

US EPA ARCHIVE DOCUMENT

# Climate Change and Biological Indicators

## Maine Database Pilot Study

NEAEB 2008

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# Pilot Studies

- Focus on detailed evaluation of potential indicators
- Taxa traits associated with climate change responses
- Regional variation among indicators and traits
- Test for trends among state data bases to test taxa and functional group hypotheses
- Categorize species according to sensitivities and responses
- Develop indexes
- Work in progress!

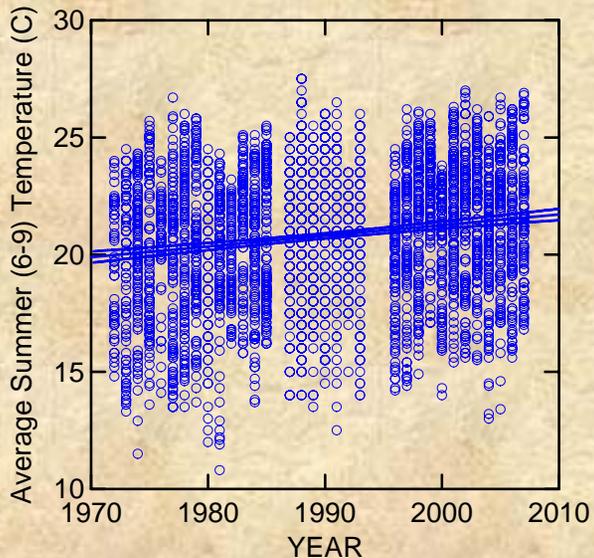
# Currently evaluating bioassessment data from:

- Maine
  - Utah
  - Ohio
  - North Carolina (and South)
- 
- Length of record
  - Repeat sampling (in addition to probabilistic)
  - Corresponding environmental data
  - Status of data (e.g. QC)
  - Expectations for regional climate change effects

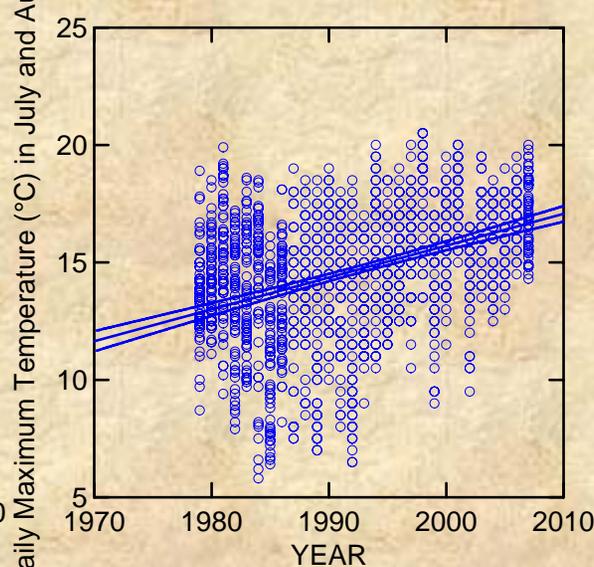
**What is our expectation of detecting climate change signal?**

