Minnesota Chapter of the American Fisheries Society Annual Meeting

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Leaving a Conservation Legacy

Abstract Book

Concurrent Session 1

Tech Talks *
Wednesday 1:20-2:40pm

*** Year-round spawning and transgenesis of common carp for genetic biocontrol research and development**

Julie Badger, Nicholas Jacob, Colby Johnson, Leland Pornschloegl, Isabel Ameli, Sam Erickson, Przemek Bajer, Michael Smanski

Presenter: Julie Badger beenk006@umn.edu
Affiliation: University of Minnesota

The common carp (*Cyprinus carpio*) is an economically and ecologically significant species, being both one of the most aquacultured fish globally and a persistent, widespread invasive species. As such, many could benefit from the ability to perform reliable, year-round transgenesis of the common carp. In the wild, common carp spawn only annually, but by artificially rotating batches of carp through accelerated temperature and day/night cycles we are able to spawn carp biweekly throughout the year. We also tested and optimized several parameters for reliable transgenesis, which we do by microinjecting into the yolk of the fertilized egg. Using these optimized protocols, we now aim to develop multiple types of genetic biocontrol against the common carp to assist in control of this invasive species.

***Swimming Towards Speciation: Engineered Genetic Incompatibility In Fish**

Leland Pornschloegl, Sam Erickson, Nicholas Jacob, Isabel Ameli, Julie Badger, Michael Smanski

Presenter: Leland Pornschloegl porns003@umn.edu
Affiliation: University of Minnesota

Common carp (*Cyprinus carpio*) are an aquatic freshwater species of fish that are native to eastern Europe and Asia with invasive populations found throughout the world. As an ecosystem engineer and a non-native fish, they pose major threats to the ecosystems, agriculture, and economies of their introduced communities. Currently employed physical and chemical methods to combat these invasive populations are insufficient for eradication and have unintended effects on the surrounding ecosystem. To overcome this, we are developing genetic biocontrol technologies to be used in conjunction with traditional methods of population control that will result in the collapse of the invasive population. One such method is Engineered Genetic Incompatibility (EGI). EGI achieves a synthetic speciation event by coupling a haplosufficient dominant lethal transgene in the form of a dCas9 based programable transcriptional activator with a haploinsufficient recessive resistance allele. This synthetic speciation event allows for two EGI fish to reproduce successfully when crossed with each other but produce no viable offspring when crossed to wild type. This can be utilized as a form of sterile male release. This technology has previously been shown to work in Saccharomyces cerevisiae and Drosophila melanogaster, but adapting this technology from a fungus or invertebrate model organism to a vertebrate non-model organism is a large step with many challenges. To bridge this gap, we have developed EGI technology in the model organism Danio rerio and have characterized its molecular components to streamline its development in non-model pest organisms.

An evaluation of the age-at-recruitment to population monitoring gears for Cisco in the Lake Superior

Jeremiah Shrovnal, Dray Carl, Ian Harding, Mark Vinson, Brad Ray, Scott Sapper, Andrew Honsey, Lynn Waterhouse
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An evolving commercial roe fishery for Cisco (*Coregonus artedi*) in Wisconsin waters of Lake Superior has resulted in a need for a more thorough understanding of how different life stages are captured via harvest and surveys. Local fishery managers actively monitor commercial harvest, and Cisco are also encountered in standardized community assessment gill net surveys in summer months along with targeted gill net surveys during spawning aggregations that are paired with hydroacoustic surveys to estimate adult densities. While age structures have been collected during these surveys in the past, a comprehensive growth analysis has yet to be conducted with the available data to estimate the time to recruitment for the various monitoring gears. The purpose of this work is to 1) utilize historical length-at-age data from Cisco collected in Wisconsin waters of Lake Superior to estimate growth, and use these growth estimates to 2) determine the age-at-recruitment to summer small-mesh gill nets, winter large-mesh gill nets, and the currently used target strength threshold for hydroacoustic surveys in Wisconsin waters. Preliminary results indicate variation in growth rates among cohorts, and that females are generally more likely to recruit to each gear type prior to males. These findings can inform future population modeling exercises and be used as a reference point for other management agencies in the Great Lakes seeking to expand monitoring efforts

***Optimizing eDNA methods for fish community assessment in Minnesota lakes**

Courtney E Larson, Chelsea Hatzenbuhler, Greg Peterson, Erik Pilgrim, Joel Hoffman, Anett Trebitz

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Affiliation: US Environmental Protection Agency

Environmental DNA (eDNA) may supplement conventional methods for fish community assessment by measuring fish-specific DNA shed by the fish community in the water of a given ecosystem, enhancing rare species detection and reducing field effort. However, eDNA is not typically paired with physical catch surveys because molecular methods remain under-studied in management contexts and it is unknown how they fit with existing protocols. Therefore, we are developing efficient, scalable methods for eDNA fish surveys in lakes to illuminate fish biodiversity over different habitats and spatial scales. We conducted eDNA fish surveys of 9 lakes in the northern Minnesota with varying habitat complexity and species diversity to determine the number and spatial distribution of samples required to detect maximal species richness compared to conventional approaches. Our 2021 survey (1093 samples from 318 sites) indicated certain species were missed with either conventional or eDNA methods, although there was considerable overlap. In small (26-40 ha) and medium (92-124 ha) lakes, eDNA methods detected as many or more species than conventional methods, with eDNA detecting 88-100% of species from historical observations and physical methods from one year's field effort detecting 50-100% of species from historical observations. Additionally, eDNA detected 10 species per lake on average that neither ongoing nor historical collection techniques have observed, increasing the probability of detecting new invaders and rare species. The views expressed in this presentation are those of the author(s) and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

Wednesday 1:20-2:40pm

Trophic Structure and Mercury Bioaccumulation in Walleye and Yellow Perch in the Upper and Lower Red Lake Basins

Marissa Pribyl, Tyler Orgon, Pat Brown, Andrew Hafs, Richard Koch
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Affiliation: Bemidji State University

Mercury is a persistent global contaminant known to travel through aquatic food webs by biomagnification. Dietary and environmental factors primarily influence mercury accumulation in fishes. Trophic structure and methylmercury dynamics in Walleye (ogaa; *Sander vitreus*) and Yellow Perch (asaawens; *Perca flavescens*) were examined in the Upper and Lower Red Lake Basins in Red Lake, Minnesota, between 2024 and 2025. Diets were collected through stomach dissection in Walleye and Yellow Perch to determine the trophic structure surrounding these species in the Red Lake system. Tissue samples were obtained from both species to analyze total mercury concentrations. In addition, shiner species (*Notropis* spp.) and a variety of freshwater fish and invertebrate species were analyzed for mercury concentrations. Emerald Shiners (*Notropis atherinoides*) and Spottail Shiners (*Hudsonius hudsonius*) were found to be the most abundant prey source in the Red Lakes and an essential part of the Walleye food chain. Tricoptera, Chironomidae, Amphipoda and additional invertebrates were targeted for mercury analysis as they were observed to be a critical component of Yellow Perch diets in the Red Lakes. Dissimilarities in mercury concentrations in Walleye between Upper and Lower Red Lake were observed in 2019 and 2020 by a previous study ($\bar{x}$= 0.215 ± 0.117 and 0.144 ± 0.077 mg/kg). It was determined that lake basin in the Red Lakes is an important variable for estimating total mercury concentrations in fishes. These observed differences between Upper and Lower Red Lake could result from multiple factors, including the diet composition of Walleye. Thus, gaining a greater knowledge of system-specific trophic structures in the Upper and Lower Red Lake basins could provide valuable information for aiding consumption advisories to better protect the Red Lake Tribal community and the general understanding of diet-related variation in tissue mercury concentration.

Mille Lacs Lake Walleye: Changes in Body Condition Over Time

Levi Suchla, Lynn Waterhouse

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Mille Lacs Lake is an economically, recreationally, and culturally significant fishery, with Walleye being one of the the main targets for anglers. Over the past 30+ years, numerous biotic and abiotic changes have occurred within the lake and have had an impact on the fishery. This project aims to explore what factors have had the biggest impact on the body condition of walleye in the lake, understand how population dynamics have operated in the lake, and determine the trends and shifts in walleye body condition and growth over time in relation to changing conditions. Additionally, a brief overview of the management strategies of the lake will also be discussed.

Improving Walleye and Lake Whitefish Performance Indicators for Lake Water Level Management on Rainy – Namakan System

Benjamin Erb, Andrew Hafs, Marianne Bachand

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Rainy Lake and Namakan Reservoir are large boreal reservoirs on the Minnesota – Ontario border. These reservoirs see large fluctuations in water level, affecting quantity and quality of available spawning habitat for fish. This project exists to validate and expand upon a model provided by Environment and Climate Change Canada which predicts spawning sites for Walleye and Lake Whitefish in the Rainy-Namakan System. Model validation was accomplished by sampling fish eggs during spawning seasons and comparing data to the predictive model. Walleye eggs were sampled on Rainy Lake only, as previous data exists for Namakan Reservoir. However, no previous scientific data exists for Whitefish eggs in the system, so it was necessary for Whitefish eggs to be sampled on Rainy Lake and Namakan Reservoir. Using the predictive model, Walleye and Whitefish were each assigned 30 sampling sites. Walleye eggs were sampled between 25 cm - 1 m of water, and Whitefish eggs were sampled in 2 – 4.5 m of water. The 2024 field season produced eggs at 19 sites for Walleye, and 9 sites for Whitefish. Walleye egg sampling occurred between April 29th and May 9th, 2024, at water temperatures between 3.8 and 13.1° C, eggs first appeared at 4.1° C and egg counts peaked between water temperatures of 5.3 and 7.5° C. Whitefish egg sampling occurred between October 15th and November 23rd when water temperatures were between 3 and 12° C. Whitefish eggs were first sampled at 7.9° C, and peaked between water temperatures of 5.9 - 7.2° C.

