



2023 Michigan Fish and Wildlife Conference Schedule

Shanty Creek Resort
Bellaire, MI
March 22-24, 2023



Plenary Speakers

Thursday, 3/23/2023

Exploring the Impacts and Outcomes of the Grand Traverse Regional Land Conservancy's Campaign for Generations

Chris Garrock, Director of Stewardship, Grand Traverse Regional Land Conservancy

Since 1991, the Grand Traverse Regional Land Conservancy has worked to protect and care for the most critical lands and waters in its five-county service area in northern Michigan. Thanks to a six-year accelerated effort, the Campaign for Generations, they have now protected more than 46,000 acres of land and 153 miles of shoreline. Chris Garrock, their Director of Stewardship, will share some highlights of those efforts and the positive benefits as a result, including the increased volunteer engagement and community science efforts that will benefit us all.

Friday, 3/24/2023

Protecting Tribal Treaty and Reserved Rights in Federal Agency Decision Making: Implementation of the 2021 Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Tribal Treaty and Reserved Rights

Rose Petoskey, Senior Counselor to the Assistant Secretary-Indian Affairs, U.S. Department of the Interior

In November 2021, 17 federal agencies signed on to the *Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Tribal Treaty and Reserved Rights* (TTR MOU). The TTR MOU commits the signatory federal agencies to coordinate and collaborate to protect on and off reservation treaty rights, reserved rights, and other similar Tribal rights. The signatory federal agencies include the following: Advisory Council on Historic Preservation, U.S. Department of Agriculture, U.S. Department of Commerce, U.S. Department of Defense, U.S. Department of Education, U.S. Department of Energy, U.S. Department of Homeland Security, U.S. Department of Housing and Urban Development, U.S. Department of the Interior, U.S. Department of Justice, U.S. Department of Labor, U.S. Department of State, U.S. Department of Transportation, U.S. Department of Veterans Affairs, U.S. Environmental Protection Agency, U.S. Office of Personnel Management, and the White House Council on Environmental Quality.

At the White House Tribal Nations Summit in November 2022, the 17 signatory agencies, coordinated through the White House Council on Native American Affairs, released a new best practices report, field guide, and accompanying flow chart to assist federal field staff in integrating the consideration of Tribal treaty and reserved rights into agency decision making processes. The best practices report and supporting guides were developed in consultation with Tribal Nations. The TTR MOU, best practices report, and supporting guides make clear that treaties are substantive federal law of equal importance to other federal laws and obligations. And as a result, federal agencies must give effect to treaty rights and should seek to safeguard them as agencies contemplate action. This presentation will provide an overview of the TTR MOU and the ongoing work of federal agencies to implement the best practices guidance.

Special Session

Thursday, 3/23/2023

Ballroom D

11:00am – 12:00pm

Q & A with Michigan DNR Leadership

Jim Dexter (Fisheries Division, Chief)

Joe Robinson (Wildlife Division, Regional Supervisor)

Invited guests from Michigan Department of Natural Resources Fisheries Division and Wildlife Division leadership will be available to answer questions directly from attendees.

Oral Presentations

Thursday, 3/23/2023

Ballroom C

10:00am

Removing Barriers: Fisheries and the Michigan AFS DEI Committee

Kyle Brumm, Dana Castle, Lydia Doerr, Tracy Galarowicz

The Michigan chapter of the American Fisheries Society strives to welcome, value, and support fisheries professionals of all identities and backgrounds. As a result, Michigan AFS formed the Diversity, Equity, Inclusion, and Justice Committee in 2022. We will connect the importance of our charge with the field of fisheries and our own experiences. We seek input from the society as we move to create a sense of belonging for all in Michigan AFS.

10:20am

Defining Relevancy: DEI Work in State Wildlife Agencies

Melissa Nichols, Clay Buchanan, Caitlin Boon, Kristin Wildman, Sofia Galvan

State wildlife agencies (SWAs) are initiating diversity, equity, inclusion, and justice (DEIJ) efforts relative to both internal agency culture and external engagement with more diverse wildlife resource beneficiaries. As illustrated by the Association of Fish and Wildlife Agency's 2019 Relevancy Roadmap, there are desires to connect to broad constituencies, but implementation and interpretation of relevancy efforts vary considerably. SWAs claim relevancy efforts that range from R3 work to engaging non-hunting wildlife recreationists to pursuing more universal and comprehensive DEI goals such as actively making conservation efforts on public lands and management programs more welcoming and responsive to the values of, the BIPOC and LGBTQIA+ communities, women, and people with disabilities. These disparate interpretations of relevancy in a conservation context create barriers for SWAs and DEI work, as misalignment on DEI issues and baseline knowledge often cause disagreement across SWA staff on prioritization and implementation of effective DEI strategies. We present findings from a content analysis of DEI plans and position statements

from across the wildlife conservation institution, examining the discourse around DEIJ as applied to relevancy and conservation. Challenges we identify align with the barriers described by the Relevancy Roadmap, including agency culture, agency capacity, and legal and political barriers. However, we connect these challenges directly to lack of clarity on what relevancy and DEIJ mean in a wildlife conservation context and a lack of alignment across all levels of the organization on goals, objectives, and metrics. We challenge the Michigan conservation community to address, separately and the relationship between, baseline knowledge and goal clarity to improve DEIJ efforts.

10:40am

Cultivating a Community of Conservationists
Spencer High

Evolution has created resilient ecosystems in nature. By observing these adaptations and applying them to our human ecosystems, we can create communities invested both in our natural world and in one another. In this talk we will analyze some mutually symbiotic relationships found within our natural communities, learn how they can teach us about human relationships, and look at ways to apply them to conservation organizations when engaging with their audiences.

12:00pm - LUNCH

1:00pm

***Evaluating the prevalence of crayfish species and owner knowledge in the pet retail trade throughout the Great Lake Basin**

Rachel Feagley, Brian Roth, Theo Berenson, Chris Pennuto, Patrick Siwula, Liz Tanner, Robert Stroess, Chelsey Blanke, Carolyn Dindorf, William Budnick

The pet retail trade is a potential invasive species pathway in the Great Lakes Basin, but more work is needed to understand the risks associated with it. Crayfish species found in the aquarium trade include several species that could outcompete native crayfish species and negatively impact aquatic ecosystems. There is currently a poor understanding of which crayfish species are prevalent in the aquarium trade, and when combined with a potential lack of species knowledge amongst aquarium retail employees, there is a substantial risk of accidental or intentional release. Crayfish have high morphological variability and confusing taxonomic nomenclature and can be bought and sold under a variety of names and colors morphs, or conversely, multiple species being bought and sold under a single name. This is especially problematic because several invasive crayfish species are nearly identical in appearance to other commonly sold species, which causes further confusion among retailers looking to avoid these species. A close examination of the retail trade across the Great Lakes Basin could identify invasion risks that derive from the sale of invasive crayfish. We executed a survey of aquarium retailers across the Great Lakes Basin to determine: 1) species of crayfish sold, 2) names these species were sold as, and 3) the level of knowledge or awareness of store employees regarding state-specific invasive crayfish species. Data from over 400 stores across eight states found six commonly sold crayfish species; however, the distribution of these species was not equal across states. Additionally, there was an overall lack of awareness of crayfish species of concern amongst pet store employees. Our research indicates that pet stores may serve as an invasion pathway within the Great Lakes Basin, but inconsistent prevalence of crayfish within the trade suggests surveillance efforts may need to increase in certain jurisdictions.

1:20pm

Eradication Efforts for Red Swamp Crayfish in Southeast Michigan

Brennen Wright, Ann Allert, Benjamin Bates, Zach Beaman, Seth Herbst, Lucas Nathan, Kathleen Quebedeaux, Brian Roth

Invasive crayfish may cause a range of effects in aquatic ecosystems including outcompeting native crayfish, consuming aquatic organisms, and degrading water quality and shoreline integrity through burrowing activity. Once introduced, eradicating invasive crayfish can be challenging due to their complex life history and use of burrows. Invasive Red Swamp Crayfish (RSC) (*Procambarus clarkii*), a worldwide invasive species, were first documented alive in Michigan in July 2017. Since then, multiple control methods have been attempted, with an emphasis on trapping. Despite removal of over 160,000 invasive crayfish, RSC persist in multiple locations. Information gained from these control methods have informed control strategies as we seek to achieve complete eradication. Michigan Department of Natural Resources received a permit to conduct pesticide treatments in small urban ponds using ExciteR, a pyrethrin-based pesticide, in 2021 and 2022. Additionally, we experimented with the use of Benseal, a Wyoming sodium bentonite plugging and sealing agent for treating crayfish in burrows in 2022. To date we have conducted five pyrethrin pond treatments, with a 95-100% decrease in trap catches immediately following treatment. In our burrow treatments with pyrethrin and/or Benseal, we documented a mortality rate of 60% on RSC. Future efforts will be to continue to treat ponds and burrows, if regulatory permits are approved, and to monitor RSC populations to determine effectiveness of these pesticide treatments; potential impacts of nontarget organisms, and the extent of pesticide concentrations in aquatic ecosystems. This presentation will highlight the treatment process and effectiveness, and future objectives for the ongoing Red Swamp Crayfish response program, including the possible use of new control technologies such as hot water in association with Benseal treatments in burrows.

1:40pm

***Experimental evidence that broadcasting rail calls and habitat quality can influence habitat selection by migrating rails**

Dustin E. Brewer, Thomas M. Gehring, Michael P. Ward, Eric M. Dunton, Rachael Pierce

Broadcasting audio to attract focal, migratory bird species to breeding habitat could help managers accomplish local and broader-scale conservation goals. This may be especially relevant to secretive marsh birds (e.g., Rallidae) and similar taxa that have experienced widespread habitat loss and population decline. Our goal was to determine if broadcasting rail calls overnight during spring migration could influence habitat selection by Virginia Rails (*Rallus limicola*), Soras (*Porzana carolina*), Yellow Rails (*Coturnicops noveboracensis*), and King Rails (*Rallus elegans*). We completed pre-experiment monitoring in 2021 (the 'control' year) and then in 2022 experimentally broadcast audio of focal species overnight between 25 March and 14 June in our central Michigan study area from lower-quality and higher-quality habitat. We determined the response of migratory rails to overnight playback via their abundance as indicated by in-person surveys. In 2022, we used autonomous recording units (ARUs) to document rail arrival dates (earliest = 5 April). Soras and Virginia Rails were the only focal species detected during surveys. We did not find within-year effects of overnight playback on rail abundance. We detected a mean of 0.86 ± 0.38 [S.E.] more rails in the experimental year, when overnight playback occurred, compared to the control year within the same wetland units. This effect was most pronounced in higher-quality habitat. Further, eBird data suggested that rail abundance and occurrence during our experimental year was also exceptional in our study area compared to the ten years prior to our study. We detected a King Rail that presumably was attracted by playback and then attempted to breed in our study area. Our results suggest that broadcasting overnight playback of focal species could be a tool that managers can use to influence habitat selection by secretive marsh birds, especially in concert with habitat restoration initiatives.

2:00pm

***The decline of a Michigan frog, and its relationship with the landscape**

Travis A. Rainey, Dr. Kirsten E. Nicholson

The current biodiversity crisis, marked in part by a disproportionate loss of amphibian diversity, is affecting all parts of the globe, including Michigan's Lower Peninsula. Blanchard's Cricket Frog (*Acris blanchardi*) is a wide-ranging, native hylid once common across its northern range edge, which includes the southern region of Michigan's Lower Peninsula. Declines across the northern range have been well documented starting in the 1970s. Understanding the magnitude of local extinction across Michigan, as well as the possible relationship between extirpation and landscape metrics can lead to informed management decisions for species recovery. For two objectives, statewide call surveys were conducted across historical sites to identify extant populations. First, the degree of decline was characterized based on these data. Additionally, landscape composition and configuration metrics within buffers of various sizes were then analyzed to identify differences between extant and extirpated sites. We found a high degree of local extinction for historical Michigan populations, including evidence for recent extirpations, suggesting the Michigan metapopulation continues to decline. From our landscape inquiries, we found significant differences in the landscape surrounding extant and extirpated sites. A mosaic of forest, development and agriculture, we found that certain anthropogenic land uses, such as agricultural disturbance, may serve to promote persistence, while other anthropogenic land uses like developed residential and commercial uses hinder persistence. Because we found evidence of a relationship between persistence and the landscape at larger spatial scales, we also assert that reduced connectivity mixed with an annual life cycle and reduced gene flow might be mitigated by corridor creation and management. Our results can provide support for conservation efforts to better facilitate increased connectivity and gene flow between populations.

