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SA Arid Lands

Vegetation and Soil Assessment of Selected Waterholes of the Diamantina and Warburton Rivers, South Australia, 2014-2016

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Warburton River April 2015; Cowarie Crossing Warburton River May 2016

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1 Study Aims and Funding Context

This study is a component of an overarching multidisciplinary project to; identify the biophysical processes influencing ecosystem health; sustain biodiversity; and inform environmental water requirements within the Diamantina River system in far north-east South Australia.

There is currently a lack of baseline data and sufficient understanding of ecosystem processes particularly in the area of soil/plant/bird associations that are indicators of the health of the system. Thus the need to acquire this knowledge to make informed management decisions and prioritise investment to identify impacts on riparian zones and ecosystem function.

The study aimed to address this knowledge requirement sequentially by;

- conducting an initial assessment of 21 selected waterholes, examining and recording the composition and structure of vegetation and bird communities in order to determine the ecological state and baseline condition of these waterholes and greater Diamantina system;
- establishing permanent monitoring sites at each of the 21 waterholes to facilitate the observation of shifts of state or trends in condition into the future.

The project was funded by the Australian Government with the professed intent to "maintain ecosystem function and increase ecosystem resilience to climate change; and increase and improve the management of biodiverse carbon stores across the country" (CoA, 2013). The funds were awarded to the South Australian Arid Lands Natural Resources Management Board (SAAL NRM Board) and co-administered with the South Australian Department of Environment, Water and Natural Resources (DEWNR)>

The significance of Biodiversity values and the need for their conservation has been recognised by Federal and State Governments with the development of strategies at both levels of government.

Federal level; Australia's Biodiversity Conservation Strategy 2010-2030 (NRMMC, 2010), defines Biodiversity very succinctly as "*the variety of all life forms*" comprising three levels,

- genetic diversity – the variety of genetic information contained in individual plants, animals and micro-organisms
- species diversity – the variety of species
- ecosystem diversity – the variety of habitats, ecological communities and ecological processes.

State Level: "No species loss: A biodiversity strategy for South Australia 2007-2017 (DEH, 2007) provides the framework for biodiversity conservation in the State. Within this framework the "South Australian Arid Lands Biodiversity Strategy – Volume 1 Region-wide Priority Actions" (DEH, 2009a) provides a regional approach and identifies the following priority actions over the life of the strategy;

- Priority Action 1. Improving ecological knowledge, decision-making and capacity.
- Priority Action 2. Reducing the impact of climate change on biodiversity.
- Priority Action 3. Reducing the impact of invasive species on biodiversity.
- Priority Action 4. Reducing the impact of total grazing pressure on biodiversity.
- Priority Action 5. Reducing the impact of land use pressure on biodiversity.

This study, through the findings of the initial assessment phase, directly addresses and contributes to Priority Action 1.

Volume 2 of the above strategy, focussing on the Channel Country bioregion in South Australia (DEH, 2009b) identifies and describes four component sub-regions, one of which is the Diamantina-Eyre in which this study has been undertaken.

2 Study Region Characteristics

2.1 Location

The study region, comprising the Diamantina and Warburton river systems, located in the far north east of South Australia, is a component of the vast drainage network of the Lake Eyre Basin (LEB) (Figure 1). The LEB is one of the world's largest internally draining, or endoreic, basins in the world (Habeck-Fardy and Nanson, 2014). The catchment of the Diamantina and Georgina rivers arising in Queensland covers an area of approximately 365,000 km^2 of the total of the 1.14 million km^2 of the LEB (Kotwicki, 1986, Kotwicki and Isdale, 1991). The range of dryland river systems within the LEB represent some of the few remaining naturally functioning, unregulated desert river systems on earth (Puckridge et al., 1998, Pisanu et al., 2015). Given their natural, unregulated, hydrological regimes these rivers provide valuable base reference systems against which to compare highly regulated systems such as those of the Murray Darling Basin thus providing valuable insights into the nature and impact of hydrological dysfunction and possible restorative actions.

2.2 Climate

The Diamantina study region is located in one of the most extreme climatic regions on the Australian continent. The area experiences an arid climate, BWh (Hot Desert) under the Köppen climate classification system, exhibiting a seasonal expression of temperatures typified by long hot summers and shorter cool winters. Rainfall in this region is very low and highly variable in timing, duration and intensity. As revealed in Figure 2 to Figure 4, this remote inland area is extremely arid, receiving on average a rainfall range of 100 to 200mm per annum with mean annual evaporation exceeding 3,600 mm. The study area is climatically located in the transition region between the tropical northern summer rainfall zone and the southern temperate winter rainfall zone. Hence the area, being influenced by both tropical and mid-latitude weather systems, can receive rainfall events in both summer and winter. However, there is moderate rainfall seasonality with major rainfall events usually associated with southern incursions of the north Australian monsoon system in late summer. Furthermore rainfall events are highly variable both spatially and temporally being influenced by both tropical and mid-latitude weather systems, influencing rainfall events in both summer and winter.

Paradoxically within this highly desiccated arid region the Diamantina and Cooper river systems provide regular annual flows or hydrological pulses driven by the abovementioned distant summer monsoonal events compounded episodically by La Nina cycles impacting the upper catchments of central, northern Queensland. Most of the major flows into Kati Thanda-Lake Eyre are provided by the Diamantina and Cooper river systems. The Diamantina catchment contributes a more reliable and voluminous flow of the two, an average of around 2.46km^2 per annum compared to the 0.63 km^2 of the Cooper.

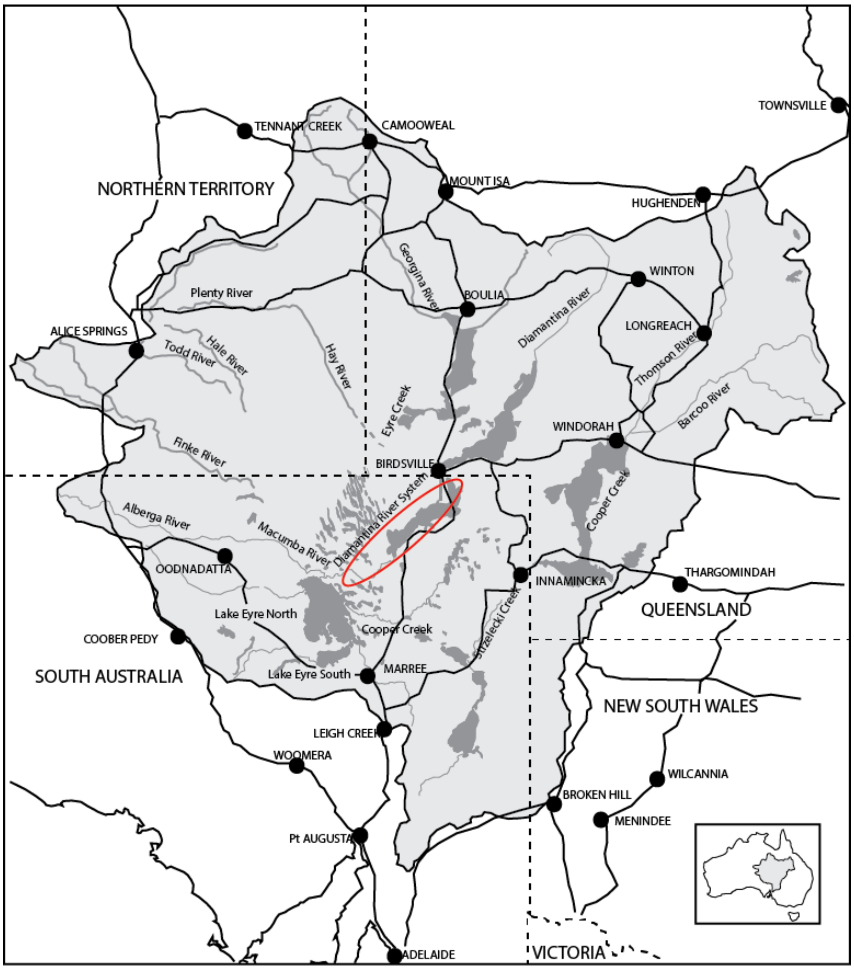


Figure 1 The Diamantina study area location (red outline) within the Lake Eyre Basin (shaded area)

Thus rainfall in the study region is characteristically described as being stochastic in nature; highly unreliable and unpredictable both spatially and temporally. The rainfall variability of the region is amongst the greatest in Australia (Figure 2).

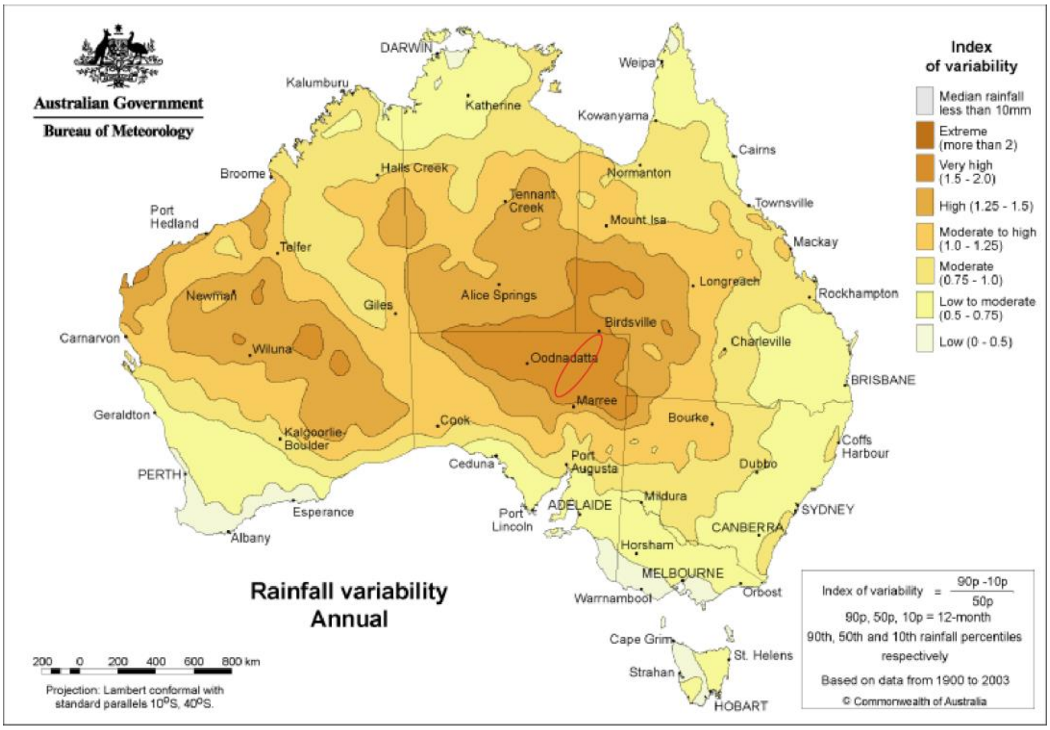


Figure 2 Rainfall variability

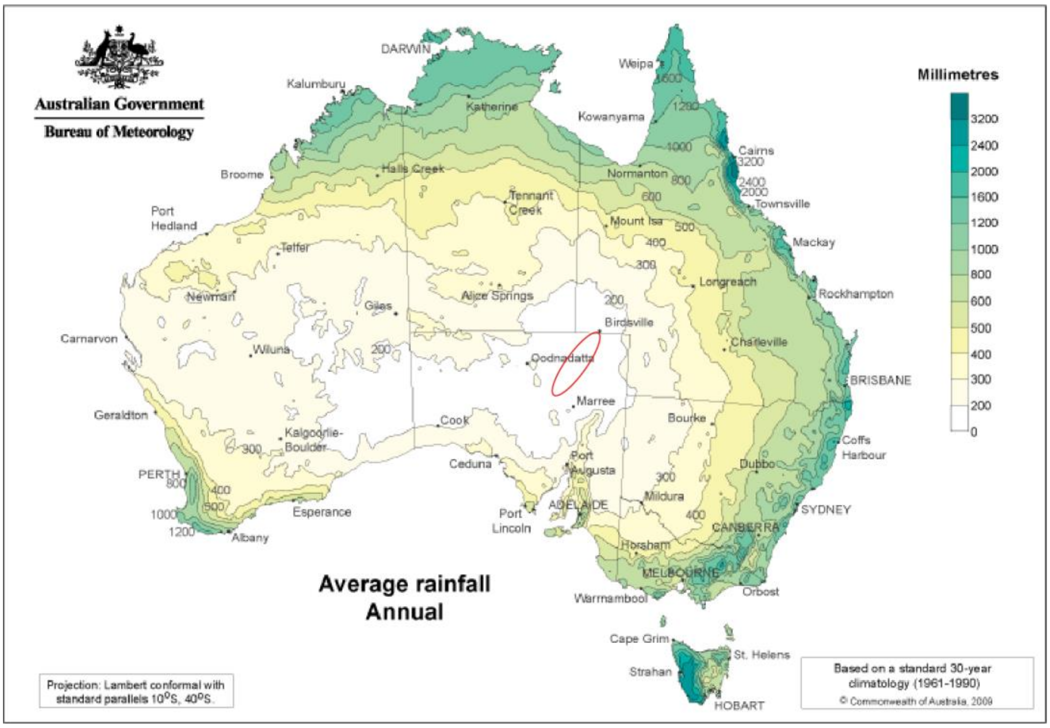


Figure 3 Average rainfall

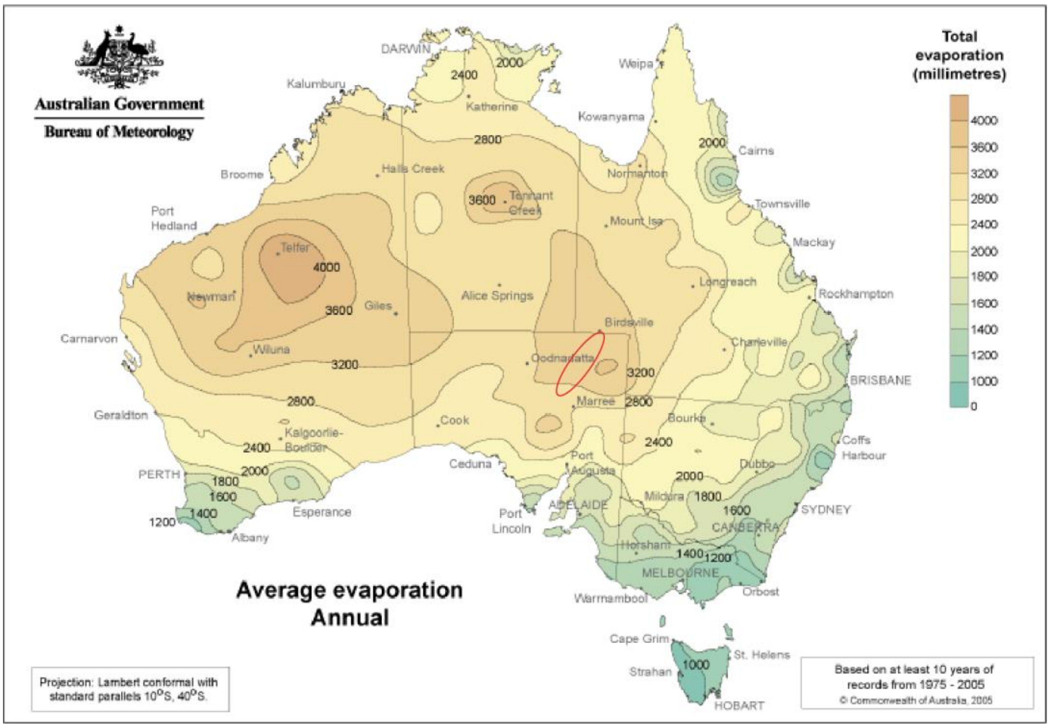


Figure 4 Average evaporation

3 The Diamantina: dryland river in an arid environment

The Diamantina, one of a number of Australian dryland rivers, typically exhibits some of the most variable patterns of flow globally. Periods of extended drought and no flow conditions may be followed by massive flooding events extending across thousands of square kilometres (Figure 5) reconnecting a previous discontinuous string of waterholes acting as refugia during times of drought, maintaining the biodiversity of the system through dry periods.

Within Australia dryland river systems have been described as the dominant river type; those systems flowing through arid zones experiencing natural 'Boom and Bust' periods of high biological productivity following infrequent or unreliable inundation. Within arid regions water is the key driver of ecological processes. Regular flows of water in such a landscape reduce the erratic, high spatial and temporal variability of rainfall events and introduce a modicum of reliability. This reliability is reflected in the biologically significant presence of long lived perennial plant communities with associated species richness and structural diversity in a desert landscape.

Along the Diamantina this riparian community is dominated by Coolibah (*Eucalyptus coolabah*) representing a thin green extrusion of green, a paradoxical burst of biodiversity within an extensive matrix of desiccated desert landscape.

There is no formal process for listing threatened ecological communities in South Australia. The South Australian Department of Environment Water and Natural Resources (DEWNR) defers to the list of threatened ecosystems as designated under the national Environment Protection and Biodiversity Conservation Act (EPBC Act) that occur in South Australia. The Coolibah dominated ecosystems of the Diamantina and Cooper river systems are not listed. (http://www.environment.sa.gov.au/managing-natural resources/Plants_Animals/Threatened_species_ecological_communities)

Whilst the EPBC Act does not consider Coolibah dominated ecosystems to be at threat in South Australia it recognises that the Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions are endangered (http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl)

However the South Australian Arid Lands Biodiversity Strategy – Volume 2 Channel Country Conservation Priorities (DEH & SAAL NRM Board) describes a number of *threatened ecological communities* (sic) on drainage lines, floodplains and swamps of the Channel Country bioregion including; Broughton Willow (*Acacia salicina*) and Coolibah (*Eucalyptus coolabah ssp. arida*) ± Bauhinia (*Lysiphyllum gilvum*) [sic = *Bauhinia gilva*] woodland along drainage lines and on floodplains.

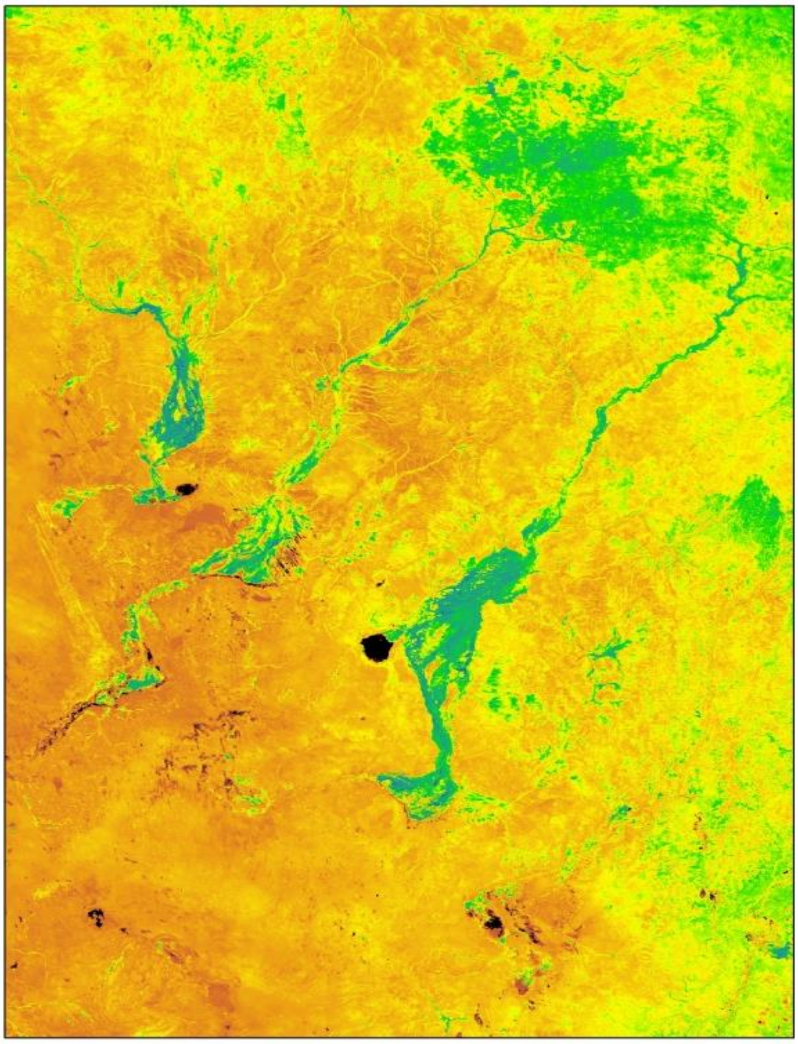


Figure 5 MODIS Satellite images: May 2000; Green/Blue: Vegetation response following flooding Black: Standing water Brown/Yellow: Surrounding landscape

3.1 Methodology

The establishment, assessment and monitoring of permanent sites was, as required by terms under the Commonwealth Biodiversity Fund, informed and guided by the "Biodiversity Fund – Ecological Monitoring Guide" (CoA, 2013). As suggested within the guide additional contributions to the development of an appropriate methodology to suit arid environmental conditions were sought and provided by "Biocondition: A condition assessment framework for terrestrial Biodiversity in Queensland; Assessment Manual" (Eyre et al., 2015). Given the spatial characteristics of the Diamantina riverine vegetation, namely a thin longitudinal transition zone between the main channel and adjacent xeric floodplain, other relevant regional sources were drawn upon, informing and complementing the Biodiversity Fund methodology (Gillen, 2010, Gillen and Drewien, 1993, Gillen and Reid, 1988, Gillen and Reid, 2013)

The interdisciplinary nature of the project (hydrology, geomorphology, ornithology, and aquatic ecology) demanded an efficient coordination of the activities of all disciplines whilst in the field. A representative selection of representative biodiverse 'hotspots' for group assessment was achieved via group consensus, enabling the efficient coordinated focus of disciplines on site and group movement between sites. The terms site(s) and waterhole(s) are used interchangeably in this report as all permanent monitoring sites have been established immediately adjacent to a specific waterhole.

3.2 Stages

Due to the remote nature of the study region and challenging nature of access to a number of sites, travel time to, within the region, and between sites, consumed a considerable portion of time in the field. Consequently the selection, initial assessment and subsequent establishment of vegetation monitoring sites required four periods of field-work also taking into account restricted access during 2016 due to extremely wet weather conditions.

April-May 2014: Sites 1 to 15 assessed over 3 transects at each site

April-May 2015: Sites 16 to 21 assessed over 3 transects at each site

April-May, July-August 2016: permanent sites established; Monitoring commenced for central transect at each site

Due to widespread rains and extensive flooding during 2016 a number of sites were inaccessible during the field period April-May, requiring a return to the region in July-August to complete permanent site establishment and initial assessment. The project team was stranded for a number of days at Andrewilla Waterhole due to heavy local rain. Whilst stranded at this location an additional site (22) was assessed opportunistically at Pelican Waterhole, approximately 3.3 kilometres west of Andrewilla. Due to the opportunistic nature of this assessment Pelican Waterhole was subsequently not established as a permanent monitoring site (All sites listed in Table 1 and locations shown in Figure 6)

Three sites were still inaccessible during the July-August return period; Site 5 Tepamimi WH, Clifton Hills Station; Site 10 Kuncherinna, Cowarie Station; and Site 13 Poonarunna WH, Kalamurina Wildlife Sanctuary. Thus 18 out of an intended 21 sites were established as permanent sites and subjected to an initial monitoring assessment.

Table 1 Site nomenclature

Site Code	Waterhole/Location	Station
1	Ultoomurra	Clifton Hills
2	Goyder Lagoon	Clifton Hills
3	Koonchera	Clifton Hills
4	Yammakira	Clifton Hills
5	Tepamimi	Clifton Hills
6	Andrewilla	Clifton Hills
7	D-Split	Pandie Pandie
8	Windmill	Pandie Pandie
9	Kalamunkinna	Cowarie
10	Kuncherinna	Cowarie
11	Stony Point	Cowarie
12	Cowarie xing	Cowarie
13	Poonarunna	Kalamurina
14	Wadlarkaninna	Kalamurina
15	Yellow	Kalamurina
16	Tinnie Landing	Kalamurina
17	Mia Mia	Kalamurina
18	Mona Downs	Cowarie
19	Yelpawaralinna	Clifton Hills

Site Code	Waterhole/Location	Station
20	Double Bluff	Pandie Pandie
21	Burt's	Clifton Hills
22	Pelican (Opportunistic)	Clifton Hills

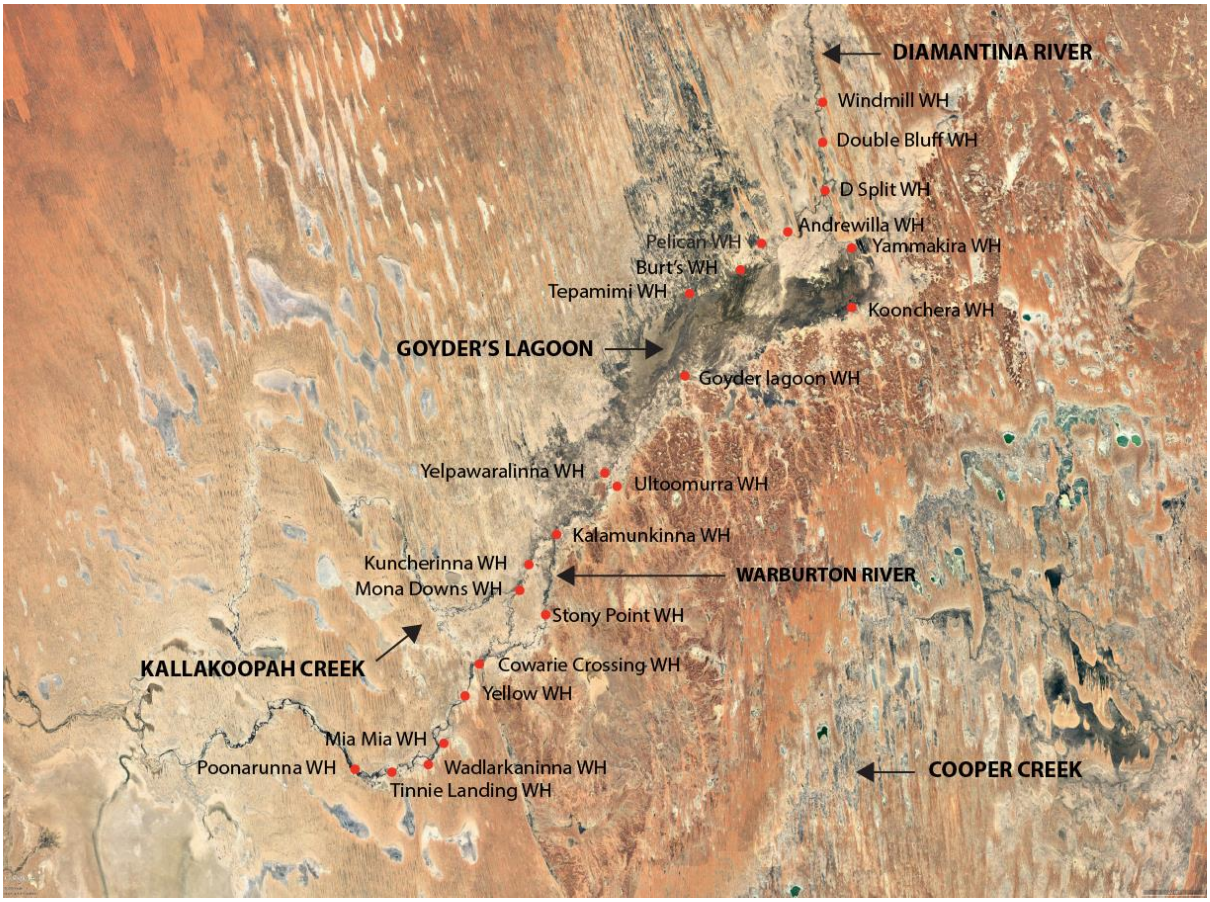


Figure 6 Waterhole locations

3.3 Assessment and establishment of monitoring

Vegetation assessment and monitoring were restricted to the riverine corridor immediately adjacent to selected waterholes. The first visit to each site/waterhole involved the establishment of three 100 metre transects to provide an indication of the variation of floristic composition along each waterhole. For ongoing monitoring purposes the central transect of the three was subsequently established as an ongoing permanent monitoring transect.

The riverine corridor, dominated by *Eucalyptus coolabah*, can vary in width according to local geomorphological conditions from the width of a single tree along straight sections of the main channel to extended woodlands on the inside bends of channel meanders. To accommodate this variability and to ensure that homogeneous representatives of the riverine community were assessed, all transects were positioned longitudinally within the Coolibah corridor parallel and immediately adjacent to each waterhole. A typical sampling layout is depicted in Figure 7, Double Bluff Waterhole, Pandie Pandie Station.

Figure 7 Double Bluff Waterhole, Site 20 – Pandie Pandie Station

Each transect commencement point was located by GPS, a compass bearing of the transect orientation recorded and site photograph taken (Appendix A). For the central transect, the permanent site, permanent star pickets were placed at the start, 20 metre point and end of the transect. All plant species, permanent and annual, occurring at each of the three transects at each site were recorded along with details of their life form, life cycle and relative abundance (semi-quantitative measure). During this initial assessment phase, all species encountered for the first time were vouchered and subsequently lodged with the South Australian Herbarium for confirmation of field identification. Additionally at all site transects, twelve, 5cm soil samples were collected at regular intervals for subsequent determination of total carbon and nitrogen.

At the permanent transect a line intercept approach was adopted to quantify the cover of permanent trees and shrubs, recording length of canopy intercepted along 100 meters for each of the species encountered (upper, mid and lower strata, Appendix L). The line intercept was then used as a baseline for assessment of groundcover condition (vegetation, litter, bare earth at regular 20m intervals within a $1m^2$ quadrat (Appendix J). The presence of feral animal activity was determined by recording recognised tracks, scats or diggings within a one metre belt transect along the length of the 100m transect (Appendix K). For all Coolibah individuals whose foliage was intercepted along the 100m line transect, measurements were recorded for canopy width and breadth, tree height and trunk diameter. If multiple trunks were present all diameters were recorded. At the midpoint of the permanent transect a soil profile was collected consisting of five 10cm increments to a depth of 50cm (Figure 8).

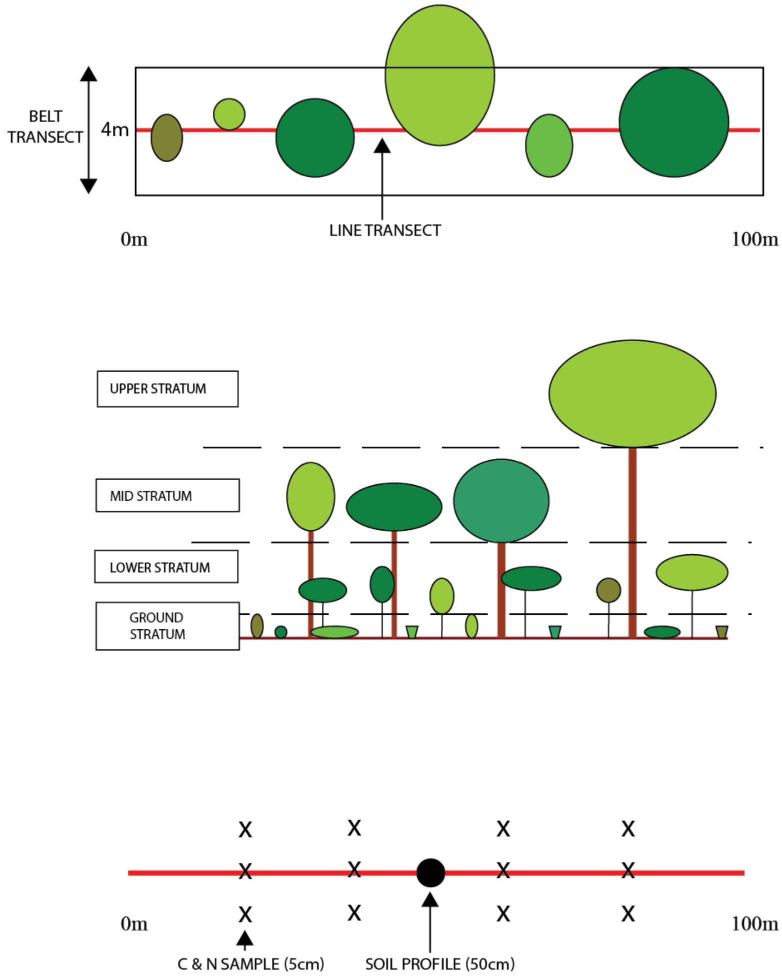


Figure 8 Configuration of permanent site; Quantitative assessment of vegetation and soils

The overall attributes directly supporting the maintenance of ecosystem and associated biodiversity, namely composition, structure and functioning (Freudenberger and Harvey, 2003, Landsberg and Crowley, 2004, Smyth and James, 2004, Worm and Duffy, 2003) of the riparian ecosystem guided the development of the ongoing monitoring framework and identification of suitable indicators;

- Composition – Species composition and richness is recognised as a useful measure of site condition particularly in the context of total grazing pressure. A reduction or absence of significant palatable perennials and annuals and concomitant increase in the number of less palatable species provides an indication of the significance of grazing pressure and condition or state of the vegetation community. Evidence of disturbance and potential state transition is provided by monitoring for introduced and invasive plant species. The monitoring of variation in species composition within a shorter time-frame can provide valuable insight into the influence of seasonal conditions and local rainfall events on the annual or ephemeral component of the vegetation community. Over the longer time-frame, the condition of dominant long-lived species, particularly those species that act as keystone components of the ecosystem, such as Coolibah, is a vital inclusion in a monitoring program (Whitford, 2002).
- Structure – The presence and maintenance of structural complexity, represented by the persistence of a range of particular perennial plant species, ranging from upper story, through mid, lower to ground layer species provides a strong indicator of overall system biodiversity. Vegetation structure contributes directly to riparian species richness and abundance of bird assemblages through provision of food, cover, nesting sites and material and general habitat (Woinarski et al., 2000, Bengsen and Pearson, 2006). Most importantly the maintenance of structural integrity of the

riparian vegetation community associated with a dryland river provides a distributional 'avenue' for bird species facilitating range distributions via a mesic corridor deep into xeric desert landscapes.

- Function – Composition and structure of the riparian vegetation community play a direct role in the overall health of ecosystem functioning through food web structures and trophic interactions directly influencing biodiversity, as exemplified by reference to avian fauna above. The role of the keystone species, Coolibah, is vital to overall system functioning along the Diamantina as will be elaborated upon later in this report. Soil upper profile condition, physically and chemically, directly influences ecosystem function as a medium through which moisture and nutrients flow and are stored. The presence of surficial plant litter and coarse woody debris contributes to soil nutrient cycles and acts as habitat and food at various trophic levels (Akoko et al., 2013).

In developing a monitoring framework that adequately addresses the complexity of maintenance biodiversity over a longer time-frame, the above attributes should be viewed as interacting at a number of complementary hierarchical levels according to the scale adopted for monitoring of biodiversity (Figure 9).

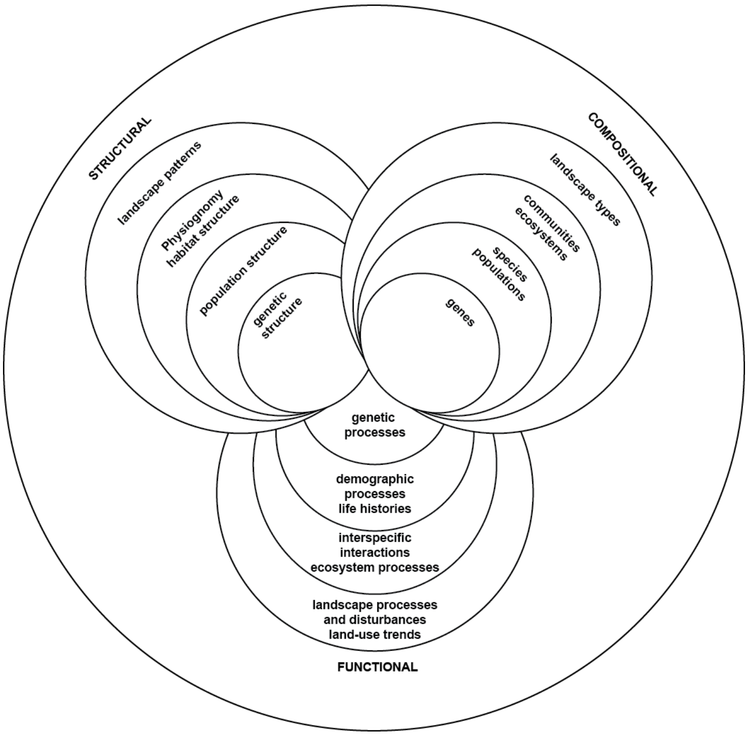


Figure 9 adapted from Noss (1990)

For example the significance of Coolibah as an indicator species of biodiversity condition operating at the scale of the riverine community is fully appreciated by considering its significant contribution to the composition, structure and functioning of the riverine ecosystem. Functionally the species acts as an ecosystem bioengineer whose trunk intercepts and obstructs the flow of wind and water, trapping soil, moisture and nutrients which in combination with shade cast by its canopy ameliorates local microclimatic and soil conditions facilitating an increased composition of plant species. The breakdown and microbial decomposition of Coolibah litter contributes directly to the cycling of carbon and associated nutrients in situ, contributing to the cycling of nutrients into and through the aquatic ecosystem of adjacent waterholes and channels. Structurally, Coolibah as a large and long lived tree provides a myriad of habitats from roots to branches at an individual level for a wide range of microbial, invertebrate and vertebrate taxa. Discarded limbs and branches falling directly into adjacent water bodies provide habitat for a range of aquatic fauna.

3.4 Limitations of study

This study must be viewed as being in the very early stages of what was intended, and should be, a long-term monitoring process. The findings achieved to date represent an assessment of vegetation and biodiversity condition at selected permanent sites at one point in time, in effect a 'still frame' from an intended motion picture, revealing short term flashes of seasonal floristic variation against a backdrop of longer term monitoring of ecosystem and biodiversity trajectory.

4 Findings

4.1 Previous botanical work

Most work of a botanical nature, involving the dryland rivers of north east South Australia, has focussed on the Cooper Creek system (see Gillen (2010) for review). There have been no systematic botanical surveys conducted over the length of the Diamantina / Warburton river systems in South Australia (pers. comm. Dr Peter Lang, SA Herbarium, 2016). The South Australian Herbarium has 265 listed collections (single specimens) with "Diamantina" as the Near Gazetted Locality (NGL) dating from 1926 (Appendix I). Accounting for repeats in this list the collection reduces to 145 taxa from this gazetted region. At a local level within the region, from the NGL, Goyder's Lagoon, 224 collections have been lodged with the SA Herbarium since 1934. More recently and restricted to this Goyder's Lagoon locality a Biological Survey of the Lagoon conducted in Nov 1993 concomitantly conducted a quadrat-based plant survey resulting in 208 vouchers representing 113 species (Appendix H).

Interestingly, a search of the literature revealed two earlier collections from the wider region. E. G. Millard sent Ralph Tate, Professor of Natural Science at the University of Adelaide, "...species collected by him in the spring of 1886 at Kalamurina Station on the Warburton River (or Lower Diamantina) 30 miles south-east of Cowarie" (Tate, 1889) (Appendix G). The other collection was made by Dr Thos. L. Bancroft from the Diamantina region north of Birdsville in Queensland, c.1891 (Bailey, 1892) (Appendix G).

During the Diamantina project, 64 transects were assessed botanically resulting in 191 species recorded from these transects over the period 2014-2016 (Appendix B).

An additional 50 species were collected opportunistically whilst moving between sites (Appendix C), resulting in a total of 241 species recorded during the project.

Table 5 lists the four most commonly encountered families recorded at all transects, accounting for 48% of all species collected during the study.

Table 2 Most commonly encountered plant families

LEGUMINOSAE	17
CHENOPODIACEAE	18
COMPOSITAE	25
GRAMINEAE	32
Taxa	**191**

The predominance of these four main families is consistent with other collections from within the broader region (Gillen, 2010, Gillen and Drewien, 1993, Gillen and Reid, 1988, Gillen and Reid, 2013).

The following species lodged with the South Australian Herbarium were deemed to be of particular interest due either to limited collections or not being commonly encountered within the region (pers. Comm., Helen Vonow, SA Herbarium, 2016);

- *Centipeda nidiformis*
- *Echinochloa turneriana*
- *Elacholoma prostrata*
- *Eryngium supinum*
- *Ipomoea diamantinensis*
- *Peplidium foecundum*

- *Ptilotus murrayi*
- *Sphaeranthus indicus*

The SA Herbarium only has three collections of *Ipomoea diamantinensis* for the State, the recent collections and observations from the project provide a significant addition to the knowledge of the species in the Diamantina region. The species was encountered broadly in the northern area of the study region during 2016, typically presenting as a fruiting, floating mass within the shallows of smaller channels and distributaries. Its common occurrence could be attributed to the widespread rains and subsequent extensive floods experienced during 2016. Establishing the widespread distribution and commonness of this species emphasises the significant value of long term monitoring in gaining valuable insights into the biology of little known taxa.

Table 3 shows the species recorded from all assessed transects that are considered to be of significance within the *Regional Species Conservation Assessment Project*: *Phase 1 Report: Regional Species Status Assessments, Outback Region* (Gillam & Urban , 2013 Regional status code: RA=Rare, NT= Near threatened; Regional trend code: o = Stable/no change, DD = Data deficient)

Table 3 Species listed in *Regional Species Conservation Assessment Project*: *Phase 1 Report*

Atriplex leptocarpa	CHENOPODIACEAE	NT	DD
Arabidella procumbens	CRUCIFERAE	NT	O
Calotis ancyrocarpa	COMPOSITAE	NT	O
Calotis plumulifera	COMPOSITAE	NT	DD
Calotis porphyroglossa	COMPOSITAE	RA	DD
Cullen discolor	LEGUMINOSAE	NT	DD
Cyperus bulbosus	CYPERACEAE	NT	O
Cyperus gymnocaulos	CYPERACEAE	NT	O
Dysphania melanocarpa	CHENOPODIACEAE	NT	DD
Gnephosis eriocarpa	COMPOSITAE	NT	DD
Lysiana subfalcata	LORANTHACEAE	NT	DD
Pycnosorus melleus	COMPOSITAE	RA	DD
Sesbania cannabina var cannabina	LEGUMINOSAE	RA	DD
Sphaeranthus indicus	COMPOSITAE	RA	DD

Additional significant species, as recognised and listed by the above report, were also collected opportunistically whilst moving between sites in the region and are presented in Table 4.

Table 4 Species collected opportunistically, listed in *Regional Species Conservation Assessment Project*: *Phase 1 Report*

Acacia dictyophleba	LEGUMINOSAE	RA	DD
Anemocarpa podolepidium	COMPOSITAE	NT	DD
Cyperus victoriensis	CYPERACEAE	NT	O
Echinochloa turneriana	GRAMINEAE	NT	O
Eleocharis plana	CYPERACEAE	RA	O
Eryngium supinum	UMBELLIFERAE	NT	O

Acacia dictyophleba	LEGUMINOSAE	RA	DD
Ipomoea diamantinensis	CONVOLVULACEAE	RA	O
Menkea crassa	CRUCIFERAE	NT	O

4.2 General vegetation observations

The more reliably watered parts of the Diamantina system contain the most structurally and floristically diverse expressions of the region's flora. In the north of the Diamantina system, above Goyder's Lagoon, the channel banks immediately adjacent to and associated with the extensive range of semi -permanent waterholes, are dominated by riverine stands of *Eucalyptus coolabah* (Coolibah) woodland, often associated with a mixed understory of *Bauhinia gilva (*Queensland Bean Tree*), Atalaya hemiglauca* (Whitewood), *Acacia stenophylla* (Broughton Willow), *A. salicina* (River Coobah) *and Eremophila bignoniiflora* (Bignonia Emubush). In the south of the system, below Goyder's Lagoon, *Bauhinia gilva, Atalaya hemiglauca,* drop out of the riverine community and *Eremophila bignoniiflora* occurs more spasmodically. The shrub *Duma florulenta* (Lignum) occurs ubiquitously within the riverine community from north to south albeit in varying degrees of density. This pattern of gradual loss of particular perennial species longitudinally down the system is also experienced on the Cooper Creek system. On the Cooper, flood pulses decrease in frequency downstream with a concomitant increase in soil pH and soil salinity levels (Gillen, 2010, Gillen and Reid, 2013).

In sections along the river system where the main channel becomes discontinuous, a prime example being the extensive Goyder's Lagoon, a braided channel system of swampy conditions results, usually dominated by *Duma florulenta* shrubland.

4.3 Naturalised and invasive species

A total of 14 of the 241 species recorded (6%) during the project were introduced or naturalized species (Table 5), following the Census of South Australian Vascular plants (http://www.flora.sa.gov.au/census.shtml)

Table 5 Introduced or naturalized species

NATURALISED TAXA **Encountered over all transects assessed 2014-2016** **(other listed naturalised species encountered opportunistically)**		
Transects (64)	**Genera/Species**	**Family**
6	*Brassica tournefortii*	CRUCIFERAE
opportunistic	*Cenchrus ciliaris*	GRAMINEAE
6	*Citrullus lanatus*	CUCURBITACEAE
2	*Datura leichhardtii*	SOLANACEAE
1	*Echinochloa crus-galli*	GRAMINEAE
1	*Euphorbia dallachyana*	EUPHORBIACEAE
1	*Gnaphalium polycaulon*	COMPOSITAE
1	*Heliotropium supinum*	BORAGINACEAE
5	*Sesbania cannabina var cannabina*	LEGUMINOSAE
1	*Solanum nigrum*	SOLANACEAE
7	*Sonchus oleraceus*	COMPOSITAE
opportunistic	*Tamarix aphylla*	TAMARICACEAE

NATURALISED TAXA Encountered over all transects assessed 2014-2016 (other listed naturalised species encountered opportunistically)		
Transects (64)	**Genera/Species**	**Family**
2	*Tribulus terrestris*	ZYGOPHYLLACEAE
1	*Verbena officinalis*	VERBENACEAE
opportunistic	*Veronica peregrina ssp. xalapensis*	SCROPHULARIACEAE

The two species of most concern are; *Tamarix aphylla*, Athel Pine or Tamarisk, listed as a weed of national significance and additionally listed as a declared pest plant of South Australia; and *Cenchrus ciliaris* Buffel Grass.

