

FALL 2018

DROUGHTSCAPE

QUARTERLY NEWSLETTER

FEATURE

NAVIGATING THE U.S.
DROUGHT MONITOR

AROUND THE WORLD

FROM DATA TO
DROUGHT MITIGATION

AROUND THE COUNTRY

REMOVING BARRIERS TO
DROUGHT PLANNING

ON THE HORIZON

NEW DROUGHT RESOURCES
FOR STATES



NATIONAL DROUGHT
MITIGATION CENTER
UNIVERSITY OF NEBRASKA

Drought Science. Planning Sense.

About the cover photo

South of Umbarger, Texas, on May 7, 2018, at the Buffalo Lake National Wildlife Refuge. Buffalo Lake was created in 1938 when the Umbarger Dam was built, but dried up by the 1970's due to overuse of the waterways that fed it.

Photo by Tim Benson

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On the web

drought.unl.edu

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From the director

Fall is my favorite time of the year. Warm days, cool evenings, the change of colors, a first snow and, of course, football! It's also time, believe it or not, to look forward to 2019 while putting some final touches on 2018, which has been a very busy year for our team.



Mark Svoboda

Projects and people come and go, but the friendships and collaborations often remain. I would also extend this sentiment to our fine group of students and newest staff members. In fact, you will find special interest stories and information on several of our graduate students and staff in this issue of DroughtScape. Some are coming, some are going and some have left and even come back! Tony Mucia (story on page 18) will be leaving the NDMC this fall, master's degree in hand, after working with us on several projects and outreach and stakeholder events over the past few years. He will undertake Ph.D. work this fall in France and we wish him all the best, as he will be missed. Claire Schirle was a graduate student intern with the NDMC a few years ago and she has now come back to the NDMC after completing her master's degree at the University of Utah. She joined the NDMC this summer as a staff climatologist (see page 17). Finally, Mary Hillis Noel, a master's student, has been working hard with NDMC staff to help us better understand the linkages between drought impacts and indicators at the state level, primarily centering on the U.S. Drought Monitor's classification table. Mary will be presenting on this topic at the upcoming American Geophysical Union and American Meteorological Society meetings, so I encourage you to stop by and see what she's been up to. Finally, I would also like to welcome Brendon Orr to our team (see page 17). He brings a wealth of experience in the web graphics design field and we very much look forward to seeing how he integrates his touch and style into the NDMC's work.

As usual, you'll find stories focused on the local, regional, national and international levels in this jam-packed edition of DroughtScape, so please give it a read and reach out to us if you like what you see, or if you would like to explore future collaborations. We're always looking to meet and work with new friends!

Check back with us in early 2019 for our winter edition of DroughtScape along with our annual report, but in the meantime let me be the first to wish you all a very safe and happy holiday season and a great new year!

THIRD QUARTER SUMMARY: JULY–SEPTEMBER, 2018

Drought greatly improves in Southern Plains and South

BY CLAIRE SCHIRLE

NATIONAL DROUGHT MITIGATION
CENTER CLIMATOLOGIST

Drought classifications are based on the U.S. Drought Monitor. Details on the extent and severity of drought are online: droughtmonitor.unl.edu.

The outlook integrates existing conditions with forecasts from the National Oceanic and Atmospheric Administration's Climate Prediction Center: www.cpc.ncep.noaa.gov.

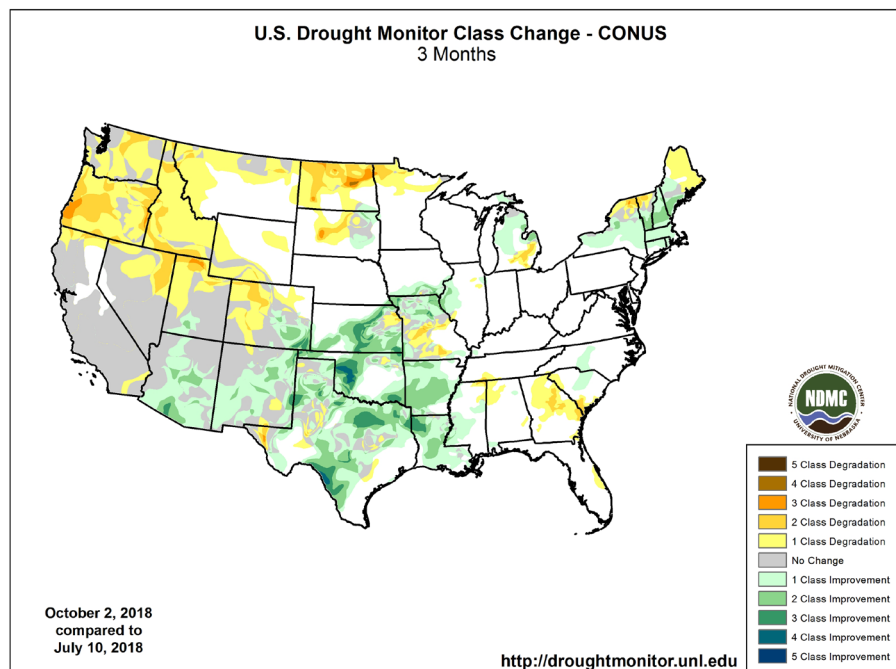
National Summary

During the third quarter of 2018, the warmest above-normal temperatures were observed in the Northeast, the Southwest and eastern Midwest, where readings were generally 2 to 6 degrees above normal. The northern third of the West and the High Plains were the coolest regions, with temperatures between 4 degrees below normal and 2 degrees above normal. The remainder of the country generally saw temperatures up to 2 degrees above normal, with some areas up to 4 degrees above normal. The western third of the country was very dry. Precipitation amounts in many areas were between 0 and 50 percent of normal. Exceptions were Arizona and a small area along the California/Nevada border where precipitation amounts were more than 300 percent of normal. Precipitation varied greatly east of the Rockies, with amounts ranging from 50 percent to 300 percent of normal.

Drought

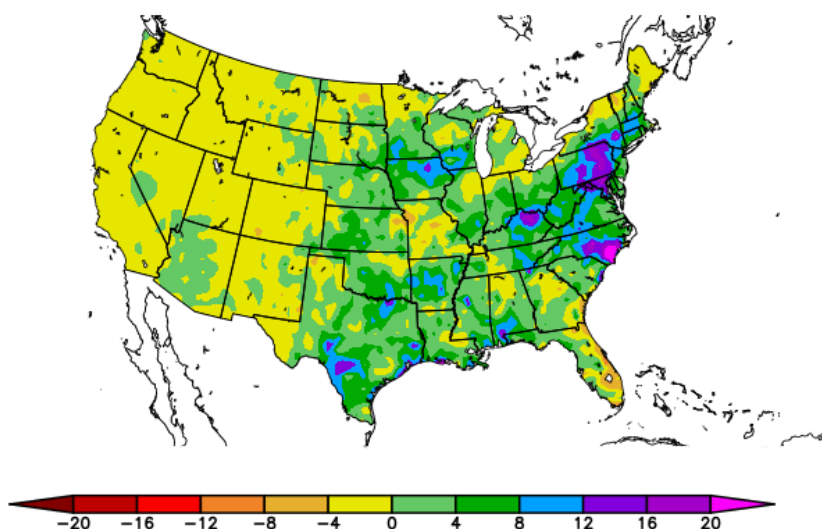
The regional extent of drought as well as the U.S. population in drought changed substantially over the quarter. In the South, drought areas were reduced an astonishing 30.93 percent, leaving only 10.81 percent of the area in drought. In the West, drought expanded, covering 11.16

Continued on page 4



National Drought Mitigation Center

This change map shows drought expansion and intensification in parts of the West and Dakotas; and drought removal in the Southern Plains and South in the third quarter of 2018.

Departure from Normal Precipitation (in)
7/1/2018 – 9/30/2018

Generated 10/10/2018 at HPRCC using provisional data.

