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Identifying weed risks and management strategies for the Chichester IBRA subregion and Fortescue river catchment

Interim report

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For:

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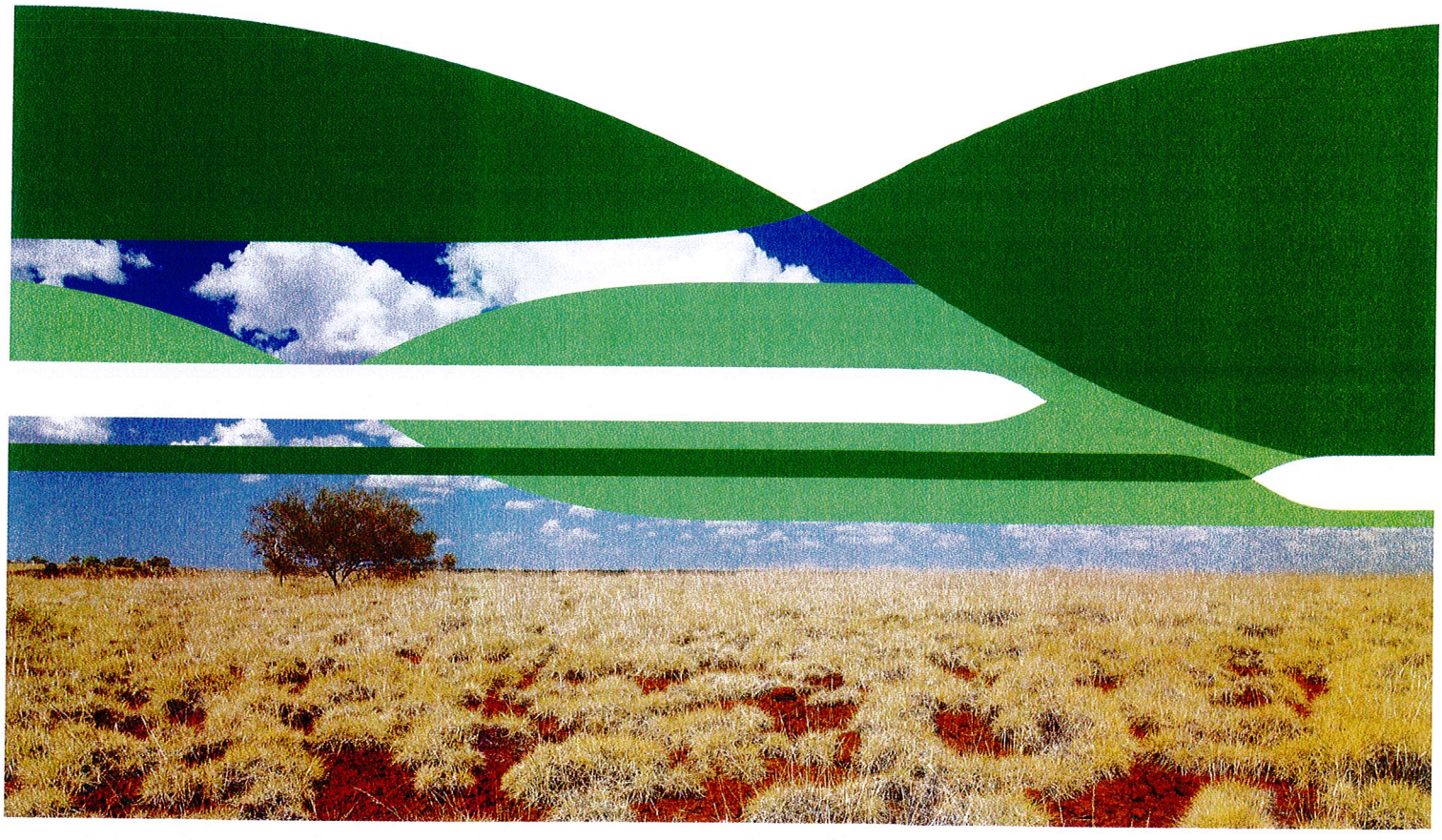
Stephen Van Leeuwen



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Important disclaimer

1 Introduction

Background

Pre- and post-border biosecurity in Western Australia requires accurate spatial and temporal quantification of weed presence and invasion dynamics. A comprehensive weed database that can be efficiently updated and expanded is a fundamental tool for weed management, from rapidly detecting or preventing new weed incursions, to guiding responses to threatening weeds, to informing weed risk assessment and control programs. The Pilbara is a major region of Western Australia where the biosecurity risk from weeds is increasing from a relatively low base and where timely development of a weeds database could help identification of management options that could have a major beneficial impact.

