

Salinity Management for Floodplain Riparian Restoration

Grabau, Matthew R.¹, Milczarek, Michael A.², Banerjee, Monisha J., and Ashlee Rudolph³

¹GeoSystems Analysis, Inc., Tucson, Arizona, USA, matt@gsanalysis.com, ²GeoSystems Analysis, Inc., Tucson, Arizona, USA, ³US Department of the Interior, Bureau of Reclamation, Boulder City, Nevada, USA

Introduction

Restoring native riparian plant communities on historic floodplains is a major objective of management agencies. For example, the Lower Colorado River Multi-species Conservation Program (MSCP), implemented by the Bureau of Reclamation, includes revegetation of over 2,900 ha of historic floodplain with salt-intolerant native riparian

Like most large rivers, the Colorado River flow is highly regulated. Therefore, riparian habitat creation must be implemented on disconnected floodplains where salinity often elevated due to a lack of overbank flooding, evapoconcentration of salts in upstream reservoirs, and addition of fertilizer salts on adjacent agricultural land. As a result, groundwater and soil salinity exceed the tolerance of native vegetation in many areas. Furthermore, because hydrology is likely insufficient to support planted vegetation, irrigation is required for habitat restoration. Application of irrigation over shallow groundwater can result in upward salinity migration, exacerbating salinity problems. Alternatively, irrigation and drainage might be managed to mitigate salinity.

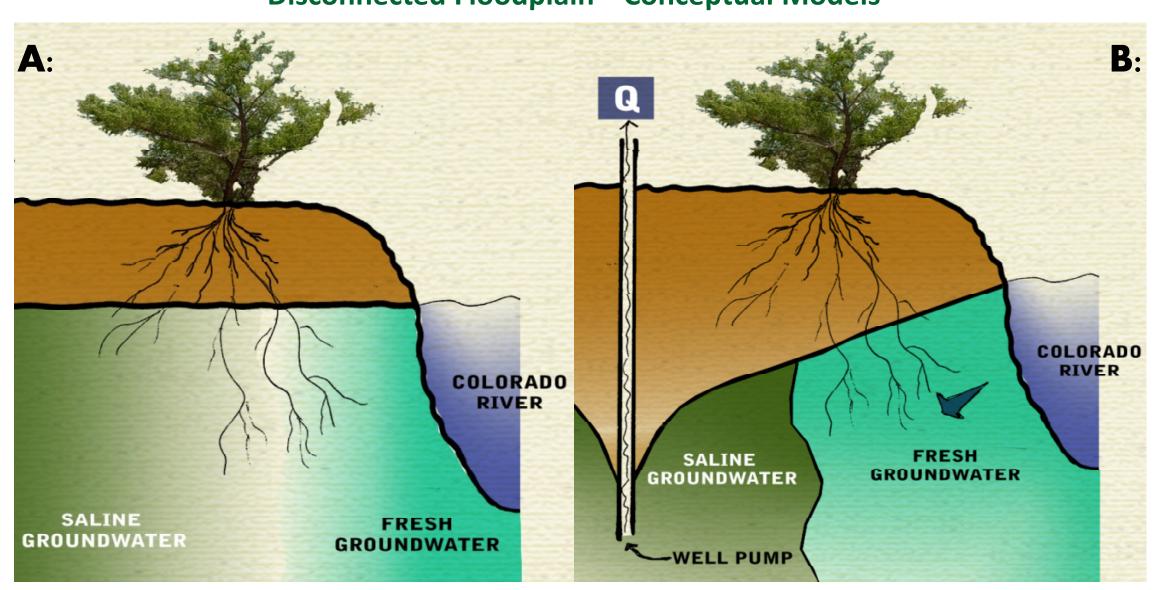
This effort aimed to identify salinity management options for riparian habitat restoration, characterize soil and groundwater conditions at current MSCP habitat creation sites, and develop potential salinity management strategies.

