

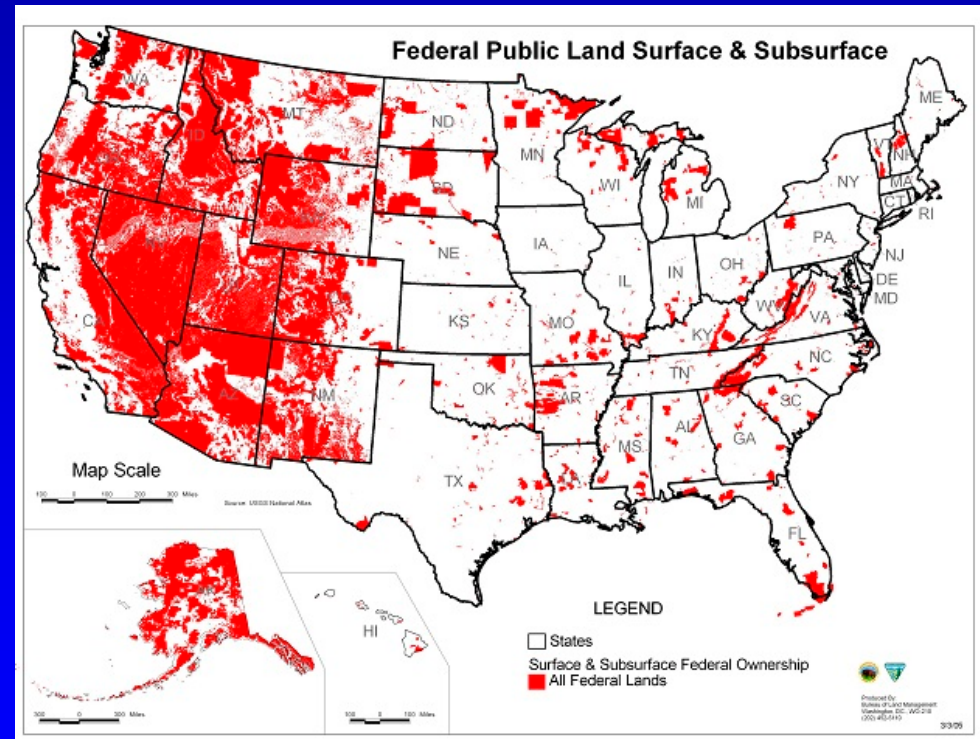
Rain Gauges for Range Monitoring: Codeveloping Tools and Best Practices for Ranch-Scale Drought Detection

**Mike Crimmins
Professor & Extension Specialist
Dept. of Soil, Water, & Environmental Science
The University of Arizona**

**Mitch McClaran – School of Natural Resources and Environment, UA
Ashley Hall – Gila County Cooperative Extension, UA
Andrew Brischke – Mohave County Cooperative Extension, UA**

Five C's in Arizona: Copper, Cattle, Citrus, Cotton, and Climate

- 73% of AZ land area is grazing land
- Arizona cattle operations valued at \$5.2 billion
- 2011 AZ calf and cattle sales: \$800 million
- Mostly public land grazing – shared stewardship

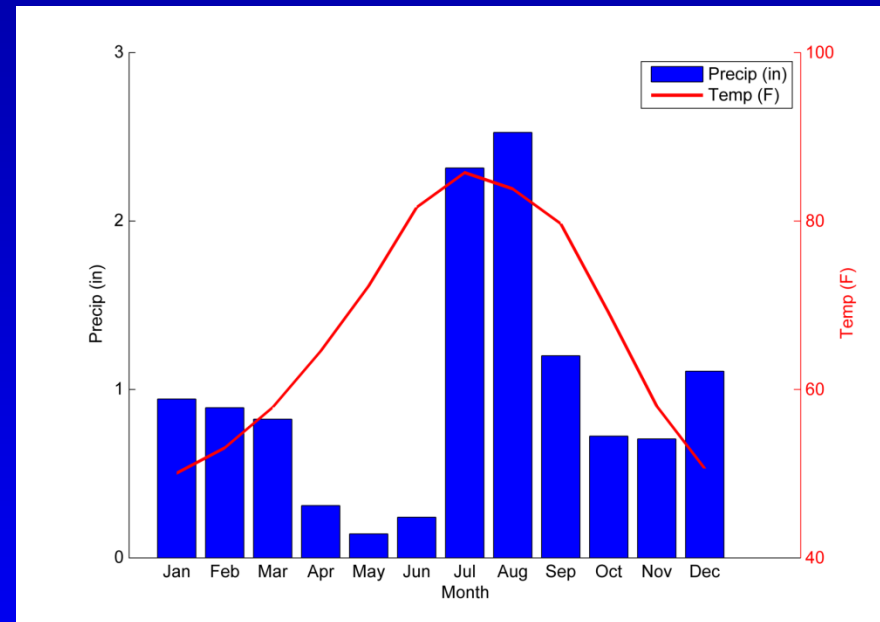


Bureau of Land Management

Kerna et al. 2014

Five C's in Arizona: Copper, Cattle, Citrus, Cotton, and Climate

- AZ has seasonal-transitional climate
- High inter-annual variability (ENSO), high spatial variability (topography, convective t'storms)
- Grazing systems vulnerable to all types of precipitation variability – *rainfed agriculture*
- *Drought monitoring and planning are critical management tools*

