Twenty years on the Nullarbor

Victorian Speleological Association

Expeditions 1999 to 2023.

Nicholas White

Photographs provided by many participants

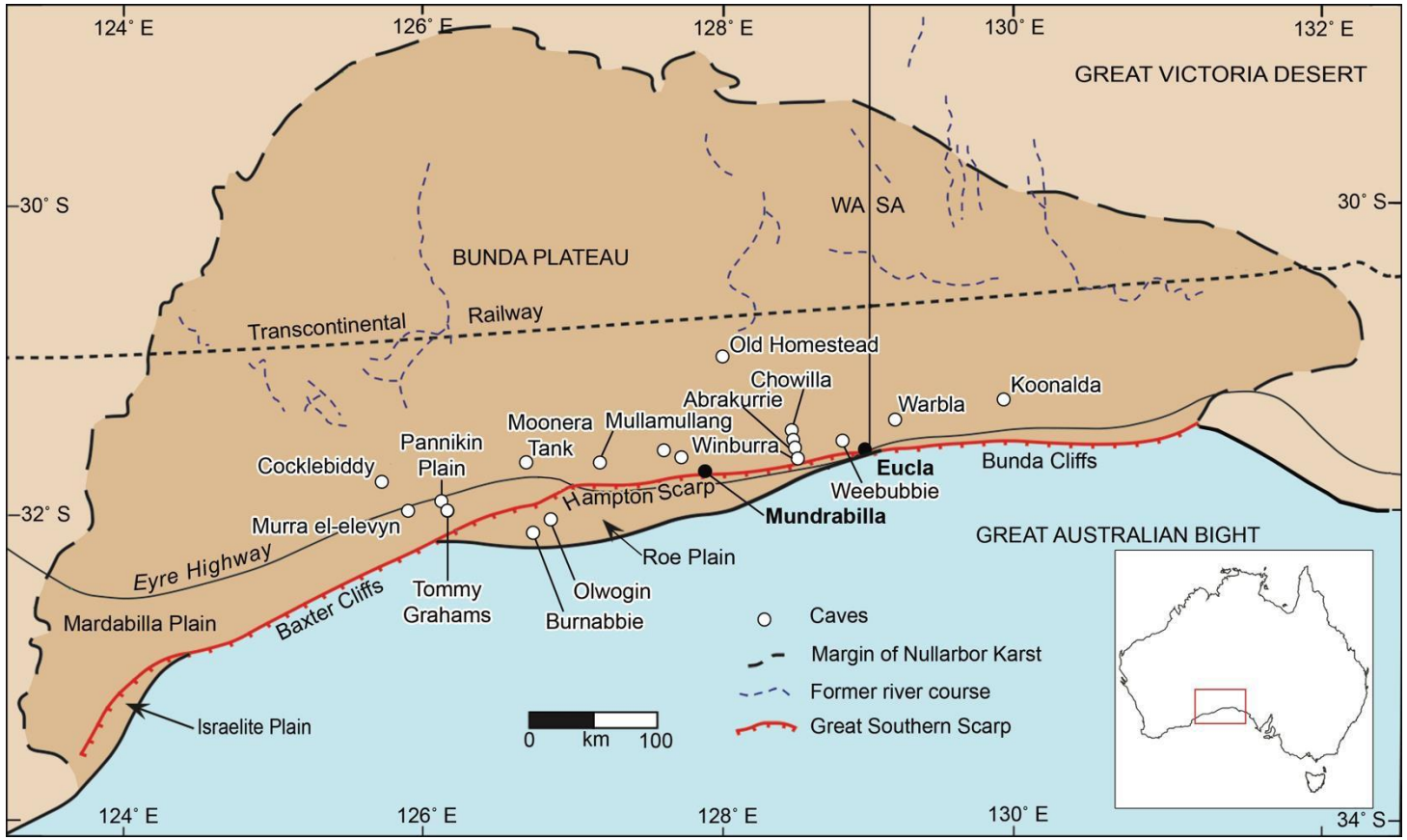
29. Oct. 2024

View of Bunda Cliffs from Air

- Bottom light-colored band is the Eocene Wilson Bluff limestone member.
- The upper layers are the younger Miocene Nullarbor Limestone member which have all the caves in this talk.
- The surface of the Plain is generally treeless and covered with chenopods and grassland.

Nullarbor Plain

- Extent of limestone plain about 240,000 sq km.
- Eyre Highway.
- Transcontinental railway.
- Main deep caves labelled.



