Nevada Monitoring System to Assess Climate Variability and Change

D. A. Devitt[1], B.M. Bird[1], B. Riddle[1], J. Arnone[2], G. McCurdy[2], B. Lyles[2], F. Biondi[3], S. Strachan[3], L. F. Fenstermaker[4], L. Saito[5], M. H. Young[6]

[1]School of Life Sciences, University of Nevada Las Vegas, 4505 S. Maryland Parkway, Las Vegas, NV 89154 USA
[2]Division of Earth and Ecosystem Sciences, Desert Research Institute, 2215 Raggio Parkway, Reno, NV 89512 USA
[3]DendroLab, Department of Geography, MS 154, University of Nevada Reno, Reno, NV 89557 USA
[4]Division of Earth and Ecosystem Sciences, Desert Research Institute, 755 E. Flamingo Road, Las Vegas, NV 89119 USA
[5]Graduate Program of Hydrologic Sciences and Dep. of Nat. Res. and Env. S., MS 186, University of Nevada Reno, Reno, NV 89557 USA
[6]Bureau of Economic Geology, University of Texas at Austin, Austin, TX 78712-8924 USA

1. Introduction

The Nevada System of Higher Education (UNLV, UNR and DRI) was awarded a multiyear NSF EPSCoR grant to support infrastructure associated with regional climate change research. The overall project is comprised of 5 components; education, cyberinfrastructure, policy, climate modeling and water/ecology. The water and ecology components are using infrastructure funding to establish a network of monitoring stations to assess the impact of climate variability and change on ecosystem function and hydrologic services.

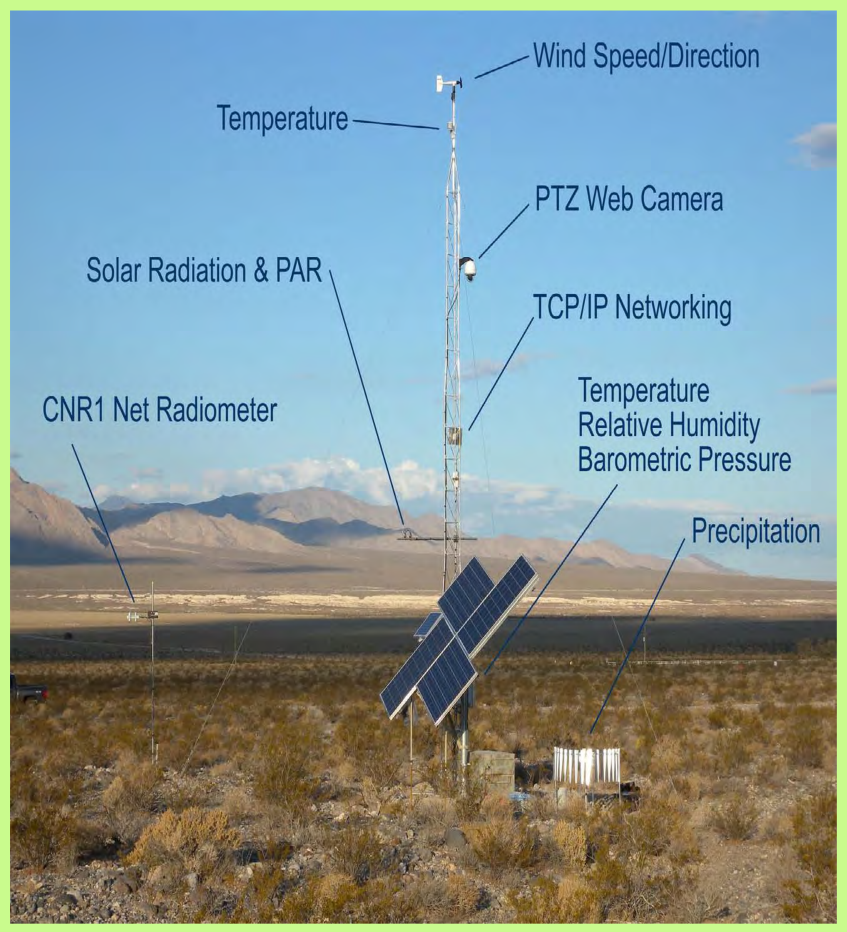
Arid regions, including Nevada, comprise 40% of the world's land surface and are home to one-third of the world's population (Ezcurra, 2006). These regions are especially vulnerable to climate change because of dependence on water resources, which are subject to increasing stress as a result of rapid urbanization (Field et al., 2007).