NOAA Regional Climate Centers

High Plains Regional Climate Center

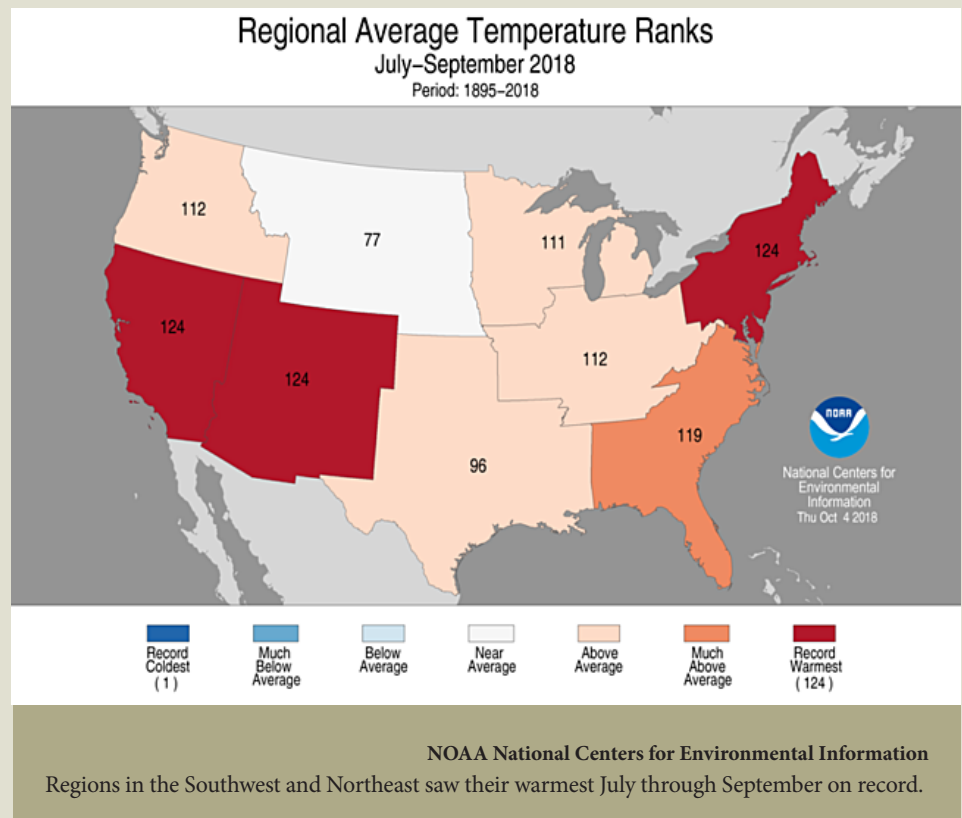
During the quarter, the West was generally dry while large precipitation surpluses were found in the eastern two-thirds of the U.S.

Continued from page 3

percent more area at the end of the quarter compared to the beginning. The number of people experiencing drought declined from 66.5 million to 55.5 million. Despite the shift in the location of drought, the total rate of drought coverage nationwide was nearly constant during the quarter, with the area of the country in each drought intensity category changing by less than one percent from the first day of the quarter to the last. By the beginning of October, 24.58 percent of the country was in drought, compared to 24.83 percent at the beginning of July.

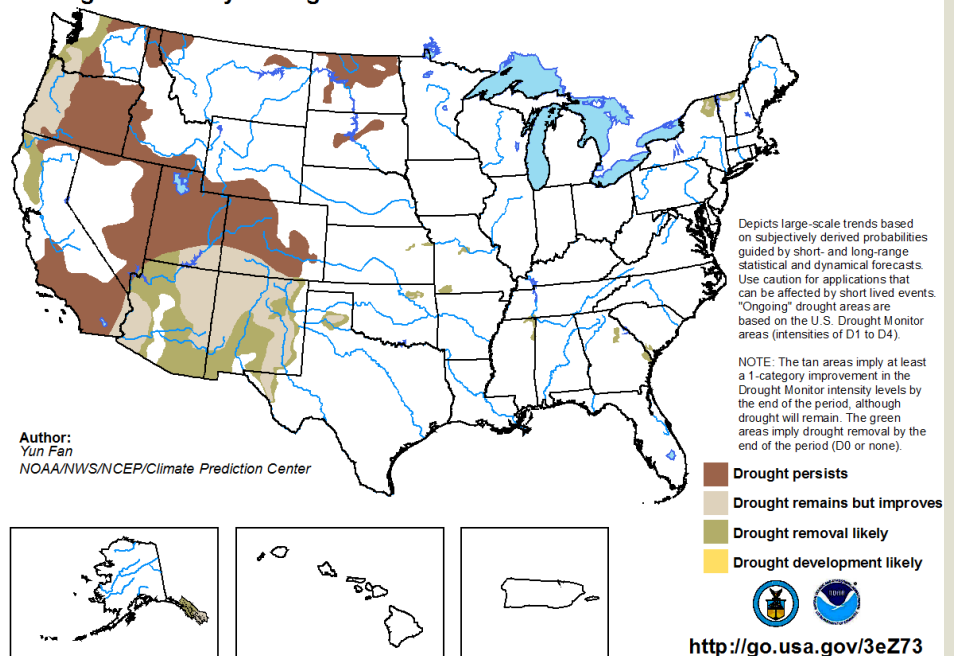
Precipitation

Many areas already experiencing dryness and drought, including the West, the Dakotas, Missouri, and far northern New England, remained dry during the three-month period, with precipitation in much of these areas less than 70 percent of normal. The Pacific Northwest Region encompassing Oregon, Washington and Idaho saw its second-driest third quarter on record. Arizona, however, saw precipitation of more than 200 percent of normal because of an active monsoon season. Much of the eastern two-thirds of the country saw above-normal precipitation with a few notable weather events. Heavy rains led to flooding in northeast Iowa and southern Wisconsin in mid to late summer. Pennsylvania saw its wettest July on record because of precipitation from atmospheric rivers in mid to late summer. On Sept. 4, tropical storm Gordon made landfall along the border between Mississippi and Alabama, bringing upwards of 10 inches of rain to the surrounding areas. Gordon also brought drenching rain to Arkansas as it moved inland. Then, on Sept. 14, Hurricane Florence made landfall in North Carolina where it brought record-breaking rain and severe flooding to large areas as it stalled over the Carolinas. The eastern two-thirds of Texas were also notably wet during the quarter, with precipitation between 130 and 300 percent of normal. Both Texas and West Virginia saw their wettest September on record.



U.S. Seasonal Drought Outlook Drought Tendency During the Valid Period

Valid for October 18 - January 31, 2019
Released October 18, 2018



Climate Prediction Center
The seasonal drought outlook indicates drought improvement or removal in several areas of the U.S.

Temperature

Much of the U.S. saw above-normal temperatures during the quarter. Regions in the Southwest and Northeast had their warmest third quarter on record and

saw temperatures from 2 to 6 degrees above normal. Many states even saw record-setting warmth. California saw its warmest July on record while Delaware,

Continued on page 5

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Connecticut, Rhode Island, Massachusetts, and New Hampshire saw their warmest August on record. Then, Utah, Arizona, Ohio, West Virginia, Maryland, Delaware, and Florida saw their warmest September on record. Montana, northeast Wyoming, the Dakotas, and the central Plains saw the coolest conditions compared to normal, with temperatures between 4 degrees below normal and 2 degrees above normal. The remainder of the country mostly saw temperatures up to 4 degrees above normal.

Outlook

The seasonal drought outlook through the end of January indicates drought improvement or removal of remaining drought in southeast Alaska, the Southern Plains, the Southeast and the Northeast. Drought improvement or removal is also likely throughout Arizona and New Mexico, in northwest California, and in the western half of Oregon and Washington. The remaining drought areas in the West and High Plains are expected to persist. Hawaii and Puerto Rico are expected to remain drought-free.



MONTHLY DROUGHT AND IMPACT SUMMARIES

For a more detailed review of conditions, please visit

drought.unl.edu/newsoutreach/monthlysummary.aspx

THIRD QUARTER 2018 IMPACT SUMMARY

Texas, Missouri, and Colorado logged late-summer impacts

The summer of 2018, a hot and dry one for much of the U.S., was the fourth hottest on record.

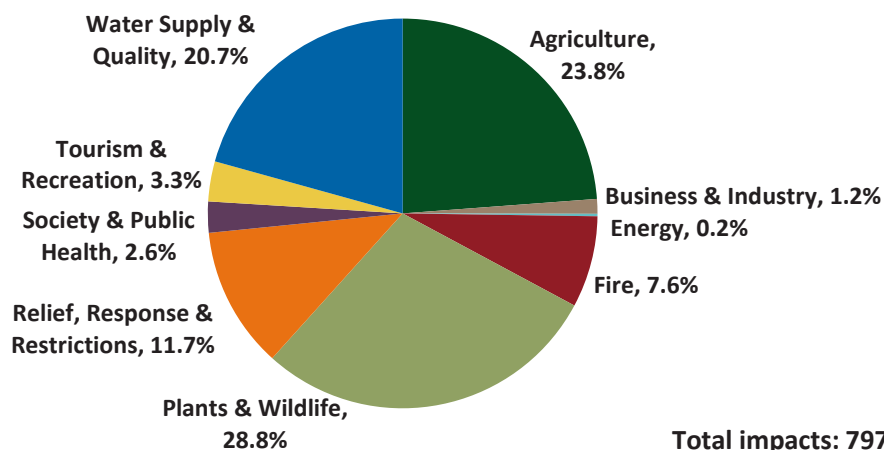
Drought intensified in the Northwest and in the northern and southern Plains through the summer, and abated in Texas and Missouri toward the end of summer. Drought remained solidly entrenched in the Four Corners region, despite the monsoon rains.

The NDMC logged 797 impacts in the Drought Impact Reporter from July through September. Texas was the state with the most impacts, with 159 describing agricultural damage and loss, as well as effects on plants and wildlife. Missouri followed with 88 impacts, largely noting agricultural challenges and water shortages. Colorado ranked third, with 86 impacts concerning plants and wildlife, in addition to water shortages.

