

**BOTANICAL SURVEY OF**

**CENTRAL PILBARA UPLANDS**

**Project (N709)**

**Final Report - Third Year 1997**

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## PRECIS

### BOTANICAL SURVEY OF CENTRAL PILBARA UPLANDS

#### Project N706

*A total of 745 uplands greater than 1 000 m elevation have been identified in the Central Pilbara. These uplands are principally located throughout the central and eastern portions of the Hamersley Range. Thirty seven of these uplands were selected as primary sites for detail botanical investigation. To ensure a representative sampling of the biophysical gradients present across the project area an additional 16 upland sites were included in the project design. These supplementary sites were less than 1 000 m elevation and were located towards the margins of the Hamersley Range.*

*Since the commencement of this project in 1995, 22 of the selected uplands have been surveyed. Permanent benchmark quadrats have been established on each upland visited and the flora within quadrats systematically recorded. Opportunistic sampling outside quadrats has also been undertaken along with the collection of soil samples for edaphic attribute characterisation.*

*A total of 327 taxa representing 133 genera in 58 families have been recorded from the uplands visited. Voucher specimens have been collected for 89% of the species encountered, with the total number of vouchers collected approaching 460. The most floristically rich families were the Asteraceae, Malvaceae, Mimosaceae and Myrtaceae. The most floristically rich genera were Acacia, Eucalyptus, Eremophila and Senna. During the project 27 species of biological significance representing 81 populations have been documented.*

*Differences in floristic composition between upland sites was evident and appears to be related to geological setting, in particular edaphic considerations. Augmentation of the species database through visits to unsampled uplands, continued development of the soil attribute database and refinement of the geological GIS should provide plausible explanations for observed biogeographical patterns.*

TITLE OF PROJECT:

Botanical Survey of Central Pilbara Uplands

AGENCY:

Western Australian Department of Conservation and Land Management (CALM), Science and Information Division.

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AIM OF PROJECT:

To comprehensively document the flora of upland sites within the Central Pilbara in order to facilitate an evaluation of the distribution of rare, geographically restricted and endangered plant species and to assist with the identification of areas of high floristic richness.

SCOPE:

1. Finalise identification of Central Pilbara upland sites using results from previous survey.
2. Continue systematic sampling of permanent quadrats on upland sites.
3. Compile results of 1996 survey.
4. Begin data entry and preliminary analysis of previous survey results.
5. Begin preparation of quantitative descriptions of species composition of each site sampled in 1996.
6. Map the distribution of any species of conservation significance recorded in previous surveys.
7. Begin the analysis of plant species data using multivariate and ordination techniques to determine patterns of species richness, turnover and distribution between upland sites.
8. Begin the development and presentation of management recommendations based on the 1996 survey, which will be designed to ensure that sites identified as biologically significant are not affected by deleterious perturbations. Such management recommendations may also include proposals for reserve gazettal if conservation values are considered to be significantly high.

## PROGRESS TOWARDS COMPLETION OF SCOPE ITEMS:

During 1997 little progress was made towards fulfilment of scope items for this project. This shortcoming in progress can be attributed principally to a nine month secondment of the chief investigator onto an inter-agency government taskforce reviewing the adequacy of the Hamersley Range conservation estate and proposed additions to augment the estate's representativeness and comprehensiveness. Logistical difficulties associated with the availability of a helicopter, which is required for access to many of the upland sites, and the delays incurred in preparation of the 1997 contract for this project also contributed to the minimal progress during 1997.

Despite these shortcomings progress was made primarily with the identification of further upland sites for survey, databasing and identification of voucher specimens and characterisation of the edaphic attributes from sites which had been surveyed. During the chief investigator's secondment extensive use was made of information collected as part of this project for upland sites in the Karijini National Park and proposed conservation estate additions. This information was used to highlight inadequacies in the existing conservation reserve system in the Hamersley Range and to identify areas of potential conflict with respect to future resource development projects, many of which impinge on upland sites. Information generated as part of the chief investigator's secondment, particularly specimen and GIS databases (flora, vegetation and geology), will also be useful to this project, especially when interpreting the patterns of species richness and turnover between upland sites and making recommendations from management and reserve gazettal to protect upland sites with significantly high conservation values.

Progress on this project is outlined below.

### **Scope 1:**

A total of 53 upland sites, comprising 37 primary and 16 supplementary sites, have now been identified within the project area (Figure 1). The 37 primary sites comply with stipulations for site selection as detailed in previous progress reports (ie. greater than 1 000 m in elevation and equidistant within the 15' latitude and longitude grid superimposed over the project area). The 16 supplementary upland sites were selected as a consequence of amendments to the site selection strategy. These amendments were prompted primarily by a desire to ensure that the biophysical gradients across the Hamersley Range, principally climatic and geological considerations, were sampled as part of this project. To this end many of the supplementary sites captured to ensure that biophysical gradients are represented in the sampling strategy are on the fringing edges of the project area and are less than 1 000 m in elevation. Consideration of logistical requirements, especially with respect to access to supplementary upland sites also influenced the selection of these sites.

The delimitation of upland sites throughout the project area was facilitated through the use of topographical and Landsat imagery captured or acquired in an appropriate GIS format. Interrogation of this data through MapInfo resulted in the identification of 745 upland sites (spot heights greater than 1 000 m elevation) throughout the project area (Figure 2) and assisted in the identification

Figure 1

Figure 2



of areas overlooked during the initial site selection process. These interrogations have also aided in the identification of areas for possible supplementary survey sites.

