Flora survey of the Colville 1:100,000 map sheet area; northern Nullarbor

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Department of Parks and Wildlife

Contents

Authors' affiliation and contributions

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Cover photo: Western myall (*Acacia papyrocarpa*) over blue bush (*Maireana sedifolia*) one of the dominant vegetation types on the COLVILLE sheet.

Abstract

A flora survey was conducted over the COLVILLE map sheet from the 27th August – 10th September 2015. Only three taxa had been collected from the map sheet prior to the survey, the species list was increased to 100 taxa. One of the three taxa previously recorded was not recollected. A further 49 taxa were recorded from areas adjacent to the northern and eastern boundary of the survey area. A total of 216 collections were made of 142 taxa representing 96% of taxa encountered. Of the 148 taxa recorded in the current survey five were new records for the Nullarbor bioregion based on Atlas of Living Australia records and a further four were new records for the Nullarbor in Western Australia. Only a single taxon (*Hibiscus krichauffianus*) on the Department of Parks and Wildlife's Priority Flora List was encountered. Six introduced taxa were recorded with Ward's Weed (*Carrichtera annua*) and Buffel Grass (*Cenchrus ciliaris*) being of particular concern. Two taxa were collected that could not be assigned to currently described species, *Senna* aff. *cardiosperma* (NG & ML 8022)) and *Senna* aff. *helmsii* (NG & ML 8032)). Given the access limitations in the area the results of this survey should be considered preliminary. Rabbits appear to be having a significant negative impact on the vegetation especially in conjunction with large wildfires converting myall (*Acacia papyrocarpa*) and bluebush (*Maireana sedifolia*) plain to grassland in some areas of the northern Nullarbor. However limited regeneration of myall was observed in the northern section of the map sheet, probably due to lower rabbit population densities from the spread of rabbit calicivirus through the area in the 1990s`. Significant populations of camels were also apparent across the area, their impact on the woodlands of the northern Nullarbor bioregion remains unclear.

Introduction

Collection of information on the distribution of flora and fauna across Australia is patchy due to size of the continent, variability in climatic condition in both time and space and the general lack of accessibility in the arid zone. The Federal government has provided some assistance to State governments to undertake survey work in areas with the least amount of available biological data. These surveys target those 1:100,000 map sheets with the fewest flora and fauna records in the national biodiversity databases. As part of this program a biological survey was recently undertaken covering the COLVILLE (4238) 1:100,000 map sheet. This report outlines the results of the flora survey of that area.

The COLVILLE sheet covers an area in the northern section of the Nullarbor bioregion *ca.* 550 km north north east of Kalgoolie and *ca.* 250 km north of Madura (Figure 1). The Nullarbor bioregion covers the most of the Tertiary limestone plateau extending from the Great Victoria Desert to Australian Bight. The map sheet is located ca. 20 km south west of the Tjuntjuntjara community. The Great Victoria Desert Nature Reserve occurs in the north east of the map sheet and the rest of the northern half of the map sheet is Pilki Native Title lands. The southern half of the study area is currently Unallocated Crown Land (Figure 1).

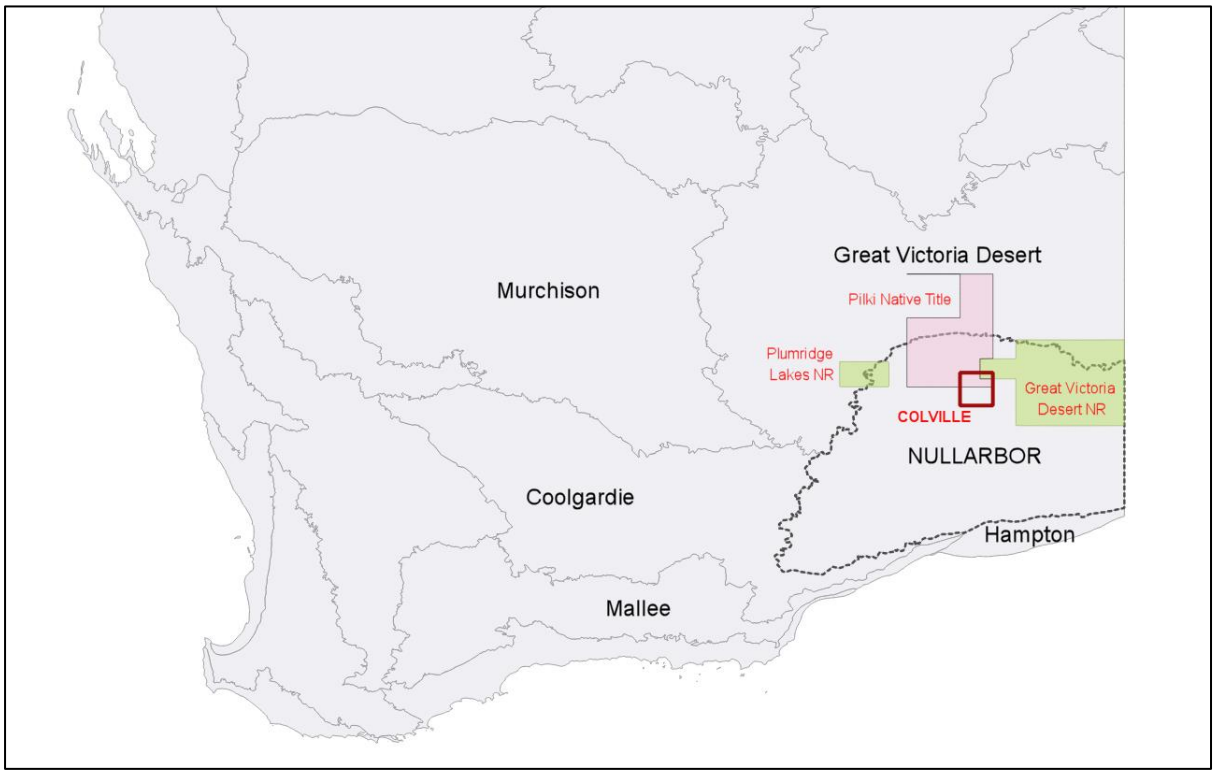

Figure 1. Location of COLVILLE sheet on the northern Nullarbor bioregion. Neighbouring bioregions also shown along with Plumridge Lakes NR, Great Victoria Desert NR and the Pilki Native Title Lands.

The earliest European exploration of the area was when Giles' 1875 expedition crossed the northern section of the map sheet in two days (15th and 16th) September 1875 (Berry 1876; Giles 1889; Brooker 2015). No plant collections were made from this area but Giles' map and journal indicate the vegetation they passed through largely comprised open grassy myall (*Acacia papyrocarpa*) scrub

(Figure 2). Giles had travelled for five days from Boundary Dam (near the Western Australia/South Australia border) through dense scrubs and was very pleased to reach more open country with 'real' grass (spinifex having disappeared). Their march continued for another 12 days before reaching Queen Victoria Springs where they found water for the first time since leaving Boundary Dam some 325 miles to the east. Giles was unimpressed with the quality of the country he travel through and remarked in his diary on the 19th September "*It was evident the region we had entered was utterly waterless….It was totally uninhabited both by man or animal.....utterly unknown to man and utterly forgotten by God*".

Giles' concept of the Queen Victoria Desert was somewhat broader than currently defined with his map showing the demarcation line between the Queen Victoria Desert and the Great Southern Plain in the vicinity of COLVILLE sheet (Figure 2). His track crossed this boundary on the 14th September coming out onto the plain and he left it again on the 20th September (Figure 2).

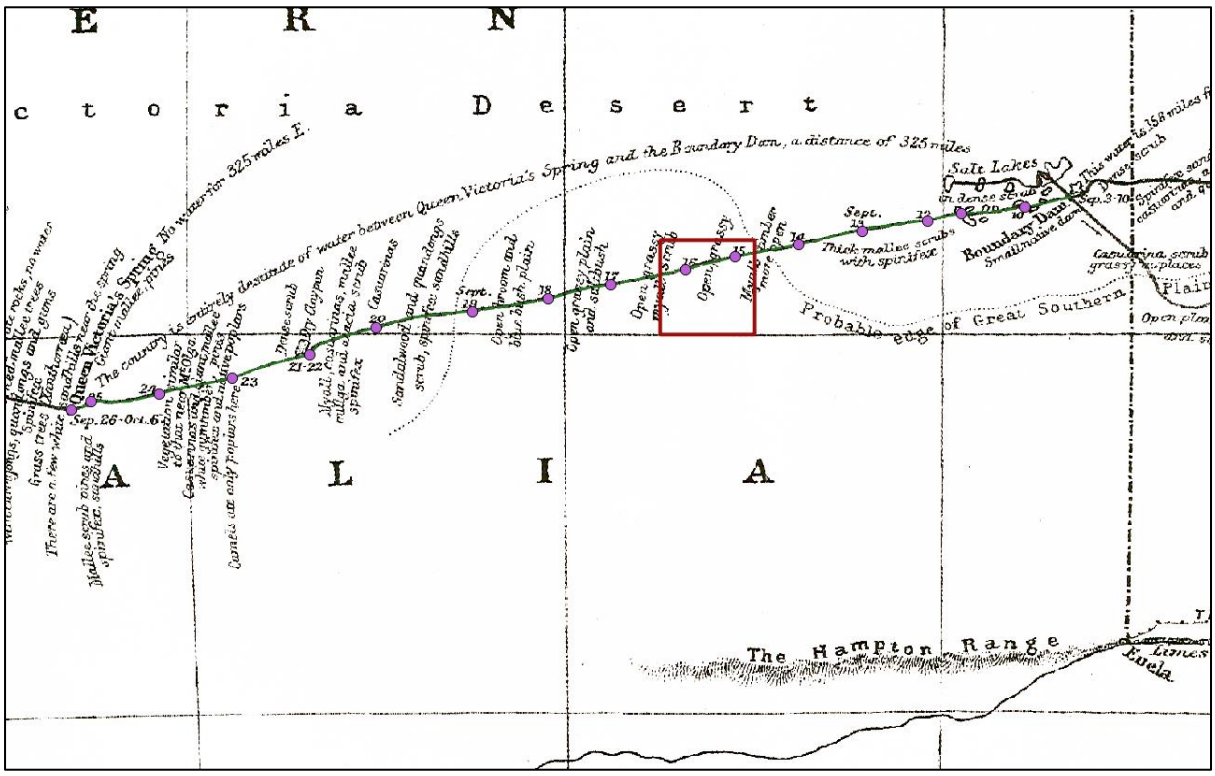

Figure 2. Excerpt from survey map covering Giles' September 1875 track from Border Dam to Queen Victoria Springs. They crossed the map sheet 14–17th September. Giles gives brief description of vegetation he passed through and notes the country is entirely destitute of water between the border and Queen Victoria Springs. Red square indicates COLVILLE sheet.

