Iowa Chapter Report

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Iowa DNR Fisheries Research

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HABITAT IMPROVEMENT

<u>Catfish Creek</u>, Swiss Valley Nature Preserve (Dubuque County)
Manchester Management partnered with the Dubuque County Conservation Board for a coldwater fish habitat improvement project on Catfish Creek. The project included 305' of stream bank stabilization using sloping, rip-rap protection, and seeding as well as the installation of 24' of bankhide as overhead cover for trout.

<u>Maquoketa River</u> (Clayton County)
Manchester management using a private contractor completed trout habtiat improvement at seven sites along a half-mile segment of public fishing easement. The overall project incuded installation of 120' of bankhides, three rock vortex weirs, and 375' of bank stabilization.

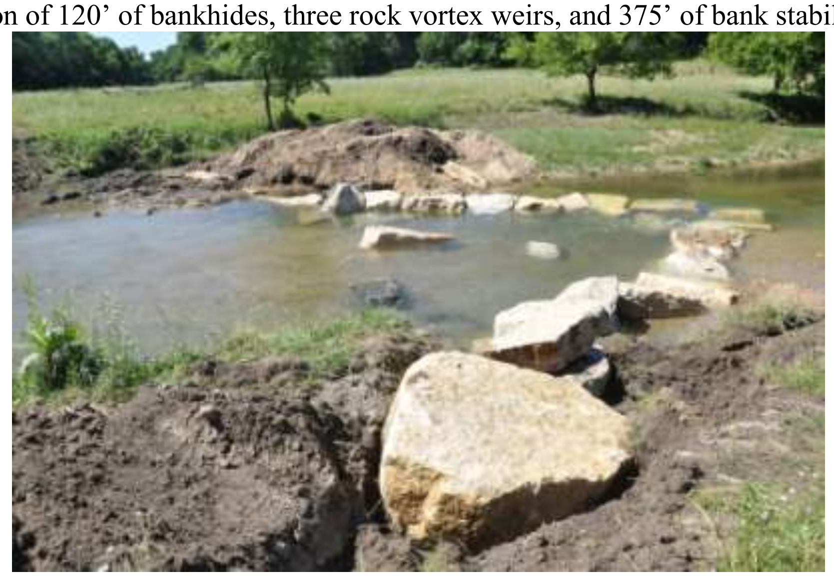


Figure 1. Upper Maquoketa River Habitat Project June 2016- Rock Weir

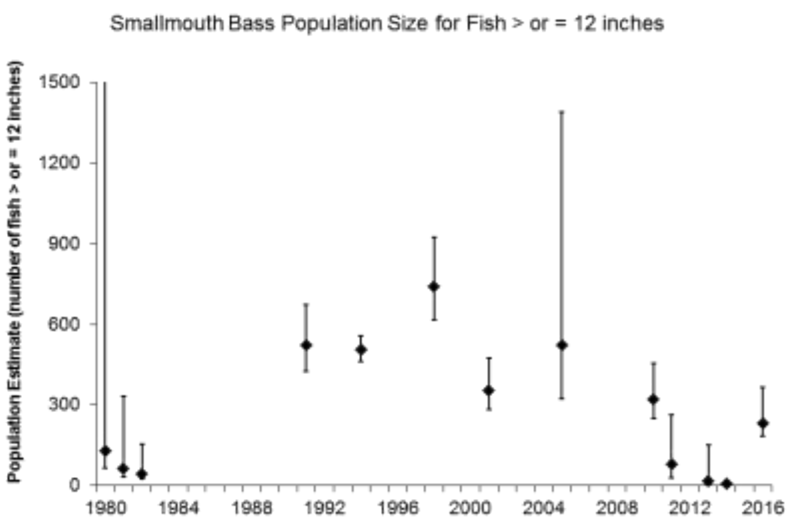
<u>Buffalo Creek</u> (Linn and Buchanan County)
Manchester Fisheries Management partnered with Linn County CCB, USFWS, Lake MacBride Fisheries, and a private consultant to address fish passage and safety issues at Coggon Dam on Buffalo Creek. This project progressed significantly during 2016 with removal of approximately the top 4.5' of dam in two stages. An additional 1.5' removal is planned along with construction of a fish passage ramp to allow fish to move across the approximately 3' grade difference that will remain between the tailwater and upstream areas. These final stages of work will allow easy passage of native aquatic species through the site while stabilizing the upstream bed and maintaining aspects attractive for fish and fishing.

Figure 2. Buffalo Creek Dam Removal Project 2016

<u>Maquoketa River</u> (Jones County)
Manchester Fisheries Management consulted with Jones County CCB on development of dam mitigation and fish passage at Mon-Maq Dam near Monticello. Preliminary design work and survey is currently underway with additional design and permitting work planned for 2017.

FISH POPULATION ASSESSMENT
Manchester fisheries management and research staff conducted a population estimate of game fish populations below the Delhi Impoundment Dam in 2016.

Figure. Population estimate for smallmouth bass (number of fish 12 inches or greater) in the Maquoketa River bass catch and release area during the period 1980 – 2016. The Delhi Dam breached during July of 2010.



FISH KILLS

Buck Creek (Delaware County) – Manchester Management was assisted by Rivers Research and DNR Environmental Services with the investigation of an 8.2-mile long fish kill on Buck Creek during July 18 and 19, 2016. Ammonia was detected in the stream, but a responsible party was not identified. The pollutant killed an estimated 41,665 fish and restitution was set at $6010.74

Brush Creek (Jackson County) – Manchester Management investigated a fish kill during September 9, 2016 that was caused by ammonia toxicity associated with manure run-off. This event killed over 3.5 miles of stream and 17522 fish were estimated as dead in the kill area with a fish restitution value set at $4044.67.

Whitewater Creek (Dubuque County) - Manchester Management investigated a fish kill on Whitewater Creek during September 19th & 20th, 2016 that was suspected to be caused by ammonia toxicity associated with manure run-off. This fish kill event impacted over 23 miles of stream and 7821 fish were estimated as dead in the kill area with a fish restitution value set at $16503.13. Ammonia was detected in the stream, but a responsible party was not identified.

