ORAL PRESENTATIONS:

Assessment of Age-0 White Bass and Walleye Seasonal Food Habits, Prey Taxa and Size Selectivity, and Diet Overlap

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Understanding age-0 White Bass *Morone chyrsops* and Walleye *Sander vitreus* food habits, prey taxa and size selectivity, and diet overlap provides early life history information. We documented these prey selection characteristics of age-0 White Bass and age-0 Walleye during in a Nebraska irrigation reservoir. Fish were sampled from 6 standardized sites and zooplankton were sampled from 15 standardized sites using from July-September. Age-0 White Bass (n =300) consumed Diptera spp., Gizzard Shad *Dorosoma cepedianum*, various insect orders, and zooplankton species while age-0 Walleye (n =79) consumed primarily *Calanoida* before shifting to Gizzard Shad. Age-0 White Bass and Walleye displayed similar trends with positive selection of *Calanoida* and negative selection of copepod nauplii. Age-0 White Bass selected larger calanoid copepods during each month and year evaluated and age-0 Walleye selected larger calanoid copepods during July. High diet overlap by caloric density was documented during August and September as age-0 White Bass and Walleye were both consuming Gizzard Shad. Results from this study identify that age-0 White Bass and Walleye share similar prey taxa, target larger zooplankton from the environment and have high dietary overlap indicating that prey has the potential to be a limiting factor.

Indexing Recruitment for Source Populations Contributing to Mixed Fisheries By Incorporating Age in Genetic Stock Identification Models

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A methodology was developed for estimating relative recruitments for source populations (sources) contributing to mixed fisheries by incorporating age into genetic stock identification models. The approach produced recruitment estimates that were strongly correlated (median correlation = 0.849; 2.5 and 97.5 percentile in correlations = 0.613 and 0.951) with simulated recruitments across various design factors, including number of sources, genetic divergence among sources, and temporal variation in source recruitments. Sensitivity analyses indicated that the approach was robust to aging inaccuracies and assumed source mortalities. Application to walleye *Sander vitreus* sources contributing to the Saginaw Bay, Lake Huron fishery produced similar recruitment estimates to assessment models. There was greater discrepancy between recruitment estimates for lake trout *Salvelinus namaycush* hatchery strains in northern Lake Michigan when compared to strain stocking levels, although this mismatch may stem from stocking levels being a poor recruitment measure. The estimation approach should prove beneficial for indexing source recruitment based on fishery or assessment

collections from mixtures, even when long-term time-series of harvest and survey data required for integrated assessments are not available.

Environmental Drivers of Lake Erie Walleye Harvest

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Changing environmental conditions can drive variability in fishery harvest. For instance, interannual variation in temperature might modify the timing and spatial extent of fish migrations, which could alter fishery catches. To better understand the linkages that exist between environmental variation and fishery catches, we explored the relationship between temperature and the temporal and spatial distribution of walleye (Sander vitreus) recreational harvest in Lake Erie during 1990-2015. Knowing that adult walleye migrate eastward from the western basin during spring and summer towards cooler temperatures, we hypothesized that: 1) years with higher spring and summer temperatures would be accompanied by reduced catches in the western basin relative to the deeper, cooler central and east basins; and 2) walleye catches in the central and eastern basins would occur earlier during the spring/summer in warmer (relative to cooler) years. To test our hypotheses, we constructed and compared generalized linear mixed models, which used spatially-explicit (10x10 min grids) recreational catch and effort information, as well as temperature, bathymetric, and abundance data. Beyond discussing the role of temperature in driving spatiotemporal patterns in walleye harvest, we discuss the implications for fisheries management under a changing climate.