2:20pm - BREAK

2:40pm

American marten occupancy and habitat associations using a camera trap array in the Northern Lower Peninsula, Michigan

Clay Wilton, Bill Parsons, Kevin Haynes

American martens (*Martes americana*) are small forest carnivores of high ecological and cultural value in Michigan. They are indicators of ecological integrity due to their close association with late-successional forests with structurally complex woody features that support numerous wildlife species. Therefore, ensuring their viability within managed landscapes demands explicit action by forest management and conservation decision making to sustain and promote the forest conditions where martens occur or are likely to occur. We used a camera trap array to estimate marten occupancy and habitat use in relation to land cover characteristics during three independent survey efforts (2020–2022) on state forest lands in the Northern Lower Peninsula (NLP) of Michigan. Our application of camera traps deployed in a grid-based survey design successfully detected martens both within areas known to be occupied by martens and in areas where martens were not previously detected. In a population whose range extent is poorly understood, and suitable habitat remains unoccupied, camera traps were a cost-effective and informative method for building upon what we know about marten distribution in the NLP. Our results may serve as a baseline for monitoring the long-term status of these populations within the NLP, including marten responses to management actions, identification of priority conservation areas, and accumulation of basic knowledge about marten in Michigan.

3:00pm

***Evaluating the Distribution of Ticks (Family: Ixodidae) of One Health Significance in a Region of Recent Expansion**

Braden DeWeerd, Andre Kapteyn, Emily Chizek, Emilia Shokoohi, Andrew Vander Tuig, Meghan May, Jean Tsao, William L. Miller

Blacklegged tick (*Ixodes scapularis*) populations have expanded in west Michigan over the past two decades, with Lyme disease occurrence also increasing over the same period. The lone star tick (*Amblyomma americanum*), which is associated with other tick-associated pathogens (e.g., Bourbon and Heartland virus diseases) and tick-related red meat allergy in geographic regions with longer establishment histories, has also expanded into southwest Michigan (Berrien County). Thus, expanding tick populations represent a recent but increasing One Health concern in west Michigan. Evaluating patterns of population occurrence and abundance for blacklegged and lone star ticks in west Michigan is important for understanding the spatial ecology of ticks in areas of recent expansion and for informing public health education and surveillance efforts. Our objective was to conduct fine-scale surveillance of Ixodid ticks in west Michigan and to compare patterns of tick occurrence and abundance within this region to previous collection years. Ticks were collected at 64 sites in west Michigan between May and August 2022. Ticks were collected using drag-cloth sampling along established trail systems. Transect distance was between 1000 to 2000 m per site. We calculated the density of nymphal and adult ticks per 1000 m² based on preliminary field analysis. Blacklegged tick densities ranged from 0.00 to 32.00 ticks per 1000 m². Total ticks collected (n=485 ticks) and average density across all sites (3.24 ticks per 1000 m²) were much lower than recorded for summer 2021 (n=1300 ticks, \bar{x} =9.21 ticks per 1000 m²). Relative abundance patterns were proportional between years, with high-density sites remaining high in both sample periods. The density of lone star ticks at a single established site in Berrien County averaged 3.73 ticks per 1000 m². Incidental reports of lone star ticks outside of the established site were higher in 2022 compared to previous years.

3:20pm

***Evaluating the use of small mammal nest boxes to improve surveillance systems for blacklegged ticks in a region of recent population expansion**

Andrew Vander Tuig, Braden DeWeerd, Andre Kapteyn, Emily Chizek, Emilia Shokoohi, Suan Paskewitz, Jean Tsao, William L. Miller

Surveillance for disease-carrying ticks and tickborne pathogens is required to inform risk assessment efforts and public health outreach, especially in regions where tick-related illnesses are increasing. The occurrence of Lyme disease in Michigan has increased over the past 20 years, driven by the expansion of blacklegged tick (*Ixodes scapularis*) populations. Standard methods for surveillance include environmental collection by drag-cloth sampling and collection from wildlife hosts, usually through live-capture techniques. These methods tend to be both labor and time intensive since they involve active surveillance. Immature blacklegged ticks can be recovered from deer mice (*Peromyscus* sp.) nests, indicating that nest box surveillance may be a feasible alternative to active sampling techniques. Our objective was to evaluate the efficacy of small mammal nest box surveillance relative to active sampling techniques in an area of recent expansion of blacklegged tick populations. We deployed nest boxes at seven sites around west Michigan in summer 2022. Sites were chosen to represent a variety of tick densities and ecological contexts. We also conducted regular drag sampling and small mammal trapping to compare surveillance methods. We recovered ticks from nest boxes at four of seven sites, although they tended to be at low numbers (≤ 3 ticks per site). Detections corresponded to a range of average drag sample densities (2.67 to 32.00 ticks per 1000 m²) and live capture counts (1.76 to

3.58 ticks per host). These preliminary results indicate that small mammal nest boxes could be a useful surveillance tool for determining presence of blacklegged ticks at sites of interest, although nest boxes may be less sensitive than active sampling techniques. Results from trials in other regions indicate that collection of larval ticks was higher in fall months, and we are continuing to process fall samples to understand how collection rate may vary with survey season.

3:40pm

Early Results from Characterization of Northern Lake Michigan Spawning Reefs

Ellary Marano, Dave Clapp, Brett Yonker, Matthew Herbert, Andrew Tucker, William Chadderton, Tracy Galarowicz, Chris Hessel, Erik Olsen

Numerous species of native fishes in Lake Michigan utilize rocky reefs for spawning. However, these reefs have historically been underrepresented in research, and prior surveys were conducted without the benefit of more modern technology. During the 2021-2022 field seasons, we collected biological data and catalogued habitat characteristics from 13 reef sites in northeastern Lake Michigan using both tripod-mounted cameras and diving as sampling techniques. Physical parameters that were measured included depth, substrate type, interstitial space, and cobble size. Biological parameters that were collected included crayfish species and density, dreissenid mussel density, cladophora height, and egg species and density. Our goal was to accurately describe the physical characteristics of these habitats as well as the aquatic communities that use them. Using these data, we have begun to assess how these sites differ in both biological and physical characteristics. Through our investigation of these differences, we believe we may improve our understanding of how these characteristics may impact spawning, egg survival, and production of native fish populations in the region. Preliminary results show relative uniformity in cobble size across sites, while crayfish populations and cladophora height are highly variable. Several sites, particularly Lee's Reef, Sutton's Reef, and Northport reef, were shown to have significant populations of native crayfish. In addition, there was significant deposition of lake whitefish (*Coregonus clupeaformis*) and Cisco (*Coregonus artedii*) eggs at Elk Rapids Reef, with the majority of lake trout (*Salvelinus namaycush*) eggs being deposited at Good Harbor Reef. Field sampling will continue into 2023 and will include additional reefs in northern Lake Michigan. Ultimately, this study will lead to recommendations for management actions prioritizing reef protection and restoration.

4:00pm

Developing a Tribal-State Manoomin/Mnomen Stewardship Plan

Frank Zomer, Jennifer Read, Danielle Fegan, Katherine Lambeth

Manoomin/mnomen, or wild rice, is staple to the subsistence of the Anishinaabek of the Great Lakes Region since the great migration. Anishinaabek communities in Michigan have taken a leadership role in the research, restoration, and protection of manoomin/mnomen throughout the state. In the development of Michigan's Water Strategy, a 30-year plan for the protection and management of Michigan's water resources, an important recurring theme in written comments and conversations with the tribes was the significance of manoomin/mnomen to their spiritual, historical, cultural, ceremonial, social values and relationships, food systems, and economies. As a result, the Tribes and the State joined to develop the Michigan Wild Rice Initiative in 2017. (MWRI, the Initiative)

In 2021, the Initiative identified the development of a collaborative Tribal-State Manoomin/ Mnomen Stewardship Plan as a top priority for them. Subsequently they secured resources and contracted with a team from the University of Michigan Water Center to support the Initiative in plan development. This presentation will describe the origins of the Michigan Wild Rice Initiative, its mission and the collaborative process of

developing the Stewardship Plan to date, including engagement with Tribal elders, knowledge keepers and traditional ricers as well as conservation groups, lake associations, environmental consultants and other manoomin-impacting entities with an interest in how manoomin is stewarded across the Michigan landscape.

4:20pm - BREAK

Thursday, 3/23/2023

Ballroom D

10:00am

***Freshwater gastropod assemblages in the Detroit and St. Clair rivers of the Laurentian Great Lakes**

Shay S. Keretz, Daelyn A. Woolnough, Nichelle M. VanTassel, Dylan T. Powell, Gabrielle Sanfilippo, Aaliyah Wright, Todd J. Morris, Ashley K. Elgin, Edward F. Roseman, David T. Zanatta

Gastropods are a highly diverse group of mollusks with as many as 74% of species listed as imperiled globally. Consequently, there has been an increased need for understanding gastropod communities throughout North America to implement conservation and management strategies. In the Laurentian Great Lakes, surveys on native gastropod populations have been sparse and most surveys have focused on invasive species. To estimate gastropod densities in two large connecting rivers of the Great Lakes, the Detroit and St. Clair rivers, benthic surveys were conducted in 2019 and 2021. Sites in the Detroit (n=56) and the St. Clair (n=51) were surveyed using a petite PONAR grab. The samples were then sieved and all gastropods were retained. Gastropods were identified to family and species where possible, and an estimated density for each site was calculated. In both the Detroit and St. Clair rivers, the gastropod families Pleuroceridae (37% and 56% total composition, respectively) and Amnicolidae-Hydrobiidae (42% and 22% total composition, respectively) had the highest densities and contributed the most to overall gastropod composition. In the Detroit River, there were a mean 321.3 ± 98.7 pleurocerids m⁻² and a mean 362.0 ± 77.3 amnicolids-hydrobiids m⁻² in the samples. In the St. Clair River, there a mean of 579.1 ± 128.3 pleurocerids m⁻² and a mean of 229.1 ± 47.2 amnicolid-hydrobiids m⁻². Invasive New Zealand Mudsnail was identified at 4 (7%) Detroit River sites and 10 (20%) St. Clair River sites, with a mean density of 0.7 ± 0.3 individuals m⁻² in the Detroit River and 17.1 ± 13.5 individuals m⁻² in the St. Clair River, which represent the first documented occurrence in these rivers. These data give insight into the diverse gastropod assemblages in the Detroit and St. Clair rivers and will be used to identify a diversity and density baseline in these rivers.

10:20am

Stranded Aquatic Biota (Mussel and Fish) Survey and Relocations in the Upper Peninsula, Michigan

Stu Kogge, Zack Pitman

In 2022, GEI conducted two stranded mussel surveys for Upper Peninsula Power Company (UPPCO) in support of their inspections and maintenance for FERC license compliance at the Main Dam for Bond Falls Flowage and the Powerhouse below the Victoria Reservoir, both of which discharge into different branches of the Ontonagon River, in the western end of the Upper Peninsula of Michigan.

In 2022, Michigan released protocols for addressing stranded mussels within lakes and reservoirs and during reservoir drawdowns. Our work involved addressing stranded mussels downstream of a reservoir, wherein modifications were needed to apply these protocols to these downstream situations. State permits and work plan approvals for this work were obtained from MDNR in advance of stranded mussel relocation efforts. This

presentation will walk through our use of historical mussel data from the Victoria Powerhouse site from a prior drawdown, methods used to address stranded aquatic biota and mussels, and results for both sites. GEI found and relocated Flutedshell (*Lasmigona costata*), a state listed Species of Concern. It is GEI's understanding this observation represents the first reporting to the state agencies for this species in this county. Recommendations for future stranded aquatic biota work in these downstream situations will be presented.