(http://www.naturalresources.sa.gov.au/aridlands/plants-and-animals/pest-plants-and-animals/pest-plants http://www.flora.sa.gov.au/census.shtml)

Athol Pine was observed at the old Mona Downs homestead on Cowarie Station (pers. Comm.. Joc Schmiechen). *Cenchrus ciliaris* Buffel Grass was not only observed and vouchered on Cowarie station (collected on a station track) but also observed around homestead buildings (on the Derwent River).

4.4 Floristics and Vegetation Structure- Initial assessment 2014-15

During the initial two years of vegetation assessment (15 sites x 3 transects per site in 2014; 5 sites x 3 transects per site in 2015) the floristic expression recorded over all transects varied considerably. A detailed presentation of all species recorded at all transects over these two assessment periods is listed in Appendices 4 & 5. Figure 10 reveals species composition recorded at the central or permanent monitoring transect at each site during 2014 and 2015; a considerable number of sites contained few, mainly perennial species. These particular sites usually also displayed recent evidence of grazing pressure.

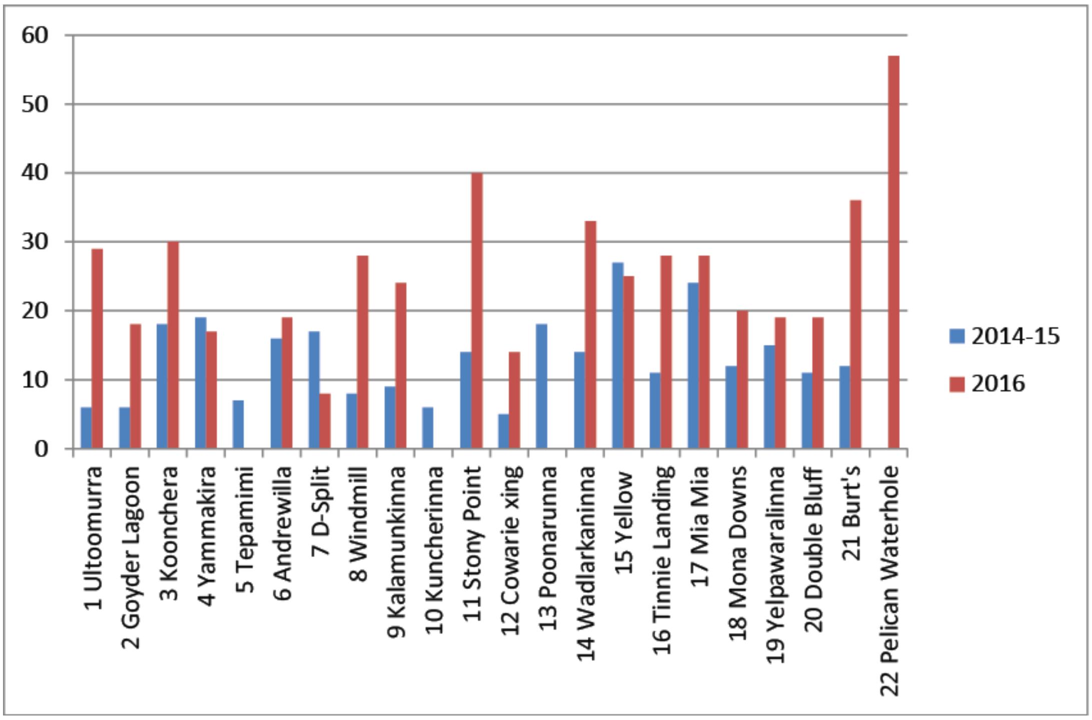


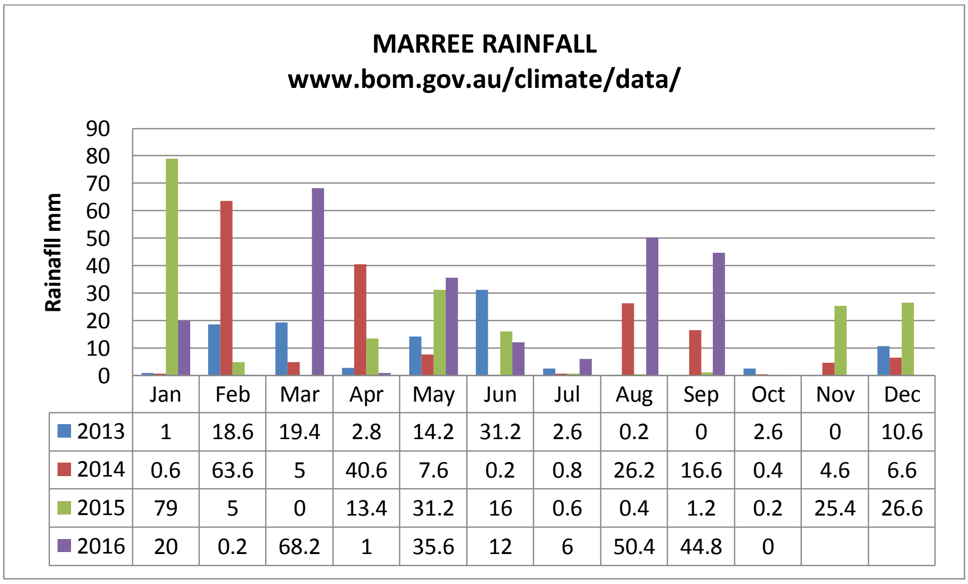
Figure 10 Floristic composition at permanent monitoring sites

The most species rich site assessed during 2014 was located on Kalamurina Wildlife Sanctuary (Yellow Waterhole). This elevated species richness may reflect local annual and ephemeral species response to significant rainfall events within this southern region of the study area received during February and April as shown in Figure 11. In contrast scant rain was received during the same period in the northern region (Figure 12). Again during 2015 the most species rich site was recorded on Kalamurina (Mia Mia Waterhole) although similar rainfall figures were recorded over the same period north and south in the region (Figure 11 and Figure 12). It is too early in the monitoring phase to attribute the elevated seasonal species richness on Kalamurina Wildlife Sanctuary to the removal of stock; monitoring seasonal variation over the long term will provide greater insight.

An additional probable factor contributing to variation in species composition across sites is the relative proximity of other landforms and associated vegetation communities to some of the riparian sites. At a number of these sites, species more commonly associated with landforms, such as floodplain, dune and gibber, may have contributed to the overall species richness of some riparian communities.

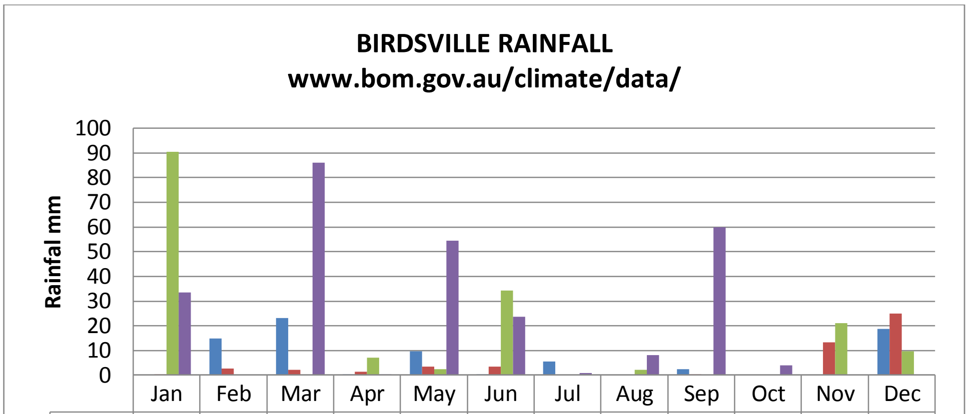
Widespread heavy rains were experienced across the region in March 2016 with an additional widespread event in May (Figure 11 and Figure 12). Both rainfall events preceded field work in the periods April-May and July-August of that year. In most instances annual species numbers recorded at sites significantly exceeded those recorded during the previous two years (Figure 10). Note that these widespread rains and associated floods during 2016 prevented access to site 5, 10 and 13, hence the absence of data in Figure 10.

As Figure 10 shows the most species rich site recorded during 2016 was site 22, Pelican Waterhole, located approximately 3.3km due west of Andrewilla Waterhole (site 6). A total of 57 species was recorded from within a 100 x 4 metre transect (Appendix D). Pelican Waterhole was assessed opportunistically whilst the study team was stranded at Andrewilla following the rains in May; a permanent monitoring site was not established at this location. Unlike the nearby Andrewilla Waterhole which is relatively permanent, Pelican Waterhole periodically dries out. In an historical sequence of Google earth images from 1984 to 2016 Andrewilla Waterhole continually retains water whilst the nearby Pelican Waterhole is dry for roughly 30% of this period. The virtually permanent water of Andrewilla would naturally result in the prolonged presence of stock within its vicinity exerting greater grazing and trampling pressure upon the vegetation than that experienced at the periodically dry Pelican Waterhole.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	1	18.6	19.4	2.8	14.2	31.2	2.6	0.2	0	2.6	0	10.6
2014	0.6	63.6	5	40.6	7.6	0.2	0.8	26.2	16.6	0.4	4.6	6.6
2015	79	5	0	13.4	31.2	16	0.6	0.4	1.2	0.2	25.4	26.6
2016	20	0.2	68.2	1	35.6	12	6	50.4	44.8	0		

Figure 11 Marree rainfall



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	0	15	23.2	0.2	9.6	0.4	5.6	0	2.4	0	0	18.8
2014	0.3	2.8	2.2	1.5	3.4	3.4	0	0	0.5	0	13.2	25
2015	90.4	0	0	7	2.5	34.4	0	2.2	0	0	21.2	9.8
2016	33.4	0	86	0.2	54.4	23.8	0.8	8.2	59.8	4		

Figure 12 Birdsville rainfall

Due to the extended history of stock grazing since the 19th century along the entire Diamantina / Warburton system, all waterholes generally represent disturbed ecosystems in varying degrees of condition or status from severely degraded to currently recovering. There are no areas of riparian vegetation representing natural condition prior to grazing against which to compare the range of current conditions. However, the conversion of Kalamurina Station in 2007 by the Australian Wildlife Conservancy to a conservation zone free of cattle provides a significant opportunity for a regional vegetation recovery reference system. The future trajectory of vegetation and biodiversity condition of all sites along the Diamantina can be very usefully referenced against the permanent monitoring sites established on Kalamurina.

Even within the individual pastoral leases assessed there is considerable variation of vegetation condition across waterholes as evidenced by comparative floristic composition (species richness and abundance) and structural complexity across all sites revealed in Figure 10 and Figure 13.

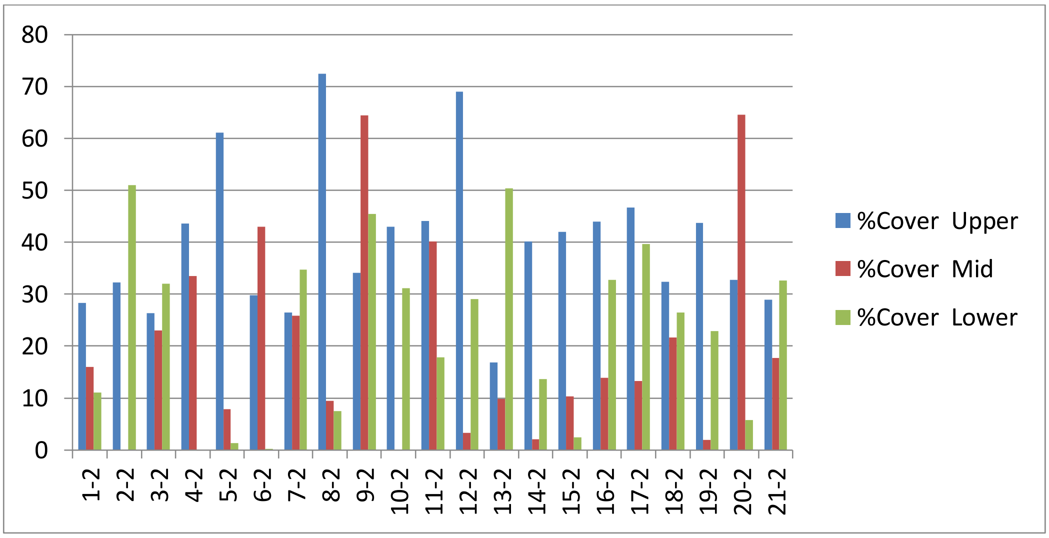


Figure 13 Percentage cover for upper, mid and lower perennial plant strata

A detailed history of stocking rates focussed upon the range of waterholes would provide greater insight into comparative grazing pressures leading to the evident range of currently disturbed states.

The densities of riparian Coolibah cover, recorded at all permanent sites along the length of the river system, varied considerably as depicted in Figure 13, where "% Cover Upper" represents that solely contributed by Coolibah the dominant species. The main influence upon Coolibah riparian density and width of woodland appears to be related to geomorphology;

densities tending to be greatest on the inside of channel bends or meanders (see Figure 7). Elsewhere, particularly where sections of channel are more direct, woodland width is dramatically reduced in many instances to the width of a single tree even though foliage cover may be almost continuous over the length of a permanent transect. The increased densities of Coolibah associated with the inside arc of meanders is of great potential interest in coming to terms with the demographic distribution of trees in the landscape. As suggested by geomorphologist, Wakelin-King (pers. comm.), these zones in fact represent active scroll bars, albeit operating 'actively' over a long time-frame. As the bars migrate laterally, the original riparian Coolibah community is 'stranded' or isolated from the leading scroll bar edge with a new cohort taking its position on the channel edge. Over time with continued channel migration this process of replacement and recruitment may be repeated multiple times, leading to the end results of dense extensive woodland. Combined dendrochronological dating and genetic analyses of selected cohorts from these zones could provide valuable insights into the veracity of this hypothesised process.

Disappointingly there was little evidence of widespread recruitment of Coolibah from the relatively recent clustered La Nina flooding events (2010-11, 2011-12). Few seedlings from this period were encountered.

In contrast a comparative survey of Cooper Creek waterholes following these periods of flood, found that almost as many sites revealed positive evidence of recent recruitment of the range of perennial shrubs and trees of the riparian fringe (Gillen and Reid, 2013). Seedlings and saplings of *Eucalyptus camaldulensis (*River Red Gum*)*, Coolibah and *Bauhinia gilva* (Queensland Bean Tree) were observed at most sites that adult individuals of these species occurred. There was also evidence of recruitment of other valuable understory species including *Pittosporum angustifolium, Atalaya hemiglauca, Eremophila bignoniiflora, Acacia salicina, Acacia stenophylla* and significantly, *Owenia acidula*. However, it was also noted that at those waterholes where there was evidence of active or relatively recent cattle pressure there was a distinct lack of recruitment. Interestingly, given the relative proximity of the Cooper and Diamantina river systems within South Australia and the similar hydrological regimes of their upper reaches (in SA), the following perennial species on the Cooper are absent from the Diamantina; *Eucalyptus camaldulensis, Melaleuca trichostachya , Owenia acidula and Pittosporum angustifolium*.

4.5 Soils

The Diamantina riverine vegetation communities occur on the deeper alluvial soils deposited proximally to waterholes creating, in some reaches, low channel levee banks. Overflow from the main channel containing fine suspended sediments has developed a blanket of fine grained clay rich soils (Vertosols) varying in depth but typically of 2 to 3 metres in depth (Figure 14). These clay rich floodplain soils, sometimes self-mulching and deeply cracking, are draped over older extensive alluvial coarse sand deposits. In areas subject to particular flooding regimes, particularly floodplain depressions, these soils may form a low-relief gilgai surface pattern.

Figure 14 Channel alluvial soil / Floodplain heavy clay

Arid and semi-arid Australia, particularly in the east, possesses some of the most extensive areas of Vertosols, globally (Figure 15).

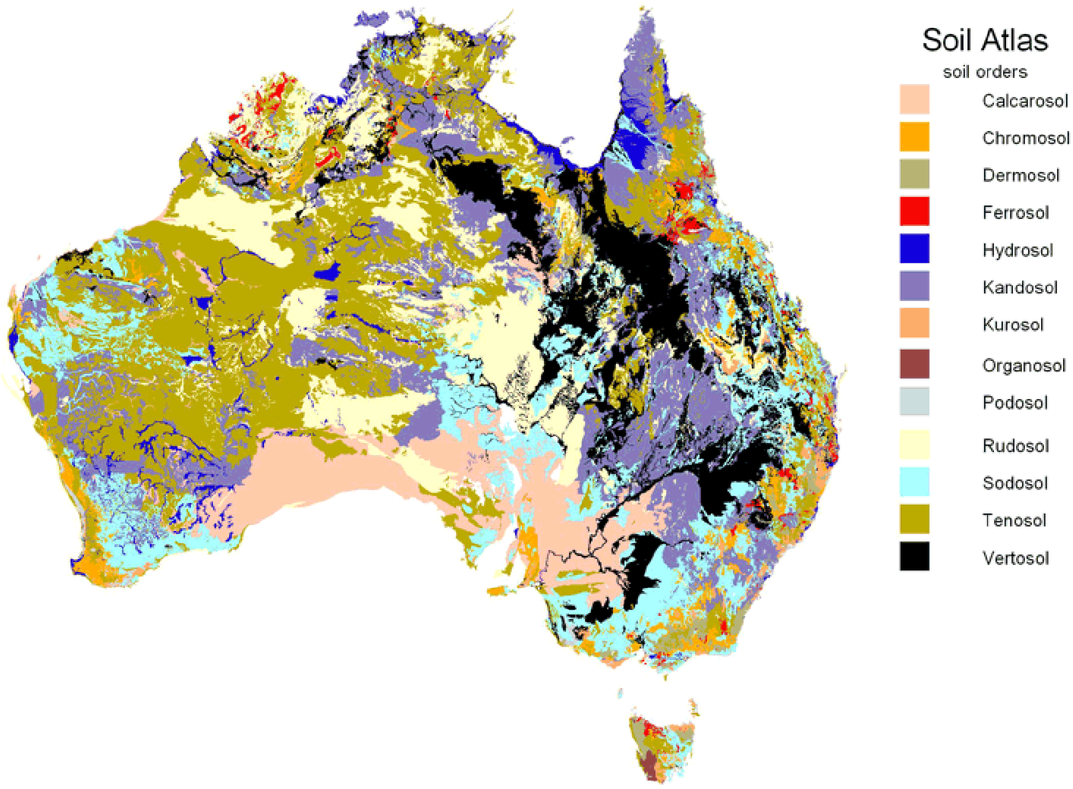
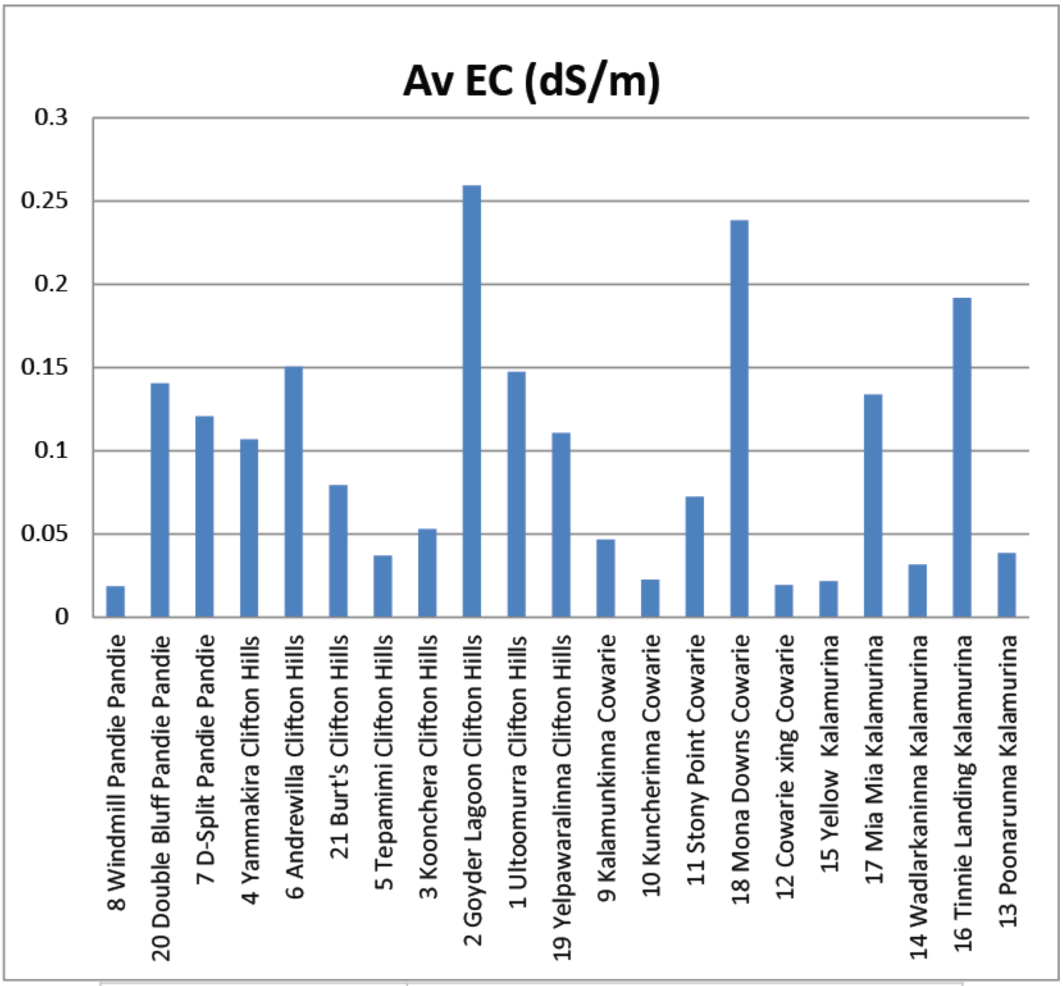


Figure 15 Soil atlas (source; http://www.asris.csiro.au/themes/Atlas.html#Atlas_Digital)

Within the Diamantina system the distribution and depth of these Vertosols strongly influences the distribution and densities of floodplain communities of Coolibah.

The texture of the soils sampled down the length of the Diamantina are generally of a silty clay loam to sandy clay loam texture as would be expected from alluvial riverine deposits. The chemical properties, salinity (EC, dS/m) and pH (Appendix E), determined for all permanent site profiles do not reveal an obvious general trend, unlike the results obtained from recent surveys on the regionally adjacent Cooper Creek System (Gillen, 2010, Gillen and Reid, 2013). On the Cooper Creek system, both alkalinity and salinity generally increased, correlating with a decrease in flood pulse frequency, with distance downstream. In other words both soil salinity and alkalinity levels showed a propensity to increase as the opportunity for the profile to be flushed by floodwaters decreased. Figure 16 shows the Diamantina sites approximately arranged in order from north to south, Site 8, Windmill waterhole representing the most northern site. Overall, as shown in Figure 16 the level of soil salinity recorded down the system is slight as reflected in associated healthy Coolibah stands. The obvious raised EC value at site 2, Goyder's Lagoon Waterhole, could possibly be due to the close proximity of the soils of the gibber pavement that abuts the periphery of the waterhole. The soils of the gibber systems are generally sodic and highly alkaline. Other anomalous EC recordings could also be attributed to the proximity to sampling sites of other land units and their associated soil types such as Gilgai floodplain soils and compacted clays at the base of adjoining dunes. However, overall, no striking patterns or trends in salinity levels are obvious, which is also the case for pH displayed in Figure 17.

The lack of clarity of the pH and EC results obtained reflects the nature of assessment undertaken within the time and resources allocated to the project. A more detailed sampling approach is obviously recommended in the future, increasing the number of soil profiles sampled across all three assessment transects associated with each site to more confidently determine local and regional trends if they exist.



	EC 1:5 (dS/m)		
	Sandy Loam	Loam	Clay
Non-Saline	<0.15	<0.17	<0.4
Slightly saline	0.16-0.3	0.18-0.35	0.41-0.8
Moderately saline	0.31-0.60	0.36-0.75	0.81-1.6
Very saline	0.61-1.2	0.76-1.45	1.6-3.2
Highly saline	>1.2	>1.45	>3.2

Figure 16 Soil salinity (EC; dS/m) at permanent sites

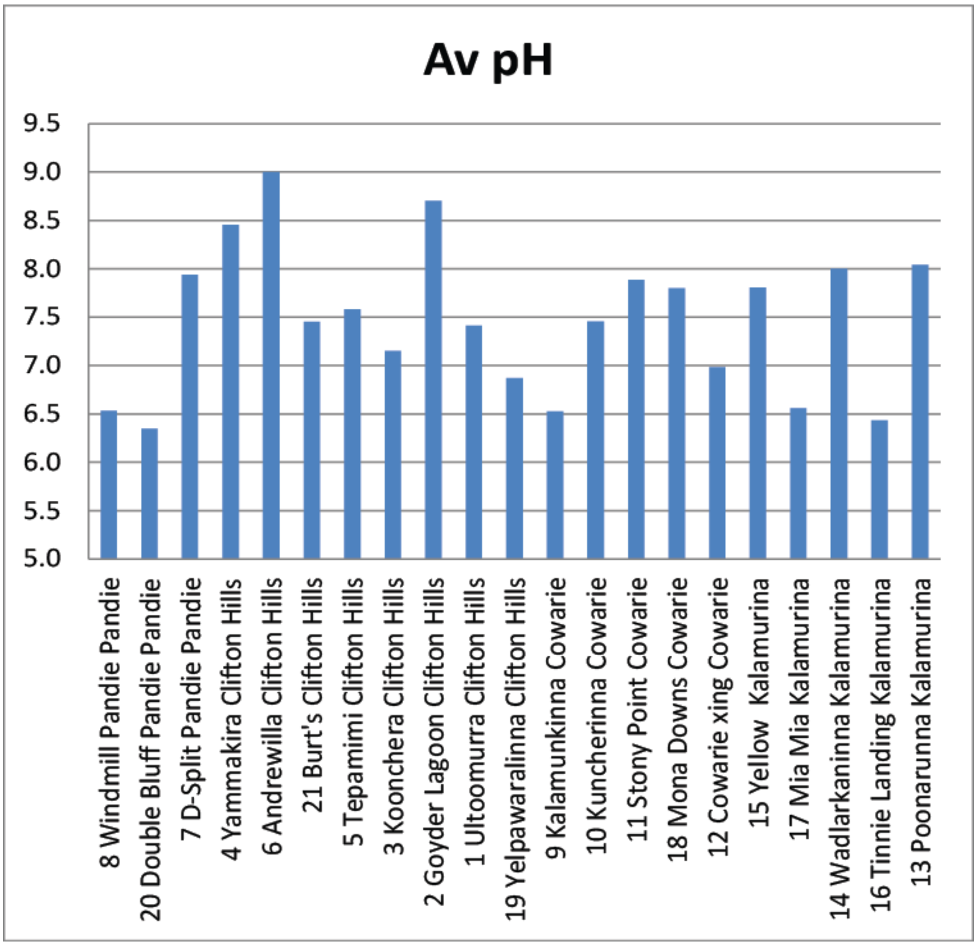


Figure 17 Soil pH at permanent sites

The raised levels of Total Carbon and Total Nitrogen evident at sites 3, 4 and 20 (Figure 18 and Figure 19) provide an insight into past stocking rates or intensities. One obvious artefact of the more intensive impacts of cattle over time is the nutrient loading that accompanies high stocking rates. The deposition of urine and faeces and subsequent incorporation into the soil surface through pugging and pulverisation of soil structure leads to raised levels of carbon and nitrogen. Such sites with their elevated levels of nutrients and pulverised fine surface soils are prime areas for potential subsequent weed infestation. On a positive note, at this early point in the monitoring phase there was little evidence of weed species at sites 3, 4 and 20. Interestingly at site 3, Koonchera Waterhole, along with the high levels of nutrient loading and associated grazing pressure there was an absence of palatable perennial species with the shrub layer being dominated by *Senecio lanibracteus,* an obviously unpalatable native 'increaser' species (Vesk and Westoby, 2001, Catford et al., 2012, Oesterheld and Semmartin, 2011).

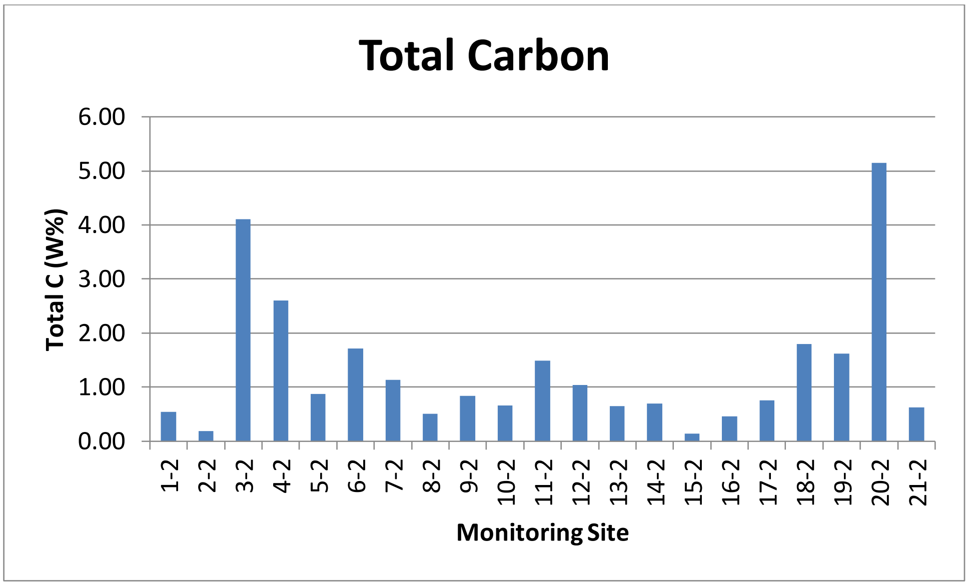


Figure 18 Soil Total Carbon (Wt%) at permanent sites

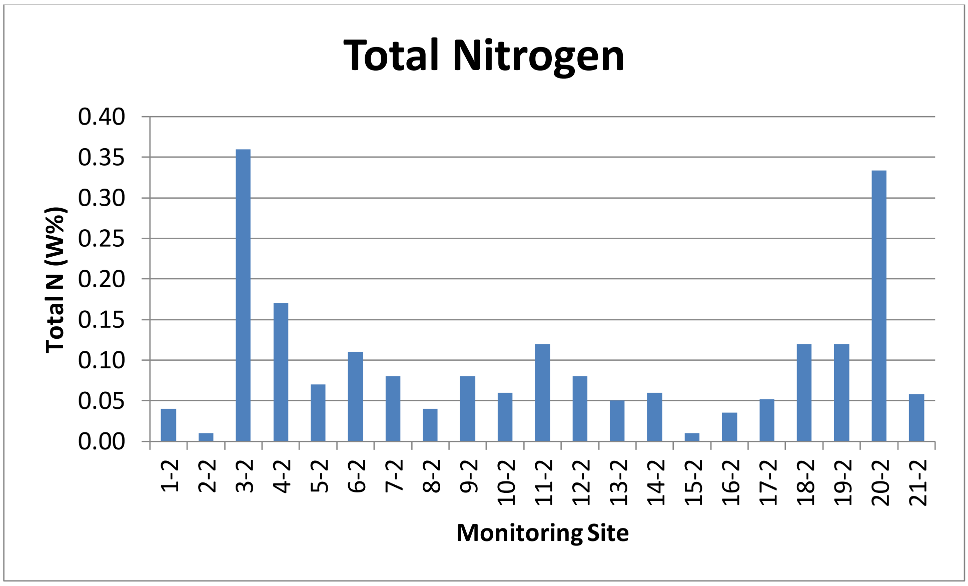


Figure 19 Soil Total Nitrogen (Wt%) at permanent sites

4.6 Impacts and threats

Threats to, and impacts upon, biodiversity values have been clearly identified at both national and state government levels. Both jurisdictional levels have developed frameworks of relevance in the context of this study.

National Level; Australia's Biodiversity Conservation Strategy 2010-2030, prepared by the National Biodiversity (NRM Ministerial Council 2010) Strategy Review Task Group, convened under the Natural Resource Management Ministerial Council, identifies the following main threats to Australia's biodiversity;

- habitat loss, degradation and fragmentation
- invasive species
- unsustainable use and management of natural resources
- changes to the aquatic environment and water flows
- changing fire regimes

- climate change

The national strategy functions as a policy 'umbrella' over those more specific national frameworks. These Include; The National framework for the Management and Monitoring of Australia's National Vegetation (NRMMC1999); The Australian Weeds Strategy (NRMMC 2007a); Australian Pest Animal Strategy (NRMMC 2007b).

South Australian State Level; The "South Australian Arid Lands Biodiversity Strategy – Volume 2 Channel Country Conservation Priorities (DEH & SAAL NRM Board), provides a threat abatement framework for the four sub-bioregions which constitute this region. The Diamantina – Eyre sub-bioregion contains the study area namely; "*The floodplains and braided streams of the Mulligan, Diamantina and Warburton, including Goyder Lagoon*".

Identified and listed threats for the Diamantina – Eyre sub-bioregion include;

- excessive total grazing pressure
- alteration to natural water flows
- competition for resources by pest plants and animals
- altered fire regimes
- fishing
- mechanical disturbance
- pollution
- climate change.

As indicated by the above list, the range of potential and actual threats to biodiversity is well appreciated and understood by stakeholders within the Lake Eyre Basin (Fisher, DCM, SANRM etc). Whilst the above threats have been differentiated it is important to realise that they may be interacting and reinforcing, and their impacts may be cumulative over time.

4.7 Climate change

Under climate change it is expected that average temperatures across all seasons will continue to increase with a high confidence expected for extended sequential days of maximum temperatures across the study region. Increased temperatures will lead to a concomitant regional increase in evaporation rates of dryland river water bodies and associated increased evapotranspiration rates leading to extended periods of water stress experienced by vegetation.

(https://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer/sub-clusters/?current=RLNC&popup=true&tooltip=true)

"The most vulnerable species will be those with long generation times [e.g. Eucalyptus coolabah], low mobility and small or isolated range. Remnant populations along permanent waterholes and within reserves may be particularly vulnerable. Many existing activities will assist to preserve biodiversity such as fencing riparian areas, maintaining or restoring connectivity in the landscape, erosion mitigation, maintaining environment flows, reduced land clearing and preventing introduction of potentially invasive species " (Cobon and Toombs, 2007).

An expected future increase in the intensity of extreme rainfall events will be accompanied by an extension of periods of exaggerated drought (Fensham et al., 2015a)

The hydrological regularity of the desert river systems of the north east Lake Eyre Basin is heavily dependent upon the complex interactions of a range of teleconnected weather systems; recurring and persistent, large-scale patterns of pressure and circulation anomalies that span vast geographical areas (McMahon et al., 2008, Lough, 1997). These include the El Nino - Southern Oscillation (ENSO) system of the Pacific Ocean; the North-West Cloud Banks and the Indian Ocean Dipole; and the inter-tropical conversion zone and its impact on seasonal monsoonal incursions (http://www.cpc.ncep.noaa.gov/data/teledoc/teleintro.shtml). The influence of these systems upon Australia is apparently shifting southwards and there is currently a degree of uncertainty regarding the resulting nature of their influence upon the hydrology of Channel River systems (pers. comm. Professor Mark Howden, Director of the Climate Change Institute). Given the dependence of Coolibah upon major flood events for the recruitment of new cohorts of the species across the region the future hydrological uncertainty relating to climate change is unsettling.

4.8 Hydrology and Geomorphology

Miller et al (2005) in broadly examining water management identify five issues of national significance in the relationship between biodiversity and the management of water resources across the rangelands in Australia. Although these issues are considered in the broader context of water management across the range of landscapes of the rangelands they are still highly relevant in the context of the landscapes of dryland river systems and reveal the nature of interactions of threats at various spatial levels;

1. ***Climate change*** – the currently observed shifts in climatic patterns will influence the spatial and temporal distribution of rainfall across the rangelands
2. ***Hydrological modification*** – any major interference with naturally functioning hydrological flow regimes along inland rivers and waterways will result in significant negative impacts to associated biological systems and impact the natural recharging of ecologically important groundwater systems.
3. ***Disruption of landscape functional* integrity** – the natural flow of water across the landscape is altered along with the associated distribution of nutrients when grazing pressure results in the damage, or potential removal, of perennial vegetation communities. The result is a "leaky landscape" (Ludwig and Tongway, 2000) as both water and nutrients are shed, or lost, from bare and compacted soil surfaces as the natural retention 'barriers' of perennial vegetation are highly altered or removed.
4. ***Increased distribution of watering points across the landscape*** – the ***advent*** of 'poly pipe' has enabled water to be distributed to previously less impacted areas of the landscape resulting in broad scale grazing pressure across the wider landscape with obvious biodiversity impacts.
5. ***Tourism and recreation focus on natural water holes*** – increased vehicular access and focus upon isolated water bodies results in a range of detrimental impacts upon biodiversity values; loss of surface vegetative litter and woody debris; soil compaction and channel bank erosion; denudation of vegetative ground cover and subshrubs and introduction of weed species. Such impacts cumulatively contribute to the local disruption of landscape functional integrity and the creation of 'leaky landscapes' (above) albeit at a local level.

Whilst the focus for this study has been upon the biodiversity values of individual waterholes or refugia of the lower Diamantina River in South Australia it is vital that the entire river network and its associated catchment are viewed holistically as one interdependent hydrological system. The key driver for ecosystem function within this interconnected, interdependent dryland river system is the naturally functioning, currently unregulated, hydrological regime. The regime is one of great natural variability and this is reflected in the evolutionary resilience of the associated biota, particularly the long lived perennial plant species whose life cycles are intimately connected to and accommodate this natural variability. Any attempt to regulate the flow of the system or to extract water for mining or irrigation development will lead to a negative cascade of impacts upon biotic and abiotic processes, negatively influencing downstream biota. The destructive nature of such impact is clearly evidenced and recorded across a range of riparian systems elsewhere globally (Fu and Guillaume, 2014) or within Australia (Colloff et al., 2015, Reid et al., 2013, Wen et al., 2013, Pisanu et al., 2015).

The Diamantina River must not be viewed as comprising only waterholes and channels but as a hydrological system that is integrally connected to adjacent floodplains. The lateral flooding events drive a vital biogeochemical cycle between channel and floodplain; a flow of nutrients and water out during flood, and back in to channel during flood drawdown. These major flood events are additionally crucial for the recharge of local aquifers down the length of the Diamantina upon which the mature Coolibah communities are heavily dependent during periods of no flow or extended drought (Fu and Burgher, 2015). It is these rare and extended lateral flood events that drive the major recruitment periods for long-lived perennials such as the keystone species *Eucalyptus coolabah*. The species is flood dependent for the widespread regional distribution of seed across the wider landscape and its subsequent germination, establishment and persistence. This period of early establishment is one of the most vulnerable parts of the life cycle of such a species and represents a rare demographic event in the generation of a new cohort or generation for the continuance of the species. Should grazing pressure, both domestic and feral, be too intense following such significant recruitment events the resulting cohort will be threatened with an obvious major demographic impact over time.

Due to the very slight gradient of the Diamantina both longitudinally (approximately 14cm per km in South Australia) and laterally across its floodplain, water flow across the landscape from floods can be significantly disrupted and at times prevented access to considerable areas (Wainwright et al., 2006). Earthworks associated with tracks, roads and their windrows can act as barriers or conduits to flow, redirecting and channelling sheet flow, disrupting natural irrigation and inundation cycles. Figure 20 depicts one such example of flow disruption showing the track into Burt's waterhole from the north during a flood event.

Figure 20 Flooded road into Burt's Waterhole

The resulting harvesting of floodwaters along the track has created a 'alternative' waterhole which was misidentified by the project team and inadvertently sampled instead of the actual Burt's waterhole immediately adjacent (Figure 21) (Wakelin-King, 2017).

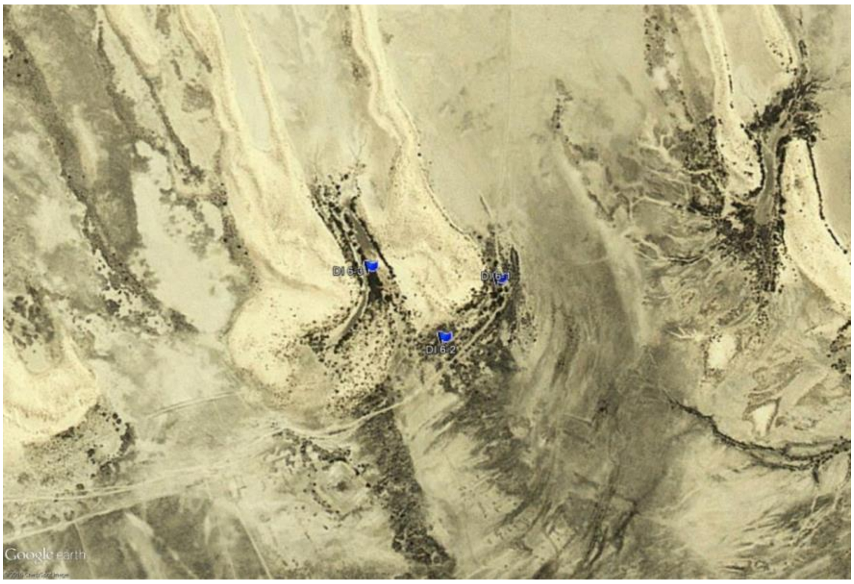


Figure 21 Burt's Waterhole

In other instances, extensive 'cemeteries' of dead coolabah throughout the region, could potentially be associated with past earthworks activities that have altered landscape hydrological processes, possibly preventing the recharge of local aquifers and regular flushing of soil profile inducing increasing osmotic stress with the concomitant concentration of salts in the upper profile (Figure 22). However the understanding of processes causing such extensive deaths is uncertain and is worthy of more intensive investigation.

Figure 22 Dead Coolibah in floodplain landscape

4.9 Total grazing pressure

The most obvious actual and recognised threat along the riverine corridor upon riparian vegetation is the direct and indirect effects of the impact of grazing animals both domestic and feral. The nature of impact influences compositional, structural and functional components of the riparian ecosystem, upon which a healthy ecosystem and associated biodiversity depends (Fisher et al., 2006, Fisher et al., 2004). The nature of this impact is generally acknowledged and widely cited in the literature;

"Globally, grazing stock are a major cause of riparian degradation, causing reductions in vegetation cover, loss of biodiversity, enhanced overland flow, streambank erosion, water eutrophication and degradation of instream processes and aquatic communities"(Lunt et al., 2007)

"Across much of the region, total grazing pressure is the main impact on riparian areas and wetlands: this varies greatly with stocking rates, season and water infrastructure…The greatest impacts occur in drought around waterholes and springs when these refugia are under stress, not only from lack of flow and high rates of evaporation, but also from water extraction."(DCQ, 2004)

"The linear nature of the watercourse results in heavy grazing pressure paralleling the creek banks. The passage of stock to and fro results in the trampling of vegetation surrounding the waterholes; soil disturbance of the steep banks, along with browsing of shrubs and trees and a loss of vegetation cover. A decline in condition is evidenced by a reduction in perennial shrubs (possible old man saltbush) and an increase in the proportion of unpalatable species in the understory e.g. lignum " (LAB, 1986)

The impacts upon the individual components; species composition; vegetation structure; and ecosystem functional process; interact, further compounding overall cumulative impacts upon, and degrading, biodiversity values. Across the study region the impact upon floristic composition includes the loss of palatable plant species both perennial and annual. The degree of impact is variable across study area waterholes and may be a reflection of the cumulative history of stocking rates between individual waterholes (Figure 10 and Figure 13). The decrease in species can be directly attributed to selective grazing and indirectly due to associated trampling and camping of stock (Wilson et al., 2006).

Due to an obvious selective grazing pressure on palatable species, overall composition on heavily stocked sites then shifts to an array of less palatable species. The loss of perennial species, from ground layer species through to upper canopy species, results directly in a reduction of structural complexity. Figure 23 shows the typical nature of grazing impact upon mid story species experienced widely across sites in the region, in this instance, *Bauhinia gilva* and *Santalum lanceolatum*. Similar evidence was encountered for other significant perennials contributing to mid and upper vegetation strata when present: *Atalaya hemiglauca*, *Eucalyptus coolabah* (saplings), and *Eremophila bignoniiflora.* The structural impact is then compounded through an inhibition of recruitment of these perennial species as seedlings are grazed and trampled resulting in some instances in the loss of these important structural elements from some sites (Goheen et al., 2007).

Figure 23 Grazed *Bauhinia gilva* (left) and *Santalum lanceolatum* (right)

As previously commented on above, there was very scant evidence of *Eucalyptus coolabah* seedlings following recent very wet periods. Coolibah regeneration encountered during the Diamantina project was patchily represented by cohorts of saplings from earlier flooding events across the region. Often these saplings exhibited the effects of continued grazing pressure from herbivores resulting in a stunted or "bonsai-like" overall growth form following repeated grazing of re-sprouting foliage

(Figure 24). At a number of sites mature Coolibah exhibited browse lines; a probable indicator that more palatable local plant species had been lost due to grazing pressure (Figure 24).

