CHAPTER 4

PLANTS AND VEGETATION

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CONTENTS

Executive Summary

CapeNature has not only a national, but international responsibility in conserving two of the world's six floral kingdoms. The greatest threats to the plant taxa are permanent habitat loss (including urban expansion, infrastructure development, and agricultural expansion), invasive alien plant species and habitat degradation. No additional extinctions have been recorded since 2012, the number of species listed at Critically Endangered has declined slightly (from 333 to 330) but there are significant increases in the Endangered and Vulnerable categories (from 575 to 636 and 801 to 900 respectively). These changes are largely due to habitat loss but illegal collecting and taxonomic revisions have also affected numbers.

Altogether 14 vegetation types have deteriorated in status due to habitat transformation from a range of competing land use pressures such as agricultural and urban expansion, industrial development, mining, renewable energy installations and coastal development.

Biodiversity within large areas of CapeNature reserves is threatened by too frequent fires. A flexible and adaptive management framework is required to effectively manage indigenous vegetation under this unpredictable threat. Thresholds for potential concern using appropriate monitoring still needs to be determined for a number of protected areas.

Six reserve clusters have extensive levels of plant invasion and therefore a risk of non-optimal biodiversity restoration exists. Prioritisation of areas for clearing are clearly identified according to objective criteria. Planned clearing projects need to strictly focus on these. Improvements and expansion of biological agent releases needs to be made. Minimal resources are required for this potentially highly effective control method.

We recommend that:

- continued rolling out and awareness of planning tools are necessary to ensure we aren't losing irreplaceable habitats;
- innovative ways of meeting the plant utilisation requirements whilst conserving source populations in Protected Areas are sought;
- thresholds of potential concern need to be identified for all reserves, supported by a long term monitoring and assessment programme;
- planning of IAP clearing projects strictly focus on the areas identified as priorities;
- formulation and implementation of an adaptive management framework for monitoring the impact of IAPs on biodiversity;
- pine management tools (e.g. herbicide) should be pursued to reduce spread; and
- biodiversity restoration, although vital, can be resource intensive, but investigation to explore options is feasible over the next period.

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1. Introduction

The Western Cape Province (WCP) includes most of the Greater Cape Floristic region. This region, which previously included the Cape Floristic Region and Succulent Karoo (Born *et al.*, 2007), is acclaimed for high levels of endemism and diversity of plant species and vegetation communities (Born *et al.*, 2007). CapeNature therefore has not only a national, but international responsibility in conserving two of the world's six floral kingdoms (Cape Floral kingdom and part of the Paleotropic kingdom). The greatest threats to the plant taxa in the WCP are permanent habitat loss (including urban expansion, infrastructure development, and agricultural expansion), invasive alien plant (IAP) species, climate change and habitat degradation (such as overgrazing and inappropriate fire regimes).

The primary mechanism for protection of floral diversity, and all the ecosystem services associated with this diversity, in the WCP is through maintaining the conservation estate and expanding it through stewardship (see Chapter 2). Protected areas face fewer threats than areas undergoing urban and agricultural expansion. In addition to expansion of the protected area network, CapeNature's focus for conserving plant diversity and ecosystem integrity has been on the alleviation of these threats.

The primary threats to plants and vegetation by far, are too frequent fires and invasive alien plants. Current efforts to address these are discussed in more detail below. Keeping track of the integrity of the WCP flora and the services it provides, is vital to know when conservation actions are required. Various monitoring projects for indigenous plant threat status and population surveillance, IAP management, thresholds for potential concern (identifying and responding to inappropriate fire regimes), and over-harvesting of species are therefore also discussed.

Methods for analyses are discussed under the respective sections and use similar techniques and tools as Le Roux *et al.*, (2012). An update of the systematic account is not included in this iteration. However, no significant changes in numbers of taxa and their endemic status have been noted. Please refer to Le Roux *et al.*, (2012) for statistics relating to systematics, distribution and endemism.

2. Conservation status of plants

2.1 Species conservation status

The first comprehensive plant Red List was produced in 2009, making South Africa the first mega-diverse country to assess its entire flora (Raimondo *et al.*, 2009). Currently, the Red List is updated regularly and the list is dynamic with changes being made when new information becomes available. These updates are made by SANBI's Threatened Species Programme team in collaboration with species experts and provincial agencies such as CapeNature. As can be seen in Table 1, there are significant changes towards increased levels of threat in the categories Endangered and Vulnerable. A large contributor to this increase has been habitat loss (mainly agriculture) in new areas (this is reflected in the Table 2).

