Thevenard Island Retirement Project
Terrestrial Ecological Monitoring Report
June 2020

Prepared for
Chevron Australia Pty Ltd

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A	08/09/2020	Draft Issued for Client Review		
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A	08/09/2020			
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Abbreviations

Abbreviation	Definition
Astron	Astron Environmental Services Pty Ltd
BC Act	*Biodiversity Conservation Act 2016*
CALM Act	*Conservation and Land Management Act 1984*
Chevron	Chevron Australia Pty Ltd
cm	Centimetre
DBCA	Department of Biodiversity, Conservation and Attractions
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ha	Hectare
KBDI	Keetch-Byram Drought Index
km	Kilometre
m	Metre
mm	Millimetre
P	Priority
PVA	Population viability analysis
subsp.	Sub species
TVI	Thevenard Island
WAM	Western Australian Museum
°C	Degrees Celsius
*****	Denotes introduced flora (weeds)

Executive Summary

Flora and fauna monitoring is undertaken on Thevenard Island (TVI) to ensure compliance with the Thevenard Island Retirement Project Terrestrial Ecological Monitoring Plan (Astron Environmental Services 2015b) and Ministerial Statement 9 (Minister for the Environment 1987), and to collect data to inform future rehabilitation activities on TVI. This report presents the results for the flora and fauna monitoring programs conducted from 17 to 22 June 2020.

Flora

The current flora and vegetation monitoring program commenced in 1987 and assesses flora species cover, richness and diversity across 33 transects within the two major geomorphic domains on TVI: inland and coastal. The program consists of analogue transects and disturbed transects classified based on the type of disturbance: seismic, cement stabilised sand with and without active revegetation, and rehabilitation.

Activities on TVI have had a localised impact on the flora and vegetation between 2017 and 2020; clearing activities have removed one disturbed transect and one analogue transect, and partially disturbed a second analogue transect. These clearing activities have removed one of two small populations of *Minuria cunninghamii* which occur on TVI and removed and disturbed two healthy populations of *Triodia epactia* grassland, which is restricted in its occurrence on TVI.

During the June 2020 monitoring, 32 taxa representing 28 genera from 16 families were recorded within the 31 transects monitored. Consistent with previous years' monitoring, **Cenchrus ciliaris* was the most widespread and abundant weed species, recorded in 13 transects during 2020, including a new record at one disturbed transect. No new species and no further introductions of weed species were detected during the 2020 monitoring that have not previously been recorded during other flora and weed monitoring surveys. Mean weed cover increased from 2017, after recording a declining trend since 2011 at the inland seismic transects. *Carpobrotus* sp. Thevenard Island (M. White 050) (Priority 3) was recorded in 10 transects during the 2020 survey and its presence within one rehabilitation transect indicates it can successfully be returned to disturbed sites.

Between 1990 and 2008 the cement stabilised sand transects have generally had lower native species richness and perennial foliar cover within both domains compared to the analogue transects. This indicated potentially negative effects of cement stabilised sand incorporation on the re-establishment of perennial species. However, since 2011 mean species richness and foliar cover within the cement stabilised sand transects have approached that of the analogue transects and the inland transects without active revegetation have exceeded mean species richness of the analogue transects in 2020. Although species richness for the coastal transects without active revegetation remain much lower than the analogue transects with no change recorded since 2017.

The trends observed in native perennial foliar cover in most monitoring transects is likely related to the response of individual species to variation in rainfall between monitoring surveys. Generally, there was a decline in perennial foliar cover, from the high levels recorded between 2005 and 2009, when high levels of rainfall were received over several years. Native species richness and perennial foliar cover then decreased and has remained stable since 2012 when average or low levels of rainfall were received. There was a slight decrease in perennial foliar cover in 2020 after a peak in 2017 when above average rainfall was recorded. Perennial cover was similar across all treatments in 2020.

Overall species diversity amongst disturbed transects is similar to or higher than analogue transects for the cement stabilised sand transects in both domains. These transects have had consistently higher diversity since 2011, although the coastal transects with active revegetation recorded a decline

between 2017 and 2020 due to a reduction of cover for two key perennial species. After nearly 30 years, the native species assemblage within the disturbed transects, particularly amongst the cement stabilised sand transects, has not converged to that of the analogue transects. The native species assemblage of the seismic and rehabilitation transects are the most similar to the analogue transects and generally more stable over time. The native species assemblage of inland cement stabilised sand transects, particularly those without active revegetation, are showing signs of converging toward the analogue transects. Whilst at the coastal domain, this treatment is not showing any signs of being similar to the analogue transects in native species assemblage. The monitoring results to date indicate that revegetation of sites using cement stabilised sand can be successful, but it will take several decades.

Fauna

The current fauna monitoring survey utilised 12 pre-existing trapping sites to monitor ground-dwelling vertebrate populations. Three of the trapping sites occur within the CALM Act Lease, representing disturbed sites, and nine trapping sites occur within the Department of Biodiversity, Conservation and Attractions Nature Reserve that represent relatively undisturbed sites. Traps were opened for four nights in June 2020.

Previous study data has shown that the populations of the two mammal species *Leggadina lakedownensis* and *Mus musculus* respond rapidly to rainfall (three months previously) and the subsequent flush of food resources (Moro and Morris 2000). When conditions are good, these species respond rapidly to resource availability and the numbers increase as a result. When conditions are poor, often due to drought or the close passage of tropical cyclones, population numbers fall. It is important to note that the rodent response is occurring at a faster time scale than the frequency of triennial monitoring on TVI.

A correlation was shown between *M. musculus* and *L. lakedownensis* numbers, with a positive relationship until a capture rate of 80 *M. musculus* individuals is reached. When there are more than 80 *Mus musculus*, *L. lakedownensis* trap rates decline in both the Nature Reserve and the CALM Act Lease area, with the rate more pronounced in the Nature Reserve. This suggests that both species respond similarly to the resource availability pulse, most likely resulting from episodic rainfall events as evidenced by a negative relationship between *L. lakedownensis* capture rates and a drought factor index. TVI has been in drought, according to the drought factor recorded for most monitoring periods. It is likely that competition occurs as soon as resource availability declines due to drought and the immediate lag between population numbers and resource availability following rainfall has concluded. The analyses indicate that the relationship between the two rodent species and rainfall/drought (and resource availability) is complex. The infrequent monitoring in recent years is unlikely to capture most episodic rainfall events and the rodents' rapid response to these events, further complicating analyses.

Very little change has been observed in overall species richness and abundance in reptiles on TVI since 1996. All reptile species except one, (*Delma tincta*) that have been previously recorded on TVI in the past ten years were captured during the June 2020 survey. *Lerista bipes* was not recorded however it has not been recorded on TVI since 1985. Species richness and abundance for reptiles across all monitoring surveys were similar between sites on the CALM Act Lease and sites on the Nature Reserve. Much of the changes or fluctuations in reptile diversity and abundance over time are potentially a response to climatic changes, such as rainfall, as reptile diversity was found to be significantly positively correlated with rainfall received in the preceding six months.

Thirty-three bird species were recorded representing 45% of the 74 bird species known for TVI. It is expected that not all bird species will be present on the island at the time of survey, given that the majority of bird species are migratory waders and are only seen on TVI seasonally. There were significant nesting efforts by *Pandion cristatus* (Osprey) with 14 nests recorded and four of those containing eggs.

No further records of feral or non-indigenous species to TVI were detected during the June 2020 survey.

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1 Introduction

Chevron Australia Pty Ltd (Chevron) operates the Thevenard Island (TVI) Asset on behalf of the project partners:

- Chevron Australia Pty Ltd (51.43%)
- Santos Offshore Pty Ltd (35.71%)
- Mobil Australia Resources Company Pty Ltd (12.86%).

West Australian Petroleum Pty Ltd carried out the original development of the TVI oilfields, which the company operated until 1999. In 1999, Chevron assumed ownership of West Australian Petroleum Pty Ltd and operation of its Western Australian Oil Assets.

Chevron's Australasia Strategic Business Unit, based in Perth, constitutes the company's upstream presence in the Australasian region and manages its interests in offshore oil, gas and liquefied petroleum gas and condensate production, including that on TVI.

1.1 Project Background

Chevron has historically used TVI as a base for producing, processing and storing hydrocarbons from several nearby oil fields. TVI is located in the Pilbara region, 25 km north-west of Onslow and 70 km south-west of Barrow Island in the Carnarvon Basin, Western Australia (Figure 1). The Island is approximately 5 km in length, 1 km at its greatest width and covers an area of approximately 550 ha. It is the largest of a group of predominantly sandy islands known as the Mackerel Islands.

TVI is a nature conservation reserve (Reserve No. 33174) vested in the conservation estate of Western Australia (herein referred to as the Department of Biodiversity, Conservation and Attractions (DBCA) Nature Reserve). Chevron has responsibility of the petroleum permit areas which contain the Saladin, Cowle, Yammaderry, Crest, Roller and Skate oilfield developments on TVI and in surrounding waters. Oil processing facilities for these fields are located at the north-eastern end of TVI, on a 25 ha site leased from DBCA (herein referred to as the *Conservation and Land Management Act 1984* (CALM Act) Lease). A small lease operated by the Mackerel Island Resort is located adjacent to the oil processing facility on the south eastern end of TVI (herein referred to as the Mackerel Island Lease) (Figure 2).

Chevron is currently undergoing decommissioning and retirement of its facilities on TVI, with the view towards undertaking site remediation and rehabilitation, and obtaining relinquishment of its lease (Golder Associates 2016). The overall TVI Retirement Project will entail plug and abandonment of production wells, decommissioning of onshore infrastructure and facilities, decommissioning of offshore pipelines and platforms and remediation and rehabilitation of the environment (Golder Associates 2016).

Chevron's End State Vision for the remediation and rehabilitation of the site is to restore to a condition similar and compatible with the adjacent environment.

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Figure 1: Location of Thevenard Island

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Author: S. Moore	Date: 18-08-2020	Datum: GDA 1994 - Projection: MGA Zone 50
Drawn: C. Dyde	Figure Ref: 30025E1-20-BIDR-1RevB_200818_TEM_Fig01_Locn	0 5 10 15 20 Km N

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Figure 2: Location of Department of Biodiversity, Conservation and Attractions managed land, CALM Act Lease and the Mackerel Island Lease on Thevenard Island

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Author: S. Moore	Date: 18-08-2020	Coordinate System: GDA 1994 MGA Zone 50
Drawn: C. Dyde	30025E1-20-BIDR-1RevB_200818_TEM_Fig02_Lease	Metres 0 50 100 150 200 N

1.1.1 History

Flora monitoring commenced at TVI in 1987 with the instalment of four baseline transects to assess the impact of construction. Additional transects have been added to the monitoring program since this time to assess the impacts caused by seismic activity and plant regrowth in rehabilitation areas and disturbed areas within the CALM Act Lease.

Chevron has conducted a fauna monitoring program on TVI since 1988. Astron Environmental Services (Astron) has carried out the monitoring program since 1996. The field techniques and survey design have undergone significant changes over the duration of the monitoring program as a result of improvements and efficiencies of fauna surveying. Limited design changes have occurred in the avian fauna census as the records are generally opportunistic in nature.

The frequency of monitoring on TVI between 1987 and 2020 is illustrated in Table 1. A summary of the changes over the duration of the flora fauna monitoring program is included in Appendix A.

Table 1: The frequency of terrestrial ecological monitoring conducted on Thevenard Island between 1987 and 2020.

Year	Flora			Fauna	
	Winter (Dry)	Winter (Wet)	Summer	Winter	Summer
1987			✔ ^		
1988	✔				
1989	✔		✔		
1990	✔		✔		
1991	✔		✔		
1992	✔		✔		
1993	✔		✔		
1994	✔		✔		
1995	✔		✔		
1996	✔		✔	✔	✔
1997	✔			✔	✔
1998		✔		✔	✔
1999	✔		✔	✔	✔
2000				✔	✔
2001	✔		✔	✔	✔
2002	✔		✔	✔	✔
2003	✔		✔	✔	✔
2004	✔			✔	
2005	✔			✔	
2006	✔				✔
2007	✔				✔
2008	✔			✔	
2011		✔			✔
2012		✔			
2013		✔			✔
2014	✔			✔	✔

Year	Flora			Fauna	
	Winter (Dry)	Winter (Wet)	Summer	Winter	Summer
2017	✔			✔	
2020	✔			✔	

^Monitoring undertaken by Dinara Pty Ltd.

1.2 Purpose and Scope

The purpose of this report is to present the results of the flora and fauna monitoring programs undertaken on TVI in June 2020. Flora and fauna monitoring methodology is guided by the Thevenard Island Retirement Project - Terrestrial Ecological Monitoring Plan (Chevron Australia Pty Ltd 2015).

The purpose of the monitoring program is to ensure compliance with all relevant legislation and to align with the Rehabilitation Implementation Plan (Chevron Australia Pty Ltd 2017a). The scope of this report includes the ecological environment within the terrestrial area on TVI. This includes both the CALM Act Lease and the DBCA Nature Reserve but excludes the Mackerel Island Lease.

2 Environmental Context

2.1 Climate

The climate of the Onslow-Thevenard Island region has been described as "pseudo-monsoonal" (Gentilli 1971) and as an arid, summer rainfall, sub-tropical zone (Department of Science and Technology 1983). The climate is controlled primarily by the sub-tropical high pressure belt that migrates southward from winter to summer.

Long-term climatic records were sourced from Bureau of Meteorology's Onslow Airport (Station 5017), which is located 25 km south-south-east of TVI. The mean annual rainfall from 1940 to 2020 is 308.4 mm, but seasonal and annual variability is high (Bureau of Meteorology 2020). The majority of rain falls between January and June with February and March generally being the wettest months (Figure 3 and Figure 4). Previous comparison of Onslow and TVI rainfall data indicate they receive a similar annual rainfall (Onslow receives on average 13 mm more rainfall; (Chevron Australia Pty Ltd 2017b).

In the 12 months prior to the June 2020 surveys, 163.8 mm of rainfall was recorded. This was 143.8 mm below the long-term (1940 to 2020) average annual rainfall for the same period (Bureau of Meteorology 2020) (Figure 4). Minimal rainfall was received in the two months leading up to the field survey with the highest monthly rainfall of 66 mm recorded in March 2020. Maximum monthly temperatures from the 12 months preceding the field survey were mostly below or close to the mean monthly maximum temperatures recorded between 1940 and 2020 (Bureau of Meteorology 2020) (Figure 4).

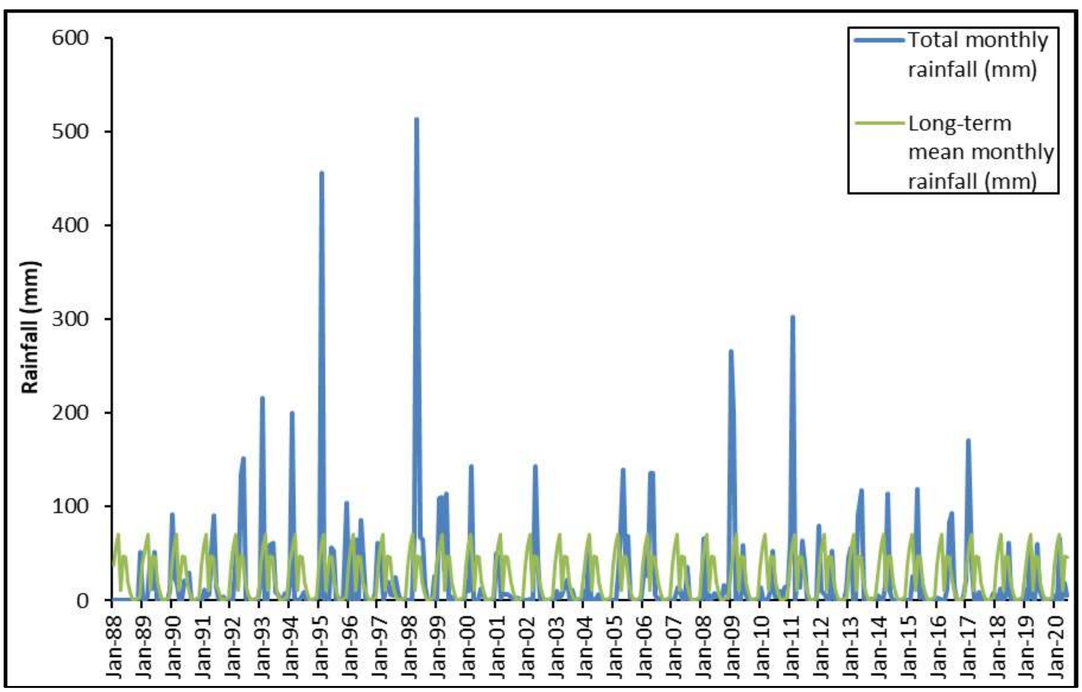

Figure 3: Total monthly rainfall (1988 to 2020) and the long-term (1940 to 2020) mean monthly rainfall. Data source: monthly rainfall 1988 to 1994, 1997 to 1999 from Chevron Australia Pty Ltd, 1995 to 2019 from Bureau of Meteorology(2020) Thevenard Island weather station 5084; long-term (1940 to 2020) rainfall from Bureau of Meteorology (2020) Onslow Airport weather station 5017.

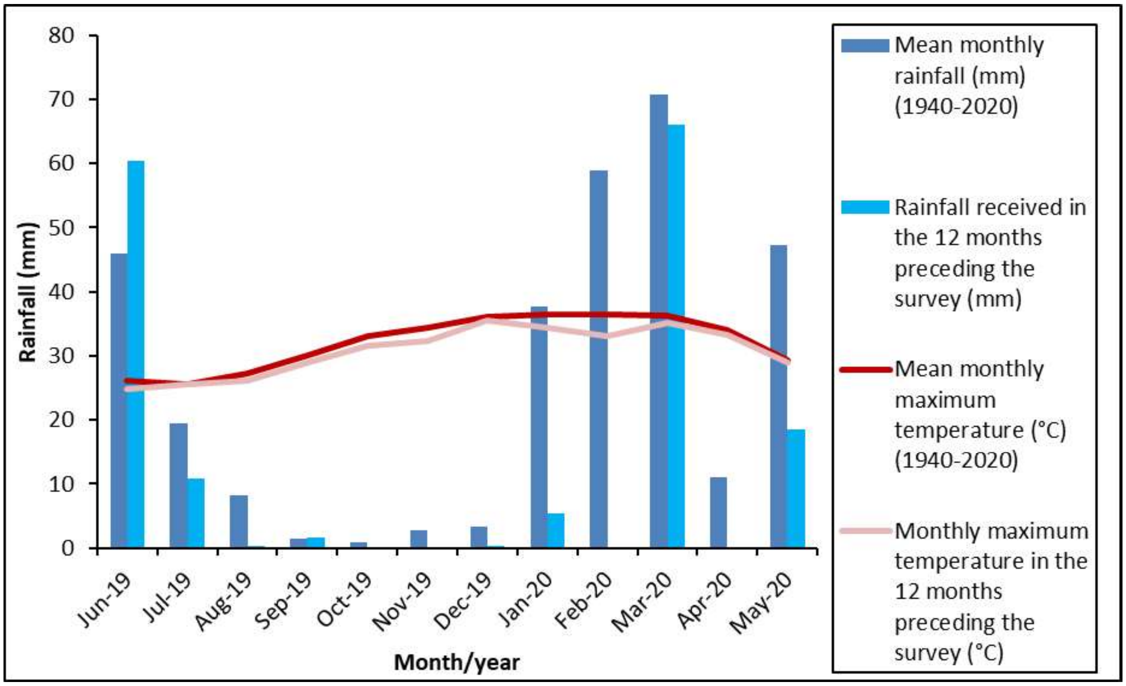

Figure 4: Long-term (1940 to 2020) mean monthly rainfall (mm) and mean monthly maximum temperature (°C), and for the 12 months preceding the June 2020 survey. Data source: long-term data from Onslow Airport weather station 5017 and data preceding the 2020 survey from Thevenard Island weather station 5084 (Bureau of Meteorology 2020).

2.2 Geomorphology, Soils and Hydrology

TVI is largely an accumulation of Holocene sandy sediment and coral reefs resting on a Pleistocene limestone foundation (LeProvost et al. 1987). Excluding beaches, the Island has three dominant geomorphic units (Astron Environmental Services 2013a):

- coastal fore-dune – a narrow rim of dunes around the perimeter of the island
- coastal plain – an undulating surface that separates the coastal fore-dune from the inland ridge system
- inland ridge – a unique geomorphic feature consisting of a series of relict dunes in the centre of the island that is undergoing degradation.

Endemic soils on TVI are typical of the relatively simple geology of cays. As TVI is a young cay the soils on the Island are recent and display relatively little development. There are two predominant soil types on TVI (Astron Environmental Services 2014a):

- medium to coarse grainstone of skeletal quartz with some lithoclastic sand on fore-dunes
- muddy grainstone on ridges and coastal plain, with the coastal plain having a higher content of sand.

TVI supports a simple groundwater system that is largely underlain by oceanic water. Fresh water forms a shallow lens (up to 70 m thick) confined by inclined saline water interfaces on the oceanic margins. Recharge occurs directly by infiltration through the sandy soils and upper calcarenite layers.

