BY EMILY BROOKS AND DANIEL WINKLER

ADAPTING TO EXTREMES

DESERT COMMUNITIES AND WATER SCARCITY

Southern California, like much of the desert southwest, has recently emerged from a decades-long drought that impacted not only natural systems, but also the desert economies and communities that rely on them. This year, as the drought "state of emergency" came to a close, desert regions saw a superbloom of wildflowers in response to dramatic winter rains in places that had been dry for years. The superbloom was a welcome event, but it also focused residents' concerns about the future of their communities under climate change. Topics like the precariousness of seasonal economies, control of tourism-oriented growth, and planning for the future under environmental uncertainty gained traction in mainstream media.

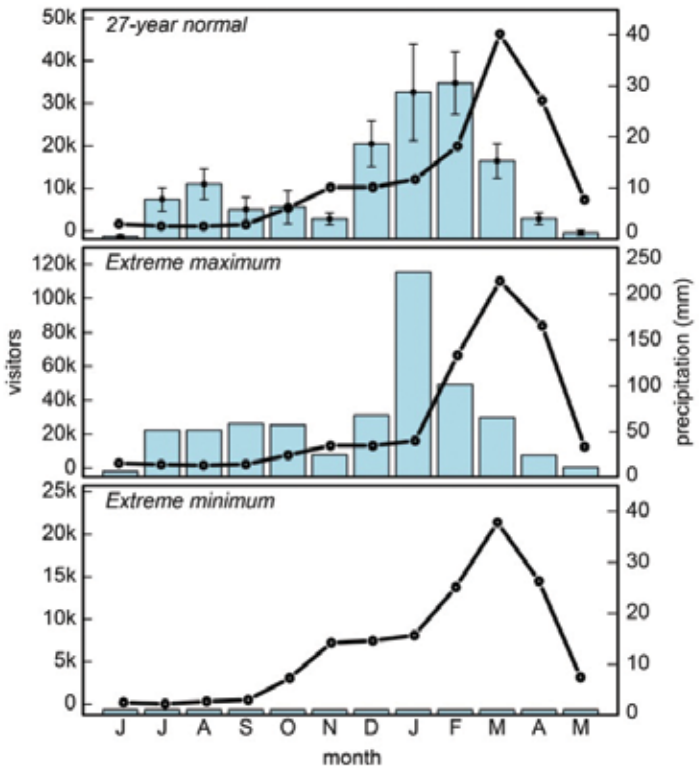

Figure 1: Twenty-seven year visitation data (black lines) at Anza-Borrego Desert State Park with monthly precipitation (blue bars) illustrated as the average across all years (upper panel), extreme maximum (middle panel), and extreme minimum number of visitors (lower panel) in relation to precipitation. Note changes in scales for each panel.

Our comments here are part of a larger interdisciplinary research project based in the Anza-Borrego Desert, in which we look at the connections between desert plants and desert people in an extreme, water-scarce environment. Deserts seem like extreme environments from a human-centered perspective, but they're also sensitive ecologies with their own set of norms. Water scarcity presents biological, socioeconomic, and cultural challenges for desert residents of all kinds. Just like plants and animals adapt to desert norms, people shift their ways of life to fit their environment and respond to its changes.

Biological Extremes: Adapted to Waiting

Desert wildflower species often have differing life history strategies that correspond to ideal conditions for germination and growth. Most winter wildflowers are annuals that complete their entire life cycle in only a few short months. Early season species typically respond to sparse rains in October and November, and initiate growth before the heavier winter rains set in. If heavier rains do not appear, many mid- and late-season species will remain dormant in the soil, and await next year's potential rains. Those that start growing will produce flowers as quickly as possible to produce at least a few seeds for next year.

In extremely good years, most species will flourish and produce seeds that will either germinate the following growing season, or remain dormant in the soil until drought years are past. Other species are not adapted to waiting, and cannot survive without minimal rain. Thus, how long a drought lasts has important implications for plant community composition depending on which species exist in the soil seed bank and how long they can withstand periods of drought. This pattern breaks down as human beings introduce invasive species that occupy substantial portions of seed banks and physical space. The survival of native plants remains unclear, especially if drought persists longer than native seeds are capable of dealing with.

Socio-Economic Extremes: An Economy Responsive to Rain

The local economies of Borrego Springs and many other desert communities are linked to the dramatic winter wildflower blooms that attract thousands of visitors. These economies are threatened by a loss of biodiversity resulting from climate change and invasive plants. These communities will likely face challenges if tourism declines along with wildflower displays. Visitation data over a twenty-seven year period highlights the dominant role of precipitation in driving tourism in Anza-Borrego State Park (Figure 1).