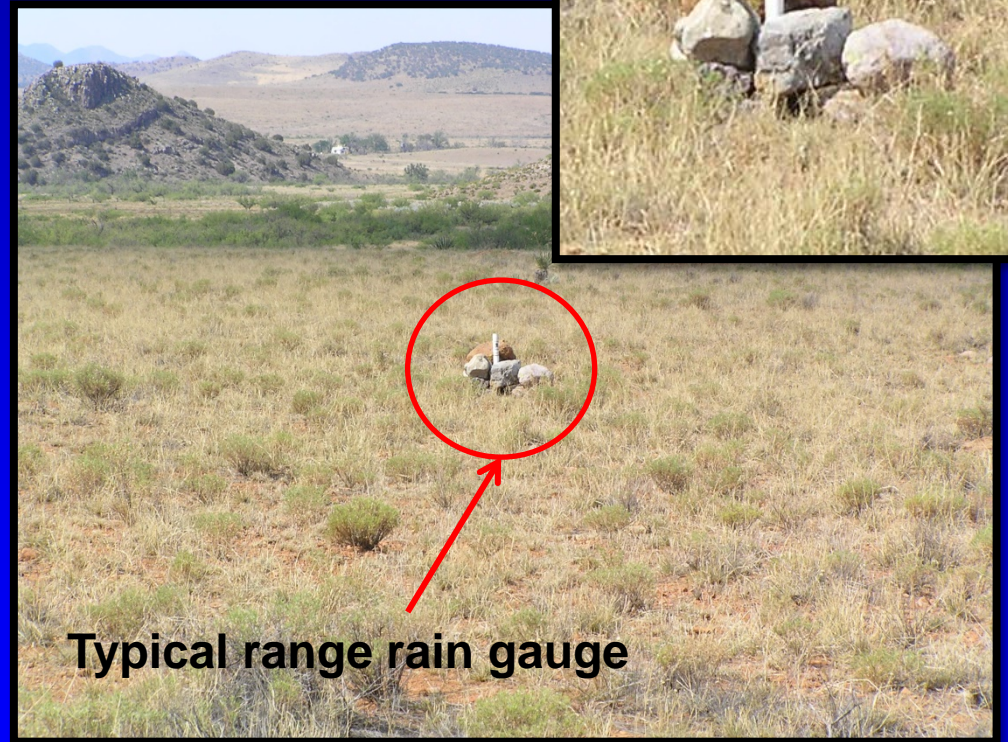


Cochise County Avg Precip/Temp

Precipitation monitoring is key management tool

“What type of information would help drought planning and management? *Rain gauges*. Some ranchers have them but don't read them. Some have only a home. Would like to see a couple per pasture”

- USFS Rangeland Mgmt Specialist



Typical range rain gauge

A rain gauge in every pasture and allotment

- *Precipitation observations can mitigate land management conflicts - need to be trusted by both parties*
- Precipitation data used in evaluating rangeland conditions relative to grazing operations
- UofA Extension has been working to develop best practices in constructing, placing and reading gauges and managing/utilizing observations



PVC depth gauge at range monitoring site near Clifton, AZ

Precipitation Monitoring Working Group (Gila County Cattlegrowers, USFS, AZ Game/Fish, BLM)

Workshop 1 (June 2016)

- Learn about rain gauge monitoring strategies, provide feedback, and help guide the scoping of online tools
- Receive several rain gauges to install and monitor over the 2016 monsoon season.

Workshop 2 (Nov 2016)

- Review rainfall observations, test new online tools, and share lessons learned
- Co-develop training materials, best practices and finalize online tools to share with other ranchers and land managers.

Workshop 3 (June 2017)

- Open training workshop using materials and best practices developed
- Encourage others to establish new rain gauges and use the new software to archive and analyze the newly collected rainfall data.

