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Invasive plant management strategy for the Chichester IBRA sub-region and Fortescue river catchment

Second interim report

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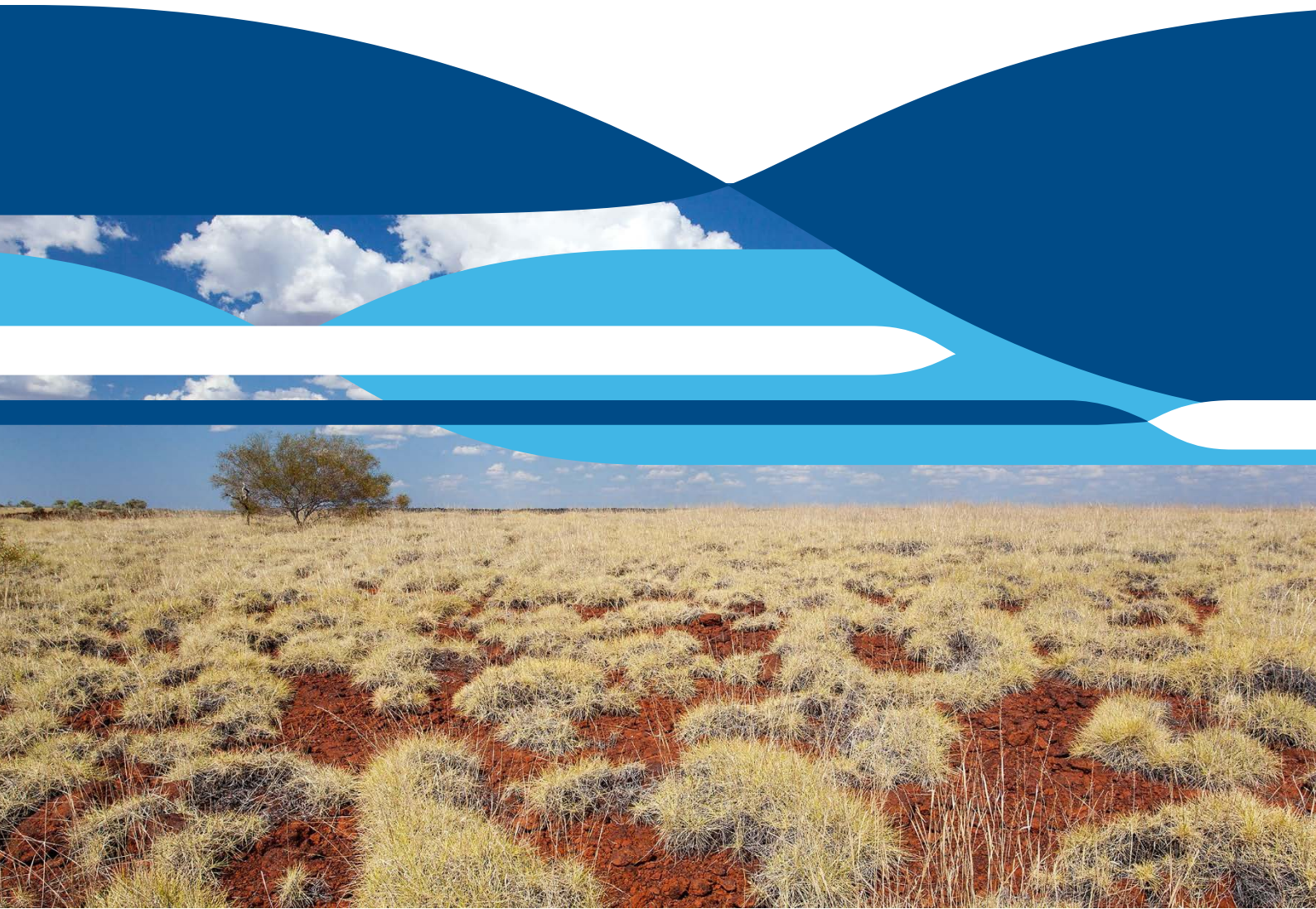
31st December 2015

For:

Western Australia Department of Parks and Wildlife

Stephen van Leeuwen



Citation

Webber, BL, Batchelor, KL & Scott, JK (2015). Identifying weed risks and management strategies for the Chichester IBRA subregion and Fortescue river catchment. Second interim report. CSIRO, Australia.

