The Flora and Fauna of vacant Crown land at White Well, Shire of Dalwallinu, Western Australia

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Abstract

A biological survey of the White Well area, a 34 400 ha area of vacant Crown land situated 40 km north-east of Wubin, Western Australia, revealed a diverse flora and fauna not well represented in existing nature conservation reserves. Five vegetation formations, two combinations of formations and two complexes were mapped. Of particular importance were scrub heath areas with a rich and diverse flora including many elements typical of the adjacent wheatbelt sandplains, and areas of Salmon Gum and York Gum woodland. The vertebrate fauna included 15 indigenous and 6 introduced mammal, 60 bird, 29 reptile and one frog species. Of particular importance were species now uncommon or of restricted distribution in the wheatbelt, ie White-tailed Dunnart, Pink Cockatoo, Malleefowl, Regent Parrot, Redthroat and Calamanthus. The Salmon Gum and York Gum woodlands were important areas for nesting by a variety of hollow-nesting bird species, including cockatoos and parrots, and as bat refuges. The declaration of the White Well area as a nature reserve would add significantly to nature conservation in Western Australia.

INTRODUCTION

In this paper we assess the conservation value of an area of vacant Crown land of approximately 34 439 ha, situated on the frontier of cereal cropping some 40 km north-east of Wubin and lying between latitudes 29°37' - 29°52' and longitudes 116°52' - 117°06'E. Open range pastoral leases occur to the north and north-east while sheep and cereal farms occur on the southern boundaries. Lakes Moore (east) and Monger (west) occur in the vicinity while a complex and uncoordinated system of smaller salt pans and salt lakes intersect the study area roughly along a south-east - north-west axis. The Great Northern Highway, which crosses the old Emu Proof (or Barrier) Fence in the study area, provides the only all weather access. Tracks along the barrier fence and occasional ungraded tracks provide access to some places during dry weather.

Reserves within the study area are: Reserve 16449, White Well water reserve, 4.0469 ha, vested in the Minister for Water Resources; Reserve 30865 - Emu Proof Fence reserve, (not vested); Reserve 9356, water, 80.9371 ha (not vested).

Nature reserves in the vicinity of the study site are few in number and small in area. The closest nature conservation reserves with detailed biological resource data are Buntine Nature Reserve (1 919 ha), Nugadong Nature Reserve (8.5 ha), East Nugadong Nature Reserve (781 ha) and un-named Nature Reserve 10351 (81 ha) 40 to 50 km south-west of White Well (Kitchener *et al.* 1979), and Karroun Hill Nature Reserve (309 687 ha) 65 km to the east (Youngson and McKenzie 1977).

This study was carried out in response to proposals to release all or part of the White Well vacant Crown land for cereal farming. The work was conducted in order to collect basic biogeographical data and to assess the nature conservation value of the area so it could be evaluated by the Environmental Protection Authority's Working Group on Land Releases. Two field trips were conducted, the first between 27 September and 2 October 1982, and the second between 6 December and 10 December 1982.

ENVIRONMENT

Landform and Soils

The general physiography is subdued with maximum topographical variation between upland areas with height above mean sea level of 366 m (vicinity of site 10) to 297 m in salt lakes adjacent to site 26. The latter occur in a broad band across the centre of the study area. Their origin, as described by Beard (1976) from data supplied in Bettenay (1962) and Bettenay and Mulcahy (1972), is believed to have resulted from a gradual drying of the continent and subsequent ponding of rivers and deposition of silt and evaporites.

The area is underlain by ancient granite and gneisses of the Yilgarn block with occasional emergences forming areas of special topographic and floristic character (as described for site 10). Laterites are encountered more commonly at depth than as surface deposits and are late Mesozoic or Early Tertiary in origin.

Table 1

Plant species recorded at White Well. Collective numbers given for specimens of uncertain identification.

