



**ILLINOIS NATURAL
HISTORY SURVEY**
PRAIRIE RESEARCH INSTITUTE

**Monitoring and Evaluation of United States Fish and
Wildlife Service Partners for Fish and Wildlife Program
Stream Restorations in Illinois
(Progress Report for 1/1/2016 – 12/31/2016)**

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INHS Technical Report 2017 (3)

United States Fish and Wildlife Service
Illinois Partners for Fish and Wildlife Program
Award F15AP00785

Issue Date: 13 January 2017

Restricted access until 11/30/2017

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Purpose of Report

This report summarizes monitoring activities completed in 2016 at Illinois Partners for Fish and Wildlife Program stream restorations. Chemical, physical and biological characteristics were evaluated at one restored and two reference stream segments associated with a streambank stabilization project in Clear Creek, Union County. Monitoring completed in 2016 is a continuation of activities conducted in 2015, and as such, monitoring objectives and methods are detailed in Metzke (2015).

Survey Location and Description of Restoration

Clear Creek is a tributary to the Mississippi River and is within the Upper Mississippi-Cape Girardeau Hydrologic Unit Code-8 (HUC8). Clear Creek is a second order stream within the monitoring area and the upstream watershed is mostly forest and grassland. Clear Creek is in the Eastern Tallgrass Prairie and Big River Landscape Conservation Cooperative (ETPBR LCC). The monitoring area likely meets the “medium streams with forested riparian zones” category within the ETPBR LCC Gulf Hypoxia Initiative (LCC 2015).

The restoration project on Clear Creek is approximately 2.5km west of Cobden in Union County (Figure 1). The restored area is in two sections and is approximately 90m long and includes stone bank armoring and weirs to prevent further erosion to the landowner’s property.

Previous Fish Surveys

The Illinois Department of Natural Resources (IDNR) has conducted fish community surveys at two locations near the monitoring area. These surveys provide an estimate of the watershed species pool and identify the presence of target species that may exist in the restored area. The first survey location is 3.6km downstream of the restoration and was last surveyed in 1986. The second is 7.8km downstream of the restoration and was surveyed in 1986 and 2009. Thirty-one species were collected at these two locations (Table 1). One of these (black redhorse) is an ETPBR LCC surrogate species (USFWS 2013) and focal species for medium streams with forested riparian zones. One, bigeye shiner, is an Illinois state endangered species. Index of Biotic Integrity (IBI, Smogor 2000) could be calculated for the downstream most IDNR survey location. Both surveys concluded Clear Creek was a “moderate” resource.

The United States Fish and Wildlife Service (USFWS) completed a pre-construction fish survey of the restoration area in 2015. That survey yielded 19 species, including bigeye shiner. Two species, bleeding shiner and pirate perch, were not recorded at the IDNR survey locations.

Survey Segment Delineation

Three survey segments were selected to monitor restoration impacts (Table 3, Figure 1). The restoration segment began just downstream of the Mountain Glenn Road bridge and terminated downstream of the downstream extent of the restoration work, a distance of 105m. This segment included riffles, runs and pools. The first reference survey segment (middle) was approximately 80m downstream of the restoration segment and was 150m long. This segment was mostly run with one

pool and it was the widest and deepest of the three segments. Approximately 250m downstream of the restoration segment and 20m downstream of the middle segment was the downstream reference segment. This segment was 100m long and contained two riffles, one small run and one large pool.

Water Quality Characterization

Dissolved oxygen and pH concentrations met the Illinois Environmental Protection Agency's (IEPA) general use water quality standard at each survey segment (Table 4). The acute ammonia IEPA standard (using the mean pH value) is 4.90mg/L and the chronic standard is 0.73mg/L, and all recorded ammonia values were below this limit. There is no phosphorus water quality standard for streams, but the standard for lakes and their direct tributaries is 0.05mg/L. Using this standard as a benchmark, all Clear Creek survey segments exceeded the maximum limit.

