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Water Source Partitioning for Shrubland Transpiration Using Innovative Field Methods

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Presenters

Dale A. Devitt, Michael Young, Matthew S. Lachniet, Jeremy Koonce, Amanda Wagner, Brian M. Bird, and J. Healey

Water Source Partitioning for Shrubland Transpiration Using Innovative Field Methods

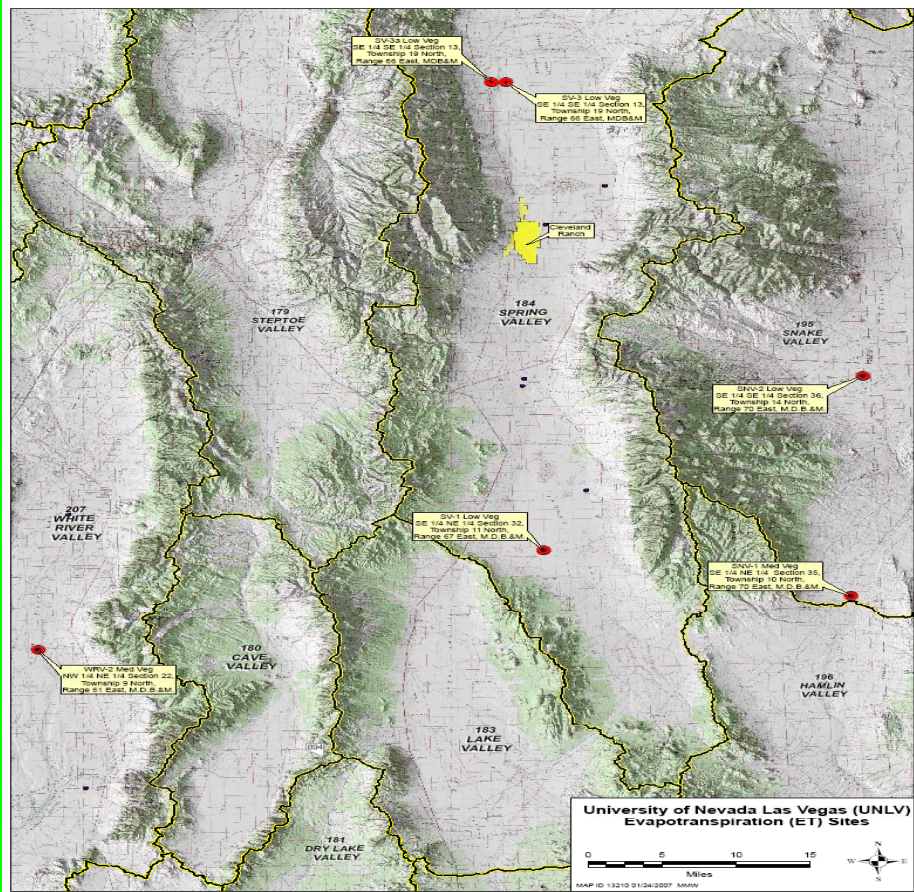


**D.A. Devitt, M.H. Young and M. Lachniet
A. Wagner, J Koonce, B. Bird, and J. Healey**

Introduction

- **Climate change models predict a decline in precipitation over the next few decades throughout much of the southwest.**
- **Such change has the potential to shift water uptake dynamics of phreatophytes**
- **If groundwater pumping also occurs, the impact of climate change could be exacerbated.**
- **A better understanding of the forces that drive the coupling and decoupling of phreatophytes to groundwater is needed.**

Nevada is a Basin Range State



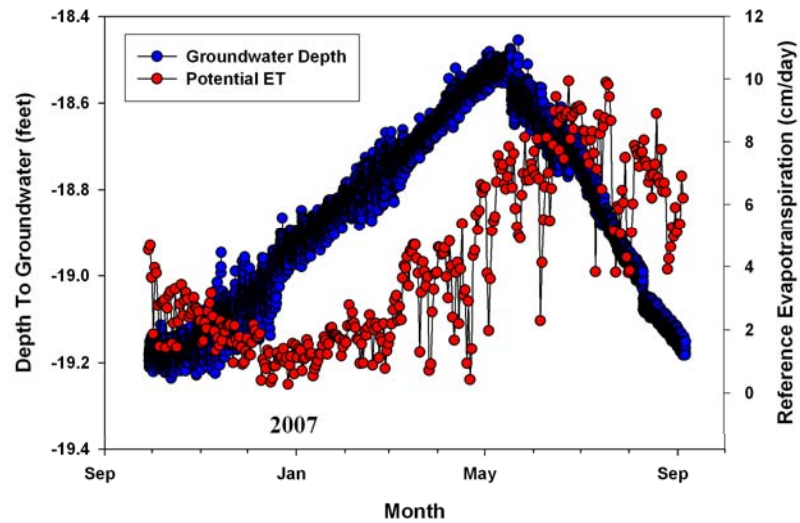
Vegetation on the valley floor of Spring Valley and Snake Valley is dominated by a mixed shrubland

Research Hypotheses

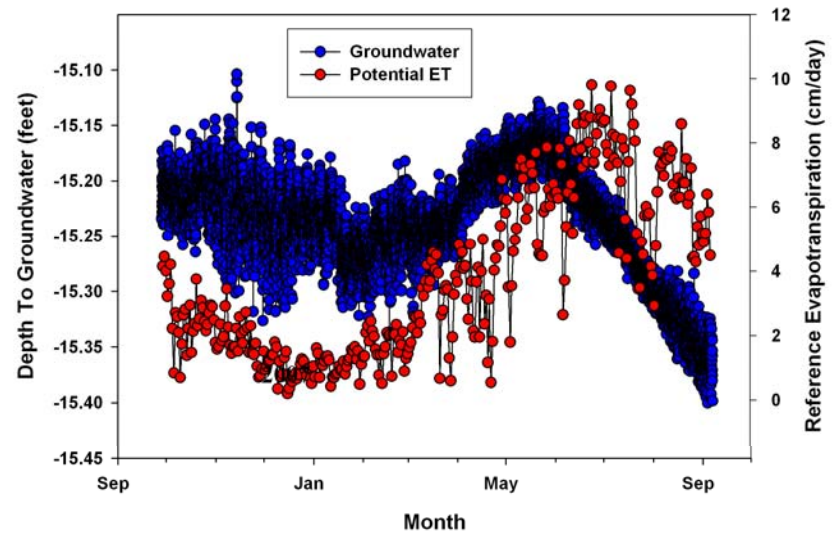
- A shift in groundwater oscillations may signal a shift in water uptake (vadose vs groundwater)
- The shift in water source may depend on shrub type, time of ppt. and soil water in storage.
- Estimating transpiration at the plant level combined with % cover of each species will enable eddy flux stand ET estimates to be partitioned.

METHODOLOGY

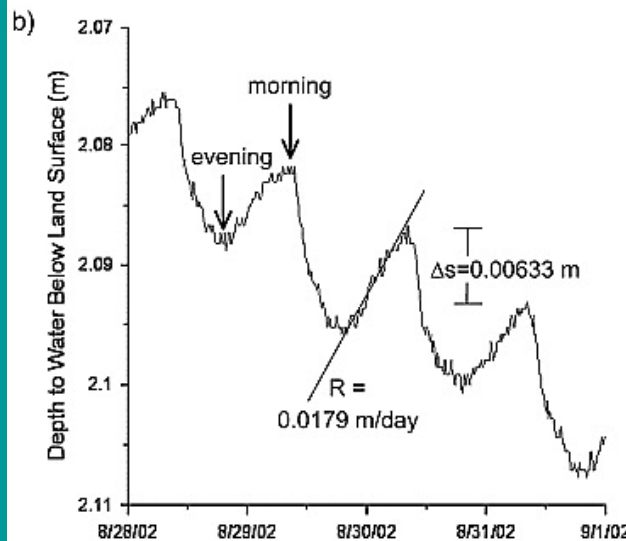
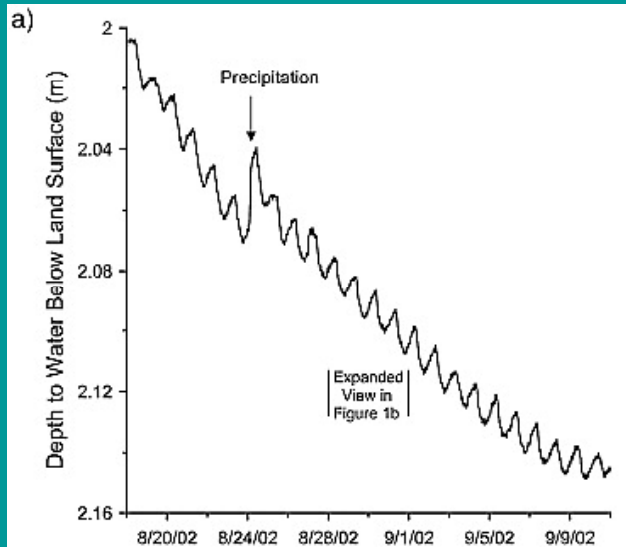
White River Valley Site 2



Spring Valley Site 1
2006 and 2007



- Estimate groundwater evapotranspiration based on groundwater oscillations.



