CHAPTER SEVEN

twisting like driftwood; then the broad slash
where a storm like a careless brush
has put a green wash through the landscape.

VARIABILITY: THE IMBALANCE OF NATURE

A decade ago conservation biologists used to talk about the need to restore 'the balance of nature'. It is a phrase that has gone out of vogue these days, because the more scientists study nature, the less balanced it appears. There are a lot of moving parts in any given ecosystem, and they seldom settle down to a neat equilibrium. Populations of species often boom and crash, as do their predators, following no tidy pattern. And, in Australia, the environment itself varies so wildly and unpredictably that living in harmonious balance might actually be a recipe for extinction. Any Australian farmer can attest that a run of 10 comfortable seasons is no guarantee that the next will not be drought. Species need to be able to survive extremes, not just average conditions.

OF DROUGHT AND FLOODING RAINS

Earlier generations of Australian scientists, influenced by the predictable seasonality of Europe and North America, at first looked for similar cycles in the biology of Australia. They talked about Australia as a kind of back-to-front place, where seasons were reversed. Many marvelled at the fact that Australian trees shed leaves and bark in summer, but kept their foliage in winter. Scientists were struck by how different the landscape was from that of their homelands, but they still struggled to interpret it in familiar terms. They looked for seasonal cycles.

And indeed there are strong seasonal cycles in Australia, which are reflected in its fauna and flora. Many animals and plants have seasonal breeding and growth habits, which are different in different climatic zones. In the south of the Murray-Darling Basin, which includes the main Murray catchment, most rain falls in winter. Further north, and especially in the Darling River catchment, the climate shifts to a more monsoonal, summer rainfall pattern. These seasonal patterns exert powerful influences over the river systems they feed, and over the life cycles of downstream floodplains.

But seasonality in Australia overlies deeper, longer-lasting and more dramatic climatic fluctuations, which have also had profound effects on the evolution of native species. The adaptations of Australian species to these larger, irregular fluctuations are much less understood than are their adaptations to seasonal changes, but may prove crucial to diagnosing the sickness of our rivers.

The El Niño cycle

The Australian climate swings around more erratically than anywhere else on Earth. Its seasonal extremes are not as dramatic as on other continents, which may have hotter summers and colder winters, but its unpredictability is unmatched. Northern Hemisphere farmers can — generally — bank on winter rainfall, and summer sunshine. Early European farmers in Australia tried to apply the same logic to the antipodean climate, often mistaking short-term fluctuations for permanent climatic conditions. In the 1880s, for example, wheat farmers in South Australia followed a run of good seasons and ploughed their way north into the fringes of the Simpson Desert, where ruined stone farm houses still stand amid some of the most arid country in Australia. (12) Europeans had never before encountered such perniciously variable weather.