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Important disclaimer

Acknowledgments

We thank Stephen van Leeuwen, Malcolm Trudgen and the WA Herbarium for providing and/or facilitating access to datasets on Pilbara weeds, the librarians from WA Main Roads Department and the Department of Parks and Wildlife for providing references, and Don Flint from the Department of Mines and Petroleum for extracting relevant reports from the MINDEX database.

Contents

Figures

Tables

Executive summary

This report summarises the research undertaken by CSIRO during the 2015 calendar year on developing a weed database for the Pilbara IBRA region of Western Australia and weed management insight for the Chichester IBRA sub-region and Fortescue river catchment. The 11 month component of the research reported on here has been primarily focused on data aggregation and consolidation of the available data into a unified digitised database.

An extensive literature review of relevant Flora and Vegetation reports in the public domain has been the primary source of information thus far, as well as data gathered from private organisations. Preliminary spatiotemporal analysis of the aggregated data via interrogation of GIS layers has commenced.

To date:

1. Weed information has been collected and added to the database from over 500 flora and vegetation reports.
2. Individual species records collated in a GIS framework for 138 weed species at over 26,000 locations across the Pilbara.
3. A bibliography of relevant documents compiled in professional referencing software (Endnote)
4. Distribution maps prepared in GIS that identified areas for higher prioritisation in ongoing data searches.

The next phase of research will focus on finalising the collation of data, including post-processing for data quality control and targeted attempts to fill information gaps, before synthesising the data to generate weed management insights.

The current phase has identified a considerable opportunity to generate powerful new weed management insight by extending the data collection phase so as to be comprehensive across the entire Pilbara, and to expand the data synthesis component to include the whole Pilbara region.

1 Introduction

Pre- and post-border biosecurity in Western Australia requires accurate spatial and temporal quantification of weed presence and invasion dynamics. A publically available 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 weed database could help identification of management options that could have a major beneficial impact.

The weeds of the Pilbara are relatively well known, and have been summarised 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), and Keighery (2010) that summarises the first two publications and adds results from additional field observations. The latter summary reports on 103 naturalised plant species for the Pilbara. The most extensive online, digitised and readily available database for weeds in Western Australia is from the Department of Parks and Wildlife's Florabase website that draws on herbarium records. However, in this database weed species are generally underrepresented in distribution relative to what is known among local land managers, and it is well known that weeds are often overlooked for their importance in herbarium-based collecting by botanists.

In the last 20 years, a huge volume of Pilbara flora and vegetation reports have been produced by botanical consultants employed by the mining industry for the purpose of obtaining environmental approvals. These Pilbara reports are mostly unpublished, but can be found in government department libraries and various online sources. These weed records, along with a range of other documented surveys, are not necessarily associated with lodged herbarium specimens, but never the less represent valuable data for understanding weeds in the Pilbara.

The objective of this collaborative study with the Western Australian Department of Parks and Wildlife (DPaW) is to develop an aggregated weed database for the Pilbara IBRA region, Western Australia, and to use this database to showcase the potential utility aggregated weed data has for understanding weed risk and improving weed management. An initial focus on the Chichester and Fortescue sub-regions has recently been expanded to collect data for the whole Pilbara IBRA region, but at this stage, synthesis and interrogation of the data will be limited to the two focal sub-regions. More specifically, this project will (i) census the flora in the four sub-regions of the Pilbara to identify weed presence and absence, including spatiotemporal patterns and population dynamics (e.g. abundance) traits, where available; (ii) census the flora of neighbouring regions in Western Australia to determine weed risks; (iii) for the Chichester and Fortescue sub-regions only, identify weed vectors, sleeper species and priorities for management; and (iv) for a prioritised selection of weeds, 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 unpublished 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. The output from the project will be a report focused on management and strategic issues. 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 report summarises progress in the second year of the project, from 1st February 2015 to 31st December 2015, based on the terms specified in the project extension negotiated in June 2015.

