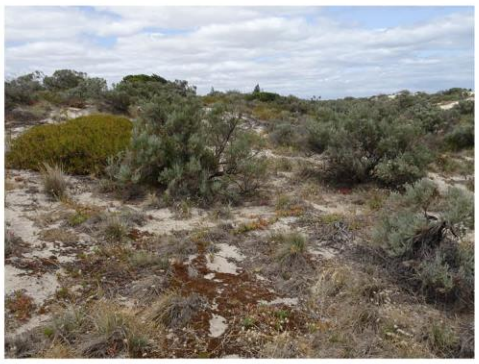
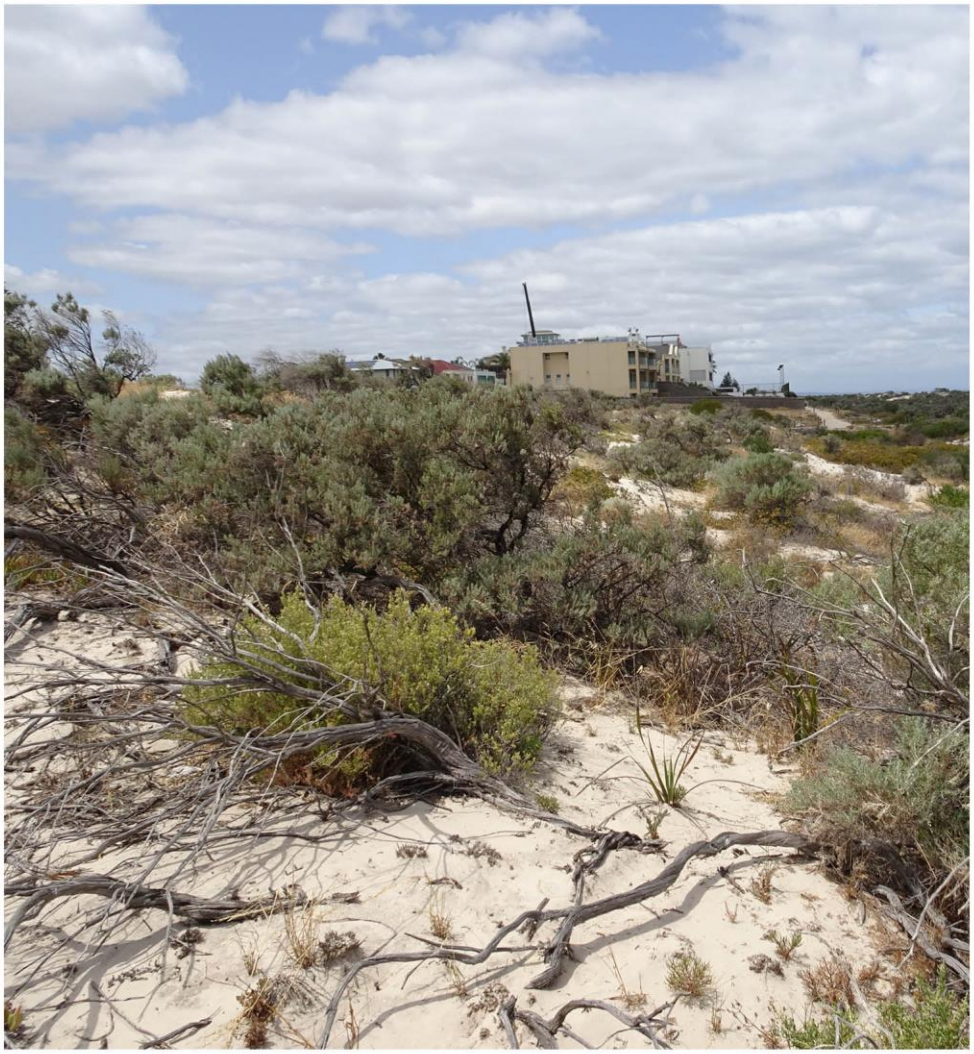


Tennyson Dunes

Vegetation Condition Change Evaluation 2014-2020

January 2020



T&M Ecologists

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Certain assumptions have been made in the preparation of this report. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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Contents

1. Introduction

In the Adelaide and Mount Lofty Ranges (AMLR) region there are 4627 square kilometres of marine waters and 333 kilometres of coastline stretching from Middleton Beach on the Fleurieu, to Mallala north of Adelaide[1]. The Tennyson Dunes are the most significant patch of pre-European coastal dunes left along the Adelaide metropolitan coastline, recently named Wara Wayingga, meaning "place of shifting sand" by the Kaurna (Adelaide's local Aboriginal people), in recognition of this fact[2].

Wara Wayingga has been labelled the most significant coastal dune system of any capital city in Australia. The dunes form the only remaining refuge for many native species of plants and animals, including 16 plant species with a regional conservation rating[2].

In 2015, T&M Ecologists prepared a Biodiversity Action Plan for Tennyson Dunes, which has helped guide activities by the Tennyson Dunes Group, Natural Resources Adelaide and Mount Lofty Ranges, and the City of Charles Sturt. The intent of this project is to provide an assessment of change in vegetation condition in the Tennyson Dunes / Wara Wayingga from assessments undertaken in 2014 as part of this original Biodiversity Action Plan.

2. Methods

2.1 BushRAT assessments

As part of developing the Tennyson Dunes On-Ground Works Biodiversity Action Plan, T&M Ecologists divided the site into Management Zones based largely on the type of vegetation present and the condition of the vegetation. In each of these Management Zones an assessment was undertaken using the "BushRAT" technique developed by the SA Department for Environment, Water and Natural Resources. Eleven sites were assessed in August and September 2014. These sites, which are shown in Figure 2.1, were re-assessed on 16th of January 2020.

The BushRAT technique is derived from the Nature Conservation Society of South Australia's 'Bushland Condition Monitoring' (BCM) methodology, including a Rapid Assessment version (Croft et al, 2005), however it assesses an area of vegetation of one hectare of consistent condition rather than the 30m x 30m quadrats used in the BCM methodology.

Three 'components' of the biodiversity value of the site are measured and scored:

- vegetation condition;
- conservation value; and
- landscape context.

Only vegetation condition is measured in the field.

[1] https://www.naturalresources.sa.gov.au/adelaidemtloftyranges/coast-and-marine/coast-and-marine-ecosystems accessed 3/1/2019

[2] Nick Crouch, pers. comm.

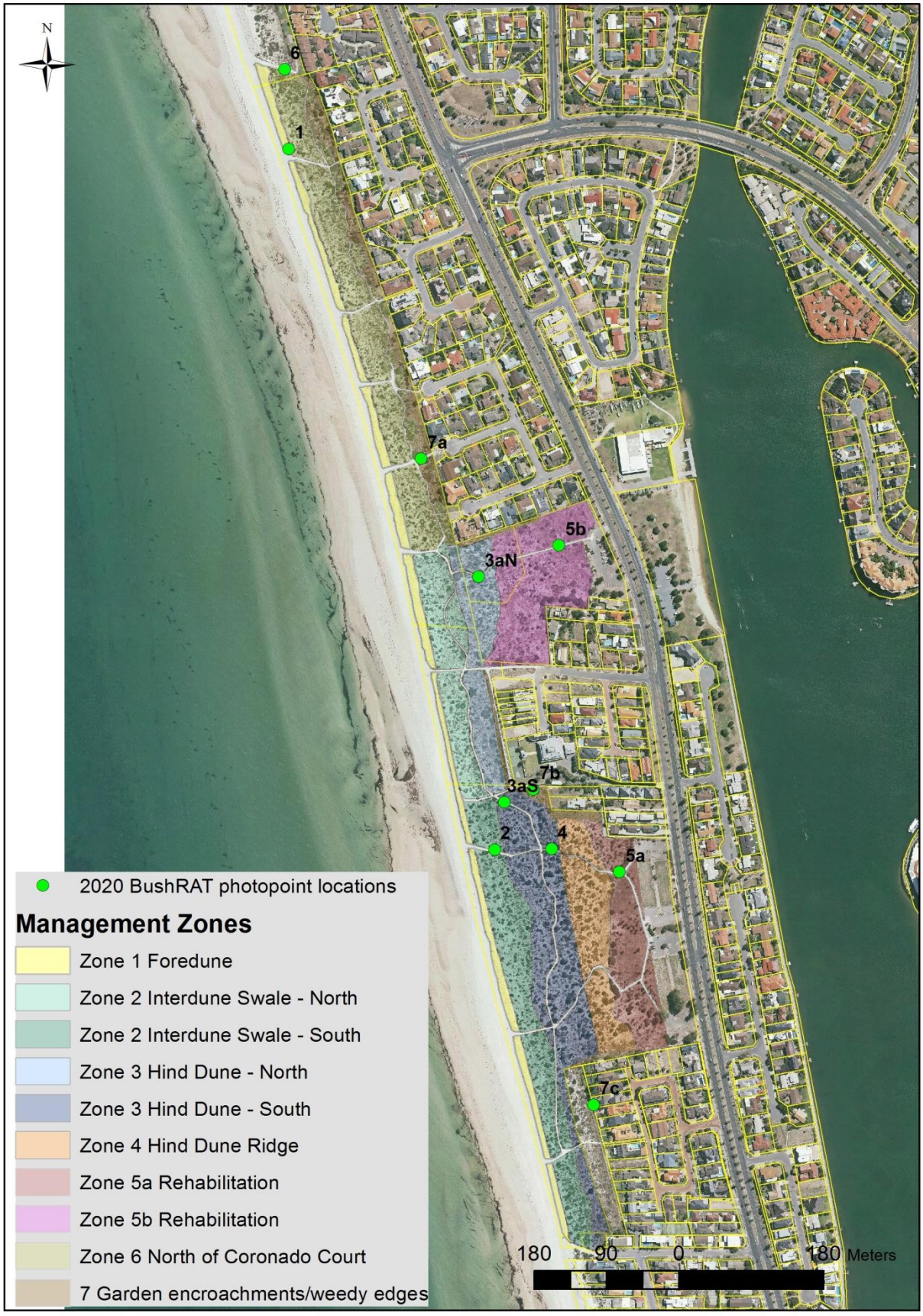

Figure 2.1: Management Zones and locations of BushRAT photopoints from the 2014 Action Plan

Regional flora conservation ratings are those of Gillam and Urban (2014)[3], with State fauna and flora conservation ratings from the Schedules of the *National Parks and Wildlife Act 1972*, and National conservation ratings from the *Environment Protection and Biodiversity Conservation Act 1999*.

It should be noted that the DEWNR BushRAT system was updated in 2017, and again in early 2019 and re-named "Native Vegetation Bushland Assessment"[4]. This update includes modifications to the scoring sheet and methodology for calculating vegetation condition, conservation significance and landscape context. However, this report has continued to use the BushRAT system as per DEWNR 2012[5], to retain compatibility with data that has previously been collected in coastal sites.

2.2 Scoring Components in the BushRAT metric

It is not the intent of this report to provide an extensive overview of the use and application of the BushRAT methodology. A full description of the method and its application can be found within DEWNR (2012)[6]. For this project, only the vegetation condition components of the BushRAT metric were scored (as these are the components that would be expected to change over time with management intervention).

Vegetation Condition Components

The Vegetation Condition Score is from a total of 80 points, or 65 points where the community is a treeless community type (such as coastal shrubland). Table 1 describes the scoring components for Vegetation Condition.

