Biodiversity and Conservation Science

Dirk Hartog Island National Park Ecological Restoration Project: Vegetation Restoration Program Report 2023/24

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August 2024

GOVERNMENT OF WESTERN AUSTRALIA

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This document is available in alternative formats on request.

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Summary

Changes in vegetation cover across Dirk Hartog Island (DHI) were assessed using imagery from the Landsat satellite series, captured between 1988 and 2024 and photo point observations. From the analysis of these data the influence of the feral goat removal program is evident. A map identifying areas of significant vegetation cover change since destocking (2008) was also created. This suggests that to 2024, 15.8 % of DHI has experienced a significant increase in vegetation cover, this is down from 29.4% in 2023.

The overall reduction in vegetation cover across DHI is most likely due to the hot and dry conditions over the past 12 months. Graphs of monthly rainfall and temperature are included in this report. Rainfall and temperature data is limited int he Shark Bay area with reliable records only going back to around 2000. However, they show that during this time the lowest 12-month period of rainfall occurred between February 2023 and January 2024, where just 61.2 mm was recorded. Adding to this, temperature records show that the highest 12-months of mean monthly temperature occurred between July 2023 and June 2024.

The area of sand dunes on the Island increased by ~7% in the past 12 months. However, this does not appear to be part of any trend and is consistent with fluctuations over the past 5 years.

Fieldwork was carried out in May 2024, with multi-spectral imagery from a remotely piloted aircraft (RPA) being captured across 12 sites with species recorded at 4 sites. This data will be analysed in the coming years.

Objectives for 2024/25:

- Analyse vegetation cover changes over DHI from Landsat imagery (1990 to 2025).
- Provide a report with summary statistics of vegetation change from analysis of Landsat imagery.
- Report on vegetation change related to destocking and goat removal.
- Complete field trips to collect field data in May 2025.
- Capture RPA imagery of monitoring sites and continue back-processing previously captured imagery to new standards.
- Expand species level assessments of plot level vegetation cover change.
- Produce a draft paper looking into the combined effects of climate and destocking on vegetation cover on DHI.

1 Introduction

Satellite imagery is being used to report on vegetation recovery for the Dirk Hartog Island National Park Ecological Restoration Project (the Project). Objectives for 2023/24 were:

- Analyse vegetation cover changes over DHI from Landsat imagery (1990 to 2024).
- Provide a report with summary statistics of vegetation change from analysis of Landsat imagery.
- Report on vegetation change related to destocking and goat removal.
- Report on species level changes to monitoring site composition using photography captured from 2015 to 2024.

Achieving the 2023/24 objectives will help achieve the wider objective to:

- Evaluate vegetation recovery in terms of species diversity and cover and correlate to environmental and grazing factors.
- Gain a greater understanding of species level vegetation the change across the Island.

2 Progress

The following section outlines progress towards achieving the 2023/2024 objectives.

2.1 Vegetation Cover Change

The analysis of vegetation cover change has continued using the same methodologies as outlined in “DHI remote sensing report - 2016-17” (DBCA) delivered August 2017.

3 Results

3.1 Climate data

Climate data acquired from the Bureau of Meteorology (BOM) indicates that 2023/24 was a period of extreme heat and low rainfall for DHI and the Shark Bay region. Complete temperature and rainfall records recorded close to DHI are quite short with rainfall extending back to 1996 at Steep Point and temperature back to 2000 at Shark Bay Airport. Temperature records were not available from Steep Point.

Rainfall records show that the lowest 12-month period of rainfall occurred between February 2023 and January 2024, where just 61.2 mm was recorded. This compares to a mean annual rainfall of 249.4 mm. Adding to this, temperature records show that the highest 12-months of mean monthly temperature occurred between July 2023 and June 2024. During this period the mean monthly temperature was 30.5 °C compared to an annual mean of 29.1 °C.

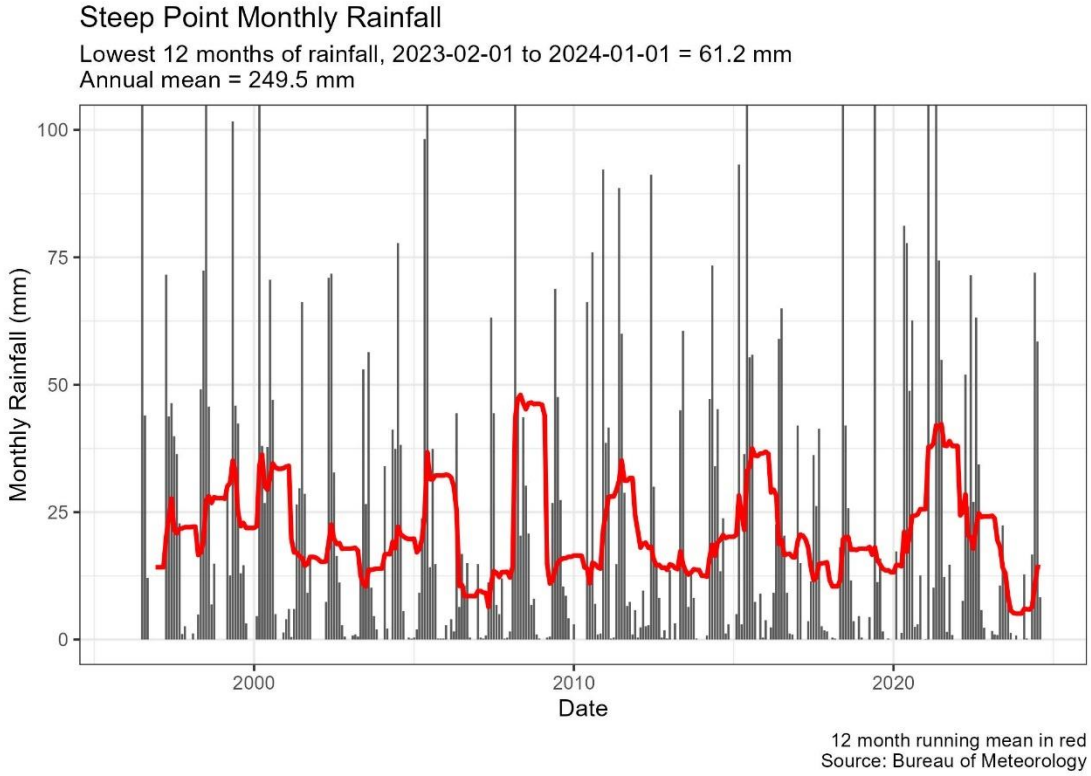


Figure 1: Monthly rainfall from the BOM station at Steep point. A 12-month running mean is shown in red.

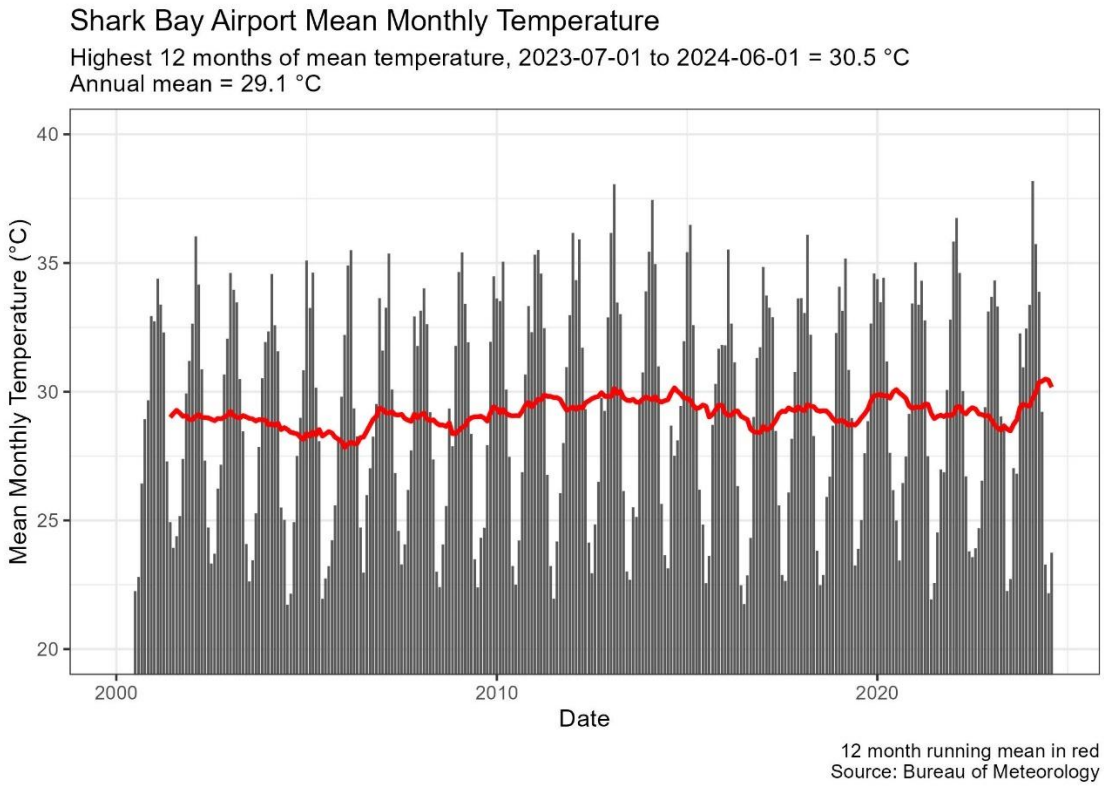


Figure 2: Mean monthly temperature from the BOM station at Shark Bay Airport. A 12-month running mean is shown in red.

3.2 Spatial extent of change

A map showing areas of vegetation change to 2009, 2010, 2023 and 2024 based on a pre destocking mean (1988 to 2008) are shown in Figure 3. Green areas indicate areas of significant vegetation cover increase, whereas orange and red indicate a reduction. Increases in vegetation cover are predominantly located in the southern third of the Island.

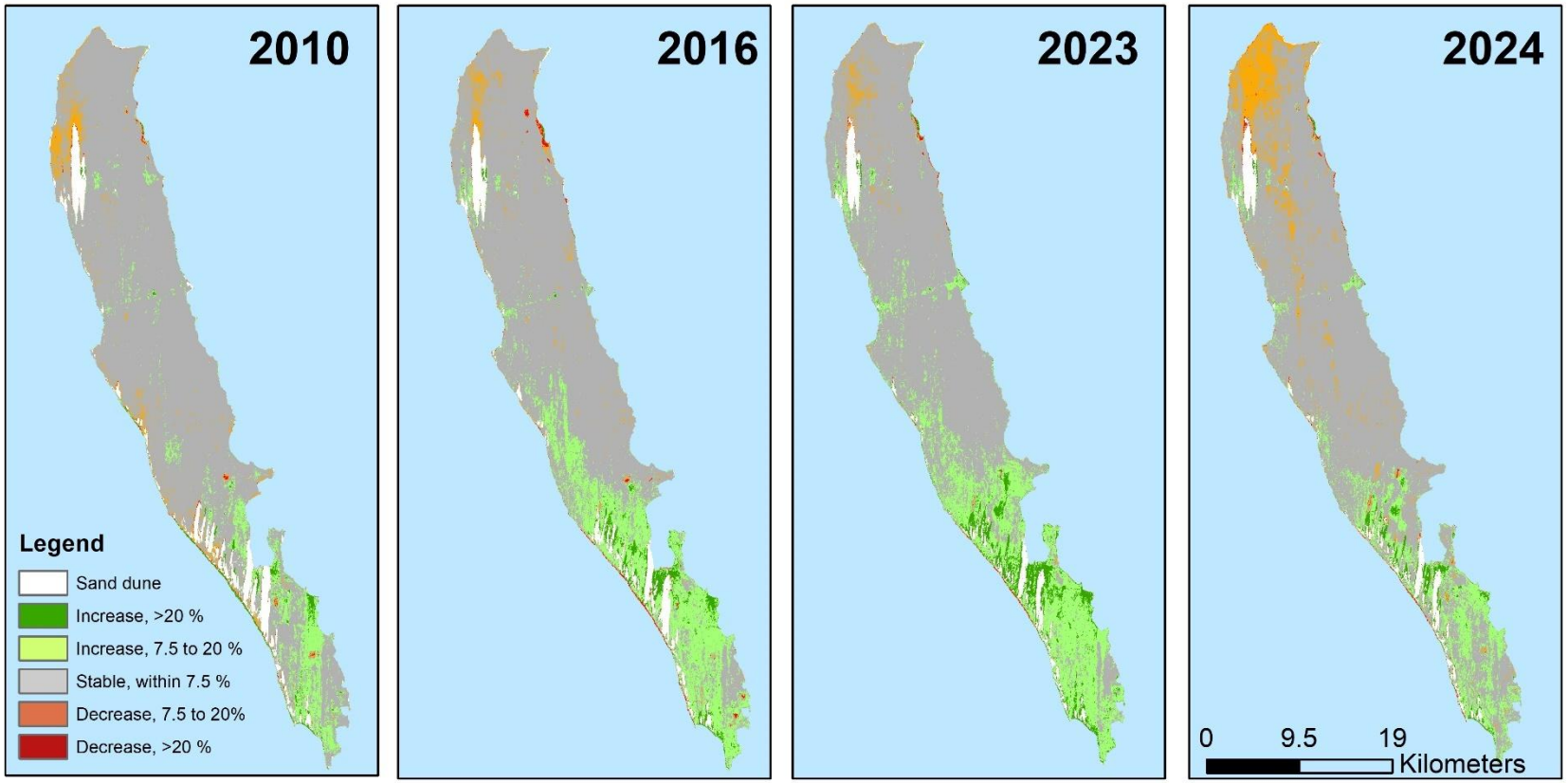
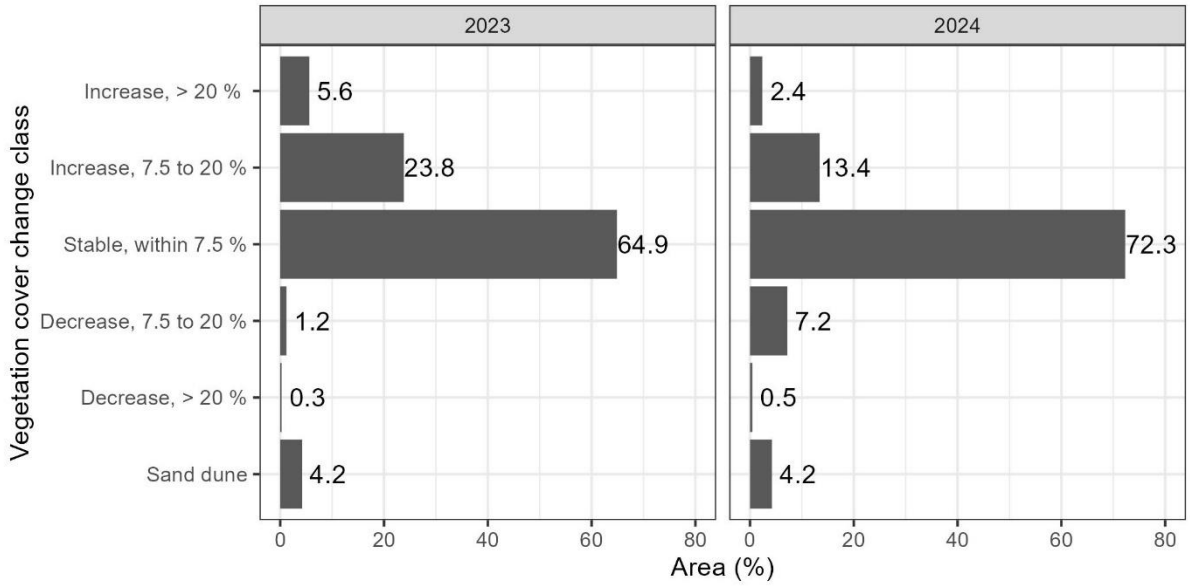


Figure 3: Significant vegetation cover change for years 2010, 2016, 2023 and 2024 based on the pre-destocking mean (1988 to 2008).

Area calculations for the classes in Figure 3 are shown in Table 1. The majority of DHI (72.3%) recorded no significant increase in vegetation cover since destocking, while 15.8% recorded either a moderate or significant increase. A decrease was recorded over 7.8% up from 1.5% in 2023. The greater area with a decrease in cover from the baseline is assumed to be related to the hot, dry conditions outlined in the previous section.

Table 1: Percentage of area per change class for 2023 to 2024 on Dirk Hartog Island.



Three time series plots showing various patterns of temporal vegetation cover change are shown in Figure 4. At point dhi_05 vegetation cover has steadily increased since the removal of feral goats, with the conditions in the past year seeming to have a negligible impact. Site dhi_08 has seen a steady drop in vegetation cover since ~ 2014 with a small drop in the past 12 months. This may be due to sand spray from the dune to the south, however this seems unlikely due to the distance and the fact that the dune is no longer moving. Alternatively, this area seems to have had minimal impact from grazing and may be more responsive to climatic change. Site dhi_11 has a similar temporal pattern to site dhi_08 but the magnitude of change is smaller, so the surrounding area is mapped as “Stable”.

