**Upper Mississippi River Basin Association**

**Water Quality Task Force Virtual Meeting**

**January 25, 2023**

**Draft Highlights and Action Items Summary**

**Approval of the WQTF October 4, 2022 Meeting Summary**

The UMRBA Water Quality Task Force (WQTF) approved the October 4, 2022 draft highlights and action items summary.

**Fast Limnological Automated Measurements (FLAMe) on the Illinois River**

Dr. Luke Loken described FLAMe ​as a mobile sampling platform designed to measure surface conditions across individual rivers and lakes. Traditional sensor technology is coupled with a global positioning system (GPS) to produce high resolution maps of surface water chemistry. The maps generated identify point source locations, infer processing rates, and produce distributions of surface water conditions. Examples of select parameters included in the sensors are temperature, conductivity, dissolved methane, dissolved carbon dioxide, nitrate, absorbance, tryptophan, algae fluorescence, and *E. coli* bacteria metabolic activity.

Loken shared the research questions for the FLAMe project on the Illinois River:

* How does water quality vary across the entire Illinois River?
* How do nutrients, turbidity, and hydrology relate to algal dynamics and productivity?
* How do these influence carbon and nitrogen cycling?

Transects for the Illinois River were collected in May, August, and November 2022. An upcoming transect is planned in March 2023. Discrete samples were also collected.

Loken displayed three transects of the following parameters: nitrate, turbidity, chlorophyll, dissolved oxygen, carbon dioxide, and methane. Note that the data are preliminary and not yet published. The three transects of nitrate data show the contributions of wastewater treatment plants in Chicago across seasons. In November, high concentrations of nitrate were observed in Chicago, likely due to reduced flow from Lake Michigan and colder temperatures.

Some initial conclusions include multiple parameters vary longitudinally in the Illinois River; nutrients, light availability, and hydrology likely control phytoplankton dynamics; and differences in respiration and production lead to variation in dissolved gases – e.g., oxygen, carbon dioxide, methane. In the future, Loken hopes to conduct similar transects on the Upper Mississippi River.

Kathi Jo Jankowski asked if there is spatial variation in carp populations longitudinally in the Illinois River (e.g., lower populations closer to Chicago)? Jankowski was curious if any top-down carp effects would impact spatial variation in chlorophyll. Loken replied that the carp observed while the transect was being conducted varied longitudinally. Carp are actively managed in the upper part of the Illinois River. Loken is aware of research that has hypothesized there is a natural chemical defense acting as a fish barrier. The research has observed that carp in the upper reaches are less fit than in the lower reaches. Loken added that on the carp and chlorophyll relationship, there is a positive bottom-up influence of algae on carp i.e., carp consume chlorophyll. Loken postulated that there is a light limitation effect near Peoria as turbidity is high. Jankowski agreed and offered to send papers showing correlations between population size and chlorophyll concentrations over time in the Illinois River and some looking at filtration effects on algal communities.

Houser noticed the high methane, chlorophyll, and dissolved oxygen (DO) concentrations downstream of Starved Rock pool and asked Loken if he has any theories about why that is occurring. Loken responded that usually methane and carbon dioxide are paired together and used as an indicator of respiration. Methane can also be coupled with primary production if there is high algae or algal biomass and more productive lakes can also have high methane. Oxygen, carbon dioxide, and methane together can illustrate the dynamics of the metabolic regime transitioning from primary production to respiration to anaerobic. Loken plans to research those dynamics in the future.

In response to a question from Albert Ettinger, Loken said all measurements are taken between 8 a.m. and 4 p.m. Carbon dioxide concentrations are quite high but in a larger river system temporal and spatial noise is less of a concern. Ettinger understands that standard eutrophication means that DO is high during the day and carbon dioxide is low. Loken said the signal of high DO during the day and carbon dioxide levels depend on how much respiration is occurring at night. Using information from fixed stations, USGS scientists have observed that carbon dioxide variation in this region is not as large. Ettinger asked if the methane concentrations are of concern for climate change impacts. Loke replied that inland waters have always been a source of greenhouse gas emissions. By design, rivers receive all the things we put in them either naturally or artificially. Loken believes that methane in urban and human-influenced areas is a larger concern than methane emission from rivers. In response to a question from Ettinger about phosphorus data, Loken replied that 30 grab samples were collected. FLAMe does not currently include a phosphate sensor. Houser asked if the primary source of methane is from Chicago’s greenhouse gas emissions. Loken said there is some human influence on methane cycling. In general, humans have elevated methane emission from inland waters. There is a positive link between eutrophication and methane – e.g., warmer temperatures create more methane and anoxia makes more methane. Loken offered to chat more as he and his collaborators are transitioning from data gathering to interpretation.