Acacia acuaria W.Fitz.
A. acuminata Benth.
*A. aff. coolgardiensis KD 660
A. andrewsii W.Fitz.
A. aneura F.Muell.
A. cochlocarpa Meissner
A. colletrioides Benth.
A. coolgardiensis Maiden
A. erinacea Benth.
A. hemiteles Benth.
A. ligulata Cunn. ex Benth.
A. longispinea Morrison
A. resinomarginea W.Fitz.
A. signata F.Muell.
A. stereophylla Meissner
A. stowardii Maiden
*A. sp. 1 KD 665
*A. sp. 2 KD 659
A. uncinella Benth.
Allocasuarina acutivalvis (F.Muell.) L.Johnson
A. campestris (Diels) L.Johnson
A. corniculata (F.Muell.) L.Johnson
Alyxia buxifolia R.Br.
Amphipogon debilis R.Br.
+Arthrocnemum sp. KD 562
+Atriplex sp. KD 655
Baeckea behrii (Schildl.) F.Muell.
B. cryptandroides F.Muell.
+B. sp. KD 547
*B. sp. nov. KD 581
Banksia benthamiana C.Gardner
Boronia oxyantha Turcz.
+B. sp. KD 590
Borya constricta D.M. Churchill
Calandrinia primuliflora Diels
Callitris columellaris F.Muell.
Calothamnus gilesii F.Muell.
Calytrix stipulosa W.Fitz.
Cassia nemophila Cunn. ex Vogel
C. sturtii R.Br.
Cephalipterum drummondii A.Gray
Chamelaucium ciliatum Desf.
Cheiranthera filifolia Turcz.
Choretrum glomeratum R.Br.
Comesperma acerosum Streetz.
Cryptandra gracilipes (Diels) C.Gardner
C. mutila Nees ex Reissek
C. polyclada Diels
Dampiera eriocephala Vriese
D. incana R.Br.
D. lavandulacea Lindley
D. luteiflora F.Muell.
Dianella revoluta R.Br.
Dichopogon strictus (R.Br.) Baker
Disphyma crassifolium (l.) L.Bolus
Dodonaea adenophora Miq.
D. bursariifolia F.Muell.
D. concinna Benth.
+D. sp. Kd 539
Ecdeiocolea monostachya F.Muell.
Eremophila aff. clarkei KD 535
E. alternifolia R.Br. var. angustifolia
E. decipiens Ostenf.
E. drummondii F.Muell.
E. oppositifolia R.Br.
Eriostemon glaber Paul G. Wilson
E. thryptomenoides S.Moore
E. tomentellus Diels
Erodium cygnorum Nees
Eucalyptus foecunda Schauer
E. gracilis F.Muell.
E. leptopodaBenth.
E. loxophleba Benth.
E. oleosa F.Muell. ex Miq.
E. redunca Schauer
E. salmonophloia F.Muell.
E. stowardii Maiden
E. striaticalyx W.Fitz.
+E. sp. KD 540
E. transcontinentalis Maiden
Exocarpos aphyllus R.Br.
+Frankenia sp. KD 625
Gastrolobium laytonii J.White
Glischrocaryon aureum (Lindley) Orch.
Grevillea candolleana Meissner
G. eriostachya Lindley
G. juncifolia Hook.
G. sarissa S.Moore
+G. sp KD 667
Hakea kippistiana Meissner
H. multilineata Meissner
H. scoparia Meissner
Halgania integerrima Endl.
Hemigenia sp. KD 611
Hibbertia huegelii (Endl.) F.Muell.
H. subvaginata (Steudel) F.Muell.
Keraudrenia integrifolia Steudel
+K. sp. KD 616
Lechenaultia macrantha Krause
Leptomeria preissiana (Miq.) A.DC.
Lobelia winfridae Diels
Logania flaviflora F.Muell.
+Maireana sp. KD 522
M. thesioides (C.Gardner) Paul G. Wilson
Malleostemon roseus (E.Pritzel) J.W.Green
Melaleuca conothamnoides C.Gardner
M. cordata Turcz.
M. filifolia F.Muell.
M. lateriflora Benth.
M. pauperiflora F.Muell.
M. thyoides Turcz.
M. uncinata R.Br.
Neurachne alopecuroidea R.Br.
Olearia calcarea F.Muell ex Benth.
O. muelleri (Sonder) Benth.
O. propinqua S.Moore
Osteospermum clandestinum (Less.) Norlindh
Petrophile divaricata R.Br.
Phebalium canaliculatum (F.Muell & Tate) J.H.Willis
P. lepidotum (Turcz.) Paul G. Wilson
P. microphyllum Turcz.
Pimelea aeruginosa F.Muell.
P. angustifolia R.Br.
P. leucantha Diels
*P. sp. nov. KD 552
Platysace maxwellii (F.Muell.) Norman
Plectrachne melvillei C.E.Hubb.
+P. sp. KD 559
Podotheca angustifolia (Labill.) Less.
Prostanthera eckersleyana F.Muell.
P. serpyllifolia (R.Br.) Briq.
Psammomoya choretroides (F.Muell.) Diels & Loes.
*Pterostylis sp. KD 575
Ptilotus helipteroides (F.Muell.) F.Muell.
P. obovatus (Gaudich.) F.Muell.
P. schwartzii F.Muell. ex Tate
Rhagodia drummondii Moq.
Ricinocarpos rosmarinifolius (Cunn.) Benth.
Santalum acuminatum (R.Br.) A.DC.
S. spicatum (R.Br.) A.DC.
Sauropus crassifolius (Muell. Arg. Airy Shaw
Scaevola spinescens R.Br.
Schoenia cassiniana (Gaudlich.) Steetz.
Senecio lautus G.Forster ex Willd.
Stackhousia monogyna Labill.
Stipa elegantissima Labill.
Stylidium macrocarpum (Benth.) R.Erickson & J.H.Willis
S. yilgarnense E.Pritzel
Templetonia sulcata (meissner) Benth.
Thelymitra antennifera (Lindley) J.D.Hook.
T. nuda R.Br.
+Thomasia sp. KD 578
Thryptomene aspera E.Pritzel
T. australis Endl.
T. decussata (W.Fitzg.) J.W.Green
T. kochii E.Pritzel
+T. sp. KD 561
Thysanotus patersonii R.Br.
Velleia discophora F.Muell.
V. rosea S.Moore
Verticordia picta Endl.
V. sp. KD 579
Waitzia acuminata Steetz
W. citrina (Benth.) Steetz
Wehlia coarctata F.Muell.
Zygophyllum iodocarpum F.Muell.

*poorly collected or undescribed
+sterile specimen, most accurate affinity

Soils are complex and have been mapped as part of the Mount Gibson Soil Survey (Plan Office, Department of Land Administration). Details of soils are contained in memoirs accompanying the regional soil map. The reliability of this map was tested during field surveys and it was found to be seriously deficient on numerous occasions. However, the survey is useful as a crude indicator of broad caternary relationships and for summarization of soil types. Soils commonly encountered in the study area include red to red-brown sandy loams, often changing to clay loam overlying granite or siliceous hardpan, or clay or calcium carbonate impregnated hardpan. The latter is a frequent component of clay loams, which are often associated with salmon gum woodlands. Sand heaths, scrub and thicket favour light brown to yellow sandy loams tending to loamy sands, often with laterite pebbles, overlying laterite at depths ranging from 12 cm to 100 cm or deeper. Lithosols are predictably associated with areas of exposed rock, rocky surface or subsurface rock and consist of a gritty, free-draining soil. Soil lenses trapped on exposed rock are typically deep-brown fertile loams supporting a rich annual flora and moss swards.

