

Temporal and Spatial Trends on Microclimate for Three Species of Coastal Sage Scrub on the Palos Verdes Peninsula

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Terri Burns taking measurements of an *Encelia californica* plant that is part of this study at Three Sisters Reserve.



Figure 1. USB-502 Data logger



Dawool Huh records while data is downloaded from the logger attached to the *Salvia leucophylla* near Terri Burns.



Location of preserves used for the experiment.

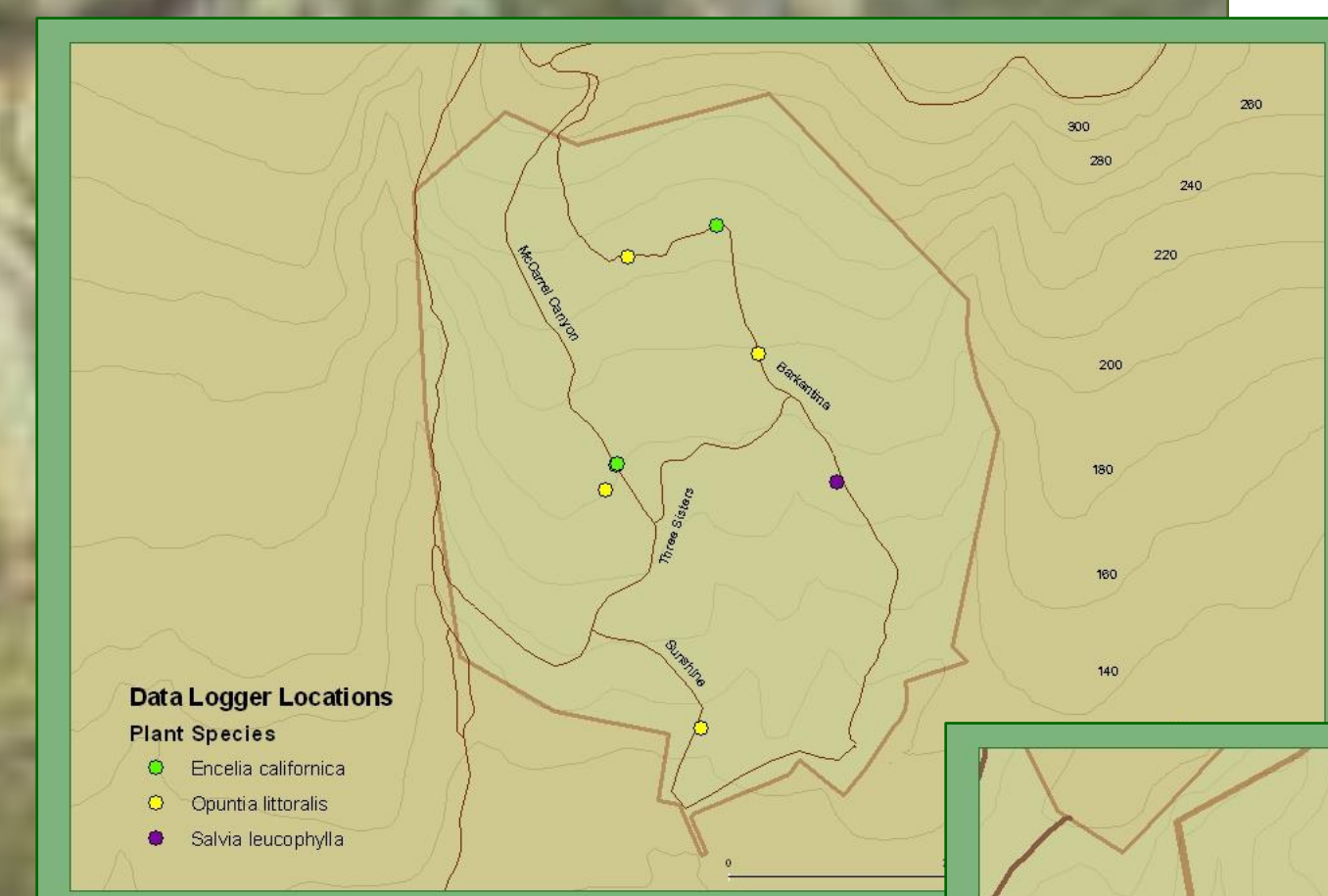


Figure 2. Data logger locations in the Three Sisters Reserve

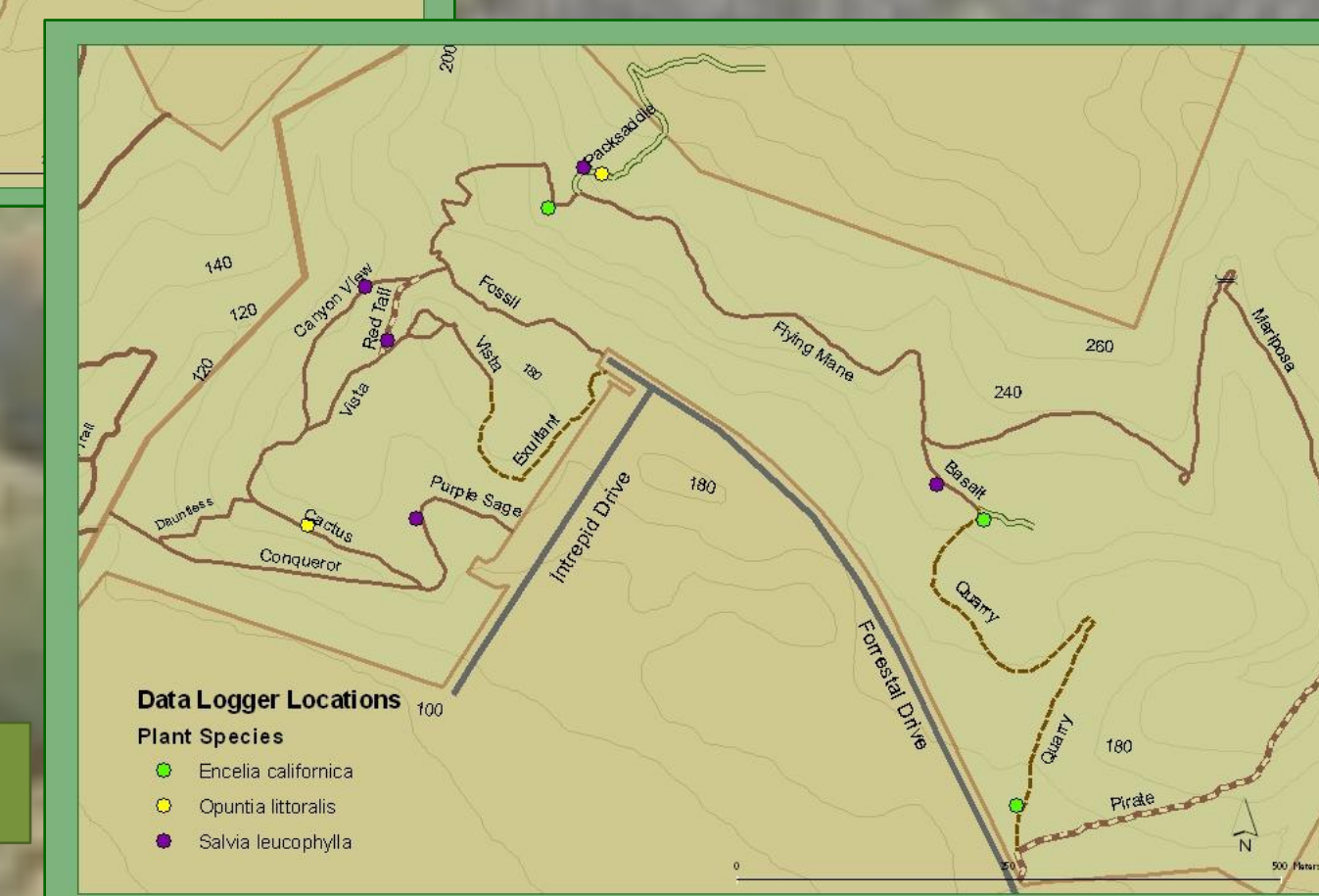


Figure 3. Data logger locations in the Forrestral Reserve

~ Introduction ~

When conducting habitat restoration work, does plant placement of differing species matter? This question was the impetus for this study of climate on a microscale that began in fall 2008.

As an on-going survey within the Palos Verdes Nature Preserve at the Three Sisters and Forrestral Reserves (Figure 1), this project enables us to investigate climate on a microscale, rather than large-scale, which is important for considering responses to climate change (Helmuth 2009, Bennie et al. 2010). The two reserves are located approximately 5 km apart, within the same elevation range.

