

George Breit<sup>1</sup>, Harland Goldstein<sup>1</sup>, Sharon McKelvey<sup>2</sup>, Richard Reynolds<sup>1</sup>  
<sup>1</sup>USGS, Denver, CO [gbreit@usgs.gov](mailto:gbreit@usgs.gov)  
<sup>2</sup>FWS, Ash Meadows National Wildlife Refuge, Amargosa Valley, NV

## Introduction:



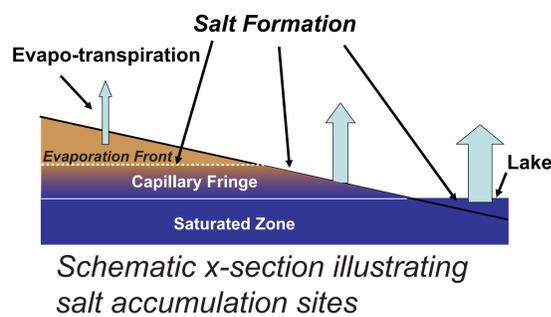
Vegetation near flowing well.

Areas underlain by shallow groundwater in the Mojave Desert commonly have surficial salt and saline soils.

Spatial changes in vegetation near these areas are related to both water and salts.

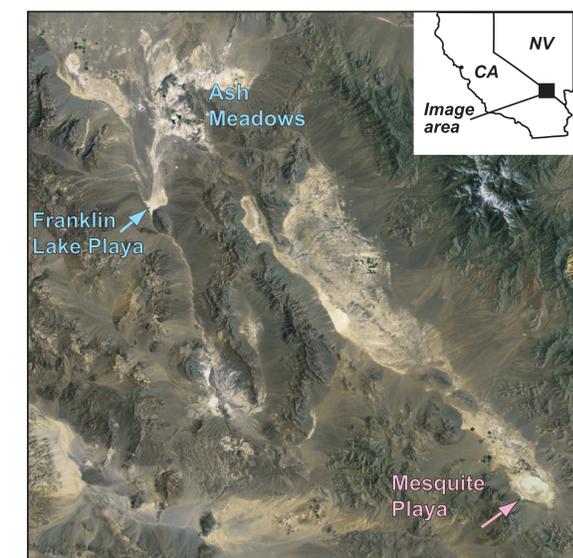
Salt can limit water uptake by plants and may contain toxic elements (i.e. As, B, Mo, Se, U) that limit plant vitality.

Position of salt accumulation depends on the depth of the evaporation front. This depth is expected to change with shifts in climate that alter precipitation and evaporation amounts.



## Approach:

We are describing the distribution, origin, and composition of salts in the Franklin Lake playa, Mesquite playa and Ash Meadows NWR. through sampling and analysis of water, salts and soils. Planned work will examine the relation of salt content of soil to threatened plants.

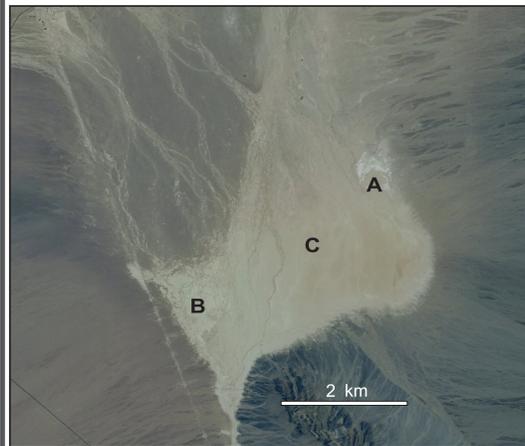


Aerial image of study areas

**Franklin Lake Playa - Ash Meadows NWR**  
**Water Depth:** 0 to 5 m  
**TDS:** 0.5 to 71 g/L  
**Common Salts:** halite (NaCl), burkeite ( $\text{Na}_6\text{CO}_3(\text{SO}_4)_2$ ), trona ( $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$ ), thenardite ( $\text{Na}_2\text{SO}_4$ )  
**Trace elements:** As, B, Se, Mo, U

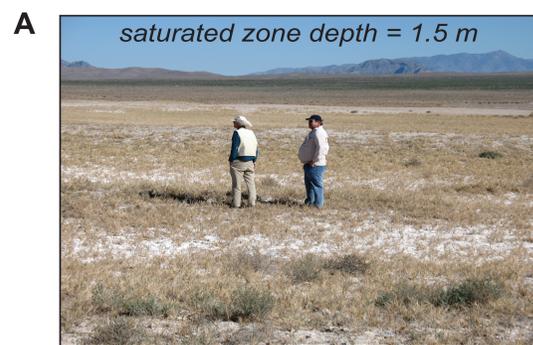
**Mesquite Playa**  
**Water Depth:** 4 to 8 m  
**TDS:** 0.3 to 211 g/L  
**Common Salts:** halite (NaCl), gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ )  
**Trace elements:** none.