Temperature trends around the country

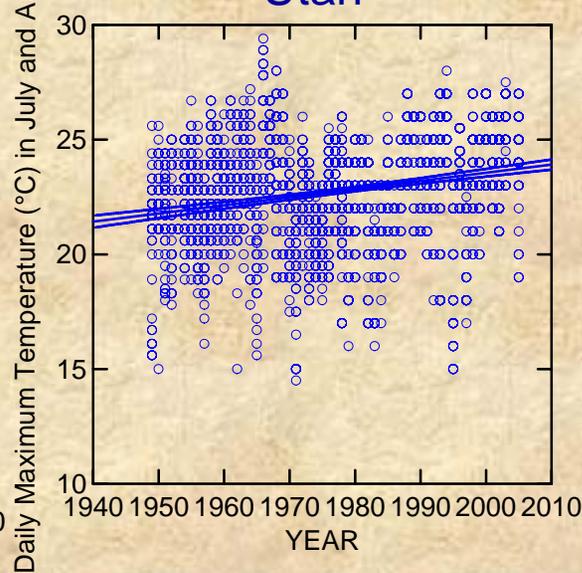
### Maine



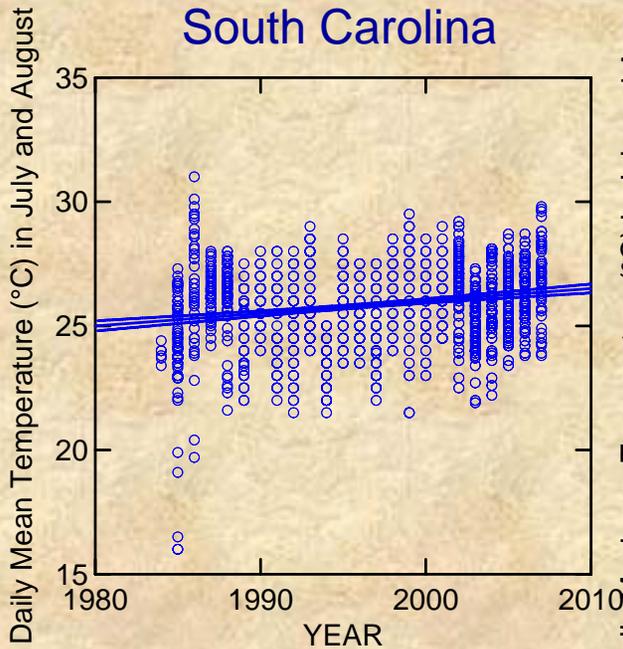
### Montana



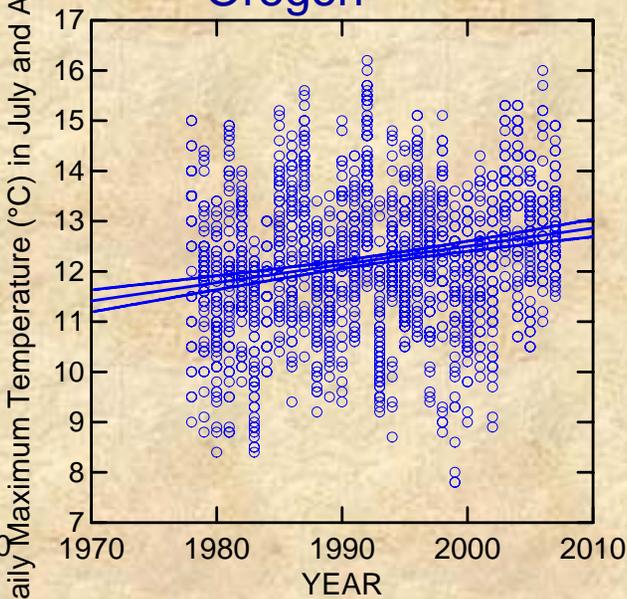
### Utah



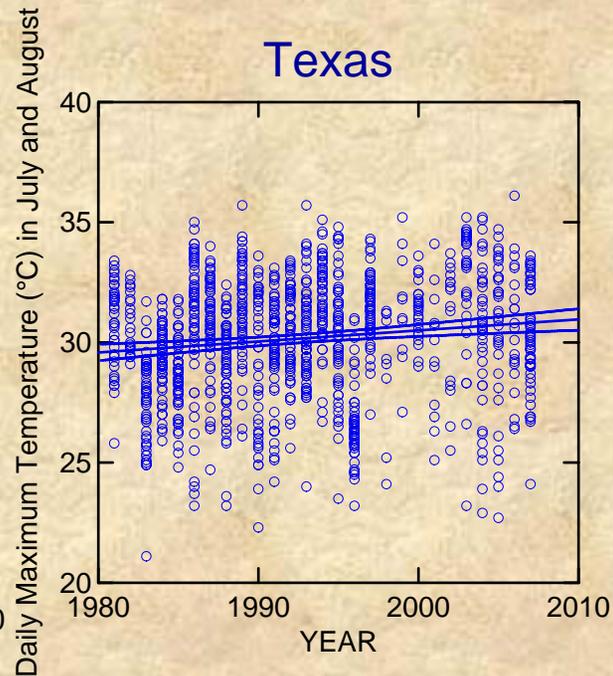
### South Carolina



### Oregon

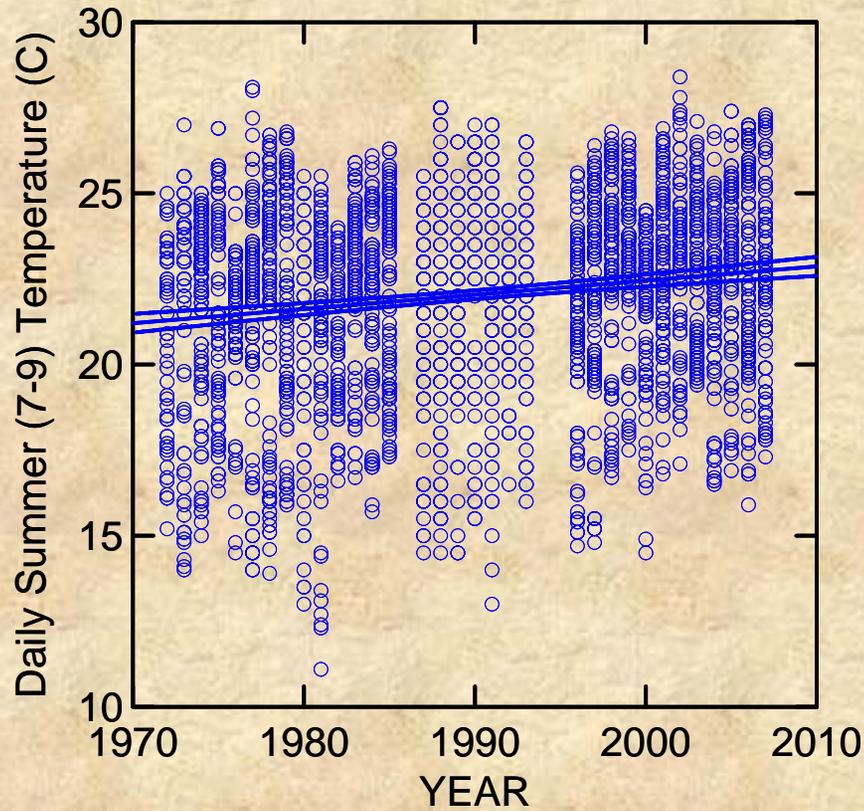


### Texas



# Daily summer temperatures St. Croix River, Maine

22+2.8



# Screening criteria

- Geological distribution
- Long term (~30 years)
- Data quality
  - max, min, or mean, not instantaneous or others
  - Celsius only records, no Fahrenheit
  - No dramatic changes
- Treatment plant <5 mile
- Upstream Dam
- Stream order ( $\leq 5$ )
- Land uses (low urban)

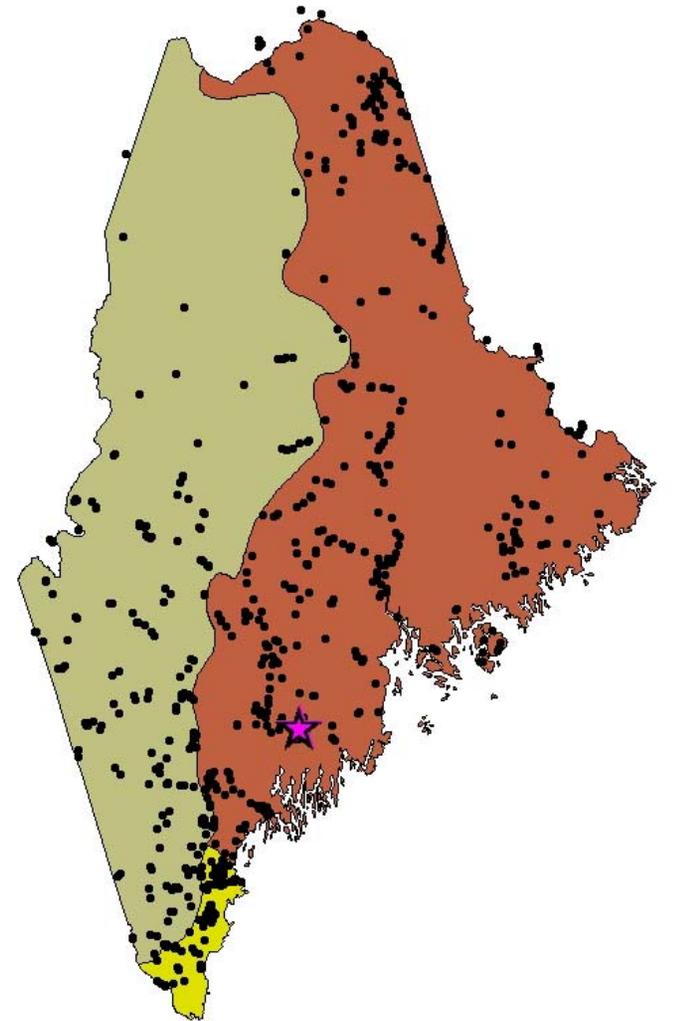
# Community Trends

Plus cautionary tale

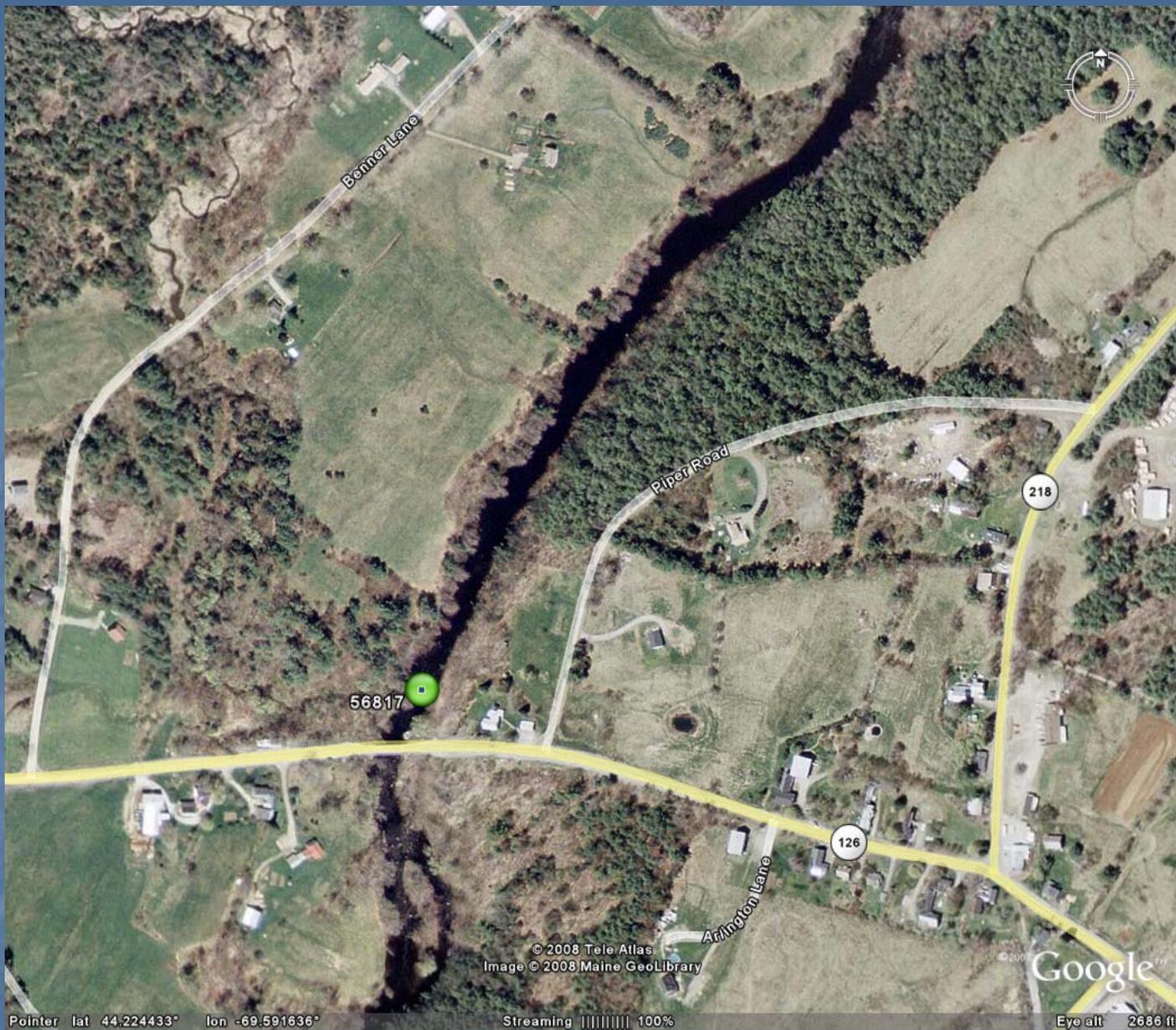
## SHEEPSCOT RIVER - STATION 74

ABOVE RT. 126 BRIDGE AT USGS GAUGE,  
N. Whitefield, ME

- 4<sup>th</sup> Order, Wadeable, Drainage Area 145 Sq. Mi.
- Reference Condition 'AA', but not 'pristine'; some non-point source pollution.
- In the Central Interior Biophysical Region and the Laurentian Plains and Hills Ecoregion
- Annual biological monitoring, 1984-2006 (=23 years).