Background

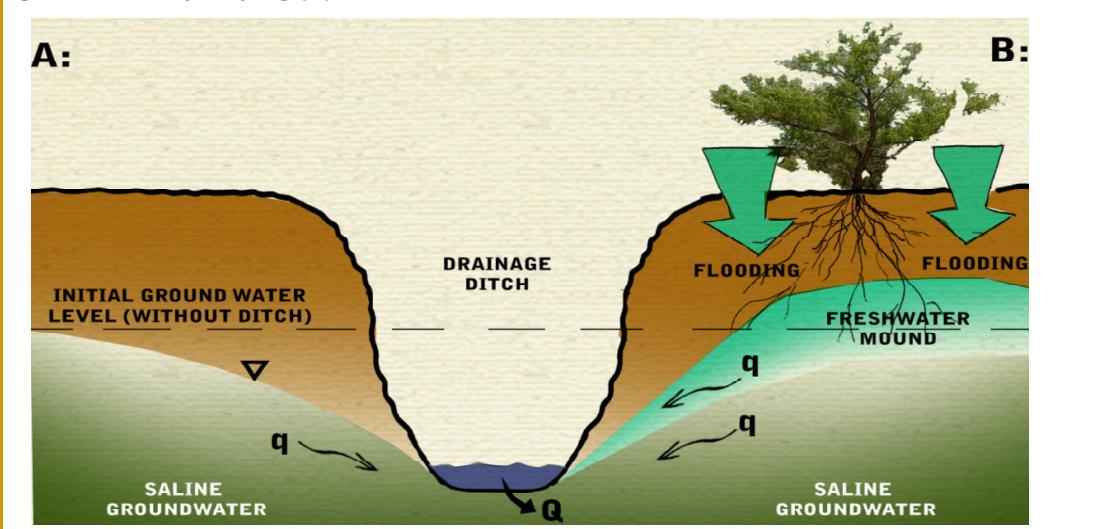
Native riparian trees require abundant, low salinity water². Therefore, revegetation is typically reliant on shallow groundwater and/or high irrigation rates.

- Shallow groundwater →
- High evaporation rates can lead to soil salinity accumulation.
- Limited unsaturated zone for leaching salts from soil—root zone typically penetrates to groundwater.
- Leached salts can accumulate in near-surface groundwater, depending on groundwater flow.
- Irrigation \rightarrow
- Addition of salts to soil profile and groundwater.
- More near-surface soil evaporation.

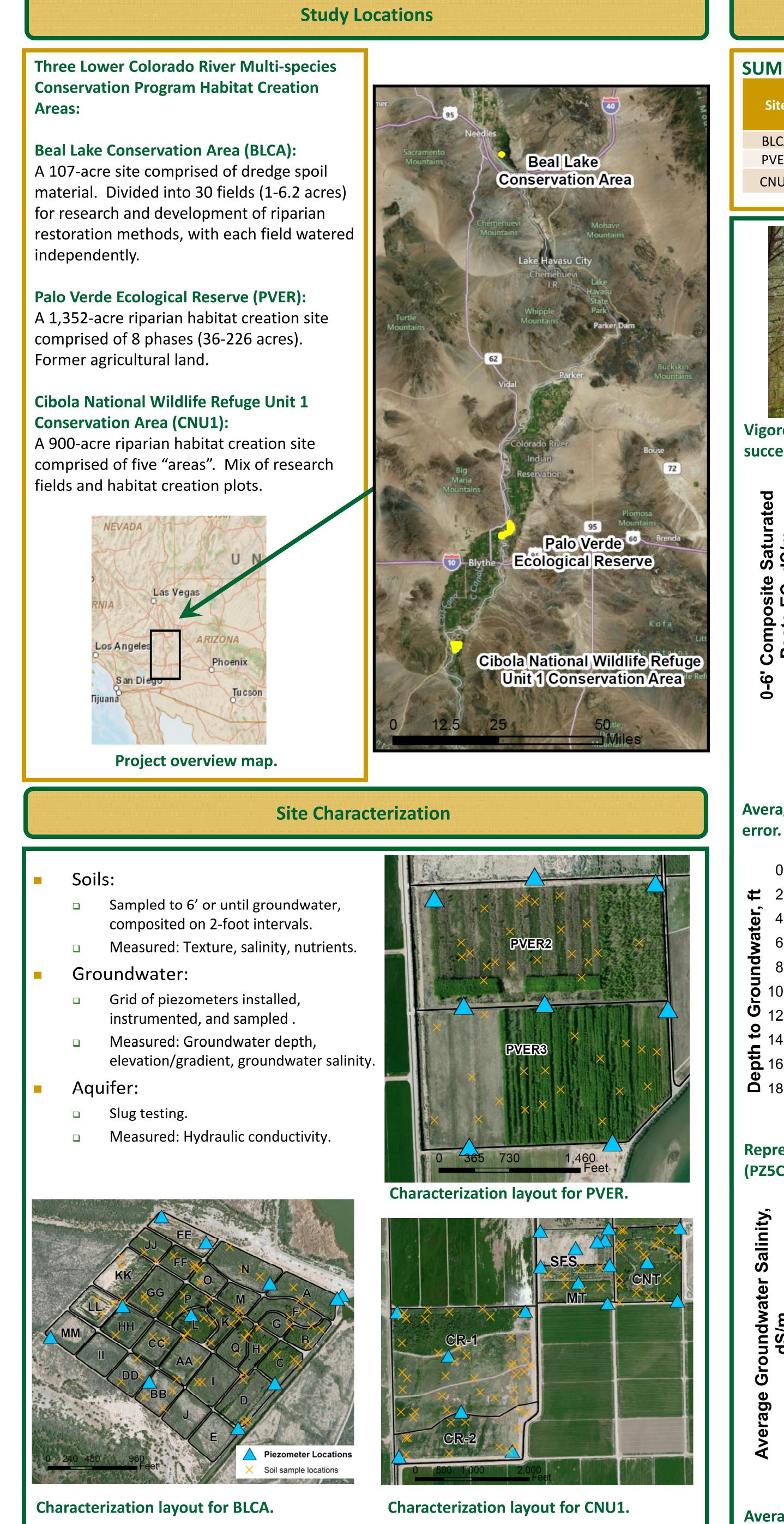
Disconnected Floodplain—Conceptual Models

