RIVERS / RESOURCE MANAGEMENT

Periphyton in our rivers:

too much of a good thing?

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Regular monitoring of the growth of algal slimes is helping to identify trends in the overall health of our larger rivers.

Periphyton is the algae growing on the bed of streams and lakes. It plays a key role in streams by turning dissolved nutrients into nutritious food (periphyton biomass) for invertebrates that are themselves food for fish and birds.

However, you can get too much of a good thing. Periphyton blooms – as thick slimy mats or long filamentous growths that cover much of the streambed – can make a stream unattractive for swimming, useless for angling, clog up water intakes, and reduce biodiversity by making the streambed habitat unsuitable for many sensitive invertebrate species.

Periphyton growth is controlled by sunlight, time available to grow since the last flood, streambed stability, water speed, nutrients, and grazing by invertebrates. Healthy streams typically have little obvious periphyton, because growth is eaten by invertebrates. Nuisance blooms are usually a symptom of a system stressed by things like over-supply of nutrients and high temperatures (that increase algal growth rates but stress some invertebrate grazers). Therefore periphyton abundance can be used as a measure of river health.

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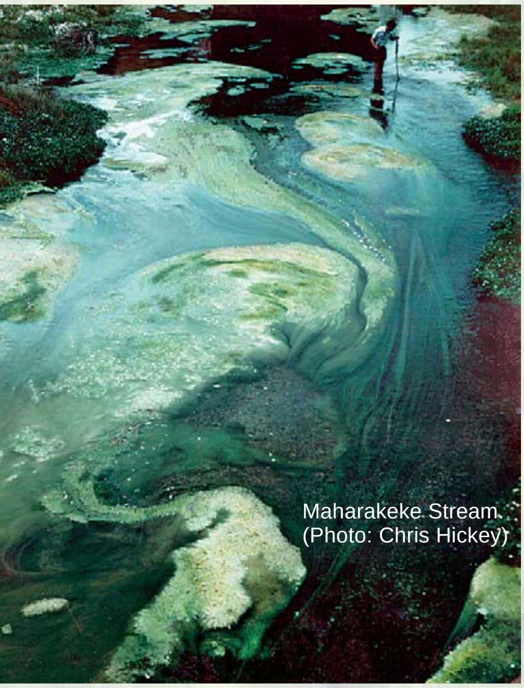


Maharakeke Stream.
(Photo: Chris Hickey)

Monitoring nuisance periphyton in NZ rivers

Since 1989, the National Rivers Water Quality Network (NRWQN) has monitored several measures of stream health, including water clarity, nutrient concentrations, and invertebrate communities, at 77 sites on major rivers throughout New Zealand. Periphyton cover is monitored monthly at the same places by wading as far across the river as is safe (the whole width where possible) and using an underwater viewer (a "reverse periscope") to observe periphyton cover in 10 equally spaced areas of riverbed.

Because we are most interested in nuisance growths, cover of filamentous algae and thick mats (more than 3 mm thick) is assessed visually. The guidelines for acceptable periphyton cover to protect aesthetic and recreational values of rivers are <60% cover of the visible streambed by mats and <30% cover by filamentous algae. We adopted 40% cover as the maximum acceptable level of total periphyton (i.e., mats + filamentous periphyton growths), based on these guidelines weighted for the greater effect of filamentous growths.

How slimy are our rivers?

Periphyton cover was highly variable, both between sites and on different days at the same site, reflecting the many influences on growth discussed above. Both filamentous algae and thick mats were often absent, but almost half the sites experienced occasional blooms when cover reached nuisance levels (>40% cover).

Are our rivers getting slimier?

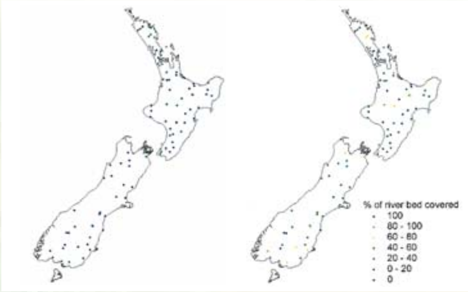
We tested for trends in the annual average total periphyton cover and the annual maximum cover over the 13 years of monitoring at each site. There was no trend at most sites from 1989 to 2001. However, annual average cover decreased at fifteen South Island sites and four North Island sites, whereas it increased at only four sites – all in the North Island.

Annual maximum cover showed similar trends, decreasing at eleven South Island sites and four North Island sites, whereas it increased at only seven sites – all but one in the North Island.

