

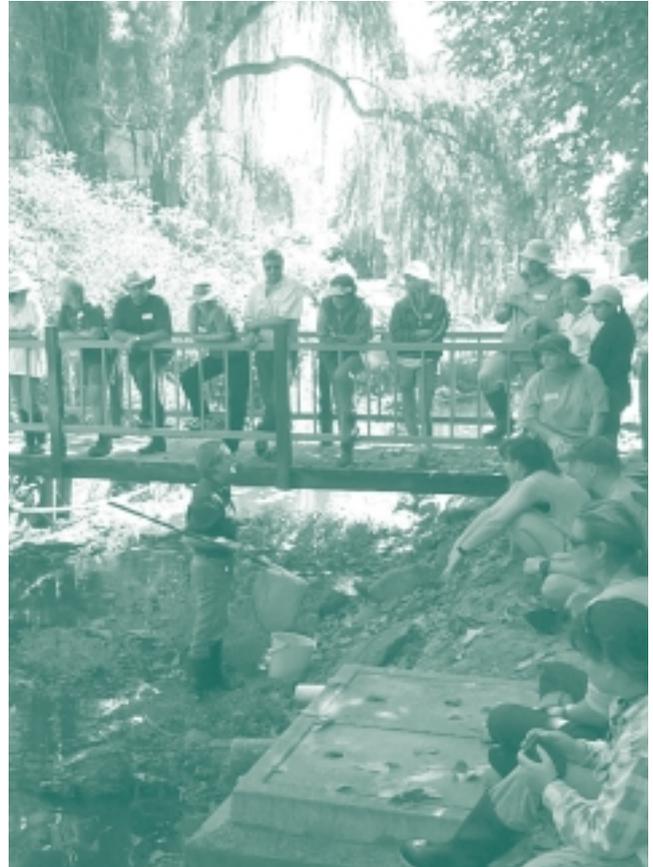


Water quality and macroinvertebrates

Introduction

Streams, rivers, wetlands and lakes are home for many small animals called macroinvertebrates. These animals generally include insects, crustaceans, molluscs, arachnids and annelids. The term macroinvertebrate describes those animals that have no backbone and can be seen with the naked eye. Some aquatic macroinvertebrates can be quite large, such as freshwater crayfish, however, most are very small. Invertebrates that are retained on a 0.25mm mesh net are generally termed macroinvertebrates.

These animals live in the water for all or part of their lives, so their survival is related to the water quality. They are significant within the foodchain as larger animals such as fish and birds rely on them as a food source. Macroinvertebrates are sensitive to different chemical and physical conditions. If there is a change in the water quality, perhaps because of a pollutant entering the water, or a change in the flow downstream of a dam, then the macroinvertebrate community may also change. Therefore, the richness of macroinvertebrate community composition in a waterbody can be used to provide an estimate of waterbody health. Macroinvertebrate communities vary across the State and different waterbodies often have their own characteristic communities. As many of the waterbodies in Western Australia are not permanent, animals are tolerant to a wide variety of environmental conditions. Most have a phase within their life cycle to escape extreme conditions. Once familiar with the taxa in your local area, you can use them as an additional way of monitoring the waterbody you are studying.



Participants learning aquatic macroinvertebrate sampling techniques from Ribbons of Blue Swan Regional Coordinator, Carlie Slodecki.



Students sorting a macroinvertebrate sample taken from the Mortlock River by Ribbons of Blue Avon Regional coordinator.