Table 2.1: Scoring components for the BushRAT metric

Vegetation condition component	Overview description
Native Plant Species Diversity	A count of the number of species present is compared to a "benchmark" value for that vegetation type. This is then allocated a score from 0-15.
Weed Score	The cover and abundance of all weed species present is recorded. The 5 weeds with the highest product of threat rating and cover are summed to provide a score. This is then compared to a "benchmark" value for that vegetation type, and allocated a score from 0-15.
Native Plant Life Forms	The cover of different native plant life forms is compared to a "benchmark" value for that vegetation type. This is then allocated a score from 0-10.
Regeneration	The total number of woody native species in juvenile or seedling form is recorded and compared to a "benchmark" value for that vegetation type. This is then allocated a score from 0-8.
Native:exotic Understorey Biomass	The percentage of the total *vegetative biomass* of shrubs and groundcover plants < 2m high that is native is noted. This is then allocated a score from 0-10.

[3] Gillam, S. and Urban, R. (2014) Regional Species Conservation Assessment Project, Phase 1 Report: Regional Species Status Assessments, Adelaide and Mount Lofty Ranges NRM Region. Department of Environment, Water and Natural Resources, South Australia.
[4] Native Vegetation Management Unit (2017). Native Vegetation Council (NVC) Bushland Assessment Manual. Department for Environment, Water and Natural Resources, Adelaide.
[5] DEWNR (2012) NVBMU BushRAT assessment and scoring Manual. Unpublished document, Department for Environment, Water and Natural Resources, Waite.
[6] DEWNR (2012) NVBMU BushRAT assessment and scoring Manual. Unpublished document, Department for Environment, Water and Natural Resources, Waite.

Vegetation condition component	Overview description
Bare Ground	The percentage of the grounds surface that is truly bare is noted and allocated a score from 0-3.
Tree Health	Average overall overstorey canopy health is allocated to a category, and then a score from 0-5. Scored only where trees are an expected component of the vegetation community.
Tree Hollows	This score relates to the number of small and large tree hollows present, with a rating of 0-5. Scored only where trees are an expected component of the vegetation community.
Fallen timber	This score relates to the amount of branch and trunk sized logs present, with a rating of 0-5. Scored only where trees are an expected component of the vegetation community.
Grazing Evidence	This score relates to evidence of grazing pressure, including pugging, compacting and chewing. The score is from 0-4.

Analysis of repeat data

The eleven BushRAT sites that were established previously in Tennyson Dunes were analysed for any detectable change, with a specific focus on changes in abundance of introduced species.

At all sites where a photopoint had previously been established it was re-taken as a part of this project. Original photographs were sourced and were recreated within the field as effectively as possible on 16th January 2020. Photographs were then loaded onto a desktop computer, and analysed on side by side 24 inch screens at full definition to detect differences (so note that representative photographs provided in this report will not have the same high definition or detail as used in analysis).

Photographs were analysed using the indicators of change shown in Table 2.2 for differences.

Table 2.2: Description of indicators of change used to compare photopoints[7]

Indicator of change	Description and use of indicator
Presence/density of trees	The presence and density of trees – in most cases would be native species. Useful in revegetation, remnant protection and grazing management projects.
Diversity of trees	The number of different species of trees that can be detected – in most cases would be native species. Useful in revegetation, remnant protection and grazing management projects.
Presence/density of shrubs	The presence and density of shrubs – in most cases would be native species. Useful in revegetation, remnant protection and grazing management projects.
Diversity of shrubs	The number of different species of shrubs that can be detected – in most cases would be native species. Useful in revegetation, remnant protection and grazing management projects.
Presence/density of grasses and/or herbaceous species	The presence and density of grasses and/or herbs. May be difficult to identify in many instances.
Diversity of grasses and/or herbaceous species	The number of different species of grasses and/or herbaceous species. May be difficult to detect different species in many instances.

[7] Adapted from Milne, T. (2015). *Review of photopoint monitoring in the SAMDB NRM region*. A report prepared for the South Australian Murray Darling Basin Natural Resources Management Board, Mount Barker.

Indicator of change	Description and use of indicator
Survival of plants (survivorship)	Number of plants that can be detected as surviving from examination of previous photographs. Particularly useful in revegetation projects, but may be difficult to detect in some instances.
Plant growth	Degree of growth of plants over time. May be useful to consider a scale (eg range pole) in photopoint if this is an important indicator of success of a project.
Age structure	Different sized/age trees and/or shrubs. May indicate successful recruitment as a result of management intervention.
Fallen timber	Fallen trees or logs that can be seen in the photograph. These are an important habitat component for many fauna species.
Leaf litter/debris	Fallen sticks, twigs and leaves on the ground. These may form habitat for fauna, and can also suppress weeds.
Flowering and fruiting plants	Whether any species can be identified that are flowering or fruiting. May be difficult to detect in many cases, but an indicator of success, for example, in revegetation projects where planted stock become reproductive.
Recruitment	New native plants entering the population that have grown from a natural seed source.
Native plant biomass	Total amount of native plant material present. May be useful as an indicator of success for erosion treatment or grazing management.
Total biomass	Total amount of plant material present. May be useful as an indicator of success for erosion treatment or grazing management.
Presence/density/diversity of woody weeds/vine weeds	The presence, density and/or diversity of different woody weed species that are present.
Presence/density/diversity of perennial grass and herbaceous weeds	The presence, density and/or diversity of different perennial grass/herbaceous weed species that are present.
Presence/density/diversity of annual grass and herbaceous weeds	The presence, density and/or diversity of different annual grass and herbaceous weed species that are present.
Extent of bare soil	The amount of visible ground that has no vegetation, or moss or lichen cover. Particularly useful indicator for projects treating erosion.
Extent of exposed rock	Similar to exposed ground, but where rock can clearly be seen in the image.
Tree/shrub shape	Plants that are being heavily grazed often have distinctive form – such as an umbrella shape (where the underside of the "umbrella" represents the maximum height that grazers can impact). May be useful for grazing management, particularly in arid zone woodlands and shrublands.
Presence/density of palatable plants	The presence or density of palatable plants that would be suppressed by grazing pressure. May require some expertise to identify the species as well as its palatability. Most useful in pastoral / arid land.
General signs of erosion	The extent of erosion visible in a photopoint.
Gully shape/extent	The shape and extent of gullying (as a result of erosion) visible in a photopoint.
Exposed roots	The extent of exposed roots (as a result of erosion) visible in a photopoint.
Slumping	The extent of slumping (gully side wall falling off).
Tree canopy health	The amount and/or health of visible leaf matter on trees in the photopoint.
Shrub canopy health	The amount and/or health of visible leaf matter on shrubs in the photopoint.
Presence/extent of water	The amount of free water visible in the photopoint.
Presence/density of emergent aquatic plants	The presence and density of emergent aquatic plants (ie plants that are rooted in shallow water with vegetative parts emerging above the water). May be particularly relevant indicator for wetland/watercourse management interventions.

Indicator of change	Description and use of indicator
Diversity of emergent aquatic plants	The number of different emergent aquatic plants that can be detected. May be difficult to identify in many cases. Particularly relevant indicator for wetland/watercourse management interventions.

3. Results

3.1` Native Species Richness

Table 3.1 provides an overview of the native species observed in each of the different Management Zones in 2014 and 2020. There is a general trend for an increase in the number of species that were detected in each of the Management Zones, particularly in Zones 5b and 7b.

One species, the Native Carrot, *Daucus glochidiatus*, was not detected in 2020 but was present in several sites in 2014. This is likely an issue of detectability rather than loss of this species, as it is only seasonally evident (late winter and spring), and so would not have been detectable when repeat assessments were undertaken in January 2020. The lack of sightings of Stalked Crassula, *Crassula closiana*, may also be due to similar reasons. Changes within individual sites are discussed in Section 3.3. Note also that this list is not a comprehensive species list for the site – species that are represented by one or 2 individuals only, or are only seasonally evident, may not have been recorded in the BushRAT assessment.

Whilst not reflected in the data (as individual species densities are not collected under the BushRAT assessment method), Matt Endacott[8] also provides the following anecdotal observations with regard to native species:

- The State Rare Hawkweed Picris (*Picris squarrosa*) has increased in abundance, especially in Management Zones 2, 3N, 3S, 6 and 7
- The regionally Vulnerable Woolly Mat-rush (*Lomandra leucocephala*) has recruited and increased in abundance in areas where intensive Perennial Veldt Grass (*Ehrharta calycina)* control has been undertaken, especially in Zone 5b
- There were previously 3 main patches of the regionally Near Threatened Satin Everlasting (*Helichrysum leucopsideum*), which have increased in size and the species is now found in several additional areas

3.2 Introduced Species Richness and Abundance

Table 3.2 shows weed species and cover/abundance categories for all weeds recorded during 2014 and 2020 assessments. To assist in understanding this complex matrix, species have been grouped by lifeform type, and sorted by weed threat rating (species listed first in each lifeform type are considered to be higher threat species in coastal vegetation). Where a species has increased in cover category rating (ie has been assessed as being more abundant), it has been shaded in red. Where a species has decreased in cover category rating (ie has been assessed as being less

[8] M. Endacott pers. comm.

abundant), it has been shaded in green. The following description summarises changes in weed abundance by lifeform type:

3.2.1 Woody Introduced Species

Woody weeds all remain at low levels, with scattered individuals only. The highly threatening weeds Western Coastal Wattle (**Acacia cyclops*) and Buckthorn (**Rhamnus alaternus*) were not detected during assessments in 2020, but were present in 2014 (although note that several small seedlings of the former have been noted in Zone 5b subsequent to survey[9], indicating ongoing vigilance is required). Scattered Tree Tobacco (**Nicotiana glauca*) were observed in the relatively degraded Management Zone 7a in 2020 but not 2014, but are not considered a high threat weed. African Boxthorn (**Lycium ferocissimum)* was detected as very scattered individuals in Management Zone 7b and 3aN where this species was not previously detected, but was not detected in Management Zone 7a where it had been detected in 2014. This species is readily spread by birds, and so is likely to continually to colonise the dunes and will be difficult to eradicate whilst still present on the Adelaide Plains. It will require ongoing vigilance to ensure its spread is restricted at Tennyson Dunes.

3.2.2 Succulent Introduced Species

There appear to have been very positive outcomes for reduction in the abundance of succulent introduced species. Only in the very degraded Management Zone 7b was an increase detected, whereas decreases were noted in all other zones where succulent species were noted previously, including a reduction from 6-25% cover in *Aeonium spp.* to scattered individuals only in Zone 7a.

3.2.3 Soft Shrub Introduced Species

The highly threatening species White Arctotis (**Arctototis stoechadifolia*) and Marguerite Daisy (**Argyranthemum frutescens ssp. foeniculaceum*) have been a focus for eradication for the Tennyson Dunes Group[10]. These species were noted as having decreased in abundance from 2014 to 2020, aside from in Management Zone 5a, where one seedling individual was noted. This was a regenerating individual from a previously treated patch, which may have been controlled prior to 2014 but re-emerged since[11].

3.2.4 Perennial Grass Introduced Species

Perennial grass species showed mixed outcomes. In some areas Perennial Veldt Grass (**Ehrharta calycina*) was recorded as having a marked decrease in cover/abundance (Zones 2, 3aN, 7c, 5b), but in three areas (Zones 3aS, 4 and 5a), it was recorded as having increased in cover. Couch (**Cynodon dactylon*) was also recorded as increasing in 3 zones, however it should be noted that these areas (Zones 5a, 5b and 7a) are management zones that are considered to be among the poorer condition areas in the Dunes.