Some 40 years later Gardner's 1928 vegetation map extended this boundary around the entire plain which he maps a *Treeless saltbush plain* (Gardner 1928). This vegetation unit covers almost the entire COLVILLE map sheet except for the very north eastern corner which he maps as *Mulga bush* (Figure 3). Gardner's northern boundary is taken from Giles' map while his southern boundary follows the telegraph line. The source he used to map the western boundary of this unit is not clear and does not conform to Gibson's 1909 geological mapping (Gibson 1909).

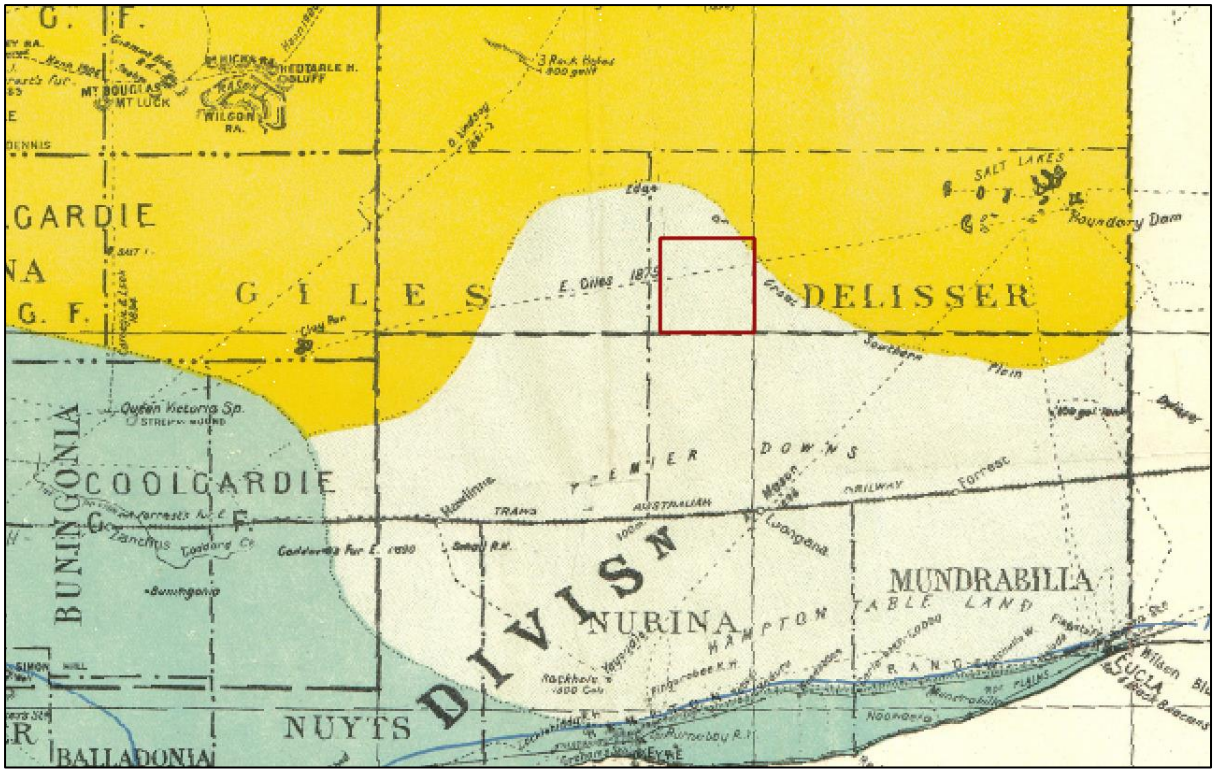

Figure 3. Portion of Gardner's 1928 State wide vegetation map. Red square indicated COLVILLE sheet. Gardner uses Giles' boundary of the Great Southern Plain and maps almost the entire sheer as *Treeless saltbush plain* (pale yellow), this was an over simplification. The other vegetation units mapped by Gardner were *Mulga bush* (orange) and *Temperate forests and woodlands with belts of sand heath and mallee* (green).

In August 1960 a party comprising Dr AR Main, Dr DL Serventy, Mr V Seventy, Mr WH Butler, Mr R Stewart and two aboriginal guides traversed the northern Nullarbor Plain (Figure 4) and recorded a log of the landscape and vegetation they passed through (Beard 1975). On the 16th of August they turned north onto the main track from Loongana – Carlisle Lakes (west of Yackadunyah) at mileage 65. Main recorded the vegetation as open myall and bluebush with some myoporum. They camped at mileage 88 after having only briefly entered the COLVILLE map sheet (Figure 4). The next day they proceeded north (just to the east of the map sheet) and recorded the country as more undulating, myall and saltbush (mileage 91); myall and bluebush, some mulga as well as myoporum and white everlastings (*Rhodanthe floribunda)* (mileage 94); mulga, curara (*Acacia tetragonophylla*) and grass on flats - myall, myoporum and bluebush on rises (mileage 105); then more heavily wooded , mulga, myall and sheoak with Cassia (*Senna*) in the creek (mileage 112). Eucalypts were seen at mileage 118 and the abandoned homestead reached at mileage 123. Main and Giles' accounts clearly indicate that Gardner's map unit (*Treeless saltbush plain*) was inaccurately applied to this area with the vegetation being largely dominated by western myall.

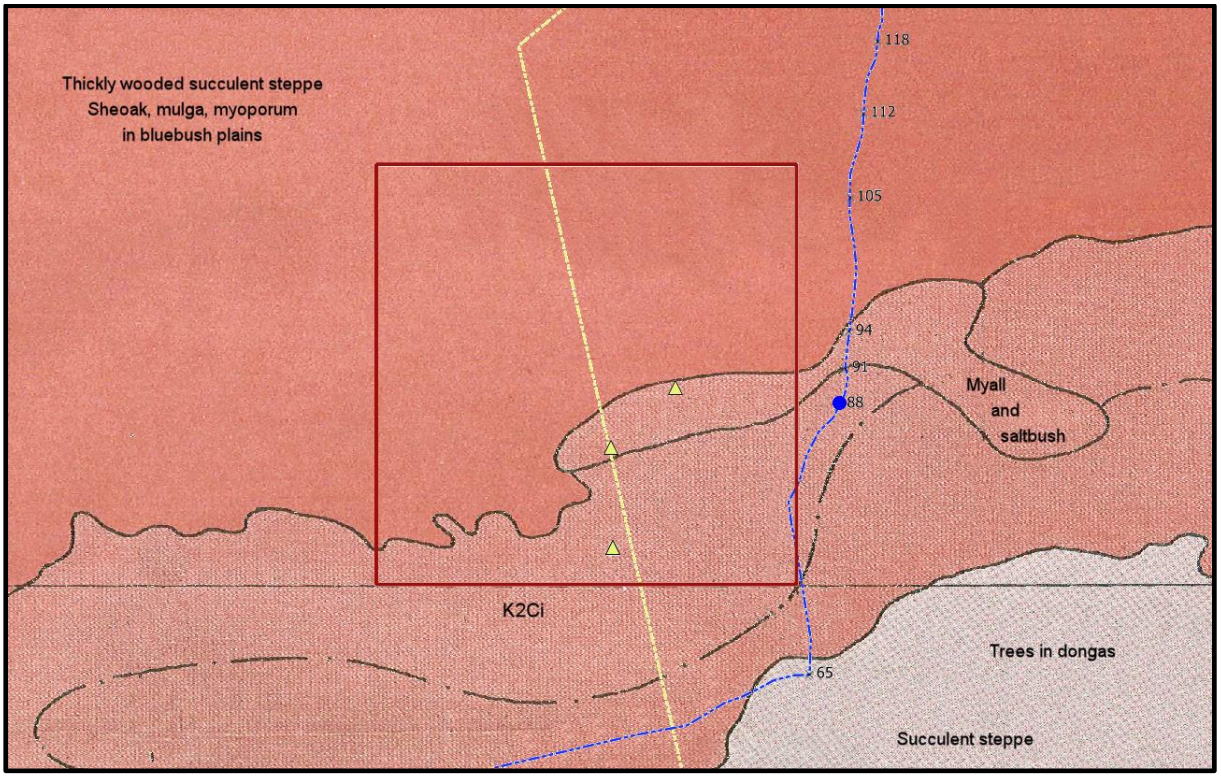

Figure 4. Mains party traversed the area in August 1960. Their track (blue) is overlain on Beard's 1975 1:1,000,000 vegetation map and the COLVILLE map sheet boundary (red). Approximate position of their mileages are shown as is their camp at mileage 88 (blue dot). The northern part of the map sheet is covered by Beard's *Thickly wooded succulent steppe* (dark brown), while the southern section is mapped as *Lightly wooded succulent steppe* (pale brown) and to the south of the map sheet is *Unwooded succulent steppe* (grey). Note Beard's code (K2Ci – Open bluebush plain) does not match his mapping unit. Also shown potential haul road alignment (yellow line) and locations of the previous collections from map sheet (yellow triangles).

The name "Nullarbor Plain" has been ascribed to either the entire extent of the limestone plateau or to the treeless portion in its centre. Lowry (1970) provided a detailed physiographic description and nomenclature for the region which is followed here. The Tertiary plateau in its entirety is referred to as Bundra Plateau and is flanked on it southern boundary by two coastal plains (Roe Plain and Israelite Plain). The Bunda Plateau itself can be divided into six regions based on soil and vegetation, two of which are covered by the COLVILLE map sheet (Figure 5). The Carlisle Plain in the north is described as an area of sandy soil with sparse myall and mulga scrubs. In the south the Nyanga Plain is underlain by a thick layer of clay and kankar and is covered by myall scrub. To south of the map sheet the Nullarbor Plain proper is found with thinner soils and vegetation dominated by bluebush (*Maireana sedifolia*), saltbush (*Atriplex* spp.) and after rains, grasses (largely *Austrostipa nitida*). A tree layer is almost totally absent.