Treeless vista

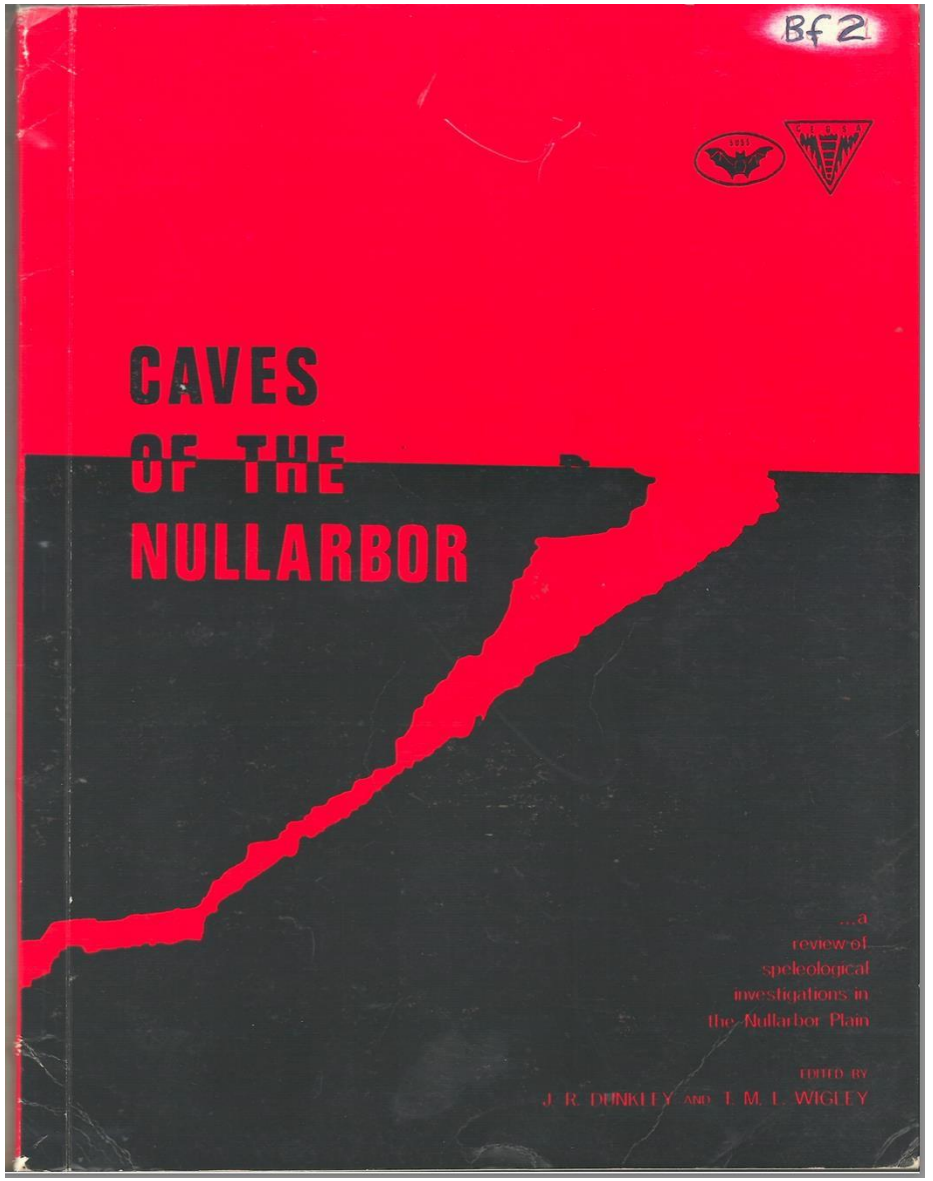
- Relatively flat.
- Bluebush and treeless plain.
- Saltbush and wombat diggings (Southern hairy nosed wombat).

Nullarbor visits by Nicholas White

- Visited Nullarbor Station in 1954 when rabbit, kangaroo and fox industry at its height.
- No morabine grasshoppers, retreat to Eyre Peninsula.
- Nullarbor a barrier to movement of species due to arid chenopod grasslands.
- Next were trips 1971 and 1972 with Ian Lewis.
- Other trips to Nullarbor including Mundrabilla caves and Old Homestead Cave.

Karst Knowledge

- Dunkley and Wigley's *Caves of the Nullarbor*, 1967, focused on deep caves
- David Lowry of WA Geological Survey conjecture on number of blowholes at 10,000 to 100,000
- Wigley – blowhole breathing
- Diving of deep caves not until Ian Lewis etal trips in 1971-2 and 1972-3



Karst exploration 1970 to 1990s

- Cave exploration continued with detailed exploration and mapping of Mullamullang Cave, Old Homestead Cave and a number of caves on Mundrabilla Station.
- In 1992, Adrian Davey and others completed a study commissioned by the Federal Department of the Environment recommending that the Nullarbor Karst Region be nominated to IUCN as a World Heritage Property.
- The West Australian government would not agree to the nomination proceeding.
- The proposition lapsed and is now covered under the EPBC Act requiring that it to be National Heritage listed first.

Ken Boland initiatives

- Arrived Melbourne and VSA from WA in early 1990s having caved with CLINC in SW WA.
- His early Nullarbor exploration was at Old Homestead Cave and Thampanna Cave.
- A three day bushwalk around Old Homestead Cave found 10 Blowholes – an easier way?
- On return he switched from gliding to an Ultralight Plane flying using the “Flightstar” one seater plane.
- GPS on one knee and notebook the other; all flying north of tree-line to allow emergency landing.
- Flight height at 250-300 m with capacity to fly lower to examine detail of features.
- Successive VSA expeditions rewarded by discovery of caves, blowholes, rock holes, megafauna and indigenous use of the Plain.