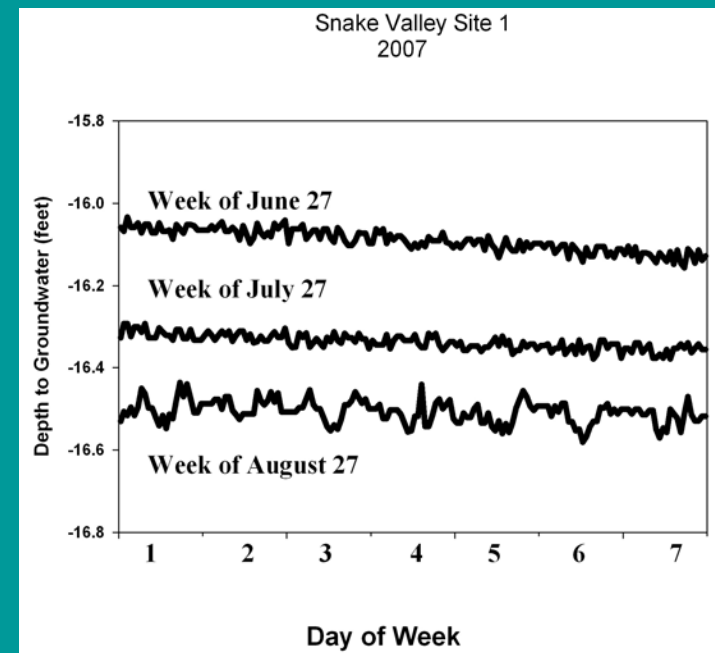
$$ET_G = S_Y (\Delta s/t + R)$$

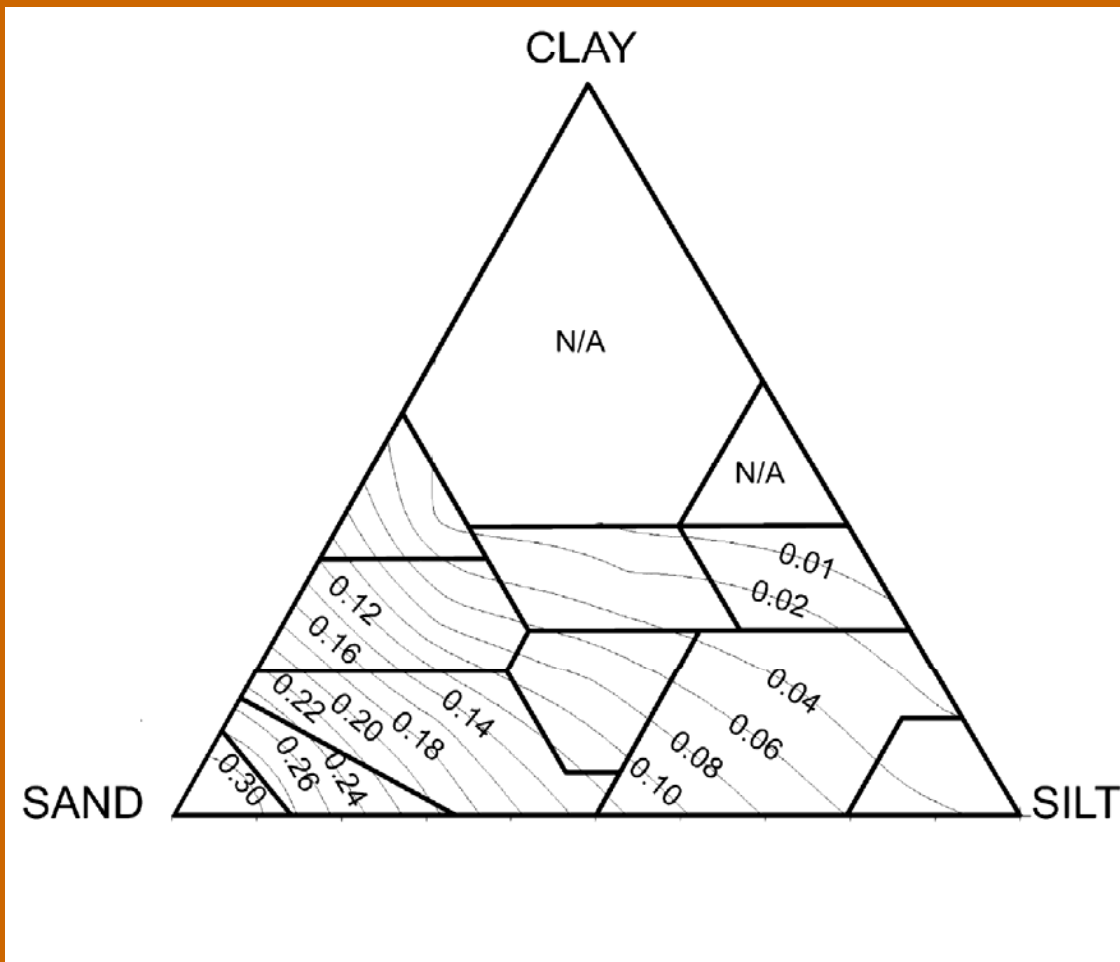
S_Y is the specific yield of the aquifer

Δs is the daily change in storage

t is the time

R is the slope of the net inflow





Estimates of specific yield based on soil texture

Loheide et al. 2005

Soil Sampling In The Capillary Fringe



Actual Measurement of Specific Yield

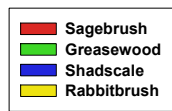
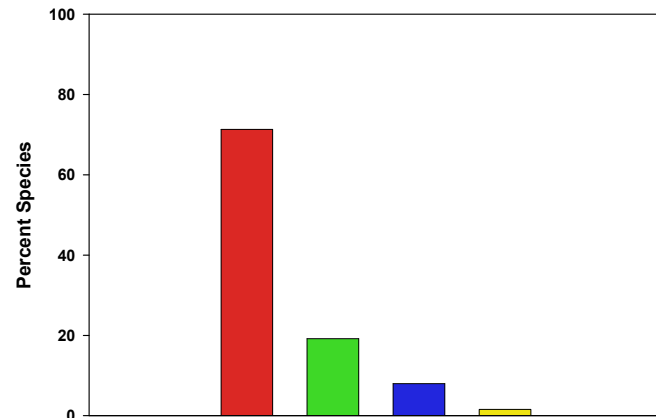


- **Estimate mix stand evapotranspiration based on eddy covariance.**

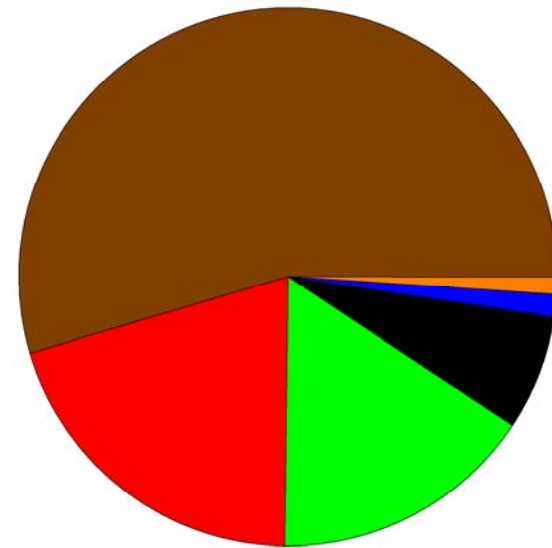
Vegetation Assessment



Species Composition

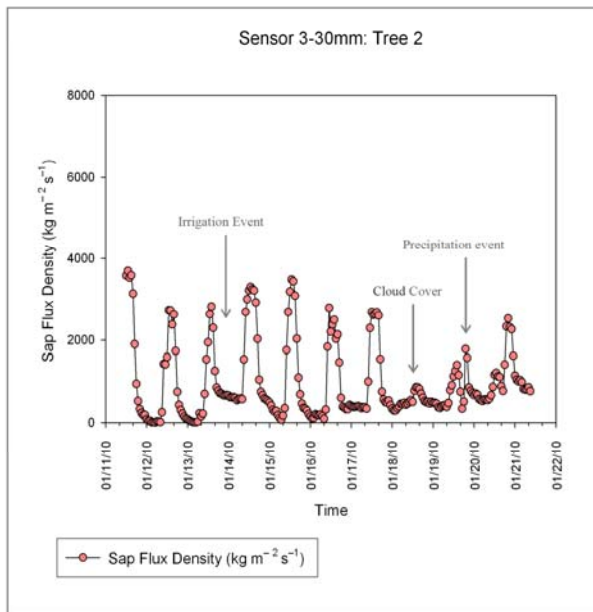
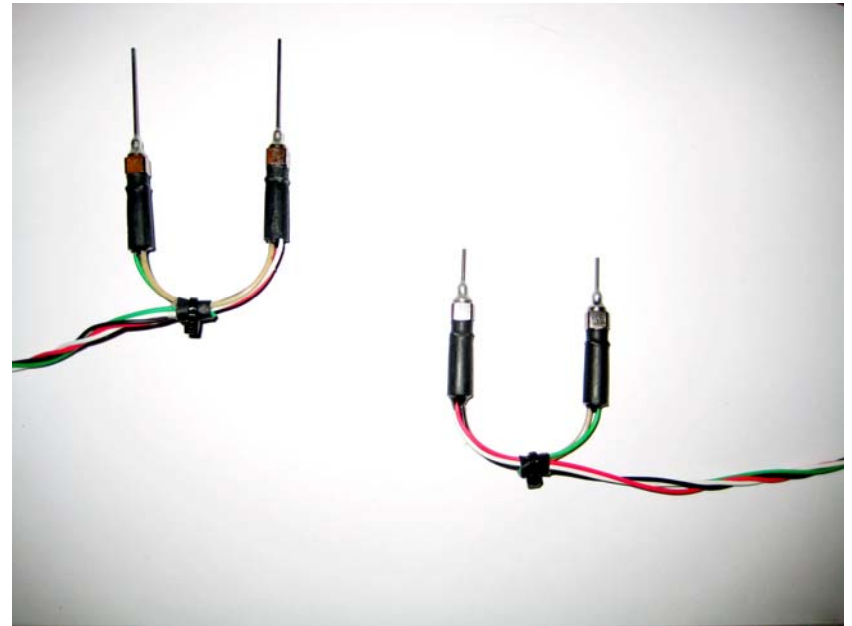