10:40am

Applications of genomic tools to lake trout management in the Great Lakes – and beyond

Kim Scribner, Seth Smith, Gordon Luikart

We describe recently developed resources including an annotated genome and high-density linkage map that will advance a new generation of genomic research on Lake Trout (*Salvelinus namaycush*) in the Great Lakes and across North America. We used these resources to address two primary goals. First, we investigated the genetic basis for lake trout phenotypic variation across Lake Superior and identified factors that contributed to genetic homogenization among Lake Superior ecomorphotypes. Ecophenotypic differentiation was shown to be associated with genes within regions putatively associated with chromosome inversions, potentially including associations with selection on proteins involved with highly conserved cell signaling pathways and genes associated with physiological function. Hybridization between ecomorphotypes increased substantially between the 1960s and 1990s. Loss of genetic diversity and phenotypic differentiation associated with different morphotypes was attributed to introgression between leans and humpers and siscowet and humpers. Secondly, we assessed the genetic basis for differential recruitment and survival of wild individuals from different hatchery strains stocked into Lake Huron. Evidence for the re-emergence of natural recruitment has recently been observed. We found evidence of elevated fitness of the Seneca Lake hatchery strain is likely attributable to adaptive genetic variation in several genomic regions. Wild fish of Great Lakes strain origin also carried putatively-adaptive alleles at some loci. Based on gene annotation, chromosomal regions with divergent allele frequencies (Seneca relative to other hatchery strains) were associated with genes identified in other fishes as being tied to swimming behavior and vascular wound healing, suggesting that fitness variation among hatchery strains may be attributed to differences in ability to avoid and survive Sea Lamprey (*Petromyzon marinus*) predation. Collectively, results demonstrate that re-establishment of viable, productive, and diverse populations of Great Lakes lake trout can benefit from understanding the genetic basis of adaptive trait variation in changing lake environments.

12:00pm - LUNCH

1:00pm

***Habitat Suitability for juvenile lake sturgeon in the Grand River**

Ben Gunnett, Eric Snyder, Marty Holtgren, Stephanie Ogren, Bill Flanagan

Lake Sturgeon (*Acipenser fulvescens*) are a State-threatened species in Michigan and have become a focus for conservation. The Lower Grand River is home to a remnant population of sturgeon between the 6th Street dam in downtown Grand Rapids and Lake Michigan. There has been limited research on juvenile lake sturgeon habitat use in low-gradient and more turbid rivers. To address this information deficit, we are developing a Habitat Suitability Index (HSI) for juvenile age 0+ lake sturgeon. An HSI combines parameters to display habitats on a scale of 0-1, 0 being poor habitat and 1 being good habitat. Parameters important to juvenile lake sturgeon include, but are not limited to, depth, velocity and substrate. A side scan sonar unit has been used to

obtain depth and substrate and an Acoustic Doppler Current Profiler (ADCP) is being used to obtain three-dimensional velocity data. The software package "PINGMapper" is being used for side-scan data processing, while "Hypack" is being used for ADCP data processing. The geometric mean of the parameters will be taken to determine a combined HSI value for each portion of the river. To obtain proof of natural reproduction in the river and to test model predictions, we conducted fall nighttime visual surveys to find and capture feeding juveniles. Once captured, fish were measured for total length, a fin clip was taken for genetic analyses, and a passive integrated transponder implanted. Sites for visual surveying were predetermined based on visibility (e.g., relatively shallow) and matched known habitat preferences for juvenile lake sturgeon. In the fall of 2022, we captured four age-0+ and one age-1+ sturgeon (two additional fish were spotted but not captured), documenting for the first time that lake sturgeon are successfully rearing in the Lower Grand River.

1:20pm

***Potential tradeoff between maximizing catchability and total removals of rare, heterogeneously distributed invasive fishes**

Rob D. Hunter, Lucas R. Nathan, John M. Dettmers, Song S. Qian, Eric Weimer, Bob Mapes, Ryan T. Young, Chris Kemp, Chris Mayer

Controlling the numbers and spread of invasive fishes often prioritizes methods that maximize catchability. High catchability is assumed to increase removals. However, tradeoffs may exist between efficiency (e.g., catch per hour) and catchability when 1) bycatch is high, 2) captures are spatially and temporally heterogeneous, and 3) target species are relatively rare. Current control methods for Grass Carp (*Ctenopharyngodon idella*) in western Lake Erie are based on methods used in Midwestern rivers with abundant invasive carps along with information on catchability and capture numbers of common surrogate species in Lake Erie. The original control-method recommendation included trammel nets combined with electro-fishing. However, the surrogate species used to develop the method are highly abundant compared to Grass Carp, and surrogates comprise the majority of bycatch. Field crews observed that removing bycatch from trammel nets limited the number of removal attempts completed each day. We hypothesized that time spent removing bycatch may offset any increase in catchability gained while using trammel nets, thereby reducing per-hour grass carp removal efficiency. To quantify efficiency differences between the combined method and electrofishing alone, we compared the number of Grass Carp captured per boat hour while accounting for spatial and temporal structuring in month, year, and sampling location. Grass Carp capture efficiency declined by 4.5 times overall when trammel nets were used. The combined method was less efficient than electrofishing alone regardless of when or where control efforts occurred, but accounting for structuring in capture trends identified additional opportunities to improve efficiency through informed effort allocations. Efficiency and total removals may be increased by limiting trammel net use and focusing effort on high-probability capture locations. Results suggest that preferred removal methods likely depend on the invasion state and may change as management actions alter the target species' abundance or behavior.

1:40pm

***Prioritizing streams for Arctic Grayling reintroduction: implications for the Boardman-Ottaway River**

Nick Vander Stelt, Carl Ruetz III, Dan Mays, Brett Fessell, Cameron Goble

Arctic Grayling (*Thymallus arcticus*) was extirpated from Michigan due to overharvest, habitat degradation, and introduction of non-native trout. Past attempts to re-establish the species in Michigan have thus far been unsuccessful. Successful Arctic Grayling reintroduction efforts in Montana have sparked interest to try to restore Arctic Grayling populations in Michigan. We assessed eight tributaries of the Boardman-Ottaway River as a part of a larger effort to support Arctic Grayling reintroduction. Our objectives were to: (1) assess habitat

suitability for Arctic Grayling in tributaries of the Boardman-Ottaway River, and (2) identify stream reaches where the existing fish assemblage would likely support the re-establishment of naturally reproducing Arctic Grayling. Average daily stream temperatures were below thermal maxima for Arctic Grayling at all survey sites and below thermal optimum in July at 14 of 16 sites. Our results suggest that the Boardman-Ottaway River contains adequate habitat in the study area because 14 of 16 sites scored 70% or greater based on the habitat rating component developed for Arctic Grayling reintroduction efforts in Michigan. Although instream habitat is promising, Brown Trout were the dominant species throughout most of the study area, which may limit reintroduction success in those areas.

2:00pm

***How are state fisheries management agencies across the US adapting to climate change? Identifying opportunities to address knowledge gaps in Michigan**

Kyle J. Brumm, Gary Whelan, Dana M. Infante

The Michigan Department of Natural Resources – Fisheries Division (Division) is tasked with managing freshwater ecosystems and fishery resources throughout the state. One of the keys to effectively managing the state's resources lies in understanding how environmental stressors affect Michigan's freshwater ecosystems. Many stressors have been documented in Michigan, including agriculture, urbanization, the spread of invasive species, and the fragmentation of rivers and streams by dams – all of whose effects are expected to intensify with climate change. In addition to understanding the risks that climate change poses to Michigan's freshwater resources, the Division has shown a vested interest in identifying how operations can be adapted to optimize the effectiveness of management decisions in the face of a changing climate. In 2022, the Division's Climate Change Committee finalized a Climate Change Action Plan (CCAP) which outlines a series of goals, objectives, strategies, and actions intended, in part, to identify opportunities to address knowledge gaps and enhance considerations of climate change in policy, management, and operations decisions. A key strategy identified in this CCAP was the need to conduct a review of climate adaptation efforts undertaken by other organizations. In support of this effort, we have developed a survey to document climate adaptation measures being considered and/or implemented by state fisheries management agencies across the United States. We also seek to identify knowledge gaps that are preventing agency staff from adjusting management decisions and operations in response to climate change, along with a ranking of measures thought to be effective at overcoming those knowledge gaps. The information obtained from this survey will provide an opportunity to synthesize and learn from successes and failures experienced by other organizations, which will be used to support the Division's climate adaptation efforts.

2:20pm - BREAK

2:40pm

***Reproductive maturation and spawning in Lake Superior burbot (*Lota lota*) in riverine and lacustrine environments of Lake Superior.**

M.J. Woodworth, J.B.K. Leonard

Burbot (*Lota lota*) are a cryophilic freshwater fish native to many cold-water systems in the Northern Hemisphere. Burbot are endangered or extirpated in some regions of their native range due to habitat changes, climate change or over exploitation. A purported increasing recreational fishery matched with lack of management is leading to interest in Lake Superior burbot. To better understand overall population dynamics, it is important to characterize the life histories leading to the production of offspring. In this study we evaluated reproductive timing in riverine and lacustrine environments in southern Lake Superior and several

tributaries. Riverine samples were obtained using hoop nets in mid-winter. Lacustrine samples were collected using set lines as well as rod and reel on several Lake Superior embayment's during ice-cover season. Captured burbot were sampled for morphometric characteristics, screened for maturity status and tagged using a 70mm T-bar tags. Results suggest that burbot undergo a spawning migration into riverine environments with high proportions of sexually maturing individuals (87.8%). Annual catches remained relatively similar with the Chocoy River yielding 303 burbot during the 2022 season and 350 burbot in 2023. The Au Train River produced fewer fish with 28 burbot captured in 2022 and 61 in 2023. The riverine spawning migration occurs during January and February with the two study rivers having similar, but not identical run timing. Within each river system, peak timing was determined using oocyte maturation staging, which remained similar during the two study periods. However, not all burbot participated in riverine migration, with reproductively maturing burbot captured in lacustrine environments throughout the late winter months at least until early April. Lacustrine catches show a much lower frequency of sexually maturing individuals (27.5%). The occurrence of reproductively mature individuals during different times suggests temporal and behavioral reproductive isolation between river and lake populations.

3:00pm

***Developmental effects of asynchronous hatching in larval burbot**

Andrew J. Shapiro, Jill B.K. Leonard

Burbot (*Lota lota*) are a native fish to the Great Lakes that spawn in river and lacustrine environments. Burbot display asynchronous hatching with hatch dates spread out over several weeks. In aquaculture, this trait is overcome by increasing temperature just prior to hatching, but the ramifications of this trait are unclear for wild ichthyoplankton. To investigate hatching asynchrony, adult burbot were captured from two rivers on the southern Lake Superior watershed to collect gametes for fertilization into 1:1 male:female families. Families were kept in a laboratory setting at 3°C and imaged throughout their developmental period to track differences in the developmental rates among embryos. Upon hatching, larvae were separated by their hatch date and photographed at hatching and every two days thereafter. Differences in total length, yolk sac area, and yolk sac utilization rate were compared between hatch dates to determine if asynchronous hatching caused differences in morphology, stage, or growth of larvae. Larvae hatched earlier had shorter total lengths with larger yolk sacs than those hatched later in the period. Hatch date accounted for 76% of the variation in yolk sac size for larvae at hatch ($F=1345$, $df=1, 407$, $P<2.2e-16$). Larvae hatched earlier (0.02 mm/day) also had faster growth rates than larvae that hatched later (0.0085 mm/day) in the asynchronous hatching period. Early hatched larvae had better growth rates and longer total lengths after the 40-day observation period. Larvae from the Chocoy and Au Train Rivers will also be compared to determine how differences in population play a role in the development and survival of larval burbot. Our results suggest that asynchronous hatching results in substantial variability in initial larval morphology and growth rates in this species and that this may persist to the end of the larval stage, which may be relevant to larval success in varying environments.

3:20pm

***Assessing the trophic dynamics of the Lake Superior fish community**

Ariel N. Edwards, Shawn P. Sitar, Ashley H. Moerke, Jonathan P. Doubek, Brandon S. Gerig

The Lake Superior food web has undergone many changes in recent decades, including the rehabilitation of the native apex predator lake charr (*Salvelinus namaycush*) and the introduction of several nonnative species. The trophic linkages and ecological requirements of the entire fish community, including predators and prey fishes, has not been assessed on a whole-lake scale in over a decade. Here, we investigate the trophic

dynamics and energy pathways across multiple regions and habitat zones of Lake Superior. From April to October of 2021, a total of five predator, four large prey fish, and five small prey fish species were collected by region and length class during coordinated, standard sampling gillnet and bottom-trawl surveys. Collected species include lean and siscowet lake charr (*Salvelinus namaycush*), burbot (*Lota lota*), Pacific salmon (*Oncorhynchus* spp.), coregonines (*Coregonus* spp.), sculpins (*Cottus cognatus* and *Myoxocephalus thompsonii*), ninespine stickleback (*Pungitius pungitius*), trout-perch (*Percopsis omiscomaycus*), and rainbow smelt (*Osmerus mordax*). To assess current trophic linkages, gut contents were examined and biomass, count, and length were measured. We found a high degree of interconnectedness in the Lake Superior food web, with Mysis as a keystone diet item for the entire fish community. Lake Superior predators displayed regional variance and ontogenetic shifts in diet structure. Further, native lake charr had a more diverse diet than introduced salmonines, exhibiting a highly opportunistic feeding strategy. Conversely, prey fish diets were less diverse, primarily reliant on both Mysis and Diporeia, and were more likely to have a single dominant diet item. This study improves our understanding of the trophic dynamics of the Lake Superior fish community and provides a baseline for future food web monitoring in the lake.

