

# Karst in Arid Australia

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## Abstract

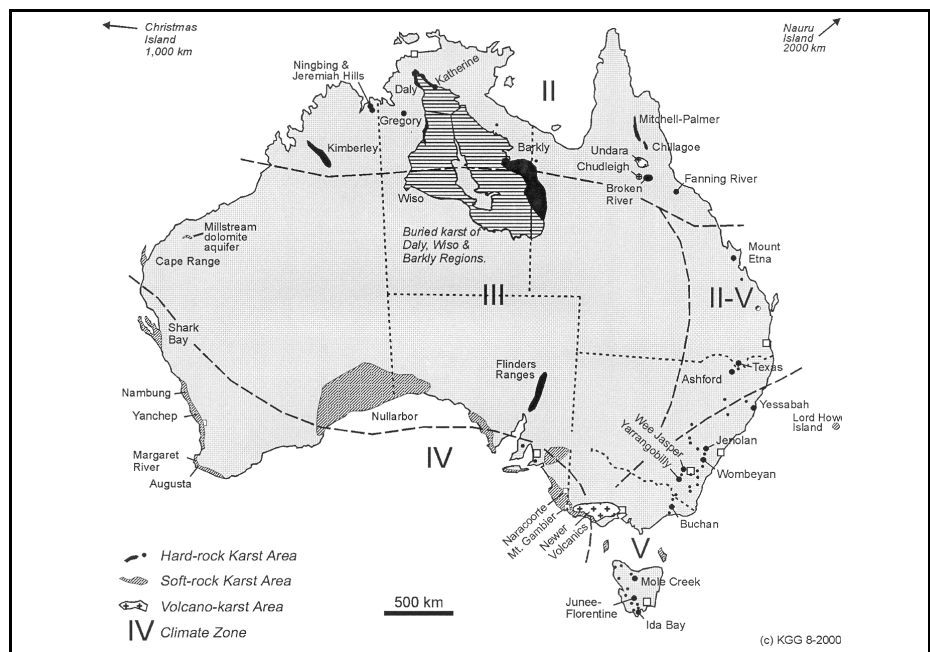
This paper presents an overview of some of Australia's arid and semiarid karst and its management. Australian climatic conditions are characterized by exceptionally high rainfall variability especially in areas of irregular low rainfall. Definitions of arid are an important component when discussing such karst development and management.

The areas discussed include the arid karsts of the Nullarbor Plain and Cape Range. The arid monsoonal areas of Northern Australia, include the Chillagoe Karst, the Camooweal Karst, the Katherine Karst, the Bullita Karst of Gregory National Park, which contains Australia's longest cave, and the karst of the Western Kimberley Region.

This paper discusses the effects of arid climates on the processes of karst development and the effects on present cave biota. Australia is a Federation of States. The States each have their own legislation governing the use, protection, and ownership of land. The effects of this will be discussed in relation to land tenure and karst protection in these remote and sparsely settled areas of Australia. In particular, many of the caves and karst areas have traditional aboriginal uses such as for occupation and for spiritual purposes. Some caves and many shelters and overhanging cliffs have rock art engraving and painting. In recent time, Native Title and indigenous land use have had to be taken into account by management agencies and by cave groups desiring access to sites for recreation or scientific purposes.

# Introduction

Australia is a dry continent with extreme variability in rainfall. Many of its karst areas reflect this aridity. The arid karsts of Northern Australia all exist in what is known as the Wet Dry Tropics characterized by a Summer Monsoon from December to March. Travel and cave exploration is precluded during the wet season. These areas have intense but variable rainfall during this wet season but practically no rainfall for the balance of the year with a very high



**Figure 1:** Australian karst areas, showing climatic zones. Zone II Monsoonal wet-dry tropics; Zone III Arid; Zone IV Mediterranean-winter wet/ summer dry.

evaporation potential. In contrast, Cape Range on Northwest Cape in Western Australia and the Nullarbor Plain are arid with less than 250 millimeters of rain per annum. This paper will restrict itself to the karst at Bullita in Gregory National Park, Northern Territory, and the semi-arid karst of the Nullarbor Plain which bridges the Western Australia and South Australia borders on the Southern Coast of Australia (Figure 1). These two karst areas will be used to exemplify some of the contrasts in management of karst areas in Australia and also because they have very active speleological investigation programs.

### Gregory Karst

The Gregory Karst is located within the Gregory National Park and is some 45 kilometers south of Timber Creek. The karst is on the boundary of the desert to the south and the wetter area to the north, which is subject to a tropical monsoon season from December to March. Most of the rainfall occurs during this period and total annual rainfall is about 600 millimeters. The evaporation potential is about 2,500 millimeters per annum. The Gregory Karst is in PreCambrian dolomite that has been exposed since the Tertiary as a result of the down cutting of rivers across the Victoria River Plateau. The karst is exposed along the East Baines River. The only macrofossils in the formation are stromatolites. Caves occur in the Supplejack Member of the Skull Creek Formation. They are network maze caves in grike fields with numerous entrances at both the edges of the limestone and there are many skylights along the grikes (Figure 2). The relief of the limestone is about 60 meters.

