American Fisheries Society

Wisconsin Chapter

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Oral Presentations

Wednesday, January 24, 2024
&
Thursday, January 25, 2024

Tundra Lodge, Green Bay, WI

Wednesday, 8:10 AM

Wisconsin's Brook Trout Reserves Confront the Challenges of Climate Change

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Joanna Griffin, Alex Latzka, John Lyons, Matt Mitro, Bradd Sims, Lori Tate

Wisconsin's native brook trout are an integral part of our natural legacy, our culture, and our identity. Brook trout are also very sensitive to changes in water temperature. Currently, 21,283 miles of streams are suitable for Brook Trout in Wisconsin. Climate and stream models (FishVis, A regional decision support tool for identifying vulnerabilities of riverine habitat and fishes to climate change in the Great Lakes Region) project a decline of 68% of the stream habitat for Brook Trout, with only 6,832 miles of suitable habitat by the year 2050. Dealing with climate change will require the best available science and meaningful participation of public and private stakeholders. The Wisconsin Initiative on Climate Change Impacts (WICCI) Coldwater Fish and Fisheries working group suggested use of triage approach to identify and allocate management resources to only those coldwater species most likely to succeed. That could include managing for brown rather than brook trout. The second strategy is to develop activities focusing on land, shoreline, water management and in-stream restoration to offset the impacts of rising air and water temperatures and changes in precipitation. The WDNR Bureau of Fisheries Management has developed a Brook Trout Reserves Program to confront the challenges of climate change. Brook Trout Reserves are a selection of some of the places in Wisconsin where brook trout have the best chance of enduring the effects of climate change and other environmental perturbations. Landscape-level conservation planning conducted by the Brook Trout Reserves Team has identified 54 Brook Trout Reserves encompassing 205 subwatersheds. These strongholds represent the best brook trout populations and their habitat that will persist in the face of climate change. We further characterize existing and potential biological, environmental, and climatic threats among the reserves and suggest an adaptation framework for their management.

Full Presentation, Professional

Wednesday, 8:30 AM

Brook trout and fish community use of spring ponds within the Plover River system, Wisconsin

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Joshua Raabe, Jared Homola

Protecting refugia that provide favorable thermal habitat could be crucial for the persistence of sensitive fish species amid changing climates. Wisconsin has thousands of miles of thermally suitable habitat for Brook Trout Salvelinus fontinalis and other coldwater species that may be threatened by climate change. Spring ponds may serve as refugia during droughts and periods of extreme weather events because of consistent groundwater input and depth that maintain cold water, but there is limited knowledge of how Brook Trout and other fishes use the spring ponds and move between connected river systems and ponds. The Plover River system in central Wisconsin contains a naturally reproducing Brook Trout population in upstream reaches and connected spring ponds. Passive integrated transponder (PIT) tags and antennas were used to determine if Brook Trout use of spring ponds varied by season from fall 2022 to winter 2023. Tagged Brook Trout were detected entering and exiting spring ponds, with movements most common in the fall, however a large proportion appeared to remain in ponds. Boat electrofishing catch per effort (CPE) of Brook Trout was higher in summer than spring and fall in the three focal ponds and the relationship between summer Brook Trout demographics and spring pond characteristics was evaluated in seven additional spring ponds. Fish communities in spring ponds and the Plover River were sampled seasonally using environmental DNA (eDNA) and relationships between communities and waterbody characteristics will be investigated. This study provides evidence that spring ponds may be used by Brook Trout as a thermal refuge in summer, informs managers of spring pond characteristics that support desirable refugia for sensitive fishes, and gives insight into appropriate management, rehabilitation, and protection of these waterbodies and populations.

Full Presentation, Student

Wednesday, 8:50 AM

Evaluating Suitable Habitat for Brook Trout (Salvelinus fontinalis) in The Driftless Area within Sandstone and Dolostone Rock Geologies

Brandon Thill, *University of Wisconsin – La Crosse*, thill2539@uwlax.edu

Jason Freund

Being the only species of stream trout native to Wisconsin, Brook Trout play a valuable role in the economics and culture of the state. As the amount of suitable habitat offered in the state of Wisconsin is expected to decrease 68% by the year 2050, it is important to research areas where the decline is not as prevalent to gain an idea of what conservation strategies may be implemented for the preservation of suitable Brook Trout habitat. Our study focuses on a small portion in the Driftless Area where Brook Trout are predicted to have available habitat over the next 50 years. The study area is divided by two bedrock geologies, sandstone and dolostone, and includes Brook Trout dominated streams and Brown Trout dominated streams. Habitat surveys and snorkel surveys were conducted using a transect based method to quantify available habitat within streams of both geologies. Through our findings thus far, multivariate models such as principal component analyses and multiple regression AICs demonstrate that lower mean summer stream temperatures were predicted by conductivity, geology type, and mean depth of the stream. Sites with these corresponding variables were more typically occupied by Brook Trout and Brown Trout were absent. Using the results from this study, we will be able to decipher which variables in the Brook Trout dominated streams are allowing the populations to remain healthy and implement them through conservation practices in other streams, ultimately providing more sustainable habitat for generations to come.

Full Presentation, Student

Wednesday, 9:10 AM

Genetic diversity, structure, and hatchery ancestry of wild Brook Trout populations in Wisconsin

Andrew Thometz, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin – Stevens Point*, 27thometz@gmail.com

Jared Homola, Matthew Mitro

Brook Trout Salvelinus fontinalis are the only native charr to Wisconsin streams. Brook Trout have been stocked throughout Wisconsin since the late 19th century to improve angling opportunities and mitigate population declines. Poor documentation of Brook Trout stocking prior to the 1970s, in addition to the stocking of non-native and domesticated strains has made it impossible to infer the ancestry of many Brook Trout populations in Wisconsin without the use of genetic tools. The Wisconsin Department of Natural Resources (WDNR) now prioritizes the use of native broodstock sources to conserve the population genetics of Wisconsin native Brook Trout; however, unknown wild population ancestries create a challenge for broodstock source selection. This study characterized the genetic diversity, hatchery ancestry, relatedness, and genetic structure for 63 wild Brook Trout populations in Wisconsin using 68 microsatellite loci. Estimates of allelic richness, heterozygosity, inbreeding coefficient, and effective population size were produced for each survey population. Discriminant analysis of principle components (DAPC) was used to assign survey populations back to simulated native or hatchery populations, yielding estimates of hatchery ancestry. Genetic structure and relatedness were evaluated using pairwise genetic distances, neighbor-joining trees, DAPC, and the program STRUCTURE. Our results indicate higher levels of genetic diversity in northern Wisconsin, low overall levels of hatchery ancestry, and relatively weak hydrological population structure. Overall, these results provide genetic information for 63 previously uncharacterized Brook Trout populations, supporting the conservation, management, and stocking practice of Brook Trout in Wisconsin.