3:40pm

Yellow Perch (*Perca flavescens*) Mortality Bottleneck Restricts Recruitment

April Simmons, Dr. David Fielder, Andrew Briggs

Historically Saginaw Bay, Lake Huron in North America sustained both an abundant Walleye and Yellow Perch population and fisheries. Walleye have recently recovered and now prey heavily on young Yellow Perch. Perch reproduce very well in Saginaw Bay but mortality between age-0 and age-1 averages 83% and has been as great as 99%. Lost from the bay is an annual influx of pelagic predators from the main basin of Lake Huron that were thought to offer a buffer on predation for Perch. Recently that was from invasive Alewives and historically from native Cisco. This predation mortality constitutes a bottleneck that is preventing recruitment to the local recreational and commercial fisheries. Both have greatly contracted and are virtually collapsed by historical standards. Attempts to bio-manipulate Walleye (liberalized harvest in hopes to reduce abundance) to benefit Perch has largely failed. Cisco reintroduction in the bay is taking place, hoped as a long-term solution. Yellow Perch availability is a major driver of recreational fishing participation in the bay. A new management plan is in development with stakeholder involvement. Consultation indicates that Perch restoration remains a high priority, but the problem seems to defy any easy solutions. What few perch do survive, grow very fast helping to compensate some for the loss of abundance.

4:00pm

Detroit to Niagara: Lake Erie CSMI Nearshore Larval Fish Communities

Robin DeBruyne, Stacy Provo, Stacey Ireland, Nathan Hudak, Haley Vanscoyoc, Zachary Amidon, James Watkins, Dimitry Gorsky, Edward Roseman

Examination of fish early-life history stage fishes use can provide information about habitat quality and recruitment of resident and transient fishes. In 2019, as part of the Lake Erie Cooperative Science and Monitoring Initiative, we conducted a lake-wide assessment of the ichthyoplankton community in U.S. nearshore waters and international offshore waters from the USEPA R/V Lake Guardian. Ichthyoplankton were sampled weekly using bongo nets at ports along from the Detroit River and along the southern shore of Lake Erie to Dunkirk, NY, and less frequently in the Niagara River and offshore. The goal of this work was to characterize the larval fish community across the lake and assess species composition, phenology, and distribution of larvae. Larval fish were captured from April 10th to August 29th. The first taxa to emerge was

coregonines (mostly lake whitefish), followed by walleye, yellow perch, and white sucker, depending on port. Few fish were collected in the Niagara River and offshore sites. Cyprinids, Morone, and yellow perch were captured at all shore ports. Species richness was highest the western basin and at Cleveland, OH. Overall larval densities were lower in Fairport, OH and Dunkirk, NY, and higher in in the western basin sites, peaking in mid-June due to high catches of gizzard shad and Morone. Few studies of the ichthyoplankton community in the central and eastern basins of Lake Erie are available for comparison, but our densities and community composition were similar to previous surveys in 2000-2002, however, our 2019 survey did not contain round goby or alewife.

4:20pm - Break

Friday, 3/24/2023

Ballroom C

10:00am

The Cervid Health Cooperative Program: an alternative approach to sampling white-tailed deer for chronic wasting disease (CWD) in Michigan

Cameron Dole

Disease surveillance programs that detect outbreaks early can lead to more effective management responses. The Michigan Department of Natural Resources (MDNR) discovered the state's first positive case of chronic wasting disease (CWD) in white-tailed deer (*Odocoileus virginianus*) in May of 2015 and has continued intensive surveillance from that point on. CWD has remained a high priority for surveillance and management because it is a transmissible, untreatable, and fatal disease that affects cervid species across North America jeopardizing herd structure and sustainability. Hunter harvested animals are sent to the Wildlife Disease Lab in Lansing in quantities as large as 30,000+ animals annually, but despite these numbers, samples are biased towards younger deer. This affects the efficacy of CWD surveillance because older (> 1 year) deer, particularly bucks, are known to have higher rates of CWD transmission compared to other age-sex classes. It was suspected that these critical samples were not being submitted for testing because hunters desired to keep trophy animals for personal possession and display. Therefore, MDNR developed the Cervid Health Cooperator Program (CHCP) in 2018 as a partnership program with Michigan taxidermists. CHCP participation has increased every year and, in 2022, the lab processed 2,678 samples from taxidermists – 2,518 (94.0%) of which were male, 131 (4.9%) were female, with an average age of 2.65 years (range 6 months – 11.5 years). More than fifty percent of bucks submitted in 2022 were through the program. CHCP accounted for 34.8% of the total statewide hunter submissions in 2022. The CHCP also highlights how incentivization can be used to increase stakeholder participation, from 5 to 61 participants and a 752% increase in sample submissions from 2021 to 2022. This unique, collaborative program provides an alternative collection method to fulfill state disease surveillance goals, while aligning with the socio-cultural motivations of hunters in Michigan.

10:20am

CWD surveillance and coordination between tribes and state

Gael Sanchez

Chronic wasting disease (CWD) is a deadly transmissible spongiform encephalopathy (TSE) that affects cervids in North America (Jewell et al., 2005). Chronic wasting disease has proven to be one of the most efficiently transmitted TSEs due to high resistance to decay in the environment, and is currently the only TSE found in

free-ranging populations of animals (Wilson et al., 2009). Chronic wasting disease was discovered in free-ranging North American cervids in 1981 and has become a significant management concern in the following decades. This disease has spread throughout the country and was first detected in wild white-tailed deer (*Odocoileus virginianus*) within the Lower Peninsula of Michigan in May 2015 and then within the Upper Peninsula in October 2018 (Figure 1). The natural resources contained within the state of Michigan play a crucial role in the economic and cultural life of many tribal nations. These resources support commercial and subsistence fishing, hunting, and gathering along with recreational activities (such as sport fishing, canoeing, hiking, and bird watching). Widespread CWD within Michigan could be highly deleterious to tribal hunting of white-tailed deer and elk. Widespread surveillance is currently the best tactic to control the further spread and protect tribal citizens from this potentially harmful disease. This project has created coordinated CWD management between the Michigan tribes and the Michigan Department of Natural Resources (MI DNR) and provided testing for Michigan tribal citizens and the Biology departments. This project has created a recognized program between the tribes and MI DNR and supported management across the state. This presentation will outline this project and provide an update on testing.

10:40am

When your eyes see it, but your mind can't make sense of it: intensive culling to reduce abundance in a suburban deer population.

Dwayne Etter, Timothy Van Deelen, Yunyi Shen, Steven Gray, Gary Roloff, John Humphreys

Reducing deer abundance is often a goal for ecosystem management, to reduce localized damage, and for disease management. Harvest of antlerless deer is frequently emphasized with the assumption that removing females will reduce overall reproductive potential. However, demographic parameters that influence deer abundance (e.g., reproduction) are density-dependent. Thus, understanding how demographic parameters within a population respond to declining abundance is imperative to effect population change. From 1992 – 2008, we culled 3,951 deer (2,242 females) from a closed, 18.8 km² suburban deer population in Chicago, IL. We recorded biological data (e.g., age, sex, reproduction) from culled deer and assessed population change using multiple abundance measures. From an initial reconstructed population of 977, we culled 1,015 deer the first 3 years and the population grew to 1,168 deer. Successive annual culls of 57–73% of the population from 1995 – 1997, resulted in a 77% decline in abundance, and we maintained the population below 44% of initial abundance from 1998 – 2008. Our culling effort was countered by an inverse density-dependent response in reproduction without a time lag. As the population was reduced, from high to low density pregnancy rates of fawns increased 0.30, and fecundity increased 0.37 and 0.17 fetuses/yearling and adult, respectively. We developed an integrated population model based on a stochastic Leslie matrix projection, and approximated population change relative to shifting culling pressure to different age and sex classes of deer. When the population was near carrying-capacity (K), shifting culling pressure to antlerless deer had little effect on deer abundance. However, after the population was reduced to $<1/2 K$, small shifts in culling pressure towards antlerless deer had pronounced effects on abundance. Increasing harvest of antlerless deer with the intention of decreasing abundance requires knowledge of the populations position relative to K, and response of deer demographics relative to abundance.

11:00am

Navigating Human-Deer Interactions

Robert Keys

Increasing human/white-tailed deer interactions within urban, suburban and exurban environments continues to increase. Car-Deer collisions, foraging on landscaping, lack of flight response and the loss of forest

understory are impacting the way we look at human/deer contact. Over the last 15 years we have worked with governmental and non-profit organizations to help them assess white-tailed deer populations on their managed properties using infrared camera capture-recapture techniques and landscape analysis. While we continue to modify our practices, we discuss our experiences navigating some of this landscape and how we have approached helping these organizations and then open up discussion to the audience to share how others may have assessed their white-tailed deer residents and formed solutions to ever increasing deer populations.

11:20am – 12:00pm

MI TWS Open Office Hours
Executive Board Members

The MI TWS Executive Board will introduce our Code of Conduct during the TWS business meeting. Given time constraints at the business meeting, we are offering an “EBoard Office Hours” where people can stop in to provide Code of Conduct feedback or discuss any other MI TWS topics of interest.

Friday, 3/24/2023
Ballroom D

10:00am

Urban Trout with Some Clout
Cleyo Harris

Southeast Michigan is not known for its coldwater resources. In fact, only 0.5% of the streams and rivers in Michigan’s portion of the Lake Erie basin are identified as a coldwater resource. Paint Creek is one of those coldwater resources and it is found in the Clinton River watershed, the most populated watershed in the state. This urban stream is surrounded by development that brings with it a substantial variety of stakeholder demands and constraints for the stream. Paint Creek also supports one of the few naturally reproducing trout fisheries in southeast Michigan. The Michigan Department of Natural Resources stocks brown trout on an annual basis to supplement the limited natural reproduction and supports partners doing additional habitat work for stream enhancements. To help understand what impact these actions are having on the trout population and to help identify future actions, a fisheries survey targeting trout was completed in 2022 that can build off numerous previous surveys of Paint Creek. Information from this survey is valuable for continued discussions with stakeholders about recreational access or use, riparian development, stormwater control, fish passage and aquatic invasive species control. Paint Creek is commonly identified as a high value resource in the area and is used in many ways to provide outreach, education, and stakeholder engagement.

10:20am

Casual conversation to Cisco confirmation: Discovering an unknown resource in the Upper Shiawassee River Watershed

Jason Gostiaux, Mike Losey, Joe Nohner

We got Cisco in nets!!! These inland populations would have likely remained undetected if not for productive conversations and listening to our partners. In June 2020, DNR Fisheries was conducting a site visit at a dam in

Davisburg, Michigan to remove the structure. After the visit, we took the opportunity to tour the downstream Shiawassee Basin Preserve owned by Springfield Township and discussed the characteristics of several small kettle lakes in the preserve. We learned that the lakes had limited fisheries data but were intrigued to know more about these well-protected systems given the Upper Shiawassee River is known to host numerous state and federally listed fish, wildlife, and plant species. We immediately began planning to sample the lakes and learn more about this unknown resource. The opportunity to sample Long Lake and Rattalee Lake in the upper Shiawassee River watershed occurred September 2022. Undeveloped access, narrow littoral zones, and steep contours limited the types of gear to experimental and straight-run gill nets. We found typical species for the area, including a variety of panfish, Largemouth Bass, and Northern Pike. Surprisingly, we also captured Cisco in both systems. Cisco are listed as Threatened in Michigan with a long history of habitat degradation and local extirpation from nutrient pollution, warming water temperatures, and other factors. Discovering a previously unknown refuge for the species was a wonderful surprise. DNR Fisheries and Springfield Township have begun planning to rehabilitate and further protect these lakes' shorelines and watersheds. Identifying two more inland Cisco populations in Michigan will influence ongoing and future conservation to preserve a threatened species in a unique location. This discovery was made possible because each organization recognized that partnerships leverage the strengths and interests of each partner and working together can accomplish incredible things.

