# American Fisheries Society

## Wisconsin Chapter

52nd Annual Meeting

**Oral Presentations**

**Wednesday, February 1, 2023**
**&**
**Thursday, February 2, 2023**

Holiday Inn Convention Center, Stevens Point, WI

# Wednesday, 8:10 AM

## Use of Remote Car Counters to Evaluate Potential Shifts in Angler Effort in Response to Implementation of More Restrictive Panfish Regulations

Daniel Dembkowski, *Wisconsin Cooperative Fishery Research Unit*, University of Wisconsin - Stevens Point, dan.dembkowski@uwsp.edu

Daniel Isermann, Zachary Feiner, Alexander Latzka

As part of the Wisconsin Department of Natural Resources Adaptive Management Project for Panfish, a series of more restrictive panfish regulations consisting of 25/10 (25 total, ≤ 10 of any one species), 15/5 (15 total, ≤ 5 of any one species), and seasonal 15/5 (15 total, ≤ 5 of any one species during May and June; 25 fish in aggregate otherwise) were implemented in 2016 with the intent of increasing panfish size structure. We deployed remote car counters at a subset of lakes within each regulation group, and also at lakes that maintained the statewide panfish regulation of 25 panfish in aggregate, during 2015 and 2016 (pre-regulation) and 2021 and 2022 (post-regulation) to determine if angler behavior shifted in response to regulation implementation, with a specific focus on whether effort may have shifted away from lakes with more restrictive regulations and toward lakes with greater opportunities for harvest. Use of car counters to index angler effort was validated by comparing car counter estimates of effort with creel data at Escanaba and Nebish lakes during 2009 and paired game camera and car counter deployments at 14 lakes during 2015. Results suggest car counters can be used to index angler effort at a broad scale, although lake-specific efficacy varied in relation to overall use and boat launch design. The distribution of effort among regulation groups differed between pre- and post-regulation time periods but we did not observe any systematic trends that would suggest broad-scale shifts in effort away from lakes with more restrictive harvest regulations and toward lakes with greater opportunities for harvest. These findings have important implications for the efficacy of using more restrictive regulations to improve panfish size structure at a broad scale.

**Full Presentation, Professional**

# Wednesday, 8:30 AM

## Angler decisions when facing walleye declines in Wisconsin

Ashley Trudeau, *University of Wisconsin - Madison*, aatrudeau@wisc.edu

Ben Beardmore, Olaf Jensen

Populations of walleye (*Sander vitreus*), a popular target species and cornerstone of the recreational fishing economy, are losing their ability to naturally reproduce in most Wisconsin lakes. At the same time centrarchids such as largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus*) have flourished. The success of management interventions such as stocking would depend in part on angler response to changes in walleye availability, including their willingness to travel greater distances and/or substitute alternative target species. As the number of quality walleye lakes continues to decline, anglers targeting this species may leave the fishery, switch target species, or concentrate their fishing effort on the remaining walleye lakes. Stated preference methods such as choice experiments allow respondents with different preferences to weigh hypothetical fishing trips that vary systematically in their properties, including travel time and catch rates. We distributed an online discrete choice experiment and survey to holders of WI resident fishing licenses. Three latent classes of anglers varied in their willingness to travel to achieve increased walleye and largemouth bass catch rates, but we found no evidence that anglers would concentrate their fishing effort on distant lakes as walleye populations declined. Neither did we find evidence that largemouth bass and bluegill were "second choice" species to walleye. Rather, most respondents were motivated by quality fishing sites for multiple species that were listed. The most committed class of anglers was also motivated to fish for species that were not included in the choice experiment, including black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescens*), and trout (*Salvelinus namaycush* and *Oncorhynchus mykiss*). These results suggest that many Wisconsin anglers may be satisfied by quality fishing for other species in the future despite ongoing walleye declines.

**Full Presentation, Professional**

# Wednesday, 8:50 AM

## Volunteer Angler Tagging Programs: Implementation, Challenges and Case Studies of Fisheries Management Applications in West-Central Wisconsin

Joseph Gerbyshak, *Wisconsin Department of Natural Resources*, joseph.gerbyshak@wi.gov

Volunteer angler tagging programs have served to be a reliable data source for fisheries management purposes on waterbodies in Chippewa and Eau Claire Counties. Data collected from these programs can provide valuable information on growth, movement, and population size. Volunteer anglers started tagging lake sturgeon with floy tags on the Chippewa River near Eau Claire in 2019 and have since administered 548 tags. Juvenile lake sturgeon are difficult to capture via traditional fisheries sampling methods such as electrofishing and gillnetting, but hook and line angling has proven to be an effective capture tool. Over multiple years, volunteer anglers have generated enough data to estimate abundance of juvenile lake sturgeon annually. Volunteer anglers from the local Muskies Inc. Chapter have implanted 305 PIT tags into musky from 2017-2021. Musky occur at a relatively low density so capturing enough fish for a precise population estimate can be difficult, but when volunteer angler tagging data is added, the precision of population estimates increases. Additionally, meaningful musky abundance estimates may be generated solely from volunteer angler tagging data given there is adequate effort. Managing volunteer angling groups can be challenging, but the opportunity to collect valuable fisheries data and build relationships with angling groups is worth the effort.

**Full Presentation, Professional**

# Wednesday, 9:10 AM

## Impact of Angling Technologies on Catch Expectations

Amanda Kerkhove, *University of Wisconsin - Madison*, kerkhoveamanda@gmail.com

Ashley Trudeau, Olaf Jensen, Daniel Isermann, Zachary Feiner

Rapid technological advancements have changed the way people live, and work, and recreational fisheries have not been isolated from these changes. Fishing technologies like underwater cameras and sonars have become increasingly popular among anglers, especially during on-ice seasons. Understanding how these technologies are impacting recreational fisheries are extremely important. Utilizing creel survey data from both Dane and Vilas counties to understand the complex relationship between angler catch expectations, catch rates, angler satisfaction, and the role that angling technologies play in social ecological systems.

