Wagers winter plants make to survive

March 26 2019, by Emily Walla

From left: Ge and Basinger examined wild winter annual plants on one of dozens of plots that have been continuously monitored for 37 years. "This is one of our more dangerous plots, because of the cholla," Basinger said. Credit: University of Arizona

Spend water or save water? Grow or reproduce? For the tiny desert plants that bloom during the winter, the choices are life-or-death

gambles, and ecologists at the University of Arizona have identified the wagers that will win.

Xing-yue Monica Ge, a graduate student in the UA Department of Ecology and Evolutionary Biology, studied more than 50 species and analyzed data spanning more than 30 years to find that only plants that closely follow a tradeoff of water use and reproduction will thrive in the desert.

Previous research done at the UA's Desert Laboratory on Tumamoc Hill identified the tradeoff by studying nine common species of winter annuals on Tumamoc Hill. Ge's research investigated this tradeoff for the entire community of winter annual plants around the Desert Laboratory.

The study, published in the prestigious journal *Ecology Letters*, found that in the face of varying temperatures and rainfall, the best balance falls along the tradeoff between growth and water-use efficiency. Plants either conserve their water and grow slowly and steadily throughout the winter, or they spend water by closely tracking rainfall and growing rapidly in response to precipitation.

"Plants must balance water and nutrient allocation to rapid growth or water conservation," Ge said.

"Plants that don't perfectly fit on the tradeoff do occur in this ecosystem, but they cannot thrive," added Ursula Basinger, one of Ge's co-authors and a UA graduate and ecology research specialist.

Ge, Basinger and the other co-authors—UA graduate student Joshua Scholl, Desert Laboratory on Tumamoc Hill Director of Research Lawrence Venable and Travis Huxman, professor of ecology and evolutionary biology at the University of California, Irvine—found that

the desert annual plants' diversity has kept the community robust as the climate has shifted.

"In these three decades, we have seen climate change: we see temperatures go up, we see precipitation go down. The trend indicates the desert is getting warmer and drier," Ge said.

The Desert Laboratory's careful monitoring of the plant community allowed Ge and her team to see how the plant community was evolving to cope with the changes by tracking which species were most abundant in each year.

"Plant species are skewing more to the water-use efficiency side, because they need to conserve their resources," Basinger said.

However, these water-efficient plants still hug the fine line of the tradeoff, balancing water and growth in the same way as water-efficient plants that are abundant even in wet winters.

"This is the most interesting result to us, since it shows that regardless of which species are currently common, they still follow this general rule," Ge said.

Ecologists often observe that diverse communities are more resilient than less diverse systems, but detailed, decade-spanning datasets needed to execute studies that scientifically support these observations are rare.

In ecological studies like Ge's, "long-term datasets are gold," said Benjamin Wilder, director of Tumamoc Hill. "In that sense, the Desert Lab is a treasure chest."

More information: Xing-Yue M. Ge et al, Functional trait trade-off and species abundance: insights from a multi-decadal study, *Ecology*

Letters (2019). DOI: 10.1111/ele.13217