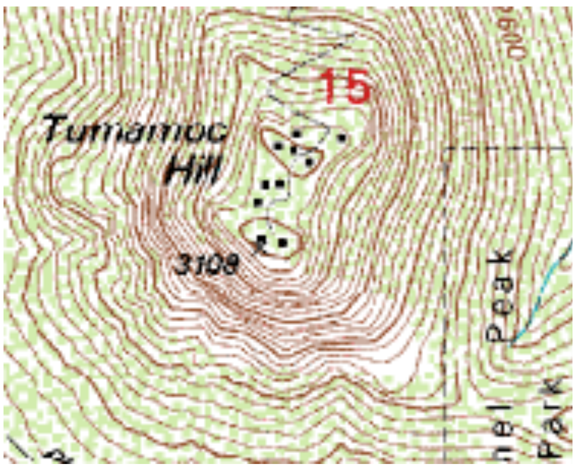
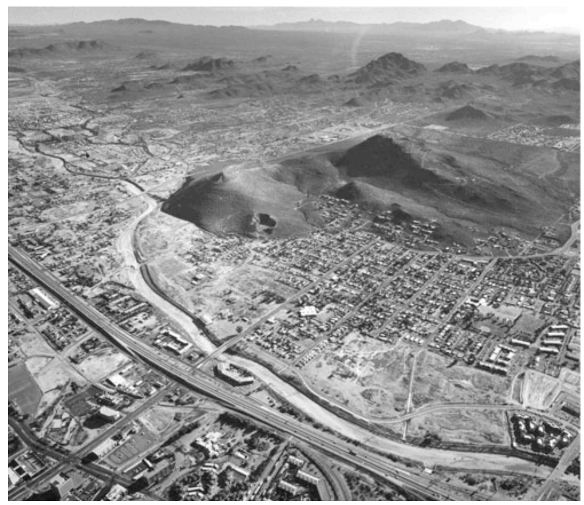
page 558

Every other year at the winter and summer solstices, my nephew Waylon Weatherley and I leave Wanship, Utah and travel to Tucson, Arizona; we camp at the base of Tumamoc Hill, which has a rather steep, north-facing slope (data are slope azimuth of -175 degrees and slope angle of 55 degrees). The first thing that you notice is the contrast in solar insulation, but then we see the big vegetation differences. On the hill slope above where we camp, none of the annual herbaceous species present in winter have Kranz anatomy, but in the summer 92% of the herbaceous species have Kranz leaf anatomy. None of the shrub or tree species has Kranz anatomy. I am sure that another observation is related. None of the herbaceous species in winter expressed leaf heliotrophic behavior, whereas it was common across many taxa in the summer herbaceous flora. This behavior difference seemed odd until I remembered the slope-azimuth data.





page 670

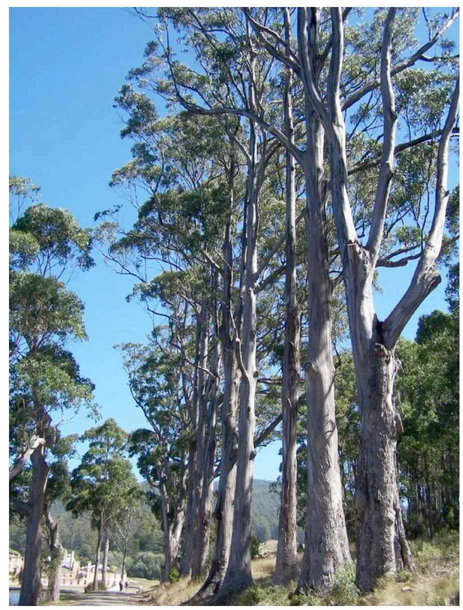
My grand nephew Wally Weatherley just took Professor Ehleringer's class on Plant Ecology in a Changing World. He particularly enjoyed the student-lead debate on fire ecology. Wally told me that this debate convinced him of the importance of educating the public about the natural "healthy" role of fires in sustaining many forest ecosystems. He is worried about discussing this issue with his father, who he thinks is convinced that fighting all fires in forest, shrubland, and grassland ecosystems is the best national policy. In fact, just recently Wally overheard his father talk to a firefighter. "Did you know that trees with serontinous cones die during an intense fire? And the 1988 Yellowstone fires were the worst possible event that could have happened to a redwood tree. Not a single dead tree survived", chuckled his father. The firefighter nodded in complete agreement. Wally has asked me to broker a peace between he and his father, in the event that an argument broke out. "Tell him he is wrong", I demanded. But first, I told Wally that I needed to know the arguments for and against a "Let it burn" forest-fire policy.

page 64

Eucalyptus globulus is tree native to the arid regions of Australia. It has become an invasive tree throughout California, Chile, Portugal, France, and Italy because it survives so well in water limited conditions, such as the summer droughts in a Mediterranean climate. Last year I spent 3 months touring Australia and measured spectral characteristics of its evergreen leaves that are often covered with waxes. Following rains storms in late autumn, the waxes fall of the leaf, washed away by the physical pressure of the striking raindrops. Three sets of observations below highlight how well adapted this species is to the drier parts of Australia.

