CHAPTER TEN

A quokkle of pelicans.
Overpaid conference delegates,
the convention of pelicans, splayfoots,
potbellied, full heads,
waddle together, trading opinions,
chaw over beakfuls of tiddlers.

CHAPTER 10

LIFELINES IN AN ARID INTERIOR

Mammals, including humans, have long-used floodplains as linear refuges in an arid and unproductive landscape. So just as billabongs may act as safe houses for aquatic life between floods, floodplains are safe-houses for many terrestrial animals and birds in dry seasons and times of drought. Many wide-ranging species of birds and bats depend on floodplain vegetation, and particularly river red gums, to nest and to breed. Australians are used to the idea that river channels are 'lifelines' in the outback; they are perhaps less familiar with the idea that floodplains, and the vegetation they support, are also lifelines.

BIG ANIMALS

Mussels

Freshwater mussels are large, sedentary shellfish, common in river channels and abundant in many other floodplain waters. They were once an important food for Aborigines, who dived for them and left huge piles of their shells on the banks of inland waterways. Mussels can survive at depths up to five metres, often living in close-packed communities. They feed on plankton and suspended organic particles, drawing in water through an extended siphon and filtering it through their gills to capture any food. Such filter feeding makes mussels especially sensitive to water pollution.

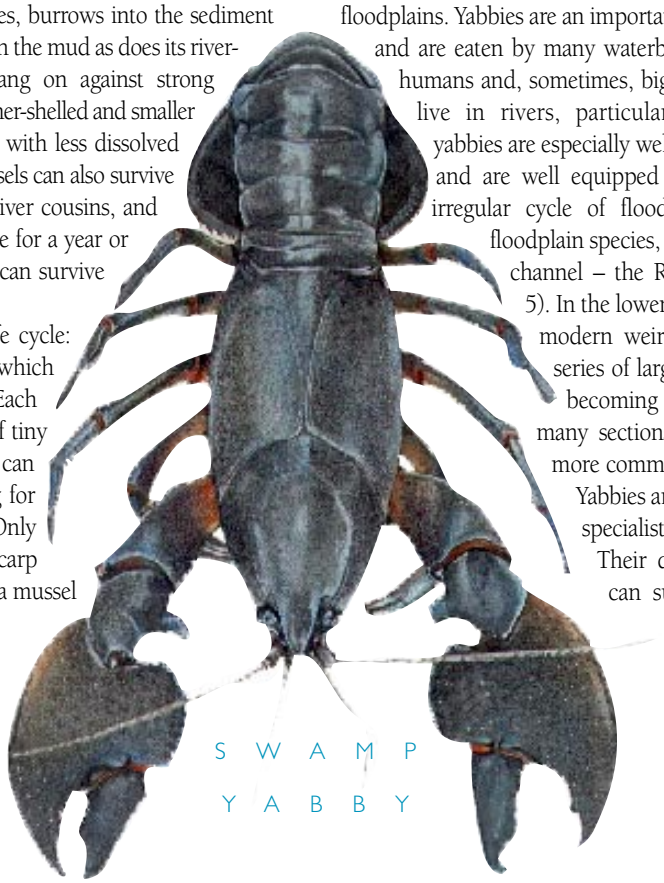
There are two main species (Chapter 5). The floodplain species, which grows to about 10 centimetres, burrows into the sediment but does not anchor itself as deeply in the mud as does its river-dwelling cousin, which has to hang on against strong currents. Floodplain mussels are thinner-shelled and smaller than river mussels, and can survive with less dissolved oxygen in the water. Floodplain mussels can also survive lean times much better than their river cousins, and can seal their shells tight and survive for a year or more without water. River mussels can survive only a week or two out of water.

Mussels have a complicated life cycle: their larvae are parasites on fish, which distribute them to new habitats. Each female mussel releases thousands of tiny larvae into the water, where they can survive for only a few days waiting for the right fish to come along. Only native fish are suitable hosts – not carp or other introduced species. When a mussel larva does make contact with the right fish, it hooks itself onto its host's gills or fins. A cyst forms, inside which the larva begins to transform into a tiny mussel. After about three weeks the juvenile mussel breaks free and sinks to the bottom. Floodplain mussels breed over a longer season than do river mussels, and their larvae can hook themselves to some tadpoles as well as to fish. (25)

Yabbies

Probably the best-known aquatic macroinvertebrate is the yabby. Because it has been commercially fished for many years, and is now being farmed, it is one of the most-studied inhabitants of floodplains. Yabbies are an important food source in inland waters, and are eaten by many waterbirds, fish, tortoises, water rats, humans and, sometimes, bigger yabbies. Although they do live in rivers, particularly in slow-moving reaches, yabbies are especially well-adapted for life in still waters, and are well equipped to cope with the floodplain's irregular cycle of floods and droughts. Like many floodplain species, yabbies have a 'pair' in the river channel – the River Murray crayfish (Chapter 5). In the lower River Murray, where a chain of modern weirs has turned the river into a series of large, still pools, Murray crays are becoming scarce, even locally extinct in many sections, while yabbies have become more common.

