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**Monitoring and Assessment of Aquatic Life in the Kaskaskia River for Evaluating IDNR
Private Lands Programs: Phase II Final Report**

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INHS Technical Report 2019 (26)

Prepared for Illinois Department of Natural Resources,
Office of Resource Conservation

Issue Date: November 13th, 2019

Unrestricted, for immediate release

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CREP Stream Monitoring Program Background

The Illinois Conservation Reserve Enhancement Program (CREP) was established in the Illinois River basin in 1998 and expanded to the Kaskaskia River basin in 2010. CREP offers financial incentives to landowners for implementing conservation practices on agricultural lands with the goal of improving water quality and enhancing wildlife habitat. The agreement between the United States Department of Agricultural and State of Illinois mandates the implementation of a monitoring program to evaluate CREP objectives (USDA 2010).

CREP has stream water quality and biological goals: Reduce sediment loading by 20% and phosphorus and nitrogen loading by 10% in the mainstem Illinois and Kaskaskia Rivers, and increase native fish and mussel stocks by 10% in the Illinois and Kaskaskia Rivers. Stream monitoring over the past two decades has focused on physicochemical assessments in the Illinois River basin, but the Illinois Department of Natural Resources' Division of Private Lands and Watersheds (PLW) intended to develop a monitoring program in the Kaskaskia River basin with a focus on the aquatic biological goals of Illinois CREP. The Illinois Natural History Survey (INHS) developed and implemented a Kaskaskia River basin stream monitoring program between 2013 and 2015 that was focused on providing a baseline status assessment of streams in the basin (CREP monitoring Phase I; Metzke and Hinz, Jr. 2017). In 2016 INHS and PLW renewed the stream monitoring program (Phase II, 2016-2017) and shifted some effort from recording the biotic and physicochemical characteristics of streams in the basin to an assessment of CREP goals with an emphasis on evaluation of biotic response to CREP practices. This report identifies objectives and summarizes monitoring effort for the Phase II stream monitoring program.

Stream Monitoring Program Objectives

Objectives for this monitoring effort facilitate assessment of CREP stream goals by evaluating physicochemical and biological trends in relation to conservation practices and providing technical support to the IDNR CREP. There were four main objectives for Phase II.

Objective 1: Continue established monitoring program that provides a basin-wide assessment of status and trends for aquatic life in wadeable streams of the Kaskaskia River basin. Phase I resulted in three years of survey information at locations along a gradient of conservation program land cover, and Phase II continued this survey effort to monitor temporal trends and enhance assessment of spatial patterns.

Objective 2: Expand sampling efforts in focal reaches to better characterize biological assemblages and physicochemical habitats of the four subbasins. Strategic selection of survey locations and additional measures of biotic response will aid assessment of CREP goals by evaluating a gradient of possible physicochemical and biological patterns relative to conservation practices.

Objective 3: Conduct additional monitoring of key aquatic species populations within the Kaskaskia River basin. Response to conservation practices may differ among stream taxa, and employing additional

biological measures for species that may be sensitive to conservation impacts provides opportunity for enhanced analytical resolution.

Objective 4: Provide technical support for IDNR's Private Lands Programs. INHS staff will assist the IDNR by managing spatial data, developing a process for prioritizing lands for reaching CREP goals and coordinating with State and Federal agencies that interact with Illinois CREP.

Objective 1 – Basin-wide Monitoring

Basin-wide monitoring of physicochemical and biological stream characteristics began in Phase I and continued in Phase II. Twenty survey reaches per year (40 total; Figure 1) were selected using a stratified random process. Reaches were divided into each of the four subbasins and then divided into one of two size categories (small, 2-10 link number, or large, 11-50 link number) and one of two local catchment Conservation Reserve Program (CRP) categories (low, 0-4.9% land use in local catchment, or high, $\geq 5\%$). Link number is the number of the 1st-order tributaries in the whole catchment based on 1:100,000 stream linework from the National Hydrography Dataset of USGS. The local catchment is the area directly draining into a stream reach (i.e., a confluence-to-confluence segment). CRP is used as a surrogate for CREP as the two programs employ similar practices and CREP enrollment in the Kaskaskia River basin is relatively low.

