



ILLINOIS NATURAL HISTORY SURVEY

T E C H N I C A L R E P O R T

Evaluating Water Temperature, Habitat and Fish Communities in Candidate Coolwater Streams in Illinois

Annual Project Report 2008

Leon C. Hinz Jr.¹, Brian A. Metzke¹,
Ann Marie Holtrop²
and John Epifanio¹

¹Division of Ecology and Conservation Science
Section of Aquatic Ecology and Conservation

²Illinois Department of Natural Resources
Office of Resource Conservation
Watershed Protection Section

Prepared for: Illinois Department of Natural Resources

State Wildlife Grant / Project Number (T-13-P-001)

INHS Technical Report 2008 (54)
Date of issue: 16 December 2008

**Illinois Natural History Survey
Center for Aquatic Ecology and Conservation**

(September 30, 2007 - September 29, 2008)

***Evaluating Water Temperature, Habitat, and Fish
Communities in Candidate Coolwater Streams in Illinois***

Annual Project Report 2008

Leon C. Hinz Jr., Brian A. Metzke,
Ann Marie Holtrop,
and John Epifanio

Submitted to

Illinois Department of Natural Resources
One Natural Resources Way
Springfield, Illinois 62702

Illinois Natural History Survey
Division of Ecology and Conservation Science
1816 South Oak Street
Champaign, Illinois 61820

December 2008

Illinois Natural History Survey Technical Report 2008/54

***Evaluating Water Temperature, Habitat, and Fish
Communities in Candidate Coolwater Streams in Illinois***

Annual Project Report 2008
Project: T-13-P-001

30 September 2007 to 29 September 2008

Leon C. Hinz Jr., Brian A. Metzke,
Ann Marie Holtrop,
and John Epifanio

Illinois Natural History Survey
Division of Ecology and Conservation Science
1816 South Oak Street
Champaign, Illinois 61820

December 2008

Dr. John Epifanio,
Project Coordinator
Illinois Natural History Survey

Dr. Brian Anderson,
Director
Illinois Natural History Survey

PROJECT TITLE: Evaluating Water Temperature, Habitat, and Fish Communities in Candidate Coolwater Streams in Illinois.

Summary:

Work during this reporting period focused on characterizing temperature, habitat, and biological communities at candidate sites. During the past year we have collected additional temperature data from 39 candidate streams and other locations and now have records from 153 stream reaches. Thirty-one sites in Illinois have been identified as cool- or coldwater based on these records. Physical habitat surveys have been conducted at 54 sites where temperature data were available. Fish and macroinvertebrate data were obtained from the cooperative basin survey program data managers for candidate sites whenever possible. These data were supplemented this year with fish and macroinvertebrate samples from eleven additional sites where temperature records suggest coolwater thermal regimes but other information was unavailable. A twelve month no cost extension was requested during this reporting period. This report summaries progress for the period beginning 30 September 2007 and ending 29 September 2008.

JOB 1. Review list of candidate coolwater streams and identify a subset of streams for validation.

We focused temperature logger deployment during the summer of 2008 at sites containing known populations of fish used to develop the candidate coolwater list (Figure 1). We targeted sites with records of banded sculpin, mottled sculpin, ironcolor shiner, ozark minnow, longnose dace, and southern redbelly dace to improve our understanding of the conditions where these species are located (Table 1).

JOB 2. Characterize the thermal regime, habitat (e.g., channel morphology), and vegetation in each stream identified in Job 1.

Thirty-nine electronic temperature recorders were deployed by INHS staff to assess thermal regimes in candidate coolwater streams segments during the summer of 2008. Another thirty-eight temperature loggers were supplied to IDNR stream specialists for deployment at additional sites (Figure 2). High spring water levels throughout Illinois prevented logger placement at some sites. We have recovered information from 46 of these sites at this time (several loggers were lost or did not deploy correctly, some loggers are still deployed). A total of 164 temperature records from 153 sites have been collected statewide during the course of this project that cover a broad range of thermal conditions (Figure 3). We plan to continue monitoring temperature at 40+ sites during 2009 to supplement these data.