Environmental changes lead to reduced Walleye production in Mille Lacs Lake, Minnesota

Thomas S. Jones

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Abundance of Walleye in Mille Lacs Lake, Minnesota, has decreased since the 1990s. Two important environmental changes likely contributed to these declines. First, water clarity increased abruptly in the mid-1990s and increased clarity continues through the present day. Second, zebra mussels and spiny waterflea invaded in the late 2000's, leading to a 90% reduction in zooplankton. Efforts to rebuild the stock through low harvest since 2013 have met with limited success. This study used multiple approaches to compare Walleye productivity changes associated with three time periods (pre-water clarity, post-water clarity, and post-invasive species). First, we estimated total annual Walleye production using an instantaneous growth model. Second, we estimated annual harvestable surpluses by summing Walleye fishing mortality and the resultant change in population size estimated from statistical catch-at-age models. These data were fit to surplus production models making various assumptions about the shape of the sustainable yield curve. All models showed reduced production after each ecological event. Recognition of reduced productivity may have ramifications for future Walleye management in Mille Lacs Lake.

Wednesday 1:20-2:40pm

Diverging fish biodiversity trends in cold and warm rivers and streams across the United States

Samantha L. Rumschlag, Brian Gallagher, Ryan Hill, Ralf B. Schäfer, Travis S. Schmidt, Taylor Woods, Darin Kopp, Michael Dumelle, Jason R. Rohr, Frederik De Laender, Joel Hoffman, Jonathan Behrens, Ryan Lepak, Devin Jones, Michael B. Mahon

Presenter: Joel Hoffman hoffman.joel@epa.gov
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Freshwater fish in the United States are at risk from changing stream temperatures and introduced fish, but effects across broad spatial extents remain unclear. We analyzed biodiversity (abundance, richness, uniqueness, functional diversity) of 389 species across 27 years and 2992 sites using biomonitoring datasets from USGS and USEPA. Biodiversity diverged across cold and warm streams across the United States. In cold streams, fish abundance and richness declined by 20.7% and 13.3% per decade, respectively, and uniqueness increased. Disturbance-sensitive periodic fish increased, and disturbance-tolerant opportunists decreased. In warm streams, fish abundance and richness increased by 27% and 5.5% per decade, respectively, and communities homogenized. Opportunistic fish replaced periodic fish. Interactions between warming and introduced fish were associated with increased rates of degradation to local fish biodiversity. This work provides motivation to conduct additional analyses with Minnesota state-level partners and datasets to evaluate how these trends vary state-by-state, to identify which fish species and assemblages are most at risk to changes, and to anticipate how management might play a role in supporting fish assemblages in the face of climate change and species introductions. This abstract neither constitutes nor necessarily reflects US EPA policy.

Characterizing shifts in fish community diversity across Isle Royale's inland lakes

David J. Gallagher, Thomas R. Hrabik

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The inland lakes of Isle Royale National Park have remained relatively isolated from human impact, providing an opportunity to explore how fish diversity has naturally shifted without confounding effects. We analyzed fish assemblages of 23 lakes sampled in the 1920s, 1990s, and 2020s to 1) assess shifts in community composition and 2) identify lakes and species changing the most. We used NMDS, PERMANOVA, and multivariate dispersion tests to examine changes in composition and homogenization between surveys. We used temporal beta diversity indices and SIMPER to identify lakes and species changing the most. We found that general community composition across all lakes remained stable with no evidence of homogenization, although larger lakes became more dominated by cool-water species. Cold-water sculpin and stickleback species were most commonly lost, while cool-water shiner species and pumpkinseed were most commonly gained. Lakes with faster and slower isostatic rebound tended to gain and lose species, respectively, potentially due to differences in species saturation. Overall, these results suggest the inland lake fish communities of Isle Royale have not homogenized over time despite gains of cool-water and losses of cold-water species in more diverse lakes.

Emerald Bowfin Ecology in Three Minnesota Lakes: Abundance, Age and Growth Analysis, and Diet Composition

Griffin R. Blegen, Shannon J. Fisher, Alec R. Lackmann, Solomon R. David, Andrew W. Hafs

Presenter: Griffin Blegen griffin.blegen@live.bemidjistate.edu
Affiliation: Bemidji State University

The Emerald Bowfin *Amia ocellicauda* is one of two surviving members of the Halecomorphi: an ancient clade with fossil records dating back to the early Triassic period. These fish, while native, have been discriminated against throughout history. This research is being done to further the ecological knowledge of Bowfin in Minnesota, as well as to provide population estimates to use as evidence for future management regulations. Bowfin were sampled during the spring of 2024, with additional sampling to occur in 2025. Using a multi-census mark-recapture model, population estimates will be gathered from three study lakes using fyke-nets. Little Toad Lake near Detroit Lakes, MN, had an abundance of 162.9 individuals; 95% CI: [118.2, 248.7], or 1.0 fish/ha, and two additional lakes will be sampled during the 2025 field season. A subsample of 46 Bowfin (22 females, 14 males) were was harvested from Little Toad Lake for dissections. These dissections consisted of the removal of otoliths, whole stomachs, gonads, caudal fin tissue, and dorsal muscle tissues. Lapillus otoliths showed ages of Bowfin ranged from 2 to 27 years old. Asymptotic length (L_∞) for females was 694.2 mm , while males had an $L_\infty$of 565.1 mm. Instantaneous growth rate (k) also differed between sexes; females: k = 0.2829 and males: k = 0.5444. Based on %IRI (percent index of relative importance (%IRI), the leading identifiable dietary items for harvested Bowfin were dragonfly larvae nymphs (%IRI = 19.9), Bluegills (%IRI = 16.1), and crayfish (%IRI = 12.6). All other identifiable dietary items present were < 10% each.

A predictive boater network for prioritizing Minnesota's aquatic invasive species prevention

Molly I. Tilsen, Aaron Muehler, Paul A. Venturelli, Nicholas B.D. Phelps, Amy Kinsley

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Affiliation: University of Minnesota and MAISRC

Many aquatic invasive species are spread through recreational boating pathways. Understanding these pathways is essential for developing effective prevention strategies. Boater networks have been used for risk assessment, optimization plans, and collaboration partners. We hypothesize that boater traffic patterns have changed since the development of existing networks, and the available data has improved in the interim. We see significant value in advancing Minnesota's boater networks and evaluating new data sources to expand regional approaches. We created predictive boater networks from new data, assessed changes in boater movement patterns, and established a current baseline for alternative data comparisons. To predict boater-mediated lake connectivity, we created a network using data from the Minnesota Department of Natural Resources' watercraft inspection program from 2018 to 2023 and XGBoost machine learning algorithm. We increased the detail of our updated networks by creating dynamic pre-pandemic, peak-pandemic, and post-peak-pandemic networks and incorporating boat-type information. We predicted weighted, directional connectivity of four boat types between 9,233 lakes. Network evaluation included model predictions, connectivity, modularity, and network influence metrics. Preliminary comparisons revealed overall spatial coverage alignment and model convergence on four of the ten most influential lakes. In the update, lakes were connected to an average of 557(sd = 1,023) other lakes, compared to 267(sd = 484) in the previous network, an average increase of 267 connections to each lake. This data-driven approach promotes collaboration between management, scientists, and stakeholders and has the potential to provide prevention prioritization and innovation across regions with patchy data availability.

Concurrent Session 2

Thursday 8:30-10:10am

Tech Talks

*The Effects of Forward-Facing Sonar on Angler Catch and Harvest

Nick Rydell

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Affiliation: MNDNR

Forward-facing sonar (FFS) has been available to recreational anglers for nearly a decade. With a recent increase in popularity, Minnesota anglers and fisheries managers have raised concerns about how the use of such technology may affect exploitation. However, little information is available regarding the effects of FFS on fish populations. The objectives of this study were to determine: 1) the percent of anglers using FFS, other forms of sonar (e.g., 2D sonar, down imaging, side imaging), and no sonar; 2) size of fish caught between FFS and non-FFS users, and 3) if angler catch and harvest rates differ between anglers using FFS and other forms of sonar. Creel survey data conducted on Minnesota lakes between 2021 and 2024 was used. Information presented will aid managers in determining how the use of forward-facing sonar may affect fish populations.

*Mercury Harvest by Anglers

Paul Radomski, Phil Talmage, and Matt Skoog

Presenter: Paul Radomski paul.radomski@state.mn.us

Affiliation: MN DNR

Mercury in fish is a human health concern. Fish tissue mercury concentrations are dependent on species, waterbody, year, and individual fish length, sex, and age. The objectives were to estimate the mercury harvest from the Rainy Lake and Lake of the Woods walleye harvest and to explore the relationship between the number of safe mercury 8-oz servings harvested and walleye length regulations. We will show the estimates of mercury harvest, the apparent benefits of length regulations, and how other variables appear to influence the number of safe walleye servings harvested.