2.3 Flora and Vegetation

The vegetation on TVI consists of four main associations that largely correspond to the three dominant geomorphic units plus disturbed areas (Table 2). The most extensive association, Association 1, is found on the inland ridge system and can be further divided into five sub-associations (Figure 5). Association 2 occurs on the coastal dunes fringing the Island. Association 3 occurs on coastal plain towards the western end of TVI and is divided into four sub-associations. Association 4 occurs on disturbed or semi-disturbed sites. Changes, primarily related to grass cover and mid-level shrub cover, occurred within these associations between 2004 and 2013. Over this time **Cenchrus ciliaris* (buffel grass) increased over the island and displaced much of the native grassland, annual herb land and mid-level perennial shrub strata (Astron Environmental Services 2013a).

The location and spatial extent of these vegetation associations prior to construction of the infrastructure in the CALM Act Lease is largely unknown. Therefore, the location of vegetation associations in the CALM Act Lease have been determined by examining aerial photographs (from 1985) and making correlations between the landform and vegetation associations in the DBCA Nature Reserve (Astron Environmental Services 2013a) (Figure 5).

Previously described vegetation associations were not necessarily aligned with the three geomorphic units on TVI. Therefore, the vegetation associations were reclassified in 2013 to better align with the geomorphic units, which also included simplification for the purposes of practical revegetation. Reconciled codes and descriptions are presented in Table 2 and are used throughout this report.

In 2017, a new Inland Ridge vegetation association was added after a field reconnaissance determined the presence of a Priority Ecological Community. A small isolated community of *Whiteochloa airoides* tussock grassland with scattered *Scaevola cunninghamii* and *Spinifex longifolius* was found to occur towards the western side of TVI, just beyond the coastal foredunes. Future surveys may record more locations of this Priority Ecological Community.

Table 2: Vegetation associations on Thevenard Island (Astron Environmental Services 2013a).

Vegetation association	Vegetation sub-associations	Geomorphic unit	Vegetation description
1	Ir1, Ir1a, Ir1b, Ir1c, Ir2	Inland ridge	Shrubland of *Acacia coriacea* over mixed open to low shrubland over grassland/open grassland and open herbs found on the inland ridge system.
2	Cf1	Coastal fore-dune	Tussock grassland over open ground creeper on fore and relic coastal dunes or in swale between dunes. There are very scattered shrubs (< 2%).
3	Cp1, Cp2, Cp3, Cp4	Coastal plain	Dwarf to low shrubland over open tussock grassland of *Eulalia aurea* over open herbland occurs on the aeolian platform towards the western end of the island.
4	D1	NA	Closed tussock grassland over very open liane on disturbed and semi-disturbed sites.

Ninety-nine plant taxa, representing 26 families and 70 genera, have been identified within the CALM Act Lease and DBCA Nature Reserve of TVI (Appendix B). This total species richness includes 10 environmental weed species that have been recorded since monitoring commenced in 1987. An additional two species, **Eragrostis minor* (smaller stinkgrass) and **Flaveria trinervia* (speedy weed), are also listed as environmental weed species but are considered naturalised (present pre-European arrival) on TVI. A number of weed species found on the Mackerel Island Lease (horticultural plantings or garden escapees) are not included in the flora species list. A summary of occurrence of all species since the commencement of monitoring is presented in Appendix B.

No flora listed as threatened under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) or declared rare flora under the *Wildlife Conservation Act 1950* (WC Act) are known to occur on TVI. One priority (P) three species, *Carpobrotus* sp. Thevenard Island (M. White 050) has been recorded (Appendix B). One P1 species, *Abutilon* sp. Onslow (F. Smith s.n. 10/9/61), which is a native species not indigenous to TVI, introduced from the mainland has also previously been recorded in 2000 and 2004.

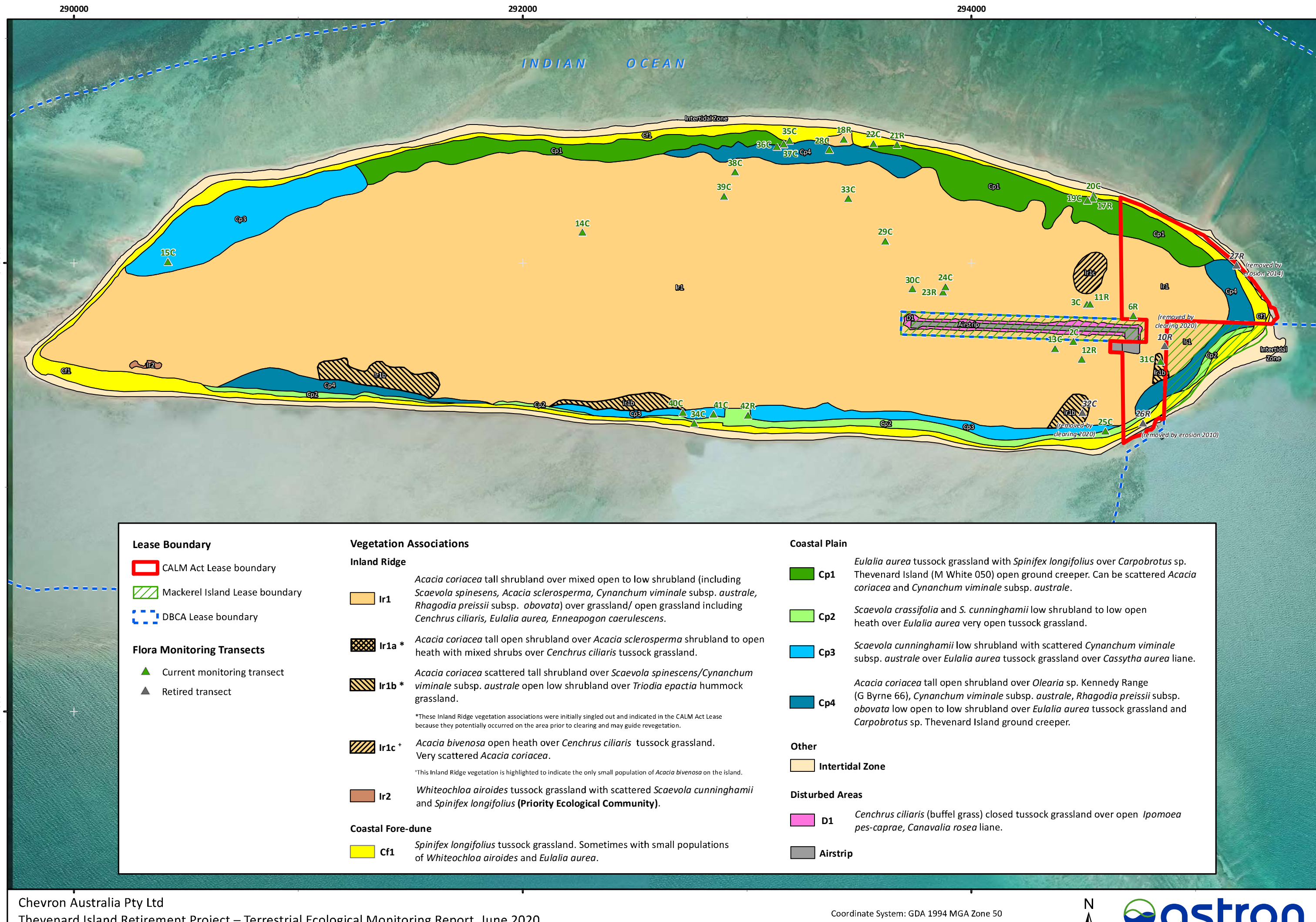

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Figure 5: Vegetation associations on Thevenard Island and location of flora monitoring transects

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Author: | Drawn: | Date: 08-09-2020 | Figure Ref: 30025E1-20-BIDR-1RevB_200908_TEM_Fig05_Veg

2.4 Fauna

The long-term monitoring of the vertebrate fauna species on TVI has enabled a comprehensive understanding of the vertebrate faunal assemblage present. Over the life of the monitoring program a total of 83 native and one introduced fauna species have been recorded. To date this comprises eight reptiles, 74 birds (including two new species recorded in the 2020 survey), one native and one introduced mammal. These species are currently extant or migratory visitors to TVI.

2.4.1 Mammals

The TVI form of the DBCA P4 listed short-tailed mouse (*Leggadina lakedownensis*) was previously thought to be a distinct species between the mainland species and those found on Mackerel Islands. However, research has shown that this is simply a larger form of the species present on the mainland (Cooper et al. 2003). The introduced house mouse (*Mus musculus*) has become abundant on TVI since it was first recorded in 1987. The level of threat this species poses to native species, specifically *L. lakedownensis*, is not completely understood.

It has been previously suggested that the *L. lakedownensis* population fluctuations are related to the abundance of *M. musculus* (Moro and Morris 2000). However, the analysis of historical trapping data in 2014 showed that a positive correlation exists between both of these species up to a capture rate of 40 individuals of *M. musculus* (Astron Environmental Services 2014b). At a capture rate of 40 *M. musculus, L. lakedownensis* capture rates plateau in the DBCA Nature Reserve and decline in the CALM Act Lease. Rainfall data suggests a drought in 2014 which, when combined with an interaction with *M. musculus,* explained 72% of the variation in *L. lakedownensis* abundance, whereby increased *M. musculus* and greater drought drives an asymptotic low for *L. lakedownensis* numbers (Astron Environmental Services 2014b). This suggests that resource availability is potentially the major constraint to population numbers before any competition between the species would take place. Both species respond similarly to the resource availability pulse resulting from episodic rainfall events. It is likely that competition occurs as soon as resource availability declines due to drought and the immediate lag between population numbers and resource availability following rainfall has concluded (Astron Environmental Services 2014b). The population viability analysis (PVA) conducted in 2014 also supported that both species are characterised by short 'boom' periods of peak population numbers, between which lie long periods when the population density is minimal (Astron Environmental Services 2015). The 'boom' cycle is closely coupled with the peaks in the vegetation index modelling food abundance as a response to recent rainfall (Astron Environmental Services 2015).

2.4.2 Reptiles

Eight species of ground-dwelling reptiles are confirmed for TVI, none of which are conservation significant according to State or Commonwealth lists. One species, *Lerista bipes* (two-toed skink) was first recorded by W.H. Butler in 1964 and again in 1985 but has not been recorded on TVI since. The presence of this skink on TVI is improbable given it is common and readily trapped in pit traps where it occurs on other offshore islands, however it is not included in the eight known reptile species for TVI. Additionally, its distinctive "swirly" tracks have not been recorded since Astron began fauna monitoring on TVI in 1996. This skink is probably no longer on TVI, but a more intensive program would be needed to verify this.

Recently a revision of the *Lerista* genus determined that *L. muelleri* is now considered *L. clara* (Smith and Adams 2007). A specimen of *Lerista*, which was captured in the 2017 fauna monitoring survey, was lodged at the Western Australian Museum (WAM) and was confirmed as *Lerista clara*. The nomenclature and sequence for other reptiles within this report is as per WAM (2020) vertebrate fauna checklist.

2.4.3 Birds

A total of 74 bird species have been recorded on TVI since fauna monitoring began, including two new species recorded during this fauna survey, pallid cuckoo (*Cacomantis pallidus*) and grey fantail (*Rhipidura albiscapa*). Of the species previously recorded, 24 are listed under Commonwealth and/or State legislation, specifically the EPBC Act and BC Act. This includes 23 species listed as migratory under the EPBC Act and the BC Act, three of which are also listed as threatened under the EPBC Act and BC Act (Appendix C). One additional species is listed as threatened under the EPBC Act and BC Act (Appendix C). The migratory species are ratified under international agreements (Japan-Australia Migratory Bird Agreement; China-Australia Migratory Bird Agreement; Republic of Korea-Australia Migratory Bird Agreement). The terrestrial species are essentially resident on TVI with some transient species such as raptors moving to and from the mainland. A number of avian species are seasonal migrants and would only be present on TVI during the southward or northward journey of their annual migration. These species would most likely utilise TVI as a staging and roosting location.

3 Methods

3.1 Flora Monitoring

3.1.1 Monitoring Program Design

Flora and vegetation were monitored at 31 of the 33 transects in 2020 (Figure 5 and Table 3). Nineteen of these transects are located within the inland broad-scale domain (comprising the coastal plain and inland ridge geomorphic domains). The remaining 14 transects are located within the coastal broad-scale domain (comprising the coastal fore-dune geomorphic domain). Transect 26R and 27R are no longer monitored as they have been lost to erosion.

Transect 32C and 10R could not be surveyed in 2020 due to clearing: transect 32C has been disturbed from clearing activities at TVI-1 Well site and transect 10R disturbed during removal of pipework. Both transects are no longer intact and have been removed from the monitoring program. Transect 31C was partially disturbed from clearing activities but was still surveyed. Transects 32C and 31C represent *Triodia epactia* grassland. This grassland is restricted in its occurrence on TVI, and prior to clearing, the *Triodia* population at 32C was considered healthy.

Within each broad-scale domain, transects are located within disturbed sites and undisturbed sites (herein referred to as 'analogue'). For the purpose of assessing the impact of the operations on the flora and vegetation, the disturbed sites are classified based on the type of impact and revegetation approach (Table 3):

- Seismic impacts (herein referred to as 'seismic') – sites impacted either by the removal of vegetation (both above and below-ground parts) or damage to vegetation (crushing or removal of above-ground parts only) during construction and during the initial and subsequent seismic programs in the DBCA Nature Reserve. Sites were left to revegetate naturally from surrounding vegetation.
- Cement stabilised sand impacts (herein referred to as 'cement stabilised sand' (CSS)) – sites impacted by the removal of vegetation and the subsequent incorporation of cement and stabilised sands into the soil during rehabilitation, such as laydown areas and roads in the CALM Act Lease as well as the Crest 4/5 Well and along the Crest 4/5 Well access track in the DBCA Nature Reserve. Sites were either subject to active revegetation activities or left to revegetate naturally (Ward Reef track and lease) from surrounding vegetation (herein referred to as 'no active revegetation').
- Rehabilitation impacts (herein referred to as 'rehabilitation') – sites impacted by the removal of vegetation, where active revegetation and weed management activities have then been implemented in the CALM Act Lease and along the Crest 4/5 Well access track and Crest Well Lease area.

Each transect is 1 m wide and 20 m or 25 m long (consisting of contiguous 1 m by 1 m quadrats). At each transect the total number and projected live foliar cover (%) for each native and non-indigenous plant taxon (both annual and perennial species) was recorded. One photograph of each transect from the start peg was also taken.

Table 3: Summary of current flora monitoring transects. NB: CSS = cement stabilised sand.

Domain	Transect	Easting (mE)	Northing (mN)	Disturbed or analogue	Impact classification	Revegetation classification
Inland	2C	294490	7625613	Analogue	Not applicable	Not applicable
	3C (matched analogue for 11R)	294516	7625815			
	13C (matched analogue for 6R)	294373	7625617			
	14C (matched analogue for 6R, and 12R)	292267	7626136			
	24C (matched analogue for 23R)	293886	7625893			
	28C (matched analogue for 18R)	293367	7626504			
	29C	293617	7626097			
	30C	293738	7625884			
	31C	294843	7625560			
	33C	293446	7262308			
	38C	292948	7626405			
	39C	292898	7626296			
	6R	294722	7625764	Disturbed	CSS	No active revegetation
	11R	294529	7625814		Seismic	No active revegetation
	12R	294492	7625570		Seismic	No active revegetation
	18R	293432	7626552		CSS	Active revegetation
	23R	293874	7625869		Seismic	No active revegetation
Coastal	15C	290410	7626029	Analogue	Not applicable	Not applicable
	19C (matched analogue for 17R)	294519	7626278			
	20C	294545	7626301			
	22C (matched analogue for 21R)	293564	7626531			
	25C	294598	7625250			
	34C	292765	7625285			
	35C	293190	7626545			

Domain	Transect	Easting (mE)	Northing (mN)	Disturbed or analogue	Impact classification	Revegetation classification
	36C	293135	7626517			
	37C	293164	7626528			
	40C	292715	7625333			
	41C	292237	7625318			
	17R	294541	7626287	Disturbed	CSS	Active revegetation
	21R	293670	7626526		Rehabilitation	Active revegetation
	42R	293004	7625321		CSS	No active revegetation

3.1.2 Field Team and Timing

The monitoring was undertaken from the 17 to 22 June 2020 by Associate Botanist Vicki Long.

3.1.3 Data Management and Analysis

The master data set containing all years of data was reviewed in 2020 with the following changes made:

- historical data was reviewed and corrected, resulting in some changes to treatment descriptions, nomenclature, blank data cells allocated "NA" or "0" where appropriate, and mean species cover values were corrected or added for transect data
- transect 10r and 32c status changed to "retired" due to disturbance in 2020
- *Euphorbia coghlanii* in all years updated to *E. trigonosperma* due to updated taxonomic nomenclature at the time of the 2020 survey
- transect start and end UTM coordinates corrected.

3.1.3.1 Floristic Cover, Species Richness and Diversity

For all transects monitored in 2020, the following variables were tested for significant differences across years and amongst treatments (analogue and disturbed; seismic, CSS and rehabilitation; active revegetation and no active revegetation), using linear models:

- Total projected live foliar cover (%) of all native perennial species recorded at each monitoring transect
- species richness measured by the number of native taxa recorded at each monitoring transect
- floristic cover diversity of all species at each monitoring transect, assessed using the Berger-Parker index which calculates the proportional dominance of the most dominant species. It is considered to be "one of the most satisfactory diversity measures available" (Magurran 1988)
- mean cover (%) of all weed species recorded at each monitoring transect.

There were no disturbed rehabilitation transects within the inland domain and no disturbed seismic transects within the coastal domain. The time-by-site type interaction was used to test for a significant difference in the trajectories of the disturbed and analogue transects over time. Analyses were performed separately for the inland and coastal domains. Model residuals were examined for normality using Shapiro's Test of Normality. If residuals were found to be non-normal, transformations were attempted; if transformations were not effective, the statistical significance of the models was tested using permutation tests in the lmPerm package (Wheeler and Torchiano 2016). All statistical analyses were performed using R (Version 3.6.0) (R Core Team 2019). A significant difference was reported if $P < 0.05$.

3.1.3.2 Species Assemblages

In order to test for changes in the plant species assemblage over time and across treatments, a permutation based multivariate analysis of variance (PERMANOVA) using the R function 'Adonis', within the R package, Vegan (Anderson et al. 2008) was used. Prior to analysis, the compositional differences between transects were calculated using the Bray-Curtis index. In order to place equal weight across taxa, data were transformed to presence-absence before calculating the distance matrix. Statistical effects of year, treatment (analogue and disturbed; seismic, CSS and rehabilitation; active revegetation and no active revegetation), and the year-by-treatment interaction were tested using a pseudo-F value derived from 999 randomisations of the data set. The tests were performed for all native species and weed species separately.

3.1.4 Limitations

Three transects had been disturbed during the 2020 survey; transect 32C and 10R had been cleared, and transect 31C was partially disturbed, but still intact. Clearing of transect 32C located at TVI-1 well site has removed one of only two populations of *Minuria cunninghamii*, which now only occurs in a very small population at the south-west end of TVI. The clearing activities at TVI-1 well site (and disturbance at transect 31C) has also removed a healthy population of *Triodia epactia* grassland, which is restricted in its occurrence on TVI.

The areas of historic rehabilitation are relatively small (4.1 ha). The results from monitoring of these areas may not be directly applicable to rehabilitation of larger areas, for example due to higher levels of seed introduction from the surrounding undisturbed vegetation for small areas of rehabilitation.

3.2 Fauna Monitoring

3.2.1 Monitoring Program Design

The current fauna monitoring survey utilised 12 pre-existing trapping sites to monitor ground-dwelling vertebrate populations (Astron Environmental Services 2013b, 2014b) (Figure 6). Trapping sites 1 to 3 occur within the CALM Act Lease and represent disturbed sites. Trapping sites 1 and 2 show a pattern of early stage succession by vegetation. Trapping site 1 was completely cleared during initial oilfield earthworks and trapping site 2 was partially cleared in early 2004 to allow the laying of electrical cable. Trapping site 3 has been relocated towards the southern oil wells and jetty infrastructure but should still be considered a disturbed location.

Trapping sites 4 to 12 occur within the DBCA Nature Reserve represent relatively undisturbed sites in two geomorphic domains: coastal plain and inland ridge. Little of the DBCA Nature Reserve has been cleared, however the vegetation associations have changed due to the invasion of **C. ciliaris,* which has spread island-wide at the time of the most recent vegetation assessment. The locations of the sites in the DBCA Nature Reserve cover a range of **C. ciliaris* density levels (high, medium and low/none).

Each trapping site was comprised of one central row of five pitfall traps along a 50 m drift-fence and two lines of five Elliot box traps (previously referred to as Sherman traps) set at 10 m intervals on either side (Figure 7). Each row was located approximately 20 m apart. Captured mammals and reptiles were identified to species level and both mammal species marked through ear notches to identify individuals. The house mouse (*Mus musculus*) was not removed from the population upon capture.

Elliot box traps were baited with a mixture of peanut butter and oats and pit traps were unbaited. Checking of all traps commenced daily at 0630 hours with all traps cleared two to three hours post sunrise. The Elliot box traps were closed after being checked to avoid exposing any trapped animals to direct sunlight and heat. They were re-opened each afternoon. The pitfall traps had foam shelters placed inside to provide shade and cover for the animals captured and would usually be kept open during the day to sample for reptiles.

