

**Note: Guidelines were changed from 5000 characters to 2-pages**

## **Heat and Water Stress Impacts on *Zeltnera venusta*, a California Wildflower**

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### **Introduction**

Climate change is one of the biggest global threats and is influencing the ecology and evolution of species. Shifts in temperature are impacting the survival of many species and accelerating biodiversity loss (Abbass et al. 2022). This is detrimental to the lives of all beings on Earth.

San Diego County is a biodiversity hotspot and its variety of species are all threatened by climate change. It's predicted that by the end of the 21st century, temperatures will rise at least 3°C and up to 6°C, and we can expect to see an increase in frequency and intensity of heat waves (Kalansky et al. 2018). Additionally, San Diego can expect to see more frequent and severe droughts with more intense seasonal dryness across the county's landscape (Kalansky et al.

2018). Heat and drought have been found to cause floral trait modification that impacts plant-pollinator interactions (Descamps et al. 2018). As San Diego is one of the many cities that is experiencing these environmental changes, any research findings could serve as a case study for other regions.

Observing how plants are adapting to multiple stressors of climate change will allow us to develop a more complete understanding of what the future holds for these species and can later be used to further adapt conservation methods, ensuring biodiversity preservation.

### **Aims, Goals, and Research Question**

To learn more about how native plants are adapting to these changes, I will focus on an annual herb that is endemic to California, *Zeltnera venusta*, more commonly known as canchalagua. It can be characterized by its radially symmetric, magenta corolla with a white base and bright yellow, and spiraled anthers (Figure 1).

In my research I will determine the effects of heat and water stress on *Zeltnera venusta*. More specifically, I want to observe how the plant's reproductive traits and phenology are impacted and how this might trickle down to changes in reproduction and plant-pollinator interactions.



**Figure 1.** An image taken by Keir Morse of *Zeltnera venusta* with floral characteristics clearly displayed. This image has a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 ([CC BY-NC-SA 3.0](https://creativecommons.org/licenses/by-nc-sa/3.0/)) license.

## Approach

To answer my questions, I will use a sample size of 60 plants divided into 6 groups, each consisting of a unique temperature and water combination (Table 1). The groups will be divided between 3 incubators, set to 18°C, 21°C, and 24°C. The average temperature in San Diego during *Z. venusta*'s flowering period is 18°C and will act as our control temperature. The increased temperatures of 21°C and 24°C based on the predicted temperature rise for 2100 (Kalansky et al. 2018). The plants will be split in half within a water treatment, one group will be well-watered (WW) with normal watering levels that replicate typical precipitation levels of its flowering months while the other will be water-stressed (WS) as it will undergo a 50% water reduction that replicates drought. These plants will be grown in 18°C, WW conditions until germination, where they will be divided and exposed to their respective treatments throughout the rest of their life cycle.

**Table 1.** Experimental setup showing heat and watering treatments and sample sizes associated with reproductive (Repro) and phenological (Pheno) traits.

Treatments	18°C		21°C		24°C	
Well-Watered (WW)	10 plants		10 plants		10 plants	
	Repro	Pheno	Repro	Pheno	Repro	Pheno
	30 flowers (3 per plant)	5 plants	30 flowers (3 per plant)	5 plants	30 flowers (3 per plant)	5 plants
Water-Stressed (WS)	10 plants		10 plants		10 plants	
	Repro	Pheno	Repro	Pheno	Repro	Pheno
	30 flowers (3 per plant)	5 plants	30 flowers (3 per plant)	5 plants	30 flowers (3 per plant)	5 plants

\* Repro - Measured for pollen viability, pollen amount, flower size, and pollen tube growth  
 Pheno - Measured for phenology and pollinator visits

For reproduction, I will look at flower size, pollen viability and number, and in vivo pollen tube growth. For each treatment, 3 flowers from each plant will be selected once their anthers have dehisced and flower size will be measured using a caliper (Table 1). The anthers will be removed and the pollen will be stained for viability, and counted under a microscope to determine the percent of pollen viability (using methods in Arathi & Smith 2023). Limited within each treatment, I will move pollen to pistils of flowers and observe the growth of the pollen tube within each pistil as it indicates reproductive performance. Collected data will be analyzed and used to determine significant differences among treatments.

For the species interactions of *Z. venusta* under two abiotic stressors, I will look at phenology and pollinators. I will record the duration of flowering and the timing of female and male-receptive flowers. Rising temperatures have the potential to influence the phenology but vary greatly due to trait differences among species (Geissler et al. 2023). Due to this, it's important to assess phenology changes for *Z. venusta* and observe any influence from heat and drought. Plant-pollinator interactions will be done in groups of 6, a flowering plant from each treatment. Once exposed to local pollinators, observations will be made of any species that visit the reproductive floral parts for 30-minute periods, 3 times a day; morning, afternoon, and evening for 2 days. I will repeat this process 4 more times to get a total of 5 plants from each treatment (Table 1). The current pollinator of *Z. venusta* is unknown and observations throughout the day allows me to account for a larger variety of pollinator species. After an observation, they will remain in their respective treatments in the incubator to maintain consistency. All data will be sorted and analyzed so that the dominant pollinator, pollination trends, and pollinator interactions can be identified for *Z. venusta*.

## References

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