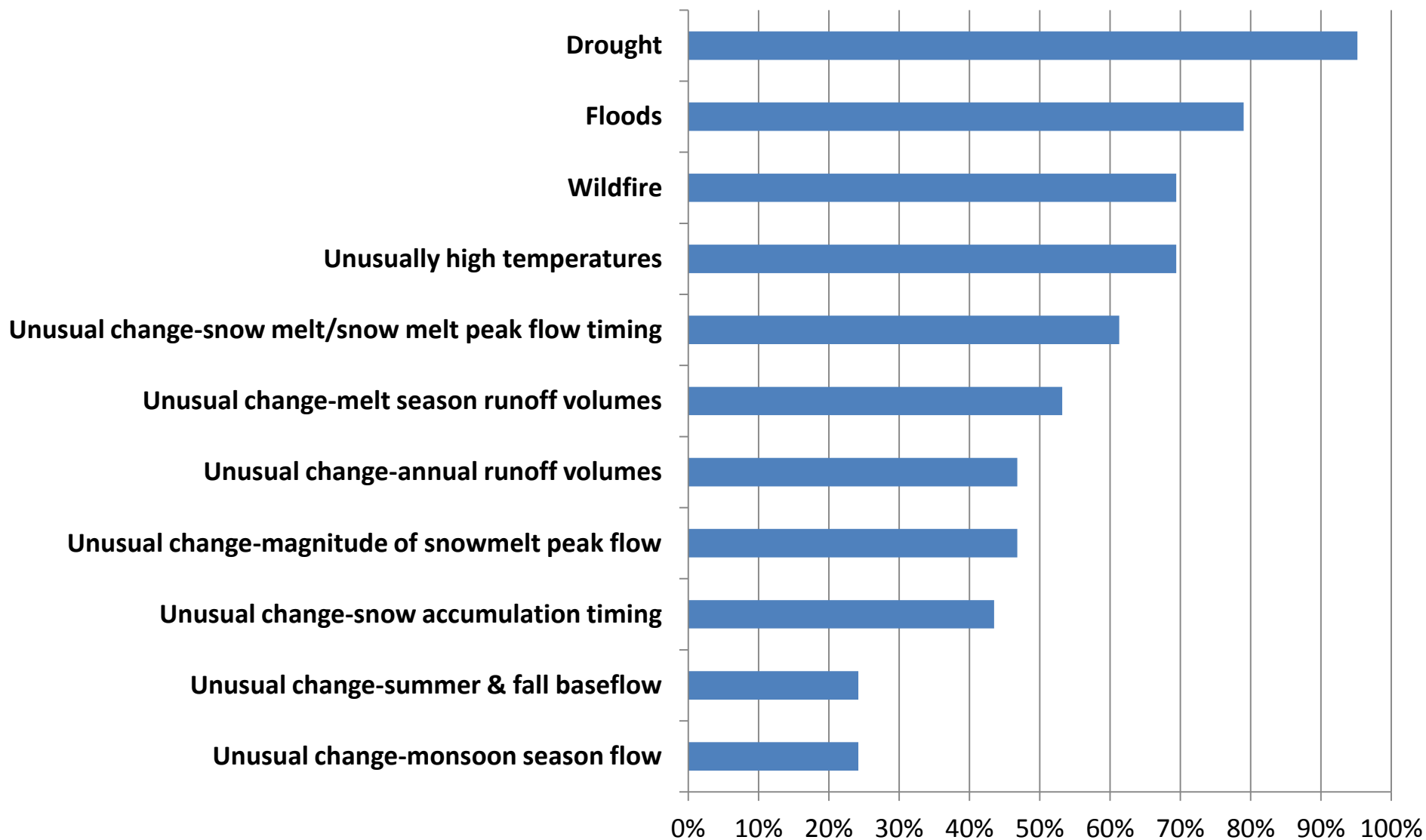


On a scale of 1 to 5, how comfortable are you that your water supply is sufficient to withstand a one-year drought? A multi-year drought?



Most comfortable	Blue
	Red
	Yellow
	Cyan
Least comfortable	White

Events experienced in past 10 years



Problems caused by events

	Lost revenue	Unanticipated expenses	Difficulty assuring system reliability
Drought	52%	52%	61%
Floods	29%	71%	49%
Wildfire	32%	86%	32%
Unusual change in snow melt or snow melt peak flow timing	13%	33%	83%
Unusual change in annual runoff volumes	33%	29%	79%
Unusual change in magnitude of snow melt peak flow	9%	41%	68%
Unusual change in melt season runoff volumes	33%	29%	81%
Unusually high temps	21%	53%	53%
Unusual change in snow accumulation timing	16%	21%	79%
Unusual change in summer and fall baseflow	27%	20%	80%
Unusual change in monsoon season flow	0%	44%	67%

Perception of likelihood of future events

	Likely	50/50 chance	Unlikely	Don't know
Drought	88%	11%	0%	2%
Unusually high temperatures	72%	17%	0%	11%
Wildfire	62%	17%	8%	13%
Unusual change in snow melt or snow melt peak flow timing	55%	33%	0%	12%
Unusual change in annual runoff volumes	54%	22%	4%	20%
Floods	53%	32%	8%	8%
Unusual change in melt season runoff volumes	53%	24%	4%	18%
Unusual change in magnitude of snow melt peak flow	47%	28%	4%	21%
Unusual change in snow accumulation timing	44%	24%	11%	20%
Unusual change in summer and fall baseflow	33%	38%	7%	22%
Unusual change in monsoon season flow	30%	26%	7%	37%