### **Scope 2:**

A total of 22 uplands sites, comprising 18 primary and four supplementary sites have been sampled throughout the project area. The majority of these sites were in the central and western portion of the Hamersley Range (Figure 1). A helicopter was used to access most of these sites as they were remote and difficult to approach by vehicle or on foot.

On each of the sampled sites a permanent benchmark quadrat has been established within which all plant taxa have been recorded. Wherever possible this quadrat is positioned to include the upland summit and the adjacent areas incorporating 1 600 m<sup>2</sup>. Quadrats this size in the Pilbara capture approximately 90% of the plants species present within a given community (van Leeuwen and Start, unpublished data). To ensure uniformity in sampling effort across all sites these quadrats were searched systematically over a one person hours period. In addition to the systematic sampling of permanent quadrats, random opportunistic sampling was also undertaken over the entire upland site. This was achieved by walking over the site and opportunistically collecting and recording all plant species encountered. A minimum of three person hours random opportunistic sampling was undertaken at each upland site.

Soil samples have been obtained from all upland sites visited. Analyses of the physical and chemical attributes for 12 of these soils samples has been undertaken and is progressing for the remainder using standard analytical procedures. Information gathered from these samples will provide an additional database to help interpret patterns of species composition and turnover between upland sites throughout the study area.

In summary, the sampling methodology being employed to sample upland site throughout the study area includes the:

- establishment of a 40 x 40 m permanently marked benchmark quadrat on the summit of each upland site;
- sampling of all plants within this quadrat for a duration of one person hour;
- opportunistic sampling of the flora on fringing slopes and screes outside the quadrat over a minimum of three person hours; and
- collection of a soil sample.

### **Scope 3:**

A total of 327 taxa (Appendix One) representing 1 149 records have been recorded during the field program from the 22 upland sites visited. Within the permanent benchmark quadrats a total of 141 taxa representing 431 records were registered. Voucher specimens have been collected for 89% of the plant species encountered, with the total number of vouchers collected for the project approaching 460 specimens.



A total of 133 genera in 58 families have been registered during the course of this project (Appendix One). The most floristically rich families were the Asteraceae, Malvaceae, Mimosaceae and Myrtaceae with in excess of 20 taxa each. The most floristically rich genera were *Acacia*, *Eucalyptus*, *Eremophila* and *Senna* being represented by 28, 26, 15 and 14 taxa, respectively. The dominance of these families and genera are likely to change with the continued identification of numerous undetermined specimens, although their relative floristic importance will probably remain unaltered as they represent important constituents of the flora of arid inland Australia.

Populations of numerous taxa of conservation and taxonomic significance have been identified during this survey. The location of these taxa are illustrated in Figure 3. The taxa of significance were:

*Acacia* sp. West Angelas (M. E. Trudgen 16163)

This recently recognised taxon, which superficially resembles *Acacia hamersleyensis*, has been collected from one upland site during this project. The four other known populations are all in the Central Hamersleys and are all upland sites, with the exception of the Dales Gorge locality. This taxon is most closely allied to a species from the east coast of Australia, although further taxonomic investigations are required to confirm these affinities.

*Brachychiton acuminatus*

This species is listed as a Priority Four taxon on CALM's Priority Flora list. The species is endemic to the Pilbara Biogeographical Region extending from the Burrup Peninsula through the Chichester Range and into the Hamersley Range. The species has been recorded from seven upland sites during this project.

*Brachychiton gregorii*

This taxon has an extensive distribution throughout arid central Australia from Shark Bay and Norseman in Western Australia through the Great Victoria and Gibson Desert into north-eastern South Australia and the central Northern Territory. During this project the species has been recorded on eight upland sites. These sites represent disjunct outlying populations from the species main distribution.

*Cryptandra monticola*

This Hamersley Range endemic, which until 1995 was listed on CALM's Priority Flora List is known from approximately 25 populations throughout the Hamersley Range. During this survey the species has been recorded from nine upland sites. The record for this species obtained from upland 5/96 extends the species distribution west by approximately 100 km.

*Dampiera* sp. Mt Bruce (M. E. Trudgen 1334)

This undescribed taxon is listed as Priority Two on CALM's Priority Flora List. The taxon is endemic to the Hamersley Range where it is known from eight populations, four recorded during the course of this project.

*Dampiera* sp. Mt Meharry (M. E. Trudgen 1178)

This undescribed taxon is listed as Priority Two on CALM's Priority Flora List. The taxon is endemic to the Hamersley Range where it is known from six populations, two recorded during the course of this project.

*Daviesia eremaea*

This species is on CALM's Priority Three flora list. The species has a distribution in the central deserts of Western Australia and the Northern

Figure 3

Territory where it principally grows in the red sands of swales between dunes. Prior to the collection of this species from two uplands in the Hamersley Range as part of this project the most westerly known population was in the Little Sandy Desert<sup>A</sup> east of Kumarina. The two Hamersley Range populations are over 230 km removed.

*Eremophila "magnifica"*

This undescribed taxon, which may consist of two distinct subspecies (R. J. Chinnock, personal communication) is endemic to the Hamersley Range. The taxon is listed on CALM's Priority Flora List as a Priority Three taxon. Prior to the commencement of this survey the taxon was known from 12 populations. An additional four populations have been documented during this project.

*Eucalyptus ewartiana*

This mallee has a distribution predominantly throughout the northern wheatbelt to Great Victoria Desert regions in southern Western Australia. Disjunct outlying populations are known from a few uplands within the Hamersley Range, namely Mt Newman, Mt Robinson and Mt Meharry. During this project the species has been recorded from six upland sites, four of which are new localities.