3.2.5 Herbaceous Introduced Species

The highly threatening species Sea Spurge (**Euphorbia paralias*), False Caper (**Euphorbia terracina*) and Gazania (**Gazania sp*.) generally showed a decrease in recorded cover, aside from scattered individuals in Zones 3aN and 7b. Mediterranean Turnip (**Brassica tournefortii*) was recorded as

[9] Nick Crouch, pers. comm.
[10] Nick Crouch, pers. comm.
[11] Nick Crouch, pers. comm.

higher cover in five Zones – whilst not considered a highly threatening weed, the relatively high cover scores recorded in a number of zones (>1-5% cover in 5 zones) indicate this species may be worth observing over time to ensure it does not become even more dominant. Cape Marigold (*Dimorphotheca pluvialis*) was also noted as significant cover in Zone 6, and has been noted in other sections of the Dunes[12]. Less threatening herbaceous weeds generally remain at low estimated cover levels (<1%).

3.2.6 Introduced Creeper Species

Whilst Bridal Creeper (**Asparagus asparagoides f. asparagoides*) scored as lower cover in 2020 than in 2014, it is likely that these lower scores are as a result of detectability. Bridal Creeper is much more difficult to detect in summer (when it has died back to underground tubers) than in spring (when it is actively growing). Meaningful comparison would require data to be collected at a similar time of year to the original assessment (i.e. August/September) .

3.2.7 Bulbaceous Introduced Species

As with Bridal Creeper, the reduction in cover scores for Soursob (**Oxalis pes-caprae*) are likely due to the difference in the seasonal timing of the assessments rather than a reflection of a true change in cover/abundance. Guildford Grass (**Romulea rosea var. australis*) conversely would be more detectable in summer than in spring. Meaningful comparison for both of these species would require data to be collected at a similar time of year (August/September) to the original assessment.

3.2.8 Annual Grass Introduced Species

Grassy weeds were generally scored at much higher cover in 2020 than in 2014. Whilst this could possibly be due to a long term change, it is considered more likely to be a function of the timing of the assessments – when initial assessments were undertaken in late winter/early spring of 2014, these annual grasses would have been in a growth stage, and likely only short, single tillers with little leaf mass and no seed heads.

When the re-assessment was undertaken in summer 2020, these annual grasses would have reached their maximum size and produced seed heads, and whilst having died off at this time of the year, would still be present and recognisable. Each plant would have significantly higher biomass in summer than in the early stages of growth in late winter/early spring. Thus the assessed cover/abundance for these annual grasses would be heavily influenced by timing of the assessments, with higher cover scores likely in late spring and summer than in winter and early spring. Meaningful comparison would require data to be collected at a similar time of year (August/September) to the original assessment.

[12] Matt Endacott, pers. comm.

Table 3.1: Native plant species lists for "BushRAT" Assessments in 2014 and 2020. Ticks in black were observed in both 2014 and 2020, ticks in red only observed in 2014, and ticks in green only observed in 2020.

Species Name	Common Name	SA[13]	AMLR[14]	Management Zone										
				1	2	3aN	3aS	4a	5a	5b	6	7a	7b	7c
Acacia cupularis	Cup Wattle		RA					✓			✓			
Acacia ligulata	Umbrella Bush		RA		✓	✓	✓	✓	✓				✓	✓
Acacia longifolia ssp. sophorae	Coastal Wattle		LC		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Acacia pycnantha	Golden Wattle		LC			✓				✓				
Adriana quadripartita	Coast Bitter-bush		RA		✓	✓	✓	✓		P				✓
Allocasuarina verticillata	Drooping Sheoak		LC			✓	✓	✓	✓	✓				
Alyxia buxifolia	Sea Box		RA		✓	✓	✓	✓						✓
Atriplex cinerea	Coast Saltbush		LC	✓	✓	✓			✓		✓	✓	✓	✓
Austrostipa flavescens	Coast Spear-grass		LC			✓		✓		✓				
Austrostipa sp.	Spear-grass									✓	✓			
Baumea juncea	Bare Twig-rush		LC					✓	✓			✓		
Billardiera cymosa ssp. cymosa	Sweet Apple-berry		LC							✓				
Callitris gracilis	Southern Cypress Pine		LC					✓	✓	✓				
Carpobrotus rossii	Native Pigface		LC		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cassytha pubescens	Downy Dodder-laurel		LC				✓	✓						
Chrysocephalum apiculatum	Common Everlasting		LC						✓	✓				
Crassula closiana	Stalked Crassula		LC		✓	✓	✓				✓			
Clematis microphylla						P	P							
Daucus glochidiatus	Native Carrot		LC		✓	✓	✓				✓			
Dianella brevicaulis	Short-stem Flax-lily		NT		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush		LC		✓		✓					✓	✓	
Enchylaena tomentosa var. tomentosa	Ruby Saltbush		LC		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ficinia nodosa	Knobby Club-rush		LC		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Helichrysum leucopsideum	Satin Everlasting		NT					✓		✓				
Kennedia prostrata	Scarlet Runner		LC			✓				P				
Kunzea pomifera	Muntries		RA		✓	✓	✓	✓	✓	✓	✓			✓
Lepidosperma gladiatum	Coast Sword-sedge		NT		✓	✓	✓	✓		✓	✓	✓	✓	✓
Leucophyta brownii	Coast Cushion Bush		NT			✓	✓	✓	✓	✓			✓	
Leucopogon parviflorus	Coast Beard-heath		NT		✓	✓	✓	✓		✓		✓	✓	✓
Lomandra leucocephala ssp. robusta	Woolly Mat-rush		VU			✓		✓	✓	✓				
Lotus australis	Austral Trefoil		NT		✓			✓	✓				✓	
Melaleuca lanceolata	Dryland Tea-tree		RA					✓	✓					

[13] Under the *National Parks and Wildlife Act 1972*

[14] Regional rating for the Adelaide and Mount Lofty Ranges region as per Gillam, S. and Urban, R. (2014) Regional Species Conservation Assessment Project, Phase 1 Report: Regional Species Status Assessments, Adelaide and Mount Lofty Ranges NRM Region. Department of Environment, Water and Natural Resources, South Australia.

Species Name	Common Name	SA[13]	AMLR[14]	Management Zone										
				1	2	3aN	3aS	4a	5a	5b	6	7a	7b	7c
Muehlenbeckia gunnii	Coastal Climbing Lignum		LC		✓	✓	✓	✓	✓	✓			✓	✓
Myoporum insulare	Common Boobialla		NT		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nitraria billardierei	Nitre-bush		RA			✓	✓			✓	✓		✓	
Olearia axillaris	Coast Daisy-bush		NT		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pelargonium australe	Austral Stork's-bill		RA		✓	✓	✓	✓	✓	✓	✓	✓	✓	
Picris squarrosa	Hawkweed Picris	RA	EN		**P**	**P**	**P**				**P**			
Pimelea serpyllifolia ssp. serpyllifolia	Thyme Riceflower		NT		✓	✓	✓	✓			✓			
Poa poiformis var. poiformis	Coast Tussock-grass		LC			✓	✓	✓	✓	✓	✓	✓	✓	
Podolepis rugata var. littoralis	Coast Copper-wire Daisy		EN				✓			**P**			✓	
Rhagodia candolleana ssp. candolleana	Sea-berry Saltbush		LC		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rytidosperma sp.	Wallaby-grass						✓	✓						
Scaevola crassifolia	Cushion Fanflower		VU		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Senecio pinnatifolius var. pinnatifolius			NT		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Spinifex hirsutus	Rolling Spinifex		LC	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Tetragonia implexicoma	Bower Spinach		LC		✓	✓	✓	✓	✓		✓	✓	✓	✓
Threlkeldia diffusa	Coast Bonefruit		NT		✓	✓	✓	✓	✓	✓	✓	✓		✓
2014 TOTAL NATIVE SPECIES COUNT				**2**	**26**	**26**	**26**	**29**	**23**	**15**	**17**	**17**	**13**	**17**
2020 TOTAL NATIVE SPECIES COUNT				**2**	**23**	**31**	**26**	**33**	**25**	**27**	**22**	**18**	**21**	**20**

Key to conservation codes: EN = Endangered, VU = Vulnerable, RA = Rare, NT = Near Threatened, LC = Least Concern

P = noted as currently present in the area[15], but not observed during field inspection

[15] Matt Endacott, pers. comm.

Table 3.2: Introduced plant species lists for "BushRAT" Assessments in 2014 and 2020. Cells shaded red have an increase in weed cover category since 2014, and cells shaded green have a decrease in weed cover category since 2014. Species marked in bold have a high priority BushRAT rating (3 or higher), indicating they are high threat coastal weeds.

Species Name	Common Name	Lifeform	Bushrat rating	Management Zone																					
				1		2		3aN		3aS		7c		4		5a		5b		6		7a		7b	
				14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20
Lycium ferocissimum	**African Boxthorn**	**Woody**	**4**						**1**			**1**	**1**							**1**	**1**	**1**			**1**
Acacia cyclops	**Western Coastal Wattle**	**Woody**	**3**																**P**			**1**			
Rhamnus alaternus	**Buckthorn**	**Woody**	**3**							**1**															
Acacia saligna	Golden Wreath Wattle	Woody	2									1													
Melaleuca nesophila	Showy Honey-myrtle	Woody	2									1													
Nicotiana glauca	Tree Tobacco	Woody	2																				1		
Eucalyptus sp.	Planted Eucalypt	Woody	1																			1	1		
Tamarix aphylla	Tamarisk	Woody	2													1									
Agave sp.	**Century Plant**	**Succulent**	**3**									**1**						**1**		**1**		**1**			**1**
Aeonium sp.	Succulent garden escape	Succulent	2									1								1a	1	3			1
Agapanthus praecox ssp. orientalis		Succulent	2															1		1		1			
Cotyledon sp.	Succulent garden escape	Succulent	1																	1	1	1a			
Arctotis stoechadifolia	**Arctotis**	**Soft shrub**	**3**														**1**			**1a**	**1a**	**3**			
Argyranthemum frutescens ssp. foeniculaceum	**Marguerite Daisy**	**Soft shrub**	**3**																	**1**		**1a**			
Galenia pubescens var. pubescens	Coastal Galenia	Soft shrub	2			1a			1			1a		1		2		1a			1a			3	1a
Osteospermum fruticosum	Daisy garden escape	Soft shrub	2									1a								1a		2			1a
Yucca sp.	Yucca	Soft shrub	2																				1		
Geranium sp. (garden escape)	Geranium	Soft shrub	1									1													
Ehrharta calycina	**Perennial Veldt Grass**	**Perennial Grass**	**4**			**2**	**1**	**4**	**1a**	**1**	**2**	**2**	**1a**	**1a**	**2**	**2**	**3**	**5**	**1a**	**1a**	**1a**	**1a**			**1a**
Ammophila arenaria	**Marram Grass**	**Perennial Grass**	**4**					**P**											**P**						
Thinopyrum junceiforme	**Sea Wheat-grass**	**Perennial Grass**	**4**	**4**	**4**			**2**		**1**										**1a**					
Cenchrus clandestinus	**Kikuyu**	**Perennial Grass**	**3**										**1**												
Cynodon dactylon var. dactylon	Couch	Perennial Grass	2			1a	1a					1a	1a			1a	3		1				2	1a	1a
Stenotaphrum secundatum	Buffalo Grass	Perennial Grass	2								P														
Arundo donax	Bamboo	Other	2									1	1												
Phoenix canariensis	Canary Date Palm	Other	1																				1	1	
Euphorbia paralias	**Sea Spurge**	**Herb**	**3**	**2**	**2**															**1**					
Euphorbia terracina	**False Caper**	**Herb**	**3**			**1a**	**1a**		**1a**	**1a**	**1a**	**2**	**2**	**1a**	**1a**	**2**	**1a**	**1a**	**1a**	**1a**	**1a**	**1a**	**1a**	**1a**	**2**	**1a**