Yabbies are good all-round survivors; not specialists like many floodplain species. Their diet is wide-ranging, and they can survive a wide range of water



SWAMP YABBY

The River Murray crayfish, *Euastacus armatus* (above) and the yabby, *Cherax destructor* (opposite page). The evolution and distribution of these freshwater crayfish dates back to early Gondawanland times, perhaps 150 million years ago.

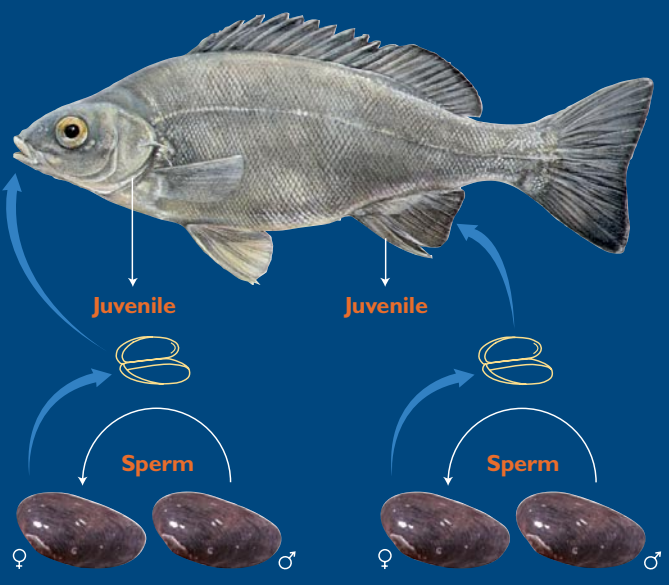
Commercial fish catch.

Photos: *David Eastburn, MDBC*

conditions. They are generalist feeders, including in their diet everything from living and dead vegetation – rotting gum leaves, water plants and algae – to living and dead invertebrates and even small fish. Yabbies produce large numbers of young, with mature females laying up to 300 or 400 eggs at a time. Females carry their eggs, and later their newly hatched young, under their curled tails until they are large enough to fend for themselves. Yabbies moult repeatedly as they grow, shedding old shells and growing new ones. Their large pincers are often broken off, usually in fights with other yabbies, and these too gradually regrow.

When a yabby's waterhole dries up, it can survive either by digging deep into the mud underneath or by walking somewhere else during the night. Yabbies can also survive high salinity – even seawater, for a short time – and will tolerate water temperatures ranging from one to 36 degrees Celsius. They can also survive big, temporary drops in the oxygen level of their water. (26)

Life cycle of a mussel



CHAPTER 10

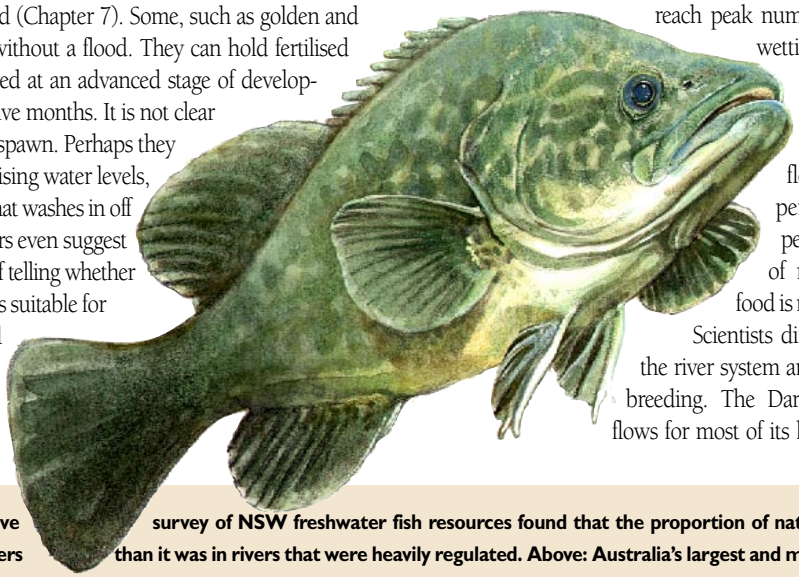
Fish

Altogether 34 different native fish species have been recorded in the freshwater reaches of the Murray-Darling system, and six of those spend some of their life cycles in the sea. The best known native fishes are the larger inland species – Murray cod, golden perch, silver perch, freshwater catfish, bony bream and river blackfish. Most other species are much smaller, including six species of gudgeon, four species of galaxias, and one species each of rainbow fish and pygmy perch. One native fish species, the trout cod, is listed as endangered, three (Macquarie perch, western chanda perch and purple-spotted gudgeon) are restricted and uncommon, and most – if not all – native inland fishes have suffered dramatic declines in abundance over the past 150 years (Chapters 13 and 14). (27)

Most native fish are carnivores, preying on micro- and macroinvertebrates, and on other fish – which means they are near the top of the food chain. This makes them very sensitive to changes in their habitat. Despite much research, many mysteries still surround their breeding behaviour in the wild (Chapter 7). Some, such as golden and silver perch, will not spawn without a flood. They can hold fertilised eggs inside their bodies, paused at an advanced stage of development, for between three and five months. It is not clear what tells the fish it is time to spawn. Perhaps they have some means of sensing rising water levels, or are sensitive to a chemical that washes in off the floodplain. Some researchers even suggest native perch may have a way of telling whether a flood will be sustained, and is suitable for breeding, or whether it will recede quickly before their young can take advantage of it. If there is no suitable flood, native perch reabsorb their eggs and do not breed that year. Other native fish, such as Murray cod, spawn every season, but large numbers of their young die as hatchlings unless there is a flood.

