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# Adapting to the Desert

UNLV Fusion staff writer

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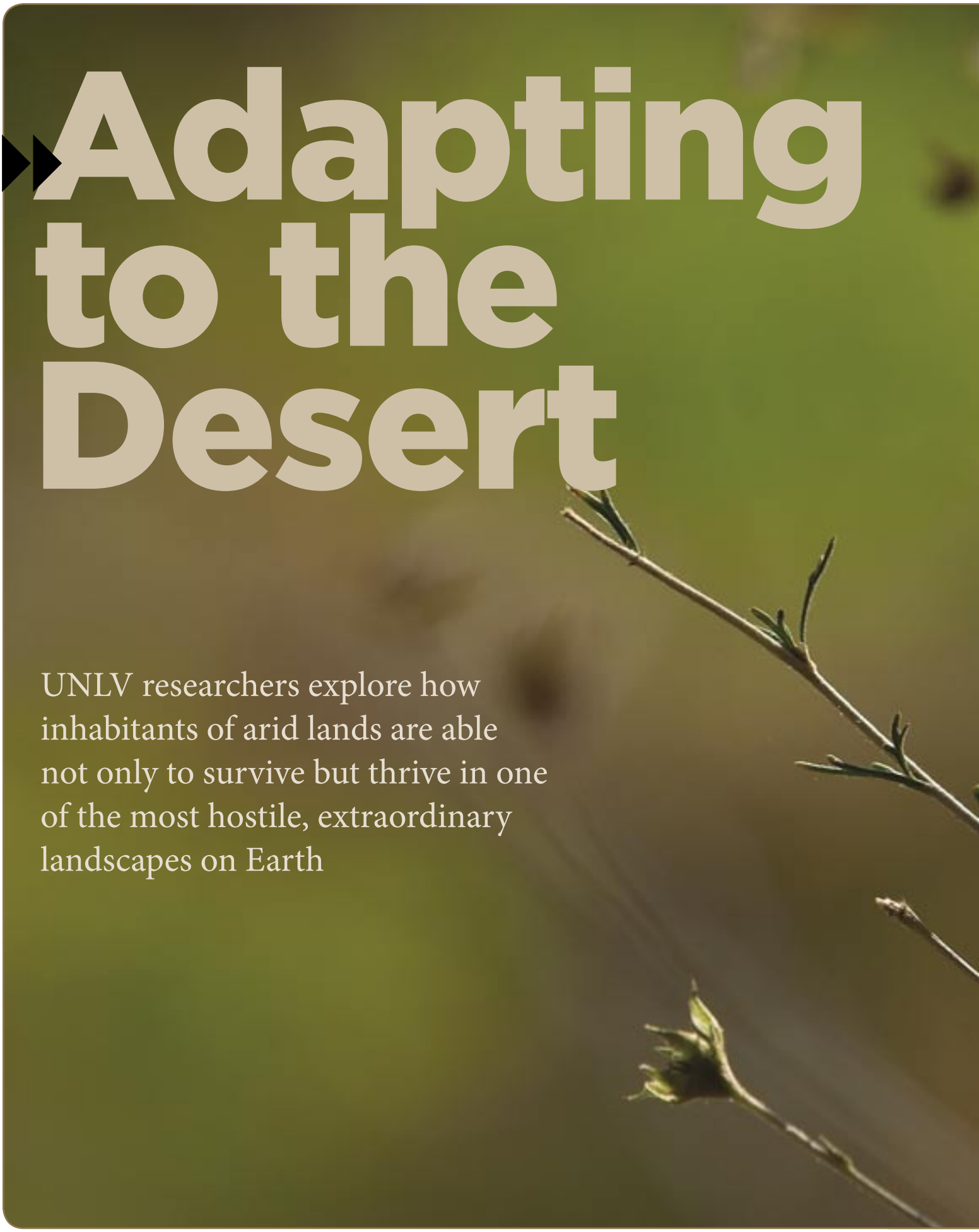
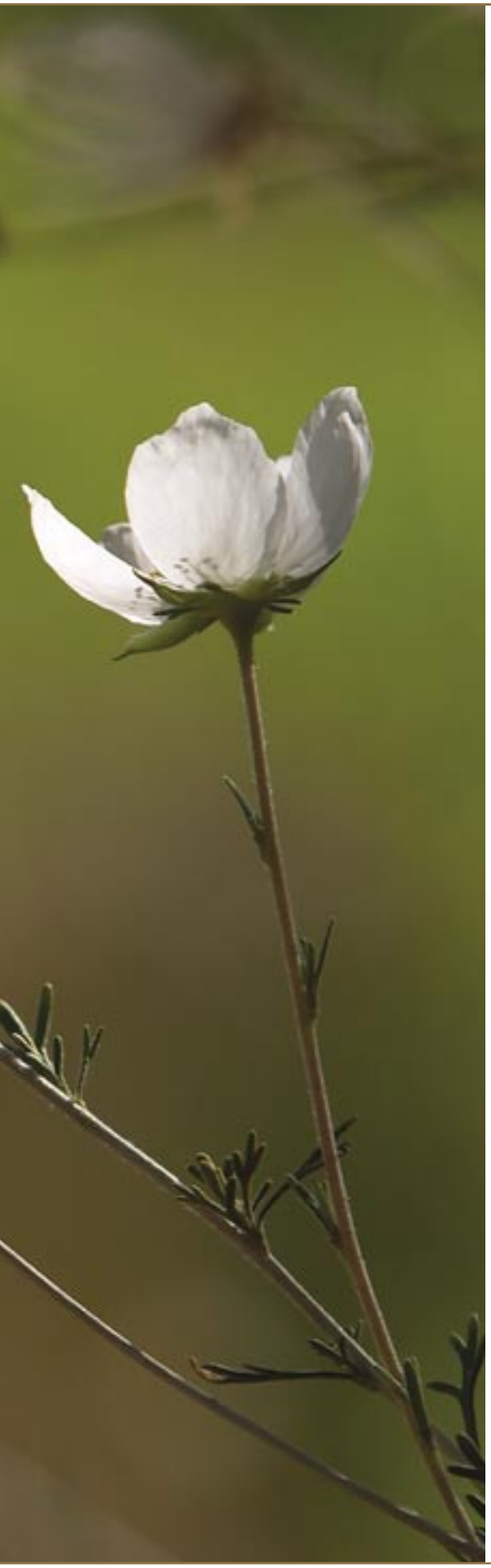
UNLV researchers explore how inhabitants of arid lands are able not only to survive but thrive in one of the most hostile, extraordinary landscapes on Earth