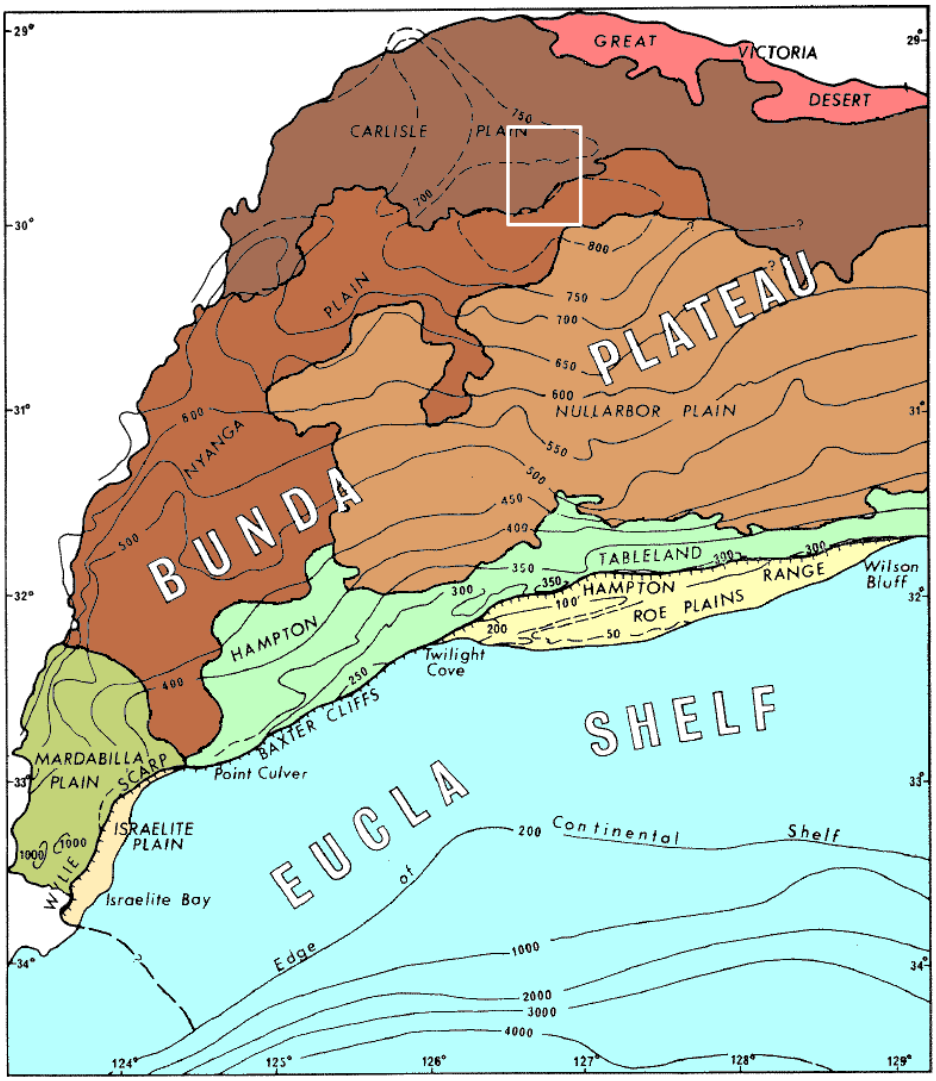

Figure 5. Lowry's (1970) landform map of the Eucla Basin. The Bunda Plateau refers to the entire plateau complex and is made up of six distinct units that differ in soil type and vegetation. The Nullarbor Plain is treeless section of the plateau with shallow soils. COLVILLE map sheet outlined in white. Terrestrial contours in feet, bathymetric contours in metres.

Beard (1975) mapped the area at 1:1,000,000 scale from aerial photo interpretation and limited ground traverses of surrounding areas (Figure 4). His broad scale map shows thickly wooded succulent steppe dominated by sheoak, mulga, myoporum on saltbush plains in the north of the map sheet, roughly corresponding to Lowry's Carlisle Plain, and an open bluebush plain in the south (on the Nyanga Plain) despite being classed as lightly wooded succulent steppe in the map legend. The Nullarbor Plain to the south of the study area is also mapped as open bluebush plain but classed as unwooded succulent steppe in the legend. The third unit mapped by Beard was a small area of myall over saltbush along the boundary between the Carlisle and Nyanga Plain (Figure 4).

There are clear inconsistencies in Beard's classification (vegetation codes on map) and his map units as well as between Beard's description and those of Lowry of the dominant vegetation unit on the Carlisle and Nyanga Plains.

More detailed floristic survey was undertaken by Keighery *et al.* (1987) as part of a biological survey of the Nullarbor region using large 2km x 2km quadrats sampling five landscape units at each of 16 campsites stratified across the entire Bunda Plateau. Five quadrats (JU01-JU05) were located on the north-south track immediately east of the COLVILLE sheet (Figure 6). Other sampled locations included Plumridge Lakes (PL) and Balladonia (BA) on the northern and western boundary of the plateau and Haig (HA) and Forrest (FO) on the treeless Nullarbor Plain. Classification of the perennial dataset showed the JU sites grouped with the other sites from near the northern and western boundary of the plateau (BA and PL). Overall this survey found low species richness and low levels of endemism compared to the surrounding bioregions.

Recently a botanical survey was undertaken of three possible haul road alignments from a proposed sand mine located near the South Australia boarder to the Trans-Australian Railway. This survey was undertaken over five days in March 2012 using a helicopter and produced floristic data from 96 widely scattered sites and mapping of three vegetation belts *ca.* four km wide for a total length of *ca.* 700 km (Woodman Environmental Consulting 2012). One of these proposed haul road alignments bisects the COLVILLE sheet (Figure 4). This survey found a 175 plant taxa and one hybrid and mapped 16 broad vegetation units along the three potential routes. Three collections from that survey were made on the COLVILLE sheet. At one site *Eremophila attenuata* (listed on Western Australian Priority Flora List as P1) was collected, and the other two taxa *Chenopodium nitrariaceum* (poorly collected) and *Eragrostis xerophila* (widespread in arid zone) were collected at a second site (Figure 4) The *Eremophila attenuata* was subsequently recollected at a third site by B. Buirchell in 2014.

Grazing by rabbits has had a major impact on the demographic structure of the western myall woodlands in the northern Nullarbor bioregion with no successful recruitment for many decades prior to the release of the calicivirus (Gilfillan 1999). A study on recovery of these woodlands were undertaken on the PL and JU Nullarbor Survey sites after the release of calicivirus in the late 1990s. That study reported successful recruitment and establishment of western myall and was hopeful that the grazing pressure was sufficiently low to allow for continued recruitment (Gilfillan 1999).

Methods

Twenty eight relevés ca. 0.25 ha were established and scored exhaustively for vascular flora. At 16 of these sites fauna surveys were carried out (11 on COLVILLE sheet, 5 to east). Twelve relevés were established on the relocated Nullarbor Survey sites located just to the east and north of the map sheet. Collections were made at an additional 42 site within the COLVILLE map sheet and at 45 sites located to the north and east of the map sheet. (Figure 6). Extensive sampling was carried out in the adjacent areas due to the difficulties of access across most of the map sheet. Sampling was carried out over 15 days from the 27th August – 10th September 2015. The survey used a single base camp located in the north east of the map sheet on the main access track.

As expected the landforms and vegetation patterns were found to be much more complex than suggested by Beard (1975). The landscape in the northern section of the map sheet was dominated by western myall over bluebush and/or saltbush (Figure 7) with smaller occurrences of mulga woodland (Figure 8a), grassland (Figure 8b), and sheoak woodland on quarzitic sandstones (Figure 9), mallee on dunes around lake. To the south open annual grassland or herblands became more common (Figure 10) with saltbush dominating low lying areas (Figure 11). To the north of the map sheet mallee woodland over *Triodia* was encountered (Figure 12). Plant collections were made in all of these habitats and wherever possible collections from at least two different locations.

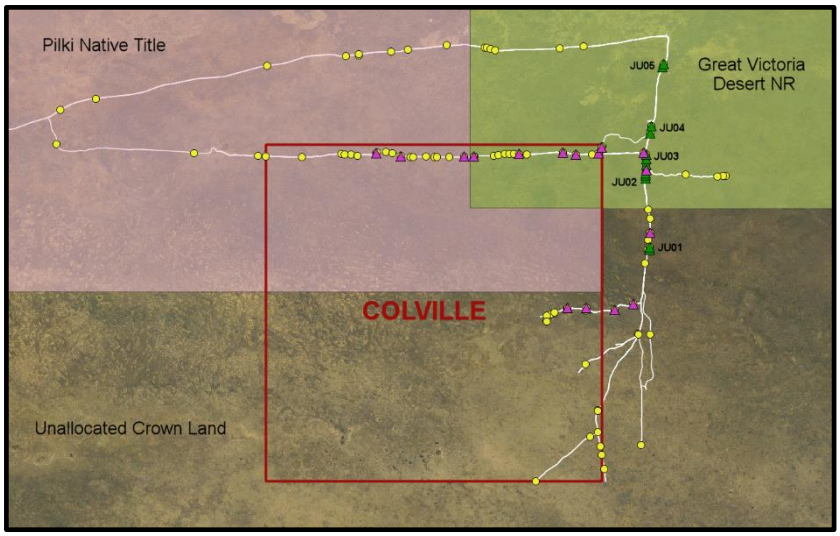

Figure 6. Locations of plant survey sites on COLVILLE map sheet (red square) and adjacent areas. Relevés were scored at the Fauna sites (pink triangles) and previous Nullarbor Survey traplines (green triangles JU01 – JU05) collections made at the other 87 sites (yellow circles). Track traversed shown in white. Background image SPOT 2009 mosaic.