Dam Mitigation and Rivers Program

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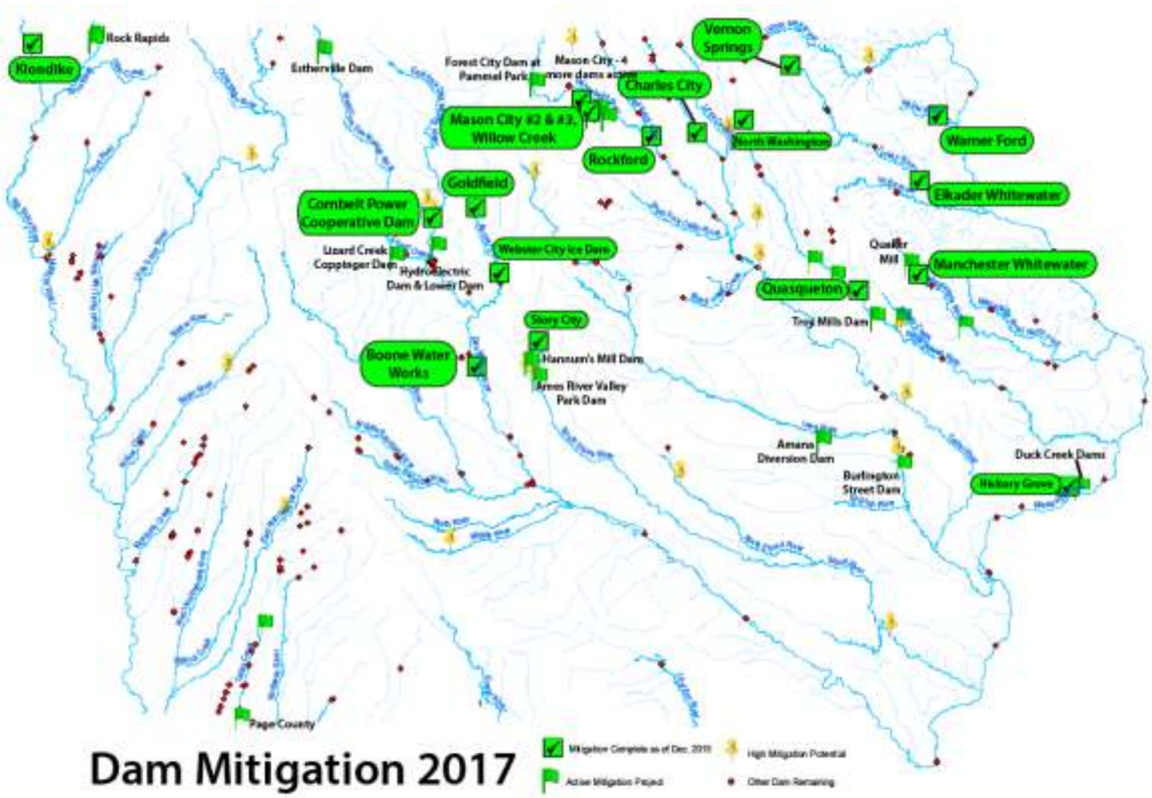
Links: http://www.iowadnr.gov/Things-to-Do/Canoeing-Kayaking/Low-Head-Dams



The Iowa DNR Dam Mitigation Program has completed 17 dam modification/removal projects and currently has 21 projects in progress.

Spirit Lake Fisheries Management Station
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Waterman Creek (O'Brien County)
Fisheries and Wildlife management staff were involved with guiding efforts to design and engineer a stream mitigation project on the Waterman Creek in O'Brien County. The Iowa DOT is developed these plans to mitigate for a stream impacts on the HWY 20 construction project. This mitigation project was accelerated to accommodate rapid HWY construction.
Onsite meetings and evaluations were conducted during 2015 and 2016 with final field review of the mitigation plans on October 5th 2015. Construction commenced during the summer of 2016. The project was completed in late fall of 2016 and consisted of bank stabilization, floodplain habitat development, in-stream habitat placement, and wetland creation. The project affected over a mile of stream.

Using Fish Habitat Assessments to Inform Conservation Goals for Prairie Streams
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Iowa's current conditions in regard to water quality are influenced by Iowa's production landscape. Iowa has one of the most altered landscapes in the world, transitioning from less than 40% of its land in row crop agriculture prior to 1940, to ~75% of acres in row crop production consistently since the 1980s. Historical records of water quality, water quantity and stream conditions exist back to the 1800s in some cases. These historical conditions provide a frame of reference regarding what was, and the National Fish Habitat Plan provides a currents assessment of the condition of Iowa's rivers and streams. Utilizing this information is necessary to appropriately frame current perspectives and discussions of what future conditions could become. Prairie restoration efforts in Iowa indicate that historic water quality conditions can be achieved today, thus the past is very insightful in this regard. Future conditions should not be solely determined by what is viewed as technologically achievable, but also what is ecologically appropriate.

River Restoration and Stream Mitigation

DNR continues to work with its partners to coordinate and improve river restoration efforts. To date, the DNR has developed a strategy, proposed a draft method for evaluating stream mitigation plans, and begun to assemble tools and techniques supporting river restoration. In addition, to make joint federal and state approval of stream mitigation projects more predictable and efficient, and to achieve long-lasting effective mitigations, the DNR has proposed modifications to Missouri's Stream Mitigation Method for use in Iowa. More information on these efforts can be found at: River Restoration

Aquatic Invasive Species (AIS) in Iowa Rivers and Streams
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The Cedar and Iowa Rivers are influenced by the zebra mussel population in Clear Lake because the outlet of Clear Lake flows into Willow Creek and then to the Winnebago, Shell Rock, Cedar, and Iowa Rivers. Low densities of veligers and individual adults have been collected from each of those rivers during past sampling but no concentrated populations have been found. The population of zebra mussels in the Spirit/Okoboji chain of lakes may impact the Little Sioux River as veligers move downstream from Lower Gar Lake through Mill Creek during high water. No monitoring of zebra mussel adults or veligers has occurred in the Little Sioux River. Lake Delhi (Delaware County) was infested with zebra mussels before the dam failed in 2010 and eliminated the former lake on the Maquoketa River. No zebra mussel adults or veligers were detected in the Maquoketa River after the Lake Delhi dam broke. A new dam was completed in 2015 to restore Lake Delhi. The lake and dam area will again be monitored to determine if zebra mussels recolonize in the lake and impact the Maquoketa River downstream of the dam.

