ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Monitoring and Assessment of Aquatic Life in the Kaskaskia River for evaluating IDNR Private Lands Programs: Annual Report 2015

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Annual Summary Report

Project Title:
Monitoring and Assessment of Aquatic Life in the Kaskaskia River for evaluating IDNR Private Lands Programs.

Project Number:
RC13CREP01

Contractor information:
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Annual Reporting Period:
1 July 2014—30 June 2015

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Goals/ Objectives:
(1) Develop and initiate monitoring program that provides a basin-wide assessment of status and trends for aquatic life in wadeable streams of the Kaskaskia River; (2) track the status of selected populations of sensitive species in focal reaches of the Kaskaskia River associated with enhanced DO regulations, BSS designation, and presence of SGNC; (3) evaluate the influence of conservation easements and associated practices on biological communities within the Kaskaskia River Basin.

Project Title: Monitoring and Assessment of Aquatic Life in the Kaskaskia River for evaluating IDNR Private Lands Programs.

Narrative:

Work during this period continued monitoring efforts to characterize fish assemblages, benthic macroinvertebrate assemblages, physical habitat and water quality in streams within the Kaskaskia basin. During summer of 2015, 48 locations were surveyed, bringing the total locations over three survey seasons to 139 (Figure 1). Many of these locations have been surveyed in multiple years to evaluate interannual variation of stream characteristics or to compliment concurrent studies, and therefore the total number of monitoring events (i.e., efforts to characterize the physiochemical and biological attributes of a stream) is 179.

Specific tasks completed during this reporting period include measuring water quality characteristics at a subset of survey locations in fall 2014, resurveying many of the focal sites and the Illinois State Water Survey (ISWS) study locations (i.e., fixed sites) for a second or third year, surveying additional basin-wide status locations and surveying some locations selected to increase data coverage at streams with relatively high CRP density. As streams with CRP densities greater than 10% are rare in the Kaskaskia River basin, we selected stream reaches with local watersheds above this threshold to ensure evaluated locations covered the range of CRP densities present in the basin.

Monitoring conducted during the three years of this study (2013-2015) can be categorized according to their purpose (Table 1, Figure 2). Ninety-two basin-wide status assessment locations have been surveyed to provide an evaluation of physiochemical and biological characteristics throughout the basin. These sites were selected in a manner that would allow assessment of trends throughout the entire basin rather than of individual sites. Fifteen locations selected from streams of biological significance have been surveyed during each of the three study years to evaluate impacts of private land programs in areas of conservation concern (high biodiversity and high dissolved oxygen streams). The ISWS has selected four locations for monitoring of discharge and sediment and nutrient loading. All four of these locations were surveyed for this study in both 2014 and 2015. An additional 31 locations were selected to provide data for student research or to gain a better understanding of processes influencing stream characteristics. For example, two surveys on the same date were conducted at nine locations to evaluate spatial heterogeneity of biota and habitat within a stream segment. Sixteen surveys were conducted at tributaries to the two large reservoirs to evaluate the influence of lentic systems on stream fish diversity.

Summer thermal characteristics were monitored at 81 locations in the basin (Figure 3) during the three years of this study. Mean daily summer temperature ranged from 18.9^{o}C to 27.2^{o}C with a mean of 23.5^{o}C. Water quality parameters were measured during 152 site visits in summer and 60 site visits in fall between 2013 and 2015. Mean values for these parameters were similar in summer and fall (Table 2) and are characteristic of Midwestern watersheds with high densities of agricultural land use. Fish were collected during 123 sampling events between 2013 and 2015. Mean standardized abundance (number of individuals per 100m of sampled stream) was 323.3 and mean standardized species richness (number of species per 100m of sampled stream) was 11.8. Index of Biotic Integrity (Smogor 2000) scores calculated from sampled fish assemblages had a range of 13 (very low) to 55 (moderate) and a mean of 36.3 (indicating an average condition within the moderately low category; Table 3). The seven overall most abundant fish species in wadeable streams of the Kaskaskia River watershed were all minnows, but that pattern varies by subwatershed (Table 4). Green sunfish is the most frequently collected species in the watershed and in three of the four subwatersheds; however, frequency of occurrence patterns vary across the subwatersheds amongst the remaining species (Table 5). QHEI scores (OEPA 2006) for the watershed range between 21 (impaired) and 77.5 (excellent) with a mean of 51.8 (moderate, Table 6). IHI scores (Sass et al. 2011) for the watershed range between 5 and 24 (which are the minimum and maximum scores possible) with a mean of 18.3, which is near the middle of the index gradient (Table 7).