Texas crops, pastures damaged by drought

Heat and drought combined to cause considerable stress and damage to crops and pastures in parts of Texas in July. In drought-affected areas, pasture and hay struggled, and finally dried up. Farmers opted to bale grain crops for feed, as the plants were not going to make grain anyway.

Impacts in the Drought Impact Reporter, July - September 2018



National Drought Mitigation Center

By August, some Texas ranchers were culling cattle or even selling entire herds as drought dried up water sources and parched forage. Livestock sales were ongoing in the Midland-Abilene-San Angelo area because pastures were bare, hay was expensive at double the usual cost and relatively scarce, and stock tanks were dry. The livestock sales resulted in big revenue losses on cattle that could have been sold for beef or other purposes.

By the end of summer, it was apparent that drought severely damaged Texas cotton. In the Abilene area, of the more

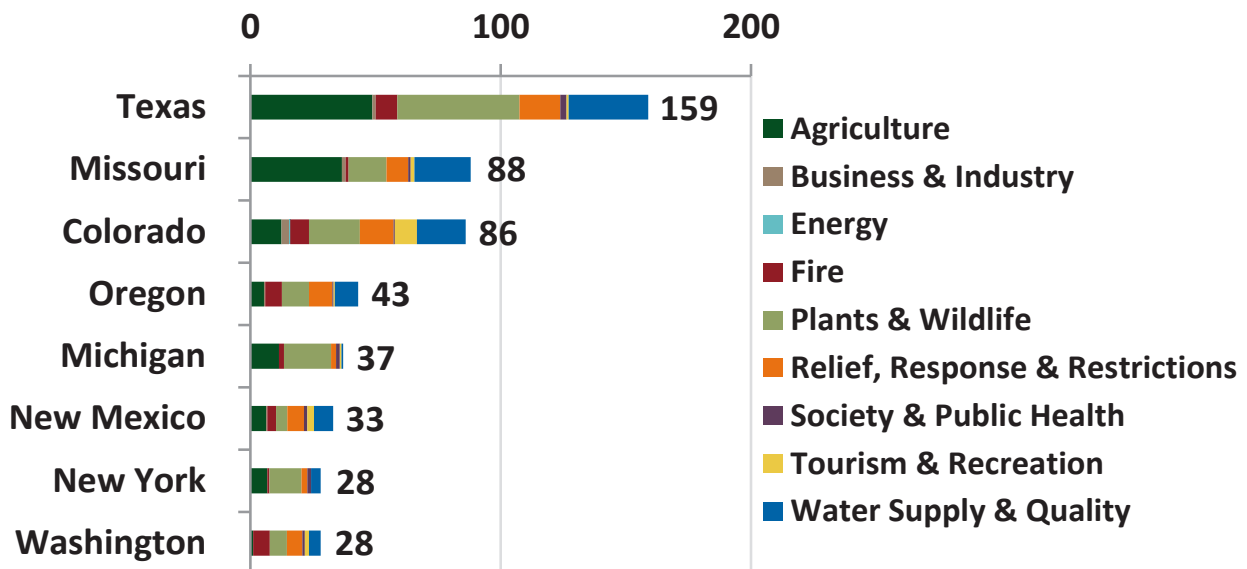
than 100,000 acres of cotton planted in the Big Country region, just 40,000 acres of cotton survived, meaning that about 60,000 acres were lost to the dry weather. The previous winter and spring were dry, leaving too little moisture to produce a crop.

["Texas Farmers Baling Grain Crops For Cattle Feed In Drought," by Sonja Begemann, Drovers \(Lenexa, Kan.\), July 24, 2018](#)

["As drought lingers, Texas ranchers opt to reduce their herds," by David Warren, The Associated Press, Aug. 15, 2018](#)

Continued on page 6

Impacts in the Drought Impact Reporter, July - September 2018



National Drought Mitigation Center

[“Dry weather affecting cotton harvest in the Big Country,” by Jillian Grace, KTXS-TV 12 Abilene \(Texas\), Sept. 17, 2018](#)

Hay prices rose as pastures dried up

In early September after a dry summer, hay prices were at least 10 percent higher than in 2017 for every month of 2018. In some states, the increases were much higher. In Kansas, prices were up 43.7 percent; in Nebraska, up 26.6 percent; and in South Dakota, up 16.5 percent. Missouri hay prices have risen more than 50 percent since the start of 2018.

In Texas, hay production southeast of Austin was about half of normal because of heat and drought. Poor production and low hay stocks meant that central Texas hay prices in early August were up about 22 percent compared to August 2017. Prices were expected to keep climbing since the growing season had just a few weeks remaining.

[“Hay prices soar after drought,” by Scott Brown, Missouri Ruralist \(St. Charles, Ill.\), Sept. 6, 2018](#)

[“Hay shortage leaves Texas ranchers scrambling for cattle feed,” by Bob Sechler, Austin American-Statesman \(Texas\), Aug. 11, 2018](#)

Missouri crop damage, high hay prices

Similar to Texas, Missouri crops and pastures were suffering, leaving cattle producers to search for hay or other feed and sell cattle. Corn was suffering, scarce hay made feeding cattle challenging, and water supplies were low. Pasture production was not sufficient to support cattle, and hay growth was about two-thirds of normal.

Hay prices have increased \$60 per ton since the start of 2018 to \$150 per ton, which was higher than record prices set during the 2012 drought. Hay production was projected at 5.2 million tons, which was less than 2012 production and the lowest since the 1988 drought.

[“Drought takes toll on Missouri farmers’ crops, cattle,” by Jim Salter, The Associated Press, Aug. 19, 2018](#)

[“2018 drought differs from 2012 in varied impact, says MU economist,” by Scott Brown, The Caldwell County News \(Hamilton, Missouri\), Aug. 28, 2018](#)

Colorado water supplies, low river flows

Poor snowpack from the previous winter left Colorado’s rivers flowing more slowly than normal, hurting rafting and recreational activities across the state. In the northwest, record heat warmed the

waters of the Yampa and White rivers, stressing fish. Fishing restrictions remained in place for nearly a half dozen rivers in the state in the latter part of August.

In west central Colorado, the Roaring Fork, Frying Pan and Crystal rivers were flowing at near-record lows, some as low as 30 percent of average, leaving anglers and ecologists worried about the effects on trout.

By the end of August, Colorado’s reservoirs were at roughly 50 percent of capacity, compared to an average of 82 percent, according to the Colorado Division of Water Resources.

Southwest Colorado was on track to have its second driest water year, behind 2002, which was the driest year in recorded history. Drought began in the fall of 2017 and has persisted since with poor snowpack during the winter, low rainfall during the spring and summer, and little in the way of monsoonal precipitation during the 2018 summer.

The lack of rain was apparent in rain gauges and reflected in river flows. The Animas River fell to a record low the last

Continued on page 7

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week of September, with flows slipping below 100 cubic feet per second on Sept. 26. A weather station at Mesa Verde recorded the least precipitation in 120 years. A gauge on the San Juan River near Bluff, Utah, showed its lowest flow in 92 years.

[Low Water Is Trouble For Trout, by Zoe Rom, Aspen Public Radio \(Colorado\), Aug. 29, 2018](#)

["Record Summer Heat Leaves Outfitters and Fish On The Yampa River In Hot Water," by Grace Hood, Colorado Public Radio \(Centennial, Colo.\), Aug. 21, 2018](#)

[SW Colorado's Basins, Reservoirs Are Parched; Blue Mesa Nears Historic Low, by Hayley Sanchez, Colorado Public Radio \(Centennial, Colorado\), Sept. 7, 2018](#)

["Colorado's 2018 water year closes as one of driest on record," by Heather Sackett, The Aspen Times \(Colo.\), Oct. 2, 2018](#)

["Animas River appears to have hit all-time low," by Jonathan Romeo, The Cortez Journal \(Colo.\), Oct. 2, 2018](#)

Low flows in the Colorado River Basin

Lower-than-expected flows in the Colorado River Basin over the summer boosted the odds of a water shortage in 2020. The U.S. Bureau of Reclamation put the chances of a shortage in Lake Mead at 57 percent, an increase from the 52 percent chance projected in May. A drought spanning nearly two decades, along with population growth, has increased water demand in the region and reduced the amount of water stored in lakes Mead and Powell. If Lake Mead falls below 1,075 feet above sea level, some water deliveries to Arizona, Nevada and Mexico would be reduced. In early September, Lake Mead was at about 38 percent of capacity, while Lake Powell was at 48 percent.

[Odds of shortage increase for vital river in US Southwest, by Dan Elliot, The Associated Press, Aug. 24, 2018](#)

[SW Colorado's Basins, Reservoirs Are Parched; Blue Mesa Nears Historic Low, by Hayley Sanchez, Colorado Public Radio \(Centennial, Colorado\), Sept. 7, 2018](#)

Drought affected Oregon yellow jackets, caused more tree deaths

Drought covered nearly the entire state of Oregon through much of the

summer, affecting plants, wildlife and agriculture. Oregonians were seeing more yellow jackets than usual in their yards and gardens as the insects sought water. In southwest Oregon, pastures were drying up where little snow fell last winter, resulting in little runoff and little feed for cattle. Hay prices were high at more than \$200 for a ton of good alfalfa.

