Scientists Discover Tiny Microbes with Potential to Cleanse Waterways

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Singapore, 18 May 2015 - A seven-year scientific study has revealed that microbial communities in urban waterways has the potential to play an important role in cleansing Singapore's waterways and also act as raw water quality indicators.

The study found that canals designed to channel rainwater host microbial communities that could remove and neutralise organic pollutants in raw water. These organic pollutants are currently at trace levels in raw water - well below the United States-Environmental Protection Agency (US-EPA) drinking water standards - which is removed during water treatment processes.

Researchers from the NUS Environmental Research Institute (NERI) and the Singapore Centre for Environmental Life Sciences Engineering (SCELSE) at Nanyang Technological University (NTU) have discovered that the untapped natural ability of microbial communities could be harnessed to treat raw water even before undergoing treatment.

This process is known as 'bioremediation', a treatment that uses naturally occurring organisms to break down organic pollutants.

The study, which was published in the scientific journal *Environmental Science & Technology*, was conducted around the Ulu Pandan catchment area in collaboration with the Singapore's national water agency, PUB.

Microbes - Nature's "garbage cleaners"

The increased demand for water in urban centres, coupled with the elevated pressures placed on the environment by high-density living, has created a demand for efficient, environmentally sustainable solutions to manage urban watersheds. Harnessing the cleansing power of microbes provides a solution to the pressing need.

The breakthrough came about after the joint research team identified members of the entire microbial community and their functions from the aquatic ecosystem at the Ulu Pandan catchment area by extracting their DNA and RNA, the genetic blueprint of life.

Apart from the discovery that the microbes could remove and neutralise organic pollutants, the researchers also found out that the presence of aluminium, copper and potassium were critical to the community's ability to perform its ecological "cleansing" properties.

The discovery of these chemical elements' influence on the microbial community's functions paves the way for researchers to better understand their "cleansing" performance through further monitoring and study.

The project's lead scientist, Associate Professor Sanjay Swarup, Deputy Director of NERI and a Research Director at SCELSE said, "This study demonstrates the power of combining an in-depth analysis of microbial community ecology with physical and chemical characteristics.

"More importantly, with the support of government administrators, environmental sustainability could be achieved naturally through science, creating a better living environment for both man and nature."

The study also examined the differences of microbial communities in residential and industrial watershed systems. It was discovered that these two microbial communities perform different functions, which shows how various land use could influence the types of microbes and the functions they are capable of performing.

Dr Gourvendu Saxena, Research Fellow at NERI and SCELSE said, "Knowing what the microbes are doing provides information on what they are responding to. These marker-based microbial functions provide a higher resolving power than chemical markers that are currently in use.

"This study has enabled us to identify the key drivers of microbial communities and their functions at a watershed-scale. The findings can be used to understand microbial activity responsible for removing and neutralizing organic pollutants, which is critical to developing ecologically friendly waterways in rapidly urbanizing environments," said Dr Saxena who is the lead author of the study.

The study also found that the Ulu Pandan catchment area was not only well-managed but is an efficient drainage system, with pollutants below the baseline safety limits.

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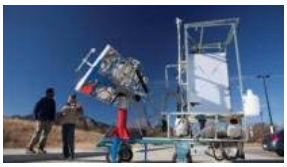
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Professor Staffan Kjelleberg, Centre Director for SCELSE at NTU said, "For decades scientists have pursued research projects that seek to understand microbes' ability to chew-up stubborn pollutants.

"This breakthrough proves that it may be possible to push the boundaries in securing the availability of clean water through natural means and hence, maintain a more sustainable environment for Singapore and other societies."

Next phase of research

The research framework laid out in this study could be easily adopted by other cities around the world in studying their own waterways, and is being adopted by the international World Harbour Project, to which SCELSE is a party of.

The World Harbour Project is a coordinated network of researchers and managers, to bring the best practices in understanding and managing urban waterways to the world.

Moving forward, the team will continue to investigate the microbial communities' ability to self-cleanse the waterways. This is done by understanding the response to manipulating key metals, identifying the most efficient microbial community composition and establishing the conditions needed for optimal bioremediation.

Plans are in place to study the effects of plants on microbial communities and explore various waterways structure designs to determine optimal settings and parameters.

The above story is based on materials provided by Nanyang Technological University.