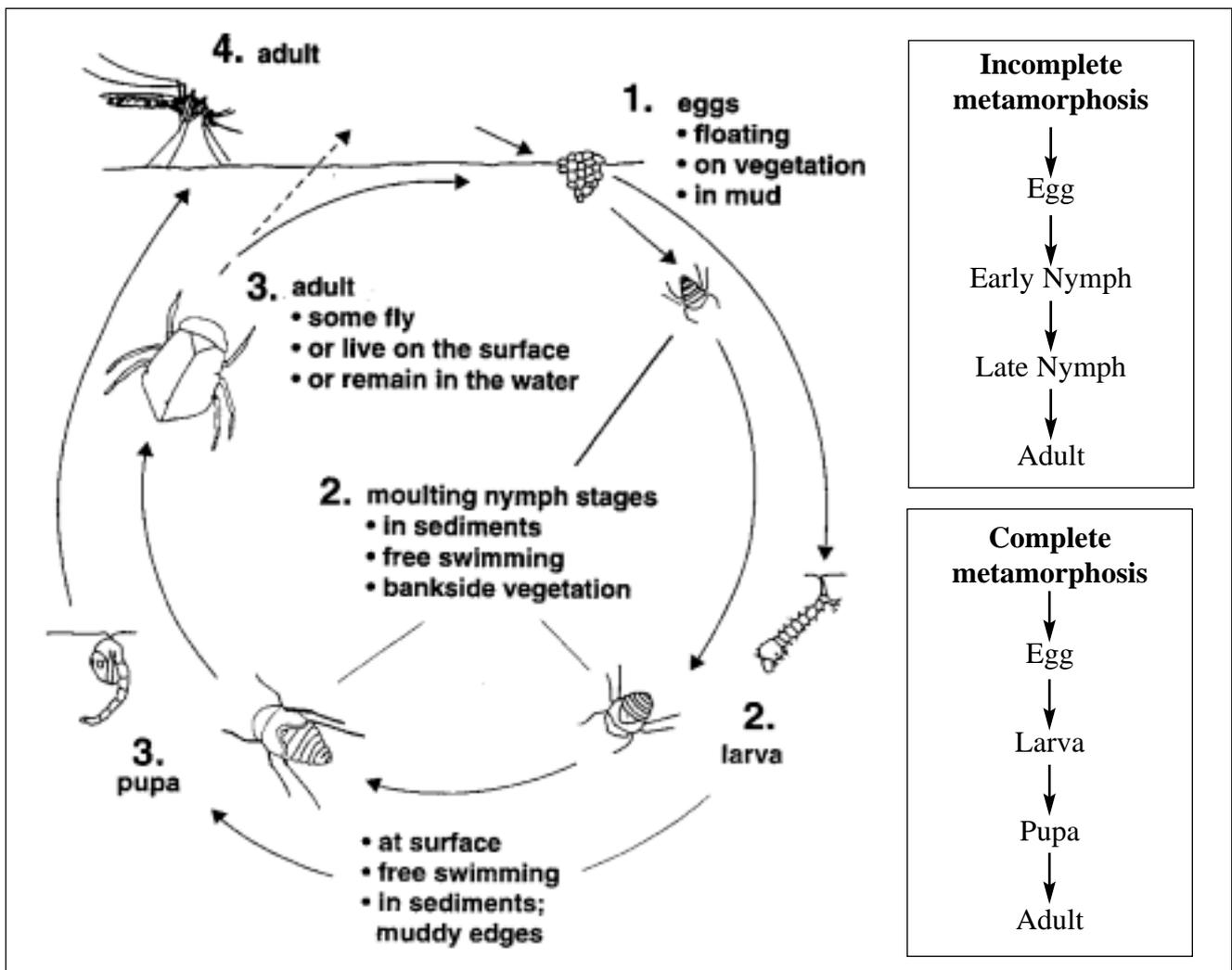


Figure 1: Insect life cycles

Life cycle

The most common types of aquatic macroinvertebrates are insects. As insects grow from an egg to an adult they change their body shape or metamorphoses. Insects show both complete and incomplete metamorphosis. Incomplete metamorphosis involves the egg hatching into a nymph. At every moulting the nymph looks more and more like the adult form. Complete metamorphosis involves the egg hatching into a larva, which is very different to the adult. The final larval stage involves the animal developing into a pupa, which is very different from the larva. From this stage the animal then develops into an adult. For most, the aquatic juvenile stage occupies by far the major proportion of the life cycle and is largely a feeding machine, leaving for the adult only a brief reproductive role. Some dragonfly larvae take three years to mature.

What do macroinvertebrates eat?

Macroinvertebrates are an important part of the aquatic food chain and can be characterised by what the animal feeds on and how it acquires it. The categories are referred

to as functional feeding groups and help describe the role each macroinvertebrate plays in an aquatic system.

Shredders feed on organic material, such as leaves and woody material, and help to convert this matter into finer particles. They require vegetation growing along a waterbody, so that plant material falls into the water, and slow flowing water so that the plant material is not swept away. Such animals include amphipods, isopods, freshwater crayfish (marron, gilgies, koonacs) and some caddisfly larvae

Collectors/Filter feeders feed on fine organic particles that has been produced by shredders, microorganisms and by physical processes. Such animals include mayfly nymph, mussels, water fleas, some fly larvae and worms.

Scrapers graze algae and other organic matter that is attached to rocks and plants. Such animals include snails, limpets and mayfly larvae.

Predators feed on live prey and are found where smaller collectors and shredders exist. Such animals include dragonfly and damselfly larvae, adult beetles and beetle larvae, some midge larvae and some stonefly larvae.

