Climate Change and Spring-Fed Wetlands

Anticipated Consequences & Monitoring Challenges

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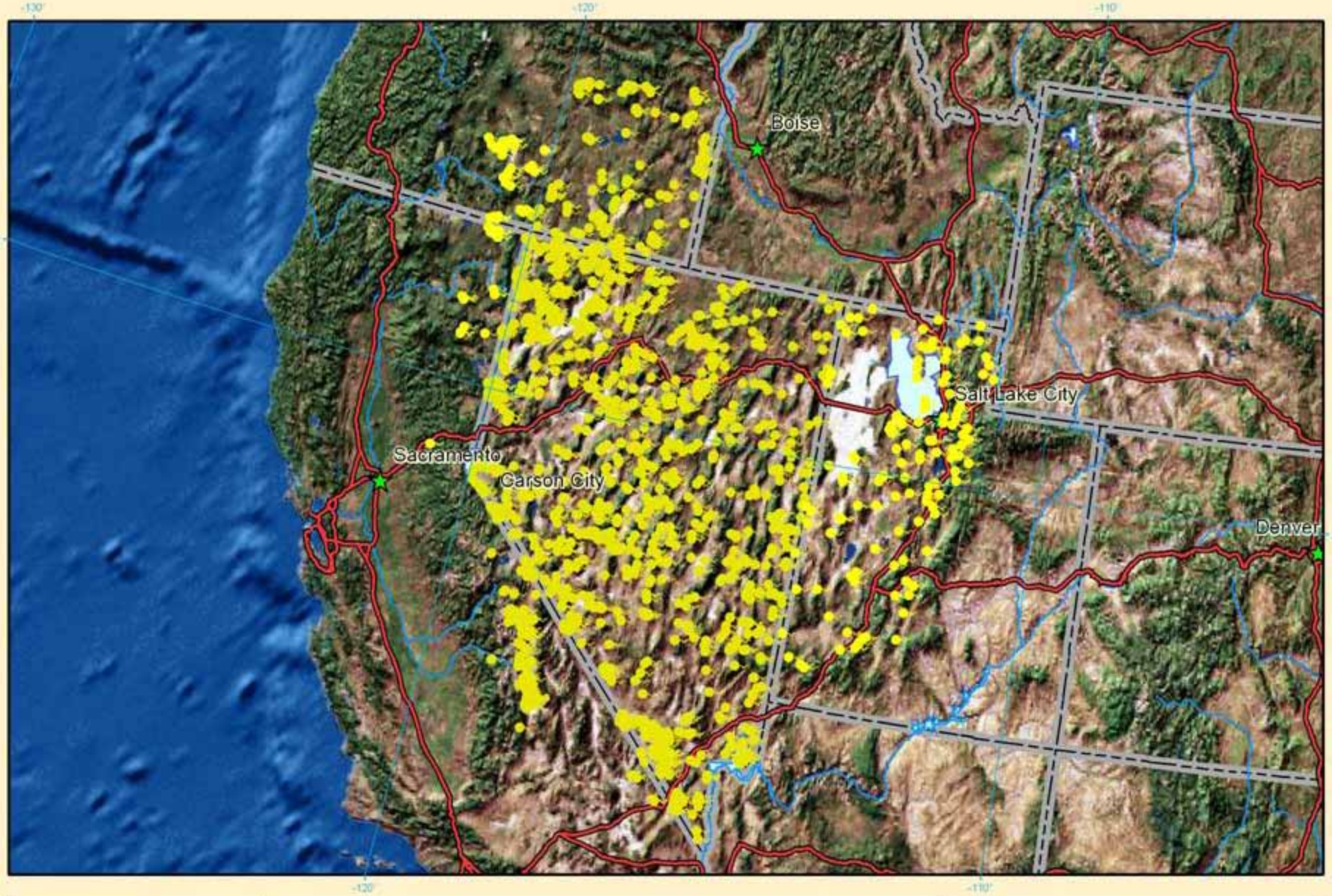