Species Name	Common Name	Lifeform	Bushrat rating	Management Zone																					
				1		2		3aN		3aS		7c		4		5a		5b		6		7a		7b	
				14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20
Gazania sp.	**Gazania**	**Herb**	**3**					**1**												**1a**	**1a**	**3**			**1a**
Trachyandra divaricata	**Dune Onion Weed**	**Herb**	**4**				**P**																		
Arctotheca calendula	Cape Dandelion	Herb	2							1												1a		1	1
Asphodelus fistulosus	Onion Weed	Herb	2			1													1						
Brassica tournefortii	Mediterranean Turnip	Herb	2			1a	1a	1a	1a		2	1a	2		2	2	3	1a	1a	1a	1a	1a	1a	1a		2
Cakile maritima ssp. maritima	Beach Rocket	Herb	2	1a	1a	1	1	1	1	1		1a	2	1	1a				1	1a	1a	1a			2
Dimorphotheca pluvialis[16]	Cape Marigold	Herb	2				P		P		P										3		P		
Medicago polymorpha var. polymorpha	Toothed Medic	Herb	2			2	2	1	1		1a								1a	1a	1a	1a	1a		
Mesembryanthemum crystallinum	Iceplant	Herb	2						1					1	1	1	1					1	1a		1a
Oenothera stricta ssp. stricta	Sweet-scented Evening Primrose	Herb	2						1a	1					1		1								
Reichardia tingitana	Reichardia	Herb	2			1a	1a	1a	1a			1a	1a			1a	1a	1a	1a	1a	1a	2	2		1a
Vicia monantha ssp. monantha	One-flower Vetch	Herb	2									1				1									
Lupinus cosentinii	Blue Lupin	Herb	2														1								
Chondrilla juncea	Skeleton Weed	Herb	2																		1		1		1
Sonchus oleraceus	Milk Thistle	Herb	1									1			P	1a		1				1a		1a	
Stellaria media	Common Chickweed	Herb	1															1							
Petrorhagia dubia	Velvet Pink	Herb	1				1																		
Tribulus terrestris	Caltrop	Herb							P										P						
Heliotropium europaeum	Common Heliotrope	Herb	1																				1		
Asparagus asparagoides f. asparagoides	**Bridal Creeper**	**Creeper**	**5**			**1a**	**1a**	**1a**		**1**		**2**		**1a**		**1**		**1**	**1**	**1**		**1a**			
Oxalis pes-caprae	**Soursob**	**Bulb**	**4**			**3**		**1a**		**2**		**5**		**2**		**2**		**3**		**1a**		**2**		**4**	
Romulea rosea var. australis	Guildford Grass	Bulb	2						1				1a				1a		1			1a		1	
Dietes iridioides	Dietes	Bulb	1																			1			
Avena barbata	Bearded Oat	Annual Grass	2			1	1	1a	1a							1a	1a	1a	1a	1a	1a	1a	2	1a	1a
Ehrharta longiflora	Annual Veldt Grass	Annual Grass	2				1				1	1a					1	1	1		1		1a	2	2
Lagurus ovatus	Hare's Tail Grass	Annual Grass	2			1a	1a		1a		1a		2		1a	1	1a	1a	2	1a	1a	2	2	1a	2
Polypogon monspeliensis	Annual Beard Grass	Annual Grass	2						1																
Vulpia sp.	Fescue	Annual Grass	2				1a		1		1				1						1a				

[16] This species was very difficult to identify in January 2020, as it had dried out and died back, but after discussion with Matt Endacott an identification was made based upon the samples collected

Species Name	Common Name	Lifeform	Bushrat rating	Management Zone																					
				1		2		3aN		3aS		7c		4		5a		5b		6		7a		7b	
				14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20	14	20
Briza maxima	Large Quaking-grass	Annual Grass	2						1				1				1				1a				
Paropholis incurva	Curly Ryegrass	Annual Grass	2				1														1				
Bromus sp.	Brome	Annual Grass	1				1		1a		1a		3		1a				1	1a	2	1a	4		2
Hordeum leporinum	Common Fox-tail	Annual Grass	1																			1			
Lamarckia aurea	Toothbrush Grass	Annual Grass	1										1												

P = noted as currently present in the area[17], but not observed during field inspection

Cover Rating			
not many, cover <1%	1	Covering 26 –50%	4
Plentiful, cover <1%	1a	Covering 51 – 75%	5
Covering 1 - 5%	2	Covering > 75%	6
Covering 5 – 25%	3		

[17] Matt Endacott, pers. comm.

3.3 Assessment of BushRAT scores and Photopoints for each Management Zone

3.3.1 Management Zone 1

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

"***Thinopyrum junceiforme, Spinifex hirsutus* Tussock Grassland**

Foredune communities naturally have a low species diversity and low plant life form diversity with a high proportion of herbs and grasses, a lack of tall shrubs and a relatively high percentage of bare ground[18].

The foredune (or primary dune) at Tennyson is dominated by the introduced Sea Wheat-grass (**Thinopyrum junceiforme*) with the native *Spinifex hirsutus* sparsely scattered throughout (approximately 1-5% projective foliage cover overall).

The removal of Sea Wheat-grass is considered unfeasible and is not a high priority as it has become naturalised in the dunes[19] and it assists in decreasing the frequency and severity of blowout development[20] along the foredune. Similarly, Sea Rocket (**Cakile maritima*) has become naturalised and currently provides sand stability and habitat and is therefore not a high priority species for control."

Table 3.3: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 1

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	2	4/15	1	2/15
Weeds	24	1/15	24	1/15
Native Plant Life forms	3	3/10	2	2/10
Regeneration	0	0/8	0	0/8
Native: Exotic Understorey Biomass		1/10		2/10
Bare Ground		2/3		2/3
Grazing Evidence		4/4		4/4
TOTAL VEGETATION CONDITION SCORE		15/65		13/65

[18] Croft, SJ, Pedler, JA & Milne, TI, 2006. *Bushland Condition Monitoring Manual. Coastal Vegetation Communities of the Southern Mt Lofty Ranges*, Nature Conservation Society of South Australia.
[19] Cordingley, S. & Petherick, C. 2006. *Vegetation Management Plan Tennyson Dune Reserve Yaitya Warra (True Indigenous Sand)*, SA Urban Forest Biodiversity Program, Adelaide.
[20] Hilton, M. et al, 2006. *The impact of exotic dune grass species on foredune development in Australia and New Zealand: A case study of Mmophila arenaria and Thinopyrum junceiforme*. Australian Geographer, 2006: 37(3) P. 313-334.

BushRAT photopoints from 2014 and 2020

Figure a: BushRat PhotoPoint Management Zone Tennyson 5/9/14 facing S at 269663,6138308

Figure b: BushRat PhotoPoint Management Zone 1 Tennyson 16/1/20

Table 3.3.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Bare Ground	Appears to be more bare ground in photopoint in 2020. No change in category for BushRAT data.	Negative	Low	Low	The location of the photopoint is at the end of a beach access, which requires regular sand removal to the beach due to accumulation along the west facing access. This may cause minor accumulation on the foredune recently after the sand has been cleated.
Overall condition score	Similar score in 2020 to 2014.	-	-	-	-
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Rolling Spinifex (*Spinifex hirsutus*) more abundant in 2020 than 2014.	Positive	Moderate	Moderate	May have naturally spread, but may also be as a result of revegetation activities.

3.3.2 Management Zone 2

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

***"Olearia axillaris, Rhagodia candolleana* ssp. *candolleana* Open shrubland**

The interdune swale at Tennyson supports a high diversity of plant species for a coastal shrubland community, including species which are now considered to be rare on the Adelaide coastline, such as *Adriana quadripartita*, *Kunzea pomifera* and *Lotus australis*. Targeted and sensitive weed control is ongoing in the swale.

Management Zone 2 has been divided into 'Zone 2 North' and 'Zone 2 South', essentially based on the successful and ongoing control of Perennial Veldt Grass, Bridal Creeper, Coastal Galenia and False Caper which has occurred in Zone 2 South, with the strategy being to shift the weed front northwards over time (into Zone 2 North).

As noted in the 2006 Vegetation Management Plan, if whole of reserve management issues such as rabbit control and fragmentation are addressed, "Little further action should be necessary besides allowing for natural regeneration with low scale supplementary plantings of structural and rarer species"".

Table 3.4: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 2

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	26	14/15	23	12/15
Weeds	22	5/15	18	7/15
Native Plant Life forms	17	9/10	18	10/10
Regeneration	5	7/8	4	6/8
Native: Exotic Understorey Biomass		9/10		9/10
Bare Ground		3/3		3/3
Grazing Evidence		2/4		4/4
TOTAL VEGETATION CONDITION SCORE		49/65		51/65

BushRAT photopoints from 2014 and 2020

Figure a: BushRat PhotoPoint Management Zone 2 Tennyson 2/9/14 facing S at 269919, 6137435

Figure b: BushRat PhotoPoint Management Zone 2 Tennyson 16/1/20

Table 3.4.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Native Plant Species Diversity	Lower species richness counts likely due to difficulty in detecting *Crassula closiana* and *Daucus glochidiatus* in summer (see Section 3.1).	Negative	Low	Low	Annual native species not dectable.
Weed Score	Decrease in cover of Perennial Veldt Grass (*Ehrharta calycina*) – both in BushRAT data and also photopoint.	Positive	Moderate	Moderate	Ongoing control of this priority species.
Bare Ground	The photopoint shows some evidence of sand movement in the foreground. There was accumulation of sand at the photopoint location estimated at 60cm deeper in 2020 than 2014.	Negative	High	Low	Photopoint adjacent to an east-west walkway.
Overall condition score	Overall condition score similar in 2020 than 2014.	-	-	-	-
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Soursob (*Oxalis pes-caprae*) prevalent in 2014 but not 2020.	Positive	High	Low	Likely due to seasonal timing of assessment see Section 3.2.7.
Shrub canopy health	There appears to have been death of at least two individuals of Coast-Daisy Bush (Olearia axillaris) visible in the photopoint.	Negative	High	Moderate	May be age-related dieback, but may also be driven by other factors, such as recent climatic conditions or competition with other species.

3.3.3 Management Zone 3a N

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

***"Olearia axillaris* Open shrubland**

Management Zone 3 supports a high diversity of native plant species. It should be noted that this zone was divided into 3a (more intact) and 3b (rehabilitation) in the 2006 Management Plan. As part of this project, the previous Management Zone 3b has been incorporated into a 'new' Management Zone 7 – "Garden encroachments/weedy edges", in an attempt to better manage and alleviate the pressures of adjacent housing development and associated garden encroachments.

Management Zone 3 has now been divided into 'Zone 3 North' and 'Zone 3 South', essentially based on the successful and ongoing control of Perennial Veldt Grass, Bridal Creeper, Coastal Galenia and False Caper which has occurred in Zone 3 South, with the strategy being to shift the weed front northwards over time (into Zone 3 North).