Donald Pereira

Walleye Management in the Red Lakes, Minnesota: Collapse, Recovery, and Cooperative Management

Gary Barnard[1]; Anthony Kennedy[1]; William Brown[2]; and, **Donald Pereira**[1]; (1) Minnesota Department of Natural Resources, (2) Red Lake Department of Natural Resources

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Fishery management jurisdiction of the Red Lakes is split between the State of Minnesota and Red Lake Band of Chippewa Indians. Historically, the Red Lakes supported productive commercial and recreational Walleye *Sander vitreus* fisheries before crashing in the 1990s from decades of overharvest. In the late 1990s, these management groups began an inter-agency effort to develop and implement a recovery plan to restore the Walleye population, which included a complete Walleye fishing moratorium with strict enforcement and a short-term fry stocking program. Public involvement occurred early in the planning stages and throughout the implementation process. Public support was essential for effective implementation of restrictive fishing regulations necessary to expedite recovery and to resume harvests. Harvest resumed in 2006 and the Walleye population reached full recovery thresholds in 2009. The collapse of the Red Lakes' walleye fisheries was catastrophic, but provided an incredible opportunity to increase our understanding of walleye population dynamics, the importance of collaborative fishery management and public involvement in decision-making processes.

David G. Fielder

Recovery of Saginaw Bay Walleye, Lake Huron

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Saginaw Bay is a large cool water region of Lake Huron and Walleye is the apex predator. The fishery collapsed in the 1940s due to declining water quality, habitat degradation, and effects of invasive species. After clean water legislation in the 1970s and the closure of the commercial fishery, a new period of improvement was achieved. Walleye fingerling stocking was implemented and a recreational fishery emerged. Recovery plans sought to restore spawning habitat and improve survival of walleye fry by creating a predation barrier to the predatory effects of the invasive Alewife. A series of cascading food-web changes took place resulting in the sudden collapse of Alewives

and Walleye natural reproduction surged beginning in 2003. Walleye stocking was discontinued and recovery targets were met in 2009. Key lessons learned include; (1) eliminating or reducing obstacles to reproduction such as habitat and water quality issues. (2) maintaining populations (via of stocking) to ensure brood fish are available when conditions improve; (3) ecosystems are resilient and will improve when released from stressors (4) great value exists in long-term data sets for guiding restoration; (5) resolve and commitment by natural resource professionals, administrators, and stakeholders is critical for sustaining restoration efforts.

Christopher Vandergoot

Back from the Brink: Sustainable Management of the Lake Erie Walleye Fishery

Christopher Vandergoot USGS Great Lakes Science Center; Matthew Faust, Ohio Department of Natural Resources; James Francis, Michigan Department of Natural Resources, Don Einhouse, New York State Department of Environmental Conservation; Richard Drouin, Ontario Ministry of Natural Resources; Chuck Murray, Pennsylvania Fish and Boat Commission; and, Roger Knight, Great Lakes Fishery Commission

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Intensive fishery exploitation during the 1950s combined with declining environmental conditions collapsed the Walleye stock during the early 1960s, but the fishery persisted at low levels until 1970 when the fishery was closed (1970-1972) due to elevated mercury concentrations in tissue samples. Lake Erie fishery managers recognized the need for a coordinated, multi-agency approach to protect this ecologically, economically, and socially important resource. In 1976, an inter-agency management framework was established, which relied on a coordinated, science-based management philosophy consisting of estimating safe harvest levels, performing applied research, and conducting annual population assessments. Today, Lake Erie Walleye support one of the largest self-sustaining freshwater fisheries in North America. Lake Erie managers have iteratively adopted changes to their population assessment model and altered harvest policies to avoid future fishery and population collapses, and more than 40 years later, Lake Erie continues to support commercial and recreational fisheries lake wide. Through time, the resurgence of this fishery can be attributed to lessons learned from coordinated management efforts associated with conducting routine population assessments, using science-based research to address key uncertainties, adopting modern stock assessment

approaches, incorporating stakeholder input into the quota setting process, and addressing environmental concerns collaboratively at the lake level.

Assessing Climate-Driven Changes in Fisheries and Ramifications for Agencies and Anglers: A Case Study of Wisconsin's Inland Lake Walleye Fishery

Ralph W. Tingley Missouri Cooperative Fish and Wildlife Research Unit; The School of Natural Resources; University of Missouri; Craig Paukert U.S. Geological Survey; University of Missouri; Missouri Cooperative Fish and Wildlife Research Unit; Gretchen Hansen Minnesota Department of Natural Resources; Matthew Diebel Wisconsin Department of Natural Resources; Alexander W. Latzka Wisconsin Department of Natural Resources; Greg G. Sass Wisconsin Department of Natural Resources; Abigail Lynch USGS National Climate Adaptation Center.