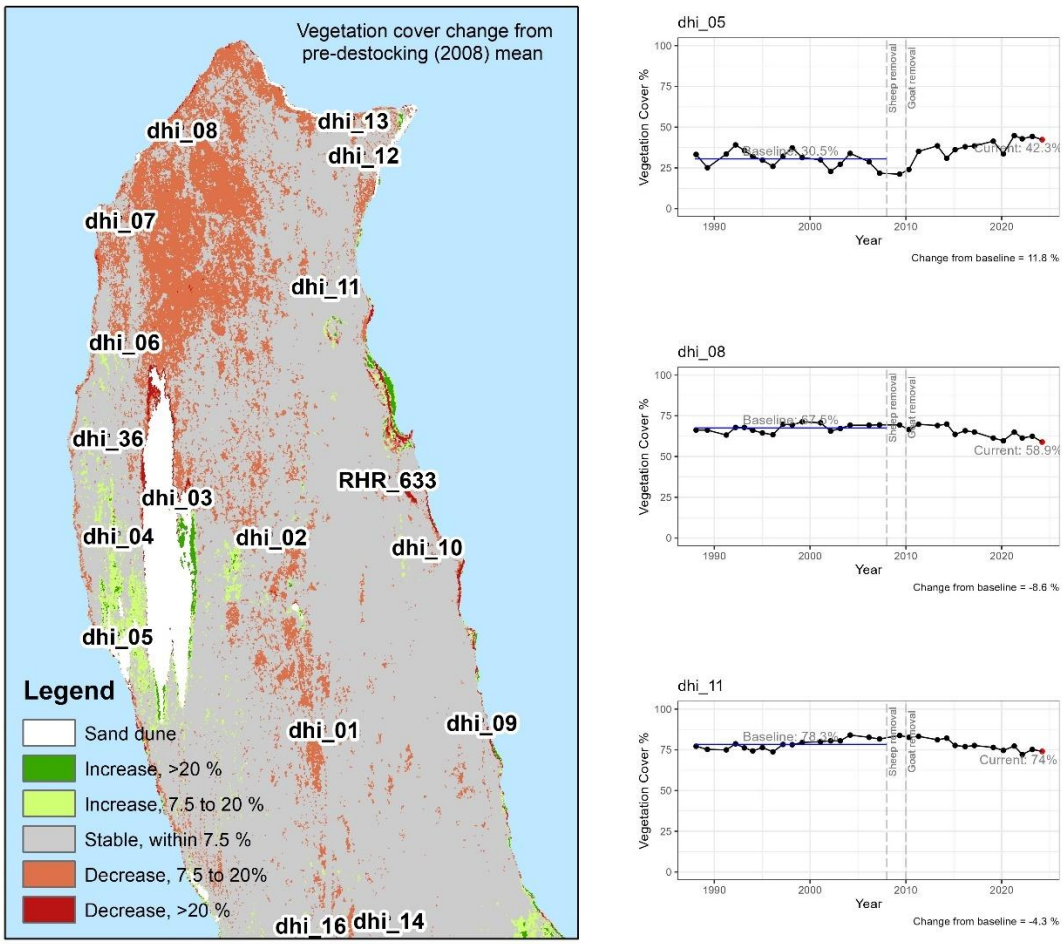


Figure 4: Areas of decreasing cover and vegetation cover timeseries plots.

3.3 Sand dune extent changes

The area of sand dune extent on DHI over the period 1957 to 2024 is shown in Figure 5. The area of sand dune on the southern third reached a maximum of 2402 ha in 2009 and is now 1599 ha.

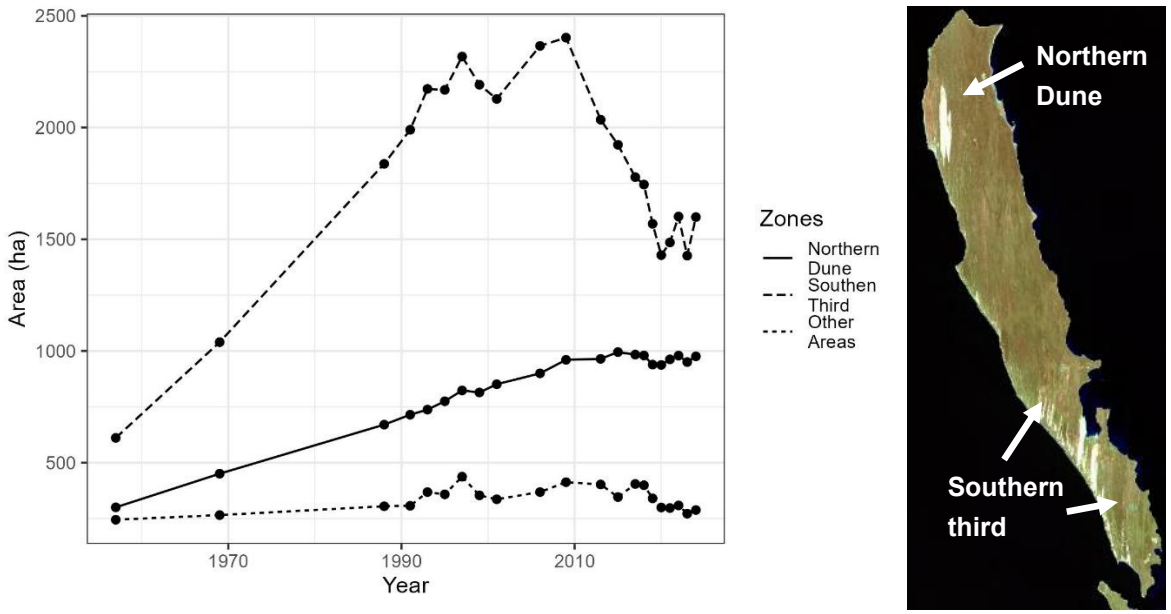


Figure 5: Sand dune extent changes across Dirk Hartog Island from 1957 to 2024.

3.4 Monitoring site observations and analysis

Site data for all photo point monitoring sites and sites added in 2014 are shown in the Appendix. Site descriptions were recorded by Greg Keighery (Senior Principal Research Scientist, DBCA) in 2014, 2016 and 2018.

Photo point photos are shown. Time series graphs of canopy cover from 1988 to 2024 are shown. The graphs show comparisons between the vegetation cover within the baseline period and current level.

Appendices 1

The following time series graphs show vegetation cover derived from Landsat satellite data from 1987 to 2024.

Site 1

Description:

Low Very Open Shrubland (2% cover); 0.5-1 metres Acacia ligulata with rarely recorded Acacia tetragonophylla.

Low shrubland (30-70% cover) 0.3- 0.5 metres of Thryptomene baeckeacea and Melaleuca cardiophylla, with rarely recorded shrubs of Stenanthemum sp., Persoonia sp., Halgania cynaea and Olearia axillaris.

Over low hummock grassland (10-30 % cover) of Triodia plurinervata.

Over scattered herbs and low shrubs (<2% cover) of Halgania cyanea, Cassytha sp., Logania sp. and Dianella revoluta.

Photo point photographs of site 1.

May 2006

May 2007

September 2008

October 2009

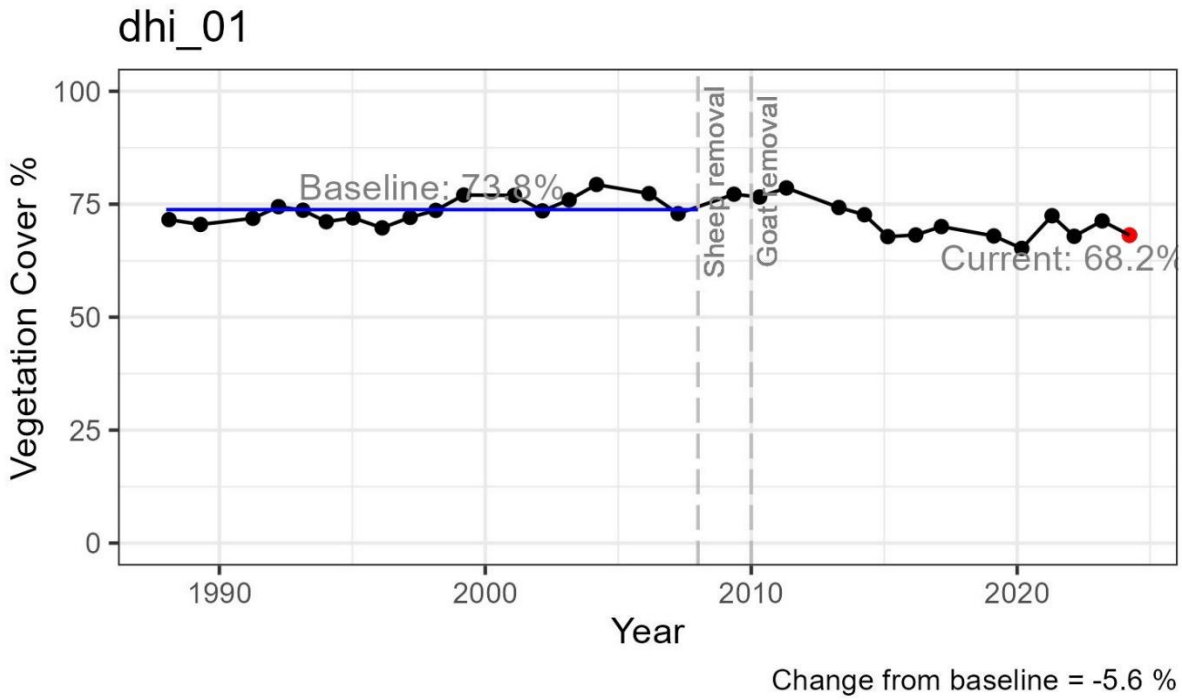
January 2012

April 2014

		
May 2016	May 2021	May 2024

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 2

Description:

Low heath of Melaleuca cardiophylla/Pileanthus limacis (30-70% cover avg 60%) 0.2 metres

Low very open grassland of Trioda plurinervata (10% cover) 0.2 metres

Rare shrubs of Mirbelia ramulosa/ Thryptomene baeckeacea/ Leptosema macrocarpum

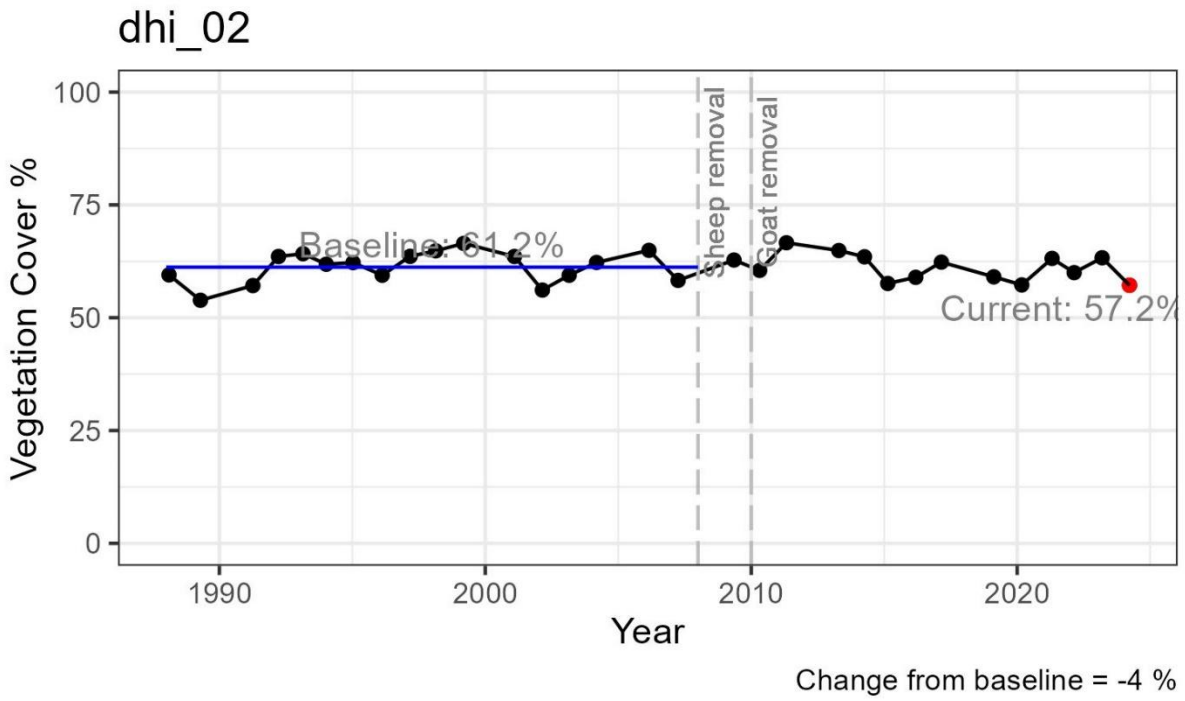
Rare herbs of Conostylis stylidioides

Photo point photographs of site 2.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012
 May 2016	 May 2024	

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 3

Description:

Low Open Shrubland (2-10% cover) 0.5-1 metres Acacia ligulata and Atriplex vesicaria

Low shrubland (10-30% cover) 0.3- 0.5 metres of Thryptomene baeckeacea and Melaleuca cardiophylla, with rarely recorded shrubs of Ptilotus obovatus, Maireana sp., Atriplex sp. and Threlkeldia diffusa

Over low hummock grassland (2- 10 % cover) of Triodia plurinervata

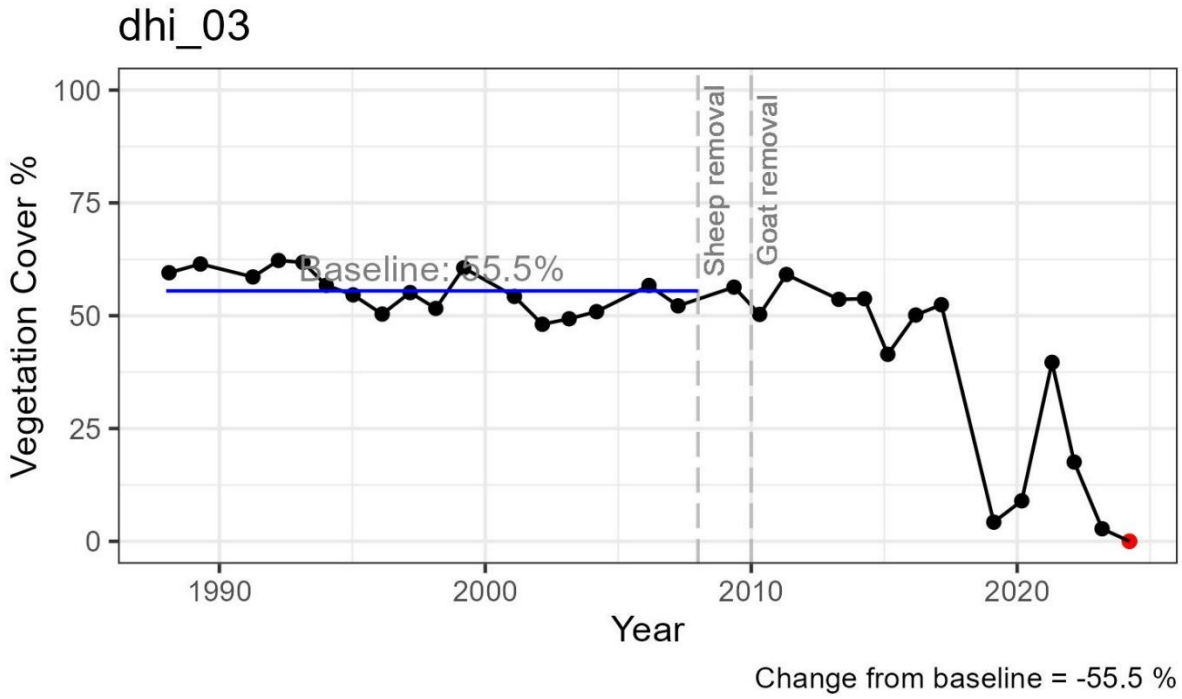
Over scattered herbs, grasses and low shrubs (<2% cover) of Acanthocarpus robustus, Cymbypogon obtectus, Carpobrotus candidus, Senecio pinnatifolius and Dianella revoluta.

Photo point photographs of plot 3.

 April 2006	 May 2007	 September 2008
 January 2012	 April 2014	 May 2017

Vegetation cover time series analysis:

This site has now been encroached by a mobile dune.



Site 4

Description:

Tall Open Shrubland (2-10% cover) 2-2.5 metres of Diplolaena grandiflora with Acacia (estimated species) sclerosperma(dead), Alectryon oleifolium and Rhagoda ~~.~~Preissii subsp. Obovata, Scaevola tomentosa

Low shrubland (30% cover) 0.3- 0.5 metres of Thryptomene baeckeacea

Prostrate to decumbent shrubland (10-30%) of Threlkeldia diffusa, mostly dead 10% alive in 2018

Over low grassland (2-10 % cover) of *Cenchrus ciliaris and Austrostipa nitida

Over scattered herbs and low shrubs (<2% cover) of Angianthus tomentosus, Podotheca gnaphaloides, *Urospermum picroides and *Brassica tournefortii. Euphorbia boophthona/ Euphorbia australis/ Commicarpus australis/ *Sonchus oleraceus, Ptilotus obovatus, Atriplex vesicaria, Zygophyllum eremaeum

1 seedling of Acacia sclerosperma, 3 seedlings of Acacia ligulata

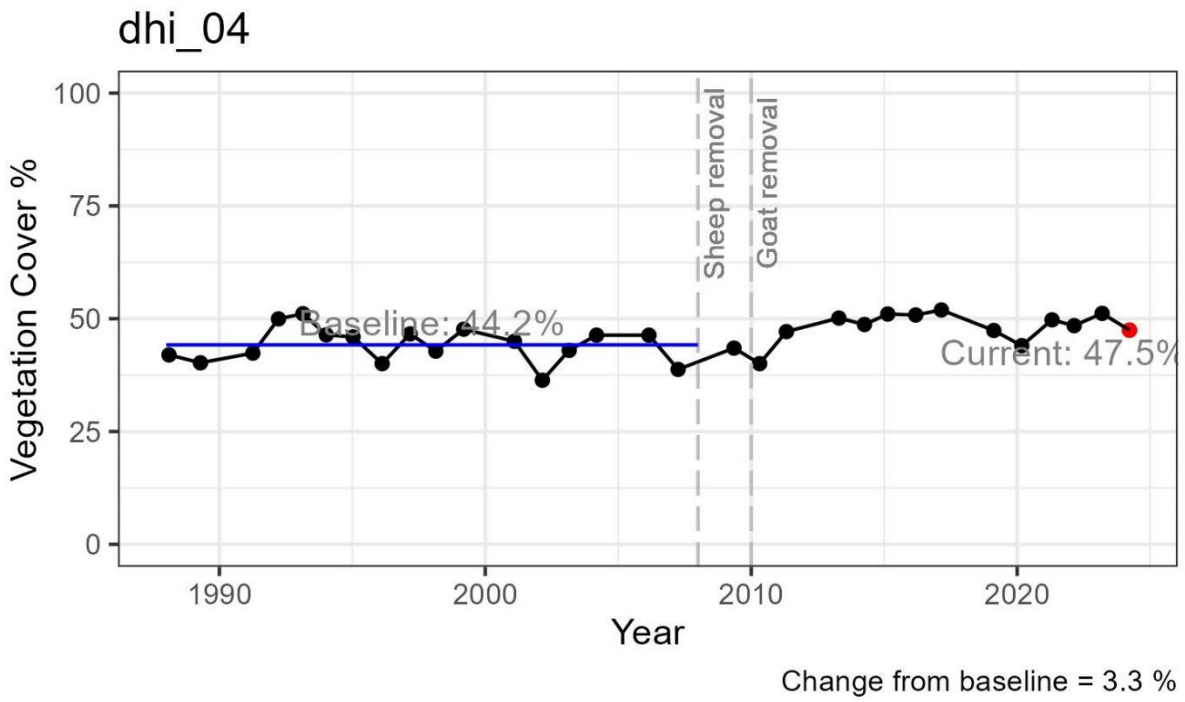
Photo point photographs of plot 4

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012

 April 2014	 May 2015	 May 2016
 May 2017	 May 2018	 May 2019
 May 2021	 May 2024	

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.