**Full Presentation, Student**

# Wednesday, 9:30 AM

## Understanding Smallmouth Bass Recruitment in Relation to Nest Fishing along Wisconsin's Door Peninsula

Eric Naas, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, enaas541@uwsp.edu

Daniel Dembkowski, Scott Hansen, Justin VanDeHey, Daniel Isermann

Smallmouth bass support important fisheries along Wisconsin's Door Peninsula, but recent declines in catch rates for smallmouth bass ≥ 18 inches have prompted concerns among stakeholders. While these declines may reflect variation in recruitment, some stakeholders believe that angling during nesting may be detrimental to recruitment. Determining reasons for declining catch rates is difficult because the Wisconsin Department of Natural Resources lacks a method for indexing smallmouth bass recruitment before bass enter the fishery at ages 3 and 4. Our research objectives are to determine if: 1) nest success varies in relation to a suite of abiotic and biotic variables, including angler effort and nest disturbance; 2) sampling effort required to detect changes in catch-per-effort (CPE) of age-0 and age-1 smallmouth bass at end of summer varies among selected sampling gears, and 3) location-specific estimates of age-0 CPE measured at end of summer are related to abiotic and biotic variables. We are monitoring nests along transects within 4 different spawning locations along the Door Peninsula, including a reference location where fishing is closed during the nesting period. We are deploying underwater cameras at individual nests within each location to observe rates of nest disturbance by anglers and predators. Factors of interest related to nest success and recruitment include nest depth, growing degree days, storm frequency, relative fishing effort, rate of angler nest disturbance, and nest predator abundance. We are also comparing modified boat electrofishing, hand-held anode electrofishing, and mini-fyke nets as methods for sampling age-0 and age-1 smallmouth bass to determine sampling effort required to detect specific changes in CPE of age-0 and age-1 bass. Our research will help fishery managers determine a sampling method to index recruitment before smallmouth bass enter the fishery and address concerns regarding the effects of nest fishing on recruitment.

**Full Presentation, Student**

# Wednesday, 10:10 AM

## Bluegill Growth and Size Structure in the Midwestern USA: Predictive Models and Benchmarks for Fisheries Management

Dakota Stankowski, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, dakotastankowski@gmail.com

Daniel Isermann, Daniel Dembkowski, Zachary Feiner, Olaf Jensen

Bluegill support important harvest-oriented fisheries across the Midwestern USA and understanding the potential effects of climate change on population dynamics at a broad spatial scale will likely be increasingly important for management. Specifically, somatic growth and size structure, which may be influenced by climate and other factors, are characteristics that can play an important role in where anglers decide to fish. Consequently, the objectives of our research are to determine if a suite of abiotic and biotic factors explain variation in bluegill growth and size structure among lakes across the Midwestern USA. We also created standards that will allow fisheries managers to categorize bluegill growth and size structure within the region. We utilized a hierarchical modeling structure to synthesize survey data on bluegill populations from across the Midwest and completed additional sampling to increase otolith-based estimates of bluegill size-at-age in Wisconsin. These results will be used to predict the future status of bluegill fisheries with climate change and how projected fishery changes might affect angler behavior and management strategies.

**Full Presentation, Student**

# Wednesday, 10:30 AM

## Using a Large-Scale Removal to Better Understand Density-Dependent Growth in Centrarchids

Rebecca Henningsen, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, bhenn504@uwsp.edu

Holly Embke, Quinnlan Smith, Giancarlo Coppola, Christopher Sullivan, Daniel Dembkowski, Zach Lawson, Joseph Hennessy, Stephen Carpenter, M. Jake Vander Zanden, Daniel Isermann

Bluegills, crappies, and largemouth bass support popular fisheries across North America and are often focal species for resource management agencies. Many fisheries management actions (e.g., harvest regulations, stocking, predator management) are implemented to manipulate or regulate density of these species and changes in density have the potential to influence somatic growth rate. However, our understanding of density-dependent growth is limited due to inconclusive experiments and difficulties in disentangling the effects of density from the many other factors that can influence growth rates. Inherent variation and low sampling effort associated with many surveys of inland fish populations likely preclude detection of even modest changes in growth. However, understanding how growth responds to drastic changes in density can provide a useful baseline for determining whether management actions are likely to achieve growth-based objectives. Since 2018, we have removed more than 280,000 centrarchids from McDermott Lake, a 33-ha lake in northern Wisconsin, to assess fish community responses to the removals. We will present preliminary results on abundance and growth responses of bluegills, black crappies, and largemouth bass to the removals and discuss our use of otolith-based back calculations to reconstruct the growth history of individual fish to acquire more information on pre-removal growth rates.

**Full Presentation, Student**

## Wednesday, 10:50 AM

### Yellow Perch Responses to a Large-Scale Centrarchid Removal

Max Monfort, *University of Wisconsin - Stevens Point*, mmonf003@uwsp.edu

Becca Henningsen, Holly Embke, Quinn Smith, Giancarlo Coppola, Daniel Dembkowski, Jason Folstad, Zachary Lawson, Joseph Hennessy, Steve Carpenter, Jake Vander Zanden, Christopher Sullivan, Daniel Isermann

Proliferation of warmwater fish in northern lakes has significant implications for food web structure and fisheries management. Specifically, proliferation of centrarchids (e.g., largemouth bass *Micropterus salmoides*, bluegill *Lepomis macrochirus*, and black crappie *Pomoxis nigromaculatus*) could have important implications for yellow perch *Perca flavescens* , a species that serves important roles in lake ecosystems as both predators and prey. However, relationships between centrarchids and yellow perch are poorly understood. A large-scale experiment that resulted in removal of more than 285,000 centrarchids from McDermott Lake in northern Wisconsin provided a unique opportunity to examine the response of the yellow perch population to the removal relative to perch population trends in Sandy Beach Lake, which served as a reference system. Metrics of interest used to describe yellow perch population trends in each lake included catch-per-unit effort (CPUE), mean TL, size structure indices (PSDs), mean age and mean lengths at age. Clear trends are not readily apparent within and between lakes for most of these metrics, although yellow perch CPUE in spring fyke nets was higher in McDermott Lake after the removal commenced. We expect that completion of ongoing age-based analyses will provide additional insights regarding how the yellow perch population in McDermott Lake responded to the removal.

