1
The Lake Eyre Basin – one of the world's great desert river systems

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Introduction

The Lake Eyre Basin dominates central Australia, covering about a seventh of the continent – the heart of our land mass (Kingsford *et al.* 2014; Fig. 1.1). Only ~60 000 people live in this vast area (Measham and Brake 2009), with the majority concentrated in its major towns such as Alice Springs (~25 000), Longreach (~3400) and Winton (1600; Fig. 1.1). The rivers of the Lake Eyre Basin connect the top to the bottom and the east to west of the basin, mostly flowing north to south to reach the amazing Kati Thanda-Lake Eyre in South Australia (Fig. 1.2). Small rivers and creeks, high in the catchment, run into the large rivers which join with other rivers and creeks as they flow south to Kati Thanda-Lake Eyre. River water stays within the Lake Eyre Basin, either flowing onto its floodplains, into waterholes and lakes, seeping into the ground, transpiring from the vegetation or evaporating. It is a system formed over millennia, from a once mighty river where megafauna roamed its banks, including 3 m long diprotodonts, giant kangaroos (2 m high), the large flightless bird *Genyornis newtoni* (2 m high), the giant goanna *Megalania prisca* (5.5 m long) and the marsupial lion *Thylacoleo carnifex* (2 m long) (Habeck-Fardy and Nanson 2014). About 100 000 years ago, this basin had much more water than today, supporting a contrasting environment, when the lake was 25 m deep at today's lowest point (Habeck-Fardy and Nanson 2014). By ~35 000 years ago, where Kati Thanda-Lake Eyre currently lies, Lake Dieri, a massive freshwater lake three times the size of today's predominantly salty lake, dominated the landscape. Long-gone aquatic animals lived here, including platypus, dolphins and even four flamingo-like species.

At 40 000–50 000 years ago, Aboriginal people established themselves in central Australia, living off the land and its rivers (Smith 2013; Tobler *et al.* 2017), which formed major trade routes to other river basins. They survived major changes in the climate as the continent became considerably drier and deserts formed. Extinction struck the megafauna and most of the large freshwater animals (Cohen *et al.* 2015). Aboriginal peoples knew their country, moving along the rivers with their permanent waterholes, and supplementing their water supplies from natural groundwater wells (Hercus and Clarke 1986) and plants. They lived on edible plants such as nardoo *Marsilea drummondi*, and harvested fish and waterbirds from the rivers. Ducks were caught with nets across the rivers. On the Coongie Lakes (Fig. 1.1), Yandruwandha people corralled colonies of pelican chicks (Fig. 1.3) until they were large enough to be harvested (Reid 2009). This strong connection to country continues today for many Aboriginal people who live within the Lake Eyre Basin.