dhi_04
Vegetation Cover %
100
75
50
25
0
Sheep removal
Goat removal
Baseline: 44.2%
Current: 47.5%
1990
2000
2010
2020
Year
Change from baseline = 3.3 %

Site 5

Description:

Open shrubland Diplolaena grandiflora (20% cover) to 1 metre, over Scaevola crassifolia

Low shrubland Capparis spinosa/ Frankenia pauciflora/ Pimelea gilgiana/ Atriplex vesicaria/ Threlkeldia diffusa/ Rhagodia preissii (20-30% cover) 0.2 metres over prostrate herbs of Carpobrotus sp. Thevenard Island (10-20%)

Scattered herbs of *Centaurea melitensis/ Euphorbia australis/ Euphorbia boophthona/ *Brassica tournefortii/ *Sonchus oleraceus (<1% cover)

Scattered grasses Cenchrus ciliaris (<2% cover), Eragrostis dielsii (<1% cover)

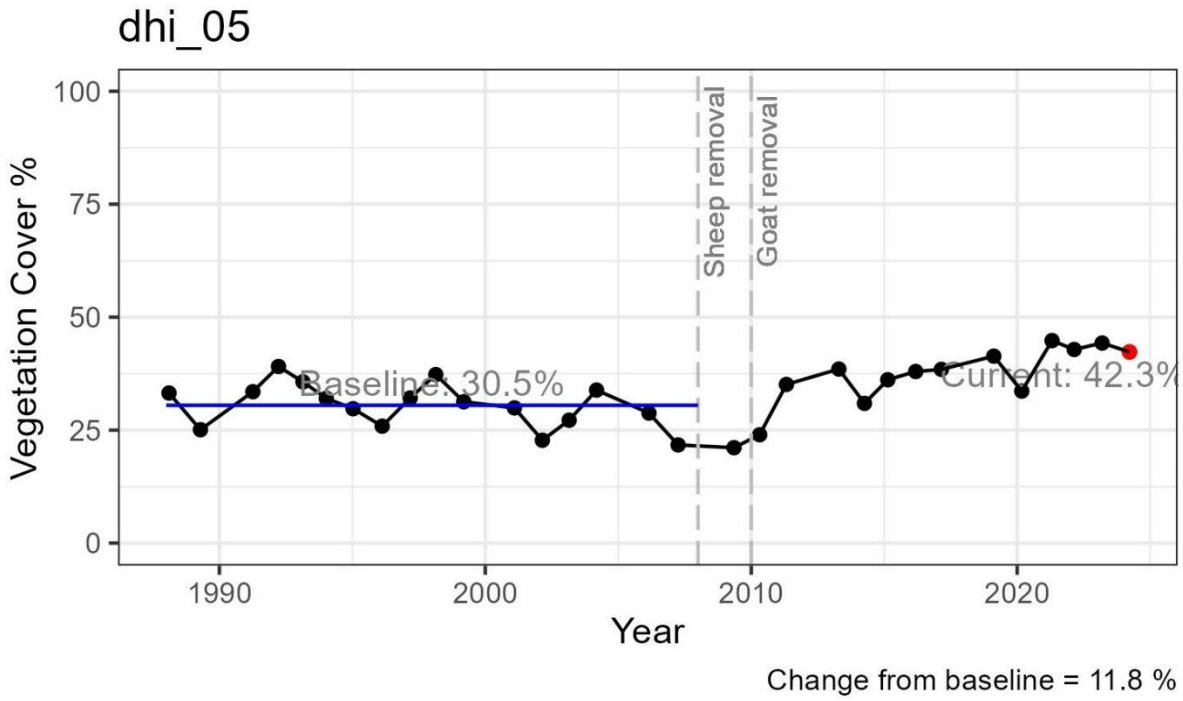
Photo point photographs of plot 5.

 May 2006	 May 2007 (peg was reinstalled)	 September 2008
 October 2009	 January 2011	 January 2012
 May 2015	 May 2015	 May2017

		
May 2018	May 2019	May 2024

Vegetation cover time series analysis:

A significant increase in vegetation cover is evident in the time series graph and site photos. The increase appears to occur following 2010, this coincides with the removal of large numbers of goats from the area.



Site 6

Description:

Acacia coriacea/ Acacia tetragonophylla (10% cover) 1 metre over

Sparse low Thryptomene baeckeacea (10% cover) shrubland 0.2 metres

Scattered Trioda plurinervata grassland (<5% cover) 0.2 metres over

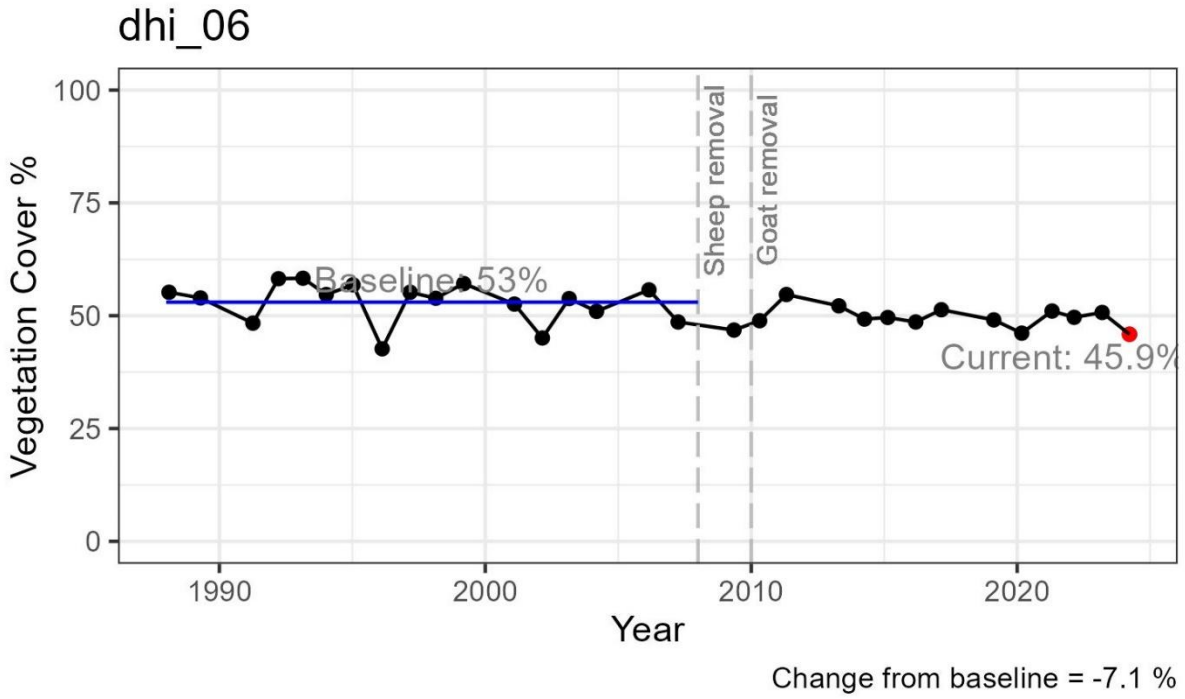
Herbs of Euphorbia boophthona/ Ptilotus gaudichaudii/ Gnephosis arachnoidea/ *Sisymbrium orientale/ *Brassica tournefortii/ Salsola australis/ Carpobrotus sp. Thevenard Island

Photo point photographs of plot 6.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012
 May 2015	 May 2016	

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 7

Description:

Low Shrubland (10-30% cover) 1-2 metres of Acacia ligulata with scattered Diplolaena dampieri, Alogyne hakeifolia, Alectryon oleifolia and Exocarpus aphyllus

Low shrubland (30% cover) 0.3- 0.5 metres of Thryptomene baeckeacea (90%), with rarely recorded shrubs of Santalum spicatum, Atriplex vesicaria, Rhagodia (estimated species) crassifolia and Threlkeldia diffusa

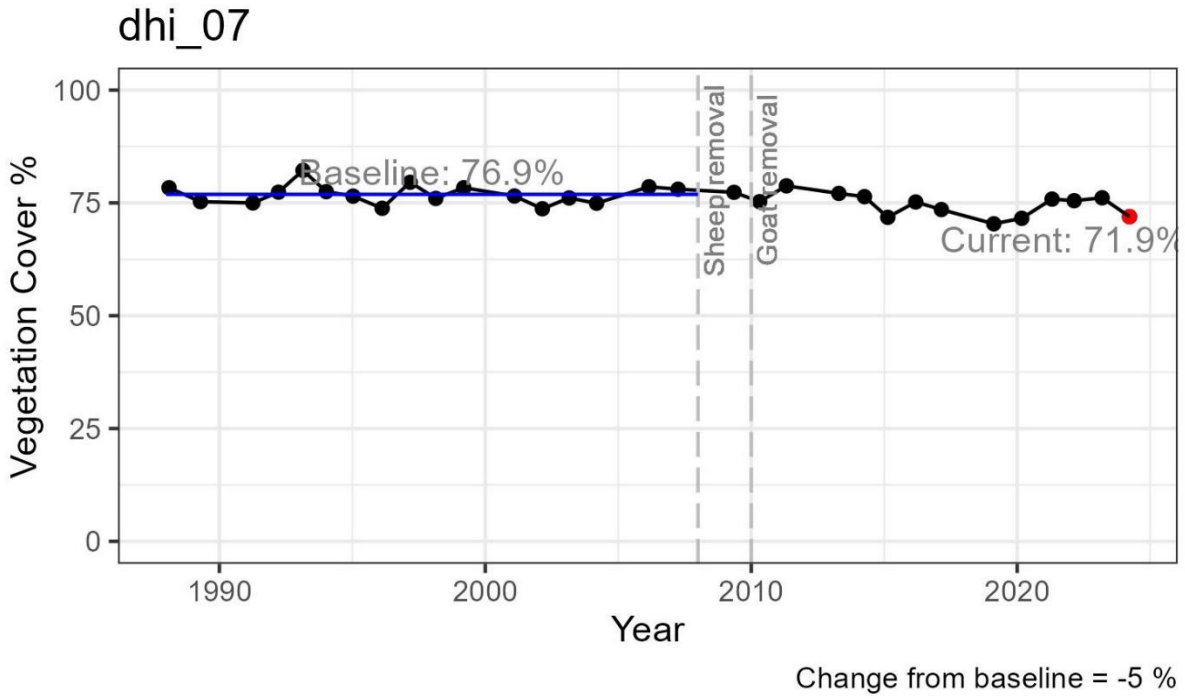
Over succulent low shrubs (2-10% cover) of Carpobrotus candidus.

Photo point photographs of plot 7.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012
 April 2014	 May 2021	

Vegetation cover time series analysis:

A slight decline in vegetation cover is now evident at the site.



Site 8

Description:

Very scattered Acacia ligulata (<1% cover) 0.5 metres

Low heath of Melaleuca cardiophylla/ Thryptomene baeckeacea (30-70% cover avg 60%) 0.2 metres over

Grassland of Trioda plurinervata (5% cover) 0.2 metres

Scattered herbs (<5% cover) of Salsola australis/ Ptilotus gaudichaudii

Photo point photographs of plot 8.

May 2006

May 2007

September 2008

October 2009

January 2011

January 2012

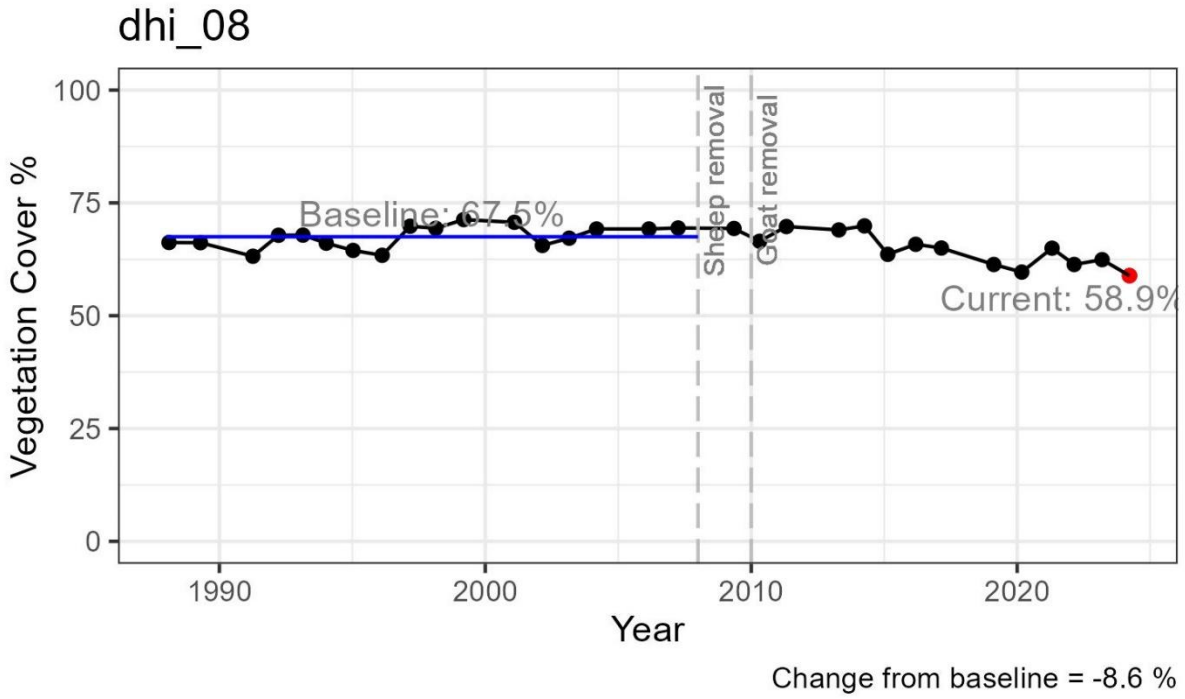
May 2015

May 2016

May 2024

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 9

Description:

Low Open Shrubland (10-30% cover) 1-1.5 metres Acacia ligulata dominated (90%) with scattered shrubs of Stylobasium spathulatum and Stennathemum sp.

Low shrubland (30% cover) 0.3-0.5 metre of Thryptomene baeckeacea, with raely recorded shrubs of Melaleuca cardiophylla and Pileanthus limacis

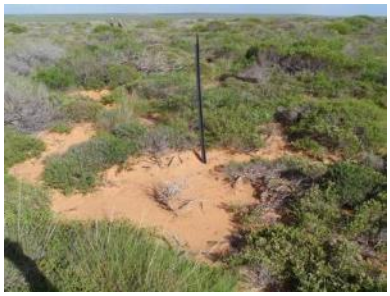
Over low hummock grassland (10-30 % cover) of Triodia plurinervata

Over scattered herbs of Dianella revoluta and Acanthocarpus preissii

(Note at this site there was a tall layer of Acacia coriacea and Acacia tetragonophylla, now mostly dead, little evidence or regeneration, possible fire)

Note: Site of interest for long term monitoring as the upper stratum of Acacia has been lost with little sign of regeneration.

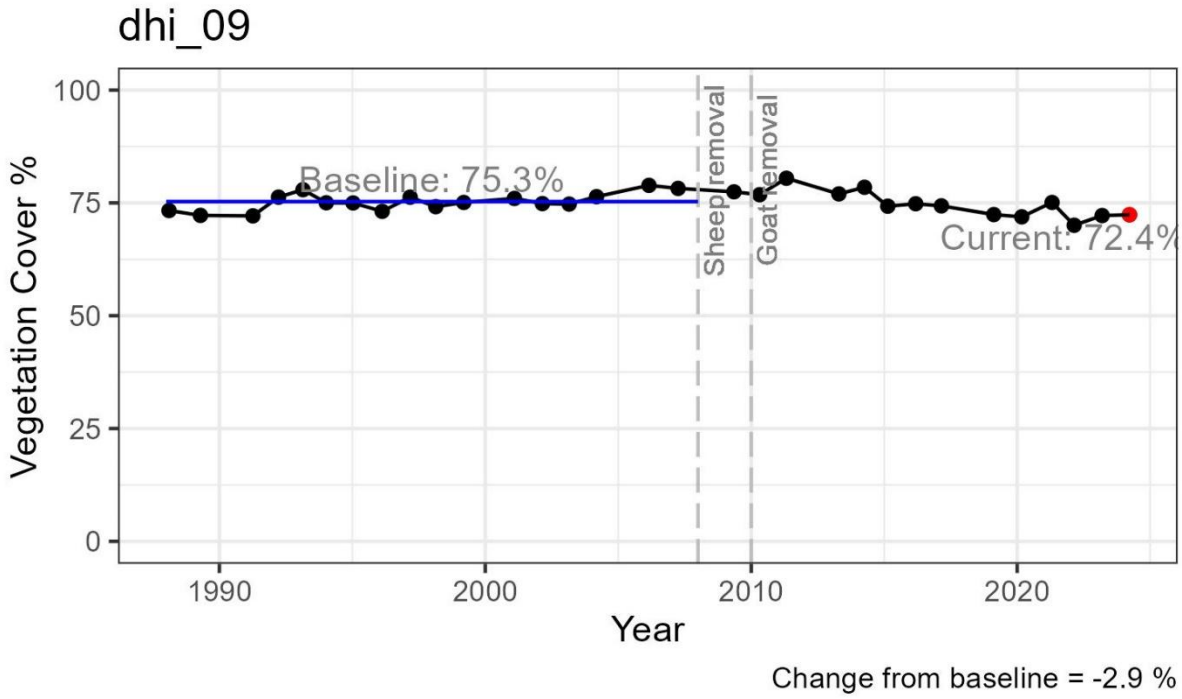
Photo point photographs of plot 9.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012

 April 2014		

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 10

Description:

Low Open Shrubland (10-30% cover) 1-1.5 metres Acacia ligulata dominated (90%) with scattered shrubs of Stylobasium spathulatum

Low shrubland (30% cover) 0.5-1 metre ofThryptomene baeckeacea, with rarely recorded shrubs of Melaleuca cardiophylla, Stennathemum sp. and Pileanthus limacis / Acanthocarpus robustus

Over low shrubland (2-10% cover) < 20cm Halgania andromedifolia/ Zygophyllum billardierei/ Beyeria calycina/ Ptilotus obovatus

Over low hummock grassland (10-30 % cover) of Triodia plurinervata with many young Triodia scattered though.

