

Worms in our waterways: Caught in (and on) the net

Louise Lawrence and Mike Hodda, CSIRO Entomology

Australians are coming to realise how important healthy river systems are to the national welfare — both agricultural and recreational. One important indicator of the health of fresh water systems is the aquatic organisms that live in them.

But the quality of the water in Australia's lakes, rivers and creeks depends not only on what is living in the water, but also on what goes on under and around it, in soils and sediments. If these are functioning properly, they can cushion the waterways against many of the problems facing them.

The decline in water quality in many of Australia's fresh water systems through pesticide residues and chemical by-products, fertilisers and acidification make the soils and sediments an increasingly important resource. For these systems to function properly, the right organisms must be present.

Scientists from CSIRO Entomology, supported by the Australian Biological Resources Study, have been looking at factors affecting water quality from a different angle. They have been getting to the bottom of things and examining the oozy sludge under the water. In particular, they were looking for the things that live in it because the presence of the right organisms is vital to maintaining a healthy system and their presence or absence provides an indication of what is happening in the system.

Australians have recently seen many images of drought showing dry, cracked mud. It isn't obvious that in this mud, either hiding or dormant as eggs or resting stages, are many organisms waiting for rain to bring them to life again.

The freshwater systems and their surrounding soils and sediments are a two way system. What is in sediment can end up in the water and all the things which get into water end up lurking in sediment with the potential to cause problems in



Plant roots (minus soil) with nematodes. This is typical of the abundance of nematodes in the soil around plant roots.



Psammomermis sp. adult female (large nematode) and *Helicotylenchus dihystera* (small nematodes).

the future — for example, nutrients like nitrogen and phosphorus, pesticides, herbicides and heavy metals.

If the sediment is functioning normally, it is a wonderful safeguard against these nasties as the things living in it can help detoxify polluting chemicals.

In healthy sediment, the unseen but useful tiny organisms such as bacteria, fungi, algae, protists (slime moulds, protozoa and primitive algae), worms, snails and arthropods, are constantly at work transforming nutrients, immobilizing or transforming nasty chemicals and stabilising the sediment.

The importance of their function only becomes obvious when, for some reason, they are not doing their job — when the water turns green because of an algal bloom, or black because everything except the most resistant microbes has died from a lethal dose of a toxic chemical.

But the sludge also contains unwanted organisms and telling the useful organisms from problem ones is not easy. CSIRO scientists have been looking at one group, nematodes or roundworms. As a result of their work, the nematodes found in soils and sediments from the Murray-Darling Basin and south-eastern Australia can now be identified on the web (www.ent.csiro.au/science/nematode.html).

This identification system is simple enough for amateur naturalists to use and this means local communities can now monitor their own freshwater systems. The website also provides information on the distribution and ecology of the nematodes — such as known associations with other organisms and what they eat.

This interactive key also covers some terrestrial nematodes which are plant parasites because they could turn up in waterways and some free-living terrestrial nematodes because they are sometimes mistaken for plant parasites. It will also allow work on the many beneficial nematodes which have been ignored till now because of a lack of identification tools. Finally, the key also includes some organisms that are not nematodes, because they are frequently misidentified as nematodes.

Nematodes are small, white worms, almost invisible to the naked eye, which can occur in huge numbers. They are only about one mm

long but are so numerous that if all the nematodes in the Murray River sediments were laid end to end, they would more than encircle the equator. The species present are a mixture of useful and problem species.

Most people have heard of nematodes which are intestinal parasites, such as Barber's pole worm in ruminants or hookworms and pinworms in humans. There are also circulatory parasites like heartworm in dogs or kidney worm in humans.

Of the nematodes which parasitise insects, some are now used as biological control agents for pests such as scarab larvae. The vast majority of nematodes are quite harmless even beneficial, as they recycle nutrients and consume pathogenic organisms — for example *Rhabditis*, which eats bacteria.

Nematodes are also parasites of plants — for example, root lesion nematode, *Pratylenchus* spp. — and cause an estimated \$400 million in crop losses in Australia every year. Occasionally it finds its way into rivers. One quirk of nematodes is that if there is a common name it is generally a pest species.

When a pest nematode such as this gets into waterways, it is important to know it is there as there is potential to spread them in irrigation water. It is also important to know how frequently they are being spread this way, and whether, as the last few drops are drained from a dam, a lot of problems are being sucked up too.

The CSIRO web site is the first step to providing this information and makes CSIRO a world leader in providing nematological information on the web.

The ease of using the web site belies the amount of research needed to tell these tiny worms apart. The effort ranged from information theory, through mathematical deconstruction of shapes and biology to extensive collecting of samples.

This first ever survey in Australia to determine the nematode fauna in Australia's fresh waters was conducted over three years with the team sampling throughout the Murray-Darling River System as well as all the major coastal river catchments from north of the NSW/Queensland border, through NSW, the ACT and Victoria, to near the mouth of the Murray in South Australia. In the process, they created a biological collection of over 10,000 nematodes, which is

one of the most comprehensive in the world. It was during these surveys that they found the root lesion nematodes in rivers.

Other nematodes discovered were in the genus *Monhystera*, which occurs in all the rivers of the Murray–Darling Basin and coastal freshwater streams of south-eastern Australia. But different species of this genus seem to occur in waters of different quality: one species is common in water which is periodically under stress, while another seems to prefer cleaner waters.

These nematodes live in intimate contact with the sediment, and any nasties it may contain. So can they be used as biomonitors to show what is happening in sediments? Can they help to determine what has happened in the past or what may happen if conditions change?

The research that has been done provides some of the tools that will help answer these questions. There are serious water quality issues which are emerging —pesticide by-products and acid generators are two of them. These new tools will help in monitoring these problems.

All the collecting that has been done, in every major river catchment of the southeast, has provided an incredible baseline data set for monitoring what is happening to Australia's fresh waters. To ensure that all specimens and data are stored properly, they have been lodged in the National Nematode Collection.

This will enable scientists in the future to determine what, if any, changes have taken place in the nematodes present. This will provide one measure of how climate change affects our waterways.

It is interesting, but logical, that many of the nematodes in sediments under rivers occur in the land beside the rivers too as sediment under the water is an extension of the land on either side.

Not only can nematodes help identify problems in waterways, but they could, in some instances, offer solutions. For example, one species contains yellow crystals which may be a detoxifying mechanism for some of the nasties in the sediment. There are numerous other possibilities yet to be documented.

Now there is a simple way to identify the nematodes found in our freshwater systems, other issues can be addressed:

- Can good nematodes be used to consume harmful microbes and enhance bacterial turnover?
- Should the frequency and effects of plant-parasitic nematodes being transported down rivers then applied to crops with irrigation water be investigated further?
- How can the data be used to monitor the conditions of river sediments and riparian verges in 50 years?
- Can use be made of species which can detoxify some of the chemicals that find their way into waterways?

Contact: Mike Hodda, CSIRO Entomology, Canberra ph 02 6246 4371 fax 02 6246 4000 email mike.hodda@csiro.au