Work conducted during this reporting period was performed primarily by one FTE research scientist aided by the Principle Investigators, two graduate students and three hourly workers. A total of eleven hourly workers (mainly undergraduate students) have assisted staff during the three years of study.

Objective 1: Basin-wide status and trends.

Overview: To evaluate contemporary physiochemical and biological status of streams in the Kaskaskia River basin and to provide a baseline for comparison to future conditions, stream segments were randomly selected using a stratified (size and CRP density categories) design and scouted in early 2014 for their suitability for chemical, habitat and biological surveys. In 2015, 27 basin-wide status assessment locations from the scouting group were surveyed (Figures 1 and 2).

Fall water quality measurement: In fall of 2014, water quality was measured at six basin-wide status assessment locations that had previously been surveyed in summer 2014. Dissolved oxygen, specific conductance, temperature and pH were measured using a Hach Company HQ40d Portable Multi-Meter, while nitrate nitrogen, total reactive phosphorus, ammonia nitrogen and turbidity were measured using a Hach Company DR900 Colorimeter with Test-N-Tube kits. The purpose of this effort was to capture conditions following harvest. A total of 31 fall water quality measurement events have occurred at basin-wide status assessment locations during the three years of this study.

Spring benthic macroinvertebrate collection: Benthic macroinvertebrates from the Orders Ephemeroptera, Plecoptera and Trichoptera (EPT) were collected in May 2015 at 19 basin-wide assessment locations using Critical Trends Assessment Program methods (Molano-Flores 2002). Water quality (temperature, dissolved oxygen, conductivity and pH) measurements and habitat observations (adjacent land use, bank erosion, channel morphology and sedimentation) were made at the time of EPT collection. Spring EPT survey samples have been processed and identified.

Temperature regime characterization: Continuous temperature loggers were deployed at 25 basin-wide assessment locations to evaluate summer thermal regime and 24 of those deployed were successfully retrieved. These data will be combined with those previously recovered in 2013 and 2014 (and from other sources) to build models for the purpose of predicting thermal regime throughout the Kaskaskia River basin. This model may improve understanding of biodiversity patterns in the basin, or could be used to further evaluate impacts of private land programs. This work is ongoing.

Summer water quality measurement: Summer water quality (dissolved oxygen, specific conductance, turbidity, pH, nitrate nitrogen, total reactive phosphorus, ammonia nitrogen and temperature) measurements were collected at 23 basin-wide status assessment locations in 2015. An additional 88 water quality measurement events occurred in 2013 and 2014 to describe background conditions within the basin and evaluate the relationship between private land programs and stream water quality.

Habitat Evaluation: Habitat characteristics were evaluated at each basin-wide status assessment location (n=24) using the Illinois Habitat Index (IHI, Sass et al. 2010) and the Qualitative Habitat Evaluation Index (QHEI, OEPA 2006). Results from these indices will be combined with the 65 other habitat evaluation events from 2013 and 2014 to describe background conditions within the basin and evaluate the relationship between private land programs and stream habitat.

Summer macroinvertebrate collection: Summer benthic macroinvertebrates were collected at 16 basin-wide status assessment locations in 2015. These samples have been preserved and are awaiting identification. Samples from 2013 and 2014 collections were processed (sediment separated from insects, insects stored in compact vials) during early summer 2015. These samples (64 of which were for the basin-wide status assessment) were sent to EcoAnalysts, Inc. (Moscow, ID) for identification and enumeration. Macroinvertebrate assemblage evaluations will be used to describe background conditions within the basin and the relationship between private land programs and stream biota.

Fish assemblage collection: Fish were collected at 23 basin-wide status assessment locations using electrofishing techniques. Fish were identified at the survey location and immediately returned to the streams. Index of Biotic Integrity (IBI, Smogor 2000) scores were calculated for each of these samples. Fish assemblage evaluations will be used to describe background conditions within the basin and the relationship between private land programs and stream biota.

