CHAPTER NINE

Two green and silver dragonflies, unfamiliar,
argue that somewhere a pool of dull water
breeds things that still live here, wild and unchosen,
simply because their ancestors did.

CHAPTER 9

THE FLOODPLAIN FOOD CHAIN

The first rung on the floodplain food chain ladder is made up of primary producers, species which break down leaves and other detritus, or which capture sunlight (Chapter 4). The smallest and most common primary producers are bacteria (Chapter 8), which are eaten by a swarm of strange, small animals known collectively as microinvertebrates. Microinvertebrates are creatures less than a millimetre long. They are difficult or impossible to see without a microscope, and include tiny creatures such as protozoans, rotifers, microcrustaceans and very small insects.

LITTLE ANIMALS

The next step up the food pyramid is the macroinvertebrates, loosely defined as animals without backbones that are more than a millimetre long. These include a few of the large, familiar floodplain inhabitants, like yabbies and mussels, as well as some of the larger insects, crustaceans, snails and their ilk. The terms 'macroinvertebrate' and 'microinvertebrate' describe an animal's size, not its taxonomy.

The largest floodplain animals, of which there are fewest, are the vertebrates – animals with backbones. These are the creatures most familiar to humans: fish, mammals, reptiles, amphibians and birds. They represent only a tiny proportion of the species that live on the land and in the waters of floodplains, but their visibility, and their position at the top of the food chain, makes them very important. The decline of large species is usually a sign that something is profoundly amiss in an ecosystem. A fish is just the tip of an iceberg – or, more correctly, the tip of a trophic pyramid (Chapter 4) – and its disappearance is usually a sure sign that something is wrong with its ecological life support system. Simply putting fish back will not solve the problem.

Small is plentiful

The tinier life is on the floodplains, the more extravagantly diverse it becomes. There are only a few species of large macroinvertebrates living on the Murray-Darling's floodplains, but hundreds of smaller ones – including, doubtless, many as yet unknown to science. Microinvertebrates are even less known, and even more abundant. So far scientists have identified more than a thousand species of microinvertebrates living on floodplains, and they believe that is just scratching the surface.

Freshwater invertebrates are often grouped according to how they go about gathering food. 'Shredders', for example, shred leaves and other organic detritus as they feed, speeding up decomposition (Chapter 8). Other groups include 'collectors and gatherers', 'filterers', 'scrapers and piercers', 'predators' and 'generalists. Each of these functional groups plays a different role in the floodplain ecosystem. In most floodplain waters a few species of invertebrates vastly out-number all others, but many are present in low numbers. Which species exist in the greatest numbers varies according to different conditions.

Midges

If yabbies are the weightiest macroinvertebrates on the floodplains, non-biting midges (Chironomids) are among the most numerous. Australia boasts more than 160 species of chironomids, with more being discovered each year. Their fast-paced life cycles and huge breeding booms are one of the primary driving forces behind the ecology of floodplains. Adult midges are similar in size and appearance to mosquitoes, and swarm in vast numbers over inland waters.

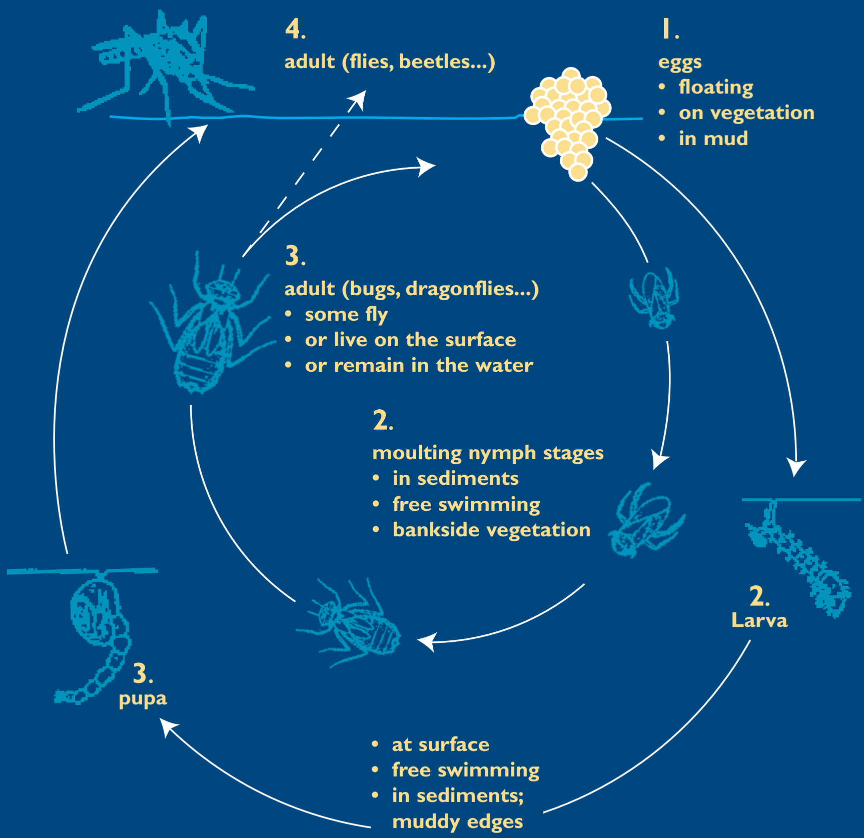
Chironomids don't bite (the so-called 'biting midges' belong to a different insect family). Most Australian species have lightning-fast life cycles which allow them to breed up in vast numbers in just a few days, taking advantage of short-lived puddles of rain water, and of floods. Their larvae, worm-like and growing up to about a centimetre long, can be found living in large numbers in the mud at the bottom of billabongs, streams and dams. Often midge larvae are coloured bright red, and these are popularly known as 'bloodworms'.