**Speed Presentation, Student**

# Wednesday, 11:00 AM

## Estimating age, growth, and mortality of inland cisco *Coregonus artedi*

Maxwel Wilkinson, *Wisconsin Department of Natural Resources*, mvwilkinson@wisc.edu

Logan Sikora, Levi Feucht, Joseph Mrnak

Inland cisco *Coregonus artedi* are an energy-dense forage fish native to some Wisconsin north-temperate oligotrophic lakes. Cisco play a critical role within their native food webs as they are a common prey item for important gamefishes (e.g., lake trout *Salvelinus namaycush*, walleye *Sander vitreus*, and muskellunge *Esox masquinongy*) and can couple benthic-pelagic energy flow. Yet, relatively little information for this species exists within inland lakes. With future climate warming and species invasions predicted to drive population declines and, in some instances, extirpations (most notably at the southern extent of their range), there is a critical need to increase our knowledge of this species to improve our management capabilities. Thus, our objectives in this study were to characterize age, growth, and mortality parameter estimates for inland cisco from two northern Wisconsin lakes (Trout Lake and White Sand Lake, Vilas Co., WI). For Wisconsin inland cisco, we estimated a maximum age of 14-yr with the most common ages being 2- and 6-yr. von Bertalanffy parameter estimates indicate that inland cisco have a greater estimated mean asymptotic length (367 mm) and Brody growth coefficient (K = 0.126) compared to what has been observed in the Laurentian Great Lakes (313 mm and K = 0.111, respectively). Annual mortality was greater than expected (39.6%) and indicates population turnover approximately every 2.5-yr. This relatively high rate of mortality may be driven by density-dependence as both White Sand Lake and Trout Lake have a much denser cisco population than surrounding inland lakes or the Laurentian Great Lakes. Updated age, growth, and mortality estimates for inland cisco will improve our ability to apply holistic fishery management approaches to lakes containing this important species. Further, if monitored for the long-term, changes in these parameter estimates may be indicative of food web changes that may precede a negative population-level response.

**Speed Presentation, Student**

## Wednesday, 11:10 AM

### Calipers versus digital- what's best for morphometric study?

Ben Martin, *University of Wisconsin - Madison*, bemartin@wisc.edu

Brian P. O'Malley, Randy Eshenroder, Yu-Chun Kao, Chris Olds, Timothy P. O'Brien, Chris L. Davis

Our primary objective was to determine how traditional morphometrics (TM) compared with geometric morphometrics in discriminating among morphologies of four forms of ciscoes of the *Coregonus artedi* complex collected from Lake Huron. One of the forms comprised two groups of the same deepwater cisco separated by capture depth, whereas the other three forms were shallow-water ciscoes. Our three groups of shallow-water ciscoes were better separated in PCAs with TM data (mean overlap 3%) than with GM data incorporating semilandmarks (mean overlap 19%). Our two deepwater cisco groups, comprising a putatively single form collected from different depths, separated more in PCAs with GM data (33% overlap) than in PCAs with TM data (66% overlap), an anomaly caused by greater decompression of the swimbladder and deformation of the body wall in the group captured at greater depths. Assignment of forms using canonical variate analysis (CVA) accurately assigned 86% of individuals using TM data, 98% of individuals using GM data incorporating semilandmarks, and 100% of individuals using GM data without semilandmarks. However, we considered assignments of individuals from the same form of deepwater cisco into separate groups as misassignments resulting from different capture depths, which reduced the accuracy of assignments with GM data to 66% with or to 68% without semilandmarks. Our secondary objective was to compare GM results with and without semilandmarks on the same form of cisco captured at different depths so as to assess the effects of swimbladder decompression on shape analysis. Separation of the two groups captured at different depths was not affected by the removal of semilandmarks, which had been expected to minimize the effect of distention of the body wall due to bloating. TM data provided better discrimination among Lake Huron ciscoes than GM data likely owing to our use of metrics known to have explanatory power.

**Speed Presentation, Professional**

## Wednesday, 11:20 AM

### Examining the Thermal Ecology of Walleye in Green Bay, Lake Michigan, Using Archival Temperature Loggers

Lisa Izzo, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, lizzo@uwsp.edu

Daniel Dembkowski, Todd Hayden, Tom Binder, Chris Vandergoot, Steve Hogler, Mike Donofrio, Troy Zorn, Charles Krueger, Daniel Isermann

Climate change related shifts in water temperature can impact recruitment success, growth, and overall habitat availability for walleye (*Sander vitreus*) throughout their range. While thermal habitat for walleye is expected to increase in much of the Great Lakes, shallow, warmer areas of the basin could be at particular risk for loss of walleye habitat as water temperatures rise. However, predictions of future habitat availability are rarely based on direct observations of walleye behavior and may fail to capture population-specific variability in thermal tolerance that could be relevant to thermal habitat projections. In this study, we used archival temperature loggers to understand the current thermal habitat use of walleye in Green Bay, the largest embayment in Lake Michigan, and predict how thermal habitat availability for the species in Green Bay could change in the future. In 2017-2018, we tagged 384 walleye with both acoustic transmitters and archival temperature loggers. Temperature loggers were set to record observations at 4-h intervals for up to 11 months, and during that time period walleye were tracked using an array of 225 stationary acoustic receivers throughout Green Bay and its tributaries. Temperature data were recovered from 40 individuals. Monthly average temperatures for individual walleye recorded in the summer (July–September) ranged from 17.2 to 25.2 °C. Only 1.2% of all temperature observations were above the temperature range used to estimate walleye thermal-optical habitat availability in previous studies (TOHA, 11–25 °C), suggesting that walleye in Green Bay are currently inhabiting water temperatures that would be included as suitable in current habitat availability models. We will examine temperature data in relation to fish locations determined from acoustic telemetry and discuss these results in the context of warming water temperatures, particularly in the southern part of Green Bay.