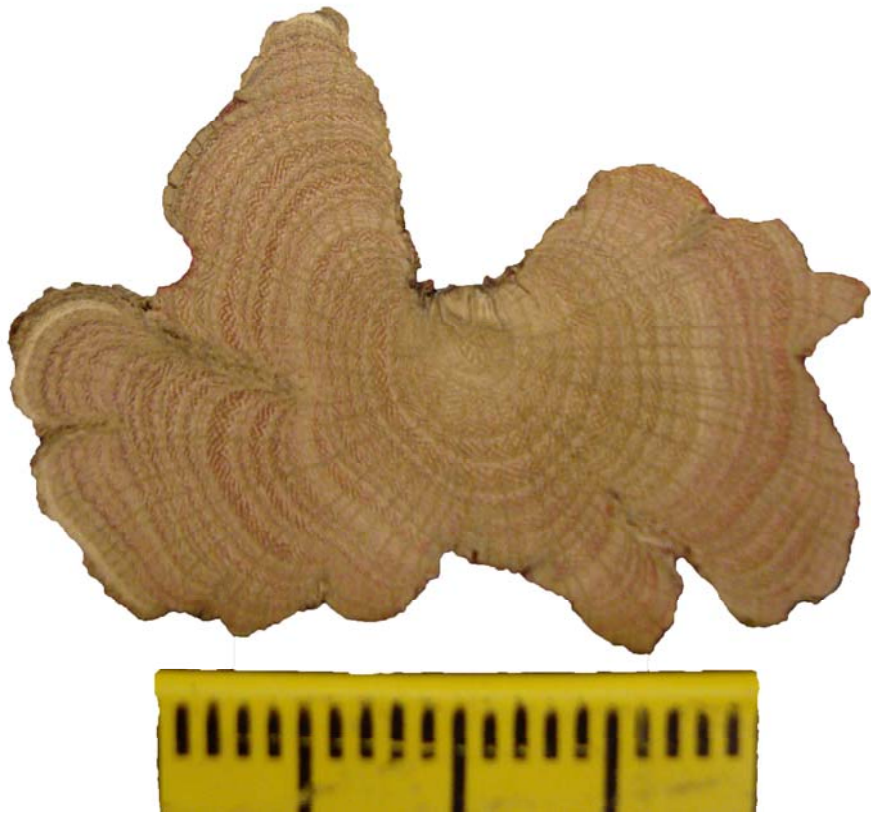
Canopy Breakdown





Estimate actual transpiration at the species level with Granier probes

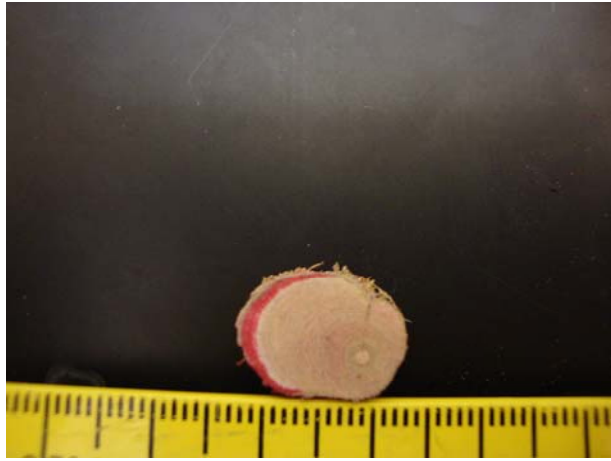




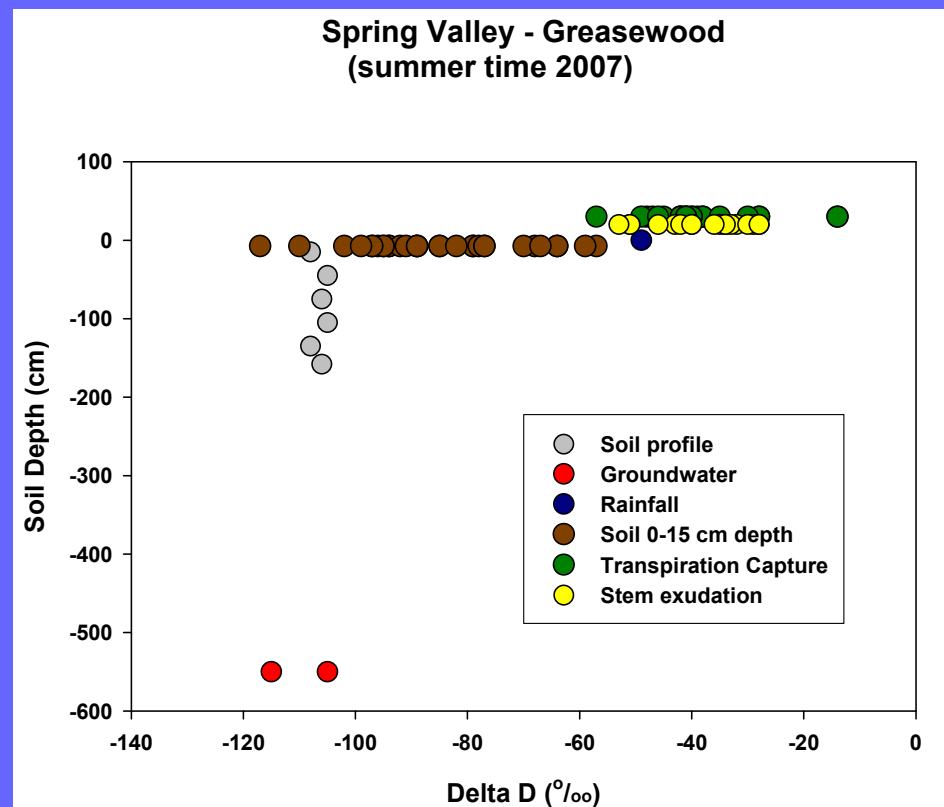
Assessing area of conductive tissue

Use of Sanfranin Red Dye





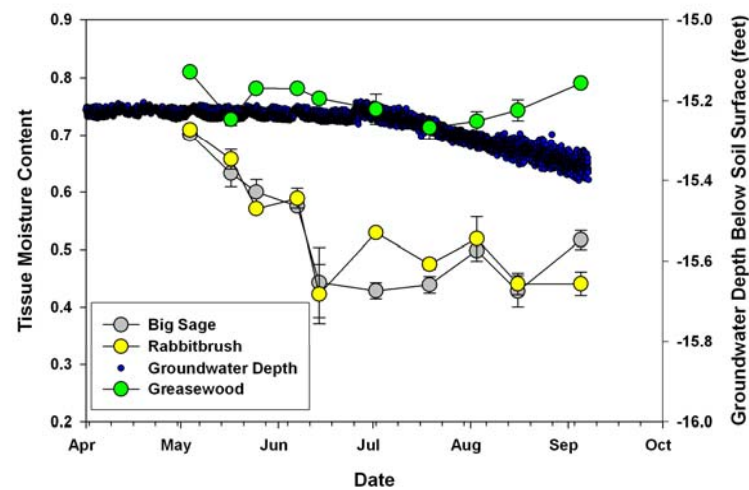
•Use isotopic analyses of soil moisture, groundwater and stem exudation to help estimate fractional water uptake from the vadose zone.



