Illinois Chapter of the American Fisheries Society
57th Annual Conference

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Greg Whitledge – President
Philip Willink – President-Elect
Blake Ruebush – Secretary
Rich Lewis – Treasurer
Jim Lamer – Past-President
Karen Rivera and Kevin Irons – Members at Large

Abstracts

Oral Presentations

Session I: Tuesday February 26, 1:10-3:10 PM

IDNR Division of Fisheries careers and the application process

Mike McClelland, Illinois Department of Natural Resources, Springfield, IL

Restoration and management of a floodplain fish community at The Nature Conservancy's Emiquon Preserve

Doug Blodgett, The Nature Conservancy, Lewistown, IL
Sally McClure, The Nature Conservancy

In 2007, The Nature Conservancy signed a Cooperative Fisheries Management Agreement with the Illinois Department of Natural Resources (IDNR) and fish community restoration began at the Emiquon Preserve along the Illinois River in west-central Illinois. A century earlier, this floodplain supported phenomenal natural abundance and diversity before isolation from the river by a levee and conversion to intensive agriculture. To start restoration of the fishery, we used agricultural pumps to lower water in ditches and rotenone was applied to eradicate the existing fish community that was dominated by rough fish including common and grass carp. Over the ensuing 5 years, 1.7 million fish (fingerlings and brood stock) of 33 native species were stocked into waters that accumulated primarily from direct precipitation. In 2009, public fishing opened on a portion of the preserve with a conservative harvest limit on Largemouth Bass (18-inch minimum and 1/day) based on a goal of maintaining a robust population to help control carp; within a few years the site was deemed one of the best bass fisheries in Illinois by some of the approximately 1000 visitors who fished here annually. With levee intact, the site remained isolated from overland flow from the Illinois and Spoon Rivers

until 2013, when the record flood on the Illinois overtopped 1800 feet of levee for 6 days. Subsequent floods in 2015 and 2016 also overtopped a short section of the levee for shorter periods. Annual fish monitoring by IDNR and the Illinois Natural History Survey and ancillary sampling by the Conservancy has documented 22 of the 33 stocked species and an additional 22 species (5 nonnatives) that were not stocked. In 2016, we completed a one-of-a-kind managed connection between the preserve and the Illinois River. In addition to its primary function of managing water, the structure is designed to facilitate control and monitoring of fish movements between the preserve and river as well as other research, which has included the use of complex sound and CO_2 to manage fish movements.

Lake Michigan Fisheries Management: Meeting Challenges with Sound Science, Partnerships and Cooperative Agency Action

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The Illinois Department of Natural Resources (IDNR) has management authority over 976,640 acres of Lake Michigan, or about 7% of the lake's total surface area. Other fisheries management authorities include DNRs from Indiana, Michigan and Wisconsin and the Chippewa-Ottawa Resource Authority (CORA), representing several Michigan-based Native American tribes. The lake and its fish community have experienced many challenges over the years brought on by habitat degradation, pollution, commercial overfishing and numerous aquatic invasive species. The IDNR uses boat DC electrofishing, gill nets and beach seining to assess sport and prey fish populations through a series of five annual fish stock assessments. Data from Illinois assessments are shared with agency partners, often combined with results from other state (e.g., INHS Lake Michigan Biological Station) and federal (e.g., USFWS and USGS) monitoring programs and used to guide management decisions on fish stocking, harvest regulation and species rehabilitation and recovery. Since 1981, cooperation and partnership among fisheries management authorities has been guided by agency participation in A Joint Strategic Plan for Management of Great Lakes Fisheries (JSP) and its Lake Committee structure/process, all facilitated by the bi-national Great Lakes Fishery Commission. A major strength of this plan is that it fosters cooperation among jurisdictions without supplanting mandated and legal responsibilities of individual state, provincial or tribal management authorities. Examples of cooperative fisheries management advanced through participation in the JSP include: Lake Michigan fish-community objectives; environmental objectives and priorities; lakewide predator assessment; Lake Trout rehabilitation strategy; salmonine stocking strategy; and a predator-prey ratio analysis.

Growth Chronology and Population Characteristics of Channel Catfish and Freshwater Drum across six Illinois Rivers

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James Lamer, Illinois Natural History Survey
Jason DeBoer, Illinois Natural History Survey
Andrya Whitten, Illinois Natural History Survey
Ben Lubinski, Illinois Natural History Survey
Jerrod Parker, Illinois Natural History Survey
Robert Colombo, Eastern Illinois University
Cassi Carpenter, Eastern Illinois University
Greg Whitledge, Southern Illinois University Carbondale
Neil Rude, Southern Illinois University Carbondale

Channel Catfish (*Ictalurus punctatus*) and Freshwater Drum (*Aplodinotus grunniens*) are two prominent North American sportfishes occupying a similar ecological niche in many river systems. Comparison of historically validated ageing structures and length frequency data can reveal dynamics of fish populations, including their recruitment, mortality, and individual growth patterns. In addition, tracking years of strong and weak growth through biochronological inference can increase understanding of the biotic and abiotic factors affecting individual reaches and rivers. This collaborative project covers reaches of six major rivers spanning Illinois, including the Wabash, Ohio, Illinois, Kankakee, Iroquois, Pools 16, 19, 20, 21, and 25 of the upper Mississippi River, as well as a small section of the lower Mississippi River. All fish were caught in 2017 and 2018 using DC electrofishing gear as part of a long term survey submitted annually to the Illinois Department of Natural Resources. Preliminary results showed that freshwater drum had the fastest growth, high mortality rates, and several recent years of low recruitment in the Ohio River. The Illinois and Wabash rivers had slower growth, lower mortality rates and few weak year classes. For catfish, growth rates, size structure, and mortality rates showed few significant differences among all of the rivers. Incorporating chronology factors by using incremental annuli distances will help reveal why we are seeing these trends. Understanding population dynamics and growth chronology of two common predatory fish spanning Illinois waterways is important for creating potential management strategies and determining their initial necessity.

Shooting for an estimate: Bowfishing tournament harvest and bow angler habits in Illinois

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Jeffrey Stein, Illinois Natural History Survey

Bowfishing presents a unique challenge to management due to the nature of archery and the lethality of the method. The few studies describing bowfishing harvest suggest that bowfishing tournaments harvest large numbers of fish at high rates, which may leave populations vulnerable to over-exploitation. In light of the growing popularity of bowfishing, we aimed to

estimate bowfishing tournament effort and harvest rates, and to characterize bow angler habits. We conducted point access creel surveys at sixteen bowfishing tournaments throughout Illinois from June 2017 to August 2018. We recorded fishing effort and catch composition from participating teams (n = 137), and surveyed individual participants about their recreational angling habits and target species favorability (n = 147). Tournament participants harvested fish at a rate of 1.73 fish per angler hour, with carp, sucker and gar species accounting for 86%, 9% and 4% of harvest respectively. While we found evidence of regional variation in bowfishing tournament harvest, tournaments held on the same waterbodies in Illinois showed little variation in catch per unit effort. Bowfishing was more important to bow angler fishing activity than rod-and-reel angling, however the majority of bow anglers used multiple harvest methods. Bow angers reported favoring multiple carp species at a higher frequency than native species groups. The conclusions of this study will inform management decisions that promote sustainable bowfishing harvest in Illinois, and have implications in the management of invasive carp species.

Nine-year Trends of Blue Suckers in an Un-impounded Midwestern River

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Cassi Moody Carpenter, Eastern Illinois University
Robert Colombo, Eastern Illinois University

The Blue Sucker, *Cycleptus elongatus*, is a unique, large-bodied catostomid endemic to North America. The lower Wabash River supports an assemblage of this species that can be sampled with greater success than in deeper rivers. Understanding the demographics of this population is an important measure to inform the conservation of this vulnerable species. This research explores nine years of Blue Sucker samples (n=499) collected via randomized DC boat electrofishing for the Illinois Long Term Wabash River Fish Population Monitoring Program, 2010-2018. We are exploring changes in size structure (total length range 66-775mm, mean 616mm) and relative abundance, and identifying trends in the population over time. We have discerned a significant declining trend in average relative weight for these Blue Suckers across the last nine years, and correlate this trend with changing river and community-level conditions. With this research, we seek to contribute to the growing body of literature regarding Blue Suckers and their conservation by measuring the static and shifting demographics of an assemblage of this species.

Paddlefish Movement and Habitat Use Using Acoustic Telemetry in Pools 14-19 on the Upper Mississippi River

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Kevin Irons, Illinois Department of Natural Resources
Kyle Mosel, U.S. Fish and Wildlife Service
James Lamer, Illinois River Biological Station

The construction of navigational dams on the Upper Mississippi River (UMR) has disrupted movement and changed available habitat of the highly migratory Paddlefish. The gates at each dam are open for different periods of time, allowing varying streamflow and opportunities for passage throughout the river. Lock and Dams (LD) 14,15, and 19 are infrequently at open river conditions, making it difficult for fish passage. To better understand native fish passage and habitat use in this poorly understood region, we acoustically tagged 121 Paddlefish and tracked their movements manually and with stationary receivers in Pools 14-19. Our manual and stationary receivers detected 88% of our tagged Paddlefish. Our results indicated that 14 of our tagged fish successfully crossed over at least one dam barrier, either upstream or downstream direction. Paddlefish have demonstrated the ability to cross difficult barriers: 5 passages at LD15 and 3 passages at LD14. Most Paddlefish detections were observed in backwater habitat for 2018 summer water conditions and have been observed to move towards channel borders in the late fall. A clear understanding of Paddlefish movement and habitat use in the UMR will allow researchers and biologists to better understand dam passage of other fishes and evaluate the impacts of invasive species invaders in this area. Additionally, preliminary data of Paddlefish movement provides beneficial information when evaluating the effects of invasive species sound deterrents at these locations on native migratory species.

Session II: Tuesday February 26, 3:30-5:30 PM

Minnows on the EDGE: Conservation prioritization incorporating evolutionary distinctiveness

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Minnows of the family Leuciscidae (Cyprinoidei) are diverse in North America, numbering over 300 species. Minnows face many threats, and some of these species are of great conservation concern in the United States. With recent advances in phylogenetic inference of cypriniform fishes, progress is being made towards an "All Cypriniformes Tree of Life", which currently incorporates phylogenetic and phylogenomic data for over 2000 species of the order. Robust phylogenies can be utilized to inform conservation prioritization because they provide data on phylogenetic diversity and evolutionary distinctiveness. We calculated EDGE scores for North American species of Leuciscidae, which incorporate phylogenetic data with IUCN Red List global rankings to assign extinction probabilities. These scores thus combine measures of evolutionary distinctiveness and global endangerment (EDGE) to allow for prioritization of conservation efforts. Of the species found in the United States, numerous species of endangered and threatened minnows have EDGE scores within the range of critically endangered species of minnows, demonstrating that these species represent important evolutionary lineages despite a lower extinction risk. In addition, within each IUCN Red List ranking we found variation in EDGE scores due to evolutionary distinctiveness, which may be informative for decisions regarding conservation of species at the same endangerment rank. By using a metric that

incorporates phylogeny, information can be provided to prioritize conservation efforts towards species that represent evolutionarily distinct components of fish fauna.