Some Oregon conifers were dying after years of drought. Stress to Douglas firs began in western Oregon in 2013-14, particularly in the southern part of the state. The trees continued to die along the Interstate 5 corridor, running north-south along the west side of the state. In addition to the Douglas firs, Western red cedar, incense cedar, grand fir and valley ponderosa pine were also succumbing.

[Drought driving more yellow jackets into backyards, KTVZ.com \(Bend, Oregon\), Aug. 6, 2018](#)

[Drought threatens local ranchers, by Greg Stiles, Medford Mail Tribune \(Oregon\), Aug. 21, 2018](#)

[Oregon conifers hit hard by years of drought; here's how to keep trees healthy, by Kym Pokorny, Portland Oregonian, Hillsboro Argus, Oregon Live.com \(Oregon\), Sept. 3, 2018](#)

Fire danger high in Michigan; crops stressed

Drought led many southern and central Michigan communities and counties to enact burn bans in the first half of July as the dry conditions increased the fire danger. The Michigan Department of Natural Resources urged residents to postpone outdoor burns and to be careful with equipment, such as ATVs and mowers, because of heightened fire risk.

Michigan corn and soybeans were stressed by heat and absence of rain, triggering wilting and leaf rolling in many fields. The second cutting of hay was smaller than usual. Pastures were drying up, forcing farmers to begin giving supplemental feed to the livestock. Disease and pest pressures were light, thanks to heat and dryness. Most fruit trees and bushes were wilting from the lack of rain, and even more mature trees were affected. Apple growth slowed in eastern Michigan because of dry soils.

["Burn bans in place for much of Mid-Michigan," by Carrie Laine, WNEM-TV CBS 5 Saginaw \(Mich.\), July 9, 2018](#)

["State: Dry conditions are fodder for wild fires," by Bob Gross, Port Huron Times Herald \(Mich.\), July 12, 2018](#)

["Hot, Dry Weather Stressing Michigan Crops," by Michigan Ag Connection, USAgNet \(Marshfield, Wis.\), July 17, 2018](#)

New Mexico rivers at a trickle

Toward the end of September, New Mexico's rivers were flowing at a fraction of their usual rate after the previous winter's poor snowpack. In Albuquerque, the Rio Grande River was flowing at 133 cubic feet per second, compared to the average of 410 cfs. Natural flows of the Rio Grande ceased in July, but the river was still flowing with supplemental water from the San Juan-Chama Project from the Colorado River Basin.

Elsewhere in New Mexico, the Elephant Butte Reservoir in the south central part of the state was at 3 percent of capacity. The Animas River at Farmington in northwestern New Mexico was at a record low, just above 0 cfs.

Numerous dead brown trout were observed in the Pecos River between Cowles and Pecos east of Santa Fe. The New Mexico Department of Game and Fish were looking into the decline in brown and rainbow trout, which officials thought was related to the current drought. The flow of the Pecos River was about half of normal. Statewide, Game and Fish typically investigates from eight to 10 fish kills annually, but this year has already reviewed nearly 20 kills.

["Drought lingers across New Mexico," by Maddy Hayden, Albuquerque Journal \(N.M.\), Sept. 28, 2018](#)

["State investigates trout die-off in Pecos River," by Olivia Harlow, Santa Fe New Mexican, Sept. 25, 2018](#)

DROUGHT IMPACT REPORTER



For more detailed reports, visit droughtreporter.unl.edu

Memory, remote sensing and a new research methodology

BY SUZANNE PLASS

NATIONAL DROUGHT MITIGATION
CENTER COMMUNICATIONS SPECIALIST

Innovative research doesn't always begin as a stroke of insight. It can start with something as simple as a conversation.

That was the genesis of a newly published study in *Weather, Climate and Society* that compared agricultural stakeholders' perceptions of the flash drought that developed across upper Great Plains states in 2016 with datasets used to compile the U.S. Drought Monitor during that same time period.

"The proposal idea was initiated through conversations that Tonya and I had back in 2015," said study lead author Jason Otkin, referring to Tonya Haigh, rural sociologist at the National Drought Mitigation Center and one of the study's co-authors. "It builds off of our prior research experience interacting with agricultural stakeholders to better understand their drought early warning needs and the potential benefits of using the satellite-derived Evaporative Stress Index dataset for this purpose. The ESI depicts anomalies in evapotranspiration (ET), which is very relevant for farmers and ranchers interested in vegetation conditions."

The survey used a unique methodology, a post-event survey of agricultural producers, to assess the accuracy of selected high-resolution drought monitoring datasets such as the ESI. The ESI is one of a suite of satellite-based assessments that are synthesized with numeric models, condition reports and scientific analysis to produce the USDM each week.

Researchers concluded that the producers' qualitative reports of conditions on the ground were useful for examining different drought indices and understanding the evolution of a drought event, particularly the kind of flash drought that evolved around the Black Hills in 2016.

Haigh believes such reports could be a useful component in future research to assess and compare different sources

of drought monitoring information.

"This may help us going forward to identify which sources of information are particularly useful for providing early warning of specific types of conditions and impacts," Haigh said. "The results could eventually lead to better recommendations of how to use various drought monitoring indices to track early and later stages of drought, and to use them as triggers for decision-making."

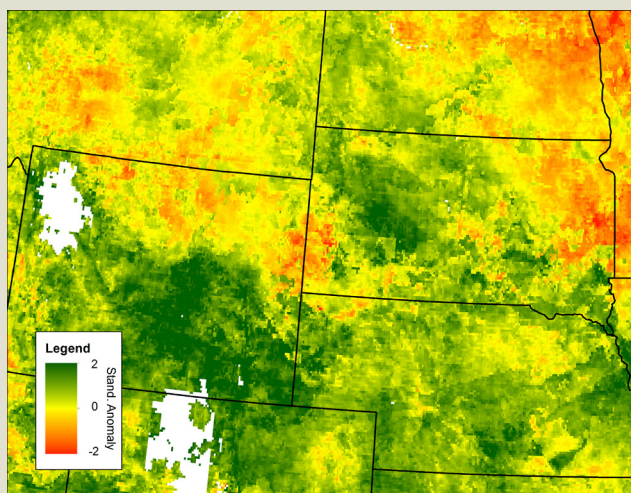
Otkin agreed, saying the research could serve as a first step in improving datasets used for drought monitoring, and in turn, benefitting producers.

"If these datasets can be improved," said Otkin, "especially in regard to monitoring the development of rapidly intensifying flash droughts, it could lead to more timely and focused government relief programs."

An unexpected outcome of the survey methodology has been interest from other researchers in the framework developed for comparing objective time series data to survey responses.

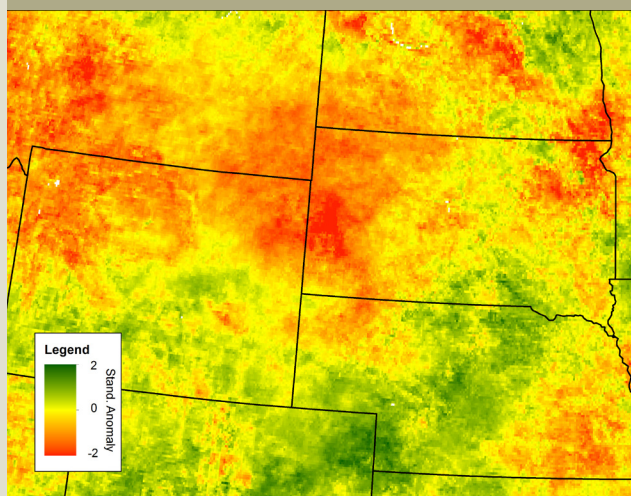
Co-author Tony Mucia, an NDMC graduate research assistant (see page 18), said the resulting graphs may look simple, but the quantitative analysis that produced them was quite complex.

"That's something I hope people explore better, to see 'Is this legitimate? Is this reproducible in other surveys?' Because if it is, this is a pretty good way to analyze the new products or the timing



Tony Mucia, NDMC

Standard anomalies of the 4-week Evaporative Stress Index (ESI), valid April 30, 2016, over the High Plains at the beginning of a flash drought.



Tony Mucia, NDMC

Standard anomalies of the 4-week Evaporative Stress Index (ESI), valid June 30, 2016, over the High Plains in the middle of a flash drought.

of when certain drought conditions occur compared to when we see a trend going down in these products," he said.

The study was funded by the NOAA Climate Program Office Sectoral Applications Research Program, with additional support from the National Integrated Drought Information System.

Haigh's analysis of the survey results related to producers' data preferences for management decisions related to drought will be published in the coming months.

Navigating the U.S. Drought Monitor

New resources help users make the most of the nation's premier drought map

"We haven't had rain in weeks. Why doesn't the U.S. Drought Monitor show my area as being in moderate drought?"

That question, or some version of it, came in to the National Drought Mitigation Center via emails or phone calls approximately 1,200 times between October 2016 and June 2017.

And that query count doesn't include requests from the media for interviews related to the USDM.