To survive and grow, native fish larvae probably need the burst of right-sized food, which is triggered by flooding. As days and weeks pass following a fresh flood, a succession of progressively larger aquatic creatures emerge from the soil or arrive from elsewhere to take up residence (Chapter 6). Interestingly, the increasing mouth sizes of growing native fish fry appear to match very closely the population peaks of progressively larger prey.

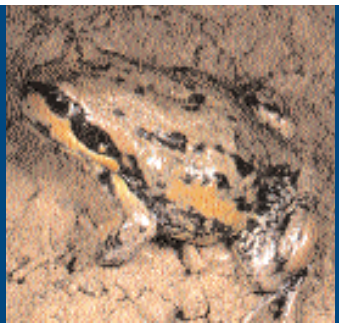
Golden and silver perch larvae, for example, begin feeding at about five or six days old. Their mouths at that age gape wide enough only to swallow rotifers (Chapter 9) and similarly small planktonic creatures – whose populations also begin to peak about five or six days after flooding. Murray cod begin feeding at about 10 to 14 days, when their mouths gape just wide enough to swallow copepods (Chapter 9) emerging from their resting stages in floodplain sediments. Freshwater catfish larvae feed for the first time at about 20 days, when their mouths gape wide enough to feed on small insects and crustaceans – which also reach peak numbers about 20 days after wetting. As fish grow, and their mouths gape wider, the size of available prey grows with them. (28) If floodplains remain either permanently wet or permanently dry, this surge of nutrients and right-sized food is not available (Chapter 12). Scientists differ about which parts of the river system are most important for fish breeding. The Darling River, for example, flows for most of its length in a deeply incised



A recent two-year intensive survey of NSW freshwater fish resources found that the proportion of native fish species was much greater in unregulated rivers than it was in rivers that were heavily regulated. Above: Australia's largest and most celebrated freshwater fish, the Murray cod. Below: River blackfish. Fish photos this spread: *Gunther Schmida*

channel and has almost no floodplains, yet fish still breed successfully in it. The river channel has narrow 'benches', which are progressively wetted as water levels rise, and some researchers argue that these are the Darling's equivalent of floodplains, and that they may be the key to fish breeding. Occasionally the Darling releases huge flows over the landscape, and mass breeding during such large, irregular floods may also prove crucial. Some scientists point to the many intermittent floodplain lakes which are progressively filled as floods roll down the northern rivers, and suggest they are the all-important growing ponds for young fish. Probably all three breeding grounds play some role (Chapter 7), but their relative importance remains a matter for considerable debate.

Scientific views about fish breeding in southern Murray-Darling rivers also are divided. Many researchers believe floodplain lakes are crucial breeding grounds for fish, and act as safe harbours in dry times for their prey. Other scientists suggest fish will spawn and grow in river channels, but need the flush of nutrients and food washed in from floodplains. And, as with the Darling, there is evidence that native fish can breed in some swollen river channels even without over-bank floods. There is even some research that suggests fish shun flooded shallows, and that nutrient-rich, fresh floodwaters may carry toxins – leached from gum leaves – which are powerful enough to kill them. (29) The details are hotly disputed, but whatever part of the river or floodplain native fish use to breed, the flood cycle is all-important.



The inland banjo frog.
Photo: *David Hunter*
Right: Golden perch, commonly known as yellowbelly.
Above right: Purple-Spotted Gudgeon.