Kim Laing asked if Loken had to create data systems to support this rich dataset? Loken agreed there is a lot of data handling. Loken and his collaborators have developed workflows to quickly QA/QC, filter, and plot data to get to interpretation. There are not site IDs for every collection point so the best place for the data is in Science Base.

**Fish Tissue Monitoring**

*National Fish Tissue Monitoring*

John Healy works in the USEPA Office of Science and Technology (OST) and described USEPA’s fish tissue monitoring studies. The first national fish tissue study conducted by USEPA was during 2000 to 2003. Since 2008, seven fish tissue studies have been conducted under the National Aquatic Resource Surveys (NARS). Across the seven studies, analysis of skin-off fillet composited samples was collected for mercury, PCBs, PFAS, and other target chemical groups that have been included periodically along the way – e.g., PBDEs, dioxins and furans. Three of the seven studies were conducted through the National Rivers and Streams Assessment (NRSA) which includes the Upper Mississippi River and its tributaries. The sampling design of NRSA is probabilistic based assessments. Fish species are selected based off their abundance, those commonly consumed by people, and the volume of tissue to be analyzed.

Some conclusions from the NARS are that mercury and PCBs are widely distributed in fish from U.S. rivers and lakes, including the Great Lakes and PFOS is the dominant PFAS in freshwater fish. PFOS was detected in nearly every river and Great Lakes fillet composite sample.

Healy provided links to learn more:

* USEPA fish tissue studies: <https://www.epa.gov/fish-tech/studies-fish-tissue-contamination>
* USEPA national lake fish tissue survey design: <https://link.springer.com/article/10.1007/s10661-008-0685-8>
* Contaminants in fish from U.S. rivers: probability-based national assessments: <https://www.sciencedirect.com/science/article/pii/S0048969722076604>
* Study comparing biopsy plugs versus whole homogenized fillet for mercury and selenium analysis: <https://link.springer.com/article/10.1007/s00244-021-00872-w>

In response to a question from Robert Voss, Healy replied that the contaminates are reported in wet weight and not percent moisture. For selenium, percent moisture is reported. Voss asked the question because Missouri DNR has been trying to process archived fish tissue, which has become desiccated over time due to the freezing process. The approach has been to weigh the fish before freezing so the weight can be used once calculations are conducted. Healy said USEPA has been trying to promote the awareness of using archived fish tissue, but there is not much interest in reanalyzing older tissue. In response to a question from Ettinger about arsenic analyzed, Healy said that arsenic is not typically analyzed except for the National Lakes Fish Tissue study reported out in 2009. It has come up in the context of naturally occurring arsenic in USEPA Region 10. Otherwise. USEPA has not conducted arsenic in fish tissue studies at a national scale. Ettinger observed total arsenic fish tissue data on the Ohio River, and concentrations were higher than the former USEPA recommended arsenic criteria. Voss advised caution with arsenic in fish tissue, stating that speciation is required to determine which form of arsenic is toxic to the fish.

Salvato asked what changes are ahead for fish tissue sampling through NRSA. Healy said USEPA is having internal discussions now on whether to move fish tissue monitoring from every five to every 10 years. Contaminants would likely include PCBs, mercury, and PFAS. The advantage of moving to a 10-year cycle would be increasing the scope of contaminants.

*Regional Ambient Fish Tissue Monitoring Program*

Steve Schaff said that most of the knowledge and history of the Regional Ambient Fish Tissue (RAFT) program has retired. The RAFT program began in 1977 after USEPA Headquarters recommended regions analyze fish tissue. The original effort was focused on analyzing whole fish and lipids but in the 1980s that shifted to fillets, the portions of fish consumed by people. The two monitoring strategies included status and trends with sites spanning the four USEPA Region 7 states: Kansas, Nebraska, Iowa, and Missouri. Initial data collected was for the following parameters: DDT, chlordane, mercury, and PCBs. The program eventually shifted to solely focus on mercury. Fish fillet plugs are taken in predatory sport fish and common carp may also be used for historical comparison. The RAFT program ended for Region 7 states but currently serves the tribes located in Region 7. Future RAFT initiatives include continued tribal sampling to promote cooperation in environmental sampling and sampling water bodies not sampled by state agencies. Schaff said he hopes to incorporate PFAS and microplastics into the sampling program.