Method of VSA Exploration

Ultralight Plane

Two planes used over the course of the Twenty Years of exploration.

- Flight Star used until 2009. (At right)
- Kitty hawk used from 2010

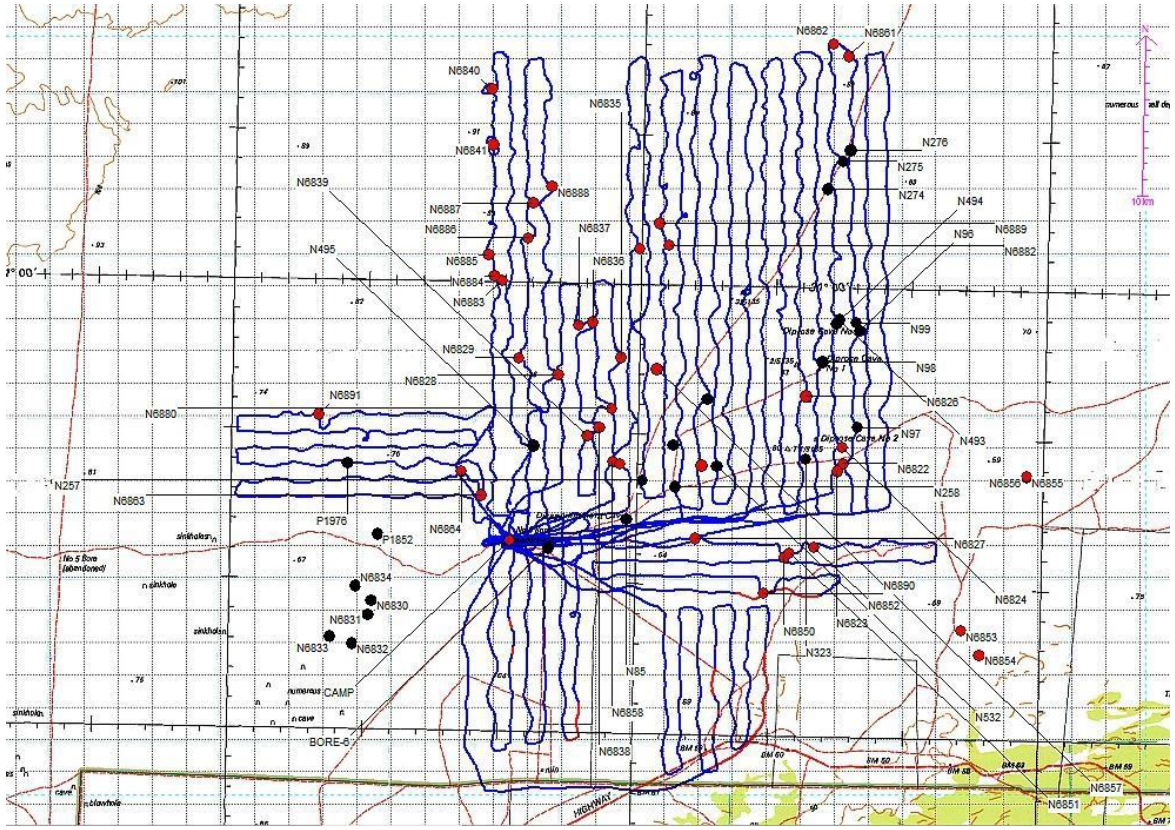
Aerial reconnaissance then ground truthed

- Bicycles (2002) used but not any better than walking.
- Electric bicycle might have worked.
- Still using 4x4s and lots of fixing punctures due to bluebush.

Data Processing

- The flight data is processed each evening, giving new Kxxxx numbers.
- Each GPS unit downloaded with Kxxxx data in morning so everyone has locations.
- Each group “bikes” or “walking” decides route to locate Kxxxx.
- Plans for each group put on notice board.
- Ken planned new flight if weather good or if weather not good he joined a “walking” group.

Flights in 2016 Northwest of Nullarbor Roadhouse



- Black dots known sites.
- Red dots new sites.