We have allowed some loggers to remain deployed during the winter and spring to document the thermal characteristics of streams during these seasons (73 records total). We currently have winter records from 4 coldwater, 11 coolwater, and 58 warmwater streams. Unusually high water levels during early 2008 led to the loss of several loggers as stream beds shifted during flood events.

In stream physical habitat surveys were conducted at an additional 33 sites that we expected were coolwater due to candidate status or based on the water temperature model. Coolwater sites are generally characterized by higher summer current velocities and greater channel complexity (as indicated by a greater number of channel units within the sample reaches) than the warmwater reaches we have data from. We also collected point estimates of water temperature at 153 sites throughout Illinois. These data will be in the development and testing of a rapid assessment protocol for tentatively identifying thermal regimes without the need for long term site monitoring (ARC 2007). Development of models for this method is underway (Figure 4).

Candidate coolwater streams were initially identified using the presence of “coolwater” fish species and output from a potential groundwater delivery model. We have relatively complete temperature records from forty-two of the original coolwater candidate sites at this time. Sixty-seven percent (12/18) of candidate sites selected due to fish presence and high ground water delivery potential were found to be correctly identified as coolwater. Sites selected with presence of candidate fish species but without high ground water delivery potential were correctly identified thirty percent of the time (7/23).

JOB 3. Determine availability and applicability of other data to predict additional coolwater streams.

Upon consultation with Kevin Cummings (INHS malacologist) we are evaluating the potential of two mussel species as indicators of coolwater conditions. Statewide distributions of the Elktoe (*Alasmidonta marginata*) and the Ellipse (*Venustaconcha ellipsiformis*) were obtained from the INHS mussels database and matched with our observed and modeled temperature records. Analysis of these data are underway.

JOB 4. Characterize a subset of streams identified in Job 3.

Further evaluation of the temperature model (Figure 1) using field based temperatures indicates that the model has an overall accuracy of 73% and does an excellent job predicting warm water sites (86%) that make up the majority of Illinois streams. However, the model is less accurate at predicting coldwater (36% correctly identified) and coolwater stream segments (25%). We plan to refine the temperature model to more accurately identify coolwater streams using the temperature records collected in this study.

A subset of the sites with field based temperature records are being used to examine inter-annual temperature variation. We now have a total of nine sites have multiple year records. Three sites (all coolwater) with summer records from three different years and six sites (four warmwater) each with two summer records. These data suggest that while interannual variation occurs these sites maintain the generally same thermal class (i.e., cold, cool, or warm) between years.

Four additional stream networks were examined for spatial and longitudinal extent of thermal conditions by monitoring temperature in adjacent and neighboring stream segments (making 8 total). These records suggest that the thermal regime within a stream network can be a complex

mosaic of cool and warm waters related to the interconnectedness of the stream channels and the differential effects of instream cover and ground water inputs (Figure 5).

JOB 5. Conduct macroinvertebrate sampling at a subset of sites.

In addition to obtaining records from IEPA cooperative basin survey macroinvertebrate collections we sampled at eleven additional sites (19 total for the project) during the summer of 2008 where preliminary analysis suggested that the streams had coolwater thermal regimes. We have also obtained additional records from IEPA at sites where temperature records have been collected. High spring water levels prevented spring sampling using protocols developed by the Critical Trends Assessment Program so we have rescheduled these EPT taxa collections for Spring 2009.

JOB 6. Compile and analyze data and write a report.

The annual report was completed identifying thirty-one coolwater sites in Illinois (Figure 6). Preliminary data were presented at the 68th Midwest Fish and Wildlife Conference, (Metzke et al. 2007, December 2007, Madison, WI.) and the Annual Meeting of the North American Benthological Society (Hinz et al. 2008, May 2008, Salt Lake City, UT).

LITERATURE CITED:

Aquatic Research Center of the Indiana Biological Survey. 2007. Development of Coolwater Index of Biotic Integrity Expectations for Use in Streams and Rivers of Indiana and Review of Existing Data. Technical Report 2007-01. Indiana Biological Survey, Aquatic Research Center, Bloomington, IN.

Hinz Jr., L. C., B. A. Metzke and J. Epifanio. 2008. Identifying coolwater streams in Illinois. North American Benthological Society Annual Meeting, Salt Lake City, UT. (25-30 May).