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Adapting management to provide opportunities for recreational and subsistence anglers is needed as environmental change continues. In some instances, stocking can be implemented to retain fisheries, but cumulative costs may be masked as habitat changes slowly over time. Therefore, assessments that weigh costs against potential benefits are valuable prioritization tools. We estimated costs to retain Wisconsin walleye inland lake fisheries predicted to lose self-sustaining populations as environmental conditions change. First, we developed current and future predictions of adult walleye presence in lakes and streams and of successful natural recruitment in lakes, then classified lakes based on ability to support walleye at each life stage. Second, we estimated costs required to retain fisheries using region-specific costs per fish and stocking protocols. We predicted that only 19% of current walleye lake fisheries will be self-sustaining at mid-century, most of which are connected to rivers that support walleye. Nearly 75% of lakes with current natural recruitment are predicted to lose self-sustaining populations but will remain stocking opportunities, with additional costs to retain fisheries estimated at $1.4 million dollars biennially. Our study also highlights how existing angler and tribal harvest data can be used with our results to prioritize future management actions

Coarse Woody Habitat and Inland Lake Fisheries: Knowns, Unknowns, and Current Studies

Greg G. Sass

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Addition of trees to the littoral zones of inland lakes is a commonly used management practice aimed to restore fish habitat. However, fishery and aquatic ecosystem responses to this management practice have rarely been evaluated. Removals of coarse woody habitat (CWH) from lakes as a result of lakeshore residential development, physical removal, and lake level decline have resulted in reduced fish growth rates, functional extirpations of forage fishes, and changes in fish behavior. Studies of CWH additions have not entirely reversed the negative influence of CWH loss; however, have served to attract fishes, increase prey diversity available to fishes, and alter fish behavior. Currently, several management issues and critical research needs remain regarding lake structural restorations including: 1) Does CWH only attract fishes?; 2) Does CWH increase fish production?; and 3) Are CWH additions beneficial to all inland lake fish species? Preliminary results from a long-term (25-30 year), whole-lake study of CWH additions (tree drops) that aims to address these critical management

and research needs by examining fish production (muskellunge, walleye, smallmouth bass, yellow perch, bluegill, rock bass) and aquatic ecosystem responses to this management practice on a northern Wisconsin lake will be discussed.

Sex Reversal Trials on Walleye, an Example of Interagency Aquaculture Cooperation

Daniel J. Schill Idaho Department of Fish and Game; Elizabeth Mamer Idaho Department of Fish and Game; Alan Johnson Iowa Department of Natural Resources; Jay Rudacille Iowa Department of Natural Resources; Aaron Andrews Kansas Department of Wildlife, Parks, and Tourism; Jason Vajnar Kansas Department of Wildlife, Parks, and Tourism; Daric Schneidewind Kansas Department of Wildlife, Parks and Tourism.
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Development of All-female Walleye broodstocks could improve angler satisfaction in Midwest states while creation of YY Male Broodstock could assist with exotic Walleye eradication. We fed fry feed top-coated with either Estradiol (E2) or Methyltestosterone (MT) at the Rathbun and Meade Hatcheries in Iowa and Kansas. At 171-176 dph, 255 and 181 fish were euthanized and necropsied from the Meade and Rathbun facilities, respectively. Control sex ratios were 53.1% Female, 43.8% Male (1 unknown) from Meade and 57.4% Female and 41% Male (1 unknown) at Rathbun. Preliminary phenotypic sex calls suggest successful recipe development for sex-reversal in both directions. The proportion designated phenotypic or intermediate females in the three E2 treatment trials ranged from 96.3 to 98.4%. The number of fish designated as either males or presumed males in the two MT trials were 94.0 and 98.4%. “Presumed” male fish lagged far behind females in development and often appeared as bloodlines. Remaining study fish from both hatchery facilities were recently transferred to the Milford Hatchery in Kansas to be reared further to confirm successful sex reversal and normal gonadal development. Combining existing fish culture experience with “outside” sex reversal expertise could prove effective for rapid development of desirable broodstocks.

