Groups co-developing approaches to improve planning for drought on public lands

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Forest Service personnel and ranchers with grazing permits on the Tonto National Forest in Arizona recently participated in a workshop to increase their preparation for drought by planning and implementing livestock management in the National Forests of the Southwestern US. The workshop, the third of three in a series, was Feb. 17, 2016.

Thirty-eight people participated, including 16 ranchers; 11 Forest Service personnel from the Tonto NF; one National Drought Mitigation Center researcher, Tonya Haigh; the Desert Landscape Conservation Cooperative director, who was asked to observe; and seven of the eight members of the research team from the University of Arizona. The first two workshops were featured in the Summer 2015 and Winter 2016 issues of DroughtScape.

In response to preferences expressed by Workshop II participants and the outcomes of the drought scenario planning exercises in that workshop, we designed activities that would continue to provide interaction and problem-solving among participants, as well as more exposure to new tools that provide local climate information and more in-depth understanding of the Forest Service decision process. The main activities for Workshop III were:

1. Exploring how online tools that provide information on the Standardized Precipitation Index for drought monitoring and NOAA Climate Prediction Center Three-Month Precipitation Outlooks can be used during annual operating Instructions meetings so that ranchers and Forest Service personnel are looking at the same drought/climate information.

2. Developing realistic expectations about the complexity and duration of the Forest Service decision process used to approve installation of infrastructure used to increase preparation for the next drought.

Standardized Precipitation Index

Our attention to SPI is based on the policy for Forest Service Region 3, in which the Tonto National Forest lies, that states “anytime the SPI reaches a value of minus 1.00 or less for the preceding 12 month period, grazing allotments should be evaluated for existing drought conditions” (R3 Manual Supplement to 2209.13.19.1). Our attention to decision points faced by ranchers and the Forest Service focused on the traditional mid-winter (January to February) AOI that sets parameters of grazing intensity and timing for the coming year and the schedule of infrastructure maintenance and construction. We also explored the adoption of a separate decision-point in early summer to address the drought conditions associated with the summer rains from the North American Monsoon because they are critical for about 75 percent of the forage production in a year.

Mike Crimmins developed the SPI Explorer Tool to view and analyze local-scale estimates of historic precipitation variability. The tool (https://cals.arizona.edu/droughtandgrazing/dashboard, Continued on page 16
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direct link https://uaclimateextension.shinyapps.io/SPItool/) was built using R programming language (https://www.r-project.org/) and a web application framework called Shiny (http://shiny.rstudio.com/), and draws upon online climate datasets offered up through web services by the Applied Climate Information System (http://www.rcc-acis.org/). Specifically, the SPI Explorer Tool uses the Parameter-elevation Relationships on Independent Slopes Model (http://www.prism.oregonstate.edu/) climate dataset which is a gridded, interpolation of monthly temperature and precipitation observations on a 4-by-4 kilometer elevation grid.

The tool is organized into tabs represented across the top of the page (Figure 1). They include:

• Set Location/Time Period: Map interface to download precipitation data for specific locations and time periods.
• Site Climate Summary: Quick look at annual precipitation totals for the selected site in graphical and table form.
• SPI Timescale Comparison: Single figure of one, three and twelve month SPI values plotted on common time axis.
• SPI-Precip Comparison: Interactive tool that allows for the exploration of precipitation statistics and SPI values for specific months and SPI timescales.
• Drought Category Transitions: Interactive tools that calculate and display the probability of transitioning from one SPI-based category to another based on historical occurrences.

The precipitation time series loaded into the tool based on the selections on the Set Location/Time Period tab determines the dataset used on all other tabs.

The SPI-Precip Comparison tab (Figure 2) produces several statistical summaries of precipitation based on selecting a specific starting month and SPI window (1, 3 or 12 months). For example, selecting 1 month SPI and July produces summary statistics and historical plots of July precipitation for the period of record selected on the first tab. The full output includes:

1. Time series plot of SPI values for selected month and timescale;
2. Raw, total precipitation values based on SPI timescale and month selection;
3. Histogram of raw precipitation values based on SPI timescale and month selection;
4. Cumulative probability distribution of the same precipitation values displayed in the histogram;
5. General precipitation statistics including extremes and terciles; and
6. Precipitation and SPI table of values that can be sorted/reordered.

The Drought Category Transitions tab (Figure 3) using the historical record to describe the likelihood of future conditions given current conditions. This is particularly useful for estimating end of summer (through September) conditions based on the condition at the start of summer (through July). Users select the month and SPI timescale for Period 1- start month and Period 2- end month. The tool provides likelihood of transition among four SPI categories: very dry (<-1), dry (-1 to 0) wet (0 to 1), and very wet (1 to 2). For example, Figure 3 shows that historically there is a 38.5 percent chance that very dry (<-1 SPI) conditions in July will persist through September, and a 15.4 percent chance that wet (0-1 SPI) conditions will follow a very dry July.

Drought Assessment and Climate Prediction Activities

During Workshop III, Mike Crimmins introduced Activity 1 by explaining how SPI is calculated and why this method makes it possible to compare the SPI between places with different average amounts of rainfall, as well as to calculate SPI over different time scales. He also explained how CPC Precipitation Forecasts are created and the significance of the color-coded maps. The group as a whole then

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completed two exercises using SPI, CPC Precipitation Outlooks, and the SPI Explorer Tool together: 1) for a February 2016 AOI meeting in Globe, Arizona, and 2) for an early monsoon check-up in August 2015. Afterward, they split into four groups, including at least one District Ranger and Range Staff and four to five ranchers, to work through the exercises for Payson, Arizona. To encourage open discussion, District Rangers, Range Staff, and ranchers from different districts were grouped together to the extent possible. Each group gathered around a separate table and was provided with a computer, projector, and screen large enough that participants could view the climate tools together. A member from the project team operated the tools for each group and each participant filled out their own exercise sheet as the group progressed through the exercise. The team member also provided additional interpretation and guidance about the operation of the SPI Tool and the completion of the exercises.