Flights 2000 to 2019

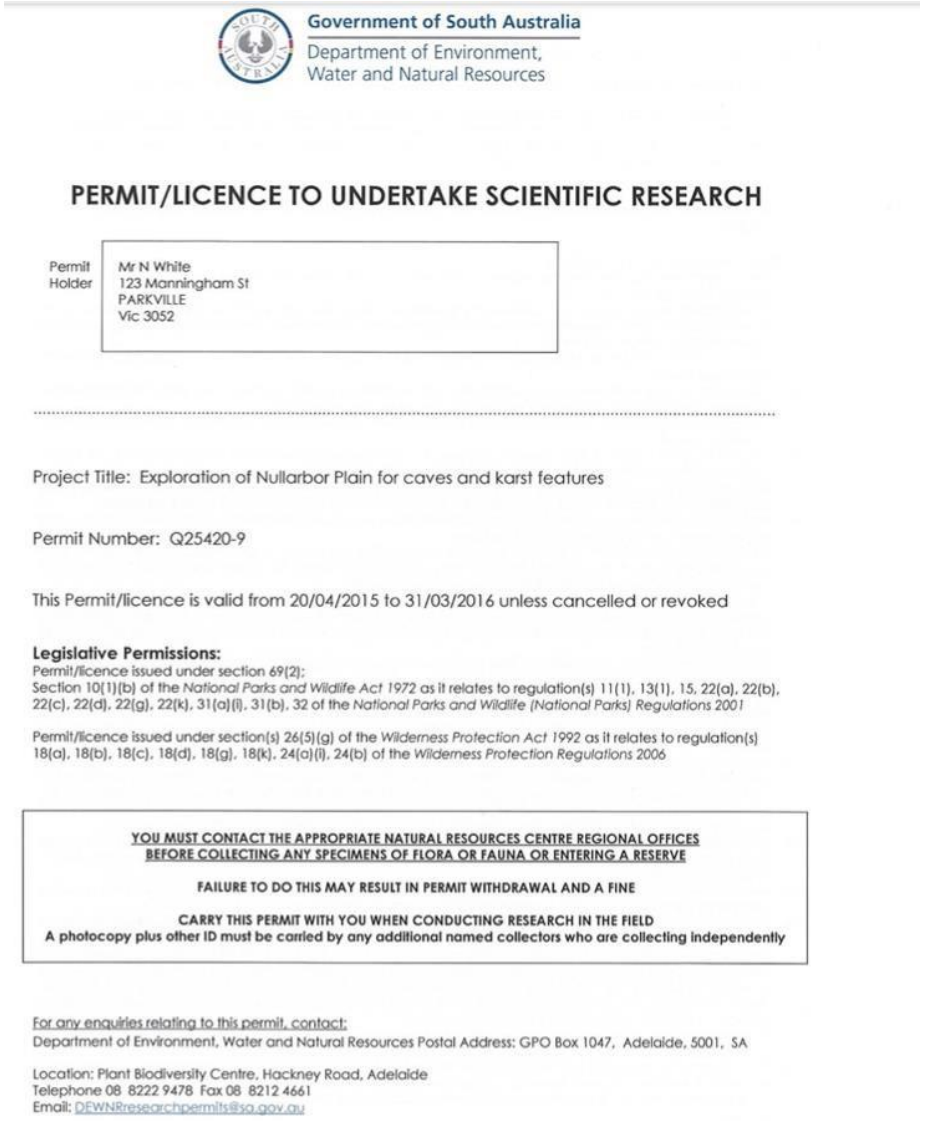
2018 Expedition with SA Museum and U. of Adelaide
Participants & a cultural ranger from the
Far West Aboriginal Corporation.

Thylacaleo Caves 2002 Reward

- 2002 expedition discovered caves with Thylacaleo skeletons and other now extinct megafauna.
- *Thylacaleo carnifex* complete skeleton discovered in a cave recently opened. probably due to rabbit or other factors.
- WA Museum through John Long obtained funds for detailed research of the deposits.
- Gavin Prideaux researched the deposits and many macropods including tree kangaroos, birds and frogs.
- Established studies on the fauna from the caves at Flinders University which continue today.

South Australia Caving

- South Australian Nullarbor caving avoids the Border Control on food.
- It requires a Scientific Permit which is oriented to biological science and not karst and geomorphic investigation.
- Logistics easier.
- Introduced Cultural Rangers or Monitors about 2014.



Government of South Australia
Department of Environment, Water and Natural Resources

PERMIT/LICENCE TO UNDERTAKE SCIENTIFIC RESEARCH

Permit Holder
Mr N White
123 Manningham St
PARKVILLE
Vic 3052

Project Title: Exploration of Nullarbor Plain for caves and karst features

Permit Number: Q25420-9

This Permit/licence is valid from 20/04/2015 to 31/03/2016 unless cancelled or revoked

Legislative Permissions:
Permit/licence issued under section 69(2):
Section 10(1)(b) of the *National Parks and Wildlife Act 1972* as it relates to regulation(s) 11(1), 13(1), 15, 22(a), 22(b), 22(c), 22(d), 22(g), 22(k), 31(a)(i), 31(b), 32 of the *National Parks and Wildlife (National Parks) Regulations 2001*

Permit/licence issued under section(s) 26(5)(g) of the *Wilderness Protection Act 1992* as it relates to regulation(s) 18(a), 18(b), 18(c), 18(d), 18(g), 18(k), 24(a)(i), 24(b) of the *Wilderness Protection Regulations 2006*