Past use and effectiveness of coping mechanisms

	Has used	Very effective	Somewhat effective	Not at all effective
Increased use of CBRFC forecasts	75%	44%	56%	0%
Increased use of other weather or climate forecasts*	71%	29%	69%	2%
Instituted water conservation program	50%	52%	48%	0%
Developed drought plan	45%	36%	59%	5%
Trained personnel	43%	48%	52%	0%
Developed emergency management plan	34%	27%	60%	13%
Increased storage	32%	67%	33%	0%
Transbasin diversion	25%	67%	33%	0%
Purchased water rights or shares	25%	54%	31%	15%
Financial incentives (rates, surcharges, budgets)	25%	33%	67%	0%
Instituted outdoor water restrictions	21%	73%	27%	0%
Changed staffing level	21%	40%	60%	0%

*Other products used by at least half of respondents: U.S. Drought Monitor, U.S. Seasonal Drought Outlook, Climate Prediction Center Precipitation and Temperature Products, CBRFC Forecast Briefings, NRCS State Basin Outlook Reports

Likelihood of using coping mechanisms in future

	Highly likely	50/50 chance	Highly unlikely
Increased use of CBRFC forecasts	75%	20%	6%
Increased use of other forecasts	73%	23%	4%
Train personnel	66%	17%	17%
Develop drought plan	65%	13%	23%
Institute water conservation program	63%	8%	29%
Develop emergency management plan	45%	18%	37%
Purchase water rights or shares	37%	14%	49%
Transbasin diversion	35%	9%	56%
Financial incentives (rates, surcharges, budgets)	34%	16%	50%
Increase storage	32%	21%	47%
Lease alternative water source/use water bank	31%	20%	49%
Institute outdoor water restrictions	31%	6%	63%
Conjunctive use of groundwater and surface water	27%	12%	61%
Institute warning system	27%	14%	59%
Change staffing level	23%	51%	26%

Top short- and long-term concerns

Short-term

- Climate variability/change incl extreme events and drought
- Water supply/demand balance
- Budget issues
- Wildfire



Long-term

- Climate variability/change incl extreme events and drought
- Water supply/demand balance
- Colorado River Compact issues
- Population growth



III. Use of forecasts and decision making



Decision for which CBRFC forecasts are useful

- Reservoir operations such as timing and volume of releases (15)
- Flooding (7)
- Issuing warnings (6)
- Drought response (4)
- Environmental issues (3)
- Power (2)
- Irrigation, maintenance, treatment plant, purchases, field work (1 each)

Factors that limit use of CBRFC forecasts

Difficulty determining quality of CBRFC forecasts	41%
Other (please specify)	27%
Difficulty knowing which CBRFC forecasts are useful	22%
Inaccuracy of CBRFC forecasts	22%
Lack of familiarity with CBRFC forecasts	22%
My organization's operating procedures	19%
Conflict between CBRFC forecasts and other forecasts I use	19%
Difficulty interpreting CBRFC forecasts	16%
Conflict between CBRFC forecasts & non-forecast factors	8%
Conflict between CBRFC forecasts & our organization's internal tools	5%
Legal constraints	3%

Next steps

One-on-one interviews of ~10-15 survey respondents. Possible areas of inquiry:

- Short and long-term organizational concerns
- Coping mechanisms – past and future
- How CBRFC forecasts and other information are used in decision making; how much weight is given to this information
- What information about the dust on snow and bark beetle research would be useful to decision makers; what form should the information take

For questions about CBRFC stakeholder survey:

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For more information and contacts for all of the projects mentioned and many more:
Western Water Assessment website:
<http://wwa.colorado.edu/>



The screenshot shows the Western Water Assessment website homepage in a Mozilla Firefox browser window. The page features a navigation menu with links for Home, About Us, Projects, Publications, Tools & Resources, and Workshops & Events. A search bar is located in the top right corner. The main content area is divided into several sections:

- Featured Article:** "How are streamflow forecasts used? Assessing how resource managers use streamflow forecasts to support planning and operations." This section includes a large image of a river winding through a desert landscape.
- Who we are, what we do:** A text block describing the Western Water Assessment (WWA) as an applied research program that addresses societal vulnerabilities related to climate, particularly in the area of water resources. It mentions work across the Intermountain West—Colorado, Utah, and Wyoming—and beyond. A link "Learn more about WWA" is provided.
- WWA Spotlight:**
 - New WWA study analyzes disincentives to water conservation:** A new study by WWA's Doug Kenney found that, especially in western contexts, water utilities face multiple financial and other constraints that tend to reduce the appeal of conservation in long-term planning efforts. Kenney's paper, published in the *Journal of the American Water Works Association*, found two major types of disincentives—those related to supply reliability and those related to utility revenues. The paper recommends considering other financial models, such as the "decoupling" model used by some electricity utilities. (January 13, 2014)
 - New study: Dust, warming portend dry future for the Colorado River:** Reducing the amount of desert dust swept onto snowy Rocky Mountain peaks could help Western water managers deal with the challenges of a warmer future, according to a new study. With support from WWA and NASA's Interdisciplinary Science program, CIRES' Jeffrey
- Recent WWA Publications:**
 - Understanding utility disincentives to water conservation as a means of adapting to climate change pressures:** A management model that systematically provides incentives for conservation may no longer promise the greatest social benefits. Read the full article at *Journal of American Water Works Association*.
 - Kenney, D. S., 2014. *Journal of American Water Works Association*, Vol. 106, No. 1, 36-46, January.**

A video player is visible at the bottom left, showing a video titled "Western Water Assessment" with a play button and a progress bar.