Avifauna census area searches were conducted around the entire coastline of TVI with opportunistic recording of avifauna in the interior. Species were identified in coastal regions of TVI, during high and low tides. Any birds observed during the checking of terrestrial fauna traps were also noted. Notes on nesting species were recorded where applicable and a targeted search of *Pandion cristatus* (Osprey) nests was conducted across the entire island.

Chevron Australia Pty Ltd

Thevenard Island Retirement Project – Terrestrial Ecological Monitoring Report, June 2020

Figure 6: Location of fauna trapping sites and avifauna census

Author: Drawn: Date: 18-08-2020 Figure Ref: 30025E1-20-BIDR-1RevB_200818_TEM_Fig06_Fauna

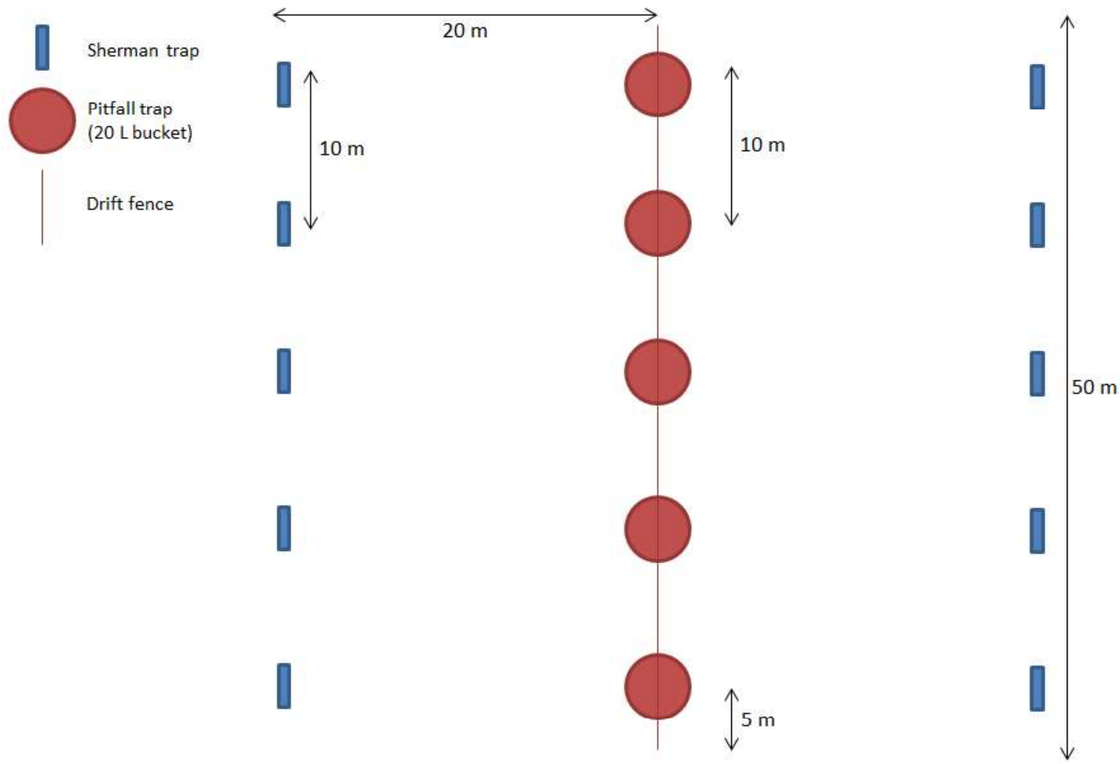


Figure 7: Schematic of trapping site layout.

3.2.2 Field Team and Timing

The field visit was undertaken from 17 to 22 June 2020 by Senior Zoologists and Zoologists .

3.2.3 Data Analysis

3.2.3.1 Mammals

Analysis was conducted for the two mammal species on TVI from 2001 to the current 2020 monitoring survey. The number of mammal captures was standardised against traps nights allowing for statistical measures to be conducted. Capture rates of *M. musculus* and *L. lakedownensis* over time was plotted and a generalised linear model based on a quasi-Poisson distribution was used to test for contrasts in temporal trends between the CALM Act Lease and DBCA Nature Reserve plots.

A generalised additive model was fitted to *L. lakedownensis* data to examine temporal trends across the CALM Lease Act and DBCA Nature Reserve. Additionally, linear or generalised additive models based on quasi-Poisson distribution were used to determine whether the number of *M. musculus* captures, buffel grass covers drought factor index (relating to soil water availability) and the Keetch-Byram Drought Index (KBDI; relating more to vegetation water availability) influenced *L. lakedownensis* trap rates. The drought factor index and KBDI were constructed from Bureau of Meteorology Onslow daily temperature and rainfall records (Bureau of Meteorology 2020) according to Finkele et al. (2006).

3.2.3.2 Reptiles

Analysis was conducted for reptile assemblages on TVI from 2001 to the current 2020 monitoring survey. The reptile fauna data captured was standardised against traps nights allowing for statistical measures to be conducted. Species diversity was calculated for each year using Simpson's Index of Diversity (1-lambda) (Hill 1973). It is commonly used in ecology to quantify the biodiversity of a habitat, taking into account the number of species present as well as the abundance of each species (Hill 1973). Reptile species richness, diversity and total abundance (captures) was calculated for each year and a generalised linear model, based on a Poisson distribution, was used to test for a change in the three parameters over time for both the CALM Act Lease and DBCA Nature Reserve plots.

Total abundance of each reptile species over time was plotted and a generalised linear model based on a quasi-Poisson distribution was used to test for contrasts in temporal trends between the CALM Act Lease and DBCA Nature Reserve plots.

Total rainfall for three, six and 12 months preceding each monitoring survey were used to test for any influence of weather conditions on reptile assemblages. Species richness, diversity and total abundance were tested for any relationship with rainfall using Kendall's correlation test.

3.2.4 Limitations

No major limitations were encountered while undertaking the field survey.

4 Results and Discussion

4.1 Flora and Vegetation

4.1.1 Overview

Thirty-two taxa representing 28 genera and 16 families were recorded at the 31 transects monitored during 2020. An additional 27 taxa representing 18 genera and six families were recorded opportunistically within surrounding vegetation. No new taxa were recorded.

Carpobrotus sp. Thevenard Island (M. White 050) P3 was recorded in 10 transects in 2020: 15C, 19C, 21R, 22C, 28C, 35C, 36C, 37C, 40C and 41C. One of these transects (28C) is located within the inland domain and the remaining located within the coastal domain. This conservation significant species was recorded at one rehabilitation transect (21R) where it had previously been recorded in 2011 and 2012. Some natural variation in occurrence has also been observed at the analogue transects. *Carpobrotus* sp. Thevenard Island (M. White 050) P3 was absent from the inland CSS active revegetation transect (18R) where it had been recorded in 2013, 2014 and 2017. This indicates that this species can successfully be returned through revegetation of disturbed sites but may be subject to natural variation in occurrence.

**Cenchrus ciliaris* was the most widespread and abundant weed species, recorded in 13 transects in 2020 (2C, 3C, 11R, 12R, 13C, 14C, 22C, 23R, 24C, 29C, 30C, 33C and 42R). This is the first occurrence of **C. ciliaris* at transect 42R since monitoring was established in 2013. This dominant weed species was recorded at 12 transects in 2017 and cover has increased since 2017. Since 2013, **Aerva javanica* (kapok) has only been recorded at one analogue transect (39C), where it was again recorded in 2020 with an increase in cover since 2017. However **A. javanica*, was recorded immediately adjacent to 36C, 37C and 38C.

Overall, weed cover across the island has increased since monitoring began in 1988, specifically **C. ciliaris* which now dominates three inland analogue transects (2C, 13C and 24C). This has resulted in a notable decline in mid-storey native species, such as *Rhagodia preisii* subsp. *obovata, Cynanchum viminale* subsp. *australe* and *Scaevola spinescens*; and native grasses such as *Enneapogon caerulescens* and *Eulalia aurea* (V. Long, Associate Botanist Astron Environmental Services, pers. comm., 3 July 2020).

Photographs of the 31 transects monitored during 2020 are provided in Appendix D.

4.1.2 Floristic Cover, Species Richness and Diversity

4.1.2.1 Inland Domain

Native perennial foliar cover was similar amongst all treatments in 2020, both due to a decline in cover at the analogue transects, and an increase in cover at the disturbed transects since monitoring commenced (Figure 8a). Since 2011, treatments have been converging following the record high cover values in 2009. Although native perennial foliar cover at the analogue transects was similar to the disturbed transects in 2020, it remains significantly higher than the disturbed transects (Table 4). The trends in foliar cover for native species in most monitoring transects are likely related to the response of individual species to between-year variation in rainfall. Native perennial foliar cover peaked between 2005 and 2009 when high levels of rainfall were received over several years. Since then, a decline was observed, with an increase in 2017 in response to above average annual rainfall. Native perennial cover then decreased after three years of below average rainfall (Figure 8a). An increase in

**C. ciliaris* abundance and distribution across TVI has also resulted in some native species being out competed, resulting in lower vegetation cover overall.

Native species richness was highest at the disturbed CSS (no active revegetation) transects in 2020 compared to all other treatments; this trend has been observed since 2011. Native species richness was significantly different between treatments, with analogue transects significantly higher than all disturbed transects and seismic transects significantly higher than CSS transects (Table 4 and Figure 9a). Although species richness at the seismic transects has been lower than the CSS transects since 2008. Species richness at the CSS active revegetation transect remains lower than the analogue transects, although fluctuates in a similar manner, and in 2008, 2013 and 2017 had the same species richness as the analogue transects. For the seismic transects and the CSS active revegetation transect, species richness in 2020 was lower than levels recorded at the establishment of monitoring in 1994 and 2001, respectively. This pattern was also observed at the analogue transects.

Species diversity varied significantly over time, within and between treatments; CSS no active revegetation transect was significantly higher compared to all other treatments (Table 4 and Figure 10a). This indicates that this transect has a relatively even contribution of cover from various species. Amongst the disturbed transects, the seismic transects had the lowest species diversity relative to all other treatments, including the analogue transects. In 2020 the seismic transects were dominated by *Cassytha aurea* and **C. ciliaris.* This treatment also had the lowest species richness amongst all other treatments. Species diversity was similar between the CSS active revegetation transect and the analogue transects, a trend that has been consistently observed since 2011. This is commensurate with the similarities in native perennial cover and species richness.

Weed cover was highest at the seismic transects relative to all other treatments in 2020, a trend that has been observed since 2002 (Figure 11a). Weed cover at the analogue transects was significantly different to all disturbed transects; higher than the CSS transects and lower than the seismic transects (Table 4 and Figure 11a). Weed cover has varied significantly over time with an overall increase to 2011, before a decrease in recent years back towards pre-1994 cover values; except for the seismic transects where weed cover has increased over time. No weeds were observed at the CSS no active revegetation transect for the first time since its establishment in 1990. This transect has peaked at 43% weed cover in 1999, with a steady decline recorded since 2007, likely influenced by on-going weed management activities. No weeds were observed at the CSS active revegetation transect for the second consecutive monitoring year, with a rapid decline recorded after peak levels of 19% in 2008. This transect is located within the DBCA Nature Reserve and is not subject to weed management activities.

Table 4: Summary of statistical analysis results between treatment types, year and interaction of treatment type and year. Treatment types: Analogue; Disturbed Seismic no active revegetation; Disturbed Cement Stabilised Sand (CSS) active revegetation; Disturbed CSS no active revegetation; Disturbed Rehabilitation active revegetation. Significant results in bold.

Domain	Variables	P-value (*F*-value)			
		Cover (native perennial)	Species richness	Diversity	Cover (weeds)
Inland	Year	P = 0.350 ($F_{1,220}$ = 0.883)	P = 0.654 ($F_{1,220}$ = 0.201)	**P < 0.001** ($F_{1,221}$ = 11.83)	**P = 0.002** ($F_{1,223}$ = 9.354)
	Treatment	P **< 0.001** ($F_{4,220}$ = 9.363)	**P < 0.001** ($F_{4,220}$ = 6.020)	**P < 0.001** ($F_{3,221}$ = 5.81)	**P = 0.007** ($F_{2,223}$ = 4.978)
	Year x Treatment interaction	P = 0.875 ($F_{3,220}$ = 0.230)	P = 0.869 ($F_{1,220}$ = 0.239)	**P = 0.023** ($F_{3,221}$ = 3.24)	P = 0.345 ($F_{2,223}$ = 1.073)
Coastal	Year	P = 0.448 ($F_{1,121}$ = 0.579)	P = 0.435 ($F_{1,120}$ = 0.613)	P = 0.880 ($F_{1,121}$ = 0.02)	P = 0.942 ($F_{1,152}$ = 0.005)
	Treatment	**P = 0.001** ($F_{3,121}$ = 8.549)	**P < 0.001** ($F_{4,120}$ = 9.085)	**P = 0.010** ($F_{3,121}$ = 3.94)	P = 0.839 ($F_{4,152}$ = 0.356)
	Year x Treatment interaction	P =0.056 ($F_{3,121}$ = 2.586)	P = 0.051 ($F_{3,120}$ = 2.669)	P = 0.538 ($F_{3,121}$ = 0.73)	P = 0.966 ($F_{3,152}$ = 0.411)

4.1.2.2 Coastal Domain

Native perennial cover was similar across all treatments in 2020, with a decline since 2017 for all treatment types except the CSS no active revegetation transect, which has increased each year since monitoring commenced in 2013 (Figure 8b). Cover at the analogue transects remain significantly higher than all disturbed transects (Figure 8b and Table 4). Since 2011, cover across all treatments have been converging, although this is primarily due to a decline in native perennial cover at the analogue transects rather than a steady increase at the disturbed transects. Cover at the CSS active revegetation transect and rehabilitation transect have fluctuated over time. The CSS active revegetation transect reached peak cover levels in 2017, with a decline in 2020 to similar levels recorded in 2001 when monitoring commenced. The rehabilitation transect peaked in 2006, likely in response to high rainfall (similar to the analogue transects), and in 2020 recorded a decrease in cover from 2017, again similar to the analogue transects. There has been minimal change in cover at the CSS active revegetation transect since monitoring commenced in 2013.

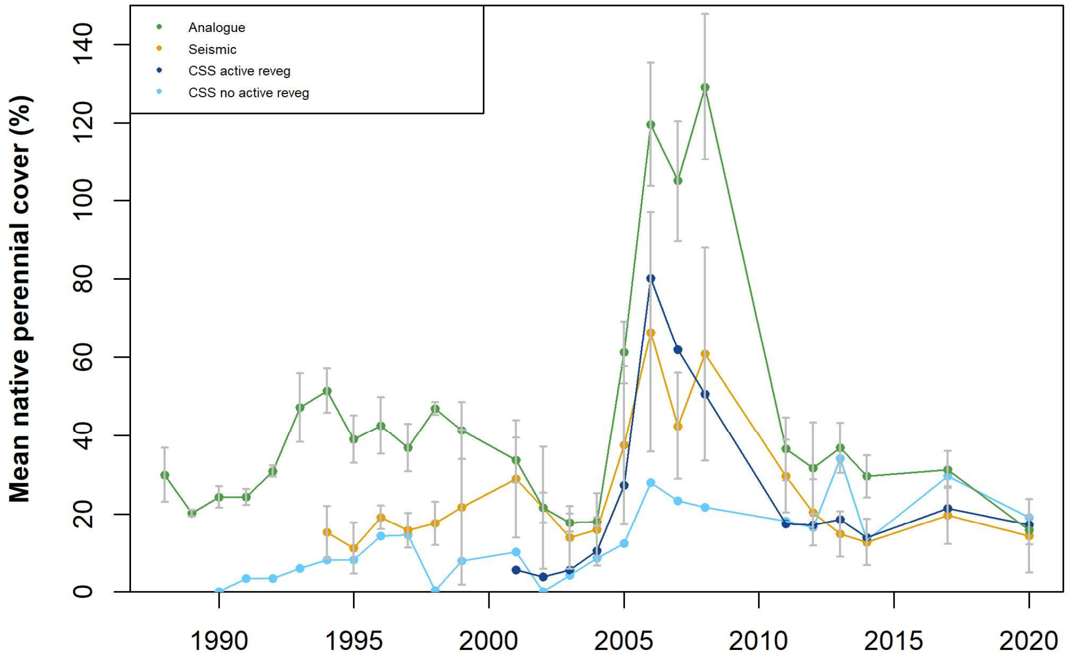
Native species richness remained consistent between 2017 and 2020 for the CSS transects, whilst the rehabilitation transect decreased after a peak in 2017 (Figure 9b). Species richness was similar for analogue transects and CSS active revegetation transects in 2020. Species richness at the CSS no active revegetation transect remains lower than all other treatments with no change recorded since 2017. Species richness was significantly higher at the rehabilitation transect compared to all other treatments (Table 4); a trend that has been observed since 2008. Similar to perennial cover, there has been an overall decline in species richness at the analogue transects since monitoring commenced in 1994.

Species diversity was significantly higher at the rehabilitation transect compared to all other treatments (Figure 10b and Table 4). This demonstrates a relatively even cover contribution from various species. However, a decline in species diversity was recorded between 2017 and 2020 to similar levels of the analogue transects, due to an increase in the dominance of *Acacia coriacea*. There was a large decline in species diversity at the CSS active revegetation transect between 2017 and 2020, due to a reduction in cover of *E. aurea* and *Ipomoea pes-caprae* resulting in a dominance of

A. coriacea. Species diversity at the CSS no active revegetation transect continues to follow a similar trend to the analogue transects.

The coastal domain has had a historically low presence of weeds since monitoring commenced in 1994, with weeds present at one analogue transect (22c); no weeds have historically been recorded at the disturbed transects that are currently monitored. Weeds were recorded for the first time since monitoring commenced in 2013 at the CSS no active revegetation transect. In 2020 weed cover was higher at the disturbed transect compared to the analogue transect, although not significantly. Further, there has been no significant change in weed cover at the analogue transect. Historically, weeds have been present at the rehabilitation transects which have now been retired from the monitoring program. This included a presence of **F. trinervia,* whereas in 2020 **C. ciliaris* was recorded; commensurate with the analogue transect.

a) Inland Domain



b) Coastal Domain

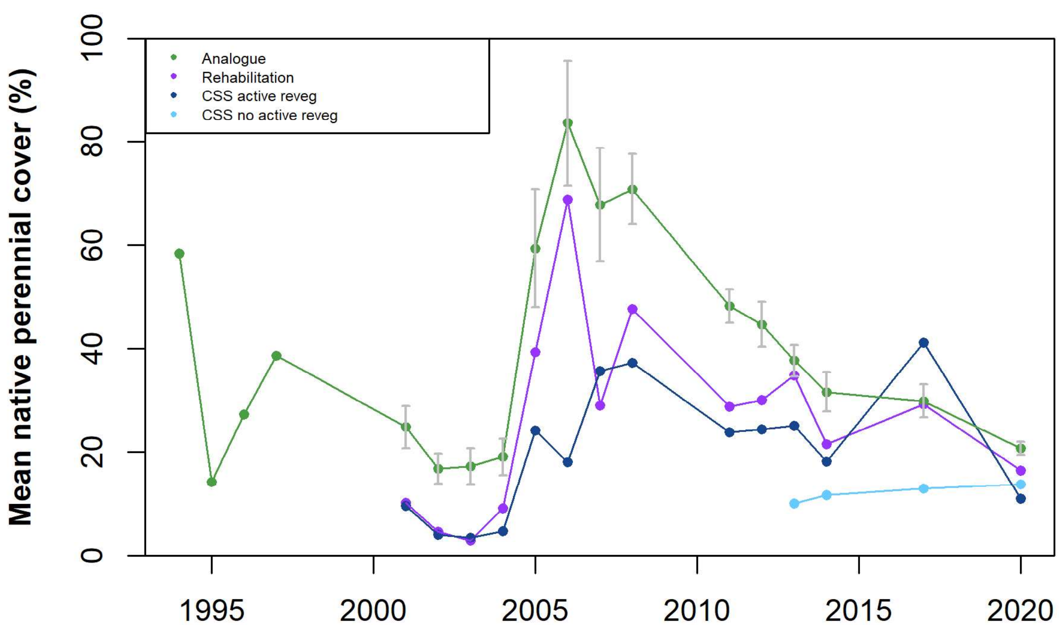
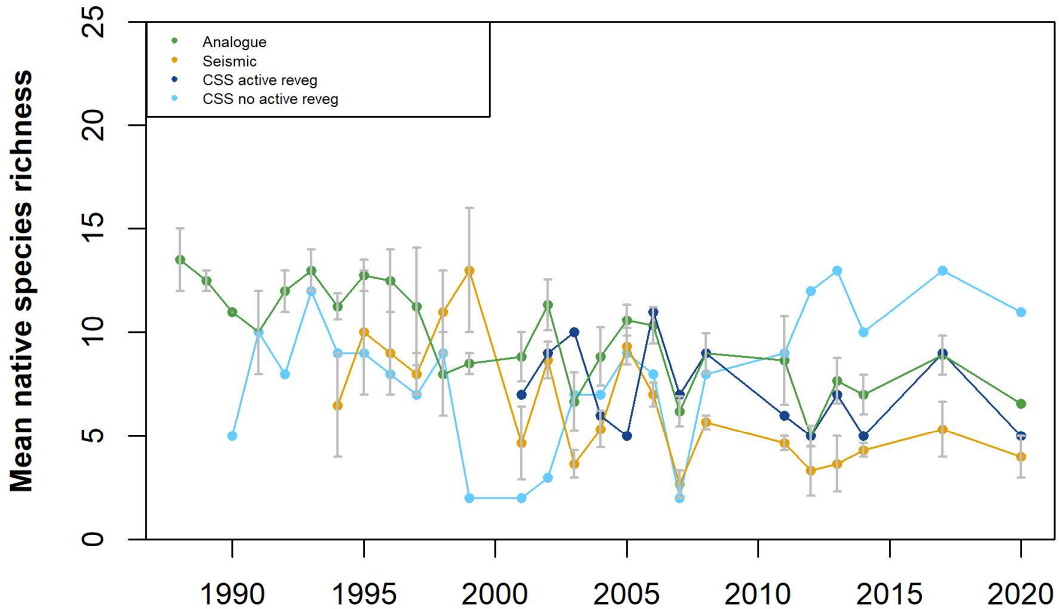