Legend
- Capital Cities
- Interstate Highways
- Rivers
- Lakes
- State Boundaries

Albers Projection

Springs of the Great Basin

0 50 100 200 300 Miles

Base map courtesy of ESRI

Springs vs. Streams

Springs

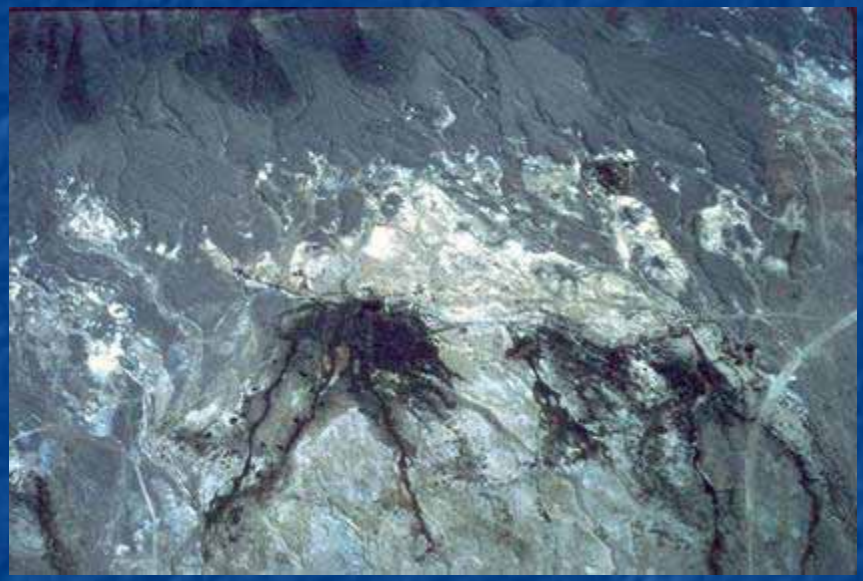
- Relatively Static
  - Discharge
  - Water Temperature
- Water Chemistry
  - Turbidity
  - Etc.
- Weak Hydraulic Processes

