ILLINOIS CHAPTER AMERICAN FISHERIES SOCIETY

2016 ILLINOIS REPORT

TO THE

NORTH CENTRAL DIVISION AFS

RIVERS AND STREAMS TECHNICAL COMMITTEE

Respectfully submitted

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ECOLOGY

Life-history expression of three popular sportfish from three distinct habitats in the Illinois River Watershed

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Understanding how a fish's environment affects life-history expression throughout its geographic range is important for effectively managing and conserving important resources. Largemouth bass, black crappie, and bluegill are popular sportfish in the Midwest, making their management and conservation a priority for many natural resource agencies. During Spring 2015, we collected largemouth bass, black crappie, and bluegill from three distinct habitats in the Illinois River Watershed (the Upper Illinois River/Lower Des Plaines River, LaGrange reach of the Lower Illinois River, and The Nature Conservancy's Emiquon Preserve, a large restored disconnected floodplain backwater) to better understand the effect of environmental differences on sportfish life-history expression. These habitats vary in many aspects, including location, contaminant load, bathymetry, water turbidity, and macrophyte abundance. We weighed and measured fishes, categorized visible parasite presence or absence, and extracted otoliths (to estimate fish age), gonads (to determine sex, estimate fecundity, and calculate GSI), and livers (to calculate HSI). Many life-history traits differed among habitats, though the results were often sex- and species-specific. Environmental factors appear to affect fish life-history expression, but more research is needed on additional factors involved (e.g., biotic interactions) and the mechanisms of effect.

Population Dynamics of Ancient Sport Fishes in the Middle Mississippi River

Edward F Culver, Illinois Natural History Survey

As part of the Long-Term Survey and Assessment of Large-River Fishes in Illinois, we have examined potential monitoring designs for ancient sport fishes (e.g. Shovelnose Sturgeon, Paddlefish) as well as main-channel fishes (e.g. Blue Catfish). We examined different combinations of two-, three-, and five-inch square mesh gill nets. Presently, we have collected data from 575 Shovelnose Sturgeon, including length and weight measurements as well as pectoral fin ray samples for aging analysis. Preliminary analysis of the catch per net-night data for the last three sampling seasons shows that Shovelnose Sturgeon CPUE in two-inch mesh gill nets was consistently the highest of the three mesh sizes. The mean length of sturgeon collected across all sampling types for the last three sampling seasons was 597mm. Age analysis of Shovelnose Sturgeon revealed age ranges between three and 22 years. The average age of fish collected was similar across the three sampling seasons. Additional analysis will be conducted to compare the population dynamics of our study to previous studies conducted prior to the closure of commercial fishing for Shovelnose Sturgeon in the Middle Mississippi River. Further study is required to determine more long-term population dynamics of these fishes.

Seasonal Habitat Use and Fine-Scale Movements of Channel Catfish in the Lower Wabash River

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Channel Catfish (Ictalurus punctatus) are one of the most sought after commercial and sport fish species throughout the Mississippi River Basin. Understanding seasonal habitat use and movement behavior is essential to properly manage Channel Catfish in lotic systems. Since September 2014, we tagged 28 Channel Catfish with acoustic transmitters within a 16-km reach of the lower Wabash River. To locate fish we conducted seasonal 24-hour active tracking supplemented with site specific tracking. Habitat parameters were recorded at each fish location to assess usage. Of the 28 tagged fish, three individuals have been harvested and 16 individuals (59%) have been located at least once for a total of 420 observations. All Channel Catfish were found within a 3-km reach of the 16-km study site with the majority of fish locations occurring along rip rap banks. Other habitats occupied included clay banks, sand bars, log jams, tributary mouths, backwater areas, and the main channel. Across all four seasons, distance moved per hour ranged from 0 – 486 m and the minimum area occupied ranged from 238 – 90,993 m2. The mean distance moved per hour was significantly higher during winter compared to spring and summer. Nocturnal (sunset-sunrise) mean hourly movements were greater than diurnal (sunrise-sunset) movements with nocturnal movements being greatest during the winter. Mean hourly movements increased with decreasing temperature. Assessing seasonal movement patterns and habitat usage will help managers determine at which scale these fish should be managed to maintain a sustainable, healthy, and economically productive fishery.

Population status and potential impacts of harvest regulations on three exploited species of Catfish in the Wabash River, IL

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Catfish (Ictaluridae) are both commercially and recreationally important in North America. Catfish account for the majority of harvest by weight within many Midwestern states including Illinois and Indiana. The Wabash River supports a substantial commercial and recreational fishery for three species of catfish: Channel Catfish (Ictalurus punctatus), Flathead Catfish (Pylodictis olivaris), and Blue Catfish (Ictalurus furcatus). It is imperative to understand the dynamics of these riverine fish under various levels of fishing exploitation in order to maintain sustainable levels of harvest of these species. This study characterizes the population demographics of three exploited species of catfish and the effects of harvest regulations within the Wabash River. Catfish were collected throughout the lower 322-km of the Wabash River from 2014-2015. A multiple-gear approach was used to sample for Catfish in order to accurately describe the demographics of the populations. A total of 1,110 catfish were collected comprising of 467 Channel catfish, 568 Flathead catfish, and 75 Blue catfish. Lengths for Blue catfish were significantly larger ($P < 0.001$) when compared to Flathead catfish and Channel catfish. Additionally, length frequency distributions differed across the three different species and gear types ($P < 0.05$). Condition as measured by relative weight varied between species and gear

types ($P < 0.05$). Blue Catfish, Channel Catfish, and Flathead Catfish showed significantly different age structure ($P < 0.001$). Total annual mortality and growth were significantly different between species and year ($P < 0.05$).This study will provide updated base-line catfish population information and provide insight for future regulation implementation for the Wabash River.

The impact of elevated carbon dioxide (CO2) on alarm cue behaviors in Fathead Minnows

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The spread of invasive species poses a serious threat to aquatic ecosystems. Previous research has shown that elevated CO2 impairs fish movement, thus making it a potentially powerful tool to block further movement of invasive fishes. However, at present, there are unknowns that need to be addressed prior to deploying CO2 barriers, such as impacts to non-target taxa. Recent work in the marine environment suggests that increased CO2 levels due to climate change can negatively affect a fish's ability to detect predators, home to natal environments, and perform aerobically; thus, elevated CO2 may have equally negative impacts on freshwater communities, an area that remains understudied. The objective of our study was to quantify the impacts of elevated CO2 on Fathead Minnow (Pimephales promelas) alarm pheromone behaviors. Fathead Minnow behaviors associated with their response to conspecific alarm pheromones were significantly impaired following exposure to elevated CO2 levels for at least 96 hours. Behaviors to alarm pheromones did not completely re-establish after 15 days of returning fish to ambient CO2 levels. Potential impacts to non-target fishes following CO2 exposure in both short- and long-term are discussed further.

Hydrodynamic function of the spiny dorsal fin of bluegill sunfish

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The spiny portion of the dorsal fin in Centrarchids is a nuisance to anglers, but why is it important for fish? In growing fish this portion of the fin is a potential deterrent to gape limited predators. However, one single spine would probably be sufficient to deter a predator. In spite of this, the spiny dorsal fin in bluegill sunfish has a larger area than the soft dorsal fin, which suggests additional hydrodynamic functions. Locally caught bluegill sunfish were brought to the lab and swam in a flow tank at 1BL.s-1 in the presence or absence of streamwise turbulence. High speed video was used to investigate the kinematics of fish swimming in three different conditions: with the fin intact, after the injection of a muscle relaxant, or an afferent nerve blocker. In control conditions, the spiny dorsal fin is normally collapsed with no turbulence, but becomes erected in the presence of turbulence to aid in recovery when fish loses its heading in the flow. Fish injected with the muscle relaxant are unable to raise their spiny dorsal fin as expected. Fish injected with the afferent nerve blocker also fail to deploy the spiny dorsal fin in response to perturbations. When exposed to turbulent conditions, the fish most affected were the fish without sensory information, followed by the fish with no muscle control of the spiny dorsal fin, indicating that the absence of a functional spiny dorsal fin decreases stability.

Genetic population structure and diversity of adult channel and blue catfish in the Wabash and Ohio Rivers

V. Alex Sotola, Aaron Schrey, Eric Bollinger, Les Frankland, Gregory W. Whitledge, Robert E. Colombo, Eastern Illinois University

For sportfishes in large rivers, little information is currently available regarding their genetic population structure and diversity which can be vital to continuing the sustainable exploitation of these fisheries. In the Midwest, channel and blue catfish are two of the most important commercial and recreational fisheries; therefore, understanding and assessing their genetic population structure and diversity should be of utmost importance for managers. We screened microsatellite loci to assess the genetic population structure and diversity of channel catfish from four sites on the Wabash River and two sites on the Ohio River. We also screened blue catfish from two sites on the Wabash River and one site on the Ohio River. We characterized the genetic population structure and diversity for both species. Of note, there is a lock and dam between two of the Ohio River sites. Heterozygosity levels for channel and blue catfish ranged from 0.517 to 0.602 and 0.446 to 0.557, respectively. Inbreeding coefficients (FIS) showed some signs of inbreeding and outbreeding for both species (channel catfish range: -0.057 to 0.216; blue catfish range: -0.147 to -0.055). There was a significant positive relationship between genetic differentiation (G”ST) and river distance (Pearson’s R=0.8138, P=0.0002) for channel catfish, but this relationship was not significant for blue catfish (Pearson’s R=-0.3653, P=0.7619). Dendrograms and PCA plots show strong defined structure for channel catfish, but there is no apparent structure for blue catfish. The presence of genetic differentiation may provide vital information for managing these commercially and recreationally exploited species.

Examining the effects of low-head dams on river ecosystems: from habitat quality to population genetics

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Artificial impoundments such as dams are extremely prevalent throughout the Midwest, and have been shown to decrease hydrologic connectivity and disrupt the natural flow regime of river systems. These physical changes can alter habitat types and precipitate a shift from lotic to lentic habitats. Environmental variation influences fish movement and dispersal, leading to changes in fish assemblages over time. We semiannually assessed habitat quality and fish assemblages at sites above and below two low-head dams on two rivers in east-central Illinois to investigate the impacts of these dams on the ecosystem. Our twelve sites included two below each dam, two sites in the pool above each dam, and two sites upriver of each dam. Additionally, we analyzed microsatellites of Longear Sunfish (Lepomis megalotis) and Bluntnose Minnow (Pimephales notatus) to evaluate genetic structuring of these species as a result of the dams. Habitat quality was lowest in the pool sites and highest in upriver sites ($p<0.05$), suggesting poorer habitat immediately above the dams. Fish habitat guilds differed among study sites, with riffle specialists preferring upriver habitats to pool habitats ($p<0.05$). Genetic analyses revealed weak genetic differentiation in Longear Sunfish among sites. Bluntnose Minnow showed genetic

differentiation between upriver sites in the North Fork and all sites in the Vermilion River, indicating a possible effect of distance ($p<0.0005$) and suggesting the presence of two genetically distinct populations. Overall, data indicate the presence of these dams influences habitat type and fish assemblages but does not contribute to genetic differentiation in these species.