Metzke, B. A., L. Hinz Jr., A. Holtrop, and J. Epifanio. 2007. Evaluating water temperature, habitat, and biotic communities in candidate coolwater streams in Illinois. 68th Midwest Fish and Wildlife Conference, Madison, WI. (10-11 December).

Table 1. Observed thermal conditions for sites containing candidate coolwater fish species in Illinois.

Species	Sites with	Sites with	Observed		
	Historic Records	Temperature Records	Cold Site	Cool Site	Warm Site
Northern Brook Lamprey	2	0	-	-	-
American Brook Lamprey	9	0	-	-	-
Least Brook Lamprey	1	0	-	-	-
Brown Trout	4	4	1	3	0
Rainbow Trout	7	2	1	1	0
Southern Redbelly Dace	135	20	3	7	10
Blacknose Dace	173	17	4	7	6
Longnose Dace	13	2	0	2	0
Ozark Minnow	23	6	1	5	0
Weed Shiner	23	3	0	0	3
Ironcolor Shiner	37	4	0	1	3
Ninespine Stickleback	4	1	0	1	0
Brook Stickleback	38	5	2	3	0
Banded Sculpin	40	10	0	0	10
Mottled Sculpin	22	4	2	2	0
Iowa Darter	4	0	-	-	-
Least Darter	11	3	0	0	3