Monsoon
Season

Project supported by:



SW
Regional
Climate
Hub



Climate Science Applications Program - University of Arizona Cooperative Extension



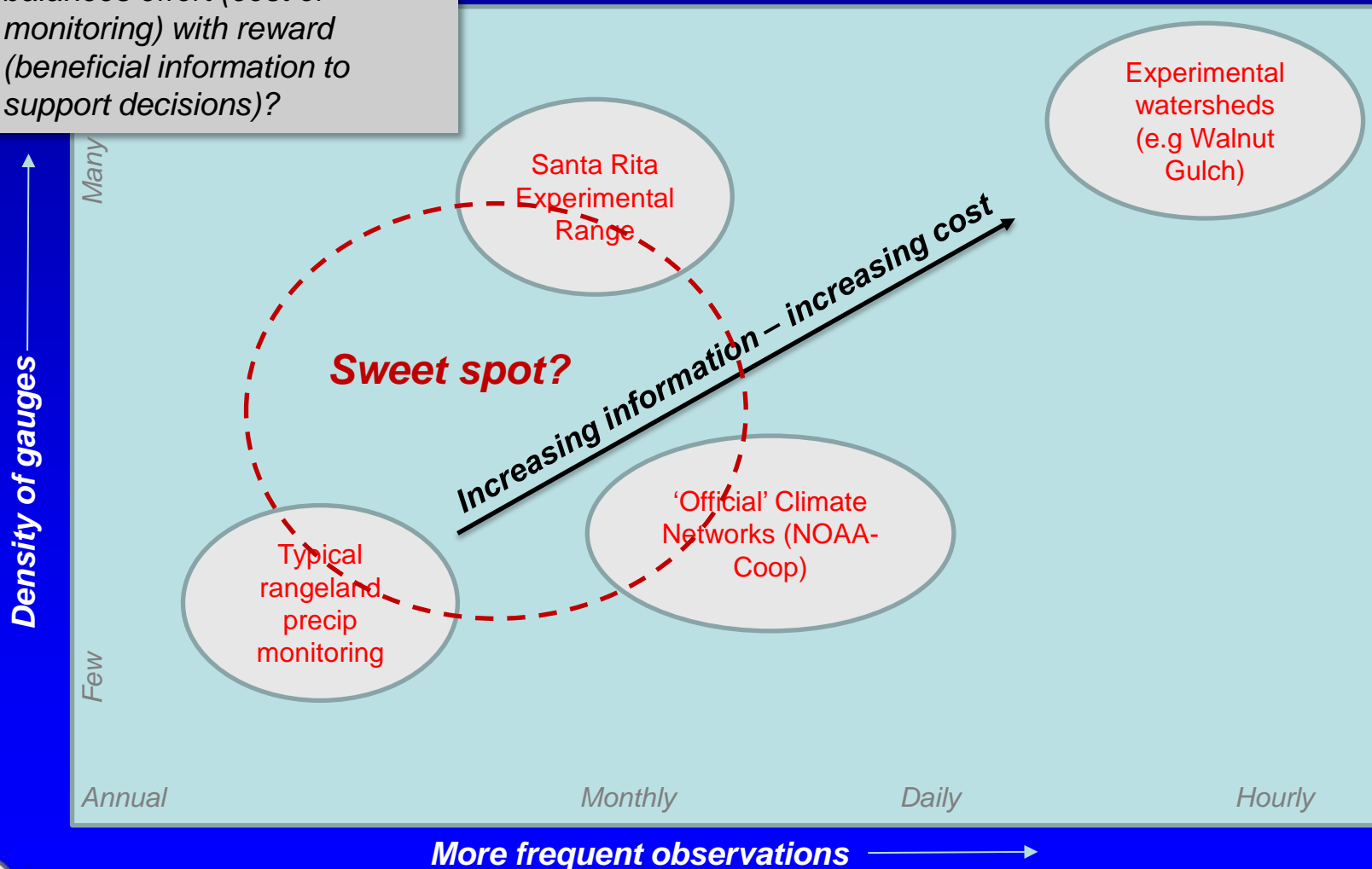
What are “best practices” in range precip monitoring?

- More is better, but need to tie to range monitoring and decision making – *Where?*
- More frequent reading of gauges will yield important information on ‘tank’ vs. ‘grass’ rains – *When?*
- What is ‘normal’ for a rain gauge without a long-term record? – **What does it mean?**



Developing a precipitation monitoring plan

Where is the 'sweet spot' that balances effort (cost of monitoring) with reward (beneficial information to support decisions)?



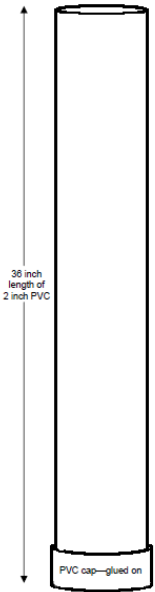
Simple rain gauges for range monitoring

Yavapai County

ARIZONA COOPERATIVE
EXTENSION

COLLEGE OF AGRICULTURE AND LIFE SCIENCES

Simple Design for a Remote Rain Gauge
By: Jeff Schalau, Associate Agent, ANR
University of Arizona Cooperative Extension, Yavapai County
840 Rodeo Dr #C, Prescott, AZ 86305
Phone: 928.445.6590 ext. 224, E-mail: jschalau@ag.arizona.edu



36 inch length of 2 inch PVC

PVC cap—glued on

Precipitation data is often useful in making land management decisions. However, sites of interest are often in remote areas that are visited infrequently. Below are instructions for building an inexpensive precipitation gauge and how to take seasonal measurements on remote sites. The precipitation gauge is made from a 36-inch length of 2 inch PVC pipe that has a PVC cap glued onto one end. The pipe is then hose clamped open-end-up to a fence post or T-post.