Potential beneficial effects of invasive Silver Carp on native fishes

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Substantial research attests to the injurious impacts invasive Silver Carp (*Hypophthalmichthys molotrix*) have on Midwestern U.S. river systems. Particularly, the dietary overlap between Silver Carp and native planktivores has resulted in declined condition and abundance of these species in areas where silver carp dominate the community (i.e., the lower Illinois River). However, additional research demonstrates Silver Carp may benefit native non-planktivorous fishes because of the carp's ability to produce young at a large scale providing an abundant prey source for native piscivores, and their nutrient rich fecal pellets may enrich benthic forage quality for native benthivores. Potential positive effects of Silver Carp for native fishes are not fully understood, and research is limited in natural systems. Here we determine whether Silver Carp benefit non-planktivorous native fishes in the lower Illinois River (i.e., Peoria, LaGrange, and Alton pools) by examining native piscivore and benthivore body condition over time utilizing two standardized long-term data programs. We found a significant positive relationship between Silver Carp abundance and native benthivore body condition. Moreover, visual trends indicate increased body condition during and immediately after strong Silver Carp year classes (2008 & 2014) for both native piscivores and benthivores. Therefore density-dependent effects may exist where juvenile Silver Carp populations and benthic nutrient levels must reach a threshold before they are exploitable (i.e., beneficial) resources. We suggest more years of data that incorporate strong Silver Carp year classes may be needed to clarify potential positive effects of Silver Carp for native non-planktivorous fish

Modular electric barrier: A scalable tool for manipulating and deterring fishes in freshwater ecosystems

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A portable and modular electric barrier was designed as a scalable system to deter, guide, or immobilize freshwater fishes across a range of waterbody dimensions. The modular electric barrier consists of 1) generators which provide power to 2) pulser cabinets which modulate

power output to 3) anode and cathode steel cables. Each pulser cabinet can provide up to 5 kW of power output, and multiple pulsers can be linked to create a larger barrier. Here, we report findings from two experiments that assessed the barriers effectiveness (i.e., the ability to deter fish activity from a location). Activity rates (detections individual-1 hr-1) of seven fish species (4 invasive, 3 native) were quantified (PIT tagged; RFID antenna) in response to the operation of the modular electric barrier. Experiment 1 indicated that an overwhelming majority (99.9%) of fish detections occurred while the barrier was off. Moreover, the responses of all fishes were similar, indicating no bias among native and invasive species. Although responses were strong, several detections were documented while the barrier was on, indicating the barrier was not 100% effective. Experiment 2 found that low, medium, and high barrier strengths affected fishes differently. Findings demonstrated that some species exhibited a greater sensitivity to low barrier strengths than others. Yet, at high barrier strengths, all species were strongly affected. Overall, findings indicate that the electric barrier was effective at deterring all fishes, suggesting the modular electric barrier may be effective at deterring a diverse assortment of species.

Comparison of Resource Use by Invasive Black Carp and Native Fish Using Isotopic Niche Analysis

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Gregory Whitledge, Southern Illinois University

Black Carp (*Mylopharyngodon piceus*) is a large, molluscivorous species native to eastern Asia and is listed as an injurious species under the Lacey Act due to their potential threat to native riverine mollusks. Available evidence indicates that Black Carp have become established in parts of the Mississippi River basin. Black Carp clearly present a potential threat to native mussels as well as other prey, and are a potential competitor for native fish species, however the true ecological impacts of Black Carp within their invaded range are unclear. The objective of this study is to compare the trophic resource use by Black Carp and Freshwater Drum in the Mississippi River and its tributaries, by assessing gut content and stable isotope (N and C) niche overlap of these two species. Results to date indicate that Black Carp and Freshwater Drum have relatively broad isotopic niches with approximately 50% overlap when encompassing about 95% of the data using Bayesian ellipses. Additional studies are needed to assess trophic interactions between Black Carp and native species.

Spatial and Temporal Patterns of Bigheaded Carp Density in the Upper Illinois River: A Tool to Inform Removal Efforts

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Bigheaded carps (*Hypophthalmichthys* spp.) have invaded much of the Illinois River, with their invasion front currently located in the Dresden Island pool, approximately 75 km from Lake Michigan. In an effort to prevent further upstream movements, contracted harvest takes place in the upper Illinois River to diminish population abundance. Due in part to this effort, bigheaded carp density at the invasion front has declined since 2012. However, maximizing harvest becomes challenging at low abundances. Identifying areas within pools where carp congregate could augment removal efficiency, but these areas may change throughout the year due to the dynamic nature of large rivers. This study sought to quantify spatial and temporal patterns of bigheaded carp density in the upper pools of the Illinois River and determine if these patterns were related to environmental conditions. Hydroacoustic surveys were conducted every other month from March-November in 2017 and 2018 to estimate bigheaded carp density throughout Dresden Island and Marseilles pools. Simultaneously, water quality measurements including temperature, dissolved oxygen, depth, and chlorophyll-a concentration were collected. Hydroacoustic results indicate low densities of bigheaded carps in main channel habitats, and highly variable usage of backwater habitats throughout the year. Initial analyses suggest main channel discharge, depth, and chlorophyll-a concentration may help explain bigheaded carp spatial and temporal patterns within a pool. These results will be useful as a means to inform locations of contracted harvest in the upper pools of the Illinois River, and to aid in understanding bigheaded carp habitat usage.

Silver Carp population genetics from tributaries of a large Midwestern river

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Silver Carp are a non-native fish species that have deleterious effects on the ecosystems they invade. Because of their destructive nature, fisheries managers devote substantial time and effort to limit the spread of these fishes. Better understanding patterns of Silver Carp reproduction and dispersal can help to better manage this invader. To determine spawning locations, we used drift nets and larval push nets in three tributaries the Wabash River to capture larval *Hypophthalmichthys* (Silver and Bighead Carp) in 2016 and 2017. Further, we used microsatellite loci to determine if genetic differences existed between larval *Hypophthalmichthys* in our three study tributaries. In total, 1,246 *Hypophthalmichthys* were collected from three tributaries, with the Little Wabash and Embarras River producing roughly 83% and 16% of larvae. Having large enough sample sizes at two sites on the Little Wabash River and one site on the Embarras River, we performed genetic analyses and found all three sites had high levels of genetic diversity. Additionally, we found minimal inbreeding or outbreeding present. The middle Little Wabash and lower Embarras River samples were found to be genetically different. We expect this research to improve our understanding of Asian carp reproduction and help fisheries professionals to better mediate their spread.

Physiological status of silver carp in the Illinois River: An assessment of fish at the leading edge of the invasion front

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Silver Carp have the potential to move from the Illinois River into the Great Lakes via the Chicago Area Waterway (CAWS). Interestingly, the leading edge of carp has not advanced closer to Chicago in almost a decade, despite a lack of any barrier. Defining why carp are NOT moving upstream will allow predictions of why they MAY move upstream in the future. The current study tests the hypothesis that the lack of upstream movement of silver carp is related to the presence of anthropogenic bioactive chemicals (ABCs) in the Illinois River. To test this hypothesis, water samples were collected from 7 sites along the Illinois River, originating upstream of the leading edge of silver carp, extending downstream, and analyzed for over 600 ABCs. Next, liver and blood were collected from silver carp at the leading edge and two downstream populations. Liver samples were analyzed using RNA-seq to quantify gene expression, while blood samples were analyzed for indices of nutrition. Results showed a number of ABCs were higher upstream of the leading edge relative to downstream, including pharmaceuticals and volatile organic compounds. Livers from silver carp at the leading edge had elevated activity of genes related to energy use, drug detoxification, and cell death, and downregulated activity of DNA repair, relative to both downstream locations. Little evidence was seen for nutritional deficits in fish from the leading edge. Together, results demonstrate a change in water quality upstream of the leading edge, and differences in molecular indices of contaminant exposure in carp from the leading edge. Results are further discussed in the context of water quality improvements in the CAWS, and the management of Silver Carp.

Reproduction and growth in Silver Carp from edge and core populations in the Illinois River

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Megan Zurliene, University of Illinois at Urbana Champaign
Cory Suski, University of Illinois at Urbana Champaign
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Silver Carp are a highly successful invasive species and have been able to invade several watersheds in the United States. When animals are expanding their range, individuals at the edge of the range are often phenotypically different than individuals at the core (edge-core effect), with edge individuals having faster life-histories. To examine if this effect is occurring in Silver Carp in the Illinois River, I assessed spawning traits and growth rates in Silver Carp from

the La Grange Reach, Marseilles Reach, and Starved Rock Reach between 2017-2018. Silver Carp from Marseilles had faster growth rates than Silver Carp from the La Grange Reach, but this effect was not true of the Starved Rock Reach versus the La Grange Reach. Spawning traits did not differ between reaches, but Silver Carp released gametes in multiple batches between May-July. Histological assessment revealed that Silver Carp are capable of spawning earlier or later than this time frame. While female Silver Carp recruit oocytes indeterminately, males develop spermatozoa determinately and must allocate their sperm reserves strategically during the spawning season. Maintenance of elevated testosterone may allow females to maintain spawning-capable status for a protracted period of time. Results from this study reveal that, while Silver Carp at the invasion front are growing faster than those in downstream reaches, annual spawning patterns do not differ.

Session III: Wednesday February 27, 8:00-10:00 PM

Habitat selection by juvenile Largemouth Bass: A comparison of macrophytes and woody habitat

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Physical structures within the littoral zone often function as a refuge from predators as well as a source of increased prey abundance for many fish species. However, suitability as a refuge may differ among habitat types, and comparisons between naturally occurring habitats are rare. Additionally, habitat selection may shift throughout ontogeny, as foraging needs and behaviors change. To test for these changes, juvenile largemouth bass were divided into three size classes and placed into tanks with three equal sections of macrophyte, open, and woody habitat. Each habitat treatment was repeated both with and without prey, and presence/absence of fish in each habitat was recorded for each trial. The two smallest size classes selected macrophytes over woody habitat, whereas the largest size class did not display a difference in selection of either habitat. In the absence of prey, overall selection was significantly greater for macrophytes, however there was no difference in selection of either habitat when prey was present. Additionally, a second experiment was conducted to observe juvenile largemouth bass growth within each habitat type. Net enclosures were built within two experimental ponds, each containing either macrophytes or woody habitat. Fish were added to each enclosure, held for four weeks, and removed to measure differences in total length. No significant differences in growth were found between habitat types. These results show that habitat selection by juvenile largemouth bass can shift throughout ontogeny, and that such shifts may be driven by prey availability. However, the type of habitat structure, whether it be macrophytes or woody habitat, may not be a key factor affecting growth.

Investigating the Relationship Between Habitat Type and Abundance of *Micropterus* Species in Two Dammed Midwestern Rivers

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Cassi Moody Carpenter, Eastern Illinois University
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Robert Colombo, Eastern Illinois University

Flow regimes have been altered by the construction of dams on many lotic systems in the United States. Physical habitat changes within these systems in response to changed hydrology may affect the community structures of fish species therein. River restoration through the removal of dams may revert the physical habitat characteristics of impounded reaches towards that of a free-flowing system and subsequently invite a fish community shift. We investigated the effects of two separate low-head dams on the Vermilion River and North Fork Vermilion River in eastern Illinois on the community structure of Smallmouth Bass (*Micropterus dolomieu*), Spotted Bass (*Micropterus punctulatus*), and Largemouth Bass (*Mictropterus salmoides*). Data were collected from 2012 to 2015 using multiple gear types at six study sites on each river; two sites in the below-dam reach, two sites within the impounded reach, and two sites upstream of the impounded reach. Catch per unit effort (CPUE) was used to estimate fish abundance within each study site. Smallmouth Bass CPUEs were significantly different between site types in both the North Fork (P-value= 0.01) and the Vermilion (P-value=0.03). Largemouth Bass CPUEs were only significantly different between sites in the North Fork (P-value= 0.02). Spotted Bass showed no significant differences in CPUE between site types in either river. Variation in abundance of each species may be driven by their physical habitat requirements. Future research will investigate the effect of dam removal on changes in available physical habitat and the community structure of *Micropterus* species.

Comparing the effects of artificial habitat and coarse woody habitat on macroinvertebrate communities and Largemouth Bass growth

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Anthony Porreca, Illinois Natural History Survey
Joseph Parkos III, Illinois Natural History Survey
David Wahl, Illinois Natural History Survey

Lentic ecosystems are negatively affected by habitat degradation due to reservoir senescence and riparian zone development. The addition of coarse woody habitat (CWH) and artificial habitat (e.g., plastic fish attractors) is a popular management strategy used to enhance systems that have experienced declines in habitat availability. However, the mechanisms by which CWH and artificial habitat additions influence aquatic food webs remain understudied. We introduced either artificial habitat structures or CWH (Quercus alba) into ten 0.04-ha experimental ponds to test whether macroinvertebrate communities and largemouth bass growth differed between introduced habitats. The experiment ran for two months and

structures were allowed to condition for one month prior to stocking juvenile largemouth bass. Macroinvertebrate communities were similar between habitat types. However, more taxa were found on the artificial structures and macroinvertebrate communities colonizing CWH appeared to increase relative to artificial habitat by the end of experiment. Largemouth bass growth did not differ between CWH and artificial habitat. Given these similarities, the decision by managers to introduce either habitat type may be dependent on differences in environmental persistence and costs associated with artificial structure or CWH. Longer experiments may be necessary to determine the maximum influence of these habitats on primary and secondary productivity, particularly as CWH conditions.