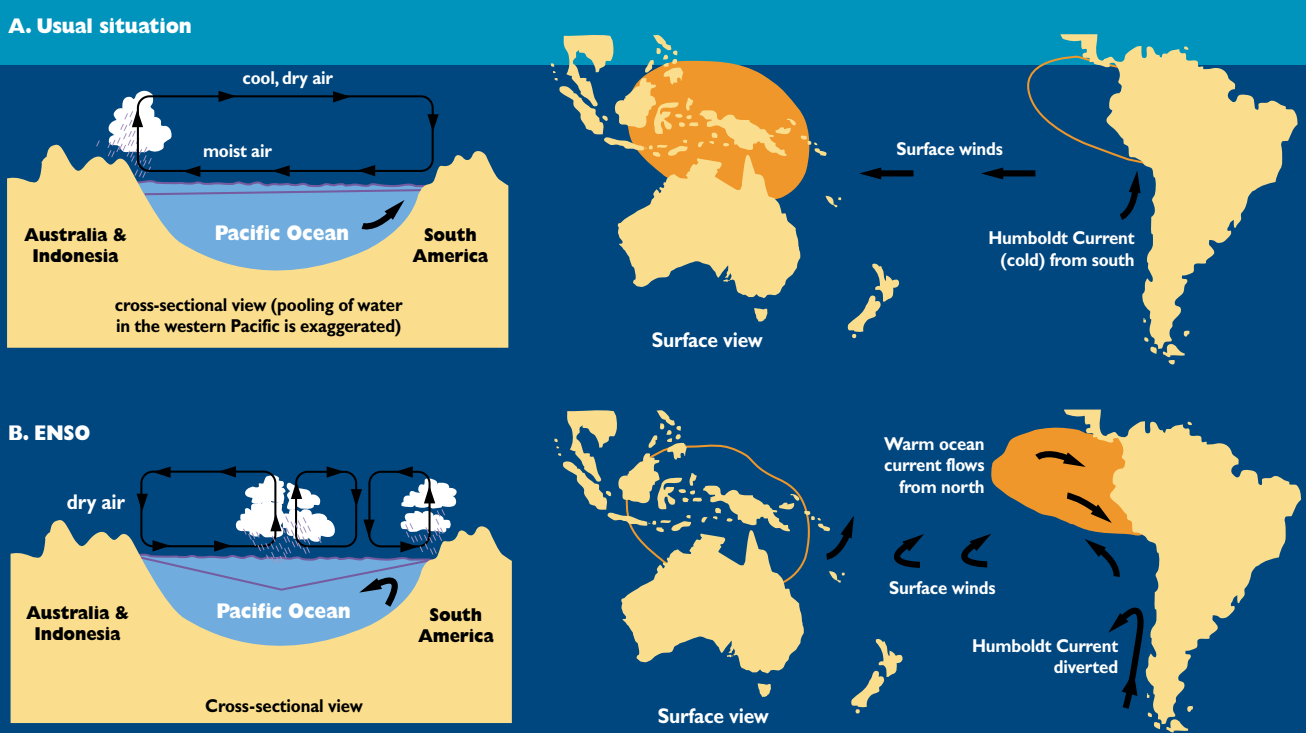
Top:

Panicum grass on the Darling River floodplain - rejuvenated after flooding.

Photo: *David Williams, CRCFE*

Bottom:

Australia's variable climate is strongly influenced by El Niño-Southern Oscillation episodes – a series of events involving oceans and atmosphere in the Southern Hemisphere. *Australian Academy of Science*



The only rule with the Australian climate appears to be that there are no rules; almost anything can happen. Terms like 'average annual rainfall' lose their meaning, when twice that much might fall in a few hours, or none for a year. So variable is the Australian climate that engineers designing city water supplies must make reservoirs four times bigger in Australia than for the same rainfall in Europe — and even then droughts cause regular shortages.

It has really only been in the past 10 years, with studies of the drought-bringing El Niño-Southern Ocean (ENSO) oscillation phenomenon, that scientists have really started to comprehend the medium-term weather cycles that are at work in Australia. ENSO is frustratingly unpredictable; a climate pattern which, every now and then, disrupts the weather of the Southern Hemisphere and causes profound droughts in Australia. It begins with a slight rise in the temperature of seawater off the coast of Peru, which triggers a series of increasingly dramatic changes to the climate of the Southern Hemisphere. In South America ENSO brings cataclysmic storms and torrential rain; in Australia it brings terrible droughts. As best as can be calculated, ENSO events happen about every two to eight years. But the cycle is irregular and unpredictable, and sometimes several ENSO events follow each other in close succession. Sometimes the climate sticks for many years in drought; sometimes it flips from drought to flood in successive seasons; sometimes there is a run of floods.

It is quite possible that the 200-odd years of European occupation is simply not a long enough study period to build up an accurate picture of Australia's weather. It might have been exceptionally wet for two centuries, or exceptionally dry. Probably it is wrong to describe any run of weather in Australia as 'exceptional'. For example: coral reefs growing off the coast of Queensland incorporate material washed out to sea by flooding rivers, providing a record of floods and droughts dating back many thousands of years. Researchers studying the coral record have found gaps in the distant past of 70 years or more between significant floods from the Burdekin River. Is it possible that such 70-year droughts could happen again in modern Australia? No-one really knows.

