

Plant Biology

Boechera, Why are you so Cool?

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[Kipling](#) once said: "Only mad-dogs and Englishmen go out in the noon day sun". To this list we can also add plants they are out in the noon day sun because they are not able to move to the shade when things get hot. Plants must survive, grow, and reproduce, wherever their seed germinates.

We have long known that high temperatures, for instance, a heat wave of 32 °C or higher, can disrupt how plants get their food ([photosynthesis](#)) and how they make baby plants ([pollination](#)). The impact of heat stress on plants can be seen in reductions in crop yield in agricultural fields during hot summers. But heat stress is also a big problem for wild or native plants. As our climate warms heat waves have become more intense. Each year we are recording more and more record highs. Heat waves are not just getting hotter they are also lasting longer, weeks instead of days. All of this is very stressful for plants and could drive many of our native species to extinction.

This research project was motivated by a few simple questions: How do plants respond to heat stress in nature? Have some plants figured out how to survive heat waves? And if so will this information useful in making crop species more tolerant to heat waves?

The goal of this research was to examine a group of native California mustard plants that live in different habitats and understand how they respond to heat stress. Seeds were collected from natural populations of different species of California mustards in the [Boechera genus](#). We collected seeds from plants that live in the [Mojave](#) and [Anza Borrego](#) deserts, plants that live in [coastal chaparral regions](#), and plants that live at high mountain tops in the [Sierra Nevada Mountains](#). We grew the plants in

our lab and exposed them to temperatures from 38 °C (100 °F) up to 47 °C (117 °F). All of the *Boechera* plants were able to tolerate heat above 38 °C. But what was both surprising and exciting was that we discovered that some of the native California mustards are perfectly happy at temperatures as high as 47 °C.

The species that is the most tolerant to heat did not come from the deserts, as we had predicted before the start of the experiment, but in fact had been collected from a very high mountain top in the Sierra Nevada Mountains. This plant ([B. depauperata](#)) is able to continue making its own food (photosynthesizing) after hours at 47 °C. It can also repair cellular damage it experiences at these high temperatures.

"Heat Shock" is how all organisms respond to high temperature stress. The [Heat Shock Proteins](#) have been called "The Paramedics of the Cell" because they can repair heat-induced cellular damage. We had expected that high levels of these proteins in *Boechera* could explain why it is able to withstand the heat. But when we looked to see if this species (*Boechera depauperata*) was protecting itself with Heat Shock Proteins we found that this is not the case. It appears that *Boechera* is not bothered by the heat and does not need the paramedics of the cell to avoid death.

How does *Boechera* stay so cool? All good scientific studies answer one question and raise ten more. We now have no shortage of new questions to ask about how *Boechera* stays cool. Does it have to do with extra sets of chromosomes? Are their leaves better at cooling off or sweating using their pores or stomates. Answers to these questions could help us keep all plants cool as the world gets hotter.

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from the National Science Foundation to Prof. Elizabeth R. Waters at San Diego State University. She is currently applying for more grants to continue her work on these amazing plants.

All science involves team work. Our *Boechera* team included Gillian Halter, a graduate student at SDSU. Both Nicole Simonetti and Cristy Suguitan were undergraduates at SDSU. Our team also included Jessica Soroksky an undergraduate at Sienna College and Ken Helm, a Professor at Sienna College. The seeds for *Boechera depauperata* were collected by Dr. Alison Colwell.