The Expression of Bluegill Behavioral Types in Chronically Heated Environments

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Joseph Parkos, Illinois Natural History Survey
Dalon White, University of Illinois
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Global climate change is expected to exert selective pressures on behavioral phenotypes within freshwater ecosystems through environmental changes associated with chronic warming of water temperatures. We compared the behavioral profiles of Bluegill (*Lepomis macrochirus)* from three power-plant cooling reservoirs to those of bluegill from three ambient reservoirs to investigate whether long-term exposure to increased water temperatures influences the expression of behavioral phenotypes. Power-plant cooling reservoirs were considered as model systems for global warming due to their year-round elevated water temperatures (~5°C) when compared to ambient reservoirs. We quantified activity, boldness, and exploration through 30-minute assays in a common laboratory setting that tested the spatial usage and response of individual fish to a suite of situations involving novel items and a predator, Largemouth Bass (*Micropterus salmoides*). For each assay, multiple measurements were recorded for each behavior, leading to the development of a principal component score (PCA) for activity, boldness, and exploration for each individual fish. PCA scores for each behavior and the presence of behavioral syndromes (correlations between behaviors) were compared between lake types (heated or ambient). We found that activity and boldness levels were consistently higher in Bluegill from heated lakes when compared to those from ambient lakes. We found limited evidence for consistent patterns of behavioral syndromes between lake types. Our results suggest that chronic exposure to warming can influence behavioral expression, providing insight for how the behavioral composition of Bluegill populations may be modified in chronically warmed systems.

Estimating Daily Growth of Age-0 Channel Catfish in a Commercially Exploited Midwestern River

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Periods of variable discharge experienced by the lower Wabash River tends to overlap with Channel Catfish (*Ictalurus punctatus*) reproduction; this leads to variable conditions during their crucial larval development stage. Furthering our understanding of abiotic impacts alongside expanding upon the cryptic information published on age-0 Channel Catfish would be advantageous to multiple facets of understanding their life history. While a male will spawn multiple times throughout the spawning season, reproduction is dictated by the females, only becoming gravid once annually; females becoming gravid at separate times leads to there being non-coeval cohorts. In their larval stages, endogenous feeding promotes a high and constant growth rate, but switching to exogenous feeding and entering the juvenile stages leads to growth dependent on the environmental conditions. We observed stable reproduction in varying conditions over four years of sampling ($p > .05$). Age and length proportions indicate a spawning season between May and early-August. Past surveys have shown there are multiple cohorts throughout the spawning season in the Wabash River; investigations into growth patterns of these cohorts by estimating daily growth from the otoliths can offer insight into which cohorts may best be utilizing their available resources. Monthly growth rates from 2018 suggest an analogous growth pattern independent of hatch date. Any variations in growth patterns could come from present conditions, normal seasonal variation, or a combination of both. Results from this study could aid in creating a recruitment index for Channel Catfish in this exploited lotic system.

Dominance and diet are unrelated within a population of invasive crayfish

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Laboratory behavioral experiments are an important tool in ecology and evolution, but whether these behaviors accurately reflect the field function of organisms remains understudied. Directly connecting laboratory behaviors to field interactions would increase understanding of a variety of organisms. A recent study proposed using stable isotopes of carbon and nitrogen to link laboratory behaviors to field function of individuals, but failed to find a relationship between laboratory dominance and trophic position within a population of the invasive rusty crayfish *Faxonius rusticus*. We replicate this study here, assessing whether methodological decisions around tissue analyzed for stable isotopes, laboratory acclimation time, and timing of primary consumer collection may have affected the result. We hypothesized more dominant crayfish would have higher trophic positions and tissue with faster turnover rates may exhibit a stronger association between laboratory behavior and recent field function. We tested this

relationship using individuals from a single population of *F. rusticus*, and related laboratory dominance to stable isotope-derived trophic position using linear regression. We failed to find a relationship between dominance and trophic position, regardless of tissue used for stable isotope analysis, acclimation time in the laboratory, and timing of primary consumer collection. Future studies should consider alternative behaviors that may better relate to function in the field and also investigate whether laboratory behavior and field function are related between, rather than within, populations.

Control of red swamp crayfish in Chicago Region to reduce risk of spread across Great Lakes Basin

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Crayfish are the largest freshwater invertebrate and pose a serious threat to the ecosystems in which they invade. They have been shown to decrease macroinvertebrate density and diversity, displace native crayfish, and alter fish communities. We have identified a reproducing population of red swamp crayfish (*Procambarus clarkii*) in the Chicago Area Waterways System (CAWS). This species has been introduced in Lake Erie, small ponds in Wisconsin, and streams in Michigan, as well as in Africa, Asia, and Europe. Due to the proximity of the CAWS to Lake Michigan and undisturbed streams with native crayfish populations, *P. clarkii* is potentially able to spread into more areas. During summer 2018, we began a removal effort of *P. clarkii* in the North Branch of the Chicago River and in the North Shore Channel. Additionally, we tested for the optimal number of nights for traps to be left in the water to achieve the highest catch rate and used mark and recapture methods to attempt to test the distance that crayfish travel in this system. In the North Branch of the Chicago River, we have recaptured 51 crayfish, traveling an average distance of 2.53 meters per night. In the North Shore Channel, we have recaptured 11 crayfish, traveling an average distance of 6.41 meters per night. Previous sampling indicated that the average CPUE (catch per unit effort) in this system was 0.843. The current CPUE of *P. clarkii* in our removal study area is 0.453.

Updated occurrence data, species distribution modeling, and potential management of the invasive scud *Apocorophium lacustre*

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Erin O'Shaughnessey

The Mississippi River, Great Lakes, and Upper St. Lawrence River Basins is a system which has been greatly impacted by introduction of invasive species, including invasive amphipods. We sought to evaluate the current distribution and predict the potential distribution of the scud

Apocorophium lacustre in this system. In the summers of 2017 and 2018, we sampled a total of 30 sites in the Chicago Area Waterway System (CAWS). We then developed a species distribution model (SDM) combining *A. lacustre* occurrence data with the EarthEnv GIS layers to model habitats suitable to invasion by *A. lacustre* using boosted regression trees. We found that *A. lacustre* was not present in any of our 2017 or 2018 sampling sites in the CAWS, including the Dresden Island and Brandon Road Pools. Our SDM predicted the potential distribution and evaluated habitat associations for *A. lacustre* with a high AUC value of 0.994. Little information exists regarding the efficacy of both the existing electric barrier and potential carbon dioxide (CO2) barriers in the CAWS system for amphipod species such as *A. lacustre*. We plan to construct lab-scale electric and CO2 barriers and test the effectiveness of these barriers in limiting amphipod movement. Our lab-scale barriers and SDM predictions of where *A. lacustre* is likely to establish populations in these basins can be used to guide management efforts in preventing the spread of this scud.

Session IV: Wednesday February 27, 10:15-12:00 PM

Regulatory Permitting and Natural Resource Laws: A Brief Look at Environmental Reviews and Your Role as Natural Resource Managers and Researchers

Nathan Grider, Illinois Department of Natural Resources, Springfield, IL
Brad Hayes, Illinois Department of Natural Resources

How can they build that there? Did they consider all the impacts to the environment? Not in my backyard! Each year, thousands of regulatory decisions that have the potential to change environmental conditions and impact natural resources are made throughout Illinois by state, local, and federal agencies. These decisions are often complicated and involve negotiations with many stakeholders. The complex laws requiring agencies to consider environmental impacts in their regulatory decisions include, but are not limited to, the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, Interagency Wetland Policy Act of 1989, the Clean Water Act, and the Rivers, Lakes and Streams Act. The task of reviewing these regulatory decisions for compliance with state natural resource laws is largely the responsibility of the lesser-known Consultation Section of the Illinois Department of Natural Resources (IDNR). With help from a publicly accessible database and Geographic Information System program known as Ecological Compliance Assessment Tool (EcoCAT), and coordination with other IDNR experts and academic colleagues, the Consultation Section works to avoid and minimize environmental impacts and keep government agencies and private developers in compliance with natural resource laws on over 10,000 projects each year. Projects range from large wind farms to minor culvert replacements. This presentation will provide an overview of laws requiring environmental compliance in government actions with a focus on aquatic natural resources and discuss their application and limits. We will also highlight projects with interesting outcomes and reveal your important role in these regulatory decisions.

Effects of temperature acclimation on the critical thermal limits and swimming performance of Bigeye Chub *Hybopsis amblops*

Qihong Dai, University of Illinois Urbana Champaign, Urbana, IL
Cory Suski, University of Illinois Urbana Champaign
Nathan Grider, Illinois Department of Nature Resources
Trent Thomas, Illinois Department of Nature Resources

Climate change suggests fishes are more likely to experience extreme variation in thermal conditions. Industrial processes can also expose fishes to thermal stressors through effluent. Thermal stressors can not only directly impact the survival of fishes, but also indirectly impact fish populations through a number of aspects, including impaired swimming performance. Bigeye chub (*Hybopsis amblops*) is a state-endangered species in Illinois. Little temperature tolerance information exists on this species. The goal of this study was to use laboratory assays to define the impacts of two acclimation temperatures on the performance and behavior of bigeye chub. To accomplish this, we conducted two assays: critical thermal maximum (CTmax) testing for upper thermal tolerance limit, as well as swimming performance testing for maximum sustained swimming and burst swimming ability. For this, n = 40 bigeye chub were collected from the wild and brought to the laboratory. Fish were acclimated for 3 weeks at 21 and 26 degrees Celsius. The CTmax of bigeye chub was 32.8+/-0.4 (standard deviation) and 36.4+/-0.9 degrees Celsius for fish acclimated to 21 and 26 degrees Celsius, respectively. The critical swimming speed (Ucrit) was = 10.8+/-1.5 and 11.3+/-0.9 Body Length/sec, and burst swimming duration = 9.3+/-4.0 and 11.8+/-5.5 sec under 12 Body Length/sec at 21 and 26 degrees Celsius, respectively. Together, results from this study can help guide the protection and restoration of bigeye chub populations from thermal stressors in the future.

Current status of the Bigeye Chub *Hybopsis amblops* in Illinois

Josh Sherwood, Illinois Natural History Survey, Champaign, IL
Jeremy Tiemann, Illinois Natural History Survey
Erika Bilger, Illinois Natural History Survey
Dan Wylie, Illinois Natural History Survey
Andrew Stites, Illinois Natural History Survey

Bigeye Chub were once found in rivers and streams across east-central and southern Illinois. By the 1970s and 1980s, it was considered to be fully extirpated from the state. Starting in the mid to late 1990s, Bigeye Chub began to reappear in streams of eastern Illinois. Because of this reappearance, we began to examine data to fill critical information gaps needed to fully conserve this species in Illinois. Using historical collections locations, we developed a species distribution model to estimate locations where this species likely once occurred in Illinois. Additionally, we examined population demographics and diet of current populations from specimen at the Illinois Natural History Survey Fish Collection. Data from this investigation will

help managers in conserving this state-endangered species, as well as potentially determine stream reaches for future re-introduction efforts.