Developing improved understanding of impacts of global climate change on a local-regional scale is imperative for regions such as the Great Basin, which includes most of Nevada, and is considered one of the most endangered ecoregions in the U.S. (Chambers et al., 2006). Close linkages that exist between stressors and their importance for land management and public policy highlight the need for an integrated approach in which biophysical and human responses to climate change are studied.

There is a real need to develop regional-scale models to better understand land-atmosphere processes that drive basin-scale climate change. This requires good observational data (e.g., temperature, precipitation, humidity, wind speed, solar radiation) to calibrate and verify regional climate models and others that are used for basin-scale assessments (e.g., hydrologic, ecological, water demand). An integrated approach that includes observational and modeling activities is necessary to make robust assessments of climate change impacts.

2. Monitoring System

10 m Tower Based Instrumentation



TCP/IP Communications

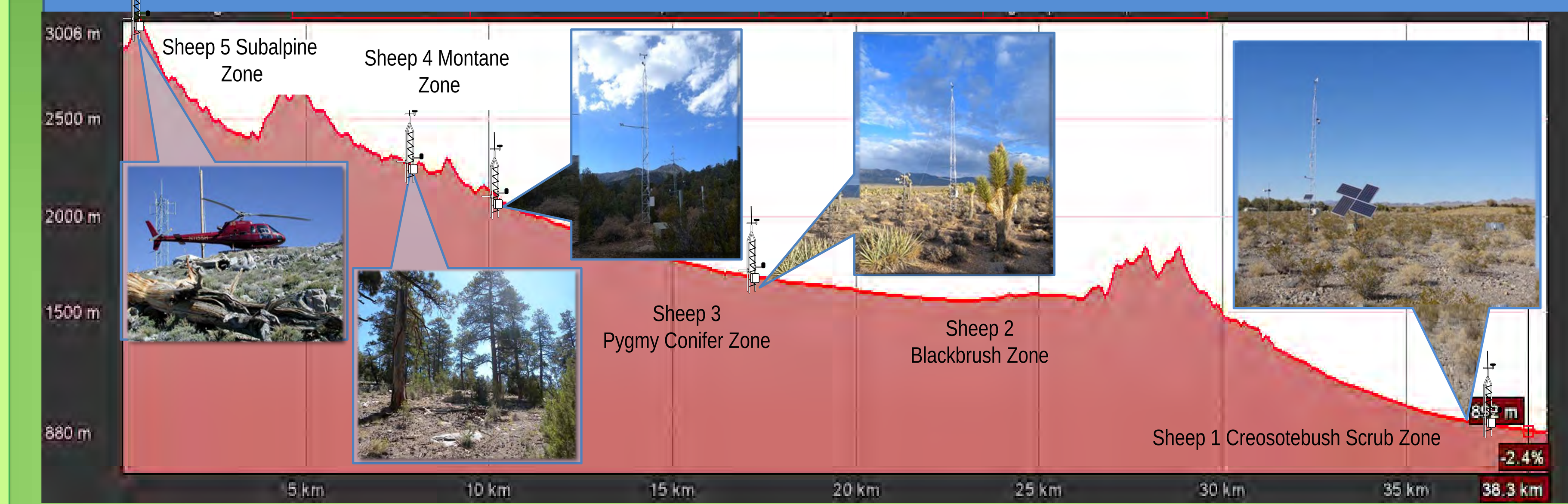
GEONOR Rain/Snow Gage