"We're answering how the map is being done, how the data is being incorporated and how does it relate to some of the relief programs of the USDA," said Brian Fuchs, NDMC climatologist and monitoring coordinator, referring

to calls most often taken by himself and by fellow NDMC climatologists Mark Svoboda and Deborah Bathke. "Those are the three main questions that tend to come up."

One of the many uses of the U.S. Drought Monitor is as a trigger for certain drought relief programs, notably the U.S. Department of Agriculture's Livestock Forage Relief Program. So as drought began to expand across the southern Plains and southwestern U.S. in late 2017, NDMC climatologists and researchers initiated cooperative education events involving multiple agencies with three goals for improving knowledge of the USDM among those who provide services to ag producers:

- Provide up-to-the-minute data on the evolving weather patterns contributing to the current drought.
- Enhance understanding of the data sources that go into compiling the weekly drought map.
- Increase awareness of how government agencies use the map and related data to allocate drought relief funds.

For NDMC, the outreach efforts were rolled out along several fronts.

Webinars and workshops

NDMC climatologists participated in a cooperative effort with staff from

WHO USES THE U.S. DROUGHT MONITOR?

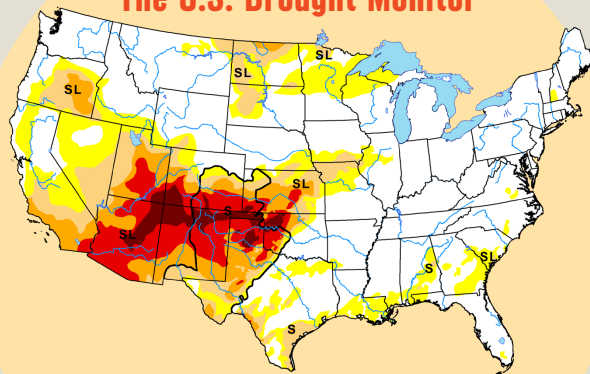
Based on a 2017 survey of the USDM Network, 2018 end-user interviews, Google Analytics, and Meltwater media tracking services



NATIONAL DROUGHT
MITIGATION CENTER
UNIVERSITY OF NEBRASKA



The U.S. Drought Monitor



Local, state, federal & tribal agencies

- Water & sanitation
- Public lands
- Public health
- Parks
- Natural resources & conservation districts
- Natural hazards
- Fire management
- Extension
- Environment
- Emergency management
- Fish & wildlife
- Agriculture

Individuals

- Water managers
- Students
- Planners
- Consultants
- Agricultural producers
- Academics

Organizations, businesses & industries

- Water suppliers
- Sports & wildlife organizations
- River associations
- Private businesses
- Navigation industry
- Intertribal associations
- Irrigation associations
- Forestry
- Engineering companies
- Dam & energy operations
- Conservation groups
- Agricultural trade organizations

Policymakers & task forces

- Governors & state offices
- State drought task forces
- State forestry commission
- Legislative & congressional offices
- Other elected officials
- Water congress

What do they use it for?

Decision-makers use the U.S. Drought Monitor to support:

- Public health advisories
- State, local, tribal or basin-level drought response triggers
- Marketing decisions
- Efficient water supply monitoring
- Fire precaution levels
- Grazing allotments
- Federal agricultural disaster relief, loans, and tax deferral
- and more

Where do they find it?

Media

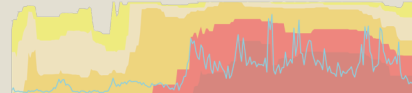
About 2,000 newspapers, broadcasters and trade publications use the U.S. Drought Monitor in any given year. The map also has 20,000-plus mentions each year on social media.

droughtmonitor.unl.edu and drought.gov

From 8 to 10 million people a year find the U.S. Drought Monitor map on its homepage, droughtmonitor.unl.edu, and 1 to 2 million view it on the U.S. Drought Portal, drought.gov.

When do they use it?

While some users track drought on a weekly basis seasonally or throughout the year, others find the U.S. Drought Monitor a go-to resource particularly when they are worried about drought. U.S. Drought Monitor web visits typically double during drought transitions.



This chart shows the proportion of California in each category of drought and the number of U.S. Drought Monitor page views from January 2012 to August 2016.

the USDA, the National Integrated Drought Information System, and others to offer ongoing webinars that provided stakeholders with updates on the evolving drought conditions. In addition to climate summaries and outlooks discussed during the webinars, each webinar offered a unique overview of a special topic, such as fire, agriculture or livestock.

“The idea was that the stakeholders out there, especially those in the media, would have a resource to go to, maybe even meet some of the partners that they weren’t aware of, that they could go to for additional resources or questions,” said Fuchs. “We had well over a hundred people participating in each of the webinars.”

At the same time, said Fuchs, NDMC began to coordinate with the USDA to provide trainings to staff in field offices of the Agricultural Research Service, the Natural Resources Conservation Service, the Farm Service Agency, the Forest Service and other branches of the agency. The project was supported through a cooperative agreement with the USDA’s Office of the Chief Economist.

“So far we’ve conducted two of these,” he said. “We did the first one in Amarillo, Texas. The second one was in Altoona, Iowa, and the third one is on the books here for October in Salt Lake City.”

Recordings of the webinars and videos of the Amarillo workshops are available online. (See “Resources,” at right.)

Educational resources

NDMC researchers and education specialists focused their attention on resource materials that could be viewed via the web or downloaded for distribution. They utilized findings of a 2017 survey of USDM authors that investigated USDM authors’ perceptions of the performance of the USDM and produced a social network analysis of the flow of information from local sources through the USDM authors to the USDM, and out again from the USDM to information providers, media and decision-makers across local, state, regional and national networks.

RESOURCES

Fact sheets and infographics

- **What is the USDM?**
Maybe you’ve seen it in the media: that map of the U.S. painted with blobs of yellow, orange and red. It shows drought – but who decides which colors go where? What does it mean for you? Find out at <https://droughtmonitor.unl.edu/AboutUSDM/WhatIsTheUSDM.aspx>
- **The U.S. Drought Monitor Network: Improving drought early warning**
A two-page infographic recently released by the NDMC that describes the U.S. Drought Monitor network. https://droughtmonitor.unl.edu/data/docs/USDM_network.pdf
- **Who uses the U.S. Drought Monitor?**
A convenient one-page summary of individuals and groups that rely on the USDM, what they use the data for, and when they use it. https://droughtmonitor.unl.edu/data/docs/USDM_network_who_uses.pdf

Social media

You can stay current on USDM information by following NDMC on social media. See page 18.

Tutorials

- **A Tutorial for the U.S. Drought Monitor**
Eleven of the most common questions about the USDM https://drought.unl.edu/archive/Tutorials/USDM_Tutorial/

YouTube

At the 2018 Amarillo drought workshop, representatives from NDMC, the U.S. Department of Agriculture’s Farm Service Agency, and the National Oceanic and Atmospheric Administration gave presentations to field office staff about how the USDM has been incorporated into each organization’s operations, and how service providers can use the USDM to communicate about drought in their region.

- **What is drought and why do we have the U.S. Drought Monitor?**
<https://www.youtube.com/watch?v=WgFy5vS0PwM>
Mark Svoboda, NDMC director, explains what drought is and the history of the USDM.
- **Evolution of the U.S. Drought Monitor**
<https://www.youtube.com/watch?v=2eFdbzlLsoc>
Brian Fuchs, NDMC monitoring coordinator, explains the collaboration between the USDA, NOAA and the NDMC to produce a weekly composite drought map with input from numerous federal and non-federal agencies.
- **How and why we track drought impacts**
https://www.youtube.com/watch?v=XpNHf_rAj_w
Mark Svoboda, NDMC director, discusses what drought impacts are and why they are tracked. The presentation includes background on the Drought Impact Reporter (DIR) and how impacts are divided by sector, giving explanations and examples for each sector.

Webinars

North Central US Monthly Climate and Drought Summary and Outlook: monthly, third Thursday at 1 p.m. Central Time. [See calendar.](#)

The team produced an infographic that illustrates the multi-layered network of observers who help inform the US Drought Monitor each week. (See “US Drought Monitor Data Gathering Network reaches throughout communities and across the nation,” DroughtScape, Summer 2018.)

Tonya Haigh, NDMC project manager and part of the research team, said that the observer input helps the authors produce a highly-credible product that more accurately depicts local conditions, and improves the nation’s communication about drought.

“The infographic has been very well received,” said Haigh. “Many users of the Drought Monitor did not previously understand the extensive process that goes on behind the scenes each week.”

A second infographic, based on results of the same 2017 survey of the 450 members of the U.S. Drought Monitor

network, is now being released. It shows the wide audiences that rely upon data from the USDM.

Social media

To extend outreach to new users, NDMC posts on Facebook and Twitter distribute the USDM weekly in English and Spanish. The posts are part of an ongoing social media news stream from NDMC on drought-related webinars, research and other new resources.

Kelly Helm Smith, NDMC assistant director and communication coordinator, was one of the contributors to the development of the USDM in 1998, and is still involved with refining map presentation to make the resource as convenient as possible for a broad range of current and potential users.