*Going with the Muskellunge Sampling Technology flow in Mantrap Lake

Calub Shavlik

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Affiliation: MN DNR Fisheries

Fisheries sampling technology has changed over time which has affected on how information is collected or analyzed so we can better manage the Muskellunge population in Minnesota. This presentation will cover the timeline from the late 80's to current and how the Park Rapids Fisheries office has used such changes in sampling methods, tagging methods, and genetic sampling to gather additional information about the Muskellunge population in Mantrap Lake.

***An Inventory of Stream Barriers within the Crow Wing River Watershed**

Brian Mason, Amanda Hillman-Roberts, Daniel O'Shea

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Affiliation: Minnesota DNR

Stream crossings, including bridges, culverts, and fords, are abundant across the landscape. However, their individual and cumulative impacts remain largely unknown. Recognition of the need to assess the impacts of culverts on watersheds and prioritize restoration efforts is growing among natural resource professionals in Minnesota. To address these concerns, the Minnesota Department of Natural Resources (MN DNR) River Ecology Unit has developed a culvert survey protocol and ranking procedure to evaluate culvert impacts on fish passage and river geomorphology. The primary goals of this program are to: 1) Inventory each stream crossing within a watershed and assess its impact on aquatic systems, 2) Rank each crossing based on the degree of its negative impact, 3) Create a prioritization list of crossings with the most significant impacts on the watershed, 4) develop project proposals and coordinate funding opportunities to address identified issues. Culverts within the Crow Wing River watershed were surveyed by various MN DNR departments between 2012 and 2024. A total of 941 stream crossings were recorded, including 25 dams and 722 culvert crossings. Of the culvert crossings, approximately 49% (362 sites) were identified as significant or complete barriers to fish passage. Site prioritization is currently ongoing, and this prioritization effort will guide the development of projects, targeting high-need sites and improve stream connectivity throughout the watershed.

***Fishing for Feedback: How do you get your fisheries science message out to stakeholders?**

Scott Mackenthun, Kamden Glade

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Affiliation: Minnesota Department of Natural Resources

Public input from various user groups is an essential component of effective fisheries management. In recent years, attendance at public meetings and presentations to angler groups has declined as more people obtain information from an ever-growing pool of resources ranging from more traditional outlets, such as print publications and radio broadcasts, to modern channels including social media and podcasts. While the variety of information sources allows consumers to receive information when, where, and how they prefer, scientists are faced with the daunting task of trying to choose where to share information so that it reaches their target audience. Furthermore, the decrease of in-person interactions among scientists and resource users often leads to communication that is uni-directional, with minimal discussion or feedback from stakeholders. This session will be intended as more of a discussion than a presentation, with opportunities for the audience to provide insights and share solutions. Key topics of discussion will include communication challenges facing fisheries professionals in 2025 and beyond, as well as tips and tools to assist in science communication.

Thursday 8:30-10:10am

Reconnecting Rivers: Otter Tail River Lake Outlet Dam Modifications

Neil Haugerud

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Dams around the country are at or exceeding their design life which puts them at risk of failure or in need of significant maintenance. Over 300 lakes in Minnesota are controlled by outlet dams with many built in the 1930's. This has increased interest in removing or modifying outlet dams. Beginning in the winter of 2022 through the fall of 2023, four lake outlet dams were converted to rock arch rapids on the upper Otter Tail River. Rock arch rapids address blockage of fish migration, eliminate hydraulic undertows, maintain the runout elevation of the lake, provides habitat that mimics natural rapids and adds a more natural aesthetic and recreational area. These structures have been installed at over 48 locations to modify lake outlets.
Lake Sturgeon (*Acipenser fulvescens*) were reintroduced to the Otter Tail River in 1997 through annual fingerling stockings until 2018. By the spring of 2024, Lake Sturgeon as well as Walleye (*Sander vitreus*), and White Sucker (*Catostomus commersonii*) were observed staging and spawning in the newly constructed rapids. Spawning activity was observed at the crest of each structure and above the weir crests. Each of the four rock arch rapids required unique design features. All sites used an alternating wave pattern of the weirs to create resting pools for large body fish, strategic gaps in the weirs to allow for fish passage, and flat stones placed upstream and downstream of the rapids to accommodate recreational users. Future evaluations of fish use and velocity investigations will be discussed.

Evaluating the ecological impacts of a 160-year-old-dam: A cost-effective approach using eDNA and habitat assessment to inform fish passage restoration

Sean Gibbs, Peter Hundt

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Affiliation: Mount Hood Environmental

This multi-year project evaluates fish and mussel assemblages in Sand Creek, a tributary to the Lower Minnesota River, with a focus on assessing the ecological impacts of Lagoon Park Dam on species distribution and habitat connectivity. Built in 1860 near Jordan, Minnesota, the dam has blocked upstream fish migration since 1960, when a significant flood destroyed the fish ladder, cutting off access to much of the Sand Creek drainage. The study employs a cost-effective approach, integrating traditional sampling methods with modern molecular techniques, to assess the potential benefits of reinstalling fish passage at the dam. To date, research efforts have included: (1) targeted fish sampling upstream and downstream of the dam, (2) delineating stream reaches across Sand Creek and its major tributaries using land use data and cluster analysis, and (3) collecting environmental DNA (eDNA) and habitat data from 21 sites across the watershed, representing diverse habitat types. Future phases will involve additional eDNA sampling, with metabarcoding analysis to detect species, and the application of an occupancy model to integrate species presence data with habitat characteristics. This approach reduces the costs and labor associated with traditional survey methods while potentially increasing the accuracy and scope of species detection. The ultimate goal of this project is to inform decisions regarding fish passage restoration at Lagoon Park Dam, promoting improved habitat connectivity, biodiversity, and ecosystem health throughout the Sand Creek watershed.

The vast majority of fish that enter Lock and Dam 5's lock, a relatively typical Upper Mississippi River lock and dam, are repelled by it and return downstream

Sorensen, Peter., Berken, Gabe, and Hatch, Jay

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Nearly 200 fish were tagged and released below Lock and Dam 5 (MN) in the spring-summers of 2022 and 2023 and tracked using a receiver array to determine whether and how they pass. This LD is of special significance because its design is similar to most, and a lock deterrent is being considered here to stop carp. Common Carp, Drum, Bowfin were captured above LD5, transplanted and released below it while Silver Carp were captured below LD5. As expected, no fish passed LD5's spillway dam because its gates were never fully open. However, while the majority of transplanted fish swam upstream into the lock's entryway, few passed: only 28/101 (27%) of Common carp, 4/9 (44%) drum, 6/21 (28%) bowfin, and 0/8 (0%) Silver Carp that entered the lock passed upstream, resulting in an average blockage rate of 75%. Examining the 2023 lock data, we discovered further evidence of strong repulsion: the typical common carp entered three times before leaving while bowfin entered twice, with most fish staying in the lock for 3 hours until the next downward bound vessel facilitated escape downstream. When the absolute number of entrances was considered, less than 10% ended with passage. We speculate that sounds in the lock combined with a large upstream sill drives fish downstream. Future studies should examine these factors as well as the possibility that locks might be modified to make them less passable and/or that deterrents placed in them might be especially effective.

If You Build It Will They Come? And Other Kevin Costner Based Inferences On The White Sturgeon Of The Kootenai River.

Ryan S. Hardy, Sean M. Wilson, Troy W. Smith, Gregory C. Hoffman, Sarah M. Stephenson, Marley Bassett, Nathan Jensen
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Affiliation: Minnesota Department of Natural Resources

The abundance of wild Kootenai River White Sturgeon (*Acipenser transmontanus*) has been declining over the last 50 years due to a number of anthropogenic causes including the alteration of the flow regime and physical habitat after the construction of Libby Dam. Currently, most White Sturgeon spawn over poor habitat lower in the river instead of further upstream in suitable gravel and cobble habitat. Since 2006, efforts have been made to enhance flows, optimize temperatures, and restore the physical habitat within the spawning corridor to cue adult sturgeon to move into and spawn over more suitable upstream habitat. In this study we evaluate the effectiveness of these actions in terms of spawner movements within the spawning reach and egg deposition timing. Spawning migrations were monitored from 2005 to 2022 using a passive array of Innovasea acoustic receivers. Egg deposition was monitored from 2010 to 2022 using egg mats at several sites throughout the spawning corridor. We used logistic regression and occupancy analyses to identify the covariates that best estimated the probability of a spawner reaching suitable upstream habitat as well as the probability of egg deposition throughout the spawning corridor respectively. Our results show that spawners moving upstream to more suitable habitat was positively influenced by sustained, high flows (>30 kcfs) and the probability of egg deposition throughout the spawning reach increased as temperatures reached and exceeded 8 °C. These results are expected to help guide water managers in optimizing future dam operations (flow and temperature) to benefit spawning White Sturgeon.