Make sure to locate the gauge away from trees, buildings, power lines, and other features that may reduce the accuracy of data collected. After securing the gauge to the post, place a small volume (2 to 3 inches) of a 50:50 mix of antifreeze and automatic transmission fluid. The ATF keeps the captured water from evaporating and the red color of the ATF makes it easy to read on a tape measure. The antifreeze keeps the water from freezing.

Measurements should be recorded following winter (usually collected in June) and summer precipitation (usually collected in early October). More frequent readings (i.e. monthly or quarterly) may be collected when justified. At each site, depth readings are taken, giving the amount of precipitation since the last reading. The gauge should be cleaned and replenished at least once per year. It is also a good idea to put a piece of hardware cloth inside the opening to prevent birds, rodents, and other small animals from entering the pipe.

On grazing allotments managed by state or federal agencies, it is a good idea to locate several precipitation gauges distributed across the management unit. Many ranchers that have permanent monitoring sites place these gauges at each site. Some users of these gauges have camouflaged them to decrease the likelihood of vandalism.

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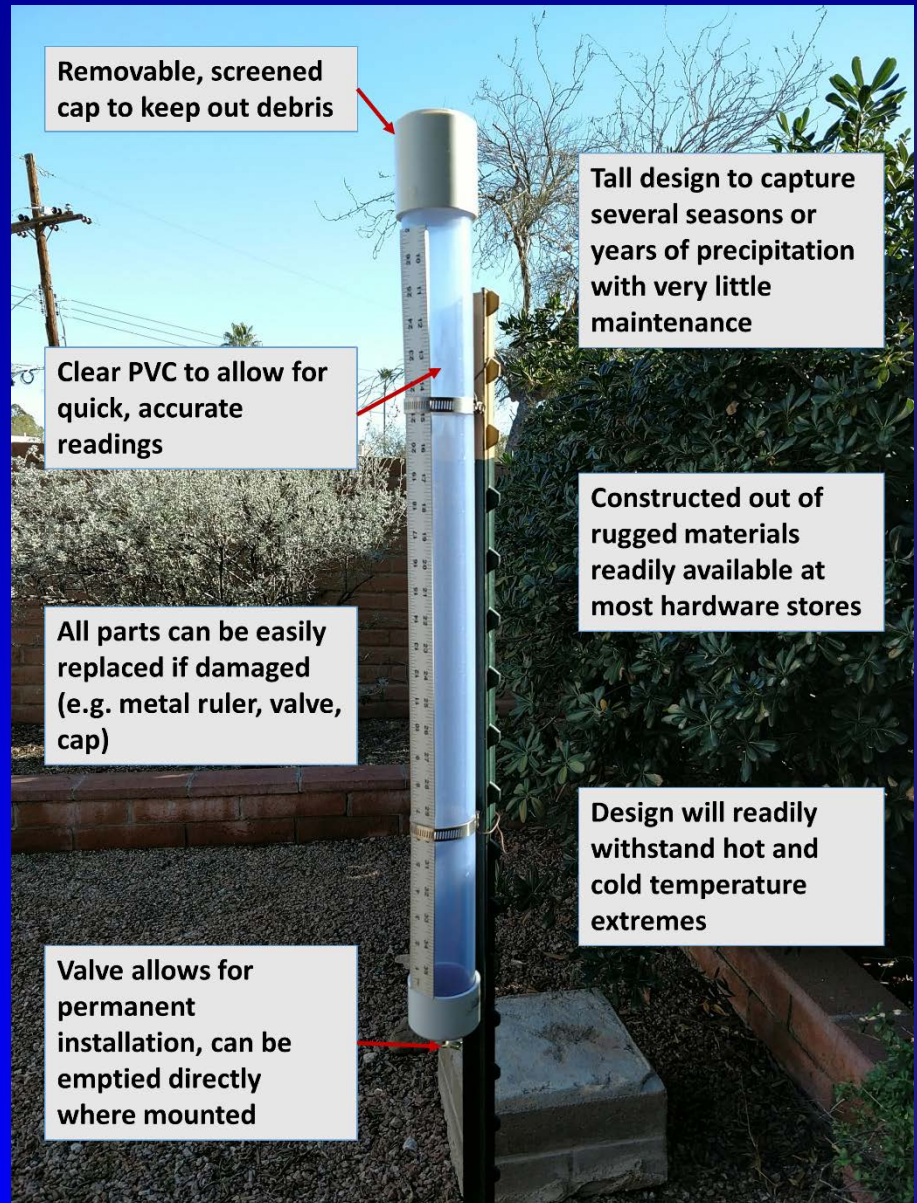
Can we design a better rain gauge for remote, range monitoring?: 'Cow proof', easy to read and maintain, inexpensive, rugged and long-lasting...





