2022 Wisconsin AFS Annual Meeting
Abstract Submission – Presentations

Great Lakes

Title: **Spatial variation in Lake Whitefish recruitment in Lake Michigan: the potential roles of zooplankton prey and the relative fitness of age-0 fish**

Author: Jordan Everson, *University of Wisconsin – Stevens Point*
Co-author(s): Daniel A. Isermann, Daniel J. Dembkowski, Scott Hansen, Jason Smith, Dave Caroffino, and Troy Zorn

Abstract:
Since the early 2000s, Lake Whitefish assessments in Lake Michigan have indicated declining trends in abundance for many Lake Whitefish stocks, which likely reflect prolonged declines in recruitment in some areas of the lake. Conversely, Lake Whitefish in southern Green Bay have shown increases in recruitment over that time. Reasons for contrasting trends in Lake Whitefish recruitment between southern Green Bay and most areas of Lake Michigan are unclear, yet understanding factors regulating spatial variation in recruitment is critical to implementing appropriate management actions that ensure the sustainability of all stocks. Recruitment dynamics are likely influenced by factors operating during early life stages and current recruitment trends appear to correspond with broadscale differences in primary productivity and zooplankton abundance, which may affect the relative fitness (i.e., weight-at-length and energy density) of age-0 fish. However, large-scale spatial assessments of zooplankton availability and relative fitness of age-0 Lake Whitefish have not been conducted in Lake Michigan. Consequently, our goals are to determine if productivity, availability of edible zooplankton, and measures of relative fitness of age-0 (larval and post-larval) Lake Whitefish vary among regions in Lake Michigan showing contrasting trends in Lake Whitefish recruitment. We will present preliminary findings based on data collected during the 2021 field season evaluating spatial variation in productivity, zooplankton, and Lake Whitefish relative fitness metrics.

Title: **Genomics reveals influence of adaptative divergence on Lake Michigan lake whitefish stock structure**

Author: Jared Homola, *USGS-Wisconsin Cooperative Fishery Research Unit, University of Wisconsin – Stevens Point*
Co-author(s): Yue Shi, Wes Larson, Peter Euclide

Abstract:
Understanding patterns of stock structure provides a basis a wide range of management actions, including identifying at-risk populations, allocating harvest quotas, informing stock assessment surveys, and establishing ecologically meaningful management units. Population structure has been evaluated for Lake Michigan's lake whitefish populations in the past using tagging, telemetry, and microsatellite genetic data, with each revealing subtle but detectable spatial structure. Here, we extend these past studies using genomic data to generate a high-resolution picture of genetic population structure and describe patterns of adaptive divergence among Lake

Michigan's lake whitefish populations. We genotyped 829 samples from 17 Lake Michigan spawning aggregates at 197,588 single nucleotide polymorphism (SNP) loci. Overall population structuring patterns were similar to those documented using 11 microsatellite loci; with key differences including splitting of a previously assumed single stock in northeastern Lake Michigan and the separation of northwestern Lake Michigan stocks into spatially overlapping northern and southern groups. Clear signals of adaptive divergence were present, and the genomic regions under selection varied among populations. For instance, the Ingalls Point spawning aggregate in West Grand Traverse Bay was strongly differentiated from other aggregates at a region on chromosome 18; whereas lake whitefish sampled from four spawning sites in northeastern Lake Michigan differed from all other locations at a region on chromosome 12. Overall patterns of genetic structure were more pronounced for loci exhibiting signals of selection relative to genome-wide patterns. The spatial and genomic complexity of adaptive variation we observed and its apparent outsized influence relative to background genetic structure suggests the patterns of adaptation in Lake Michigan lake whitefish are highly site-specific and strong enough of persist despite ongoing gene flow.

Title: **Tributary Use of Walleye and Lake Whitefish in Green Bay**

Author: Lisa Izzo, *USGS-Wisconsin Cooperative Fishery Research Unit, University of Wisconsin – Stevens Point*
Co-author(s): Daniel Isermann, Daniel Dembkowski, Todd Hayden, Tom Binder, Chris Vandergoot, Scott Hansen, Troy Zorn, David Caroffino, and Charles Kruger

Abstract:
Tributaries serve as important habitat for a variety of Great Lakes fishes, especially during the spawning period. In addition, sampling of many migratory fishes for population assessment takes place in rivers during the spawning period when populations are condensed in a small area. Because of this, gaining an understanding of timing and duration of tributary use can be essential for management in order to assess and protect economically important species. In this study, we used acoustic telemetry to examine tributary use for two species that are important to both the recreational and commercial fisheries of Green Bay: Walleye (Sander vitreus) and Lake Whitefish (Coregonus clupeaformis). We implanted 362 Walleye and 425 Lake Whitefish with acoustic transmitters in 2017 and 2018. Tagged fish were monitored by an array of acoustic receivers in the Fox, Oconto, Peshtigo, Menominee, Cedar, Escanaba, Whitefish, and Rapid rivers as well as Green Bay proper. These data will be used to characterize entry and exit timing from the rivers, relationships between tributary use timing and environmental factors, residency during spawning and non-spawning periods, and fidelity to rivers across years for both species. These results will contribute to an increased understanding of habitat needs across seasons for two culturally and economically important species in the Great Lakes, and allow for improved assessment and management of these populations.

Title: **Seasonal patterns in movements of hatchery and wild Chinook salmon in Lakes Michigan and Huron**

Author: Matthew Kornis, *U.S. Fish and Wildlife Service*

Co-author(s): Shannon Cressman, Francesco Guzzo, Allen Lane, Lindsey McKinney, Kevin Pankow, Anthony Rieth, James Webster, and Charles Bronte

Abstract:
Millions of Chinook salmon are annually stocked in the Great Lakes to support and diversify sport fisheries. From 2011 through 2016, the U.S. Fish and Wildlife Service adipose-fin clipped and coded-wire tagged all Chinook salmon stocked into Lakes Michigan and Huron, in part to better understand their spatial ecology. Managers are interested in details on natal homing of both hatchery and wild fish, as well as seasonal patterns in their distribution. We analyzed Chinook salmon coded-wire tag returns, wild Chinook salmon relative abundance, and total relative abundance in 10 day increments in most management units in Lake Michigan and northern Lake Huron. Hatchery Chinook salmon usually displayed natal homing in late summer and fall to the management unit where they were stocked despite a brief stream residency after release. The arrival of hatchery fish to their home stocking areas varied by management unit: peak arrivals were earlier in southeastern Lake Michigan and later in northwestern Lake Michigan and Lake Huron. Relative abundance of wild Chinook salmon (without tags and finclips) was greatest in northeastern Lake Michigan in fall, and suggested this region is a focal point for wild production. Periods of high and low total relative abundance occurred in all units, but at different times of year, consistent with broad scale, forage-driven movements of Chinook salmon during summer. These results have implications for management of tributary fisheries during fall and for managing angler expectations to account for seasonally variable abundance of Chinook salmon in different areas in spring and summer.