Figure 8: Mean native perennial species foliar cover (%) for analogue and disturbed transects. Error bars are standard error.

a) Inland Domain



b) Coastal Domain

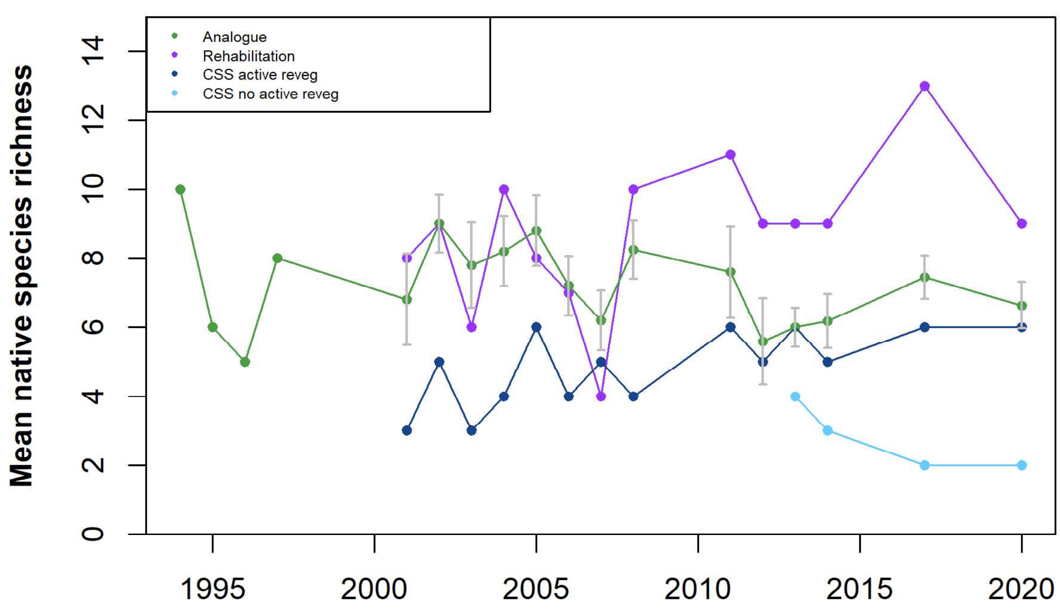
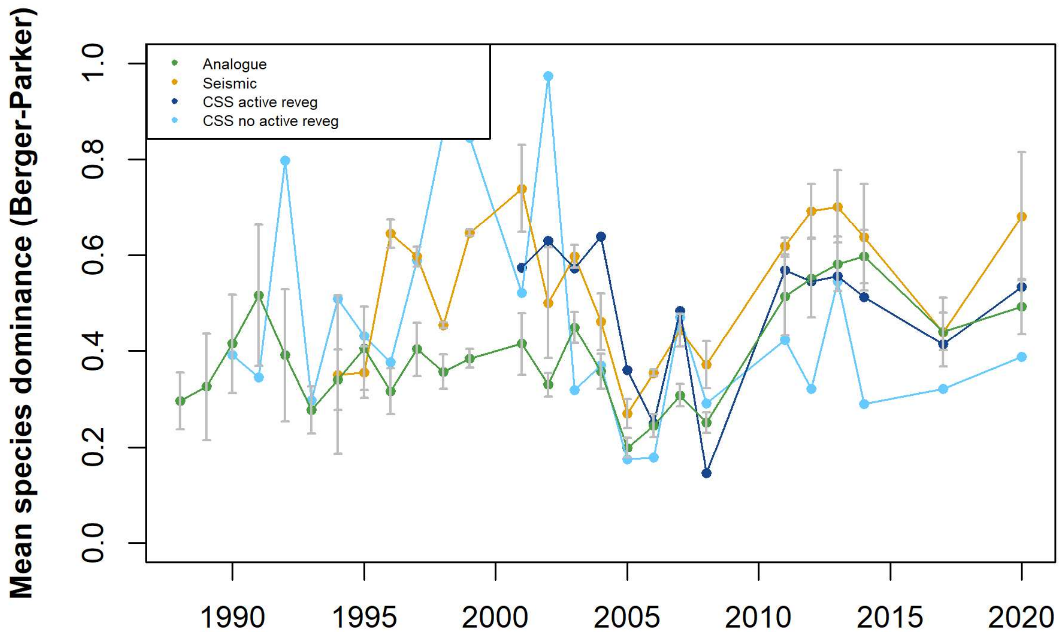


Figure 9: Mean native species richness for analogue and disturbed transects. Error bars are standard error.

a) Inland Domain



b) Coastal Domain

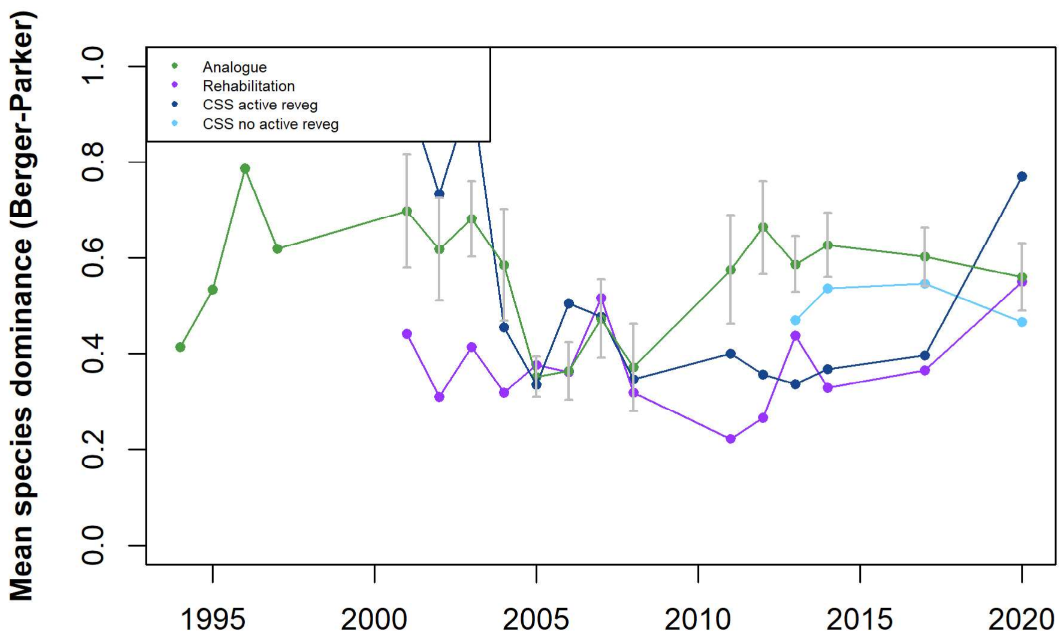
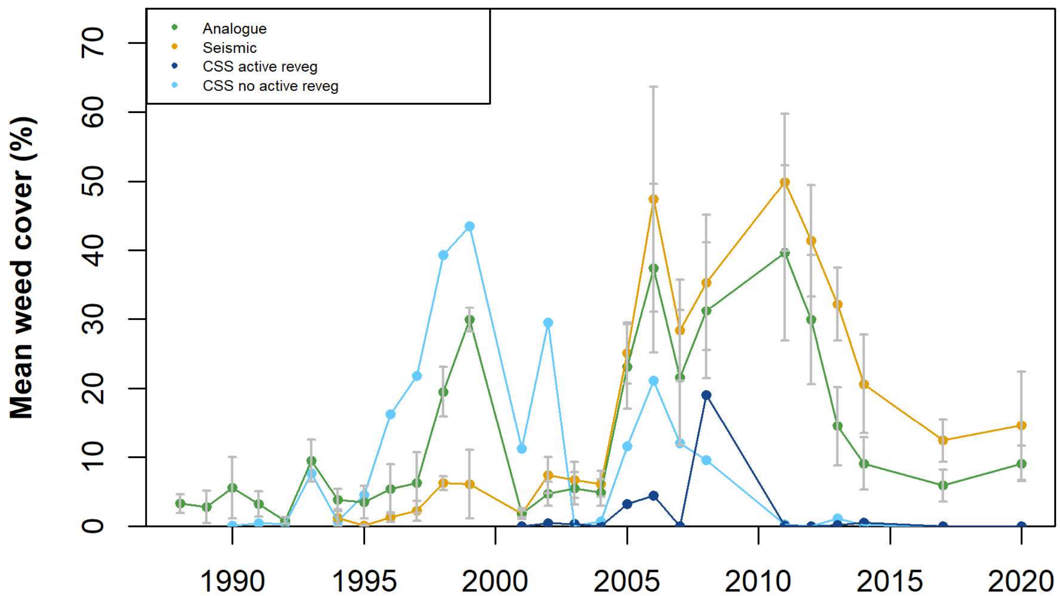


Figure 10: Mean species diversity as quantified by mean species dominance (Berger-Parker index) for analogue and disturbed transects. Error bars are standard error.

a) Inland Domain



b) Coastal Domain

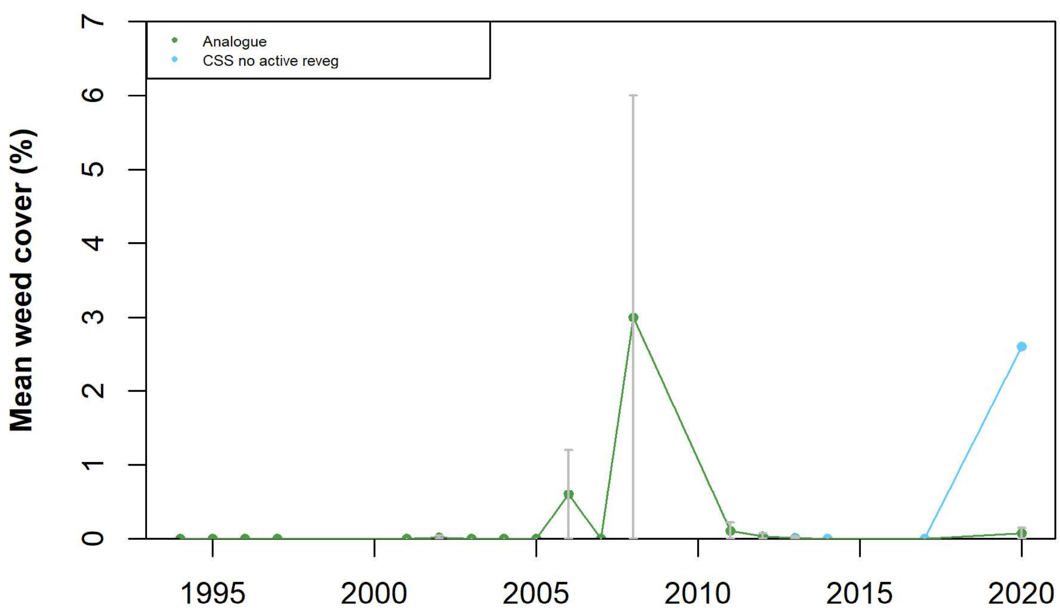


Figure 11: Mean weed species foliar cover (%) for analogue and disturbed transects. Error bars are standard error.

4.1.3 Rehabilitation Progress

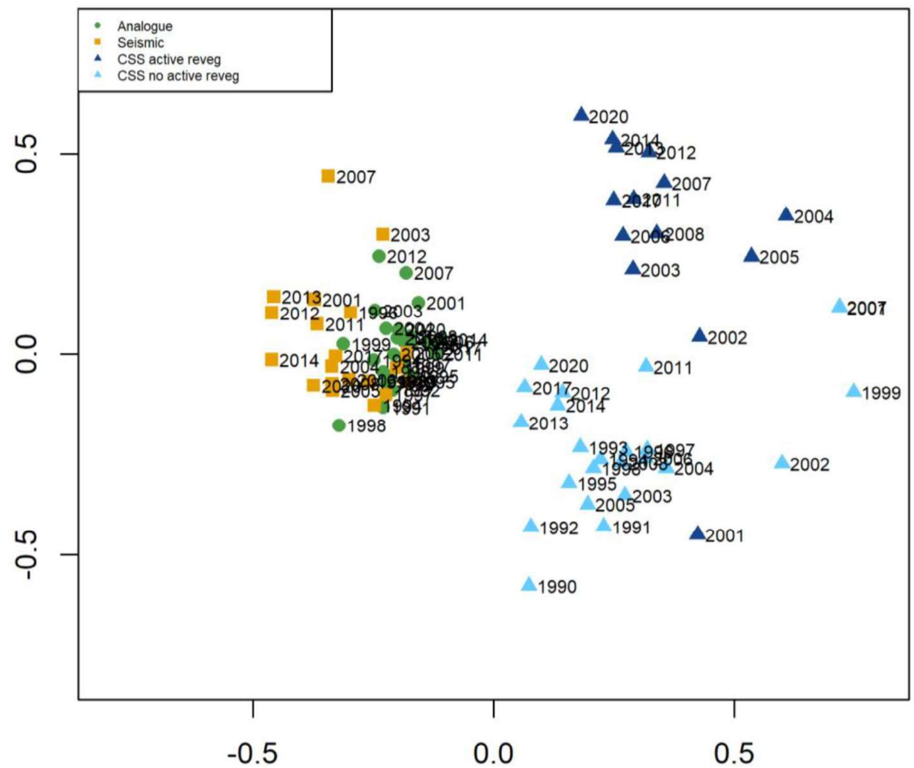
4.1.3.1 Inland Domain

Two dimensional ordination of the native species assemblage showed a distinct separation between treatment ($F_{3,228}$ = 21.94, P = 0.001) with CSS active revegetation transects clustering to the top right, CSS no active revegetation transects clustering to the bottom right, although analogue and seismic transects were more similar to each other and clustering to the left (Figure 12a). The CSS no active revegetation transects showed some signs of converging towards the native species assemblage of the analogue transects, however the CSS active revegetation transects did not. The CSS transects (both with and without active revegetation) have an absence of some key perennial species that dominate the analogue transects, such as *Acacia sclerosperma, Rhagodia pressii* and *S. spinescens.* The native species assemblage of the seismic transects was similar to the analogue transects and becoming more stable over time. These seismic transects and the analogue transects share keystone species, such as *A. coriacea, Acacia sclerosperma*, *C. viminale* subsp. *australe* and *S. spinescens* with similar cover values. This indicates that natural revegetation after seismic disturbance within the inland domain can be successful over time without active revegetation activities.

4.1.3.2 Coastal Domain

Two dimensional ordination of the native species assemblage showed a distinct separation between treatment ($F_{3,128}$ = 9.31, P = 0.001) with CSS no active revegetation transects clustering to the top left, analogue transects clustering bottom left, although CSS active revegetation transects and rehabilitation transects clustering were more similar to each other and clustering to the right (Figure 12b). The rehabilitation transect, and to a lesser extent the CSS active revegetation transect, are showing signs of converging to be similar in composition to the analogue transect. However, the CSS no active revegetation transect is not showing any signs of being similar to the analogue transects, primarily due to the consistently low species richness at the disturbed transect, rather than a difference in species assemblage. All disturbed transects have a very low cover of the dominant species in the analogue transects: *Spinifex longifolius*.

a) Inland Domain



b) Coastal Domain

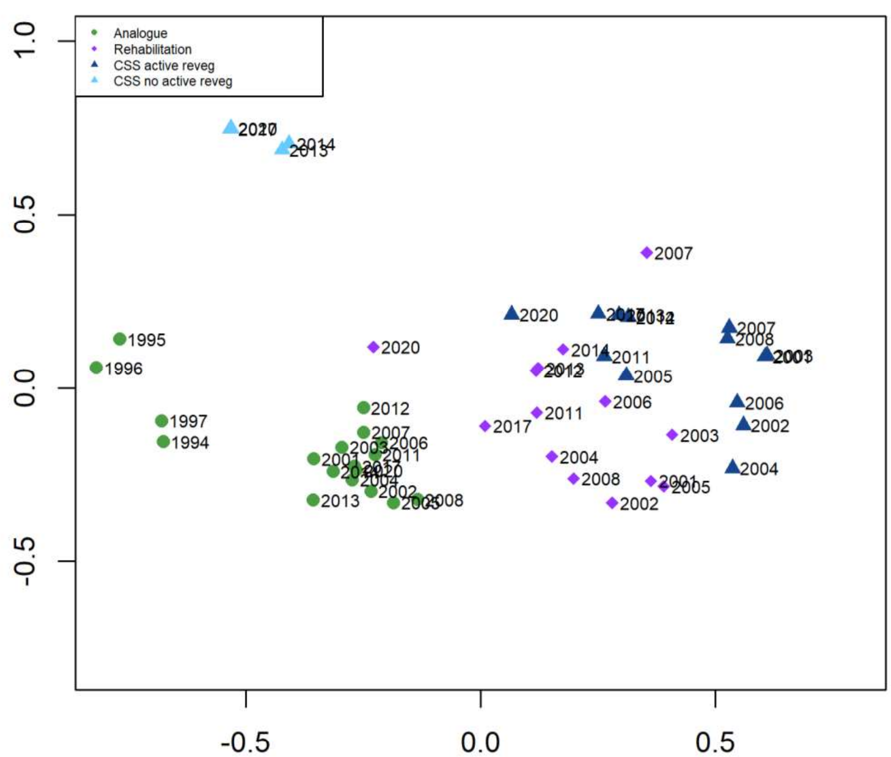


Figure 12: Two-dimensional ordination of native species assemblage composition based on multi-dimensional scaling within analogue and disturbed transects. Distances between samples are calculated using Bray-Curtis index on presence-absence data.

4.2 Fauna

4.2.1 Mammals

Since Astron began fauna monitoring on TVI in 1996, a total of 4,010 captures of *M. musculus* (2,116 on the CALM Act Lease and 1,894 on the DBCA Nature Reserve) and a total of 889 captures of *L. lakedownensis* (328 on the CALM Act Lease and 561 on the DBCA Nature Reserve) has been recorded (Appendix E). This is not a reflection of individuals as mark-capture studies only began in November 2013 (Astron Environmental Services 2013b).

Since 2013 and including the current 2020 records, 1,150 individuals of *M. musculus* (342 on the CALM Act Lease and 808 on the DBCA Nature Reserve) and a total of 310 individuals of *L. lakedownensis* (68 on the CALM Act Lease and 242 on the DBCA Nature Reserve) (Figure 13) have been recorded (Astron Environmental Services 2013b, 2014b)

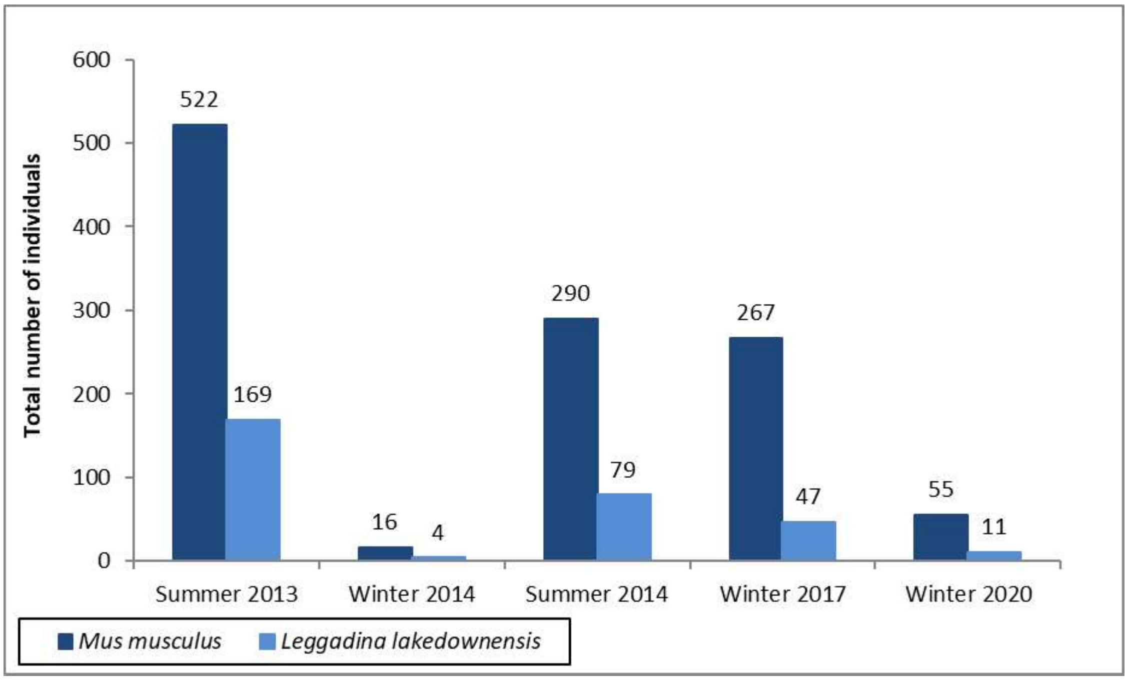


Figure 13: Total number of *Mus musculus* and *Leggadina lakedownensis* individuals recorded on Thevenard Island from 2013 to 2020.