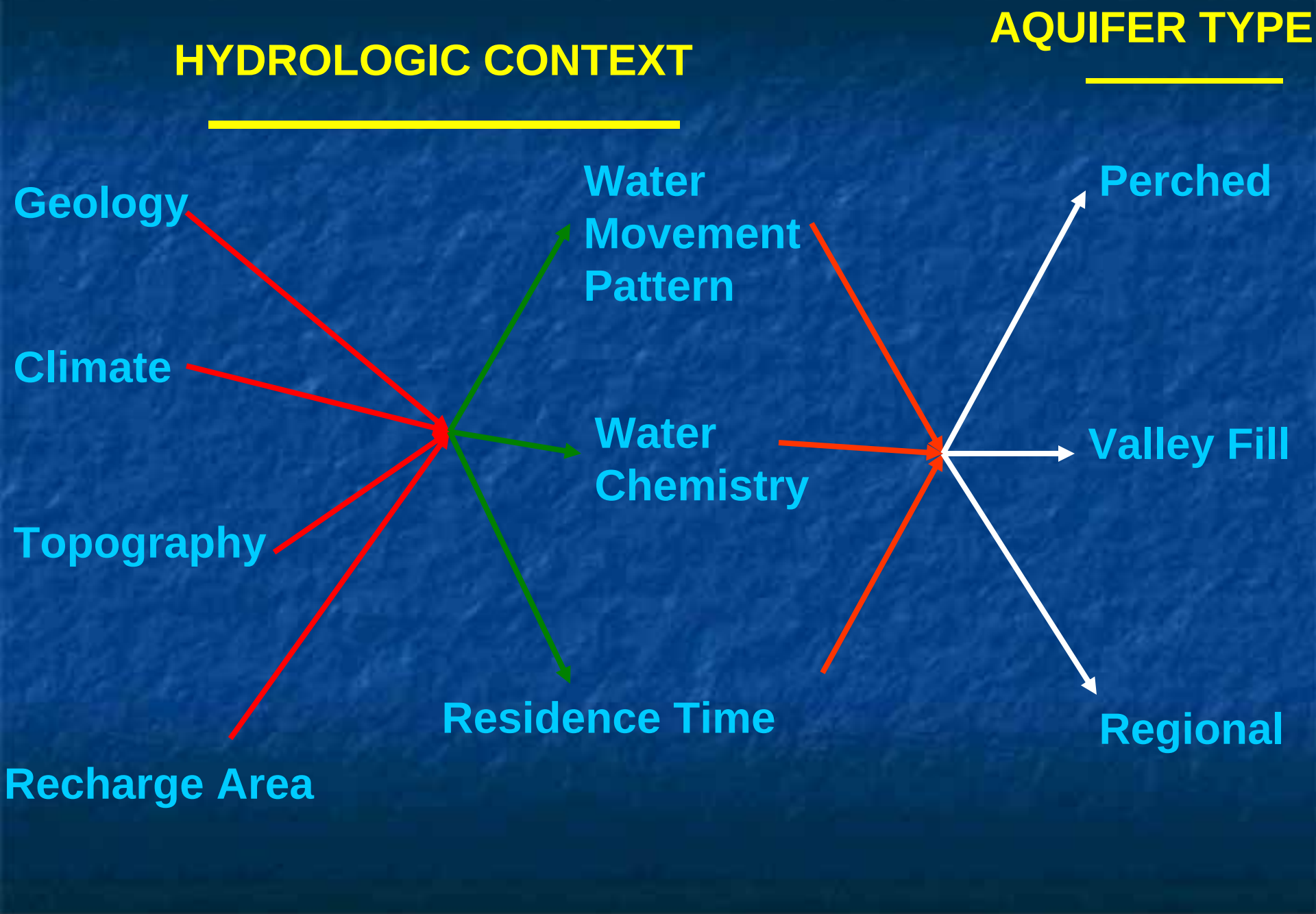
Streams

- Relatively Variable
  - Discharge
  - Water Temperature
  - Water Chemistry
  - Turbidity
  - Etc.
- Strong Hydraulic Processes

Basic Landscape Characteristics

- Comparatively Small
- Individual or Provinces
- Most are Isolated from Other Aquatic Systems
- Often the Only Water Over Large Areas
- Each is Distinctive
  - Biota
  - Size
  - Discharge
  - Temperature
  - Etc.




HYDROLOGIC CONTEXT
AQUIFER TYPE
Geology
Climate
Topography
Recharge Area
Water Movement Pattern
Water Chemistry
Residence Time
Perched
Valley Fill
Regional

Great Basin Aquifer Generalities

- **Perched (Mountain)**
  - Small (Watershed)
  - Springs discharge on mountain or ridge blocks
  - Short residence time (seasonal or annual)
  - Many not persistent, scoured by floods
- **Valley Fill**
  - Small to large (mountain mange)
  - Springs discharge at lower elevations (bajada or valley floor)
  - Residence time yearly to 10s of year
  - Persistence > 20 yr.
- **Regional**
  - Large (Basin & Range)
  - Springs discharge on valley floor
  - Long residence time (100s to 10000s)

HYDROLOGIC CONTEXT AND ENDEMISM

Perched

Valley Fill

Regional

SPRING ENVIRONMENT

Aquifer Provinance

Water Chemistry

Temperature

Persistence

Landscape Setting

Human Uses

Habitat Heterogeneity

Aquatic & Riparian Community Structure

SPRING ENVIRONMENTS

- Ephemeral
- Harsh water chemistry
- High temperature
- High human use impacts
- Scouring Floods

- Persistent flow
- Good water quality
- Low temperature
- Low human use
- Low stress