Full Presentation, Student

Wednesday, 9:30 AM

Brook Trout Population Characteristics in a Large Wisconsin Spring Pond

Dave Seibel, *Wisconsin Department of Natural Resources,* david.seibel@wisconsin.gov

Taylor Curran

McGee Lake is a 23-acre spring pond with a native, naturally reproducing brook trout population. The trout fishery of this large spring pond has been managed for quality trout fishing since 1990 with a 12 inch minimum size limit, daily bag limit of 2, and artificial lures only regulations.

Surveys and population estimates have been done annually every October, following the close of the angling season, since 2008. Since 2018, Passive Integrated Transponder tags (PIT) have been implanted in all trout 6 inches and larger captured in the annual mark-recapture boom electrofishing surveys. Data will be presented showing population estimates, age and growth, survival, and longevity.

Speed Presentation, Professional

Wednesday, 10:00 AM

Identifying potential sources of natural recruitment of muskellunge in Green Bay, Lake Michigan

Ryan Eastman, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, reastman@uwsp.edu

Daniel Isermann, Daniel Dembkowski, Robert Davis, and Jason Breeggemann

Southern Green Bay represents a world-class trophy muskellunge (Esox masquinongy) fishery despite little evidence of natural recruitment and the population being reliant on stocking. Efforts have been made to document natural recruitment at known spawning locations, with effort being focused on the Fox and Menominee rivers over multiple years. Results have shown little evidence of successful hatching within the sampling area. Recent research has shown that approximately half of adult muskellunge in southern Green Bay may spawn outside of tributaries in areas where egg and larval sampling was not intensive. These open water spawning areas could represent sources of natural recruitment within southern Green Bay. Visual observations and very limited occurrences of by-catch of naturally reproduced young of year muskellunge from the Sturgeon Bay area (e.g., Little Sturgeon Bay, Sawyer Harbor) suggest spawning is occurring in this area, but it is unknown if these fish contribute to the southern Green Bay muskellunge population. Spawning locations and habitat characteristics associated with successful hatching in and around Sturgeon Bay remain unknown. Determining if natural recruitment of muskellunge is occurring outside of Green Bay's tributaries has important implications for meeting ecosystem recovery goals. Therefore, our objectives are to determine if: (1) successful hatching is occurring at open-water locations in Green Bay, including locations in the Sturgeon Bay area, (2) presence of eggs or larval muskellunge at a location is related to a suite of habitat characteristics including distance to shore, bottom slope, depth, dissolved oxygen, substrate type, and aquatic vegetation, and (3) muskellunge spawning in the Sturgeon Bay area contribute to the overall population in southern Green Bay.

Speed Presentation, Student

Wednesday, 10:10 AM

Evaluating Alternative Creel Survey Designs in the Context of Walleye Exploitation Rates in the Ceded Territory of Wisconsin

Colin Dassow, *Wisconsin Department of Natural Resources, Office of Applied Science,* *colin.dassow@wisconsin.gov*

Stephanie Shaw, Ashley Trudeau, Olaf Jensen, Greg Sass

Creel survey information remains some of the most difficult and costly fisheries information to collect, yet it is also some of the most valuable information decision makers can have when making management decisions. However, the lack of creel information available for recreational fisheries relative to the large amount of biological information available for these same fisheries highlights the need for creative ways to collect more creel information. Here, 5 hypothetical creel survey designs were compared to the full creel data for the Ceded Territory of Wisconsin to understand how one fishery metric of management significance, angling exploitation rate, estimated from each reduced data scenario compares to the full set of creel information. On an aggregate and individual year basis each of the five reduced data scenarios produced exploitation rates that were not statistically different from the exploitation rate calculated using the full set of creel data. This result suggests that several avenues may be available to transition from a creel survey predicated on a large amount of sampling for a small number of lakes to a survey where a smaller amount of data can be collected in exchange for the ability to survey more systems annually without major sacrifices in the quality of information collected.

Speed Presentation, Professional

Wednesday, 10:20 AM

Delineation of walleye stock structure in Lake Superior

Erik Cristan, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, ecris967@uwsp.edu

Peter Euclide, Chris Wilson, Dray Carl, and Jared Homola

Lake Superior walleye (Sander vitreus; Ojibwe: Ogaa) have a prominent history among local fishing communities. In the 1950s and 1960s, walleye abundance declined and never fully recovered, persuading the Lake Superior Technical Committee (LSTC) to implement a walleye rehabilitation plan in 2001. The rehabilitation plan emphasizes delineation of walleye stock structure in Lake Superior as a research objective to aid restoration efforts. To date, local stock structure of walleye has been assessed in northwestern and southeastern portions of Lake Superior using microsatellite genetic markers, but no basin-wide analysis has been attempted. Advances in genomic techniques have led to increased power to distinguish subtle stock structure differences in fish populations, including the development of a genotyping-in-thousands (GT-seq) panel designed for Great Lakes walleye. Here, we examine in-basin Lake Superior spawning walleye aggregates and out-of-basin stocking sources throughout Michigan, Minnesota, Ontario, and Wisconsin to delineate stock structure differences and stocking influences using GT-seq. Preliminary results from 14 in-basin spawning aggregates and several out-of-basin stocking sources identified multiple reporting group clusters using discriminant analysis of principal components. Our results suggest Lake Superior is comprised of genetically discrete walleye stocks that could serve as biologically grounded units for restoration and management objectives emphasized in the LSTC rehabilitation plan. Distinguishing spatially discrete walleye stocks may provide a basis for inferring how habitat features influence gene flow among stocks. Understanding how stock structure is arranged throughout the lake could also inform stocking efforts and help preserve patterns of endemic genetic variation. Distinct stocks can also serve as reporting groups for mixed stock analysis, which may help assess stock-specific spatial distribution and contributions to the fishery.

