



TERN  
AusPlots

# Summary of Sites at the Boyagin flux station

August 2016



*Eucalyptus accedens*, *Eucalyptus wandoo* subsp. *wandoo* woodland, Boyagin Nature Reserve



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## Acknowledgments

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## Contents

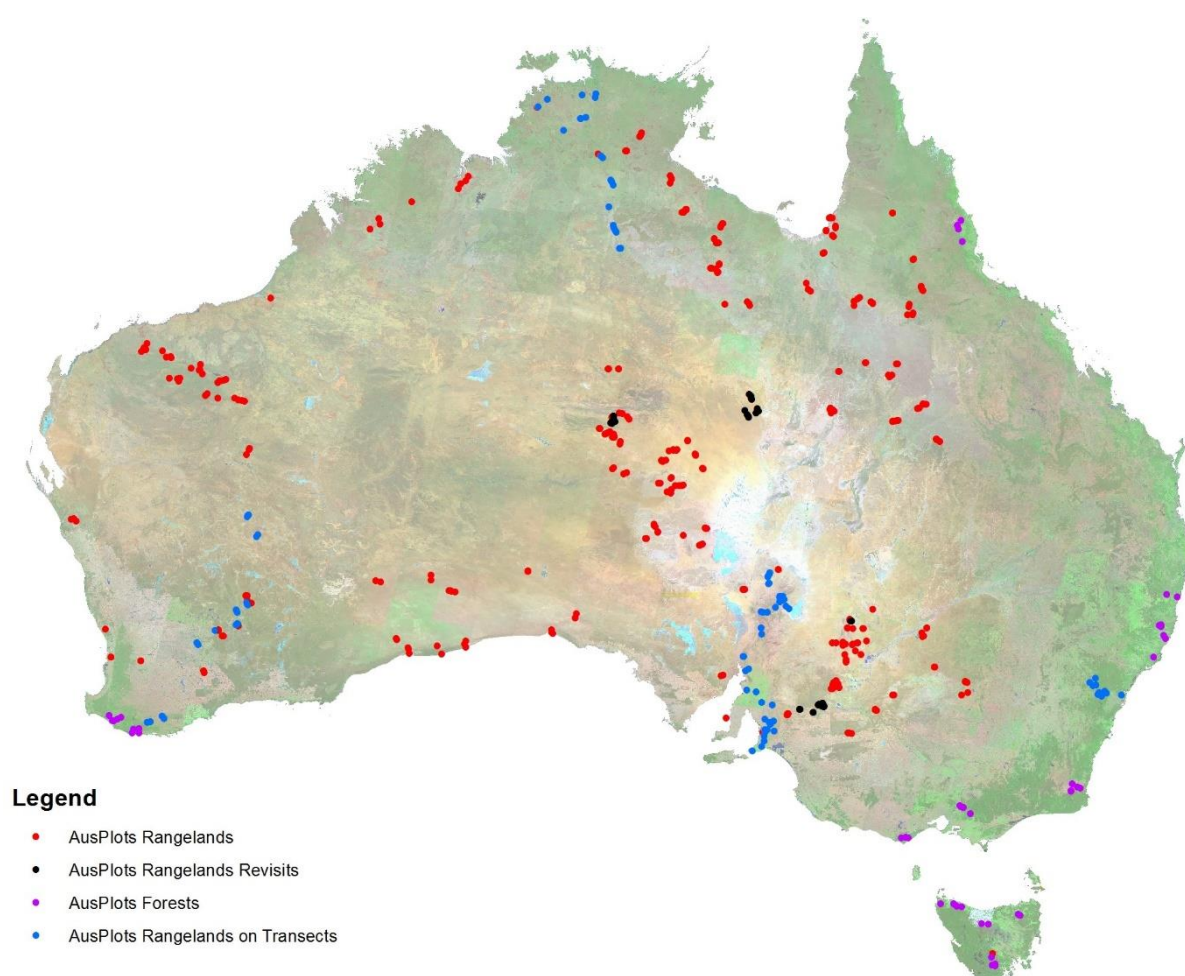
Introduction.....	1
Accessing the Data.....	3
Point intercept data .....	3
Plant collections .....	3
Leaf tissue samples.....	3
Site description information .....	3
Structural summary.....	3
Leaf Area Index .....	3
Basal area.....	3
Soil classification .....	4
Soil meta barcoding samples .....	4
Soil bulk density .....	4
3D Photo Panorama .....	4
Regional Context.....	6
Potential Uses for AusPlots Data from the Boyagin flux station .....	9
For more information .....	9
Appencides .....	10
 Appendix 1. Summary of AusPlots data and samples from at the Boyagin flux station.....	10
Appendix 2. Plot locations .....	11
Appendix 3. Point intercept data .....	12
Appendix 4. Substrate and growth form .....	13
Appendix 5. Structural Summary.....	14
Appendix 6. Soil Classification.....	15
Appendix 7. Bulk density.....	15
Appendix 8. Plant collection.....	16



## Introduction

In August 2016, AusPlots, part of the Terrestrial Ecosystems Research Network (TERN), undertook surveys at the Boyagin flux station, Western Australia. The surveys involved vegetation and soils work following the AusPlots Rangelands methodology, with 2 plots completed. The plots are part of over 580 plots completed nationally. Figure 1 shows the national AusPlots plot network, and Figure 2 shows the locations of the plots at the Boyagin flux station.