**Speed Presentation, Professional**

# Wednesday, 11:30 AM

## Wisconsin AFS Student-Mentor Program: What it is, How it Works, How to Get Involved, and Plans for the Future

Stephanie Shaw, *Wisconsin Department of Natural Resources*, stephanie.shaw@wisconsin.gov

Holly Embke, Kayla Reed, Joshua Raabe, Mike Seider, Max Wolter

The Wisconsin Chapter of the American Fisheries Society Student-Mentor Program was created in 2020. It was designed to provide the opportunity for students to connect with professional mentors virtually and year-round. The mentor program was the brainchild of past president Max Wolter (WI DNR). It is overseen by the Student Affairs Committee of WI AFS. In addition to networking opportunities for students the program offers services such as resume review and mock interviews. Since 2020, we have had 29 professionals volunteer to be mentors. Mentors come from a range of agencies and careers fields: U.S. Fish & Wildlife Service, U.S. Forest Service, U.S. Geological Survey, Wisconsin Sea Grant, Wisconsin DNR, one non-profit volunteer, as well as participation from past WI AFS members that are now working in other states and countries. Mentor areas of interest cover a range of areas of expertise in the fisheries profession from gamefish management, fisheries research, rare or threatened species, invasive and non-game species management, fish health, habitat, administration and policy. Mentorship duration is up to the needs of the student. Mentorship can be brief, for students that have questions about a particular career path or agency and only need to meet once, or mentorships are free to last longer depending on the needs of the student. Since the start of the program we have had 9 student-mentor pairings. The Student Affairs Committee is currently working on evaluating the program using surveys sent to past participants as well as non-participants. The goal of the surveys is to gauge the success of past student-mentor pairings and gain a better understanding of why students have not participated in the program, and what services would be most valuable to them. Future goals and updates for the mentor program include adding an online signup form for students and increasing awareness about the program by scheduling regular information sessions with student subunits.

**Full Presentation, Professional**

# Wednesday, 1:00 PM

## Brook Trout population response to Brown Trout Removal in Maple Dale Creek, WI

Kirk Olson, *Wisconsin Department of Natural Resources*, kirk.olson@wisconsin.gov

In 2019, the La Crosse WDNR Fisheries Management crew initiated a project to restore Brook Trout populations in Male Dale Creek through removal of Brown Trout. Between 2019 and 2022, 7,185 age 1 and older and 13,133 young of the year Brown Trout were removed from 3.5 stream miles of stream upstream of a fish passage barrier. Since the project began, biomass and density of Brook Trout have increased substantially relative to a nearby reference stream. Brown Trout density and biomass remained stable in the first year after the project began, thanks to strong recruitment, but have since declined to low levels. Our results add to the body of literature that indicate Brown Trout displace Brook Trout in Driftless Area streams and support mechanical removal of Brown Trout as a feasible option for Brook Trout restoration where fish passage barriers prevent re-colonization.

**Full Presentation, Professional**

## Wednesday, 1:20 PM

### Impacts of New Zealand Mud Snails on Southern Wisconsin Trout Streams

Kimberly Kuber, *Wisconsin Department of Natural Resources*, Kimberly.Kuber@colostate.edu

Dan Preston, Fernando Carvallo, Landon Falke, James Amrhein

New Zealand mud snails (*Potamopyrgus antipodarum*) are a widespread aquatic invasive species with established populations on five continents. They are small, easily transported, and difficult to control. First detected in North America in the late 1980's, New Zealand mud snails were discovered in Wisconsin on Black Earth Creek in Dane County in 2011. There are currently nine known populations in southern Wisconsin and they are predicted to become more widespread due to inadvertent transport by river users. Streams supporting New Zealand mud snails include economically important trout fisheries, however the impacts to stream food webs in Wisconsin streams are unknown. We surveyed ten trout streams in southern Wisconsin, six of which were invaded by New Zealand mud snails. Gastric lavages were performed on a subset of brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*) and mottled sculpin (*Cottus bairdii*) captured at each site during spring, summer, and winter. Mud snail densities ranged from around 200 to 55,000 per m2 and increased strongly at two sites over the survey period. Mud snail populations were positively correlated with nutrient concentrations and negatively correlated with stream discharge. Total densities of native invertebrates were negatively correlated with mud snail densities. New Zealand mud snails were being consumed by trout and mottled sculpin at all sites where mud snails were present. Brown trout were the dominant trout species at eight of the streams surveyed in this study. Trout body condition and population size structure did not appear to be affected by mud snail presence. These data serve as one piece of the puzzle to understanding impacts of New Zealand mud snails on trout fisheries in Wisconsin and should help to motivate future efforts to minimize their continued spread.