10:40am

Determining connectivity between the Boardman River, Grand Traverse Bay(s), and Lake Michigan proper in support of FishPass.

Reid Swanson, Daniel Zielinski, Darryl Hondorp, Aaron Fisk, Andrew Muir

Enhancing connectivity by barrier removal and developing fish passage solutions is a major initiative of fishery management agencies in the Great Lakes. The GLFC is leading the installation of FishPass – a developmental selective bi-directional fish passage facility on the Boardman (Ottaway) River in Traverse City, MI. Effects of enhanced connectivity on Great Lakes fishery production and ecosystem function are poorly understood. We hypothesize that enhanced connectivity between tributaries, bays, and lake basins, re-establishes ecosystem energy and nutrient cycles, thereby increasing fishery production. The question of how enhanced connectivity affects fishery production in the Great Lakes is much broader and long-term than can be addressed by a single research project; therefore, our research aims to use acoustic telemetry to establish a framework and specifically address how temporal abiotic variables influence spatial-temporal patterns of fish movement between tributary, bay, and lake basin. An improved understanding of tributary-bay-lake habitat coupling will not only aid in predicting the consequences of selective fish passage on the re-establishment of energy and nutrient pathways, but also provide practical data for FishPass, including a baseline of current movement rates to facilitate future assessment of restoration, and site-specific information on river entry cues and timing that will facilitate sorting of desirable and non-desirable species. Understanding the spatial and temporal dynamics of fish movement is prerequisite to a fulsome assessment of the energy and nutrient cycling hypothesis and ultimately understanding the implications of restoring full or partial connectivity in Great Lakes tributaries on fishery production. Herein, we present context on the FishPass project, share preliminary results from acoustic telemetry studies of 205 fish tagged in 2020-2022 (n= lake sturgeon=1, lake trout=28, rainbow trout=53, smallmouth bass=30, white sucker=50, longnose sucker=53), and outline future research plans.

11:00am

Aquatic macrophyte sampling methods

Dan Hayes, Jeremy Hartsock, Molly Engelman, Jo Latimore, Erick Elgin

Aquatic macrophytes are one of the dominant elements of lake habitat and have been sampled in a many ways to meet different goals and objectives. Various incarnations of sampling by throwing a rake have been developed, differing in the approaches to selection of sampling points and number of rake tosses. Neighboring states have adopted a single rake toss approach for macrophyte sampling, leading agencies in Michigan to evaluate the benefits of this approach to provide consistent data regionally. We implemented a two rake toss approach in 20 lakes that allowed us to compare the statistical properties of a one toss versus two toss sampling method. We show that a single rake toss approach underestimates true occurrence of aquatic macrophytes due to incomplete detection probability as shown in an occupancy analysis. We also show that a single rake toss approach yields similar estimates of species richness but requires more points to be sampled than a two rake toss approach. Our experience is that approximately 100 points could be sampled per day with a two rake toss approach, yielding observed species richness close to predicted richness, and providing reasonable precision of estimates of coverage for common species.

11:20am

Understanding Sources of Data Mismatch When Ground-Truthing Side-Scan Sonar Surveys

Jason Fischer, Robert Hunter, Ryan Trimbath, Justin Chiotti

Side-scan sonar provides a means to classify benthic habitat over large continuous stretches. Habitat classification based on the interpretation of sonar imagery, rather than direct observation, can result in classification inaccuracies. Therefore, ground-truthing data are needed to validate the accuracy of classifications derived from side-scan sonar imagery. However, the ability to reliably assess classification accuracy with ground-truthing data is dependent on the spatial accuracy of the side-scan sonar image projections and the ground-truthing data points. Additionally, spatial projection of side-scan sonar data relies on several assumptions, including the riverbed is flat and that the survey vessel is moving in a straight line parallel to the orientation of the sonar transducer. Positional and projection errors can result in a spatial mismatch between substrate classifications and ground-truthing data, that can give false impression of classification accuracy. We propose an approach that acknowledges the potential for spatial mismatch between recreational-grade side-scan sonar imagery and ground-truthing data. The approach creates a spatial buffer, equal to the GPS accuracy, around each ground-truthing data point to identify the area most likely containing the true location of a ground-truthing datum. The buffered area can then guide accuracy assessments in several ways, such as comparing ground-truthing data to the dominant habitat type in the buffer or limiting assessments to locations where there is a high-degree of confidence that habitat patches and ground-truthing data overlap. Although, this approach introduces opportunities for subjectivity, they can be minimized by determining and documenting how ground-truthing data will be used prior to accuracy assessments. We present this method to elicit discussion of improvements to reduce subjectivity and develop a broadly accepted method to acknowledge and communicate the role of spatial inaccuracies when considering multiple sources of error from imperfect remote sensing data.

Poster Presentations

Thursday, 3/23/2023

Bellaire Ballroom

7:30 - 9:00 pm

Topic: Fisheries

Early-season succession of zooplankton in the North Channel of Lake Huron

Simon D.D. Freeman, Cory O. Brant, Jonathan P. Doubek, Kevin L. Kapuscinski, Ralph W. Tingley

Zooplankton are a critical food source for age-0 fishes in the Great Lakes during their first several months of life in beach (defined here as ≤ 1 m depth) and nearshore (defined here as 1-15 m depth) habitats after ice-off. However, the phenology of zooplankton in Great Lakes beach and nearshore habitats is largely unknown, as sampling for zooplankton typically occurs in the pelagic zone and not throughout the year. Further, increased consumption of phytoplankton by invasive dreissenid mussels has decreased the amount of zooplankton available (i.e., food quantity) and altered the species composition (i.e., food quality). The North Channel is an area of Lake Huron thought to be less impacted by dreissenid mussels and offer increased protection from the wind and currents that affect the main lake basin. To better understand the early season succession of zooplankton, we sampled from late April through late July on beaches and in nearshore zones in the North Channel, as well as along the southwest shore of Lake Huron. Preliminary observations reveal high densities of zooplankton, particularly of cladoceran taxa, just after ice-off in the North Channel. Future directions include processing the zooplankton samples from the southwest shore of Lake Huron and comparing the seasonal succession, density, biomass, and community composition of zooplankton in the North Channel to southern Lake Huron to determine if differences exist spatially and temporally. Understanding the seasonal succession of zooplankton in shallower waters is important, as mismatches in the timing of larval fish production and their food resources may help explain recruitment variability.

Identifying and characterizing coregonine spawning habitat in Lake Erie

Christopher Bucher, Emily Eberly, Zach Amidon, Justin Chiotti, Robin DeBruyne, Lauren Eaton, Jason Fischer, Dmitry Gorsky, Greg Kennedy, Chris Mayer, Pippa Kohn, Stacy Provo, Ed Roseman, John Deller, James Markham

Historically, Lake Erie supported a successful commercial fishery with large catches of Lake Whitefish and Cisco (*Coregonus* spp.). Both species' populations crashed in the early to mid 1900s due to overfishing, habitat degradation, and anthropogenic alterations. Cisco were considered extirpated from Lake Erie and Lake Whitefish catch rates became low and variable. Identifying and characterizing coregonine spawning habitat will improve our understanding of various factors limiting recruitment and enhance restoration efforts occurring in the basin. Recent collections of coregonine sac fry larvae in the central and eastern basins and Lake Whitefish eggs in the western basin suggest viable spawning locations exist in all three basins, but further field sampling is necessary to provide more insight into habitat use and factors influencing egg and larval survival. To identify these important spawning locations, historic and predicted spawning areas were sampled along the southern shore of the central and eastern basins of Lake Erie during fall 2021 using egg mats and egg pumps. Eggs pumps were towed for 2-5 minutes, with three tows per site. Lake Whitefish and Lake Trout eggs were found at the Lorain, Fairport, and Barcelona/Shorehaven reef sites beginning in late November and persisting through December when ice conditions prevented further sampling. Eggs were found over hard substrates at site depths ranging from 3 to 7 m. Additional assessments in 2022 will detail substrate habitat characteristics of all sampled sites and continue to determine spawning habitat use of Lake Whitefish in Lake Erie.

Lake Sturgeon Early Life History Sampling in the St. Marys River

Riley Ralph, Savannah Blower, Robin DeBruyne, Dustin Bowser, Matt Angelosanto, Nathan Hudak, Nell McGuan, Emily Eberly, Stacy Provo, Haley VanScoyoc, Jason Fischer, Justin Chiotti, Ed Roseman

The St. Marys River is a Great Lakes connecting waterway that flows from Lake Superior to Lake Huron and has been designated as an Area of Concern due to the negative impacts of dredging and urban development. Restoration efforts to improve degraded habitats have been completed in this system and monitoring for rare, threatened, or endangered species, specifically lake sturgeon (*Acipenser fulvescens*) has been done in recent years. Rocky substrate areas in the tailrace of a US powerplant near Sault Ste. Marie, MI, were sampled in 2018 and 2019 confirming lake sturgeon spawning and larval drift. Our objective in this study was to expand egg and larval sampling to other potential lake sturgeon spawning habitats within the river, specifically an area known as Rock Cut, about 30 kilometers downstream of the tailrace. Egg mat and larval D-frame sampling occurred from late June through late July in 2022. Four egg mats were set around the Rock Cut and three more in the tailrace to serve as a control. Four D-frame nets were set downstream of the Rock Cut. In 2022, lake sturgeon eggs were collected in the tailrace, but not in the Rock Cut. There were 40 individual overnight D-frame sets that collected 503 larval fish, most of which were identified as rainbow smelt (*Osmerus mordax*), but no larval lake sturgeon were detected. We identified four new areas within the river that meet the physical habitat needs for lake sturgeon spawning to be sampled in subsequent years. The tailrace continues to be a spawning location for lake sturgeon in the St. Marys River, and future evaluation of habitats that meet lake sturgeon spawning requirements could identify additional areas for spawning and nursery habitat improvements.

Gear Efficiency and Distribution of Eurasian Ruffe in Northern Green Bay, Lake Michigan

Dalton Hendricks, Matthew Petasek, Cari-Ann Hayer, Troy Zorn

Since their introduction to the Laurentian Great Lakes in the mid 1980's, Eurasian Ruffe (*Gymnocephalus cernuus*) have spread and become abundant in Lake Superior. Ruffe were first detected in the St. Louis estuary in Lake Superior where their population rapidly increased, and they spread out to various parts of the lake. However, since being first documented in Little Bay de Noc in northern Green Bay, Lake Michigan in 2004, the Ruffe population has remained isolated, yet self-sustaining. Since 2017, surveys have shown Ruffe catches in Little Bay de Noc continue to increase dramatically. This study was implemented to determine the most efficient gear and to determine if Ruffe have or are spreading beyond Bay de Noc because of higher population densities. To understand how to detect ruffe, several gears, including experimental gill nets and Windermere traps, were used at known hotspot ruffe locations (based on a long-term dataset from Michigan DNR dating back to 2004) within Little Bay de Noc during May and June 2022. Gill nets detected ruffe ranging from 67 mm – 143 mm and CPUE was 29.2 in May and 3.2 in June; and Windermere traps did not detect any Ruffe. Ruffe comprised 22% of total catch in 2022 gillnets. Our results indicate that we can detect Ruffe of all size class with gill nets. In 2023, we will continue to sample Little Bay de Noc to examine population dynamics but also sample outside this area to document potential spread.

Quantitative ecology of brook trout in a Michigan stream over a 55-year period

Andrew Nuhfer, Gaylord Alexander

Long-term monitoring data sets provide the foundation for understanding population dynamics and modeling population response to change. Long-term data on stream trout populations are useful for quantifying population-level processes (survival, growth, etc.), providing baseline estimates of mean and variation, and depicting temporal trends. Annual sampling of brook trout between 1949 and 2004 in a reach of Hunt Creek, Michigan represents one of the longest quantitative population records for a vertebrate species. The brook

trout population, recreationally fished during 1950-1965 and closed to fishing since, was sampled annually via electrofishing to generate population estimates. The age-specific estimates of fish density, annual survival, and growth provided baseline data for Hunt Creek and experimental “control” values for comparison with similar data nearby reaches subjected to various experimental treatments. Using this dataset, we quantify long-term mean and variation in these parameters for brook trout and explore relationships among them. This effort provides information useful to anglers, fishery managers and researchers, and enables dissemination of a rare, long-term dataset to the scientific community.

