V Discussion

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The Jackson–Kalgoorlie Study Area is a topographically diverse region and contains seven of the 10 landform units encountered in the Eastern Goldfields. The Helena and Aurora Ranges are excellent examples of Hill (banded ironstone formation) (Figure 4, Plate 4). Bungalbin Hill, at 684 m in the Aurora Range, is the highest point in the region. Undulating Plain (greenstone), Broad Valley and Salt Lake Feature are also well represented, while the extensive areas of Sandplain contain important admixtures of the south-western and arid floras. Granite Exposure is more frequent in the western portion of the Study Area and there are a few small breakaways. Mt Walter was the only occurrence of Hill (quartz) noted during field work.

Important landform types which are apparently not represented in the Study Area are Drainage Line, Dune Field and Calcareous Plain. The few small drainage patterns seen were not of sufficient size to be considered a landform category for the Study Area.

The northern boundary of the Study Area coincides approximately with the mulga-eucalypt line which demarcates the inland extent of the winter-rainfall region. The vegetation is principally that of the South-western Interzone with a small area in the south-western corner representative of the South-West Botanical Province (Beard 1980).

The detailed vegetation papers of Beard (1972, 1978) describe and map the major vegetation types within the Study Area. During the current field survey these maps were assessed for reliability and, considering the scale of mapping (1:250,000), provide an adequate overview of the vegetation based on structure. However, the extensive area of '*Acacia* thicket on Sandplain' mapped by Beard (1972) to the north-east of Bungalbin Hill, is in fact an important inland extent of the principally Myrtaceous-Proteaceous heaths common on Sandplains in the South-West (Figure 4). Black and white photography at 1:75,000, supplemented by field traverses, was the basis for drafting the vegetation map of the Bungalbin Hill survey area (Figure 4). Difficulty was occasionally encountered, on the aerial photography in differentiating the various types of low woodland vegetation.

Modifications of the natural environment over the past 150 years include the clearing of extensive areas in the south-western part of the Study Area for farming, the leasing of several large areas for grazing, and the mining of gold, iron and gypsum with its associated infrastructure. However, mining and exploration tracks have also been responsible for greatly improving access within the area. Pastoral leases generally follow the Undulating Plain (greenstone) and adjacent Broad Valley, but modification by stock has been only moderate in these areas. Most of the central areas have very poor access and there is limited surface or subterranean water, both factors accounting for the relatively unmodified vegetation systems of the area.

Most of the extensive woodlands and low woodlands within the Study Area are regarded as being too open to carry a fire. Chenopods, which dominate the Salt Lake Feature and are a common understory in many woodlands, are strongly fire resistant and thus help in restricting the extension of fire in these associations. The vegetation of Sandplain is denser and is burnt about every 10 to 30 years (mainly lightning strikes). The dense vegetation on some Hill landforms, coupled with a hummock grass stratum, allows fires to spread; this was evidenced by recent burns on Mt Walter.

The Study Area is a classical transitional zone from the predominantly South-West Botanical Province flora in the South-West to the predominantly Eremaean Botanical Province flora in the north-east. Characteristic species of the former are *Acacia restiacea, Stypandra imbricata, Xanthorrhoea preissii* while of the latter are *Acacia aneura* and *Eremophila eriocalyx.* The occurrence of some characteristically south-western plant species in the drier north-eastern part of the Study Area can be related to the increased availability of water from run-off from Granite Exposure.

None of the vegetation types recorded were unique to the Study Area. Hill (banded ironstone formation) tends to have its own vegetation patterns and this landform unit carries the important inland species *Dryandra arborea,* whose distribution is centred on the Study Area (Keighery 1980). This species also has companion species which are considerable extensions of previously known ranges to the south.

The Study Area is floristically very rich with 783 species recorded. This is considerably more than elsewhere in the Eastern Goldfields where an area of similar size (Widgiemooltha–Zanthus Study Area) had only 535 species recorded (Newbey *et al.* 1984). The richness of the flora results from the high number of landform units present, the diverse topographical representation and the fact that the area is a transition zone between the South-West and Eremean Botanical Provinces.