Frogs

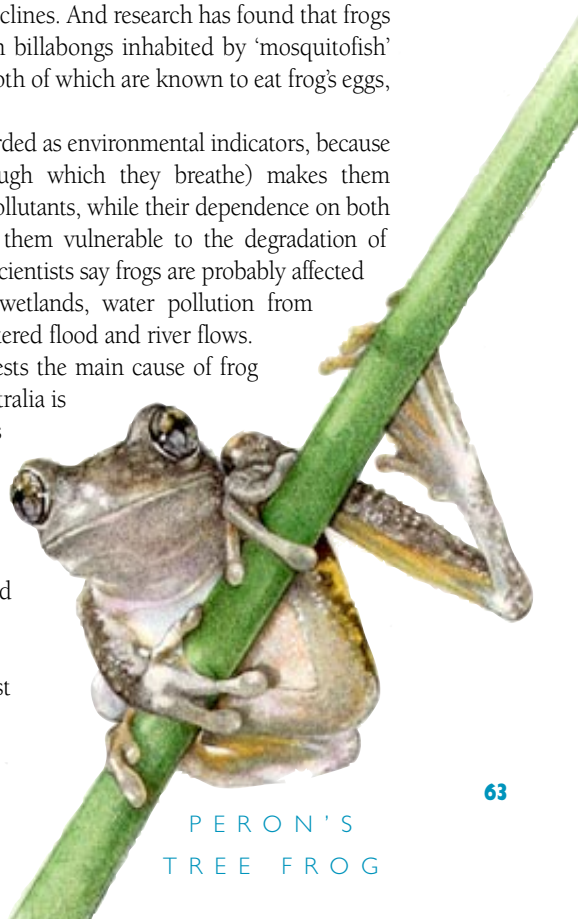
Most of the 53 native frog species known to inhabit the Murray-Darling catchment can be found on floodplains, where they make use of temporary waterholes, and sometimes rivers, for breeding. The River Murray, for example, is home to Peron's tree frog, which shelters beneath the bark of eucalyptus trees, and the inland banjo frog, which breeds in billabongs. The barking frog and the plains froglet live among dense aquatic vegetation at the water's edge.

World-wide frogs are suffering a dramatic decline, with both numbers and species plummeting in many areas. There have been several recent recorded frog extinctions, including at least two in Australia (in tropical Queensland) in the past 15 years. Scientists suspect that many different causes lie behind the global decline in frogs, most — but not all — of which stem from environmental degradation. The extent to which the global decline is affecting Australia's floodplain frogs is unknown.

One study of floodplain billabongs along the Murrumbidgee River found that the numbers and species of frogs changed according to which plants grew in and near the water — which means removing water plants and floodplain vegetation (Chapter 13) probably harms frogs. Exotic fish also take a toll. In some Murray-Darling waterways, tadpole-eating trout have been blamed for frog declines. And research has found that frogs are unlikely to breed in billabongs inhabited by 'mosquitofish' (gambusia) and carp, both of which are known to eat frog's eggs, and tadpoles.

Frogs are often regarded as environmental indicators, because their moist skin (through which they breathe) makes them peculiarly sensitive to pollutants, while their dependence on both land and water makes them vulnerable to the degradation of either. On floodplains, scientists say frogs are probably affected by the salinisation of wetlands, water pollution from many sources and by altered flood and river flows.

New research suggests the main cause of frog declines in tropical Australia is a disease — perhaps introduced — which is sweeping through rainforest areas. The same disease has been discovered infecting wild frogs in south-eastern Australia, but in such areas it is probably just one of many causes of their decline. (30)



PERON'S TREE FROG

CHAPTER 10

Tortoises

There are at least four species of tortoises (or turtles) (31) in the Murray-Darling Basin, although so far only the three more southerly species have been formally described by scientists and given Latin names. Tortoises have been living in the Basin river system for as long as it has existed – all inland species are descended from Gondwanan ancestors, with close relatives only in South America. Although each prefers a different habitat, the three southern tortoises can all be found on floodplains – sometimes, indeed, all three species inhabit a single billabong.

Tortoises are long-lived creatures, with life spans similar to those of humans. They mature at about 12 years, and can live to 70. Despite their slow metabolism, they are important high-level consumers in freshwater environments, and are often very abundant in floodplain waterways. Their breeding is strictly seasonal. Females lay hard-shelled, oblong eggs in buried nests near water, which are vulnerable to being dug up and eaten by foxes. Research suggests that as many as 95 percent of tortoise eggs are taken by foxes before they hatch. Because of their slow breeding and long life spans, declines in tortoise populations are likely to lag many years behind degradation of their nesting environment.

The Murray, or short-necked, tortoise prefers deep, permanent water. It feeds on water plants, still or slow-moving aquatic animals and carrion. It lays up to three clutches of about 25 eggs each spring, burying them in shallow holes on the bank near water. The two-centimetre-long eggs take about 45 days to hatch.

The foul-smelling tortoise often found in farm dams, the common long-necked tortoise, specialises in moving into new waterbodies, taking advantage of the sudden flush of life after flooding. During dry spells it retreats to permanent waters such as billabongs, where it can sometimes be found in large numbers. After floods, the common long-necked tortoise moves quickly out of such permanent refuges into fresh floodwaters, and is often found by motorists crossing roads after rain. It is a strict carnivore, hunting yabbies, small fish, tadpoles, insects and large plankton. Like the Murray tortoise, it is a spring breeder, typically laying two clutches, each of about 15 eggs, some distance from water.

The broad-shelled, long-necked tortoise is also a carnivore, which hunts from ambush. It lies in wait, buried under mud, striking out with its long neck to catch passing fish and other prey. When it strikes, the floor of its mouth drops sharply, sucking in water – and prey – in a savage gulp. It has an unusual breeding cycle. Females lay two clutches of about 30 eggs each winter, burying them sometimes a kilometre or more from water. The eggs can take up to a year to hatch. Like common tortoises, broad-shelled tortoises seal their egg burrows with wet mud.