**Full Presentation, Professional**

# Wednesday, 1:40 PM

## Reproductive success of early generation and domesticated Brook Trout in Wisconsin

Andrew Thometz, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, athom393@uwsp.edu

Matthew Mitro, Jared Homola

Brook Trout *Salvelinus fontinalis* have been stocked throughout Wisconsin since the late 19th century to improve angling opportunities and mitigate population declines. When stocking to reestablish self-sustaining populations, it is important to consider the fitness of fish being released. Many studies have investigated the fitness of hatchery-derived salmonids, generally observing inferior survival and reproductive success when compared with early generation fish of wild parentage. However, to the best of our knowledge no studies have made such comparisons for Brook Trout reproductive success. To improve stocking effectiveness, fisheries managers may stock first-filial generation Brook Trout (F1; wild parents) or second-filial generation fish (F2; wild grandparents) rather than domesticated Brook Trout that have been maintained in hatcheries for many generations. We used genetic analyses following experimental stocking to determine the relative reproductive success among F1, F2, and domestic Brook Trout. From 2018 to 2020, 500 F1, 500 F2, and 500 domestic Brook Trout were stocked each year into Strutt Creek in Iowa County, Wisconsin. Strutt Creek supported reproduction by Brown Trout Salmo trutta and no Brook Trout were present prior to stocking. Wild Brook Trout collected in subsequent electrofishing surveys (n = 256) were assigned as offspring of F1, F2, or domestic stocked fish using multivariate and parentage analyses. Principal components analyses indicated wild offspring most often aligned with the stocked F1 fish and were rarely associated with stocked domestic fish, suggesting uneven reproductive contributions from the F1 and F2 fish relative to domestic fish. Parentage analyses will be used to improve the precision of relative reproductive success estimates for F1 versus F2 versus domestic Brook Trout. An understanding of reproductive potential for stocked Brook Trout will help inform future propagation, management, and restoration strategies.

**Full Presentation, Student**

# Wednesday, 2:00 PM

## Insights From a Climate Change 'Afterscape': How a Cold-Water Fish Thrives in a Hot Basin

Nick Hahlbeck, nhahlbeck4@gmail.com

Climate change is global, but animals adapt within landscapes. Many global analyses predict how warming will threaten cold-adapted animals, but few incorporate ecological information from the scales at which animals respond. Since 2016, we have explored how a cold-water fish thrives in a seasonally hot landscape that offers a glimpse of conditions projected in many Wisconsin watersheds. In the Upper Klamath Basin of interior Oregon, redband trout Oncorhynchus mykiss newberrii reach unusually large sizes despite extreme temperatures, nutrient loading, and hypoxia in most available habitat. Radio telemetry revealed a unique biannual migration, along which we sampled energetic condition and diet throughout the year. We found that fish stored energy by foraging in the hyper-productive lake when temperatures were optimal in spring and fall, then expended that energy on less productive summer refuges and winter spawning grounds when lake temperatures were adverse. Paired water quality and electrofishing surveys in a warm tributary revealed that though juvenile fish exploited cool groundwater refuges like the adults, they were similarly abundant and grew faster in the warmest available habitat. We extended the study to a part of the landscape recently fragmented by dams and added respirometry to our methods. We found that the dams likely eliminated cool refuge-seeking behavior in this neighboring population, but that physiological heat tolerance increased in response. Preliminary analysis indicated that the warm summer habitats used by fish in both populations served as refuges from hypoxia. Our results highlight the importance of considering multiple landscape factors like food, oxygen, and temperature together when assessing climate vulnerability of cold-water fish.

**Full Presentation, Professional**

# Wednesday, 3:30 PM

## Genome-Wide Analyses of Channel Catfish Population Structure Throughout Wisconsin

Jared Homola, *USGS, Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, jhomola@uwsp.edu

Paul Albosta

For decades, genetic structure has been used to delineate fish management units. Past technologies limited genetic structure analyses to neutral variation, which remains useful for understanding patterns of connectivity. Over the past decade, technology advances now allow adaptive genetic variation to be assayed alongside neutral variation, providing new insights into the mechanisms that influence population structure. The complementary inferences provided by analyses of neutral and adaptive variation now represent the best available science for delineating management units. Channel catfish support recreational fisheries in Wisconsin and throughout much of their range, making them a common target of management action, including stocking. Limited past stocking of channel catfish in Wisconsin with growing angler interest represents a unique opportunity to characterize the species' endemic structure. We used restriction-site associated DNA sequencing to genotype 530 channel catfish from 22 Wisconsin waterbodies at over 110,000 SNP loci. Analyses of neutral genetic structure identified several spatially defined breakpoints. For instance, Lake Dubay and Castle Rock Lake—both reservoirs of the central Wisconsin River—are genetically similar, whereas the lower Wisconsin River and its tributary (the Baraboo River) are substantially differentiated. Other relationships are less intuitive, such as Lake Winnebago channel catfish being indistinguishable from those in one tributary (Wolf River), but different from another (Upper Fox River). We also detected adaptive variation, including regions of chromosomes 13 and 20. Upcoming analyses will determine the role of genes in those regions and characterize their patterns of spatial variation throughout Wisconsin. This research improves understanding of the spatial grain of genetic structure of channel catfish and provides a resource for fishery managers to consider when making decisions regarding channel catfish propagation.

