BERNARD ROAD BUSHLAND, CARABOODA

Boundary Definition: bushland (part taken to cadastre) boundary (Boundary adjusted from that in draft *Perth's Bushplan.*)

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 129
Area (ha): bushland 102.2
Map no. 13
Map sheet series ref. no. 2034–IV NE
Other Names: Submission Area 290
Local Authorities (Suburb): Shire of Wanneroo (Carabooda)

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Spearwood Dunes

Sands derived from Tamala Limestone (Qts: S7)
Tamala Limestone (Qtl: LS2)

VEGETATION AND FLORA

Vegetation Complexes

Spearwood Dunes

Cottesloe Complex — Central and South

Floristic Community Types: *not sampled, types inferred

Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes

*24 Northern Spearwood shrublands and woodlands
*26b Woodlands and mallees on limestone
*28 Spearwood *Banksia attenuata* or *B. attenuata — Eucalyptus* woodlands

WETLANDS

No wetlands mapped

THREATENED ECOLOGICAL COMMUNITIES

Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: limestone ridge, vegetated uplands
Vegetation and Flora: limited survey (DEP 1998, WAWA 1995)

Structural Units

Uplands — Sands derived from Tamala Limestone: *Eucalyptus gomphocephala* Woodland to Forest over *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland

Uplands — Tamala Limestone: Shrublands to Closed Heaths dominated by one or more combinations of *Melaleuca huegelii, M. systena* and *Dryandra sessilis* var. *cygnorum*

Vegetation Condition: >70% Very Good to Excellent, <30% Good to Completely Degraded, with areas of severe localised disturbance

Total Flora: not known

Significant Flora: *Sarcozona bicarinata* (3); typical Tamala Limestone taxa — *Melaleuca huegelii, Grevillea preissii, Trymalium ledifolium* var. *ledifolium, Petrophile serruriae* subsp. nov. (GJK 11421)

Fauna: not known

Linkage: adjacent bushland to the north (canopy cover), east and south-west (Site 130, across road); part of Greenway 2 (Tingay, Alan & Associates 1998a); part of a regionally significant contiguous bushland/wetland linkage (Part A, Map 7)

Other Special Attributes: adjacent to Coogee Swamp and Springs (*Melaleuca rhaphiophylla* Low Woodland to Low Open Forest; *Baumea articulata* Sedgeland) which have a significant aquatic invertebrate fauna and are a significant bird breeding area (WAWA 1995); contains historical cave (important fossils) and other karst features (Bastian, 1998; Submission no. 176d); recommended for protection in the study of City of Wanneroo bushland (Trudgen 1996); consolidates the linkage between Yanchep and Neerabup National Parks

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Not listed

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities, Rarity
Recommendation: Part A: Basic Raw Materials Negotiated Planning Solution. Part B: Rural Complementary Mechanism (see Table 3, Volume 1).

BERNARD ROAD BUSHLAND, CARABOODA

Boundary Definition: bushland taken to cadastre boundary

SECTION 1: CADASTRAL INFORMATION

(Lots, locations and derived information to be updated in the public submission period)

Bushplan Site no. 129 **Map no.** 18

Map sheet series ref. no. 2034–IV NE

Area (ha): total 102.8; bushland 102.3

Other Names
Submission Area 290

Local Authorities (Suburb)
Shire of Wanneroo (Carabooda)

Ownership Categories
State Government, Private (including commercial organisation)

Zoning
MRS: Rural
TPS: Rural, Landscape, No zone

Lot/Location/Reserve numbers (Purpose), Street name
50, 6268 Bernard Rd; 6155, 6265, 6266 Wanneroo Rd
Crown Reserve

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
Tamala Limestone (Qtl: LS2)

VEGETATION AND FLORA

Vegetation Complexes

Spearwood Dunes
Cottesloe Complex — Central and South

Floristic Community Types: *not sampled, types inferred

Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*24 Northern Spearwood shrublands and woodlands
*26b Woodlands and mallees on limestone
*28 Spearwood *Banksia attenuata* or *B. attenuata* — *Eucalyptus* woodlands

WETLANDS

No wetlands mapped

THREATENED ECOLOGICAL COMMUNITIES

Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: limestone ridge, vegetated uplands

Vegetation and Flora: limited survey (DEP 1998, WAWA 1995)

Structural Units
Uplands - Sands derived from Tamala Limestone: *Eucalyptus gomphocephala* Woodland to Forest over *Banksia attenuata*, *B. menziesii* and *Allocasuarina fraseriana* Low Woodland
Uplands- Tamala Limestone: Shrublands to Closed Heaths dominated by one or more combinations of *Melaleuca huegelii*, *M. acerosa* and *Dryandra sessilis* var. *cygnorum*

Vegetation Condition: >70% Very Good to Excellent, <30% Good to Completely Degraded, with areas of severe localised disturbance

Total Flora: not known

Significant Flora: *Sarcozona bicarinata* (3); typical Tamala Limestone taxa - *Melaleuca huegelii*, *Grevillea preissii*, *Trymalium ledifolium* subsp. *ledifolium*, *Petrophile serruriae* subsp. nov. (GJK 11421)

Fauna: no known information

Linkage: adjacent bushland to the north, east and south-west (BS130, across road); part of proposed Greenway 2 (Tingay, Alan & Associates 1997a); part of a regionally significant contiguous bushland/wetland linkage (Volume 2A, Map 8)

Other Special Attributes: adjacent to Coogee Swamp and Springs (*Melaleuca rhaphiophylla* Low Woodland to Low Open Forest; *Baumea articulata* Sedgeland) which have a significant aquatic invertebrate fauna and are a significant bird breeding area (WAWA 1995); contains historical cave (important fossils) and other karst features (Bastian 1998; Submission no. 176d); recommended for protection in the study of City of Wanneroo bushland (Trudgen 1996); consolidates the linkage between Yanchep and Neerabup National Parks

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Not listed

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities, Rarity

Opportunities and/or Constraints

Opportunities: Bushplan Site/part Bushplan Site under TPS Landscape Zoning, Crown Reserve

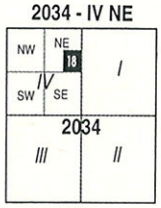
Constraints: private land; under Priority and General Mineral Resource Area (limestone), mining tenement M70/139 (Swan Portland Cement, operator Menchetti) for limestone cement

Recommendation: The most appropriate mechanism for the protection of this Bushplan Site be considered through the public comment period in consultation with the land owner(s).

LEGEND

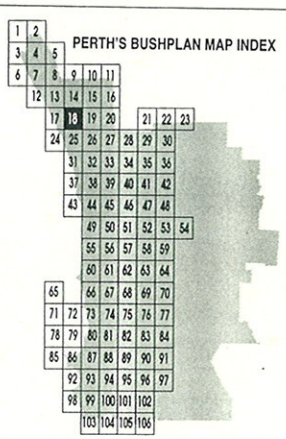
- **472** — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- *696* — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2034 - IV NE



1 : 25 000 AMG Reference Grid showing Perth's Bushplan Map Sheet Breakdown

PERTH'S BUSHPLAN MAP INDEX



N

SCALE

0 500 1000

Metres

Produced by Project Mapping Section
Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw-map7//environ/bushplan//bushv2_18.dgn

Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

What Did George Grey Discover?

The first historic reference to the caves of the Yanchep area comes from the pen of the explorer George Grey (later Sir George Grey). Following his first journey of exploration in the Kimberley region, he made in December 1838 a short trip up to the Moore River area, which without the arduous circumstances of the major exploration was for him a pleasant interlude. On the way back towards Perth his party camped at a spot north of a lake called Man-bee-bee (Mambibby in a later spelling), which was the open water at the Southern end of Lake Yanchep, today's Lock McNess. His Journal for December 6th (pp.308 & 309) then reads as follows:

"December 6. - This morning, we started at daybreak, and breakfasted at Man-bee-bee, and immediately after breakfast resumed our route. I left the main party with two natives, and travelled up a swampy valley, running nearly in the same line as the chain of lakes we had followed in going. The natives insisted on it, that these lakes were all one and the same water; and when, to prove to the contrary, I pointed to a hill running across the valley, they took me to a spot in it, called Yun-de-lup, where there was a limestone cave, on entering which I saw, about ten feet below the level of the bottom of the valley, a stream of water running strong from S. to N. in a channel worn through the limestone. There are several other remarkable caves about here, one of which was called the Doorda Mya, or the Dog's house. Probably, therefore, the drainage of this part of the country is affected by the chain of lakes, which must afterwards fall into the river I saw to the northward. We slept at Now-oor-goop."

This is the sole reference to cave visitation on the part of Grey. It doubtless refers to the Yanchep area, and in a very general sense Grey may be acknowledged as the 'discoverer' of the Yanchep caves. However, to say, as the cave guides used to do for many years, that he discovered the tourist cave Crystal Cave, was totally without foundation. Henry White discovered it in 1903. Nor did Grey discover the nearby Yonderup Cave, as one person suggested (Downey, 1958), for that cave contains no stream. The historian Ian Elliott (Elliott, 1977) tried to ascertain where the cave seen by Grey might be, but was stymied over the fact that no Yanchep cave stream was known which flowed from south to north. He considered that the 'swampy valley' Grey followed on making his approach to this cave was probably Yonderup Lake.

I rejected this interpretation, mainly because Yonderup Lake lies precisely along the chain of the lakes. The small gap between it and Loch McNess (Grey's Man-bee-bee) makes it an obvious route for the party to take. Whereas Grey says of his swampy valley: "running nearly in the same line as the chain of lakes we had followed -". So this was a feature either slightly divergent or slightly offset from the line. It would have to be more or less open at its northern end, but closed off by a hill at its southern end - the direction of his travel. It would also have to be between Man-bee-bee and Now-oor-goop, which is today's Lake Nowergup, situated about ten kilometres south of Yanchep.

For some years I attempted to find a cave fitting the description inside the southern half of Yanchep National Park, but without any success. Caves with streams there are, but they

either run the wrong way, or are in the wrong topographic setting, or simply too dark to be the sort of cave that the local aboriginal folk may have entered. The last point needs to be fully grasped, for the cave was already well known to them, including the fact that it contained a stream. Clearly it would have to be bright enough inside for them to access the stream without any lighting.