Full Presentation, Student

Wednesday, 10:40 AM

The relative importance of individual identity, maternal traits, and environment as predictors of egg characteristics in walleye (Sander vitreus)

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Stephanie L. Shaw, Zachary S. Feiner, Greg G. Sass

Individual, sex-specific, and environmental factors may influence gamete characteristics and contributions to recruitment in fishes. We tested for the influence of maternal, abiotic, and biotic factors on egg diameter and quality (i.e., oil droplet diameter) for walleye (Sander vitreus) in Escanaba Lake, Wisconsin, during 2018-2023 (omitting 2020). Analyses were conducted on fish captured once and for the same individuals captured multiple times during our study period. In the single-capture analysis, increasing maternal length was weakly related to larger egg diameter and oil droplet size. Increased yellow perch abundance potentially was related to increased intra-clutch variation, whereas a later ice-off date was significantly related to reduced intra-clutch variation. Spawning phenology (i.e., difference between ice of date and date of spawning event) was related to every response variable, with a later date of spawning leading to smaller and more variable egg and oil droplets. Among fish that were sampled over multiple years, individual identity was a strong predictor of egg and oil diameter. Although individual walleye may exhibit stable egg quality over time, environmental factors may influence population-level egg characteristics. Our results suggest that regulations that preserve among individual variation in egg traits could increase the chances that environmental conditions will be favorable for spawning and recruitment for at least some fish.

Full Presentation, Professional

Wednesday, 11:00 AM

Hitting a moving target: Identifying critical periods for spawning and recruitment of walleye in Escanaba Lake

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Stephanie L. Shaw, Greg G. Sass

Fish recruitment is influenced by myriad abiotic and biotic factors that vary in space and time. Potential "critical periods" may exist when the presence or absence of optimal environmental conditions determines year class strength; however, critical periods are difficult to identify quantitatively (often being summarized as, e.g., average spring temperatures), and may be altered by broad-scale stressors like climate change. We used a novel sliding windows analytical approach to identify potential critical temperature and precipitation windows for walleye (Sander vitreus) recruitment success (defined as age-0 abundance in the fall) in a 57-year time series from Escanaba Lake, Wisconsin, USA. Walleye spawn timing was influenced by the interaction of water temperature and photoperiod, with photoperiod cues more important when water temperatures remained colder than optimal for spawning late in the year. Using the full time-series, we observed no significant critical periods for walleye recruitment. However, when dividing the data into early (1958-1984), middle (1984-2002), and recent (2003-2019) time periods, precipitation in the two weeks after spawning had a strong negative effect on recruitment in recent years. Our results suggest a growing importance of precipitation for walleye recruitment, a concern given future projections for a wetter Wisconsin climate. More broadly, weak evidence for clearly defined critical periods may mean that biotic variables are more important than abiotic conditions, or that the relative importance of environmental factors are context-dependent and vary from year to year, complicating attempts to accurately predict year class strength using predefined environmental variables.

Full Presentation, Professional

Wednesday, 11:20 AM

Identifying Walleye and Lake Whitefish Spawning Habitat to Inform Habitat Improvements for Lake Sturgeon in the Lower Fox River below De Pere Dam

Braden Lensing, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, blensing@uwsp.edu

Daniel Dembkowski, Jason Breeggemann, Scott Hansen, and Daniel Isermann

Previous research indicates that lake sturgeon Acipenser fluvescens recruitment is extremely limited in the Lower Fox River below De Pere Dam. Constructing offshore reefs as spawning habitat has the potential to enhance the recruitment of lake sturgeon. However, spawning habitat of other species must first be identified to ensure that restoration efforts for lake sturgeon do not result in loss of spawning habitat for other species. The Lower Fox River supports spawning runs of lake whitefish Coregonus clupeaformis and walleye Sander vitreus, both of which support important fisheries in southern Green Bay. Our objectives are to use intensive egg sampling to: 1) identify the location and habitat in which lake whitefish and walleye spawn; 2) examine the relationship between spawning sites and environmental factors; and 3) inform placement of lake sturgeon spawning reefs to minimize loss of lake whitefish and walleye spawning habitat. Egg mats and a suction pump will be used to sample whitefish and walleye eggs from 2023 to 2025. Initial sampling for whitefish eggs in November 2023 was successful. Eggs were first detected on November 8 with a water temperature of 8.2° C and there was obvious spatial variation in egg densities.

Speed Presentation, Student

Wednesday, 11:30 AM

If you protect it, they will come: Protected areas and Lake Whitefish in Lake Superior

Dray Carl, *Wisconsin Department of Natural Resources*, dray.carl@wisconsin.gov

Scott A. Sapper, Michael J. Seider

Aquatic protected areas are commonly used for fish conservation, restoration, and management and associated levels of protection for fish stocks can vary greatly. Using fishery-independent survey data over 43 years, we evaluated whether lake whitefish (Coregonus clupeaformis) population dynamics (recruitment, mortality, growth, and maturity) differed among nearshore partially protected areas (PPAs; commercial fishing prohibited or severely limited), offshore no-take refuges, and unprotected areas in the Apostle Islands region of Lake Superior. Lake whitefish recruitment and biomass increased at faster rates in nearshore PPAs and offshore refuges than unprotected areas during the initial phase after protected areas were established (1980-2000). Recruitment and biomass stabilized in all management areas in the post-rebuild phase (2002-2022), and mortality was lower in the nearshore PPAs. Mean size of adult lake whitefish decreased within protected areas as abundance increased but not in unprotected areas, suggesting a density-dependent growth response and spillover to the fishing grounds, which was reflected in commercial gill net catch rates. However, nearshore PPAs still harbored larger, faster-growing, and earlier-maturing lake whitefish, likely due to underlying habitat differences. Tag recaptures indicated greater minimum distances traveled near an offshore refuge compared to a nearshore PPA, suggesting habitat gradients may influence boundary porosity. PPAs provided added protection and benefits for lake whitefish in areas of higher vulnerability where ceasing all fishing was not reasonable. Managers should consider implementing networks of protected areas across multiple habitats as tools for conserving spawning biomass, maintaining diverse population demographics, and preserving portfolio effects to enhance recruitment and population stability.