Browse line on mature Coolibah

Figure 24 Grazed Coolibah Goyder's Lagoon Waterhole

Over time stocking pressure results in the degradation and destabilization of alluvial waterhole banks through the trampling and destruction of stabilizing vegetation, particularly Lignum, *Duma florulenta*. The associated removal of plant leaf and woody litter exposes the soil surface and subsequent pugging and pulverisation destroys soil surface structure of these sandy clay loams (Figure 25 and Figure 26). This soil disturbance along with nutrient loading associated with faeces and urine provides suitable conditions for the potential establishment of exotic plant or weed species with a propensity for rapid spread if possessing broad dispersal powers and rapid growth to maturity (Connell and Slatyer, 1977). The invasive species of greatest concern encountered during this study is *Cenchrus ciliaris* (Buffel Grass); currently recognized as a most aggressive invasive species over significant areas of the arid zone and poses a significant threat to biodiversity values wherever encountered (Fensham et al., 2015b, Grice, 2004).

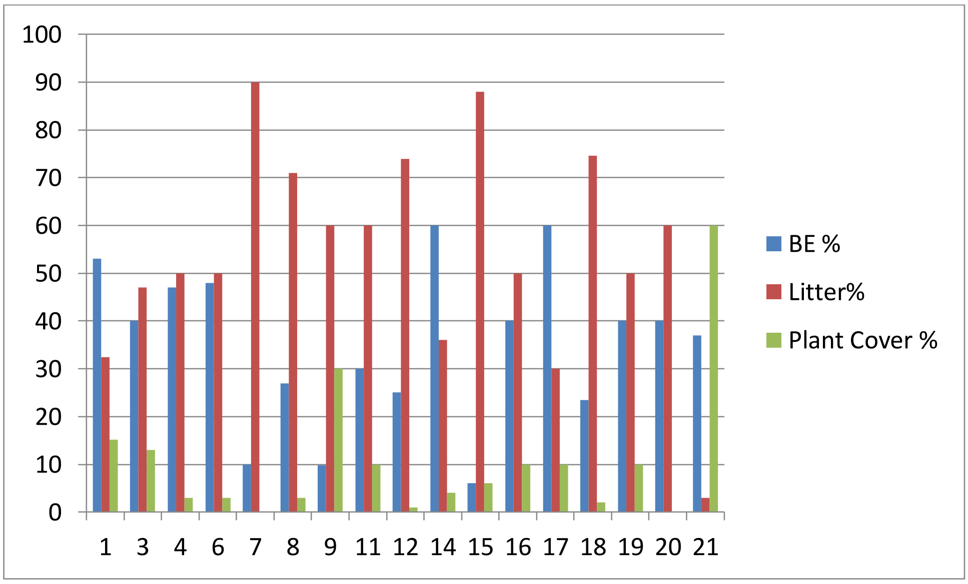


Figure 25 Ground layer condition across all permanent sites

Kalamurina Wildlife Sanctuary, Transect 3, Mia Mia Waterhole

Cowarie Station , Transect 3, Mona Downs Waterhole

Figure 26 Vegetation condition comparison

In contrast to the loams of channel banks, the heavy clays of floodplains immediately adjacent to many waterholes become compacted. With the concomitant loss of perennial plant cover due to grazing pressure these denuded and compacted areas readily shed water and nutrients following rainfall events compromising the integrity of natural landscape functional processes (Ludwig et al., 2004, Pringle and Tinley, 2003).

Figure 27 Bare ground and erosion: Andrewilla Waterhole adjacent floodplain

As an example of the processes described above, Figure 27 depicts the floodplain/floodout environment immediately adjacent to the riparian corridor of Andrewilla Waterhole on Clifton Hills Station. The water and nutrients shed directly from this surface into the waterhole further aggravating landscape function (Ludwig et al., 2004) by actively eroding the alluvial bank and undermining perennial trees and shrubs; Figure 28.

Figure 28 Active gully erosion and undermining of Coolibah; Andrewilla Waterhole

Potentially compounding the above stated problems is the possible additional pressure that could be exerted by the range of feral animal species occurring within the region should their numbers increase (Edwards et al., 2004). Evidence, albeit currently limited across sites, of the presence of the following feral animals was recorded; pig, camel, rabbit and horse/donkey (Appendix K).

Ironically the only direct visual observation of a rabbit across all study sites was on the conservation property of Kalamurina Wildlife Sanctuary (Tinnie Landing Waterhole). Kalamurina also exhibited indirect evidence of rabbit activity provided by extensive diggings and warrens at Yellow Waterhole. Evidence of the presence of pigs was scant and confined to two sites; Goyder's Lagoon Waterhole, Clifton Hills Station; and D Split Waterhole, Pandie Pandie Station. However, it is of concern to note that feral pigs, occurring upstream in Queensland on both the Diamantina and Cooper systems are now significantly extending their known range;

"Feral animal activity, particularly pigs can result in significant degradation of streamline vegetation. This activity and associated impacts have been progressing down the catchment into the lower Cooper and Diamantina in recent years."(DCQ, 2004)

Camels were only directly observed once during the study when a pair was encountered grazing in the vicinity of Yelpawaralinna on Clifton Hills Station. Indirect evidence was provided by camel scats recorded from Ultoomurra Waterhole, Clifton Hills Station and Wadlarkaninna Waterhole, Kalamurina Wildlife Sanctuary. The feral camel population in Central Australia is currently thought to be in the vicinity of 1 million, posing a widespread and serious problem for arid zone ecosystems (Colloff, 2014). The population has expanded rapidly over the last two decades heavily impacting the scarcer, productive, nutrient rich, well watered parts of the desert landscape. The threat to refugia associated with dryland river systems is obvious and very serious (Thapa et al., 2016). The problem will require a nationally coordinated response (Box et al., 2016, Woolnough et al., 2016).

4.10 Fire

During one period of field work during the project an extensive column of smoke was observed rising above an area of Goyder's Lagoon. The previous weather has been clear with no evidence of thunderstorms and associated lightening. One can only assume that such a fire had been deliberately lit within the extensive lignum swamp community. The burning of swamp communities to enhance cattle production has been recognised within the broader Diamantina and Cooper Creek systems;

"An emerging vegetation issue in Channel Country is the burning of lignum swamp communities to facilitate mustering and increase pasture extent" (DCG, 2012).

Intermittently flooded lignum dominated swamps, exemplified by the 1,300km^2 Goyder's Lagoon on Clifton Hills Station, have been recognised as increasingly significant waterbird habitats. As wetland habitat has decreased elsewhere in Australia as a result of hydrological regulation or associated development, the inland wetlands of the Channel country have been seen to play an increasingly important role in supplying habitat and breeding sites for a range of significant nomadic and migratory water bird species (Pisanu et al., 2015, Reid et al., 2009). Deliberate burning of this habitat directly imperils the rich natural ecosystem production and biodiversity values of a wetland of national and international significance.

Goyder's Lagoon has been listed in the Directory of Important Wetlands in Australia, and at an international level with Birdlife International as an 'Important Bird Area'.(https://www.environment.gov.au/water/wetlands/publications/directory-important-wetlands-australia-third-edition ; http://birdlife.org.au/documents/OTHPUB-IBA-supp.pdf)

A report by Reid et al (2010), considered waterbird populations across the range of wetlands on floodplains associated with the river systems of the LEB Channel Country. Their study included survey of Goyder's Lagoon as a component of the Diamantina Channel wetlands. Although their three succinct statements of significance (below) focussed on the greater Channel Country system they emphasised in the report that the whole was a sum of its parts and that all was dependent upon the interconnectedness of wetland systems through a natural unregulated flooding regime;

- *Channel Country confirmed to be of outstanding importance, one of the most important regions for waterbirds in Australia (in terms of numbers, breeding, and migratory species) and of global importance*
- *Particularly important for a suite of species/populations notably the many species numbering over their 1% thresholds and for Australian Pelican, Glossy Ibis, Black-tailed Native-hen and Freckled Duck in terms of breeding*
- *Channel Country has contributed substantially to national populations of waterbirds through the drought-stricken decade 2000-2009 without which waterbird declines (exacerbated by scarce habitat in the Murray-Darling Basin) may have been catastrophic.*

These statements aptly summarise the nature of significance of Goyder's Lagoon a major zone of transition between the Diamantina River to the north and Warburton River to the south. The swamp is virtually devoid of Coolibah trees, in contrast to the heavily wooded Coolibah riverine corridors that mark the passage of both Diamantina and Warburton Rivers. Recent genetic analysis of leaf material has indicated that the populations of Coolibah to the north and south of the Goyder Lagoon 'buffer' may be genetically differentiated. This preliminary work requires more vigorous and systematic research for positive verification (Gillen 2017).

5 Discussion

5.1 Significance of the Diamantina River system and associated Coolibah community

The currently unregulated dry land river systems of the Lake Eyre Basin (LEB), as exemplified by the Diamantina River, are currently amongst the few naturally functioning examples globally. At both national and international levels, extensive deliberate hydrological disruption has drastically and detrimentally altered the associated ecology of other dry land river systems. Thus the rivers of the LEB provide an increasingly valuable reference system. Ongoing monitoring and increased understanding of the eco-hydrological functioning of the LEB river systems will provide valuable insights into future rehabilitation and restoration programs for degraded dysfunctional river systems elsewhere in Australia.

The presence of the perennially vegetated riverine communities of the Diamantina River represent a dynamic and biodiverse ecosystem of incongruous productivity when juxtaposed against the desiccated dunes of the surrounding Simpson Desert. Generally the broader arid landscapes of central Australia such as desert dune fields are highly dependent upon local rainfall events to drive ecosystem function. However, within these desert landscapes and those of the LEB in particular, such rainfall events are highly variable and unpredictable spatially and temporally (Schwinning et al., 2004). The classical concept of the functional response of such a stochastic system is that of Noy-Mier (1973) which depicts the response (pulse) of ephemeral or annual plant species to a random rainfall event (Figure 29) The life cycle of a typical ephemeral species is highly adapted to these random events of scarce moisture availability, allocating few resources to development of biomass, instead, cycling rapidly through flowering, fruiting and seed dispersal stages to ensure continuance of the species.

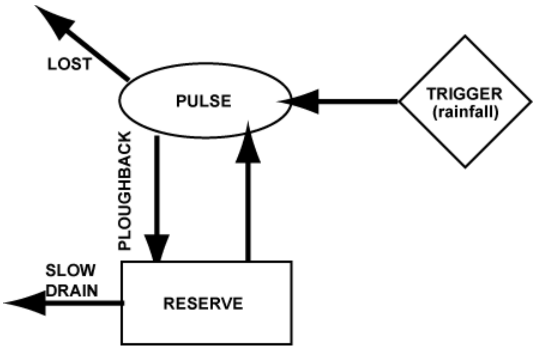


Figure 29 Noy-Meir conceptual ephemeral plant response model

In contrast to the obvious unpredictability of these rainfall dependent systems, the dryland rivers of the LEB with their associated reliable hydrological regimes provide a more regular source of moisture supporting the development of a perennial vegetation community of structural and compositional diversity.

The riverine corridor of the Diamantina represents a significant mesic zone of transition or ecotone between the aquatic and proximal more xeric vegetation communities associated with river channel and lateral floodplains respectively (Tabacchi et al., 1996, Gregory et al., 1991). Ecologically ecotones are generally considered to be zones of high biodiversity driven, in the instance of the Diamantina River, by the bilateral flow of nutrients and water between channel and floodplain (Risser, 1995). Regular flood pulses down the river channel sustain the vegetated corridor concomitantly recharging local groundwater systems where possible upon which the long lived Coolibahs depend for moisture during natural periods of drought. During times of major floods driven by monsoonal and La Nina influences high in the Queensland catchment, floodwaters break free of the channel confine, flowing through the ecotonal Coolibah corridor and out across adjacent floodplains transporting and depositing debris, seeds and associated nutrients. As the floodwaters draw down over time and recede back into the channel, nutrients, resulting from the biological pulse of activity across the floodplains, are drawn back into the channel recharging the associated trophic systems of the aquatic ecosystem.

The regularity and hence reliability of the hydrological regime of the Diamantina is the main driver of the persistence of Coolibah riverine woodlands and the broader albeit sparser distribution of the species across the associated floodplain landscape. The dominance of Coolibah has a major role in contributing and supporting the biodiversity of the system and as such could be viewed as a keystone species influencing directly and indirectly biotic and abiotic processes supporting a broad range of associated taxa. Disrupting the naturally functioning hydrological regime by major, upstream, water extractions, irrigation activities, diversions or off stream storage, would have major detrimental ramifications for Coolibah which would cascade through associated and dependent trophic levels.

The recruitment of Coolibah, a long-lived perennial, is very dependent upon major, uncommon extensive flood events. Coolibah seed is dispersed widely during these events both longitudinally down the system and laterally across the adjacent floodplain (Figure 30). These extreme and uncommon flood events are strongly correlated with a clustered sequence of 'flood years' driven by the La Nina cycle of the ENSO system. The sequence of wet years flooding the region and saturating the soil profile facilitates the dispersal, germination, establishment and persistence of new cohorts of Coolibah.

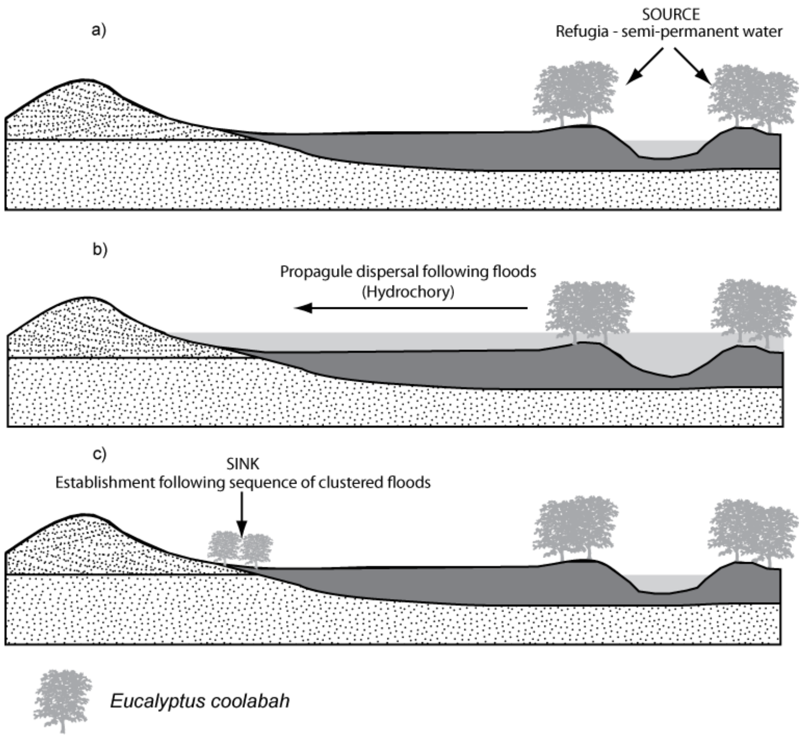


Figure 30 Flood driven dispersal of Coolibah across floodplain landscape; conceptual model

Once established, mature Coolibah ameliorate climatic and soil conditions immediately below their canopies. It has been established for a number of Australian phreatophytes, including Eucalypt species, exhibiting dimorphic root structure, that tap roots, via a process of hydraulic lift, bring groundwater at depth to the upper soil profile making moisture available to the lateral root system (Brooksbank et al., 2011, Dawson and Pate, 1996, Holland et al., 2006, McLean, 2014, Stephen et al., 1998) So potentially for the phreatophytic Coolibah, tapping into groundwater at depth, via hydraulic lift during dry conditions the tree could raise moisture to the upper soil profile where it would become accessible not only to its shallower lateral root system but also provide moisture and associated nutrients to a range of soil biota and other plant species. This potential mechanism of hydraulic lift in relation to Coolibah needs to be verified. Coolibah thus serves as a facilitator providing ameliorated climatic and suitable abiotic and biotic conditions and thus extending habitat for a range of taxa in an otherwise harsh and stressful environment (Figure 31).

Depicted in Figure 31, the fundamental niche effectively circumscribes the potential environmental distribution of a plant species given ideal resource conditions which address the physiological requirements of the species in the absence of competition. Under competition for resources with other cohabiting plant species this potential 'fundamental' envelope or niche is reduced, as shown, given resource constraints.

In harsh physiologically stressful ecosystems such as deserts the presence of perennials such as Coolibah substantially ameliorates environmental conditions, as described above, beneath their canopies extending the potential range and distributions of species beyond that which would be possible without such protection. Coolibah drawing on resources at depth, rather than competing for resources with shallower rooted species effectively facilitates their presence, extending their range.

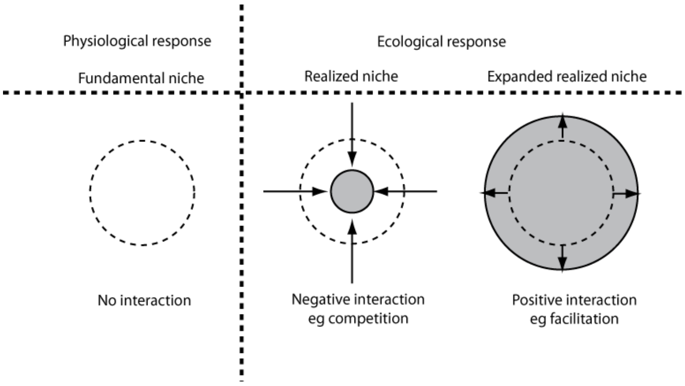


Figure 31 Facilitation: conceptual model

6 Recommendations

6.1 Monitoring

This study has achieved; the inventory of plant species and assessment of vegetation condition associated with selected water holes of the Diamantina and Warburton Rivers systems; and the initiation of a site based and systematic monitoring program to establish a benchmark against which to monitor vegetation and associated biodiversity trends over time.

Assessment has provided a view of current state and provides a benchmark of condition against which to monitor future system shifts – recovering, stable, or degrading (Gintzburger and Saidi, 2010).

As depicted in the model of Figure 32, assessment and the establishment of a monitoring program represent the very early stages in the development of a monitoring framework. It is generally recognized, particularly in relation to arid ecosystems dominated by long-lived perennials, that monitoring such systems is a long-term undertaking (Parr et al., 2003). Long-term monitoring is an interactive and adaptive process required to detect positive or negative trends in the composition, structure and functioning of biodiversity over time.

Research should be integrally associated with monitoring in order to develop a depth of understanding of the nature of processes driving and maintaining biodiversity. Research should be guided by a conceptual model of the patterns and processes supporting ecosystem function (Westoby et al., 1989, Eyre et al., 2015). The conceptual model guides the design of the monitoring process and provides working hypotheses of system functionality for focused research.

As depicted in Figure 32, long term monitoring and integrated research and modelling serve an iterative function in continually refining and informing evidence based policy and management frameworks.

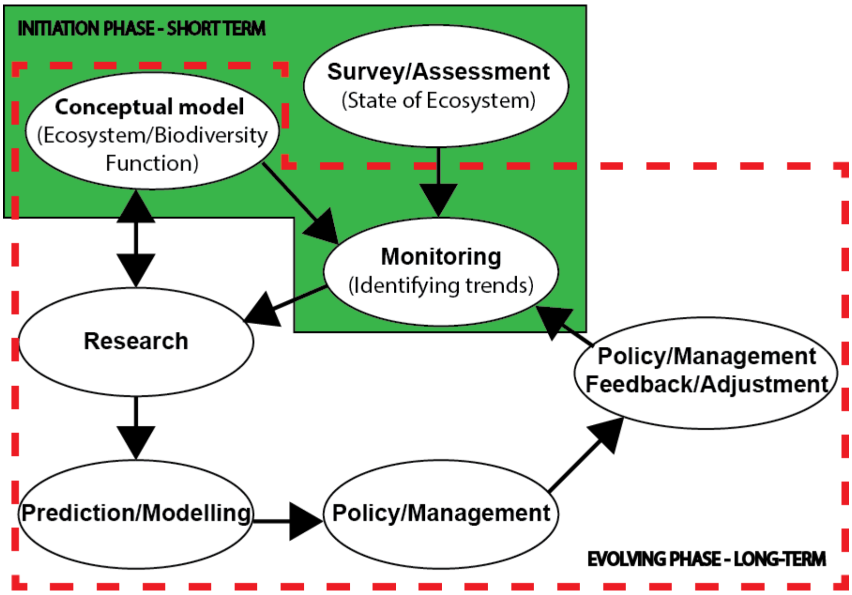


Figure 32 Long-term ecosystem monitoring program; conceptual model (adapted from: Parr et al. (2003))

The data generated from this study will be entered and stored within the Biological Databases of South Australia and should also be provided to the national program for rangelands; The Australian Collaborative Rangelands Information System (ACRIS);

- https://www.environment.sa.gov.au/Science/Information_data/Biological_databases_of_South_Australia
- https://www.environment.gov.au/land/rangelands/acris

It is strongly recommended that the Diamantina monitoring program be continued into the future. The future development of the program should be participatory; directly involving regional stakeholders in the evolution of monitoring and research processes, directly educating, informing and providing feedback to all stakeholders.

Considerable resources have been expended to date, designing and establishing the site based systematic monitoring framework; to build on this initial investment ongoing funding should be sought. It is generally understood that arid ecosystems require long-term monitoring in order to separate the 'noise' associated with natural seasonal fluctuations in order to confidently detect underlying trends in condition; as reflected in the comments below, the commitment to long-term monitoring must be supported by a commitment to ongoing funding;

"The Challenging reality for governments and NRM authorities is that meaningful outcomes of a rangeland biodiversity monitoring program will not be forthcoming within the usual 3 year project (and political) funding cycle. Rather, governments must be convinced that a monitoring program is not a 'project', but an ongoing core government function to support evidence-based policy and management, so the design of the program will need to be adequate for these purpose."(Eyre et al., 2011)

"Long-term monitoring is the best available source of data against which to evaluate ecosystem changes. Such data can inform adaptive management, allowing managers to determine baseline conditions against which effects of disturbances can be evaluated, limits of acceptable change be set and the efficacy of interventions assessed….. It is therefore of concern that monitoring programs are often restricted in duration and extent and contingent upon limited funding, given that the cost of monitoring is far less than that of policy implementation or the value of benefits derived from wetland restoration" (Colloff et al., 2015)

It is clear that at both national and state levels governments and NRM authorities have clearly identified and recognized the need for biodiversity conservation and management of threatening processes at national, state, regional and bioregional levels.

At the national level 'Australia's Biodiversity Conservation Strategy' provides both the overarching framework for biodiversity conservation at the broad scale and targeted strategies focussed on specific identified threats and management issues;

- National Framework for the Management and Monitoring of Australia's Native Vegetation
- The Australian Weeds Strategy (revised 2007)
- Australian Pest Animal Strategy
- National Principles for Rangelands Management

(https://www.environment.gov.au/biodiversity/conservation/strategy/related-frameworks)

Both Queensland and South Australian Governments have also developed broad biodiversity conservation strategies for their respective states. Within the context of the Diamantina monitoring project, relevant regional NRM authorities in both Queensland and South Australia have developed strategies for maintaining and enhancing the region's natural resources and biodiversity values;

- http://dcq.org.au/wp-content/uploads/2015/04/DCQ-NRM-PLAN-2016-2020.pdf
- http://dcq.org.au/wp-content/uploads/2015/04/Biodiversity-plan-part-1-final.pdf
- http://dcq.org.au/wp-content/uploads/2015/04/Biodiversity-plan-part2.pdf
- http://dcq.org.au/wp-content/uploads/2015/04/Community-Information-Paper.pdf
- http://www.naturalresources.sa.gov.au/aridlands/about-us/our-regions-plan

The relevant regional stakeholders have been directly involved in the development of these strategies and plans and are well aware of the need for integrated cross border cooperation and coordination in the management and delivery of NRM and biodiversity conservation programs. Management and policy structures are in place, stakeholders are engaged and informed. Funding is required at a regional level to underpin the necessary research and monitoring to provide stakeholders with appropriate data to inform and support evidenced based biodiversity conservation.

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If I have inadvertently omitted any individual or organisation I apologise in advance.

8 References

AKOKO, E., ATEKWANA, E. A., CRUSE, A. M., MOLWALEFHE, L. & MASAMBA, W. R. L. 2013. River-wetland interaction and carbon cycling in a semi-arid riverine system: the Okavango Delta, Botswana. *Biogeochemistry,* 114, 359-380.

BAILEY, F. M. 1892. Notes upon some plant specimens collected by Dr Thos. L. Bancroft. *The proceedings of the royal society of Queensland,* 8.

BENGSEN, A. J. & PEARSON, R. G. 2006. Examination of factors potentially affecting riparian bird assemblages in a tropical Queensland savanna. *Ecological Management & Restoration,* 7, 141-144.

BOX, J. B., MCBURNIE, G., STREHLOW, K., GUEST, T., CAMPBELL, M., BUBB, A., MCCONNELL, K., WILLY, S., ULURU, R., KULITJA, R., BELL, B., BURKE, S., JAMES, R., KUNOTH, R. & STOCKMAN, B. 2016. The impact of feral camels (<i>Camelus dromedarius</i>) on remote waterholes in central Australia. *The Rangeland Journal,* 38, 191-200.

BROOKSBANK, K., VENEKLAAS, E. J., WHITE, D. A. & CARTER, J. L. 2011. The fate of hydraulically redistributed water in a semi-arid zone eucalyptus species. *Tree Physiology,* 31, 649-658.

CATFORD, J. A., DAEHLER, C. C., MURPHY, H. T., SHEPPARD, A. W., HARDESTY, B. D., WESTCOTT, D. A., REJMÁNEK, M., BELLINGHAM, P. J., PERGL, J., HORVITZ, C. C. & HULME, P. E. 2012. The intermediate disturbance hypothesis and plant invasions: Implications for species richness and management. *Perspectives in Plant Ecology, Evolution and Systematics,* 14, 231-241.

COA 2013. Biodiversity Fund: Ecological Monitoring Guide. Canberra: Commonwealth of Australia.

COBON, D. & TOOMBS, N. 2007. Practical adaptation to climate change in regional natural resource management. Toowoomba.

COLLOFF, M. J. 2014. *Flooded forest and desert creek: Ecology and history of the River Red Gum,* Melbourne, CSIRO.

COLLOFF, M. J., CALEY, P., SAINTILAN, N., POLLINO, C. A. & CROSSMAN, N. D. 2015. Long-term ecological trends of flow-dependent ecosystems in a major regulated river basin. *Marine and Freshwater Research,* 66, 957-969.

CONNELL, J. H. & SLATYER, R. O. 1977. Mechanisms of Succession in Natural Communities and Their Role in Community Stability and Organization. *The American Naturalist,* 111, 1119-1144.

DAWSON, T. E. & PATE, J. S. 1996. Seasonal Water Uptake and Movement in Root Systems of Australian Phraeatophytic Plants of Dimorphic Root Morphology: A Stable Isotope Investigation. *Oecologia,* 107, 13-20.

DCG 2012. MANAGING FOR RESILIENCE Desert Channels Queensland's Biodiversity Plan: Part 2 – Management and values of the Desert Channels Region 2012-2017. Desert Channels Group.

DCQ 2004. Our country:our future - A community information paper for the Queensland section of the Lake Eyre Basin. Desert Channels Queensland Inc.

DEH 2007. No species Loss: A biodiversity strategy for South Australia 2007-2017. Department of Environment and Heritage, South Australia.

DEH 2009a. South Australian Arid Lands Biodiversity Strategy – Volume 1: Region-wide Priority Actions. Port Augusta: South Australian Arid Lands NRM Board, Department for Environment and Heritage.

DEH 2009b. South Australian Arid Lands Biodiversity Strategy – Volume 2: Channel Country Conservation Priorities. Port Augusta: South Australian Arid Lands NRM Board, Department for Environment and Heritage.

EDWARDS, G. P., POPLE, A. R., SAALFELD, K. & CALEY, P. 2004. Introduced mammals in Australian rangelands: Future threats and the role of monitoring programmes in management strategies. *Austral Ecology,* 29, 40-50.

EYRE, T. J., FISHER, A., HUNT, L. P. & KUTT, A. S. 2011. Measure it to better manage it: a biodiversity monitoring framework for the Australian rangelands. *The Rangeland Journal,* 33, 239-253.

EYRE, T. J., KELLY, A. L., NELDNER, V. J., WILSON, B. A., FERGUSON, D. J., LAIDLAW, M. J. & FRANKS, A. J. 2015. BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland, Assessment Manual. Version 2.2. Brisbane: Department of Science, Information Technology, Innovation and Arts.

FENSHAM, R. J., FRASER, J., MACDERMOTT, H. J. & FIRN, J. 2015a. Dominant tree species are at risk from exaggerated drought under climate change. *Global Change Biology,* 21**,** 3777-3785.

FENSHAM, R. J., WANG, J. & KILGOUR, C. 2015b. The relative impacts of grazing, fire and invasion by buffel grass (<i>Cenchrus ciliaris</i>) on the floristic composition of a rangeland savanna ecosystem. *The Rangeland Journal,* 37**,** 227-237.

FISHER, A., HUNT, L., KUTT, A. & MAZZER, T. 2006. Biodiversity monitoring in the rangelands: A way forward: Volume 2; Case Studies. Alice Springs: Desert Knowledge CRC.

FISHER, A., HUNT, L., LANDSBERG, J., PHELPS, D., SMYTH, A. K. & WATSON, I. A. N. 2004. Review of total grazing presure management issues and priorities for biodiversity conservation in rangelands: A resource to aid NRM planning. Alice Springs: Desert Knowledge CRC Project Report No. 3.

FREUDENBERGER, D. & HARVEY, J. 2003. Assessing the benefits of vegetation enhancement for biodiversity: A draft framework. Report for Environment Australia. Canberra.

FU, B. & BURGHER, I. 2015. Riparian vegetation NDVI dynamics and its relationship with climate, surface water and groundwater. *Journal of Arid Environments,* 113**,** 59-68.

FU, B. & GUILLAUME, J. H. A. 2014. Assessing certainty and uncertainty in riparian habitat suitability models by identifying parameters with extreme outputs. *Environmental Modelling & Software,* 60**,** 277-289.

GILLEN, J. S. 2010. *An ecological study of the landscape, perennial plants and soils of the Cooper Creek floodplain, South Australia.* Ph.D., Australian National University.

GILLEN, J. S. & DREWIEN, G. 1993. A vegetation survey of the Kanowana Wetlands, Cooper Creek, South Australia; A states assistance cooperative project with ANPWS & SANPWS. Adelaide: SA Department of Environment and Land Management.

GILLEN, J. S. & REID, J. R. W. 1988. Vegetation. *In:* REID, J. R. W. & GILLEN, J. S. (eds.) *The Coongie Lakes Study.* Adelaide: Department of Environment and Planning.

GILLEN, J. S. & REID, J. R. W. 2013. Vegetation and soil assessment of selected waterholes of the main and northwest channels of Cooper Creek, SA: A report by the Australian national University to the South Australian Arid Lands Natural Resources Management Board. Port Augusta.

GINTZBURGER, G. & SAIDI, S. 2010. From inventory to monitoring in semi-arid and arid rangelands. *In:* SQUIRES, V. R. (ed.) *Range and Animal Sciences and Resources Management, Volume 2.* UNESCO - Encyclopedia of Life Support Systems (EOLSS)

GOHEEN, J. R., YOUNG, T. P., KEESING, F. & PALMER, T. M. 2007. Consequences of Herbivory by Native Ungulates for the Reproduction of a savanna Tree. *Journal of Ecology,* 95**,** 129-138.

GREGORY, S. V., SWANSON, F. J., MCKEE, W. A. & CUMMINS, K. W. 1991. An Ecosystem Perspective of Riparian Zones. *BioScience,* 41**,** 540-551.

GRICE, A. C. 2004. Weeds and the monitoring of biodiversity in Australian rangelands. *Austral Ecology,* 29**,** 51-58.

HABECK-FARDY, A. & NANSON, G. C. 2014. Environmental character and history of the Lake Eyre Basin, one seventh of the Australian continent. *Earth-Science Reviews,* 132**,** 39-66.

HOLLAND, K. L., TYERMAN, S. D., MENSFORTH, L. J. & WALKER, G. R. 2006. Tree water sources over shallow, saline groundwater in the lower River Murray, south-eastern Australia: implications for groundwater recharge mechanisms. *Australian Journal of Botany,* 54**,** 193-205.

KOTWICKI, V. 1986. *Floods of Lake Eyre,* Adelaide, SA Engineering and Water Supply Department.

KOTWICKI, V. & ISDALE, P. 1991. Hydrology of Lake Eyre, Australia - El-Nino Link. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 84**,** 87-98.

LAB 1986. Rangeland Assessment Branch: Innamincka Station. Adelaide: Land Assessment Branch,South Australian Department of Lands.

LANDSBERG, J. & CROWLEY, G. 2004. Monitoring rangeland biodiversity: Plants as indicators. *Austral Ecology,* 29**,** 59-77.

LOUGH, J. M. 1997. REGIONAL INDICES OF CLIMATE VARIATION: TEMPERATURE AND RAINFALL IN QUEENSLAND, AUSTRALIA. *International Journal of Climatology,* 17**,** 55-66.

LUDWIG, J. A. & TONGWAY, D. J. 2000. Viewing rangelands as landscape systems. *In:* ARNALDS, O. & ARCHER, S. (eds.) *Rangeland Desertification.* Spinger Netherlands.

LUDWIG, J. A., TONGWAY, D. J., BASTIN, G. N. & JAMES, C. D. 2004. Monitoring ecological indicators of rangeland functional integrity and their relation to biodiversity at local to regional scales. *Austral Ecology,* 29**,** 108-120.

LUNT, I. D., JANSEN, A. M. Y., BINNS, D. L. & KENNY, S. A. 2007. Long-term effects of exclusion of grazing stock on degraded herbaceous plant communities in a riparian Eucalyptus camaldulensis forest in south-eastern Australia. *Austral Ecology,* 32**,** 937-949.

MCLEAN, E. H. 2014. *Patterns of water use by the riparian tree Melaleuca argentea in semi-arid northwest Australia.* Ph.D., The University of Western Australia

MCMAHON, T. A., MURPHY, R. E., PEEL, M. C., COSTELLOE, J. F. & CHIEW, F. H. S. 2008. Understanding the surface hydrology of the Lake Eyre Basin: Part 2—Streamflow. *Journal of Arid Environments,* 72**,** 1869-1886.

MILLER, C., JAMES, C., KROON, F., FISHER, A., HANCOCK, P., SMYTH, A. K. & GORDON, I. 2005. Best Practice Sustainable Water Management in the Rangelands. Desert Knowledge CRC Project Report No. 6 (June 2005). Alice Springs: Desert Knowledge CRC and CSIRO Sustainable Ecosystems.

NOY-MEIR, I. 1973. Desert Ecosystems: Environment and Producers. *Annual Review of Ecology and Systematics,* 4**,** 25-51.

NRMMC 2010. Australia's Biodiversity Conservation Strategy 2010-2030. Canberra: Natural Resource Management Ministerial Council.

OESTERHELD, M. & SEMMARTIN, M. 2011. Impact of grazing on species composition: Adding complexity to a generalized model. *Austral Ecology,* 36**,** 881-890.

PARR, T. W., SIER, A. R. J., BATTARBEE, R. W., MACKAY, A. & BURGESS, J. 2003. Detecting environmental change: science and society—perspectives on long-term research and monitoring in the 21st century. *Science of The Total Environment,* 310**,** 1-8.

PISANU, P., KINGSFORD, R. T., WILSON, B. & BONIFACIO, R. 2015. Status of connected wetlands of the Lake Eyre Basin, Australia. *Austral Ecology,* 40**,** 460-471.

PRINGLE, H. & TINLEY, K. 2003. Are we overlooking critical geomorphic determinants of landscape change in Australian rangelands? *Ecological Management & Restoration,* 4**,** 180-186.

PUCKRIDGE, J. T., SHELDON, F., WALKER, K. F. & BOULTON, A. J. 1998. Flow variability and the ecology of large rivers. *Marine and Freshwater Research,* 49**,** 55-72.

REID, J. R. W., COLLOFF, M. J., ARTHUR, A. D. & MCGINNESS, H. M. 2013. Influence of Catchment Condition and water resource development on waterbird assemblages in the Murray-Darling Basin, Australia. *Biological Conservation,* 165**,** 25-34.

REID, J. R. W., KINGSFORD, R. T. & P, J. R. 2009. Waterbird Surveys in the Channel Country Floodplain Wetlands, Autumn 2009. Report by Australian National University, Canberra, University of New South Wales, Sydney, and Wetlands International – Oceania, Brisbane, for the Australian Government Department of Environment, Water, Heritage and the Arts.

RISSER, P. G. 1995. Biodiversity and Ecosystem Function. *Conservation Biology,* 9**,** 742-746.

SCHWINNING, S., SALA, O. E., LOIK, M. E. & EHLERINGER, J. R. 2004. Thresholds, memory, and seasonality: understanding pulse dynamics in arid/semi-arid ecosystems. *Oecologia,* 141**,** 191-193.

SMYTH, A. K. & JAMES, C. D. 2004. Characteristics of Australia's rangelands and key design issues for monitoring biodiversity. *Austral Ecology,* 29**,** 3-15.

STEPHEN, S. O. B., ADAMS, M. A., TURNER, N. C. & ONG, C. K. 1998. The Redistribution of Soil Water by Tree Root Systems. *Oecologia,* 115**,** 306-311.

TABACCHI, E., PLANTY-TABACCHI, A.-M., SALINAS, M. J. & DÉCAMPS, H. 1996. LANDSCAPE STRUCTURE AND DIVERSITY IN RIPARIAN PLANT COMMUNITIES: A LONGITUDINAL COMPARATIVE STUDY. *Regulated Rivers: Research & Management,* 12**,** 367-390.

TATE, R. 1889. Plants of the Lake Eyre Basin. *Transactions of the Royal Society of South Australia,* 11.

THAPA, R., THOMS, M. C. & PARSONS, M. 2016. The response of dryland floodplain vegetation productivity to flooding and drying. *Journal of Arid Environments,* 129**,** 42-55.

VESK, P. A. & WESTOBY, M. 2001. Predicting Plant Species' Responses to Grazing. *Journal of Applied Ecology,* 38**,** 897-909.

WAINWRIGHT, P., TUNN, Y., GIBSON, D. & CAMERON, J. 2006. Wetland mapping: Channel country bioregion, South Australia. Adelaide: Department for the Environment and Heritage.

WAKELIN-KING, G. A. 2017. Geomorphology of the Diamantina River catchment (SA); Report to Natural Resources SA Arid Lands. Adelaide: South Australian Arid Lands Natural Resources Management Board.

WEN, L., MACDONALD, R., MORRISON, T., HAMEED, T., SAINTILAN, N. & LING, J. 2013. From hydrodynamic to hydrological modelling: Investigating long-term hydrological regimes of key wetlands in the Macquarie Marshes, a semi-arid lowland floodplain in Australia. *Journal of Hydrology,* 500**,** 45-61.

WESTOBY, M., WALKER, B. & NOY-MEIR, I. 1989. Opportunistic Management for Rangelands Not at Equilibrium. *Journal of Range Management,* 42**,** 266-274.

WHITFORD, W. G. 2002. *Ecology of desert systems,* London, Academic Press.

WILSON, A., JANSEN, A., CURTIS, A. & ROBERTSON, A. 2006. Measuring riparian condition: A comparison of assessments by landholders and scientists. *Ecological Management & Restoration,* 7**,** 123-129.

WOINARSKI, J. C. Z., BROCK, C., ARMSTRONG, M., HEMPEL, C., CHEAL, D. & BRENNAN, K. 2000. Bird Distribution in Riparian Vegetation in the Extensive Natural Landscape of Australia's Tropical Savanna: A Broad-Scale Survey and Analysis of a Distributional Data Base. *Journal of Biogeography,* 27**,** 843-868.

WOOLNOUGH, A. P., EDWARDS, G. & HART, Q. 2016. Feral camels: a nationally significant pest animal requiring a national management approach. *The Rangeland Journal,* 38**,** 109-115.

WORM, B. & DUFFY, J. E. 2003. Biodiversity, productivity and stability in real food webs. *Trends in Ecology & Evolution,* 18**,** 628-632.

