CHAPTER FIVE

THE BIODIVERSITY OF FLOODPLAINS

Until about 20 years ago all aquatic species collected from inland river systems were unceremoniously lumped together, no matter where they were found. Scientists didn't take much notice whether the animals and plants they collected lived in rivers, or in the billabongs, lakes, backwaters and other wetland habitats that surrounded them. Floodplains were largely ignored; all attention was on the river channels.

But subsequent research has turned all that on its head. Floodplains are now looking like very important places indeed. Studies have found that floodplain waters harbour at least 100, and perhaps 1,000, times more species than do the rivers that flow past them. Billabongs and lakes along the Upper Murray, for example, have been revealed as biological treasure troves, so rich in tiny species that some scientists compare them favourably with that giant of freshwater biodiversity, the Amazon River.

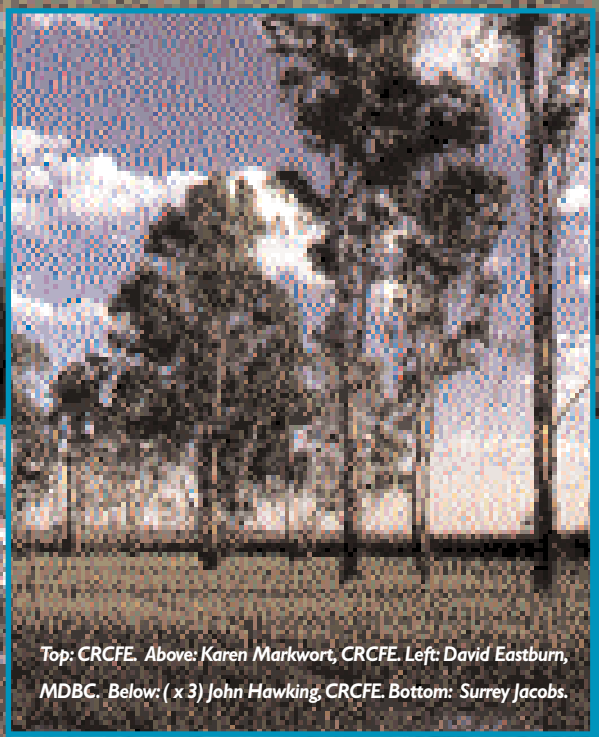
AUSTRALIA'S LITTLE AMAZON

It is a new way of thinking. In the past Australia's inland waterways were regarded as being home to just a handful of species compared with rivers elsewhere in the world. After all, the driest inhabited continent, a land almost entirely without permanent inland lakes, could hardly be expected to have much in the way of freshwater biodiversity — or could it?

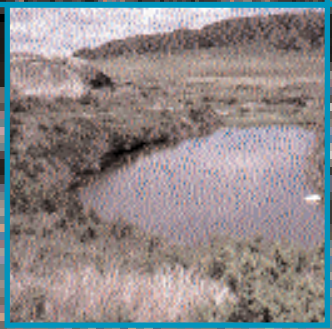
In the Amazon River scientists have identified more than 1,300 fish species, with more doubtless still waiting to be found. (7) In East Africa, Lake Victoria alone holds more than 300 species of cichlid fishes. (8) By contrast the entire Murray-Darling Basin is home to just 34 native fish species, and six of those spend part of their lives in the sea. (9) But the River Murray carries just 0.25 percent as much flow as the Amazon, which releases more water into the sea in a day than the Murray does in a year (10). And Africa's Lake Victoria, roughly the same size as Tasmania, is far larger than any Murray-Darling water body. For its size the Murray-Darling Basin has more than its share of the world's fish species.

At a smaller scale, the biodiversity of the Murray-Darling Basin's waters is strikingly apparent. The highly variable nature of the river system has created a complex mosaic of ever-changing yet persistent habitats, each of which is home to a different mix of species. Australia may have few permanent inland lakes, but its billabongs, intermittent lakes, swamps and other floodplain wetlands are an internationally important repository of many unique plants and animals. Along some river reaches, for example, billabongs make up 60 percent or more of the surface area of water, and in the Western Division of New South Wales there are more than 500 intermittent lakes larger than 100 hectares. These floodplain wetlands, despite their variable environment, can be surprisingly long-lived. One study has found that two billabongs near Albury have existed for at least 5,000 years, and perhaps longer. Such billabongs harbour swarms of tiny species — many too small to be seen by unaided human eyes.

Floodplain lakes are usually longer-lived than billabongs, and contain similarly high biodiversity. They are dry for much of the time, but when filled can remain flooded for several years, providing rich wetland environments in the midst of arid landscapes. Typically a floodplain lake fills when its parent river floods, then slowly drains and evaporates as the flood recedes. As floodwaters wet the dry lakebed mud, a swarm of tiny creatures erupt from eggs, cysts, burrows, spores and other drought-proof resting stages, where they have been waiting since the last flood — perhaps many years in the past — for their chance to feed and to breed. Floodwaters bring with them other creatures, including newly spawned fish. Still others arrive by air, including flying insects and birds. For weeks, months or years after filling, floodplain lakes boil with life as rich and diverse as that of any lake system in the world (Chapter 6).