As with Management Zone 2, the primary focus should be on management of whole of reserve issues such as rabbit control, sensitive weed control, controlling people access, and low scale supplementary plantings of structural and rarer species. "

Table 3.5: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 3aN

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	26	14/15	31	15/15
Weeds	34	2/15	15	8/15
Native Plant Life forms	18	10/10	18	10/10
Regeneration	4	6/8	4	6/8
Native: Exotic Understorey Biomass		7/10		8/10
Bare Ground		3/3		3/3
Grazing Evidence		4/4		4/4
TOTAL VEGETATION CONDITION SCORE		**46/65**		**54/65**

BushRAT photopoints from 2014 and 2020

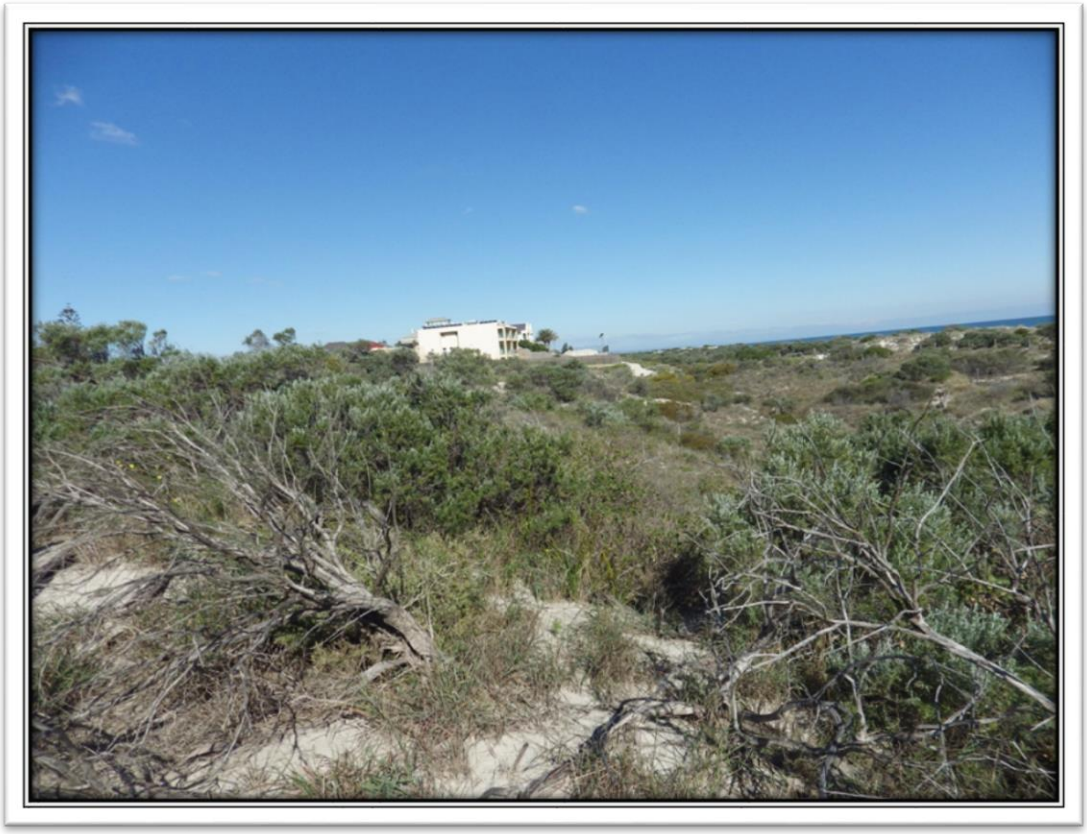

Figure a: BushRat PhotoPoint Management Zone 3aN Tennyson 7/8/14 facing S at 269899, 6137775

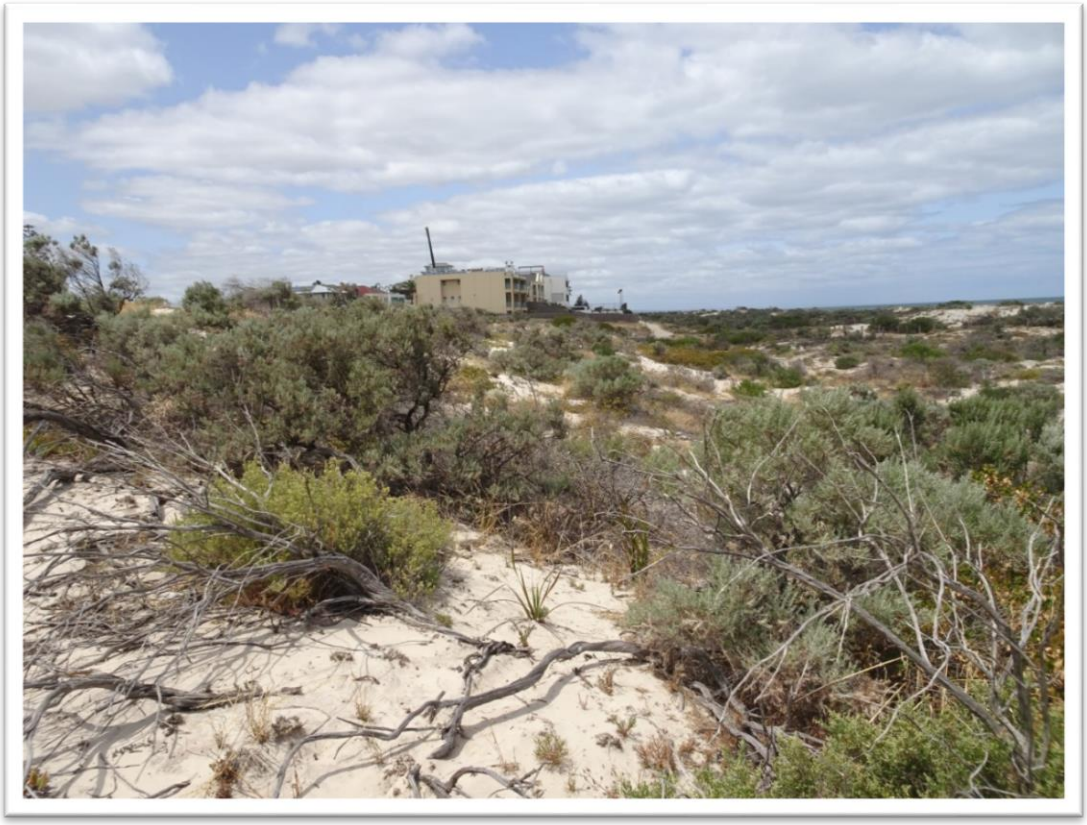

Figure b: BushRat PhotoPoint Management Zone 3aN Tennyson 16/1/20

Table 3.5.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Weed Score	Decrease in cover of Perennial Veldt Grass (*Ehrharta calycina*) – both in BushRAT data and also photopoint.	Positive	High	High	Ongoing control of this priority species.
Bare Ground	More bare ground evident in 2020 than 2014 in photopoint.	Neutral	High	Moderate	Likely due to control of Perennial Veldt Grass (*Ehrharta calycina*) making bare ground/sand more visible.
Overall condition score	Overall condition score better in 2020 than 2014.	Positive	Moderate	Moderate	Change driven principally by decrease in cover/abundance of weeds, notably Perennial Veldt Grass (*Ehrharta calycina*).
Shrub canopy health	There appears to have been death of at least three individuals of Coast-Daisy Bush (*Olearia axillaris*) visible in the photopoint.	Negative	High	Moderate	May be age-related dieback, but may also be driven by other factors, such as recent climatic conditions or competition with other species.

3.3.4 Management Zone 3a S

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

***"Olearia axillaris* Open shrubland**

Management Zone 3 supports a high diversity of native plant species. It should be noted that this zone was divided into 3a (more intact) and 3b (rehabilitation) in the 2006 Management Plan. As part of this project, the previous Management Zone 3b has been incorporated into a 'new' Management Zone 7 – "Garden encroachments/weedy edges", in an attempt to better manage and alleviate the pressures of adjacent housing development and associated garden encroachments.

Management Zone 3 has now been divided into 'Zone 3 North' and 'Zone 3 South', essentially based on the successful and ongoing control of Perennial Veldt Grass, Bridal Creeper, Coastal Galenia and False Caper which has occurred in Zone 3 South, with the strategy being to shift the weed front northwards over time (into Zone 3 North).

As with Management Zone 2, the primary focus should be on management of whole of reserve issues such as rabbit control, sensitive weed control, controlling people access, and low scale supplementary plantings of structural and rarer species. "

Table 3.6: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 3aS

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	26	13/15	26	13/15
Weeds	16	8/15	19	7/15
Native Plant Life forms	18	10/10	18	10/10
Regeneration	4	6/8	6	8/8
Native: Exotic Understorey Biomass		10/10		9/10
Bare Ground		3/3		3/3
Grazing Evidence		3/4		4/4
TOTAL VEGETATION CONDITION SCORE		**53/65**		**54/65**

BushRAT photopoints from 2014 and 2020

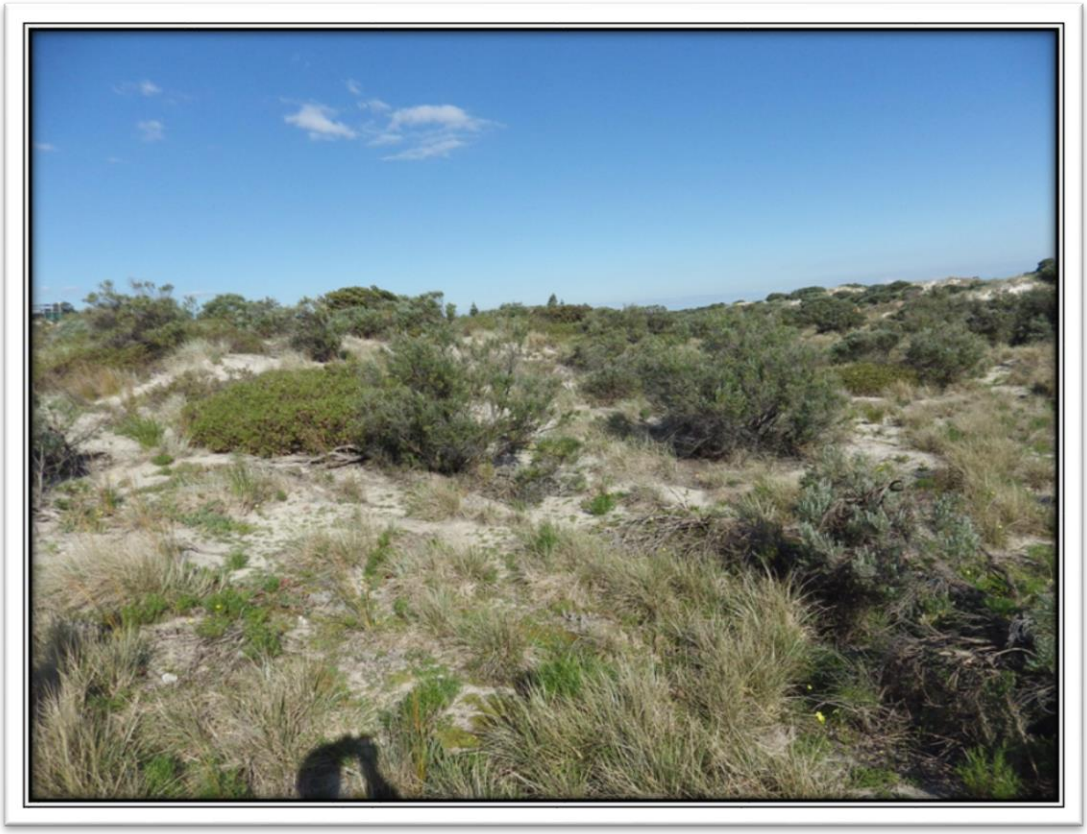

Figure a: BushRat PhotoPoint Management Zone3aS Tennyson 7/8/14 facing S at 269931, 6137494

