Metropolitan Water Reclamation District *of* Greater Chicago

Press Release

Allison Fore
Public and Intergovernmental Affairs Officer
312.751.6626
allison.fore@mwrd.org
100 East Erie Street, Chicago, Illinois 60611

For immediate release
December 17, 2020

Seven-year study by the MWRD and Argonne National Laboratory assesses the metagenomics of local waterways

Scientists with the Metropolitan Water Reclamation District of Greater Chicago (MWRD) and U.S. Department of Energy's Argonne National Laboratory have concluded a seven-year Microbiome Project resulting in an unprecedented look into the microbes that impact the quality of the Chicago Area Waterway System (CAWS).

The Phase III report of the groundbreaking CAWS Microbiome Project was recently released providing another look into the microbial makeup of water in the CAWS. The study concluded that there were changes in the microbial composition and dynamics of the CAWS following the implementation of state-of-the-art disinfection technologies at the MWRD's water reclamation plants (WRPs) in 2016, and expansions to the MWRD's Tunnel and Reservoir Plan (TARP) with the completion of storage reservoirs. By taking water samples from 16 locations on the CAWS during recreational season from 2013 to 2016, analyzing them through a DNA sequencer and comparing them with samples taken after 2016, the scientists were able to document changes in composition of microbial communities in the river.

The results of this source tracking study attributed microorganisms in the CAWS to a wide range of sources, ranging from wildlife to water discharged from the MWRD WRPs. The scientists also examined how rain events affect bacterial diversity and levels of sewage indicator bacteria in the CAWS. In total, they discovered that the CAWS maintains a rich and diverse microbial community of more than 30,000 species of bacteria found in the water and sediment.

"This leading-edge research helps all of us understand our waterways beyond what we see, smell and touch. It helps us understand at the microscopic level so that we know how to keep pushing for even cleaner rivers," said MWRD Commissioner Cam Davis.

The study also demonstrated a very low abundance (0–0.25%) of virulence associated genes in the CAWS sites across all the years of collection (2013–2019), which suggests that pathogenic bacteria are low in abundance.

A recently completed study by the MWRD and Argonne National Laboratory offers new insight into the makeup of the Chicago Area Waterway System (CAWS) at a microbial level and sheds light into safe recreational use of urban waters.

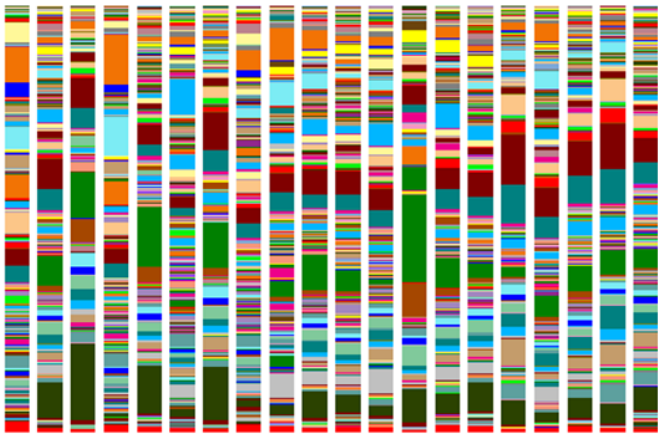
The CAWS Microbiome Project puts the MWRD and Argonne at the forefront of environmental research by examining the microbial communities at the molecular level, addressing sources of contamination and healthy water systems, the report notes. "This study represents the most comprehensive and longest characterization of the microbiome of an urban waterway yet attempted," the report states.

In addition to studying the microbial composition of the CAWS over time and determining the potential sources of bacteria in the CAWS, the study examined the CAWS microbial communities prior to and following implementation of disinfection at the Terrence J. O'Brien and Calumet Water Reclamation Plants and the implementation of the Thornton Composite Reservoir (TCR) and the McCook Reservoir Stage I of the Tunnel and Reservoir Plan.

Constructing the TCR near South Holland, Ill. and connecting it to the TARP's Deep Tunnel in 2015 was instrumental in improving the Calumet River System.

(continued)

Seven-year study by the MWRD and Argonne National Laboratory, *cont.*



The many colors highlight the vast diversity of bacteria found in the Chicago Area Waterway System (CAWS); each column is a different site, and each color represents a unique bacterial species. The CAWS maintains a healthy and diverse bacterial community with more than 30,000 species of bacteria found in the water and sediment. Scientists from the MWRD and Argonne are gaining a better understanding of the source of those microbes.

The makeup of a waterway like the North Branch of the Chicago River intersects with a variability of activity and influences from human and animal contact to runoff of nearby land. A new study of the Chicago Area Waterway System draws the MWRD closer to understanding the diverse microorganisms in the water and tracks them to their sources.

The TCR has virtually eliminated combined sewer overflows (CSOs) that formerly discharged into waterways when overwhelmed sewer systems could not contain intense rainstorms. The 7.9-billion-gallon TCR holds this untreated water until the nearby Calumet WRP has the capacity to treat this additional water. The reduction in CSOs appears to correspond to the study findings of a decrease in the sewage indicator bacteria in the Calumet River System after the TCR was put into service.

The report concluded that the results from this seven-year long microbiome study have provided further evidence that the MWRD's investments, especially the TARP reservoirs, have led to significant microbial water quality improvement, as shown by the proportion of known pathogens, natural river water biomarkers, sources of microbial pollution, and functional pathways.

However, the results also find that the water quality in the CAWS is impacted by conditions that are outside the control of wastewater treatment technologies, such as wildlife, stormwater runoff and existing sediment which also influence the microbial communities of the CAWS.

While the MWRD already monitors and analyzes fecal coliform bacteria, this genomic understanding of the microbial health of the CAWS takes it to a new level, thanks to DNA sequencing and shotgun metagenomics used in this study, which captures a detailed view of the microbial community at a molecular level.

"While the traditional analysis evidenced the removal of potential pathogens, the molecular approach has provided categorical identification of those potential pathogens and identified their source, virulence and resistance pathways," the report states. "These extra data obtained through sophisticated diagnostic monitoring will be useful, especially as multi-drug resistant infectious disease transmission has become a serious public health concern. Identifying which bacterial species are being transmitted through the sewage system, and which antibiotics they are resistant to, can provide an early warning system for the spread of such infections in the human population."

Molecular monitoring has also been demonstrated to be effective in tracking population infection rates in cities during the COVID-19 pandemic. "Similar approaches could be used in Chicago to track current and potential future pathogens," said Mark Grippo, Argonne Ecologist. "This study has demonstrated the utility of genetic monitoring tools for studying the efficacy of future improvements like riparian habitat enhancement and TARP expansion."

An article regarding this study, titled "Chicago Area Waterway System Microbiome Study," appears in the October – November edition of Advances in Water Research published by the Water Research Foundation. It can be found at this link: https://bit.ly/2VwcTF9.

This is the second major study on the CAWS that the MWRD released in recent months following new research with the Shedd Aquarium that revealed a surging fish population in the CAWS. While the MWRD and Argonne researchers are gaining a new understanding of the microbial makeup of the CAWS, the MWRD and Shedd documented a gradual increase in the total number of fish, native fish and total fish species, while the number of invasive species declined.