Recorded temperature increased from downstream to upstream (Table 4), but this pattern likely resulted from increasing air temperature as the day progressed. Dissolved oxygen concentration was highest at the restoration segment and approximately 47% greater than the mean of the reference segments. One possible explanation for this pattern is that the restoration segment had a more open canopy resulting in greater oxygen production by algae; however, the precise reason for the pattern cannot be determined with certainty. Nitrate nitrogen was much lower at the two reference segments. Again, it is difficult to determine why there is a localized increase in nitrate concentration at the restoration segment, but possible sources include leaching from nearby septic systems, fertilizer use at nearby residences or release from algae. The locally higher concentration (as opposed to a downstream gradient) may result from a very low discharge present during the survey. Velocity was too slow at the restoration segment to calculate discharge, but at the downstream reference segment discharge was approximately 0.010m³/sec, or 0.24mgd. Nitrate, phosphorus and ammonia concentrations were lowest at the middle reference segment. One explanation for this pattern is the middle segment has more than three times the volume of water than the other two segments. More water volume coupled with very low flows could create heterogeneity in nutrient concentrations. Turbidity, pH and conductivity were similar between the three segments.

Physical Characterization

Qualitative Habitat Evaluation Index (QHEI, OEPA 2006) scores ranged from 69 to 83 (Table 3). The restoration and downstream reference segment scored in the excellent category while the middle reference segment was in the good category. All three segments scored well in the riparian and gradient metrics. The middle reference segment scored lower than the other two segments in five of the seven metrics and the lower index score resulted largely from the lack of riffles and low quantity of large substrates. Boulders placed at the restoration segment as part of the restoration project improved the substrate and channel metrics relative to conditions prior to restoration.

The Illinois Habitat Index (IHI, Sass et al. 2010) scores ranged from 16 to 21 (Table 5). Both the restoration and middle reference segments scored 16, which is near the middle of the index score range. The downstream reference segment scored a 21, which is near the highest (best) end of the range. The largest difference between the segments was the high riffle metric score at the downstream reference

segment. All segments scored low on the woody debris metric due to the lack of wood in the stream channel.

Fish Assemblage Characterization

Overall, 24 fish species from eight families were collected from Clear Creek (Table 6). One third of the species and 0.54 of the individuals collected were Cyprinids (minnows). Banded sculpin, found at the two reference segments, is a state focal species for evaluating climate change. Bleeding shiner was collected at the downstream reference segment and is a State Species in Greatest Conservation Need (SGCN). Bigeye shiner is a State SGCN and endangered species and was collected at the middle reference and restoration segments. No collected species were ETPBR LCC focal or surrogate species. Five species collected in 2016 were not recorded during the 2915 FWS survey.

The downstream reference segment had the highest density of fish species and individuals (Table 6). The restoration segment had the second highest species density and the middle reference segment had the second highest abundance density. Proportional abundance of Cyprinids increased from upstream to downstream (Figure 2). Centrarchids comprised approximately 0.24 of collected individuals at the restoration and middle reference segments, but just 0.10 at the downstream reference. The proportion of Percids (darters) was highest at the downstream reference segment and lowest at the middle reference segment.

IBI scores were 49, 50 and 52 at the restoration, middle reference and downstream reference segments, respectively, but all segments were categorized as “moderate” resources. All segments scored a 5 or 6 in six of the ten metrics. Few differences between segments were present as only one metric (proportion specialist benthic invertivore species) had a point spread greater than two. There was no metric in which the restoration segment was higher than the reference segments.

Ecological Impacts of Restoration

The restoration structures in Clear Creek altered habitat characteristics which was reflected in some QHEI metrics. Siltation was low in the reference segments so there was little room for improvement in substrate characteristics that may result from a stream bank stabilization project, like the Clear Creek restoration. Nitrate nitrogen was highest at the restoration segment, but it is unlikely this resulted from restoration activities. No other chemical, physical or biological patterns between the restoration and reference segments were detectable. Overall, Clear Creek rates well for the evaluations utilized in this monitoring effort, suggesting the restoration activities maintain rather than greatly improve stream characteristics.

