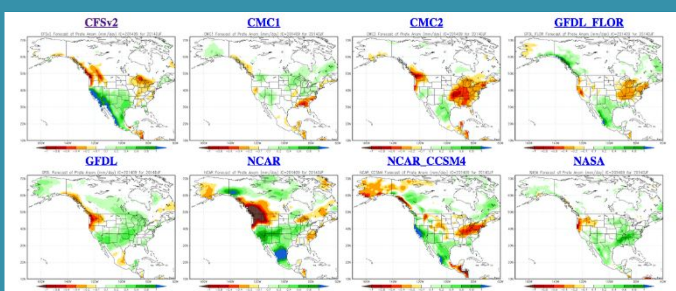
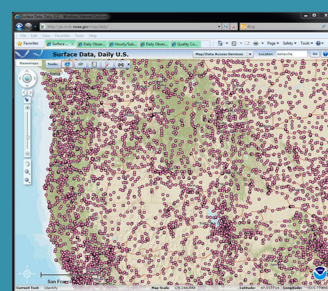
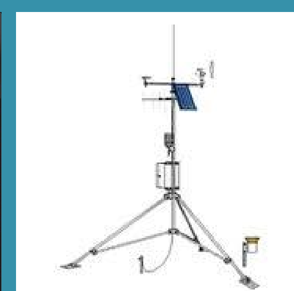
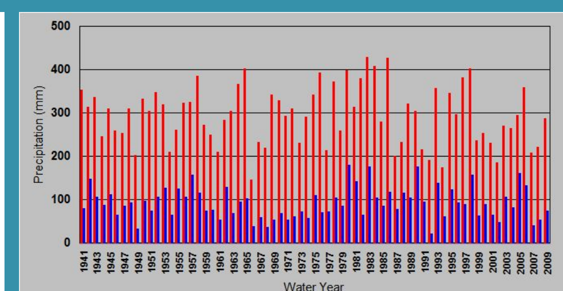
Weather and climate tools for rangeland restoration planning and management









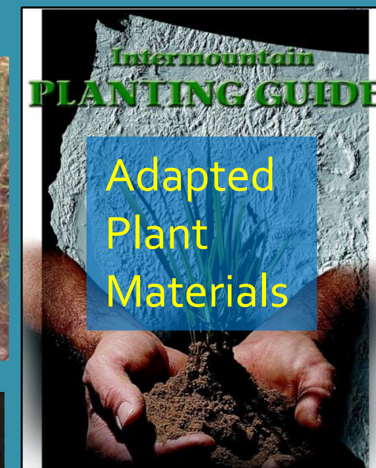
Stuart Hardegree, Corey Moffet (USDA-ARS)
John Abatzoglou, Katherine Hegewisch (University of Idaho)
and Mark Brunson (Utah State University)

United States
Department of the Interior
Bureau of Land Management

BURNED AREA EMERGENCY STABILIZATION and REHABILITATION

BLM Handbook H-1742-1

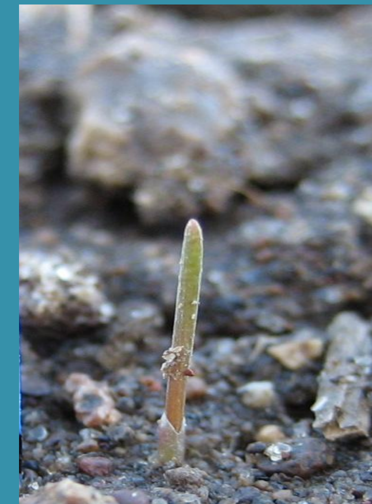
Site Availability, Species Availability, Species Performance



