Using Rainforest Research

What's in a stream? Using stream residents to monitor stream health

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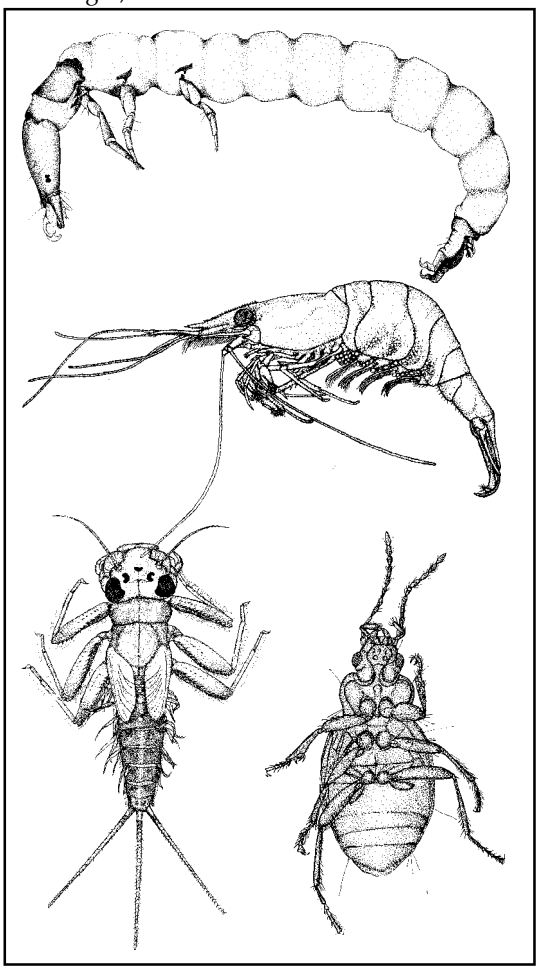
The Queensland Wet Tropics has some magnificent streams and rivers, which have helped shape the landscape and which provide habitats for a myriad of wonderful plants and animals. In fact, the number of species of invertebrate animals inhabiting some of thesesstreams apparently equals or exceeds invertebrate diversity in any stream world-wide. These invertebrates – including shrimps, snails, worms and insects such as dragonfly and mayfly larvae – form an important component of the diversity of the Wet Tropics, and are important in the normal ecological processes in streams. They are a major part of the food web, in that they process and harness organic material in streams, and they are important as food for fish, platypus and other aquatic vertebrates, and for terrestrial vertebrates such as insectivorous birds which feed on the terrestrial stages of many aquatic insects. So, what's in a stream is a wealth of species all with particular requirements for food, habitat and water quality, adding up to a complexity of inter-relationships and interactions with the environment.

Why research protected streams?

Richard Pearson and his team of CRC staff and students have been documenting the invertebrate fauna of Wet Tropics streams, and have been seeking answers to questions such as why is the diversity in these streams so high, where did it originate, and how is it maintained? Answers to such questions are important, of course, in managing streams appropriately. Active management of streams needs to be considered even in the apparently protected Wet Tropics World Heritage Area because of increasing pressure from agricultural impacts originating outside the WTWHA, from water extraction for domestic and agricultural use, from contamination from roads and other infrastructure, and from disturbance and contamination by recreational and tourism uses. To assist with improved management, Richard and his team have been conducting a research program designed to develop improved stream monitoring techniques for the Wet Tropics, based on the fauna of the streams. So what's in a stream is not only important in its own right, but it tell us what the status of the stream is – is it disturbed, or is it in its natural pristine condition?



Some invertebrate stream residents visible to the naked eye
Top: *Trichoptera, family Philopotamidae* ***(Caddis fly larvae)*** *(A Cairns)*
Centre: *Crustacea, family Atyidae* ***(Shrimp)*** *(L Davis)*
Bottom left: *Ephemeroptera, family Leptophlebiidae* ***(Mayflie)*** *(A Cairns)*
Bottom right: *Coleoptera, family Carabidae* ***(beetle)*** *(L Davis)*

Use of the biota (animals, plants and other organisms) in monitoring fresh waters is a well-tried technique. It is based on the fact that each organism has particular environmental requirements, and where these are not met, the organism will be absent. For example, trout have rather a low temperature threshold for development of their eggs, so although the adults could live in some streams of the Wet Tropics, they cannot establish successful breeding populations there (thankfully). Certain worms and fly larvae can tolerate very low dissolved oxygen levels while other invertebrate species cannot. So the presence of these tolerant species in the absence of others is strong indication that low levels of oxygen are occurring, possibly because of organic pollution. Thus, these invertebrates can be used as indicators of disturbance.

