12-2021

The potential of remotely sensed vegetation indices for monitoring pasture condition

Pouria Ramzi
Department of Primary Industries and Regional Development, Western Australia

Karen Holmes
Department of Primary Industries and Regional Development, Western Australia

Recommended Citation

Ramzi P and Holmes K (2021) 'The potential of remotely sensed vegetation indices for monitoring pasture condition in Western Australia's pastoral rangelands', Resource management technical report 419, Department of Primary Industries and Regional Development, Western Australian Government.

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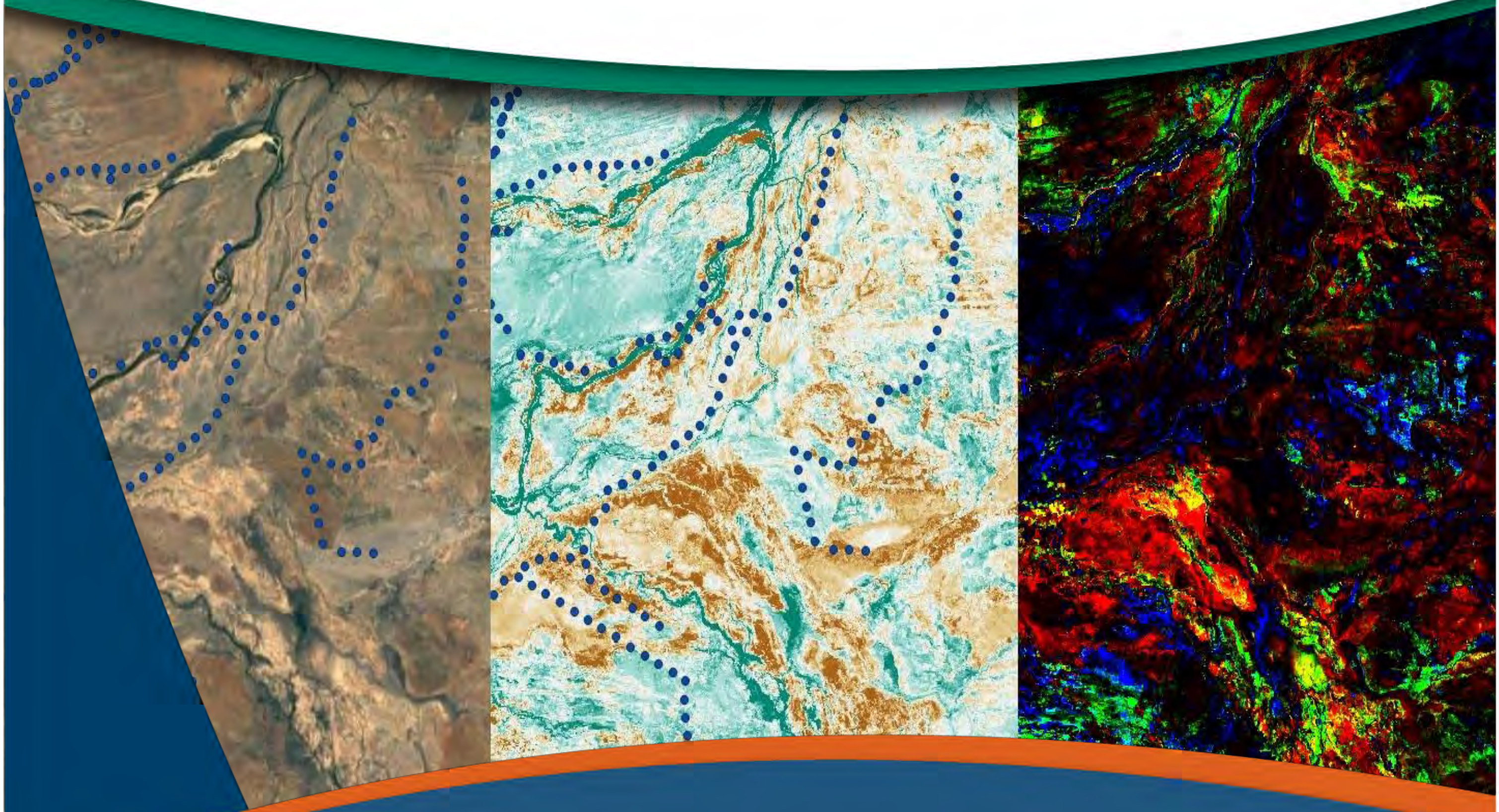
The potential of remotely sensed vegetation indices for monitoring pasture condition in Western Australia's pastoral rangelands



Resource management technical report 419

The potential of remotely sensed vegetation indices for monitoring pasture condition in Western Australia's pastoral rangelands

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Pouria Ramzi and Karen Holmes

ISSN 1039-7205

Cover: Traverse points overlayed on true colour Landsat, vegetation index and vegetation index trend composite (photo: P Ramzi)

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Department of Primary Industries and Regional Development
3 Baron-Hay Court, South Perth WA 6151
Telephone: +61 (0)8 9368 3333
Email: enquiries@dpird.wa.gov.au
Website: dpird.wa.gov.au

Contents

Acknowledgements

This report documents the initial stage of developing a new monitoring system for effectively assessing and tracking overall lease condition across Western Australia's pastoral leases. This is a part of the pastoral lands reform project initiated by the Western Australian Government to improve the management of pastoral lands and address the recommendations made by the Office of the Auditor General.

We would like to acknowledge Geosciece Australia and National Computational Infrastructure for providing the Landsat NBART analysis-ready Earth observation satellite imagery.

We are most grateful to the pastoral lease inspectors who have collected on-ground condition data over the past few decades. Current inspectors provided extensive and valuable feedback and we offer particular thanks to Philip Thomas, Matthew Fletcher, Kathryn Ryan, David Barker, Damian Priest, Josh Foster, Wayne Fletcher and Peter-Jon (PJ) Waddell. We would like to acknowledge Dr Rick Fletcher, Dr Rob Sudmeyer, Mr. Nathan Penny and Dr Todd Robinson (Curtin University) for their thoughtful and constructive comments and recommendations on this work. We also thank Dr Jeremy Wallace (formerly CSIRO) who reviewed this work and provided valuable suggestions, and Angela Rogerson and Janet Paterson (Sciscribe) for editing this report.

Shortened forms

Short form	Long form
ANOVA	analysis of variance
AUC	area under curve
BRDF	bidirectional reflectance distribution function
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPIRD	Department of Primary Industries and Regional Development
ETM+	Enhanced Thematic Mapper Plus
EVI	Enhanced Vegetation Index
GDVI2, 3, 4	Generalised Difference Vegetation Index 2, 3 and 4
GPS	global positioning system
km; km^2	kilometre; square kilometre
LMI	Land Monitor Index
K-NN	K-Nearest Neighbour (machine learning method)
m	metre
MSAVI2	modified soil-adjusted vegetation index 2
MODIS	Moderate Resolution Imaging Spectroradiometer
NBART	Normalised BRDF Atmospheric Corrected Reflectance that is Topographically corrected
NDVI	Normalised Difference Vegetation Index
NIR	near-infrared
OA	overall accuracy
OLI	Operation Land Imager
PA	producer’s accuracy
PLAGA	Pastoral lease assessment using geospatial analysis (project)
RCA	rangeland condition assessment
RF	Random Forest (machine learning method)
RGB	red, green, blue
ROC	receiver operating characteristic
SAVI	Soil-adjusted Vegetation Index
STVI-1	Stress Related Vegetation Index 1
SVM	Support Vector Machine (machine learning method)
SWIR	short-wave infrared
TM	Thematic Mapper
UA	user’s accuracy
VI	vegetation index
WA	Western Australia

Summary

The Department of Primary Industries and Regional Development (DPIRD) is developing an integrated monitoring system using remote sensing and on-ground measurements to track pasture condition across Western Australia's pastoral region. We extended and adapted the methods developed in the Pastoral Lease Assessment Using Geospatial Analysis (PLAGA) project (Robinson et al. 2012), which combined remotely sensed vegetation indices (VIs) with on-ground pasture condition observations to assess the potential of using different vegetation indices in a statewide condition monitoring system.

There were 6 regions in WA's pastoral rangelands with DPIRD on-ground condition traverse points: Kimberley and Broome, Pilbara, Yalgoo and Sandstone, Goldfields, Nullarbor and Other Rangelands. In these regions, we evaluated 8 Landsat VIs (EVI, GDVI2, GDVI3, GDVI4, LMI, MSAVI2, NDVI and STVI-1) to measure their correlation with the on-ground condition classes ('good', 'fair', 'poor') in 5 stratification levels:

- land system
- functional group (land type)
- pre-European vegetation type
- pasture (habitat) type
- broad vegetation group (management unit).

The experiments were done using 3 discrimination and classification strategies:

- fairs-excluded strategy – 2 classes using good and poor points, and excluding the fair points
- fairs-included strategy – 2 classes using good and fair points as one class, and poor points as the other class
- 3-class strategy – 3-class machine learning classification using good, fair and poor points.

The VIs were computed using NBART Landsat 5 (Thematic Mapper [TM]), Landsat 7 (Enhanced Thematic Mapper Plus [ETM+]) and Landsat 8 (Operation Land Imager [OLI]) multispectral imagery downloaded from the Australian Geoscience Data Cube.

Discrimination potential and reliability of VIs varied among geographic regions and stratification levels. In the Nullarbor region, the LMI and STVI-1 produced the highest discrimination potential between condition classes (mean area under curve [AUC] = 0.70–0.80) and the highest overall reliability of 67–100% in all stratification levels. In contrast, the highest discrimination any VI could produce in the Yalgoo and Sandstone region was a mean AUC of 0.56–0.61 with correspondingly low overall reliability (less than 40%) by the EVI and LMI, which means in most of the groups in all stratification levels, no VI produced adequate discrimination. Of all the regions, the discrimination potential and reliability of using a VI to monitor condition was highest in the Nullarbor region.

Maps and tables in the appendixes outline the groups making up each stratification level and where VIs can or cannot be confidently adopted for monitoring pasture condition.

The patch-wise use of VIs (rather than simply adopting a particular VI over an entire region) increased reliability, indicating that the use of VIs should be customised for each region.

Our study revealed several issues with using the current condition data to evaluate the potential of remote sensing VIs. No field data was available for many pastoral stations (especially in the Gascoyne, Meekathara, Murchison and Wiluna land conservation districts which were called ‘Other Rangelands region’ in this work) and correlations between VIs and pasture condition ratings in some groups within stratification levels were not adequate. This implies that the on-ground condition assessments need to be modified or that quantitative data needs to be collected separately to calibrate or validate remote sensing products.

Based on our findings and the limitations of available condition data, future research should focus on determining condition indicators (such as vegetation cover patchiness and clumpiness) using the VI with the highest adequate discrimination potential in each group of a stratification level. Monitoring groundcover change over time based on time series analysis is another aspect of condition that could be derived using the suggested VIs in each group of a stratification level.

1 Introduction

Active pastoral leases in WA cover 857,833 km2 or 40% of the state's land area and the dominant land use is grazing livestock. Monitoring landscape condition across these pastoral stations is a critical DPIRD activity. A monitoring system that provides timely and accurate information on landscape condition to land managers and regulatory agencies is needed to sustainably manage the resources. Such a monitoring system was recognised in the Office of the Auditor General (AOG) report (2017) on the management of pastoral lands in WA, which called for the Pastoral Lands Board, supported by DPIRD and the Department of Planning, Lands and Heritage to develop a statewide system for tracking landscape condition. The AOG's report recommended an integrated monitoring system (based on remote sensing and on-ground assessments) to inform land management activities at regional and individual station levels.

In this study, we revisited and extended methods developed in the pastoral lease assessment using geospatial analysis (PLAGA) project (Robinson et al. 2012) by combining field inventories of pasture condition with vegetation indices derived from Landsat satellite imagery and evaluated the feasibility of these commonly used, and relatively easy to apply, remote sensing products in the context of developing a formal condition monitoring program.

We also developed workflows for accessing and processing data from national repositories which can be used for a variety of purposes. This report describes this initial stage of developing a monitoring system for tracking pasture condition across WA's pastoral region.

2 Background

Historically, pastoral lease condition has been observed and recorded by field inspectors travelling along existing tracks (‘traverses’), but resources for these on-ground activities are shrinking and the data collected has limitations. One of the largest limitations is the irregular, relatively low density, spatial coverage of sites and low frequency of repeat observations, which are a consequence of the vast survey area and its difficult access. These data availability and distribution issues make timely detection of condition change very difficult.

Remote sensing is a complementary tool for overcoming the limitations of on-ground surveys because it can provide full coverage of an area of interest in a quantifiable and repeatable way, extending across large areas and through time (Bastin et al. 1998; Booth and Tueller 2003; Furby et al. 2009; Wallace and Thomas 1998). Since about 1995, DPIRD has applied coarse-resolution MODIS (250 m pixel resolution) remote sensing imagery for regional summaries of vegetation dynamics and has subsequently documented significant environmental degradation in the rangelands (DAFWA 2017). However, these regional summaries do not supply sufficient detail of condition within individual pastoral leases to assist with on-ground decision-making or compliance enforcement. Recent advances in remote sensing and imagery availability in Australia offer potential for pasture condition monitoring at higher resolution over large spatial extents at frequent repeat intervals.

In 2008−2012, researchers at Curtin University in collaboration with DPIRD examined the use of remote sensing to assess trends in land condition via the PLAGA project (Robinson et al. 2012). The objective was to improve the capacity of natural resource management and land administration agencies to record, monitor and communicate changes in land condition across the vast extent of the rangelands. In that project, 7 remote sensing VIs were evaluated for their potential to discriminate between good and poor field-measured rangeland condition assessments. Indices were computed using the Australian Greenhouse Office National Carbon Accounting System repository of calibrated Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) mosaics. Discrimination was assessed at 2 levels of stratification: pastoral station and vegetation functional group. The results confirmed the benefits of using satellite VIs for monitoring condition and informing sustainable management of pastoral rangelands (Robinson et al. 2012).

2.1 Comparison of the PLAGA project and this study

Since 2012, DPIRD and other state agencies have not deployed the PLAGA project’s findings or any other method using Landsat imagery for monitoring condition. Consequently, in this study we revisited the PLAGA methods and assessed their potential for use in a condition monitoring program using new DPIRD rangeland condition data is available such as the recent rangeland condition assessments (RCAs) in the Kimberley region as well as new sources of satellite imagery (Landsat 8) and improved computing power. Compred to the PLAGA project, we included additional stratification levels, which may better define boundaries for management. We also evaluated other VIs and used additional statistical methods for discrimination and classification to gain the highest possible discrimination and reliability from VIs for

monitoring. Table 2.1 outlines the main differences between the PLAGA project and this study.

Table 2.1: Comparison of methodology details of the PLAGA project and this study

Component	PLAGA project (2008−2012)	This study (2020)
Vegetation indices (VI)	Green + Red bands; LMI; NDSVI; NDVI, Red band; STVI-1; STVI-3	EVI; GDVI2, GDVI3, GDVI4, LMI, MSAVI2, NDVI, STVI-1
Stratification levels	Pastoral station; Functional group	Land system; Functional group; Pre-European vegetation type; Pasture type; Broad vegetation group
Regions	Kimberley; Pilbara; Gascoyne; Mid West; Wheatbelt–Goldfields; Nullarbor	Kimberley and Broome; Pilbara; Yalgoo and Sandstone; Goldfields; Nullarbor; Other Rangelands
Method	ROC (Receiver Operating Characteristic) AUC (area under curve) to discriminate between good and poor points	ROC AUC to discriminate between good and poor points Machine learning applied to classify VI values into good, fair and poor condition ratings (3-class)
Satellite data	The calibrated Landsat 5 TM mosaics from the Australian Greenhouse Office National Carbon Accounting System Land Cover program	Landsat 5 TM, Landsat 7 ETM+ and Landsat 8 OLI mosaics from the Australian Geoscience Data Cube

3 Vegetation indices

A VI is a combination of reflectance measurements from different spectral bands that provides information about vegetation cover (Bastin et al. 1998; Campbell 1996; Jafari et al. 2007; Wallace et al. 2006). An optimal VI must accurately discriminate vegetation cover from the background (Curry et al. 2008).

We evaluated 8 VIs commonly used for monitoring pasture condition in arid to semi-arid regions such as the WA rangelands (Table 3.1).

The Enhanced Vegetation Index (EVI) was proposed by Liu and Huete (1995) to simultaneously correct the effects of soil and atmosphere within the VI equation. Therefore, EVI is less sensitive to soil and atmosphere conditions than the NDVI or soil-adjusted vegetation indices (SAVI and MSAVI2; Xue and Su 2017). In Australia, EVI correlates well with phenology (Ma et al. 2013; Restrepo-Coupe et al. 2016), while also minimising the effect of bare soil on the calculation of the index (Huete et al. 2002).

Wu (2014) proposed a group of VIs for dryland vegetation condition assessment called the Generalised Difference Vegetation Indices (GDVIs) by generalising NDVI using power operation. According to his study, the power operation (2 for GDVI2, 3 for GDVI3 and 4 for GDVI4) leads to higher sensitivity and dynamic range of these derivatives of NDVI in low vegetated areas.

The Land Monitor Index (LMI) is a plant–water sensitive VI that uses the mid-infrared (MIR) and red band of the electromagnetic spectrum and was derived by discriminant analysis of good versus poor woodlands in the south-west of WA (Cacetta et al. 2001; Wallace et al. 2006). The rationale behind this index is that vegetation is expected to have a lower reflectance in both bands than bare, dry soil. The PLAGA project found this VI produced the highest level of discrimination summarised over the entire WA pastoral rangelands.

The Normalised Difference Vegetation Index (NDVI) is the most widely used VI and was proposed by Rouse et al. (1974). The use of NDVI in the semi-arid regions of Australia has been criticised because of its high sensitivity to the effects of soil brightness and colour, atmosphere, cloud and shadows, and its inability to detect ungreen (dry) vegetation (Bastin et al. 1995; O'Neill 1996; Marsett et al. 2006; Jafari et al. 2007; Robinson et al. 2012). However, we included this index because it is still being used by DPIRD and other government agencies in WA.

The Soil-Adjusted Vegetation Index (SAVI) has low sensitivity to soil colour and moisture changes in the background and reduces background soil brightness effects (Huete 1988). The modified SAVI (MSAVI2) is a simplified version of the SAVI and was proposed by Richardson and Wiegand (1977). This index is mostly useful for monitoring drought and desertification, estimating grassland, analysing plant growth, and monitoring soil changes such as soil erosion (Xue and Su 2017).

The Stress Related Vegetation Indices (STVI-1, 2, 3, 4) were proposed by Thenkabail et al. (1994) as plant–water sensitive VIs that use the MIR, the near-infrared (NIR) and red bands. They found STVIs worked better in yield prediction, wet and dry biomass and plant height estimation than slope-based indices such as the NDVI and MSAVI2. O'Neill (1996) applied STVIs to chenopod shrublands in western New South Wales and

suggested STVI-1 was a useful index for research related to vegetation observations in these environments. This VI produced the second highest discrimination potential compared to its rivals, including other STVIs in the PLAGA project, so we only assessed STVI-1 from this group in our study.

Table 3.1: Summary of the vegetation indices used in this study

Vegetation index	Equation	Correlation with cover	Comment
EVI[a] (Liu and Huete 1995)	$\frac{2.5(\rho_{NIR} - \rho_R)}{\rho_{NIR} + 6\rho_R - 7.5\rho_B + 1}$	Positive	Less sensitive than NDVI and SAVI to soil and atmosphere conditions
GDVI2[a] (Wu 2014)	$\frac{\rho_{NIR}^2 - \rho_R^2}{\rho_{NIR}^2 + \rho_R^2}$	Positive	Higher sensitivity and dynamic range in low vegetated areas
GDVI3[a] (Wu 2014)	$\frac{\rho_{NIR}^3 - \rho_R^3}{\rho_{NIR}^3 + \rho_R^3}$	Positive	Higher sensitivity and dynamic range in low vegetated areas
GDVI4[a] (Wu 2014)	$\frac{\rho_{NIR}^4 - \rho_R^4}{\rho_{NIR}^4 + \rho_R^4}$	Positive	Higher sensitivity and dynamic range in low vegetated areas
LMI (Caccetta et al. 2001)	$\rho_R + \rho_{MIR}$	Negative	Produced the highest discrimination potential in the PLAGA project
MSAVI2 (Richardson and Wiegand 1977)	$0.5\left\{(2\rho_{NIR} + 1) - \sqrt{(2\rho_{NIR} + 1)^2 - 8(\rho_{NIR} - \rho_R)}\right\}$	Positive	Less sensitive to soil colour and moisture
NDVI (Rouse et al. 1974)	$\frac{\rho_{NIR} - \rho_R}{\rho_{NIR} + \rho_R}$	Positive	Limited potential in rangelands, but commonly used by DPIRD and Landgate
STVI-1 (O'neill 1996)	$\frac{\rho_{MIR} \times \rho_R}{\rho_{NIR}}$	Negative	Produced the second highest discrimination potential in the PLAGA project

ρ = reflectance band; B = blue (Band 1); MIR = mid-infrared (Band 5); NIR = near-infrared (Band 4); R = red (Band 3)

a Index was not included in the PLAGA project (Robinson et al. 2012).

4 Datasets

DPIRD's archived traverse data was used to assess VIs computed from Landsat satellite images and identify those most suitable for monitoring the condition of different land types. Landsat images were extracted from the national imagery archives for all field observation locations and image dates were chosen as close to the date of traverse as possible.

4.1 Study area

On-ground traverse points with pasture condition ratings (Section 4.2) were available for 6 regions: Kimberley and Broome, Pilbara, Yalgoo and Sandstone, Goldfields, Nullarbor, and some stations in the Ashburton and Meekatharra land conservation districts which we called 'Other Rangelands'. We only considered areas in each pastoral region where traverse points were available at the time of doing this study. The boundaries of the study area, including the West Kimberley district, which was the only area with available pasture type and broad vegetation group maps, are shown in Figure 4.1.

DPIRD generally divides the pastoral rangelands into 2 areas based on dominant vegetation type:

- Northern Rangelands, which contains the Kimberley and the Pilbara regions. This is characterised by grasslands
- Southern Rangelands, which is mostly south of the Pilbara region and is characterised by shrublands.

Other divisions have also been used for different purposes. For example, in *Status of the Western Australian pastoral rangelands 2020: condition, trend and risk* (DPIRD 2020), the rangelands are divided into 4 regions: Kimberley and Broome, Pilbara, upper Southern Rangelands and lower Southern Rangelands.

In the PLAGA project, assessments were done for the Kimberley and Broome as one region, and the rangelands south of the Kimberley, including the Pilbara, as another region. The idea behind this was that the vegetation and soil types in the Kimberley and Broome region were unique, while the other regions (the Pilbara and southern rangelands) contained some similar and sometimes the same vegetation and soil type groups (for example, the Divide and Jamindee land systems can be found in the Pilbara region and the Southern Rangelands). We adopted this division strategy to assess the overall performance of the VIs and compare the results with the PLAGA project.

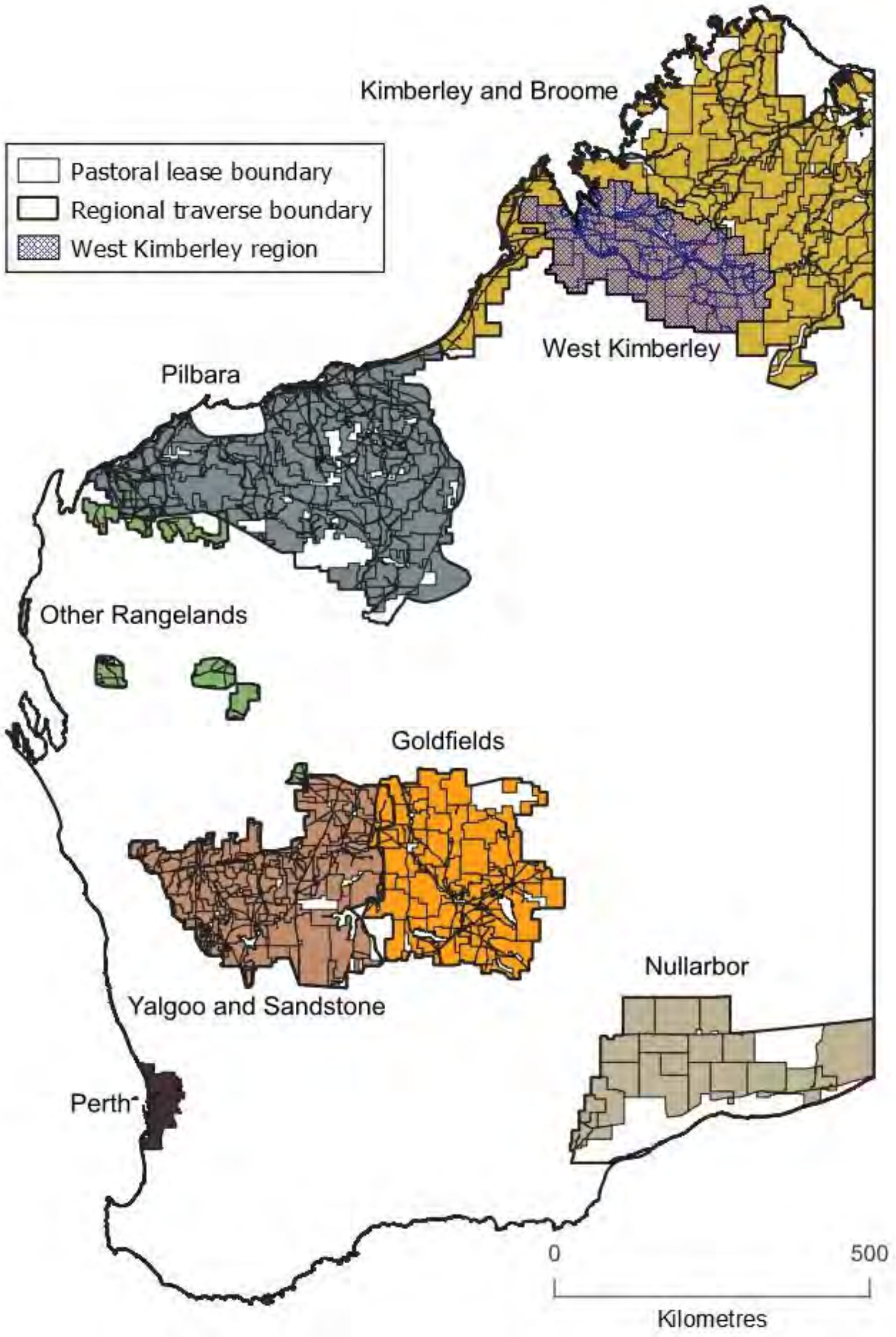


Figure 4.1: Location of the regions and the pastoral leases in the WA rangelands where traverse points were available

4.2 Traverse data and condition classes

DPIRD reports on pastoral rangeland condition for the Commissioner of Soil and Land Conservation to inform the Pastoral Lands Board (PLB). This is part of DPIRD's obligation to meet the requirements outlined in the '*Soil and Land Conservation Act 1945 and the Land Administration Act 1997'*. Ground-based traverses, undertaken by department officers since the late 1990s, are the typical way to collect information on pasture and rangeland condition. DPIRD and the PLB also use traverse data to determine whether pastoral leases are compliant with lease requirements. A pastoral

station consists of one or more pastoral leases. Existing tracks are used as traverse routes, and at 1 km intervals along these routes, a georeferenced assessment of condition over an area within a nominal radius of 50 m is made. These points are called traverse data, traverse sites or traverse points (hereafter referred to as traverse point unless clarification is required). Data collection is generally timed to coincide with the region’s dry season and records persistent (perennial) vegetation cover and its botanical composition because this is the most important indicator of rangeland condition (Waddell and Galloway in press). Data collected includes site name and coordinates, traverse date, land system, pasture type and pasture condition rating, rangeland condition, and erosion extent and rating (Figure 4.2).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	WPT	Easting	Northing	Pad_Name	Land_Sys	Past_Type	PC	species1	species2	species3	Ero_Type	Ero_Con	RC	Grazing	Comment	Zone	Date
2	WPT 1	372976	7999812	DUFFER	RIC	BSGP	3	HEECON	EULAUR	TRIINT	A	2	2	0	CHRFAL ARIPRU CA	52	6/06/2009
3	WPT 2	373198	7998918	DUFFER	RIC	RAPP	3	EULAUR	DICFEC	ARILAT	0	0	2	0	XERLAN CHRFAL HI	52	6/06/2009
4	WPT 3	373146	7997946	DUFFER	DOK	RAPP	4	SCLBCO	CENSET	SPOACT	0	0	3	0	CHRFAL XERLAN EU	52	6/06/2009
5	WPT 4	373700	7997165	DUFFER	DOK	HSPP	3	TRIINT	ARICON	ERIOBT	A+D	1	2	0	HEECON ARIPRU C	52	6/06/2009
6	WPT 5	373790	7996199	DUFFER	DOK	HSPP	2	TRIINT	EULAUR	ARICON	0	0	1	0	CYMBOM HEECON	52	6/06/2009
7	WPT 6	373219	7998439	DUFFER	RIC	BUGP	3	HEECON	CENSET	ERAFAL	0	0	2	0	ALI 17 NO CHRFAL	52	6/06/2009
8	WPT 7	373237	8000990	DUFFER	RIC	ASGP	2	ENNPUR	ARICON	CENSET	0	0	1	0	HEECON ERAFAL A	52	6/06/2009

PC = pasture condition; RC = rangeland condition

Figure 4.2: Sample of a survey traverse data for a pastoral lease

Pasture condition, which is recorded for each traverse point during on-ground inspections, describes the current condition of the vegetation compared with the optimal condition that could be expected given the potential of the site. Pasture condition is rated from ‘1 (very good)’ to ‘5 (very poor)’ using the criteria summarised in Table 4.1 (Waddell et al. 2010), depending on how close the current condition is to the optimal condition. Rangeland (or range) condition is another rating which describes the state of a rangeland ecological community in relation to its ability to conserve water, soil and nutrients compared to an optimal state unaltered by grazing or physical disturbance. DPIRD's rangelands officers use the matrix of soil erosion extent and pasture condition ratings to arrive at the rangeland condition rating ‘1 (good), 2 (fair) and 3 (poor)’ for each traverse point during assessments (DAFWA 2019).

Like the PLAGA project, we used pasture condition ratings for all tests performed in this study because the erosion type and severity cannot be detected by vegetation indices.

A traverse point will be assigned a pasture condition differently if changes in plant density or plant composition or both occur through time, for example, from palatable perennial (desirable) species to intermediate or undesirable species, or vice versa. Therefore, condition is not simply a measure of cover, and the relationship between plant density and plant composition can be complicated depending on the land type.

Table 4.1: Criteria used to assign a pasture condition rating to a traverse point

Condition class (Score)	Rating	Condition indicators
Very good	1	Cover and composition of shrubs, perennial herbs and grasses is near optimal; free of obvious reductions in palatable perennial plant species or increases in unpalatable plant species liable to reduce production potential
Good	2	Perennials present include all or most of the palatable plant species expected; some less palatable or unpalatable plant species may have increased, but total perennial cover is not very different from the optimal
Fair	3	Moderate losses of palatable perennials and/or increases in unpalatable shrubs or grasses, but most palatable species are still present; foliar cover is less than sites rated as good or very good, unless unpalatable plant species have increased
Poor	4	Conspicuous losses of palatable perennials; foliar cover is either decreased through a general loss of perennials or increased by invasion of unpalatable plant species
Very poor	5	Few palatable perennials remain; cover is either greatly reduced, with much bare soil, arising from loss of palatable plant species, or has become dominated by a proliferation of unpalatable plant species

Source: (Waddell et al. 2010)

Table 4.2 provides a summary of all available traverse points for this study. The datasets for the Pilbara and Nullarbor were used in the PLAGA project. Apart from Peedamulla Station (Pilbara) and Balladonia Station (Nullarbor), no recent survey has been done in these regions. In the Kimberley and Broome region, stations and leases are inspected and reassessed on a 3-year cycle, which means that many traverse points with coordinates have been collected in these regions since the PLAGA project ended in 2012. Unlike in the PLAGA project, no data was available for the Gascoyne, Mid West and Wheatbelt regions, except for a few stations in the Ashburton and Meekatharra land conservation districts (the Other Rangelands in our study). In the Goldfields, traverse points used in the PLAGA project were not available and alternative points with condition ratings were located and imported from a MicroStation design file and intersected with the land system polygons to define their land system attributes. The pasture type and date were not recorded for these points, so the dates of nearby inventory sites were used as an approximation for satellite imagery dates. Some points in the Yalgoo and Sandstone region might be the same as those used in the PLAGA project, but this is not certain because the PLAGA datasets were not available.

Table 4.2: Summary of available traverse data in WA pastoral regions

Region	Number of traverse points	Date of traverse	Is the data different from that used in the PLAGA project?
Kimberley and Broome	20,230	May 2000 – May 2019	Yes, new traverse points collected after 2012
Pilbara	11,784	May 1996 – August 1997	No
Yalgoo and Sandstone	8,511	September 1992 – November 1993	Yes, but some may be the same
Goldfields	2,324	September 1988 – May 1990	Yes, traverse points were not available for this region so inventory sites were used instead
Nullarbor	7,535	September 2005 – May 2007	No
Other Rangelands	1,875	November 2006 – November 2018	Yes, but some may be the same

Traverse points rated ‘1’, ‘2’ or ‘3’ were grouped together as good and points rated ‘4’ and ‘5’ were grouped as poor. These groupings were needed because of the similarities between classes and the limited number of points in each condition class. In the PLAGA project, the authors excluded the ‘3’ (fair) condition scores from the analysis because they believed these points were not statistically distinguishable from the good or the poor condition. Instead, a 2-class discrimination method using only good (1 and 2) and poor (4 and 5) ratings was used, which avoided the somewhat ambiguous middle rank of fair. This decision was based on the analysis of a pastoral lease in the Fitzroy River catchment, West Kimberley, in one of their previous experiments (Robinson et al. 2009). However, in the Results and Discussion of their report, they concluded: ‘fair condition ratings could be separated from poor condition ratings, but fair condition ratings could not be separated from good condition ratings’, which contradicts their assumption in the PLAGA project. Furthermore, excluding fair points from analysis often resulted in a site number below the minimum required to apply discrimination and classification algorithms.

We tested 3 discrimination and classification strategies to determine which one extracted the most information from the available data:

- fairs-excluded strategy – 2 classes using only good and poor points and excluding the fair (like the PLAGA approach)
- fairs-included strategy – 2 classes using good and fair points as one class and poor points as the other class
- 3-class strategy − 3-class machine learning classification using good, fair and poor points.

4.3 Satellite remote sensing data

Landsat images were extracted from the national imagery archives for all field observation locations and image dates were chosen as close to the date of traverse as possible. We used Landsat imagery to calculate the VIs because, unlike freely available higher resolution new sensors (such as Sentinel 2), Landsat series have continually observed Earth's surface to meet a wide range of information needs for more than 40 years (Wulder et al. 2008). This extended time series is critical because some ground-based traverses go back to the early 1990s.

We used Nadir Bidirectional Reflectance Distribution Function (BRDF) Adjusted Reflectance with Terrain illumination correction (NBART) and geometrically referenced images. NBART is corrected for atmospheric reflectance and topography. We downloaded the data from the Australian Geoscience Data Cube, which is hosted by National Computational Infrastructure, and provides analysis-ready Earth observation satellite imagery, as well as related data from multiple satellite and other acquisition systems. The data cube hosts the Australian Landsat Archive from Landsat 5 TM, Landsat 7 ETM+ as mosaics of 6 spectral bands and Landsat 8 Operation Land Imager (OLI) as mosaics of 7 spectral bands, all with 25 m ground pixel size. It also houses other national Earth observation collections, alongside gridded datasets such as rainfall and elevation.

To see an example of how the different VIs look, a 100 × 180 km area in the Pilbara was selected (Figure 4.3) and the 8 VIs used in this study with available good, fair and poor traverse points plotted on them are illustrated in Figure 4.4. Note, the pixel values of the EVI, GDVIs, MSAVI2 and NDVI are between −1 and 1. The LMI and STVI-1 are negative indices with values varying between 0 and 10,000. To make these comparable with the other indices, we inverted the VI value for each pixel to 10,000 minus that VI value, which still gives a value between 0 and 10,000, and then rescaled the resulting raster to between −1 and 1.

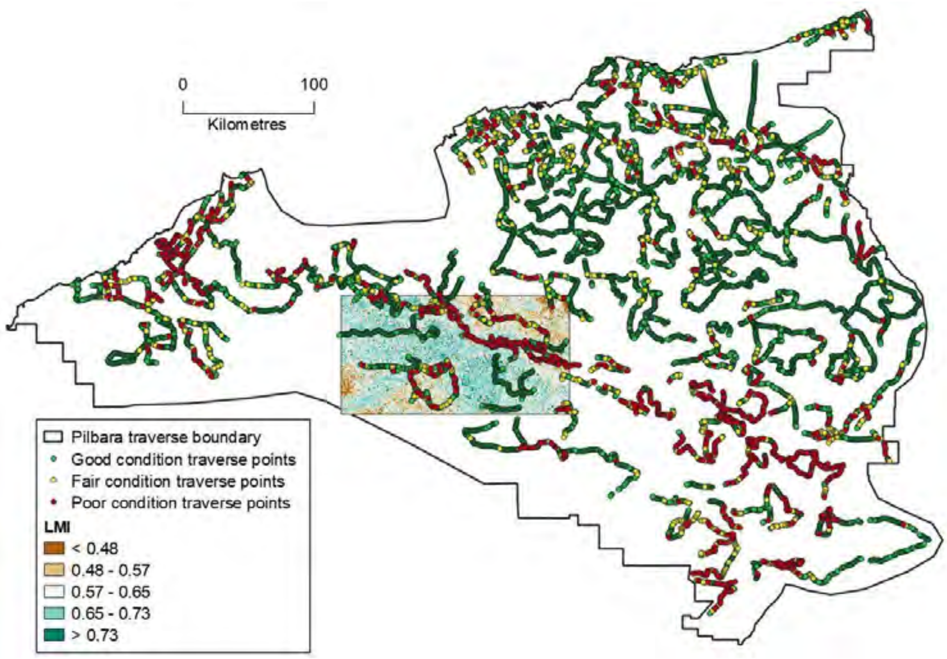
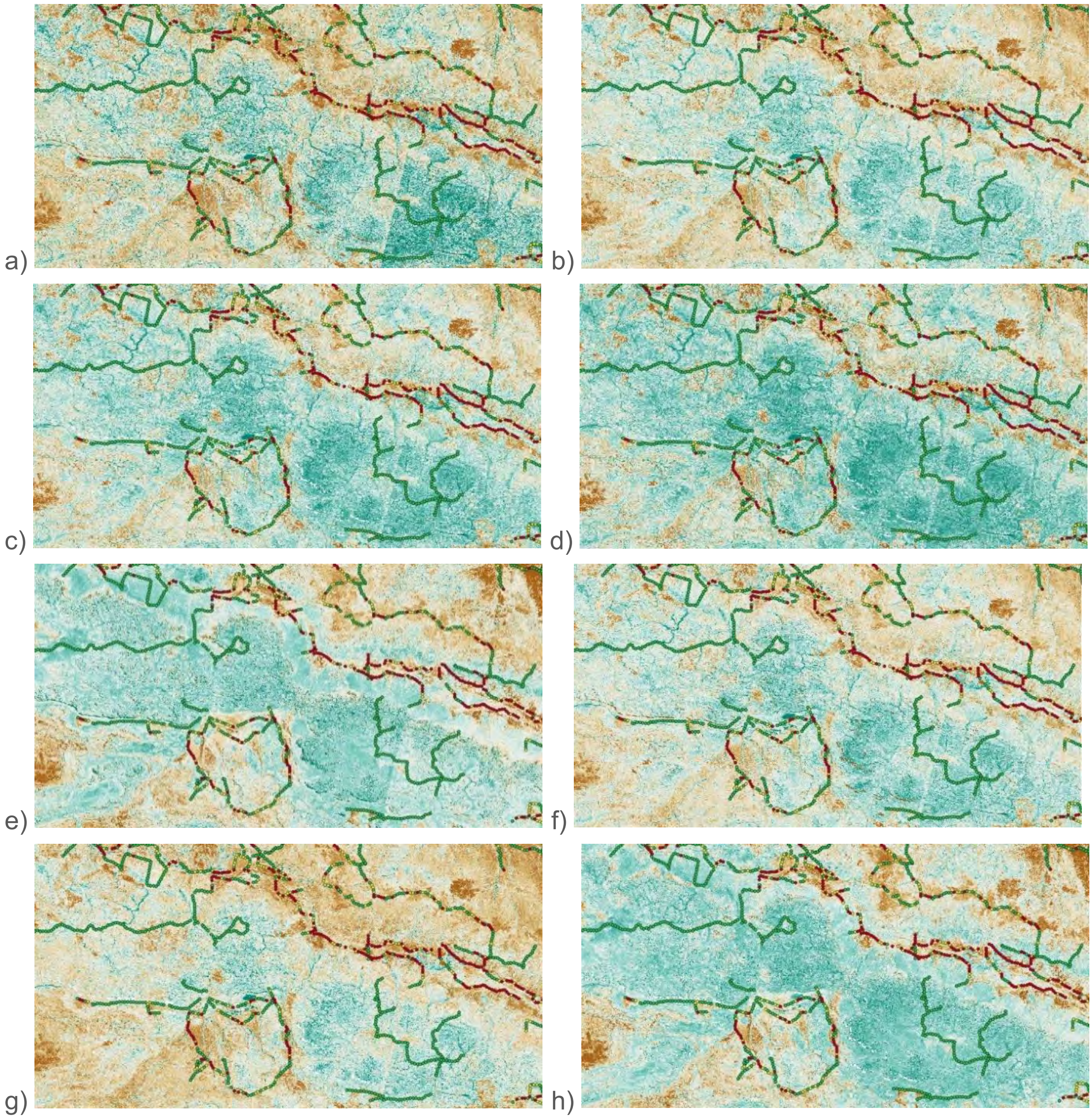


Figure 4.3: Location of an example area in the Pilbara and the available traverse points in this region



Notes:

1. Good condition traverse points are green, fair points are yellow, poor points are red.
2. Blue on the VI indicates the larger values which represent denser vegetation cover where good condition traverse points are expected; brown indicates the smaller values which represent bare ground where poor points are expected.

Figure 4.4: Vegetation indices and available traverse points on the selected area shown in Figure 4.3: a) EVI; b) GDVI2; c) GDVI3; d) GDVI4; e) inverted LMI; f) MSAVI2; g) NDVI; and h) inverted STVI-1

5 Stratification

Stratification refers to the division of an area into subregions with a high degree of internal homogeneity. To evaluate VIs, we stratified the traverse points using vegetation types and soil types recorded for each point. Existing vegetation or soil-landscape maps could also have been used or, alternatively, regions could have been defined on spectral contrast information as was done in Australia's national land cover monitoring system (Richards et al. 2001).

There is no consensus on which stratification is most appropriate for remote sensing of pasture condition. However, several studies suggest that as heterogeneity (i.e. spectral variation) increases within the stratification, the discrimination ability of the VI weakens (Bastin et al. 2006; Jafari et al. 2007; Pickup et al. 1998).

In the PLAGA project, Robinson et al. (2012) used functional groups and pastoral station boundaries for stratification. However, since a station can contain different soil and vegetation types, we chose not to examine this stratification type. Instead, we tested 5 levels of stratification from the physical environment and the plant communities' records of traverse points and the existing vegetation and soil-landscape maps – land systems, functional groups, pre-European vegetation types, pasture types and broad vegetation groups − to determine where remote sensing could be used, and the VI or VIs that produced the highest discrimination potential for pasture condition.

5.1 Land system

The land system approach to map different country types has been used in most of the regional rangeland surveys in WA. The concept of land systems was first used by Christian and Stewart (1953) who defined a land system as 'an area with a recurring pattern of topography, soils and vegetation'. These recurring patterns can be seen using aerial photography and other remotely sensed images. It is assumed areas with a similar pattern represent the same land system and then these are ground-truthed during field surveys.

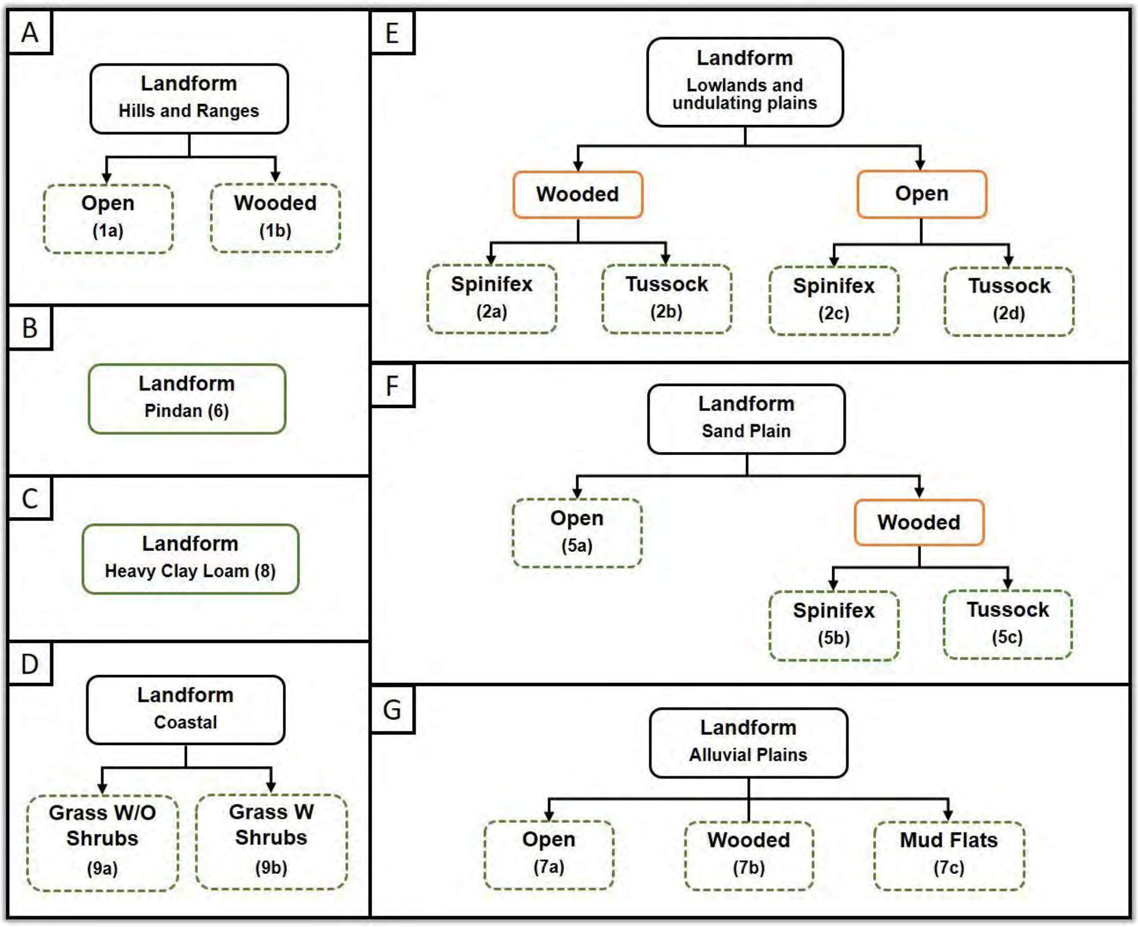
Land system boundaries were traditionally mapped from 1:50,000-scale aerial photographs and then overlaid on topographical maps or pastoral plans at any required scale.

The minimum-sized area of land considered mappable at these scales is about 1 km^2. Narrower areas, for example 500 m, can be mapped provided they are at least 1.5 km long. This allows long sinuous features, such as a creek, to be mapped (Waddell et al. 2010). The survey maps were published at 1:250,000 scale and are available in digital format (DPIRD 2018). More recent land surveys and their associated spatial datasets are more accurate than historical surveys in terms of content consistency and minimum mapped area because land surveyors have incorporated recent technology, such as terrain models and geophysical imagery, to identify land systems and their boundaries (PJ Waddell, personal communication, 10 September 2020). Modelling techniques are also being applied to predict soil-landscape associations explicitly for the south-west of WA (Holmes et al. 2014) and is planned to be extended to the rangelands. Among 175 land systems with the minimum required number of traverse points for assessment in

our study area (Figure 4.1), 62 of them were in the Kimberley and Broome region and the rest were in the Pilbara and southern rangelands.

5.2 Functional group (land type)

Functional groups or land types are aggregations of similar land systems. Initially, we grouped land systems into primary functional groups based on the published description of landform, dominant land unit or pasture type, and underlying vegetation. Where necessary, we split a primary group based on overstorey (open or wooded) and or grassland type (see Figure 5.1 A, D–G). The conceptual model for assigning the 110 land systems in the Kimberley and Broome region into 16 functional groups is shown in Figure 5.1, with further details in Appendix A: Table A1. Table A2 summarises the 444 land systems in the Pilbara and southern rangelands region classified into 44 functional groups.



Note: The black rectangular boxes represent the underlying landform, orange represents an intermediate separation of the landform, and green solid and dashed line boxes represent primary and split functional groups, respectively.

Source: Robinson et al. (2012)

Figure 5.1: Conceptual model for assigning functional groups in the Kimberley and Broome region.

5.3 Pre-European vegetation type

The pre-European vegetation mapping of WA details the original natural vegetation presumed to have existed before European settlement. Descriptions of each of the vegetation types can be found in the DPIRD (2017) database. The major sources of data in this database are the published and unpublished mapping of JS Beard at 1:250,000 scale; there are 30,000 polygons covering 160 map sheets. We assessed 48 groups in this study where the minimum number of traverse points were available (Appendix B).

5.4 Pasture (habitat) type

The interrelationships between the physical environment and the plant communities it supports can be described by classifying sampling points (inventory sites) into pasture types. Pasture types are classified in terms of combinations of landforms, soil types and plant communities. They closely resemble the 'ecological site' of the Society for Range Management (1991) and the 'habitat' category of Tinley (1991). In rangeland surveys of pastoral areas in WA, pasture types have been referred to as 'pasture lands' (Payne et al. 1988), 'pasture types' (Payne et al. 1987), 'vegetation types' (Curry et al. 1994), 'site types' (Pringle et al. 1994) and 'habitat types' (Payne et al. 1998). In this study, we called them pasture types because this is the term used in most DPIRD reports.

Pasture types are generally referred to by their landform, dominant taxon and dominant vegetation stratum. They are given an appropriate 4-letter code, for example, PXCS which indicates a plain with mixed chenopod shrubland (Waddell et al. 2010). In this study, we assessed the potential of VIs for 33 pasture types in the Kimberley and Broome region and 66 pasture types in the Pilbara and southern rangelands regions.

Pasture types are typically not mapped over the landscape but are assigned as proportions of the map polygons; however, explicit pasture type spatial prediction for WA's pastoral rangelands is being developed and at the time of preparing this report, the map for the West Kimberley land conservation district was made (Figure 5.2d). This approach uses machine learning to identify relationships between the georeferenced observations of pasture types recorded for each traverse point during traverse surveys, and environmental rasters (e.g. digital elevation model, gamma radiometric, soil and climate data) to predict pasture type distributions (Fletcher et al. in press).

5.5 Broad vegetation group (management unit)

Broad vegetation groups or management units are aggregations of similar pasture types with similar stocking rates and management, but these have not yet been made for all pasture types in WA's rangelands. Grouping pasture types by land management characteristics reduces the number of classes (pasture types). This simplification increases the number of observations per class, making statistical modelling more viable. Appendix C lists the broad vegetation groups in the WA rangelands.

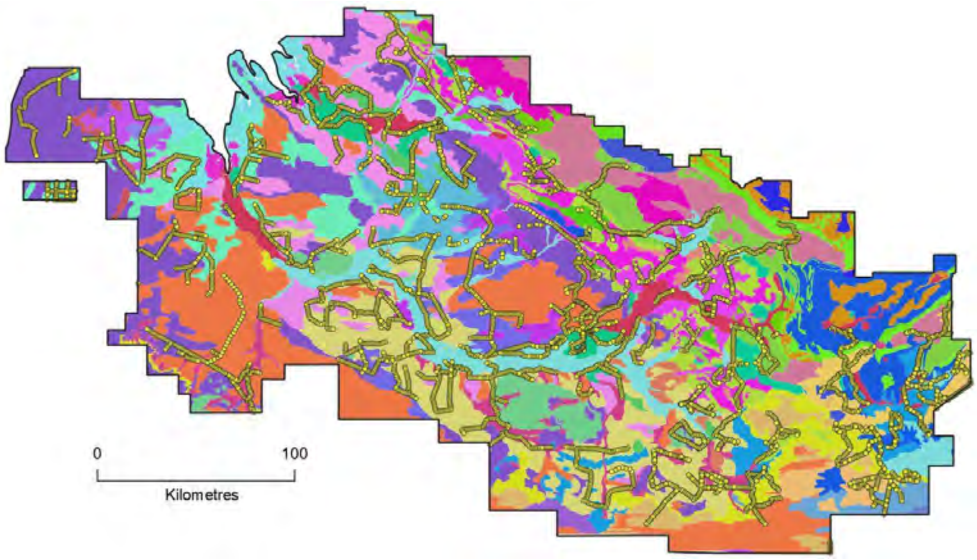
Broad vegetation group maps are also being developed by DPIRD but have only been completed for the West Kimberley (Fletcher et al. in press).

5.6 Example of stratification maps

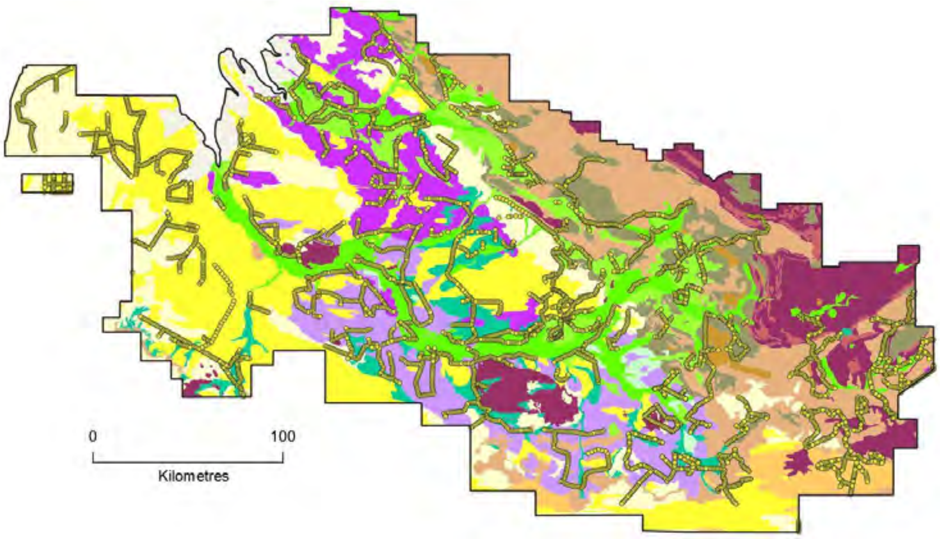
For display purposes, Figure 5.2 shows the available traverse points overlaid on maps of the 5 stratification levels used in this study for the West Kimberley. Individual groups within each of these stratification levels are illustrated in assorted colours, but legends are not provided because each stratification map contains many groups.

The number of groups and internal homogeneity in land systems and pasture types is higher than in the other 3 stratification levels. The land systems, functional groups and pre-European vegetation types are in vector format (polygons at 1:250,000 scale). The pasture types and broad vegetation groups maps (although still in development) are in raster format and their resolution is currently 90 m, so they contain more-detailed spatial information on distributions. The pre-European vegetation types is less important for pastoral monitoring, but we analysed it to compare to the other strata and because it is valuable for conservation monitoring applications.

a)



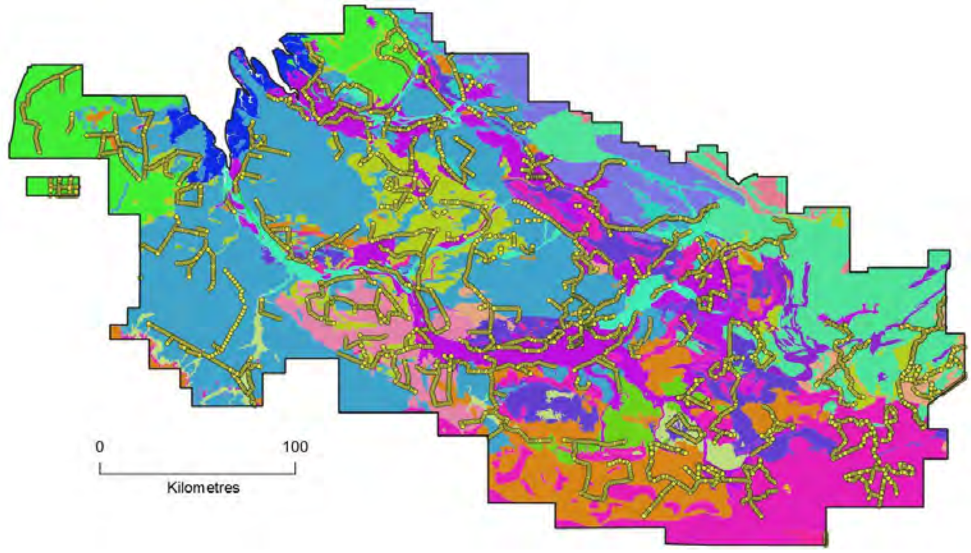
b)



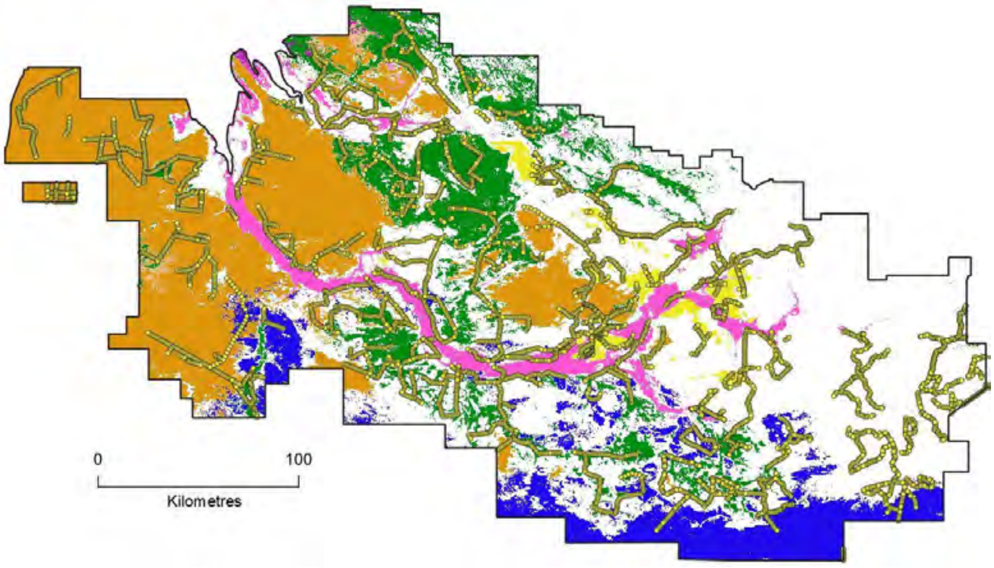
(continued)

Figure 5.2: Example of the distribution of the traverse points overlying stratification level maps of the West Kimberley: a) land systems; b) functional groups; c) pre-European vegetation types; d) pasture types; and e) broad vegetation groups

c)



d)



e)

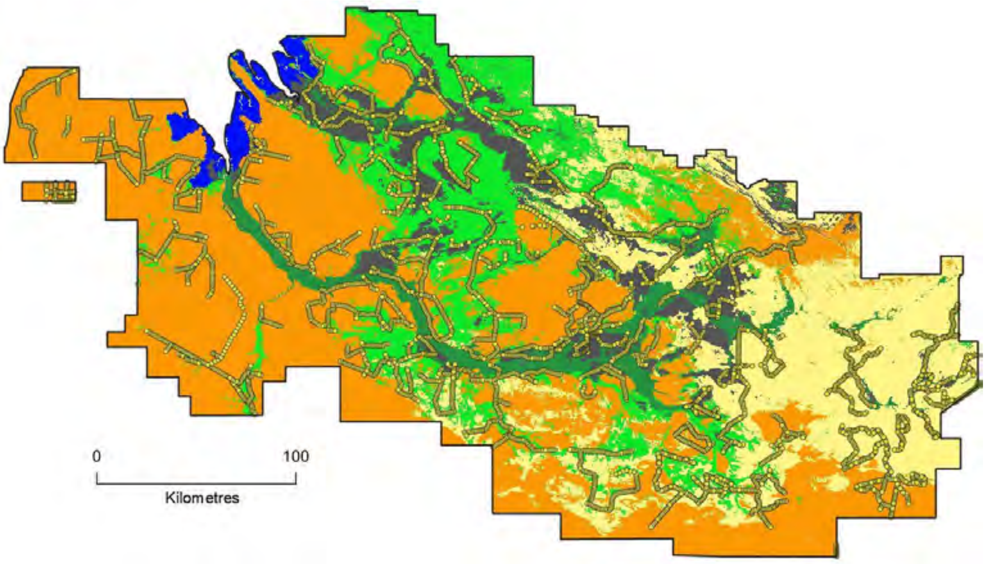


Figure 5.2 (continued): Example of the distribution of the traverse points overlying stratification level maps of the West Kimberley

6 Methods

Figure 6.1 shows the steps taken to reassess the PLAGA project using the latest Landsat imagery and all available DPIRD survey and rangeland condition assessment (RCA) traverse condition data. The aim was to measure the correlation between Landsat VIs and condition data to determine for which individual groups of each stratification level, remote sensing VIs are effective enough to be used for monitoring pasture condition.

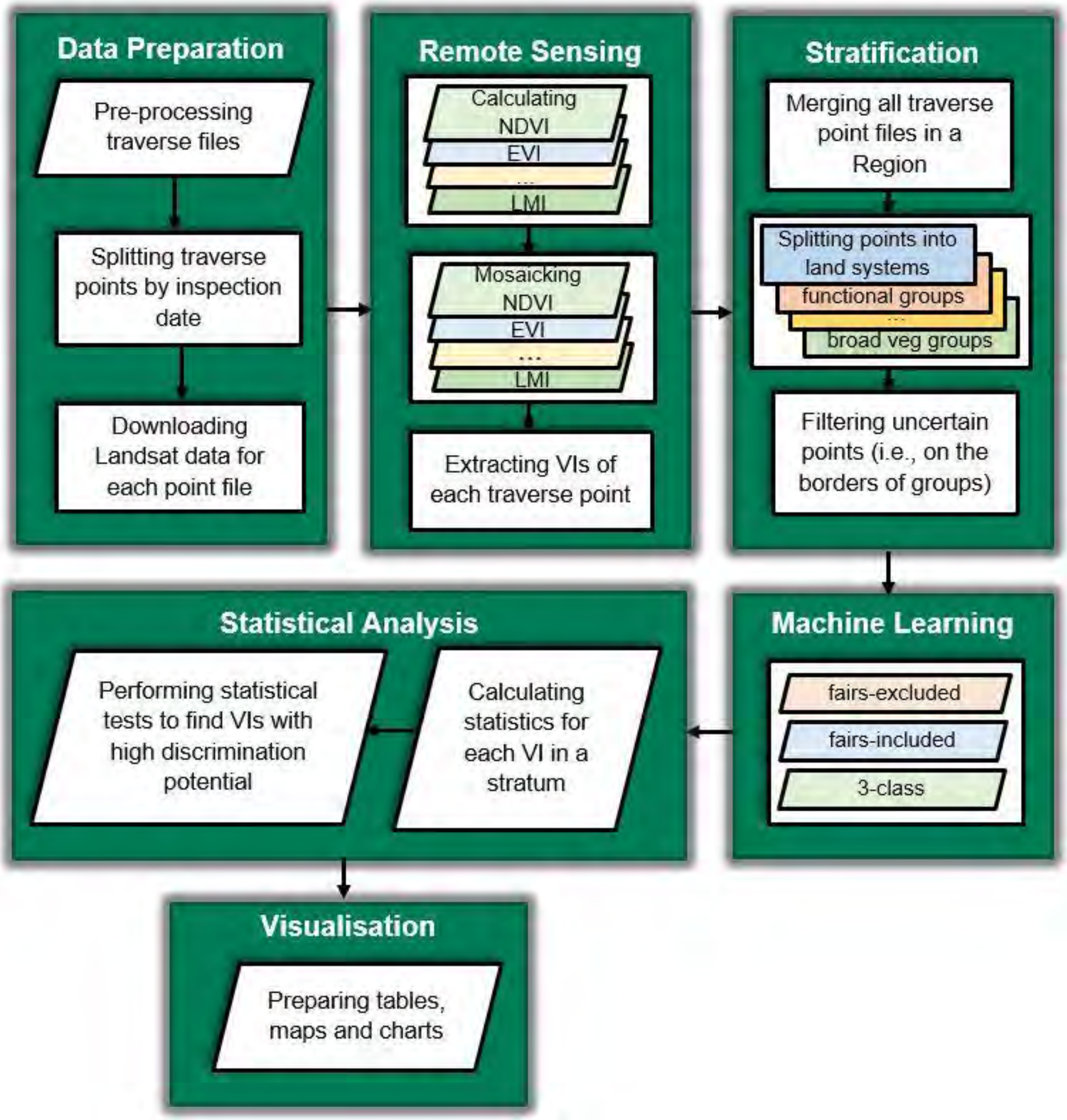


Figure 6.1: Flow chart of the method used to measure the correlation between Landsat vegetation indices (VIs) and DPIRD traverse point data to determine which VIs could be used for monitoring pasture condition for individual groups of each stratification level

6.1 Data preparation

The first step was to collate, prepare and clean the field data and Landsat satellite imagery. Because the traverse condition data was collected over decades and by different inspectors using different methods (survey or RCA), the format of each data spreadsheet was different. The naming of fields, coordinate systems and even the format of the same fields differed. For example, pasture condition on some dates was collected in word format as good, poor and fair and in some others as integers (a ranking of 1 to 5). Some files did not have coordinates and we had to open the GPS log files in those areas and find the coordinates by point names. In some files, the date of the traverse observation was missing so we used the dates from RCA report files to select imagery. Some points did not have pasture condition ratings or other required information, so we excluded these from further analyses. This data collation step took half of our project time.

6.2 Remote sensing

Next, we split the point files by inspection dates into separate files and downloaded the contemporaneous Landsat data for those areas. We selected Landsat NBART bands as close to the date of the traverse observations as possible. Where more than one suitable image was available for an inspection period of a lease, we calculated the medoid (median value for each pixel) and used it to compute the VIs. This removed the biases in the pixel values due to undected cloud and shadows. Then we mosaicked the VI rasters for each traverse point (split by date) and assigned their values to each traverse point using the GPS coordinates recorded at that point. Because the on-ground assessment of condition is made over an area with a nominal radius of 50 m and the pixel size of Landsat VIs is 25 m, we used weighted averaging based on the distance of each traverse point to the centre of the 4 closest pixels to calculate the VI value for each traverse point.

6.3 Stratification

As outlined in Section 5, we used 5 levels of stratification in this study: land system, functional group, pre-European vegetation type, pasture type and broad vegetation group.

Like the PLAGA project, in all stratification levels, groups with fewer than 70 traverse points and 3 points in each pasture condition class were removed from the 2-class strategies based on the minimum number of points suggested by Jiménez-Valverde and Lobo (2007) for the construction of stable and meaningful receiver operating characteristic (ROC) curves. For the 3-class strategy, we excluded the groups in each stratification level with fewer than 85 traverse points and 5 points in each class because they did not have empirically acceptable classification performance.

Next, we filtered out the points less confidently assigned to a group of a stratification level. We identified the traverse points that were within 50 m of a stratum boundary because these were likely to be in transition zones. Deleting these from the analysis reduced possible confusion and increased the area under curve (AUC) value and classification accuracy in almost all stratification levels.

6.4 Discriminating condition ratings and classification

As with the PLAGA project, we used ROC analysis to determine the VIs with the highest potential to discriminate between 2-class condition classes within each group for all stratification levels and those that could be confidently used in monitoring those groups. A ROC curve is a graphical plot that illustrates the diagnostic ability of a binary classifier system as its discrimination threshold is varied. It is created by plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold settings. This is essentially a numerical summary of the confusion matrix commonly used to assess classification accuracy.

To create ROC curves, we transformed the traverse points into binary format (good = 1 in fairs-excluded strategy, good/fair = 1 in fairs-included strategy and poor = 0 in both) and we sorted the pixel value of the VIs extracted at each of these points in ascending order. We defined a set of thresholds from the VI values as half the distance (in numerical space) between each successive pair. For example, if the VI value of 2 successive traverse points after sorting is 0.71 and 0.73, respectively, we set the threshold at 0.72. At each threshold we calculated the TPR and FPR and generated a ROC curve by plotting the FPR (x-axis) against the TPR (y-axis). The formulas for the TPR and the FPR are

$$TPR = \frac{nGP_i}{nGP}$$

$$FPR = \frac{nPP_i}{nPP}$$

where nGP_i is the cumulative number of good or good/fair points at threshold *i*, *nGP* is the total number of these points, nPP_i is the cumulative number of poor points at threshold *i,* and *nPP* is the total number of poor points in the dataset (Fielding and Bell 1997; Fawcett 2006).

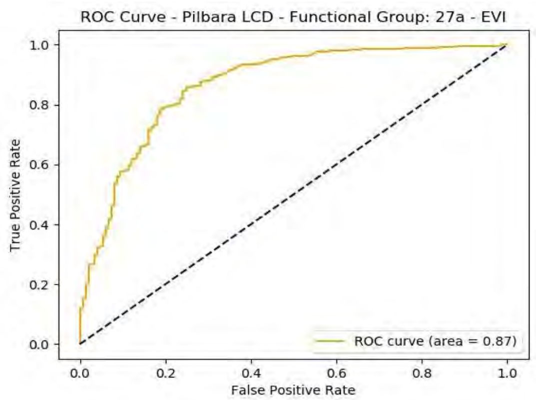
We then used the ROC curve to generate a summary statistic known as the area under curve (AUC), which is calculated using the trapezoidal rule (Figure 6.2) (Pontius and Schneider 2001). A VI that perfectly discriminates between good and poor condition will have an AUC of 1, while a model no better than random chance has an AUC of 0.5. Based on the ranges proposed by Hosmer and Lemeshow (2000), which were also adopted by Robinson et al. (2012), an AUC greater than or equal to 0.7 for any VI tested suggested adequate discrimination for where remote sensing could be used. Likewise, if all VIs produced an AUC less than 0.7, the area was considered to have inadequate discrimination and using VIs for monitoring should therefore be avoided. We had groups in each stratification level with AUC values slightly lower than 0.7; however, the difference between them and 0.7 was not statistically significant, so we considered 0.67 as the AUC threshold for adequate discrimination.

We further assessed the possibility of discriminating between good and fair ratings in each group of the stratification levels in different regions. This is not possible with ROC analysis, which only illustrates the diagnostic ability of binary classifiers, so we used multiclass machine learning classification methods – K-Nearest Neighbour, Random Forest and Support Vector Machine; Appendix D – to classify VI values into 3 condition

classes: good, fair and poor. We considered overall accuracies (OA) above 0.67 as successful application of VIs for predicting pasture condition. In all experiments, we considered about 70% of the traverse points in each condition class as the training dataset and the rest were used for evaluation. To decrease variation and increase classification reliability, we repeated each experiment 10 times on randomly selected training datasets and then averaged the results. The parameters of the RF and SVM classifiers were calculated using the 10-fold cross validation (grid search) technique.

Figure 6.2 shows an example of a ROC curve with its AUC, and a confusion matrix and the accuracies derived from it. Appendix D4 contains details of the OA, user's accuracy and producer's accuracy metrics.

a)



b)

		Actual Conditions Ranks			
		good	fair	poor	UA
Predicted Condition Ranks	good	334	13	9	0.94
	fair	3	17	3	0.74
	poor	2	1	9	0.75
	PA	0.99	0.55	0.43	OA = 0.91

UA = user's accuracy; PA = producer's accuracy; OA = overall accuracy

Figure 6.2: Example of: a) a receiver operating characteristic (ROC) curve and its area under curve (AUC) value from the fairs-excluded strategy using the EVI for a functional group; b) a confusion matrix and the accuracies derived from it using the LMI for a functional group

6.5 Statistical analysis

The most suitable VI(s) for monitoring the condition of a region in a stratification level are not necessarily the ones with the highest mean AUC or mean OA over all groups for that stratification level. When we compare different models (VIs and strategies in this study), statistical analysis is necessary to identify the most accurate and suitable VI(s). We calculated and used summary statistics, such as minimum, maximum, mean, median and standard deviation for each VI for these comparisons. We compared the means to identify significant differences between VIs' discrimination and classification potential using analysis of variance (ANOVA; $\alpha = 0.05$). This determined if the differences between the VI with the highest mean value of AUCs or OAs in a stratification level and its rivals were statistically significant, although this test does not show where the difference lays. To realise which VIs' potential were significantly lower, we needed to compare each VI separately to the VI with the largest AUC or OA using a 2-tailed z-test (for stratification levels with more than 30 groups with the minimum required number of points) or a 2-tailed t-test (for stratification levels with fewer than 30 groups) and a 95% confidence interval.