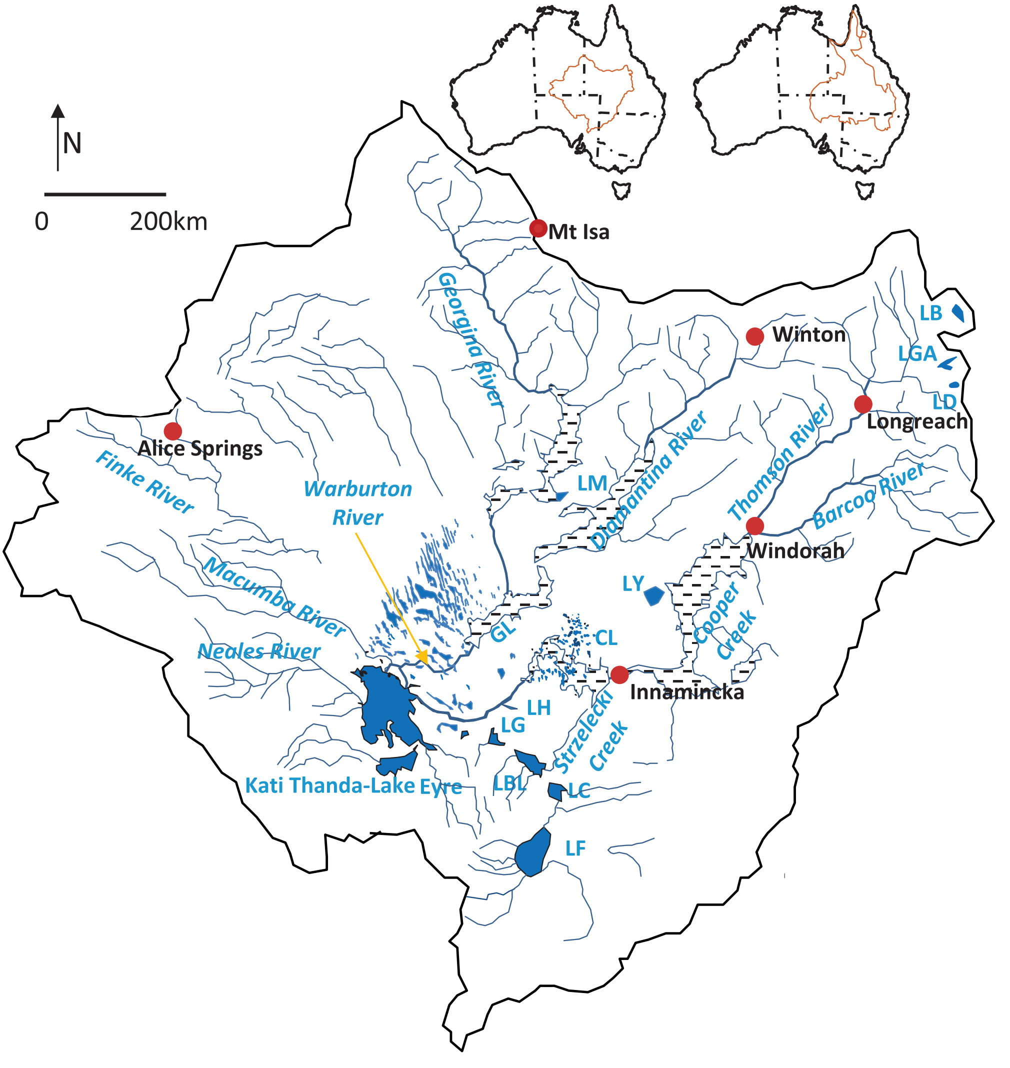

Fig. 1.1. The Lake Eyre Basin, its major rivers and wetlands and key towns in central Australia. Left inset shows the Lake Eyre Basin while the right inset shows the Great Artesian Basin. Major floodplains (hatched), include Goyders Lagoon (GL), while major lakes (filled) include Coongie Lakes (CL), Lake Blanche (LBL), Lake Buchanan (LB), Lake Callabonna (LC), Lake Dunn (LD), Lake Frome (LF), Lake Galilee (LGA), Lake Hope (LH), Lake Gregory (LG), Lake Machattie (LM) and Lake Yamma Yamma (LY).

In the 1800s, European explorers including Edward John Eyre, John McDouall Stuart and Major Warburton struck out across this landscape, searching for productive lands and water. The 1860 expedition of Robert O'Hara Burke and William John Wills from Melbourne to northern Australia remains the most notorious. Their deaths, on Cooper Creek (Fig. 1.4), were a lesson in both the harshness of these deserts and also European arrogance in the dismissal of life-saving Indigenous knowledge. Burke and Wills's party survived by eating spore cases of the ubiquitous floodplain fern, nardoo, but neglected to

Fig. 1.2. Kati Thanda-Lake Eyre receives water regularly but very seldom fills enough to provide large productive areas for fish and waterbirds (photo, R.T. Kingsford).

Fig. 1.3. Australian pelicans form large breeding colonies on some of the large lakes of the Lake Eyre Basin where there are islands, such as Lake Machattie (photo, R. T. Kingsford).