The fourth, undescribed, Murray-Darling tortoise has been reported in the Namoi and Gwydir rivers in the north of the Basin, although it may range as far south as the Macquarie Marshes. Very little is known of its biology, but it is considered threatened because of an as yet unexplained disease causing blindness.

Photo: *Australian Archives*

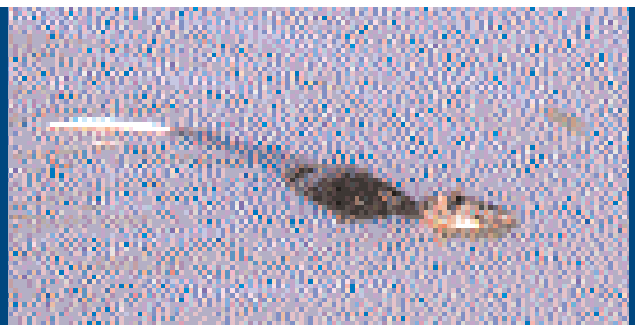
Water rats

The water rat was once hunted for its thick fur, which is deep golden brown to almost black on its back, and creamy orange underneath. It is one of Australia's native placental mammals. Unlike the pouched marsupials and egg-laying monotremes, which are descended from mammals that have lived in Australia since the break-up of Gondwana, placental mammals arrived from Asia only in the past 15 million years.

Native water rats can grow up to 60 centimetres long, including their tails. They are accomplished swimmers, with partly webbed hind feet. They dive for yabbies, mussels and fish, which they often carry to nearby rocks or stumps – 'feeding tables' – to dismember and eat. They also eat insects, and even young birds, and are sometimes blamed for stealing fish out of nets. Water rat feeding tables, adorned with cracked yabby and mussel shells, can often be found near deep billabongs and along riverbanks.

Water rats are often active during the day, and they shelter in round-entranced burrows dug into the banks of waterbodies. Their burrow entrances, about 15 centimetres in diameter, are usually well protected by vegetation, often with well-beaten tracks leading down to the water. (32)

Water rat, Photo: ***David Watts/A.N.T. Photo Library***



Platypuses

Platypuses lead such secretive lives that they are often believed to be rare. But in fact they are quite common throughout eastern Australia, including in the headwaters of the Murray-Darling river system. They are most abundant in upland waterways, but are also seen occasionally in the lower reaches of the River Murray — and have even been sighted as far west as Renmark, in South Australia.

Platypuses are monotremes, members of the smallest branch of the mammal family tree. Most of the world's mammals are placentals; a few — chiefly Australian — are pouched marsupials, but just three, the platypus and two species of echidna, are egg-laying monotremes. (33) And unlike more recent arrivals to Australia, such as the placental water rats, platypuses have been inhabiting the southern continent since it broke away from Gondwana (Chapter 3).

Platypuses are found mostly in shallower waterways, with steep, tree-lined banks, although floods often prompt them to move from fast-flowing streams to calmer backwaters and billabongs. They feed on bottom-dwelling creatures such as insect larvae, shrimps and snails, which they find using a peculiar sixth sense: receptors on their rubbery bills that detect the faint electrical charges emitted by their prey. While underwater, they store their food in special cheek pouches, coming to the surface to grind it with the horny pads that replace their molar teeth during their first few months of life.

Platypuses use two types of burrows. Females rear their young in nesting burrows, which may be up to 30 metres long and include several side chambers. The second, usually shorter, types are known as camping burrows, and are used as daytime refuges.

Like water rats, platypuses were exploited by the fur trade at the turn of the century. However, concerns about their falling numbers prompted Victoria to protect them in 1892, followed by New South Wales in 1901, Queensland in 1906 and South Australia in 1912. In earlier decades, platypuses also died in large numbers in fishing nets. Smaller mesh sizes in modern nets mean few are now caught by commercial fishers, although many may still die in illegal nets.

River regulation does not appear to have affected where platypuses are found in the Murray-Darling system, although it may have had some impact on their numbers. For example, bank-full river flows in summer (Chapter 12) may drown young platypuses before they emerge from their river-bank nesting burrows in January. Small weirs and dams do not appear to present adult platypuses, or their dispersing young, with serious problems. However, large dams, such as Burrinjuck Dam on the Murrumbidgee River, do act as barriers to platypus movement.

Platypuses are often seen in the shallow edges and headwaters of dams and weirs; but they shun deeper reservoir water. The release of cold, bottom water from such storages into waterways may also affect the health of platypuses downstream, by upsetting the bottom-dwelling invertebrates which are their food supply, and by forcing them to burn up extra energy negotiating cold, fast-flowing currents. Similarly, increased sediment in the water may also affect platypuses' food supply, while their burrow sites can be damaged by eroding river banks and livestock trampling. (34)

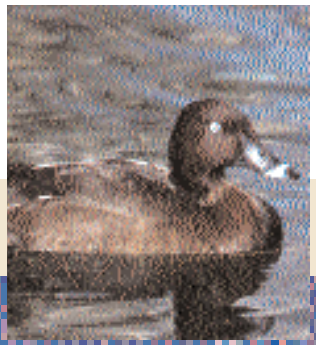
Birds

Floodplains are rich feeding and breeding grounds for birds. Some live there permanently, others visit seasonally or during floods. Some 240 species of birds, including many waterbirds, have been recorded just in the Barmah-Millewa red gum forests, and more than 100 around a single billabong near Albury. Many of these birds use river red gums and other floodplain vegetation as nesting sites, and the season and duration of floods is crucial to their breeding success.