Apart from that, there is really quite a lot of information stated or implied in Grey's brief description. The following facts can be adduced:

(i) cave is situated between Yanchep and Lake Nowergup,
(ii) at the south end of a swampy valley,
(iii) on a hillside at the end of this valley,
(iv) contains a stream running south to north,
(v) the stream runs in a defined channel,
(vi) roomy entrance, to allow light entry,
(vii) reasonably bright as far as the stream.

To this may be added the likelihood that the cave be fairly low on the hillside. In this region all the streams are at the water table, thus any cave having an entrance high on a hill would be highly unlikely to permit light penetration to a stream deep within the cave. In other words, one would be looking for a roomy chamber as well as a roomy entrance, with the stream only a short distance inside the chamber.

Beyond the southern boundary of the National Park there is a swampy tract which runs south-eastwards for approximately two kilometres, taking in Mindarie Lake and Coogee Swamp. The valley is terminated at its southern end by an east-west group of hills., the highest being a prominent hill easily visible from the north. Bernard Road South runs alongside the northern flank of this hill, before swinging around the swamp, with Coogee Spring situated in a reedy hollow just below the northern side of the road as it descends to the swamp level.
On 22nd February I visited for the first time a cave situated just off the south side of Bernard Road South. The cave, known as the Doogarch Site, is registered as an Aboriginal Site. The location is within Reserve 24637.

The cave is well known to local residents, and contains a variety of litter. Its spacious, walk-in entrance opens to the northwest, allowing sunlight to shine in, especially in the morning. The main chamber opens up directly from the entrance area, permitting ample amounts of indirect light to reach most parts of the chamber. There is a short descent to a streamway at the base of the western wall of the chamber. A second, smaller chamber can be entered from the southern side of the main chamber. This chamber, which is much darker, also descents to the steam channel in two places. At the time of visiting it the stream was dry, as are most of the underground streams in the area, due to record low levels. However, there is ample evidence in the form of solution carved rocks, to indicate that at normal flow this would be a substantial stream, up to a metre deep in spots.

I checked the trend of the stream, finding that it runs approximately south to north, winding between north-east and northwest. Since there was no water at present, I was able to crawl along the stream bed, and found that it runs from the main chamber in a north-westerly direction, directly towards the Coogee Spring. It was clear that this would be the normal direction of flow of the stream. Solution markings in the portion of the stream that runs through the main chamber show that at normal flow it would run in a defined channel. (By contrast, many Yanchep cave streams are broad and shallow, with an ill-defined margin that disappears under cave walls).

REMARKS

When it comes to details, each cave is unique. A description of one cave would never be matched by another. In my experience of trying to match a cave to the original explorer's description, I have found that a cave either fits beautifully, or is 'miles out'.

This particular cave fits Grey's cave description at every point. It fits with respect to its geographic setting and internal features. It is not necessary here to reiterate the points previously listed, as it is clear that each of them matches up perfectly. Furthermore it is noteworthy that the cave is also an Aboriginal Site. The number of caves actually visited by the Nyoongah folk was very limited, due to their well known fear of dark places. Thus, any caves which were bright enough to not frighten them away would be few and far between. I have carefully assessed all other stream caves in the region, and am sure that the only other stream cave likely to have been frequented would be Whites Grotto - which, however, runs the wrong way as well as being in the wrong geographic setting.

I conclude therefore, that this cave on Reserve 24637 is, as well as being an Aboriginal Site, the first cave to have been visited by a white man in W.A. It is thus of great cultural and historic importance.

As regards the 'Doorda Mya' mentioned by Grey, I consider that he did not visit this spot, but was simply told about it. The feature is in Boomerang Gorge at Yanchep, and was visited later by Septimus Roe, in 1841. Had Grey gone to this feature it would have been a considerable detour, of which he makes no mention. Furthermore, the Gorge itself is such a distinctive feature that Grey could not have failed to include a brief description of it, had he actually seen it.

Lex Bastian

REFERENCES

Downey, J. 1958. *History of Yanchep*. Claremont Teachers College paper.

Elliot, I. 1977. *Yanchep Caves*. W.A. Historical Society paper.

Grey, G. —. *Expeditions in Western Australia, 1837-1839*. Facsimile Edition, 1983; Hesperian Press.
(The above can be viewed at the Battye Library)

Report on Caves on Reserve 24637
(on Mining Reserve 24637)

The Caves of Bernard Rd

Introduction

Following information from members of the Coogee Springs Area Resident Environmentalists (CARE) members of the Western Australian Speleological Group (Inc) (WASG) examined the proposed quarry site on Bernard Rd, Carabooda. Prior to the contact by members of the CARE group the WASG was not aware of the proposed quarry. Examination of our records indicated that no caves had been previously recorded at this site by WASG members despite the recording of over 400 karst features in the Yanchep area.

Permission to enter the proposed quarry site was sought from the lease holder of reserve 24637, Swan Portland Cement (SPC). This was forthcoming on the proviso that the information obtained was forwarded to SPC (A copy of this report was forwarded to SPC). Fifteen members of the WASG visited the site on Sunday 26 February 1995. The private property section of the proposed lease is owned by Earnie Gibb. Mr Gibb was approached for permission to explore for caves on his property. Permission was declined and this proposed quarry area has not been examined for caves.

Geology and Geomorphology of Yanchep

East of Yanchep area is a vast area of sandplain at the base of the Darling Fault Scarp. This area serves as a catchment for the Gnangara water mound, a feature of great importance in the future of Perth's water supply. The slope of this mound increases in the area of the Yanchep caves and the water moves mainly as streams down this gradient. The numerous enclosed water-logged depressions and lakes within the karst no doubt play a role in recharging karst water and may themselves be the result of a series of cavern collapses and stream diversions. Springs have been seen in the sea west of Yanchep.

History

The recent history of the Doogarch Site is published by Bastian 1995. This site is clearly of significance to both aboriginal people as well as being the first cave recorded in West Australia's European history. Documentation is currently being prepared for listing of this site with the Australian Heritage Commission as a historical site.

Caves discovered on Reserve 24637

The following caves were discovered on mining reserve 24637:-

Yn 428. Doogarch Cave. This cave has been registered as an aboriginal site with the WA Museum. This cave is a very historical site having been shown to Sir George Grey in 1838 by local aboriginals. (see Bastian 1995)

Yn 429 Gidgee Karipa (Spear Cave). This shallow cave contains the remains of a turtle which had fallen into the cave. The shaft of an aboriginal spear was discovered in the rockpile at the bottom of the cave. A chamber in the cave contains considerable cave decoration. Bone material was discovered in the cave.

Yn 430 Hidden Cave. This large chamber (30m long x 1.5m high x 20m wide) contains considerable coloured decoration. Areas of decoration within the cave were active when the cave was visited on 26/02/95.

Yn 431. Small cave 1m from the edge of Bernard Rd. This cave is still being formed by the water run-off from the road. The cave is formed in a rift which drops vertically to 4m deep.

Yn 432. A small entrance about 0.75m diameter leads to a small cave leading in the direction of the Coogee Springs. Not fully explored.

Yn 433. A collapse entrance 8m long x 1.5m high leads to a potential cave. This entrance was not entered - cave unexplored.

Yn 434. Solution pipe 0.75m in diameter. Pipe too tight to enter. May be enterable by enlarging the hole. No draught noticed.

Yn 435. Large slot at top of the hill. Slot is approximately 60m long by 0.5m wide. May lead to cave - at pre sent unexplored.

Hydrology

The currently dry Coogee Springs is a major resurgence for the limestone hill to its south. It is clear that all of the caves and karst features discovered are related to the underground stream that feeds the spring. Only Doogarch Cave (Yn 428) shows evidence of an underground stream when the spring is active. The other caves are classic inclined fissure caves developed by collapse onto the underground streamway. As is typical of this type of cave they do not extend to the currently developing stream passage. However the existence of the caves clearly indicates the presence of the underground stream.

Speleothems (Cave formations)

The three major caves located on the proposed quarry site all contain areas of significant speleothem development. Hidden Cave (Yn 430) in particular contains an excellent area of mainly dry, orange formations that are likely to become fully active during the winter. The speleothems include stalactites, stalagmites, straws, columns, shawls, flowstone, rimstone pools, moonmilk, and helictites.

Palaeontology and Archaeology

Yn 428 Doogarch Cave

Canis familiaris (Dog)
Much of a dog skeleton was located near the entrance. Unfortunately the jaws and skull are missing.

Antechinus flavipes leucogaster (Yellow-footed Antechinus)
Three jaws were found in a pocket of flowstone near the entrance.

Notomys(?) (hopping mouse)
A jaw was found in association with Antechinus material.

Chelodina oblonga (Western Long-necked Turtle) skull from Doogarch Cave, Carrabooda, WA
Lindsay Hatcher

Chelodina oblonga (Western Long-necked Turtle)
A female long-necked turtle skeleton with eggs was located and collected by Lindsay Hatcher from the phreatic base of the cave.

Yn 429 Gidgee Karipa (Spear Cave)

Chelodina oblonga (Western Long-necked Turtle)
One was identified resting in a small crevice at the bottom of the cave.

A spear shaft (which is possibly aboriginal in origin) was recovered. It was found resting amongst broken limestone boulders at the bottom of the cave. It has been lodged with the WA Museum.

Yn 430 Hidden Cave

Bettongia lesueur (Burrowing Bettong)
A skull was collected by Brian Vine (and will subsequently be lodged with the Western Australian Museum). The Burrowing Bettong is now extinct throughout mainland Australia, with remnant populations surviving on islands off the Western Australian coast.

Oryctolagus cuniculus (Rabbit)
Skull and jaw were noted.

Canis familiaris dingo (Dingo)
Skull, jaw and some post-cranial material appear to have been washed into an inaccessible fissure deep within the cave.

Trichosurus vulpecula (Common Brushtail Possum)
A skull was found resting on a sandy wash-out near the eastern wall.

Macropus fuliginosus (Western Grey Kangaroo)
Much of the post-cranial material is lying on the floor in the centre of the cave.

Generally, the material located is recent. The *Bettongia lesueur* and aboriginal spear shaft are significant finds. The *Chelodina oblonga* is an unusual occurrence within caves. All of the bone material should be removed if mining is to occur in this area. The removed material should be lodged with the Western Australian Museum.