- ★ Site 56817.shp
  - Datapoints.shp
- Ecoregion.shp
- Laurentian Plains and Hills
  - Northeastern Coastal Zone
  - Northeastern Highlands

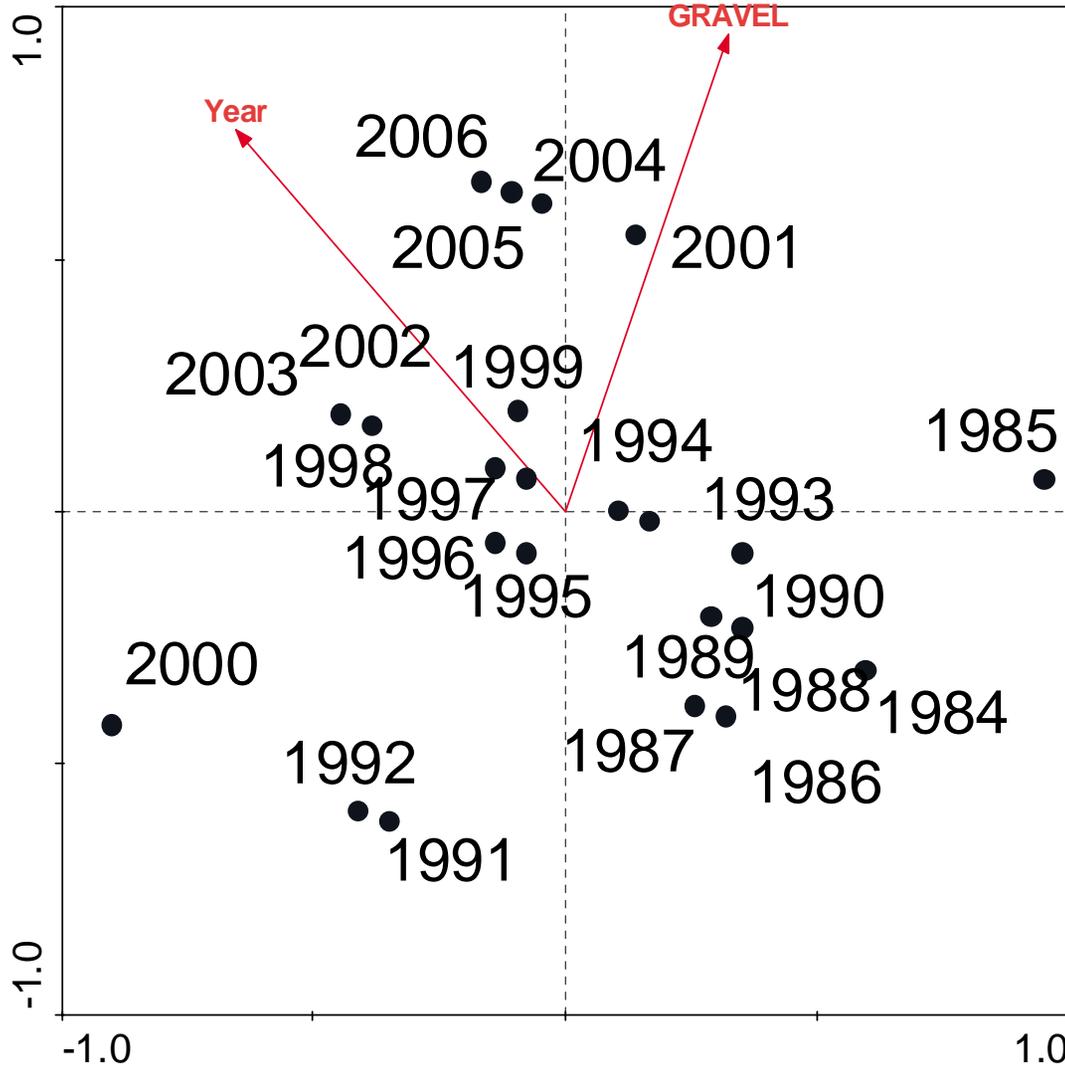


**SITE 56817 – SHEEPSCOT RIVER - STATION 74**

# Sheepscot River Canonical Correspondence Analysis

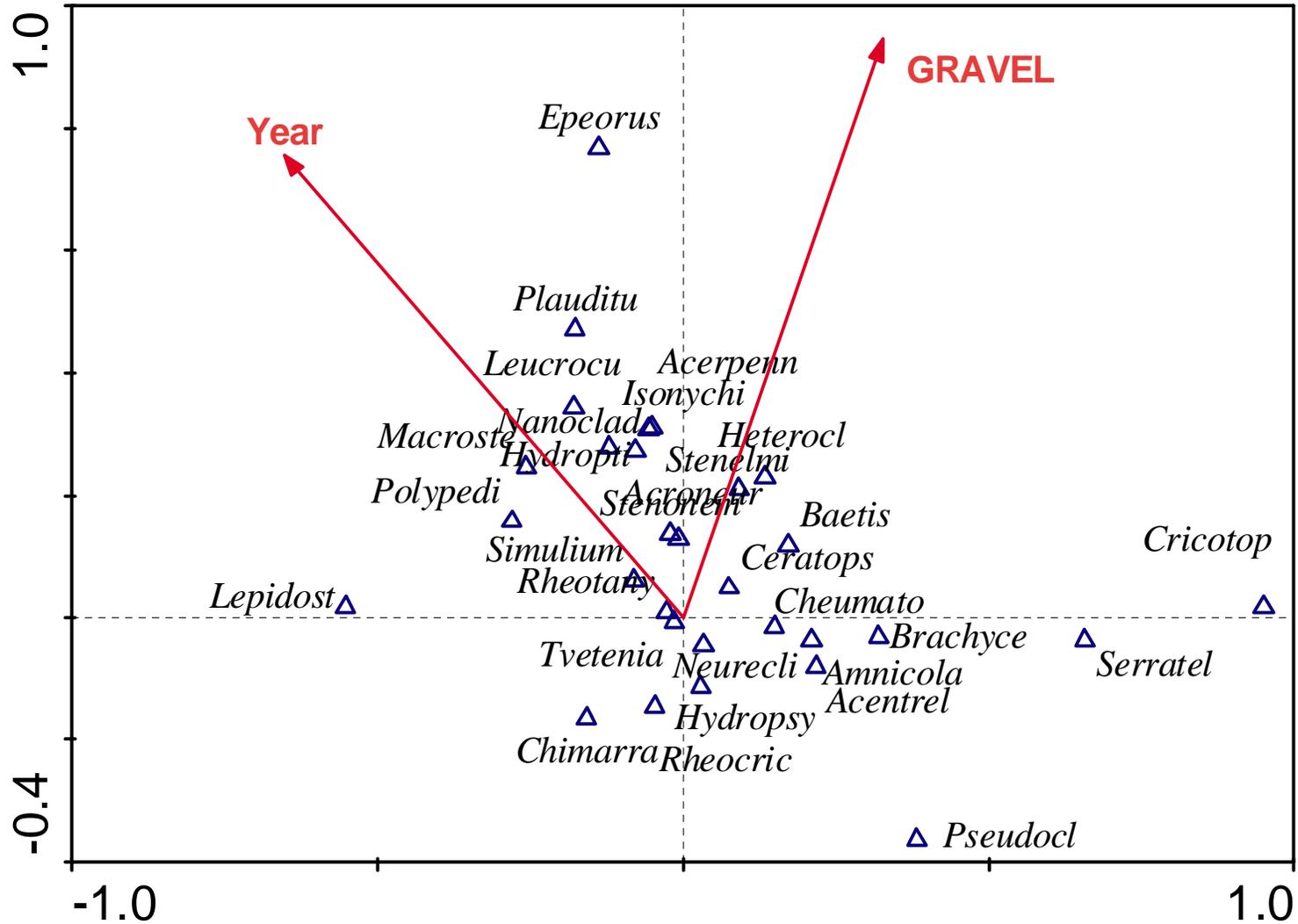
- Included OTU evaluation, collapsing to genera, excluding family as separate taxon when multiple genera found
- Trends due to taxonomy still possible
- Used relative abundance
- Only included significant covariates