During the current fauna monitoring survey 55 individuals of *M. musculus* (18 on the CALM Act Lease and 37 on the DBCA Nature Reserve) and a total of 11 individuals of *L. lakedownensis* (3 on the CALM Act Lease and 8 on the DBCA Nature Reserve) were recorded (Figure 14).

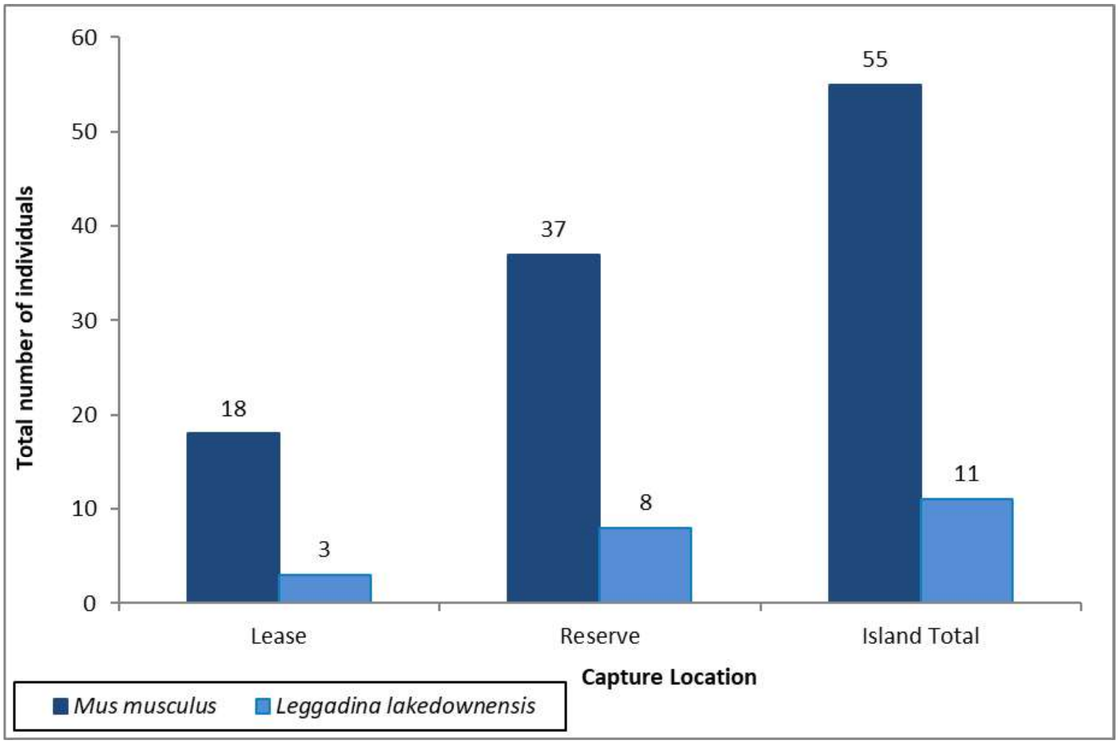


Figure 14: Total number of *Mus musculus* recorded and *Leggadina lakedownensis* individuals recorded on Thevenard Island within the CALM Act Lease and DBCA Nature Reserve during the current 2020 monitoring survey.

4.2.1.1 Spatial Trends

The 2020 rate of captures of *L. lakedownensis* in the CALM Act Lease (1.7 ± 1.0 captures) was slightly lower when compared to the DBCA Nature Reserve (2.4 ± 1.7 captures; t = 0.86, P = 0.40). Conversely, *M. musculus* had a significantly higher rate of capture in 2020 on the CALM Act Lease (14.4 ± 8.0 captures) compared to the DBCA Nature Reserve (11.7 ± 29.8 captures; t = 3.64, P = 0.002), despite the CALM Act Lease having a lower total number of captures and individuals.

Captures rates differed between *L. lakedownensis* and *M. musculus* over a range of buffel grass (**C. ciliaris*) cover in 2020 (Figure 15). There was no statistically significant influence of buffel grass density on *M. musculus* trap rates, but there was a statistically significant influence of buffel grass density on *L. lakedownensis* trap rates ($F_{1,10}$ = 12.05, P = 0.006), with more captures within the highest buffel grass density (Figure 15). However, from 2013 to 2020 for which buffel grass cover is available, capture rates were similar for both rodent species with no statistically significant influence of buffel grass density on trap rates.

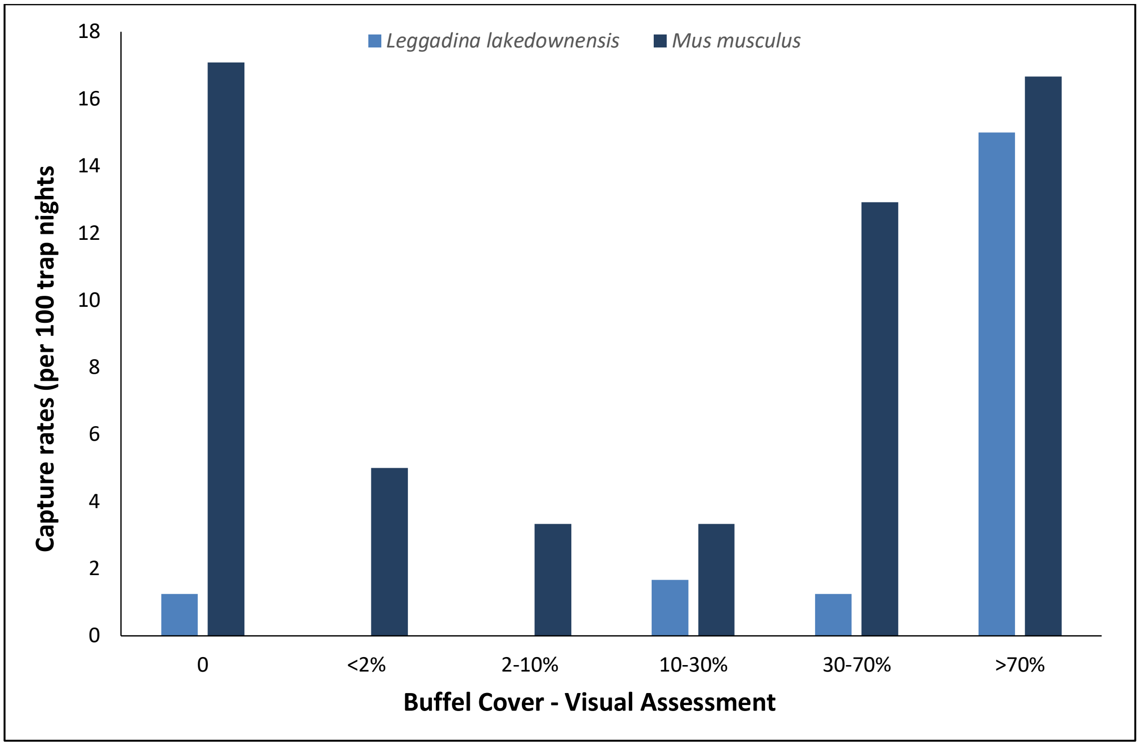


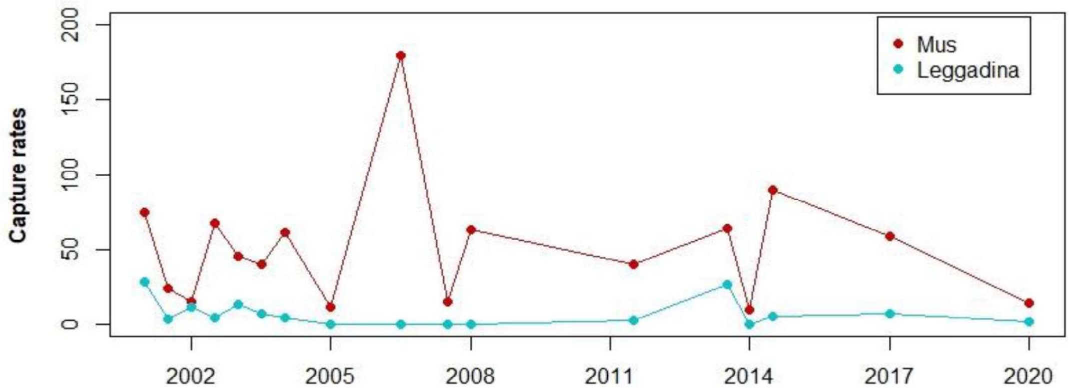
Figure 15: Trap success in levels of buffel grass cover (standardised for trap effort) for both rodent species in 2020.

4.2.1.2 Temporal Trends

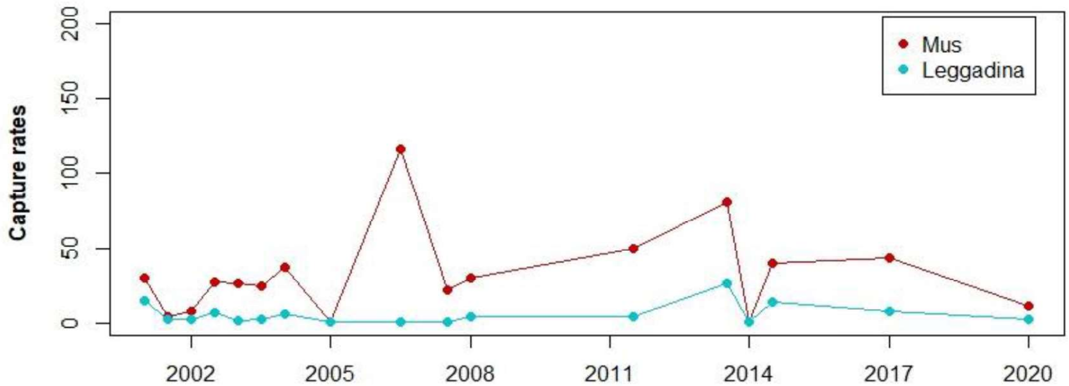
The mean trapping rate of *L. lakedownensis* in 2020 was 2.2 individuals per 100 trap nights of effort. For comparison with the last monitoring survey, the mean trapping rate of *L. lakedownensis* in 2017 was 7.8 individuals per 100 trap nights of effort. In the context of the historical rates of captures for *L. lakedownensis,* the low rate of capture recorded in 2020 has been observed in previous years including winter 2005, 2008 and 2014, and summer 2007 and 2008 (Figure 16). There were also times of high rates of capture in winter 2001 and summer 2013, which suggests a strong boom-bust population cycle.

Both *M. musculus* and *L. lakedownensis* capture rates showed similar trends in both the CALM Act Lease and DBCA Nature Reserve, and hence were modelled across the whole island as a single dataset. *M. musculus* capture rates modelled over time exhibited a significant trend over time, showing a strong cyclical boom-bust cycle of approximately five years (Figure 17). *Leggadina lakedownensis* capture rates modelled over time also showed a significant trend over time, however, it was not the boom-bust cycle like that of *M. musculus.* Instead, it appears there was a significant crash in *L. lakedownensis* numbers at the peak of *M. musculus* numbers in 2006, and then *L. lakedownensis* numbers have slowly recovered to a peak in summer 2014, before remaining fairly stable (Figure 17).

a) CALM Act Lease



b) DBCA Nature Reserve



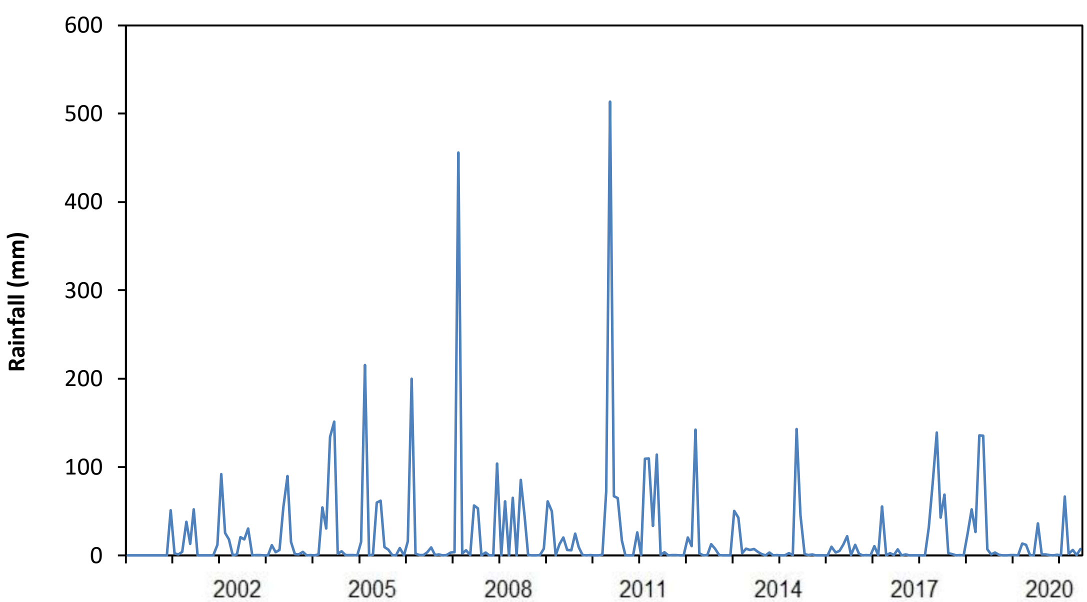
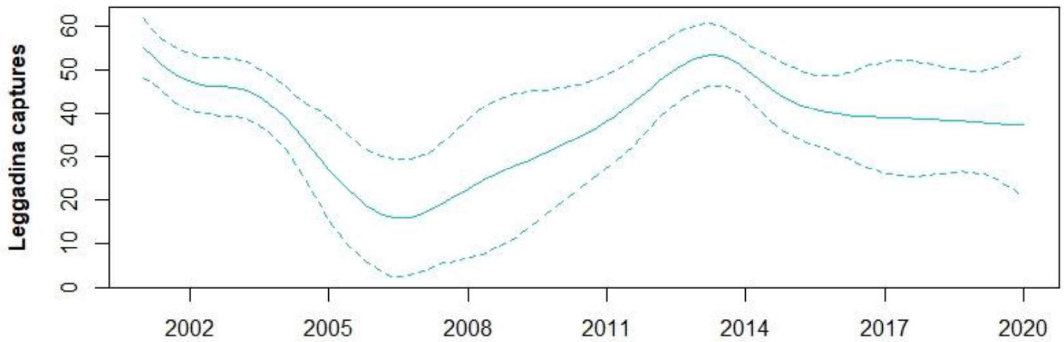
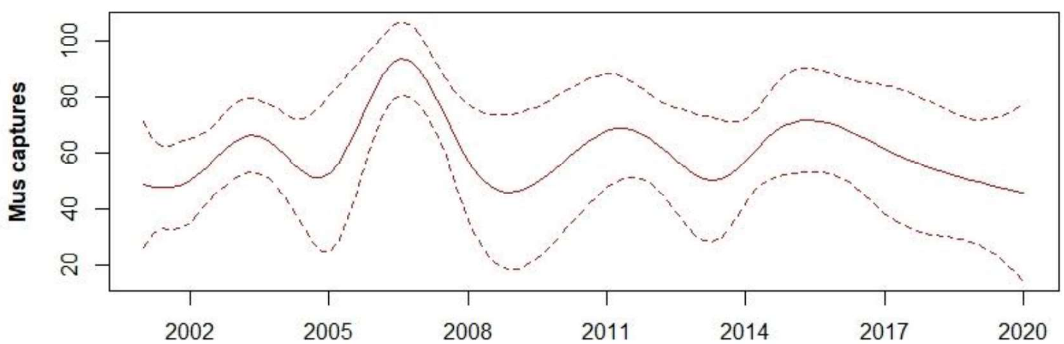


Figure 16: Changes in *Mus musculus* capture rates (red) and *Leggadina lakedownensis* capture rates (blue) over time on the CALM Act Lease (a) and DBCA Nature Reserve (b). Total monthly rainfall for the Thevenard Island-Onslow region is shown in (c). Values are adjusted to density per 100 trap nights. Note different scales on graphs.





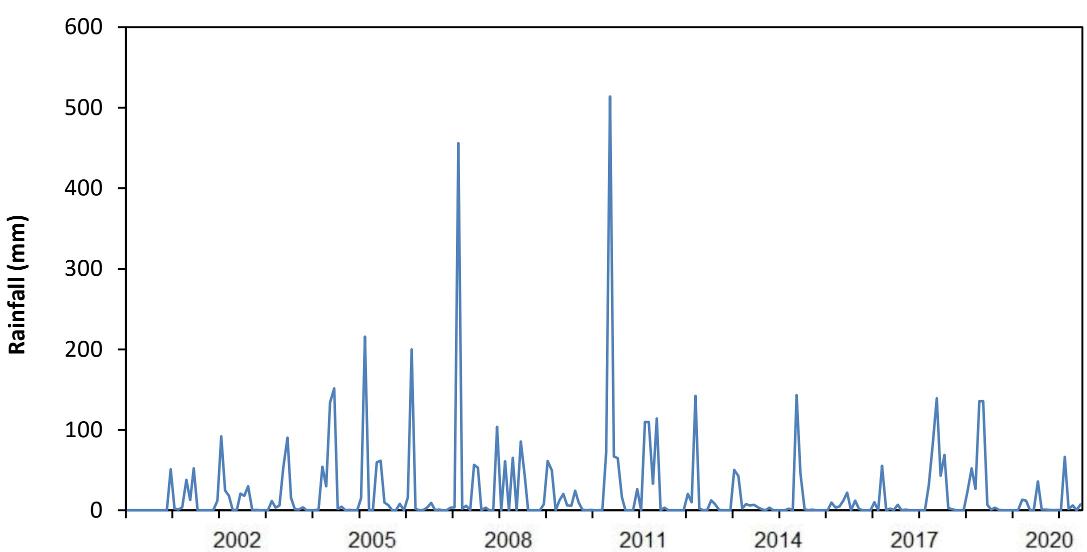


Figure 17: *Leggadina lakedownensis* (blue) and *Mus musculus* (red) capture rates modelled over time across the whole island Values are adjusted to density per 100 trap nights. Dotted lines are the 95% confidence intervals. Note different scales on graphs.

Rodent abundance in arid Australia is often linked with rainfall events over the preceding period (Dickman et al. 1989). Analysis of trap captures (per 100 nights) between 2001 and 2020 as a response to drought factor index, KBDI and *M. musculus* trap success showed a drought factor x *M. musculus* interaction which explained 70.1% of the variation in *L. lakedownensis* trap success (Table 5). *L. lakedownensis* trap success rates were negatively correlated with both *M. musculus* trap rates and with the drought factor index (Table 5).

Table 5: Model summary for *L. lakedownensis* capture rates over time.

Term	Estimate	Standard error	P-value
Intercept	11.70	6.11	0.07
M. musculus	-0.25	0.08	**0.01**
Drought Factor	-1.13	0.63	0.09
M. musculus x Drought Factor interaction	0.03	0.01	**0.005**

The relationship between *L. lakedownensis* and *M. musculus* capture rates was significant (P = 0.01), indicating that the most influential factor determining *L. lakedownensis* captures is the number of *M. musculus.* Across the island, *L. lakedownensis* captures were positively correlated with *M. musculus* up to a trapping rate of approximately 80 *M. musculus* (Figure 18). With more than 80 *M. musculus*, *L. lakedownensis* trap rates declined.

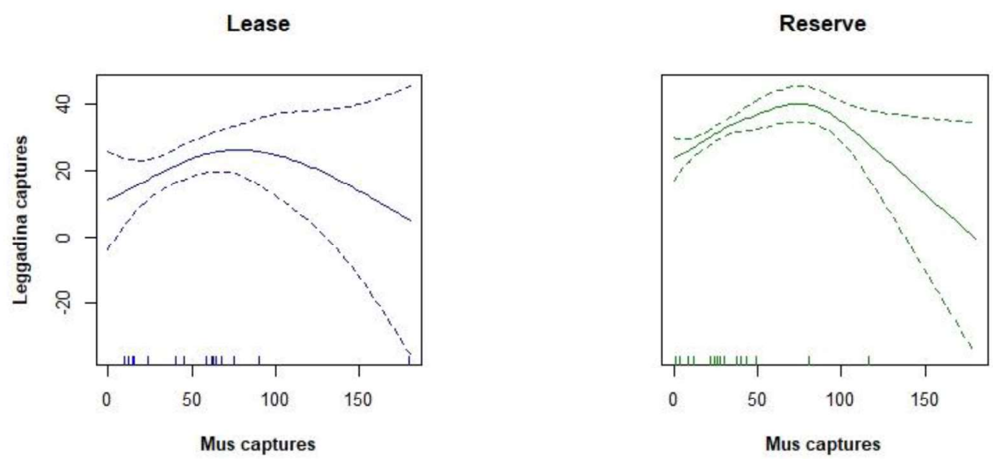


Figure 18: *Leggadina lakedownensis* capture rates modelled over time against *Mus musculus* capture rates within the CALM Act Lease (left, blue) and DBCA Nature Reserve (right, green). Values are adjusted to density per 100 trap nights. Dotted lines are the 95% confidence intervals, tick marks inside x axis indicate data points used in analysis.