Objective 2: Status of sensitive species (focal stream monitoring).

Overview: Focal stream survey locations (n=15, Figures 1 and 2) were established in stream segments where Biologically Significant Streams (BSS; Bol et al. 2007) and Enhanced Dissolved Oxygen streams (IDNR/IEPA 2006) overlapped. These locations were selected to evaluate impacts of private land programs in areas of conservation concern. During this reporting period efforts focused on surveying focal locations for a third summer survey season. Sampling methods used for each task are described in Objective 1.

Fall water quality measurement: In November 2014, water quality at nine of the 15 focal locations was measured.

Spring benthic macroinvertebrate collection: Spring EPT collection occurred at all 15 focal locations. All locations were also sampled in 2014 so that we might evaluate interannual variability. Identification of these samples has been completed.

Temperature regime characterization: Continuous temperature recorders were deployed at all 15 focal locations in 2015. Thirteen loggers were retrieved and contained valid data. Four focal locations have temperature data from both 2014 and 2015. These data will be used in thermal regime modeling as described in Objective 1.

Summer water quality measurement: Summer water quality parameters were measured at 12 focal locations in 2015. A total of 42 summer water quality measurement events have occurred at focal locations during this study. These data will be used in evaluations of patterns in water quality as described in Objective 1.

Habitat Evaluation: Habitat characteristics were evaluated at 12 focal locations using the IHI and the QHEI. Forty-two habitat evaluations have occurred at focal locations during this study. These data will be used in evaluations of patterns in stream habitat as described in Objective 1.

Summer macroinvertebrate collection: Benthic macroinvertebrates were collected at 12 focal locations in summer 2015. A total of 42 collections have been made at focal locations during this study. Those samples from 2013 and 2014 have been processed and sent to EcoAnalysts, Inc. for identification. These data will be used in evaluations of patterns in stream macroinvertebrates as described in Objective 1.

Objective 3: Influence of private land conservation efforts (fixed site monitoring):

Overview: ISWS selected four locations for their monitoring that we use as fixed sites (Figures 1 and 2) to evaluate physiochemical and biological characteristics while ISWS concurrently evaluates discharge, sediment loading and nutrient loading. Sampling methods used for each task are described in Objective 1.

Fall water quality measurement: In November 2014, water quality parameters at three ISWS locations were measured during a single visit to each of these sites.

Spring benthic macroinvertebrate collection: Spring EPT were collected at two ISWS locations in 2015. Three spring EPT collections have occurred during this study. Identification of these samples has been completed.

Temperature regime characterization: Continuous temperature recorders were placed in all four ISWS locations in spring 2015. Only one logger with valid data was recovered from these sites during the study.

Summer water quality measurement: Water quality measurements were made at all four ISWS locations in summer 2015. All four locations were also monitored in 2014.

Habitat Evaluation: Habitat was evaluated using the IHI and the QHEI in summer 2015 at all four ISWS locations. These four locations were also evaluated in 2014.

Summer macroinvertebrate collection: Benthic macroinvertebrates were collected at all four ISWS locations in summer 2015. ISWS locations were also visited in 2014 and benthic macroinvertebrates were collected then as well. These samples have been sorted and are currently being identified.

Fish assemblage collection: Fish were again collected at three of the ISWS locations in summer 2015. The same three were also surveyed in 2014. The forth site is too large for our gear to effectively sample.

Reporting:

Three presentations at scientific conferences (Drake et al. 2015a, Drake et al. 2015b, Drake et al. 2015c) were given. Presentations described relationships between fish assemblages and watershed CRP density. Quarterly reports and this annual report were prepared and submitted.

Literature Cited:

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Drake, L., Y. Cao, L.C. Hinz, Jr., and B.A. Metzke. 2015a. The Conservation Reserve Program and Its Effect on Fish Diversity in the Kaskaskia Basin. American Fisheries Society Meeting, Portland, OR.

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Ohio Environmental Protection Agency. 2006. Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Technical Bulletin EAS/2006-06-1. State of Ohio Environmental Protection Agency, Division of Surface Water, June 2006.

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Table 1. Frequency of survey events (data collection) and number of locations (unique stream segments) for physiochemical and biotic characterization of streams in the Kaskaskia River basin between 2013 and 2015.