This report provides a snapshot of some of the data which was collected during the survey work. A more detailed description of the methods used can be found online in our *AusPlots Rangelands Survey Protocols Manual* (White *et al.* 2012), available from our website [www.ausplots.org](http://www.ausplots.org).



**Figure 1. AusPlots plot network**

*LandSat Image used courtesy of the Commonwealth Department of the Environment*





## Accessing the Data

All of the data the AusPlots collects is freely available online through the AEKOS data portal at [www.aekos.org.au](http://www.aekos.org.au). It can also be viewed on the Soils to Satellites website which contains a range of useful visualisations sourced from the Atlas of Living Australia. At <http://www.soils2satellites.org.au/>.

### Point intercept data

The point intercept method is a straightforward method that is readily repeatable and requires little instruction to produce reliable plot information. It provides accurate benchmark data at each plot including substrate type and cover; as well as species structural information such as growth form, height, cover and abundance and population vertical structure. The demographic information produced at each plot can be compared spatially to indicate plot differences, and temporally to indicate change over time. Additionally, the cover data collected at each plot can be used to validate cover data extrapolated through remote sensing techniques.

### Plant collections

Each species that is found within the plot has a herbarium grade sample taken. These have all been formally identified by the WA herbarium. Much of the material is then lodged at the WA herbarium or at the Ausplots facility in Adelaide.

### Leaf tissue samples

All of the above samples also have leaf tissue samples taken. This involves placing leaf samples from each species into a cloth bag and drying them on silica desiccant. All of the dominant species have an extra 4 samples collected. These samples are available for use on application to Ausplots facility in Adelaide. They are able to be used for genetic analysis, Isotopic composition and range of other uses.

### Site description information

Contextual information is also collected at each site. This includes measures of slope an aspect, surface strew and lithology, and information on the grazing and fire history of the site. The sites location is also recorded with a differential GPS and the plot corners and centres (with landholder permission) marked with a star picket.

### Structural summary

Detailed structural summary information is also collected at each site. When combined with the height and cover information from the point intercept data it enables the creation of structural description compatible with and NVIS level 5 description.

### Leaf Area Index

In plots where a mid and/or upper canopy is present a measure of Leaf Area is recorded. The tool used is an LAI-2200 and it captures LAI measurements in a range of canopies using one or two sensors attached to a single data logger (LI-COR 1990). The LAI data has a range of potential application such as studies of canopy growth, canopy productivity, woodland vigour, canopy fuel load, air pollution deposition, modelling insect defoliation, remote sensing, and the global carbon cycle.

### Basal area

Basal area measurements are collected across plots where woody biomass is taller than 2m. Basal area measurements provide information useful for calculating biomass and carbon levels and for structural studies. The wedge aperture, the length of string – 50 cm (and hence the distance from the eye and subsequent angle from the eye to the edges of the wedge aperture) and species count are all important in calculations. Algorithms developed for use with the basal wedge include the above data to calculate plant basal area on a per hectare basis even though species are counted outside the one hectare plot area. The method is plotless but used because it is based on the



concept of circles (trunks/basal area) within circles (circular plots) – the area of one varies proportionally to the change in the area of the other. Use of the basal wedge may be superseded by further improvement of the 3D photo point method and development of algorithms to provide information on vegetation community structure.

### **Soil classification**

Soils descriptions i.e. information recorded, number of recordings and coverage of locations, are generally poor across the rangelands region of Australia. The plot descriptions and soil characterisations collected will substantially alleviate this paucity of information. The data collected can also be used to increase the reliability of the rangelands component of the Soil and Landscape Grid of Australia, produced by the TERN facility consistent with the Global Soil Map specifications. Analyses of the collected samples will greatly enhance the level of knowledge (e.g. nutrient and carbon levels) and hence understanding of rangelands soils and how they will respond to climate change and management options. It is hoped to eventually be able to analyse all 9 of the soil pits from within the plot using a number of different methods e.g. wet chemistry, MIR or NIR (mid infrared spectrometry or near infrared spectroscopy) either individually to provide a measure of variation of the parameter being measured across a plot or bulked together and a sub-sample extracted and analysed to provide a mean value for that parameter across a plot.

### **Soil meta barcoding samples**

Metagenomics is the study of genetic material recovered directly from environmental samples. Soil metagenomics provides the opportunity to understand what organisms are present at survey plots and provides an indication on their abundance. The collection techniques result in a bias towards higher order organisms. All of the Ausplots at the Boyagin flux station have soil meta barcoding samples collected.