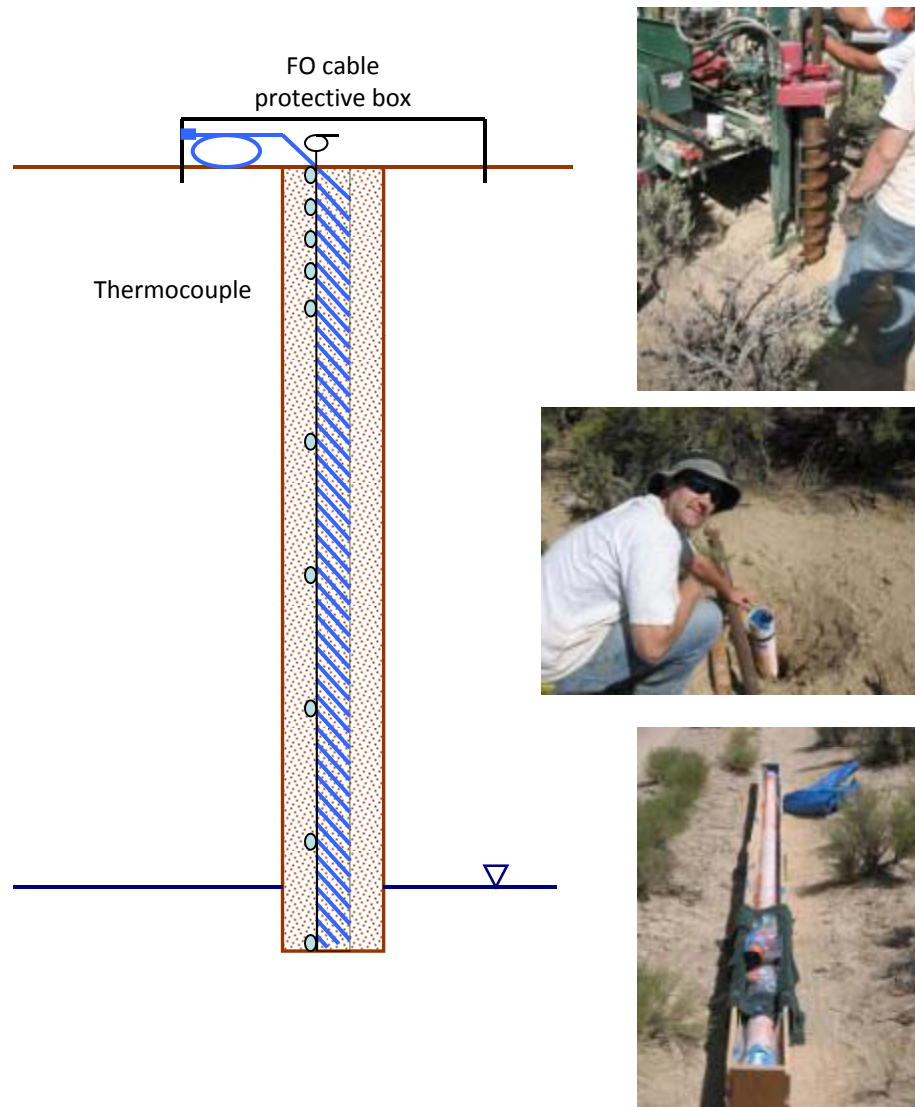
•Link groundwater oscillations to % phreatophytes, depth to groundwater, ET_{ref} , transpiration and vadose soil water in storage.



Spring valley Site 1
2007

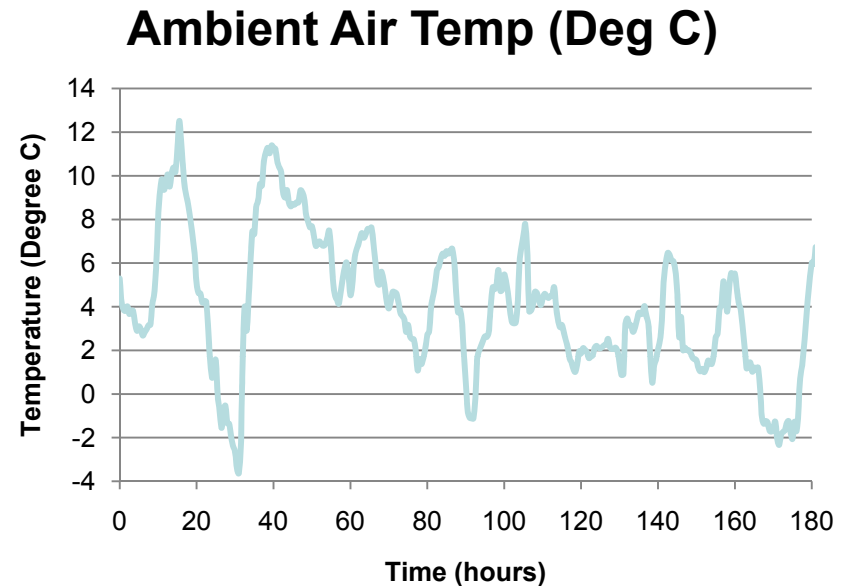
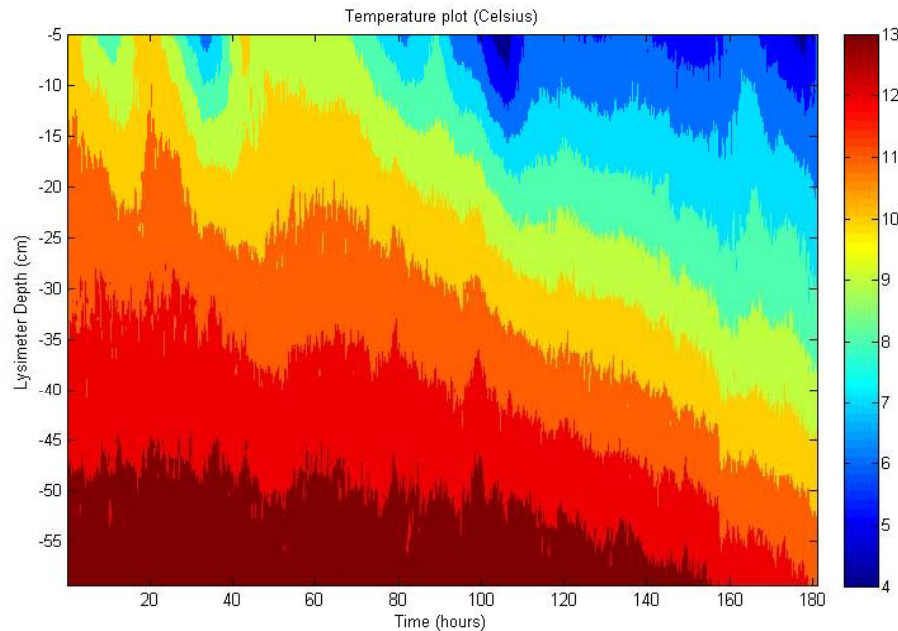


Fiber Optic (FO) Distributed Temperature Sensing (DTS) Pole Setup



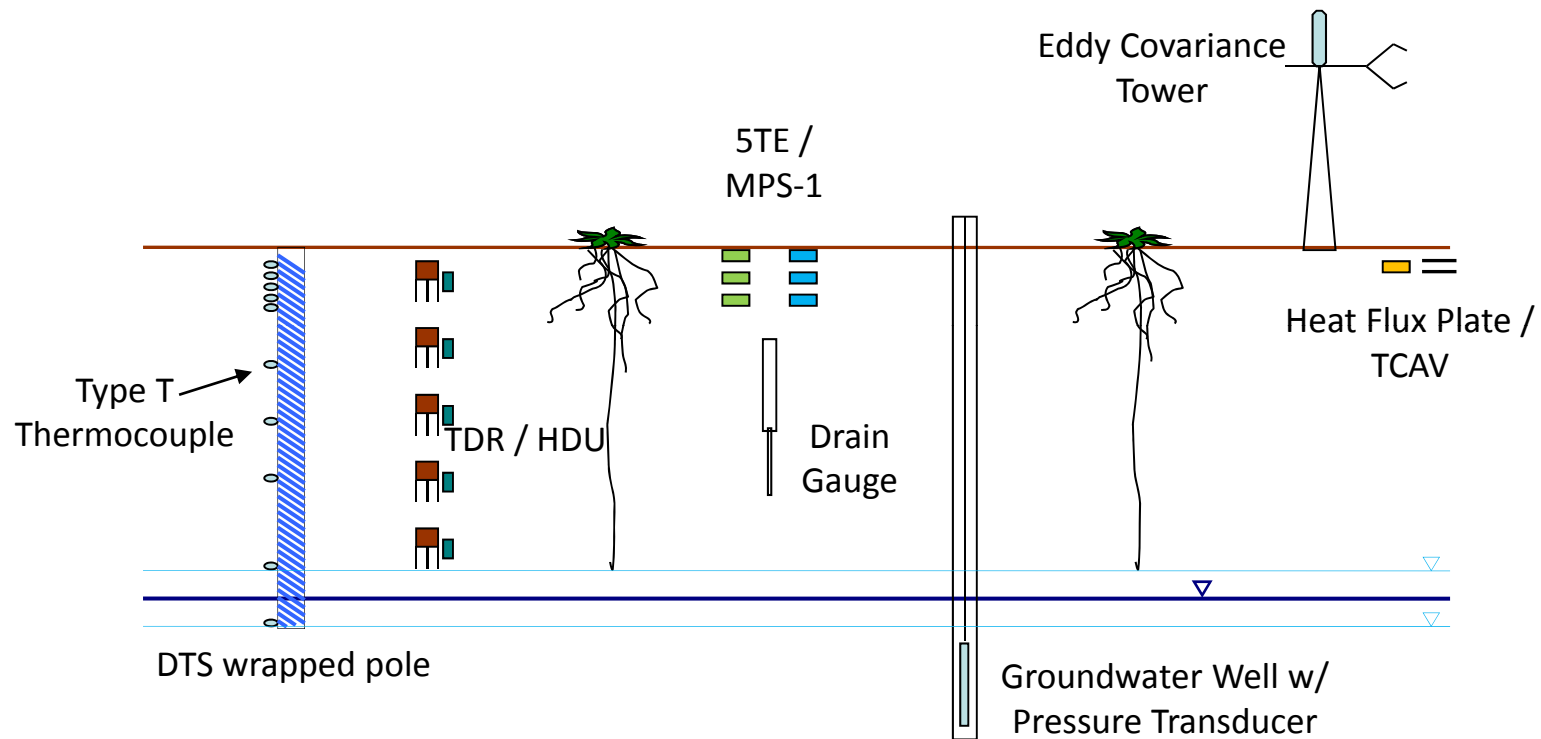
- 7.6 cm (3") Sch 40 PVC Pole wrapped with FO cable
- Thermocouples located every 20 cm for first 100 cm, and 100 cm thereafter
- Install to depth just below groundwater table
- Measures average temperature over 1 m of FO cable (vertical resolution of approximately 1.14 cm depth per 1 m of cable)