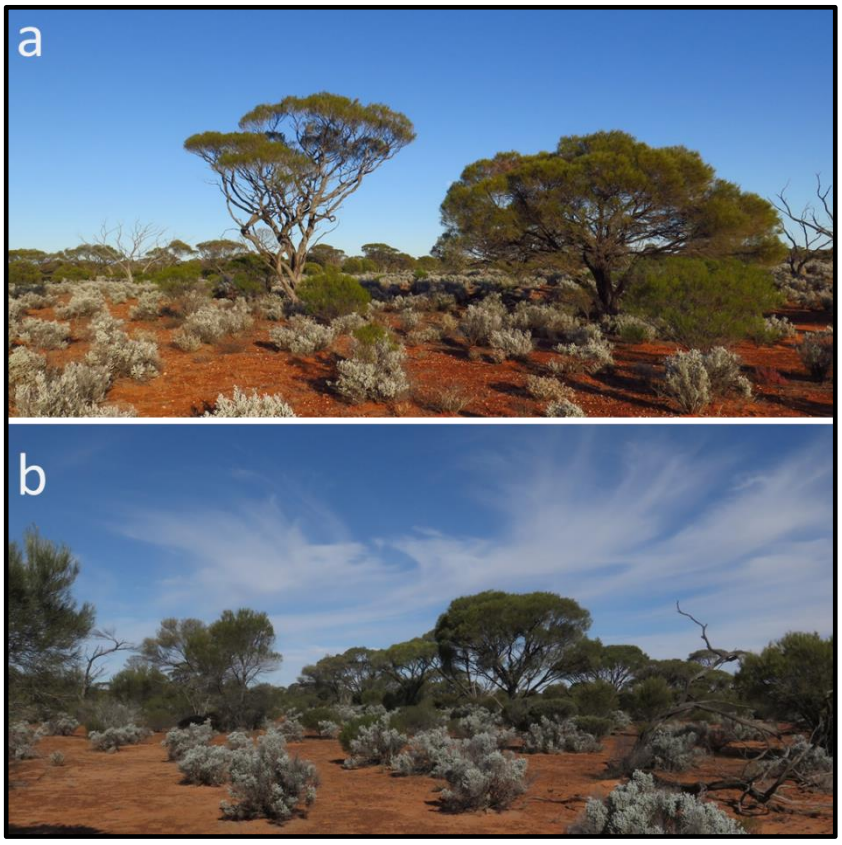

Figure 7. Western myall (*Acacia papyrocarpa*) was the dominant canopy species over much of the northern half of the COLVILLE map sheet. The understory was variously dominated by a) saltbush (*Atriplex* spp.) or b) bluebush (Maireana sedifolia).

Collecting followed standard methods with flowering and fruiting material being pressed after each days collecting, brief descriptions were compiled for all sites and locations determined by handheld GPS. At the 28 unbounded relevés generally 30-40 minutes was spent sampling the area. At the completion of the surveys the plant presses were dried and frozen before processing. Nomenclature follows current usage at the Western Australian Herbarium.

Once the collections had been identified the geographical range of the species was determined from distribution maps available on Atlas of Living Australia spatial portal (ALA, accessed July 2016). Although no taxa were found to be restricted to the Nullarbor a number of new records for this region were documented. Seasonal conditions were somewhat dry and the grass flora in particular was under collected due to lack of flowering material.

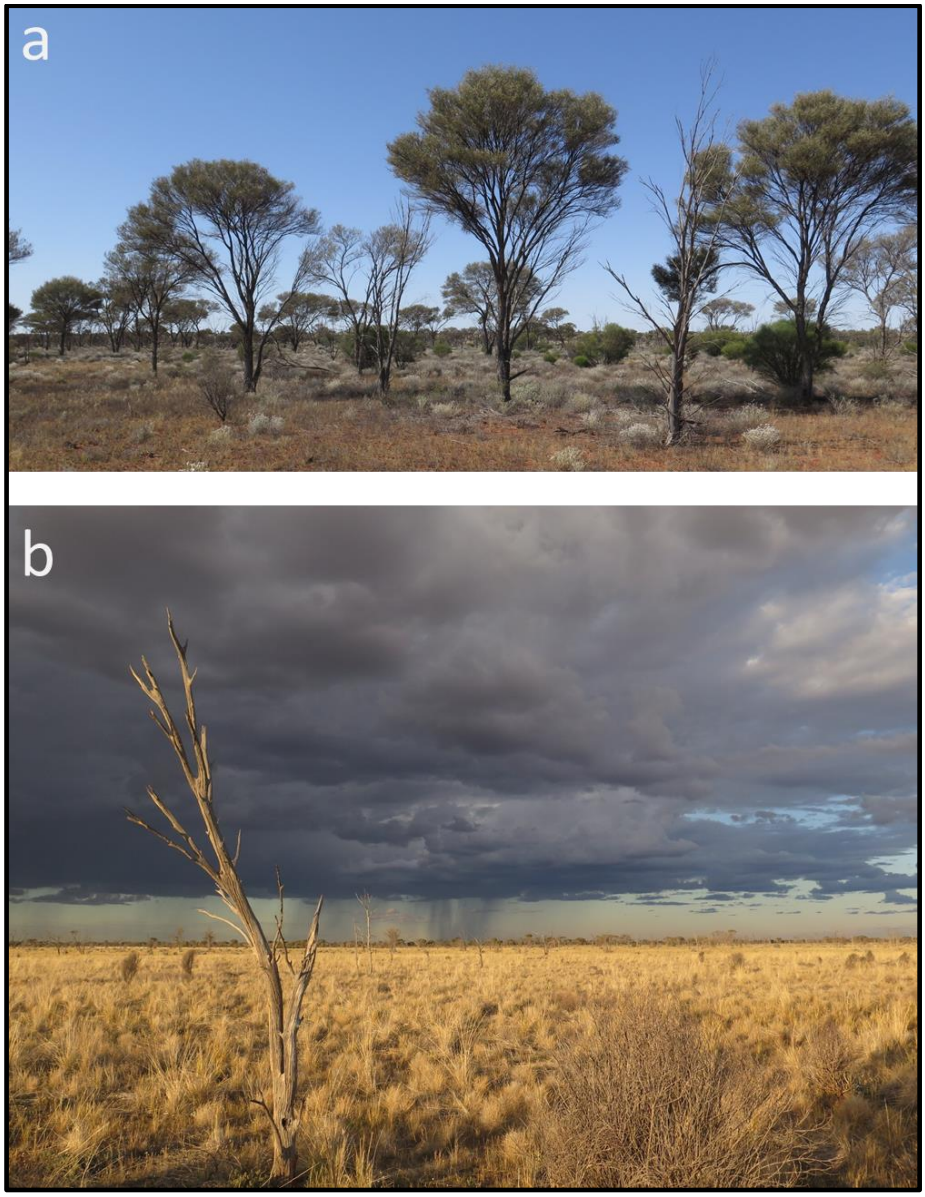

Figure 8a) Open mulga woodland was a minor component of the northern section of the map sheet. b) In burnt areas in the north and much of the southern section of the map sheet the landscape was dominated by *Austrostipa* grassland.

The Nullarbor Survey report (McKenzie and Downing 1987) provided an appendix with quadrat and trapsite locations. Each trapline was marked with a standing starbar and a second bar driven down close to the ground surface. The location of this ground level mark was then fix to an accuracy of ± 5m by the Australian Survey Office. A landscape photo was taken near the primary trapline at each site and reproduced in the report.

Four of the five primary trapline markers for the JU sites were relocated and photopoints identified. These were rephotographed to allow visual assessment of vegetation change across three decades (1984 – 2015). The JU03 site marker appears to have been removed by roadworks. A new photopoint was established close to the original location.

Figure 9. On colluvial deposits of the Colville sandstones *Casuarina pauper* was the dominant canopy species.

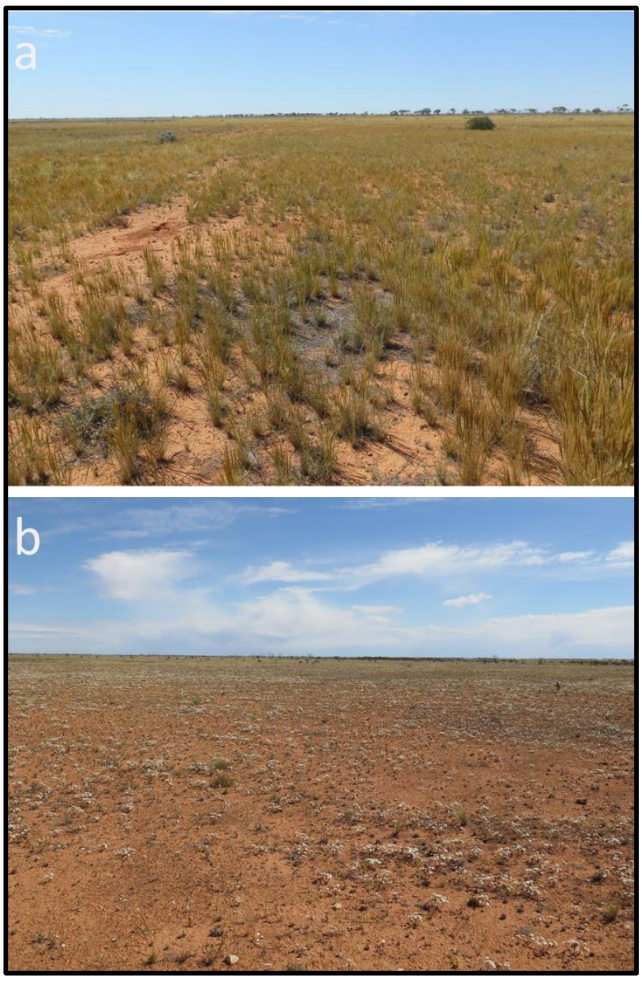

Figure 10a) Open annual *Austrostipa* grasslands are common on the south of the COLVILLE map sheet and in places gives way to b) open herbland dominated by *Rhodanthe floribunda.* Both associations appear to have developed as a result of burning and rabbit grazing eliminating the overstorey and shrub species.