9 Appendix A

9.1 All Sites / All Transects Locational Data

Station	Water Hole	Site & Transect	Lat	Long	Transect Bearing	Visitation Date
Clifton Hills	Ultoomurra WH	1-1	-27.145972	138.728877	334	30/04/2014
Clifton Hills	Ultoomurra WH	1-2	-27.144008	138.731401	266	29/04/2014
Clifton Hills	Ultoomurra WH	1-3	-27.146258	138.726486	184	30/04/2014
Clifton Hills	Goyders Lag WH	2-1	-26.887699	138.969819	54	1/05/2014
Clifton Hills	Goyders Lag WH	2-2	-26.888909	138.965437	240	30/04/2014
Clifton Hills	Goyders Lag WH	2-3	-26.885989	138.973544	250	1/05/2014
Clifton Hills	Koonchera WH	3-1	-26.687393	139.506175	78	1/05/2014
Clifton Hills	Koonchera WH	3-2	-26.68857	139.503239	195	2/05/2014
Clifton Hills	Koonchera WH	3-3	-26.687468	139.503386	10	2/05/2014
Clifton Hills	Yammakira WH	4-1	-26.52323	139.438012	130	4/05/2014
Clifton Hills	Yammakira WH	4-2	-26.527326	139.441333	140	5/05/2014
Clifton Hills	Yammakira WH	4-3	-26.530671	139.44519	102	5/05/2014
Clifton Hills	Tepamimi WH	5-1	-26.668094	138.992526	318	5/05/2014
Clifton Hills	Tepamimi WH	5-2	-26.671033	138.993479	182	5/05/2014
Clifton Hills	Tepamimi WH	5-3	-26.673801	138.992031	194	6/05/2014
Clifton Hills	Andrewilla WH	6-1	-26.53768	139.25656	180	6/05/2014
Clifton Hills	Andrewilla WH	6-2	-26.54205	139.253669	205	7/05/2014
Clifton Hills	Andrewilla WH	6-3	-26.545307	139.252161	180	7/05/2014
Pandie Pandie	D Split WH	7-1	-26.405285	139.398148	108	8/05/2014
Pandie Pandie	D Split WH	7-2	-26.407328	139.401028	90	8/05/2014
Pandie Pandie	D Split WH	7-3	-26.406207	139.403995	30	8/05/2014
Pandie Pandie	Windmill WH	8-1	-26.123125	139.386747	320	9/05/2014
Pandie Pandie	Windmill WH	8-2	-26.121243	139.383272	260	9/05/2014
Pandie Pandie	Windmill WH	8-3	-26.121235	139.380605	270	9/05/2014
Cowarie	Kalamunkinna WH	9-1	-27.285875	138.550179	330	10/04/2014
Cowarie	Kalamunkinna WH	9-2	-27.282866	138.5501	10	10/04/2014
Cowarie	Kalamunkinna WH	9-3	-27.279981	138.552183	30	10/04/2014
Cowarie	Kuncherinna WH	10-1	-27.362561	138.470334	154	11/04/2014
Cowarie	Kuncherinna WH	10-2	-27.365143	138.469666	208	11/04/2014
Cowarie	Kuncherinna WH	10-3	-27.368318	138.467374	210	11/04/2014
Cowarie	Stony Pt WH	11-1	-27.453071	138.524433	38	12/05/2014
Cowarie	Stony Pt WH	11-2	-27.454305	138.52239	245	12/05/2014
Cowarie	Stony Pt WH	11-3	-27.454916	138.519241	190	12/05/2014
Cowarie	Cowarie Xing	12-1	-27.610844	138.305952	200	13/05/2014
Cowarie	Cowarie Xing	12-2	-27.608776	138.308301	82	13/05/2014
Cowarie	Cowarie Xing	12-3	-27.608285	138.311452	65	13/05/2014
Kalamurina	Poonarunna Bore	13-1	-27.871922	137.915383	150	14/05/2014

Station	Water Hole	Site & Transect	Lat	Long	Transect Bearing	Visitation Date
Kalamurina	Poonarunna Bore	13-2	-27.870637	137.912262	280	14/05/2014
Kalamurina	Poonarunna Bore	13-3	-27.872521	137.910122	165	14/05/2014
Kalamurina	Wadlarkaninna WH	14-1	-27.869583	138.150174	310	14/05/2014
Kalamurina	Wadlarkaninna WH	14-2	-27.869018	138.146241	40	15/05/2014
Kalamurina	Wadlarkaninna WH	14-3	-27.870118	138.142304	240	15/05/2014
Kalamurina	Yellow WH	15-1	-27.704546	138.25028	90	15/05/2014
Kalamurina	Yellow WH	15-2	-27.70473	138.253079	262	16/05/2014
Kalamurina	Yellow WH	15-3	-27.705795	138.258037	100	16/05/2014
Kalamurina	Tinnie WH	16-1	-27.891702	138.020299	220	1/05/2015
Kalamurina	Tinnie WH	16-2	-27.890368	138.021447	10	1/05/2015
Kalamurina	Tinnie WH	16-3	-27.888415	138.021482	330	1/05/2015
Kalamurina	Mia Mia WH	17-1	-27.818338	138.187125	170	2/05/2015
Kalamurina	Mia Mia WH	17-2	-27.820514	138.186461	230	2/05/2015
Kalamurina	Mia Mia WH	17-3	-27.818442	138.182946	230	2/05/2015
Cowarie	Mona Downs WH	18-1	-27.39567	138.452806	30	5/05/2015
Cowarie	Mona Downs WH	18-2	-27.393372	138.454065	10	5/05/2015
Cowarie	Mona Downs WH	18-3	-27.391468	138.455243	20	5/05/2015
Clifton Hills	Yelpawaralinna WH	19-1	-27.127916	138.708443	220	7/05/2015
Clifton Hills	Yelpawaralinna WH	19-2	-27.12938	138.706303	240	7/05/2015
Clifton Hills	Yelpawaralinna WH	19-3	-27.129892	138.703549	260	7/05/2015
Pandie Pandie	Double Bluff WH	20-1	-26.265989	139.393275	50	11/05/2015
Pandie Pandie	Double Bluff WH	20-2	-26.264935	139.395488	40	11/05/2015
Pandie Pandie	Double Bluff WH	20-3	-26.263786	139.397819	10	11/05/2015
Clifton Hills	Burt's WH	21-1	-26.587129	139.151328	220	13/05/2015
Clifton Hills	Burt's WH	21-2	-26.588787	139.149748	230	13/05/2015
Clifton Hills	Burt's WH	21-3	-26.586986	139.147431	320	14/05/2015
Clifton Hills	Pelican WH	22	-26.544071	139.219533		13/05/2016

10 Appendix B

10.1 All Families/Genera/Species Encountered Over All Surveyed Sites 2014 – 2016

Family	Species
AMARYLLIDACEAE	1
AZOLLACEAE	1
HALORAGACEAE	1
JUNCAGINACEAE	1
LABIATAE	1
MARSILEACEAE	1
MYRTACEAE	1
RUBIACEAE	1
SANTALACEAE	1
SAPINDACEAE	1
VERBENACEAE	1
BORAGINACEAE	2
CAMPANULACEAE	2
LYTHRACEAE	2
MYOPORACEAE	2
PORTULACACEAE	2
SCROPHULARIACEAE	2
POLYGONACEAE	3
AIZOACEAE	4
AMARANTHACEAE	4
CONVOLVULACEAE	4
CUCURBITACEAE	4
GOODENIACEAE	4
LORANTHACEAE	4
CRUCIFERAE	5
NYCTAGINACEAE	5
SOLANACEAE	6
ZYGOPHYLLACEAE	6
CYPERACEAE	7
EUPHORBIACEAE	9
MALVACEAE	11
LEGUMINOSAE	17
CHENOPODIACEAE	18
COMPOSITAE	25

Family	Species
AIZOACEAE	4
AMARANTHACEAE	4
AMARYLLIDACEAE	1
AZOLLACEAE	1
BORAGINACEAE	2
CAMPANULACEAE	2
CHENOPODIACEAE	18
COMPOSITAE	25
CONVOLVULACEAE	4
CRUCIFERAE	5
CUCURBITACEAE	4
CYPERACEAE	7
EUPHORBIACEAE	9
GOODENIACEAE	4
GRAMINEAE	32
HALORAGACEAE	1
JUNCAGINACEAE	1
LABIATAE	1
LEGUMINOSAE	17
LORANTHACEAE	4
LYTHRACEAE	2
MALVACEAE	11
MARSILEACEAE	1
MYOPORACEAE	2
MYRTACEAE	1
NYCTAGINACEAE	5
POLYGONACEAE	3
PORTULACACEAE	2
RUBIACEAE	1
SANTALACEAE	1
SAPINDACEAE	1
SCROPHULARIACEAE	2
SOLANACEAE	6
VERBENACEAE	1

Family	Species
GRAMINEAE	32
Taxa	**191**

Family	Species
ZYGOPHYLLACEAE	6
Taxa	**191**

Genera/Species	Family
Abutilon fraseri	MALVACEAE
Abutilon fraseri ssp. *fraseri*	MALVACEAE
Abutilon fraseri ssp. diplotrichum	MALVACEAE
Abutilon halophilum	MALVACEAE
Abutilon otocarpum	MALVACEAE
Abutilon sp	MALVACEAE
Acacia ligulata	LEGUMINOSAE
Acacia salicina	LEGUMINOSAE
Acacia stenophylla	LEGUMINOSAE
Alternanthera nodiflora	AMARANTHACEAE
Amaranthus grandiflorus	AMARANTHACEAE
Amaranthus macrocarpus var macrocarpus	AMARANTHACEAE
Amaranthus mitchellii	AMARANTHACEAE
Ammannia multiflora	LYTHRACEAE
Amyema preissii	LORANTHACEAE
Arabidella procumbens	CRUCIFERAE
Aristida anthoxanthoides	GRAMINEAE
Aristida contorta	GRAMINEAE
Aristida holathera var. holathera	GRAMINEAE
Atalaya hemiglauca	SAPINDACEAE
Atriplex angulata	CHENOPODIACEAE
Atriplex fissivalvis	CHENOPODIACEAE
Atriplex leptocarpa	CHENOPODIACEAE
Atriplex nummularia	CHENOPODIACEAE
Atriplex pseudocampanulata	CHENOPODIACEAE
Atriplex sp	CHENOPODIACEAE
Atriplex velutinella	CHENOPODIACEAE
Austrobryonia micrantha	CUCURBITACEAE
Azolla filiculoides	AZOLLACEAE
Bauhinia gilva	LEGUMINOSAE
Boerhavia burbidgeana	NYCTAGINACEAE
Boerhavia coccinea	NYCTAGINACEAE
Boerhavia dominii	NYCTAGINACEAE

Genera/Species	Family
Boerhavia schomburgkiana	NYCTAGINACEAE
Brassica tournefortii	CRUCIFERAE
Calocephalus platycephalus	COMPOSITAE
Calotis ancyrocarpa	COMPOSITAE
Calotis hispidula	COMPOSITAE
Calotis plumulifera	COMPOSITAE
Calotis porphyroglossa	COMPOSITAE
Centipeda cunninghammii	COMPOSITAE
Centipeda nidiformis	COMPOSITAE
Centipeda thespidiodes	COMPOSITAE
Chenopodium auricomum	CHENOPODIACEAE
Chloris pectinata	GRAMINEAE
Citrullus lanatus	CUCURBITACEAE
Commicarpus australis	NYCTAGINACEAE
Convolvulus eyreanus	CONVOLVULACEAE
Cressa cretica	CONVOLVULACEAE
Crinum flaccidum	AMARYLLIDACEAE
Crotalaria cunninghamii	LEGUMINOSAE
Cucumis argenteus	CUCURBITACEAE
Cucumis melo	CUCURBITACEAE
Cullen australasicum	LEGUMINOSAE
Cullen cinereum	LEGUMINOSAE
Cullen discolour	LEGUMINOSAE
Cullen patens	LEGUMINOSAE
Cullen sp	LEGUMINOSAE
Cyperus bulbosus	CYPERACEAE
Cyperus difformis	CYPERACEAE
Cyperus gymnocaulos	CYPERACEAE
Cyperus iria	CYPERACEAE
Cyperus rigidellus	CYPERACEAE
Dactyloctenium radulans	GRAMINEAE
Datura leichhardtii	SOLANACEAE
Diplachne fusca ssp. muelleri	GRAMINEAE
Diplatia grandibractea	LORANTHACEAE
Duma florulenta	POLYGONACEAE
Dysphania glomulifera ssp. eremaea	CHENOPODIACEAE
Dysphania melanocarpa	CHENOPODIACEAE
Dysphania truncata	CHENOPODIACEAE

Genera/Species	Family
Echinochloa crus-galli	GRAMINEAE
Einadia nutans ssp. eremaea	CHENOPODIACEAE
Elacholoma prostrata	SCROPHULARIACEAE
Enchylaena tomentosa var. glabra	CHENOPODIACEAE
Enneapogon avenaceus	GRAMINEAE
Enneapogon polyphyllus	GRAMINEAE
Eragrostis basedowii	GRAMINEAE
Eragrostis confertiflora	GRAMINEAE
Eragrostis dielsii var. dielsii	GRAMINEAE
Eragrostis leptocarpa	GRAMINEAE
Eragrostis setifolia	GRAMINEAE
Eragrostis sp	GRAMINEAE
Eragrostis tenellula	GRAMINEAE
Eremophila bignoniiflora	MYOPORACEAE
Eremophila longifolia	MYOPORACEAE
Eriachne aristidea	GRAMINEAE
Eriochloa australiensis	GRAMINEAE
Eriochloa crebra	GRAMINEAE
Eriochloa pseudoacrotricha	GRAMINEAE
Eucalyptus coolabah	MYRTACEAE
Euphorbia dallachyana	EUPHORBIACEAE
Euphorbia drummondii	EUPHORBIACEAE
Euphorbia ferdinandi var. ferdinandi	EUPHORBIACEAE
Euphorbia ferdinandi var. saxosiplaniticola	EUPHORBIACEAE
Euphorbia porcata	EUPHORBIACEAE
Euphorbia tannensis ssp. eremophila	EUPHORBIACEAE
Euphorbia wheeleri	EUPHORBIACEAE
Glinus lotoides	AIZOACEAE
Gnaphalium polycaulon	COMPOSITAE
Gnephosis eriocarpa	COMPOSITAE
Goodenia cycloptera	GOODENIACEAE
Goodenia fascicularis	GOODENIACEAE
Goodenia glauca	GOODENIACEAE
Goodenia sp	GOODENIACEAE
Haloragis aspera	HALORAGACEAE
Heliotropium supinum	BORAGINACEAE
Hibiscus krichauffianus	MALVACEAE
Ipomoea polymorpha	CONVOLVULACEAE

Genera/Species	Family
Isolepis congrua	CYPERACEAE
?Leiocarpa	GRAMINEAE
Lepidium papillosum	CRUCIFERAE
Lepidium phlebopetalum	CRUCIFERAE
Lepidium sagittulatum	CRUCIFERAE
Lotus cruentus	LEGUMINOSAE
Lysiana exocarpi ssp exocarpi	LORANTHACEAE
Lysiana subfalcata	LORANTHACEAE
Lythrum wilsonii	LYTHRACEAE
Malva preissiana	MALVACEAE
Malvastrum americanum var. americanum	MALVACEAE
Marsilea drummondii	MARSILEACEAE
Minuria rigida	COMPOSITAE
Minuria sp	COMPOSITAE
Myriocephalus rudallii	COMPOSITAE
Nicotiana velutina	SOLANACEAE
Othonna gregorii	COMPOSITAE
Panicum laevinode	GRAMINEAE
Panicum sp	GRAMINEAE
Paractaenum novae-hollandiae ssp. reversum	GRAMINEAE
Phyllanthus lacunellus	EUPHORBIACEAE
Polycalymma stuartii	COMPOSITAE
Polygonum plebeium	POLYGONACEAE
Portulaca oleracea	PORTULACACEAE
Portulaca intraterranea	PORTULACACEAE
Pseudognaphalium luteoalbum	COMPOSITAE
Pseudoraphis spinescens	GRAMINEAE
Pterocaulon sphacelatum	COMPOSITAE
Pycnosorus melleus	COMPOSITAE
Rhagodia spinescens	CONVOLVULACEAE
Rhodanthe moschata	COMPOSITAE
Rumex crystallinus	POLYGONACEAE
Rutidosis helichrysoides ssp. helichrysoides	COMPOSITAE
Salsola australis	CHENOPODIACEAE
Santalum lanceolatum	SANTALACEAE
Sauropus trachyspermus	EUPHORBIACEAE
SclerolaenaSclerolaena sp	CHENOPODIACEAE
Sclerolaena bicornis	CHENOPODIACEAE

Genera/Species	Family
Sclerolaena diacantha	CHENOPODIACEAE
Sclerolaena intricata	CHENOPODIACEAE
Senecio depressicola	COMPOSITAE
Senecio lanibracteus	COMPOSITAE
Senna artemisioides ssp filifolia	LEGUMINOSAE
Senna artemisioides ssp quadrifolia	LEGUMINOSAE
Senna artemisioides ssp. × sturtii	LEGUMINOSAE
Sesbania cannabina var cannabina	LEGUMINOSAE
Setaria jubiflora	GRAMINEAE
Sida ammophila	MALVACEAE
Sida cunninghamii	MALVACEAE
Sida sp	MALVACEAE
Solanum chenopodinum	SOLANACEAE
Solanum esuriale	SOLANACEAE
Solanum nigrum	SOLANACEAE
Solanum oligacanthum	SOLANACEAE
Sonchus oleraceus	COMPOSITAE
Sphaeranthus indicus	COMPOSITAE
Sphaeromorphaea littoralis	COMPOSITAE
Sporobolus mitchellii	GRAMINEAE
Stemodia florulenta	SCROPHULARIACEAE
Swainsona sp	LEGUMINOSAE
Synaptantha tillaeacea	RUBIACEAE
Tetragonia tetragonioides	AIZOACEAE
Teucrium racemosum	LABIATAE
Tragus australianus	GRAMINEAE
Trianthema triquetra	AIZOACEAE
Tribulus eichlerianus	ZYGOPHYLLACEAE
Tribulus terrestris	ZYGOPHYLLACEAE
Trichodesma zeylanicum var. zeylanicum	BORAGINACEAE
Triglochin isingiana	JUNCAGINACEAE
Trigonella suavissima	LEGUMINOSAE
Triraphis mollis	GRAMINEAE
Typha australis	CYPERACEAE
Urochloa piligera	GRAMINEAE
Urochloa praetervisa	GRAMINEAE
Verbena officinalis	VERBENACEAE
Wahlenbergia communis	CAMPANULACEAE

Genera/Species	Family
Wahlenbergia tumidifructa	CAMPANULACEAE
Zaleya galericulata	AIZOACEAE
Zygochloa paradoxa	GRAMINEAE
Zygophyllum ammophilum	ZYGOPHYLLACEAE
Zygophyllum howittii	ZYGOPHYLLACEAE
Zygophyllum simile	ZYGOPHYLLACEAE
Zygophyllum sp.	ZYGOPHYLLACEAE

11 Appendix C

11.1 Additional genera/species encountered outside surveyed sites and opportunistically across the region 2014 – 2016

Family	Species
AMARANTHACEAE	1
AMARYLLIDACEAE	1
CHENOPODIACEAE	6
COMPOSITAE	7
CONVOLVULACEAE	2
CRASSULACEAE	1
CRUCIFERAE	3
CYPERACEAE	4
GRAMINEAE	11
LEGUMINOSAE	7
MYOPORACEAE	1
RANUNCULACEAE	1
SCROPHULARIACEAE	3
UMBELLIFERAE	2
Taxa	50

Family	Species
AMARANTHACEAE	1
AMARYLLIDACEAE	1
CRASSULACEAE	1
MYOPORACEAE	1
RANUNCULACEAE	1
CONVOLVULACEAE	2
UMBELLIFERAE	2
CRUCIFERAE	3
SCROPHULARIACEAE	3
CYPERACEAE	4
CHENOPODIACEAE	6
LEGUMINOSAE	7
COMPOSITAE	7
GRAMINEAE	11
Taxa	50

Genera/Species	Family
Acacia dictyophleba	LEGUMINOSAE
Acacia oswaldii	LEGUMINOSAE
Anemocarpa podolepidium	COMPOSITAE
Arabidella eremigena	CRUCIFERAE
Aristida latifolia	GRAMINEAE
Atriplex spongiosa	CHENOPODIACEAE
Blennodia pterosperma	CRUCIFERAE
Brachyscome eriogona	COMPOSITAE
Calostemma luteum	AMARYLLIDACEAE
Cenchrus ciliaris	GRAMINEAE
Crassula colligata ssp. lamprosperma	CRASSULACEAE
Crotalaria smithiana	LEGUMINOSAE
Cyperus pygmaea	CYPERACEAE
Cyperus victoriensis	CYPERACEAE
Daucus glochidiatus	UMBELLIFERAE
Dichanthium sericeum ssp sericeum	GRAMINEAE

Genera/Species	Family
Diplachne fusca ssp uninervia	GRAMINEAE
Echinochloa turneriana	GRAMINEAE
Eleocharis acuta	CYPERACEAE
Eleocharis plana	CYPERACEAE
Epaltes cunninghamii	COMPOSITAE
Eremophila macdonnellii	MYOPORACEAE
Eryngium supinum	UMBELLIFERAE
Glossostigma diandra	SCROPHULARIACEAE
Ipomoea diamantinensis	CONVOLVULACEAE
Ipomoea muelleri	CONVOLVULACEAE
Lachnagrostis filiformis	GRAMINEAE
Leptochloa fusca	GRAMINEAE
Maireana ciliata	CHENOPODIACEAE
Maireana microcarpa	CHENOPODIACEAE
Malacocera albolanata	CHENOPODIACEAE
Menkea crassa	CRUCIFERAE
Minuria integerrima	COMPOSITAE
Myosurus australis	RANUNCULACEAE
Panicum effusum var. effusum	GRAMINEAE
Peplidium foecundum	SCROPHULARIACEAE
Pluchea rubelliflora	COMPOSITAE
Ptilotus murrayi	AMARANTHACEAE
Rhodanthe microglossa	COMPOSITAE
Rhodanthe stricta	COMPOSITAE
Sclerolaena brachyptera	CHENOPODIACEAE
Sclerolaena lanicuspis	CHENOPODIACEAE
Senna artemisioides ssp. oligophylla	LEGUMINOSAE
Setaria dielsii	GRAMINEAE
Sporobolus actinocladus	GRAMINEAE
Swainsona laxa ?	LEGUMINOSAE
Swainsona phacoides	LEGUMINOSAE
Swainsona stipularis	LEGUMINOSAE
Tripogon loliiformis	GRAMINEAE
Veronica peregrina ssp. xalapensis	SCROPHULARIACEAE

12 Appendix D

12.1 All Sites All Transects Floristic Data

Site Code	Waterhole/Location	Station
1	Ultoomurra	Clifton Hills
2	Goyder Lagoon	Clifton Hills
3	Koonchera	Clifton Hills
4	Yammakira	Clifton Hills
5	Tepamimi	Clifton Hills
6	Andrewilla	Clifton Hills
7	D-Split	Pandie Pandie
8	Windmill	Pandie Pandie
9	Kalamunkinna	Cowarie
10	Kuncherinna	Cowarie
11	Stony Point	Cowarie
12	Cowarie xing	Cowarie
13	Poonarunna	Kalamurina
14	Wadlarkaninna	Kalamurina
15	Yellow	Kalamurina
16	Tinnie Landing	Kalamurina
17	Mia Mia	Kalamurina
18	Mona Downs	Cowarie
19	Yelpawaralinna	Clifton Hills
20	Double Bluff	Pandie Pandie
21	Burt's	Clifton Hills

Code	Life Form/Height Class
LA	Trees 5-15m
LB	Trees <5m
S	Shrubs >2m
SA	Shrubs 1.5-2.0m
SB	Shrubs 1.0-1.5m
SC	Shrubs 0.5-1.0m
SD	Shrubs 0-0.5m
GT	Grass >0.5m
GL	Grass <0.5m
H	Hummock Grass
VT	Sedges >0.5m

Code	Life Form/Height Class
VL	Sedges <0.5m
P	Mat Plants
J	Herbaceous spp
V	Vines
MI	Misteltoes
MO	Mosses
LI	Lichens

Code	Life Cycle(s) (L)
Sd	Seedling
B	Budding
F	Flowering
S	Fruiting/shedding
Sp	Shed
V	Vegetative
Re	Regenerating
D	Dead
Do	Dormant
Sn	Senescing

Code	Cover Abundance Scale (A)
R	Solitary plant
I	Isolated plants
L	Isolated clumps
T	Sparsely present cover small (<5%)
1	Plentiful but of small cover (<5%)
2	Any number of individuals covering
	5 – 25% of the area
3	Any number of individuals covering
	25 – 50% of the area
4	Any number of individuals covering
	50 – 75% of the area
5	covering more than 75% of the area
R	Solitary plant

Site 1 – Ultoomurra Wh - Clifton Hills

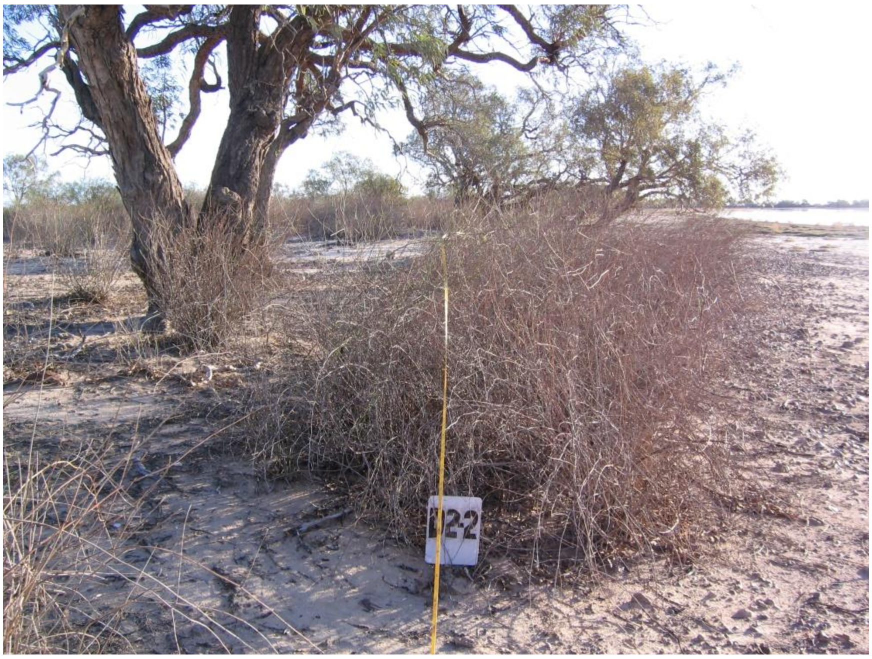
Site	Species	Life Form	Life Cycle	Abund
1-1	Duma florulenta	sa	do	2
	Eucalyptus coolabah	la	sp	2
	Acacia salicina	lb	b/f	3
	Enchylaena tomentosa var. glabra	sd	v	1
	Santalum lanceolatum	lb	v	r
	Acacia stenophylla	lb	v	1
	Lysiana exocarpi ssp exocarpi	mi	f	t
	Chenopodium auricomum	sc	v	t
	Senecio lanibracteus	sc	d/do	t
1-2	Eucalyptus coolabah	la	sp	3
	Duma florulenta	sa	v	3
	Senecio lanibracteus	sd	d/do	1
	Acacia salicina	s	b/f	1
	Enchylaena tomentosa var. glabra	sd	v	t
	Acacia stenophylla	s	b	t
1-3	Eucalyptus coolabah	la	sp	2
	Acacia salicina	lb/s	b/f/s	3
	Senecio lanibracteus	sc	d/do	1
	Enchylaena tomentosa var. glabra	sd	v	t
	Acacia stenophylla	lb/s	b	1
	Duma florulenta	s	v/do	2
	Lysiana exocarpi ssp exocarpi	mi	f	1
	Santalum lanceolatum	lb	v	r

Site Photo – Permanent Transect

Site 2 – Goyder Lagoon Wh - Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
2-1	Eucalyptus coolabah	lb	sp	2
	Duma florulenta	sa	f/v	2
	Acacia stenophylla	s	b	1
	Acacia salicina	s	f	1
	Enchylaena tomentosa var. glabra	sc	sp	r
	Trianthema triquetra	j	sd	t
	Chenopodium auricomum	sc	f	r
	Teucrium racemosum	j	s	t
	Goodenia fascicularis	sd	v	t
	Portulaca intraterranea	sd	sd	t
2-2	Duma florulenta	sa	f/v	3
	Eucalyptus coolabah	lb	v/s/sp	2
	Teucrium racemosum	j	b/v	t
	Acacia stenophylla	sa	v	1
	Portulaca intraterranea	j	v	t
	Cressa cretica	j	v	t
2-3	Eucalyptus coolabah	lb	s	2
	Duma florulenta	sa	f/v	2
	Marsilea drummondii	x	v	t
	Tetragonia tetragonioides	j	v	t

Site	Species	Life Form	Life Cycle	Abund
	Goodenia sp	j	sd	t
	Acacia stenophylla	s	b	t
	Acacia salicina	s	b/f	3
	Portulaca intraterranea	j	sd	t
	Chenopodium auricomum	sc	v	r



Site Photo – Permanent Transect

Site 3 – Koonchera Wh - Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
3-1	Eucalyptus coolabah	lb	sp/s	r
	Duma florulenta	s	f	1
	Acacia stenophylla	lb	f	2
	Portulaca intraterranea	j	sd/v	1
	Dactyloctenium radulans	gl	f	1
	Nicotiana velutina	j	sd	1
	Alternanthera nodiflora	j	sd	t
	Salsola australis	j	sd	t
	Sonchus oleraceus	j	sd	t
	Boerhavia coccinea	j	f	t
	Citrullus lanatus	j	sd/f	t
	Trianthema triquetra	j	sd	t
	Dysphania truncata	j	sd	1

Site	Species	Life Form	Life Cycle	Abund
	Marsilea drummondii	x	v	r
	Sesbania cannabina var cannabina	j	sd	t
	Echinochloa crus-galli	gl	sd	t
	Cyperus iria	vl	v/f	t
	Phyllanthus lacunellus	j	s	t
	Tribulus eichlerianus	j	s	t
	Enchylaena tomentosa var. glabra	sc	s	r
3-2	Duma florulenta	s	f/v	2
	Enchylaena tomentosa var. glabra	sd	s	t
	Nicotiana velutina	j	v	1
	Portulaca intraterranea	j	v	1
	Senecio lanibracteus	sb	f	2
	Citrullus lanatus	j	f/sd	t
	Eucalyptus coolabah	lb	sp	3
	Acacia stenophylla	s/lb	b/f	2
	Acacia salicina	s/lb	b/f	2
	Dactyloctenium radulans	j	f	1
	Sesbania cannabina var cannabina	j	sd	1
	Eragrostis setifolia	j	f/s	1
	Boerhavia coccinea	j	f	1
	Eriochloa australiensis	j	b	t
	Einadia nutans ssp. eremaea	sd	v	r
	Chenopodium auricomum	sd	v	r
	Amyema preissii	mi	sp	r
	Malva preissiana	j	sd	r
3-3	Senecio lanibracteus	sb	f	2
	Enchylaena tomentosa var. glabra	sd	s/sp	t
	Salsola australis	j	v	t
	Tribulus eichlerianus	j	f/s	t
	Nicotiana velutina	j	f/sd	1
	Eucalyptus coolabah	lb	sp	2
	Zygophyllum simile	j	s	t
	Eragrostis basedowii	gl	f	1
	Sauropus trachyspermus	j	s	t
	Phyllanthus lacunellus	j	s	t
	Paractaenum novae-hollandiae ssp. reversum	gl	b	1
	Boerhavia coccinea	j	f/s	1
	Dactyloctenium radulans	gl	sp	t

Site	Species	Life Form	Life Cycle	Abund
	Portulaca intraterranea	j	sd	1
	Trianthema triquetra	j	s	t
	Eriochloa australiensis	gl	b	t
	Citrullus lanatus	j	f	t
	Acacia stenophylla	lb	f	1
	Duma florulenta	sc	v	r
	Euphorbia wheeleri	j	f/s	t
	Ipomoea polymorpha	j	sd/f/s	1
	Dysphania truncata	j	s	t
	Santalum lanceolatum	lb	sp	r

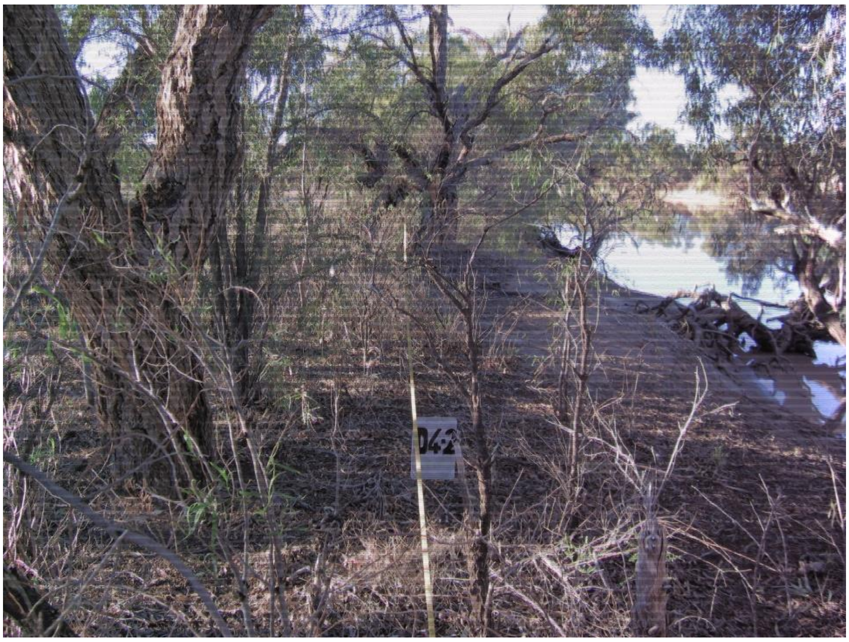
Site Photo – Permanent Transect

Site 4 – Yammakira Wh - Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
4-1	Atalaya hemiglauca	lb	v	1
	Acacia salicina	s	b/f	2
	Eucalyptus coolabah	lb	v	4
	Solanum chenopodium	sa	f/s	1
	Minuria rigida	sd	f	t
	Santalum lanceolatum	s	s/sp	2
	Lysiana exocarpi ssp exocarpi	mi	f	t
	Enchylaena tomentosa var. glabra	sc	s/sp	t

Site	Species	Life Form	Life Cycle	Abund
	Bauhinia gilva	lb	v	2
	Duma florulenta	sa	v	t
	Eremophila bignoniiflora	s	v	1
	Abutilon halophilum	j	sp	t
	Setaria jubiflora	gl	do	1
	Acacia stenophylla	s	b	t
4-2	Eucalyptus coolabah	lb	v	3
	Bauhinia gilva	s/lb	v	2
	Acacia salicina	s/lb	b/f	2
	Enchylaena tomentosa var. glabra	sd	v	t
	Abutilon halophilum	j	sd	1
	Eremophila bignoniiflora	s	v	1
	Solanum chenopodium	sc	f/s	1
	Atalaya hemiglauca	lb	v	1
	Zygophyllum simile	j	sd	t
	Santalum lanceolatum	s	v/s/sp	1
	Lysiana exocarpi ssp exocarpi	mi	f/s	t
	Salsola australis	j	sd	t
	Boerhavia coccinea	gl	f/s	t
	Tribulus terrestris	p	s	t
	Senna artemisioides ssp quadrifolia	sb	sd	t
	Setaria jubiflora	gl	v	t
	Duma florulenta	sb	v	r
	Acacia stenophylla	s	b/f	t
	Teucrium racemosum	sd	b/f	1
4-3	Eucalyptus coolabah	lb	s	3
	Enchylaena tomentosa var. glabra	sd	v/s/sp	t
	Atalaya hemiglauca	lb	v	1
	Duma florulenta	sb	v/b/f	t
	Bauhinia gilva	lb	s/sp	2
	Setaria jubiflora	gl	b	t
	Abutilon halophilum	j	sd	t
	Portulaca intraterranea	j	sd	t
	Acacia stenophylla	s	b/f	1
	Minuria rigida	sd	f/s/sp	t
	Santalum lanceolatum	lb	s/sp	1
	Acacia salicina	s	b	2
	Solanum chenopodium	sd	v	t

Site	Species	Life Form	Life Cycle	Abund
	Solanum esuriale	j	sd/f/s	t
	Malvastrum americanum var. americanum	sd	s	t



Site Photo – Permanent Transect

Site 5 – Tepamimi Wh - Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
5-1	Eucalyptus coolabah	lb	s	3
	Acacia salicina	s/lb	b/f	3
	Bauhinia gilva	s/lb	v	2
	Enchylaena tomentosa var. glabra	sd	v	1
	Eremophila bignoniiflora	s	v/f	1
	Acacia stenophylla	s/lb	b/f	1
	Nicotiana velutina	j	sd	t
	Salsola australis	j	sd	t
5-2	Eucalyptus coolabah	s	s	4
	Duma florulenta	sa/s	v/f/do	3
	Enchylaena tomentosa var. glabra	sc/sd	v/s/sp	1
	Atriplex nummularia	sa	v	1
	Acacia stenophylla	s	v/b/f	1
	Chenopodium auricomum	sb	v/f	1
	Bauhinia gilva	lb	v	r
5-3	Duma florulenta	s	v/f/do	3
	Eucalyptus coolabah	lb	s	2

Site	Species	Life Form	Life Cycle	Abund
	Typha australis	vt	s/sp	1
	Enchylaena tomentosa var. glabra	sd	v	t
	Chenopodium auricomum	sb	f	r
	Senecio lanibracteus	sc	v/f	t
	Teucrium racemosum	sd	v	t
	Sonchus oleraceus	j	v	t
	Acacia stenophylla	s	v	1

Site Photo – Permanent Transect

Site 6 – Andrewilla Wh - Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
6-1	Eucalyptus coolabah	lb	s	3
	Eremophila longifolia	sa	v	1
	Bauhinia gilva	lb	sd/v/sp	2
	Atalaya hemiglauca	s/lb	v	2
	Eremophila bignoniiflora	sa	v	1
	Acacia salicina	s/lb	b/f	2
	Abutilon halophilum	j	sd/f/s/sp	1t
	Enchylaena tomentosa var. glabra	sd	v	t
	Amyema preissii	mi	s	r
	Acacia stenophylla	lb	b/f	2
6-2	Eucalyptus coolabah	lb	v	3

Site	Species	Life Form	Life Cycle	Abund
	Atalaya hemiglauca	lb	sd/v	1
	Bauhinia gilva	lb	sd/v/sp	1
	Sclerolaena bicornis	j	d	t
	Enchylaena tomentosa var. glabra	sd	v	1
	Zygophyllum simile	j	sd	t
	Setaria jubiflora	gl	sd	t
	Duma florulenta	sc	v/f	t
	Eremophila bignoniiflora	s	v	1
	Acacia stenophylla	s	b/f	2
	Nicotiana velutina	j	sd	t
	Portulaca intraterranea	j	sd	t
	Malva preissiana	j	sd	t
	Santalum lanceolatum	sa	v	r
	Tribulus eichlerianus	j	sd	t
	Lysiana exocarpi ssp exocarpi	mi	f	r
6-3	Eucalyptus coolabah	lb	v	3
	Bauhinia gilva	lb	v	1
	Atalaya hemiglauca	lb	v	2
	Malvastrum americanum var. americanum	sd	v/f/s	t
	Senna artemisioides ssp filifolia	sa	v	t
	Acacia salicina	s	b/f	1
	Zygophyllum simile	j	sd/s	t
	Enchylaena tomentosa var. glabra	sd	v	t
	Eremophila bignoniiflora	s	v	1
	Sclerolaena bicornis	j	d	t
	Nicotiana velutina	j	sd	1
	Einadia nutans ssp. eremaea	sd	v	r
	Santalum lanceolatum	ls/lb	v	t
	Sida ammophila	sd	s/sp	1
	Salsola australis	j	sd	t
	Acacia stenophylla	s	b/f	1
	Tribulus eichlerianus	j	sd/f	t
	Portulaca intraterranea	j	sd	t
	Hibiscus krichauffianus	sd	v	t
	Lysiana exocarpi ssp exocarpi	mi	f	r
	Abutilon fraseri	sd	sd/f	t

Site Photo – Permanent Transect

Site 7 – D-Split Wh – Pandie Pandie

Site	Species	Life Form	Life Cycle	Abund
7-1	*Eucalyptus coolabah*	*lb*	*v*	*3*
	Acacia salicina	*s*	*v/b/f*	*3*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*t*
	Santalum lanceolatum	*lb*	*s/sp*	*r*
	Cyperus bulbosus	*vl*	*v*	*t*
	Nicotiana velutina	*j*	*sd*	*t*
	Bauhinia gilva	*sd*	*sd*	*t*
	Panicum sp	*gl*	*d*	*t*
	Setaria jubiflora	*gl*	*d*	*t*
	Portulaca intraterranea	*j*	*d*	*t*
	Duma florulenta	*sc*	*v*	*t*
	Eremophila bignoniiflora	*lb*	*v*	*r*
	Senecio lanibracteus	*sc*	*f/s/sp*	*t*
7-2	*Eucalyptus coolabah*	*lb*	*v*	*2*
	Santalum lanceolatum	*s/lb*	*b/s/sp*	*1*
	Duma florulenta	*s*	*v*	*1*
	Acacia salicina	*s/lb*	*b/f*	*2*
	Enchylaena tomentosa var. glabra	*sd*	*v/s/sp*	*t*
	Setaria jubiflora	*gl*	*sp/d*	*1*
	Panicum sp	*gl*	*sp/d*	*1*
	Boerhavia coccinea	*j*	*sp/d*	*1*

Site	Species	Life Form	Life Cycle	Abund
	Portulaca intraterranea	*j*	*sp/d*	*1*
	Cucumis melo	*j*	*s*	*1*
	Lysiana exocarpi ssp exocarpi	*mi*	*f/s*	*t*
	Solanum nigrum	*j*	*f/s*	*t*
	Zygophyllum simile	*j*	*s*	*t*
	Tribulus eichlerianus	*j*	*s*	*t*
	Cucumis argenteus	*j*	*s*	*t*
	Amyema preissii	*mi*	*s*	*r*
	Senecio lanibracteus	*sc*	*d*	*1*
7-3	*Eucalyptus coolabah*	*lb*	*v/s/sp*	*5*
	Acacia stenophylla	*s*	*b/f*	*t*
	Acacia salicina	*s/lb*	*v/b/f*	*3*
	Santalum lanceolatum	*s/lb*	*b/s/sp*	*1*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*t*
	Setaria jubiflora	*gt*	*sp/d*	*1*
	Portulaca intraterranea	*j*	*d*	*t*
	Atalaya hemiglauca	*s/lb*	*sd/v*	*1*
	Bauhinia gilva	*sd*	*sd*	*t*

Site Photo – Permanent Transect

Site 8 – Windmill Wh – Pandie Pandie

Site	Species	Life Form	Life Cycle	Abund
8-1	*Eucalyptus coolabah*	*lb*	*v*	*3*
	Bauhinia gilva	*lb*	*sd/s/sp/*	*2*
	Santalum lanceolatum	*s/lb*	*v*	*1*
	Atalaya hemiglauca	*lb*	*v*	*1*
	Acacia salicina	*s/lb*	*b/f*	*2*
	Duma florulenta	*sa*	*f*	*1*
	Setaria jubiflora	*gt*	*sp/do*	*1*
	Pseudoraphis spinescens	*gl*	*v*	*t*
	?Leiocarpa	*j*	*d*	*t*
8-2	*Eucalyptus coolabah*	*lb*	*v*	*3*
	Acacia salicina	*s/lb*	*v/b/f*	*1*
	Amyema preissii	*mi*	*sp*	*r*
	Duma florulenta	*sb*	*v/do*	*2*
	Setaria jubiflora	*gt*	*do/v/s*	*1*
	Bauhinia gilva	*s*	*v*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*t*
	Diplatia grandibractea	*mi*	*s/sp*	*1*
8-3	*Eucalyptus coolabah*	*lb*	*v*	*3*
	Bauhinia gilva	*s/lb*	*v*	*2*
	Acacia salicina	*s/lb*	*v/b/f*	*2*
	Santalum lanceolatum	*s/lb*	*b/s/sp*	*2*
	Atalaya hemiglauca	*s/lb*	*v*	*1*
	Enchylaena tomentosa var. glabra	*sd*	*v/s/sp*	*t*
	Eremophila bignoniiflora	*s*	*d*	*t*
	Setaria jubiflora	*gt*	*do/v/s*	*1*
	Lysiana exocarpi ssp exocarpi	*mi*	*f/s*	*t*

Site Photo – Permanent Transect

Site 9 – Kalamunkinna Wh – Cowarie

Site	Species	Life Form	Life Cycle	Abund
9-1	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Duma florulenta	*s*	*do/v/f*	*4*
	Acacia salicina	*s/lb*	*v/b/f*	*2*
	?Leiocarpa	*j*	*d*	*1*
	Senecio lanibracteus	*sb*	*d*	*t*
	Enchylaena tomentosa var. glabra	*s*	*s*	*r*
	Portulaca intraterranea	*j*	*sd*	*1*
	Nicotiana velutina	*j*	*sd*	*1*
	Phyllanthus lacunellus	*j*	*sd*	*1*
	Tetragonia tetragonioides	*j*	*sd*	*1*
	Solanum oligacanthum	*sd*	*v*	*1*
	Cucumis melo	*j*	*sd*	*t*
	Boerhavia dominii	*j*	*sd*	*t*
9-2	*Eucalyptus coolabah*	*lb*	*s*	*2*
	Duma florulenta	*s*	*v/f*	*3*
	Santalum lanceolatum	*lb*	*b/s/sp*	*r*
	?Leiocarpa	*j*	*d*	*1*
	Senecio lanibracteus	*sc*	*d*	*t*
	Chenopodium auricomum	*sc*	*v/f*	*t*
	Acacia salicina	*s*	*b/f/sp*	*2*

Site	Species	Life Form	Life Cycle	Abund
	Enchylaena tomentosa var. glabra	*sd*	*v*	*t*
	Acacia stenophylla	*s*	*v/b*	*2*
9-3	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Acacia stenophylla	*s*	*b*	*2*
	?Leiocarpa	*j*	*d*	*1*
	Chenopodium auricomum	*sc*	*v*	*1*
	Duma florulenta	*s*	*v/f*	*2*
	Santalum lanceolatum	*s*	*s/sp*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*v/s/*	*t*
	Teucrium racemosum	*sd*	*do/v*	*1*
	Senecio lanibracteus	*sc*	*do/v*	*1*
	Acacia salicina	*s*	*b/f*	*1*
	Diplatia grandibractea	*mi*	*s/sp*	*t*

Site Photo – Permanent Transect

Site 10 – Kuncherinna Wh – Cowarie

Site	Species	Life Form	Life Cycle	Abund
10-1	*Eucalyptus coolabah*	*lb*	*s/sp*	*1*
	Duma florulenta	*s*	*do/v/f*	*2*
	Atriplex nummularia	*sa*	*v/f*	*t*
	Acacia salicina	*s/lb*	*b/f/sd*	*1*
	Senecio lanibracteus	*sa*	*v/f*	*t*
	Enchylaena tomentosa var. glabra	*sa*	*s/sp*	*t*
	Acacia stenophylla	*s*	*b*	*t*

Site	Species	Life Form	Life Cycle	Abund
10-2	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Duma florulenta	*sa*	*do/v/f*	*3*
	Atriplex nummularia	*sb*	*f*	*r*
	Chenopodium auricomum	*sc*	*v*	*r*
	Senecio lanibracteus	*sc*	*d*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*r*
10-3	*Eucalyptus coolabah*	*s/lb*	*v*	*3*
	Acacia stenophylla	*s*	*v/b/f*	*2*
	Duma florulenta	*sa*	*do/v*	*1*
	Acacia salicina	*s*	*b/f*	*1*
	Enchylaena tomentosa var. glabra	*sd*	*s*	*1*
	Atriplex nummularia	*sc*	*d*	*t*

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Site 11 – Stony Point Wh – Cowarie

Site	Species	Life Form	Life Cycle	Abund
11-1	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Acacia salicina	*s/lb*	*b/f/sp*	*2*
	Enchylaena tomentosa var. glabra	*sd*	*s/sp*	*1*
	Duma florulenta	*s*	*do*	*2*
	? Leiocarpa	*j*	*d*	*1*
	Portulaca intraterranea	*j*	*sd*	*1*

Site	Species	Life Form	Life Cycle	Abund
	Eremophila bignoniiflora	*s*	*v*	*r*
	Eragrostis sp	*gl*	*do*	*t*
	Sclerolaena bicornis	*sd*	*d*	*t*
	Malva preissiana	*j*	*d*	*t*
	Swainsona sp	*v*	*v/d*	*t*
	Sida sp	*sd*	*d*	*1*
11-2	*Eucalyptus coolabah*	*s/lb*	*s*	*3*
	Enchylaena tomentosa var. glabra	*sc*	*v/s*	*2*
	Acacia salicina	*s*	*b/f/sp*	*2*
	?Leiocarpa	*j*	*d*	*1*
	Pterocaulon sphacelatum	*jd*	*d*	*1*
	Portulaca intraterranea	*j*	*sd*	*1*
	Zygophyllum simile	*j*	*sd*	*t*
	Phyllanthus lacunellus	*j*	*sd*	*t*
	Salsola australis	*j*	*sd*	*t*
	Acacia stenophylla	*s*	*v/b*	*r*
	Swainsona sp	*v*	*d/v*	*1*
	Duma florulenta	*s*	*do*	*1*
	Sclerolaena bicornis	*sd*	*d*	*t*
	Amaranthus mitchellii	*j*	*f/s*	*t*
11-3	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Acacia salicina	*s/lb*	*b/f*	*2*
	Rhagodia spinescens	*sa/sc*	*f*	*2*
	Enchylaena tomentosa var. glabra	*sc/sd*	*s*	*1*
	Chenopodium auricomum	*sa*	*v*	*r*
	Zygophyllum simile	*j*	*sd/s*	*t*
	Portulaca intraterranea	*j*	*sd/f*	*1*
	Senecio lanibracteus	*sc*	*v/d*	*1*
	?Leiocarpa	*j*	*d*	*1*
	Amyema preissii	*mi*	*d/v*	*t*
	Salsola australis	*j*	*sd*	*t*
	Boerhavia coccinea	*j*	*sd/f*	*t*
	Trianthema triquetra	*j*	*s*	*t*

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Site 12 – Stony Point Wh – Cowarie

Site	Species	Life Form	Life Cycle	Abund
12-1	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Duma florulenta	*sa*	*do/v*	*3*
	Enchylaena tomentosa var. glabra	*sd*	*v/s*	*1*
	?Leiocarpa	*j*	*d*	*1*
	Portulaca intraterranea	*j*	*sd*	*1*
	Senecio lanibracteus	*sc*	*d/v/f*	*1*
	Atriplex nummularia	*sc*	*v*	*1*
	Sclerolaena bicornis	*sd*	*d*	*t*
	Einadia nutans ssp. eremaea	*sd*	*v/s*	*1*
	Boerhavia dominii	*j*	*f*	*t*
	Acacia salicina	*s*	*b/f/sp*	*2*
	Eragrostis dielsii var. dielsii	*gl*	*f/sd*	*t*
	Eriochloa australiensis	*gl*	*f/sd*	*t*
	Haloragis aspera	*j*	*sd*	*t*
	Brassica tournefortii	*j*	*sd*	*t*
	Dactyloctenium radulans	*gl*	*f*	*t*
	Trianthema triquetra	*j*	*s*	*t*
	Phyllanthus lacunellus	*j*	*v*	*t*
	Malva preissiana	*j*	*sd*	*t*
	Tetragonia tetragonioides	*j*	*sd*	*t*
12-2	*Eucalyptus coolabah*	*lb*	*s*	*4*