Site Availability, Species Availability, Species Performance

Seed

Germinated seed

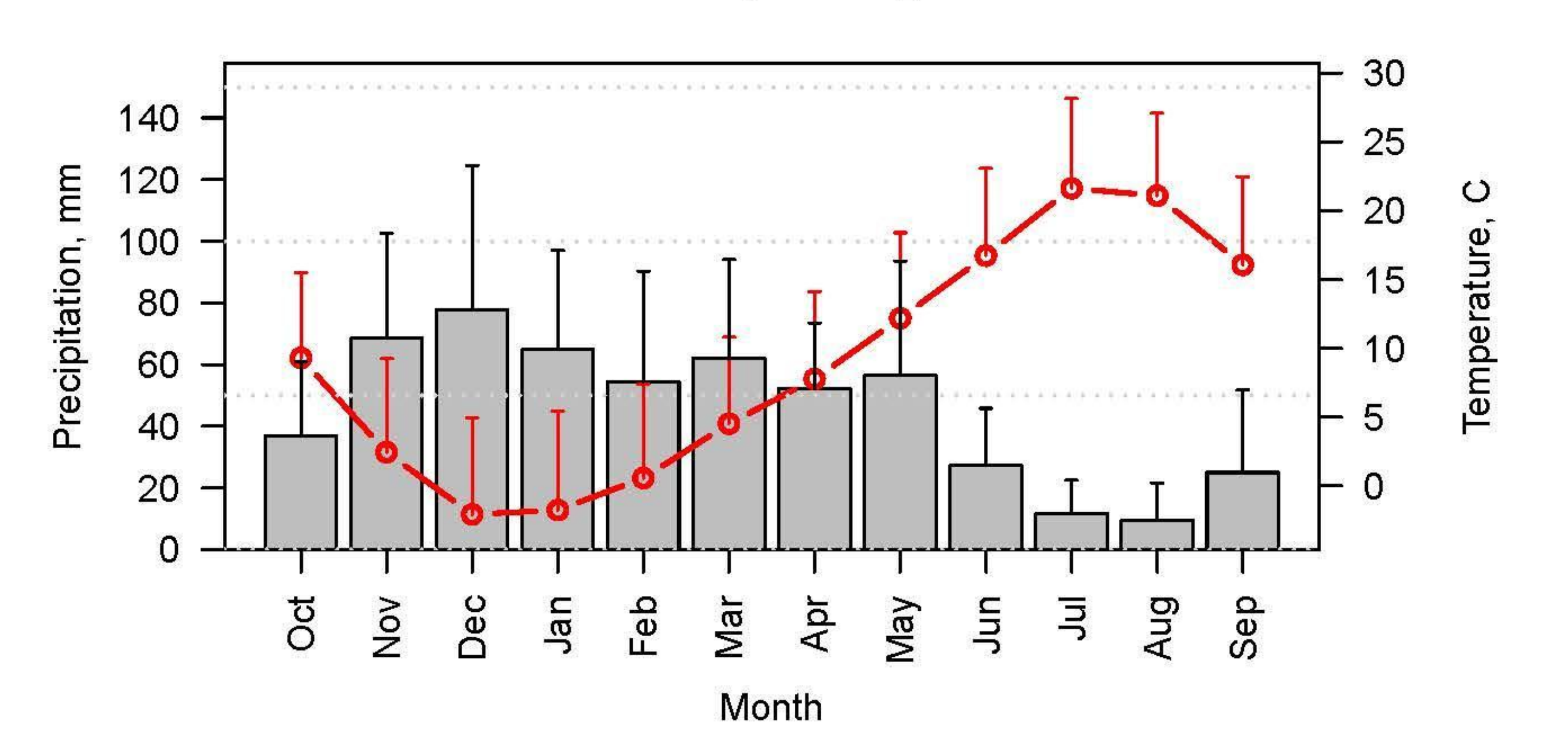


Emerged seedling

Adult

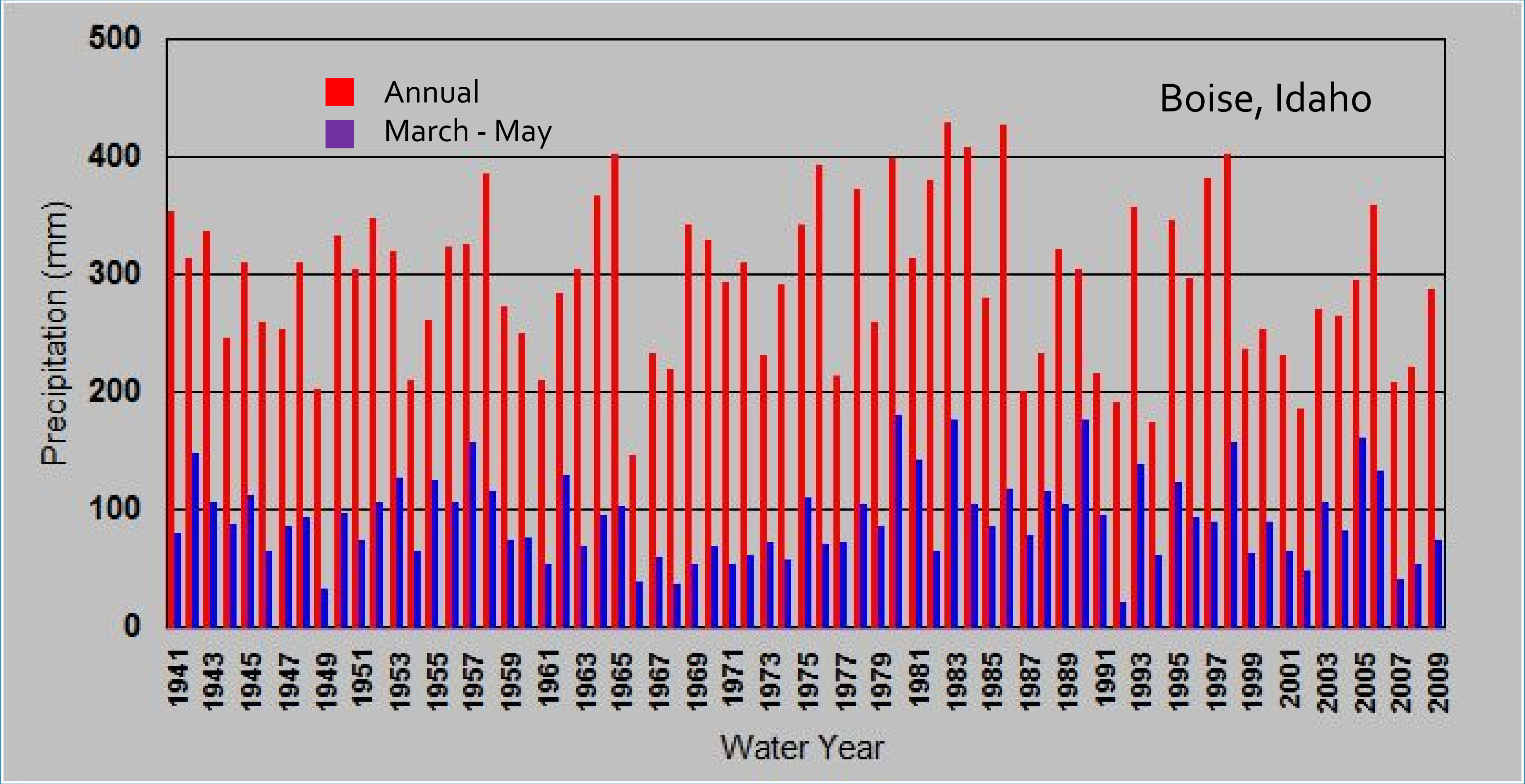
Juvenile

Established seedling

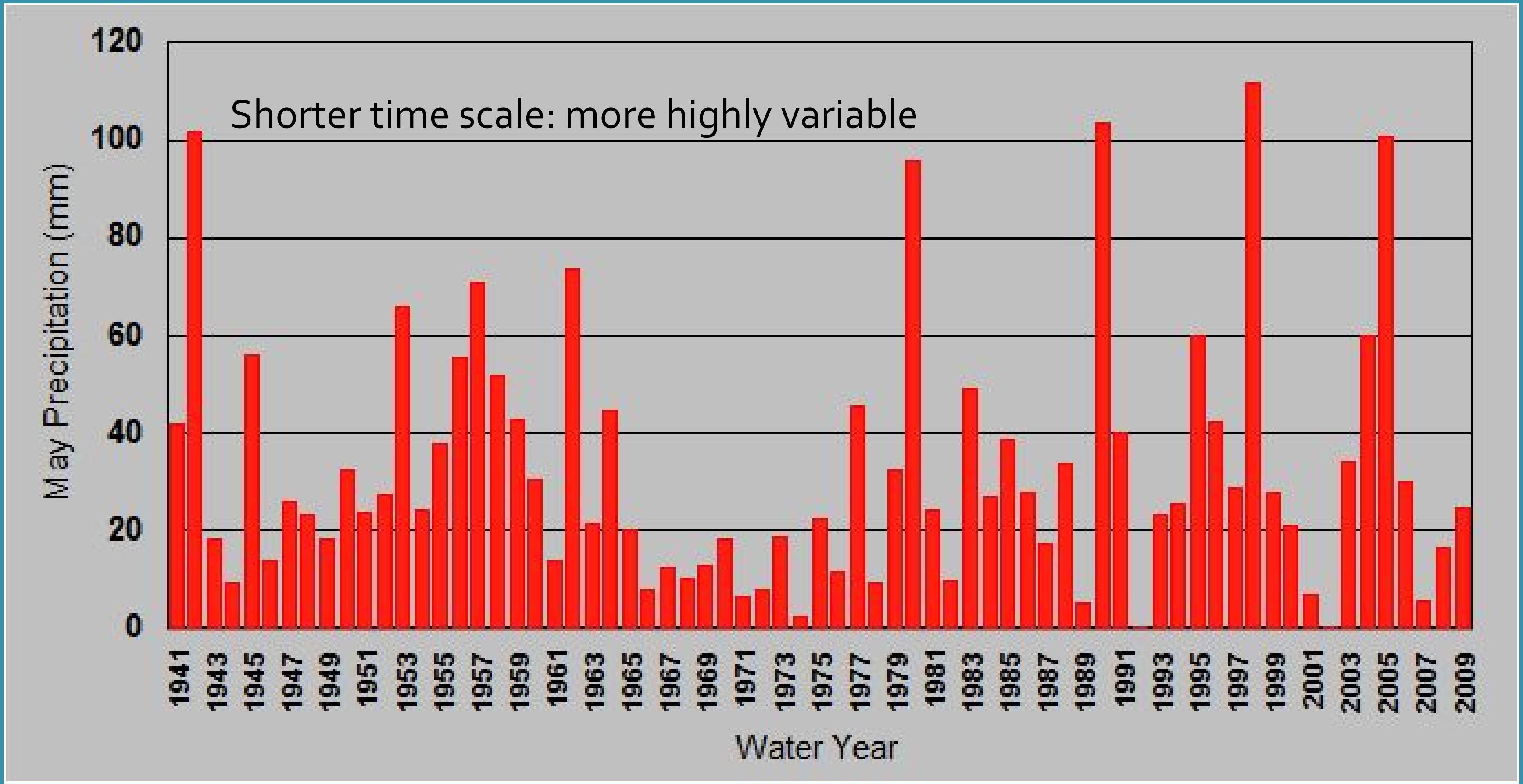


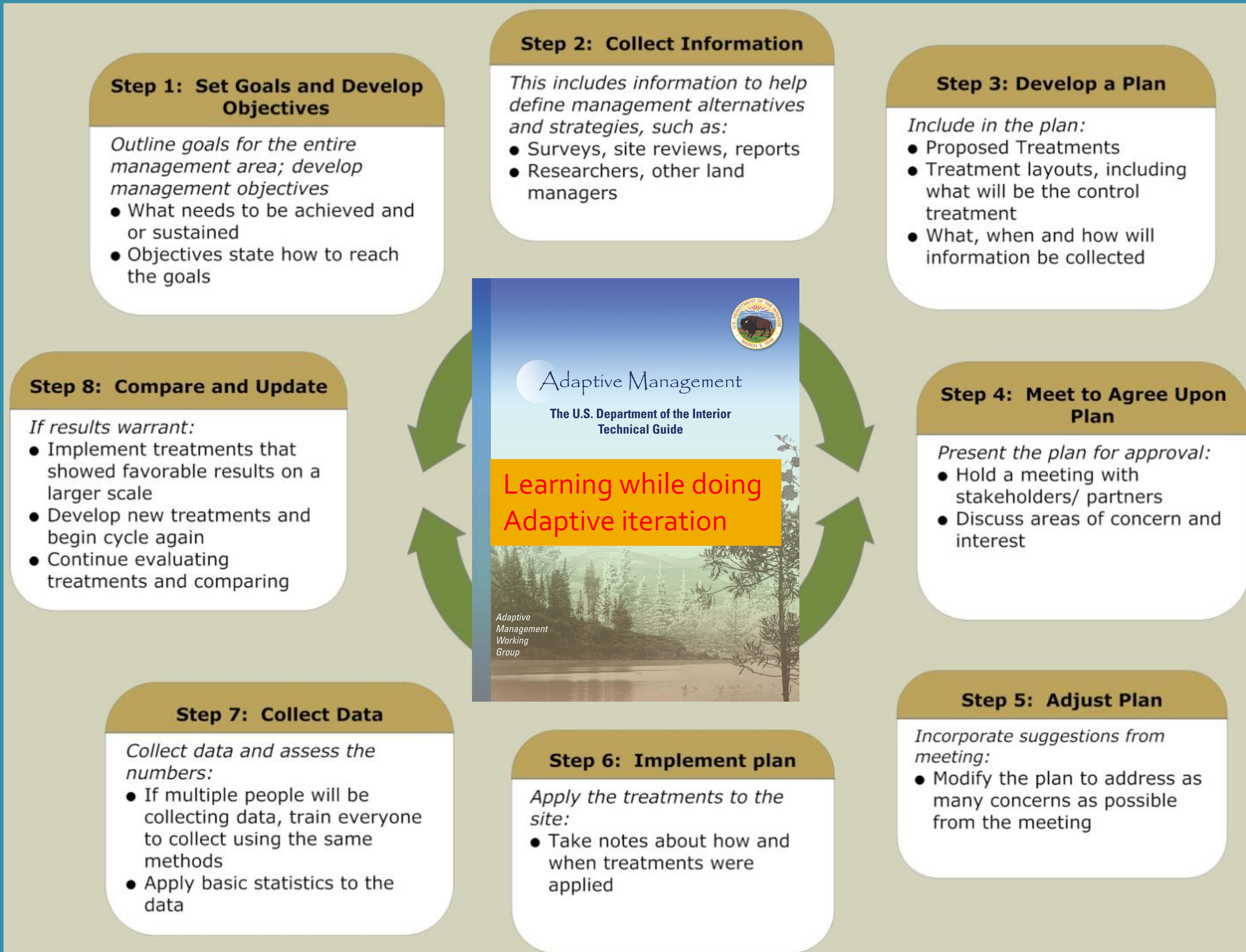
Precipitation, mm
0
20
40
60
80
100
120
140
Temperature, C
0
5
10
15
20
25
30
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

Rangeland Weather: Arid/Semi-arid, Highly Variable

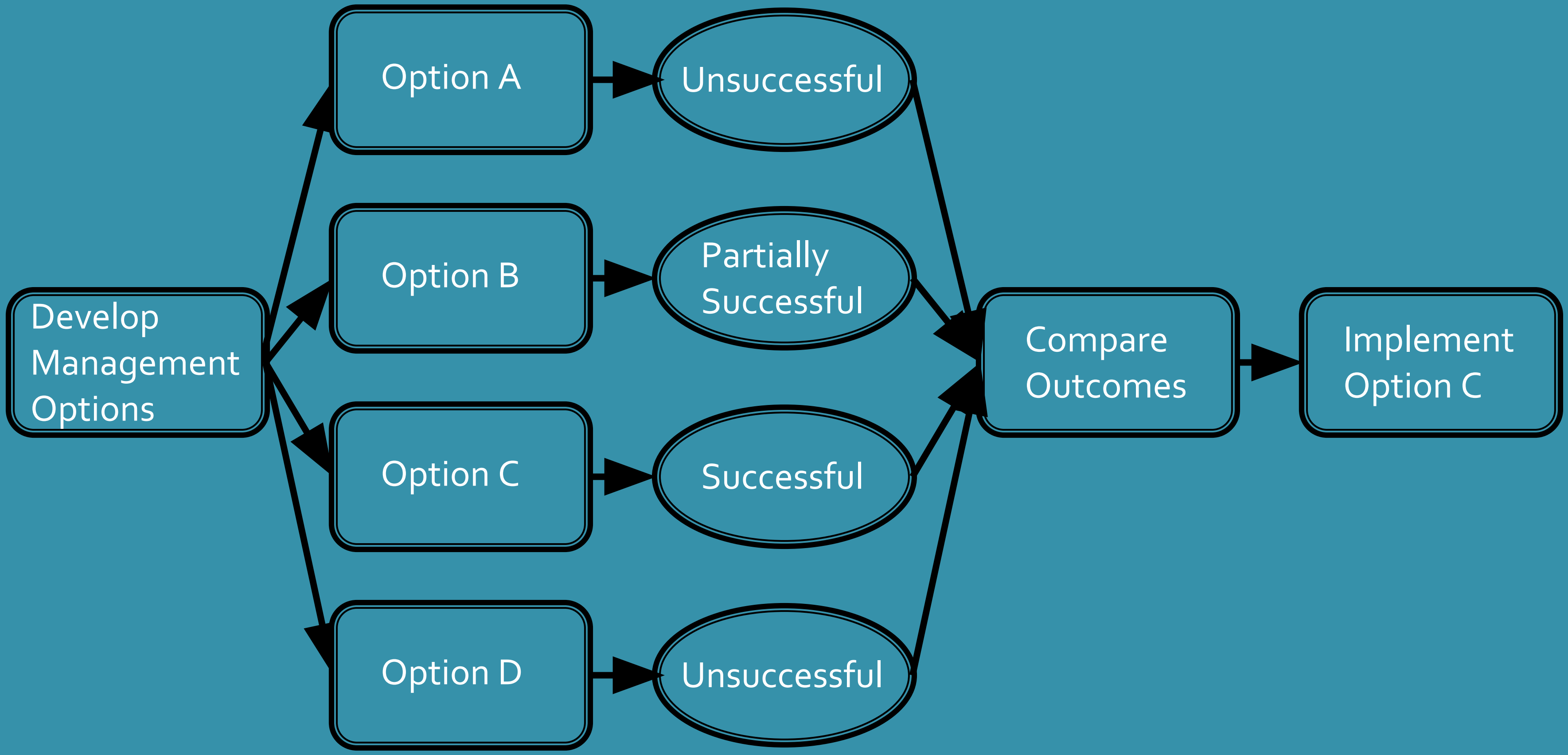


Rangeland Weather: Arid/Semi-arid, Highly Variable




Step 1: Set Goals and Develop Objectives
Outline goals for the entire management area; develop management objectives
What needs to be achieved and or sustained
Objectives state how to reach the goals
Step 2: Collect Information
This includes information to help define management alternatives and strategies, such as:
Surveys, site reviews, reports
Researchers, other land managers
Step 3: Develop a Plan
Include in the plan:
Proposed Treatments
Treatment layouts, including what will be the control treatment
What, when and how will information be collected
Step 4: Meet to Agree Upon Plan
Present the plan for approval:
Hold a meeting with stakeholders/ partners
Discuss areas of concern and interest
Step 5: Adjust Plan
Incorporate suggestions from meeting:
Modify the plan to address as many concerns as possible from the meeting
Step 6: Implement plan
Apply the treatments to the site:
Take notes about how and when treatments were applied
Step 7: Collect Data
Collect data and assess the numbers:
If multiple people will be collecting data, train everyone to collect using the same methods
Apply basic statistics to the data
Step 8: Compare and Update
If results warrant:
Implement treatments that showed favorable results on a larger scale
Develop new treatments and begin cycle again
Continue evaluating treatments and comparing
Adaptive Management
The U.S. Department of the Interior
Technical Guide
Learning while doing
Adaptive iteration
Adaptive Management Working Group