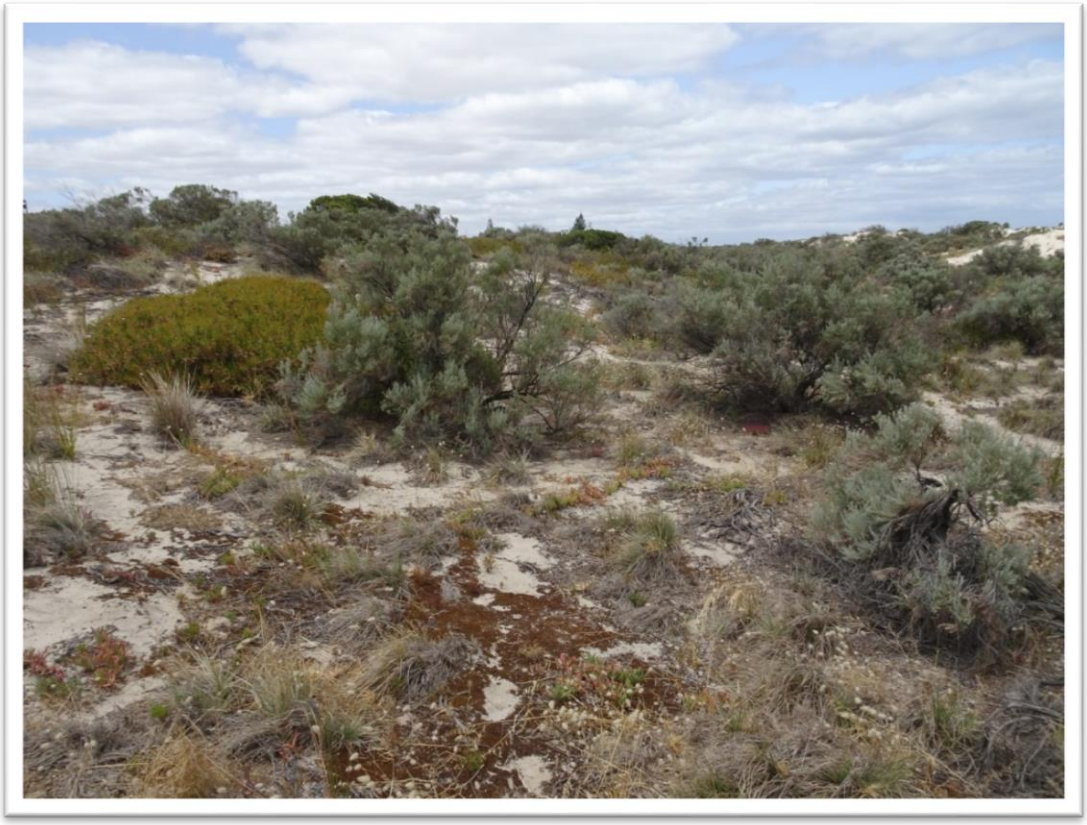

Figure b: BushRat PhotoPoint Management Zone 3aS Tennyson 16/1/20

Table 3.6.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Bare Ground	Moss cover more evident in 2020 than in 2014.	Neutral	High	Low	May represent seasonality of assessment rather than real change across years.
Overall condition score	Similar condition scores 2020 and 2014.				
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Hare's Tail Grass (*Lagurus ovatus*) evident in 2020 photopoint but not 2014.	Negative	High	Low	Likely due to seasonal timing of assessment see Section 3.2.8.
Shrub canopy health	There appears to have been death of at least one individual of Coast-Daisy Bush (*Olearia axillaris*) visible in the photopoint.	Negative	High	Moderate	May be age-related dieback, but may also be driven by other factors, such as recent climatic conditions or competition with other species.
Presence/density/ diversity of perennial grass, sedge and herbaceous weeds	Cover of Rolling Spinifex (*Spinifex hirsutus*) appears to have decreased in photopoint from 2014 to 2020.	Neutral	Low	Low	Unclear what may have driven this change. Generally this species is more abundant on foredune than in swale.
Presence/density/ diversity of perennial grass, sedge and herbaceous native species.	*Senecio pinnatifolius var*. more abundant in 2014 than 2020 photopoints.	Neutral	High	Low	May be driven by seasonal differences between assessments.
Density of low shrubs / mat plants	Cover of Karkalla (*Carpobrotus rossii*) appears to have increased in photopoint from 2014 to 2020.	Neutral	Low	Low	May represent real change in cover, but may also simply be increased detectability due to lower cover of other species.

3.3.5 Management Zone 4

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

***"Leucopogon parviflorus, Olearia axillaris, Acacia longifolia* var. *sophorae* +/- *Myoporum insulare* Shrubland**

The dominant overstorey species on the Hind Dune Ridge are *Leucopogon parviflorus* and *Olearia axillaris*, with the occasional *Melaleuca lanceolata*.

It should be noted that this zone was subdivided into 4a (more intact) and 4b (rehabilitation) in the 2006 Management Plan. Due to revegetation and weed control efforts, particularly in the vicinity of the southern carpark, this area is no longer deemed to be as degraded or in need of large-scale rehabilitation. The previously mapped Zone 4b near the northern carpark has now been incorporated into Management Zone 5b and a broadscale revegetation program is recommended in this area (see Section 7.5 for details).

As with Management Zones 2 and 3, the primary focus in Management Zone 4 should be on management of whole of reserve issues such as rabbit control, sensitive weed removal and track rationalisation, with low scale supplementary plantings of structural and rarer species as required. "

Table 3.8: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 4

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	29	14/15	33	15/15
Weeds	13	9/15	19	7/15
Native Plant Life forms	18	10/10	14	8/10
Regeneration	4	6/8	3	4/8
Native: Exotic Understorey Biomass		9/10		7/10
Bare Ground		3/3		3/3
Grazing Evidence		2/4		3/4
TOTAL VEGETATION CONDITION SCORE		**53/65**		**47/65**

BushRAT photopoints from 2014 and 2020

Figure a: BushRat PhotoPoint Management Zone 4 Tennyson 7/8/14 facing S at 269990, 6137436

Figure b: BushRat PhotoPoint Management Zone 4 Tennyson 16/1/20

Table 3.8.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Overall condition score	Overall condition score has decreased from 53 to 47. Understorey biomass and weed cover were the major changes, driven by an increase in cover of *Brassica tournefortii* and Perennial Veldt Grass (*Ehrharta calycina*).	Negative	Moderate	Moderate	This Management Zone may not have been a priority area for activity on Perennial Veldt Grass (*Ehrharta calycina*) in recent years.
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Perennial Veldt Grass (*Ehrharta calycina*) was estimated as higher cover in 2020 than 2014.	Negative	Moderate	Moderate	Change in cover of Perennial Veldt Grass (*Ehrharta calycina*). This Management Zone may not have been a priority area for activity on this species in recent years.
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Soursob (*Oxalis pes-caprae*) prevalent in 2014 but not 2020.	Positive	High	Low	Likely due to seasonal timing of assessment see Section 3.2.7.
Shrub canopy health	There appears to have been death of at least one individual of Coast-Daisy Bush (*Olearia axillaris*) visible in the foreground and several in the background of the photopoint. Also one *Acacia ligulata/cupularis* has also died.	Negative	High	Moderate	May be age-related dieback, but may also be driven by other factors, such as recent climatic conditions or competition with other species.

3.3.6 Management Zone 5a

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

***"Allocasuarina verticillata, Callitris gracilis* Very low Woodland (back dune adjacent southern carpark)**

The structure and diversity of this area, which abuts the southern car park, has changed markedly since the 2006 Vegetation Management Plan due to several broad-scale revegetation projects, most recently in 2014. The site now supports an open cover of Sheoak (*Allocasuarina verticilata*), Native Pine (*Callitris gracilis*) and Dryland Tea-tree (*Melaleuca lanceolata*) over a range of small shrubs and groundcovers including *Senecio pinnatifolius, Scaevola crassifolia, Tetragonia implexicoma, Threlkeldia diffusa* and *Rhagodia candolleana*. Of note, is the presence of *Lomandra leucocephala* ssp. *robusta* and *Kunzea pomifera*, both of which are regenerating well.

Plantings in 2014 follow the mapping undertaken by the Coast Protection Board, DEWNR and have been divided into three sub-units:

- *Melaleuca lanceolata* Open low woodland + *Tetragonia implexicoma*
- *Scaevola crassifolia* Shrubland
- *Allocasuarina verticillata* Low open woodland"

Table 3.9: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 5a

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	23	11/15	25	12/15
Weeds	24	5/15	30	3/15
Native Plant Life forms	17	8/10	16	8/10
Regeneration	1	2/8	3	4/8
Native: Exotic Understorey Biomass		7/10		3/10
Bare Ground		3/3		1/3
Grazing Evidence		2/4		3/4
TOTAL VEGETATION CONDITION SCORE		**43/80**		**40/80**

BushRAT photopoints from 2014 and 2020

Figure a: BushRat PhotoPoint Management Zone 5a Tennyson 2/9/14 facing N at 270074, 6137407

Figure b: BushRat PhotoPoint Management Zone 5a Tennyson 16/1/20

Table 3.9.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Native:exotic Understorey Biomass	Estimated as lower native:exotic cover in 2020 than 2014.	Negative	High	Low	Annual grassy weeds more prevalent in 2020 than 2014 may be reason for lesser estimate in 2020.
Overall condition score	Slight decrease in overall condition score.	Negative	Moderate	Low	May be principally driven by increase in annual grassy weed cover in 2020 assessments.
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Annual grassy weeds evident in 2020 photopoint and BushRAT data but not 2014.	Negative	High	Low	Likely due to seasonal timing of assessment see Section 3.2.8.
Presence/density/ diversity of perennial grass, sedge and herbaceous native species.	*Senecio pinnatifolius var*. more abundant in 2014 than 2020 photopoints.	Neutral	High	Low	May be driven by seasonal differences between assessments.
Density of low shrubs / mat plants	Cover of Karkalla (*Carpobrotus rossii*) appears to have increased in photopoint from 2014 to 2020.	Positive	Moderate	Moderate	Likely as a result of revegetation activities.
Plant growth	Dropping She-oaks (*Allocasuarina verticillata*) and Native Pine (*Callitris gracilis*) have survived and continued to grow. Cones more abundant on central She-oak in 2020 than 2014.	Positive	High	High	Ongoing survival and growth of revegetation.

3.3.7 Management Zone 5b

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

***"Olearia axillaris* Open shrubland with emergent *Allocasuarina verticilllata* (back dune adjacent northern carpark)**

Management Zone 5b, abutting the northern carpark, supports only scattered remnant vegetation and scattered plantings throughout. Perennial Veldt Grass dominates with over 50% projective foliage cover.