07/26/2016

Accumulation Precipitation Gauge



Supporting tools and resources

Precipitation Logbook Generator About Tool Choose a location Generate Logbook

Set location and download data

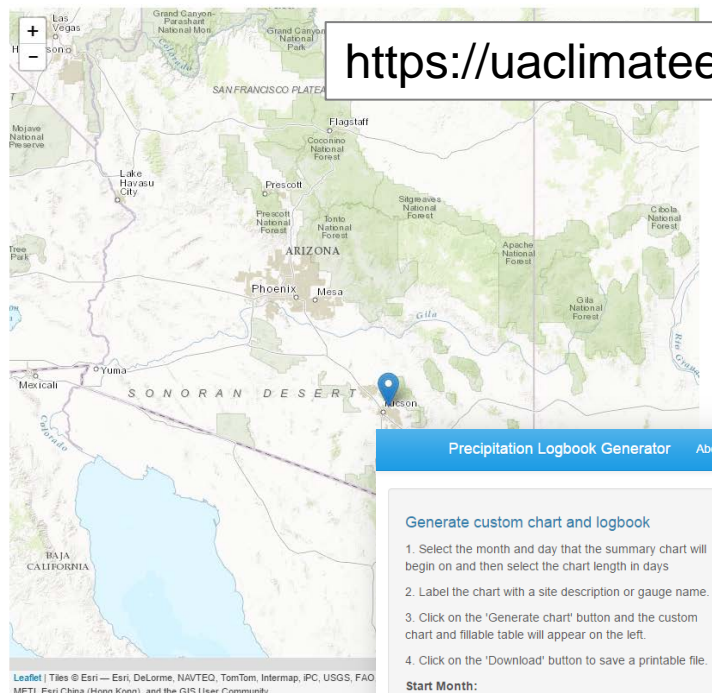
1. Click map to select location (use +/- buttons to zoom, use cursor to pan -- only works for locations within continental U.S.)
2. Click 'Download data' button (this may take a couple of seconds, look to upper right corner for progress message)
3. Proceed to Generate Logbook page

Download data

Selected location

Latitude: 32.268554462148

Longitude: -110.906810760498



<https://uaclimateextension.shinyapps.io/precipChart/>

Precipitation Logbook Generator About Tool Choose a location Generate Logbook

Generate custom chart and logbook

1. Select the month and day that the summary chart will begin on and then select the chart length in days
2. Label the chart with a site description or gauge name.
3. Click on the 'Generate chart' button and the custom chart and fillable table will appear on the left.
4. Click on the 'Download' button to save a printable file.

Start Month: 6

Start Day: 15

Chart length (days): 120

Site name: Tucson, AZ

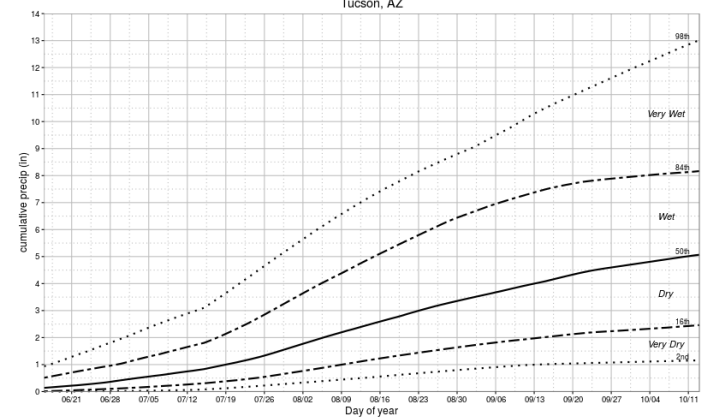
Generate Chart

Download printable chart/table (html file that can be opened and printed with browser)

Download

Cumulative Precipitation Chart

Tucson, AZ



Selected location

Lat: 32.268554462148
Lon: -110.906810760498
Elevation (ft): 2391.7
Center of data grid cell

Lat: 32.25
Lon: -110.916667
Elevation (ft): 2428
Distance between selected location and center of grid cell (ft): 7407

Precipitation Logbook Generator



Where?: Key allotments or pastures
When?: Tie observations to decision timing
What?: Precipitation climatology provides context