While the discrimination potential of a VI in a particular group or landscape of a stratification level can be adequate, it does not mean it is reliable across all groups. In

other words, the VI's potential may not be adequate in other groups of that stratification level. We computed a metric called 'candidate or VI reliability' (herein referred to as VI reliability) for each VI in a stratification level as the percentage of groups (with minimum required number of points) with an AUC or OA greater than or equal to 0.67. Furthermore, to summarise the potential of remote sensing over regions using a patchwork of VIs for each stratification level, we computed a second reliability metric called 'overall reliability', which used any VI with an AUC or OA greater than or equal to 0.67 in a group.

6.6 Visualising condition change

The value of a VI for a particular pixel may vary over time because of climate, fires or condition changes caused by grazing pressure or management. Availability of Landsat satellite imagery for the past 30 years makes it a suitable data source for monitoring the dynamics of vegetation condition. To analyse and visualise changes through time in each group in the stratification levels, the VI with the highest adequate level of discrimination between the condition ratings needs to be used.

A simple and conventional way to visualise change over time is the linear slope trend raster (Figure 6.3a). In this method, the linear trend for each pixel value (the VI value here) through time is calculated. For linear trends using VIs, high positive values signify vegetation cover increased over time, negative values indicate vegetation cover decreased over time, and values around zero indicate no change (Karfs et al. 2009; Lawes and Wallace 2008; Wallace et al. 2006).

A more effective tool at depicting change is known as 'trend composite'. These form the basis of the Vegmachine™ software and are created by computing the linear trend and the curvature (quadratic component) of a VI over time (Karfs et al. 2004; Beutel at al. 2019). In the PLAGA project, VI trend composites were generated using orthogonal polynomial coefficients (Draper and Smith 1998; Robinson et al. 2012). This numerical method for calculating linear slope and quadratic curvature for pixel values through time is very efficient and fast, especially when implemented on a vast area with many image pixels. However, it has a large limitation that makes it impractical in our study. The assumption in the numerical method is that data points in a time series are uniformly distributed through the time. However, in a long time series, the possibility of having large areas covered and masked with cloud or cloud shadows is very high. In addition, in some years and on certain dates in some areas, no satellite data is captured and recorded. To deal with this limitation, we implemented the conventional least square method to estimate the slope and curvature of VI time series datasets by estimating the coefficients of first and second order polynomials.

Trend composites were generated from 3 layers to be displayed as an RGB (red, green, blue) image. RGB channels are used to store the required information of linear slope and curvature as follows:

- red channel − negative linear slope or decreasing trend (all positive slope values were set to zero); this signifies vegetation cover had decreased
- green channel − positive curvature (all negative curvature values were set to zero); this signifies there was no change in vegetation cover

- blue channel − positive linear slope or increasing trend (all negative slope values were set to zero); this signifies vegetation cover had increased.

Figure 6.3b shows an example of a VI trend composite for a land system. The displayed colour summarises vegetation condition behaviour of each pixel over time. Table 6.1 summarises the output colours of a trend composite and their interpretations (Karfs et al. 2004). The flow chart for making the VI trend composites is shown in Figure 6.4.

a)

b)

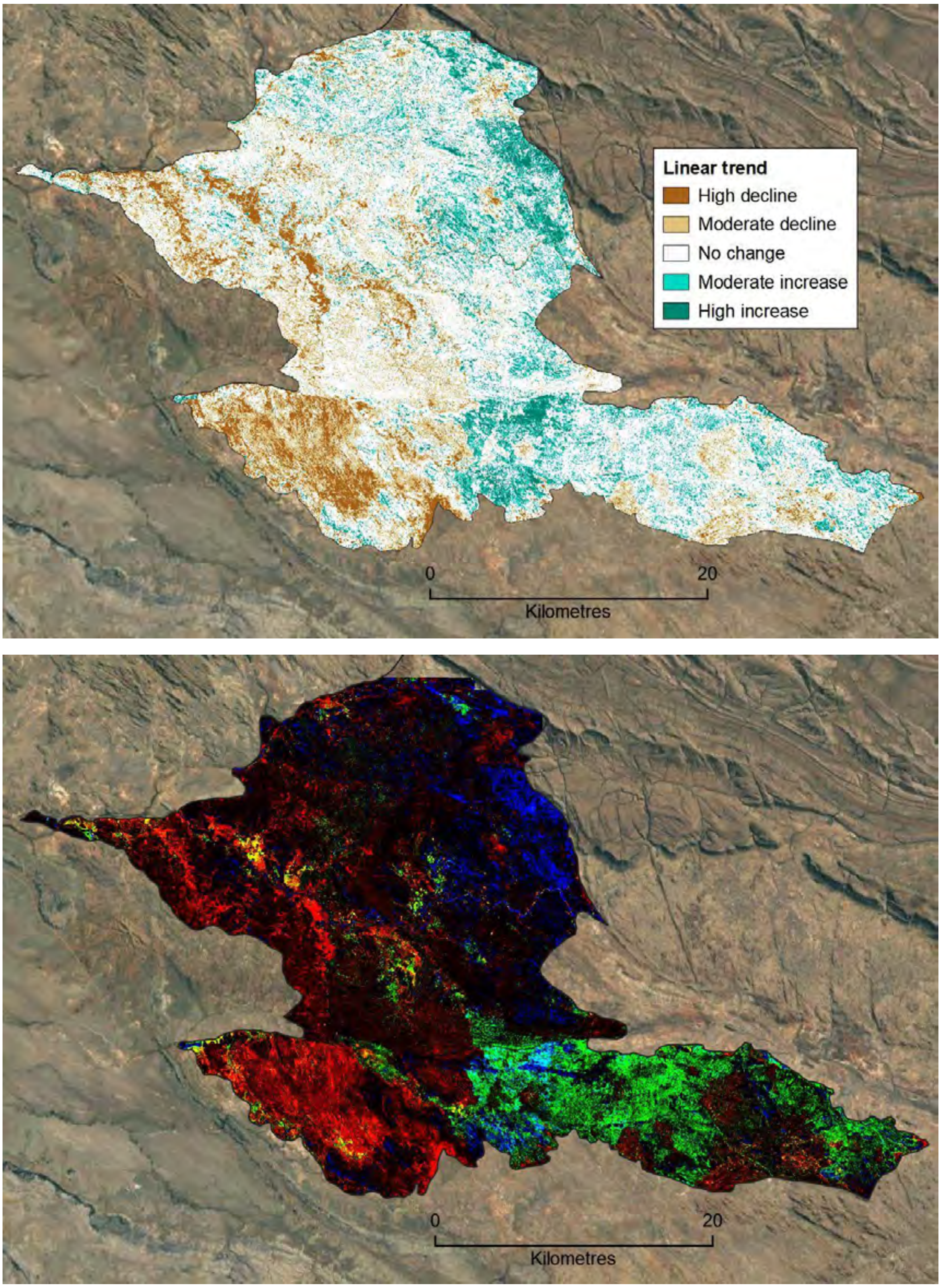


Figure 6.3: Example of vegetation cover trend maps in a land system: a) linear trend; b) trend composite

Table 6.1: Interpretation of the colours associated with a vegetation cover trend composite

Colour	Interpretation
Red	Vegetation cover has decreased over the period
Blue	Vegetation cover has increased over the period
Green	Vegetation cover has recently increased
Yellow/orange	Vegetation cover has recently increased but not up to original levels
Cyan	Vegetation cover has increased overall, with a greater increase recently
Black	Vegetation cover has not changed

Source: Robinson et al. (2012)

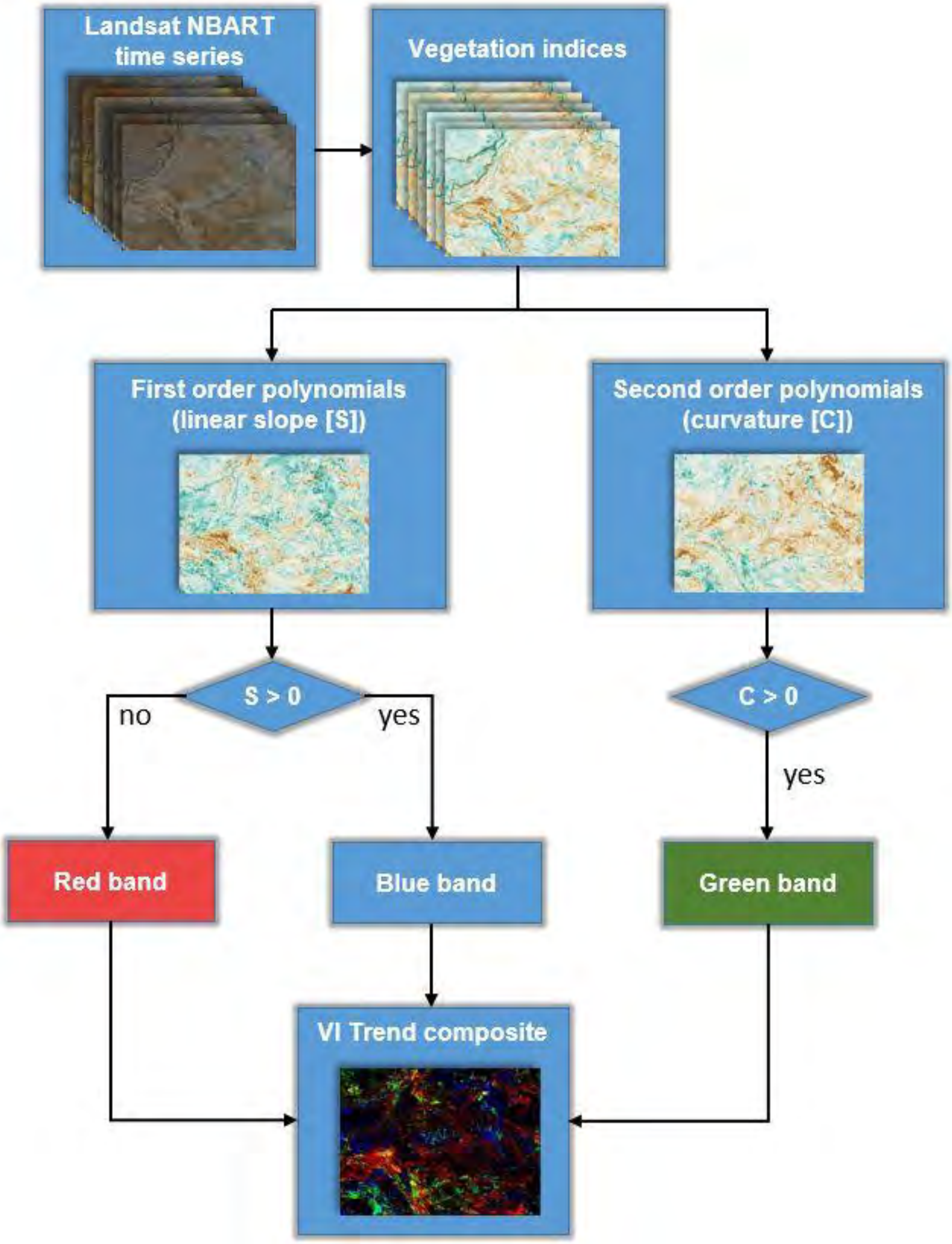


Figure 6.4: Flow chart of the steps to generate a trend composite using Landsat NBART time series

7 Experimental results

We applied the methods described in Section 6 to determine the Landsat VIs most useful for monitoring pasture condition for individual groups in the stratification levels. Such VIs are called the 'most suitable indices' — those with a high mean AUC or OA and high reliability — which means they have the highest potential to discriminate between condition classes.

To assess the overall discrimination performance of each VI, we divided the WA rangelands into the Kimberley and Broome region and the Pilbara and southern rangelands region (Section 4.1). Accordingly, we merged the points relating to the same groups in each stratification level in different regions to create a single file for each group. This process increased the number of points in all groups and made discrimination and classification analysis possible for the groups that did not have the minimum required number of points in an individual region. The results presented in this section and Appendix E.

Note that the same groups in a stratification level in different regions are not necessarily identical. For example, an individual pasture type may contain slightly different vegetation and landscape composition in the Nullarbor and Goldfields regions. This means the overall discrimination potential of a VI in a particular group or landscape can be adequate, but it does not necessarily mean it is reliable in all regions. To evaluate the discrimination potential of VIs in each region, we split all the traverse point files and VIs into geographic regions and applied the 3 discrimination and classification strategies for each region. This regional analysis enabled ease of access and cross-referencing with the associated maps of each region. A drawback, however, was the reduced number of points in the smaller groups, which decreased the accuracies and reliabilities, especially in the 3-class strategy. The results of this regional assessment are presented in Appendix E.

The initial results of our analysis in the Kimberley and Broome, Yalgoo and Sandstone, Goldfields, and some stations in the Nullarbor regions revealed that the 3 GDVIs never produced discrimination better (statistically significant) than NDVI. As a result, we did not continue to assess the GDVIs.

7.1 Overall discrimination performance

In this section we present and compare the AUC values for the fairs-excluded and fairs-included (2-class) strategies and the OA values for the 3-class strategy summarised for all the groups within different stratification levels in the Kimberley and Broome region and in the Pilbara and southern rangelands region, together with the reliability values.

7.1.1 Fairs-excluded strategy

Using the fairs-excluded strategy, the VIs with the highest potential for discriminating between good and poor condition classes in the Kimberley and Broome region, on average, were the LMI and STVI-1 (mean AUC = 0.64–0.70; Table 7.1). These were also the most reliable VIs irrespective of stratification level and were capable of adequate discrimination (AUC ≥ 0.67) for about half of the groups in all stratification levels.

The VIs with the highest potential for discrimination using the fairs-excluded strategy in the Pilbara and southern rangelands region were the STVI-1 for land systems, functional groups and broad vegetation groups (mean AUC = 0.64−0.68) and EVI (mean AUC = 0.64–0.65) for pre-European vegetation types and pasture types. The LMI was also a suitable VI for broad vegetation groups and its potential was not statistically different to the STVI-1. These were the most reliable VIs for the stratification levels, although the VI reliabilities for pasture types and broad vegetation groups were below 40%. However, encouragingly, the overall reliability of using remote sensing VIs for monitoring all stratification levels was above 52% (Table 7.2).

Table 7.1: Summary statistics for the fairs-excluded strategy in the Kimberley and Broome region

Stratification level	Vegetation index	N[a]	Area under curve (AUC) value					Reliability (%)	
			Minimum	Maximum	Mean[b]	Median	SD	VI[c]	Overall[d]
Land system	EVI	49	0.24	0.76	0.59	0.62	0.11	26.53	67.34
	GDVI2	49	0.35	0.77	0.60	0.61	0.11	32.65	
	GDVI3	49	0.35	0.77	0.60	0.61	0.11	32.65	
	GDVI4	49	0.35	0.78	0.60	0.61	0.11	32.65	
	LMI	49	0.45	0.98	0.70i	0.71	0.13	63.27	
	MSAVI2	49	0.35	0.77	0.60	0.61	0.11	32.65	
	NDVI	49	0.35	0.77	0.60	0.61	0.11	30.61	
	STVI-1	49	0.42	0.92	0.70i	0.71	0.12	59.18	
Functional group	EVI	14	0.35	0.67	0.53	0.56	0.09	7.14	50.00
	GDVI2	14	0.41	0.68	0.56	0.56	0.08	7.14	
	GDVI3	14	0.41	0.68	0.56	0.56	0.08	7.14	
	GDVI4	14	0.41	0.68	0.56	0.56	0.08	7.14	
	LMI	14	0.54	0.83	0.66i	0.65	0.08	42.86	
	MSAVI2	14	0.41	0.68	0.56	0.56	0.08	7.14	
	NDVI	14	0.41	0.68	0.56	0.56	0.08	7.14	
	STVI-1	14	0.53	0.80	0.64i	0.62	0.08	42.86	
Pre-European vegetation type	EVI	19	0.42	0.88	0.59	0.56	0.11	21.05	63.16
	GDVI2	19	0.41	0.90	0.60	0.59	0.11	15.79	
	GDVI3	19	0.41	0.90	0.60	0.59	0.11	15.79	
	GDVI4	19	0.41	0.90	0.60	0.59	0.11	15.79	
	LMI	19	0.44	0.90	0.67i	0.69	0.12	57.89	
	MSAVI2	19	0.41	0.90	0.60	0.59	0.11	15.79	
	NDVI	19	0.41	0.89	0.60	0.59	0.11	15.79	
	STVI-1	19	0.48	0.91	0.67i	0.70	0.12	63.16	

(continued)

Table 7.1 continued: Summary statistics for the fairs-excluded strategy in the Kimberley and Broome region

Stratification level	Vegetation index	N[a]	Area under curve (AUC) value					Reliability (%)	
			Minimum	Maximum	Mean[b]	Median	SD	VI[c]	Overall[d]
Pasture type	EVI	30	0.28	0.88	0.62i	0.64	0.13	46.67	66.67
	GDVI2	30	0.37	0.84	0.61i	0.63	0.14	33.33	
	GDVI3	30	0.38	0.84	0.61i	0.63	0.14	33.33	
	GDVI4	30	0.38	0.84	0.61i	0.63	0.14	33.33	
	LMI	30	0.36	0.81	0.65i	0.69	0.12	56.67	
	MSAVI2	30	0.37	0.84	0.61i	0.63	0.14	33.33	
	NDVI	30	0.37	0.84	0.61i	0.63	0.14	33.33	
	STVI-1	30	0.34	0.83	0.64i	0.67	0.13	50.00	
Broad vegetation group	EVI	8	0.42	0.76	0.63i	0.64	0.11	37.50	62.50
	GDVI2	8	0.45	0.73	0.62i	0.62	0.09	37.50	
	GDVI3	8	0.45	0.73	0.62i	0.62	0.10	37.50	
	GDVI4	8	0.45	0.73	0.62i	0.62	0.09	37.50	
	LMI	8	0.53	0.80	0.66i	0.66	0.08	50.00	
	MSAVI2	8	0.45	0.73	0.62i	0.62	0.09	37.50	
	NDVI	8	0.45	0.72	0.61i	0.61	0.09	37.50	
	STVI-1	8	0.53	0.81	0.65i	0.65	0.09	37.50	

SD = standard deviation

a Number of groups that the summary statistics are drawn from (groups with at least 70 traverse points within the region and at least 3 points in each condition class).

b The means with symbol 'i' within the column for a stratification level were not significantly different, but they were significantly different to the ones without this symbol ($\alpha = 0.05$).

c Percentage of groups in a stratification level with AUC greater than or equal to 0.67 for each VI.

d Percentage of groups where at least one of the VIs tested had an AUC greater than or equal to 0.67.

Note: The most suitable VI(s) for each stratification level (has the highest reliability value and the mean AUC was not significantly different from the highest mean AUC) is shown in bold.

Table 7.2: Summary statistics for the fairs-excluded strategy in the Pilbara and southern rangelands region

Stratification level	Vegetation index	N[a]	Area under curve (AUC) value					Reliability (%)	
			Minimum	Maximum	Mean[b]	Median	SD	VI[c]	Overall[d]
Land system	EVI	96	0.21	0.96	0.65i	0.62	0.16	45.83	57.29
	GDVI2	43	0.18	0.80	0.56	0.54	0.12	16.28	
	GDVI3	43	0.18	0.80	0.56	0.54	0.12	16.28	
	GDVI4	43	0.19	0.80	0.56	0.54	0.12	16.28	
	LMI	96	0.31	0.99	0.64i	0.64	0.14	43.75	
	MSAVI2	96	0.18	0.96	0.63i	0.61	0.15	40.63	
	NDVI	96	0.18	0.96	0.63i	0.61	0.15	40.63	
	STVI-1	96	0.31	0.99	0.65i	0.65	0.14	46.88	
Functional group	EVI	33	0.50	0.87	0.68i	0.67	0.10	51.52	66.67
	GDVI2	20	0.48	0.83	0.64i	0.63	0.09	35.00	
	GDVI3	20	0.48	0.83	0.64i	0.63	0.09	35.00	
	GDVI4	20	0.48	0.83	0.64i	0.63	0.09	35.00	
	LMI	33	0.52	0.88	0.66i	0.65	0.08	42.42	
	MSAVI2	33	0.48	0.84	0.66i	0.64	0.10	45.45	
	NDVI	33	0.48	0.84	0.66i	0.64	0.10	45.45	
	STVI-1	33	0.53	0.88	0.68i	0.68	0.08	54.55	
Pre-European vegetation type	EVI	24	0.27	0.90	0.65i	0.68	0.15	54.17	54.17
	GDVI2	14	0.37	0.84	0.58	0.58	0.14	21.43	
	GDVI3	14	0.37	0.84	0.58	0.58	0.14	21.43	
	GDVI4	14	0.37	0.84	0.58	0.58	0.14	21.43	
	LMI	24	0.29	0.98	0.60i	0.59	0.15	29.17	
	MSAVI2	24	0.28	0.88	0.62i	0.66	0.15	50.00	
	NDVI	24	0.28	0.88	0.62i	0.66	0.15	50.00	
	STVI-1	24	0.27	0.97	0.62i	0.63	0.15	41.67	
Pasture type	EVI	53	0.23	0.96	0.64i	0.62	0.15	39.62	52.83
	GDVI2	25	0.42	0.91	0.59	0.58	0.12	16.00	
	GDVI3	25	0.42	0.91	0.60	0.58	0.12	16.00	
	GDVI4	25	0.42	0.91	0.60	0.58	0.12	12.00	
	LMI	53	0.28	0.92	0.62i	0.61	0.13	35.85	
	MSAVI2	53	0.23	0.91	0.61i	0.60	0.15	32.08	
	NDVI	53	0.23	0.91	0.61i	0.60	0.15	32.08	
	STVI-1	53	0.26	0.91	0.62i	0.60	0.14	37.74	

(continued)

Table 7.2 continued: Summary statistics for the fairs-excluded strategy in the Pilbara and southern rangelands region

Stratification level	Vegetation index	N[a]	Area under curve (AUC) value					Reliability (%)	
			Minimum	Maximum	Mean[b]	Median	SD	VI[c]	Overall[d]
Broad vegetation group	EVI	23	0.40	0.97	0.64i	0.61	0.13	34.78	52.18
	GDVI2	21	0.42	0.96	0.61i	0.60	0.15	19.05	
	GDVI3	21	0.42	0.96	0.61i	0.60	0.15	17.39	
	GDVI4	21	0.42	0.96	0.61i	0.60	0.15	17.39	
	LMI	23	0.44	0.92	0.65i	0.60	0.12	39.13	
	MSAVI2	23	0.42	0.96	0.61i	0.59	0.13	17.39	
	NDVI	23	0.42	0.96	0.61i	0.59	0.13	17.39	
	STVI-1	23	0.44	0.92	0.64i	0.61	0.12	39.13	

SD = standard deviation

a Number of groups that the summary statistics are drawn from (groups with at least 70 traverse points within the region and at least 3 points in each condition class).

b The means with symbol 'i' within the column for a stratification level were not significantly different, but they were significantly different to the ones without this symbol (α = 0.05).

c Percentage of groups in a stratification level with AUC greater than or equal to 0.67 for each VI.

d Percentage of groups where at least one of the VIs tested had an AUC greater than or equal to 0.67.

Note: The most suitable VI(s) for each stratification level (with the highest reliability value and the mean AUC was not significantly different from the highest mean AUC) is shown in bold.

7.1.2 Fairs-included strategy

Using the fairs-included strategy in the Kimberley and Broome region, the LMI had the highest potential for discriminating between good/fair and poor condition classes (mean AUC = 0.61–0.66) and was the most reliable VI in land system, functional group, pre-European vegetation type and pasture type stratification levels, although STVI-1 had similar discrimination potential and reliability in pasture types. For broad vegetation groups, EVI was the most reliable VI (37.5%) and although its mean AUC (0.62) was lower than those of LMI and STVI-1, we considered it as the most suitable VI in this stratification level because the differences between the mean AUC values were not statistically significant (Table 7.3).

In the Pilbara and southern rangelands region, the EVI had the highest potential for discrimination (mean AUC = 0.61–0.63) and was the most reliable in 3 of the 5 stratification levels. For land systems and pasture types, the STVI-1 and LMI were the best VIs because their reliabilities were higher. The overall reliabilities for all stratification levels were between 33% and 50% in this region (Table 7.4).

Table 7.3: Summary statistics for the fairs-included strategy in the Kimberley and Broome region

Stratification level	Vegetation index	N[a]	Area under curve (AUC) value					Reliability (%)	
			Minimum	Maximum	Mean[b]	Median	SD	VI[c]	Overall[d]
Land system	EVI	62	0.32	0.92	0.60	0.61	0.12	24.19	61.20
	GDVI2	62	0.33	0.89	0.60	0.61	0.12	35.48	
	GDVI3	62	0.32	0.89	0.60	0.61	0.12	37.10	
	GDVI4	62	0.33	0.89	0.60	0.61	0.12	35.48	
	LMI	62	0.31	0.96	0.66i	0.68	0.15	56.45	
	MSAVI2	62	0.33	0.89	0.60	0.61	0.12	35.48	
	NDVI	62	0.33	0.89	0.60	0.61	0.12	33.87	
	STVI-1	62	0.33	0.94	0.66i	0.67	0.14	51.61	
Functional group	EVI	15	0.39	0.77	0.56	0.58	0.10	6.67	40.00
	GDVI2	15	0.43	0.66	0.56	0.56	0.07	0.00	
	GDVI3	15	0.43	0.71	0.57	0.56	0.08	6.67	
	GDVI4	15	0.43	0.66	0.56	0.56	0.07	0.00	
	LMI	15	0.51	0.76	0.62i	0.61	0.07	33.33	
	MSAVI2	15	0.43	0.66	0.56	0.56	0.07	0.00	
	NDVI	15	0.43	0.66	0.56	0.56	0.07	0.00	
	STVI-1	15	0.54	0.73	0.62i	0.59	0.06	26.67	
Pre-European vegetation type	EVI	22	0.43	0.83	0.58	0.57	0.09	18.18	54.55
	GDVI2	22	0.43	0.84	0.59	0.60	0.10	13.64	
	GDVI3	22	0.43	0.84	0.59	0.60	0.10	13.64	
	GDVI4	22	0.43	0.84	0.59	0.60	0.10	13.64	
	LMI	22	0.42	0.85	0.65i	0.67	0.11	54.55	
	MSAVI2	22	0.43	0.84	0.59	0.60	0.10	13.64	
	NDVI	22	0.43	0.83	0.59	0.60	0.10	13.64	
	STVI-1	22	0.47	0.86	0.64i	0.66	0.11	45.45	
Pasture type	EVI	33	0.26	0.81	0.61i	0.63	0.12	30.30	51.52
	GDVI2	33	0.34	0.84	0.60i	0.62	0.12	30.30	
	GDVI3	33	0.35	0.86	0.61i	0.62	0.12	30.30	
	GDVI4	33	0.35	0.84	0.60i	0.62	0.12	30.30	
	LMI	33	0.36	0.77	0.61i	0.63	0.11	42.42	
	MSAVI2	33	0.35	0.83	0.60i	0.62	0.12	30.30	
	NDVI	33	0.34	0.84	0.60i	0.62	0.12	30.30	
	STVI-1	33	0.31	0.80	0.62i	0.61	0.12	42.42	

(continued)

Table 7.3 continued: Summary statistics for the fairs-included strategy in the Kimberley and Broome region

Stratification level	Vegetation index	N[a]	Area under curve (AUC) value					Reliability (%)	
			Minimum	Maximum	Mean[b]	Median	SD	VI[c]	Overall[d]
Broad vegetation group	EVI	8	0.45	0.74	0.62i	0.63	0.09	37.50	37.50
	GDVI2	8	0.47	0.71	0.61i	0.61	0.08	25.00	
	GDVI3	8	0.47	0.71	0.61i	0.62	0.08	25.00	
	GDVI4	8	0.47	0.71	0.61i	0.61	0.08	25.00	
	LMI	8	0.51	0.77	0.64i	0.64	0.08	25.00	
	MSAVI2	8	0.47	0.71	0.61i	0.61	0.08	25.00	
	NDVI	8	0.47	0.70	0.60i	0.61	0.08	12.50	
	STVI-1	8	0.51	0.78	0.63i	0.64	0.09	25.00	

SD = standard deviation

a Number of groups that the summary statistics are drawn from (groups with at least 70 traverse points within the region and at least 3 points in each condition class).

b The means with symbol 'i' within the column for a stratification level were not significantly different, but they were significantly different to the ones without this symbol (α = 0.05).

c Percentage of groups in a stratification level with AUC greater than or equal to 0.67 for each VI.

d Percentage of groups where at least one of the VIs tested had an AUC greater than or equal to 0.67.

Note: The most suitable VI(s) for each stratification level (with the highest reliability value and the mean AUC was not significantly different to the highest mean AUC) is shown in bold.

Table 7.4: Summary statistics for the fairs-excluded strategy in the Pilbara and southern rangelands region

Stratification level	Vegetation index	N[a]	Area under curve (AUC) value					Reliability (%)	
			Minimum	Maximum	Mean[b]	Median	SD	VI[c]	Overall[d]
Land system	EVI	113	0.25	0.95	0.61i	0.59	0.14	33.63	44.25
	GDVI2	58	0.23	0.75	0.54	0.53	0.11	13.79	
	GDVI3	58	0.23	0.75	0.54	0.53	0.11	13.79	
	GDVI4	58	0.23	0.75	0.54	0.54	0.11	13.79	
	LMI	113	0.27	0.98	0.61i	0.59	0.13	31.86	
	MSAVI2	113	0.23	0.95	0.60i	0.57	0.14	33.63	
	NDVI	113	0.23	0.95	0.60i	0.57	0.14	33.63	
	STVI-1	113	0.24	0.98	0.61i	0.59	0.13	36.29	
Functional group	EVI	36	0.41	0.86	0.63i	0.62	0.11	33.33	41.67
	GDVI2	26	0.36	0.99	0.60i	0.58	0.15	23.08	
	GDVI3	26	0.36	0.99	0.60i	0.58	0.15	23.08	
	GDVI4	26	0.36	0.99	0.60i	0.58	0.15	23.08	
	LMI	36	0.39	0.87	0.61i	0.60	0.09	19.44	
	MSAVI2	36	0.39	0.82	0.62i	0.60	0.11	30.56	
	NDVI	36	0.39	0.82	0.62i	0.60	0.11	30.56	
	STVI-1	36	0.41	0.87	0.62i	0.61	0.10	22.22	

(continued)

Table 7.4 continued: Summary statistics for the fairs-excluded strategy in the Pilbara and southern rangelands region

Stratification level	Vegetation index	N[a]	Area under curve (AUC) value					Reliability (%)	
			Minimum	Maximum	Mean[b]	Median	SD	VI[c]	Overall[d]
Pre-European vegetation type	EVI	26	0.28	0.89	0.62i	0.65	0.15	46.15	50.00
	GDVI2	17	0.37	0.83	0.58i	0.58	0.13	23.53	
	GDVI3	17	0.37	0.83	0.58i	0.58	0.13	23.53	
	GDVI4	17	0.37	0.83	0.58i	0.58	0.13	23.53	
	LMI	26	0.30	0.98	0.58i	0.58	0.13	23.08	
	MSAVI2	26	0.29	0.88	0.60i	0.63	0.14	38.46	
	NDVI	26	0.29	0.88	0.60i	0.63	0.14	38.46	
	STVI-1	26	0.28	0.97	0.60i	0.60	0.14	34.62	
Pasture type	EVI	66	0.24	0.89	0.62i	0.62	0.13	34.85	47.00
	GDVI2	33	0.35	0.88	0.59i	0.58	0.12	21.21	
	GDVI3	33	0.35	0.87	0.59i	0.58	0.12	21.21	
	GDVI4	33	0.35	0.87	0.59i	0.58	0.12	21.21	
	LMI	66	0.28	0.88	0.61i	0.61	0.12	36.36	
	MSAVI2	66	0.23	0.87	0.60i	0.59	0.14	27.27	
	NDVI	66	0.23	0.87	0.60i	0.59	0.14	27.27	
	STVI-1	66	0.27	0.88	0.61i	0.62	0.13	33.33	
Broad vegetation group	EVI	24	0.45	0.97	0.61i	0.57	0.12	25.00	33.33
	GDVI2	22	0.46	0.95	0.59i	0.55	0.14	22.73	
	GDVI3	22	0.46	0.95	0.59i	0.55	0.14	22.73	
	GDVI4	22	0.46	0.95	0.59i	0.55	0.14	22.73	
	LMI	24	0.30	0.85	0.59i	0.58	0.12	20.83	
	MSAVI2	24	0.46	0.95	0.59i	0.55	0.13	20.83	
	NDVI	24	0.46	0.95	0.59i	0.55	0.13	20.83	
	STVI-1	24	0.43	0.89	0.59i	0.56	0.12	25.00	

SD = standard deviation

a Number of groups that the summary statistics are drawn from (groups with at least 70 traverse points within the region and at least 3 points in each condition class).

b The means with symbol 'i' within the column for a stratification level were not significantly different, but they were significantly different to the ones without this symbol (α = 0.05).

c Percentage of groups in a stratification level with AUC greater than or equal to 0.67 for each VI.

d Percentage of groups where at least one of the VIs tested had an AUC greater than or equal to 0.67.

Note: The most suitable VI(s) for each stratification level (with the highest reliability value and the mean AUC was not significantly different to the highest mean AUC) is shown in bold.

7.1.3 3-class strategy

As discussed in Section 6.4, we used 1-NN (K-NN when K = 1), RF and SVM machine learning methods to distinguish between good, fair and poor condition classes.

By comparing the summary statistics of the 3 machine learning methods using the ANOVA test on OA values, we determined that the RF and SVM significantly outperformed the 1-NN, but the differences between the RF and SVM were not statistically significant. We decided to use the SVM method in the 3-class strategy because it produced higher reliabilities.

In the Kimberley and Broome region, the 3-class strategy produced no statistically significant difference between the 8 VIs in their potential to discriminate between the condition classes, with all mean OAs between 0.51 and 0.55; however, in the functional group and pre-European vegetation type stratification levels, the reliabilities of the LMI and STVI-1 were higher (Table 7.5). All VI and overall reliabilities for all stratification levels were low (7−17%) compared to the fairs-excluded and fairs-included strategies.

In the Pilbara and southern rangelands region, the LMI was generally the most suitable VI and had the highest potential to discriminate between classes for functional groups, pre-European vegetation types, pasture types and broad vegetation groups (mean OAs = 0.58−0.67) and had reliabilities between 30% and 46%, although in functional groups and pre-European vegetation types, the EVI and STVI-1 were suitable candidates as well (Table 7.6). In this region, the STVI-1 produced the highest mean OA (0.60) and reliability (33%) for land systems compared to the other VIs.

Table 7.5: Summary statistics for the 3-class strategy in the Kimberley and Broome region

Stratification level	Vegetation index	N[a]	Overall accuracy (OA)					Reliability (%)	
			Minimum	Maximum	Mean	Median	SD	VI[c]	Overall[c]
Land system	EVI	53	0.38	0.86	0.53i	0.51	0.11	13.20	15.09
	GDVI2	53	0.38	0.86	0.53i	0.51	0.11	13.20	
	GDVI3	53	0.38	0.86	0.53i	0.51	0.11	11.32	
	GDVI4	53	0.38	0.86	0.53i	0.51	0.11	11.32	
	LMI	53	0.38	0.86	0.55i	0.52	0.11	13.20	
	MSAVI2	53	0.38	0.86	0.53i	0.50	0.11	13.20	
	NDVI	53	0.38	0.86	0.53i	0.51	0.11	13.20	
	STVI-1	53	0.39	0.86	0.55i	0.52	0.10	13.20	
Functional group	EVI	15	0.41	0.73	0.53i	0.51	0.10	6.67	13.33
	GDVI2	15	0.41	0.73	0.53i	0.51	0.09	6.67	
	GDVI3	15	0.41	0.73	0.53i	0.51	0.09	6.67	
	GDVI4	15	0.41	0.73	0.53i	0.51	0.09	6.67	
	LMI	15	0.41	0.73	0.53i	0.54	0.0.08	13.33	
	MSAVI2	15	0.41	0.73	0.53i	0.51	0.09	6.67	
	NDVI	15	0.41	0.73	0.53i	0.51	0.09	6.67	
	STVI-1	15	0.42	0.73	0.53i	0.51	0.08	13.33	

(continued)

Table 7.5 continued: Summary statistics for the 3-class strategy in the Kimberley and Broome region

Stratification level	Vegetation index	N[a]	Overall accuracy (OA)					Reliability (%)	
			Minimum	Maximum	Mean	Median	SD	VI[c]	Overall[c]
Pre-European vegetation type	EVI	22	0.38	0.77	0.50i	0.48	0.10	9.09	13.64
	GDVI2	22	0.41	0.77	0.51i	0.48	0.10	9.09	
	GDVI3	22	0.38	0.77	0.51i	0.48	0.10	9.09	
	GDVI4	22	0.40	0.77	0.51i	0.49	0.10	9.09	
	LMI	22	0.40	0.77	0.52i	0.50	0.09	13.64	
	MSAVI2	22	0.39	0.77	0.51i	0.49	0.10	9.09	
	NDVI	22	0.37	0.77	0.51i	0.48	0.10	9.09	
	STVI-1	22	0.41	0.77	0.51i	0.50	0.09	9.09	
Pasture type	EVI	30	0.37	0.82	0.54i	0.50	0.12	16.67	16.67
	GDVI2	30	0.41	0.82	0.53i	0.50	0.12	16.67	
	GDVI3	30	0.40	0.82	0.53i	0.49	0.12	16.67	
	GDVI4	30	0.40	0.82	0.54i	0.50	0.12	16.67	
	LMI	30	0.41	0.83	0.54i	0.49	0.12	16.67	
	MSAVI2	30	0.40	0.82	0.53i	0.49	0.12	16.67	
	NDVI	30	0.37	0.82	0.53i	0.48	0.12	16.67	
	STVI-1	30	0.43	0.83	0.55i	0.50	0.12	16.67	
Broad vegetation group	EVI	8	0.41	0.80	0.53i	0.49	0.12	12.50	12.50
	GDVI2	8	0.39	0.80	0.53i	0.49	0.12	12.50	
	GDVI3	8	0.39	0.80	0.52i	0.48	0.12	12.50	
	GDVI4	8	0.39	0.80	0.52i	0.48	0.12	12.50	
	LMI	8	0.41	0.80	0.53i	0.49	0.12	12.50	
	MSAVI2	8	0.39	0.80	0.52i	0.48	0.12	12.50	
	NDVI	8	0.39	0.80	0.52i	0.48	0.12	12.50	
	STVI-1	8	0.40	0.80	0.53i	0.49	0.12	12.50	

SD = standard deviation

a Number of groups that the summary statistics are drawn from (groups with at least 85 traverse points within the region and at least 5 points in each condition class).

b The means with symbol 'i' within the column for a stratification level were not significantly different, but they were significantly different to the ones without this symbol (α = 0.05).

c Percentage of groups in a stratification level with OA greater than or equal to 0.67 for each VI

d Percentage of groups where at least one of the VIs tested had an OA greater than or equal to 0.67.

Note: The most suitable VI(s) for each stratification level (with the highest reliability value and the mean OA was not significantly different to the highest mean OA) is shown in bold

Table 7.6: Summary statistics for the 3-class strategy in the Pilbara and southern rangelands region

Stratification level	Vegetation index	N[a]	Overall accuracy (OA)					Reliability (%)	
			Minimum	Maximum	Mean	Median	SD	VI[c]	Overall[c]
Land system	EVI	98	0.38	0.96	0.59i	0.56	0.15	31.63	32.65
	GDVI2	52	0.39	0.88	0.54	0.50	0.15	21.15	
	GDVI3	52	0.40	0.88	0.55	0.51	0.15	21.15	
	GDVI4	52	0.40	0.88	0.55	0.50	0.15	21.15	
	LMI	98	0.36	0.96	0.60i	0.56	0.15	31.63	
	MSAVI2	98	0.37	0.96	0.59i	0.55	0.15	31.63	
	NDVI	98	0.35	0.96	0.59i	0.56	0.15	31.63	
	STVI-1	98	0.39	0.96	0.60i	0.57	0.15	32.65	
Functional group	EVI	36	0.39	0.95	0.59i	0.54	0.18	30.56	30.56
	GDVI2	24	0.40	0.80	0.52	0.49	0.13	16.67	
	GDVI3	24	0.38	0.80	0.52	0.49	0.13	16.67	
	GDVI4	24	0.38	0.80	0.52	0.49	0.13	16.67	
	LMI	36	0.39	0.95	0.58i	0.50	0.18	30.56	
	MSAVI2	36	0.36	0.95	0.58i	0.50	0.18	27.58	
	NDVI	36	0.37	0.95	0.57i	0.49	0.18	27.58	
	STVI-1	36	0.39	0.95	0.59i	0.51	0.18	30.56	
Pre-European vegetation type	EVI	26	0.42	0.95	0.67i	0.64	0.15	46.15	46.15
	GDVI2	16	0.40	0.82	0.59	0.55	0.13	25.00	
	GDVI3	16	0.39	0.82	0.59	0.55	0.13	25.00	
	GDVI4	16	0.40	0.82	0.59	0.55	0.13	25.00	
	LMI	26	0.39	0.95	0.67i	0.64	0.15	46.15	
	MSAVI2	26	0.42	0.95	0.67i	0.64	0.15	42.30	
	NDVI	26	0.42	0.95	0.66i	0.64	0.15	42.30	
	STVI-1	26	0.41	0.95	0.67i	0.64	0.15	46.15	
Pasture type	EVI	54	0.38	0.98	0.62i	0.59	0.15	40.74	44.23
	GDVI2	27	0.37	0.87	0.54	0.50	0.14	22.22	
	GDVI3	27	0.40	0.87	0.54	0.50	0.14	22.22	
	GDVI4	27	0.37	0.87	0.54	0.50	0.14	22.22	
	LMI	54	0.39	0.98	0.62i	0.58	0.15	42.59	
	MSAVI2	54	0.39	0.98	0.62i	0.59	0.15	40.74	
	NDVI	54	0.39	0.98	0.61i	0.59	0.16	40.74	
	STVI-1	54	0.40	0.98	0.61i	0.58	0.15	40.74	

(continued)

Table 7.6 continued: Summary statistics for the 3-class strategy in the Pilbara and southern rangelands region

Stratification level	Vegetation index	N[a]	Overall accuracy (OA)					Reliability (%)	
			Minimum	Maximum	Mean	Median	SD	VI[c]	Overall[c]
Broad vegetation group	EVI	24	0.37	0.92	0.59i	0.54	0.15	25.00	29.17
	GDVI2	22	0.37	0.92	0.56i	0.53	0.15	18.18	
	GDVI3	22	0.38	0.92	0.56i	0.52	0.15	18.18	
	GDVI4	22	0.38	0.92	0.56i	0.52	0.15	18.18	
	LMI	24	0.41	0.92	0.60i	0.53	0.14	29.17	
	MSAVI2	24	0.37	0.92	0.59i	0.53	0.15	25.00	
	NDVI	24	0.37	0.92	0.58i	0.53	0.15	25.00	
	STVI-1	24	0.38	0.92	0.59i	0.53	0.14	25.00	

SD = standard deviation

a Number of groups that the summary statistics are drawn from (groups with at least 85 traverse points within the region and at least 5 points in each condition class).

b The means with symbol 'i' within the column for a stratification level were not significantly different, but they were significantly different to the ones without this symbol (α = 0.05).

c Percentage of groups in a stratification level with OA greater than or equal to 0.67 for each VI.

d Percentage of groups where at least one of the VIs tested had an OA greater than or equal to 0.67.

Note: The most suitable VI(s) for each stratification level (with the highest reliability value and the mean OA was not significantly different from the highest mean OA) is shown in bold.

7.1.4 Most suitable VIs over all discrimination and classification strategies

In the Kimberley and Broome region, the LMI, EVI and STVI-1 produced the highest potential to discriminate between good and poor classes in most of the groups in each stratification level using fairs-excluded and fairs-included strategies (Appendix E). In some groups, more than one VI (and sometimes all VIs) could distinguish between the 2 classes. The mean AUC values of VIs in the fairs-excluded strategy were higher than those of the fairs-included strategy, but in general, the differences were not statistically significant. Using the 3-class strategy, the STVI-1 and LMI were the most suitable VIs, although the differences between them and the other VIs were not statistically significant in pasture type and broad vegetation group stratification levels. The OAs and reliability values in 3-class strategy were lower than the AUCs and reliabilities in the fairs-excluded and fairs-included strategies but measuring the statistical significance of this difference is very complicated because AUCs and OAs are of a different nature.

In the Pilbara and southern rangelands region, the STVI-1, followed by the LMI and EVI, produced the highest potential to discriminate between condition classes, with higher reliabilities than the other VIs.

Figure 7.1 and Figure 7.2 show the reliabilities of different VIs (the percentage of stratification levels in which a VI produced an AUC or OA ≥ 0.67) across 5 stratification levels using the fairs-excluded, fairs-included and 3-class strategies. These figures depict the data in Table 7.1 to Table 7.6. In the Kimberley and Broome region, the LMI and STVI-1 most commonly produced the highest reliabilities, while the EVI usually produced the highest reliability in the Pilbara and southern rangelands region. The

reliabilities of the GDVI2, GDVI3 and GDVI4 were almost the same and generally low for all stratification levels and strategies in all regions. The MSAVI2 and NDVI produced similar reliabilities to each other throughout our study.

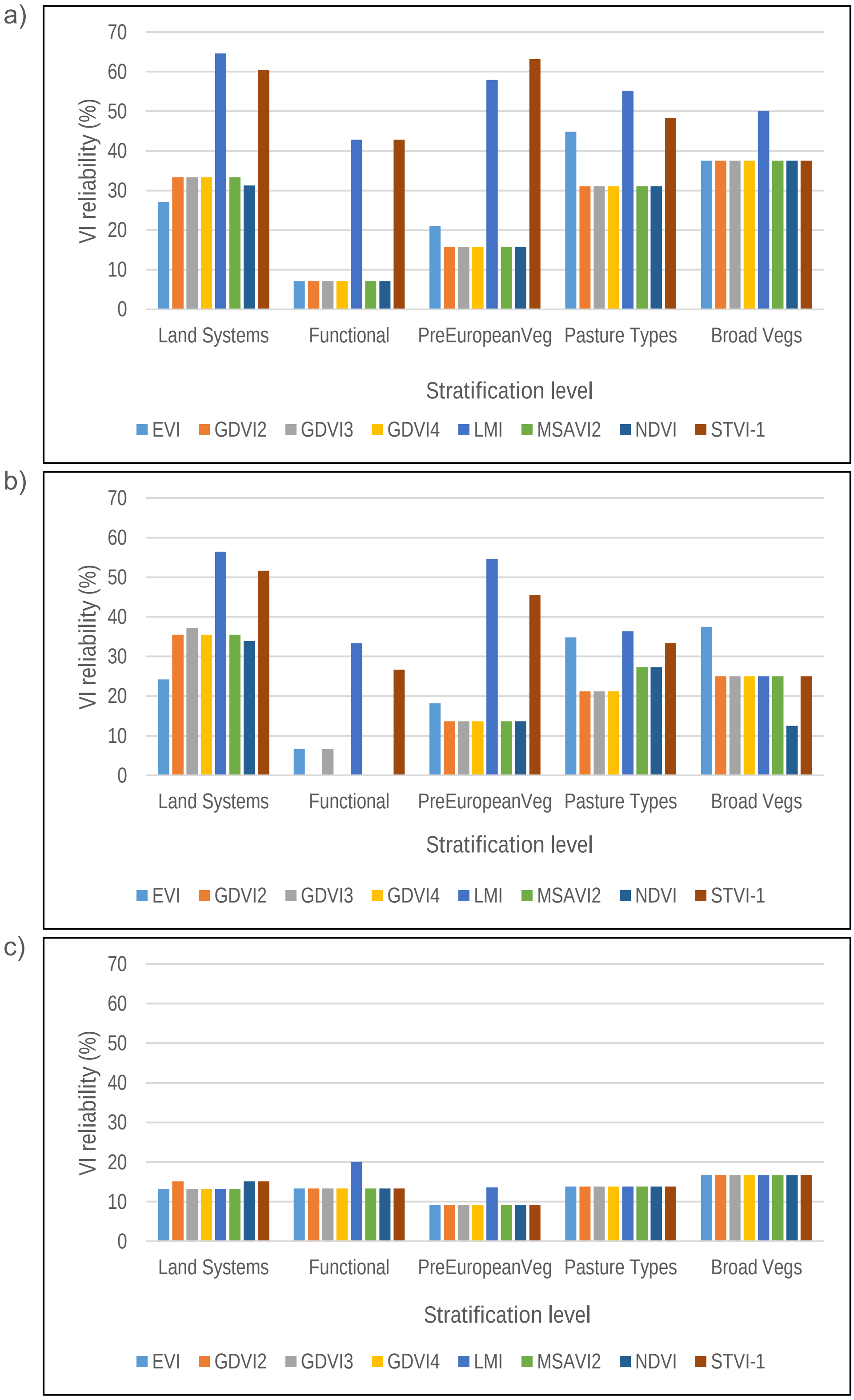


Figure 7.1: Reliabilities of vegetation indices (VIs) across 5 stratification levels in the Kimberley and Broome region, using: a) fairs-excluded strategy; b) fairs-included strategy; c) 3-class strategy

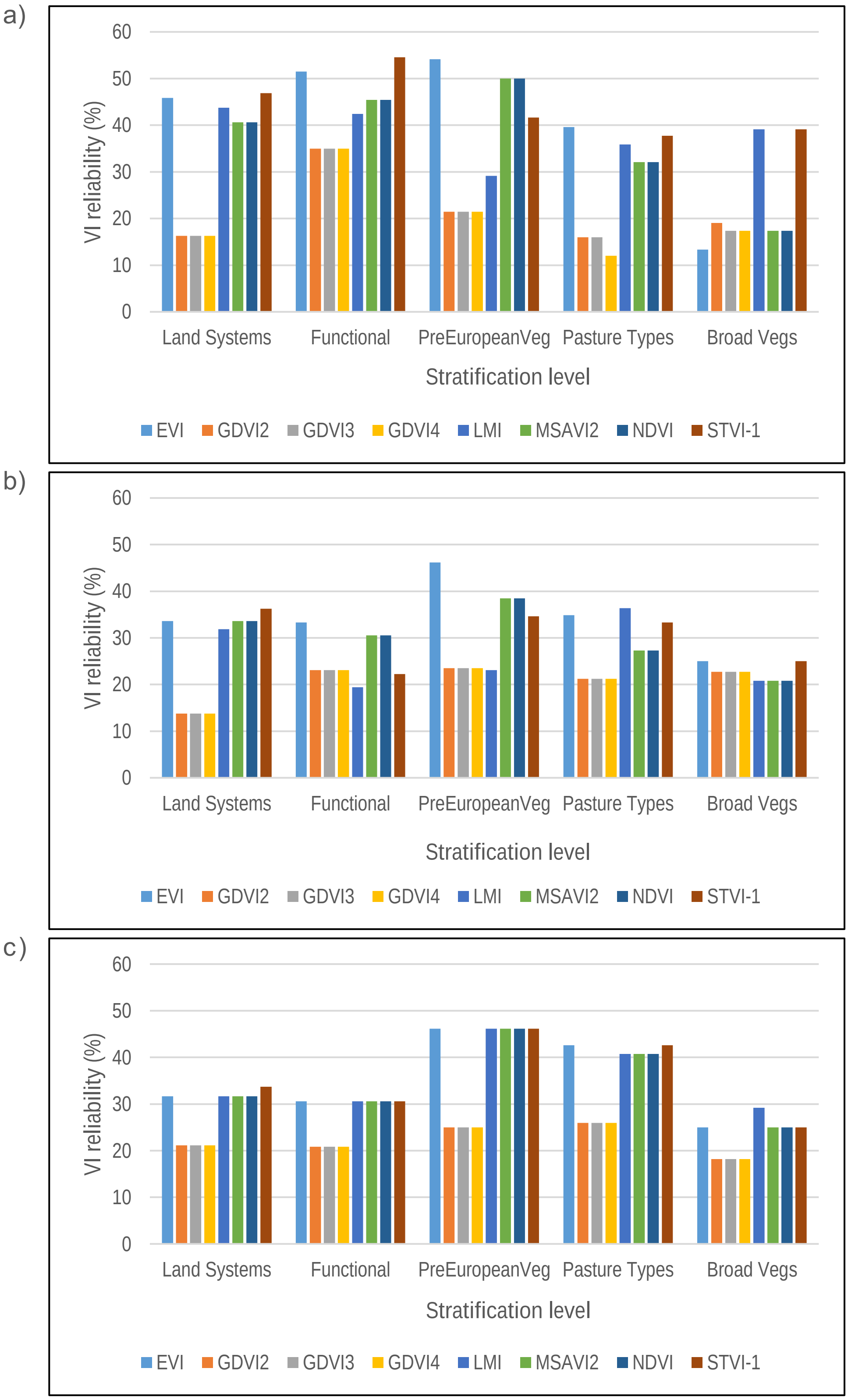


Figure 7.2: Reliabilities of vegetation indices (VIs) across 5 stratification levels in the Southern Rangelands, using:
a) fairs-excluded strategy; b) fairs-included strategy; c) 3-class strategy

7.2 Discrimination performance by stratification level in each region

Tables 7.7 and 7.8 represent the most suitable VI(s) for monitoring a stratification level using the 3 discrimination and classification strategies in each region. These tables show which combination of stratification level and VI had the highest potential for monitoring the pasture condition in each individual region.

The VI(s) with the highest mean AUC or OA value and reliability in all stratification levels in each region are shown in bold to give us an idea about selecting the most suitable VI(s) for monitoring the pasture condition for a particular stratification level. Appendix F contains more details for each region.

Table 7.7: The most suitable VI(s) for monitoring a stratification level using fairs-excluded and fairs-included strategies in each region

		Land system		Functional group		Pre-European vegetation type		Pasture type		Broad vegetation group	
Region	Statistic	F-exc	F-inc	F-exc	F-inc	F-exc	F-inc	F-exc	F-inc	F-exc	F-inc
Kimberley and Broome	VI[a]	LMI	LMI	LMI; STVI-1	LMI	STVI-1	LMI	LMI	LMI; STVI-1	LMI	EVI
	AUC	0.70	0.66	0.66	0.62	0.67	0.65	0.65	0.62	0.66	0.62
	Rel (%)	63.27	54.84	42.86	33.33	63.16	54.55	56.67	42.42	50.00	37.50
Pilbara	VI	STVI-1	NDVI; STVI-1	EVI; LMI; NDVI	EVI; NDVI	EVI; NDVI	EVI	EVI	EVI	na	na
	AUC	0.66	0.63	0.70	0.67	0.72	0.72	0.64	0.62	na	na
	Rel (%)	61.29	52.94	62.50	52.94	80.00	81.82	47.37	38.10	na	na
Yalgoo and Sandstone	VI	LMI; STVI-1	All	EVI; LMI; STVI1	EVI	LMI	STVI-1	EVI	LMI	LMI	LMI
	AUC	0.57	0.56	0.63	0.60	0.61	0.60	0.61	0.58	0.59	0.57
	Rel (%)	22.22	10.35	27.27	14.29	40.00	33.33	30.00	20.00	27.00	12.50
Goldfields	VI	EVI; LMI; STVI-1	EVI; LMI; NDVI	EVI; STVI-1	All	EVI	EVI; LMI; NDVI	na	na	na	na
	AUC	0.60	0.58	0.65	0.59	0.63	0.55	na	na	na	na
	Rel (%)	26.09	12.90	38.46	13.33	33.33	12.50	na	na	na	na
Nullarbor	VI	LMI	LMI	EVI; LMI; STVI-1	LMI	LMI; STVI1	LMI; STVI-1	LMI	LMI	LMI	LMI
	AUC	0.77	0.73	0.75	0.70	0.80	0.75	0.73	0.70	0.76	0.70
	Rel (%)	85.71	66.67	75.00	75.00	100.00	100.00	85.71	72.22	100.00	75.00
Other Rangelands	VI	EVI	EVI	STVI-1	EVI	LMI; STVI-1;	STVI-1	STVI-1	EVI	STVI-1	NDVI
	AUC	0.87	0.64	0.70	0.69	0.81	0.72	0.73	0.73	0.77	0.69
	Rel (%)	100.00	75.00	80.00	63.64	100.00	60.00	100.00	75.00	100.00	70.00

AUC = mean area under curve; F-exc = fairs-excluded strategy; F-inc = fairs-included strategy; na = not assessed in this stratification level because the traverse points did not have this record; Rel = VI reliability; VI = vegetation index

a The VI with the highest mean AUC value and reliability.

Note: The VI with the highest mean AUC value and reliability in all stratification levels in each region is shown in bold.

Table 7.8: The most suitable VI(s) for monitoring a stratification level using the 3-class strategy in each region

Region	Statistic	Land system	Functional group	Pre-European vegetation type	Pasture type	Broad vegetation group
Kimberley and Broome	VI[a]	All	LMI; STVI-1	LMI	**All**	All
	OA	0.55	0.53	0.52	0.54	0.53
	Rel (%)	13.20	13.33	13.64	16.67	12.50
Pilbara	VI	LMI; STVI-1	All	**All**	All	na
	OA	0.67	0.71	0.75	0.66	na
	Rel (%)	46.43	43.75	66.67	44.44	na
Yalgoo and Sandstone	VI	All	LMI	**All**	LMI	All
	OA	0.54	0.53	0.59	0.53	0.55
	Rel (%)	16.67	23.08	27.27	15.79	20.00
Goldfields	VI	All	**All**	None	na	na
	OA	0.52	0.53	0.51	na	na
	Rel (%)	14.29	21.43	0.00	na	na
Nullarbor	VI	All	All	All	STVI-1	LMI; STVI-1;
	OA	0.66	0.72	0.72	0.68	0.68
	Rel (%)	41.18	50.00	66.67	71.43	62.50
Other Rangelands	VI	None	None	None	LMI	All
	OA	0.55	0.56	0.52	0.64	0.61
	Rel (%)	0.00	0.00	0.00	60.00	33.33

na = not assessed in this stratification level because the traverse points did not have this record; OA = mean overall accuracy; Rel = VI reliability; VI = vegetation index

a The VI with the highest mean OA value and reliability.

Note: The VI with the highest mean OA value and reliability in all stratification levels in each region is shown in bold.

For each region, we generated 8 maps to visualise the areas where the VIs successfully discriminated between condition classes. Six individual maps to show the land system and functional group stratification levels using the 3 discrimination and classification strategies (fairs-excluded, fairs-included and 3-class). The maps for each stratification level were then combined to show the total area where VIs could be used for condition monitoring. In other words, the final two maps show the location of the land systems and functional groups where at least one VI could discriminate between condition classes. Figure 7.3 shows the overview of these final maps for all regions combined.

At the time of finalising this report, the classification map of pasture types and broad vegetation groups was only available for the West Kimberley, so we prepared maps of where VIs could be used for these stratification levels. Although we assessed the VIs for pre-European vegetation types, we did not generate maps for this stratification level

because it is less important for pastoral monitoring applications. Appendix F contains all the maps.

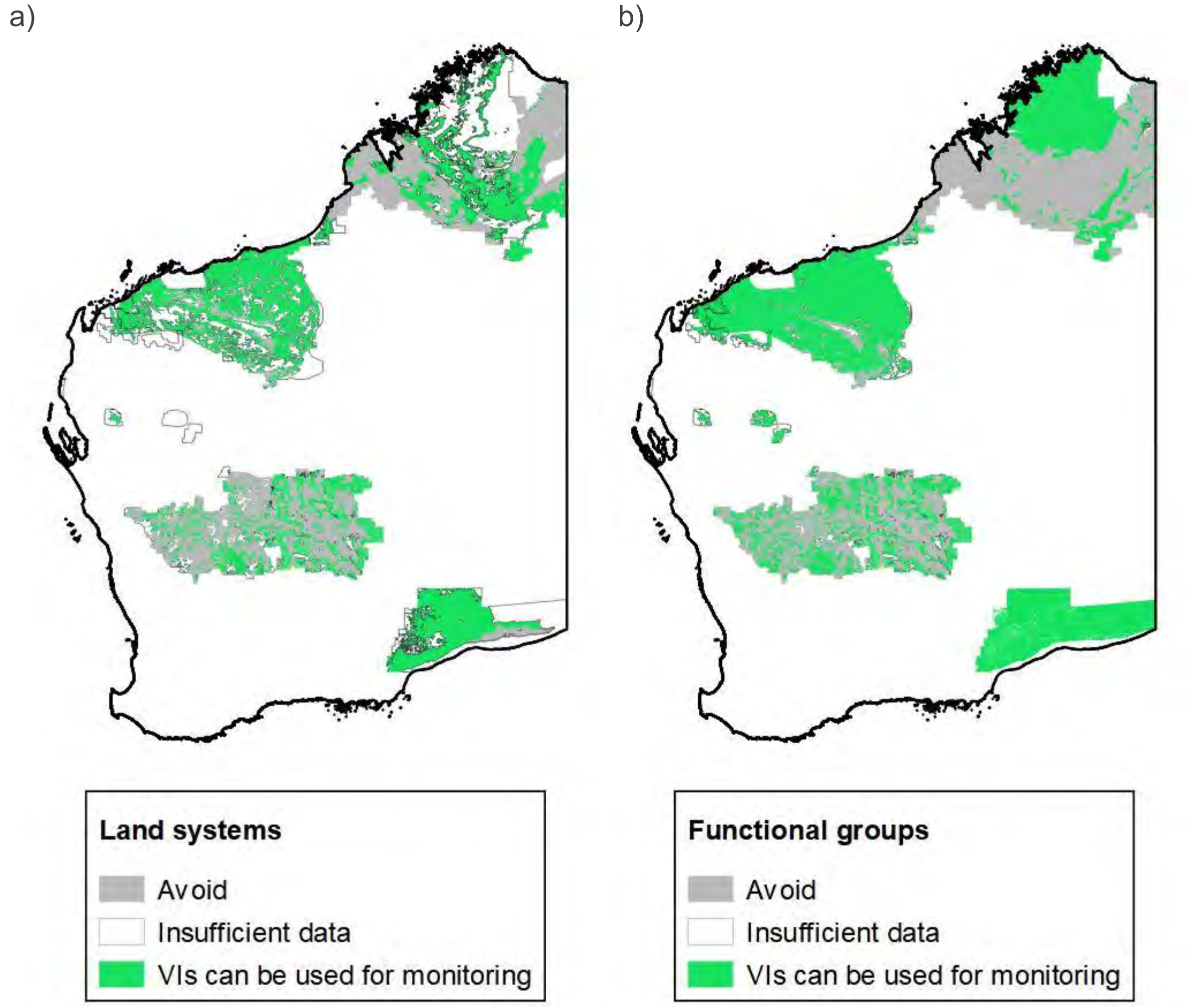


Figure 7.3: Overview of the area where remote sensing VIs can be used for monitoring pasture condition in WA's pastoral rangelands when using: a) land systems; b) functional groups

8 Discussion

The objective of our study was to measure the correlation between DPIRD's on-ground traverse data and Landsat's satellite imagery VIs to quantify the areas throughout WA's pastoral rangelands where VIs can be used to confidently monitor pasture condition. We reassessed the findings and extended the methods of the PLAGA project (Robinson et al. 2012) using the most recent on-ground condition data and satellite imagery, and advanced methods and hardware for data processing. The work was inspired by a growing need for more-robust and reliable monitoring approaches, noted shortcomings in the PLAGA project, and opportunities offered by VIs and stratification levels developed since 2012.

The potential for applying VIs for monitoring pasture condition is discussed by geographic region in the following subsections. We discuss possible reasons for the low discrimination between pasture condition classes in some regions, how to use VIs in monitoring systems and the future work required in this area.

8.1 The capability and reliability of VIs

This section discusses the capability of VIs to discriminate between condition classes in different regions of the pastoral rangelands using the 3 condition discrimination and classification strategies.

8.1.1 Overall capability

In the Kimberley and Broome region, the LMI and STVI-1 delivered the highest mean AUC and OA values and reliabilities, and therefore the highest discrimination potential. Previous studies also showed the high potential of these 2 VIs for mapping vegetation over different land types, for example, in the semi-arid rangelands of Australia (Wallace et al. 1994; Jafari et al. 2007; Robinson et al. 2012). In the Pilbara and southern rangelands region, the EVI (which was not tested in the PLAGA project), then the LMI and STVI-1, were the most suitable VIs for condition monitoring with the highest potential to discriminate between condition classes in all stratification levels. The high reliabilities of these 3 VIs suggest they are the least sensitive to variations in vegetation types, soil type, soil colour, soil moisture and atmospheric conditions (Jafari et al. 2007; Tarin et al. 2020).

The least discriminating and least reliable indices were the GDVIs, MSAVI2 and NDVI. The NDVI has been widely criticised for use in condition monitoring because it is only sensitive to actively photosynthesising, green vegetation and therefore has limited appeal if the vegetation is in a stage of senescence or lacks the contrast between red and infrared reflectance, as is often the case for vegetation in arid to semi-arid rangelands (O'Neill 1996, Marsett et al. 2006, Jafari et al. 2007; Robinson et al. 2012). Our study confirms this finding. The MSAVI2 and GDVIs were strongly correlated to the NDVI and therefore may be ineffective for the same reasons.

However, there were some groups in some stratification levels that were well discriminated using NDVI, especially in the Kimberley and Broome region and Pilbara region. One reason for this is the ephemeral greening from unseasonal rainfall in these regions, which was captured by NDVI. Another reason might be the problem of

generalisation which, as explained in Jafari et al. (2007), describes the size and the heterogeneity of the land types within aggregated groups in functional group or broad vegetation group stratification levels. NDVI is considered as a suitable VI for general cover monitoring in areas with combined plant, plant litter and cryptogam cover.

8.1.2 Kimberley and Broome region

The Kimberley and Broome region differs from the other regions because it contains unique land types (land systems, functional groups and pasture types).

The LMI and STVI-1 produced the highest discrimination potential in this region. This is like the findings of the PLAGA project and other research in arid and semi-arid rangelands of Australia (Jafari et al. 2007; Lawes and Wallace 2008; Wallace et al. 2006). These 2 VIs appear to be less sensitive than other VIs to different soil and vegetation types in various stratification groups.

The many traverse points in this region, and repeat sampling over years, made the discrimination and classification results more robust and reliable than those calculated in regions with sparse field data.

8.1.3 Pilbara region

The Pilbara was one of the regions where VIs produced high discrimination potential and reliability. In the land system stratification level, the STVI-1 produced the highest discrimination potential and reliability (Table 7.7, Table 7.8). In other stratification levels and using fairs-excluded and fairs-included strategies, the EVI and other VIs using the NIR band produced higher discrimination potential than the STVI-1 and LMI, which were the VIs found to have the highest discrimination potential in the PLAGA project. However, in the PLAGA project, the discrimination potential of VIs was tested using only pastoral stations and functional groups, and the EVI was not evaluated.

One surprising finding in this region was the higher discrimination potential and reliability of the 3-class strategy in the pasture type stratification level, which means only the 3-class strategy could adequately discriminate condition classes and it is even possible to discriminate between good, fair and poor classes in 44% of the pasture types. One reason for this might be the numerous available traverse points (about 12,000) with a good spatial distribution and high data consistency (the data was collected over just 11 months in 1996–1997 and by the same inspectors).

8.1.4 Yalgoo and Sandstone, and Goldfields regions

In these regions, the discrimination potential of VIs was relatively low for all stratification levels using any of the discrimination and classification strategies. These regions also had correspondingly low overall reliabilities (less than 40% in both regions). The VIs with the lowest discrimination potential were the NDVI, MSAVI2 and GDVIs, with less than 28% reliability for all stratification levels in the Yalgoo and Sandstone, and less than 23% in the Goldfields.

A possible reason for this low potential compared to other regions could be the perennial overstorey vegetation (e.g. mulga) and the large proportion of poor ratings in some groups of the stratification levels. For example, functional group 21b (denser acacia washplain over shrub) had 998 good and 760 poor points, while 23a (halophyte

shrub with scattered acacia overstorey) had 138 good and 125 poor points in the Yalgoo and Sandstone region. This results in unrepresentative point samples in which the overstorey dominates the reflectance in Landsat pixels, causing VI pixel values to be high and overestimating cover and condition. However, these overstorey plants are often not palatable and so are not considered in the field assessment. This means the condition ratings are not reflected by the satellite spectra, and therefore no VI discriminates well in these areas. This hypothesis should be tested using higher resolution imagery with the same or better spectral resolution than Landsat.

Another reason for the low discrimination in the Goldfields might be the quality of the field data. Fewer than 2000 points were available, and these were imported from an old MicroStation design file and converted to a GDA94 (Geocentric Datum of Australia 1994) coordinate reference system. The points did not have land system attributes recorded during their inspections, so they were intersected with the land system polygons. These points also did not have the date of traverse recorded, so the dates of nearby inventories were used as an approximation.

8.1.5 Nullarbor region

Condition was well discriminated in this region compared to the other regions. The mean AUC and mean OA were above 0.66 and the reliability was even 100% in some stratification levels (Table 7.7, Table 7.8). The LMI and then STVI-1 produced the highest discrimination potential, which confirms the PLAGA project findings. The other VI which use the NIR band produced the lowest capability, with reliabilities below 50%. One reason for this might be the presence of perennial plants from the Chenopodiaceae family, most of which are notoriously difficult to detect with NIR-based indices, particularly when they are grey. Also, the soils are regularly covered with a microphytic crust that inflates the NIR reflectance. Consequently, areas with a poor condition rating due to a lack of perennial shrubs may still have an inflated NIR response from the photosynthetic properties of the crusts (O’Neill 1996; Robinson et al. 2012), making them difficult to distinguish from fair or good condition.

According to Robinson et al. (2012), even the Red band and the Green + Red index, although not tested in our study, provided adequate discrimination in this region. This suggests many high resolution RGB sources of imagery (such as drone, archived high resolution colour aerial photography and cost-effective satellite data) could be used for monitoring this region.

8.1.6 Other Rangelands region

In most of the groups in the stratification levels in this region, the STVI-1 produced the highest discrimination potential and reliability in the fairs-excluded and fairs-included strategies, and the NDVI and GDVIs produced the lowest discrimination. The sample size for this region was extremely small (for example, there was only one land system with the minimum required number of points) and therefore the statistics were not conclusive. This region needs further analysis.

8.2 Possible reasons for low discrimination in some regions

Low discrimination in some regions (e.g. the Yalgoo and Sandstone, and Goldfields) was likely due to the presence of overstorey plants (e.g. mulga) dominating the reflectance of a 25 × 25 m pixel. To test this, more on-ground data and higher resolution imagery are required. Sentinel 2 satellite data may be the most appropriate for matching the spectral resolution of Landsat with improved spatial resolution (10 m).

Another explanation for the low discrimination could result from the criteria for rangeland condition assessment used by DPIRD. As outlined in Section 4.2, a change in pasture condition can result from a change in vegetation cover (detectable by Landsat) or a change in species composition (possibly undetectable by Landsat). Therefore, different ratings in pasture condition may be associated with similar vegetation cover, but a difference in botanical composition that can be pastorally desirable (e.g. *Chrysopogon* and *Astrebla*) or undesirable (e.g. *Aristida*). In other words, while the field assessment will record a pasture condition as good or poor in these situations, the capacity of this change to be discriminated by any of the VIs would be limited because reflectance from desirable perennial grasses will have been replaced by reflectance from undesirable perennial grasses.

Other limitations with the rangelands pasture condition rating system and historical traverse data:

a) traverses do not provide evidence of condition at a distance beyond about 50 m from tracks
b) in some groups of a stratification level, the number of traverse points is limited and can be unevenly distributed − because the traverse routes do not cross all groups throughout a pastoral station − which can result in a biased assessment that may decrease the discrimination potential of any VI
c) traverses may not capture the full spatial variation in condition across a pastoral lease, and areas with declining condition outside of the sampling design may never be observed
d) traverses are heavily dependent on operator judgement and skill and therefore are vulnerable to external criticism (Friedel and Shaw 1987)
e) condition classes of the traverse points are imbalanced in many locations (e.g. there is a greater number of points recorded as having good condition than poor condition). This makes discrimination and classification difficult because too few examples are available from all classes
f) the traverse point positions are sometimes different from the actual observation sites, making it difficult to extract the correct imagery data and thereby degrading the correlation between VI and condition. This difference occurs because the inspector sometimes needs to move from the pre-recorded coordinates because of a restricted view or access to a landscape, which results in the observation not corresponding to the VI values at the recorded location.