Figure 11. Atriplex shrublands occupy the heavier soils in the drainage depressions, on drier sites western myall forms the overstorey.

Figure 12. To the north of the map sheet mallees (*Eucalyptus concinna, E. socialis*) over spinifex (*Triodia scariosa*) was encountered on isolated red dunes.

Results

During the survey 148 taxa including varieties and hybrids were recorded and 216 collections were made of 142 (96%) of these taxa (Appendix 1). Twenty nine families were recorded in the survey, the most common families were Chenopodiaceae (24 taxa), Fabaceae (23), Asteraceae (21), Poaceae (13), Malvaceae (10), and Scrophulariaceae (9). Of the 148 taxa recorded four were new records to the Western Australian section of the Nullarbor, and five were new records for entire Nullarbor (Table 1). These figures cover all 115 sites surveyed both in and adjacent to the COLVILLE sheet (Appendix 1).

Table 1. New records for the Western Australian section of the Nullarbor bioregion and the bioregion as a whole.

Taxon	New Record
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP 1266)	Nullarbor
Alyogyne pinoniana	Nullarbor
Calocephalus knappii	Nullarbor
Euphorbia ferdinandi var. *ferdinandi*	Nullarbor
Senna sp. Meekatharra (E. Bailey 1-26)	Nullarbor
Abutilon otocarpum	WA Nullarbor
Senna artemisioides subsp. *quadrifolia*	WA Nullarbor
Zygophyllum apiculatum	WA Nullarbor
Zygophyllum simile	WA Nullarbor

No threatened taxa were recorded during the survey, and only one taxon on the Department of Parks and Wildlife's Priority Flora List were encountered (*Hibiscus krichauffianus* – P3). The Priority Flora List is a State based list of taxa under consideration for listing as Threatened Flora. Taxa that have not yet been adequately surveyed may be added to the Priority Flora List under Priorities 1, 2 or 3 (Jones 2014). This taxon is much more widespread to the east of the WA border (Figure 13).

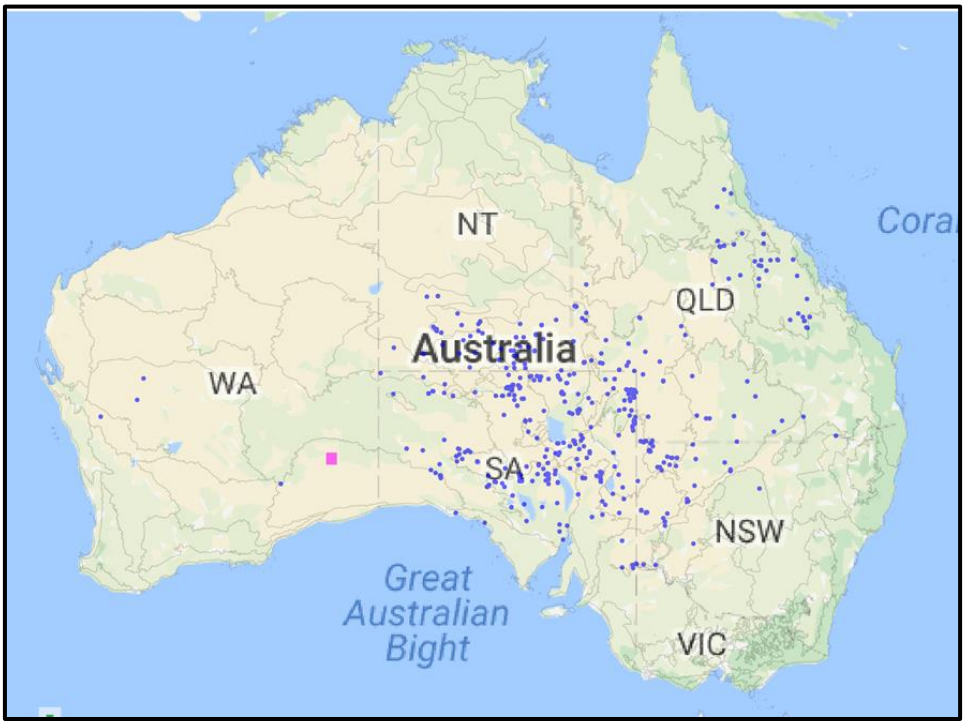

Figure 13. Distribution of Priority 3 *Hibiscus krichauffianus* across Australia (ALA accessed July 2016). Very few collections are known from Western Australia. Pink square is location of COLVILLE map sheet.

Seven introduced taxa were recorded of which buffel grass (*Cenchrus ciliaris,* Figure 14) and Ward's weed (*Carrichtera annua,* Figure 15) are of most concern (Table 2).

Figure 14. Buffel grass infestation (*Cenchrus ciliaris*) on drainage line, population is spreading into undisturbed bushland away from track.

Figure 15. Ward's weed (*Carrichtera annua*) was widespread in study area becoming particularly obvious around rabbit warrens, presumably this species is unpalatable. This photo was taken in a small depression, Ward's weed is the dark green plants in the right side of the photograph, and the white daisy is *Rhodanthe floribunda*.

Phrase names are used on FloraBase (WA Herbarium 1998–) to identify species that are likely to represent "good" taxa though not yet formally described. Two taxa with phrase names were recorded in the current survey.

- *Abutilon oxycarpum* subsp. Prostrate (A.A. Mitchell PRP 1266) is widespread in the Murchison and Yalgoo bioregions with an outlying collection from Central Ranges. This collection represents a range extension of several hundred kilometres (Figure 16).

- *Senna* sp. Meekatharra (E. Bailey 1-26) is also widespread in the Murchison, Yalgoo and Gascoyne bioregions. This collection also represents a range extension of several hundred kilometres (Figure 17).

Figure 16. *Abutilon oxycarpum* subsp. Prostrate (A.A. Mitchell PRP 1266) is widespread in the Murchison and Yalgoo bioregions but mostly absent from the eastern half of the State (ALA accessed July 2016). Collection from COLVILLE is a new record for the Nullarbor. Pink square is location of COLVILLE map sheet.

Figure 17. *Senna* sp. Meekatharra (E. Bailey 1-26) is also widespread in the Murchison and Yalgoo bioregions and extends into the Gascoyne and Pilbara (ALA accessed July 2016). Collection from COLVILLE is a new record for the Nullarbor. Pink square is location of COLVILLE map sheet.

Two further taxa were collected that could not be assigned to currently described species:

- *Senna* aff. *cardiosperma* (NG & ML 8022)
- *Senna* aff. *helmsii* (NG & ML 8032)

The taxonomy of this group is notoriously complex and finding new variants is not unusual.

Table 2. Introduced taxa found in COLVILLE survey.

Family	Taxon
Asteraceae	*Sonchus oleraceus*
Brassicaceae	*Brassica tournefortii*
	Carrichtera annua
Geraniaceae	*Erodium aureum*
Lamiaceae	*Salvia verbenaca*
Malvaceae	*Malvastrum americanum*
Poaceae	*Cenchrus ciliaris*

The comparison of the 1984 Nullarbor Survey and contemporary site photos shows a general decline in the cover of western myall (JU01 – Figure 18, JU02 – Figure 19, JU04 – Figure 21) but the density of the understory shrubs (bluebush and/or saltbush) appears similar. There has been extensive western myall regeneration at JU04 not seen at the other sites. The mulga woodland at JU05 (Figure 22) has lost most of the tree cover presumably from a combination of burning and rabbit grazing. We were not able to relocate the JU03 marker which appears to been removed by roadworks. The vegetation in this area has been severely burnt over and disturbed since 1984 and the location of the photopoint could not be determined. A new photopoint was established (Figure 20).

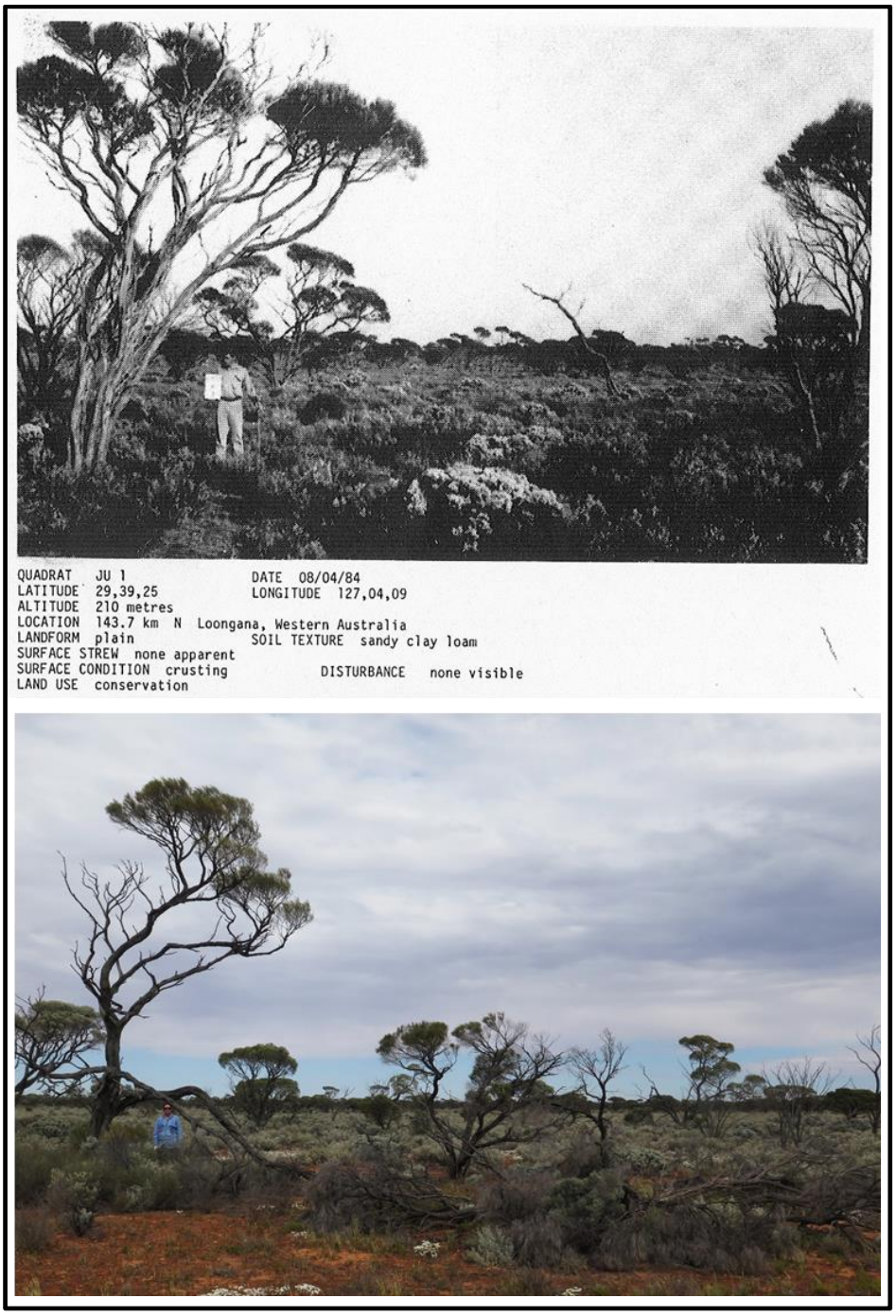

Figure 18. JU01 – 30/08/2016. Western myall less dense than see in the 1984 photo.