Climate

The area has a mediterranean climate, with a summer temperature range of 19-36°C and winter range of 6-18°C (Commonwealth Meteorological Bureau data). Two-thirds of the annual rainfall comes as gentle soaking rains in winter and result from the influence of southern low pressure systems and associated cold fronts. Summer rain occurs as sporadic thundershowers or more rarely from tropical cyclonic disturbances or rain-bearing depressions. Annual precipitation records are not available for the study area but Meteorological Bureau data from adjacent stations indicate that the mean annual rainfall is about 300 mm.

Vegetation

Vegetation was assessed and classified according to the method of Muir (1977). Twenty-seven sample sites were chosen to represent, as far as possible, all accessible vegetation types and sampled for floristic composition by collection, where possible, of appropriate diagnostic parts. The data for these are available on request.

The distribution of the selected formations was mapped from air photographs (Fig. 1). Table 1 shows the plant species recorded at White Well, with those elements of the flora considered rare (Rye and Hopper 1981; Patrick and Hopper 1982), geographically restricted (Rye 1982), poorly collected (Marchant and Keighery 1979), as well as undescribed taxa, highlighted. Table 2 gives the taxonomic distribution of the flora and Table 3 shows the extent of the vegetation formations in the study area. Finally, an attempt was made to define conservation priority areas in terms of their botanical uniqueness and practicalities of management and to assess the impact of possible subdivision on the biological integrity of these areas.

Table 2.

Taxonomic distribution of flora recorded in the White Well study area.

FAMILY	NUMBER OF GENERA	NUMBER OF SPECIES
Casuarinaceae	1	3
Mimosaceae	1	19
Proteaceae	4	10
Myrtaceae	10	34
Apocynaceae	1	1
Poaceae	4	5
Chenopodiaceae	4	5
Rutaceae	2	5
Liliaceae	5	7
Portulacaceae	1	1
Cupressaceae	1	1
Caesalpiniaceae	1	2
Asteraceae	7	10
Pittosporaceae	1	1
Santalaceae	4	5
Polygalaceae	1	1
Rhamnaceae	1	3
Goodeniaceae	4	8
Aizoaceae	1	1
Sapindaceae	1	4
Restionaceae	1	1
Myoporaceae	1	5
Geraniaceae	1	1
Frankeniaceae	1	1
Fabaceae	2	2
Haloragaceae	1	1
Boraginaceae	1	1
Lamiaceae	2	3
Dilleniaceae	1	2
Sterculiaceae	2	3
Lobeliaceae	1	1
Loganiaceae	1	1
Euphorbiaceae	2	2
Thymelaeaceae	1	4
Apiaceae	1	1
Celastraceae	1	1
Orchidaceae	2	3
Amaranthaceae	1	3
Stackhousiaceae	1	1
Stylidiaceae	1	2
Zygophyllaceae	1	1
TOTAL	82	166

The region has been visited by botanists since exploration and development of farming areas in the central wheatbelt began in the late 19th century. More recently, Beard (1976) has assessed the vegetation as part of his 1:250 000 map series, while Kitchener *et al.* (1979) undertook a detailed survey of flora and fauna on four reserves within 50 km of the

Table 3.

Areas (ha) occupied by vegetation formations in each of four 'sectors' formed by the intersection of Great Northern Highway with the Emu Barrier Fence. From Fig. 1 the 'sectors' are numbered 1-4 starting from the top, left-hand corner, in a clockwise direction.

VEG[a]	SECTOR 1	2	3	4	TOTAL
T	2 829	6 464	801	644	10 738
S	8	107	108	122	345
M	80	4 861	518	799	6 258
SC	87	240	73	412	812
WL	2 503	3 705	594	624	7 426
WS	59	1 450		56	1 565
T & M	762	2 278	508		3 548
WS & WL		1 622		78	1 700
SH		966	304	777	2 047
TOTAL	6 328	21 693	2 906	3 512	34 439

([a])T = thicket; S = salinas, salt pans and other hypersaline environments; M = mallee shrubland; SC = vegetation of intersalina dunes, lunettes; WL = york gum (*Eucalyptus loxophleba*) woodland; WS = salmon gum (*E. salmonphloia)* woodland; T & M = thicket with mallee; WS & WL = salmon and york gum mixed woodland; SH = scrub heath.

White Well study area. The latter provide the most comprehensive inventory of plant species and vegetation in the vicinity of the study area. Analysis of species similarities indicates that only one of the three sites, Buntine Nature Reserve, contains more plant species than White Well. However, less than 15 per cent of species are common to both areas, even if the species lists for the nearby Nugadong Nature Reserve are included. This comparison highlights the unique flora of transitional woodland, which, although agronomically wheatbelt, contains few of the plant elements commonly associated with nearby wheatbelt nature reserves. Examination of botanical collections in the Western Australian Herbarium (PERTH) from areas extending into drier regions to the north-east do show a higher percentage of common species (<25 per cent) in common with the study area. This figure would probably be higher if systematic botanical resources studies were undertaken in the south-west Eremaean. Currently, however, no significant reserves exist that would sufficiently preserve these Eremaean species outside the White Well locality.

By reference to Figure 1 and Tables 1 and 2, and the descriptions of the vegetation for the 27 sample sites, certain floristic features became evident.

1. The study area contains elements of both wheatbelt and Eremaean floras; these being located in sand heath or scrub formations (viz. wheatbelt sandplain flora) in the south-western parts of the study area in the former, with the latter showing strongest development in the central and north-eastern areas. However, it is common to find traditional Eremaean species such as mulga (*Acacia aneura*) and spinifex species (*Plectrachne* spp.) frequenting 'sandplain-type' vegetation adjacent to the Emu Barrier Fence.