2 Project progress

2.1 Progress towards planned outcomes

OUTCOME 1: A CENSUS OF WEED FLORA IN THE PILBARA

Weed data aggregation and database construction

The information required to develop the weed risk assessment exists primarily in the hundreds of flora and vegetation reports (FVRs) commissioned by government departments, mining companies and land developers for the purpose of obtaining a native vegetation clearing permit (NVCP) or a mining proposal activity. A proportion of these are available online, but many exist in hardcopy form only at various government libraries. Additional data was sourced from the DPaW herbarium and from Malcolm Trudgen, a botanist who has extensive data collections from the Pilbara regions. Lastly, more obscure or lesser known weed databases are being obtained from a range of additional sources, including directly from resource extraction companies and from Natural Resource Management (NRM) groups.

Data sources

FVRs were sourced from the following locations:

- EPBC Act Notices Database. An activity (i.e. mine expansion) that likely to have a significant impact on a matter of national environmental significance (i.e. threatened ecological communities) is required to be assessed by the Commonwealth Department of Environment. Flora and Vegetation reports that form part of this assessment are made publically available at https://www.environment.gov.au/epbc/public-notices. A request was made to the Department of Environment for all applications concerning the Pilbara IBRA region – a database of 69 referrals for the Chichester/Fortescue subregions and 107 for the Hamersley/Roebourne subregions were supplied:
- Western Australian Department of Main Roads library. A small number of Main Roads commissioned reports were sourced from their internal library.
- Department of Parks and Wildlife departmental library https://science.dpaw.wa.gov.au/conslib.php, and Stephen van Leeuwen's professional library.
- Western Australian Environmental Protection Authority's Consultation Hub https://consultation.epa.wa.gov.au/.
- Western Australian Department of Mines and Petroleum MINDEX database http://minedexext.dmp.wa.gov.au/minedex/external/common/appMain.jsp.
- Department of Environment Regulation NVCP application ftp server ftp://ftp.dec.wa.gov.au/Permit/.
- Database exports from individual mining companies
- General online searches using keywords, such as 'Pilbara', 'flora' and 'weeds' and others.

Database construction

FVRs published after 2005 largely follow the format outlined by EPA (2004), with georeferenced location of weeds often included in appendices in the documents. Prior to 2005, weeds in FVRs were usually

mentioned as being present without any georeferenced data. In addition, a number of FVRs detail flora in vegetation assemblages rather than point data. In these instances weeds are recorded as being present over either the mine tenement ID (polygon) or mine point location. Information specifically extracted from each FVR were:

- Tenement/pastoral lease ID
- Type of survey (Desktop, Level 2, Rare Flora, Biological Survey etc)
- Survey timing and number of visits
- Asset name
- Total number of weed species
- Number and size of quadrats/releves,
- Weed GPS locations
- Date of collection
- GPS locations of quadrats with no weeds (i.e. zero or absence records)
- Density and/or abundance metrics of weeds

Details on collectors name and number of people hours dedicated to each report, site descriptions and condition were not recorded in this project. Data on species that are native to WA but due to mining activity have extended their distribution has been captured when specifically mentioned in the FVR. All data is currently being aggregated in an MSExcel spreadsheet.

It is envisaged that the literature review and data capture aspect of this project, based on the current project scope (but see Section 2.3), will be completed by late February 2016 and will have captured weed data from approximately 700 FVRs. As detailed in the current project scope, it will not be possible for this to be a thoroughly exhaustive review, as (i) additional time would be required to include a number of recently identified datasets, (ii) a number of FVRs have proven to be just too difficult to obtain and (iii) some databases have not been possible to obtain due to excessive costs for data release and/or not meeting the requirement that the data will be made publically available.

Preliminary database insights

Weed data presented in this preliminary summary has been collated from FVRs, the WA Herbarium and from the data collected by Malcolm Trudgen and Associates (Table 1; Figure 1). To date weed records have been extracted from over 500 Pilbara FVR yielding 138 individual species over 26,000 locations.