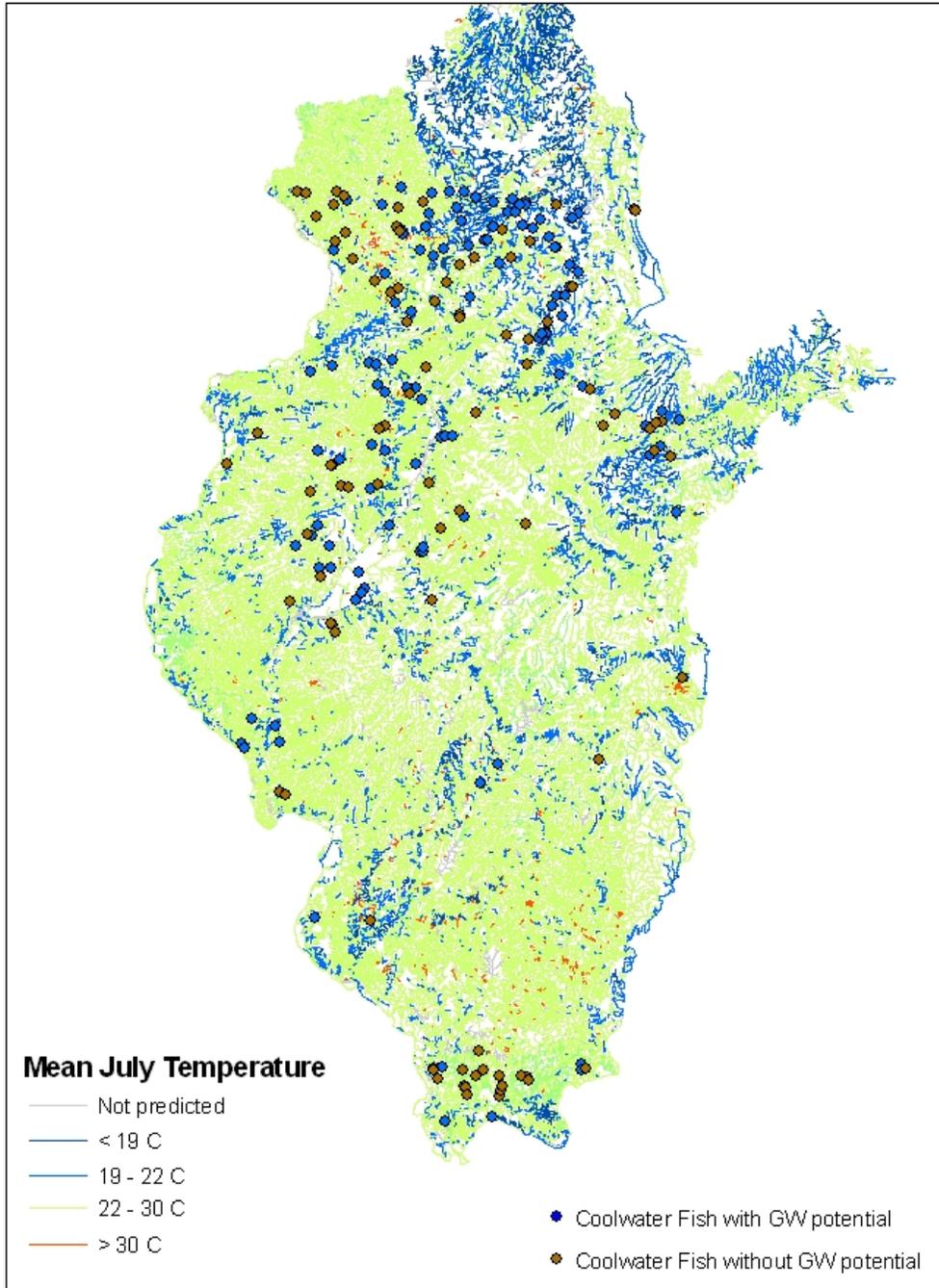


Figure 1. Candidate Coolwater sites and Summer Stream Temperatures based on model output.

