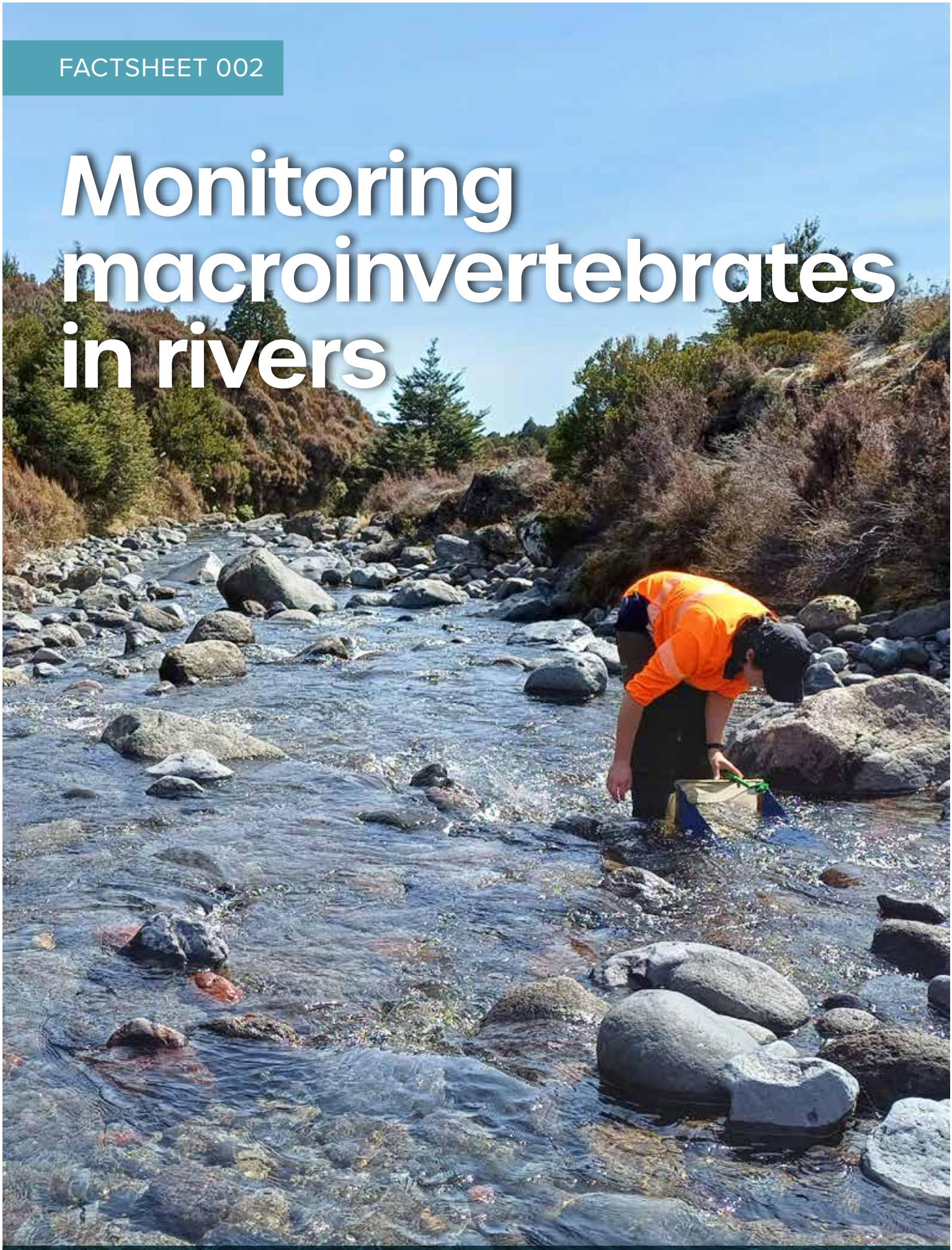
FACTSHEET 002

Monitoring macroinvertebrates in rivers



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Monitoring Freshwater Improvement

Macroinvertebrates are animals that lack a backbone and, while small, are large enough to be seen with the naked eye. The freshwater environments they inhabit are varied and include everything from pristine rivers and streams to muddy lowland streams, wetlands, lakes and ponds.

Aquatic macroinvertebrates include insects in their larval stages, as well as snails, worms and crustaceans that live in water. Some macroinvertebrates (e.g. snails) live their entire lives in water, while others (e.g. mayflies) spend only part of their lives in water during the larval or nymph stages and then emerge to live their adult life out of water.

Macroinvertebrates have adapted in different ways to survive in the habitats in which they are found. Examples of physical adaptations include having claws or hooks to allow clinging on to substrates in fast flowing waters, having hairy legs to trap drifting food, breathing through gills, or trapping air bubbles under their exoskeleton. They have also adapted to feed on a variety of things. Some macroinvertebrates feed on dead leaves and wood, others are grazers eating periphyton, some are filter feeders taking food out of the water as it drifts past, while others are carnivorous (feeding on other aquatic insects).