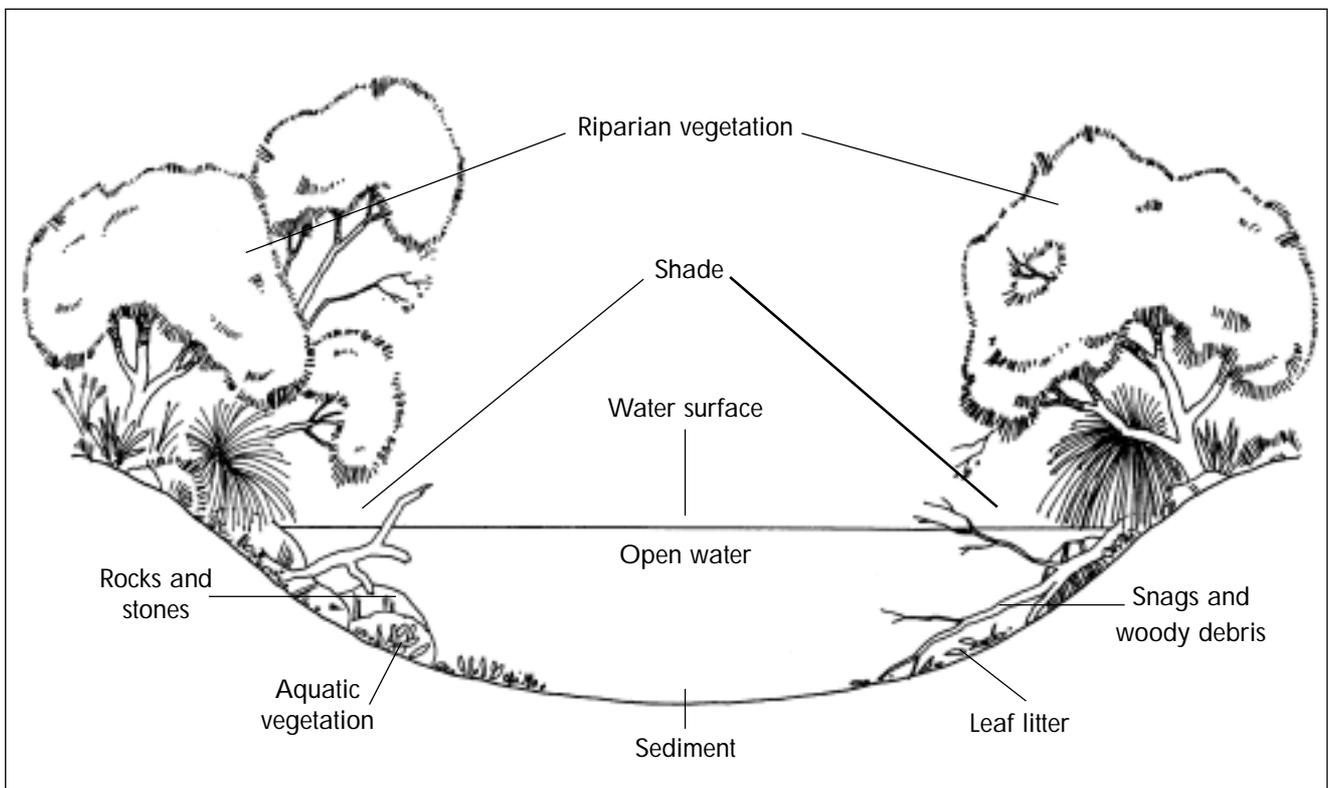


Figure 2: Habitats in a generalised waterbody

Habitat

Macroinvertebrates live in many different places in a waterbody. Some live on the water's surface, some in the water itself, others in the sediment or on the bottom or on submerged rocks, logs, and leaf litter. Each type of habitat provides a surface or spaces on or within which macroinvertebrates can live.

The most important feature around a waterbody is vegetation. Aquatic plants, particularly rushes and sedges, provide a surface on which macroinvertebrates can live. In addition, they balance the water flow, light availability and temperature around them. Shade by native trees and shrubs beside the water can reduce the extremes in temperature. Native trees, shrubs, rushes and sedges protect banks from erosion, help to control the water flow, and act as nutrient filters. Logs, branches, bark and leaves that fall into the water provide habitat for aquatic organisms. Leaf litter forms an important part of a food web for macroinvertebrates which feed on this material, or on the bacteria and fungi which cause it to decay.

In fast flowing water (lotic) such as the upland streams, the bed consists of large rocks and stones and the stream is heavily shaded. The influence of vegetation is very high. This provides food supply for largely collectors and shredders. Macroinvertebrates are adapted to fast flowing water by having powerful suckers or gripping legs.

In slow moving or still water (lentic) such as lowland rivers or wetlands, the bed may be sandy or muddy with increased light penetration. Nutrients are available and produce conditions for algal growth. Collectors and

scrapers dominate the macroinvertebrate community. Collectors will burrow into the sediment or filter their food directly from the water column. Grazers will be found on rocks, snags and woody debris or aquatic plants. In both lotic and lentic waterbodies, predators are found where their preferred prey is located.

Water condition and macroinvertebrates

Environmental modifications or pollution can alter macroinvertebrate communities. Poor catchment management can exaggerate the turbidity of water. In highly turbid water, the light penetration is reduced affecting photosynthesis of plants and also increases the temperature of the water. The suspended solids may clog respiratory surfaces or interfere with feeding appendages. Filter feeders receive reduced nutritional value and expend more energy to collect food, as otherwise they will starve. High levels of suspended solids may begin to settle and change the composition of the bed of the waterbody as it coats rocks and vegetation. This can affect movement, feeding, habitat and reproduction of some macroinvertebrates.

Salinity is a major problem facing waterbodies in the south-west of Western Australia. Macroinvertebrate communities have varying tolerances to different levels of salinities. A decrease in the range of Marron has been attributed to the increase of salinity in south-west rivers. However studies in WA have shown that generally crustaceans are more tolerant to rising salinity than insects.

The riparian vegetation balances the temperature in a healthy aquatic system. If this vegetation is cleared, it gives rise to more light penetration and an increase in turbidity from exposed soil. Industrial discharges or stormwater runoff from hot surfaces (eg roads and carparks) could increase the temperature quickly and discharges from reservoirs could release cooler water. Some macroinvertebrates might be able to tolerate slight increases in temperature. Sensitive macroinvertebrates such as stoneflies, which are restricted to cool, fast flowing waterbodies, cannot cope with such changes.