Using stream residents to monitor stream health

But why not simply measure dissolved oxygen levels? Of course, we do monitor oxygen and many other important variables. However, each variable is not constant. Oxygen levels in natural systems may vary substantially, being high during the day when plants are photosynthesising, and decreasing overnight as photosynthesis ceases but as respiration (by plants and animals) continues. Input of contaminants may vary – for example, rain may wash in contaminants from roads or dairies, or disturbance by swimmers may only occur on warm days. To pick up the effects of such disturbance on water quality would require continuous monitoring of a host of variables, which

The Rainforest CRC is a research partnership involving the Commonwealth and Queensland State governments, the Wet Tropics Management Authority, the tourism industry, Aboriginal groups, CSIRO, James Cook University, Griffith University and The University of Queensland

would be prohibitively expensive in equipment and labour. The biota offers a cheaper alternative.

The real benefit of using biological indicators is that plants and animals provide an indication of what has gone before. Presence of a particular mayfly, for example, indicates that not only are conditions tolerable now, but have been for some time (depending on the mobility and life history of the species). Moreover, presence of that species indicates not only that the habitat or oxygen levels are and have been suitable, but that *every other conceivable factor* has been suitable too! This includes factors we might not have thought of, let alone tried to measure. The biota, therefore, can provide an integrated view of the variety of conditions over time.

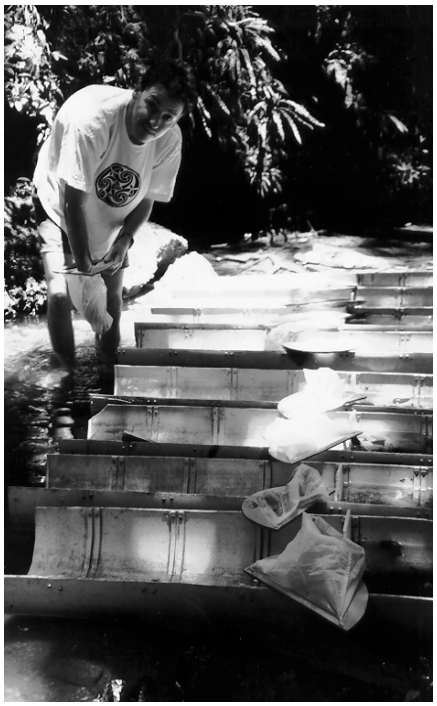
Not all disturbance is bad

Of course, we have to know something of the ecology of streams and their biota to be able to apply these techniques, and the Rainforest CRC has directed much of its research effort at this understanding. It is necessary, for example, to understand the impacts of natural disturbance so that changes in the biota are not inappropriately interpreted. It is important to understand how some of the more likely contaminants might affect different components of the biota, so that the monitoring measures being used can be calibrated. And it is important to understand the dynamics of species so that false interpretations are not made. For example, the effluent from a particular sugar mill was having a deleterious effect on a stretch of stream in north Queensland, and this was indicated by the assemblage of invertebrates living on the stream bottom. Absence of fish also suggested that things were not right – except at the weekend when the mill was not discharging. At this time the fish came in and fed on the abundant population of tolerant invertebrates. So, in this case fish were not good indicators of environmental quality because of their mobility, whereas the less mobile invertebrate assemblage, which could not adjust to temporarily improved conditions at the weekend, gave an integrated view of past conditions.

Equipment used for measuring dissolved oxygen (Photo: Niall Connolly)

Richard and his research team have sampled and monitored scores of sites in the Wet Tropics, and have undertaken experiments to examine effects of a variety of disturbances, such as sedimentation, enhanced nutrient inputs, low dissolved oxygen from organic effluents, recreational swimming, as well as natural events such as flooding and drought. They are in the final stages of developing a manual for monitoring Wet Tropics streams, for use by agencies, consulting organisations, and other interested groups.

So, what's in a stream in the Wet Tropics is not only a unique and diverse biota, reflecting the natural values of the World Heritage Area, but also the means to assess and monitor the integrity of the stream – its habitat values and its water quality. This capacity is vital for appropriate long-term management of these unique resources.



PhD student Niall Connolly monitoring effects of sedimentation on stream invertebrates

For more information

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