Cave Biology

Two biospeleologists examined the three major caves for cave life. The results of these examinations are shown below:-

SPECIMENS FOR W.A. MUSEUM - Collector: Rob Foulds [License SF 1435]

RF.434 DOOGARCH CAVE [YN.428]
CARABOODA DISTRICT 26TH.FEB., 1995
1 tiny web spider Body Length = 3mm 10-05am. Abdomen dark under and translucent white on top. Very hairy. Prominent spinnerets. 2 humps on abdomen just behind pedicel. Small dark cephalo-thorax thickly covered with hair.

Leg pair I is longest. Very hairy legs. Apparently a Uloborid. Taken from web of largely horizontal strands at the edge of the daylight zone on the South side of the entrance. 1 of 5 similar spiders seen in the same edge habitat. Some 10+ Theridiids on webs nearby. 1 very large female [B.L.24mm] L. hasselti nearby on web with 3 egg sacs, in shaded daylight zone. Many chironomid midge seen in the entrance chamber. Some isopods on the floor of the entrance chamber under the rock-pile. Rotting roots and vegetable matter close by. Many "lacey" webs among rocks on the floor - possibly belonging to Baiami spp.

OUTSIDE TEMP. = 24deg.C. RH= 52%
INSIDE CAVE [STREAMBED] TEMP. = 19deg.C. RH=91%
INTERMITTENT STRONG AND AUDIBLE BREEZE OUT OF THE CAVE. CAVE HAS ATTACHED IDENTIFIER

RF.435 [YN.428] DOOGARCH CAVE
CARABOODA DISTRICT 26 Feb.,1995
1 small cockroach Body Length = 15mm Red/Brown top to segmented body. Yellow underneath body and yellow legs. Legs get progressively larger from head to rear. Spikes on leg segments. Large eyes. Antennae just slightly longer than the body. 2 large spiracles at the rear. Order Blattodea.
Taken from sand floor. In DARK ZONE. 1 of 4 seen in sandy crawl to South of dry streambed. Small amounts of vegetation detritus near. 40+ collembolla on moonmilk on roof here.
5 more isopods seen on ledge among vegetable detritus in the internal rift past the streambed and 15m in from the entrance.
2 tiny translucent spiders [poss. troglobitic] seen here on horizontal strand webs suspended between rocks in the breezeways. Both showed no reaction to light but when breathed upon, successfully exhibited escape behaviour. Also 1 small Theridiid seen above the dry streambed on a web of many apparently 'messy' strands. Web in breezeway of this south section.

OUTSIDE TEMP. = 24deg.C. RH= 52%
INSIDE CAVE [STREAMBED] TEMP. = 19deg.C. RH=91%
INTERMITTENT STRONG AND AUDIBLE BREEZE OUT OF THE CAVE. CAVE HAS ATTACHED IDENTIFIER

RF.436 [YN.428] DOOGARCH CAVE
CARABOODA AREA 26th.FEB.,1995
1 Small Isopod Body Length : 4mm
White body, small stumpy antennae and larger jointed antennae. Dark "gutstain" towards the rear. 7 pairs walking legs on forward body segments. 2 pairs pushing legs on rear segments. Apparently very small eyes. Isopoda : Oniscoidea
Taken from floor of entrance chamber under rockpile near tree root. DARK ZONE. Bones of frog and tortoise shell found near. Dog skeleton in gour pool above this. Chironomid midge in entrance chamber.

OUTSIDE TEMP. = 24deg.C. RH= 52%
INSIDE CAVE [STREAMBED] TEMP. = 19deg.C. RH=91%
INTERMITTENT STRONG AND AUDIBLE BREEZE OUT OF THE CAVE. CAVE HAS ATTACHED IDENTIFIER

RF.437 DOOGARCH CAVE [YN.428]
CARABOODA AREA 26th. FEB.,1995
2 Insects [Collembolla] BL 3mm pm
Dark yellow body with 6 legs grouped below head. Long extended fercula, taken from moonmilk on roof of dry streamway 12m into the cave at the edge of the dark zone.

OUTSIDE TEMP. = 24deg.C. RH= 52%
INSIDE CAVE [STREAMBED] TEMP. = 19deg.C. RH=91%
INTERMITTENT STRONG AND AUDIBLE BREEZE OUT OF THE CAVE. CAVE HAS ATTACHED IDENTIFIER

RF.440 DOOGARCH CAVE [YN.428]
CARABOODA DISTRICT 11 March, 1995
1 small spider Body Length: 6mm 1-30pm. Dark sternum. Pale abdomen. Dark markings like 2 inverted "v"'s on the sides of the abdomen. Legs I & IV longest. Legs II & III shortest. Leg pair I almost translucent. All legs banded in colour. Small cephalo-thorax and small palps. Prominent spinnerets. Presumed Theridiidae. Some few Chironomid midge in entrance chamber. No collembola seen on streambed roof. Only 1 small translucent yellow spider [poss. troglobitic] seen in breezeway. This spider hid among the breakdown pile when it detected our breath. It was on a single horizontal strand web. 1 dark winged moth [BL 16mm] on the roof of the entrance chamber about 6m into the cave in the twilight zone.

NO TEMPERATURE OR HUMIDITY DATA MEASURED ON THIS TRIP. INTERMITTENT AND AUDIBLE BREEZE OUT OF THE CAVE.

All temperature and humidity measurements made with "Brannan" whirling hygrometer, and all specimens preserved in 70% ethyl alcohol.

Cave Surveys

An above ground survey was undertaken which located the caves and karst features reported below.

The underground survey of Doogarch Cave was commenced but not completed on the 26th February 1995. A survey of Hidden Cave is yet to be completed.

Conclusions

A significant number of caves and karst features were found associated with the Coogee Springs at the northern end of the proposed limestone quarry. It is clear that any attempt to mine the limestone hill containing these caves is likely to have a deleterious effect on the underground stream as well as the cave sites.

Furthermore the eastern side of the hill (the private property belonging to Mr Gibb) has not been examined at all and may contain further significant caves.

It is our considered opinion that the integrity of the hill should be maintained and no mining should be undertaken. If this were the case then we believe that Swan Portland Cement should forgo the mining lease they currently hold but they should be compensated with an alternative lease in non-cavernous limestone elsewhere.

Rob Foulds
Lindsay Hatcher
Rauleigh Webb

References

Bastian, L. (1995). What Did George Grey Discover? *The Western Caver* V35 p41-43

PHASCOLARCTOS (MARSUPIALIA, VOMBATOIDEA) AND AN ASSOCIATED FOSSIL FAUNA FROM KOALA CAVE NEAR YANCHEP, WESTERN AUSTRALIA

M. ARCHER

Western Australian Museum, Perth, W.A.

Abstract

A recently discovered fossil fauna from Koala Cave (Yn 118), Yanchep, Western Australia, contains the marsupials Sthenurus brownei, Potorous platyops, Phascolarctos sp., Perameles sp., Vombatus sp., and a large snake. The fauna is in some respects comparable with the Mammoth Cave and Labyrinth Cave faunas of the Cape Leeuwin-Cape Naturaliste region.

Introduction

In 1971, Mr. S.B. Bennett showed Mr. P.J. Bridge, Mr. and Mrs. B.G. Muir, Mrs. S.J. Hallam and the author a series of caves he had discovered in "Coastal Limestone" near Yanchep, about 48 km north of Perth. One of these, now known as Koala Cave (Yn 118), drew attention when Mr. Bridge discovered a dentary of Sthenurus brownei (Western Australian Museum fossil vertebrate specimen 72.1.1139) in a deposit of loose reddish sand well within the cave. Later, Mr. Bridge, Mr. G.W. Kendrick, Mrs. E. Archer and the author returned to the cave to obtain a small sample of the fauna for preliminary analysis. Dr. D. Merrilees and Messrs. Bennett and A. Baynes returned on two further occasions to recover more of the material. The entire collection has been lodged in the Western Australian Museum.

The Nature of the Deposit

The Phascolarctos-bearing deposit in Koala Cave consists of a loose reddish quartz sand which is locally lithified. Some of the lithified parts of the deposit adhere to the roof of the cave. This deposit contains bones, limestone fragments, snail shells, charcoal, and root structures of the sort referred to as dikaka (Glennie and Evamy, 1968). The fauna reported in this paper was collected from the unconsolidated parts of this deposit on the cave floor (Figure 1).

In addition to the Phascolarctos-bearing deposit, there are at least two other sorts of clastic deposits visible in Koala Cave. The first is a strongly lithified, perhaps intraformational, breccia. It contains no visible bones, charcoal or other non-limestone clasts. It forms at least part of the ceiling to which the lithified parts of the Phascolarctos-bearing

deposit adhere. The other sort of clastic deposit is an unconsolidated dark sediment which contains some bones and charcoal. This darker deposit covers much of the floor of Koala Cave. Associated with all three clastic deposits are flowstones, dripstones or moonmilk, some of which probably represent episodes of carbonate deposition by vadose waters (Jennings, 1971).

Downslope and northwest of the accumulation of the Phascolarctos-bearing deposit is a depression in the cave floor. Sediments are slowly filtering down through a hole at this point into what may be spaces in underlying limestone rubble. The reddish Phascolarctos-bearing sediments and the darker unconsolidated sediments are both contributing material into this area. A small collection of bones including a premolar of Sthenurus brownei(W.A.M. 72.1.1146) was retrieved from sediments removed from the hole. However, because of the mixed origin of the sediments, the material recovered is not discussed in this paper.

Interpreted History of the Koala Cave and its Deposits

Koala Cave is a curved fissure trending approximately northeast by southwest. It is probable that the cave resulted from a collapse producing an inclined fissure of the sort discussed by Bastian (1964). When collapse or subsidence occurs over a weak area, such as an underground cavity, lateral fissures may form. Brain (1958) describes such a process for the development of certain caves of the Transvaal such as Swartkrans Cave. If collapse were to open these fissures to the outside they would receive detritus from the surface. Depending on the size of openings to the surface, the material accumulated in the fissures would consist of varying proportions of externally and internally derived debris.

Because the strongly lithified breccia of Koala Cave contains no bones or charcoal, it probably developed either as the cave formed by collapse (Jennings, 1968), or later after the cave had formed but before it had opened to the surface. The Phascolarctos-bearing deposit appears to have been a wedge-shaped deposit developed in a fissure in the therefore older, strongly-lithified breccia (Figure 2). From the shape of the ceiling and floor, it may be concluded that the bottom of this fissure collapsed, bringing down with it the unconsolidated part of the Phascolarctos-bearing deposit but leaving the lithified parts adhering to the ceiling, which is the top of the original fissure (Figure 3). Sometime after this collapse, the more recent darker unconsolidated sediments accumulated in the cave.