Example Results



- 16 Jan through 23 Jan, 2010 temperature variations as a function of soil depth
- Diurnal variations more pronounced near the surface and damped with depth
- Phase lag in soil temperature as compared to ambient air temperature

Spring and Snake Valleys, NV, Conceptual Diagram

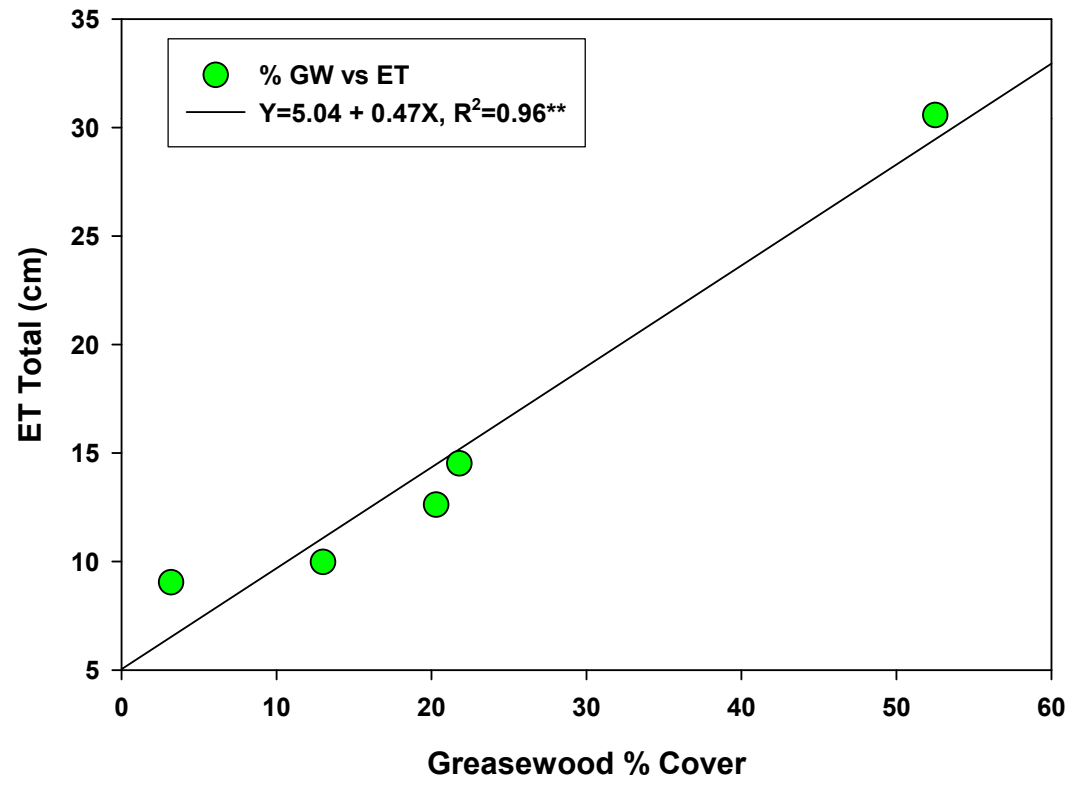


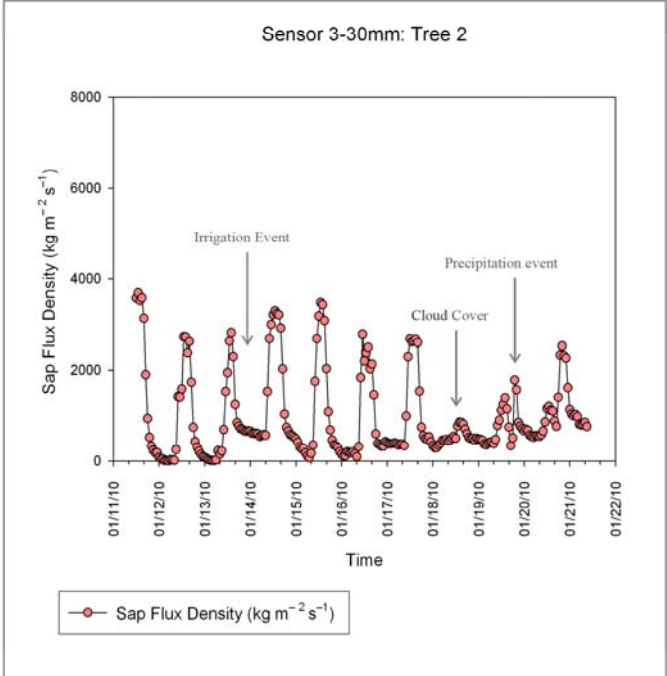
- Newly DTS-wrapped PVC poles need to be installed
- Pending on an instrument grant, soil moisture instruments (5TE/MPS-1) and drain gauges, will also be installed

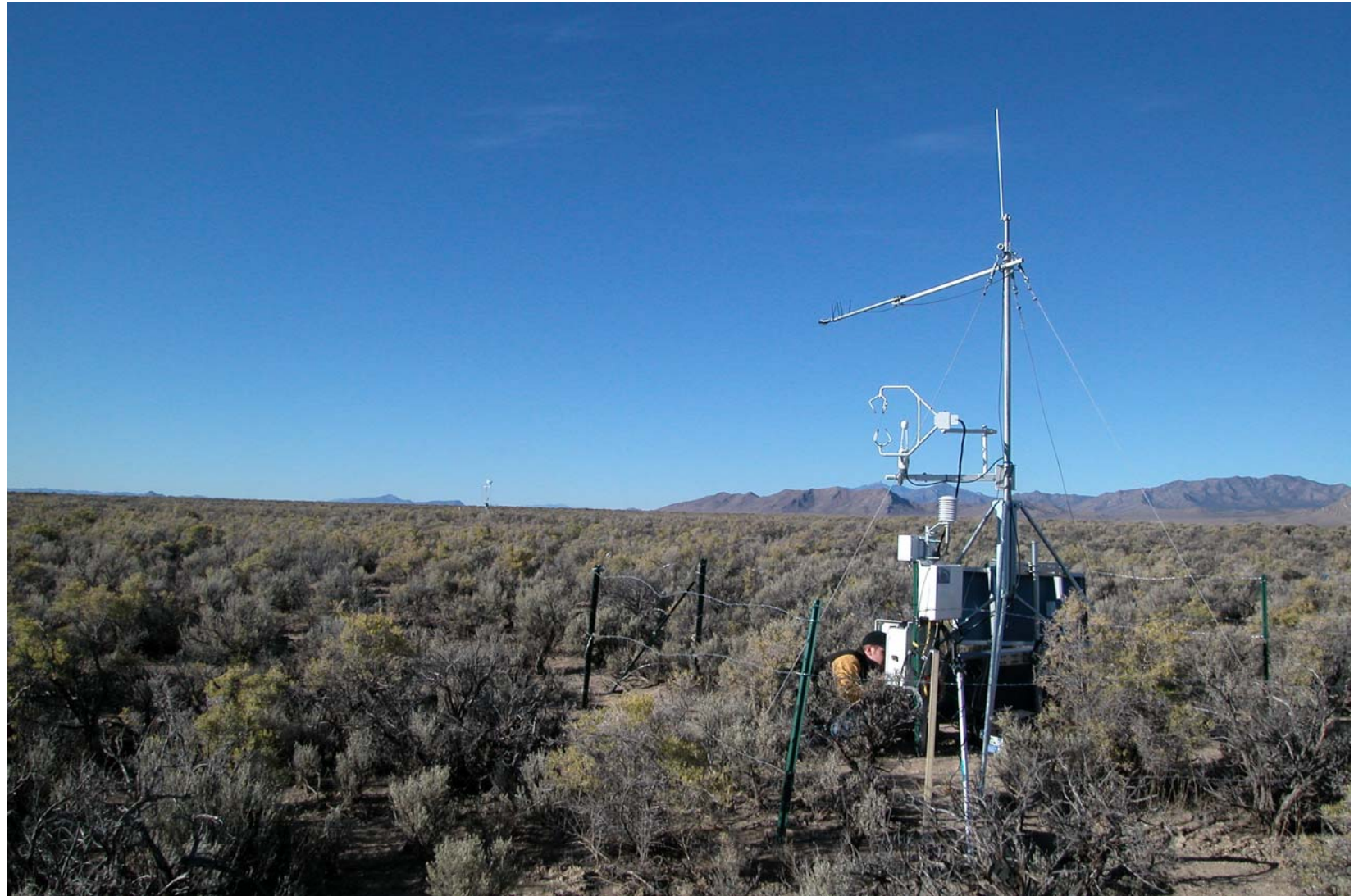
Current Status

- **Assessed species composition and % cover.**
- **Collecting groundwater, eddy flux and Penman Monteith ET_{ref} data (Arnone and Jasoni)**
- **Dye studies conducted to assess area of conductive tissue of each species and general patterns to guide probe installation to occur within the next two weeks.**
- **Installation of DTS (distributed temperature sensing fiber cable) is now ready for installation.**
- **Samples taken in late fall - soil, groundwater and transpirational capture for isotopic analysis. Additional samples will be taken in two weeks, and then during the active growing period in May and more stressful periods of July and August.**
- **Still waiting for permit for the Snake Valley site!!**

