Water quality assessment using invertebrates – desk based study

Macroinvertebrates are animals without a backbone that are large enough to be seen with the naked eye. Freshwater macroinvertebrates spend part or all of their life cycle in flowing or standing waters. They include insects (fly nymphs and larvae, beetles and bugs), snails, mussels, leeches, worms, flatworms, slaters and shrimps. Fly nymphs and larvae leave water when they metamorphose and reach maturity, spending their adult life on land. In many cases, their adult life stage is short and lasts only from several hours to a few days. In contrast, to their immature stage spent in water can last for one or two years.

Macroinvertebrates play an important role in the aquatic food web - they feed on algae and plant material, such as leaves, helping to break down organic matter. They also provide a source of food for other animals, such as fish, birds and mammals. Macroinvertebrates are also good indicators of water quality because different species have different levels of tolerance to pollution. They also show integrated responses to pollution over time, rather than just at the time of sampling (like spot water samples analysed for the pollutant chemicals), and as such, they are useful for assessing the health of freshwater ecosystems.

Eutrophication (over-enrichment with plant nutrients such as phosphorus and nitrogen) is a significant problem that affects the quality of fresh waters, leading to decreased levels of dissolved oxygen in the water and lower levels of biodiversity. The main sources of nutrients are discharges from wastewater treatment systems and run-off from agricultural land. Some freshwater macroinvertebrate species are more sensitive to this form of pollution than others and, therefore, investigating which macroinvertebrate groups are present or absent and comparing abundance of these groups allows us to assess water quality.

Water quality assessment

Desk study

In this practical, you will investigate the effects of eutrophication on freshwater macroinvertebrate in rivers. You will compare results provided by SEPA from their macroinvertebrate surveys samples with water quality from two sites characterised by different nutrient levels.

Materials required for water quality assessment

- Pens/pencils
- Notebooks
- White board/ notice board and sticky notes

Method

Water quality and abundance of different groups of macroinvertebrates have been recorded at two sampling sites within the Loch Leven catchment – one located on the South Queich and the other on the Greens Burn.

The results from SEPA's analyses of water and macroinvertebrate samples are shown in Tables 1 and 2, respectively. The higher the number of organisms in the sample, the more abundant they are.

The production of this resource was funded by the William Grant Foundation

- Look at the differences in water quality between the two sampling sites using the results shown in Table 1. What do the results indicate in terms of pollution?
- Based on your conclusions from Table 1, and the abundance of different macroinvertebrate groups recorded at these sites (Table 2), which groups of macroinvertebrates are more tolerant to pollution and which are more sensitive?
- What aspects of water quality are not causing the differences in macroinvertebrates between sites?

Table 1 Water quality measurements

Determinand (unit)	**Sampling site/sample year**	
	South Queich	Greens Burn
	2007	
Dissolved oxygen (% saturation)	97.6	91.3
pH	7.7	7.8
Phosphorus (mg/L)	0.050	0.182
Electrical conductivity (µS/cm)	198	355
	2011	
Dissolved oxygen (% saturation)	98.1	89.1
pH	7.6	7.6
Phosphorus (mg/L)	0.027	0.062
Electrical conductivity (µS/cm)	180	356

Table 2 Macroinvertebrate counts per sample

Organism	**Sample site & sample year**	
	South Queich	Greens Burn
	2007	
Mayfly nymphs	211	6
Stonefly nymphs	33	1
Caddis fly larvae	31	5
Fly larvae	135	128
Snail	1	15
Worm	15	20
	2011	
Mayfly nymphs	312	39
Stonefly nymphs	142	22
Caddis fly larvae	24	54
Fly larvae	26	119
Snail	0	10
Worm	8	43

The production of this resource was funded by the William Grant Foundation