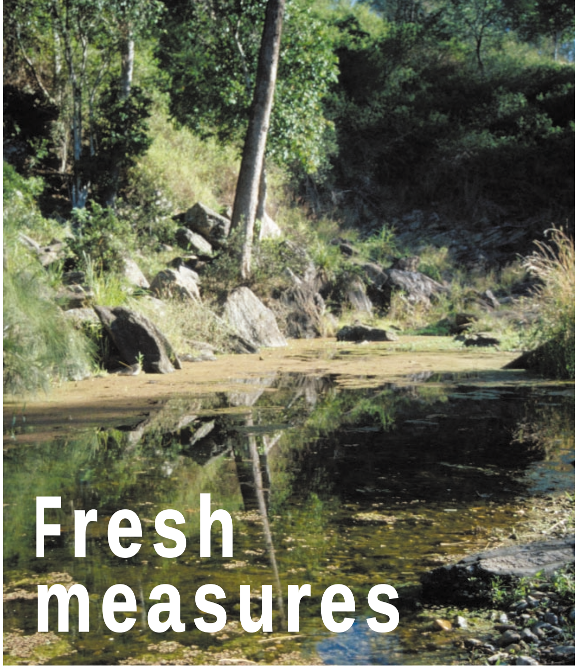


Wendy Pyper

Fresh measures

Five groups of indicators that provide a broad picture of freshwater ecosystem health have been identified as part of the South-east Queensland Regional Water Quality Management Strategy.

The indicator groups were determined during a scientific task called Design and Implementation of Baseline Monitoring and will be used by stakeholders involved in the Healthy Waterways Partnership.

'Stakeholders want good science to tell them what they need to measure in order to understand the health of freshwater systems,' says task coordinator, Mick Smith, of the Centre for Catchment and In-Stream Research at Griffith University.

'They also want a state-of-the-art program to monitor the health of these systems and follow the effects of management actions.'

Identifying indicators

To identify suitable indicators for a monitoring program, a team of freshwater ecologists, natural resource managers, statisticians, water-quality specialists and community representatives was assembled.

The team, which included Smith and Dr Bronwyn Harch, a statistician with CSIRO Mathematical and Information Sciences, listed 56 potential indicators relating to physical, chemical and biological attributes of ecosystem health. Conceptual models were then used to short-list indicators that provided direct measures of ecosystem health. The models indicated, for example, that rather than measuring dam numbers or changes to water flows, the real measure of health was the native fish community.

'Without floods, many native fish don't get the environmental cues to breed, or the chance to lay eggs on the floodplain,' Smith says. 'So measuring the number and diversity of native fish species reveals the ecological consequences of altered water flows.'

The short-listed indicators were then 'road-tested' in a major field trial to determine their response to a known gradient of disturbance: land clearing.

'Land clearing is the major cause of environmental disturbance across Australia, and south-east Queensland is no exception, with more than half the land in the region being cleared for grazing, cropping or urban developments,' Smith says.

'If indicators are to provide a useful measure of ecosystem health, they must respond to different levels of land clearing. Then, when management actions, such as revegetation, are implemented to improve the health of the stream, changes in health can be detected through changes in the indicators.'

For example, an increase in the number of native fish species two years after revegetating a stream section would indicate an improvement in stream health.

Twenty-two indicators showed a strong response across minimally, moderately and highly-impacted sites. Responses to increasing environmental disturbance included decreasing species richness among native fish, and increasing algal growth.

After ensuring each indicator provided different information about ecosystem health, and considering the practical and financial implications of measuring each one, a final list of 15 indicators was proposed.