Population Characteristics, Connectivity and Recruitment Sources of Spotted Bass in Southern Illinois Streams

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Naturally occurring chemical markers, such as trace elements and stable isotopes, within calcified structures of fishes have proven useful for determining environmental history and natal origin of fishes. Differences in the chemical signatures of tributaries within lotic networks are reflected within structures such as otoliths, fin rays, and spines. In this study, we are using fin ray microchemistry to determine environmental history and population characteristics of stream-dwelling spotted bass in southern Illinois. Fin rays are being used as a non-lethal alternative to otoliths due to the limited distribution and relatively small population size of spotted bass in Illinois waters. Spatial differences in water chemistry were identified within the range of spotted bass in southern Illinois to detect where movements between chemically distinct environments may occur. One-way Analysis of Variance followed by Tukey's Honesty Significant Differences Tests was conducted to test for differences in water chemistry parameters among sites. In 2014, spotted bass were collected from southern Illinois streams during IDNR electrofishing surveys, as well as by seining, and angling. In 2015, spotted bass were collected from the Ohio River in addition to several tributaries to allow for comparison of population characteristics between these habitats. All fish were collected by electrofishing in 2015 to prevent gear bias. Fish were promptly released upon obtaining a total length and the left leading pectoral and pelvic fin rays. Fin rays from each fish were mounted in epoxy molds and a thin transect was cut from each to be used for age estimation and trace element (Strontium/Calcium and Barium/Calcium ratios) analysis. Analysis of fin ray chemistry data for fish collected in 2014 indicated that both Sr/Ca and Ba/Ca were needed to reconstruct environmental history of individual fish. Age estimates derived from sectioned fin rays are being used to compare population age composition, growth characteristics, and mortality rates in the Ohio River and its tributaries in southern Illinois.

Effects of 17β estradiol in the metabolism of sunfish species

Neeta Parajulee Karki, Robert Colombo, Karen Gaines, Anabela Maia, Eastern Illinois University

Fish natural habitats are getting increasingly contaminated with various estrogenic compounds, including 17β estradiol (E2). E2 is known to cause adverse effects on the reproductive system of male fish; however the effects of E2 on other aspects of fish metabolism are not well documented and are likely to vary depending on the levels of stress the fish is subjected to. The objective of this study is to evaluate the effects of varying concentrations of E2 exposure on the basal and stressed metabolic rate of sunfish species. There will be two treatments (E2

concentration 40 and 80 ng/l) and one control group (no E2). The experiment is ongoing in a small mesocosm setup to mimic natural conditions while controlling as many variables as possible, and we will initiate E2 exposure soon. Basal and maximum aerobic scopes have been measured using close respirometry at the beginning of the experiment and will also be measured at the end of the experiment. The duration of the basal metabolic trials was 30 minutes under resting condition, whereas for chasing trails, it was 30 minutes after intensive chasing for 5 minutes. Preliminary results showed an increase in the oxygen consumption when sunfish were subjected to stress by chasing. The mass corrected mean oxygen consumption during basal metabolism and maximum metabolic scope were 205.3 mgO2Kg-1.h-1 and 243.1 mgO2Kg-1.h-1 respectively. This research will help to understand the role of varying concentration of E2 compounds on the metabolism of sunfishes.

A Comparison of Fish Communities in Contiguous Backwater and Vegetated Impounded Areas of Pool 19, Upper Mississippi River

Eli G. Lampo, James T. Lamer, Brent Knights, James Larson, and Jon Vallazza, Western Illinois University

Sedimentation in the impoundment behind a high-head dam (~10m; Lock and Dam 19) on the Upper Mississippi River near Keokuk, IA created a unique shallow-water ecosystem dominated by floating-leaf and submersed aquatic vegetation. The importance of these post-impoundment, vegetated areas for fish is not well understood. To increase our understanding, we compared the community structure, composition, and size structure of fish between these areas and contiguous backwaters in Pool 19. We sampled 180 randomly stratified sites over four, 6-week periods from May 19th- Oct 31st, 2014. We fished paired sets of tandem fyke (1/4 in. diameter mesh) and mini-fyke nets (1/8 in. diameter mesh) with standardized methods. We sampled 63,503 fish representing 64 species (48,879 fishes and 50 species from impounded sites and 14,624 fishes and 55 species from contiguous backwater sites). Species composition and structure were greatest in the impounded areas. These results suggest that as sediment continues to accumulate in Pool 19, the resultant aquatic vegetation and associated habitat for centrarchids, catastomids, and cyprinids will expand.

Using Otolith Analysis and Microchemistry to Estimate Growth and Identify Recruitment Sources of Ohio River Sauger

Alex Loubere, Gregory Whitledge, Neil Rude, Devon Oliver, Southern Illinois University

Sauger are a recreationally important species in the Ohio River basin and population assessment and monitoring is needed in order to provide the most accurate and useful management recommendations for state and federal agencies to maintain the integrity of the fishery. The objectives of this study are to use stable isotope and trace element analyses of otoliths to identify principal recruitment sources and inter-river movement patterns of Ohio River sauger and to compare body condition and growth and mortality rates among pools in the lower Ohio River. Water data collected over several years indicate significant differences in chemistry between the Ohio River and its tributaries. This will allow us to distinguish individuals that originated in the

Ohio River from those of tributary origin. Sauger were collected from the lower six pools of the Ohio River during November and December of 2014 and 2015, measured for length and weight, and their sagittal otoliths extracted for ageing and chemical analyses. Age data were used to estimate growth and mortality rates for each pool. Mean relative weight was also compared among pools. Preliminary results indicated that mean Wr differed among the sampled pools. Identification of the principal sources of sauger recruitment to the fishery in each of the lower Ohio River navigation pools will facilitate conservation of important natal habitats for this species and contribute to assessment of the most appropriate spatial scale for managing sauger stocks.

The evaluation of a cost-effective, digital approach to estimate fecundity in freshwater fishes

Rich Pendleton, Andrew Casper, Jason DeBoer, Andrea Fritts,Mark Fritts, Nikolai Klibansky, Levi Solomon, T.D. VanMiddlesworth, Illinois Natural History Survey

Determining the basic life-history of organisms enhances our ecological understanding and ability to conserve or manage species. However, oftentimes the resources and time needed to document expression of life-history traits can hinder our ability to understand the ecology of a species. Studies of species reproductive traits, such as fecundity, inform researchers and managers of the reproductive potential of a species and offer insight into population dynamics. However, traditional gravimetric methods of estimating fecundity in fishes can be costly and laborious. Using methodology developed for marine fishes, we evaluate a cost-effective, digital approach (i.e. auto-diametric) to estimate fecundity using free ImageJ software to determine the validity and accuracy of auto-diametric estimates relative to gravimetric estimates within freshwater systems. We collected three freshwater fishes within an environmentally heterogeneous watershed to determine if estimation methodology (auto-diametric vs. gravimetric) is influenced by species, size of individual, or location. Strong correlations between methods existed for medium- to large-sized bluegill and largemouth bass, however, little to no correlation existed between the methods for black crappie. Location influenced the strength of the relationship between counting methods, but was predominately an artifact of the size of individuals collected within each location. Currently, auto-diametric methodology provides a quicker and relatively accurate way to estimate fecundity for bluegill and largemouth bass, yet refinements must be made to account for smaller individuals and potential differences in ovary physiology and/or egg development among species.

Habitat selection by non-game fish species in a large river

Jordan Pesik, Cassi Carpenter, Evan Boone, Tim Edison, Leslie Frankland, Robert Colombo, Eastern Illinois University

Since only a few sport-fish species occupy the majority of commercial, recreational and fisheries research interests, most studies have focused on understanding the influence of habitat on distribution patterns of these select species. However, little study has entertained habitat preferences of non-game fish in large rivers. We were interested in evaluating the influence of

microhabitat features and water conditions on the distribution of several riverine fishes. The Wabash River is the twelfth longest river in the contiguous United States and the longest unimpounded river (lower 622km unimpounded) East of the Mississippi River, which provides a unique system for study due to its unregulated flow regime and intact floodplain. Data was collected as part of a long-term electrofishing river monitoring project on the Wabash River. Preliminary results indicate Shorthead Redhorse (Moxostoma macrolepidotum) and Blue Sucker (Cycleptus elongates) both prefer silt/sand substrates over gravel or rock substrates. Not only does preliminary analysis indicate gravel substrate holds fewer individuals, but data also suggest individuals holding in gravel areas are smaller in size. While ontogenetic separation in habitat selection is common in many species of fish, many suckers are known to utilize gravel bars for spawning. Our results indicate additional environmental variables may have a strong influence on habitat selection of these species in a large river.

Status and trends of Largemouth Bass in the La Grange Reach of the Illinois River from 1993-2015

Jacob Huey, Rich Pendleton, Levi Solomon, and Andrew Casper, Illinois Natural History Survey

Upper Mississippi River fishes are the subject of commercial and recreational fisheries, both of which contribute substantially to local economies. For example, recreation on the Upper Mississippi River alone has been estimated to provide 18,000 jobs and generate $1.2 billion for the economy per year; recreational fishing for several fish species is a key component of this economic activity. An area of the Upper Mississippi River System that has received extensive research over the past 22 years is the La Grange Reach of the Illinois River. Within this reach, Largemouth Bass Micropterus salmoides have been monitored through extensive fish community sampling conducted by the Long Term Resource Monitoring (LTRM) element of the Upper Mississippi River Restoration Program using a multi-gear stratified random sampling (SRS) design since 1993. Using LTRM data, we investigate trends in proportional size distribution (PSD), catch per unit effort (CPUE), and relative weight (Wr) of Largemouth Bass over time. Based on data from day electro-fishing in connected backwater areas, catch per unit effort has declined more drastically for preferred and quality PSD categories, when compared to stock and sub-stock PSD categories. However, trends in relative weight have remained stable across all PSD categories. Declines in CPUE observed over time could be due to competition with invasive species, altered river hydrology, or lack of habitat needed at critical life stages of the Largemouth Bass. Further analysis of long-term monitoring data may reveal direct causes for these declines and may provide managers essential information regarding the status and trends of this recreational fish species.

Trends in the populations of White and Yellow Bass over 21 years within the Illinois River

Jacob McQuaid, Rich Pendleton, Levi Solomon, and Andrew Casper, Illinois Natural History Survey

White Bass (Morone chrysops) and Yellow Bass (Morone mississippiensis), to a lesser degree, are recreationally valued fishes within the Upper Mississippi River System (UMRS). The

Illinois River is a major tributary of the UMRS, in which, the Upper Mississippi River Restoration Program's Long Term Resource Monitoring (LTRM) element has consistently collected data on these species since 1993. LTRM data from the La Grange Reach of the Illinois River were used to evaluate the status and trends of both White and Yellow Bass by calculating relative weight (Wr), catch-per-unit-effort (CPUE), and proportional size distribution (PSD). In addition, otoliths were collected from 2012-2015 to evaluate age structure and length-at-age of both species. Trends in relative weight revealed no discernable pattern over time for either species. However, the overall CPUE, accounting for fishes of all sizes, indicated that both species are in decline, with White Bass experiencing a greater decline compared to Yellow Bass. The cause of these trends is difficult to pinpoint due to the multitude of stressors acting on the system, such as siltation, invasive species, pollution, and the continued impacts of navigation. Trends in CPUE among different PSD categories, in addition to age structure information, may help clarify the overall declines observed in CPUE. Overall, these results indicate populations of White and Yellow Bass are in decline and highlight the importance of long-term data when assessing populations of sport fishes.