Instream temperature recorders were placed at a subset of basin-wide monitoring reaches to measure summer thermal regime. Fifteen of these recorders were recovered with intact temperature data. At each sampling site dissolved oxygen, specific conductance, temperature and pH were measured using a Hach HQ40d Portable Multi-Meter, while nitrate nitrogen, total reactive phosphorus, ammonia nitrogen and turbidity were measured using a Hach DR900 Colorimeter with Test-N-Tube kits at each basin-wide monitoring reach once during the summer survey event. Chloride was measured using Hach Quintab test strips beginning in 2017.

Habitat characteristics were evaluated at all basin-wide monitoring reaches using the Illinois Habitat Index (IHI, Sass et al. 2010) and the Qualitative Habitat Evaluation Index (QHEI, Ohio Environmental Protection Agency 2006). The IHI is comprised of five metrics which reflect landscape disturbance. Index scores range from 5 to 24 with higher scores reflecting better quality habitat. The QHEI qualitatively evaluates habitat characteristics thought to be important to fish assemblages. The QHEI is computed from summing 6 principle metrics to give a Total QHEI Score which ranges from 0 to 100. The higher the score the higher quality fish habitat.

Fish surveys occurred at all basin-wide monitoring reaches and followed IDNR Basin Survey procedures (Illinois Department of Conservation 1994) using either a DC backpack electrofishing unit (LR-20, Smith Root) or a 30-foot AC electric seine powered by a 120 volt generator. Collected fish were identified and enumerated on site and returned to the stream. Fish assemblages were qualified using the Index of Biotic Integrity (IBI, Smogor 2000). The IBI categorizes fish assemblages into five qualitative categories by summarizing ten diversity and trait-based metrics.

Summer benthic macroinvertebrates were collected at each basin-wide monitoring reach using the IEPA 20-jab procedure (IEPA 2011). Jabs were divided proportionately among main habitat types (e.g., riffles, runs, and pools) within the survey reach. Collected invertebrates were field preserved in ethanol, sorted

in the laboratory for a 300-organism fixed-count subsample, and transported to EcoAnalysts, Inc. (Moscow, ID) for taxonomic identification and enumeration. Thirty-two of these samples have been processed by EcoAnalysts.

Mussel surveys were conducted at seven reaches selected from locations with high mussel abundance or species richness (Shasteen et al. 2013). These reaches were selected to evaluate basin-wide status of mussel assemblages and to provide opportunity for evaluation of temporal trends in mussel assemblage composition. A four person-hour qualitative survey was conducted at each reach. If one or more mussels were collected, an additional four person-hour survey was conducted at an adjacent sampling section within the same confluence to confluence stream segment as the first survey. An eight person-hour effort was employed as a compromise between the standard four person-hour survey and a more intense, but thorough, effort (e.g., 16 person-hours; Huang, et al. 2011).

Objective 2 – Focal Reach Surveys

The stratified-random approach to reach selection used for basin-wide monitoring distributes survey effort spatially across the basin and along a gradient of CRP density; yet, a survey design which limits the influence of confounding factors (e.g., differences in watershed land use, geology, species pool, etc.) could allow a focused evaluation of physicochemical and biotic response to CREP practices. Eight pairs of survey reaches were selected for this objective. A high CRP density reach ($\geq 10\%$ in the local watershed) and a low CRP density reach ($< 10\%$) were identified for each pair. Paired reaches were located in adjacent, similarly-sized tributaries of the same larger-order stream to minimize variation in land use, geology, stream size, and species pool. All paired reaches were surveyed in 2016 and half again in 2017.