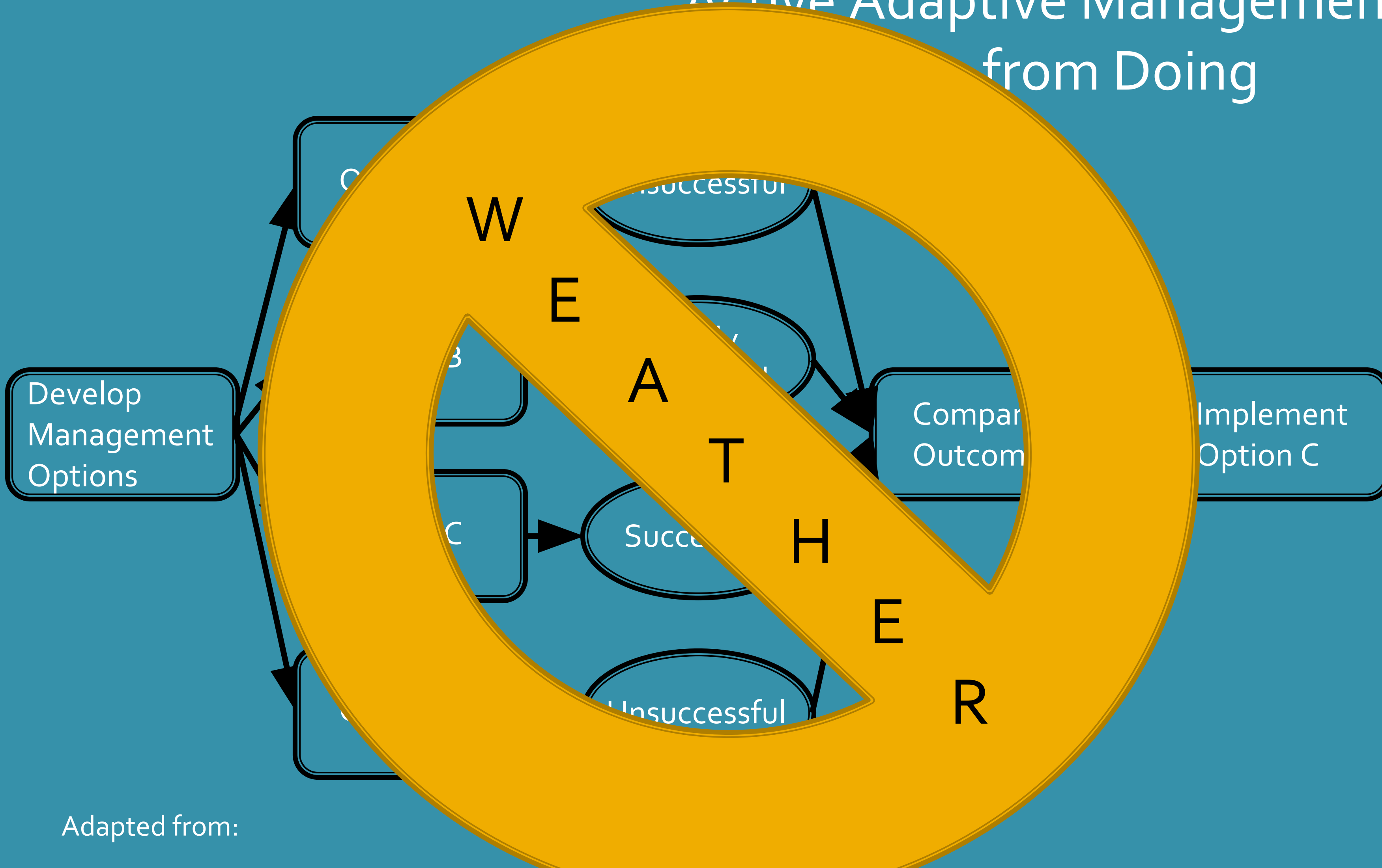
Active Adaptive Management
Learn from Doing



Adapted from:

Allen CR, JJ Fontaine, KL Pope and AS Garmestani. 2011. Adaptive management for a turbulent future. Journal of Environmental Management 92:1339-1345