ENVIRONMENTAL STRESS

SPRING COMMUNITIES

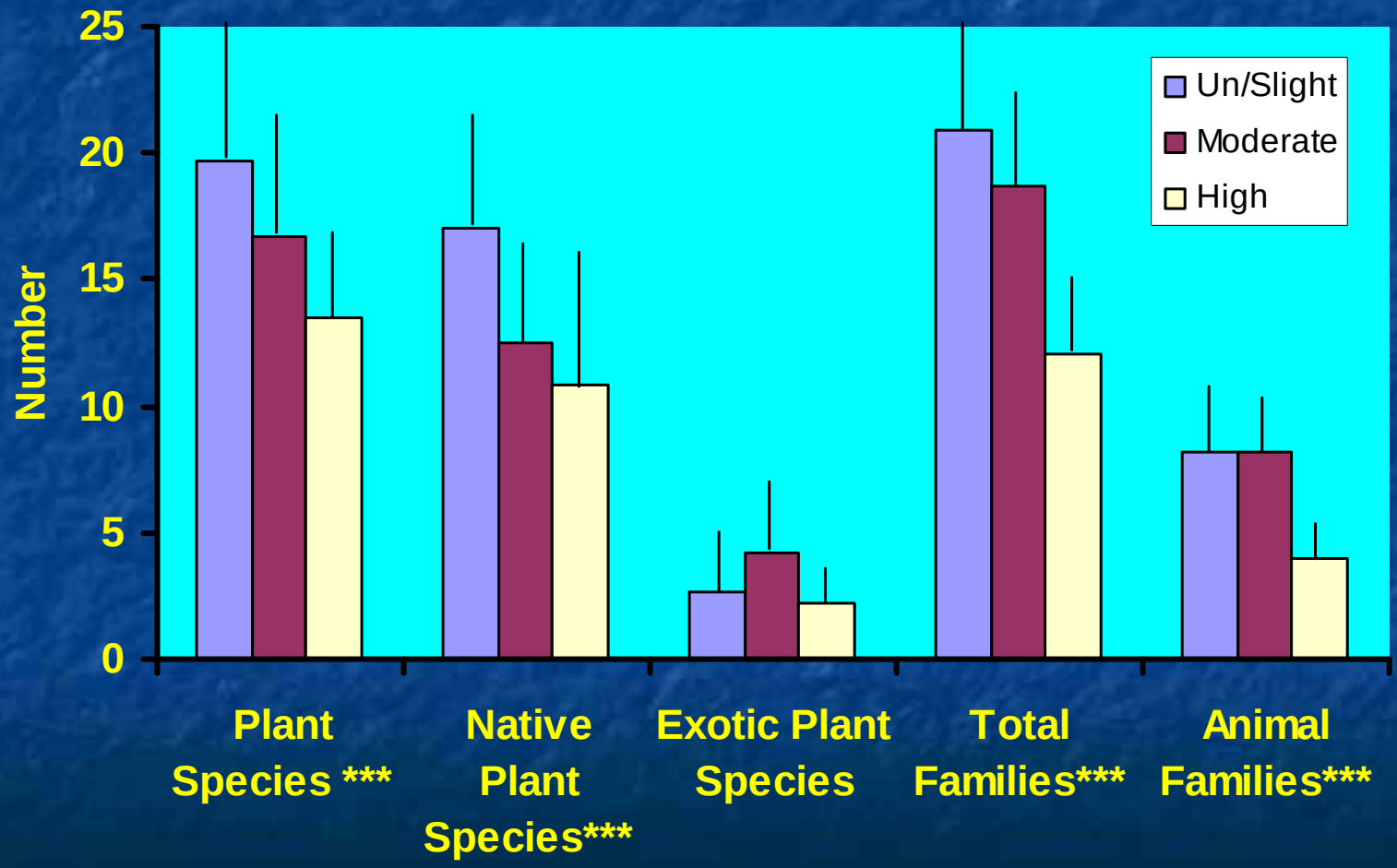
- Tolerant organisms
- Low richness
- Woody vegetation absent
- Upland & non-native vegetation
- Crenobiontics absent