Fig. 1.4. Memorial to Robert O'Hara Burke, who died on Cooper Creek on 28 June 1861. He was the leader of the ill-fated Burke and Wills expedition to northern Australia (photo, R. T. Kingsford).

roast it to remove the damaging enzyme 'thiaminase', which contributed to their demise. Misreading these landscapes, Charles Sturt, a successful explorer of the continent's Murray–Darling Basin rivers, underestimated the size and importance of Cooper Creek, naming it a creek in 1845, presumably unconvinced that it was sufficiently large to be called a river. Two rivers (the Barcoo and the Thomson) flow into the Cooper, which can flood across up to 80 km of floodplain – clearly a substantial river.

Colonisation was sometimes brutal to Aboriginal people in many parts of Australia, including the Lake Eyre Basin (see Chapter 9). Large grazing properties were established as the settlers and cameleers moved in (Lockyer 2012). This included the legendary Sidney Kidman who built an empire of large pastoral properties across inland Australia. To this day, pastoral land management for cattle and sheep remains the most widespread commercial activity across the Lake Eyre Basin. In contrast, there are a few – and relatively small – areas established for irrigated agriculture (see Chapter 20). The other major economic activity is the mining of minerals, oil and gas (see Chapter 19. Tourism is also rapidly increasing in importance, particularly because of its contribution to economic viability in the more remote parts of the Basin (see Chapter 13). All people and their industries are supported by large regional centres, such as Longreach and Alice Springs, as well as some iconic smaller towns such as Birdsville, Innamincka and Windorah (Fig. 1.1). The sustainability of many of these industries and people is inextricably intertwined with the ecology of the rivers of the Lake Eyre Basin.

For its size, cultural and environmental values, the Lake Eyre Basin is truly one of the world's great desert rivers. It is also unique because its rivers remain largely unregulated, without major dams, flow diversions or floodplain developments. In 2014, the Lake Basin Partnership won the Australian Riverprize, followed by the International Riverprize in 2015. This was particularly significant as it was the first time in 17 years that the judging panel had awarded the prize to a free-flowing river for protection (see Chapter 7). Many of the world's rivers are highly developed, with large dams and weirs fundamentally altering flows (Nilsson *et al.* 2005) and affecting livelihoods and dependent biodiversity (Vörösmarty *et al.* 2010).

In this chapter, I briefly describe the Lake Eyre Basin rivers and dependent wetlands, their boom and bust cycles, dealt with in more detail later (see Chapter 2), followed by their ecological values, supplementing the chapters on fish (Arthington and Balcombe 2017; Chapter 3), turtles (see Chapter 5) and small mammals (see Chapter 6). Finally, I focus on the direct and indirect human impacts on the Basin's rivers and wetlands, given the long history of water resource development in Australia, and I canvas the impact of feral animals and plants, grazing and climate change on the region's globally important environmental and cultural values.

The rivers and wetlands of the Lake Eyre Basin

The Lake Eyre Basin in the centre of Australia (1.14 million km^2) includes large parts of Queensland, the Northern Territory and South Australia, and a small slice of New South Wales (Habeck-Fardy and Nanson 2014; Fig. 1.1). Another great basin, the Great Artesian Basin (1.7 million km^2), lies underneath the Lake Eyre Basin, as well as stretching further to the north (Fig. 1.1). Most of the focus of this book is on the surface waters of the Lake Eyre Basin, although reliable groundwater from the Great Artesian Basin has been critical to pastoral properties and towns. For example, bores along the famous Birdsville Track allowed stock to be walked to the railhead in Maree (Gibbs 2006). Also, the Great Artesian Basin naturally erupts to the surface, creating artesian springs with their own unique ecosystems, including endemic fish species (see Chapters 3 and 4). Access to groundwater also represents an important part of a broad search for sustainability, particularly in relation to its use by mining (see Chapters 19 and 20) and outback communities.