Herbs of Dianella revolta.

(Note at this site there was a tall layer of Acacia coriacea and Acacia tetragonophylla, now mostly dead, little evidence or regeneration, ?fire)

Note: Site of interest for long term monitoring as the upper stratum of Acacia has been lost with little sign of regeneration.

Undergoing successional change

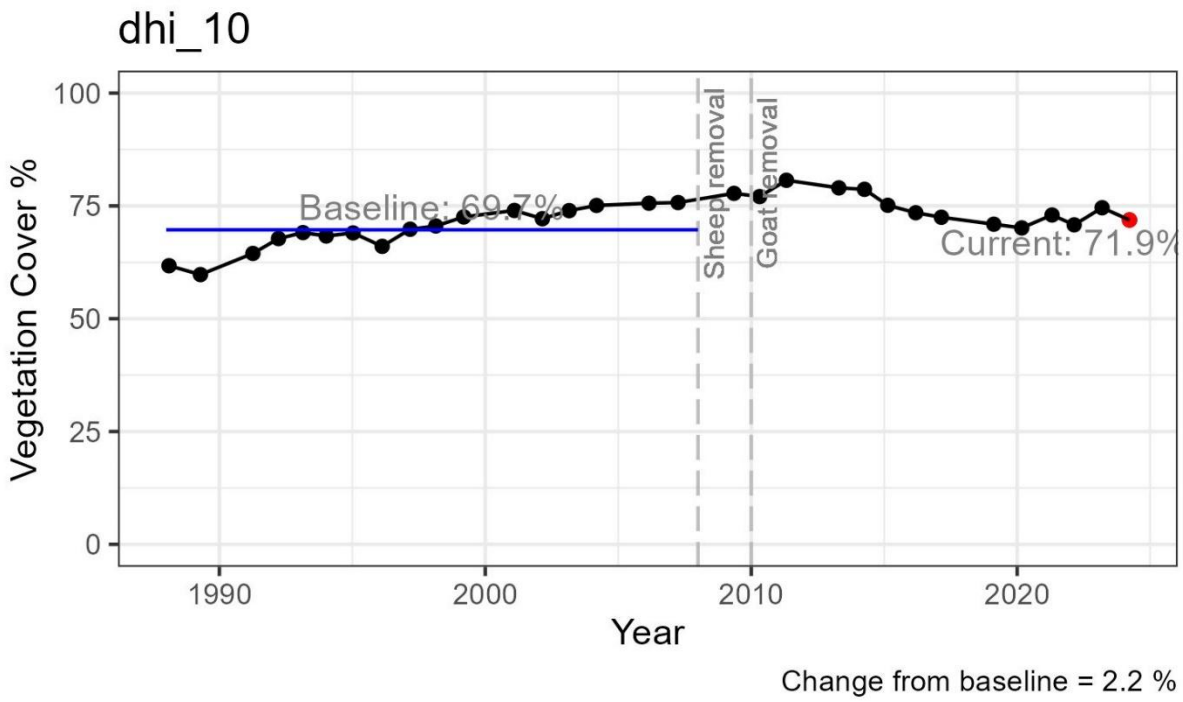
Photo point photographs of plot 10.

		
May 2006 (view angle inconsistent)	May 2007	September 2008

 October 2009	 January 2011	 January 2012
 April 2014	 May 2015	 May 2016
 May 2017	 May 2018	 May 2019
 May 2021	 May 2024	

Vegetation cover time series analysis:

The upward trend in vegetation cover has continued since the last report. The increase in cover may be due to long term recovery from fire or reduced grazing pressure. Grazing in the north of DHI is known to have decreased from the 1960s.


dhi_10
Vegetation Cover %
100
75
50
25
0
1990
2000
2010
2020
Year
Baseline: 69.7%
Sheep removal
Goat removal
Current: 71.9%
Change from baseline = 2.2 %

Site 11

Description:

Very Open Shrubland (2-10%) 1-2 metres of Acacia sclerosperma and Acacia tetragonophylla (largely dead)

Low Open Shrubland (2-10% cover) 1 metres Acacia ligulata

Low shrubland (30% cover) of 0.3- 0.5 metres of Thryptomene baeckeacea and Melaleuca cardiophylla, with rarely recorded shrubs of Stylobasium spathulatum, Stenanthemum sp. and Pileanthus limacis

Over low hummock grassland (30 % cover) of Triodia plurinervata

Over scattered herbs (<2%) of Conostylis stylidioides and Dianella revoluta.

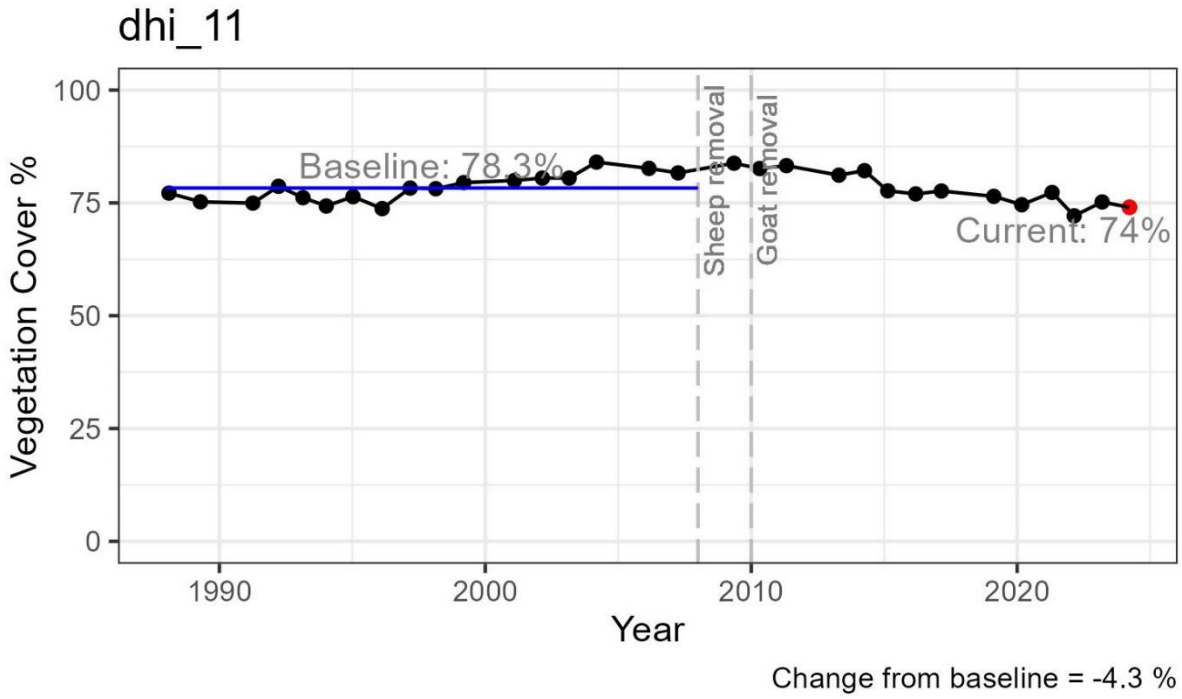
Note: Site of interest for long term monitoring as the upper stratum of Acacia has been lost with little sign of regeneration.

Photo point photographs of plot 11.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 April 2014
 May 2018		

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 12

Description:

Open Mallee shrubland, 1-1.5 metres of Eucalyptus fruticosa and Eucalyptus oraria

Low Open Shrubland (2-10% cover);1 metre of Acacia ligulata

Low dense shrubland (30-70% cover) of 0.3- 0.5 metres of Thryptomene baeckeacea and Melaleuca cardiophylla, with rarely recorded shrubs of Stylobasium spathulatum, Stenanthemum sp., Olearia dampieri and Pileanthus limacis. With vines of Cassytha racemosa

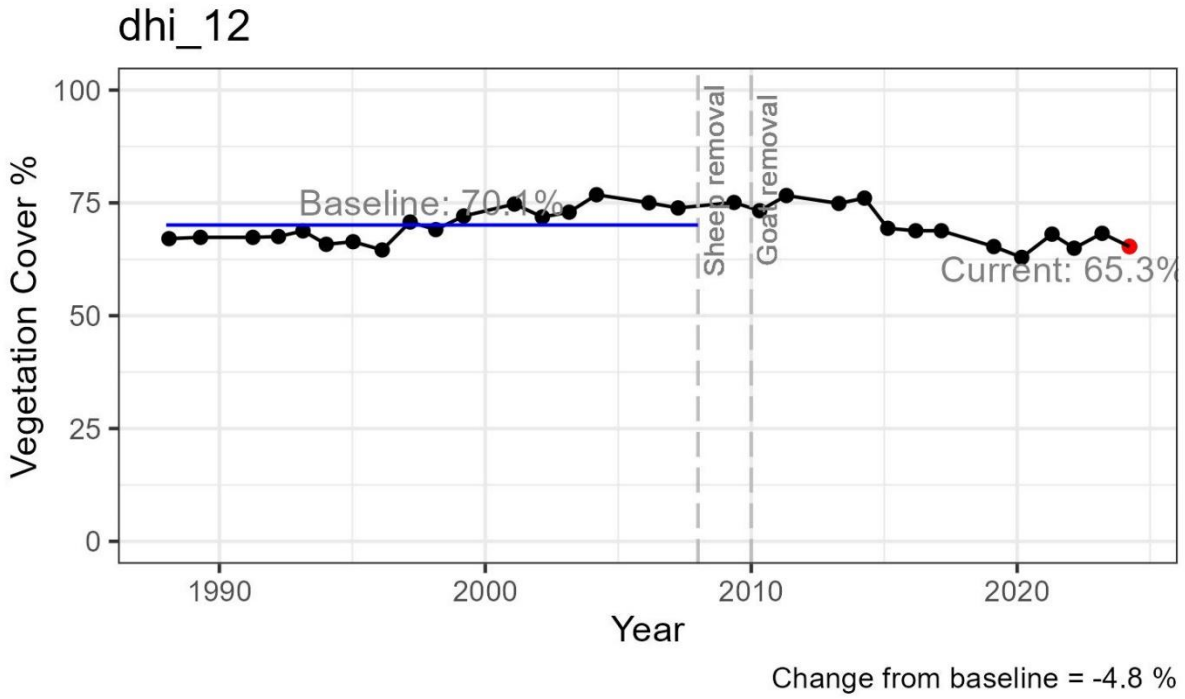
Over low hummock grassland (10-30 % cover) of Triodia plurinervata

Photo point photographs of plot 12.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012
 April 2014	 May 2018	 May 2024

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 13

Description:

Low Open Shrubland (2-10% cover) 1 metres Acacia ligulata

Low shrubland (30% cover) 0.3- 0.5 metres of Thryptomene baeckeacea and Melaleuca cardiophylla, with rarely recorded shrubs of Stenanthemum sp., Mirbelia ramulosa and Pileanthus limacis

Over low hummock grassland (10-30 % cover) of Triodia plurinervata

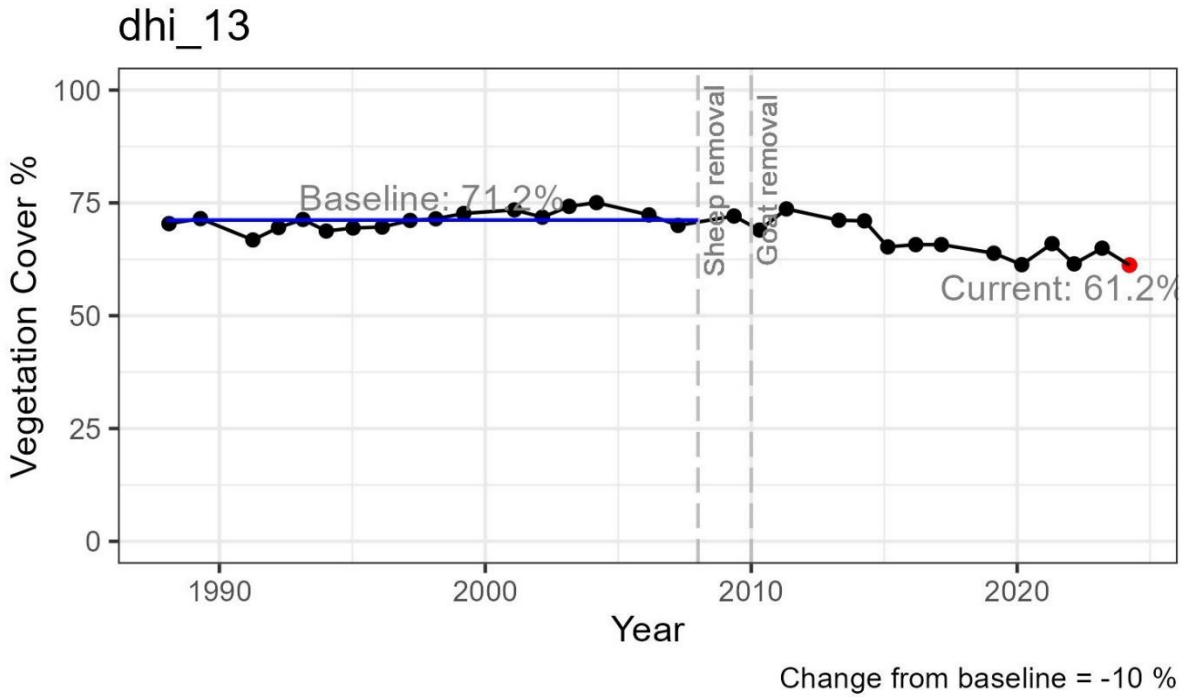
Over scattered herbs and low shrubs (<2% cover) of Halgania cynea, Cassytha sp., Logania sp. and Dianella revoluta.

Photo point photographs of plot 13.

 May 2006	 May 2007 (peg reinstalled)	 September 2008
 October 2009	 January 2011	 January 2012
 April 2014	 May 2018	

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 14

Description:

Low Open Shrubland (2-10% cover) 1-2 metres Acacia ligulata dominated (70%) with Exocarpus aphyllus

Dense low shrubland (30-70% cover) 0.5-1 metre of Melaleuca cardiophylla, Thryptomene baeckeacea, Westringia rigida and scattered Stylobasium spathulatum and Pileanthus limacis

Over low open shrubs (2% cover) of Halgania cyanea

Over low hummock grassland (10 % cover) of Triodia plurinervata

Over scattered herbs of Salsola australis and Angianthus tomentosus

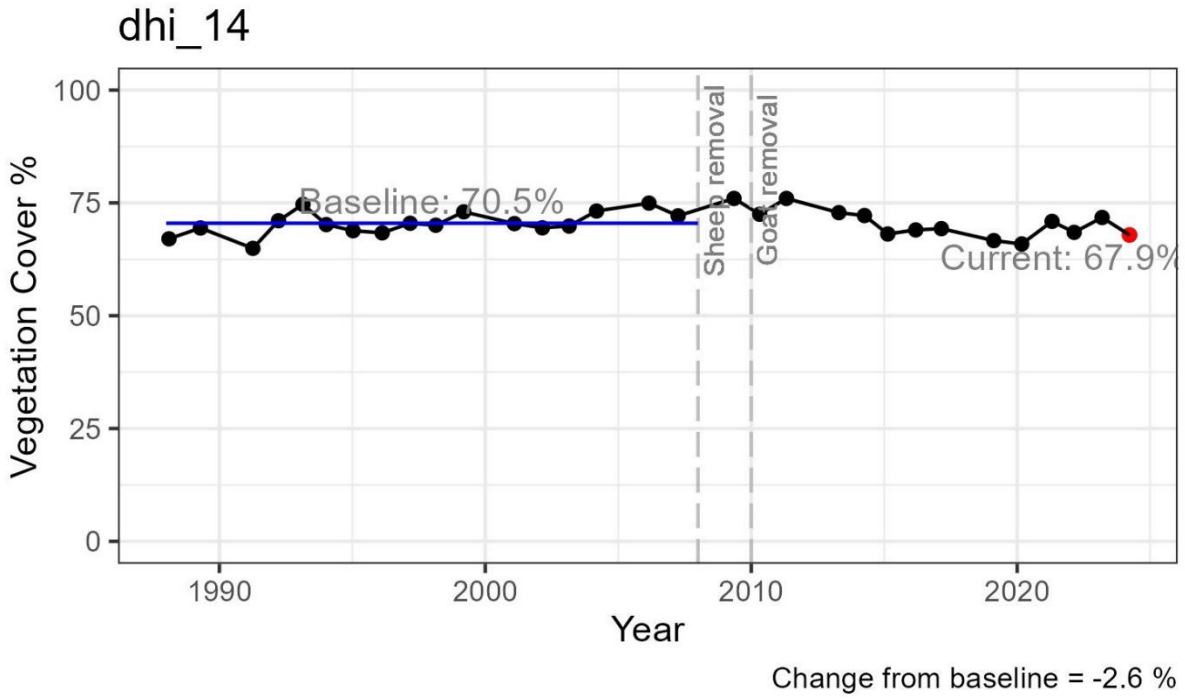
Photo point photographs of plot 14.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012
 April 2014	 May 2016	 May 2021

 May 2024		

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site 15

Description:

Low Open Shrubland (2-10% cover) 0.5-1.5 metres Acacia ligulata dominated (70%) with Exocarpus aphyllus and Alectryon oleifolius

Over low shrubland (2-10% cover) 0.5 metre of Olearia axillaris(70%) and Mirbelia viminea, Diplolaena grandiflora, Rhagodia baccata , Enchylaena tomentosa, Acacia tetragonophylla and Thryptomene baeckeacea/ Scaevola spinescens/ Scaevola crassifolia. Rare Atriplex vesicoica, Solanum orbiculatum, corpobrotus candidus, Acacia linophylla, Threlkeldia diffusa, Scaevola tomentosa

Over low grassland (30 % cover) of Triodia plurinervata

Over scattered herbs of Salsola australis and Angianthus tomentosus/ Acanthocarpus preissii/ Austrostipa nitida

Photo point photographs of plot 15.