EXOTIC SPECIES

Asian Carp eggs, larvae and juveniles all found closer to Lake Michigan

(IL AFS Environmental Concerns Report)

On June 18, 2015, three Silver Carp larvae were collected, approximately a mile-and-a-half upstream of the I-55 Bridge (Channahon, Illinois), in the Dresden Island Pool of the Des Plaines River (River Mile 279.3). These individuals ranged from 8.5 – 10.0 mm (0.33-0.39 inches) total length. Asian carp eggs (either Silver or Bighead Carp) were also identified from samples collected from Marseilles and Starved Rock pools of the Illinois River, as well as from downstream pools (LaGrange and Peoria). These detections are within areas that Bighead and Silver Carp have historically been captured; however, this is the first collection of larval fish upstream of Henry, Illinois (approximately 90 miles downstream on the Illinois River from this detection location in Dresden Island Pool). No additional Asian carp larvae were collected in this 90-mile stretch of the Illinois River in 14 sampling visits from April 27, 2015 to September 14, 2015.

On October 22, U.S. Fish and Wildlife Service (USFWS) sampling crews detected two juvenile silver carp in the Marseilles Pool of the Illinois River. This site, near Moody Bayou, upstream of Seneca, Illinois, marks the furthest upstream location fish of this size have been captured. The fish, captured via electrofishing and measuring about 6.5 inches in length, will be aged by researchers to determine what year they were spawned. These juvenile fish are approximately 12 miles closer than their previous finding. Currently, there are three locks and dams, the electric dispersal barriers and more than 76 miles between them and Lake Michigan. This finding brings the leading edge of juvenile Asian carp detections about 66 miles closer to Lake Michigan than it was at the beginning of 2015.

Monitoring for juvenile Asian carp in the Illinois River, Des Plaines River, and the Chicago Area Waterway System (CAWS) takes place through sampling identified in the 2015 Monitoring and

Response Plan by the Illinois Department of Natural Resources, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and research organizations from throughout the state. Most notably, USFWS targeted these smaller fish with standard and experimental gears to increase detection of these sizes of Asian carp, concentrating on the historical locations and identifying any upstream movement. This sampling targets a segment of the Asian carp population typically missed with adult sampling gears and provides information to help determine where Asian carp are successfully spawning.

Complete details of the 2015 Monitoring and Response Plan for Asian carp in the Illinois River and CAWS can be found online at www.asiancarp.us.

Exploitative effects of bighead carp: alterations to organic matter exchanges within and between ecosystems

Scott F. Collins, David H. Wahl, Illinois Natural History Survey

Asian carp are invasive planktivores that are capable of greatly depleting planktonic resources and have demonstrated the capacity to achieve high levels of productivity. Due to inefficiencies of converting food into fish tissue, portions of consumed materials are egested and shunted to benthic habitats. We explored how bighead carp alter pools of organic matter between pelagic and benthic habitats, and across ecosystem boundaries via insect emergence. Here we report evidence from a manipulative experiment demonstrating that bighead carp (Hypophthalmichthys nobilis) greatly reapportion pools of organic matter from pelagic to benthic habitats to such a degree that additional effects propagated across ecological boundaries into terrestrial ecosystems. Strong direct consumption by bighead carp reduced filamentous algae, biomass and production of zooplankton, and production of a native planktivorous fish within pelagic habitats, and reduced the cross-boundary emergence of adult Chaoboridae midges. Consequently, reduced herbivorous zooplankton indirect increased phytoplankton (chlorophyll a) via trophic cascade. Reductions in these pools of organic matter accompanied strong flows (i.e., total consumption) through bighead carp populations, which in turn supported a high degree of carp production and concomitant losses of materials due to egestion. Egested material subsidized benthic Chironomidae larvae, increasing their standing crop biomass, as well as cross-boundary fluxes of their adult life stage. The perception and conception of bighead and silver carp should evolve beyond competitors for planktonic resources, to mediators and processors of nutrients and energy within and across ecosystems.

Catching carp: Experimental evaluations of juvenile and adult gears for the collection of Asian carp

Scott F. Collins, Matthew J. Diana, Steven E. Butler, David H. Wahl, Illinois Natural History Survey

In two gear comparison experiments, we sought to determine the best approach for sampling juvenile and adult bighead (Hypophthalmichthys nobilis) and silver carp (H. molitrix). For juveniles, six gears were compared to determine the most effective approach to collecting age-0

Asian carp. Mini-fykes and beach seines were the most effective for sampling littoral habitats. Purse seines and pulsed-DC electrofishing had similar catches, but electrofishing was more effective in main channels and purse seines were more effective in backwater lakes. Cast nets and gill nets were determined ineffective for collecting age 0 Asian carp. For adults, we compared fyke, hoop, and pound nets to determine the most effective gear in terms of catch rates and labor hours over three years. For each respective experiment, gears were deployed concurrently. Adult gears were compared in backwater lake habitats. Catch rates for the adult gear comparison were consistently greater in pound nets for all fishes, bighead carp, and silver carp. Pound net catches were one to three orders of magnitude greater in pound nets than in either fyke and hoop nets. Pound nets also collected larger bighead in comparison to hoop and fyke nets. In general, hoop nets were rather ineffective at catching Asian carp in backwater lakes when compared to other gears. Pound nets were a cost-effective means of collecting large numbers of Asian carp in terms of catch per labor invested. Although unconventional, pound nets may be an important and effective gear for collecting large numbers of Asian carp.

Juvenile Asian carp predation on the La Grange Reach, Illinois River

Eli G. Lampo, James T. Lamer, Brent Knights, Jon Vallaza, James H. Larson, Andrew Casper, Rich Pendleton, and Levi Solomon, Western Illinois University

The Silver Carp spawning event in 2014 has led to an abundance of juvenile silver carp in the La Grange Reach of the Illinois River. The objectives of our study were to determine if native piscivores are using these year one fish as forage, estimate the length of silver carp that were consumed, and, to determine if there was a significant relationship between predator length and the length of silver carp they consumed. We collected fish from contiguous backwaters and tributaries on the La Grange Reach of the Illinois River using pulsed DC- electrofishing. During diet analysis we used the presence of silver carp pharyngeal teeth and masticating pads to confirm the identification of silver carp in the piscivores diets. We collected 919 piscivores representing 17 species of fish. 5 species of fish were found to have eaten silver carp: largemouth bass, shortnose gar, white bass, white crappie, and channel catfish. The frequency of occurrence percentage for silver carp was 9.7% for largemouth bass (n=257), 17.8% for shortnose gar (n=28), 9.1% for white bass (n=77), 2.1% for channel catfish(n=48), and 1.9% for white crappie(n=52). We found that there was a significant relationship between the size of masticating pads and silver carp length($p<0.0001$). We estimated the length of silver carp by measuring the masticating pads found during diet analysis and comparing them to the sizes of masticating pads from known length silver carp. We determined that there was a significant relationship between largemouth bass length and the length of silver carp consumed ($p<.0001$).

Influence of a Gated Dam on the Seasonal Movements and Upstream Passage of Asian Carp in the Illinois River

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Invasive Bighead Carp (Hypophthalmichthys nobilis) and Silver Carp (H. molitrix),hereafter, Asian Carp (AC), pose a major threat to the Great Lakes ecosystem as they advance toward Lake Michigan via the Illinois River. Starved Rock Lock and Dam (SRLD) is the most downstream gated dam on the Illinois River, therefore presenting the first navigation challenge for upstream migrating AC. Since 2013, less than 1% of acoustically tagged AC have passed upstream through SRLD. In addition, hydroacoustic surveys indicate the abundance of AC significantly declines upstream of SRLD. Our objective was to investigate the permeability of SRLD to AC migration. We increased our acoustic receiver network around SRLD and tagged an additional 119 AC downstream of SRLD. This information will allow us to relate AC movements to environmental variables and the operation of gates at SRLD, which will be particularly important for managing AC and reducing their upstream movement at other gated dams along the Illinois and Mississippi Rivers.

Direct and Indirect Effects of Invasive Asian Carp on Native Communities

Elizabeth P. Tristano and James E. Garvey, Southern Illinois University

Invasive species may alter primary productivity and nutrient content in native ecosystems, affecting condition of native species. For example, planktivorous Asian carp (Hypophthalmichthys spp.) may alter freshwater trophic dynamics, reduce phytoplankton and zooplankton, and compete with native gizzard shad (Dorosoma cepedianum). To examine how Asian carp affect zooplankton, system primary productivity, and gizzard shad, we conducted a series of pond mesocosm experiment with varying densities of gizzard shad and silver carp (H. Molitrix). Ponds were sampled weekly for zooplankton abundance, chlorophyll a concentration, and water column NH4, NO3, and PO4 concentrations throughout each experiment. Additionally, gizzard shad gut samples were taken at the conclusion of the experiment. Preliminary results suggest that Asian carp presence does not significantly affect gizzards growth, although zooplankton density and chlorophyll a concentration declined in the presence of Asian carp over time. This result could be due to a lack of competition between Asian carp and gizzard shad for food resources, as is evident by the high amount of detritus found in gizzard shad diets. Additionally, although water NH4, NO3, and PO4 concentrations do not appear to differ in the presence or absence of Asian carp, these fish may alter detrital quality, thereby providing a high quality food source for gizzard shad.

Zooplankton Response to Asian Carp Harvesting in Illinois River Backwaters

Brian Zalay and Andrew F. Casper, Illinois Natural History Survey

Since Asian carp (Hypophthalmichthys nobilis and Hypophthalmichthys molitrix) have arrived in the Illinois River, they appear to have a major negative impact on zooplankton.In an effort to protect the Great Lakes by keeping the Asian carp population low and thus to reduce the pressure on the electric barrier, the Illinois DNR has contracted ten commercial fishing crews to conduct regular Asian carp removals. The objectives of this study are to understand the zooplankton ecological response to the reduction of Asian carp and thus determine the effectiveness of Asian carp harvesting for ecosystem recovery. The fishing crews harvested bimonthly at select

backwaters of the upper reaches of the Illinois River. The hypothesis is that zooplankton, a major food source for Asian carp and other fish, may respond positively to the harvesting. Although zooplankton have recovered from other types of disturbances in different ecosystems, it is not known how zooplankton might respond to planktivore harvesting in a large river system. Zooplankton samples were collected over four months at ten backwaters during the summer of 2015. The macrozoolankton community was primarily copepod nauplii followed by cladocerans and copepods. I will compare the zooplankton community structure between a spectrum of Illinois River backwaters with harvesting of Asian carp at different frequencies and intensities.

Biotic response to the establishment and expansion of Asian carp in the Illinois River

Jason DeBoer, Mark Fritts, Daniel Gibson-Reinemer, Collin Hinz, Doyn Kellerhalls, Richard Pendleton, Levi Solomon, Andrew Casper, Illinois Natural History Survey

As a heavily modified river system that connects the Mississippi River watershed to the Great Lakes watershed, the IRW is a conduit for the movement of invasive species between watersheds. The most-recent – and perhaps most-feared – invasives are Asian carps, which threaten the Great Lakes themselves, and countless highly productive miles of connected rivers as well. In the 1950s, Illinois Natural History Survey scientists initiated a standardized electrofishing sampling program (Long-Term ElectroFishing - LTEF) on the Illinois River Waterway (IRW). The Upper Mississippi River Restoration Program's Long Term Resource Monitoring (LTRM) element combines environmental monitoring, research, systemic data acquisition, and modeling to provide a solid scientific foundation for its partners in the Upper Mississippi River System. Using the unparalleled spatio-temporal record of the LTEF and LTRM programs in Illinois, we present an analysis of ongoing large-scale datasets, including ebbs and flows in Asian carp CPUE, condition, and chronic effects on the fish, zooplankton, and phytoplankton communities. These programs provides biotic community data prior to the invasion and at every step as it happens. Our objective is to provide a better understanding of how Asian carps have affected biotic communities throughout the IRW. We believe these findings may provide indications of how Asian carp populations can become established and grow in novel habitats.