Full Presentation, Professional

Wednesday, 1:00 PM

Vertical distribution of Lake Superior Cisco (Coregonus artedi) spawning aggregations and implications for evaluating management benchmarks

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Jeremiah Shrovnal, Brad Ray, Dray Carl, Scott Sapper, Chris Zunker, Ross Lind

Cisco (Coregonus artedi) support an emerging commercial roe fishery in Lake Superior. Historic efforts to manage Cisco fisheries on the Great Lakes resulted in the collapse of many stocks due, in part, to misunderstood life histories. Wisconsin fishery managers recently began using hydroacoustic surveys as a method for monitoring trends in adult spawning Cisco abundance in November and early December. The Wisconsin Department of Natural Resources also pairs hydroacoustic surveys with gill netting surveys to apportion the relative composition of males and females for eventual use in estimates of biomass and exploitation. The gill net survey design has included paired top-floated and bottom-set gill nets from 2016-2022. Cisco in Lake Superior are believed to be pelagic spawners, so only the sex ratios from the top nets are currently used in tandem with the hydroacoustic surveys. However, the sex distribution of Cisco during spawning aggregations has previously been described as dynamic. The goals of this research were to 1) determine if sex-selective bias between top-floated and bottom-set gill net catch of Cisco exists and if that bias may change throughout the spawning and sampling season, 2) explore how the distribution and potential gear bias of males and females may influence sex ratios used for exploitation estimates, and 3) determine the effect that maturity (i.e., gonadal development state) has on the vertical distribution of Cisco during spawning aggregations. Multi-level aggregated binomial regressions were used to explore the vertical distribution of Cisco within sex and maturity combinations, and those models were used to simulate the potential for error when only using top nets to determine sex ratios when using known inputs. Results highlight a need for caution when relying on gill nets to apportion Cisco sex ratios during spawning aggregations and provide support for a non-pelagic alternative hypothesis of spawning behavior.

Full Presentation, Professional

Wednesday, 1:20 PM

Evaluating shifts in fish community production and predator abundance in northern Wisconsin lakes with different walleye recruitment histories

Max Wilkinson, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, mwilk933@uwsp.edu

Daniel Dembkowski, Stephanie Shaw, Greg Sass, Joseph Mrnak, Daniel Isermann

The Ceded Territory of Wisconsin is a lake-rich region of northern Wisconsin that has experienced variable changes in its joint tribal and recreational fishery in recent decades. Declines in walleye Sander vitreus production and recruitment coupled with increases in warm-water species abundance (e.g., largemouth bass Micropterus salmoides) have led fishery managers to make difficult decisions about future management directives. An increase in centrarchid species abundance may limit the number of finite resources available for walleye production in northern Wisconsin lakes, as well as impact population demographics of prey species (e.g., yellow perch Perca flavescens and bluegill Lepomis macrochirus) via direct predation. Some lakes have experienced long-term, stable natural walleye recruitment despite increases in centrarchid abundance, pointing to context-dependence in the ecosystem effects that occur from centrarchid establishment. Thus, the goals of this study are: (1) determine if declines in walleye productivity are related to increased production of centrarchid species across the gradient of walleye recruitment categories (natural, combination, and stocked) and (2) determine how changes in largemouth bass and walleye abundances may affect size-structure of yellow perch and bluegill. We will be estimating fish production for all centrarchid species and walleye in a suite of lakes with variable walleye recruitment histories, as well as use bioenergetic models to predict the effects of varying largemouth bass and walleye abundances on yellow perch and bluegill size-structure. Although high largemouth bass abundance may displace walleye productivity, we hypothesize their versatility in prey selection may lead to higher size-structure for bluegill and more variable responses in yellow perch dynamics based upon selective predation pressure by both largemouth bass and walleye.

Full Presentation, Student

Wednesday, 1:40 PM

Long-Term Trends and Effects of Coarse Woody Habitat on Fish Communities

Quinn Smith, *University of Wisconsin - Madison*, qcsmith2@wisc.edu

Greg Sass, Joe Mrnak, Olaf Jensen, Jake Vander Zanden

Coarse woody habitat (CWH) experiments in lakes have increased in popularity in the midwestern United States to combat negative aquatic ecological effects associated with lakeshore residential development. Previous short-term experiments associate CWH additions with positive effects and CWH removals with negative effects with regards to the fish community. However, many CWH additions are treated as short-term experiments, with few revisited, leaving long-term effects uncertain. To evaluate CWH dynamics and influences on the aquatic ecosystem over 20 years, we revisited the site of a CWH addition (Camp Lake, Vilas Co. WI), examining CWH characteristics and piscivore diets and movement. Camp Lake is naturally divided into two basins, a reference basin and a treatment basin that received a CWH addition in 2004. In Camp Lake's addition basin, littoral CWH decreased from 141 logs/km to 87 logs/km, while the reference basin increased from 40 logs/km to 103 logs/km. Largemouth bass diets in the addition basin did not shift and were dominated by fish, while diets from the reference basin shifted from fish and macroinvertebrate dominance to fish dominance. Population estimates for largemouth bass were similar for each basin during the CWH addition study and remained similar, but at higher numbers, 20 years post CWH addition. Changes in CWH density reinforce the idea that lake ecosystems are dynamic, changing water levels likely redistributed added CWH in Camp Lake and led to the addition of new CWH to the reference basin. Similar trends of largemouth bass diets in Camp Lakes addition basin and shift to fish dominance in the reference basin may reflect lasting influences of added CWH even as logs move and degrade. Our results suggest the short-term benefits of CWH additions may persist on longer timescales, and management activities should consider the effects on fish communities over decades.