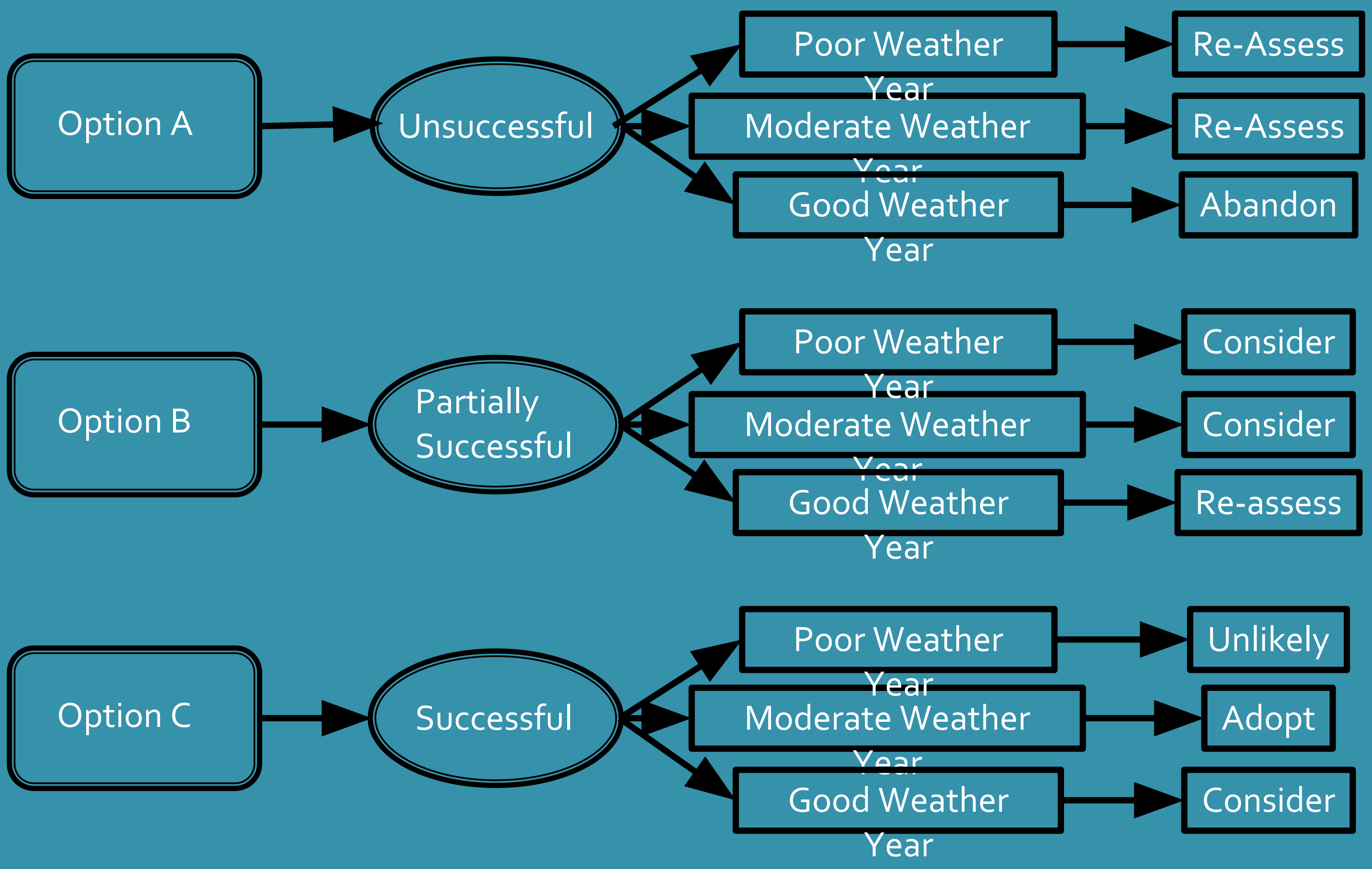
Active Adaptive Management
… from Doing



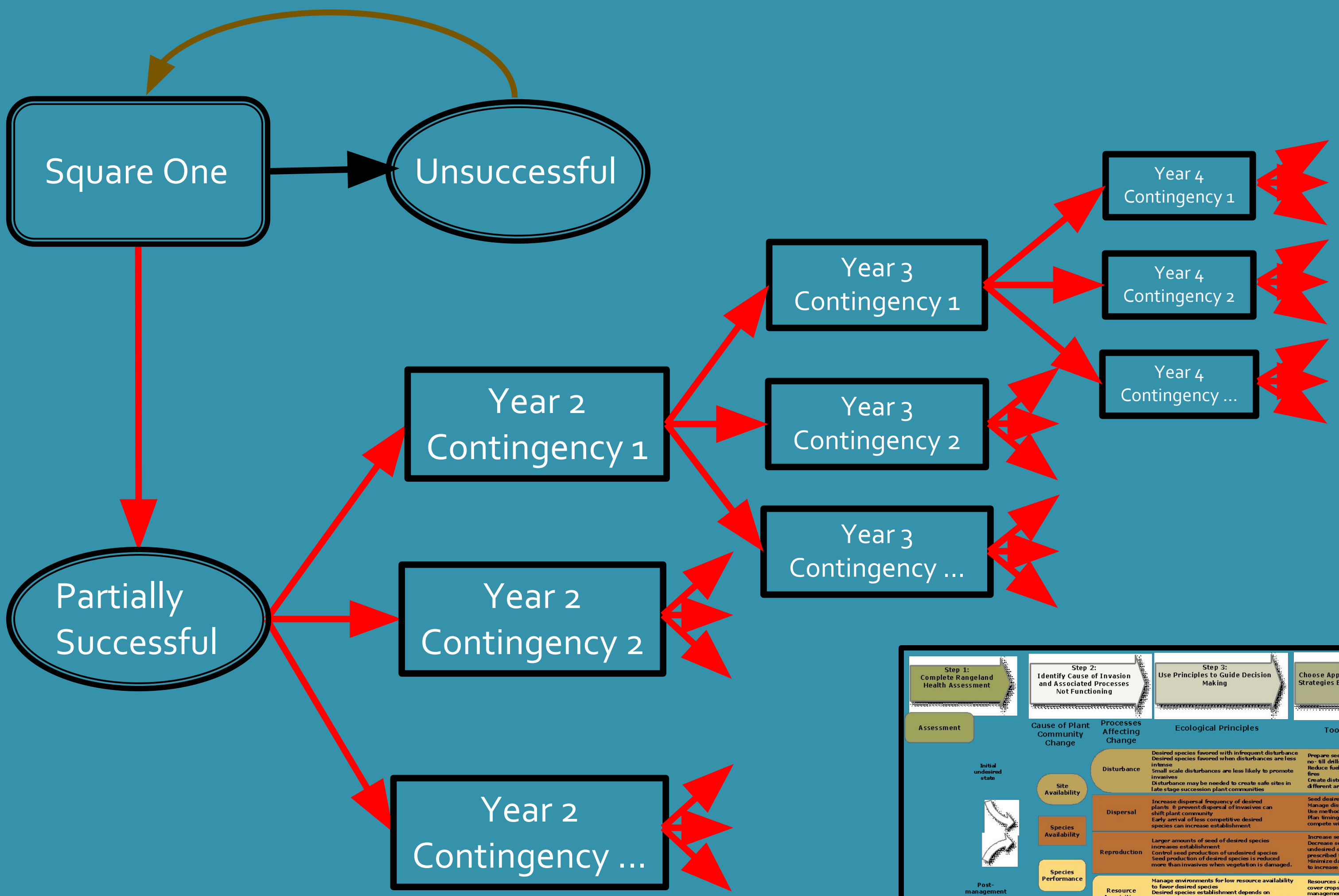
Adapted from:

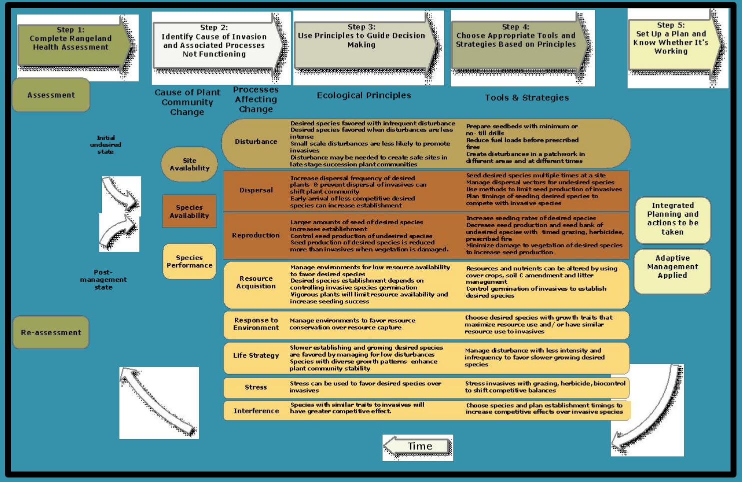
Allen CR, JJ Fontaine, KL Pope and AS Garmest… Adaptive management for a turbulent future. Journal of Environmental Management 92:1339-1345

Weather Centric Adaptive Management



Iterative/Contingency Adaptive Management





Step 1: Complete Rangeland Health Assessment

Step 2: Identify Cause of Invasion and Associated Processes Not Functioning

Step 3: Use Principles to Guide Decision Making

Step 4: Choose Appropriate Tools and Strategies Based on Principles

Step 5: Set Up a Plan and Know Whether It's Working

Assessment

Initial undesired state

Cause of Plant Community Change	Processes Affecting Change	Ecological Principles	Tools & Strategies
Site Availability	Disturbance	Desired species favored with infrequent disturbance Desired species favored when disturbances are less intense Small scale disturbances are less likely to promote invasives Disturbance may be needed to create safe sites in late stage succession plant communities	Prepare seedbeds with minimum or no-till drills Reduce fuel loads before prescribed fires Create disturbances in a patchwork in different areas and at different times
Species Availability	Dispersal	Increase dispersal frequency of desired plants & prevent dispersal of invasives can shift plant community Early arrival of less competitive desired species can increase establishment	Seed desired species multiple times at a site Manage dispersal vectors for undesired species Use methods to limit seed production of invasives Plan timings of seeding desired species to compete with invasive species
	Reproduction	Larger amounts of seed of desired species increases establishment Control seed production of undesired species Seed production of desired species is reduced more than invasives when vegetation is damaged.	Increase seeding rates of desired species Decrease seed production and seed bank of undesired species with timed grazing, herbicides, prescribed fire Minimize damage to vegetation of desired species to increase seed production
Species Performance	Resource Acquisition	Manage environments for low resource availability to favor desired species Desired species establishment depends on controlling invasive species germination Vigorous plants will limit resource availability and increase seeding success	Resources and nutrients can be altered by using cover crops, soil C amendment and litter management Control germination of invasives to establish desired species
	Response to Environment	Manage environments to favor resource conservation over resource capture	Choose desired species with growth traits that maximize resource use and/or have similar resource use to invasives
	Life Strategy	Slower establishing and growing desired species are favored by managing for low disturbances Species with diverse growth patterns enhance plant community stability	Manage disturbance with less intensity and infrequency to favor slower growing desired species
	Stress	Stress can be used to favor desired species over invasives	Stress invasives with grazing, herbicide, biocontrol to shift competitive balances
	Interference	Species with similar traits to invasives will have greater competitive effect.	Choose species and plan establishment timings to increase competitive effects over invasive species