It should be noted that DPIRD has recently developed the *Framework for sustainable pastoral management*, which defines the quantitative regional land condition standards

for acceptable pastoral land management outcomes (Fletcher 2021). To meet the requirements of the framework, a series of complementary quantitative measures of pasture condition are being developed. These new on-ground measurements of pasture condition based on the density, population demography and health status of indicator species will replace the current qualitative assessments that determine the good, fair and poor condition ratings reported in RCAs. The new approach will minimise most of the limitations of the traverse data listed above.

8.3 Pattern of errors in different regions

A common issue with the field condition data in this study was ‘the class imbalance problem’, which occurs when most points in most stratification groups are rated as good or fair rather than poor.

Most machine learning algorithms work best when the number of data points in each class are roughly equal. When the numbers of one class far exceed the other, the classifier will be trained using more good samples (for example) and tends to classify poor points as good because this is the most likely class overall. This is more noticeable in land types that have the minimum number of required points for classification, but not the minimum number of points in each class (in our case, insufficient points with a poor condition rating). Examples for this imbalance are the following land systems in the Pilbara region: Bonney has 108 good points and only 1 poor point; Calcrete and Talga have 152 and 108 good and fair points, respectively, but no poor points.

By comparing the patterns of classification errors in all stratification levels and in all regions, we observed that the ratio of false negative points to the total number of negative (poor) points (false omission error) was larger than the ratio of false positive points to the total number of positive (good) points (false recovery rate). This was generally the result of a class imbalance due to very few poor points.

8.4 How to use the selected indices in monitoring systems

The strategy comparisons inform how VIs might be used for monitoring condition at the pastoral station or lease level.

The best performing VI for smaller spatial units (land systems or pasture types) should be used for each pastoral station. The most suitable VI for larger, aggregated groups within stratification levels that cover the station should only be used if the discrimination of the smaller spatial units is inadequate (e.g. insufficient number of traverse points in land systems or pasture types). This cannot be tested for all areas in WA because the field condition data available is patchy and sparse over most of the rangelands. A statistically robust test of VIs for land systems or pasture types would require collecting a large amount of new field validation data.

Aggregating the data from smaller spatial groups (land systems and pasture types) into the larger, aggregated groups (functional groups and broad vegetation groups) smooths over local spatial variation and depending on the size of the units and alignment with natural features, the aggregated summaries can sometimes be misleading. In other words, aggregation introduces bias (Malczewski 2000). This problem is commonly referred to as the modifiable area unit problem (Openshaw 1984).

9 Conclusion

The aim of our study was to revisit the PLAGA project and evaluate the capability of VIs generated via Landsat satellite imagery to discriminate between field-based condition ratings over the WA pastoral rangelands and for monitoring the condition change.

We reassessed the PLAGA project because it used only functional groups and pastoral station boundaries as spatial divisions for analysing the VIs, and these might not be the best boundaries for land management. Also, because the PLAGA project excluded the fair condition points, we used different classification strategies to determine if we could discriminate between good, fair and poor points. We used new sources of data, such as DPIRD's recent on-ground traverse data (e.g. recent RCAs in the Kimberley region) and satellite imagery (Landsat 8) which were not available in 2012, and we tested other VIs suggested by the recent research for arid and semi-arid regions.

We assessed 8 VIs (EVI, GDVI2, GDVI3, GDVI4, LMI, MSAVI2, NDVI, STVI-1), in 5 stratification levels (land system, functional group, pre-European vegetation type, pasture type and broad vegetation group), using 3 discrimination and classification strategies (ROC for binary classification to discriminate good or good and fair points from poor points, and 3-class machine learning classifiers to discriminate between good, fair and poor points).

The major findings from our study:

- Our results support the PLAGA project findings for the functional group stratification level using the fairs-excluded strategy in the Pilbara and Nullarbor regions — we used the same data, same stratification levels and same strategy. Like the PLAGA project, our results showed that the LMI and STVI-1 were the most suitable VIs for most of the individual functional groups in these regions.
- In general, the most suitable and reliable VIs were the LMI and STVI-1 in the Kimberley and Broome region, and the EVI (not tested in the PLAGA project), LMI and STVI-1 in the Pilbara and southern rangelands regions.
- The potential and reliability of the 3-class strategy was low compared to the fairs-included and fairs-excluded strategies. However, the 3-class strategy is still useful because it can be used to discriminate between good, fair and poor condition classes in groups with adequate OA values within stratification levels. It was also revealed that in some groups (e.g. the Nita and Mulan land systems), the discrimination potential of the fairs-included and fairs-excluded strategies were not adequate but the 3-class strategy could adequately discriminate condition classes from VIs.
- The discrimination potential and reliability of VIs varied among regions. The highest potential came from using the LMI and STVI-1 in the Nullarbor region, while all VIs produced low potential in the Yalgoo and Sandstone, and Goldfield regions. The NDVI, MSAVI2 and GDVIs were generally poor discriminators, and we recommend not using these for monitoring pasture condition.
- The most suitable VIs varied for stratification levels in each region. This implies that using a patchwork of VIs rather than any one particular VI over a region

would significantly increase the reliability. In other words, a ‘one-size-fits-all’ approach is unlikely to produce adequate discrimination and reliability, and the selection of VIs must be adapted to the area of interest.

- In many regions no on-ground condition data was available, so our analysis does not represent the entire pastoral rangelands region. Furthermore, the correlation between VIs and condition ratings in some of the pastorally important groups (such as the Mitchell Grass Alluvial Plain and Pindan pasture types in the Kimberley and Broome region) was not adequate and this highlighted several issues around using condition ranks to train and validate remote sensing VIs. The main problems are that the defining criteria for pasture condition (e.g. differentiation between species required) cannot be captured by Landsat sensors, and legacy data is highly skewed (class imbalance problem), making classification difficult.
- Available on-ground traverse data is limited, which makes calibrating remote sensing products for monitoring condition difficult. Most of the data is collected at a single point in time and is probably affected by seasonal conditions. Some data dates back to the 1990s and would probably be rated differently if re-examined today by other inspectors.
- Each VI has its own limitations and even a combination of different VIs may not adequately map all groups within stratification levels and differentiate between vegetation types (e.g. overstorey and understorey, palatable perennial (desirable) and undesirable).
- A single type of monitoring is unlikely to suit all stakeholders. VI trends may suit some users, but other kinds of remote sensing data might be needed to support state-scale activities. Potential users of a remote sensing monitoring program are diverse, which suggests multiple kinds of monitoring will need to be conducted to meet the needs of DPIRD and other stakeholders. For instance, rangeland ecologists may want to identify the presence or absence of indicator species, while the Commissioner of Soil and Land Conservation would require information on erosion risk.
- Remote sensing is a complementary tool for overcoming the logistical constraints of on-ground condition assessment sites. The most suitable VIs and VI trends for each monitoring unit or group of a stratification level are useful tools for officers doing lease inspections. These products have the potential to highlight areas with low or decreasing vegetation cover that need to be visited for more detailed investigation.

10 Future work

In future work, we will evaluate other sources of remote sensing data and products to increase discrimination potential and reliability of our models for monitoring the pasture condition of pastoral regions. These new datasets will include high resolution satellite and drone imagery, environmental variables and fractional cover (FC) data (Lymburner et al. 2014).

Fractional cover is a remote sensing product derived from Landsat and Sentinel-2 multispectral bands and estimates the components of land cover in 3 main categories: bare ground, actively growing (photosynthetic) vegetation, and senescent (non-photosynthetic) vegetation, including litter (Guerschman et al. 2009). This product was used in the Pastoral Land Board’s annual report 2017−2018 for Australia’s land condition monitoring (Zlotkowski et al. 2018) and is already used by other states, such as Queensland, Northern Territory, New South Wales and Tasmania, in their agricultural and pastoral monitoring programs. The main limitation of FC for monitoring the WA rangelands is its poor calibration in WA because of the limited calibration sites. Consequently, regular collection of FC calibration sites commenced in mid-2020. Until the calibrated FC products for WA become available and their potential for monitoring condition are approved, we recommend using the most suitable VIs for each group of a stratification level (identified in this study) for monitoring.

We will evaluate the use of robust binary classifiers or regression models instead of ROC, and the effect of the training sample size on classification performance.

Other planned research includes designing quantitative methods for recording condition during lease inspections, revising the groups of stratification levels to reflect monitoring aims more closely, and exploring spatial patterns of groundcover and dynamics as a reflection of condition.

Some possible reasons for why VIs produced low discrimination potential in some areas were outlined in the Discussion. These should be investigated further with the aid of botanists or rangelands inspectors to discover why VIs in some land units were unable to discriminate between condition classes.

Appendixes

Appendix A Summary of functional groups

Table A1 Functional groups in the Kimberley and Broome region

Functional group	Primary functional group description	Subgroup (differentiation description)	Land system	Area (ha)	Number of traverse points in each pasture condition class		
					Good	Fair	Poor
1a	Hills and ranges	Open woodland	Burramundi, Clifton, Elder, Forrest, Headley, Looingnin, Lubbock, Pompey, Precipice, St George, Wickham	3,203,265	471	402	184
1b	Hills and ranges	Woodland	Buldiva, Dockrell, Pinkerton, Weaber	5,831,115	664	217	120
2a	Hills, lowlands and undulating plains	Woodlands with spinifex grass	Fork, Foster, Franklin, Karunjie, Macphee, Pago, Ruby2	2,801,080	360	185	87
2b	Hills, lowlands and undulating plains	Woodlands with tussock grass	Antrim, Barton, Dinnabung, Kennedy2, Napier	2,351,040	390	288	159
2c	Hills, lowlands and undulating plains	Open woodlands with spinifex grass	Bohemia, Cockburn, Cowendyne, Frayne, Geebee, Koongie, Margaret, Neillabublica, Pigeon, Richenda, Rose, Tableland, Texas, Windjana, Winnecke	3,830,014	1,566	872	706
2d	Hills, lowlands and undulating plains	Open woodlands with tussock grass	Amy, Glenroy, Gordon, Isdell, Mandeville, Nelson, O'Donnell, Tanmurra, Tarraji	1,093,696	954	711	680
5a	Sandplains and dunes	Open shrublands over spinifex	Barry, Billiluna, Bulka, Coolindie, Egan, Gilgie, Gourdon, Great Sandy, Landrigan, Little Sandy, Lucas, Myroodah	2,488,062	829	360	161

(continued)

Table A1 continued: Functional groups in the Kimberley and Broome region

Functional group	Primary functional group description	Subgroup (differentiation description)	Land system	Area (ha)	Number of traverse points in each pasture condition class		
					Good	Fair	Poor
5b	Sandplains and dunes	Wooded shrublands over spinifex	Cornish, Gidgia, Mulan, Nita, Sisters, Spincrete	2,009,735	827	192	47
5c	Sandplains	Wooded shrublands over grass	Buchanan, Cockatoo, Kennedy	3,429,111	208	127	51
6	Pindan	No subgroup	Camelgooda, Fraser, Lowangan, Luluigui, Mamilu, Parda, Phire, Reeves, Wanganut, Yeeda	4,273,553	1,164	956	291
7a	Alluvial plains	Without trees	Bannerman, Calwynyardah, Chestnut, Coonangoody, Lake Gregory	463,217	306	193	105
7b	Alluvial plains	With trees	Angallari, Betty, Snap, Sturt Creek, Wolfe	310,209	146	100	103
7c	Alluvial plains	Mud flats	Carpentaria	548,495	51	32	8
8	Heavy clays (cracking clays)	No subgroup	Alexander, Anna, Argyle, Djada, Duffer, Fossil2, Gladstone, Gogo, Inverway, Ivanhoe, Leopold, Oscar, Wave Hill, Willeroo	1,996,769	1,210	1,145	661
9a	Coastal grass	Without Shrubs	Eighty Mile, Legune, Roebuck	130,702	147	72	12
9b	Coastal grass	With shrubs	Mandora, Mannerie	82,625	10	8	4

Table A2 Functional groups in the Pilbara and southern rangelands region

Functional group	Primary functional group description	Subgroup (differentiation description)	Land system	Area (ha)	Number of traverse points in each pasture condition class		
					Good	Fair	Poor
10a	Hills and ranges with acacia shrublands	Scattered acacia on hills	Agamemnon, Augustus, Billy, Charley, Diorite, Farmer, Gabanintha, Glenburgh, Hospital, Kooline, Kunderong, Naluthanna, Norie, Peak Hill, Prairie, Treuer, Two Hills, Ullawarra, Weld, Wyarri, Yagahong	753,441	91	162	75
10b	Hills and ranges with acacia shrublands	Denser acacia on hills	Bevon, Brooking, Dryandra, Fossil, Glengarry, Laminar, Laverton, Marandoo, Moogooloo, Mulgul, Mulline, Princess, Singleton, Tallering, Teutonic, TumblaGooda, Watson, Woodrarrung	630,774	317	429	334
11	Hills and ranges with spinifex grasslands	Spinifex on hills (with or without scattered trees)	Black, Boolaloo, Callawa, Capricorn, Granitic, Houndstooth, Jubilee, Mckay, Nanutarra, Newman, Range, Robertson, Rocklea, Ruth, Talga	6,687,695	1,611	60	20
12a	Mesas, breakaways and stony plains with acacia or eucalypt woodlands	Breakaways with scattered acacia and shrubs	Boondin, Crete, Gumbreak, Hootanui, Sandiman, Sherwood, Yilgangi	1,065,797	463	356	331
12b	Halophytic shrublands	Breakaways with denser acacia and shrubs	Euchre, Laterite, Narryer, Olympic, Pells, Table, Thomas, Tooloo, Waguin	538,280	240	95	26
13	Mesas, breakaways and stony plains with spinifex grasslands	Breakaways with spinifex	Coongimah, Kumina, Oakover, Robe	584,624	284	7	7

(continued)

Table A2 continued: Functional groups in the Pilbara and southern rangelands region

Functional group	Primary functional group description	Subgroup (differentiation description)	Land system	Area (ha)	Number of traverse points in each pasture condition class		
					Good	Fair	Poor
14a	Low hills with eucalypt or acacia woodlands	Scattered acacia over shrubs	Graves, Leonora, Lynne, Pillawarra, Sodary	139,820	46	73	71
14b	Undershrubs	Denser acacia over shrubs	Badgeradda, Lawrence, Wiluna	88,206	36	34	23
15a	Low hills and stony plains with acacia shrublands	Scattered acacia over shrubs	Collier, Doman, Edenhope, James, Killara, Mindura, Sunrise, Wongawol	127,774	8	31	38
15b	Low hills and stony plains with acacia shrublands	Denser acacia over shrubs	Ajana, Beasley, Felix, Phillips, Windarra	287,592	89	182	177
16a	Stony plains with acacia shrublands	Scattered acacia over shrubs	Boulder, Dural, Ethel, Ford, Garry, George, Koonmarra, Mabbutt, Millrose, Paraburdoo, Ruby1, Sugarloaf, Sylvania, Tangadee, Yagina, Yarrameedie	276,682	97	109	43
16b	Stony plains with acacia shrublands	Denser acacia over shrubs	Bandy, Challenge, Latimore, O'Brien, Sedgman, Windalia, Windidda, Woodlands	572,045	177	200	119
16c	Stony plains with acacia shrublands	Scattered acacia over grass	Dollar, Elimunna, Kanjenjie	119,094	60	43	41
17a	Stony plains with acacia shrublands and halophytic shrublands	Scattered acacia over shrubs	Austin, Barwidgee, Bryah, Firecracker, Gransal, Gundockerta, Jimba, Kalyaltcha, Kurubuka, Mantle, Mundong, Nadarra, Nallex, Nubev, Scoop, Violet, Winning, Wongong	1,092,754	399	558	564
17b	Stony plains with acacia shrublands and halophytic shrublands	Denser acacia over shrubs	Durlacher, Mongolia, Moriarty, Nerramyne, Yinnietharra	346,819	123	138	63

(continued)

Table A2 continued: Functional groups in the Pilbara and southern rangelands region

Functional group	Primary functional group description	Subgroup (differentiation description)	Land system	Area (ha)	Number of traverse points in each pasture condition class		
					Good	Fair	Poor
17c	Stony plains with acacia shrublands and halophytic shrublands	Scattered acacia over grass	Adrian, Duffy, Horseshoe, Wapet	34,754	4	1	1
18a	Stony plains with spinifex grasslands	Hard spinifex with scattered acacia overstorey	Billygoat, Buckshot, Bullimore, Divide, Egerton, Giralia, Heppingstone, Leeman, Lochinvar, Mosquito, Paterson, Peedamulla, Platform, Pyramid, Satirist, Stuart, Taillefer, Tanpool, Taylor, Tyrrell, Uaroo, Yelma	5,918,056	2,410	227	106
18b	Stony plains with spinifex grasslands	Hard spinifex with acacia overstorey	Boolgeeda, Gregory, Kirgella, Mallee, Marmion, Nirran, Pan	1,835,908	710	80	20
18c	Stony plains with spinifex grasslands	Soft spinifex with scattered acacia overstorey	Cardabia, Learmonth, Macroy, Mallina, Paradise, Urandy, Yankagee	1,992,053	2,029	226	81
19a	Nullarbor	Open Nullarbor with maireana/atriplex	Arubiddy, Balgair, Chowilla, Deakin, Gafa, Haig, Jubilee, Koonjarra, Kybo, Loongana, Lowry, Moonera, Morris, Pondana, Reid, Shake Hole, Skink, Thampanna, Vanesk, Woorlba	3,937,876	1,982	856	358
19b	Nullarbor	Scattered tree overstorey with maireana	Carlisle, Colville, Gunnadorah, Kanandah, Moodini, Mundrabilla, Nanambinia, Naretha, Nyanga, Seemore, Virginia	1,863,235	1,371	527	116
19c	Nullarbor	Denser overstorey with margins	Balladonia, Caiguna, Eucla, Gumbelt, Moopina, Weebubbie	1,264,303	509	32	8
19d	Nullarbor	Open Nullarbor, largely lost shrubs with sclerolaenas and annual grasses	Bullseye, Kinclaven, Kitchener, Kyarra, Nightshade, Nurina, Oasis, Rabbit	1,091,048	508	523	142

(continued)

Table A2 continued: Functional groups in the Pilbara and southern rangelands region

Functional group	Primary functional group description	Subgroup (differentiation description)	Land system	Area (ha)	Number of traverse points in each pasture condition class		
					Good	Fair	Poor
20a	Sandplains and occasional dunes with grassy acacia shrublands	General sandplain with scattered overstorey cover	Brown, Cahill, Lyons, Yalbalgo	124,109	28	53	25
20b	Sandplains and occasional dunes with grassy acacia shrublands	General sandplain with high overstorey cover	Bannar, Bidgemia, Breberle, Bungabandi, Cooloomia, Ella, Eurardy, Highway, Inscription, Joseph, Kalbarri, Kalli, Lakeside, Liver, Nanga, Nerren, Peron, Sandplain, Yaringa	1,691,762	781	142	96
21a	Wash plains on hardpan with mulga shrublands	Scattered acacia washplain over shrub	Ararak, Belele, Blech, Bubbagundy, Channel, Cole, Diamond, Doolgunna, Duketon, Fan, Fisher, Frederick, Jamindie, Jingle, Jurrawarrina, Landor, Macadam, Mitchell, Nooingnin, Three Rivers, Tiger, Trennaman, Wadjinyanda, Wannamunna, Washplain, Yandil, Zebra	1,444,671	414	456	396
21b	Wash plains on hardpan with mulga shrublands	Denser acacia washplain over shrub	Bunny, Cadgie, Deadman, Desdemona, Flood, Hamilton, Helag, Illaara, Jundee, Lorna, Marlow, Monk, Outwash, Pindar, Rainbow, Ranch, Spearhole, Stonehut, Tango, Tealtoo, Tindalarra, Wash, Winmar, Woodline, Wooramel, Yalluwin, Yanganoo, Yowie	6,001,416	2,133	2,426	1,889
21c	Wash plains on hardpan with mulga shrublands	Acacia washplain over spinifex	Pindering	38,737	47	5	3

(continued)

Table A2 continued: Functional groups in the Pilbara and southern rangelands region

Functional group	Primary functional group description	Subgroup (differentiation description)	Land system	Area (ha)	Number of traverse points in each pasture condition class		
					Good	Fair	Poor
22a	Alluvial plains with acacia shrublands	Alluvial plain (shrubland with scattered acacia overstorey)	Byro, Clere, Cowra, Doney, Globe, Holmwood, Hooley, Marillana, Millex, Minderoo, Narbung, Sherlock, Snakewood Stork, Trillbar, Yandi	520,366	203	188	176
22b	Alluvial plains with acacia shrublands	Alluvial plain (shrubland with acacia overstorey)	Campsite, Christmas, Gumland, Kanowna	46,949	19	14	25
23a	Alluvial plains with halophytic shrublands	Halophyte shrub ± scattered acacia overstorey	Barrabiddy, Bayou, Birrida, Bunyip, Chargoo, Cundelbar, Cyclops, Delta, Donovan, Edward, Ero, Foscal, Joy, Macleod, Merbla, Mileura, Monitor, Outcamp, Peedawarra, Roderick, Sable, Siberia, Skipper, Steer, Sturt, Wandagee, Warroora, Weenyung, Wilson, Yalkalya, Yewin	524,940	306	266	390
23b	Alluvial plains with halophytic shrublands	Halophyte shrub, denser acacia and 'other' shrubs association	Beringaram, Coolabulla, Gearle, Gneudna, Racecourse, Salune, Sandal, Spot, Talawana, Target, York	39,422	4	10	10
24a	Alluvial plains with tussock grasslands	Tussock grass without shrubs	Bibbingunna, Brockman, Cheetara, Horseflat, Marloo, Pullgarah, Turee, White Springs, Wona, Yarcowie	581,332	455	183	289
24b	Alluvial plains with tussock grasslands	Tussock grass with more shrubs	Balfour, Cheela, Rous	194,438	103	75	76
25a	Calcrete plains with spinifex grasslands	Spinifex with sparse acacia or shrubs	Calcrete, Carleeda	145,891	140	12	2
25b	Calcrete plains with spinifex grasslands	Spinifex with denser acacia or shrubs	Cosmo, Lime, Zanthus	77,413	53	4	3

(continued)

Table A2 continued: Functional groups in the Pilbara and southern rangelands region

Functional group	Primary functional group description	Subgroup (differentiation description)	Land system	Area (ha)	Number of traverse points in each pasture condition class		
					Good	Fair	Poor
26	Calcrete plains with acacia shrublands	Scattered acacia over various shrubs	Bibra, Cunyu, Mary, Melaleuca, Tamala, Tarcumba, Toolonga, Trealla, Warri	135,698	61	81	116
27a	River plains with grassy woodlands and tussock grasslands	River plains, grass with scattered overstorey	Cane, Fortescue, Nanyarra, River, Yamerina	729,294	515	187	164
27b	River plains with grassy woodlands and tussock grasslands	River plains, shrub with scattered overstorey	Jigalong	71,292	7	14	43
27c	River plains with grassy woodlands and tussock grasslands	River plains, grass with dense overstorey	Ashburton, Coolibah, Gascoyne, Yanrey	200,333	47	38	124
28	Salt lakes and fringing alluvial plains with halophytic shrublands	Scattered to moderately close halophytic shrublands with occasional acacias	Boonderoo, Carnegie, Darlot, Lefroy, Marsh, Weelarrana, Wolarry, Wooleen	1,350,229	1,036	315	97
29a	Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation	Coastal scattered acacia over shrub	Cullawarra, Damper, Littoral	241,688	89	5	1
29b	Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation	Coastal closed acacia over shrub	Coast, Coquina, Culver, Edel, Lyell, Roe, Toolinna, Wurrengoodyea, Zuytdorp	846,209	181	16	2
29c	Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation	Coastal scattered acacia over grass	Cheerawarra, Dune, Onslow	124,495	140	22	14

Appendix B Summary of pre-European vegetation types

Table B1: Pre-European vegetation types in the WA pastoral rangelands

Pre-European vegetation type	Description	Area (ha)	Number of traverse points in each pasture condition class		
			Good	Fair	Poor
4	Woodland other	1,617,925	816	618	137
5	Medium-low woodland	45,586	29	18	10
8	Low woodland, open low woodland or sparse woodland	12,478,366	12,518	4,447	4,107
9	Low woodland or open low woodland	514,994	436	272	120
14	Thicket	791,659	452	352	78
15	Scrub, open scrub or sparse scrub	2,521,134	2,200	807	769
16	Mallee	918,730	617	336	173
20	Dwarf scrub or open low shrub	51,019	19	9	10
21	Pindan woodland	1,456,542	572	258	260
22	Pindan with low trees	3,120,023	153	118	24
23	Grasslands, high grass savanna woodland on basalt	2,693,231	924	421	374
24	Grasslands, high grass savanna woodland on sandstone	5,046,486	630	313	197
25	Grasslands, tall bunch-grass savanna woodland	233,013	192	104	69
26	Grasslands, tall bunch-grass low-tree savanna	1,104,397	991	340	408
27	Grasslands, tall bunch-grass savanna	1,709,009	2,793	1,134	1,049
28	Grasslands, short bunch-grass low-tree savanna	476,682	1,438	474	507
29	Grasslands, short bunch-grass savanna	995,763	736	417	152
30	Grasslands, curly spinifex savanna woodland or low trees	4,867,527	1,890	907	517
31	Grasslands, tall bunch-grass open savanna woodland	342,001	267	119	94
32	Riverine sedgeland/grassland with trees	251,737	175	72	22
34	Tree steppe	34,868	3	3	0
35	Low-tree steppe	6,287,158	962	917	30
36	Sparse low-tree steppe	1,306,138	773	595	117
37	Tree and shrub steppe	1,202,663	506	440	44
38	Shrub steppe	1,0728,835	5,665	4,839	511
39	Sparse shrub steppe	738,957	632	546	43
40	Grass steppe	688,856	182	164	11
41	Spinifex complexes	908,770	388	316	52

(continued)

Table B2 continued: Pre-European vegetation types in the WA pastoral rangelands

Pre-European vegetation type	Description	Area (ha)	Number of traverse points in each pasture condition class		
			Good	Fair	Poor
42	Samphire with thicket and scattered trees	11,688	4	3	1
43	Saltbush and/or bluebush with woodland or scattered trees	152,129	130	119	9
44	Samphire with scattered medium or low trees	21,135	22	14	8
45	Saltbush and/or bluebush with low trees	324,494	284	182	70
46	Saltbush and/or bluebush with scattered low trees	2,346,011	2,841	1,786	745
47	Samphire with thicket/scrub	80,192	98	53	30
48	Saltbush and bluebush with scrub or open scrub	344,572	434	239	118
49	Saltbush and bluebush	4,442,394	3,552	2,016	1,168
50	Samphire	543,593	621	374	159
51	Saltlake, lagoon or clay pan	820,112	143	101	32
53	Tidal mud flat	535,880	62	56	4
54	Rock	34,563	19	15	2
104	Woodland/Shrub (mallee) steppe	68,013	61	61	0
105	Woodland/Succulent steppe with open low woodland	489,794	487	390	76
106	Low woodland/Scrub	104,143	98	26	46
110	Scrub or very open scrub/Grass steppe	415,689	314	139	95
111	Pindan/Tall bunch-grass savanna with low trees	260,392	246	103	119
112	Curly spinifex low-tree savanna/Sparse low-tree-steppe	601,067	62	43	13
113	High grass savanna woodland/Curly spinifex savanna	894,079	114	44	55
114	Curly spinifex or short grass low-tree savanna/Grass steppe	391,207	993	584	220
115	Short bunch-grass low-tree savanna/Tree steppe	516,545	498	158	165
116	Short bunch-grass savanna/Grass steppe	697,799	977	643	198
117	Sparse low-tree steppe/Sparse shrub steppe	1,159,773	322	315	7
119	Low woodland or open low woodland/bluebush and saltbush	124,419	4	1	1
120	Succulent steppe bluebush and saltbush/samphire	9,821	4	2	2

Appendix C Summary of broad vegetation groups

Table C1 Broad vegetation groups in the Kimberley and Broome region

Broad vegetation group code	Pasture type code	Broad group description	Number of traverse points in each pasture condition class		
			Good	Fair	Poor
BLKSL	BGAP, BSPP, MGAP, RAPP	Black soil	892	736	410
FRTGR	BUGP, FRGP, FRGR, FRIP	Frontage grass	258	291	194
OTHER	CENC, LITP, MELS, OTHE, OTHP, TAPP	Other	189	123	89
OTHER2	BSBP, CSAS, LMSS, RGRA, RGRB, SASW, STCP, SWCP	Other 2	521	452	139
PINDN	CSPP, CSRG, CUSP, PINP, SOSP, SSPP	Pindan	3,078	1,439	417
RIBGR	ASGP, BUSP, PLSP, RGRP, SHGR, WGBB, WGBP	Ribbon grass	906	1,446	1,623
SPXHIL	HASP, HSHP, HSPP, HSSP, LOSP	Spinifex/Hill	2,151	426	117
Unknown	Unknown	Unknown	458	342	158

Table C2 Broad vegetation groups in the Pilbara and southern rangelands regions

Broad vegetation group code	Pasture type code	Broad group description	Number of traverse points in each pasture condition class		
			Good	Fair	Poor
ASGRF	ASGF, CSGF, MSGF, SSGF	Acacia short grass forbs	18	48	8
BLUEB	BLUE, BLUS, CHMA, CPBS, NCSG, PEXW, PSAS	Bluebush pasture	23	30	47
BUFFL	TUGR	Buffel grass	77	134	86
EAESP	ACMS, CEAS, EUAW, PEEW	Eucalypt, Acacia, Eremophila, Senna	115	131	41
EUCCH	EMCW, ESAW, ESCW, ESOW, EXCW, EXHS, EXSW, PEBW, PECW, PEPB, PESW	Eucalypt chenopod plain	598	104	58
GRSTP	GNEW	Greenstone stony plains	6	5	5
HARSP	HASP, HSHI, HSPG, HSSP, PHSG, SAHS, SAMA, SAMU	Hard spinifex	364	22	6
HEATH	BCHS, COHE, ECHW, EHEW, HEAT, LSHE, SCHE, TRHE	Heath	15	0	0
HPMSP	CPMG, GMGW, GMUW, GRMS, GRMU, HCAS, HMCS, HPAS, HPMS, LHMS, MGRW, MUBW	Hardpan mulga	768	1,340	1,023

(continued)

Table C2 continued: Broad vegetation groups in the Pilbara and southern rangelands regions

Broad vegetation group code	Pasture type code	Broad group description	Number of traverse points in each pasture condition class		
			Good	Fair	Poor
MIXCH	CXCS, CXCW, DACS, DDXS, DMCS, FRAN, LDCS, MCHS, MHHS, MXHS, NXCS, PXCS – PXHS	Mixed chenopod shrub	1,037	372	196
NULBR	DBGR, DCGR, DDSS, DGGR, DPGR, MHXS, MPBS, MSAS, MSCW, MXCS, MXCW, MXSS, PBAC, PBLS, PXLS, SWCS	Nullarbor	1,941	642	155
OTHER	ACGU, ACHS, ACSS, ANNH, BRXS, CAOS, CAPW, CBBS, CBKW, CCAS, CDSH, CEUW, CGSW, CMAS, CMES, COAS, CSGR, CSHG, CXSS, EMEW, EXAN, GGLS, GGSL, GHAS, GHMW, GRDS, GROS, HPCS, IRMS, JAMS, KOPI, LAWS, LISW, LOMW, MBIG, MELS, MELW, MESS, MFBW, MHGW, MUCR, NGHS, OTHP, PDFT, PLAS, RHMS, SBAS, SWBL, UFTH, UNVE, XSBG, XXNP	Other	240	156	115
RIPAR	ACCR, CRGS, CRLS, DAHW, DEGW, DESG, DMES, DRAS, DRCW, DRMS, RIMS, RIVS	Riparian association	79	142	69
SACES	ISAS, SAES, SCJS, SIAS, SIMS, SMMS, STAS, XAOS	Stony acacia, Eremophila	233	318	131
SALTP	BLSS, BSSL, CHAT, PYCW, SALS, SALT, SBLS, SSAS	Saltbush pasture	555	203	125
SAMPH	SAMP, SAMS	Samphire	119	11	8
SANDP	ACSA, AEGF, ASSW, CYSS, LACS, MAAS, MASA, PINW, PYAW, SAAS, SACS, SASP, SCMS, SDSH, SDUS	Sandplain	964	126	35
SGASP	GABS, GMUS, GRHS, SGRS	Sandy granitic acacia shrubland	200	173	78
SNAKW	ASWS – SSWS	Snakewood	80	83	93
SOSPX	ASSG, CASG, HESG, PMSS, PSSG, SOSP	Soft spinifex	144	50	8
SPWGR	ESOG, MSOG, OBIG, SWOG	Spear grass wallaby grass	610	459	153
STMXC	BCLS, BECW, MUXW, SBMS, SSMS, STCH, USBS	Stony mixed chenopod	64	103	173
TSKGR	ATUG, TGER, TGMI	Tussock grass	79	135	86
WANDR	LMWS, MUWA, PLMS, SWGS, WABS – WBGS	Wanderrie	557	357	140
Unknown	Unknown	Unknown	332	216	283

Appendix D Machine learning classification methods

We used 3 machine learning classification methods – K-Nearest Neighbour, Random Forest and Support Vector Machine − to discriminate between good, fair and poor condition classes using VIs.

D.1 K-Nearest Neighbour method

K-Nearest Neighbour (K-NN) is a nonparametric supervised machine learning method for classification that is fast and easy to implement (Friedman et al. 2001; Fukunaga 1990). It predicts the label of the test sample by gathering the 'K' nearest training samples. The label of the test sample is determined based on the majority vote of the labels of the nearest training samples. If $K = 1$, the unlabelled sample is simply assigned the label of its nearest neighbour (Figure D1). We used the 1-NN as one of the 3-class machine learning methods in this study.

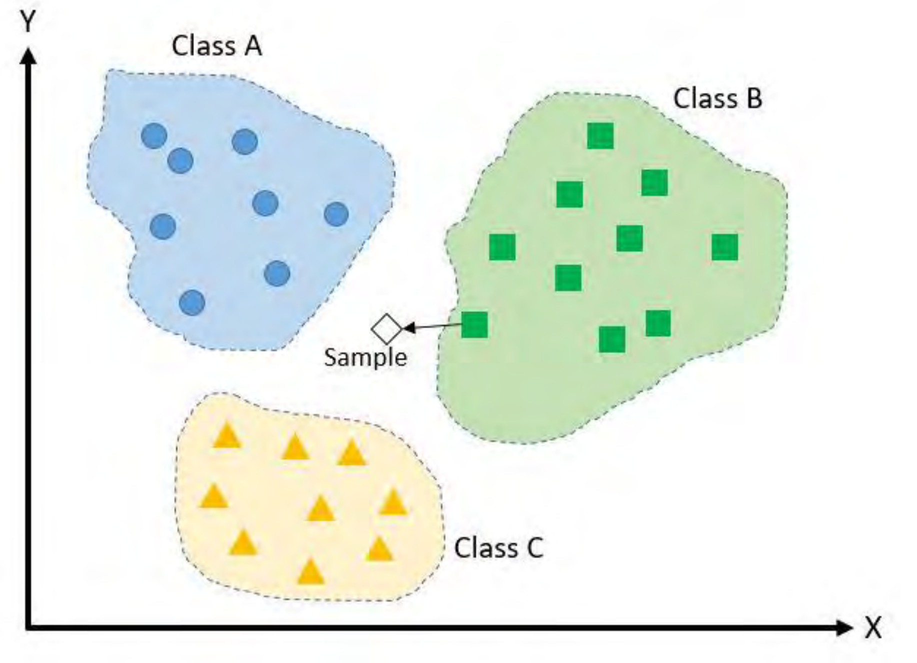


Figure D1: Concept of the 1-Nearest Neighbour (1-NN) method, where the label of the nearest sample is assigned to the unlabelled sample

D.2 Random Forest method

The idea behind Random Forest (RF) is that improved classification and regression accuracy can be achieved by using ensembles of decision trees (Breiman 2001). Final predictions are obtained by aggregating over the ensemble. As the base constituents of the ensemble are tree-structured predictors, and since each of these trees is constructed randomly, these procedures are called 'random forests'.

In this approach, each tree is formed by selecting a subset of input samples randomly at each node and the best split based on these samples in the training set is calculated. The tree is grown using classification and regression tree (CART) methodology (Breiman et al. 1984) to its maximum size, without pruning. This subspace

randomisation scheme is blended with bagging (Breiman 1996; Biau et al. 2010; Biau 2012) to resample, with replacement, the training dataset each time a new individual tree is grown.

Figure D2 shows the structure of the RF method for classification. Increasing the number of trees leads to better training but may cause overfitting and increase the processing time. Therefore, it is essential to estimate the optimum parameters to achieve the best results (Friedman et al. 2001).

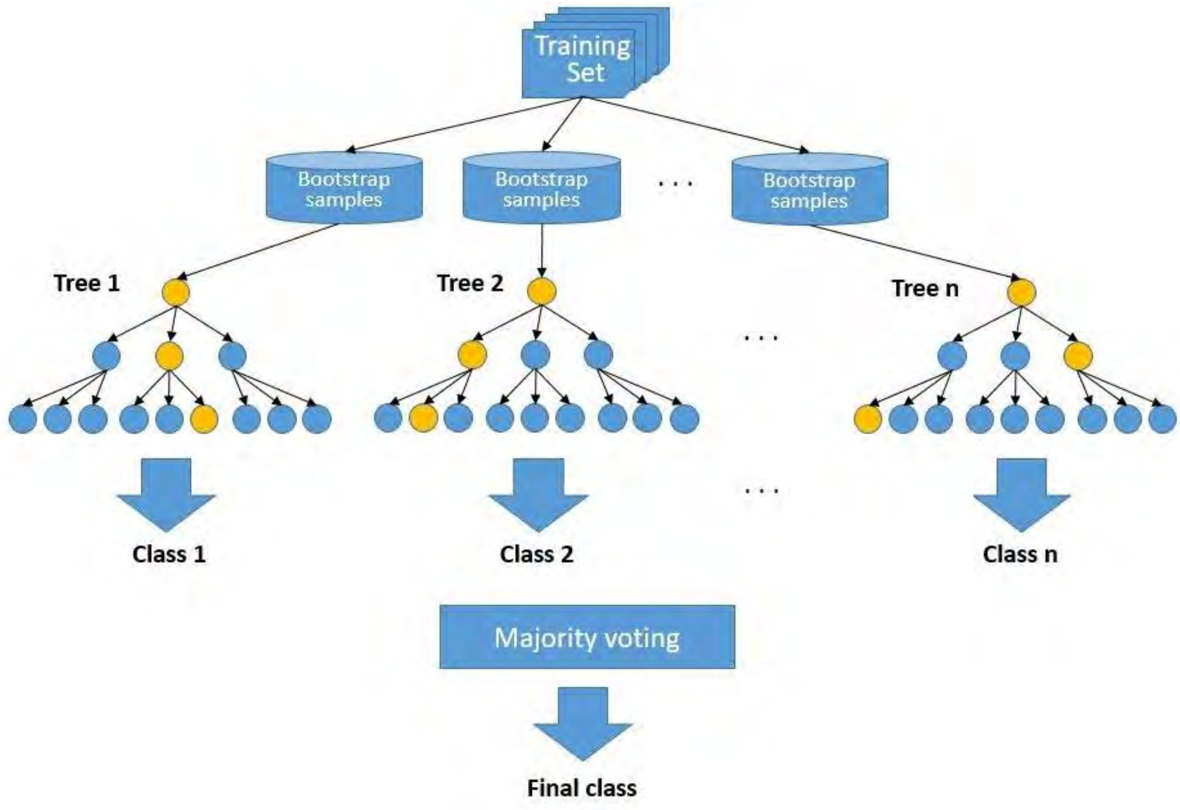


Figure D2: Structure of the RF method, where the final label of an input sample is obtained by majority voting over the ensemble of decision trees

D.3 Support Vector Machine algorithm

Support Vector Machine (SVM) is a supervised and linear machine learning method that is usually used for 2-class problems (Cortes and Vapnik 1995). In this method, the aim is to find a hyperplane in n-dimensional space (where ‘n’ is number of features) that differentiates the 2 classes by maximising the margin between them (Boser et al. 1992; Vapnik 2013). This method first finds the support vectors (SVs) or the points on the margin of each class and then fits 2 lines to them. The main objective is to maximise the distance between these lines (Figure D3).

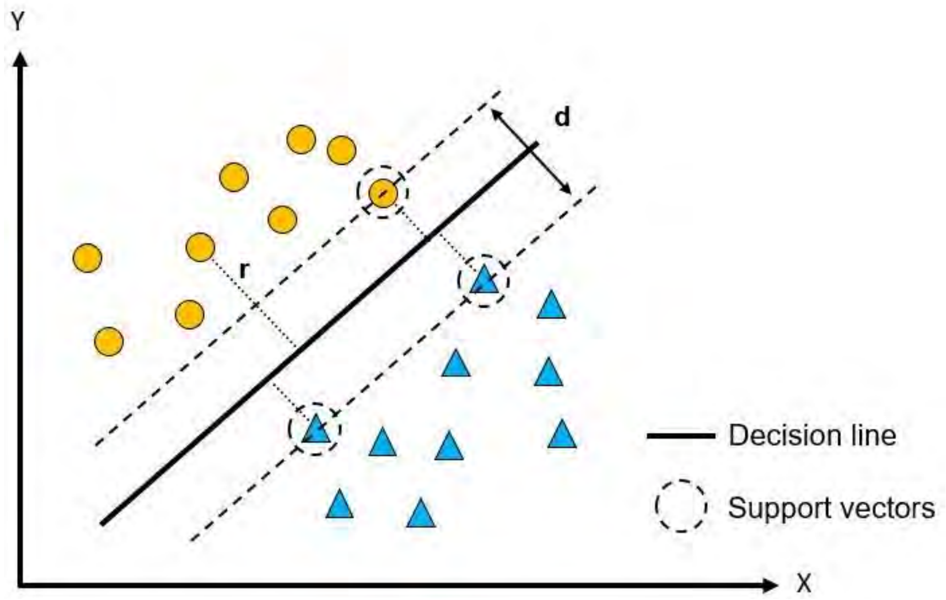


Figure D3: Concept of the SVM method for classification, where the decision hyperplane (line in a 2-dimensional space) is determined by maximising the margin between 2 classes

If we assume $W^T x + b = 0$ as the equation of the decision line (hyperplane), then the equation of the margin lines will be $W^T x + b + 1 = 0$ and $W^T x + b - 1 = 0$ (the distance between the decision line and margins is normalised to 1) and the distance between 2 margin lines is calculated by

$$\mathrm{d} = \frac{|W^{\mathrm{T}}\mathrm{x}_1 + \mathrm{b}|}{\|W\|} + \frac{|W^{\mathrm{T}}\mathrm{x}_2 + b|}{\|W\|} = \frac{1}{\|W\|} + \frac{1}{\|W\|} = \frac{2}{\|W\|} \quad \text{(D1)}$$

where x is the input samples or features, x_1 and x_2 are the SVs of the 2 classes, W is the weight vector, b is bias and d is the distance between 2 margins.

According to Equation D1, the objective is to maximise d or minimise $\|W\|$ or the norm of W to find a line with maximum margin. This is a nonlinear (quadratic) optimisation problem and can be solved by the Lagrange multipliers method (Theodoridis and Koutroumbas 2009).

D.3.1 Nonlinear classifier and kernel method

In most of the real-world classification tasks, the classes are not linearly separable. SVMs function by nonlinearly projecting the input data to a higher dimension feature space, which makes them separable by a hyperplane (Figure D4). The functions used to project the input data are called kernels or kernel machines (Shawe-Taylor and Cristianini 2004). Examples of these include polynomial, Gaussian (more commonly referred to as radial basis functions) and quadratic functions. Each function has its own parameters, which are usually determined through a cross validation process. In most of the remote sensing applications, Gaussian kernel (Equation D2) is preferred to the others (Mountrakis et al. 2011), so we used it in this study:

$$K(x) = exp(-\gamma \|x\|^2);\ \gamma > 0 \tag{D2}$$

where x is the input samples or features, $\|\ \ \|$ is the norm operator, exp is the exponential operator and $\gamma > 0$ is a constant parameter.

Note that classification in high dimension feature spaces results in overfitting in the input space; however, this is controlled in SVM by structural risk minimisation (Vapnik 1995).

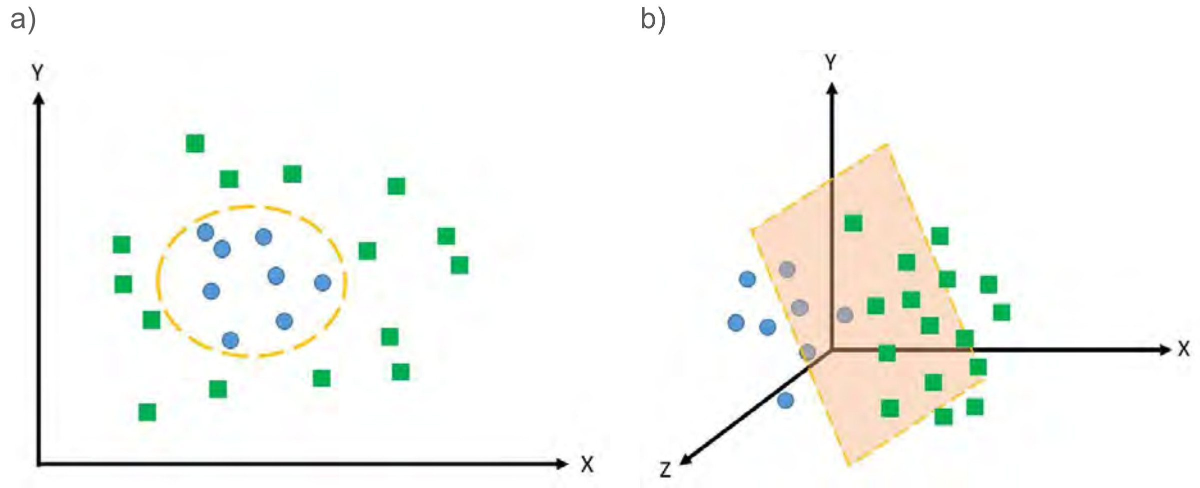


Figure D4: Concept of a nonlinear classification problem: (a) 2 classes are separable, but cannot be discriminated with a decision line; (b) 2 classes are separable by a hyperplane after projecting the points to a higher dimension space using a kernel function

D.3.2 Multilabel classification

As mentioned earlier, SVM is essentially a binary (2-class) classification method that needs to be modified to be used in multiclass classification. Two of the common methods to enable this adaptation are the one-against-one (1A1) and one-against-all (1AA).

1A1 is the method that calculates each possible pair of classes of a binary classifier for an N-class problem. Each classifier is trained on a subset of training examples of the 2 involved classes. In this method, all $N(N-1)/2$ binary classifications are combined to estimate the final output (Hsu and Lin 2002; Weston and Watkins 1998). The most important problem caused by this method is the existence of unclassifiable regions, which can be solved using the 1AA technique.

For an N-class problem, the 1AA method constructs N SVMs (one SVM per class), which is trained to distinguish the samples of one class from samples of all remaining classes (Hsu and Lin 2002). The *i*th SVM is trained using all the learning examples in the *i*th class with positive labels and the others with negative labels and, finally, N hyperplanes are obtained. All N binary classifications are then combined by a majority voting scheme to estimate the final output. This approach is suitable for problems with large amounts of data (Hsu and Lin 2002; Weston and Watkins 1998).

Like most remote sensing classification studies (Mountrakis et al. 2011), we used the 1AA approach. Figure D5 shows the concept of this technique for a 3-class classification.

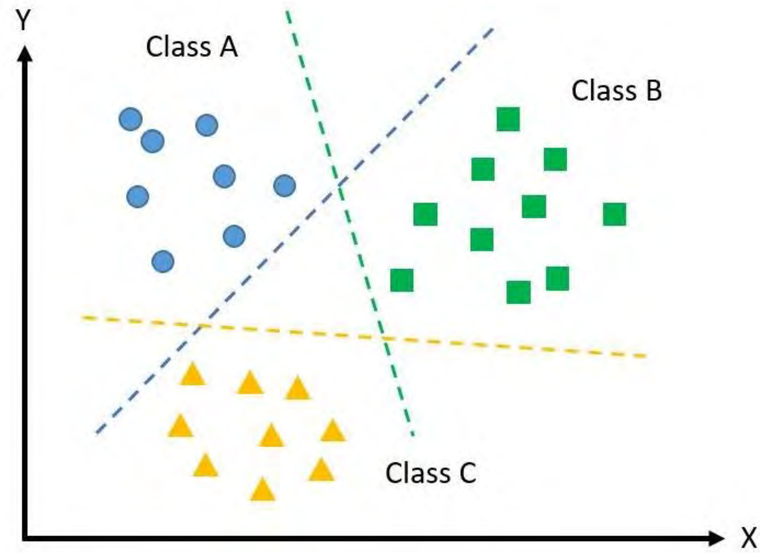


Figure D5: Concept of the 1AA strategy for solving a multiclass problem, where N binary classifiers are trained and N decision hyperplanes are generated for dividing N classes in hyperspace

D.4 Multiclass accuracy assessment

The metrics used to evaluate the multiclass classification accuracy of a VI by a classification method were overall accuracy (OA), user's accuracy (UA) and producer's accuracy (PA), which are derived from the classification confusion matrix (Table D1).

Table D1: Example of a confusion matrix and the accuracies derived from it

		Actual condition rating			User's accuracy
		Good	Fair	Poor	
Predicted condition rating	Good	334	13	9	0.94
	Fair	3	17	3	0.74
	Poor	2	1	9	0.75
Producer's accuracy		0.99	0.55	0.43	Overall accuracy = 0.91

The value of OA represents the proportion of correctly classified points, where in a perfect classification, all the points are classified correctly, and OA value is equal to 1.

The UA (also known as reliability or precision) of a particular class is calculated by the number of true positives (total number of the correctly classified points) divided by the total number of predicted points in that class. According to this definition, UA specifically determines how often a class on the map is present on the ground.

The PA (or recall) of a class is calculated by the total number of true positives divided by the total number of reference points in that class. Therefore, PA represents how often the real classes on the ground are correctly shown on the classification map.

In the example confusion matrix in Table D1, the accuracies were computed as follows:

Correctly classified samples: 334 + 17 + 9 = 360

Total number of samples: 391

OA: 360 / 391 = 0.91

UA_{good} = 334 / (334 + 13 + 9) = 0.94

PA_{good} = 334 / (334 + 3 + 2) = 0.99

UA_{fair} = 17 / (3 + 17 + 3) = 0.7317

PA_{fair} = 17 / (13 + 17 + 1) = 0.55

UA_{poor} = 9 / (2 + 1 + 9) = 0.75

PA_{poor} = 9 / (9 + 3 + 9) = 0.43

Appendix E Area under curve and overall accuracy values of vegetation indices

Notes for the tables in this appendix:

- The groups within each stratification level without the minimum required number of traverse points (70 points and at least 3 points in each condition class for fairs-excluded and fairs-included strategies, and 85 points and at least 5 points in each condition class for 3-class strategy) are not included.
- The AUC and OA values of each VI exceeding the adequacy threshold (0.67) in each group are shown in bold.
- The mean AUC, mean OA and VI reliability values of the most suitable VI(s) – VI with the highest reliability value and the mean AUC or mean OA was not significantly different from the highest mean AUC or mean OA − in each table are shaded blue.
- The GDVIs were not assessed in the Nullarbor and Pilbara regions so the AUC and OA values of these VIs are represented by an asterisk in the tables for the Pilbara and southern rangelands region.

E.1 Kimberley and Broome region

Table E1: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Kimberley and Broome region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Alexander	0.61	0.54	0.54	0.54	0.63	0.54	0.54	0.64
Antrim	0.58	0.58	0.58	0.58	0.57	0.58	0.58	0.60
Argyle	0.57	0.55	0.55	0.55	0.60	0.55	0.55	0.58
Barton	0.52	0.62	0.62	0.64	0.98	0.62	0.62	0.92
Bohemia	0.47	0.46	0.46	0.46	0.67	0.46	0.46	0.64
Calwynyardah	0.62	0.61	0.61	0.61	0.73	0.61	0.61	0.71
Camelgooda	0.37	0.44	0.44	0.44	0.47	0.44	0.43	0.47
Cockatoo	0.60	0.61	0.61	0.61	0.59	0.61	0.62	0.58
Cockburn2	0.60	0.54	0.54	0.54	0.74	0.54	0.55	0.68
Coolindie	0.69	0.70	0.70	0.70	0.60	0.70	0.70	0.67
Coonangoody	0.65	0.69	0.69	0.69	0.68	0.69	0.69	0.71
Cowendyne	0.54	0.54	0.54	0.54	0.58	0.54	0.54	0.57
Dinnabung	0.52	0.44	0.44	0.44	0.49	0.44	0.44	0.42
Djada	0.73	0.70	0.70	0.70	0.77	0.70	0.69	0.78
Dockrell	0.42	0.41	0.41	0.41	0.60	0.41	0.41	0.55
Forrest	0.60	0.58	0.58	0.58	0.72	0.58	0.58	0.69
Fossil2	0.62	0.63	0.63	0.63	0.72	0.63	0.63	0.73
Frayne	0.49	0.45	0.45	0.45	0.53	0.45	0.45	0.53
Geebee	0.67	0.73	0.73	0.73	0.75	0.73	0.72	0.74
Glenroy	0.41	0.35	0.35	0.35	0.92	0.35	0.35	0.82

(continued)

Table E1 continued: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Kimberley and Broome region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Gogo	0.76	0.77	0.77	0.78	0.79	0.77	0.77	0.79
Gordon	0.76	0.74	0.74	0.74	0.72	0.74	0.74	0.76
Inverway	0.72	0.64	0.64	0.64	0.71	0.64	0.64	0.71
Ivanhoe	0.48	0.55	0.55	0.55	0.46	0.55	0.55	0.48
Kennedy	0.66	0.70	0.70	0.70	0.92	0.70	0.70	0.84
Koongie	0.58	0.60	0.60	0.60	0.80	0.60	0.60	0.78
Looingnin	0.68	0.65	0.65	0.65	0.75	0.65	0.65	0.75
Lubbock	0.65	0.65	0.65	0.65	0.77	0.65	0.65	0.79
Luluigui	0.64	0.67	0.67	0.67	0.80	0.67	0.67	0.78
Margaret	0.59	0.61	0.61	0.61	0.86	0.61	0.60	0.83
Mulan	0.63	0.61	0.61	0.61	0.64	0.61	0.61	0.65
Myroodah	0.69	0.70	0.70	0.70	0.76	0.70	0.70	0.75
Napier	0.63	0.72	0.72	0.72	0.59	0.72	0.72	0.63
Neillabublica	0.62	0.68	0.68	0.68	0.82	0.68	0.67	0.79
Nita	0.24	0.48	0.48	0.48	0.47	0.48	0.48	0.50
ODonnell	0.70	0.66	0.66	0.66	0.81	0.66	0.66	0.79
Pigeon	0.76	0.74	0.74	0.74	0.90	0.74	0.74	0.91
Pinkerton	0.50	0.52	0.52	0.52	0.56	0.52	0.52	0.57
Pompey	0.73	0.73	0.73	0.73	0.90	0.73	0.73	0.89
Richenda	0.67	0.61	0.61	0.61	0.76	0.61	0.61	0.76
Roebuck	0.64	0.70	0.71	0.70	0.71	0.70	0.70	0.73
Ruby2	0.69	0.71	0.71	0.71	0.73	0.71	0.70	0.76
Sisters	0.47	0.47	0.47	0.47	0.67	0.47	0.47	0.63
Sturt Creek	0.40	0.52	0.52	0.52	0.71	0.52	0.52	0.67
Wanganut	0.65	0.60	0.60	0.60	0.69	0.60	0.60	0.66
Wave Hill	0.59	0.55	0.55	0.55	0.57	0.55	0.55	0.57
Wickenham	0.51	0.47	0.47	0.47	0.59	0.47	0.47	0.56
Winnecke	0.66	0.69	0.69	0.69	0.83	0.69	0.69	0.80
Yeeda	0.40	0.40	0.40	0.40	0.45	0.40	0.40	0.43
Number of groups	49	49	49	49	49	49	49	49
Minimum	0.24	0.35	0.35	0.35	0.45	0.35	0.35	0.42
Maximum	0.76	0.77	0.77	0.78	0.98	0.77	0.77	0.92
Mean	0.59	0.60	0.60	0.60	0.70	0.60	0.60	0.70
Median	0.62	0.61	0.61	0.61	0.71	0.61	0.61	0.71
Standard deviation	0.11	0.11	0.11	0.11	0.13	0.11	0.11	0.12
VI reliability (%)	26.53	32.65	32.65	32.65	63.27	32.65	30.61	59.18
Overall reliability (%)	67.34							

Table E2: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Kimberley and Broome region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
1a	0.55	0.56	0.56	0.56	0.60	0.56	0.56	0.60
1b	0.41	0.43	0.43	0.43	0.58	0.43	0.43	0.56
2a	0.59	0.62	0.62	0.62	0.69	0.62	0.62	0.70
2b	0.67	0.68	0.68	0.68	0.54	0.68	0.68	0.58
2c	0.57	0.57	0.57	0.57	0.70	0.57	0.56	0.68
2d	0.61	0.59	0.59	0.59	0.83	0.59	0.59	0.80
5a	0.63	0.64	0.64	0.64	0.76	0.64	0.65	0.75
5b	0.35	0.41	0.41	0.41	0.60	0.41	0.41	0.57
5c	0.48	0.54	0.54	0.54	0.66	0.54	0.54	0.60
6	0.46	0.48	0.48	0.49	0.55	0.48	0.48	0.53
7a	0.63	0.65	0.65	0.65	0.72	0.65	0.65	0.71
7b	0.47	0.56	0.56	0.56	0.71	0.56	0.56	0.67
8	0.57	0.51	0.51	0.51	0.61	0.51	0.51	0.59
9a	0.49	0.55	0.56	0.55	0.65	0.55	0.55	0.64
Number of groups	14	14	14	14	14	14	14	14
Minimum	0.35	0.41	0.41	0.41	0.54	0.41	0.41	0.53
Maximum	0.67	0.68	0.68	0.68	0.83	0.68	0.68	0.80
Mean	0.53	0.56	0.56	0.56	0.66	0.56	0.56	0.64
Median	0.56	0.56	0.56	0.56	0.65	0.56	0.56	0.62
Standard deviation	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08
VI reliability (%)	7.14	7.14	7.14	7.14	42.86	7.14	7.14	42.86
Overall reliability (%)	50.00							

Table E3: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Kimberley and Broome region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
21	0.53	0.49	0.49	0.49	0.53	0.49	0.49	0.51
22	0.42	0.47	0.47	0.47	0.51	0.47	0.47	0.51
23	0.50	0.54	0.54	0.54	0.60	0.54	0.54	0.58
24	0.66	0.65	0.65	0.65	0.71	0.65	0.65	0.69
25	0.70	0.72	0.72	0.72	0.82	0.72	0.72	0.82
26	0.68	0.69	0.69	0.69	0.76	0.69	0.69	0.75
27	0.52	0.47	0.47	0.47	0.56	0.47	0.47	0.53
28	0.66	0.65	0.65	0.65	0.72	0.65	0.65	0.73

(continued)

Table E3 continued: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Kimberley and Broome region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
29	0.52	0.48	0.52	0.48	0.44	0.48	0.48	0.48
30	0.63	0.59	0.60	0.59	0.80	0.59	0.59	0.78
31	0.66	0.66	0.66	0.66	0.69	0.66	0.66	0.72
32	0.53	0.59	0.60	0.59	0.73	0.59	0.59	0.70
35	0.53	0.57	0.57	0.57	0.69	0.57	0.56	0.67
36	0.43	0.41	0.41	0.41	0.58	0.41	0.41	0.53
38	0.56	0.59	0.59	0.59	0.71	0.59	0.62	0.71
40	0.54	0.58	0.58	0.58	0.60	0.58	0.59	0.57
111	0.88	0.90	0.90	0.90	0.90	0.90	0.89	0.91
114	0.62	0.66	0.66	0.66	0.80	0.66	0.65	0.80
115	0.69	0.65	0.65	0.65	0.65	0.65	0.65	0.70
Number of groups	19	19	19	19	19	19	19	19
Minimum	0.42	0.41	0.41	0.41	0.44	0.41	0.41	0.48
Maximum	0.88	0.90	0.90	0.90	0.90	0.90	0.89	0.91
Mean	0.59	0.60	0.60	0.60	0.67	0.60	0.60	0.67
Median	0.56	0.59	0.60	0.59	0.69	0.59	0.59	0.70
Standard deviation	0.11	0.11	0.11	0.11	0.12	0.11	0.11	0.12
VI reliability (%)	21.05	15.79	15.79	15.79	57.90	15.79	15.79	63.16
Overall reliability (%)	63.16							

Table E4: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Kimberley and Broome region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASGP	0.78	0.76	0.76	0.76	0.74	0.76	0.76	0.77
BGAP	0.67	0.59	0.59	0.59	0.47	0.59	0.59	0.47
BSBP	0.50	0.47	0.47	0.47	0.55	0.47	0.47	0.58
BSGP	0.75	0.75	0.75	0.75	0.62	0.75	0.75	0.66
BUGP	0.46	0.47	0.48	0.48	0.36	0.47	0.44	0.39
CAHP	0.77	0.81	0.81	0.81	0.75	0.81	0.81	0.78
CSPP	0.64	0.65	0.65	0.65	0.75	0.65	0.65	0.74
CSRG	0.51	0.51	0.50	0.51	0.65	0.51	0.50	0.60
CUSP	0.70	0.71	0.71	0.71	0.71	0.71	0.71	0.75
FRGP	0.69	0.66	0.66	0.66	0.73	0.66	0.65	0.72
HASP	0.73	0.73	0.73	0.73	0.77	0.73	0.73	0.79

(continued)

Table E4 continued: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Kimberley and Broome region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
HSHP	0.47	0.42	0.42	0.43	0.58	0.42	0.42	0.55
HSPP	0.77	0.74	0.74	0.74	0.81	0.74	0.73	0.83
LGAP	0.53	0.38	0.38	0.38	0.77	0.38	0.38	0.64
MGAP	0.45	0.40	0.40	0.40	0.52	0.40	0.40	0.50
MGUP	0.68	0.65	0.65	0.65	0.52	0.65	0.65	0.57
OTHP	0.69	0.68	0.68	0.68	0.67	0.68	0.68	0.65
PINP	0.50	0.51	0.51	0.51	0.54	0.51	0.51	0.53
PLSP	0.28	0.37	0.38	0.38	0.40	0.37	0.37	0.34
RAPP	0.60	0.63	0.63	0.63	0.45	0.63	0.63	0.49
RBGR	0.88	0.84	0.84	0.84	0.81	0.84	0.84	0.83
RGAP	0.43	0.39	0.39	0.39	0.62	0.39	0.39	0.56
RGRA	0.62	0.63	0.63	0.63	0.73	0.63	0.63	0.71
RGRB	0.74	0.73	0.73	0.73	0.74	0.73	0.73	0.75
RGRP	0.70	0.66	0.66	0.66	0.71	0.66	0.66	0.71
SOSP	0.58	0.57	0.57	0.57	0.72	0.57	0.57	0.69
SSPP	0.56	0.61	0.61	0.61	0.70	0.61	0.61	0.69
TTGP	0.66	0.63	0.63	0.63	0.62	0.63	0.63	0.60
Unknown	0.51	0.61	0.61	0.61	0.69	0.61	0.61	0.68
WGBP	0.74	0.80	0.80	0.80	0.73	0.80	0.80	0.77
Number of groups	30	30	30	30	30	30	30	30
Minimum	0.28	0.37	0.38	0.38	0.36	0.37	0.37	0.34
Maximum	0.88	0.84	0.84	0.84	0.81	0.84	0.84	0.83
Mean	0.62	0.61	0.61	0.61	0.65	0.61	0.61	0.64
Median	0.65	0.63	0.63	0.63	0.69	0.63	0.63	0.67
Standard deviation	0.13	0.14	0.14	0.14	0.12	0.14	0.14	0.13
VI reliability (%)	46.67	33.33	33.33	33.33	56.67	33.33	33.33	50.00
Overall reliability (%)	66.67							

Table E5: Area under curve values and summary statistics from the fairs-excluded strategy for broad vegetation groups in the Kimberley and Broome region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
BLKSL	0.56	0.52	0.52	0.52	0.53	0.52	0.52	0.53
FRTGR	0.65	0.62	0.62	0.62	0.65	0.62	0.61	0.65
OTHER	0.71	0.69	0.70	0.69	0.61	0.69	0.69	0.62
OTHER2	0.62	0.62	0.62	0.62	0.69	0.62	0.62	0.68
PINDN	0.42	0.45	0.45	0.45	0.59	0.45	0.45	0.56
RIBGR	0.73	0.70	0.70	0.70	0.74	0.70	0.70	0.74
SPXHIL	0.76	0.73	0.73	0.73	0.80	0.73	0.72	0.81
Unknown	0.60	0.60	0.61	0.60	0.68	0.60	0.61	0.66
Number of groups	8	8	8	8	8	8	8	8
Minimum	0.42	0.45	0.45	0.45	0.53	0.45	0.45	0.53
Maximum	0.76	0.73	0.73	0.73	0.80	0.73	0.72	0.81
Mean	0.63	0.62	0.62	0.62	0.66	0.62	0.61	0.66
Median	0.64	0.62	0.62	0.62	0.66	0.62	0.61	0.65
Standard deviation	0.11	0.09	0.10	0.10	0.08	0.09	0.09	0.09
VI reliability (%)	37.50	37.50	37.50	37.50	50.00	37.50	37.50	37.50
Overall reliability (%)	62.50							

Table E6: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Kimberley and Broome region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Alexander	0.62	0.55	0.55	0.55	0.65	0.55	0.55	0.64
Anna	0.54	0.47	0.47	0.47	0.31	0.47	0.47	0.40
Antrim	0.59	0.59	0.59	0.59	0.51	0.59	0.59	0.55
Argyle	0.55	0.53	0.53	0.53	0.58	0.53	0.53	0.56
Barry	0.48	0.46	0.46	0.46	0.45	0.46	0.45	0.48
Barton	0.49	0.59	0.59	0.60	0.95	0.59	0.59	0.86
Bohemia	0.49	0.48	0.47	0.47	0.67	0.48	0.47	0.63
Calwynyardah	0.61	0.61	0.61	0.61	0.70	0.61	0.60	0.69
Camelgooda	0.41	0.47	0.47	0.47	0.49	0.47	0.46	0.49
Carpentaria	0.77	0.62	0.71	0.62	0.53	0.62	0.62	0.59
Chestnut	0.72	0.76	0.76	0.76	0.82	0.76	0.76	0.80
Cockatoo	0.56	0.57	0.57	0.57	0.55	0.57	0.57	0.54
Cockburn2	0.58	0.55	0.55	0.55	0.69	0.55	0.55	0.65
Coolindie	0.67	0.68	0.68	0.68	0.59	0.68	0.68	0.65

(continued)

Table E6 continued: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Kimberley and Broome region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Coonangoody	0.66	0.69	0.69	0.69	0.69	0.69	0.69	0.70
Cowendyne	0.50	0.52	0.52	0.52	0.55	0.52	0.52	0.54
Dinnabung	0.48	0.41	0.41	0.41	0.47	0.41	0.41	0.42
Djada	0.69	0.67	0.67	0.67	0.73	0.67	0.66	0.74
Dockrell	0.42	0.42	0.42	0.42	0.59	0.42	0.41	0.54
Duffer	0.64	0.69	0.69	0.69	0.70	0.69	0.69	0.73
Egan	0.91	0.89	0.89	0.89	0.81	0.89	0.89	0.91
Forrest	0.69	0.67	0.67	0.67	0.74	0.67	0.67	0.73
Fossil2	0.62	0.64	0.64	0.64	0.71	0.64	0.64	0.72
Franklin	0.74	0.77	0.77	0.77	0.83	0.77	0.77	0.84
Fraser	0.46	0.33	0.33	0.33	0.39	0.33	0.33	0.36
Frayne	0.46	0.45	0.45	0.45	0.48	0.45	0.45	0.48
Geebee	0.65	0.71	0.71	0.71	0.74	0.71	0.70	0.72
Gia	0.92	0.89	0.89	0.89	0.96	0.89	0.89	0.94
Glenroy	0.46	0.44	0.43	0.43	0.87	0.43	0.44	0.79
Gogo	0.75	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Gordon	0.76	0.75	0.75	0.75	0.72	0.75	0.75	0.75
Inverway	0.70	0.65	0.65	0.65	0.67	0.65	0.64	0.68
Ivanhoe	0.50	0.55	0.55	0.55	0.46	0.55	0.55	0.48
Karunjie	0.32	0.35	0.32	0.35	0.38	0.35	0.35	0.33
Kennedy	0.66	0.69	0.69	0.69	0.88	0.69	0.69	0.82
Koongie	0.57	0.59	0.59	0.59	0.76	0.59	0.59	0.74
Lake Gregory	0.63	0.69	0.69	0.69	0.86	0.69	0.69	0.84
Looingnin	0.65	0.62	0.62	0.62	0.72	0.62	0.62	0.71
Lubbock	0.64	0.63	0.63	0.63	0.73	0.63	0.63	0.74
Luluigui	0.60	0.62	0.62	0.62	0.67	0.62	0.62	0.66
MacPhee	0.56	0.50	0.50	0.50	0.71	0.50	0.50	0.70
Margaret	0.59	0.60	0.60	0.60	0.80	0.60	0.59	0.79
Mulan	0.64	0.61	0.61	0.61	0.63	0.61	0.61	0.65
Myroodah	0.66	0.67	0.67	0.67	0.70	0.67	0.67	0.70
Napier	0.65	0.70	0.70	0.70	0.57	0.70	0.70	0.61
Neillabublica	0.63	0.67	0.67	0.67	0.82	0.67	0.67	0.80
Nita	0.33	0.49	0.49	0.49	0.55	0.49	0.49	0.54
ODonnell	0.60	0.56	0.56	0.56	0.70	0.56	0.56	0.68
Pigeon	0.71	0.69	0.69	0.69	0.87	0.69	0.70	0.87

(continued)

Table E6 continued: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Kimberley and Broome region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Pinkerton	0.55	0.57	0.57	0.57	0.58	0.57	0.56	0.59
Pompey	0.75	0.75	0.75	0.75	0.88	0.75	0.75	0.88
Richenda	0.65	0.61	0.61	0.61	0.71	0.61	0.61	0.71
Roebuck	0.60	0.66	0.66	0.66	0.64	0.66	0.66	0.67
Ruby2	0.68	0.69	0.69	0.69	0.69	0.69	0.68	0.72
Sisters	0.46	0.47	0.47	0.47	0.66	0.47	0.47	0.62
Sturt Creek	0.45	0.50	0.50	0.50	0.62	0.50	0.50	0.60
Tableland	0.74	0.75	0.76	0.76	0.40	0.76	0.76	0.38
Wanganut	0.64	0.61	0.61	0.61	0.67	0.61	0.61	0.65
Wave Hill	0.58	0.54	0.54	0.54	0.52	0.54	0.54	0.52
Wickenham	0.58	0.56	0.56	0.56	0.63	0.56	0.56	0.62
Winnecke	0.66	0.68	0.68	0.68	0.79	0.68	0.67	0.77
Yeeda	0.43	0.43	0.43	0.43	0.48	0.43	0.43	0.46
Number of groups	62	62	62	62	62	62	62	62
Minimum	0.32	0.33	0.32	0.33	0.31	0.33	0.33	0.33
Maximum	0.92	0.89	0.89	0.89	0.96	0.89	0.89	0.94
Mean	0.60	0.60	0.60	0.60	0.66	0.60	0.60	0.66
Median	0.62	0.61	0.61	0.61	0.68	0.61	0.61	0.67
Standard deviation	0.12	0.12	0.12	0.12	0.15	0.12	0.12	0.14
VI reliability (%)	24.19	35.48	37.10	35.48	56.45	35.48	33.87	51.61
Overall reliability (%)	61.20							

Table E7: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Kimberley and Broome region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
1a	0.59	0.59	0.59	0.59	0.63	0.59	0.59	0.63
1b	0.44	0.45	0.45	0.45	0.57	0.45	0.45	0.56
2a	0.61	0.64	0.64	0.64	0.67	0.64	0.64	0.68
2b	0.66	0.67	0.66	0.66	0.51	0.67	0.67	0.55
2c	0.58	0.57	0.57	0.57	0.67	0.57	0.57	0.66
2d	0.59	0.56	0.56	0.56	0.76	0.56	0.56	0.73
5a	0.62	0.63	0.63	0.63	0.71	0.63	0.63	0.71
5b	0.39	0.43	0.44	0.43	0.62	0.43	0.43	0.58
5c	0.46	0.51	0.51	0.51	0.61	0.51	0.52	0.56
6	0.49	0.51	0.51	0.51	0.56	0.51	0.51	0.54