The Fauna

The fossil material was identified as follows (numbers are Western Australian Museum catalogue numbers). The taxonomy is that used by Ride (1970).

Mammalia

Marsupialia

Dasyuridae

phascogaline, indet.(72.1.1129)

Peramelidae

Perameles sp. (72.1.1130)

Isoodon obesulus (72.1.1131)

Tarsipedidae

Tarsipes sp. (72.1.1132)

Phascolarctidae

Phascolarctos sp. (72.1.1133)

Vombatidae

Vombatus sp. (72.1.1140)

Macropodidae

Potorous platyops (72.1.1134)

Bettongia penicillata (72.1.1135)

Macropus eugenii (72.1.1137)

M. irma (72.1.1141)

M. cf. M. fuliginosus (72.1.1138)

Setonix brachyurus (72.1.1136)

Sthenurus brownei (72.1.1139)

Muridae

Pseudomys shortridgei (72.1.1147)

P. occidentalis (72.1.1142)

Notomys sp. (72.1.1143)

Reptilia

a large snake, ? boid (72.1.1145)

a lizard (indet.) (72.1.1144)

Mollusca

Bothriembryon bulla (72.110)

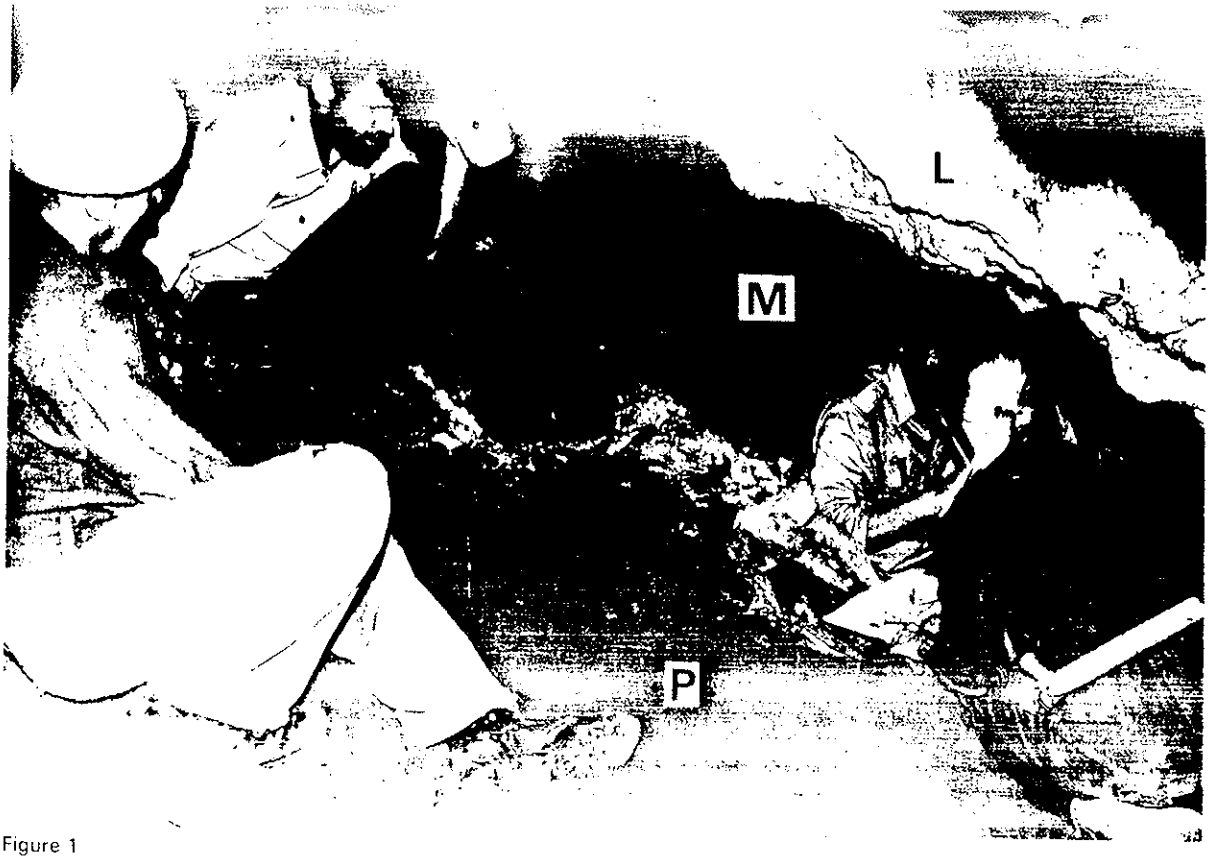


Figure 1

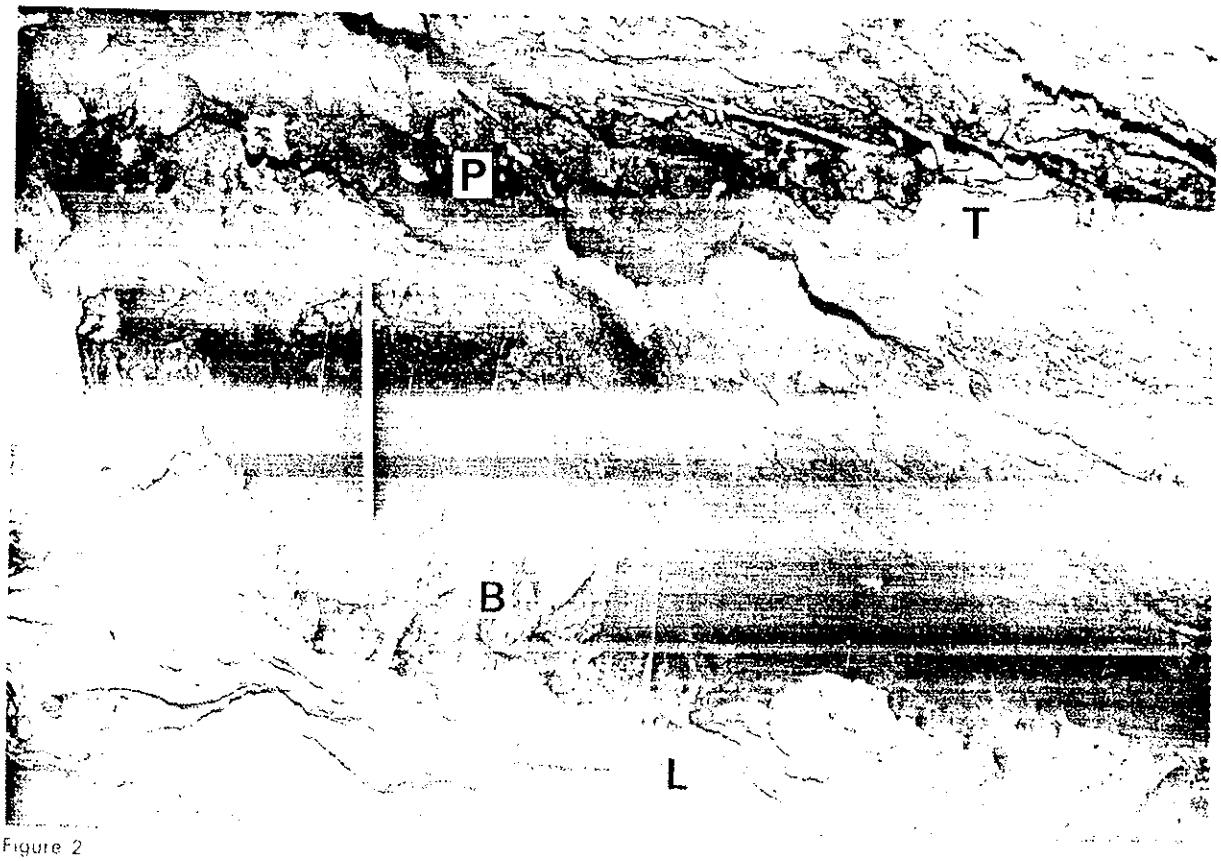


Figure 2

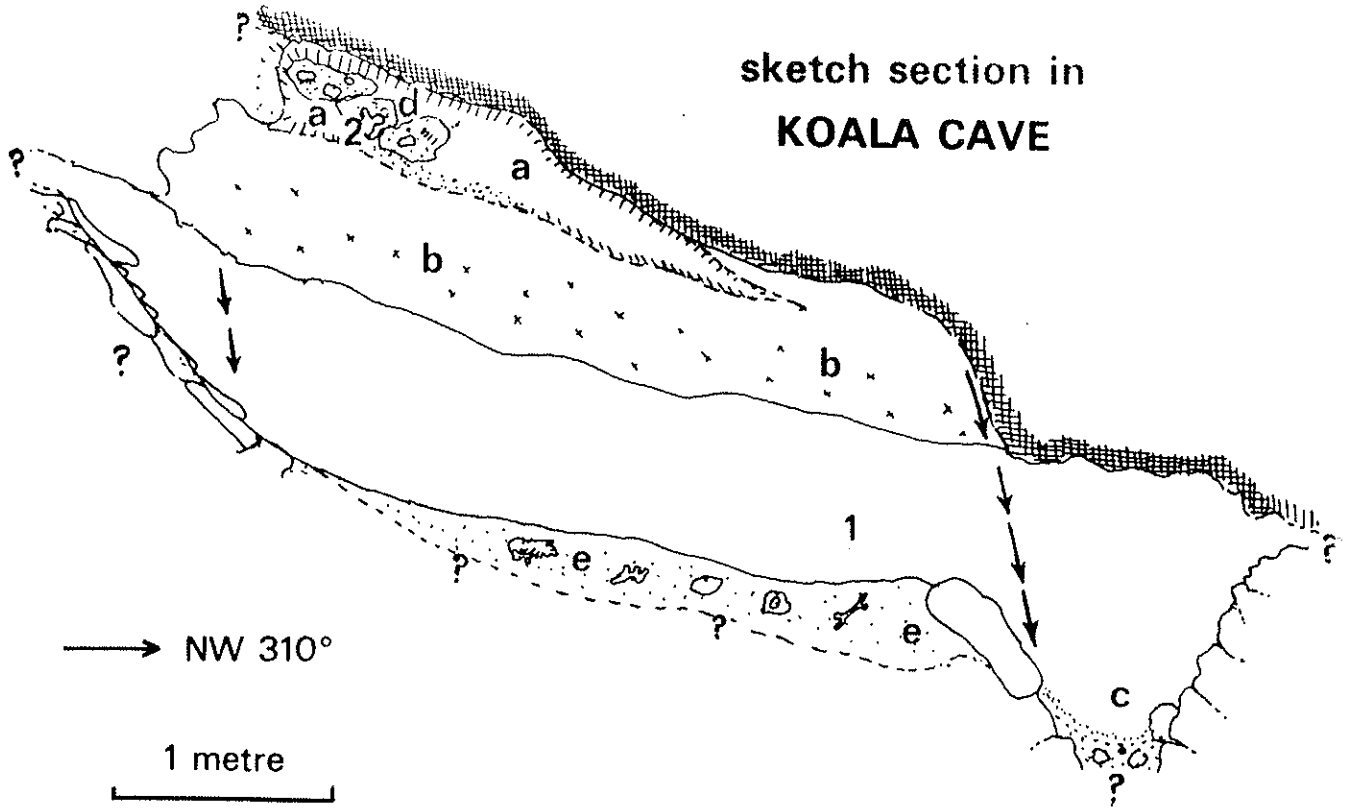


Figure 3

Figure 1. Discovering the Phascolarctos-bearing deposit in Koala Cave. The foot in the centre foreground rests on unconsolidated Phascolarctos-bearing deposit (P). The limestone (L) in the upper right is the inclined ceiling of Koala Cave. The dark sediment (M) in the distance is the relatively more modern unconsolidated deposit. Photo by B. Muir

Figure 2. Remnant of the Phascolarctos-bearing deposit in the original fissure. The rule has 30 cm of tape exposed. The base of the rule rests on the bottom (B) of the original fissure. The limestone (L) below that is the ceiling of Koala Cave. The extended tip of the rule points to consolidated remnants of Phascolarctos-bearing deposit (P) which adhere to the top (T) of the original fissure. Photo by B. Muir

Figure 3. A sketch section through the Phascolarctos-bearing deposit. Centre of figure 1 (1), centre of figure 2 (2), original fissure (a), sheared limestone face (b), funnel (c), consolidated Phascolarctos-bearing deposit (d), unconsolidated Phascolarctos-bearing deposit (e). The arrows indicate the probable direction in which the limestone block fell that exposed the Phascolarctos-bearing deposit. Section interpreted from a sketch by P.J. Bridge.

Discussion

The following seven species in the fauna are of particular interest.

Perameles sp.

Ride (1970) states that Perameles bougainville is only common in Western Australia as a living animal on Bernier and Dorre Islands in Shark Bay, but various fossil occurrences, some of which appear to represent late Recent times, are known (Merrilees, 1968). It occurs in Recent cave deposits from the Moore River-Dongara region to the Cape Leeuwin-Cape Naturaliste region (Lundelius, 1960; Dortch and Merrilees, 1972).

Vombatus sp.

No species of Vombatus is recorded living in Western Australia (Ride, 1970) but three fossil occurrences are known (Merrilees, 1968, 1969). Only two of these fossil occurrences are radiometrically dated and these dates exceed 25,000 radiocarbon years B.P. (Merrilees, 1968).

Phascolarctos sp.

No records of living Phascolarctos are known from Western Australia (Ride, 1970). Fossil occurrences have been reported previously from three Western Australian deposits (Merrilees, 1968, 1969). Only one of these deposits is dated and the date exceeds 31,000 radiocarbon years B.P. (Merrilees, 1968). It is interesting to note that Phascolarctos cinereus has been successfully maintained by man (Ride, 1970) in Yanchep Park within historic times as a tourist attraction.

Tarsipes sp.

The Koala Cave specimen representing this species is a fragment of a pelvis. The record is of interest because Tarsipes has never previously been recorded as a fossil. This is probably in part due to its small size and the fact that its very rudimentary teeth would almost certainly pass through any sieve used to recover bone materials from cave deposits. Vose (1972) mentions that Tarsipes spencerae has been collected live from Yanchep Park.

Sthenurus brownei

All species of Sthenurus are extinct. Three fossil occurrences of S. brownei are known in Western Australia (Merrilees, 1967, 1968). The only deposit which is dated exceeds 31,000 radiocarbon years B.P. (Merrilees, 1968).

Potorous platyops

Ride (1970) records this species as rare, noting that it has not been

collected live for almost a century. It may be extinct. Butler and Merrilees (1971) have reviewed knowledge about the known Quaternary distribution of the species. The species has not previously been recorded from the Perth Basin farther south than the Moore River-Dongara region. The Koala Cave specimens represent a south coastal range extension for the species.

The large snake, possibly a boid

The only recorded large fossil snake, probably a species of Python from the southwest of Western Australia is from Mammoth Cave (Merrilees, 1968). Several vertebrae from Koala Cave represent a large snake and are very similar to specimens from Mammoth Cave (e.g., 66.5.1).