The weeds of the Pilbara have been reviewed in three publications, the checklist of weeds per IBRA region (Keighery and Longman 2004) (86 taxa), a list of weeds found in the region's pastoral lands (Van Vreeswyk *et al.* 2004) (44 taxa), both of which are summarised and combined with subsequent field work in Keighery (2010). The latter reports on 103 naturalised plant species for the Pilbara. Many of these weeds are illustrated in the 2nd Edition of Western Weeds (Hussey et al. 2007). The Department of Parks and Wildlife in 2013 has also produced a priority weed list for the Pilbara which considers 150 taxa (http://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds).

Purpose of this plan

The objective of this collaborative study with the Western Australian Department of Parks and Wildlife is to develop a weed database for use in weed risk assessment and management strategy for the Chichester IBRA subregion and Fortescue Catchment in the Pilbara, Western Australia. More specifically, this project will (i) census the flora in the two focal regions to identify weed risks (ii) census the flora of neighbouring areas to determine weed risks; (iii) identify weed vectors, sleeper species and priorities for management; and (iv) assess the potential for change in weed risk profiles taking into account climate change.

The study is to be undertaken as a "desk-top" analysis, using published reports and publically available information that will form the basis for data used in the report. The project will not involve field work or sampling in the study area. This data will underpin a targeted weed risk assessment study to guide management and strategic issues. A report will be prepared outlining these issues for use in on ground weed management. Scientific papers will also be prepared to address issues of invasion ecology and impacts on biodiversity, depending on the quality and extent of data obtained during the project.

This interim report summarises progress in the initial 10 months of the project, from 1st April 2014 to 30th January 2015.

2 Project progress

2.1 Progress towards planned outcomes

OUTCOME 1: CENSUS THE FLORA IN THE FOCAL REGIONS TO IDENTIFY WEED RISKS

Weed census

A complete listing of all weed/alien or suspected alien species from the Pilbara IBRA region was established from Keighery (2010), NatureMap (http://naturemap.dpaw.wa.gov.au), the wider literature and mining company reports. These species, along with their various attributes (habitat, taxonomy, distribution, weed status, management recommendations) are being tabulated in an excel spreadsheet (the documenting of attributes is estimated to be 50% complete). So far, 169 species are listed and are being considered, with further appropriate refinement of the database to come as further data is added.

Weed information from mining reports

Mining reports with flora and vegetation details from the Chichester and Fortescue regions have been processed for adding into the database. Aside from bibliographic content, we extracted weed information from the floristic data and assigned classes in the database as follows:

1. Weeds not mentioned.
2. General mention (no species, or a general statement "weeds found").
3. Presence/absence (species listed, but not quantitative data).
4. Frequency (species listed, quantitative data (floristic surveys over a defined area), species georeference data.

If georeferenced data for species is included in the report, then the locations were extracted and mapped to show their distribution. The location of each study area – usually defined by a set of co-ordinates (i.e. point location, area or corridor). Land use categories (e.g. mining tenement and/or pastoral lease) are also being recorded.

Weed records in Environmental Impact Statements (map locations)

Between 2000 and 2014, 70 applications for mining/infrastructure approvals were made under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 that concerned the Chichester and Fortescue regions of Western Australia. Of those reports, 58 mention weeds in the project area, and 31 of those provided detailed floristic studies and locations of weed species. 61 exotic weed species have been identified from these reports (Table 1), and 8 native species are found to occur in the Pilbara well outside their original native range.

Table 1. Frequency of species from location records in the Chichester and Fortescue region (from EPBC reports 2000-2014).