2007
5/10-9/5

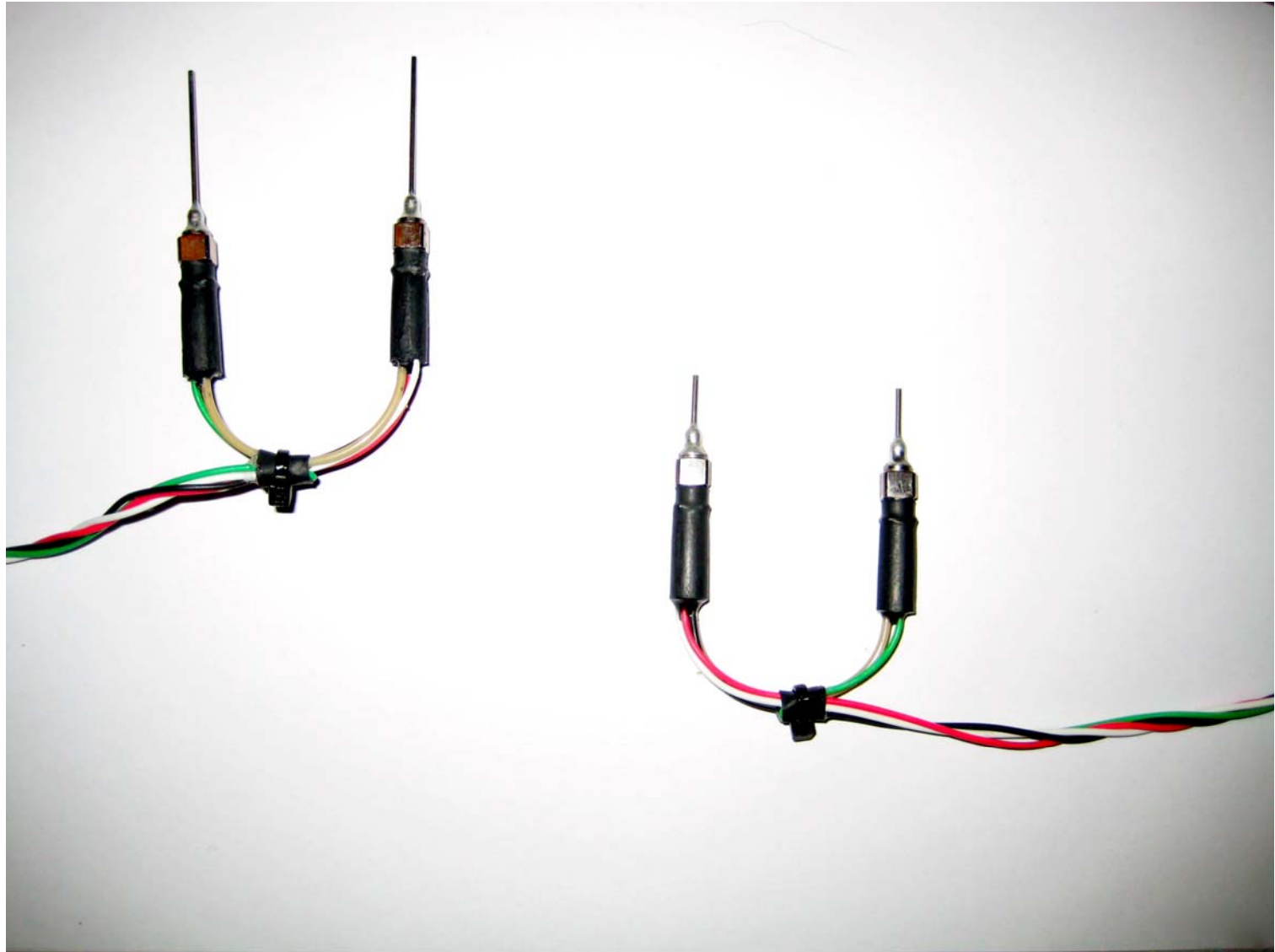




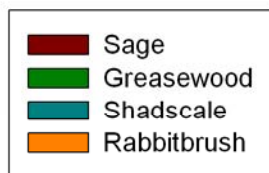
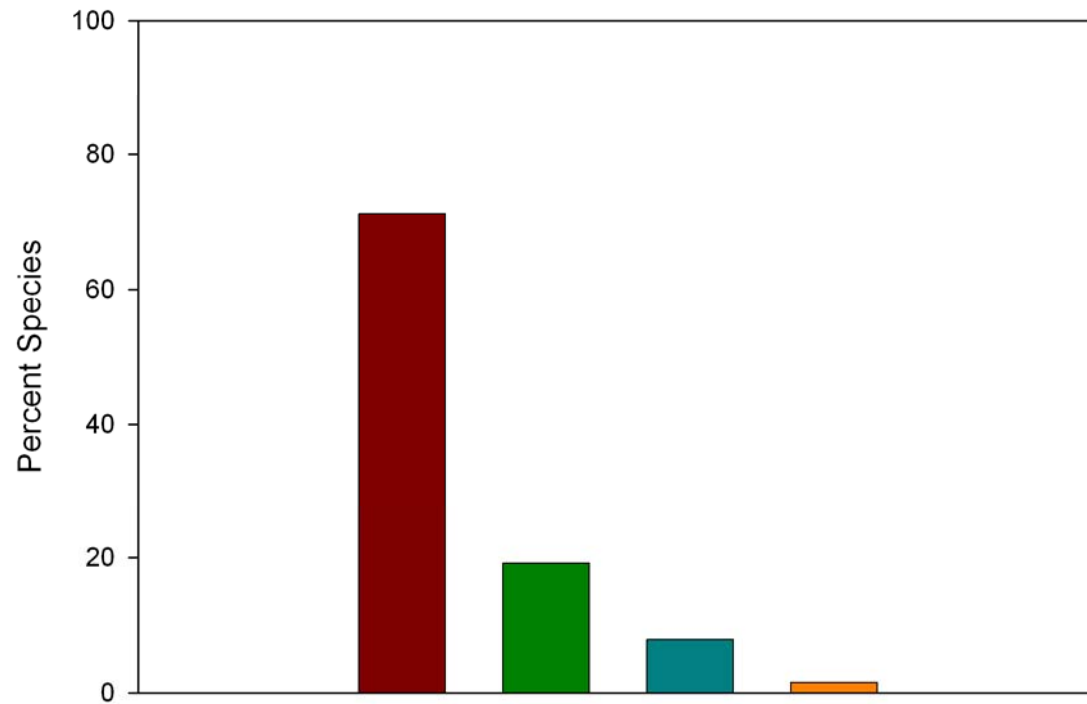