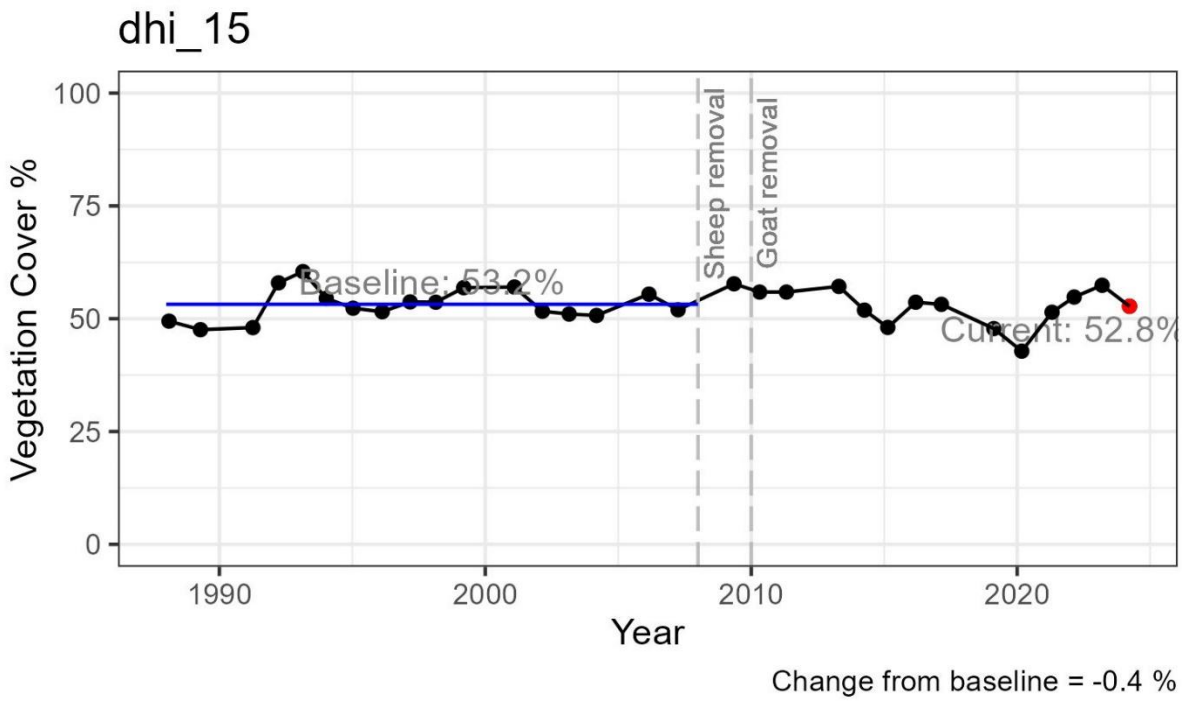
 May 2006	 September 2008	 October 2009
 January 2011	 January 2012	 April 2014
 May 2015	 May 2016	 May 2018

		
May 2019	May 2021	May 2024

Vegetation cover time series analysis:

A continual upward trend is evident with a step increase following 1991. The increase in cover may be due to long term recovery from reduced grazing pressure. Grazing in the north of DHI is known to have decreased from the 1960s. This is supported by nearby fence posts (see image below), indicating that the area was once a yard and would therefore have been grazed heavily.

The graph below shows vegetation cover derived from Landsat satellite data from 1987 to 2021 and mean (1987 to 2008) baseline (top). CUSUM chart with 3 standard deviation control line (bottom).


dhi_15
Vegetation Cover %
100
75
50
25
0
1990
2000
2010
2020
Year
Sheep removal
Goat removal
Baseline: 53.2%
Current: 52.8%
Change from baseline = -0.4 %

Site 16

Description:

Tall very open shrubland, 2-3 metres (< 2% cover) of scattered Pittosporum phillyraeoides

Low Open Shrubland (10-30% cover) 1-2 metres; Acacia ligulata dominated (70%) with Exocarpus aphyllus (20%) and Alectryon oleifolius

Over low shrubland (2-10% cover) 0.5 metre of Thryptomene baeckeacea with scattered shrubs of Mirbelia viminea, Olearia dampieri, Westringia rigida, Rhagodia crassifolia, Acanthocarpus robustus, Acacia leptospermoides and Melaleuca cardiophylla, Scaevola spinescens, Scaevola tomentose, Solanum orbiculatum, Zygophyllum eremaeum, Westringia dampieri

Over low dense grassland (30-70 % cover) of Triodia plurinervata

Over scattered herbs of Salsola australis, Maireana triptera, Ptilotus gaudichaudii and Angianthus tomentosus.

With vine Aphanopetalum clematidium

cryptogamic soil crust (30% cover)

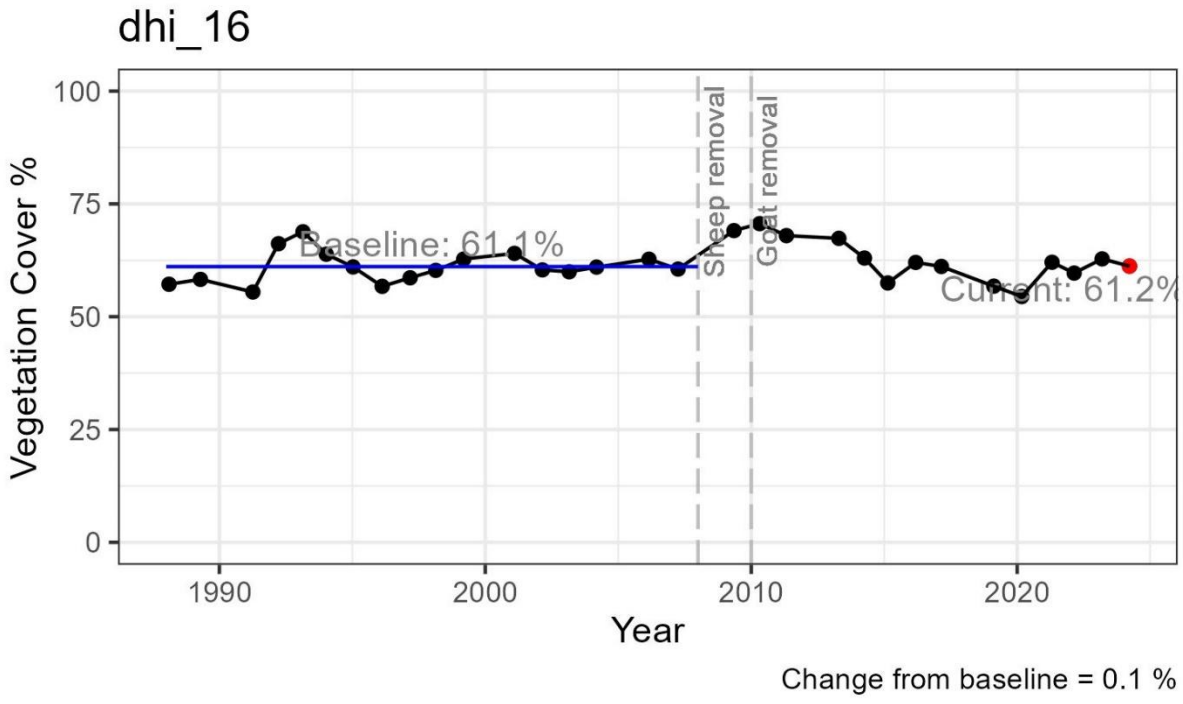
Photo point photographs of plot 16.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012

 April 2014	 May 2016	 May 2018
 May 2021		

Vegetation cover time series analysis:

A significant increase in vegetation cover was recorded at this site. This increase appears to be part of a continual upward trend, with a step increase following 1991. The increase in cover may be due to long term recovery from reduced grazing pressure. Grazing in the north of DHI is known to have decreased from the 1960s.



Site 17

Description:

Low dense bunch grassland (>80 % cover) of Cenchrus ciliaris

With rare shrubs of Keraundrinia hermaniifolia

Note: Site of interest for long term monitoring for shrub encroachment.

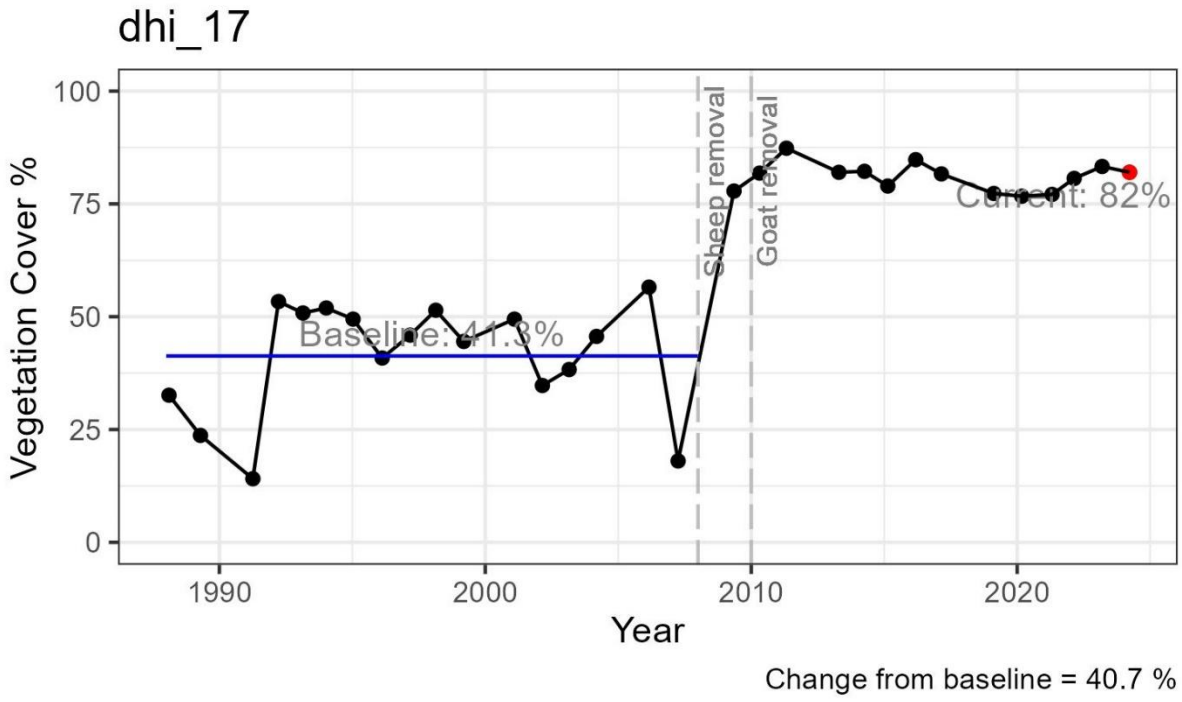
Photo point photographs of plot 17.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012
 April 2014	 May 2016	 May 2017

 May 2021		

Vegetation cover time series analysis:

A significant step increase in vegetation cover was recorded at this site following destocking. This increase appears directly related to a reduction in grazing pressure following the removal of livestock in 2008. The increase can be attributed to buffel grass (Cenchrus ciliaris).



Site 18

Description:

Low Open Shrubland (2-10% cover) 1-2 metres of Acacia ligulata

Dense low shrubland (30-70% cover) 20 cm- 0.5 metre of Thryptomene baeckeacea (60 %) with Melaleuca cardiophylla, Westringia rigida and scattered Hemigenia sp., Spyridium sp., Alogyne hakeiformis and Pileanthus limacis

Over low hummock grassland (10 % cover) of Triodia plurinervata

Over scattered herbs of Salsola australis and Angianthus tomentosus

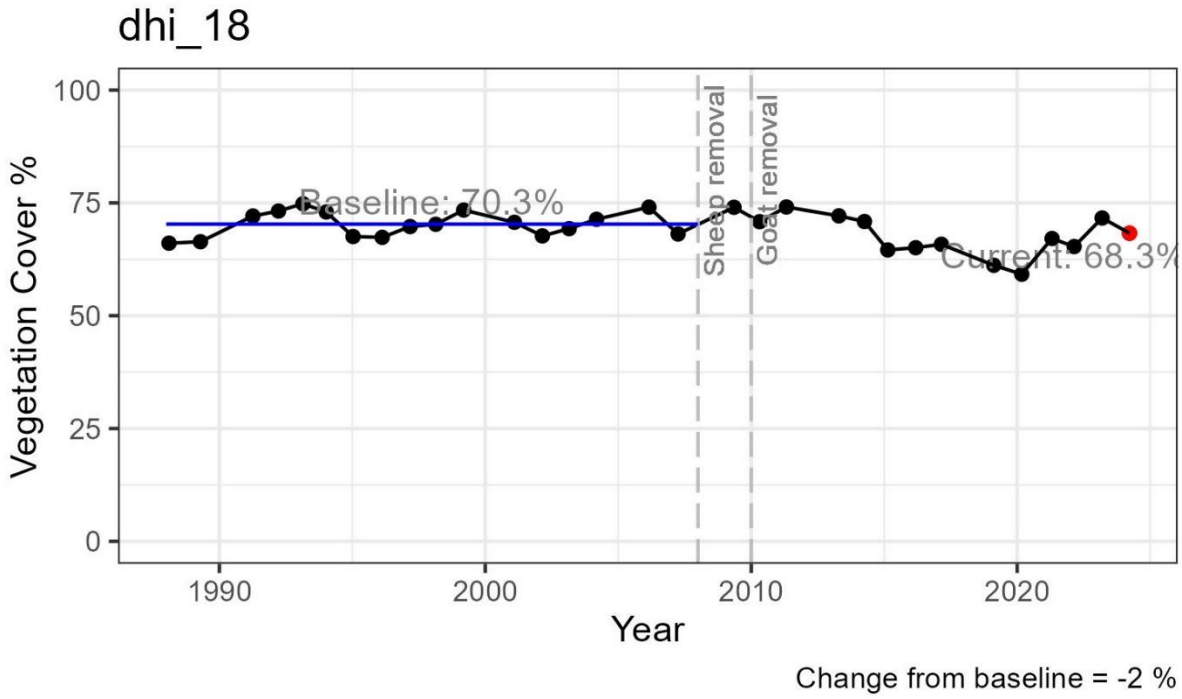
Photo point photographs of plot 18.

 May 2006	 May 2007	 September 2008
 October 2009	 January 2011	 January 2012
 April 2014	 May 2015	 May 2016

 May 2021		

Vegetation cover time series analysis:

No change.



Site 19

Description:

Open shrubland Acacia ligulata/ Acacia tetragonophylla/ Acacia coriacea/ Melaleuca sp? (10-30% cover) 1-2 metres

Very open shrubs of Exocarpos aphyllus/ Rhagodia crassifolia/ Atriplex cinerea/ Scaevola tomentosa (<2% cover) 0.5-1 metre

Low very open shrubland of Frankenia pauciflora/ Solanum aviculare (<25 cover) 0.2 metres over

Low grassland of *Cenchrus cilaris (30-70% cover , 2-10% in areas) 0.3 metres

Scattered herbs of *Brassica tournefortii/ *Sonchus oleraceus/ *Silene nocturna/ *Reichardia tingitana, Acanthocarpus robustus

Scattered grasses of Eragrostis dielsii/ Austrostipa nitida/ Astrostipa elegantissima/ Rytidosperma occidentalis

Vines observed in 2018 Threlkeldia diffusa, Aphanopetalum clematidium, Enchylaena tomentosa

Evidence of major germination of weeds in 2015 and Ptilotus obovatus

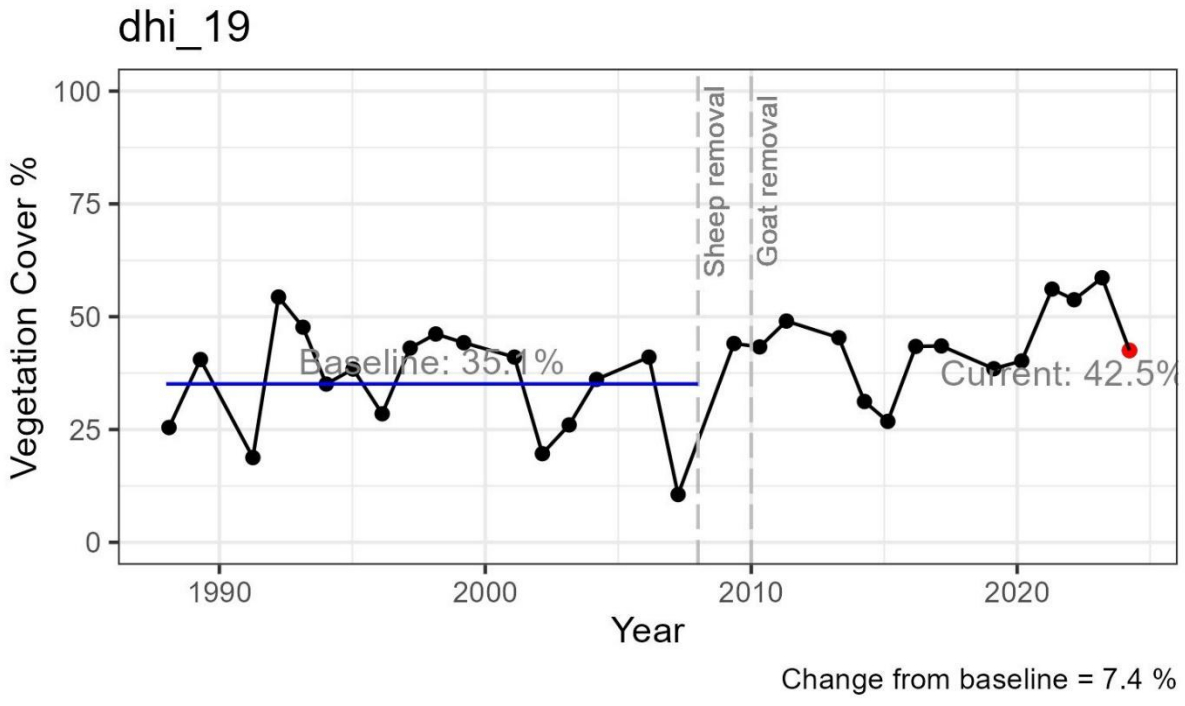
Photo point photographs of plot 19.

 May2006	 May 2007	 September 2008
 October 2009	 May 2015	 May 2016

 May 2017	 May 2018	 May 2019
 May 2021	 May 2024	

Vegetation cover time series analysis:

A significant step increase in vegetation cover was recorded at this site following destocking. Change in cover and composition at the site continues with new species of vines noted in 2018.