### **Soil bulk density**

The soil bulk density (BD), also known as dry bulk density, is the weight of dry soil divided by the total soil volume. The total soil volume is the combined volume of solids and pores which may contain air or water, or both. The average values of air, water and solid in soil are easily measured and are a useful indication of a soils physical condition. Soil test results are most often presented either as a percentage of soil (e.g. % organic carbon) or as a weight per unit of soil (e.g. nitrogen, mg/kg). As bulk density is a measure of soil weight in a given volume, it provides a useful conversion from these units to an area basis unit (e.g. t/ha). The resulting number gives an easily understandable idea of the carbon storage or nutritional status of the soil on an area basis.

### **3D Photo Panorama**

AusPlots uses a three-dimensional method for photographing the site. This involves taking three 360 degree panoramas in a triangular pattern. This allows the creation of a 3D model of the vegetation within the site which can be used to monitor change over time, track plot condition as well as providing a unique, fast measurement of basal area and biomass. Photo panoramas for each of the plots are shown below.



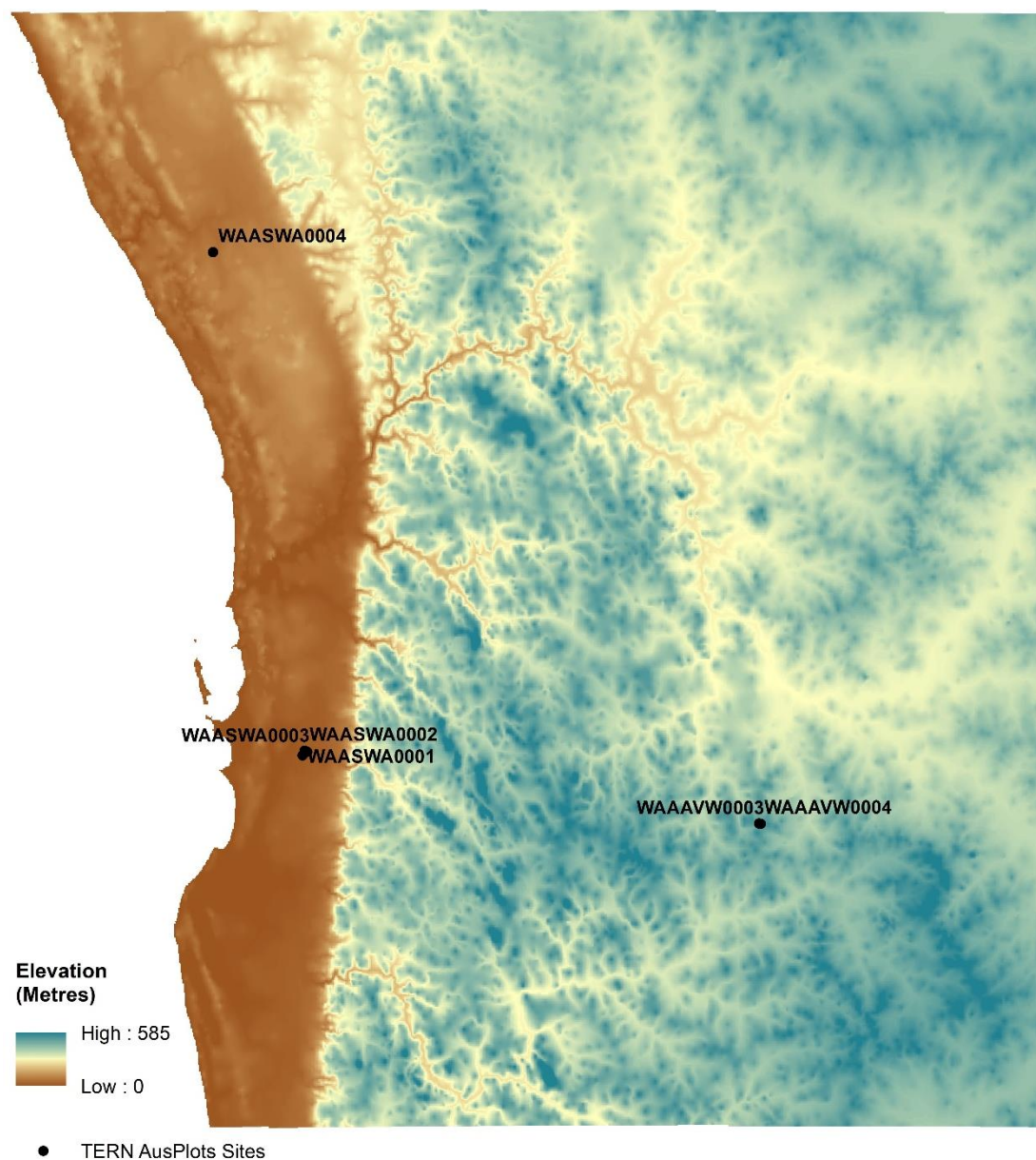
WAAAVW003



WAAAVW004

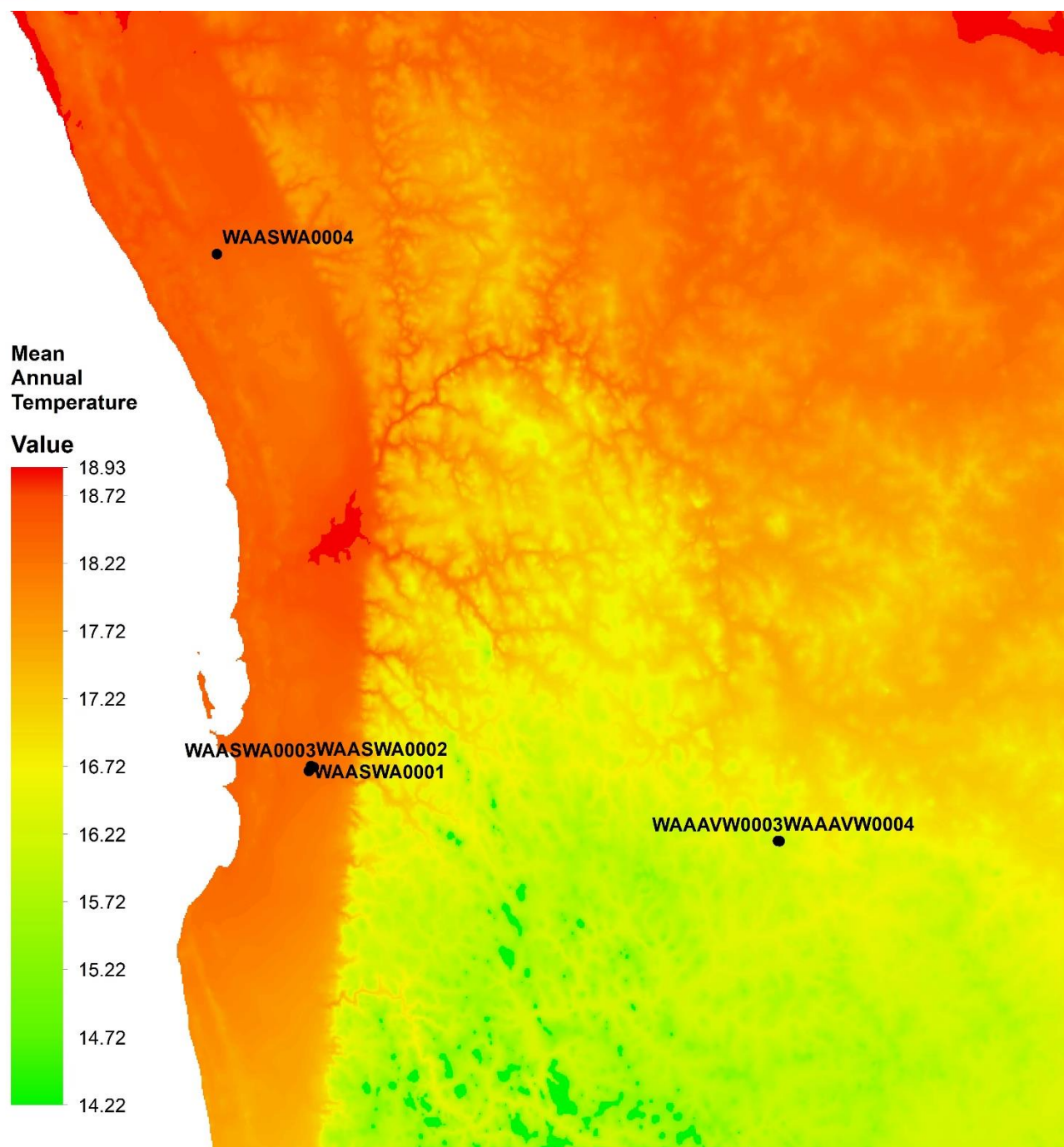


## Regional Context



**Figure 3. Modelled 9s elevation**

*Data from: Xu and Hutchinson, 2011. ANUCLIM Version 6.1. Fenner School of Environment and Society, Australian National University, Australia.*