The vast Lake Eyre Basin has large areas of wetlands (~8.5 million ha; Bino *et al.* 2016), including artesian springs, waterholes, river channels, swamps, floodplains, and freshwater and saline lakes, predominantly supplied by its network of rivers and creeks (Fig. 1.1). The Great Artesian Basin supplies the springs, but most other wetlands are dependent on flows in the rivers. There are two major north–south catchments where most of the water flows (Cooper Creek and the Georgina–Diamantina catchment), and there are four smaller and more temporary rivers flowing east into Kati Thanda-Lake Eyre (Fig. 1.2), including the Neales and Macumba Rivers (Fig. 1.1). The Cooper Creek catchment is the most easterly of the large catchments, flowing south-west from Great Dividing Range. Its two main rivers, the Thomson and Barcoo Rivers (Fig. 1.1), are supplied by various creeks (e.g. Aramac Creek) and rivers (e.g. Alice River) before joining to form Cooper Creek, just upstream of the town of Windorah. The famous Channel Country is downstream of this confluence, where the Cooper can have a flood front which extends up to 80 km across, before it channelises and flows south-west into South Australia. This vast floodplain is like a sponge, soaking up water from the river and reducing the amount of water flowing downstream (Knighton and Nanson 1994). The river then flows past the small town of Innamincka, where it divides in large floods. Strzelecki Creek flows south to eventually reach the lakes north of the Flinders Ranges (Lake Blanche, Lake Gregory and Lake Callabonna, Fig. 1.1). However, most of the flow goes west where Cooper Creek bifurcates to supply the network of Coongie Lakes and a south arm, detailed in Chapter 2. The massive complex of lakes is within the Innamincka Regional Reserve (1.3 million ha), and includes the internationally recognised wetland of Coongie Lakes National Park, listed for its high environmental values (Puckridge *et al.* 2010). Once many of the lakes in this complex have filled, the northern branch flows south to join the southern branch of the Cooper (see Chapter 2), before flowing south-west again, where it floods a series of freshwater lakes and swamps (Kingsford *et al.* 1999). It then becomes confined to a channel before eventually reaching the eastern part of Kati Thanda-Lake Eyre. Flow patterns are highly variable (Kingsford *et al.* 2014): the Lower Cooper can flow every four years, and the Cooper reaches Kati Thanda-Lake Eyre about every 13 years (Kingsford *et al.* 1999).

To the west of this large catchment, water flows down the Georgina and Diamantina Rivers (Fig. 1.1). Water flows south-west along the Diamantina River, past the town of Winton and then past Birdsville, before forming the massive floodplain of Goyders Lagoon. To the west, the Georgina River and its tributaries flow south to meet Eyre Creek and its vast floodplain (Fig. 1.5), which includes large freshwater lakes (e.g. Lake Machattie). It also receives water from the Mulligan River, on the eastern edge of the Simpson Desert, before flowing south to join the Diamantina River's water in Goyders Lagoon. Once this floodplain is inundated, the river channel reforms as the Warburton River before flowing on to reach Kati Thanda-Lake Eyre. Four separate smaller rivers (e.g. Neales River) flow into the lake from the west (Fig. 1.1); their flows are more temporary than the rivers to the east, given their catchments lie in the most arid part of the continent (Kingsford *et al.* 2014).