Table 1 Summary of weed locations and species in various collections

SOURCE	# WEED POINT LOCATIONS	# SPECIES
FVRs	26000	138
Trudgen Database	2900	60
DPaW Herbarium	880	135

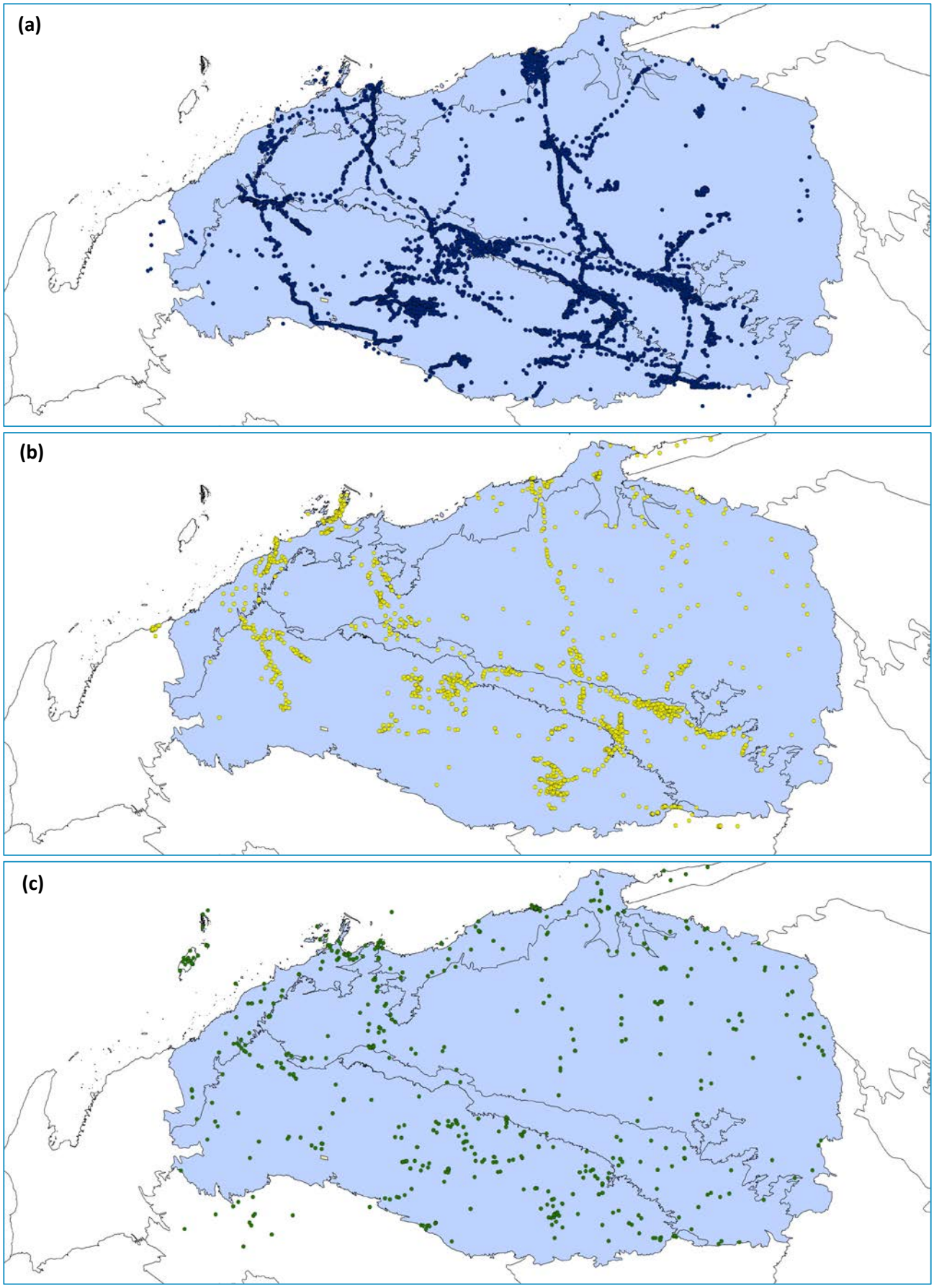

Figure 1 Aggregated weed records for the Pilbara IBRA region from a preliminary database interrogation (November 2015), representing (a) all weed records compiled from FVRs, (b) the database compiled by Malcolm Trudgen, and (c) herbarium records (i.e. Florabase).

