DROUGHT HANDBOOK APPENDICES

SECTION 4

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1 APPENDIX 1: DROUGHT PLAN EXAMPLES

Here are some sample trigger dates and actions from rancher drought plans. You can find them at https://ranchdrought.unl.edu/.

Example Drought Plan: Alexander Ranch in South-Central Kansas:

April 1

- End of the winter dormant season and the beginning of the growing season for warm season grasses
- Less than 4" of moisture during the winter dormant season (killing frost or Nov 1 till April 1)
    - No prescribed burns should be prescribed.
    - Plan to increase the length of rest periods earlier than usual.

June 15

- About half of the forage is produced by June 15
- 75% (15.75") of the annual average rainfall is received between Nov 1 & June 15
- If the rainfall is 80% (12.60") of 75% (15.75"), then the stocking rate should be decreased by weight. (Finish culling herd C)
- If the rainfall is 60% (6.30") of the 75% (15.75") then the stocking rate should be decreased 40-50% by weight (Cull herd B deep)
- The 3 weeks following June 15th are very critical. By July 15 the destocking should be completed.
- Rest periods should be as long as possible by June 1 if any indicator of a drought is present.
- Graze periods should be as long as possible to allow the other paddocks to rest for as long as possible.

Example Drought Plan: Shamrock Ranch, SW Nebraska

April 1

- "We get a lot of moisture in March, so I really monitor March, and my first critical date is April 1st."

May-June

- "Two-thirds of our grass growth will be here by mid-June. Our big moisture months are April, May, and June. If you know your dry [in] April and May, you've already lost 2/3 of your growth."
- "When it's dry, you'd better start depopulating something. You'd better get those cows out of there that have not calved. You better get a cow that has a bad bag, and you had to help her, you better get her and her calf out of there. Sell some of those pairs. You'd better get your stockers moving."
- Destock custom grazers
- "...Every custom grazer knew that when I pulled the plug, they had to go." I gave them a month's notice, then I gave them three weeks' notice that the cattle had to leave."
- Stick to the plan, don't second guess
- "It's all that planning and understanding so that you don't have to think about it when you are in the depths of the emotion." - Shamrock Ranch, SW Nebraska

2 APPENDIX 2: COLORADO CLIMATE

Colorado sits in an awkward 'middle child' location: not really SW, not really Southern Plains, but not Northern Plains either. Plus, we have the high elevation west slope, mountains, and plains to the east. The Pacific Ocean temperatures along the equator and in the north impact our weather patterns. And, according to some studies, so does the North Atlantic Ocean. Because of where Colorado is in North America, that impact varies depending on where you are in the state [44].

Awareness of ocean temperature cycles can prove useful when thinking about precipitation and potential grass growth. There are two separate warm & cold cycles in the Pacific Ocean that impact Colorado weather. The North Atlantic Ocean may also play a role. The El Niño-Southern Oscillation (ENSO) cycle along the Equator is the best known of the three. But the Pacific Decadal Oscillation (PDO) in the North Pacific can reduce or increase the El Niño/La Niña impact. And the North Atlantic (Atlantic Multi-decadal Oscillation (AMO)) may have a hand in the Pacific cycles as well.

El Niño-Southern Oscillation (ENSO)

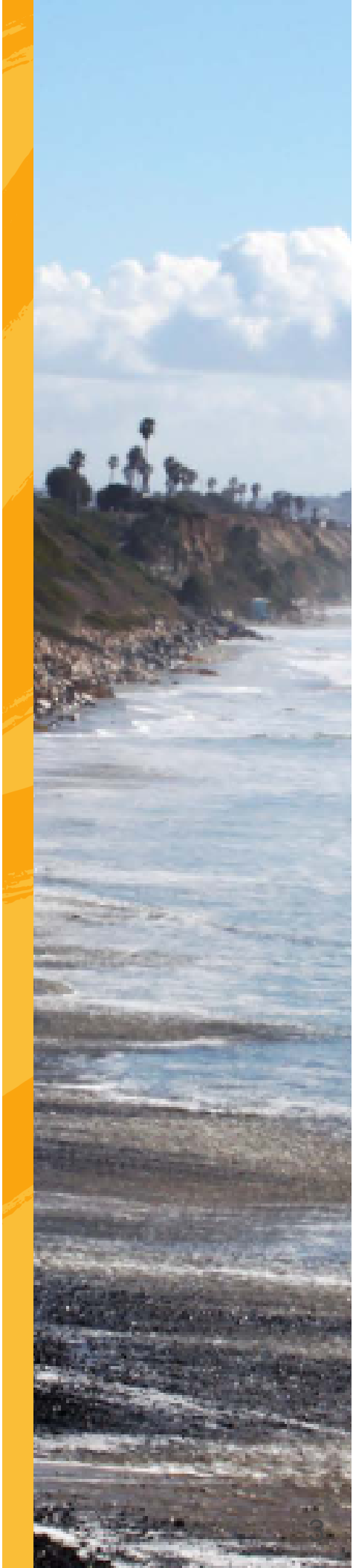
The El Niño-Southern Oscillation (ENSO) refers to sea surface temperatures along the Equator in the Pacific Ocean, generally east of the International Date Line. These shifts tend to occur on 2–7-year cycles, often with 'neutral conditions during the summer. El Niño and La Niña refer to the ocean temperature, warm vs cold. But which one is which, and what does it mean for Colorado?