*Eucalyptus pilbarensis*

This species is endemic to the Pilbara Biogeographical Region being almost entirely restricted to the Hamersley Range. The species is listed on CALM's Priority Flora List as a Priority Four taxon. Prior to this project the species was known from 13 populations. During this project the species has been recorded from three new localities. Several of the undetermined *Eucalyptus* specimens may also represent this taxon.

*Hibbertia glaberrima*

This species is listed as a Priority Two taxon on CALM's Priority Flora list. The species was only known from Mt Bruce in Western Australia, although the species has also been recorded from numerous populations in the MacDonnell Ranges, Northern Territory. During this project a population of *H. glaberrima* was located on Mt Robinson.

*Hibbertia* aff. *glaberrima* (SVL 2822)

This taxon is closely allied to typical *H. glaberrima* from which it differs in floral morphology. Further investigations are required to ascertain if these differences are significantly pronounced to warrant recognition of the taxon as a distinct species. This taxon has been recorded from nine upland sites during this project.

*Melaleuca leiocarpa*

This species is common in spinifex and mallee communities of the Murchison and Coolgardie Biogeographical Regions in Western Australia. The record of this species on Mt Wall, obtained during this project, is the only collection from the Hamersley Range. This Mt Wall population is a disjunct outlier which is 180 km north of the next nearest population on Mt Augustus.

*Newcastellia cephalantha*

This species is distributed throughout the Eremaean Botanical Province of Western Australia extending from Telfer to south of Wiluna and from Kumarina east to the Northern Territory border. The species is also found

<sup>A</sup> The populations of *Daviesia eremaea* located in the Little Sandy Desert east of Kumarina were recorded during the National Reserve System Program project N706 - Biological Survey of the Southern Little Sandy Desert.

in the Northern Territory, Queensland and South Australia. This species has been recorded from one upland site during this project which is the first record of the taxon in the Hamersley Range and Pilbara Biogeographical Region. This population is a disjunct outlier located 190 km north west of the next nearest population.

*Newcastellia spodiotricha*

This species is found in arid Western Australia, Northern Territory, Queensland and South Australia. Within Western Australia its distribution extends from the Edgar Range to Muggan Rockhole (Warburton Range) near the border with the Northern Territory. The species has been recorded from one upland site during this project which is the first record of the taxon in the Hamersley Range and Pilbara Biogeographical Region. This population is a disjunct outlier located approximately 250 km west of the next nearest population in the Little Sandy Desert.

*Olearia plucheacea*

This species is endemic to Western Australia occurring in the Gascoyne and Murchison Biogeographical Regions. This species is known from approximately eight populations throughout the two regions. The collection of this species from one upland site during this project represents the first record of this taxon in the Hamersley Range and Pilbara Biogeographical Region. This disjunct outlying population is 220 km north east of the next nearest population on Mt Augustus.

*Paraceterach reynoldsii*

Three new populations of this species have been located during this project. Until the commencement of this project no specimens of this Central Australian taxon were housed in the W. A. Herbarium, although the species had previously been cited as occurring in Western Australia<sup>B</sup>. It is understood that these records were based on specimens collected from Dales Gorge in the Hamersley Range.

*Pimelea forrestiana*

This species has a distribution which until recently was centred on the Gascoyne and Murchison Biogeographical Regions, although the Type collection was made from Mt Pyrtton in the Hamersley Range by John Forrest in 1869. Recent collections have confirmed that the species does occur in the Hamersley Range, although these records are infrequent. During this project the species has been recorded from nine upland sites including the Type locality.

*Pimelea microcephala*

This species has a widespread distribution across Australia occurring in all mainland states. In Western Australia the species occurs from North West Cape to the Nullarbor where it is usually found growing in shrublands on sand. One population has previously been recorded in the Hamersley Range. During this project another population was located north of Mt Robinson.

*Prostanthera campbelli*

This species is endemic to Western Australia extending from the Ashburton to Avon-Wheatbelt Biogeographical Regions. The population recorded during this project is the first from the Hamersley Range and Pilbara Biogeographical Region. This population is a disjunct outlier

<sup>B</sup> Hnatiuk, R. J. (1990). *Census of Australian Vascular Plants*, Bureau of Flora and Fauna, Australian Flora and Fauna Series, No 11.



located approximately 220 km north east of the next nearest population on Mt Augustus.

*Scaevola acacioides*

This species is listed as Priority Two on CALM's Priority Flora List. The species has a distribution centred on the Hamersley Range, although outlying populations occur in the Barlee Range. During this project an additional two populations have been located.

*Stenanthemum petraeum*

This recently described species has a distribution throughout central Western Australia from Mt Augustus eastwards to Warburton. The species is also known from the Peterrmann Range in the Northern Territory. It has previously been collected on only one occasion in the Hamersley Range at a location approximately 25 km north of the population located during this project.

*Taplinia saxatilis*

This woody herb is known from several populations throughout the Gascoyne and Murchison Biogeographical Regions. Prior to the collection of this species from one Hamersley Range upland site during this project the most northern population known for this species was on Mt Augustus. Recently the species has been recorded from another upland site in the Hamersley Range near West Angela Hill.

*Thryptomene wittweri*

This species is gazetted as Declared Rare Flora. The species has a peculiar distribution occurring on three hilltops throughout the Eremaean Botanical Province of Western Australia. The species is also known from Palm Valley in the Northern Territory. During this project the species was recorded on Mt Meharry, a previously known population.