Thursday 8:30-10:10am

Draw Down in Little Rock Lake, was it Novel and Effective

M.L. Julius, E. Altena
Presenter: Matthew Julius mljulius@stcloudstate.edu
Affiliation: St Cloud State University

Nutrient management in aquatic ecosystems became a priority in the late 1960's and early 1970's. Phosphorus and nitrogen reduction in disparate eutrophic systems became and remains a focus of these mitigation strategies. These restoration best practices have remained largely static for the last half century. During this same period stock management efforts have developed from a species centric to ecosystem approach. Anthropogenically induced eutrophication has continued as urbanization has expanded. Recently new strategies have emerged as theoretical debates over bottom up and top down proposals are resolved with data. Research efforts suggest a multi facetted approach is warranted in restoration efforts. This work suggests that historical mitigation recommendations are not ill conceived, but must be blended with whole ecosystem efforts to maximize efficacy. Little Rock Lake, MN has been a hyper eutrophic system since the late 1970's. Best practices to restore the system have been employed during this time; including septic compliance, shore line restoration, etc. These efforts did not yield limnologic improvement in the system. In 2019, a draw down effort occurred. This work involved a simultaneous flushing of lake water, followed by efforts to restore shoreline vegetation. All historically proposed best practices were included in this effort, but executed in a more dramatic fashion. The lake system has continued to show improvement, post this limonologic shock, and is consistent with ecosystem stability hypotheses. This work suggests that initial mitigation tools are not wrong, but execution efforts need to be revisited. Additionally, new mitigation ideas may also contribute to the "shock" efforts applied to the system.

Planning for integrated lake management

Raymond M Newman, Kaitlyn M Hembre, Maija E Weaver
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Traditional lake management is often balkanized into narrow disciplinary, special-interest and agency-based perspectives while lake management issues are becoming increasingly complex. A holistic, integrated lake management approach is needed. We illustrate how consideration of carp, nutrient, fisheries and native and invasive plant management should all be integrated in lake management planning. We also demonstrate a new multi-value aquatic plant assessment that can better evaluate management outcomes by assessing plant community health (IBI), invasive species (ISI), and single species dominance (SSD) separately. For water quality improvements with external nutrient loading reductions followed by internal load management, assessment and control of abundant common carp populations is key to longer term success. However, lake managers should also anticipate increases in native and invasive aquatic plants with both carp control and nutrient reductions. Carp removal resulted in increases in aquatic plants in several metro lakes and an assessment of 7 lakes with alum treatments showed significant increases in frequency of total and native plant occurrence after alum treatment with a reduction in curlyleaf pondweed and a mixed response from Eurasian watermilfoil. Increases in bluegill abundance have been associated with decreases in milfoil weevil populations and subsequent increases in Eurasian watermilfoil. Assessment of metro lakes with our new multi-index approach revealed a range of plant responses to management. For alum treatments, Beck's IBI increased and there was no change in ISI or SSD. Carp removal in Staring Lake resulted in an increase in IBI, no change in ISI, and an increase in SSD. However, a following fluridone herbicide treatment resulted in decreases in all three indices; the invasives and dominance were controlled but the native plant community was degraded. An integrated management approach will better serve stakeholders and lake communities.

Minnesota's Rivers and Streams Probabilistic Survey

Michael Feist, John Genet, Nathan Mielke

Presenter: Nathan Mielke nathan.mielke@state.mn.us
Affiliation: Minnesota Pollution Control Agency

Environmental monitoring is essential for investigating the quality, quantity, and overall health of Minnesota's aquatic resources. The Minnesota Pollution Control Agency's (MPCA) biological monitoring program implements a comprehensive monitoring approach on rivers and streams that includes measures of the fish and aquatic macroinvertebrate communities, water chemistry, and in-stream habitat. The MPCA has employed these measures in probabilistic surveys that enable researchers to monitor a relatively few number of sites to characterize the condition of rivers and streams throughout Minnesota. Significant improvement in biological condition was demonstrated statewide over the 10-year period between surveys as measured by mean index scores for both fish and macroinvertebrate communities. However, improvement in mean index scores has not translated to a higher percentage of stream miles meeting aquatic life use expectations. Several more iterations will be required before trends can be sufficiently evaluated, a primary goal of these probabilistic surveys, to clarify whether any pattern is consistent with a long-term trend or merely represents annual variability.

Midnight musings about Cisco populations

Beth Holbrook, Will French

Presenter: Beth Holbrook beth.holbrook@state.mn.us
Affiliation: Minnesota Department of Natural Resources

Cisco are the most commonly distributed coldwater fish species in Minnesota and are vulnerable to losses in oxythermal habitat as a result of eutrophication and climate change. The Minnesota Department of Natural Resources (MN DNR) is conducting Cisco assessments on approximately eight lakes each summer 2024-2026 as part of a research project evaluating correlations between hydroacoustic abundance and environmental DNA (eDNA) concentrations, which also includes conducting annual assessments on three lakes as part of the long-term monitoring Sentinel Lakes Program. Pelagic surveys include multi-mesh vertical gill nets and mobile hydroacoustic surveys that are conducted after sunset when Cisco shoals disperse and the distribution of fish becomes more homogeneous, facilitating more accurate estimates of size and abundance. As a result, we spend a lot of time in a boat driving slowly around a lake after dark, discussing patterns that we have observed in population abundance, vertical gill net catch rates, and temperature-dissolved oxygen profiles. We will present data for some of the questions we have pondered including: Is the amount of oxythermal habitat changing in Minnesota lakes? Is the amount of oxythermal habitat correlated with Cisco abundance estimates from hydroacoustics? Are hydroacoustic estimates and vertical gill net catch rates correlated? This presentation will highlight Cisco-related data collected by the MN DNR and some of the questions it can be used to answer.

Biofluorescence in Fishes and Applications of Fluorescent Imaging

Matthew Davis and Sarah Gibson
Presenter: Matthew Davis mpdavis@stcloudstate.edu
Affiliation: St. Cloud State University

Biofluorescence is a phenomenon where a living organism absorbs light at one wavelength and re-emits light energy at a lower wavelength. This can result in various glowing fluorescent patterns typically ranging from green, orange, and red. Recent studies have identified the presence of biofluorescence across vertebrates, including ray-finned fishes. In general, fish biofluorescence is common throughout the ray-finned fish tree-of-life and is morphologically variable. Putative functions for fluorescence in fishes includes intraspecific communication, camouflage, and predation. In this presentation we will explore the widespread occurrence of biofluorescence across the fish family tree in a variety of aquatic habitats. We will also highlight the value of fluorescence for imaging fishes and other potential use cases of fluorescence, such as species identification, surveying, digital imaging, and anatomical study.

Concurrent Session 3

Thursday 10:30-11:30a

A preliminary analysis of Minnesota's rough fisheries demonstrates large shifts in catch across time

Sorensen, Peter W. , Lee, Vicky, Pauly, Daniel, Palomares, Maria L.D

Presenter: Peter Sorensen soren003@umn.edu
Affiliation: University of Minnesota

Understanding trends in fisheries catch across time can be useful to assess their overall health and potential for improvement. Since 1907, Minnesota has recognized a diverse group of 29 mostly-native fishes of low commercial value as "rough fish" and the DNR has neither monitored nor regulated them. Half of these are catostomids. Fortunately, the situation changed in 2024 with the passage of the Native Fish Bill; but the way forward is unclear because little is known about these species or their fisheries. We seek to remedy this scenario. Using a process known as catch reconstruction, we reviewed over 100 technical reports, newspaper articles, Facebook posts, creel survey data, and web pages that address rough fish/ fishing, interviewed several dozen experts, and reviewed the laws that define this fishery. We identified the basic components of the fishery as well as data for years for which relatively definitive information were available. We then extrapolated from these points using estimates of the number of fishers. We found the rough-fish fishery to have 5 components, which by order of biomass in 2022 were: 1) Bowfishing (~1.49 MT/y), 2) Commercial (~1.21 MT/y); 3) Native-fish enthusiasts (~0.67 MT/y); 4) Recreational bycatch (~0.05 MT/y), and 5) Fishers who catch them for sustenance (~0.03MT/y). While commercial rough fish catch has steadily diminished since 1950, bowfishing has increased but recently plateaued. In 2022 the largest catch by weight was Common Carp, followed by Drum, Redhorse, Burbot, and Buffalo. Catch of most species has either plateaued or is dropping, with each being targeted in different ways. It will be tricky to disentangle these variables to develop effective management plans for these important species.

LCCMR Enhancing Minnesota River Fish Ecology

Amanda Craft, Anthony Sindt, Hannah Winters (Anema)

Presenter: Amanda Craft amanda.craft@state.mn.us
Affiliation: MN DNR

The Minnesota River has more than 80 fish species and is a known recreational fishery for anglers that seek walleye, channel catfish, and freshwater drum, plus many more species that are present. Due to changes in invasive species, landscape, climate, population dynamics, and conservation efforts there is a gap in knowledge on the Minnesota's food web, distribution, and movement patterns. There is much to be discovered on the diets of lower trophic fish, this study evaluated the diets of bigmouth buffalo, emerald shiner, gizzard shad, and spotfin shiner. These fish species are known to be mostly planktivorous fish, phytoplankton and zooplankton samples were also collected to determine food availability. Along with collecting data on food webs in the Minnesota River, data was collected on the distribution of benthic fishes using benthic trawl surveys. Movement patterns were collected by implanting tags in different species and also tracked their movements. The outcomes of this project will contribute to understanding and protecting key native fish species and their habitats, help to track changes to the Minnesota River ecosystem in the future.