High levels of nutrients in the form of nitrogen and phosphorus from fertilisers and wastewater can activate excessive algal growth (algal blooms). The death and decay of these algae can produce toxins and stagnant conditions. In these conditions, macroinvertebrate community diversity is usually reduced but there is generally an increase in the abundance of a few species. These macroinvertebrates are able to take advantage (opportunistic) of the altered conditions and exploit the excess of food supply. Red midge larvae (Chironomids) are very tolerant to low levels of dissolved oxygen.

Toxic materials can enter waterbodies from industrial and agricultural wastewater and can include such substances as pesticides and heavy metals. The effect to the macroinvertebrate communities may be short-term (acute) if the pollutant exists in the water at high enough concentrations. In most cases, however, toxicants concentrations and discharges vary considerably. Therefore, emphasis is placed on long-term effects (chronic) where toxins can accumulate and become concentrated in food chains. Macroinvertebrates communities could be effected by decreased reproduction, impaired behavioural responses, disease or eventually death. The presence of such toxicants generally tends to reduce the overall diversity of macroinvertebrates.

The response to pollutants can vary enormously. For example, most species of mayfly nymph do not respond well to sediment or organic pollutants, but some are quite tolerant. The larvae of dragonflies and damselflies can be quite tolerant of salinity, but are harmed by other pollutants. Some animals can act as pollution indicator species because they respond to specific changes in the water conditions.

Why monitor with macroinvertebrates?

Macroinvertebrates are sampled in waterbodies because they are useful biological indicators of change in the aquatic systems. The main advantages of using macroinvertebrates is that some have life span of up to a year and greater, they are relatively sedentary, have varying sensitivities to changes in water quality and they are easily collected and identified.

It is very important to note, however, that when assessing macroinvertebrates, other physical, chemical and other biological data should be considered to support the waterbody assessment. Other biological measures could include riparian vegetation, fish, frogs, birds, algae and faecal coliforms. Common physical and chemical parameters assessed in Ribbons of Blue/Waterwatch WA monitoring programs include temperature, turbidity, conductivity, pH, nutrients and dissolved oxygen.

Macroinvertebrate sampling

There are various ways to sample macroinvertebrates and the method used depends on a whole host of reasons, in particular, your reasons for sampling. This method presented in this booklet provides a rapid, and effective way of sampling macroinvertebrates and ideally suits school and community groups. The procedure is adaptable, whether the desire for the group is purely for awareness or whether the sampling is part of a monitoring program. Ribbons of Blue is an education network which works with many school and community groups and can provide training for registered groups in macroinvertebrate sampling.

Where to sample

You can sample in a range of waterbodies, including such as rivers, streams, creeks, drains, lakes, wetlands and ponds. Choose a site or a number of sites that have easy access and are easily accessible. If the site lies on privately owned land, ensure you have permission to sample. Your choice of sites will depend on your reasons for monitoring eg. effect of rehabilitation at a site or the effect of a pipe entering a stream.

Safety

Safety considerations are paramount. Under no circumstances should you sample at any site that might be unsafe and never sample alone. At the end of the sampling session it is recommended that you wash your hands thoroughly before consuming food. Here are some more points to consider:

1. Understand the risks
2. Never sample alone
3. Never go into the water above your knees
4. Avoid contact with polluted water
5. Choose safe sites
6. Wear appropriate clothing
7. Take safety gear and a first aid kit
8. Plan and maintain contact with help

When to sample

If macroinvertebrate sampling is being conducted as part of a monitoring program, data should be collected at least once or twice a year. The highest diversity is generally when the high water levels and flows have reduced and temperatures are beginning to increase. For rivers in the south west, this would be in spring and for wetlands this would be in late winter, spring and early summer. The times differ because rivers rapidly stop flowing as soon as rainfall stops. The frequency and time of sampling will depend on your reasons for sampling and efforts to minimise disturbance.

Minimise disturbance

Macroinvertebrate sampling does disturb the macroinvertebrates and their habitats. It is important that the impact is kept to a minimum. Frequency of sampling should be limited to four times a year. Only allow one or two people at a time to enter the water to sample. Once macroinvertebrates are identified and recorded they should be returned to the water unharmed as soon as possible to where they were sampled. If any other animals such as fish and amphibians are caught, they must be returned immediately as the primary focus of this type of sampling is macroinvertebrates. Remember all native fish and amphibians are protected.

Equipment

There are various items of equipment required for the sampling, sorting and identification of aquatic macroinvertebrates. To ensure that the sampling is a success, here is a checklist of equipment that you should bring.



A collection of equipment used in the sampling, sorting and identification of macroinvertebrates.

Checklist

- | | |
|--|---|
| <input type="checkbox"/> Sampling net | <input type="checkbox"/> Sorting Equipment - spoons, pipettes |
| <input type="checkbox"/> Waders/boots | <input type="checkbox"/> Magnifying glass |
| <input type="checkbox"/> Buckets | <input type="checkbox"/> Identification keys |
| <input type="checkbox"/> Sorting trays | <input type="checkbox"/> Clipboards and pencils |
| <input type="checkbox"/> Ice-block trays | |

How to take a sample

To conduct macroinvertebrate sampling someone will need to enter water and they should have appropriate clothing, preferably waders. Use the handle of the dip net to gauge of the depth and composition of the waterbed prior to entering. Sampling needs to be conducted for at least 5 minutes. Over-sampling is better than under-sampling to ensure the greatest range of macroinvertebrates.