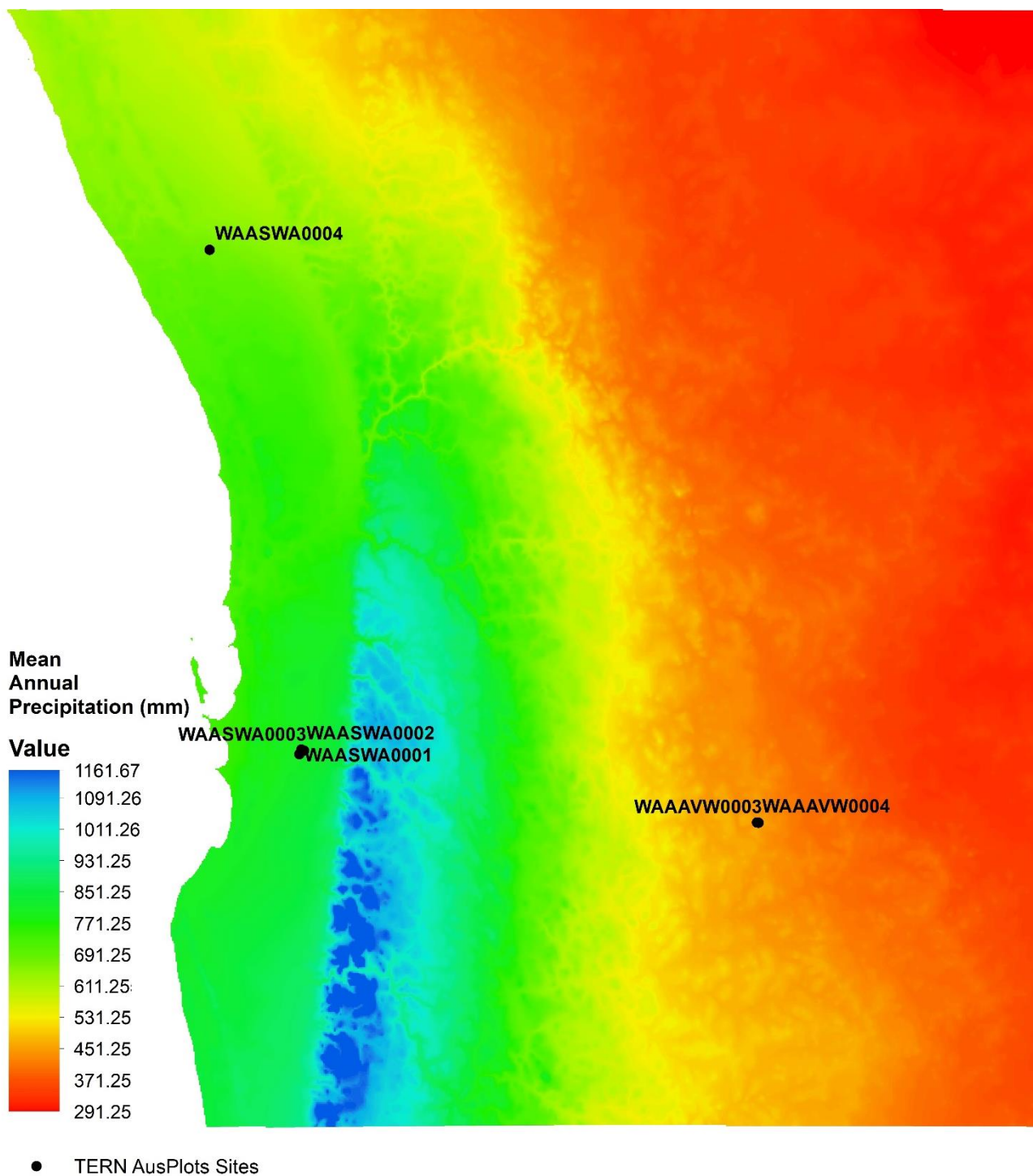


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**Figure 4. Mean annual temperature**

Data from: Xu and Hutchinson, 2011. ANUCLIM Version 6.1. Fenner School of Environment and Society, Australian National University, Australia.





**Figure 5. Mean annual Precipitation**

*Climate Data from: Xu and Hutchinson, 2011. ANUCLIM Version 6.1. Fenner School of Environment and Society, Australian National University, Australia.*

## Potential Uses for AusPlots Data from the Boyagin flux station

The AusPlots survey method was developed out of a dire need for consistent, national scale ecological data and surveillance monitoring. As such, the data can be used in a range of ways both at the Boyagin flux station but also to allow comparisons across the continent. Currently, a range of researchers and land managers make use of the data and samples. Some example applications that may be applicable within the region are listed below.

- Assessing vegetation change using the AusPlots methodology as both a baseline and a continued surveillance monitoring tool.
- Detecting the impact of invasive species based on soil and vegetation data.
- Ground-truthing satellite derived vegetation and soil data
- Soil carbon analysis using the soil bulk density samples
- Mapping soil phosphorus, nitrogen and other nutrients using soil pit and subsite samples
- Assessing fuel loading using the basal area and leaf area data.
- Use of the leaf tissue samples for genetic and isotopic analysis.