Average values reveal a close link between monthly average rainfall and average visitation to the Park (Figure 1 upper panel). Visitation peaks in March with an average of 46,000 visitors, preceded by winter rainfall that stimulates wildflower blooms. The extreme maximums found in the middle panel of Figure 1 reveal that increased precipitation corresponds to increased visitation *(note change in axes scales for precipitation and visitation)*. Visitors still arrived during years with very low precipitation, but in drastically reduced numbers (Figure 1 lower panel). Visitation in these dry years can likely be attributed to the many other recreational opportunities in the park, such as hiking and community events.

Similar trends show up across the Desert Southwest (Figure 2). Visitors, like desert wild-flowers, begin to arrive at state and national parks, preserves, and monuments as the rains appear in late fall and peak in early spring. Above average visitation occurs as wildflower displays are underway in nearly all of the desert parks. Combined, our data suggest what many locals already know: the economies of Borrego Springs and many desert communities rely heavily on seasonal tourism centered on various recreational opportunities, but the regular wildflower blooms are a primary attraction.

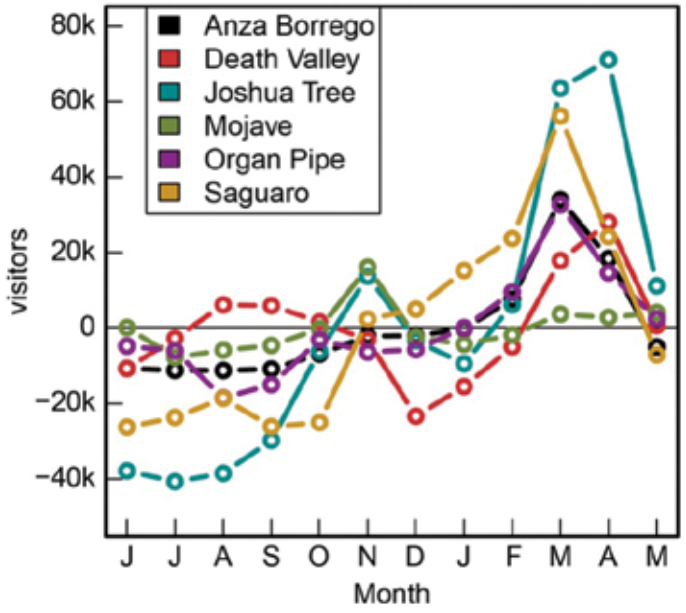

Figure 2: Southwest park visitation by month

Cultural Extremes: Borregon extremophiles

Alongside our quantitative data, we also gathered qualitative data from community histories and interviews with residents to examine how climate extremes impact social, political, and cultural life.

First, seasonal fluctuations in weather and climate drive the "seasonal round" of Borrego Springs: the normative activities and practices that make up community members' daily lives. The wildflower blooms driving spring tourism booms are just one example. Residents also describe potential flash floods determining which roads they use in late summer, mild weather marking the return of "snowbird" residents and the ideal time for civic engagement in mid-winter, and so on. Locals are (both by necessity and by choice) keenly aware of how small environmental changes impact nearly all aspects of social life.

Second, the Borrego Valley Groundwater Basin depends solely on local groundwater, which isolates Borrego Springs both hydrologically and politically from its neighbors. While a history of high pumping (and a persistent belief among some that the water supply was functionally infinite) have led to an overdraft, it is still possible for residents to bring water use into sustainable balance without importation or desalination. Water managers here face the same challenges as their counterparts in other desert communities. Statewide drought and groundwater sustainability mandates assume that water scarcity is exceptional, but here in the desert, as locals say, "We're always in a drought."

Third, many locals share a personal and community identification with desert extremophile lifestyles. Their self-identification as "desert people" or "desert rats" is based on specific cultural practices, such as adapting the human environment by using swamp coolers, deploying expert knowledge in knowing how to work outside in summer, and engaging in social activities like volunteering with service organizations or admiring a beautiful desert view. These practices are likely to shift or become vulnerable in response to climate change. When residents talk about their hopes and fears for the future, they wonder if this sense of community will disappear.

Conclusions

As the Anza-Borrego Desert weathers an abnormally warm summer and looks ahead to another wet winter, our understanding of local norms and extremes shifts along with our previous baselines. What will the future of this interlinked biological, socio-economic, and cultural system look like under climate change? Desert communities will be tested on their flexibility to respond to climate change and uncertain forecasts; a difficult thing to achieve when economic planning can require years of preparation.

One potential cultural adaptation comes from mobilizing the power behind the personal identification many residents feel with the desert and its extremes. This sense of shared desert culture shapes nearly all aspects of how locals think about themselves as members of a community; how they decide what is worth protecting and promoting to visitors; and how they make difficult choices to plan for an even more extreme future.

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