Air and Water Temperature Relationships in Trout Streams of Northeastern Iowa

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Abstract

Water temperature is an important habitat component of aquatic ecosystems, especially for streams that harbor species like trout that require a narrow range of temperatures. The Driftless Area is known for its trout habitat as many of the streams are classified as coldwater streams and fed by groundwater. The Driftless Area is characterized by its steep bluffs and bedrock geology littered with karst features. These karst features lead to many streams having significant groundwater inputs into streams across the region. Trout prefer stable water temperatures less than 20°C and identifying stream reaches that contain suitable temperature habitat has been difficult. In this study we used stream water temperature monitoring data from the Iowa Department of Natural resources collected from 76 known trout stream segments across the Driftless Area of northeastern Iowa.

Background and Importance

- Trout are an economically important group of sport fishes in the Driftless Area
  - $950M dollars to region (Anderson 2016)
- Considerable coldwater stream habitat considerations
  - Habitat fragmentation
  - Competition between Brook and Brown Trout limits range of species
  - Increasing temperatures from climate change threatens distributions of both species (Mitro et al. 2019)
    - Preferred maximum summer temperature
      - Prefer less than 20 °C (Krider et al. 2013)
      - Maximum 24.6°C (Mitro et al. 2019)
    - Cold water often supplied by groundwater
- Identification of suitable coldwater habitat critical for management of trout species
  - In situ temperature datalogger information

Objective:

The objective of this study was to determine temperature relationships among streams in the Driftless Area of northeastern Iowa. This data will be useful for my thesis research comparing stream temperature data to remote sensing imagery to reclassify stream segments in the Driftless Area of Iowa

Methods

- Stream temperature data via temperature loggers
  - Previous data has been collected (Kelly 2020)
  - Currently temperature loggers are deployed throughout the driftless area of Iowa
  - 79 stream segments
- Air temperature data via nearby regional weather stations
  - Weekly averages
  - Public data
- Data analysis – Linear Regression
  - Related weekly mean stream water temperatures to weekly air temperatures (*sensu* Krider et al. 2013)

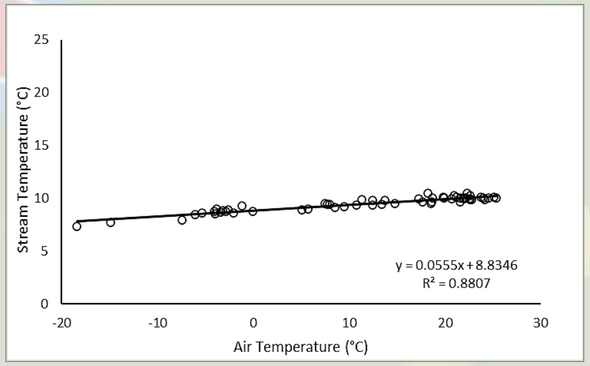

Figure 1. Weekly air vs. stream water temperatures in stream presumably influenced by groundwater

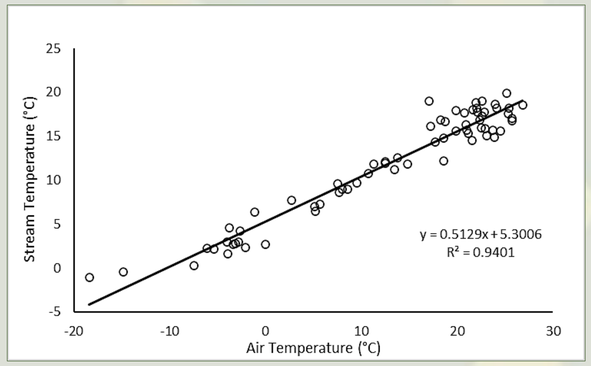

Figure 2. Weekly air vs. stream water temperatures in stream presumably not influenced by groundwater

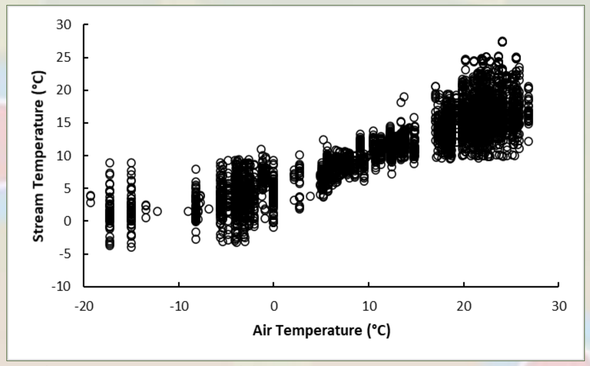

Figure 3. Mean Weekly water temperature vs. mean weekly air temperature for all streams

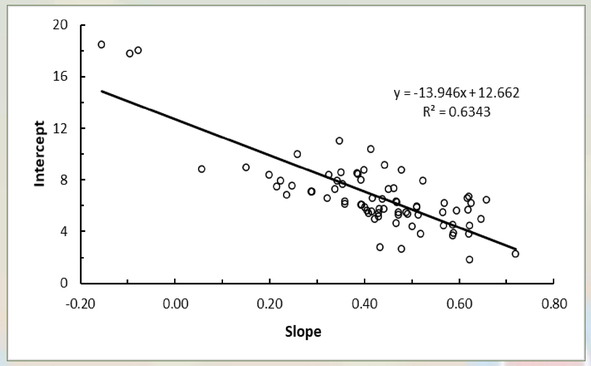

Figure 4. Linear Regression model of intercepts vs. slopes of streams

Study Area

Results

- Groundwater influenced streams exhibit less temperature variation (Figure 1)
- Streams with less groundwater influence exhibit greater temperature variation and steeper slopes (Figure 2)
- Combined regression analysis for all 76 streams (Figure 3)
  - Slope: 0.42 and Intercept: 6.0
  - R^2: 0.85

Discussion

- Currently there is a lot of variation in "coldwater" stream classification
  - Linear regression analysis of air and water temperatures shows parameter differences between groundwater-influenced streams and weather influenced streams
  - Groundwater-fed streams are more temperature stable and maintain lower maximum temperatures
- Findings were similar to Krider et al. (2013) study in southeast Minnesota
- Modeling is important as climate change is expected to increase air temperature

Future Studies

- Reassessment of coldwater streams using remote sensing
  - See Mishra et al. (oral presentation)
- Temperature relationship analysis of more Driftless Area streams

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Map data: Iowa Geodata

References

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