Support for USFWS Goals

The restoration activities in Clear Creek enhanced 0.04 miles of stream in the Mississippi River USFWS Region 3 Focal Area (USFWS 2011). There were no focal or surrogate species in the surveyed segments, nor did the restoration appear to improve IBI scores. Monitoring activities did improve communication

between the USFWS and the landowner and increase accountability to the public (Partners for Fish and Wildlife Program Goals 3 and 5; USFWS 2010).

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Table 1. List of species collected by the Illinois Department of Natural Resources in Clear Creek during the 1986 and 2009 surveys.

Common Name

Banded sculpin
Bigeye shiner
Bluegill
Black redhorse*^
Bluntnose minnow
Blackstripe topminnow
Brook silverside
Blackspotted topminnow
Common carp
Creek chubsucker
Central stoneroller
Creek chub
Emerald shiner
Fantail darter
Golden redhorse
Green sunfish
Johnny darter
Largemouth bass
Logperch
Longear sunfish
Orangethroat darter
Orangespotted sunfish
Rainbow darter
Redfin shiner
Sand shiner
Shortnose gar
Slender madtom
Spotted bass
Spotted gar
Striped shiner
Yellow bullhead

*ETPBR LCC surrogate species

^ ETPBR LCC focal species for mid- sized streams with forested riparian zones

Table 2. List of species collected by the US Fish and Wildlife Service at the Clear Creek restoration segment in 2015.

Common Name

Banded sculpin
Bigeye shiner
Blackstripe topminnow
Bleeding shiner
Bluntnose minnow
Central stoneroller
Creek chub
Creek chubsucker
Fantail darter
Green sunfish
Johnny darter
Logperch
Longear sunfish
Orangethroat darter
Pirate perch
Rainbow darter
Redfin shiner
Slender madtom
Striped shiner

Table 3. Channel morphology characteristics and QHEI metric scores and results for Clear Creek survey segments.

Segment	Channel Characteristics			QHEI Metric Scores								QHEI Score	QHEI Category
	Mean Width (m)	Mean Depth (m)	Surveyed Length (m)	Channel Unit Composition	Substrate	Cover	Channel	Riparian	Pool/Current	Riffle/Run	Gradient		
Restoration	4.7	0.27	105	10% riffle, 50% run, 40% pool	18.5	12	16	8.5	8	4	10	77	Excellent
Middle	6.7	0.44	150	85% run, 15% pool	14	14	14	10	5	2	10	69	Good
Downstream	4.7	0.25	100	35% riffle, 5% run, 60% pool	18	15	16	10	8	6	10	83	Excellent
					20	20	20	10	12	8	10	100	

Maximum Score:

Table 4. Recorded values for chemical parameters measured during Clear Creek survey efforts.

Segment	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% saturation)	Nitrate (mg/L)	Reactive Phosphorus (mg/L)	Ammonia (mg/L)	Turbidity (AHU)	pH	Conductivity
Restoration	28.9	9.43	124.9	2.7	0.31	0.1	23	8.46	272
Middle	26.2	6.68	83.9	0.2	0.14	0	29	8.16	289
Downstream	24.5	6.11	74.3	0.8	0.37	0.22	31	8.24	274

Table 5. IHI metric scores and results for Clear Creek survey segments.

<u>Segment</u>	<u>IHI Metrics</u>					<u>IHI Score</u>
	<u>Buffer and Bare Bank</u>	<u>Substrate Ratio</u>	<u>Shade</u>	<u>Riffle</u>	<u>Woody Debris</u>	
Restoration	5	4	4	2	1	16
Middle	5	4	4	1	2	16
Downstream	5	5	4	5	2	21
<i>Maximum Score</i>	5	5	4	5	5	24

Table 6. Fish density (number/100m) in Clear Creek.

