Where the Rubber Meets the Road – Why we Need (Better) Seasonal Forecasts (especially for drought)

When the Rain Stops: Drought on Subseasonal and Longer Timescales
Aspen Global Change Institute
September 11, 2018
The Mighty Rio Grande –
The Centerpiece of American Southwest Folklore
New York Times this week:

“The Rio Grande is Dying, Does Anybody Care?”
Recent literature on the impacts of climate change on western water

Western water and climate change

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ABSTRACT United States is a region long defined by water challenges. Climate change promises to exacerbate these challenges, but does not, for the most part, introduce entirely new issues. Climate change projections for the western United States show increases in temperature and attendant increases in evapotranspiration rates, although likely the northernmost parts of the United States will see declines. However, the combination of increased evapotranspiration and decreased precipitation may result in a situation much different from the past. Western water resources may be under greater pressure from climate change impacts expected from increased temperatures and rising sea levels.

Key words: Centennial Paper; climate change; western United States; water resources

If climate change is the shark, then water is its teeth.
—Paul Dickinson, CEO of Carbon Disclosure Project

INTRODUCTION

The western United States has always been a nexus of great opportunity and great challenge for the Nation. The region is notable for burgeoning human settlements and its “wide open spaces.” Natural disturbances and native ecosystems are complex terrains and diverse climates. The region has abundant resources and its scarce ones. Water has always played a pivotal role in its development, so that, to the extent mismatched elsewhere, water has been a limiting factor in where agriculture was undertaken, in where and how large its settlements have grown, and in the character and survival of many of its natural landscapes. And now, like so much of the Earth, social and natural conditions in the western United States are changing rapidly due to a variety of influences, including its long history of recurrent and severe droughts, floods, water-quality contamination, environmental degradation and endangered species, strong competition for the often limited water supplies that exist among a diverse set of
• Infrastructure designed to capture snowmelt on tributaries.

• Above Elephant Butte, there is no water storage on the mainstem.

• Available storage generally does not exceed one year’s needs.
A highly variable system....
Differences in forecast information in different regions of the country

NOAA River Forecast Centers
Information available from NOAA River Forecast Centers

West Gulf River Forecast Center

COLORADO BASIN RIVER FORECAST CENTER
NATIONAL WEATHER SERVICE | NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Conditions Map

River Conditions
Data Updated: 11/8/16

- Show
- Data
- Forecast
- Reservoir Inflow
- Reservoir Outflow
- Official Flood
- Active
- Not Available
- Normal
- Significant Rise
- Near Bankfull
- Above Bankfull
- Above Flood Stage
- Outlook (+3 days)

- POPPET Alerts

Snow Conditions
Water Supply Forecasts
Peak Flood Probability
Reservoir Conditions
Daily Precipitation
Monthly Precipitation
Soil Moisture
Map Options
Search Points

Lat: 37.6 Lng: -110.5, Zoom: 6

RECLAMATION
Have we experienced “flash drought”?

DROUGHT:
'Across most of the West, snowpack isn't just low -- it's gone'

Scott Streater, E&E reporter
Published: Friday, May 8, 2015

Higher temperatures have already melted most of the mountain snowpack across the West, according to a sobering new report from the Department of Agriculture that warns this could lead to water supply shortfalls this summer.
New Mexico’s Disappearing Snowpack - 2016

**Jan 01, 2016**

- Sangre De Cristo Mountain Range: Current Snow Water Equivalent (SWE) Basin-wide Percent % of 1981-2010 Median
- Zuni Bluewater River, Rio Chama River, Jemez River, Pecos River, Alamosa River
- Colors: unavailable, <60%, 50-69%, 60-79%, 70-90%, 90-109%, 110-129%, 130-149%, >150%

**Mar 19, 2016**

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*Data unavailable at time of posting or measurement is not representative of this time of year.*

Provisional Data Subject to Revision
How do we use this science on drought forecasting?
And when do we need the information?
Early (January – February) Forecast Related Decisions by Reclamation

"The Bureau that Changed the West"
How much water do we need to acquire for endangered species?

- **Spring Pulse** to support minnow spawning, floodplain connection, riparian health, and nutrient exchange.
- Lease of water for Reclamation's supplemental water program to support summertime flows.
Example of additional flexibility: 2015 El Vado Operations

Water stored under March 24 resolution, subsequently released May 20 – 29 to support spring pulse
How much water can we save to meet the needs of the Middle Rio Grande Pueblos’ Prior & Paramount Water Rights?

Can be stored even under Rio Grande Compact Storage Restrictions (Article VII)
When should we store in El Vado Reservoir to maximize storage but still maintain flood storage capacity until end of runoff period?

