Ecological Analysis of Hydrologic Disturbance Regimes in Streams of North and South Dakota

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Overview of presentation

- Why hydrologic disturbance?
  - Definitions and theory
- How can EMAP deal with it?
  - Regional streamflow analysis
- What are preliminary results for Dakota streams?

What is disturbance?

- “any relatively discrete event in time that disrupts ecosystem structure and changes resources, substrate, or the physical environment”
- Characterized by frequency, intensity, duration, and predictability of events

Hydrologic Disturbance

- Streamflow: fundamental component of physical template in streams
  - Linked to functional organization of stream communities
- Variability: measure of habitat disturbance
  - Intensity, frequency, and predictability of floods and prolonged low-flow periods

Stream Types

- Intermittent versus perennial
- Flood frequency and predictability
  - Snowmelt versus rainstorm
- Seasonal patterns
  - Summer versus winter

Predicted Fish Response

- Intermittent streams
  - Small body size, generalist, highly mobile
  - Simple communities, abiotic control
- Frequent floods
  - Similar to intermittent streams
- Predictable floods
  - Larger body size, specialist
  - Complex communities, seasonal biotic control

Issue for EMAP

- EMAP-West: hydrologic context is important
- Potential for regional insight
- Problem: need to estimate flow metrics

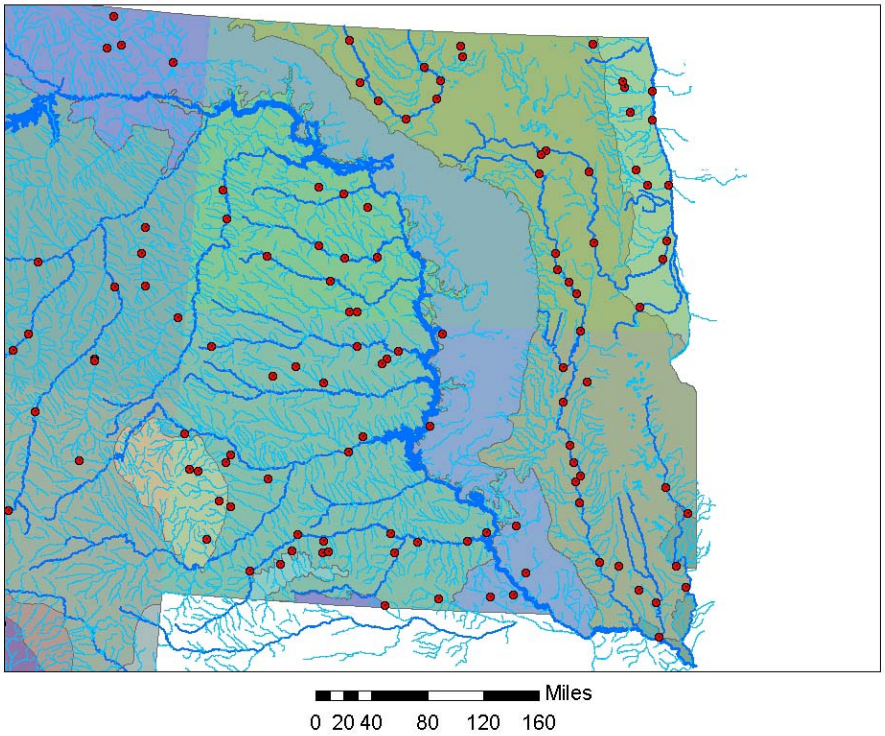
Regionalization of Flow Regimes

- Pool data from sites with gages (USGS) to provide inference for sites without gages (EMAP)
- Define regions where individual flood and low-flow frequency curves are similar
- Combine individual curves to form single dimensionless frequency curve, scaled by site-specific factor (index flow)

Preliminary streamflow metrics

- Flood regime
  - Skewness and variability of annual peak flow
  - Index of bankfull flow
  - Mean timing of annual flood
- Low-flow regime
  - Index of baseflow stability
  - Important low-flow event
  - Mean timing of annual low flow