Top: CRCFE. Above: Karen Markwort, CRCFE. Left: David Eastburn, MDBC. Below: (x 3) John Hawking, CRCFE. Bottom: Surrey Jacobs.



CHAPTER 5

How diverse are floodplains?

Researchers are now trying to work out just how rich floodplain waters really are, and what part that biodiversity plays in the health of the larger river system. Billabongs, for example, are among the best-known features of Australian floodplains. They are found throughout the Murray-Darling Basin, and are clustered very thickly in some areas. Floodplain billabongs come in all shapes and sizes; the best-known being the classic 'oxbows', formed when curved stretches of river are cut off from the main channel (Chapter 3). A concerted effort is now being made to try to classify billabongs according to their different types.

Australia's best-studied billabongs are the Ryans group on the River Murray floodplain near Albury, which is where much of the little that is known about billabongs has been learned. There are still many unanswered questions.

For example; do individual billabongs contain species, which are not only different from those in the river, but also different from those in other billabongs? Some scientists believe future research will find that floodplain billabongs are amazingly rich in species — that, like oceanic islands, each one might contain species found nowhere else in the world.

But floodplain billabongs are inundated whenever their parent rivers flood. Some researchers argue that this means billabong organisms may not be isolated for long enough to evolve into separate species; that floods periodically mix them all up and wash them from billabong to billabong. Perhaps, they say, billabongs all start off with roughly the same mix of species as a flood recedes, but between floods the mix changes because of different soils, different surrounding vegetation, different water properties or just blind chance.
For example, if just one large, predatory fish, such as a Murray cod, is stranded in a billabong as the flood recedes, it could change the entire composition of the pool. The Murray cod might eat all the small fish in the billabong, which would otherwise represent the top of the food chain. With the small fish gone, the creatures they would otherwise have preyed on might flourish. That could trigger a cascade down the food chain, leaving the billabong with a very different mix of species from an identical waterbody that didn't have a Murray cod trapped in it.

So an important, and thus far unanswered, question for Australian freshwater ecologists is whether each flood 'resets' life in floodplain billabongs when it connects them to each other and to the river, or conversely whether each billabong keeps its individual mix of species intact even if it is completely submerged. It matters greatly, because if a flood does reset all billabongs, the mix of species left in any one of them as the water recedes is merely an inconsequential accident. But if billabongs keep their mix of species intact even under flooding, each one may carry a unique storehouse of biodiversity.

If each billabong does carry its own unique species, then destroying or degrading even a single billabong could cause extinctions. Do such tiny species, which have survived so long and in such harsh conditions, deserve the same consideration now given to Australia's larger — and cuter — endangered animals?

There is growing evidence that floods do not entirely reset floodplain communities, and that at least some of a billabong's individuality can survive flooding. Some floodplain waterbodies — small anabranches and backwaters, for example — are never disconnected from their main river channels, yet the species which live in them are as diverse, numerous and peculiar as those in any billabong. Also, scientists have drawn up samples from billabongs submerged two or three metres deep under floods, and have found the same kinds of small animals living in them as were found there before the flood; animals quite different from those in the covering floodwater.

About eight percent of the approximately 1,000 species of billabong microinvertebrates (animals less than a millimetre long — Chapter 9) which have been discovered so far are known from only single billabongs. And samples taken from billabongs only metres apart sometimes show up completely different suites of species.


Photo: Karen Markwort, CRCFE

Even when the mix of species found in two adjacent billabongs is very similar, scientists nearly always find some creatures in one billabong that are not present in the other. They also find the same species in nearby billabongs at different times — as if their inhabitants are going through similar cycles, but are out of step with each other. A cycle in one billabong might be just getting started when it is finishing in another.

Because few billabongs have been studied in detail, it is not clear yet whether some do harbour species unique to themselves, or whether further sampling will find the same creatures dwelling elsewhere. There are similar uncertainties about the status of species inhabiting other floodplain wetlands. Whatever future research might find, one thing is clear: Australia has a lot more species living in its river systems than anyone has previously suspected, and most live on floodplains rather than in river channels.