(continued)

Table E7 continued: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Kimberley and Broome region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
7a	0.64	0.66	0.66	0.66	0.71	0.66	0.66	0.71
7b	0.50	0.55	0.55	0.55	0.63	0.55	0.55	0.62
7c	0.77	0.62	0.71	0.62	0.53	0.62	0.62	0.59
8	0.58	0.52	0.52	0.52	0.59	0.52	0.52	0.57
9a	0.48	0.53	0.53	0.53	0.60	0.53	0.53	0.59
Number of groups	15	15	15	15	15	15	15	15
Minimum	0.39	0.43	0.44	0.43	0.51	0.43	0.43	0.54
Maximum	0.77	0.67	0.71	0.66	0.76	0.67	0.67	0.73
Mean	0.56	0.56	0.57	0.56	0.62	0.56	0.56	0.62
Median	0.58	0.56	0.56	0.56	0.62	0.56	0.56	0.59
Standard deviation	0.10	0.07	0.08	0.07	0.07	0.07	0.07	0.06
VI reliability (%)	6.67	0	6.67	0	33.33	0	0	26.67
Overall reliability (%)	40.00							

Table E8: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Kimberley and Broome region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
21	0.55	0.52	0.52	0.52	0.54	0.52	0.52	0.53
22	0.43	0.47	0.47	0.47	0.52	0.47	0.47	0.51
23	0.50	0.53	0.53	0.52	0.56	0.53	0.53	0.55
24	0.62	0.61	0.61	0.61	0.67	0.61	0.61	0.65
25	0.69	0.71	0.71	0.71	0.78	0.71	0.71	0.78
26	0.68	0.68	0.68	0.68	0.71	0.68	0.68	0.72
27	0.52	0.48	0.48	0.48	0.56	0.48	0.48	0.54
28	0.62	0.61	0.61	0.61	0.67	0.61	0.60	0.67
29	0.56	0.49	0.52	0.49	0.42	0.49	0.49	0.47
30	0.63	0.60	0.60	0.60	0.77	0.60	0.60	0.75
31	0.66	0.66	0.65	0.65	0.67	0.66	0.65	0.69
32	0.56	0.58	0.58	0.58	0.67	0.58	0.58	0.66
35	0.53	0.56	0.56	0.56	0.67	0.56	0.55	0.65
36	0.45	0.43	0.43	0.43	0.58	0.43	0.43	0.54
38	0.58	0.60	0.60	0.60	0.68	0.60	0.62	0.69
40	0.54	0.58	0.58	0.58	0.59	0.58	0.58	0.58

(continued)

Table E8 continued: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Kimberley and Broome region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
41	0.62	0.64	0.64	0.64	0.71	0.64	0.64	0.71
53	0.53	0.45	0.45	0.45	0.48	0.45	0.45	0.48
111	0.83	0.84	0.84	0.84	0.85	0.84	0.83	0.86
113	0.50	0.66	0.66	0.66	0.79	0.66	0.66	0.76
114	0.61	0.64	0.64	0.64	0.77	0.64	0.64	0.76
115	0.68	0.64	0.64	0.64	0.59	0.64	0.64	0.64
Number of groups	22	22	22	22	22	22	22	22
Minimum	0.43	0.43	0.43	0.43	0.42	0.43	0.43	0.47
Maximum	0.83	0.84	0.84	0.84	0.85	0.84	0.83	0.86
Mean	0.59	0.59	0.59	0.59	0.65	0.59	0.59	0.64
Median	0.57	0.60	0.60	0.60	0.67	0.60	0.60	0.66
Standard deviation	0.09	0.10	0.10	0.10	0.11	0.10	0.10	0.11
VI reliability (%)	18.18	13.64	13.64	13.64	54.55	13.64	13.64	45.46
Overall reliability (%)	54.55							

Table E9: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Kimberley and Broome region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASGP	0.66	0.67	0.67	0.67	0.58	0.67	0.67	0.61
BGAP	0.69	0.61	0.62	0.61	0.46	0.62	0.61	0.46
BSBP	0.57	0.50	0.50	0.49	0.60	0.50	0.50	0.60
BSGP	0.70	0.71	0.71	0.71	0.60	0.71	0.71	0.63
BUGP	0.46	0.50	0.50	0.50	0.39	0.49	0.46	0.40
CAHP	0.79	0.84	0.84	0.84	0.77	0.84	0.84	0.80
CSPP	0.63	0.63	0.63	0.63	0.72	0.63	0.63	0.71
CSRG	0.52	0.53	0.53	0.54	0.64	0.53	0.53	0.60
CUSP	0.66	0.68	0.68	0.68	0.68	0.68	0.68	0.72
FRGP	0.65	0.63	0.63	0.63	0.67	0.63	0.62	0.67
HASP	0.71	0.71	0.71	0.71	0.74	0.71	0.71	0.77
HSHP	0.46	0.41	0.41	0.42	0.57	0.41	0.41	0.54
HSPP	0.75	0.73	0.73	0.73	0.77	0.73	0.71	0.80
LCSP	0.56	0.55	0.55	0.55	0.48	0.55	0.55	0.51
LGAP	0.52	0.42	0.42	0.42	0.66	0.42	0.42	0.59
LITP	0.55	0.60	0.63	0.59	0.42	0.60	0.60	0.54

(continued)

Table E9 continued: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Kimberley and Broome region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
MGAP	0.46	0.42	0.42	0.42	0.51	0.42	0.42	0.50
MGUP	0.65	0.61	0.61	0.61	0.57	0.61	0.61	0.58
OTHP	0.65	0.64	0.64	0.64	0.63	0.64	0.64	0.60
PINP	0.51	0.51	0.51	0.51	0.54	0.51	0.51	0.53
PLSP	0.26	0.34	0.35	0.35	0.37	0.35	0.34	0.31
RAPP	0.55	0.57	0.57	0.57	0.44	0.57	0.57	0.46
RBGR	0.81	0.79	0.79	0.79	0.76	0.79	0.79	0.78
RGAP	0.45	0.42	0.42	0.42	0.58	0.42	0.42	0.54
RGRA	0.61	0.62	0.62	0.62	0.73	0.62	0.62	0.70
RGRB	0.69	0.70	0.70	0.70	0.68	0.70	0.70	0.70
RGRP	0.68	0.65	0.65	0.65	0.69	0.65	0.65	0.69
SOSP	0.57	0.57	0.57	0.57	0.69	0.57	0.57	0.67
SSPP	0.58	0.62	0.62	0.62	0.68	0.62	0.62	0.68
STCP	0.79	0.79	0.79	0.79	0.67	0.79	0.79	0.71
TTGP	0.65	0.62	0.62	0.62	0.57	0.62	0.62	0.56
WGBP	0.72	0.77	0.77	0.77	0.70	0.77	0.77	0.74
Unknown	0.57	0.58	0.58	0.58	0.63	0.58	0.58	0.62
Number of groups	33	33	33	33	33	33	33	33
Minimum	0.26	0.34	0.35	0.35	0.37	0.35	0.34	0.31
Maximum	0.81	0.84	0.84	0.84	0.77	0.84	0.84	0.80
Mean	0.61	0.60	0.61	0.61	0.61	0.60	0.60	0.62
Median	0.63	0.62	0.62	0.62	0.63	0.62	0.62	0.61
Standard deviation	0.12	0.12	0.12	0.12	0.11	0.12	0.12	0.12
VI reliability (%)	30.30	30.30	30.30	30.30	42.42	30.30	30.30	42.42
Overall reliability (%)	51.52							

Table E10: Area under curve values and summary statistics from the fairs-included strategy for broad vegetation groups in the Kimberley and Broome region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
BLKSL	0.55	0.51	0.51	0.51	0.51	0.51	0.51	0.51
FRTGR	0.63	0.61	0.61	0.61	0.63	0.61	0.60	0.63
OTHER	0.68	0.66	0.66	0.65	0.57	0.66	0.65	0.58
OTHER2	0.62	0.61	0.61	0.61	0.66	0.61	0.61	0.65
PINDN	0.45	0.47	0.47	0.47	0.59	0.47	0.47	0.56
RIBGR	0.69	0.67	0.67	0.67	0.70	0.67	0.67	0.70
SPXHIL	0.74	0.71	0.71	0.71	0.77	0.71	0.70	0.79
Unknown	0.61	0.61	0.62	0.61	0.66	0.61	0.61	0.64
Number of groups	8	8	8	8	8	8	8	8
Minimum	0.45	0.47	0.47	0.47	0.51	0.47	0.47	0.51
Maximum	0.74	0.71	0.71	0.71	0.77	0.71	0.70	0.79
Mean	0.62	0.61	0.61	0.61	0.64	0.61	0.60	0.63
Median	0.63	0.61	0.62	0.61	0.64	0.61	0.61	0.64
Standard deviation	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.09
VI reliability (%)	37.50	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Overall reliability (%)	37.50							

Table E11: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Kimberley and Broome region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Alexander	0.46	0.45	0.45	0.45	0.48	0.45	0.45	0.45
Anna	0.57	0.57	0.57	0.57	0.58	0.57	0.58	0.61
Antrim	0.38	0.38	0.39	0.38	0.41	0.38	0.38	0.41
Argyle	0.40	0.41	0.44	0.43	0.41	0.41	0.41	0.42
Barry	0.46	0.47	0.45	0.45	0.53	0.46	0.48	0.50
Bohemia	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Calwynyardah	0.51	0.51	0.51	0.51	0.57	0.51	0.51	0.53
Camelgooda	0.50	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Carpentaria	0.60	0.62	0.61	0.62	0.58	0.63	0.59	0.61
Chestnut	0.56	0.56	0.56	0.56	0.60	0.56	0.56	0.58
Cockatoo	0.47	0.47	0.48	0.47	0.48	0.48	0.48	0.48
Cockburn2	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.48
Coonangoody	0.44	0.44	0.44	0.44	0.45	0.44	0.44	0.46
Cowendyne	0.52	0.52	0.52	0.52	0.53	0.52	0.52	0.53

(continued)

Table E11 continued: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Kimberley and Broome region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Dinnabung	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59
Djada	0.42	0.43	0.43	0.46	0.40	0.39	0.39	0.41
Dockrell	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Forrest	0.51	0.51	0.51	0.51	0.52	0.51	0.51	0.51
Fossil2	0.50	0.51	0.50	0.50	0.52	0.51	0.51	0.57
Fraser	0.68	0.67	0.64	0.59	0.67	0.67	0.67	0.63
Frayne	0.49	0.51	0.49	0.49	0.51	0.50	0.49	0.52
Geebee	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Glenroy	0.48	0.48	0.48	0.49	0.54	0.49	0.50	0.49
Gogo	0.49	0.50	0.52	0.54	0.48	0.50	0.51	0.50
Gordon	0.63	0.63	0.63	0.64	0.63	0.63	0.63	0.63
Inverway	0.55	0.55	0.55	0.55	0.56	0.55	0.56	0.56
Ivanhoe	0.39	0.38	0.40	0.39	0.38	0.38	0.39	0.39
Karunjie	0.39	0.42	0.49	0.41	0.41	0.41	0.38	0.47
Koongie	0.61	0.61	0.61	0.61	0.62	0.61	0.61	0.62
Looingnin	0.41	0.41	0.42	0.43	0.44	0.41	0.42	0.50
Lubbock	0.48	0.48	0.48	0.48	0.50	0.48	0.48	0.54
Luluigui	0.53	0.53	0.53	0.53	0.55	0.53	0.53	0.53
MacPhee	0.43	0.43	0.42	0.43	0.44	0.43	0.43	0.53
Margaret	0.53	0.53	0.53	0.53	0.56	0.53	0.53	0.56
Mulan	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Myroodah	0.46	0.46	0.46	0.46	0.48	0.46	0.46	0.46
Napier	0.49	0.49	0.49	0.50	0.50	0.50	0.49	0.51
Neillabublica	0.68	0.68	0.68	0.68	0.70	0.68	0.68	0.69
Nita	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.68
ODonnell	0.47	0.45	0.46	0.46	0.46	0.46	0.45	0.46
Pigeon	0.50	0.52	0.51	0.54	0.61	0.52	0.53	0.67
Pinkerton	0.45	0.43	0.43	0.44	0.46	0.44	0.43	0.45
Pompey	0.60	0.59	0.59	0.59	0.59	0.59	0.60	0.60
Richenda	0.45	0.40	0.41	0.41	0.43	0.39	0.39	0.41
Roebuck	0.56	0.53	0.53	0.54	0.54	0.52	0.52	0.52
Ruby2	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Sisters	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.56
Sturt Creek	0.42	0.41	0.42	0.41	0.46	0.41	0.43	0.44
Wanganut	0.45	0.45	0.45	0.45	0.46	0.45	0.45	0.46

(continued)

Table E11 continued: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Kimberley and Broome region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Wave Hill	0.41	0.41	0.40	0.41	0.42	0.40	0.41	0.43
Wickenham	0.49	0.52	0.49	0.50	0.50	0.50	0.52	0.54
Winnecke	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.65
Yeeda	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Number of groups	53	53	53	53	53	53	53	53
Minimum	0.38	0.38	0.39	0.38	0.38	0.38	0.38	0.39
Maximum	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Mean	0.53	0.53	0.54	0.54	0.54	0.53	0.53	0.55
Median	0.50	0.51	0.51	0.51	0.52	0.51	0.51	0.53
Standard deviation	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10
VI reliability (%)	13.20	13.20	11.32	11.32	13.20	13.20	13.20	13.20
Overall reliability (%)	15.09							

Table E12: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Kimberley and Broome region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
1a	0.49	0.49	0.49	0.46	0.45	0.48	0.49	0.46
1b	0.66	0.66	0.66	0.66	0.67	0.66	0.66	0.67
2a	0.57	0.57	0.57	0.57	0.58	0.57	0.57	0.57
2b	0.46	0.46	0.47	0.47	0.46	0.46	0.47	0.46
2c	0.51	0.51	0.51	0.51	0.50	0.50	0.51	0.51
2d	0.41	0.41	0.41	0.41	0.46	0.41	0.41	0.48
5a	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
5b	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
5c	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
6	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
7a	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
7b	0.43	0.42	0.44	0.43	0.47	0.42	0.44	0.43
7c	0.59	0.61	0.64	0.66	0.58	0.57	0.59	0.60
8	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.42
9a	0.55	0.55	0.54	0.55	0.58	0.54	0.54	0.57

(continued)

Table E12 continued: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Kimberley and Broome region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Number of groups	15	15	15	15	15	15	15	15
Minimum	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.42
Maximum	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Mean	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Median	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Standard deviation	0.09	0.09	0.09	0.09	0.08	0.09	0.09	0.08
VI reliability (%)	6.67	6.67	6.67	6.67	13.33	6.67	6.67	13.33
Overall reliability (%)	13.33							

Table E13: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Kimberley and Broome region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
21	0.49	0.54	0.53	0.51	0.46	0.55	0.56	0.45
22	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
23	0.46	0.46	0.46	0.46	0.47	0.46	0.46	0.47
24	0.50	0.50	0.50	0.50	0.52	0.50	0.50	0.51
25	0.54	0.54	0.54	0.54	0.56	0.54	0.54	0.57
26	0.43	0.45	0.43	0.42	0.46	0.43	0.43	0.43
27	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
28	0.41	0.41	0.38	0.40	0.42	0.39	0.40	0.41
29	0.55	0.51	0.51	0.51	0.51	0.51	0.51	0.52
30	0.49	0.49	0.49	0.49	0.49	0.48	0.49	0.49
31	0.45	0.45	0.44	0.45	0.47	0.44	0.44	0.45
32	0.44	0.43	0.44	0.43	0.47	0.44	0.45	0.47
35	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
36	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
38	0.66	0.65	0.65	0.65	0.67	0.65	0.65	0.65
40	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
41	0.38	0.43	0.47	0.49	0.50	0.39	0.46	0.53
53	0.42	0.41	0.41	0.40	0.40	0.42	0.43	0.41
111	0.48	0.48	0.48	0.48	0.51	0.48	0.48	0.50
113	0.48	0.48	0.48	0.48	0.50	0.49	0.48	0.51
114	0.59	0.59	0.59	0.59	0.60	0.59	0.59	0.60
115	0.42	0.43	0.43	0.43	0.41	0.42	0.37	0.43

(continued)

Table E13 continued: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Kimberley and Broome region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Number of groups	22	22	22	22	22	22	22	22
Minimum	0.38	0.41	0.38	0.40	0.40	0.39	0.37	0.41
Maximum	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Mean	0.50	0.51	0.51	0.51	0.52	0.51	0.51	0.51
Median	0.48	0.48	0.48	0.49	0.50	0.49	0.48	0.50
Standard deviation	0.10	0.10	0.10	0.10	0.09	0.10	0.10	0.09
VI reliability (%)	9.09	9.09	9.09	9.09	13.64	9.09	9.09	9.09
Overall reliability (%)	13.64							

Table E14: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Kimberley and Broome region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASGP	0.50	0.50	0.51	0.51	0.53	0.50	0.51	0.51
BGAP	0.50	0.50	0.50	0.50	0.52	0.50	0.51	0.51
BSBP	0.57	0.52	0.48	0.53	0.57	0.48	0.47	0.50
BSGP	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.50
BUGP	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.58
CSPP	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
CSRG	0.47	0.46	0.48	0.50	0.48	0.49	0.46	0.49
CUSP	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
FRGP	0.40	0.40	0.40	0.40	0.43	0.40	0.40	0.44
HASP	0.82	0.82	0.82	0.82	0.83	0.82	0.82	0.83
HSPP	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
LCSP	0.44	0.45	0.44	0.44	0.45	0.44	0.45	0.45
LGAP	0.44	0.42	0.44	0.44	0.42	0.43	0.46	0.50
LITP	0.57	0.58	0.57	0.58	0.57	0.58	0.59	0.61
MGAP	0.47	0.47	0.47	0.47	0.48	0.48	0.48	0.47
MGUP	0.43	0.43	0.43	0.42	0.43	0.42	0.43	0.44
OTHP	0.45	0.44	0.45	0.44	0.51	0.44	0.45	0.49
PINP	0.45	0.43	0.43	0.43	0.43	0.43	0.43	0.43
RAPP	0.39	0.40	0.41	0.46	0.40	0.42	0.40	0.43
RBGR	0.59	0.61	0.56	0.63	0.49	0.57	0.41	0.54
RGAP	0.39	0.40	0.43	0.41	0.41	0.40	0.40	0.44
RGRA	0.47	0.46	0.46	0.46	0.48	0.46	0.46	0.53

(continued)

Table E14 continued: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Kimberley and Broome region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
RGRB	0.48	0.48	0.47	0.48	0.48	0.48	0.47	0.50
RGRP	0.51	0.52	0.51	0.52	0.48	0.51	0.51	0.47
SOSP	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
SSPP	0.78	0.77	0.77	0.78	0.77	0.77	0.77	0.77
STCP	0.47	0.52	0.47	0.59	0.45	0.48	0.48	0.65
TTGP	0.50	0.50	0.50	0.50	0.51	0.50	0.50	0.51
Unknown	0.54	0.45	0.46	0.45	0.47	0.45	0.47	0.50
WGBP	0.54	0.54	0.54	0.54	0.55	0.55	0.54	0.57
Number of groups	30	30	30	30	30	30	30	30
Minimum	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.43
Maximum	0.82	0.82	0.82	0.82	0.83	0.82	0.82	0.83
Mean	0.54	0.53	0.53	0.54	0.54	0.53	0.53	0.55
Median	0.50	0.50	0.49	0.50	0.49	0.49	0.48	0.50
Standard deviation	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
VI reliability (%)	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67
Overall reliability (%)	16.67							

Table E15: Overall accuracies and summary statistics from the 3-class strategy for broad vegetation groups in the Kimberley and Broome region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
BLKSL	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
FRTGR	0.41	0.39	0.39	0.39	0.41	0.39	0.39	0.40
OTHER	0.48	0.48	0.48	0.47	0.50	0.47	0.48	0.48
OTHER2	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
PINDN	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
RIBGR	0.49	0.48	0.48	0.47	0.48	0.47	0.48	0.48
SPXHIL	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Unknown	0.49	0.50	0.49	0.50	0.50	0.49	0.49	0.49
Number of groups	8	8	8	8	8	8	8	8
Minimum	0.41	0.39	0.39	0.39	0.41	0.39	0.39	0.40
Maximum	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Mean	0.53	0.53	0.52	0.52	0.53	0.52	0.52	0.53
Median	0.49	0.49	0.48	0.48	0.49	0.48	0.48	0.49
Standard deviation	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
VI reliability (%)	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Overall reliability (%)	12.50							

E.2 Pilbara and southern rangelands region

Table E16: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Anna	0.41	*	*	*	0.54	0.45	0.45	0.44
Ararak	0.69	0.65	0.65	0.65	0.69	0.65	0.65	0.71
Arubiddy	0.91	*	*	*	0.98	0.83	0.83	0.98
Balfour	0.83	*	*	*	0.64	0.80	0.80	0.72
Balgair	0.74	*	*	*	0.89	0.76	0.76	0.82
Bandy	0.42	0.34	0.34	0.34	0.44	0.34	0.34	0.37
Bannar	0.25	0.18	0.18	0.19	0.41	0.18	0.18	0.31
Bevon	0.52	0.51	0.51	0.51	0.61	0.50	0.51	0.60
Billygoat	0.57	*	*	*	0.78	0.55	0.56	0.73
Boolgeeda	0.82	*	*	*	0.87	0.82	0.82	0.88
Brockman	0.81	*	*	*	0.68	0.73	0.73	0.77
Bullimore	0.59	0.58	0.58	0.58	0.60	0.58	0.58	0.60
Caiguna	0.88	*	*	*	0.96	0.81	0.81	0.93
Cane	0.91	*	*	*	0.46	0.88	0.88	0.65
Carnegie	0.45	0.43	0.43	0.43	0.53	0.43	0.43	0.52
Challenge	0.72	0.71	0.72	0.72	0.71	0.71	0.71	0.71
Coolibah	0.73	*	*	*	0.65	0.71	0.71	0.71
Cunyu	0.53	0.52	0.52	0.52	0.55	0.52	0.52	0.55
Darlot	0.69	0.64	0.64	0.64	0.46	0.64	0.64	0.49
Deadman	0.55	0.53	0.53	0.53	0.53	0.53	0.53	0.54
Desdemona	0.67	0.64	0.64	0.64	0.64	0.64	0.64	0.65
Divide	0.79	*	*	*	0.56	0.78	0.77	0.70
Doney	0.47	0.45	0.45	0.45	0.54	0.45	0.45	0.51
Ero	0.82	0.80	0.80	0.80	0.78	0.80	0.80	0.79
Euchre	0.57	0.53	0.53	0.54	0.68	0.53	0.52	0.66
Fan	0.53	*	*	*	0.54	0.53	0.53	0.52
Fortescue	0.72	*	*	*	0.85	0.73	0.73	0.84
Gafa	0.57	*	*	*	0.43	0.59	0.59	0.46
Globe	0.87	0.79	0.79	0.79	0.64	0.79	0.79	0.70
Gransal	0.63	0.62	0.62	0.62	0.62	0.62	0.61	0.62
Gumbelt	0.59	*	*	*	0.56	0.62	0.63	0.60
Gumbreak	0.65	0.57	0.58	0.58	0.55	0.57	0.57	0.55
Gundockerta	0.55	0.52	0.52	0.52	0.52	0.52	0.52	0.54

(continued)

Table E16 continued: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Haig	0.56	*	*	*	0.70	0.56	0.56	0.63
Hamilton	0.50	0.52	0.52	0.52	0.59	0.52	0.52	0.57
Hooley	0.58	*	*	*	0.65	0.52	0.52	0.63
Horseflat	0.86	*	*	*	0.31	0.84	0.84	0.44
Jamindie	0.78	*	*	*	0.63	0.76	0.76	0.70
Joseph	0.35	0.29	0.30	0.30	0.42	0.29	0.29	0.38
Jundee	0.70	0.69	0.69	0.69	0.67	0.69	0.69	0.70
Jurrawarrina	0.79	*	*	*	0.76	0.76	0.76	0.82
Kalli	0.80	0.76	0.76	0.76	0.71	0.76	0.76	0.75
Kanandah	0.72	*	*	*	0.74	0.68	0.68	0.74
Kinclaven	0.72	*	*	*	0.67	0.73	0.73	0.68
Koonjarra	0.71	*	*	*	0.75	0.63	0.63	0.72
Kybo	0.86	*	*	*	0.83	0.85	0.85	0.85
Leonora	0.54	0.53	0.53	0.53	0.46	0.53	0.53	0.49
Macroy	0.69	*	*	*	0.66	0.69	0.69	0.68
Mallina	0.60	*	*	*	0.52	0.61	0.60	0.53
Marmion	0.76	0.74	0.74	0.74	0.66	0.74	0.74	0.68
Mileura	0.49	0.47	0.47	0.47	0.55	0.47	0.48	0.53
Monitor	0.62	0.60	0.60	0.60	0.70	0.60	0.60	0.68
Monk	0.58	0.56	0.56	0.56	0.58	0.56	0.56	0.58
Moonera	0.85	*	*	*	0.90	0.83	0.83	0.87
Moriarty	0.53	0.53	0.53	0.53	0.62	0.52	0.53	0.59
Mosquito	0.51	*	*	*	0.73	0.50	0.50	0.70
Nanambinia	0.73	*	*	*	0.76	0.75	0.75	0.79
Naretha	0.81	*	*	*	0.80	0.81	0.81	0.80
Nightshade	0.96	*	*	*	0.99	0.96	0.96	0.99
Nita	0.21	0.48	0.48	0.48	0.37	0.30	0.30	0.35
Nooingnin	0.52	*	*	*	0.51	0.55	0.55	0.54
Nubev	0.53	0.51	0.51	0.51	0.54	0.51	0.51	0.54
Nurina	0.60	*	*	*	0.69	0.62	0.62	0.65
Nyanga	0.82	*	*	*	0.86	0.76	0.76	0.83
Oakover	0.57	*	*	*	0.78	0.56	0.56	0.88
Onslow	0.84	*	*	*	0.56	0.88	0.88	0.66
Paraburdoo	0.61	*	*	*	0.45	0.51	0.51	0.50

(continued)

Table E16 continued: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Paradise	0.88	*	*	*	0.85	0.86	0.86	0.86
Paterson	0.53	*	*	*	0.58	0.52	0.52	0.57
Pondana	0.71	*	*	*	0.75	0.71	0.71	0.74
Rainbow	0.59	0.60	0.60	0.60	0.63	0.60	0.60	0.63
Ranch	0.59	0.54	0.54	0.54	0.73	0.54	0.54	0.69
River	0.81	*	*	*	0.56	0.76	0.76	0.62
Rocklea	0.80	*	*	*	0.73	0.76	0.76	0.76
Shakehole	0.62	*	*	*	0.69	0.60	0.60	0.65
Sherwood	0.57	0.54	0.54	0.54	0.65	0.54	0.54	0.62
Spearhole	0.84	*	*	*	0.74	0.85	0.85	0.82
Stuart	0.67	*	*	*	0.76	0.62	0.62	0.74
Thampanna	0.51	*	*	*	0.64	0.50	0.50	0.60
Tiger	0.54	0.52	0.52	0.52	0.49	0.52	0.52	0.49
Tindalarra	0.60	0.57	0.58	0.58	0.63	0.57	0.57	0.61
Turee	0.84	*	*	*	0.81	0.80	0.80	0.84
Tyrrell	0.36	0.50	0.49	0.49	0.44	0.50	0.50	0.54
Uaroo	0.40	*	*	*	0.44	0.38	0.37	0.45
Urandy	0.46	*	*	*	0.75	0.41	0.41	0.67
Vanesk	0.79	*	*	*	0.86	0.77	0.77	0.85
Violet	0.57	0.56	0.56	0.56	0.51	0.56	0.56	0.54
Waguin	0.80	0.77	0.77	0.77	0.75	0.77	0.77	0.77
Wilson	0.66	0.66	0.66	0.66	0.69	0.66	0.66	0.68
Windarra	0.55	0.53	0.53	0.53	0.59	0.53	0.53	0.58
Wona	0.61	*	*	*	0.49	0.61	0.61	0.60
Woodline	0.58	0.55	0.55	0.55	0.51	0.55	0.55	0.52
Woorlba	0.87	*	*	*	0.79	0.91	0.91	0.84
Yamerina	0.85	*	*	*	0.77	0.82	0.82	0.75
Yanganoo	0.54	0.57	0.57	0.57	0.53	0.57	0.57	0.55
Yowie	0.46	0.46	0.46	0.46	0.47	0.46	0.46	0.46
Number of groups	96	43	43	43	96	96	96	96
Minimum	0.21	0.18	0.18	0.19	0.31	0.18	0.18	0.31
Maximum	0.96	0.80	0.80	0.80	0.99	0.96	0.96	0.99
Mean	0.65	0.56	0.56	0.56	0.64	0.63	0.63	0.65
Median	0.62	0.54	0.54	0.54	0.64	0.61	0.61	0.65
Standard deviation	0.16	0.12	0.12	0.12	0.14	0.15	0.15	0.14
VI reliability (%)	45.83	16.28	16.28	16.28	43.75	40.63	40.63	46.88
Overall reliability (%)	57.29							

Table E17: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Pilbara and southern rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10a	0.62	0.64	0.64	0.64	0.68	0.60	0.60	0.68
10b	0.51	0.48	0.48	0.48	0.68	0.48	0.48	0.61
11	0.80	*	*	*	0.70	0.79	0.79	0.75
12a	0.60	0.58	0.58	0.58	0.60	0.58	0.58	0.60
12b	0.68	0.66	0.66	0.66	0.67	0.64	0.64	0.67
13	0.61	*	*	*	0.73	0.64	0.64	0.85
14a	0.64	0.62	0.62	0.62	0.61	0.62	0.62	0.62
15b	0.59	0.55	0.55	0.55	0.64	0.55	0.55	0.64
16a	0.66	*	*	*	0.61	0.59	0.59	0.63
16b	0.68	0.68	0.68	0.68	0.71	0.68	0.67	0.70
16c	0.80	*	*	*	0.72	0.75	0.75	0.76
17a	0.57	0.56	0.56	0.56	0.54	0.56	0.56	0.56
17b	0.67	0.67	0.67	0.67	0.66	0.67	0.67	0.66
18a	0.58	0.57	0.57	0.57	0.55	0.56	0.56	0.57
18b	0.80	0.80	0.79	0.80	0.80	0.78	0.78	0.83
18c	0.71	*	*	*	0.66	0.70	0.70	0.69
19a	0.59	*	*	*	0.65	0.57	0.57	0.62
19b	0.83	*	*	*	0.85	0.78	0.78	0.84
19c	0.67	*	*	*	0.72	0.68	0.68	0.71
19d	0.74	*	*	*	0.76	0.61	0.61	0.72
20b	0.87	0.83	0.83	0.83	0.88	0.83	0.83	0.88
21a	0.66	0.68	0.68	0.69	0.61	0.63	0.63	0.63
21b	0.65	0.65	0.65	0.65	0.65	0.64	0.64	0.66
22a	0.68	0.76	0.76	0.76	0.71	0.69	0.69	0.73
23a	0.66	0.62	0.62	0.62	0.63	0.62	0.62	0.64
24a	0.81	*	*	*	0.55	0.77	0.77	0.66
24b	0.83	*	*	*	0.59	0.81	0.81	0.68
26	0.50	0.58	0.58	0.58	0.56	0.48	0.48	0.53
26b	0.59	0.61	0.61	0.61	0.68	0.61	0.61	0.68
27a	0.87	0.76	0.76	0.76	0.63	0.84	0.84	0.69
27c	0.70	*	*	*	0.64	0.67	0.67	0.69
28	0.54	0.51	0.51	0.51	0.52	0.52	0.52	0.53
29c	0.76	*	*	*	0.64	0.77	0.77	0.68

(continued)

Table E17 continued: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Pilbara and southern rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Number of groups	33	20	20	20	33	33	33	33
Minimum	0.50	0.48	0.48	0.48	0.52	0.48	0.48	0.53
Maximum	0.87	0.83	0.83	0.83	0.88	0.84	0.84	0.88
Mean	0.68	0.64	0.64	0.64	0.66	0.66	0.66	0.68
Median	0.67	0.63	0.63	0.63	0.65	0.64	0.64	0.68
Standard deviation	0.10	0.09	0.09	0.09	0.08	0.10	0.10	0.09
VI reliability (%)	51.52	35.00	35.00	35.00	42.42	45.46	45.46	54.55
Overall reliability (%)	66.67							

Table E18: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Pilbara and southern rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
4	0.54	0.47	0.47	0.47	0.46	0.44	0.44	0.45
8	0.66	0.63	0.63	0.63	0.64	0.64	0.64	0.66
9	0.42	0.37	0.37	0.37	0.47	0.37	0.37	0.45
14	0.57	0.54	0.54	0.54	0.65	0.54	0.54	0.61
15	0.73	0.69	0.69	0.69	0.76	0.70	0.70	0.76
16	0.69	*	*	*	0.76	0.69	0.69	0.75
22	0.27	*	*	*	0.29	0.28	0.28	0.27
29	0.79	*	*	*	0.63	0.73	0.73	0.68
32	0.80	*	*	*	0.61	0.75	0.75	0.71
35	0.82	*	*	*	0.54	0.77	0.76	0.68
37	0.72	0.65	0.65	0.65	0.55	0.74	0.74	0.65
38	0.72	0.61	0.61	0.61	0.54	0.70	0.70	0.61
39	0.51	*	*	*	0.63	0.49	0.49	0.61
40	0.90	*	*	*	0.98	0.88	0.88	0.97
41	0.56	0.54	0.54	0.54	0.50	0.54	0.53	0.52
45	0.51	*	*	*	0.55	0.49	0.49	0.54
46	0.64	0.47	0.47	0.47	0.57	0.57	0.57	0.57
48	0.57	0.56	0.56	0.56	0.53	0.56	0.56	0.56
49	0.73	*	*	*	0.76	0.67	0.67	0.74
50	0.67	0.63	0.63	0.63	0.67	0.65	0.65	0.67
51	0.40	0.37	0.37	0.37	0.35	0.37	0.37	0.36

(continued)

Table E18 continued: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Pilbara and southern rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
105	0.72	*	*	*	0.75	0.74	0.74	0.75
110	0.82	0.77	0.77	0.77	0.73	0.78	0.78	0.76
116	0.79	0.84	0.84	0.84	0.49	0.78	0.78	0.54
Number of groups	24	14	14	14	24	24	24	24
Minimum	0.27	0.37	0.37	0.37	0.29	0.28	0.28	0.27
Maximum	0.90	0.84	0.84	0.84	0.98	0.88	0.88	0.97
Mean	0.65	0.58	0.58	0.58	0.60	0.62	0.62	0.62
Median	0.68	0.58	0.58	0.58	0.59	0.66	0.66	0.63
Standard deviation	0.15	0.14	0.14	0.14	0.15	0.15	0.15	0.15
VI reliability (%)	54.17	21.43	21.43	21.43	29.17	50.00	50.00	41.67
Overall reliability (%)	54.17							

Table E19: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
AHSG	0.57	*	*	*	0.49	0.54	0.54	0.47
APBG	0.61	*	*	*	0.67	0.60	0.60	0.59
APRG	0.84	*	*	*	0.57	0.81	0.81	0.67
APXG	0.75	*	*	*	0.56	0.63	0.63	0.56
ARPG	0.70	*	*	*	0.50	0.65	0.65	0.57
ASSG	0.78	*	*	*	0.82	0.76	0.76	0.81
ASWS	0.51	0.44	0.44	0.44	0.53	0.48	0.48	0.49
BSSL	0.68	*	*	*	0.70	0.69	0.69	0.72
CCAS	0.77	0.66	0.66	0.66	0.85	0.66	0.66	0.82
CEAS	0.65	0.65	0.65	0.65	0.62	0.65	0.65	0.63
CENC	0.96	0.91	0.91	0.91	0.56	0.91	0.91	0.73
DAGW	0.82	*	*	*	0.63	0.76	0.76	0.71
DEGW	0.83	*	*	*	0.72	0.78	0.78	0.76
DRMS	0.49	0.47	0.47	0.47	0.55	0.47	0.47	0.52
EXCW	0.87	*	*	*	0.87	0.87	0.87	0.89
EXSW	0.41	*	*	*	0.58	0.30	0.30	0.34
HMCS	0.76	0.72	0.72	0.73	0.67	0.72	0.72	0.71
HPMS	0.54	0.54	0.54	0.54	0.54	0.52	0.52	0.54

(continued)

Table E19 continued: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
LHMS	0.47	0.49	0.49	0.49	0.52	0.49	0.49	0.51
MAAS	0.52	0.52	0.52	0.52	0.57	0.52	0.52	0.56
MPBS	0.60	*	*	*	0.71	0.54	0.54	0.65
MSAW	0.53	*	*	*	0.51	0.52	0.52	0.53
MUBW	0.66	0.64	0.64	0.63	0.58	0.64	0.64	0.60
MUWA	0.60	0.61	0.61	0.61	0.74	0.61	0.61	0.69
MXCS	0.85	*	*	*	0.79	0.74	0.74	0.76
OBIG	0.83	*	*	*	0.79	0.84	0.84	0.82
PASS	0.26	*	*	*	0.34	0.23	0.23	0.29
PBLS	0.66	*	*	*	0.73	0.62	0.62	0.70
PHSG	0.56	*	*	*	0.65	0.62	0.62	0.66
PINW	0.41	0.42	0.42	0.42	0.46	0.42	0.41	0.43
PLMS	0.64	0.58	0.58	0.58	0.55	0.58	0.58	0.56
PMHS	0.84	*	*	*	0.79	0.79	0.79	0.83
PSMS	0.50	*	*	*	0.59	0.44	0.44	0.55
PSSG	0.60	*	*	*	0.54	0.60	0.60	0.57
PXCS	0.62	*	*	*	0.71	0.59	0.59	0.66
PXHS	0.60	0.65	0.65	0.65	0.48	0.53	0.53	0.50
SACS	0.57	0.47	0.48	0.48	0.61	0.47	0.47	0.56
SAES	0.59	0.57	0.57	0.57	0.55	0.57	0.57	0.57
SAMP	0.56	0.47	0.47	0.47	0.44	0.48	0.48	0.44
SASS	0.23	*	*	*	0.28	0.23	0.23	0.26
SBMS	0.62	0.59	0.59	0.59	0.50	0.59	0.59	0.51
SGRS	0.61	0.58	0.58	0.58	0.62	0.58	0.58	0.61
SIMS	0.53	0.49	0.49	0.49	0.65	0.49	0.49	0.59
SOSP	0.84	0.89	0.89	0.89	0.64	0.89	0.89	0.74
SSPG	0.68	0.67	0.67	0.66	0.69	0.67	0.67	0.68
SSSG	0.53	*	*	*	0.56	0.50	0.50	0.58
SSTS	0.75	*	*	*	0.36	0.69	0.69	0.47
SWCS	0.69	*	*	*	0.92	0.78	0.78	0.91
SWGS	0.69	0.66	0.65	0.66	0.56	0.66	0.66	0.60
SWOG	0.61	*	*	*	0.69	0.50	0.50	0.62
TGCE	0.54	0.54	0.54	0.54	0.81	0.54	0.54	0.73
Unknown	0.73	0.66	0.66	0.66	0.66	0.68	0.68	0.69

(continued)

Table E19 continued: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
XSBG	0.69	*	*	*	0.71	0.68	0.68	0.70
Number of groups	53	25	25	25	53	53	53	53
Minimum	0.23	0.42	0.42	0.42	0.28	0.23	0.23	0.26
Maximum	0.96	0.91	0.91	0.91	0.92	0.91	0.91	0.91
Mean	0.64	0.60	0.60	0.60	0.62	0.61	0.61	0.62
Median	0.62	0.58	0.58	0.58	0.61	0.60	0.60	0.60
Standard deviation	0.15	0.12	0.12	0.12	0.13	0.15	0.15	0.14
VI reliability (%)	39.62	16.00	16.00	12.00	35.85	32.08	32.08	37.74
Overall reliability (%)	52.83							

Table E20: Area under curve values and summary statistics from the fairs-excluded strategy for broad vegetation groups in the Pilbara and southern rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
BLUEB	0.70	0.64	0.64	0.64	0.56	0.64	0.64	0.60
BUFFL	0.54	0.54	0.54	0.54	0.81	0.54	0.54	0.73
EAESP	0.61	0.65	0.65	0.65	0.59	0.61	0.61	0.60
EUCCH	0.58	0.44	0.44	0.44	0.55	0.50	0.50	0.52
HARSP	0.97	0.96	0.96	0.96	0.83	0.96	0.96	0.90
HPMSP	0.60	0.58	0.58	0.58	0.59	0.58	0.58	0.59
MIXCH	0.61	0.64	0.64	0.64	0.57	0.56	0.55	0.57
NULBR	0.63	*	*	*	0.69	0.59	0.59	0.65
OTHER	0.66	0.60	0.60	0.60	0.69	0.62	0.62	0.68
PINDN	0.40	0.42	0.42	0.42	0.58	0.42	0.42	0.53
RIPAR	0.47	0.47	0.47	0.47	0.52	0.45	0.45	0.49
SACES	0.68	0.64	0.64	0.64	0.72	0.66	0.66	0.71
SALTP	0.70	0.79	0.79	0.79	0.59	0.70	0.70	0.63
SAMPH	0.55	0.47	0.47	0.47	0.44	0.48	0.48	0.44
SANDP	0.49	0.48	0.48	0.48	0.52	0.48	0.48	0.51
SGASP	0.69	0.66	0.66	0.66	0.70	0.66	0.66	0.69
SNAKW	0.56	0.52	0.52	0.52	0.64	0.52	0.52	0.59
SOSPX	0.84	0.89	0.89	0.89	0.64	0.89	0.89	0.74
SPWGR	0.74	*	*	*	0.76	0.66	0.66	0.74
STMXC	0.60	0.55	0.55	0.55	0.57	0.58	0.58	0.57

(continued)

Table E20 continued: Area under curve values and summary statistics from the fairs-excluded strategy for broad vegetation groups in the Pilbara and southern rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
TSKGR	0.55	0.55	0.54	0.54	0.80	0.55	0.55	0.73
Unknown	0.84	0.81	0.82	0.82	0.92	0.81	0.81	0.92
WANDR	0.66	0.62	0.62	0.62	0.60	0.62	0.62	0.61
Number of groups	23	21	21	21	23	23	23	23
Minimum	0.40	0.42	0.42	0.42	0.44	0.42	0.42	0.44
Maximum	0.97	0.96	0.96	0.96	0.92	0.96	0.96	0.92
Mean	0.64	0.61	0.61	0.62	0.65	0.61	0.61	0.64
Median	0.61	0.60	0.60	0.60	0.60	0.59	0.59	0.61
Standard deviation	0.13	0.15	0.15	0.15	0.12	0.13	0.13	0.12
VI reliability (%)	34.78	19.05	17.39	17.39	39.13	17.39	17.39	39.13
Overall reliability (%)	52.18							

Table E21: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Anna	0.45	0.47	0.47	0.47	0.48	0.46	0.46	0.42
Ararak	0.61	0.59	0.59	0.59	0.63	0.59	0.59	0.63
Arubiddy	0.88	*	*	*	0.95	0.79	0.79	0.96
Balfour	0.75	*	*	*	0.62	0.72	0.72	0.67
Balgair	0.69	*	*	*	0.84	0.71	0.71	0.78
Bandy	0.39	0.32	0.32	0.32	0.41	0.32	0.32	0.34
Bannar	0.29	0.23	0.23	0.23	0.43	0.23	0.23	0.34
Bevon	0.52	0.51	0.51	0.51	0.60	0.51	0.51	0.59
Bidgemia	0.69	0.70	0.70	0.70	0.59	0.70	0.70	0.68
Billygoat	0.57	*	*	*	0.78	0.55	0.56	0.73
Boolgeeda	0.81	*	*	*	0.85	0.81	0.80	0.87
Brockman	0.76	*	*	*	0.66	0.70	0.70	0.73
Brooking	0.56	0.52	0.52	0.52	0.68	0.52	0.52	0.67
Bullimore	0.56	0.55	0.55	0.55	0.57	0.55	0.55	0.57
Caiguna	0.86	*	*	*	0.94	0.80	0.80	0.91
Cane	0.90	*	*	*	0.43	0.88	0.88	0.59
Carnegie	0.46	0.45	0.45	0.45	0.54	0.45	0.45	0.53
Challenge	0.65	0.64	0.65	0.65	0.62	0.64	0.64	0.64

(continued)

Table E21 continued: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Coolibah	0.69	*	*	*	0.60	0.67	0.67	0.65
Cunyu	0.39	0.39	0.39	0.39	0.48	0.39	0.39	0.45
Darlot	0.66	0.62	0.62	0.62	0.47	0.62	0.62	0.49
Deadman	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54
Desdemona	0.60	0.58	0.58	0.58	0.60	0.58	0.58	0.60
Divide	0.78	*	*	*	0.55	0.77	0.76	0.68
Doney	0.51	0.47	0.47	0.47	0.53	0.47	0.47	0.50
Elimunna	0.61	*	*	*	0.52	0.57	0.57	0.53
Ero	0.75	0.73	0.73	0.73	0.71	0.73	0.73	0.72
Euchre	0.58	0.53	0.54	0.54	0.66	0.53	0.53	0.63
Fan	0.47	*	*	*	0.50	0.47	0.47	0.47
Fortescue	0.66	*	*	*	0.79	0.68	0.68	0.78
Gabanintha	0.57	0.59	0.59	0.59	0.56	0.59	0.59	0.59
Gafa	0.54	*	*	*	0.42	0.53	0.53	0.42
Globe	0.74	0.72	0.72	0.72	0.55	0.72	0.72	0.61
Gransal	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Gumbelt	0.59	*	*	*	0.56	0.62	0.62	0.59
Gumbreak	0.60	0.54	0.54	0.54	0.53	0.54	0.54	0.52
Gundockerta	0.53	0.52	0.52	0.52	0.51	0.52	0.52	0.53
Haig	0.55	*	*	*	0.66	0.55	0.55	0.60
Hamilton	0.51	0.52	0.52	0.52	0.56	0.52	0.52	0.55
Hooley	0.57	*	*	*	0.58	0.54	0.54	0.57
Hootanui	0.51	0.52	0.52	0.51	0.48	0.52	0.52	0.49
Horseflat	0.80	*	*	*	0.31	0.79	0.79	0.40
Jamindie	0.75	*	*	*	0.61	0.73	0.73	0.67
Joseph	0.33	0.28	0.28	0.29	0.41	0.28	0.28	0.37
Jundee	0.62	0.61	0.61	0.61	0.61	0.61	0.61	0.62
Jurrawarrina	0.75	*	*	*	0.70	0.74	0.74	0.77
Kalli	0.76	0.73	0.72	0.72	0.68	0.73	0.72	0.71
Kanandah	0.61	*	*	*	0.58	0.59	0.59	0.59
Kinclaven	0.64	*	*	*	0.62	0.65	0.65	0.62
Koonjarra	0.67	*	*	*	0.71	0.59	0.59	0.67
Kybo	0.79	*	*	*	0.78	0.78	0.78	0.79
Laverton	0.70	0.67	0.67	0.67	0.62	0.67	0.67	0.64

(continued)

Table E21 continued: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Leonora	0.57	0.57	0.56	0.56	0.48	0.57	0.57	0.52
Macroy	0.68	*	*	*	0.66	0.69	0.69	0.68
Mallina	0.59	*	*	*	0.49	0.59	0.59	0.50
Marmion	0.76	0.74	0.74	0.74	0.66	0.74	0.74	0.68
Mileura	0.49	0.48	0.48	0.48	0.53	0.48	0.48	0.52
Monitor	0.46	0.44	0.44	0.44	0.57	0.44	0.44	0.55
Monk	0.55	0.53	0.53	0.53	0.54	0.53	0.53	0.54
Moonera	0.84	*	*	*	0.88	0.82	0.82	0.85
Moriarty	0.52	0.50	0.50	0.50	0.59	0.50	0.50	0.56
Mosquito	0.52	*	*	*	0.73	0.51	0.51	0.69
Nallex	0.55	0.55	0.55	0.55	0.51	0.55	0.56	0.54
Nanambinia	0.66	*	*	*	0.67	0.67	0.67	0.69
Nanyarra	0.68	0.65	0.65	0.65	0.73	0.65	0.65	0.71
Naretha	0.71	*	*	*	0.73	0.71	0.71	0.73
Nerramyne	0.54	0.56	0.56	0.56	0.53	0.56	0.56	0.55
Nightshade	0.95	*	*	*	0.98	0.95	0.95	0.98
Nita	0.25	0.49	0.49	0.49	0.41	0.32	0.32	0.38
Nooingnin	0.50	*	*	*	0.51	0.52	0.51	0.53
Nubev	0.50	0.50	0.50	0.50	0.54	0.50	0.50	0.53
Nurina	0.54	*	*	*	0.61	0.55	0.55	0.57
Nyanga	0.78	*	*	*	0.81	0.73	0.73	0.78
Oakover	0.56	*	*	*	0.78	0.56	0.56	0.87
Olympic	0.35	0.30	0.29	0.29	0.27	0.30	0.30	0.24
Onslow	0.83	*	*	*	0.53	0.86	0.86	0.63
Paraburdoo	0.59	*	*	*	0.44	0.50	0.50	0.49
Paradise	0.81	*	*	*	0.77	0.78	0.78	0.78
Paterson	0.53	*	*	*	0.58	0.52	0.52	0.56
Peedamulla	0.59	*	*	*	0.68	0.56	0.56	0.71
Pindar	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.57
Pondana	0.65	*	*	*	0.70	0.66	0.66	0.69
Pullgarah	0.77	*	*	*	0.82	0.76	0.76	0.80
Rainbow	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Ranch	0.60	0.57	0.57	0.57	0.72	0.57	0.57	0.70
River	0.79	*	*	*	0.54	0.75	0.75	0.60

(continued)

Table E21 continued: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Rocklea	0.80	*	*	*	0.73	0.75	0.75	0.76
Shake Hole	0.61	*	*	*	0.67	0.59	0.59	0.64
Sherwood	0.54	0.52	0.52	0.52	0.60	0.52	0.52	0.58
Spearhole	0.83	*	*	*	0.70	0.83	0.83	0.77
Steer	0.61	0.60	0.60	0.60	0.43	0.60	0.60	0.45
Stuart	0.66	*	*	*	0.74	0.63	0.63	0.72
Thampanna	0.53	*	*	*	0.63	0.52	0.52	0.60
Tiger	0.54	0.52	0.52	0.52	0.47	0.52	0.52	0.48
Tindalarra	0.56	0.55	0.55	0.55	0.61	0.55	0.55	0.59
Turee	0.70	*	*	*	0.75	0.68	0.68	0.75
Tyrrell	0.38	0.50	0.50	0.50	0.45	0.50	0.50	0.56
Uaroo	0.40	*	*	*	0.44	0.38	0.37	0.45
Urandy	0.45	*	*	*	0.73	0.40	0.40	0.66
Vanesk	0.75	*	*	*	0.83	0.74	0.74	0.83
Violet	0.52	0.52	0.52	0.52	0.51	0.52	0.52	0.52
Waguin	0.78	0.75	0.75	0.75	0.72	0.75	0.75	0.75
Wilson	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Wiluna	0.37	0.37	0.37	0.37	0.46	0.37	0.37	0.40
Windarra	0.54	0.52	0.52	0.52	0.52	0.52	0.52	0.53
Wona	0.62	*	*	*	0.47	0.63	0.63	0.58
Woodline	0.57	0.55	0.55	0.55	0.50	0.55	0.55	0.52
Woorlba	0.84	*	*	*	0.76	0.88	0.88	0.81
Wyarri	0.54	0.53	0.53	0.53	0.55	0.53	0.53	0.55
Yalbalgo	0.46	0.50	0.50	0.50	0.51	0.50	0.50	0.53
Yamerina	0.83	*	*	*	0.75	0.80	0.80	0.73
Yanganoo	0.53	0.55	0.55	0.55	0.51	0.55	0.55	0.52
Yowie	0.45	0.44	0.44	0.44	0.45	0.44	0.44	0.44
Number of groups	113	58	58	58	113	113	113	113
Minimum	0.25	0.23	0.23	0.23	0.27	0.23	0.23	0.24
Maximum	0.95	0.75	0.75	0.75	0.98	0.95	0.95	0.98
Mean	0.61	0.54	0.54	0.54	0.61	0.60	0.60	0.61
Median	0.59	0.53	0.53	0.54	0.59	0.57	0.57	0.59
Standard deviation	0.14	0.11	0.11	0.11	0.13	0.14	0.14	0.13
VI reliability (%)	33.63	13.79	13.79	13.79	31.86	33.63	33.63	36.29
Overall reliability (%)	44.25							

Table E22: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Pilbara and southern rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10a	0.56	0.57	0.57	0.57	0.61	0.55	0.55	0.61
10b	0.53	0.51	0.51	0.51	0.63	0.51	0.51	0.59
11	0.80	*	*	*	0.71	0.79	0.79	0.76
12a	0.57	0.55	0.55	0.55	0.58	0.55	0.55	0.57
12b	0.67	0.65	0.65	0.65	0.65	0.64	0.64	0.65
13	0.61	*	*	*	0.73	0.64	0.64	0.85
14a	0.65	0.63	0.63	0.63	0.59	0.63	0.63	0.61
14b	0.41	0.39	0.39	0.39	0.51	0.39	0.39	0.45
15a	0.61	0.55	0.55	0.55	0.39	0.55	0.55	0.41
15b	0.55	0.53	0.53	0.53	0.56	0.53	0.53	0.56
16a	0.53	*	*	*	0.49	0.49	0.49	0.50
16b	0.63	0.63	0.63	0.63	0.63	0.63	0.62	0.63
16c	0.71	*	*	*	0.66	0.68	0.68	0.68
17a	0.55	0.54	0.54	0.54	0.53	0.54	0.54	0.54
17b	0.60	0.60	0.60	0.59	0.59	0.60	0.60	0.59
18a	0.58	0.56	0.56	0.56	0.54	0.56	0.56	0.56
18b	0.79	0.78	0.78	0.78	0.78	0.77	0.77	0.82
18c	0.70	*	*	*	0.65	0.69	0.69	0.68
19a	0.58	*	*	*	0.63	0.55	0.55	0.60
19b	0.77	*	*	*	0.78	0.73	0.73	0.77
19c	0.67	*	*	*	0.72	0.67	0.67	0.70
19d	0.66	*	*	*	0.68	0.59	0.59	0.65
20a	0.57	0.55	0.55	0.56	0.52	0.55	0.55	0.57
20b	0.86	0.82	0.82	0.82	0.87	0.82	0.82	0.87
21a	0.59	0.60	0.60	0.60	0.52	0.56	0.56	0.53
21b	0.60	0.60	0.60	0.60	0.60	0.59	0.59	0.60
22a	0.64	0.69	0.69	0.69	0.63	0.65	0.65	0.65
23a	0.63	0.60	0.60	0.60	0.60	0.60	0.60	0.62
24a	0.77	*	*	*	0.53	0.74	0.74	0.63
24b	0.76	*	*	*	0.57	0.74	0.74	0.64
26	0.42	0.36	0.36	0.36	0.49	0.41	0.41	0.47
26b	0.52	0.53	0.53	0.53	0.60	0.53	0.53	0.59
27a	0.83	0.70	0.70	0.70	0.60	0.81	0.81	0.66
27c	0.65	*	*	*	0.57	0.62	0.62	0.61

(continued)

Table E22 continued: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Pilbara and southern rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
28	0.54	0.52	0.52	0.52	0.53	0.52	0.52	0.54
29c	0.75	*	*	*	0.62	0.76	0.77	0.66
Number of groups	36	23	23	23	36	36	36	36
Minimum	0.41	0.36	0.36	0.36	0.39	0.39	0.39	0.41
Maximum	0.86	0.82	0.82	0.82	0.87	0.82	0.82	0.87
Mean	0.63	0.58	0.58	0.58	0.61	0.62	0.62	0.62
Median	0.62	0.56	0.56	0.56	0.60	0.60	0.60	0.61
Standard deviation	0.11	0.10	0.10	0.10	0.09	0.11	0.11	0.10
VI reliability (%)	33.33	15.38	15.38	15.38	19.44	30.56	30.56	22.22
Overall reliability (%)	41.67							

Table E23: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Pilbara and southern rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
4	0.54	0.48	0.48	0.48	0.48	0.45	0.45	0.46
8	0.61	0.58	0.58	0.58	0.58	0.59	0.59	0.59
9	0.42	0.38	0.39	0.39	0.46	0.38	0.38	0.44
14	0.54	0.52	0.52	0.52	0.62	0.52	0.52	0.58
15	0.67	0.65	0.65	0.65	0.72	0.65	0.65	0.71
16	0.65	*	*	*	0.72	0.64	0.64	0.70
22	0.28	*	*	*	0.30	0.29	0.29	0.28
29	0.76	*	*	*	0.60	0.71	0.71	0.65
32	0.79	*	*	*	0.62	0.74	0.74	0.71
35	0.82	*	*	*	0.53	0.76	0.76	0.68
37	0.71	0.64	0.64	0.64	0.55	0.73	0.73	0.64
38	0.71	0.58	0.58	0.58	0.53	0.69	0.69	0.59
39	0.51	*	*	*	0.62	0.49	0.49	0.61
40	0.89	*	*	*	0.98	0.88	0.88	0.97
41	0.55	0.53	0.53	0.53	0.49	0.53	0.53	0.52
45	0.48	*	*	*	0.51	0.46	0.46	0.50
46	0.58	0.47	0.46	0.46	0.53	0.53	0.53	0.53
47	0.70	0.70	0.71	0.71	0.65	0.71	0.71	0.69
48	0.57	0.56	0.56	0.56	0.54	0.56	0.56	0.56

(continued)

Table E23 continued: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Pilbara and southern rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
49	0.68	*	*	*	0.71	0.63	0.63	0.69
50	0.65	0.61	0.61	0.61	0.65	0.63	0.63	0.65
51	0.39	0.37	0.37	0.37	0.37	0.37	0.37	0.38
105	0.70	*	*	*	0.71	0.71	0.71	0.72
106	0.43	0.47	0.47	0.47	0.57	0.47	0.47	0.56
110	0.77	0.74	0.74	0.74	0.68	0.75	0.75	0.71
116	0.75	0.83	0.83	0.83	0.47	0.75	0.75	0.51
Number of groups	26	17	17	17	26	26	26	26
Minimum	0.28	0.37	0.37	0.37	0.30	0.29	0.29	0.28
Maximum	0.89	0.83	0.83	0.83	0.98	0.88	0.88	0.97
Mean	0.62	0.57	0.57	0.57	0.58	0.60	0.60	0.60
Median	0.65	0.57	0.57	0.57	0.58	0.63	0.63	0.60
Standard deviation	0.15	0.13	0.13	0.13	0.13	0.14	0.14	0.14
VI reliability (%)	46.15	17.64	17.64	17.64	23.08	38.46	38.46	34.62
Overall reliability (%)	50.00							

Table E24: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
AHSG	0.54	*	*	*	0.47	0.52	0.52	0.46
AMSG	0.86	0.85	0.85	0.85	0.74	0.85	0.85	0.82
APBG	0.59	*	*	*	0.65	0.58	0.58	0.57
APRG	0.80	*	*	*	0.56	0.79	0.79	0.66
APXG	0.74	*	*	*	0.56	0.64	0.64	0.56
ARPG	0.63	*	*	*	0.47	0.60	0.61	0.52
ASSG	0.74	*	*	*	0.78	0.73	0.73	0.77
ASWS	0.53	0.47	0.48	0.48	0.52	0.51	0.51	0.50
BRXS	0.70	0.68	0.69	0.69	0.71	0.68	0.68	0.71
BSSL	0.66	*	*	*	0.68	0.66	0.66	0.69
CCAS	0.71	0.61	0.61	0.61	0.81	0.61	0.61	0.77
CEAS	0.62	0.60	0.60	0.60	0.61	0.60	0.60	0.61
CENC	0.89	0.82	0.82	0.82	0.51	0.82	0.82	0.67
DAGW	0.78	*	*	*	0.61	0.72	0.72	0.68
DEGW	0.80	*	*	*	0.70	0.75	0.75	0.74

(continued)

Table E24 continued: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
DRMS	0.52	0.50	0.50	0.50	0.51	0.50	0.50	0.51
ESAW	0.64	*	*	*	0.67	0.64	0.64	0.65
EXCW	0.84	*	*	*	0.86	0.85	0.85	0.87
EXSW	0.41	*	*	*	0.58	0.30	0.30	0.33
GASS	0.63	*	*	*	0.63	0.51	0.51	0.64
HASP	0.71	0.71	0.71	0.71	0.74	0.71	0.71	0.77
HMCS	0.66	0.64	0.64	0.64	0.62	0.64	0.64	0.63
HPMS	0.54	0.53	0.53	0.53	0.50	0.53	0.53	0.51
JAMS	0.82	0.77	0.77	0.77	0.80	0.77	0.77	0.81
LHMS	0.43	0.45	0.45	0.45	0.50	0.45	0.45	0.48
MAAS	0.53	0.53	0.53	0.53	0.58	0.53	0.53	0.58
MPBS	0.59	*	*	*	0.70	0.54	0.54	0.64
MSAW	0.49	*	*	*	0.46	0.48	0.48	0.48
MUBW	0.65	0.62	0.62	0.62	0.57	0.62	0.62	0.59
MUWA	0.56	0.58	0.58	0.58	0.67	0.58	0.58	0.64
MXCS	0.82	*	*	*	0.75	0.72	0.72	0.73
OBIG	0.72	*	*	*	0.70	0.72	0.72	0.71
PASS	0.26	*	*	*	0.34	0.24	0.24	0.29
PBAC	0.76	*	*	*	0.75	0.78	0.78	0.76
PBLS	0.64	*	*	*	0.69	0.59	0.59	0.67
PESW	0.43	0.35	0.35	0.35	0.50	0.35	0.35	0.43
PHSG	0.56	*	*	*	0.65	0.62	0.62	0.66
PINW	0.43	0.45	0.45	0.45	0.46	0.45	0.45	0.45
PLMS	0.63	0.58	0.58	0.58	0.56	0.58	0.58	0.57
PMHS	0.84	*	*	*	0.78	0.79	0.79	0.82
PMOG	0.69	*	*	*	0.70	0.66	0.66	0.69
PSAS	0.54	0.49	0.49	0.49	0.44	0.49	0.49	0.43
PSMS	0.50	*	*	*	0.58	0.45	0.45	0.55
PSSG	0.59	*	*	*	0.53	0.59	0.59	0.55
PXCS	0.60	*	*	*	0.67	0.58	0.58	0.64
PXHS	0.58	0.59	0.59	0.59	0.49	0.52	0.52	0.51
SACS	0.57	0.48	0.48	0.49	0.61	0.48	0.48	0.56
SAES	0.55	0.54	0.54	0.54	0.53	0.54	0.54	0.54
SAMP	0.55	0.47	0.47	0.47	0.44	0.48	0.48	0.43
SASS	0.25	*	*	*	0.28	0.24	0.24	0.27
SBLS	0.48	0.44	0.44	0.44	0.70	0.44	0.44	0.63

(continued)

Table E24 continued: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
SBMS	0.55	0.53	0.53	0.53	0.52	0.53	0.53	0.52
SGRS	0.61	0.58	0.59	0.59	0.60	0.58	0.58	0.60
SIMS	0.49	0.47	0.47	0.47	0.59	0.47	0.47	0.54
SMMS	0.69	0.73	0.73	0.73	0.38	0.73	0.73	0.39
SOSP	0.84	0.87	0.87	0.87	0.61	0.87	0.87	0.71
SSPG	0.67	0.66	0.66	0.66	0.68	0.66	0.66	0.67
SSSG	0.53	*	*	*	0.56	0.49	0.49	0.57
SSTS	0.63	*	*	*	0.37	0.60	0.60	0.46
SWCS	0.68	*	*	*	0.88	0.76	0.76	0.88
SWGS	0.63	0.60	0.60	0.60	0.53	0.60	0.60	0.56
SWOG	0.57	*	*	*	0.65	0.48	0.48	0.58
TGCE	0.53	0.55	0.55	0.55	0.72	0.55	0.55	0.68
Unknown	0.69	0.64	0.64	0.64	0.64	0.66	0.66	0.66
XAOS	0.73	*	*	*	0.75	0.74	0.74	0.77
XSBG	0.58	*	*	*	0.64	0.57	0.57	0.63
Number of groups	66	33	33	33	66	66	66	66
Minimum	0.25	0.35	0.35	0.35	0.28	0.24	0.24	0.27
Maximum	0.89	0.88	0.87	0.87	0.88	0.87	0.87	0.88
Mean	0.62	0.59	0.59	0.59	0.61	0.60	0.60	0.61
Median	0.62	0.58	0.58	0.58	0.61	0.59	0.59	0.62
Standard deviation	0.13	0.13	0.13	0.12	0.13	0.14	0.14	0.13
VI reliability (%)	34.85	21.21	21.21	21.21	36.36	27.27	27.27	33.33
Overall reliability (%)	47.00							

Table E25: Area under curve values and summary statistics from the fairs-included strategy for broad vegetation groups in the Pilbara and southern rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASGRF	0.78	0.73	0.72	0.72	0.30	0.72	0.73	0.43
BLUEB	0.54	0.49	0.49	0.49	0.43	0.49	0.49	0.43
BUFFL	0.53	0.55	0.55	0.55	0.72	0.55	0.55	0.67
EAESP	0.60	0.60	0.60	0.60	0.59	0.58	0.58	0.59
EUCCH	0.57	0.46	0.46	0.46	0.54	0.49	0.49	0.51
HARSP	0.97	0.95	0.95	0.95	0.82	0.95	0.95	0.89
HPMSP	0.57	0.55	0.55	0.55	0.54	0.55	0.55	0.55

(continued)

Table E25 continued: Area under curve values and summary statistics from the fairs-included strategy for broad vegetation groups in the Pilbara and southern rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
MIXCH	0.59	0.58	0.58	0.58	0.56	0.54	0.54	0.55
NULBR	0.60	*	*	*	0.65	0.56	0.56	0.62
OTHER	0.58	0.54	0.54	0.54	0.61	0.54	0.54	0.60
PINDN	0.45	0.47	0.47	0.47	0.59	0.47	0.47	0.56
RIPAR	0.47	0.47	0.47	0.47	0.48	0.46	0.46	0.47
SACES	0.54	0.53	0.53	0.53	0.56	0.54	0.54	0.55
SALTP	0.68	0.79	0.79	0.79	0.58	0.68	0.68	0.61
SAMPH	0.55	0.47	0.47	0.47	0.44	0.48	0.48	0.43
SANDP	0.50	0.48	0.48	0.48	0.52	0.48	0.48	0.52
SGASP	0.66	0.63	0.63	0.63	0.65	0.63	0.63	0.65
SNAKW	0.52	0.49	0.50	0.50	0.61	0.49	0.49	0.55
SOSPX	0.84	0.87	0.87	0.87	0.61	0.87	0.87	0.71
SPWGR	0.68	*	*	*	0.70	0.62	0.62	0.67
STMXC	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52
TSKGR	0.54	0.56	0.56	0.56	0.72	0.56	0.56	0.68
Unknown	0.76	0.74	0.74	0.74	0.85	0.73	0.73	0.85
WANDR	0.61	0.58	0.58	0.58	0.57	0.58	0.58	0.57
Number of groups	24	22	22	22	24	24	24	24
Minimum	0.45	0.46	0.46	0.46	0.30	0.46	0.46	0.43
Maximum	0.97	0.95	0.95	0.95	0.85	0.95	0.95	0.89
Mean	0.61	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Median	0.57	0.55	0.55	0.55	0.58	0.55	0.55	0.56
Standard deviation	0.12	0.14	0.14	0.14	0.12	0.13	0.13	0.12
VI reliability (%)	25.00	22.73	22.73	22.73	20.83	20.83	20.83	25.00
Overall reliability (%)	33.33							

Table E26: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Anna	0.57	0.57	0.57	0.59	0.57	0.56	0.56	0.57
Ararak	0.50	0.49	0.51	0.50	0.50	0.49	0.49	0.54
Arubiddy	0.68	*	*	*	0.68	0.68	0.70	0.69
Balfour	0.62	*	*	*	0.48	0.53	0.50	0.46
Balgair	0.67	*	*	*	0.68	0.67	0.68	0.67
Bandy	0.72	0.72	0.71	0.73	0.74	0.72	0.72	0.74
Bannar	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Bevon	0.48	0.48	0.48	0.48	0.49	0.48	0.49	0.49
Billygoat	0.92	*	*	*	0.92	0.92	0.92	0.92
Boolgeeda	0.91	*	*	*	0.91	0.91	0.91	0.91
Brockman	0.45	*	*	*	0.54	0.48	0.45	0.50
Bullimore	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Cane	0.52	*	*	*	0.49	0.54	0.57	0.46
Carnegie	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Challenge	0.44	0.44	0.44	0.44	0.45	0.44	0.44	0.45
Coolibah	0.59	*	*	*	0.59	0.59	0.59	0.60
Cunyu	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.55
Darlot	0.62	0.62	0.62	0.62	0.63	0.62	0.62	0.62
Deadman	0.73	0.71	0.73	0.72	0.71	0.73	0.73	0.72
Desdemona	0.40	0.42	0.41	0.42	0.41	0.43	0.41	0.43
Doney	0.55	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Elimunna	0.45	*	*	*	0.43	0.44	0.42	0.43
Ero	0.57	0.51	0.54	0.54	0.49	0.43	0.35	0.51
Euchre	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Fan	0.46	*	*	*	0.45	0.46	0.46	0.46
Fortescue	0.55	*	*	*	0.54	0.50	0.52	0.64
Gabanintha	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Globe	0.53	0.55	0.53	0.53	0.54	0.54	0.57	0.54
Gransal	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Gumbreak	0.50	0.49	0.50	0.50	0.53	0.49	0.50	0.51
Gundockerta	0.42	0.41	0.41	0.42	0.45	0.41	0.42	0.43
Haig	0.63	*	*	*	0.63	0.63	0.63	0.64
Hamilton	0.45	0.46	0.45	0.46	0.46	0.45	0.46	0.47
Hooley	0.40	*	*	*	0.39	0.41	0.42	0.43
Hootanui	0.43	0.43	0.44	0.43	0.46	0.43	0.44	0.48

(continued)

Table E26 continued: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Horseflat	0.46	*	*	*	0.51	0.53	0.52	0.46
Jamindie	0.51	*	*	*	0.49	0.49	0.49	0.54
Jundee	0.46	0.44	0.44	0.44	0.45	0.44	0.44	0.44
Jurrawarrina	0.57	*	*	*	0.56	0.56	0.56	0.62
Kalli	0.73	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Kanandah	0.57	*	*	*	0.59	0.57	0.58	0.57
Kinclaven	0.59	*	*	*	0.58	0.58	0.59	0.58
Koonjarra	0.76	*	*	*	0.76	0.76	0.76	0.76
Kybo	0.59	*	*	*	0.59	0.59	0.60	0.59
Laverton	0.49	0.50	0.51	0.48	0.50	0.48	0.49	0.53
Leonora	0.46	0.46	0.46	0.46	0.49	0.46	0.46	0.47
Macroy	0.95	*	*	*	0.95	0.95	0.95	0.95
Mallina	0.77	*	*	*	0.78	0.77	0.77	0.77
Marmion	0.84	0.83	0.83	0.84	0.84	0.84	0.84	0.84
Mileura	0.40	0.40	0.40	0.40	0.42	0.40	0.41	0.41
Monk	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Moonera	0.73	*	*	*	0.73	0.73	0.73	0.73
Moriarty	0.46	0.46	0.45	0.48	0.51	0.45	0.48	0.49
Nanambinia	0.62	*	*	*	0.60	0.61	0.61	0.60
Nanyarra	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Naretha	0.56	*	*	*	0.57	0.56	0.57	0.57
Nerramyne	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
Nightshade	0.77	*	*	*	0.76	0.77	0.77	0.76
Nita	0.81	0.67	0.67	0.68	0.81	0.81	0.81	0.81
Nooingnin	0.43	*	*	*	0.41	0.43	0.37	0.48
Nubev	0.49	0.49	0.49	0.49	0.52	0.49	0.50	0.50
Nurina	0.53	*	*	*	0.55	0.53	0.53	0.55
Nyanga	0.81	*	*	*	0.81	0.81	0.81	0.81
Onslow	0.75	*	*	*	0.75	0.75	0.75	0.75
Paraburdoo	0.68	*	*	*	0.68	0.68	0.68	0.68
Paradise	0.55	*	*	*	0.56	0.55	0.56	0.57
Paterson	0.85	*	*	*	0.85	0.85	0.85	0.85
Peedamulla	0.75	*	*	*	0.76	0.75	0.75	0.75
Pindar	0.52	0.58	0.56	0.54	0.59	0.56	0.57	0.61
Pondana	0.44	*	*	*	0.46	0.45	0.45	0.48