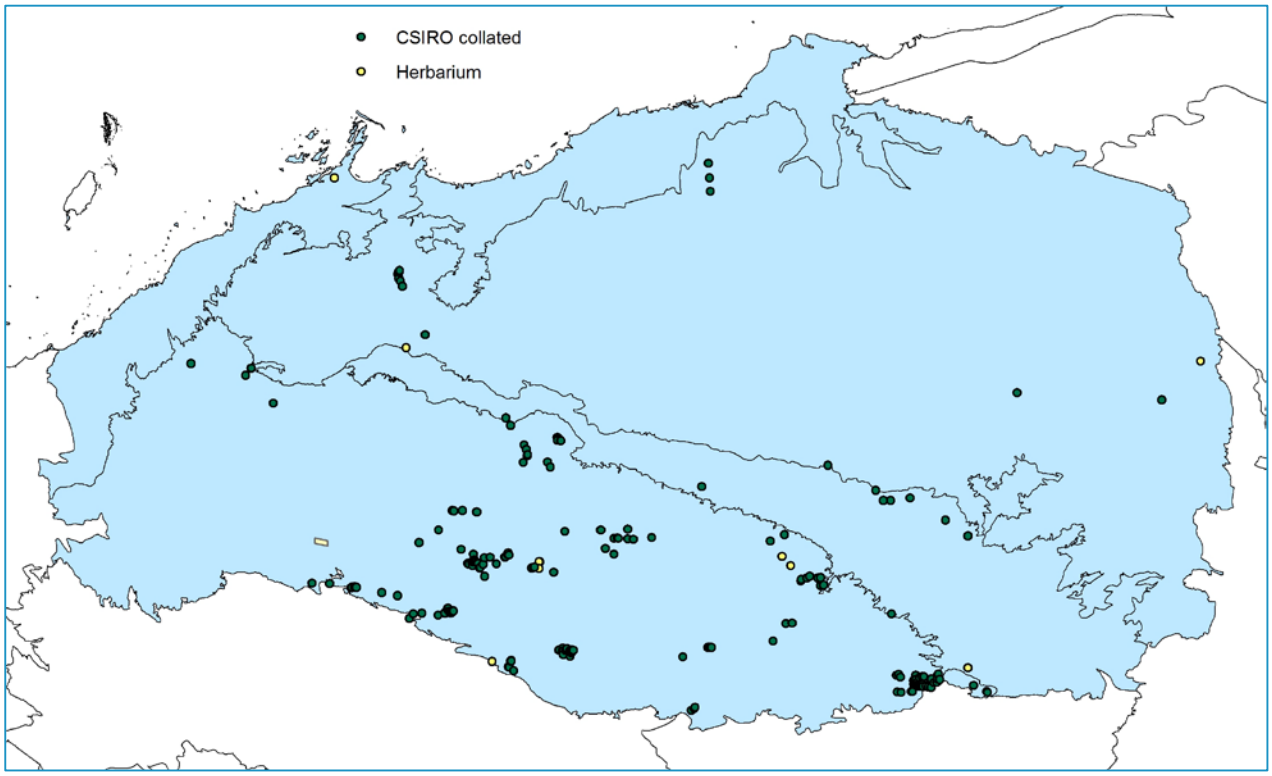

Figure 2 Aggregated distribution of Ruby Dock (*Acetosa vesicaria*) in the Pilbara IBRA region.

Buffel grass (*Cenchrus ciliaris*) is by far the most abundant weed species extracted from the FVRs, which is no surprise as its dominant throughout much of the Pilbara. A total of 18 weed species have been recorded in excess of 100 times (Table 2). For many weed species, such as Ruby Dock (Acetosa vesicaria), the known range documented in the expanding project database (467 records) greatly exceeds that of the Herbarium (i.e. Florabase; 11 records; Figure 2). Specific challenges exist for the database, particularly relating to weeds of uncertain native status, or range shifting natives. For example, *Bidens bipinnata* and *Portulaca oleracea* are common in many reports, but because the weed status of both is debatable and botanists will not always record them as such, their reporting has been inconsistent.