Site	Species	Life Form	Life Cycle	Abund
	Duma florulenta	*s*	*do/v*	*3*
	Senecio lanibracteus	*sc*	*f/do*	*1*
	?Leiocarpa	*j*	*d*	*1*
	Acacia salicina	*s*	*b/f*	*1*
12-3	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Duma florulenta	*s*	*do*	*5*
	?Leiocarpa	*j*	*d*	*1*
	Senecio lanibracteus	*sc*	*v/do*	*1*
	Acacia salicina	*s*	*b/f*	*2*

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Site 13 – Poonarunna Wh – Kalamurina

Site	Species	Life Form	Life Cycle	Abund
13-1	*Eucalyptus coolabah*	*lb*	*s/sp*	*2*
	Duma florulenta	*s*	*v/do*	*3*
	Acacia salicina	*s*	*b/f/s/sp*	*2*
	Malva preissiana	*j*	*sd/d*	*2*
	Lysiana exocarpi ssp exocarpi	*mi*	*f*	*r*
	Senecio lanibracteus	*sc*	*do/v*	*t*
	?Leiocarpa	*j*	*d*	*2*
	Enchylaena tomentosa var. glabra	*sc/sd*	*v*	*t*
	Acacia stenophylla	*s/lb*	*b*	*t*

Site	Species	Life Form	Life Cycle	Abund
	Convolvulus eyreanus	*j*	*sd*	*t*
	Senecio depressicola	*j*	*sd*	*t*
	Dactyloctenium radulans	*gl*	*s*	*t*
	Zygophyllum simile	*j*	*s*	*t*
	Portulaca intraterranea	*j*	*v*	*t*
	Trigonella suavissima	*j*	*v*	*t*
	Cyperus gymnocaulos	*vl*	*v*	*t*
	Enneapogon avenaceus	*gl*	*s*	*t*
	Nicotiana velutina	*j*	*sd*	*t*
	Phyllanthus lacunellus	*j*	*sd*	*t*
13-2	*Eucalyptus coolabah*	*lb*	*s/sp*	*2*
	Acacia salicina	*s/lb*	*b/f/sp*	*2*
	Duma florulenta	*s/sb*	*do/v/f*	*3*
	?Leiocarpa	*j*	*d*	*1*
	Sonchus oleraceus	*j*	*sd*	*t*
	Senecio lanibracteus	*sc*	*v/f/s/sp*	*1*
	Cyperus gymnocaulos	*vl*	*sp*	*1*
	Einadia nutans ssp. eremaea	*sd*	*v*	*r*
	Nicotiana velutina	*j*	*sd*	*1*
	Trianthema triquetra	*j*	*v*	*t*
	Eragrostis dielsii var. dielsii	*gl*	*s*	*1*
	Dysphania truncata	*j*	*b/f*	*1*
	Eragrostis basedowii	*gl*	*v*	*t*
	Euphorbia wheeleri	*j*	*sd*	*t*
	Portulaca intraterranea	*j*	*sd*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*sd*	*t*
	Triraphis mollis	*gl*	*s*	*r*
	Paractaenum novae-hollandiae ssp. reversum	*gl*	*b*	*r*
13-3	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Duma florulenta	*s*	*do*	*2*
	Acacia salicina	*lb/s*	*b/f*	*2*
	?Leiocarpa	*j*	*d*	*1*
	Portulaca intraterranea	*j*	*sd*	*t*
	Nicotiana velutina	*j*	*sd*	*t*
	Zygophyllum simile	*j*	*f/sd/s*	*t*
	Tetragonia tetragonioides	*j*	*sd*	*t*
	Malva preissiana	*j*	*sd*	*t*
	Trigonella suavissima	*j*	*sd*	*t*

Site	Species	Life Form	Life Cycle	Abund
	Calotis hispidula	*j*	*sd/b*	*t*
	Zygophyllum howittii	*j*	*sd/s*	*t*
	Brassica tournefortii	*j*	*sd*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*v/s*	*t*
	Haloragis aspera	*j*	*sd*	*t*
	Sonchus oleraceus	*j*	*sd*	*t*

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Site 14 – Wadlarkaninna Wh – Kalamurina

Site	Species	Life Form	Life Cycle	Abund
14-1	*Eucalyptus coolabah*	*lb*	*s*	*2*
	Acacia salicina	*s*	*b/f*	*3*
	Portulaca intraterranea	*j*	*sd/v*	*1*
	Dactyloctenium radulans	*gl*	*s*	*1*
	Dysphania truncata	*j*	*f*	*t*
	Haloragis aspera	*j*	*sd/v*	*1*
	Trianthema triquetra	*j*	*v/s*	*t*
	Einadia nutans ssp. eremaea	*sd*	*v*	*r*
	Phyllanthus lacunellus	*j*	*sd*	*t*
	Eragrostis basedowii	*gl*	*b*	*t*
	Senecio lanibracteus	*sd*	*d*	*t*
	Duma florulenta	*sc*	*v*	*1*
	Aristida contorta	*gl*	*s*	*t*

Site	Species	Life Form	Life Cycle	Abund
	Euphorbia drummondii	*j*	*v*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*t*
	Lepidium phlebopetalum	*j*	*sd*	*t*
	Citrullus lanatus	*j*	*sd*	*r*
	Sclerolaena diacantha	*j*	*sd*	*t*
14-2	*Eucalyptus coolabah*	*lb*	*s/sp*	*3*
	Acacia salicina	*s*	*b/f*	*2*
	Duma florulenta	*sb*	*do/v/f*	*1*
	?Leiocarpa	*j*	*d*	*1*
	Teucrium racemosum	*j*	*v*	*t*
	Portulaca intraterranea	*j*	*sd*	*1*
	Tetragonia tetragonioides	*j*	*sd*	*1*
	Einadia nutans ssp. eremaea	*sd*	*v*	*t*
	Senecio lanibracteus	*sd*	*do/f*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*sd/v*	*t*
	Ipomoea polymorpha	*j*	*s*	*r*
	Sclerolaena diacantha	*j*	*sd*	*t*
	Haloragis aspera	*j*	*v/f*	*t*
	Calotis hispidula	*j*	*f*	*t*
14-3	*Eucalyptus coolabah*	*lb*	*s*	*3*
	Acacia salicina	*s*	*b/f*	*3*
	Brassica tournefortii	*j*	*sd*	*1*
	Dysphania truncata	*j*	*f/sd*	*1*
	Duma florulenta	*sb*	*do/v*	*1*
	Enchylaena tomentosa var. glabra	*sd*	*s*	*1*
	Tetragonia tetragonioides	*j*	*sd*	*1*
	Salsola australis	*j*	*sd*	*1*
	Portulaca intraterranea	*j*	*sd*	*1*
	Euphorbia wheeleri	*j*	*sd*	*t*
	Acacia stenophylla	*s*	*b/f*	*2*
	Zygophyllum howittii	*j*	*s*	*1*
	Phyllanthus lacunellus	*j*	*s*	*t*
	Commicarpus australis	*j*	*f/s*	*t*
	Triraphis mollis	*gl*	*f*	*t*
	Calotis hispidula	*j*	*f*	*t*
	Trianthema triquetra	*j*	*v*	*t*
	Zygophyllum simile	*j*	*s*	*t*
	Eragrostis dielsii var. dielsii	*gl*	*b*	*t*

Site	Species	Life Form	Life Cycle	Abund
	Eragrostis basedowii	*gl*	*s*	*t*
	Dactyloctenium radulans	*gl*	*s*	*t*
	Ipomoea polymorpha	*j*	*sd*	*1*
	Polycalymma stuartii	*j*	*sd*	*t*
	Tribulus eichlerianus	*j*	*s*	*t*
	Amaranthus grandiflorus	*j*	*f/s*	*1*
	Atriplex sp	*j*	*sd*	*1*
	Tragus australianus	*gl*	*s*	*t*

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Site 15 – Yellow Wh – Kalamurina

Site	Species	Life Form	Life Cycle	Abund
15-1	*Eucalyptus coolabah*	*lb*	*s*	*4*
	Duma florulenta	*lb*	*v/do*	*4*
	Brassica tournefortii	*s*	*sd*	*4*
	Tetragonia tetragonioides	*j*	*sd*	*1*
	Einadia nutans ssp. eremaea	*j*	*s/sp*	*1*
	Amaranthus grandiflorus	*sd*	*f/s*	*1*
	Zygophyllum simile	*j*	*s*	*1*
	Portulaca intraterranea	*j*	*s*	*1*
	Setaria jubiflora	*j*	*b*	*t*
	Senecio lanibracteus	*gl*	*d*	*t*

Site	Species	Life Form	Life Cycle	Abund
	Tribulus eichlerianus	*sc*	*f/s*	*t*
	Phyllanthus lacunellus	*j*	*v*	*1*
	Commicarpus australis	*j*	*f/s*	*t*
	Euphorbia wheeleri	*j*	*s*	*1*
	Trianthema triquetra	*j*	*f/s*	*1*
	Gnephosis eriocarpa	*j*	*sd/f*	*t*
	Salsola australis	*j*	*sd*	*1*
	Eragrostis dielsii var. dielsii	*gl*	*b*	*1*
	Nicotiana velutina	*j*	*v/f*	*1*
	Dactyloctenium radulans	*gl*	*b*	*1*
	Dysphania truncata	*j*	*f/s*	*1*
	Portulaca intraterranea	*j*	*f*	*1*
	Triraphis mollis	*gl*	*b*	*t*
	Ipomoea polymorpha	*j*	*sd*	*t*
	Tragus australianus	*gl*	*b*	*t*
	Sida sp	*j*	*sd*	*t*
	Othonna gregorii	*j*	*sd*	*t*
	Paractaenum novae-hollandiae ssp. reversum	*gl*	*b*	*t*
15-2	*Eucalyptus coolabah*	*lb*	*s/sp*	*3*
	Duma florulenta	*s*	*do/v/f*	*2*
	Acacia salicina	*s*	*b/f*	*2*
	Brassica tournefortii	*j*	*sd*	*1*
	Salsola australis	*j*	*sd*	*1*
	Amaranthus grandiflorus	*j*	*s/sp*	*t*
	Portulaca intraterranea	*j*	*f*	*1*
	Senecio lanibracteus	*sc*	*d*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*v/s*	*2*
	Nicotiana velutina	*j*	*sd*	*1*
	Commicarpus australis	*j*	*f/s*	*t*
	Triraphis mollis	*gl*	*b*	*t*
	Paractaenum novae-hollandiae ssp. reversum	*gl*	*b*	*1*
	Phyllanthus lacunellus	*j*	*v/s*	*t*
	Tribulus eichlerianus	*j*	*sd*	*t*
	Sauropus trachyspermus	*j*	*v*	*t*
	Euphorbia wheeleri	*j*	*f/s*	*t*
	Zygophyllum simile	*j*	*s*	*t*
	Ipomoea polymorpha	*j*	*sd*	*1*
	Sida sp	*sd*	*sd/s*	*t*

Site	Species	Life Form	Life Cycle	Abund
	Gnephosis eriocarpa	*j*	*sd/f*	*t*
	Dysphania truncata	*j*	*sd/f*	*t*
	Sclerolaena diacantha	*sd*	*sd*	*t*
	Dactyloctenium radulans	*gl*	*b*	*t*
	Trianthema triquetra	*j*	*v/f/s*	*t*
	Polycalymma stuartii	*j*	*sd*	*t*
	Eragrostis dielsii var. dielsii	*gl*	*b*	*t*
15-3	*Acacia ligulata*	*s*	*sp*	*1*
	Portulaca intraterranea	*j*	*f*	*1*
	Eucalyptus coolabah	*lb*	*s/sp*	*2*
	Duma florulenta	*s*	*do/v*	*2*
	Acacia salicina	*s*	*b/f*	*2*
	Brassica tournefortii	*j*	*sd*	*1*
	Phyllanthus lacunellus	*j*	*s*	*1*
	Paractaenum novae-hollandiae ssp. reversum	*gl*	*f*	*1*
	Eragrostis dielsii var. dielsii	*gl*	*b*	*1*
	Euphorbia wheeleri	*j*	*sd*	*t*
	Nicotiana velutina	*j*	*sd*	*t*
	Ipomoea polymorpha	*j*	*sd*	*t*
	Portulaca intraterranea	*j*	*s*	*1*
	Trianthema triquetra	*j*	*f/s*	*t*
	Sida sp	*j*	*sd*	*t*
	Enchylaena tomentosa var. glabra	*sc/sd*	*s*	*1*
	Commicarpus australis	*j*	*f/s*	*t*
	Amaranthus grandiflorus	*j*	*f/s*	*1*
	Dactyloctenium radulans	*gl*	*b*	*t*
	Salsola australis	*j*	*sd/s*	*t*
	Senecio lanibracteus	*sc*	*d*	*t*

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Site 16 – Tinnie Landing Wh – Kalamurina

Site	Species	Life Form	Life Cycle	Abund
16-1	*Eucalyptus coolabah*	*lb*	*v*	*2*
	Acacia salicina	*s*	*v*	*2*
	Cyperus gymnocaulos	*vl*	*v/sp*	*1*
	Sphaeromorphaea littoralis	*j*	*s*	*1*
	Portulaca intraterranea	*j*	*sp*	*1*
	Euphorbia porcata	*j*	*s/sp*	*1*
	Tribulus eichlerianus	*j*	*s/sp*	*1*
	Paractaenum novae-hollandiae ssp. reversum	*gl*	*s/sp*	*t*
	Alternanthera nodiflora	*j*	*sp*	*t*
	Phyllanthus lacunellus	*j*	*s*	*t*
	Eragrostis dielsii var. dielsii	*gl*	*sp*	*t*
	Duma florulenta	*sa/sb*	*v*	*1*
	Cullen discolor	*j*	*s*	*t*
	Triraphis mollis	*gl*	*s*	*t*
	Rutidosis helichrysoides ssp. helichrysoides	*j*	*v*	*t*
	Sida ammophila	*j/sd*	*v*	*t*
	Austrobryonia micrantha	*j*	*s/sp*	*t*
	Ipomoea polymorpha	*j*	*s/sp*	*t*
	Eriochloa crebra	*gl*	*s/sp*	*t*
	Trichodesma zeylanicum var. zeylanicum	*j*	*v*	*t*
	Zygochloa paradoxa	*H*	*v*	*t*

Site	Species	Life Form	Life Cycle	Abund
	Crotalaria cunninghamii	*sc*	*v*	*t*
	Amaranthus grandiflorus	*j*	*sp*	*t*
	Sclerolaena diacantha	*sd*	*v*	*t*
16-2	*Eucalyptus coolabah*	*lb/la*	*v*	*2*
	Enchylaena tomentosa var. glabra	*sc*	*s/sp*	*1*
	Duma florulenta	*s*	*v*	*3*
	Portulaca intraterranea	*j*	*s/sp*	*1*
	Cyperus gymnocaulos	*vt*	*v*	*t*
	Acacia salicina	*sa/lb*	*v*	*1*
	Salsola australis	*j*	*s*	*t*
	Sclerolaena diacantha	*sd*	*s*	*t*
	Teucrium racemosum	*sd*	*sp*	*t*
	Trianthema triquetra	*j*	*d*	*t*
	Boerhavia schomburgkiana	*j*	*sp*	*t*
16-3	*Eucalyptus coolabah*	*la/lb*	*v*	*2*
	Duma florulenta	*s*	*v*	*2*
	Dactyloctenium radulans	*GL*	*SP*	*T*
	Enchylaena tomentosa var. glabra	*SD*	*V*	*1*
	Acacia salicina	*s/lb*	*v*	*1*
	Portulaca intraterranea	*j*	*s/sp*	*1*
	Chenopodium auricomum	*sc*	*sp*	*r*
	Teucrium racemosum	*sd*	*v*	*r*
	Abutilon otocarpum	*j*	*v*	*r*
	Trianthema triquetra	*j*	*sp*	*t*
	Alternanthera nodiflora	*j*	*v*	*r*
	Acacia stenophylla	*lb*	*v*	*t*
	Amyema preissii	*mi*	*sp*	*t*

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Site 17 – Mia Mia Wh – Kalamurina

Site	Species	Life Form	Life Cycle	Abund
17-1	*Eucalyptus coolabah*	*lb*	*v*	*3*
	Acacia salicina	*s/lb*	*b*	*2*
	Portulaca intraterranea	*j*	*sp*	*1*
	Duma florulenta	*s/sa*	*v*	*3*
	Enchylaena tomentosa var. glabra	*sd*	*v/s/sp*	*1*
	Acacia stenophylla	*lb*	*v*	*2*
	Amaranthus grandiflorus	*j*	*sp*	*t*
	Alternanthera nodiflora	*j*	*s/sp*	*t*
	Boerhavia schomburgkiana	*j*	*sp*	*t*
	Tribulus terrestris	*j*	*sp*	*t*
	Sclerolaena intricata	*j*	*s*	*t*
	Dactyloctenium radulans	*gl*	*d*	*t*
	Trianthema triquetra	*j*	*so*	*t*
	Chenopodium auricomum	*sd*	*v*	*t*
	Amaranthus grandiflorus	*j*	*sp*	*t*
	Salsola australis	*j*	*v*	*t*
	Marsilea drummondii	*x*	*v*	*t*
	Teucrium racemosum	*j*	*sp*	*t*
	Eriochloa crebra	*gl*	*sp*	*t*

Site	Species	Life Form	Life Cycle	Abund
17-2	*Eucalyptus coolabah*	*la/lb*	*v*	*3*
	Acacia salicina	*s/lb*	*v/b*	*2*
	Enchylaena tomentosa var. glabra	*sd*	*v/s*	*1*
	Duma florulenta	*s/sa*	*v*	*3*
	Trianthema triquetra	*j*	*s/sp*	*t*
	Portulaca intraterranea	*j*	*s/sp*	*1*
	Eragrostis dielsii var. dielsii	*gl*	*sp*	*1*
	Pterocaulon sphacelatum	*sd*	*v*	*t*
	Alternanthera nodiflora	*j*	*sp*	*1*
	Sida ammophila	*j*	*v*	*t*
	Nicotiana velutina	*j*	*b/f/sp*	*1*
	Eriochloa crebra	*gl*	*sp*	*t*
	Sporobolus mitchellii	*gl*	*sp*	*1*
	Acacia stenophylla	*s/lb*	*v*	*2*
	Amaranthus grandiflorus	*j*	*sp/d*	*t*
	Goodenia glauca	*j*	*sp*	*t*
	Chloris pectinata	*gl*	*sp*	*t*
	Sauropus trachyspermus	*j*	*s*	*t*
	Cyperus gymnocaulos	*vt*	*v*	*t*
	Triraphis mollis	*gl*	*sp*	*t*
	Sphaeromorphaea littoralis	*j*	*b/f*	*t*
	Salsola australis	*j*	*v*	*t*
	Rutidosis helichrysoides ssp. helichrysoides	*j*	*f/s*	*t*
	Phyllanthus lacunellus	*j*	*v/s*	*t*
17-3	*Eucalyptus coolabah*	*la/lb*	*v*	*3*
	Duma florulenta	*s*	*v*	*3*
	Portulaca intraterranea	*j*	*sp*	*1*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*1*
	Acacia salicina	*lb/s*	*b*	*1*
	Boerhavia coccinea	*j*	*f/sp*	*1*
	Cucumis melo	*j*	*f/s/sp*	*t*
	Eriochloa crebra	*gl*	*sp*	*t*
	Trichodesma zeylanicum var. zeylanicum	*j*	*v*	*t*
	Sida ammophila	*sd*	*v*	*t*

Site Photo – Permanent Transect

Site 18 – Mona Downs Wh – Cowarie

Site	Species	Life Form	Life Cycle	Abund
18-1	*Eucalyptus coolabah*	*lb/la*	*v*	*4*
	Duma florulenta	*sa*	*v*	*2*
	Portulaca intraterranea	*j*	*sd*	*1*
	Enchylaena tomentosa var. glabra	*sd*	*sd*	*1*
	Haloragis aspera	*j*	*sd*	*t*
	Boerhavia schomburgkiana	*j*	*sd/v*	*t*
	Sclerolaena intricata	*j*	*sd/s*	*t*
	Alternanthera nodiflora	*j*	*s/sp*	*1*
	Acacia salicina	*s/lb*	*v/sp*	*1*
	Salsola australis	*j*	*sd*	*t*
	Santalum lanceolatum	*lb*	*s*	*t*
	Centipeda nidiformis	*j*	*f*	*1*
	Rumex crystallinus	*j*	*f*	*r*
	Sphaeromorphaea littoralis	*j*	*f*	*t*
	Glinus lotoides	*j*	*v*	*t*
	Cullen sp	*j*	*sd/v*	*t*
18-2	*Eucalyptus coolabah*	*lb*	*v*	*2*
	Acacia salicina	*s*	*v/b*	*3*
	Enchylaena tomentosa var. glabra	*sc*	*v/s*	*1*

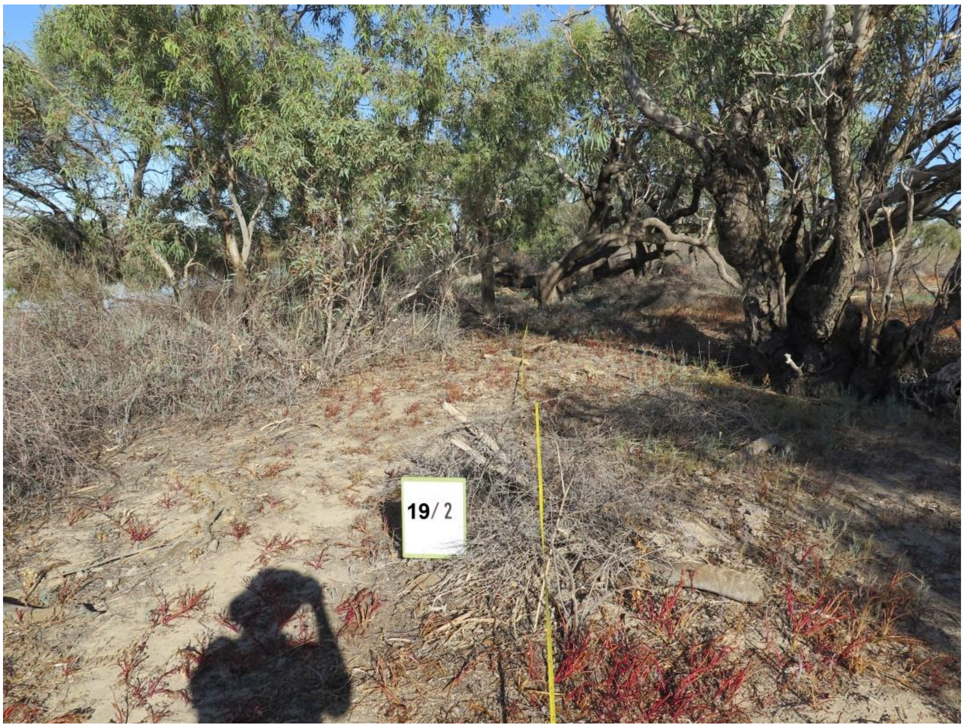
Site	Species	Life Form	Life Cycle	Abund
	Salsola australis	*j*	*v/sd*	*t*
	Boerhavia schomburgkiana	*j*	*v/do*	*t*
	Acacia stenophylla	*lb*	*v*	*t*
	Tetragonia tetragonioides	*j*	*sd*	*t*
	Alternanthera nodiflora	*j*	*sp*	*t*
	Sclerolaena intricata	*j*	*sd/s*	*t*
	Teucrium racemosum	*j*	*v*	*t*
	Cullen sp	*j*	*sd/v*	*t*
	Santalum lanceolatum	*s*	*b*	*t*
18-3	*Eucalyptus coolabah*	*la/lb*	*v*	*4*
	Duma florulenta	*s/sa*	*v/f*	*4*
	Santalum lanceolatum	*s/lb*	*b*	*t*
	Trianthema triquetra	*j*	*s/sp*	*t*
	Portulaca intraterranea	*j*	*sd*	*t*
	Enchylaena tomentosa var. glabra	*j*	*sd*	*t*
	Sclerolaena intricata	*j*	*sd*	*t*
	Haloragis aspera	*j*	*v*	*t*
	Acacia stenophylla	*sd*	*v*	*t*
	Acacia salicina	*s*	*b/sp*	*2*
	Cucumis melo	*j*	*v*	*r*

Site Photo – Permanent Transect

Site 19 – Yelpawaralinna Wh – Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
19-1	*Eucalyptus coolabah*	la/lb	v/s/sp	3
	Duma florulenta	s	V	3
	Acacia stenophylla	s/lb	v	2
	Portulaca intraterranea	j	sd	1
	Enchylaena tomentosa var. glabra	sd	sd/v/s	t
	Alternanthera nodiflora	j	s/sp	1
	Boerhavia burbidgeana	j	sp	t
	Cucumis melo	j	f/s	1
	Trianthema triquetra	j	s/sp	t
	Amaranthus grandiflorus	j	s/sp	t
	Eriochloa crebra	gl	sp	t
	Salsola australis	j	v	t
	Acacia salicina	s/lb	v/b	2
	Santalum lanceolatum	lb	v	1
	Lysiana subfalcata	mi	f/s	1
	Zeylia galericulata	j	s	t
	Abutilon fraseri ssp. fraseri	j	f	s
19-2	*Eucalyptus coolabah*	la/lb	v/s/sp	3
	Duma florulenta	sa	v	2
	Portulaca intraterranea	j	sd	1
	Salsola australis	j	sd/v/f	1
	Santalum lanceolatum	lb	b/f/sd	1
	Boerhavia burbidgeana	j	sp	1
	Zeylia galericulata	j	s/sp	t
	Sesbania cannabina var cannabina	j	sd	t
	Eriochloa crebra	gl	sp	t
	Trianthema triquetra	j	sp	t
	Enchylaena tomentosa var. glabra	sd	v/s	1
	Sclerolaena intricata	j	s	1
	Amaranthus grandiflorus	j	d	1
	Acacia stenophylla	lb	v	t
	Chenopodium auricomum	sb	s/sp	t
19-3	*Eucalyptus coolabah*	lb	v	2
	Duma florulenta	sb	v/f	2
	Portulaca intraterranea	j	sd	1

Site	Species	Life Form	Life Cycle	Abund
	Alternanthera nodiflora	*j*	*s/sp*	*1*
	Sesbania cannabina var cannabina	*j*	*sd/s*	*t*
	Enchylaena tomentosa var. glabra	*j*	*sd*	*1*
	Cucumis melo	*j*	*f/s*	*t*
	Glinus lotoides	*j*	*f*	*t*
	Centipeda cunninghammii	*j*	*f*	*t*
	Calotis porphyroglossa	*j*	*f*	*t*
	Acacia stenophylla	*lb*	*v*	*1*
	Dactyloctenium radulans	*j*	*d*	*t*
	Boerhavia burbidgeana	*j*	*d*	*t*



Site Photo – Permanent Transect

Site 20 – Double Bluff Wh – Pandie Pandie

Site	Species	Life Form	Life Cycle	Abund
20-1	*Eucalyptus coolabah*	*la/lb*	*v*	*4*
	Acacia stenophylla	*lb*	*v*	*1*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*1*
	Acacia salicina	*s/lb*	*b/f*	*2*
	Duma florulenta	*sb*	*v*	*t*
	Bauhinia gilva	*la/lb*	*v/sp*	*2*
	Teucrium racemosum	*j*	*v/f*	*t*

Site	Species	Life Form	Life Cycle	Abund
	Salsola australis	*j*	*sd*	*1*
	Portulaca intraterranea	*j*	*sd*	*1*
	Boerhavia burbidgeana	*j*	*sp/d*	*1*
	Setaria jubiflora	*gl*	*v*	*1*
	Abutilon sp	*j*	*v*	*t*
20-2	*Eucalyptus coolabah*	*la/lb*	*v*	*4*
	Atalaya hemiglauca	*la/lb*	*v*	*2*
	Bauhinia gilva	*la/lb*	*sd/v/s*	*2*
	Acacia salicina	*lb*	*f/b/sp*	*2*
	Eremophila bignoniiflora	*lb*	*v*	*t*
	Portulaca intraterranea	*j*	*sd*	*t*
	Setaria jubiflora	*gl*	*v*	*t*
	Amaranthus grandiflorus	*j*	*d*	*t*
	Lysiana subfalcata	*mi*	*f*	*r*
	Cucumis melo	*j*	*s*	*r*
	Amyema preissii	*mi*	*s*	*r*
20-3	*Eucalyptus coolabah*	*la/lb*	*v*	*4*
	Acacia salicina	*lb*	*b/v*	*3*
	Santalum lanceolatum	*lb*	*s/sp*	*2*
	Portulaca intraterranea	*j*	*sd*	*1*
	Setaria jubiflora	*gl*	*sp*	*2*
	Amaranthus grandiflorus	*j*	*sp/d*	*t*
	Duma florulenta	*sb*	*v*	*t*
	Lysiana exocarpi ssp exocarpi	*mi*	*f*	*t*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*1*
	Lysiana subfalcata	*mi*	*f*	*t*
	Cucumis melo	*j*	*f*	*t*
	Alternanthera nodiflora	*j*	*sp*	*t*
	Abutilon sp	*j*	*sp*	*t*

Site Photo – Permanent Transect

Site 21 – Burt's Wh – Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
21-1	*Eucalyptus coolabah*	*la/lb*	*v/s*	*3*
	Duma florulenta	*sb*	*v/b/f*	*2*
	Cyperus difformis	*vl*	*s*	*1*
	Sphaeranthus indicus	*j*	*f*	*1*
	Teucrium racemosum	*j*	*v*	*t*
	Senecio lanibracteus	*j/sc*	*sd/v*	*t*
	Acacia salicina	*s*	*b/f*	*1*
	Acacia stenophylla	*lb*	*b/f*	*1*
	Eragrostis tenellula	*gl*	*s/sp*	*1*
	Eragrostis confertiflora	*gl*	*s/sp*	*1*
	Alternanthera nodiflora	*j*	*s/sp*	*t*
	Centipeda cunninghammii	*j*	*v*	*t*
	Pseudognaphalium luteoalbum	*j*	*f*	*t*
	Amyema preissii	*mi*	*s/sp*	*t*
	Tribulus eichlerianus	*j*	*s/sp*	*t*
	Ipomoea polymorpha	*j*	*sp*	*t*
	Glinus lotoides	*j*	*f/s*	*t*
	Marsilea drummondii	*x*	*s*	*t*
21-2	*Eucalyptus coolabah*	*lb*	*v*	*2*

Site	Species	Life Form	Life Cycle	Abund
	Duma florulenta	*sa/s*	*v*	*2*
	Chenopodium auricomum	*sb*	*s/sp*	*1*
	Acacia stenophylla	*s*	*v*	*2*
	Acacia salicina	*s*	*b/f*	*1*
	Eremophila bignoniiflora	*s*	*v*	*r*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*t*
	Portulaca intraterranea	*j*	*sd*	*t*
	Marsilea drummondii	*x*	*d*	*t*
	Tribulus eichlerianus	*j*	*s/sp*	*t*
	Solanum esuriale	*sd*	*v/s*	*t*
	Trianthema triquetra	*j*	*sp*	*t*
21-3	*Eucalyptus coolabah*	*la/lb*	*v*	*4*
	Duma florulenta	*sa/sb*	*v*	*3*
	Acacia salicina	*s*	*b/f*	*2*
	Enchylaena tomentosa var. glabra	*sd*	*v*	*1*
	Santalum lanceolatum	*lb*	*v*	*r*
	Senecio lanibracteus	*sd*	*f*	*r*
	Einadia nutans ssp. eremaea	*sd*	*v*	*r*
	Chenopodium auricomum	*sd*	*sd*	*r*
	Glinus lotoides	*j*	*s/sp*	*t*
	Sphaeranthus indicus	*j*	*s/sp*	*r*

Site Photo – Permanent Transect

Site 22 – Pelican Wh – Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
22-2	*Eucalyptus coolabah*	*lb*	*v*	*3*
22-2	*Acacia salicina*	*s*	*v/f*	*1*
22-2	*Eragrostis basedowii*	*GGL*	*f/s*	*t*
22-2	*Duma florulenta*	*s*	*v/f*	*1*
22-2	*Nicotiana velutina*	*j*	*f*	*t*
22-2	*Sida ammophila*	*sd/j*	*v*	*1*
22-2	*Ipomoea polymorpha*	*vi*	*f/s/sp*	*t*
22-2	*Cyperus rigidellus*	*vl*	*f/s*	*t*
22-2	*Cyperus iria*	*vl*	*f/s/sp*	*t*
22-2	*Tribulus eichlerianus*	*j*	*s/sp*	*2*
22-2	*Panicum laevinode*	*gl*	*s/sp/t*	
22-2	*Enchylaena tomentosa var. glabra*	*sd*	*s/sp*	*t*
22-2	*Swainsona sp*	*j*	*v*	*t*
22-2	*Lotus cruentus*	*j*	*v*	*t*
22-2	*Glinus lotoides*	*j*	*f/s/sp*	*1*
22-2	*Alternanthera nodiflora*	*j*	*s/sp*	*1*
22-2	*Sesbania cannabina var cannabina*	*sc*	*f/s*	*1*
22-2	*Cullen australasicum*	*sc*	*v/f*	*1*
22-2	*Cucumis melo*	*vi*	*f/s*	*1*
22-2	*Sauropus trachyspermus*	*j*	*s*	*t*
22-2	*Verbena officinalis*	*j*	*v*	*t*
22-2	*Eragrostis dielsii var. dielsii*	*gl*	*s*	*t*
22-2	*Triraphis mollis*	*gl*	*s*	*t*
22-2	*Salsola australis*	*j*	*v*	*1*
22-2	*Portulaca intraterranea*	*j*	*v*	*t*
22-2	*Euphorbia dallachyana*	*j*	*s*	*t*
22-2	*Dactyloctenium radulans*	*gl*	*s*	*t*
22-2	*Urochloa praetervisa*	*gl*	*v*	*t*
22-2	*Sporobolus mitchellii*	*gl*	*s/sp*	*t*
22-2	*Haloragis aspera*	*j*	*v*	*t*
22-2	*Trianthema triquetra*	*j*	*s/sp*	*t*
22-2	*Sclerolaena diacantha*	*sd*	*s*	*t*
22-2	*Phyllanthus lacunellus*	*j*	*s*	*t*
22-2	*Datura leichhardtii*	*j*	*s*	*r*
22-2	*Sclerolaena sp*	*sd*	*s*	*t*

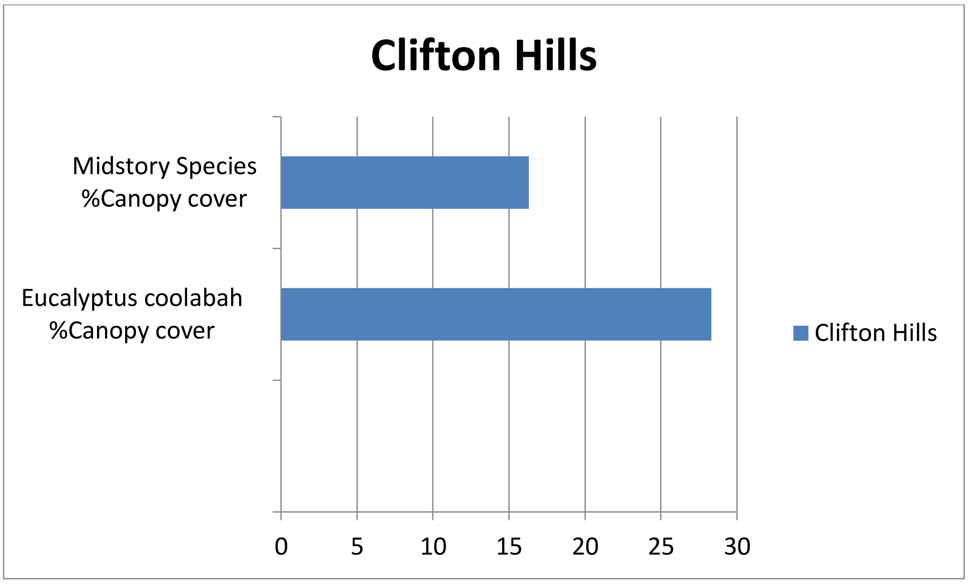
Site	Species	Life Form	Life Cycle	Abund
22-2	*Amaranthus mitchellii*	*j*	*s*	*1*
22-2	*Boerhavia burbidgeana*	*j*	*v*	*t*
22-2	*Sida cunninghamii*	*sd*	*v*	*t*
22-2	*Eremophila bignoniiflora*	*s*	*v*	*t*
22-2	*Aristida holathera var. holathera*	*gl*	*b*	*t*
22-2	*Rutidosis helichrysoides ssp. helichrysoides*	*j*	*f*	*t*
22-2	*Pterocaulon sphacelatum*	*j*	*f*	*t*
22-2	*Sclerolaena bicornis*	*sd*	*s*	*t*
22-2	*Euphorbia tannensis ssp. eremophila*	*j*	*f*	*t*
22-2	*Atalaya hemiglauca*	*lb*	*v*	*1*
22-2	*Bauhinia gilva*	*s*	*v*	*t*
22-2	*Urochloa piligera*	*gl*	*s*	*t*
22-2	*Stemodia florulenta*	*j*	*f*	*t*
22-2	*Enneapogon polyphyllus*	*gl*	*s*	*t*
22-2	*Eragrostis setifolia*	*gl*	*sp*	*t*
22-2	*Goodenia cycloptera*	*j*	*f*	*t*
22-2	*Acacia stenophylla*	*s*	*v*	*t*
22-2	*Eragrostis tenellula*	*gl*	*sp*	*t*
22-2	*Marsilea drummondii*	*x*	*v*	*t*
22-2	*Diplachne fusca ssp. muelleri*	*gl*	*f/s*	*t*
22-2	*Synaptantha tillaeacea*	*j*	*f/s*	*t*
22-2	*Ammannia multiflora*	*j*	*f/s*	*t*

13 Appendix E

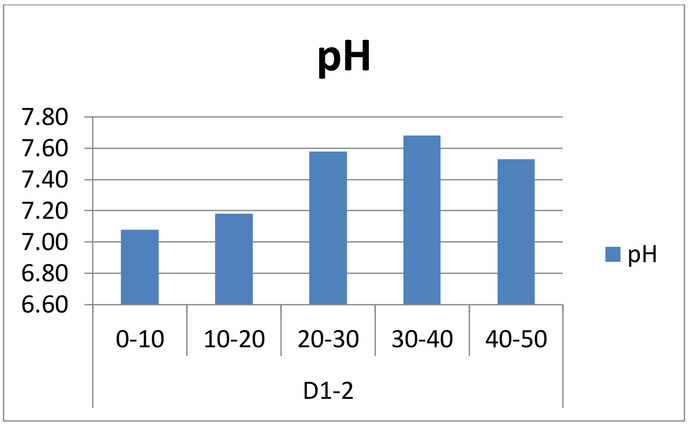
13.1 All Permanent Sites/Transects Plant Data Monitoring Phase 2016

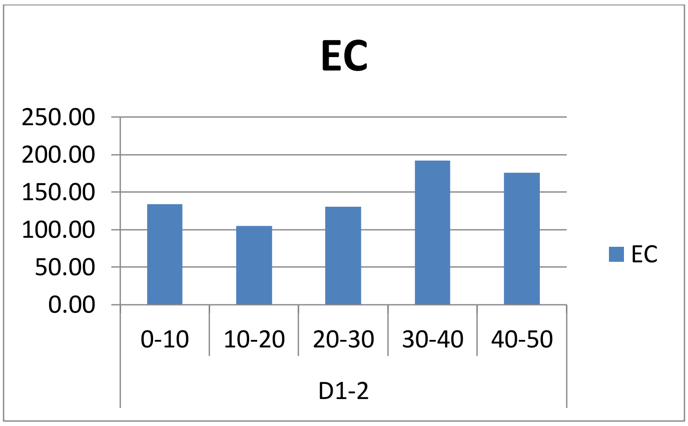
Site 1-2 – Ultoomurra Wh - Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
1-2	*Eucalyptus coolabah*	lb	b	2
1-2	*Santalum lanceolatum*	s	v	t
1-2	*Duma florulenta*	s	v	2
1-2	*Chenopodium auricomum*	sb	f	t
1-2	*Portulaca intraterranea*	j	v/sp	1
1-2	*Alternanthera nodiflora*	j	sp	1
1-2	*Teucrium racemosum*	j	f/s/sp	t
1-2	*Trianthema triquetra*	j	sp	1
1-2	*Urochloa praetervisa*	gl	s	t
1-2	*Goodenia glauca*	j	v	t
1-2	*Enchylaena tomentosa var. glabra*	sd	v/s	t
1-2	*Haloragis aspera*	j	v	t
1-2	*Amaranthus mitchellii*	j	s/sp	1
1-2	*Cullen australasicum*	j	sd/f/s/	1
1-2	*Tribulus eichlerianus*	j	sp	t
1-2	*Boerhavia burbidgeana*	j	f/s/sp	1
1-2	*Atriplex angulata*	j	s	t
1-2	*Cucumis melo*	vi	f/s/d/	t
1-2	*Einadia nutans ssp. eremaea*	sd	v	t
1-2	*Acacia stenophylla*	lb/s	v	1
1-2	*Pterocaulon sphacelatum*	j	v	t
1-2	*Citrullus lanatus*	vi	f/s	t
1-2	*Cucumis argenteus*	vi	f/s	t
1-2	*Rutidosis helichrysoides ssp. helichrysoides*	j	f/s	t
1-2	*Lysiana exocarpi ssp exocarpi*	mi	f	r
1-2	*Sida cunninghamii*	j	v	r
1-2	*Glinus lotoides*	j	sp	t
1-2	*Acacia salicina*	s/lb	b/f/d	2
1-2	*Marsilea drummondii*	x	v	t



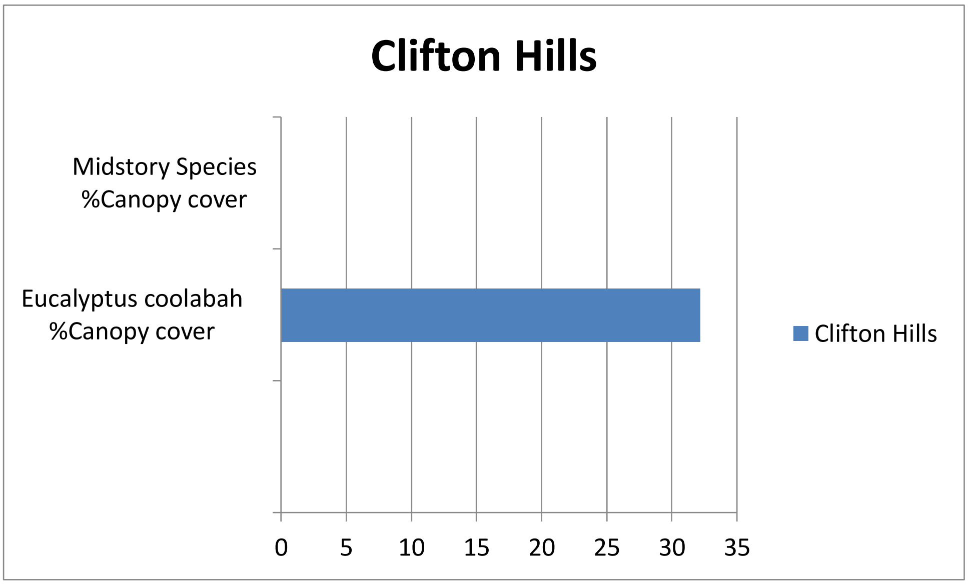
Site Photo – Permanent Transect



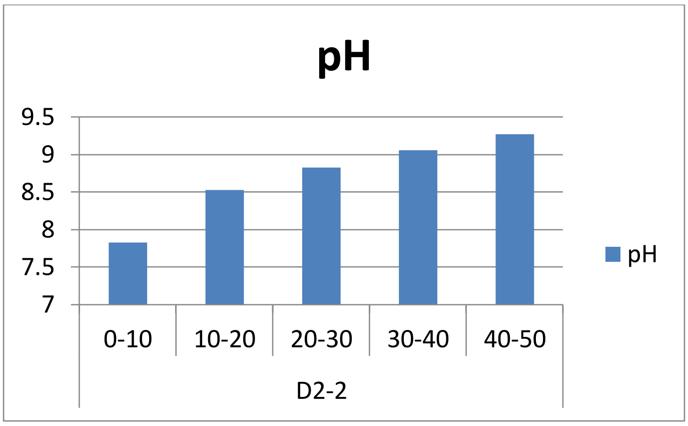


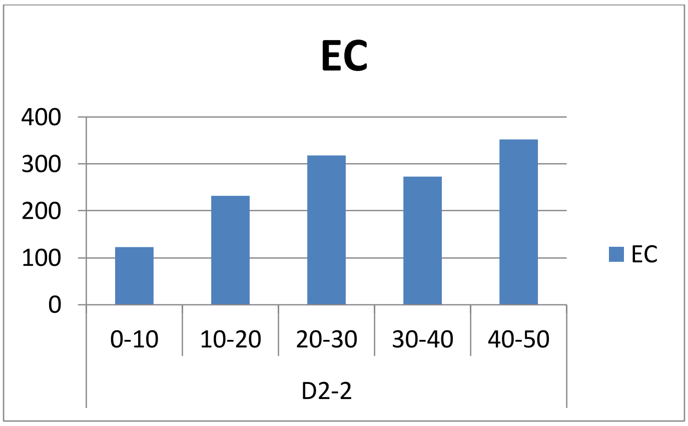
Site 2 – Goyder Lagoon Wh - Clifton Hills