The negative interaction with the drought factor index was not quite statistically significant (P = 0.09), but the fact that the drought factor term excluded the KBDI term in the model implies that rodents may respond rapidly to rainfall events. *L. lakedownensis* capture rates were more responsive to soil moisture deficits, which occur more quickly following significant rainfall than vegetation moisture deficits as measured by KBDI. For the majority of monitoring events the drought factor on TVI was at the maximum value of 10, with exceptions in June 2002, June 2005, February 2006 and May 2008. There was a significant *M. musculus* by drought factor interaction, whereby when *M. musculus* increases over 80 captures *L. lakedownensis* appears to respond positively to higher drought index (Figure 19), indicating that the relationship between the rodent species and environment on TVI is complex. At longer time scales, a five-year cyclical trend in *M. musculus* capture rates was observed, however it appears that the rodents may respond more rapidly to rainfall events. This five-year trend may be more an artefact of the frequency of monitoring, given monitoring has been triennial since

2008. It is likely that rodent numbers are fluctuating at a finer scale than the frequency of current monitoring.There have also been changes to the monitoring program over time, including removal of *M. musculus* from the island at certain times during the monitoring (and ceased in 2016) and the transition to triennial monitoring in recent years, which is likely to affect any analysis of the relationship between rodent abundance and rainfall/drought factors.

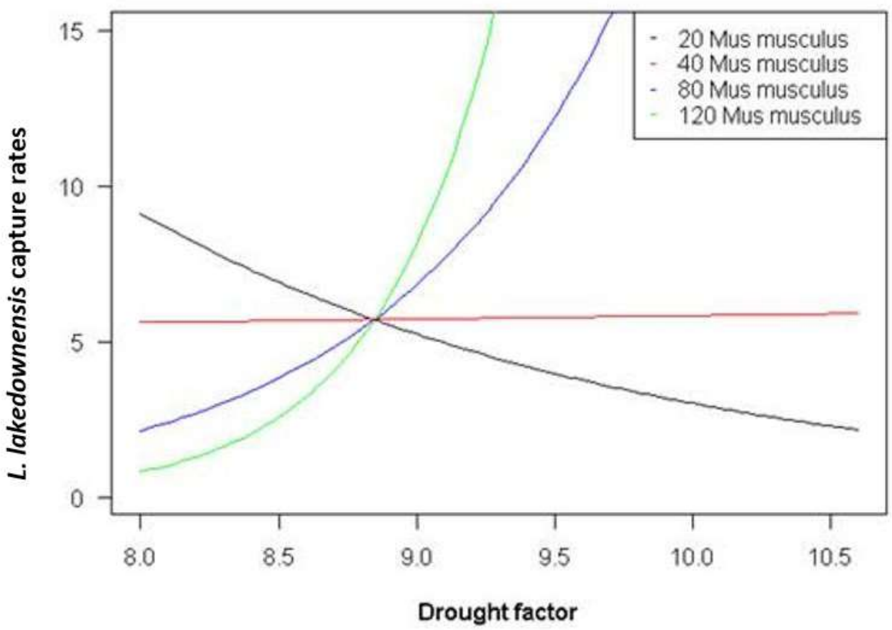


Figure 19: *L. lakedownensis* capture rates modelled against the drought factor index with simulated *M. musculus* numbers.

4.2.2 Reptiles

Seven out of eight reptile species previously recorded since 2002 were trapped during the June 2020 monitoring (Table F.1 and F.2, Appendix F). These included *Ctenotus saxatilis* (rock ctenotus), *Lerista clara* (previously *L. muelleri*), *Heteronotia binoei* (Bynoe's gecko), *Gehyra variegata* (variegated tree dtella), *Menetia greyii* (Grey's skink), *Varanus acanthurus* (spiny-tailed monitor) and *Amphibolurus gilberti* (Gilbert's dragon). *Delma tincta* (Excitable delma) was not recorded. *Lerista bipes* was also not recorded during the June 2020 survey and has not been recorded on TVI since 1985 (Appendix F). Recently a revision of the *Lerista* genus determined that *L. muelleri* is now considered *L. clara* on TVI (Smith and Adams 2007). A specimen lodged at the WAM in 2017 was confirmed as *L. clara* (WAM reference number R176533).

Species richness, abundance and diversity was similar between the CALM Act Lease and DBCA Nature Reserve. Total reptile species richness did not significantly change over time for either the CALM Act Lease or DBCA Nature Reserve (Figure 20a). Species diversity was found to significantly increase over time on the DBCA Nature Reserve (F = 5.74, P = 0.031) but not on the CALM Act Lease (Figure 20b). Reptile diversity was found to be significantly positively correlated with rainfall received in the preceding three, six and 12 months, with the most significant correlation being rainfall received six months prior to surveys (Kendall's Tau = 0.42, P = 0.024).

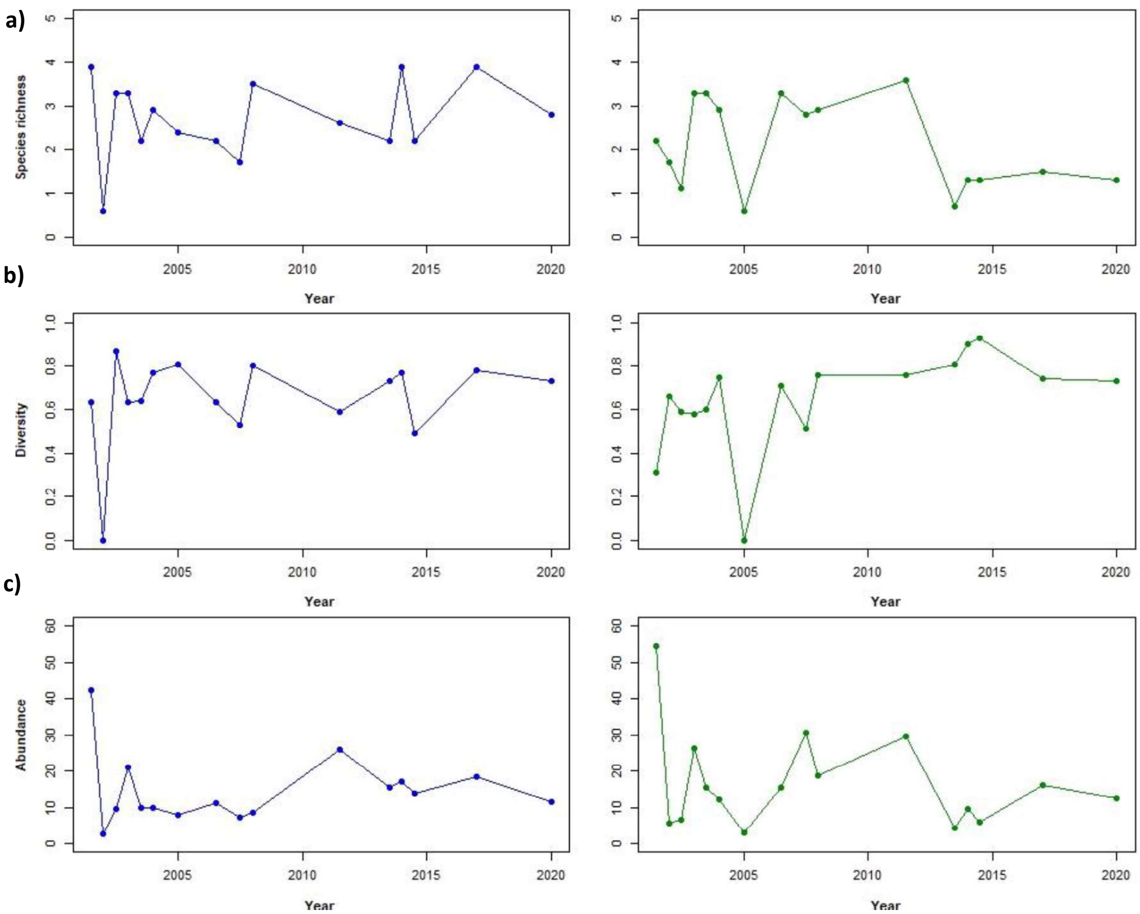


Figure 20: Changes in species richness (a), species diversity (Simpson's Index) (b) and total captures (abundance) (c) over time on the CALM Act Lease (left, blue) and DBCA Nature Reserve (right, green).Values are adjusted to density per 100 trap nights.

Total abundance (total number of captures) did not significantly change over time for either the CALM Act or DBCA Nature Reserve (Figure 20c). For the majority of species, there were no significant temporal changes in abundance for the CALM Act Lease and DBCA Nature Reserve plots, with the exception of one species (Figure 21). *Gehyra variegata* was found to significantly increase over time on the CALM Act Lease ($t = 2.53$, $P = 0.02$; Figure 21d).

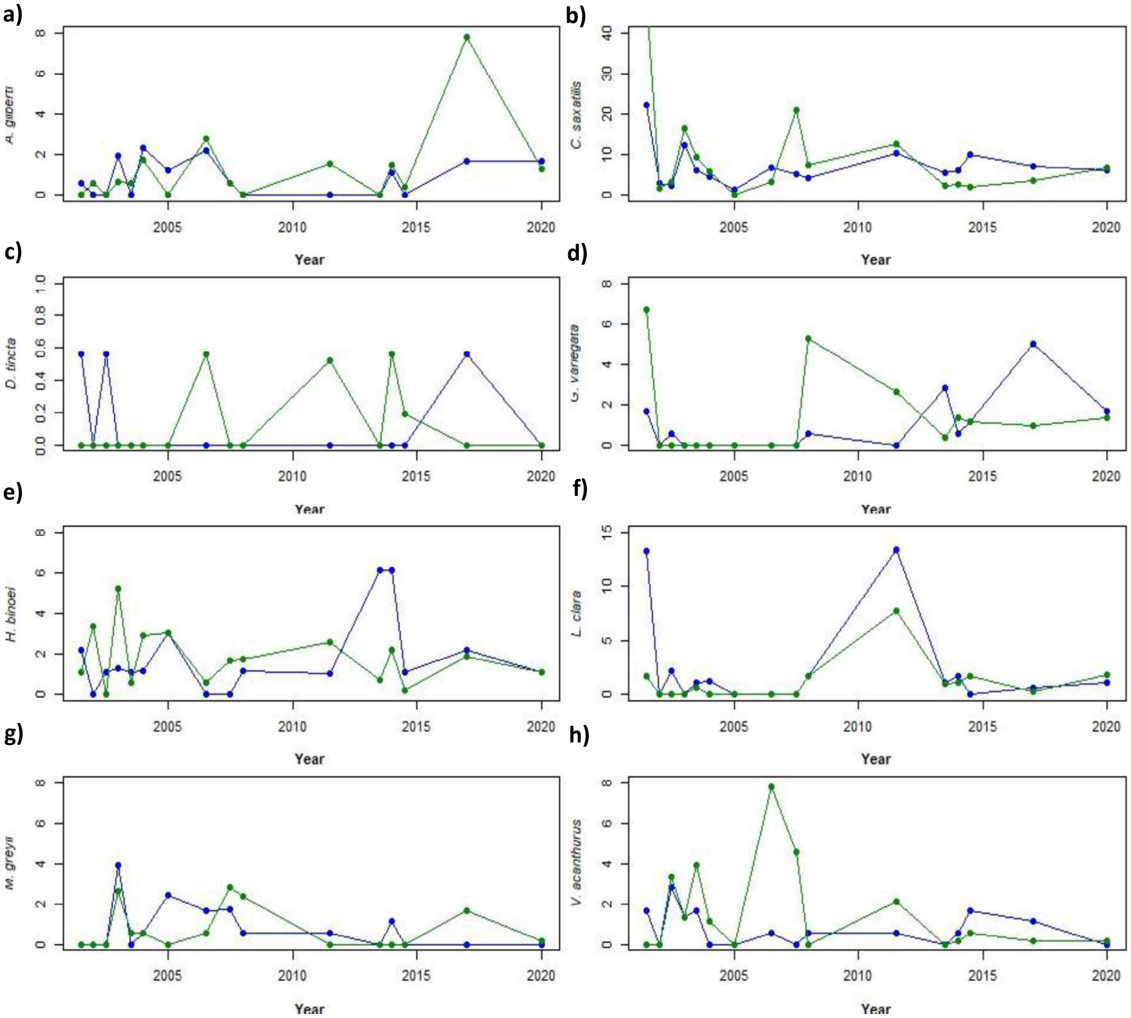


Figure 21: Changes in abundance of *Amphibolurus gilberti* (a), *Ctenotus saxatilis* (b), *Delma tincta* (c), *Gehyra variegata* (d), *Heteronotia binoei* (e), *Lerista clara* (f), *Menetia greyii* (g) and *Varanus acanthurus* (h) on the CALM Act Lease (blue) and DBCA Nature Reserve (green). Values are adjusted to density per 100 trap nights.

4.2.3 Birds

Since 1996, a total of 74 avian species have been observed on TVI (Appendix C), inclusive of the two new species recorded for this fauna survey; *Cacatua sanguinea* (pallid cuckoo) and *Rhipidura albiscapa* (grey fantail). The current survey recorded 33 species, representing 45% of the bird species known for TVI. Most of the species recorded were common for TVI; some exceptions include *Cinclorhamphus mathewsi* (rufous songlark), *Sterna dougallii* (roseate tern) and *Cacatua sanguinea* (little corella) which are common for the mainland but are infrequently recorded upon TVI.

One species, the fairy tern, *Sternula nereis nereis*, is listed as Vulnerable under the EPBC Act and Vulnerable under the BC Act. Three records of this species (2, 3 and 7 individuals each) were recorded on the shoreline and/or coastal areas on the northside of the island in the DBCA Nature Reserve. A further three species, *Pandion cristatus* (eastern osprey), *Sterna nilotica* (gull-billed tern) and *Sterna bergii* (crested tern) are all listed as Migratory under the EPBC Act and BC Act. A total of 14 eastern osprey nests were recorded: three collapsed, seven intact but empty and four active nests with eggs. Of the four active nests, three nests contained four eggs and one nest had two eggs.

4.2.4 Non-indigenous Species

Other than *M. musculus* (house mouse), no additional feral or non-indigenous vertebrate fauna species were recorded during the June 2020 monitoring.

5 Conclusions

5.1 Flora and Vegetation

Since monitoring commenced on TVI in 1987, the vegetation has undergone considerable change in native perennial cover, species richness and diversity, with an observed increase in the dominance of **C. ciliaris*, and consequent decrease in native species cover, richness and diversity, more so at the inland domain. No new weed species and no further introductions of weed species to TVI were detected during the 2020 monitoring survey, although mean weed cover has increased from 2017 levels at the seismic transects, after a declining trend had been observed since 2011 within the inland domain. Few weeds have ever been recorded within the coastal domain, however in 2020 the first record of **C. ciliaris* was recorded at a single disturbed transect. The overall increase of **C. ciliaris* across TVI, especially within the DBCA Nature Reserve, is highly likely to inhibit successful revegetation activities in the absence of on-going weed management.

Increased activity on the island as part of the TVIR project has had an impact on two inland vegetation monitoring transects, which were completely removed and another that was partially disturbed since the 2017 monitoring survey. The disturbance of these transects may be influencing the trends observed for native perennial cover, species richness and diversity which has generally declined since 2017 for the analogue and disturbed transects within the inland domain. The trends in recent years for native perennial cover observed in most monitoring transects within both the inland and coastal domains is likely related to the response of individual species to between year variation in rainfall. Below average rainfall for the preceding three years has likely attributed to the observed decline in perennial cover, species richness and diversity since 2017 along with an increase in the abundance of **C. ciliaris* which, during a dry period when it has died back to rootstock, is not well reflected in the cover assessments within transects, but which does influence species diversity.

Native perennial cover at the disturbed transects was similar to the analogue transects in 2020, however analogue transects generally have significantly higher cover compared to all other treatments at both domains. Continued monitoring is required to determine if the disturbed transects are maintaining similar cover to the surrounding native vegetation. The monitoring program has shown that successful vegetation establishment can be achieved both with and without active revegetation, but that it may take several decades. For the inland domain, the CSS transect without active revegetation had the highest native species richness and species diversity of all disturbed transects and is showing signs of converging towards the analogue transects in terms of native species assemblage. The CSS transects with active revegetation displayed similar trends to the analogue transects for cover, richness and diversity, but are the least similar in native species assemblage compared to the other treatments. The seismic transects had low species richness and diversity due to weed invasion. Within the coastal domain, the CSS transect without active revegetation had similar diversity to the analogue transects but had the lowest species richness of all transects and showed no signs of becoming similar in terms of native species assemblage. This transect also recorded its first presence of **C. ciliaris*, with higher cover than the analogue transect. The CSS transect with active revegetation had similar species richness to the analogue transects in 2020, but low diversity due to a decline in the cover of two key perennial species. The coastal rehabilitation transect continues to have the highest native species richness of all treatments, and consistently has a high species diversity.

Although native perennial cover, species richness and diversity at the disturbed transects are becoming similar to the analogue transects, ordination of the native species assemblages demonstrate that this has only been consistently achieved for the inland seismic transects. These treatments share keystone species. The CSS transects across both domains have an absence of some key perennial species that are dominant within the analogue transects. Coastal CSS transects with active revegetation were more similar to the analogue transects, whilst inland CSS transects without active revegetation were more similar.

5.2 Fauna

In the context of the historical rates of captures, the rate of capture for *L. lakedownensis* recorded in 2020 was low but similar values have been observed in previous years including winter 2005, 2008 and 2014, and summer 2007 and 2008. Large changes in capture rates and a lack of trend over time for the two species of mammals found on TVI over the lifetime of the monitoring program are possible evidence of a strong boom-bust population cycle; however, this boom-bust response is occurring at a much faster time scale than the frequency of monitoring. All historical trapping data and the PVA conducted in 2014 support this (Astron Environmental Services 2013b, 2014b, 2017). It has been suggested that the *L. lakedownensis* population fluctuations are related to the abundance of *M. musculus* (Moro and Morris 2000), that is, high numbers of *M. musculus* were shown to coincide with low numbers of *L. lakedownensis*. The monitoring data agreed with Moro and Morris (2000) that the number of *M. musculus* is the most significant factor affecting *L. lakedownensis* numbers; however, analysis of the monitoring data show that a positive correlation exists between both these species up to a capture rate of around 80 individuals of *M. musculus*. With more than 80 *M. musculus* then *L. lakedownensis* trap rates decline in the both the DBCA Nature Reserve area and the CALM Act Lease area, with the rate more pronounced in the DBCA Nature Reserve. This suggests that potentially resource availability is the major constraint to population numbers before any competition between the species would take place. That is, both species respond similarly to the resource availability pulse resulting from episodic rainfall events.

Analysis also showed a negative association of *L. lakedownensis* capture rates with the drought factor index (but not KBDI) indicating that rodents may respond rapidly to rainfall events and it may be more a case of rainfall timing rather than just the amount. There was also a *M. musculus/*drought factor interaction, indicating that the relationship between the two rodent species and drought/rainfall (and hence resource availability) is complex. The transition to triennial monitoring in recent years, is likely to affect any analysis of the complex relationship between rodent abundance and rainfall/drought factors given the monitoring data suggests that they respond rapidly to episodic rainfall events

Buffel grass does not seem to be a factor in *L. lakedownensis* capture rates and in fact, 2020 trap rates for *L. lakedownensis* were higher in areas of high buffel grass cover. This is somewhat contrary to the majority of studies conducted on other fauna species that mostly indicate a negative relationship between native fauna diversity and/or abundance and buffel grass (Eyre et al. 2009, Smyth et al. 2009, Marshall et al. 2012, Young and Schlesinger 2015).

In contrast to the two rodent species, very little change has been observed in overall species richness and abundance in reptiles on TVI since Astron commenced fauna monitoring in 1996. In addition, very little change has been seen between the CALM Act Lease and DBCA Nature Reserve areas. All reptile species that have been previously recorded on TVI in the past ten years were captured during this survey, aside from *D. tincta* and *L. bipes*. The latter species has not been recorded on TVI since 1985. Species richness and abundance for reptiles across all monitoring surveys have generally not differentiated between sites on the CALM Act Lease and on the DBCA Nature Reserve with exceptions being *G. variegata* which was found to significantly increase over time on the CALM Act Lease and species diversity was found to significantly increase over time on the DBCA Nature Reserve. Much of the changes or fluctuations in reptile diversity and abundance are potentially a response to climatic changes such as rainfall. Reptile diversity was found to be significantly positively correlated with rainfall received in the preceding six months. Higher rainfall is likely to contribute to an increase in vegetative cover on TVI and food availability such as invertebrate species, thus providing more suitable habitat for reptile species.

During the 2020 monitoring, 33 bird species were recorded representing 45% of the 74 bird species known for TVI. It is expected that not all bird species will be present on the island at the time of survey, given that the majority of bird species for TVI are migratory waders and are only seen seasonally. These seasonal migrants would only be present on TVI during the southward or northward journeys of their annual migration. As the survey was conducted during June, outside of the known presence for these species due to the normal migration patterns, the low number of waders recorded is not largely unexpected. Thevenard Island continues to provide a staging and roosting location for migratory conservation significant waders and seabirds, particularly the eastern osprey.