## For more information

More information on the AusPlots facility can be found on our website [www.AusPlots.org](http://www.AusPlots.org)

For more information regarding the survey work at the Boyagin flux station and assistance downloading and utilising the data from *AEKOS* and *Soils2Satellites* contact Emrys Leitch, AusPlots Field Survey Officer, [emrys.leitch@adelaide.edu.au](mailto:emrys.leitch@adelaide.edu.au)

For more information regarding the AusPlots facility, contact Ben Sparrow, AusPlots Director, [ben.sparrow@adelaide.edu.au](mailto:ben.sparrow@adelaide.edu.au)



## Appendices

### Appendix 1. Summary of AusPlots data and samples from at the Boyagin flux station

AusPlots Data and Samples	Count
<i>Total Collections</i>	137
<i>Total Leaf Tissue Samples</i>	208
<i>Total number of soil samples</i>	48
<i>Total weight of soil (kg)</i>	48
<i>Number of sites with Bulk Density data</i>	2
<i>Number of Sites with LAI</i>	2
<i>Number of Sites with Basal wedge</i>	2
<i>Total metagenomic samples</i>	18
<i>Total metagenomic weight (kg)</i>	9

## Appendix 2. Plot locations

Plot Name	Date	Location	latitude	longitude
WAAAVW0003	06-Oct-16	-32.479693	116.935659	Boyagin Nature Reserve, South West of Brookton. 14.8 North West of Pingelly.
WAAAVW0004	06-Oct-16	-32.480396	116.938906	Boyagin Nature Reserve, 14km South West of Brookton. 15.2km North West of Pingelly



### Appendix 3. Point intercept data

Plot name	Herbarium ID	Common name	Approx. % cover	WA Cons. Status
WAAAVW0003	Eucalyptus accedens	Powder bark Wandoo	30.69	
WAAAVW0003	Eucalyptus wandoo subsp. wandoo	Wandoo	3.37	
WAAAVW0003	Eucalyptus accedens		1.98	
WAAAVW0003	Hibbertia montana		0.10	Priority Flora Category 4
WAAAVW0004	Eucalyptus accedens	Powder bark Wandoo	21.78	
WAAAVW0004	Eucalyptus wandoo subsp. wandoo	Wandoo	12.57	
WAAAVW0004	Bossiaea eriocarpa	Common Brown Pea	0.89	
WAAAVW0004	Hibbertia montana		0.50	Priority Flora Category 4
WAAAVW0004	Millotia tenuifolia var. laevis		0.40	Priority Flora Category 2

#### Appendix 4. Substrate and growth form

Plot name	Growth form	Approx. % cover by growth form
WAAAVW0003	Tree/Palm	33.07
WAAAVW0003	Shrub	4.46
WAAAVW0003	Forb	2.48
WAAAVW0003	Tussock grass	0.59
WAAAVW0003	Sedge	0.40
WAAAVW0003	Rush	0.10
WAAAVW0003	Heath-shrub	0.10
Plot name	Growth form	Approx. % cover by growth form
WAAAVW0004	Tree/Palm	32.87
WAAAVW0004	Shrub	3.86
WAAAVW0004	Forb	2.57
WAAAVW0004	Tussock grass	1.19
WAAAVW0004	Heath-shrub	0.59
WAAAVW0004	Sedge	0.50
WAAAVW0004	Vine	0.20

Plot name	Substrate	Approx. % substrate
WAAAVW0003	Leaf litter	85.94
WAAAVW0003	Gravel	7.92
WAAAVW0003	Bare ground	4.26
WAAAVW0003	Coarse woody debris	0.79
WAAAVW0003	Rock	0.79
WAAAVW0003	Cryptogam	0.30

Plot name	Substrate	Approx. % substrate
WAAAVW0004	Leaf litter	80.89
WAAAVW0004	Gravel	15.35
WAAAVW0004	Bare ground	2.08
WAAAVW0004	Coarse woody debris	0.69
WAAAVW0004	Cryptogam	0.50
WAAAVW0004	Rock	0.30
WAAAVW0004	Outcrop	0.20

## Appendix 5. Structural Summary

Plot name	Structural description
WAAAVW0003	Eucalyptus accedens, Eucalyptus wandoo subsp. wandoo woodland to open forest. Very sparse mid story- some juvenile Eucalyptus spp. Diverse but sparse ground story.
WAAAVW0004	Eucalyptus accedens and Eucalyptus wandoo subsp. wandoo mixed woodland to open forest.



## Appendix 6. Soil Classification

Plot name	Upper depth	Lower depth	Horizon	Texture	Colour when moist	ph	ec	effervescence
WAAAVW0003	0	0.13	A1	Sand	10YR56	5.8	0.1	Non-calcareous
WAAAVW0003	0.13	0.5	A2	Sand	10YR31	6.2	0.07	Non-calcareous
WAAAVW0004	0	0.07	A1	Loamy sand	10YR33	6.3	0.1	Non-calcareous
WAAAVW0004	0.07	1	A2	Loamy sand	10YR68	6.8	0.08	Non-calcareous

## Appendix 7. Bulk density

Plot name	Sample depth	Fine earth weight	Fine earth bulk density
WAAAVW0003	0 to 10cms	189.65	0.97
WAAAVW0003	10 to 20cms	184.21	0.97