Full Presentation, Student

Wednesday, 2:00 PM

Directing ecosystems through purposeful food web rewiring

Joseph Mrnak, *University of Wisconsin – Madison,* mrnak@wisc.edu

M. J. Vander Zanden and G.G. Sass

Invasive species are a global concern. After an invasive species establishes, they often disrupt ecosystems leading to new dynamics and species interactions, making management efforts difficult. Panarchy theory is a conceptual framework to account for the dual and seemingly contradictory characteristics (stability and change) of all complex systems across distinct spatial and temporal scales. Panarchy theory has the potential to be applied to gain better insight into invaded system dynamics by creating a framework to characterize complex natural systems. This framework allows for management actions (e.g., whole-lake biomanipulations, invasive species control, native species restoration) to be leveraged against natural and induced ecosystem processes, providing a greater probability of desired outcomes. Following this framework, we are conducting two whole-lake experiments aimed at invasive rainbow smelt (Osmerus mordax) control and native cisco (Coregonus artedi) restoration. We will be testing whether food web structure (i.e., presence or absence of apex predators) influences the interactions among invasive and native forage fishes. The application of panarchy theory should be viewed as a conceptual extension of efforts to restore ecosystems and(or) manage fisheries using a food web and ecosystem context (i.e., “food web thinking”, ecosystem-based fisheries management).

Full Presentation, Student

Wednesday, 2:20 PM

Population demographics and factors influencing abundance of Yellow Perch in inland Wisconsin lakes

Robert Davis, *Northland College*, rdavis@northland.edu

Danial Dembkowski, Ryan Eastman, Daniel Isermann

Yellow perch are one of the most ubiquitous panfishes in Wisconsin and are highly sought by anglers fishing Wisconsin's inland waters. Despite their ubiquity and popularity, little is known about the status (i.e., population demographics and dynamics) of many yellow perch populations in Wisconsin. Consequently, we evaluated population size and age structure, growth, and recruitment of 31 inland Wisconsin yellow perch populations sampled from spring fyke nets during 2018 and 2019. Additionally, we paired yellow perch relative abundance (CPUE) data from historical surveys with a suite of lake- and landscape-level biotic and abiotic factors to identify factors explaining variation in perch abundance. Based on in-field sampling during 2018 and 2019, yellow perch population characteristics varied substantially with CPUE ranging from 0.1-206 fish/fyke net night, proportional size distribution from 0-58, number of year classes present from 3-11, age-class diversity from 0.2-2.0, mean total length at age 3 from 117-184 mm, and recruitment variability index from -0.84-0.77. No evidence of spatial synchrony in recruitment was detected among the 31 perch populations included in our evaluation. Biotic and abiotic variables explained approximately 35% of the variation in yellow perch CPUE. Walleye and black crappie abundance were positively related to yellow perch CPUE, whereas growing degree days were negatively related to perch CPUE. Our study provides a basis for understanding the status of yellow perch populations in inland Wisconsin lakes, information that is currently lacking at a statewide scale.

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Full Presentation, Professional

Wednesday, 3:30 PM

Beware the bloodsuckers of the Deep!

Ted Treska, *Great Lakes Fishery Commission,* ttreska@gmail.comt

This presentation will provide a background of the sea lamprey problem in the Great Lakes, the current control program in place to suppress their numbers and where the program is headed in the future. From barriers to lampricide treatments targeting larval lamprey, many techniques are employed to reduce the impact of these invasive species on the fisheries and ecosystems of the Great Lakes.

Full Presentation, Professional

Wednesday, 3:50 PM

Estimating the number of spawning sea lamprey (Petromyzon marinus) within streams using genetic pedigree reconstruction

Samantha Straus, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, sstraus@uwsp.edu

Steven Fong, Kim Scribner, Nick Johnson, Travis Brenden, and John Robinson, Jared Homola

The invasion of sea lamprey (Petromyzon marinus) in the upper Great Lakes in the 20th century led to widescale ecological and economic damage. Ongoing control efforts have reduced sea lamprey abundances by 90%; however, these control mechanisms negatively affect native fishes and there is concern about the development of lampricide resistance and declining public support for lampricide use. Beginning in 2020, SupCon is an adaptive management effort to evaluate supplemental control methods for sea lamprey. The methods primarily deter/disrupt spawning that could be used alongside other control efforts. Accurate estimates of effective population sizes and the number of successful spawners are critical for rigorously evaluating supplemental control methods. We collected and genotyped larval and transformer sea lamprey from 13 experimental SupCon streams from 2020 to 2023 to assess efficacy of alternative control strategies. We reconstructed pedigrees of captured larvae using genetic data to estimate the effective number of breeders (Nb) and number of successful spawners (Ns) that gave rise to different larval sibling groups. By using genetic mark-recapture techniques, we detected individuals from the same sibling group across years, allowing inter-annual tracking of downstream drift and growth of sibling groups. We found that Nb and Ns varied among tributaries, and that in a study stream treated with lampricide, Nb and Ns declined following treatment. We also found the number of offspring produced per spawning adult to be highly variable both among and between streams and sampling years. Sea lamprey are a highly productive species, and few adults can contribute many offspring to the next generation. Understanding how various control methods influence spawning success may provide a means of designing more effective and sustainable control strategies.

Full Presentation, Student

Wednesday, 4:10 PM

Genetic diversity and population structure of Southern Brook Lamprey (Ichthyomyzon gagei) in Wisconsin and Mississippi

Erin Brino, *University of Wisconsin - La Crosse*, erinbrino@gmail.com

David A. Schumann, Todd W. Osmundson

Taxonomic classifications that fail to represent underlying biological diversity undermines conservation efforts for at-risk lampreys (order Petromyzontiformes). Southern Brook Lamprey (Ichthyomyzon gagei) predominantly occur in the southeastern United States, but disjunct populations have been described in Wisconsin. Previously-observed slight differences in meristic and morphometric traits between the disjunct populations raise the question of whether the northern population comprises an evolutionarily distinct lineage. We assessed the genetic distinctiveness of Southern Brook Lamprey captured from three streams in Wisconsin (n = 32) and two in Mississippi (n = 7) using population genomic and phylogenetic analyses of single-nucleotide polymorphism data obtained through double digest restriction-site associated DNA sequencing (ddRADseq). A phylogenetic analysis of mitochondrial cytochrome b sequences distinguished the populations but placed both in a clade with Southern Brook Lamprey and the closely related Chestnut Lamprey. Population genomic analyses identified moderate to high genetic divergence between the two ranges, with lower levels of differentiation between the Wisconsin watersheds. These results, in conjunction with past morphological analyses, provide evidence that the northern population is genetically distinct from the southern population and, as a result of its restricted range, may warrant separate conservation attention, further research, and recognition as a distinct taxon.