Title: **You Shall Not Pass: Assessing Aquatic Connectivity in the Lake Michigan Basin**

Author: Zac Locklear, *U.S. Fish and Wildlife Service*
Co-author(s): Jessica Collier

Abstract:
Aquatic habitats and their dependent species in the Upper Midwest are under threat from a variety of stressors, including habitat fragmentation. Reducing the ability for species to move freely throughout their range can decrease genetic diversity, inhibit spawning runs, isolate previously connected populations, and potentially lead to species extirpation. By assessing where all potential barriers across a watershed exist, informed decisions can be made about where to restore population connectivity and resiliency. However, with an estimated 100,000 potential barriers to aquatic organism passage in the Lake Michigan Basin, prioritization and planning with partners is key to effective aquatic connectivity restoration. Using the Green Bay Fish & Wildlife Conservation Office Lake Michigan Strategic Habitat Plan (2020 – 2024) and partnership discussions as our framework, we identified priority sub-watersheds by calculating the amount of cool and cold-water streams in the U.S. Fish & Wildlife Service (USFWS) priority combined watersheds, in addition to identifying gaps in previous barrier inventories. We focused on cooler streams as the majority of our priority species depend on them, but some warm-water streams were chosen with our partners. This process resulted in 501 barrier inventories being completed by the USFWS using the Great Lakes Stream Crossing Inventory from December 2020-2021, with 82% of sites returning some form of barrier score. We also tested different tools for informing barrier removal decisions such as bivariate mapping, barrier hotspot analysis, and

upstream miles re-connected at the sub-watershed scale. This process allows us to be flexible in the field while providing key conservation data to our partners. Our project illustrates the importance of collaboration, prioritization, and robust geospatial analysis for mutual restoration goals across the Lake Michigan Basin, and provides a framework for future aquatic connectivity assessments.

Title: **Lake Trout and Cisco body condition highlights strong predator/prey coupling**
Author: Ben Martin, *University of Wisconsin Madison*
Co-author(s): Jake Vander Zanden

Abstract:
Predator-prey coupling can result in oscillations of predator-prey abundances. Strong predator-prey coupling can also trigger entire ecosystem trophic cascades where the shifts in predator and prey abundances has a rippling impact on lower trophic levels. Here, we investigated how the body condition (body weight relative to body length) of a strongly coupled predator and prey changes as their respective population densities shifted due to cascading interactions. We found that predator and prey body condition was strongly influenced by their respective population densities, which signifies strong population density dependence. Further, we found predator and prey body conditions were inversely related, which highlights strong predator-prey coupling. We further note that in cases where coupled predator-prey have inverse body condition relationships, we can use historical length/weight data to illuminate past ecological conditions. Here, we were able to suggest whether the food web was historically a three or four-tier based on historical predator body condition. Overall, this study highlights strong predator-prey coupling as indicated by inverse body condition, and highlights the application of synthesizing long-term trends in body condition.

Title: **Initial Insights on the Thermal Ecology of Lake Whitefish in Northwestern Lake Michigan**
Author: Kayla Reed, *University of Wisconsin – Stevens Point*
Co-author(s): Lisa Izzo, Tom Binder, Todd Hayden, Daniel Dembkowski, Scott Hansen, David Caroffino, Christopher Vandergoot, and Daniel Isermann

Abstract:
Lake whitefish Coregonus clupeaformis is a native species supporting important recreational and commercial fisheries in the Great Lakes. Climate-related changes in water temperatures have important implications for the future sustainability of these fisheries. However, projecting future availability of suitable thermal habitat is difficult because little is known about lake whitefish thermal ecology in the Great Lakes. To address this lack of information, archival temperature loggers were implanted into 400 lake whitefish that were captured by boat electrofishing and commercial netting from locations in and around Green Bay during October-November 2017. These locations included Big Bay de Noc, the Fox, Menominee, and Peshtigo rivers, and North and Moonlight Bays along the lakeside of the Door Peninsula. These fish were part of an acoustic telemetry study. Fish were released with a $100 reward loop tag to encourage fishers to return acoustic transmitters and thermal loggers. Temperatures were recorded for 11 months at 4-

hour intervals. Seventeen temperature loggers were returned but three contained thermal data for fish caught prior to the logger start date and were not used in analysis. During winter (December-March) lake whitefish inhabited water temperatures between 0 and 8.0 oC, while in the summer (June-mid September) lake whitefish inhabited water temperatures between 3.5 and 20.5 oC. Differences in temperature records indicate that fish were moving among areas of different temperatures on some dates in the summer. Lake whitefish thermal ecology data will be analyzed in relation to movement data determined from acoustic transmitters. The results from this work contribute to baseline understanding of lake whitefish thermal ecology.

Title: **Degraded Great Lakes Coastal Wetlands as biodiversity hotspots**
Author: Titus Seilheimer, *University of Wisconsin Sea Grant*

Abstract:
Great Lakes coastal wetlands are productive spawning and nursery habitats that serve more than 70% of fish species in the basin. Wetland habitat has also been lost in the Great Lakes, especially in urban areas, and degraded in other areas. The remaining habitat is especially important, especially in areas with small amounts of wetland habitat. Wisconsin's Lake Michigan coast from Manitowoc County south to the state line is exposed to wave action, with high bluffs, and few coastal wetlands. The Little Manitowoc River is a small marsh in the city of Manitowoc. The wetland's watershed is dominated by agriculture causing degraded water quality in the river (elevated nutrients and sediment loads). Although the wetland habitat is dominated by Typha sp. and limited submergent vegetation, the marsh is still home to 24 fish species. Evidence of the importance of the site as a nursery is demonstrated by the presence of juvenile sport fish species, like yellow perch, northern pike and smallmouth bass. In a degraded state, this site is an important habitat, so habitat restoration could have added benefits to the local fish community.