Asian Carp, Sport Fish Declines, Major Floods and Climate Change: A Lighthearted Romantic Comedy

John Chick, Illinois Natural History Survey

An analysis of 20 years of monitoring data from six reaches of the Upper Mississippi River System (UMRS) provides empirical evidence that silver carp have a negative influence on the abundance of adult sport fishes. Given that silver carp primarily consume phytoplankton and zooplankton, and few sport fish species consume these resources as adults, the mechanism for this negative influence is unlikely to be direct competition for prey resources. Instead, patterns in the abundance of young of the year and juvenile sport fishes interact with both water temperature and the abundance of silver carp, suggesting that silver carp may be constraining the recruitment of sport fishes. Over the past 20 years, all six reaches of the UMRS have shown

similar increases in water temperature during the growing season (April – October), but recruitment of sport fish is only increasing in the upper three reaches of the UMRS where silver carp are not yet established. Another aspect of climate, flood frequency and magnitude, has been increasing through time in the lower reaches of the UMRS. Increased flooding may improve reproductive success of silver carp which spawn when river levels rise and have larvae that follow the edge of flood waters into floodplain habitats. One potential ray of hope for preventing the spread of Asian carp to the Great Lakes or other areas within the UMRS is the discovery that silver carp are very susceptible to spinal injury from pulsed DC-electrofishing. This raises the possibility that slight modifications of the electric barriers in the Chicago Area Waterway System could potentially increase their effectiveness at preventing silver carp from entering Lake Michigan.

Assessing Movement of Adult Silver Carp and Bighead Carp in the Upper Illinois Waterway System Using GPS Satellite and Radio Telemetry

Andrew T. Mathis, James T. Lamer, James H. Larson, Brent Knights, John Vallazza, Kevin Irons, Western Illinois University

Invasive silver carp and bighead carp have established populations throughout the Illinois River. Efforts to prevent invasion into the Great Lakes rely on a comprehensive monitoring program. Despite a wealth of information on Asian carp movement, a finer-scale approach to understand real-time movements and habitat use would strengthen management efforts. We are testing GPS tags to determine patterns of movement, identify potential feeding and spawning areas, and inform commercial removal efforts in the Upper Illinois River. To optimize and determine the feasibility of this technology, data logging tags (manually tracked with radio telemetry) were tethered to bighead and silver carp species in raceway and field experiments. Seven of fifteen field-deployed tags have been recovered and have returned 1,461 individual waypoints. We have demonstrated the use of this technology to monitor Asian carp and will begin testing remotely-accessed, real-time satellite-linked prototypes in January 2016. Fine-scale accuracies and fast acquisition speeds, make this an ideal tool and is the first use of GPS technology to track fish in riverine systems.

Temporal effects of river discharge on Asian carp abundance and size structure in the Wabash River

Daniel R. Roth, Evan C. Boone, Cassi J. Carpenter, Leslie D. Frankland, Robert E. Colombo, Eastern Illinois University

The lower Wabash River, is unimpounded and follows a more natural hydrological pattern than impounded rivers of similar size. This temporally and spatially variable pattern has tremendous effects on biota within the system. Invasive Asian carp (Hypophthalmichthys spp.) are of major concern within the Wabash and exhibit variable patterns of abundance between years. We sought to examine possible effects the dynamic hydrology of the Wabash has on Asian carp populations through the use of Long Term Electrofishing Survey data. During 2014, the Wabash River followed a relatively average cycle with several moderate flood pulses throughout the spring,

followed by low flows from early summer into fall. In 2015, typical spring flood pulses occurred, but an abnormally large pulse occurred later and subsisted through much of the summer. Catch per unit effort of Asian carp, silver carp in particular, more than doubled between these years. Preliminary results suggest that this major difference is partially driven by discharge among years. Size structure in 2014 was dominated by large individuals (>500mm), and in 2015 a high abundance of small individuals (<200mm) appeared in June and persisted throughout much of the summer. This suggests that Asian carp utilized the long flood period of 2015 for spawning, evident in the high number of young of year individuals. These results support previously findings that Asian carp spawning activity is highly dependent on discharge. This further elucidates what factors affect the abundance of these prolific invasive species and could aid in the practice of better control efforts.

Quantification of daily otolith increments in young of year Asian carp

Emily A. Szott, James T. Lamer, James H. Larson, Brent Knights, John Vallazza, Levi Solomon, Rich Pendleton, Andrew Casper, Western Illinois University

Silver and bighead carp are invasive species that have become established throughout the Mississippi River Basin. A large body of research and resources have been dedicated to their management. Despite these efforts, information on hydrological spawning triggers and growth of young of year Asian carp is lacking. Here, daily incremental growth annuli from sagittal and lapillus otoliths are used to estimate birth and growth of young of year Asian carp. We collected juvenile Asian carp from the LaGrange Reach of the Illinois River following a large spawning event in August 2014. Total length was measured, and the lapillus and sagittal otoliths removed from each individual. A 0.5 cm x 0.5 cm piece of caudal fin tissue was excised for later genetic analysis. Otoliths were aged from 20 fish per 5 mm length group (15-79 mm). The extracted otoliths were mounted to slides with cyanoacrylate, polished, photographed, and aged. Otolith microstructure was validated using juvenile Asian carp from Chinese aquaculture. Aging the juvenile Asian carp gives valuable information on the growth of this poorly studied life history stage. Preliminary results show that the collected Asian carp range from 26 to 44 days old, putting their days of birth between June 23 and July 11, 2014. Further study of age will help determine spawning periodicity and hydrological conditions responsible for spawning. Ultimately, the ability to determine daily growth rates of young of year Asian carp will help in the management of these invasive species.

FISH HEALTH

White Grub in Centrarchidae from the Ohio River Drainage

Evan Boone, Les Frankland, Devon Keeney, Jeffrey Laursen, and Robert Colombo, Eastern Illinois University

White grub (Posthodiplostomum minimum centrarchi) is a juvenile strigeoid trematode that has been documented in many centrarchid fishes. It infects fish by cercariae penetrating the skin, so transmission should be more efficient in slow moving water, and most studies are done on lentic

systems where sunfish predominate. In this study, eleven centrarchid fish species (spotted bass (n=126), largemouth bass (n=18), smallmouth bass (n=8), bluegill (n=44), green sunfish (n=26), longear sunfish (n=50), orangespotted sunfish (n=36), redear sunfish (n=17), warmouth (n=13), black crappie (n=15), and white crappie (n=6)) were collected from the Ohio River Drainage in 2014 and 2015. Organs were examined for the presence of white grub metacercariae. Prevalence of white grub ranged from 0 in white crappie to 100% in redear sunfish and warmouth. Prevalence in bluegill, the most commonly studied host, was 86.4%. Mean intensity of white grub ranged from one in black crappie to 231 in spotted bass. To adjust for the effect of host size on intensity infections were standardized by organ and body weight. White grub metacercariae were recovered from the head, liver, heart, kidney, and spleen. White grub burdens in individual organs varied by host. Preliminary genetic evidence suggests that there may be two species of white grub in this system, one in the genus Micropterus and one in the genus Lepomis.

FISH KILLS

Cattle farmer cited in massive Vermilion County fish kill

(IL AFS Environmental Concerns Report)

Illinois Environmental Protection Agency Director Lisa Bonnett has referred an enforcement action to the Illinois Attorney General's office against a Vermilion County cattle facility for allegedly causing livestock waste to enter Stony Creek and Salt Fork of the Vermilion River, causing significant mortality to fish and other aquatic life. In the referral, IEPA requests the Attorney General to obtain an immediate order requiring compliance measures be taken by the operator, Mr. Gabe Sheperd.

On September 11, 2015, IEPA received a Hazardous Materials Incident Report stating that a valve was left open on an aboveground manure tank, resulting in the release of an unknown amount of liquid cattle waste into Stony Creek. Impacts were identified for several miles downstream into Salt Fork, a high quality stream known to harbor several state-listed fish species. An IDNR inspection estimated about ten miles of impact, killing fish down to the Oakwood Road bridge of the Salt Fork.

An estimated 98,747 fish were killed with a value of over $24,000. At least three state-listed fish species had been killed (River Redhorse, Bigeye Chub, and Bluebreast Darter). The pollution had passed through one of the relocation sites for the federally endangered Northern Riffleshell and Clubshell mussels. Impacts to mussels could not be determined during the investigation, as high turbidity from the discharged material and above normal flows prevented visual observation of the substrate in most locations.

In the referral, IEPA identified numerous violations of the Illinios Environmental Protection Act, Illinois Compiled Statutes and Illinois Administrative Code. IEPA is seeking prompt enforcement action and proper remediation of the affected areas. Remediation is to include collection of any waste located outside of the waste management system, thorough cleaning of the drainage area down gradient, and restoration of the impacted grass waterway. *(Illinois Dept of Natural Resources press release, 9/17/2015)*

State files lawsuit against dairy in fish kills

Edith Brady-Lunny eblunny@pantagraph.com
Jan 27, 2016

BLOOMINGTON — The State of Illinois is suing a Bellflower dairy accused of releasing raw sewage into Lone Tree Creek three times, killing more than 200,000 fish and other aquatic life, including some on the state's endangered species list. A June 2 hearing is scheduled in the lawsuit filed in McLean County by Illinois Attorney General Lisa Madigan's office against Stone Ridge Dairy and its owners, the George Kasbergen family.

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The lawsuit filed last month claims that runoff from the state's largest dairy, located south of Bellflower, contaminated the creek and the Sangamon River in three incidents between the business's opening in 2002 and Sept. 10, 2010. Ironically, the source of the contamination was "insufficiently treated human waste from an overloaded, undersized, improperly chlorinated, sand-field septic system" at the dairy facility and a tile system linked to the Lotus Drainage District, said the lawsuit.

Illinois Dept. of Natural Resources staff initiated an investigation into the fish kills in September 2010 after the agency received a call from a concerned resident who reported brown-stained water in the creek. The IDNR estimated that about 40,000 fish were killed at that time. Other aquatic life including Mudpuppies (a Threatened species in Illinois), crayfish, frogs and mussels were also killed.

The lawsuit documents two previous incidents, one in 2003 where 65,000 fish were killed and a 2004 investigation where investigators collected 104,000 dead fish and other aquatic life. The state is seeking reimbursement of $7,165 for its costs related to the investigations and the un-specified value of the fish and aquatic life.

Lawyers for the state note in court documents that no fish kills have occurred in the area since 2010 when the facility "stopped overloading its sand filter septic system and has made significant progress toward removal of remnant field tile and installation of an extensively upgraded field tile grid in its waste application fields".

IMPERILLED FISH SPECIES

Four rare fish species added to Illinois Threatened and Endangered list

(IL AFS Environmental Concerns Report)

Last year (2015) saw the addition of four fish species to the state's T/E list. They are the American eel *(Anguilla rostrata),* crystal darter *(Crystallaria asprella),* brassy minnow *(Hybognathus hankinsoni),* and American brook lamprey *(Lethenderon appendix).* All four were assigned "Threatened" status. The crystal darter had been considered "Extirpated" but was recently rediscovered in Illinois waters. These new additions bring the state-listed fish species total to 35 (19 Endangered, 16 Threatened).

