Cleaning up our freshwater streams

Slime is key to stream health

Understanding stream slime is essential for the management, monitoring and restoration of stream ecosystems.

Professor Gillian Lewis is an environmental microbiology specialist whose work focuses on the microbial aspects of restoring degraded waters. Professor Lewis has a long history of studying the occurrence, survival and behaviour of contaminating microbes (particularly human viruses and the bacterial contamination indicators E.coli and Enterococci) in marine and freshwater, and now leads the Stream Biofilm Project, evaluating the role of microbial biofilms in stream health and function.

Biofilms - more commonly known as slime - are actually complex communities of microscopic bacteria, algae, fungi, protozoa and tiny animals, and are an important component in stream ecosystems. Professor Lewis and her colleagues at the Centre for Microbial Innovation (CMI) are studying biofilms to help develop monitoring, restoration and rehabilitation processes and techniques for streams.

Understanding the role of biofilms in streams is vital for management and restoration of streams, and important for local councils and companies responsible for maintaining urban and rural water quality.

“Bacteria and other micro-organisms play a key role in streams by fixing and recycling organic matter and nutrients. This makes them critical to the bottom-up supply of energy and organic matter to the food web,” says Professor Lewis. “Biofilms have become increasingly recognised as an important food resource for insects and fish, changing the way we view energy flows within stream food webs. This has profound implications for how local authorities manage their stream ecosystems.”

For example, stream restoration efforts often focus upon improving vegetation on stream banks. The resulting shading reduces water temperature and light levels, but also changes the biofilm community. Biofilms can also adsorb and modify toxic contaminants, changing our understanding of how these substances impact stream ecosystems.

The Stream Biofilm Project employs a variety of advanced molecular biology techniques, with the aim of determining the factors driving biofilm function and the influence of these on stream food webs. The research team also wants to determine the critical factors for ensuring the establishment and maintenance of biofilms, and their contribution to environmental services in stream systems.

This research has revealed that stream biofilms are home to very complex bacterial communities, and the bacterial community composition changes in response to environmental conditions - especially water chemistry. This has led to collaboration with regional councils to develop a bacterial community index (BCI) method for assessment of stream health. Based upon the rapid analysis of bacterial DNA in biofilm samples, evaluation of the BCI method is ongoing, but promising results to date indicate it may provide an efficient and widely applicable tool for assessing stream health.

The Centre for Microbial Innovation uses specialised research expertise to unravel the secrets of microbes and investigate how their behaviours can be exploited across fields as diverse as food, health, energy and the environment.
Practical applications of biofilm research

+A bacterial community index for assessing stream ecosystem health
The stream biofilm research team has developed a bacterial community index (BCI) method for assessment of stream ecosystem quality, based on rapid analysis of bacterial DNA profiles. A preliminary BCI has been developed based upon biofilm samples from throughout the Auckland region, and this is being followed up by an extensive evaluation programme involving analysis of samples from hundreds of streams throughout New Zealand. Potential key advantages of the BCI method include rapid detection of environmental stressors at lower trophic levels, wider applicability, and greater discrimination of poor quality streams than existing invertebrate and fish-based indices. Collection of biofilm samples is straightforward and creates little disturbance, while processing and analysis of samples is relatively efficient and inexpensive.

+Stormwater treatment system assessment
The stormwater treatment system for the Albany Busway Station carpark includes swales, rain gardens, a stormwater filter and a wetland to treat the stormwater prior to discharge. Assessment of the microbial biofilm communities in the pipes between treatment processes allowed Professor Lewis and her team to evaluate the comparative biological effectiveness of each component of the treatment system. Ultimately, they were also able to assess the impact of the discharge on the stream microbial biofilm community and infer the relative quality of the community compared to other sites in the region. The outcome of this is a potential approach to monitoring ecosystem enhancements within a treatment system.

+Wider implications of biofilm research
Biofilms can form on almost every imaginable surface from rock, metal and plastic, to glass, contact lenses and human tissue. All biofilms need to form is enough nutriment and some water. The implications of this range from the state of your teeth to the contamination of medical devices and boat hulls, and to pipe blockages in energy-generating systems, including hydro and geothermal facilities. However, biofilms can be very useful in reducing biochemical oxygen demand (BOD), pathogens, nitrogen and phosphorus, and in adsorbing metals from stormwater, wastewater treatment plants and private septic systems. Understanding the nature and function of these communities may allow us to optimise these systems.

Auckland UniServices Ltd
Auckland UniServices Limited is the largest research and development company of its kind in Australasia and a wholly owned company of The University of Auckland.

UniServices manages The University’s intellectual property and is responsible for all research-based consultancy partnerships and commercialisation.

By connecting its clients with The University’s brightest academic minds, UniServices provides commercial organisations the innovative technologies they seek, and governments the national programmes they need. The results can mean huge strides in a company’s international competitive edge, or in a country’s health, education and welfare capability.

UniServices’ open innovation and world-class thinking can change the world.

www.cmi.ac.nz

Contact
Parin Rafiei-Thompson
Business Manager - Science
+64 9 373 7522
p.rafiei-thompson@auckland.ac.nz

Dr. Susan Turner
CMI Director
+64 9 373 7599
s.turner@auckland.ac.nz

Auckland UniServices Limited
Level 10, UniServices House, 70 Symonds St, Auckland
Private Bag 92019 AMC, Auckland 1142, New Zealand
www.uniservices.co.nz

Confocal microscopy of stream biofilm
Confocal microscopy of biofilm bacteria