Trout

Title: **Evaluating Brook Trout Connectivity and Spring Pond Use Within the Plover River System, Wisconsin**
Author: Keenan Foley, *University of Wisconsin – Stevens Point*
Co-author(s): Joshua Raabe, Jared Homola, Tim Parks

Abstract:
Brook Trout Salvelinus fontinalis are a popular sport fish that require coldwater, so identifying thermal refugia is critical in successful management as considerable habitat loss is predicted across Wisconsin streams due to climate change. More than 1,000 spring ponds occur in northern Wisconsin and may serve as thermal refugia for Brook Trout given consistent groundwater inputs and deeper water. However, expensive hydraulic dredging may be required and Brook Trout use of these unique habitats within river systems is relatively unknown. Therefore, we are studying Brook Trout in spring ponds and river reaches within the Plover River, Marathon County, Wisconsin from September 2021 to Spring 2023. Our objectives are to determine if Brook Trout: (1) genetic diversity and population structure varies among spring ponds or between spring ponds and river, (2) use spring ponds seasonally, (3) for spawning, (4) access to

spring ponds is affected by spring pond or outlet characteristics. We are sampling Brook Trout via boat electrofishing in spring ponds (n=5) and barge electrofishing in river sections (n>3) to collect biological data and fin clips for genetics and to PIT tag. We are installing PIT antenna arrays at the outlet of three ponds to monitor pond use and connectivity relative to environmental conditions and pond characteristics. We will use restriction-site associated DNA sequencing to evaluate genetic variation within the river system, such as potential divergence among pond and river reaches to evaluate the extent of connectivity and reproductive isolation. This study will assist Brook Trout management in areas of Wisconsin with spring ponds and more broadly by increasing understanding of life history strategies that may be important with changing climate and environmental conditions.

Title: **Seasonal Brook Trout movement in northeastern Wisconsin**

Author: Emma Lundberg, *Wisconsin Department of Natural Resources*
Co-author(s): Matthew Mitro

Abstract:
Brook Trout Salvelinus fontinalis may exhibit highly variable movement patterns in streams, with some individuals showing high site fidelity and others making long-distance movements. Observations of extensive movement would highlight the importance of connectivity and may support ongoing efforts to maintain free-flowing conditions by controlling beaver. While an ongoing study on beaver and trout investigates the extent to which beaver dams impede trout movement, we conducted a system-wide study in Upper Middle Inlet (UMI), Marinette County, to investigate the importance of seasonal movement in the population dynamics of Brook Trout in northeastern Wisconsin streams. In this work we asked, 1) what is the seasonal timing and extent of Brook Trout movement in northeastern Wisconsin streams, and 2) how might observed movement patterns influence decisions about trout and beaver management? We used single-pass electrofishing to capture, tag, and recapture trout with passive integrated transponder (PIT) tags at discrete times and locations throughout UMI (08-2019 to 12-2021). We also used OregonRFID PIT-tag detection arrays at two discrete locations in UMI to continuously scan for bidirectional movement of PIT-tagged trout. Many recapture or detection events occurred within <1 km of tagging locations, but some individuals were observed moving long distances of up to 14.7 km between capture or detection events. We observed three main seasonal movement patterns: 1) upstream movement late-summer into early-fall during spawning season, 2) downstream movement post-spawn at the onset of winter conditions, and 3) upstream movement in late spring following the transition from winter to spring conditions. With these data, we gather a better understanding of the role that riverine connectivity plays in northeastern Wisconsin, which has the potential to be affected by changes in connectivity such as the fragmentation of streams by beaver dams.

Title: **Long-term trends in Wisconsin stream trout recruitment and the effects of seasonal weather**

Author: Brian Maitland, *Wisconsin Department of Natural Resources*
Co-author(s): Alex Latzka

Abstract:
Climate warming and shifts in rainfall regimes are a major threat to aquatic biodiversity, but few empirical studies have examined their combined effects at large spatial and temporal scales. Here we analyze 26 years of standardized survey data to quantify changes in Brook Trout (Salvelinus fontinalis) and Brown Trout (Salmo trutta) young-of-year summer abundance (an important driver of population dynamics) across 247 streams in Wisconsin, USA. After accounting for landscape and climate factors, as well as random year-to-year effects, we identified long-term trends in Brook and Brown Trout YOY abundance, with the direction of trends varying by subbasin (HUC8) and stream reach. We found strong negative effects of spring rainfall on both species, particularly above 1.5 standard deviations, and strong negative effects of winter rainfall on Brook Trout. Increased summer rainfall was associated with higher recruitment strength in both species. Maximum daily spring temperatures were positively related to YOY Brown Trout abundance, and negatively related to YOY Brook Trout abundance above and below 1.5 standard deviations. We also identified interaction among landscape factors and climate effects. Our results indicate that extreme seasonal weather will have the potential to exert strong and differential effects on trout recruitment in a changing climate. Management actions that maximize resiliency of populations in response to extreme weather should be prioritized to buffer negative impacts.

Title: **Spawning redd habitats of Salmonidae species within the Bois Brule River, WI**

Author: Benjamin Schleppenbach, *Wisconsin Department of Natural Resources*
Co-author(s): Tom Hrabik, Daniel McCann, Greg Sass

Abstract:
The Bois Brule River is a renowned, spring-fed, western Lake Superior tributary that supports five naturally reproducing populations of salmonid species: native brook trout Salvelinus fontinalis, brown trout Salmo trutta, rainbow trout Oncorhynchus mykiss, coho salmon Oncorhynchus kisutch, and chinook salmon Oncorhynchus tshawytscha. This sympatric mix of native and introduced species that includes potamodromous and stream resident life histories induces overlap of natural reproduction strategies and spawning habitat requirements. With increases in recreational angler use, combined with predicted changes to trout stream habitat in Wisconsin from a warming climate, understanding species interactions during spawning will become increasingly important to guide management of these sportfish populations. Our objective is to map species-specific spawning redd locations and evaluate physical, flow, and thermal conditions in these habitats during 2021 and 2022. Redd surveys will be conducted by canoe over a 9 river mile section that encompasses historically important spawning areas. Preliminary results from the first field season indicate spring spawning rainbow trout and fall spawning pacific salmon species are using the same spawning locations on larger gravel reefs in the center of the channel, downstream of riffle sections. Native brook trout were found spawning on smaller substrates with slower streamflow on the edges of the stream channel, with large congregations of spawning activity occurring in shoreline areas of lentic habitat. Results from this study will provide valuable spawning habitat information and increase understanding of species interactions for stream habitat management of the Brule River in the future and may provide insight into management of other Great Lakes tributaries with similar sympatric, naturally reproducing salmonid species.