Site 21

Description:

Low Open Shrubland (10-30% cover) 1-2 metres Acacia ligulata, Atriplex vesicaria, Alectryon oleifolius, Exocarpus aphyllus/ Scaevola spinescens/ Scaevola tomentose

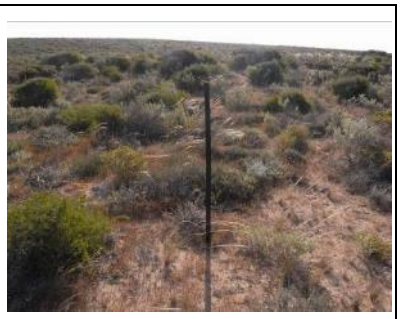
Low shrubland (10-30% cover) 0.3- 0.5 metres of Pimelea gilgiana, Frankenia pauciflora and Sclerolaena diacantha/ Myoporum insulare

Over low hummock grassland (10-30 % cover) of Triodia plurinervata

Herbs (2-10%) Chenopdium melanocarpum, Angianthus tomentosus, Calotis hispidula, Brachyscome iberiidifolia, Maireana georgei and Ptilotus gaudichaudii/ Lawrencia viridigrisea

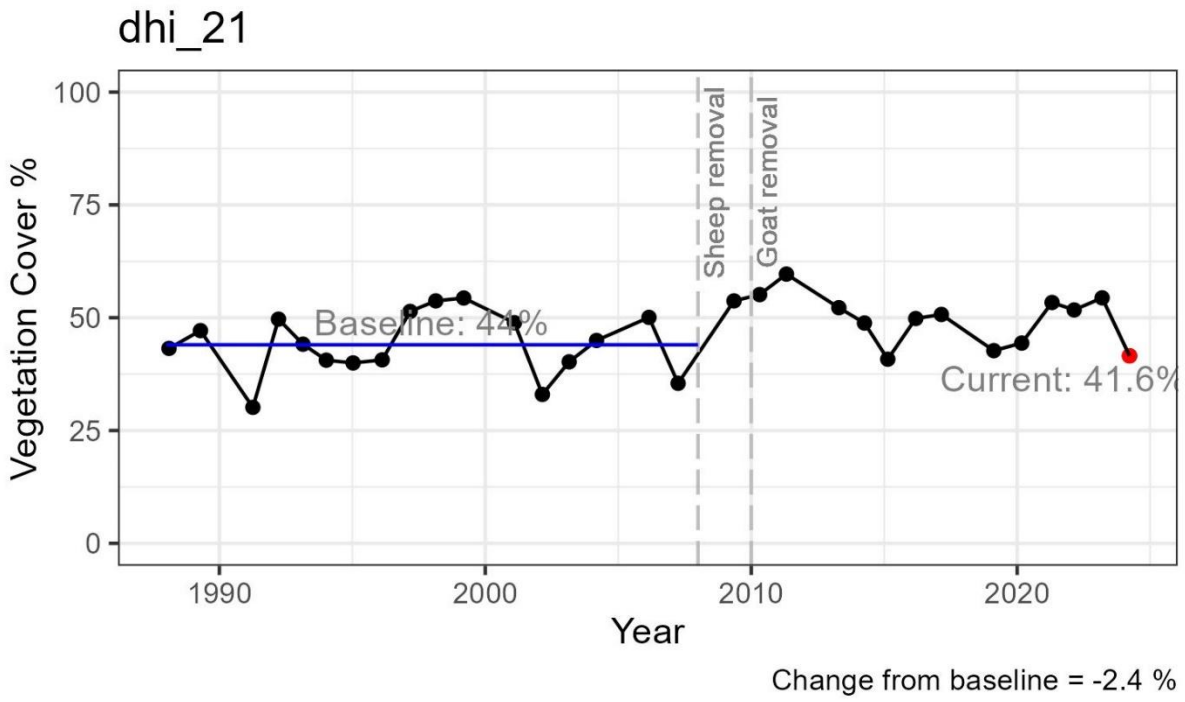
Abundant germination of annual in 2015 of Lawrencia sp./ Euphorbia boophthona/ Austrostipa nitida

Photo point photographs of plot 21.

 May 2006	 September 2008	 October 2009
 April 2014	 May 2015	 May 2016

Vegetation cover time series analysis:

A significant increase in vegetation cover was recorded at this site following destocking.



Site 22

Description:

Low Open Shrubland (2-10% cover) 1-2 metres Acacia rostellifera, Exocarpos aphyllus

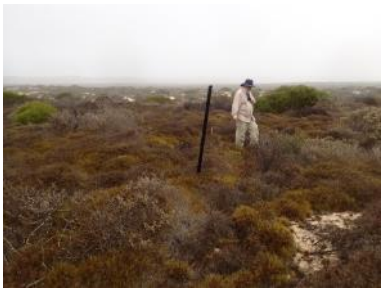
Low dense shrubland (30-70 % cover) 0.3-0.6 metres of Thryptomene baeckea (40%), with Rhagodia (estimated species) crassifolia, Scaevola crassifolia and Diplolaena grandiflora

Low open shrubland (2-10 % cover) of less than 0.5 metres of Pimelea gilgiana and Threlkeldia diffusa, Frankenia panciflora, Enchylaena tomentosa

Over dense hummock grassland (50-70 % cover) of Triodia plurinervata

Over herbs, grasses and low shrubs (2-10 % cover) of Senecio glossanthus,Bromus arenarius, *Brassica tournefortii, Acanthocarpus preissii and Angianthus tomentosus.

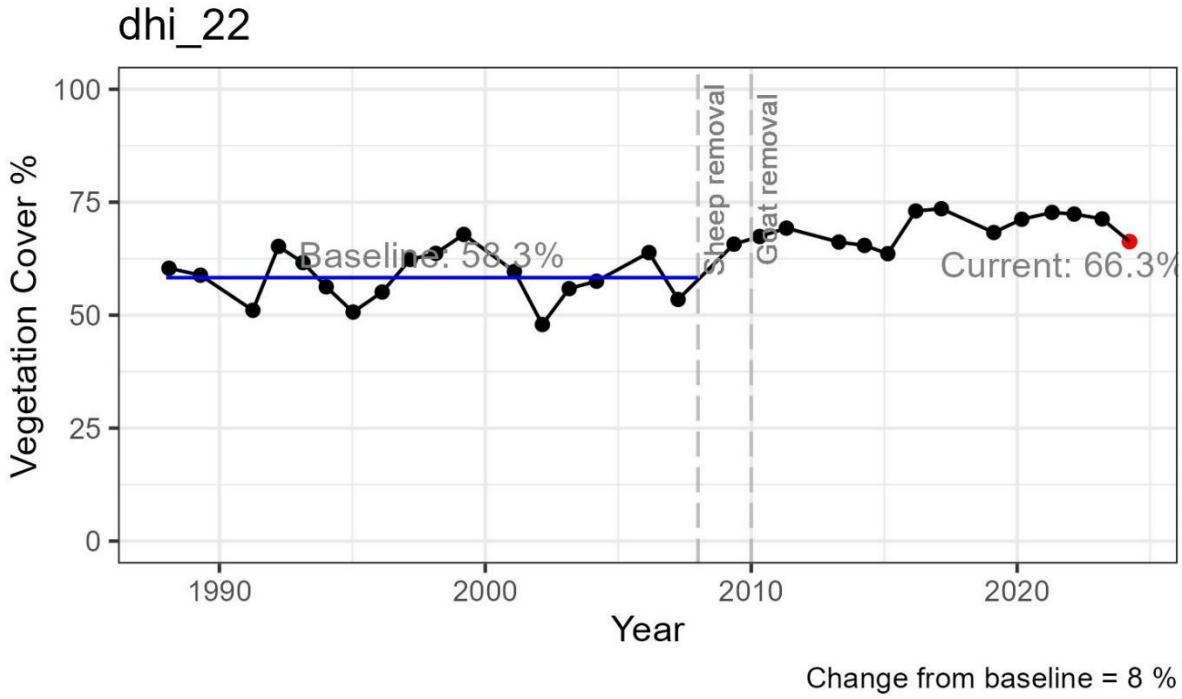
Photo point photographs of plot 22.

		
May 2006	September 2008	October 2009
		
April 2014	May 2018	May 2021

 May 2024		

Vegetation cover time series analysis:

A significant increase in vegetation cover was recorded at this site following destocking.



Site 23

Description:

Low Open Shrubland (2-10% cover) 1-2 metres Acacia ligulata and Pittosporum phylliraeoides

Low shrubland (30% cover) 0.3- 0.5 metres of Scaevola nitida, Atriplex vesicaria, Scaevola tomentosa, Thryptomene baeckeacea, Pimelea gilgiana, Daviesia hakeoides, Rhagodia crassifolia, Bossiaea spinescens, Exocarpus aphyllus, Solanum orbiculare, Olearia dampieri, Threlkeldia diffusa, Frankenia pauciflora, Ptilotus obovatus, Scaevola spinescens, Diplolaena grandiflora

Over low hummock grassland (10-30 % cover) of Triodia plurinervata

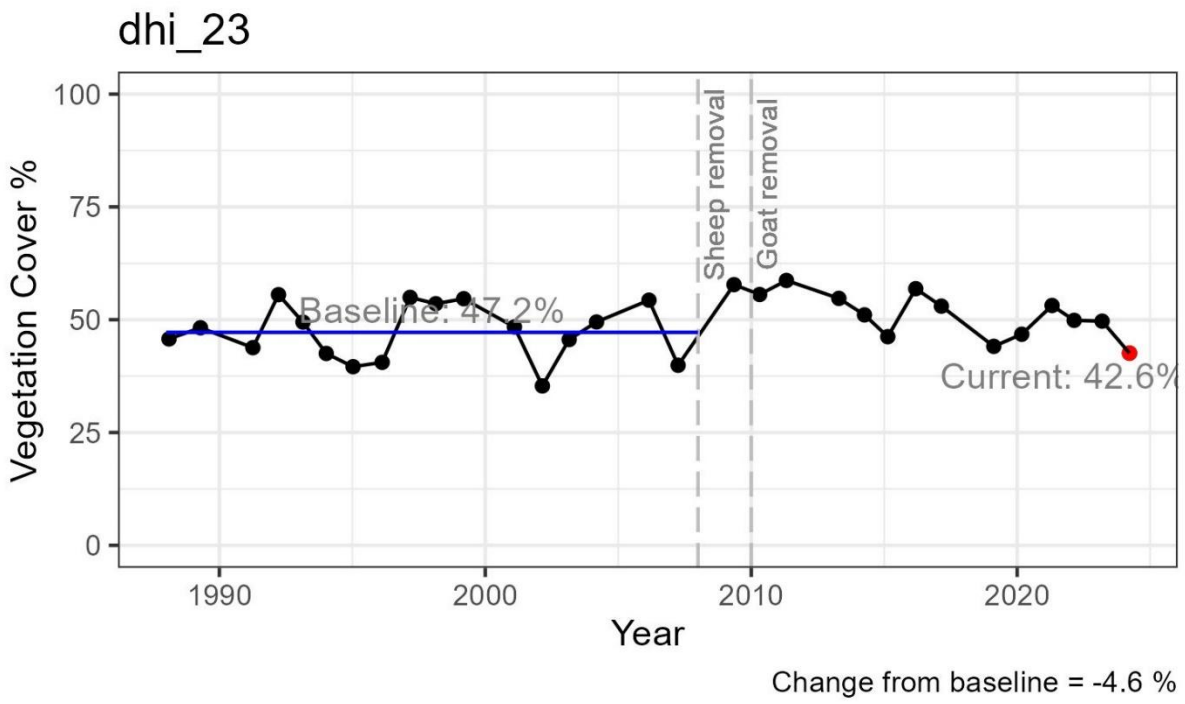
Over herbs, grasses and low shrubs (2-10 % cover) of Senecio pinnatifolius, Maireana sp., Austrostipa sp., *Brassica tournefortii, Acanthocarpus robustus, Gnephosis arachnoidea and Dianella revoluta.

Photo point photographs of plot 23.

 May 2006	 September 2008	 October 2009
 April 2014	 May 2018	

Vegetation cover time series analysis:

A significant increase in vegetation cover was recorded at this site following destocking.



Site 30

Description:

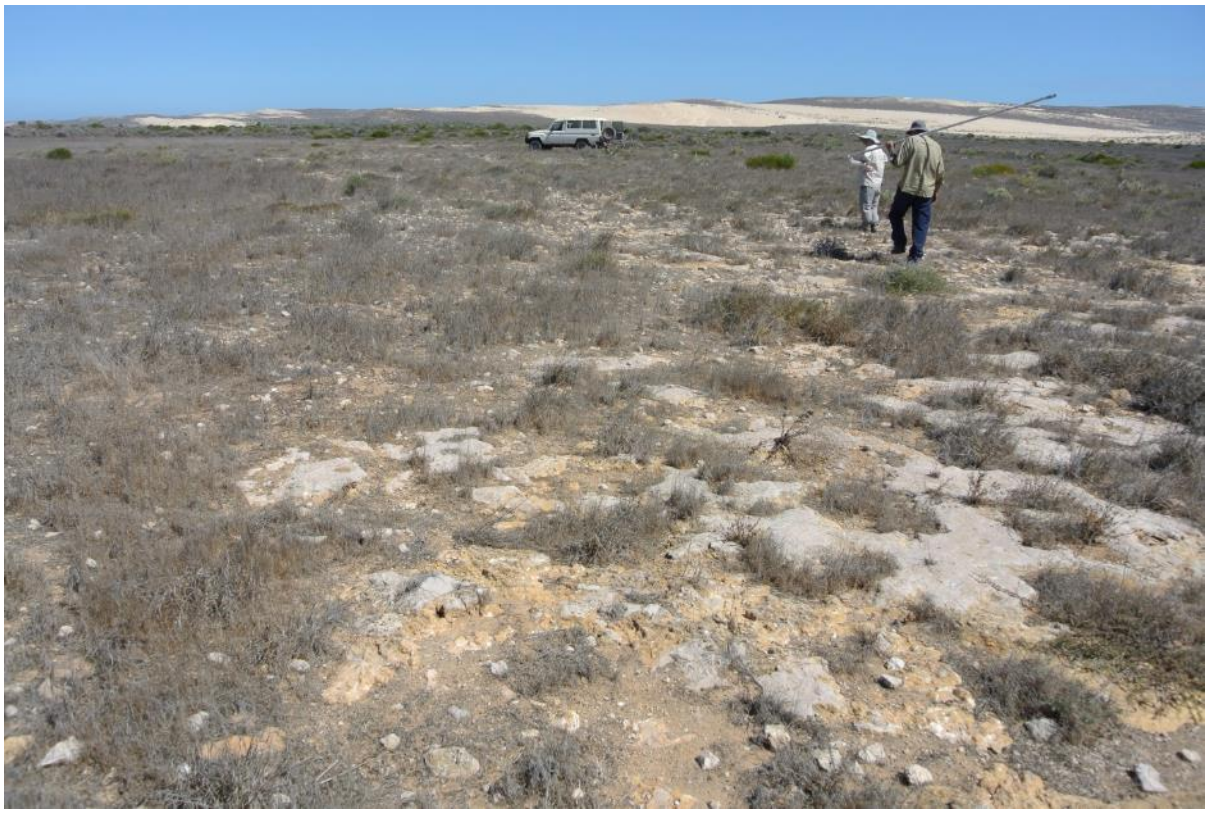
Open Shrubland (2-10% cover) 0.5-1metres Acacia ligulata, Capparis spinosa, Atriplex vesicaria, Rhagodia baccata, Scaevola tomentosa, Exocarpus aphyllus and Scaevola spinescens

Low shrubland (<2% cover) < 0.5metres of Frankenia pauciflora, Solanum orbiculatum, Threlkeldia diffusa, Diplolaena grandiflora and Pimelea gilgiana

Over low bunch grassland (10-30 % cover) of *Cenchrus ciliaris and *Cenchrus setiger

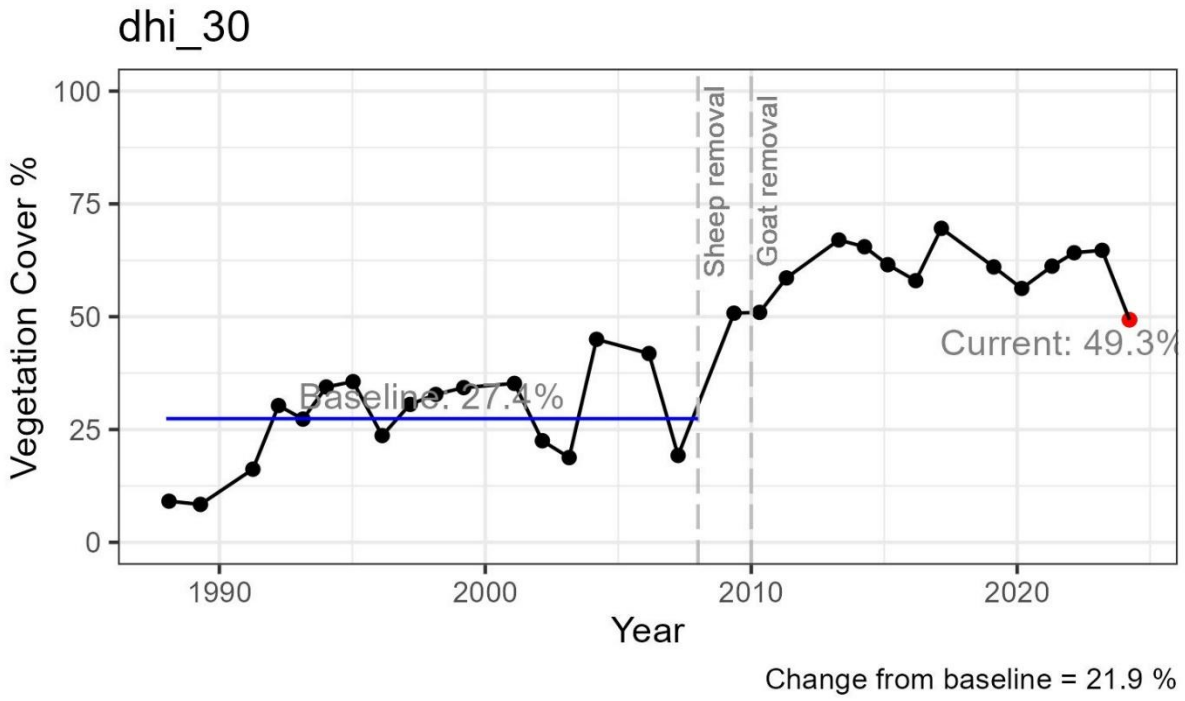
Over herbs, grasses and low shrubs (<10 % cover) of *Melilotus indicus, *Sonchus oleraceus, *Brassica tournefortii, Euphorbia australis, Enchyleana tomenytosa, *Urospermum picroides, *Malva parviflora, Crassula colorata, *Bromus diandrus and *Chenopodium murakle.