- Intolerant organisms
- High richness
- Woody vegetation
- Obligatory wetland vegetation
- Crenobiontics possible

Disturbance & Taxonomic Richness

Spring Mountains, NV

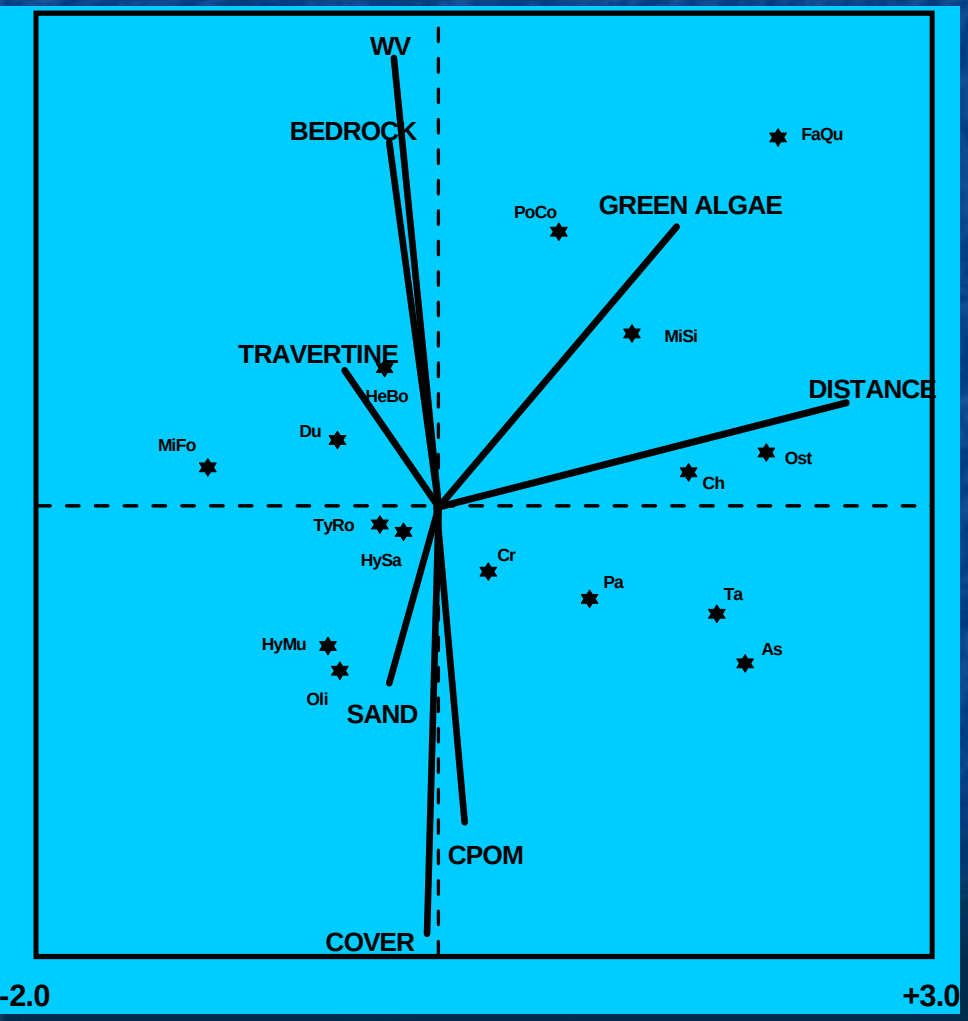
*** = p < .001



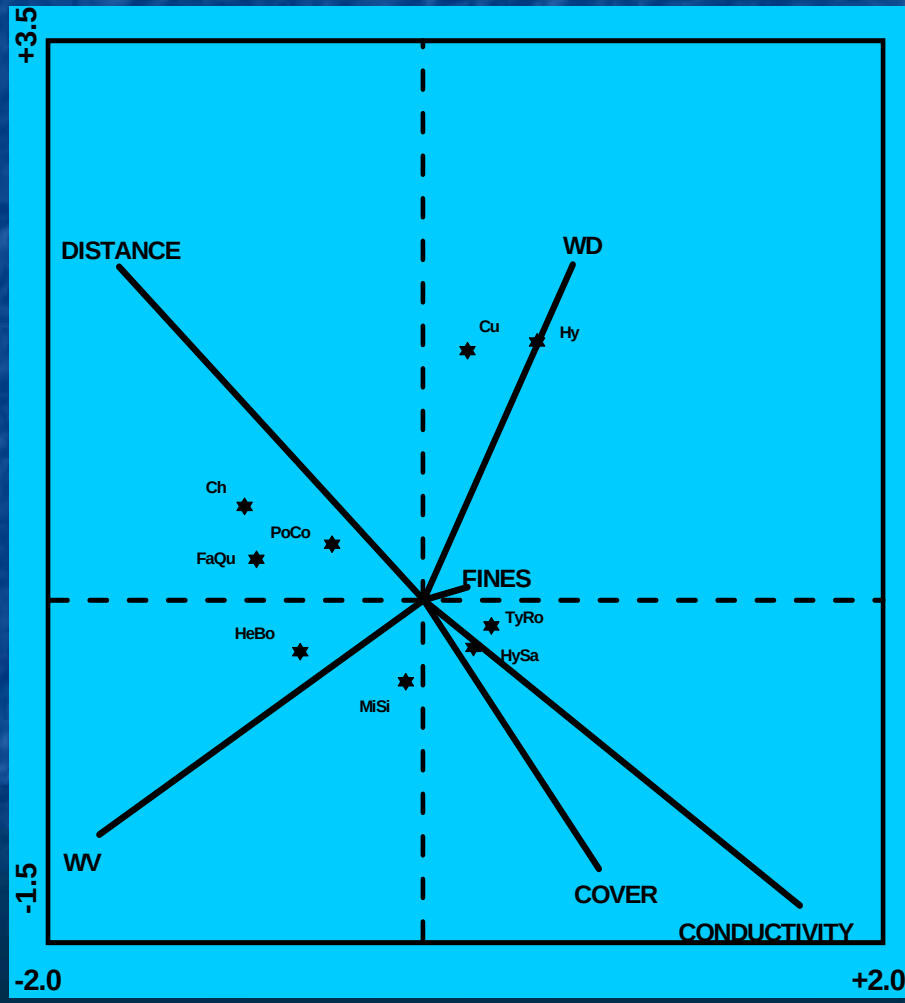
Influential Environmental Factors

Death Valley

Travertine Springs

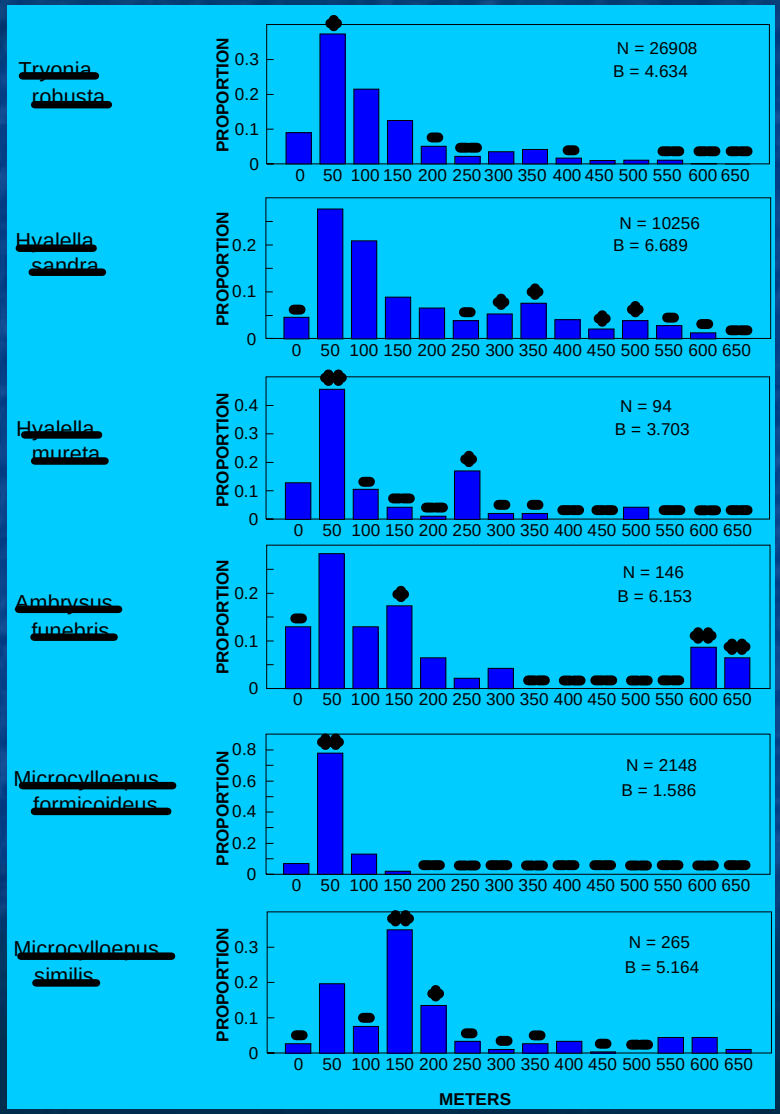


Nevares Springs

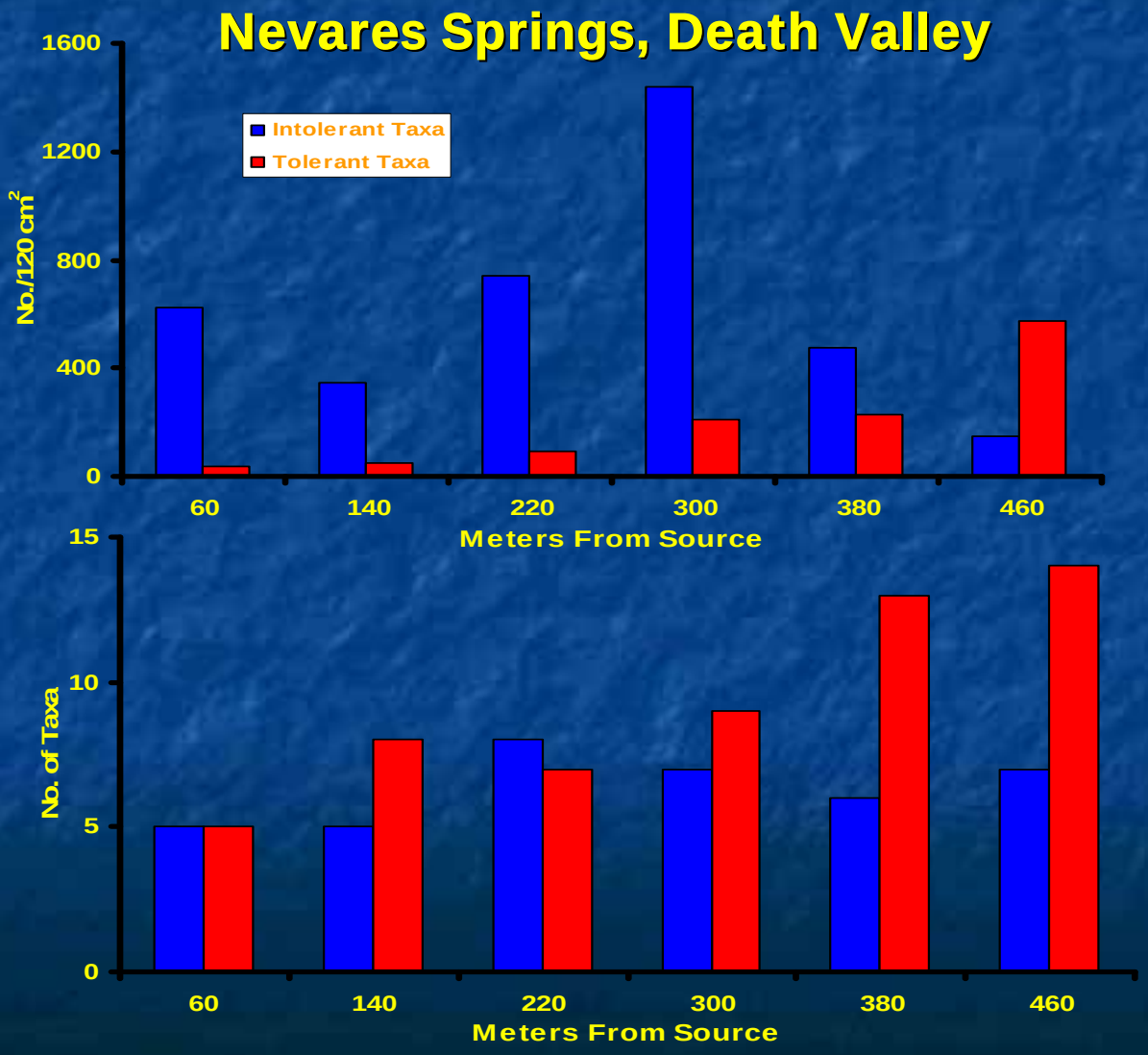


Crenobiontic BMI Distribution

Travertine Springs,
Death Valley



BMI Community along Spring Brook Gradient



Biotic Organization

Source

- Temporal Variation Low
- Low BMI Density, Diversity