Status survey of Iowa Darter and Banded Killifish

Josh Sherwood (INHS), Phil Willink (Shedd Aquarium), Jeremy Tiemann (INHS), and others are preparing to do a status survey of a couple state-threatened fishes. The Iowa Darter and Banded Killifish are more common than previously thought and results might be instrumental in delisting the species.

Greater Redhorse (Moxostoma valenciennesi) and River Redhorse (Moxostoma carinatum) Status and Distribution in the Fox River near Aurora, Illinois

Leonard Dane, Deuchler Environmental, Inc.

Deuchler Environmental, Inc. (DEI) was contracted by Fox Metro Water Reclamation District (FMWRD) to evaluate the biological condition of the Fox River in the Aurora area. In the sampling conducted by DEI from 2010 through 2014, no River Redhorse were collected but Greater Redhorse were collected throughout the entire study area, both upstream and downstream of the FMWRD combined sewer overflow (CSO) and treated effluent. The collection of Greater Redhorse was significant as it was a new record to the Aurora area of the Fox River as of 2010. The fact that they have been collected every year since 2010 indicated that there is a viable population within the study area. The presence of Greater Redhorse was significant since the species was thought to be extirpated from Illinois at one time. In addition to the study results, this presentation focuses on the habitat characteristics that influence the distribution of the Greater Redhorse within the study area.

MANAGEMENT

Catfish, algae team up to help clean up Chicago River

Dawn Reiss, City Lab
December 22, 2015

In the world of angling, voracious channel catfish are considered an easy catch. Thanks to the catfish's ability to "manage some degradation"—as Margaret Frisbie, executive director of the nonprofit Friends of the Chicago River, puts it—releasing the hardy fish into Chicago's river system is a simple way to show the effects of water pollution and measure signs of progress. "The channel catfish is the canary in the coal mine," Frisbie says. "If they can survive, other things can happen."

In a city like Chicago, which took a mandate from the U.S. Environmental Protection Agency in 2011 to start the cleanup of the notoriously polluted three-pronged branch of the Chicago River, that's important. A decade ago, Frisbie, who began working with the advocacy group in 2000, dreamed up and had built a 42-foot-long floating fish hotel: an island made of coconut fibers filled with native plants, demonstrating how downtown Chicago could offer a habitat where fish could easily thrive. Now that vision is becoming a more permanent reality.

Earlier this year, backed by a $300,000 grant, Frisbie's group and the Illinois Department of Natural Resources completed a two-year-long project of releasing 195,000 baby channel catfish into the river system and creating 400 nesting cavities made of permeable concrete tubes, which mimic submerged logs. "You should have seen it," says Frisbie. "They came up from southern Illinois in a truck, and were shot out of pipes into the river."

This is the biggest fish release in the Chicago River's history, and Frisbie says it will take four or five years—the time it takes a catfish to mature—for advocates to see the long-term effects. Back in the 1970s, there were only an estimated five to seven species in the water (channel catfish not among them), compared to more than 70 species today. That long-term gain in ecological health is what made the project possible. "It wasn't worth doing until we knew it would be successful. We've finally gotten the river to the point where we could do this," Frisbie notes.

Although channel catfish are native to the region, until recently they have been in limited in numbers due to poor water quality and lack of habitat. Two of the biggest contributors to the river's degradation: phosphorus and nitrogen, which reach the river through, among other things, human waste, and cause algae to grow like mad. Scientists actually refer to phosphorus and nitrogen as nutrients. Dale Robertson, a research hydrologist for the U.S. Geological Survey, describes it this way: "At first, the nutrients help the algae to grow overabundantly, and the fish can eat more. But then the algae becomes so much, then it dies and decomposes, taking the oxygen out of the water. It's like putting food into an aquarium—if you put too much in, you have problems."

Right now, Chicago is dealing with an aquatic buffet where the food is rotting. Phosphorus is a mineral found in humans, animals, and plants. Although it is a pollutant and can cause algae blooms (the reason many states have banned it in dish detergent), it is also an essential element which helps repair tissue and build strong bones and teeth, and a non-renewable resource that can be recovered and reused.

Unlike other states in the Midwest, Illinois hasn't set limits on how much phosphorus can be allowed in rivers and streams. There are plenty of factors that contribute to Chicago's high phosphorus and nitrogen levels. The city is only starting to disinfect its treated sewage before dumping it back into the river. Another factor is combined sewer overflows. Although these have declined substantially in recent years, raw sewage is still regularly released into Chicago's river system.

In anticipation of state regulation, the Metropolitan Water Reclamation District (MWRD) will open the world's largest phosphorus recovery plant in February. The district will add chemicals to sewage to make a fertilizer product it can sell. It's also begun testing another method to help recover phosphorus. Surprisingly, the idea involves cultivating algae inside one of its plants. The algae eats the phosphorus while it's in wastewater. After being cultivated, the algae can be scraped off conveyor-like belts and sold for a profit.

"We already know algae recovers phosphorus and nitrogen from the wastewater, and when you don't want it to grow, it will grow and it becomes a nuisance," says Tom Kunetz, assistant director of engineering for MWRD. "But if we can control the growth of the algae ... it can become a benefit to us."

A six-month pilot that concluded earlier this month didn't yield enough algae to be commercially viable. However, in September, the district started a one-year study at its O'Brien plant using a revolving algal biofilm reactor (nicknamed RAB) that was developed at Iowa State University. Vertical conveyor belts, about six feet tall and three feet wide, revolve in a continual loop, dropping into 1,200 gallons of wastewater and then climbing into the air as multiple types of algae grow on them.

The algae scrapes off "like a sticky tomato paste," Kunetz says, adding that it can then be composted and used as a fertilizer or as organic waste to feed anaerobic digesters. If this method ends up being permanently deployed, Kunetz says it would help reduce phosphorus and nitrogen levels in Chicago's wastewater, and potentially in other cities', too.

That means catfish—among other species—will be able to breathe a little easier. Next summer, the state Department of Natural Resources will begin conducting tests near the catfish nesting sites to see if the fish are eating and reproducing. In the meantime, Frisbie and her fellow river advocates will research other cities' approaches and discuss more ways Chicago might reduce its phosphorus levels. "We have to take what other people have done and figure out the answer for our own water system," she says. "We are on a voyage of discovery at this point. We are at the very beginning."

Evaluating the effect of environmental conditions and gear on the detection and occupancy of large river fishes

Daniel K. Gibson-Reinemer, David R. Stewart , Andrew F. Casper, Mark W. Fritts, and Jason A. DeBoer, Illinois Natural History Survey/U.S. Fish & Wildlife Service

Sampling in non-wadeable rivers presents methodological challenges for monitoring fish species. Changing environmental conditions may affect the ability to accurately capture species (i.e., detection) and consequently lead to inappropriate inferences on occupancy rates. We used data from a multi-year sampling program on the Kankakee River to estimate detection and occupancy for 41 species using hierarchical Bayesian multi-season mixture models. Fish were sampled using AC boat electrofishing and shoreline seining across seven years. Few species had high detection probabilities, although some centarchids (e.g., Smallmouth Bass) were efficiently sampled by boat electrofishing. Moderate changes in environmental conditions, such as water velocity and temperature, produced moderate changes in detection and occupancy. Our results suggest that samples collected with relatively moderate environmental fluctuations and under similar conditions may be unlikely to introduce large bias in estimates of detection and occupancy among years for sportfish species compared to species that are highly mobile with fluctuating population sizes.

Fish Population Monitoring on the Wabash River

Cassi J. Moody-Carpenter, Alex Sotola, Evan Boone, Eric K. Bollinger, Scott Meiners, Leslie D Frankland, and Robert E. Colombo, Eastern Illinois University

The Wabash River is a very unique system because a large portion of it is free flowing; therefore makes it a good representative of a more "natural" large river ecosystem. Furthermore, it also provides an important sport and commercial fishery for both Indiana and Illinois. To effectively monitor and assess fish populations, shoreline DC-electrofishing and electrified trawls were completed during 2014-2015. Each fish sampled was measured to total length (mm) and weighed (g). A total of 30.6 hours of DC electrofishing and 17.85 hours of trawling have been completed during project. Electrofishing collected 68 species, while trawling only collected 42 species. However, species assemblage and size classes collected was different between gears. Future assessments of fish populations in Wabash River may need to incorporate electrified trawl sampling in order to collect necessary individuals or size classes.

Standardizing a Multi-Gear Approach for Sampling Ohio River Catfishes

Devon Oliver, Troy Laughlin, Neil Rude and Gregory Whitledge, Southern Illinois University

Standardized sampling methods to assess catfish populations are well developed for lentic systems. However, they are not as well developed in lotic systems and development of standardized sampling methods in lotic systems are necessary to accurately analyze population characteristics. Many gear types have been used to sample the populations of catfish in riverine systems; catchability is not constant throughout the age distribution within an individual gear type, and a multi-gear approach may be essential to representatively sample catfish populations. Electrofishing, trotlines and hoop nets have been found to sample several different size classes illustrating size selectivity in channel and flathead catfish in other studies. The objective of this portion of our study was to develop standardized sampling protocols for channel, flathead, and blue catfishes in the Illinois section of the Ohio River. Catfishes were sampled from May-October 2012-2015 using electrofishing, trot lines, and hoop nets. We found that trot lining was among the most effective gears for sampling blue and channel catfish >300 mm total length (TL). DC electrofishing at 15 pps was most effective for sampling small catfish <300 mm TL, whereas 60 pps was most effective for channel catfish 300-600 mm TL. Hoop nets and low-pulse DC electrofishing both collected broad size ranges of flathead catfish.

Utility and precision of hard structures used to estimate age for three species of gar

Sarah Huck, Solomon David, Jeffery Stein, Illinois Natural History Survey

Recreational angling for gars has grown in popularity in recent years, yet we lack a fundamental understanding of population dynamics in Illinois requisite for proper management and conservation. Age data is essential to describe population parameters, however, there are few studies describing which hard structures are best used to estimate age of gars. Therefore, we collected Spotted Gar (n=94), Shortnose Gar (n= 79), and Longnose Gar (n= 47) from multiple Illinois watersheds to assess the precision and utility of otoliths, cleithra, pectoral fin rays, and branchiostegal rays for age estimation based on collection process, preparation to read annuli, and precision between readers. Pectoral fin rays generated the best between reader precision (Spotted Gar (CV= 5.21 ± 0.80), Shortnose Gar (CV= 7.97 ± 1.55), Longnose Gar (CV= 9.57 ±

2.15)), followed by branchiostegal rays (Spotted Gar (CV= 8.76 ± 0.90), Shortnose Gar (CV=14.73 ± 3.13), Longnose Gar (CV= 16.66 ± 5.35)) for all three species. Precision estimates for cleithra were significantly worse than pectoral fin rays for Spotted Gar (ANOVA, $P < 0.001$) and Shortnose Gar (ANOVA, $P = 0.002$), while otoliths were significantly worse than pectoral rays for Longnose Gar (ANOVA, $P < 0.001$). Our results suggest pectoral fin rays are most useful to age Spotted, Shortnose, and Longnose Gars compared to branchiostegal rays, otoliths, and cleithra. Therefore, pectoral fin rays can be used to estimate population dynamics of gars to determine if management strategies are necessary to sustain Illinois populations.