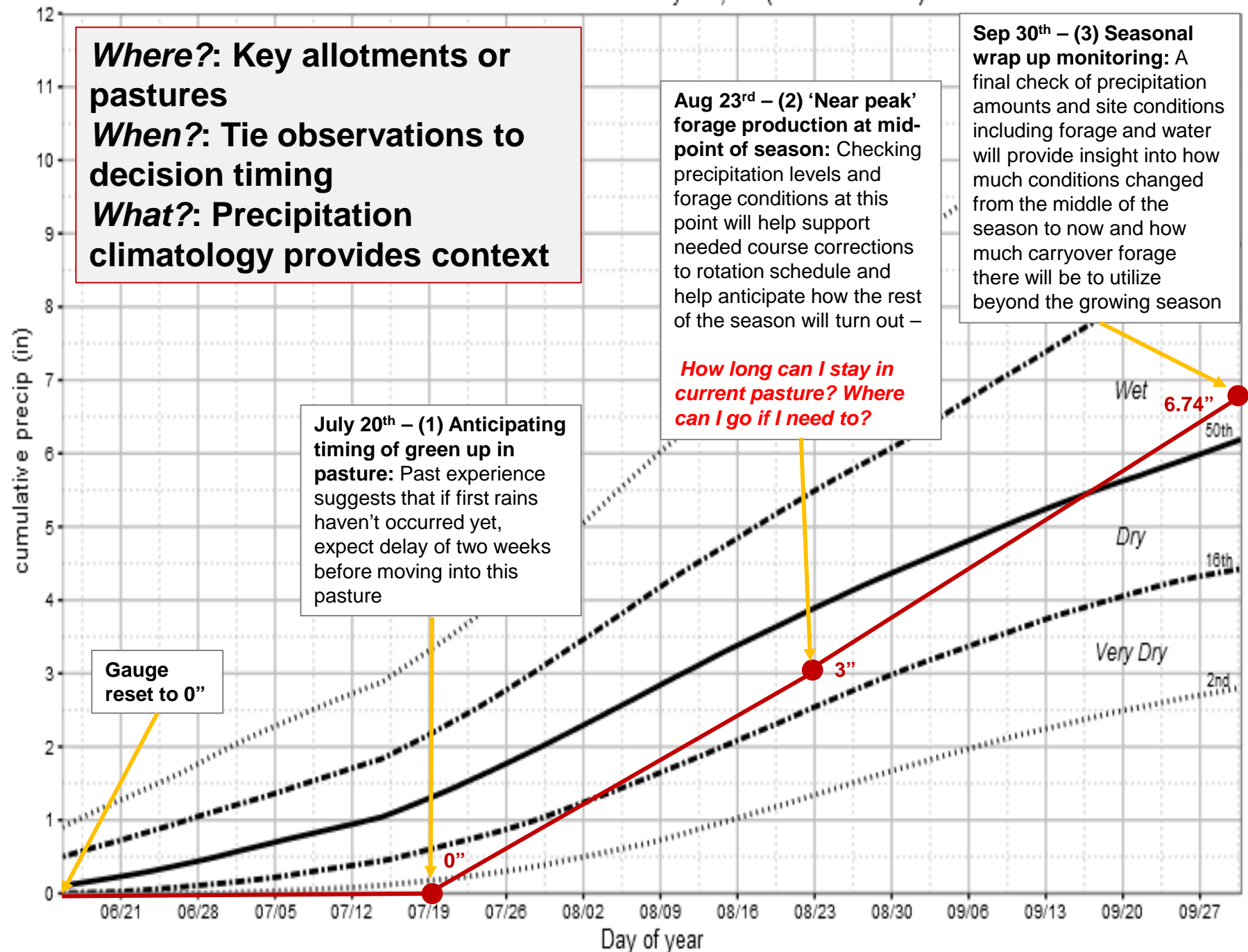
Sep 30th – (3) Seasonal wrap up monitoring: A final check of precipitation amounts and site conditions including forage and water will provide insight into how much conditions changed from the middle of the season to now and how much carryover forage there will be to utilize beyond the growing season

Aug 23rd – (2) ‘Near peak’ forage production at mid-point of season: Checking precipitation levels and forage conditions at this point will help support needed course corrections to rotation schedule and help anticipate how the rest of the season will turn out –

How long can I stay in current pasture? Where can I go if I need to?

July 20th – (1) Anticipating timing of green up in pasture: Past experience suggests that if first rains haven't occurred yet, expect delay of two weeks before moving into this pasture