Ryan Sparks asked if antibacterial or other atopic solutions are applied to the area of the plug to prevent future disease? Were plug samples composite samples or individual fish samples? Schaff replied that antibiotic spray is not used for RAFT samples, but it is used for the NRSA. The samples are composite samples for each sampling location, and average weight and length is recorded. Salvato asked how long fish tissue data has been collected for tribes. Schaff was unsure but recalled it was around 2008.

*Missouri’s Mississippi River Data*

Voss recalled that in 2012 USEPA dropped trend site support for organics and other contaminants, but still supported mercury fish tissue analysis. Missouri DNR decided to absorb the cost of analysis but narrowed its sites to 13 statewide collected every other year. Two of those sites are on the Mississippi River at Caruthersville and Hannibal.

Voss presented results comparing average concentrations over time for bottom feeders at Caruthersville and Hannibal. One note of caution is that over the years, Missouri DNR has used multiple laboratories for fish tissue analysis. USEPA Region 7 was the first lab used through the RAFT program, then USGS Columbia Environmental Research Center was used, then Pace Analytical and as of 2021, Eurofins. Voss has observed noise in the data. For example, for DDT and metabolites, the trend was generally decreasing. There is a noticeable spike of DDT in 2021, which may be related to the change in laboratories but could have also been a spike in the contaminant. Voss added that 3-5 whole fish fillets are composited and blended together. This method aims to mitigate an individual fish spiking the concentration of the contaminant. Voss said that variables like the average body weight and average percent fat of the fish are important to take into account and can affect what the concentrations of contaminants are doing over time.

Salvato asked if the new laboratory used by Missouri DNR can analyze previously frozen samples to help determine the cause of the spike. Voss replied that Missouri DNR will not go back and analyze old fillets. There were years that Lindane, for example, would spike and the next year would be lower. In response to a question from Salvato about accessing fish tissue data, he said that the data are available to download but there is not a public interactive tool. Healy asked about the decision to look at whole fish rather than fillets. Voss replied that the RAFT long term trend sites used whole fish for bottom feeders and DNR wanted to maintain that for trend analysis. For fish advisories, Missouri DNR collects fillets and biopsy plugs for mercury and lead. There is a mercury dataset for bottom feeders, but the concentrations are low.

Micah Bennett asked Voss if Missouri has preliminary work on cyanotoxins in fish tissues in Missouri. Bennett recalled there is a session at the national fish workshop coming up. Voss replied that Missouri Department of Health, Missouri Conservation Department, and one of the state universities were involved. Voss recalled fillet data were low or non-detect for microcystin, while liver tissue had hits ranging from 300-400 ng/g.

*Iowa’s Mississippi River Data*

Ken Krier described Iowa’s effort to conduct fish tissue monitoring after analysis under Region 7 was significantly reduced in 2012. The Iowa Fish Tissue Monitoring Program (IFTMP) is a continuation of the RAFT program. Moving forward trend sites will be sampled every five years (the last sample was in 2016). Data are used to develop trends and not for fish advisories. Iowa’s methodology is to analyze fish tissue plugs for mercury in predator species and to analyze composite skin-off fillet samples from bottom feeder species for mercury, chlordane, PCBs and dieldrin.

Krier displayed the contaminants analyzed in fish tissue since 1980s. He observed that the data are hard to show in a meaningful way because analytes were dropped out over time. In general, the contaminant average concentrations are as follows:

* PCBs: The last time Iowa issued a “do not eat” advisory level was in 1982. Since the late 1980s there have been few instances where there is a “one meal per week” advisory.
* Chlordane: Concentrations of the contaminant since 1982 have been far below the “one meal per week” advisory.
* Mercury: There has been no exceedances of the “one meal per week” advisory since 1982. For mercury results in predatory fish species, only once has the average concentration exceed the “one meal per week” advisory level of 0.3 mg/kg.
* Dieldren and DDE: Since 1982, results for both contaminants have decreased to near 0 mg/kg.
* Selenium and Pentachloroanisole (PCA): Both contaminants have had spikes in concentrations since 1988 and 1994 for PCA and selenium, respectively.

Next steps for the IFTMP are to finish statewide length Mercury advisories in 2023, restart bottom feeder status and trend sampling, conduct follow-up sampling on PCB advisory waterbodies, and to incorporate emerging contaminants in the program moving forward – e.g., PFAS.

Ettinger asked if the general takeaway is that fish tissue results are looking good except for mercury. Krier agreed but caveated that it is important to look at the results with age of fish and sampling techniques. Healy agreed that mercury data has been consistent over the years. Higher concentrations are observed in lentic water bodies.

