SCELSE
Singapore Centre on Environmental Life Sciences Engineering

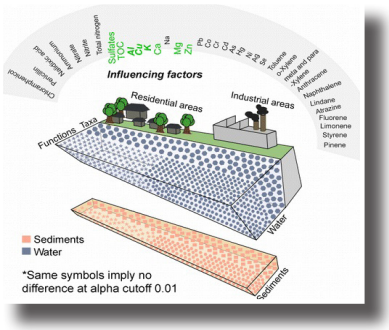
Newsletter
January 2015

Microbial communities in megacity waterways

With the rapid pace of urbanisation, megacities in many parts of the world are turning to engineered waterways to keep up with high water demand. Microbial communities within such waterways are indispensable to the ecosystem due to their involvement in a wide range of biogeochemical processes, such as nutrient cycling. Thus, understanding the associations of these microbial communities with their environment is essential to the development of ecologically sustainable and efficient waterways.

SCELSE researchers adopted widely used ecogenomics approaches to analyse the composition and potential functions of microbial communities in combination with environmental metadata. They analysed 48 environmental parameters measured over one year, combined with spatial analysis of microbial communities.

Focusing on the Sungei Ulu Pandan watershed, which has both residential and industrial land-use types, they found that sediments harbour more diverse microbial communities than the water phase.



Residential microbial communities showed higher species richness than industrial communities and had a different functional gene abundance profile. Also, metals are major drivers of microbial communities. Just three metals - copper, potassium and aluminium, explained between 7-11% of the variation in taxa and functions.

"This study demonstrates the power of combining indepth composition and function analyses of complex microbial communities with physical and chemical data, to understand how microbial communities explain the waterway's condition," said SCELSE centre director, Prof. Staffan Kjelleberg.

"The microbial community can also act as indicators of stability and function and determine which stressors we should take note of in a precise fashion, conducted throughly over space and time."

Findings from this study will help the watershed managers to monitor the ecological health of waterways ecosystem with finer resolution, thus allowing them to influence the functional potential of the microbial communities and enhance critical ecological services for the development of sustainable self-cleaning waterways.

"Ultimately we want to understand which microorganisms are needed to provide overall ecosystem function to enure the system is robust, healthy and functional," Prof. Kjelleberg said.

Calendar

SCELSE Seminars

9:30 - 10:30am

29 Jan: Gayatri Shankar Chilambi and Poh Wee Han 9:30am
Prof. Gerard Wong (UCLA) 11:00am
CR3 (SBS-01n-23)
05 Feb: Prof. Hans Flemming, University of Duisburg-Essen
CR4 (SBS-01n-24)
12 Feb: Wesley Goi, NUS
CR4 (SBS-01n-24)
26 Feb: Sumitra Debina Mitra and Tan Jun Hou - CR4 (SBS-01n-24)

Group meetings

Kline Group meeting: **Mondays 9am**, B3 Meeting Room (please check with Kimberly prior to joining).

Workshops

28-30 Jan: Ziggy Marzinelli's Workshop on experimental design and data analysis. 9:00am to 5:30pm. SBS Classroom 5 (TR+5), Level 1

Events

11 Feb: SCELSE Happy Hour. From 5:30 pm. B2 Coffee Lounge.

Summer Course for PhD students

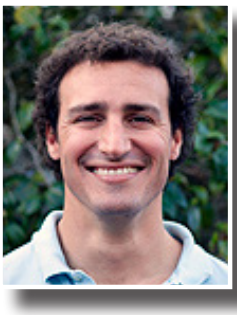
19 Jul - 1 Aug: Host-microbe symbiosis: old friends and foes. Instituto Gulbenkian de Ciência, Portugal.

Conferences 2015

2 - 6 Aug: Society for Industrial Microbiology and Biotechnology Annual Meeting and Exhibition. Philadelphia, USA.

Experimental design and data analysis workshop

Dr Ezequiel (Ziggy) Marzinelli from the Centre for Marine Bio-innovation, University of New South Wales is back to give a two-day workshop at SCELSE on experimental design and data analysis from the 28th to 30th of January. The focus of the workshop is the design of surveys and experiments to test scientific hypotheses and on how to ensure data allows for sound analysis and interpretation.



The workshop includes computer exercises and practical examples from real ecological and environmental studies, and consists of theoretical lectures and practical exercises and lasts for two days. The theoretical lectures introduce the concepts and the practical exercises allow students to practice with real multivariate data, doing various analyses with the statistical software provided and interpreting the results.

"It's great to have a lot of people for this course," Ziggy said.

"Anyone doing science should have a sound understanding of experimental design."

Participant Angel Anika Cokro agrees. "The workshop is helpful for those who are starting their experiments, to understand to best way to set them up," she said.

A more advanced extension of the present course will feature in a follow up workshop in a few months time.

INTRODUCING SCELSE HAPPY HOUR!

We are pleased to introduce our very own Happy Hour, to be held on the Wednesday of the 2nd week of each month, starting in February. It is a great opportunity for SCELSE researchers to mingle. Please join us at the B2 coffee lounge on Wed 11th February, from 5:30 pm.