Bighead Carp and Silver Carp have been reported in increasing numbers throughout the Mississippi and Missouri Rivers and tributaries in Iowa for over 10 years. DNR-AIS staff assisted with Asian carp collection for an Iowa State University (ISU) research project funded by DNR-AIS and FWS that began in 2013 and will continue through 2017. The project is evaluating Asian carp population characteristics, dynamics, and reproduction in the Mississippi, Des Moines, Skunk, Iowa, Cedar, Rock, and Maquoketa Rivers. Bighead, Silver, and Grass Carp reproduction had not been documented in Iowa prior to the study. Over 16,000 eggs and 72,000 age-0 fishes of unknown species were collected in 2014 and 2015 from the Cedar, Iowa, Skunk, Des Moines and Mississippi Rivers. In addition, 2,964 adult Asian carp were collected from the Mississippi, Des Moines, Skunk, and Iowa Rivers. Asian carp eggs and age-0 fish were captured in the Skunk, Iowa, and Mississippi Rivers in 2014. The highest densities of age-0 Asian carp occurred within the tributaries and immediately downstream of each confluence with the Mississippi River. Adult Silver Carp were more numerous than Bighead Carp in all locations sampled. Asian carp size and age structure and growth rates varied among sites. A complete summary of that study is provided under the Iowa State University Research section of this report.

Due to the identification of New Zealand mudsnails in Black Earth Creek in Wisconsin in 2013, seasonal employees began interviewing Iowa trout stream anglers in 2014. Natural Resources Aides for the Decorah and Manchester areas conducted 214 interviews on 17 trout streams in 2016. Sixty-two percent of those anglers knew about the AIS Law, and only 20% were familiar with New Zealand mudsnails, which are a prohibited AIS in Iowa.

Iowa Stream Biological Assessment – 2016/2017

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Iowa Department of Natural Resources, Water Quality Monitoring and Assessment Section, Stream Bioassessment Program. https://programs.iowadnr.gov/bionet/Docs/About

The Iowa Department of Natural Resources Water Quality Monitoring and Assessment Section (IDNR-WQMA) and the State Hygienic Laboratory (SHL) Limnology Section continue gathering benthic macroinvertebrate, fish assemblage and stream habitat data throughout the State to assess the biological condition of Iowa's rivers and streams in accordance with Federal Clean Water Act monitoring and reporting requirements. The bioassessment program currently has four primary focus areas: 1) status and trend monitoring; 2) reference (benchmark) biological criteria development; 3) impaired stream assessment; and 4) nutrient criteria development.

Status and Trend Monitoring

Status and trend monitoring continues according to a five-year rotational schedule established for approximately 100 warm water ***wadeable stream reference sites***. In 2016, 26 warm water wadeable stream reference sites were scheduled to be sampled; however, only 14 sites were sampled due to poor sampling conditions. In 2017, 12 sites from the FY17 contract and 29 sites from the FY18 contract are scheduled to be sampled. In the next few years, the current population of wadeable reference sites, along with other sites that have been sampled historically, will be reviewed to see if changes (additions and/or subtractions) need to be made to the wadeable reference site population.

Status and trend monitoring continues according to a five-year rotational schedule established for 16 ***coldwater stream reference and candidate reference sites*** The Iowa coldwater reference site network is sampled on a five year rotation with three or four sites sampled annually. A report on the ***coldwater stream benthic macroinvertebrate IBI (CBI)*** is available on the web at http://publications.iowa.gov/21843/.

Biological Trend Sampling
In 2016, IDNR chose nine reference sites (7 WW and 2 CW) to be sampled annually for fish, benthic macroinvertebrates and physical habitat. The nine biological trend sites will also have continuous water and air temperature data recorded. These sites will be part of EPA Region VII's Regional Monitoring Network (RMN).

Reference condition development
The focus of ***reference condition development*** work continued/continues to be sampling candidate reference sites representing ***small (headwater) warm water perennial streams***. More intensive sampling was conducted from 2013-2016 on headwater streams than occurred in the past. IDNR WQMA will soon begin the process of analyzing all the HW data and developing the IBIs for HW streams.

The IDNR Bioassessment program is also continuing to work on the development of a **non-wadeable river benthic macroinvertebrate IBI**. Benthic macroinvertebrate samples were collected in non-wadeable rivers across the state at both existing and new sites in 2012-2016. The non-wadeable BMIBI development will continue in 2017.

Impaired stream assessment
Historically intensive water quality monitoring and bioassessments were completed as part of the ***Stressor Identification (SI)*** process. Due to budgetary constraints, future SI monitoring and development is on hold.

In 2016, no fish assemblage sampling was conducted in stream segments needing ***status updates*** following ***fishkill events*** that occurred several years ago resulting in Section 303(d) impairment listings for aquatic life uses. In 2017, IDNR WIS and WQMA sections plan on sampling 4-5 streams needing status updates due to fish kills.

In 2016, five potentially biologically impaired streams had verification sampling conducted to determine their status. In 2017, three potentially biologically impaired streams will have verification sampling conducted to determine their status.

Nutrient criteria development
Sampling and analysis of benthic macroinvertebrate, fish and water quality data continues to be done to support the development and evaluation of ***nutrient criteria*** for the protection of ***stream aquatic communities***. The current work is focusing on collecting and analyzing data for nutrient stressor and response parameters including nitrogen, phosphorus, benthic and sestonic algal chlorophyll A, and diel dissolved oxygen flux.

Stream habitat indicators
Physical habitat characteristics such as stream width, depth, instream cover, and substrate composition are important environmental factors that shape Iowa's stream fish species

assemblages. The IDNR's stream biological assessment program collects physical habitat data to help interpret fish assemblage sampling results in order to assess stream health condition and the attainment status of designated aquatic life uses. In 2015, a study was completed from which quantitative habitat indicators and interpretative guidelines were developed for specific applications within the stream bioassessment program. These tools might also be useful to natural resource managers for purposes such as stream habitat improvement prioritization, goal-setting, and performance assessment. The final report is available at http://publications.iowa.gov/id/eprint/21408.

Online Fish, Benthic Macroinvertebrate, Habitat and Water Quality Data
BioNet, the Iowa bioassessment ***internet database*** **(**https://programs.iowadnr.gov/bionet/**)**, is online and it stores and provides public access to data from the IDNR's stream bioassessment program. BioNet summarizes sampling data for benthic macroinvertebrates, fish, and stream habitat from 1994 to the present and also links to water quality data collected at the sites. BioNet is also the new repository for fish sampling data collected by the Fisheries Bureau of IDNR. BioNet continues to be updated, improved and polished on a daily basis.

Interior Rivers Research
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Response of Fish and Habitat to Stream Rehabilitation Practices in Iowa
Stream habitat is a key factor influencing the health of stream fish populations. Iowa's river and stream fish resources have been greatly impacted by habitat degradation. Concerned with the continued degradation of river and stream habitats and fisheries, Iowa resource managers are interested in using stream rehabilitation practices to effectively improve these resources. This study began in 2010 to evaluate Iowa river and stream rehabilitation practices and develop management guidelines to improve river and stream habitat as well as fishing opportunities for Iowa anglers.