Site	Species	Life Form	Life Cycle	Abund
2-2	*Eucalyptus coolabah*	lb	v	2
2-2	*Duma florulenta*	sa	v/f/sp	3
2-2	*Teucrium racemosum*	j/sd	v/sp	1
2-2	*Rumex crystallinus*	j	sd	t
2-2	*Centipeda cunninghammii*	j	sd	1
2-2	*Calotis plumulifera*	j	f	t
2-2	*Myriocephalus rudallii*	j	f	t
2-2	*Nicotiana velutina*	j	f	t
2-2	*Rutidosis helichrysoides ssp. helichrysoides*	j	f	t
2-2	*Pycnosorus melleus*	j	f	t
2-2	*Enchylaena tomentosa var. glabra*	j	sd	t
2-2	*Senecio depressicola*	j	sd	t
2-2	*Goodenia fascicularis*	j	b/f	t
2-2	*Alternanthera nodiflora*	j	s	t
2-2	*Haloragis aspera*	j	v	t
2-2	*Isolepis congrua*	vl	s	t
2-2	*Senecio lanibracteus*	j	sd	t
2-2	*Azolla filiculoides*	x	sd	t



Site Photo – Permanent Transect

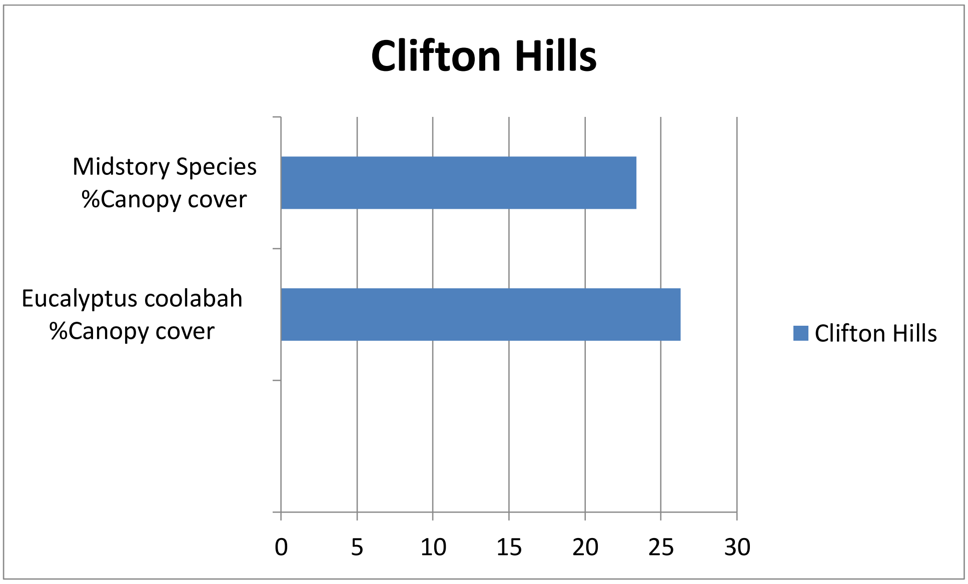




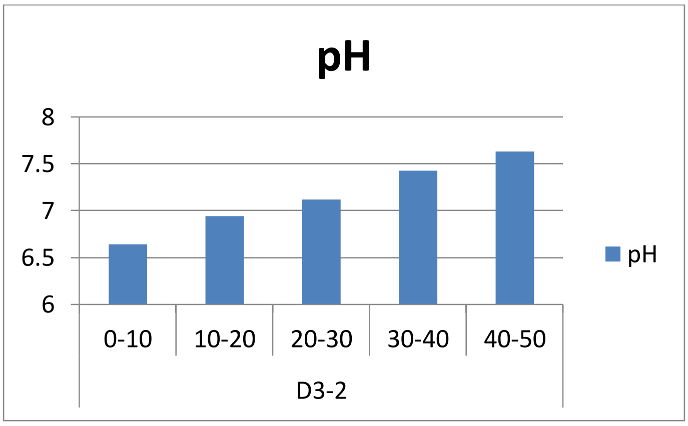
Site 3 – Koonchera Wh - Clifton Hills

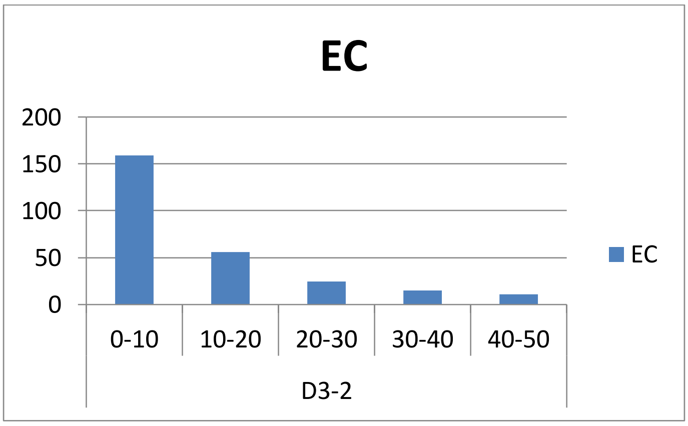
Site	Species	Life Form	Life Cycle	Abund
3-2	*Eucalyptus coolabah*	lb	v	3
3-2	*Acacia stenophylla*	lb	v/f/s/sp	2
3-2	*Acacia salicina*	lb	v	2
3-2	*Senecio lanibracteus*	sb	b/f/sp	2
3-2	*Enchylaena tomentosa var. glabra*	sb/sd	s	1
3-2	*Duma florulenta*	s/sd	v/f/s/sp	1
3-2	*Tetragonia tetragonioides*	j	s	1
3-2	*Portulaca intraterranea*	j	v/sp	1
3-2	*Arabidella procumbens*	j	f	t
3-2	*Trigonella suavissima*	j	f	t
3-2	*Nicotiana velutina*	j	f	1
3-2	*Malva preissiana*	j	b/f/sd	1
3-2	*Solanum nigrum*	j	v/s	t
3-2	*Dysphania melanocarpa*	j	f/s	1
3-2	*Calotis hispidula*	j	f	t
3-2	*Senecio depressicola*	j	f	t
3-2	*zygophyllum howittii*	j	s	t
3-2	*Paractaenum novae-hollandiae ssp. reversum*	gl	f	t

Site	Species	Life Form	Life Cycle	Abund
3-2	*Trianthema triquetra*	j	f	t
3-2	*Zygophyllum ammophillum*	j	s	T
3-2	*Boerhavia coccinea*	j	sp	T
3-2	*Euphorbia ferdinandi var ferdinandi*	j	s	T
3-2	*Cullen patens*	j	b	T
3-2	*Chenopodium auricomum*	sd	v/sd	T
3-2	*Sonchus oleraceus*	j	b	T
3-2	*Amaranthus macrocarpus var macrocarpus*	j	f	T
3-2	*Lepidium papillosum*	j	s	T
3-2	*Triraphis mollis*	gl	f	T
3-2	*Dactyloctenium radulans*	gl	b	T
3-2	*Eragrostis basedowii*	gl	b	T



Site Photo – Permanent Transect

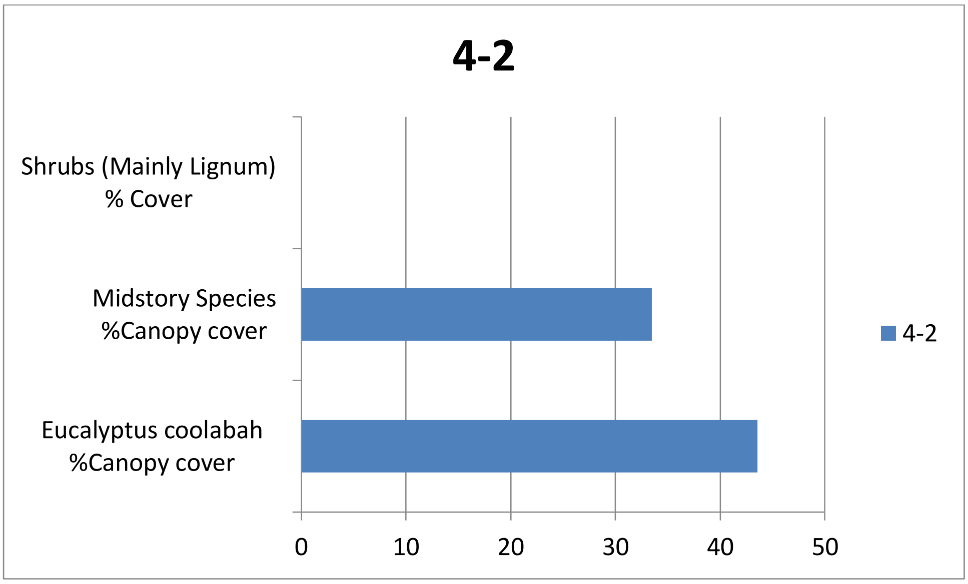




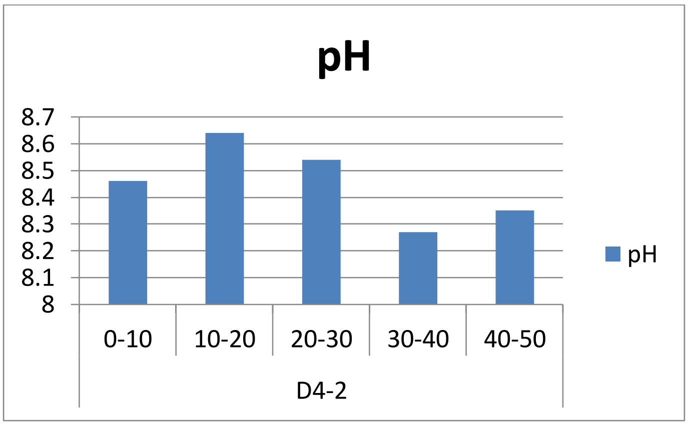
Site 4 – Yammakira Wh - Clifton Hills

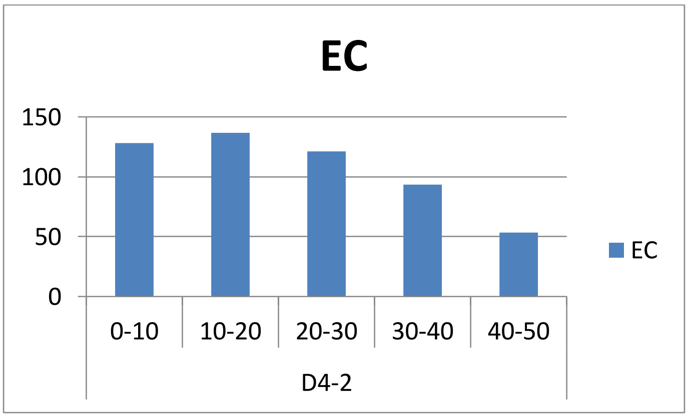
Site	Species	Life Form	Life Cycle	Abund

Site	Species	Life Form	Life Cycle	Abund
4-2	*Eucalyptus coolabah*	lb	v	3
4-2	*Acacia salicina*	s/lb	b/f	2
4-2	*Bauhinia gilva*	s/lb	v/sd	2
4-2	*Santalum lanceolatum*	s	v/f/s/sp	1
4-2	*Duma florulenta*	s	v	T
4-2	*Solanum chenopodinum*	sd	v/sd	1
4-2	*Senna artemisioides ssp. × sturtii*	sd	v	T
4-2	*Eremophila bignoniiflora*	sd	v	T
4-2	*Atalaya hemiglauca*	lb/s	v	1
4-2	*Boerhavia burbidgeana*	j	sd/v	1
4-2	*Enchylaena tomentosa var. glabra*	sd	v	T
4-2	*Abutilon fraseri ssp. diplotrichum*	j	sd	1
4-2	*Acacia salicina*	sd	v	R
4-2	*Lysiana exocarpi ssp exocarpi*	mi	f	R
4-2	*Teucrium racemosum*	sd	v	T
4-2	*Tribulus eichlerianus*	j	v/sd	T
4-2	*Urochloa praetervisa*	gl	v	T



Site Photo – Permanent Transect





Site 5 – Tepamimi Wh - Clifton Hills

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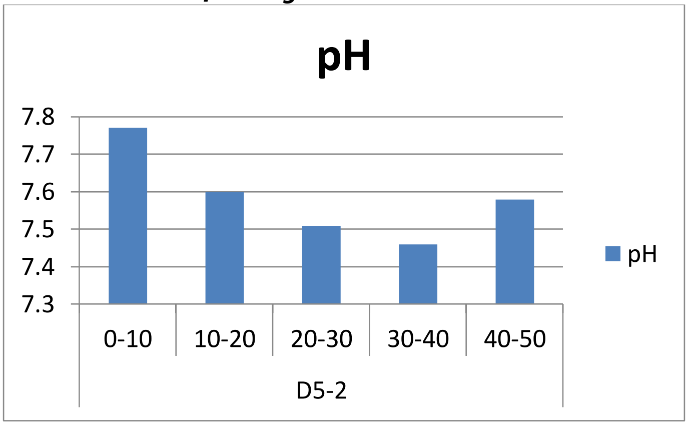
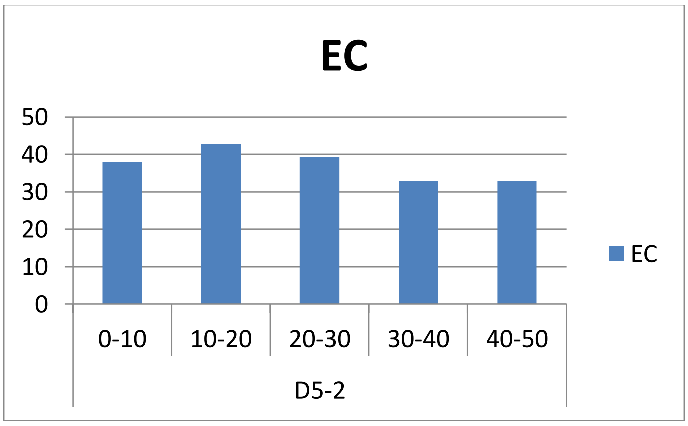
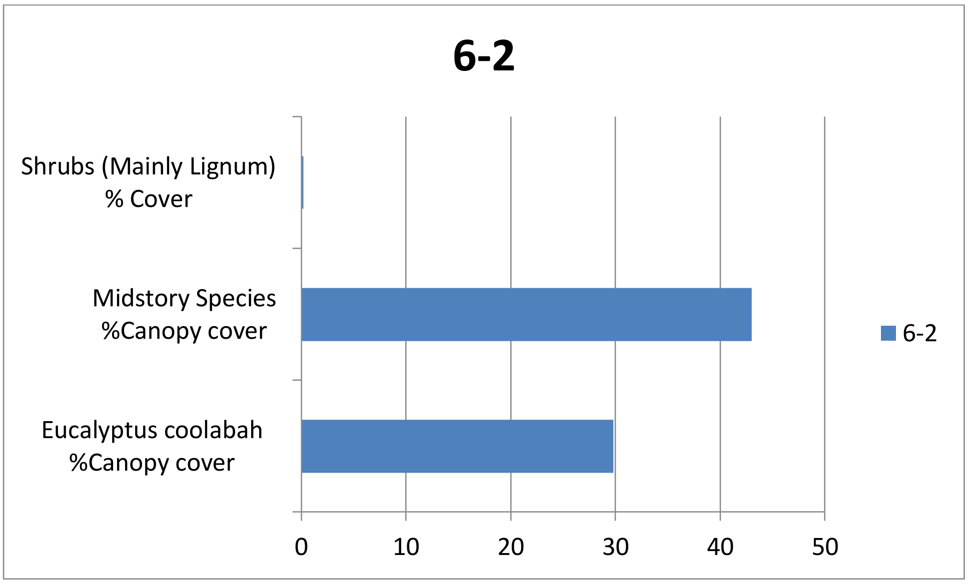




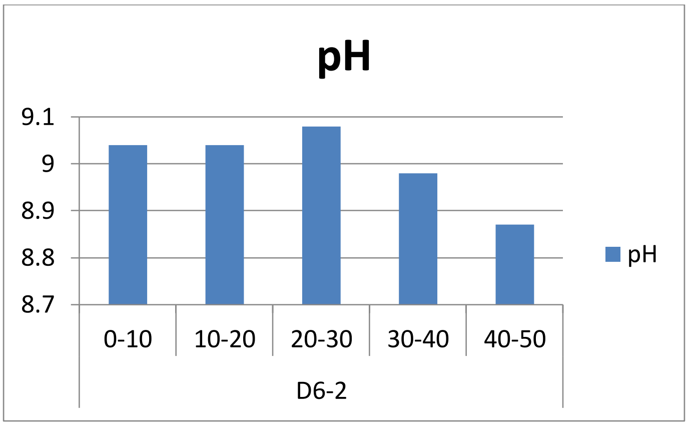
Site 6 – Andrewilla Wh - Clifton Hills

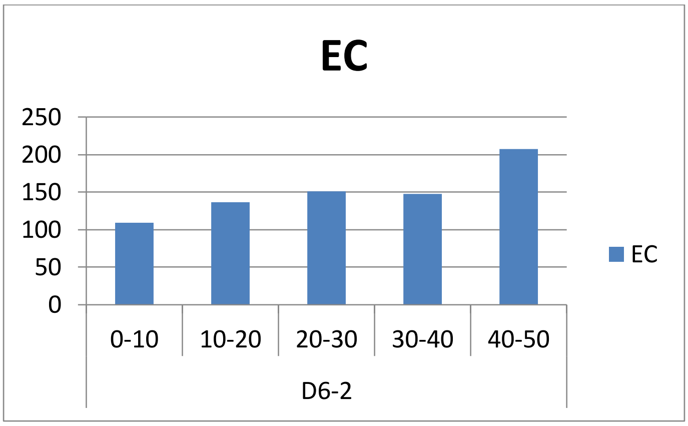
Site	Species	Life Form	Life Cycle	Abund
6-2	*Eucalyptus coolabah*	lb	v	3
6-2	*Bauhinia gilva*	lb	v	1
6-2	*Eremophila bignoniiflora*	s	v	1
6-2	*Atalaya hemiglauca*	lb	v	1
6-2	*Santalum lanceolatum*	lb/s	v	T
6-2	*Enchylaena tomentosa var. glabra*	sd	sd/v	1
6-2	*Acacia salicina*	lb/s	b/f	2
6-2	*Salsola australis*	j	sd/s	T
6-2	*Sclerolaena intricata*	j	s	T
6-2	*Portulaca oleracea*	j	sd	1
6-2	*Zaleya galericulata* ssp. *australis*	j	s/sp	T
6-2	*Tribulus eichlerianus*	j	s/sp	T
6-2	*Urochloa praetervisa*	gl	s/sp	T
6-2	*Amaranthus mitchellii*	j	s/sp	T
6-2	*Zygophyllum sp.*	j	s	T

Site	Species	Life Form	Life Cycle	Abund
6-2	*Solanum esuriale*	j	v	t
6-2	*Trianthema triquetra*	j	sp	T
6-2	*Boerhavia burbidgeana*	j	f	T
6-2	*Lysiana subfalcata*	mi	f	T



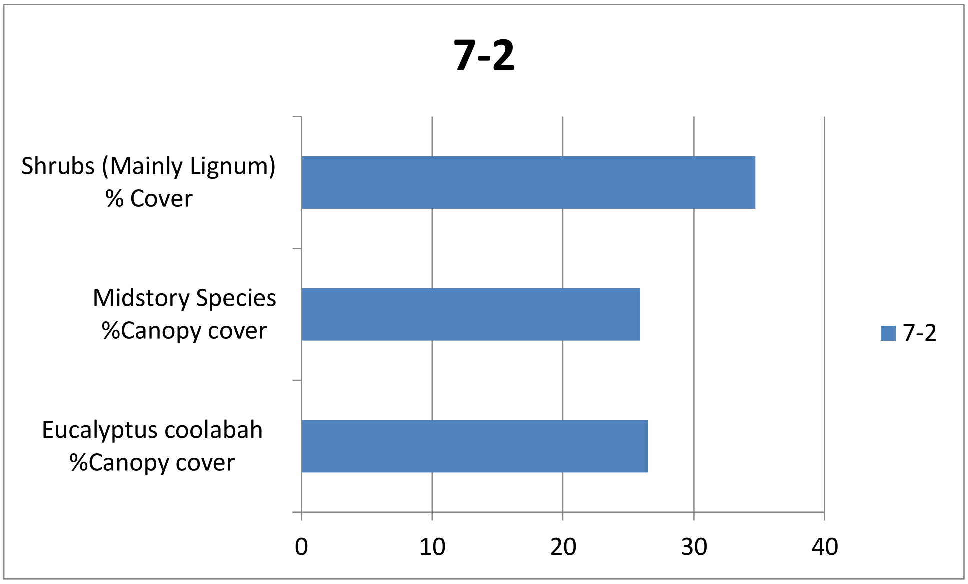
Site Photo – Permanent Transect



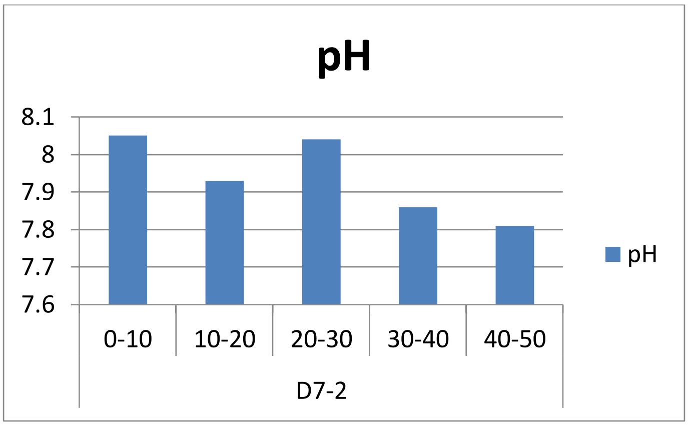


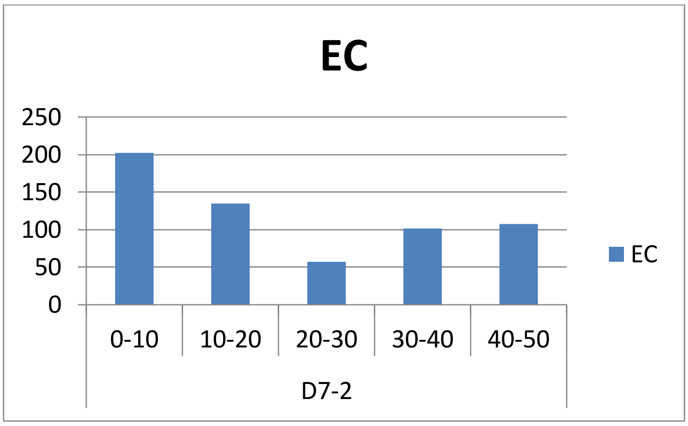
Site 7 – D-Split Wh – Pandie Pandie

Site	Species	Life Form	Life Cycle	Abund
7-2	*Eucalyptus coolabah*	lb	v	2
7-2	*Acacia salicina*	s/lb	b/f/d	1
7-2	*Santalum lanceolatum*	s/lb	b/f/s	1
7-2	*Duma florulenta*	s	v	2
7-2	*Boerhavia burbidgeana*	j	sp	T
7-2	*Lysiana exocarpi ssp exocarpi*	mi	f/s	T
7-2	*Enchylaena tomentosa var. glabra*	sd	v	T



Site Photo – Permanent Transect

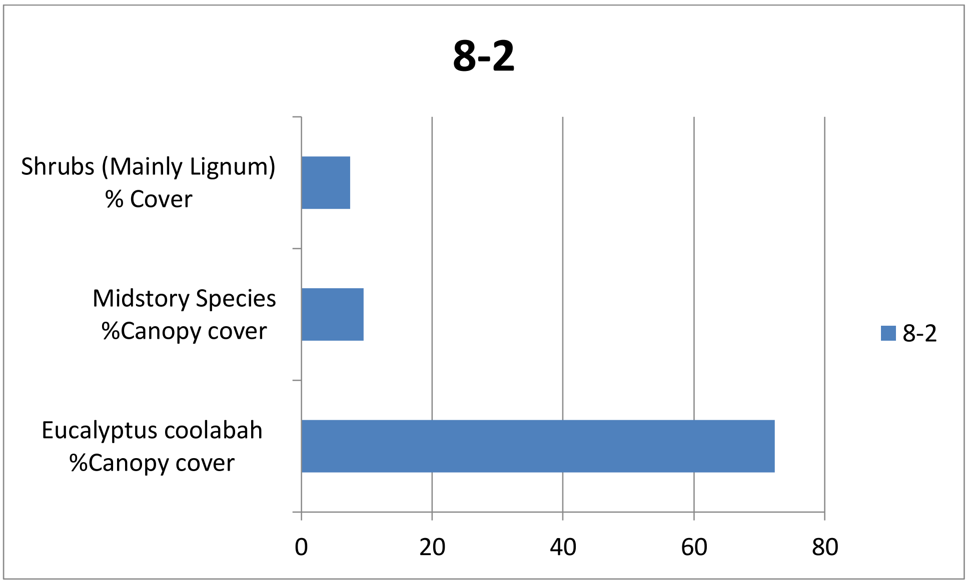




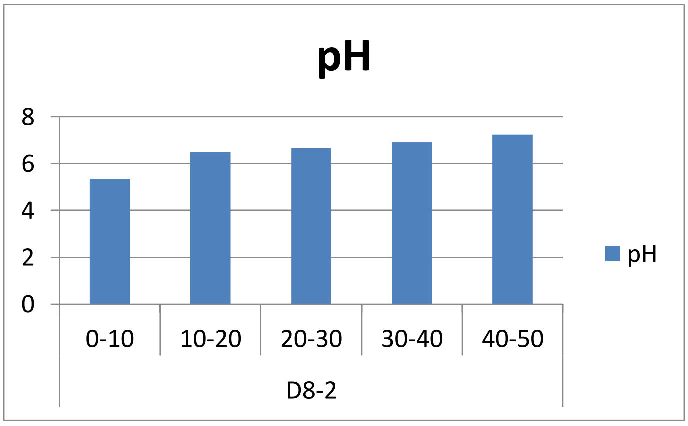
Site 8 – Windmill Wh – Pandie Pandie

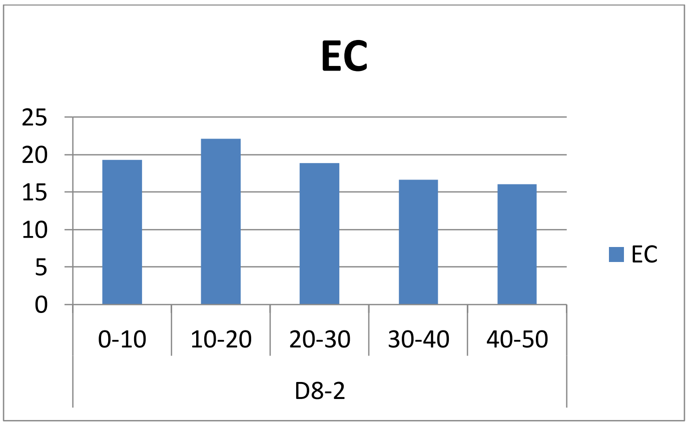
Site	Species	Life Form	Life Cycle	Abund
8-2	*Eucalyptus coolabah*	lb	v	3
8-2	*Duma florulenta*	sa	v/do/f	2
8-2	*Acacia salicina*	s	f/v	1
8-2	*Bauhinia gilva*	lb	v	T
8-2	*Urochloa praetervisa*	gl	f/s	2
8-2	*Einadia nutans ssp. eremaea*	sd	s	T
8-2	*Senecio depressicola*	j	f	1
8-2	*Senecio lanibracteus*	j	sd	T
8-2	*Salsola australis*	j	s	T
8-2	*Cyperus bulbosus*	Vl	v	T
8-2	*Chenopodium auricomum*	sd	sd/v	T
8-2	*Arabidella procumbens*	j	f	T
8-2	*Goodenia glauca*	j	sd/v	T
8-2	*Enchylaena tomentosa var. glabra*	sd	v/sp	T
8-2	*Nicotiana velutina*	j	sd/f	T
8-2	*Tetragonia tetragonioides*	j	sd/f	T
8-2	*Calotis hispidula*	j	f/s	T
8-2	*Minuria sp*	j	f	T

Site	Species	Life Form	Life Cycle	Abund
8-2	*Polycalymma stuartii*	j	f	t
8-2	*Calocephalus platycephalus*	j	sd/f	1
8-2	*Pseudognaphalium luteoalbum*	j	f/sd	1
8-2	*Malva preissiana*	j	f	T
8-2	*Gnaphalium polycaulon*	j	f	T
8-2	*Lepidium sagittulatum*	j	s	T
8-2	*Sonchus oleraceus*	j	f	T
8-2	*Amyema preissii*	mi	sp	R
8-2	*Wahlenbergia communis*	j	f/s	T
8-2	*Rumex crystallinus*	j	f	T



Site Photo – Permanent Transect

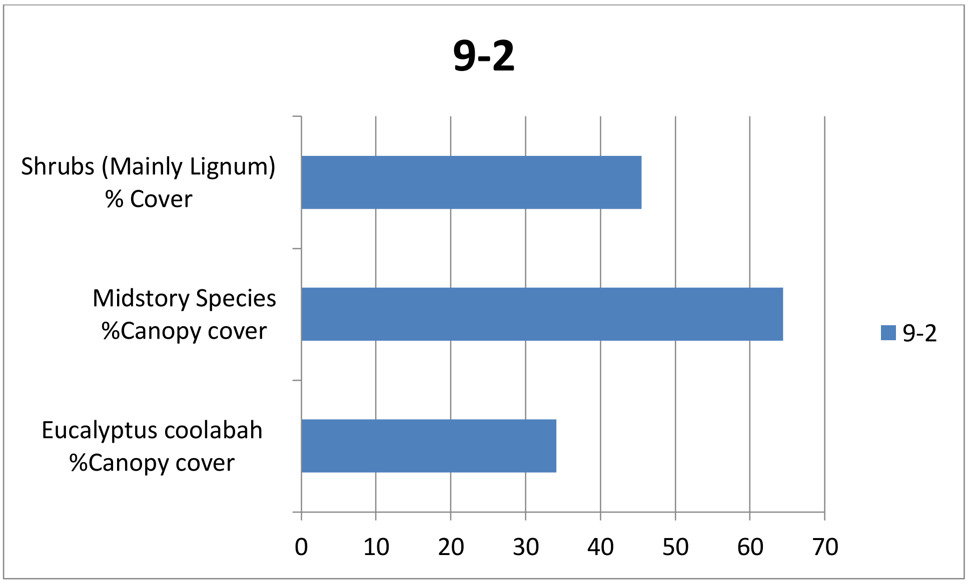




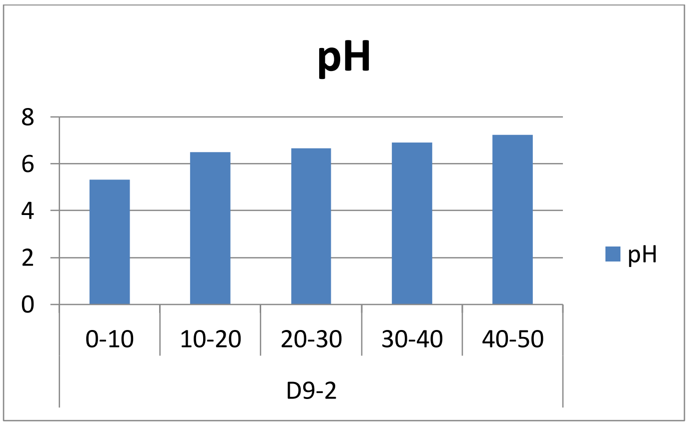
Site 9 – Kalamunkinna Wh – Cowarie

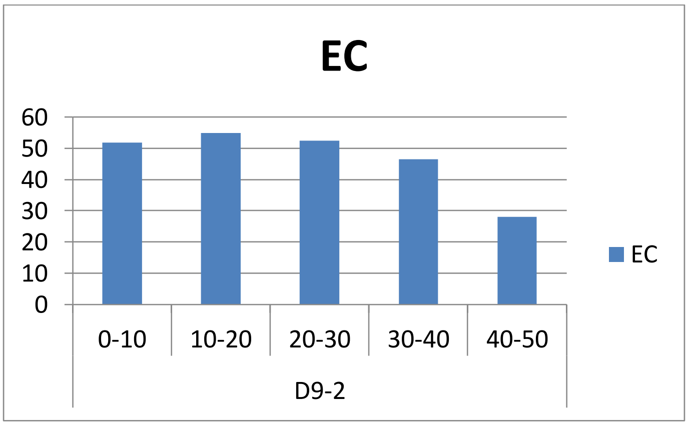
Site	Species	Life Form	Life Cycle	Abund

Site	Species	Life Form	Life Cycle	Abund
9-2	*Eucalyptus coolabah*	lb	v	2
9-2	*Santalum lanceolatum*	lb	b	T
9-2	*Duma florulenta*	s	f/v/do	3
9-2	*Senecio lanibracteus*	j	sd	1
9-2	*Portulaca intraterranea*	j	s/sp	2
9-2	*Tetragonia tetragonioides*	j	s	1
9-2	*Acacia stenophylla*	s	v	2
9-2	*Acacia salicina*	s	sd/d	2
9-2	*Alternanthera nodiflora*	j	s/sp	1
9-2	*Cucumis melo*	vi	s	3
9-2	*Boerhavia coccinea*	j	s/sp	1
9-2	*Urochloa praetervisa*	j	f	T
9-2	*Malva preissiana*	j	b/f	1
9-2	*Sonchus oleraceus*	j	b	T
9-2	*Enchylaena tomentosa var. glabra*	sd	v	1
9-2	*Senecio depressicola*	j	F	T
9-2	*Rutidosis helichrysoides ssp. helichrysoides*	j	f	1
9-2	*Enneapogon polyphyllus*	gl	f	T
9-2	*Enneapogon avenaceus*	gl	s	T
9-2	*Dysphania melanocarpa*	j	s/sp	T
9-2	*Trigonella suavissima*	gl	s	T
9-2	*Atriplex fissivalvis*	j	s	T
9-2	*Sclerolaena intricata*	j	s	T
9-2	*Einadia nutans ssp. eremaea*	j	v	T



Site Photo – Permanent Transect





Site 10 – Kuncherinna Wh – Cowarie

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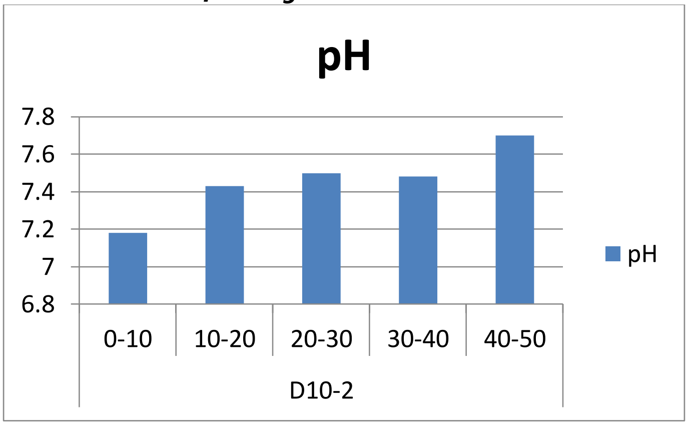
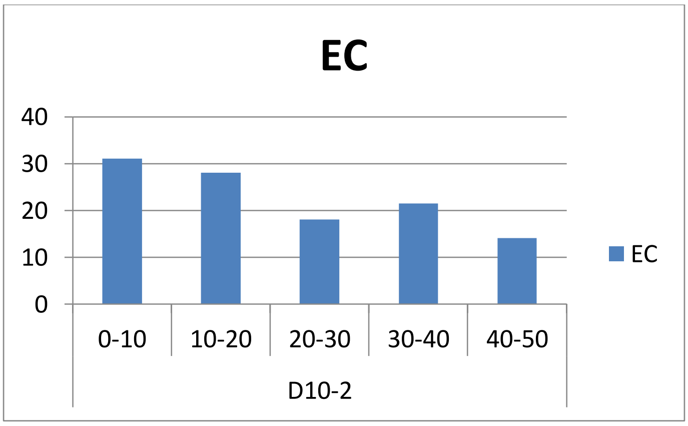
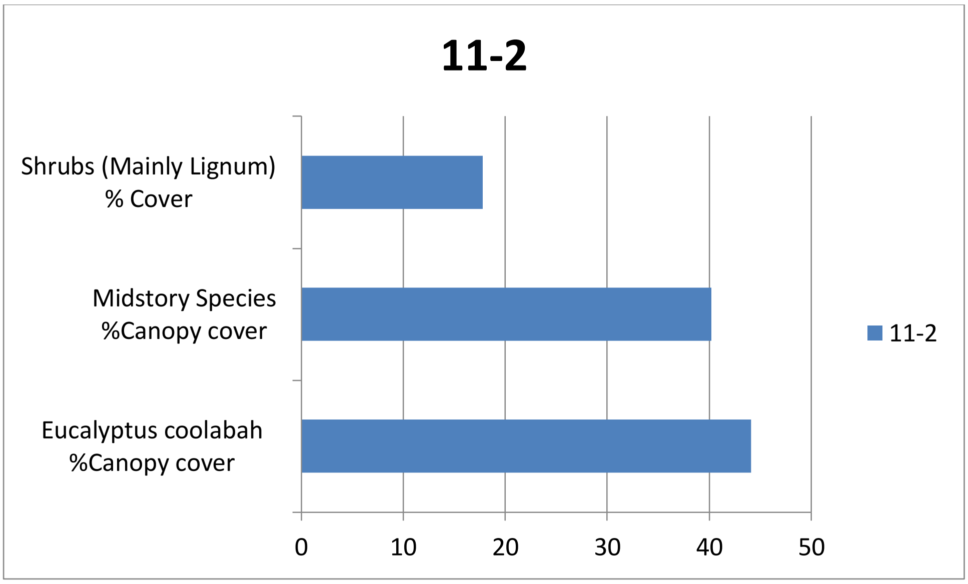




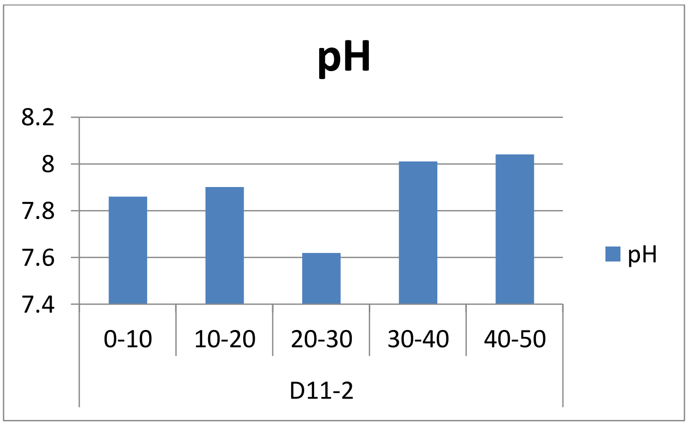
Site 11 – Stony Point Wh – Cowarie

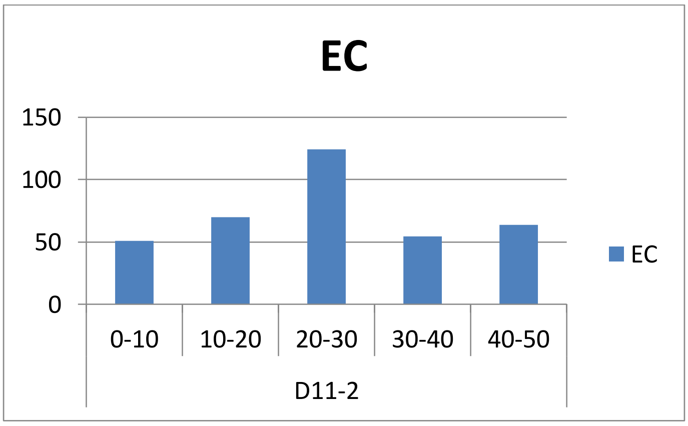
Site	Species	Life Form	Life Cycle	Abund
11-2	*Eucalyptus coolabah*	lb	v	3
11-2	*Acacia salicina*	s	v/f	2
11-2	*Acacia stenophylla*	s	v	T
11-2	*Enchylaena tomentosa var. glabra*	sd	s	2
11-2	*Duma florulenta*	sa	v	T
11-2	*Einadia nutans ssp. eremaea*	sd	v	T
11-2	*Nicotiana velutina*	j	f/s	1
11-2	*Tetragonia tetragonioides*	j	s	1
11-2	*Sonchus oleraceus*	j	b/t/s	1
11-2	*Boerhavia coccinea*	j	s/sp	2
11-2	*Zygophyllum ammophilum*	j	s	2
11-2	*Cucumis melo*	Vi	d/s	1
11-2	*Setaria jubiflora*	gl	f	T
11-2	*Zygophyllum howittii*	j	s	T
11-2	*Sida ammophila*	sd	v	T

Site	Species	Life Form	Life Cycle	Abund
11-2	*Sida cunninghamii*	sd	v	t
11-2	*Salsola australis*	j/sd	v	T
11-2	*Rhodanthe moschata*	j	f	1
11-2	*Polycalymma stuartii*	j	f	T
11-2	*Portulaca intraterranea*	j	f/s	T
11-2	*Dysphania melanocarpa*	j	f/s	1
11-2	*Triraphis mollis*	gl	f	1
11-2	*Paractaenum novae-hollandiae ssp. reversum*	gl	f	1
11-2	*Senecio depressicola*	j	f	T
11-2	*Othonna gregorii*	j	f	T
11-2	*Senecio lanibracteus*	j	sd	T
11-2	*Calotis hispidula*	j	s	T
11-2	*Tribulus eichlerianus*	j	s	T
11-2	*Trianthema triquetra*	j	s/sp	T
11-2	*Gnephosis eriocarpa*	j	b/f	T
11-2	*Enneapogon polyphyllus*	gl	s/sp	T
11-2	*Enneapogon avenaceus*	gl	f/s/sp	T
11-2	*Pterocaulon sphacelatum*	j	b/f	T
11-2	*Alternanthera nodiflora*	j	s/sp	T
11-2	*Phyllanthus lacunellus*	j	s	T
11-2	*Cullen australasicum*	j	b	T
11-2	*Sonchus oleraceus*	j	f	T
11-2	*Tragus australianus*	gl	f/s	T
11-2	*Arabidella procumbens*	j	f	T
11-2	*Cucumis argenteus*	vi	f	T



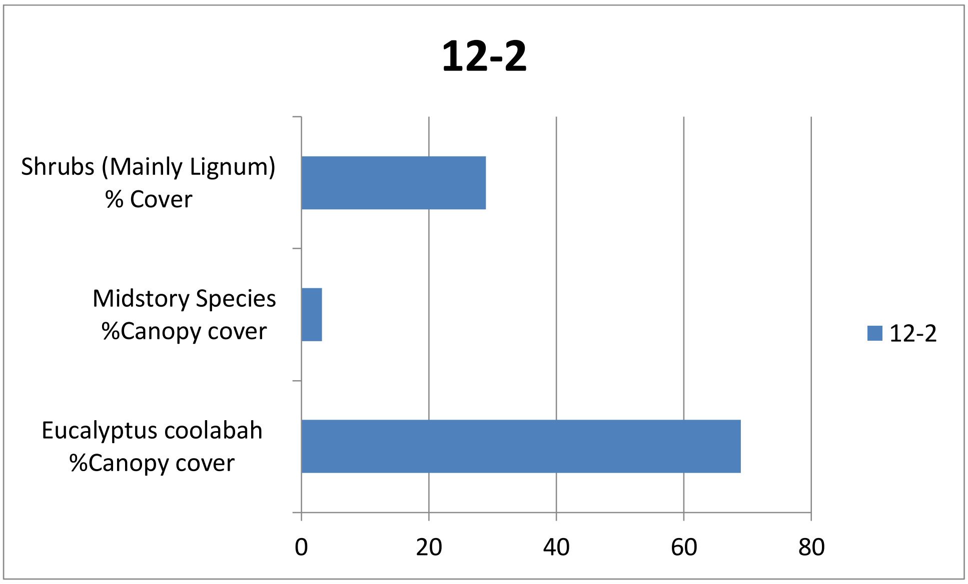
Site Photo – Permanent Transect



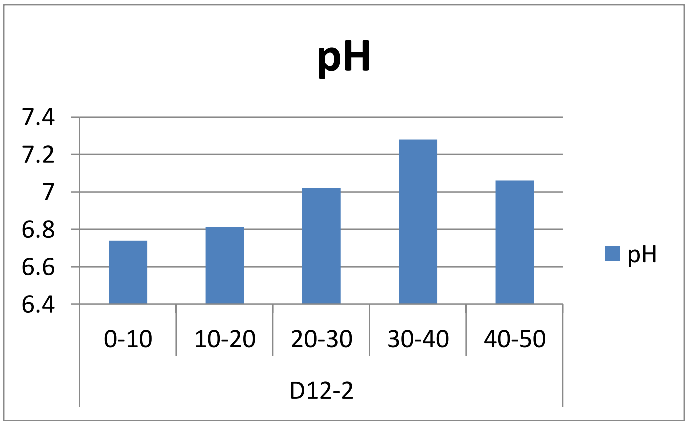


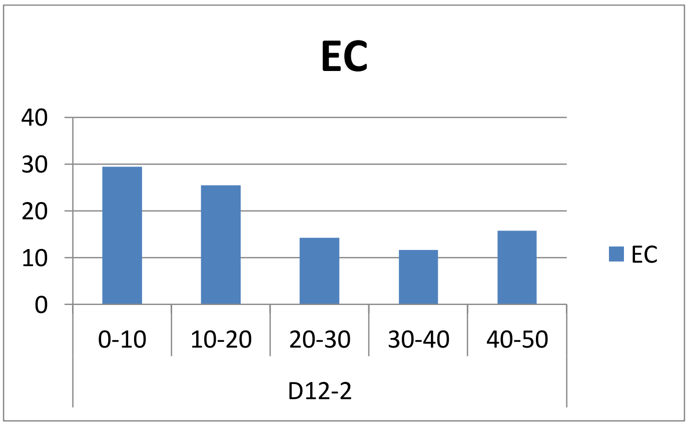
Site 12 – Stony Point Wh – Cowarie

Site	Species	Life Form	Life Cycle	Abund
12-2	*Eucalyptus coolabah*	lb	v	4
12-2	*Duma florulenta*	s	v	3
12-2	*Cucumis melo*	vi	f/s	1
12-2	*Boerhavia burbidgeana*	vi	s/sp	T
12-2	*Eriochloa pseudoacrotricha*	gl	v/s	1
12-2	*Alternanthera nodiflora*	j/sd	s/sp	R
12-2	*Phyllanthus lacunellus*	j	s	T
12-2	*Paractaenum novae-hollandiae ssp. reversum*	gl	b/s	1
12-2	*Enchylaena tomentosa var. glabra*	sd	sd	R
12-2	*Acacia salicina*	lb	f	R
12-2	*Nicotiana velutina*	j	f/s/sp	T
12-2	*Tetragonia tetragonioides*	j	s	T
12-2	*Trichodesma zeylanicum var. zeylanicum*	j	v	R
12-2	*Goodenia glauca*	j	sd	T



