Do algae grow in acid mine waters?

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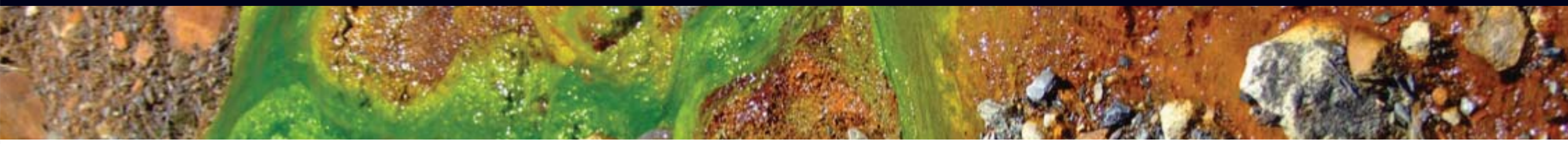

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Yes! It certainly does. Most New Zealand streams and rivers have a wide range of algae growing on their beds. These algae can be comprised of thin layers of slippery diatoms to large beds of filamentous blue-green algae (Fig. 1). Freshwater algae have been well studied in New Zealand, although historically, little work has been done on New Zealand algae in streams and rivers receiving acid mine drainage. Algal assemblages can be spatially complex and temporally highly variable depending on a wide range of environmental and biological factors. In streams, light, nutrients, temperature, current velocity, physical disturbance, substrate, competition and invertebrate grazing can all influence algal diversity and biomass. However, in systems receiving acid mine drainage (AMD), the chemical characteristics of the receiving waters are often of overriding importance and can strongly structure all aspects of algal communities.

Acid mine drainage is often characterized by high acidity (low pH), high concentrations of dissolved metals (e.g. Fe, Al, Zn), and metal oxide deposition. Metal oxides commonly precipitate from solution when acidic waters mix with waters of higher pH. Algal communities respond to these environmental stressors and may be structured by a combination of chronic and acute toxicity to pH, heavy metal contamination and metal oxide deposition.

In this bulletin we present the findings of a study looking at algal communities in 52 streams on the West Coast of the South Island ranging from streams with very low pH (<3) and high heavy metals (>2 mg/l) to natural circum-neutral streams with background metal concentrations. Most streams were selected from abandoned coal mining sites near Reefton or within Brunner Coal Measures on the Stockton and Denniston Plateaus.

Greater numbers of taxa were found as pH increased, reaching a maximum in circum-neutral sites (6.5 to 7.6) where a total of 56 taxa were collected (Fig. 2).

Fig. 1 *Algae community associated with a stable discharge abandoned mine adit pH 2.9 on the Denniston Plateau*

Are algal communities in AMD streams predictable?

The relative abundance of differing algal phyla changed markedly among streams of differing pH (Fig. 3). At the lowest pH euglenids and green algae were dominant and as pH increased blue-greens and red algae became more important. Within the algal phyla specific taxa showed strong tolerances to low pH and heavy metals. In particular, *Klebsormidium acidophilum, Navicula cincta* and *Euglena mutabilis* were common in highly impacted waters (Fig. 4). Several algal taxa occurred in very high densities at some sites (Fig. 5). These high biomasses seemed to occur where flows were very stable, invertebrate grazers were less common and when few other algae were present.

The most significant single factor influencing community structure across our streams was pH. Although heavy metals and metal precipitates are important factors, pH alone accounted for much of the variation in communities.

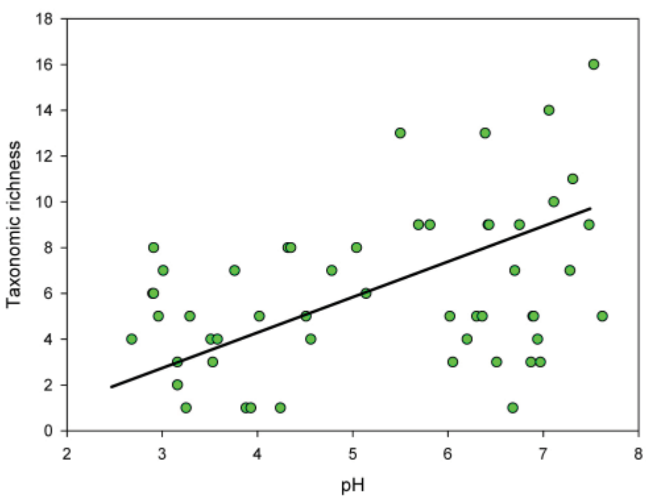

Fig. 2 *Number of algal taxa found in steams of varying pH*

Can algae be used to assess the ecological impacts of AMD?