Booms and busts and 'in between' flows drive this 'water environment'

Rivers of the Lake Eyre Basin are among the most variable in the world (Puckridge *et al.* 1998; McMahon *et al.* 2008). They oscillate between periods of extensive floods, driven primarily by summer seasonal rains of the Northern Australian Monsoon (Allan 1985), and extreme dry periods when there is little water in the landscape. Large tropical weather systems, particularly in La Niña years, can drive sequences of floods which may take many months to flow through the remarkably flat landscape all the way to Kati Thanda-Lake Eyre in South Australia (Kotwicki and Allan 1998; Puckridge *et al.* 2000; Costelloe *et al.* 2006). Kati Thanda-Lake Eyre receives water reasonably frequently, but rarely fills unless these

Fig. 1.5. The Georgina River catchment, including Eyre Creek, creates vast areas of Channel Country where water spreads out across the floodplain through a network of small channels (photo, R. T. Kingsford).

sequential floods occur (Kingsford *et al.* 2014). Floods which cover most of the lake return about every eight years (Kotwicki and Isdale 1991). Small floods or 'in between' flows are also critical to ensuring that waterholes are replenished and retain water through long dry periods (Bunn *et al.* 2006a). Variation in flows and flooding occurs up and down the rivers, varying in time and area. No two floods are the same. Minor changes in the rivers can alter where the water goes. Boom and bust cycles drive much of the ecology of the rivers and wetlands, producing tremendous responses in biological productivity during floods, which then 'shut down' during the bust periods.

This complex variability in timing and extent of river flows imposes its signature on the network of rivers and wetlands. These can be broadly grouped into five different habitat types: waterholes, the main and ephemeral channels, floodplains, freshwater lakes and salt lakes. There are also many small claypans, swamps and interdunal areas that are not necessarily connected to the rivers and fill from local rainfall. They are an important part of the ecology, often with high concentrations of frogs (Main and Bentley 1964; Kingsford *et al.* 2006a) and invertebrates, such as freshwater crabs (*Austrothelphusa transversa*) and tadpole shrimps (*Triops australiensis*). Artesian springs supplied by the Great Artesian Basin (Fig. 1.1), also independent of the main rivers, are extremely important wetlands, supporting communities of plants, invertebrates and fish often found nowhere in the world except in these isolated inland pools, described in Chapter 3.

Ubiquitous waterholes along the main rivers (Fig. 1.6), some permanent, are the most reliable (and iconic) natural aquatic habitats in this system, despite varying considerably in their ephemerality (Silcock 2010). They are usually 4–6 m deep, although some can be up to 25 m deep (McMahon *et al.* 2008; Kingsford *et al.* 2014). These waterholes are critically important during dry periods, providing survival refuges for aquatic animals such as fish (see Chapters 3 and 4) and turtles (see Chapter 5). Algae around their edges drives their ecology during these dry periods, providing food for the animals (Bunn *et al.* 2003; Fellows *et al.* 2007). Even in dry times, fish may breed in these waterholes (Kerezsy *et al.* 2011). As dry periods continue, evaporation lowers water levels and water quality declines considerably, with drying of some waterholes causing widespread death of fish and turtles (see Chapter 4). Many of the plants stop growing or die, leaving seeds behind to germinate in a subsequent flood (Brock *et al.* 2006). During dry periods, concentrations of fish and shrimps inevitably mean that Australian pelicans (*Pelecanus conspicillatus*), cormorant species (*Phalacrocorax* sp.), darters (*Anhinga novaehollandiae*) and yellow-billed spoonbills (*Platalea flavipes*) often concentrate on these waterholes (Fig. 1.6). Subsequent boom periods come when the tributaries run and fill the main channels and waterholes of the major rivers.

Once the waterholes are full, water spreads across the adjacent floodplain through a network of ephemeral channels. The floodplains are extensive in some places (40–80 km wide; Kingsford *et al.* 2014). This is the Channel Country, where myriads of channels intertwine to take water out over the vast floodplains. The larger floodplains of Lake Eyre

Fig. 1.6. Dry periods leave only the waterholes with water where fish, turtles and some waterbirds congregate, waiting for the next flood (photo, A. Emmott).