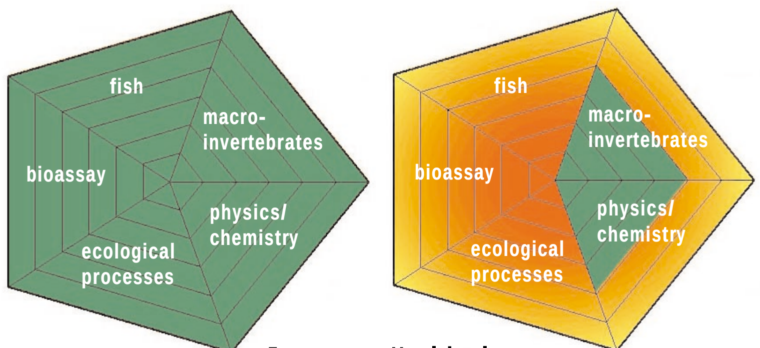
Healthy plotting

To provide meaningful reports on ecosystem health, the team developed Ecosystem Health plots, or EcoH plots: pentagons containing five wedges (one for each indicator group). The pentagons are red in the middle, fading to orange and yellow at the edge. Green wedges are placed over the background, depending on the status of each indicator.

'An all-green pentagon means that each indicator is in near-pristine condition,' Harch says. 'But as the health of a stream decreases, the amount of orange and red in the pentagon increases.'

Individual wedges can be used to diagnose the cause of a disturbance, because the different indicators respond to different aspects of disturbance. For example, macroinvertebrates respond primarily to land use and water chemistry, while ecosystem processes (plant and algal growth and respiration) are influenced by water and sediment chemistry and riparian condition.

Harch says the DIBM study, and the ongoing monitoring and reporting stemming from it, will fulfil stakeholder needs in two ways.



Ecosystem Health plots

At undisturbed or minimally disturbed sites, (green pentagon), all indicators reflect a healthy stream. At a disturbed site, (orange pentagon), poor scores for fish, nutrients (bioassay) and ecosystem processes reflect a loss of riparian cover and degraded in-stream habitat.

'It provides a framework for identifying the most relevant indicators to use to characterise ecosystem health. It also ensures that other factors that enhance ecosystem health, such as riparian condition, are incorporated into future decision making processes for rehabilitation,' she says.

'Secondly, assessing ecosystem health using EcoH plots provides managers with a graphical tool to monitor changes in health over time. This is important when assessing the impact of rehabilitation programs.'

Results from indicator monitoring at 120 freshwater sites in the Moreton Bay catchment will be linked with the marine Ecosystem Health Monitoring Program. This information will then feed into an annual report card on the health of the region's waterways.

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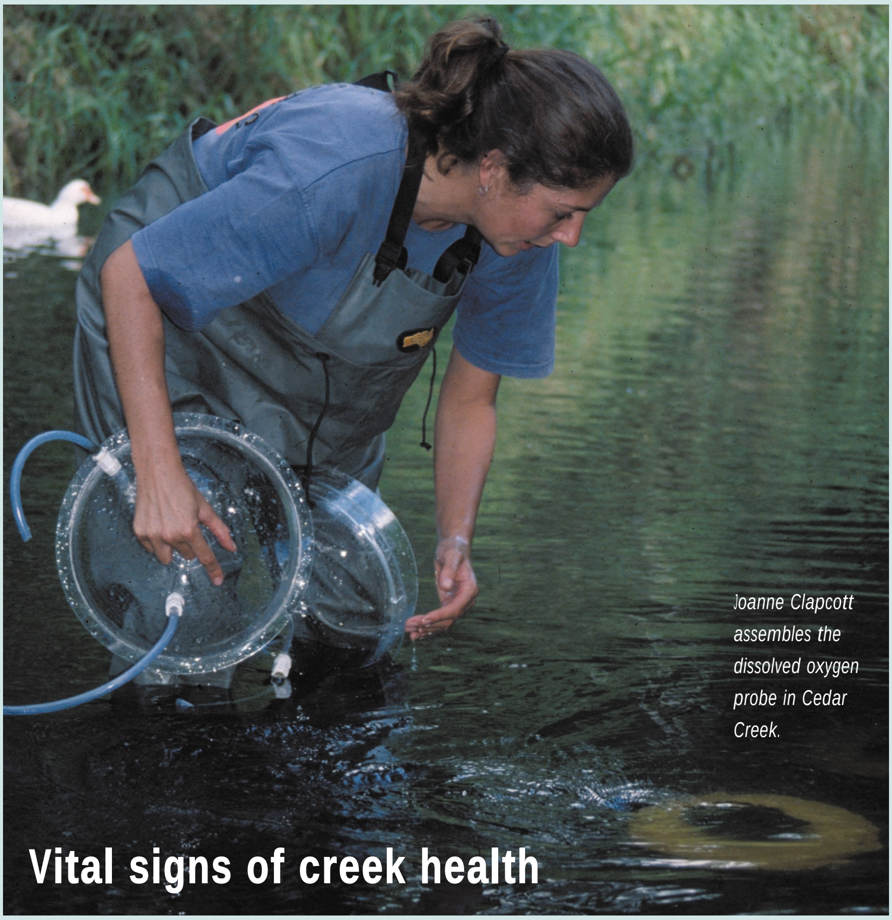