*Thysanotus manglesianus*

This fringed lily is common in the transitional rainfall zone between the South-west and Eremaean Botanical Provinces. It has a range which extends from Meekatharra to Balladonia and is usually found growing in sandy soils. The population located on Mt Meharry during this project is the most north and is a disjunct outlier. The next nearest known population is on Mt Augustus, some 220 km further south.

*Thysanotus "inaequalis"*

This undescribed fringed lily is very poorly known but appears to have a distribution throughout the Murchison and Coolgardie Biogeographical Regions of Western Australia. The taxon has also been collected in South Australia. The nearest known population to the two located during this project is at Meekatharra, 400 km south of the Central Hamersley Range.

Genus sp. nov. (SVL 2683)

This taxon appears to be new to science and has not previously been recorded in the scientific literature. The taxon is closely allied to the genus *Olearia* from which it differs in the absence of ray florets. It is an attractive plant with large flowers. Only one population of this taxon has been located during this project.

Many of the undescribed taxa listed, and some of those which have been tentatively identified in Appendix One, may also be of conservation and taxonomic significance. This is particularly true for many of the unidentified specimens in the Goodeniaceae, Tiliaceae and Malvaceae and for taxa of

*Eucalyptus* and *Eremophila*. Many of these unidentified specimens may represent novel taxa which will require identification by specialist taxonomists before an assessment of conservation status can be made. Ongoing identification and specimen processing will clarify these problems.

One environmental weed, Ruby Dock (*Acetosa vesicaria*), was recorded on several of the upland sites visited. This species has unfortunately become more common in the Pilbara favouring disturbed sites associated with mining operations, particularly waste rock dumps and associated scree and batters. The species appears to be invading some upland sites as a consequence of its inflated fruits which aid in wind dispersal and the inherent nature of many upland sites which comprise scree slopes.

Results from the chemical and physical analyses of the soil samples collected from the 20 sample sites are presented in Table 1. There is considerable variation between uplands sites in many of the attributes assessed, in particular electrical conductivity (EC), total phosphorus (P total) and exchangeable cations, particularly calcium (Ca).

#### **Scope 4:**

Processing, incorporation and databasing of plant specimens into the Pilbara Regional Herbarium is progressing. Duplicate specimens are also being forwarded to the Western Australian Herbarium and, in the case of specimens of taxonomic interest, vouchers are being forwarded to appropriate taxonomists at Eastern States and overseas institutions.

A specimen database has been established and is continually being augmented as new specimen identifications become available. Development of the GIS database is progressing and currently contains themes related to vegetation (Beard's 1 : 000 000 map), land systems and geology. The latter two themes require accuracy verification and further development to ensure that they are useful products. A cadastral/tenure theme is also in the process of being developed and the relief theme is continually being refined as new data becomes available. Development of a fire history theme is not feasible as CALM and Local Government fire history records are not comprehensive enough to accurately delimit burnt area throughout the project area. The use of satellite imagery was investigated as an alternative to assist with the development of a fire history map for the project area, however, interpretation problems, principally associated with geological consideration, put the use of this tool and its development beyond the scope of this project.

#### **Scope 5:**

Preliminary work has commenced on the compilation of quantitative descriptions for the floristic composition and richness of the surveyed upland sites. Preliminary, exploratory analyses of the data support the notion that edaphic considerations have a marked impact on species distribution and the floristic composition of upland sites in the Hamersley Range. These edaphic considerations are intrinsically the product of the geological setting with the most

**Table 1** Chemical and physical attributes of the soils from 12 upland sites in the Central Pilbara.

Burrup Quadrat No.	EC (1:5) mS/m	pH (H <sub>2</sub> O)	pH (CaCl <sub>2</sub> )	Org C (W/B) %	N (total) %	P (total) mg/kg	P (HCO <sub>3</sub> ) mg/kg	Ca <sup>1</sup> (exch) me%	Mg (exch) me%	Na (exch) me%	K (exch) me%	Al (exch) me%	Mn (exch) me%	Sand %	Silt %	Clay %
1/96	2	6.3	5.1	1.06	0.071	437	6	4.46 <sup>b</sup>	1.08 <sup>b</sup>	0.04 <sup>b</sup>	0.32 <sup>b</sup>	0.75 <sup>b</sup>	0.19 <sup>b</sup>	65.5	18.5	16.0
2/96	1	5.6	4.4	1.22	0.079	365	6	1.73 <sup>b</sup>	0.44 <sup>b</sup>	0.02 <sup>b</sup>	0.24 <sup>b</sup>	0.03 <sup>b</sup>	0.13 <sup>b</sup>	60.0	24.0	16.0
3/96	2	6.3	5.2	0.60	0.037	297	9	4.42 <sup>b</sup>	2.64 <sup>b</sup>	0.02 <sup>b</sup>	0.49 <sup>b</sup>	0.02 <sup>b</sup>	0.24 <sup>b</sup>	65.0	17.5	17.5
4/96	12	6.0	5.3	1.73	0.103	442	7	8.06 <sup>b</sup>	1.93 <sup>b</sup>	0.17 <sup>b</sup>	0.34 <sup>b</sup>	0.04 <sup>b</sup>	0.15 <sup>b</sup>	63.5	22.0	14.5
5/96	2	6.4	5.3	2.50	0.149	458	6	8.80 <sup>b</sup>	1.81 <sup>b</sup>	0.03 <sup>b</sup>	0.25 <sup>b</sup>	1.26 <sup>b</sup>	0.12 <sup>b</sup>	55.5	28.0	16.5
6/96	1	5.4	4.2	2.17	0.123	385	4	1.15 <sup>b</sup>	0.46 <sup>b</sup>	<0.02	0.26 <sup>b</sup>	0.02 <sup>b</sup>	0.13 <sup>b</sup>	69.5	17.0	13.5
7/96	2	6.4	5.3	1.02	0.049	482	11	6.68 <sup>b</sup>	1.47 <sup>b</sup>	<0.02	0.29 <sup>b</sup>	0.10 <sup>b</sup>	0.19 <sup>b</sup>	57.0	22.0	21.0
8/96	2	6.0	4.7	1.47	0.083	788	20	5.21 <sup>b</sup>	1.89 <sup>b</sup>	0.03 <sup>b</sup>	0.48 <sup>b</sup>	0.03 <sup>b</sup>	0.15 <sup>b</sup>	65.5	20.5	14.0
9/96	1	6.3	5.1	0.84	0.041	458	7	4.78 <sup>b</sup>	0.96 <sup>b</sup>	<0.02	0.18 <sup>b</sup>	0.32 <sup>b</sup>	0.33 <sup>b</sup>	53.5	30.0	16.5
10/96	2	5.8	4.7	1.99	0.117	437	8	6.86 <sup>b</sup>	1.20 <sup>b</sup>	0.02 <sup>b</sup>	0.38 <sup>b</sup>	0.08 <sup>b</sup>	0.17 <sup>b</sup>	74.0	10.5	15.5
11/96	2	5.9	4.9	1.54	0.084	405	6	5.36 <sup>b</sup>	0.82 <sup>b</sup>	<0.02	0.22 <sup>b</sup>	<0.02	0.03 <sup>b</sup>	55.0	25.5	19.0
12/96	1	6.1	4.8	1.35	0.081	340	4	3.46 <sup>b</sup>	2.80 <sup>b</sup>	0.03 <sup>b</sup>	0.29 <sup>b</sup>	<0.02	0.03 <sup>b</sup>	55.0	25.5	19.0