The midge is one of nature's great opportunists. Within hours of a pool forming, adults arrive to lay eggs. The hatching larvae take advantage of the first flush of growth triggered when dried sediment is wetted. They feed on algae, plants, diatoms and decaying organic matter, sometimes secreting tiny nets to catch passing morsels. The full life cycle of a floodplain midge can take as little as 11 days to complete. Less than two weeks after a new flood, adults may emerge in huge numbers. In the water, midge larvae provide food for slower breeders such as dragonflies and newly hatched fish, while the swarming adults are eaten by ducks, other birds and insects.

The aquatic larval stage of the dragonfly (right) undergoes a spectacular metamorphosis to emerge as an adult. As soon as its wings have dried, the insect can take its maiden flight. These predatory insects have excellent vision which allows them to catch their prey in mid-flight. Photos: *John Hawking, CRCFE*

Above: This damselfly is a close relative to the dragonfly, both belonging to the order Odonata. You can distinguish damselflies from dragonflies by the symmetrical wings of the former.

Typical macroinverterbrate life cycles



Internationally midges are among the best-studied aquatic insects, because they are economically important. In Australia they are major pests of rice. They breed in flooded irrigation bays, feeding on germinating rice seeds and threatening sizeable crop losses. Spraying rice-eating midges with insecticides is an expensive task, which has to be repeated every fortnight. As soon as one population of chironomids is poisoned, a new one moves in. In one intriguing recent study, rice researchers from New South Wales have speculated that midges might be even better adapted to being 'first-in, first-out' after a flood than they previously thought. It may be that growing midge larvae give off some kind of chemical signal that stops more adults laying eggs in the same pond. If so, rice growers spraying one generation of midges may also be removing the deterrent that stops the next generation from moving in. (22)

Midges have also been studied, in Australia and overseas, because their larvae appear to be super-sensitive to chemical contamination in waterways. Overseas scientists have developed special keys which count birth defects in the mouthparts (or 'teeth') of midge larvae. The more contaminated the water, the more deformities. Studies of midge larvae in the Lower River Murray have found surprisingly high numbers with deformed mouthparts (23). The significance of such frequent deformities is still being debated, with researchers looking at using chironomids as potential 'biomonitors' of water and sediment quality.