There are two different methods of sampling macroinvertebrates. A kick sample is used for flowing water with mainly rocky bottoms. The sediment and stones are disturbed immediately upstream of the net by stirring it up using your feet so that the animals are dislodged and are swept into the net, which is located just downstream of your feet. A sweep sample is used in deep water or muddy bottoms and sampling along banks and amongst vegetation. Bounce the net backwards over the bottom to stir up the sediment, then scoop it forward. Repeat, swirling the debris back into the net. Scrape the net up against emergent vegetation and submerged rocks and logs. The focus in macroinvertebrate sampling is to sample as many of these habitats as possible in order to collect the majority of the macroinvertebrate taxa at a site.

Carefully rinse the net several times in the waterbody to let the excess sediment pass through. Transfer the contents of the net into a bucket that is waiting at the shoreline half-filled with water from the site.

How to sort a sample

Sorting should be performed at the site immediately after sampling. Select a position to sort that is flat, and not in direct sunlight. Gently mix the sample in the bucket to ensure that the contents are evenly distributed. Empty some or the entire sample into a white tray, which has about 2cm of clean water. Bear in mind that too much sample might make it impossible to see any of the taxa. Allow the sample to settle and observe any movement in the water. Using a spoon or a plastic pipette, carefully collect any taxa that are seen. If you are too vigorous in sorting you may stir up all the material making it quite hard to see any of the taxa in the tray. Transfer collected taxa into a white ice-block tray for a closer observation with a magnifying glass. Make sure that the ice-block tray also has clean water in the compartments. Place similar macroinvertebrates into the same compartments. The sorting process should take a minimum of 20 minutes as some taxa are quite hard to find, particularly to an inexperienced eye. Remember some taxa can be very large and others can be smaller than 1 mm that may look like a grain of sand. When you believe all taxa are found it is recommended to keep on looking for a further 10 minutes.

It is not necessary to pick out every animal, but rather, pick out as many different types as possible. This is the information that will be recorded on the data sheet and used to estimate the health of the waterbody.



Participant sampling site, which is a still body of water with muddy sediments.



Participant sampling site, which is a flowing drain with emergent vegetation.



Participants sorting a macroinvertebrate sample and using an identification key.

How to classify macroinvertebrates

Before identification it is important to understand how living things are classified. There is a huge variety of life on earth which can be quite confusing, so biologists have developed a system that assembles all the living things into groups. The basic groupings are Kingdom, Phylum, Class, Order, Family, Genus and Species.

The groups are arranged in a hierarchical system. Within a kingdom are groups called phyla, within a phylum there are groups called classes, within a class there are groups called orders, and so on. A kingdom is a large and broad division such as whether the living thing is a plant or an animal, while on the other end of the system, species is a finite division with members sharing very similar attributes.

Marron are a very well known invertebrate inhabiting the waterbodies of the south west of Western Australia. Here is an example of the classification of this animal. Therefore, scientists would refer to the Marron as *Cherax tenuimanus*. This naming system is called a binomial system and consists of two parts. The first part is the generic name which has the first letter as a capital and then is followed by the specific name which is all lower case. The name should also be written in italics as above or underlined eg. *Cherax tenuimanus*.

Classification of a marron

Kingdom	Animalia
Phylum	Arthropoda
Class	Crustacea
Order	Decapoda
Family	Parastacidae
Genus	<i>Cherax</i>
Species	<i>Cherax tenuimanus</i>

How to identify macroinvertebrates

Identification can be conducted concurrently with sorting or afterwards. Use an identification key (such as Ribbons of Blue/Waterwatch WA resources) to accurately identify what you have found. If you have trouble identifying a macroinvertebrate, try taking a photo or drawing a sketch with a description so it can be identified later. Once the macroinvertebrates have been sorted and identified they should be returned back to the water that they were collected from immediately.

Recording

When you have completed the sorting and identification, mark down on the Macroinvertebrate Data Sheet what you have found. Count each type of organism only once. Also make notes about abundance and any other observations.

Interpretation

Each macroinvertebrate is either present or not present at a site for a combination of reasons. Take into account lifecycle, seasons, water flow, riparian vegetation, habitats and water quality to try to explain why each animal is living at a site and how it is interacting with the environment and other organisms. Some macroinvertebrates can be classed as either sensitive or tolerant depending on their response to specific changes in the water conditions. With further monitoring and more data, it could be possible to calculate sensitivity ratings for each animal. Also you can compare your data at a site at different times of the year, or with different sites in the same catchment or stream, or with different waterbodies.

Useful references

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For more information contact



Level 2 Hyatt Centre, 3 Plain Street
East Perth Western Australia 6004

Telephone: (08) 9278 0300

Facsimile: (08) 9278 0301

Website: <http://www.wrc.wa.gov.au/ribbons>
or your regional office.