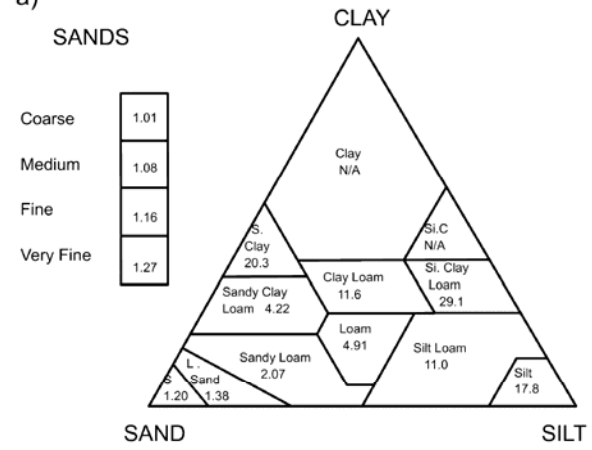




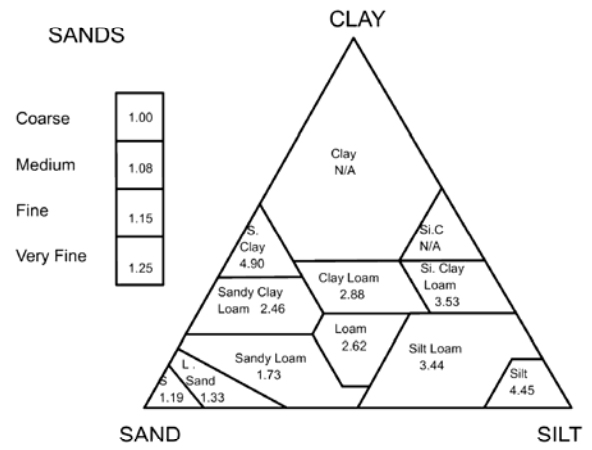
Species Composition

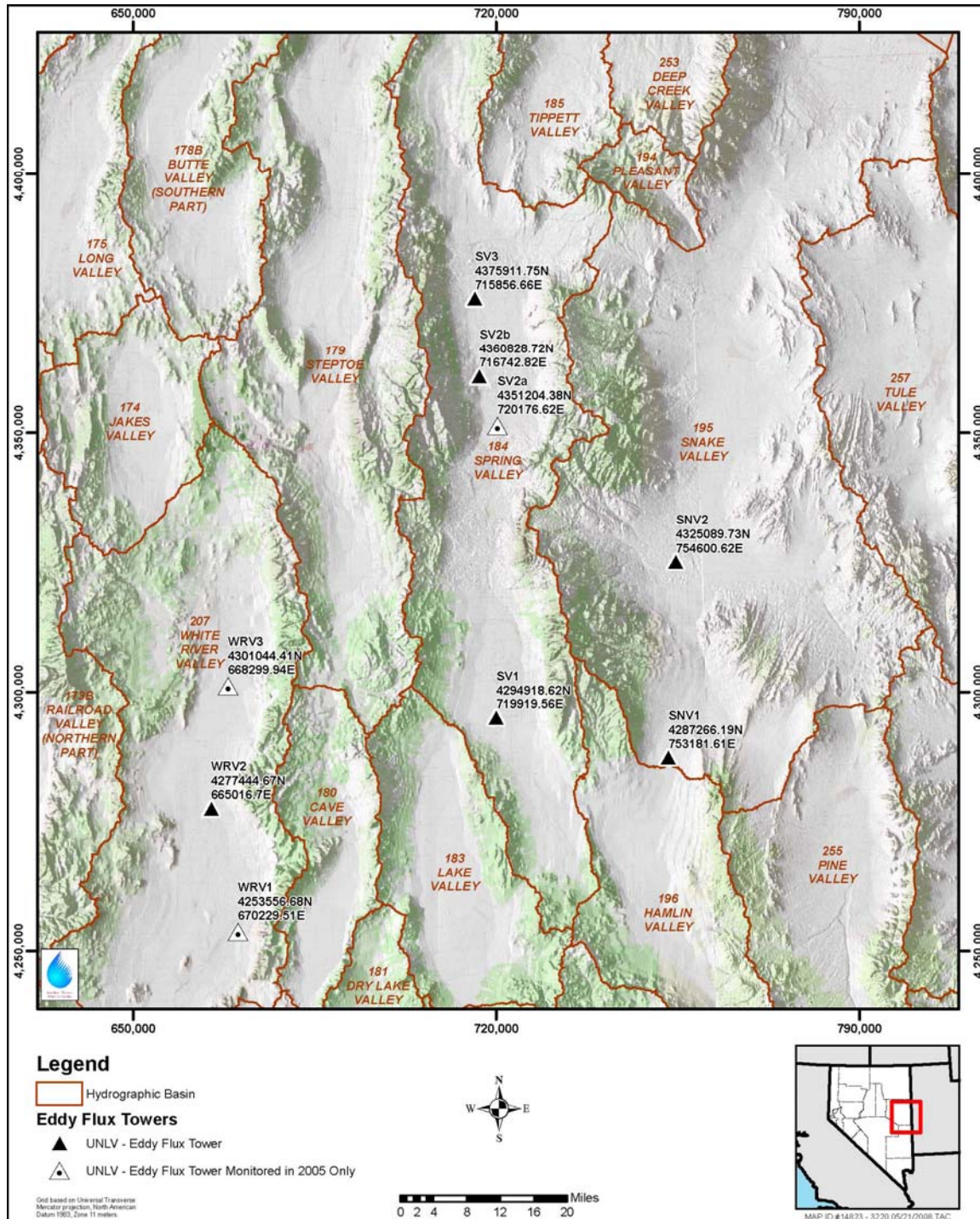


a)

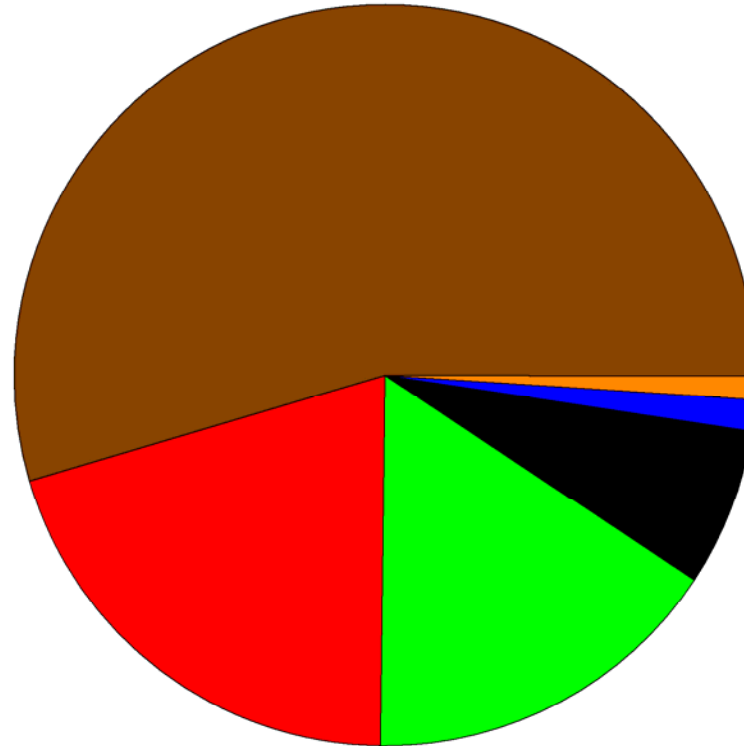


b)



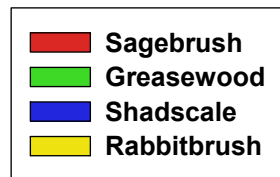
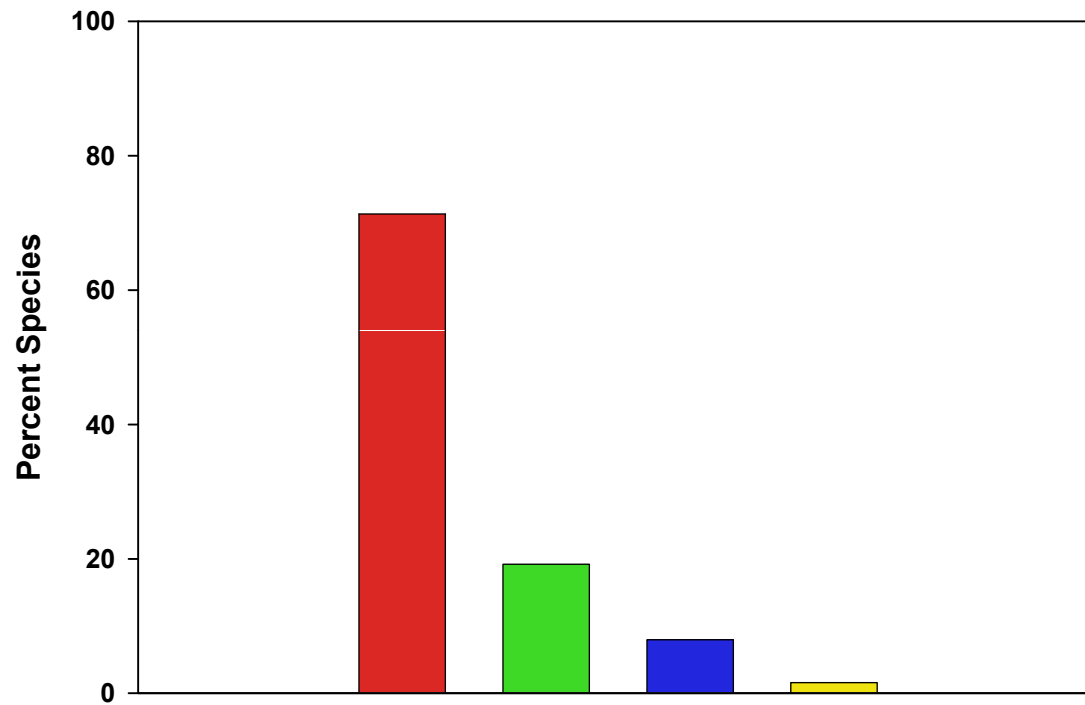


Canopy Breakdown

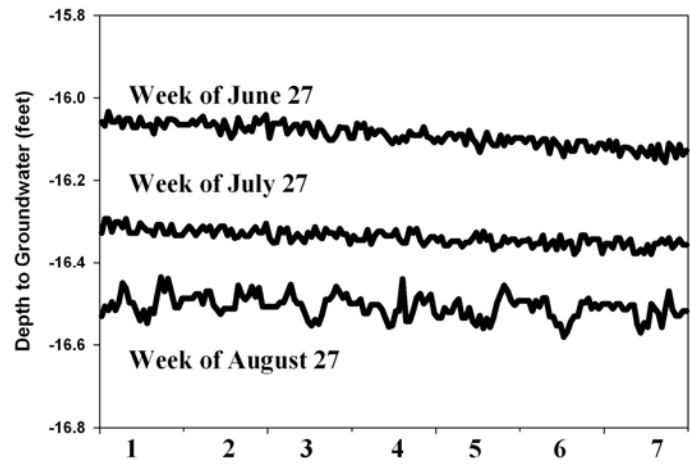


Bare Soil	54.55%
Greasewood	20.21%
Sagebrush	15.94%
Dead Cover	6.90%
Shadscale	1.37%
Rabbitbrush	1.0231%