Site photograph, April 2014



Vegetation cover time series analysis:

A significant step increase in vegetation cover was recorded at this site following destocking. The increase is likely to be due to an increase in buffel grass (Cenchrus ciliaris) cover.



Site 31

Description:

Open Shrubland (2-10% cover) 1-2 metres Diplolaena grandiflora (mostly dead)

Low shrubland (10-30% cover) 0.5-1 metres of Acacia ligulata, Rhagodia crassifolia, Atriplex vesicaria, Pembertonia latisquamea, Scaevola tomentosa and Exocarpus aphyllus/Scaevola spinescens/Pimelea microcephala

Over low bunch grassland (2-10 % cover) of Austrostipa nitida, Austrostipa elegantissima, Amphipogon sp. and *Cenchrus ciliaris

Over herbs, grasses and low shrubs (10 % cover) of Bromus arenarius, *Bromus diandrus (both major components), Frankenia pauciflora, Ptilotus gaudichaudii, Angianthus tomentosus, *Brassica tournefortii, Chenopdium melanocarpum, Tetragonia diptera, Senecio pinnatifolius and Ptilotus polystachyus.

Note: Here the upper shrub Diplolaena grandiflora has largely died, however, this species (on Bernier and Dorre) appears en masse after fire or heavy storms grows and eventually dies out. This would be a very interesting site to monitor long term for natural cycles.

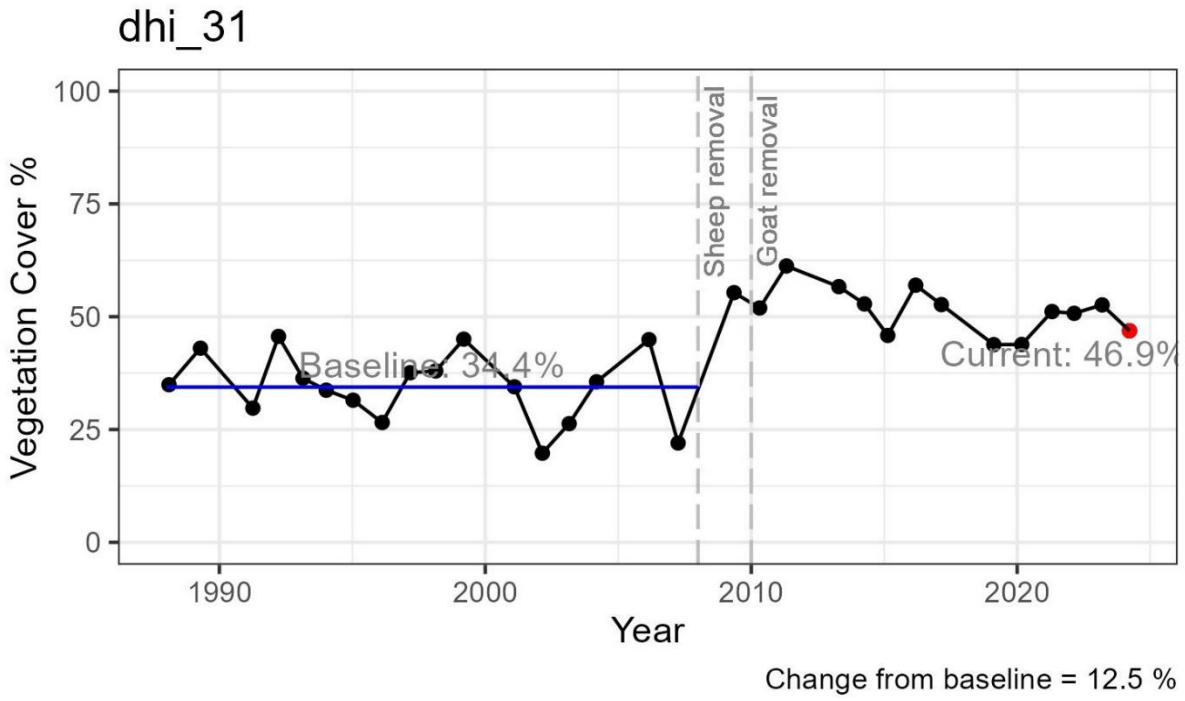
2015 abundant germination of Threlkeldia diffusa/ Ptilotus obovatus

Site photographs,

		
May 2015	May 2016	May 2017

Vegetation cover time series analysis:

A significant step increase in vegetation cover was recorded at this site following destocking. The increase is likely to be due to an increase in buffel grass (Cenchrus ciliaris) cover.



Site 32

Description:

Open Shrubland (2-10% cover) 1-2.5 metres Atriplex vesicaria, Rhagodia baccata

Low shrubland (10-30% cover) 0.5-1 metres of Acacia ligulata, Rhagodia crassifolia, Solanum orbiculatum and Threlkeldia diffusa / Mirbelia ramulosa

Over low bunch grassland (2-10 % cover) of *Cenchrus ciliaris

Over herbs, grasses and low shrubs (10-30 % cover) of Bromus arenarius, *Bromus diandrus (both major components), *Mesembryanthemum crystallinum, *Centaurium erythraea, *Brassica tournefortii, * Centaurea melitensis/ *Chenopodium murale

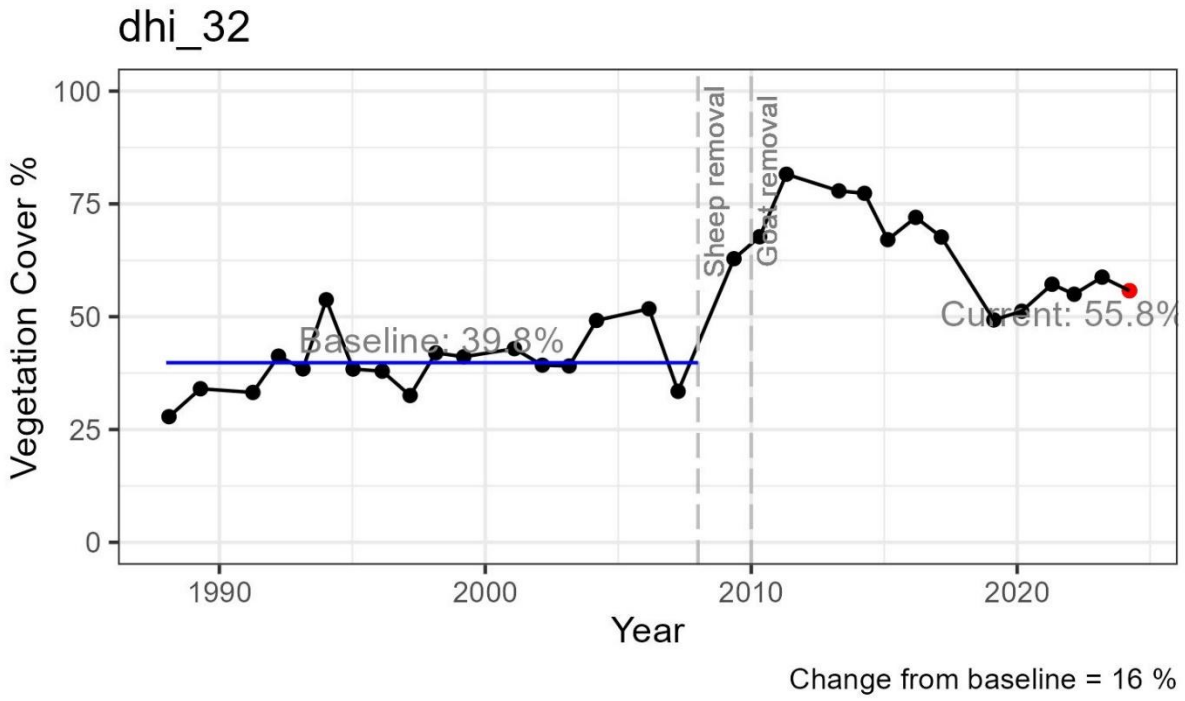
Note: Site of interest for long term monitoring for changes in buffel grass cover.

Site photographs

		
May 2015	May 2017	

Vegetation cover time series analysis:

A significant step increase in vegetation cover was recorded at this site following destocking. The increase is likely to be due to an increase in buffel grass (Cenchrus ciliaris) cover.



Site 33

Description:

Open Shrubland (10-30% cover) 1-2 metres Acacia ligulata (50% dead), Scaevola tomentosa, Exocarpus aphyllus, Atriplex vesicaria

Low shrubland (10-30% cover) of< 0.5metres of Threlkeldia diffusa, Diplolaena grandiflora, Pimelea gilgiana, Mirbelia ramulosa, Pembertonia latisquamea,Rhagodia crassifolia, Acacia idiomorpha, Dampier asp., Thryptomene baeckeacea, Stylobasium spathulatum,

Over low hummock grassland (30-70% cover) of Triodia plurinervata

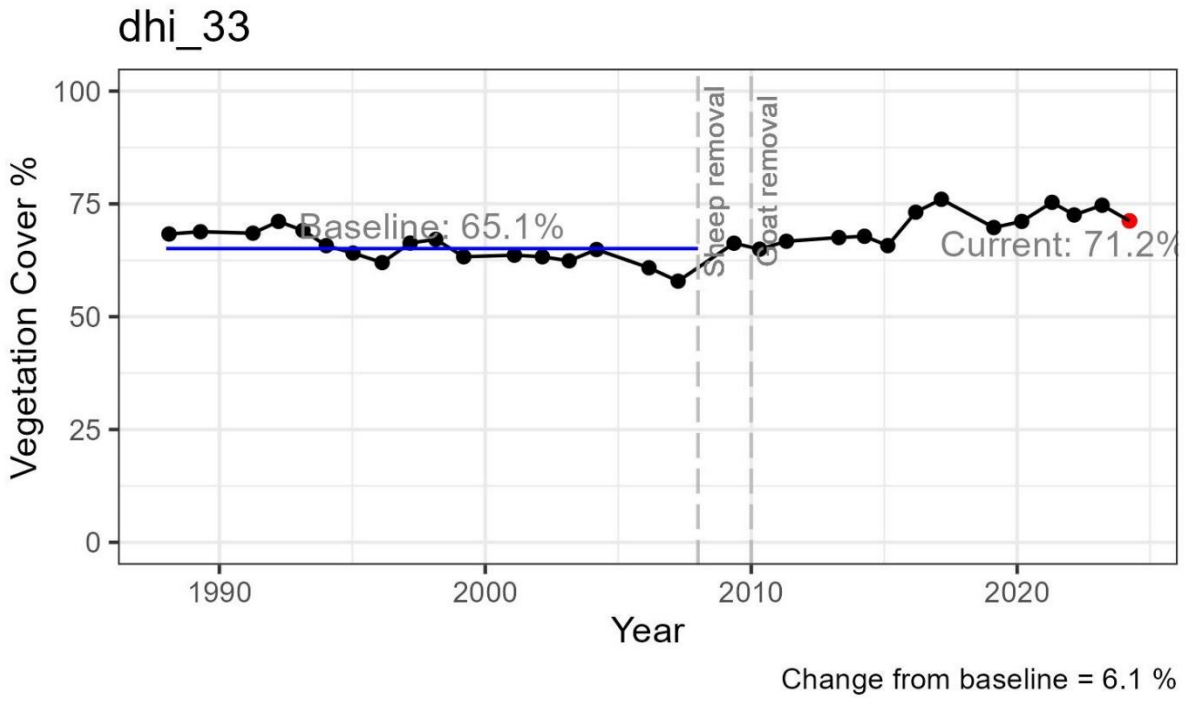
Over low very open bunch grassland (2-10 % cover) of Austrostipa nitida, Austrostipa elegantissima, Amphipogon sp. and *Cenchrus ciliaris

Over herbs, grasses and low shrubs (<10 % cover) of Acanthocarpus preissii, Acanthocarpus robustus, Bromus arenarius, *Bromus diandrus (both major components), Frankenia pauciflora, Ptilotus gaudichaudii, Angianthus tomentosus, *Brassica tournefortii, Chenopdium melanocarpum, Tetragonia diptera, Senecio pinnatifolius and Ptilotus polystachyus.

Site photograph, April 2014

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series. Cover values appear to drop rapidly in 2006 and 2007 coinciding with low rainfall but return to the normal range after 2008.



Site 34

Description:

Low very open trees (<2%) Pittosporum phylliraeoides

Open Shrubland (10-30% cover) 1-2 metres Acacia ligulata, Alectryon oleifolius, Atriplex vesicara, Exocarpus aphyllus, Ptilotus obovatus and Stylobasium spathulatum/ Scaevola spinescens/Scaevola tomentose

Low shrubland <2% cover) 0.3- 0.5 metres of Pembertonia latisquamea, Frankenia pauciflora, Rhagodia crassifolia, Pimelia gilgiana, Enchylaena tomentosa

Over low hummock grassland (30-70 % cover) of Triodia plurinervata

Over low bunch grassland (2-10 % cover) of Austrostipa nitida and Austrostipa elegantissima

Over herbs, grasses and low shrubs (10 % cover) of Bromus arenarius, *Bromus diandrus (both major components), Angianthus tomentosus, *Brassica tournefortii, Chenopdium melanocarpum, Senecio pinnatifolius and Ptilotus polystachyus.

2015 rain abundant annuals of Ptilotus nobilis/ Euphorbia boophthona/ * Sisymbrium erysimoides/ Lobelia gibbosa

Site photographs

<table>
<tr>
<td> 
April 2014</td>
<td> 
May 2017</td>
<td> 
May 2018</td>
</tr>
<tr>
<td> 
May 2019</td>
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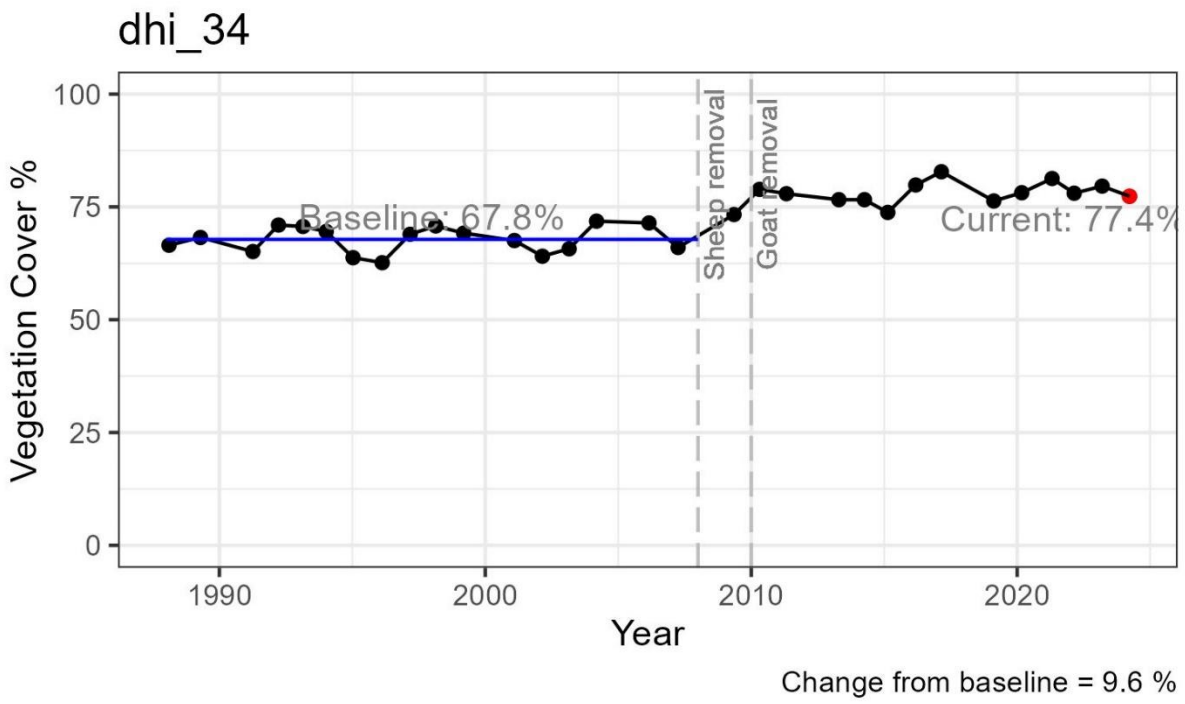
Vegetation cover time series analysis:

A significant step increase in vegetation cover was recorded at this site following destocking. No buffel grass (Cenchrus ciliaris) was evident at the site.



Site 35

Description:

Low Open Shrubland (10-30% cover) 1-2 metres Acacia ligulata and Scaevola spinescens

Low shrubland (30% cover) 0.3- 0.5 metres of Atriplex vesicaria, Threlkeldia diffusa and Frankenia pauciflora/ Rhagodia candolleana/ Pimelea microcephala/ Bossiaea spinescens

Over low hummock grassland (10-30 % cover) of Triodia plurinervata and Triodia schinzii

Over low bunch grassland (2-10 % cover) of Austrostipa nitida and Austrostipa elegantissima

Over herbs, grasses and low shrubs (10 % cover) of Bromus arenarius, *Bromus diandrus, Angianthus tomentosus, Angianthus sp., *Brassica tournefortii, Chenopdium melanocarpum, Goodenia sp., Enchylaena tomentosa

Abundant germination of annuals – Lawrencia viridigrisea

Note: Buffel grass evident at 2-10 % cover in 2014 and 2016 but could not be found alive or dead in 2018.