Integrated Planning and actions to be taken

Adaptive Management Applied

Post-management state

Re-assessment

Time

AREA-WIDE EBIPM
SCIENCE-BASED SOLUTIONS FOR INVASIVE ANNUAL GRASSES

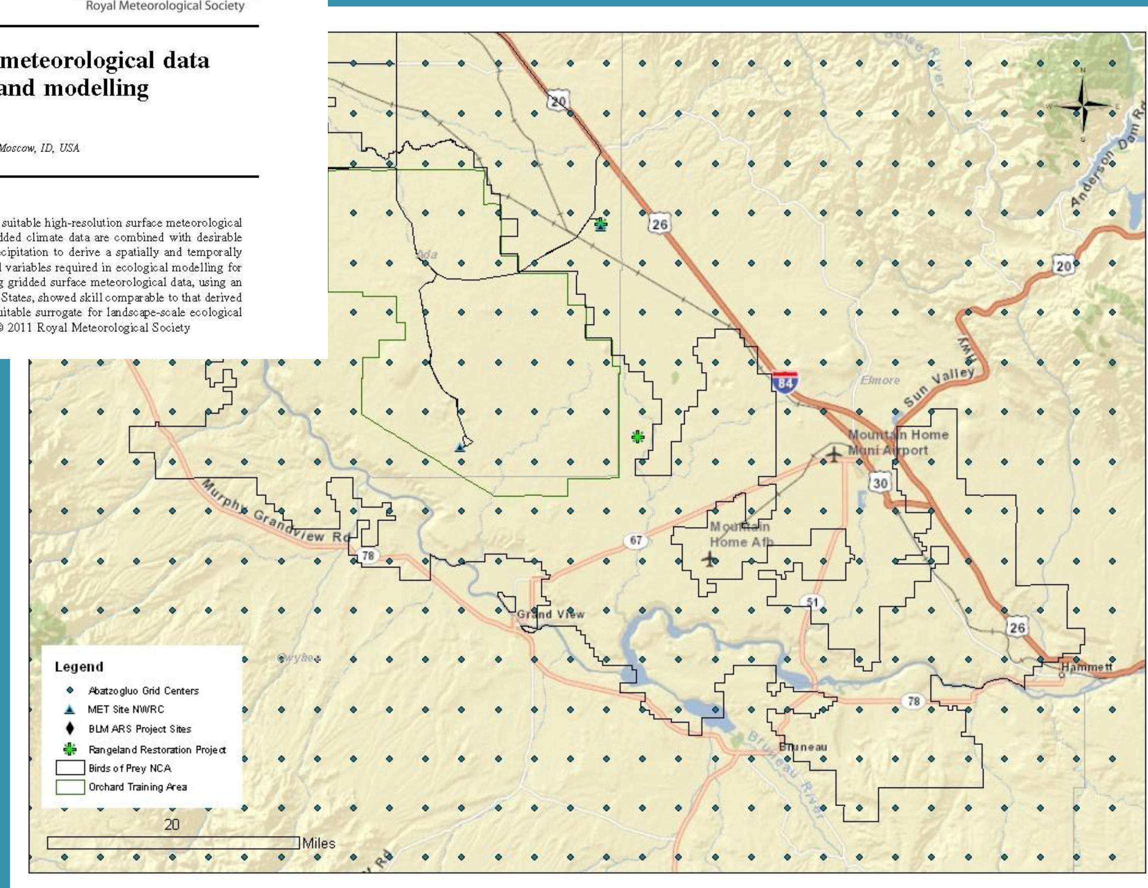
INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. 33: 121–131 (2013)
Published online 21 December 2011 in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/joc.3413

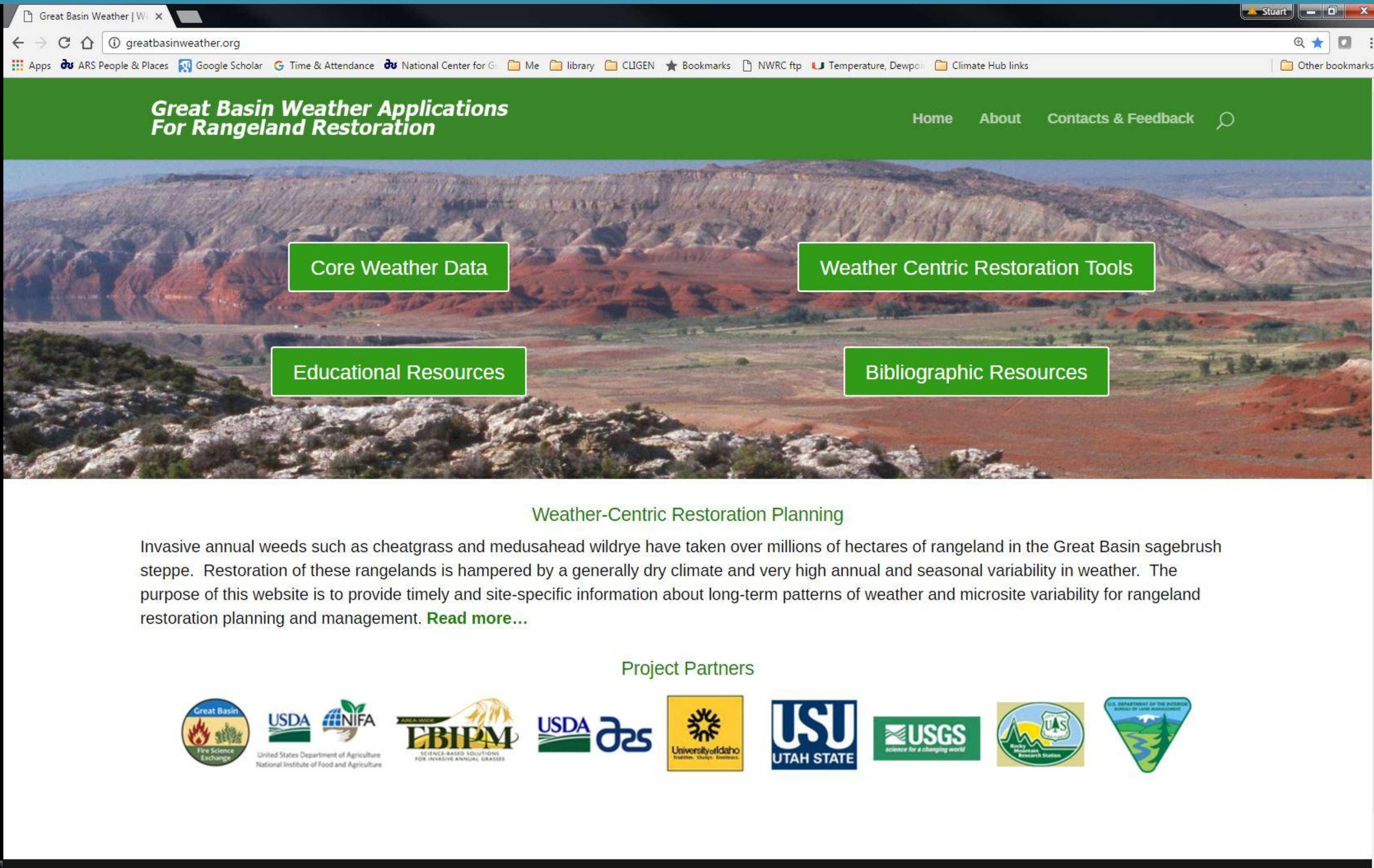
RMetS
Royal Meteorological Society

Development of gridded surface meteorological data for ecological applications and modelling

John T. Abatzoglou*
Department of Geography, University of Idaho, Moscow, ID, USA

ABSTRACT: Landscape-scale ecological modelling has been hindered by suitable high-resolution surface meteorological datasets. To overcome these limitations, desirable spatial attributes of gridded climate data are combined with desirable temporal attributes of regional-scale reanalysis and daily gauge-based precipitation to derive a spatially and temporally complete, high-resolution (4-km) gridded dataset of surface meteorological variables required in ecological modelling for the contiguous United States from 1979 to 2010. Validation of the resulting gridded surface meteorological data, using an extensive network of automated weather stations across the western United States, showed skill comparable to that derived from interpolation using station observations, suggesting it can serve as suitable surrogate for landscape-scale ecological modelling across vast unmonitored areas of the United States. Copyright © 2011 Royal Meteorological Society





Great Basin Weather | W
greatbasinweather.org
Apps
ARS People & Places
Google Scholar
Time & Attendance
National Center for G
Me
library
CLIGEN
Bookmarks
NWRC ftp
Temperature, Dewpo
Climate Hub links
Other bookmarks
Great Basin Weather Applications
For Rangeland Restoration
Home
About
Contacts & Feedback
Core Weather Data
Weather Centric Restoration Tools
Educational Resources
Bibliographic Resources
Weather-Centric Restoration Planning
Invasive annual weeds such as cheatgrass and medusahead wildrye have taken over millions of hectares of rangeland in the Great Basin sagebrush steppe. Restoration of these rangelands is hampered by a generally dry climate and very high annual and seasonal variability in weather. The purpose of this website is to provide timely and site-specific information about long-term patterns of weather and microsite variability for rangeland restoration planning and management. Read more…
Project Partners
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National Institute of Food and Agriculture
EBIPM
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UTAH STATE
USGS

Weather-Centric Restoration Tools

Rangeland restoration practices in the Intermountain western United States are typically implemented in a single planting season for the purposes of Emergency Stabilization and Rehabilitation (ESR) after wildfire. This necessarily links restoration and rehabilitation success to the probability of a single year providing sufficiently favorable microclimatic conditions for desirable plant establishment. It is currently difficult to evaluate how ESR and rangeland restoration practices might be impacted by weather variability, or what kind of expectations there should be for success given the high likelihood of establishment failure in any given season or year.