Fish and crayfish species in the Murray-Darling Basin

Family	Species	Common name
Native fish		
Wholly freshwater species		
Clupeidae	*Nematalosa erebi*	Bony bream
Galaxiidae	*Galaxias rostratus*	Murray jollytail
	Galaxias olidus	Mountain galaxias
Retropinnidae	*Retropinna semoni*	Australian smelt
Plotosidae	*Tandanus tandanus*	Freshwater catfish
Melanotaeniidae	*Melanotaenia fluviatilis*	Crimson-spotted rainbowfish
	Melanotaenia maculata	Chequered rainbowfish
Atherinidae	*Craterocephalus stercusmuscarum*	Flyspecked hardyhead
	Craterocephalus eyresii	Lake Eyre hardyhead
Ambassidae	*Ambassis castelnaui*	Western chanda perch
Percichthyidae	*Maccullochella peeli*	Murray cod
	Maccullochella macquariensis	Trout cod
	Macquaria ambigua	Golden perch
	Macquaria australasica	Macquarie perch
Terapontidae	*Bidyanus bidyanus*	Silver perch
	Leiopotherapon unicolor	Spangled perch
Kuhliidae	*Nannoperca australis*	Southern pygmy perch
Gadopsidae	*Gadopsis marmoratus*	River blackfish
	Gadopsis bispinosus	Two-spined blackfish
Eleotridae	*Hypseleotris klunzingeri*	Western carp gudgeon
	Hypseleotris galii	Firetail gudgeon
	Hypseleotris sp.4	Midgley's carp gudgeon
	Hypseleotris sp.5	Lake's carp gudgeon
	Mogurnda adspersa	Purple-spotted gudgeon
	Philypnodon grandiceps	Flat-headed gudgeon
	Philypnodon sp.1	Dwarf flat-headed gudgeon
Diadromous species		
Mordaciidae	*Mordacia mordax*	Short-headed lamprey
Geotriidae	*Geotria australis*	Pouched lamprey
Anguillidae	*Anguilla australis*	Short-finned eel
Galaxiidae	*Galaxias maculatus*	Common jollytail
Bovichthidae	*Pseudaphritis urvillii*	Congolli
Percichthyidae	*Macquaria colonorum*	Estuary perch
Introduced fish		
Salmonidae	*Salmo trutta*	Brown trout
	Salmo salar	Atlantic salmon
	Oncorhynchus mykiss	Rainbow trout
	Salvelinus fontinalis	Brook trout
Cyprinidae	*Cyprinus carpio*	Carp*
	Carassius auratus	Goldfish*
	Tinca tinca	Tench
	Rutilus rutilus	Roach
Percidae	*Perca fluviatilis*	European perch (redfin)
Poeciliidae	*Gambusia affinis*	Mosquitofish
Cobitidae	*Misgurnus anguillicaudatus*	Oriental weatherloach
Native crayfish		
	Cherax destructor	Yabby
Parastacidae	*Euastacus armatus*	River Murray crayfish

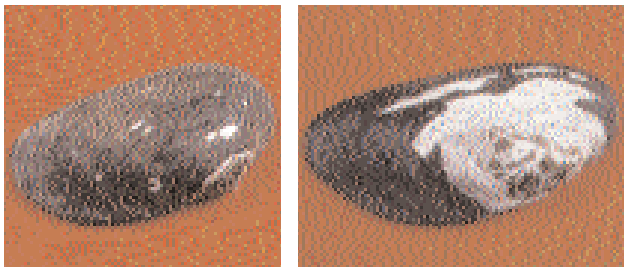
* Hybrids between carp and goldfish are quite common. Source: Cadwallader & Lawrence 1990; Geddes 1990.

Pairing

Interestingly, the different habitats offered by Australia's inland river channels and their floodplains have led to the evolution of many 'paired' species, living side by side yet subtly different. For example, the large, freshwater mussels found in Australia's inland rivers are closely related to the mussels found in billabongs, and at first glance they look quite similar. But they are now known to be two different species. One is adapted to clinging to riverbanks in fast-flowing, aerated currents. The other nestles on shallow billabong sediment and is adapted to the more variable floodplain conditions (Chapter 10).

The same pairing of species can be found at all scales among river and billabong species (Chapter 10). River Murray crayfish are found only in the fast-flowing river channel, for example, while yabbies proliferate in floodplain waters. Indeed, a new species of 'swamp yabby', first described from the Barmah forest in 1994 (11), appears to be even better adapted than common yabbies to life in a well-watered floodplain. The claws of swamp yabbies are shaped differently from those of common yabbies, and they appear to spend most of their lives burrowing in mud.

Some researchers have found evidence that changed flows are causing floodplain species to invade areas which were once home to their river channel counterparts — floodplain mussels, for example, have replaced river mussels downstream of weirs, and yabbies have replaced Murray crayfish in the South Australian section of the River Murray.



Top left: In the Murray there are two common forms of mussel: *Velesunio ambiguus* (left), a floodplain species typical of billabongs, lakes, creeks and small streams; and the larger, *Alathyria jacksoni* (right), which is adapted for big river environments and lives only in the fast-flowing reaches of the Murray and its larger tributaries.

Right: The River Murray is inhabited by two freshwater crayfish, the yabby, *Cherax destructor* (above right), which occurs in billabongs and ponds as well as slow-flowing streams, and the River Murray crayfish, *Euastacus armatus* (left) which is restricted to the main channel and its tributaries. Photos: *John Hawking, CRCFE*

Photo: *David Eastburn, MDBC*