Regular occurrence of Banded Killifish *Fundulus diaphanus* in benthic offshore waters near Calumet Harbor - Lake Michigan

Brandon Harris, US Fish and Wildlife Service, New Franken, IL
Bradley Smith, US Fish and Wildlife Service
Cari Ann Hayer, US Fish and Wildlife Service

Banded Killifish *Fundulus diaphanus* are typically viewed as a nearshore species closely associated with emergent or submergent vegetation in shallow, calm waters where they forage on small invertebrates. This species is commonly collected in littoral waters of the Laurentian Great Lakes, usually along margins of coastal wetlands, drowned river mouth lakes, and slow-moving streams. However, in recent years, Banded Killifish have been routinely collected farther offshore in gill net surveys (6 and 10 mm bar mesh panels) of the Calumet Harbor area, Lake Michigan. Individual specimens have been collected up to 2.9 km from shore and in depths up to 9.8 m in open waters of Lake Michigan - highly unusual habitat for this small, littoral species. We hypothesize that shifting habitat conditions in this part of the lake have incentivized Banded Killifish to range farther from shore than would be expected of this species. Specifically, the proliferation of the invasive quagga mussel *Dreissena bugensis* has created physical structure in what is otherwise a sandy, barren bottom and has allowed for dense growth of Cladophora, a native filamentous green algae, at greater depths due to improved water clarity. This deeper offshore habitat likely supports higher productivity than the shallow, sandy shorelines along much of the Calumet Harbor area. These observations highlight the changing dynamics of nearshore fish communities following the introduction of invasive species and provides an extreme example of habitat use by this species.

Using larvae to better understand catostomid reproduction within midsized river systems

Kellie Hanser, Eastern Illinois University, Charleston, IL
Robert Colombo, Eastern Illinois University
Cassi Carpenter, Eastern Illinois University
Anthony Porreca, Illinois Natural History Survey
Aaron Schrey, Georgia Southern University

Catostomidae, the third largest freshwater fish family, comprises a high percentage of fish biomass in lotic systems throughout North America. Despite their presence, there is little information on the reproductive life history for this family in large, midwestern rivers and their tributaries. To address this, we sampled larval fish in three tributaries of both the Illinois River and Wabash River in conjunction with environmental data on factors thought to be important for reproduction. Between 2016 - 2018, we collected 2293, 463 and 171 catostomid larvae from

the Illinois and Wabash River tributaries, respectively. Due to the morphological difficulty of identifying catostomid larvae past family taxonomic level, Next Generation Sequencing (NGS) and Sanger Sequencing was used to identify catostomid larvae to either genus or species. Results of larvae identification are still pending due to processing time. We expect Wabash River tributaries to have a higher abundance of *Moxostoma* (Redhorse) while the Illinois River tributaries will have a higher abundance in *Ictiobus* (Buffalo) due to differences in connectivity between the systems. Future research will examine composition shifts in catostomid larvae species throughout the year as well as differences in composition between years.

Role of environmental context and individual coping style on angling vulnerability

Toniann Keiling, University of Illinois Urbana Champaign, Urbana, IL
Michael Louison, University of Illinois Urbana Champaign
Cory Suski, University of Illinois Urbana Champaign

Recreational fishing can negatively impact fish populations through the removal of fish with specific coping styles. The specific mechanism(s) defining why fish strike lures are unknown, as are how environmental factors influence capture. Understanding these mechanisms will help predict catch rates and identify how harvest can shape populations. Objectives included how coping styles, defined as consistent sets of physiological and behavioral traits, interacted with environmental contexts to influence angling vulnerability in three separate studies. Largemouth bass behavior assays and stress responsiveness were measured in a laboratory and followed by angling in ponds. Environmental contexts included food availability and the presence/absence of habitat to test for variations in capture vulnerability. Results showed that behavior type did not influence capture, either on its own or across feeding or habitat contexts. Rather, prey availability only influenced capture rates across angling days. Results are further discussed within the framework of factors leading to fish captures, and how selective harvest may shape fish populations and aquatic ecosystems.

Cool it: Physiological response of fish to capture by winter ice-anglers

Michael Louison, McKendree University, Lebanon, IL
Jeffrey Stein, Illinois Natural History Survey
Hanna Winter, Illinois Natural History Survey
Caleb Hasler, University of Winnipeg
Cory Suski, University of Illinois at Urbana-Champaign

Catch-and-release angling is a highly popular conservation tool. However, research has shown that, depending on how a captured fish is handled, post-release physiological impairment can occur, sometimes leading to mortality. The majority of this research has been done on fish captured during the open-water season (spring, summer, and fall) with little attention paid to fish captured during winter ice-angling. This is a major hole in our knowledge of how fish

respond to capture, as ice-angling is a major recreational activity at many northern latitudes. To fill this gap, we have conducted a series of studies both at field sites in Eastern Wisconsin and in the laboratory examining the hormonal and metabolic response of fish to ice-angling capture. In the first, ice-angling was found to result in muted stress response in ice-angled Northern Pike, *Esox lucius*, albeit with a prolonged recovery period. Handling time did not impact the overall response. In the second, reflex testing on ice-angled Bluegill *Lepomis macrochirus* and Yellow Perch *Perca flavescens* demonstrated that, while the recovery duration for stress hormones is prolonged, recovery of vitality does occur following capture. Finally, a study on bluegill subjected to a simulated ice-angling bout found that overall metabolic costs of capture were low, and that reduced air exposure duration can greatly reduce metabolic recovery time. Collectively, these works are among the first to examine the physiological impact of ice-angling capture on fish, and pave the way for further study into the response of fish in alternative contexts.

Session V: Wednesday February 27, 1:00-2:45 PM

Effects of Wastewater Effluent on Fin Length Body Condition and Growth of Fathead Minnows

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Anabela Maia, Rhode Island College
Robert Colombo, Eastern Illinois University ,

The Sangamon River flows approximately 396 kilometers through central Illinois and is impounded in the city of Decatur for municipal use. The Sanitary District of Decatur (SDD) processes residential, medical, and industrial waste before releasing effluent into the river downstream of the dam. Discharge from the dam is significantly reduced during periods of low precipitation. As a result, the downstream stretch of the river is dominated by wastewater effluent. A high density of fish exhibiting elongated fins reside in this stretch of the river. To assess the relationship between effluent and fin elongation, Fathead minnows were exposed to wastewater effluent in microcosms at SDD and at a second wastewater treatment plant located in Charleston, Illinois. In addition, two control groups were exposed to dechlorinated tap water. Standard length, individual fin lengths, and weight was recorded for a total of 32 fish from each treatment during an 8-week time span. SDD treatment fish had significantly longer fins but were in poor condition and exhibited slower growth than other treatments. Our results are indicative of a causal relationship between SDD wastewater effluent and the fin elongation observed in fish of the Sangamon River. We hypothesize that fin elongation is the result of chronic exposure to contaminants and heavy metals present in the effluent.

Determining Thermal Refuge of Fish Populations in a Highly Polluted River

Ryan Sparks, Eastern Illinois University, Mattoon, IL
Cassi Moody-Carpenter, Eastern Illinois University
Robert Colombo, Eastern Illinois University

In Decatur, Illinois, the Sangamon River is dammed in order to create a reservoir that supplies water for residential and industrial uses. Five miles downstream of the reservoir, the Sanitary District of Decatur releases treated wastewater into the Sangamon River. During times of drought or low precipitation, water is released in low quantities through the dam causing issues with siltation and higher concentration of effluent downstream of the Sanitary District. This effluent is combined wastewater from over 20 large industrial companies and the effects on fish populations are unknown. Monthly water quality data from around the Sanitary District has been collected since 2007. Water quality data showed a significant difference in temperature during winter months between the upstream and effluent site ($p < 0.03$). Recently, seasonal fish surveys were conducted on fixed sites around the effluent using DC barge electrofishing during low flows and DC boat electrofishing during high flows. DC barge electrofishing was conducted during the low flows of the 2018 summer months resulting in higher total abundance of total fish caught in our upstream sites compared to our effluent and downstream sites. Majority of the catch in the upstream sites were Cyprinidae and Centrarchidae with 57 percent and 25 percent of the total catch, respectively. Further investigation into seasonal fish surveys on a stretch of the Sangamon River can help better explain patterns in fish populations in relation to the point source pollution and determine if fish are utilizing the effluent as a thermal refuge during colder months.

Recovery of Riverine Fish Assemblages After a Variety of Anthropogenic Disturbances

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Scott Meiners, Eastern Illinois University
Trent Thomas, Illinois Department of Natural Resources
Robert Colombo, Eastern Illinois University

Disturbances among communities are common, but the response of fish assemblages to anthropogenic fish kills is rarely investigated. To determine how rapidly, or if recovery occurs without further mitigation, complete quantification of the fish recovery process is necessitated. We evaluated the recovery of six creeks located in central Illinois, including an undisturbed control system. Data analysis included pre- and post-kill comparisons of species richness, catch per unit effort (CPUE), and index of biotic integrity (IBI) and non-metric multidimensional scaling (NMS) to visually compare compositional shifts. We found that richness and IBI experienced dramatic shifts within the first year after the kill, while CPUE remained relatively consistent among sampling events. Interestingly, extinction was not limited to only rare species. There were also multiple colonizations of new species that were not present prior to the perturbation. NMS revealed that some creeks experienced little compositional shift similar to

that of the control system while other creeks are still experiencing large shifts. Lastly, the rate of compositional change decreased significantly over time among all locations, especially within the first year. Richness and IBI have clearly recovered from the disturbance and continue to exceed the original pre-kill values; however, assemblages in some locations have shifted into a different community structure and are continuing to change. Our results make recovery among these systems difficult to assess calling into question the predictability of the system's response. Further functional analysis of these systems, including fish length distribution, may help to alleviate some of these discrepancies.

Effects of improved water quality on fish species distribution and sportfish abundance in the upper Des Plaines River

Steve Pescitelli, Illinois Department of Natural Resources, Plano, IL
Tristan Widloe, Illinois Department of Natural Resources

Benefits to fish and aquatic systems resulting from the Clean Water Act have been well documented in the Illinois Waterway system and other Northeastern Illinois streams. The long history of degraded water quality conditions, combined with the availability of long term fishery data, provides the opportunity to document the reestablishment of fish assemblages in restored river reaches. Previous surveys documented the restoration of fish assemblages in the Des Plaines River upstream of the Brandon Road Lock and Dam where 33 new fish species were collected between 1983 and 2013. Combining data from previous surveys with results from 2018, we investigated changes in temporal and geographic distribution patterns of several game and non-game species within the upper Des Plaines River, as well as potential sources of recruitment. Recent dam removals on the Des Plaines River may have facilitated fish movement. Results from 2018 followed the positive trends observed in previous Des Plaines River surveys. Another surprising result from the 2018 survey was the increase in sportfish abundance, particularly Smallmouth Bass. From 2013 to 2018, CPUE of Smallmouth Bass increased from 6 to 37 fish/hour in downstream reaches, with two of the stations exceeding 70 fish/hour. Rockbass, Bluegill, and Largemouth Bass also increased throughout the river. Recent additions to the Tunnel and Reservoir System may have contributed to improvements in the fishery. Based on recent microchemistry data from Southern Illinois University, fish movement from the lower Des Plaines and Illinois Rivers may also be contributing to increased species richness and improved sport fishery.

A Microchemical Analysis of Native Fish Passage through Brandon Road Lock and Dam

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Gregory Whitledge, Southern Illinois University
Devon Oliver, Arizona Game and Fish Department
Stephen Pescitelli, Illinois Department of Natural Resources
Brent Knights, US Geological Survey

Fish species richness within the Des Plaines River watershed has increased over the last 30 years. It has been suggested that the majority of new species have migrated upstream past Brandon Road Lock and Dam (BRLD) from the Illinois, Kankakee, and Lower Des Plaines Rivers. Enhancement of BRLD has been proposed to prevent the upstream transfer of aquatic invasive species to the Great Lakes Basin. These modifications may negatively impact native fish populations by reducing upstream movement and access to recruitment sources. To assess current native fish passage through the lock and dam, a microchemical study is being conducted using fin rays from fish collected from the Des Plaines, Illinois, and Kankakee Rivers. Fin ray chemical signatures can be used to indicate whether fish collected in the Des Plaines have previously passed upstream through BRLD. Results to date indicate that some upstream lock passage does occur in centrachids, ictalurids, and catostomids. This knowledge will inform assessment of potential impacts of barrier enhancement at BRLD and perhaps other lock and dam structures on native riverine fishes.