Modern knowledge of caves in the area followed a British led expedition in 1988 (Storm and Smith, 1989). Following this trip, the Canberra Speleological Society has conducted trips to the area for two or three weeks each year during June and July, the winter period. Local cavers from the Top End Speleological Society also conduct

trips and have explored and mapped numerous caves. The karst extends for some 20 kilometers north-south and up to one kilometer wide. There are many outlying exposures, which have not been investigated to date and exposures along other rivers outside the Gregory National Park. The total length of known caves now exceeds 150 kilometers. The Bullita Cave System is currently the longest cave in Australia at 81 kilometers. Each year the explored and surveyed length of this cave system is increased in length by three to ten kilometers.

The aboriginal inhabitants of the area knew caves in the Gregory Karst. Shelters were used for occupation and many have associated cave art. In only one instance has rock art been found well within a cave, all other art is in overhang, rock shelter, and entrance locations. The art consists of ochre paintings of animals and mythical beings. Many of these sites have important cultural and spiritual significance. Cave exploration has led to the discovery of numerous important sites, which are documented, but the locations are made known only to National Park personnel. Many of these sites are vulnerable to damage, particularly natural weathering. Only one or two sites are visited frequently by tourists. No photographs of these are included in the paper due to respect for aboriginal sensitivities.

The caves have not been investigated biologically although bats are known to roost in some of the caves during the wetter times of the year. Vertebrate fossil deposits have not been found. Many of the caves flood in part during the wet season. Given the richness of



**Figure 2:** Cave passage in Bullita Cave with fig tree roots.

fauna found elsewhere, for example Cape Range and Chillagoe, there is potential for important biological work.

The area was a leasehold cattle station from the 1920s until the 1980s when it was gazetted as the Gregory National Park which is administered by the Northern Territory Conservation Commission. To date, development of the Park has been limited; access is by a two-wheel drive road from Timber Creek to Bullita but all other roads require four-wheel-drive vehicles. Cave exploration has been conducted with permission from the Conservation Commission. Casual cave exploration is not encouraged since the karst is rugged and remote and climatic conditions are harsh. As yet there is not an operational management plan for the Park although the two caving clubs have contributed information and advice for planning purposes.

### **Nullarbor Plain**

The Nullarbor Plain is one of the largest limestone regions in the world at about 200,000 square kilometers in area. It is a flat-lying, shallow marine plain of Miocene age overlain with some Pleistocene dunes particularly near the coast. It is so named because of the lack of trees (null arbor). All the northern part of the limestone is virtually without trees and only has saltbush and grasses up to one meter in height. The climate is arid to semi-arid with rainfall of 260 millimeters per annum close to the coast but only 180 millimeters per annum at the railway on the northern edge of the exposed limestone. The Nullarbor Plain has no



**Figure 3:** Lake in Weebubbie Cave with water supply pipe, subsequently removed.

surface streams and little relief. A number of deep caves exist. These occur at the bottom of large collapse dolines and a number of these caves intersect the watertable at about 90 meters (Figure 3). It was not until 1970 that successful cave diving trips were undertaken with modern scuba gear. Cocklebidy Cave is 6,260 meters long; with about 5,200 meters underwater, the longest cave dive in the world. Other long caves include Mullamullang Cave (12,000 meters) and Old Homestead Cave (8,000 meters). The other feature of the plains are the "blowholes" so named because they breathe in and out depending on atmospheric pressure. There are currently about 1,000 of these known. Many are very short but some are quite extensive. They are generally less than 20 meters deep. They are mainly concentrated on the broad, low ridges (two to five meters) about the plain. A recent innovation has been to locate these using an ultralight aircraft to position sites by GPS and then systematic exploration using the GPS locations to find entrances. Most of the deep caves have probably been discovered as these were known from local information followed by systematic visiting of all sites on aerial photographs of the area in the late 1950s to early 1960s (Dunkley and Wigley, 1967).

Numerous troglobytes have been found in the caves. Some of the caves have extensive vertebrate fossil assemblages, which have only been minimally examined to date. There has been considerable geomorphic investigation of the Plain and its caves. Aboriginal use of the plain involved hunting and travelling routes. Caves were used as a water source (high in  $MgSO_4$ ), for occupation, for mining of flint nodules, and for cultural purposes. Some of the caves have etched engravings and others ochre paintings.