## Franklin Lake Playa:

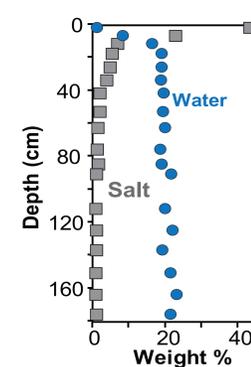


Aerial image of Franklin Lake playa

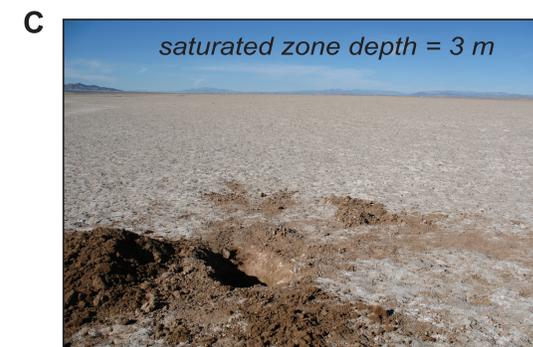
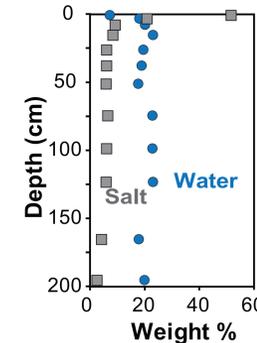
Samples of soil were collected from locations (A, B, C) in the Franklin Lake playa. The water and soluble salt contents were measured as shown below. Although soil water contents were similar among sites, salt content and vegetation are distinct.



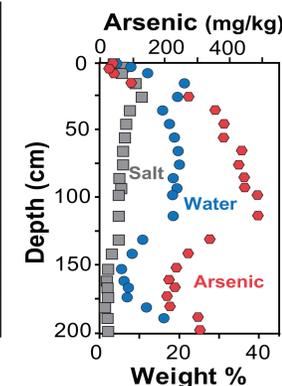
*Distichlis* in areas dominated by sodium sulfate salt. Salt content is low below 40 cm.



Vegetation on coppice dunes. Surface is dominated by sodium chloride and carbonate.



No vegetation on surface with low salt content. Increased salt with depth. Note high arsenic content in water-soluble fraction.

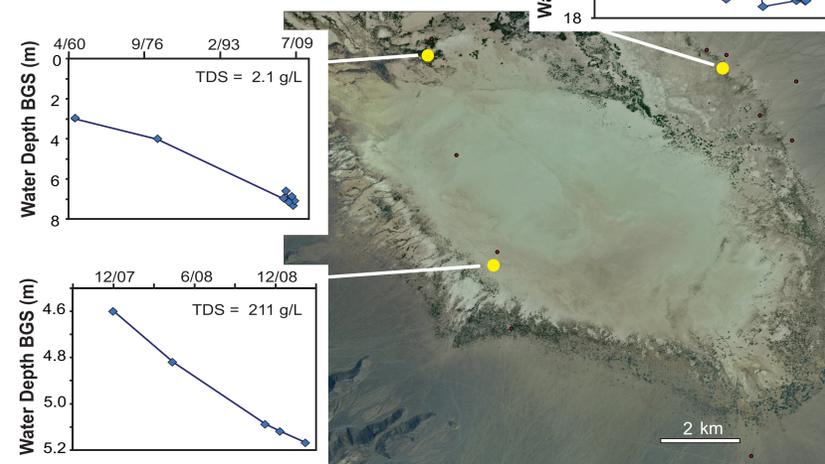


## Mesquite Playa:

Mesquite trees marginal to this playa have indications of declining vitality. The decline in viable trees may be related to lower water levels and lateral spread of saline water from the playa center.

Salts in this area lack trace element enrichments.

(Groundwater level data from USGS NWIS and Jim Yount (USGS).)



Aerial image of Mesquite playa

## Ash Meadows NWR:



Aerial image of Ash Meadows

Ash Meadows is a desert oasis where about 60,000 m<sup>3</sup> day<sup>-1</sup> of groundwater is discharged. This water sustains endangered fish as well as one endangered and 6 threatened plant species. Pan evaporation of 250 cm yr<sup>-1</sup> indicates the origin of local salt accumulations. Salts contain high contents of trace elements. Restoration and climate change may modify water and salt distribution.

### Threatened Plants:

- Ash Meadows milkvetch (*Astragalus pfeonix*)
- Ash Meadows Sunray (*Enceliopsis nudicaulis corrugata*)
- Spring-loving centaury plant (*Centaurium namophilum*)
- Ash Meadows ivesia (*Ivesia kingii eremica*)
- Ash Meadows gumplant (*Grindelia fraxino-pratensis*)
- Ash Meadows blazingstar (*Mentzelia leucophylla*)



Ash Meadows Milkvetch surrounded by Na<sub>2</sub>SO<sub>4</sub>