



Using stream insects to predict the health of rivers with coal mine inputs

Key points of this fact sheet

- Coal high in sulphur and metals commonly produces acid mine drainage (AMD). AMD which leaches into streams often has serious effects on stream life.
- Stream insects are good indicators of the health of a river.
- Streams with acidic water (pH <4) and with high levels of metals will have very unhealthy stream communities with few insects and no fish.
- Streams with pH 4-6 but high metals may have more insect species but if iron precipitates are present insects and fish will be affected.

Stream insects or invertebrates are widely used as indicators of how healthy a stream is.

We could use water chemistry, stream algae or fish but for various reasons these are not as useful as insects.

These small animals are useful indicators because they live almost their entire lives in streams and rivers, and any healthy stream will almost always have stream insects.

Unlike water chemistry, stream invertebrate communities don't change much unless they experience some major disturbance.

Stream insects are also food for larger animals such as fish (e.g., whitebait and trout) and birds, so they play a role in supporting the recreational and economic value of a stream or river.

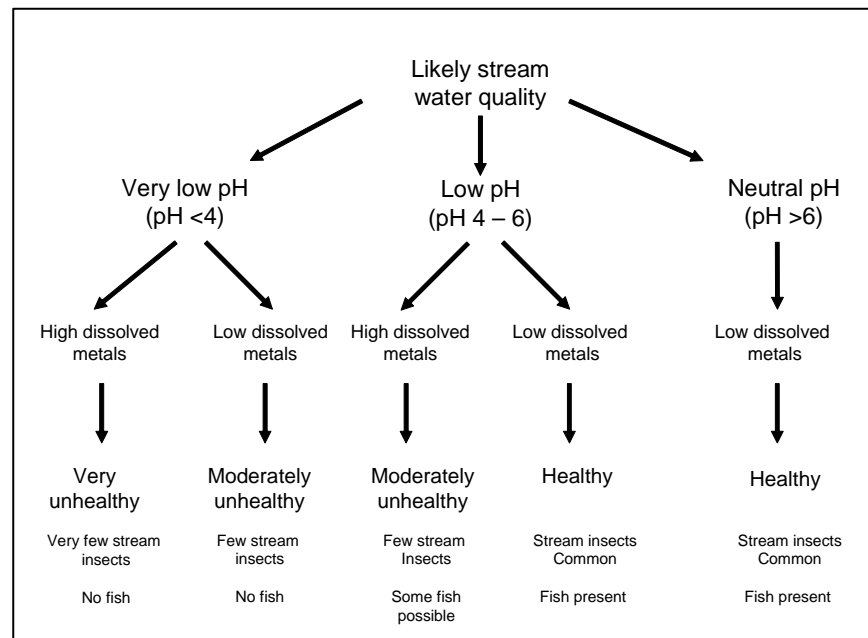
Figure 1 (below): Acid mine drainage might range from very acidic and high in metals to neutral water with no metals.

How can coal mine discharges affect stream life?

Some coal mines, especially those in Brunner coal measures have high pyrite concentrations. These are rich in sulphur and often have metals such as iron, aluminium, zinc and nickel.

During mining the sulphur reacts with water and air and can produce run-off which is acidic and high in heavy metals. This is called acid mine drainage (AMD). Although many rivers on the West Coast of the South Island have naturally acidic water these are not as acidic as AMD, and natural streams virtually never have high heavy metal concentrations.

From our research we have grouped the effects of AMD based on acidity (measured by pH) and metals. Figure 1 shows the possible ranges of water quality that might occur in AMD. The most severe impact on stream life occurs when water is highly acidic (pH <4) and has high concentrations of metals (Figure 1).



This fact sheet is part of series relating to a framework for predicting and managing water quality impacts of mining on streams.

The framework was developed as part of a collaborative research programme aimed at helping mining companies, councils and other end-users make more informed decisions about the possible environmental effects of mining on streams and how to reduce those effects. Stakeholders and end-users assisted in the development of the framework which explains:

- how you can assess the likely water quality coming from a mine,
- the impacts that mine water will have on stream life,
- options for management or treatment of mine drainage and
- guidance on how best to monitor mine discharges.