The first project being evaluated is the modification of the Vernon Springs Dam on the Turkey River at Cresco. The dam was converted into a series of rock arch rapids in late July 2010 to address safety and fish passage concerns. Pre-construction fish community and habitat sampling was done at three sites above the dam and two sites below. Over 3,900 game and non-game fish were marked below the dam to monitor fish movement over the new structure. Fish community and habitat sampling was also done at three sites on the Volga River to serve as control sites for the three upstream sites on the Turkey River. Post-construction sampling upstream of the project found 16 Black Redhorse, 11 Golden Redhorse, 3 Walleye, and 1 Northern Hog Sucker that moved upstream over the structure. Smallmouth Bass and Black Redhorse were sampled post-construction above the dam at sites on the Turkey River and N. Branch Turkey River where they were not found pre-construction.

Pre-project fish and habitat data were collected in 2012 and 2013 for a dam removal on the Shell Rock River in Rockford. The dam was removed in the winter of 2014 and two years of post-project sampling have been completed. Golden Redhorse and Northern Hog Sucker were collected for the first time at sites above the dam in 2014, and increasing numbers of these species were found upstream in 2015. Channel Catfish numbers also increased at sites above the former dam.

A whitewater park and habitat improvement project was completed in spring 2015 at the site of the Marion Street Dam on the Maquoketa River in Manchester. Pre-project fish and habitat sampling was done at sites upstream and downstream of the dam in 2012-2014. Over 6,600 fish of 18 species were marked downstream of the dam to monitor fish movement over the new structures. Sampling in 2015 and 2016 found 234 marked fish representing 9 species that had moved upstream over the structures. Continued monitoring of these projects and investigations of additional stream rehabilitation projects will help guide future decisions and lead to improved methods, designs, and sharing of resources to improve Iowa's river and stream fisheries.

Angler Response to Stream Rehabilitation Practices in Iowa

Interest in modifying and removing aging, low head dams on Iowa's interior rivers has increased over the past several years. This interest is driven by safety/liability concerns, deterioration of existing dams, and a desire to increase river recreation opportunities. Areas below dams are often popular fishing spots. A common concern is that dam removal or modification projects will negatively impact angling, particularly below the dam. The impact of dam removal or modification on angling has not been studied in Iowa and little information is available from other states.

A whitewater park and habitat improvement project was completed in spring 2015 at the site of the Marion Street Dam on the Maquoketa River in Manchester. The dam was removed and six structures were built to create whitewater features while also letting fish pass upstream. The project is expected to improve angler access and fish habitat at the site. A roving angler survey was started in April 2012 to collect pre-project data on angler use, catch, and harvest on the Maquoketa River upstream and downstream of the dam. Anglers were surveyed in April-October for three years before, and will be surveyed for three years after construction. During 2012-2014, total angler participation ranged from 4,232 to 6,797 angler hours per year. Smallmouth Bass, Common Carp, Walleye, Bluegill, Crappie, Suckers, and Channel Catfish were caught most often during this period. The second year of post-project monitoring began in April 2016. In 2016, total angler participation was 3,770 angler hours per year, and Smallmouth Bass, Walleye, Bluegill, and Suckers were caught most often.

Measuring the impacts of a dam modification or removal project in Iowa will provide information to help managers address angler concerns with future projects. This information may also help identify project features which benefit anglers that can be incorporated into future projects.

Evaluating Interior River Fingerling Walleye Stocking Strategies

Walleye fingerling stocking has greatly increased Iowa's interior river Walleye populations over the last 20 years. This has created an increasingly popular fishery that has brought Walleye fishing opportunities close to home for many Iowa anglers. The success of this program has also increased demand for two inch long, Mississippi River strain Walleye fingerlings. Limited hatchery space has made it difficult to consistently produce enough fingerlings of the size and genetic strain requested for the program. Providing information needed to more efficiently use our limited hatchery production, and exploring the potential of other fish culture systems to meet the demands of the river Walleye program is the focus of this study.

Available pond culture space has been a limiting factor for producing Mississippi River strain fingerling Walleye to stock in interior rivers. Recent research at the Rathbun Fish Culture Research Facility has shown promising results raising Walleye fingerlings using an alternative method, intensive fry culture. Intensively reared walleye fry are stocked into recirculating tanks and trained to eat formulated feed from day 1 post-hatch, instead of stocking them into ponds where they eat zooplankton (extensive culture). Evaluating the relative contribution of intensively reared fingerlings to interior river Walleye fisheries will determine if this production method could help further improve river Walleye fisheries.

Study sites were selected on four Iowa rivers to evaluate the contribution of intensively reared Walleye fingerlings to interior river Walleye populations. Extensively reared fingerlings were marked, hauled, and stocked alongside intensively reared fingerlings to serve as a control. Walleye fingerlings produced by this culture method are known to survive and contribute to river Walleye fisheries if river conditions are favorable. Intensively cultured Walleye fingerlings were marked with a circle freeze brand, and extensively cultured fish were marked with a bar brand. Over 61,000 marked intensively and extensively cultured walleye fingerlings were stocked in the Wapsipinicon, Maquoketa, Shell Rock and Cedar rivers in June 2016. Study sites were sampled during late-September and October to determine survival and growth of walleye fingerlings. This process will be repeated for several years. The results will help guide Walleye fingerling production and stocking methods to provide the greatest benefits for sustaining and improving Walleye fisheries in Iowa rivers.

Iowa DNR, Mississippi River Fish Research

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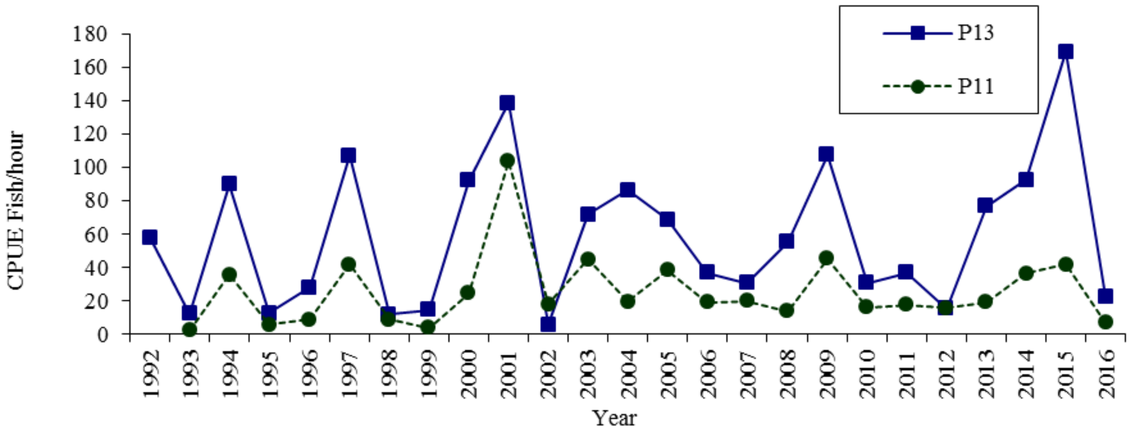
An evaluation of Walleye and Sauger populations and associated fisheries in Pools 11 and 13 of the Upper Mississippi River