Segment	Cyprinidae					Catostomidae					Ictaluridae		
	Breave shiner	Bleeding shiner	Bluntnose minnow	Central stoneroller	Creek chub	Redfin shiner	Sand shiner	Striped shiner	Creek chubsucker	Spotted sucker	White sucker	Slender madtom	Yellow bullhead
Restoration	12.4	0	50.4	5.7	1.9	10.5	0	11.4	10.5	0	0	6.7	1.0
Middle	14.7	0	41.5	10.1	6.0	14.7	0	30.2	24.8	0.7	0.7	0.7	0
Downstream	0	3.0	43.0	68.0	24.0	4.0	1.0	11.0	3.0	0	0	16.0	2.0

Table 6, continued. Fish density (number/100m) in Clear Creek.

Segment	Centrarchidae			Percidae			Cyprinodontidae		Aphredoderidae		Cottidae		
	Bluegill	Green sunfish	Largemouth bass	Longear sunfish	Fantail darter	Johnny darter	Logperch	Orangethroat darter	Blackspeckled topminnow	Pirate perch	Banded sculpin	Total Richness	Total Abundance
Restoration	13.3	13.3	3.8	20.0	1.0	3.8	4.8	18.1	21.9	1.0	0	18.1	210.9
Middle	17.4	6.0	7.4	22.1	0.7	3.4	5.4	4.7	2.0	2.0	2.0	14.1	217.1
Downstream	1.0	14.0	1.0	8.0	6.0	2.0	1.0	27.0	6	0	3	20	244.0