Site Photo – Permanent Transect





Site 13 – Poonarunna Wh – Kalamurina

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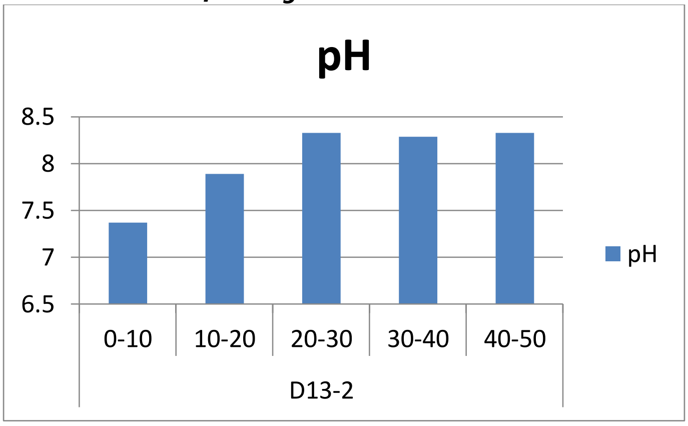
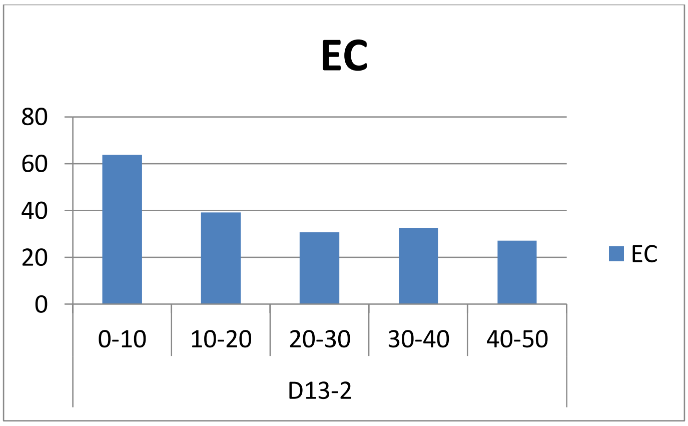
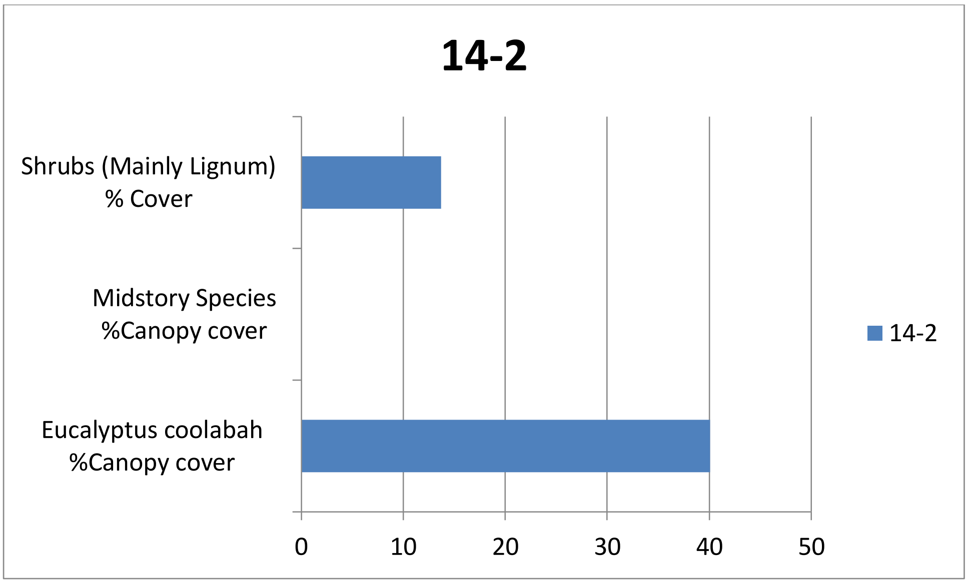




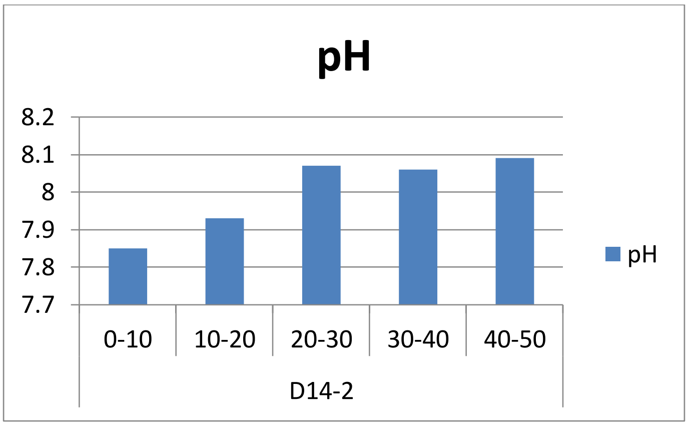
Site 14 – Wadlarkaninna Wh – Kalamurina

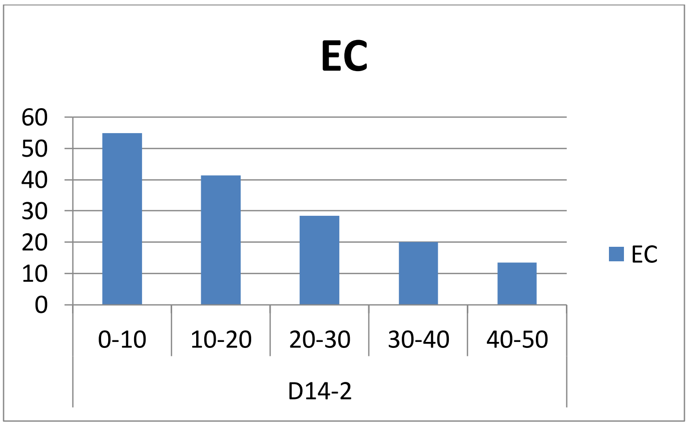
Site	Species	Life Form	Life Cycle
14-2	*Eucalyptus coolabah*	lf	Lc
14-2	*Duma florulenta*	sb	F
14-2	*Acacia salicina*	s	F
14-2	*Sphaeromorphaea littoralis*	j	F
14-2	*Glinus lotoides*	j	s/sp
14-2	*Phyllanthus lacunellus*	j	S
14-2	*Sclerolaena intricata*	j	S
14-2	*sclerolaena diacantha*	j/sd	S
14-2	*Trianthema triquetra*	j	D
14-2	*Portulaca intraterranea*	j	Sp
14-2	*Alternanthera nodiflora*	j	Sp
14-2	*Enchylaena tomentosa var. glabra*	sd	V
14-2	*Boerhavia burbidgeana*	j	f/s
14-2	*Heliotropium supinum*	j	f/s
14-2	*Stemodia florulenta*	j	F

Site	Species	Life Form	Life Cycle
14-2	*Lythrum wilsonii*	j	f
14-2	*Wahlenbergia tumidifructa*	j	F
14-2	*Polygonum plebeium*	j	F
14-2	*Einadia nutans ssp. eremaea*	sd	V
14-2	*Haloragis aspera*	j	S
14-2	*Atriplex velutinella*	j	S
14-2	*Tetragonia tetragonioides*	j	Sd
14-2	*Cucumis melo*	vi	f/s
14-2	*Teucrium racemosum*	sd	F
14-2	*Eragrostis dielsii var. dielsii*	gl	s/sp
14-2	*Aristida anthoxanthoides*	gl	s/sp
14-2	*Sauropus trachyspermus*	sd/j	S
14-2	*Aristida holathera var. holathera*	gl	D
14-2	*Rutidosis helichrysoides ssp. Helichrysoides*	j	sd/f
14-2	*Sclerolaena bicornis*	sd	S
14-2	*Atriplex pseudocampanulata*	j	S
14-2	*Atriplex leptocarpa*	j	S
14-2	*Dactyloctenium radulans*	gl	D



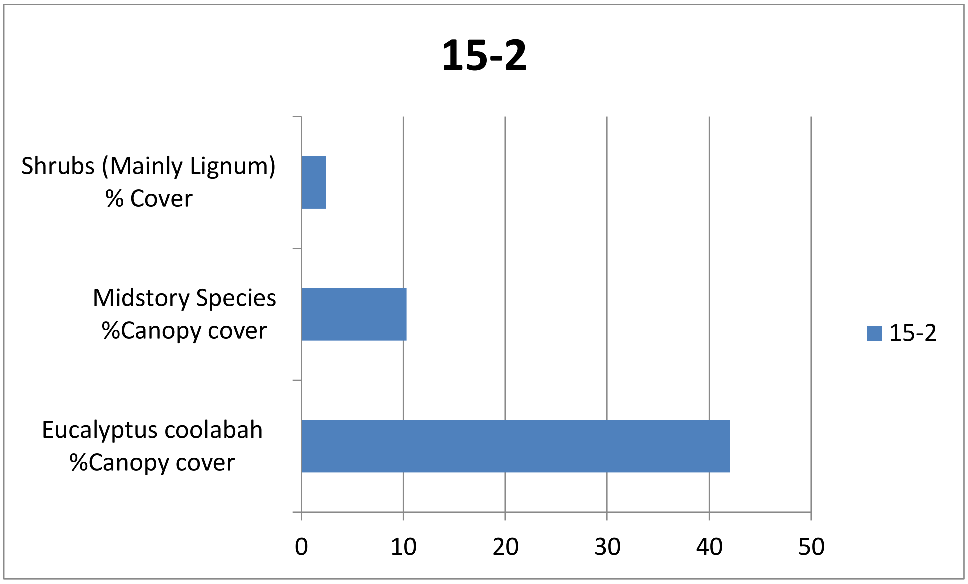
Site Photo – Permanent Transect



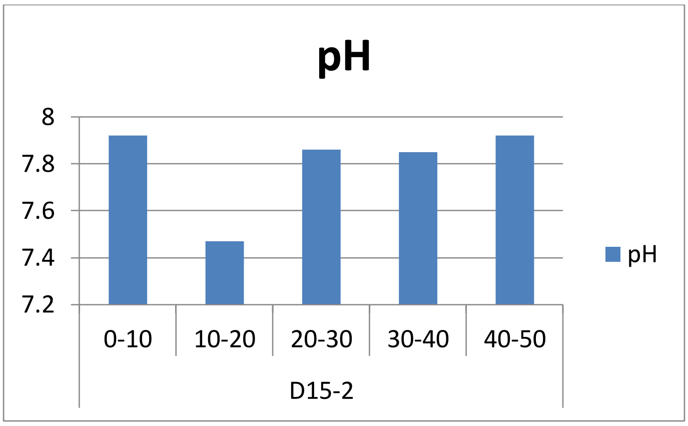


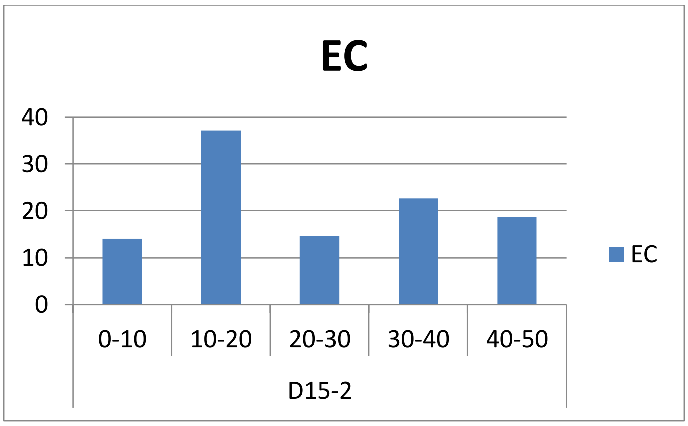
Site 15 – Yellow Wh – Kalamurina

Site	Species	Life Form	Life Cycle	Site
15-2	*Eucalyptus coolabah*	l	v	3
15-2	*Acacia salicina*	lb/s	b/f	2
15-2	*Duma florulenta*	sa/sb	s/sp	2
15-2	*Malva preissiana*	j	sd/f/s	T
15-2	*Tribulus eichlerianus*	j	f/s/sp	3
15-2	*Enchylaena tomentosa var. glabra*	sd	s	1
15-2	*Amaranthus grandiflorus*	j	s	1
15-2	*Portulaca intraterranea*	j	f/s/sp	1
15-2	*Paractaenum novae-hollandiae ssp. reversum*	gl	b	T
15-2	*Sida ammophila*	sd	b	T
15-2	*Trichodesma zeylanicum*	j	sp	T
15-2	*Boerhavia burbidgeana*	j	s/sp	2
15-2	*Sclerolaena diacantha*	sd	s	T
15-2	*Eriachne aristidea*	gl	sp	T
15-2	*Salsola australis*	j	d/s/sp	1
15-2	*Sida ammophila*	sd	s	T
15-2	*Triraphis mollis*	gl	sp	T
15-2	*Cucumis argenteus*	vi	f/s	1
15-2	*Nicotiana velutina*	j	sd/f	T
15-2	*Ipomoea polymorpha*	j	s	T
15-2	*Sauropus trachyspermus*	j	s	T
15-2	*Phyllanthus lacunellus*	j	s	T
15-2	*Aristida holathera var. holathera*	gl	s	T
15-2	*Euphorbia ferdinandi var. saxosiplaniticola*	j	s	T
15-2	*Euphorbia ferdinandi var. ferdinandi*	j	s	T



Site Photo – Permanent Transect

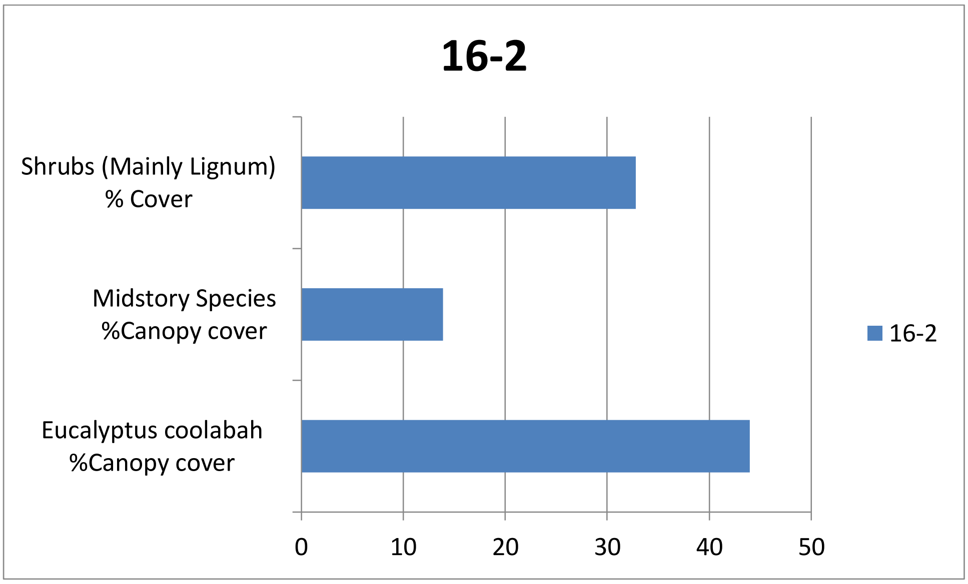




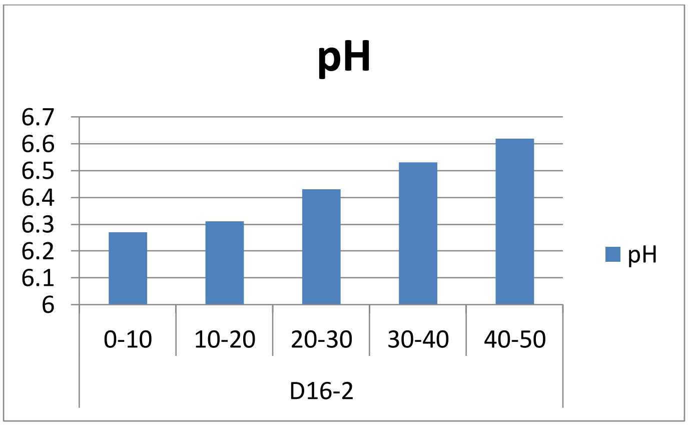
Site 16 – Tinnie Landing Wh – Kalamurina

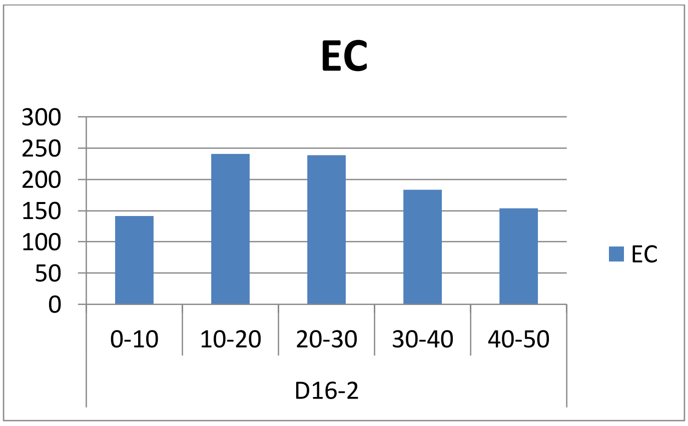
Site	**Species**	**Life Form**	**Life Cycle**	**Site**
16-2	*Eucalyptus coolabah*	lb/la	v	2
16-2	*Acacia salicina*	sa/lb	b/f	1
16-2	*Duma florulenta*	**s**	**v**	**3**
16-2	*Portulaca intraterranea*	j	sp	1
16-2	*Alternanthera nodiflora*	sd	sp	1
16-2	*Nicotiana velutina*	j	f/sp	1
16-2	*Rutidosis helichrysoides ssp. helichrysoides*	j	f/s	1
16-2	*Boerhavia burbidgeana*	j	s/sp	T
16-2	*Sphaeromorphaea littoralis*	j	f	T
16-2	*Trianthema triquetra*	j	sp/d	T
16-2	*Glinus lotoides*	j	sp/d	T
16-2	*Cyperus gymnocaulos*	vl	sp	T
16-2	*Goodenia glauca*	j	sp	T
16-2	*Stemodia florulenta*	j	f	T
16-2	*Cucumis melo*	vi	s	T
16-2	*Enchylaena tomentosa var. glabra*	sc	s	1
16-2	*Eriochloa crebra*	gl	sp	T
16-2	*Cullen australasicum*	j/sc	f	T

Site	Species	Life Form	Life Cycle	Site
16-2	*Eragrostis dielsii var. dielsii*	gl	s/sp	T
16-2	*Senecio lanibracteus*	j	sd/v	T
16-2	*Tetragonia tetragonioides*	j	s	T
16-2	*Teucrium racemosum*	j	f/s/sp	T
16-2	*Haloragis aspera*	j	s/sp	T
16-2	*Einadia nutans ssp. eremaea*	vi	s/sp	T
16-2	*Malva preissiana*	j	f/s/sp/d	T
16-2	*Pterocaulon sphacelatum*	j	v	T
16-2	*Sporobolus mitchellii*	gl	v	T
16-2	*Phyllanthus lacunellus*	j	s	T



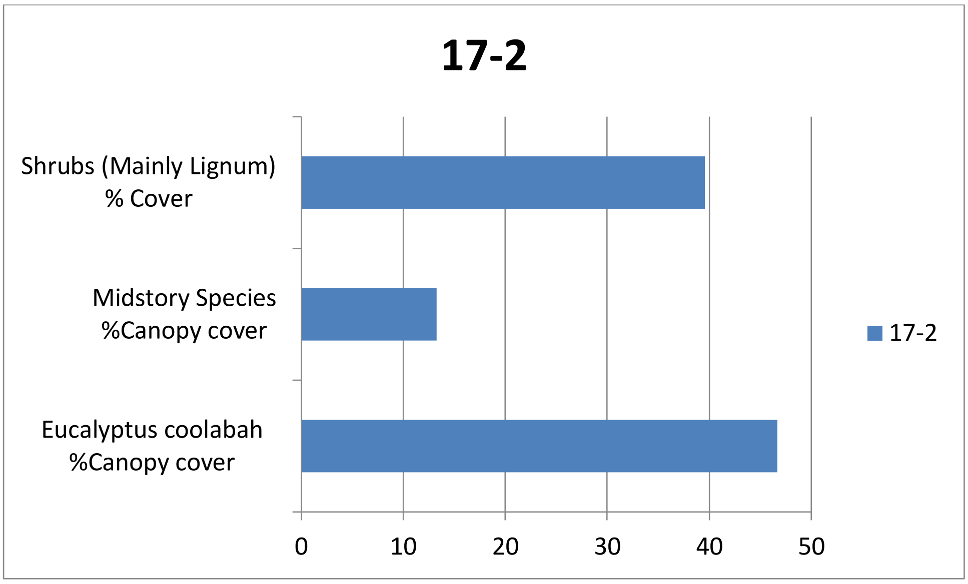
Site Photo – Permanent Transect



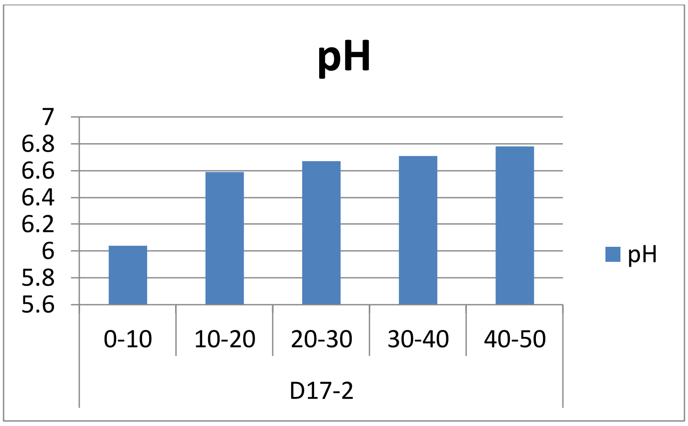


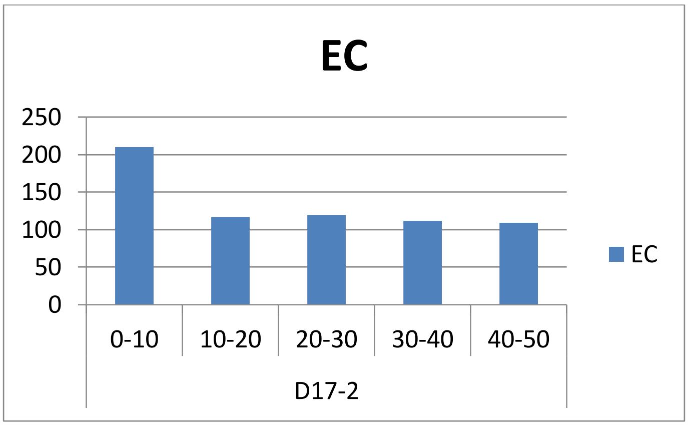
Site 17 – Mia Mia Wh – Kalamurina

Site	Species	Life Form	Life Cycle	Site
17-2	*Eucalyptus coolabah*	la/lb	v	3
17-2	*Acacia salicina*	s/lb	v/b/f	2
17-2	*Duma florulenta*	s	v	3
17-2	*Malva preissiana*	j	b/f/s/sp	1
17-2	*Tetragonia tetragonioides*	j	s	1
17-2	*Alternanthera nodiflora*	j	s/sp	2
17-2	*Boerhavia burbidgeana*	j	f/s/sp	2
17-2	*Eriochloa pseudoacrotricha*	gl	sp	T
17-2	*Goodenia glauca*	j	v/f/s/sp	1
17-2	*Solanum nigrum*	j	f/s/sp	1
17-2	*Sphaeromorphaea littoralis*	j	f	T
17-2	*Marsilea drummondii*	X	v/sp	1
17-2	*Senecio lanibracteus*	j	sd	T
17-2	*Pterocaulon sphacelatum*	j	v	T
17-2	*Glinus lotoides*	j	b/s/sp	T
17-2	*Cucumis melo*	vi	f/s	2
17-2	*Nicotiana velutina*	j	b/f	T
17-2	*Portulaca intraterranea*	j	s/sp	1
17-2	*Stemodia florulenta*	j	v	t
17-2	*Sporobolus mitchellii*	gl	v/sp	2
17-2	*Eragrostis dielsii var. dielsii*	gl	f	T
17-2	*Dysphania glomulifera ssp. eremaea*	j	sp	T
17-2	*Cyperus gymnocaulos*	vl	sp	T
17-2	*Lotus cruentus*	j	s	T
17-2	*Cullen australasicum*	j	sd	R
17-2	*Rutidosis helichrysoides ssp. helichrysoides*	j	f	T
17-2	*Atriplex leptocarpa*	j	s	T
17-2	*Wahlenbergia tumidifructa*	j	f	T



Site Photo – Permanent Transect

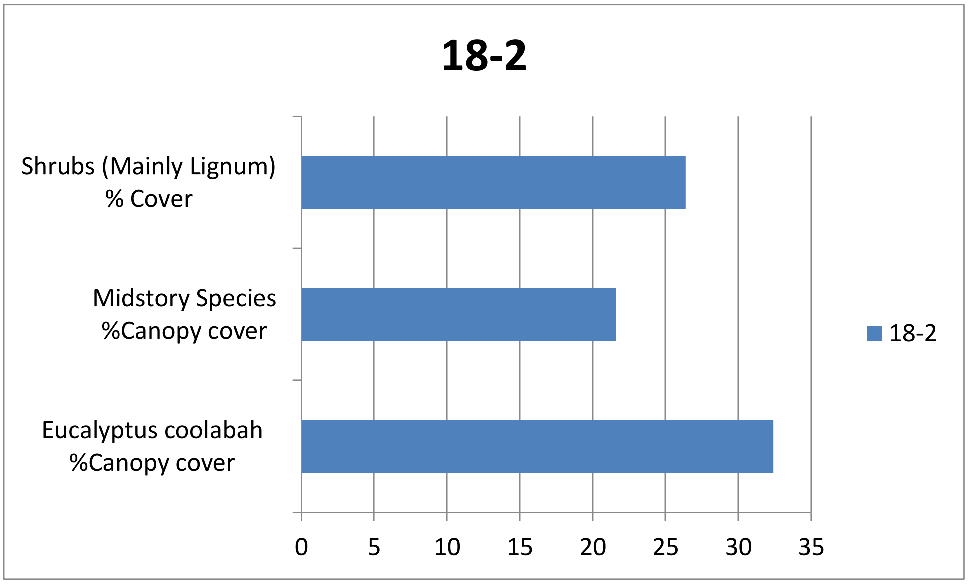




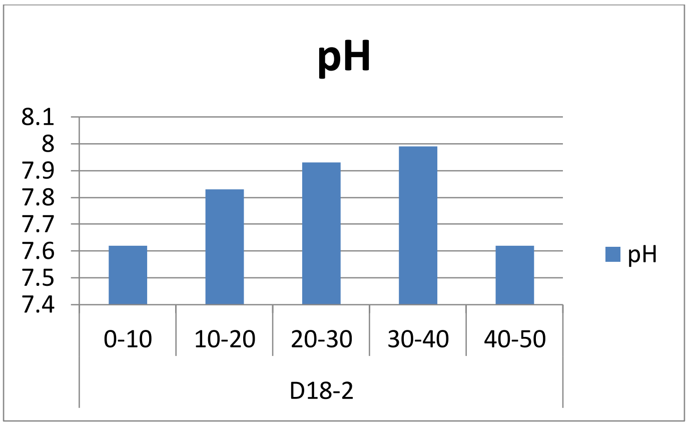
Site 18 – Mona Downs Wh – Cowarie

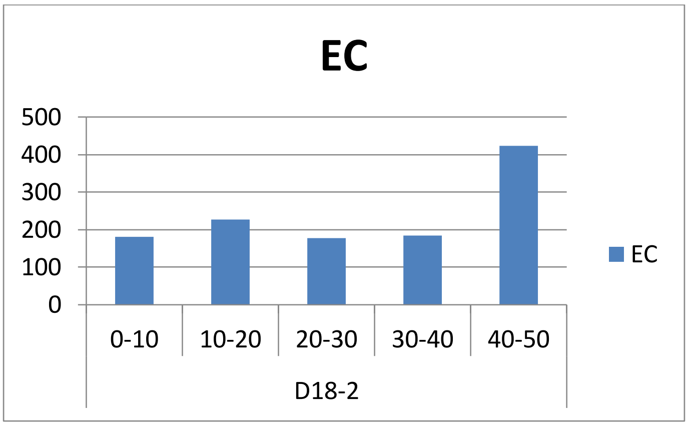
Site	Species	Life Form	Life Cycle	Site
18-2	*Eucalyptus coolabah*	lb	v/s	2
18-2	*Acacia salicina*	lb/s	v	3
18-2	*Acacia stenophylla*	lb/s	v/s	1
18-2	*Enchylaena tomentosa var. glabra*	sd	v	T
18-2	*Citrullus lanatus*	vi	f	R
18-2	*Teucrium racemosum*	sd	f/v	T
18-2	*Sclerolaena intricata*	j	s	T
18-2	*Boerhavia burbidgeana*	j	s/sp	1
18-2	*Sclerolaena diacantha*	j	s	T
18-2	*Atriplex pseudocampanulata*	j	s	T
18-2	*Haloragis aspera*	j	v	T
18-2	*Alternanthera nodiflora*	j	s/sp	T
18-2	*Salsola australis*	sd	s	T
18-2	*Duma florulenta*	s	v/s/sp	2
18-2	*Sclerolaena bicornis*	j	s	T
18-2	*Einadia nutans ssp. eremaea*	j	sd	R
18-2	*Glinus lotoides*	j	s/sp	T
18-2	*Malva preissiana*	j	sd	T

Site	Species	Life Form	Life Cycle	Site
18-2	*Santalum lanceolatum*	s	v	R
18-2	*Cullen sp*	j	sd	R



Site Photo – Permanent Transect

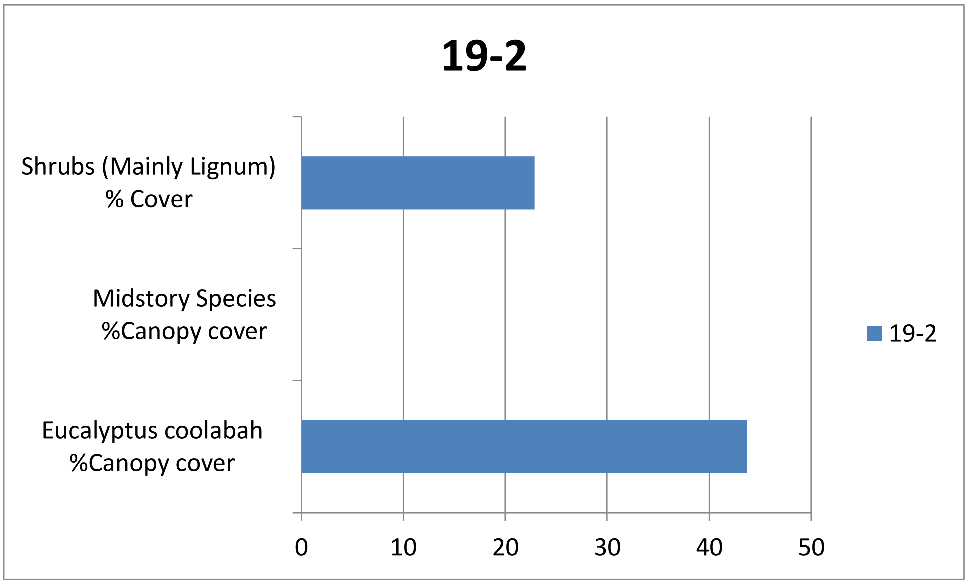




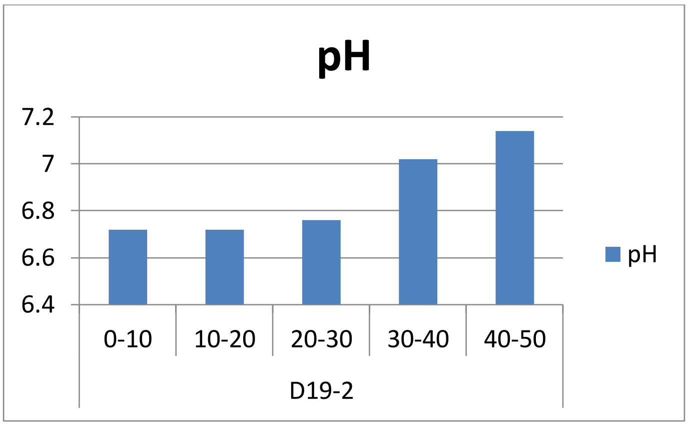
Site 19 – Yelpawaralinna Wh – Clifton Hills

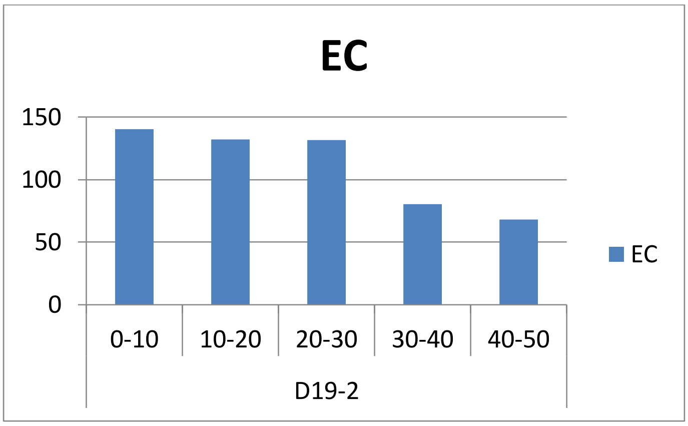
Site	Species	Life Form	Life Cycle	Site
19-2	*Eucalyptus coolabah*	lb	v/s/sp	3
19-2	*Santalum lanceolatum*	lb	v	1
19-2	*Duma florulenta*	s	v	2
19-2	*Chenopodium auricomum*	sb	f	T
19-2	*Sclerolaena intricata*	j	s	1
19-2	*Salsola australis*	j	s	1
19-2	*Boerhavia burbidgeana*	j	sp/d	1
19-2	*Zeylia galericulata*	j	s	T
19-2	*Zygophyllum ammophilum*	j	s	T
19-2	*Urochloa praetervisa*	gl	sp	T
19-2	*Amaranthus mitchellii*	j	sp	T
19-2	*Crinum flaccidum*	j	v	T
19-2	*Enchylaena tomentosa var. glabra*	sd	v/s	1
19-2	*Cucumis melo*	vi	f/s/sp	T
19-2	*Abutilon sp*	j	sd	T
19-2	*Acacia stenophylla*	lb	v	T

Site	Species	Life Form	Life Cycle	Site
19-2	*Trianthema triquetra*	j	sp/d	T
19-2	*Sclerolaena bicornis*	j	s	T
19-2	*Enneapogon avenaceus*	gl	sp	T



Site Photo – Permanent Transect

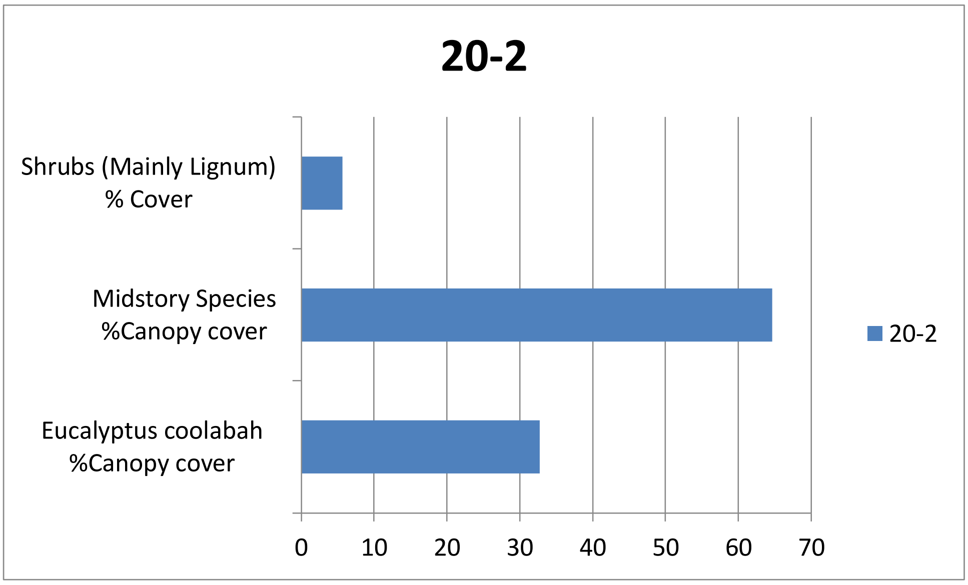




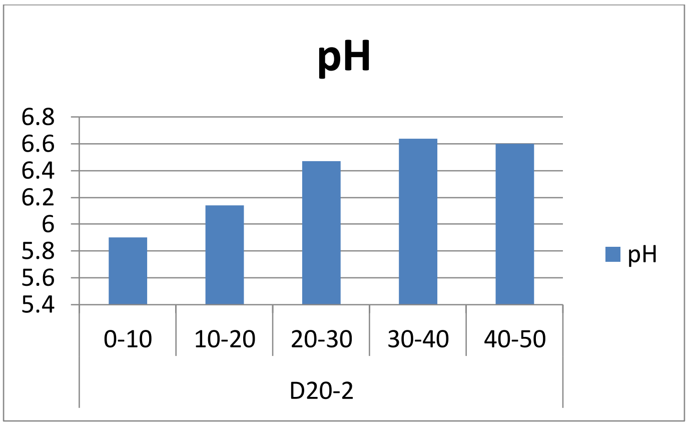
Site 20 – Double Bluff Wh – Pandie Pandie

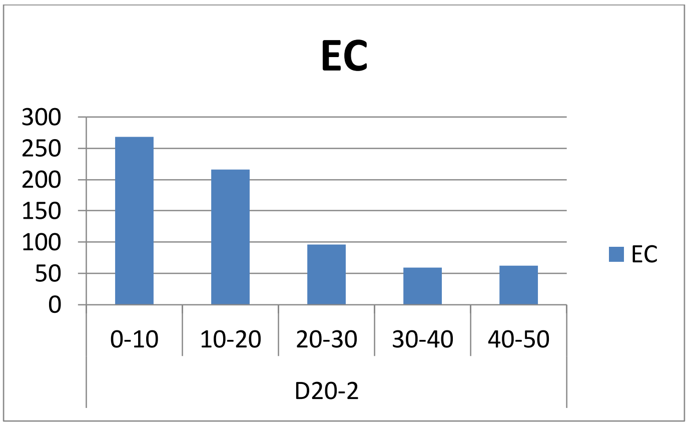
Site	Species	Life Form	Life Cycle	Site
20-2	*Eucalyptus coolabah*	lb	v/sp	4
20-2	*Bauhinia gilva*	lb	v/s	2
20-2	*Eremophila bignoniiflora*	s	v	T
20-2	*Acacia salicina*	s/lb	v/b/f	2
20-2	*Duma florulenta*	s	v	T
20-2	*Tetragonia tetragonioides*	j	sd	T
20-2	*Eriochloa pseudoacrotricha*	gl	sp	T
20-2	*Enchylaena tomentosa var. glabra*	sd	v	T
20-2	*Cucumis melo*	vi	f/s	T
20-2	*Amaranthus mitchellii*	j	sp	T
20-2	*Sauropus trachyspermus*	j	s	T
20-2	*Boerhavia burbidgeana*	j	s/sp	T
20-2	*Ipomoea polymorpha*	j	s/sp	T
20-2	*Datura leichhardtii*	j	f/s	T
20-2	*Portulaca oleracea*	j	sp	T
20-2	*Atalaya hemiglauca*	lb	sd	2

Site	Species	Life Form	Life Cycle	Site
20-2	*Lysiana subfalcata*	mi	s/sp	T
20-2	*Santalum lanceolatum*	lb	b/f	T
20-2	*Urochloa praetervisa*	gl	s/sp	T



Site Photo – Permanent Transect

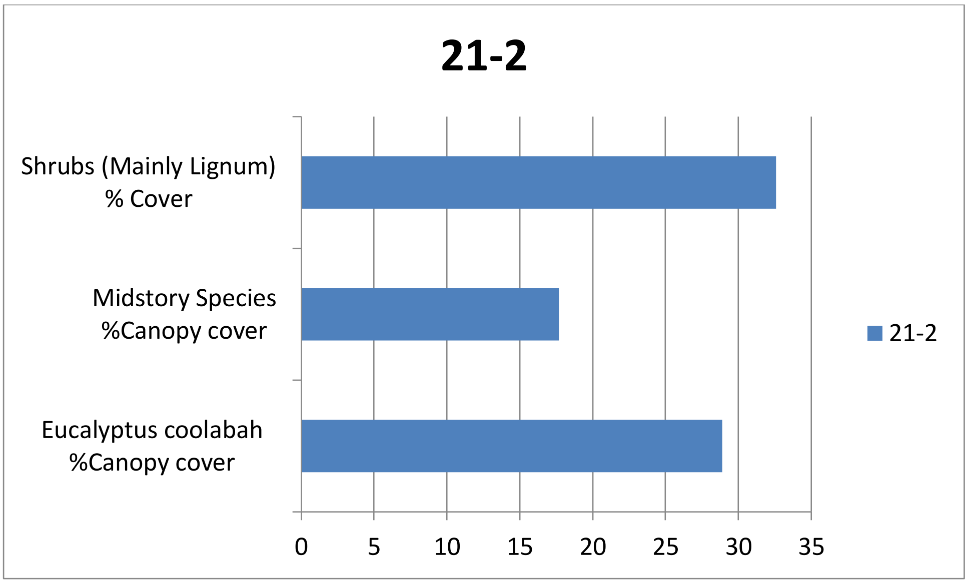




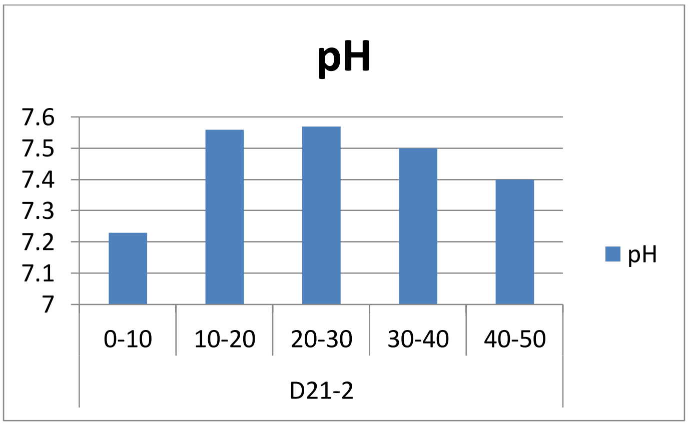
Site 21 – Burt's Wh – Clifton Hills

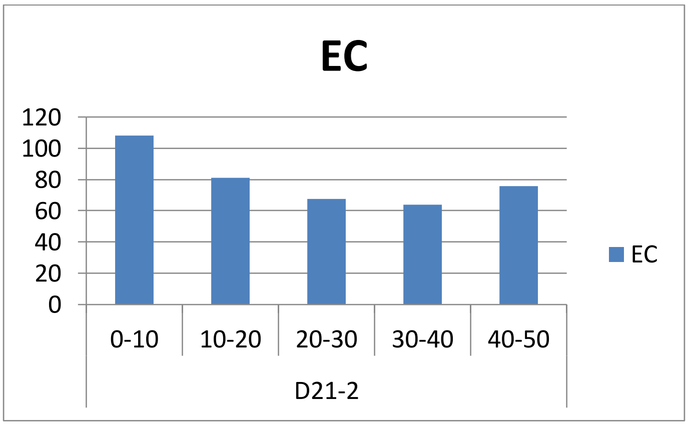
Site	Species	Life Form	Life Cycle	Site
21-2	*Eucalyptus coolabah*	lb	sp	2
21-2	*Acacia stenophylla*	s	v	2
21-2	*Duma florulenta*	sa	f	2
21-2	*Senecio depressicola*	j	f/s/sp	2
21-2	*Trigonella suavissima*	j	b/f	3
21-2	*Marsilea drummondii*	x	v/s	1
21-2	*Alternanthera nodiflora*	j	f	1
21-2	*Centipeda cunninghammii*	j	f	1
21-2	*Centipeda thespidiodes*	j	f	1
21-2	*Elacholoma prostrata*	j	f	T
21-2	*Chenopodium auricomum*	sb	f	1
21-2	*Cullen cinereum*	j	b/f	1
21-2	*Pycnosorus melleus*	j	b/f	T
21-2	*Urochloa praetervisa*	gt	f/s	T
21-2	*Rumex crystallinus*	j	v	R
21-2	*Ammannia multiflora*	j	f	1
21-2	*Pseudognaphalium luteoalbum*	j	sd/f	1
21-2	*Nicotiana velutina*	j	f	R