This study was initiated to estimate abundance, length frequency, age structure, total mortality, and growth of Walleye and Sauger in Pools 11 and 13 of the Upper Mississippi River (UMR). Since 2004, this study has also included an evaluation of the 20–27 inch release slot harvest regulation for Walleye in Pools 12-20. This regulation was implemented in April 2004 to increase spawning stock and ultimately stabilize and increase recruitment.

Sampling for Walleye and Sauger in Pools 11 and 13 was conducted using pulsed DC electrofishing. Tailwater sampling was conducted at night in October 2015. Fall electrofishing catch rates during 2016 for age 0 Walleye and Sauger were 22.4 and 32.5 fish/hr in the Pool 13 tailwater and 6.9 and 7.4 fish/hr in Pool 11. River levels were too high for summer wingdam sampling and negatively influenced fall catch rates.

Fall tailwater electrofishing CPUE of age 0 Walleye (<10 inches) collected in Pools 11 and 13 in the UMR from 1992 to 2016.



<u>Assessment of Iowa's Shovelnose Sturgeon sport fisheries</u>

Standard sampling protocols for Shovelnose Sturgeon.

Efficiency and size selectivity of boat electrofishing, drifted trammel netting, and trawling were assessed on the Cedar River during annual Shovelnose Sturgeon sampling 2-4 May 2016. Boat electrofishing units traveled downstream occasionally varying their speed in relation to current. Pedal time was recorded for each electrofishing run. Drifted trammel nets were 100-ft in length by 6-ft deep with ½-inch Foamcore float lines and 30-lb. Leadcore lead lines. Outer wallings were constructed of number 9 multifilament nylon and were 6-ft deep with 12-in bar mesh. Inner wallings were constructed of number 139 multifilament nylon and were 8-ft deep (hobbled to 6-ft) with 2-in bar mesh. Wooden mules were attached to the ends of nets while drifting to pull them downstream and help prevent them from closing. Drifted trammel nets were set perpendicular to flow and allowed to drift downstream. Time and distance of each drift was recorded with a watch and GPS unit. Trawling was conducted with a modified (Missouri) trawl by personnel from the Missouri Department of Conservation and Southeast Missouri State University who were experts with the gear. Trawls were deployed and pulled in a downstream direction, typically for three minutes, but time was recorded for each trawl. All captured fish were enumerated and measured to the nearest 1-mm fork length (FL), weighed to the nearest gram, and tagged on a pectoral fin with an individually numbered Monel bird wing tag (Model 1000-3). Sex of each fish was recorded as female (flowing eggs or obvious distended abdomen with large black stripe), male (flowing milt), or unknown.

Mean FL of Shovelnose Sturgeon captured with drifted trammel nets was significantly larger than those captured with electrofishing or trawling, which did not differ (Figure 1; ANOVA; $F = 17.71$; $df = 2, 1{,}185$; $p < 0.0001$; Tukey). Efficiency of each gear was compared by dividing the number of Shovelnose Sturgeon captured by each gear type by the number of boat days the gear was utilized (i.e. three electrofishing boats sampling for two days = 6 boat days). Trawling crews captured on average five and 15 more Shovelnose Sturgeon per sampling day than crews drifting trammel nets or electrofishing, respectively (Table 1). The percentage of female Shovelnose Sturgeon captured in each gear was significantly different with drifted trammel nets capturing a higher percentage than electrofishing and trawling (Table 2; $\chi 2 = 13.5$; $df = 2$; $p = 0.0011$). These gear types will continue to be evaluated in future segments and this information will be used to develop standard sampling protocols for Shovelnose Sturgeon.

Table 1. Sample size, mean length (in), standard error, size range, effort, and catch per boat per day of Shovelnose Sturgeon captured via electrofishing, drifted trammel net, and modified (Missouri) trawl on the Cedar River, May 2016.

Gear	EF	Trawl	TN
N	674	225	289
Mean (in)	23.5	23.2	24.3
SE	0.136	0.150	0.095
Min (in)	12.1	14.4	16.0
Max (in)	31.6	30.6	31.6
Boat Days	4.5	1.5	2.0
Catch/day	135	150	145

Table 2. Proportion of Shovelnose Sturgeon identified as female or male/unknown sex captured via electrofishing, drifted trammel net, and modified (Missouri) trawl on the Cedar River, May 2016.

Gear	Female	Male	Unknown
Electrofishing	0.20	0.80	0.20
Trammel Net	0.31	0.69	0.31
Trawling	0.23	0.77	0.23

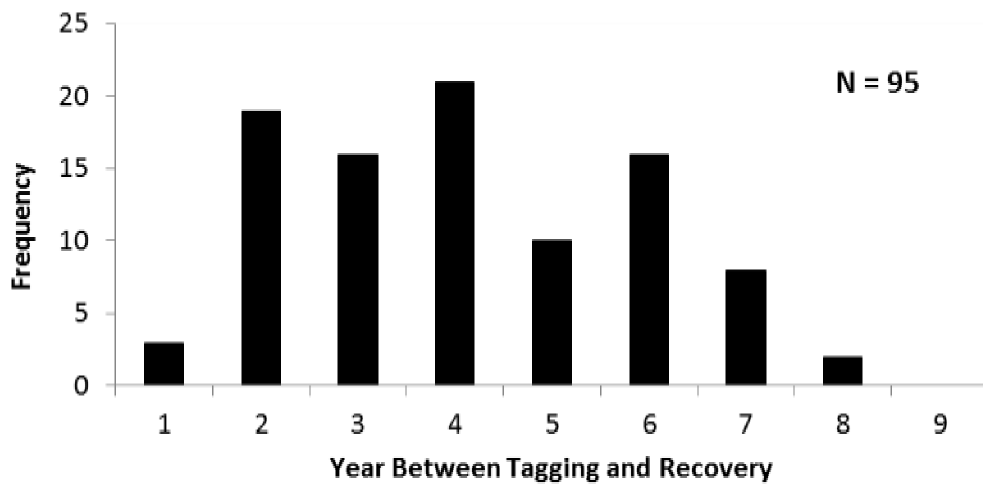
Evaluate Shovelnose Sturgeon population demographics
Shovelnose Sturgeon migrate into the Des Moines and Cedar rivers from the Mississippi River to spawn every spring and support popular recreational fisheries. Fisheries managers were concerned that inadequate commercial regulations and increased harvest on the Mississippi River may adversely affect these recreational fisheries.

