**Condition Change: UC ANR contributed to increased preparedness and resilience to extreme weather and climate change**

**Issue**

The associated effects of climate change are increasing the risk of extreme weather events that negatively impact California’s ecosystems and communities. Because of our changing climate, rangelands, forests and peri-urban areas are experiencing the effects of intense wildfires and persistent droughts. Land managers and land owners need effective response and adaptation strategies to best manage the land so they are better prepared to deal with the growing risks. Communities need to be better prepared to deal with the growing risks of hazards from fires and droughts.

**Methods**

UC ANR collaborates with agencies and land owners that have been impacted by catastrophic fires and droughts and provides science-based information to aid in recovery and prevention efforts and develop improved practices.

Research at the UC Davis Agriculture Experiment Station (AES) location is testing alfalfa and forage grasses and available germplasm from around the globe to help growers select successful species and varieties for now and the future. Growers are benefitting by understanding which varieties are adaptable to drought conditions and can optimize use of limited water resources(Charles Brummer and Dan Putnam). In another project, research has shown that the reporting time of snow melt and summer rainfall appears to influence reproduction of pest squirrels and projects that climate change will impact reproduction rate of these vertebrate pests (Van Vuren). Another AES project at the UC Davis location is modeling the risks and benefits of moving species in response to climate change. To date the model has identified scenarios of when to move species to increase diversity and when the risks are too great (Marissa Baskett). An AES project at the UC Berkeley location is focused on understanding the resilience of forest trees to drought. Scientists are mapping the geographic distribution of the 98 tree species in California, and documenting their mortality during the 2012-2016 drought (Inez Fung).

A network of University of California Cooperative Extension (UCCE) scientists helped conduct California’s Fourth Climate Assessment. Regional outreach workshops were then held to share resources and support adaptation planning. One UCCE scientist organized a public workshop in the North Coast Region of California (Ted Grantham).

After the devastating Camp Fire in 2018 forage crops were covered in ash, growers were unsure if the crops were safe for dairy cattle. A collaborative effort to collect samples from hay, pasture, and corn silage crops were analyzed with a veterinary toxicologist. Results were interpreted and shared with clientele, and with local agencies through the Camp Fire Research Symposium (Betsy Karle).

A long-term forage production project tracks forage quality, forage production, and future impacts of drought and climate change. Results are summarized each year in an annual report. With partners the results were presented to 62 participants at two workshops in Solvang and Tulare, titled 2019 CA Rangeland Climate & Drought Workshops Weather, Grass and Drought: Planning for Uncertainty (Royce Larsen).

In partnership with local individuals and non-profits UCCE scientists gathered over 30 individuals from local businesses, organizations, and government agencies involved in the emergency food response efforts in the wake of fires in Santa Rosa for an Emergency Food Response Convening. Participants shared expertise, discussed how to prepare for the future, and worked to align efforts for emergency food response. One UCCE advisorcoded the data, co-authored a summary report, and shared findings with the County of Sonoma Board of Supervisors (Julia Van Soelen Kim).

UC ANR scientists conducted research, outreach, and education projects identifying the need for guidance and training for prescribed fire operations as a management tool (Rob York). Three workshops with a focus on fire ecology, safety, planning and prescribed fire were held in San Benito County.  One training included a three acre live-fire burn as part of an integrated approach to controlling yellow starthistle and mustard (Devii Rao). In another part of the state, a scientist developed a collaborative working relationship with fire safe councils, small forest landowners, and community groups, through outreach, presentations, and technical assistance on hazardous fuel reduction and forest stewardship supporting the development of the Meadow Valley Firewise Community (Ryan Tompkins). Two academics organized thirteen prescribed burns and successfully demonstrated using fire to treat over 1,100 acres across the state. In 2018, the academics formed the Humboldt County Prescribed Burn Association. Additionally, workshops and live-fire trainings in other counties have spurred movement toward the creation of at least 15 other prescribed burn associations across the state (Lenya Quinn-Davidson and Jeffery Stackhouse).

Another scientist has continued collaboration with local and international scientists on research to better understand home loss from wildfires and strengthen the materials used by California land use planning professionals. The scientist used data on structure ignition patterns, weather conditions during wildfires, and fire progression maps, and statistical analyses to improve understanding of why home losses occur. These efforts have resulted in new insights about structure losses and how that may influence fire-related land use planning decisions (Max Moritz).

