

Detecting climate change: a classification of bioindicators to distinguish effects

Britta G. Bierwagen¹, Susan Julius¹, Michael T. Barbour², Jeroen Gerritsen², Anna T. Hamilton², and Michael Paul²

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

²Center for Ecological Sciences, Tetra Tech, Inc.

North American Benthological Society
55th 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
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- 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

	<i>Insensitive to Climate Change</i>	<i>Sensitive to Climate Change</i>	<i>Sensitive to Climate Change and Other Stressors</i>
<i>Indicator</i>	Warmwater fish	Fish community composition	Salmon egg to fry survival
<i>Response</i>	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



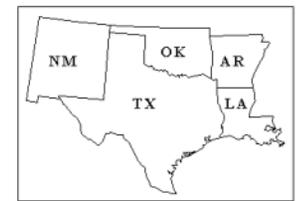
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Next Steps

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



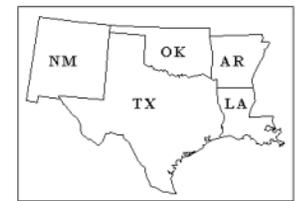
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Thank You!

Questions?

bierwagen.britta@epa.gov

202-564-3388