All of the other mammal species recorded here from the Koala Cave fauna have been recorded as living within historic times near the Perth or the Swan River area (Shortridge, 1910; Glauert, 1950; Bannister, 1969; Ride, 1970) except Pseudomys shortridgei, P. occidentalis and Notomys sp. P. shortridgei and P. occidentalis have been reported to occur in cave faunas in or near the Yanchep area (Lundelius, 1957). Two species of Notomys were collected live in historic time from or near New Norcia, Western Australia (Ride, 1970). This is the closest modern locality record to Yanchep for species of the genus Notomys. A species of the genus has been recorded by Dortch and Merrilees (1972) from Devil's Lair in the Cape Leeuwin-Cape Naturaliste region and by Lundelius (1960) from Wedge's Cave, about 80 kilometres north of Yanchep.

Considered as a whole, the Koala Cave fauna is best compared with those of Labyrinth and Mammoth Caves. A preliminary note on the Labyrinth Cave fauna has been given by Merrilees (1969), and the most recent review of the Mammoth Cave fauna is that of Merrilees (1968). These faunas are compared in Table 1.

The Mammoth Cave specimens were recovered from a much greater bulk of deposit than were those of Labyrinth and Koala Caves. For this reason the absence of certain species such as Thylacoleo sp., Thylacinus cynocephalus, Sthenurus occidentalis, Protemnodon sp. and others from the Koala and/or Labyrinth Cave deposits may be due to sampling accidents. On the other hand, the absence of certain species from the Mammoth Cave fauna such as Potorous platyops, Bettongia penicillata (see Merrilees, 1968, for comments about the specimens of this species from Mammoth Cave) and Notomys sp. which are represented in the Koala Cave deposit is probably significant. Merrilees (1968) suggested that Bettongia penicillata entered the Cape Leeuwin-Cape Naturaliste region after the time of accumulation of the Phascolarctos-bearing deposit in Mammoth Cave deposit. Ride (1970) and Butler and Merrilees (1971) state that Potorous platyops is not known to have occurred in Quaternary times in the Cape Leeuwin-Cape Naturaliste area. The significance of the absence of Notomys from the Mammoth Cave deposit is not clear, partly because there are relatively few murids in the Western Australian

TABLE 1

A COMPARISON OF VERTEBRATE SPECIES RECORDED BY MERRILEES (1968, 1969) FROM THE MAMMOTH AND LABYRINTH CAVE DEPOSITS WITH THOSE FROM THE KOALA CAVE DEPOSIT

Marsupials	Koala Cave	Labyrinth Cave*	Mammoth Cave
small dasyurid(s)	X	-	X
Dasyurus sp.	-	-	X
Sarcophilus harrisii	-	X	X
Thylacinus cynocephalus	-	-	X
Isoodon obesulus	X	X	X
Perameles sp.	X	-	X
Trichosurus vulpecula	-	-	X
Pseudocheirus peregrinus	-	-	X
Thylacoleo sp.	-	X	X
Phascolarctos sp.	X	X	X
Vombatus sp.	X	X	X
Potorous platyops	X	-	-
P. tridactylus	-	-	X
Bettongia penicillata	X	?	.
Setonix brachyurus	X	-	X
Protemnodon sp.	-	-	X
Wallabia bicolor	-	-	X
Macropus irma	X	-	X
M. eugenii	X	-	X
M. fuliginosus	X	-	X
Sthenurus occidentalis	-	-	X
S. brownei	X	X	X
Zygomaturus trilobus	.	-	X
Tarsipes sp.	X	-	-
Non-Marsupials			
monotremes	-	X	X
Notomys sp.	X	-	-
other murids	X	-	X
bat	-	-	X
bird	-	X	X
large snake	X	-	X
lizard	X	-	-

* species list modified, after Merrilees (1968, 1969).

Museum collections from Mammoth Cave, and partly because these specimens have not yet been examined in detail. It is possible, considering the modern distribution of Notomys species, that the absence of Notomys from the Mammoth Cave deposit reflects an unsuitable environment for this species in the area of Mammoth Cave at the time of accumulation of the Mammoth Cave deposit. The absence of Tarsipes sp. in the Mammoth Cave fauna is not surprising for reasons noted above.

Conclusion

The Koala Cave (Yn 118) fauna contains several poorly known species, some of which may be extinct in Western Australia. Most of these species are present in a similar fauna known from Mammoth Cave. The significance of differences between the two faunas remains to be clarified. A comparison between these faunas as well as those of Labyrinth and Strong's Cave will give a clearer picture of late Pleistocene mammal species and distributions in south-western Australia.

Acknowledgments

The author would like to thank Mr. S. Bennett for initially showing him the cave, and Mr. Bennett and Dr. D. Merrilees, Mr. P.J. Bridge, Mr. G.W. Kendrick, Mr. A. Baynes, Mr. and Mrs. B. Muir, Mrs. S.J. Hallam, and Mrs. M. Archer for help in making initial collections and for stimulating comments. Messrs. Baynes and Kendrick kindly identified respectively the murid and molluscan material. Dr. Merrilees and Mr. Kendrick kindly read and criticised the text of the paper. Mr. Bridge made the diagrams on which Figure 3 is based. The author was supported during the time spent on this project by an Australian Research Grants Committee award to Dr. W.D.L. Ride (Director, Western Australian Museum). General information was obtained about the Quaternary distribution of Western Australian mammals while the author was supported by a Fulbright Scholarship from the Australian American Educational Foundation, and subsequently by a grant from the Explorers Club.