In the 2017 update, 175 Western Cape species have changed status. Factors influencing increases in threat status include taxonomic revisions, illegal collecting and habitat loss. Increased and targeted fieldwork by a range of workers now coordinated through networks such as SANBI's CREW program using the Red List as an index has also resulted in numerous taxa being "downlisted" (a decrease in threat status) as well as "uplisted" due to better field knowledge.

Table 1: Changes to the South African Red List threat status of threatened indigenous plant species in the Western Cape over the past 5 years.

IUCN Threat status	2012	2017
Extinct	21	20
Extinct in wild	3	3
Critically Endangered and Presumed extinct	37	38
Critically Endangered	296	292
Endangered	575	636
Vulnerable	801	900

Table 2. Plant Species in the Western Cape which are of Conservation Concern but not yet threatened. (These categories were not listed in the 2012 report and are included as a baseline for the next report).

Threat status	2017
Near Threatened	323
Critically Rare	110
Rare	822
Data Deficient (Insufficient Information)	216
Data Deficient (Taxonomically Problematic)	563

A future trend to watch out for is the elevation of species in the Critically Rare (110) and Rare (822) (Table 2) categories into the threatened categories. These species are either known from a single site (Critically Rare) or meet at least one of the four South African criteria for rarity (see National Red List Categories section of redlist.sanbi.org) but are not exposed to any direct and plausible threat. With the proliferation of invasive alien plants and climate change related precipitation uncertainty, areas such as nature reserves, which were previously regarded as safe, are vulnerable unless additional resources are sourced and competently disbursed.

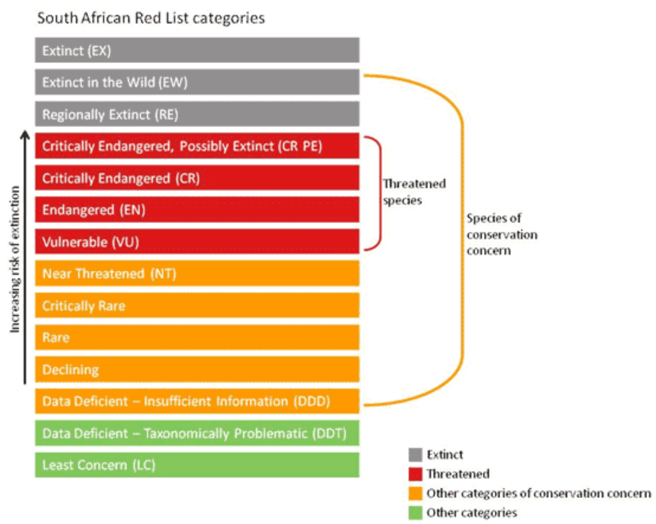

Figure 1: South African Red List categories indicating that threatened species are a subset of species that are of conservation concern. Source: SANBI Red List.

In total, there are 3 923 Species of Conservation Concern (SCC) in the Western Cape. Species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD)." (SANBI 2017), see Figure 1. A full list of these species is available at http://redlist.sanbi.org/.

2.2. Vegetation conservation status

Since April 2013, CapeNature has had a conservation planner and this has enabled the organisation to have up to date conservation statuses for vegetation types. The last national update was in 2011 and according to the National Environmental Management: Biodiversity Act (No. 10 of 2004), the list must be reviewed at least every five years and this is now possible. CapeNature has thus been able to do updates in 2014 and 2016. As can be seen, rapid transformation of habitat occurred in several areas, leading to increased threat status. Results with status changes are in Table 2.

This section is to be read in conjunction with the 2012 SOB report (Le Roux *et al.* 2012), emphasis has been placed on the threatened ecosystems (Figure 2) as opposed to listing all vegetation types in the Western Cape as was done previously. Readers would notice that the figures of total hectares remaining for the various vegetation types from 2012 and 2017 do not match up. Like the Red List, the SA vegetation map is regularly updated with in-field information, improved spatial products and techniques contributing towards a more up to date understanding of the spatial extent of habitat.

Increased scrutiny of vegetation maps and detailed field observations mean that there are also new vegetation types, such as Peninsula Shale Fynbos, Nardouw Sandstone Fynbos and Citrusdal Shale Renosterveld (Dayaram *et al.*, 2016).