Larval Fish Export in Response to Varying Compensating Gate Discharge at the Sault Rapids, St. Marys River

Signe VanDrunen, Mark DuFour, Edward Roseman, Robin DeBruyne, Kevin McDonnell, Brandon Gerig

The St. Marys River (SMR) forms the border between Michigan, USA and Ontario, Canada connecting lakes Superior and Huron. Discharge is controlled by a compensating gate system upstream of the SMR rapids. Because spring and summer discharge fluctuates widely, resource managers required information on how flow variability influences larval fish drift. We estimated annual larval fish export in relation to variable discharge during 2018-2021 and compared results to published habitat model predictions. Mean discharge and water temperature were lowest in 2021 and highest in 2019. Water warming rates during high discharge differed from low discharge trends. Across years, we identified 10 families and 14 species of fish larvae drifting from the rapids. During our study, larval rainbow smelt (*Osmerus mordax*) densities were best explained by water temperature, discharge, and year of sampling while non-smelt densities were best explained by year of sampling and water temperature. Using a Bayesian state-space model, we estimated rainbow smelt larvae exceeded 30% of total export. Observed catch composition differed from previously published hydrodynamic models suggesting that modeled species did not spawn in the rapids. However, our catch composition was similar to prior river-wide studies conducted in the 1980s and 1990s. Future research on SMR larval fish export should be expanded to increase river coverage to identify spawning habitats for sensitive species included in the hydrodynamic model and of concern to resource managers.

Bluespotted salamander migration at Marquette’s Presque Isle Park: Preliminary Findings Gathered Through Citizen Science

A.J. Hill, L. Childs, J.B.K. Leonard

Bluespotted salamanders (*Ambystoma laterale*) are a common amphibian found in northeastern North America, including the Great Lakes. The species is known for its annual springtime migration where individuals of both sexes emerge from underground, often navigating snow, to move to nearby wetlands to breed. In Marquette, MI, a population of *A. laterale* occurs on Presque Isle Park and makes annual migrations across a park road. Early work showed substantial vehicle mortality which led to a springtime road closure. Since that time, the migration has become a focal point for the community, which in turn has attracted nationwide attention. In this poster, we present preliminary information on the timing of the reproductive migration based on a Citizen Science project where the public conducts field counts of animals during the migration. The data characterize the evening onset of migration and help define the environmental conditions during which the salamanders migrate. Spring 2022 data also suggests that the *A. laterale* migration is more extended than previously suggested. Interestingly, the data also describes the public visitorship to the migration site. Future plans include establishment of a parallel data collection program with NMU students, inclusion of camera trapping, and assessment of differences in migratory timing between *A. laterale* and their unisexual hybrid species (*A. laterale* x *A. jeffersonianum*) that co-occur in this population.

Developmental staging of maturing oocytes, embryos, and larvae of Lake Superior burbot at pseudonatural temperatures

A.J. Shapiro, M.K. Woodworth, A.K. Pupo, J.B.K. Leonard

Burbot, *Lota lota*, is a piscivore native to the Laurentian Great Lakes and northern latitudes globally. The species is the sole freshwater member of the marine-origin Gadiformes and employs very small, ichthyoplanktonic embryos and larvae. The fish is a cold-water specialist and little is understood about how it combined mid-winter spawning and with prolonged early life stages in Lake Superior. In this presentation, we give an overview of stages of oocyte maturation, embryonic development, and the post-hatching larval stages in samples gathered from wild Lake Superior burbot. Samples were collected via oocyte catheterization and embryonic families reared in our laboratory. Results show an extended oocyte maturation period accompanied by growth in size, begun in the fall prior to mid-winter spawning, with a short, final maturation phase culminating in a short window for spawning. Oocytes at maturity (1.0 ± 0.05 mm diameter) are clear and have a single, large oil droplet. Following fertilization, initial development at 30°C is rapid with embryos reaching the 16 cell stage by 36 hours post fertilization. Gastrulation occurs from 8 to 9 days post fertilization (dpf). Bud stage occurred after folding-over at 10 dpf. Eyes become pigmented at 24-27 dpf and the neuromasts of the lateral line form near hatching. Under natural temperature conditions, hatching is asynchronous with families taking as many as 26 days to hatch. Swim bladder inflation can begin as early as 15 dpf. The yolk sac is fully absorbed at approximately 85 dpf. It is important to note that extensive asynchronous hatching combined with the long embryonic period introduces substantial intra-individual variability in development, even within a genetic family. Our work has allowed characterization of the developmental changes in the earliest life stages of this species, which provides a scaffold for future work on ecology and early life history variation in this unusual species.

Identifying coasters: stable isotopes provide evidence of lake to stream movements by individual brook trout

Troy Zorn, Brandon Gerig

Coaster brook trout exhibit a migratory life history which includes a period of lake residence. Coaster brook trout populations had declined by the 1860's along portions of the Michigan shore of Lake Superior due to overfishing, with declines further exacerbated by habitat degradation and introduced species. Rehabilitation of the coaster life history is highly desired by managers, but these factors combined with a lack of understanding of coaster ecology continue to hamper restoration efforts. Managers lack an ability to document occurrence of coaster populations because large brook trout are rarely encountered in surveys and documenting migratory behavior typically requires intensive, multi-year tagging studies or lethal otolith-based analyses. Our objective was to determine if stable isotope signatures (SIS) of fin clips from stream-captured brook trout could be used to identify prior lake-based foraging, hence residency. As a proof of concept, we compared SIS of stream captured juvenile and adult coho salmon, a species with known periods of stream and lake residency. SIS of Lake Superior captured char provided lake-based SIS for comparison with those of stream-captured brook trout. SIS of brook trout from the Pilgrim River (known to host coasters) were examined to determine if distinct SIS changes were associated with increased size, a potential correlate of lake residency and foraging. Our findings provide support for use of SIS as a non-lethal technique for confirming prior Lake Superior foraging and associated migrations by stream-captured brook trout.

***Restoring lateral connectivity to a Muskegon River wetland**

Ashley S. Fleser, Carl R. Ruetz III

Freshwater resources are under increasing stress from human activities. Great Lakes coastal wetlands provide habitat, support biodiversity and supply critical ecosystem services. These wetlands are particularly vulnerable to human activities such as agriculture and land development. Therefore, coastal wetlands have become increasingly targeted for restoration activities. Recent research indicates a need for more rigorous monitoring and evaluation of restoration efforts. In this study, we sampled fishes and water quality before and after restoration of a wetland associated with the lower Muskegon River near Muskegon, Michigan. The restoration site was a diked wetland celery field. The purpose of the restoration was to restore the hydrologic connection between the river and the wetland, restoring lateral connectivity. Preliminary results indicate a marked shift in fish assemblage that is consistent with improved water quality. Thus, we found evidence that restoring lateral river connectivity and enhancing habitat improved the ecological health of a riverine wetland.

***Temporal Effects of Preservation on the Shape and Size of Yellow Perch**

Jacob Yingling, Tyler Hoyt, Carl Ruetz

Preservation of fish often involves fixation in formalin followed by preservation in ethanol. This preservation technique can alter the size and shape of specimens, although the effects are often species specific. We evaluated the temporal effects of preservation on the body size and shape of adult Yellow Perch (*Perca flavescens*). To collect specimens, we sampled 42 Yellow Perch from three drowned river mouth lakes (White Lake, Lake Macatawa, and Arcadia Lake). Upon capture, fish were transported to the laboratory, fixed in formalin, and then preserved in ethanol. Measurements (length, mass, and photograph to analyze shape) were made on fresh fish (i.e., prior to preservation) and 3 and 6 weeks after being preserved. Shape was analyzed using geometric morphometrics. Preliminary results suggested the effects of preservation on the shape and size were complex, although we found evidence that shape changed with preservation. Thus, we recommend the conservative approach of only comparing shape among Yellow Perch that have been preserved, at least initially, for the same amount of time.

***Fish Assemblage Structure in Great Lakes Coastal Wetlands**

Matthew S. Silverhart, Carl R. Ruetz III, Matthew J. Cooper, Donald G. Uzarski

Coastal wetlands in the Great Lakes are important habitats for many fishes. The geographic scale and diversity of land uses in the region result in substantial environmental variation among coastal wetlands. Annual surveys were conducted as part of the Great Lakes Coastal Wetland Monitoring Program (GLCWMP) to better understand wetland condition across the basin. Fyke nets were used to sample fish in 1,224 unique monodominant vegetation zones during 2011-2020. A total of 588,709 fish were captured, representing 109 different species. Yellow Perch (*Perca flavescens*) was the most abundant species in the catch (31%). Preliminary results suggested that basin, hydrogeomorphic type, monodominant vegetation type, and sampling year were each associated with variation in fish assemblages. For instance, fish assemblages in the more oligotrophic Lakes Michigan, Huron, and Superior appeared more similar to each other than the more eutrophic Lakes Erie and Ontario. Lacustrine and barrier protected wetlands had similar fish assemblages while riverine wetlands had less variation in community structure than the other wetland types. While we found large amounts of variation in fish assemblage structure in Great Lakes coastal wetlands, we identified patterns that can be used to further define how fish assemblages vary across the Great Lakes basin.

***Assessment of an Aquatic Remotely Operated Vehicle to Survey Fishes in an Inland Lake**

Elizabeth Belanger, Kevin Kapuscinski

Remotely operated vehicles (ROVs) provide means to explore new and challenging aquatic environments to collect data. Traditional fisheries sampling methods, such as electrofishing, trap nets, or seines, may induce excessive stress or injure handled fish. Additionally, these gears are selectively biased and cannot observe fish behaviors. The objectives of our study were to [1] assess the effectiveness of a tethered ROV as a method of locating and identifying fish in an inland lake, [2] compare presence/absence and relative abundance data collected with the ROV to data collected with traditional gear types, and [3] determine if fish observations were related to substrate type, depth, the month of sampling, or transect type (from shore or boat). A total of 32 50 m transects were established perpendicular to the shore in ≤ 9 m depth in Monocle Lake, Brimley, MI. Half of the transects were conducted in June and half in August, and within these time periods, half were conducted from shore and half from a boat. The transects followed the bottom contours of the lake, and the ROV recorded depth, temperature, substrate, and video that was later viewed for fish observations. Of the 32 transects surveyed, 38% observed fish, of which 48% of those fish were identifiable to family, 49% were identifiable to species, and 3% were unidentifiable. The total distance surveyed (factored for depth) resulted in 1,641 m within the 71.2 ha lake. The number of fish observed per meter of transect surveyed was 0.038 fish/m (analogous to catch per unit effort). The species composition observed using the ROV differed from that sampled with trap nets during the same month, indicating a potential difference in sampling biases associated with the two gears. For example, 78% of fish collected in trap nets found were Rock Bass, and no Rock Bass were found using the ROV. The frequency of fish observations in transects with a vegetated substrate was greater than in transects that consisted predominantly of mud, rock-gravel, sand, or mixed substrates. Fish sightings were not related to depth, the month of sampling, or the transect type. Further research is needed to determine the selectivity bias of ROVs compared to other samples.

***Temporal Patterns of Profundal Fish Assemblages in Lake Michigan Drowned River Mouths**

Tyler Hoyt, Dr. Carl R. Ruetz III

Drowned river mouth (DRM) lakes are productive habitats within the Lake Michigan ecosystem. Despite this, winter fish assemblages in the profundal zone of DRM lakes are largely unexplored. We evaluated the temporal patterns of winter fish assemblages in the profundal zone of four DRM lakes along eastern Lake Michigan. From late October to January, we used gill nets to sample 1,215 fish comprised of 21 species. We show that during winter, the profundal zone is inhabited by a diverse array of fish species. The catch of these species often varied greatly over time. We observed four main patterns: increasing catch over time (eg., Yellow Perch *Perca flavescens* in Lake Macatawa, decreasing catch over time (eg., Lake Trout *Salvelinus namaycush* in Pere Marquette Lake), minimal change over time (eg., Lake Sturgeon *Acipenser fulvescens* in Muskegon Lake), or no clear pattern (eg., Freshwater Drum *Aplodinotus grunniens* in Muskegon Lake). Additionally, some patterns were shared across multiple lakes while others differed. Catch of species such as Yellow Perch increased over time across all DRM lakes, while Northern Pike *Esox lucius* increased in abundance in Pere Marquette Lake while decreasing in abundance in Pentwater Lake. We conclude that winter fish assemblages inhabiting the profundal zone of DRM lakes likely vary temporally during the winter, which has important implications for habitat use.