It is recommended that a revegetation program is developed for Management Zone 5b, with efforts over the next five years aiming to replicate an *Allocasuarina verticillata, Melaleuca lanceolata* Low woodland formation. This would provide a significant buffer to the main dunes system."

Table 3.10: Comparison of "BushRAT" scoring attributes from 2014 to 2020

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	15	9/15	27	14/15
Weeds	30	3/15	18	7/15
Native Plant Life forms	11	6/10	17	9/10
Regeneration	1	2/8	1	2/8
Native: Exotic Understorey Biomass		2/10		6/10
Bare Ground		3/3		3/3
Grazing Evidence		1/4		4/4
TOTAL VEGETATION CONDITION SCORE		**26/65**		**45/65**

BushRAT photopoints from 2014 and 2020

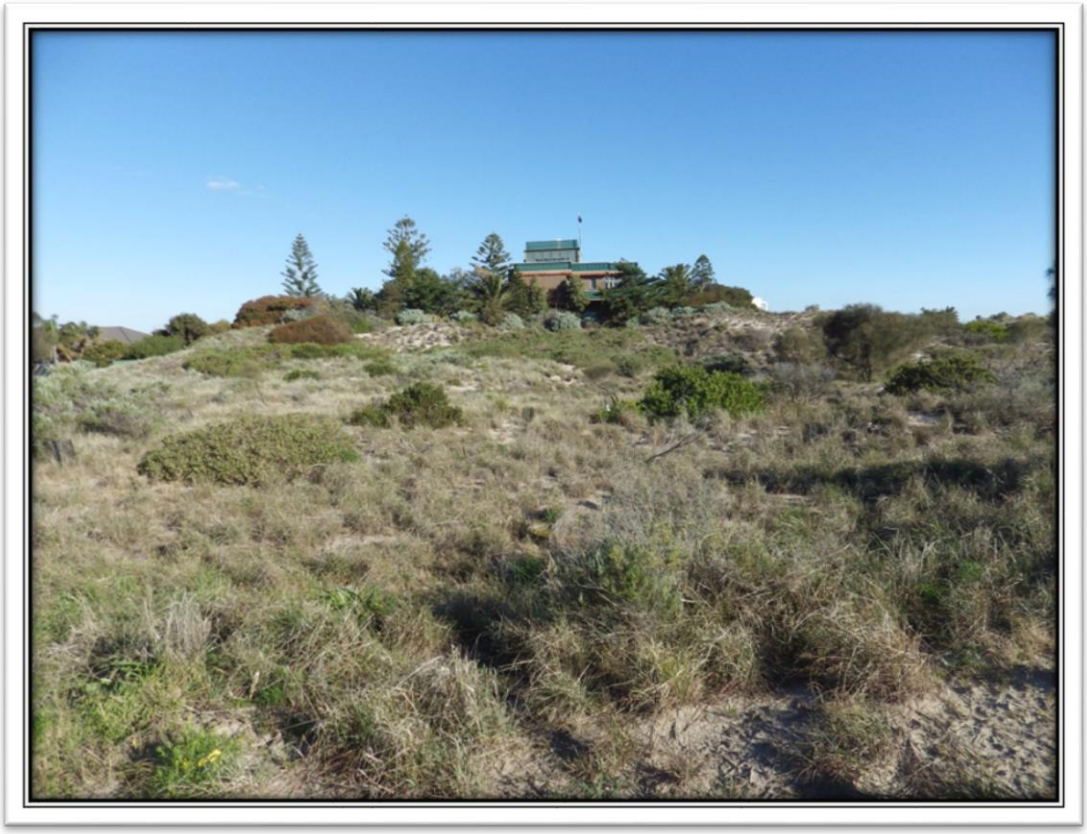

Figure a: BushRat PhotoPoint Management Zone 5b Tennyson facing S at 269999, 6137814

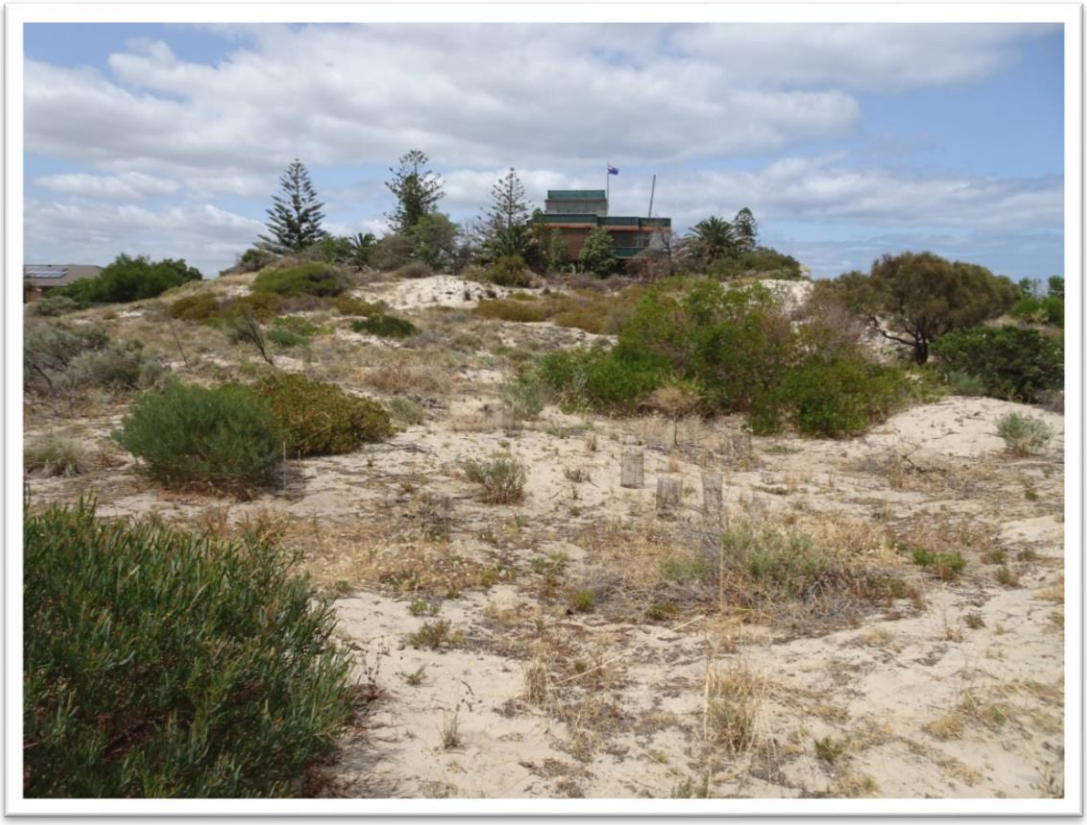

Figure b: BushRat PhotoPoint Management Zone Tennyson 16/1/20

Table 3.10.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Native Plant Species Diversity	Not detectable in photopoints, but BushRAT data showed an increase in species richness from 15 to 27 species.	Positive	High	High	Recent revegetation has increased species richness in this Management Zone.
Native Plant Life Forms	Not detectable in photopoints, but BushRAT data showed an increase in the cover of a variety of native plant life forms.	Positive	High	High	Recent revegetation has increased cover in a variety of native plant lifeforms in this Management Zone.
Native:exotic Understorey Biomass	Percentage of the understorey composed of native species has increased in both photopoints and BushRAT data.	Positive	High	High	Principally driven by a decrease in cover of Perennial Veldt Grass (*Ehrharta calycina*)
Bare Ground	A higher amount of bare sand visible in 2020 than 2014.	Positive	High	High	In 2014 bare ground was very low due to presence of Perennial Veldt Grass (*Ehrharta calycina*). Removal of this species has opened more bare sand, which is considered appropriate for a coastal dune system (ie the Veldt Grass was driving an unnaturally high ground cover in this Management Zone).
Overall condition score	Increased from 26 to 45, principally due to factors discussed above.	Positive	High	High	Weed control and revegetation programs.
Weed Score	Decrease in cover of Perennial Veldt Grass (*Ehrharta calycina*) – both in BushRAT data and also photopoint.	Positive	High	High	Ongoing control of this priority species.

3.3.8 Management Zone 6

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

"Interdune swale and remnant patches of hind-dune vegetation north of Coronado Court

This zone occurs between the foredune and the narrow north-south walking track north of Coronado Court, and also includes small patches of moderately intact hind-dune vegetation which persist between the areas of garden encroachments, abutting the houses on the eastern boundary of the zone.

This zone has not been a focus of active management in the past few years, but it is recommended that, with the potential incorporation of this area into the conservation reserve, it should be a high priority for weed control and supplementary planting over the next five years in order to improve its biodiversity value. "

Table 3.11: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 6

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	17	10/15	22	12/15
Weeds	18	7/15	17	7/15
Native Plant Life forms	20	10/10	19	10/10
Regeneration	4	6/8	4	6/8
Native: Exotic Understorey Biomass		9/10		8/10
Bare Ground		3/3		3/3
Grazing Evidence		4/4		4/4
TOTAL VEGETATION CONDITION SCORE		**49/65**		**50/65**

BushRAT photopoints from 2014 and 2020

Figure a: BushRat PhotoPoint Management Zone 6 Tennyson facing S at 269658, 6138407

Figure b: BushRat PhotoPoint Management Zone Tennyson 16/1/20

Table 3.11.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Overall condition score	Condition score has remained relatively consistent.				
Bare Ground	Appears to be more bare ground in photopoint in 2020. No change in category for BushRAT data.	Negative	Low	Low	The location of the photopoint is along a beach access, which has bare ground which may promote sand movement.

3.3.9 Management Zone 7a

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

"Areas of garden encroachments and weedy edges

Garden encroachments occur most notably north of Coronado Court, but also in other areas where houses abut the eastern dunes boundary. They are a significant problem and a high priority management issue at Tennyson because they:

- are a source of high threat weed species;
- cause erosion;
- alter soil chemistry and composition;
- provide potential harbours for pest animals such as rabbits;
- fragment and degrade the dune vegetation and its habitat values for native birds and reptiles;
- create an atmosphere of implied ownership by private residents upon public land; and
- detract from the aesthetic values of the area (i.e. the dunes provide a 'natural' buffer between the beach and houses).

It is recommended that the problem of garden encroachments is addressed with individual landholders, on a case by case basis, to resolve the following issues:

- where the boundary between the dunes and private property occurs;
- the planting/dumping of inappropriate garden species within the dunes; and
- private beach access paths through the dunes."

Table 3.12: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 7a

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	17	10/15	18	11/15
Weeds	32	3/15	20	6/15
Native Plant Life forms	13	8/10	12	7/10
Regeneration	1	2/8	3	4/8
Native: Exotic Understorey Biomass		3/10		6/10
Bare Ground		3/3		3/3
Grazing Evidence		4/4		4/4
TOTAL VEGETATION CONDITION SCORE		**33/65**		**41/65**

BushRAT photopoints from 2014 and 2020

Figure a: BushRat PhotoPoint Management Zone 7a Tennyson 7/8/14 facing SE at 269828, 6137922

Figure b: BushRat PhotoPoint Management Zone 7a Tennyson 16/1/20

Table 3.12.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Weed Score	BushRAT weed score has improved, principally due to control of succulent species.	Positive	High	High	Control program for weeds in this Management Zone.
Native:exotic Understorey Biomass	The proportion of the understorey that is native has been estimated to have increased from 2014 to 2020.	Positive	High	High	Lower cover of introduced species, particularly succulents such as *Aeonium sp*.
Bare Ground	More bare ground visible in 2020 than 2014 photopoint.	Neutral	Low	Low	Likely due to increased visibility due to removal of succulent species.
Overall condition score	Increased from 33 in 2014 to 41 in 2020, mostly due to reduced cover of weedy succulent species.	Positive	High	High	Weed control program.
Presence/density/ diversity of perennial grass, sedge and herbaceous weeds	Succulent species, such as *Aeonium spp*., are no longer evident in the photopoint.	Positive	High	High	Ongoing weed control has removed these species.
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Gazania (*Gazania sp*.) are no longer evident in the photopoint.	Positive	High	High	Ongoing weed control has removed these species.