Interestingly, the latter two have immediately been recognised as threatened ecosystems as they occur in areas of the Western Cape where agricultural expansion in the last decade has been rapid.

Altogether 14 vegetation types have deteriorated in status due to habitat transformation (see highlighted in Table 2) from a range of competing land use pressures such as agricultural and urban expansion, industrial development, mining , renewable energy installations and coastal development (see Chapter 2).

Plate 1. Rooibos tea lands in Nardouw Sandstone Fynbos, a newly described vegetation type.

A further significant environmental quality erosion factor is the continuing problem posed by IAPs as they outcompete indigenous species, change nutrient regimes, abstract more water and provide a higher fuel load which leads to more intense fires.

As stated in Le Roux *et al.*, (2012) certain vegetation types are listed as threatened on "criteria D1 (threatened plant species associations). Ecosystems with naturally high levels of plant rarity and endemism (e.g. Kogelberg Sandstone Fynbos, Overberg Sandstone Fynbos and Peninsula Sandstone Fynbos) have now been listed as threatened, although much of their original extent remains intact." This listing is incredibly important as it highlights that the chances of locating SCC are very likely in these vegetation units.

A significant contribution towards conservation of several under-conserved threatened vegetation types* on the West Coast, has been through the multi-stakeholder Dassenberg Coastal Catchment Partnership (DCCP) which involves state agencies, NGOs and local communities. The area is notable not only for its endemic and rich flora (>300 threatened species out of >1 200 species) but also for the contribution towards regional water security and connectivity which will act as a backbone to the area's climate change resilience. The region has a high proportion of unemployed inhabitants

*Swartland Shale Renosterveld (CR), Swartland Granite Renosterveld (CR), Atlantis Sand Fynbos (CR D1), Swartland Silcrete Renosterveld (CR) and Cape Flats Dune Strandveld (EN)

Critically Endangered (CR) ecosystems	• ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation.
Endangered (EN) ecosystems	• ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems.
Vulnerable (VU) ecosystems,	• ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems.
Protected ecosystems	• ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed as critically endangered, endangered or vulnerable

Figure 2: Definitions of threat status for ecosystems.

and there are significant socio-economic opportunities in the restoration and maintenance of the natural resources of the DCCP area. To date about 2 700 ha is being managed as Protected Areas by the City of Cape Town, with a further 7 000 ha being managed by CapeNature in the Ganzekraal/Mamre area. These areas are in various stages of declaration and there is still significant chance of consolidation towards the "Dreams for the Dassenberg" vision of a continuous conservation corridor from Riverlands Nature Reserve to the coast as envisioned in the 1995 eponymous Kilian report.

3. Threats to plant species and communities

3.1 Habitat Loss

The major driver of biodiversity loss in the Western Cape remains the permanent transformation of natural vegetation for development purposes. Please refer to Chapter 2 of this report for details of these changes.

3.2 Climate Change

Whilst mentioned in the 2012 report as a concern, recent research has been able to begin to quantify impacts at a species (White *et al*., 2016) and ecosystem level (Slingsby *et al*., 2017). The Critically Endangered Clanwilliam Ceder (*Widdringtonia cederbergensis*) has experienced a constant decline which has not been arrested by the declaration of the Cederberg Wilderness area in 1973. Increased temperatures and shorter fire return intervals associated with climate change induced precipitation variability (and subsequent drought) are the main drivers in adult tree mortality and reduced seedling recruitment and establishment (White *et al.,* 2016).

At an ecosystem level, the long term plot monitoring work at the Cape Point section of Table Mountain National Park (the initial plots laid out and recorded by Hugh Taylor in 1966, resurveyed by Sean Privett and team in 1996 and again by Slingsby *et al.,* (2010)), has produced sobering results. Weather records indicated a >1°C increase in temperatures as well as an increase in the duration of hot dry summer weather. Extended extreme summer conditions had a noticeable impact on fynbos species recruitment in the first year after fire, with a pattern of sensitive species with a low tolerance to high temperatures disappearing and being replaced by more temperature tolerant species. Additionally, the study found a lag effect attributable to previous woody IAP infestations (Slingsby *et al.*, 2017). This lends urgency to CapeNature's IAP management efforts, as Cape Point has had a good track record of IAP removal and affected areas have been clear for more than 30 years.