# Sheepscot



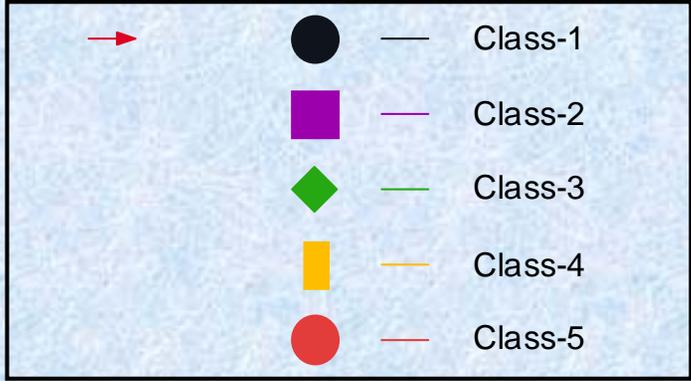
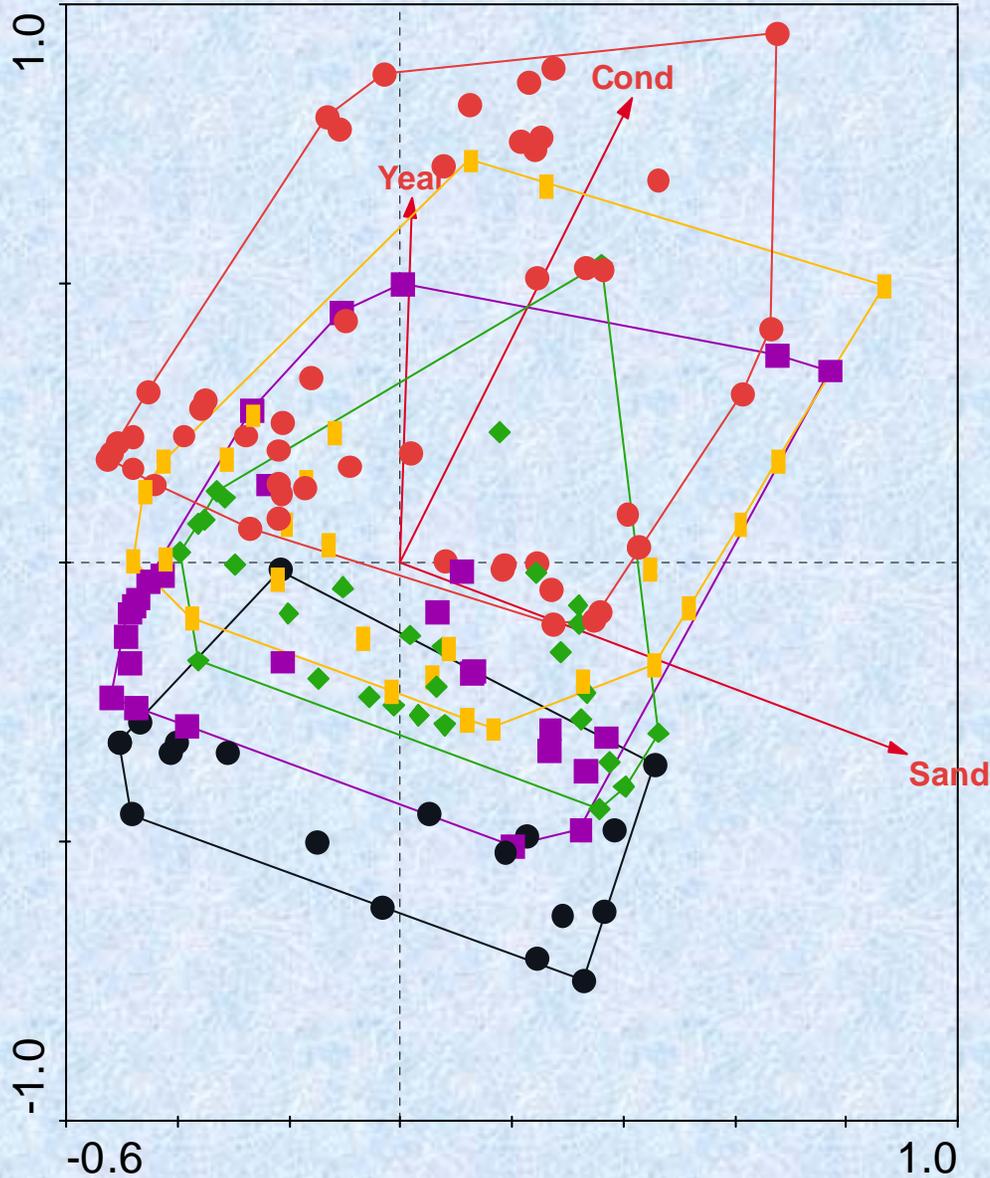
**Year is strongest factor**