Dragonflies

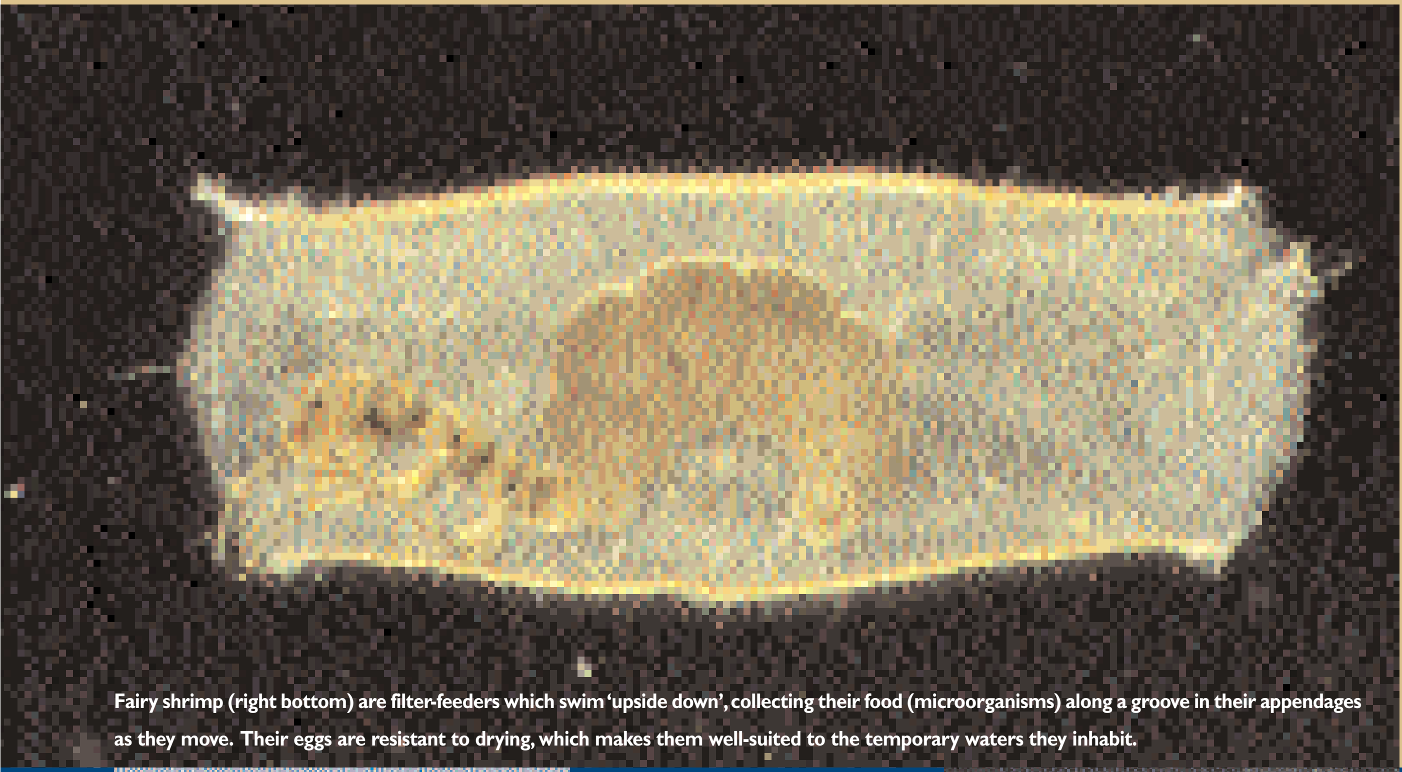
Weight for weight, dragonflies are among the most violent creatures on the floodplain. In the water their larvae live by hunting and ambushing other insects, tadpoles and even small fish. As flying adults they hunt moths and other flying insects, attacking them on the wing. It is a lifestyle they have been practising for a very long time; they are among the Earth's greatest survivors. The earliest dragonfly fossils date from about 300 million years ago, before dinosaurs appeared on the scene. Dragonflies somehow survived the huge but mysterious extinction which struck the world about 245 million years ago, when an estimated 96 percent of all species on Earth were extinguished. They then shared the Earth for 185 million years with dinosaurs. *Tyrannosaurus rex* was buzzed by dragonflies, some of which in its time were the size of model aeroplanes. When the dinosaurs became extinct 65 million years ago, taking perhaps 80 percent of all other species with them, dragonflies survived again.

The aquatic larvae of dragonflies, and of their close relatives, damsel flies, go through between 10 and 15 moults after hatching from their eggs. With each moult the larvae grow larger, and are able to hunt larger prey – including each other. They harpoon their victims with a hugely modified lower lip, adapted by evolution into a triangle-shaped, spring-loaded organ called a 'mask'. After its final moult, a dragonfly larva crawls out of the water, climbing up the stem of an emergent plant or some other semi-submerged object. Once out of the water, it rests. Then its skin splits open to allow a bedraggled adult to emerge, leaving behind a dried shell. Such dried shells are common sights near waterbodies, adorning plant stems, logs, rocks or any other objects partly immersed in the water.

In river channels dragonflies have long-lasting and very specialised larval stages, while those living on floodplains are short-lived opportunists, which can hatch and grow quickly to take advantage of floods (Chapter 5). One river-dwelling species takes seven years to complete its larval stages, and lives only on logs under waterfalls, while some opportunist floodplain-dwellers complete their entire life cycles in less than two months. Many river-dwelling dragonflies are survivors from the break-up of Gondwana, while the opportunistic floodplain species are more recent invaders from the tropics. In river channels, dragonfly larvae take up residence in sunken logs and snags, while in billabongs they live mostly among living water plants.