“Part of the continual evolution of the U.S. Drought Monitor is user testing,”

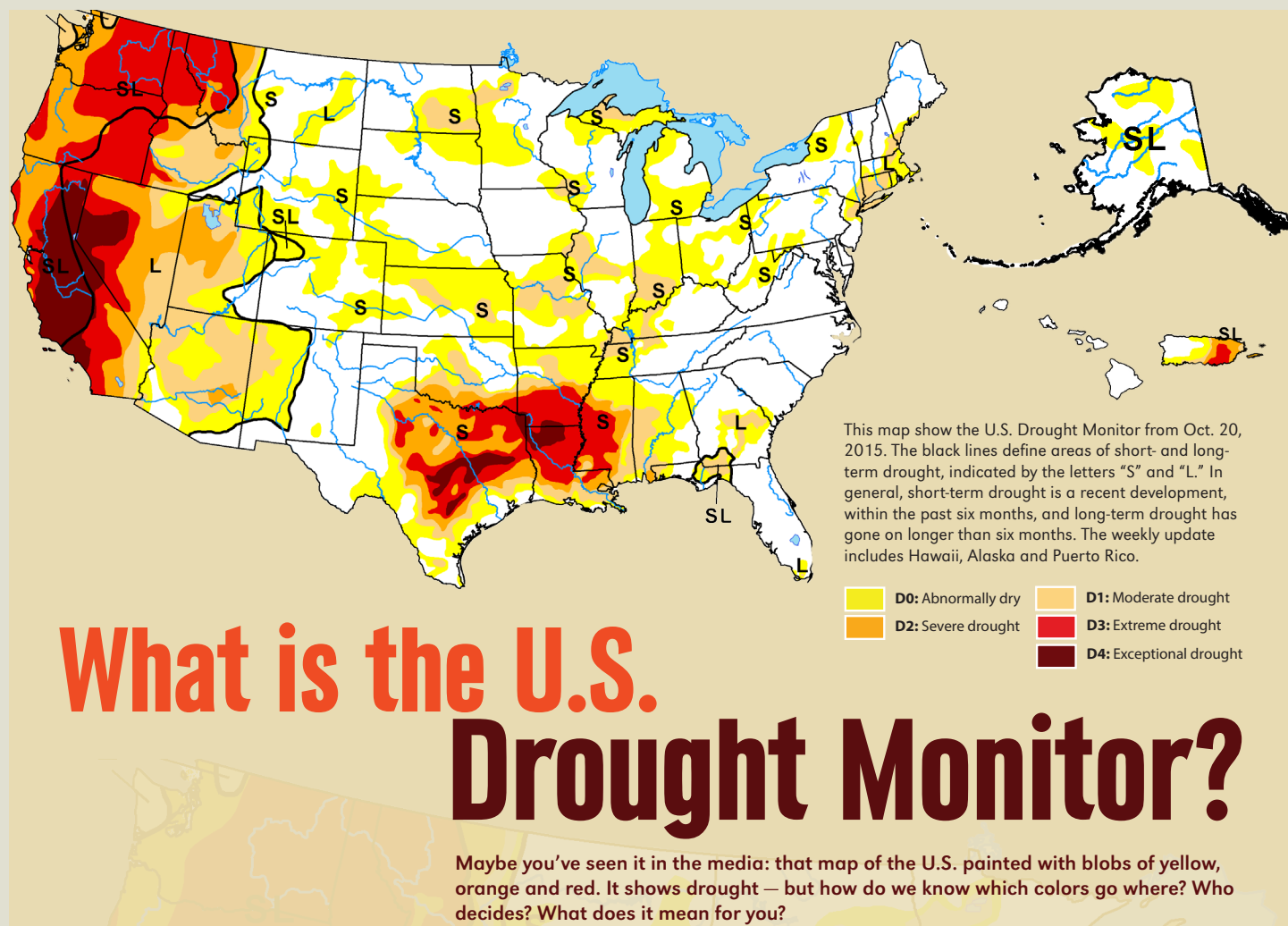
said Smith. “We try to make sure that any enhancements to the map and the USDM website make sense for the majority of users, not just for an expert audience.”

Looking ahead

As 2019 draws near, new rounds of workshops and webinars are already being planned by NDMC and its partners, using feedback from the 2018 workshops.

Mark Svoboda, NDMC director, said he is pleased with how the workshops have been received so far.

“These workshops, webinars and new resources have been a great way of helping more service providers and decision-makers understand the process of generating the USDM,” said Svoboda. “We’re looking forward to helping even more people benefit from these outreach tools in the year ahead.”



Planners discuss the barriers to effective drought mitigation planning

REPRINTED BY PERMISSION OF THE AMERICAN PLANNING ASSOCIATION

BY JOSEPH DEANGELIS

RESEARCH ASSOCIATE, AMERICAN PLANNING ASSOCIATION HAZARDS PLANNING CENTER

In late July, 30 planners, drought researchers, water management experts, and federal agency representatives gathered for a summit at the American Planning Association's (APA) Chicago offices to discuss the role of planning in local and regional drought mitigation. The summit, jointly organized by APA's Hazards Planning Center and the University of Nebraska-Lincoln's National Drought Mitigation Center (NDMC), is a major step in a [two-year FEMA grant-funded initiative](#) intended to study how planners and allied professionals can better understand the influence of drought on other local natural hazards, and the steps that can be taken to mitigate drought's impacts on people and the built and natural environments.

In a series of facilitated large and small group discussions, multi-disciplinary teams of planners and drought experts, led by APA's Shannon Burke and NDMC's Cody Knutson, discussed the science of drought prediction and forecasting, the barriers preventing planners from taking a more active role in planning for drought, and the types of guidance, training, and capacity-building actions that can help to overcome these barriers.

In these discussions, participants regularly highlighted that drought's role in contributing to and precipitating other natural hazards (such as flooding, wildfire, and landslides), calls for deeper and more impactful integration of drought mitigation and adaptation in all aspects of local land use planning. However, this requires significant outreach to both experts and drought specialists to better understand the primary gaps in education, training, and access to actionable drought data and information.

Attendees raised several thought-provoking ideas and needs during the summit, including:

- The complex role of climate change in worsening drought, and the need for both adaptation and mitigation actions that deal with both in a coordinated way
- The need for drought monitoring and forecasting to be packaged and made useable for planning practitioners
- Ensuring engagement and regular communication with those in the agricultural community to discuss how they are impacted by drought, and what actions they can take to mitigate drought conditions both locally and regionally
- The role of planners in gathering valuable and qualitative information to help build a case for drought mitigation actions like adopting ordinances to prioritize or control water use
- Communicating the co-benefits of green infrastructure or climate adaptation actions in mitigating or adapting to drought
- Providing targeted regional guidance to planners serving a diverse array of community types and sizes
- Participants also got a sneak preview of the results of an APA and NDMC survey sent to APA members to identify their needs and obstacles at the intersection of drought mitigation and planning. With responses from all fifty states, the survey identified critical information and resource needs necessary for planners to address drought comprehensively.

APA Hazards Planning Center Manager Shannon Burke observed that the survey was extremely useful in helping to assess the familiarity of planners with drought and drought-related impacts. "The survey found that planners need guidance to identify mitigation options, their associated costs and benefits and actionable methods for integrating drought risk into their planning efforts Shannon Burke. Planners are also interested in information about how to use

Continued on page 13



Photo: Kelly Wilson, American Planning Association

Attendees of the drought summit discuss land use planning issues in a breakout group. Pictured, from left: Joe DeAngelis, APA, Abby Hostettler, USDA, Cody Knutson, NDMC, Logan Sand, Colorado Department of Local Affairs, Ruth Rouse, Orange Water and Sewer Authority, Nancy Beller-Simms, NOAA.

Continued from page 12

monitoring and prediction data to address potential future drought conditions.”

The survey report summarizing these findings is now complete and can be [found here](#).

Findings from the summit and the survey will play a significant role in the development of both a planner's guidebook for drought mitigation, and a series of training and education sessions. The guidebook, a major forthcoming publication jointly developed by APA and NDMC, will provide planners with the tools they need to more deeply integrate drought mitigation and adaptation into their planning efforts and daily implementation work. Similarly, the training and educational events will engage planners in the practice of drought mitigation planning and will be a significant step in bridging both technical and capacity gaps for planners nationwide.

This work will also feed into APA's ongoing [water and planning initiative](#) and, in concert with other ongoing initiatives, will help to



Photo: Kelly Wilson, American Planning Association

Breakout group discusses the role of planning in local and regional drought mitigation. Clockwise: Mark Svoboda, NDMC, Jim Schwab, Jim Schwab Consulting and Chair-Elect of the APA HMDR Division, Nicole LaRosa, FEMA, Troy Brundidge, APA, and Marta Blanco-Castano, Wood.

bolster links between planning practice, land use, and water resources management.

APA and NDMC are grateful to the many attendees and the valuable input they provided at the summit. Visit

the [Drought Mitigation Planning in a Multi-Hazards Context](#) page for more information, resources, and updates.

