

Introduction

An overview of the Murray–Darling Basin

Over 300 million years ago during the Carboniferous period, Australia collided with what are now parts of South America and New Zealand. The entire region was uplifted and created the Eastern Highlands or Great Dividing Range. It is Australia's most significant mountain range and the third longest land-based range in the world. It extends more than 3500 km from the north-eastern tip of Queensland, down the entire length of the eastern coastline through New South Wales, into Victoria and eventually ends on the central plain at the Grampians in Western Victoria. The width of the range varies from ~160 km to over 300 km.

The highest areas of the Australian continent are in the Great Dividing Range and it was a formidable barrier to westward migration for European settlers until 1813. There is a wide variety of vegetation throughout its length, from rainforest and

wet sclerophyll forest to woodlands and alpine grasslands that provide important habitat for a great diversity of wildlife.

Rivers that originate in the Great Dividing Range run east into the Pacific Ocean or west into the Murray–Darling Basin (MDB): an area of 1 059 000 km² or 14% of Australia's total land area. The MDB is a massive depression that spans most of New South Wales, Northern Victoria, the Australian Capital Territory, the lower third of Queensland and the south-eastern corner of South Australia.

The area was first explored by European pioneers Hamilton H. Hume and William H. Hovell in 1824. Five years later, Charles Sturt navigated down the Murrumbidgee River to encounter the Murray River and named it after Sir George Murray when his team reached the connection with the Darling River.

An extract of an account of the journey from Sturt's diary, published in London in 1833, was typical for the time.



Wide-mouthed Frog (*Cyclorana novaehollandiae*). Photo: M. G. Swan



Eastern Bearded Dragon (*Pogona barbata*). Photo: S. K. Wilson



Unbanded Shovel-nosed Snake (*Brachyuropsis incinctus*). Photo: S. K. Wilson



Peron's Tree Frog (*Litoria peronii*). Photo: M. G. Swan

‘The plains were open to the horizon. Views as boundless as the ocean. No timber but here and there a stunted gum or a gloomy cypress. Neither bird nor beast inhabited these lonely regions over which the silence of the grave seemed to reign.’

But there were Indigenous Australians living along the river, as they had been for 40 000 years, and in the World Heritage Willandra Lakes and Mungo National Park north-east of Wentworth and north of Mildura and Balranald. The Mungo region was recognised in 1981 as an important geological area and for its history of Indigenous occupation. The rich resources of the rivers and the adjacent lands maintained a denser population and more settled lifestyle than could be supported in more arid areas.

After this early exploration period the development of the agricultural districts of inland New South Wales began and today the MDB is an area of great productivity for agriculture, logging and mining. It is Australia’s most important agricultural region, containing over 40% of Australian farms that produce wool, cotton, wheat, sheep, cattle, dairy produce, rice, oil-seed, wine, fruit and vegetables for both domestic and international markets.

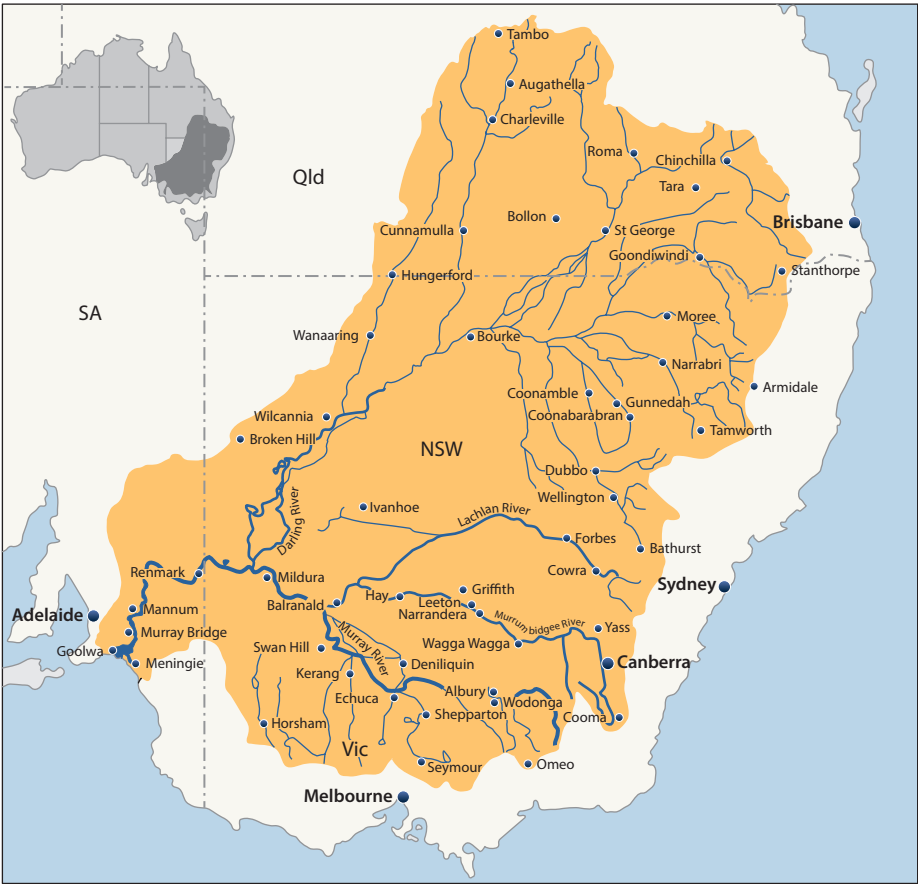
Over two million people live in the Murray–Darling Basin, from the national capital Canberra to many of Australia’s major inland towns including Toowoomba, Tamworth, Dubbo, Orange, Wagga Wagga, Albury-Wodonga, Shepparton and Bendigo.