Dendrometer Tree Diameter Growth Sensor

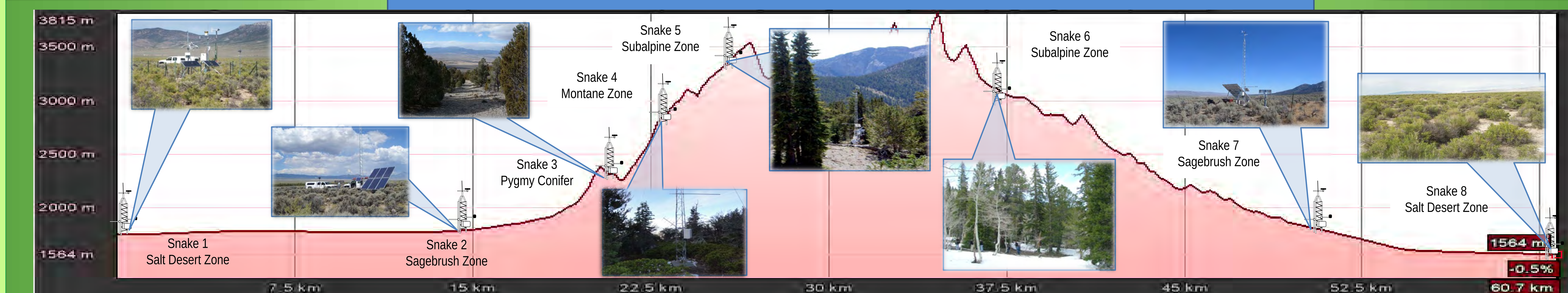
Instrument Type	Make/Model	Output units	Sensor Placement
Net Radiometer	Kipp & Zonen CNR1	$W\ m^{-2}$	2-3m ags
Quantum Sensor	LiCor 190SA	$\mu mol\ m^{-2}\ s^{-1}$	3m ags
Pyranometer	LiCor 200SZ	$\mu mol\ m^{-2}\ s^{-1}$	3m ags
Capacitive RH	CSI HMP50	%, & ^oC	2m ags
Propeller Anemometer/ Wind Vane	RM Young 05103	$m\ s^{-1}$, degrees from North	10m ags
Ambient Air Temperature Thermocouple	OMEGA Copper Const.	^oC	2m & 10m ags
Barometric Pressure Sensor	Setra 278	kPa	1.5-2m ags
Sonic Snow Gage	Judd Communications	mm	3-4m ags
GEONOR Rain/Snow	GEONOR T-200B	mm	1-3m ags
Tipping Bucket	Hydro. Svs. TB4	mm	1-3m ags
Sap Velocity Sensor	Dynamax TDP	dT ^oC, g/cm^3	1-2m ags
Dendrometer	Ag. Elec. Corp.	µm	1-2m ags
NDVI Senor (660-730nm)	SKYE SKR1800	Unit less	1-3m ags
Soil Heat Flux	Huseflux HFP01SC	$W\ m^{-2}$	8 cm bgs
Soil thermal conductivity, diffusivity, & specific heat	East 30 DPHP	$W\ m-1\ °C-1$, $J\ m^{-2}\ K^{-1}$, $J\ kg^{-1}\ K^{-1}$	8 cm bgs
Soil Water Matric Potentia (-10 to 2500 kPa)	CSI 229	kPa	8 cm bgs
Time Domain Reflectometer (TDR)	CSI CS616	m^3m^{-3}	10-60 cm bgs