Species	# records	Species (continued)	# records
Cenchrus ciliaris	964	*Citrullus lanatus*	4
Bidens bipinnata	385	*Trianthema portulacastrum*	4
Malvastrum americanum	356	*Asphodelus fistulosus*	4
Portulaca oleracea	258	*Calotropis procera*	4
Aerva javanica	247	*Ocimum basilicum*	4
Cenchrus setiger	204	*Passiflora foetida* var. *hispida*	3

Species	# records	Species (continued)	# records
Vachellia farnesiana	188	*Typha orientalis*	3
Setaria verticillata	134	*Heliotropium europaeum*	3
Cucumis melo ssp. agrestis	74	*Parkinsonia aculeata*	3
Citrullus colocynthis	51	*Passiflora foetida*	3
Flaveria trinervia	38	*Chloris barbata*	2
Argemone ochroleuca subsp. *ochroleuca*	34	*Sisymbrium orientale*	2
Tribulus terrestris	18	*Indigofera oblongifolia*	2
Echinochioa colona	18	*Phyla nodiflora* var. *nodiflora*	1
Cynodon dactylon	17	*Eragrostis minor*	1
Acetosa vesicaria	16	*Gomphrena celosioides*	1
Chloris virgata	14	*Sida acuta*	1
Sigesbeckia orientalis	9	*Stylosanthes hamata*	1
Sonchus oleraceus	9	*Lactuca serriola*	1
Bidens pilosa	9	*Melochia pyramidata*	1
Prosopis gladulosa	8	*Crotalaria juncea*	1
Solanum nigrum	8	*Typha sp.* (prob domingensis)	1
Datura leichhardtii	6	*Pennisetum pedicellatum*	1
Digitaria ciliaris	6	*Phoenix dactylifera*	1
Conyza bonariensis	6	*Jatropha gossypiifolia*	1
Lactuca saligna	5	**Total**	**3135**

Other weed records

We have yet to determine how many other reports (e.g. Rangeland condition reports) have been produced that concern the Chichester and Pilbara that were not subject to approval under EPBC Act 1999. However, a number have been identified from the reference pages of the EPBC reports. As they are not publically available we are attempting to source them via inter-library loan.

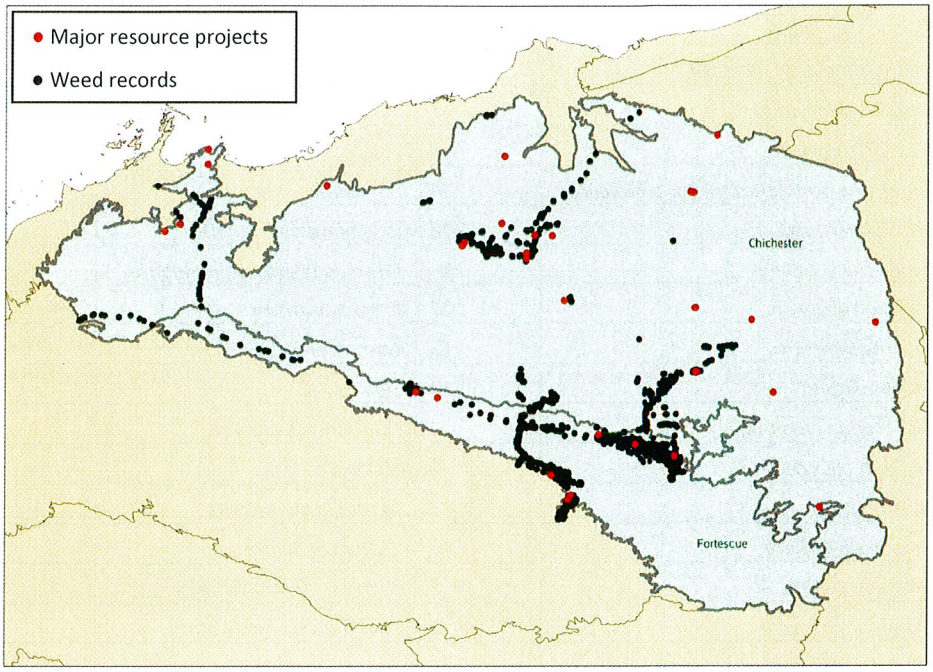
Results of weed records in mining reports

3135 individual weed species records have been extracted from the floristic surveys (Figure 1). Most are located around major resource extraction projects and associated road/rail transport infrastructure. The next phase of this study will look areas not captured in the EPBC reports, using keyword searches on the names of abandoned/closed mines, station names, pastoral leases and defunct company names.

Further data mining of these reports may reveal additional weeds, particularly for reports that do not provide information on weed or native status. Only one report highlighted the presence of Western Australian native species that have naturalised outside their traditional range (most from the Kimberley).