2. Species richness is greater in southern parts of the study area, particularly in sand-heath type vegetation reminiscent of the flora of wheatbelt sandplains. Although poorly represented on the whole, annual species would be expected to have been strongly developed in open woodland formations in the central and northern regions of the study area, thereby boosting the species richness index for these areas. The paucity of annual species may be an artefact of the drought-like conditions experienced in the region over the two to three years prior to the survey.

3. Six species were recorded which do not coincide with any known taxa. Three of these occur in southern regions of the study area and include a *Baeckea*, a *Pimelea* and a *Pterostylis*. Three undescribed *Acacia* species were found in the southern and central regions.

Only the northern extremities failed to produce any undescribed species. All undescribed taxa were referred to the following for inclusion in taxonomic revisions:

Acacia spp.	B. Maslin (Perth)
Baeckea sp. nov.	M. Trudgeon (Perth)
Pimelea sp. nov.	B. Rye (Perth)
Pterostylis sp.	M. Clements (Canberra)

A comprehensive species list for the study area is provided in Table 1, with a breakdown of families and genera given in Table 2. These illustrate the diverse nature of the flora. For example, no single family contributes more than 20 per cent of the species recorded for the study area. In comparison, Griffin, Hnatiuk and Hopper (1982) showed that in northern sand-heath vegetations nearly half of the species came from the families Proteaceae, Myrtaceae and Leguminosae.

Vegetation Formations

Beard (1976) in his vegetation map of the Perenjori region rationalized the vegetation of the study area into two formations, viz. 'mixed *Acacia* thicket on sandplain' and '*Eucalyptus loxophleba* sclerophyll woodland', and a system which included saline habitats. Although adequate for the scale of mapping used by him, this was found to be inadequate for the purposes of this study.

Five vegetation formations, two combinations of formations and two complexes were delineated and described for the White Well study area. A breakdown of these vegetation units and their respective contributions (by area) are provided in Table 3 and in the vegetation map in Figure 1.

The formations recorded were:

THICKET (T): Represented by dense to very dense, 2-5 m tall shrubs of *Acacia* and *Allocasuarina*. Associations with other genera, chiefly *Melaleuca* and *Eucalyptus*, may occur on laterite. Although vulnerable to repeated burning this is the most widespread and common formation in the study area. *Acacia* dominated thicket occurs along the drier eastern perimeter of the area.

YORK GUM WOODLAND (WL): 8-20 m tall single or multi-stemmed york gums (*Eucalyptus loxophleba*) of varying density over a sparse to dense understorey consisting of a variety of dominants. Typically developed on sandy loam or more rarely on grey sands (intersalina dunes for example). This formation shows remarkable physiognomic heterogeneity with certain stands containing both tall tree and mallee forms of the york gum. This is a common formation in the study area with height and diameter of trunks decreasing with increasing aridity.

MALLEE SHRUBLAND (M) : Next most widespread formation and characterised by 2-4 m tall, sparse to dense mallee *Eucalyptus* over a complex and rich substratum of 0.5-1.0 m tall shrubs containing mixed dominants. Soils variable though usually deep sandy loams.

SCRUB HEATH (SH) : Restricted to southern regions of the study area where soils are deep sands or sandy loams or clays, typically low heath with occasional emergent mallee (*Eucalyptus*, *Acacia* or *Allocasuarina*). Flora rich and diverse sharing many elements in common with typical wheatbelt or sandplain flora.

SALMON GUM WOODLAND (WS) : Conspicuous, with large 20-30 m tall salmon gums (*Eucalyptus salmonophloia*) over a sparse multi-strata understorey. Soils red to red brown loamy sands over a hardpan of clay or calcium carbonate concretion. A widespread but infrequent formation.

Vegetation complexes recorded were:

SALINA VEGETATION (S) and INTERSALINA DUNE VEGETATION (SC) : (S) is extremely variable with seasonally inundated areas either barren or vegetated with sparse to very dense samphire heath to 0.5 m. (SC) variable, from open shrubland to closed thicket all to 4 m, *Melaleuca* and *Acacia* species are common dominants. Soils free draining grey sands to red brown sandy loams and clays.

LITHIC AND LITHOSOL VEGETATION. Associated with exposed sheet rock, breakaways and rocky soils. Vegetation variable from moss swards with annuals in loamy soil lenses to dense, 3 m thicket on deeper soils.

Two formation combinations are mapped, one consisting of thicket interspersed with mallee shrubland (T + M), the other, york gum woodland with scattered occurrences of salmon gum codominant with york gums (WS + WL).

VERTEBRATE FAUNA

Mammals

Some mammals were recorded by direct observation during day time, and at night from vehicles with the aid of a spotlight. Many species could only be