PHOTOGRAPHY BY GERI KODEY

On a scorching day in July, the Mojave Desert might seem an uninviting, barren wasteland to the casual observer. But to UNLV researchers, the desert is an amazing resource and far from barren. On the contrary, they find it remarkably fertile ground — for research.

They know that America's Southwest deserts are complex yet delicate ecosystems where unique species of plants and animals continue to thrive despite some of the most extreme climate conditions in the world.

"This may not be a very comfortable place for the native Mojave plants, animals and microbes, but it's great for biologists interested in how living systems cope with extreme and otherwise stressful environmental conditions," says UNLV biological sciences professor Peter Starkweather. He adds that the study of the desert's natural environment is of vital importance, as it provides us with great insight into how its inhabitants are able to survive and adapt, and how living systems in general respond to extreme conditions.

Starkweather and several of his biological sciences colleagues are focusing their research in this area as part of UNLV's Integrated Approaches to Abiotic Stress Program (IAAS), which is dedicated to discovering how organisms adapt to the stresses of a variety of non-living — or "abiotic" — components of the desert environment (e.g., wind, heat, cold, drought, and salinity). Their findings may one day influence the preservation, protection, and maintenance of the world's many arid regions.

The abiotic stress initiative relies on faculty research strengths available throughout the Nevada System of Higher Education. The program is part of a statewide National Science Foundation EPSCoR project known locally as RING TRUE II, which stands for "Research Infrastructure for Nevada's Growth: Targeting Research with Uniqueness and Excellence." (See related article, "About EPSCoR.") More than 30 researchers from several Nevada institutions — including UNLV, the University of Nevada, Reno, and the Desert Research Institute — participate in the program.

Initiated in 2002, the IAAS program has already produced a number of major accomplishments, including:

- 79 peer-reviewed scientific papers.
- $27 million in competitive federal and other research grants (22 percent from the National Science Foundation).
- Supervised training of eight postdoctoral scholars, 18 graduate students, and 31 undergraduate students.
- Three Nevada-hosted research symposia attended by international scholars and NSF representatives.
- Contributions to start-up packages for nine newly hired faculty members.

About 15 UNLV faculty members have been working with their students on IAAS research projects. Just a few examples of their projects are noted below and serve to illustrate the nature and scope of IAAS research.