**Full Presentation, Professional**

## Wednesday, 3:50 PM

### Evaluating Potential Factors Limiting Lake Sturgeon Reproductive Success in the Upper Fox River

Everett Johnson, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, ejohn681@uwsp.edu

Daniel Dembkowski, Jeffrey Dimick, Margaret Stadig, Daniel Isermann

The Lake Winnebago System (LWS) in East-Central Wisconsin supports one of the largest lake sturgeon populations in North America which provides a popular spear fishery each February. Lake Sturgeon in the LWS primarily spawn in the Wolf and Fox rivers, but the lack of larval sturgeon in drift net samples suggest that successful hatching may not be occurring in the Fox River. Conversely, larval sturgeon are routinely collected at spawning sites in the Wolf River and its tributaries. The objective of our research is to determine if habitat characteristics differ among spawning sites where successful reproduction has been identified via presence of larvae (sites in the Wolf River and its tributaries) versus sites in the Fox River where larval sturgeon have never been collected. Habitat metrics measured at each site include flow, dissolved oxygen, temperature, siltation rates and periphyton growth. We are also sampling macroinvertebrate communities at each site to better understand habitat conditions within each location. Additionally, we are using mark-recapture information obtained by the Wisconsin Department of Natural Resources during spawning surveys to determine if lake sturgeon spawning in the Fox River exhibit site fidelity and whether sex ratios and length frequency distributions of these fish differ when compared to other spawning locations. Results from this research can help guide habitat improvement efforts within the LWS.

**Full Presentation, Student**

## Wednesday, 4:10 PM

### Larval Lake Sturgeon (*Acipenser fulvescens*) acceptance of formulated diets based on maternal lineages

Jadon Motquin, *University of Wisconsin - La Crosse*, jamotquin@gmail.com

David Schumann, Doug Aloisi, Orey Eckes, Eric Strauss

Lake Sturgeon (*Acipenser fulvescens*) have been successful for millions of years until recently overexploitation and habitat degradation has led to declines in population density within the Great Lakes and Mississippi River basins. Aquaculture of Lake Sturgeon can be a costly and labor-intensive act by which brine shrimp, blood worms, and krill (traditional diets) are fed. Otohime and Skretting (formulated diets), a much cheaper option, was fed to Lake Sturgeon to determine acceptance rates across maternal lineages while comparing survival, growth (total length), and body condition to traditional diets. Over a 120-day study period, three maternal lineages were divided into eighteen tanks where each maternal lineage had triplicate tanks of formulated diets and triplicate tanks of traditional diets. Eggs were collected at the Wolf River, near Shawano, Wisconsin and fertilized onsite prior to transport to the Genoa National Fish Hatchery. Survival was recorded daily throughout the study, and a subsample of sturgeon from each tank were measured to total length (±1 mm) and weighed (±0.001 g) biweekly starting at 56 days post hatch. Dissolved oxygen (mg/L), pH, and saturation (total pressure) were measured daily, and temperature (°C) was measured once every 15 minutes to monitor rearing conditions. A Kaplan Meier analysis revealed that distribution of mortality was significantly different for all females. A two-way ANOVA revealed significantly higher survival for traditional diets than formulated diets on day 120 ($\chi 2 = 3886$, df = 5, $P < 0.001$). A repeated measures ANOVA revealed both total length ($F_{1,11} = 62.2$, $P < 0.001$) and body condition ($F_{2,11} = 4.37$, $P = 0.04$) to be higher for traditional diets than formulated diets. The alternative feeding regime proposed provides further data showing that maternal lineages were similar, within diets, in all parameters measured and provides evidence that Lake Sturgeon will survive and grow once acceptance has occurred.

**Full Presentation, Student**

# Thursday, 8:00 AM

## Electronic Great Lakes Guide Reporting

Bradley Eggold, *Wisconsin Department of Natural Resources*, bradley.eggold@wisconsin.gov

Scott Hansen

Prior to 2022, guides who took clients out on the Great Lakes for fishing trips were generally not reporting their trips despite administrative code that allowed the department to capture that information. With the increase in the Lake Whitefish population in Green Bay, the level of interest on this fishery and fishing in Lake Superior, the fisheries program began a process to create a method to capture fishing guide trips on the Great Lakes. A "paper" reporting system was initiated in 2017 specifically to capture data from guided trips targeting lake whitefish on Green Bay. However, reporting compliance became inconsistent and the rule as written was difficult to enforce. Therefore, in 2021 the Fisheries program began a process to formalize a method to capture fishing guide trips on all Wisconsin waters of the Great Lakes. After a thorough analysis of the various options available, we decided to use a Survey 123 application from Environmental Systems Research Institute (ESRI) to capture this vital information. This process culminated in a new rule being approved starting on January 1, 2022 that made it mandatory for guides to report their fishing trips on selected Great Lakes waters. For 2022 and 2023, guides fishing in Lake Superior and Green Bay are required to report their fishing trips using this application. This talk will provide the background for the approach and results from the first year of the program.

**Full Presentation, Professional**

# Thursday, 8:20 AM

## Assessment of Spatial and Temporal Variation in Stock-Specific Harvest Rates for Lake Michigan's Lake Whitefish Fishery

Alicia Krause, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, akrau335@uwsp.edu

Yue Shi, Wesley Larson, Jared Homola

Fish stocks often exhibit spatial genetic structure arising in part from spawning site fidelity. Genetically distinct stocks may occupy the same geographic areas during non-spawning times, resulting in mixed stock harvests, as is the case for Lake Michigan's lake whitefish (*Coregonus clupeaformis*). Lake whitefish support the largest commercial fishery in the Great Lakes and a growing recreational fishery. Past lake whitefish population declines due to invasive species and over-harvesting resulted in implementing geographic management units in the 1970s-80s with the intention of protecting distinct spawning populations with unique population dynamics. However, past tagging and genetic studies have suggested that lake whitefish stocks often mix during non-spawning periods leading to concerns that more vulnerable stocks could experience over-harvesting. We are using genotyping-in-thousands (GT-seq) to inform mixed-stock analyses (MSAs) throughout Lake Michigan to quantify spatial and temporal variation in the mixing of lake whitefish from seven genetically delineated stocks. Preliminary analyses of 1784 lake whitefish collected throughout Lake Michigan during non-spawning times show both spatial and temporal variation in habitat occupancy among stocks. For instance, we observed contributions from all stocks in eastern Lake Michigan harvests, whereas harvests from northwestern areas of the lake were dominated by local stocks. Furthermore, stock-specific contributions to harvests in and around Big Bay de Noc were steady between 2010-2022, whereas substantial shifts in stock-specific contributions were observed through time in northern Lake Michigan. Upcoming analyses will assess the origins of over 1000 additional harvested Lake Michigan lake whitefish and inform the initial development of mixture-aware statistical catch-at-age models to account for the influence of stock mixing on stock-specific recruitment estimates.