This Fact Sheet is one in a series providing information
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Macroinvertebrate Data Sheet

Group: _____	Site: _____
Contact : _____	Sampling Net: _____
Date: _____	Time: _____
Sampling Time: _____ mins	Sorting Time: _____ mins

Macroinvertebrate	Classification	Present (✓)	Comments
PHYLUM ARTHROPODA – CLASS INSECTA			
Stonefly larvae	Plecoptera (order)		
Mayfly nymph	Ephemeroptera (order)		
Caddisfly larvae	Trichoptera (order)		
Dragonfly larvae	Odonata (order)		
Damselfly larvae	Odonata (order)		
Water boatmen	Corixidae (family)		
Backswimmers	Notonectidae (family)		
Water scorpion	Nepidae (family)		
Water measurer	Hydrometridae (family)		
Water strider	Gerridae (family)		
Riffle beetle/larvae	Elmidae (family)		
Predacious diving beetle adult/larvae	Dytiscidae (family)		
Water scavenger beetle adult/larvae	Hydrophilidae (family)		
Whirligig beetle adult/larvae	Gyrinidae (family)		
Mosquito larvae and pupae	Culicidae (family)		
Blackfly larvae	Simuliidae (family)		
Soldier fly larvae	Stratiomyidae (family)		
Biting midge larvae	Ceratopogonidae (family)		
Non-biting midge larvae	Chironomidae (family)		
Springtails	Collembola (order)		
PHYLUM ARTHROPODA - CLASS CRUSTACEA			
Freshwater crayfish	Parastacidae (family)		
Freshwater prawn	Decapoda (order)		
Water flea	Cladocera (suborder)		
Amphipod	Amphipoda (order)		
Ostracod	Ostracoda (subclass)		
Copepod	Copepoda (subclass)		
Isopod	Isopoda (order)		
PHYLUM ARTHROPODA - CLASS ARACHNIDA			
Water mite	Acarina (order)		
Water spider	Araneae (order)		
PHYLUM MOLLUSCA			
Freshwater mussel	Bivalvia (class)		
Freshwater snail	Gastropoda (class)		
PHYLUM ANNELIDA			
Segmented worm	Oligochaeta (class)		
Leeches	Hirudinea (class)		
PHYLUM NEMATODA			
Roundworms	Nematoda (phylum)		
PHYLUM PLATYHELMINTHES			
Flatworms	Turbellaria (class)		
MACROINVERTEBRATE DIVERSITY (TOTAL) *			

*Add up the number of ✓'s to determine the total number of different macroinvertebrates found. The presence of various freshwater macroinvertebrates may vary according to season, lifecycle, water flow, habitat and water quality.

Backswimmer

Backswimmers as the name suggests are active swimmers that swim upside down. They periodically break the water surface with their abdomen to collect air. They prey on a range of small aquatic animals.

SIZE: Up to 7 mm



Biting midge larvae

Biting midge larvae have a slender, whitish body, and their movement is snake-like. They are found in sediments near the banks of rivers and lakes and feed on algae and organic material, while some are predators.

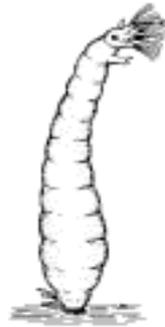
SIZE: Up to 12 mm



Blackfly larvae

Blackfly larvae are cylindrical in shape with the abdomen thickened. They have a pair of 'brushes' on the head and prefer running water. They are found attached to rocks and stones.

SIZE: Up to 7 mm



Caddisfly larvae

Caddisfly larvae are worm-like insect larvae with three pairs of legs on the first three body segments. They are usually found in cases made from rolled leaves, hollow twigs or sand glued together with only their head and legs protruding when they move.

SIZE: Up to 20 mm



Damselfly larvae

Damselfly larvae are more slender than dragonflies, have a distinct head section, and three gills on the tail tip. They are found on plants, among stones and leaf litter, or on the waterbed.

SIZE: Up to 27 mm



Dragonfly larvae

Dragonfly larvae are short, robust predators with wing pads and internal gills. They are found on plants, among stones and leaf litter, or on the waterbed.

SIZE: Up to 50 mm



Mayfly nymph

Mayfly nymph have three long filaments at the end of their abdomen, with wing pads and lateral gills along the abdomen. They have short antennae, and a single claw on each foot. They are found under stones in fast flowing water or among plants in slow flowing water.

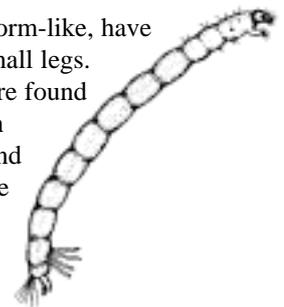
SIZE: Up to 10 mm



Non-biting midge

Non-biting midge larvae are worm-like, have a visible head and 2 pairs of small legs. Some are red in colour. They are found in sediments sometimes in high numbers. They feed on algae and organic material while some are predacious.