# Sheepscot

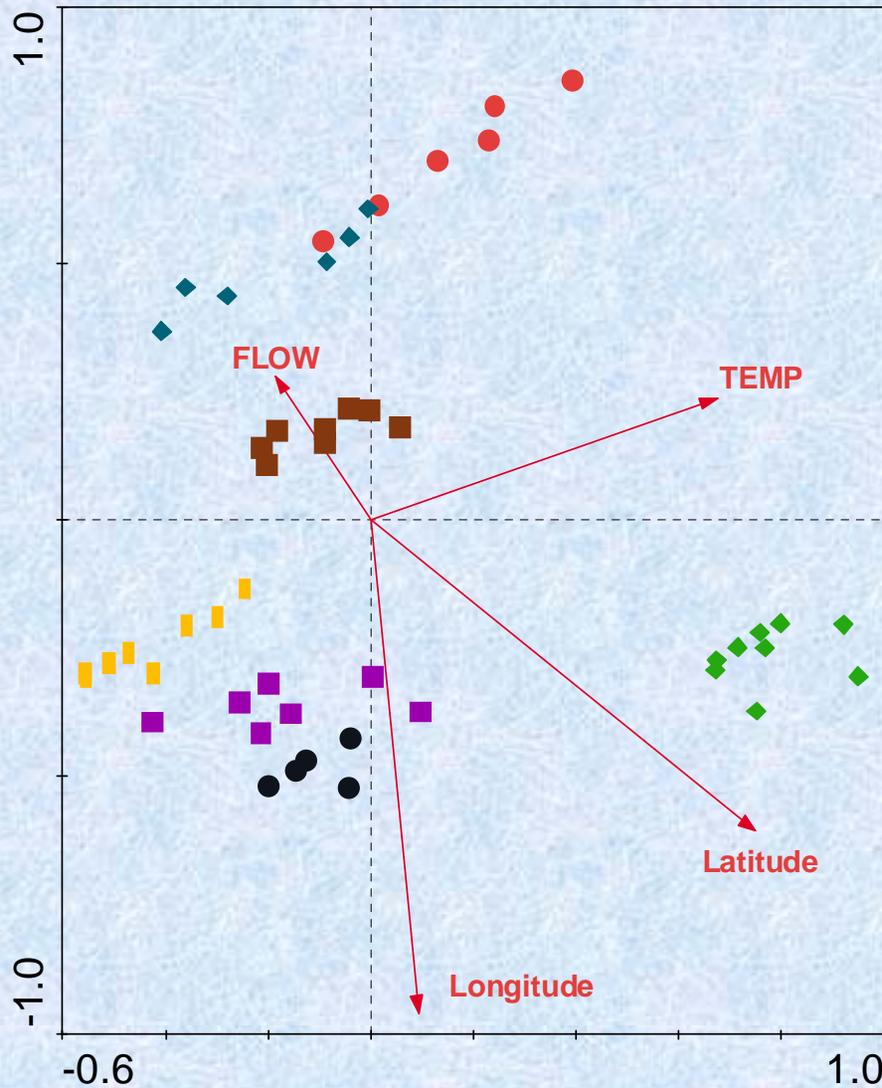


# Central Interior (Laurentian Plains and Hills)

## CCA biplot according to six year classes



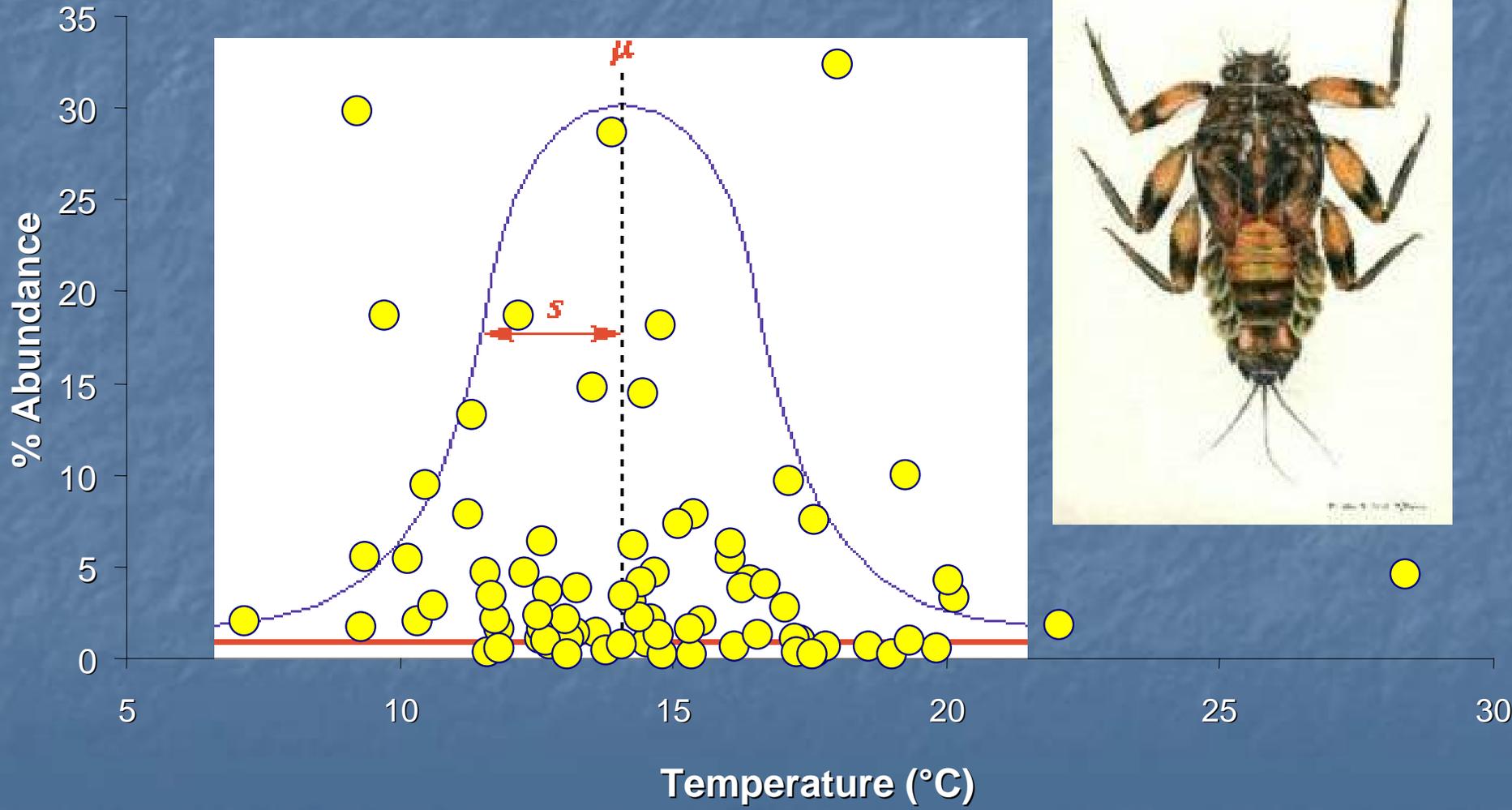
# Reference Sites from Maine Northeastern Coastal Zone