**Full Presentation, Student**

# Thursday, 8:40 AM

## Lake Whitefish Spawning in Green Bay Tributaries: Genetics, Behavior, Dynamics, and Demographics

Ryan Eastman, *Wisconsin Department of Natural Resources*, ryan.eastman@wisconsin.gov

Lisa Izzo, Jared Homola, Paul Albosta, Daniel Dembkowski, Scott Hansen, and Daniel Isermann

The resurgence of lake whitefish (Coregonus clupeaformis) spawning in several tributaries to Green Bay (primarily the Menominee, Fox, and Peshtigo rivers) prompted the Wisconsin DNR to begin conducting electrofishing surveys on these rivers in November 2009 that included tagging in some years. Additionally, since 2017, more than 400 lake whitefish collected from tributaries in November were implanted with acoustic transmitters to track movements and were assigned to genetic stocks using assignment testing informed by a genotyping-in-thousands panel developed specifically for Lake Michigan lake whitefish. We used these data sources to assess genetic stock structure, spawning site fidelity, as well as trends in recruitment, size structure, growth, and age composition of lake whitefish spawning in these three tributaries. Genetic analyses indicate that lake whitefish spawning in these rivers assign to two different stocks that generally align with northern and southern Green Bay and acoustic telemetry indicates that river-specific spawning site fidelity is high, but a fraction of these fish may not always return to rivers each spawning season. Preliminary analyses suggest that mean total length of whitefish encountered in November on the Fox and Menominee Rivers has increased over time, but ongoing age-based analyses will provide greater insights regarding potential temporal trends in stock dynamics and demographics.

**Full Presentation, Professional**

# Thursday, 9:00 AM

## Initial Insights of the Thermal Ecology of Lake Whitefish in Northwestern Lake Michigan

Kayla Reed, *University of Wisconsin - Stevens Point*, kreed684@uwsp.edu

Lisa Izzo, Tom Binder, Todd Hayden, Daniel Dembkowski, Scott Hansen, David Caroffino, Christopher Vandergoot, Charles Krueger, Daniel Isermann

Lake whitefish *Coregonus clupeaformis* are a native coldwater species supporting important recreational and commercial fisheries in the Laurentian Great Lakes. Climate-related changes in water temperature may have important implications for the future sustainability of these fisheries. However, projecting future habitat availability is difficult because limited information is available on lake whitefish thermal ecology in the region. In this study, archival temperature loggers were implanted into 400 lake whitefish from northwestern Lake Michigan, including Green Bay, during October–November 2017. Loggers recorded temperature for 11 months at 4-hr intervals. Thirteen recovered temperature loggers were used in analyses. In winter (1 December–31 March), temperatures occupied by lake whitefish ranged from 0 to 8.0 °C, while in spring (1 April–31 May) temperatures ranged from 0 to 20.0 °C. In summer (1 June–15 September) and fall (16 September–7 November), lake whitefish occupied temperatures of 4–21.5 and 4–21.0 °C, respectively. During the summer, 58% of observations from lake whitefish were outside the reported optimal temperature range (10-14 °C) and an average of 11% of observations were outside the broad thermal niche (7-17 °C) previously described. Our results suggest that lake whitefish from northwestern Lake Michigan show some tolerance for warmer water temperatures (>14 °C) than previously reported. This study provides initial insights on lake whitefish thermal ecology in Lake Michigan and can be used as a baseline for future work aimed at determining how lake whitefish habitat availability may change in the future.

**Full Presentation, Student**

# Thursday, 9:20 AM

## Preliminary Patterns in Relative Survival, Movement, and Wild Recruitment of Steelhead in Lake Michigan

Matthew Kornis, *US Fish & Wildlife Service,* matthew_kornis@fws.gov

James Webster, Allen Lane, Kevin Pankow, Anthony Rieth, Shannon Cressman, Francesco Guzzo, Eric Forbes, and Charles Bronte

Millions of steelhead are annually stocked in the Great Lakes to support and diversify sport fisheries, and managers are interested in better understanding their population attributes and ecology. Since 2017, the U.S. Fish and Wildlife Service has adipose-fin clipped all steelhead stocked into Lakes Michigan and Huron, except in 2020 due to Covid-19, with most receiving coded-wire tags to identify stocking location, genetic strain, and year class. We analyzed steelhead return data from the sport fishery in lakes Michigan and Huron to explore movement patterns, measure and assess factors affecting relative survival, and estimate wild production. Wild steelhead comprised 33 – 45% of the population for the 2017 – 2019 year classes, with annual wild production estimates ranging from 1.0 – 1.6 million smolts. Steelhead moved long distances post-release, comparable to Chinook salmon, and angler harvest of steelhead was not dependent on stocking location outside of spawning season. Steelhead stocked in southern Lake Michigan appeared to have higher relative survival than those stocked in northern Lake Michigan. Fish stocked at older life stages (yearlings vs. fingerlings) and at larger sizes also appeared to have higher relative survival, similar to previous studies. This study is ongoing, and additional data will add to these results and permit exploration of effects of genetic strain. These results have implications for steelhead management and stocking strategies in Lake Michigan.