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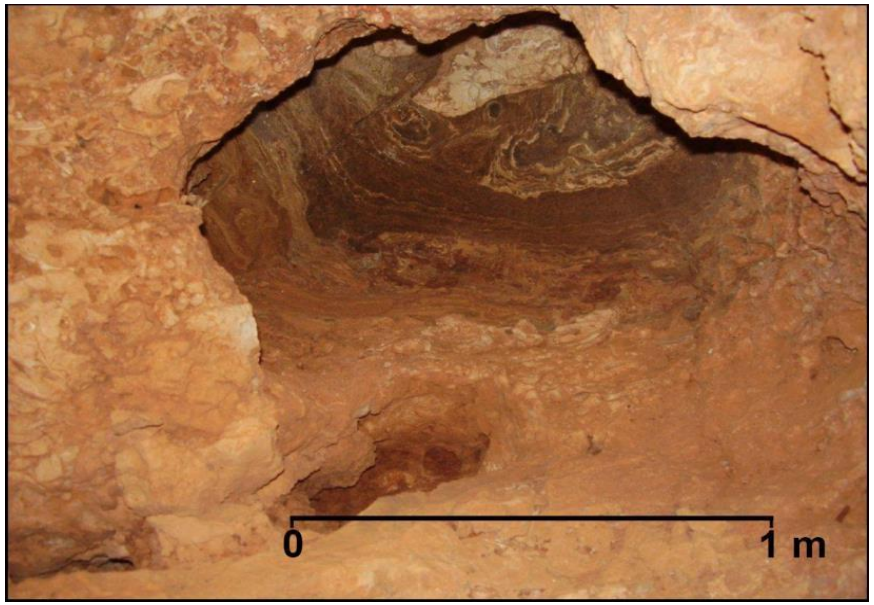
Enigma of Blowholes

- Both David Lowry and Joe Jennings proposed mechanisms of blowhole formation, upwards stoping to form domes or cupolas.
- All formation mechanisms involved active meteoric water.
- Conjecture on how many (10,000 to100,000 Lowry estimate) and their location. Many were near roads and tracks.
- These were some of the questions thrown up by Ken Boland when we initiated the expeditions.
- Little did we know that the expeditions would define the location of blowholes or the mechanism of their formation.

Blowhole entrance

A member of the group in a shallow blowhole.