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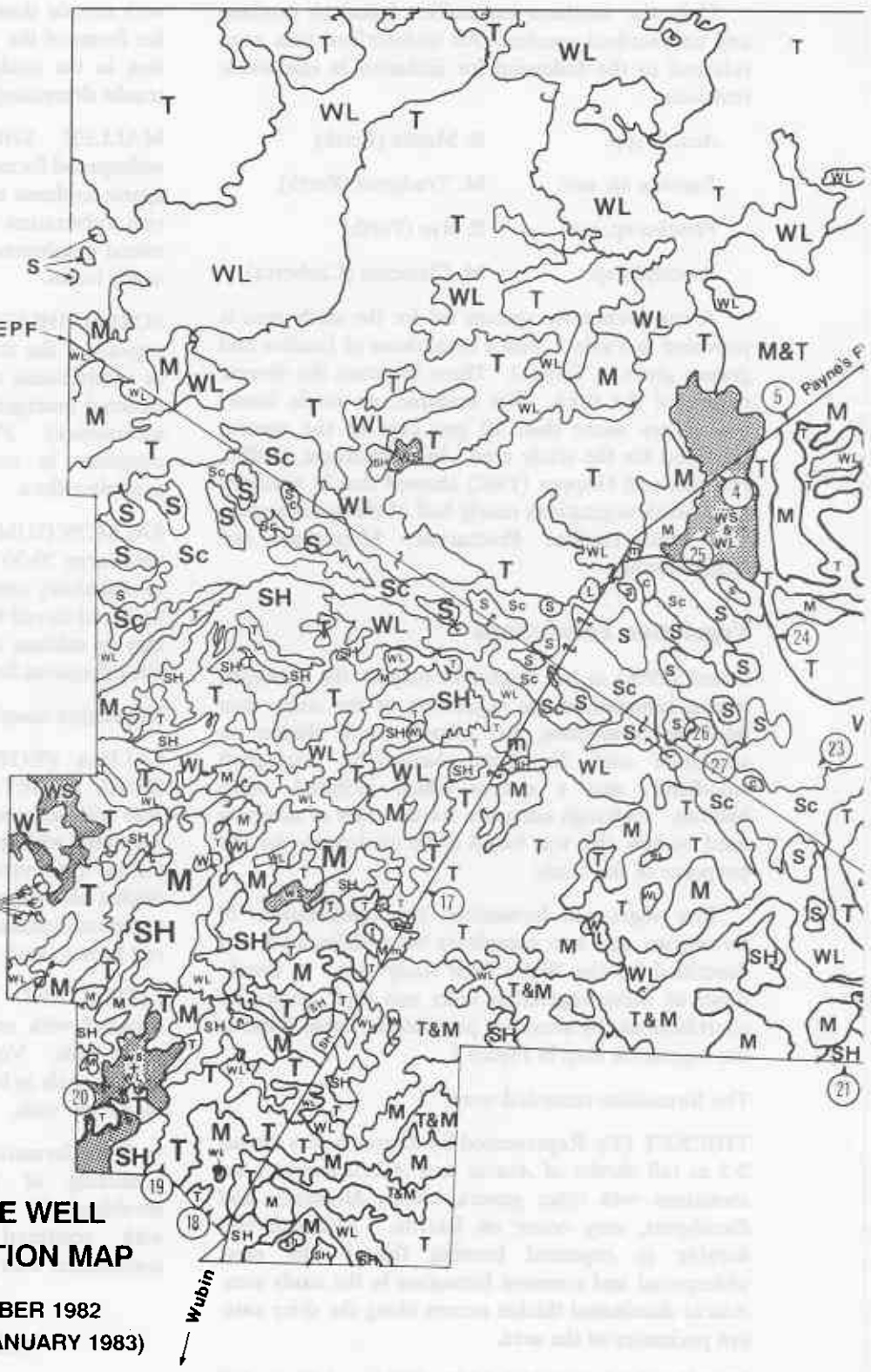


- WHITE WELL VEGETATION MAP

DECEMBER 1982
(REVISED JANUARY 1983)

LEGEND

WL : Eucalyptus loxophleba woodland

WS : E. salmonophloia woodlands

SH : Scrub heath

M : Mallee shrubland

T : Thicket (often with mallee designated T&M)