Our results from 2008-09 showed that *Opuntia littoralis* (prickly pear cactus) occurred in warmer, drier areas while *Salvia leucophylla* (purple sage) occurred in cooler, more humid areas within distances of 10 – 50 m. There were no significant trends for the third plant in our study *Encelia californica* (California bush sunflower).

The following analysis investigates the variation between summer and winter and between the two preserves measured during 2009-2010.

~ Methods ~

Data loggers (Measurement Computing USB-502, Figure 1) recording temperature, relative humidity, and dew point along with a date/time stamp collected at 30-minute intervals, were deployed within various stands of three coastal sage scrub species:

- *Encelia californica* – California bush sunflower
- *Opuntia littoralis* – prickly pear cactus
- *Salvia leucophylla* – purple sage

The selected stands were located within two reserves of the Palos Verdes Nature Preserve, Three Sisters and Forrestral (Figures 2 & 3). Daily average, maximum, and minimum values were computed for temperature, relative humidity, and dew point. Temporal trends were investigated by comparing variation within species in summer (Jun – Aug) and in winter (Dec – Feb) using a t-test on the standard deviation values. Spatial trends were investigated by comparing variation within species between the two reserves, Forrestral and Three Sisters using a t-test or the Mann Whitney Rank Sum Test for non-normal data.

Table 1. Temporal comparison showing more variability occurs primarily in winter, with significant values bolded.

	<i>Encelia californica</i>		<i>Opuntia littoralis</i>		<i>Salvia leucophylla</i>		P value
	Sum	Win	Sum	Win	Sum	Win	
Temperature (C)							
Avg SD	2.373	2.886	2.589	3.136	5.103	4.104	0.984
Max SD	3.785	7.148	4.625	7.02	4.139	6.313	0.002
Min SD	2.326	2.164	2.047	2.659	2.066	2.277	0.276
Relative Humidity (%)							
Avg SD	10.793	16.723	10.891	20.47	11.565	19.852	0.003
Max SD	7.011	16.269	7.763	16.48	8.037	12.509	0.005
Min SD	10.934	19.468	11.359	20.857	9.426	20.267	<0.001
Dew Point (C)							
Avg SD	2.119	3.071	2.074	3.44	2.324	3.416	<0.001
Max SD	1.529	4.645	1.732	3.314	1.697	3.775	0.005
Min SD	3.93	13.481	4.112	4.382	5.094	4.215	0.388

Table 2. Results of statistical comparison of average temperature, relative humidity, and dew point between the Three Sisters and Forrestral Reserves.

	Average Temperature			Average Relative Humidity			Average Dew Point		
	N	Median	P	N	Median	P	N	Median	P
<i>Encelia californica</i>									
Three Sisters	55	15.267	0.005	55	71.229	0.706	55	9.363	0.100
Forrestral	55	14.125		55	72.979		55	8.455	
<i>Opuntia littoralis</i>									
Three Sisters	139	19.958	0.569	139	72.849	<0.001	139	14.129	0.270
Forrestral	139	20.255		139	69.632		139	13.790	
<i>Salvia leucophylla</i> *									
Three Sisters	208	19.205	0.483	210	75.078	<0.001	209	13.729	0.748
Forrestral	208	20.023		210	71.975		209	13.324	

* Average temperature was tested with the t-test

~ Results ~

- We found greater variability in winter than summer with significant differences for maximum temperature, all humidity values, and for average and maximum dew point values. (Table 1)
- Spatial differences were inconsistent, with significant results found only for average temperature with *Encelia* and average humidity for *Opuntia* and *Salvia* (Table 2).

~ Conclusions ~

The observed variability may be driven by extreme values, especially in winter, and will be our topic for the forthcoming year. Extreme values are important because they may be the limiting factors influencing plant microhabitat. To do this, Gaines and Denny (1993) provides a statistical approach for investigating extremes that will shed light on our observed trends.

The inconsistent results in the spatial comparison tell us that we can combine data from the two preserves for the ultimate analysis. We will continue to investigate this aspect as we gather more data.

In addition to restoration applications, this work is significant in capturing localized effects on these three species that can be used as a baseline for monitoring changes due to climate change. For example, Johnstone and Dawson (2010) discovered a 33% reduction in summer fog frequency in the coastal redwood region that related to changes in the coastal climate. Will the Palos Verdes Peninsula be subjected to a similar change?

~ Literature Cited ~

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