Blowholes

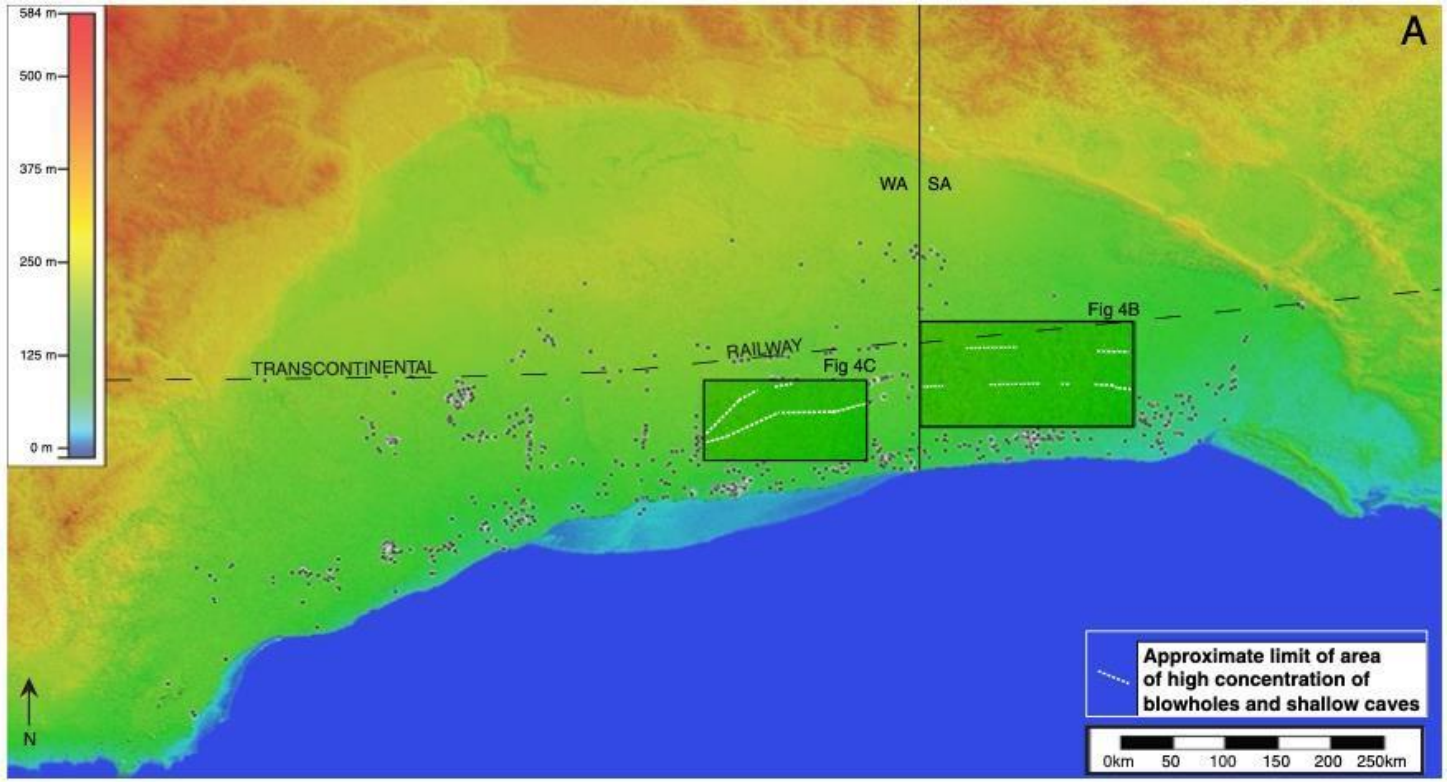


- Most numerous feature except for rock holes.
- Sub-circular smooth-walled vertical shafts tens of centimetres to 1-2 m in diameter, limited vertical development (median depth ~7.5 m).
- Blowhole entrances are frequently shaped like a truncated dome.
- Up to 15m in width and 35m deep.

Blowhole breathing

- Cavers at breathing holes.
- Tom Wigley's had measured the air movements of some caves and calculated volumes of the cave.
- Porosity and permeability of the limestone involved influences air movements.

Location of Blowholes



- During trips it was apparent there was a broad irregular band blowholes.
- Shannon Burnett came on the 2011 expedition.
- Shannon defined a band of blowholes about 60 to 75 km from present coastline.
- The blowholes fitted the flank margin cave definition.

Golfcourse Cave

- Named for its approx. 18 roof windows.
- A cave with lots of contents.

Golfcourse Cave

- Dingo skulls on floor of cave (sampled for DNA analysis).
- Western brown snake or Gwardar.
- Masked owl (*Tyto novaehollandiae*).

Golfcourse Cave

- Dingo skulls from floor of Golfcourse Cave. SA Nullarbor.
- Taken to get pre-1800 dingo DNA in 2017 trip.
- Soulimi (2024) used two of these for pre-colonial DNA study.
- The ages were estimated as 892 and 1,113 BP.
- Their mitochondrial DNA was consistent with other West Australian samples but the East Australian and K’gari dingo is slightly different.

Flank Margin Caves

- Mylroie and Carew described flank margin caves in very young limestones in the Bahamas and extended this to Pacific Islands.
- It was apparent to VSA Expedition members that the blowholes and caves we were finding, fitted this model.
- Burnett et al (2014) put it together for the Nullarbor based on the VSA Expedition results.
- Mylroies' also later identified other such caves elsewhere in Australia – Portland, KI and Cape Range.