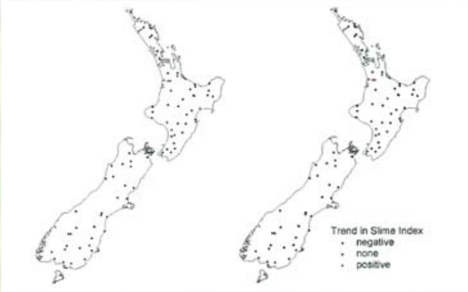
So we can say that periphyton declined more often than it increased at the NRWQN sites over the last 13 years. At face value, this suggests a general improvement in river health, which is encouraging for resource managers. However, it is possible that river flow patterns and nutrient concentrations related to El Niño/Southern Oscillation weather patterns (measured using the ENSO Index) may have had more influence than changes in land and river management. This is currently under more detailed investigation.

Do our rivers get slimier downstream?

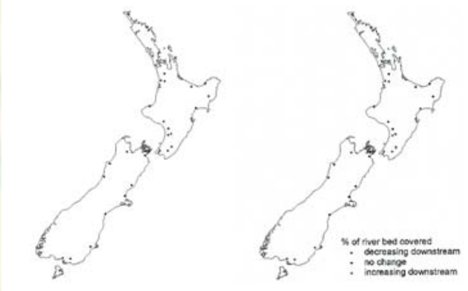
Lower areas of large river catchments tend to have more intensive agriculture and more urban areas than upper parts. The nutrient enrichment and higher water temperatures that



Total periphyton cover at NRWQN sites. **left:** Mean of annual means; **right:** Mean annual maximum cover.



Trends in annual periphyton cover at NRWQN sites from 1989 to 2001. **left:** Annual means; **right:** Annual maximum cover.



Downstream changes in periphyton cover. **left:** Annual means; **right:** Annual maximum cover.

generally result from such land development might be expected to lead to more periphyton growth at downstream sites than at upstream sites along rivers. In some cases changes in riparian shade along a river may influence periphyton, but most of the NRWQN rivers are too wide for this effect to be important.

We compared upstream and downstream sites using 26 paired reaches along 23 rivers. Comparing sites upstream and downstream of areas of land development on the same river reduces the varying influence of flood effects among rivers.

At almost half of these paired sites (12 pairs), periphyton cover increased downstream. This was particularly striking in the Tukituki, Mataura, Oreti, and Waitara rivers. Periphyton at the upstream site in these rivers was very low, whereas the annual maximum observed cover downstream typically exceeded the aesthetic nuisance level (>40% cover).

Only two rivers had lower cover at the downstream site and high turbidity probably restricted the periphyton development at one of these (Wanganui River). Along the Manawatu River, periphyton cover dropped between the site near Dannevirke and downstream at Palmerston North, indicating changes in periphyton growth conditions, but increased again below wastewater discharges from Palmerston North and associated industries.

Decreased streambed stability and turbid water (that reduces the light reaching the stream bed) probably limited periphyton growth at several of the downstream sites with cover lower than or similar to their upstream pair (e.g., Waikato at Rangiriri, Rangitaiki at Te Teko, Mohaka at Raupunga, Waipaoa at Kanakanaia). However, for the Rangitikei, Buller, Grey, Hurunui, Waimakariri, Opihi and Taieri rivers, similar periphyton cover at the upstream and downstream sites probably indicated that land management changes between the sites have not been large enough to cause increased periphyton growth. Alternatively, any influences were cancelled out by other factors (such as less stable riverbed or more invertebrate grazers).

Trends in the difference in periphyton cover between downstream and upstream sites on individual rivers provide another way of assessing trends in river health. We found no statistically significant trends in these differences over the 13 years of observations in most rivers. However, there were trends of decreasing difference in cover between the upstream and downstream sites at six of the site pairs (Ngaruroro, Mohaka, Tukituki, Hutt, Mataura and Oreti) indicating improved river health downstream. The difference got bigger on the Waipa and Hurunui rivers, indicating deterioration. In the Mataura River, the trend towards smaller downstream increase in periphyton cover may be related to improved wastewater treatment and removal of significant discharges into the river over the last few years.

In conclusion, the NRWQN periphyton monitoring indicates that periphyton did not generally become more abundant in these larger New Zealand rivers between 1989 and 2001. Although this suggests that resource management has ”held the line” in most cases, preliminary analysis suggests that weather patterns associated with the ENSO climate pattern contributed to the observed patterns in periphyton cover. Ongoing regular monitoring of periphyton cover at these sites provides a useful measure of the effects of changes in land and river management on river health, which adds to the picture provided by water quality and invertebrate monitoring. ■

Further reading

Biggs, B.J.F. (2000). New Zealand periphyton guideline: detecting, monitoring and managing enrichment of streams. Ministry for the Environment, Wellington, 122 p.

Scarsbrook, M. R.; Boothroyd, I.K.G.; Quinn, J.M. (2000). New Zealand’s National Water Quality Network: Trends in macroinvertebrate indicators. *New Zealand Journal of Marine and Freshwater Research 34*: 289–302.

See www.niwa.co/ncwr/nrwqn for a more detailed report listing summary statistics for individual sites.

Teachers: this article can be used for Biology L8 A.O. 8.1b. See other curriculum connections at www.niwa.co.nz/pubs/wa/resources

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