	Survey Purpose					
Evaluated Characteristic	**Basin-Wide Status**	**Focal**	**ISWS**	**Student Research/ Special Questions**	**Total Events**	**Total Locations**
Fish Assemblage	83	0	6	34	123	113
Benthic Macroinvertebrate Assemblage	78	42	8	23	151	126
Spring EPT Macroinvertebrate Assemblage	68	30	3	0	101	86
Water Quality	117	66	11	16	210	126
Temperature Regime	47	18	2	0	67	60
Habitat	87	42	8	34	171	159
Total Locations:	92	12	4	31		

Table 2. Mean (and range) of seven water quality parameters measured between 2013 and 2015 in the Kaskaskia River basin.

Time period	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	pH	Nitrate (mg/L)	Ammonia (mg/L)	React. Phosphate (mg/L)	Turbidity (AHU)
Summer	7.4 (1.1 - 13.4)	603 (96 - 1570)	7.9 (7.2 - 9.0)	3.1 (0 - 16.5)	0.1 (0 - 2.5)	0.6 (0 - 6.7)	28.2 (0 - 177)
Fall	9.7 (0.4 - 17.2)	707 (293 - 2035)	8.3 (7.2 - 9.0)	2.6 (0 - 12.0)	0.3 (0 - 6.4)	1.0 (0 - 10.7)	34.4 (5 - 153)

Table 3. Mean (and range) of metrics used to evaluate fish assemblages sampled between 2013 and 2015.

Abundance (#/100m)	Richness (Species/100m)	IBI Score
323.3 (2.9 - 1919.5)	11.8 (1.1 - 21.9)	36.3 (13 - 55)

Table 4. Rank abundance for the top 20 most common fish species in wadeable streams of the Kaskaskia River basin.

		Subwatershed Rank			
Species	Watershed Rank	Upper	Shoal	Middle	Lower
Bluntnose minnow	1	1	3	8	3
Sand shiner	2	2	1	5	4
Creek chub	3	5	4	2	1
Central stoneroller	4	3	8	3	2
Red shiner	5	4	2	10	5
Bigmouth shiner	6	13	9	1	9
Silverjaw minnow	7	7	5	4	11
Green sunfish	8	15	6	6	8
Bluegill	9	16	11	7	6
White sucker	10	6	14	22	7
Blackstripe topminnow	11	8	15	9	13
Johnny darter	12	10	7	12	12
Longear sunfish	13	9	16	17	10
Redfin shiner	14	11	13	21	19
Pirate perch	15	14	27	11	14
Suckermouth minnow	16	18	10	20	17
Yellow bullhead	17	22	12	15	15
Creek chubsucker	18	17	19	19	27
Striped shiner	19	12	117	117	116
Largemouth bass	20	25	17	18	16

Table 5. Rank frequency of occurrence for the top 20 most common fish species in wadeable streams of the Kaskaskia River basin.

		Subwatershed Rank			
Species	**Watershed Rank**	**Upper**	**Shoal**	**Middle**	**Lower**
Green sunfish	1	2	1	1	1
Creek chub	2	3	3	4	4
Yellow bullhead	3	8	2	3	3
Bluntnose minnow	4	1	6	7	5
Bluegill	5	10	4	2	2
Blackstripe topminnow	6	4	8	6	8
Largemouth bass	7	15	7	5	6
Red shiner	8	7	5	11	12
Central stoneroller	9	6	11	19	9
Johnny darter	10	5	12	13	13
Longear sunfish	11	11	14	9	10
White sucker	12	13	16	16	7
Sand shiner	13	14	10	12	11
Redfin shiner	14	12	9	14	15
Tadpole madtom	15	16	17	15	17
Pirate perch	16	17	22	8	14
Silverjaw minnow	17	19	13	17	26
Creek chubsucker	18	9	19	20	31
Suckermouth minnow	19	25	15	22	16
Bigmouth shiner	20	23	18	21	19

Table 6. Mean and range of QHEI metric and index scores for evaluated streams in the Kaskaskia River watershed between 2013 and 2015.