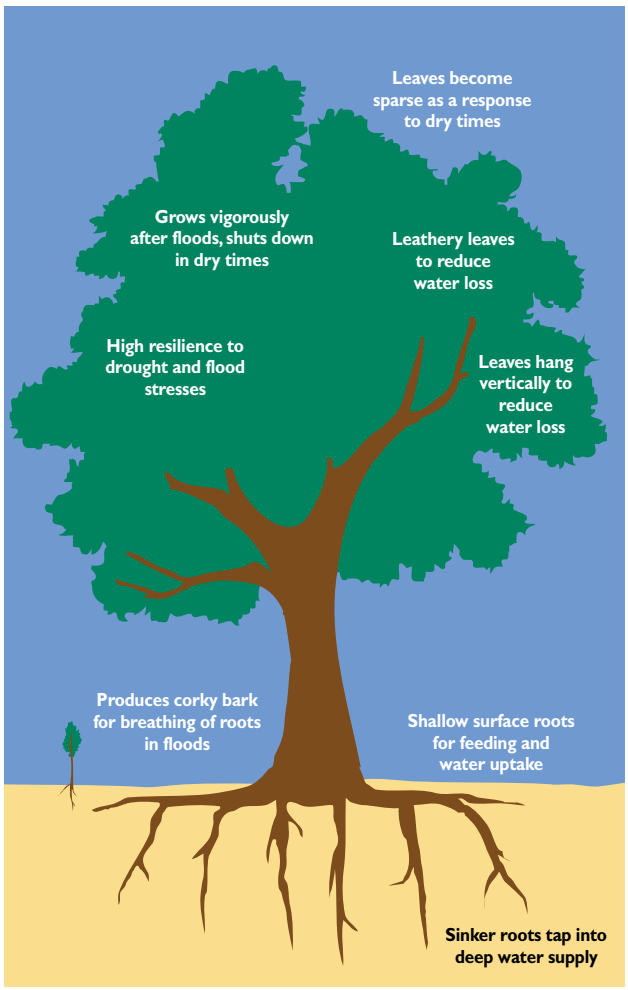
The natural volume of flow in the Darling River in particular can vary enormously and erratically, depending on rainfall in the highly variable catchments of the Darling's tributaries. This makes the task of allocating water sustainably from the river all the more difficult. When natural flow can vary by nearly 1,000 percent, dividing up an 'average' year's water among human users and the environment presents obvious difficulties. As the famous poem says, Australia is indeed 'a land of drought and flooding rains'.

The result of this highly variable climate is what scientists call a 'patchy' landscape; a mosaic of different habitats which change continuously and present species with the challenge of surviving under many different conditions. This means the secret strength of Australia's wildlife is not its ability to survive cold winters and warm summers, but its ability to survive just about anything nature can throw at it.

Some like it tough

Australia's environment is sometimes described as 'fragile'. It is not; it is as tough as old boots. Australia's wildlife has survived for millions of years in the most variable climate on Earth, living on the world's poorest soils and coping with droughts, floods, fires and salinity in this most hostile of continents. One clear lesson from ecological research in Australia and overseas over the past two decades has been that the more diverse an ecosystem is, the better it is at surviving such extreme shocks. The rich biodiversity discovered on Australia's floodplains may well be nature's insurance policy against the shocks imposed by the continent's peculiarly fluctuating climate.

Adaptations of river red gums to the variable Australian climate



The effects of River Murray flows on floodplain inundation, flooding frequency, and flood duration under natural (pre-regulation) and current (regulated) conditions at Chowilla.

River Murray flow ML/day	Area inundated (hectares) at Chowilla*	% area of Chowilla Floodplain inundated	Return Period** (number of times peak flows occur in 100 years)		Duration (number of months in which river flow shown in first column is exceeded)	
			Natural	Current	Natural	Current
3000	—	—	100	100	11.8	11.9
5000	—	—	100	100	11.4	9.5
10000	—	—	100	94	10.1	4.6
15000	—	—	99	82	8.8	4.7
20000	—	—	99	63	7.8	4.6
25000	—	—	97	56	7.1	4.2
30000	—	—	96	51	6.4	3.9
35000	1000	5.6	94	46	5.7	3.5
40000	1400	8.0	91	40	4.9	3.3
45000	1700	9.6	83	34	4.6	3.2
50000	2200	12.4	79	30	3.9	2.7
55000	3100	17.5	—	—	—	—
60000	4000	22.6	59	21	3.9	2.5
65000	4800	37.1	—	—	—	—
70000	5600	37.6	49	15	3.6	2.9
75000	6700	37.8	45	—	—	—
80000	82000	46.3	45	12	3.2	2.6
85000	10000	56.4	—	—	—	—
90000	11100	62.7	37	11	3.1	2.1
95000	12200	68.9	—	—	—	—
100000	13200	74.6	32	9	2.9	2.0
110000	14200	80.2	27	5	2.4	3.2
120000	15000	84.7	23	5	2.2	2.8
130000	15900	89.8	19	4	2.0	3.0
140000	16800	94.9	14	4	2.1	2.5
150000	17700	100	12	4	2.2	1.5
200000	17700	100	3	1	2.0	2.0
250000	17700	100	1	1	2.0	<1
300000	17700	100	1	0	2.0	—