The Nullarbor forms part of Australia's mythology. It was the barrier between Western Australia and the eastern states and was not crossed until 1840 to 1841. It was not until the telegraph line was constructed (1877) close to the coast and the railway further north that the plain became more accessible. Both Western Australia and South Australia leased the land for sheep and cattle grazing. In South Australia, all the leases have been revoked and the limestone portions are now in National Park or on aboriginal land. In Western Australia, a number of grazing leases have lapsed but on the richer, higher rainfall areas near the coast there are still leasehold cattle properties. Some years ago planning to have the whole of the Plain put forward as a World Heritage Area was initiated but this lapsed due to the politicization of such

initiatives. The caves are thus inadequately protected and there is little management on the ground. This is despite the Plain and its caves being outstanding in a national and international context.

Most caving is conducted responsibly and only a couple of the caves receive very many visitors. Amongst these is Mullamullang Cave where damage in the Easter Extension to the Salt Cellars and "Coffee and Cream" sections is excessive. The rare troglobitic spider, which only occurs in and around the "Dome," 4.5 kilometers into the cave, is extremely vulnerable to disturbance and collecting. At one stage, it was thought that it was extinct but more recently active webs have been observed. This spider is at the end of a very tenuous food chain at the far end of the cave.

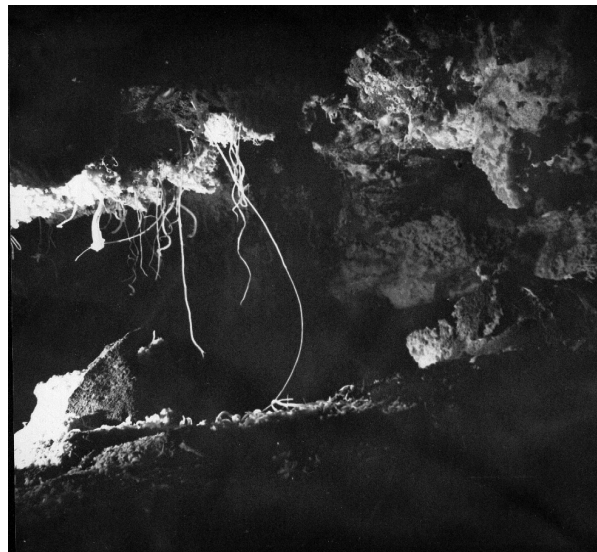
Caving trips to the Nullarbor are generally of an expedition nature for several weeks. Cavers need to be self-sufficient for all needs including water. Rescue services are thousands of kilometers away. This is particularly relevant to diving parties where decompression chambers are very long distances away.

### Landscape Fragility

Australia has an old landscape. Its soils are shallow. There has been little or no rejuvenation through uplift and other mechanisms. Abuses of land from overgrazing and the introduction of exotic plants and animals have caused regional extinctions of many species. On the Nullarbor rabbits, foxes, and cats have reduced the populations of many animals. Grazing by sheep and cattle have similarly reduced the condition of native pastures. Areas that are not now subject to sheep and cattle pressure are reverting to the original condition but there will remain a legacy of a reduced number of vertebrate species on the Nullarbor. It is not known whether these changes on the surface have endangered cave biological populations due to changes in food chains. There appear to be a number of bat roosts that have not been used for many years. It is not known whether these reflect the changes of surface tenure and usage or are part of much longer term responses to climate change.

Underground conditions on the Nullarbor reflect the arid environment. Caving contributes to damage, particularly surface trampling. Natural processes of rejuvenation such as flooding, as occur in higher rainfall karsts, are most infrequent in arid karsts and, except for wind deposited sand and for fretting from the walls, damage from trampling lasts a very long

time. Many calcite speleothems exhibit damage due to salt wedging and it is not uncommon to see piles of broken formations shattered by this salt wedging. In some places quite magnificent halite and gypsum speleothems occur (Figure 4). There is no evidence of deliberate vandalism but problems of track widening and indis-



**Figure 4:** *Halite salt formation, Easter Extension, Mullamullang Cave.*

criminant tracking occur.

In Gregory National Park, there are less dramatic changes than on the Nullarbor; however, there are exotic weed infestations and feral horses and donkeys continue to affect vegetation recovery. The caves have not had very many visitors and tracking or other damage is minimal. Visits to the cave art sites are limited. Problems may emerge if cave usage were to go up. The greatest problem faced by management would be if inexperienced cavers got lost in what are very extensive caves.

### Conclusions

Arid karsts in Australia are very fragile and the caves need careful management to prevent trampling of floors particularly. Mechanisms of track marking are in use in many sensitive caves; however, the single most pressing need is for deliberate management of the deep caves on the Nullarbor Plain. The Nullarbor Plain in Western Australia needs legislative protection and more focussed management attention. For the South Australian section, more on-ground management would prove beneficial. The Plain is now visited extensively, particularly to watch whales at the Head of the Great Australian

Bight. Also visitation by both cavers and cave divers results in change within the caves despite subscribing to minimal impact caving codes.

At Bullita, some long term management strategies need to be formulated to contend with people with karst interests, be they casual visitors on "Round Australia" trips or more serious speleological visitors. The present access through very restricted access permits cannot continue for long, given that the Bullita Cave System is now the longest cave in the country.

### **Acknowledgments**

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