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YANCHEP AREA

ADDITIONS TO THE YANCHEP CAVE LIST - 1994 / 1995

This list covers the period June 1994 to the end of May 1995. LVB's contribution was done on behalf of CALM, until November 1994 in the employ of the Chemistry Centre of WA., then as an early retiree (i.e. redundant). Other WASG members have made contributions.

Most of the caves/holes listed are inside the Yanchep National Park, those outside the Park being listed separately. No definite new discoveries were made, however some significant extensions to the previously accessed limits of a cave were made, and are mentioned in each case.

CAVES INSIDE YANCHEP NATIONAL PARK

YN422. Group of large open rifts on the ridge north of Carpark Cave. The biggest has a rift line of black arrows along it, of unknown date; but perhaps dating from when the nearby valley was used as a camping ground.

YN423. Collapse on ridge top north of YN422; open to the west, with vertical walls on the other sides, minor fissure chamber beneath the east wall.

YN424. Small inclined fissure cave adjacent to the Yaberoo-Budjara Trail, A second small chamber was accessed by LVB and Richard Wood on 25th November, and then pushed a little further, to a total depth of 9 metres; impenetrable beyond that point.

YN425. Large collapse area, on the hill south of the Old Yanchep Road. There is a line of semi-lit chanters along the southern edge of the collapse.

YN426. Small inclined fissure chamber close to YN8O. The fissure is fairly steep, to a depth of approximately 5 metres.

YN436. Small cave north of Census Cave, located by Rob Foulds' party on 20th May. A steep descending section was opened up, and pushed down to a bottom level with 12m of stream way.

YN439. Proposed name: "Stanley Steamer". Large draughting solution pipe just south of the workshop area, which gives access to a cave with several small chambers and water in various corners. Two further chambers were entered via a water duck by LVB on 11th July 1995.

HOLES NOT YET PENETRATED, INSIDE YANCHEP NATIONAL PARK

YN427. Narrow steep fissure high on the hillside north of YN127; a possible chamber is partly visible down it.

YN437. Small breathing hole, in a hollow close to the southernmost of the four cottages opposite the workshop.

YN438. Small solution pipe with a good draught, on hillside above YN421. The pipe has been partially opened up, but is hard caprock.

Features Numbered Outside the National Park

The following caves and holes were assigned numbers following a check of the hill on the south side of Bernard Road South, to counter a quarry proposal which would have removed the upper part of the hill. LVB located the first one (YN428), the rest were then located by a WASG party.

YN428. Proposed name: "Doogarch Cave". This cave, which is an Aboriginal Site, has been identified as the cave first visited by Lt. George Grey on 6th December 1838. The cave, which is close to the road, has an entrance opening to the north, allowing light to penetrate into most corners of a roomy main chamber. The cave has a second chamber, and a stream way with solution carved rock; however, the stream is now dry due to the abnormally low water table. It contains same good decoration.

YN429. Proposed name: "Gidgee Karipa" (meaning: Spear Cave). Small cave on a northern spur of the hill. Turtle bones, and an aboriginal spear have been found in it.

YN430. Cave on the northern brow of the plateau top of the hill. The cave is an inclined fissure developed along a rift line, and contains some attractive small decoration. (The name "Hidden Cave" was coined, however this is misleading, as the entrance is not small or hidden to any extent.)

YN431. Small entrance beside the road; has a road sign in it.

YN432. Very small cave; heads towards Coogee Spring.

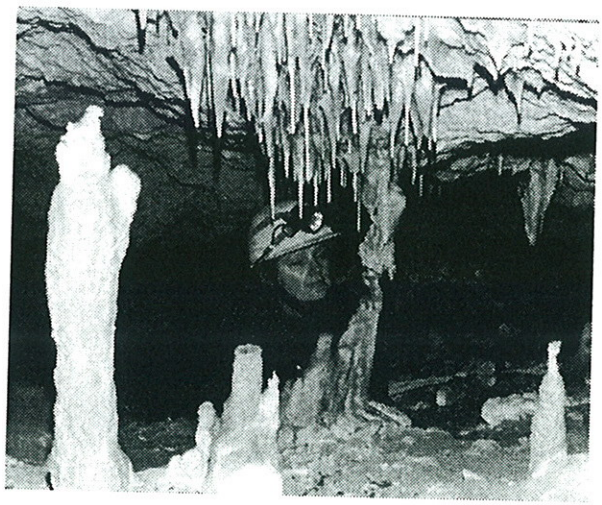
YN433. Collapse, uphill from YN431

YN434. Solution pipe west of YN430.

YN435. Slot near top of hill; unexplored as yet.

Postscript: Although there are probably not many more features yet unlocated inside the Yanchep National Park, there are undoubtedly many outside. So far the search has concentrated on features inside the Park, however since the YN cave area goes down to about 8 kilometres south of the Park, there is the potential to add probably upwards of 100 or even 200 to the list.

Lex Bastian



Kaye Armstrong in Hidden Cave, Bernard Rd, Carrabooda, WA.
Rauleigh Webb

Suggested name of area (1996)

Some Other Commonly used Names:
Subm 290 Carabooda (MfP Ref: 229)

Area (ha):

Local Authorities (Suburb)

Zoning
MRS: Rural
TPS:

Lot/Reserve numbers, Street name

Ownership Categories (Purpose)

LANDFORM AND SOIL

Geomorphology and soils
Spearwood Dunes
Sands derived from Tamala limestone (Qts: S7)
Tamala limestone (Qtl: LS2)

REGIONAL VEGETATION AND FLORA

Vegetation Complex
Spearwood Dunes
Cottesloe Complex - Central and South

Floristic Community Types: not sampled types inferred (*)
Supergroup 4 - Uplands centred on Spearwood and Quindalup Dunes
*24 Northern Spearwood shrublands and woodlands
*26b Woodlands and mallees on limestone
*28 Spearwood *B. attenuata* or *B. attenuata - Eucalyptus* woodlands

REGIONAL WETLANDS

No wetlands mapped

THREATENED COMMUNITIES

Not assessed

AREA DESCRIPTION

Landscape features:limestone ridge, tall dune, vegetated uplands
Vegetation and Flora
Structural units: (limited survey)
Eucalyptus gomphocephala Woodland over *Banksia attenuata, B. menziesii*.and *Allocasuarina fraseriana* Low Woodland; Shrublands to Closed Heaths dominated by, or combinations of, *Melaleuca huegellii, M. acerosa* and *Dryandra sessilis*.
Remnant Vegetation (canopy only):
Vegetation Condition: >90% Excellent to Very Good with<10% Good to Degraded
Total Flora: not known
DRF/Priority and significant flora: *Carpobrotus* sp. Hepburn (1) and a series of limestone endemic taxa.

Fauna
Mammals: not surveyed
Linkage: adjacent bushland to west (Subm 291) recognised, fragmented link to north (M3) available, east

Special Attributes:

INTERNATIONAL AND NATIONAL SIGNIFICANCE

Not listed

CONSERVATION RECOMMENDATIONS

Criteria met for inclusion: Representation of ecological communities, Diversity, Rarity, Maintaining ecological systems or natural processes, Scientific or evolutionary importance,
Constraints: Private land
Recommendation:

Subm No 176 & 270

We nominate the following areas for consideration in the System 6 Update. These areas include significant bushland and landscapes which warrant inclusion in a regional conservation network. The areas, shown on the attached maps, are noted below.

(a) • Moore River estuary and land to the south including Wilbinga and Caraban MPA. This covers vegetation and landforms of the Quindalup and Spearwood dunes and could be a large coastal conservation reserve forming a greenbelt north of the metropolitan region. It should link with Wabling MPA and Yeal Nature Reserve to form an east-west greenbelt across a number of soil and vegetation types on the coastal plain.

(b) • Bombing Range wetlands and Banksia woodlands north east of Pinjar, which includes RAAF Pearce Air Weapons Range and State Forest. Large, intact area of Banksia woodlands on Bassendean dunes with perched Paperbark damplands. Could form part of a major reserve network linking Yeal Nature Reserve and Melaleuca Park; the proposed Gnangara biological corridor. Situated on recharge area of the Gnangara groundwater mound.

✓(c) • Coastal bushland south of Yanchep townsite, in Yanchep/Eglinton. Quindalup dune vegetation that could link the coastal reserve and Yanchep National Park. An east-west belt of open space has been proposed in this area.

(d) • Limestone heathlands and Tuart-Banksia woodlands near Bernard Road, Carabooda. Cottesloe central and south complex vegetation in excellent to very good condition. Situated near Coogee Spring. Part of potential link between Yanchep National Park, western chain wetlands and Neerabup National Park. Historically important cave.

✓(e) • Remnant bushland between Yanchep and Neerabup National Parks; west of Wanneroo Road, north of Romeo Road. Includes Tuart, Jarrah and Banksia woodlands and limestone heathlands in excellent to very good condition. Forms a link between these conservation reserves. Limestone ridge is landscape feature.

✓(f) • Bushland between Wesco Road and Wattle Avenue including Shire View Hill. Diverse limestone heathlands including rare and uncommon mallee eucalypts (Yanchep Mallee, Rock Mallee and Fremantle Mallee). Limestone Marlock woodlands and merges to Marri-Banksia woodland. Number of vegetation types in very good condition. Carpet python seen near Shire View Hill, suggesting fauna habitat value. Includes high limestone ridges, important landscape feature.

(g) • Lake Neerabup and adjacent bushland. Linear sumpland including sedgelands; limestone ridge along eastern edge with Tuart and Cheesewood. Large, intact area of bushland to east including limestone heathlands and Tuart and Marri woodlands. Karst features include Orchestra Shell Cave; important Aboriginal heritage site. Adjacent Neerabup National Park and connects with Shire View Hill bushland.

✓(h) • Flynn Drive bushland, Neerabup. Large, intact remnant of Karrakatta central and south complex vegetation. Includes Banksia woodlands in pristine-excellent condition. Occurs between Neerabup National Park and eastern wetland chain and State Forest.

✓(i) • Coastal bushland north of Quinns Rocks. Vegetation in excellent to very good condition, associated with series of parabolic Quindalup dunes. Parrotbush heathland and Banksia woodlands on Cottesloe soils in swales. Recognised in North West Corridor environmental audit.

✓(j) • Coastal bushland between Burns Beach and Mindarie Keys. Significant Quindalup dune landforms and vegetation, includes cuspate foreland, parabolic dune and sandsheets. Addition of land north and south would consolidate existing System 6 area and add to vegetation types represented. Part of link between coast and Neerabup National Park. Recognised in several studies as an important area.