Source: MDBC Canberra, River Murray Monthly Simulation Model
* to nearest 100 hectares
** Figures refer to highest daily flow in the month, not average daily flows for the month.

CHAPTER 7

Many of the problems that now plague river life stem from the fact that we have made life too easy, safe and predictable on floodplains. How well would carp compete with native fish in the Murray-Darling river system before it was tamed for human use? Could they thrive in anything like their present numbers in a system fed by indigestible, toxic eucalyptus leaves? In a system that sometimes shrivelled to a chain of saline ponds — as the lower River Murray used to do in long droughts? In a system in which waterbodies frequently dried out, or flooded spectacularly across thousands of square kilometres? Native fish are as finely attuned to these irregular weather cycles as they are to seasonal flooding. Carp, by contrast, are purely seasonal creatures.

Most Australian native species have in-built mechanisms for surviving extended droughts, and for taking advantage of good years. Many, such as kangaroos, can adjust their breeding to suit the seasons. The variable climate has created a complex mix of habitats, to which native species have adapted. Waterbirds follow the shifting mosaic of intermittent lakes and wetlands around inland Australia, breeding in vast numbers when seasons are good and retreating to small, permanent refuges when droughts set in.

Long-lived and short-lived organisms face different survival problems in a variable environment. Long-lived species, such as tortoises or river red gums, are adapted to Australia's full range of climatic conditions; in their lifetimes individuals must survive both long droughts and major floods. By contrast short-lived organisms flourish when conditions are right, then suffer large die-offs when conditions change. Often they survive only as drought-proof eggs or resting stages buried in dried sediment until some cue — usually flooding — reawakens them.

Most floodplain species are either able to travel considerable distances to colonise new water as fast as it appears, or have drought-proof resting stages in which they can await the next inundation. Scientists have successfully hatched tiny crustaceans from dry lake soil heated to 60 degrees Celsius before being wetted. Yabbies burrow underground to escape drying, and have been found alive in burrows three metres deep beneath a dry lakebed in western New South Wales — eight years after the lake last held water. (13) Yabby burrows hold small amounts of water in which other small species also find refuge until the next flood.

Some species are as variable as the conditions they must survive. For example, there is confusing evidence about the breeding behaviour of Murray-Darling fish (Chapter 10). Do fish spread out on floodplains to take advantage of seasonal floods? Do they depend on the filling of intermittent inland lakes? Do they breed in engorged river channels even when there is no over-bank flood? Do they depend on the really big floods that occasionally sweep down river valleys to bolster their numbers? Do they live and breed in flood runners? Do they migrate long distances upstream, or do they breed quite locally?

The evidence is mixed, and the truth might be that they do all of these things, in different river systems and at different times. Intriguingly, such variable behaviour by native fish in different parts of the Basin may have an echo in their genes. Recent studies have found that fish of the same species taken from different parts of the Basin are genetically quite different. Native fish do migrate up and down their home river stretches, and individuals occasionally travel enormous distances, but for the most part fish populations in different tributaries appear to remain separate from each other. Their genetics may be as variable as their habitats.

Surface water in inland Australia exists only as a shifting mosaic, which changes in time and space. Australian species have learned to shift with that mosaic. It is quite likely that Murray-Darling freshwater ecosystems have never been in any permanent balance. For native plants and animals floodplains may have always been a movable feast. That is a reality that makes them very difficult systems to study, and exceptionally difficult to manage sustainably once they have been disturbed. The many thousands of plant and animal species that live on Australia's floodplains are extraordinarily tough and well-adapted, but at the same time they are extraordinarily vulnerable. They have learned to thrive in extreme and highly variable conditions, but they do not compete so well when their world is made predictable and uniform.

Lower Murray wetland, Mannum, South Australia. Photo: *David Eastburn, MDBC*