Thursday 10:30-11:30a

SAM-WAESTOCK Workbook: A Gill Net Selectivity Walleye Stocking Evaluation Tool

Tanner Stevens

Presenter: Tanner Stevens tanner.stevens@state.mn.us
Affiliation: MNDNR

WAESTOCK has been used by the MNDNR as an efficient way to evaluate Walleye stocking for individual lakes. While an extremely useful tool there are some limitations. Namely it is limited to ages 1-6 and doesn't account for capture efficiency. The SAM model was recently developed by MNDNR and tribal biologists to estimate population density while also accounting for gill net selectivity. Because Walleye stocking gill net evaluations rely on precise indices that are properly calibrated to the population; it is imperative that capture efficiency be included in stocking evaluations. The SAM-WAESTOCK worksheet uses the output from the SAM model to input into a modified WAESTOCK workbook. This allows for the consideration of large numbers of fish that perfectly match the selectivity of gill nets resulting in high catch which may not accurately reflect the population. This workbook also allows for the inclusion of ages 1-13 in the stocking evaluation resulting in more opportunities to evaluate a year class. This talk will discuss why and how this workbook was developed, its uses, and compare against previous Walleye stocking tools.

Effects of Gastric Lavage on Muskellunge Survival

Kamden Glade

Presenter: Kamden Glade Kamden.glade@state,mn.us
Affiliation: MN DNR

Stomach content investigations, especially of large piscivores, provide resource managers with valuable information concerning diet patterns, community structure, and species interactions. Gastric lavage allows for detailed study of prey items including species identification and prey size while, in theory, allowing for the safe release of studied individuals back into the ecosystem. While survival rates reported in previous studies have been high, no previous research has explicitly investigated the survival of Muskellunge following this procedure. A statewide research project on Muskellunge diets, coupled with targeted mark-recapture population assessments using PIT tags, provides an opportunity to track the survival of individual Muskellunge over time and compare survival rates between fish included in the diet study and those only included in population assessments. Preliminary data from six lakes indicate that the proportion of recaptured individuals is similar between the two groups, with the caveat that sample sizes are still relatively low in most lakes. Furthermore, the individuals that have been recaptured to this point do not provide evidence of any strong correlation between prey consumed and recapture probability. We will continue to monitor PIT tag data to track individuals into the future, but preliminary results suggest that gastric lavage is an effective technique to collect stomach contents from Muskellunge without adverse effects on survival.

Stock Status and Safe Harvest Level Evaluation for Sauger in Minnesota Waters of Lake of the Woods

Brett Nelson, Matt Skoog

Presenter: Matt Skoog matthew.skoog@state.mn.us
Affiliation: Minnesota Department of Natural Resources

Lake of the Woods is managed as a high-quality multi-species fishery and is intensively monitored through a variety of management activities such as gamefish population assessments and recreational creel surveys which are described in the Lake of the Woods Fisheries Management Plan. The Lake of the Woods Fisheries management plan is currently in revision. Sauger are one of the primary management species for Minnesota waters of Lake of the Woods and are managed as a harvest-oriented fishery. A substantial increase in fishing pressure, especially in the winter, has led to concerns about the potential for over-exploitation of Sauger in Lake of the Woods. Additionally, Sauger harvest has exceeded the established safe harvest threshold without apparent negative effects on the sustainability of the Sauger population. These concerns led to a desire to develop performance indicators to detect potential over exploitation, use these new performance indicators to assess the current status of the Lake of the Woods Sauger stock, and update the safe harvest threshold for inclusion in the new management plan. Results of this analysis include the establishment of biological performance indicators covering growth, mortality, and recruitment along with an updated harvest threshold for Lake of the Woods Sauger.

Poster Session

A modern Minnesota lake classification system: emphasizing fish assemblage data

Jack Abel, Christopher Rounds, Dr. Gretchen Hansen

Presenter: Jack Abel abel0124@umn.edu
Affiliation: University of Minnesota Twin Cities - Department of Fisheries, Wildlife, and Conservation Biology

Lake fish assemblages afford numerous ecological, cultural, and economic services. Fisheries managers strive to maintain healthy fish assemblages by collecting data on lakes and using that information to dictate management practices. However, in extremely lake-dense regions such as Minnesota, gathering enough data to effectively monitor hundreds of lakes and their respective fish assemblages can be extremely difficult. Lake classification systems serve as potential tools to alleviate this because they allow managers to identify conservation needs spatially and infer relationships among lakes in a timely manner. Here we present an updated lake classification system for Minnesota lakes based primarily on fish assemblage data. We incorporated recently collated fish assemblage data sourced from the Minnesota Department of Natural Resources into multivariate regression trees to create different lake classes. We used limnological covariates to describe distinct fish communities that were widely available and existed for our study lakes such as depth, area, transparency, and temperature regime. Ultimately, our final framework consists of up-to-date, distinct lake classes describing the variables associated with unique fish assemblages. This lake classification system can be used by fisheries managers and scientists to infer trends in fish populations across Minnesota.

Comparison of Hoop Nets to Trap Nets in Sampling Panfish

Jayden Alsleben, Dr. Andrew Hafs, and Tanner Stevens

Presenter: Jayden Alsleben jaydenr178@gmail.com
Affiliation: Bemidji State University

Panfish including Bluegill *Lepomis macrochirus* and Black Crappie *Pomoxis nigromaculatus* are gamefish species of significance found in Minnesota. Hoop nets and trap nets are two types of gear that can be used to sample these fish. Fisheries managers and anglers alike are interested in the best tactics to capture panfish. The behavior of fish, including bluegill and black crappie, change throughout the sampling season and make it difficult to assume accurate representations. Trap nets have historically been adequate in sampling near shore populations, but questions surrounding the gear have allowed other options to be pursued. The objective of this study is to compare the effectiveness of hoop nets to trap nets by analyzing the difference in abundance, richness, and lengths of panfish. Nets were set within two weeks of each sample period. Captured panfish accounted for 96.5% of the total catch between the two nets. Black crappie CPUE increased significantly ($P < 0.01$) with hoop nets while bluegill CPUE was not significantly ($P = 0.30$) different by net type. The average lengths for bluegill captured in hoop net were longer than those captured in trap nets. Bias in gear selectivity may have produced different catch rates and size structures for each net and species. Further studies will be needed to accurately estimate the differences in each nets ability to sample panfish.

The Next Frontier: Development of a Lake Fish Biogeographical Model in the Canadian Shield, Minnesota

Jessica Massure, Derek Bahr, Jacquelyn Bacigalupi

Presenter: Jacquelyn Bacigalupi jacquelyn.bacigalupi@state.mn.us
Affiliation: MNDNR Fisheries

Fish communities in Minnesota's lakes have been impacted by various anthropogenic stressors, and to varying degrees. The Minnesota Department of Natural Resources (MNDNR) created a lake fish index of biological integrity (FIBI) tool that has been used to identify impaired or vulnerable fish communities in lakes across the state. However, the FIBI was not suitable for Canadian Shield lakes as they are situated in a landscape with a limited stressor gradient. In addition, they typically have soft water, low species diversity and a unique geologic history. Further, they often have limited fish survey data due to difficult access and sampling conditions. However, there is a need to describe the fish community to monitor change from climate change, logging, mining, shoreline development, connectivity limitations, predator stocking, non-native fish species impacts (e.g. Smallmouth Bass), aquatic invasive species (e.g. Spiny Waterflea, Zebra Mussels), or other stressors. The goals of this study are to summarize existing fish species survey information and community and niche information on lakes, classify lakes into comparable groupings based on lake characteristics, identify data gaps, determine best sampling methods to fill data gaps, determine stressor gradients in the region, and ultimately create a lake fish biogeographical model for the region. The monitoring data and models developed will be used to protect these high-quality resources and identify restoration needs. We will summarize the initial investigation of available fish community data and lake classifications.

GROWTH OF SPATIALLY SEPERATED YELLOW PERCH POPULATIONS IN A LARGE LAKE SYSTEM

Ian Berglund, Dr. Andrew Hafs

Presenter: Ian Berglund dr9559ri@go.minnstate.edu
Affiliation: Bemidji State University

Yellow perch, *Perca flavescens*, is a staple species of angling efforts as well as commercially targeted for table fare across the species' range. Yellow perch are a good indicator species of how an aquatic system is fairing and population dynamics will often provide insight relative to predator and prey dynamics. Yellow perch growth, like any other species, can be dictated by the conditions of their habitat. Specimens in favorable conditions will tend to have increased growth, relative weight, and increased length at 50% maturity. Fish in poor conditions will see worsened metrics. Different lakes possess different conditions that dictate the growth rates for respective populations. The question posed in this study is within large lake ecosystems with isolated bays, do yellow perch grow at different rates within different bays of the same lake. Leech Lake, Minnesota is a large mesotrophic lake that encapsulates four distinct bays that form the lake. Leech Lake provides quality yellow perch habitat and can support an expansive population. Yellow perch were weighed (g), measured (mm), and aged via otoliths. For this study, age-2 yellow perch were examined, and their growth and relative weights were compared between each of the four sites within the aforementioned bays. Significance testing suggested yellow perch growth rates did differ among the bays of Leech Lake ($p=0.04$), suggesting that fish communities are stationary enough to be influenced by the conditions present in their specific ranges.

