Stream macroinvertebrate responses to conventional, integrated and organic farming practices

F.S. Magbanua[1], C.D. Matthaei[1], G. Blackwell[2] & C.R. Townsend[1]

[1]Department of Zoology, University of Otago, Dunedin, New Zealand

[2]Centre for the Study of Agriculture, Food and Environment, University of Otago, Dunedin, New Zealand

Background

Expansion and intensification of agricultural production in New Zealand has resulted in biodiversity loss in streams and changes to ecosystem functioning. An understanding of how particular farming practices influence streams is critical if we are to identify practical measures for maintaining and enhancing stream ecosystems.

Recent reviews of published literature comparing organic and conventional agriculture revealed that organic farming can have positive effects on a wide range of taxa in terrestrial ecosystems (Bengtsson et al. 2005, Hole et al. 2005), but we do not know whether this benefit extends to streams flowing through the landscape. Here we focus on whether the avoidance of industrial pesticides and fertilisers in ***organic farming***, or their reduced used in farms practicing ***integrated management***, reduces the impact on stream ecosystems associated with ***conventional farming***.

Objective

Measure the impacts on sheep/beef farms of organic, integrated management and conventional farming practices on invertebrate communities in streams

Methods

15 streams in sheep/beef properties (Fig. 1) sampled in February 2007

- 5 streams in organic, 5 in integrated and 5 in conventional farms, arranged in geographically distinct triplets
- Six replicate macroinvertebrate samples collected from each stream, three from an upstream site and three from a downstream site within the farm boundary
- Response variables measured were invertebrate taxon richness, Ephemeroptera-Plecoptera-Trichoptera (EPT) taxon richness, Shannon diversity index (*H*), density of EPT, and Macroinvertebrate Community Index (MCI)
- Two-level nested ANOVAs tested for patterns in invertebrate parameters comparing upstream to downstream locations and, more importantly, comparing among the three levels of farming intensity

Figure 1 Map showing the location of the triplets of sheep/beef farms.

Results

- No consistent upstream (us) vs. downstream (ds) patterns
- Significant differences across farm management practices in invertebrate taxon richness (Fig. 2) and in the density (Fig. 3) and richness (Fig. 4) of EPT taxa - conventional farms had the lowest values
- Shannon diversity index (1.62 - 1.84) and MCI scores (within 80-99 range) did not distinguish streams across farming practices (not shown)

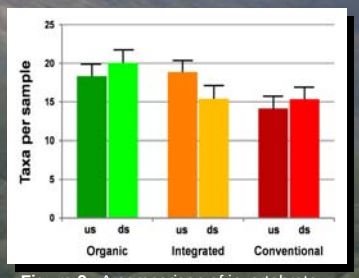

Figure 2 A comparison of invertebrate taxon richness by management system (*P*=0.012).

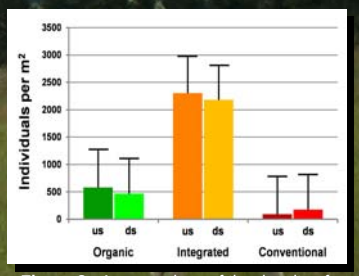

Figure 3 A comparison of the density of EPT taxa by management system (*P*=0.001).

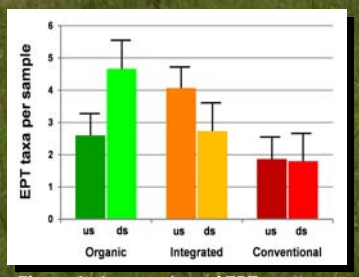

Figure 4 A comparison of EPT taxon richness by management system (*P*=0.008).

Conclusions

The Macroinvertebrate Community Index (MCI) and species diversity *H* indicate that all streams are experiencing moderate impacts from farming.

However, different farm management regimes within the same land use category (sheep/beef farms) can result in subtle changes to stream invertebrate community composition, especially in sensitive groups such as EPT taxa.