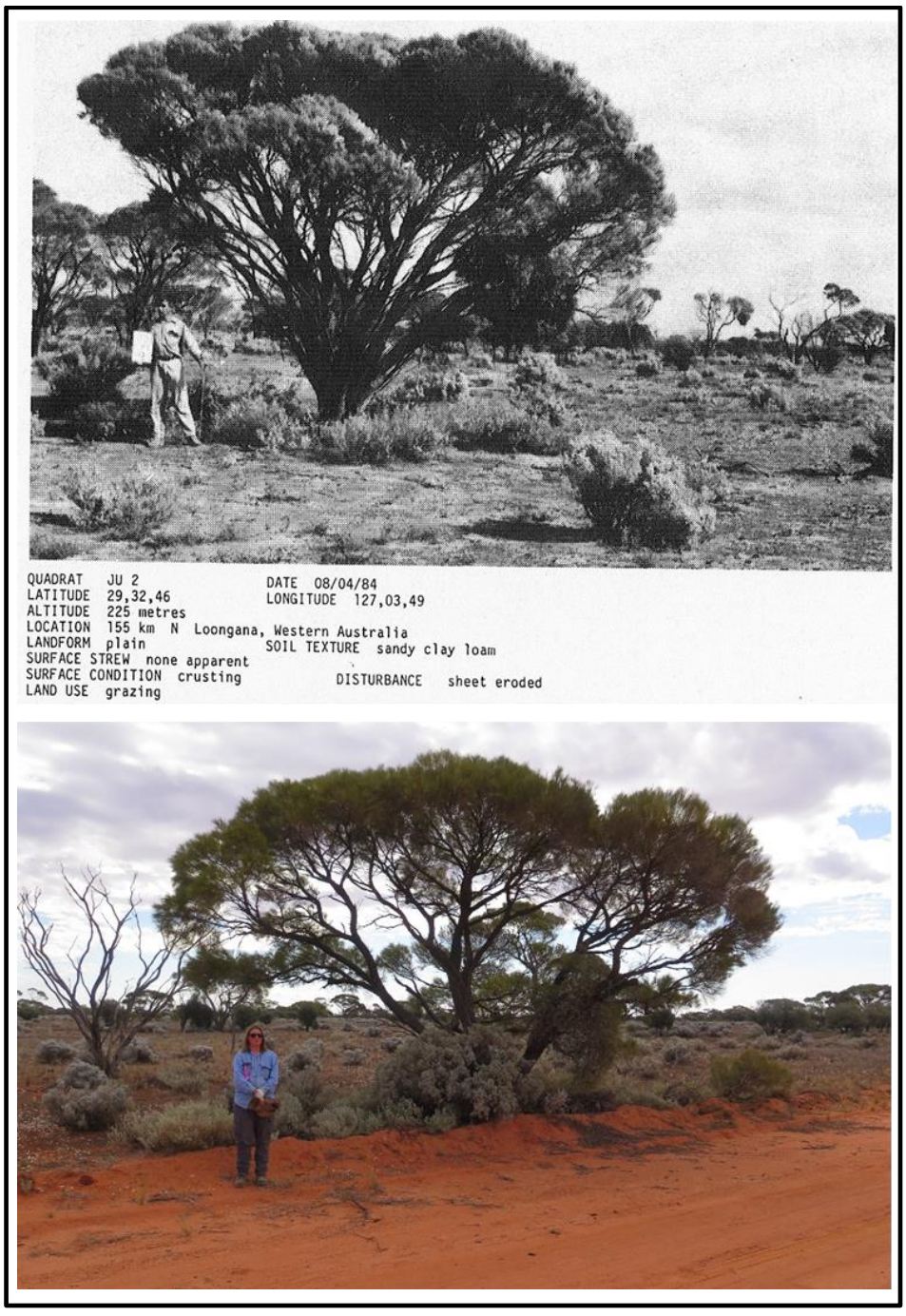

Figure 19. JU02 – 30/08/2016. Western myall less dense than see in the 1984 photo, width of road significantly increased.

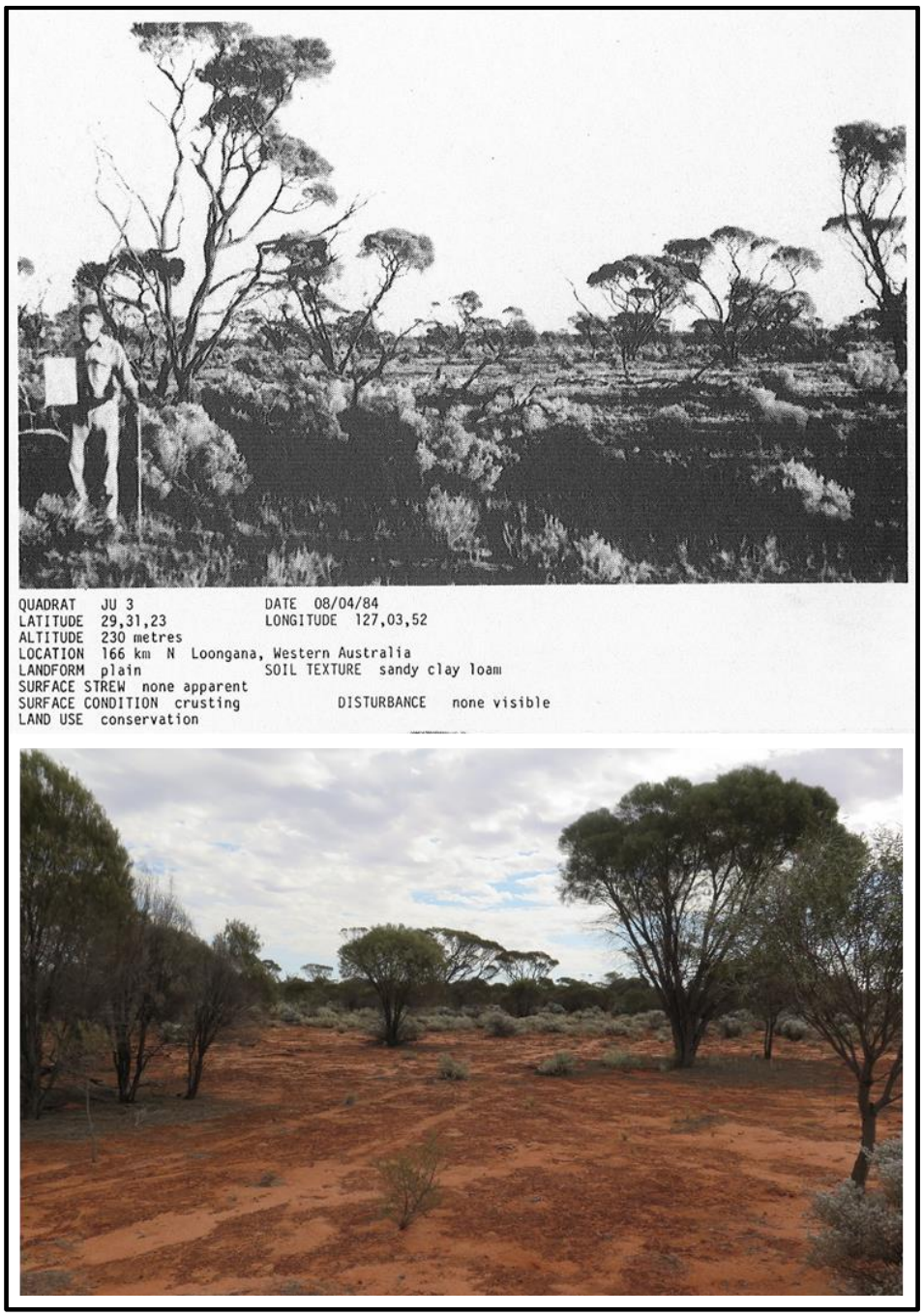

Figure 20. JU03 – 30/08/2016. Site has been heavily disturbed and burnt, could not relocate photo point, overall the western myall appears less dense than see in the 1984 photo.