El Vado Reservoir, near Chama, NM
What will be our staffing needs for river monitoring and for supplemental pumping from drains?
How much we will be able to allocate to Reclamation’s San Juan-Chama Project Contractors?
State of New Mexico: What will be our delivery obligations under the Rio Grande Compact, and when should we make deliveries?

(will a good monsoon save us?)
Municipalities (Albuquerque, Santa Fe...)

- Will there be sufficient carriage water to allow diversion of drinking water from the Rio Grande?
- How much of the year will the city be reliant on groundwater?
- How much surface water will the city need to set aside to make up for past impacts of groundwater pumping?
- Will there be sufficient water to store any relinquishment credits under the Rio Grande Compact?
Irrigation District (Middle Rio Grande Conservancy District)

- How much water can we store before we enter Compact Storage Restrictions – for Pueblos and for non-Indians?
- Will we be able to store Compact relinquishment water?
- Should we Implement water bank for farmers who have sold their water rights?
Farmers

• Will there be sufficient water for a full season?
• What should we plant?
• Note – in the Middle Rio Grande, almost all farming is alfalfa or native pasture. I postulate that this is largely due to the unreliability of the supply.
Fish & Wildlife Service

- “Incidental Take” allowance for silvery minnow
- Staffing needs for minnow rescue in locations where the river dries.
Recreation Industry

Will there be water for rafting? Fishing? What will be our staffing requirements for guides?
And everyone asks – what is the chance of a good monsoon?
Are these New Mexico forests sustainable? Are they resilient? What is the difference?

Is resilience always a good thing?
Resilience

The capacity of a system to absorb a spectrum of disturbances and reorganize so as to retain essentially the same function, structure, and feedbacks—to have the same identity (Walker and Salt 2012).
Or at Tigger says – “how well we bounce”!

Life is not about how fast you run or how high you climb but how well you bounce.

~Vivian Komori

Source: Pinterest
Stationarity assumes that the statistical properties of hydrologic variables in future time periods will be similar to past time periods.

We need a new paradigm for a world of continual change.

“Climate change undermines a basic assumption that historically has facilitated management of water supplies, demands, and risks.”

And why do we hear so much about resilience these days?
Systems are dynamic, constantly changing.

The adaptive cycle of a healthy, resilient system.

- **Emergence (Renewal)**: Successful aspen establishments will require stronger, more effective management of species that browse on aspen seedlings and bark.
- **Consolidation (Maturity)**: Northern New Mexico Forest uplands are a mature pine dominated landscape. This forms a natural reservoirs that captures snow during the winter and releases the moisture as runoff in the spring and summer.
- **Birth**: Successional forest has grown over many years.
- **Creative Destruction**: Forest fires are a part of the adaptive cycle, clearing the way for emerging growth and continuing this adaptive cycle.
Thinking in socio-ecological systems...

Humans are part of ecological systems, and ecological components are part of human systems, with numerous components that are interlinked and interdependent.
Panarchy – thinking across scales...

And the systems are interlinked across scales.
What makes Rio Grande Upland Forests vulnerable to disturbance?

Exposure: The resource and the change it is experiencing.
- Temperature increase,
- Decrease in snowpack,
- Loss of soil moisture.

Sensitivity – How a resource fares when exposed to change. Sensitivity is affected by:
- Forest overgrowth,
- Moisture-stress of trees.

Adaptive Capacity – How the system is able to anticipate, respond, cope and recover.
- Ecological diversity,
- Available seed sources,
- Patchiness.
Rio Grande Upland Forests

1. Context
   Rio Grande Upland Forest

2. Disturbance
   Event that might or might not result in crossing a threshold

3. Resilience
   Will that disturbance cross over a threshold?

4. Reaction to disturbance
   Maintain the same system or transform a new system with different structure and function (e.g., cope, recover, learn)

- Exposure
- Sensitivity
- Adaptive capacity

Resilience of what?
Resilience to what?
Transformation!

Successful aspen establishments will require stronger, more effective management of species that browse on aspen seedlings and bark.

Northern New Mexico Forest uplands are a mature pine dominated landscape. This forms a natural reservoirs that captures snow during the winter and releases the moisture as runoff in the spring and summer.

Emergence (Renewal)

Northern New Mexico Forest uplands are a mature pine dominated landscape. This forms a natural reservoirs that captures snow during the winter and releases the moisture as runoff in the spring and summer.

Consolidation (Maturity)

Successional forest has grown over many years.

Disturbance

Forest fires are a part of the adaptive cycle, clearing the way for emerging growth and continuing this adaptive cycle.

Creative Destruction

New system with new adaptive cycle
Transformation!