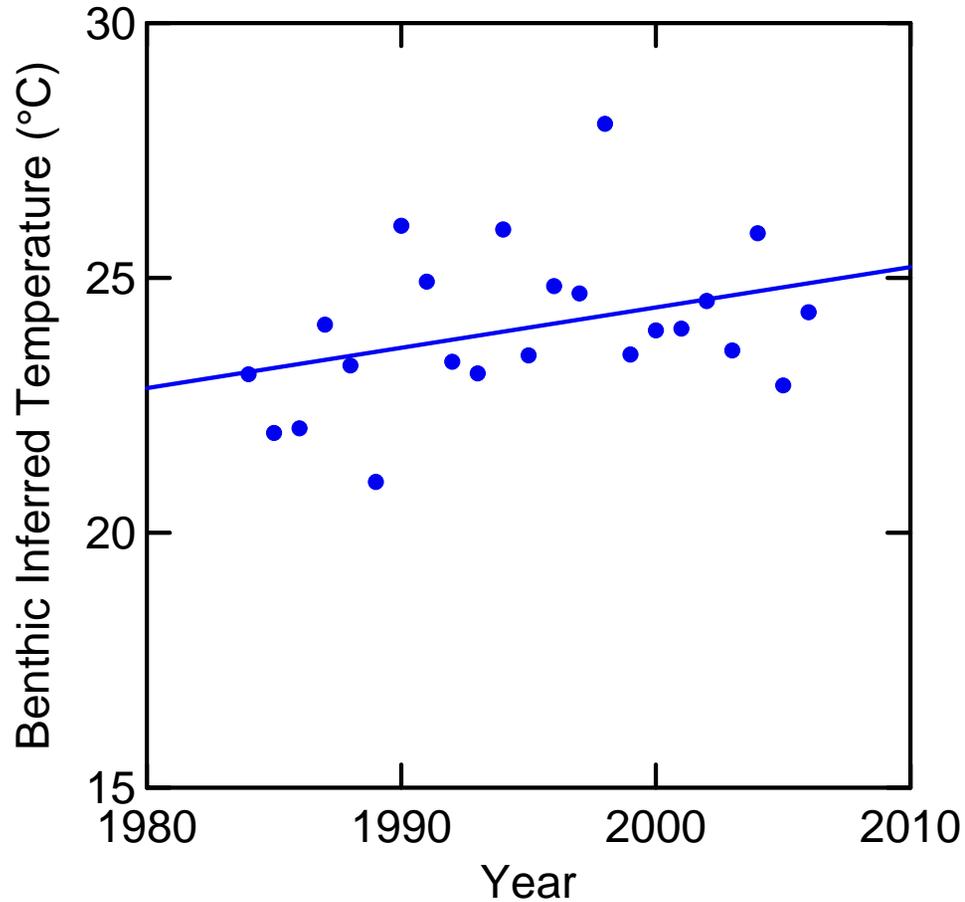
Latitude and site also important

# Weighted averaging models

## *Drunella doddsi*

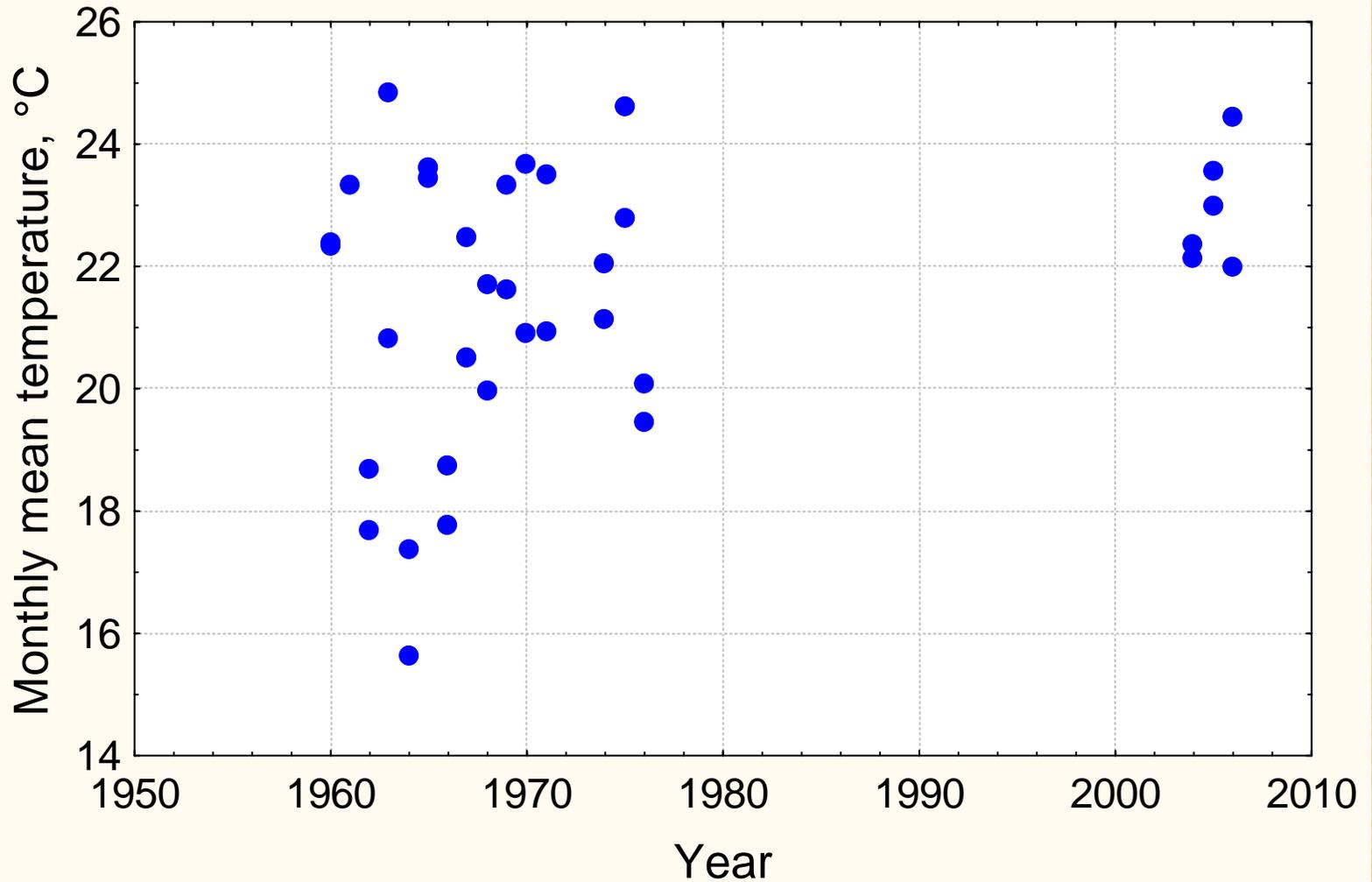


# Sheepscot: Benthos inferred temperature



# Sheepscot River, ME

## July, August average temperatures

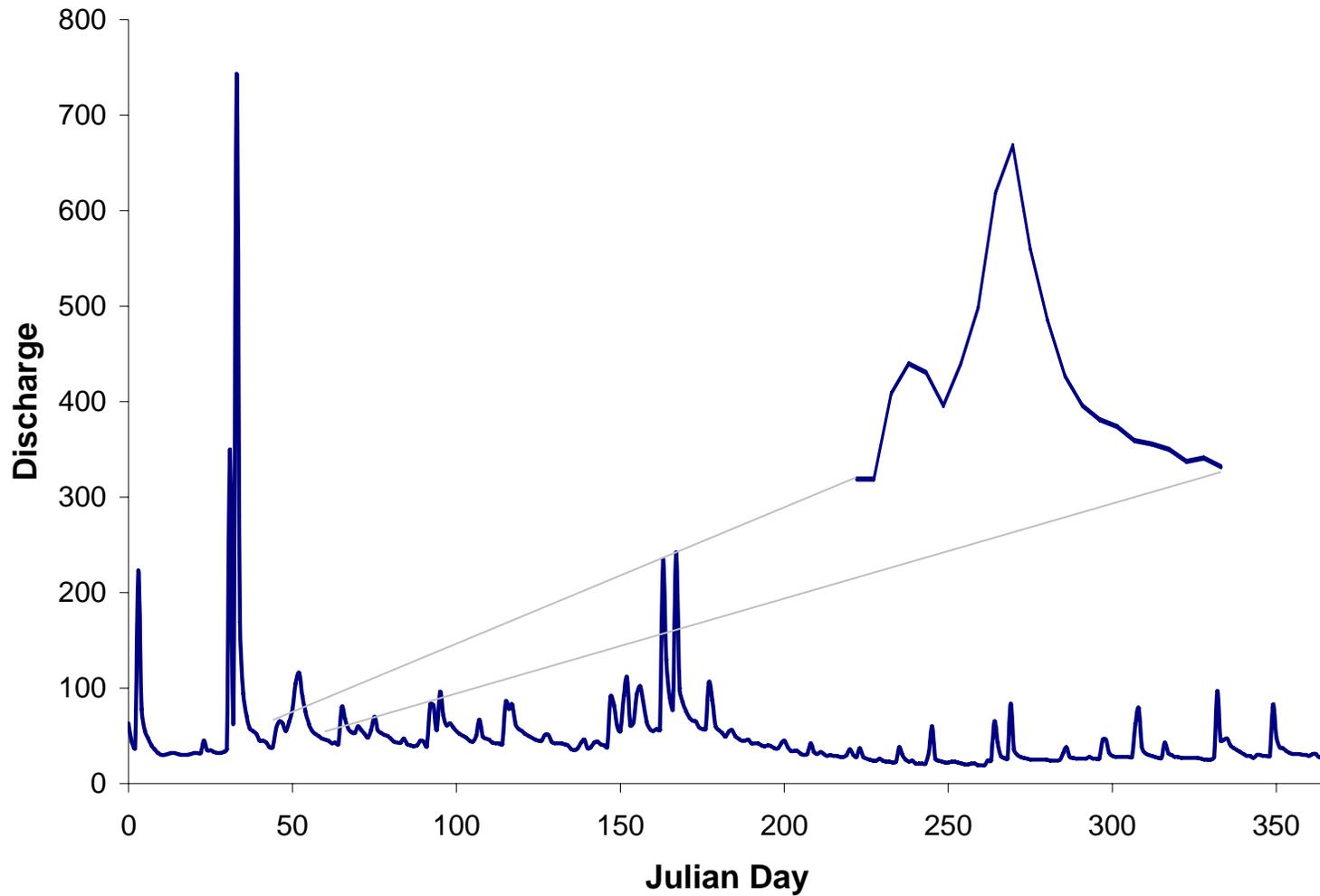


# Related Work: Hydrologic Indicators

# Some Climate Predictions

- Southeast
  - Increase in precipitation, altered flow
  - More flooding
  - Lower minimum flows
- Mid-Atlantic
  - Similar precipitation
  - Fewer floods

# Standard Metrics



# Indicators of Hydrologic Alteration (IHA)

Conservation Biology 1996, v. 10(4)

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## **A Method for Assessing Hydrologic Alteration within Ecosystems**