Shovelnose Sturgeon were sampled with boat electrofishing on the Des Moines River, downstream of Ottumwa, IA, 25-28 April 2015 and with boat electrofishing, drifted trammel nets, and trawling on the Cedar River near Mt. Vernon, IA, 2-4 May 2016. All fish captured from these interior rivers were measured fork length (mm), weighed (g), and tagged on the leading edge of the pectoral fin with an individually numbered Monel self-piercing ear tag (Model 1000-3). Sex of each fish was recorded as female (flowing eggs or obvious distended abdomen with large black stripe), male (extruding milt), or unknown.

On the Des Moines River, 658 Shovelnose Sturgeon were collected at a mean catch rate of 122 fish/hr (SE 26.3). Mean length was 22.7-inches. Females and male/unknown sex fish comprised 11 and 89 percent of fish sampled, respectively. On the Cedar River, 674 Shovelnose Sturgeon were collected via electrofishing with a mean catch rate of 61 fish/hr (SE 6.64). Mean length of Shovelnose Sturgeon captured with electrofishing was 23.6-inches. Females, males, and unknown sex fish comprised 20, 20, 60 percent of fish sampled, respectively. Shovelnose Sturgeon mean length was larger on the Cedar River which was the opposite of what was observed in 2015 samples (ANOVA, $p < 0.0001$).

Spawning periodicity was studied at the Cedar River by measuring years between tagging and recapture for gravid females. To date, 95 gravid female Shovelnose Sturgeon have been recaptured, including 17 in 2016. Peak recoveries occurred at 2, 4, and 6 years at large indicating a two year spawning periodicity (Figure 1). However, high recoveries at year 3 indicated periodicity was likely variable.

Figure 1. Frequency distribution of years between tagging and recovery of gravid female Shovelnose Sturgeon tagged and recaptured on the Cedar River, Iowa from 2006-2016.



<u>*Evaluation of Mississippi River habitat restoration projects*</u>

Fishery response to habitat restoration
It is widely accepted among fisheries managers that availability of suitable overwintering habitat is a limiting factor for centrarchids in the Upper Mississippi River (UMR). Lock and dam construction in the 1930's greatly increased total aquatic area of the UMR and provided deep backwater areas favorable to centrarchid populations; however, sediment deposition in backwaters has reduced the quantity of deepwater lentic habitats. Recent fish telemetry studies found that centrarchids travel short distances (< 3 miles) to reach suitable overwintering backwater areas with low current velocities, water depth > 1 m, water temperatures 1-3°C warmer than the main channel, and adequate dissolved oxygen levels. As the post-impoundment UMR ages and backwater sedimentation continues, these areas will be less common and centrarchid abundance will likely decline.

The Water Resources Development Act of 1986 created the US Army Corps of Engineers' Upper Mississippi River Restoration (UMRR) Program and its two elements, the Long Term Resource Monitoring (LTRM) and Habitat Rehabilitation and Enhancement Project (HREP) elements. The Iowa Department of Natural Resources works collaboratively as part of the partnership of state and federal agencies that make up the UMRR-EMP. Creation of the HREP component provided river managers with a means for restoring river habitat and multiple HREPs have specifically focused on mitigating effects of backwater sedimentation through sediment dredging, restoration of aquatic connections between backwater and channel areas, and installing control structures that allow introduction of oxygen-rich channel water into backwaters areas during periods of hypoxia.

The Pool 12 Overwintering HREP will involve rehabilitation and enhancement of four overwintering areas in Pool 12, UMR: Kehough Slough, Stone, Sunfish, and Tippy lakes (Figure 1). Construction of Phase I, Sunfish Lake is nearing completion and construction on Phase II, Stone and Tippy lakes, is scheduled to begin in 2016. Pre-construction monitoring was initiated in 2006 to assess temporal changes in fish abundance, physical condition, and biomass at three spatial scales: 1) the individual contiguous backwater scale, 2) contiguous backwater aquatic areas scale (all backwaters within a pool), and 3) navigation pool scale (all aquatic area within a pool).

For assessment at the individual contiguous backwater scale, six lakes were initially selected for sampling: three lakes scheduled to be rehabilitated (Fishtrap, Stone, and Sunfish lakes) and three additional control lakes (Frentress, Greens and Wise lakes). During subsequent planning, Fishtrap Lake was dropped from the HREP due to zinc contamination in the lake sediments, but it was retained in our study as a control lake. During FY2016, sampling at the remaining two HREP overwintering sites, Kehough Slough and Tippy Lake, was initiated (Figure 1). Shoreline samples were collected using LTRMP fyke-netting procedures at five sites in each lake during the first week of November. Sites were initially randomly chosen and will be fixed for the duration of this study to maximize our ability to detect change due to management intervention. During FY2016, 3,453 fish from 22 species were collected in 40 net nights of effort.

Growth and mortality rate response of Bluegill was indexed using mean length at age within HREP backwaters and control backwaters. During FY2016, 925 Bluegill (i.e., ten per 1-cm length interval from each lake) were retained for age-growth analysis. In the laboratory, saggital otoliths were removed from each fish, and sex was determined through inspection of gonads. Otoliths were observed in whole view using a dissecting microscope and reflected light to determine the number of growth annuli at time of capture. Sectioned otoliths were viewed with light transmitted by fiber optic cable to validate age for fish older than age-4. Annual mortality rate was estimated from catch curve analysis on age-1 and older fish. Annual mortality estimates ranged from 55% at Frentress Lake to 68% at Wise Lake.