(continued)

Table E26 continued: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Pilbara and southern rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Pullgarah	0.51	*	*	*	0.55	0.44	0.44	0.50
Rainbow	0.45	0.46	0.45	0.46	0.47	0.45	0.45	0.45
Ranch	0.45	0.45	0.45	0.45	0.47	0.45	0.45	0.47
River	0.81	*	*	*	0.81	0.81	0.81	0.81
Rocklea	0.96	*	*	*	0.96	0.96	0.96	0.96
Shake Hole	0.60	*	*	*	0.60	0.60	0.60	0.60
Sherwood	0.42	0.42	0.42	0.42	0.43	0.42	0.42	0.42
Steer	0.49	0.49	0.49	0.49	0.49	0.49	0.50	0.49
Stuart	0.80	*	*	*	0.80	0.80	0.80	0.80
Thampanna	0.48	*	*	*	0.48	0.48	0.48	0.48
Tiger	0.44	0.43	0.43	0.44	0.44	0.43	0.44	0.47
Tindalarra	0.46	0.46	0.46	0.46	0.47	0.46	0.46	0.46
Turee	0.67	*	*	*	0.67	0.65	0.65	0.67
Tyrrell	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Uaroo	0.90	*	*	*	0.90	0.90	0.90	0.90
Violet	0.38	0.39	0.44	0.40	0.36	0.37	0.40	0.39
Waguin	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Wilson	0.73	0.73	0.73	0.73	0.74	0.73	0.73	0.73
Wiluna	0.54	0.52	0.52	0.55	0.58	0.53	0.60	0.70
Windarra	0.43	0.44	0.44	0.42	0.45	0.44	0.42	0.46
Wona	0.49	*	*	*	0.50	0.49	0.49	0.49
Woodline	0.41	0.41	0.41	0.41	0.41	0.42	0.41	0.42
Woorlba	0.80	*	*	*	0.82	0.80	0.80	0.80
Wyarri	0.57	0.57	0.57	0.57	0.58	0.57	0.58	0.57
Yalbalgo	0.50	0.49	0.49	0.49	0.49	0.49	0.49	0.50
Yamerina	0.73	*	*	*	0.73	0.73	0.73	0.74
Yanganoo	0.45	0.45	0.45	0.45	0.44	0.44	0.46	0.45
Yowie	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Number of groups	98	52	52	52	98	98	98	98
Minimum	0.38	0.39	0.40	0.40	0.36	0.37	0.35	0.39
Maximum	0.96	0.88	0.88	0.88	0.96	0.96	0.96	0.96
Mean	0.59	0.54	0.55	0.55	0.60	0.59	0.59	0.60
Median	0.56	0.50	0.51	0.50	0.56	0.55	0.56	0.57
Standard deviation	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
VI reliability (%)	31.63	21.15	21.15	21.15	31.63	31.63	31.63	32.65
Overall reliability (%)	32.65							

Table E27: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Pilbara and southern rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10a	0.49	0.50	0.50	0.50	0.49	0.49	0.49	0.49
10b	0.40	0.40	0.40	0.40	0.42	0.40	0.40	0.40
11	0.95	*	*	*	0.95	0.95	0.95	0.95
12a	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.41
12b	0.67	0.66	0.66	0.66	0.67	0.66	0.66	0.67
13	0.95	*	*	*	0.95	0.95	0.95	0.95
14a	0.43	0.40	0.45	0.47	0.40	0.44	0.40	0.42
14b	0.52	0.59	0.54	0.55	0.54	0.50	0.46	0.61
15a	0.48	0.48	0.48	0.49	0.49	0.49	0.48	0.48
15b	0.41	0.41	0.41	0.41	0.44	0.41	0.42	0.44
16a	0.63	*	*	*	0.50	0.57	0.49	0.51
16b	0.43	0.45	0.42	0.41	0.46	0.43	0.42	0.46
16c	0.45	*	*	*	0.49	0.45	0.50	0.58
17a	0.39	0.41	0.40	0.39	0.40	0.39	0.38	0.39
17b	0.52	0.50	0.51	0.51	0.49	0.47	0.46	0.48
18a	0.88	0.80	0.80	0.80	0.88	0.88	0.88	0.88
18b	0.88	0.78	0.78	0.77	0.88	0.88	0.88	0.88
18c	0.87	*	*	*	0.87	0.87	0.87	0.87
19a	0.62	*	*	*	0.62	0.62	0.62	0.62
19b	0.69	*	*	*	0.68	0.68	0.68	0.69
19c	0.92	*	*	*	0.92	0.92	0.92	0.92
19d	0.57	*	*	*	0.49	0.51	0.48	0.58
20a	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.50
20b	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
21a	0.44	0.47	0.47	0.47	0.41	0.43	0.41	0.43
21b	0.40	0.40	0.40	0.39	0.39	0.39	0.39	0.39
22a	0.41	0.43	0.46	0.48	0.39	0.44	0.38	0.45
23a	0.43	0.42	0.41	0.41	0.44	0.41	0.41	0.45
24a	0.60	*	*	*	0.49	0.58	0.49	0.49
24b	0.56	*	*	*	0.42	0.47	0.54	0.45
26	0.51	0.54	0.54	0.54	0.51	0.51	0.51	0.51
26b	0.42	0.40	0.38	0.38	0.40	0.36	0.37	0.41
27a	0.59	0.51	0.51	0.51	0.59	0.59	0.59	0.59
27c	0.59	*	*	*	0.59	0.59	0.59	0.59

(continued)

Table E27 continued: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Pilbara and southern rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
28	0.73	0.72	0.72	0.72	0.72	0.73	0.72	0.73
29c	0.79	*	*	*	0.79	0.79	0.79	0.79
Number of groups	36	24	24	24	36	36	36	36
Minimum	0.39	0.40	0.38	0.38	0.39	0.36	0.37	0.39
Maximum	0.95	0.80	0.80	0.80	0.95	0.95	0.95	0.95
Mean	0.59	0.52	0.52	0.52	0.58	0.58	0.57	0.59
Median	0.54	0.49	0.49	0.49	0.50	0.50	0.49	0.51
Standard deviation	0.18	0.13	0.13	0.13	0.18	0.18	0.18	0.18
VI reliability (%)	30.56	16.67	16.67	16.67	30.56	27.58	27.58	30.56
Overall reliability (%)	30.56							

Table E28: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Pilbara and southern rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
4	0.76	0.53	0.53	0.53	0.76	0.76	0.76	0.76
8	0.42	0.40	0.39	0.40	0.39	0.42	0.42	0.41
9	0.62	0.62	0.62	0.62	0.63	0.62	0.62	0.62
14	0.79	0.79	0.79	0.78	0.79	0.78	0.79	0.79
15	0.45	0.45	0.46	0.44	0.47	0.45	0.45	0.44
16	0.54	*	*	*	0.55	0.54	0.54	0.55
22	0.76	*	*	*	0.76	0.76	0.76	0.76
29	0.57	*	*	*	0.57	0.57	0.57	0.57
32	0.62	*	*	*	0.53	0.58	0.46	0.50
35	0.95	*	*	*	0.95	0.95	0.95	0.95
37	0.87	0.82	0.82	0.82	0.87	0.87	0.87	0.87
38	0.85	0.64	0.64	0.64	0.85	0.85	0.85	0.85
39	0.86	*	*	*	0.86	0.86	0.86	0.86
40	0.89	*	*	*	0.89	0.89	0.89	0.89
41	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
45	0.64	*	*	*	0.64	0.64	0.64	0.64
46	0.64	0.55	0.55	0.55	0.64	0.64	0.64	0.64
47	0.55	0.55	0.55	0.55	0.59	0.55	0.55	0.56
48	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
49	0.57	*	*	*	0.57	0.57	0.57	0.57

(continued)

Table E28 continued: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Pilbara and southern rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
50	0.60	0.59	0.59	0.59	0.60	0.60	0.60	0.60
51	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
105	0.80	*	*	*	0.80	0.80	0.80	0.80
106	0.47	0.46	0.46	0.47	0.46	0.47	0.47	0.47
110	0.49	0.41	0.46	0.44	0.47	0.44	0.48	0.48
116	0.67	0.52	0.52	0.53	0.67	0.66	0.66	0.67
Number of groups	26	16	16	16	26	26	26	26
Minimum	0.42	0.40	0.39	0.40	0.39	0.42	0.42	0.41
Maximum	0.95	0.82	0.82	0.82	0.95	0.95	0.95	0.95
Mean	0.67	0.59	0.59	0.59	0.67	0.67	0.66	0.67
Median	0.64	0.55	0.55	0.55	0.64	0.64	0.64	0.64
Standard deviation	0.15	0.13	0.13	0.13	0.15	0.15	0.15	0.15
VI reliability (%)	46.15	25.00	25.00	25.00	46.15	42.30	42.30	46.15
Overall reliability (%)	46.15							

Table E29: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
AHSG	0.76	*	*	*	0.77	0.76	0.76	0.76
AMSG	0.53	0.53	0.52	0.55	0.52	0.53	0.52	0.54
APBG	0.78	*	*	*	0.78	0.78	0.78	0.78
APRG	0.69	*	*	*	0.44	0.61	0.42	0.53
APXG	0.58	*	*	*	0.58	0.58	0.58	0.58
ARPG	0.54	*	*	*	0.53	0.44	0.47	0.46
ASSG	0.70	*	*	*	0.70	0.70	0.70	0.71
ASWS	0.39	0.37	0.40	0.37	0.40	0.39	0.39	0.42
BSSL	0.66	*	*	*	0.68	0.65	0.65	0.65
CEAS	0.47	0.48	0.46	0.46	0.48	0.46	0.47	0.47
CCAS	0.66	0.66	0.66	0.66	0.67	0.66	0.66	0.66
DAGW	0.57	*	*	*	0.57	0.57	0.57	0.57
DEGW	0.78	*	*	*	0.78	0.78	0.78	0.78
DRMS	0.50	0.53	0.51	0.50	0.52	0.52	0.50	0.51
ESAW	0.47	*	*	*	0.49	0.47	0.47	0.49
HMCS	0.44	0.40	0.40	0.40	0.43	0.42	0.42	0.40
HPMS	0.44	0.46	0.46	0.46	0.44	0.44	0.44	0.44

(continued)

Table E29 continued: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
LHMS	0.46	0.46	0.44	0.46	0.47	0.44	0.45	0.46
JAMS	0.68	0.68	0.68	0.68	0.70	0.68	0.68	0.70
MAAS	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
MPBS	0.69	*	*	*	0.69	0.69	0.69	0.69
MSAW	0.50	*	*	*	0.51	0.51	0.50	0.50
MUBW	0.42	0.41	0.42	0.41	0.41	0.42	0.42	0.42
MUWA	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
MXCS	0.83	*	*	*	0.83	0.83	0.83	0.83
OBIG	0.56	*	*	*	0.52	0.58	0.59	0.53
PBLS	0.67	*	*	*	0.67	0.67	0.67	0.67
PESW	0.50	0.50	0.50	0.51	0.52	0.51	0.50	0.52
PHSG	0.98	*	*	*	0.98	0.98	0.98	0.98
PINW	0.65	0.65	0.65	0.65	0.66	0.65	0.65	0.67
PLMS	0.48	0.48	0.47	0.48	0.48	0.48	0.47	0.48
PMOG	0.41	*	*	*	0.45	0.41	0.44	0.45
PSAS	0.45	0.46	0.45	0.45	0.49	0.47	0.46	0.45
PSMS	0.53	*	*	*	0.52	0.52	0.52	0.52
PSSG	0.92	*	*	*	0.92	0.92	0.92	0.92
PXCS	0.67	*	*	*	0.67	0.67	0.67	0.68
PXHS	0.62	0.42	0.42	0.42	0.62	0.62	0.62	0.62
SAES	0.38	0.39	0.40	0.39	0.39	0.39	0.39	0.40
SAMP	0.84	0.83	0.83	0.83	0.84	0.84	0.84	0.84
SASS	0.81	*	*	*	0.81	0.81	0.81	0.81
SBMS	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
SGRS	0.43	0.43	0.43	0.43	0.44	0.43	0.43	0.44
SIMS	0.60	0.60	0.60	0.60	0.60	0.59	0.60	0.61
SMMS	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
SOSP	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
SSSG	0.91	*	*	*	0.91	0.91	0.91	0.91
SSTS	0.57	*	*	*	0.59	0.57	0.58	0.57
SWCS	0.79	*	*	*	0.79	0.79	0.79	0.79
SWGS	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
SWOG	0.63	*	*	*	0.64	0.63	0.63	0.64
TGCE	0.45	0.45	0.45	0.45	0.47	0.45	0.45	0.45
Unknown	0.53	0.58	0.58	0.58	0.45	0.52	0.52	0.47

(continued)

Table E29 continued: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Pilbara and southern rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
XAOS	0.67	*	*	*	0.68	0.67	0.67	0.67
XSBG	0.77	*	*	*	0.77	0.77	0.77	0.77
Number of groups	54	27	27	27	54	54	54	54
Minimum	0.38	0.37	0.40	0.37	0.39	0.39	0.39	0.40
Maximum	0.98	0.86	0.86	0.86	0.98	0.98	0.98	0.98
Mean	0.62	0.54	0.54	0.54	0.62	0.62	0.61	0.61
Median	0.59	0.50	0.50	0.50	0.58	0.59	0.59	0.58
Standard deviation	0.15	0.14	0.14	0.14	0.15	0.16	0.16	0.15
VI reliability (%)	40.74	22.22	22.22	22.22	42.59	38.88	38.88	40.74
Overall reliability (%)	44.23							

Table E30: Overall accuracies and summary statistics from the 3-class strategy for broad vegetation groups in the Pilbara and southern rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASGRF	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
BLUEB	0.46	0.47	0.50	0.46	0.47	0.47	0.47	0.47
BUFFL	0.45	0.45	0.45	0.45	0.47	0.45	0.45	0.46
EAESP	0.46	0.47	0.46	0.46	0.48	0.46	0.47	0.46
EUCCH	0.78	0.45	0.45	0.45	0.78	0.78	0.78	0.78
HARSP	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
HPMSP	0.43	0.44	0.43	0.43	0.43	0.43	0.43	0.43
MIXCH	0.64	0.41	0.44	0.44	0.64	0.64	0.64	0.64
NULBR	0.71	*	*	*	0.71	0.71	0.71	0.71
OTHER	0.48	0.44	0.42	0.47	0.48	0.47	0.47	0.50
PINDN	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
RIPAR	0.53	0.54	0.52	0.53	0.53	0.52	0.52	0.53
SACES	0.55	0.54	0.56	0.53	0.51	0.52	0.48	0.51
SALTP	0.63	0.57	0.57	0.56	0.63	0.63	0.63	0.63
SAMPH	0.84	0.87	0.87	0.87	0.84	0.84	0.84	0.84
SANDP	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
SGASP	0.44	0.44	0.45	0.44	0.49	0.44	0.44	0.46
SNAKW	0.37	0.37	0.38	0.38	0.41	0.37	0.37	0.38
SOSPX	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
SPWGR	0.50	*	*	*	0.50	0.50	0.50	0.52
STMXC	0.51	0.52	0.52	0.52	0.51	0.51	0.51	0.51

(continued)

Table E30 continued: Overall accuracies and summary statistics from the 3-class strategy for broad vegetation groups in the Pilbara and southern rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
TSKGR	0.45	0.45	0.45	0.45	0.46	0.45	0.45	0.45
Unknown	0.60	0.59	0.60	0.59	0.67	0.57	0.58	0.59
WANDR	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Number of groups	24	22	22	22	24	24	24	24
Minimum	0.37	0.37	0.38	0.38	0.41	0.37	0.37	0.38
Maximum	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Mean	0.59	0.56	0.56	0.56	0.60	0.59	0.58	0.59
Median	0.54	0.53	0.52	0.52	0.53	0.53	0.53	0.53
Standard deviation	0.15	0.15	0.15	0.15	0.14	0.15	0.15	0.14
VI reliability (%)	25.00	18.18	18.18	18.18	29.17	25.00	25.00	25.00
Overall reliability (%)	29.17							

E.3 Pilbara region

Table E31: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Pilbara region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Anna	0.23	0.77	0.42	0.42	0.43
Balfour	0.83	0.64	0.80	0.80	0.72
Billygoat	0.57	0.78	0.55	0.56	0.73
Boolgeeda	0.80	0.87	0.80	0.79	0.88
Brockman	0.81	0.68	0.73	0.73	0.77
Cane	0.89	0.45	0.85	0.85	0.60
Coolibah	0.73	0.65	0.71	0.71	0.71
Divide	0.79	0.56	0.78	0.77	0.70
Fan	0.53	0.54	0.53	0.53	0.52
Fortescue	0.72	0.85	0.73	0.73	0.84
Hooley	0.58	0.65	0.52	0.52	0.63
Horseflat	0.86	0.31	0.84	0.84	0.43
Jamindie	0.78	0.63	0.76	0.76	0.70
Jurrawarrina	0.79	0.76	0.76	0.76	0.82
Macroy	0.69	0.66	0.69	0.69	0.68
Mallina	0.60	0.52	0.61	0.60	0.53
Mosquito	0.51	0.73	0.50	0.50	0.70
Nita	0.16	0.17	0.16	0.16	0.18
Nooingnin	0.52	0.51	0.55	0.55	0.54

(continued)

Table E31 continued: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Pilbara region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Oakover	0.57	0.78	0.56	0.56	0.88
Paradise	0.88	0.85	0.86	0.86	0.86
Paterson	0.53	0.58	0.52	0.52	0.57
River	0.81	0.53	0.77	0.77	0.60
Rocklea	0.80	0.73	0.76	0.76	0.76
Spearhole	0.84	0.74	0.85	0.85	0.82
Stuart	0.64	0.75	0.59	0.59	0.72
Turee	0.84	0.81	0.80	0.80	0.84
Uaroo	0.39	0.43	0.36	0.35	0.44
Urandy	0.46	0.75	0.41	0.41	0.67
Wona	0.61	0.49	0.61	0.61	0.60
Yamerina	0.84	0.77	0.81	0.81	0.75
Number of groups	31	31	31	31	31
Minimum	0.16	0.17	0.16	0.16	0.18
Maximum	0.89	0.87	0.86	0.86	0.88
Mean	0.66	0.64	0.65	0.65	0.66
Median	0.72	0.66	0.71	0.71	0.70
Standard deviation	0.19	0.16	0.17	0.17	0.16
VI reliability (%)	54.84	48.39	54.84	54.84	61.29
Overall reliability (%)	74.19				

Table E32: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Pilbara region

Functional group	EVI	LMI	MSAVI2	NDVI	STVI-1
5b	0.16	0.17	0.16	0.16	0.18
11	0.81	0.70	0.78	0.78	0.75
13	0.61	0.73	0.64	0.64	0.85
16a	0.72	0.65	0.66	0.66	0.69
16c	0.73	0.63	0.68	0.68	0.67
18a	0.59	0.58	0.58	0.58	0.60
18b	0.79	0.84	0.79	0.79	0.86
18c	0.71	0.66	0.70	0.70	0.69
21a	0.65	0.61	0.61	0.61	0.62
21b	0.86	0.66	0.87	0.87	0.77
22a	0.63	0.59	0.61	0.61	0.63
24a	0.81	0.55	0.77	0.77	0.66

(continued)

Table E32 continued: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Pilbara region

Functional group	EVI	LMI	MSAVI2	NDVI	STVI-1
24b	0.83	0.63	0.80	0.80	0.70
27a	0.87	0.60	0.85	0.85	0.67
27c	0.73	0.64	0.71	0.71	0.71
29c	0.66	0.53	0.70	0.70	0.54
Number of groups	16	16	16	16	16
Minimum	0.16	0.17	0.16	0.16	0.18
Maximum	0.87	0.84	0.87	0.87	0.86
Mean	0.70	0.61	0.68	0.68	0.66
Median	0.73	0.63	0.70	0.70	0.68
Standard deviation	0.17	0.14	0.16	0.16	0.15
VI reliability (%)	62.50	18.75	62.50	62.50	62.50
Overall reliability (%)	75.00				

Table E33: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Pilbara region

Pre-European vegetation type	EVI	LMI	MSAVI2	NDVI	STVI-1
4	0.96	0.49	0.94	0.94	0.62
8	0.74	0.69	0.72	0.72	0.73
22	0.27	0.29	0.28	0.28	0.27
29	0.79	0.63	0.73	0.73	0.68
32	0.81	0.61	0.76	0.76	0.71
35	0.82	0.54	0.77	0.77	0.68
37	0.76	0.53	0.79	0.78	0.68
38	0.73	0.48	0.71	0.71	0.57
39	0.50	0.63	0.49	0.48	0.61
116	0.78	0.42	0.77	0.77	0.48
Number of groups	10	10	10	10	10
Minimum	0.27	0.29	0.28	0.28	0.27
Maximum	0.96	0.69	0.94	0.94	0.73
Mean	0.72	0.53	0.69	0.69	0.60
Median	0.77	0.54	0.74	0.74	0.65
Standard deviation	0.19	0.12	0.18	0.18	0.14
VI reliability (%)	80.00	10.00	80.00	80.00	50.00
Overall reliability (%)	80.00				

Table E34: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Pilbara region

Pasture type	EVI	LMI	MSAVI2	NDVI	STVI-1
AHSG	0.57	0.49	0.54	0.54	0.47
APBG	0.61	0.67	0.60	0.60	0.59
APRG	0.84	0.57	0.81	0.81	0.67
APXG	0.75	0.56	0.63	0.63	0.56
ARPG	0.70	0.50	0.65	0.65	0.57
ASSG	0.78	0.82	0.76	0.76	0.81
DAGW	0.82	0.63	0.76	0.76	0.71
DEGW	0.83	0.72	0.78	0.78	0.76
HPMS	0.60	0.49	0.58	0.58	0.52
PASS	0.26	0.34	0.23	0.23	0.29
PHSG	0.56	0.65	0.62	0.62	0.66
PMHS	0.84	0.79	0.79	0.79	0.83
PSMS	0.50	0.59	0.44	0.44	0.55
PSSG	0.60	0.54	0.60	0.60	0.57
SAES	0.63	0.50	0.61	0.61	0.54
SASS	0.23	0.28	0.23	0.23	0.26
SSSG	0.53	0.56	0.50	0.50	0.58
SSTS	0.75	0.36	0.69	0.69	0.47
Unknown	0.75	0.50	0.71	0.71	0.57
Number of groups	19	19	19	19	19
Minimum	0.23	0.28	0.23	0.23	0.26
Maximum	0.84	0.82	0.81	0.81	0.83
Mean	0.64	0.56	0.61	0.61	0.58
Median	0.63	0.56	0.62	0.62	0.57
Standard deviation	0.18	0.14	0.17	0.17	0.15
VI reliability (%)	47.37	21.05	36.84	36.84	26.32
Overall reliability (%)	57.89				

Table E35: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Pilbara region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Anna	0.24	0.75	0.43	0.43	0.43
Balfour	0.75	0.62	0.72	0.72	0.67
Billygoat	0.57	0.78	0.55	0.56	0.73
Boolgeeda	0.79	0.86	0.79	0.79	0.87
Brockman	0.76	0.66	0.70	0.70	0.73
Cane	0.88	0.41	0.85	0.85	0.54
Coolibah	0.69	0.60	0.67	0.67	0.65
Divide	0.78	0.55	0.77	0.77	0.69
Elimunna	0.61	0.52	0.57	0.57	0.53
Fan	0.47	0.50	0.47	0.47	0.47
Fortescue	0.66	0.79	0.68	0.68	0.78
Hooley	0.57	0.58	0.54	0.54	0.57
Horseflat	0.80	0.30	0.78	0.78	0.39
Jamindie	0.75	0.61	0.73	0.73	0.67
Jurrawarrina	0.75	0.70	0.74	0.74	0.77
Macroy	0.68	0.66	0.69	0.69	0.68
Mallina	0.59	0.49	0.59	0.59	0.50
Mosquito	0.52	0.73	0.51	0.51	0.69
Nita	0.17	0.18	0.17	0.17	0.18
Nooingnin	0.50	0.51	0.52	0.51	0.53
Oakover	0.56	0.78	0.56	0.56	0.87
Paraburdoo	0.50	0.38	0.39	0.39	0.42
Paradise	0.81	0.77	0.78	0.78	0.78
Paterson	0.53	0.58	0.52	0.52	0.56
Pullgarah	0.77	0.82	0.76	0.76	0.80
River	0.80	0.52	0.75	0.75	0.58
Rocklea	0.80	0.73	0.76	0.76	0.76
Spearhole	0.83	0.70	0.83	0.83	0.77
Stuart	0.64	0.74	0.59	0.59	0.72
Turee	0.70	0.75	0.68	0.68	0.75
Uaroo	0.39	0.43	0.36	0.36	0.44
Urandy	0.45	0.73	0.40	0.40	0.66
Wona	0.62	0.47	0.63	0.63	0.58
Yamerina	0.83	0.74	0.79	0.79	0.73

(continued)

Table E35 continued: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Pilbara region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Number of groups	34	34	34	34	34
Minimum	0.17	0.18	0.17	0.17	0.18
Maximum	0.88	0.86	0.85	0.85	0.87
Mean	0.64	0.62	0.63	0.63	0.63
Median	0.67	0.64	0.68	0.68	0.67
Standard deviation	0.17	0.16	0.16	0.16	0.15
VI reliability (%)	50.00	44.12	52.94	52.94	52.94
Overall reliability (%)	70.59				

Table E36: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Pilbara region

Functional group	EVI	LMI	MSAVI2	NDVI	STVI-1
5b	0.17	0.18	0.17	0.17	0.18
10a	0.68	0.71	0.65	0.65	0.71
11	0.81	0.70	0.78	0.77	0.75
13	0.61	0.73	0.64	0.64	0.85
16a	0.65	0.63	0.60	0.60	0.66
16c	0.66	0.58	0.62	0.62	0.61
18a	0.59	0.57	0.58	0.58	0.59
18b	0.79	0.83	0.78	0.78	0.85
18c	0.70	0.65	0.69	0.69	0.68
21a	0.61	0.58	0.58	0.58	0.59
21b	0.85	0.64	0.85	0.85	0.74
22a	0.60	0.56	0.58	0.58	0.58
24a	0.77	0.53	0.74	0.74	0.63
24b	0.75	0.61	0.72	0.72	0.67
27a	0.85	0.57	0.83	0.83	0.65
27c	0.69	0.60	0.67	0.67	0.65
29c	0.65	0.51	0.70	0.70	0.53
Number of groups	17	17	17	17	17
Minimum	0.17	0.18	0.17	0.17	0.18
Maximum	0.85	0.83	0.85	0.85	0.85
Mean	0.67	0.60	0.66	0.66	0.64
Median	0.68	0.60	0.67	0.67	0.65
Standard deviation	0.15	0.14	0.15	0.15	0.15
VI reliability (%)	52.94	23.53	52.94	52.94	41.18
Overall reliability (%)	64.71				

Table E37: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Pilbara region

Pre-European	EVI	LMI	MSAVI2	NDVI	STVI-1
4	0.95	0.49	0.93	0.93	0.61
8	0.69	0.64	0.66	0.66	0.67
22	0.28	0.30	0.29	0.29	0.27
29	0.76	0.60	0.71	0.71	0.65
32	0.79	0.61	0.74	0.74	0.70
35	0.82	0.53	0.76	0.76	0.68
37	0.75	0.53	0.77	0.77	0.67
38	0.73	0.47	0.71	0.70	0.56
39	0.50	0.63	0.49	0.49	0.61
110	0.96	0.98	0.89	0.89	0.98
116	0.75	0.40	0.75	0.74	0.46
Number of groups	11	11	11	11	11
Minimum	0.28	0.30	0.29	0.29	0.27
Maximum	0.96	0.98	0.93	0.93	0.98
Mean	0.72	0.56	0.70	0.70	0.62
Median	0.75	0.53	0.74	0.74	0.65
Standard deviation	0.19	0.17	0.18	0.18	0.17
VI reliability (%)	81.82	9.09	72.73	72.73	45.45
Overall reliability (%)	81.82				

Table E38: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Pilbara region

Pasture type	EVI	LMI	MSAVI2	NDVI	STVI-1
AHSG	0.54	0.47	0.52	0.52	0.46
APBG	0.59	0.65	0.58	0.58	0.57
APRG	0.80	0.56	0.79	0.79	0.66
APXG	0.74	0.56	0.64	0.64	0.56
ARPG	0.63	0.47	0.60	0.61	0.52
ASSG	0.74	0.78	0.73	0.73	0.77
DAGW	0.78	0.61	0.72	0.72	0.68
DEGW	0.80	0.70	0.75	0.75	0.74
GASS	0.63	0.63	0.51	0.51	0.64
HPMS	0.56	0.48	0.54	0.54	0.51
PASS	0.26	0.34	0.24	0.24	0.29
PHSG	0.56	0.65	0.62	0.62	0.66

(continued)

Table E38 continued: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Pilbara region

Pasture type	EVI	LMI	MSAVI2	NDVI	STVI-1
PMHS	0.84	0.78	0.79	0.79	0.82
PMOG	0.69	0.70	0.66	0.66	0.69
PSMS	0.50	0.58	0.45	0.45	0.55
PSSG	0.59	0.53	0.59	0.59	0.55
SAES	0.58	0.53	0.57	0.57	0.55
SASS	0.25	0.28	0.24	0.24	0.27
SSSG	0.53	0.56	0.49	0.49	0.57
SSTS	0.63	0.37	0.60	0.60	0.46
Other	0.72	0.51	0.68	0.68	0.57
Number of groups	21	21	21	21	21
Minimum	0.25	0.28	0.24	0.24	0.27
Maximum	0.84	0.78	0.79	0.79	0.82
Mean	0.62	0.56	0.59	0.59	0.58
Median	0.63	0.56	0.60	0.60	0.57
Standard deviation	0.16	0.13	0.15	0.15	0.14
VI reliability (%)	38.10	19.05	28.57	28.57	23.81
Overall reliability (%)	38.10				

Table E39: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Pilbara region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Balfour	0.58	0.46	0.56	0.50	0.40
Billygoat	0.92	0.92	0.92	0.92	0.92
Boolgeeda	0.94	0.94	0.94	0.94	0.94
Brockman	0.45	0.50	0.45	0.45	0.51
Cane	0.59	0.53	0.47	0.50	0.43
Coolibah	0.59	0.59	0.59	0.59	0.60
Elimunna	0.46	0.41	0.48	0.39	0.44
Fan	0.46	0.45	0.46	0.45	0.46
Fortescue	0.52	0.53	0.50	0.50	0.56
Hooley	0.39	0.41	0.41	0.41	0.46
Horseflat	0.46	0.50	0.52	0.51	0.47
Jamindie	0.51	0.49	0.52	0.51	0.54
Jurrawarrina	0.56	0.56	0.56	0.56	0.63
Macroy	0.95	0.95	0.95	0.95	0.95
Mallina	0.77	0.78	0.77	0.77	0.77

(continued)

Table E39 continued: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Pilbara region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Nita	0.90	0.90	0.90	0.90	0.90
Nooingnin	0.40	0.41	0.41	0.43	0.48
Paraburdoo	0.71	0.72	0.71	0.71	0.71
Paradise	0.53	0.53	0.56	0.57	0.56
Paterson	0.85	0.85	0.85	0.85	0.85
Pullgarah	0.49	0.67	0.44	0.44	0.62
River	0.81	0.81	0.81	0.81	0.81
Rocklea	0.96	0.96	0.96	0.96	0.96
Stuart	0.83	0.83	0.83	0.83	0.83
Turee	0.65	0.65	0.65	0.65	0.67
Uaroo	0.91	0.91	0.91	0.91	0.91
Wona	0.49	0.50	0.49	0.49	0.49
Yamerina	0.73	0.73	0.73	0.73	0.74
Number of groups	28	28	28	28	28
Minimum	0.39	0.41	0.41	0.41	0.40
Maximum	0.96	0.96	0.96	0.96	0.96
Mean	0.66	0.67	0.66	0.66	0.67
Median	0.59	0.59	0.59	0.59	0.63
Standard deviation	0.20	0.19	0.20	0.20	0.19
VI reliability (%)	42.85	46.43	42.85	42.85	46.43
Overall reliability (%)	50.00				

Table E40: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Pilbara region

Functional group	EVI	LMI	MSAVI2	NDVI	STVI-1
5b	0.90	0.90	0.90	0.90	0.90
10a	0.47	0.47	0.47	0.48	0.51
11	0.96	0.96	0.96	0.96	0.96
13	0.95	0.95	0.95	0.95	0.95
16a	0.55	0.54	0.54	0.54	0.55
16c	0.50	0.52	0.50	0.51	0.51
18a	0.91	0.91	0.91	0.91	0.91
18b	0.94	0.94	0.94	0.94	0.94
18c	0.88	0.88	0.88	0.88	0.88
21a	0.48	0.40	0.46	0.47	0.41
22a	0.43	0.43	0.43	0.44	0.44

(continued)

Table E40 continued: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Pilbara region

Functional group	EVI	LMI	MSAVI2	NDVI	STVI-1
24a	0.60	0.49	0.59	0.49	0.49
24b	0.62	0.43	0.58	0.50	0.46
27a	0.65	0.65	0.65	0.65	0.65
27c	0.59	0.59	0.59	0.59	0.60
29c	0.82	0.83	0.82	0.82	0.82
Number of groups	16	16	16	16	16
Minimum	0.43	0.40	0.43	0.44	0.41
Maximum	0.96	0.96	0.96	0.96	0.96
Mean	0.71	0.69	0.71	0.70	0.69
Median	0.64	0.63	0.62	0.62	0.62
Standard deviation	0.20	0.22	0.20	0.21	0.22
VI reliability (%)	43.75	43.75	43.75	43.75	43.75
Overall reliability (%)	43.75				

Table E41: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Pilbara region

Pre-European vegetation type	EVI	LMI	MSAVI2	NDVI	STVI-1
08	0.55	0.47	0.54	0.53	0.48
22	0.76	0.76	0.76	0.76	0.76
29	0.57	0.57	0.57	0.57	0.57
32	0.62	0.48	0.50	0.50	0.47
35	0.95	0.95	0.95	0.95	0.95
37	0.87	0.87	0.87	0.87	0.87
38	0.88	0.88	0.88	0.88	0.88
39	0.87	0.87	0.87	0.87	0.87
116	0.68	0.68	0.68	0.68	0.68
Number of groups	9	9	9	9	9
Minimum	0.55	0.47	0.50	0.50	0.47
Maximum	0.95	0.95	0.95	0.95	0.95
Mean	0.75	0.73	0.73	0.73	0.73
Median	0.76	0.76	0.76	0.76	0.76
Standard deviation	0.14	0.17	0.16	0.16	0.17
VI reliability (%)	66.67	66.67	66.67	66.67	66.67
Overall reliability (%)	66.67				

Table E42: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Pilbara region

Pasture type	EVI	LMI	MSAVI2	NDVI	STVI-1
AHSG	0.76	0.77	0.76	0.76	0.76
APBG	0.78	0.78	0.78	0.78	0.78
APRG	0.59	0.43	0.48	0.42	0.56
APXG	0.58	0.58	0.58	0.58	0.58
ARPG	0.51	0.46	0.47	0.44	0.46
ASSG	0.70	0.70	0.70	0.70	0.70
DAGW	0.57	0.58	0.57	0.57	0.57
DEGW	0.78	0.78	0.78	0.78	0.78
HPMS	0.42	0.42	0.43	0.42	0.45
PHSG	0.98	0.98	0.98	0.98	0.98
PMOG	0.43	0.46	0.43	0.41	0.51
PSMS	0.52	0.52	0.52	0.54	0.52
PSSG	0.92	0.92	0.92	0.92	0.92
SAES	0.45	0.38	0.40	0.42	0.40
SASS	0.81	0.81	0.81	0.81	0.81
SSSG	0.91	0.91	0.91	0.91	0.91
SSTS	0.57	0.58	0.57	0.57	0.57
Unknown	0.58	0.48	0.54	0.48	0.48
Number of groups	18	18	18	18	18
Minimum	0.42	0.38	0.40	0.41	0.40
Maximum	0.98	0.98	0.98	0.98	0.98
Mean	0.66	0.64	0.65	0.64	0.65
Median	0.58	0.58	0.58	0.58	0.58
Standard deviation	0.17	0.19	0.18	0.19	0.17
VI reliability (%)	44.44	44.44	44.44	44.44	44.44
Overall reliability (%)	44.44				

E.4 Yalgoo and Sandstone region

Table E43: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Yalgoo and Sandstone region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Bannar	0.25	0.18	0.18	0.19	0.41	0.18	0.18	0.31
Bullimore	0.58	0.57	0.57	0.57	0.58	0.57	0.57	0.61
Carnegie	0.59	0.51	0.51	0.51	0.59	0.51	0.51	0.58
Challenge	0.68	0.68	0.68	0.68	0.69	0.68	0.67	0.69
Ero	0.80	0.77	0.78	0.78	0.75	0.78	0.77	0.76
Euchre	0.57	0.53	0.53	0.54	0.68	0.53	0.52	0.66
Gransal	0.66	0.64	0.64	0.64	0.66	0.64	0.64	0.67
Joseph	0.35	0.29	0.30	0.30	0.42	0.29	0.29	0.38
Jundee	0.54	0.53	0.53	0.53	0.61	0.53	0.53	0.60
Kalli	0.80	0.76	0.76	0.76	0.71	0.76	0.76	0.75
Mileura	0.40	0.39	0.39	0.39	0.45	0.39	0.39	0.43
Monk	0.58	0.57	0.57	0.57	0.51	0.57	0.57	0.54
Sherwood	0.54	0.51	0.51	0.51	0.61	0.51	0.51	0.59
Tindalarra	0.60	0.57	0.58	0.58	0.63	0.57	0.57	0.61
Tyrrell	0.36	0.50	0.49	0.49	0.44	0.50	0.50	0.54
Woodline	0.58	0.55	0.55	0.55	0.51	0.55	0.55	0.52
Yanganoo	0.57	0.60	0.60	0.60	0.55	0.60	0.61	0.57
Yowie	0.54	0.50	0.50	0.51	0.49	0.50	0.50	0.48
Number of groups	18	18	18	18	18	18	18	18
Minimum	0.25	0.18	0.18	0.19	0.41	0.18	0.18	0.31
Maximum	0.80	0.77	0.78	0.78	0.75	0.78	0.77	0.76
Mean	0.55	0.54	0.54	0.54	0.57	0.54	0.54	0.57
Median	0.57	0.54	0.54	0.54	0.58	0.54	0.54	0.58
Standard deviation	0.14	0.15	0.15	0.14	0.11	0.15	0.15	0.12
VI reliability (%)	16.67	16.67	16.67	16.67	22.22	16.67	16.67	22.22
Overall reliability (%)	27.78							

Table E44: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Yalgoo and Sandstone region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10b	0.62	0.56	0.56	0.57	0.72	0.56	0.55	0.68
12a	0.57	0.53	0.53	0.53	0.52	0.53	0.53	0.52
12b	0.70	0.66	0.66	0.66	0.68	0.66	0.66	0.68
16b	0.69	0.68	0.68	0.69	0.70	0.68	0.68	0.70
17a	0.63	0.63	0.62	0.63	0.59	0.62	0.62	0.60
17b	0.59	0.59	0.59	0.58	0.55	0.59	0.59	0.56
18a	0.55	0.55	0.55	0.55	0.53	0.55	0.55	0.58
20b	0.68	0.62	0.62	0.62	0.66	0.62	0.62	0.66
21b	0.64	0.62	0.62	0.62	0.63	0.62	0.62	0.63
23a	0.63	0.61	0.61	0.61	0.53	0.61	0.61	0.56
28	0.59	0.51	0.51	0.51	0.59	0.51	0.51	0.58
Number of groups	11	11	11	11	11	11	11	11
Minimum	0.55	0.51	0.51	0.51	0.52	0.51	0.51	0.52
Maximum	0.70	0.68	0.68	0.69	0.72	0.68	0.68	0.70
Mean	0.63	0.59	0.60	0.60	0.61	0.59	0.59	0.61
Median	0.63	0.61	0.61	0.61	0.59	0.61	0.61	0.60
Standard deviation	0.05	0.05	0.05	0.05	0.07	0.05	0.05	0.06
VI reliability (%)	27.27	9.09	9.09	9.09	27.27	9.09	9.09	27.27
Overall reliability (%)	36.36							

Table E45: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Yalgoo and Sandstone region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
4	0.52	0.47	0.47	0.47	0.60	0.47	0.47	0.55
8	0.59	0.57	0.57	0.57	0.59	0.57	0.57	0.59
9	0.44	0.39	0.39	0.39	0.50	0.39	0.39	0.48
13	0.71	0.70	0.70	0.70	0.76	0.70	0.70	0.74
14	0.59	0.56	0.56	0.56	0.69	0.56	0.56	0.64
15	0.62	0.58	0.59	0.59	0.68	0.58	0.58	0.65
38	0.68	0.65	0.65	0.65	0.78	0.65	0.65	0.77
41	0.61	0.57	0.57	0.57	0.55	0.57	0.57	0.57
46	0.51	0.50	0.50	0.50	0.47	0.50	0.50	0.49
48	0.51	0.50	0.50	0.50	0.46	0.50	0.50	0.47

(continued)

Table E45 continued: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Yalgoo and Sandstone region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Number of groups	10	10	10	10	10	10	10	10
Minimum	0.44	0.39	0.39	0.39	0.46	0.39	0.39	0.47
Maximum	0.71	0.70	0.70	0.70	0.78	0.70	0.70	0.77
Mean	0.58	0.55	0.55	0.55	0.61	0.55	0.55	0.60
Median	0.59	0.56	0.57	0.57	0.59	0.56	0.56	0.58
Standard deviation	0.08	0.09	0.09	0.09	0.12	0.09	0.09	0.11
VI reliability (%)	20.00	10.00	10.00	10.00	40.00	10.00	10.00	20.00
Overall reliability (%)	40.00							

Table E46: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Yalgoo and Sandstone region

Pasture types	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASWS	0.47	0.44	0.44	0.44	0.56	0.44	0.44	0.50
CCAS	0.77	0.66	0.66	0.66	0.85	0.66	0.66	0.82
CEAS	0.65	0.65	0.65	0.65	0.62	0.65	0.65	0.63
DRMS	0.52	0.49	0.49	0.49	0.55	0.49	0.50	0.53
HMCS	0.75	0.71	0.71	0.71	0.66	0.71	0.71	0.70
HPMS	0.52	0.49	0.49	0.50	0.51	0.49	0.49	0.50
LHMS	0.48	0.50	0.50	0.50	0.52	0.50	0.50	0.52
MAAS	0.52	0.52	0.52	0.52	0.57	0.52	0.52	0.56
MUBW	0.67	0.64	0.64	0.63	0.58	0.64	0.64	0.60
MUWA	0.76	0.78	0.77	0.77	0.78	0.78	0.78	0.78
PINW	0.41	0.42	0.42	0.42	0.46	0.42	0.41	0.43
PLMS	0.64	0.58	0.58	0.58	0.55	0.58	0.58	0.56
PXHS	0.68	0.65	0.65	0.65	0.53	0.65	0.65	0.57
SACS	0.57	0.48	0.48	0.48	0.61	0.48	0.48	0.57
SAES	0.61	0.60	0.60	0.60	0.57	0.60	0.60	0.59
SAMP	0.58	0.52	0.52	0.52	0.38	0.52	0.52	0.40
SBMS	0.62	0.59	0.59	0.59	0.50	0.59	0.59	0.51
SGRS	0.61	0.58	0.58	0.58	0.62	0.58	0.58	0.61
SIMS	0.61	0.57	0.57	0.57	0.69	0.57	0.57	0.66
SWGS	0.69	0.66	0.65	0.66	0.56	0.66	0.66	0.60

(continued)

Table E46 continued: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Yalgoo and Sandstone region

Pasture types	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Number of groups	20	20	20	20	20	20	20	20
Minimum	0.41	0.42	0.42	0.42	0.38	0.42	0.41	0.40
Maximum	0.77	0.78	0.77	0.77	0.85	0.78	0.78	0.82
Mean	0.61	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Median	0.61	0.58	0.58	0.58	0.57	0.58	0.58	0.57
Standard deviation	0.10	0.09	0.09	0.09	0.11	0.09	0.09	0.10
VI reliability (%)	30.00	10.00	10.00	10.00	15.00	10.00	10.00	15.00
Overall reliability (%)	35.00							

Table E47: Area under curve values and summary statistics from the fairs-excluded strategy for broad vegetation groups in the Yalgoo and Sandstone region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
EAESP	0.65	0.65	0.65	0.65	0.62	0.65	0.65	0.63
EUCCH	0.51	0.44	0.44	0.44	0.53	0.44	0.44	0.50
HPMSP	0.57	0.55	0.55	0.55	0.56	0.55	0.55	0.56
MIXCH	0.68	0.64	0.64	0.64	0.56	0.64	0.64	0.60
OTHER	0.66	0.63	0.63	0.63	0.72	0.63	0.63	0.70
RIPAR	0.52	0.49	0.49	0.49	0.55	0.49	0.50	0.54
SACES	0.66	0.63	0.63	0.63	0.69	0.63	0.63	0.68
SALTP	0.54	0.50	0.50	0.50	0.56	0.50	0.50	0.54
SAMPH	0.58	0.52	0.52	0.52	0.38	0.52	0.52	0.40
SANDP	0.49	0.47	0.47	0.47	0.52	0.47	0.47	0.51
SGASP	0.69	0.66	0.66	0.66	0.70	0.66	0.66	0.69
SNAKW	0.55	0.51	0.51	0.51	0.63	0.51	0.50	0.58
STMXC	0.65	0.61	0.61	0.61	0.55	0.61	0.61	0.56
Unknown	0.46	0.37	0.37	0.38	0.71	0.37	0.36	0.64
WANDR	0.69	0.65	0.65	0.65	0.61	0.65	0.65	0.63
Number of groups	15	15	15	15	15	15	15	15
Minimum	0.46	0.37	0.37	0.38	0.38	0.37	0.36	0.40
Maximum	0.69	0.66	0.66	0.66	0.72	0.66	0.66	0.70
Mean	0.59	0.55	0.56	0.56	0.59	0.55	0.55	0.58
Median	0.58	0.55	0.55	0.55	0.56	0.55	0.55	0.58
Standard deviation	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.08
VI reliability (%)	20.00	0	0	0	27.00	0	0	0
Overall reliability (%)	40.00							

Table E48: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Yalgoo and Sandstone region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Bannar	0.29	0.23	0.23	0.23	0.43	0.23	0.23	0.34
Bullimore	0.59	0.57	0.57	0.57	0.58	0.57	0.57	0.61
Carnegie	0.61	0.54	0.54	0.54	0.62	0.54	0.54	0.61
Challenge	0.63	0.63	0.63	0.64	0.62	0.63	0.63	0.63
Doney	0.59	0.53	0.53	0.53	0.57	0.53	0.53	0.55
Ero	0.71	0.69	0.69	0.69	0.68	0.69	0.69	0.68
Euchre	0.58	0.53	0.54	0.54	0.66	0.53	0.53	0.63
Gabanintha	0.53	0.58	0.58	0.57	0.59	0.58	0.58	0.59
Gransal	0.61	0.60	0.60	0.60	0.62	0.60	0.60	0.63
Hootanui	0.55	0.56	0.56	0.55	0.52	0.56	0.60	0.55
Joseph	0.33	0.28	0.28	0.29	0.41	0.28	0.28	0.37
Jundee	0.54	0.52	0.52	0.52	0.59	0.52	0.528	0.57
Kalli	0.76	0.73	0.72	0.72	0.68	0.73	0.728	0.71
Mileura	0.44	0.44	0.44	0.44	0.47	0.44	0.44	0.46
Monk	0.58	0.57	0.57	0.57	0.53	0.57	0.57	0.55
Moriarty	0.53	0.50	0.50	0.50	0.64	0.50	0.50	0.57
Nallex	0.55	0.55	0.55	0.55	0.51	0.55	0.56	0.54
Nerramyne	0.54	0.56	0.56	0.56	0.53	0.56	0.56	0.55
Olympic	0.35	0.30	0.29	0.29	0.27	0.30	0.30	0.24
Pindar	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.57
Rainbow	0.61	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Sherwood	0.54	0.50	0.50	0.50	0.59	0.50	0.50	0.56
Tindalarra	0.56	0.55	0.55	0.55	0.61	0.55	0.55	0.59
Tyrrell	0.38	0.50	0.50	0.50	0.45	0.50	0.50	0.56
Violet	0.62	0.62	0.63	0.62	0.61	0.62	0.62	0.65
Waguin	0.80	0.76	0.76	0.76	0.74	0.76	0.76	0.76
Woodline	0.57	0.55	0.55	0.55	0.54	0.55	0.55	0.52
Yanganoo	0.59	0.62	0.62	0.62	0.55	0.62	0.62	0.57
Yowie	0.54	0.51	0.51	0.51	0.48	0.51	0.51	0.49
Number of groups	29	29	29	29	29	29	29	29
Minimum	0.29	0.23	0.23	0.23	0.27	0.23	0.23	0.24
Maximum	0.80	0.76	0.76	0.76	0.74	0.76	0.76	0.76
Mean	0.55	0.54	0.54	0.54	0.56	0.54	0.54	0.56
Median	0.56	0.55	0.55	0.55	0.58	0.55	0.56	0.57
Standard deviation	0.11	0.12	0.12	0.12	0.10	0.12	0.12	0.11
VI reliability (%)	10.35	10.35	10.35	10.35	10.35	10.35	10.35	10.35
Overall reliability (%)	10.35							

Table E49: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Yalgoo and Sandstone region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10a	0.65	0.68	0.68	0.68	0.63	0.68	0.68	0.66
10b	0.58	0.55	0.55	0.56	0.65	0.55	0.55	0.62
12a	0.55	0.51	0.51	0.51	0.52	0.51	0.51	0.51
12b	0.69	0.65	0.65	0.65	0.66	0.65	0.65	0.66
16b	0.63	0.63	0.63	0.64	0.63	0.63	0.63	0.63
17a	0.57	0.56	0.56	0.56	0.55	0.56	0.56	0.56
17b	0.55	0.56	0.56	0.56	0.52	0.56	0.56	0.53
18a	0.56	0.56	0.56	0.56	0.53	0.56	0.56	0.59
20b	0.67	0.61	0.61	0.61	0.65	0.61	0.61	0.65
21b	0.63	0.61	0.61	0.61	0.60	0.61	0.61	0.61
22a	0.59	0.53	0.53	0.53	0.57	0.53	0.53	0.55
23a	0.59	0.58	0.58	0.58	0.51	0.58	0.58	0.54
26	0.55	0.55	0.55	0.55	0.56	0.55	0.55	0.55
28	0.61	0.54	0.54	0.54	0.62	0.54	0.54	0.61
Number of groups	14	14	14	14	14	14	14	14
Minimum	0.55	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Maximum	0.69	0.68	0.68	0.68	0.66	0.68	0.68	0.66
Mean	0.60	0.58	0.58	0.58	0.59	0.58	0.58	0.59
Median	0.59	0.56	0.56	0.56	0.59	0.56	0.56	0.60
Standard deviation	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
VI reliability (%)	14.29	7.14	7.14	7.14	0.00	7.14	7.14	0.00
Overall reliability (%)	21.42							

Table E50: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Yalgoo and Sandstone region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
4	0.52	0.48	0.48	0.48	0.59	0.48	0.48	0.55
8	0.57	0.56	0.56	0.56	0.56	0.56	0.56	0.57
9	0.45	0.40	0.40	0.40	0.49	0.40	0.40	0.47
13	0.66	0.65	0.66	0.66	0.68	0.65	0.65	0.68
14	0.58	0.55	0.55	0.55	0.68	0.55	0.55	0.63
15	0.59	0.56	0.56	0.56	0.64	0.56	0.56	0.61
38	0.68	0.64	0.64	0.64	0.78	0.64	0.64	0.77
41	0.60	0.57	0.57	0.57	0.54	0.57	0.57	0.57

(continued)

Table E50 continued: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Yalgoo and Sandstone region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
46	0.52	0.52	0.52	0.52	0.49	0.52	0.52	0.51
47	0.70	0.70	0.71	0.70	0.65	0.70	0.72	0.69
48	0.52	0.52	0.52	0.52	0.48	0.52	0.52	0.49
49	0.80	0.80	0.80	0.80	0.61	0.80	0.80	0.68
Number of groups	12	12	12	12	12	12	12	12
Minimum	0.45	0.40	0.40	0.40	0.48	0.40	0.40	0.47
Maximum	0.80	0.80	0.80	0.80	0.78	0.80	0.80	0.77
Mean	0.60	0.58	0.58	0.58	0.60	0.58	0.58	0.60
Median	0.58	0.56	0.56	0.56	0.60	0.56	0.56	0.59
Standard deviation	0.10	0.11	0.11	0.11	0.09	0.11	0.11	0.09
VI reliability (%)	25.00	16.67	16.67	16.67	25.00	16.67	16.67	33.33
Overall reliability (%)	41.67							

Table F51: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Yalgoo and Sandstone region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASWS	0.49	0.47	0.48	0.48	0.56	0.47	0.47	0.52
BRXS	0.70	0.68	0.69	0.69	0.71	0.68	0.68	0.71
CCAS	0.71	0.61	0.61	0.61	0.81	0.61	0.61	0.77
CEAS	0.62	0.60	0.60	0.60	0.61	0.60	0.60	0.61
DRMS	0.54	0.52	0.52	0.52	0.51	0.52	0.52	0.52
HMCS	0.66	0.64	0.64	0.64	0.61	0.64	0.64	0.63
HPMS	0.56	0.56	0.56	0.56	0.52	0.56	0.55	0.53
JAMS	0.82	0.77	0.77	0.77	0.80	0.77	0.77	0.81
LHMS	0.46	0.47	0.47	0.47	0.51	0.47	0.47	0.50
MAAS	0.53	0.53	0.53	0.53	0.58	0.53	0.53	0.58
MUBW	0.65	0.62	0.62	0.62	0.57	0.62	0.62	0.59
MUWA	0.72	0.74	0.73	0.73	0.69	0.74	0.74	0.72
PESW	0.43	0.35	0.35	0.35	0.50	0.35	0.35	0.43
PINW	0.43	0.45	0.45	0.45	0.46	0.45	0.45	0.45
PLMS	0.63	0.58	0.58	0.58	0.56	0.58	0.58	0.57
PSAS	0.54	0.49	0.49	0.49	0.44	0.49	0.49	0.43
PXHS	0.62	0.60	0.60	0.60	0.53	0.60	0.60	0.56
SACS	0.57	0.48	0.49	0.49	0.61	0.48	0.48	0.57

(continued)

Table E51 continued: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Yalgoo and Sandstone region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
SAES	0.60	0.57	0.57	0.57	0.54	0.57	0.57	0.55
SAMP	0.57	0.52	0.52	0.52	0.37	0.52	0.52	0.40
SBLS	0.51	0.46	0.45	0.45	0.69	0.46	0.46	0.62
SBMS	0.55	0.53	0.53	0.53	0.52	0.53	0.53	0.52
SGRS	0.61	0.59	0.59	0.59	0.60	0.59	0.59	0.60
SIMS	0.59	0.56	0.56	0.56	0.64	0.56	0.56	0.62
SWGS	0.63	0.60	0.60	0.60	0.53	0.60	0.60	0.56
Number of groups	25	25	25	25	25	25	25	25
Minimum	0.43	0.35	0.35	0.35	0.37	0.35	0.35	0.40
Maximum	0.82	0.77	0.77	0.77	0.81	0.77	0.77	0.81
Mean	0.59	0.56	0.56	0.56	0.58	0.56	0.56	0.57
Median	0.59	0.56	0.56	0.56	0.56	0.56	0.56	0.57
Standard deviation	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.10
VI reliability (%)	16.00	12.00	12.00	12.00	20.00	12.00	12.00	16.00
Overall reliability (%)	20.00							

Table E52: Area under curve values and summary statistics from the fairs-included strategy for broad vegetation groups in the Yalgoo and Sandstone region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
BLUEB	0.54	0.49	0.49	0.49	0.44	0.49	0.49	0.43
EAESP	0.62	0.60	0.60	0.60	0.61	0.60	0.60	0.61
EUCCH	0.53	0.46	0.46	0.46	0.57	0.46	0.46	0.53
HPMSP	0.59	0.57	0.57	0.57	0.55	0.57	0.57	0.56
MIXCH	0.63	0.60	0.60	0.60	0.55	0.60	0.60	0.58
OTHER	0.62	0.58	0.58	0.58	0.67	0.58	0.58	0.65
RIPAR	0.54	0.52	0.52	0.52	0.52	0.52	0.52	0.52
SACES	0.64	0.61	0.61	0.61	0.64	0.61	0.61	0.64
SALTP	0.56	0.53	0.53	0.53	0.59	0.53	0.53	0.58
SAMPH	0.57	0.52	0.52	0.52	0.37	0.52	0.52	0.40
SANDP	0.50	0.48	0.48	0.48	0.53	0.48	0.48	0.52
SGASP	0.66	0.63	0.64	0.64	0.65	0.63	0.63	0.65
SNAKW	0.55	0.52	0.52	0.53	0.62	0.52	0.52	0.57
STMXC	0.56	0.54	0.54	0.54	0.53	0.54	0.54	0.53
Unknown	0.48	0.39	0.40	0.40	0.71	0.39	0.38	0.65

(continued)

Table E52 continued: Area under curve values and summary statistics from the fairs-included strategy for broad vegetation groups in the Yalgoo and Sandstone region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
WANDR	0.66	0.62	0.62	0.62	0.59	0.62	0.62	0.61
Number of groups	16	16	16	16	16	16	16	16
Minimum	0.48	0.39	0.40	0.40	0.37	0.39	0.38	0.40
Maximum	0.66	0.63	0.64	0.64	0.71	0.63	0.63	0.65
Mean	0.58	0.54	0.54	0.54	0.57	0.54	0.54	0.56
Median	0.57	0.53	0.53	0.54	0.58	0.53	0.54	0.57
Standard deviation	0.06	0.07	0.07	0.06	0.09	0.07	0.07	0.08
VI reliability (%)	0	0	0	0	12.50	0	0	0
Overall reliability (%)	12.50							

Table E53: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Yalgoo and Sandstone region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Bannar	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Carnegie	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Challenge	0.44	0.44	0.44	0.44	0.45	0.44	0.44	0.44
Doney	0.48	0.49	0.47	0.48	0.48	0.47	0.47	0.47
Ero	0.48	0.42	0.49	0.49	0.39	0.40	0.49	0.41
Euchre	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Gransal	0.43	0.42	0.42	0.42	0.42	0.42	0.42	0.43
Hootanui	0.47	0.45	0.45	0.46	0.45	0.45	0.46	0.50
Jundee	0.45	0.45	0.45	0.47	0.52	0.45	0.47	0.47
Kalli	0.72	0.72	0.72	0.72	0.73	0.72	0.72	0.73
Mileura	0.41	0.42	0.41	0.40	0.42	0.39	0.43	0.39
Monk	0.39	0.39	0.41	0.40	0.41	0.40	0.39	0.42
Moriarty	0.45	0.40	0.39	0.39	0.41	0.38	0.37	0.42
Nerramyne	0.57	0.57	0.57	0.57	0.58	0.57	0.57	0.57
Pindar	0.55	0.53	0.48	0.49	0.59	0.51	0.57	0.60
Rainbow	0.46	0.45	0.45	0.45	0.46	0.45	0.47	0.47
Sherwood	0.44	0.44	0.44	0.44	0.45	0.44	0.44	0.44
Tindalarra	0.46	0.46	0.46	0.46	0.48	0.46	0.46	0.46
Violet	0.46	0.40	0.41	0.41	0.42	0.41	0.44	0.42
Waguin	0.59	0.59	0.59	0.59	0.60	0.59	0.59	0.60
Tyrrell	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80

(continued)

Table E53 continued: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Yalgoo and Sandstone region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Woodline	0.41	0.41	0.40	0.41	0.41	0.42	0.41	0.42
Yanganoo	0.48	0.49	0.47	0.48	0.48	0.47	0.47	0.48
Yowie	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Number of groups	24	24	24	24	24	24	24	24
Minimum	0.39	0.39	0.39	0.39	0.39	0.38	0.37	0.39
Maximum	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Mean	0.53	0.52	0.52	0.52	0.54	0.52	0.53	0.53
Median	0.48	0.47	0.47	0.48	0.48	0.46	0.47	0.47
Standard deviation	0.14	0.15	0.14	0.14	0.14	0.15	0.14	0.14
VI reliability (%)	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67
Overall reliability (%)	16.67							

Table E54: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Yalgoo and Sandstone region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10a	0.49	0.49	0.50	0.49	0.50	0.49	0.49	0.49
10b	0.42	0.42	0.42	0.42	0.43	0.42	0.42	0.43
12a	0.40	0.40	0.40	0.40	0.41	0.40	0.40	0.40
12b	0.65	0.65	0.65	0.65	0.67	0.65	0.65	0.65
16b	0.45	0.43	0.42	0.42	0.43	0.43	0.44	0.44
17a	0.41	0.41	0.41	0.40	0.41	0.40	0.41	0.42
17b	0.47	0.47	0.47	0.47	0.49	0.47	0.47	0.49
18a	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
20b	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
21b	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.39
22a	0.47	0.48	0.50	0.47	0.48	0.47	0.49	0.47
23a	0.39	0.41	0.45	0.42	0.41	0.42	0.37	0.38
28	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.65
Number of groups	13	13	13	13	13	13	13	13
Minimum	0.38	0.38	0.38	0.38	0.38	0.38	0.37	0.38
Maximum	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Mean	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Median	0.46	0.47	0.47	0.47	0.48	0.47	0.47	0.47
Standard deviation	0.17	0.16	0.16	0.16	0.16	0.16	0.17	0.16
VI reliability (%)	15.38	15.38	15.38	15.38	23.08	15.38	15.38	15.38
Overall reliability (%)	23.08							

Table E55: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Yalgoo and Sandstone region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
4	0.52	0.53	0.53	0.52	0.53	0.53	0.52	0.53
8	0.38	0.38	0.39	0.39	0.38	0.38	0.38	0.39
9	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
13	0.45	0.45	0.45	0.45	0.46	0.45	0.45	0.45
14	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
15	0.44	0.43	0.43	0.44	0.44	0.43	0.43	0.43
38	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
41	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
46	0.40	0.40	0.40	0.42	0.41	0.41	0.41	0.43
47	0.55	0.55	0.55	0.55	0.58	0.55	0.55	0.56
48	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Number of groups	11	11	11	11	11	11	11	11
Minimum	0.38	0.38	0.39	0.39	0.38	0.38	0.38	0.39
Maximum	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Mean	0.58	0.58	0.58	0.58	0.59	0.58	0.58	0.58
Median	0.55	0.55	0.55	0.55	0.58	0.55	0.55	0.56
Standard deviation	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
VI reliability (%)	27.27	27.27	27.27	27.27	27.27	27.27	27.27	27.27
Overall reliability (%)	27.27							

Table E56: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Yalgoo and Sandstone region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASWS	0.39	0.39	0.39	0.37	0.39	0.37	0.39	0.42
CEAS	0.46	0.46	0.47	0.48	0.47	0.48	0.47	0.47
DRMS	0.52	0.50	0.51	0.52	0.50	0.52	0.51	0.52
HMCS	0.45	0.43	0.39	0.39	0.43	0.40	0.39	0.41
HPMS	0.44	0.43	0.44	0.44	0.43	0.42	0.42	0.42
LHMS	0.46	0.46	0.46	0.44	0.50	0.46	0.46	0.45
MAAS	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.87
MUBW	0.42	0.42	0.42	0.42	0.42	0.42	0.41	0.41
MUWA	0.54	0.53	0.54	0.53	0.53	0.54	0.54	0.54
PESW	0.50	0.50	0.50	0.50	0.51	0.50	0.50	0.52
PINW	0.65	0.65	0.65	0.65	0.67	0.65	0.65	0.65

(continued)

Table E56 continued: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Yalgoo and Sandstone region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
PLMS	0.48	0.48	0.48	0.49	0.48	0.48	0.48	0.48
PSAS	0.45	0.45	0.45	0.46	0.49	0.45	0.45	0.48
PXHS	0.42	0.43	0.43	0.42	0.43	0.42	0.42	0.42
SAES	0.40	0.40	0.40	0.40	0.41	0.41	0.40	0.41
SBMS	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
SGRS	0.42	0.42	0.42	0.42	0.43	0.43	0.42	0.43
SIMS	0.60	0.60	0.61	0.59	0.60	0.60	0.61	0.62
SWGS	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Number of groups	17	17	17	17	17	17	17	17
Minimum	0.39	0.39	0.39	0.37	0.39	0.37	0.39	0.41
Maximum	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.87
Mean	0.53	0.52	0.52	0.52	0.53	0.52	0.52	0.53
Median	0.46	0.46	0.47	0.48	0.48	0.48	0.47	0.47
Standard deviation	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
VI reliability (%)	10.52	10.52	10.52	10.52	15.79	10.52	10.52	10.52
Overall reliability (%)	15.79							

Table E57: Overall accuracies and summary statistics from the 3-class strategy for broad vegetation groups in the Yalgoo and Sandstone region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
BLUEB	0.47	0.45	0.45	0.46	0.50	0.46	0.46	0.48
EAESP	0.46	0.47	0.47	0.47	0.47	0.48	0.47	0.47
EUCCH	0.45	0.45	0.45	0.45	0.52	0.46	0.45	0.46
HPMSP	0.42	0.41	0.42	0.42	0.42	0.42	0.41	0.41
MIXCH	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.43
OTHER	0.43	0.43	0.42	0.45	0.47	0.42	0.44	0.45
RIPAR	0.50	0.50	0.51	0.50	0.53	0.50	0.50	0.52
SACES	0.47	0.47	0.47	0.47	0.48	0.47	0.47	0.47
SALTP	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
SANDP	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
SGASP	0.45	0.44	0.44	0.44	0.48	0.44	0.45	0.47
SNAKW	0.38	0.38	0.38	0.38	0.39	0.38	0.38	0.39
STMXC	0.55	0.55	0.55	0.55	0.55	0.54	0.55	0.55
Unknown	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
WANDR	0.54	0.55	0.54	0.54	0.54	0.54	0.55	0.54

(continued)

Table E57 continued: Overall accuracies and summary statistics from the 3-class strategy for broad vegetation groups in the Yalgoo and Sandstone region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Number of groups	15	15	15	15	15	15	15	15
Minimum	0.38	0.38	0.38	0.38	0.39	0.38	0.38	0.39
Maximum	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Mean	0.54	0.54	0.54	0.54	0.55	0.54	0.54	0.54
Median	0.47	0.47	0.47	0.47	0.50	0.47	0.47	0.47
Standard deviation	0.16	0.16	0.16	0.16	0.15	0.16	0.16	0.16
VI reliability (%)	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Overall reliability (%)	20.00							

E.5 Goldfields region

Table E58: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Goldfields region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Ararak	0.67	0.63	0.63	0.63	0.68	0.63	0.63	0.70
Bevon	0.57	0.56	0.56	0.56	0.62	0.56	0.56	0.63
Bullimore	0.67	0.63	0.63	0.63	0.62	0.63	0.63	0.64
Carnegie	0.46	0.46	0.46	0.46	0.55	0.46	0.46	0.54
Darlot	0.69	0.64	0.64	0.64	0.43	0.64	0.64	0.46
Deadman	0.59	0.54	0.54	0.55	0.54	0.54	0.54	0.54
Desdemona	0.69	0.65	0.65	0.65	0.63	0.65	0.65	0.64
Gransal	0.64	0.62	0.62	0.63	0.61	0.62	0.62	0.61
Gundockerta	0.55	0.52	0.52	0.52	0.52	0.52	0.52	0.54
Hamilton	0.42	0.45	0.45	0.45	0.50	0.45	0.45	0.48
Jundee	0.58	0.57	0.57	0.57	0.62	0.57	0.57	0.63
Leonora	0.54	0.53	0.53	0.53	0.46	0.53	0.53	0.49
Marmion	0.93	0.90	0.90	0.90	0.77	0.90	0.90	0.81
Mileura	0.66	0.63	0.63	0.63	0.77	0.63	0.63	0.75
Monitor	0.65	0.64	0.64	0.63	0.75	0.64	0.64	0.74
Monk	0.55	0.51	0.51	0.51	0.56	0.51	0.51	0.55
Nubev	0.53	0.49	0.49	0.49	0.53	0.49	0.49	0.54
Rainbow	0.59	0.60	0.60	0.60	0.65	0.60	0.60	0.65
Sherwood	0.61	0.57	0.57	0.57	0.69	0.57	0.57	0.68
Violet	0.48	0.46	0.46	0.46	0.39	0.46	0.46	0.40
Wilson	0.50	0.50	0.50	0.50	0.56	0.50	0.50	0.54

(continued)

Table E58 continued: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Goldfields region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Windarra	0.58	0.56	0.56	0.56	0.55	0.56	0.56	0.56
Yowie	0.69	0.69	0.69	0.69	0.68	0.69	0.69	0.70
Number of groups	23	23	23	23	23	23	23	23
Minimum	0.42	0.45	0.45	0.45	0.39	0.45	0.45	0.40
Maximum	0.93	0.90	0.90	0.90	0.77	0.90	0.90	0.81
Mean	0.60	0.58	0.58	0.58	0.59	0.58	0.58	0.60
Median	0.59	0.57	0.57	0.57	0.61	0.57	0.57	0.61
Standard deviation	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10
VI reliability (%)	26.09	8.70	8.70	8.70	26.09	8.70	8.70	26.09
Overall reliability (%)	34.78							

Table E59: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Goldfields region

Functional Group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10b	0.58	0.55	0.56	0.56	0.65	0.56	0.55	0.65
12a	0.63	0.63	0.63	0.63	0.66	0.63	0.63	0.63
14a	0.62	0.61	0.61	0.60	0.57	0.61	0.61	0.59
15b	0.61	0.56	0.56	0.56	0.59	0.56	0.56	0.60
16b	0.83	0.79	0.79	0.79	0.78	0.79	0.79	0.78
17a	0.58	0.56	0.56	0.56	0.50	0.56	0.56	0.53
18a	0.67	0.63	0.63	0.63	0.62	0.63	0.63	0.64
18b	0.88	0.86	0.85	0.86	0.81	0.86	0.86	0.83
21a	0.67	0.64	0.64	0.64	0.60	0.64	0.64	0.62
21b	0.71	0.69	0.69	0.69	0.66	0.69	0.69	0.68
23a	0.64	0.59	0.59	0.59	0.68	0.59	0.59	0.67
26	0.59	0.61	0.61	0.61	0.68	0.61	0.61	0.68
28	0.61	0.59	0.59	0.59	0.52	0.59	0.59	0.55
Number of groups	13	13	13	13	13	13	13	13
Minimum	0.58	0.55	0.56	0.56	0.50	0.56	0.55	0.53
Maximum	0.88	0.86	0.85	0.86	0.81	0.86	0.86	0.83
Mean	0.67	0.64	0.64	0.64	0.64	0.64	0.64	0.65
Median	0.64	0.61	0.61	0.61	0.65	0.61	0.61	0.65
Standard deviation	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08
VI reliability (%)	38.46	23.08	23.08	23.08	30.76	23.08	23.08	38.46
Overall reliability (%)	53.85							

Table E60: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Goldfields region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
8	0.68	0.65	0.65	0.65	0.64	0.65	0.65	0.66
15	0.63	0.60	0.60	0.60	0.62	0.60	0.60	0.64
37	0.70	0.69	0.69	0.69	0.34	0.68	0.69	0.41
38	0.62	0.61	0.61	0.61	0.13	0.61	0.61	0.21
46	0.53	0.51	0.51	0.51	0.47	0.51	0.51	0.50
50	0.61	0.60	0.60	0.60	0.62	0.60	0.60	0.62
Number of groups	6	6	6	6	6	6	6	6
Minimum	0.53	0.51	0.51	0.51	0.13	0.51	0.519	0.21
Maximum	0.70	0.68	0.69	0.69	0.64	0.68	0.69	0.66
Mean	0.63	0.61	0.61	0.61	0.47	0.61	0.61	0.51
Median	0.62	0.60	0.60	0.61	0.55	0.60	0.60	0.56
Standard deviation	0.06	0.06	0.07	0.06	0.21	0.06	0.06	0.18
VI reliability (%)	33.33	16.67	16.67	16.67	0.00	16.67	16.67	0.00
Overall reliability (%)	33.33							