No rare flora species (Rye and Hopper 1981) were recorded during this survey, but those species listed in Table 4 (columns 1-3) may be classified as such after further study. The floristic survey highlighted three important areas based on the concentration of first collections; Aurora Range and Sandplain in the north-east (7 spp.), Walyahmoning Rock (3 spp.) and Yacke Yackine Dam (2 spp.). Also recorded at the first area are three rarely collected species.

The vertebrate fauna of the Study Area had been poorly documented prior to this survey. This study has shown that the area is an important interzone between the faunas which have a distribution based on the more mesic south-west and those centred on the more arid interior (Dell and How this publ.). Over the Study Area many south-western species are replaced by, or are sympatric with, their arid-zone congeners, a factor common to reptiles, birds and mammals. Amphibians were not recorded frequently as both survey areas were in regions of little surface water and rapid drainage. Although no species were recorded that were endemic to the area, many important range extensions were

noted, some of several hundred kilometres. The Bungalbin survey area was particularly important both biogeographically and for species richness of reptiles and mammals. Thirteen species of gecko were collected, and the vegetation mosaic on Sandplain has the richest small mammal assemblage recorded in the Eastern Goldfields.

Fourteen reserves have been set aside in the Study Area partly or primarily for the conservation of fauna and flora; their combined areas occupy 4.8% of the Study Area (Table 11). The Mount Manning Nature Reserve straddles the boundaries of the Jackson–Kalgoorlie and the Barlee–Menzies Study Areas and has been the subject of an intensive survey by Burbidge *et al.* (in prep.). Walyahmoning Rock Nature Reserve was examined botanically during the current survey but the only information on the vertebrate fauna are unpublished reports of Baynes (pers. comm.). None of the smaller reserves were surveyed, but they are in general sited on Sandplain, or Granite Exposure with some small areas of Broad Valley represented.

Four landform categories, Salt Lake Feature, Hill (banded ironstone formation), Hill (quartz) and Undulating Plain (greenstone) are not represented in any reserves while Breakaway and Broad Valley are inadequately represented.

The Study Area has 9 Vegetation Systems (Beard 1972, 1978) represented within its boundaries (Table 12). Three of these, Bungalbin, Highclere and Jaurdi, are virtually confined to it, although none are represented in existing reserves. Of the 52 vegetation types recorded, 7 are poorly represented and 4 adequately represented in the Walyahmoning Rock Nature Reserve. Although Granite Complex is well represented in this reserve and some others in the south-west, similar complexes are in need of reservation in the north-east to conserve the heterogenous vegetation characteristic of these complexes.

The survey was conducted during years which were generally below the average rainfall (Figure 2), and it is highly probable that collections made after a wetter year will produce additional plant species. Areas in the north-west and south-west of the Study Area need further examination while areas adjacent to and including the Helena and Aurora Ranges should be examined at times of the year other than August and September. This is supported by Keighery's (1980) work in May 1978 which recorded three plant species not collected by us near Aurora Range. Granite Exposure and Salt Lake Feature are the landforms most likely to provide rare or new species of flora.

The adequacy of sampling for vertebrate fauna can be assessed from Figures 5-9 which indicate that additional work should record additional species both in the survey areas and sample sites. Of the 8 landform units and sub-units of the Study Area, 6 were surveyed for fauna. Breakaway, which has a scattered occurrence, and Hill (quartz) represented by Mt Walter, are in need of examination. The isolated and variable vegetation of Hill (banded ironstone formation) suggests additional sampling of these would be valuable. Only 10 of the 52 vegetation types recorded were sampled for fauna. Many of the remainder were isolated and small (<1 ha) in extent, however *Acacia acuminata* Tall Shrubland on Granite

Table 11 Flora and Fauna Reserves of Study Area.