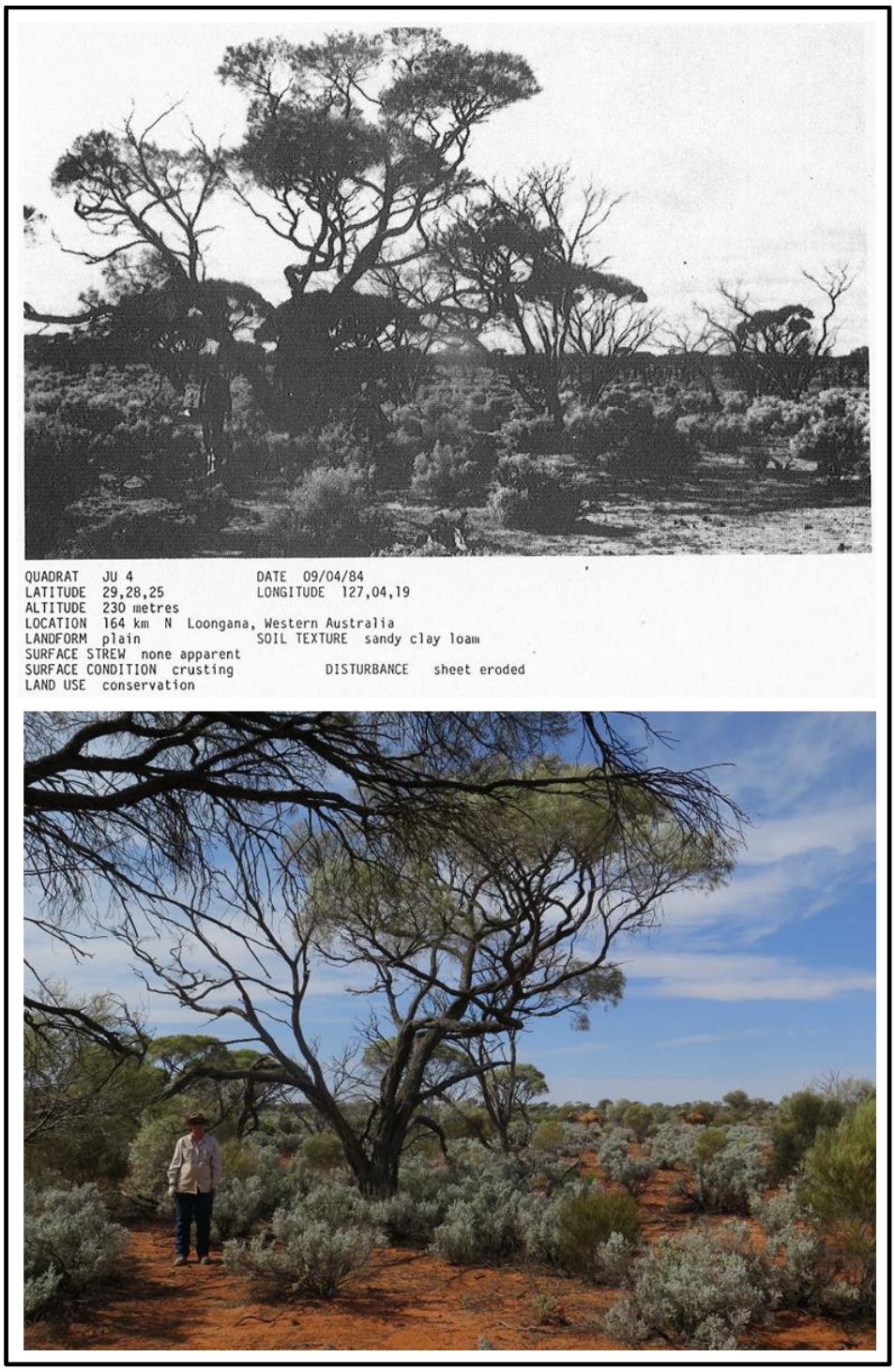

Figure 21. JU04 – 05/09/2016. Decrease in mature western myall compared to 1984 photo but high density of a juvenile cohort probably dating from the calicivirus epidemic in the 1990s. Note camels in mid-ground right of photo.

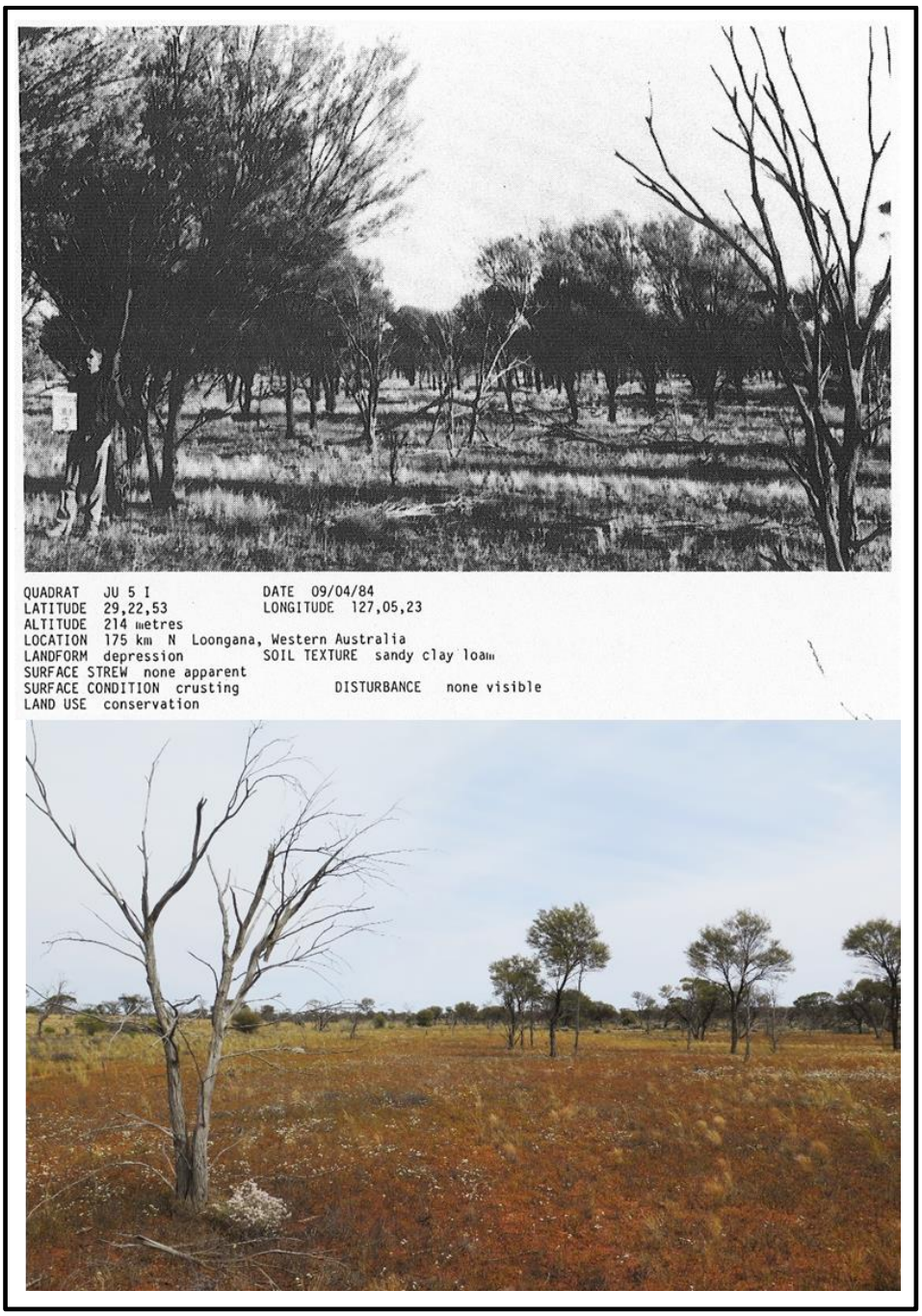

Figure 22. JU05 – 05/09/2016. Massive reduction in density of mulga compared with the 1984 photo. Precise photopoint could not be relocated but thinning of mulga consistent across entire land unit. Differences on the cover of grasses likely to be seasonal variation.

Discussion

Little botanical survey work has been undertaken on the COLVILLE sheet largely due to it remoteness and the circumstance that the main access tracks in the area pass to the north and east (Figure 23). Indeed the earliest herbarium collections made from this sheet were from 2012 as a result of a helicopter survey (Figure 4).

While the vegetation of the Nullarbor bioregion has been severely impacted by the rabbit grazing, historically the northern section was quite variable in structure. Giles (1889) records leaving the thick scrub of the preceding five days on the eastern edge of the COLVILLE sheet and entering more open myall which became well grassed as he proceeded west. He mapped this boundary as the edge of the "Great Southern Plain". This description of the country is not congruent with Beard's 1:1 000 000 mapping and may reflect either a mapping scale issue or changes in structure due to fire history.

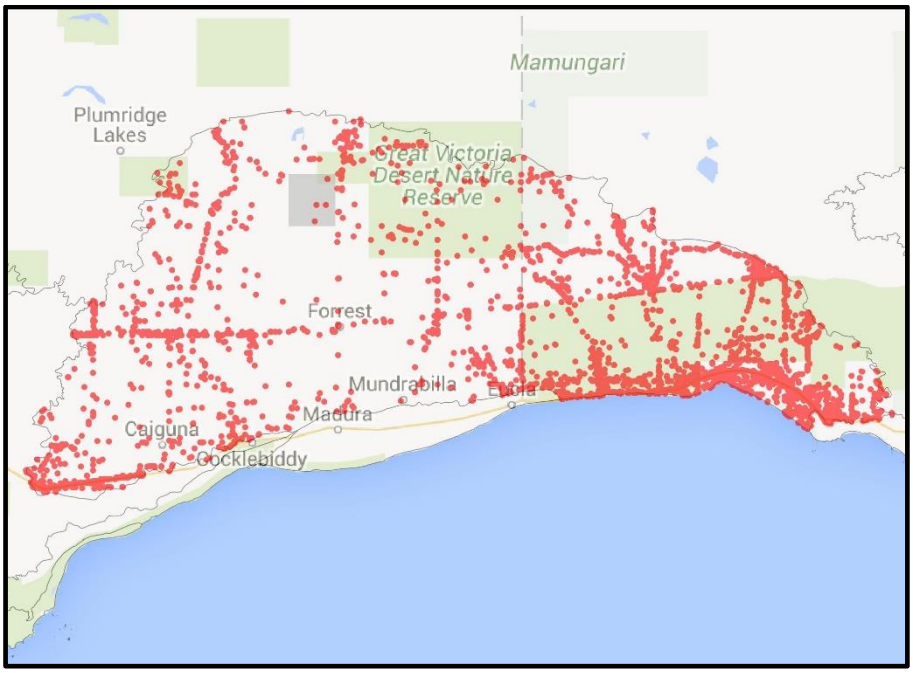

Figure 23. Almost 23,000 herbarium collections have been made from the Nullarbor bioregion representing some 1465 taxa (ALA – accessed July 2016). The COLVILLE sheet (grey square) had only six collections, two of these were in error and were in fact collected by Helm in 1891 from further north in the Great Victoria Desert. Three of the remaining collections were made in 2012 from a helicopter survey of a proposed haul road alignment with the fourth being made in 2014.