Evaluation of Freshwater Fish Communities with Edna Metabarcoding: A Quantitative Perspective

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Accurate data on species distribution and abundance are critical for conservation and management of aquatic resources. Several inventory methods, such as gillnets survey, are widely used to estimate those parameters. However, gillnets can be invasive and may cause unwanted mortality in the fish communities studied. Environmental DNA (eDNA) analysis, which consists of detecting DNA traces released by species in their environment, could be used as an alternative or complementary to traditional methods. In this study, we evaluate the pros and cons between metabarcoding and gillnets for monitoring freshwater fish communities in terms of species richness and relative abundance. Gillnetting and water sampling were performed at 17 sites in the Rupert River (Canada) and two different water filtration protocols were used. Metabarcoding was performed with two different amplicons (COI and 12s). We also used species-specific quantitative PCR approach on the walleye to assess the correlation with the

metabarcoding results. Over all sampling sites, metabarcoding generally detected more species than gillnets and also revealed variable level of correlation between eDNA sequences vs. catch-per-unit-effort, with the highest correlation being observed for walleye. This study confirms that adding metabarcoding analysis would improve the performance of such monitoring surveys, especially in remote areas.

Evaluation of Acoustic Telemetry Grids for Determining Aquatic Animal Movement and Survival

Christopher Vandergoot USGS Great Lakes Science Center;
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Acoustic telemetry studies have frequently prioritized linear configurations of hydrophone receivers, such as perpendicular from shorelines or across rivers, to detect the presence of tagged aquatic animals. We evaluated two-dimensional acoustic receiver arrays (grids: receivers spread uniformly across space) as an alternative approach to provide estimates of survival, movement, and habitat use. Performance of variably-spaced receiver grids (5–25 km spacing) was evaluated by simulating (1) animal tracks as correlated random walks; (2) variable tag transmission intervals along each and (3) probability of detection of each transmission based on logistic detection range curves. From simulations, we quantified i) time between successive detections on any receiver (detection time), ii) time between successive detections on different receivers (transit time), and iii) distance between successive detections on different receivers (transit distance). Comparison of the simulations with pilot studies on three fish species (walleye *Sander vitreus*, common carp *Cyprinus carpio*, and channel catfish *Ictalurus punctatus*) from two independent large lake ecosystems (Lakes Erie and Winnipeg) revealed shorter detection and transit times than what simulations predicted. By spreading effort uniformly across space, grids can improve understanding of fish migration over the commonly employed receiver line approach, but with increased time cost for maintaining grids.

Observations on Wind Patterns and Associated Nearshore Water Velocities Affecting Substrates and the Early Life History of Walleye in Minnesota Glacial Lakes

Douglas Zentner University of Arkansas at Pine Bluff; Timothy Cross Minnesota Department of Natural Resources; Joshua Raabe University of Wisconsin-Stevens Point; Peter Jacobson Minnesota Dept of Natural Resources; Benjamin Schall South Dakota Game, Fish, and Parks; William Herb University of Minnesota
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Wind and water dynamics have rarely been quantified in lakes other than the North American Great Lakes. We present findings on wind-wave energy influence on nearshore substrates in these systems, with implications to Walleye early life history. Wind patterns, fetch, shoreline slope, and riparian height influence nearshore habitat distribution within Minnesota glacial lakes. Models accurately predicted site substrate composition at individual (78%) and multiple (68%) lake scales. Measurements of 2-dimensional nearshore currents in Belle Lake, MN allowed us to map current response to wind energy. Inward shoreline bends (bay features) sustained current directions predominantly toward shore and outward bends (point features) predominantly away

from shore. Predominant flows along shorelines offered insight into longshore drift. Nearshore water movements associated with Bulrush spp. had altered directionality and decreased velocity. Walleye spawning occurred in high wind energy areas where 2-dimensional velocity measurements showed variable currents across sites and years. Currents may effect recruitment as velocities capable of transporting eggs were observed. Currently wind speed, wind direction, and wave height data are being collected at multiple lakes to create accurate wave height and energy models. Understanding shoreline wind and wave dynamics offers insight into undocumented factors that influence aquatic biota, physical and chemical habitats.