John and Joan Mylroie at Naracoorte Caves

Flank margin conditions on an island

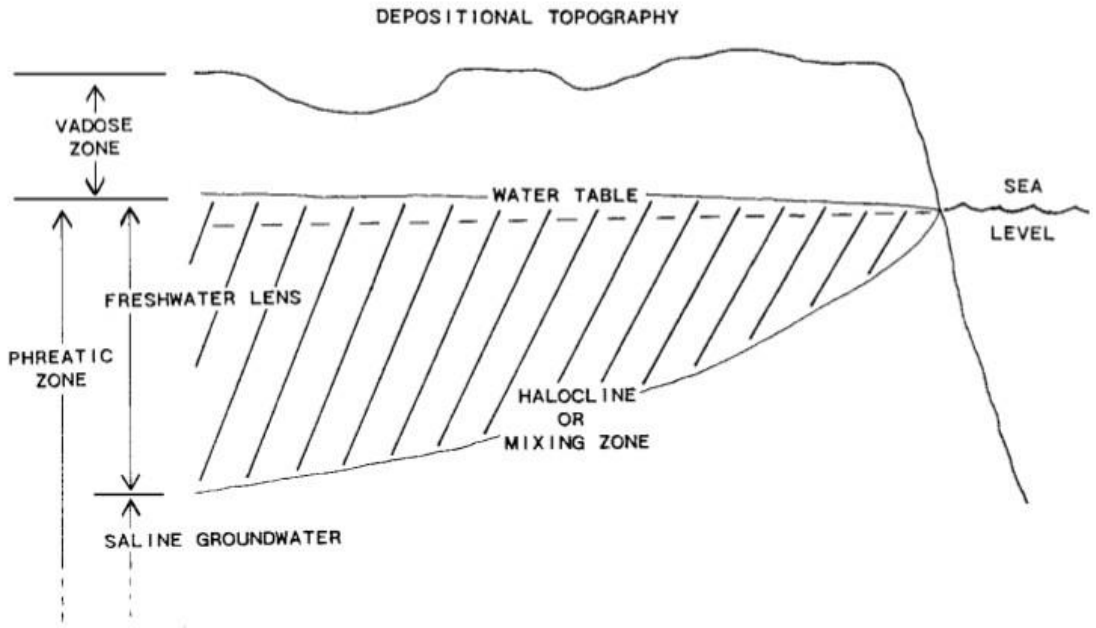
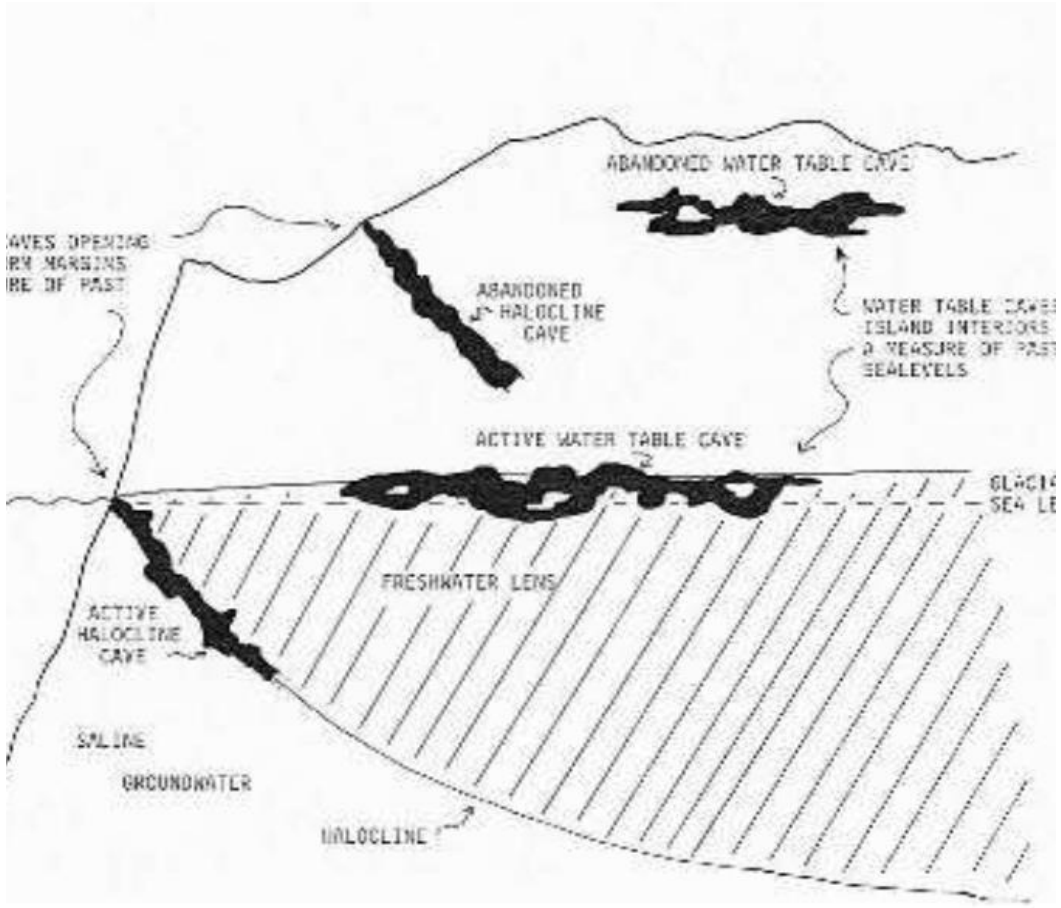


Fig. 1. Diagrammatic representation of a freshwater lens in a carbonate island showing the various hydrologic environments found between the land surface and the saline groundwater. The boundary between the freshwater lens and the saline groundwater may be a sharp halocline as pictured here, or a broad region of changing salinity called a mixing zone.

- Interface of freshwater lens and salt water and saline groundwater.
- Ghyben-Herzberg Lens.
- Caves form at the coast but without entrances
- Not to scale, vertically exaggerated.

Flank margin caves

- Abandoned caves after drop in water table; new caves form at lower level.
- Formation of both water table cave and halocline cave.
- The conditions recognized for the blowholes and some of the shallow caves on the Nullarbor Plain. First example on continental setting.
- Milner has examples of these water table caves in the Bunda Cliffs as does Lipar & Ferk on the Hampton Scarp.
- Not to scale, vertically exaggerated.



Flank Margin Cave Summary (1)

- Found in “bands”; in Bunda Cliffs and on Hampton Range and Isabella Plain scarp (Lipar and Ferk (2015).
- Many are on the top or sides of ridges but others may be covered over in the swales between ridges.
- There are two known such bands:
  1. Along the coast and including those exposed on the Bunda Cliffs and up to 20 km north of the present coast.
  2. The band 50-70km inland, and – see next slide.
  3. Possibly one north of Railway but more field work needed to confirm this.
- These bands relate to previous coastlines.

Flank Margin Cave Summary (2)

- Formed at the groundwater interface with meteoric and saline sea water from mixing corrasion.
- Formed without entrances as can be seen on the Bunda Cliffs.
- We only know those blowholes and shallow caves exposed by surface lowering from either collapse or solution pipe (blowhole) exposure. There may be more blowholes close to the present surface.
- The “blowholes” exposed by surface lowering of the Plain which is estimated to have been 30 to 60 m since sea retreated about 15 Ma.
- No vertical levelling study of the blowholes has been conducted, they exist to the north and south of the identified band.
- The Nullarbor Plain has uplifted more in the west than the east.
- Some but not all of the shallow caves of the Nullarbor are of Flank Margin origin.