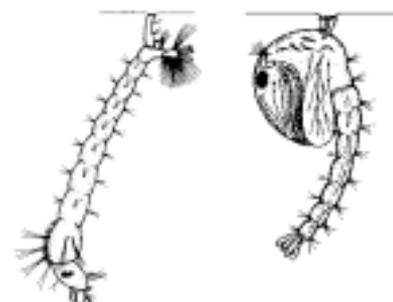
SIZE: Up to 30 mm



Mosquito pupae and larvae

Mosquito larvae have a head with feeding 'brushes', an enlarged thorax and a breathing tube on the end of the abdomen. Larvae are usually found in still waters and feed on decaying organic material and algae. They swim in a wriggling motion. Pupae are aquatic and do not feed. They have a breathing tube on the thorax.

SIZE: 3-6 mm



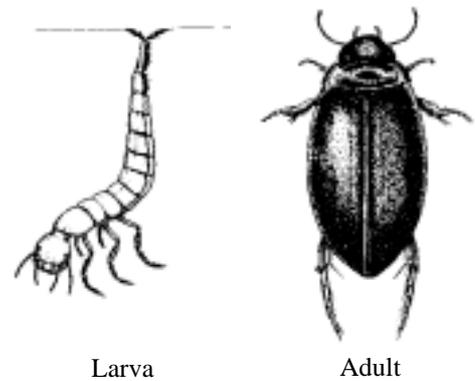
Larva

Pupa

Predacious diving beetle

Adults are strong swimmers and use their flattened hind legs as oars. Many are dark in colour, however, the range of colouration is considerable. Larvae are long and slender with prominent mouth parts. They prefer slow or still water where they rest at the surface waiting for prey. As the name suggests they are carnivores and feed on small aquatic animals and even prey on small vertebrates.

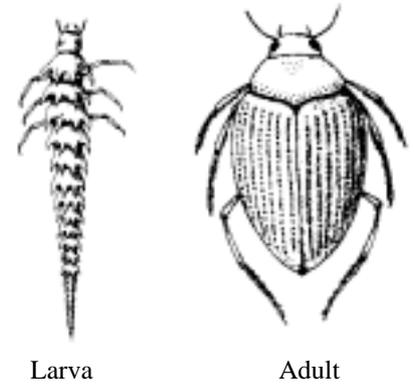
SIZE: Adult up to 35 mm, Larva up to 55 mm



Crawling water beetle

Adults are poor swimmers and are subsequently found in still waterbodies or in sheltered streams. The adults have a distinguishing large coxal plate at the base of the hind legs. Eggs are laid on vegetation. The larvae are slender and have backward-pointing breathing processes on each abdominal segment. They are herbivores.

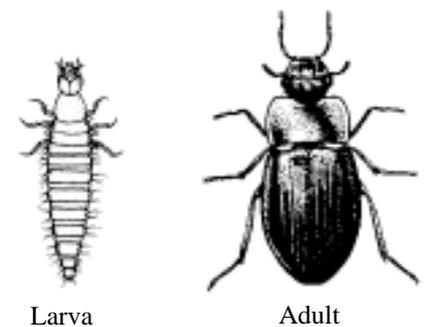
SIZE: Adult and Larva up to 6 mm



Scavenger beetle

Adults have a smooth oval-shaped body and are dark and dull in colour. Larvae are slender, have well-developed mouthparts and have gills on the abdomen. Adults and larvae are found in slow moving or still waters. The adults mainly feed on plant material while larvae are carnivorous and feed on small aquatic animals.

SIZE: Adults more than 40 mm, Larva up to 8 mm



Springtail

Springtails are primitive wingless insects with a forked appendage (furcula) on the abdomen. They are found on the water surface regularly in large numbers. They feed on dead and decaying plant and animals material.

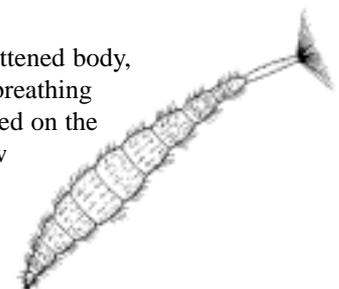
SIZE: Up to 3 mm



Soldierfly larvae

Soldierfly larvae have a flattened body, pointed at either end. The breathing tube has a tuft of hair located on the last segment. They are slow moving and feed upon decaying organic material and algae.

SIZE: Up to 30 mm



Stonefly larvae

Stonefly larvae have two long tails, tubes of thread-like gills on their undersides, wing pads, antennae, and two claws on each foot. They are found among stones or plants in clear, cool, well oxygenated streams.

SIZE: Up to 8 mm



Water boatman

Water boatman are shield shaped with long back legs used for swimming. Wings overlap to leave a small triangle at the back. Some are predators while others feed on small particles of organic material. They are found in the water column sometimes in high densities.

SIZE: Up to 10 mm



Water measurer

Water measurers have a long slender body, with long legs and feet which helps them move across the water surface. They are usually found around emergent vegetation and feed on small animals found at the water surface.

SIZE: Up to 16 mm



Water scorpion

Water scorpions have a long broad flattened body with a large rear breathing tube, and clasping front legs. They live in slow-flowing water amongst vegetation.

SIZE: Up to 50 mm (not including breathing tube)



Water strider

Water striders have long 2nd and 3rd pairs of legs that are spread widely. The 1st pair of legs are used to capture prey. They are commonly found on the water surface regularly in small groups.