Investigating the Relationship between Fish and Private Land Conservation Programs

Brian A. Metzke and Leon C. Hinz, Jr., Illinois Natural History Survey

Incentive-based private land conservation programs (e.g., Conservation Reserve Program, CRP) preserve or enhance environmentally sensitive properties in exchange for payments or tax liability reduction. The assumption of these programs is that enrolled lands provide a direct (e.g., habitat quantity or enhancement) or indirect (e.g., reduced sedimentation) benefit to wildlife. Because the direct link between private conservation lands and stream fish may be difficult to evaluate, our objective was to describe the relationship between environmental characteristics and fish assemblages and then use that information to estimate how private lands might influence assemblage composition. We sampled fish, measured water quality and qualitatively assessed stream habitat at 81 locations in Kaskaskia River basin. We used linear regression and Akaike's Information Criterion (AIC) to identify which models best estimate the relationship between stream and watershed characteristics and fish assemblages. Fish assemblage composition correlated with sampling effort, habitat heterogeneity, riparian zone characteristics and stream disturbance. We used CRP density within a watershed to quantify private conservation land in the Kaskaskia River basin. CRP density correlated with some of the same factors as did fish assemblages suggesting the potential for these lands to influence fish assemblages. Investigating the interaction between private conservation lands and streams is a first step in identifying ways these lands can be used to enhance stream biota.

The Relationship of the Fish Index of Biotic Integrity to the Qualitative Habitat Evaluation Index in Illinois Streams

David B. Muir, Illinois Environmental Protection Agency

The Qualitative Habitat Evaluation Index (QHEI), (Rankin, E. T. 1989), was developed by Ohio EPA and is used to evaluate the potential of stream habitat to support aquatic life. It was adopted by Illinois EPA in 2005 and is used routinely in Cooperative Intensive Basin Stream Surveys. The QHEI is mostly a subjective visual evaluation of habitat quality based on substrate, instream cover, riparian zone, bank erosion, channel morphology, pool/glide quality, riffle/run quality and gradient. Although used by Illinois EPA since 2005, its relationship to fish communities in Illinois streams and its effectiveness as a predictor of biological potential in Illinois has not been evaluated. This study looks at the relationship between Fish Index of Biotic Integrity scores and QHEI scores collected from 2006 through 2010 at 456 Cooperative Intensive Stream Survey

sites across Illinois. Results show that the FIBI has a somewhat weak but statistically significant correlation to the QHEI. FIBI scores grouped into Good, Fair and Poor categories of the QHEI are also significantly different. Although the QHEI is not a good predictor of Biotic Potential at scores above the fair range (45), values in the poor and very poor ranges may indicate lower biotic potential. Also, 74% of QHEI scores below 45 are associated with FIBI scores indicating impairment of aquatic life use.

Efficiently Sampling Fish Assemblages in the Tributaries of Large Rivers with Boat-Mounted Electrofishing

Jerrod Parker, John Epifanio, Yong Cao, Illinois Natural History Survey

Major tributaries of large rivers in Illinois are often non-wadeable and have substantial variation in flow among seasons and years. Complex channel geo-morphology, limited areas for boat entry, and flow variability greatly effect access to portions of these medium sized rivers. It is a challenge to sufficiently document the long-term responses of fish assemblages to natural environmental changes and human disturbances with constrained resources and problematic access. Key factors to account for when designing a sampling regime are the number of sampling sites and sampling frequency. To address the relative importance of these factors, we made use of three consecutive years of intensive boat-mounted electrofishing data collected from 25 fixed site locations within the 6th order Kankakee River, a major tributary of the Illinois River. Fifteen minute pulsed-DC electrofishing surveys were conducted between early June and Late October in 2013, 2014, and 2015 for a total of 42.5 hours of electrofishing effort. These data were assessed to determine the contribution of year, season, and segment to the total variance in fish samples. The results were combined with field experience to help produce a practical sampling regime that should adequately capture long-term responses of fish to environmental factors.

MUSSELS

Assessment of short-distance translocation efficacy as project mitigation

Jeremy Tiemann, Illinois Natural History Survey

A bridge reconstruction project on Jane Addams Memorial Tollway (I-90) over the Kishwaukee River in northern Illinois provided an opportunity to assess the efficacy of short-distance translocations as a mitigation tool for freshwater mussel conservation. We marked 100 mussels with passive integrated transponder tags, released them ~200 meters upstream of the construction site in 2013, and monitored them monthly throughout the spring and summer 2013-2015. We used Cormack-Jolly-Seber Random models to estimate apparent survival rates and found survival is lowest the first month after translocation and stabilizes thereafter. We conclude short-distance translocation is a viable tool for species conservation but will not eliminate all mortality.

Lowhead dam impacts on freshwater mussels in the Vermilion River

Jeremy Tiemann, Illinois Natural History Survey

Published our paper addressing the effects of lowhead dams on freshwater mussels in the Vermilion River. Compared with reference sites, impounded areas and plunge zones had lower mussel abundance and extant species richness. We also examined literature accounts and museum collections to determine species distributions in the basin and compared those data to locations of the three dams and location of the former Homer Park Dam, which was removed over 50 years ago. Two species, Yellow Sandshell (Lampsilis teres) and the state-threatened Black Sandshell (Ligumia recta), are now found only downstream of the Danville Dam. Mapleleaf (Quadrula quadrula), which was found only downstream of the Homer Park Dam prior to 1950, has expanded its range upstream since the dam was removed. Data collected during this study contributes insights into the effects of lowhead dams on freshwater mussel abundance and species richness in Midwestern streams, and will be used as a baseline to compare to future post-dam removal collections.

Shellfish decision: Rare mussel holds up Kishwaukee bridge repairs

(IL AFS Environmental Concerns Report)

BELVIDERE — For the second time since 2013, a rare mollusk has delayed bridge repairs in Boone County. The Belvidere Public Works Department's plan to repair concrete, add guard rails and replace expansion joints on the Newburg Road bridge 5 miles west of downtown will have to wait until 2017 while the Illinois Department of Natural Resources determines whether a colony of Black Sandshell mussels need to be removed from the Kishwaukee River.

"It's just a delay," said Public Works Director Brent Anderson. "That whole process has to take place during the summer months … so we're going to lose this construction season." Anderson estimated the repairs will cost $500,000.

Black Sandshell mussels are classified by the DNR as a threatened species in Illinois rivers. Native mussels like the black sandshell are natural water filters for river systems, filtering out diatoms and green algae. Their shells and even their waste are vital to river ecosystems. "It affects water clarity when they die," said mussel expert Lisie Kitchel, a DNR conservation biologist. "These guys are really the kidneys, or filters, of the whole river system."

Mussels, particularly Black Sandshells, are very sensitive to water quality. They are one of the first species to go when rivers become polluted and one of the last to return when water quality improves. Kitchel said the Black Sandshell population in northern Illinois is rebounding, but slowly. "The fish come back first, then the insects ... and eventually the crayfish and last are the mussels," Kitchel said. "For rare species it takes longer to recover." Kitchel said that until mussel populations rebound, a river system hasn't returned to full health.

This isn't the first time a rare mussel has halted bridge repairs. In February 2012, a portion of a beam on the Orth Road bridge in Timberlane collapsed. While local officials intended to repair

the bridge in 2013, the project was delayed for more than a year while state officials searched a small creek beneath the bridge for Spike mussels. *(Rockford Register-Star, 1/11/2016)*

Translocation of federally-endangered mussels

Jeremy Tiemann, Illinois Natural History Survey

(In 2015, staff from the Illinois Natural History Survey continued to monitor translocated populations of two federally-endangered freshwater mussel species in the Vermilion River basin (Wabash River drainage). Between 2010 and 2014, a total of 2,099 Northern Riffleshell (Epioblasma rangiana) and 1,766 Clubshell (Pleurobema clava) have been translocated to eight sites in the Vermilion River basin, Champaign and Vermilion counties, Illinois. These translocated animals have been monitored seasonally since being moved to Illinois. For the 2015 calendar year, 36% (716) of the 1,991 available Northern Riffleshell were encountered, and of those physically examined, 61% (54 of 88) were alive. Conversely, 77% (1,359) of the 1,758 available Clubshell were encountered, and of those examined, 82% (106 of 129) were alive. The encounter and survival rates from the raw data collected in 2015 were comparable to previous years in Illinois. Throughout the duration of the project, both Northern Riffleshell and Clubshell have had higher encounter rates in the spring and autumn than summer. This relocation project is being funded, in part, by a natural resource damage assessment settlement (Hegeler Zinc—Lyondell Basell Companies) to the U.S. Fish and Wildlife Service and to the State of Illinois, and by the U.S. Fish and Wildlife Service's Ohio River Basin Fish Habitat Partnership.)

The physiological effects of CO2, in the context of a non-physical barrier to fish movement, on freshwater mussels

Kelly D. Hannan, Jennifer D. Jeffrey, Caleb T. Hasler, Cory D. Suski, University of Illinois

The movement and spread of invasive fish species is a topic of recent concern. In the Midwestern US, Asian carp are an invader of particular concern due to the recent expansion of their populations. Gas barriers aimed at deterring fish movement, such as CO2, are gaining in popularity as areas of elevated CO2 have been shown to be effective at deterring fish movement. However, little research has investigated potential consequences of these barriers on non-target species, such as mussels. Freshwater mussels are one of the most imperiled animals worldwide, and have some of their highest diversity in North America, and zones of high CO2 have potential to impact these organisms. The goal of the current study was to quantify the impacts of short-term and chronic exposures to elevated CO2, and subsequent recovery, on freshwater mussels. Hemolymph ions such as, Ca2+, Cl-, Mg2+, and Na+ were measured along with hemolymph glucose and body condition indices. Results from these studies indicate that freshwater mussels experienced physiological disturbances related to acid base disturbance following CO2 exposure, but body condition is unaffected even after chronic exposure, and there is evidence of recovery following removal of the CO2 challenge. Results are further discussed in the context of how CO2 barriers may impact non-target organisms.

Vermilion River Mussel Projects – from reintroductions to dam removal

Jeremy S. Tiemann, Alison P. Stodola, Sarah A. Douglass, and Kevin S. Cummings, Illinois Natural History Survey

Freshwater mussels are a vital component of stream ecosystems. Their sensitivity to stream habitats and their sessile, filter-feeding habits allow them to be biological indicators of stream integrity. Freshwater mussels play an important role in aquatic ecosystems by providing a food source for many animals, habitat for algae and aquatic insect larvae, and nests and refugees for certain species of fishes. In addition, mussels help stabilize stream substrate against the scouring effects of floods. However, North American freshwater mussels have undergone drastic decline during the past century, and subsequently have become one of the most imperiled groups of animals. Of the approximate 350 species of freshwater mussels native to North America, nearly three-quarters are extinct, federally–listed as endangered or threatened, or are in need of conservation status. Factors responsible for the decline in freshwater mussels include habitat destruction and environmental contamination. Loss of this taxonomic group affects ecosystem function, influences nutrient cycling, and may indicate declining water quality. In this presentation, we will discuss two on-going projects occurring in the Vermilion River basin that aim to enhance the freshwater mussel assemblage. The first project is Steps Taken During the Reintroduction of Two Federally-Endangered Mussels, which will reflect how a salvage project in Pennsylvania has provided an opportunity for the translocation of two federally-endangered freshwater mussels back into Illinois. The second project is Effects of Lowhead Dams on Freshwater Mussels, which will discuss the two upcoming dam removals occurring in the basin and how these dams appear to have affected the freshwater mussel assemblage.