In follow-up, Ettinger asked about the state of the knowledge of chloride liberating mercury in sediment. Voss said how mercury gets into fish tissue depends on the form mercury is in. If mercury has undergone methylation, then that form can magnify up the food chain. Different aspects of waterbodies affect the methylation rate. For example, a waterbody receiving fungicides or pesticides used on golf courses may have legacy mercury issues. Prevailing winds and coal burning will impact deposition rates. Missouri Department of Conservation is thinking about how to manage waterbodies if atmospheric deposition is constant. Are there other ways to manage fisheries or waterbodies to discourage the methylation rate and biomagnification rate? A possible strategy is monitoring the growth rates of fish populations. – i.e., to ensure that fish growth rates are stunted, which is a negative consequence of mercury exposure. Voss concluded that it is good to keep an eye on mercury but teasing out if it is increasing or decreasing is complicated.

Zach Leibowitz asked if any of the presenters considered collecting fish egg/ovaries for selenium analysis as the current 304a are based on these values. Voss said that Missouri does analyze selenium in tissues but does not have contaminant concerns for selenium sources in state waters. Missouri DNR looks at selenium for its ability to mitigate the effects of mercury in fish tissue, so it pays attention to the mercury and selenium ration, less the 304a criteria. Healy said that selenium criteria include a fish tissue fillet component in addition to the egg/ovaries and recorded as a dry weight.

*Discussion*

* *Please describe how your state is involved in NARS and NRSA and how funding is leveraged.*  *And what fish tissue methodology is used e.g., plugs, composite, skin on or off fillets.*

*Minnesota –* Laing said Minnesota PCA does not participate in NRSA. The funding is given back to USEPA to contract out field sampling. PCA does utilize the CWA Section 106 dollars to conduct a statewide intensification survey. Fish contaminant work is not included as part of that but in PCA’s watershed monitoring program. PCA analyzes composite fillets for mercury, PCBs, and PFAS. In response to a question from Salvato, Laing said that Minnesota PCA participates in the National Lakes Assessments, National Coastal Assessments, sometimes with the wetlands assessment, and is considering participating in NRSA. In response to a question from Salvato about why Minnesota has not participated in the surveys, Laing replied that the methodologies vary too greatly. USEPA Region 5 is going to be in Minnesota this summer to conduct side by side monitoring.

*Wisconsin –* Mike Shupryt said that Wisconsin DNR participates in all the NARS surveys. The funding is used to enhance state scale surveys and typically samples approximately 50 sites within the state (except for wetlands and coastal surveys). Giblin said that Wisconsin uses skin-on fillets except for catfish and bullheads. Shupryt added the fish contaminant program is robust between the water qualities and fisheries department. In response to a question from Salvato, Giblin said that fish contaminant analysis on the UMR rotates by pool.

Shupryt agreed with Laing’s statement that the methods do not always line up. Healy asked for more clarification about which methods do not line up and which indicators Laing and Shupryt are referring to. Laing replied many indicators do not line up, not just fish contaminant indicators. The side-by-side monitoring with Region 5 this summer will help Minnesota determine based on sampling methodologies which datasets it can utilize. Laing agreed with Shupryt’s comment that if the methods are vastly different, then participation in NARS is closer to a contractor relationship than a participant relationship. Laing added the fish collection methodology in streams is fairly similar. Macroinvertebrate sampling in rivers and streams is very different. The USEPA fish collection method for large rivers is different than Wisconsin’s method. Healy said he would follow up with specific questions. He is interested in increasing state and tribal participation in NARS.

*Illinois –* Sparks said Illinois EPA does not participate in NARS but is planning to participate in the upcoming 2028-2029 NRSA. Illinois EPA’s fish tissue methodologies use skin-off fillets and composite samples of three to five species of similar length.

*Iowa –* Kendall said that Iowa State Hygienic Laboratory (SHL) does NRSA sampling in a contract with Iowa DNR. Krier emphasized the challenge of putting a team together to do additional sampling. Iowa DNR’s ambient program is conducted with the help of SHL staff.

*Missouri –* Voss said fish tissue sampling for mercury is individual fish tissue analysis of nonlethal plug samples. When composite samples are analyzed, fish samples are compiled by combining samples of similar sized fish with less than 25% of variation in size. Whereas for mercury analysis, a variation in size is desired to understand length and age questions of fish associated with mercury contaminant levels. For NRSA, money is passed to USEPA to conduct the monitoring. For other national assessments, funding is passed to the University of Missouri.