Basin rivers are downstream of Windorah on Cooper Creek, and upstream of Birdsville, Goyders Lagoon and Eyre Creek in the Diamantina–Georgina system (Fig. 1.1). When the water reaches the floodplains, there is tremendous increase in algal (Costelloe *et al.* 2005; Bunn *et al.* 2006b) and plant productivity, with the germination and rapid growth of plants (Brock *et al.* 2006; Capon and Brock 2006). Invertebrates hatch from dormant eggs and proliferate (Boulton *et al.* 2006). These floodplains form vast areas for foraging fish, turtles, waterbirds (Kingsford *et al.* 1999), as well as many small terrestrial mammals and other animals (see Chapter 6). Native fish species respond much better to these floods than alien species do, capitalising on the widespread availability of invertebrate and plant food (Costelloe *et al.* 2010). Waterbirds arrive on the floodplain from nearby lakes or other river basins, sometimes from thousands of kilometres away (Roshier *et al.* 2002; Roshier *et al.* 2006; Kingsford *et al.* 2010). They breed in their thousands in these areas, utilising nesting areas provided by flooded vegetation. Colonies of ibis (*Threskiornis* sp.), egrets and herons (*Ardea* sp.) and rufous night herons (*Nycticorax caledonicus*) can return to traditional nesting areas on the floodplains of Eyre Creek and Goyders Lagoon. These floodplains dry within months (Kingsford *et al.* 2010), with many plants and animals completing their life cycles in this short time, and those more dependent on water moving back into waterholes or the lakes.

The salt and freshwater lakes are widespread and particularly important for the ecology of the Lake Eyre Basin rivers. They include Lake Galilee in the north-east, Lake Machattie in the west and Kati Thanda-Lake Eyre in the south. They fill when the rivers or creeks run. For example, Lake Machattie fills from Eyre Creek while Lake Yamma Yamma fills from Cooper Creek. Kati Thanda-Lake Eyre fills from both the major river catchments, Cooper Creek and Georgina–Diamantina, as well as from the eastern flowing rivers and even creeks from the south. Some, like Lake Galilee, have their own internal catchment, which doesn't connect with the major river systems. The lakes of the Lake Eyre Basin vary in salinity from freshwater lakes (e.g. Coongie Lakes and lower Cooper lakes) to highly saline lakes such as Kati Thanda-Lake Eyre (Fig. 1.2). Freshwater lakes are important areas for biodiversity, supporting large populations of waterbirds, fish, invertebrates and other organisms (Kingsford *et al.* 1999; Kingsford *et al.* 2010; Puckridge *et al.* 2010). Many of these lakes, even if within the major river system, can also fill from local rainfall and also become saline in the final stages of their drying (e.g. Lake Hope, Fig. 1.1; Kingsford *et al.* 1999). Once flooded, salt plays a particularly critical part in the ecology of the salt lakes; it forces the clay particles to come together so they drop out of the water column by force of gravity, clearing the water. This allows sunlight to penetrate to the lake bed where aquatic plants (e.g. sea grasses) can grow in dense concentrations (Porter *et al.* 2006), contributing to incredible productivity for invertebrates and waterbirds (Kingsford and Porter 1994). These lakes, particularly where there are islands, provide habitat for colonies of Australian pelicans (e.g. Lake Eyre: Waterman and Read 1992; Coongie Lakes: Reid 2009). Importantly, salt and freshwater lakes often retain water for much longer than the floodplains – sometimes up to three or four years – providing a critical refuge for fish, turtles and waterbirds (Kingsford *et al.* 1999; Kingsford *et al.* 2010).

Development and other threats to the rivers

There are considerable pressures on the world's biodiversity and natural resources, primarily from direct and indirect effects of human development, including habitat loss and degradation, invasive species, overharvesting, pollution and climate change (Kingsford *et al.* 2009). The rivers of the Lake Eyre Basin and their dependent organisms, people and cycles are similarly affected by human pressures, although the degree of this impact varies considerably. The most serious threat is habitat loss and degradation through the potential large-scale diversion of water from the rivers and their wetlands (Kingsford *et al.* 2014).