Round Goby - *Neogobius melanostomus* - Dispersal into the DuPage River - Potential Bait Bucket Introduction

Endora Roberts, Chicago, IL
Philip Willink, Aquarius Project
James Lurkey, Illinois Natural History Survey
Kurt Hettiger, Shedd Aquarium

The Round Goby, *Neogobius melanostomus*, is an invasive fish to the United States and hails from Eastern Europe in the Caspian and Azov Sea area. It was transported in ballast water of freighters in the late 1980s or early 1990s and spread its way through the Great Lakes and down into subsequent waterways. It is extremely aggressive in its nature and approach to integration within an ecosystem. This fish was originally sighted at the mouth of the DuPage River in Illinois in 2007 just below a 9-foot dam that cuts off any possibility of further movement upstream. In 2014 it was reported that the fish had been sighted in the middle of the DuPage River watershed. Within the next three years, *N. melanostomus* sightings have appeared in numerous sample studies through organizations such as the Midwest Biodiversity Institute, the Illinois Natural History Survey, the Forest Preserve District of DuPage County, and Shedd Aquarium citizen science Great Lakes Fish Finder project through iNaturalist. It is hypothesized that the Round Goby was introduced to the DuPage River through an anthropogenic measure, possibly via angler bait buckets.

Pulling the plug - Results of the fish and mussel salvage following the removal of the Danville Dam on the Vermilion River

Jeremy Tiemann, Illinois Natural History Survey, Champaign, IL
Alison Stodola, Illinois Natural History Survey
Rachel Vinsel, Illinois Natural History Survey
Trent Thomas, Illinois Department of Natural Resources

Dams have been impounding rivers and aiding the progression of human society for more than 4,000 years. Dams, however, are one of the major sources of anthropogenic disturbances and affect streams in a myriad of ways. The consequential effects of the 76,000+ dams in the United States have resulted in highly regulated and severely disrupted riverine ecosystems with altered and fragmented habitats and modified aquatic assemblages (e.g., insects, mollusks, and fishes). One such system that is affected by impoundments is the Vermilion River (Wabash) basin. Nestled within east-central Illinois, the Vermilion River basin remains one of the highest quality and most biodiverse drainages in Illinois with 45 species of mussels and ~100 species of fishes. However, there were 4 dams present in the Danville area that affected migration, altered the species composition, and fragmented populations of fishes and mussels. To help restore the river and enhance the aquatic assemblages it supported, the two functionally obsolete dams were slated for removal, and per the signed Incidental Take Authorization from the Illinois Department of Natural Resources, fishes and mussels had to be salvaged from the dewatered zone. The first removal – the Danville Dam – was removed during the summer and autumn of 2018. During the project, 1 fish and 905 live individuals of 23 species of mussels were salvaged from the dewatered areas and relocated into deeper waters. Interestingly, four listed species were documented alive within the impounded area. We will review these and other project outcomes, and discuss how fishes and mussels should naturally recolonize the former impounded areas of the Danville Dam.

Session VI: Wednesday February 27, 3:00-4:45 PM

Effects of sample depth and location on environmental DNA performance for fish, zooplankton, and zoobenthos in temperate lakes

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Jennifer Drummond, Rice University
Yiyuan Li, University of Notre Dame
Crysta Gantz, Portland State University
Scott Egan, Rice University

We sought to evaluate how depth and location of environmental DNA (eDNA) water samples affects performance of meta-barcoding for freshwater organisms including fish, zooplankton, and zoobenthos in temperate lakes. We took eDNA water samples in 12 Michigan lakes,

stratified as three nearshore and three offshore random locations. At each of these six locations per lake, we took a 250 ml surface water sample, and a 250 ml sample from just above the lake bed using a Van Dorn sampler. We filtered eDNA from water samples and Illumina-sequenced gene fragments to characterize fish, zooplankton, and zoobenthos communities. eDNA abundance was greater for zooplankton than zoobenthos regardless of sample location or depth across lakes. For fish, eDNA results differed considerably between lakes, but location and depth of water samples within lakes had little effect on characterizing communities. Alternatively, for zooplankton, eDNA results were relatively similar between our lakes, but deep water and offshore samples were consistently different from nearshore and shallow eDNA samples within lakes. We demonstrate that sampling design for eDNA meta-barcoding depends on the target taxonomic group in temperate lakes.

Should I stay or should I flow? The clash between *Corbicula fluminea* eDNA and stream flow

Amanda Curtis, University of Illinois at Urbana Champaign, Urbana, IL
Jeremy Tiemann, Illinois Natural History Survey
Sarah Douglass, Illinois Natural History Survey
Mark Davis, Illinois Natural History Survey
Eric Larson, University of Illinois at Urbana Champaign

Environmental DNA (eDNA) has been shown to be an effective tool for detecting low abundance invasive or imperiled species. However, many unknowns related to the physical, chemical, and biological aspects of the target organisms and their environment hinder the successful application of eDNA to detect new invasive or imperiled species. Here we used two local streams equipped with USGS flow gages to examine how stream flow and temperature over the course of a year might influence eDNA copy number of the invasive Asian clam (*Corbicula fluminea*). Next, we sampled 8 central-Illinois streams to examine whether *C. fluminea* density was related to the amount of eDNA captured both at summer low-flows and during fall high-flow. Preliminary analyses indicated that eDNA had a significant positive relationship with temperature, where eDNA copy number increased as temperature increased, which we attribute to biological activity and reproduction. Additionally, we found that as stream flow increased, eDNA copy number declined, indicating that sampling during high-flows could result in a decreased ability to detect a very abundant species. We found no relationship between *C. fluminea* density and eDNA copy number and further, we found that sampling during fall high-flow also resulted in non-detections when *C. fluminea* were present (false negatives). Our study presents novel findings that stream flow can dilute eDNA, which may have serious implications for the detection of low abundance organisms. Further, we suggest that researchers desiring to use eDNA should take into account knowledge of their biological organism and system prior to sampling efforts.

Using Bayesian decision networks to guide restoration of freshwater mussels in Illinois

Sara Andree, Illinois Natural History Survey, Champaign, IL
Alison Stodola, Illinois Natural History Survey
Sarah Douglass, Illinois Natural History Survey

There is a need for adaptive management tools which can aid in decision-making regarding restorative action for freshwater mussels in rehabilitated systems. Bayesian decision networks allow the inclusion of both empirical data and expert evaluation to account for uncertainty and determine optimal management action under specific conditions. We used Bayesian decision networks to determine best management options for the recently improved West Branch DuPage and South Branch Kishwaukee Rivers in northern Illinois. Management options were no action, propagation of juveniles, relocation of adults, release of inoculated host fish, or dam removal. Models were built for two target species, Ellipse (*Venustaconcha ellipsiformis*) and Spike (*Eurynia dilatata*), and tested for sensitivity to 1) dataset (long term presence, current presence, and current abundance), 2) stream subset (two target streams, six non-target streams, or both), and 3) expert opinion metrics (median, minimum, or maximum). Models using maximum values tended to choose No Action less often, and predicted higher likelihood of mussel establishment after management action. Models were also more sensitive when using only target streams. Propagation of juveniles was most often recommended for Ellipse, while optimal decision for Spike fluctuated between propagation of juveniles and no action. Use of all stream data and median expert opinion values resulted in the most balanced models. Bayesian decision networks offer a useful tool for restoration of freshwater mussel species. However, consideration should be given to empirical data type used to determine prior probabilities and expert opinion bias when using this approach.

Propagation for conservation of common freshwater mussels in an urban stream system: what do they do and why should I care?

Jessi DeMartini, Urban Stream Research Center, Forest Preserve District DuPage County, Wheaton, IL
Joe Limpers, Urban Stream Research Center
Jim Intihar, Urban Stream Research Center

Native freshwater mussels (family Unionidae) are among the most imperiled faunal groups in the United States and the world. In Illinois, over half of the 80 known species are endangered, threatened, extinct, extirpated or species in need of conservation. Freshwater mussels provide important ecosystem services and live in a waterway near you outside your back door. The intent of propagation is to augment low population numbers of live species within the waterway as a community restoration effort. The objectives of our conservation effort is to: keep common freshwater mussel species common in an urban stream system, restore the native mussel assemblage community and the ecosystem services they provide and establish wild, self- sustaining populations with recruitment over time. In 2016-17, we propagated,

reared and released 24, 377 sub-adult mussels of three common species; Plain pocketbook *Lampsilis cardium*, Fatmucket *Lampsilis siliquoidea* and White heelsplitter *Lasmigona complanata* at 37 sites across 18 miles in the West Branch DuPage River and two tributaries. In 2018, we began monitoring 9mm PIT (passive integrated transponders) tagged individuals with an underwater antenna unit revealing 65% pinged *L. cardium* and 74% *L. siliquoidea*.

A preliminary analysis of mussel population dynamics in the Kishwaukee River

Sarah Douglass, Illinois Natural History Survey, Champaign, IL
Jeremy Tiemann, Illinois Natural History Survey
Ethan Kessler, Illinois Natural History Survey
Michael Dreslik, Illinois Natural History Survey

In 2013, the Illinois State Toll Highway Authority concluded a lane expansion project on the I-90 Toll Road from Chicago to Rockford, Illinois. INHS researchers initiated two studies during the last several years to evaluate the mussel community and possible long-term effects from construction practices in the Kishwaukee River at I-90. A short distance translocation study using two common mussel species marked with passive integrated transponder (PIT) tags and released upstream of the construction site began in 2013 and completed in 2015. In August 2015, we initiated a capture-mark-recapture mussel population study with special emphasis on rare and state-listed mussels. We've recorded life history data annually and monitored PIT tagged animals when water levels allow. These data will allow us a better understanding of biotic and abiotic factors influencing the mussel community within the Kishwaukee River and recolonization efforts within the post-construction stream area. Here, we present a preliminary analysis of apparent survival and detection rates for the mussel population existing at I-90. As the Kishwaukee River is a highly valuable biological and public aquatic resource, long-term monitoring and research will assist land managers with needed information for retaining healthy ecosystems and intact biological communities. Additionally, results from our research will help inform mussel species' conservation at a broader scale.

Investigating the efficacy of floating vs hand-held PIT tag readers at freshwater mussel translocation sites

Alison Stodola, Illinois Natural History Survey, Champaign, IL
Rachel Vinsel, Illinois Natural History Survey
Jeremy Tiemann, Illinois Natural History Survey
Kirk Stodola, Illinois Natural History Survey

Mussels are often relocated prior to construction projects to conserve populations or boost populations in a depauperate area. Tagging relocated individuals with passive integrated transponder (PIT) tags allows researchers to monitor survival and movement of these animals across time. However, detecting these animals requires increasingly more time and

geographical coverage, as animals move to new areas within or outside of relocation sites. In Illinois, we have tagged over 5000 mussels at over a dozen sites as part of federal recovery plans, Illinois Department of Transportation, or Illinois State Toll Highway Authority projects. We compared detection rates of PIT tagged mussels at a subset of these sites using a large-scale floating antenna (measures 4 feet by 10 feet) to small-scale handheld wands (measures 12 inches wide) and also tested efficacy of the floating antenna to traverse stream sections several miles long. During this study, we discovered locations of tagged animals over 2 miles from the original relocation area. In the most extreme cases, mussels were found that had not been located in five years despite eight sampling events. We also tested performance of both reader types at various tag densities (range of one tag per square meter to 90 tags per square meter) to understand limitations of the technology in translocated mussel beds. We found that the large-scale antenna performed significantly worse than the small-scale handheld wand at nearly all densities greater than 1 tag per square meter, likely due to interference from multiple tags in the read zone.