For assessment at the backwater contiguous aquatic areas (all backwaters within a pool) and navigation pool scales, Pool 13 will serve as a control pool to determine if observed temporal changes in fish abundance, biomass, and physical condition within Pool 12 are due to habitat management or “natural” variation. A stratified random sampling design was used to provide pool-wide estimates of fishery parameters. Backwater contiguous aquatic areas were assessed as part of the larger stratified random sampling design. Sampling sites were randomly selected within strata and sample locations are “re-selected” on an annual basis in an effort to maintain consistency between Pool 12 data and those collected in Pool 13 as part of standard LTRMP sampling. Fish community samples were collected using LTRMP electrofishing procedures at randomly selected shoreline sites during September 15-October 31. Sampling sites consisted of 200-m shoreline transects centered upon a randomly selected shoreline point identified through GIS. If randomly selected sites were deemed “inaccessible” the closest accessible alternate site was chosen from a list of randomly selected alternate site locations. Effort within strata followed that applied in Pool 13 as part of standard LTRMP monitoring: backwater contiguous shoreline (n = 8), impounded shoreline (n = 4), main channel border unstructured (n = 4), main channel border wingdam (n = 3), and side channel border (n = 2). During Segment 20, 3,133 fish of 45 species were collected from Pool 12 during pool-wide electrofishing efforts.

Movement of fish in response to habitat restoration
In order to study centrarchid winter habitat use and spring dispersal patterns, fifty crappie spp. were transmittered in Kehough Lake starting in mid-November 2015 after water temperatures fell

below 10°C. Advance Telemetry Systems (ATS) Model F2210 radio transmitters were attached to dorsal spines using stainless steel suture.

During open water periods, GPS coordinates, dissolved oxygen, temperature, depth, secchi, and flow were measured at each fish location. During winter, GPS coordinates were recorded at each fish location and four fixed water quality sites were monitored for surface and bottom temperature and dissolved oxygen, secchi, flow, and ice and snow depths.

Fish were tracked intensively at Kehough Slough starting on 9 December 2015 through 22 April 2016 when it was determined that all fish had expired. Higher than normal river levels persisted throughout the study period and record flooding occurred in late-December that inundated the entire Kehough Slough complex creating low temperatures and excessive flows throughout overwintering areas. The stress of prolonged exposure to low temperatures and flow during this period likely caused the complete mortality of study fish. Fifty crappies were tagged in Kehough during November 2016 and tracking is ongoing.

This research will yield a greater understanding of how many, and at what interval, overwintering areas are required in a pool to maintain healthy centrarchid populations. In addition, this information will aid river managers in setting quantitative objectives for overwintering habitat restoration needs at the pool and ultimately reach scale. We will also address landscape pattern themes by looking at how landscape features around overwintering backwaters affect the utilization distribution of centrarchids, which will also aid in future project designs and site selections. We hope to broaden our understanding of the habitat requirements and preferences of centrarchids not only during critical winter months, but year-round. Data obtained during this study will also be used for future post-construction assessments of habitat use changes at Kehough Slough and Stone and Tippy lakes.

Bellevue LTRMP station

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Pool 13 - Fish Stuff:

Aside from working in high water levels throughout all sampling periods (we were forced picked a lot of alternate sites), all 300 samples were completed on time. We collected a total of 18,226 fish in 2016 and the number of species observed this year was 57.

We collected no new species of record for the year, although we did collected specimens of black buffalo, brown bullhead, silver redhorse, pallid shiner, silver lamprey, weed shiner, and western sand darter. The five most numerically abundant species collected in 2016 were mimic shiner, bluegill, emerald shiner, pumpkinseed, and river shiner. Species collected that have endangered or threatened status in Iowa included one western sand darter and 118 weed shiners. No bighead, grass, or silver carp were observed or collected within the pool in 2016.

The following are a few examples of long-term abundance trends of selected Pool 13 fishes from 1993-2016.

Channel catfish

Catch rates of channel catfish in our small hoop nets were poor this year – well below the twenty-three year median. Unusually high water levels throughout the sampling year may have been a contributing factor to the low catches of channel catfish in hoop nets this year. Channel catfish catches in 2009-2012 were also below average following excellent collections from 2006-2008.

Like last year, channel catfish had an another average spawning season in 2016 relative to the larger year classes of 2005, 2006, and 2010-2012. Tailwater trawling in Pool 13 for age-0 channel catfish (<4 inches) yielded 2.3 fish/haul compared to the twenty-three year median of 2.7 fish/haul. However, the proportion of healthy, catchable-sized catfish (PSD and *Wr*) has remained fairly good over the last two decades. Although size structure of fishes over 16" has been highly variable over time, the trend appears to be independent of body condition. That said, anglers and commercial harvesters should have another decent year of catfishing in 2017 in Pool 13.

Largemouth bass
The abundance and condition of largemouth bass populations in Pool 13 were once again very solid in 2016. The backwater day electrofishing catch rate of largemouth in 2016 (12.0 fish/15 min.) was slightly above the 23-year median catch, with peak catch rates occurring in 2011 and 2012. Abundance for the species has been somewhat variable over time, but has shown a steady increase over the last 23 years in Pool 13 with a relatively low mortality rate in 2016 (i.e., consistent year-class strength with few weak age classes in the last six years: see age-frequency graphic).

Trends in mean relative weight (*Wr*; fall 2000-2016) for largemouth bass in Pool 13 are graphed below. Mean *Wr* are calculated by Gabelhouse size categories of stock to quality, quality to preferred, and preferred to memorable lengths. There was steady increase in mean *Wr* for all three size categories of largemouth bass compared to last year. Relative weight values continue to be well within accepted ranges for healthy bass populations and there appears to be no apparent detrimental effects of largemouth bass virus for this neck of the river. Recreational and tournament bass anglers here have been very pleased with the numbers of 2-3 pound fish for many years now.

Additionally, fisheries staff collected, aged (otoliths) and sexed (gonads) 246 largemouth bass from regular LTRM sampling in the fall (period 3) of 2016 to gain some insight of age, growth, and mortality of the species in Pool 13. We collected an additional 142 fish that were randomly assigned ages and sexes from our aged and sexed fish. The majority of these unaged fish were assigned as age-0. Sex ratios of the empirical data were approximately 50/50 and unsexed fish were randomly assigned sexes at that ratio. Age-0 largemouth bass were fully recruited to electrofishing by the fall age-0.