**Harmful Algal Blooms**

*The Ohio River HAB Prediction Tool*

Greg Youngstrom discussed the catalyst for the development of the Ohio River HAB Prediction Tool. On August 19, 2015, a HAB was first reported just upstream of Wheeling, WV. In just a couple of weeks it extended over 650 miles, nearly to Evansville, IN and lasted over two months. Recreation advisories covered over 800 miles of the Ohio River. The final recreation advisory was lifted on November 4, 2015.The development of the risk characterization tool was a partnership between USEPA, National Weather Service (NWS) and ORSANCO.

After the 2015 HAB event, USEPA Office of Research Development (ORD) studied and observed two dynamics of the bloom: the bloom spread faster than the flow of water in the river, and rainfall patterns for the duration of the event transitioned from extremely wet to far drier than normal. The combination of events seemed to indicate that rainfall events flush existing nutrients in the river. There is already algae in the system, and long residence times between locks and dams (L&D) allows for the cyanobacteria to bloom.

The model supporting the Ohio River HAB Prediction Tool is based off flow data, the only parameter of sufficient density for statistical analysis, both temporally and spatially. Youngstrom displayed the tool, noting points at each of the L&Ds as well as a few select pool areas. The data capabilities include comparing current flow patterns to 2015 patterns and a display of the percentage of likelihood of a bloom. Water quality parameters from ORSANCO gages and two USGS supergages can also be incorporated. Youngstrom said if there is increased probability of a bloom occurring, he will make a more detailed investigation as to whether deploying ORSANCO staff into the field is necessary.

Considering limited ORSANCO staff capacity and the geographic magnitude of 981 miles of Ohio River, the tool is critical to focus in the areas most needed. Future developments include using the NWS extended forecasts to make future HAB predictions, including turbidity as a controlling factor, and creation of a mobile version.

Ettinger asked if ORSANCO plans to use the data to take action with regard to nutrient levels. Youngstrom said that ORSANCO is active in the Hypoxia Task Force and developing nutrient criteria for the Ohio River.

**Administrative Items**

*Future Meetings*

The next WQEC-WQTF hybrid meeting will be scheduled for June 13-14, 2023 in Muscatine, Iowa.

**Participants**

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| --- | --- |
| Ryan Sparks  | Illinois Environmental Protection Agency  |
| Dan Kendall | Iowa Department of Natural Resources  |
| Ken Krier | Iowa Department of Natural Resources  |
| Kim Laing  | Minnesota Pollution Control Agency  |
| Glenn Skuta | Minnesota Pollution Control Agency |
| Heather Peters | Missouri Department of Natural Resources |
| Robert Voss | Missouri Department of Natural Resources |
| Micah Bennett | U.S. Environmental Protection Agency, Region 5  |
| Kathy Roeder | U.S. Environmental Protection Agency, Region 5  |
| Chelsea Paxson  | U.S. Environmental Protection Agency, Region 7 |
| Steve Schaff  | U.S. Environmental Protection Agency, Region 7  |
| Zachary Leibowitz | U.S. Environmental Protection Agency, Region 7 |
| John Healy | U.S. Environmental Protection Agency  |
| Lisa Larimer | U.S. Environmental Protection Agency  |
| John Wathen | U.S. Environmental Protection Agency  |
| Megan Williams | U.S. Environmental Protection Agency |
| Erin Spry  | Upper Mississippi River Basin Association |
| Lauren Salvato  | Upper Mississippi River Basin Association |
| Shawn Giblin | Wisconsin Department of Natural Resources  |
| Mike Shupryt | Wisconsin Department of Natural Resources  |
| Sean Strom | Wisconsin Department of Natural Resources  |
| Mike Halsted | Wisconsin Department of Transportation  |
| Doug Daigle | Lower Mississippi River Basin Subcommittee |
| Greg Youngstrom | Ohio River Sanitation Commission  |
| Luke Loken | U.S. Geological Survey, Upper Midwest Science Center  |
| Jeff Houser | U.S. Geological Survey, Upper Midwest Environmental Science Center |
| Kathi Jo Jankowski | U.S. Geological Survey, Upper Midwest Environmental Science Center |
| Nicole Manasco  | U.S. Army Corps of Engineers, Rock Island District |
| Davi Michl | U.S. Army Corps of Engineers, Rock Island District |
| Mike Skrabacz | U.S. Army Corps of Engineers, Rock Island District |
| Charles Brown | City of Moline Utilities  |
| Albert Ettinger | Mississippi River Collaborative |