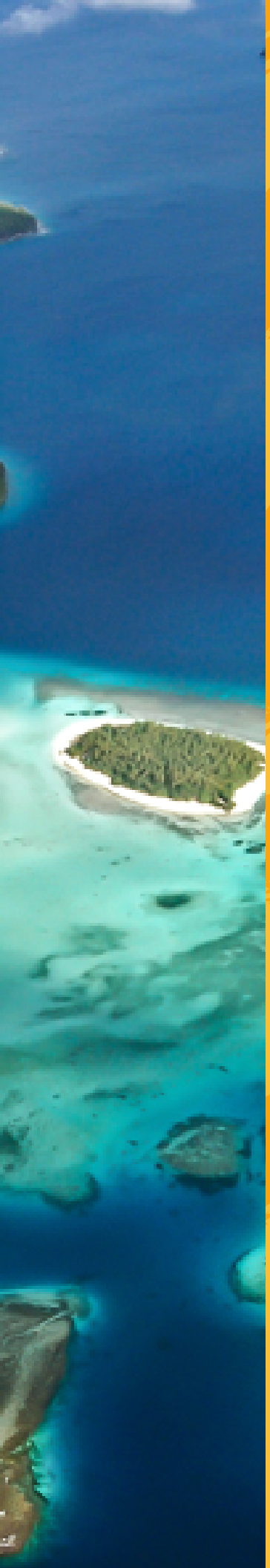
Warm phases are called El Niño. Just as warm water in a bathtub steams up the mirror, water vapor escapes into the air when sea temperatures are warm. This flow of vapor feeds the winter Subtropical Jet Stream and keeps it flowing across the southern U.S. It is not surprising then that El Niño (warm bathtub) is strongly correlated to wetter conditions in the southwest and central plains areas of the U.S. Examples of recent El Niño events include the winter of 2015-2016 (which was a very strong El Niño) and the moderately strong El Niño winters of 2002-2003 and 2009-2010.

Cold phases are referred to as La Niña. Just as an ice bath does not steam up the mirrors, a cold sea puts less vapor into the air. Less vapor tends to turn the Subtropical Jet stream north over the Pacific Ocean and to join the Polar Jet Stream. Not surprisingly, La Niña (cold bathtub) is correlated to dry conditions in the southwest and central plains of the U.S. Recent strong La Niña's occurred in the winter of 2007-2008 and 2010-2011 while 2011-2012, 2020-2021, and 2021-2022 were considered moderate events. A typical La Niña will develop in late summer or fall, peak in the winter, then weaken in spring.

The El Niño/La Niña cycle most commonly provides insight into potential conditions the following winter at a longer lead time (often up to 6 months). This is because of the somewhat regular swings in the last summer & fall ocean temperatures and resulting winter precipitation. On the other hand, when the El Niño Southern Oscillation near the equator is 'neutral,' local precipitation patterns drive the forage system more than ocean conditions.

Evaluate ENSO's status https://www.pmel.noaa.gov/elnino/.





Pacific Decadal Oscillation

The Pacific Decadal Oscillation (PDO) refers to sea surface temperature changes in the North Pacific Ocean. These fluctuations between warm and cold phases run on a 10–30-year cycle. Just as on the equator, warmer water evaporates more readily than cooler water. More evaporation puts more water into the jet stream and tends to yield more reliable rainfall on the eastern Plains. On the other hand, cold phase impacts on rainfall are less reliable and more variable. For instance, the North Pacific Ocean was in a cold phase from 1999-2013. During that time, eastern Colorado saw notably dry years in 2002, 2006 and 2012. There were also some wet years, like 2009 and 2010, which shows the high variability. A cold phase began again in 2020.