Leaf spectral observations at different wavelengths (nm)	Leaf absorptance with wax (%)	Leaf absorptance without wax (%)		Tree #	Mean leaf angle observations (degrees from horizontal)
375	50	50			
400	78	96		1	87
425	78	96		2	87
450	70	90		3	89
475	70	90		4	88
500	70	88		5	86
525	60	88		6	88
550	50	86		7	85
575	54	88		8	89
600	61	90		9	89
625	67	92		10	86
650	68	95		11	87
700	69	96		12	88
725	21	25			
750	4	3			
775	1	1			
800	1	1			

page 65



Leaves of *Eucalyptus globulus*

page 44

During the past summer, I was lucky enough to be able to work with the famous Professor Olle Björkman of the Carnegie Institution of Washington, measuring photosynthesis rates on plants under natural conditions in the field. The very sophisticated instruments in his mobile laboratory allowed me to measure photosynthesis rates under very carefully controlled conditions, even though all measurements were taking place in the field. Using instruments in his mobile laboratory, I measured net photosynthesis in *Encelia farinosa* under two levels of soil water availability: well watered and water stressed. The data that I obtained follow. Photosynthesis was measured as net carbon dioxide uptake in μmol CO_2 m^{-2} s^{-1}. Photon flux density was measured in μmol photons m^{-2} s^{-1}. Leaf temperature was measured in degrees Celsius. Ambient CO_2 (c_a) was 377 ppm and intercellular CO_2 (c_i) concentrations were measured in ppm. Variations in c_i concentrations from the naturally occurring value were created by introducing the plant into an environment where atmospheric CO_2 varied while other environmental parameters were held constant.

Experimental treatment 1

Data point #	Net photosynthesis, μmol CO_2 m^{-2} s^{-1}	Leaf temperature, °C	Intercellular CO_2, ppm	Photon flux, μmol m^{-2} s^{-1}
1	5.2	30	78	2,000
2	24.5	29	155	2,000
3	35.0	30	200	2,000
4	43.3	30	264	2,000
5	53.4	29	444	2,000
6	55.6	30	634	2,000
7	55.7	30	755	2,000

Experimental treatment 2

Data point #	Net photosynthesis, μmol CO_2 m^{-2} s^{-1}	Leaf temperature, °C	Intercellular CO_2, ppm	Photon flux, μmol m^{-2} s^{-1}
1	3.2	30	78	2,000
2	14.7	29	155	2,000
3	21.0	30	200	2,000
4	26.0	30	264	2,000
5	32.0	29	444	2,000
6	33.4	30	634	2,000
7	33.4	30	755	2,000

In experiment in which plants were well watered, the leaf conductance was 0.7 mol m^{-2} s^{-1}. In contrast, in plants were grown under water stress, the leaf conductance was to 0.4 mol m^{-2} s^{-1}.

Of immense interest to me, I noticed that the c_i/c_a ratios remained nearly constant at 0.7 between the two growth regime treatments.

page 231

Last year I tried to repeat a number of classic plant ecology studies focusing on nutrients and plant growth in the Intermountain West. My students and I grew *Artemisia tridentata, Astragalus utahensis,* and *Acer grandidentatum* from seed for an entire year. One of the students was sensitive to infections and so we sterilized the sandy soils to avoid the potential for his getting sick. Another student was sensitive to hayfever and so we terminated the experiment before plants could flower. To allow for natural plant-microbial interactions, some of the seeds were sprayed with *Rhizobium* and/or mycorrhizal fungal spores. Different treatments existed, including high and low water treatments levels, full sunlight versus half-shade, and nitrogen and/or phosphorus. Plants biomass (grams per plant) was measured at the end of the experiment. Roots were excavated and examined for the presence of root nodules as indicators of nitrogen fixation. Below are some of the data for *Acer grandidentatum*.

Treatment					Observation
Seeds sprayed with Rhizobium	Seeds sprayed with various fungal spores	Well watered (watered weekly)	Phosphorus fertilizer added once	Nitrogen fertilizer added once	Total plant biomass (g)
+	-	+	+	+	
+	+	+	-	+	
-	+	+	+	+	
-	-	+	-	+	

Unfortunately, the student was late in turning in his data. I finally got the total plant biomass values today: 65 g, 12 g, 55 g, and 45 g. Then, I realized that the student had forgotten to tell which total plant biomass values were associated with each treatment above.

page 287

Today I attended a rally in Salt Lake City where the mayor was promoting the use of xeriphytic (xerophytic) vegetation as a landscape tool to reduce outdoor water use, but traffic was bad and I only got there at the end of the rally. The mayor and college students were extolling the virtues of natural vegetation as a landscape feature in our yards. Across the street was a protest group with signs saying “Preserve Kentucky blue grass”, “Green lawns mean green jobs”, and “Big government should not look into my backyard”. From what I heard at the end, it sounded as if each side had valid arguments for and against requiring xeriphytic vegetation in all or a portion of our front and back yards.