There is a long history of changing the flows of rivers in the Lake Eyre Basin. Aboriginal people formed small dams across claypans (Gibbs 2009). Chinese 'gardeners' in the 19th century first diverted water from the rivers' waterholes to irrigate paw-paw, bananas and oranges (Silcock 2009). There was even a waterwheel built at Cullyamurra Waterhole, near Innamincka (Fig. 1.1) while sophisticated weirs were built on the Diamantina River near Winton in the 1880s to control water for local gardens (Silcock 2009; Fig. 1.7). After colonisation by Anglo-Europeans, most governments and communities in Australia began developing water resources on our rivers by building dams and diverting water, predominantly for irrigation. The aim was to improve the regularity and predictability of water (Gibbs 2009), which is – somewhat ironically – the antithesis of the behaviour of the rivers of the Lake Eyre Basin (Walker *et al.* 1997). In the 1930s, the Bradfield Scheme was the 'grand plan' for the Lake Eyre Basin, with the Thomson River to receive water diverted from coastal rivers such as the Tully River, engineered to 'flow' over the Great Dividing Range through tunnels, similar to the Snowy Mountains Hydroelectric Scheme (Gibbs 2009). In ensuing decades, sporadic small irrigation developments have occurred along the rivers of the Lake Eyre Basin, and continue to this day (see Chapter 20), but there has been no large-scale irrigation development (i.e. equivalent to that along the rivers of the Murray–Darling Basin (Kingsford 2000a)). Water is also diverted to supply the towns in the Lake Eyre Basin, sometimes using weirs to hold water back (e.g. the weir at Longreach on the Thomson River).

Large-scale developments of rivers come at considerable environmental, cultural and economic cost. Around the world, the impacts of water resource developments, the building of dams, diversion of water and development on floodplains have caused widespread degradation of rivers (Lemly *et al.* 2000; Kingsford *et al.* 2006b; Kingsford 2015; Kingsford *et al.* 2016). The impacts include loss of biodiversity, pressure on ecosystem services, damage to Aboriginal cultural sites and declining socio-economic viability. There is also increasing recognition that the environmental and cultural values of river basins also have real economic value (see Chapter 18). In Australia, there is no worse example of the size and scale of severe ecological degradation than the rivers and wetlands of the Murray–Darling Basin, where there is widespread death of floodplain eucalypts, including river red gums, other plants, declining invertebrates, waterbirds, frogs, native fish and even woodland birds and small mammals (Kingsford *et al.* 2015). Development of water resources has come at considerable economic cost, severely affecting the livelihoods of pastoralists (see Chapter 14). Some rectification of this problem, by returning some water to the environment, has cost the Australian taxpayer more than 12 billion dollars and considerable public angst.

Fig. 1.7. Chinese 'gardeners' were among the first developers of the rivers of the Lake Eyre Basin, creating weirs, such as this one on the Diamantina waterholes, which controlled water that could then be diverted to irrigate vegetables (photo, R. T. Kingsford).

Development of the rivers of the Lake Eyre Basin could easily have followed a similar path, when the Currareva development proposal on Cooper Creek was put forward in 1995 (see Chapter 17). This was essentially an irrigation development similar in size and volume to those already established in the more easterly Murray–Darling Basin rivers, with the potential to harvest and store water from small, medium and large floods in off-river storages. There is no more notorious example of the ecological and social impacts of such development than that on the Condamine–Balonne River system, the last major river to be developed in the Murray–Darling Basin (Kingsford 2000b), where small-scale irrigation developments were ratcheted up under increasing pressure from the irrigation industry, often abetted by different Queensland Government agencies (see Chapter 21). This has had considerable impacts on socio-economic values downstream (see Chapter 15).

Increasingly, there is concern that exploration and development of mining projects, particularly their use of significant volumes of water and their exploration and development footprint on floodplains, may affect the sustainability of the Lake Eyre Basin rivers. Depending on the size of such developments, flow patterns of the rivers may be severely altered, affecting both environmental values and human communities downstream. Pollution of waterways is a serious threat, evidenced by the disastrous spillage of pollutants from the Lady Annie mine into the Georgina River catchment in 2009 (see Chapter 19).