	Metrics							
	Substrate	**Cover**	**Channel**	**Riparian**	**Pool-Current**	**Riffle-Run**	**Gradient**	**Index Score**
Mean:	8.1	10.1	13.0	5.9	6.2	2.3	6.2	51.8
Range:	0.5 - 15.5	5 - 15	6 - 18	2 - 10	-2 - 10	0 - 7	2 - 10	21 - 77.5
Max possible score:	*20*	*20*	*20*	*10*	*12*	*8*	*10*	*100*

Table 7. Mean and range of IHI metric and index scores for evaluated streams in the Kaskaskia River watershed between 2013 and 2015.

	Metrics					
	Buffer and Bare Bank	**Substrate**	**Shade**	**Riffle**	**Woody Debris**	**IHI Score**
Mean:	4.2	4.3	2.9	3.5	3.4	18.3
Range:	1 - 5	1 - 5	1 - 4	1 - 5	1 - 5	5 - 24
Max. possible score:	*5*	*5*	*4*	*5*	*5*	*24*

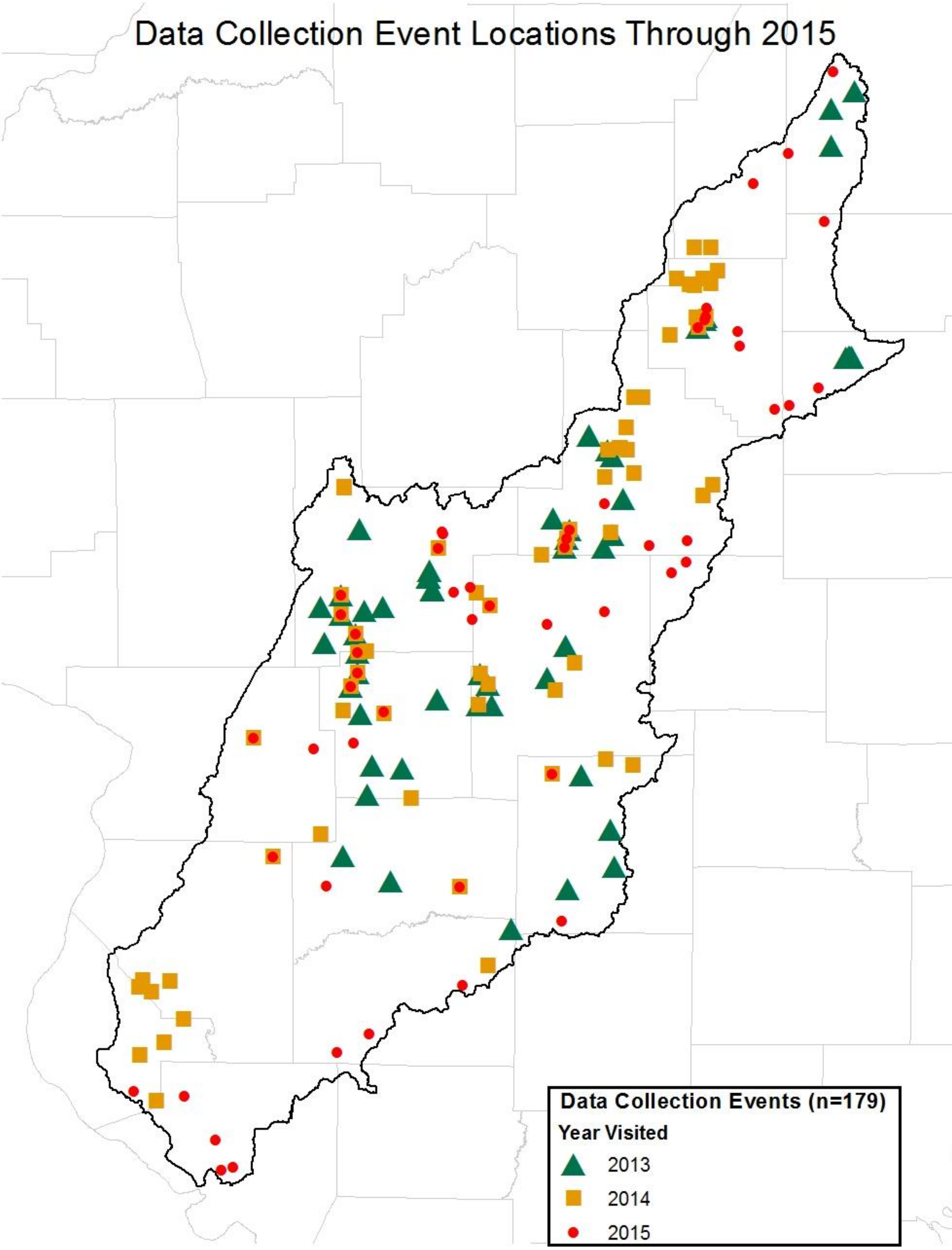

Figure 1. Location and survey year for all data collection events between 2013 and 2015.