L : Lithic complexes

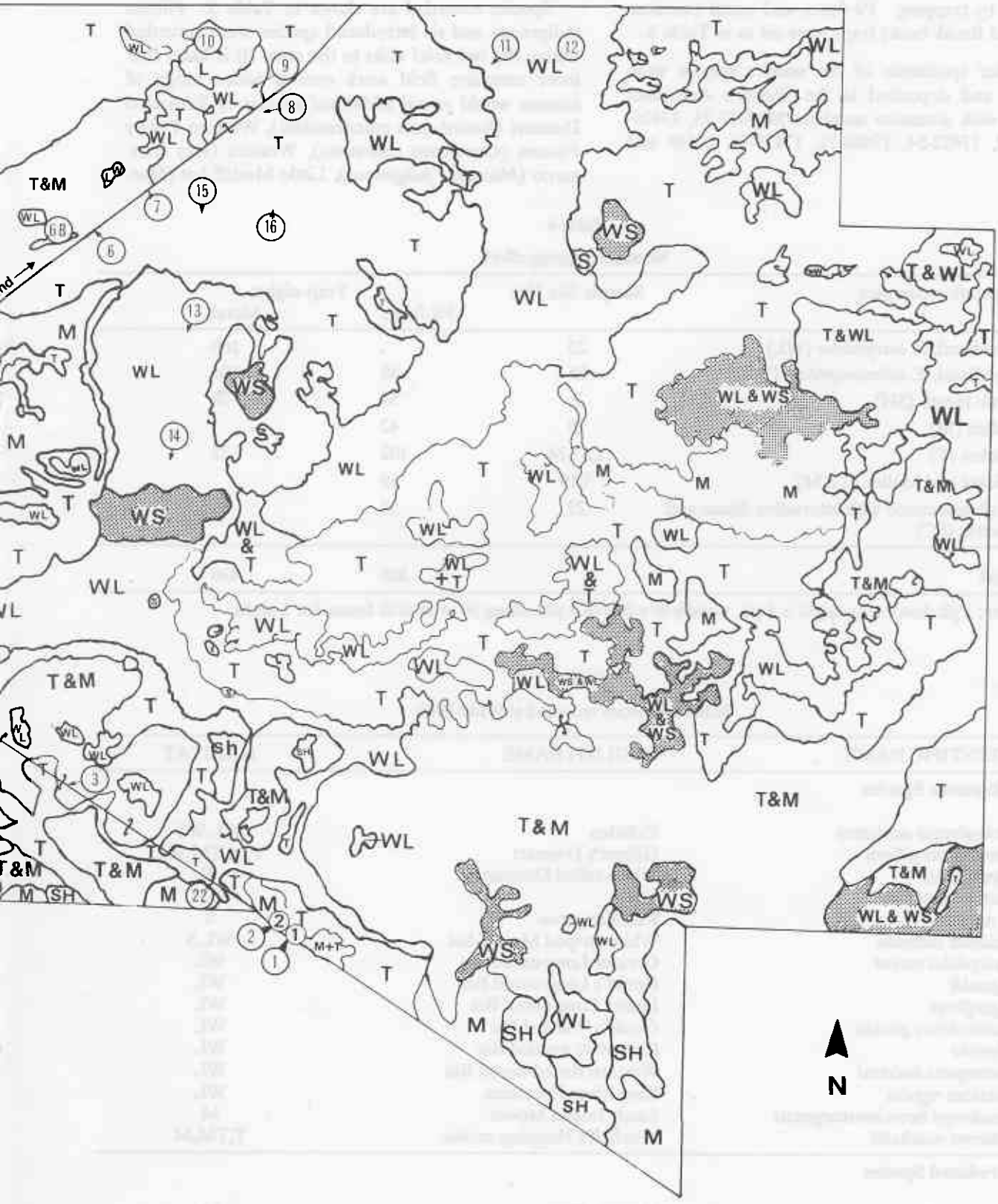
S : Salinas

SC : Scrub assoc. with inter-salina dunes and lunettes

EPF : Emu-proof fence

(22) →Sample sites (see text) - (1) (2) (3) (18) (23) (24) (25) represent trapline site numbers

APPROX SCALE 1:25 000


T
WL
T&M
M
WS
WL&WS
T&WL
SH
sh
N

recorded by trapping. Pit-fence and metal (medium Elliott and Break-back) traps were set as in Table 4.

Voucher specimens of the smaller species were collected and deposited in the Western Australian Museum with accession numbers M17417-23, 17426-40, 17442, 17452-54, 17468-71, 17473-74, 24549 and 24553.

Species recorded are shown in Table 5. Fifteen indigenous and six introduced species were recorded during the two brief visits to the area. It is likely that more extensive field work over a wider range of seasons would reveal additional species eg Fat-tailed Dunnart (*Sminthopsis crassicaudata*), Western Pygmy Possum (*Cercartetus concinnus*), Western Grey Kangaroo (*Macropus fuliginosus*), Little Mastiff-bat (*Mor-*

Table 4

Mammal trapping effort

Vegetation complex	Sample Site Nos	Trap-nights	
		Pit-fence	Metal
Woodland, *E. loxophleba* (WL)	23		160
Woodland, *E. salmonophloia* (WS)	25	48	120
Scrub Heath (SH)	2	54	78
Mallee (M)	18	42	
Thicket (T)	1,17,24	102	72
Thicket and Mallee (T&M)	3,19	89	
Scrub associated with intersalina dunes and lunettes (SC)	27	54	
Total		389	430

Note: 1 pit-fence trap-night is 1 pit, usually in a line of 6 pits along 50 m of drift fence, for 1 night.

Table 5

Mammal species recorded at White Well

SCIENTIFIC NAME	ENGLISH NAME	HABITAT
Indigenous Species		
Tachyglossus aculeatus	Echidna	WL,WS
Sminthopsis gilberti	Gilbert's Dunnart	T,M,TM,WL
S. granulipes	White-tailed Dunnart	T
Macropus robustus	Euro	WL,L
M. rufus	Red Kangaroo	S
Tadarida australis	White-striped Mastiff-bat	WL,S
Nyctophilus major	Greater Long-eared Bat	WL
N. gouldi	Gould's Long-eared Bat	WL
N. geoffroyi	Lesser Long-eared Bat	WL
Chalinolobus gouldii	Gould's Wattled Bat	WL
C. morio	Chocolate wattled Bat	WL
Scotorepens balstoni	Western Broad-nosed Bat	WL
Eptesicus regulus	King River Eptesicus	WL
Pseudomys hermannsburgensis	Sandy Inland Mouse	M
Notomys mitchellii	Mitchell's Hopping-mouse	T,TM,M
Introduced Species		
Mus musculus	House Mouse	M
Oryctolagus cuniculus	Rabbit	all
Equus equus	Horse	T
Bos taurus	Cattle	all
Ovis aries	Sheep	T,WS
Vulpes vulpes	Red Fox	M,TM,T

mopterus planiceps) and, possibly, the Ash-grey Mouse *(Pseudomys albocinereus).*

The mammal fauna we recorded from the White Well area is a mixture of widespread species, eg Echidna (*Tachyglossus aculeatus*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*) and Gould's Wattled Bat (*Chalinolobus gouldii*), species of arid regions near their south-western limit, eg Red Kangaroo (*Macropus rufus*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*) and Western Broad-nosed Bat (*Scotorepens balstoni*) and species of the south-west eg Gilbert's Dunnart (*Sminthopsis gilberti*), White-tailed Dunnart (*Sminthopsis granulipes*), Gould's Long-eared Bat (*Nyctohilus gouldi*) and King River Eptesicus (*Eptesicus regulus*). Of particular note are the records of White-tailed Dunnart (*Sminthopsis granulipes*), an uncommonly recorded species of the inland parts of the south-west, and of Gould's Wattled Bat (*Chalinolobus gouldii*), which is at the inland periphery of its range.

The woodlands were particularly rich in bats. A bat trap set at water for three nights (6-7-8 December 1982) captured 83 individuals of seven species.

Birds

Birds were recorded opportunistically during the whole survey.

In the species list (Table 6) birds are listed with the vegetation complex(es) (see p. 6) in which they were sighted. Breeding records are marked.

Scientific and common names follow Blakers *et al.* (1984).