See you there!

SCELSE **PEOPLE PROFILE**

Martin Tay
Research Fellow

When you go swimming in a public pool, the water looks clear to the eye, but what are the microbes that reside within? That is what Dr Martin Tay is investigating. Martin is a research fellow at SCELSE focusing on characterising the microbial community and detection of pathogens in swimming pools. He works together with Prof. Michael Givskov and Dr Yang Liang in the Public Health and Medical Biofilms cluster. During his PhD, Martin studied bacteriophage community shifts and their correlation with various stages of aerobic granulation in activated sludge. His PhD project involved the processing of large volumes of samples, which usually required long hours of monitoring when done manually.

"The logical solution would be to use automated systems that are available commercially. However, such systems are priced at hundreds of thousands of dollars, therefore in order to overcome this problem I decided to teach myself how to build my own system with open source hardware and lower the cost by two orders of magnitude," he said. Martin's hands-on approach become especially important for the processing of swimming pool samples, and the automated systems he built can also benefit the future generation of students in SCELSE.

Martin graduated from Singapore Polytechnic with a diploma in Biotechnology in 2003 and went to University of New South Wales in Australia where he obtained a BSc with first class honours in 2008. Upon return to Singapore, he took up a National Research Foundation PhD scholarship to study at NTU, and he attained his PhD last year.

When asked about what he found most enjoyable about his projects, Martin said being able to interact and learn from people in the different research disciplines at SCELSE. He also likes the opportunity to work with talented internship and honours project students. "I find it enjoyable to be able to do research that can contribute directly to my own country," he said.

Publication profile

Pyocyanin and PQS: Partners in crime

SCELSE researchers uncover electrochemical interactions between two virulence factors in *Pseudomonas aeruginosa*

Pyocyanin, produced by the pathogen *Pseudomonas aeruginosa*, contributes directly to its virulence by inactivating host proteases. In addition, the Pseudomonas quinolone signal (PQS) molecule can also contribute indirectly to virulence.

While it is previously known that pyocyanin and PQS are linked at the level of genetic regulation, it is also possible that they interact via homogeneous electron transfer mechanisms.

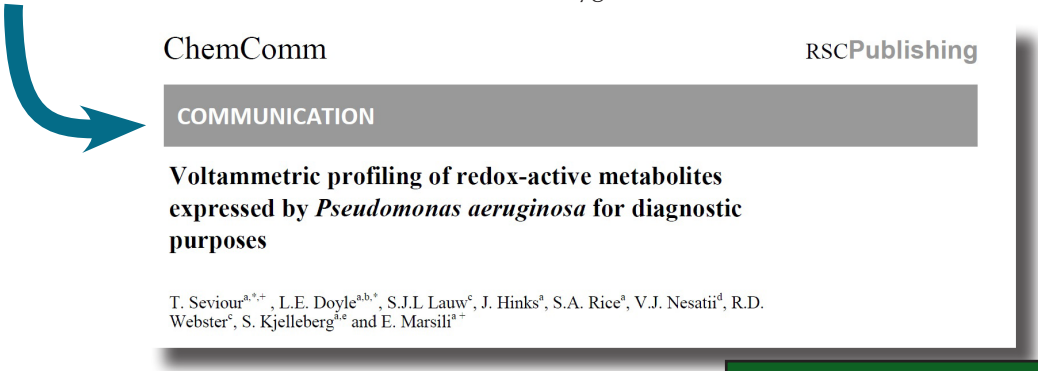
Recently, researchers at SCELSE showed that PQS is an anti-oxidant and may protect pyocyanin from self-oxidation, thus prolonging pyocyanin activity. They demonstrate for the first time the simultaneous, real-time electrochemical detection of PQS and pyocyanin in growth cultures. Using cyclic voltammetry (CV) and differential pulse voltammetry (DPV) they generated an electrochemical profile of microbially-produced redox metabolites with time.

The concentration of pyocyanin detected in growing cultures is dependent on the applied potential and increases as the working electrode potential decreases. The likely explanation for this observation is, due to partial or complete PQS oxidisation at high electrode potential combined with the effect of pyocyanin synthesis being downregulated, the depletion of PQS leaves pyocyanin more susceptible to self-oxidation.

In addition, oxygen radicals produced in PQS oxidation may in turn oxidise pyocyanin. Although the biological importance of the electrochemical interactions remains to be fully elucidated, PQS and pyocyanin are biochemically connected through redox cycling and oxidative stress responses.

High-resolution detection of *P. aeruginosa* redox metabolites would help early diagnosis and treatment of sepsis and other life-threatening infections.

Further research in this area should expand the range of microbial metabolites that can be detected through electrochemical methods, thus leading to rapid characterisation of *P. aeruginosa* infections in healthcare settings.



ChemComm RSCPublishing

COMMUNICATION

Voltammetric profiling of redox-active metabolites expressed by *Pseudomonas aeruginosa* for diagnostic purposes

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