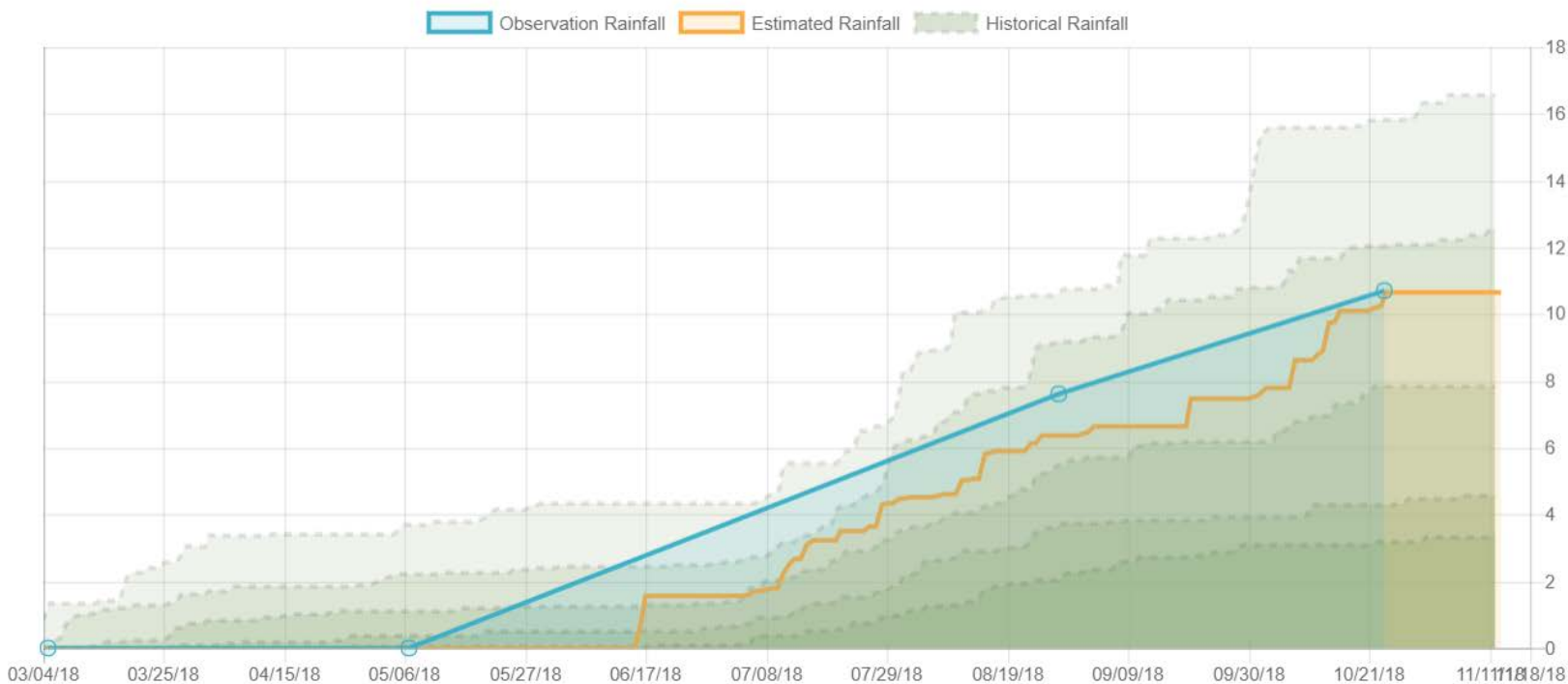
Gauge reset to 0"



Set precipitation date range
 Controls cumulation results. Limited to 365 days.
 12/01/2017 - 11/13/2018 **SET RANGE**

? RAINFALL CHART

All data ▾
 Chart X-Axis will not precede first observation date with this selection



Me (The Owner) 2-2 7.13" AUG 28 2018

GAUGES SHARED WITH ME

It appears no other registered MyRAINge Log member has added you as a helper to a gauge. Go tell someone you want to help!

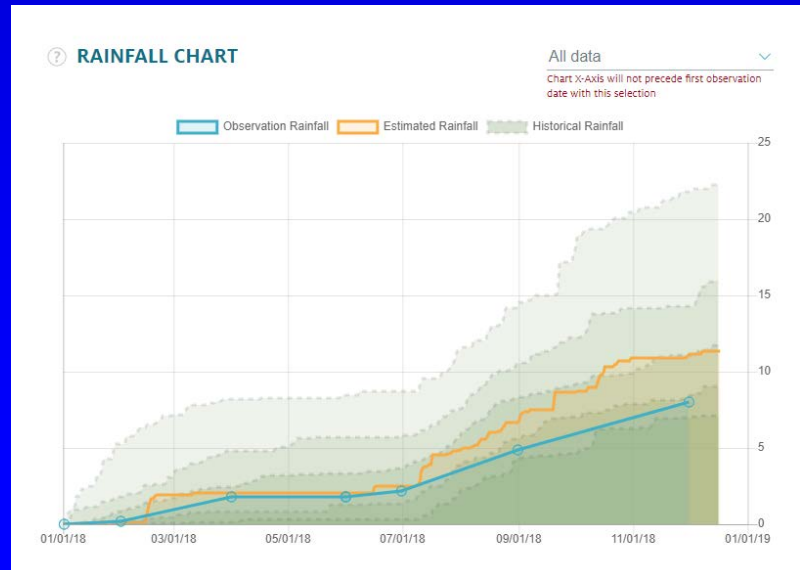
Supporting tools and resources



Working to continue to expand monitoring through hands-on workshops...