Wendy Pyper

Joanne Clapcott assembles the dissolved oxygen probe in Cedar Creek.

Vital signs of creek health

SKIRTING AN apparent rest area for birds, freshwater ecologist Joanne Clapcott spies a promising site for her equipment. A jumble of plastic tubing, digital display instruments, probes, pump, thermometer, battery pack, and two large plastic domes, is gratefully deposited. Hitching up her waders, Clapcott enters Cedar Creek, a waterway that traverses both the Brisbane and Pine River catchments.

We're here to measure the gross primary production and respiration rates of algae in the creek. These are two of 15 'indicators' (see main story) that provide information about ecosystem health to the freshwater Ecosystem Health Monitoring Program.

Clapcott and her colleague Nerida Beard from the Griffith University Centre for Catchment and In-Stream Research will assemble their equipment in-stream and leave it to record 24-hour variations in dissolved oxygen, temperature and light availability.

Knee-deep in the creek, Clapcott probes the creek bed with her hands to assess its composition. For the experiment to be meaningful, a representative sample of the bed must be collected.

'We're going to create a micro-environment of the stream bed inside the plastic domes,' Clapcott says. 'By extrapolating from the results inside the dome, we'll be able to work out the rate of productivity per metre of stream bed.'

Clapcott withdraws four, fist-sized, algae-coated rocks from the creek bed and arranges two in the centre of each of the two domes' base plates. The plates are submerged in about 50 cm of water and their transparent semi-circular lids are secured. A small pump is attached to each dome to circulate the water inside and across the business end of the oxygen probe fitted to the top of the dome.

'Over the next 24 hours the algae will photosynthesise and produce oxygen during the day and the probe will detect an increase in dissolved oxygen,' Clapcott says. 'At night, respiration by the algae will use some of this oxygen. So we'll see a series of peaks and troughs as the amount of dissolved oxygen fluctuates.'

Clapcott says a small flux in dissolved oxygen during the 24-hour period will indicate that the rate of stream productivity is slow. This is common in streams where healthy riparian vegetation and tree cover limits the amount of light available for photosynthesis

In more disturbed areas, such as this Cedar Creek site, productivity rates increase and the water quickly reaches saturation point for dissolved oxygen. At night, respiration rates are also high, rapidly depleting the water of oxygen. Large fluctuations can have an adverse effect on many freshwater animals.

As well as dissolved oxygen, Clapcott will measure temperature, as higher temperatures allow greater dissolved oxygen concentrations. A light logger stubbed into the creek bed beside the domes will record the average light every 10 minutes. These measurements will assist with the final interpretation of results.

Other indicators will be measured twice a year by Clapcott and other scientists involved in the freshwater Ecosystem Health Monitoring Program.

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