Human Dimensions

Title: **Does local knowledge matter? A comparison of fish catch rates among local, non-local, and non-resident anglers of three northern Wisconsin lakes**

Author: Michael Lant, *Wisconsin Department of Natural Resources*
Co-author(s): Greg G. Sass, Zachary S. Feiner, Derek H. Ogle

Abstract:
Understanding influences of angler proximity on fisheries resources, the distances anglers are willing to travel, and their success rates after they arrive could influence fisheries resiliency and management. The Northern Highlands Fishery Research Area near Boulder Junction, Vilas County, WI maintains a compulsory creel census for five research lakes. Using ZIP code information from angler residence, we developed anglershed maps to discern species-specific (muskellunge, smallmouth bass, walleye, yellow perch) angler proximity to three lakes and categorized discrete angler groups (local, non-local, non-resident) based on proximity. We used creel census data during 2014-2019 to test for differences in angler catch rates and effort among angler groups. Among all angler groups and species, catch rate and effort were generally equal with minor species-specific differences. Our hypothesis of "local knowledge" being the primary influential variable for catch rate was not supported. Our results suggest a need to manage for all angler groups due to generally equivalent species-specific catch rates and effort independent of proximity to fishing opportunities.

Title: **Assessing Public Opinions and Preferences for Panfish Management**

Author: Allison Scott, *Wisconsin Department of Natural Resources*
Co-author(s): Alexander W. Latzka, Robert H. Holsman

Abstract:
Fisheries managers often use surveys to measure public opinions, but other social science tools, which could improve survey design and fill critical information gaps, are often overlooked. We used three social science tools—windshield cards, focus groups, and a statewide survey—to assess public opinions about panfish experimental fishing regulations and management in Wisconsin. Windshield cards revealed high levels of support for experimental regulations regardless of whether respondents perceived resultant positive effects; however, the most restrictive regulation received the highest opposition. Focus groups revealed complex environmental, biological, and social interactions that informed development of the statewide survey. Participants expressed interest and concern about the use of fishing electronics and technology, a topic that we subsequently investigated in the statewide survey. Participants also revealed differences between panfish user groups (e.g., open-water versus ice anglers, harvest-oriented versus catch-and-release anglers, avid versus casual anglers), which allowed us to design survey questions that would be meaningful to a wider audience. Generally, focus group participants supported the experimental regulations but viewed the most restrictive regulations as temporary tools. Although windshield cards and focus groups generally emphasized opinions and preferences of avid anglers and active users of experimental lakes, the statewide survey revealed opinions representative of the wider angling public in Wisconsin. Notably, it revealed reluctance to permanently reduce the statewide daily bag limit. We will discuss these preliminary findings

and associated implications for panfish management in Wisconsin. This case study highlights the importance of using reliable social science techniques to estimate public opinions, and we encourage fisheries managers to use social science methods that are both relevant and meaningful to their questions of interest.

Walleye

Title: **Black Crappie Influences on Walleye Natural Recruitment in Northern Wisconsin Lake**

Author: Steven Broda, *Wisconsin Department of Natural Resources*
Co-author(s): Zachary S. Feiner, Joseph T. Mrnak, Stephanie L. Shaw, and Greg G. Sass

Abstract:
Fish natural recruitment is influenced by abiotic and biotic factors. Natural recruitment has declined in northern Wisconsin Walleye Sander vitreus populations over time. Previous research has suggested that White Crappie Pomoxis annularis may negatively influence Walleye recruitment. We used Black Crappie Pomoxis nigromaculatus and age-0 Walleye relative abundance data collected during 1991- 2017 to test for: 1) trends in age-0 Walleye and Black Crappie relative abundance over time; 2) a relationship between age-0 Walleye and Black Crappie relative abundance; 3) patterns in age-0 Walleye and Black Crappie relative abundance in a subset of lakes with longer-term data for both species over time; and 4) the influence of several abiotic and biotic covariates (including Black Crappie relative abundance) on age-0 Walleye recruitment. Over the time timeseries, Age-0 Walleye relative abundance significantly declined while Black Crappie significantly increased. The relationship between age-0 Walleye and Black Crappie relative abundance showed a strong, threshold effect such that age-0 Walleye relative abundance was always less at greater Black Crappie relative abundances. In a subset of lakes with more long-term data, reciprocal relationships were generally observed between age-0 Walleye and Black Crappie relative abundances. Of the abiotic and biotic covariates tested to explain variability in the age-0 Walleye and Black Crappie relative abundance relationship, only Black Crappie relative abundance was significant. Our results suggest that Black Crappie may negatively influence Walleye natural recruitment; however, we caution that our findings only reveal pattern and not a mechanistic explanation for negative interactions between the species. Additional research is critically needed to test for mechanistic interactions between Walleye and Black Crappie and to inform co-management of these species.

Title: **Abiotic and biotic influences on walleye (Sander vitreus) recruitment depensation in Wisconsin**

Author: Collin Dassow, *Wisconsin Department of Natural Resources*
Co-author(s): Greg Sass

Abstract:
Recruitment depensation or elevated juvenile mortality with declining adult stock size, can prevent or delay or stock recovery from overharvest and/or other factors. In most sportfish, juvenile survival is assumed to increase as adult stock size declines (i.e., compensatory

recruitment). However, recruitment depensation, can occur if adult stock size is reduced below a critical threshold. Recruitment depensation threatens exploited fish populations because as stock size is reduced, populations can become trapped in a positive feedback loop where declining abundance leads to declining recruitment and further abundance declines. Using estimates of depensatory recruitment dynamics from 28 walleye populations in Wisconsin identified by Sass et al. (2021), we modeled variation in walleye recruitment depensation. The best fitting model contained covariates for climate, land use, and fish community composition, all interacting with largemouth bass relative abundance to explain variation in depensation. The consistent interaction effect of largemouth bass relative abundance across the other covariates suggests a key role this competitor species may play in walleye recruitment at low stock sizes. Specifically, as largemouth bass became more abundant, the risk of depensatory recruitment increased. Using this model, the vulnerability to depensation was predicted for 117 walleye lakes with insufficient data to estimate the risk of depensation directly. Predictions suggested that many walleye lakes considered would be vulnerable to depensatory recruitment should stock sizes decrease significantly. Using these predictions of vulnerability to depensation, we discuss how managers might prioritize lakes using their risk of depensation and adult walleye densities.