Dakota Streams

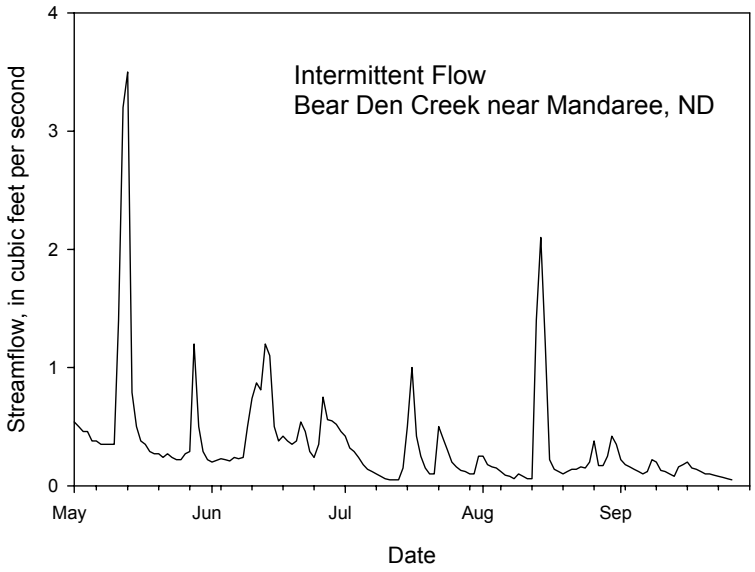


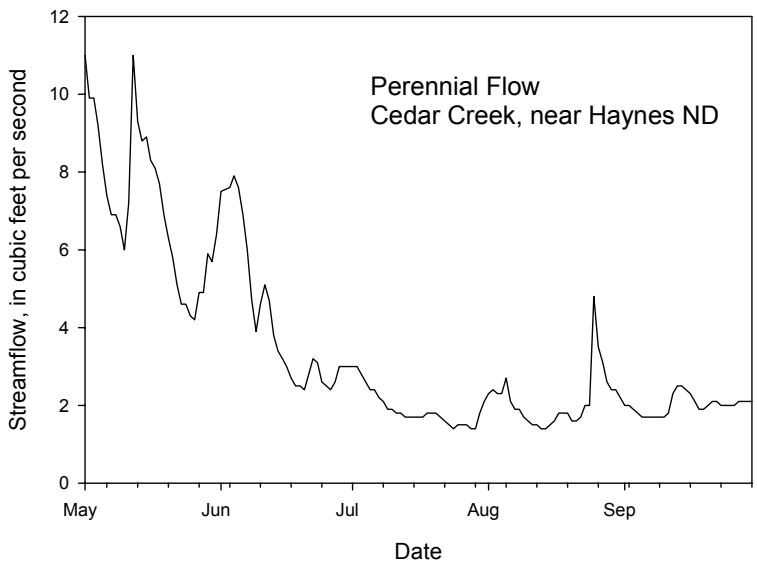
- **Great Plains**
- **Variable climate**
  - Thunderstorms
  - Variable runoff

Watershed characteristics

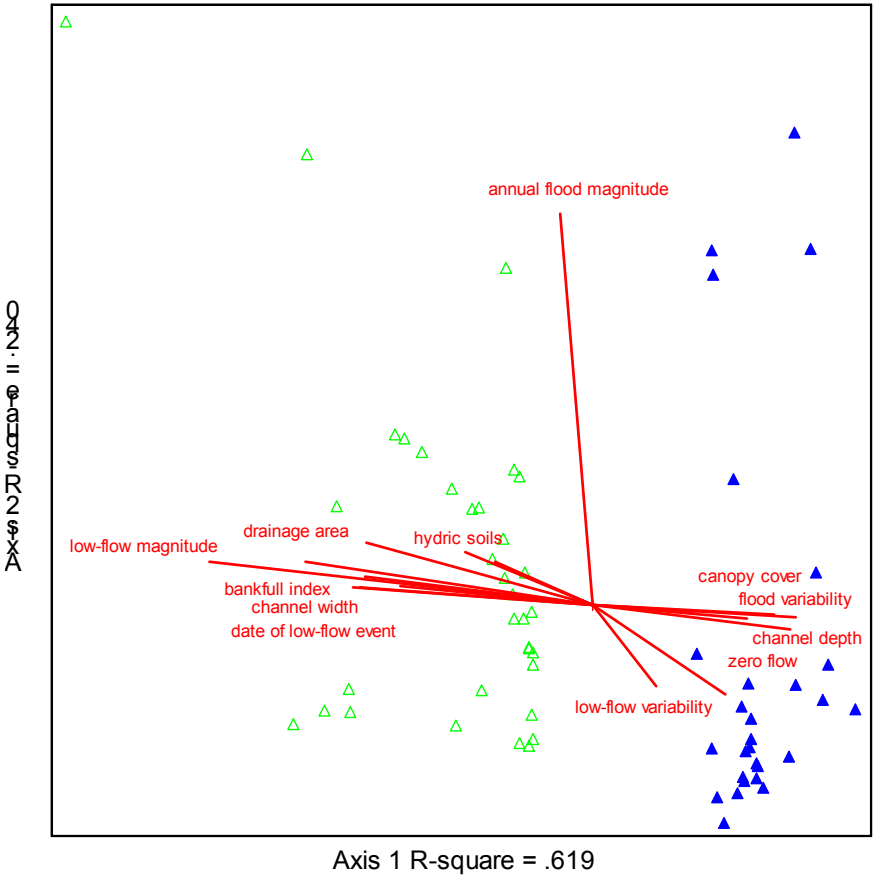
- Lowland streams
  - Flat
  - Thick soils
  - Agriculture
- Upland streams
  - More steep
  - Forest and Range