Note: 1 Methods used in determination of exchangeable cations:  
a extracted in 1M NH<sub>4</sub>Cl, pH 7.0  
b extracted in 0.1M BaCl<sub>2</sub>  
c extracted in 1M NH<sub>4</sub>Cl, pH 8.5



pronounced differences in floristic composition being apparent between Brockman Iron Formation (banded iron) and Mt Jope Volcanics (basalts).

#### **Scope 6:**

A GIS database for plant species of conservation, taxonomic and biological significance has been developed. The distribution of populations for the 27 significant species detailed in Scope Item 3 is provided in Figure 3. Interrogation of the WA Herbarium database (WAHERB) and the databases of resources companies with interests in the project area are being examined to identify additional populations for the species of significance, especially in instances where they occur on upland sites. This data will be used to develop a detailed GIS database on the distribution of significant flora which will facilitate the assessment of floristic richness patterns throughout the project area. This data will also expedite assessments of the representativeness and adequacy of the existing reserve system in the project area.

#### **Scope 7:**

Some preliminary exploratory analyses have been undertaken on the flora databases in order to elucidate patterns of species distribution, turnover and richness. These results indicated that some upland sites are particularly rich in species (eg. Mt Robinson), especially those species which are represented by disjunct outlying populations. As previously reported, geological setting also appears to significantly influence the distribution of species. The position of the upland site with reference to the Hamersley Escarpment also appears to influence site floristics, although more detailed analysis and a large site database will be required to confirm this proposition.

#### **Scope 8:**

Distributional data for flora species of biological and conservation significance is already being utilised for routine management and operational procedures within the Karijini National Park. Species distributional data has been incorporated onto Wildfire Threat Analysis maps for the national park and areas immediately adjacent, especially in the proposed Mulgalands Natural Resources Management Area around Mt Robinson and Giles Point. The species distributional data has also been incorporated into operational plans, such as the Master Burn Plan for Karijini National Park which is associated with the development of strategic aerial buffers for the control and suppression of wildfires.

The flora database developed during this project has been used to help justify the case for incorporating significant parcels of vacant Crown land, adjacent to Karijini National Park, into the conservation estate. The data has been used to highlight some inadequacies, in terms of species representativeness, of upland sites within the national park and has also been used to illustrate how the inclusion of floristically rich uplands (eg. Mt Robinson) will significantly augment the comprehensiveness of the reserve system in the project area.

Data collected during this project has also been used to assist with the environmental assessments on a number of resource developments in the project area, namely the Environmental Review and Management Plan for Robe River Iron Associate's West Angelas project and the Public Environmental Review for BHP Iron Ore's Mining Area C proposal.

No formal proposals for reserve gazettal have been developed as part of this project, although the data has been used to strengthen the arguments for existing proposals, as outlined above.

#### PLANNED ACTIVITIES TOWARDS COMPLETION OF SCOPE ITEMS:

In 1998 it is planned to visit and sample the remaining 29 upland sites. Research will also continue on the identification of plant specimens collected, their databasing and ultimately incorporation into herbaria. Analytical work will also continue on the collected soil samples. Development of the GIS database will also proceed with the capture of additional themes and verification of geological and cadastral themes. Development of proposals for reserve acquisition and recommendations for management will also be initiated to ensure that uplands with significant biological value are represented on the conservation estate.