Climate change has the potential to exacerbate the problem of water resource development, although there is considerable uncertainty in climate predictions for the inland desert regions.

Rainfall and evaporation, the two most important drivers of the ecology of the rivers, are the variables most likely to be affected by climate change. Predictions for rainfall remain considerably uncertain, with potentially more intense rainfall, but there is high confidence for increasing temperatures (Reisinger *et al.* 2014), which means increasing evaporation. Inevitably, this will restrict the amount of time that different plants and animals have to complete their life cycles during boom periods, when most reproduction and recruitment occur.

The most widespread threat to the rivers, their dependent biodiversity and human livelihoods comes from the large range – and number – of invasive species. Control of these species can take considerable resources (Firn *et al.* 2015a; Firn *et al.* 2015b), even though some species have been deliberately introduced by government agencies. Feral animals within the Lake Eyre Basin include species from tropical Australia, such as sleepy cod (*Oxyeleotris lineolata*) and redclaw crayfish (*Cherax quadricarinatus*), as well as alien species from other parts of the world, such as the goldfish (*Carassius auratus*) and mosquito fish (*Gambusia affinis*) (see Chapter 3). These adaptable and widespread animals have the potential to out-compete native species and disrupt ecosystems. Within the last 10 years, introduced cane toads (*Rhinella marina*) have become common along Cooper Creek and may be driving a decline in goanna populations, as elsewhere. Introduced mammals are also widespread, including camels (*Camelus dromedarius*), pigs (*Sus scrofa*), foxes (*Vulpes vulpes*) and cats (*Felis catus*). Camels and pigs can damage watering areas while foxes and cats prey on small mammals, birds, reptiles and invertebrates. Similarly, invasive plant species are widespread across the catchment, forcing a strong focus on control given their impacts on biodiversity and grassland productivity for livestock (Firn *et al.* 2015b). These species include various cactus species, prickly acacia (*Vachellia nilotica*), rubber vine (*Cryptostegia grandiflora*), parkinsonia (*Parkinsonia aculeate*) and buffel grass (*Cenchrus ciliaris*).

People have a strong connection to waterholes (Silcock 2010), which is manifested in increasing tourist visitation leading to pollution around waterholes and damage to vegetation through the felling of logs for camp fires and trampling of sensitive riparian groundcover plants. Livestock grazing may also contribute to some loss of plant cover, as well as increased sedimentation of waterholes, although there remains relatively little evidence of widespread change in over more than a century (Silcock *et al.* 2013). The practice of stocking and destocking in unison with natural boom and bust cycles may create some resilience to livestock grazing impacts in the landscape.

Conclusion

Knowledge of the environmental values and threats to the sustainability of the rivers of the Lake Eyre Basin has rapidly increased in the last decade. This knowledge continues to reinforce the iconic status of this magnificent river basin which covers such a large part of the continent (Pisanu *et al.* 2015). Indeed, it was the combination of significant cultural and environmental values and free-flowing status that resulted in the Lake Eyre Basin Partnership receiving the prestigious Australian and International Riverprizes in 2014 and 2015 respectively. The Basin is clearly one of the great desert river systems of the world, and one of few unaffected by dams, major diversions of water or developments on its productive floodplains. Development of the rivers for irrigation will inevitably continue to be a major threat, as long as there is potential for governments and their communities to believe that a 'traditional' development path is the way forward. Adequate assessment of the impact of water resource development on cultural and environmental values remains critical (see Chapter 18), as does recognition of the global importance of the free-flowing status of the rivers. Clearly the prudent, sensible and responsible approach for the future is to maintain this globally unique river system in good health – anything less will represent a failure of our nation to learn from past mistakes.

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