Table E60: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Goldfields region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Ararak	0.60	0.57	0.57	0.57	0.63	0.57	0.57	0.63
Bevon	0.57	0.56	0.56	0.56	0.61	0.56	0.56	0.62
Bullimore	0.63	0.59	0.59	0.59	0.58	0.59	0.59	0.59
Carnegie	0.45	0.45	0.45	0.45	0.53	0.45	0.45	0.53
Cunyu	0.45	0.46	0.46	0.46	0.52	0.46	0.46	0.52
Darlot	0.65	0.62	0.62	0.62	0.44	0.62	0.62	0.47
Deadman	0.58	0.54	0.54	0.55	0.54	0.54	0.54	0.55
Desdemona	0.62	0.59	0.60	0.60	0.60	0.60	0.59	0.61
Gransal	0.59	0.58	0.58	0.58	0.57	0.58	0.58	0.57
Gumbreak	0.80	0.77	0.77	0.77	0.74	0.77	0.77	0.74
Gundockerta	0.53	0.52	0.52	0.52	0.51	0.52	0.52	0.53
Hamilton	0.46	0.48	0.48	0.48	0.54	0.48	0.48	0.53
Jundee	0.53	0.52	0.52	0.52	0.58	0.52	0.52	0.58
Laverton	0.70	0.67	0.67	0.67	0.62	0.67	0.67	0.64
Leonora	0.57	0.57	0.56	0.56	0.48	0.57	0.57	0.52
Marmion	0.92	0.90	0.90	0.90	0.77	0.90	0.90	0.80

(continued)

Table E60 continued: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Goldfields region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Mileura	0.61	0.59	0.59	0.59	0.69	0.59	0.59	0.67
Monitor	0.51	0.49	0.49	0.48	0.61	0.49	0.49	0.61
Monk	0.54	0.51	0.51	0.51	0.53	0.51	0.51	0.53
Moriarty	0.42	0.39	0.39	0.39	0.54	0.39	0.39	0.52
Nubev	0.50	0.49	0.49	0.49	0.53	0.49	0.49	0.53
Rainbow	0.53	0.54	0.54	0.54	0.53	0.54	0.54	0.53
Ranch	0.56	0.52	0.52	0.52	0.67	0.52	0.52	0.65
Sherwood	0.58	0.54	0.54	0.54	0.62	0.54	0.54	0.61
Steer	0.67	0.69	0.69	0.69	0.38	0.69	0.69	0.44
Tiger	0.55	0.53	0.53	0.53	0.49	0.53	0.53	0.49
Violet	0.47	0.46	0.46	0.46	0.42	0.46	0.46	0.42
Wilson	0.59	0.57	0.57	0.58	0.58	0.57	0.57	0.58
Windarra	0.59	0.57	0.57	0.57	0.53	0.57	0.57	0.55
Wyarri	0.54	0.53	0.53	0.53	0.55	0.53	0.53	0.55
Yowie	0.66	0.65	0.65	0.65	0.65	0.65	0.65	0.66
Number of groups	31	31	31	31	31	31	31	31
Minimum	0.42	0.39	0.39	0.39	0.38	0.39	0.39	0.42
Maximum	0.92	0.90	0.90	0.90	0.77	0.90	0.90	0.80
Mean	0.58	0.56	0.56	0.56	0.57	0.56	0.56	0.57
Median	0.57	0.54	0.54	0.55	0.55	0.54	0.54	0.55
Standard deviation	0.10	0.10	0.10	0.10	0.09	0.10	0.10	0.08
VI reliability (%)	12.90	12.90	12.90	12.90	12.90	12.90	12.90	9.68
Overall reliability (%)	16.13							

Table E61: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Goldfields region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10a	0.57	0.55	0.55	0.55	0.58	0.55	0.55	0.57
10b	0.58	0.56	0.56	0.56	0.62	0.56	0.56	0.62
12a	0.63	0.60	0.60	0.60	0.62	0.60	0.60	0.62
14a	0.61	0.59	0.59	0.59	0.53	0.59	0.59	0.56
15b	0.60	0.57	0.57	0.57	0.56	0.57	0.57	0.57
16b	0.71	0.67	0.67	0.68	0.67	0.67	0.67	0.67
17a	0.56	0.55	0.55	0.55	0.49	0.55	0.55	0.51
17b	0.42	0.39	0.39	0.39	0.54	0.39	0.39	0.52
18a	0.63	0.59	0.59	0.59	0.58	0.59	0.59	0.59

(continued)

Table E61 continued: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Goldfields region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
18b	0.87	0.85	0.85	0.85	0.80	0.85	0.85	0.82
21a	0.60	0.57	0.57	0.57	0.55	0.57	0.57	0.56
21b	0.65	0.63	0.63	0.63	0.61	0.63	0.63	0.62
23a	0.62	0.58	0.58	0.58	0.63	0.58	0.58	0.64
26	0.52	0.53	0.53	0.53	0.60	0.53	0.53	0.59
28	0.60	0.58	0.58	0.58	0.51	0.58	0.58	0.54
Number of groups	15	15	15	15	15	15	15	15
Minimum	0.42	0.39	0.39	0.39	0.49	0.39	0.39	0.51
Maximum	0.87	0.85	0.85	0.85	0.80	0.85	0.85	0.82
Mean	0.61	0.59	0.59	0.59	0.59	0.59	0.59	0.60
Median	0.60	0.58	0.58	0.58	0.58	0.58	0.58	0.59
Standard deviation	0.10	0.10	0.10	0.10	0.07	0.10	0.10	0.08
VI reliability (%)	13.33	13.33	13.33	13.33	13.33	13.33	13.33	13.33
Overall reliability (%)	13.33							

Table E62: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Goldfields region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
8	0.63	0.60	0.61	0.61	0.59	0.61	0.60	0.60
14	0.29	0.23	0.23	0.23	0.35	0.23	0.23	0.33
15	0.59	0.57	0.57	0.57	0.58	0.57	0.57	0.60
37	0.70	0.68	0.68	0.68	0.40	0.68	0.68	0.46
38	0.58	0.58	0.58	0.58	0.13	0.58	0.58	0.19
46	0.52	0.50	0.50	0.50	0.48	0.50	0.50	0.50
50	0.59	0.59	0.59	0.59	0.61	0.59	0.59	0.61
51	0.49	0.49	0.49	0.49	0.46	0.49	0.49	0.47
Number of groups	8	8	8	8	8	8	8	8
Minimum	0.29	0.23	0.23	0.23	0.13	0.23	0.23	0.19
Maximum	0.70	0.68	0.68	0.68	0.61	0.68	0.68	0.61
Mean	0.55	0.53	0.53	0.53	0.45	0.53	0.53	0.47
Median	0.59	0.58	0.58	0.58	0.47	0.58	0.58	0.48
Standard deviation	0.12	0.13	0.13	0.13	0.16	0.13	0.13	0.15
VI reliability (%)	12.50	12.50	12.50	12.50	0.00	12.50	12.50	0.00
Overall reliability (%)	12.50							

Table E63: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Goldfields region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Ararak	0.50	0.49	0.50	0.50	0.50	0.49	0.50	0.53
Bevon	0.47	0.47	0.47	0.47	0.49	0.47	0.47	0.47
Bullimore	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.72
Carnegie	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Cunyu	0.46	0.45	0.45	0.45	0.47	0.46	0.45	0.47
Darlot	0.60	0.60	0.60	0.60	0.61	0.60	0.60	0.60
Deadman	0.72	0.71	0.71	0.71	0.71	0.73	0.73	0.71
Desd Mona	0.41	0.41	0.43	0.41	0.42	0.47	0.44	0.41
Gransal	0.40	0.40	0.40	0.40	0.41	0.40	0.40	0.42
Gundo Ckerta	0.41	0.41	0.42	0.41	0.41	0.41	0.41	0.44
Hamilton	0.45	0.47	0.45	0.45	0.47	0.46	0.46	0.46
Jundee	0.50	0.50	0.50	0.50	0.51	0.50	0.50	0.50
Laverton	0.50	0.48	0.51	0.50	0.49	0.50	0.48	0.54
Leonora	0.46	0.46	0.46	0.46	0.48	0.46	0.46	0.47
Marmion	0.83	0.78	0.82	0.82	0.80	0.81	0.79	0.81
Mileura	0.39	0.40	0.39	0.43	0.43	0.39	0.44	0.53
Monk	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Moriarty	0.62	0.61	0.58	0.59	0.61	0.63	0.60	0.63
Nubev	0.52	0.52	0.52	0.52	0.53	0.52	0.52	0.52
Rainbow	0.47	0.49	0.50	0.48	0.49	0.48	0.50	0.50
Ranch	0.42	0.41	0.41	0.42	0.43	0.43	0.42	0.44
Sherwood	0.40	0.40	0.40	0.40	0.42	0.40	0.40	0.42
Steer	0.53	0.53	0.53	0.53	0.54	0.53	0.53	0.53
Tiger	0.43	0.43	0.43	0.43	0.47	0.44	0.43	0.45
Violet	0.42	0.40	0.45	0.42	0.43	0.38	0.36	0.40
Windarra	0.48	0.44	0.45	0.44	0.44	0.45	0.46	0.45
Wyarri	0.57	0.57	0.57	0.58	0.57	0.57	0.57	0.57
Yowie	0.59	0.58	0.59	0.58	0.60	0.60	0.59	0.59
Number of groups	28	28	28	28	28	28	28	28
Minimum	0.39	0.40	0.39	0.40	0.41	0.38	0.36	0.40
Maximum	0.83	0.81	0.82	0.82	0.81	0.81	0.81	0.81
Mean	0.52	0.51	0.52	0.52	0.52	0.52	0.52	0.53
Median	0.47	0.48	0.48	0.48	0.49	0.48	0.48	0.50
Standard deviation	0.12	0.12	0.12	0.12	0.11	0.12	0.12	0.12
VI reliability (%)	14.29	14.29	14.29	14.29	14.29	14.29	14.29	14.29
Overall reliability (%)	14.29							

Table E64: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Goldfields region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
10a	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
10b	0.36	0.37	0.37	0.38	0.40	0.36	0.38	0.40
12a	0.44	0.44	0.43	0.43	0.44	0.43	0.43	0.45
14a	0.44	0.42	0.43	0.43	0.43	0.42	0.42	0.44
15b	0.43	0.43	0.45	0.44	0.45	0.45	0.44	0.46
16b	0.41	0.40	0.51	0.48	0.55	0.41	0.43	0.56
17a	0.38	0.38	0.38	0.39	0.39	0.38	0.38	0.39
18a	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.72
18b	0.79	0.79	0.79	0.80	0.79	0.78	0.79	0.80
21a	0.41	0.38	0.38	0.40	0.39	0.39	0.41	0.44
21b	0.40	0.42	0.40	0.43	0.40	0.41	0.40	0.40
23a	0.50	0.50	0.50	0.49	0.50	0.50	0.49	0.50
26	0.36	0.42	0.40	0.41	0.40	0.36	0.39	0.49
28	0.76	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Number of groups	14	14	14	14	14	14	14	14
Minimum	0.36	0.37	0.37	0.38	0.39	0.36	0.38	0.39
Maximum	0.79	0.79	0.79	0.80	0.79	0.78	0.79	0.80
Mean	0.49	0.50	0.50	0.51	0.51	0.49	0.50	0.53
Median	0.43	0.43	0.44	0.44	0.44	0.43	0.43	0.48
Standard deviation	0.15	0.15	0.15	0.14	0.14	0.15	0.15	0.14
VI reliability (%)	21.43	21.43	21.43	21.43	21.43	21.43	21.43	21.43
Overall reliability (%)	21.43							

Table E65: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Goldfields region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
8	0.42	0.40	0.41	0.41	0.38	0.40	0.38	0.38
15	0.47	0.47	0.46	0.45	0.45	0.45	0.46	0.46
46	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
50	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
Number of groups	4	4	4	4	4	4	4	4
Minimum	0.42	0.40	0.41	0.41	0.38	0.40	0.38	0.38
Maximum	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Mean	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Median	0.52	0.52	0.51	0.51	0.51	0.51	0.51	0.51
Standard deviation	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
VI reliability (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overall reliability (%)	0.00							

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Table E66: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Nullarbor region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Arubiddy	0.91	0.98	0.83	0.83	0.98
Balgair	0.74	0.89	0.76	0.76	0.82
Caiguna	0.88	0.96	0.81	0.81	0.93
Gafa	0.57	0.43	0.59	0.59	0.46
Gumbelt	0.59	0.56	0.62	0.63	0.60
Haig	0.56	0.70	0.56	0.56	0.63
Kanandah	0.72	0.74	0.68	0.68	0.74
Kinclaven	0.72	0.67	0.73	0.73	0.68
Koonjarra	0.71	0.75	0.63	0.63	0.72
Kybo	0.86	0.83	0.85	0.85	0.85
Moonera	0.85	0.90	0.83	0.83	0.87
Nanambinia	0.73	0.76	0.75	0.75	0.79
Naretha	0.81	0.80	0.81	0.81	0.80
Nightshade	0.96	0.99	0.96	0.96	0.99
Nurina	0.60	0.69	0.62	0.62	0.65
Nyanga	0.82	0.86	0.76	0.76	0.83
Pondana	0.71	0.75	0.71	0.71	0.74
Shake-Hole	0.62	0.69	0.60	0.60	0.65
Thampanna	0.51	0.64	0.50	0.50	0.60
Vanesk	0.79	0.86	0.77	0.77	0.85
Woorlba	0.87	0.79	0.91	0.91	0.84
Number of groups	21	21	21	21	21
Minimum	0.51	0.43	0.50	0.50	0.46
Maximum	0.96	0.99	0.96	0.96	0.99
Mean	0.74	0.77	0.73	0.73	0.76
Median	0.73	0.76	0.75	0.75	0.79
Standard deviation	0.13	0.14	0.12	0.12	0.14
VI reliability (%)	71.43	85.71	66.67	66.67	71.43
Overall reliability (%)	85.71				

Table E67: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Nullarbor region

Functional group	EVI	LMI	MSAVI2	NDVI	STVI-1
19a	0.59	0.65	0.57	0.57	0.62
19b	0.83	0.85	0.78	0.78	0.84
19c	0.67	0.72	0.68	0.68	0.71
19d	0.74	0.76	0.61	0.61	0.72
Number of groups	4	4	4	4	4
Minimum	0.59	0.65	0.57	0.57	0.62
Maximum	0.83	0.85	0.78	0.78	0.84
Mean	0.71	0.75	0.66	0.66	0.72
Median	0.71	0.74	0.64	0.64	0.72
Standard deviation	0.10	0.08	0.09	0.09	0.09
VI reliability (%)	75.00	75.00	50.00	50.00	75.00
Overall reliability (%)	75.00				

Table E68: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Nullarbor region

Pre-European vegetation type	EVI	LMI	MSAVI2	NDVI	STVI-1
4	0.72	0.80	0.72	0.72	0.77
16	0.69	0.76	0.69	0.69	0.75
45	0.77	0.89	0.73	0.73	0.84
46	0.78	0.81	0.73	0.73	0.78
49	0.74	0.78	0.67	0.67	0.75
105	0.72	0.75	0.74	0.74	0.75
Number of groups	6	6	6	6	6
Minimum	0.69	0.75	0.67	0.67	0.75
Maximum	0.78	0.89	0.74	0.74	0.84
Mean	0.74	0.80	0.71	0.71	0.77
Median	0.73	0.79	0.72	0.72	0.76
Standard deviation	0.03	0.05	0.03	0.03	0.04
VI reliability (%)	100.00	100.00	100.00	100.00	100.00
Overall reliability (%)	100.00				

Table E69: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Nullarbor region

Pasture type	EVI	LMI	MSAVI2	NDVI	STVI-1
BSSL	0.68	0.70	0.69	0.69	0.72
EXCW	0.87	0.87	0.87	0.87	0.89
EXSW	0.41	0.58	0.30	0.30	0.34
MPBS	0.60	0.71	0.54	0.54	0.65
MSAW	0.53	0.51	0.52	0.52	0.53
MXCS	0.85	0.79	0.74	0.74	0.76
OBIG	0.83	0.79	0.84	0.84	0.82
PBLS	0.66	0.73	0.62	0.62	0.70
PXCS	0.62	0.71	0.59	0.59	0.66
PXHS	0.62	0.72	0.57	0.57	0.64
SWCS	0.69	0.92	0.78	0.78	0.91
SWOG	0.61	0.69	0.50	0.50	0.62
XSBG	0.69	0.71	0.68	0.68	0.70
Unknown	0.71	0.75	0.63	0.63	0.69
Number of groups	14	14	14	14	14
Minimum	0.41	0.51	0.30	0.30	0.34
Maximum	0.87	0.92	0.87	0.87	0.91
Mean	0.67	0.73	0.63	0.63	0.69
Median	0.67	0.72	0.62	0.62	0.70
Standard deviation	0.12	0.10	0.15	0.15	0.15
VI reliability (%)	50.00	85.71	42.86	42.86	57.14
Overall reliability (%)	85.71				

Table E70: Area under curve values and summary statistics from the fairs-excluded strategy for broad vegetation groups in the Nullarbor region

Broad vegetation group	EVI	LMI	MSAVI2	NDVI	STVI-1
EUCCH	0.71	0.76	0.68	0.68	0.72
MIXCH	0.64	0.73	0.60	0.60	0.68
NULBR	0.63	0.69	0.59	0.59	0.65
OTHER	0.91	0.93	0.90	0.90	0.92
SALTP	0.68	0.70	0.69	0.69	0.72
SPWGR	0.74	0.76	0.66	0.66	0.74
Unknown	0.71	0.75	0.63	0.63	0.69
Number of groups	7	7	7	7	7
Minimum	0.63	0.69	0.59	0.59	0.65
Maximum	0.91	0.93	0.90	0.90	0.92

(continued)

Table E70 continued: Area under curve values and summary statistics from the fairs-excluded strategy for broad vegetation groups in the Nullarbor region

Broad vegetation group	EVI	LMI	MSAVI2	NDVI	STVI-1
Mean	0.72	0.76	0.68	0.68	0.73
Median	0.71	0.75	0.66	0.66	0.72
Standard deviation	0.12	0.11	0.14	0.14	0.15
VI reliability (%)	71.43	100.00	42.86	42.86	85.71
Overall reliability (%)	100.00				

Table E71: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Nullarbor region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Arubiddy	0.88	0.95	0.79	0.79	0.96
Balgair	0.69	0.84	0.71	0.71	0.78
Caiguna	0.86	0.94	0.80	0.80	0.91
Gafa	0.54	0.42	0.53	0.53	0.42
Gumbelt	0.59	0.56	0.62	0.62	0.59
Haig	0.55	0.66	0.55	0.55	0.60
Kanandah	0.61	0.58	0.59	0.59	0.59
Kinclaven	0.64	0.62	0.65	0.65	0.62
Koonjarra	0.67	0.71	0.59	0.59	0.67
Kybo	0.79	0.78	0.78	0.78	0.79
Moonera	0.84	0.88	0.82	0.82	0.85
Nanambinia	0.66	0.67	0.67	0.67	0.69
Naretha	0.71	0.73	0.71	0.71	0.73
Nightshade	0.95	0.98	0.95	0.95	0.98
Nurina	0.54	0.61	0.55	0.55	0.57
Nyanga	0.78	0.81	0.73	0.73	0.78
Pondana	0.65	0.70	0.66	0.66	0.69
Shake Hole	0.61	0.67	0.59	0.59	0.64
Thampanna	0.53	0.63	0.52	0.52	0.60
Vanesk	0.75	0.83	0.74	0.74	0.83
Woorlba	0.84	0.76	0.88	0.88	0.81
Number of groups	21	21	21	21	21
Minimum	0.53	0.42	0.52	0.52	0.42
Maximum	0.95	0.98	0.95	0.95	0.98
Mean	0.70	0.73	0.69	0.69	0.72
Median	0.67	0.71	0.67	0.67	0.69
Standard deviation	0.13	0.14	0.12	0.12	0.14
VI reliability (%)	52.38	66.67	52.38	52.38	61.91
Overall reliability (%)	66.67				

Table E72: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Nullarbor region

Functional Group	EVI	LMI	MSAVI2	NDVI	STVI-1
19a	0.58	0.63	0.55	0.55	0.60
19b	0.77	0.78	0.73	0.73	0.77
19c	0.67	0.72	0.67	0.67	0.70
19d	0.66	0.68	0.59	0.59	0.65
Number of groups	4	4	4	4	4
Minimum	0.58	0.63	0.55	0.55	0.60
Maximum	0.77	0.78	0.73	0.73	0.77
Mean	0.67	0.70	0.64	0.64	0.68
Median	0.67	0.70	0.63	0.63	0.68
Standard deviation	0.08	0.07	0.08	0.08	0.07
VI reliability (%)	50.00	75.00	50.00	50.00	50.00
Overall reliability (%)	75.00				

Table E73: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Nullarbor region

Pre-European vegetation type	EVI	LMI	MSAVI2	NDVI	STVI-1
4	0.71	0.79	0.71	0.71	0.76
16	0.65	0.72	0.64	0.64	0.70
45	0.73	0.84	0.69	0.69	0.79
46	0.71	0.73	0.68	0.68	0.71
49	0.69	0.73	0.63	0.63	0.71
105	0.70	0.71	0.71	0.71	0.72
Number of groups	6	6	6	6	6
Minimum	0.65	0.71	0.63	0.63	0.70
Maximum	0.73	0.84	0.71	0.71	0.79
Mean	0.70	0.75	0.68	0.68	0.73
Median	0.71	0.73	0.68	0.68	0.71
Standard deviation	0.03	0.05	0.03	0.03	0.04
VI reliability (%)	83.33	100.00	66.67	66.67	100.00
Overall reliability (%)	100.00				

Table E74: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Nullarbor region

Pasture type	EVI	LMI	MSAVI2	NDVI	STVI-1
BSSL	0.66	0.68	0.66	0.66	0.69
ESAW	0.64	0.67	0.64	0.64	0.65
EXCW	0.84	0.86	0.85	0.85	0.87
EXSW	0.41	0.58	0.30	0.30	0.33
MPBS	0.59	0.70	0.54	0.54	0.64
MSAW	0.49	0.46	0.48	0.48	0.48
MXCS	0.82	0.75	0.72	0.72	0.73
OBIG	0.72	0.70	0.72	0.72	0.71
OTHR	0.74	0.83	0.67	0.67	0.76
PBAC	0.76	0.75	0.78	0.78	0.76
PBLS	0.64	0.69	0.59	0.59	0.67
PXCS	0.60	0.67	0.58	0.58	0.64
PXHS	0.61	0.71	0.56	0.56	0.63
SWCS	0.68	0.88	0.76	0.76	0.88
SWOG	0.57	0.65	0.48	0.48	0.58
XAOS	0.62	0.62	0.59	0.59	0.61
XSBG	0.73	0.75	0.74	0.74	0.77
Unknown	0.58	0.64	0.57	0.57	0.63
Number of groups	18	18	18	18	18
Minimum	0.41	0.46	0.30	0.30	0.33
Maximum	0.84	0.88	0.85	0.85	0.88
Mean	0.65	0.70	0.62	0.63	0.67
Median	0.64	0.69	0.62	0.62	0.66
Standard deviation	0.11	0.10	0.13	0.13	0.13
VI reliability (%)	38.89	72.22	38.89	38.89	50.00
Overall reliability (%)	72.22				

Table E75: Area under curve values and summary statistics from the fairs-included strategy for broad vegetation groups in the Nullarbor region

Broad vegetation group	EVI	LMI	MSAVI2	NDVI	STVI-1
EUCCH	0.70	0.74	0.67	0.67	0.70
MIXCH	0.62	0.70	0.59	0.59	0.66
NULBR	0.60	0.65	0.56	0.56	0.62
OTHER	0.74	0.77	0.73	0.73	0.76
SACES	0.72	0.74	0.73	0.73	0.75
SALTP	0.66	0.68	0.66	0.66	0.69
SPWGR	0.68	0.70	0.62	0.62	0.67
Unknown	0.62	0.62	0.59	0.59	0.61
Number of groups	8	8	8	8	8
Minimum	0.60	0.62	0.56	0.56	0.61
Maximum	0.74	0.77	0.73	0.73	0.76
Mean	0.67	0.70	0.64	0.64	0.68
Median	0.67	0.70	0.64	0.64	0.68
Standard deviation	0.05	0.05	0.07	0.07	0.06
VI reliability (%)	50.00	75.00	37.50	37.50	62.50
Overall reliability (%)	75.00				

Table E76: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Nullarbor region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Arubiddy	0.68	0.68	0.68	0.69	0.70
Balgair	0.67	0.67	0.68	0.67	0.67
Haig	0.63	0.63	0.64	0.63	0.64
Kanandah	0.57	0.59	0.57	0.58	0.59
Kinclaven	0.58	0.58	0.58	0.58	0.59
Koonjarra	0.76	0.76	0.76	0.76	0.78
Kybo	0.59	0.59	0.61	0.62	0.63
Moonera	0.73	0.73	0.73	0.73	0.73
Nanambinia	0.62	0.60	0.61	0.61	0.63
Naretha	0.57	0.56	0.56	0.56	0.63
Nightshade	0.76	0.76	0.77	0.76	0.77
Nurina	0.53	0.56	0.53	0.54	0.57
Nyanga	0.81	0.81	0.81	0.81	0.81
Pondana	0.45	0.47	0.44	0.44	0.54
Shake Hole	0.60	0.60	0.60	0.60	0.60

(continued)

Table E76 continued: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Nullarbor region

Land system	EVI	LMI	MSAVI2	NDVI	STVI-1
Thampanna	0.48	0.48	0.48	0.48	0.50
Woorlba	0.80	0.81	0.80	0.80	0.80
Number of groups	17	17	17	17	17
Minimum	0.45	0.47	0.44	0.44	0.50
Maximum	0.81	0.81	0.81	0.81	0.81
Mean	0.64	0.64	0.64	0.64	0.66
Median	0.62	0.60	0.61	0.62	0.63
Standard deviation	0.10	0.10	0.11	0.11	0.09
VI reliability (%)	41.18	41.18	41.18	41.18	41.18
Overall reliability (%)	41.18				

Table E77: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Nullarbor region

Functional group	EVI	LMI	MSAVI2	NDVI	STVI-1
19a	0.62	0.62	0.62	0.62	0.63
19b	0.68	0.68	0.68	0.68	0.72
19c	0.92	0.92	0.92	0.92	0.92
19d	0.58	0.50	0.50	0.51	0.61
Number of groups	4	4	4	4	4
Minimum	0.58	0.50	0.50	0.51	0.61
Maximum	0.92	0.92	0.92	0.92	0.92
Mean	0.70	0.68	0.68	0.68	0.72
Median	0.65	0.65	0.65	0.65	0.67
Standard deviation	0.13	0.15	0.16	0.15	0.12
VI reliability (%)	50.00	50.00	50.00	50.00	50.00
Overall reliability (%)	50.00				

Table E78: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Nullarbor region

Pre-European vegetation type	EVI	LMI	MSAVI2	NDVI	STVI-1
4	0.87	0.87	0.87	0.87	0.87
16	0.54	0.55	0.54	0.54	0.56
45	0.72	0.73	0.72	0.73	0.73
46	0.69	0.68	0.68	0.68	0.71
49	0.57	0.57	0.57	0.57	0.62
105	0.80	0.80	0.80	0.80	0.80

(continued)

Table E78 continued: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Nullarbor region

Pre-European vegetation type	EVI	LMI	MSAVI2	NDVI	STVI-1
Number of groups	6	6	6	6	6
Minimum	0.54	0.55	0.54	0.54	0.56
Maximum	0.87	0.87	0.87	0.87	0.87
Mean	0.70	0.70	0.70	0.70	0.72
Median	0.70	0.70	0.70	0.70	0.72
Standard deviation	0.12	0.11	0.12	0.12	0.10
VI reliability (%)	66.67	66.67	66.67	66.67	66.67
Overall reliability (%)	66.67				

Table E79: Overall accuracies and summary statistics from the 3-class strategy for pre-pasture types in the Nullarbor region

Pasture type	EVI	LMI	MSAVI2	NDVI	STVI-1
BSSL	0.65	0.65	0.65	0.65	0.66
ESAW	0.47	0.47	0.47	0.47	0.52
MPBS	0.69	0.69	0.70	0.69	0.70
MSAW	0.51	0.52	0.50	0.50	0.56
MXCS	0.83	0.83	0.83	0.83	0.83
OBIG	0.56	0.47	0.59	0.56	0.56
PBLS	0.67	0.67	0.67	0.67	0.68
PXCS	0.67	0.67	0.67	0.67	0.68
PXHS	0.83	0.83	0.83	0.83	0.83
SWCS	0.79	0.79	0.79	0.79	0.79
SWOG	0.63	0.64	0.63	0.63	0.68
Unknown	0.63	0.63	0.63	0.63	0.64
Number of groups	14	14	14	14	14
Minimum	0.47	0.47	0.47	0.47	0.52
Maximum	0.83	0.83	0.83	0.83	0.83
Mean	0.67	0.67	0.67	0.67	0.68
Median	0.67	0.67	0.67	0.67	0.68
Standard deviation	0.11	0.11	0.11	0.11	0.09
VI reliability (%)	57.14	57.14	57.14	57.14	71.43
Overall reliability (%)	71.43				

Table E80: Overall accuracies and summary statistics from the 3-class strategy for broad vegetation groups in the Nullarbor region

Broad vegetation group	EVI	LMI	MSAVI2	NDVI	STVI-1
EUCCH	0.84	0.84	0.84	0.84	0.85
MIXCH	0.73	0.73	0.73	0.73	0.73
NULBR	0.71	0.71	0.71	0.71	0.71
OTHER	0.78	0.74	0.78	0.79	0.74
SACES	0.63	0.65	0.63	0.63	0.63
SALTP	0.65	0.67	0.65	0.65	0.67
SPWGR	0.50	0.52	0.50	0.50	0.50
Unknown	0.63	0.63	0.63	0.63	0.63
Number of groups	8	8	8	8	8
Minimum	0.50	0.52	0.50	0.50	0.50
Maximum	0.84	0.84	0.84	0.84	0.85
Mean	0.68	0.68	0.68	0.69	0.68
Median	0.68	0.68	0.68	0.68	0.68
Standard deviation	0.10	0.09	0.10	0.10	0.09
VI reliability (%)	50.00	62.50	50.00	50.00	62.50
Overall reliability (%)	62.50				

E.7 Other Rangelands region

Table E81: Area under curve values and summary statistics from the fairs-excluded strategy for land systems in the Other Rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Globe	0.87	0.79	0.79	0.79	0.64	0.79	0.79	0.70
Number of groups	1	1	1	1	1	1	1	1
Minimum	0.87	0.79	0.79	0.79	0.64	0.79	0.79	0.70
Maximum	0.87	0.79	0.79	0.79	0.64	0.79	0.79	0.70
Mean	0.87	0.79	0.79	0.79	0.64	0.79	0.79	0.70
Median	0.87	0.79	0.79	0.79	0.64	0.79	0.79	0.70
Standard deviation	na	na	na	na	na	na	na	na
VI reliability (%)	100.00	100.00	100.00	100.00	0	100.00	100.00	100.00
Overall reliability (%)	100.00							

na = not applicable

Table E82: Area under curve values and summary statistics from the fairs-excluded strategy for functional groups in the Other Rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
11	0.72	0.99	0.99	0.99	0.59	0.99	0.99	0.67
18a	0.62	0.65	0.65	0.65	0.55	0.65	0.65	0.57
21a	0.80	0.80	0.80	0.80	0.75	0.80	0.80	0.77
22a	0.56	0.60	0.60	0.60	0.71	0.60	0.60	0.67
27a	0.82	0.76	0.76	0.76	0.86	0.76	0.76	0.84
Number of groups	5	5	5	5	5	5	5	5
Minimum	0.56	0.60	0.60	0.60	0.55	0.60	0.60	0.57
Maximum	0.82	0.99	0.99	0.99	0.86	0.99	0.99	0.84
Mean	0.70	0.76	0.76	0.76	0.69	0.76	0.76	0.70
Median	0.72	0.76	0.76	0.76	0.71	0.76	0.76	0.67
Standard deviation	0.11	0.15	0.15	0.15	0.13	0.15	0.15	0.11
VI reliability (%)	60.00	60.00	60.00	60.00	60.00	60.00	60.00	80.00
Overall reliability (%)	80.00							

Table E83: Area under curve values and summary statistics from the fairs-excluded strategy for pre-European vegetation types in the Other Rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
15	0.61	0.55	0.55	0.55	0.90	0.55	0.55	0.89
38	0.62	0.63	0.63	0.63	0.70	0.63	0.63	0.69
110	0.83	0.77	0.77	0.77	0.67	0.77	0.77	0.71
116	0.88	0.84	0.84	0.84	0.95	0.84	0.84	0.94
Number of groups	4	4	4	4	4	4	4	4
Minimum	0.61	0.55	0.55	0.55	0.67	0.55	0.55	0.69
Maximum	0.88	0.84	0.84	0.84	0.95	0.84	0.84	0.94
Mean	0.74	0.70	0.70	0.70	0.80	0.70	0.70	0.81
Median	0.73	0.70	0.70	0.70	0.80	0.70	0.70	0.80
Standard deviation	0.14	0.13	0.13	0.13	0.14	0.13	0.13	0.13
VI reliability (%)	50.00	50.00	50.00	50.00	100.00	50.00	50.00	100.00
Overall reliability (%)	100.00							

Table E84: Area under curve values and summary statistics from the fairs-excluded strategy for pasture types in the Other Rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
HPMS	0.70	0.70	0.70	0.70	0.66	0.70	0.70	0.67
SOSP	0.84	0.89	0.89	0.89	0.64	0.89	0.89	0.74
SSPP	0.68	0.67	0.67	0.66	0.69	0.67	0.67	0.68
TGCH	0.54	0.54	0.54	0.54	0.81	0.54	0.54	0.73
USBS	0.71	0.68	0.68	0.68	0.81	0.68	0.68	0.82
Number of groups	5	5	5	5	5	5	5	5
Minimum	0.54	0.54	0.54	0.54	0.64	0.54	0.54	0.67
Maximum	0.84	0.89	0.89	0.89	0.81	0.89	0.89	0.82
Mean	0.69	0.70	0.70	0.69	0.72	0.70	0.70	0.73
Median	0.70	0.68	0.68	0.68	0.69	0.68	0.68	0.73
Standard deviation	0.11	0.12	0.13	0.13	0.08	0.13	0.12	0.06
VI reliability (%)	80.00	80.00	80.00	60.00	60.00	80.00	80.00	100.00
Overall reliability (%)	100.00							

Table E85: Area under curve values and summary statistics from the fairs-excluded strategy for broad vegetation groups in the Other Rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
BUFFL	0.54	0.54	0.54	0.54	0.81	0.54	0.54	0.73
MIXCH	0.91	0.82	0.82	0.82	0.66	0.82	0.82	0.73
OTHER	0.67	0.67	0.67	0.67	0.73	0.67	0.67	0.74
SOSPX	0.84	0.89	0.89	0.89	0.64	0.89	0.89	0.74
TSKGR	0.55	0.55	0.54	0.54	0.80	0.55	0.55	0.73
Unknown	0.85	0.80	0.80	0.80	0.92	0.80	0.80	0.93
Number of groups	6	6	6	6	6	6	6	6
Minimum	0.54	0.54	0.54	0.54	0.64	0.54	0.54	0.73
Maximum	0.91	0.89	0.89	0.89	0.92	0.89	0.89	0.93
Mean	0.73	0.71	0.71	0.71	0.76	0.71	0.71	0.77
Median	0.76	0.74	0.74	0.74	0.77	0.74	0.74	0.74
Standard deviation	0.16	0.15	0.15	0.15	0.11	0.15	0.15	0.08
VI reliability (%)	66.67	66.67	66.67	66.67	66.67	66.67	66.67	100.00
Overall reliability (%)	100.00							

Table E86: Area under curve values and summary statistics from the fairs-included strategy for land systems in the Other Rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Bidgemia	0.69	0.70	0.70	0.70	0.59	0.70	0.70	0.68
Globe	0.74	0.72	0.72	0.72	0.55	0.72	0.72	0.61
Nanyarra	0.68	0.65	0.65	0.65	0.73	0.65	0.65	0.71
Yalbalgo	0.46	0.50	0.50	0.50	0.51	0.50	0.50	0.53
Number of groups	4	4	4	4	4	4	4	4
Minimum	0.46	0.50	0.50	0.50	0.51	0.50	0.50	0.53
Maximum	0.74	0.72	0.72	0.72	0.73	0.72	0.72	0.71
Mean	0.64	0.64	0.64	0.64	0.60	0.64	0.64	0.63
Median	0.69	0.67	0.67	0.67	0.57	0.67	0.67	0.64
Standard deviation	0.13	0.10	0.10	0.10	0.10	0.10	0.10	0.08
VI reliability (%)	75.00	50.00	50.00	50.00	25.00	50.00	50.00	50.00
Overall reliability (%)	75.00							

Table E87: Area under curve values and summary statistics from the fairs-included strategy for functional groups in the Other Rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
11	0.71	0.99	0.99	0.99	0.62	0.99	0.99	0.69
16a	0.57	0.57	0.57	0.57	0.30	0.57	0.57	0.32
18a	0.62	0.66	0.66	0.66	0.55	0.66	0.66	0.56
20a	0.57	0.55	0.55	0.56	0.52	0.55	0.55	0.57
20b	0.69	0.70	0.70	0.70	0.59	0.70	0.70	0.68
21a	0.67	0.65	0.65	0.65	0.60	0.65	0.65	0.61
21b	0.76	0.76	0.76	0.76	0.65	0.76	0.76	0.71
22a	0.57	0.60	0.60	0.60	0.61	0.60	0.60	0.60
23a	0.68	0.55	0.55	0.55	0.54	0.55	0.55	0.57
27a	0.74	0.70	0.70	0.70	0.78	0.70	0.70	0.76
29c	0.96	0.92	0.92	0.92	0.94	0.92	0.92	0.95
Number of groups	11	11	11	11	11	11	11	11
Minimum	0.57	0.55	0.55	0.55	0.30	0.55	0.55	0.32
Maximum	0.96	0.99	0.99	0.99	0.94	0.99	0.99	0.95
Mean	0.69	0.70	0.70	0.70	0.61	0.70	0.70	0.64
Median	0.68	0.66	0.66	0.66	0.60	0.66	0.66	0.61
Standard deviation	0.11	0.15	0.15	0.15	0.16	0.15	0.15	0.16
VI reliability (%)	63.64	45.46	45.46	45.46	18.18	45.46	45.46	45.46
Overall reliability (%)	63.64							

Table E88: Area under curve values and summary statistics from the fairs-included strategy for pre-European vegetation types in the Other Rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
15	0.50	0.46	0.46	0.46	0.84	0.46	0.46	0.82
38	0.61	0.62	0.62	0.62	0.66	0.62	0.62	0.66
106	0.43	0.47	0.47	0.47	0.57	0.47	0.47	0.56
110	0.76	0.74	0.74	0.74	0.63	0.74	0.74	0.67
116	0.85	0.83	0.83	0.83	0.92	0.83	0.83	0.91
Number of groups	5	5	5	5	5	5	5	5
Minimum	0.43	0.46	0.46	0.46	0.57	0.46	0.46	0.56
Maximum	0.85	0.83	0.83	0.83	0.92	0.83	0.83	0.91
Mean	0.63	0.62	0.62	0.62	0.72	0.62	0.62	0.72
Median	0.61	0.62	0.62	0.62	0.66	0.62	0.62	0.67
Standard deviation	0.18	0.16	0.16	0.16	0.15	0.16	0.16	0.14
VI reliability (%)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	60.00
Overall reliability (%)	60.00							

Table E89: Area under curve values and summary statistics from the fairs-included strategy for pasture types in the Other Rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
AMSG–AMSP	0.86	0.85	0.85	0.85	0.74	0.85	0.85	0.82
CENC	0.86	0.78	0.78	0.78	0.49	0.78	0.78	0.62
HPMS	0.71	0.70	0.70	0.70	0.59	0.70	0.70	0.63
SMMS	0.69	0.73	0.73	0.73	0.38	0.73	0.73	0.39
SOSP	0.84	0.88	0.87	0.87	0.61	0.87	0.87	0.71
SSPG	0.67	0.66	0.66	0.66	0.68	0.66	0.66	0.67
TGCE	0.53	0.55	0.55	0.55	0.72	0.55	0.55	0.68
Unknown	0.65	0.64	0.64	0.64	0.76	0.64	0.64	0.76
Number of groups	8	8	8	8	8	8	8	8
Minimum	0.53	0.55	0.55	0.55	0.38	0.55	0.55	0.39
Maximum	0.86	0.88	0.87	0.87	0.76	0.87	0.87	0.82
Mean	0.73	0.72	0.72	0.72	0.62	0.72	0.72	0.66
Median	0.70	0.71	0.71	0.71	0.64	0.71	0.71	0.67
Standard deviation	0.12	0.11	0.11	0.11	0.13	0.11	0.11	0.13
VI reliability (%)	75.00	62.50	62.50	62.50	50.00	62.50	62.50	62.50
Overall reliability (%)	100.00							

Table E90: Area under curve values and summary statistics from the fairs-included strategy for broad vegetation groups in the Other Rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASGRF	0.78	0.73	0.72	0.72	0.30	0.72	0.73	0.43
BUFFL	0.53	0.55	0.55	0.55	0.72	0.55	0.55	0.67
CENC	0.86	0.78	0.78	0.78	0.49	0.78	0.78	0.62
HARSP	0.91	0.83	0.83	0.83	0.65	0.83	0.83	0.72
HPMSP	0.69	0.68	0.68	0.68	0.61	0.68	0.68	0.65
SACES	0.65	0.66	0.66	0.66	0.53	0.66	0.67	0.53
SALTP	0.59	0.56	0.56	0.56	0.36	0.56	0.56	0.36
SOSPX	0.84	0.88	0.87	0.87	0.61	0.87	0.87	0.71
TSKGR	0.54	0.56	0.56	0.56	0.72	0.56	0.56	0.68
Unknown	0.77	0.72	0.72	0.72	0.86	0.72	0.72	0.86
Number of groups	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Minimum	0.53	0.55	0.55	0.55	0.30	0.55	0.55	0.36
Maximum	0.91	0.88	0.87	0.87	0.86	0.87	0.87	0.86
Mean	0.72	0.69	0.69	0.69	0.58	0.69	0.69	0.62
Median	0.73	0.70	0.70	0.70	0.61	0.70	0.70	0.66
Standard deviation	0.14	0.12	0.12	0.12	0.17	0.12	0.12	0.15
VI reliability (%)	60.00	60.00	60.00	60.00	30.00	60.00	70.00	50.00
Overall reliability (%)	90.00							

Table E91: Overall accuracies and summary statistics from the 3-class strategy for land systems in the Other Rangelands region

Land system	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
Globe	0.53	0.53	0.54	0.56	0.54	0.57	0.59	0.55
Nanyarra	0.59	0.59	0.59	0.59	0.60	0.59	0.59	0.60
Yalbalgo	0.50	0.49	0.49	0.49	0.50	0.49	0.49	0.50
Number of groups	3	3	3	3	3	3	3	3
Minimum	0.50	0.49	0.49	0.49	0.50	0.49	0.49	0.50
Maximum	0.59	0.59	0.59	0.59	0.60	0.59	0.59	0.60
Mean	0.54	0.54	0.54	0.55	0.54	0.55	0.55	0.55
Median	0.53	0.53	0.54	0.56	0.54	0.57	0.59	0.55
Standard deviation	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04
VI reliability (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overall reliability (%)	0.00							

Table E92: Overall accuracies and summary statistics from the 3-class strategy for functional groups in the Other Rangelands region

Functional group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
20a	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.51
21a	0.64	0.64	0.64	0.64	0.65	0.64	0.64	0.64
21b	0.57	0.58	0.57	0.57	0.57	0.57	0.58	0.58
22a	0.48	0.57	0.55	0.53	0.50	0.58	0.55	0.49
27a	0.51	0.51	0.51	0.51	0.56	0.51	0.51	0.56
Number of groups	5	5	5	5	5	5	5	5
Minimum	0.48	0.50	0.50	0.50	0.50	0.50	0.50	0.49
Maximum	0.64	0.64	0.64	0.64	0.65	0.64	0.64	0.64
Mean	0.54	0.56	0.55	0.55	0.56	0.56	0.56	0.56
Median	0.51	0.57	0.55	0.53	0.56	0.57	0.55	0.56
Standard deviation	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VI reliability (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overall reliability (%)	0.00							

Table E93: Overall accuracies and summary statistics from the 3-class strategy for pre-European vegetation types in the Other Rangelands region

Pre-European vegetation type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
15	0.41	0.42	0.46	0.48	0.55	0.45	0.44	0.49
38	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
106	0.47	0.46	0.47	0.46	0.47	0.46	0.46	0.47
110	0.46	0.38	0.45	0.43	0.41	0.40	0.38	0.43
116	0.52	0.53	0.53	0.52	0.59	0.53	0.52	0.57
Number of groups	5	5	5	5	5	5	5	5
Minimum	0.41	0.38	0.45	0.43	0.41	0.40	0.38	0.43
Maximum	0.56	0.56	0.56	0.56	0.59	0.56	0.56	0.57
Mean	0.48	0.47	0.49	0.49	0.52	0.48	0.47	0.50
Median	0.47	0.46	0.47	0.48	0.55	0.46	0.46	0.49
Standard deviation	0.05	0.07	0.04	0.04	0.07	0.06	0.06	0.05
VI reliability (%)	0.00	0.00.	0.00	0.00	0.00	0.00	0.00	0.00
Overall reliability (%)	0.00							

Table E94: Overall accuracies and summary statistics from the 3-class strategy for pasture types in the Other Rangelands region

Pasture type	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
HPMS	0.65	0.64	0.64	0.64	0.67	0.64	0.65	0.64
SMMS	0.76	0.77	0.76	0.76	0.76	0.76	0.76	0.76
SOSP	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
TGCE	0.45	0.45	0.45	0.45	0.47	0.45	0.45	0.45
Unknown	0.59	0.59	0.59	0.59	0.61	0.59	0.59	0.60
Number of groups	5	5	5	5	5	5	5	5
Minimum	0.45	0.45	0.45	0.45	0.47	0.45	0.45	0.45
Maximum	0.76	0.77	0.76	0.76	0.76	0.76	0.76	0.76
Mean	0.63	0.63	0.63	0.63	0.64	0.63	0.63	0.63
Median	0.65	0.64	0.64	0.64	0.66	0.64	0.65	0.64
Standard deviation	0.12	0.12	0.12	0.12	0.11	0.12	0.12	0.12
VI reliability (%)	40.00	40.00	40.00	40.00	60.00	40.00	40.00	40.00
Overall reliability (%)	60.00							

Table E95: Overall accuracies and summary statistics from the 3-class strategy for broad vegetation groups in the Other Rangelands region

Broad vegetation group	EVI	GDVI2	GDVI3	GDVI4	LMI	MSAVI2	NDVI	STVI-1
ASGRP	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
BUFFL	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
CACES	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
HARSP	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
HPMSP	0.63	0.63	0.63	0.63	0.64	0.63	0.63	0.63
SALTP	0.59	0.61	0.59	0.61	0.59	0.62	0.61	0.59
SOSPX	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
TSKGR	0.45	0.45	0.45	0.45	0.47	0.45	0.45	0.45
Unknown	0.58	0.55	0.55	0.53	0.62	0.55	0.46	0.56
Number of groups	9	9	9	9	9	9	9	9
Minimum	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Maximum	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Mean	0.61	0.60	0.60	0.60	0.61	0.60	0.59	0.61
Median	0.61	0.62	0.61	0.62	0.63	0.63	0.62	0.61
Standard deviation	0.11	0.11	0.11	0.11	0.10	0.11	0.12	0.11
VI reliability (%)	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33
Overall reliability (%)	33.33							

Appendix F Maps showing where VIs can be used for monitoring pasture condition in each region

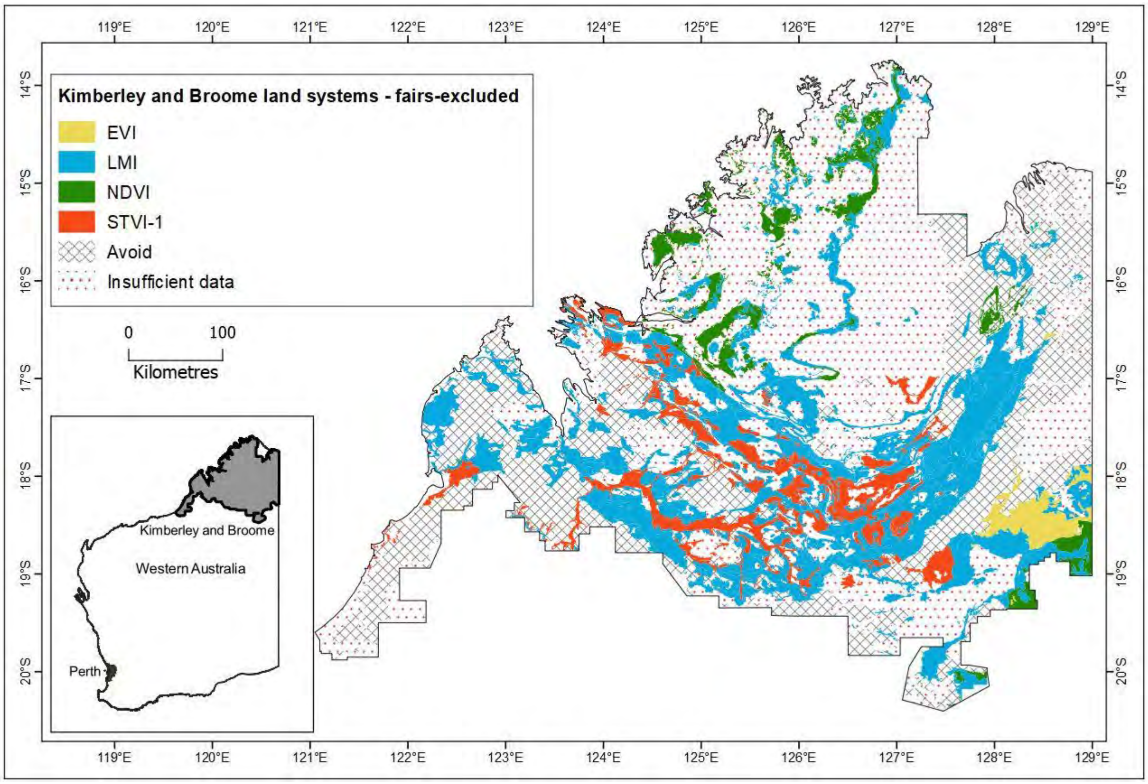

Figure F1: The most suitable VIs for monitoring pasture condition of land systems in the Kimberley and Broome region using fairs-excluded strategy

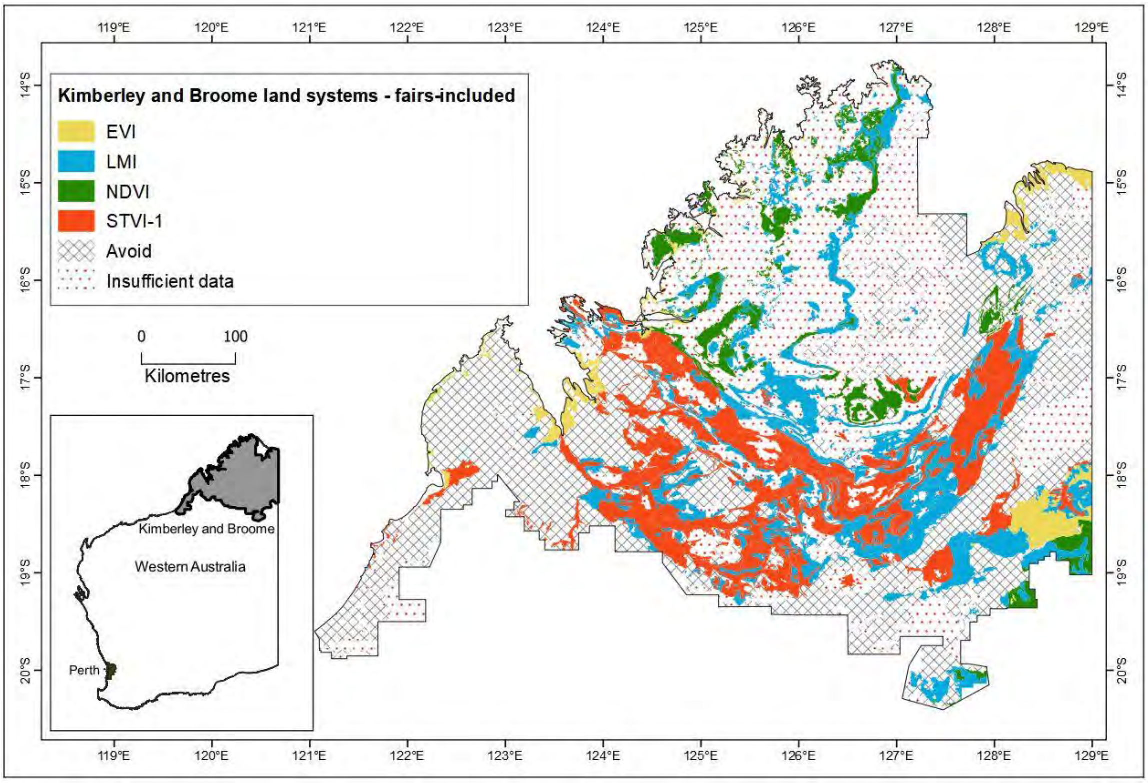

Figure F2: The most suitable VIs for monitoring pasture condition of land systems in the Kimberley and Broome region using fairs-included strategy

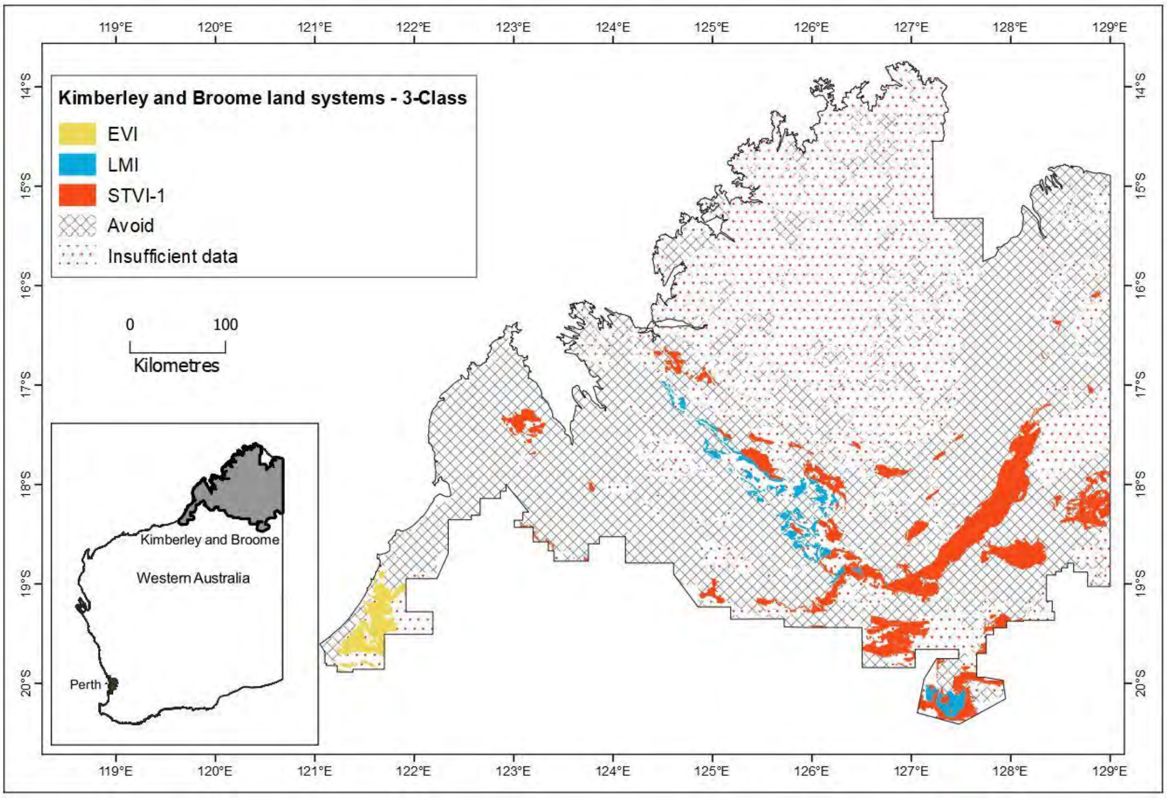

Figure F3: The most suitable VIs for monitoring pasture condition of land systems in the Kimberley and Broome region using 3-class strategy

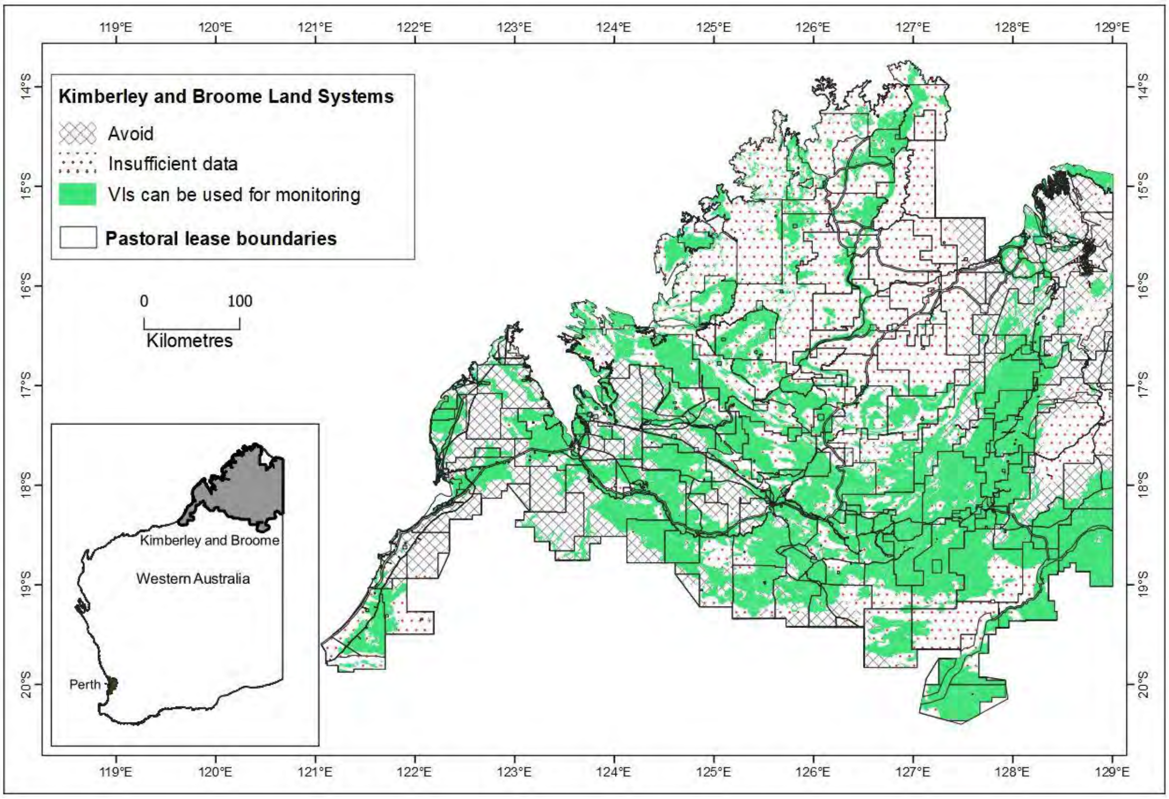

Figure F4: Where VIs can be used for monitoring pasture condition of land systems in the Kimberley and Broome region

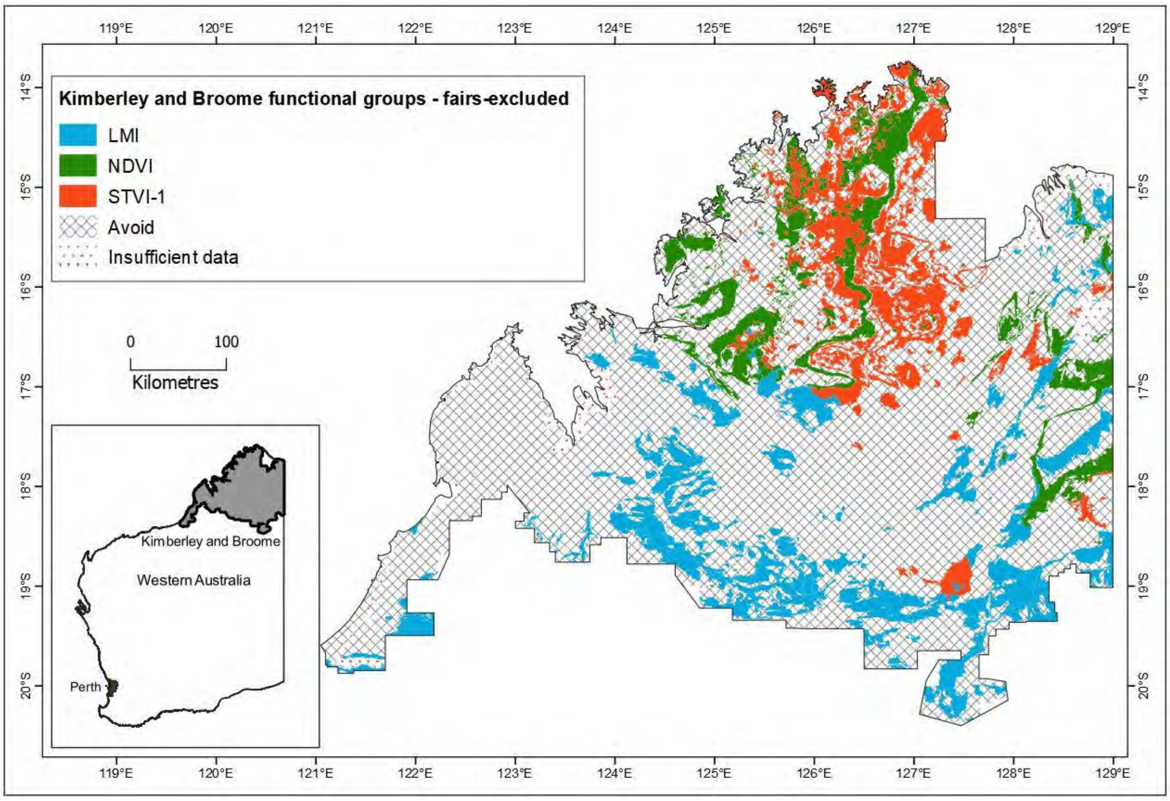

Figure F5: The most suitable VIs for monitoring pasture condition of functional groups in the Kimberley and Broome region using fairs-excluded strategy

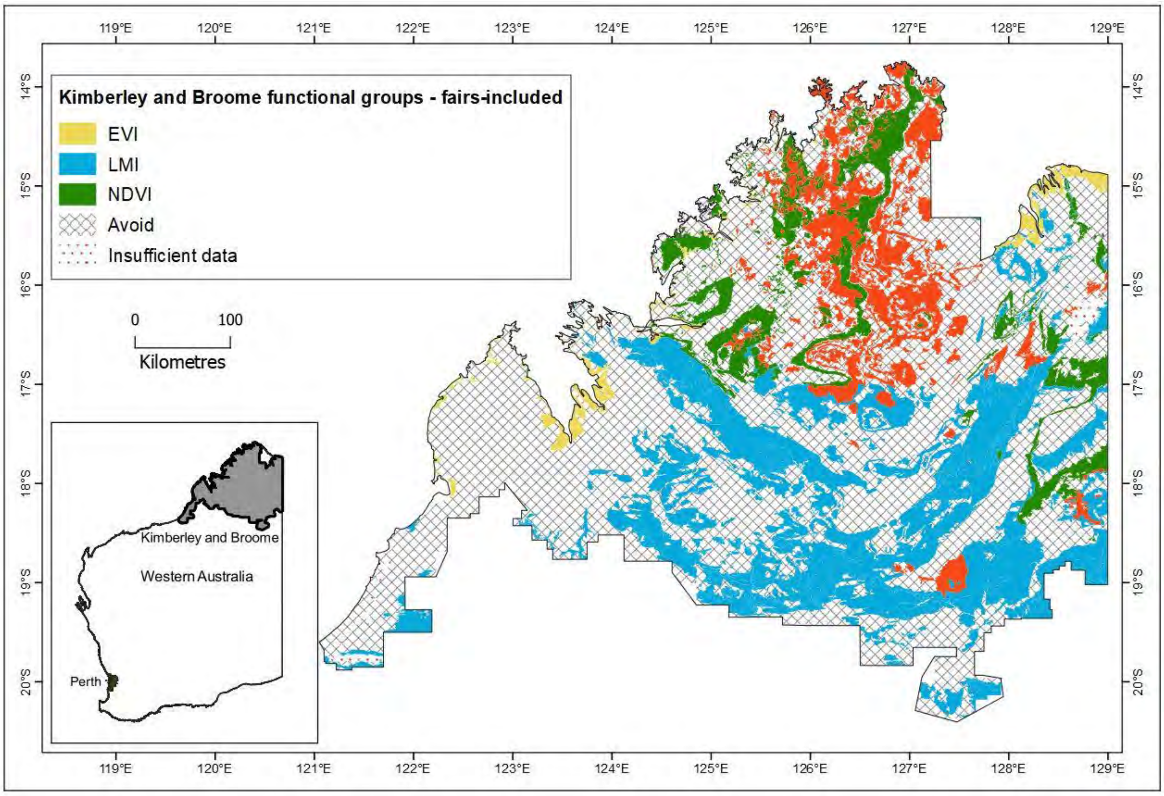

Figure F6: The most suitable VIs for monitoring pasture condition of functional groups in the Kimberley and Broome region using fairs-included strategy

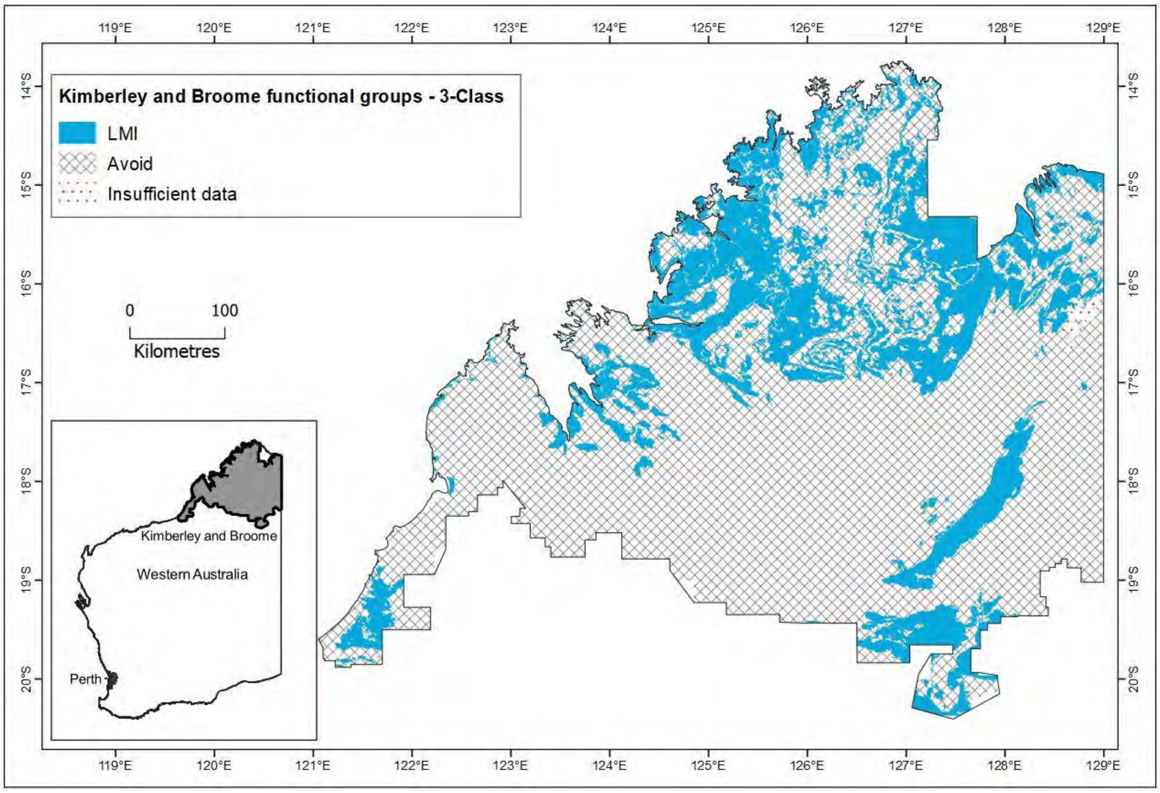

Figure F7: The most suitable VIs for monitoring pasture condition of functional groups in the Kimberley and Broome region using 3-class strategy

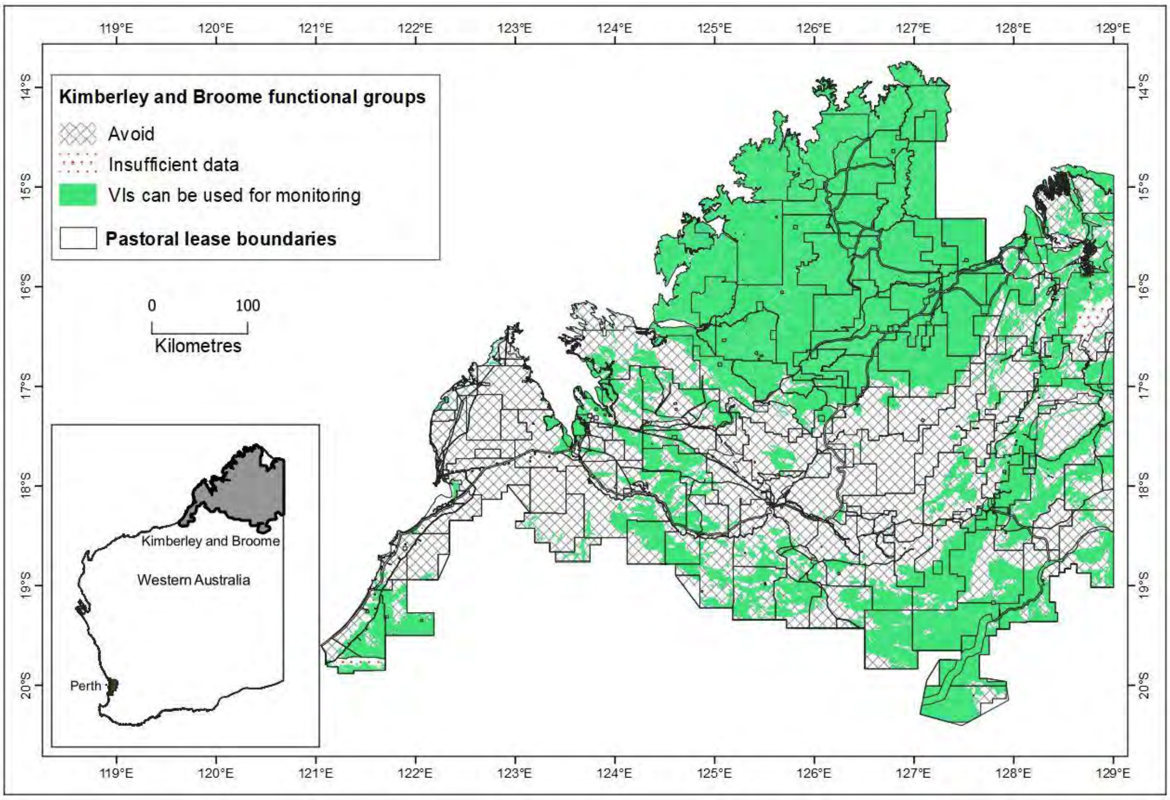

Figure F8: Where VIs can be used for monitoring pasture condition of functional groups in the Kimberley and Broome region