Searching the Depths of Lake Michigan for Meteorites from Outer Space

Philip Willink, Aquarius Project, La Grange Park, IL
Chris Bresky, Adler Planetarium
Marc Fries, NASA
Mark Hammergren, Adler Planetarium
Shane Larson, Northwestern University
Philipp Heck, Field Museum
Jennika Greer, Field Museum

On February 6, 2017, a meteor streaked over Chicago, exploding into thousands of bits that rained down into Lake Michigan. In the first collaborative scientific effort among Adler Planetarium, Field Museum, Shedd Aquarium, and NASA, we are attempting to retrieve meteorites from this fall in hundreds of feet of water. Video footage of the meteor was used to recreate its trajectory from the asteroid belt between Mars and Jupiter, where the object orbited for 4.5 billion years. Once it exploded in Earth's atmosphere, weather radar was used to track the objects to the surface of Lake Michigan. The bottom of Lake Michigan is being surveyed with Remotely Operated Vehicles and a specially designed sled created from neodymium magnets and reused materials from Shedd Aquarium's food court and Adler Planetarium exhibits. Cameras with live feeds are attached to the sled, allowing us to conduct visual surveys of the lake bottom. What we have seen is a complete domination of the bottom of Lake Michigan by Quagga Mussels. They completely cover the substrate for miles in every direction. Although professional scientists are involved, teen students have participated in every stage and are critical to the success of The Aquarius Project.

Session VII: Thursday February 28, 8:15-10:00 PM

Status and trends of Smallmouth Buffalo in the Upper Mississippi River System

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Levi Solomon, Illinois Natural History Survey
Taylor Bookout, Illinois Natural History Survey
Seth Love, Illinois Department of Natural Resources
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Buffalo (*Ictiobus* sp.) are one of the most important commercially harvested species on the Upper Mississippi River system (UMRS). Despite this, little work has been done to assess buffalo populations. Using catch data from hoop nets and day electrofishing, we calculated the catch per unit effort (CPUE) for Smallmouth Buffalo (*Ictiobus bubalus*) in six river reaches covered by the Upper Mississippi River Restoration Program's Long Term Resource Monitoring element (UMRR-LTRM): five pools on the Mississippi River (pools 4, 8, 13, 26 and the Open River reach) as well as the La Grange Reach on the Illinois River. Trends in CPUE for the six LTRM reaches indicate a downward trend for Smallmouth Buffalo populations since the program's inception in 1993. In 2017, otoliths were collected from Smallmouth Buffalo from the LTRM reaches of the Mississippi River and the upper and lower Illinois River to determine the age structure of fish across multiple distinct reaches of the UMRS. A total of 664 Smallmouth Buffalo were aged and age estimates range from 0-36 years old with total annual mortality ranging from 0.06-0.097. Results from this study can be used to help inform management of the Smallmouth Buffalo commercial fishery on the UMRS.

Operational impacts of a water management structure on the surrounding fish communities in the lower Illinois River

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Water management structures (WMS) are commonly used to regulate water levels in restored backwaters of large rivers and impacts to the surrounding ecosystem vary depending on their design and operation. These managed connections can offer a balance between maintaining quality habitat in restored areas and providing benefits to floodplain river systems. From 2016-2018, we quantified the response of the fish communities (i.e., changes in abundance and composition) to the WMS operation at the Emiquon Preserve, a 6700-acre restored floodplain lake adjacent to the La Grange Reach of the lower Illinois River. Fish communities were evaluated using boat electrofishing and environmental conditions were assessed on both sides of the WMS (i.e., Emiquon and Illinois River) when it was closed, gravity feeding, and mechanically pumping water into the Illinois River. Multivariate analyses indicated a change in fish communities surrounding the WMS when it was operational: specifically, a change was detected in the Illinois River when the structure was pumping water and in Emiquon when the WMS was both gravity feeding and pumping water. These changes were due to increased abundance of dominate fish species in both the Illinois River (i.e., gizzard shad, white bass, and emerald shiners) and Emiquon (i.e., gizzard shad, largemouth bass, bluegill, and bowfin). Environmental parameters indicated that the

flow of water created by the WMS changes the surrounding habitat by providing a microhabitat of increased flow and highly productive water. This study suggests that managed connections between restored backwater habitats provide a benefit to large river ecosystems.

The Influence of Cultural Values on Angler Behaviors and the Spread of Aquatic Invasive Species in the Great Lakes Region

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Aquatic invasive species (AIS) are a major threat to biodiversity in aquatic ecosystems. One of the mechanisms contributing to the spread of AIS in the Great Lakes Region is anglers, many of whom engage in behaviors that can spread AIS, such as moving boats and reusing live bait. We explored how cultural values affected what behaviors anglers engaged, and how this could can contribute to the spread of invasive species. In Fall 2018, we distributed an online survey to members of the American Fisheries Society (AFS) chapters in Illinois and New York (N = 121). We evaluated previous experience, species targeted, self-reported knowledge, bait use, and fishing location for subgroups of respondents defined by their cultural value orientations. Results indicated that AFS members were experienced anglers that targeted a variety of different species, and knowledge of AIS, bait use, and fishing location varied across different subgroups of respondents that held different cultural value orientations. We provide insights on how long-term drivers of behavior (i.e., cultural values) can be leveraged to generate deeper insights on descriptive characteristics of fishing experiences. This study aims to guide future management decisions, and establishes a starting point for a larger survey that will be distributed to anglers across five US states in the Great Lakes region and the province of Ontario.

A case for creel: assessing the fishery response to management actions on Lake Michigan

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Fisheries in Lake Michigan are cooperatively assessed and managed across multiple jurisdictions. The Illinois Natural History Survey has conducted an annual creel survey to estimate sport fishing effort and harvest by anglers fishing the Illinois waters of Lake Michigan since 1986. In this period, Lake Michigan has undergone extensive anthropogenic change, especially through species invasions and oligotrophication, presenting unique challenges for fishery managers. As trout and salmon populations have experienced increased natural reproduction, fishery managers have sought to balance predation by salmonids on diminishing prey. Specifically, reductions in lake-wide stocking of salmonids (primarily Chinook Salmon) have been implemented four times over the last 20 years. The creel survey represents an important means of assessing the impact of these stocking changes on recreational fishing effort and harvest. Moreover, creel data aid in tracking and identifying changes in the fishery, providing

informative data for decision-making. Our dataset illustrates large long-term declines in fishing effort, yet moderate declines in harvest. Salmonid harvest rates have remained relatively stable despite reductions in stocking. These results suggest that ecologically-necessary stocking cuts have had small impacts on the salmonid fishery in Illinois waters of Lake Michigan, perhaps due to buffering effects of a diverse salmonid community. However, declining angler effort points to persistent and emerging challenges that will continue to require continued assessment and adaptive management. Creel surveys remain a useful tool to quantify fishery management endpoints.

Drying Regime and Fish Assemblage Composition in Headwater Streams

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Disturbance regime (e.g., drying, flooding) correlates with fish community composition in many lotic systems. Pooling and drying are natural occurrences in headwater streams (1st to 3rd order) of the Kaskaskia River basin, but the frequency and duration of these events vary annually. Water levels were monitored in 2016 and 2017 to estimate conditions under which headwater streams pool and dry in a subbasin of the Kaskaskia. Models indicate between 0 and 0.63 of stream length in the subbasin may pool or dry in August, depending upon timing and volume of precipitation. Fish were surveyed quarterly in the subbasin and assemblage composition was compared to estimated frequency of pooling and drying. Temporal variability in species richness increased and assemblage similarity decreased as the estimated number of dry days increased. This study suggests processes related to drying regime play an important role in seasonal fish community composition.

Spatial variation of zooplankton across multiple spatial scales in Midwestern reservoirs

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Joseph Parkos, University of Illinois and INHS
David Wahl, University of Illinois and INHS

Zooplankton are a critical component in aquatic food webs because they are the primary link between basal resources and higher trophic levels. Although several studies have evaluated factors influencing spatial distribution of zooplankton in natural lakes, few have characterized mechanisms driving spatial distribution of zooplankton in reservoirs, and fewer still focus on temperate reservoirs. Reservoirs differ greatly from natural lakes because of shorter hydraulic residence times and greater shoreline development ratios. Here, we summarize three projects describing zooplankton spatial distribution across multiple scales and what implications these mechanisms have for structuring aquatic food webs and the distribution and growth of fish. We focus on three scales: 1) fine-scale interactions among zooplankton, macrophytes, and fish with differing diets, 2) regional-scale influence of gizzard shad on near and offshore zooplankton density, and 3) reservoir-scale changes in density from upper, riverine areas to lower, lacustrine habitats above dams. Our observations suggest that zooplankton exhibit high spatial complexity at multiple spatial scales and that understanding these mechanisms can benefit fisheries management decisions on a range of topics including habitat additions, spatial distribution of sampling for both pelagic and littoral fishes, and predicting resource availability for larval fish production for riverine spawning fishes.

Flipping a Fishery: A Management Brief

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Andrew Plauck, Illinois Department of Natural Resources

The ability of management agencies to alter fish community structure of large lentic systems has been documented in myriad instances by the use of many different techniques and management approaches over the years. However, there is a paucity of published data and literature regarding the ability of managers to alter fish community structure in small man-made lakes by the removal of a single target species to "flip" a fishery. The goal for the study lake was to mimic a "northern cool water fishery" within DuPage County. Smallmouth Bass (*Micropterus dolomieu*), Walleye (*Sander vitreus*), and Yellow Perch (*Perca flavescens*) were to be the primary species. Due to unforeseen circumstances, Largemouth Bass were stocked into the lake. Since 2016, efforts to remove and relocate Largemouth Bass (*Micropterus salmoides*) from the landlocked quarry lake have occurred. The intent is to facilitate the establishment of a smallmouth bass, walleye and yellow perch as originally intended. Largemouth bass CPUE (fish/hr.), to date, has not shown any statistically significant trends. To date, responses of smallmouth bass to this management effort have been largely unsuccessful with no clear increases in relative abundance as measured by CPUE. The yellow perch population has become established since stocking occurred, and there have been no significant changes in CPUE since removal of largemouth bass began in 2016. Yearly average length of yellow perch, has increased since 2016. The walleye population has followed the same trend as yellow perch. Continued monitoring and management efforts are needed, and are planned to continue through the fall of 2020.

Session VIII: Thursday February 28, 10:15-11:45 PM

Behavioral composition effects growth of exploratory and nonexploratory Largemouth Bass

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Largemouth Bass have established behavioral types along the exploring behavioral axis which also show differences in diets, suggesting there are differences in foraging effort and/or habitat utilization. We used a mesocosm experiment to test the hypothesis that populations composed of mixed behavioral types would lead to more efficient use of prey resources and reduced competition between individuals than populations composed of similar behavioral types. We used three treatments, one with all exploratory type Largemouth Bass, one with all non-exploratory type and one with a 50/50 mix of behavioral types. Treatments with similar behavioral types had lower growth than treatments with mixed behavioral types, supporting the outcome of our hypothesis. However, examination of resource use found no differences between treatments with similar behavioral types compared to those with mixed behavioral types. These results suggest that differences in behavioral composition in a population has the potential to impact growth trajectories of Largemouth Bass, though the mechanism responsible for these differences remains unclear. Despite that, behavioral composition could be an important factor to consider when managing Largemouth Bass populations and suggests that management practices that enhance the diversity of different behavioral types could be beneficial to individual growth and performance.

Active Bluegill Management for Improved Angling Quality with an Emphasis on Regulations: Walnut Point Lake a Case Study in Central Illinois

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A growing body of literature indicates that active bluegill management can maintain or increase angling quality in bluegill fisheries. In 1999, as part of a state-wide bluegill management study, a 203 mm minimum length limit and 10 bluegill/day harvest limit were applied to Walnut Point Lake (21 ha). Bluegill soon stockpiled below the minimum length limit, typical of fish populations with good recruitment and average growth, characteristic of most bluegill populations. In 2007, a maximum length limit was applied allowing the harvest of 15 bluegill/day, of which, only 5 could be > 203 mm. Age structure and the number of large bluegill collected improved. In 2013, concerns regarding body condition and potentially growth prompted liberalization of the limit to 20 bluegill/day (still allowing 5 fish > 203 mm). Body condition and the number of large bluegill collected improved. Under the maximum length limit the average number of large bluegill (> 203 mm) collected in surveys is significantly higher ($P < 0.02$) than in pre-regulation years (< 1999). The application and tailoring of this regulation, coupled with angler education, has demonstrated biological and sociological benefits in this bluegill fishery for eleven consecutive years. Resource-appropriate regulations, similarly tailored, could provide long-term angling quality benefits in other bluegill fisheries. As with all species, creel and size limits should be adjusted to account for the unique population characteristics, morphological and habitat characteristics, and angling pressure for each water body.