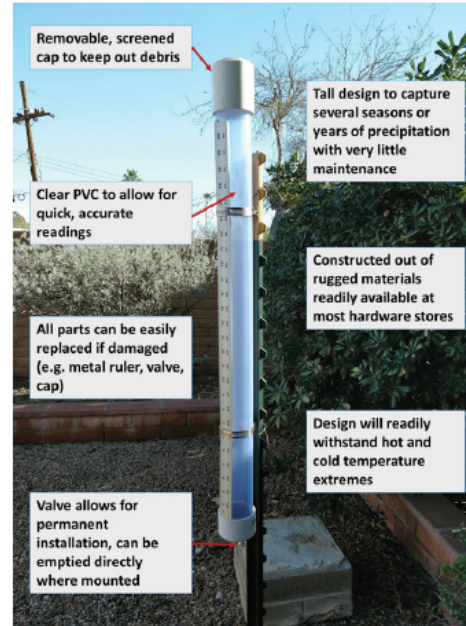
Rain Gauge Workshop – Clifton, AZ Dec 2018



Rain Gauge Construction Guide (UA Extension Bulletin)

Do-it-yourself construction guide: Rugged accumulation precipitation gauge for remote monitoring

Michael A. Crimmins, Mitchel McClaran, Julie Brugger, Ashley Hall and Douglas Tolleson



Introduction

Precipitation is the key variable in assessing drought status and tracking changes in drought conditions. Precipitation

unattended site? A simple and inexpensive accumulation gauge can help in this situation. These gauges are typically

https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1747-2017_0.pdf

Precip Monitoring Best Practices Guide (UA Extension Bulletin)

Rain Gauges for Range Management: Precipitation Monitoring Best Practices Guide

Michael A. Crimmins, Mitchel McClaran, Julie Brugger, Ashley Hall, Douglas Tolleson and Andrew Brischke

Introduction

Precipitation in the form of rain and snow is critical to many aspects of working lands from controlling the growth of vegetation used in grazing by livestock and wildlife to recharging local water resources found in springs, tanks and riparian areas. Land management decisions often require some knowledge of how much precipitation fell within a management unit to assess how past actions have performed and what to do next. For example, do forage conditions reflect a lack of precipitation or grazing management? Did the next pasture or allotment in my rotation get any rainfall over the past season?

Given that precipitation monitoring is important, where and how do we usually get this information? Typically, we consult websites and maps that track precipitation observations from airports and backyard observers. These 'official' sites, managed by volunteer and federal agency programs, do a good job of maintaining a steady stream of high quality data, but often are located near cities away from rural and backcountry areas where the bulk of land management activities occur. Estimates provided by interpolating between these official gauges can provide just that, estimates. Knowing how much and when precipitation fell in your pasture, allotment or land management unit is a key variable for sound decision making and requires collecting precipitation data directly at that site.

Overall, this "best practices" guide will cover some of the basic approaches to collecting and using precipitation observations at remote sites in support of rangeland management including:

- Tying observations to a drought plan
- Where to place gauges and how often to record observations
- Managing and using precipitation observations

This guide will also highlight some new tools that help put



Figure 1. Clear PVC rain gauge (photo courtesy of J. Lyman)

Rain gauges

Precipitation monitoring is one of the most straightforward aspects of weather and climate monitoring and does not require overly sophisticated or expensive equipment. Simple rain gauges consisting of a collection container suffice under most situations. Gauges made out of PVC tubes capped at one end and mounted to fence posts in key areas have been utilized by ranchers and land managers for many years. These gauges typically have a small amount of oil in the gauge to

piece of information to support a management decision.

for direct reading of the precipitation amounts in the gauge

<https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1751-2017.pdf>

Drought and Grazing

Introduction

Drought threatens livestock and natural resources on rangelands. It reduces rain-fed forage and drinking water for livestock, diminishes the quantity and quality of critical water resources for sensitive wildlife species, and increases wildfire risk. Planning for drought means to become better prepared for the next drought, because drought is inevitable.

Planning for drought on the 90 million acres of Forest Service lands in the western US can minimize impacts to livestock and natural resources, but that planning requires collaboration between ranchers and Forest Service.

Since 2013, our team has been working with ranchers and Forest Service staff to support collaborative drought planning by building drought information tools, guides to monitor drought conditions, and guides to support the drought planning process. This web site provides access to those tools, guides and other resources to improve drought planning where ever it is needed.

Goal

Improve the preparation for drought and response to recurring drought through collaborations between livestock ranchers and Forest Service managers.

Approach

Develop drought information tools and guides to monitor drought, and integrate those tools and guides to support collaborative drought planning by ranchers and Forest Service staff.

<https://cals.arizona.edu/droughtandgrazing/>

Thanks!

crimmins@email.arizona.edu

<http://cals.arizona.edu/climate>