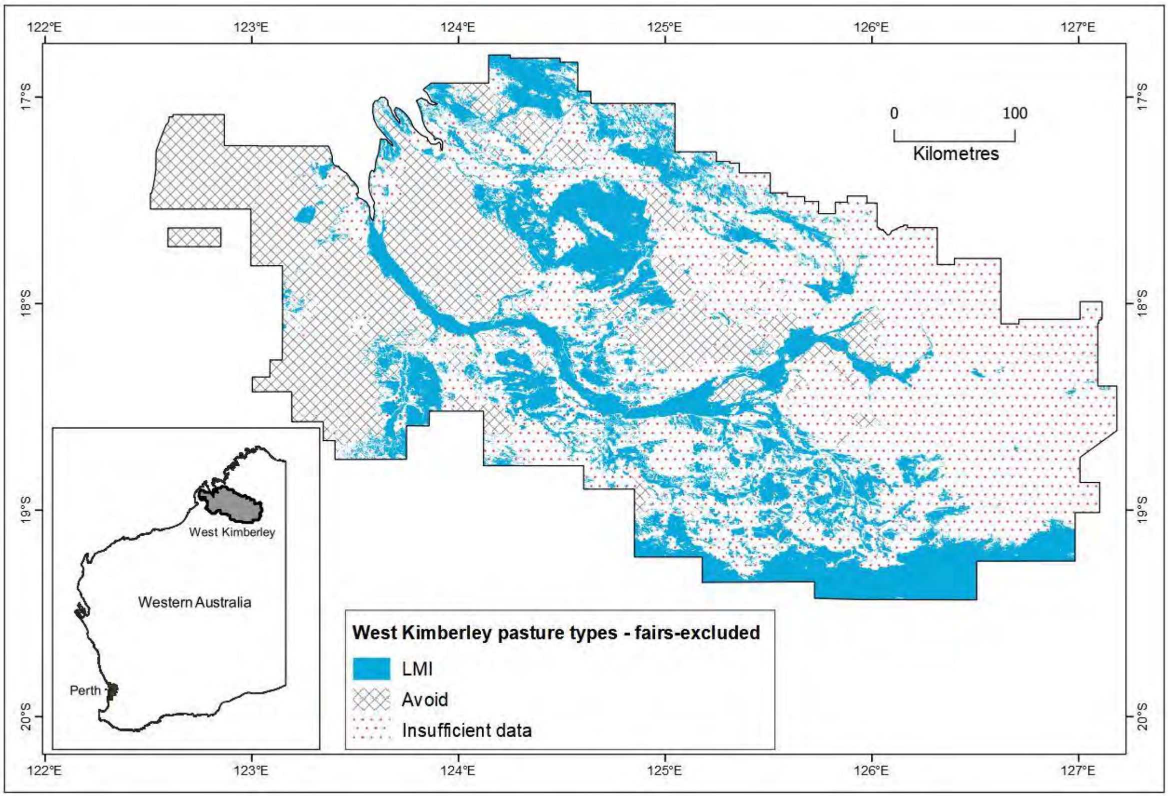

Figure F9: The most suitable VIs for monitoring pasture condition of pasture types in the West Kimberley district using fairs-excluded strategy

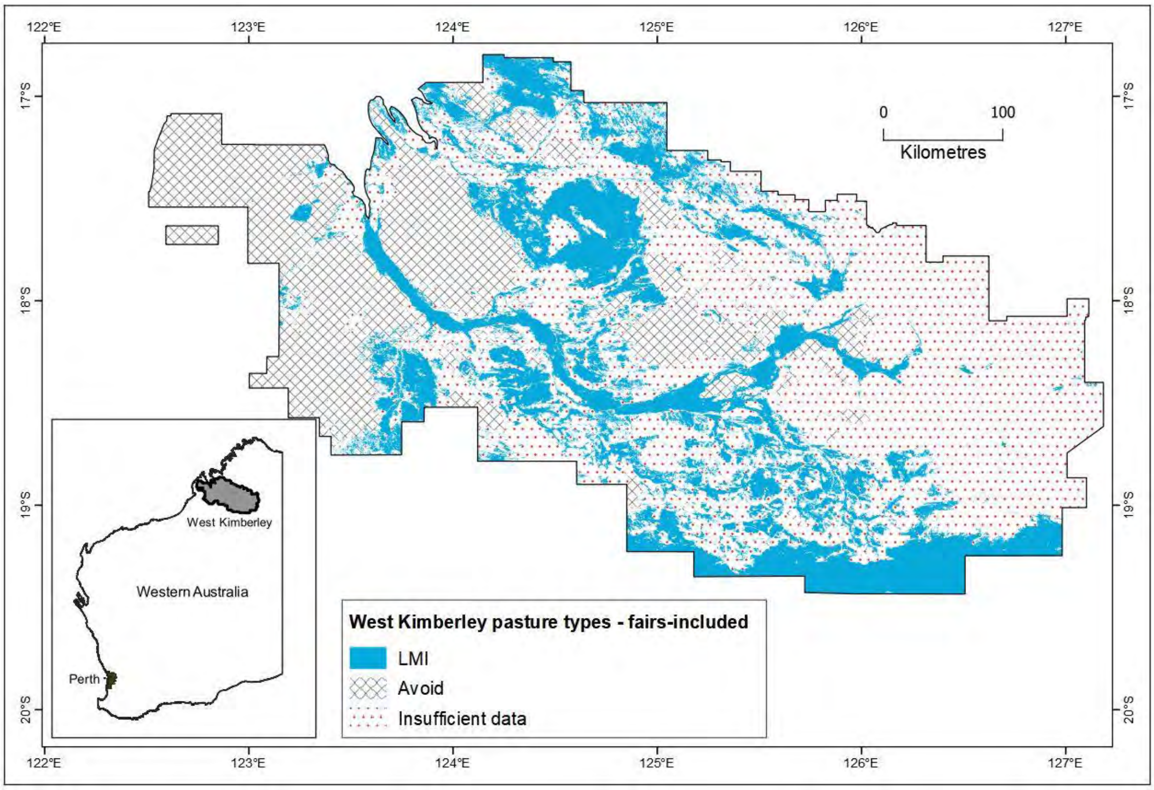

Figure F10: The most suitable VIs for monitoring pasture condition of pasture types in the West Kimberley district using fairs-included strategy

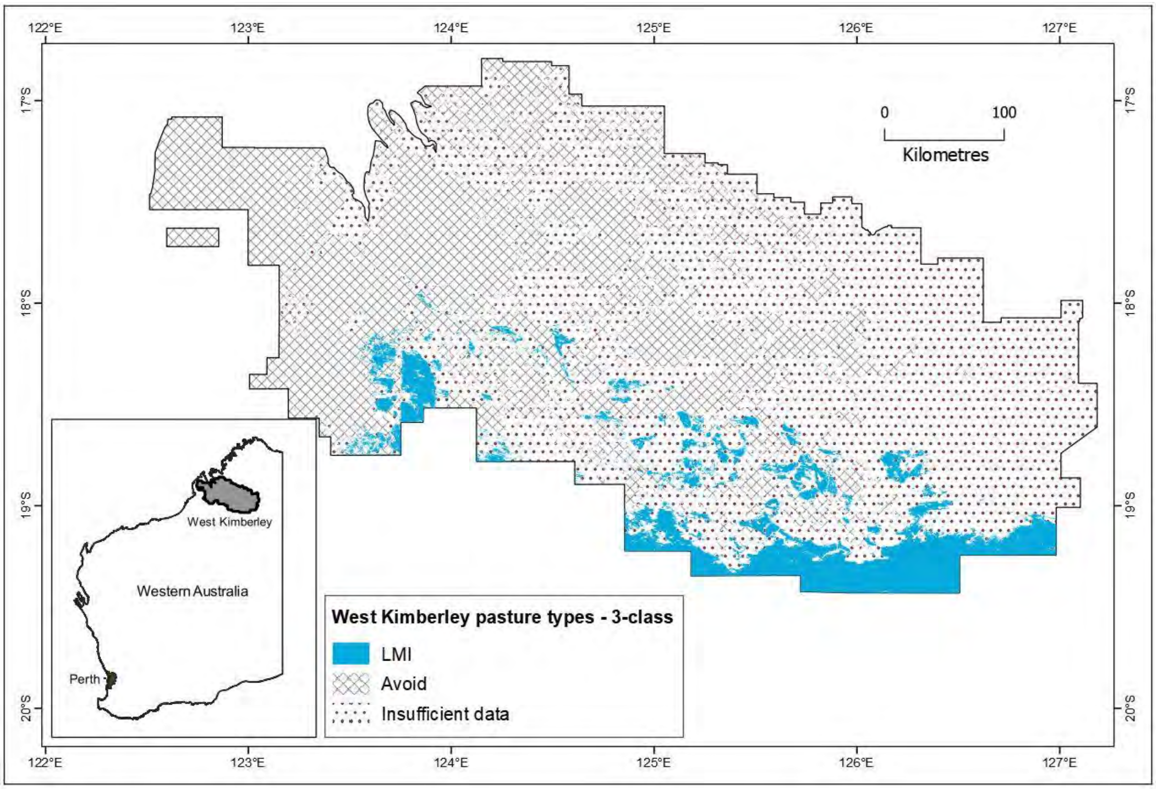

Figure F11: The most suitable VIs for monitoring pasture condition of pasture types in the West Kimberley district using 3-class strategy

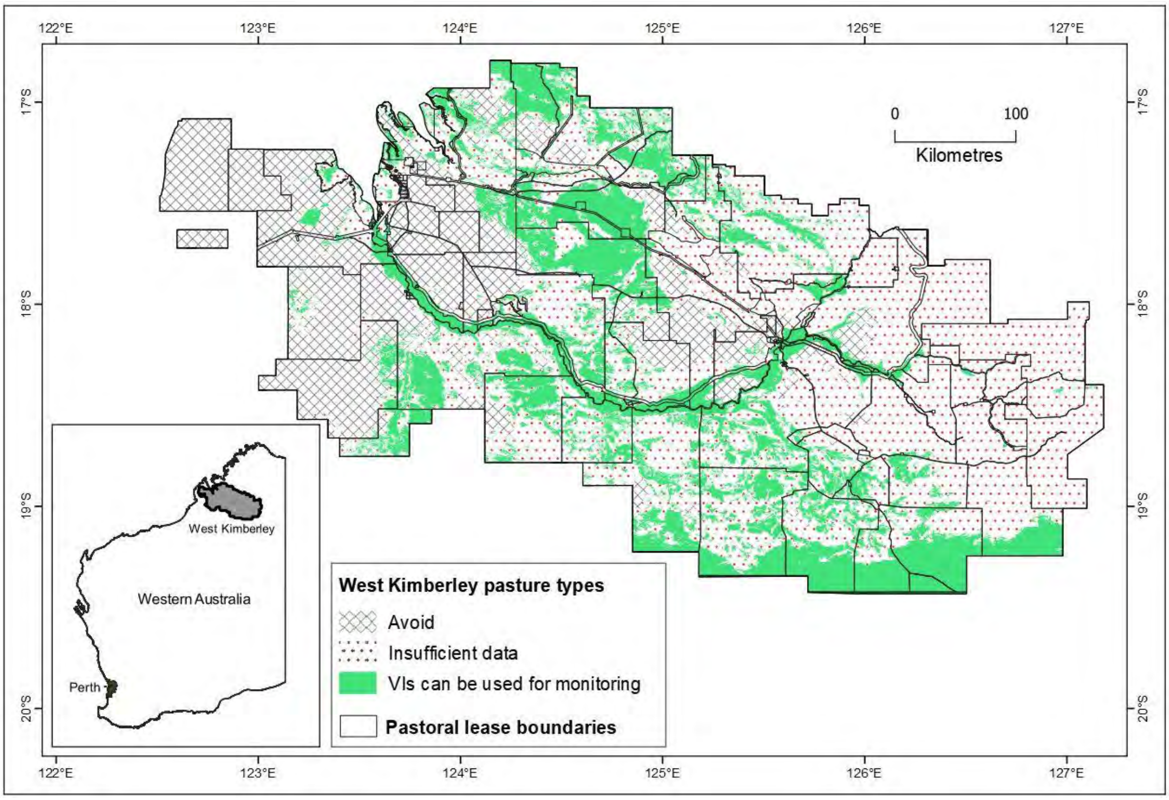

Figure F12: Where VIs can be used for monitoring pasture condition of pasture types in the West Kimberley land conservation district

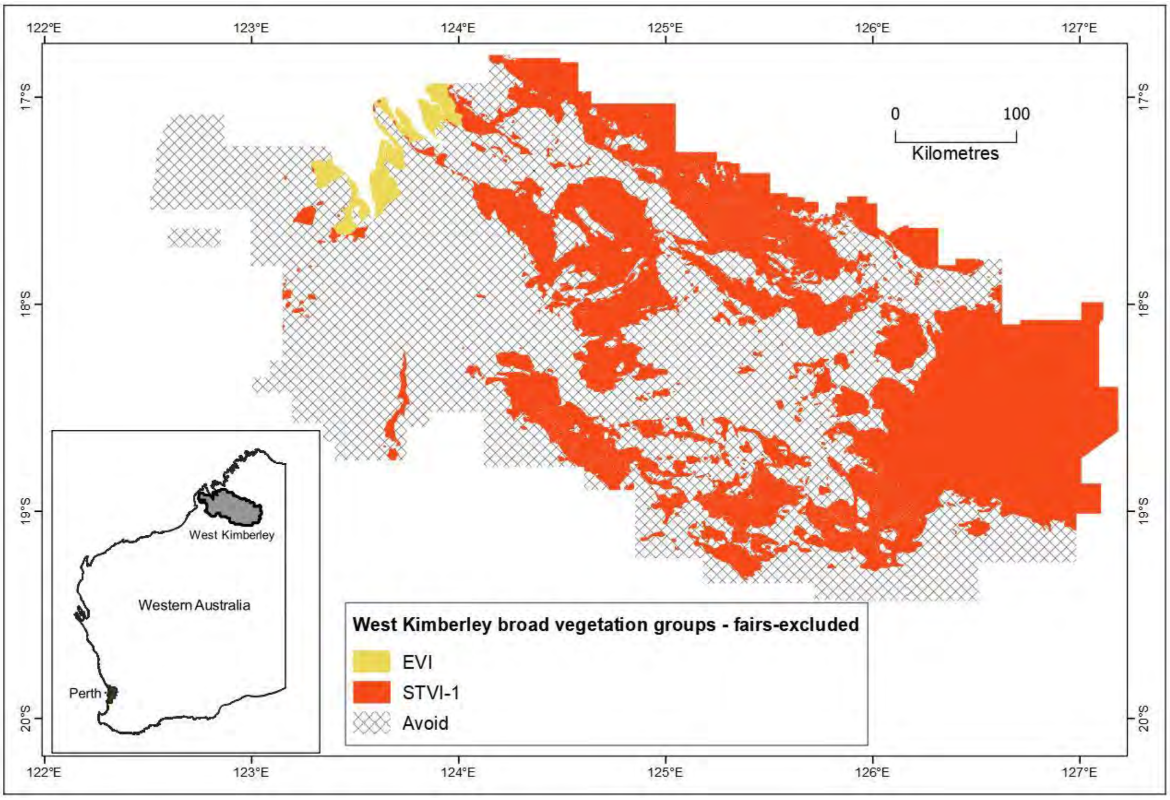

Figure F13: The most suitable VIs for monitoring pasture condition of broad vegetation groups in the West Kimberley district using fairs-excluded strategy

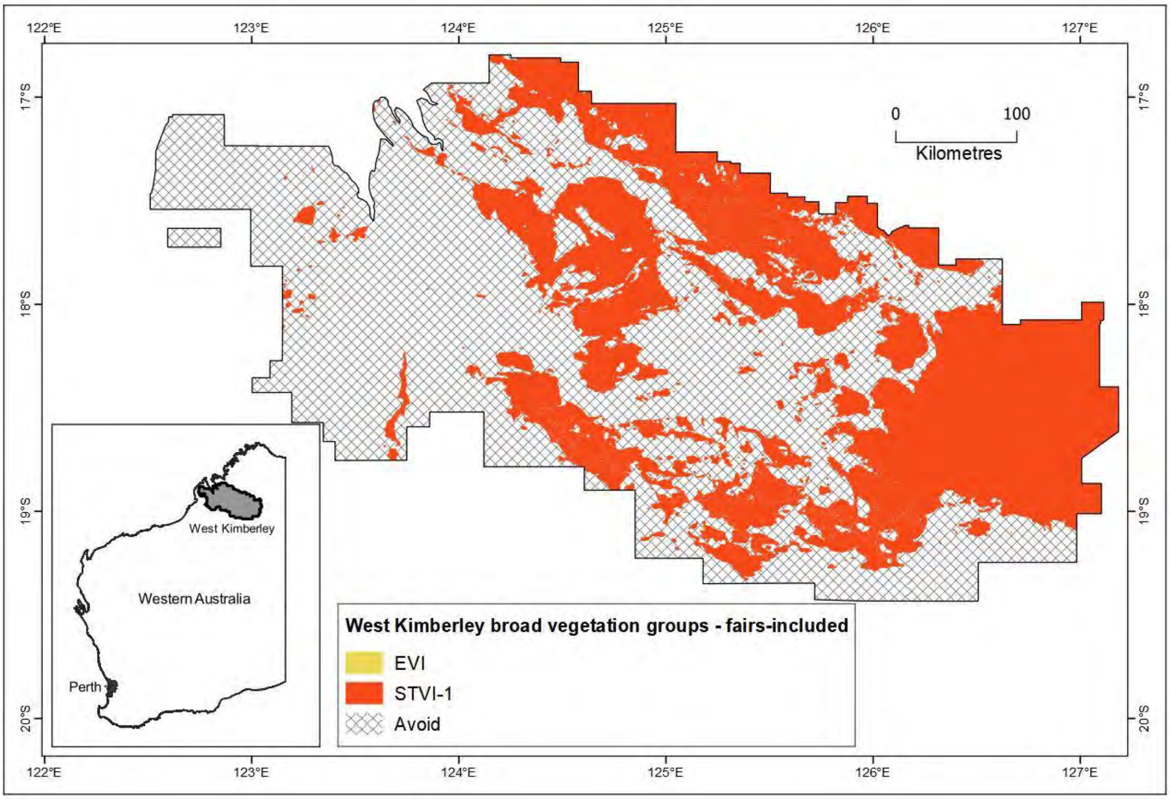

Figure F14: The most suitable VIs for monitoring pasture condition of broad vegetation groups in the West Kimberley district using fairs-included strategy

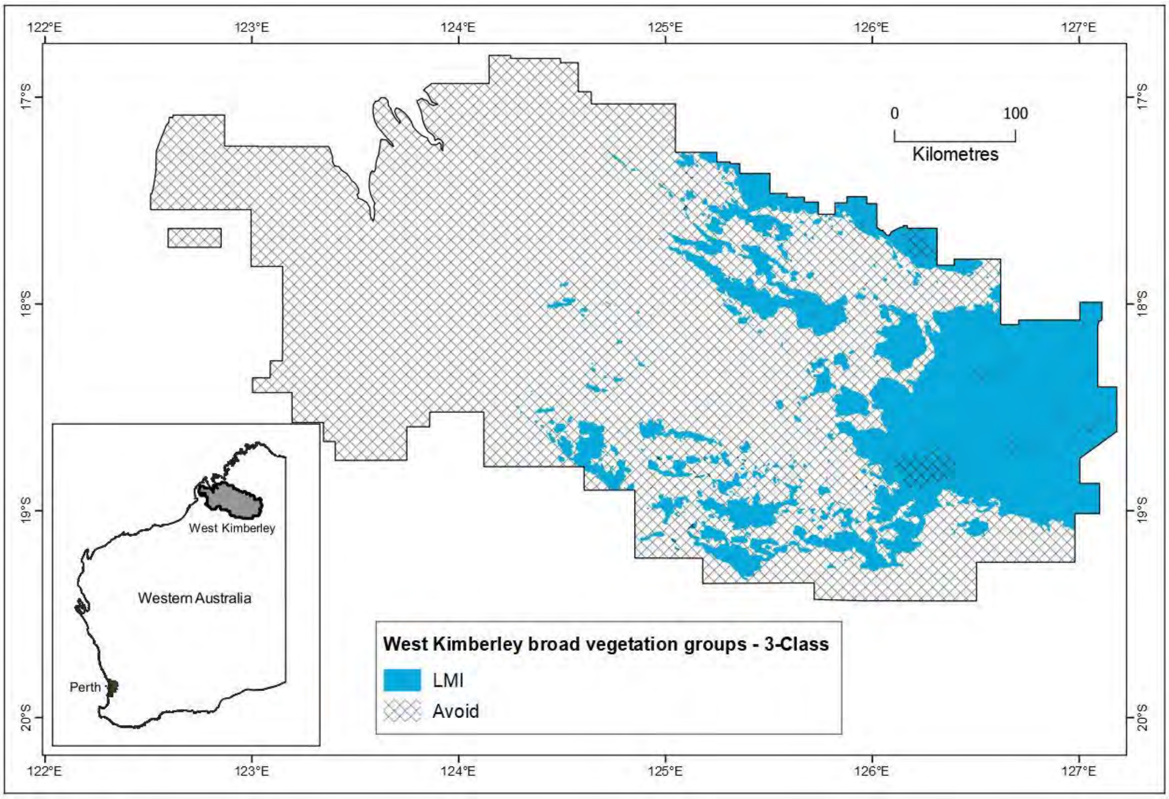

Figure F15: The most suitable VIs for monitoring pasture condition of broad vegetation groups in the West Kimberley district using 3-class strategy

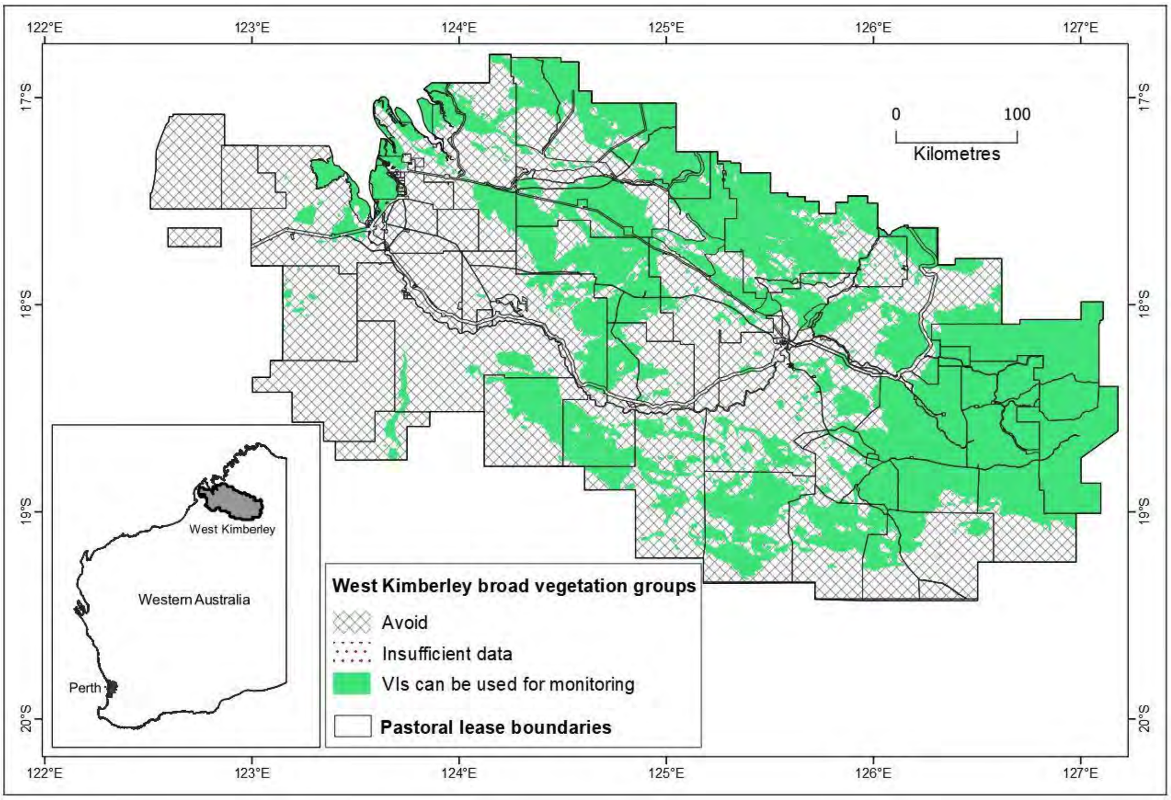

Figure F16: Where VIs can be used for monitoring pasture condition of broad vegetation groups in the West Kimberley land conservation district

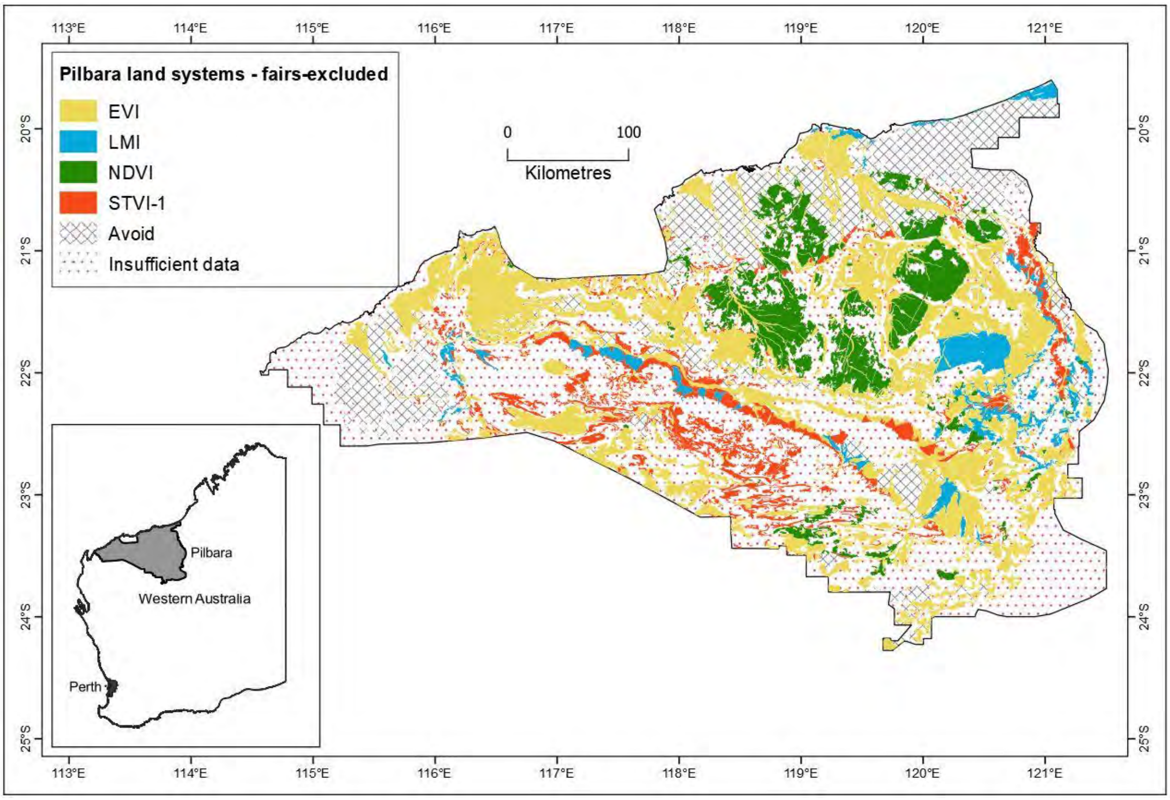

Figure F17: The most suitable VIs for monitoring pasture condition of land systems in the Pilbara region using fairs-excluded strategy

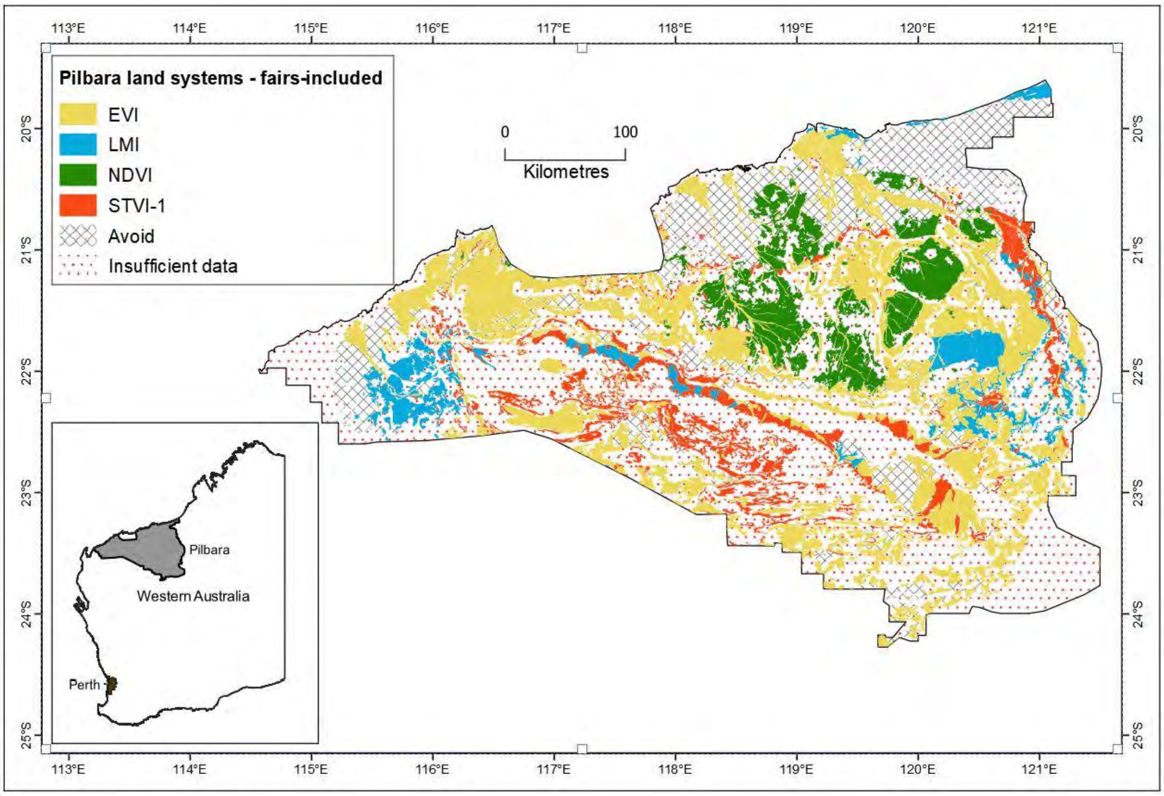

Figure F18: The most suitable VIs for monitoring pasture condition of land systems in the Pilbara region using fairs-included strategy

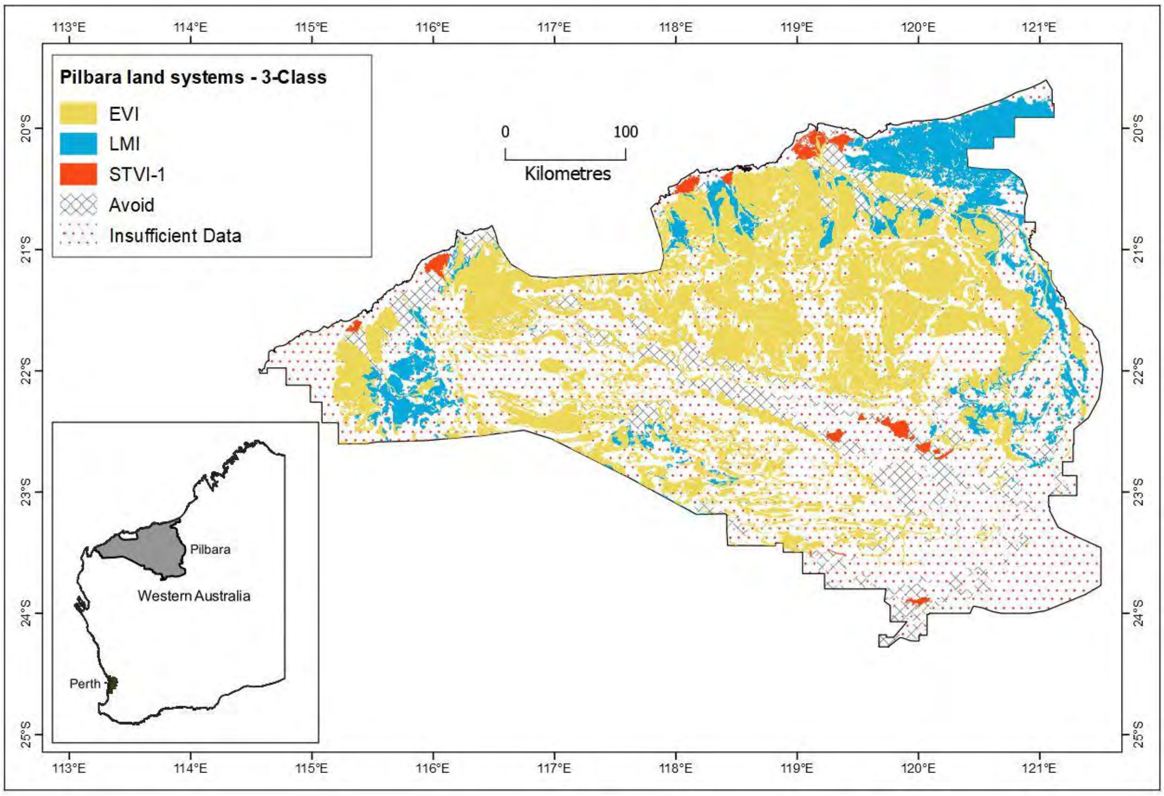

Figure F19: The most suitable VIs for monitoring pasture condition of land systems in the Pilbara region using 3-class strategy

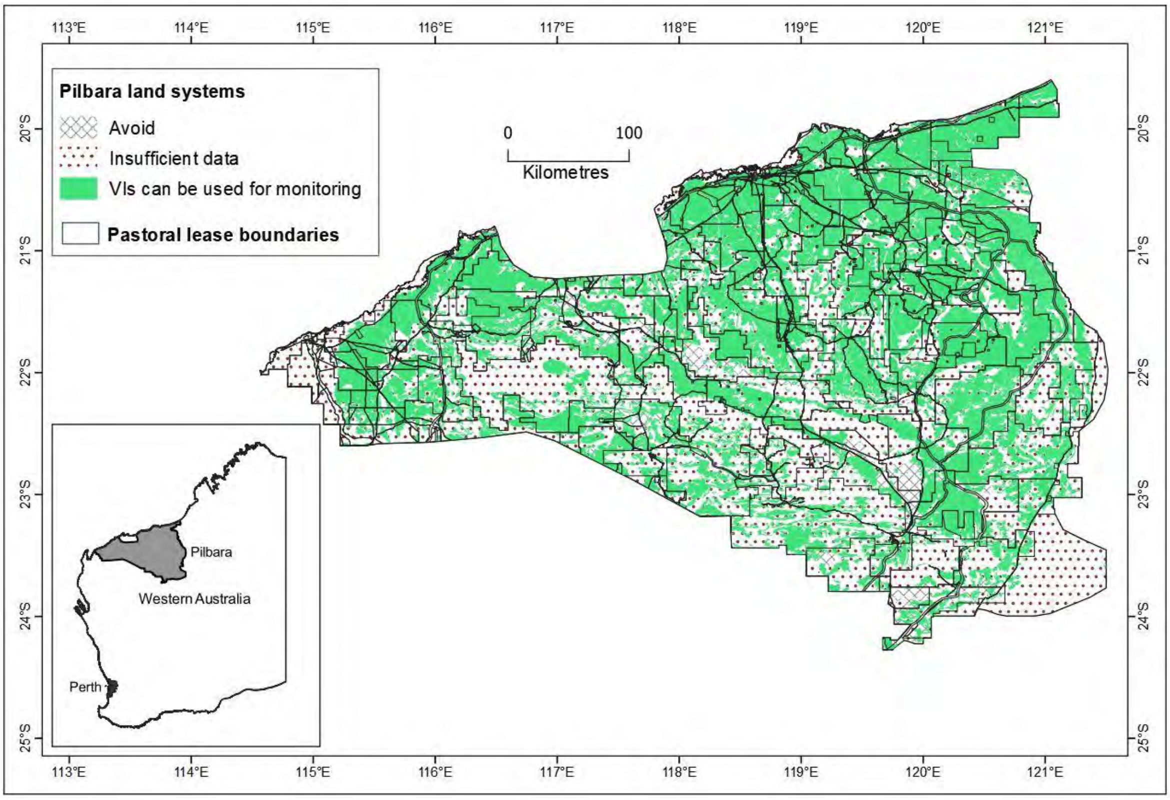

Figure F20: Where VIs can be used for monitoring pasture condition of land systems in the Pilbara region

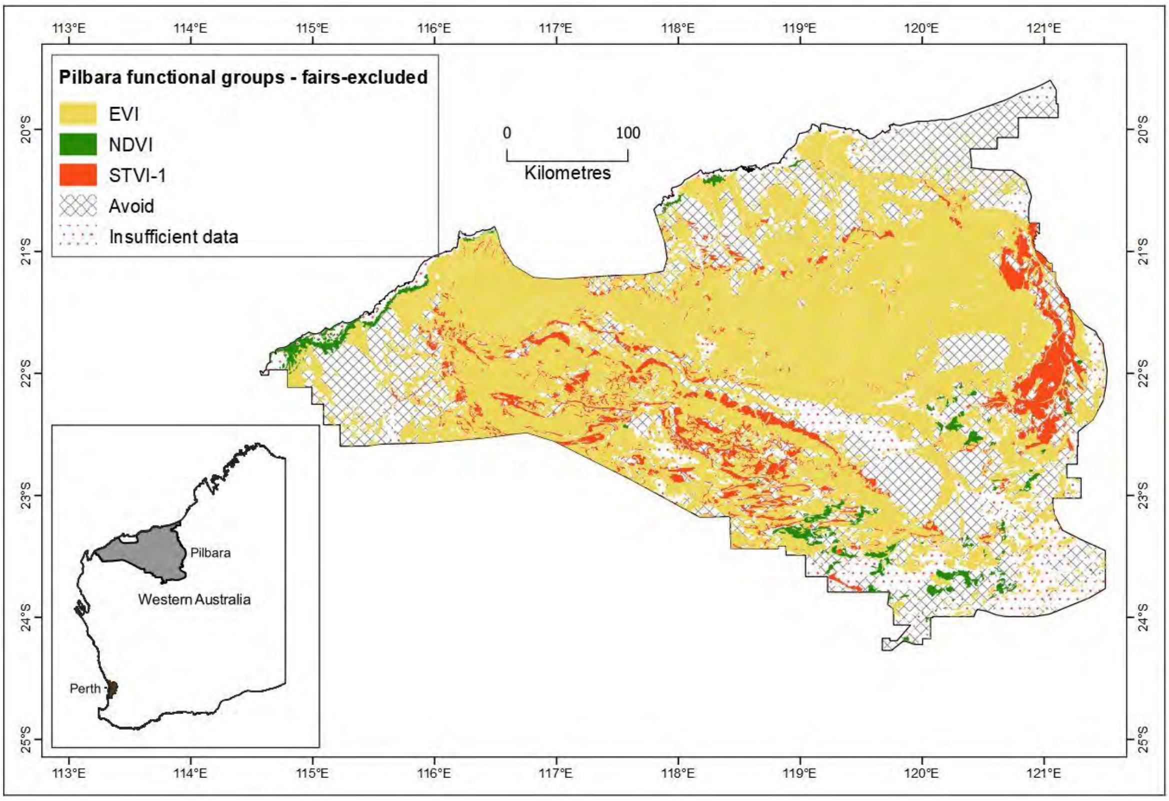

Figure F21: The most suitable VIs for monitoring pasture condition of functional groups in the Pilbara region using fairs-excluded strategy

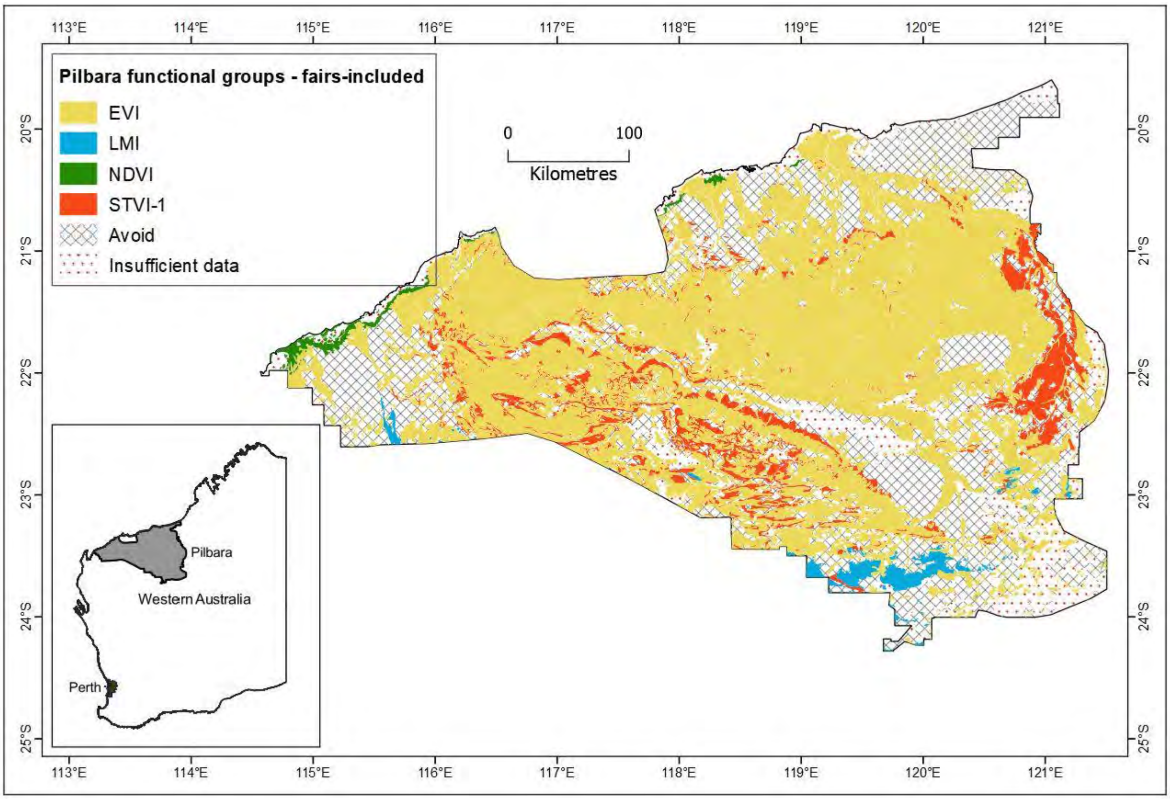

Figure F22: The most suitable VIs for monitoring pasture condition of functional groups in the Pilbara region using fairs-included strategy

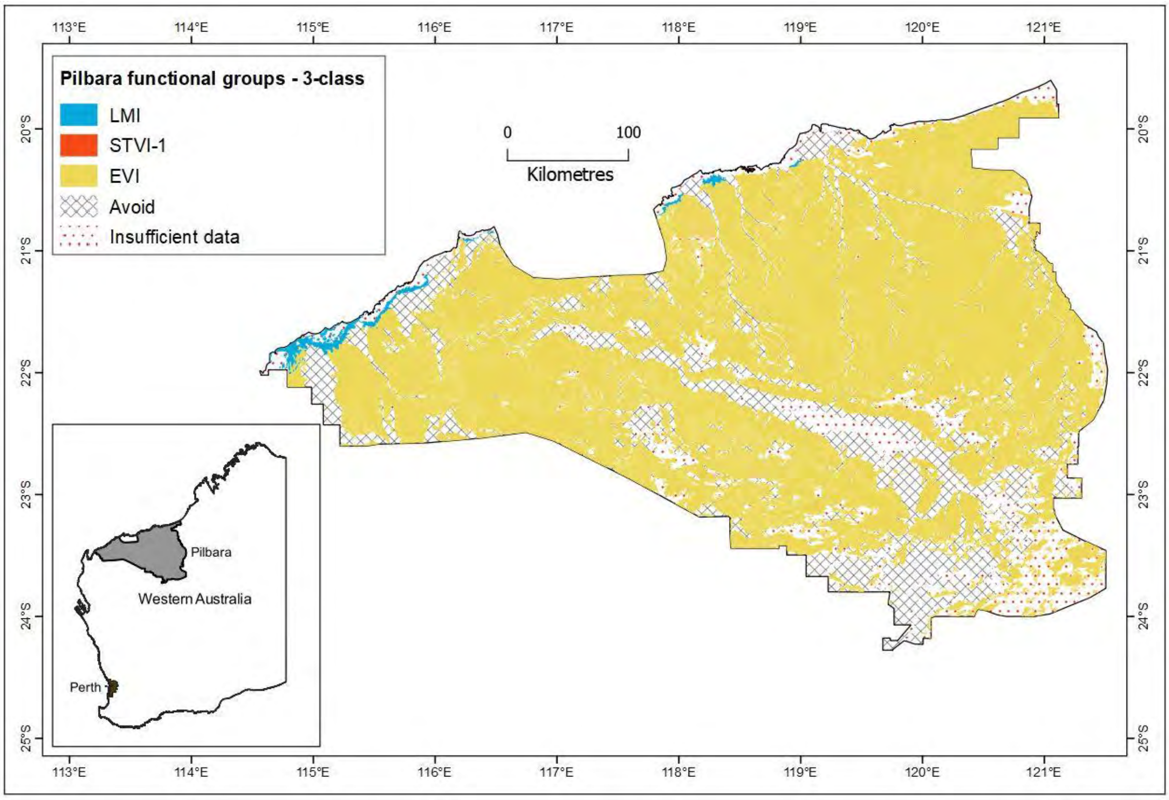

Figure F23: The most suitable VIs for monitoring pasture condition of functional groups in the Pilbara region using 3-class strategy

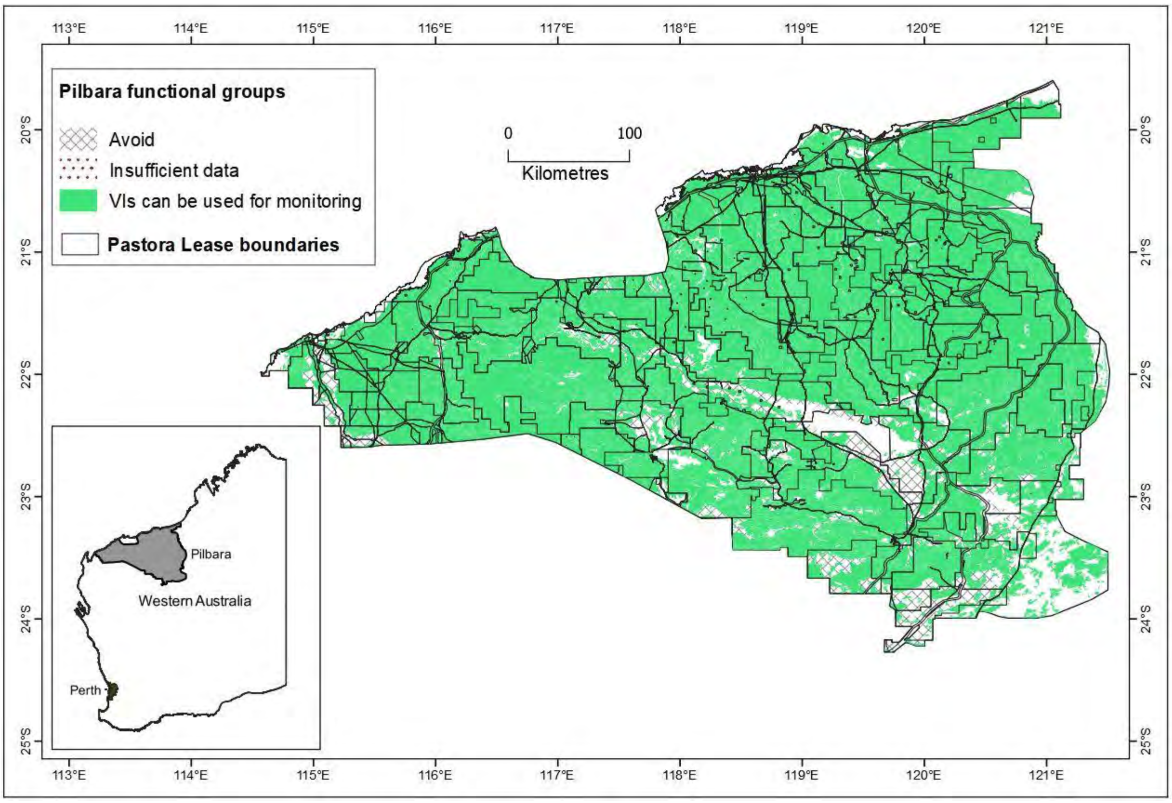

Figure F24: Where VIs can be used for monitoring pasture condition of functional groups in the Pilbara region

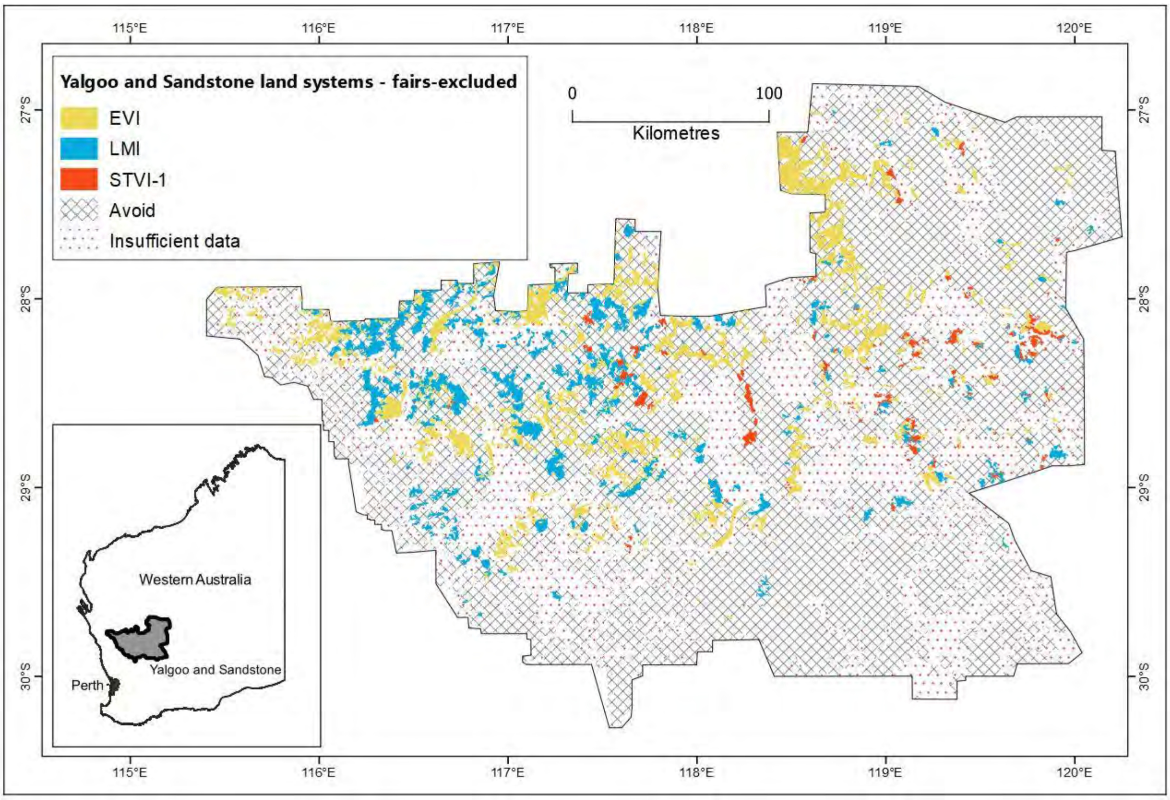

Figure F25: The most suitable VIs for monitoring pasture condition of land systems in the Yalgoo and Sandstone region using fairs-excluded strategy

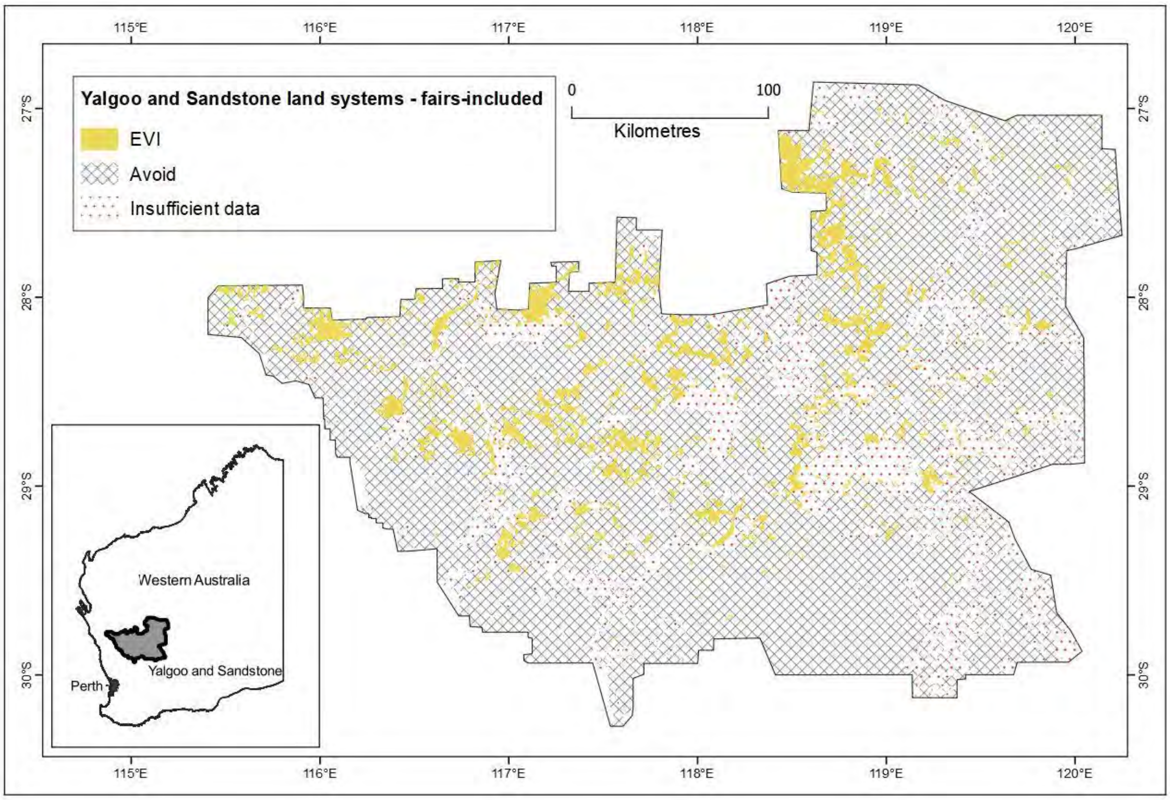

Figure F26: The most suitable VIs for monitoring pasture condition of land systems in the Yalgoo and Sandstone region using fairs-included strategy

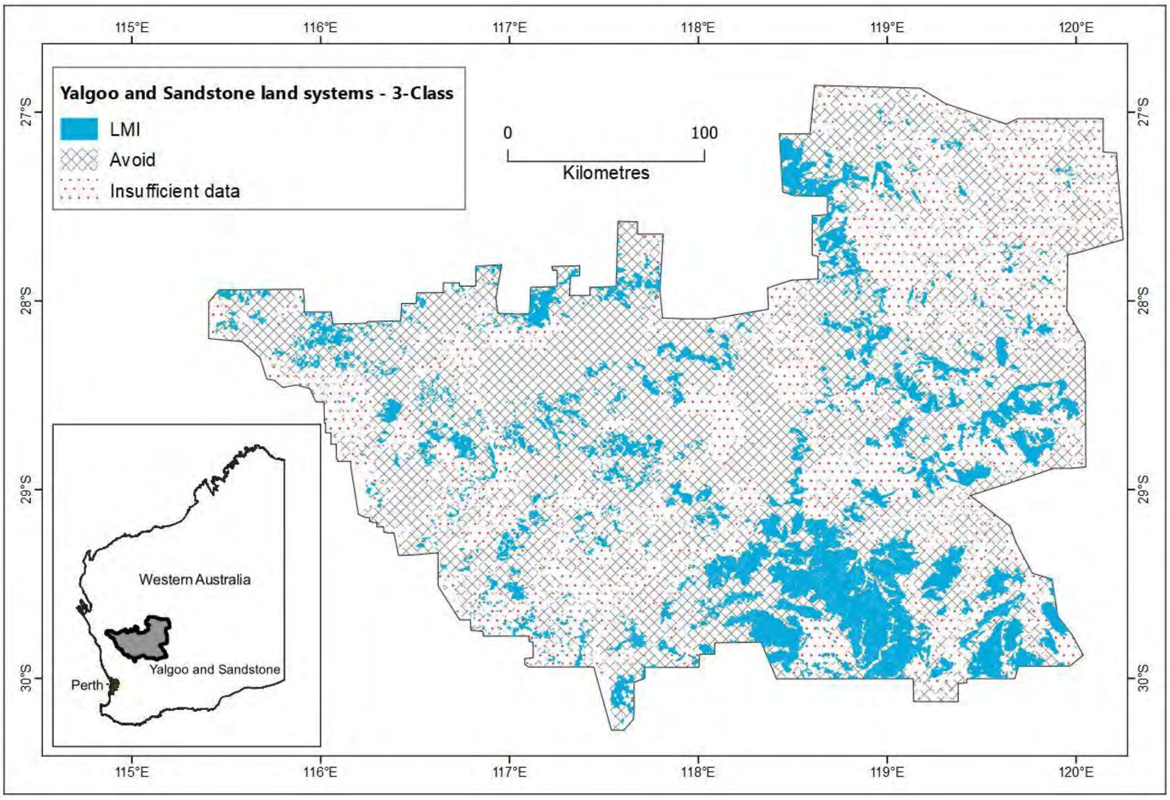

Figure F27: The most suitable VIs for monitoring pasture condition of land systems in the Yalgoo and Sandstone region using 3-class strategy

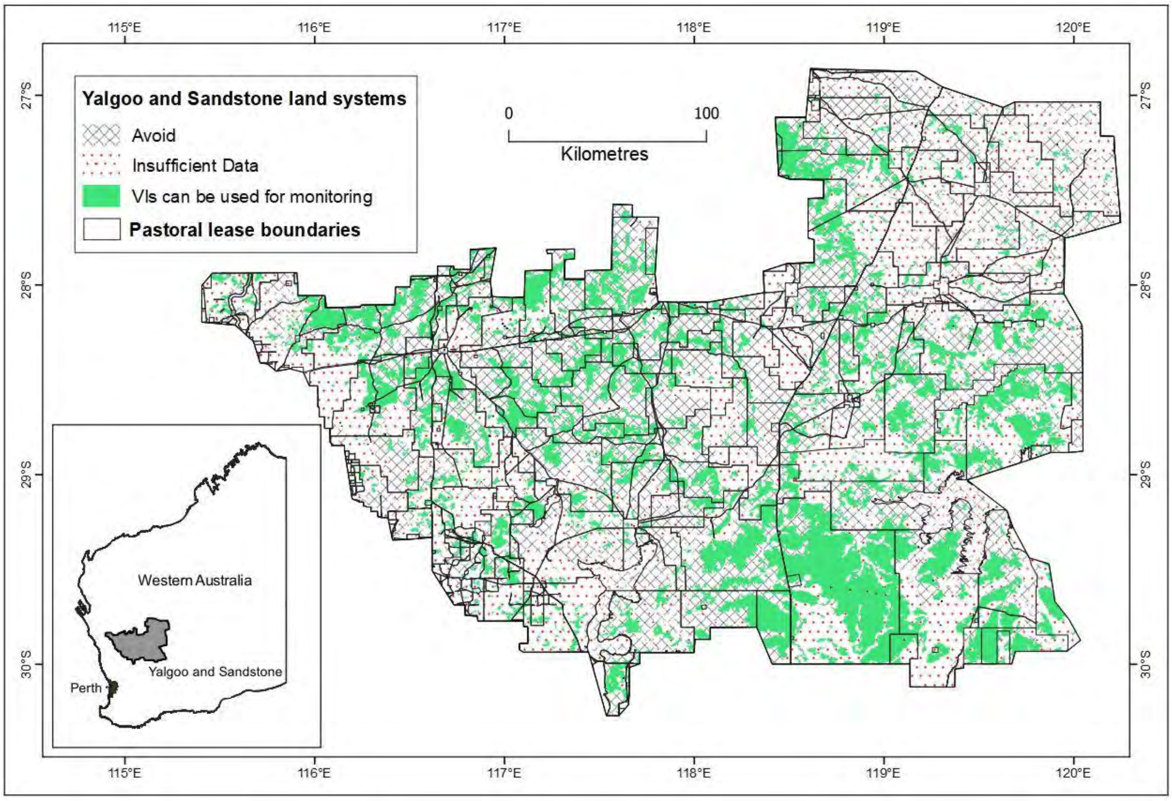

Figure F28: Where VIs can be used for monitoring pasture condition of land systems in the Yalgoo and Sandstone region

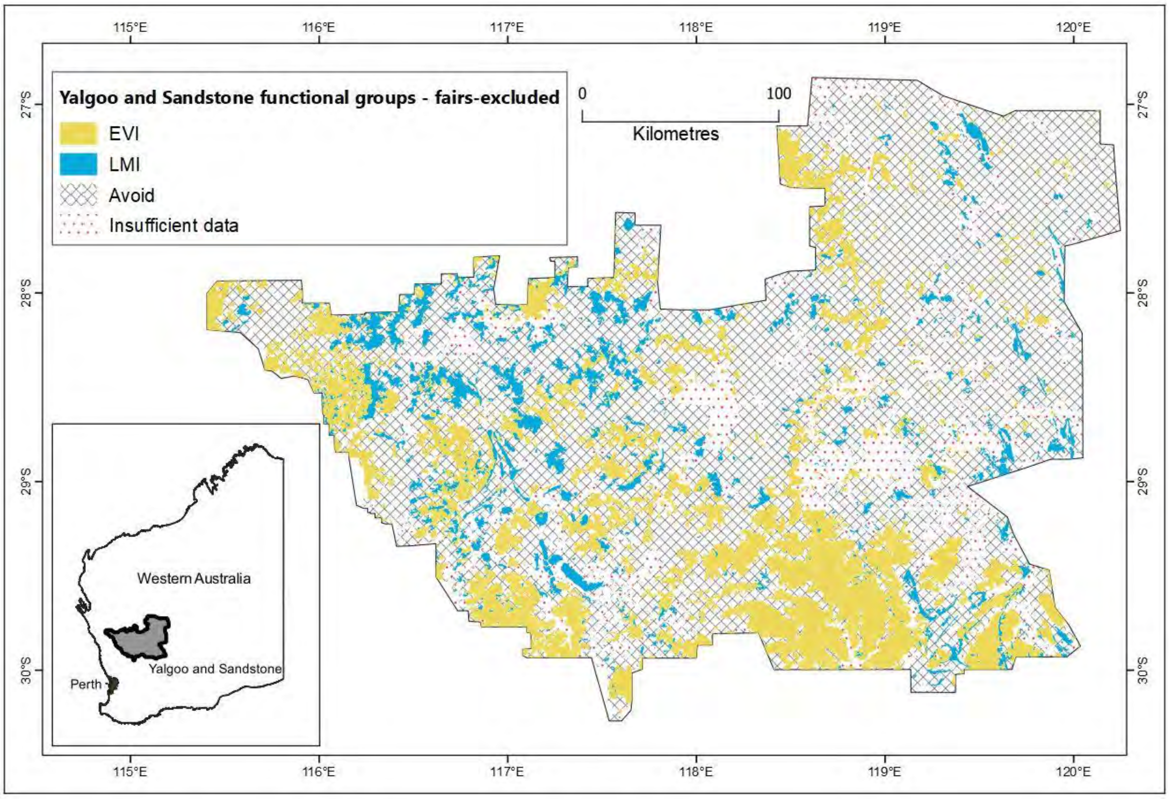

Figure F29: The most suitable VIs for monitoring pasture condition of functional groups in the Yalgoo and Sandstone region using fairs-excluded strategy

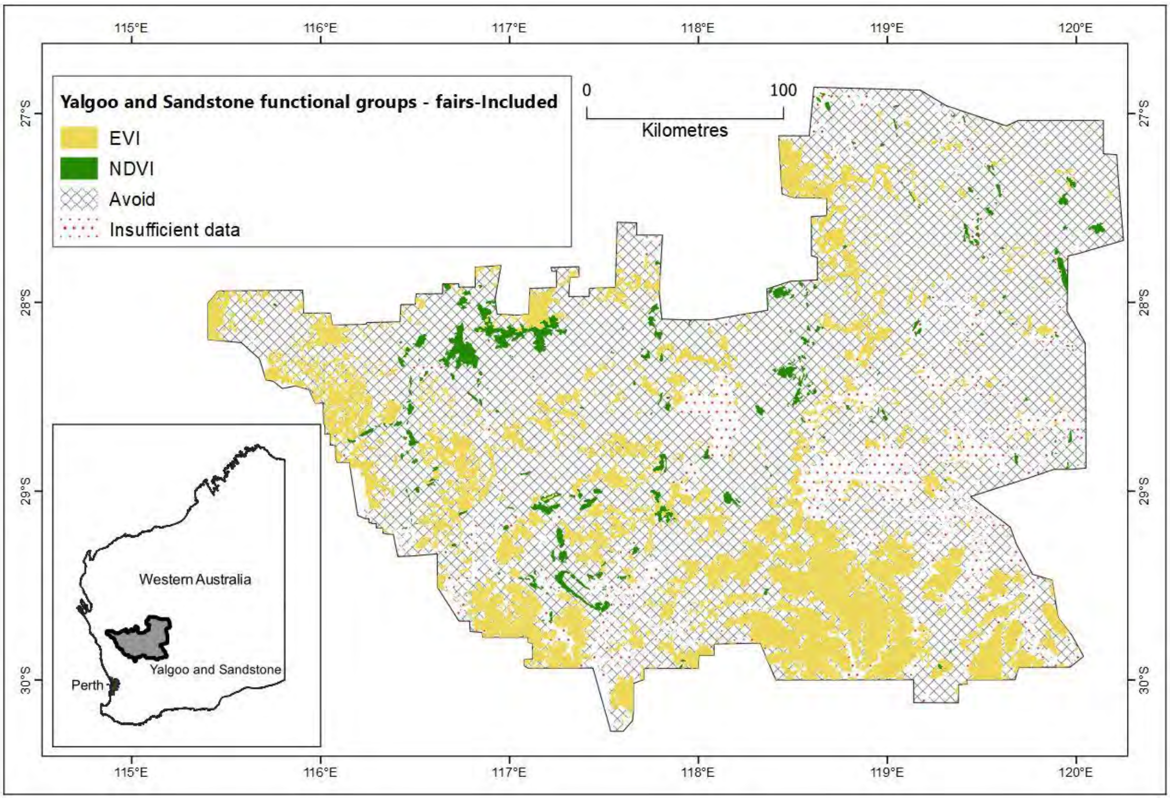

Figure F30: The most suitable VIs for monitoring pasture condition of functional groups in the Yalgoo and Sandstone region using fairs-included strategy

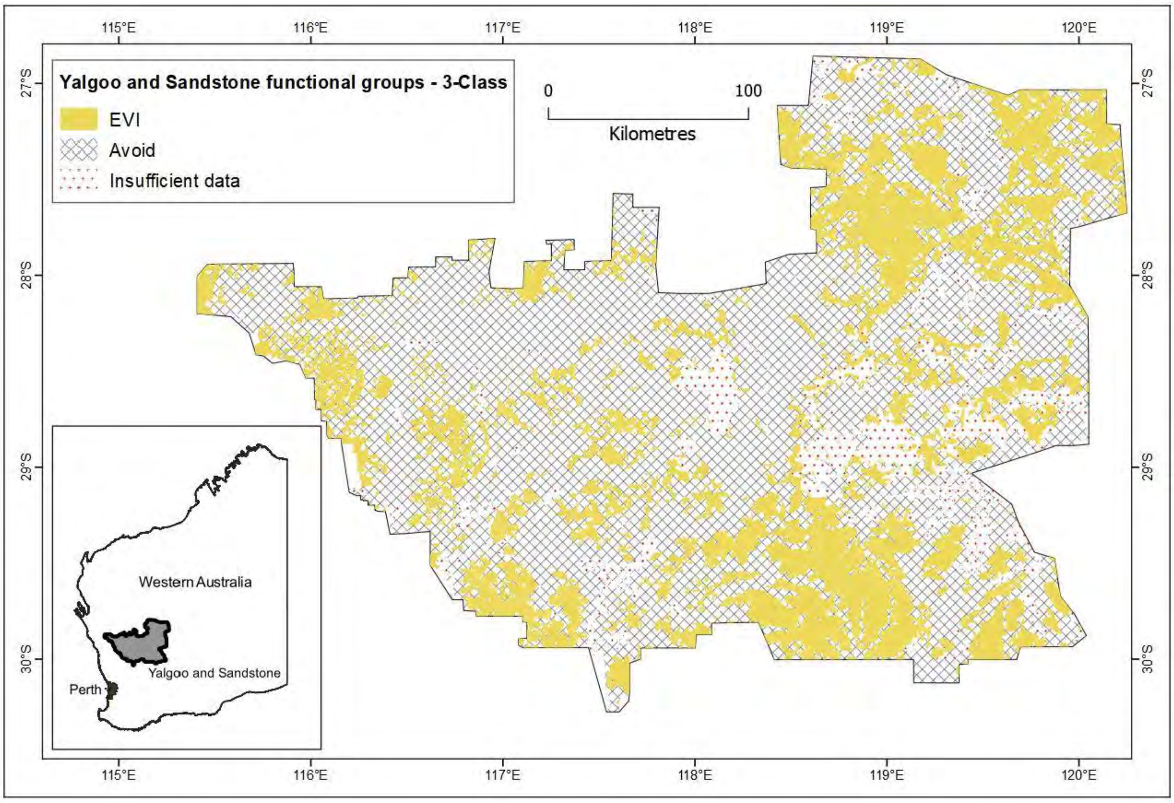

Figure F31: The most suitable VIs for monitoring pasture condition of functional groups in the Yalgoo and Sandstone region using 3-class strategy

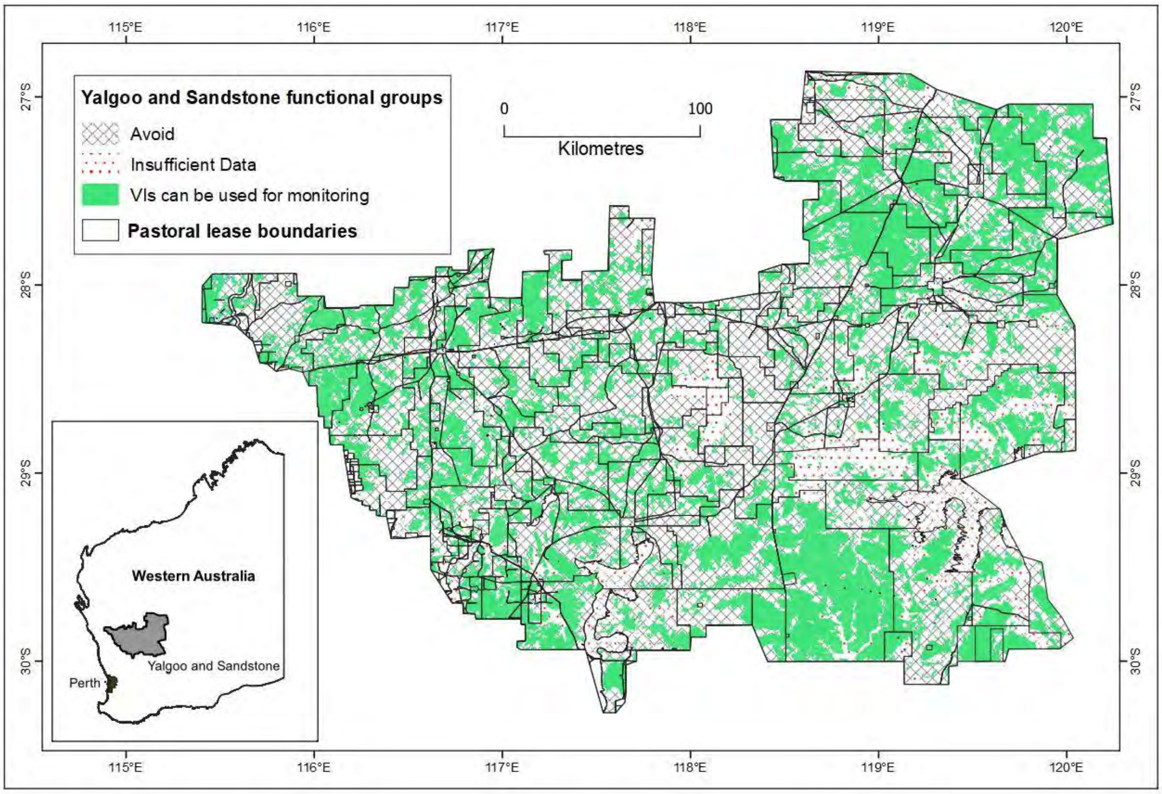

Figure 32: Where VIs can be used for monitoring pasture condition of functional groups in the Yalgoo and Sandstone region