Field research studies in rangeland restoration are also typically of limited duration and published results may not represent the full spectrum of conditions likely to be experienced at a given site. Spatial and temporal weather-analysis may enhance the interpretation of historical planting data, support expanded inferences from short-term field studies, and facilitate meta-analysis of diverse field studies in rangeland restoration.

We describe access and use of new databases and tools that can be used for retrospective analysis of historical planting success, interpretation of field results within the context of natural site variability, and methodology for developing realistic expectations for long-term management planning in our highly variable environment.

This site provides historical weather information on a 4-km grid for the 48 contiguous states, seedbed microclimatic simulations for post-fire seedbed temperature and water availability over time, and a site-specific restoration-climatology report that can be customized for location and soil type.

Tools

Weather Tool Form

- Historical Daily Weather
- Seedbed Microclimate Simulations
- Restoration Climatology (report)

Search

Core Weather Data

Weather-Centric Restoration Tools

Educational Resources

- Module 1: Weather Variability
- Module 2: Weather and Microclimate
- Module 3: Microclimate and Plant Response

Bibliographic References

Great Basin Fire Rehabilitation and Restoration Climatology Report

Report[1] **generated**: Tue Oct 11 11:47:36 2016

Site name: Warm Springs Field Study

Site location[2]: 43.5975° N, 116.1234° W

GridMET location[3]: 43.6044° N, 116.1055° W, and 1204m MSL

The data used in this report spans a period of 36.7 years, from January 1, 1979 through September 30, 2015. Weather data were extracted from the GridMET database (Abatzoglou, 2013) which is supported by the University of Idaho, Northwest Knowledge Network and made available online at: http://climate.nkn.uidaho.edu/RangelandForecast/downloadModels.php.

Surface soil textures used for 2-cm freezing and desiccation modeling: Clay Loam (sand 35%, silt 30%, and clay 35%).

This report was generated from the Great Basin Rangeland Weather Applications for Restoration and Management (GB-RangeWARM) web site which is hosted by the Great Basin Fire Science Exchange and Secretarial Order 3336 Science Support Center.

Additional details regarding the content of this report and potential utility for rangeland restoration project analysis and planning can be obtained from Moffet et al. (2017).

Location Maps:

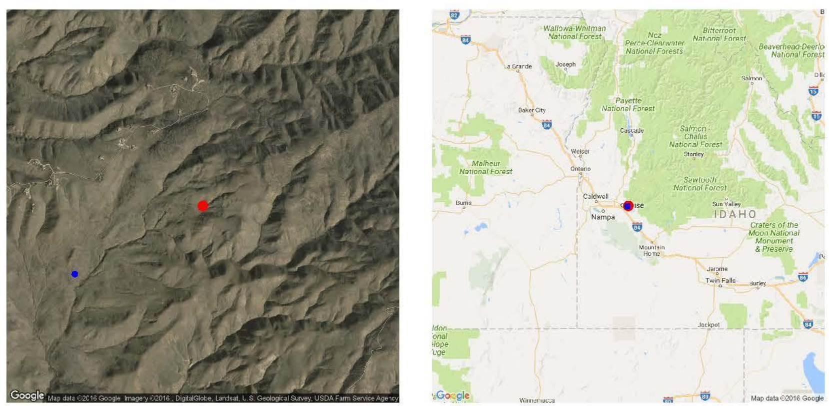

Figure 1: The locations of the site (small blue dot) and GridMET grid centerpoint (large red dot) used to generate this report shown on local scale aerial photography (left panel) and on a state scale road map (right panel).

[1]Version: 1.0.0 (2016-08-31)
[2]Small blue dot plotted on maps in Figure 1.
[3]Large red dot plotted on maps in Figure 1.

Introduction

Rangeland systems in the Great Basin and intermountain west are undergoing rapid and extensive changes from landscape disturbance caused by wildfire and the expansion of invasive annual weeds. These systems are generally arid and semi-arid but successful restoration after disturbance requires a sufficient period of favorable weather to carry desirable plant species through germination, emergence and early seedling growth and development. Interpretation of weather effects on the life cycle of seeded species requires relatively more detailed information than is generally available from long-term, average summaries of climate. Weather variability influences both the initial success of restoration practices, and the subsequent successional trajectory of plant communities over relatively long time periods. This influence is also highly unique to the location, time period, and management scenario of a given field site.

This interpretive tool uses the gridded/modeled weather dataset described by Abatzoglou et al. (2013) to provide a number of graphical and tabular products to assist restoration practitioners in the interpretation of weather effects on plant community development. At this time, the principal utility of this tool is retrospective analysis of historical field plantings, but these data can also inform the restoration practitioner of longer-term requirements and expectations for adaptive management, and contingency planning for achieving longer-term restoration goals for establishment and persistence of resilient and functionally diverse plant communities.

Monthly Average Climate

The monthly average temperature and precipitation are shown in Figure 2 and Table 1. Averages for each month is based on years when the entire month has been observed.

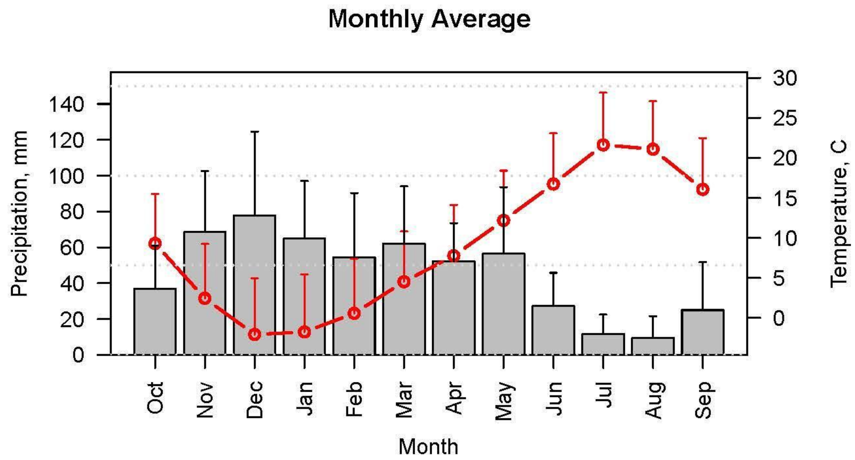

Figure 2: Seasonal climatology of the site. Bars represent monthly precipitation and symbols represent monthly temperature averages (error bars are 1 SD above mean) for the period of record.