Full Presentation, Student

Thursday, 8:00 AM

Assessment of Automated Bait Delivery Systems for Grass Carp Aggregation in the Sandusky River, Ohio with Applications to the Upper Mississippi River

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James J. Wamboldt, Matthew R. Acre, David A. Schumann

Invasive Grass Carps *Ctenopharyngodon idella* can alter trophic dynamics via excessive aquatic macrophyte consumption when introduced beyond their native range. Increasing commercial captures of Grass Carp in the Upper Mississippi River and Great Lakes basins paired with their ability to evade traditional fisheries gears represent a substantial challenge for management. Attractants have been used to control populations of other invasive carps (e.g., Common Carp Cyprinus carpio), but their potential application to Grass Carp control has not yet been fully recognized. Our study aims to describe the ability of automated bait delivery systems to alter the movement behaviors and aggregate Grass Carp in the Sandusky River. Specifically, our objectives were to: (1) describe Grass Carp movement ecology before, during, and after bait dispersal, and (2) determine Grass Carp movement responses to feeding; use of the feeding area (i.e., 100 m from the platform), time occupied at feeding area, and the attraction distance from the feeding area. We evaluated Grass Carp movements (n = 22) at three locations in the riverscape during 2022 (May-September) after deploying either a canola or algal bait. Refinements to this approach are now being evaluated in Pool 19 of the Mississippi River to better understand Grass Carp movement ecology and responses to automated bait delivery systems. If successful, these methods could provide a way to aggregate Grass Carp to increase efficiency of concentrated removals.

Full Presentation, Student

Thursday, 8:20 AM

Population Characteristics of Buffalo in Wisconsin: Contribution and Resiliency to Bowfishing Harvest

Ryan Bohen, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, rbohe873@uwsp.edu

Daniel J. Dembkowski, Alexander W. Latzka, Joseph M. Hennessy, Jared J. Homola, Daniel A. Isermann

Bigmouth and smallmouth buffalo (herein buffalo) are native, non-game fishes that rarely receive management attention. Increased participation in bowfishing has prompted some efforts to better understand the population dynamics of buffalo and other native fish to determine their resiliency to harvest. Buffalo are native to many water bodies in Wisconsin, but little information exists regarding their population dynamics and contribution to bowfishing harvest. Consequently, our research objectives are to: 1) describe age composition, reproductive traits, and population dynamics for buffalo populations in Wisconsin; 2) use simple predictive models to assess their resiliency to harvest, and 3) determine the extent to which buffalo contribute to harvest in bowfishing tournaments. We are collecting buffalo from 15 Wisconsin waterbodies with the help of the Wisconsin Department of Natural Resources and Wisconsin Bowfishing Association (WBA). Specimens will be collected via boat electrofishing, seine nets, fyke nets, gillnets, bowfishing and commercial fishing. Otoliths will be extracted from each fish and used for age estimation. Population metrics will include sex-specific mean length-at-age, Shannon diversity index, total number of age classes present, length at 50% maturity and age at 50% maturity. Spawning potential ratios and total mortality rates will inform harvest models. Bowfishing harvest will be recorded at 5 annual WBA tournaments in 2023 and 2024. All fish brought to the weigh-in will be enumerated and identified to species or species group. The number of teams competing in each tournament will be recorded to account for differences in effort. Our research will provide fishery managers with landscape-level population information on buffalo in Wisconsin and help inform future management decisions.

Full Presentation, Student

Thursday, 8:40 AM

Investigations of Bluegill age and size structure difference from three different Mississippi River overwintering sites near La Crosse, Wisconsin

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Troy Clement, Kristina Pechacek, Andrew Schneyer, Trevor Raatz

Annual Wisconsin Department of Natural Resources late fall electrofishing within Mississippi River centrarchid overwintering sites indicated differences in size structure were occurring among backwater lakes used by bluegill for overwintering. It was unclear if the size structure difference was due to differences in age structure of populations, growth rates, harvest or environmental variables affecting survival. Our 2020 pilot study focused on collecting otoliths for aging from ten bluegill/half inch group/site in late fall from three different known Mississippi River overwintering sites of different habitat quality within a 2-mile section of the Mississippi River near La Crosse, WI. The number of bluegill otoliths aged from Pile Lake, Broken Arrow, and Bluff Slough were 126, 93, and 128, respectively. Mean length at age 2 for Pile and Broken (152 mm (6.0 inches) and 150 mm (5.9 inches), respectively) were not significantly different, but both were significantly greater than Bluff Slough mean length at age 2 (142 mm (5.6 inches)). Maximum age observed for backwaters was 5 for Bluff and Broken, and 4 for Pile. Von Bertlanffy growth curves for the three sites were calculated using aged and assigned aged fish. Pile had a fit issue, it never plateaued, probably because no age 5 fish were picked up. The other two lakes had overlapping 95% CIs for parameter estimates (length at infinity – i.e., mean maximum length and k – i.e., the rate that growth reaches the plateau). Broken had higher mean maximum length (9.4 inches) than Bluff (8.9 inches). K was slightly greater for Broken (0.37) than Bluff (0.31). Our pilot study indicates population age and size structure may be partially influenced by overwintering site characteristics.