AMERICA'S NEWEST INVADER? - DISCOVERY OF A THIRD CORBICULA SPECIES IN ILLINOIS

Jeremy S. Tiemann, Sarah A. Douglass, Mark A. Davis, and Kevin S., Illinois Natural History Survey

Corbicula, a "hyper-invasive alien" with great biofouling capabilities, was first recorded in North America in 1924 in British Columbia and breached the Continental Divide in the late 1950s. Since then, it has spread throughout the continent. Corbicula taxonomy is muddled and unclear, as is the number of species that have become established. Literature reports vary from an invasion of but a single species to invasions of multiple species. The Midwest has long been recognized as having only Corbicula fluminea. However, in 2008, a tentative second species, Corbicula largilllierti, began appearing in the navigable rivers of Illinois. It has purple nacre with more compressed, tighter ridges when compared with C. fluminea. A third Corbulid species was discovered in Illinois while sampling the Illinois River near Marseilles on 15 October 2015. Over 200 individuals were collected in conjunction with C. fluminea and C. largillierti. This undetermined species has fuchsia colored rays radiating from the umbo and white nacre with purple lateral teeth. It is currently unknown in North America, and we have no information for what the species is or its potential impact on aquatic ecosystems. In collaboration with the University of Michigan - Museum of Zoology, genomic and morphometric assessments are being employed to confirm the identity of this undocumented

Corbulid and also that of C. largillierti. Accurate species delimitations are essential for informing adaptive management, developing predictive invasion/dispersal models, and assessing potential effects on aquatic ecosystems. We request that our colleagues to please alert us to the presence of unusual Corbulids in your study areas if encountered.

RESTORATION

Fish community structure in a restored stream: what is driving dissimilarity?

Carl A. Favata, Robert E. Colombo, Don Roseboom, Tim Straub, Anabela Maia, Eastern Illinois University

Anthropogenic habitat degradation has devastated Midwestern stream ecosystems, yet comprehensive assessments of these impacts remain infrequent. Recent restoration efforts in East-Central Illinois have contributed to unravel complex dynamics driving an altered stream. Our research examined the long-term linkages between structural rehabilitation and ecomorphology of fishes in Kickapoo Creek. We monitored habitat integrity and fish communities annually in seven 200m reaches using single-pass DC barge electrofishing. Nonmetric multidimensional scaling of assemblage data displayed dissimilar temporal shifts in community structure, with assemblages varying significantly as a factor of habitat rehabilitation. Restored reaches displayed beneficial increases in evenness and diversity, characterized by abundance of Centrarchidae, Catostomidae, Percidae, and Ictaluridae species. Permutational regression analyses significantly linked community structure with overall habitat integrity and driving habitat parameters — mean channel depth and abundance of boulder substrate, deep pools, submerged logs, and aquatic, terrestrial and overhanging vegetation. Significant multiple regression analyses on species abundances supported our multivariate models and confirmed that fish were most sensitive to changes in substrate profile. We correlated substrate and velocity profiles in each reach, and investigated the linkages between flow alteration and ecomorphology using a model species. We modeled the effects of flow alteration in the lab on cost of transport in Longear Sunfish (Lepomis megalotis) navigating a turbulent flow regime. Ecomorphology of Longear Sunfish suggests that increased metabolic demands associated with navigating complex flow regimes may affect behavior, driving habitat use and distribution. This highlights a key physiological mechanism responsible for shifts in community structure following intensive habitat and flow alteration.

Assessing the status of Smallmouth Bass in a recently restored urban stream using acoustic telemetry

James Lukey; Jeffrey Stein, Illinois Natural History Survey

The West Branch of the DuPage River underwent a major restoration from 2005 to 2012. Prior to the restoration sport fish populations in this reach were highly depleted, and restoration efforts included the construction of habitat to specifically attract sport fish, especially Smallmouth Bass.

In order to assess the current status of the Smallmouth Bass population a three year tracking program was undertaken, evaluating preferred areas, movement patterns, seasonal variations and impacts of flow. Fish were surgically implanted with acoustic tags and tracked using manual tracking and using an array of passive receiver units located throughout the restored river reach. Smallmouth Bass were found to prefer specific areas within the reach, likely related to habitat features such as depth and substrate, and these preferences were found to be larger during winter. The bass were shown to vary in the amount of movement they undertook during the tracking period as some individuals appear relatively sessile, staying within one of the preferred areas for the entire time while others were found to take large movements up and down the restored reach. While this urban stream was found to have extreme changes in flow with recorded flows measuring from 0.7m3/s to 70.2m3/s the impact on bass movement seemed minimal and the movements that occurred were more correlated to seasonal changes. This study showed that a healthy population of adult Smallmouth Bass are resident to this restored reach, and that restoration efforts were successful in creating good habitat areas for them.

Evaluation of the Blackberry Creek Dam removal on stream fish assemblages

Stephen Pescitelli, Illinois Department of Natural Resources

Blackberry Creek Dam was in place for 175 years prior to removal in March 2013. The 12 ft. high dam was located 800 ft. upstream of the Fox River, blocking fish movement in the entire stream system. Compared to nearby un-dammed streams, Blackberry Creek was lacking some common migratory and intolerant fishes which contributed to lower IBI scores. Two weeks following dam removal in March, we collected spawning Shorthead Redhorse and Quillback Carpsucker. Shorthead Redhorse spawning nests were observed throughout the area upstream of the former dam. We also observed spawning Smallmouth Bass and Longnose Gar upstream following dam removal. The largest post-removal changes were observed in the former dam pool where fish species richness was three times greater and CPUE increased by a factor of 20 compared to pre-removal conditions. The IBI also increased by 11 points. We collected 25 fish species in the former dam pool which were not found in the pooled area prior to removal. Ten of the species collected upstream of the dam following removal were not previously recorded at any upstream sampling locations from pre-removal surveys. Smallmouth Bass and Channel Catfish were last collected upstream of the dam in 1997 and were in low abundance. Both species were common in the upstream segments following dam removal and young-of-the-year of both species were found four miles upstream of the former dam. A brief description of the dam removal process will also be presented.

WATER QUALITY

Clean Water Rule mired in judicial swamp

(IL AFS Environmental Concerns Report)

Last week (2/22/2016) the Sixth U.S. Circuit Court of Appeals in Cincinnati ruled that it will hear challenges to the Clean Water Rule (CWR) first proposed by the Obama administration in

2014 to clarify the jurisdiction of the Clean Water Act in regulating pollution and development activities on the nation's streams and wetlands. This decision prevents appeals in numerous federal district Courts across the country; federal appellate courts can set legal precedent and are often the final arbiter in cases such as these.

The rulemaking was crafted by the two agencies charged with implementation of the Clean Water Act (U.S. Environmental Protection Agency and U.S. Army Corps of Engineers) to clarify the definition of "Waters of the United States" following two separate Supreme Court decisions which had scaled back the Act's applicability over tributary streams and isolated wetlands. In first, *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers,* the high court ruled that non-navigable, "intra-state" streams and isolated wetlands not adjacent to navigable waters did not warrant federal protection under the Act.

A subsequent Supreme Court ruling in 2006 *(Rapanos et al v. United States)* split the court (4-4 with one abstention) over whether streams and wetlands without a direct hydrologic or ecological connection to navigable waters warranted protection. In the wake of these decisions, USEPA and USACE have been operating within a relatively narrow jurisdictional framework crafted provisionally in the 1980's.

In order to more fully implement the original intent of the Act, EPA and the Corps drafted rulemaking in 2014 to better define the term "waters of the United States". This 300 plus page document was crafted by wetland scientists, hydrologists and other technical experts familiar with the ecological and socio-economic value of wetland protection. It restored protection to headwater streams, prairie potholes and other resources vital to the nation's interests (fish and wildlife, flood control, pollution abatement etc.)

Not surprisingly, this move was met with a firestorm of opposition from the nation's developers and agricultural interests. The term "Waters of the United States (WOTUS)" was misinterpreted to include manmade ditches, ephemeral swales and even puddles. The Farm Bureau launched a "Ditch the Rule" campaign discrediting the rulemaking as a White House power grab aimed at restricting the most routine agricultural activities (cleaning ditches, building fences, weed control) as well as the building of homes and businesses.

Republicans on Capitol Hill voiced their opposition by invoking the little used Congressional Review Act to overturn the expanded regulations. Last November, the Senate passed their version of the bill 53 to 44 and in January the House voted 253-166 in favor of dropping the new rule. Both votes were largely along party lines.

On January 19, President Obama used the ninth veto of his presidency to reject Congress' overturning of the Clean Water Rule. In a message to Congress he stated "Too many of our waters have been left vulnerable. Pollution from upstream sources ends up in the rivers, lakes, reservoirs, and coastal waters near where most Americans live and on which they depend for their drinking water, recreation and economic development".

The Sixth Circuit's decision was the desired outcome for the Obama administration as Dept. of Justice officials had urged a single appellate ruling instead of numerous cases spread across district courts nationwide. In the wake of this decision, all but one district court (within the 8th

Circuit in North Dakota) have dropped similar lawsuits. However, the move precariously places 20 separate challenges to the Clean Water Rule in the hands of a three member panel. Of course, this November's elections and a looming Supreme Court appointment may ultimately determine the long term fate of this and other landmark environmental lawmaking.
(Compiled from Greenwire and other various other news and reference sources)

Illinois dodges toxic bullet from Ohio River algae boom

(IL AFS Environmental Concerns Report)

Recreationists and public water suppliers along Illinois' portion of the Ohio River received a major scare last year when a massive algae bloom affected over 630 miles of the river. The culprit was *Microcystis aeruginosa*, technically a cyanobacteria but long classified as a "blue green algae" owing to its appearance and ecological attributes. Of major concern was the organism's toxic byproduct, microsytin, a known hepatotoxin which can cause wheezing, skin rashes, diarrhea, vomiting and even liver damage under long term exposure.

According to a chronology presented jointly by the Ohio River Valley Water Sanitation Commission (ORSANCO) and the US Army Corps of Engineers, the bloom was first observed near Wheeling, WV in mid-August and made its way along five border states over the next six weeks. Initial cell counts (31,000,000 cells/ml) were impressive but peak toxin levels (1900 ug/L in early September) stayed below official advisory levels.

Still, advisories warning against primary contact (swimming, wading) were issued by several states and public water suppliers along the river had to significantly increase their treatment costs to avoid contamination of the water source for some five million people (none was reported). The IL Dept of Public Health and IEPA issued a Precautionary Advisory between September 25 and October 22 but weekly observations and water sampling by these agencies showed nothing above normal background levels. A saving grace for Illinois was a widespread rain event across the Ohio River valley on September 30 which rejuvenated river flows and, coupled with cooling temperatures, hastened the river's recovery. Just prior to his, the furthest downstream extent of the "Harmful Algae Bloom" (its official designation) was near Evansville, IN over 50 miles from the Illinois border at the Wabash River mouth.