Reserve No.	Name	Area (km²)	Purpose	Vesting
1432	Sandford Rocks	8.1	Water & Flora & Fauna	N.P.N.C.A.
18199	Unnamed	1.7	Flora & Fauna	N.P.N.C.A.
19210	Chiddarcooping	52.2	Water & Flora & Fauna	N.P.N.C.A.
23338	Geeraning Rock	6.8	Water & Flora & Fauna	Min. for W.S.S.D.
23339	Elachbutting Hill	4.7	Water & Flora & Fauna	Min. for Works
24465	Yanneymooning Hill	1.2	Water & Flora & Fauna	Min. for W.S.S.D.
26403	Unnamed	1.1	Flora	N.P.N.C.A.
27146	Unnamed	1.2	Flora	N.P.N.C.A.
32864	Unnamed	14.4	Flora	N.P.N.C.A.
32865	Unnamed	5.8	Flora	N.P.N.C.A.
32993	Unnamed	0.4	Flora & Fauna	N.P.N.C.A.
35752	Walyahmoning Rock	206.6	Flora & Fauna	N.P.N.C.A.
36918	Koolyanobbing	137.5	Flora & Fauna	N.P.N.C.A.
36208	Mt. Manning	776.0*	Flora & Fauna	N.P.N.C.A.
Total		1220.7		

N.P.N.C.A. = National Parks and Nature Conservation Authority

*An additional (797.8 km²) is present in the Barlee–Menzies Study Area.

Exposure; *Eucalyptus oleosa* Mallee and *A. quadrimarginea* Tall Shrubland on Hill (banded ironstone formation); *Allocasuarina acutivalvis* Tall Shrubland on Hill (quartz) and Sandplain; mosaics on Salt Lake Feature; *E. oldfieldii* Mallee on Sandplain; *E. clelandii* Low Woodland on Undulating Plain (greenstone) and *E. longicornis* Low Woodland on Broad Valley all occupy larger scattered areas and are in need of survey.

The Jackson–Kalgoorlie Study Area is a region of high topographical variation supporting a rich and diverse vegetation. Its proximity to the inland extent of the regular winter rainfall region makes it of particular biogeographic significance as evidenced by both the flora and vertebrate fauna species recorded. The findings of our study support the suggestion put forward by Keighery (1980) that the CTRC (1974) recommendation of making the Mt Manning Range/Die Hardy Range and Mt Jackson Range a reserve be extended to include the Helena and Aurora Ranges and the land enclosed by these major features. This would ensure the conservation of several representatives of the highly variable vegetation associated with the range together with large and relatively unmodified areas of eucalypt woodland, mallee and tall shrubland.

Table 12 Representation of the Vegetation Systems within the Study Area (km²)

Vegetation System	Total	Within S Area	Reserves A	B	C	D	E	F	G	H	I	J	K	L	M	N*	Total
Boorabbin	17265	1565	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bungalbin	445	425	.	.	.	.	.	.	.	.	.	.	.	.	.	23.0	23.0
Die Hardy	2155	1805	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Highclere	660	585	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jackson	11115	9460	.	.	.	.	.	.	.	.	.	.	.	.	137.5	753.0	890.5
Jaurdi	5875	5090	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Karroun	7130	2160	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kunanalling	3070	560	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Moorine Rock	12570	2290	8.1	1.7	52.2	6.8	4.7	1.2	1.1	1.2	14.4	5.8	0.4	209.6	.	.	1220.7
TOTAL		23985	8.1	1.7	52.2	6.8	4.7	1.2	1.1	1.2	14.4	5.8	0.4	209.6	137.5	776.0	1220.7

Reserves: A = Sandford Rocks (1432)
B = Unnamed (18199)
C = Chiddarcooping (19210)
D = Geeraning Rock (23338)
E = Elachbutting Hill (23339)
F = Yanneymooning Hill (24465)
G = Unnamed (26403)
H = Unnamed (27146)
I = Unnamed (32864)
J = Unnamed (32865)
K = Unnamed (32999)
L = Walyahmoning Rock (35752)
M = Koolyanobbing (36918)
N = Mt. Manning (36208)

S Area Study Area

*The Mt. Manning Nature Reserve also extends into the Barlee – Menzies Study Area (797.8 km²).

Areas were calculated from Beard (1978; 1979).

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