

# Detecting climate change: a classification of bioindicators to distinguish effects

**Britta G. Bierwagen<sup>1</sup>, Susan Julius<sup>1</sup>, Michael T. Barbour<sup>2</sup>, Jeroen Gerritsen<sup>2</sup>, Anna T. Hamilton<sup>2</sup>, and Michael Paul<sup>2</sup>**

<sup>1</sup>Global Change Research Program, National Center for Environmental Assessment, Office of Research & Development, U.S. Environmental Protection Agency

<sup>2</sup>Center for Ecological Sciences, Tetra Tech, Inc.

North American Benthological Society  
55<sup>th</sup> Annual Meeting

June 6, 2007  
Columbia, SC

# Key Messages

**Biological indicators may be affected by climate change**

**Categorizing indicators according to climate sensitivity is one step in controlling for or detecting climate change effects**



# Outline

- A very brief overview of biocriteria
- How climate change affects biological indicators
- Categories of indicators
- Indicator classes
- Next steps



# *Biocriteria*

- **Targets define desired biological condition of waterbody**
    - Assess ecosystem health
    - Element of water quality standards
- 
- EPA biocriteria guidance documents exist for:
    - Rivers & Streams, Lakes, Wetlands, Estuaries & Coastal Areas
  - Biocriteria guidance is under development for:
    - Coral Reefs

# State Biocriteria Program Goals

- Stressor identification
- Monitor BMP effectiveness
- TMDL assessment & monitoring
- Status & trends in water quality & condition
  - Baselines
  - Water quality standards
- Aquatic life uses determination





# Climate Change & Biocriteria Programs

- Additional stressor on ecosystem
- Affects both reference & non-reference sites
- Current indicators may be confounded by climate change effects on ecosystems
- Biocriteria program management goals
  - Difficult to establish goal if baseline is changing
  - Or goals may be impossible to meet



Overview - *Climate Change Effects* - Categories of Indicators - Indicator Classes - Next Steps

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# *How do existing biological indicators respond to climate change?*



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# Categories of Indicators

	<b><i>Insensitive to Climate Change</i></b>	<b><i>Sensitive to Climate Change</i></b>	<b><i>Sensitive to Climate Change and Other Stressors</i></b>
<b><i>Indicator</i></b>	Warmwater fish	Fish community composition	Salmon egg to fry survival
<b><i>Response</i></b>	No change in majority of range	Cold- and coolwater fish species decline, warmwater fish species increase	Decreased survival due to increased turbidity from sediment input due to increased precipitation and/or land use change

# *What Defines Climate-Insensitive?*

- Ecological events not cued to temperature
- Species is tolerant of broad temperature range
- Tolerant of wide range of hydrologic conditions
  - High flows or low flows
  - High variability in flow
  - Variation in salinity



# What Defines Climate-Sensitive?

- Ecological events cued to temperature
- Species exists in narrow temperature range
- Intolerant of certain hydrologic conditions
  - High flows or low flows
  - Saltwater intrusion



M.Wenger, USFWS

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# Climate-Sensitive Indicator Classes

- Phenology (timing of emergence, reproduction, flowering, etc.)
- Number of reproductive periods
- Vulnerable life stage to climate variable
- Thermal tolerance
- Hydrological tolerance



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# Examples of Sensitive Indicators

## Phenology

- Earlier emergence of stoneflies and mayflies with warmer temperatures
- Earlier trout spawning in warmer water



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# Examples of Sensitive Indicators

Longer growing season leads to an increase in the number of reproductive periods

- Increase in algal productivity
- Additional reproductive periods of amphipod species



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# Examples of Sensitive Indicators

## Life stage vulnerable to climate variable

- Decrease in salmon egg to fry survival from increased turbidity from erosion



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# Examples of Sensitive Indicators

## Thermal tolerance

- Increase in peak abundance of thermophilic copepod species
- Shift from cold- and coolwater to warmwater fish species



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# Examples of Sensitive Indicators

## Hydrological tolerance

- Decline of drought intolerant mussel spp.
- Decrease in autumn spawning salmonid species
- Decrease in salt intolerant wetland plants



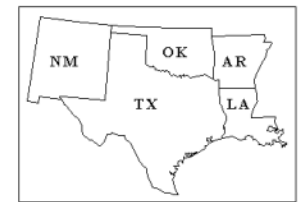
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# Next Steps

- Evaluate and understand how current indicators respond to climate change regionally
- Evaluate novel indicators to detect climate change



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# Thank You!

## Questions?

[bierwagen.britta@epa.gov](mailto:bierwagen.britta@epa.gov)

202-564-3388