Evaluate the Pacific Decadal Oscillation's Status:
https://www.ncdc.noaa.gov/teleconnections/pdo

El Niño and the North Pacific Decadal Oscillation Together

The influence of El Niño Southern Oscillation sea-surface temperature changes along the equator (El Niño/La Niña) on Colorado weather is much more reliable than North Pacific (Pacific Decadal Oscillation) sea temperatures. A great example is the 1930's (i.e., the Dust Bowl period). Even though the North Pacific was generally warm, which should mean more water vapor in the air, the equatorial waters were cool to neutral. This cool to neutral condition "overrode" the warm North Pacific influence, and we know the result. Our understanding of PDO and its influence on Colorado weather is constantly changing. The ENSO signal, though it yields mixed and somewhat inconsistent results, is the best we have to work with right now [45].

Atlantic Multi-Decadal Oscillation (AMO)

Just like the Pacific Ocean temperatures change, the Atlantic Multi-decadal Oscillation (AMO) is a natural variability occurring in the North Atlantic Ocean. The Atlantic has historically had a longer cycle, running 60-80 years (a cold phase lasted from 1870 to the mid-1920's). More recently, it was in a cold phase from the mid-1960's to 2000 and has been warm since then.

To date, little research has been done in extensive pasture settings for climate interactions with beef production in Western Colorado. One study found that when a warm phase of the Atlantic (Atlantic Multidecadal Oscillation (AMO), it is aligned with cold ENSO and PDO (the triple whammie!) There was a high drought risk in western Colorado. Other work using Global Climate Models concluded that a warm Atlantic lead to decreased summer precipitation in the Western U.S. and Mexico.

Evaluate the Atlantic Multi-Decadal Oscillation:
https://tropical.colostate.edu/archive_amo.html

Reference	Link
Irrigation Scheduling: The Water Balance Approach	https://extension.colostate.edu/resource/irrigation-scheduling-the-water-balance-approach/
Effects of Weather on Irrigation Requirements	https://irrigationtoolbox.com/ReferenceDocuments/Extension/Colorado/04721.pdf
Limited Irrigation Management: Principles and Practices	https://extension.colostate.edu/resource/limited-irrigation-management-principles-and-practices/
Managing Alfalfa and Other Forages with Less Water	https://drought.extension.colostate.edu/wp-content/uploads/sites/57/2022/03/Alfalfa-Water-Use-Drought-Workshop-SW-Colorado-2022.pdf
Seasonal Water Needs and Opportunities for Limited Irrigation for Colorado Crops	https://extension.colostate.edu/resource/seasonal-water-needs-and-opportunities-for-limited-irrigation-for-colorado-crops/
Water Irrigation Scheduler for Efficient Application (WISE) Tool	http://wise.colostate.edu/

3 APPENDIX 3: TOOLBOX

Drought Planning Resources

- National Drought Mitigation Center - Drought Plan Resources
  - https://drought.unl.edu/
- Guide to Co-Developing Drought Preparation Plans for Livestock Grazing on Southwest National Forests [1]
  - https://cales.arizona.edu/droughtandgrazing/guides.html
- An Easy-to-Use System for Developing a Drought Management Contingency Plan. 2017. University of Arizona Cooperative Extension AZ1725.
  - https://cales.arizona.edu/droughtandgrazing/guides.html

Climate and Weather Resources

- Intermountain West Climate Dashboard - Western Water Assessment
  - https://wwa.colorado.edu/resources/intermountain-west-dashboard
- Current U.S. Drought Monitor Conditions
  - https://droughtmonitor.unl.edu/
- Colorado Climate Center
  - https://climate.colostate.edu/
- Climate at a Glance
  - https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/city/time-series
- Colorado Basin Forecast for in depth streamflow and reservoir information:
  - https://www.cbrfc.noaa.gov/lmap/lmap.php

Range and Livestock Resources

- Rangeland Management Before, During and After Drought
  - https://rangelandsgateway.org/dlio/3759
- Skillful Grazing Management on Semiarid Rangelands
  - https://extensionpublications.unl.edu/assets/pdf/ec162.pdf
- Drought Decision Support Tool for Ranchers
  - https://ucanr.edu/sites/Siskiyou_County_Coop_Extension/files/362154.pdf?mc_cid=7f528867b9&mc_eid=9338860fd4
- Ranch Drought Monitoring Dashboard
  - https://drought.unl.edu/Monitoring/DroughtMonitoringTools.aspx
- Eastern Plains: GrassCast
  - https://grasscast.unl.edu/

Risk Management Resources

- Resiliency Self-Assessment
  - https://abm.extension.colostate.edu/wp-content/uploads/sites/61/2020/10/Resiliency-Rack-Card.pdf

Webinars

- A comprehensive list of webinars is available at droughtadvisors.org[1]

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