[HTTPS://PLANNING.ORG/BLOG/BLOG-POST/9158329/](https://planning.org/blog/blog-post/9158329/)

Exploring climate issues from a county management perspective

BY SUZANNE PLASS

NATIONAL DROUGHT MITIGATION
CENTER COMMUNICATIONS SPECIALIST

Deb Bathke, NDMC climatologist and education coordinator, was among the experts recently invited to speak in laymen's terms about the science of climate and water issues at the Nebraska Association of County Officials September 2018 Institute of Excellence.

“As Nebraskans and members of the scientific community, I think that we as NDMC scientists have an important contribution to make to climate education in our state,” said Bathke. “We can present the facts and acknowledge the climate controversies at events like the NACO Institute. We can also answer questions as participants discuss their values and the potential responses their community can make to climate and water concerns.”

The September event was an encore offering of the Institute, which had received good reviews from those who attended the first gathering in Kearney, Nebraska last February. The National Drought Mitigation Center, the School of Natural Resources at the University of Nebraska-Lincoln, and Nebraska Extension partnered with NACO to present both 2018 sessions of the Institute.

The goals of the day-long workshop included increasing understanding of the science of water and climate issues confronting public and private sector leaders across the state and enhancing awareness of resources for decision-makers dealing with changes in water availability.

Bathke and Kelly Helm Smith, assistant director and communication coordinator for



Photo: Suzanne Plass, NDMC

From left, David Potter, Lower Platte South Natural Resources District, Nicole Wall, NDMC, Phil Luebbert, JEO Consulting Group, and Jessica Jones, Nebraska Extension, use conversation mapping to discuss climate data at the NACO 2018 Advanced Institute on Climate & Water, Sept. 7, 2018.

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NDMC, were among the featured panelists in a discussion of current and future drought and water impacts affecting city, county and statewide governance.

NDMC post-doctoral researcher Theresa Jedd kicked off the afternoon session with an overview of her research on climate and drought in outdoor recreation and tourism sectors. After presentations concluded,

Photo: Suzanne Plass, NDMC
Brian Roland, Village of Ceresco, initiates mapping of future opportunities for community leaders making decisions about climate and water.

Nicole Wall, NDMC outreach and research specialist, led workshop participants through a conversation mapping strategy to explore next steps in developing responses to climate and water issues.

The mapping activity provided participants a framework to discuss the climate and water institute concepts in small groups, and also to share their insights and concerns with workshop leaders. It is a model Wall likes to use with communities as they begin to develop a drought monitoring plan.

“That input from stakeholders really benefits the greater public and their needs, especially in planning processes,” said Wall. “Local voices matter and should be heard when it comes to addressing climate and water issues.”

Strategic Framework for Drought Risk Management and Enhancing Resilience in Africa: White Paper

A white paper for drought policy in Africa compiled by Tsegaye Tadesse, NDMC climatologist and geospatial coordinator, was published in June 2018 by the United Nations Convention to Combat Desertification. The paper follows discussions of Tadesse’s proposal for a Drought Resilient And Prepared Africa, presented at the August 2016 African Drought Conference in Windhoek, Namibia.

The conference was organized by the UNCCD, the World Meteorological Organization and the Food and Agriculture Organization of the United Nations, and hosted by the Government of Namibia. It brought together ministers and delegates from across Africa to promote proactive drought management (see “Drought management framework for Africa approved,” DroughtScape, Fall 2016), and resulted in “The Windhoek Declaration for Enhancing Resilience to Drought in Africa.”

Tadesse said that DRAPA, as the proposal is known, is designed to build

an effective drought risk management approach, along with enhanced resilience at continental, regional, national or local and community levels.

“The DRAPA strategic framework will have elements that are aligned with the priorities of African regional networks, such as the IGAD drought disaster resilience and sustainability initiative, national action programs, and the global disaster risk reduction frameworks,” said Tadesse. “The strategic framework and its implementation are expected to ensure a substantial reduction of drought impacts on human lives in Africa.”

With DRAPA in place, and in collaboration with international institutes and countries around the world, Tadesse believes that Africa can integrate drought risk management into sustainable development policies and planning.

“However,” said Tadesse, “funding to support such an effort is still a challenge.”

STRATEGIC FRAMEWORK FOR DROUGHT RISK MANAGEMENT AND ENHANCING RESILIENCE IN AFRICA

WHITE PAPER

This document was discussed at the African Drought Conference on August 15-19, 2016 at the Country Club and Resort in Windhoek, Namibia, organized by the UNCCD, FAO and WMO.



United Nations
Convention to Combat
Desertification

Read the white paper: https://www.unccd.int/sites/default/files/relevant-links/2018-07/African_drought_white_paper.pdf

Mena global policy forum looks from data to mitigation

REPRINTED WITH PERMISSION FROM THE INTERNATIONAL CENTER FOR BIOSALINE AGRICULTURE (ICBA)

Leading experts from more than 10 countries, including the Czech Republic, Jordan, Lebanon, Mexico, Morocco, South Africa, Tunisia, the United Arab Emirates and the USA have urged policymakers and governments to speed up development of climate change adaptation strategies to ward off growing risks like drought to food and water security.

Around 40 experts convened in Dubai, United Arab Emirates, Sept. 26–28, 2018, at an international policy workshop, organized by the United States Agency for International Development, the International Center for Biosaline Agriculture, and the National Drought Mitigation Center of the University of Nebraska - Lincoln, USA.

As climate change-induced droughts are becoming more frequent and severe, especially in regions like the Middle East and North Africa (MENA), the workshop looked at how various initiatives such as the ICBA-led project “Regional Drought Management System for Middle East & North Africa” can help to better respond to droughts and lessen their impacts.

The workshop was designed to facilitate cross-country learning on drought management from countries in the MENA region where the project had been implemented, as well as other countries where drought is a persistent threat.

Participants discussed, among other things, drought monitoring development and validation of results, vulnerability and impact assessment results and how they could be used in policy development and planning, as well as shared ideas on going forward with planning and policy-making.

Experts from Jordan, Lebanon, Morocco and Tunisia presented drought monitoring validation results for their respective countries. For the past several years, in collaboration with national governments and organizations such as USAID, the Food and Agriculture



ICBA

The experts convened in Dubai, United Arab Emirates, Sept. 25–26, 2018 at an international policy workshop, which was organized by the United States Agency for International Development (USAID), the International Center for Biosaline Agriculture (ICBA), and the National Drought Mitigation Center (NDMC) of the University of Nebraska - Lincoln, USA.



ICBA

Experts from Jordan, Lebanon, Morocco and Tunisia presented drought monitoring validation results for their respective countries.

Organization of the United Nations, and NDMC, ICBA's climate modeling scientists have been providing hands-on training in these countries on how to create drought maps through an operational drought monitoring system. As a result, the local specialists have been able to successfully monitor the severity and location of droughts, helping local authorities to better plan and manage water resources and other drought-related problems.

Speaking at the event, Ismahane Elouafi, director general of ICBA, said: “MENA-RDMS is one of the key projects at ICBA. Our region is a drought-prone region; it is a region which has suffered droughts for over 50 years and climate change impact is getting more severe. As part of our mandate as a public international research-for-development institution to improve agriculture in

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marginal environments, we aim to empower policy-makers in the region through robust drought management programs that will allow them to plan for and manage the impacts of droughts on food and water security.”

One of the main presentations during the workshop was about the recent water crises in Cape Town, South Africa. Kevin Winter, a senior lecturer at the Environmental and Geographical Science Department, the University of Cape Town, said of this: “A city without water is a catastrophe; we need to adapt much faster to the drivers of change. We need to invest in water; demand management is a top priority. Our experience of drought in Cape Town shows that it is rapid and unpredictable. We have just been through a drought that has probably a chance of happening once in 350 years; it is very difficult to predict.”

“Mapping the drought through a particular framework and set of indicators is the first stage of building a comprehensive picture, because it needs to be operated and applied at a particular scale and it is also helping to refine the indications of factors that are causing drought in regions like the MENA. Information which is properly analyzed becomes crucial to building policy and building wisdom at the same time,” added Winter.

For his part, Rene Lobato Sanchez, a scientist at the Mexican Institute of Water Technology, who spoke about the successes and lessons learned on drought management in Mexico, said: “In Mexico, drought is a big issue! Droughts have moved societies in and around. There is evidence that civilizations have disappeared because of droughts. So drought for us is a big concern especially because when droughts become longer, they affect the society by leading to migrations, starvations, and change in ecosystems. This workshop is very important as I am meeting experts from the MENA region. We are trying to see how drought behaves and how we can create drought maps through drought

monitoring systems. It gives us at least the initial inputs on how to respond to droughts. Based on the data, we can go to policy-makers and work with them and make decisions, such as how to ensure the least impact of drought on the population.”