Measurement Site Locations and Elevations

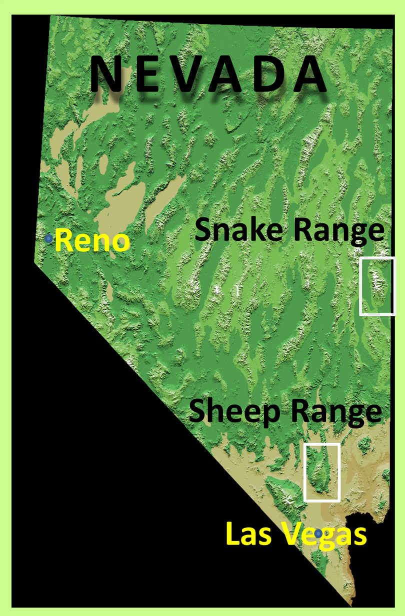
Sheep Range Transect



Snake Range Transect



3. Transect and Station Description



Transect	Site	Geographic Region	Zone	Predominant Species	Coordinates	Elevation (m)	Permits
Snake	1	Great Basin	Salt Desert	Greasewood	38.697740, -114.088762	1564	BLM
Snake	2	Great Basin	Sagebrush	Big Sage	38.925283, -114.407664	1790	Long Now
Snake	3	Great Basin	Pygmy Conifer	Pinyon Pine, Juniper	38.906564, -114.348539	2200	BLM
Snake	4	Great Basin	Montane	White/Douglas Fir, Ponderosa Pine	38.889856, -114.331536	2810	Long Now
Snake	5	Great Basin	Subalpine	Bristlecone/Limber Pine, Engleman Spr.	38.906094, -114.308878	3355	Long Now
Snake	6	Great Basin	Subalpine	Bristlecone/Limber Pine, Engleman Spr.	39.009978, -114.310192	3070	GB Natl. Park
Snake	7	Great Basin	Sagebrush	Big Sage	39.020603, -114.176414	1835	NV Conservancy
Snake	8	Great Basin	Salt Desert	Greasewood	39.03773, -114.058754	1560	BLM
Sheep	1	Mojave	Creosotebush	Creosote, Bursage	36.435345, -115.355850	900	Fish & Wildlife
Sheep	2	Mojave	Blackbrush	Blackbrush, Joshua Tree	36.519724, -115.163297	1670	Fish & Wildlife
Sheep	3	Mojave	Pygmy Conifer	Pinyon Pine, Juniper	36.572808, -115.204060	2065	Fish & Wildlife
Sheep	4	Mojave	Montane	Ponderosa Pine	36.590255, -115.214166	2320	Fish & Wildlife
Sheep	5	Mojave	Subalpine	Bristlecone Pine	36.657641, -115.200777	3015	Fish & Wildlife

4. **Key** Science Questions

Ecological Change and Water Resources

Science Question	Research Activities	Output	Infrastructure Utilized	Linkages to other components?	Researcher(s)
1. What are the linkages among climate variability, latitude-elevation with eco-hydrologic processes?	Transect data analysis, modeling	Transect data and conceptual models	Transects, Model outputs, Data Portal, and Faculty/student	Climate, Policy, Cyber-infrastructure	J. Arnone, F. Biondi, L. Saito, D. Devitt
2. How are target species affected by climate at different elevations	Transect data analysis, modeling, field studies	Transect data, conceptual models and additional species data	Transects, Model outputs, Data Portal, and Faculty/student	Climate, Cyber-infrastructure	J. Arnone, F. Biondi, L.Fenstermaker, L. Saito, B.Riddle, D.Devitt
3. How is water partitioned among veg. zones with elevation	Transect data analysis, modeling	Transect data and conceptual models	Transects, Model outputs, Data Portal, staff	Climate, Cyber-infrastructure	J. Arnone, F. Biondi, L. Fenstermaker, L. Saito, D. Devitt
4. How resilient is the Great Basin versus the Mojave to climate variability	Transect data analysis, modeling	Transect data, conceptual models, linked modeling with climate & data portal	Transects, Model outputs, Data Portal, and Faculty/student	Climate, Policy, Education, and Cyber-infrastructure	J. Arnone, F. Biondi, L. Fenstermaker, L. Saito, B.Riddle
5. How do recent responses/ measurements relate to paleo-environments	Transect and regional data analysis, models, field studies	Transect data, conceptual models	Transects, Model outputs, Data Portal, and staff	Climate and Cyber-infrastructure	J. Arnone, F. Biondi, L. Saito, B. Riddle
6. How can transect data be used to address questions at varying scales	Transect and regional data analysis, models	Transect data, linked models with climate modeling & data portal	Transects, Model outputs, Data Portal, and staff	Climate, Policy, and Cyber-infrastructure	J. Arnone, F. Biondi, L. Fenstermaker, L. Saito, D. Devitt

➢Science questions (Table above) are all linked to the successful acquisition of data from the transects and are all based on an interdisciplinary approach.

➢These key science questions all have direct linkages to other components (education, cyberinfrastructure, policy & climate).

➢Addressing the science questions will be dependent on researchers successfully leveraging the transect system to acquire competitive funding.

5. Final Thoughts

➢Both transects should be fully operational by Spring 2011.

➢Numerous research projects (seed grants) have been initiated to take advantage of the new research sites and incoming data sets.

➢Researchers are encouraged to build strong ties with the climate change scientific community (regional, national, international).

➢Public access to the data sets should begin in 2012.

6. Acknowledgements

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7. Citations

Chambers, J.C., et al., 2006. Collaborative Management and Research in The Great Basin – Examining the Issues and Developing a Framework for Action. Draft Report: http://www.cabnr.unr.edu/GreatBasinWatershed/Issues_Papers.pdf (cited with permission).

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