The lack of natural, permanent lakes in Australia means that most inland waterbirds follow the floods, migrating over long distances from one intermittent waterbody to the next. It is the first flush of growth and nutrients following a flood that often provides the food needed for bird breeding. Adult midges, for example, form great swarms, skimming over the surface of fresh floodwaters where they are eaten by ducks. Waterbirds prey on yabbies and other floodplain macroinvertebrates, and on fish. Their health and breeding success is very closely linked to the productivity of the water they frequent.

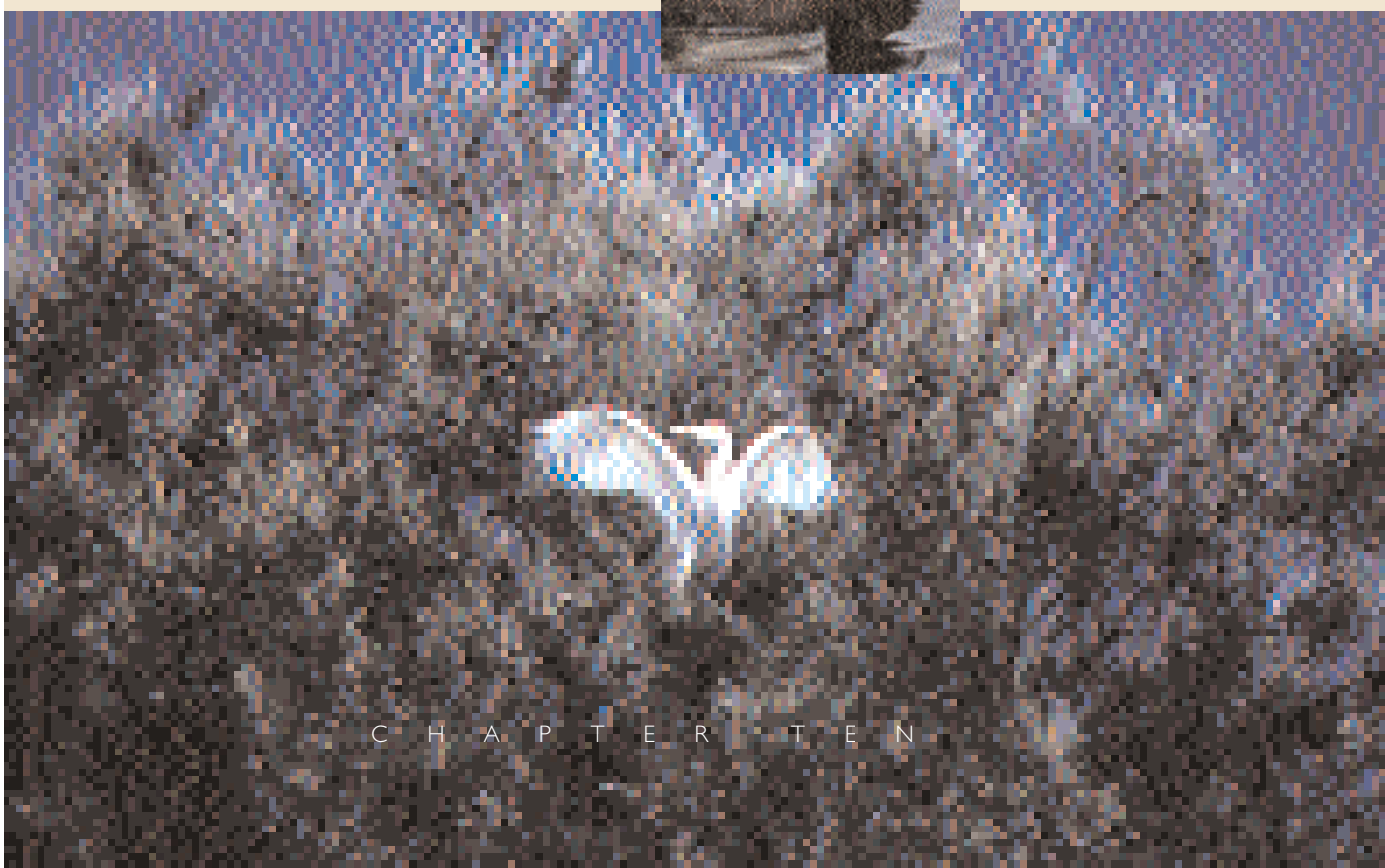
Permanent waterbodies are useful refuges in dry years, but to breed in large numbers many Australian waterbirds need fresh floodwaters. Only two species of Murray Basin waterbirds, musk and blue-billed ducks, are seasonal breeders which do not depend on floods. The cues that trigger breeding in other waterbirds are different for different species, and perhaps even within species, but most are linked to flooding. In some cases, for example, breeding is triggered by increasing body weight or fat reserves, sure signs that there is more food available for raising chicks. If floods turn out to be short-lived, birds often abandon their nests and move elsewhere (Chapter 7).