Jon Woodhead, Geochemistry Lab, (Uni Melb)

- Jon Woodhead's Geochemistry Laboratory established that the Uranium-Lead (U/Pb) radioactive decay series overlapped with the Uranium-Thorium (U/Th) decay series. This overlap was established using Nullarbor speleothem samples.
- Samples of speleothems were collected from many areas of the Plain including samples from caves from the VSA expeditions.
- The VSA samples from SA Nullarbor expeditions dates ranged from 6 to 2.9 Ma. This includes with a wet period of 5 to 3 Ma during the Pliocene.
- The oldest stalagmite sample was 9.6 Ma from a cave to the north, near the railway.
- Kale Sniderman (Uni Melb) extracted pollen from the stalagmite samples from the wetter Pliocene period and demonstrated a much richer vegetation, a woodland rather than the arid chenopod grassland at present explaining some of the Thylacaleo Cave fauna such as "tree kangaroos" and predators such as Thylacaleo.
- Alison Blyth (Curtain University) used one of the 2.9 Ma dated speleothem samples to extract residual organics which were plant lignins which explained the "black" speleothem colour (not bushfire soot).

Paleontology
Marsupial tiger

- Upper picture shows dentition of lower jaw (*Thylacinus cynocephalus*) – skulls located in several caves.
- Lower picture (*Thylacinus cynocephalus*) sampled for museum study and ancient DNA analysis.
- These are from South Australian caves.

Masked Owl

- Modern owl pellets below feeding roost (Golfcourse Cave).
- Owl (*Tyto novaehollaniae*) feeding roost debris from regurgitated owl pellets (18 to 20 mammals both rodent and marsupial species).
- Patricia Wooley (Latrobe University) is interested in whether the mulgara, a dasyurid, still lived on the Nullarbor.

Masked Owl diet

- Feeding roost had bone material of Dasycercus (Madura Cave, Lundelius, 1974).
- We collected pellets from numerous caves.
- Pellet examination from a number of sites almost exclusively introduced house mouse (*Mus musculus*).
- This due to introduced cat producing regional extinction
- Low number of caves with active owls at present.

Wildlife on the Plain – Camp visitors!

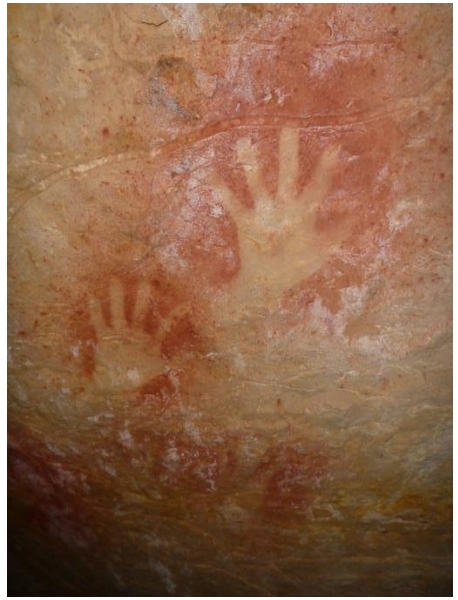
Nankeen Kestrel

- Kestrels very common on Plain, most common raptor observed.
- Kestrel chicks in cave on a Spring trip.

Cave inhabitants

- Cave Crickets on red ochre hand painting.
- Red back spiders, in most blowholes.

Indigenous cave use



- Red ochre handprints found in a number of caves, normally within natural light zone.
- Burnt stick used to light cave in dark zone.

Rockhole

- Ken Boland at a rockhole with an animal track into it.
- White stone markers indicate routes & features.
- Numerous unnamed rockholes present on Plain, most with evidence of indigenous use as well as animal use.

Rockholes littered with artifacts

- Tectites were worked to make artifacts.
- Quartz artifacts, imported from northern Eyre Peninsula.

Imported tools

- Baler shell found (used to carry water) associated with pooled water in a cave with a sheltered water pool some 70 km from coast
  - Southern baler shell (*Melo miltonis*)
- Grinding stone made of imported quartz rich rock, from northern Eyre Peninsula, located next to shallow cave cluster with aboriginal use

Summary VSA Expeditions

- Ken Boland's questions answered; using ultralight plane and GPS for locating sites.
- Over 3,500 new caves and karst features recorded.
- About 20+ Expeditions, bone recovery trips towards the end.
- VSA led but participants from OSS, NC and KSS, CEGSA and CLINC, relied on capacity for a month long trip (members retired).
- Involvement of scientists, new disciplines and method advances from several Universities and Museums, leading to publications.
- Thylacaleo Caves, Thylacines etc.
- Shannon Burnett, Flank Margin Caves and estimate of 20,000 "blowholes".
- Wet Pliocene (Woodhead, Sniderman) tree kangaroos, Thylacaleo etc.
- Impoverishment of small animal fauna, due to predators (cat) and mice.
- Mirning, extensive cave use plus rockhole network provided travelling routes across Plain.

Future exploration

- Use of drones to locate features.
- Would need bigger drones programmed to fly a grid.
- Further exploration would discover caves with valuable contents and elaborate on karst processes in this, the largest arid limestone karst in the world.