Title: **Supply-and-Demand Dynamics Associated with Using Stocking to Maintain Walleye Fisheries in the Face of Climate Change**

Author: Robert Davis, *USGS-Wisconsin Cooperative Fishery Research Unit, University of Wisconsin – Stevens Point*
Co-author(s): Daniel Isermann, Gretchen Hansen, Stephanie Shaw, Zachary Lawson, Joseph Hennessy, Alex Latzka, Dale Lodgson, John Hoxmeier, Doug Schultz, Brian Blackwell, Seth Herbst, Scott Gangl, Rebecca Krogman, Keith Koupal, Joseph Conroy

Abstract:
Stocking is already required to maintain many walleye fisheries in the Midwestern USA, but potential declines in natural recruitment observed in some lakes could lead to increased demand for supplemental stocking to support walleye fisheries. Additionally, many previous stocking events have not been successful in meeting management objectives. In many states, walleye available for stocking are already a limited resource. If climate change further reduces the viability of naturally reproducing walleye populations management decisions about where stocking will occur will become more complex and this decision-making process will require better information on where stocking is likely to be successful in meeting management objectives. The objectives of our study are to determine if the probability of stocking success is related to a suite of abiotic and biotic variables and to simulate whether probability of stocking success may change under various scenarios that might be expected under continued climate change (e.g., warmer water, longer growing seasons, changes in predator abundance). Data will be obtained from management agencies throughout the Midwest, providing a broad regional context for our analyses. We will discuss the approach we have employed to identify explanatory factors that will be used in our models, explain the criteria we are using to define stocking success, and provide a preview of the modeling framework we plan to employ to address our objectives.

Title: **Post-stocking analysis of extended growth fingerling Walleye Sander vitreus in Northern Wisconsin lakes**

Author: Brenden Elwer, *University of Wisconsin – Stevens Point*
Co-author(s): Justin VanDeHey, Greg Sass, Stephanie Shaw, Logan Sikora, Joseph Hennesy, and Joseph Mrnak

Abstract:
lleye Sander vitreus is a prized sportfish in Wisconsin, that has been experiencing recruitment and hence population declines. In 2013, the Wisconsin Walleye Initiative began in attempt to offset declining Walleye populations by increasing stocking efforts. Hence, determining which factors may be affecting the survival of these stocked Walleyes is important. The objectives of this study were to determine if (1) differences in natural mortality of stocked Walleye existed among stocking densities, lake recruitment codes, and lake conductivity, (2) resulting adult Walleye abundances differed among lakes with differing stocking densities and (3) estimate cost to creel for age-4 stocked Walleye. Natural mortality rates were estimated by combining the number of stocked age-0 Walleye with age-0 Walleye abundance estimates from fall electrofishing and comparing to estimated age-1 abundances the following year. Significant differences in natural mortality rates were found for 7 of 15 comparisons of recruitment codes (commonly involving primarily stocked vs natural recruiting lakes), 2 of 6 tests comparing conductivity (low conductivity lakes being different from moderate to high conductivity), and 1 of 3 tests for stocking densities (5 vs 10 fish/acre). After estimating survival to and in-turn abundances to age-4, no lake-specific conditions or stocking rate densities were likely to achieve the management goal of 3 fish/acre or a fishable population of 1.5 fish/acre. Based on average survival rates and variable production costs, cost to creel for an age-4 Walleye ranged from $19.23 to $38.47. Based on stocking density-specific survival rates, lakes stocked at 10 fish/acre had the lowest cost to creel. Natural mortality of Walleye from age-0 to age-1 was very high and dependent on both conductivity and recruitment code of a lake. Our results suggest stocking is expensive and often yielded low return. Hence stocking events should be carefully planned to maximize return on investment.

Title: **The Birds and the Bees and the Rocks and the Weeds – Better Understanding of Aquatic Habitats and Their Relationships with Walleye Reproductive and Recruitment Success in Northern WI Lakes**

Author: Lawrence Eslinger, *Wisconsin Department of Natural Resources*
Co-author(s): Paul Frater

Abstract:
Natural reproduction and recruitment success in walleyes is a topic of great concern and has been declining regionally across lakes in northern Wisconsin over recent decades. We used fall walleye recruitment surveys in conjunction with aquatic macrophyte surveys to assess trends between natural walleye recruitment and the percentage of a lake's area where aquatic plants were present. Using a negative binomial generalized linear model we found a significantly decreasing trend between age 0 walleye CPE and aquatic plant prevalence in lakes with self-sustaining walleye populations. In addition, we developed a novel approach for determining preferred walleye spawning areas using nearshore substrate data collected during shoreland

habitat assessments. While these efforts are still works-in-progress, we hope to continue to refine and develop them to aid in better understanding the structural aspects of aquatic habitats that promote natural walleye reproductive and recruitment success in northern Wisconsin lakes.

Title: **Implications of increasingly unpredictable phenology for walleye recruitment**

Author: Zachary Feiner, *Wisconsin Department of Natural Resources*
Co-author(s): Martha Barta, Greg Sass, Gretchen Gerrish, Noah Lottig, Hilary Dugan

Abstract:
Climate change is influencing the timing of ecological events (in other words, their phenology) in natural systems globally. In lakes, the timing of important events like ice off, fish spawning, and plankton blooms are not only shifting earlier; they are also becoming much more unpredictable in their phenology from year to year. Such variability has the potential to alter lake habitats, change food web connections, and impact fish recruitment. We used long-term phenological records of ice-off and walleye spawn timing in hundreds of lakes across Wisconsin, Minnesota, and Michigan to test for effects of unpredictable ice phenology on walleye spawning and recruitment. Walleye spawning was highly correlated with ice-off across years and populations, and both have become increasingly variable in recent decades. Ice-off trended earlier over time, while there was little consistent temporal trend in walleye spawning phenology. This led to an apparent lag in the responsiveness of walleye spawning to changes in ice-off, where a one day/year change in ice-off corresponded to only a 0.6 day/year change in walleye spawning phenology. Walleye recruitment showed evidence of match-mismatch dynamics, as recruitment was poor in both early and late years and only high in years when spawning occurred with average timing. Thus, the observed increasing frequency of extreme years and highly variable phenology could lead to additional erosion of walleye recruitment success in Midwestern lakes with further climate change.