Size of Age-0 *Sander vitreus* Pre and Post *Dreissena polymorpha* Infestation on Brainerd Area Lakes

Quady Bernu, Dr. Andrew W. Hafs

Presenter: Quady Bernu pg8737wb@go.minnstate.edu
Affiliation: Bemidji State University

Walleye *Sander vitreus* is the Minnesota state fish and is found in most of Minnesota's 11,842 lakes. This fish is a major contributor to Minnesota's economy and is a vital predator fish in lake ecology. Zebra mussels, *Dreissena polymorpha* were first found in Minnesota inland lakes in the 1980's and have spread rapidly throughout the state. These mussels have had huge impacts on water clarity as well as phytoplankton and zooplankton population levels. This affects how age-0 fish feed, especially a low light feeding predator fish like walleye. In 2020 a study took place on age-0 walleye on Minnesota's large lakes and it intended to find if zebra mussels affected age-0 walleye growth. Summer seine netting occurred and supported the conclusion that age-0 walleye were negatively impacted by zebra mussel invasion on large lakes. In this study, the lakes used were from a select area and are smaller than Minnesota's large lakes. The goals of this study were to determine how the size and abundance of age-0 walleye are impacted by changing water clarity in central Minnesota lakes. Fall electrofishing data was collected on age-0 walleye from the Brainerd and Bemidji Department of Natural Resources offices. Zebra mussel invasion dates and water clarity measurements were collected from the Minnesota DNR and Minnesota Pollution Control Agency. Size and number of fish captured were analyzed through the years pre and post zebra mussel invasion.

Impact of Ambient Light Levels on Silver and Bighead Carp Schooling Behavior

Amelia Berry, Brooke Vetter, Michael Frett, Allen Mensinger

Presenter: Amelia Berry berr8662@stthomas.edu
Affiliation: University of St. Thomas

Silver (*Hypophthalmichthys molitrix*) and bighead carp (*H. noblis*; collectively bigheaded carp) are invasive fish species that have spread along the Mississippi river and now threaten to establish populations in the Great Lakes. There are currently many efforts to control bigheaded carp populations involving research on non-physical deterrents to prevent them from swimming upstream and mass collection efforts. Understanding the schooling behaviors of bigheaded carp can aid in these deterrent or removal strategies, as researchers can target schools of fish rather than individuals. In addition to the lateral line, vision likely plays a key role in bigheaded carp school formation, so it is important to determine how light availability impacts schooling behavior. The differences in schooling behaviors of bigheaded carp were examined between different light conditions and times of day. Overhead lights were programmed to a 24-hour cycle to simulate 6 natural light conditions in a 10,000 L model lock and dam tank. Fish (N=10 individuals, N=6 schools) were placed in the tank to acclimate for 12 hours overnight and then observed the following day during the sunrise, daylight, and sunset programmed times the following day. Results suggest that both schooling and swimming behavior in bigheaded carp are impacted by different light levels. The findings from this study could potentially aid in the effectiveness of invasive carp deterrent research and capture strategies.

Characterization of the Pomme de Terre River Macroinvertebrate community prior to restoration of natural flow by construction of stone arch rapids

Logan B. Blanke, Payton Prieve, Tracey M. Anderson

Presenter: Logan Blanke blank224@morris.umn.edu
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Many small dams on rivers throughout the country that were built during the early 20th Century are no longer in operation or are failing. These dams influence sediment dynamics, obstruct natural flow of the river, and affect stream biota including fish, native mussels and macroinvertebrates. One option for these aging dams is removal and/or channel modification to help restore natural river conditions. The Pomme de Terre River in west central Minnesota has multiple aging dams, the largest being the mill dam on Crissy Lake Reservoir in Morris. In January of 2026, the MN DNR plans to modify the river channel by installing stone arch rapids to bypass the mill dam. We are characterizing the macroinvertebrate community upstream and downstream from the proposed construction in order to have baseline data for comparison after the project is completed. During fall of 2024, we collected macroinvertebrate kick samples from two sites downstream and one site upstream of the dam. Specimens were then sorted and will be identified to family or genus and assigned to functional feeding group. The presence of sediment tolerant groups and habitat specialists will also be noted. Preliminary analysis suggests that in mid-channel habitats filter-feeders and collector-gatherers are common, which is typical of agricultural streams. Shredders and predators are more common in cut-bank habitats. Future changes in the macroinvertebrate composition may be linked to changes in sedimentation as natural flow conditions in the river become established.

A Sample of Fish Communities in Beaver Ponds of Northern Minnesota

Reed Cumberland, Dr. Andrew Hafs

Presenter: Reed Cumberland nw7126lq@go.minnstate.edu
Affiliation: Bemidji State University

The North American beaver *Castor canadensis* is an ecosystem engineer and a keystone species to the environment. Beaver inhabit ponds and construct dams to build ponds that provide habitat for certain fish. Little information is provided on the species of fish that live in beaver ponds. The objective of this study is to sample the fish communities in beaver ponds while comparing the effectiveness of two styles of minnow traps. Twelve beaver ponds were selected in the Bemidji area to be sampled. The quantity and species caught in each style of trap were recorded to compare effectiveness of each trap and a sample of the fish community. A total of seven different species and hybrids were caught and a significant increase in catch in most species in the clover leaf style of minnow trap was observed.

Holy crappie! Hybrids and the curious case of disappearing white crappie in Southern Minnesota lakes

Hayley Darke, Loren Miller, David Staples

Presenter: Hayley Darke darke011@umn.edu
Affiliation: University of Minnesota, MN Department of Natural Resources

Black crappie (*Pomoxis nigromaculatus*) have a statewide distribution in Minnesota while white crappie (*P. annularis*) are found only in the southern portion of the state. In the area where the species ranges overlap, hybrids of the two species of crappie are naturally occurring. Most first generation (F1) individuals are misidentified as black crappie in the field, though they are typically longer at age than pure black crappie because of hybrid vigor. While hybrids are not a direct threat to fishery health, they do affect how fishery health is assessed by inflating length-at-age measurements of black crappie, having management implications. This project aims to identify F1 individuals from lakes in southern Minnesota. The hybrid length data will be removed, and lengths for pure species black crappie will be used in an ongoing, state-wide study of factors affecting black crappie growth. Scale samples collected by the Minnesota Department of Natural Resources in 2024 underwent DNA extraction and genotyping using seven species-specific microsatellite markers. A sample from one lake had 15% hybrids, mostly F1s, consistent with past findings of F1 hybrid crappies in southern Minnesota lakes. Six other lakes had few hybrids, none of which were F1s. This spurred an examination of historical lake survey data that indicated an overall decrease in white crappie populations across southern Minnesota. Screening for F1 hybrids will still be important for populations in which they occur but a decline in white crappies appears to be limiting the potential for hybrids in many lakes.

Using a non-invasive, molecular approach to determine sex ratios of Lake Sturgeon (*Acipenser fulvescens*) in the St. Louis River estuary

Noah Grode, Chelsea Hatzenbuhler, Nick Bogyo, Loren Miller, Dan Wilfond, and Courtney Larson

Presenter: Noah Grode Grode.Noah@epa.gov
Affiliation: Oak Ridge Institute of Science Education - USEPA

Lake Sturgeon (*Acipenser fulvescens*) serve both a cultural and ecological role in many freshwater systems. In the St. Louis River estuary, Lake Sturgeon populations historically were extirpated due to habitat degradation, overfishing and contamination, and work to restore their populations is ongoing. Lake Sturgeon populations are hard to survey due to the species not reaching sexual maturity until later in life, and sexing in the field is a challenge as they cannot be differentiated based on physical differences other than by the expression of gametes. Recently a female-specific locus within the genome of six sturgeon species was identified, along with the subsequent identification of this region in Lake Sturgeon. This opened the door for the development of a molecular assay for determining the sex of sturgeons using non-invasive fin clip tissue and a qPCR-melt curve assay. In 2023 and 2024, the Minnesota Department of Natural Resources and the 1854 Treaty Authority collected 302 fin clips from Lake Sturgeons in the St. Louis River estuary. Currently the molecular sexing assay is being carried out to determine the sex ratio of this population. The sturgeon that have been molecularly sexed have been determined to be male. This is the first time this technique is being used in the St. Louis River estuary, and this work will aid in population models and management decisions. The views expressed in this presentation are those of the author(s) and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

An Investigation into Southern Minnesota Stream Health and Water Quality

Dan Hart, Oluwafemi Oladejo, Juliet Kurtz, and Dr. Susan Colvin

Presenter: Dan Hart bc6573th@go.minnstate.edu
Affiliation: Minnesota State University, Mankato

Freshwater ecosystems account for more than half of all fish species diversity, with much of the diversity found in streams and rivers. Over 92,000 miles of these waterways span throughout Minnesota. Many of which, especially those of Southern Minnesota, can be heavily degraded. We collected water quality and habitat data such as dissolved oxygen, temperature, total nitrogen, substrate composition, % leaf coverage, and turbidity from several Southern Minnesota streams. Additionally, we collected macroinvertebrate samples and examined their EPT index to estimate the overall stream health. EPT indices measure the percent abundance of pollution-sensitive organisms from orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Our streams ranged from 78% to 0% EPT abundances, displaying a sharp differentiation between higher to very low-quality streams. We further investigated if these macroinvertebrate communities would display functional feeding group predictions as posited by the River Continuum Concept, which hypothesizes more organisms that feed on coarse materials such as leaves gather in the headwaters and organisms feeding on algae are represented in larger streams and rivers. Overall, our data indicates that sites with low EPT indices further depart from functional feeding group predictions, despite having high levels of leaf coverage. When compared with water quality data, it appears that streams with high levels of sedimentation have a disproportionately low EPT richness, indicating turbidity may be a primary driver of aquatic taxa assemblage.