The climate is subtropical in the north, semi-arid in the west and mostly temperate in the south.

Water is the most valuable resource in the Murray–Darling river system, with the majority of it flowing in from along the southern and eastern rim. About 85% of the vast catchment has almost no regular run-off into rivers.

The MDB is the largest and most complex river system in Australia and contains Australia’s three longest rivers: the Murray (2508 km), Murrumbidgee (1690 km) and the Darling/Barwon river system (2740 km). All the rivers have very low gradients over most of their length, causing them to flow slowly.

Water quality is paramount and threats to water quality include high salinity because large quantities of salt occur naturally. Floodplains are an important feature of the Basin because floodplain



Murray–Darling Basin showing major rivers and towns

vegetation uses groundwater in the soil profile and prevents water and salts rising to the surface or being transported to the river.

Increased salinity into the Basin’s water resources is often increased by activities such as irrigation development and land clearing.

Major threats to the flora and fauna of the MDB include the quantity of water removed from the river systems, habitat loss and alteration, exotic invasive species and diseases.

The Murray–Darling Basin catchments

The large depression of the MDB receives all the water from inland-flowing streams, creeks and rivers. Water from the northern catchment flows into the Darling River and water from the southern catchment flows into the Murray River. There are 22 major catchments (or sub-basins) within the Murray–Darling Basin. Although most of the major rivers flow into either the Darling or the Murray, some, such as the

Paroo, Lachlan and Wimmera, terminate in wetlands or marshes. The water from these rivers only reaches the Darling or the Murray in years of extremely heavy rainfall.

The topography and vegetation can vary between the different catchments, with floodplain forests, woodlands and

wetlands requiring different amounts of water throughout the year. Water management in rivers with monitored flows have affected the type, diversity and nature of plant communities along the rivers and floodplains. This has resulted in a decline of species such as River Red Gums, Black Box and Lignum shrublands.



Murray–Darling Basin showing the different catchments. Source: Murray–Darling Basin Authority (<https://www.mdba.gov.au/discover-basin/catchments>). CC-BY4.0

Kiewa Catchment

Kiewa Catchment is the smallest in the Murray–Darling Basin, though it makes a significant contribution to flows in the Murray River. The landscape of the catchment ranges from the high plains of the Great Dividing Range, at around 1600 m, to the northern floodplains near Albury–Wodonga with an elevation of around 160 m.

The east and west branches of the Kiewa River rise in the alpine environment of the Great Dividing Range, south-east of Mount Bogong. The western branch rises near Mount Hotham, then flows northwards, mostly unregulated, through a steep forested valley. The east branch begins as a series of small streams near Falls Creek and flows northwards, delivering water to a series of pondages, tunnels and aqueducts for the largest hydro-electric scheme in Victoria. The east branch of the Kiewa River is joined by the Bogong and Mountain creeks before merging with the west branch of the Kiewa north of Mount Beauty.

The Kiewa River then flows northwards through a widening valley with significant remnant vegetation and some of the most productive farming land in north-east

Victoria. The lower reaches of the river divert into floodplain wetlands before merging with the Murray River between Albury–Wodonga and Lake Hume.

Most of the catchment receives more than 700 mm average annual rainfall, with the Bogong High Plains experiencing almost 2500 mm, including snow in winter. The upper reaches of the Kiewa River feature alpine wetlands of national significance. Remnant patches of significant riparian vegetation occur along most of the Kiewa River and is in good to excellent condition in the higher reaches, but steadily declines downstream.

There are no major urban centres in the Kiewa Valley. Small towns include Tangambalanga, Kiewa, Yackandandah, Mount Beauty and Falls Creek. About 50% of the water extracted from the Kiewa River is for urban use and industry. The other half is for irrigated agriculture, predominantly dairying. Tourism is important to the region, with a focus on fishing and snow sports.