These results are concerning for the rest of the Province, as Cape Point as a peninsula has access to the cooling effects of the Atlantic. As an example, the Swartland and Greater West Coast region have increases of mean annual temperature of 1.5-3°C predicted by the middle of the century (WCDoA and WCDEA&DP 2016). As shown by the Clanwilliam Ceder, already range-restricted species in sensitive habitats (such as high altitude wetlands) are likely to struggle under these conditions and the identification of a subset of such "indicator species" for monitoring is a priority that will be addressed in the next year. This is a bleak forecast for a region already in the grips of a historic drought. Innovation and adaptation will be required in order for livelihoods dependent on natural resources such as agriculture to persist and be successful into the future.

Table 2: A list of the threatened terrestrial ecosystems of the Western Cape and their protection levels relative to conservation targets. Changes in vegetation threat status are highlighted in yellow and new vegetation types highlighted in blue

Vegetation Unit	Total ha of vegetation Unit / Threatened Ecosystem in SA 2012	% of Vegetation Unit / Threatened Ecosystem in WCP	2017 Original Extent Threatened Ecosystem in WCP	2017 ha remaining Threatened Ecosystem in WCP	2017 % remaining Threatened Ecosystem in WCP	WCP Conservation target as a %	WC_Ecosystem Protection Levels as a % of conservation target	Ecosystem threat status 2012 SOB	CapeNature Endangered Ecosystem Threat Status 2016	Change	Status Change	Year Changed
Agulhas Limestone Fynbos	29438	100	29438,3	23626,59	80,3	32	39,59	VU (D1)	VU (D1)			
Agulhas Sand Fynbos	23046	100	23045,5	9169,69	39,8	32	23,66	EN	EN			
Albertinia Sand Fynbos	70770	100	70755,5	38124,23	53,9	32	20,39	VU	VU			
Atlantis Sand Fynbos	69833	100	68831,2	26556,48	38,6	30	11,56	CR (D1)	CR (D1)			
Bokkeveld Sandstone Fynbos	136140	39	44862,1	35219,12	78,5	29	3,76	VU (D1)	VU (D1)			
Boland Granite Fynbos	49906	100	52093,1	27055,32	51,9	30	88,46	VU	VU			
Breede Alluvium Fynbos	51044	100	50155,8	18402,78	36,7	30	10,61	EN	EN			
Breede Alluvium Renosterveld	49813	100	49757,2	21199,70	42,6	27	3,40	VU	EN	more threatened	VU-EN	2016
Breede Sand Fynbos	9275	100	9765,5	4529,93	46,4	30	6,17	VU	VU			
Cape Flats Dune Strandveld	42426	100	39002,7	15283,27	39,2	24	75,12	EN	EN			
Cape Flats Sand Fynbos	54584	100	55924,9	2492,57	4,5	30	5,46	CR	CR (A1 & D1)			
Cape Lowland Alluvial Vegetation	35821	100	35907,8	8136,12	22,7	31	4,94	CR	CR			
Cape Vernal Pools	20	95	19,4	6,06	31,2	24	0,00	EN	EN			
Cape Winelands Shale Fynbos	8570	100	8497,9	3983,98	46,9	30	99,11	VU	VU			

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Cederberg Sandstone Fynbos	244854	100	251211,9	220868,57	87,9	29	200,94	VU (D1)	VU (D1)			
Central Ruens Shale Renosterveld	201063	100	201095,7	8781,38	4,4	27	0,74	CR	CR			
Ceres Shale Renosterveld	49162	100	49161,7	21561,60	43,9	27	5,22	VU	VU			
Citrusdal Shale Renosterveld		3636,6	24	872,8	0,00	new					new	
Eastern Coastal Shale Band Vegetation	7824	18	1409,1	736,37	52,3	27	161,26	VU	VU			
Eastern Little Karoo	155495	100	155495,1	120340,93	77,4	16	4,15	VU	VU			
Eastern Ruens Shale Renosterveld	276902	100	276995,4	29580,21	10,7	27	1,29	CR	CR			
Elgin Shale Fynbos	27946	100	27947,1	3226,28	11,5	30	32,51	CR	CR			
Elim Ferricrete Fynbos	66528	100	66528,4	16694,06	25,1	30	10,38	CR	CR			
Garden Route Granite Fynbos	43160	100	43045,4	9649,80	22,4	23	1,58	EN	CR	more threatened	EN-CR	2014
Garden Route Shale Fynbos	56633	93	52676,2	19865,66	37,7	23	15,73	VU	EN	more threatened	VU-EN	2016
Greyton Shale Fynbos	26884	100	26651,9	10104,70	37,9	30	22,52	EN	EN			
Groot Brak Dune Strandveld	20277	100	20060,3	9102,67	45,4	36	2,46	EN	EN			