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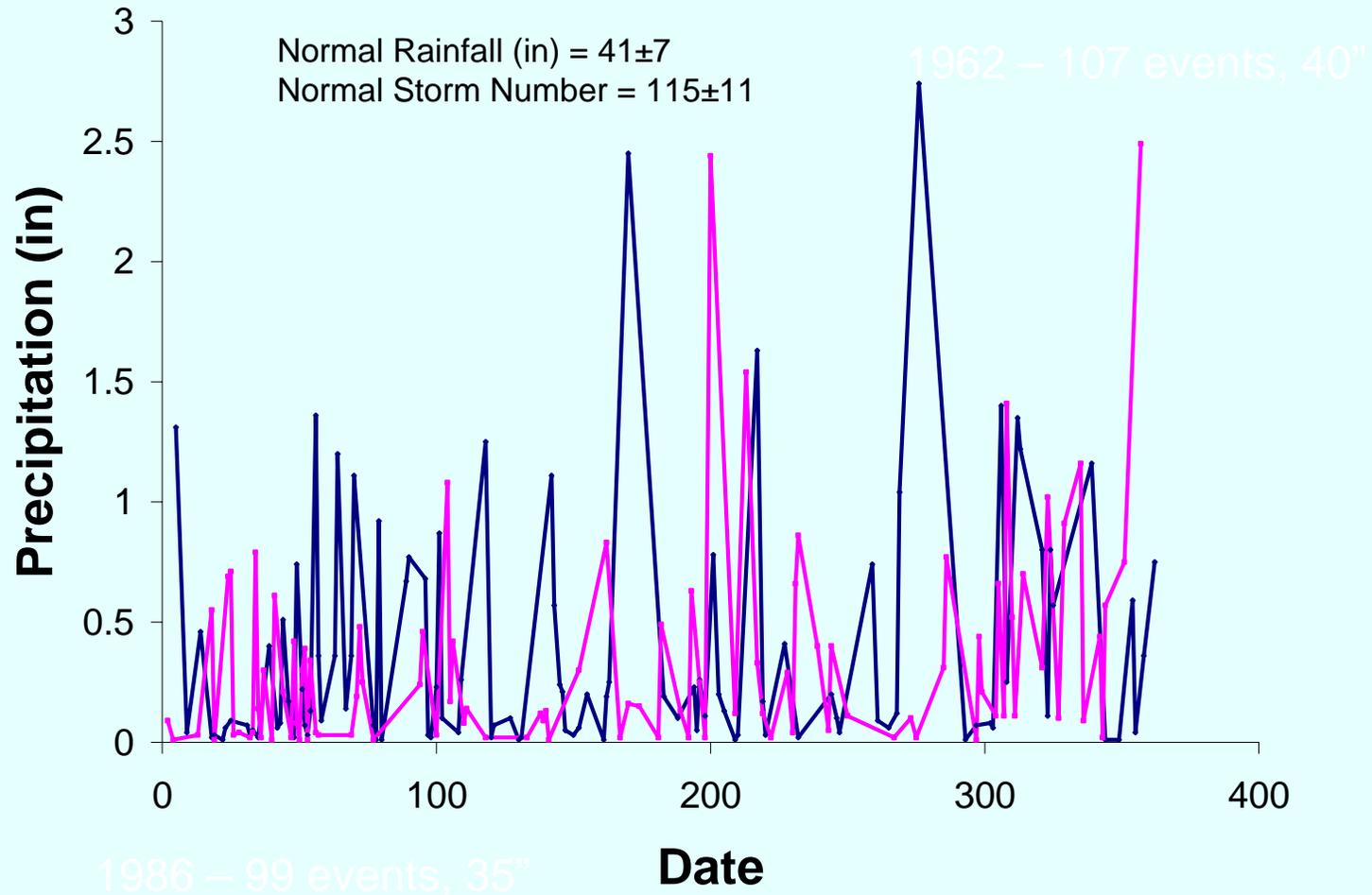
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# A Flow Case Study

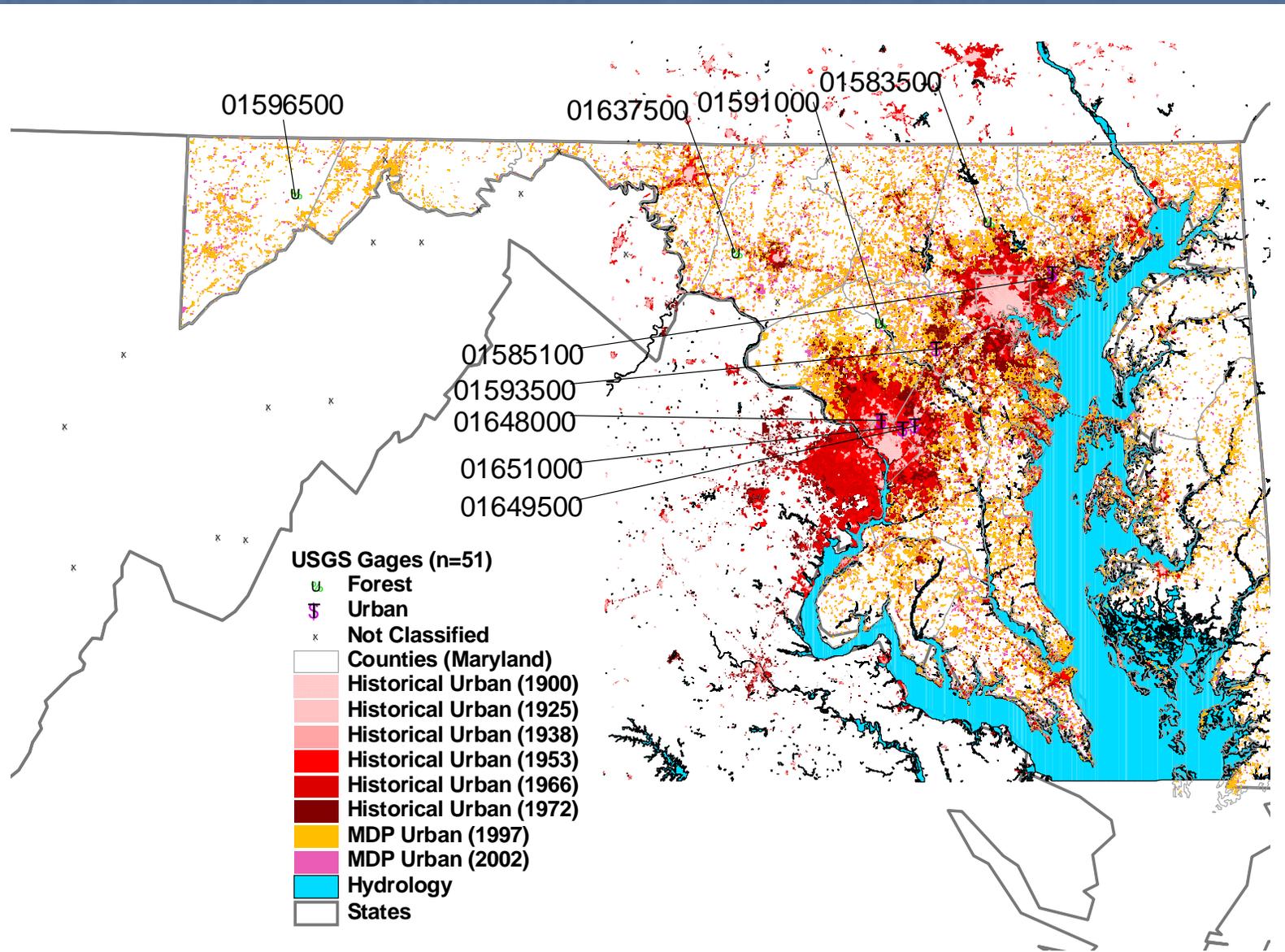
- How would hydrologic response to climatic change in Mid-Atlantic compare with land use impacts?
- Focused on Baltimore-Washington Metroplex.
- Gathered historic precipitation and flow data

# Find "future climate"-like years from past.

"Future"	Normal
1963	1960
1964	1961
1967	1985
1968	1987
1969	1992
1976	1994
1986	1997
2002	2001



# Collect urban and forest flow data



# What we did

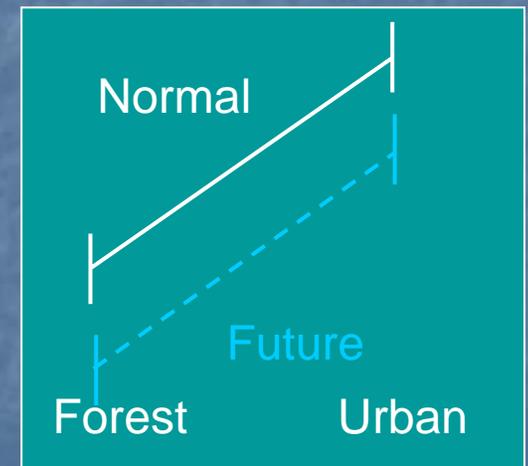
- Calculated flashiness and IHA parameters
- Looked at relative effect of land use and “climate” with ANOVA