Table 6 lists 60 species from the study area, including 26 non-passerines and 34 passerines. The number of species recorded in each vegetation complex was:

WL	*Eucalyptus loxophleba* woodland	42
WS	*Eucalyptus salmonophloia* woodland	22
SH	Scrub Heath	3
M	Mallee Shrubland	12
T	Thicket (including T&M)	22
L	Lithic complexes	2
S	Salinas	5
SC	Scrub associated with inter-salina dunes and lunettes	4

One species, the Emu (*Dromaius novaehollandiae*), was seen only along the Emu Barrier Fence.

Almost all species recorded have a widespread distribution and could be expected to occur in the study area. The Regent Parrot, Red-tailed Black-Cockatoo, Golden Whistler and Rufous Tree-creeper are at the limit of their ranges.

Further study would undoubtedly increase the species list for this area. Based on our experience we suggest that work in other seasons would add the following species: Whistling Kite, Collared Sparrowhawk, Little Button-quail, Mulga Parrot, Bourke's Parrot, Black-eared Cuckoo, Shining Bronze Cuckoo, Rainbow Bee-eater, Ground Cuckoo-shrike, White-winged Triller, Hooded Robin, Grey Fantail, White-browed Babbler, Slaty-backed Thornbill, Shy Hylacola, White-winged Fairy-wren, Variegated Fairy-wren, Australian Sitella, Mistletoebird, Brown Honeyeater, Yellow-fronted Honeyeater, White-eared Honeyeater, Brown-headed Honeyeater, Red Wattlebird and Masked Woodswallow. Assuming that all these species occur in the study area, it has a total bird fauna of around 85 species.

The Salmon Gum and York Gum woodlands are especially important breeding places for hollow-nesting species, eg Pink (or Major Mitchell) Cockatoo, Red-tailed Black-Cockatoo, Galah, Little Corella, Port Lincoln Parrot (or Ringneck), Regent Parrot, Tree Martin, Australian Owlet-nightjar, Rufous Tree-creeper and Striated Pardalote. This type of vegetation is now very limited in the adjacent wheatbelt.

Reptiles and Amphibians

Reptiles and Amphibians were recorded by capture in pit-fence traps and Elliott traps as well as by opportunistic searching. Table 7 shows the species and the vegetation formation(s) in which they were recorded.

Voucher specimens were deposited in the Western Australian Museum with accession numbers R81609 - 81644 and R81902 - 81928.

We recorded one (possibly two) species of frogs and 29 species of reptiles. More work would undoubtedly add to the known fauna. However, the species diversity compares favourably with Karroun Hill Nature Reserve, which has a known herpetofauna of one frog and 24 reptile species (Youngson and McKenzie 1977), with Buntine Nature Reserve, which has 4 frog and 23 reptile species (Kitchener *et al.* 1979) and with other nearby nature reserves.

DISCUSSION

The White Well area possesses elements of both the South West and Eremaean Botanical Provinces (Burbidge 1960; Beard 1980) considered by Erickson *et al.* (1973) to constitute a vegetation unit termed 'transitional woodland'. This vegetation, with its unique

Table 6

Bird species recorded at White Well

SPECIES	VEGETATION FORMATION	BREEDING?
CASUARIDAE		
Dromaius novaehollandiae, Emu	All	B
ACCIPITRIDAE		
Accipiter fasciatus, Brown Goshawk	WL	B
Aquila audax, Wedge-tailed Eagle	WL	old nest
Hieraaetus morphnoides, Little Eagle	T,S	
FALCONIDAE		
Falco peregrinus, Peregrene Falcon	WL	
F. longipennis, Australian Hobby	WL,SH	
F. berigora, Brown Falcon	T,WL,WS,TM	
F. cenchroides, Australian Kestrel	M,WS,WL	
MEGAPODIIDAE		
Leipoa ocellata, Malleefowl	T	
OTIDIDAE		
Ardeotis australis, Australian Bustard	S	
CHARADRIIDAE		
Vanellus tricolor, Banded Lapwing	WL*	
COLUMBIDAE		
Phaps chalcoptera, Common Bronzewing	T,WL,T&M	
Ocyphaps lophotes, Crested Pigeon	WS,SH	
CACATUIDAE		
Calyptorhynchus magnificus, Red-tailed Black-Cockatoo	WL,WS	B
Cacatua roseicapilla, Galah	M,WL,WS	B
C. sanguinea, Little Corella	WL,WS	B
C. leadbeateri, Pink Cockatoo	WL,WS	B
OLYTELITIDAE		
Polytelis anthopeplus, Regent Parrot	WL,WS	B
PLATYCERCIDAE		
Barnardius zonarius, Port Lincoln Ringneck	WL,WS	B
CUCULIDAE		
Cuculus pallidus, Pallid Cuckoo	S,M,WL	
Chrysococcyx basalis, Horsefield's Bronze-Cuckoo	SC,WL	
STRIGIDAE		
Ninox novaeseelandiae, Southern Boobook	WL	
PODARGIDAE		
Podargus strigoides, Tawny Frogmouth	WL,SC	
AEGOTHELIDAE		
Aegotheles cristatus, Australian Owlet-nightjar	WL	
CAPRIMULGIDAE		
Caprimulgus guttatus, Spotted Nightjar	S	
ALCEDINIDAE		
Halcyon pyrrhopygia, Red-backed Kingfisher	WL	
HIRUNDINIDAE		
Cheramoeca leucosternum, White-backed Swallow	T	
Cecropis nigricans, Tree Martin	WL,WS,T&M	B