In adding reports to the database, it has become apparent that reporting standards changed considerably after 2008. That is, since 2008, vague references to weeds being "present" without any supporting quantitative data has become unacceptable for the approval process. Therefore, based on the quality of data provided in reports from 2000-2008, we expect that reports compiled prior to 2000 to be of lesser value, unless compiled for a purpose other than resource extraction.

Figure 1: Location of weeds listed in Table 1 (from EPBC reports 2000-2014)



OUTCOME 2: CENSUS THE FLORA OF NEIGHBOURING AREAS TO IDENTIFY WEED RISKS

Subsequent to this project starting one of us (JKS) was invited to write a book chapter on weeds and arid regions. The analysis of information for part of this chapter has allowed a more detailed assessment of the flora of neighbouring regions to identify weed risk for the Pilbara regions that are the focus of this project. Two lines of information are being investigated, firstly a list of the alien flora was obtained from NatureMap for each of the arid region IBRA subregions (Figure 2), secondly, published information on plot based studies were assessed. Station based information is a third line of investigation is being examined.

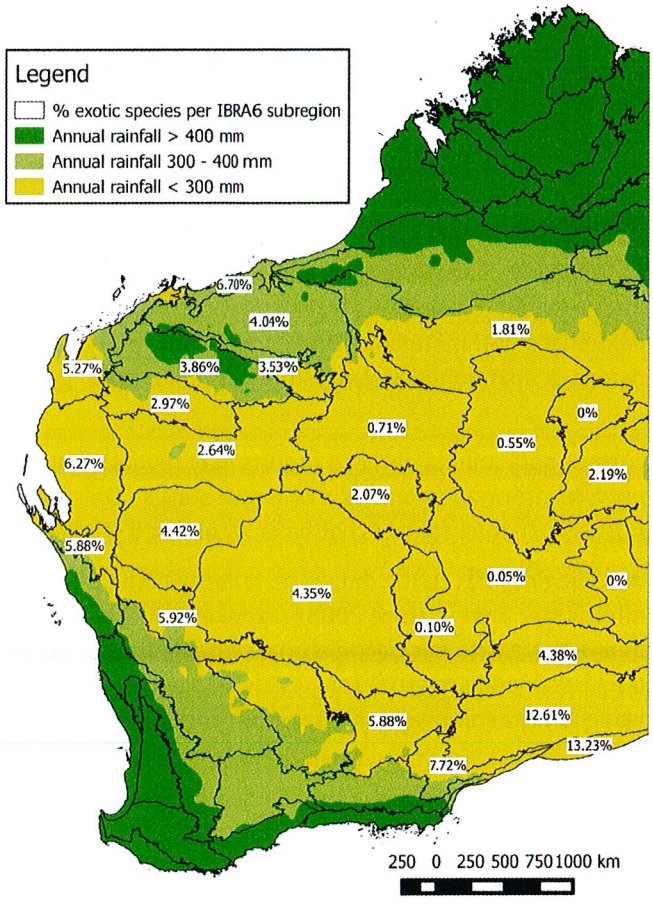


Figure 2. Western Australia showing the IBRA6.1 subregions and the average annual rainfall (Australian Government Bureau of Meteorology 2014) grouped to show the moist regions (> 400 mm) , a transition zone (300 to 400 mm) and the most arid regions (an average of less than 300 mm rainfall per year). The percentage of alien species out of the total flora based on records in NatureMap (Western Australian Department of Parks and Wildlife 2014b) is shown per IBRA subregion. Small subregions were excluded or combined in a larger subregion for analysis. Pilbara regions were included in the analysis because the cyclonic nature of rainfall makes these regions effectively arid.

The alien flora of arid regions in WA comprises 316 species. Only one species out of all the weed flora (*Indigofera oblongifolia*) has the Pilbara as its first point of naturalisation. This strongly implies that the threat of invasion is from neighbouring regions in Australia and not from overseas (despite the high level of activity at Pilbara ports). Further insight from the completed book chapter will be incorporated into the final report.

OUTCOME 3: IDENTIFY WEED VECTORS, SLEEPER SPECIES & PRIORITIES FOR MANAGEMENT

An annotated species list is under preparation now that the number of weed species under consideration is stabilising. This includes, with explanation, the sleeper species and recommendations for species-based management. Spatial analyses as appropriate and priorities for management will be determined once we have a complete picture.