Summer flow patterns



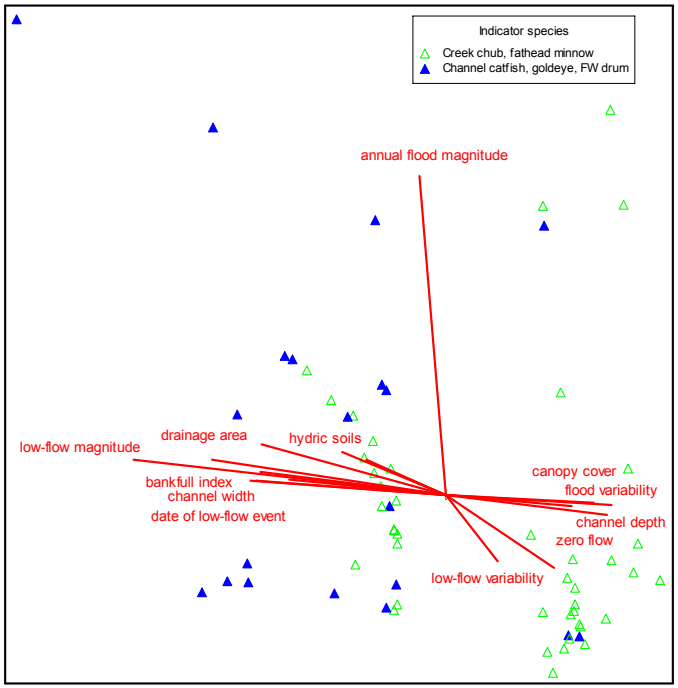


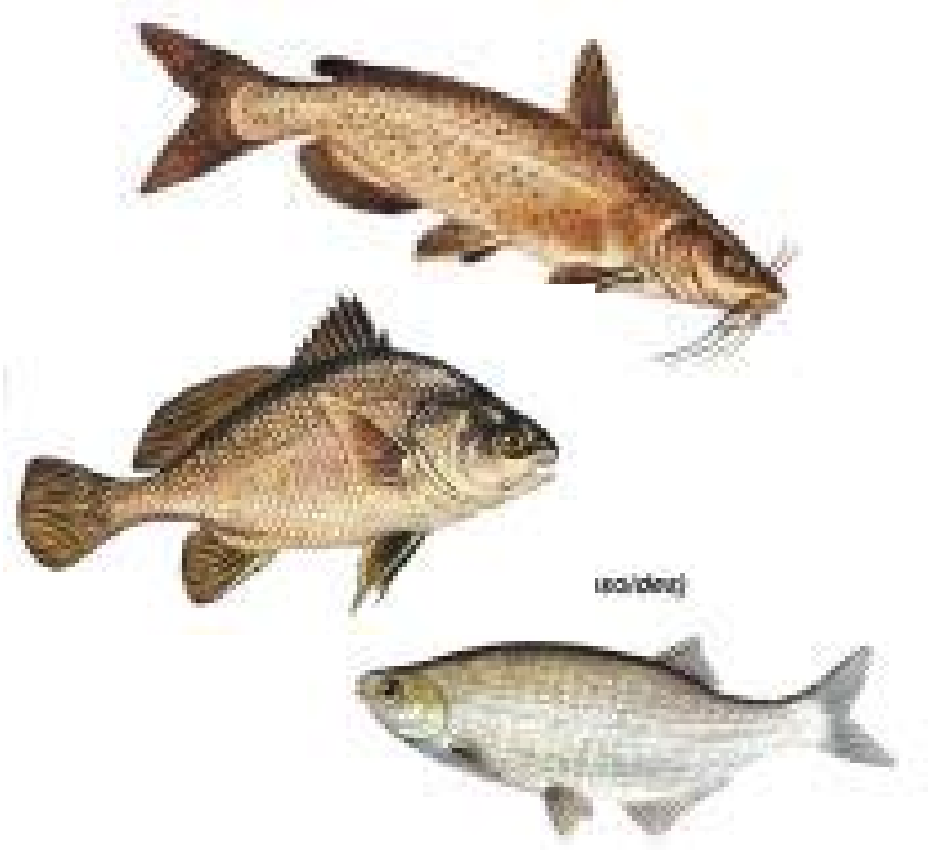
Preliminary streamflow metrics



- Axis 1: low-flow gradient
  - Intermittent to perennial
  - Small to large
  - Variability
- Axis 2: flood gradient
  - Flood magnitude

Flow and fish





Conclusions

- Streamflow variability: important component of disturbance regime for streams
- EMAP: potential to evaluate disturbance ecology theory on regional scale
- Preliminary results: streamflow metrics provide meaningful context for fish distributions