Leadership has also been provided in fire resiliency by documenting home loss in the cities of Santa Rosa, Redding, and Paradise, sharing knowledge on home loss and the intersection of landscaping and home design with local, national and international media, hosting numerous educational events and advising and working with policy makers and agencies (Yana Valachovic and Stephanie Quarles).

As a result of UC ANR research and extension, participants learned and adopted practices that lead to improved preparedness and resiliency to climate change and extreme weather.  Outcomes with specific measured indicators follow.

**Outcomes**

**Participants gained understanding of strategies to respond to climate change and extreme weather.**

* Of 200 workshop participants from local government, tribes, and non-governmental organizations in the North Coast Regional workshop on climate change, 90% gained a better understanding of regional vulnerabilities to climate change and 77% learned strategies for local climate action. (Ted Grantham)
* The toxicology test results showed clientele and agency staff that there was no contamination to the forage crops from the fires. It was important to verify the safety and quality of the crops, as toxicological impacts could have been financially devastating to the $6.37 billion industry. (Betsy Karle)
* Participants in the Rangeland Climate and Drought Workshops reported they will use what they learned to update their drought plans. Additionally, the annual reports are used by Agricultural Commissioners and Farm Service Agency personnel in Monterey, San Luis Obispo, and Santa Barbara Counties to understand the severity of droughts when they occur. (Royce Larsen)

 **Participants intend to adopt prescribed fire practices.**

* The prescribed fire workshops led to a change in attitudes and likelihood to participate in prescribed fire activities in the future. When asked, “What ways might you consider being involved in prescribed burning?” 44% said they would become a member of a Prescribed Burn Association if we had one, and 33% said they would be willing to help develop a prescribed burn association. (Devii Rao)

**Participants adopted prescribed fire practices.**

* Support from UC ANR led to the development of the Plumas Underburn Cooperative, which has helped local landowners burn safely to reduce hazardous fuels. Additionally, the cooperative was able to secure grant funding for equipment and tools and support burn planning and workshops to be delivered in 2020. (Lenya Quinn-Davidson, Jeff Stackhouse, Ryan Tompkins)

**Science-based information was applied to policy and decision making.**

* Outcomes from the Emergency Food Response Convening included the inclusion of emergency food response in the County’s Recovery and Resiliency Framework. Longer term anticipated outcomes include improved efforts during future disasters. (Julia Van Soelen Kim)
* Three bills, which were influenced by UC ANR's work on prescribed fire were signed into law in 2019:
	+ 1) SB 901, which includes $200 million per year for the next five years to fund forest health and fire prevention work, including prescribed fire along with key support for oak woodland restoration. (Yana Valachovic)
	+ 2) SB 1260, which is focused primarily on prescribed fire and includes pieces on liability and training
	+ 3) AB 2091, which mandates the development of new insurance options for prescribed fire. (Lenya Quinn-Davidson and Jeffery Stackhouse)
* Policies shaped by UC ANR research to improve fire resiliency led to another bill that was signed into law in 2019: AB 38, which includes a funding mechanism to help retrofit homes to meet the new wildfire resilience standards. Policy work has also led to the commitment to standardize defensible space inspection training. (Yana Valachovic)
* Research to better understand home loss from wildfires helped refine CALFIRE’s post-fire assessment protocols.  Work in this area has also led to discussions with legislative staffers in Sacramento, who are eager to identify policy improvements concerning fire and land use planning through SB 182. (Max Moritz)
* CALFIRE is also using the UCCE's updated statewide fire probability models and maps as part of their avoided greenhouse gas emissions program. The models are used to estimate how fuel reduction treatments funded by CAL FIRE would lessen future fire severity and emissions. (Max Moritz)
* UC ANR's work also contributed to the development of new guidelines from the California Department of Forestry and Fire Protection for fire suppression personnel throughout the state. The guidelines are designed to make permitting and prescribed fire operations more consistent across the state. (Rob York)
* UC ANR's work on prescribed fire has led to the development of a new statewide program called California Prescribed Burn Boss Certification. Through this program individuals can be certified as experienced prescribed burn experts. This is a major development toward facilitating prescribed burning in California. (Rob York and Lenya Quinn Davidson)

The aforementioned measured outcomes demonstrate participants learning about and developing new management paradigms to address the challenges that come with a changing climate. There is much work to be done, in 2018, nearly 2 million acres burned and over 24,000 structures were damaged or destroyed in California. New legislation and policy informed by UC ANR’s science-based research will help increase forest and rangeland resiliency and decrease the impact of fires and droughts. In these UC ANR contributes to building climate resilient communities and ecosystems.