MOTACHILIDAE		
Anthus novaeseelandiae, Richard's Pipit	S	
CAMPEPHAGIDAE		
Coracina novaehollandiae, Black-faced Cuckooo-shrike	T,WL	
MUSCICAPIDAE		
Petroica goodenovii, Red-capped Robin	T,SC,WL, WS,T&M	B
PACHYCEPHALIDAE		
Microeca leucophaea, Jacky Winter	WL	
Pachycephala pectoralis, Golden Whistler	T	
P. rufiventris, Rufous Whistler	T,WS,WL,M&T	
Colluricincla harmonica, Grey Shrike-thrush	T,M,WS	
Oreoica gutturalis, Crested Bellbird	T,M,WL	
Rhipidura leucophrys, Willie Wagtail	WL,WS,L	
ORTHONYCHIDAE		
Cinclosoma castanotum, Chestnut Quail-thrush	T,M	
MALURIDAE		
Malurus splendens, Spendid Fairy-wren	SC	
ACANTHIZIDAE		
Sericornis brunneus, Redthroat	T,M,T&M	B
S. fuliginosus, Calamanthus	M	
Smicrornis brevirostris, Weebill	WL,WS	
Acanthiza apicalis, Inland Thornbill	WL	
A. uropyglalis, Chestnut-rumped Thornbill	WL,WS,SH	
A. chrysorrhoa, Yellow-rumped Thornbill	L,WL	B
Aphelocephala leucopsis, Southern Whiteface T		
CLIMACTERIDAE		
Climacteris rufa, Rufous Tree-creeper	WL,WS	B
MELIPHAGIDAE		
Acanthagenys rufogularis, Spiny-cheeked Honeyeater	WL,WS,T&M	
Manorina flavigula, Yellow-throated Miner	M,WL	
Lichenostomus virescens, Singing Honeyeater	T,M,WL	
Phylidonyris albifrons, White-fronted Honeyeater		M
EPHTHIANURIDAE		
Ephthianura albifrons, White-fronted Chat	adj. paddock	T
PARDALOTIDAE		
Pardalotus striatus, Striated Pardalote	WL,WS	
GRALLINIDAE		
Grallina cyanoleuca, Australian Magpie-lark	WL	
ARTAMIDAE		
Artamus cinereus, Black-faced Woodswallow	T	
CRACTICIDAE		
Cracticus torquatus, Grey Butcherbird	WL,WS,T	B
C. nigrogularis, Pied Butcherbird	T,M,WL,T&M	
Gymnorhina tibicen, Australian Magpie	WL	
Strepera versicolor, Grey Currawong	WL	
CORVIDAE		
Corvus bennetti, Little Crow	WS	B

Note: Crows were uncommon and were seldom identified to species.
*flying overhead

Table 7

Amphibians and Reptiles recorded at White Well

SPECIES	VEGETATION FORMATION
Amphibia	
LEPTODACTYLIDAE	
Neobatrachus centralis, Trilling Frog	M
N. sp.	T,M
Reptilia	
GEKKONIDAE, Geckoes	
Diplodactylus granarienis	M,WL
D. intermedius	M
D. maini	T,WL
D. pulcher	T,T&M
Gehyra variegata, Tree Dtella	M,WL
Heteronotia binoei, Bynoe's Gecko	SC,WL
Oedura reticulata, Reticulated Velvet Gecko	WL
Rhynchoedura ornata, Beaked Gecko	SC
PYGOPODIDAE, Legless Lizards	
Delma australis	SC
AGAMIDAE, Dragon Lizards	
Ctenophorus ornatus, Rock Dragon	L
C. scutulatus, Lozenge-marked Dragon	T,M,SC,T&M
C. cristatus, Crested Dragon	WL
Moloch horridus, Thorny Devil	T,M,T&M
Pogona minor minor, Western Bearded Dragon	T
SCINCIDAE, Skinks	
Cryptoblepharus plagiocephalus	WL,WS
Ctenotus mimetes	M,WL
C. pantherinus pantherinus	T
C. schomburgkii	T,M,WL,T&M
Lerista gerrardii	SC
Menetia greyii	SC,WL
Morethia butleri	WL
M. obscura	M
Tiliqua occipitalis, Western Blue-tongue	M
T. rugosa, Bobtail	SC
VARANIDAE, Goannas	
Varanus gouldii, Bungarra	T
V. caudolineatus	T,L
TYPHLOPIDAE, Blind Snakes	
Ramphotyphlops hamatus	T
ELAPIDAE, Elapid Snakes	
Denisonia fasciata, Rosen's Snake	T,S
Pseudonaja nuchalis, Gwardar	S

blend of species enriched by stately 'goldfields woodlands' is not well represented in existing nature conservation reserves.

The vegetation of the area is in good condition. Except for minor disturbance around the White Well water source, the area showed little disturbance from rabbits, weed incursions or too-frequent burning. The saline areas are pristine and the vegetation is stable compared with the usual degraded and expanding salinas in the wheatbelt.

The unusually poor rainfall experienced in the area immediately prior to the survey resulted in an understatement of its floristic richness and additional work would be repaid, especially in a good season.

The vertebrate fauna is also a mixture of south-west and arid zone species. Nevertheless, it protects many wheatbelt species that are now becoming increasingly rare in the remnants of bush remaining in that largely cleared landscape. Examples include Gilbert's Dunnart, White-tailed Dunnart, Pink Cockatoo, Malleefowl, Regent Parrot, Redthroat and Calamanthus.

The salmon gum and york gum woodlands are particularly important areas for a number of hollow-nesting birds, including the Pink Cockatoo, which is a declared rare species in Western Australia. The vast majority of these vegetation types have been cleared in the wheatbelt and the number of nest hollows in remnants is falling (Saunders *et al.* 1982, 1985; Saunders and Ingram 1987).

There are few nearby nature conservation reserves (see Introduction). The declaration of the White Well area as a nature reserve would add significantly to nature conservation in Western Australia. The excision of even small areas adjacent to existing farms could destroy vegetation types and species not found elsewhere in the area.

Recommendation: We recommend that the whole of the area of vacant Crown land be declared a Class A reserve for the Conservation of Flora and Fauna and that it be vested in the National Parks and Nature Conservation Authority.

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