Macroinvertebrates are important in aquatic environments because they help recycle nutrients by scavenging dead or decaying plants and animals. In turn, macroinvertebrates are a food source for animals higher up the food chain (e.g. fish and birds).

Sorting a macroinvertebrate sample in the field. Photo credit: NIWA

Macroinvertebrate indices

Macroinvertebrates are good indicators of water quality. There are a wide range of macroinvertebrate species, and some are more tolerant to pollution than others. For example, some taxa such as snails (Gastropoda) and flies (Chironomidae) are generally considered to be tolerant of poor-quality water, while others such as mayflies (Ephemeroptera) and stoneflies (Plecoptera) prefer good water quality. The macroinvertebrate community at a given site may be considered a result of the prevailing water quality at that site.

Biological indices can be calculated to assess relationships between macroinvertebrate communities and water quality at a study site. These indices were designed specifically for New Zealand streams and describe the proportion of "sensitive" species relative to other macroinvertebrates. The higher the score, the better the stream conditions. Biological indices commonly used in New Zealand are:

- **MCI** - Macroinvertebrate Community Index
- **QMCI** - Quantitative Macroinvertebrate Community Index
- **EPT Taxa** - Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies)
- **ASPM** - Average Score Per Metric

It is also important to note that many other factors, such as climate, geology, flows and riverbank vegetation, also affect the presence or absence of sensitive and tolerant species. When using biological indices to assess the health of a river these other factors also need to be considered.

For more technical information on biological indices, how to calculate them and interpretation of the scores relative to water quality, refer to:

- the LAWA website
- A User Guide[1] for the Macroinvertebrate Community Index
- The relevant National Environmental Monitoring Standard (NEMS)[2]

How do we monitor macroinvertebrates?

Macroinvertebrates are easy to collect from wadeable rivers or streams, using a kick net or a Surber sampler. The samples are then sent to a laboratory, where they are sorted, identified and counted; the biological indices can then be calculated.

The collection method used will depend on why the samples are being collected. Kick-netting does not require sampling from a fixed area of streambed and is therefore considered "semi-quantitative". Use of a Surber sampler is quantitative in that it samples a defined area of the streambed and provides data estimates on population density (number of organisms per m^2).

Most aquatic macroinvertebrates live in New Zealand rivers and streams year-round, and while adapted to the usual flow patterns in which they live, they can be displaced or die during floods when streambed substrates (rocks, cobbles, gravel, etc.) are moved. Macroinvertebrates are therefore best monitored during summer months following a stable period of low flows, although they can be sampled at other times of the year, provided flows have been stable for a couple of weeks and the stream can be safely waded. Sampling once a year is usually enough to provide information on the macroinvertebrate communities present.

For more information on how to collect and process (sort, identify and preserve) samples, and calculate macroinvertebrate indices, see the relevant NEMS[2].

EMERGING TECHNOLOGIES

Traditional sampling and processing of macroinvertebrates can be intrusive, labour intensive and costly. To overcome some of these limitations, the use of environmental DNA (eDNA) is being trialled. Biological material is collected by filtering water samples using special collection kits. DNA is then extracted from the material captured on the filter in a laboratory. The eDNA is then analysed and compared with a reference database to provide a list of the species present in the sample (including insects, fish, bacteria, plants and algae). There are a range of eDNA suppliers in New Zealand. Discuss your needs with the service provider to ensure that the results will be useful, and check with them about sample and data ownership.

How much will it cost?

The cost of collecting and processing macroinvertebrate samples will depend on the type of sampling undertaken and level of output data required.

COLLECTION COSTS

To carry out macroinvertebrate sample collection, either a kick net or Surber sampler will be required; each should have a net mesh size of 500 µm. The cost of a kick net is currently around $250–300 and a Surber sampler about $500. In addition, sampling jars, labels and isopropyl alcohol for preserving the samples will be required, at a cost of ~$50 per site. It usually takes about an hour to sample macroinvertebrates at a site, plus travel time to access the site.

PROCESSING COSTS

A number of laboratories and consulting firms throughout New Zealand are able to process (sort and identify) macroinvertebrate samples. The cost will likely be ~$300–$450 per sample. An eDNA sampling and analysis package will cost around $300 per sample per site (depending on the provider) and you will need to collect at least 6 samples, to be following best practice guidance, so the total cost of eDNA methods is $1800.

For more information on the costs associated with carrying out a monitoring programme, see the Monitoring Costs information sheet on the Monitoring Freshwater Improvements website.

Further Reading

[1]Stark JD, Maxted, JR 2007. A user guide for the Macroinvertebrate Community Index. Prepared for the Ministry for the Environment. Cawthron Report No. 1166.

[2]National Environmental Monitoring Standards Macroinvertebrates: Collection and Processing of Macroinvertebrate Samples from Rivers and Streams. Available from https://www.nems.org.nz/documents/

Identifying macroinvertebrate species using a microscope

Monitoring Freshwater Improvement

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