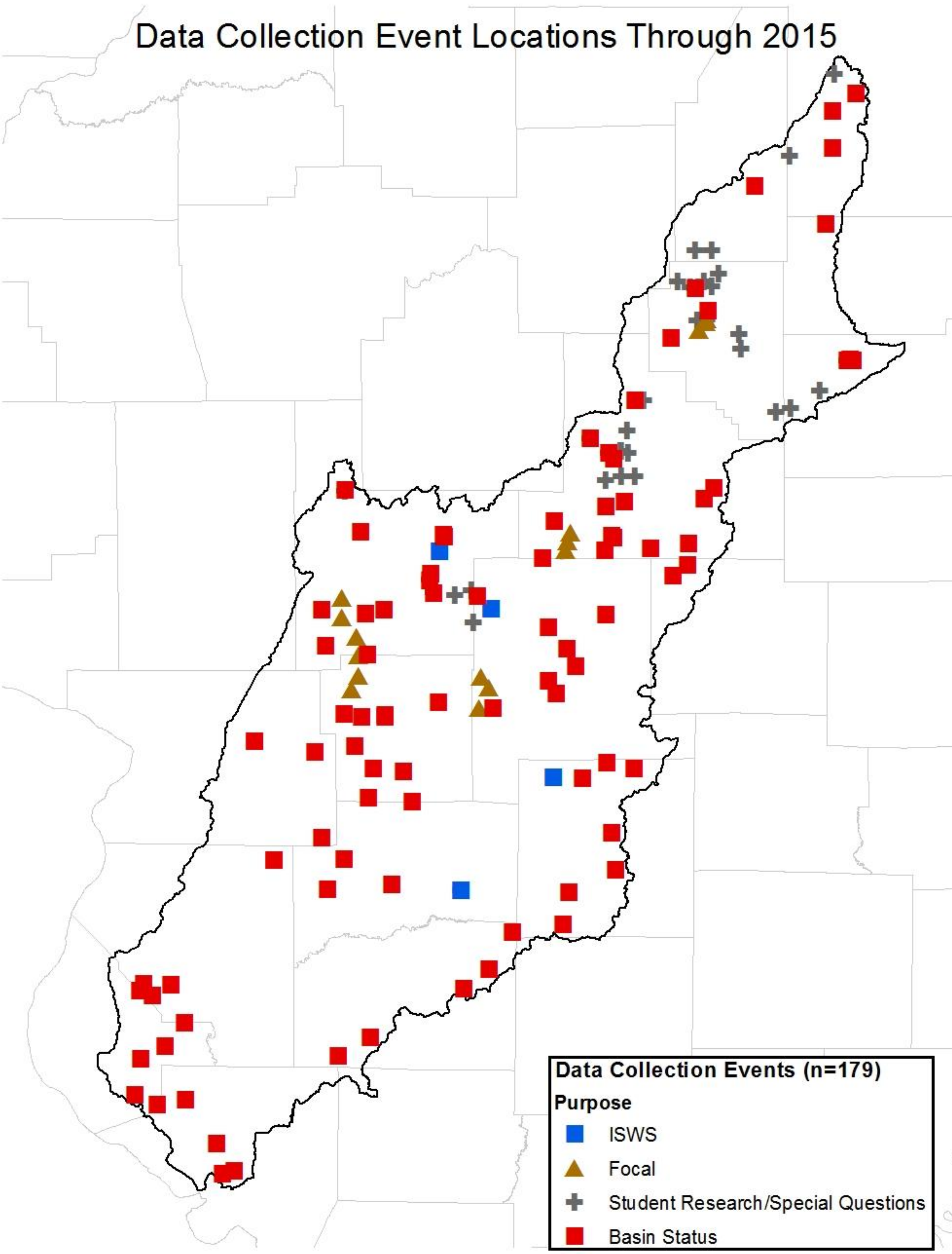

Figure 2. Location and purpose for all data collection events between 2013 and 2015.