## Appendix 8. Plant collection

\*Denotes introduced species

Plot name	Herbarium determination	Common Name	WA Cons. Status
WAAAVW0003	Acacia pulchella var. pulchella	Prickly Moses	
WAAAVW0003	Aira cupaniana	Silvery Hair Grass	
WAAAVW0003	*Arctotheca calendula	African Marigold	
WAAAVW0003	Astroloma epacridis		
WAAAVW0003	Austrostipa hemipogon	Half-bearded Spear-grass	
WAAAVW0003	Austrostipa sp.	Spear-grasses	
WAAAVW0003	Austrostipa sp. (subgenus Falcatae)		
WAAAVW0003	Banksia nobilis subsp. nobilis		
WAAAVW0003	Blennospora drummondii	Dwarf Beauty-heads	
WAAAVW0003	Bossiaea eriocarpa	Common Brown Pea	
WAAAVW0003	Caladenia falcata	Fringed Mantis Orchid	
WAAAVW0003	Caladenia flava subsp. flava	Cowslip Orchid	
WAAAVW0003	Calandrinia calyptrata	Pink Purslane	
WAAAVW0003	Chamaescilla corymbosa var. corymbosa	Blue Stars	
WAAAVW0003	Chamaescilla versicolor		
WAAAVW0003	Conostylis setigera subsp. setigera		
WAAAVW0003	Crassula colorata var. colorata		
WAAAVW0003	Dampiera lavandulacea		
WAAAVW0003	Desmocladius asper		
WAAAVW0003	Dianella revoluta	Black-anther Flax-lily	
WAAAVW0003	Diuris sp.	Donkey Orchids	
WAAAVW0003	Drosera macrantha	Bridal Rainbow	
WAAAVW0003	Ericksonella saccharata	Sugar Orchid	
WAAAVW0003	Eucalyptus accedens	Powder bark Wandoo	
WAAAVW0003	Eucalyptus accedens		
WAAAVW0003	Eucalyptus wandoo subsp. wandoo	Wandoo	
WAAAVW0003	Gahnia australis		
WAAAVW0003	Gastrolobium parviflorum	Box Poison	
WAAAVW0003	Grevillea monticola		
WAAAVW0003	Hakea lissocarpha	Duck and Drake Bush	
WAAAVW0003	Hibbertia hemignosta		
WAAAVW0003	Hibbertia montana		Priority Flora Category 4
WAAAVW0003	Hordeum leporinum	Barley Grass	
WAAAVW0003	Hovea chorizemifolia	Holly-leaved Hovea	
WAAAVW0003	Isolepis marginata	Coarse Club-rush	
WAAAVW0003	Lagenophora huegelii	Coarse Bottle-daisy	
WAAAVW0003	Lawrencella rosea	No Generally Accepted Common Name	
WAAAVW0003	Lepidosperma leptostachyum		
WAAAVW0003	Lepidosperma sp.	Swordsedges	

Plot name	Herbarium determination	Common Name	WA Cons. Status
WAAAVW0003	Leucopogon cordatus		
WAAAVW0003	Lomandra sp.	Cocky's Bootlace	
WAAAVW0003	Lysimachia arvensis	Scarlet Pimpernel	
WAAAVW0003	Melaleuca tuberculata var. tuberculata		
WAAAVW0003	Millotia tenuifolia var. tenuifolia	Soft Millotia	
WAAAVW0003	Neurachne alopecuroides		
WAAAVW0003	Petrophile divaricata		
WAAAVW0003	Petrophile heterophylla		
WAAAVW0003	Podolepis lessonii		
WAAAVW0003	Podolepis sp.		
WAAAVW0003	Pterostylis aff. nana		
WAAAVW0003	Pterostylis sp.	Greenhoods	
WAAAVW0003	Rhodanthe citrina		
WAAAVW0003	Rytidosperma setaceum	Smallflower Wallaby Grass	
WAAAVW0003	Rytidosperma sp.	Wallaby Grass	
WAAAVW0003	Schoenus nanus	Tiny Bog-sedge	
WAAAVW0003	Stackhousia pubescens		
WAAAVW0003	Stylidium ciliatum	Golden Triggerplant	
WAAAVW0003	Thelymitra graminea	Shy Sun Orchid	
WAAAVW0003	Thysanotus patersonii	Twining Fringe Lily	
WAAAVW0003	Trachymene pilosa	Dwarf Parsnip	
WAAAVW0003	Trichocline spathulata	Native Gerbera	
WAAAVW0003	*Vulpia bromoides	Brome Fescue	
WAAAVW0003	*Vulpia muralis	Wall Fescue	
WAAAVW0003	*Vulpia myuros f. myuros	Rat's Tail Fescue	
WAAAVW0003	Xanthorrhoea drummondii		
WAAAVW0004	Acacia browniana var. intermedia		
WAAAVW0004	Acacia lasiocarpa var. sedifolia		
WAAAVW0004	Acacia pulchella var. pulchella	Prickly Moses	
WAAAVW0004	Aira cupaniana	Silvery Hair Grass	
WAAAVW0004	Astroloma epacridis		
WAAAVW0004	Austrostipa elegantissima	Elegant Spear-grass	
WAAAVW0004	Austrostipa sp.	Spear-grasses	
WAAAVW0004	Banksia nivea subsp. nivea		
WAAAVW0004	Banksia squarrosa subsp. squarrosa		
WAAAVW0004	Blennospora drummondii	Dwarf Beauty-heads	
WAAAVW0004	Boronia scabra subsp. scabra		
WAAAVW0004	Bossiaea eriocarpa	Common Brown Pea	
WAAAVW0004	Bryophyte		
WAAAVW0004	Caladenia flava subsp. flava	Cowslip Orchid	
WAAAVW0004	Calandrinia calyptrata	Pink Purslane	