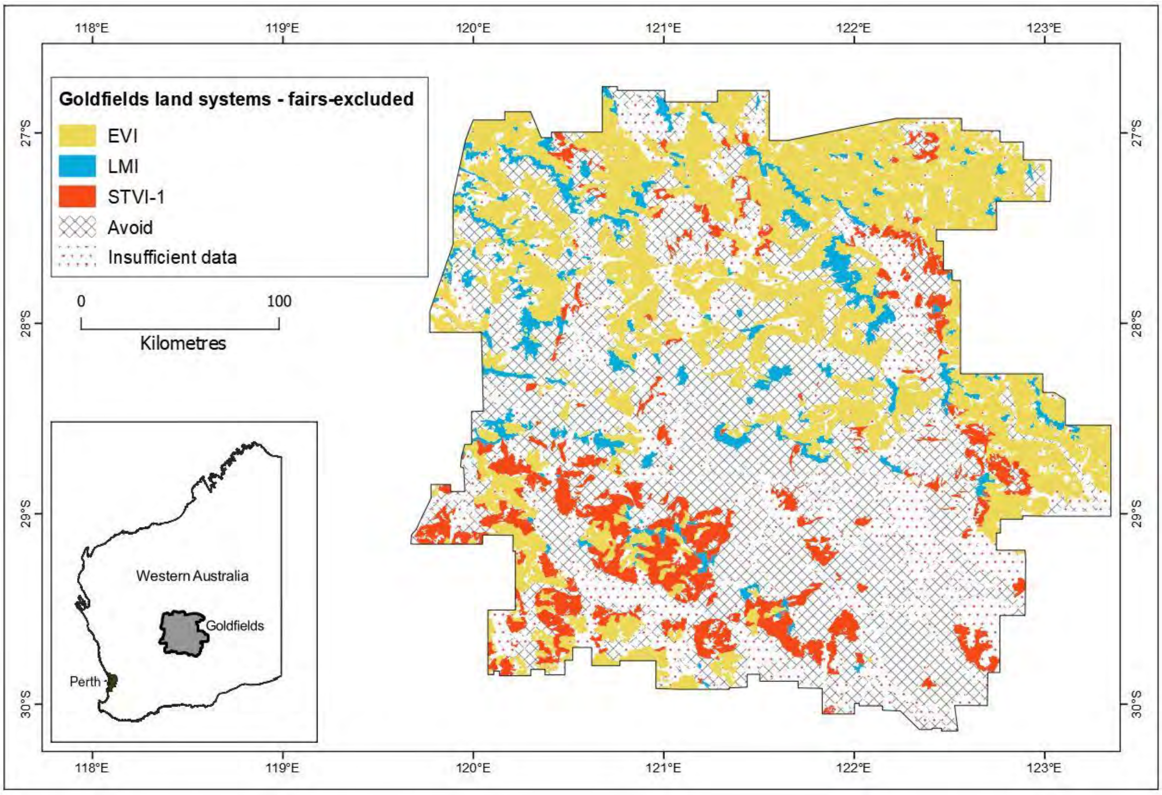

Figure F33: The most suitable VIs for monitoring pasture condition of land systems in the Goldfields region using fairs-excluded strategy

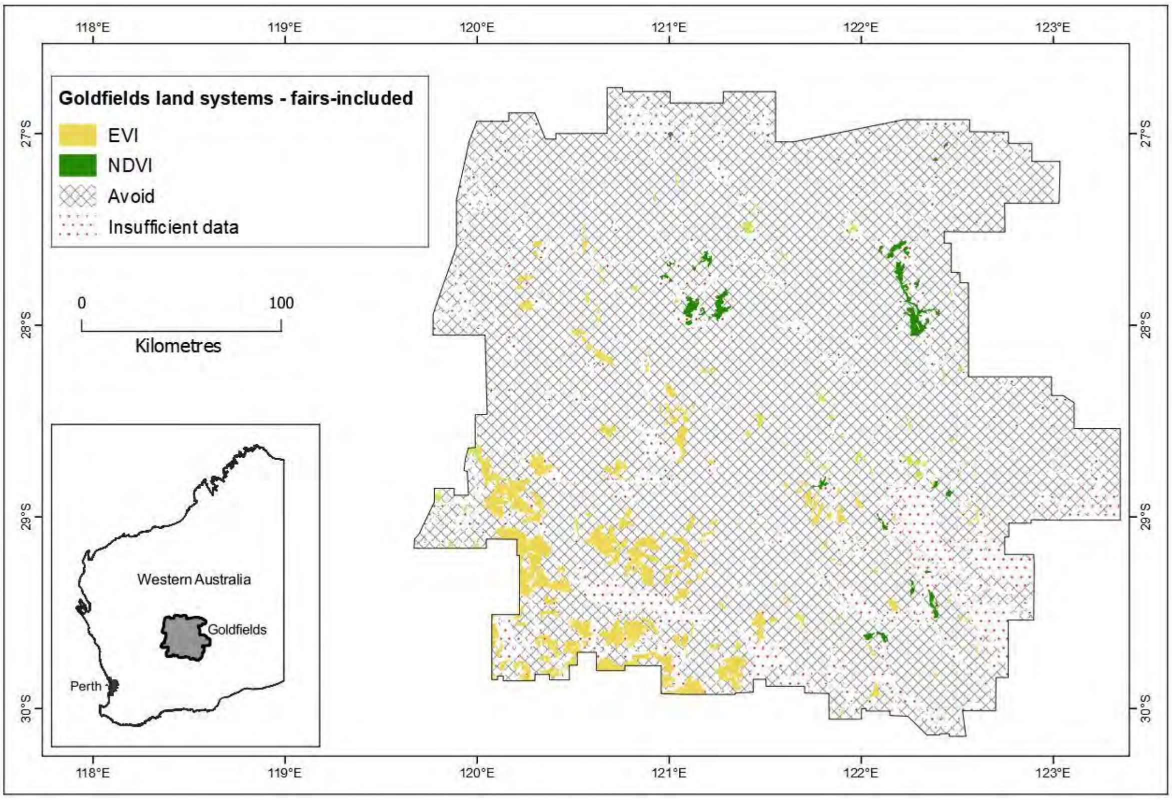

Figure F34: The most suitable VIs for monitoring pasture condition of land systems in the Goldfields region using fairs-included strategy

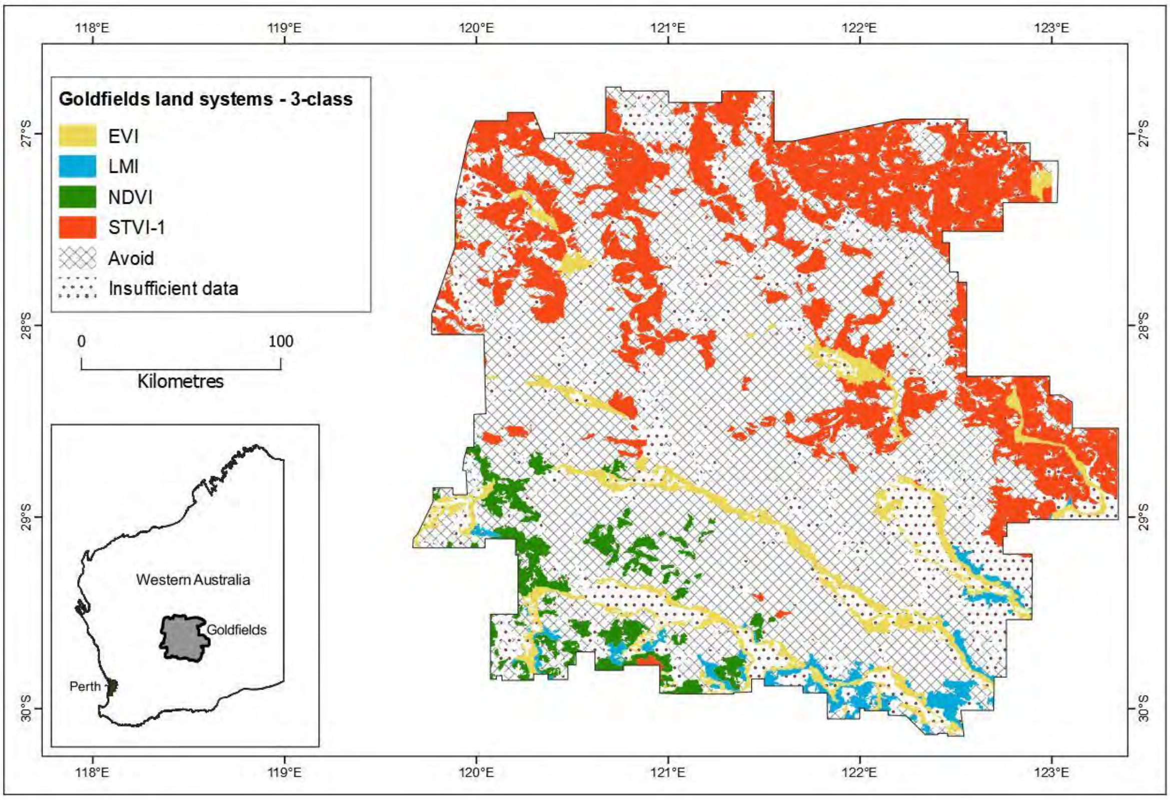

Figure F35: The most suitable VIs for monitoring pasture condition of land systems in the Goldfields region using 3-class strategy

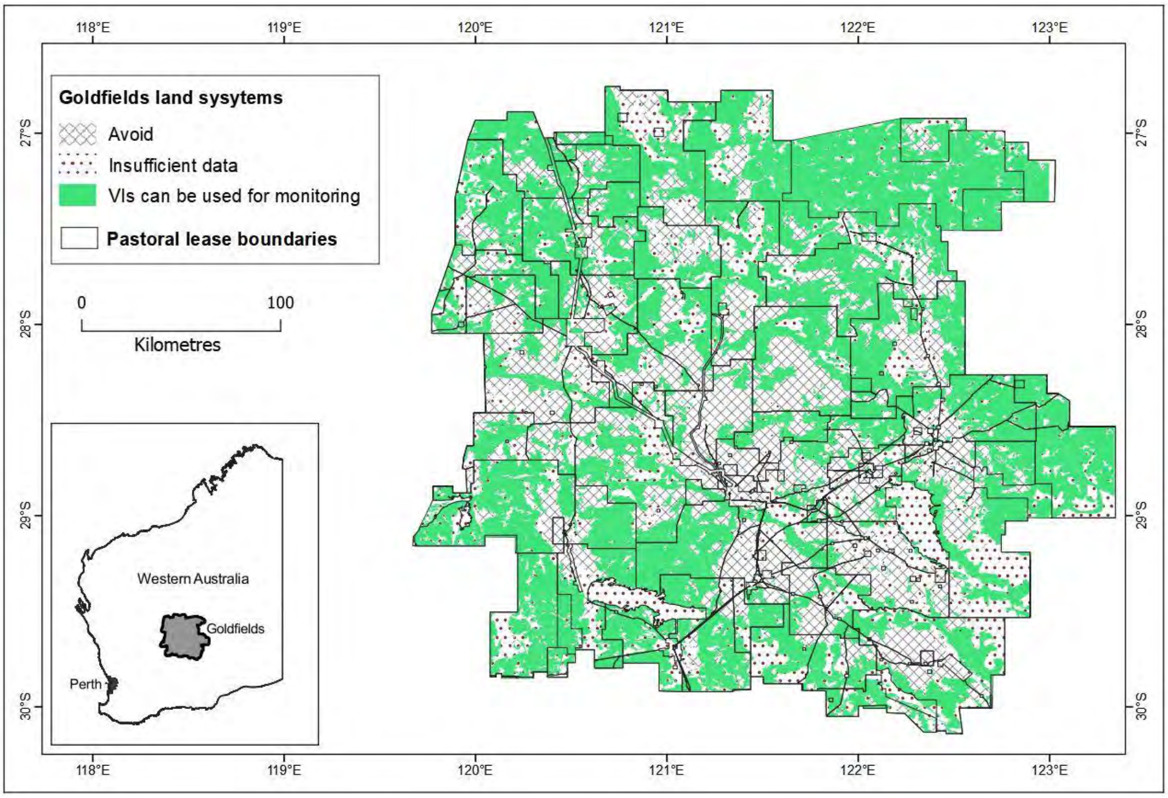

Figure F36: Where VIs can be used for monitoring pasture condition of land systems in the Goldfields region

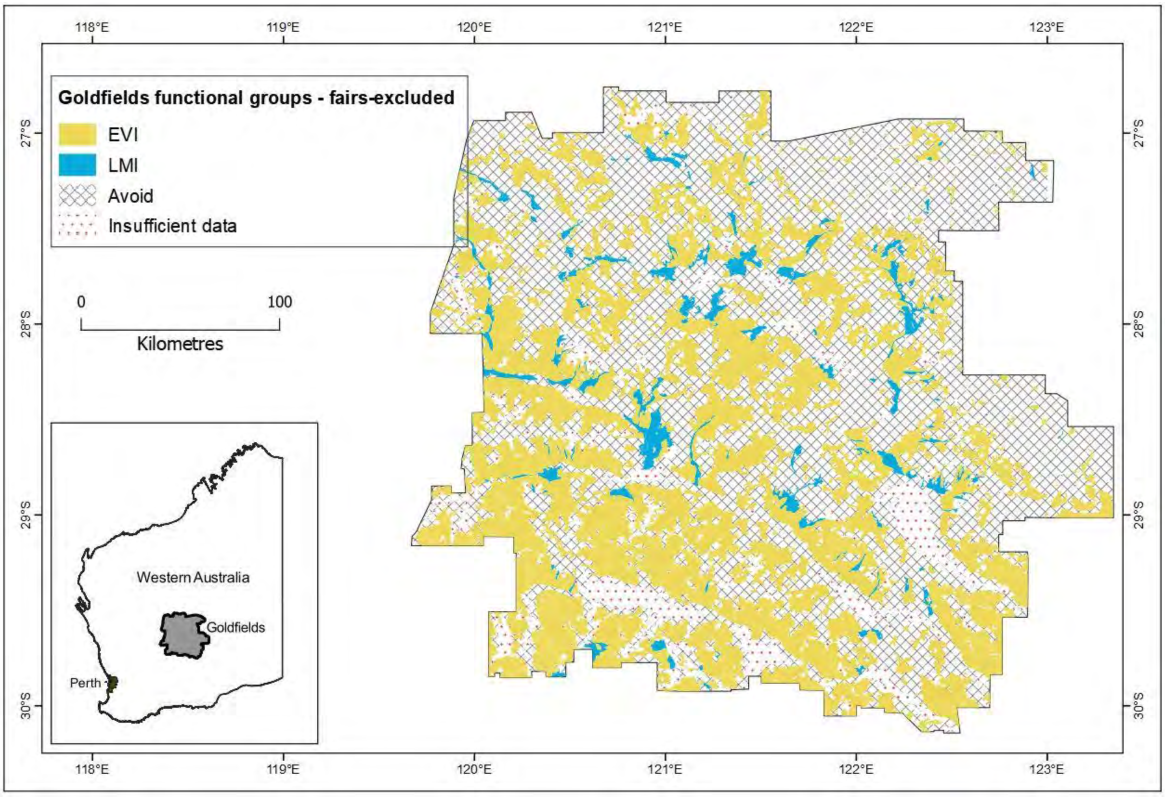

Figure F37: The most suitable VIs for monitoring pasture condition of functional groups in the Goldfields region using fairs-excluded strategy

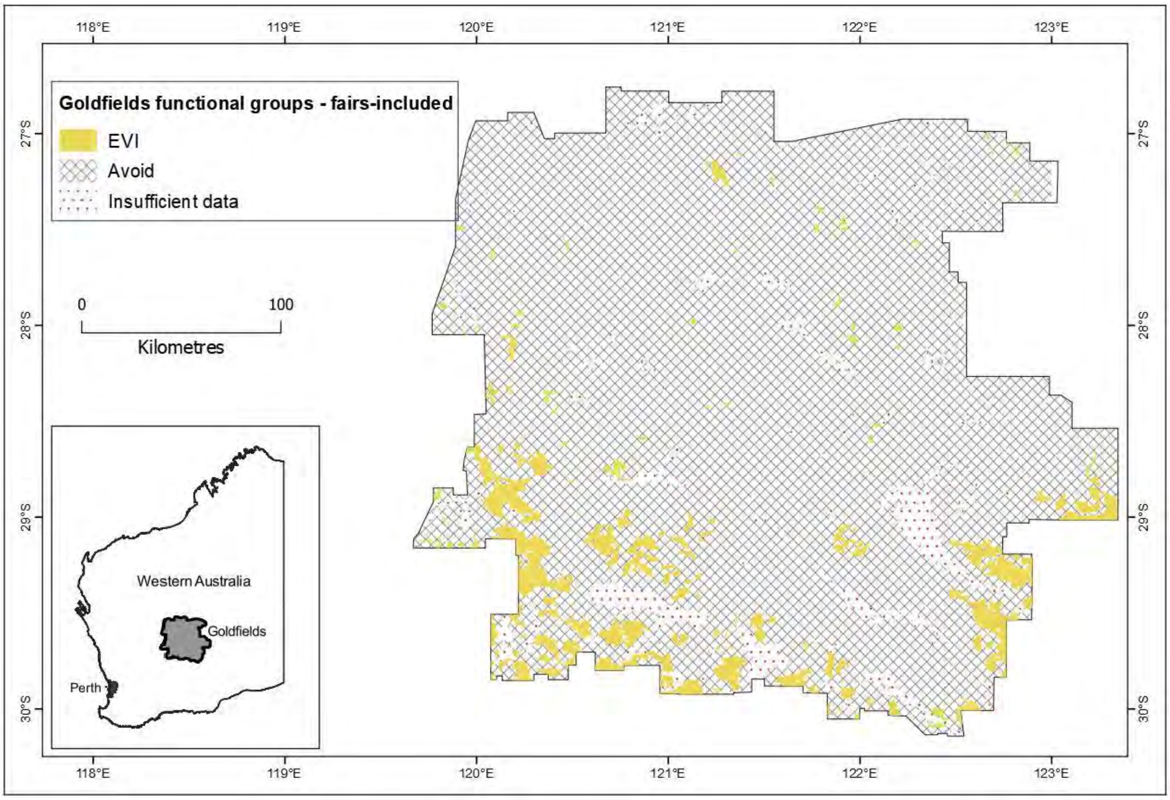

Figure F38: The most suitable VIs for monitoring pasture condition of functional groups in the Goldfields region using fairs-included strategy

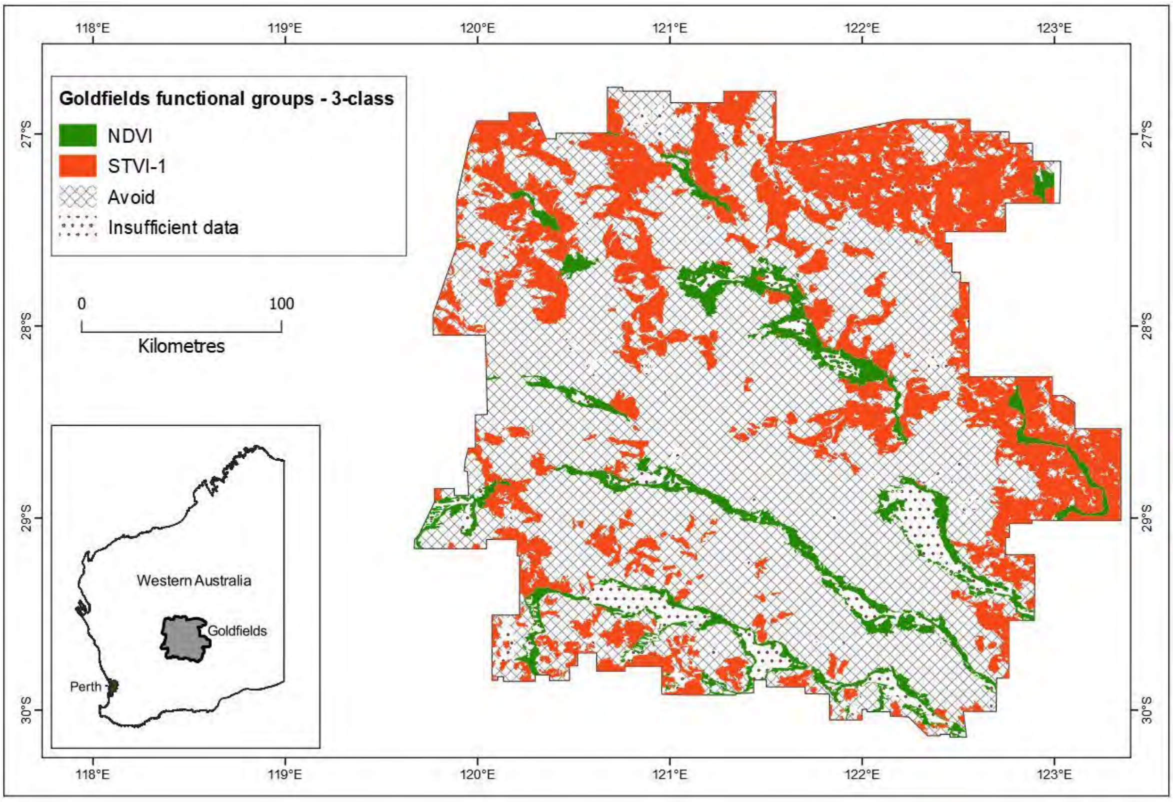

Figure F39: The most suitable VIs for monitoring pasture condition of functional groups in the Goldfields region using 3-class strategy

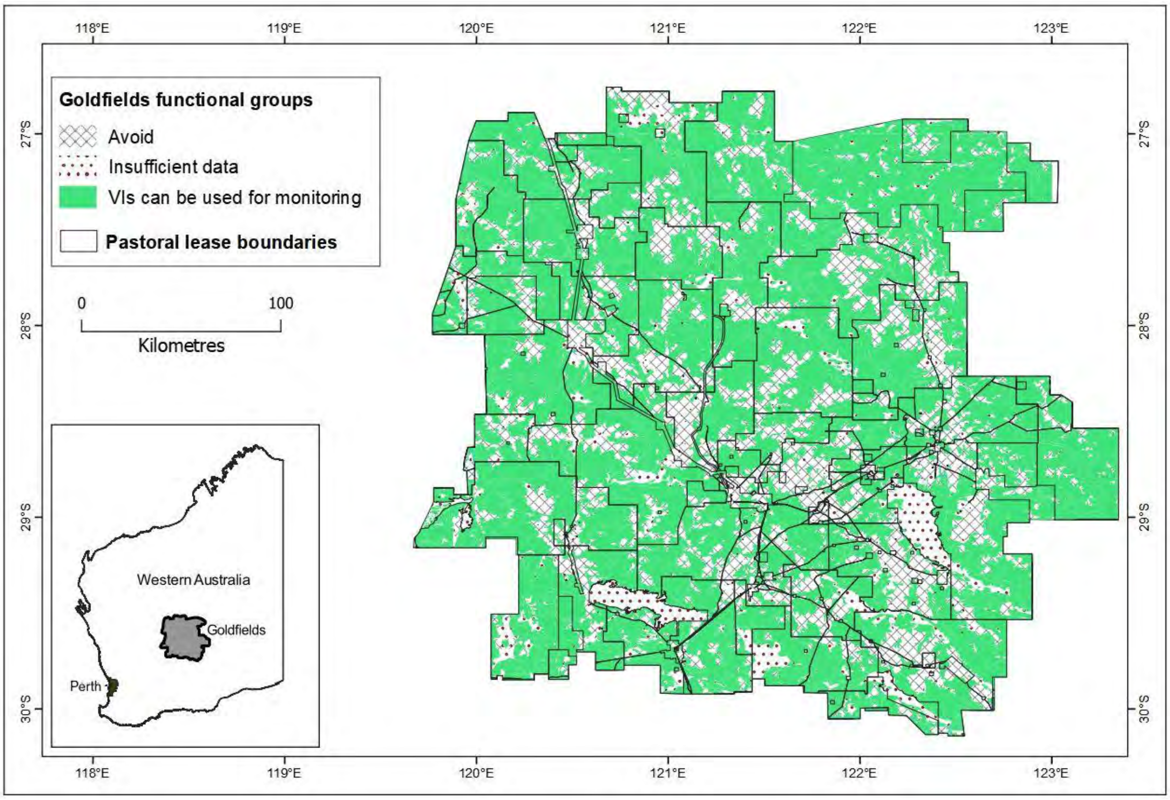

Figure F40: Where VIs can be used for monitoring pasture condition of functional groups in the Goldfields region

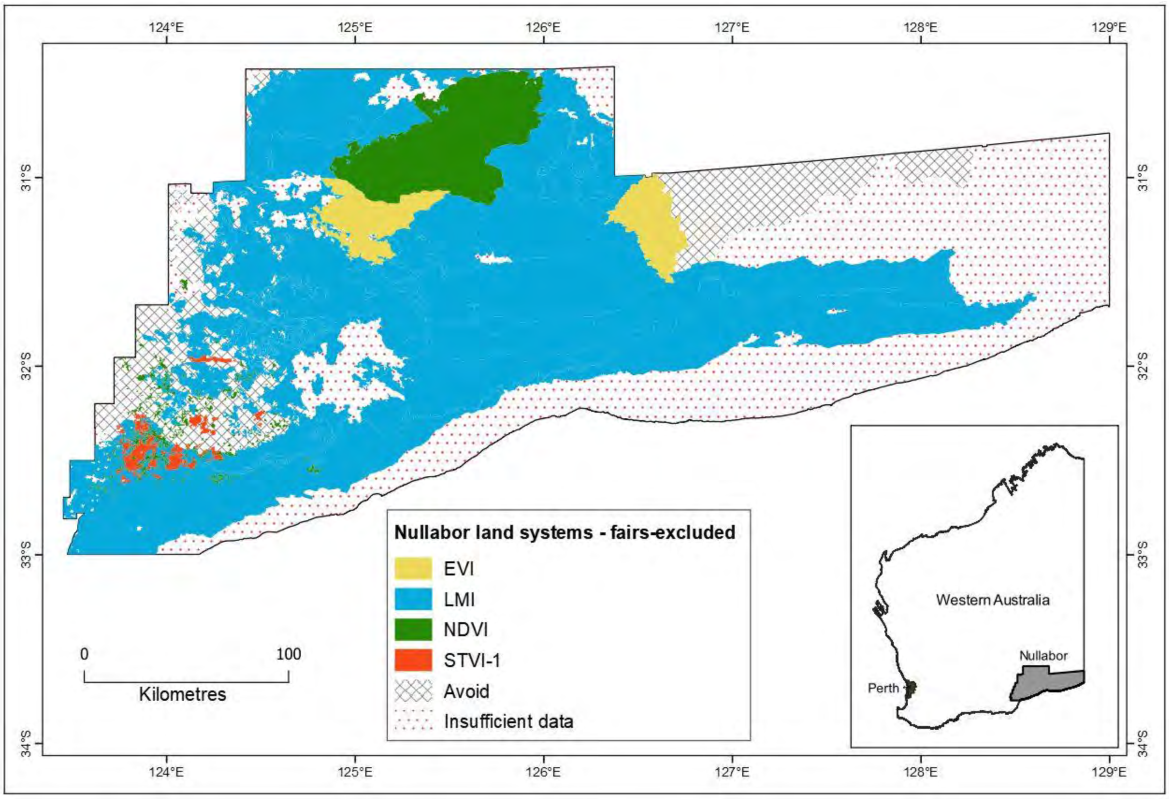

Figure F41: The most suitable VIs for monitoring pasture condition of land systems in the Pilbara region using fairs-excluded strategy

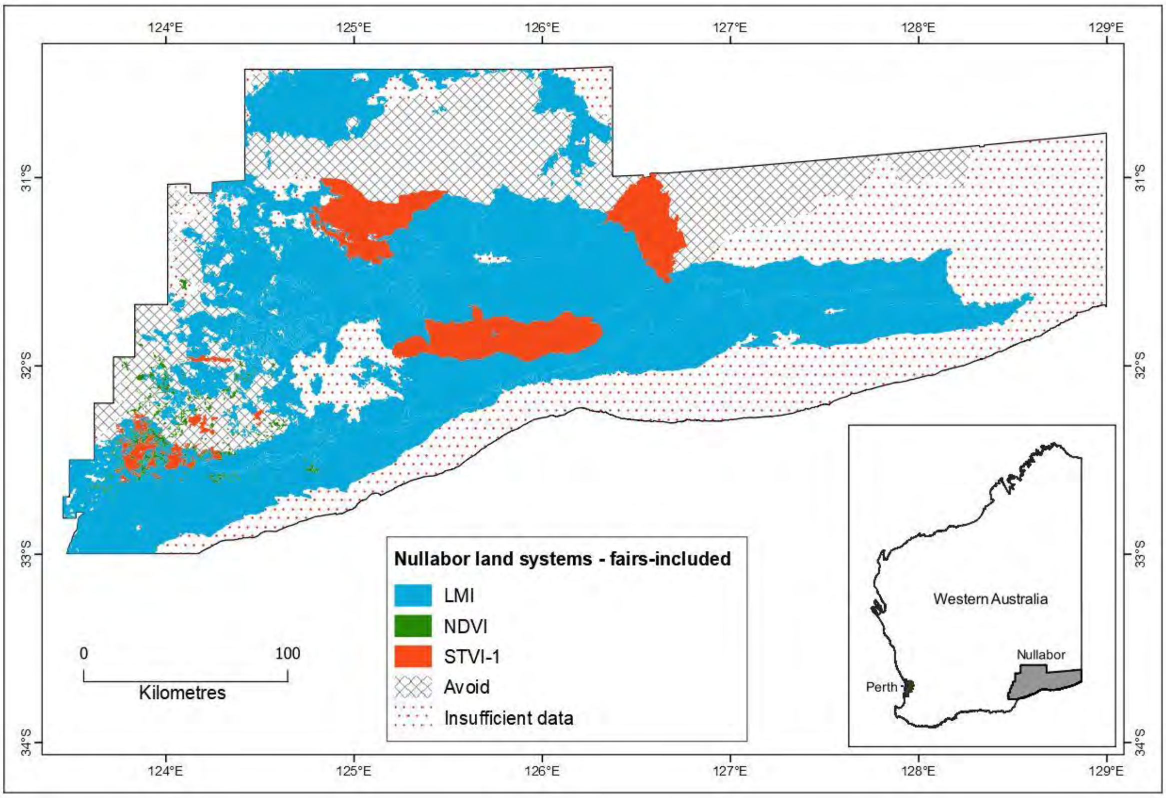

Figure F42: The most suitable VIs for monitoring pasture condition of land systems in the Pilbara region using fairs-included strategy

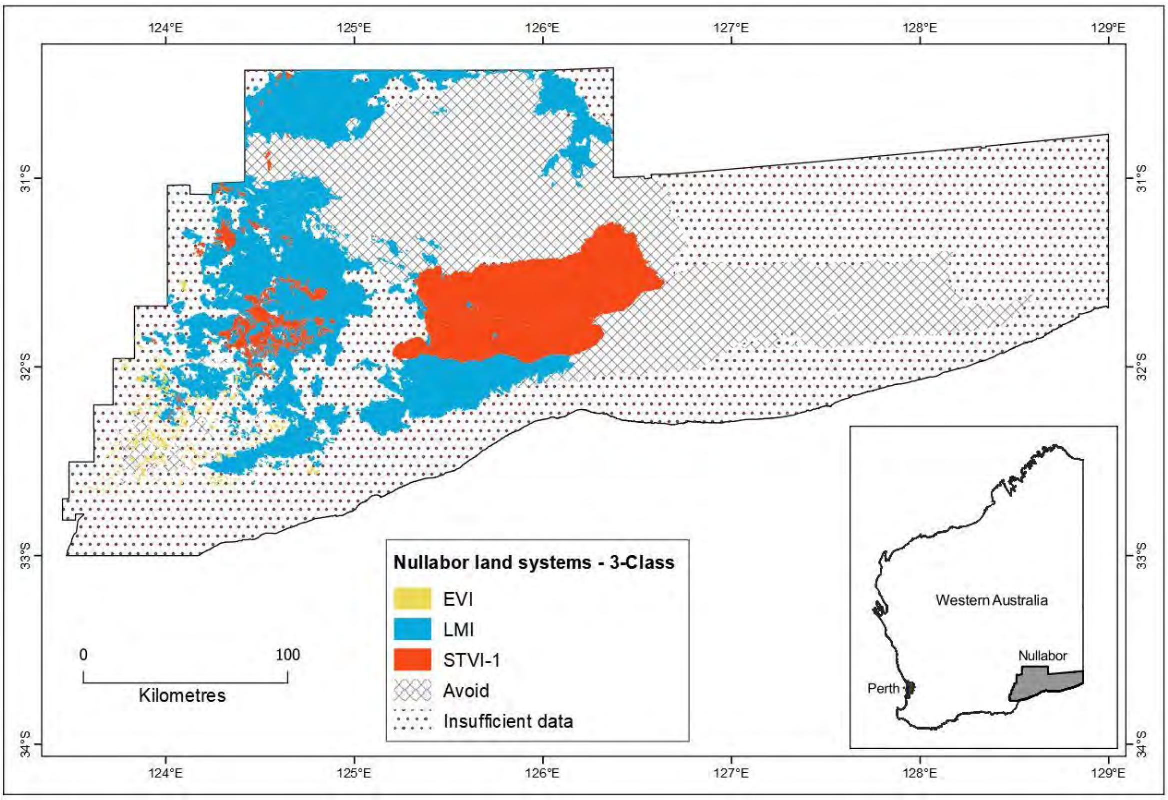

Figure F43: The most suitable VIs for monitoring pasture condition of land systems in the Pilbara region using 3-class strategy

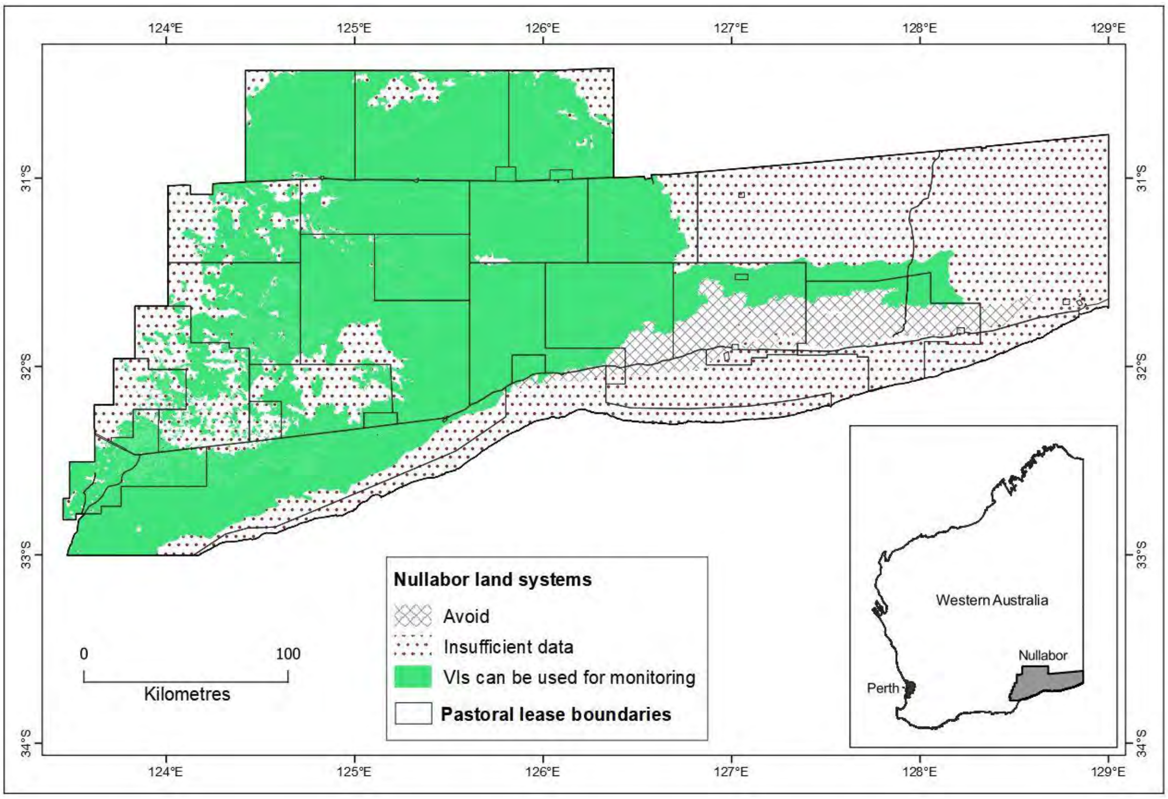

Figure F44: Where VIs can be used for monitoring pasture condition of land systems in the Nullarbor region

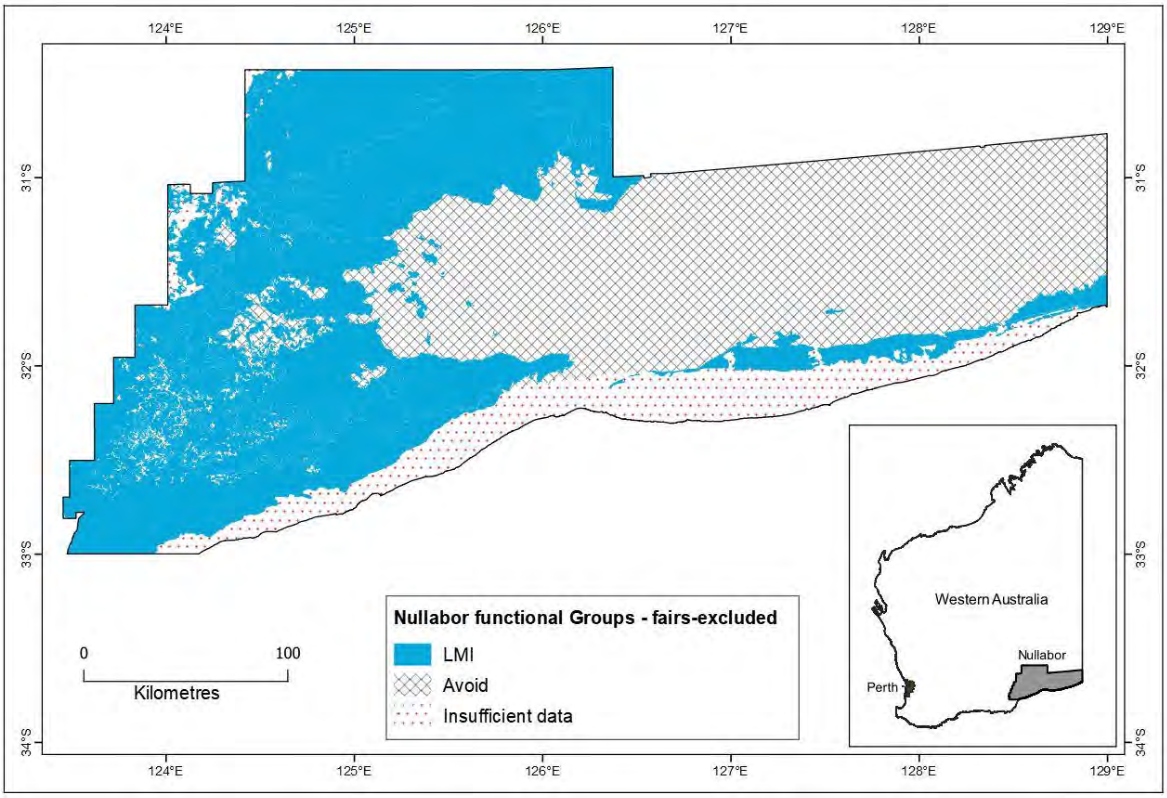

Figure F45: The most suitable VIs for monitoring pasture condition of functional groups in the Pilbara region using fairs-excluded strategy

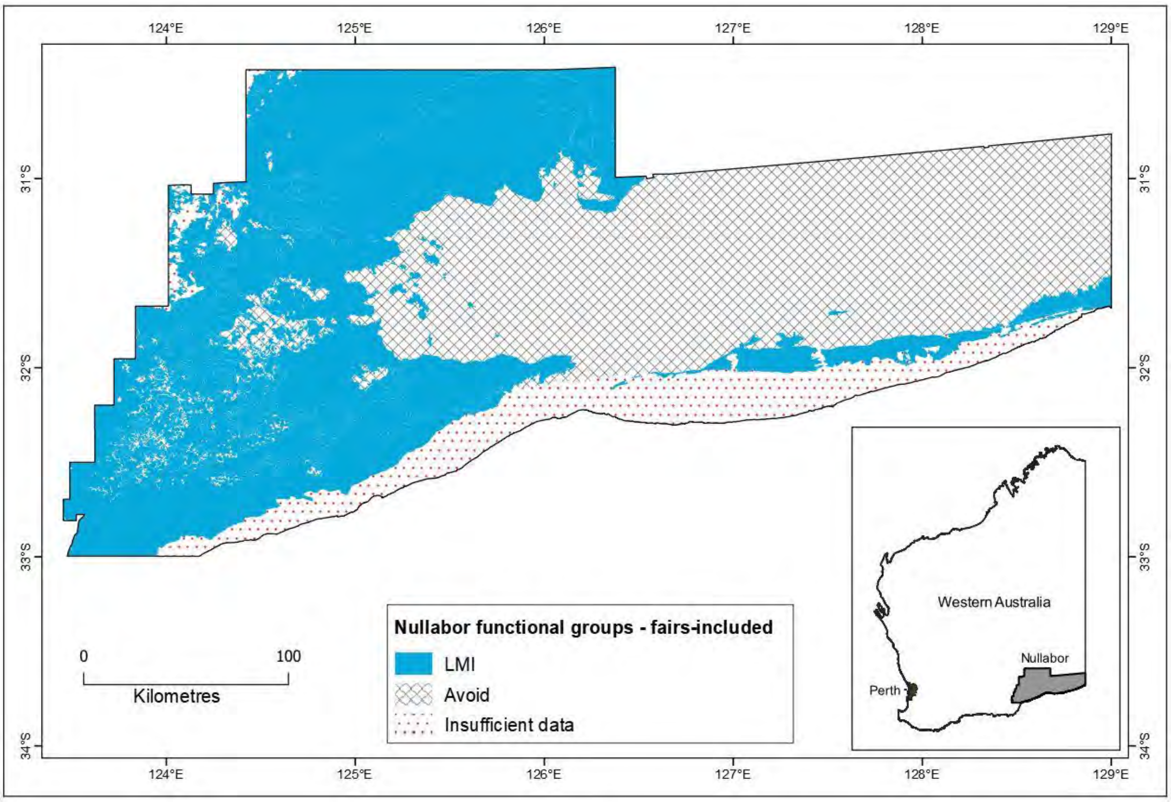

Figure F46: The most suitable VIs for monitoring pasture condition of functional groups in the Pilbara region using fairs-included strategy

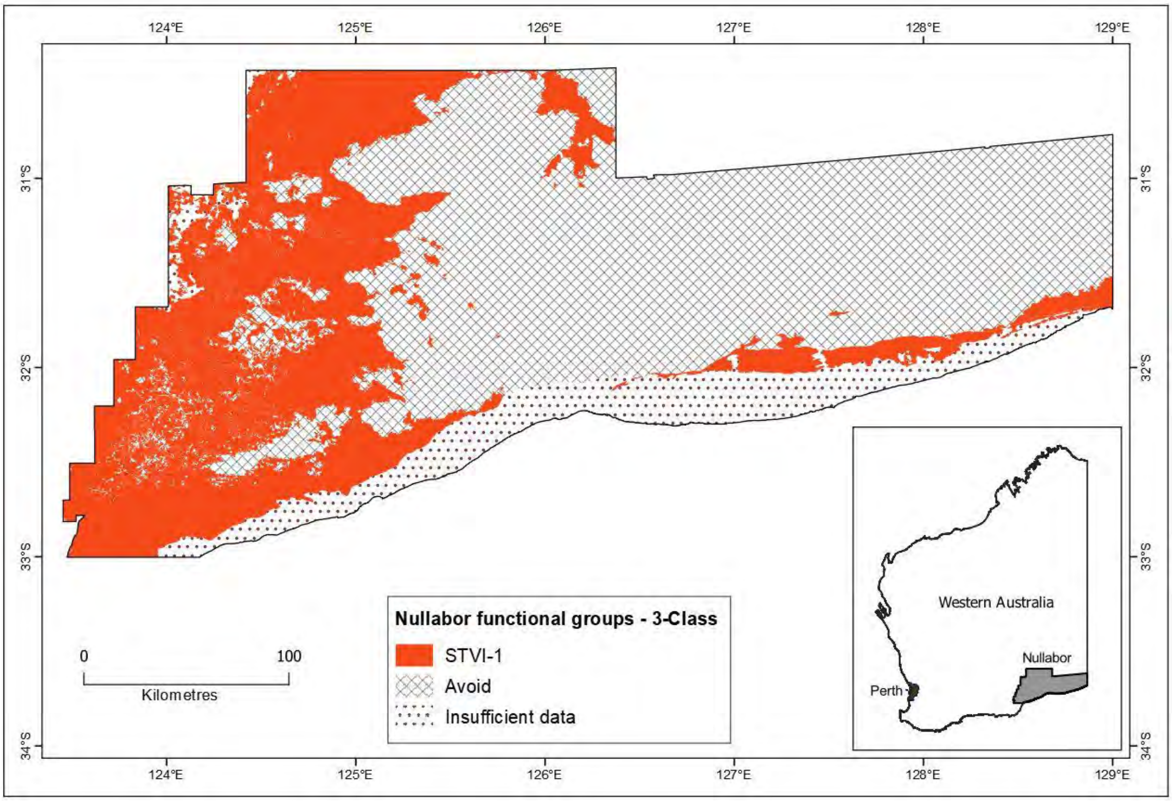

Figure F47: The most suitable VIs for monitoring pasture condition of functional groups in the Pilbara region using 3-class strategy

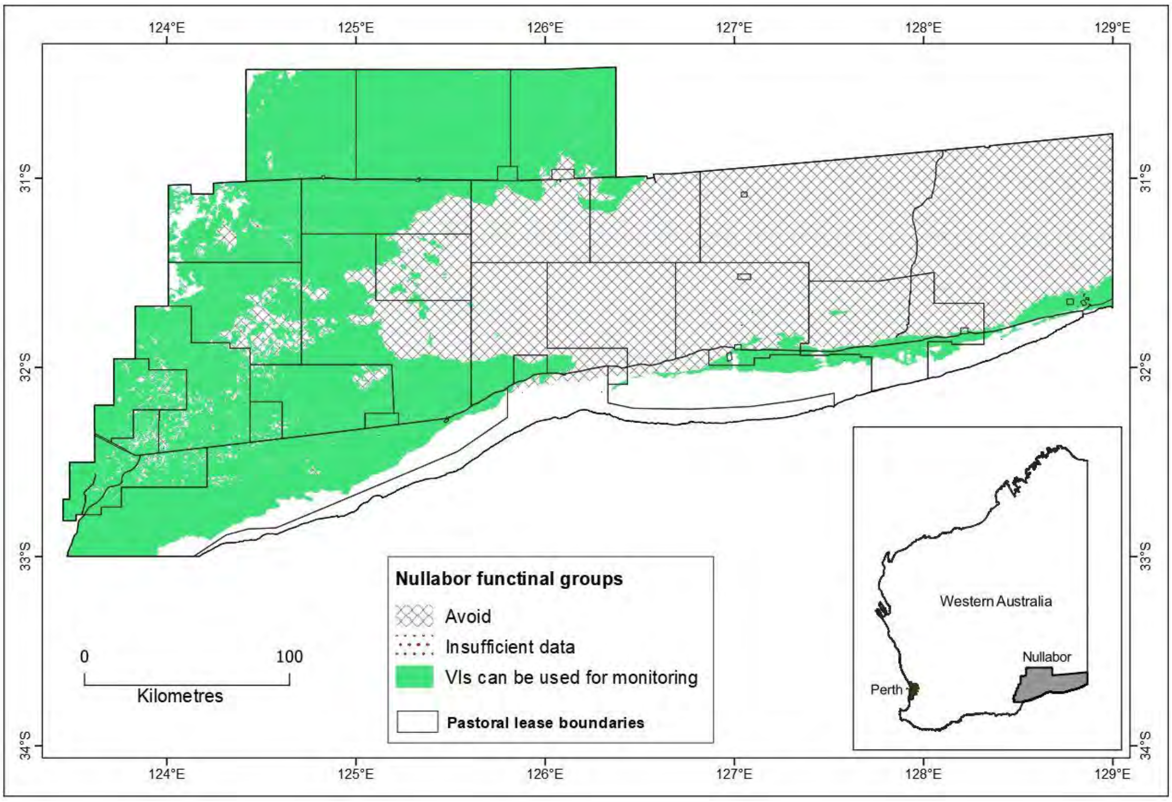

Figure F48: Where VIs can be used for monitoring pasture condition of functional groups in the Nullarbor region

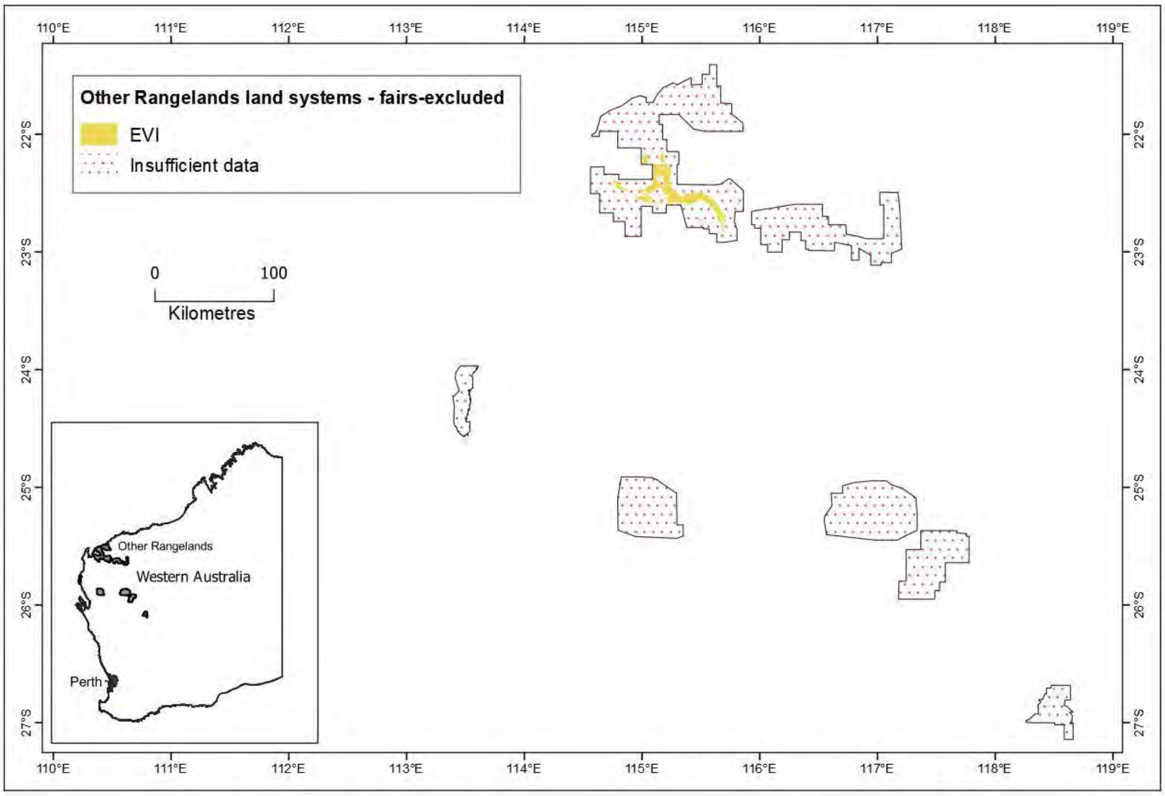

Figure F49: The most suitable VIs for monitoring pasture condition of land systems in the Other Rangelands region using fairs-excluded strategy

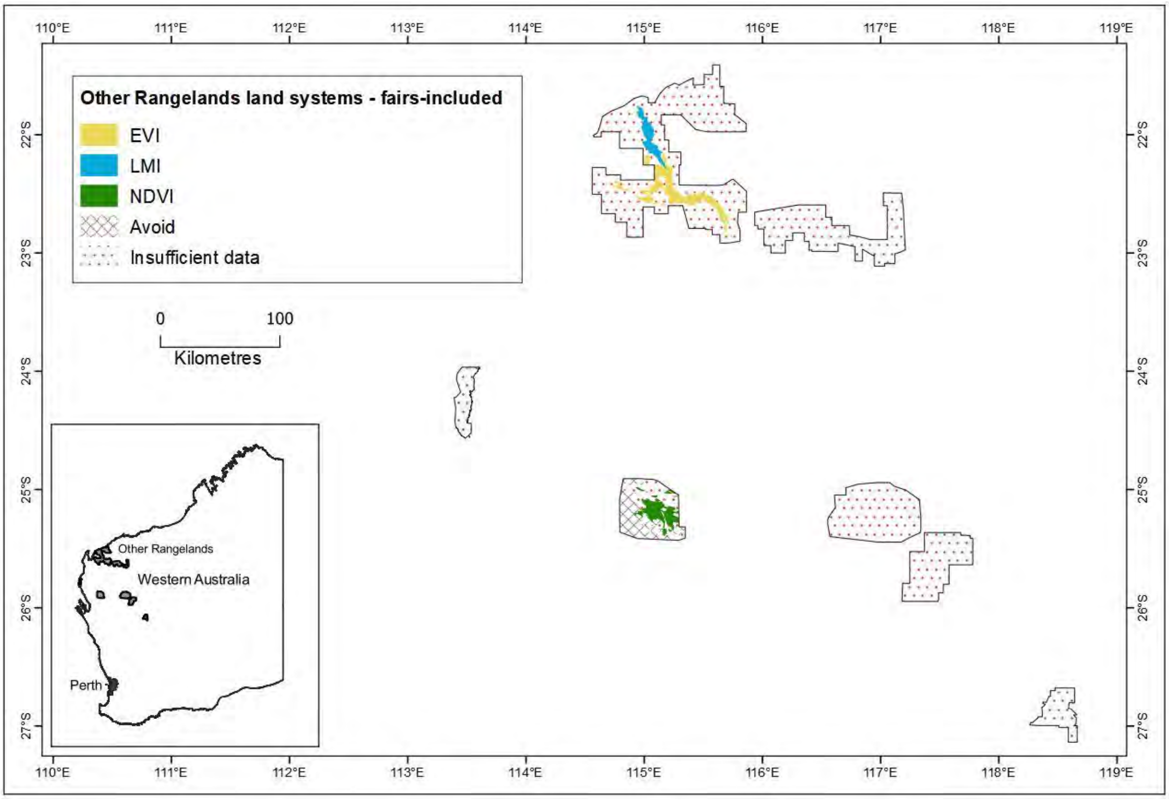

Figure F50: The most suitable VIs for monitoring pasture condition of land systems in the Other Rangelands region using fairs-included strategy

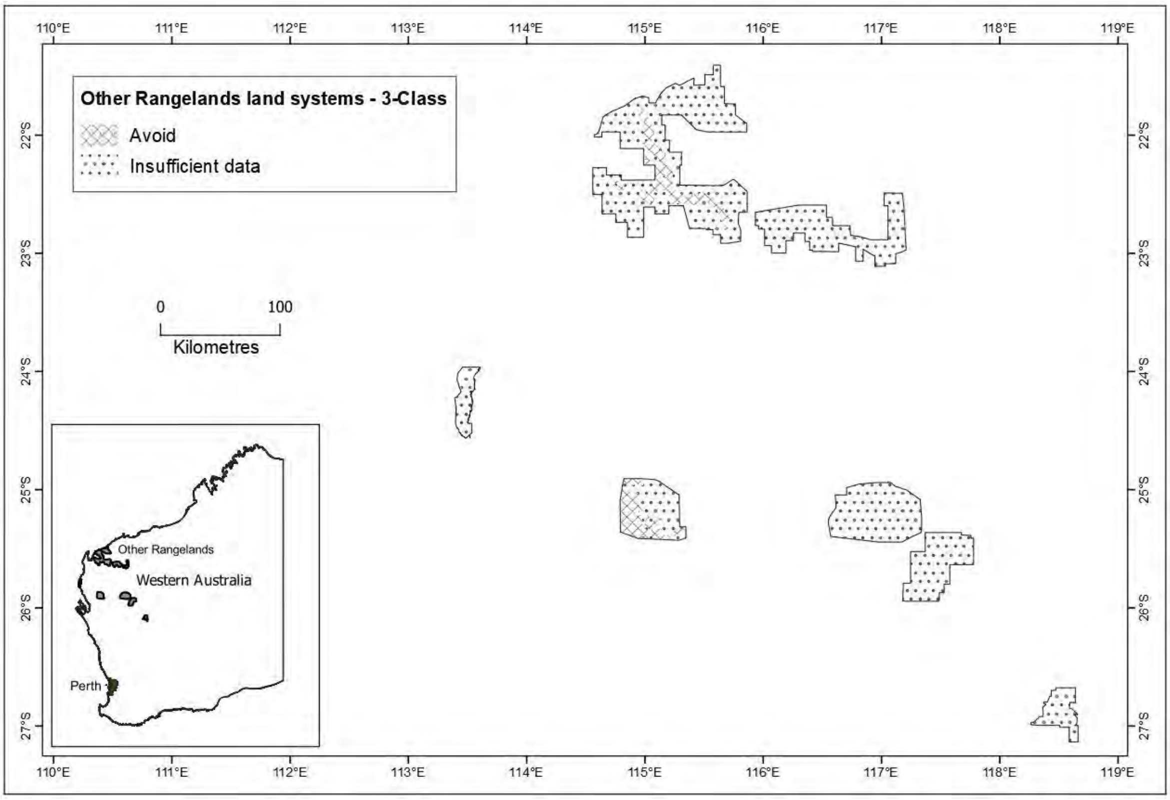

Figure F51: The most suitable VIs for monitoring pasture condition of land systems in the Other Rangelands region using 3class strategy

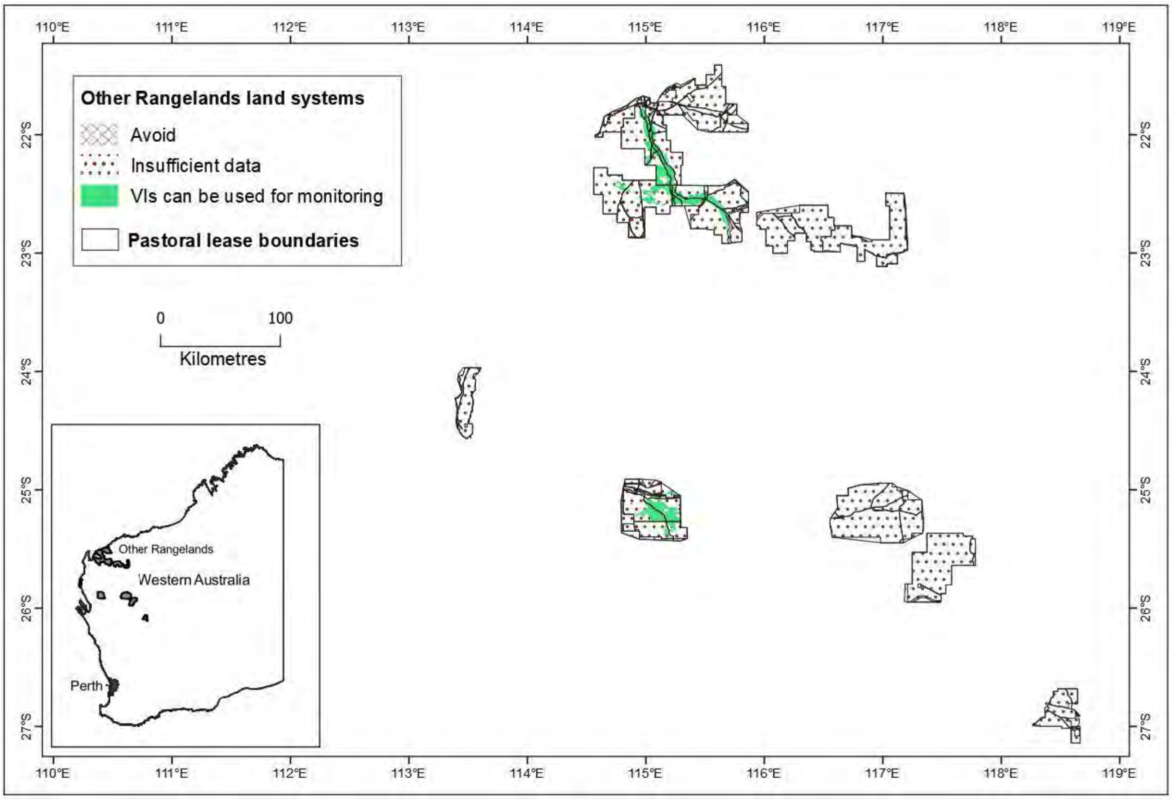

Figure F52: Where VIs can be used for monitoring pasture condition of land systems in the Other Rangelands region

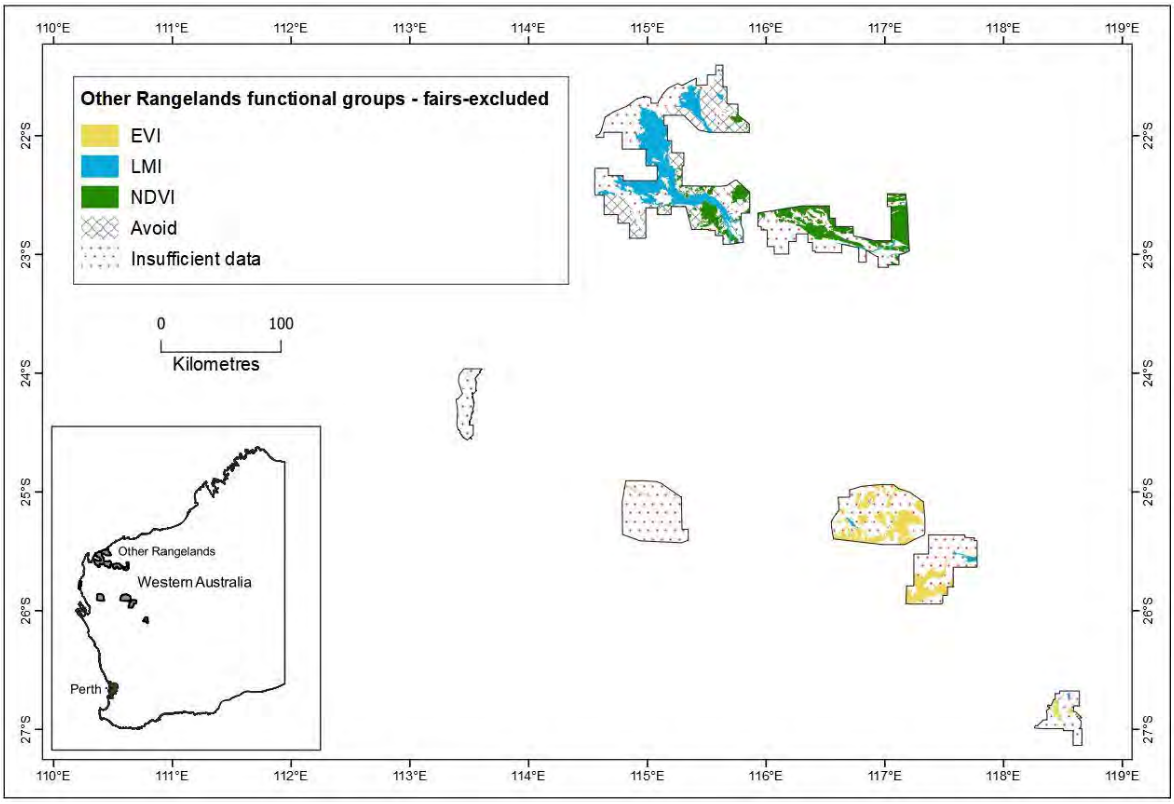

Figure F53: The most suitable VIs for monitoring pasture condition of functional groups in the Other Rangelands region using fairs-excluded strategy

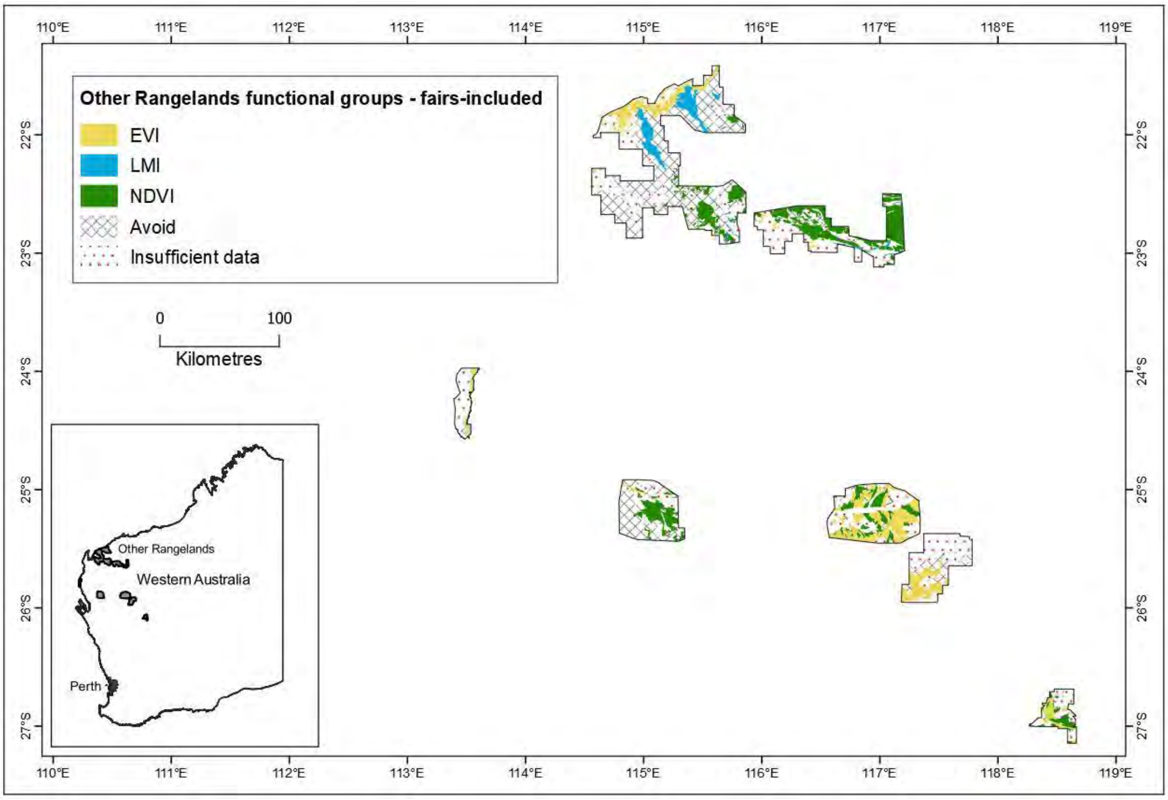

Figure F54: The most suitable VIs for monitoring pasture condition of functional groups in the Other Rangelands region using fairs-included strategy

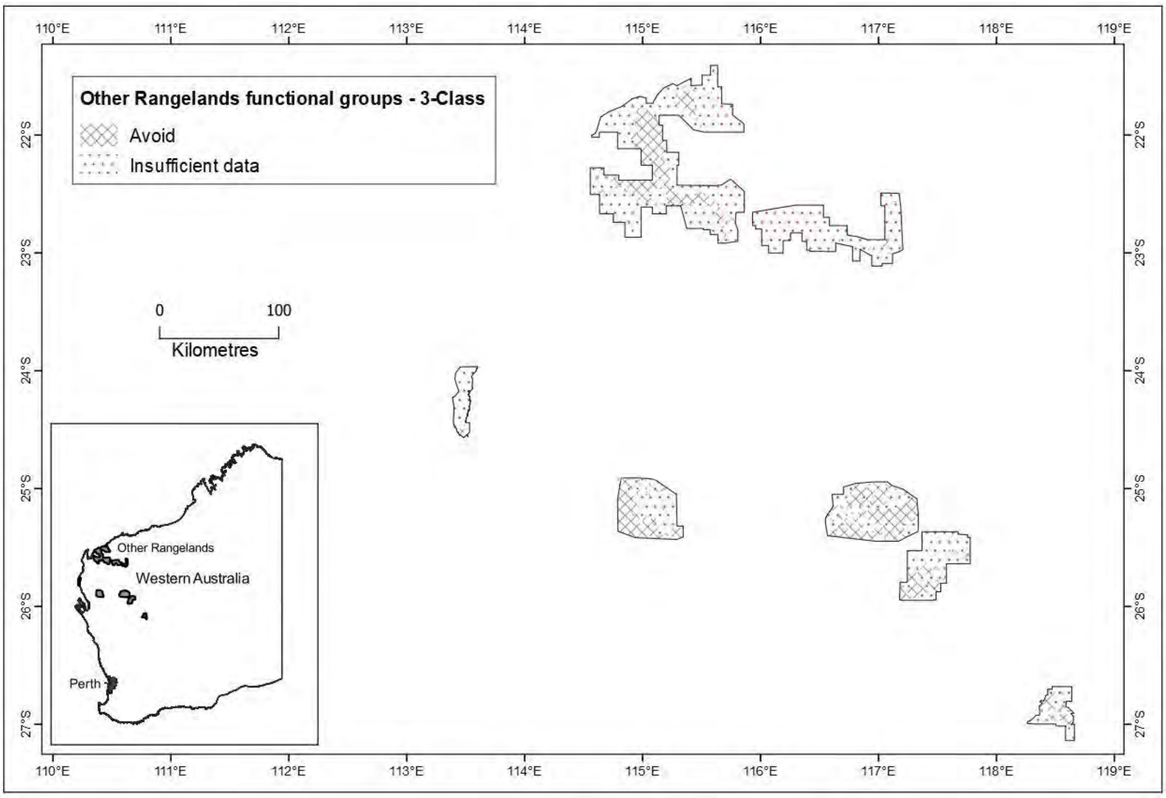

Figure F55: The most suitable VIs for monitoring pasture condition of functional groups in the Other Rangelands region using 3-class strategy

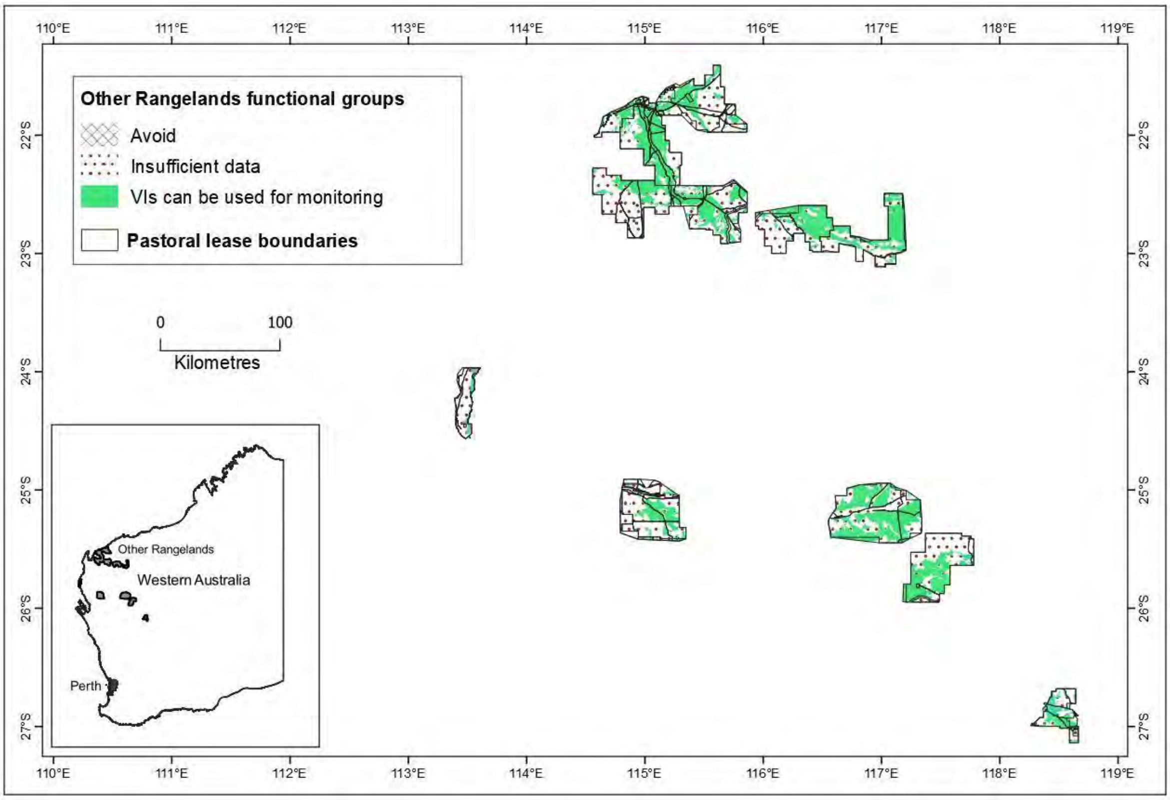

Figure F56: Where VIs can be used for monitoring pasture condition of functional groups in the Other Rangelands region

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