\* \* \* \* \*

## APPENDIX ONE

## Appendix One

### Vascular Plant Species

#### Botanical Survey of Central Pilbara Uplands

December 1997

*This list of vascular plants includes all specimens collected during the 1995 and 1996 field programs and subsequently identified before 1 December 1997. Taxa are listed alphabetically in the order of genus and species in their respective families. The family sequence follows approximately the classification presented in Green (1985) "Census of the Vascular Plants of Western Australia". Nomenclature generally follows Green op. cit. and that employed by the Western Australian Herbarium, apart from a few exceptions where recent taxonomic revisions have suggested alternative classifications.*

\* *Introduced species.*

## APPENDIX ONE

## ADIANTACEAE

*Cheilanthes brownii*  
*Cheilanthes sieberi*  
*Cheilanthes* sp. nov. (SVL 2812)  
*Paraceterach reynoldsii*

## CUPRESSACEAE

*Callitris glaucophylla*

## POACEAE

*Amphipogon caricinus*  
*Aristida contorta*  
*Cymbopogon obtectus*  
*Cymbopogon* sp. nov.  
*Eriachne dominii*  
*Eriachne mucronata*  
*Iseilema vaginiflorum*  
*Paraneurachne muelleri*  
*Themeda triandra*  
*Triodia epactia*  
*Triodia pungens*  
*Triodia wiseana*

## CYPERACEAE

*Cyperus cunninghamii*

## ANTHERICACEAE

*Thysanotus manglesianus*  
*Thysanotus "inaequalis"*  
*Tricoryne "trudgeniana"*

## MORACEAE

*Ficus platypoda* var. *lachnocaulon*  
*Ficus platypoda* var. *minor*

## PROTEACEAE

*Grevillea berryana*  
*Grevillea leucodendron*  
*Grevillea stenobotrya*  
*Grevillea striata*  
*Grevillea wickhamii* subsp. *aprica*  
*Hakea suberea*  
*Hakea* sp. nov. (SVL 2720)

## SANTALACEAE

*Exocarpos sparteus*  
*Santalum lanceolatum*

## LORANTHACEAE

*Amyema miquelii*  
*Diplatia* aff. *grandibracteata*  
 (SVL 2825)

## POLYGONACEAE

\* *Acetosa vesicaria*

## CHENOPODIACEAE

*Dysphania rhadinostachya*  
*Rhagodia eremaea*  
*Salsola kali*

## AMARANTHACEAE

*Ptilotus aervoides*  
*Ptilotus auriculifolius*  
*Ptilotus calostachyus*  
*Ptilotus carinatus*  
*Ptilotus exaltatus*  
*Ptilotus gomphrenoides*  
*Ptilotus helipteroides*  
*Ptilotus macrocephalus*  
*Ptilotus obovatus*  
*Ptilotus polystachyus*  
*Ptilotus rotundifolius*

## GYROSTEMONACEAE

*Codonocarpus cotinifolius*

## PORTULACACEAE

*Calandrinia* aff. *tepperiana*  
 (SVL 2043)

## CARYOPHYLLACEAE

*Polycarpaea holtzei*  
*Polycarpaea longiflora*

## APPENDIX ONE

## MENISPERMACEAE

*Tinospora smilacina*

## LAURACEAE

*Cassytha capillaris*

## CAPPARACEAE

*Capparis lasiantha*  
*Capparis spinosa*  
*Capparis umbonata*  
*Cleome viscosa*

## BRASSICACEAE

*Lepidium oxytrichum*

## PITTOSPORACEAE

*Pittosporum phylliraeoides* var.  
*microcarpa*

## SURIANACEAE

*Stylobasium spathulatum*

## MIMOSACEAE

*Acacia adoxa*  
*Acacia aneura*  
*Acacia arida*  
*Acacia atkinsiana*  
*Acacia ayersiana*  
*Acacia bivenosa*  
*Acacia coriacea* subsp. *seriophylla*  
*Acacia coriacea* subsp. *pendens*  
*Acacia cowleana*  
*Acacia dictyophleba*  
*Acacia hamersleyensis*  
*Acacia* sp. West Angela (M. E. Trudgen 16163)  
*Acacia inaequilatera*  
*Acacia kempeana*  
*Acacia maitlandii*  
*Acacia marramamba*  
*Acacia monticola*  
*Acacia pachyacra*  
*Acacia pruinocarpa*  
*Acacia pyriformis*

*Acacia rhodophloia*  
*Acacia spondylophylla*  
*Acacia stowardii*  
*Acacia* aff. *subtessarogona* (SVL 2738)  
*Acacia synchronicia*  
*Acacia tenuissima*  
*Acacia tetragonophylla*  
*Acacia validinervia*

## CAESALPINIACEAE

*Petalostylis labicheoides*  
*Senna artemisioides* subsp. *x artemisioides*  
*Senna artemisioides* subsp. *helmsii*  
*Senna artemisioides* subsp. *oligophylla*  
*Senna artemisioides* subsp. *sturtii*  
*Senna artemisioides* subsp. sp. nov. (SVL 2063)  
*Senna cardiosperma* subsp. *cardiosperma*  
*Senna* sp. "cardiosperma group" (SVL 2706)  
*Senna glutinosa* subsp. *ferraria*  
*Senna glutinosa* subsp. *glutinosa*  
*Senna glutinosa* subsp. *luerssenii*  
*Senna glutinosa* subsp. *pruinosa*  
*Senna notabilis*  
*Senna pleurocarpa* var. *augustifolia*  
*Senna* sp. nov. (SVL 1946)