Full Presentation, Professional

Thursday, 9:00 AM

Defining connectivity of Great Lakes smallmouth bass populations using genomics and telemetry

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Dan Isermann, Lisa Izzo, Scott Hansen, Troy Zorn, Zak Slagle, Peter Euclide, and Jared Homola

Smallmouth bass Micropterus dolomieu populations have expanded in the Great Lakes and support destination fisheries in all five lakes. Increased occurrence of competitive catch-and-release fishing tournaments targeting smallmouth bass may degrade natural patterns of connectivity by artificially concentrating bass around release locations or by mixing discrete stocks through translocation. Consequently, fishery managers need to define an appropriate scale for managing smallmouth bass "stocks". We initiated a large-scale study in Lake Michigan in spring 2023 combining acoustic telemetry and genomics to assess patterns of natural connectivity among spatially proximal spawning groups by evaluating rates of spawning site fidelity in multiple habitat types (tributaries or small embayments), dispersal after spawning, and whether smallmouth bass spawning in tributaries consist primarily of river-run or river-resident ecotypes. During spring 2023, we implanted 210 adult smallmouth bass with Innovasea V13 acoustic transmitters with 3-year battery life. Transmitters were distributed among seven spawning locations (30 transmitters each in four tributaries to Green Bay and three embayments of Wisconsin's Door Peninsula). Movements of smallmouth bass will be monitored passively with extensive networks of acoustic receivers. We will present preliminary estimates of survival, observations regarding post-tagging residency in tributaries and embayments, and insights on rates of natural connectivity among embayments of Wisconsin's Door Peninsula. We will also discuss future components of this project, including a displacement experiment that will occur in spring 2024 to determine if translocation events (such as tournament weigh-in procedures) could disrupt stock structure or natural levels of connectivity.

Full Presentation, Professional

Thursday, 9:20 AM

Nest Fishing and Smallmouth Bass Recruitment along Wisconsin's Door Peninsula

Dan Isermann, *Wisconsin Cooperative Fishery Research Unit, University of Wisconsin - Stevens Point*, dan.isermann@uwsp.edu

Eric Naas, Daniel Dembkowski, Scott Hansen, Justin VanDeHey

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 inherent variation in recruitment, some stakeholders believe that angling during nesting may be detrimental to recruitment. Our objectives were to determine if nest success and age-0 catch-per-effort (CPE) measured at end of summer varies in relation to a suite of abiotic and biotic variables, including angler effort and rates of nest disturbance. We deployed underwater cameras and monitored nests along transects within 4 different spawning locations along the Door Peninsula, including a reference location closed to fishing during the nesting period. We also compared modified boat electrofishing, hand-held anode electrofishing, and mini-fyke nets as methods for sampling age-0 and age-1 smallmouth bass. Nest success was significantly different among sites and years. Spawning locations on the Green Bay side of the Door Peninsula exhibited higher nest success rates in 2022 and 2023 (range = 30-55%) than embayments on the Lake Michigan side (range = 12-20%), despite more angler effort and higher rates of angler nest disturbance. In 2022, recruitment appeared to follow similar trends, with bayside spawning locations displaying higher age-0 catch rates; age-0 CPE data for 2023 were not yet available. Our research will help address concerns regarding the effects of nest fishing on smallmouth bass recruitment as well as identify a sampling method for indexing recruitment into the future.

Full Presentation, Professional

Thursday, 9:40 AM

Understanding Smallmouth Bass (Micropterus dolomieu) Preferred Habitat and Spatial Distribution Along the Couderay River, Sawyer County, Wisconsin

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Max Wolter, Scott Braden, Evan Sniadajewski, Colin Dassow

Smallmouth bass are a popular sport fish with a fighting reputation among anglers, especially when targeted in rivers. Few studies have documented how smallmouth bass use riverine habitat types and distribute themselves throughout a river. A better understanding would be beneficial to not only to anglers pursuing this species, but to fishery and habitat managers as well. We studied the Couderay River in Sawyer County over 5 years with PIT-tag mark-recapture data and population sampling occurring every year across the entirety of the river. In the final year of the project, a habitat analysis was conducted. A Ripley's K analysis was used to determine if the distribution and clumping of the smallmouth was statistically significant. We found that the distribution of fish was not random and was significantly clumped along the river, confirming use of preferred habitats. Points along the river with varying angling catch rates (low to high) were identified for further habitat analyses. Habitat measurements including water depth, flow, substrate type, and other notable features were collected at 48 total sites. Using a random forest model, we were able to determine which habitat characteristics were significantly correlated with catch rate. Significant habitat features included the percentage of sand or gravel substrate, average depth, and the area of depth greater than 0.5m for sample sites. Analysis of variance and associated Tukey tests indicated that there are significant differences among the catch rate classes associated with average depth and the percentage of gravel substrate. The information and data collected from this study can be used by habitat managers when pursuing restoration/improvements to smallmouth bass riverine habitat. Noting that smallmouth tend to inhabit these specific habitats within a river, angling/hooking mortality along with protection of these areas should be taken into consideration when determining proper management of the species.

Full Presentation, Professional

Thursday, 10:20 AM

Nebagamon Creek Habitat Renovation and Proactive Mitigation

Paul Piszczek, *Wisconsin Department of Natural Resources*, paul.piszczek@wisconsin.gov

A 500-foot section of Nebagamon Creek in northwest Wisconsin was renovated by removing a deteriorated abandoned rail grade and culvert. This seemingly ordinary project was unique in many aspects of planning, implementation, and post-implementation. The rail grade's immense size (nearly 40 feet high, 110 feet wide, and 600 feet long) coupled with the bulky 12-foot-wide, 110-foot-long concrete culvert metaphorically represented the magnitude of the planning effort, from collaborating with private landowners to conducting flood studies to procuring permits and municipal agreements. Ironically, the details of least consequence to stream habitat renovation were of greatest interest to the landowners on whose property the work was to be completed. While the fish passage barrier, the potential for nearly 30,000 cubic yards of soils to entomb downstream trout and salmon spawning habitat, and the channel's stability drew the interest of resource agencies, sport clubs, conservation organizations and the public, the project's early traction was considerably influenced by identifying the landowners and addressing their concerns regarding property access and livestock containment. The prominent, nearly 150-year-old position once held by the embankment and culvert was reduced to nothing, its foothold extirpated from the lives of brook trout, rainbow trout, chinook salmon, and numerous other fishes.