Site	Species	Life Form	Life Cycle	Site
21-2	*Eremophila bignoniiflora*	s	f	R
21-2	*Senecio lanibracteus*	j	sd/v	T
21-2	*Teucrium racemosum*	j	v	R
21-2	*Pterocaulon sphacelatum*	j	sd/v	T
21-2	*Portulaca intraterranea*	j	s	1
21-2	*Triglochin isingiana*	j	s/sp	1
21-2	*Wahlenbergia communis*	j	b/f/s/sp	1
21-2	*Gnephosis eriocarpa*	j	f	1
21-2	*Lepidium papillosum*	j	f/s	T
21-2	*Atriplex velutinella*	j	f	T
21-2	*Calocephalus platycephalus*	j	b/f	1
21-2	*Eragrostis leptocarpa*	gl	f	T
21-2	*Eragrostis setifolia*	gl	f	T
21-2	*Dactyloctenium radulans*	gl	f	T
21-2	*Calotis hispidula*	j	f/s	1
21-2	*Solanum esuriale*	j/sd	s	T
21-2	*Tetragonia tetragonioides*	j	s	T
21-2	*Calotis ancyrocarpa*	j	f	T



Site Photo – Permanent Transect





14 Appendix F

14.1 Permanent Sites - Soil Data Total C (Wt. %) Total N (Wt. %) pH, EC (µs/cm)

Site	Depth (cms)	EC	pH
D1-2	0-10	134.10	7.08
	10-20	104.80	7.18
	20-30	130.5	7.58
	30-40	192.4	7.68
	40-50	175.6	7.53
D2-2	0-10	122.7	7.83
	10-20	231.6	8.53
	20-30	318.3	8.83
	30-40	272.4	9.06
	40-50	352.0	9.27
D3-2	0-10	159.0	6.64
	10-20	56.1	6.94
	20-30	24.42	7.12
	30-40	15.04	7.43
	40-50	10.95	7.63
D4-2	0-10	128.4	8.46
	10-20	136.8	8.64
	20-30	121.0	8.54
	30-40	93.3	8.27
	40-50	53.6	8.35
D5-2	0-10	38.0	7.77
	10-20	42.8	7.6
	20-30	39.3	7.51
	30-40	32.9	7.46
	40-50	32.9	7.58
D6-2	0-10	109.5	9.04
	10-20	136.4	9.04
	20-30	150.9	9.08
	30-40	148.0	8.98
	40-50	207.1	8.87
D7-2	0-10	202.1	8.05
	10-20	134.8	7.93
	20-30	57.2	8.04
	30-40	101.1	7.86

Site	Av C Total C (Wt. %)	Av N Total N (Wt. %)
1-1	0.85	0.06
1-2	0.54	0.04
1-3	1.48	0.11
2-1	0.51	0.03
2-2	0.19	0.01
2-3	0.77	0.05
3-1	0.69	0.05
3-2	4.11	0.36
3-3	0.11	0.01
4-1	2.26	0.15
4-2	2.60	0.17
4-3	2.14	0.15
5-1	0.31	0.02
5-2	0.87	0.07
5-3	1.55	0.18
6-1	5.69	0.37
6-2	1.72	0.11
6-3	0.93	0.07
7-1	0.57	0.58
7-2	1.14	0.08
7-3	2.46	0.17
8-1	0.63	0.05
8-2	0.51	0.04
8-3	2.55	0.18
9-1	2.60	0.18
9-2	0.84	0.08
9-3	1.39	0.11
10-1	0.95	0.08
10-2	0.66	0.06
10-3	0.69	0.06
11-1	1.74	0.12
11-2	1.49	0.12

	40-50	107.3	7.81
D8-2	0-10	19.32	5.34
	10-20	22.08	6.51
	20-30	18.84	6.67
	30-40	16.66	6.9
	40-50	16.01	7.24
D9-2	0-10	51.9	5.32
	10-20	55.0	6.51
	20-30	52.5	6.67
	30-40	46.5	6.9
	40-50	28.09	7.24
D10-2	0-10	31.05	7.18
	10-20	28.14	7.43
	20-30	18.14	7.5
	30-40	21.59	7.48
	40-50	14.19	7.7
D11-2	0-10	50.9	7.86
	10-20	69.6	7.9
	20-30	124.3	7.62
	30-40	54.3	8.01
	40-50	63.7	8.04
D12-2	0-10	29.4	6.74
	10-20	25.47	6.81
	20-30	14.24	7.02
	30-40	11.64	7.28
	40-50	15.81	7.06
D13-2	0-10	63.7	7.37
	10-20	39.2	7.89
	20-30	30.81	8.33
	30-40	32.57	8.29
	40-50	27.25	8.33
D14-2	0-10	54.9	7.85
	10-20	41.4	7.93
	20-30	28.46	8.07
	30-40	20.04	8.06
	40-50	13.55	8.09
D15-2	0-10	13.98	7.92
	10-20	37.2	7.47
	20-30	14.66	7.86

11-3	1.47	0.11
12-1	0.48	0.04
12-2	1.04	0.08
12-3	0.66	0.05
13-1	0.43	0.04
13-2	0.65	0.05
13-3	1.68	0.12
14-1	0.27	0.02
14-2	0.70	0.06
14-3	0.53	0.04
15-1	0.45	0.04
15-2	0.14	0.01
15-3	0.20	0.02
16-2	0.47	0.04
17-2	0.75	0.05
18-2	1.80	0.12
19-2	1.62	0.12
20-2	5.15	0.33
21-2	0.63	0.06

	30-40	22.72	7.85
	40-50	18.68	7.92
D16-2	0-10	141.7	6.27
	10-20	240.7	6.31
	20-30	238.7	6.43
	30-40	183.9	6.53
	40-50	153.4	6.62
D17-2	0-10	210.4	6.04
	10-20	117.2	6.59
	20-30	119.5	6.67
	30-40	112	6.71
	40-50	109.4	6.78
D18-2	0-10	180.9	7.62
	10-20	226.7	7.83
	20-30	177.1	7.93
	30-40	184.3	7.99
	40-50	423	7.62
D19-2	0-10	140.4	6.72
	10-20	132.2	6.72
	20-30	131.4	6.76
	30-40	80.4	7.02
	40-50	68.1	7.14
D20-2	0-10	268.2	5.9
	10-20	215.8	6.14
	20-30	96.1	6.47
	30-40	59.2	6.64
	40-50	62	6.6
D21-2	0-10	108	7.23
	10-20	81.1	7.56
	20-30	67.5	7.57
	30-40	63.9	7.5
	40-50	75.6	7.4

15 Appendix G

15.1 E G Millard 1886 – Florisitc List

15.2 Dr Thos. L. Bancroft C.1891 – Floristic List

1. E G Millard 1886

Order	Species
CRUCIFERAE	*Sisymbrium cardaminoides*
CRUCIFERAE	*Erysimum lasiocarpum*
CRUCIFERAE	*Erysimum blennodia*
CRUCIFERAE	*Lepidium monoplocoides*
MALVACEAE	*Sida corrigata*
MALVACEAE	*Abutilon Fraseri*
EUPHORBIACEAE	*Euphorbia Drummondi*
EUPHORBIACEAE	*Phyllanthus lacunarius*
ZYGOPHYLLACEAE	*Zygophyllum ammophilum*
ZYGOPHYLLACEAE	*Zygophylum Howittii*
ZYGOPHYLLACEAE	*Nitraria Schoeberi*
PORTULACACEAE	*Claytonia Balonnensis*
AMARANTACEAE	*Euxolus Mitchellii*
AMARANTACEAE	*Ptilotus latifolius*
AMARANTACEAE	*Ptilotus incanus*
AMARANTACEAE	*Alternanthera triandra*
CHENOPDIACEAE	*Chenopdium auricomum*
CHENOPDIACEAE	*Atriplex leptocarpum*
CHENOPDIACEAE	*Bassia diacantha*
CHENOPDIACEAE	*Bassia quinquecuspis*
FICIODEAE	*Tetragonia expansa*
FICIODEAE	*Aizoon quadrifidum*
LEGUMINOSAE	*Psoralea patens*
LEGUMINOSAE	*Indigofera hirsuta*
LEGUMINOSAE	*Swainsonia phacoides*
LEGUMINOSAE	*Cassia eremophila*
HALORAGEAE	*Haloragis ceratophylla*
RUBIACEAE	*Oldenlandia tillaeacea*
COMPOSITAE	*Minuria integerrima*
COMPOSITAE	*Calotis lappulacea*
COMPOSITAE	*Calotis hispidula*
COMPOSITAE	*Epatles Cunninghami*

Order	Species
COMPOSITAE	*Gnephosis eriocarpa*
COMPOSITAE	*Rutidosis helichrysoides*
COMPOSITAE	*Helipterum strictum*
COMPOSITAE	*Helipterum moschatum*
COMPOSITAE	*Helipterum incanum*
COMPOSITAE	*Senecio Gregori*
COMPOSITAE	*Senecio brachyglossus*
COMPOSITAE	*Senecio Cunninghami*
CAMPANULACEAE	*Wahlenbergia gracilis*
GOODENOVIEAE	*Goodenia glauca*
GOODENOVIEAE	*Goodenia cycloptera*
GOODENOVIEAE	*Goodenia microptera*
GOODENOVIEAE	*Scaevola collaris*
PLANTAGINEAE	*Plantago varia*
SOLONACEAE	*Solanum orbiculatum*
SOLONACEAE	*Nicotiana suaveolens*
SCROPHULARICEAE	*Stemodia Morgania*
BORAGINEAE	*Heliotropium Curassavicum*
LABIATAE	*Teucrium racemosum*
VERBENACEAE	*Verbena macrostachya*
LILIACEAE	*Bulbine semibarbata*
NAIADEAE	*Triglochin centrocarpa*
CYPERACEAE	*Fimbristylis ferruginea*
CYPERACEAE	*Fimbristylis velata*
GRAMINEAE	*Lappago racemosa*
GRAMINEAE	*Aristida arenaria*
GRAMINEAE	*Pappophorum commune*
	59 Taxa

2. Dr Thos. L. Bancroft C.1891

Species
Capparis spinosa var. nummularia
C. Mitchelli
Portulaca oleraceae
Tribulus occidentalis
Psoralea patens
Tephrosia rosea

Species
Sesbania aculeata
Cassia sturtii
Acacia peuce
A. aneura
A. hakeoides
Bauhinia carroni
Eucalyptus bicolor
Ammania muliflora
Gnaphalium luteo-album
Sarcostemma australe
Solanum oligacanthum
S. esuriale
Lycium
Nicotiana suaveolens
Eremophila polyclada
Loranthus exocarpi
Euphorbia drummondii
E. eremophila
E. serrata
Gramineae x 30spp.
Sporobolus virginicus var. pallida
Marsilea drummondii
Chenopodiaceae x 17spp.
Chenopodium auricomum
Atriplex nummularia
A. vesicaria
Kochia brevifolia
Approx. 73 taxa

16 Appendix H

16.1 Goyder Lagoon Survey floristic list

Abutilon oxycarpum (F.Muell.) Benth. var. oxycarpum
Acacia oswaldii F.Muell.
Acacia victoriae subsp. arida Pedley
Alternanthera denticulata R.Br.
Alternanthera nodiflora R.Br.
Amaranthus mitchellii Benth.
Amyema preissii (Miq.) Tiegh.
Anemocarpa podolepidium (F.Muell.) Paul G.Wilson
Aristida anthoxanthoides (Domin) Henrard
Astrebla pectinata (Lindl.)F.Muell.
Atalaya hemiglauca (F.Muell.) F.Muell. ex Benth.
Atriplex angulata Benth.
Atriplex crassipes J.M.Black var. crassipes
Atriplex limbata Benth.
Atriplex lindleyi subsp. conduplicata (F.Muell.) Paul G.Wilson
Atriplex nummularia Lindl. subsp. nummularia
Atriplex sp.
Atriplex spongiosa F.Muell.
Atriplex velutinella F.Muell.
Boerhavia dominii Meikle & Hewson
Brachyscome sp.
Bulbine alata Baijnath
Calandrinia sp.
Calocephalus platycephalus (F.Muell.) Benth.
Calotis hispidula (F.Muell.) F.Muell.
Calotis sp.
Centipeda cunninghamii (DC.) A.Braun & Asch.
Chenopodium auricomum Lindl.
Chloris pectinata Benth.
Citrullus lanatus (Thunb.) Matsum. & Nakai
Craspedia sp.
Cullen australasicum (Schltdl.) J.W.Grimes
Cullen pallidum (Burb.) J.W.Grimes
Cynanchum floribundum R.Br.
Dentella pulvinata Airy Shaw

Digitaria coenicola (F.Muell.) Hughes
Diplatia grandibractea (F.Muell.) Tiegh.
Dissocarpus biflorus (R.Br.) F.Muell. var. biflorus
Duma florulenta (Meisn.) T.M.Schust.
Dysphania melanocarpa (J.M.Black)Mosyakin & Clemants f. melanocarpa
Einadia nutans subsp. eremaea Paul G.Wilson
Enchylaena tomentosa var. glabra
Eremophila bignoniiflora (Benth.) F.Muell.
Eriachne aristidea F.Muell.
Eriochiton sclerolaenoides (F.Muell.) A.J.Scott
Ethuliopsis cunninghamii (Hook.) F.Muell.
Eucalyptus coolabah Blakely & Jacobs
Frankenia serpyllifolia Lindl.
Glinus lotoides L.
Glycine canescens F.J.Herm.
Gnephosis arachnoidea Turcz.
Goodenia cycloptera R.Br.
Goodenia fascicularis F.Muell. & Tate
Haloragis aspera Lindl.
Leiocarpa leptolepis (DC.) Paul G.Wilson
Lepidium sp.
Lysiana exocarpi (Behr) Tiegh. subsp. exocarpi
Maireana aphylla (R.Br.) Paul G.Wilson
Maireana appressa (Benth.) Paul G.Wilson
Maireana ciliata (F.Muell.) Paul G.Wilson
Maireana coronata (J.M.Black) Paul G.Wilson
Maireana georgei (Diels) Paul G.Wilson
Maireana microcarpa (Benth.) Paul G.Wilson
Malvastrum americanum (L.) Torr. var. americanum
Marsilea drummondii A.Braun
Minuria rigida J.M.Black
Nicotiana velutina H.-M.Wheeler
Osteocarpum acropterum var. acropterum
Pimelea trichostachya Lindl.
Plantae sp.
Polygonum plebeium R.Br.
Portulaca intraterranea J.M.Black
Portulaca oleracea L.
Pterocaulon sphacelatum (Labill.) F.Muell.

Pycnosorus pleiocephalus (F.Muell.) J.Everett & Doust
Rutidosis helichrysoides DC. subsp. helichrysoides
Salsola australis L.
Sauropus trachyspermus (F.Muell.) Airy Shaw
Scaevola parvibarbata Carolin
Sclerolaena brachyptera (F.Muell.) S.W.L.Jacobs
Sclerolaena glabra (F.Muell.) Domin
Sclerolaena lanicuspis (F.Muell.) F.Muell. ex Benth.
Senecio lanibracteus I.Thomps.
Senecio pinnatifolius A.Rich.
Senna artemisioides subsp. filifolia Randell
Sesbania cannabina (Retz.)Poir. var. cannabina
Sida ammophila F.Muell. ex J.H.Willis
Sida cunninghamii C.T.White
Sida fibulifera Lindl.
Sida sp.
Sida trichopoda F.Muell.
Solanum ellipticum R.Br.
Solanum esuriale Lindl.
Solanum oligacanthum F.Muell.
Sphaeranthus indicus L.
Sphaeromorphaea littoralis (Retz.)A.R.Bean
Sporobolus actinocladus (F.Muell.) F.Muell.
Stemodia glabella W.R.Barker
Tecticornia disarticulata (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson
Tecticornia medullosa (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson
Teucrium racemosum R.Br.
Trachymene glaucifolia (F.Muell.) Benth.
Trianthema triquetra Willd.
Tribulus hystrix R.Br.
Tribulus sp.
Tribulus terrestris L.
Trichodesma zeylanicum (Burm.f.) R.Br. var. zeylanicum
Triodia basedowii E.Pritz.
Tripogon loliiformis (F.Muell.) C.E.Hubb.
Triraphis mollis R.Br.
Verbena officinalis L.
Zygochloa paradoxa (R.Br.) S.T.Blake
Zygophyllum simile H.Eichler

17 Appendix I

17.1 SA Herbarium Collections from Diamantina Region

Record number	Collector	Species
AD96806674	S. Morgan	Swainsona laxa
AD97534386B	Dr Morgan	Swainsona phacoides
AD97631681A	Dr. Morgan	Calotis hispidula
AD97231038	Dr. Morgan	Calotis hispidula
AD97632040B	J.B. Cleland	Calotis porphyroglossa
AD96128022	T.R.N. Lothian, D.E. Francis	Calotis porphyroglossa
AD97848511	Anon.	Streptoglossa adscendens
AD97240272	J.B. Cleland	Anemocarpa podolepidium
AD97131196	Dr Morgan	Streptoglossa cylindriceps
AD97413025L	J.M. Black	Wahlenbergia tumidifructa
AD97524097	E.A. Brooks	Cenchrus ciliaris
AD95707036	D. Morgan	Echinochloa inundata
AD966040301	Dr. Morgan	Lotus cruentus
AD97231046	J.B. Cleland	Calotis hispidula
AD96127177	T.R.N. Lothian, D.E. Francis	Calotis hispidula
AD97243064	J.B. Cleland	Streptoglossa adscendens
AD96127032	T.R.N. Lothian, D.E. Francis	Minuria integerrima
AD96127125	T.R.N. Lothian, D.E. Francis	Streptoglossa adscendens
AD968061046	Anon.	Bulbine alata
AD97227024	J.B. Cleland	Myriocephalus stuartii
AD97240224	J.B. Cleland	Minuria denticulate
AD966072250	J.B. Cleland	Rhodanthe stricta
AD966072259	Dr. Morgan	Rhodanthe stricta
AD97231276	D. Morgan	Rhodanthe uniflora
AD97233298	D. Morgan	Rhodanthe floribunda
AD96127176	T.R.N. Lothian, D.E. Francis	Rhodanthe floribunda
AD97644336	A.M. Morgan	Minuria rigida
AD97240261	J.B. Cleland	Minuria rigida
AD97241096	J.B. Cleland	Ethuliopsis cunninghamii
AD96127185	T.R.N. Lothian, D.E. Francis	Pseudognaphalium luteoalbum
AD966050951	D. Morgan	Pycnosorus melleus
AD966050885	J.B. Cleland	Pycnosorus melleus
AD96128021	T.R.N. Lothian, D.E. Francis	Pycnosorus melleus
AD97630650b	D. Morgan	Pycnosorus melleus

Record number	Collector	Species
AD97630650c	Anon.	Pycnosorus melleus
AD96127012	T.R.N. Lothian, D.E. Francis	Swainsona phacoides
AD97534395B	Dr. Morgan	Swainsona swainsonioides
AD97549325	L. Reese	Goodenia fascicularis
AD97211170	Dr. Morgan	Crotalaria cunninghamii
AD97211209	Dr. Morgan	Crotalaria eremaea ssp. Eremaea
AD97219208	Dr. Morgan	Cullen australasicum
AD97537303	J.Z. Weber	Crotalaria cunninghamii
AD97739123	J.B. Cleland	Cullen australasicum
AD96127128A	T.R.N. Lothian, D.E. Francis	Cullen cinereum
AD97739083	J.B. Cleland	Cullen cinereum
AD97219210	J.B. Cleland	Cullen cinereum
AD97219211	J.B. Cleland	Cullen cinereum
AD96127128B	T.R.N. Lothian, D.E. Francis	Cullen australasicum
AD97508234	R.L. Crocker	Bulbine alata
AD96127172	T.R.N. Lothian, D.E. Francis	Bulbine alata
AD966051944	J.B. Cleland	Leiocarpa brevicompta
AD966051942	J.B. Cleland	Leiocarpa brevicompta
AD96127122	T.R.N. Lothian, D.E. Francis	Leiocarpa brevicompta
AD96123220	Dr. Morgan	Senna artemisioides ssp. Filifolia
AD96127117	T.R.N. Lothian	Centipeda crateriformis ssp. Crateriformis
AD97414169	J.B. Cleland	Centipeda crateriformis ssp. Crateriformis
AD97221034	J.B. Cleland	Centipeda crateriformis ssp. Crateriformis
AD97221039	J.B. Cleland	Centipeda crateriformis ssp. Crateriformis
AD97538108	J.Z. Weber	Acacia tetragonophylla
AD97538110	J.Z. Weber	Acacia oswaldii
AD97538109	J.Z. Weber	Hakea leucoptera ssp. Leucoptera
AD96005002	J.B. Cleland	Eremophila bignoniiflora
AD95833106	R.L. Crocker	Eremophila bignoniiflora
AD96005001	Dr. Morgan	Eremophila bignoniiflora
AD96004135	Dr. Morgan	Eremophila maculata ssp. Maculate
AD97301143	D. Morgan	Myoporum montanum
AD97312323	[Dr.] Morgan	Marsilea drummondii
AD96529049H	Dr. Morgan	Marsilea drummondii
AD96529027	L. Reese	Marsilea drummondii
AD96529028	L. Reese	Marsilea drummondii
AD96250190B	J.B. Cleland	Santalum lanceolatum
AD96250055	J.B. Cleland	Santalum lanceolatum

Record number	Collector	Species
AD95735066	J.B. Cleland	Ranunculus pumilio var. pumilio
AD96127115	T.R.N. Lothian, D.E. Francis	Atriplex acutiloba
AD96128116	T.R.N. Lothian, D.E. Francis	Atriplex angulata
AD96316002	T.R.N. Lothian, D.E. Francis	Atriplex holocarpa
AD96127116	T.R.N. Lothian, D.E. Francis	Atriplex spongiosa
AD97647228	J.B. Cleland	Atriplex sp.
AD97647260	D. Morgan	Chenopodium auricomum
AD97537286	J.Z. Weber	Enchylaena tomentosa var. Tomentose
AD95820044	Dr Morgan	Sclerolaena bicornis var. Bicornis
AD95909090	E.G. Millard	Sclerolaena constricta
AD95820049	Dr Morgan	Sclerolaena muricata var. Muricata
AD96103103	T.R.N. Lothian, D.E. Francis	Diplatia grandibractea
AD96104120	Dr. Morgan	Lysiana subfalcata
AD97230233	J.B. Cleland	Calotis ancyrocarpa
AD96127173	T.R.N. Lothian, D.E. Francis	Calotis ancyrocarpa
AD99436219	D. Morgan	Calotis ancyrocarpa
AD96127105	T.R.N. Lothian, D.E. Francis	Rutidosis helichrysoides ssp. Helichrysoides
AD97642196d	J.B. Cleland	Rutidosis helichrysoides ssp. Helichrysoides
AD97632042	L. Reese	Calotis porphyroglossa
AD966041728	L. Reese	Mimulus gracilis
AD966020324	L. Reese	Mimulus gracilis
AD97622170	L. Reese	Mimulus gracilis
AD97643111B	J.B. Cleland	Sphaeranthus indicus
AD97749538	J.B. Cleland	Sphaeranthus indicus
AD97241081	J.B. Cleland	Sphaeranthus indicus
AD97219194	Dr. Morgan	Cullen pallidum
AD97609182C	J.B. Cleland	Trigonella suavissima
AD96127127	T.R.N. Lothian, D.E. Francis	Datura leichhardtii
AD966031164	D. Morgan	Datura leichhardtii
AD95711068	J.B. Cleland	Nicotiana velutina
AD95630002	J.B. Cleland	Nicotiana velutina
AD95631016	J.B. Cleland	Nicotiana velutina
AD97614153	J.B. Cleland	Nicotiana velutina
AD97613099C	H. Basedow	Solanum oligacanthum
AD96623117F	D. Morgan	Dysphania platycarpa
AD96623119A	J.B. Cleland	Dysphania platycarpa
AD96643086	J.B. Cleland	Goodenia fascicularis
AD96717091B	L. Reese	Goodenia cycloptera

Record number	Collector	Species
AD96127113	T.R.N. Lothian, D.E. Francis	Goodenia glauca
AD96128003	T.R.N. Lothian, D.E. Francis	Rumex crystallinus
AD97537289	J.Z. Weber	Rumex crystallinus
AD96808791	J.B. Cleland	Rumex crystallinus
AD96808789	[Dr] Morgan	Rumex crystallinus
AD96128004	T.R.N. Lothian, D.E. Francis	Rumex crystallinus
AD96808788	J.B. Cleland	Rumex crystallinus
AD96806228	J.B. Cleland	Polygonum plebeium
AD96127124	T.R.N. Lothian, D.E. Francis	Polygonum plebeium
AD96808794	J.B. Cleland	Muehlenbeckia florulenta
AD97512173b	Dr Morgan	Aristida anthoxanthoides
AD966060353	Dr Morgan	Aristida anthoxanthoides
AD96825213A	Dr. Morgan	Chloris pectinata
AD966072589	Dr. Morgan	Chloris pectinata
AD95833065	R.L. Crocker	Pycnosorus melleus
AD96806411	Dr. Morgan	Euphorbia wheeleri
AD96127028	T.R.N. Lothian, D.E. Francis	Eragrostis dielsii
AD96209126	J.B. Cleland	Eragrostis basedowii
AD97546214	Morgan	Eragrostis basedowii
AD97630509	R.L. Crocker	Sphaeranthus indicus
AD98119194	L. Reese	Eragrostis leptocarpa
AD96128002	T.R.N. Lothian, D.E. Francis	Eragrostis setifolia
AD96209176	Morgan	Eragrostis xerophila
AD96127003	T.R.N. Lothian, D.E. Francis	Eragrostis xerophila
AD97523310A	J.B. Cleland	Eriochloa pseudoacrotricha
AD96312115	T.R.N. Lothian, D.E. Francis	Eriochloa pseudoacrotricha
AD966100331	Dr Morgan	Iseilema membranaceum
AD968071204	Dr. Morgan	Leptochloa fusca ssp. Muelleri
AD95708025	D. Morgan	Panicum decompositum
AD96127121	T.R.N. Lothian, D.E. Francis	Panicum effusum var. Effusum
AD99140234	J.B. Cleland	Panicum laevinode
AD97521188	R.L. Crocker	Panicum laevinode
AD97220122	[D.] Morgan	Paractaenum refractum
AD97219366	J.B. Cleland	Setaria dielsii
AD96127011	T.R.N. Lothian, D.E. Francis	Sporobolus actinocladus
AD96127004	T.R.N. Lothian, D.E. Francis	Sporobolus actinocladus
AD96807684	Dr Morgan	Triraphis mollis
AD96127024	T.R.N. Lothian, D.E. Francis	Triraphis mollis

Record number	Collector	Species
AD96128016	T.R.N. Lothian, D.E. Francis	Glinus lotoides
AD97537287	J.Z. Weber	Glinus lotoides
AD968071004	J.B. Cleland	Gunniopsis papillata
AD98150331	Dr Morgan	Trianthema triquetra
AD97544155	J.B. Cleland	Tetragonia moorei
AD96807693	J.B. Cleland Per collector: D. Morgan	Tetragonia moorei
AD96128015	T.R.N. Lothian, D.E. Francis	Tetragonia moorei
AD96807703	J.B. Cleland	Tetragonia moorei
AD96127123	T.R.N. Lothian, D.E. Francis	Dysphania platycarpa
AD96006128	Anon.	Dysphania platycarpa
AD96006139	Dr Morgan	Dysphania platycarpa
AD966021133	Dr Morgan	Ptilotus murrayi var. Murrayi
AD966021149	Dr Morgan	Ptilotus murrayi var. Murrayi
AD96215252A	L. Reese	Ptilotus murrayi var. Murrayi
AD96215252B	Anon.	Ptilotus murrayi var. Murrayi
AD96215252C	Dr Morgan	Ptilotus murrayi var. Murrayi
AD95828057	J.B. Cleland	Myosurus minimus var. Australis
AD97408167A	J.B. C[leland]	Myosurus minimus var. Australis
AD97408167B	J.B. C[leland]	Myosurus minimus var. Australis
AD966080233	Dr Morgan	Papaver hybridum
AD96112093	Dr Morgan	Arabidella eremigena
AD96112014	J.B. Cleland	Arabidella eremigena
AD966020178	J.B. Cleland	Arabidella eremigena
AD96128126	T.R.N. Lothian, D.E. Francis	Arabidella eremigena
AD96114022C	Anon.	Arabidella eremigena
AD96115052	R.L. Crocker	Blennodia canescens var. Pterosperma
AD96112023	Dr Morgan	Blennodia canescens var. Pterosperma
AD96114003F	L. Reese	Harmsiodoxa blennodioides
AD966020182	Dr Morgan	Menkea crassa
AD966020732	D. Morgan	Phlegmatospermum eremaeum
AD966051781	J.B. Cleland Per collector: D. Morgan	Lepidium phlebopetalum
AD97606430C	D. Morgan	Lepidium phlebopetalum
AD96847020A	D. Morgan	Menkea australis
AD96114020D	L. Reese	Arabidella eremigena
AD966020790	D. Morgan	Phlegmatospermum cochlearinum
AD96404268	Dr. Morgan	Phlegmatospermum cochlearinum
AD96404270	Anon.	Phlegmatospermum cochlearinum
AD97539050	E.N.S. Jackson	Senecio lanibracteus

Record number	Collector	Species
AD966020232	J.B. Cleland Per collector: Dr. Morgan	Ptilotus polystachyus var. polystachyus
AD99832406	R.J. Bates	Echinochloa turneriana
AD96808756	D. Morgan	Nitraria billardierei
AD96808759	J.B. Cleland Per collector: W. Morgan	Tribulus eichlerianus
AD95641036	Dr. Morgan	Erodium sp.
AD96247125E	Dr. Morgan	Zygophyllum howittii
AD96128114	T.R.N. Lothian, D.E. Francis	Zygophyllum simile
AD95829061	Dr. Morgan	Erodium cicutarium
AD96247341	Dr. Morgan	Zygophyllum howittii
AD96803278	J.B. Cleland	Haloragis aspera
AD96127175	T.R.N. Lothian, D.E. Francis	Haloragis aspera
AD98561761	D.N. George	Alopecurus geniculatus
AD97647227	J.B. Cleland	Atriplex sp.
AD96011115	Dr. Morgan	Daucus glochidiatus
AD97541018	J.Z. Weber	Trachymene glaucifolia
AD96012010	Dr Morgan	Trachymene glaucifolia
AD97619018	L. Reese	Daucus glochidiatus
AD96806832	J.B. Cleland	Abutilon otocarpum
AD96601955	Anon.	Malvastrum americanum
AD96127119	T.R.N. Lothian, D.E. Francis	Synaptantha tillaeacea var. Tillaeacea
AD96127107	T.R.N. Lothian, D.E. Francis	Synaptantha tillaeacea var. Tillaeacea
AD97119083	Dr Morgan	Trichodesma zeylanicum var. Zeylanicum
AD96911063	R.L. Crocker	Mentha australis
AD96127174	T.R.N. Lothian, D.E. Francis	Teucrium racemosum
AD966041882	J.B. Cleland	Stemodia florulenta
AD97625168B	Dr H. Basedow	Stemodia florulenta
AD96127171	T.R.N. Lothian, D.E. Francis	Plantago cunninghamii
AD96127108	T.R.N. Lothian, D.E. Francis	Wahlenbergia tumidifructa
AD97616012	T.R.N. Lothian, D.E. Francis	Wahlenbergia tumidifructa
AD98645227	J.B. Cleland	Wahlenbergia tumidifructa
AD96127114	T.R.N. Lothian, D.E. Francis	Wahlenbergia tumidifructa
AD95805076	J.B. Cleland	Isolepis australiensis
AD97519328A	L. Reese	Isolepis australiensis
AD97519328B	J.B. Cleland	Isolepis australiensis
AD97519329B	Anon.	Isolepis marginate
AD97620065B	J.B. Cleland	Eremophila bignoniiflora
AD97648381A	J.B. Cleland	Leiocarpa brevicompta
AD966051956	D. Morgan	Leiocarpa websteri

Record number	Collector	Species
AD966051956A	D. Morgan	Brachyscome lineariloba
AD97613368A	J.B. Cleland	Lythrum wilsonii
AD97539266	E.N.S. Jackson	Acacia ramulosa var. Ramulosa
AD97221402	J.B. Cleland	Eucalyptus coolabah
AD96127110	T.R.N. Lothian, D.E. Francis	Sonchus hydrophilus
AD96808766	D. Morgan	Tribulus hystrix
AD97246223	J.B. Cleland	Senecio gregorii
AD97210125	J.B. Cleland Per collector: E.A. Brooks	Eleocharis plana
AD96419092	Dr. Morgan	Solanum lacunarium
AD96128001	T.R.N. Lothian, D.E. Francis	Trigonella suavissima
AD96141041	Dr. Morgan	Senecio depressicola
AD96128014	T.R.N. Lothian, D.E. Francis	Senecio depressicola
AD96127109	T.R.N. Lothian, D.E. Francis	Senecio depressicola
AD96128013	T.R.N. Lothian, D.E. Francis	Senecio depressicola
AD97218209	J.B. Cleland	Frankenia
AD97228295	J.B. Cleland	Frankenia
AD97423308A	J.B. Cleland	Frankenia
AD97423309B	J.B. Cleland	Frankenia
AD182130K	F.M. Bailey	Frankenia
AD97228296	L. Reese	Frankenia
AD97218195	J.B. Cleland	Frankenia
AD97225187	J.B. Cleland	Lachnagrostis filiformis
AD97225183	D. Morgan	Lachnagrostis filiformis
AD966031619	J.B. Cleland	Malva preissiana
AD96803076	J.B. Cleland	Haloragis glauca f. Sclopetifera
AD97618200	J.B. Cleland	Haloragis glauca f. Sclopetifera
AD95701002	E. Ashby	Ipomoea diamantinensis
AD97826039B	Dr Morgan	Minuria rigida
AD98403198B	L. Reese	Brachyscome campylocarpa
AD97607630A	L. reese	Frankenia annua var. Orthotricha
AD97607630B	J.B. Cleland	Frankenia annua var. Orthotricha
AD97747822B	Dr Morgan	Ptilotus murrayi
AD98335171B	Dr Morgan	Swainsona flavicarinata
AD98625091B	Dr Morgan	Rhodanthe uniflora
AD98919124B	Dr Morgan	Eryngium supinum
AD98919124C	J.B. Cleland	Eryngium supinum
AD98919125B	Dr Morgan	Eryngium supinum
AD97231208	D. Morgan	Gnephosis eriocarpa

Record number	Collector	Species
AD97643072F	D. Morgan	Gnephosis eriocarpa
AD97643072A	Anon.	Gnephosis eriocarpa
AD97643057	L. Reese	Gnephosis eriocarpa

18 Appendix J

18.1 Ground Cover Monitoring Sites - 2016

	BE %	Litter%	Plant Cover %	
1	52	32	15	100
3	40	47	13	100
4	46	50	4	100
6	43	52	5	100
7	29	70	1	100
8	26	71	3	100
9	10	55	35	100
11	18	68	14	100
12	23	73	3	100
14	47	47	6	100
15	20	60	20	100
16	33	56	17	106
17	58	18	24	100
18	23	75	2	100
19	35	40	25	100
20	42	57	1	100
21	38	3	59	100

19 Appendix K

19.1 Exotic Fauna Evidence

Site	Rabbit Dung	Rabbit Burrows Scratchings	Camel Dung	Camel Tracks	Pig Dung	Pig Tracks Diggings	Dingo Dung	Dingo Tracks	Horse Dung	Horse Tracks	Cattle Dung	Cattle Tracks Pugging/Camp
1-2			1								4	
2-2						2					1	
3-2											21	6
4-2											4	4
5-2	No Access											
6-2											2	8
7-2						1					19	4
8-2											16	
9-2												5
10-2	No Access											
11-2		3										2
12-2											9	16
13-2												
14-2	4	1	2				1		1		2	
15-2	2	7										
16-2	No Exotics											
17-2	No Exotics											
18-2		1									2	4
19-2			1								23	2
20-2											13	4
21-2												12

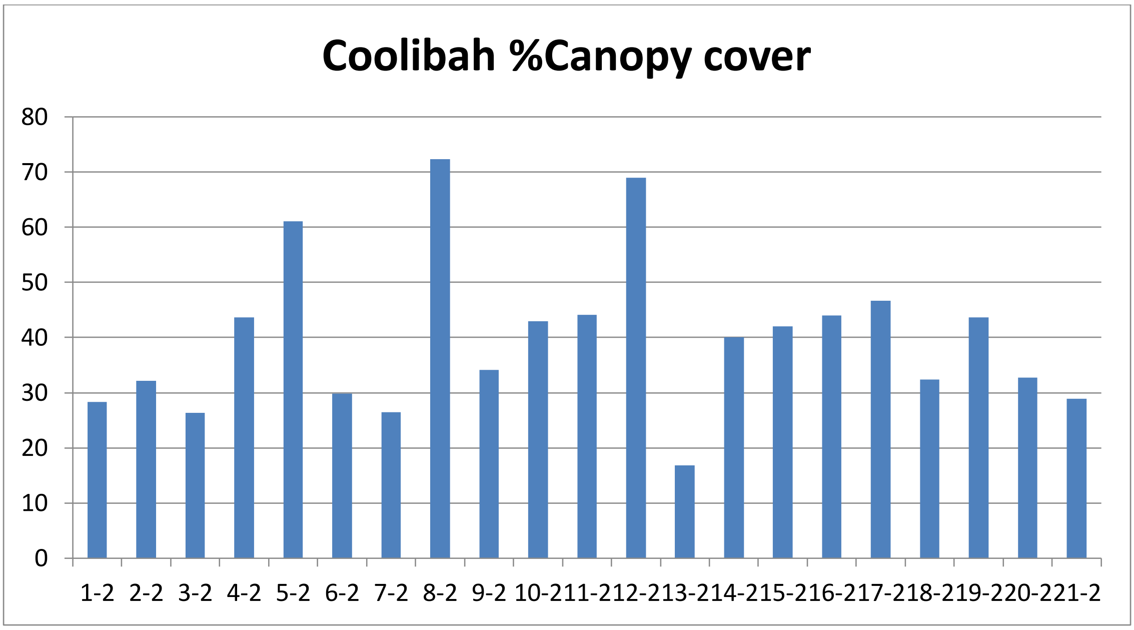
20 Appendix L

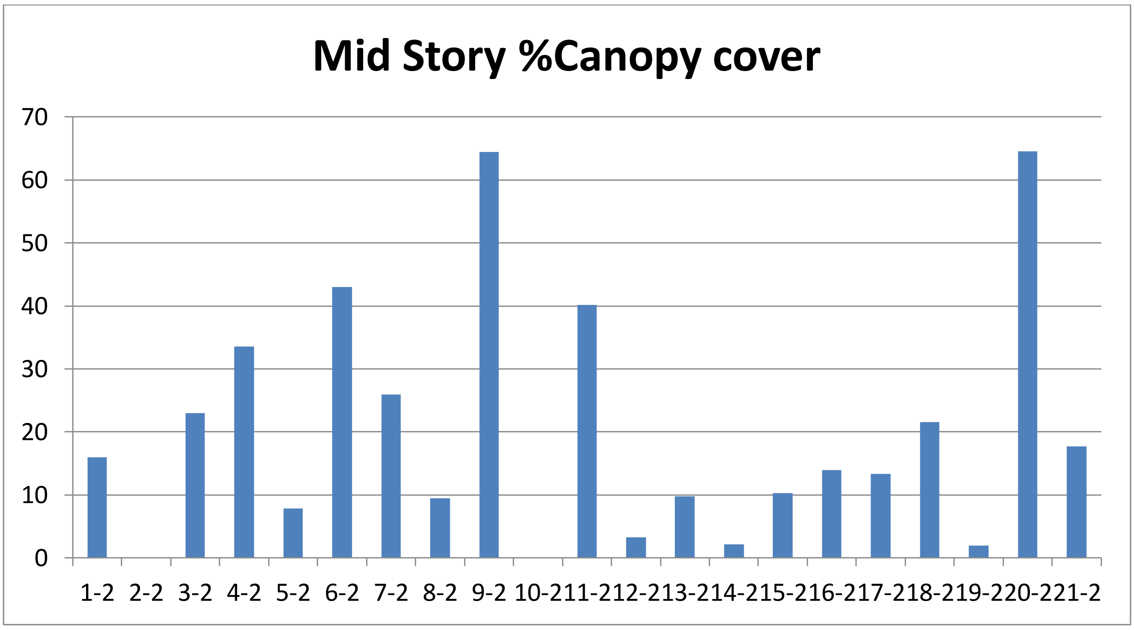
20.1 Perennial vegetation cover – All permanent monitoring sites

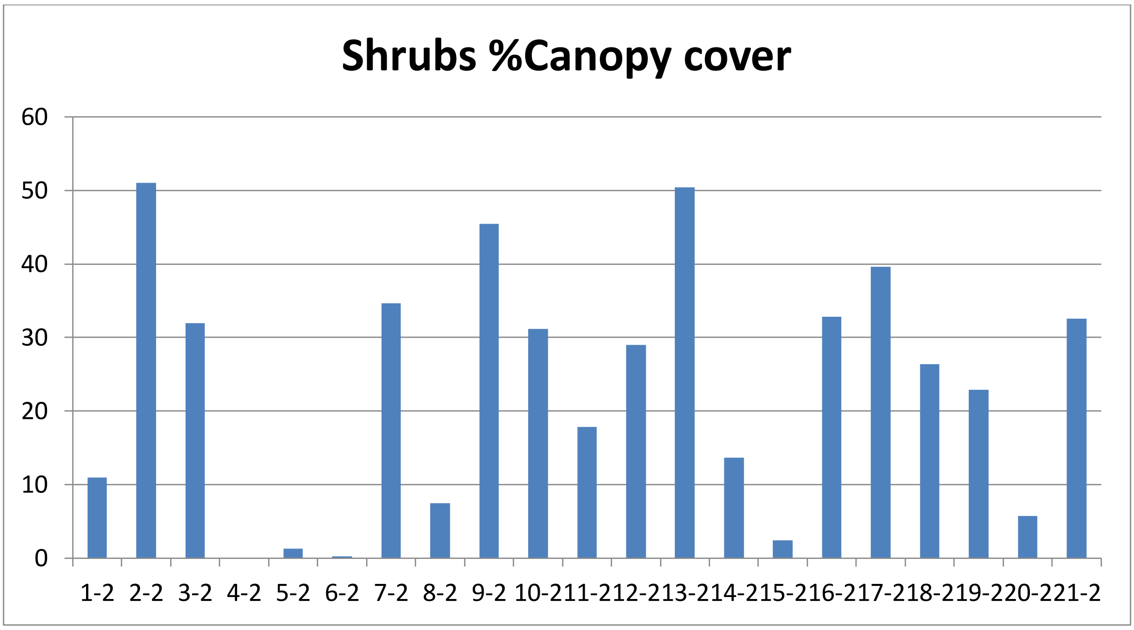
Coolibah	
Sites	%Canopy cover
1-2	28
2-2	32
3-2	26
4-2	44
5-2	61
6-2	30
7-2	27
8-2	72
9-2	34
10-2	43
11-2	44
12-2	69
13-2	17
14-2	40
15-2	42
16-2	44
17-2	47
18-2	32
19-2	44
20-2	33
21-2	29

Mid Story	
Sites	%Canopy cover
1-2	16
2-2	0
3-2	23
4-2	34
5-2	8
6-2	43
7-2	26
8-2	10
9-2	64
10-2	0
11-2	40
12-2	3
13-2	10
14-2	2
15-2	10
16-2	14
17-2	13
18-2	22
19-2	2
20-2	65
21-2	18

Shrubs	
Sites	%Canopy cover
1-2	11
2-2	51
3-2	32
4-2	0
5-2	1.3
6-2	0.2
7-2	34.7
8-2	7.5
9-2	45.5
10-2	31.2
11-2	17.8
12-2	29
13-2	50.4
14-2	13.7
15-2	2.4
16-2	32.8
17-2	39.6
18-2	26.4
19-2	22.9
20-2	5.7
21-2	32.6


Coolibah %Canopy cover
80
70
60
50
40
30
20
10
0
1-2 2-2 3-2 4-2 5-2 6-2 7-2 8-2 9-2 10-211-212-213-214-215-216-217-218-219-220-221-2


Mid Story %Canopy cover
70
60
50
40
30
20
10
0
1-2 2-2 3-2 4-2 5-2 6-2 7-2 8-2 9-2 10-211-212-213-214-215-216-217-218-219-220-221-2


Shrubs %Canopy cover
60
50
40
30
20
10
0
1-2 2-2 3-2 4-2 5-2 6-2 7-2 8-2 9-2 10-211-212-213-214-215-216-217-218-219-220-221-2