Biofilms in streams: Restoring ecological resilience to modified stream systems through biofilm manipulation

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Project Summary

Restoration of freshwater systems is identified as a national priority in the environmental protection (freshwater) SPO, and in the FRST sustainability review. To be successful stream restoration must identify and re-establish the stream component(s) most influential in stream health. Microbial biofilms are such components. Biofilms play key roles in primary production, cycling of nutrients, water quality remediation, suspended sediment removal, and energy flow to higher tropic levels. This project will build on previous research success and test different stream restoration strategies for effectiveness in development and maintenance of a resilient biofilm capable of supporting stream health.

A stream biofilm is composed of microscopic bacteria, fungi, diatoms and algae in a complex polymer linked assemblage, which coats most surfaces in water. Macroscopically, biofilms appear as surface slimes on bed material, organic debris and aquatic plants. Within stream food webs biofilms are intensively grazed by protozoans, heterotrophic algae, macrobenthic invertebrates and some native fish such as yellow-eyed mullet.

Despite the critical role of biofilms in stream ecosystems, very little is known about the factors influencing their occurrence, structure and function.

Fundamental knowledge of how biofilms achieve ecosystem services is a critical prerequisite to effective management of stream ecosystems and is the major focus of this research. This knowledge will underpin our ability to monitor and predict consequences of stream management activities.

The research team will closely interact with environmental management teams in regional councils to developing new thinking and practical skills for stream restoration through biofilm manipulation.

Our previous work has developed methods for effective biofilm sampling, analysis of microbial species composition and nutritional value within the food web. These studies have provided important insights into how biofilms vary within and between sites, and over seasons. The project will determine the factors driving biofilm function, and the influence of these on the stream food web. We also aim to determine the critical factors for ensuring the establishment and maintenance of biofilms, and their contribution to environmental services in stream systems. The project has 3 objectives, which will determine:

- The effects of stream environment and water quality on biofilm composition,
- Trophic interactions between biofilms and stream biota
- Methods for biofilm manipulation to support effective stream restoration & management.

The work will culminate in a series of recommendations for stream restoration and management strategies that will optimise biofilm function as the biological foundation of stream health.

The research addresses the strategic objectives of fundamental knowledge development, restoration and environmental inventory within the Environmental Protection SPO. The restoration benefits will be achieved through close interaction with regional and local councils and through presentation of findings at user fora.

The research will use the state-of-the-art molecular biology, microscopy and bioinformatics facilities of the School of Biological Sciences, University of Auckland to support leading edge investigations in this complex area. The research team of microbiologists (Drs Lewis (PI), Turner, Saul and Stott) and macrobenthic invertebrate ecologist (Dr Boothroyd) brings together a unique set of relevant skills and extremely strong linkages to users (regional and local councils, government, environmental consultants and business). The team has a demonstrated capability in providing advice and building effective collaboration with relevant users. This research will extend the competencies of existing environmental professionals and will also support development of New Zealand's skill base through training of new researchers (post-graduate students).