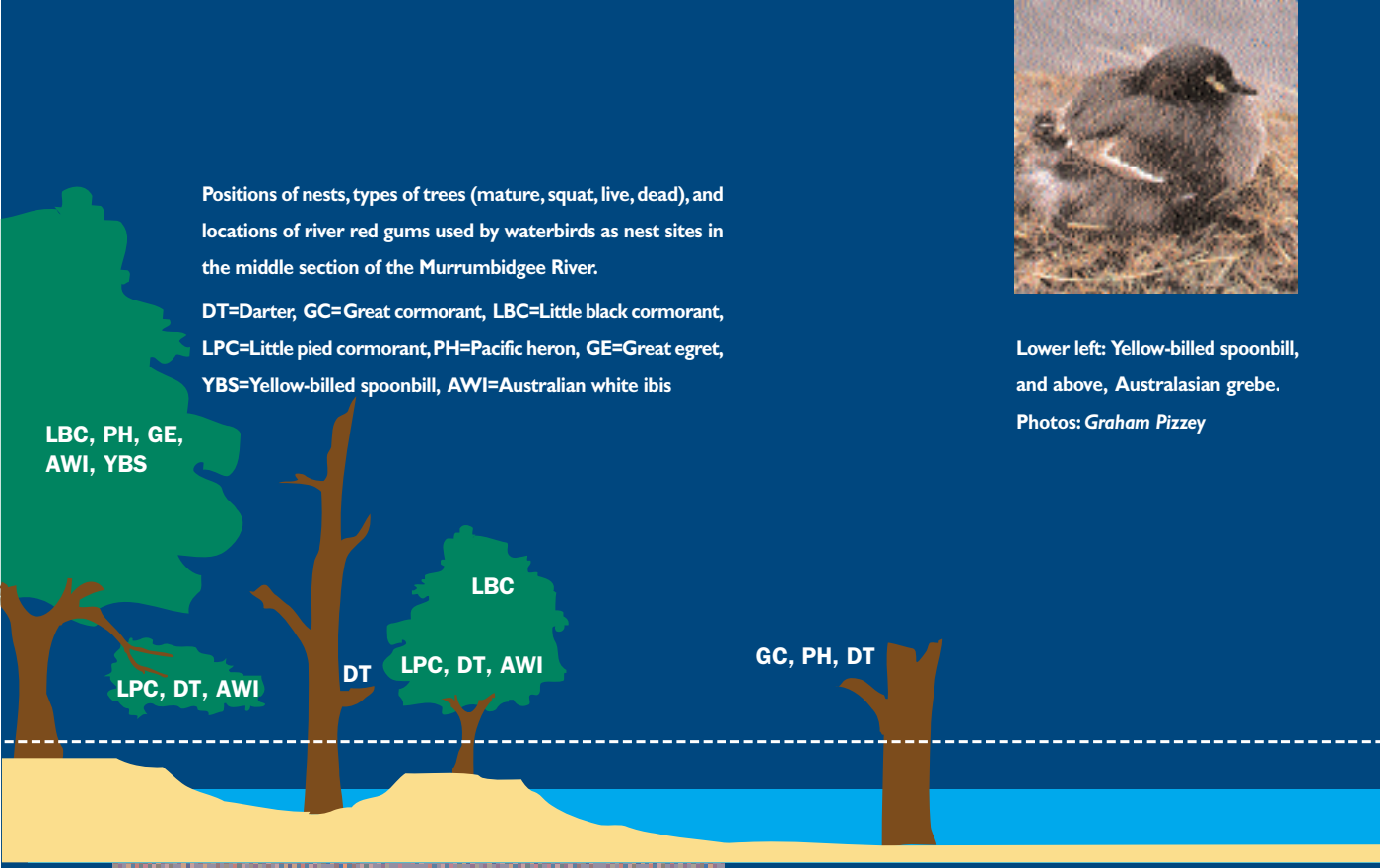
Monitoring waterbird numbers on the floodplain is a thankless task. The numbers of birds breeding on any given waterbody can change by several orders of magnitude from one year to the next – at its most extreme, from zero to tens of thousands. They move freely between wetlands, lakes, floodplains and billabongs according to what water is available that year. Droughts may cause spectacular population crashes. (35)



White-eyed duck. *Graham Pizzey*

Below: Plumed egret in a casaurina. ***W. Lawler***





Positions of nests, types of trees (mature, squat, live, dead), and locations of river red gums used by waterbirds as nest sites in the middle section of the Murrumbidgee River.