Table 2 Summary of most frequent weeds in the collated database

Species	Frequency	Species	Frequency
Cenchrus ciliaris	9680	*Flaveria trinervia*	403
Malvastrum americanum	2982	*Cucumis melo* subsp. *agrestis*	362
Bidens bipinnata	2338	*Citrullus colocynthis*	210
Cenchrus setiger	1703	*Echinochloa colona*	148
Aerva javanica	1693	*Sonchus oleraceus*	134
Portulaca oleracea	1686	*Cynodon dactylon*	133
Argemone ochroleuca* subsp. *ochroleuca	1021	*Chloris virgata*	122
Vachellia farnesiana	962	*Sigesbeckia orientalis*	106
Setaria verticillata	499	*Cucumis sp.*	68
Acetosa vesicaria	467		

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

The census of neighbouring IBRA regions has, for the most part, been completed. The aggregated weed data from NatureMap is awaiting integration into the overall Pilbara-focused database for analysis and interrogation in the coming months.

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

Further progress on the annotated weed species list has been made. This includes, with explanation, the sleeper species and recommendations for species-based management. Preliminary spatiotemporal analyses have been started on the aggregated database to test for functionality and requirements for data import and export. Spatial analysis conducted up to this point has primarily been to identify areas of the Pilbara poorly captured in the literature review, but where mining activity and/or infrastructure presence would suggest FVRs should exist. An example of this is in areas where applications for a NVCP have been approved but there are no nearby weed records in the database.

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, 2 and 3 being close to completion.

2.2 Risks and challenges

CSIRO restructure

Ongoing disruption to project team stability as a result of the 2014 CSIRO restructure is still influencing the project. Anticipated new appointments in the broader team delivering this project have been delayed, meaning workloads being managed by project personnel remain higher than ideal. Despite these challenges, contingency plans have been put in place, including for an anticipated project extension to include analysis for the entire Pilbara region. Either way, we anticipate to be able to complete the project on schedule and to budget.

Data access

Some further challenges in obtaining data are still possible obstacles in the project, due to most remaining sources of information lying in off-line, unsearchable reports in archives, libraries and collections of organisations and private companies. While it is impossible to predict how close we will be able to come to getting all available data for Pilbara weed records, recent progress has been very encouraging, and may well be the beginning of a 'snowball effect' of data release that we had hoped to ignite with this project.

2.3 New opportunities

The recent expansion of data collection to now include all four Pilbara sub-regions combined with the wealth of data flowing in for all regions, has opened up a significant opportunity to (i) extend the data collection to include harder to obtain/extract and recently identified data sources, and (ii) expand the database interrogation to the whole of the Pilbara, rather than just the Chichester and Fortescue regions, as currently planned. If this expansion was possible, it would provide far more useful insight for on-ground weed management in the Pilbara, due to the common links and issues between multiple sub-regions.

Moreover, it would strengthen the case for making the underlying weeds database available to interested end-users via on online open access platform. Efforts to secure additional funding to allow for this expanded analysis would be a high priority for future weed research investment in the Pilbara.

3 Summary & conclusions

Approximately 18 months into the 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 the majority of the available data has been sourced, digitised and entered. The majority of records collated thus far via the FVRs are centred on areas of with heavy mining activities or infrastructure projects, whereas the Trudgen and Herbarium (Florabase) data are more spatially (and temporally) distributed throughout the Pilbara.

Another 200 FVRs have yet to be processed, and these together with the database outputs from a range of mining companies are expected to result in over 140 weed species and 40,000 individual species records being collated for subsequent synthesis and interrogation. The individual species records collated by this project is similar to that of the herbarium in terms of total number of species, but the detail of the data is likely to result in novel records from a spatial and/or temporal perspective. As such we anticipate that when the database analysis component is complete, particularly if an extension of scope to cover the whole Pilbara is approved, the project will have generated considerable knowledge with direct and significant utility for on ground weed managers in the Pilbara.

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