Recovery and healing of Shortnose Gar using novel surgical methods for transmitter implantation

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Sarah King, Illinois Natural History Survey
Jeffrey Stein, Illinois Natural History Survey

Knowledge regarding the movement of wild fishes provides valuable information of their spatial ecology, habitat use, and migration patterns. Telemetry methods utilizing either radio or acoustic signals require that a transmitter be affixed to the animal, introducing the potential for adverse effects on the natural movements of study animals. Intracoelemic transmitter implantation has been documented to have limited adverse effects and is considered the best method for long-term tracking relative to gastric insertion or external attachment. Surgical methods for transmitter implantation are well known in the literature, however, these methods cannot be used on more primitive fishes such as Lepisosteids due to the complexity of their armored, ganoid scales. Midwood et al. (2018) introduced a specialized procedure to implant transmitters in the body cavity of Longnose Gars in Lake Ontario. The surgical procedure was deemed successful based on fish detections at multiple receivers; however, healing rates were unavailable due to the lack of recaptured individuals over time. To further our knowledge on the recovery and healing rate using these novel surgical techniques, we conducted a sham surgery study on Shortnose Gar to monitor post-surgery impacts over time. Forty-seven gar were subjected to one of three treatment groups; control, sedation only, or sedation and sham surgery, and monitored over a

period of 64 days. Results from our study provide insight to the expected healing rate of gars using intracoelemic transmitter attachment methods in a field setting.

A mechanistic synthesis of function and effect size of habitat additions in marine and freshwater systems

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Anthony Porreca, Illinois Natural History Survey
Scott Collins, Illinois Natural History Survey
Thomas Detmer, Illinois Natural History Survey
David Wahl, Illinois Natural History Survey

Adding habitat is a common management approach for both marine and freshwater fisheries, with the goal of these additions to increase either fish production or catchability. Realized effects will partly depend on the function of added habitat in the managed system. Habitat added to increase fish abundance must enhance growth, survival, or reproduction, while additions designed to increase catchability must be detectable and attractive to target species. Production and aggregation are not entirely separate as the same habitat features that can increase fish growth, reproduction, and survival would also serve to attract fish. Although there are many important differences between freshwater and marine ecosystems, there is the potential for ecological patterns and processes that apply to both of these environments. We review decades of peer-reviewed, scientific literature to compare approaches, methods, and outcomes between freshwater and marine investigations and to identify patterns that transcend differences between different aquatic environments. Differences and similarities in pattern and scale of response are interpreted through ecological theories associated with population dynamics and spatial ecology.

Wabash River Shovelnose Sturgeon natal environment and movement ecology: insights from fin ray microchemistry

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Insight into environments that contribute recruits to commercial fisheries within riverine systems is important for effective population management and conservation. Shovelnose Sturgeon are an important commercial species inhabiting the Wabash River drainage. River of origin and environmental history for Shovelnose Sturgeon populations in the Wabash River are unknown despite the species' geographically wide range and use of river systems in which commercial fishing for sturgeon is prohibited (e.g., the Missouri and lower Mississippi rivers). Fin ray microchemistry is a non-lethal technique that is useful for determining recruitment sources and important locations and river systems used by fishes. Therefore, we applied this technique to Wabash River collected adult Shovelnose Sturgeon to identify their recruitment sources and movement ecology. Adult Shovelnose Sturgeon (n = 150) were collected during 2013 at multiple locations throughout the lower 320 river miles of the

Wabash River. Based on fin ray core (river-of-origin) Sr:Ca signatures, 50% of adult Shovelnose Sturgeon originated in the Wabash River, the Ohio River contributed 40% of the individuals, and 10% were of unknown origin. Collection location did not affect the percentage of recruits from each source. Numerous fish exhibited inter-river movement during early and juvenile life stages, but most individuals returned to the Wabash River during adult life stages. Our results suggest the Ohio River and perhaps other large rivers are important environments for recruitment and refuge of adult Shovelnose Sturgeon collected from the Wabash River, and inter-jurisdictional stock assessments and management strategies should be considered.

Evaluating the long term status and trends of selected sportfish populations in the La Grange Reach of the Illinois River

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Kristopher Maxson, Illinois Natural History Survey
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Long-term trends of populations of fishes can provide information related to their management, including insights into potential stressors affecting those populations. For example, the absence of specific year classes, or groups of year classes, can allow biologists to evaluate past conditions to determine what contributed to this reproduction/recruitment decline and guide future research and management. Additionally, declines of specific sizes of fish can provide insight into potential population bottlenecks within a system. Over the past 25 years (1993-2017), the Upper Mississippi River Restoration Program's Long Term Resource Monitoring (LTRM) element has extensively sampled the fish community of the La Grange Reach of the Illinois River and collected extensive data on Yellow Bass *Morone mississippiensis*, White Bass *M. chrysops*, Largemouth Bass *Micropterus salmoides*, Bluegill *Lepomis macrochirus*, Black Crappie *Pomoxis nigromaculatus*, and White Crappie *P. annularis*. Results indicate that these species populations (with the exception of Yellow Bass) have significantly declined in relative abundance over time while relative weight has remained reasonably stable. While it is generally known that our large Midwestern rivers face a multitude of stressors (invasive species, sedimentation, altered hydrology, etc.), knowing what stressors are driving these declines should be a priority.

Poster Presentations

Hooking Time Influences Hooking Location for Ice-angled Northern Pike Caught on Tip-ups

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Caleb Hasler, University of Winnipeg
Michael Louison, McKendree University

Ice angling is a popular activity during the winter months at northern latitudes. For ice-fishers, Tip-up rigs are a popular device used to capture Northern Pike, *Esox lucius*. When a fish grabs a bait rigged on a tip-up, a flag pops up and alerts the angler to the fish, however the amount of time spent hooked on a tip-up before a fish is retrieved may vary. Studies of open water fishing have found that an increase in the time between the strike and the hookset can cause an increased probability in hook ingestion by fish, which can lead to mortality. However, this has not been well documented for ice-angled fish. To fill this gap, we collected Northern Pike over a span of 4 days, waiting predetermined periods of time (0 to 7 min) before setting the hooks. We determined that increasing time between strike and hookset (flag time) does influence the location where the fished is hooked ($p=0.0438$), with a shift in hook location from lip to mouth to gills. However, regardless of time, none of the fish ingested the hook, and longer times more often resulted in the bait being dropped. Therefore, although flag time does influence the location or depth of hooking, it does not necessarily influence hook ingestion. Despite this, since prior work has shown that hooking in the gills increases the risk of mortality for angled fish, we recommend anglers pursue fishing practices that minimize hook time in Northern Pike.

Do stream flow extremes predict abundance of the invasive clam *Corbicula fluminea*?

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The Asian clam *Corbicula fluminea* has proven to be an extremely successful invasive species globally. *Corbicula fluminea* negatively affects native biodiversity like freshwater mussels, as well as ecosystem function and services. Streamflow regime, including frequency and magnitude of floods and droughts, is a major driver of instream habitat conditions and population processes of freshwater organisms, but few studies to date have directly investigated relationships between streamflow and *C. fluminea*. We tested the relationship between *C. fluminea* abundance and flow extremes (recent floods and droughts) in streams throughout central Illinois. We estimated *C. fluminea* abundance using quadrat sampling at eight streams with USGS flow gauges between mid-June and mid-July 2018. We modeled *C. fluminea* density in response to high and low stream flows and the frequency of floods in the preceding year and compared model performance using AIC. *Corbicula fluminea* abundance varied widely across our study sites, from apparent absence to a high abundance of 28.5 individual per square half meter. However, we found no relationship between *C. fluminea* abundance and either the frequency of floods or the magnitude of high and low flow conditions. Future studies should investigate other abiotic or biotic factors that may better explain abundance, and associated impacts, of *C. fluminea* in streams of central Illinois and elsewhere.

Air exposure duration and ambient temperatures interact to impact swimming performance in fish subjected to a winter angling simulation

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Michael Louison, Professor
Jeffrey Stein, Professor
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Many recreational anglers engage in catch-and-release angling, research indicates that capture and handling can cause disturbance and impairment for released fish. Much of this work has been done during warm-weather months, with little work performed in the winter when ice-anglers in temperate regions target fish. To quantify the impacts of ice angling on released fish, we performed a series of experiments using Bluegill *Lepomis macrochirus* and Largemouth Bass *Micropterus salmoides*. In all experiments, fish were first subjected to a simulated angling bout at +5 C, followed by 30 s or 5 min of air exposure at either ambient (+3-8 C) or sub-freezing (-7 C) air temperatures. Fish were then assessed for either critical swimming speed (Bluegill), oxygen consumption (Bluegill), burst swimming speed (Largemouth Bass), or gill damage (Largemouth Bass). Results showed that 5 min air exposure at -7 C negatively impacted critical swimming speed for bluegill, and that other treatments had no impact on any other metrics. Collectively, results provide best handling recommendations for ice anglers releasing fish to minimize impacts on individuals and populations.

Ecosystem Response to Bigheaded Carp Harvest: Zooplankton Recovery following the 2016 and 2017 Unified Method in the HMS Pits

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Bigheaded carps (*Hypophthalmichthys molitrix* and *H. nobilis*) populations have been increasing in the Illinois River since the 2000s and have caused trophic level effects on the river ecosystem. Previous studies have shown dramatic declines in zooplankton abundance following bigheaded carp invasion. Due to their short generation times, zooplankton could potentially serve as an indicator of bigheaded carp harvest success. In 2016 and 2017 a rigorous multi-agency harvest effort, called the Unified Method, contracted commercial fishermen to coordinate a large scale harvest at the Hanson Material Services (HMS) Sand and Gravel Pits near Morris, Illinois. The West pit is a semi-closed system connected to the East pit by a culvert. Meanwhile, the East pit is fully connected to the Illinois River. The Unified Method harvest occurred in the West pit but not in the East pit. We sampled zooplankton at multiple sites within each pit once before and three times after the Unified Method harvest. The zooplankton response was variable between years and dependent on the taxa being analyzed. The effect of harvest on zooplankton abundance was significant for naupliar and adult copepods in both years, and significant for rotifers in 2017, while sample month was significant for all taxa. Our results suggest that the zooplankton taxa with shorter reproduction cycles (rotifers) may respond more quickly to harvest than those with longer reproductive cycles (cladocerans).

White Bass Demographics: Using Otolith Microchemistry Analyses to determine recruitment sources and spatial patterns of White Bass in the Large Rivers of Illinois.

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Gregory Whitledge, Southern Illinois University

Large riverine systems contain a large network of variable habitats that fish species utilize throughout their life. This broad expanse of habitat combined with large volumes of water make sampling larval and juvenile fish challenging. The result is little being known about recruitment sources for many fish species. Hard structure microchemistry can be used as an alternative method to identify natal environments. To assess natal environments and movement of White Bass (*Morone chrysops*), an otolith microchemistry study is being conducted on the large rivers of Illinois (Mississippi River, Ohio River, Illinois River, and Wabash River). White Bass are being collected from the four rivers using electrofishing. Differences in the Strontium:Calcium (Sr:Ca) ratios of the water chemistry and the White Bass otoliths will designate which tributary or river the fish originated. Differences in the microchemistry across the plane of the otolith will be used to indicate possible movement between the large river and its tributaries throughout their life. Better understanding the recruitment patterns and demographics of White Bass may better inform the extent and importance of tributaries to White Bass in these systems.