3.3.10 Management Zone 7b

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

The assessment undertaken in Management Zone 7b was not included in the original Action Plan, as it was only a very small area and was included in Management Zone 7. However, it was re-assessed and the data is presented below:

Table 3.13: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Zone 7b

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	13	8/15	21	12/15
Weeds	20	6/15	20	6/15
Native Plant Life forms	6	3/10	8	4/10
Regeneration	1	2/8	2	3/8
Native: Exotic Understorey Biomass		2/10		2/10
Bare Ground		1/3		1/3
Grazing Evidence		3/4		4/4
TOTAL VEGETATION CONDITION SCORE		**25/65**		**32/65**

BushRAT photopoints from 2014 and 2020

Figure a: BushRat PhotoPoint Management Zone Tennyson 7b facing SSE at 269967, 6137510

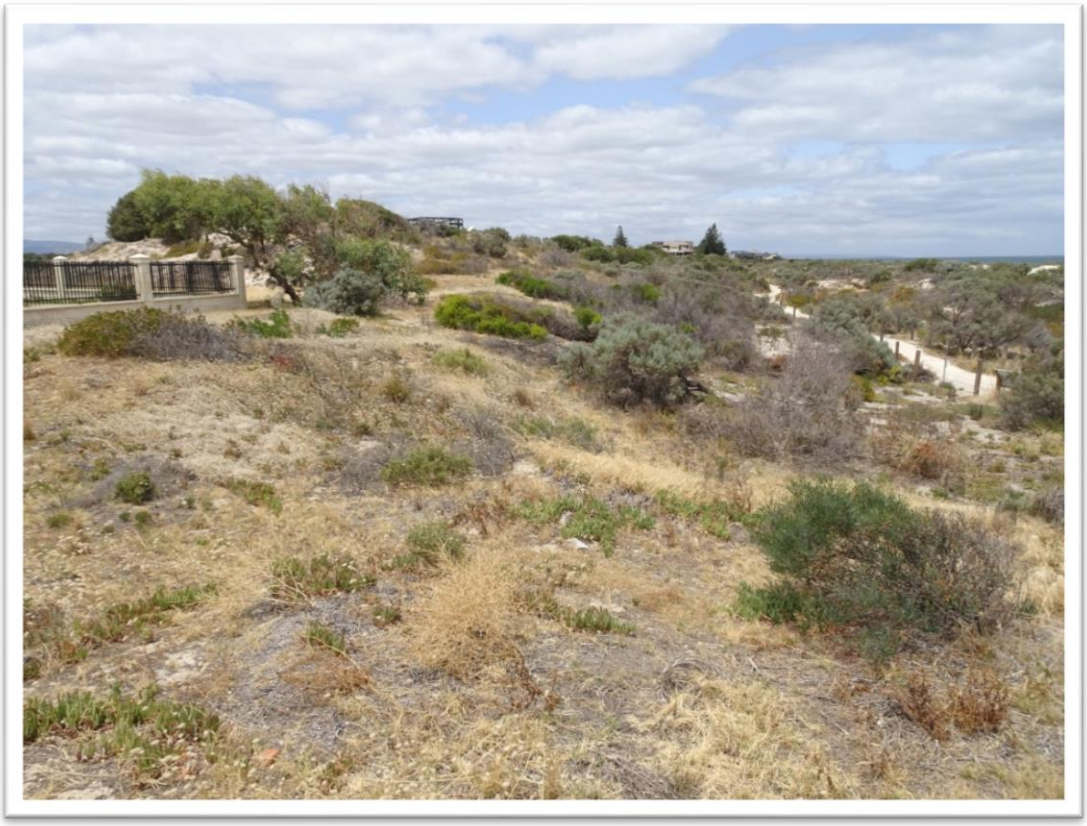

Figure b: BushRat PhotoPoint Management Zone 7b Tennyson 16/1/20

Table 3.13.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this management unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Native Plant Species Diversity	21 native species scored in 2020, compared to 13 in 2014.	Positive	Moderate	Moderate	Likely to be a result of revegetation activities.
Overall condition score	Improved from 25 in 2014 to 32 in 2020.	Positive	Moderate	Moderate	Driven principally by increase in native plant species present in the assessment area, likely due to revegetation activities.
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Hare's Tail Grass (*Lagurus ovatus*) evident in 2020 photopoint but not 2014.	Negative	High	Low	Likely due to seasonal timing of assessment see Section 3.2.8.
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Soursob (*Oxalis pes-caprae*) prevalent in 2014 photopoint but not 2020.	Positive	High	Low	Likely due to seasonal timing of assessment see Section 3.2.7.

3.3.11 Management Zone 7c

Description of this Management Zone from 2015 Tennyson Dunes Biodiversity Action Plan:

Management Zone 7c was initially assessed as Management Zone 3b in the original Action Plan. Results for the BushRAT were not included in the original report, as it was a small section of land that was under the care and control of City of Charles Sturt Council. However, as data was gathered in this area in 2014, it has been included in this report. It is a relatively small area that was previously heavily invaded by plants from nearby gardens, with succulent species common.

Table 3.7: Comparison of "BushRAT" scoring attributes from 2014 to 2020 – Management Unit 7c

Attribute	2014		2020	
	Raw score	Scaled Score	Raw score	Scaled Score
Native Plant Species Diversity	17	10/15	20	12/15
Weeds	23	5/15	22	5/15
Native Plant Life forms	10	6/10	12	7/10
Regeneration	1	2/8	4	6/8
Native: Exotic Understorey Biomass		3/10		3/10
Bare Ground		1/3		3/3
Grazing Evidence		3/4		4/4
TOTAL VEGETATION CONDITION SCORE		**30/65**		**40/65**

BushRAT photopoints from 2014 and 2020

Figure a: BushRat PhotoPoint Management Zone 7c Tennyson 7/8/14 facing W at 270042, 6137117

Figure b: BushRat PhotoPoint Management Zone 7c Tennyson 16/1/20

Table 3.7.1: Confidence and possible causative reasons for changes in photopoints and BushRAT scores in this Management Unit

Relevant change indicators	Specific detail	Positive or negative change	Confidence change is real	Confidence change represents long-term change at broad scale	Possible causative reasons
Overall condition score	Increased from 30 in 2014 to 40 in 2020, through a variety of indicators.	Positive	Moderate	Moderate	
Presence/density/ diversity of perennial grass, sedge and herbaceous weeds	Succulent species, such as *Aeonium spp*., are no longer evident in the photopoint.	Positive	High	High	Ongoing weed control has removed these species.
Shrub canopy health	There appears to have been death of at least three individuals of Coast-Daisy Bush (*Olearia axillaris*) visible on the dune in the background	Negative	High	Moderate	May be age-related dieback, but may also be driven by other factors, such as recent climatic conditions or competition with other species.
Presence/density/ diversity of annual grass, sedge and herbaceous weeds	Annual grassy weeds evident in 2020 photopoint and BushRAT data but not 2014.	Negative	High	Low	Likely due to seasonal timing of assessment see Section 3.2.8.
Bare Ground	More bare ground visible in 2020 than 2014 photopoint.	Neutral	Low	Low	Likely due to increased visibility due to removal of succulent species.

4. Summary of Results and Discussion

The timing of the assessments (summer in 2020 versus late winter / early spring in 2014) is considered likely to have compromised the ability to assess some attributes, particularly those heavily influenced by seasonal timing, including:

- Cover of annual grassy weeds
- Cover of annual herbaceous species, especially Soursob (**Oxalis pes-caprae*)
- Cover of Bridal Creeper (**Asparagus asparagoides*)

It is recommended that if future re-assessment is undertaken, then it is in late August/early September to help reduce these seasonal impacts. Notwithstanding this, re-assessment of the BushRAT sites and photopoints has demonstrated a number of changes within Tennyson Dunes / Wara Wayingga, many of which are due to the ongoing efforts of the Tennyson Dunes Group, supported by contractors managed by Natural Resources Adelaide and Mount Lofty Ranges. Changes that are considered noteworthy are summarised below, as either positive or negative changes:

Positive changes

- Decrease in cover of Perennial Veldt Grass (**Ehrharta calycina*) in Management Zones 2, 3aN, 7c, 5b. Estimated cover of this species in these Management Zones was significant (eg in Zone 3a was 26-50% and Zone 5b was 51-75%), and now in all of these zones is estimated at <1% cover.
- Succulent species, such as **Aeonium* spp., and **Cotyledon* sp., which were formerly abundant in some Management Zones, especially adjacent to houses, are now reduced to very scattered individuals only.
- Highly threatening daisy species, such as White Arctotis (**Arctototis stoechadifolia*) and Marguerite Daisy (**Argyranthemum frutescens ssp. foeniculaceum*) have decreased in abundance or have been eradicated.
- Priority woody weeds have been eradicated or reduced to very low levels.
- Species richness has increased in most management zones, likely as a result of targeted revegetation, combined with weed control.
- There has been a large improvement in overall condition, including species richness, weed abundance, cover and abundance of plant lifeforms, and estimated native:exotic biomass in Management Zone 5b.

In addition the following anecdotal observations[21] have been made:

- The State Rare Hawkweed Picris (*Picris squarrosa*) has increased in abundance, especially in Management Zones 2, 3N, 3S, 6 and 7
- The regionally Vulnerable Woolly Mat-rush (*Lomandra leucocephala*) has recruited and increased in abundance in areas where intensive Perennial Veldt Grass (*Ehrharta calycina)* control has been undertaken, especially in Zone 5b
- There were previously 3 main patches of the regionally Near Threatened Satin Everlasting (*Helichrysum leucopsideum*), which have increased in size and the species is now found in several additional areas

[21] Matt Endacott, pers. comm.

Negative changes

- Increase in cover of Perennial Veldt Grass (**Ehrharta calycina*) in Management Zones 3aS, 4 and 5a. Whilst still estimated at <5% cover in these areas, these estimates still represent an increase from the 2014 assessment.
- Cape Marigold (*Dimorphotheca pluvialis*) appears to have increased in cover within the Dunes, especially in Management Zone 6

In addition to these changes, three changes were noted that are recommended for ongoing vigilance, as whilst not currently clearly positive or negative, may cause significant impact in the dunes if the detected trends continue. These are:

- Dieback of Coast Daisy-bush (*Olearia axillaris*). This was detected in a number of photopoints. Some dieback of Coast Beard-heath (*Leucopogon parviflorus*) was also noted at the time of inspection, but was not borne out in the data or photopoints due to the relatively low abundance of this species. Whilst this dieback may be due to age, ongoing vigilance is recommended in case there are other causative reasons.
- Continued movement or accumulation of sand, noted in a number of photopoints.
- Continued high cover of the herbaceous weed Mediterranean Turnip (**Brasssica tournefortii*). Whilst not considered a high threat weed, it was at significant cover in a number of Management Zones at the 2020 assessment.