SIZE: Up to 12 mm



Water mite

Water mites have a flat disc-like body and can be variously coloured. They swim in open water, among plants, or on the bottom in slowly flowing water. Most are predators, some are parasitic.

SIZE: Up to 2.5 mm



Whirligig beetle

Adults have short antennae and their forelegs are very long whilst the mid and hind legs are short and paddle-like. They are dark with a metallic sheen and oval-shaped. They are found in still or slow flowing waters and are found at the water surface. As the name suggests they swim in a whirling motion in the surface film and dive below the surface. They are predators and feed on those animals that fall into the water.

SIZE: Adult up to 6 mm, Larva up to 20 mm



Larva



Adult

Water spider

Water spiders are found at the water surface and are very active predators. They can submerge taking with them a supply of air trapped in their hairs.

SIZE: Up to 25 mm



Amphipod

Amphipods, typically, have a distinct head and thorax, a 6-segmented abdomen and 7 pairs of walking legs. They are usually found in muddy sediments and leaf litter, but can be free swimming.

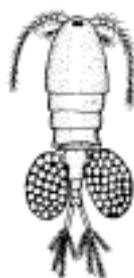
SIZE: Up to 10 mm



Copepod

Copepods are small tear-drop shaped crustaceans. They move in a pulse motion through the water. They filter feed fine particles including microalgae and decomposing material, while some are predators or parasitic.

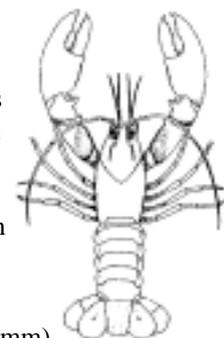
SIZE: Up to 2 mm



Freshwater crayfish

Includes Marron, Gilgies and Koonacs. They have 2 large forelegs or claws, a well developed abdomen with a fan-like tail (Uropods). They feed on living or dead plant and animal material and are found in burrows and amongst rocks and vegetation.

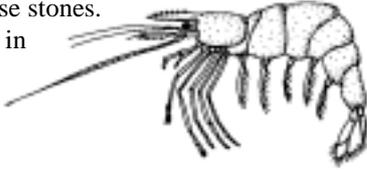
SIZE: Up to 300 mm (usually <100 mm)



Freshwater prawn

Prawns are familiar small crustaceans with slender legs and claws. They are found among aquatic plants and loose stones. Can be very abundant in some areas and can tolerate low salinities.

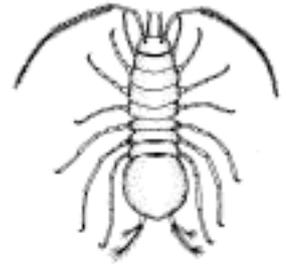
SIZE: Up to 50 mm



Isopod

Isopods have a distinct head and no body shield (carapace). Similar to amphipods but gills are found on the abdomen. They are slow crawlers and feed on dead and decaying material.

SIZE: Up to 12 mm



Ostracod

Ostracods are a crustacean enclosed within a shell (carapace). They are found crawling around the waterbed and amongst aquatic plants but can be active swimmers.

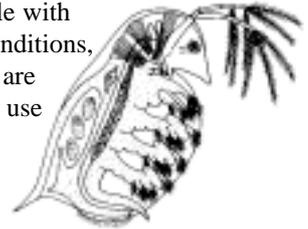
SIZE: 0.4 – 1.5 mm



Water flea

Water fleas are only just visible with the naked eye. In eutrophic conditions, abundance can be great. They are free swimming organisms and use a large pair of antennae for locomotion.

SIZE: most <1 mm



Freshwater mussel

Mussels are soft bodied animals enclosed in two hard, hinged shells. A large muscular foot extends out of the shell for locomotion. They can be found on stable sandy or muddy bottoms.

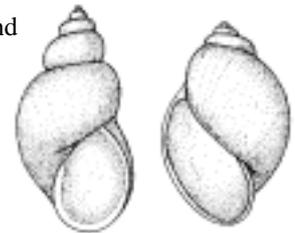
SIZE: Up to 80 mm



Freshwater snail

Aquatic snails are similar to land snails but are usually smaller. They feed using a rasping tongue (radula) which grinds and scrapes off algae from rocks and plant material.

SIZE: Up to 65 mm



Flatworm

Flatworms have a flattened unsegmented body with dark eye spots which can usually be seen. They feed on dead and decaying animal material and glide over stones and vegetation.

SIZE: Up to 15 mm



Leech

Leeches have suckers at each end of their body. Most can swim using undulating motions. They prefer stony or vegetated habitats so they can attach themselves. Some are parasites living on blood of animals. Others feed on small invertebrates

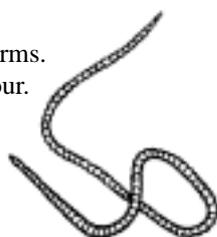
SIZE: Up to 100mm



Segmented worm

Segmented worms resemble earthworms. They are usually a red or brown colour. They feed on dead and decomposing plant material and are found within the sediments.

SIZE: Up to 30mm



Round worm (Nematode)

Round worms are thin, elongate and cylindrical in shape. They are found on the waterbed where they feed on all types of organic material. They can be very abundant.

SIZE: Up to 12mm