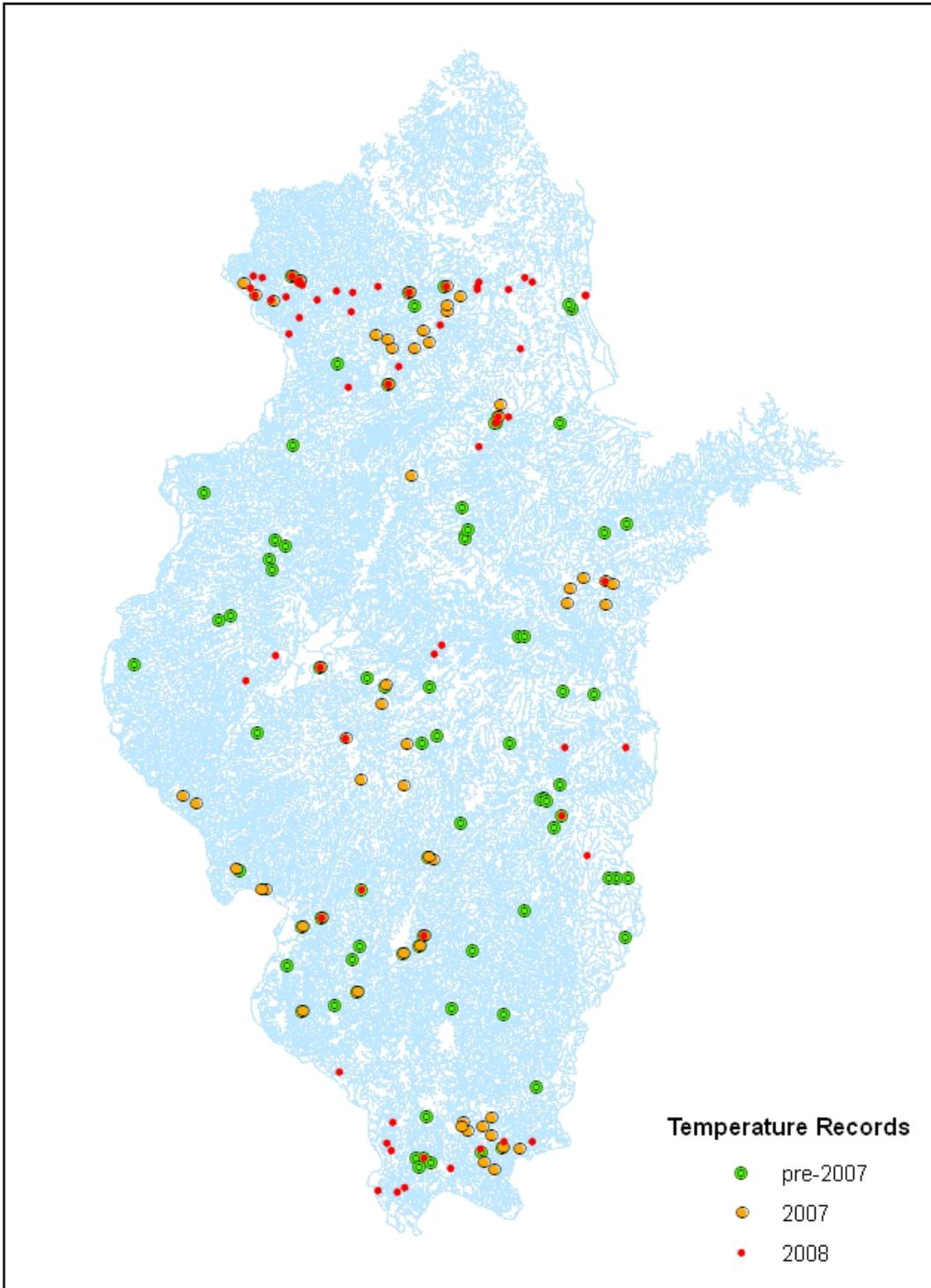


Figure 2. Distribution of stream temperature records in Illinois.

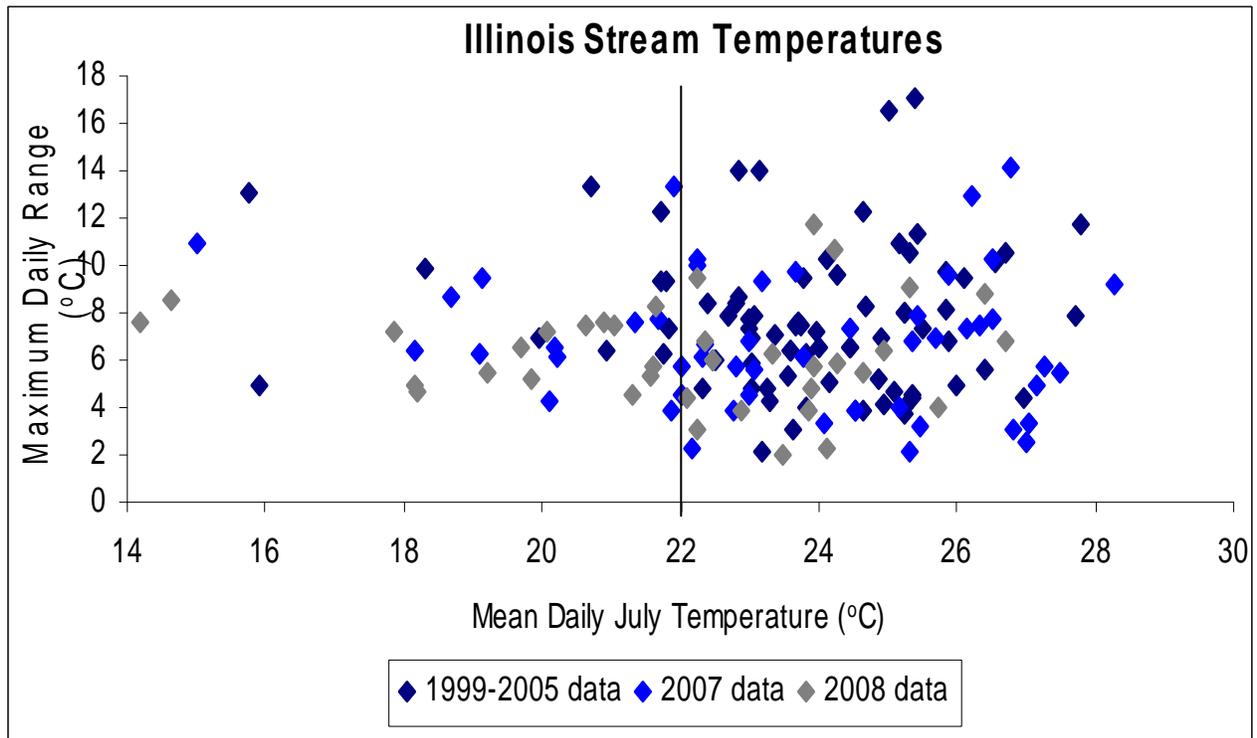


Figure 3. Mean summer water temperatures from 146 streams in Illinois. We have identified coolwater streams as those that have mean daily temperatures below 22 °C. Nine sites have multiple records [3 with 3 records (all coolwater), 6 with 2 records (2 coolwater)] that have been plotted separately.