We did not find any size specific differences in mean *Wr* between sexes either, (Gabelhouse categorical, paired *t*-tests; $\alpha = 0.05$) which was a little surprising. Stock-quality and greater sized males were no more fit than their counterpart females, and I really thought there would be differences in Q-P and P-M fish. Though age 0-2 male largemouth bass tended to be slightly longer than females of those same ages, we found no significant differences among length at age between the sexes (paired *t*-tests; $\alpha = 0.05$). On average, ages 3-5 female largemouth were longer than their counterpart males, but these difference in length-at-age were also not significant. Since we found no differences in length at age or *Wr* between sexes, both sexes (and a few fish of indeterminate sex) were combined for mean length at age:

The un-weighted catch-curve regression analysis of ages 0-3 resulted in an estimate of 62% total annual mortality. I know it's a bit of a no-no to do, but the coefficient of determination was very strong ($r^2 = 0.9506$) for ages 0-7 and this resulted in a mortality estimate of 51%. The growth curve estimate of theoretical maximum length of largemouth bass (von Bertalanffy - sexes combined; dashed, horizontal line in graph below) is roughly 436 mm or 17.1 inches. The upper and lower 95% confidence limits at age are a little wide (the product of the variation in length at age between the sexes), but for this year I feel pretty good about that estimate considering we collected very few preferred-length (and greater) fish.

From 1993-2016 here in Pool 13, we've sampled relatively few bass that have attained 431 and 457 mm (RSD17=4; RSD18=2, respectively), and less than .05% of stock length or greater fish have been $\geq$ 20". Of the 5,762 stock-length and better largemouth we've collected in that span, a total of three fish that have been twenty inches or more, with the largest specimen being a 20.4 incher in 1995. The theoretical maximum and the upper 95 CI of 462 mm (18.2 inches) are somewhat light considering we have collected fish longer than that. Again, this is was function of collecting relatively few preferred-length fish this fall. In hindsight, I wish we would have spent an additional day shocking to collect a few more older fish that we know are out there...

Shovelnose sturgeon

Tailwater trawling catch rates were a little better than the long-term median for shovelnose in 2016. Trawl yields for shovelnose sturgeon averaged 3.2 fish/haul, and this slightly higher the twenty-four year median of 2.5 fish/haul. Like our hoop netting catches, high river levels throughout the 2016 sampling season may have had some adverse effect on the catchability of sturgeon in our fixed-site, tailwater trawling efforts.

Collections of age-0 fish ($\leq$ 9 inches) attributed to 16% of the total sturgeon catch in our trawls in 2016. We have continued to see excellent recruitment of the strong 2011 year class over the last five years, although the spawns were on the lighter side from 2012-2014. Naturally, the annual recruitment of the 2011 year-class has been driving the increase of fish $\geq$ 15 over the last four years, and fish $\geq$ 25 inches contributed to 9% of the total catch in 2016.

Size structure trends (RSD 15, 20, and 25) in shovelnose sturgeon for the years 1993-2016 are as follows: (Note – Size structure for 1993 and 2006-2008 should be viewed with caution, because of small sample size: n < 30).

Pool 13 – Water Quality Stuff:

Standardized water quality monitoring was conducted at randomly selected sampling sites in Pool 13 and at fixed-site sampling in the mainstem and tributaries of Pools 12, 13, and 14 in 2016. Over 12,300 water quality observations were recorded using 20 parameters during this span. Annual long-term trend data from stratified random sampling collections in backwaters, impoundment, main channel, and side channels on Pool 13 from 1994-2016 (all periods; i.e., spring, summer, fall, and winter) indicates variable but flat trends of suspended solids, total nitrogen (one exception - winter), total phosphorus, and turbidity. The long-term trend of mean total nitrogen in all strata, (and especially the backwater stratum in winter) had been increasing over time from 2008-2011. Backwater mean total nitrogen peaked in 2011 and then in 2012 dramatically dropped to an all-time low. In 2016, total nitrogen in winter backwater samples spiked to a twenty-two year high. This large jump in total nitrogen may be partially attributed to a relatively mild winter. Area precipitation that is normally bound as snow in the winter months, fell as rain. In turn, watershed run-off to Upper Mississippi River tributaries was unusually high, and Pool 13 river levels were atypically three to four feet higher than normal during these winter months.

Pool 13 - Vegetation Stuff:

Standardized aquatic vegetation monitoring was conducted at 450 sites randomly distributed within Pool 13 during 2016. Sixteen species of submersed vegetation and two species of rooted floating vegetation were sampled in 2016. No new species of aquatic vegetation were observed in 2016. Of the submersed plant species observed in Pool 13, six of the more prevalent species (coontail, curly-leaf pondweed, elodea, myriophyllum, sago pondweed, and vallsineria) were chosen to examine long-term abundance trends (abundance index) by stratum from 1998-2015. Abundance indices essentially measure the quantity of submersed species using presence or absence and the plant density rating in a given year. Coontail exhibited a long-term increase over time in all strata, but has been decreasing since 2011. Curly-leaf pondweed, Elodea and Myriophyllum abundance has been highly variable in backwaters and in the impounded portion of Pool 13. Trends for sago pondweed showed low variability in abundance from 1998-2006 in all strata, but has been somewhat variable since. Vallisneria has steadily increased abundance in the impounded portion of Pool 13 since 2002, but has been decreasing in abundance 2013.

Also a summation of all submerged aquatic vegetation (SAV; pooled by year; abundance index) was examined, to get a general sense for broader vegetation trends in Pool 13 over the last eighteen years. The overall trend in SAV has shown an increase in abundance from 2000-2012, with the main increase in SAV occurring from 2004-2012. Recently SAV has curtailed since peaking in 2012. Although the abundance of SAV in backwaters and the impounded portion of Pool 13 have been somewhat variable over the last five years, abundances of SAV in the main channel borders and side channels have decreased substantially since 2012.

Pool 12 HREP Stuff:
In late October and early November 2016, the Bellevue LTRM and Fisheries Research stations completed an eleventh year of electrofishing and fyke netting for the Pool 12 HREP fisheries evaluation. All data from 2016 has been entered and verified. We collected 4,397 fish of 28 species from the fyke netting segment of the study and 2,214 fish of 50 species from the electrofishing segment. One pallid shiner was documented from the pool-wide electrofishing segment, and one redfin (grass) pickerel was documented from the fyke netting segment. Nine hundred twenty-two bluegill were retained from the eight backwater fyke netting locations for aging and sexing in 2016, and we completed otolith extraction and sexing of bluegills in mid-November. Data from aged bluegill were processed through a SAS script that randomly assigns ages to the unaged bluegill, so that we can obtain accurate age frequencies and mortality estimates for eight backwater lakes in 2016. We will be focusing on changes in the abundance, size structure, and condition in centrarchids among HREP backwaters in Pool 12 versus non-HREP Pool 12 backwaters (pre- versus post-HREP) with Pool 13 data serving as an overall point of control (a control for natural variation).