Uncovering the Past to Protect Minnesota's Walleye Fisheries

Grace L. Hemmelgarn, Adam J. Heathcote, Mark B. Edlund, Heidi M. Rantala, Jeffrey R. Reed, Kylie Cattoor, Michael Verhoeven, Denver Link, Gretchen J. A. Hansen
Presenter: Grace Hemmelgarn hemme129@umn.edu
Affiliation: University of Minnesota

Minnesota lakes are changing in ways which can create stressful conditions for walleye and the aquatic organisms they depend on. The sensitivity of walleye populations to changes in the past can inform successful management of these economically, culturally, and environmentally important resources under future conditions. In this project, we are examining relationships between water clarity, temperature, zooplankton communities, and fish communities based on contemporary lake survey data from the Minnesota DNR and sub-fossil zooplankton remains in recently deposited surface sediments. We are assessing which zooplankton metrics are related to walleye catch rates, and which of these metrics are measurable from sediment samples. We have collated 115 surveys from 32 lakes in which we have paired zooplankton and fish surveys. Preliminary analyses of contemporary data that include lake temperature, clarity, and area as covariates show that walleye catch rates under present-day conditions are not well predicted by mean zooplankton length, cladoceran Shannon Diversity, or the proportion of zooplankton biomass made up of cladocerans. Future multivariate analyses will further investigate the relationship between zooplankton and fish communities. Additionally, we are documenting historical environmental and ecological changes in a group of important walleye lakes using sub-fossil remains in historical lake sediment cores to understand how environmental conditions and fish communities have changed in the decades/centuries before present-day monitoring programs began. Combined, these two approaches will enable us to reconstruct historical fish community composition and its relationship to environmental conditions over the past 200+ years. The objectives are to understand which conditions in a lake are associated with changes in fish community structure, where and when walleye populations were the most resilient to change, and what lakes are most sensitive to future perturbations.

Growing Degree Days Compared to Growth of Walleye and Sauger From Different Systems

Benjamin Hoover, Dr. Andrew W. Hafs

Presenter: Benjamin Hoover ly2874gh@go.minnstate.edu
Affiliation: Bemidji State University

Walleye *Sander vitreus* and Sauger *Sander canadensis* exist in most river and lake systems across the state of Minnesota and have historically been a highly sought-after species. Variable water temperatures play a significant role in the growth of cold-blooded organisms such as walleye and sauger . Therefore, the objective of this study is to test for a relationship between growing degree days and the growth of walleye and sauger from Lake Pepin, Leech Lake, and Lake of the Woods. Data for growth and age was readily available and was sourced from MN DNR lake survey data base from 2006 to 2023. Growing degree data were sourced from Weather Underground. A regression test was run on the data. Results are still pending.

Aquatic invertebrate populations in roadside wetlands in relation to water characteristics

Ellie Isakson, Dr. Andrew W. Hafs

Presenter: Ellie Isakson eisakson03@gmail.com
Affiliation: Bemidji State University

The continual habitat destruction and draining of wetland systems makes the need to understand the ecology of roadside wetlands all the more necessary. Roadside wetlands provide valuable habitat to countless aquatic invertebrates, which can provide insight into the health of the wetland system due to their diversity. By collecting a sample of the aquatic invertebrate population within a wetland and identifying specimens down to the family level, information can be inferred about the health and quality of that wetland. The objective of this study was to analyze the populations of aquatic invertebrates in roadside wetlands in relation to water characteristics such as pH, salinity, conductivity, water depth and temperature, and dissolved oxygen. This was done by collecting samples of invertebrate populations from 16 different roadside wetlands, in addition to data on water quality characteristics using a D-frame net, YSI Probe, and a Handheld Multimeter. Then by using R to create an NMDS graph, the expected results for this study are that the water quality characteristics that have the most impact on invertebrate populations in wetlands closest to paved roads are the level of dissolved oxygen, PH, and temperature.

Effect of anthropogenic masking noise on signal detection in otophysan fishes

Alexandra Johnson, Brooke Vetter

Presenter: Alexandra Johnson john5037@stthomas.edu
Affiliation: University of St. Thomas

In the underwater environment, fish are exposed to human-generated sound or "anthropogenic noise" (e.g., motorboat traffic). This study investigated the impact of boat motor sound on the behavior and physiology of common carp (*Cyprinus carpio*) and yellow bullhead catfish (*Ameiurus natalis*). We conditioned monospecific schools (N = 3 – 4 individuals) to associate a 405 Hz sound stimulus (136 dB re: 1 uPa) with food rewards. If conditioning was successful, we then applied increasing levels of masking boat noise (0.06 – 10 kHz) to evaluate if fish still exhibited the conditioned response. We also used the auditory evoked potential electrophysiology method to evaluate the impact of masking boat noise (136 dB re: 1 uPa and 146 dB re: 1 uPa) on fish hearing thresholds. Auditory threshold tuning curves showed that both species' lowest thresholds were between 400 and 800 Hz. Across the range of frequencies evaluated (100 Hz – 3 kHz), we found moderate threshold shifts (0 – 6 dB) for both species exposed to the 136 dB re: 1 uPa masking noise. The greatest threshold shifts occurred in common carp exposed to the 146 dB re: 1 uPa masking noise, especially from 400 Hz-1 kHz in (16.2 – 12.6 dB increase), which were significantly ($p < 0.05$) higher than baseline thresholds.

Whirlwind tour of MN AFS

Jessie Koehle

Presenter: Jessie Koehle jkoehle.mnafs@gmail.com
Affiliation: City of Eagan

Are you new to the Minnesota Chapter of American Fisheries Society? Or have you attended meetings for years without really knowing how meetings are organized or why they matter (like me, before I joined a committee)? Read this poster to see how MN AFS works, how MN chapter fits into the Division and National scope of AFS, how you can get involved, and some benefits of being a member.

Patterns in stream fish species richness across ecoregions and habitat types

Juliet Kurtz, Oluwafemi Oladejo, Dan Hart, and Dr. Susan Colvin

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Streams are dynamic and structurally diverse habitats that support a high biodiversity of freshwater fish. Characteristics such as reach length, stream width, and depth are major drivers of biodiversity in lotic systems. Following predictions of Island Biogeography Theory (IBT), biodiversity is positively correlated with stream size; increased habitat volume provides greater physical space, resource availability, and niche spaces. The goal of this project was twofold, we analyzed the influence of stream volume on fish biodiversity across ecoregions. Data such as stream depth, width, and length were collected from Alabama, Arkansas, Maine, and Minnesota. An analysis of covariance was utilized to assess the potential differential impact of stream volume across ecoregions. Not unexpectedly, we found stream volume was positively correlated with fish species richness, but the relationship was unique to each ecoregion. Additionally, because many stream ecosystems are drying and shifting from perennial systems to intermittent systems, we examined differences in richness between pools and riffles in Minnesota streams to investigate if pools separated by dry or reduced riffle sections could temporarily act as refugia for all species. Higher fish species richness was found in pools, yet some species were present only in riffle habitats. The findings indicate streams act as expected by IBT, but pools and riffles are unique "islands" and must both be present to support a wider diversity of fish species.

Assessing Aquatic Biodiversity Near Power Plants in Minnesota

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St. Cloud State University and Xcel Energy have partnered for several years to conduct biodiversity surveys and ecological studies on aquatic taxa found near bodies of water associated with power plants in Minnesota, including plants in Becker, Monticello, and Black Dog. In this study we will be discussing the preliminary results of current work in progress on aquatic vertebrate and macroinvertebrate collections made upstream and downstream of thermal discharge from power plants in Monticello and Burnsville.

Evaluating water quality upstream and downstream from a proposed restoration project on the Pomme de Terre River in Morris, MN

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The recent push to restore natural river conditions provides opportunities to investigate the effects of dam removal and channel modification, particularly if data are collected before such projects are initiated. The MN DNR plans to modify the Pomme de Terre River channel at the Crissy Lake dam (Morris, MN) by constructing and directing water flow over stone arch rapids to remove the barrier to fish, restore flow, and enhance river conditions. We aim to characterize the Pomme de Terre River upstream and downstream from the project site before construction to provide data to compare with river conditions after the project is completed. We collected data bi-weekly from September–November at 3 sites upstream and 3 downstream from the Crissy Lake dam. We measured dissolved oxygen (DO), total dissolved solids (TDS), and Turbidity at each site. Average (range) values downstream were: DO 11.70 (7.36-17.53) mg/L, TDS 509.78 (469.20-:605.70) ppm, and Turbidity 2.70 (1.10-5.75) ntu. Average values upstream were: DO 12.54 (7.23-21.58) mg/L TDS of 476.79 (424.40-666.4) ppm, and Turbidity of 1.61 (0.55-4.00) ntu. DO levels suggest high levels of primary productivity and the capability of supporting aquatic life. TDS would be considered on the high-acceptable side of drinking water. Low turbidity levels show no indication of water quality impairment and reflect base flow conditions and lack of erosion in the absence of significant precipitation during the study period.