**Full Presentation, Professional**

# Thursday, 9:40 AM

## Body Size, Trophic Position, and Habitat Coupling in Lake Michigan's Food Web

Bryan Maitland, *University of Wisconsin - Madison*, bmaitland@wisc.edu

Friedrich Keppeler, Olaf Jensen, Joel Hoffman, David Bunnell, A. Scott McNaught, Brandon Gerig

The landscape theory of food web architecture (LTWFA) describes relationships among animal body size, mobility, and coupling of energy channels from heterogeneous habitats. As such, it can help predict which species are likely to play a critical role in connecting different parts of a food web. However, empirical tests of the LTWFA are rare and support differs among terrestrial, freshwater, and marine systems. Further, it remains unclear whether the theory applies in highly invaded ecosystems such as the Laurentian Great Lakes. Here, we test predictions of the LTWFA by quantifying links among animal body size, trophic position, and the coupling of energy channels from nearshore littoral and offshore pelagic habitats using carbon and nitrogen stable isotope ratio data from organisms throughout the Lake Michigan food web—a dynamic system shaped by biotic and abiotic interactions. Consistent with the LTFWA, we found a gradual increase in the coupling of phytoplankton and littoral algal energy channels with larger body sizes and higher TPs. Because energy transfer among habitats and diverse basal production sources promote stable food webs and species diversity, our results suggest the Lake Michigan food web may be resilient to changing ecological conditions.

**Full Presentation, Professional**

# Thursday, 10:30 AM

## Analyzing Demographic Patterns in Reproductive Success for Walleye *Sander vitreus* in Escanaba Lake, Wisconsin, Using Parentage Analysis

Robert Davis, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, bdavis@uwsp.edu

Levi Simmons, Stephanie Shaw, Greg Sass, Daniel Isermann, Wes Larson, Jared Homola

Determining whether shifts in fish population demographics influence reproductive success is important for understanding population resiliency to environmental change and harvest. Previous studies have suggested that larger female walleye may experience greater reproductive success because of higher fecundity and larger eggs. Whether these larger fish produce offspring that are more likely to survive to subsequent life stages has not been tested in a wild population. We used genetic-based parentage analysis to test whether parental length, age, and growth rate of both sexes explained variation in the reproductive success of walleye in Escanaba Lake, Wisconsin. Fin clips were obtained from 1339 adult walleye and 1138 juveniles over 4 years, providing a pool of prospective parents and offspring that were assigned back to parents via genetics. Total lengths (TLs) of prospective parents ranged from 251 - 750 mm and ages ranged from 2 – 21 years. Based on parentage analysis, 342 of the 1339 prospective parents had at least one offspring survive to the first fall, which we used as a measure of reproductive success. After adjusting for mortality, model selection identified two supported models for explaining variation in reproductive success: one with year and growth rate as predictors and another with year, growth rate, and age. Probability of reproductive success increased with length and growth rate in females, while no predictors were significant for males. Our findings indicate that fast growing walleyes reaching longer lengths may have the highest probability of reproductive success and this could have implications for walleye management.

**Full Presentation, Professional**

# Thursday, 10:50 AM

## Empirical evaluation of walleye (*Sander vitreus*) thermal-optical habitat in northern Wisconsin lakes

Benjamin Vasquez, *Wisconsin Cooperative Fishery Research Unit*, University of Wisconsin - Stevens Point, bvasq705@uwsp.edu

Daniel Dembkowski, Olaf Jensen, Stephanie Shaw, Greg Sass, Quinn Smith, Holly Embke, M. Jake Vander Zanden, Zachary Feiner, Joseph Mrnak, Gretchen Hansen, Daniel Isermann

Available evidence suggests that walleye population status is influenced by water temperature and light levels and that the availability of thermal-optical habitat area (TOHA) considered optimal for walleye growth has changed over time. Despite the apparent connection between TOHA and population status, no previous study has empirically assessed walleye habitat use in relation to TOHA. We used acoustic and archival tagging technology to determine: 1) if walleye TOHA use varies among three northern Wisconsin lakes in relation to season and walleye total length; 2) if the TOHA model employed in previous research accurately defines TOHA for walleye in the three study lakes; and 3) if data resolution and cost-effectiveness differs between acoustic telemetry or archival tags used to monitor walleye habitat use. We selected lakes with different walleye recruitment histories and lake morphology that also provided high probabilities of subsequent recapture of tagged fish. We surgically implanted tags into walleye from these lakes during May 2022 and light and temperature loggers have been deployed within each lake, along with acoustic receivers. We will present preliminary observations from our study. This research will help determine if walleye population status may be related to TOHA and help inform future studies to describe thermal-optical habitat use of fish in inland lakes.

**Full Presentation, Student**

# Thursday, 11:10 AM

## Early Evaluation of a Revised Walleye Management Regime in the Wisconsin Ceded Territory Using an Established Exploitation Management Benchmark

Tom Cichosz, *University of Wisconsin - Stevens Point*, thomas.cichosz@wisconsin.gov

In 2015 a new management system utilizing a standardized bag limit (3 walleye/day) with more restrictive angler harvest regulations replaced a sliding bag limit system as the primary means to regulate angler harvest of adult walleye in Wisconsin Ceded Territory joint fishery. In 2016 the Wisconsin Department of Natural Resources also began using a Mixed Effects Model (MEM) for setting of safe harvest levels in most Ceded Territory waters. Relative to the previous linear regression models used, this MEM was expected to redistribute tribal harvest via high-efficiency gears, allowing for more- or less harvest in documented high- or low-density fisheries, respectively. I assessed walleye exploitation from 1990 through 2020 to evaluate performance of management efforts in the mixed (spearing and angling) walleye fishery in the Wisconsin Ceded Territory. Changes in management effectiveness with changing management regimes were assessed against an established limit-reference benchmark.

**Full Presentation, Professional**

## Thursday, 11:30 AM

### Keynote Address: Role of WI AFS throughout Career

Steve Gilbert, Retired - *Wisconsin Department of Natural Resources*