Plot name	Herbarium determination	Common Name	WA Cons. Status
WAAAVW0004	Calothamnus quadrifidus subsp. quadrifidus		
WAAAVW0004	Centrolepis aristata	Pointed Centrolepis	
WAAAVW0004	Centrolepis drummondiana		
WAAAVW0004	Chamaescilla corymbosa var. corymbosa	Blue Stars	
WAAAVW0004	Conostylis setigera subsp. setigera		
WAAAVW0004	Crassula colorata var. colorata		
WAAAVW0004	Dampiera obliqua		
WAAAVW0004	Desmocladius asper		
WAAAVW0004	Drosera glanduligera	Common Scarlet Sundew	
WAAAVW0004	Drosera macrantha	Bridal Rainbow	
WAAAVW0004	Eucalyptus accedens	Powder bark Wandoo	
WAAAVW0004	Eucalyptus accendens		
WAAAVW0004	Eucalyptus drummondii	Drummond's mallee	
WAAAVW0004	Eucalyptus wandoo subsp. wandoo	Wandoo	
WAAAVW0004	*Galium murale	Small Bedstraw.	
WAAAVW0004	Gastrolobium parviflorum	Box Poison	
WAAAVW0004	Grevillea leptobotrys	Tangled Grevillea	
WAAAVW0004	Grevillea tenuiflora	Tassel Grevillea	
WAAAVW0004	Hakea lissocarpha	Duck and Drake Bush	
WAAAVW0004	Hibbertia montana		Priority Flora Category 4
WAAAVW0004	Hydrocotyle callicarpa	Small Pennywort	
WAAAVW0004	Hypochaeris glabra	Dandelion	
WAAAVW0004	Isolepis marginata	Coarse Club-rush	
WAAAVW0004	Lagenophora huegelii	Coarse Bottle-daisy	
WAAAVW0004	Lawrencella rosea	No Generally Accepted Common Name	
WAAAVW0004	Laxmannia squarrosa		
WAAAVW0004	Lepidobolus preissianus subsp. preissianus		
WAAAVW0004	Lepidosperma leptostachyum		
WAAAVW0004	Levenhookia pusilla	Midget Stylewort	
WAAAVW0004	Lomandra effusa	Cocky's Bootlace	
WAAAVW0004	Lysimachia arvensis	Scarlet Pimpernel	
WAAAVW0004	Melaleuca tuberculata var. tuberculata		
WAAAVW0004	Millotia tenuifolia var. laevis		Priority Flora Category 2
WAAAVW0004	Neurachne alopecuroidea		
WAAAVW0004	Oxalis sp.	Wood sorrel.	
WAAAVW0004	Petrophile heterophylla		
WAAAVW0004	Petrophile striata		
WAAAVW0004	Phyllangium sp.		
WAAAVW0004	Platysace cirrosa	Karna	
WAAAVW0004	Podolepis lessonii		

Plot name	Herbarium determination	Common Name	WA Cons. Status
WAAAVW0004	<i>Podotheca angustifolia</i>	Sticky Heads	
WAAAVW0004	<i>Poranthera microphylla</i>	Small Poranthera	
WAAAVW0004	<i>Pterostylis</i> aff. <i>nana</i>		
WAAAVW0004	<i>Pterostylis sargentii</i>	Frog Greenhood	
WAAAVW0004	<i>Rhodanthe citrina</i>		
WAAAVW0004	<i>Schoenus nanus</i>	Tiny Bog-sedge	
WAAAVW0004	<i>Siloxerus multiflorus</i>	Small Wrinklewort	
WAAAVW0004	* <i>Sonchus oleraceus</i>	Annual Sowthistle	
WAAAVW0004	<i>Stackhousia pubescens</i>		
WAAAVW0004	<i>Stylidium androsaceum</i>		
WAAAVW0004	<i>Stylidium ciliatum</i>	Golden Triggerplant	
WAAAVW0004	<i>Stylidium uniflorum</i> subsp. <i>uniflorum</i>		
WAAAVW0004	<i>Thelymitra</i> sp.	Sun Orchids	
WAAAVW0004	<i>Thysanotus patersonii</i>	Twining Fringe Lily	
WAAAVW0004	<i>Trachymene pilosa</i>	Dwarf Parsnip	
WAAAVW0004	<i>Verticordia grandiflora</i>	Claw Featherflower	
WAAAVW0004	<i>Xanthorrhoea</i> sp.	Grass-trees	



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