Minnesota's Priority Native Rough Fish: Gars and Bowfins

Alyssa Rausch and Solomon R. David

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In the Native Fish Conservation Report, the Minnesota Department of Natural Resources stated there is a lack of data regarding age structure, population dynamics, and ecology regarding "native rough fish" species. Established sampling strategies for native rough fish are also lacking. Among the priority native rough fishes listed in the report, the top three were Emerald Bowfin, Shortnose Gar, and Longnose Gar. As predators, hosts for freshwater mussels, and migratory species, these priority native rough fishes play important roles in Minnesota's lakes and rivers. Effective management of their populations is key to maintaining ecosystem function and conservation of freshwater biodiversity. To address these issues, we are collaborating with MNDNR and partners to collect age, growth, relative abundance and ecological data for gars and bowfin in the state. Fish will be collected by electrofishing, seining, and fyke netting across three river systems (Mississippi, St. Croix, and Minnesota Rivers) and three inland lakes from 2025-2027. Otoliths, population demographics, and stable isotope analysis of fin tissues will be used to develop age-growth models and inform our understanding of native rough fish ecology. Pilot field surveys in 2024 identified key habitat and localities, and resulted in collection of 49 Longnose Gars, 60 Shortnose Gars, and 40 Emerald Bowfins. Our study directly addresses priority native rough fish knowledge gaps identified by MNDNR, and as directed by the MN legislature. These strategies will also be adapted for other native rough fish species, helping to improve native fish conservation and management in Minnesota.

Can small scale removal of invasive hybrid cattails benefit nearshore lake ecosystems?

Claire Rude, Amy Schrank

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Invasive hybrid cattails are widespread in Minnesota and form dense monoculture stands along lakeshores, posing threats to organisms that rely on nearshore aquatic ecosystems. We are researching whether small-scale mechanical removal of these cattails helps mitigate negative ecological impacts by allowing native vegetation to reestablish and providing habitat for fish. We are conducting a study in several lakes across Minnesota, where we established side by side plots within cattail stands and mechanically removed cattails in one plot during 2021, leaving the other as a control. In the first year post-cattail removal, we found an increase in submerged aquatic vegetation and shifts in the fish community to support more minnows and darters compared to the control sites. We are currently conducting a follow-up study to look at the ecological impacts several years post-cattail removal and further assess changes to the fish and plant communities in removed sites. For each paired set of treatment and control sites, we also selected nearby plots with native vegetation to provide a comparison of the conditions prior to cattail invasion. At each site, we are sampling the fish and vegetation community, and at some sites we are sampling fish at several points across the summer to study seasonal differences. Our results will provide further insights to the ecosystem level impacts of hybrid cattail monocultures. If our research shows that this strategy of removal provides ecological benefits, this solution could be applied quickly by managers and even private landowners.

Stream Burbot? Yes, really.

Murphy Steininger, Jonathon Newkirk, John Sandberg

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People are often surprised to learn that Burbot (*Lota lota*) are commonly found in Minnesota's rivers and streams. Across 30 years of stream biomonitoring, MPCA electrofishing crews have collected Burbot from nearly 700 unique riverine locations, tallying nearly 10,000 individuals. This poster provides a broad overview of riverine Burbot distribution in Minnesota, summarizes habitat and water quality characteristics of where they are found, identifies other species often found in association with Burbot, and the ranks the relative tolerance level of Burbot to selected environmental variables and potential stressors.

Bugs Below Zero: engaging communities in winter stream ecology

Amy Schrank, Rebecca Swenson, Alyssa Anderson, Corrie Nyquist, Bruce Vondracek

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Participatory science programs in which communities conduct hands-on data collection can increase the spatial scale of field studies, improve science literacy, increase interactions between scientists and society, and foster stewardship of local freshwater ecosystems. Programs that combine outreach, education, and community science activities are especially important for topics and issues with little public awareness. The Bugs Below Zero project is a grant-supported effort to raise awareness of winter-active aquatic insects and their important role in stream food webs. Bugs Below Zero combines classroom resources, educational events, digital tools, and a participatory science effort, available via the Anecdata digital platform. The project is supported by an interdisciplinary team from the agricultural communication and marketing, environmental sciences, entomology, and fisheries wildlife, and conservation biology disciplines. Bugs Below Zero activities are targeted at anglers, outdoor recreation enthusiasts, conservationists, nature and environmental education centers, and classrooms from K-12 and higher education institutions. We offer insights from our formative research efforts on the barriers and motivations for participation in community science projects and advice on how to structure public science projects to appeal to both K-12 instructors and higher education faculty. We found that ideal programs provide a sense of place and collaboration, hands-on education components, flexible data collection protocols, and tangible results. Our work has also identified untapped interest among educators and public audiences in participating in freshwater ecology data collection over the winter, since this season offers limited opportunities for outdoor labs, volunteer programs, and fieldwork.

The Effect of Zebra Mussels on Minnesota Fish Communities

Benjamin Strei, Andrew Hafs

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Zebra mussels *Dreissena polymorpha* are an aquatic invasive species that has been spreading quickly throughout Minnesota water bodies since 1989. Zebra mussels are known to change certain morphological conditions in lakes such as turbidity, phytoplankton abundance, and aquatic invertebrate populations. However, no study in Minnesota has shown a correlation between the infestation of zebra mussels and the health of a lake's fish community. Therefore, the objective of this study is to determine whether zebra mussels have an impact on fish communities in Minnesota lakes. The Minnesota Department of Natural Resources has been collecting Lake Indices of Biological Integrity (Lake IBI) scores since the early 2000's to measure the health of the lakes fish community. Lakes in Minnesota that had an IBI survey taken both before and after the introduction of Zebra mussels were included in this study. The scores from these lakes were then graphed and analyzed by a paired t-test to determine changes in fish community health. Additionally, years since infestation and the change in the IBI score was graphed and analyzed using regression statistics. This determined the predicted change in score for every year that the lake has been infested. A significant difference in IBI score change was found in scores before versus after infestation, however, no significant difference was found between the years since infestation and change in IBI score.

Evaluating the Condition of Age-0 Burbot in relation to Diet

Cian Verbridge, Andrew W Hafs

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Burbot are becoming more and more popular for angling and aquaculture. However, populations have been declining across the world. Very little information is available about their early life and their interactions in the ecosystem due to challenges in sampling. Condition estimates and diet metrics were used to better understand the status of burbot in Lake Bemidji. Using backpack electrofishing, 45 young of the year burbot were collected. The lengths ranged from 86 to 146 mm. The wet weights ranged from 4.29 to 24.36 g. The stomach contents were removed and stored in ethanol for later analysis. The burbot were then dried in an oven at 60 ℃ and weighed to calculate percent dry weight. R was used for statistical analyses and to build an NMDS chart. The mean percent dry weight was 18.1%. Prey species were identified to the lowest taxonomic level possible. Prey abundance and frequency of occurrence were calculated for all sampled fish. NMDS will be used to relate prey types to condition estimates. Final results are pending.

Effect of Anthropogenic Sound on Foraging Behavior in Bluegill (*Lepomis macrochirus*)

Dayna Wiley, Trevor Keyler

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Anthropogenic noise can have adverse effects on fish populations. High-amplitude noise can cause hearing damage and interfere with essential behaviors, including feeding, migration, and reproduction. Studies suggest that fish regularly exposed to boat noise exhibit different behavioral responses compared to populations in quieter environments. We collected bluegill sunfish (*Lepomis macrochirus*) from a lake with no motor use (Quiet Lake; Lake Sagatagan, Collegeville, MN) and examined their foraging behavior in response to playback of motorboat traffic (0.06-10 kHz; 150 dB re 1 µPa). This behavior was compared to bluegill from a lake with motor use allowed (Loud Lake; Upper Spunk Lake, Avon, MN). Bluegill (N = 5 individuals per trial; N = 5 trials per condition) were exposed to 48-hour trials under four conditions: Quiet Lake with no sound, Quiet Lake with simulated boat traffic (sound), Loud Lake with no sound, and Loud Lake with sound, for a total of four experimental conditions. Fathead minnows (Pimephales promelas) were replenished ad libitum at three time points for each trial (Day 1 daytime, Day 1 nighttime, and Day 2 daytime) to maintain a constant prey population of 10 minnows throughout the trials. Our analysis revealed no statistically significant differences in minnow consumption between groups ($H = 6.22$, $p = 0.102$), suggesting that sound and lake conditions did not significantly affect foraging behavior. However, there was a significant difference across time points ($p = 0.04$), with more minnows consumed on Day 1 than Day 2.

Morphological comparisons between northern and southern populations of Longnose Gar and Shortnose Gar

Jonathan Wilson-Thieroff, Solomon R. David

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Historically, gars (Lepisosteidae) have been labeled as “rough fish” by North American fisheries management, and are often considered undesirable by anglers, particularly in the northern extent of their range. Existing research on Longnose and Shortnose Gars has typically focused on populations in the central and southern parts of their range, whereas studies on northern peripheral populations are rare. We compared the morphology of peripheral Longnose and Shortnose Gar populations in Minnesota, and to southern core populations in Louisiana and Mississippi. Gars were collected using boat electrofishing and gill nets from the Minnesota, Mississippi, and St. Croix Rivers, (n = 29 Shortnose Gars and n = 27 Longnose Gars), representing northern populations of each species. Gars from southern populations in the Mississippi River in Vidalia, LA, and Wilkinson, MS, were collected using gill nets (n = 55 Shortnose Gars and n = 15 Longnose Gars). Preliminary analyses (ANOVA, $\alpha = 0.05$) comparing the ratio of snout length to total length among populations found significant differences between male and female Longnose Gars, and between northern and southern female Longnose Gars. No significant variation in snout length to total length ratios were observed between Shortnose Gar populations or sexes. These morphological comparisons will inform ongoing analyses and our understanding of variation in ecology and life history among gar populations.