Title: **Walleye and Yellow Perch in Northern Wisconsin Lakes: Recruitment Trends and Importance of Perch as Prey for Larval and Post-Larval Walleye**

Author: AnaSara Gillem, *USGS-Wisconsin Cooperative Fishery Research Unit, University of Wisconsin – Stevens Point*
Co-author(s): Dan Isermann, Dan Dembkowski, Joe Hennessy, Alex Latzka

Abstract:
Some lakes in northern Wisconsin that previously sustained natural Walleye recruitment have exhibited declines in recruitment over the past two decades. Recent data have suggested that Yellow Perch and Walleye recruitment are affected by similar environmental factors, but declining trends in Yellow Perch recruitment success may have gone undetected due to lack of targeted sampling. Additionally, a lower abundance of juvenile Yellow Perch could be related to Walleye recruitment success. The objectives of this study are to determine if the following differ between lakes with different Walleye recruitment histories (sustained vs. declined): 1) density and spatial distribution of zooplankton prey; 2) relative importance of larval Yellow Perch and zooplankton to larval and post-larval Walleye diets; and 3) trends in age-0 Yellow Perch

abundance. Larval Walleye as small as 9 mm had fish present in their diets. Densities of larval Yellow Perch were not significantly different between recruitment histories; however, abundance of age-0 Yellow Perch was significantly different between recruitment histories in June-July. Sampling occurred in 2021 and will continue in 2022 using several different gears to target Walleye and Yellow Perch in their first few months of life.

Title: **Compensatory Density-Dependent Mortality Between Age-0 and Age-1 Walleye in Ceded Territory of Wisconsin Lakes**

Author: Logan Zebro, *Wisconsin Department of Natural Resources*
Co-author(s): Greg G. Sass, Stephanie L. Shaw, Steven Chipps

Abstract:
Age-0 and age-1 Walleye (Sander vitreus) natural recruitment has declined in many populations within the Ceded Territory of Wisconsin (CTWI) over the past 20 years. Using CTWI age-0 and age-1 Walleye relative abundance (CPE) data during 1990-2019, we tested for density-dependent compensatory mortality between age-0 and age-1 Walleye. Age-1 Walleye mortality was consistently high at high age-0 CPE and was highly variable and low at low age-0 CPE. To test for factors explaining variability in age-0 to age-1 Walleye mortality at low age-0 CPE, we used a mixed effects model. Covariates used in the mixed effects model included temperature (May surface temperature, peak temperature, CV of temperature 0-30 days following ice out, and growing degree days above 50 C), and lake characteristics (lake surface area, shoreline development factor, stratification duration, ice duration). Age-0 Walleye CPE was included as a density dependent factor and age-1 CPE was used test for cannibalism of age-1 Walleye on age-0 Walleye. Important variables based on AIC model weight included age-0 CPE, May surface temperature, peak temperature, and lake surface area. Age-0 Walleye CPE influenced age-0 to age-1 walleye mortality (density-dependence) the most, followed by May surface temperatures. Increased May surface temperatures resulted in greater juvenile Walleye mortality. Peak temperature was negatively correlated with juvenile Walleye mortality and lake surface area was positively correlated with juvenile Walleye mortality. Factors contributing to our findings could be climate change, increased metabolic rates in predatory species due to increased May surface temperatures, and greater lake surface area tending to have greater species diversity and abundance incurring more competition on Walleye. Fisheries managers have little control of environmental factors effecting fish populations, thus stressing the importance of conserving resilient, naturally recruiting Walleye populations.

Rehabilitation Projects

Title: **Successful reintroduction of the state-endangered starhead topminnow in the Wisconsin River above the Prairie du Sac Dam**

Author: John Lyons, *University of Wisconsin Madison*
Co-author(s): Dave Marshal, Sue Marcquenski, Tim Larson, Jean Unmuth

Abstract:

The stronghold of the state-endangered starhead topminnow (Fundulus dispar) in Wisconsin is in the Lower Wisconsin River (LWR) below the Prairie du Sac Dam, but populations there are threatened by nitrate pollution from adjacent intensive row-crop agriculture and invasive western mosquitofish (Gambusia affinis). Starhead topminnows formerly occurred above the dam but long ago disappeared. To increase their distribution and provide a refuge from the threats in the LWR, we undertook a project to re-establish starhead topminnows above the dam. We collected wild starhead topminnows from the LWR and brought them to an offsite pond, spawned them in the pond, and then raised and stocked the offspring at seven sites above the dam. Although husbandry was challenging at times, spawning and survival in the pond were excellent, and from 134 brood fish collected in 2018 and 2019, we were able to reintroduce 6,309 starhead topminnows during 2019-2021. Survival and reproduction at two sites above the dam, Gallus Slough and Stoners Bay of Lake Wisconsin, was good, and within a year of stocking in 2019 and 2020 we estimate several thousand new young-of-year starhead topminnows had been produced at each site. Numbers were lower at a slough near the I90/94 bridge stocked in 2019, but there we had evidence of three generations of offspring. At three stocking sites we could not find starhead topminnows, and low water prevented assessment of a fourth. Why stocking was effective at some sites but apparently not at others was unclear. Nonetheless, it appears that starhead topminnow have been successfully reintroduced into about 15 km of the Wisconsin River above the Prairie du Sac Dam. We will continue monitoring the stocked sites in 2022 and beyond and hope to use the findings from this study to guide reintroductions of other rare Wisconsin fishes.

Title: **Is top-down control a requirement for food web restoration? Effects of a whole-lake invasive rainbow smelt (Osmerus mordax) removal and native cisco (Coregonus artedi) introduction in two north-temperate lakes**

Author: Joseph Mrnak, *University of Wisconsin Madison*
Co-author(s): Logan W. Sikora; M. Jake Vander Zanden; Greg G. Sass

Abstract:
Invasive species are a global concern for aquatic ecosystems. Though prevention is the best management practice for invasive species control, detection often occurs after the species has established within a system. Post-establishment, new ecosystem dynamics and species interactions become rampant. These new dynamics and interactions may lead to an alternative ecosystem state, making management efforts difficult. Alternative ecosystem states highlight the importance of “food web thinking” as opposed to the traditional single species management framework. Panarchy theory allows for the incorporation of a systems approach when considering fisheries management actions. Here, we purposefully leverage panarchy theory during two whole-lake biomanipulations by intentionally forcing a release in the adaptive cycle and dictating resource and species availability going into reorganization via manual rainbow smelt removals and cisco reintroductions. We are testing whether the control of rainbow smelt and restoration potential of cisco is mediated by the presence/absence of apex predators (i.e., walleye, muskellunge, and smallmouth bass). Cisco stocking occurred during fall of 2020 and 2021. Rainbow smelt removals started in spring of 2021 and will continue through spring of 2024. Our study will have implications for future native species reintroductions and invasive species control efforts.