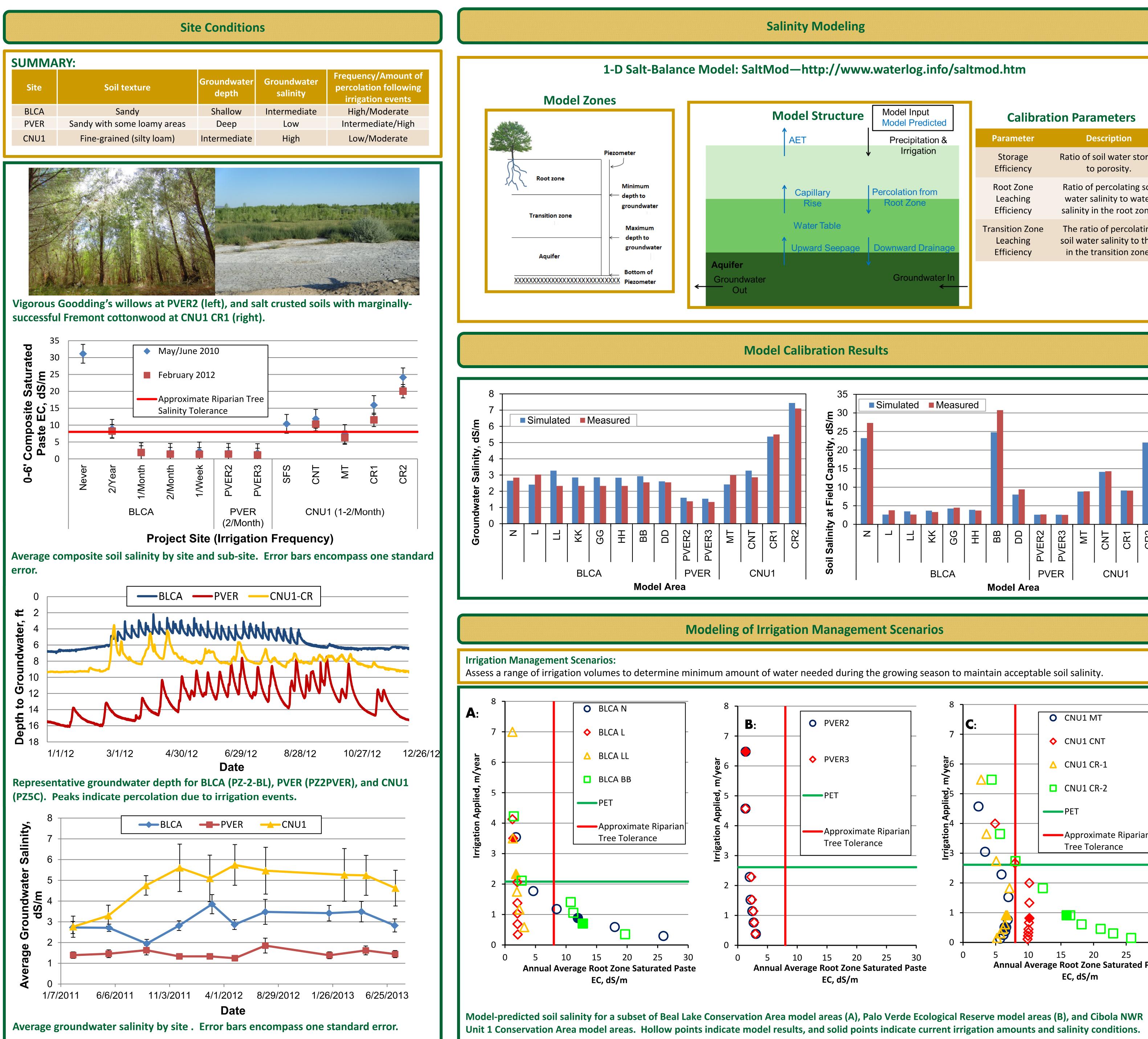


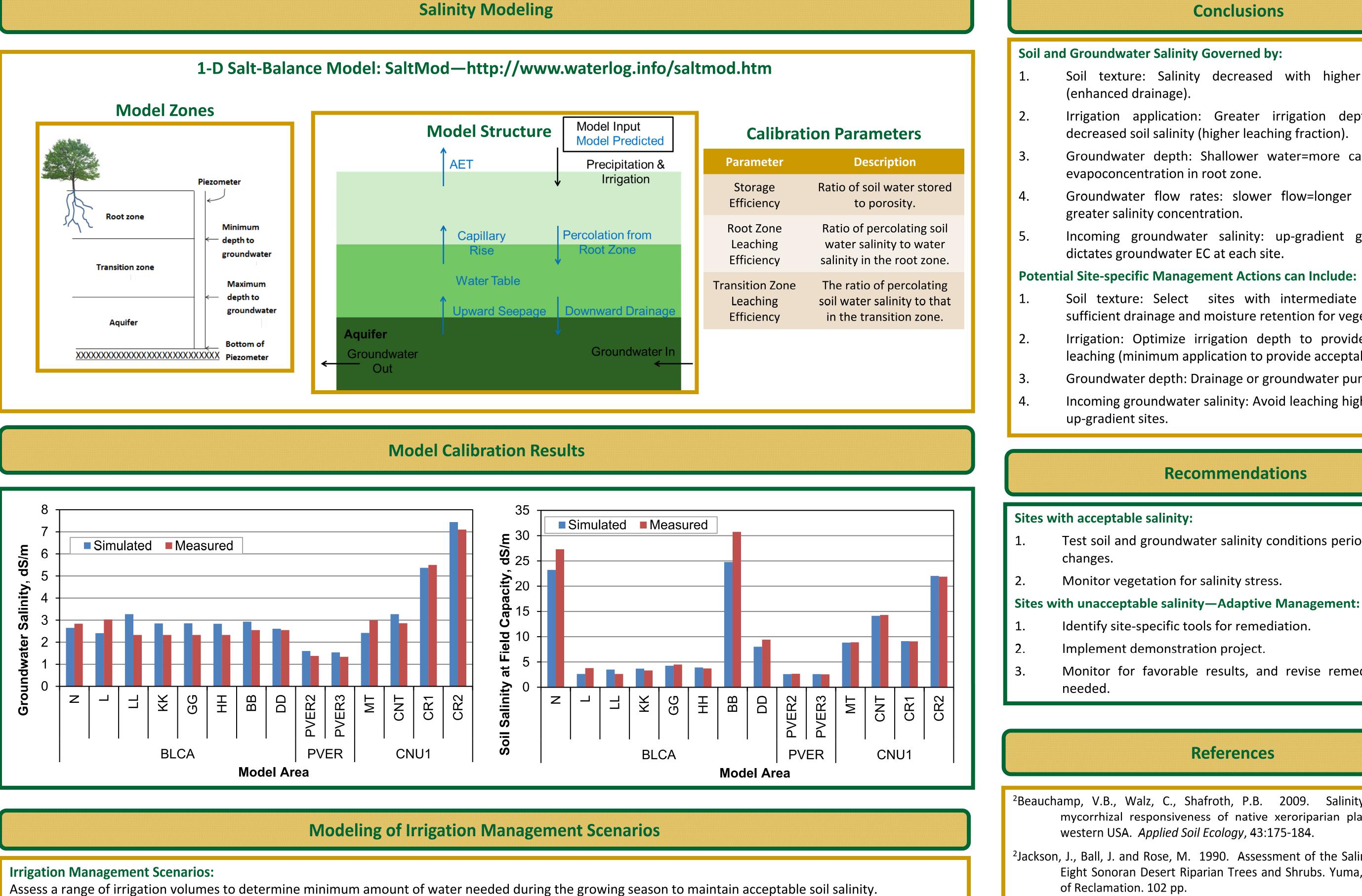
River/aquifer interactions—no management (A) and inducing groundwater freshening by groundwater pumping (B).