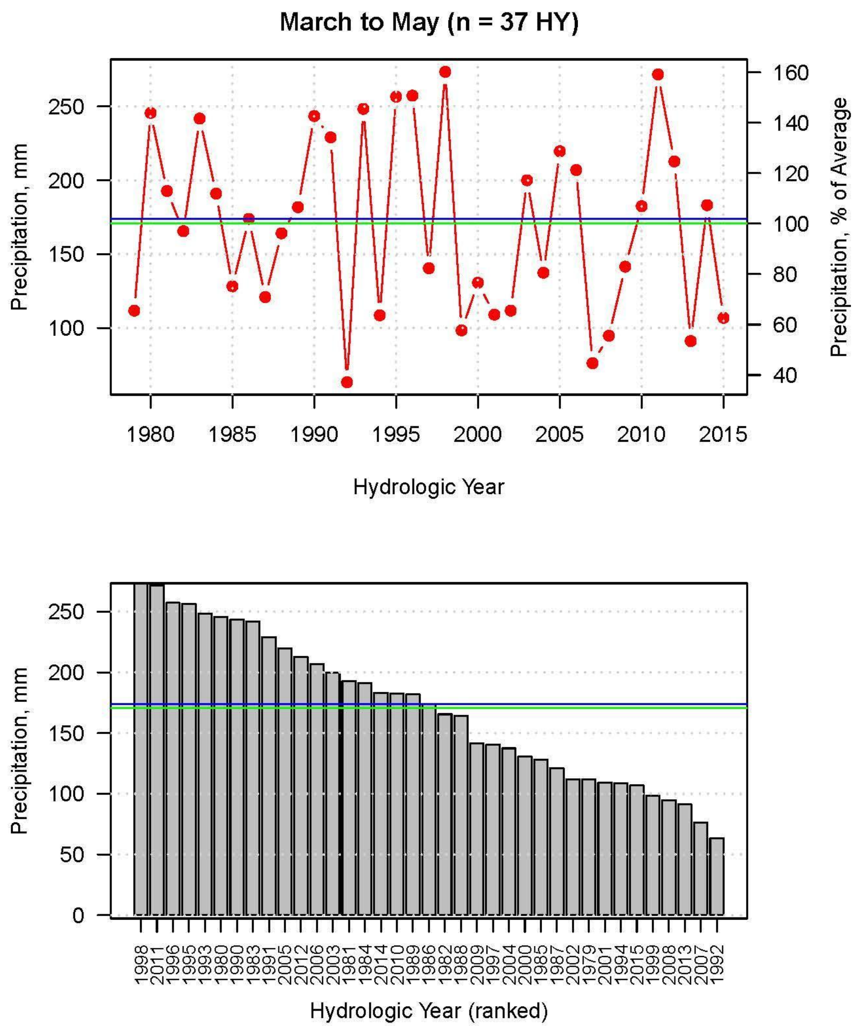

Figure 6: Interannual variation in precipitation totals for the spring months of a hydrologic year. The green horizontal lines mark the average precipitation and the blue horizontal lines mark the median.

Table 1: Summary of monthly precipitation and temperature for the site over the period of record.

Month	Precip. (mm)	Temp. (C)	SD Precip. (mm)	SD Temp. (C)	N
October	36.9	9.3	24.1	1.6	36
November	68.5	2.4	34.0	2.2	36
December	77.8	-2.1	46.8	2.4	36
January	64.8	-1.8	32.2	2.6	37
February	54.5	0.6	35.9	2.2	37
March	62.0	4.5	32.1	1.6	37
April	52.1	7.8	21.3	1.7	37
May	56.5	12.2	37.0	1.6	37
June	27.3	16.7	18.6	1.7	37
July	11.7	21.6	10.8	1.9	37
August	9.6	21.1	12.0	1.4	37
September	25.0	16.1	26.8	1.8	37

Seasonal Pattern of Surface Soil Freezing and Drought

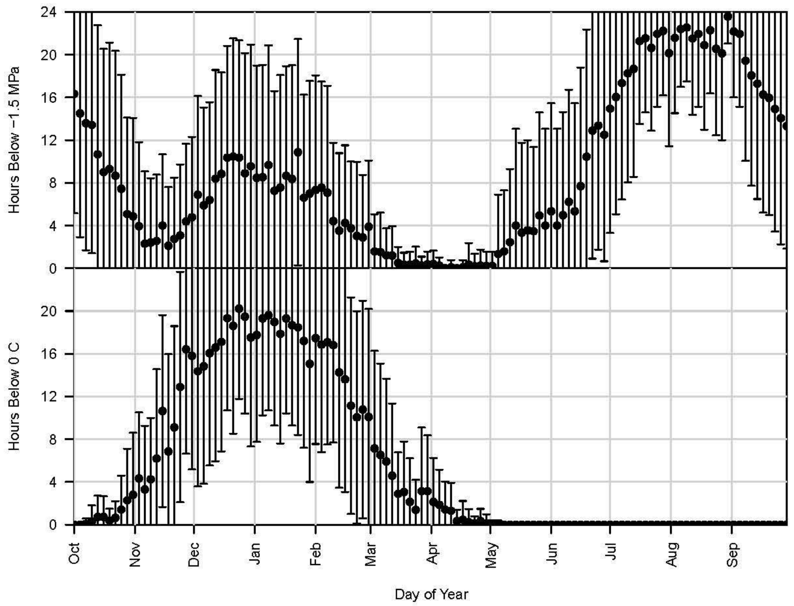

Figure 3: Seasonal pattern of the average number of hours per day of soil temperature below 0°C or soil water potential below -1.5 MPa for days with at least 1 hour below temperature and water potential thresholds. Error bars represent ± 1SD

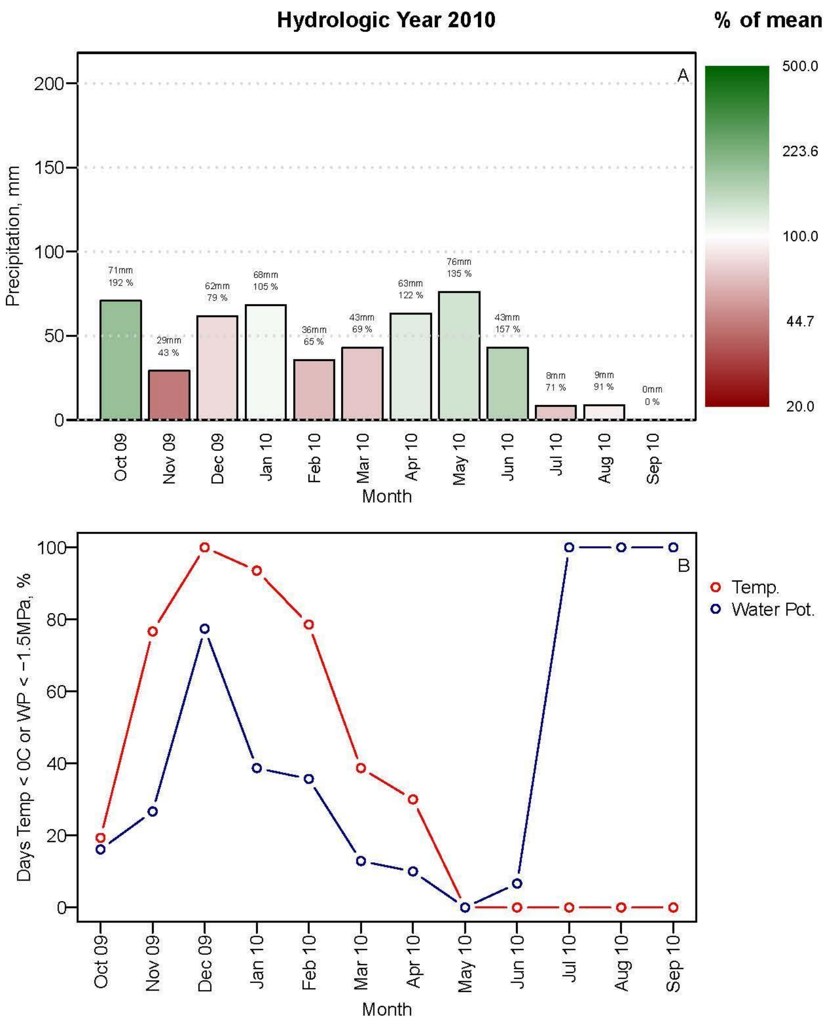

Figure 50: Monthly pattern of (1) precipitation for the hydrologic year in mm (left axis) and percent of normal (period of record mean: color coding) (panel A) and (2) percentage of days freezing (< 0°C) and water stress (< -1.5MPa) thresholds were exceeded (panel B).

Management Implications:

- Access to weather information where you don't have a weather station.
- Retrospective analysis of field success in terms of seasonal patterns of precipitation, air temperature, and soil conditions.
- Expansion of inferences from short term field studies.
- Interpretation of field results for adaptive management
- Development of long-term, weather-centric contingency plans for rangeland restoration

Questions?

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Anne Halford
Katherine Hegewisch
Jeremy James
Gwendwr Meredith

GBRMP

NRCS Natural Resources Conservation Service

Idaho State University

Great Basin Science Delivery Project

AREA-WIDE EBIPM SCIENCE-BASED SOLUTIONS FOR INVASIVE ANNUAL GRASSES

USDA NIFA United States Department of Agriculture National Institute of Food and Agriculture

USDA ars

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

USGS science for a changing world

USU UTAH STATE

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The Great Basin Landscape Conservation Cooperative

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

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Bruce Roundy
Jeanne Schneider
Nancy Shaw
Roger Sheley
Tony Svejcar
Justin Welty

The preceding presentation was delivered at the

2017 National Native Seed Conference

Washington, D.C. February 13-16, 2017

This and additional presentations available at http://nativeseed.info

NATIVE SEED NETWORK

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