For the February AOI meeting, current drought conditions were determined from the 12-month SPI for Arizona (http://www.wrcc.dri.edu/wwdt/index.php?region=az). Next, seasonal precipitation outlooks were determined from the NOAA CPC Precipitation Outlook forecast (http://www.cpc.ncep.noaa.gov/products/predictions/long_range/). Participants then used the SPI Explorer Tool to determine the high-low values for the terciles being projected in the seasonal outlook. This provided hands-on practice to access the forecast and to evaluate just how much rain is within each tercile, as well as the likelihood of that tercile occurring in the next three months. For the August AOI meeting, instead of the CPC Precipitation Outlook, drought likelihoods based on the historic record were generated using the Drought Category Transition tab in the SPI tool. This information could be more valuable during discussions in summer about what types of preparations should be made for possible drought conditions because in the Southwest, three-month summer precipitation outlooks are typically “equal chances” of falling within each of the three terciles.

**Realistic Expectations about the Forest Service Decision Process**

This second major activity asked participants to develop realistic expectations about the nature and duration of project reviews performed by the Forest Service. This is critical for drought preparations because it determines how long it will take to get a project approved before installation. Longer review durations make it more likely that the next drought will occur before the installation is approved and available to provide greater flexibility to respond to drought conditions.

To begin, the entire group discussed and provided input describing the most likely type and duration of decision given a variety of characteristics such as presence of endangered species, arrival of a new district ranger, and previous completion of an impact analysis. That information was used during small group exercises in which groups filled out worksheets for two scenarios for a water development project which asked participants to identify:

1. What type of decision is most likely given the characteristics of the project;
2. The steps in the decision process;
3. How long it would take to complete the decision process;
4. Who was going to track the progress of the decision process;
5. How was that progress going to be communicated;
6. What events might occur to lengthen the process;
7. How much longer would the process take with that event; and
8. How you would respond to the new event that slowed the process.

Overall, the workshop met its objectives. Evaluations indicated that all respondents felt that the workshop...
improved their understanding of how drought information could be used to increase their ability to prepare for drought, and that their understanding has increased considerably throughout the series of workshops. Ranchers’ understanding of the Forest Service decision process, how long it takes, and how to become more engaged in Forest Service decision processes for long-term drought planning has also improved. Analysis of workshop recordings, notes, and evaluations indicates that workshop activities continued to promote communication, joint problem-solving, and development of a common framework for looking at drought information and co-developing decisions among ranchers and Forest Service personnel.

The research team continues to work to translate the success of the project into the “Guide to Drought Preparation for Livestock Grazing Allotments on Southwest National Forests” to conduct follow-up research to determine longer-term impact of the project, and to promote further activities that will continue productive interactions and improve drought planning and preparedness on the Tonto NF and the region.

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NDMC founder, drought legend retires

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After nearly 40 years with the University of Nebraska-Lincoln, Don Wilhite, founding director of the National Drought Mitigation Center, former School of Natural Resources director and dedicated applied climate professor, has retired and will shift to emeritus status.

June 30 was his official last day. “It’s been a great honor to work with the university since I joined the faculty in 1977,” Wilhite said. “On both the domestic and international side, it has been very rewarding to see my emphasis on drought preparedness and drought policy as well as my emphasis on the development of drought early warning systems and vulnerability assessments being adopted as part of NOAA’s National Integrated Drought Information System and by agencies of the United Nations such as the World Meteorological Organization, the U.N.’s Convention to Combat Desertification and the U.N.’s Food and Agriculture Organization.

“I have really enjoyed working with all of the faculty and staff in SNR over the years and wish the unit nothing but success in the years ahead.”

Wilhite was the founding director of the International Drought Information Center in 1989, which focused at an international level on reducing vulnerability to drought through projects directed at planning, early warning and mitigation. The center created a guidebook on drought preparedness for developing countries, organized training seminars and conferences related to drought and water resource management, and helped shape drought policy.

This work took him to Africa, Brazil, Thailand, China, Switzerland and Uruguay, among dozens of others countries that were seeking advice for drought planning. The IDIC was active until 2002.

In 1995, Wilhite founded the National Drought Mitigation Center, whose focus has been on reducing societal vulnerability to drought, nationally and internationally, through the development of preparedness plans that emphasize proactive mitigation measures and the adoption of national drought policies that are focused on risk reduction. When Wilhite began working with U.S. states, only three had drought plans. Today, 47 do. The NDMC may best be known for its work on the U.S. Drought Monitor, a weekly map of drought conditions, of which Wilhite and the NDMC were instrumental in getting created. Countries around the world have sought to emulate the map for their own drought response.

Wilhite served as the director of the NDMC until 2007, when he was appointed director of the School of Natural Resources. He stepped down from that post in 2012 to rejoin the Applied Climate Science faculty. His focus since has been on fostering drought management policy internationally and on climate change and its impacts on the state, and in September 2014, he was one of four authors that published “Understanding and Assessing Climate Change: Implications for Nebraska.”

“This report has attracted a great deal of attention across the state and has resulted in numerous initiatives on- and off-campus to identify adaptation and mitigation actions for specific sectors,” he wrote in his faculty profile. Sector-based roundtable discussions that followed resulted in a summary report, released in early 2016, which Wilhite hopes will

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