- Crenobiontics Possible
- Intolerant BMIs
- Dense Riparian (Obligatory Wetland spp.)

Mid-Reach

- Temporal Variation Moderate
- Increased BMI Density, Diversity
- Tolerant BMIs
- Decreasing Crenobiontics
- Opening Riparian (Facultative Wetland spp.)

Terminus

- Temporal Variation High
- No Crenobiontics
- Highly Tolerant BMIs
- Decreased BMI Diversity
- Open Riparian (Upland spp.)
- Amphibians most likely

Natural & Cultural Disturbance

Number of Sampled Springs and Percent of Disturbed Springs

Park	No.	Dry	Scour	Don't Dry or Scour	Human	Undisturbed
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JOTR	109	33	65	0	17	0
LAME	89	36	46	29	46	6
PARA	206	46	28	13	66	< 0.1
DEVA	762	51	36	27	32	11

JOTR = Joshua Tree National Park

LAME = Lake Mead National Recreation Area

PARA = Grand Canyon-Parashant National Monument

DEVA = Death Valley National Park

Monitoring Challenges

- Site selection
  - Persistent
  - Minimal human & natural disturbances
  - Paired with watershed & groundwater monitoring sites
  - Historical records
- Sample methods
  - Minimally intrusive
  - Biotic & environmental

Anticipated Affects of Climate Change

Environmental

- Altered recharge (lower precipitation, rain vs. snow)
  - Decreased discharge
    - **Increased drying frequency (intermittent springs)**
    - **Shorter springbrooks**
    - **Decreased habitat heterogeneity**
    - **Altered thermal regimes**
    - **Altered chemistry ?**

Anticipated Affects of Climate Change

Biological

- Extinction
  - **Unlikely by natural causes**
  - **Increased likelihood from compounded human effects**
- Extirpations
  - **Amphibians**
- Altered Communities
  - **Increased tolerant animal habitat**
  - **Decreased intolerant animal habitat**
  - **Reduced extent of riparian & aquatic communities**

Acknowledgements

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