The Kiewa Catchment has 16 species of frogs and 42 species of reptiles.

These include the Southern Green Stream Frog (*Litoria nudidigitus*), Victorian Tree Frog (*Litoria paraewingi*), Spotted Tree Frog (*Litoria spenceri*), Alpine Tree Frog (*Litoria verreauxii alpina*), Victorian Smooth Frog (*Geocrinia victoriana*), Dendy's Toadlet (*Pseudophryne dendyi*), Olive Delma (*Delma inornata*), Alpine She-oak Skink (*Cyclodomorphus praealtus*), Alpine Water Skink (*Eulamprus kosciuskoi*), Guthega Skink (*Liopholis guthega*), Highlands Copperhead (*Austrelaps ramsayi*) and White-lipped Snake (*Drysdalia coronoides*).



Falls Creek area, Victoria. Photo: M. G. Swan



Spotted Tree Frog (*Litoria spenceri*). Photo: S. Mahony



Alpine She-oak Skink (*Cyclodomorphus praealtus*). Photo: M. G. Swan

Foam-nesting ground frogs (Family Limnodynastidae)

A family consisting of small to large ground-dwelling frogs that occur in a variety of habitats throughout Australia.

They lack discs on their fingers or toes and some species are adapted to burrowing and have noticeably large shovel shaped metatarsal tubercles. Most species have prominent eyes and may have a horizontal or vertical pupil.

With the exception of the genus, *Neobatrachus*, they all produce eggs in a floating, foamy eggs mass and are often laid in temporarily inundated depressions or ponds. They perform inguinal amplexus and females often have flanged fingers to help create the frothy nest.



Limnodynastidae spawn. Photo: M. G. Swan

Tusked Frog (Genus *Adelotus*)

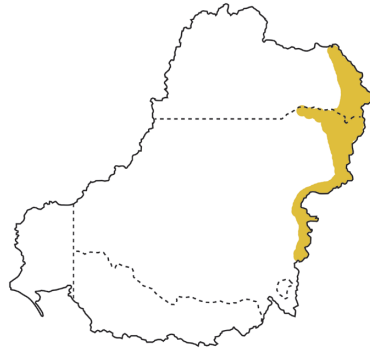
The sole member of this genus, *Adelotus brevis*, is a medium-sized frog with a broad head. Males have a large pair of 'tusks' at the front of the lower jaw, which are only visible if the jaw is opened. The purpose of these tusks is not well understood but the males which are larger than the females

may use them in encounters over territory and sexual selection.

The Tusked Frog occurs in the north-eastern area of the MDB, being more associated with the coast and ranges.

Tusked Frog

Adelotus brevis



TL: Males 34–44 mm; females 29–38 mm

Description: Medium-sized flattened body with broad head and rounded snout. Dorsal surface usually rough with many warts and ridges and grey or brown to almost black with irregular pattern and distinctive butterfly-shaped patch between eyes. Tympanum hidden and eyes with horizontal pupil and golden-brown iris. Sometimes narrow pale mid-vertebral stripe present. Fold of brown skin from eye to base of front limb. Throat dark grey or black, with white flecks. Ventral surface smooth, with vivid black or dark grey and white marbling that extends over abdomen and underside of



Adelotus brevis (male), Gloucester, New South Wales. Photo: S. Mahony



Adelotus brevis (showing tusks). Photo: D. O'Brien

legs. Groin, thighs and lower legs with bright red or orange patches. Fingers and toes with trace of webbing, with females having broad flanges on first and second fingers.

Habitat: Found around permanent water in wet and dry sclerophyll forest, and also farmland in the north-east of the MDB.

Notes: Males call during spring and summer from inside crayfish burrows or nests hidden beneath vegetation and leaf litter at the edges of ponds and stream pools. The call is a slowly repeated, moderately pitched 'g-lunk'. Females deposit unpigmented eggs in foam clumps and tadpoles are a deep dark brown. Metamorphosed frogs have been recorded from December to February.

Identification: *Adelotus brevis* is the only frog in its range with a combination of boldly marbled belly with bright red colouration on the underside of the groin and thigh. Males can be further distinguished by their very broad head and presence of two tusks on the lower jaw inside the mouth.

Conservation status: Vulnerable (Qld); Endangered population in Nandewar and New England Tableland Bioregion (NSW); Near Threatened (IUCN Red List).

MDB catchments: Condamine-Balonne, Border Rivers, Gwydir, Namoi.

Banjo frogs and marsh frogs (Genus *Limnodynastes*)

Limnodynastes is a genus containing 15 species that occur in different regions of Australia. It is well represented in the MDB, with four species of stout marsh frogs and five species of the well-known, globular shaped, banjo frogs.

These frogs occupy a wide variety of habitats with marsh frogs generally found in association with still, permanent water and banjo frogs adapted for burrowing into the soil. Banjo frogs are readily identified by a prominent, large tibial gland.