Full Presentation, Professional

Thursday, 10:40 AM

Macrophyte coverage improves largemouth bass abundance and size-structure: a RAD application for aquatic plant management in Wisconsin lakes

Elise Bass, *University of Wisconsin - Stevens Point*, ebass556@uwsp.edu

Joseph T. Mrnak, Maxwel V. Wilkinson

Climate change is predicted to alter north-temperate ecosystems via lake warming, which could be followed by an increase in macrophyte production, forcing managers to decide whether to resist, accept, or direct these changes. Though warmer waters and more macrophytes are beneficial to some native species (e.g., Centrarchidae), this habitat change may negatively affect others (e.g., walleye Sander vitreus). Centrarchids (e.g., largemouth bass Micropterus salmoides; LMB) are known to win competitive and predatory interactions with walleye in warmer, more macrophyte dominant systems. Thus, in warming lakes unlikely to support walleye, macrophyte management could be a tool to accept ecosystem changes and provide robust centrarchid fisheries. Our objective was to explore potential relationships between LMB electrofishing catch-per-unit-effort (CPUE; fish/miles shocked), proportional size distribution (PSD), and the proportion of the littoral zone that is vegetated (PLV) across the Ceded Territory of Wisconsin. We found that LMB CPUE, PSD-Preferred (proportion of stock-length fish that are also preferred length), and PSD-Memorable were significantly positively related to PLV. We also found a significant inverse relationship between PSD-Quality and PLV while no relationship was found between PSD-Stock and PLV. Weighted binomial logistic regressions show that PLV was a significant predictor of PSD-Quality, -Preferred, and -Memorable. Results suggest increasing macrophyte coverage may promote an increase in LMB relative abundance and, on average, an increase in size structure. Given the negative (and cascading) effects of climate change on native coolwater species, some systems are likely to become dominated by LMB. Macrophyte management may therefore represent a strategy to accept these changes and improve expanding LMB fisheries, providing an example of how Resist-Accept-Direct (RAD) decision- making may be integrated into aquatic ecosystem management.

Speed Presentation, Student

Thursday, 10:50 AM

What do long-term water temperature datasets say about climate change and Wisconsin trout streams?

Matthew Mitro, *Wisconsin Department of Natural Resources, Office of Applied Science,* matthew.mitro@wisconsin.gov

The Wisconsin Initiative on Climate Change Impacts published its first assessment in 2011 on the effects climate change may have on the state's natural resources, including an evaluation of risks and vulnerabilities and recommendations on adaptation strategies to build resilience in our ecosystems. In that assessment, trout in coldwater streams were put up as the poster child of fisheries threatened with losses attributable to climate change. Fish dependent on cold water are logically threatened by warming, and early modeling efforts allowed us to project the effects warming may have on coldwater habitat for trout. Models projected stream habitat losses of 68% for Brook Trout and 32% for Brown Trout by the mid-21st century compared to the late 20th century. As we approach the midway point to the mid-21st century, it is fair to ask, how are our inland trout resources faring? Here I focus on trends in thermal conditions in trout streams and reach back towards the mid-20th century using long-term water temperature datasets for three trout streams in different regions of the state: the Kinnickinnic River (1992-present), the North Branch Pemebonwon River (1982-present), and Lawrence Creek (1960-present). A 32-year continuous dataset for the Kinnickinnic River and its Rocky Branch tributary showed an increasing trend in water temperatures from 1992 to 2012 and a decreasing trend from 2012 to 2023, with a net effect of little change over the 32-year period. In the North Branch Pemebonwon River, there was no significant change in summer weekly mean water temperatures measured in 1982, 1984, 1986, 2000, and 2018-2023. And in Lawrence Creek, summer monthly mean water temperatures were lower in 2018-2023 than in 1960-1965. These trout streams appear to have been resistant to the warming effects of climate change over the measured periods. I will discuss various hypotheses as to why this was the case and why we should consider this a fisheries management success.

Full Presentation, Professional

Thursday, 11:10 AM

Integrated modeling of recreational fisheries for climate adaptation in Wisconsin

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Paul Frater, Ben Beardmore, Olaf Jensen, Zachary Feiner

Wisconsin's recreational fisheries are experiencing a number of social and ecological changes. Interactions of warming waters, increasing shoreline development, aquatic invasive species, and high levels of harvest are resulting in changes to fish communities that will be difficult or potentially impossible to reverse. Of particular significance is the loss of socially and economically important coolwater species such as walleye (Sander vitreus) in many lakes. Understanding and adapting to the ramifications of these changes requires integrating what we know about changing aquatic ecosystems with the dynamic behavior of recreational anglers. We are developing a simulation model that integrates projected changes in water temperature, fish population dynamics, and recreational angler behavior to investigate their emergent effects on the Wisconsin inland lake fishery under different climate scenarios. Within this model, population dynamics and growth of walleye and bluegill populations are parameterized by empirical data specific to particular lakes or watersheds. Across days and years, simulated recreational anglers with different preferences choose fishing sites based on empirically derived tradeoffs between travel time and fishing quality. In this step of model development, we are testing the simulation's ability to efficiently replicate landscape patterns of fishing effort and harvest. This development of a simple but effective baseline model will allow us to test key biological and social assumptions, evaluate management alternatives, and propose strategies for climate adaptive fisheries management.

Full Presentation, Professional

Thursday, 11:30 AM

A quick dish on WICCI Fish – Updates from the Fisheries Working Group of the Wisconsin Initiative on Climate Change Impacts

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Zach Feiner, Paul Cunningham, Colin Dassow, Holly Embke, Gene Hatzenbeler, Jared Homola, Dan Isermann, Olaf Jensen, Zach Lawson, Matt Mitro, Jonathan Pyatskowit, Adam Ray, Craig Roberts, Aaron Shultz, Greg Sass, Laura Schmidt, Titus Seilheimer, Stephanie Shaw, Bradd Sims, Iyob Tsehaye, Max Wolter

The Fisheries Working Group of WICCI (the Wisconsin Initiative on Climate Change Impacts) is made up of academic, tribal, state, and federal researchers and managers across Wisconsin. We investigate the effects of a changing climate on Wisconsin's cold, cool, and warmwater fisheries, and seek to identify climate adaptation options for agencies and other stakeholders to pursue. We recently completed analyses of current adaptation approaches in Wisconsin and characterized them using the Resist-Accept-Direct framework, and our members are now focused on pursuing new adaptation strategies, new science, and new collaborations. In this talk, we will give an overview of some of our recent group efforts including our own research prioritization and development of a public-facing resource to guide pursuit of appropriate climate adaptations projects. We will also highlight some of the climate change research and adaptation projects being led by our members, hoping to demonstrate both the breadth of ways in which climate change is affecting Wisconsin fisheries, and the breadth of adaptation opportunities there are to pursue.

Full Presentation, Professional