## PAPILIONACEAE

*Daviesia eremaea*  
*Gastrolobium grandiflorum*  
 Genus sp. nov. (SVL 2015)  
*Glycine tabacina*  
*Gompholobium polyzygum*  
*Indigofera "fractiflexa"*  
*Indigofera monophylla*  
*Indigofera* sp. nov. (SVL 2011)  
*Indigofera* sp. nov. (SVL 2023)  
*Indigofera* sp. nov. (SVL 2794)  
*Isotropis atropurpurea*  
*Mirbelia viminalis*  
*Rhynchosia minima*  
*Rhynchosia* aff. *minima* (SVL 2050)  
*Rhynchosia* sp. Bungaroo Creek (M. E. Trudgen 12402)

## APPENDIX ONE

*Swainsona maccullochiana*  
*Swainsona* sp. Hamersley Station  
 (A. A. Mitchell 196)

*Corchorus* sp. nov. (SVL 2808)  
*Triumfetta* sp. nov. (SVL 1717)  
*Triumfetta* sp. nov. (SVL 2800)  
*Triumfetta* sp. nov. (SVL 2806)

## ZYGOPHYLLACEAE

*Tribulus platypterus*  
*Tribulus astrocarpus*  
*Tribulus suberosus*

## POLYGALACEAE

*Polygala chinensis*

## EUPHORBIACEAE

*Euphorbia boophthona*  
*Phyllanthus maderspatensis*

## CELASTRACEAE

*Maytenus* aff. *cunninghamii*

## STACKHOUSIACEAE

*Stackhousia* sp. nov. (SVL 1961)

## SAPINDACEAE

*Alectryon oleifolius*  
*Atalaya hemiglaucula*  
*Dodonaea coriacea*  
*Dodonaea lanceolata*  
*Dodonaea peteolaris*  
*Dodonaea viscosa* subsp.  
*angustissima*  
*Dodonaea viscosa* subsp. *mucronata*  
*Dodonaea viscosa* subsp. *spatulata*

## RHAMNACEAE

*Cryptandra monticola*  
*Stenanthemum petraeum*  
*Ventilago viminalis*

## TILIACEAE

*Corchorus* sp. nov. (SVL 1956)  
*Corchorus* sp. nov. (SVL 2064)  
*Corchorus* sp. nov. (SVL 2080)  
*Corchorus* sp. nov. (SVL 2705)  
*Corchorus* sp. nov. (SVL 2750)

## MALVACEAE

*Abutilon lepidum*  
*Abutilon* sp. nov. (SVL 1949)  
*Gossypium robinsonii*  
*Hibiscus coati*  
*Hibiscus goldsworthii*  
*Hibiscus* aff. *haynaldii* (SVL 1998)  
*Hibiscus* aff. *haynaldii* (SVL 2813)  
*Hibiscus leptocladus*  
*Malvastrum americanum*  
*Sida fibulifera*  
*Sida* "golden calys"  
*Sida* sp. nov. (SVL 1951)  
*Sida* sp. nov. (SVL 1966)  
*Sida* sp. nov. (SVL 1978)  
*Sida* sp. nov. (SVL 1995)  
*Sida* sp. nov. (SVL 1997)  
*Sida* sp. nov. (SVL 2046)  
*Sida* sp. nov. (SVL 2066)  
*Sida* sp. nov. (SVL 2694)  
*Sida* sp. nov. (SVL 2707)  
*Sida* sp. nov. (SVL 2735)  
*Sida* sp. nov. (SVL 2746)

## STERCULIACEAE

*Brachychiton acuminatus*  
*Brachychiton gregorii*  
*Brachychiton* sp. nov. (SVL 2702)  
*Keraudrenia integrifolia*  
*Rulingia rotundifolia*  
*Waltheria indica*  
*Waltheria virgata*

## DILLENACEAE

*Hibbertia glaberrima*  
*Hibbertia* aff. *glaberrima* (SVL 2822)

## VIOLACEAE

*Hybanthus aurantiacus*



## APPENDIX ONE

## THYMELAEACEAE

*Pimelea forrestiana*  
*Pimelea microcephala*

## MYRTACEAE

*Calytrix carinata*  
*Corymbia deserticola*  
*Corymbia ferriticola*  
*Corymbia terminalis*  
*Corymbia* aff. *terminalis*  
*Corymbia* sp. nov. (SVL 2737)  
*Corymbia* sp. nov. (SVL 2765)  
*Eucalyptus ewartiana*  
*Eucalyptus gamophylla*  
*Eucalyptus kingsmillii*  
*Eucalyptus leucophloia*  
*Eucalyptus pilbarensis*  
*Eucalyptus* aff. *pilbarensis*  
(SVL 2823)  
*Eucalyptus rupullulans*  
*Eucalyptus trivalvis*  
*Eucalyptus "xerothermica"*  
*Eucalyptus* aff. *"xerothermica"*  
*Eucalyptus* sp. nov. (SVL 2085)  
*Eucalyptus* sp. nov. (SVL 2086)  
*Eucalyptus* sp. nov. (SVL 2671)  
*Eucalyptus* sp. nov. (SVL 2679)  
*Eucalyptus* sp. nov. (SVL 2680)  
*Eucalyptus* sp. nov. (SVL 2696)  
*Eucalyptus* sp. nov. (SVL 2697)  
*Eucalyptus* sp. nov. (SVL 2699)  
*Eucalyptus* sp. nov. (SVL 2713)  
*Eucalyptus* sp. nov. (SVL 2732)  
*Eucalyptus* sp. nov. (SVL 2754)  
*Eucalyptus* sp. nov. (SVL 2768)  
*Eucalyptus* sp. nov. (SVL 2785)  
*Eucalyptus* sp. nov. (SVL 2789)  
*Eucalyptus* sp. nov. (SVL 2795)  
*Eucalyptus* sp. nov. (SVL 2803)  
*Melaleuca leiocarpa*  
*Thryptomene wittweri*