■ Biological sciences professors Carl Reiber and Peter Starkweather examine organisms that come to life in the temporary pools that form in the desert after it rains. These organisms, such as fairy shrimp and tadpole shrimp, emerge from once-dormant eggs that reside on dry desert land until a sudden shower provides them with the watery environment necessary for hatching. Then, they live out their entire existence in these shallow, ephemeral pools. "We are not exactly sure why, but the drying period of dormancy is necessary for them to come to life," Reiber says. "So the desert climate is critical to their existence. And with the research capabilities we have at UNLV, we are now able to explore the genes that take them in and out of dormancy. No one has yet been able to identify how this mechanism works in these creatures." Reiber adds that this study seeks to shed light on how the early stages of development in these life forms are influenced by the stresses of the desert. »»»

■ Penny Amy, professor of biological sciences, studies the ecology and physiology of bacterial survival in the environment. She focuses on the processes used by bacteria to adapt to specific environments; in particular, she examines the influence of microbes on corrosion/degradation processes occurring deep below the Earth's surface. "The subsurface environment is as different from the Earth's surface as another planet," Amy says. "Yet, through our research, we have discovered that there are more deep, subsurface organisms than surface organisms." Working with a number of graduate students, Amy has led the effort in applying the results of this study to a significant issue in Nevada: the Yucca Mountain Nuclear Repository. "This research has led to considerable design changes in the containment of nuclear waste to be stored in Yucca Mountain and allowed for the optimal longevity of containment packages that will be placed in that location." Amy and her team also study the microbes that pollute the natural waters of Southern Nevada and are seeking ways to improve water quality.

■ Biological sciences professors Steven de Belle and Stephen Roberts study fruit flies as a genetic model system of how stress affects organisms. "There are many biological indicators of stress, including hormone levels, behavior, and temperament," de Belle says. "What people need to understand is that although fruit flies are anatomically very different from other animals, it does not mean that they are genetically different from other animals; in fact, the metabolic process is the same." Both de Belle and Roberts have discovered that stress does compromise the ability of the brain in fruit flies to mediate learning and memory. "If we can take fruit flies under stress out in the field and determine that improving their environment will also improve their brains' capacity to learn and remember, then we may develop a clearer perspective on the very heated debate over 'nature versus nurture,'" he says, referring to the controversy over whether heredity or experience is more important to an organism's development. He hopes to add to the body of knowledge in biology that seeks to educate the public about the stress society places on natural environments and the resulting compromise all organisms may experience as a consequence.

■ Biological sciences professor Dawn Neuman leads a team investigating plant responses to environmental stress; she is examining how roots and shoots are integrated under a changing environment. As she continues her research with undergraduate and graduate students, Neuman hopes to create an understanding of how plants react to stress in order to enhance the overall knowledge of crop performance and plant survival in a natural environment. "Abiotic stress response," Neuman notes, "is the driving force for species survival."

Such projects, and the IAAS program in general, have had an enormous impact on the UNLV biological sciences department, as well as the College of Sciences, according to Ronald Yasbin, dean of the college.

"The departments are interdependent. When one does well it helps everyone," Yasbin says, adding that the program has attracted a number of internationally recognized faculty members and provided significant start-up research support for new biology faculty members.

Reiber, who is also the chair of the biological sciences department, adds that the success of this kind of program helps build the reputation of the university as a whole.

"I believe the individuals in the biological sciences department have collectively created an outstanding program that is bringing greater recognition to UNLV. We have an incredible team, including faculty, post-docs, and graduate students, who are attending international conferences and are receiving substantial grant funding. The larger academic community is taking notice."

## About EPSCoR

UNLV is an active participant in the federally funded Experimental Program to Stimulate Competitive Research, or EPSCoR. Established by the National Science Foundation in 1978, EPSCoR was launched to promote the scientific expertise of university faculty and students in regions comparatively underfunded by federal agencies. Twenty-five states, including Nevada, have been designated as eligible for EPSCoR support.