Title: **Effects of Bullhead Removal on Fish Community Dynamics in a Northern Wisconsin Lake: Project Update**

Author: Logan Sikora, *USGS-Wisconsin Cooperative Fishery Research Unit, University of Wisconsin – Stevens Point*
Co-author(s): Justin VanDeHey and Greg Sass

Abstract:
Bullheads Ameiurus spp. are found throughout much of the United States yet remain a relatively understudied species. However, Black A. melas and Yellow Bullheads A. natalis, are capable of becoming a nuisance and dominating the biomass in north temperate systems, which can influence native community structure. Further, empirical evidence suggests that Ameiurus spp. may be negatively related to recruitment and abundances of some popular northern Wisconsin sportfishes (e.g., Walleye Sander vitreus and Yellow Perch Perca flavescens). Thus, additional research and data synthesis related to understanding the ecological role of bullheads and associated effects on native fish communities are needed. To explore these further, we conducted a whole-lake bullhead removal in a northern Wisconsin lake. The goal of the project is to shine light on critical bullhead intra- and interspecific interactions as well as community structuring mechanisms. The study will provide key information on the ecological role bullheads play in structuring north temperate lakes. Over the course of the study, a total of 779,208 bullheads (11,292.9 fish/ha) accounting for 3230.7 kg of biomass (46.8 kg/ha) were removed from Howell Lake with 685 net/nights, 12 hours of electrofishing effort, and approximately 19 hours of dipnet effort. The results aid in understanding the role of bullheads in a fish community, which may be critical information for future management decisions, when managing at the community, rather than the population level.

Panfish

Title: **Seasonal habitat use of yellow perch in a north temperate lake**

Author: Levi Feucht, *University of Wisconsin Madison*
Co-author(s): Logan W. Sikora; Greg G. Sass; Joseph T. Mrnak

Abstract:
Yellow Perch (Perca flavescens) are an ecologically and recreationally important fish species across their native range. Yet, for many north-temperate systems (e.g., inland Wisconsin lakes), little is known about the species seasonal habitat use and ecology. To further our understanding of this important cool-water sportfish, we characterized Yellow Perch seasonal habitat use between littoral and pelagic habitats during the open water period of 2021 in Crystal Lake (Vilas Co., WI). We conducted contemporaneous sampling in littoral and pelagic areas using mini-fyke nets and hydroacoustics surveys paired with vertical gillnets during May - October. We found an inverse relationship between Yellow Perch habitat use and seasonality. Littoral relative abundance estimates were greatest in the spring and declined steadily through October. Pelagic relative abundance estimates were lowest in the spring, peaked at the onset of stratification, and remained relatively consistent through October. Yellow Perch size-structure was greater in the

pelagia indicating: 1) large adult Yellow Perch preferred pelagic environments; and(or) 2) sub-adults and juveniles selected for littoral habitats likely resulting from increased refugia. Our results emphasize the importance of evaluating gear bias and have implications for future assessments, particularly when the target species may exhibit multiple habitat preferences within a lake.

Title: **Response of Yellow Perch to water level fluctuations in north-temperate lakes**

Author: Gabrielle Shay, *University of Wisconsin Madison*
Co-author(s): Greg G. Sass; Joseph T. Mrnak

Abstract:
Information on Yellow Perch (Perca flaevscens) population dynamics and response to various biotic and abiotic factors in inland north-temperate lakes is sparse. Water level fluctuations are known to influence habitat and biological communities within the littoral zones of lakes, yet this information is generally lacking for Wisconsin Yellow Perch outside of drought effects on coarse woody habitat and Yellow Perch persistence. We characterized Yellow Perch population level responses to natural water level fluctuations in four north temperate Wisconsin lakes using a 39-year time-series (NTL-LTER). We identified eight years of above average high water and nine years of below average low water for analysis (two replicates per treatment). We found that high water levels correlated with greater proportional size distributions (PSD-S, PSD-Q), greater mean fyke net relative abundance, and lower mean vertical gill net relative abundance, though generally not statistically significant. Mean Yellow Perch relative weight varied among lakes and did not follow a consistent pattern. Our lack of statistically significant findings could be attributed to a lack of power to detect effects due to low sample sizes. However, this may potentially suggest a buffering mechanism of these north-temperate, oligotrophic lakes due to their small surface area to volume ratios, relative lack of nutrients, and(or) littoral habitat structure compared to other systems (i.e., shallow, eutrophic lakes; e.g., prairie pothole glacial lakes). Our results suggest that natural water level fluctuations do not appear to be an environmental concern for Yellow Perch populations in north temperate lakes, although water level influences on littoral structural habitat was not considered here.

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

Author: Dakota Stankowski, *USGS-Wisconsin Cooperative Fishery Research Unit, University of Wisconsin – Stevens Point*
Co-author(s): Daniel A. Isermann, Daniel J. Dembkowski, Zachary S. Feiner, and Olaf P. Jensen

Abstract:
Bluegill support important harvest-oriented fisheries across the Midwestern USA, making it important for fishery managers to understand the potential effects of climate change on population dynamics at a broad spatial scale. Specifically, somatic growth and size structure are characteristics influenced by climate and other environmental factors that can play an important role in determining where anglers decide to fish. Consequently, the objectives of this research are to determine if a suite of abiotic and biotic factors explain variation in bluegill growth and size

structure among lakes across the Midwestern USA. We also aim to provide fisheries managers with growth and size structure standards for categorization of bluegill populations within the region. We plan to utilize a hierarchical modeling structure to synthesize survey data on bluegill populations from across the Midwest, as well as additional sampling to increase otolith-based estimates of bluegill length-at-age in Wisconsin. These results will be used to predict the future status of bluegill fisheries with climate change and to determine how projected fishery changes might affect angler behavior.