## HALORAGACEAE

*Haloragis gosseii*

## ARALIACEAE

*Astrotricha hamptonii*

## APIACEAE

*Daucus glochidiatus*  
*Trachymene oleracea*  
*Trachymene* aff. *oleracea*

## OLEACEAE

*Jasminum didymum* subsp. *lineare*

## LOGANIACEAE

*Mitrasacme* sp. nov. (SVL 1983)

## ASCLEPIADACEAE

*Gymnema* sp. nov. (SVL 2820)  
*Gymnema* sp. nov. (SVL 2824)  
Genus sp. nov. (SVL 2027)  
*Rhyncharrhea linearis*  
*Sarcostemma viminale* subsp. *australe*

## CONVOLVULACEAE

*Evolvulus alsinoides*  
*Ipomoea* aff. *pes-caprae*  
*Porana commixta*

## BORAGINACEAE

*Halgania* aff. *solanacea*  
*Heliotropium heteranthum*  
*Trichodesma zeylanicum*

## VERBENACEAE

*Clerodendrum* sp. nov. (SVL 1959)

## CHLOANTHACEAE

*Newcastelia cephalantha*  
*Newcastelia spodiotricha*  
*Spartothamnella teucriflora*

## LAMIACEAE

*Plectranthus intraterraneus*  
*Plectranthus* aff. *intraterraneus*  
(SVL 2809)



## APPENDIX ONE

*Prostanthera albiflora*  
*Prostanthera campbellii*  
*Prostanthera* sp. nov. (SVL 1969)

## SOLANACEAE

*Nicotiana benthamii*  
*Nicotiana occidentalis*  
*Solanum ferosissimum*  
*Solanum horridum*  
*Solanum lanceolatum*  
*Solanum lasiophyllum*  
*Solanum sturtianum*  
*Solanum* aff. *sturtianum* (SVL 2718)  
*Solanum* sp. nov. (SVL 1974)  
*Solanum* sp. nov. (SVL 1988)  
*Solanum* sp. nov. (SVL 1994)  
*Solanum* sp. nov. (SVL 2028)  
*Solanum* sp. nov. (SVL 2718)  
*Solanum* sp. nov. (SVL 2753)  
*Solanum* sp. nov. (SVL 2815)

## ACANTHACEAE

*Rostellularia adscendens* subsp.  
*adscendens*  
*Rostellularia adscendens* subsp.  
*clementii*

## MYOPORACEAE

*Eremophila cuneifolia*  
*Eremophila exilifolia*  
*Eremophila forrestii*  
*Eremophila fraseri*  
*Eremophila latrobei*  
*Eremophila longifolia*  
*Eremophila "magnifica"* subsp.  
*"magifica"*  
*Eremophila "magnifica"* subsp.  
*"velutina"*  
*Eremophila* sp. nov. (SVL 1968)  
*Eremophila* sp. nov. (SVL 2036)  
*Eremophila* sp. nov. (SVL 2041)  
*Eremophila* sp. nov. (SVL 2677)  
*Eremophila* sp. nov. (SVL 2681)  
*Eremophila* sp. nov. (SVL 2693)  
*Eremophila* sp. nov. (SVL 2743)

## RUBIACEAE

*Canthium latifolium*  
*Canthium lineare*  
*Hedyotis crouchiana*  
*Pomax umbellata*  
*Pomax* aff. *umbellata* (SVL 2012)

## CUCURBITACEAE

*Mukia maderaspatana*

## LOBELIACEAE

*Lobelia heterophylla*

## BRUNONIACEAE

*Brunonia australis*

## GOODENIACEAE

*Dampiera candicans*  
*Dampiera* sp. Mt Bruce  
(M. E. Trudgen 1334)  
*Dampiera* sp. Mt Meharry  
(M. E. Trudgen 1178)  
*Dampiera* sp. nov. (SVL 2714)  
*Goodenia cusackiana*  
*Goodenia heterochila*  
*Goodenia prostrata*  
*Goodenia stobbsiana*  
*Goodenia trichophylla*  
*Goodenia triodiophylla*  
*Goodenia* sp. nov. (SVL 1947)  
*Goodenia* sp. nov. (SVL 1980)  
*Goodenia* sp. nov. (SVL 2013)  
*Goodenia* sp. nov. (SVL 2797)  
*Scaevola acaciodes*  
*Scaevola browniana*  
*Scaevola parvifolia* subsp. *pilbarae*  
*Scaevola* sp. nov. (SVL 2722)  
*Velleia connata*

## ASTERACEAE

*Bidens pilosa*  
*Calocephalus* sp. Wittenoom  
(A. S. George 1082)  
*Calotis eremaea*  
*Calotis hispidula*

## APPENDIX ONE

*Calotis multicalus*  
*Chrysocephalum pterochaetum*  
*Chrysocephalum semicalvum*  
*Chrysogonum trichodesmoides*  
Genus sp. nov. (SVL 2683)  
*Olearia plucheacea*  
*Olearia sturtii*  
*Olearia xerophila*  
*Pterocaulon serrulatum* var. *velutinum*  
*Pterocaulon sphaeranthoides*  
*Rhodanthe helichysoides*  
*Senecio magnificus*  
*Sigesbeckia orientalis*  
*Streptoglossa bubakii*  
*Taplinia saxatilis*  
*Vittadinia virgata*  
*Wedelia* sp. Hamersley  
(A. S. Western 8444)

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