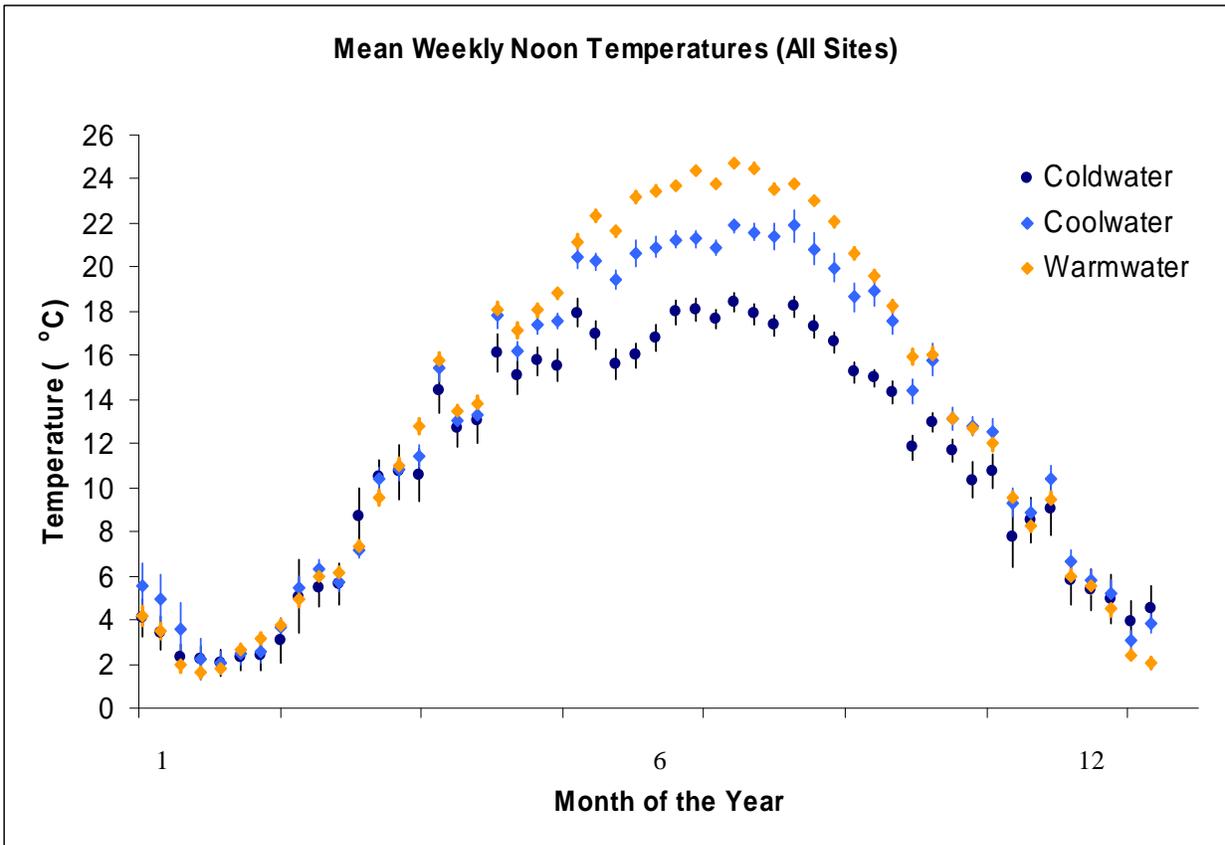


Figure 4. Distribution of weekly mean temperatures for streams with characteristic cold, cool, and warm summer conditions based on approach used by the Indiana Biological Survey in the development of coolwater index of biotic integrity (ARC 2007). Note the good separation between the thermal classes during the summer months.

