Effects of Water Development on Arid Land Freshwater Ecosystems

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Effects of water development on arid land freshwater ecosystems

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Blue Lake
Aquatic habitat connectivity

- much attention focused on fragmentation, but increased connectivity may also have ecological consequences
  - taxonomic, functional, and genetic homogenization of previously distinct communities
  - may result in loss of species with adaptations for different environmental conditions
Columbia Basin Project

• Columbia Basin Project built six dams and >300 miles of canals for irrigation, flood protection, and power production in eastern Washington
  • irreversibly changed the region and lakes within it

• changed groundwater levels, created reservoirs, altered connectivity between previously disconnected systems
Objectives

• to compare chemical and biological characteristics of waterbodies sampled in the 1940s to contemporary samples
  – assess effects of hydrologic manipulations

• to examine effects of changing connectivity on plankton communities
Results: Salinity

**Hydrologic Manipulations**

**Paired t-test**
- $t_8 = 2.41$
- $p = 0.021$

**No Hydrologic Manipulations**

**Paired t-test**
- $t_{13} = 0.249$
- $p = 0.40$

**Graphs:**
- **Salinity (ppt)**
- **historical** vs **contemporary**
- **decrease**
- **no change**
- **increase**
Results: Connectivity

- unexpectedly, highest richness found in canals and reservoirs
- hydrologic connectivity via canals explained more variation in zooplankton communities than natural connectivity – though environment seems to be more important

\[ t_{36} = 1.704, \ p = 0.048 \]

**Species richness**

- **with**
- **without**

**Hydrologic manipulations**

![Graph showing species richness with and without hydrologic manipulations](image)

**T-test**

- 93% for just natural waterways
- 88% for all waterways
- 5% for space + environment
- 2% for space
- 2% for environment

- **Environment**: 93% for just natural waterways, 88% for all waterways
- **Space + Environment**: 5% for just natural waterways, 10% for all waterways
- **Space**: 2% for just natural waterways, 2% for all waterways
Conclusions and next steps

- future work will explore why canals/reservoirs appear to be biodiversity hotspots for zooplankton
- arid lakes are useful systems to understand and predict responses to hydrological and environmental change
  - unique case study over 70+ years
  - what are consequences for ecosystem functions and services given these changing biotic and abiotic conditions?

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