Potential Sources of Sauger Sander Canadensis for Reintroduction into Lake Erie

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Information about current and historical population structure helps fishery managers make informed decisions about potential sources for re-establishment of commercially important species. Genetic tools allow analysis of historical samples to provide insights about suitability of potential donor stocks. The commercial fishery for Lake Erie Sauger was one of the first fisheries to collapse in Lake Erie. The Ohio Department of Natural Resources is considering another attempt since the current fish community and habitat conditions are currently suitable for Sauger survival and proliferation. Choosing potential sources for reintroduction programs requires consideration of several factors. A review of the literature and a genetic analysis of historical Sauger collections and contemporary samples from possible donor populations were performed to develop list of best candidates for a re-introduction program. Comparisons of genetic diversity and other life history parameters of historical Lake Erie Sauger to contemporary Sauger from the Ohio River to populations from Ontario, Quebec, Wisconsin, and South Dakota indicated that while life history and ecological conditions were similar there were genetic differentiation among all potential donor sources and historical collections of Sauger from Lake Erie with contemporary populations from the Ohio River being most similar to historic Lake Erie Sauger.

Variety Pack: Utilizing a Diversity of Data Sources to Assess Angler Behavior in Response to Fisheries Management Actions

Tony J. Barada Nebraska Game and Parks Commission; Aaron J. Blank Nebraska Game and Parks Commission

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Recreational fisheries managers are tasked with many things, but the end goal often involves satisfying the anglers utilizing the resource. Obtaining angler-focused data can be difficult and expensive. Traditionally, licensed angler surveys (mail or email) and on-site creel surveys have been used to monitor angler behavior. However, there are many

other outlets where anglers express their opinions, attitudes and behavior. We used an online fishing community forum to assess angling pressure and catch on a regional level. During this analysis, we were able detect increases in relative fishing pressure and catch in response to implementing an aggressive walleye stocking program. We also explored other forms of online data to help characterize and explain local angler behavior. Ultimately, we demonstrate that using a combination of available data (obtained by traditional and emerging methods) can give managers the best overall description of the anglers and angler groups they are managing for.

Those Were the Days: Are Historical Changes in Abundance and Community Structure of Kawartha Lakes (Ontario, Canada) Piscivore Communities the Result of Climate Warming?

Michael Fox Trent University

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Changes in the piscivore community of four large lakes in the Kawartha Lake region of Ontario (Canada) were examined using fisheries assessment data over a 35 year period (1980-2015), and relating catches to trends in temperature, turbidity and total phosphorus concentration. Over this period, mean summer temperature increased by an average of 5% annually. Both turbidity and total phosphorus concentration decreased significantly over time in three of the lakes. Mean CPUE of walleye in trapnets showed a declining temporal trend in all of the lakes. In contrast, three lakes showed an increase in largemouth and smallmouth bass CPUE over time. As a result, piscivore community composition changed, with a regional-scale decline in the abundance of walleye relative to that of warmwater bass species. While the decline in air temperature over time generally corresponded with an increase in relative walleye abundance, the latter was more strongly predicted by either turbidity, total phosphorus concentration or the two variables in combination in three of the lakes. These data suggest that climate warming, in combination with regional declines in turbidity and nutrient concentration are affecting the makeup of the fish community in the Kawartha Lakes by favouring bass over walleye.

Trends in Relative Weight of Percid Stocks in Select New York Waters 1991–2016

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Walleye *Sander vitreus* and Yellow Perch *Perca flavescens* are a common predator-prey combination in North America that is actively managed to support fisheries throughout New York State (NYS). Fishery status in most fish populations is strongly linked to growth rates, change in body composition, and condition. In many cases relative weight (Wr) may be a more robust predictor of fecundity than that of growth. The ability to quantify the relation between fish weight and length is essential for effective fisheries management. We used Bayesian hierarchical methods to estimate changes in Wr using length-weight data for Walleye and Yellow Perch collected from various waters in southeastern NYS from 1991 to 2016. Walleye Wr was similar between waterbodies, but Wr of Yellow Perch was lower in Canadarago Lake than in other lakes, consistent with

regional concerns about this population. Decreases in Wr of Yellow Perch in this system occurred concomitantly with Alewife Alosa pseudoharengus introduction. On a regional scale, annual Wr for Walleye increased from 79 to 104, and Wr for Yellow Perch decreased from 73 to 84. Future work on percids in this region will investigate a number of factors that influence length-weight relationships.
*Student