Speaking about the partnership with ICBA, Mark Svoboda, NDMC director and research associate professor at UNL, said: “It has been a great opportunity to utilize the expertise of ICBA’s team in the MENA region to help us to work in these countries. It has really been a great experience and we look forward to working with ICBA down the road. Part of the strategy of this project and particularly this workshop is about transitioning from the collection of data, the information from the early-warning system, and the ‘now what’ moment. This means how we use this information in decision-making and how we integrate it into policy-making and planning and what sort of mitigation measures we can take that can reduce the impact of drought.”

While addressing the participants, Rachael McDonnell, a principal scientist in water governance and policy at ICBA, highlighted the accomplishments of the MENA-RDMS project. McDonnell thanked partners, particularly local governments, USAID and NDMC for their generous support to the project.

ICBA has been leading the MENA-RDMS project since 2015. The main aim of the center’s climate change work is to develop new insight into the possible impacts of climate change on water and food security, particularly in areas that are currently or likely to become marginal, and to develop innovative adaptation policy, technical and information solutions.

[HTTPS://WWW.BIOSALINE.ORG/NEWS/2018-09-26-6600](https://www.biosaline.org/news/2018-09-26-6600)



ICBA
NDMC Director Mark Svoboda



SHARING PROGRESS, OUTCOMES & INSIGHTS FROM DROUGHT MANAGEMENT SYSTEM PROJECT

The International Center for Biosaline Agriculture produced a video this summer highlighting progress being made by MENA nations participating in workshops to develop national drought monitoring programs and plans.

The video features interviews with Michael Hayes, climatologist and former director of the National Drought Mitigation Center, and Sami Tarabieh, national project manager for the United Nations Development Program in Jordan.

[Watch the video.](#)

NDMC welcomes new staff

Brendon Orr

Brendon joined the National Drought Mitigation Center in August 2018 as a web graphics designer following a 14-year career in academia and nonprofit agencies.

He previously worked for the University of Wyoming Department of Geology and Geophysics as the managing/online editor of the peer-reviewed scientific journal *Rocky Mountain Geology* and as the department's web designer. He has also been an online consultant for GeoScienceWorld, the largest online aggregate of geoscience journals, where he worked on a remote team to help transition the website from one hosting provider to another.

When not online, Brendon usually wants to be outside running, biking, gardening or enjoying live music. He teaches and practices yoga in his spare time and is also a proud dog daddy of two canines.



National Drought Mitigation Center
Brendon Orr, Web Graphics Designer

Claire Schirle

Claire joined the drought center in July 2018 as a climatologist. She earned bachelor's degrees in meteorology-climatology and mathematics from the University of Nebraska-Lincoln in 2016 and a master's degree in atmospheric science from the University of Utah in 2018. As an undergraduate, Claire was a student intern with the NDMC where she conducted research focusing on the validation of the Vegetation Drought Response Index (VegDRI) using vapor pressure deficit and helped make improvements to the Drought Risk Atlas. In graduate school, her research focused on radar and microphysical observations of snowfall in high latitudes. She is currently using her research and scientific writing experience to support many ongoing projects at the drought center. These projects include creating drought and climate summaries for NDMC publications, researching relationships between vapor pressure deficit and drought impacts to aid in the development and testing of drought indices, researching trends in drought indices across the U.S., and providing supporting materials for the production of the U.S. Drought Monitor.



National Drought Mitigation Center
Claire Schirle, Climatologist

NDMC master's student Mucia to Météo-France

Starting in November, National Drought Mitigation Center graduate research assistant Tony Mucia will be looking at remote sensing data from a new vantage point on Earth.

"I am excited to announce that I have accepted a 3-year PhD position at Météo-France in Toulouse, France!" Mucia wrote on his Facebook feed last spring. "I will be working on assimilating satellite data into land surface models to forecast drought weeks or months in the future. Shout-out to President Macron for creating the 'Make Our Planet Great Again' program which is funding this project. Now off to learn French."

It's a move Mucia couldn't have imagined for himself when he started at the University of Nebraska-Lincoln in electrical engineering. Rather than engineering, he soon found himself exploring meteorology, then climatology. The climate classes, partly because they gave him an opportunity to work with proxy datasets and satellites, became the focus of his work.

"I've been huge into space, satellites and rockets and stuff," said Mucia. "So every time a new weather satellite like the GOES, GOES-R, GOES-S satellites have been launched, I've been following those for years up to the event and was explaining to my friends exactly how they get in to this orbit and all that type of stuff."

Through undergraduate work at NDMC Mucia became involved in research on VegDRI and QuickDRI. Those projects eventually led him to graduate research related to NASA's Gravity Recovery and Climate Experiment mission data.

"My master's primarily focused on how this GRACE product captures drought severity and drought extent in the U.S., comparing GRACE data to other drought indices and other data," he said.

Most recently at NDMC, Mucia was part of a team of researchers who developed a method to compare human observations of drought impacts with remote sensing data (see page 8).

And how did that land him a job in France?

The opportunity Mucia seized had its origins in an initiative launched by French President Emmanuel Macron. In late 2017 Macron's government launched the "Make Our Planet Great Again" program, an initiative to attract climate scientists to France that has received international media coverage. Selected researchers received funding from a \$70 million grant pool, and received contracts lasting up to five years, according to the [Washington Post](#).

In early 2018, a second round of applicants, Ph.D. students, were sought for 93 MOPGA projects. Mucia applied to four projects, was interviewed for three, and selected for projects in Toulouse and Savoie Mont Blanc. Those projects then submitted Mucia's name to the MOPGA office coordinating assignments. Mucia begins his work at Météo-France, the French national meteorological service, in Toulouse on November 6.



Photo: Tony Mucia

Graduate research assistant Tony Mucia along the banks of Seine river as it flows through Paris, France.

Mucia said that he is excited to get started, and learn about what the specifics of the job will be.

"Météo-France has a specific land-surface model that they use globally that they are continuously working on. They've sent me several publications just in the last month on the analysis of how this model is doing, so that hopefully what I will be doing is assimilating certain datasets. I think it will be NDVI, and some greenness indices into the model as well meteorological forecasts for producing short-term outlooks and analyzing how well those outputs performed, and using those to force the model and see what the outputs are, and then comparing those outputs to reality."

As his departure date nears, Mucia is wrapping up what he considers to be this stage of his work with NDMC, but starting in 2020 he will see his NDMC colleagues again. At that time it will be at conferences in Europe, as a representative of Météo-France.

Category	Description	Possible Impacts in the United States
D0	Abnormally Dry	Going into drought: Short-term dryness slowing planting, growth of crops or pastures Coming out of drought: Some lingering water deficits Pastures or crops not fully recovered
D1	Moderate Drought	Some damage to crops, pastures Streams, reservoirs, or wells low, some water shortages developing or imminent Voluntary water-use restrictions requested
D2	Severe Drought	Crop or pasture losses likely Water shortages common Water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses Widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses Shortages of water in reservoirs, streams, and wells creating water emergencies

➔

Category	Possible Impacts in Colorado
D0	Hay production decreases, some cattle sold Irrigation begins sooner
D1	Rangeland brown and no growth, very little hay, selling more cattle Dryland commercial row crops suffering Wildfires increase Pheasant population lower, ski resorts closing earlier
D2	CRP lands suffering Farmers reduce planting Fire season early Low snowpack, snow melt early, low surface water levels, reduced river flow, increased water temperature
D3	Natural disaster areas declared Pasture conditions worsen Disaster program assistance begins City landscapes dying Fish kill Reduction in rafting, fishing, pheasant hunting, skiing Grasshopper and insect infestation Reservoirs extremely low, mandatory water restrictions
D4	Dust storms, widespread topsoil removal Large agricultural and recreational economic loss

State-by-state drought classification table developed by NDMC graduate student

In the not-too-distant future, citizens in every state in the United States and Puerto Rico may have a customized drought severity classification table, based on impacts observed during the onset of drought.

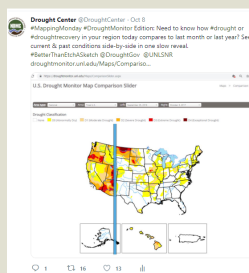
The new nationwide drought resource is being developed by researcher Mary Noel, a master's student at the University of Nebraska-Lincoln's School of Natural

Resources. She'll be presenting her work at several upcoming conferences including the American Geophysical Union Fall Meeting in Washington, D.C., Dec. 10–14, and the American Meteorological Society annual meeting in Phoenix, Jan. 6–10, 2019.

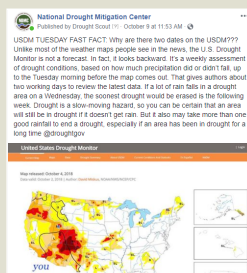
The state-by-state tables may replace or supplement the generic, nationwide description of possible impacts on the

[U.S. Drought Monitor classification scheme](#). Noel's tables are based on impacts recorded in the National Drought Mitigation Center's Drought Impact Reporter. The project is funded by the National Integrated Drought Information System.

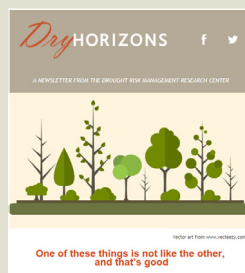
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