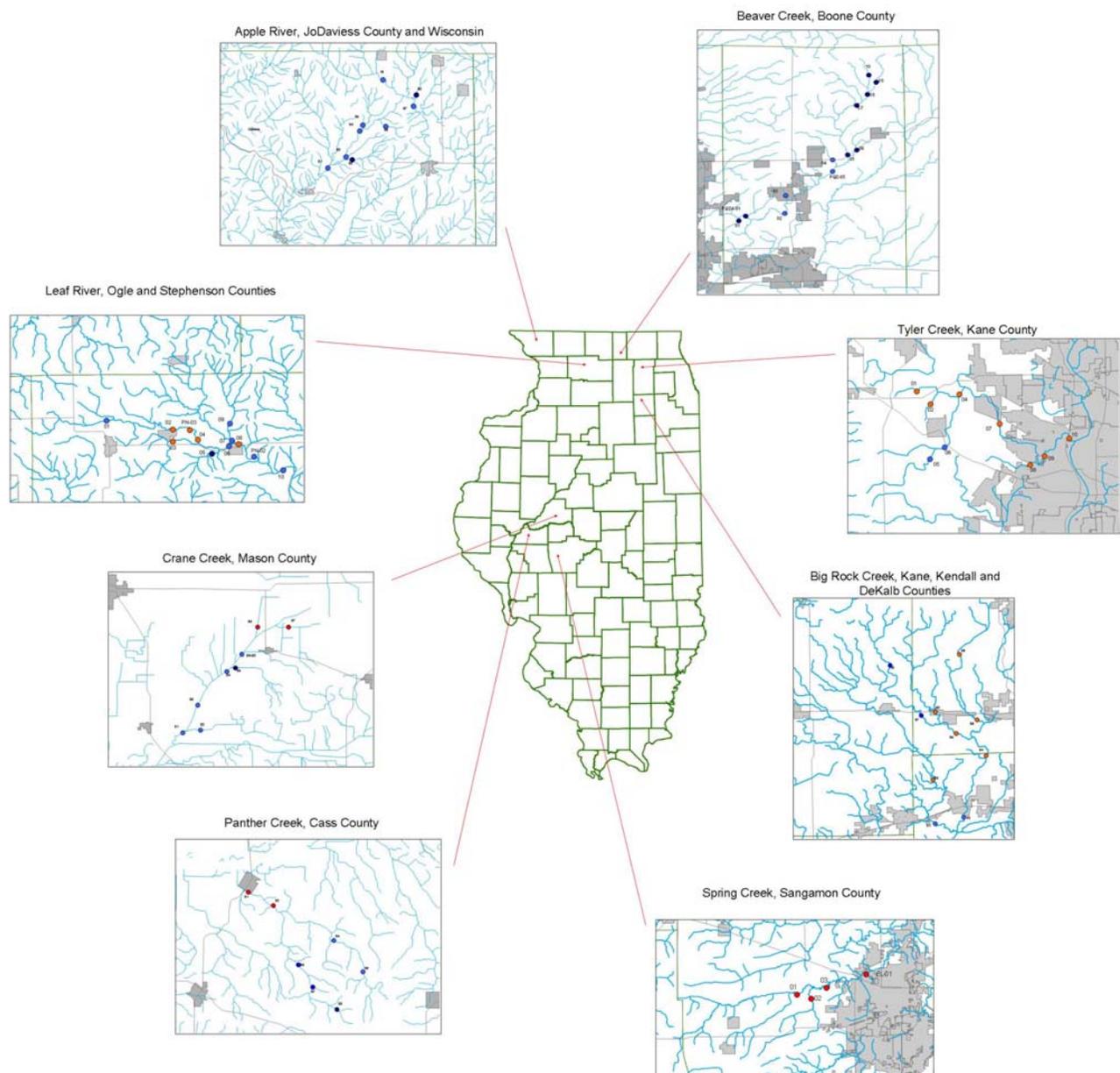


Figure 5. Statewide thermal patterns from network sampling Summers 2007-2008. Coolwater sites had mean daily temperatures less than $22\text{ }^{\circ}\text{C}$ during the sampling interval and are shaded in blue, warmwater sites had mean daily temperatures of greater than $22\text{ }^{\circ}\text{C}$ and are shaded in red.