✓(k) • Jarrah-Banksia woodland north of Wanneroo Road works depot. Bushland in fair to good condition, with adjoining land west of Wanneroo Road it covers a transect of remnant vegetation from Lake Joondalup inland. Includes mature trees with hollows for birds, adds to bushland habitat in Yellagonga Regional Park.

S/N

BS 129

Carabooda 23 23/10/96

Limestone outcrop
burnt ≈ 4 yrs ago

Mel hueg (1.2m 10-30%)
previously to 2m over
(>70% <1m) Scaevola, Trym. alb, Mel ac, Ac lasio, Dry [illegible]
Acac rost, Grev preis
Cond Excellent - intact moss
Trachy pil., Parat deb, crav col

Land Dry sessil >70% to 1.5m, below 'ridge'

Tuart Woodland to Forest
Pink Pet slm
Hib hyp, Xanth prei, Alloca humil
lyme 30-70%

23/10/96

B. grand, Ac sal, Bank att
Grev vest Jack calcic
Ac pul, Petroph. long
Stip flav.
Dich crin,
Hard comp
COND Very Good
Local rubbish dumping tracks, Briz
Hak [illegible],

(Coogee Springs to N include also (see Jenny Arnold's book))

Ningana
Swale cleared, planted with 'eucalypts'

Duckpond List

FLORISTIC COMMUNITY TYPES - PERTH METROPOLITAN AREA (PMA)

All floristic community types (FCT) identified from the sites in the Perth Metropolitan Area are listed below.
Garden Island, Rottnest Island and the Wilbinga area are included at this stage. Floristic community types will be inferred from the distributions of the FCT's and geomorphic units for areas in which we have no sites that are considered by other processes to be significant (MfP, Submissions to System 6 Update etc).

Key

Floristic Community Types
FCT confined to PMA = #**FCT**
FCT principally confined to PMA = **FCT**

DRAFT Threatened Communities (CALM)
CR = Critically Endangered
EN -= Endangered
VU = Vulnerable

CR, EN & VU are boxed to indicate the categories considered as threatened.

Identified as Threatened or Poorly Plant Communities by the DEP, not included in the above

DD = Data deficient
NA = Not assessed

Major Geomorphic Systems on the Plain (see Figure 1)
DN = Dandaragan Plateau
RH = Ridge Hill Shelf (Foothills)
PP = Pinjarra Plain
BS = Bassendean Dunes
SS = Spearwood Dunes
LS = Tamala Limestone surfaces in Spearwood Dunes
QS = Quindalup Dunes

Areas
Listed from N to S in the PMA, areas in ***italics*** are considered the least suitable opportunities within the PMA for conservation of this FCT.

* = Floristic Community Type inferred

SUPERGROUP 1 - FOOTHILLS/PINJARRA PLAIN

1a NA *E. haematoxylon* - *E. marginata* woodlands on Whicher foothills

Single site in the PMA **Norman** (Norm 02 = DRF site), most northern occurence, disjunct

2 EN Southern wet shrublands

Predominantly southern, single occurrence in **M53** (M53 04 =*Bybylis*), most northern occurence, disjunct

3a CR *E. calophylla* - *Kingia australis* woodlands on heavy soils

Predominantly in the PMA, two occurences outside (Pinjarra 1, C53 SWaroona)
*Pearce1 Threatened &/or poorly res
*Pearce2 Threatened &/or poorly res

M53 (most N sites) missing 3

3b VU *E. calophylla - E. marginata* woodlands on sandy clay soils M80
M80 Ellis Brook Valley Reserve (most N) missing 5

3c CR *E. calophylla- Xanthorrhoea preissii* woodlands and shrublands
Pearce5 Threatened &/or poorly res (most N)
*Pearce3 Threatened &/or poorly res
M17 Ellen Brook Nature Reserve
Talbot Road Bushland, Shire of Swan
Mundijong Road Threatened &/or poorly res...

S8 NA *E. wandoo* Woodlands (Scarp)
*Pearce6 Threatened &/or poorly res
M15 Pearce Aerodrome (Pearce 03)
M21 Red Hill
M80 Ellis Brook Valley Reserve

SUPERGROUP 2: SEASONAL WETLANDS

4 NA *Melaleuca preissiana* damplands (BS, BS/PP)
Gnangara Water Reserve
M9 Melaleuca Park (many mined for marl)
Subm Ellenbrook Bushland
M13 Whiteman Park
Subm 178 Lightening Swamp, Noranda
M40 Dianella Open Space (small area)
M52 Perth Airport
Gosnells Area 34, Trudgen & Keighery (1995)
Gosnells Area 4, Trudgen & Keighery (1995)
Gosnells Area 6, Trudgen & Keighery (1995)
M95 Forrestdale Lake
M98 Reserve C31874 Casuarina
M99 Modong NR
M105 Lowlands property
Subm 220 Lot 399 Henderson Rd, west of Serpentine

5 NA Mixed shrub damplands (PP,BS; predominantly PMA)
Gnangara Water Reserve
M14 Bullsbrook NR
Lot 39 Great Northern Highway, Ellenbrook
M8 Lake Pinjar
Subm 116 Ellenbrook Bushland (Vines)
M52 Perth Airport
M105 Lowlands property
M93 Harry Waring Marsupial Reserve
M94 Jandakot Airport
Paganoni block

7 VU Herb rich saline shrublands in clay pans (PP, PMA central)
M14 Bullsbrook NR
*Pearce2 Threatened &/or poorly resM52 Perth Airport
Gosnells Area 33, Trudgen & Keighery (1995)
Prop. Yule Brook Nature Reserve
Punrack Rd Threatened /or poorly res..., Serpentine

8 VU Herb rich shrublands in clay pans (PP, PMA central)
M15 Pearce Aerodrome
*Pearce2 Threatened &/or poorly res
*Pearce3 Threatened &/or poorly res
*Pearce5 Threatened &/or poorly res
M17 Ellen Brook Nature Reserve
Gosnells Area 33, Trudgen & Keighery (1995)
M95 Forrestdale Lake
Prop. Yule Brook Nature Reserve
Mundijong Road Threatened &/or poorly res...

9 VU Dense shrublands on clay flats (PP, N most in PMA)
LG Brickwood Reserve (most N)
Mundijong Road Threatened &/or poorly res...

10a EN Shrublands on dry clay flats (PP, N in PMA)
M8 Lake Pinjar (most N, and only assoc Qts/Qpb)
Gosnells Area 33, Trudgen & Keighery (1995)
M69 Part Prop. Yule Brook Nature Reserve
M95 Forrestdale Lake
Punrack Rd Threatened /or poorly res..., Serpentine

11 NA Wet forests and woodlands (SS/BS, BS, PP; centred PMA)
M14 Bullsbrook NR
M17 Twin Swamps NR
M92 North Lake
M99 Modong NR
M93 Harry Waring Marsupial Reserve
M105 Lowlands property

12 NA *M. teretifolia* and / or *Astartea* aff. *fascicularis* shrublands (BS, most N)
M8 Lake Pinjar (most N)
M52 Perth Airport
M95 Forrestdale Lake

13 NA Deeper wetlands on heavy soils (PP?BS, PP; PMA central)
M100 Reserve C22167, south west of Byford
Paganoni block

14 DD Deeper wetlands on sandy soils (broad Qpb, Qpt)
M4 Ridges MPA
M5 Yeal NR

15 VU Forests and woodlands of deep seasonal wetlands (PP, PMA central)
M15 Pearce Aerodrome
M17 Twin Swamps NR
Subm 219 Yangedi Swamp Bushland

16 NA Highly saline seasonal wetlands (esturine/saltlakes, PMA south)
M61 Alfred Cove
M67 Canning River Foreshore, Salter Point to Clontarf
M91 Naval Base

17 NA ***M. rhaphiophylla* - *Gahnia trifida* seasonal wetlands** (OS, SS; mostly south Swan except for Guild)

M92 Mt Brown (effectively most N)
Paganoni block
M104 Leda
M103 Lake Cooloongup

18 VU Shrublands on calcareous silts
Subm Ellenbrook Bushland

#19a CR Sedgelands in Holocene dune swales (QS)
M102 Lake Richmond
M106 Port Kennedy

#19b NA Woodlands over sedgelands in Holocene dune swales (Qhs)
M3 Yanchep NP
M103 Lake Cooloongup

S1 NA ***Astartea* aff. *fascicularis/Melaleuca* species dense shrublands** (BS; Pinjar south)

M8 Lake Pinjar (N)
Subm 199 Caversham Airbase
Gosnells Area 34, Trudgen & Keighery (1995)
Subm 219 Yangedi Swamp Bushland

S2 NA northern *Pericalymma ellipticum* dense low shrublands (PP/BS, BS; mostly PMA)

M8 Lake Pinjar
M9 Melaleuca Park
Subm Ellenbrook Bushland
Subm 199 Caversham Airbase
Hartfield Park, Forrestfield, Threatenened &/or poorly res.(most S)

S3 NA Wet sedgelands on sandy clays (BS, BS/SS; Gosnells N, one outside PMA)

M8 Lake Pinjar
Subm Ellenbrook Bushland
M8 Lake Gnangara
Gosnells Area 6, Trudgen & Keighery (1995) (moost S)

S5 NA ***Acacia saligna* wetlands** (associated calcareous soils)
Subm Ellenbrook Bushland

S6 NA Northern dense low shrublands (Qpb/Qpa, DN; Ellenbrook N)
Subm Ellenbrook Bushland (most S)

S7 Northern woodlands to forests over tall sedgelands alongside permanent wetlands (SS, BS, PP, DN, mostly PMA)

M15 Pearce Aerodrome
M41 Bennett Brook
Subm 199 Caversham Airbase
M7 Lake Joondalup
M47 Bold Park
M61 Alfred Cove (most S)

S17 NA ***Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes** (BS, DN; mostly N PMA, S east Yalgorup)

Subm Ellenbrook Bushland
M8 Lake Pinjar

M13 Whiteman Park
M8 Lake Gnangara

SUPERGROUP 3: UPLANDS, CENTRED ON BASSENDEAN DUNES AND THE DANDARAGAN PLATEAU

20a EN *Banksia attenuata* woodlands over species rich dense shrublands
(SS, PP/RH; almost all PMA)
Koondoola Threatened &/or poorly res...
Landsdale Threatened &/or poorly res...
M12 Marangaroo
Subm 275 Maida Vale Reserve
Subm 284 Bushmead Rifle Range
Activ Threatened &/or poorly res...
Sultana Rd Threatened &/or poorly res...
Agriculture Protection Board, Forrestfield
M52 Perth Airport
M53 Reserve C29880 Forrestfield
Hartfield Park, Forrestfield, Threatenened &/or poorly res..