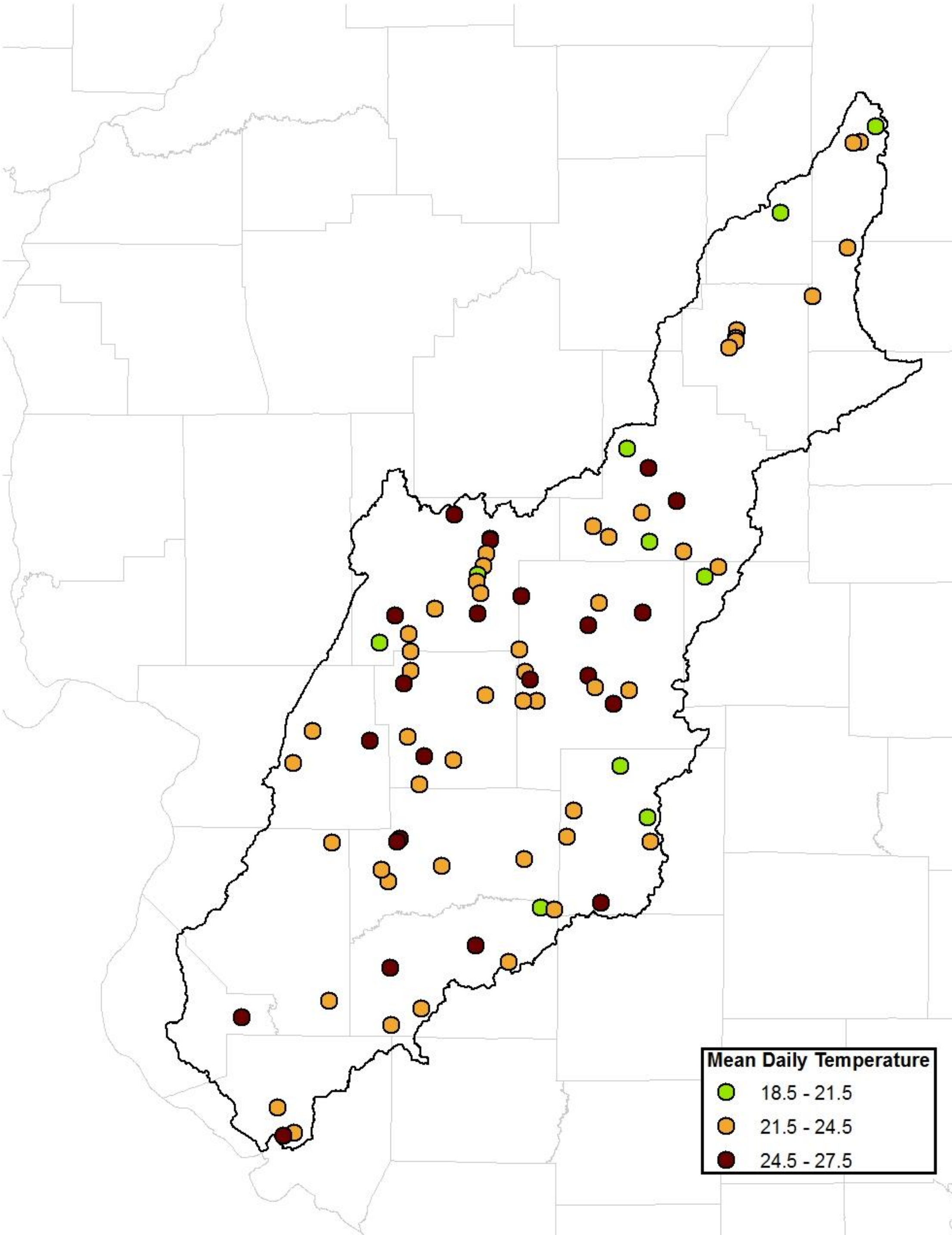

Figure 3. Location and mean daily summer temperature for all valid temperature data (n=81) recorded between 2013 and 2015.