Water temperature recorders were deployed at all 16 paired reaches and recovered at 14. Water quality, habitat, benthic macroinvertebrates, and fish were sampled following basin-wide monitoring procedures during each summer survey event. Water samples were collected at a subset of paired sites during seven summer and fall high-flow events and nitrate, nitrite, total nitrogen, total Kjeldahl nitrogen, reactive phosphorus and total suspended solids were assessed by Prairie Analytical Laboratories (Springfield, Illinois). Dissolved oxygen, specific conductance, temperature, chloride (2017 only) and pH were measured during high-flow collection events. Night blacklight surveys were conducted at 15 of the 16 paired reaches in 2016 to sample adults of the insect Orders Ephemeroptera, Plecoptera and Trichoptera (EPT). Collected EPT were preserved and later identified to the lowest possible taxonomic resolution to produce an inventory of taxa present at each reach. Mussels were surveyed at each reach following basin-wide monitoring procedures.

Objective 3 – Focal Population Monitoring

Objectives 1 and 2 emphasize community response to conservation land, but stream biota may exhibit more subtle responses, including variation in length-weight relationships of individuals among populations. Length and weight of targeted species were measured to evaluate impact of conservation land in space and time.

Reduction in sediment loading is a goal of CREP and so eleven fish species sensitive to sedimentation were selected to evaluate response of these populations to a gradient of conservation land density. Length and weight of sensitive species were measured at all paired reaches and an additional fifteen reaches (identified as “sensitive species reaches”; Figure 1) surveyed in both 2016 and 2017 in the upper Kaskaskia River subbasin following basin-wide monitoring procedures. More than 2700 fish were measured.

Fish population demographic patterns, or stock indices, can be used to evaluate population response to factors of interest, like density of conservation land. Stock indices that use length-weight relationships are suitable for this study as the Illinois Department of Natural Resources Division of Fisheries maintains a database with the lengths and weights of fish collected during community and sport fish surveys. Length and weight relationships (e.g., length-weight regressions, relative condition factor, relative weight) can be compared across time periods (e.g., before and after CREP) or relative to a focal measure (e.g., watershed CREP land use density).

Lengths and weights of large-bodied fishes were extracted from the Fisheries database. The number of measured individuals is sufficient for evaluation of length and weight relationships for several, mostly large-bodied, species. The Division of Fisheries database is under revision and additional species and data-years may be accessible when complete.

Objective 4 – Technical support

Effort for this objective focused on enhancing coordination between CREP and programs with similar goals and on identifying priority CREP sign-up areas.

Current CREP GIS data infrastructure was updated by integrating geospatial data from other existing Private Lands and Watersheds (PLW) Programs, including locations of Conservation Stewardship Plans, Forestry Development Act Plan, Illinois Recreational Access Program Plans and US Fish and Wildlife Service Private Land projects. This expanded database will identify overlap with CREP properties, and aid evaluation of PLW program activities and decision making.

Conservation Priority Areas (CPAs) were developed and proposed to USDA’s Farm Service Agency (FSA) for their Conservation Reserve Program (CRP)CPAs prioritize focal areas of the Illinois Wildlife Action Plan and focal watersheds for the Illinois Nutrient Loss Reduction Strategy (NLRs), and take into account CRP density, availability, acceptance, interest and eligibility More than six million acres of cropland are within identified CPAs (Figure 2).

Several CREP practices have been identified by the NLRs as supportive of Strategy goals. An accounting of acres enrolled in these practices was developed to support NLRs and will be used to estimate CREP contribution to NLRs over time.

Summary of Phase II Stream Monitoring Effort

One hundred nine survey events at 88 locations were completed for Phase II of CREP stream monitoring. Basin-wide monitoring of physicochemical and biological characteristics continues from Phase I and provides a method for evaluating temporal trends as CREP enrollments develop in the Kaskaskia River basin. The addition of mussel surveys to basin-wide monitoring provides another taxon for evaluation. Focal reach and focal population surveys provide enhanced resolution for evaluation of physicochemical and biological response to conservation lands. Technical support of IDNR PLW improved resolution and availability of data for coordination of CREP goals.