Very few stream insect species can survive in these streams (Figure 2), and no New Zealand fish can live long in such water. So stream life in these waters will be in very poor condition.

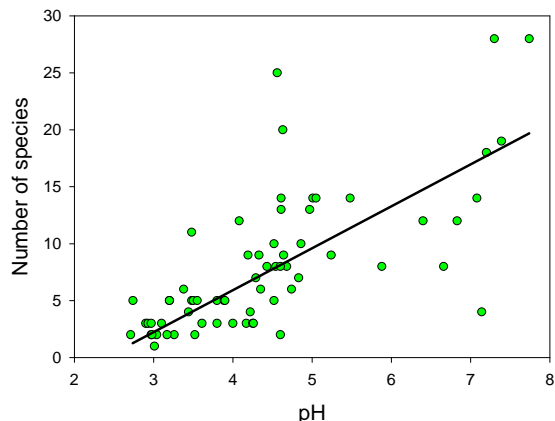


Figure 2: Generally, very few New Zealand stream insect species are found in waters with low pH.

Streams with very low pH usually have high metals as well, but there can be cases where acidic streams have low metal levels. These streams would also have few insects and no fish.

Streams with water around pH 4-6 might be affected depending on the level of metals in the water or the presence of iron or aluminium precipitates.

Iron precipitate is caused when large amounts of iron form an orange coating over the streambed and cover algae and insects (Figure 3).

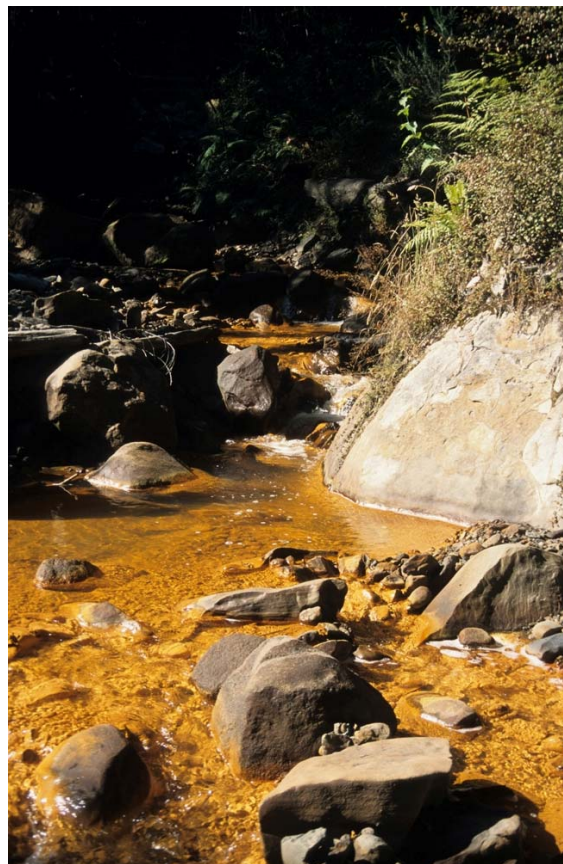


Figure 3: The stonefly *Austroperla cyrene* coated in iron hydroxide precipitate.

If high metal levels are present then some species of stream insects might still occur and possibly some fish. However, these communities will not be very healthy.

In contrast, streams with pH 4-6 and low metal concentrations occur naturally on the West Coast, and have diverse, healthy insect and fish communities.

Streams with neutral pH and very low metal content should support a full range and abundance of aquatic life. However, if mining activities cause turbidity and sedimentation then stream life could still be affected by these additions to the stream.



A stream near Reefton with low pH (approx 3.5) and iron hydroxide precipitate. This stream had <4 stream invertebrate species present.

More information on the framework and underlying research is available from other fact sheets in this series and at:

http://www.crl.co.nz/research/mine_drainage.asp.

Jon S. Harding (University of Canterbury), Jo Cavanagh (Landcare Research), Olivier Champeau (Landcare Research), and Hamish Greig (University of Canterbury)

This work was funded by the Foundation for Science, Research and Technology (FRST) grant CRLX0401 in collaboration with CRL Energy, Landcare Research, the University of Canterbury and the University of Otago. Solid Energy (NZ) generously provided access to some sites.