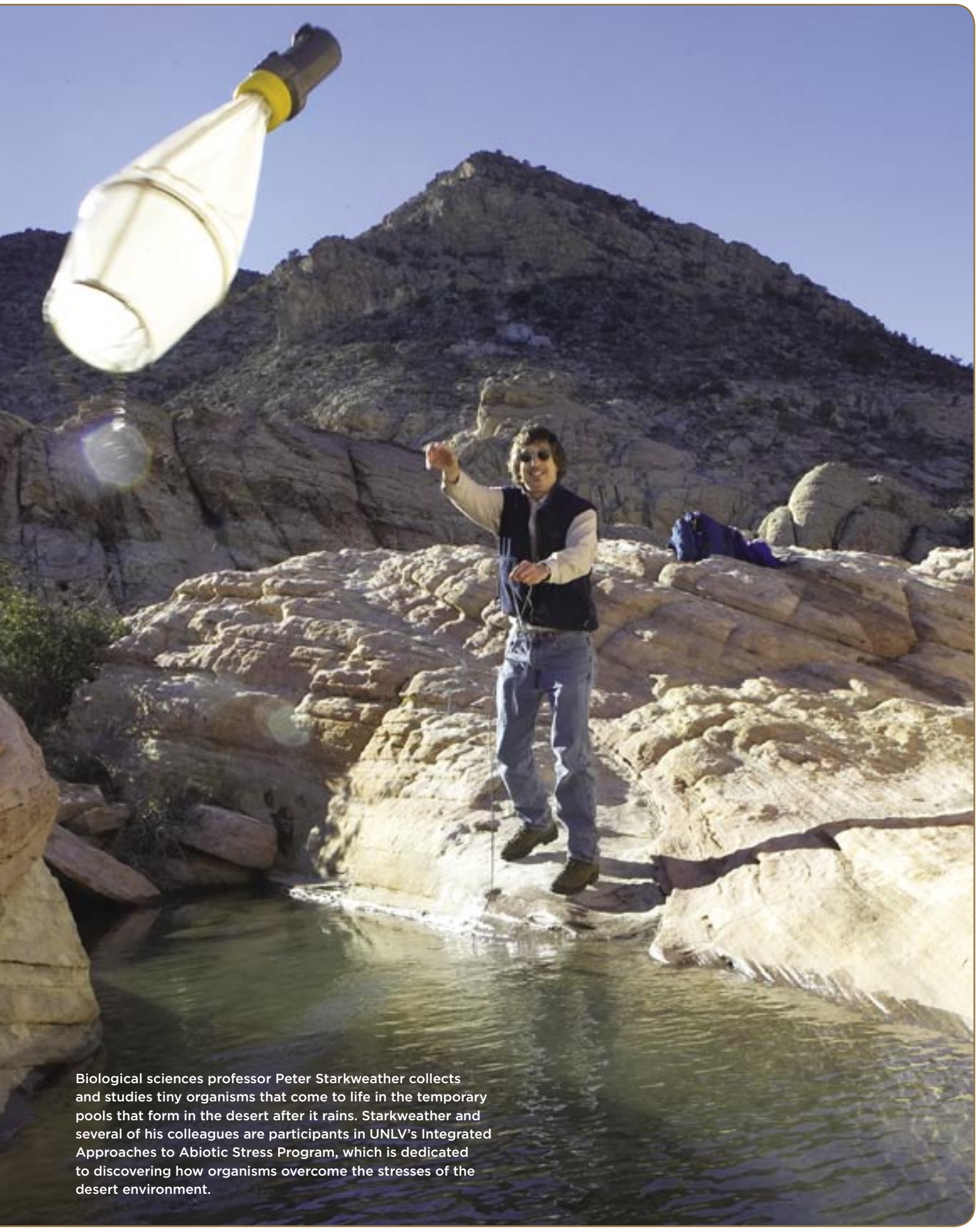
The program seeks to enhance involved states' "academic research infrastructure and research competitiveness," particularly in subject areas that serve the national interest. Ultimately, this is intended to increase the quality of scientific research nationwide as all universities become more equally equipped to compete for federal and private sector support. Several federal funding agencies, such as the Environmental Protection Agency, the National Institutes of Health, and NASA, have adopted their own EPSCoR or EPSCoR-like programs in recent years to stimulate research.

Since 1985 — when UNLV received the state's first EPSCoR award — a total of more than $73 million in the program's funding has been directed to the research enterprise in Nevada.

One example of a successful EPSCoR research project currently under way in Nevada is Ring True II (Research Infrastructure for Nevada Growth: Targeting Research with Uniqueness and Excellence). UNLV has partnered with the University of Nevada, Reno, and the Desert Research Institute for this project; the institutions are currently completing the third year of the three-year $9 million infrastructure-building award from EPSCoR.

Ring True II involves research being conducted in three major areas: Nanostructured Materials and Devices, Advanced Computing for Environmental Science, and Integrated Approaches to Abiotic Stress. UNLV chemistry professor Dennis Lindle serves as the Nevada NSF EPSCoR director for the Ring True II project.

UNLV participates in a number of other EPSCoR-funded projects that build on the state's unique resources and existing strengths and that foster interdisciplinary and interinstitutional collaborations. These collaborations typically lead to sharing of both equipment and expertise, making EPSCoR programs efficient at maximizing resources within a given state.



Biological sciences professor Peter Starkweather collects and studies tiny organisms that come to life in the temporary pools that form in the desert after it rains. Starkweather and several of his colleagues are participants in UNLV's Integrated Approaches to Abiotic Stress Program, which is dedicated to discovering how organisms overcome the stresses of the desert environment.