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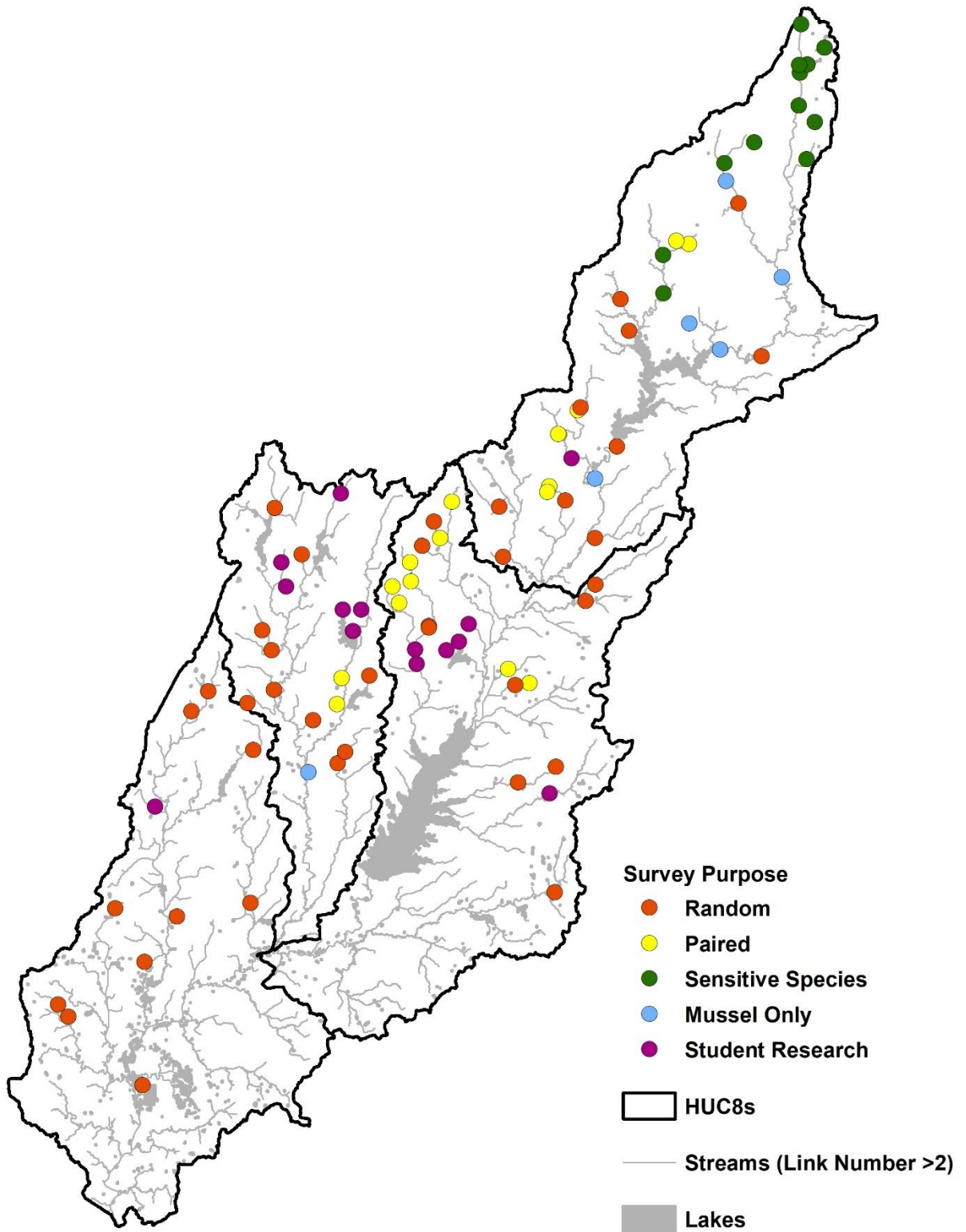


Figure 1. Survey locations for Phase II of CREP stream monitoring (2016-2017).