20b EN Eastern *Banksia attenuata* and / or *E. marginata* woodlands
(BS/PP/RH; PMA soth, predom. PMA, 2 areas outside)
M52 Perth Airport (most N)
Rushton Rd Threatened &/or poorly res...
LG Brickwood Reserve
*Connel 48
M83 Cardup NR
Norman Threatened &/or poorly res...
Lambkin Reserve, Serpentine

#20c CR Eastern shrublands and woodlands
(Qpa; entirely PMA)
Subm 284 Bushmead Rifle Range
Talbot Road Bushland, Shire of Swan

20d NA Dandaragan Plateau shrublands and woodlands
(RH, DN; single PMA)
M80 Ellis Brook Valley Reserve (atypical)

21a NA Central *Banksia attenuata* - *E. marginata* woodlands
(SS, BS; PMA mostly northern sites)
Gnangara Water Reserve (most N)
M5 Yeal NR
M8 Lake Pinjar
Subm Ellenbrook Bushland
Subm 199 Caversham Airbase
M105 Lowlands property
M83 Cardup NR
M93 Harry Waring Marsupial Reserve
M98 Reserve C31874 Casuarina
M95 Forrestdale Lake
M104 Leda
Paganoni block
Tamworth Hill

21c NA Low lying *Banksia attenuata* woodlands or shrublands (BS, PP; mostly PMA)

SF 65
Gnangara Water Reserve
M17 Twin Swamps NR
Subm Ellenbrook Bushland
M13 Whiteman Park
M69 Part Prop. Yule Brook Nature Reserve
M94 Jandakot Airport
M95 Forrestdale Lake
Subm 250 Denis de Young Reserve 33002
M99 Modong NR

22 NA *Banksia ilicifolia* woodlands (BS, DN; PMA central)

Gnangara Water Reserve
M8 Lake Pinjar
M4 Ridges MPA
M9 Melaleuca Park
Subm Ellenbrook Bushland
M13 Whiteman Park
M100 Reserve C22167, south west of Byford
M94 Jandakot Airport
Subm 250 Denis de Young Reserve 33002

#23a NA Central *Banksia attenuata - B. menziesii* woodlands (BS; ALL PMA)

SF 65
M14 Bullsbrook NR (most N)
M8 Lake Pinjar
M8 Lake Gnangara
M13 Whiteman Park
M40 Dianella Open Space
M52 Perth Airport
Hartfield Park, Forrestfield, Threatenened &/or poorly res..
Ken Hurst Park, Leeming
M69 Part Prop. Yule Brook Nature Reserve
Gosnells Area 4, Trudgen & Keighery (1995)
Gosnells Area 6, Trudgen & Keighery (1995)
M92 North Lake
M93 Harry Waring Marsupial Reserve
M94 Jandakot Airport
M97 Wandi NR
M98 Reserve C31874 Casuarina
M99 Modong NR
M100 Reserve C22167, south west of Byford
M105 Lowlands property
Subm 114 Crestwood Estate Bushland
Subm 178 Lightening Swamp, Noranda
Subm 195 Telecommunication networks, Dianella
Subm 212 Kensington Bushland
Subm 219 Yangedi Swamp Bushland
Subm 220 Lot 399 Henderson Rd, west of Serpentine
Subm 27 Gillon Street, Karawara
Subm 87 Annois Road, Bibra Lake

23b NA Northern *Banksia attenuata - B. menziesii* woodlands (BS, DN; PMA north from Ellenbrook Bushland)

Gnangara Water Reserve
M4 Ridges MPA
M5 Yeal NR
M9 Melaleuca Park
Subm Ellenbrook Bushland (most S)

23c NA North - Eastern *Banksia attenuata* - *B. menziesii* woodlands
(SS mostly outside PMA)
M3 Yanchep NP

S9 NA *Banksia attenuata* woodlands over dense low shrublands
(SS, DN mostly outside PMA)
Subm Ellenbrook Bushland (only BS, most S)

SUPERGROUP 4: UPLANDS CENTRED ON SPEARWOOD AND QUINDALUP DUNES

SPEARWOOD DUNES

24 NA Northern Spearwood shrublands and woodlands
(SS; mostly PMA, only one area outside, atypical)
M6 Neerabup NP
Subm 159 Hepburn Bushland Reserve
M35 Star Swamp
M36 Trigg Bushland Reserve
M47 Bold Park
M55 Buckland Hill
M93 Thompson Lake
M56 Foreshore Reserves, Mosman Park (Chidley Point)
M58 Blackwall Reach Foreshore
M91 Naval Base
M92 Mt Brown
M103 Lake Cooloongup (most S)

25 NA Southern *E. gomphocephala* - *Agonis flexuosa* woodlands
(SS: PMA most north then south)
M1 Two Rocks (most N)
M47 Bold Park
M7 Lake Joondalup
M104 Leda
Paganoni block

Subm 116 Ellenbrook Bushland (atypical)

26a ?NA *M. huegelii* - *M. acerosa* shrublands of limestone ridges
(LS/SS; major distrib PMA, series of disjunct areas)
M3 Yanchep NP
M4 Ridges MPA
Shire View Hill Threatened &/or poorly res...

26b ?NA Woodlands and mallees on limestone
(LS/SS; major distrib PMA, series of disjunct areas)
Wilbinga
M1 Two Rocks
M3 Yanchep NP
M4 Ridges MPA
Military Rd, W of Gingin
SF 65
Subm 159 Hepburn Bushland Reserve

27 NA Species poor mallees and shrublands on limestone
Wilbinga
M3 Yanchep NP
Shire View Hill Threatened &/or poorly res...
Burns Beach
M47 Bold Park

28 NA Spearwood *B. attenuata* or *B. attenuata* - *Eucalyptus* woodlands (SS, DN: PMA then north, majority distribution in PMA)

M14 Bullsbrook NR (outlier on east)
*Pearce1 Threatened &/or poorly res
*Pearce2 Threatened &/or poorly res
*Pearce4 Threatened &/or poorly res
*Pearce6 Threatened &/or poorly res

M1 Two Rocks
SF 65
M3 Yanchep NP
M4 Ridges MPA
M6 Neerabup NP
M7 Lake Joondalup
LG Reserve 8121 (DEPOT)
M7 Woodvale NR
M11 Warwick
Subm 146 Pinnaroo Memorial Cemetary Bushland
Subm 159 Hepburn Bushland Reserve
M35 Star Swamp
M36 Trigg Bushland Reserve
Shenton Park Bushland
M49 Kings Park
M64 Wireless Hill Park
M63 Harry Sandon Park
M72 Sir Frederick Samson Park
M92 North of North Lake on Murdoch land
M93 Harry Waring Marsupial Reserve
M104 Leda (most S)

QUINDALUP SANDS

29a NA Coastal shrublands on shallow sands (QS; PMA central)

Burns Beach
M2 Burns Beach
M2 Mindarie
Subm 146 Pinnaroo Memorial Cemetary Bushland
M36 Trigg Bushland Reserve
M91 Naval Base
M96 Garden Island
M102 Lake Richmond

Wilbinga
C45 Rottnest Island

29b NA *Acacia* shrublands on taller dunes (QS; PMA north, except Yalgorup)

M1 Two Rocks
M2 Mindarie
Mindarrie
M36 Trigg Bushland Reserve
M47 Bold Park
M46 Swanbourne Beach and Rifle Range
M106 Port Kennedy (PMA most S, single at Yalgorup futher S)

Wilbinga

#30a1 EN *Callitris preissii* forests (QS, only Metro)

M96 Garden Island

30a2 ?EN Woodlands and shrublands on Holocene dunes (re-allocated from 30c)

M3 Yanchep NP

M47 Bold Park
M54 Foreshore reserves, Peppermint Grove
M66 Mount Henry
M90 Woodman Point
M96 Garden Island

30b NA Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands
M3 Yanchep NP (outlier, mostly Bunbury and south)

#11 NA Northern *Acacia rostellifera - Melaleuca acerosa* shrublands
(QS; PMA central)
M2 Mindarie
M36 Trigg Bushland Reserve
M46 Swanbourne Beach and Rifle Range
M47 Bold Park
C45 Rottnest Island

S12 NA Rottnest Island *Callitris preissii* and/or *M. lanceolata* forests and woodlands
C45 Rottnest Island

Strandline Quindalup Sands, probablly go south but not sampled.

S13 NA Northern *Olearia axillaris - Scaevola crassifolia* shrublands
M2 Mindarie
M36 Trigg Bushland Reserve
M46 Swanbourne Beach and Rifle Range

Wilbinga

#S14 NA *Spinifex longifolius - Tetragonia decumbens* low shrublands
M2 Mindarie
M36 Trigg Bushland Reserve
M46 Swanbourne Beach and Rifle Range

Not suitable for consideration in designing reserves:

6 NA Weed dominated wetlands on heavy soils
Pearce5 Threatened &/or poorly res..
M17 Ellen Brook Nature Reserve
M17 Twin Swamps NR
M83 Cardup NR

S15 Weed group, poorly allied
M1 Two Rocks
M21 Red Hill
M47 Bold Park

Water
AUTHORITY

REVIEW OF PROPOSED CHANGES TO ENVIRONMENTAL CONDITIONS

Gnangara Mound Groundwater Resources

(Section 46)

BS 147
MARGINUP
SPEARN

REV
950297A

Water
AUTHORITY

BS 383
NOWERGUP
SPEARN

BS 399
MELALEUCA
BASSN

REVIEW OF PROPOSED CHANGES TO ENVIRONMENTAL CONDITIONS

BS 193
GNANGARA
BASSN

BS 324
JANDAKUP
BASSN

BS 299
JOONDALUP
SPEARN

BS 462
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Gnangara Mound Groundwater Resources

(Section 46)

SPEARN
COOGEE
SPRINGS
BS 129

BS 288
YANCHEP
SPEARN

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APPENDICES

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