POSTERS

P-61: Population Dynamics of Spawning Walleye in Otsego Lake, NY (poster)

Hayley Dower SUNY Oneonta; Dan Stich State University of New York College at Oneonta

Monday, August 20, 2018 06:00 PM - 08:30 PM Atlantic City Convention Center- Hall B

Walleye are a popular game fish in North America that are stocked to support recreational fisheries and attempted control of Alewife. Following the reduction of Alewife in Otsego Lake, NY, there is evidence that Walleye are successfully recruiting through natural reproduction. This research attempted to provide information about the walleye population. We investigated demographics of spawning walleye, collected 528 spawners in tributaries during spring 2017, and applied PIT tags. We recaptured Walleye throughout the year for quantitative estimates of population parameters. Sex ratios, age, growth, and size structure were estimated using this information. Walleye in Otsego Lake appear to be fast growing compared to other regional lakes, and sizes were similar between streams. Preliminary results indicate a low proportion of females across spawning streams (< 10%), consistent with previous work. Females (mean = 537 mm TL) were also significantly larger than males (mean = 487 mm TL), a relationship that was consistent across streams. These results indicate that Walleye are likely persisting at relatively low densities corresponding to fast growth rates even after the elimination of Alewife from this system, but that recruitment may be sensitive to harvest of large females from this population in the absence of stocking.

P-139: Using Monte Carlo Simulations to Estimate Larval Abundance of Walleye (Sander vitreus) in the Maumee River, Lake Erie (poster)

Nathan Johnston Bowling Green State University; Jeffrey G. Miner Bowling Green State University

Monday, August 20, 2018 6:00 PM - 08:30 PM Atlantic City Convention Center- Hall B

Walleye (*Sander vitreus*) is an important sportfish in Lake Erie and its surrounding tributaries. However, estimates of recruitment for this and many fishes is highly variable. Just using environmental factors to predict recruitment has been shown to be imprecise, and the high variability of recruitment year to year adds uncertainty to future predictions. The intensity of sampling in previous studies has ranged across a wide temporal scale, from every 5 hours to twice every week. Due to the high amount of uncertainty, a model must be used which accounts for it. Therefore, a Monte Carlo Simulation was run using

2016 and 2017 estimates of larval walleye abundance and compared to 2018 estimates to establish the efficacy of this method as a predictor of larval abundance.

P-142: Dynamic Patterns of Zooplankton Prey and Larval Fish Growth in a Lake Erie River/Bay Complex

(poster)

Christopher Kemp Bowling Green State University; Jeffrey G. Miner Bowling Green State University;

Monday, August 20, 2018 6:00 PM - 08:30 PM Atlantic City Convention Center Hall B

Walleye and White Bass are important sport fisheries within Lake Erie and are contributors to the regional economy. Biologists recognize that year-class strength is correlated with larval fish survival and growth rates. Upon exogenous feeding, availability of zooplankton prey resources can be critical (match-mismatch hypothesis). Zooplankton densities within nursery habitats can show significant heterogeneity, depending on a number abiotic factors. We quantified the densities of larval fish and zooplankton in Sandusky River/ Bay at 23 sites in the spring and summer (April 2018 - June 2018) to determine the degree of spatial heterogeneity in zooplankton densities while also quantifying the overlap of Walleye and White Bass larval fish growth and densities with these zooplankton resources. We found that in areas of shallow depth and low flow, where water has been retained for greater periods, zooplankton density was greater and community membership was different when compared to areas of greater water depth and high flow. Larval fish densities were greater in areas of increased hydrologic retention when compared to areas of greater water depth and flow. These results highlight the extreme spatial and temporal patterns of zooplankton prey in nursery habitats and growth rate differences for larval fishes in these patterns.