Saline groundwater draining (A) and saline groundwater draining with freshwater mounding due to flooding (B).







PVER3

Approximate Riparian

20 25 30

Tree Tolerance

Annual Average Root Zone Saturated Paste

EC, dS/m

BLCA N

♦ BLCA L

BLCA LL

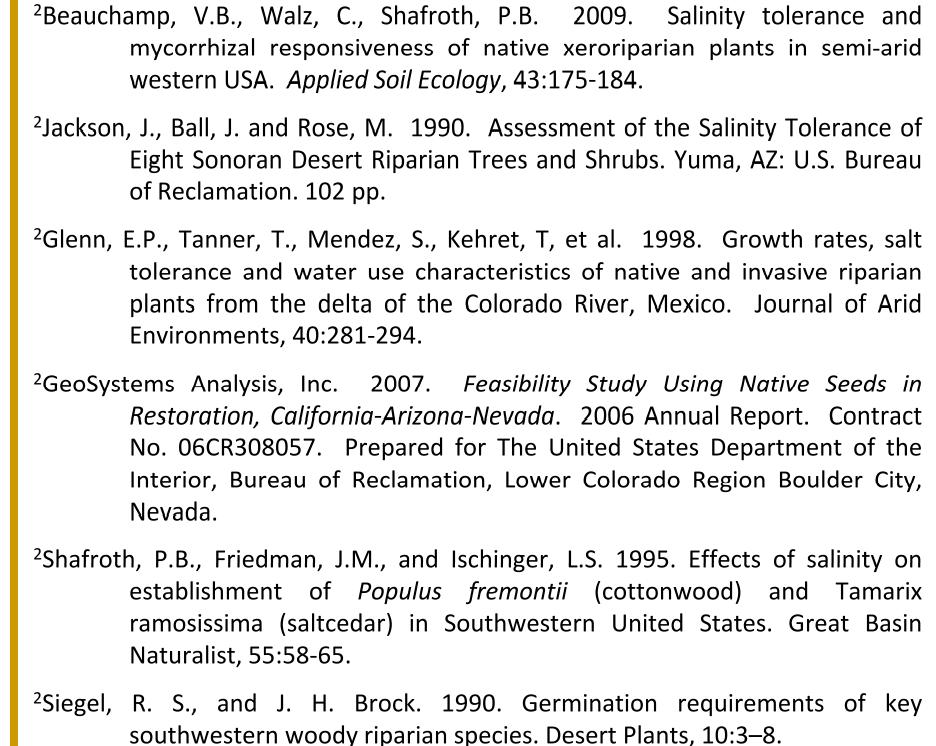
BLCA BB

Annual Average Root Zone Saturated Paste

EC, dS/m

Approximate Riparian

Tree Tolerance



O CNU1 MT

CNU1 CNT

△ CNU1 CR-1

CNU1 CR-2

Annual Average Root Zone Saturated Paste

EC, dS/m

Approximate Riparian

Tree Tolerance

Conclusions

decreased soil salinity (higher leaching fraction).

Soil texture: Salinity decreased with higher percent sand

Irrigation application: Greater irrigation depth resulted in

Groundwater depth: Shallower water=more capillary rise and

Groundwater flow rates: slower flow=longer residence time,

Incoming groundwater salinity: up-gradient groundwater EC

Soil texture: Select sites with intermediate soil textures—

Irrigation: Optimize irrigation depth to provide sufficient salt

Incoming groundwater salinity: Avoid leaching high salt loads from

Test soil and groundwater salinity conditions periodically to detect

Monitor for favorable results, and revise remediation tools as

References

leaching (minimum application to provide acceptable salinity).

sufficient drainage and moisture retention for vegetation

Groundwater depth: Drainage or groundwater pumping.

Recommendations

Soil and Groundwater Salinity Governed by:

evapoconcentration in root zone.

dictates groundwater EC at each site.

Monitor vegetation for salinity stress.

Implement demonstration project.

Identify site-specific tools for remediation.

Potential Site-specific Management Actions can Include:

greater salinity concentration.

(enhanced drainage).

up-gradient sites.



Habitat Conservation Plan. Final. December 17. (J&S 00450.00.)

¹USBR. 2004. Lower Colorado River Multi-Species Conservation Plan, Volume II:

Sacramento, CA.

We thank the Bureau of Reclamation Lower Colorado Regional office and the LCR MSCP for their support and funding of these efforts. Thanks to Cibola NWR and Havasu NWR staff for their support in implemented field studies.