No additional feral or non-indigenous species to TVI were detected during the 2020 monitoring.

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Appendix A: History of Terrestrial Monitoring on Thevenard Island

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Flora and Vegetation

Establishment of flora and vegetation monitoring commenced on TVI in 1987 with the instalment of four baseline transects by Dinara Pty Ltd to assess the impact of construction. Astron Engineering Pty Ltd continued this monitoring in 1988. In 1990 and 1994 two additional transects were installed by Astron to monitor plant regrowth on a disturbed area within the CALM Act Lease where concrete had been incorporated into the soil. Further seismic activity in 1993 prompted the installation of additional transects to monitor any impacts caused by this activity. A revegetation program commenced in 1999 and was monitored against additional control transects in the Parks and Wildlife Lease. In 2013, 14 additional transects were established by Astron to provide baseline information on vegetation associations that were not represented or under-represented by the existing transects and to monitor the spread and impact of **Aerva javanica* (kapok). With the addition of these transects there are at least three transects in areas without impacts of operations in every vegetation association that would have been present in the Lease prior to the development.

Flora and vegetation monitoring was not undertaken in 2000, 2009 and 2010.

Fauna

Chevron has conducted a fauna monitoring program on TVI since 1988. Astron has carried out the monitoring program since 1996, during which time the field techniques and survey design has undergone significant changes. This has occurred largely in the trapping design, which was generally targeting ground-dwelling vertebrate species, specifically the murids *Leggadina lakedownensis* and the introduced house mouse, *Mus musculus*. The changes occurred in the number of sites, location of sites and design of grids or arrays during the life of the monitoring period. The changes over time are a result of improvements and efficiencies of fauna surveying in the corresponding period. However pitfall traps and Elliot box traps were used consistently across the monitoring period. Little design changes have occurred in the avian fauna census for the duration of the monitoring program as generally most of the records were opportunistic in nature.

Previous to 1996 four pit trap lines were located next to Astron vegetation monitoring sites and had been in operation since 1988. In May 1996 a further set of pit traps were installed in a rehabilitation area next to vegetation transects, incorporating Elliot traps on an ad hoc nature. Since 1996 each pit line has five 20 litre (L) plastic buckets as traps each 5 m apart with a 30 centimetre (cm) high wire mesh drift fence. Additional sites using Elliot box traps were placed in a targeted rather than systematic order. Between 1996 and 2001 fauna monitoring surveys were undertaken biannually in the winter and summer months. Winter monitoring was undertaken between May and July, following the summer rainfall season. Summer monitoring was undertaken in October or November, at the end of the dry winter months and before summer rainfall.

In 2001 a more strategic and repeatable approach was developed with six trapping grids. Three trap sites were situated within the CALM Act Lease and three trap sites were situated on the Parks and Wildlife Nature Reserve. Each trapping grid was comprised of two rows of five pitfall traps and five Elliot traps set at 20 m intervals (Figure A.1). Each row was located approximately 20 m apart where each pitfall trap had its own drift-fence length of 10 m. The frequency of the monitoring surveys varied considerably; between 2001 and 2003 surveys were undertaken biannually, then biennially till the winter survey in 2008, and once in the summer of 2011. Monitoring was not undertaken in 2009, 2010 and 2012.

In 2013 the trapping array design was reduced to five pitfall traps per site with one continuous drift fence. The number of trapping sites was increased to 12 sites; comprised of three re-established sites on the CALM Act Lease and nine new sites within the Parks and Wildlife Nature Reserve (Figure

A.2). At this stage two summer (November 2013, October 2014) and three winter (May 2014, May 2017, June 2020) surveys have been completed utilising this improved design.

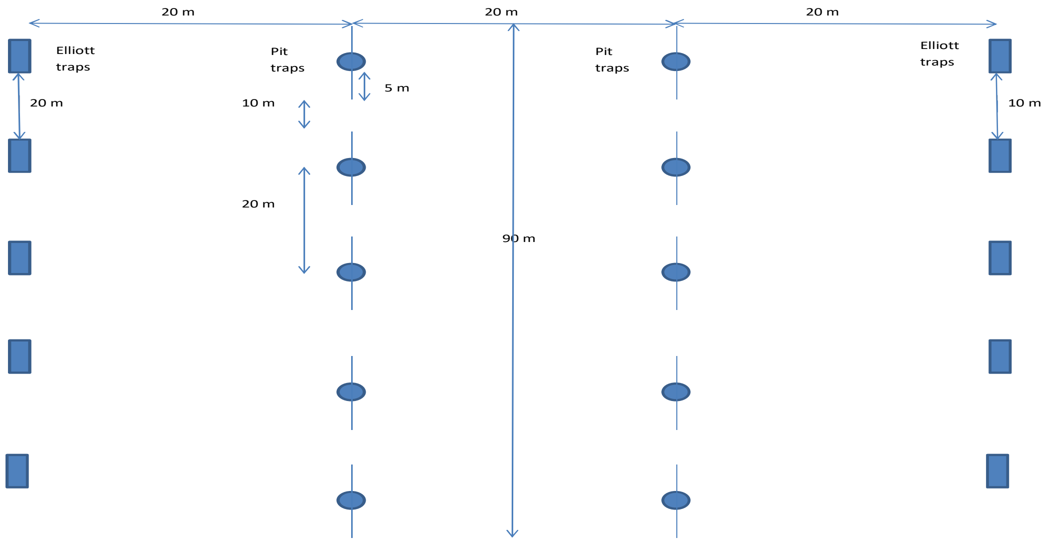

Figure A.1: Schematic of trapping site layout from 2001-2013 (not to scale).

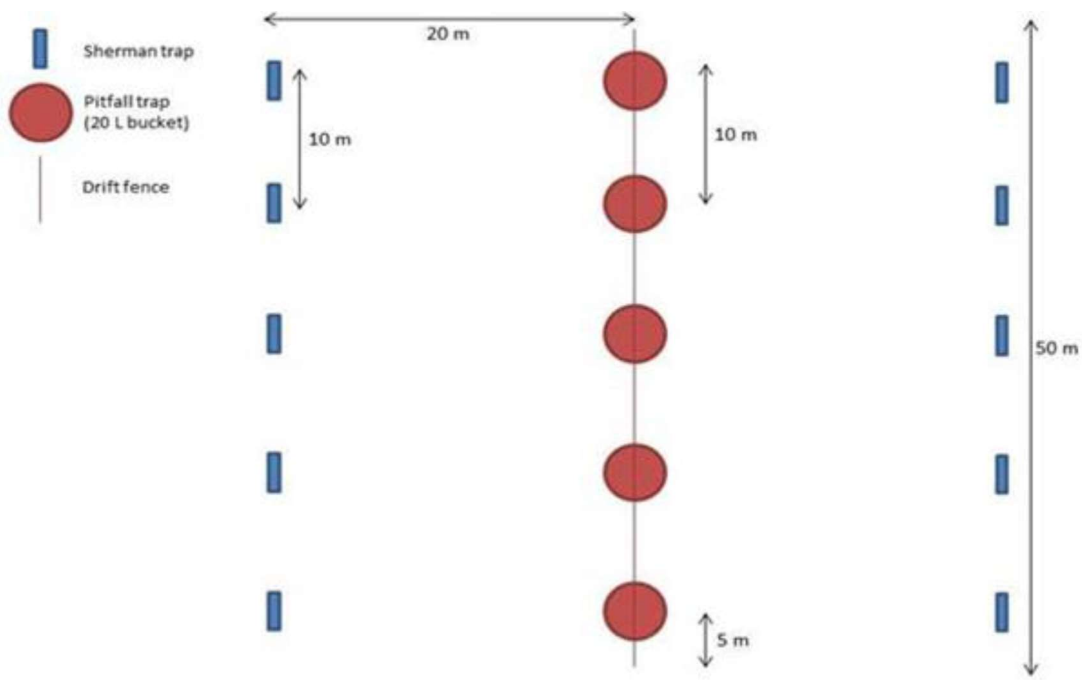

Figure A.2: Schematic of trapping site layout from 2013 - present (not to scale).

Appendix B: Thevenard Island Vascular Flora Species List and Year by Species Matrix (1987 to 2020)

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Table B.1: Thevenard Island vascular flora species list (1987 to 2020).

Family	Species	Recorded in transects 2020	Recorded opportunistically 2020
Aizoaceae	*Carpobrotus* sp. Thevenard Island (M. White 050) P3	✓	
	Sesuvium portulacastrum		
Amaranthaceae	**Aerva javanica*	✓	✓
	Amaranthus undulatus	✓	✓
	Ptilotus villosiflorus		✓
Apocynaceae	*Cynanchum viminale*	✓	✓
Asteraceae	*Angianthus cunninghamii*	✓	✓
	**Conyza bonariensis*		
	Flaveria trinervia°		✓
	Launaea sarmentosa		✓
	Minuria cunninghamii		✓
	Olearia sp. Kennedy Range (G. Byrne 66)	✓	✓
	Pterocaulon sphacelatum	✓	✓
	**Sonchus oleraceus*		
Boraginaceae	*Trichodesma zeylanicum*#		
Caryophyllaceae	**Polycarpon tetraphyllum*		
Chenopodiaceae	*Atriplex isatidea*		✓
	Atriplex semilunaris		
	Dysphania kalpari		
	Dysphania plantaginella		✓
	Rhagodia preissii subsp. *obovata*	✓	✓
	Salsola australis	✓	✓
	Threlkeldia diffusa	✓	✓
Cleomaceae	*Cleome viscosa*	✓	✓
Convolvulaceae	*Bonamia erecta*#		
	Ipomoea muelleri#		
	Ipomoea pes-caprae	✓	✓
Crassulaceae	*Crassula tetramera*		
Cyperaceae	*Cyperus bulbosus*		✓
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*		
	Euphorbia australis		✓
	Euphorbia drummondii	✓	
	Euphorbia tannensis subsp. *eremophila*	✓	✓
	Euphorbia trigonosperma (previously *Euphorbia coghlanii*)	✓	✓
Fabaceae	*Acacia ?ampliceps* (2006)		✓
	Acacia bivenosa "Airlie Island" variant (2006)		✓

Family	Species	Recorded in transects 2020	Recorded opportunistically 2020
Fabaceae	*Acacia bivenosa* (typical variant) (2006)	✓	✓
	Acacia coriacea	✓	✓
	Acacia gregorii		✓
	Acacia pyrifolia#		
	Acacia sclerosperma subsp. *sclerosperma* (island variant 1) (2006)		✓
	Acacia sclerosperma subsp. *sclerosperma* (island variant 2) (2006)		✓
	Acacia sclerosperma subsp. *sclerosperma* (typical variant) (2006)	✓	✓
	Acacia synchronicia		
	Acacia tetragonophylla		✓
	Acacia trachycarpa#		
	Alysicarpus muelleri#		
	Canavalia rosea	✓	✓
	Crotalaria cunninghamii#		
	Indigofera colutea#		
	Indigofera linifolia#		
	Rhynchosia cf. minima	✓	✓
	Senna glutinosa subsp. *chatelainiana*		
	Senna notabilis#		
	Sesbania cannabina#		
	**Stylosanthes hamata*		
	*Vigna lanceolata***		
Goodeniaceae	*Goodenia* sp.**		
	Scaevola crassifolia		✓
	Scaevola cunninghamii	✓	✓
	Scaevola spinescens	✓	✓
Gyrostemonaceae	*Gyrostemon ramulosus*#		
Haloragaceae	*Haloragis gossei***		
Hemerocallidaceae	*Corynotheca flexuosissima*	✓	✓
Lauraceae	*Cassytha aurea* var. *aurea*	✓	✓
Malvaceae	*Abutilon lepidum*#		
	Abutilon sp.#		
	Corchorus incanus subsp. *incanus*#		✓
	Melhania oblongifolia		
	Sida fibulifera	✓	✓
Nyctaginaceae	*Boerhavia coccinea*#		

Family	Species	Recorded in transects 2020	Recorded opportunistically 2020
Nyctaginaceae	*Boerhavia schomburgkiana*		✓
	Commicarpus australis	✓	✓
Poaceae	*Aristida contorta*		
	Aristida holathera		
	**Cenchrus ciliaris*	✓	✓
	**Cenchrus setaceus*		
	**Cenchrus setiger*		
	**Cynodon dactylon*		
	Enneapogon caerulescens		✓
	Eragrostis dielsii		
	Eragrostis minor°		✓
	Eulalia aurea	✓	✓
	Sorghum plumosum		
	Spinifex longifolius	✓	✓
	Sporobolus virginicus		✓
	Triodia angusta#		✓
	Triodia epactia	✓	✓
	Triraphis mollis	✓	✓
	Whiteochloa airoides		✓
Portulacaceae	*Portulaca intraterranea*		✓
	Portulaca pilosa*		
Rubiaceae	*Synaptantha tillaeacea*	✓	✓
Sapindaceae	*Diplopeltis eriocarpa*		✓
Solanaceae	*Nicotiana occidentalis*		✓
	**Solanum esculentum*		
Zygophyllaceae	*Roepera aurantiaca*		✓
	Tribulus occidentalis		✓

Note: * Introduced exotic (weed) species.

Introduced mainland native species that have been introduced to Chevron lease since construction.

° Species widespread and existing prior to Chevron lease – since classified as being weed species. Considered "naturalised" on islands.

** Species that have been recorded in the past but have not been listed since 1987. These have been retained for the present as it is considered they may exist in very small populations.

Table B.2: Thevenard Island year by species matrix.

Family	Species^	ERMP	Nov 1987	1987	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2011	2012	2013	2014	2017	2020
Aizoaceae	*Carpobrotus* sp. Thevenard Island (M. White 050) P3	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Sesuvium portulacastrum				+													+	+	+	
Amaranthaceae	**Aerva javanica*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Amaranthus undulatus			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ptilotus villosiflorus	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Asclepiadaceae	*Cynanchum viminale*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Asteraceae	*Angianthus cunninghamii*		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	**Conyza bonariensis*																	+	+		
	Flaveria trinervia°	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Launaea sarmentosa	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Minuria cunninghamii			+	+										+		+		+		+
	Olearia sp. Kennedy Range (G. Byrne 66)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Pterocaulon sphacelatum	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	**Sonchus oleraceus*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Boraginaceae	*Trichodesma zeylanicum*																	+	+		
Caryophyllaceae	**Polycarpon tetraphyllum*	+	+	+	+	+	+	+	+	+						+	+				
Chenopodiaceae	*Atriplex isatidea*	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Atriplex semilunaris																	+	+		

Family	Species^	ERMP	Nov 1987	1987	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2011	2012	2013	2014	2017	2020
Chenopodiaceae	*Dysphania kalpari*																		+		
	Dysphania plantaginella			+	+		+					+	+	+		+	+	+	+	+	+
	Rhagodia preissii subsp. *obovatus*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Salsola australis	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Threlkeldia diffusa	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cleomaceae	*Cleome viscosa*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Convolvulaceae	*Bonamia erecta*[+]																	+	+		
	Ipomoea muelleri[#]					+		+					+						+		
	Ipomoea pes-caprae	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Crassulaceae	*Crassula tetramera*[1]			+	+																
Cyperaceae	*Cyperus bulbosus*			+						+		+		+						+	+
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*[#]				+	+	+	+	+			+	+	+	+						
	Euphorbia australis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Euphorbia drummondii			+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
	Euphorbia tannensis subsp. *eremophila*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Euphorbia trigonosperma (formally *Euphorbia coghlanii*)			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Fabaceae	*Acacia ?ampliceps* (2006)													+	+	+	+	+	+	+	+
	Acacia bivenosa "Airlie Island" form			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Acacia bivenosa (typical variant)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Family	Species^	ERMP	Nov 1987	1987	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2011	2012	2013	2014	2017	2020
Fabaceae	*Acacia coriacea*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Acacia gregorii	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Acacia pyrifolia[#]				+	+	+	+	+	+	+	+					+				
	Acacia sclerosperma subsp. *sclerosperma* (typical variant) (2006)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Acacia sclerosperma subsp. *sclerosperma* (island variant 1) (2006)													+	+	+	+	+	+	+	+
	Acacia sclerosperma subsp. *sclerosperma* (island variant 2) (2006)													+	+	+	+	+	+	+	+
	Acacia synchronicia				+			+			+	+						+			
	Acacia tetragonophylla		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Acacia trachycarpa[#]				+	+	+	+	+			+				+	+	+	+		
	Canavalia rosea	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Crotalaria cunninghamii[#]					+	+								+						
	Indigofera colutea[#]											+				+	+				
	Indigofera linifolia[#]				+																
	Rhynchosia cf. *minima*	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Senna glutinosa subsp. *chatelainiana*				+																
	Senna notabilis[#]						+														
	Sesbania cannabina[#]											+	+					+			

Family	Species^	ERMP	Nov 1987	1987	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2011	2012	2013	2014	2017	2020
Fabaceae	**Stylosanthes hamata*					+			+	+	+	+	+	+		+	+				
	Swainsona pterostylis[#]								+												
	*Vigna lanceolata***																				
Goodeniaceae	*Goodenia* sp.**																				
	Scaevola crassifolia	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Scaevola cunninghamii		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Scaevola spinescens	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Gyrostemonaceae	*Gyrostemon ramulosus*[#]				+	+	+	+				+				?	+				
Haloragaceae	*Haloragis gossei***	+	+																		
Hemerocallidaceae	*Corynotheca flexuosissima*		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Lauraceae	*Cassytha aurea* var. *aurea*	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Malvaceae	*Abutilon lepidum*[#]									+											
	Abutilon sp.Onslow (F. Smith s.n. 10/9/61) P1[#]								+		+										
	Corchorus incanus subsp. *incanus*[#]				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+
Sterculiaceae	*Melhania oblongifolia*		+		+		+					+			+		+			+	
	Sida fibulifera			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nyctaginaceae	*Boerhavia coccinea*[#]																	+	+		
	Boerhavia schomburgkiana	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Commicarpus australis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Family	Species^	ERMP	Nov 1987	1987	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2011	2012	2013	2014	2017	2020
Poaceae	*Aristida contorta*[#]				+																
	Aristida holathera				+														+		
	**Cenchrus ciliaris*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	**Cenchrus setaceus*					+	+	+								+			+		
	**Cenchrus setiger*																	+	+		
	**Cynodon dactylon*				+	+	+			+		+									
	Enneapogon caerulescens		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Eragrostis dielsii																	+	+	+	
	Eragrostis minor°			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Eulalia aurea	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Sorghum plumosum	+	+																		
	Spinifex longifolius	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Sporobolus virginicus	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Triodia angusta[#]					+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
	Triodia epactia			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Triraphis mollis			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Whiteochloa airoides		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Portulacaceae	*Portulaca intraterranea*			+	+				+		+	+	+	+	+	+	+	+	+	+	+
	Portulaca pilosa*	+	+																		

Family	Species^	ERMP	Nov 1987	1987	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2011	2012	2013	2014	2017	2020
Rubiaceae	*Synaptantha tillaeacea*		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Sapindaceae	*Diplopeltis eriocarpa*	+	+	+	+		+	+	+	+	+	+	+	+		+	+	+	+	+	+
Solanaceae	*Nicotiana occidentalis*			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	
	**Solanum esculentum*																	+	+		
Zygophyllaceae	*Roepera aurantiaca*		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Tribulus occidentalis		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Note:

^ List includes species observed in transects and opportunistically.

* Introduced exotic (weed) species.

Introduced mainland native species that have been introduced to Chevron lease since construction.

o Species widespread and existing prior to Chevron lease – since classified as being weed species. Considered "naturalised" on islands.

** Species that have been recorded in the past but have not been listed since 1987. These have been retained for the present as it is considered they may exist in very small populations.

1 First record for the Pilbara Region (R. Cranfield).

2 First record for offshore Island (D. Symon).

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Appendix C: Avian Species Recorded at Thevenard Island (2001 to 2020)

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Table C.1: Avian species recorded at Thevenard Island from 2001 to 2020.