Members of the genus *Limnodynastes* may be confused with trilling frogs, genus *Neobatrachus*, but those species have a vertical pupil, or with *Platyplectrum ornatum* but that species usually has a distinctive hourglass shape on the dorsum.

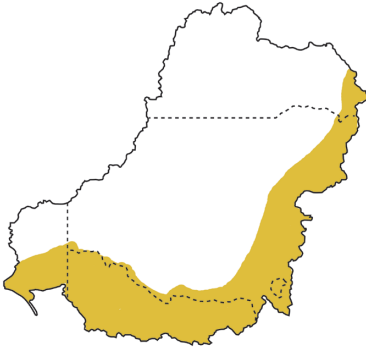
Banjo frogs (Genus *Limnodynastes*)

South-eastern Banjo Frog

Limnodynastes dumerilii dumerilii

TL: Males 52–70 mm; females 52–73 mm

Description: Large globular shaped body



Limnodynastes dumerilii dumerilii, Moama, New South Wales. Photo: M. G. Swan

with short head and broadly rounded snout. Broad, dark stripe runs from snout, through eye and tympanum to base of forelimb, bordered below by thick orange-brown or golden glandular ridge. Dorsum granular, grey or brown with darker irregular markings and may be smooth or with low rounded warts. Usually yellow or orange mottling on flanks. Prominent, large tibial gland. Tympanum indistinct. Eyes with horizontal pupil and golden iris. Ventral surface smooth and pale usually marbled with brown or yellow. Fingers unwebbed, toes with varying degrees of webbing. Large shovel-shaped metatarsal tubercle.

Habitat: Widespread in the east and southern areas of the MDB. Occurs through a range of habitats including dry woodlands, granite outcrops, farmland, heaths and mallee.

Notes: A species capable of burrowing during drier conditions and often sighted after rain periods or around waterways. Males call from within vegetation usually floating in ponds during spring and autumn. Up to 4000 eggs may be produced in a foamy raft among vegetation. The call is a hollow, resonating ‘bonk’ and tadpoles are deep dark brown with small gold markings. Metamorphosed frogs have been recorded from December to April.

Identification: *Limnodynastes dumerilii dumerilii* is similar to the other species of banjo frogs and can be distinguished by less toe fringing, a tibial gland the same colour as the body, lack of red on the groin or thighs and a ventral surface marbled in brown or yellow.

Conservation status: Not listed.

MDB catchments: Condamine-Balonne, Border Rivers, Gwydir, Namoi, Macquarie-Castlereagh, Lower Darling, Lachlan, Murrumbidgee, Lower Murray, Mid-Murray, Upper Murray, Wimmera, Loddon-Avoca, Campaspe, Goulburn-Broken, Ovens, Kiewa, Mitta Mitta.

Snowy Mountains Banjo Frog

Limnodynastes dumerilii fryi

TL: Males 52–75 mm; females 52–83 mm

Description: Large globular shaped body with short head and broadly rounded snout. Broad dark stripe runs from snout, through eye and tympanum to base of forelimb, bordered below by thick orange-brown or golden glandular ridge from eye



Limnodynastes dumerilii fryi, Kosciuszko National Park, New South Wales. Photo: D. Hunter

to arm. Dorsum granular with numerous scattered low warts. Grey, olive-brown to dark brown, generally with yellow or orange mottling on flanks. Prominent, large tibial gland. Tympanum indistinct. Eyes with horizontal pupil and golden iris. Ventral surface smooth and usually marbled with cream or yellow. Fingers unwebbed, toes up to one-quarter webbed. Large shovel-shaped metatarsal tubercle.

Habitat: Found in stream pools, ponds and farm dams in the Snowy Mountains in the Upper Murray catchment.

Notes: This large burrowing frog calls during spring and early summer from within vegetation beside ponds and stream pools. The call is similar to *Limnodynastes*

dumerilii dumerilii but with a lower frequency. Eggs are laid in floating foamy clumps among vegetation. Tadpoles are deep dark brown with small gold markings. Metamorphosed frogs have been recorded in November.

Identification: *Limnodynastes dumerilii fryi* differs from other species of banjo frogs by its larger body size and being restricted to the Snowy Mountains.

Conservation status: Not listed.

MDB catchments: Upper Murray.

Variegated Banjo Frog

Limnodynastes dumerilii variegatus



TL: Males 52–64 mm; females 52–65 mm

Description: Large globular shaped body with short head and broadly rounded snout. Broad dark stripe from snout, through eye and tympanum to base of forelimb, bordered below by thick pale beige glandular ridge from eye to arm. Dorsum strongly granular with numerous scattered raised warts. Brown or light brown to pale orange with larger, darker irregular blotches throughout, with remnant of vertebral stripe. Prominent