Preliminary assessments of phylogeography and habitat patterns for the imperiled Slippershell mussel, *Alasmidonta viridis

Gabrielle E. Sanfilippo, Kentaro Inoue, David T. Zanatta

Slippershell, *Alasmidonta viridis*, is a regionally imperiled freshwater mussel species native to headwaters and small tributaries of the Great Lakes and Mississippi River systems. The species has experienced apparent

population declines likely attributed to range-wide anthropogenic disturbances. Basic biology and ecology of the species remain largely undocumented because the species is small-bodied and therefore difficult to detect in traditional surveys. Species taxonomy, phylogeography, and ecological niche at micro-habitat and landscape scales are understudied. Targeted surveys were conducted in 2022 at sites of Slippershell observations recorded between 1926 and 2017 in Michigan. Live individuals (n=93) were found at 7 sites of the 27 sites surveyed and genetic swabs were collected for further population genomic analysis. Quadrat searches (1 m²) were performed at the location of each live individual observation to record sediment composition, stream flow, depth, and co-occurring mussel species. Quadrat-specific stream variables did not significantly describe the differences between sites where Slippershell were observed. Ordination and regression will be used to quantify differences in land cover, average sediment grain size, surficial geology, and impervious surface cover between sites where Slippershell were detected versus not detected. Landscape analyses will quantify differences across three different scales: HUC-12 watersheds, 100 m stream buffers, and 1 km upstream reaches from surveyed sites. Furthermore, genetic results will be used to describe possible patterns in genetic diversity and differentiation among populations in the Great Lakes, Interior Highlands, Mississippi River, Ohio River, and Tennessee/Cumberland River watersheds. Detailed descriptions of Slippershell distribution, phylogeography and population genetics, and current habitat use are important for proper conservation and status assessment of the species, especially in the face of human-induced habitat change.

Determining Threshold Level and Sensitivity of eDNA Testing for the Freshwater Invasive Species, *Didymosphenia geminata

Raven S. McKechnie, Ashley H. Moerke, Shawnee R. McMillian, Britton D. Ranson Olson

Didymosphenia geminata (Didymo), an invasive diatom that forms thick mats and can cause ecological and economic damage, was recently detected in Michigan waters. The main method of control against Didymo currently is through the prevention of continued spread. eDNA is a novel approach to detect Didymo early, but it lacks guidelines for sampling and extraction methods. It also is unclear how the varying characteristics of the waterbody, the concentration of Didymo populations, and the distance of Didymo from the sampling site can affect the results of eDNA, and therefore the ability to accurately detect Didymo. The objective of my research project is to quantify the detection threshold level and sensitivity of eDNA methods to improve early detection of Didymo in Michigan waters. To achieve this, water samples were taken at varying distances from a stream with a known Didymo infestation to test the sensitivity of the eDNA technology and when the “signal” can no longer be detected. Preliminary results indicate that the eDNA concentration of Didymo is highest at the source of infestation, diminishing with increasing distance from the infestation source. These findings will help improve interpretation of eDNA data for Didymo, as well as inform sampling guidelines for using eDNA to effectively monitor Didymo in river systems.

***Evaluating survival of surrogate fish species using multiple incubators: Continuing efforts towards reintroducing Arctic Grayling (*Thymallus arcticus*) into Michigan Streams**

Josh Mutchler, T.G. Zorn, B.S. Gerig

The Arctic grayling was extirpated from the northern streams of the Lower Peninsula of Michigan in the 1930's. Over the past century several attempts to reintroduce grayling to Lower Michigan have been unsuccessful due to poor habitat quality, predation, overharvest, and failed stocking attempts. More recently, Arctic Grayling have been successfully reintroduced to the Upper Missouri River Basin of Montana using an experimental stream side rearing device known as a Remote Site Incubator (RSI). Although the RSI operates efficiently in high gradient streams of Montana, RSI performance in Lower Michigan streams are subject to low flow, sediment accumulation, and require significant effort for deployment. As such, the Michigan DNR as part of the Michigan Arctic Grayling Initiative proposed an alternative instream rearing device described as a Floating Basket Incubator (FBI). In this study, we tested the efficiency between RSI's and FBI's in both stream

and hatchery environments by determining the percent of survival for three Arctic grayling surrogate species: Steelhead (*Oncorhynchus mykiss*), Brook Trout (*Salvelinus fontinalis*) and Walleye (*Sander vitreus*). Our goal is to determine which incubator will be most suitable for raising Arctic Grayling based on percent survival of surrogate species. Preliminary results suggest that hatch percent of Steelhead was significantly different between incubator types at Thompson State Fish Hatchery, and was not significantly different at Cherry Creek. Hatch percent for Brook Trout in Cherry Creek was significantly higher in RSI's than FBI's, and at Marquette State Fish Hatchery hatch percent was significantly lower in RSI's than FBI's. Results suggest that hatch success is highly variable among surrogate species. Although FBI's have shown a higher proportion of hatch success for most trials, future experiments will provide more support for introduction methods of Arctic Grayling by fisheries managers.

***Oocyte maturation in Lake Superior burbot (*Lota lota*)**

M.J. Woodworth, J.B.K. Leonard

The Order Gadiformes is primarily composed of marine cods, but also includes a single, freshwater species, the burbot (*Lota lota*). Burbot have an extraordinarily large native circumglobal range that includes all of the Laurentian Great Lakes. Within the Great Lakes, burbot occupy a critical niche as a top predator and demonstrate several life histories linked to reproductive strategy. Understanding the development of a fertile oocyte and the environmental factors affecting maturation is a fundamental step towards understanding burbot reproduction, population dynamics and environmental resiliency. In this study we evaluated the final stages of oocyte maturation in wild-captured burbot. Burbot were captured from riverine and lacustrine environments of Lake Superior. Each fish was processed for morphometric characteristics and screened for oocyte development. Collected oocytes were characterized to maturation stage. Additionally, five maturing females were obtained from riverine environments and held under natural photoperiod and temperature to assess daily oocyte progression. Results from this study indicate that female burbot are reproductively "ripe" for a very short time period (12-24hrs) and an individual likely releases all oocytes in this short period. Additionally, burbot oocytes undergo significant hydration during the final stages of maturation, which we observed to be up to 0.01mm in diameter growth per day. Our findings highlight the long duration of female maturation which culminates in a short active reproductive period that can be characterized by oocyte morphology. This strategy emphasizes the importance of the reproductive timing and access to appropriate mates and spawning habitat for successful reproduction in this species.

***Using Unionids to Detect Contaminants In The Chippewa River, Mount Pleasant, MI, USA**

Alexis E Bruce, Marta J Springer, Hunter J Carrick, Daelyn A Woolnough

Unionids (family Unionidae) are filter feeding bivalves and likely filter contaminants found in riverine habitat. It is unknown how unionids adapt to changing environmental conditions including variable contaminants and habitats. Unionids in Michigan are experiencing population declines. This study focuses on unionids in the reach of the Chippewa River that flows through Mount Pleasant, Michigan. We know, from a 2015 study, that the dominant unionid species within the Chippewa River shifts from upstream (*Eurynia dilatata*) to downstream (*Actinonaias ligamentina*) and unquantified levels of contaminants in the river should be considered a potential reason for this shift. We performed short mussel surveys at five sites within the Chippewa River in September 2022 while concurrently collecting water, sediment, and algae for a larger study. From these data, a unionid species common at all five sites, *Actinonaias ligamentina* (Mucket), was chosen for contaminant analyses in the larger study. Catch per unit effort and community composition of unionids found at the sampling sites were analyzed, compared, and found to be variable (e.g., 0.05 to 0.27 live individuals per person hour). Also, many female *A. ligamentina* were gravid (i.e., fertilized larval stage), so viability tests were performed to determine the variation among individuals and sites; viability is the potential gravid mussels have to release larval stage offspring (i.e., glochidia) that can attach to host fish. Habitat, quantified as percent

sediment size class using the Wentworth Scale, was found to be variable across the five sampling sites and ranged from pebble and cobble dominated sites (e.g., 3 out of 5 sites with 70% or more pebble and cobble substrate combined) to sites dominated by sand and silt (e.g., one site had 80% sand and silt combined). These data can be used for unionid conservation in the Chippewa River and contribute to a larger contaminant study.

***Preliminary Comparison of Contaminants In Water, Sediment, And Mussel Tissue Upstream and Downstream an a Mid-Michigan River**

Marta J. Springer; Hunter J. Carrick, Daelyn A. Woolnough

Contaminants of emerging concern (CECs) include a range of chemicals that have been increasingly detected in natural systems and are of interest due to their potential influence on aquatic organisms. Chemical classes of pesticides, pharmaceuticals and personal care products, hormones, plasticizers, per- and polyfluoroalkyl substances, and industrial chemicals have been found in the Great Lakes Basin. Freshwater mussels are aquatic organisms exposed to CECs and due to their relatively sedentary nature, they can be used as environmental monitors for contaminants. Potential impacts of CECs on mussels are important to understand since mussels provide many ecosystem services and can comprise >50% of total benthic biomass. A 2015 study of the Chippewa River through Mount Pleasant, Michigan showed a shift in mussel assemblage diversity and density up to downstream of the city. Upstream diversity averaged 4.8 species, dominated by *Eurynia dilatata* to 6.9 species downstream dominated by *Actinonaias ligamentina*. Density averaged 26.5 to 105.2 live mussels per person hour up to downstream. The current study considers how CECs detected in water and sediment samples differ in an up to downstream gradient and whether CECs in mussel tissues exhibit the same trends. This poster will present previous findings on up to downstream mussel assemblages and limited CEC studies, compared to preliminary results of CECs in all matrices sampled. Future research will conduct surveys of mussel diversity and density in the Chippewa River and examine final results of CECs tested for presence in water, sediment, and mussel tissue as they relate to mussel assemblages. The results of this study will provide important baseline and comparative information on the trends of CECs found in these matrices in up to downstream gradients. Understanding which CECs are detected can help to guide future priorities on the effects these CECs may have on aquatic organisms and their communities.

***Unionid Movement and Assemblages in Transitional Areas Influenced by Dams**

Nicole Vellequette, David Zanatta, Daelyn Woolnough

Dams have been shown to contribute to declining biodiversity in freshwater resulting from loss of suitable of habitat and fragmentation. Water level fluctuations, sedimentation, and alteration of habitat by dams are hypothesized to negatively influence native mussel (unionid) assemblages. Unionids are an aquatic faunal group that provide ecosystem services and are sensitive to changes in their environment. Therefore, loss of species diversity and changes to unionid assemblages in transitional areas around dams requires further research. In central Michigan, a chain of several reservoir lakes is located along the Tittabawassee and Tobacco rivers, with unionid abundance and diversity varying by location in the system. This study will evaluate distribution and predictability of unionid assemblages in the lotic to lentic transitional zone upstream of Edenville Dam along the Tobacco River, which is known to support a diverse unionid assemblage. This transitional river reach exhibits a gradient of high to low unionid species richness and unionid density. In this reach, multiple live and many shells of the federally endangered *Epioblasma triquetra* (Snuffbox), have been found; shells indicate a previously larger population of Snuffbox in this reach. This study aims to better understand movement of unionids in water drawdown simulated conditions that occurs in reservoirs across North America via vivarium experiment. A summer 2023 field study and the corresponding experimental design will be presented as well as preliminary unionid survey data that initiated these questions. Results of these field and experimental studies could be used to understand unionid assemblages and their variability in reservoir transitional zones. The vivarium experiments will also allow for a finer understanding of unionid

movement and distribution during water drawdowns under controlled conditions. Together, assemblage predictions and movement data could be used in future management practices to conserve unionids in these complex transitional reaches around dams.