DT=Darter, GC=Great cormorant, LBC=Little black cormorant, LPC=Little pied cormorant, PH=Pacific heron, GE=Great egret, YBS=Yellow-billed spoonbill, AWI=Australian white ibis

Lower left: Yellow-billed spoonbill, and above, Australasian grebe.
Photos: *Graham Pizzey*

Planigales and dunnarts

Not all floodplain inhabitants follow fresh floodwaters. Some move in as the water recedes, making their homes in dry floodplains, then move out again when the floods return. The intermittent lakes in the arid north-west of the Murray-Darling Basin are wetted less regularly than its south-eastern floodplains, and during the long, dry spells such lakes are home to some of Australia's least-studied marsupials.

When water retreats from floodplain lakes, their clay beds dry out, shrinking and splitting until they are crazed with deep cracks and holes. These cracks are colonised by ferocious, mouse-sized marsupial carnivores, planigales and dunnarts, which are related to other, larger native Australian meat-eaters, including Tasmanian devils and quolls.

Although research into the behaviour of these small marsupials in the wild is still in its preliminary stages, it may be that they flourish on dry floodplain lakes because such sites are home to relatively few carnivorous lizards, which would otherwise compete with them. Lizards' slower metabolism and sedentary behaviour may prevent them from successfully recolonising the lakes between floods, while the holes and cracks provide the planigales and dunnarts with safe habitats.

For their size, planigales and dunnarts are among Australia's most fearsome marsupials. They are nocturnal hunters, stalking the spiders and centipedes which share the cracked lakebed soils with them, and also killing and eating small lizards and other animals, sometimes as large as themselves. Female planigales can produce two litters of between six and eight young in a breeding season, which lasts from August to February. (36)

Floods large enough to fill such floodplain lakes roll down the Darling River system only about once every five to 10 years or longer. Once flooded, the lakes can take two or three years to dry out. The marsupial carnivores reinvade the lakebeds as the water retreats, but there is an obvious, and so far unanswered, question: where do they go in the meantime? Perhaps, researchers suggest, planigales and dunnarts represent more examples of Australian species that are adapted to the continent's peculiar climatic variability. Perhaps, like inland waterbirds in reverse, planigales and dunnarts have learned to thrive in the mosaic of shifting dryland habitats left behind by irregular and unpredictable flooding. Perhaps variability is the key to their health.

Main breeding stimuli for Murray-Darling Waterbirds

Common Name	Scientific Name	Breeding Stimulus
Great crested grebe	*Podiceps cristatus*	Flooding
Hoary-headed grebe	*Poliocephalus poliocephalus*	Flooding
Australasian grebe	*Tachybaptus novaehollandiae*	Flooding; seasonal
Australian pelican	*Pelecanus conspicillatus*	Flooding
Darter	*Anhinga melanogaster*	Flooding
Great cormorant	*Phalacrocorax carbo*	Seasonal; flooding
Pied cormorant	*Phalacrocorax varius*	Seasonal; flooding
Little black cormorant	*Phalacrocorax sulcirostris*	Flooding; seasonal
Little pied cormorant	*Phalacrocorax melanoleucos*	Flooding; seasonal
Pacific heron	*Ardea pacifica*	Flooding; seasonal
White-faced heron	*Egretta novaehollandiae*	Flooding; seasonal
Great egret	*Ardea alba*	Flooding; seasonal
Little egret	*Egretta garzetta*	Flooding
Intermediate egret	*Ardea intermedia*	Flooding
Rufous night heron	*Nycticorax caledonicus*	Flooding; seasonal
Glossy ibis	*Plegadis falcinellus*	Flooding
Sacred ibis	*Threskiornis aethiopica*	Flooding
Straw-necked ibis	*Threskiornis spinicollis*	Flooding; seasonal
Royal Spoonbill	*Platalea regia*	Flooding
Yellow-billed spoonbill	*Platalea flavipes*	Seasonal; flooding
Black swan	*Cygnus atratus*	Seasonal; flooding
Freckled duck	*Stictonetta naevosa*	Flooding
Australian shelduck	*Tadorna tadornoides*	Flooding
Pacific black duck	*Anas superciliosa*	Flooding; seasonal
Grey teal	*Anas gracilis*	Flooding; seasonal
Chestnut teal	*Anas castanea*	Flooding
Australasian shoveler	*Anas rhynchotis*	Flooding; seasonal
Pink-eared duck	*Malacorhynchus membranaceus*	Flooding
Hardhead	*Aythya australis*	Flooding
Maned duck	*Chenonetta jubata*	Flooding; seasonal
Blue-billed duck	*Oxyura australis*	Rainfall; seasonal
Musk duck	*Biziura lobata*	Seasonal
Black-tailed native hen	*Gallinula ventralis*	Seasonal
Dusky moorhen	*Gallinula tenebrosa*	Flooding
Purple swamphen	*Porphyrio porphyrio*	Flooding; seasonal
Eurasian coot	*Fulica atra*	Seasonal; flooding
Brolga	*Grus rubicundus*	Flooding

Source; Murray-Darling Basin Commission, Sue Briggs