The bloom had been set up by a wet period in June and July contributing nutrient laden runoff followed by a hot, dry August/September period which led to uncharacteristically stagnant conditions in the river. Similar conditions in 2014 caused municipalities along western Lake Erie (notably Toledo, OH) to curtail use of the lake as a public water source. As Illinois and other midwestern states struggle to rein in nitrogen and phosphorus inputs to our rivers, lakes and streams, the 2015 Ohio River bloom provides a sobering alarm to expedite such efforts.
(Compiled from N.Y Times 10/01/2015, ORSANCO/USACE presentation and personal communication with IEPA staff)

Stormwater Science: A Watershed & Lakes Perspective

Brian Valleskey, Illinois Lake Management Association

The timeline of stormwater management has us led us to where we are today. Mandated municipal management of stormwater and watershed protection via agency policy. For many of us stormwater runoff is the key hydrologic input for lake water levels and brings with it all the evils of the watershed. How does the interpretation and management of stormwater policy at these levels impact our lakes, streams, and other water resources? How do policy and stormwater science match up? How can I as an interested stakeholder play a part in informed decision making? These are a few questions we will touch upon during this presentation.

Solving Stormwater Challenges Through Coordination: The Calumet Stormwater Collaborative

Danielle Gallet, Metropolitan Planning Council

The Calumet Stormwater Collaborative (CSC) was formed to bring together a range of stakeholders involved with or affected by urban flooding in the Calumet region, which encompasses south Chicago and some southern suburbs. MPC has been the facilitator of CSC since April 2014, which is made up of national, state and local government partners, non-profits, private organizations and community members, and has been going strong with well-attended monthly meetings and organized working groups, which are leading to productive improvements. Some of the results include: bringing hands-on assistance, planning and resources to multiple municipalities; creation of best practice green infrastructure design templates for communities; a working paper that MPC will be releasing with CH2M on how a robust, regional stormwater modeling tool could function and provide resources in decision-making to communities; and the development of a needs assessment and preliminary market analysis report to better understand the role green infrastructure installation and maintenance can have in local jobs and work training opportunities within communities. Beyond the accomplishments of this collaborative, the specific design, engagement and retention of members has been a case study for how to develop a successful stakeholder engagement process that keeps individuals and various agencies consistently involved and productive.

Update on the Illinois Nutrient Loss Reduction Strategy

Marcia Willhite, Illinois Environmental Protection Agency

Illinois has two water quality problems to solve caused by losses of phosphorus and nitrate-nitrogen to water: 1) local impacts to in-state rivers lakes and streams, and 2) Illinois' significant contribution of nutrients that reach the Gulf of Mexico and contribute to the hypoxic zone. Over the past three years, Illinois EPA and Illinois Department of Agriculture have worked with stakeholders to develop a strategy for addressing these losses which includes actions directed at point sources, agricultural non-point sources and urban stormwater.

Establishment of the Nutrient Monitoring Council

Gregg Good, Illinois Environmental Protection Agency

The Illinois Nutrient Loss Reduction Strategy (NLRS) guides state efforts to improve water quality by reducing nitrogen and phosphorus levels in our lakes, streams, and rivers. It lays out a comprehensive suite of best management practices for reducing nutrient loads from wastewater treatment plants and urban and agricultural runoff. Recommended activities target the state's most critical watersheds and are based on the latest science and best-available technology. The NLRS also calls for more collaboration between state and federal agencies, cities, non-profits, and technical experts on issues such as water quality monitoring, funding, and outreach. The NLRS was developed by a Policy Working Group led by the Illinois EPA and the Illinois Department of Agriculture, with coordination and facilitation assistance provided by Illinois Water Resource Center-Illinois Indiana Sea Grant. Key to implementation of the NLRS is the establishment of five working groups now convened that will be continuing to work over the next two years to answer questions raised in the NLRS and monitoring progress. One of the five working groups established is the Nutrient Monitoring Council (NMC) whose overarching charge is to coordinate water quality monitoring efforts by government agencies, universities, non-profits, and industry. Formally established at its first meeting on May 13, 2015, the NMC is comprised of representatives from agencies and organizations involved in monitoring nutrients, including Illinois EPA, the Illinois State Water Survey, U.S. Geological Survey, Illinois Department of Natural Resources, sewage treatment plants, agricultural groups, and others. The NMC meets three to four times a year to coordinate the development and implementation of monitoring activities that provide the information necessary to respond to three primary charges, including (a) calculating annual nutrient loads leaving the state, (b) calculating annual nutrient loads leaving selected high priority watersheds, and (c) assessing improvements to or declines in water quality. This presentation will provide an overview of the NMC, its development, its membership, its primary charges, its activities to date, and its plans for the future.

What it means when the USGS builds a Superstation

Paul Terrio, Kelly Warner, David Fazio, Colin Peake, and Shawn Cutshaw, U.S. Geological Survey

The State of Illinois contributes substantial amounts of nutrients (nitrogen and phosphorus) to the Mississippi River and Gulf of Mexico. Relatively new methods for continuously monitoring nitrate, phosphate, and turbidity concentrations are providing a more detailed picture of nutrient concentrations and loads over time and during important low- and high-flow events. The U.S. Geological Survey (USGS), in cooperation with the Illinois Environmental Protection Agency, has implemented a network of monitoring stations that provide a continuous data record of streamflow, nitrate, phosphate, turbidity, pH, dissolved oxygen, temperature, and specific conductance. These stations are called nutrient super gages. Data from these nutrient super gages are transmitted to the USGS in near real-time and are generally available to the public within several hours of measurement. These data will provide improved data sets for water-quality modeling, trend and loading analyses, and other important data analyses. The Illinois nutrient super gage network measures nutrients and turbidity (a surrogate for suspended sediment) from the drainage areas of eight major river basins that collectively account for over 70 percent of the

land area of Illinois. The continuous monitoring at these nutrient super gages will provide a comprehensive record of nutrient concentrations and loads exported from Illinois. Comparison of the continuous water-quality data with laboratory analyses is done routinely and plans call for verification sampling during at least four storm events over the first year of operation of each nutrient super gage. This verification sampling is important for determining phosphates, turbidity, and sediment relations that are used to calculate total phosphorus loads.

Mysterious Brown Algae: A Fox River Phenomenon

Karen Clementi, Deuchler Environmental, Inc.

On behalf of the Fox Metro Water Reclamation District, Deuchler Environmental, Inc. (DEI) has been collecting biological and water chemistry data on the Aurora-area of the Fox River for the past several years. During this study, DEI started documenting a new kind of algal bloom in 2013 that was discovered to be a diatom species, a type of brown algae. Other types of algae have high public and scientific prominence, such as blue-green algae (cyanobacteria) and green algae that cause a large portion of the Fox River to be included on the 303(d) list as an impaired water for nuisance algae; however, diatom blooms are a newly-observed phenomenon on the Fox. DEI collaborated with the several entities to investigate the details of this bloom. Subsequently, DEI was able to use the 2013 and 2014 ambient condition data to predict a 2015 diatom bloom. This early warning information fostered positive public relations with recreational users and environmental groups, and provided information to local governmental bodies and the IEPA to utilize when they received citizen inquiries. This presentation will focus on DEI's diatom bloom monitoring from 2013 to 2015 and possible causes of these blooms.

Health Effects of Freshwater Harmful Algal Blooms: People, Pets, and Livestock

Wanda M. Haschek and Val R. Beasley, University of Illinois

In the Midwest, harmful algal blooms occur in lakes, reservoirs and stagnant rivers, and toxin production is promoted by high temperatures and concentrations of nutrients, especially phosphates and nitrates. People, pets, livestock and wildlife, including birds and fish, have been harmed by algal blooms after skin contact, ingestion, and inhalation. In the Midwest, cyanobacteria that produce microcystins and anatoxins are most often involved. Microcystin contamination recently caused Toledo, Ohio, to shut down its public water supply for several days. Microcystins mainly target the liver. Clinical signs include vomiting, diarrhea, and death. Kidney patients on dialysis in Brazil died when microcystin-contaminated water was used. Microcystin poisoning also causes chronic liver failure and possibly cancer. Anatoxins affect the nervous system and cause deaths from respiratory failure within minutes or hours. Because other types of toxins are sometimes produced, clinical signs from harmful algal blooms may also involve skin and eye irritation or damage. Apart from the problems in Brazil, relatively small numbers of human deaths from freshwater harmful algal blooms have been reported, but animal deaths are more common and occur sporadically in Illinois and other states. If exposure to algal toxins is suspected, water samples should be collected for possible toxin analysis and medical or veterinary care sought. In event of death, postmortem studies should be performed as soon as

possible to rule out other causes of disease and determine if the findings are consistent with algal toxicity. Specific cases of algal toxicity in pets and livestock will be presented.

Spatial and Temporal Effects of Wastewater Treatment Effluent on Fish Communities in an Illinois River Tributary

Bethany Hoster, David Petry, Clinton Morgeson, Sarah Huck, Robert E. Colombo, Eastern Illinois University

Artificial impoundments and wastewater treatment effluent have the potential to alter water quality and flow regimes of rivers. During periods of low flow, wastewater can account for the majority of a river's composition downstream of an effluent discharge, causing changes in water quality and impacting biotic communities. The Sangamon River is impounded in Decatur, IL, and approximately 4 miles downstream receives effluent from the Sanitary District of Decatur. To determine the impact of effluent, we assessed fish communities using electrofishing above and below the effluent discharge in 2013 and 2015. Additionally, we assessed water quality parameters monthly, including dissolved oxygen, pH, temperature, conductivity, alkalinity, hardness, total nitrates, and total phosphates. River discharge was recorded monthly. Catch per unit effort differed between upstream and downstream reaches in 2013, as well as between years for both reaches. Although shifts in relative abundances of families were observed between 2013 and 2015, no significant changes in the relative abundance of sport fishes were found. Water quality differed between reaches and years, with river discharge being the largest cause of variance. Data showed homogeneous water quality throughout the river when river discharge was greater than 200 cubic feet per second. These results indicate water quality in the Sangamon River is impacted by effluent discharge, as well as by temporal variations. These results also suggest effluent discharge effects water quality the greatest during periods of low flow from the Lake Decatur Dam.

The Bioaccumulation of Mercury and Selenium in Fish from the Lower Illinois River

Kimberly Shoemaker, Caleb Wehling, Ben Lubinski, & Z.-Q. Lin, Southern Illinois University-Edwardsville

Mercury (Hg) is a well-known pollutant that is prevalent in the Illinois-Missouri area due to a high concentration of coal fired power plants. Selenium (Se) is an essential micronutrient that is required for the production of certain proteins. It has been reported that selenium may have the ability to mitigate mercury's toxic effects through the formation of more stable compounds. This study explores the possibility of using the molar ratio Se:Hg in fish tissue as a bioindicator of mercury's environmental effects. Fish samples of different local common species were collected from the Lower Illinois River near Grafton, Illinois. Each fish was dissected for brain, heart, kidney, liver, gill, skin, scale, and muscle tissue samples. The samples were acid digested and analyzed for concentrations of selenium and mercury using ICP-MS. Mercury and selenium concentrations and Se:Hg molar ratios were compared among different tissues and species to determine which tissue(s) or species are more or less affected by mercury and have a higher potential for mercury toxicity. Diet effects on the molar ratio Se:Hg were also examined. Results

show that Se:Hg molar ratios were lowest in muscle tissue for all species surveyed, with the exception of gizzard shad, indicating that muscle tissue is most affected by mercury bioaccumulation. Filter feeders were found to have lower muscle tissue Se:Hg molar ratios indicating these species accumulate more active mercury and represent a higher toxicity risk for consumers than non-filter feeders.