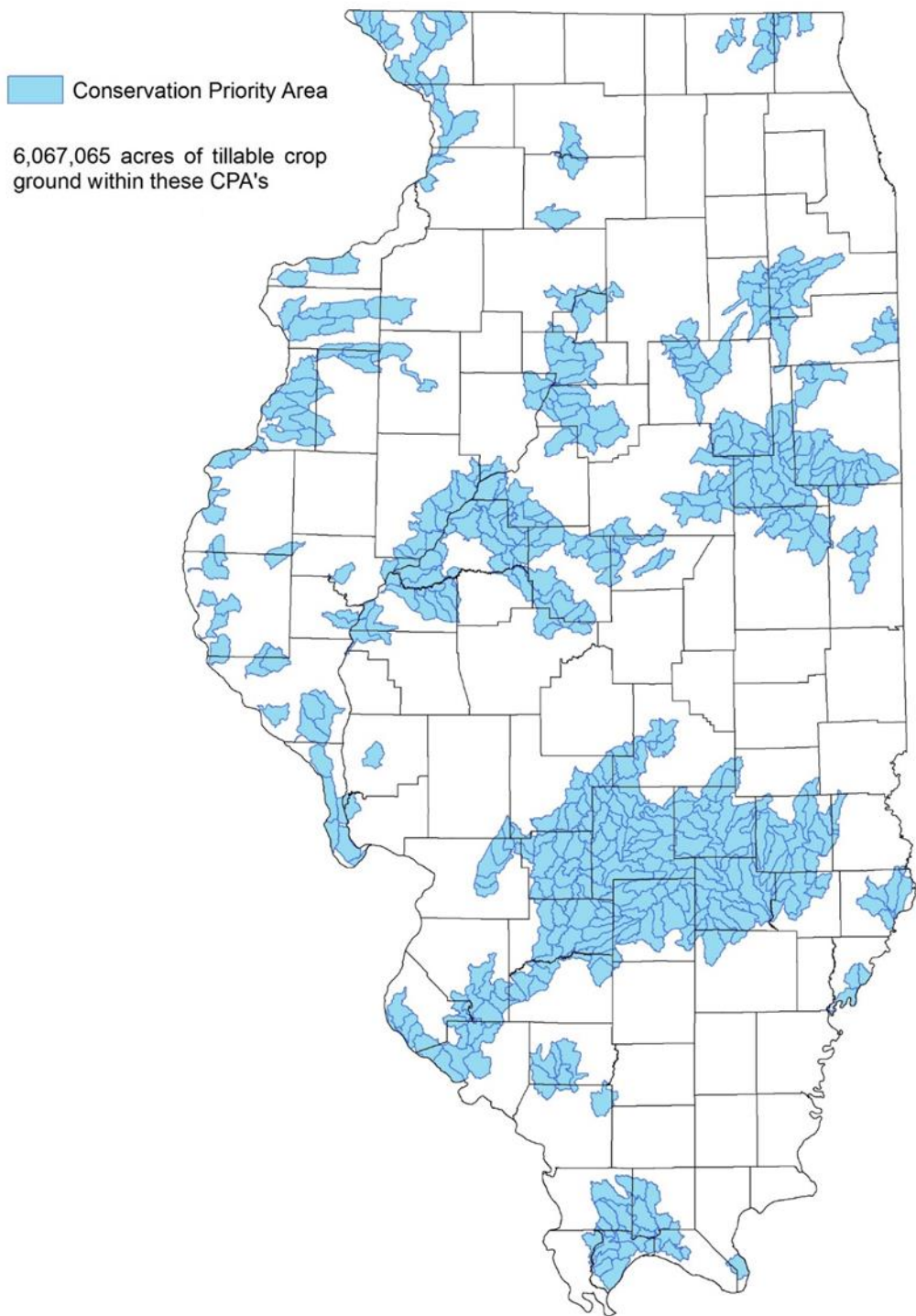


Figure 2. Conservation Reserve Program (CRP) Conservation Priority Areas (CPAs) developed and proposed to USDA