Site photographs

April 2014

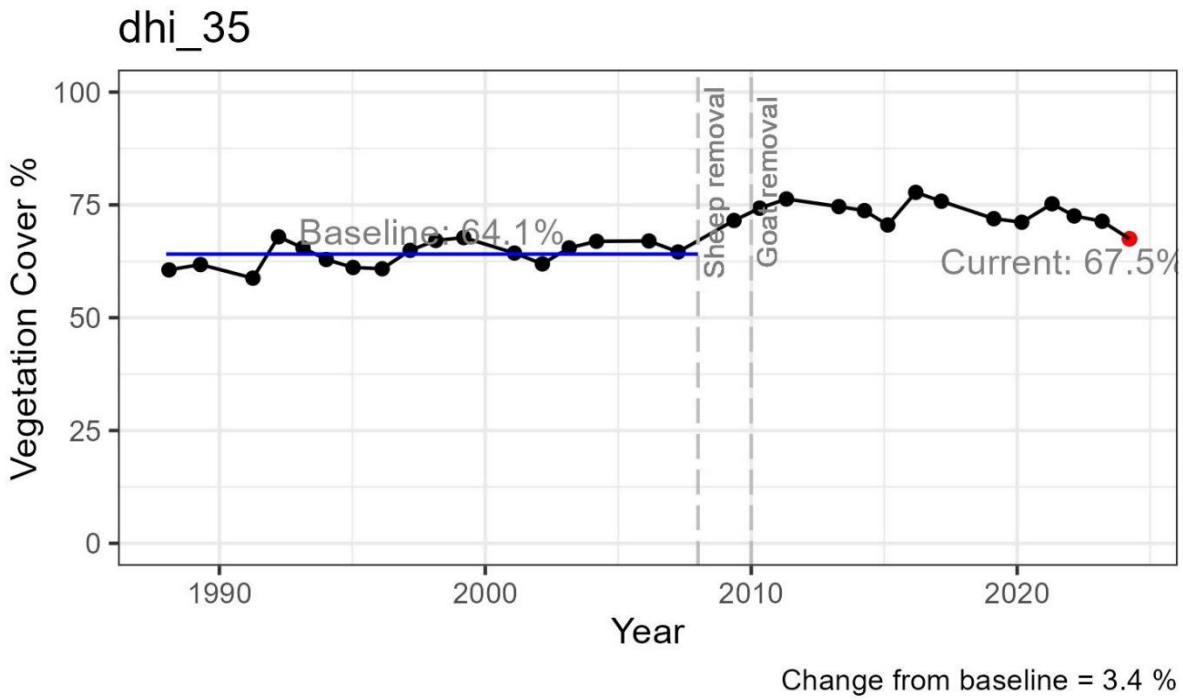
May 2016

May 2018

May 2019

Vegetation cover time series analysis:

A significant step increase in vegetation cover was recorded at this site following destocking. Some buffel grass (Cenchrus ciliaris) was evident at the site.



Site 36

Description:

Low Open Shrubland (2-10% cover) 1 metre Acacia teragonophylla and Acacia coriacea (90% dead) with Diplolaena grandiflora (60% dead)

Low shrubland (10-30% cover) 0.1- 0.5 metres of Capparis spinosa (30%), Atriplex vesicaria, Alogyne hakeifolia, Solanum lasiophyllum, Pimelea microcephala, Thryptomene baeckeacea, Threlkeldia diffusa, Rhagodia crassifolia and Ptilotus obovatus

Over grassland (10-30 % cover) of Cymbypogon obtectus, *Cenchrus ciliaris, *Bromus japonicas

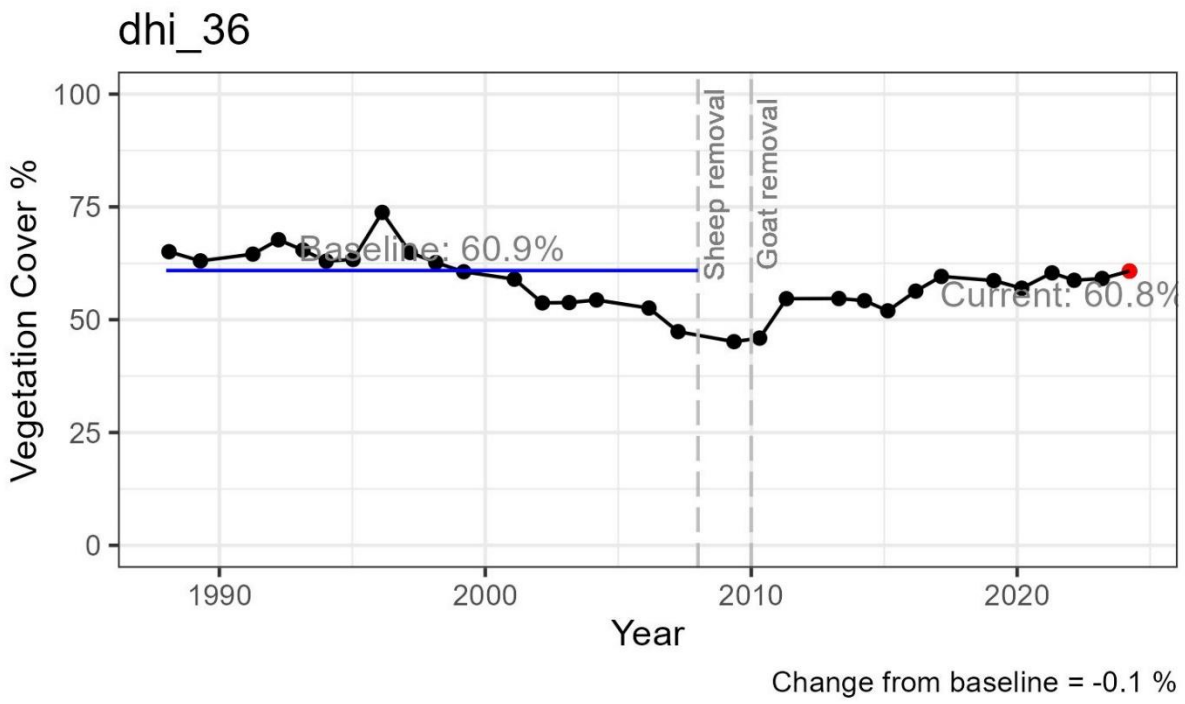
Over herbs and low shrubs (2-10% cover) of *Urospermum picroides, *Bidens bipinnata, *Solanum nigrum , *Sonchus oleraceus, *Centaurium eryhthraea, Conostylis stylidioides, Acanthocarpus preissii, *Hypochaeris glabra, Euphorbia boopthona, *Brassica tournefortii, mHalgania cynea, Cassytha sp., Logania sp. and Dianella revolute, Goodenia sp 2, Senecio pinnatifolius, Maireana sp., Austrostipa sp., *Brassica tournefortii, Gnephosis arachnoidea and Eragrostis dielsii.

Note: Acacia layer has died no apparent regeneration. Lots annual weeds. Obviously must have been heavily grazed, perhaps after a fire and sheep/goats ate all the seedlings or there was a drought after a small fire or both.

Site photo, April 2014

Vegetation cover time series analysis:

A step decrease in vegetation cover appears to occur following 2000. The cause for this is not evident.



Site 37

Description:

Low mixed heath of Thryptomene baeckeacea/ Atriplex vesicaria/ Scaevola tomentosa/ Melaleuca cardiophylla/Acacia ligulata/ Frankenia pauciflora/ Dodonaea aptera/ Rhagodia baccata/ Exocarpos aphyllus (30-70% cover, avg 60%) 0.2-0.5 metres

Open grassland of Trioda plurinervata (30-70% cover) 0.2-0.5 metres, rare Austrostipa elegantissima

Herbfield of Salsola australis/ Acanthocarpus robustus/ Urospermum picroides

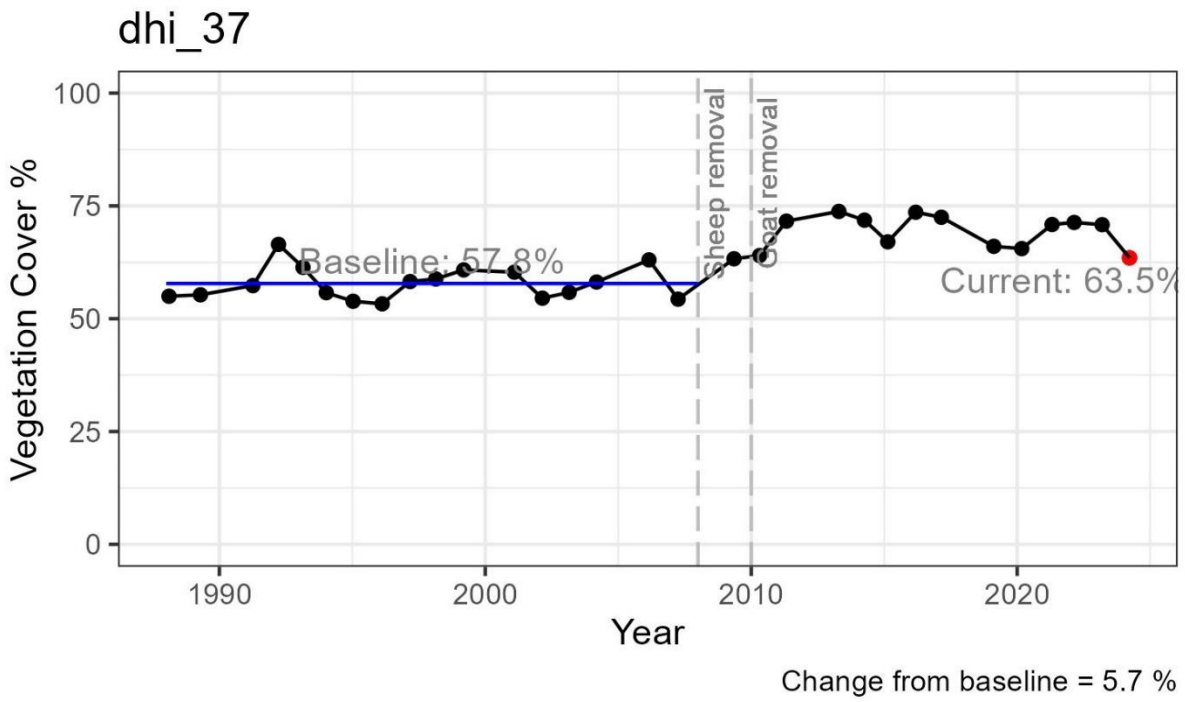
Annual grasses of Austrostipa nitida

Many young Acacia ligulata plants

Few scattered Diplolaena grandiflora

 **May 2015**	 **May 2016**	

Vegetation cover time series analysis:


dhi_37
Vegetation Cover %
100
75
50
25
0
1990
2000
2010
2020
Year
Baseline: 57.8%
Current: 63.5%
Sheep removal
Goat removal
Change from baseline = 5.7 %

Site AGWA 657

Description:

Low very open trees (<2%) Pittosporum phylliraeoides

Low Open Shrubland (2-10% cover) 1-2 metres of Exocarpus aphyllus, Scaevola tomentosa, Diplolaena grandiflora and Scaevola spinescens

Low shrubland (10-20% cover) 0.5-1 metres of Atriplex vesicaria, Scaevola nitida, Teragonia implexicoma/ Stylobasium spathulatum/ alectryon oleifolius

Low shrubland 2-10% cover) 0.3- 0.5 metres of Pembertonia latisquamea, Ptilotus obovatus, Frankenia pauciflora, Rhagodia crassifolia, Threlkeldia diffusa, Aphanopetalum clematidium and Pimelia gilgiana/ Solanum orbiculatum/ Acanthocarpus preissii

Over low bunch grassland (10-30 % cover) of *Cenchrus ciliaris, Austrostipa nitida and Austrostipa elegantissima

Over herbs, grasses and low shrubs (10 % cover) of Acanthocarpus robustus, Bromus arenarius, *Bromus diandrus, Angianthus tomentosus, Angianthus sp., *Brassica tournefortii, Chenopdium melanocarpum, Goodenia sp., Goodenia sp 2, Senecio pinnatifolius,*Brassica tournefortii.

2015 germination of Ptilotus obovatus

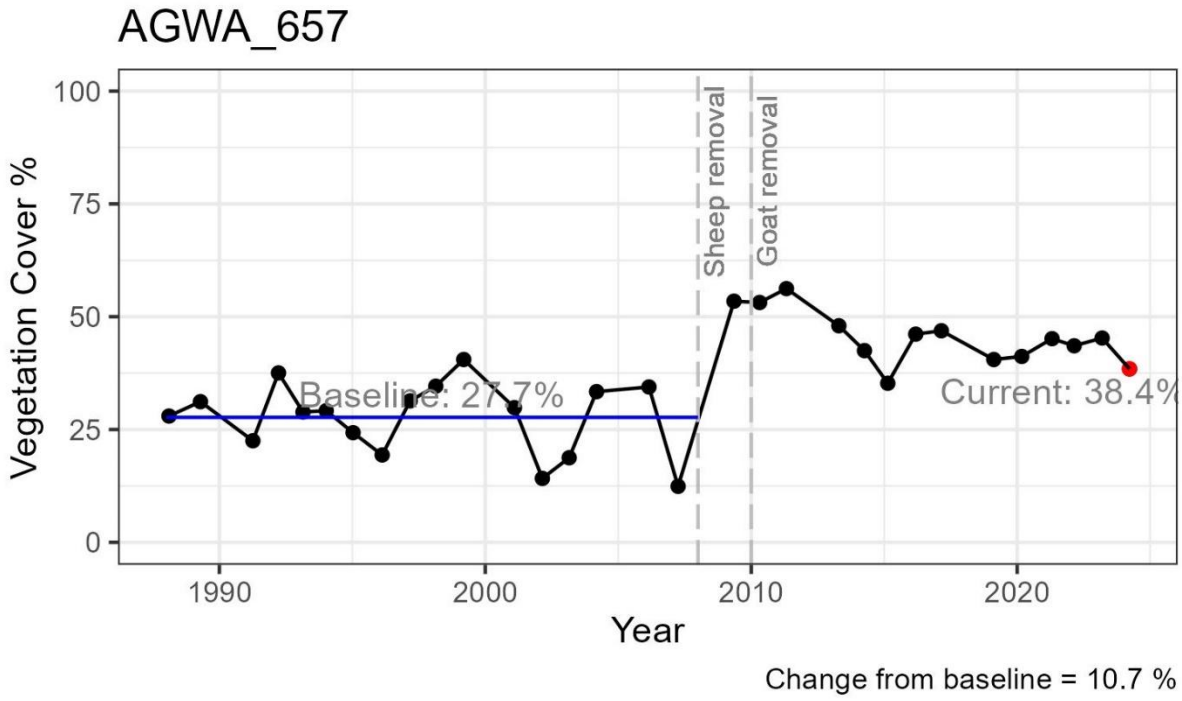
In 2018 some coverage of buffel but plants appear to be only surviving as rootstock.

Photo point photographs of plot AGWA657.

May 2007	September 2008	October 2009
 January 2011	 January 2012	 April 2014
 May 2015	 May 2016	 May 2017
 May 2018	 May 2019	 May 2021
 May 2024		

Vegetation cover time series analysis:

A significant step increase in vegetation cover was recorded at this site following destocking. This may be attributed to an increase in cover of buffel grass (Cenchrus ciliaris).



Site AGWA 662

Description:

Low Very Open Shrubland (2% cover) 0.5- 0.6 metre of Acacia ligulata

Dense low shrubland (40-70% cover) 0.3- 0.5 metre of Melaleuca cardiophylla, Thryptomene baeckeacea and scattered Stenanthemum sp., Pileanthus limacis, Halgania cyanea, Mirbelia ramulosa and Exocarpus aphyllus

Over low hummock grassland (10-30 % cover) of Triodia plurinervata

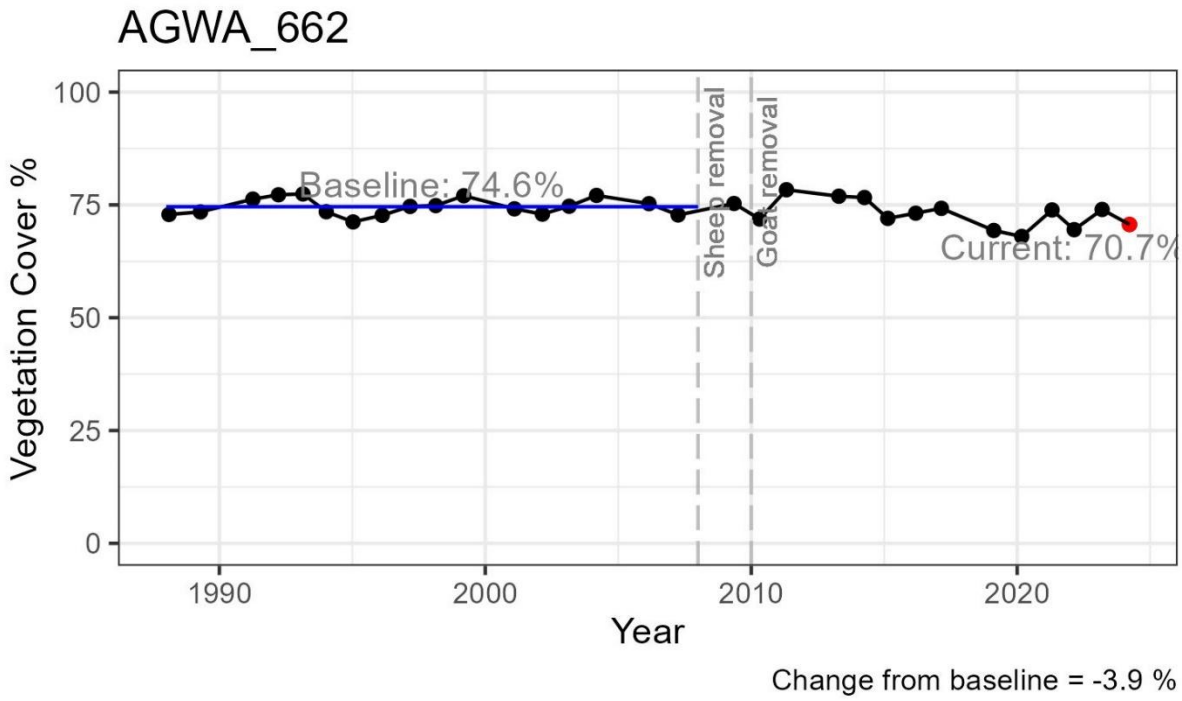
Over scattered herbs of Salsola australis

Photo point photographs of plot AGWA 662.

 January 2011	 April 2014	 May 2021
 May 2024		

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.



Site RHR 633

Description:

Very Open Shrubland (2-10%) 1-2 metres of Acacia coriacea and Acacia tetragonophylla

Low Open Shrubland (10% cover) 0.5-1 metres Acacia ligulata

Low shrubland (30% cover) 0.3- 0.5 metre of Thryptomene baeckeacea and Melaleuca cardiophylla, with rarely recorded shrubs of Stylobasium spathulatum, Mirbelia viminea, Leptosema macrophyllum, Acacia bidiomorpha, Halgania cynanea, Stenanthemum sp. and Pileanthus limacis

Over low open hummock grassland (2-10 % cover) of Triodia plurinervata

Over scattered sedges (2-10%) of Lepidobolus preissianus.

Photo point photographs of plot RHR633.

 May 2006	 May 2007	 September 2008
 January 2011	 January 2012	 April 2014

Vegetation cover time series analysis:

No significant change in vegetation cover is evident in the time series.