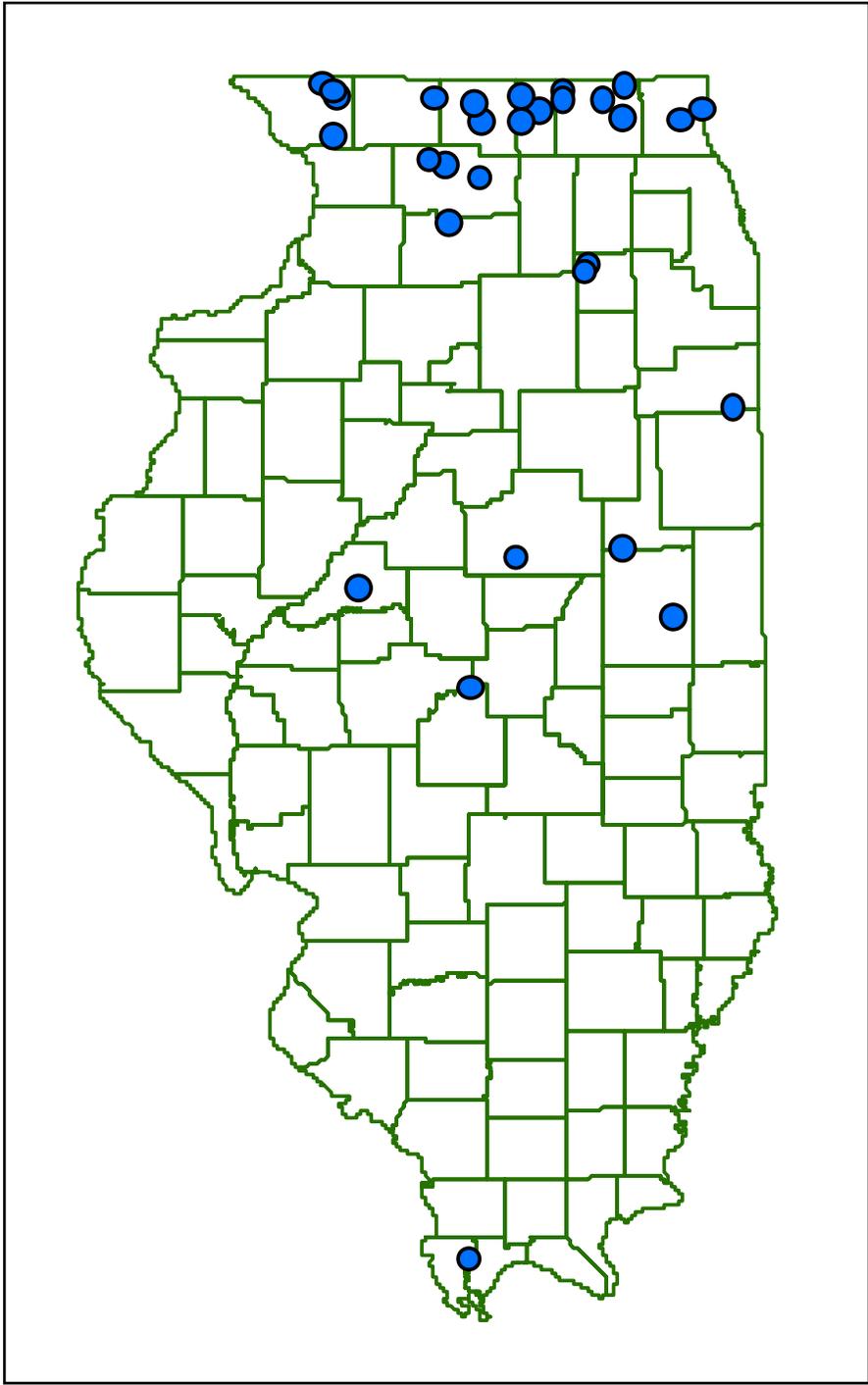


Figure 6. Coolwater and Coolwater stream sites (mean summer temperatures < 22 C) in Illinois identified from measured water temperatures (1999-2008).