Land Use – Yes  
Climate - No

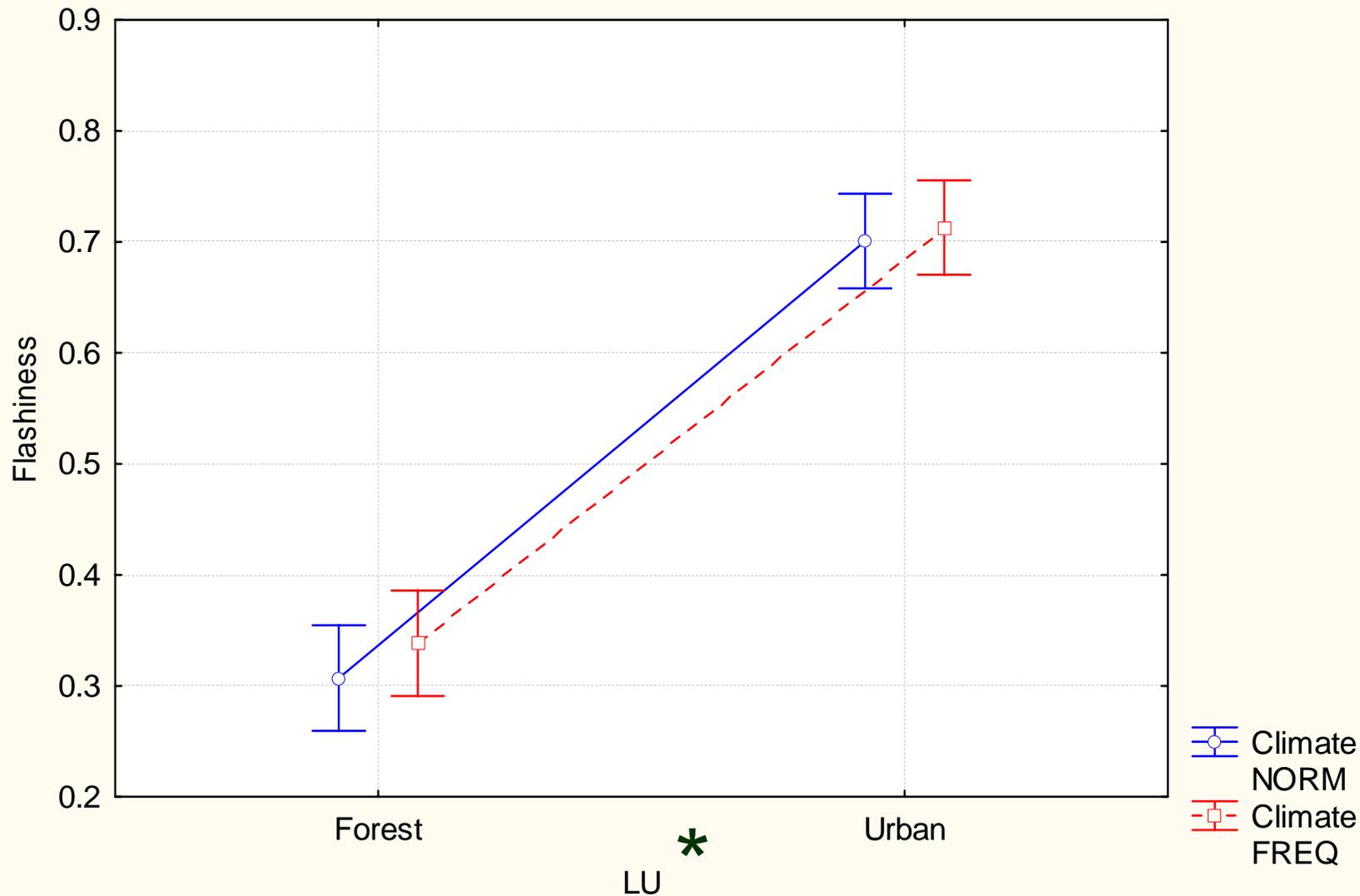


Land Use – No  
Climate - Yes

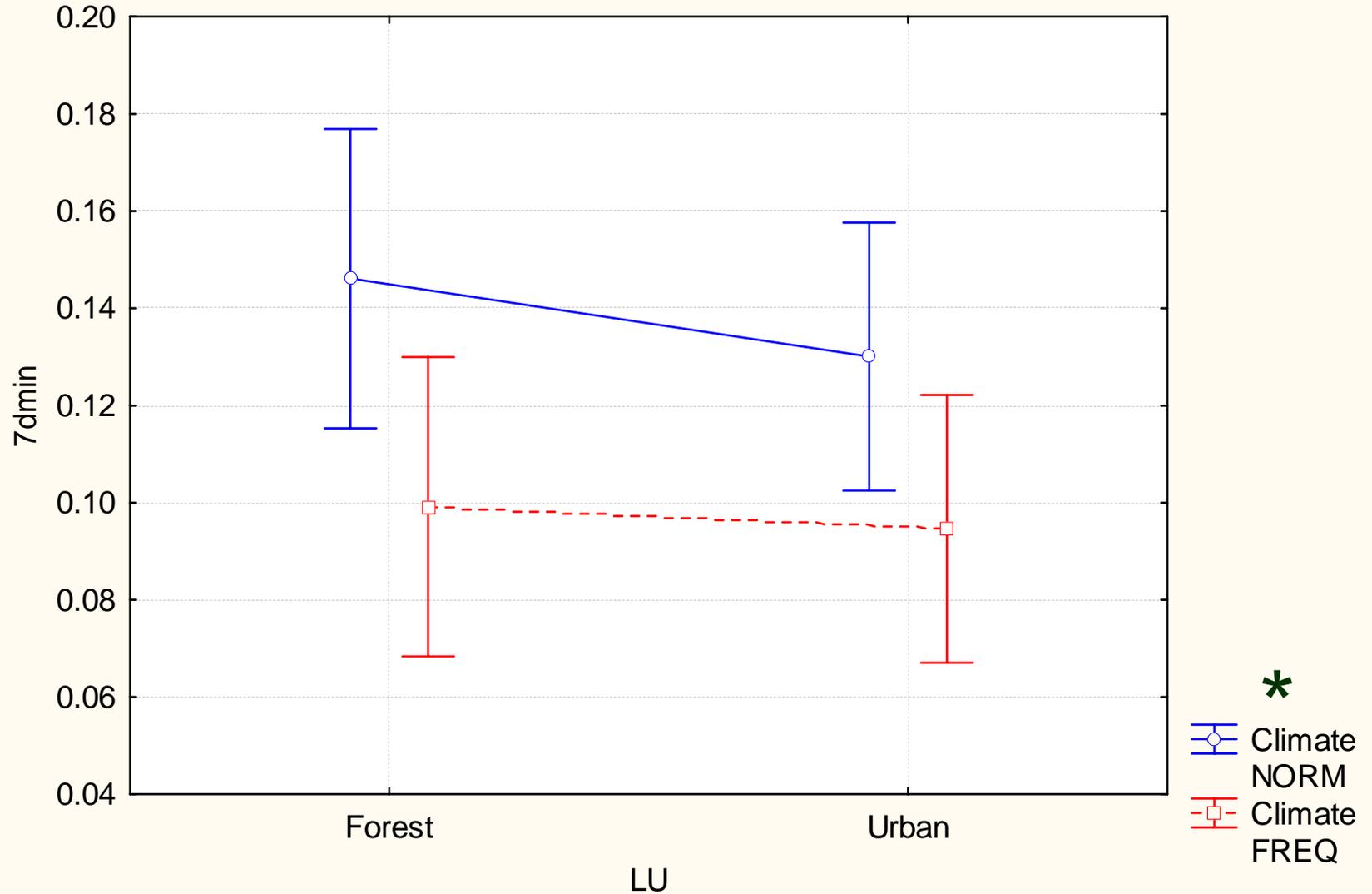


Land Use – Yes  
Climate - Yes

# What we found



# What we found



# Findings so far

- Strong evidence that climate change is now visible in stream temperature records
- Moderate evidence that biota are also changing in response to climate (but there are confounding factors)
- Prediction: changes in frequency and intensity of storms will affect severity of low flows (7Q10)