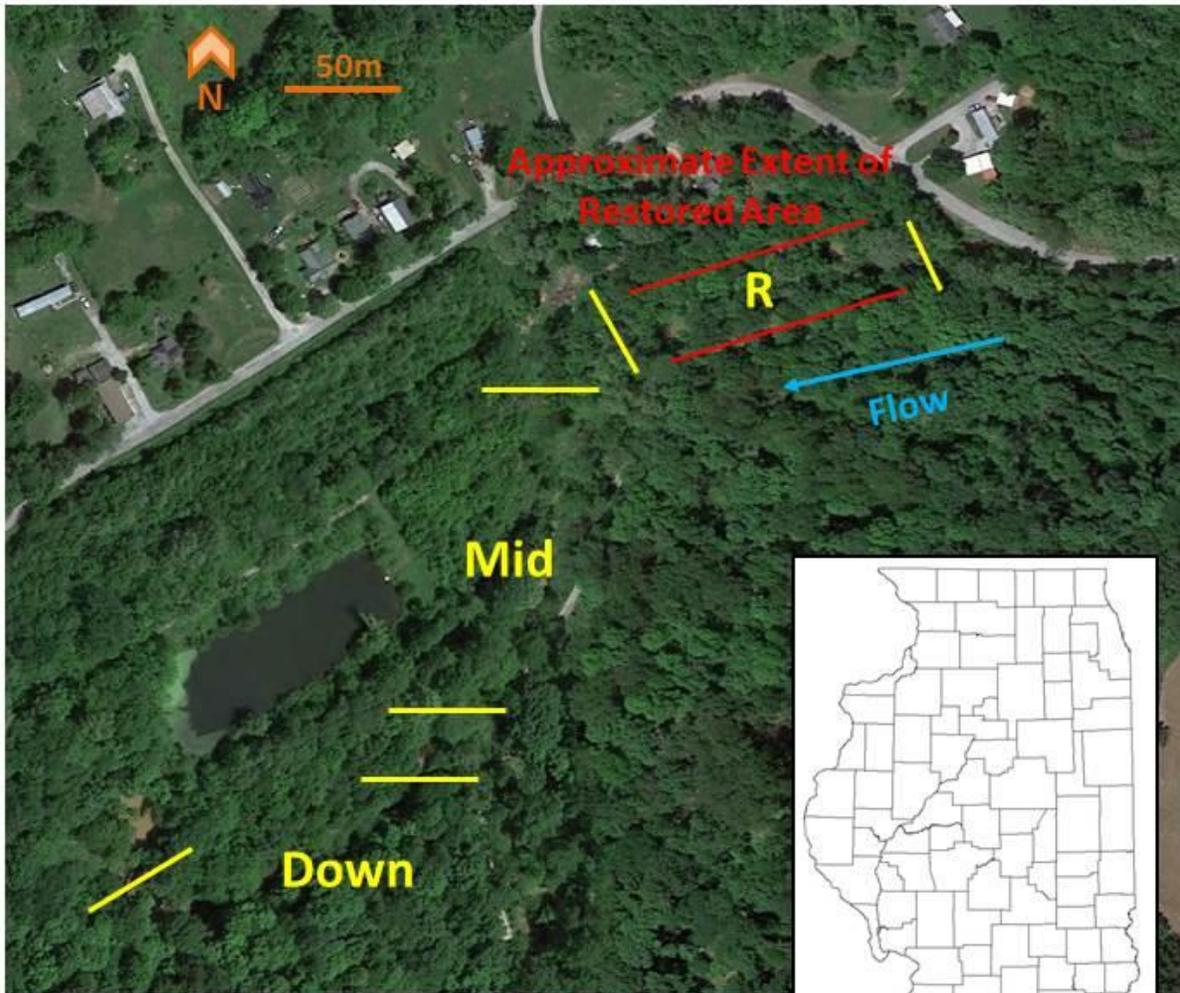


Figure 1. Clear Creek restoration location (inset) and survey area (aerial photograph). The restoration segment (R) was the upstream most segment and included all of the restoration work. The reference segments were located approximately 80m (Mid) and 250m (Down) downstream of the restoration segment. Yellow bars denote boundaries of the surveyed segments. Red bars indicate the boundaries of restoration activities.

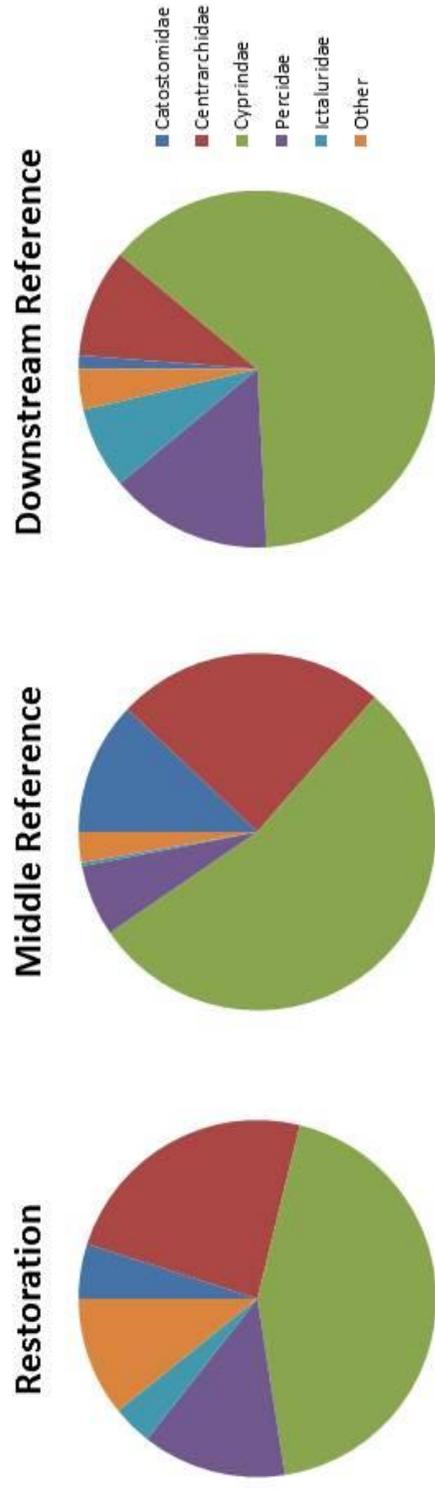


Figure 2. Proportional abundance of fish families collected in Clear Creek.