Our results show that some taxa do very well in acid mine waters while other common algae are unable to tolerate these extreme chemical conditions. Regardless, *any assessment of the impact of AMD can not depend on simple observations of percentage cover or estimates of biomass* as some acid tolerant species can proliferate under these conditions. If algae are to be incorporated in any ecological assessment of AMD then this assessment must focus on identification of the taxa present at a site.

Our survey indicates that a predictable community of AMD-tolerant taxa often develops in streams that are severely affected by acidic mine drainage. It seems likely that prolific growths of acid-tolerant taxa, including *K. acidophilum* and *E. mutabilis*, can be used as indicators of AMD-affected conditions in streams.

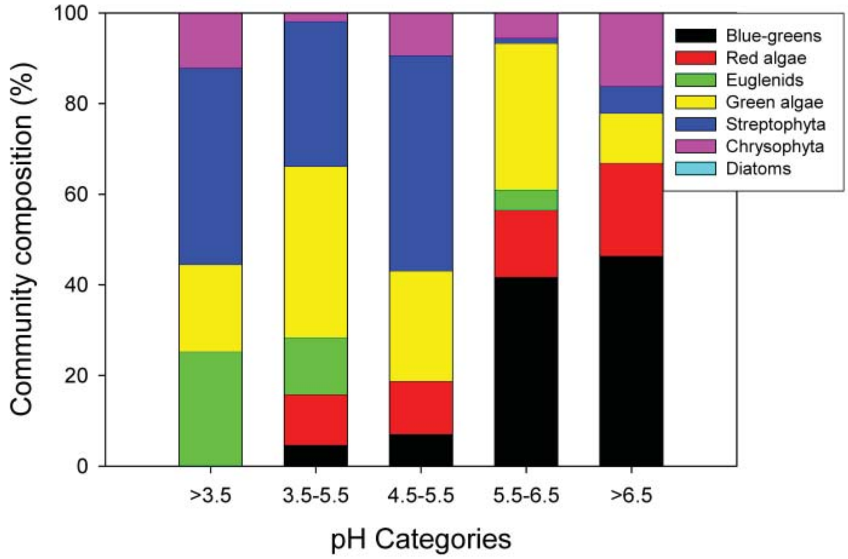

Fig. 3 *Major algal groups occurring in differing pH ranges.*

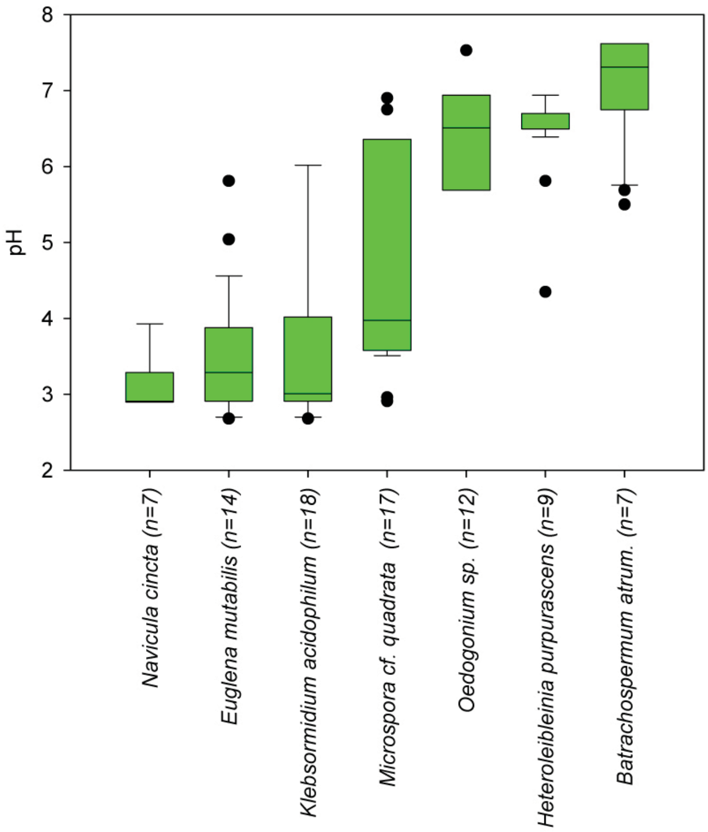

Fig. 4 *Algal taxa with preferences for differing pH*

Fig. 5 *Algal growth at a mine seepage near in Nine Mile Creek*

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