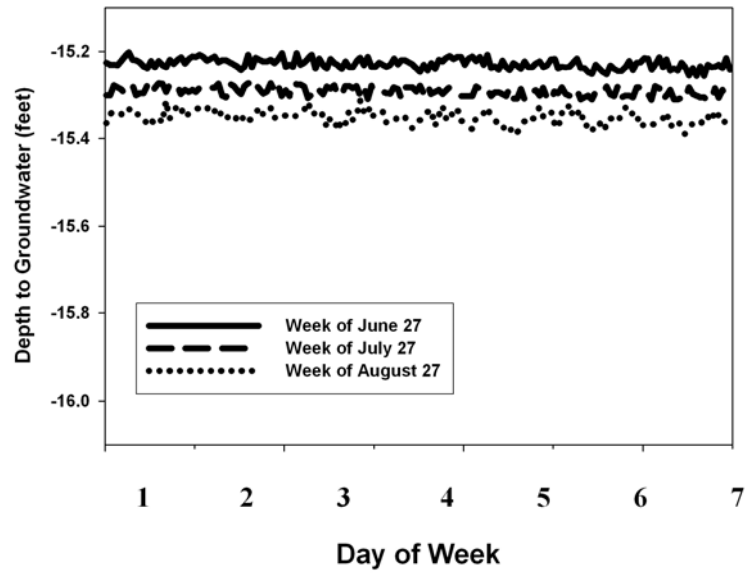
Species Composition

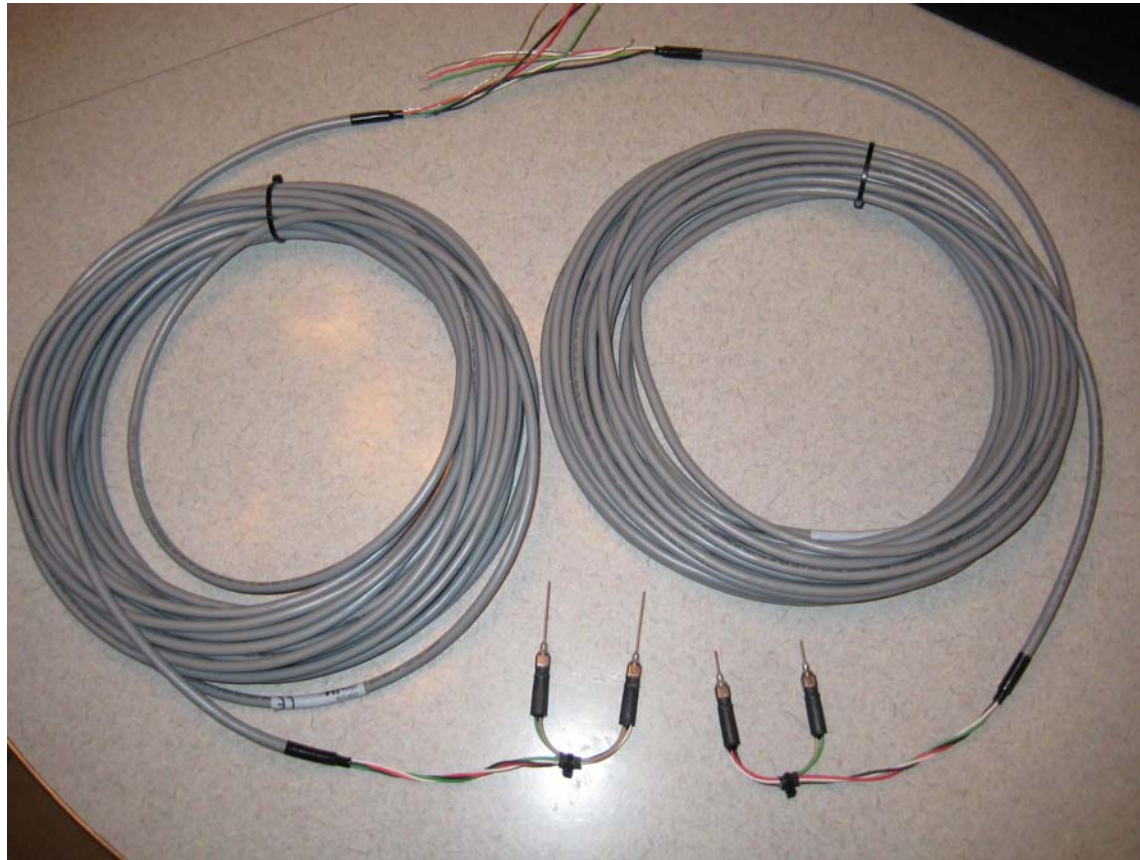


Snake Valley Site 1
2007



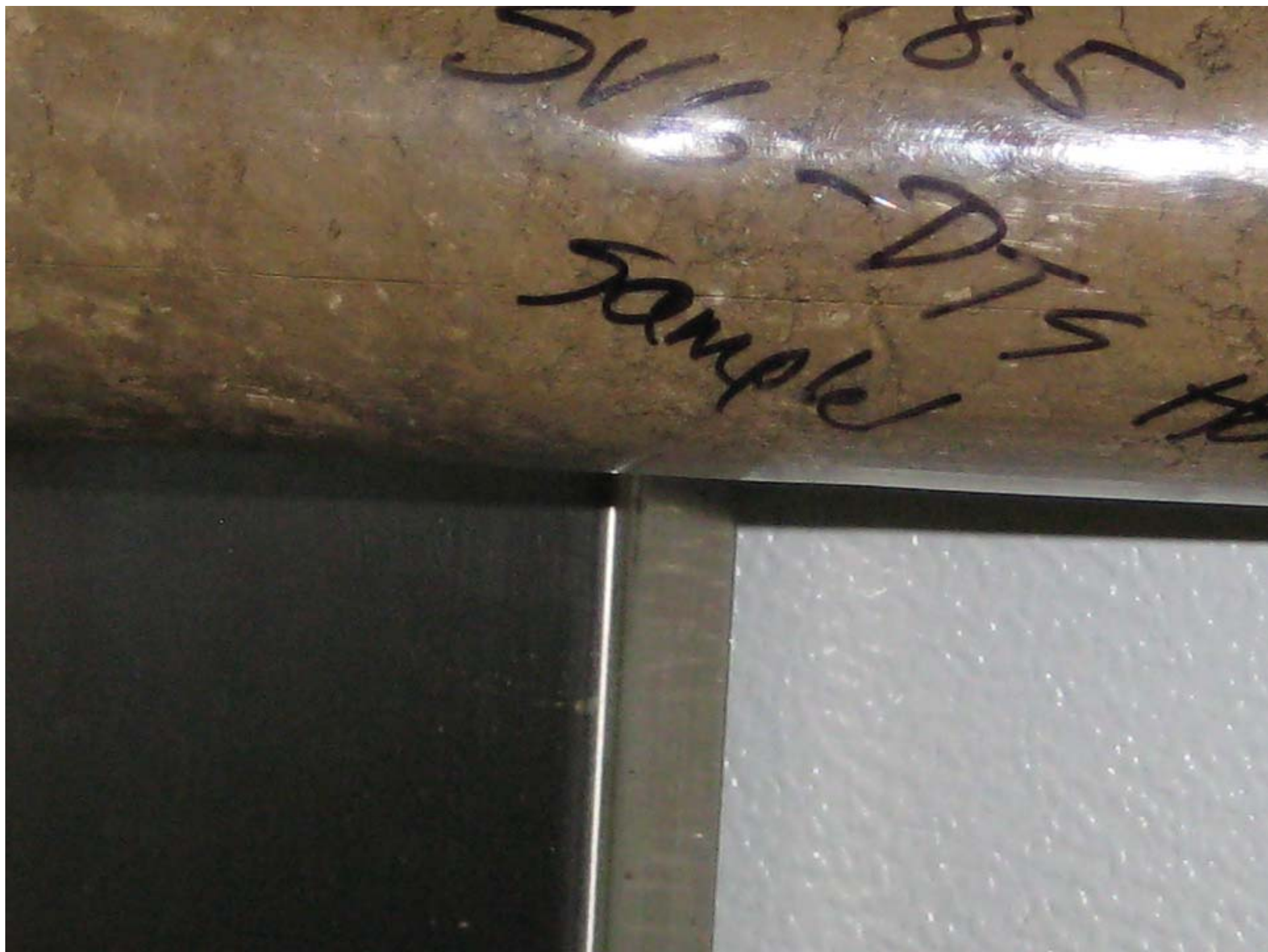
Spring Valley Site 1
2007





5.5

sample





8/18/09

SVE

19.5' - 10.5'

UP

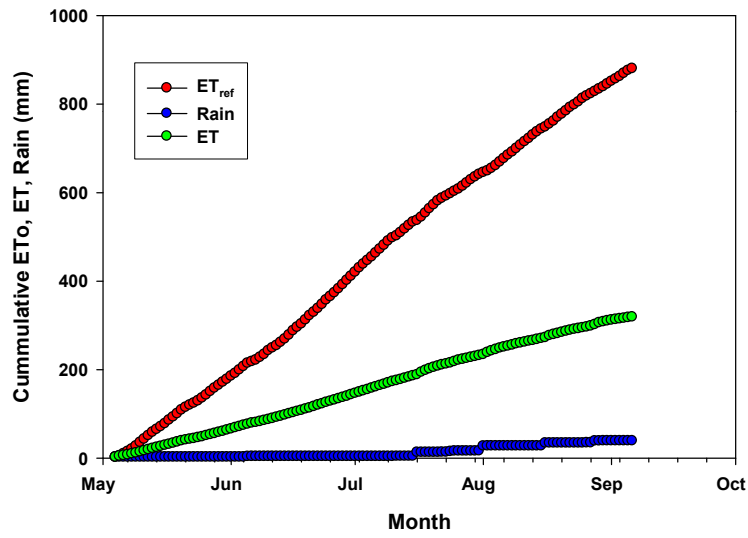


19.5' - 20.5'

SV6 - D12 Hole
Sample 2

up

Snake Valley 1
2007



Snake Valley 2
2007