Scientific Name	Common Name	Conservation codes			2001		2002		2003		2004 May	2005 June	2006 February	2007 March	2008 May	2011 October	2013 November	2014 May	2017 May	2020 June
		EPBC Act	BC Act	DBCA priority list	June	November	June	November	May	November										
PELECANIDAE																				
Pelecanus conspicillatus	Australian pelican					X	X	X	X	X	X	X		X			X	X		
PROCELLARIIDAE																				
Puffinus pacificys	Wedge-tailed shearwater	IA	IA																	
PHALACROCORACIDAE																				
Phalacrocorax varius	Pied cormorant				X	X		X	X	X	X		X	X	X		X	X		
Phalacrocorax sulcirostris	Little black cormorant														X	X				
ARDEIDAE																				
Egretta sacra	Eastern reef heron				X	X	X	X	X	X	X	X	X	X			X	X		X
ACCIPITRIDAE																				
Pandion haliaetus	Osprey	IA	IA		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elanus caeruleus	Black-shouldered kite					X				X			X				X	X	X	
Haliaeetus leucogaster	White-breasted sea eagle					X			X	X		X	X	X	X		X	X	X	
Circus assimilis	Spotted harrier				X	X	X	X	X								X	X	X	X
Haliastur indus	Brahminy Kite																		X	
FALCONIDAE																				
Falco longipennis	Australian hobby									X					X					
Falco cenchroides	Australian kestrel				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Falco berigora	Brown falcon								X			X				X				
PHASIANIDAE																				
Coturnix ypsilophora	Brown quail				X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
BURHINIDAE																				
Esacus neglectus	Beach stone-curlew				X	X	X	X	X	X		X		X	X		X	X	X	X
HAEMATOPODIDAE																				
Haemotopus longirostris	Pied oystercatcher				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Haemotopus fuliginosus	Sooty oystercatcher												X						X	
CHARADRIIDAE																				
Pluvialis squatarola	Grey plover	IA	IA														X	X		
Pluvialis fulva	Pacific golden plover	IA	IA																	
Charadrius leschenaultii	Greater sand plover	VU & IA	VU & IA			X			X								X			
Charadrinus mongolus	Lesser sand plover	EN & IA	EN & IA						X							X	X			X
Charadrius ruficapillus	Red-capped plover				X	X		X	X	X	X	X		X		X	X	X	X	X
SCOLAPACIDAE																				
Arenaris interpres	Ruddy turnstone	IA	IA		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Numenius madagascariensis	Eastern curlew	CR &IA	CR &IA																	
Numenius phaeopus	Whimbrel	IA	IA						X	X							X			
Tringa brevipes	Grey-tailed tattler	IA	IA				X		X		X	X					X	X		
Actitus hypoleucos	Common sandpiper	IA	IA			X		X								X		X		

Scientific Name	Common Name	Conservation codes: EPBC Act	Conservation codes: BC Act	Conservation codes: DBCA priority list	2001 June	2001 November	2002 June	2002 November	2003 May	2003 November	2004 May	2005 June	2006 February	2007 March	2008 May	2011 October	2013 November	2014 May	2017 May	2020 June
Tringa nebularia	Greenshank	IA	IA			X				X										
Tringa totanus	Common redshank	IA	IA																	
Limosa limosa	Black-tailed godwit	IA	IA																	
Limosa lapponica	Bar-tailed godwit[1]	IA	IA				X		X	X	X	X			X	X	X			
Calidris ruficollis	Red-necked stint	IA	IA							X							X	X		
Calidris alba	Sanderling	IA	IA		X	X			X	X		X		X	X	X	X	X		X
LARIDAE																				
Larus novahollandiae	Silver gull				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sterna caspia#	Caspian tern	IA	IA		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sterna hirundo#	Common tern	IA	IA			X		X	X		X	X		X		X	X	X		
Sterna dougallii#	Roseate tern	IA	IA																	X
Sterna nereis nereis	Fairy tern	VU	VU		X	X	X	X	X			X		X	X	X		X	X	X
Sterna bergii	Crested tern				X		X	X	X	X	X	X	X	X	X		X	X	X	X
Sterna bengalensis#	Lesser crested tern	IA	IA		X			X	X	X	X	X		X		X	X	X		
Sterna albifrons#	Little tern	IA	IA					X		X					X	X		X		
Onychoprion anaethetus#	Bridled tern	IA	IA														X			
Sterna nilotica	Gull-billed tern								X							X	X	X		X
Sterna fuscata	Sooty tern									X					X					
COLUMBIDAE																				
Geopelia humeralis	Bar-shouldered dove				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CACATUIDAE																				
Cacatua sanguinea	Little corella				X	X	X	X											X	X
PSITTACIDAE																				
Melopsittacus undulatus	Budgerigar															X				
CUCULIDAE																				
Cacomantis pallidus	Pallid cuckoo																			X
Chrysococcyx basalis	Horsfield's bronze cuckoo						X												X	
APODIDAE																				
Apus pacificus#	Fork-tailed swift															X				
ALCEDINIDAE																				
Todiramphus sanctus	Sacred kingfisher					X														
HIRUNDINIDAE																				
Hirundo neoxena	Welcome swallow				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hirundo nigricans	Tree martin								X	X	X	X	X	X	X		X			X
Hirundo ariel	Fairy martin															X				
MOTACILLIDAE																				
Anthus australis	Australian (Richard's) pipit				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CAMPEPHAGIDAE																				
Coracina novaehollandiae	Black-faced cuckoo shrike				X			X			X	X	X	X	X			X		

Scientific Name	Common Name	Conservation codes			2001		2002		2003		2004 May	2005 June	2006 February	2007 March	2008 May	2011 October	2013 November	2014 May	2017 May	2020 June
		EPBC Act	BC Act	DBCA priority list	June	November	June	November	May	November										
Lalage tricolor	White-winger triller							X							X					
DICRURIDAE																				
Rhipidura albiscapa	Grey fantail																			X
Rhipidura leucophrys	Willie wagtail				X							X	X		X				X	X
Grallina cyanoleuca	Australian magpie-lark						X	X												
SYLVIIDAE																				
Eremiornis carteri	Spinifexbird				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cinclorhampus cruralis	Brown songlark								X		X	X	X		X	X	X			X
Cinclorhamphus mathewsi	Rufous songlark															X				X
MELIPHAGIDAE																				
Lichenostomus virescens	Singing Honeyeater																		X	X
Acanthagenys rufogularis	Spiny-cheeked honeyeater							X					X						X	
Epthainura tricolor	Crimson chat																			
ZOSTEROPIDAE																				
Zosterops luteus	Yellow white-eye				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PASSERIDAE																				
Taeniopygia guttata	Zebra finch												X		X				X	X
ARTAMIDAE																				
Artamus leucorhynchus	White-breasted woodswallow				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Artamus cyanopterus	Dusky woodswallow				X															
Artamus minor	Little woodswallow														X					
CORVIDAE																				
Corvus bennetti	Little crow													X						
TOTAL № SPECIES					**26**	**28**	**24**	**30**	**34**	**29**	**25**	**30**	**24**	**27**	**30**	**29**	**36**	**33**	**28**	**33**

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Appendix D: Vegetation Monitoring Transect Photographs

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Plate D.1: Transect 2C – start.

Plate D.2: Transect 3C – start.

Plate D.3: Transect 6R – start.

Plate D.4: Transect 11R – start.

Plate D.5: Transect 12R – start.

Plate D.6: Transect 13C – start.

Plate D.7: Transect 14C – start.

Plate D.8: Transect 15C – start.

Plate D.9: Transect 17R – start.

Plate D.10: Transect 18R – start.

Plate D.11: Transect 19C – start.

Plate D.12: Transect 20C – start.

Plate D.13: Transect 21R – start.

Plate D.14: Transect 22C – start.

Plate D.15: Transect 23R – start.

Plate D.16: Transect 24C – start.

Plate D.17: Transect 25C – start.

Plate D.18: Transect 28C – start.

Plate D.19: Transect 29C – start.

Plate D.20: Transect 30C – start.

Plate D.21: Transect 31C – start.

Plate D.22: Transect 33C – start.

Plate D.23: Transect 34C – start.

Plate D.24: Transect 35C – start.

Plate D.25: Transect 36C – start.

Plate D.26: Transect 37C – start.

Plate D.27: Transect 38C – start.

Plate D.28: Transect 39C – start.

Plate D.29: Transect 40C - start.

Plate D.30: Transect 41C – start.

Plate D.31: Transect 42R – start.

Appendix E: Murids Recorded on Thevenard Island (1996 to 2020)

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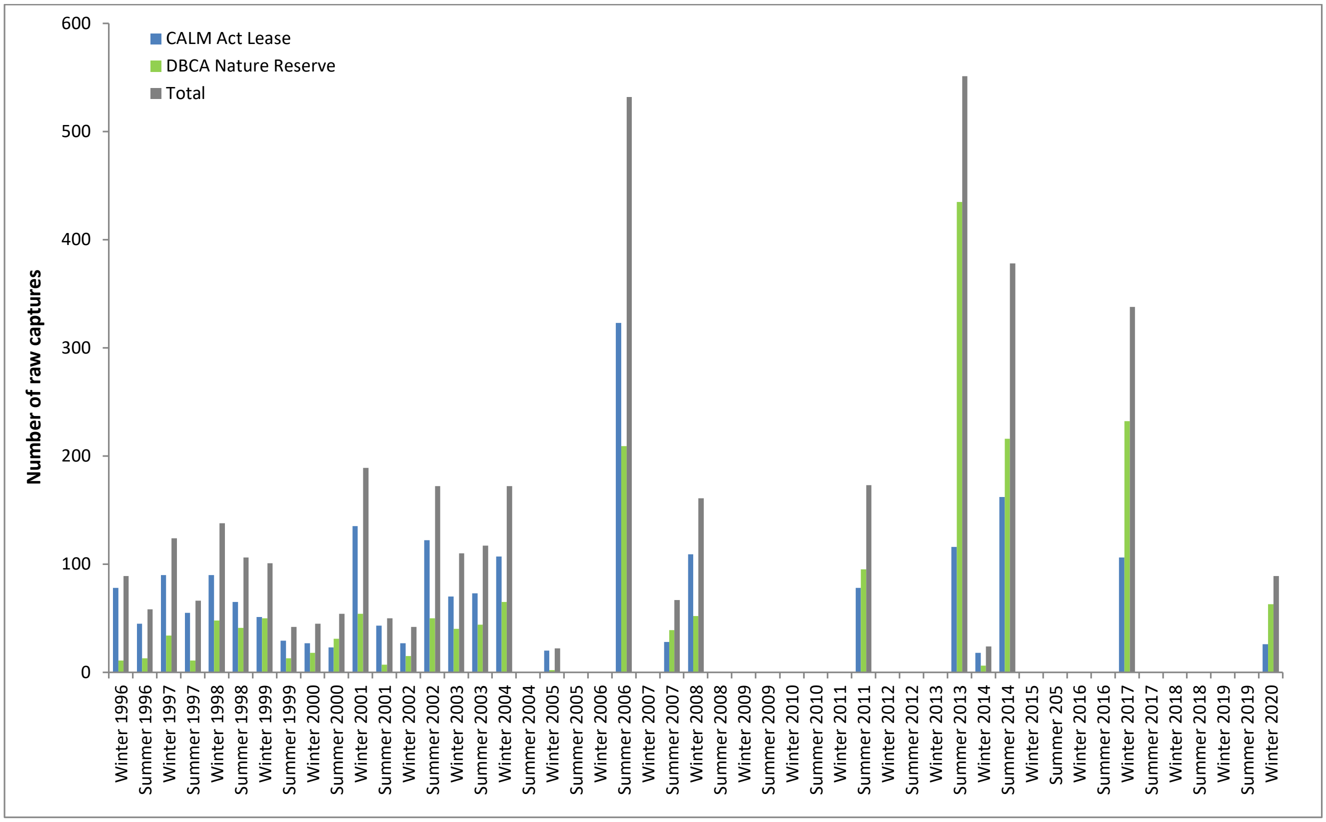

Figure E.1: Total captures of *Mus musculus* recorded at trapping grids on Thevenard Island from 1996-2020.

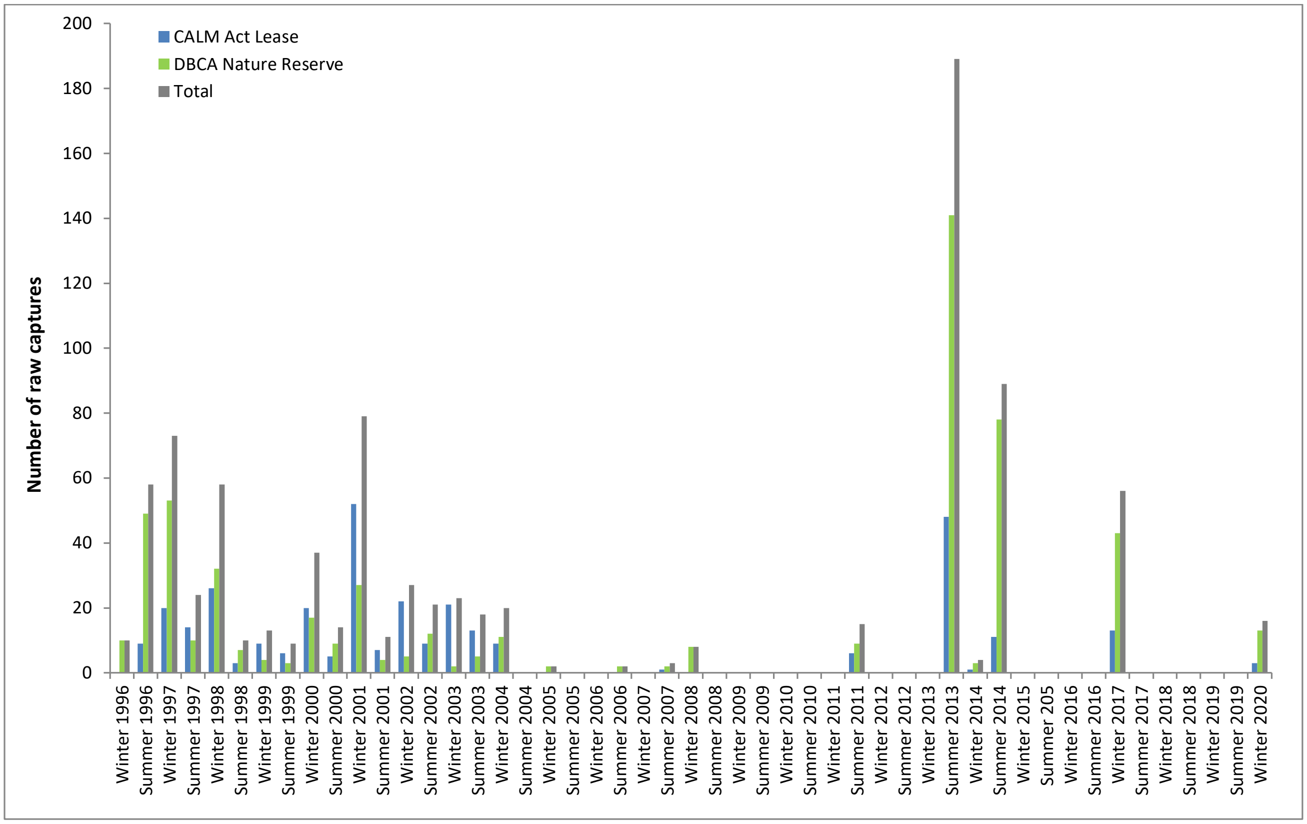

Figure E.2: Total captures of *Leggadina lakedownensis* recorded at trapping grids on Thevenard Island from 1996-2020.

Appendix F: Fauna Species Recorded at Trapping Grids on Thevenard Island (2002 to 2020)

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Table F.1: The number of mammal and reptile captures (including recaptures) per trapping site on Thevenard Island, June 2020.

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Total
Landform	Lease	Lease	Lease	Inland Ridge	Inland Ridge	Inland Ridge	Inland Ridge	Inland Ridge	Inland Ridge	Aeolian	Aeolian	Aeolian	
Mammals													
Mus musculus	18	6	2	2	5	3	10	0	2	4	15	22	**89**
Leggadina lakedownensis	0	2	1	1	0	0	9	3	0	0	0	0	**16**
Reptiles													
Amphibolurus gilberti	1	1	1	1	0	0	0	0	1	2	0	3	**10**
Ctenotus saxatilis	2	2	7	4	6	3	7	4	7	3	1	1	**47**
Gehyra variegata	3	0	0	1	1	0	2	0	1	1	0	1	**10**
Heteronotia binoei	0	1	1	0	0	0	2	0	2	0	2	0	**8**
Delma tincta	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Lerista clara	1	0	1	1	2	3	1	0	1	0	2	0	**12**
Menetia greyii	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Varanus acanthurus	0	0	0	0	0	0	0	0	0	0	1	0	**1**
TOTAL	**7**	**4**	**10**	**7**	**9**	**6**	**12**	**4**	**12**	**6**	**7**	**5**	**89**

Table F.2: Fauna species recorded at trapping grids on Thevenard Island from 2002 to 2020.

Monitoring Period	Location	Site	*Ctenotus saxatilis*	*Amphibolurus gilberti*	*Heteronotia binoei*	*Varanus acanthurus*	*Lerista clara*	*Menetia greyii*	*Delma tincta*	*Gehyra variegata*	*Mus musculus*	*Leggadina lakedownensis*	No. species / site	No. species / location
June 2002	Lease	1	X								X	X	3	3
		2	X								X	X	3	
		3	X								X	X	3	
	Reserve	4			X						X	X	3	5
		5	X	X							X	X	3	
		6	X		X						X		3	
October 2002	Lease	1	X		X	X	X				X		5	9
		2	X	[X]			X		X	X	X	X	6	
		3	X			X					X	X	4	
	Reserve	4	X			X					X	X	4	5
		5		[X]		X					X	X	3	
		6	X			X					X	X	4	
May 2003	Lease	1	X	X	X	X		X			X	X	7	8
		2	X	X	X			X		[X]	X	X	6	
		3	X			X		X			X	X	5	
	Reserve	4	X	X	X			X			X		5	7
		5	X		X	X		X			X	X	6	
		6	X					X			X		3	
November 2003	Lease	1	X		X	X					X	X	5	8
		2	X	[X]	X	X				[X]	X	X	5	
		3	X			X	X				X	X	5	
November 2003	Reserve	4	X			X					X	X	4	8
		5		X	X	X					X		4	
		6	X				X	X			X		4	
May 2004	Lease	1	X	X	X						X		4	9
		2	X	X		[X]				[X]	X	X	4	
		3		X	X		X	X			X	X	6	
	Reserve	4	X		X	X					X	X	5	7
		5	X	X	X						X	X	5	
		6	X	X		X		X			X		5	
June 2005	Lease	1	X	X							X		3	6
		2			X			X		[X]	X		3	
		3		X				X			X		3	
	Reserve	4			X						X		2	3
		5			X							X	2	
		6			X						X		2	
February 2006	Lease	1	X	X				X			X		4	6
		2	X	X		X				[X]	X		4	
		3	X	X				X			X		4	

Monitoring Period	Location	Site	*Ctenotus saxatilis*	*Amphibolurus gilberti*	*Heteronotia binoei*	*Varanus acanthurus*	*Lerista clara*	*Menetia greyii*	*Delma tincta*	*Gehyra variegata*	*Mus musculus*	*Leggadina lakedownensis*	No. species / site	No. species / location
	Reserve	4	X	X	X	X					X	X	6	8
		5		X		X			X		X		4	
		6	X			X		X			X	X	5	
March 2007	Lease	1	X	X				X			X		4	5
		2	X					X			X		3	
		3	X								X	X	3	
	Reserve	4	X		X	X		X			X		5	7
		5	X			X		X			X		4	
		6	X	X		X		X			X	X	6	
May 2008	Lease	1	X		X	X	X				X		5	7
		2	X								X		2	
		3	X				X	X		X	X		5	
	Reserve	4	X		X		X			X	X	X	6	8
		5	X		X		X	X		X	X	X	7	
		6	X	[X]				X		X	X	X	5	
October 2011	Lease	1	X		X		X				X		4	7
		2	X		X		X				X	X	5	
		3	X			X	X	X			X	X	6	
	Reserve	4	X		X		X			X	X	X	6	9
		5	X	X	X	X	X			X	X		7	
		6	X		X	X	X		X		X	X	7	
November 2013	Lease	1	X		X					X	X	X	5	6
		2	X		X		X				X	X	5	
		3	X		X					X	X	X	5	
November 2013	Reserve	4									X	X	2	6
		5					X				X	X	3	
		6	X							X	X	X	4	
		7	X								X	X	3	
		8					X			X	X	X	4	
		9	X								X	X	3	
		10			X		X				X	X	4	
		11			X						X	X	3	
		12	X								X	X	3	
May 2014	Lease	1		X	X	X	X	X			X		6	9
		2	X		X					X	X	X	5	
		3	X	X	X		X	X			X		6	
May 2014	Reserve	4	X				X			X			3	9
		5	X			X	X		X			X	5	
		6	X		X					X	X		4	
		7	X		X		X				X		4	
		8			X					X			2	

Monitoring Period	Location	Site	*Ctenotus saxatilis*	*Amphibolurus gilberti*	*Heteronotia binoei*	*Varanus acanthurus*	*Lerista clara*	*Menetia greyii*	*Delma tincta*	*Gehyra variegata*	*Mus musculus*	*Leggadina lakedownensis*	No. species / site	No. species / location
		9	X		X						X		3	
		10		X	X		X		X	X	X		6	
		11	X	X	X						X	X	5	
		12	X	X	X					X			4	
May 2017	Lease	1	X	X	X	X				X	X		6	9
		2	X	X						X	X	X	5	
		3	X	X	X		X		X		X	X	7	
	Reserve	4	X			X				X	X		4	10
		5	X				X	X			X	X	5	
		6	X			X	X			X	X	X	6	
		7	X			X	X		X	X	X	X	7	
		8	X							X	X	X	4	
		9	X		X		X			X	X	X	6	
		10	X			X				X	X	X	5	
		11	X	X	X		X			X	X	X	7	
		12	X	X		X				X	X	X	6	
June 2020	Lease	1	X	X			X			X	X		5	7
		2	X	X	X						X	X	5	
		3	X	X	X		X				X	X	6	
	Reserve	4	X	X			X			X	X	X	6	9
		5	X				X			X	X		4	
		6	X				X				X		3	
		7	X		X		X			X	X	X	6	
		8	X									X	3	
		9	X	X	X		X			X	X		6	
		10	X	X						X	X		4	
		11	X		X	X	X	X			X		6	
		12	X	X						X	X		4	