Potpourri

Title: **Applications of Parentage-based tagging in Stocking Evaluations**

Author: Paul Albosta, *USGS-Wisconsin Cooperative Fishery Research Unit, University of Wisconsin – Stevens Point*
Co-author(s): Jared J. Holoma

Abstract:
Tagging programs are critical for evaluating the success of fish stocking efforts. Analysis of tag recovery data from stocked fish can be used to evaluate numerous processes, including survival of stocked fish, return-to-creel rates, dispersal patterns, and growth rates. Traditional tagging methods can be expensive, may require invasive techniques, and can affect behavior and survival of tagged fish. In addition, some fish may lose their tag over time, regenerate a fin clip tag that cannot be identified, sustain a fin injury that resembles a fin clip tag on an untagged fish, or require lethal recovery of the tag. All these issues reduce the usefulness of tagging data and their ability to guide fisheries management decisions. An alternative to these traditional methods is parentage-based tagging (PBT), which only requires a fin clip from broodstock fish for genetic analysis. The genetic information of the broodstock is used to genetically "tag" all offspring, which can be unambiguously assigned back to their parents. PBT is labor efficient—collecting genotypes from dozens to hundreds of broodstock individuals results in passive tagging of all their offspring, potentially millions of fish. When offspring are later captured, genotyped, and assigned to parental broodfish, results can be used to gain information including hatchery of origin, age of stocked fish, and distinguishing stocked fish from natural populations without the potential for false assignment. We recently used PBT to evaluate stocking success of walleye in six Wisconsin lakes. We found that the proportion of stocked walleye ranged from 97.4% to 0.0% in these lakes. Additionally, an aging assessment determined that 26% of walleye stocked into Lake Mendota in 2014 that were collected in 2019 were assigned incorrect ages. PBT is increasingly being recognized as a viable tagging strategy for stocked fishes in Wisconsin with similar projects underway in our lab for four additional species.

Title: **Lower Chippewa River Lake Sturgeon - Here today, gone tomorrow: A preliminary look at movement of the spawning stock**

Author: Joseph Gerbyshak, *Wisconsin Department of Natural Resources*

Abstract:

It is known that Lake Sturgeon (Acipenser fulvescens) need large stretches of riverine habitat to fulfill life history needs, and according to tagging information, Lake Sturgeon have been recorded traveling long distances in the upper Mississippi River watershed. Floy and PIT tag returns show that Lake Sturgeon tagged in the Chippewa River have been captured in the St. Croix River, Wisconsin River, Red Cedar River and as far south as Pool 20 in the Mississippi River, at least a 495-mile journey. Many questions remain about the geographic extent of their home range, frequency of movement between tributaries, and whether different stocks exist in each tributary or if there is one large Mississippi River population. A project is underway to answer these questions using hydroacoustics to monitor the movement of these fish. Eleven receivers have been placed in the Chippewa River, Red Cedar River, St. Croix River and Black River to monitor use of these waterbodies by Lake Sturgeon. These receivers will complement an array of receivers deployed in the Mississippi River by other agencies. In April of 2021, during the spawning run on the Chippewa River, 40 Lake Sturgeon (30 males, 8 females, 2 unknowns) were surgically implanted with Vemco V16 10-year transmitters. Receivers were downloaded in August of 2021 and initial data indicates that 80% of the Lake Sturgeon tagged left the Chippewa River within six weeks of tagging and 35% left within one week of tagging. These initial results suggest that the majority of Lake Sturgeon using the Chippewa River to spawn are not Chippewa River resident fish and that the Chippewa River is likely a vital tributary for Lake Sturgeon natural reproduction.

Title: **Station Holding and Movement of Slimy Sculpin (Cottus Cognatus) on Differing Substrates**

Author: Avery Lettenberger, *University of Wisconsin – La Crosse*
Co-author(s): David Schumann

Abstract:
Coldwater streams in the Driftless region of Southwestern Wisconsin are sensitive to inputs of fine sediments that limit interstitial space that is crucial to benthic fishes. Land-use practices and climate change threaten to increase the fine sediment load through overland flow. Freshwater sculpin (Cottus spp.) minimize energetic demands by maintaining position in flowing water by anchoring into large substrates that can be embedded. We describe the influence of embedded sediments on the station-holding abilities of Slimy Sculpin (Cottus cognatus). Slimy Sculpin swimming performance was measured in a 10-L Brett-type flume using an endurance protocol that measures time-to-failure. Sculpin (n = 80) were tested on unembedded gravel (Mean Gravel Diameter =8.3±2.4 mm, n = 100) and gravel fully embedded by fine-sand at eight velocity increments (i.e., 5, 10, 15, 20, 25, 30, 40, 45 cm s-1). Failure time was recorded when the sculpin became impinged on the downflow grate for >10 s with a maximum time of 200 min and no longer respond to a physical stimulus. It is assumed at 200 min that the fish can sustain its position at this velocity indefinitely. Endurance was observed to be higher on the gravel substrate through trials and calculated metrics. The mean failure time at 20 m/s had a difference of 33% between the groups at 57.6 min for gravel and 38.7 min for embedded gravel. Simulated upstream and downstream movement on these same substrate groups is ongoing and currently being tested in a 185-L cascading stream system. Slimy Sculpin in the region are already under stressors from climate change and are preyed on by non-native Brown Trout (Salmo trutta) that are well researched. However, research focused on the risk of sedimentation on sculpin

energetics are rare despite the potential negative population level effects. The distribution of Slimy Sculpin could be influenced by the landscape changes that alter sedimentation rates.

Title: **Lake Chub (Couesius plumbeus) and Longnose Sucker (Catostomus catostomus) distribution and occurrence patterns in the Black Hills, South Dakota**

Author: Kristina Morben, *University of Wisconsin – La Crosse*
Co-author(s): Chelsey Pasbrig, Jeremy Kientz, Jake Davis, David A. Schumann

Abstract:
Freshwater fish populations are at-risk of decline due to habitat degradation, overexploitation and expansion of non-native species. Recovery efforts are hindered for non-game species because relatively little knowledge exists despite being disproportionately represented by species at-risk of extinction. Lake Chub (Couesius plumbeus) and Longnose Sucker (Catostomus catostomus) were thought to be historically abundant and widespread; however, recent surveys documented declines in South Dakota. To inform future management, we updated the distribution and described the population structure of these fishes in the Black Hills region of South Dakota. We identified abiotic and biotic factors that influence detection and occurrence patterns of these species. Fifty-five stream reaches were sampled using backpack electrofishing based on historical records (1893-1989), more recent records (1990-2020), and exploratory criteria (i.e., nearby known sites). Instream habitat and riparian metrics were measured at eleven equidistant points along the stream reach. Detection histories were built using a nested hierarchical framework by sampling three transects (100 m) within each 500m reach. Detection covariates (i.e., temperature, conductivity and turbidity) and occupancy covariates (i.e., water velocity, instream structure and aquatic vegetation) were used to construct competing candidate models and ranked using AIC. We captured 17,809 individual fish, only few were target species: Longnose Sucker (139) and Lake Chub (252). Longnose Sucker and Lake Chub were detected at 8 and 6 stream reaches, respectively. Moving forward, we will describe the genetic interrelatedness of both species and collect finer scale habitat metrics in known streams for higher resolution occupancy and detection models. A complete understanding of the distribution and environmental factors on both species will inform future management efforts, such as reintroductions or habitat restoration of these native fish.