OUTCOME 4: ASSESS THE POTENTIAL FOR CHANGE IN WEED RISK PROFILES TAKING INTO ACCOUNT CLIMATE CHANGE

No progress as yet on Outcome 4, as this depends on Outcomes 1 and 2 being close to completion. However, three studies completed in 2014 will form the framework for how this issue will be addressed:

1. AdaptNRM project on weeds and climate change establishes a framework of weed management under climate change (http://adaptnrm.csiro.au/invasive-plants-climate-change/).
2. A case study was developed for the interaction of buffel grass and climate change (http://www.nintione.com.au/resource/AustralianRangelandsAndClimateChange_CenchrusCiliarisBuffelGrass.pdf).
3. The collection of all published reports on weeds modelled for climate change using CLIMEX (https://data.csiro.au/dap/search?q=Adaptnrm+weed).

2.2 Risks and challenges

CSIRO Restructure

During 2014, CSIRO was subjected to considerable disruption due to a massive restructure and ensuing redundancies (including one of the staff involved in this project) imposed due to the Federal budget. As a result, project leadership is now being undertaken by Bruce Webber and Kathryn Batchelor's time in the project has increased. Our planned GIS spatial analyst is now located in a different Flagship (these were Divisions before) and continuing access to this GIS expertise is being negotiated. Despite these challenges, we anticipate being able to fully complete the project by the end of 2015.

Data access

Considerable challenges in obtaining data lie ahead, as most remaining sources of information lie in off-line, unsearchable reports in archives, libraries and collections of organisations and private companies. Many of these sources are reports produced for the benefit of mining companies, and which are not made publically available unless part of the mine approval process. A number of reports are listed in the DPaW library catalogue, and we have sought access to these via CSIRO's inter-library loan process with varying success (some libraries have closed). We have also requested reports directly from authors, so far without success. The next phase of this project will involve spending time physically at repositories of information, including the DPaW library, searching for flora reports. We have plans to specifically target geographical areas not well represented in this study.

2.3 New opportunities

• The book chapter on weeds of arid regions (being written by JKS) has provided us with the opportunity to include more extensive information on adjoining regions. This extra information is likely to provide an ideal platform for future work on expanding this database to other regions.

• The new project lead (BLW) is exploring funding opportunities via a collaboration with DAFWA, to use ALA infrastructure to underpin a publically available weeds-focused database for Western Australia. If approved, this would be the ideal platform for delivering the data generated by this project to the public and end users. To this extent, database design in this study is being done to ensure future compatibility in anticipation of this funding direction getting support.

• It is becoming increasingly clear that the spatiotemporal documentation of georeferenced records is creating the opportunity to document shifts in the range of native species. If these can be related to anthropogenic landscape modification or human dispersal, these changes could be used to guide appropriate management choices. While such a study is beyond the scope of this project, it could prove a fruitful research direction for future collaborations.

3 Conclusions

At the mid-point of this 21 month project, considerable progress against the outcomes has been made given the challenges faced. A database that is compatible with future research directions in this area has been constructed and collation of the available data is progressing. This is extending the known reviews of weeds in this area, suggesting this research is likely to provide valuable new insight for managing weeds in the Pilbara. It is expected that the project will be completed by the planned finishing date of 30 Dec 2015.

3.1 References

Hussey, B.M.J., Keighery, G.J., Dodd, J., Lloyd, S.G., Cousens, R.D., 2007. Western Weeds a guide to the weeds of Western Australia Second Edition. Weed Society of WA Inc., Victoria Park, WA.

Keighery, G., 2010. The naturalised vascular plants of the Pilbara region, Western Australia. Records of the Western Australian Museum, Supplement 78, 299-311.

Keighery, G.J., Longman, V., 2004. The naturalized vascular plants of Western Australia 1: Checklist, environmental weeds and distribution in IBRA regions. Plant Protection Quarterly 19, 12-32.

Van Vreeswyk, A.M.E., 2004. Vegetation. In: Van Vreeswyk, A.M.E., Payne, A.L., Leighton, K.A., Hennig, P. (Eds.), An inventory and condition survey of the Pilbara Region, Western Australia. Technical Bulletin No. 92. Western Australian Department of Agriculture, Perth, Australia, pp. 109–124.

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