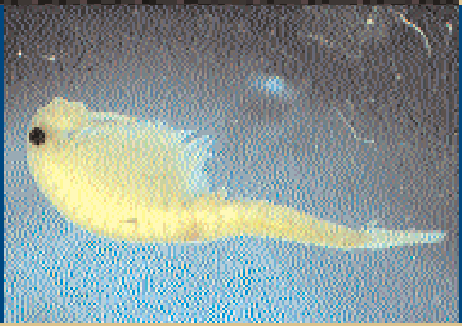
Many of Australia's dragonflies and damselflies are descendants of Gondwana's ancient fauna. Photos this spread: *John Hawking, CRCFE*

Top: This silk purse caddis fly, secretes a silk-like case which it attaches to algae or a rock for support so that it doesn't get washed away in flowing waters. The case is built during its last stage as a larva and pupa in preparation for emergence as an adult.



Fairy shrimp (right bottom) are filter-feeders which swim 'upside down', collecting their food (microorganisms) along a groove in their appendages as they move. Their eggs are resistant to drying, which makes them well-suited to the temporary waters they inhabit.

Left: A copepod nauplius, or larva, which gradually assumes the adult structure after a series of six moults.



The next rung down: microinvertebrates

On a microscopic scale, which few Australians ever have a chance to see, floodplain waters teem with thousands of species of rotifers, microcrustaceans, protozoans, molluscs and other tiny animals. When there are plenty of bacteria to feed on, a litre of billabong water may contain more than a million protozoans and several hundred thousand rotifers. They in turn provide food for macroinvertebrates and for very young hatchling fish.

Among the larger microinvertebrates are tiny crustaceans, related to the more familiar yabbies and crayfish but far smaller. Copepods, for example, are a subclass of crustaceans that never grow large enough to be seen clearly without a microscope – the largest species grows to only four millimetres long. Most copepods are much tinier; between a half and two millimetres long when fully grown. They feed on bacteria and other microscopic organisms, and – a little like their large cousins, yabbies – female copepods carry their eggs around with them in egg sacs on their tails. Aside from rotifers and protozoans, copepods are perhaps the most common microinvertebrate inhabitants of floodplains.

Rotifers

Rotifers are probably the most abundant multi-celled animal on river floodplains, but until 15 years ago almost nothing was known about Australian species. Different species of rotifer vary enormously in shape, but a typical one might be shaped like a swimming barrel, with a head at one end and a grasping foot at the other. Some species have rings of hair-like cilia around their heads, which wave in time – like a Mexican wave at a cricket match – making them look like spinning wheels as they move through the water.

The world's largest known species of rotifer is only three millimetres long, and most are much less than a millimetre. The smaller rotifers are about the same size as single-celled creatures like protozoans, whose domain they share, but they are every bit as complicated in their structure and behaviour as much larger animals. Rotifers feed mostly on bacteria, but also on detritus, algae, plants and each other, and they are highly specialised in their feeding and breeding habits.

A typical rotifer lives for only a few days, and is female, producing perhaps three or four eggs every 24 hours. Males are rare and are seldom seen. In their tiny world rotifers are fierce and ingenious hunters. Some species use a tentacle-like organ to grab the 'tails' (flagella) of passing bacteria, dragging their wriggling victims to their mouths. Others bore holes into single-celled algae and suck out their insides, or slice long filaments of algae into segments and eat them end on, like spaghetti.

One billabong rotifer, *Ascomorphella volvocicola*, lays its eggs only in the middle of Volvox colonies. Volvox are sperm-like, single-celled algae, which join together for protection in spherical colonies – heads in, tails out. Volvox swim their colonies by wagging their tails in unison, and together they represent too large a mouthful for most rotifers. But *Ascomorphella volvocicola* is not put off. It chews its way into the middle of a volvox colony, hitching a ride inside the tumbling sphere. The rotifer lays its eggs inside, and when the young rotifers hatch, they have a ready food supply – they eat the volvox cells head first from the inside, before swimming off to find a new colony to invade. (24)

Protozoans

Protozoans are the smallest of the microinvertebrates. Most individuals consist of only a single cell, but despite their small size they are complex, mobile organisms with sophisticated behaviour. They live in most environments on Earth, and have been found in enormous numbers in floodplain waters, particularly when bacterial numbers are high. They graze on bacteria, and are in turn eaten by rotifers, microcrustaceans and other small floodplain creatures.

Some protozoans have long flagella, which they thrash to push them through the water. Others, like the well-known amoeba, move by stretching a lump of themselves forward, then pouring the rest of their body after it. Still others are covered in a fur of short flagella, which they wave in time – like tiny oars – to swim through the water.

Rotifers are very abundant in billabongs. There are about 640 known species of rotifers in Australia. Most rotifer species (there are four in this picture) are tiny, the most common being less than 200 micrometres (0.2 millimetres) in length. Photos: *Russell Shiel, CRCFE*

Inset: The case of a testate amoeba, or rhizopod. This single-celled animal makes its case from silica, which it extracts from the water.