***Freshwater Mussel Habitat Modeling in GIS using Maximum Entropy Species Distribution**

Matthew Sawle, Dr. Hari Kandel, and Dr. Ashley Moerke

Hydropower facilities often perform planned and unplanned maintenance, which require the drawdowns that drain water from littoral areas and lead to high mortality of native freshwater mussels. Facilities are required to rescue and relocate any freshwater mussels that are found within the reservoir to avoid mortalities. The objective of this study is to develop a spatial model in ArcGIS to determine potential habitat of freshwater mussels in littoral areas of reservoirs.

We aim design a mussel habitat model in ArcGIS using input characteristics similar to a species distribution and environmental niche model, MaxEnt, that takes presence-only data and environmental variables to generate a relative occurrence rate. For this purpose, we have produced bathymetry of selected reservoirs using remote sensing (WorldView-3) imageries and collected littoral habitat data in the field over the past two years. We characterize mussel habitats by overlaying preferred depth, type of substrate material, (e.g., gravel, cobble), and dominant vegetation types on the shoreline guided by our observations. The data generated so far in Big Quinnesec, Hemlock Falls, and Chalk Hill reservoirs in Western Upper Peninsula of Michigan, suggest that the shoreline segments with cobble, gravel, and sand dominated substrate, minimal vegetation, and a depth range of 0.4-0.8 m (average depth 0.64 m) are the preferred habitat characteristics. Likewise, mussel species such as Wabash pigtoes appeared to be preferring habitat areas with heavy vegetation and silt which is different from that of Flute, Spike and Three Ridge mussels. This result offers us an important insight to ultimately design a spatial habitat prediction model in ArcGIS. Final habitat model will be visualized in ArcGIS against presence locations of mussels to rank the input habitat attributes.

***Freshwater mussel (Unionidae) populations in the St Marys River, 2010-2022**

Chris Wedding, Ashley Moerke, Anjanette Bowen

Native freshwater mussels (Unionidae) in Michigan are imperiled due to current and historical anthropogenic activities. Out of the 43 native mussel species in the state, 19 are considered endangered or threatened, which has led to growing focus on research and conservation of native mussels. The St. Marys River is a Great Lakes connecting channel, but despite being more intensively surveyed for fish, there are no extensive surveys on mussels to date. There have not been large amounts of invasive mussels (zebra and quagga mussels) recorded in the St. Marys, so it may be a haven for native mussels to thrive. The purpose of this study is to: 1) determine the distribution, diversity, and abundance of freshwater mussels in the St Marys River, 2) to see if there is a relationship between mussel distribution and river habitat (e.g., substrate, depth), and 3) to determine if mussel populations have changed over the last decade. Mussels were collected at over 30 locations along the St. Marys River from USFWS bottom trawls for fish. We worked in coordination with the Alpena USFWS, and joined them on their research vessel to identify freshwater mussels that were collected during these surveys. Additionally, we used data and photos from 2010-2011 surveys to identify and quantify historic mussel populations. During the surveys in 2010-2011 and 2022, only Giant Floater (*Pyganodon grandis*) was collected, along with invasive dreissenids. Although diversity was low in the river, most sampling was conducted in the main channel and additional sampling in nearshore areas may give managers a better picture of Unionid diversity in this important connecting channel and help identify locations for future conservation efforts in the river.

Topic: Wildlife

***The impact of time, temperature, and season on exurban deer movements**

Jacob Beke, Nhan Phan, Robert Keys

Exurban deer populations are constantly coming in contact with humans which can result in loss of landscape plants, and result in deer vehicle collisions. We investigated exurban deer movement based on their movements with temperature, time of day, and season. We used infrared triggered trail cameras set up in four random locations on game trails in an exurban park in Cascade Township, Michigan. Cameras collected data from 1 September to 31 December 2022. Pictures were examined for the number of deer in each picture using two examiners filtering for repeated pictures from the same cameras. Deer population numbers were determined using unique bucks from each of the three collection seasons and a Lincoln-Petersen population model. Time of day, season (pre-rut, rut, post-rut), and temperature were used as independent factors affecting deer movement and were analyzed using regression analysis and ANOVA. There was no significant effect on deer movement for time of day which was not expected because of the crepuscular nature of deer. In the same way there was no significant effect for season, with pre-rut, rut and post-rut showing similar movement trends. Temperature was the only variable that affected the movement of deer, with the peak movement around 7°C. This leads us to believe exurban deer may not have their movements influenced by the time of day or seasonality as deer in rural areas.

***Effects of urbanization and climate change on ranges of the common grackle (*Quiscalus quiscula*), Eastern meadowlark (*Sturnella magna*), red-headed woodpecker (*Melanerpes erythrocephalus*), and wood thrush (*Hylocichla mustelina*) in Michigan**

Alex Hamilton, Andrew Stauffer, William Miller, Robert Keys

Avian conservation research is expanding due to the loss of 3 billion birds in North America over the last several decades from threats including urbanization and climate change. Bird ranges shift in response to these factors, so we aimed to determine the extent of directional changes in the ranges of four native passerines over three distinct years across the state of Michigan. We used eBird observation data on sample species from 2011, 2016 and 2019 during the Breeding Bird Survey dates and compared it with USGS national land cover data to find mean centers for each bird's range. Shifts for each species were minimal and varied in direction, making it hard to make claims about the effects of urbanization and climate change on this small scale. The rapid expansion of eBird participation may impact the shifts observed. A longer study timeframe may yield more significant results.

***Dynamic occupancy modeling of Rallidae species in Great Lakes coastal wetlands**

Megan Casler, Thomas Gehring, Donald Uzarski, Benjamin Heumann

Michigan has the longest freshwater shoreline of any of any U.S. state. These shorelines, in Michigan and across the Great Lakes, support the remaining coastal wetland habitat vital to populations of wetland dependent species such as secretive marsh birds. Coastal wetlands can vary widely in size, vegetation communities present, and exposure to natural and anthropogenic disturbances. As part I of my research, I have explored the detection of four common species of the Rallidae family within coastal wetlands spanning the entire Great Lakes Basin over the period of 2011-2022. The results of the detection modeling will be used in part II of my research, modeling the occupancy of these species over the same temporal and spatial extent. One goal of this research is to increase wetland protection and management for secretive marsh bird species like American coots, common gallinules, soras, and Virginia rails by determining which locations and wetland

characteristics best support the occupancy of these four species in Great Lakes coastal wetlands across the basin.

***Avian Predation of the Red-backed Salamander (*Plethodon Cinereus*)**

Endi Piovesana, Dr. Alexa Warwick

One of the primary contributors to the biomass of a forest ecosystem is the salamander family Plethodontidae, the lungless salamanders. In parts of the Midwest and stretching into the northeast, the predominant plethodontid species is the Red-backed salamander (*Plethodon cinereus*). Although the species is well studied, the salamander's importance as a prey item for forest dwelling avian species is inconsistent in current literature. As many forest dwelling avian species are experiencing population declines, it is important to determine whether a significant relationship exists between these species and the *P. cinereus*. We hypothesized that *P. cinereus* would serve as a rare but desirable food source for several avian species, especially those that primarily ground forage, such as the American Robin, Gray Catbird, and Blue Jay. We used trail cameras and clay model salamanders at 9 locations within Rose Lake State Wildlife Area for a total of 8 months to directly observe predation attempts. Additionally, we performed PCR analysis of avian fecal samples for evidence of *P. cinereus* DNA. Trail cameras captured several predation attempts by American Robins and Blue Jays; however, no *P. cinereus* DNA was detected in any of the five fecal samples analyzed. The results so far suggest *P. cinereus* populations may attract and support these avian communities, but more research is needed. Future study efforts include food choice preference experiments to determine the desirability of the *P. cinereus* in comparison to other food sources.

***Estimating the Number of White-tailed Deer (*Odocoileus virginianus*) in an Urban Nature Preserve using Wildlife Cameras**

Caedmon Morgret, Jen Howell, William L. Miller

White-tailed deer (*Odocoileus virginianus*) are ecologically and culturally important large herbivores found in the Great Lakes region. Deer are often widespread and overabundant, can adapt to various environments, included human-dominated ecosystems. In Michigan, urbanization interferes with deer spatial distribution and movement, increasing human-deer and deer-environment interactions. These interactions are often negative and can lead to economic (e.g., property damage), ecological (e.g., overgrazing and competition), and human health (e.g., increased vehicle collisions and higher disease transmission) costs. Understanding the distribution of local deer populations may aid in land management decisions and potentially mitigate the negative impacts of their overabundance and concentration. Our study objective was to conduct a trail camera survey to determine herd distribution and abundance patterns during the 2022 breeding season. We placed 18 trail cameras throughout a 145-acre area encompassing the Calvin University Ecosystem Preserve and Native Gardens (CEPNG) and cross-country course. Cameras were deployed for three weeks during the breeding season in 2022 (Sept. – Oct.), evenly divided among management subunits, and placed in areas with evidence of deer activities. We identified 15 unique bucks and captured >1000 images of antlerless deer. The population size was estimated at approximately 60 individuals, corresponding to about 2.34 acres per deer. This estimation contrasts the targeted density of 2 to 4 deer per 100 acres identified in the CEPNG land management plan. The CEPNG occurs along a narrow corridor of forested space embedded in an urban-suburban matrix. The number of unique males identified was surprisingly high and may have been influenced by increased movement of nonresident bucks during the breeding season, potentially biasing results. While these preliminary results may not reflect resident population size, they provide insight into space use patterns of local deer populations. Continued surveys may provide further insights into local deer densities and population characteristics.

***What Risk Does Baiting Deer Pose to Non-target Species?**

Rebekah M. Agnew, Samantha E. Courtney, Sonja A. Christensen, Gary J. Roloff, and David M. Williams

Since the origin of big-game hunting in the United States, the ethics behind baiting have frequently been questioned, but the cascading ecological impacts are often overlooked. As baiting presents a concentrated food source for white-tailed deer (*Odocoileus virginianus*), it also attracts a variety of species that otherwise might not interact closely with deer, potentially encouraging the spread of parasites, bacteria, or diseases among organisms. Little is known about how concentrated sources of food might be facilitating the spread of diseases, such as chronic wasting disease (CWD) among non-target species on the landscape. Therefore, it is critical that we understand how baiting wildlife may influence disease transmission across the landscape and risks it poses to multiple species. Considering these factors, we asked: what species are visiting deer bait sites and are they interacting in a manner that poses a risk for disease transmission among species? To address this question, our objectives were to 1) determine species using bait sites 2) quantify the total amount of time a species spends at each site; and 3) quantify the nature and duration of interactions that occur among species. The study occurred in an agricultural region of southern Michigan at 10 bait sites (separated by 3 km). We viewed approximately 3745 hours of video footage collected at camera trapping arrays from January-April 2022. Video footage was recorded on a 24-hour period, 7-days per week. We identified 31 species, 2,296 contact events among species, and 34.03 hours of other species being present at the bait sites. These results provide a better understanding of the potential disease risks that baiting poses to non-target wildlife species.

***A Pond of Their Own: Influences of Still Waterbody Use on Wood Turtle Movements**

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In the private working forests of Michigan's western Upper Peninsula, wood turtles (*Glyptemys insculpta*) are a focus of collaborative conservation. Wood turtles are currently being considered for listing under the Endangered Species Act of 1973, but little information is available on wood turtle ecology in private working forests. One aspect of wood turtle ecology that is of particular interest to forest managers is the timing and extent of seasonal movements from occupied rivers. Wood turtles spend the fall, winter, and spring in and near these rivers, and move into adjacent uplands during the summer where they may be exposed to risk due to forest management activities. Using VHF radio-telemetry, we collected location data from 10 adult female wood turtles between early May and late October of 2021 and 2022 in two watershed basins of Michigan's western Upper Peninsula. Our analysis indicated that the mean maximum weekly distance traveled by all wood turtles during the post-nesting season in each basin was similar (North basin: 151m, SE=23.58; South basin: 182m, SE=46.24), but distances traveled during pre-nesting were dissimilar (North basin: 20m, SE=5.87; South basin: 116m, SE=44.62). Upon further examination, this discrepancy may be due to two southern basin turtles moving from the river to a temporary pond in early spring. When incorporating this pond into our distance from water analysis, the dissimilarity between basins during pre-nesting was diminished (North basin: 20m, SE=5.87; South basin: 20m, SE=11.6). Currently, seasonally restricted smart buffers are used to reduce risks to wood turtles from forest management activities around flowing water. However, our results suggest that further work is needed to understand the influence of still waterbodies on wood turtle movements and the potential need to account for still waterbodies when incorporating smart buffers into forest management plans.