Improving Hydroacoustic Monitoring Efforts of Bigheaded Carps near the Invasion Front: An Analysis of Target Detectability

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Bigheaded carps (*Hypophthalmichthys* spp.) pose a major threat to Great Lakes ecology, tourism, recreation, and economics. Improved understanding of monitoring methods in uninvaded areas will help reduce the potential of unnoticed range expansion. Hydroacoustic sampling is used extensively in the upper Illinois and Des Plaines rivers for monitoring and surveillance of bigheaded carp populations at and upstream of the invasion front. However, detectability of bigheaded carps with hydroacoustic gear in these areas is largely unknown. This study sought to quantify uncertainty in hydroacoustic detection ability. Acoustic targets (8” hard-shell trawl buoys) were deployed subsurface in known locations throughout a 2.1 km reach of the Des Plaines River in the Brandon Road Pool (upstream of current invasion front). Target strength (TS) of buoys was measured before deployment. A series of five replicate hydroacoustic surveys was then conducted along a standardized transect to obtain an estimate of detectability of acoustic targets. For analyses, a buffer of 8m was created around each target location to account for boat drift during deployment. Single target detections (fish tracks) within the TS range of the buoy were exported from hydroacoustic data and overlayed onto the buffered deployment location map to determine whether buoys were observed. Relatively low abundances of medium-to-large fishes present in this stretch of river reduced the likelihood of false detections. These results will be valuable for quantifying the ability of this surveillance gear to detect an invasive fish species spreading farther upstream, and may be more widely useful to assess its utility in monitoring species present at low abundances.

Community dynamics of an impounded and free flowing river

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Navigation dams, such as those on the Illinois and Mississippi Rivers, reduce hydrologic connectivity and alter flow regimes in river systems. Effects on community dynamics include interfering with fish reproductive cues and altering zooplankton community dynamics, an essential food source for larval fishes. However, there is a lack of research on navigation dams, and their effects on fish communities are not clearly understood. Studies simultaneously examining fish spawning and zooplankton communities are critical because phenological changes in either fish or zooplankton have the potential to cause a mismatch between spawning and larval food availability. On the other hand, increased water residence time within dammed rivers may lead to increased zooplankton and be beneficial to larval fishes. To determine if navigation dams have altered the spawning cues of fishes, we collected larval fish and zooplankton throughout the spawning season in the Illinois (dammed) and Wabash (undammed)Rivers from 2014 to 2017. We compared larval community composition and peak spawning times for individual fish families between rivers. These data were compared to river hydrographs and zooplankton abundances. Larval fish densities peaked in June in both rivers every year, typically around the timing of peak zooplankton abundance. In the Wabash River Cyprinidae and Catostomidae were the most abundant families and Catostomids were nearly 8 times more abundant than in the Illinois. Conversely, Clupeidae was the most abundant family in the Illinois River, being 8 times more abundant than in the Wabash River. Our research will improve our understanding of ecosystem dynamics within these large rivers and the effects of navigation dams.

Habitat Preferences of Asian Carp on the Upper Illinois River an Acoustic Telemetry Study

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Asian Carp are a highly invasive species introduced into the Mississippi River System in the mid 1970's and now, due to expanding populations, are a pervasive threat to invading the Great Lakes. The Dresden Island, Marseilles, and Starved Rock Asian Carp populations in the upper Illinois River (leading edge) pose the greatest risk to the Great Lakes and therefore understanding their habitat use and behavior in this region are important for removal efforts to limit further expansion. Therefore, the objectives of our study were to use acoustic telemetry to determine habitat preferences and connectivity, and areas of concentration of silver carp, bighead carp, and grass carp at this leading edge of the invasion. We tracked the three Asian carp species from early March until November 2018 using a mobile Vemco VR-100 receiver at pre-defined grid points (0.54 km apart) within the three pools. Ninety-two tagged Asian carp have been detected (53 in Dresden Island Pool, 14 in Marseilles Pool, and 31 in Starved Rock Pool). Data from this study will be used to identify seasonal habitats of Asian carp to increase the efficiency of contracted harvest of potential Great Lake's Asian carp propagules. Continued research will result in a better understanding of the factors influencing Asian carp habitat use and connectivity to help predict these behaviors and target removal efforts.

Towards Asian Carp Attractants

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Asian Carp, particularly silver carp, present a serious, immediate, and continuing threat to aquatic ecosystems throughout and beyond the Midwest. A variety of methods for the removal of such species, primarily from the Mississippi river basin and surrounding watersheds, have been investigated, but to date have yielded mixed results in terms of allowing for the efficient removal of these fish. A review of this data infers that food-based attractants may provide the most efficient, cost-effective route to the large scale removal of Asian carp, principally from rivers, via the use of easily implemented commercial hoop netting methods. Progress towards the goal of developing effective food-based attractant, specific to Asian carp, which may then be utilized by commercial fishermen and/or other entities (in place of typical catfish or other baits) with standard hoop netting or other equipment is presented. Specific information relating to feed formations and alternate modes of deployment are also highlighted.

Mapping of Lake Trout (*Salvelinus namaycush*) spawning habitat at offshore reefs in Illinois waters of Lake Michigan

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Steven Robillard, Illinois Department of Natural Resources
Sergiusz Czesny, Illinois Natural History Survey

Measuring the success of lake trout rehabilitation efforts in Lake Michigan in part requires an accurate assessment of the availability and use of spawning reefs in Illinois waters of Lake Michigan. Lake trout prefer habitats with a slope of 15-60° and cobble or rubble substrate with sufficient interstitial spaces for spawning. Previous work involved bathymetry and substrate descriptions of two historical spawning sites, Julian's and Waukegan Reefs, where the Illinois Department of Natural Resources (IDNR) conducts annual fall spawning assessments. The objective of this study is to document the location and map the extent of previously unsampled offshore reefs. The bathymetric maps developed from this project aid IDNR in expanding lake trout spawning assessments to previously unsampled reefs. The current project explored three new reefs (North, Wilmette, and Lake Bluff Reefs) and two extensions (Waukegan East and Waukegan South) of what is now considered the "Waukegan Reef Complex." Bathymetric contour maps were produced for all four reefs, though Lake Bluff Reef will require more mapping transects to attain complete coverage. Reef habitat was found at Waukegan South, Wilmette, and Lake Bluff while exploration of the Waukegan East area yielded no prominent bathymetric features. Maps provided to IDNR were used to determine gillnet placement at North and Wilmette reefs in 2017 and 2018 lake trout spawning assessments and mature lake trout were sampled at both. Future work will finish transects from Lake Bluff Reef, focus on new, undocumented reefs, and include side scan sonar to allow classification of benthic habitat.

Fecundity Estimates of the Gravel Chub *Erimystax x-punctatus* Pisces: Leuciscidae

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Joshua Sherwood, Illinois Natural History Survey
Jeremy Tiemann, Illinois Natural History Survey

Basic natural history information is often lacking for rare aquatic species. This study aims to address the lack of life history knowledge for the Gravel Chub (*Erimystax x-punctatus*). Fecundity of Gravel Chub was assessed by performing egg counts on vouchered museum specimens. Our results indicate a strong relationship between fecundity and body size as well as temperature.

Effects of Sedation Techniques on Stress Responses in Bluegill Sunfish

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Robert Colombo, Eastern Illinois University Biological Sciences
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The process of sedating fish is necessary for a variety of procedures in research and within field or laboratory settings. Information regarding chemical sedatives, such as MS-222 (95% tricaine methanesulfate), suggests that it is often insufficient for field use due to extensive recovery time and withdrawal. Subsequently, alternatives to chemical sedatives are being explored, of which electronarcosis is a popular option. Electronarcosis applies particularly to "immediate-release" situations, as it is found to have rapid recovery times and minimal lasting effects on fish. Few studies provide an overview of the effects of sedation on its subjects, and large gaps remain with regard to the species-specific responses to the treatment. Therefore, we sought to compare the short-term physiological effects of Bluegill sunfish (*Lepomis macrochirus*) subjected to electronarcosis and MS-222 sedation techniques. We hypothesize that sedation achieved by electronarcosis will provide an overall decreased stress response in its subjects. Bluegill sunfish were exposed to species-specifc doses of MS-222 or electrical stunning to achieve complete sedation. Immediately following sedation, basal metabolic rates of fish were monitored with indirect calorimetry. Basal metabolic rates were employed as indicators of aerobic physiological activity on fish. Cortisol levels were assayed after metabolic screening. Blood samples were collected at 0, 0.5, or 1 hour post-treatment for each group and compared to a pre-treatment control. Plasma cortisol levels and metabolic rates are expected to have an overall decreased value in subjects treated with electrosedation, deeming it a more practical alternative to chemical treatments.

Habitat Use of Larval Fish in Backwater Reaches of the Upper Mississippi River

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Since the unintended introduction into the waterways of the southern United States in the 1970s, Asian Carp have become widely established throughout a majority of the Mississippi River drainage basin. Abundances of Asian Carp have remained low in Pools 17, 18, and 19, due to the structural characteristics of Lock and Dam 19. Adult Asian Carp have been closely monitored, however larval fish communities in these pools have not been well characterized. The objectives of this study were to investigate and describe early life history of Asian Carp, as well as to describe larval fish habitat preference in the Upper Mississippi River. Early stages of Asian Carp require backwater reaches of riverine habitat to grow and develop. Quatrefoil light traps were used to sample for larval fishes from May to September of 2016 and 2017 when main channel water temperatures were above 17C. To better determine habitat use, twelve light traps were deployed for a minimum of one hour at various locations representing several habitat conditions. The conditions sampled were recorded as woody or vegetation for cover, and open or shoreline for location. Weather conditions were recorded as calm or windy, as well as clear or rainy. Water quality was tested for each light trap location. Larval fish collected were enumerated, measured and identified to family. A total of 1,108 individual light trap samples were collected over the two-year period, representing twelve different families. A majority of the individuals identified were native cyprinid and centrarchids.

Effects of white grub parasite on Illinois River sportfish from three distinct habitats

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Differences in habitat quality can influence fish life-history expression, affecting growth, longevity, and body condition, and often affecting fish health. *Posthodiplostomum* spp. is a group of trematode parasites that infect the visceral tissue of freshwater fishes, and are commonly found in centrarchids. These parasites, commonly known as white grubs, utilize a three-host life cycle that includes mollusks, fish, and piscivorous birds. During the fish-host life stage, the parasite is in the metacercariae stage. In this study, we collected largemouth bass, black crappie, and bluegill from three different locations of the Illinois River: the upper river, lower river, and the Emiquon Preserve. We selected these species because they are economically important sportfishes found throughout the Illinois River. We selected these locations because of differences in geomorphology, water quality, and aquatic vegetation among the locations. We removed a 0.05-gram sample from the anterior, middle, and posterior portion of each fish liver, and pressed it between two microscope slides. We then counted white grub metacercariae using a dissecting microscope. White grub metacercariae abundance was generally greater in bluegill than in largemouth bass and black crappie, and also generally greater in Emiquon than in the upper and lower Illinois River. We believe species-specific differences in parasite abundance are associated with diet and habitat preferences of the three species, and location-specific differences in parasite abundance are associated with abundance of aquatic vegetation, which is a result of differences in geomorphology and water quality.

Size Selectivity of Gill Nets Used to Target Silver and Bighead Carp in the Upper Mississippi

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Bigheaded carp (Bighead Carp and Silver Carp) are highly invasive fishes in the Mississippi River System and can be detrimental to native fishes and ecosystems. To limit their impact and further expansion, fishermen have been contracted through state and federal agencies to remove bigheaded carp using predominantly gill nets. Mesh size of entanglement gears determines the size structure of fishes able to be captured. To increase efficiency and effectiveness of bigheaded carp harvest and minimize the capture of bycatch, it is important to understand the relationship of gill net mesh size with the size structure of persistent populations. Therefore, the objective of our study is to determine the size of bigheaded carp and commonly encountered bycatch that are effectively caught in different sized gill nets based on their size (bar size = 7.62, 8.89, 10.16, 10.8, 11.43, 12.7, 13.335, and 15.24 cm). Gill nets were used in pools 16 through 20 on the Mississippi River to capture silver carp (n=445) and bighead carp (n=72). Multiple areas were targeted for their capture including backwater, and main channel areas of bigheaded carp. With this information managers will be able to more efficiently target bigheaded carp if knowledge of population size structure is available.