The interaction of fire and rabbit grazing permanently removing shrub and tree layers from the plant associations of the Nullarbor has been well documented, especially in the pastoral region of the south (Gillieson *et al.* 1996; Waddell *et al.* 2010). It is clear from Main's early description from 1960, Beard's mapping from 1970 and this current survey that this conversion of western myall over bluebush/saltbush to grassland has also been widespread in the northern Nullarbor. In the southern half of the map sheet the vegetation along the eastern boundary is now essentially *Austrostipa* grassland or *Rhodanthe* herblands where Main reported it as myall over bluebush and Beard's vegetation codes indicate it was a bluebush plain.

In the northern half of the map sheet areas there are areas of grassland that may have been induced by fire/rabbit grazing but most of the area is still cover by myall over bluebush/saltbush. Comparisons

of photos taken in 1984 and 2015 suggest there has been a general decrease in the cover of the myall with little evidence of regeneration. However at JU04 significant regeneration of myall is apparent (Figure 21) and this was observed in localised areas elsewhere during the survey. This regeneration event may have been a result of a crash in rabbit numbers in the 1990s due to the release of rabbit calicivirus (Gilfillan 1999). The long term trajectory of these communities will depend on trends in rabbit population numbers and fire frequency.

Compared to a recent similar survey in the Great Victoria Desert (Gibson *et al.* 2015) far fewer species (148 *cf.* 381) and families (29 *cf*. 45) were found in the current survey. This smaller flora is likely to be a result of the harsh edaphic conditions caused by the shallow high pH soils over massive limestones. Despite the lower diversity nine new records for the Nullarbor bioregion were recorded, four of these had previously been recorded from the South Australian section of the Nullarbor bioregion. The JU sites from the 1984 Nullarbor Survey recorded 58 taxa sampling two habitats along the eastern boundary of the map sheet. The larger number recorded in the current survey (148) simply reflects the larger number of habitats sampled.

While the overall number of introduced taxa found during the current survey was low, Ward's weed was particularly pervasive and buffel grass was spreading along access tracks. Rabbits along with fire have, and may continue to, cause major ecosystem transition from shrublands and woodlands to grasslands. In addition camel density appears to be high (Figure 24) and their impact on the northern Nullarbor woodlands remains unclear.

Figure 24. Large numbers of camels were observed during the survey on both the COLVILLE map sheet and adjacent areas.

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Appendix 1.

List of plant taxa recorded on the COLVILLE map sheet and adjacent areas.

Family	Qualifier	Taxon	COLVILLE	Other
Aizoaceae				
		Tetragonia eremaea	1	1
Amaranthaceae				
		Ptilotus gaudichaudii subsp. *gaudichaudii*		1
		Ptilotus obovatus	1	1
		Ptilotus polystachyus		1
Apiaceae				
		Daucus glochidiatus	1	
Apocynaceae				
		Rhyncharrhena linearis	1	1
Asteraceae				
		Brachyscome ciliaris	1	1
		Brachyscome trachycarpa	1	1
		Calocephalus knappii		1
		Calotis breviradiata		1
		Calotis multicaulis		1
		Cephalipterum drummondii	1	1
		Chrysocephalum pterochaetum	1	1
		Cratystylis conocephala	1	1
		Leiocarpa websteri	1	1
		Minuria multiseta	1	1
		Podolepis aristata subsp. *affinis*	1	1
		Podolepis capillaris	1	1
		Pterocaulon sphacelatum		1
		Pycnosorus pleiocephalus	1	1
		Rhodanthe floribunda	1	1
		Rhodanthe maryonii		1
		Rhodanthe nullarborensis	1	1
		Schoenia ayersii	1	1
		Sonchus oleraceus	1	1
		Trichanthodium skirrophorum	1	1
		Vittadinia eremaea	1	1
Boraginaceae				
		Omphalolappula concava		1
Brassicaceae				
		Brassica tournefortii	1	1
		Carrichtera annua	1	1
		Lepidium phlebopetalum	1	1
		Menkea villosula		1
		Stenopetalum lineare var. *lineare*	1	1
Casuarinaceae				
		Casuarina pauper	1	1
Chenopodiaceae				
		Atriplex acutibractea subsp. *acutibractea*	1	

Family	Qualifier	Taxon	COLVILLE	Other
		Atriplex limbata		1
		Atriplex nummularia	1	1
		Atriplex nummularia subsp. *spathulata*	1	1
		Atriplex vesicaria	1	1
		Chenopodium curvispicatum	1	1
		Chenopodium desertorum subsp. *desertorum*		1
		Chenopodium gaudichaudianum	1	1
		Chenopodium nitrariaceum	1	1
		Dissocarpus paradoxus	1	
		Dysphania melanocarpa		1
		Enchylaena tomentosa	1	1
		Eriochiton sclerolaenoides	1	1
		Maireana erioclada		1
		Maireana georgei	1	1
		Maireana integra		1
		Maireana pyramidata	1	
		Maireana sedifolia	1	1
		Maireana trichoptera	1	1
		Maireana turbinata	1	
		Salsola australis	1	1
		Sclerolaena diacantha	1	1
		Sclerolaena obliquicuspis	1	1
		Sclerolaena patenticuspis	1	1
Convolvulaceae				
		Convolvulus recurvatus subsp. *nullarborensis*	1	1
Euphorbiaceae				
		Euphorbia ferdinandi var. *ferdinandi*	1	
		Euphorbia multifaria		1
		Euphorbia tannensis subsp. *eremophila*	1	1
Fabaceae				
		Acacia aneura	1	1
		Acacia aptaneura	1	
	?	*Acacia ayersiana*		1
		Acacia kempeana		1
		Acacia ligulata		1
		Acacia mulganeura		1
		Acacia nyssophylla		1
		Acacia oswaldii	1	1
		Acacia papyrocarpa	1	1
		Acacia pteraneura	1	1
		Acacia tetragonophylla	1	1
		Cullen cinereum	1	1
		Lotus cruentus	1	1
		Senna aff. *cardiosperma* (NG & ML 8022)	1	
		Senna aff. *helmsii* (NG & ML 8032)	1	
		Senna artemisioides subsp. *filifolia*	1	
		Senna artemisioides subsp. *petiolaris*	1	1
		Senna artemisioides subsp. *quadrifolia*	1	

Family	Qualifier	Taxon	COLVILLE	Other
		Senna artemisioides subsp. *x artemisioides*	1	1
		Senna sp. Meekatharra (E. Bailey 1-26)	1	
		Swainsona affinis		1
		Swainsona formosa	1	1
		Swainsona tenuis	1	1
Geraniaceae				
		Erodium aureum	1	
		Erodium carolinianum	1	1
		Erodium cygnorum	1	1
Goodeniaceae				
		Goodenia pinnatifida	1	1
		Scaevola spinescens	1	1
Gyrostemonaceae				
	?	*Gyrostemon ramulosus*		1
Lamiaceae				
		Salvia verbenaca		1
Loranthaceae				
		Amyema quandang var. *quandang*	1	1
Malvaceae				
		Abutilon cryptopetalum		1
		Abutilon otocarpum		1
		Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP 1266)		1
		Alyogyne pinoniana		1
		Hibiscus krichauffianus[1]		1
		Malva weinmanniana	1	1
		Malvastrum americanum	1	1
		Sida calyxhymenia	1	1
		Sida fibulifera	1	1
		Sida spodochroma	1	1
Myrtaceae				
		Eucalyptus concinna		1
		Eucalyptus oleosa subsp. *oleosa*	1	
		Eucalyptus socialis		1
Nitrariaceae				
		Nitraria billardierei	1	1
Pittosporaceae				
		Pittosporum angustifolium		1
Poaceae				
		Aristida contorta	1	1
		Austrostipa nitida	1	1
		Austrostipa puberula	1	1
		Austrostipa vickeryana		1
		Cenchrus ciliaris	1	1
		Enneapogon avenaceus		1
		Enneapogon caerulescens	1	1
		Enneapogon cylindricus	1	1
		Eragrostis dielsii		1
		Eragrostis xerophila	1	1

Family	Qualifier	Taxon	COLVILLE	Other
		Paspalidium clementii		1
		Rytidosperma setaceum	1	1
		Triodia scariosa		1
Polygonaceae				
		Duma florulenta	1	1
Portulacaceae				
		Calandrinia polyandra	1	1
		Calandrinia ptychosperma		1
Santalaceae				
		Exocarpos aphyllus		1
		Santalum acuminatum	1	1
Sapindaceae				
		Alectryon oleifolius subsp. *canescens*	1	1
		Dodonaea viscosa subsp. *angustissima*		1
Scrophulariaceae[2]				
		Eremophila falcata		1
		Eremophila hygrophana		1
		Eremophila latrobei	1	1
		Eremophila latrobei subsp. *glabra*		1
		Eremophila longifolia		1
		Eremophila maculata subsp. *brevifolia*	1	
		Eremophila paisleyi		1
		Eremophila scoparia	1	1
		Myoporum platycarpum subsp. *platycarpum*	1	1
Solanaceae				
	?	*Lycium australe*		1
		Nicotiana occidentalis subsp. *obliqua*	1	1
		Solanum lasiophyllum		1
		Solanum orbiculatum subsp. *orbiculatum*	1	1
		Solanum sp. aff. *ellipticum* sens. lat.		1
Zygophyllaceae				
		Zygophyllum apiculatum		1
		Zygophyllum eremaeum	1	1
		Zygophyllum iodocarpum	1	1
		Zygophyllum ovatum	1	1
		Zygophyllum simile	1	
		Zygophyllum tesquorum		1

1) Listed as Priority 3 taxon.

2) *Eremophila attenuata,* a Priority 1 taxon, has been previously recorded from the map sheet