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Hangklip Sand Fynbos	8121	100	8689,1	3870,88	44,5	30	74,17	EN	EN			
Hawequas Sandstone Fynbos	105105	100	105052,8	100394,29	95,6	30	293,75	VU (D1)	VU (D1)			
Hopefield Sand Fynbos	179882	100	97682,8	55343,56	56,7	30	26,05	VU	VU			
Kango Limestone Renosterveld	50177	100	50177,0	39051,90	77,8	29	9,40	VU	VU			
Knysna Sand Fynbos	15370	100	15354,6	1478,52	9,6	23	14,26	CR	CR			
Kogelberg Sandstone Fynbos	91530	100	91425,9	73478,03	80,4	30	243,60	CR (D1)	CR (D1)			
Kouebokkeveld Alluvium Fynbos	18002	100	18001,7	4908,74	27,3	29	12,62	EN	CR	more threatened		
Kouebokkeveld Shale Fynbos	42791	100	42790,7	20921,33	48,9	29	59,33	VU	VU			
Lamberts Bay Strandveld	45156	100	70614,4	35218,52	49,9	24	18,15	LT	VU	more threatened		
Langkloof Shale Renosterveld	20715	72	14939,2	1783,97	11,9	29	0,00	CR	CR		LT-VU	2014
Leipoldtville Sand Fynbos	275679	100	197756,4	80838,72	40,9	29	1,61	VU	EN	more threatened		
Lourensford Alluvium Fynbos	5529	100	3547,2	137,02	3,9	30	0,80	CR	CR			
Montagu Shale Renosterveld	163657	100	160673,7	123668,67	77,0	27	28,58	VU	VU			
Mossel Bay Shale Renosterveld	79589	100	79588,8	30977,24	38,9	27	0,72	EN	EN			

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Muscadel Riviere	42238	100	41793,4	7532,71	18,0	16	3,64	CR	EN			
Nardouw Sandstone Fynbos		36665,3	24	8799,7	0,00	new						
Overberg Sandstone Fynbos	116903	100	116853,0	95847,62	82,0	30	33,25	CR (D1)	CR (D1)			
Peninsula Granite Fynbos	8869	100	9290,1	3112,67	33,5	30	96,98	CR	CR			
Peninsula Sandstone Fynbos	23268	100	21870,1	19985,30	91,4	30	261,78	EN (D1)	EN (D1)			
Peninsula Shale Fynbos	New Vegetati on Type		1263,4	558,02	44,2	24	201,30		VU	more threatened	LT-VU	2016
Peninsula Shale Renosterveld	2972	100	2418,7	242,17	10,0	26	35,48	CR	CR			
Piketberg Quartz Succulent Shrubland		282,4	26	73,4	0,00	more threatened					VU-CR	2014
Piketberg Sandstone Fynbos	46053	100	41510,4	36329,42	87,5	29	5,91	VU (D1)	VU (D1)			
Potberg Ferricrete Fynbos	4046	100	4046,1	1473,08	36,4	30	15,54	EN	EN			
Ruens Silcrete Renosterveld	20970	100	20970,3	1904,32	9,1	27	1,18	CR	CR			
Saldanha Flats Strandveld	76097	100	158617,9	54632,09	34,4	24	22,78	VU	EN	more threatened	VU-EN	2014
Saldanha Granite Strandveld	23503	100	27704,2	7564,83	27,3	24	39,46	EN	EN			

Vegetation Unit	Total ha of vegetation Unit / Threatened Ecosystem in SA 2012	% of Vegetation Unit / Threatened Ecosystem in WCP	2017 Original Extent Threatened Ecosystem in WCP	2017 ha remaining Threatened Ecosystem in WCP	2017 % remaining Threatened Ecosystem in WCP	WCP Conservation target as a %	WC_Ecosystem Protection Levels as a % of conservation target	Ecosystem threat status 2012 SOB	CapeNature Endangered Ecosystem Threat Status 2016	Change	Status Change	Year Changed
South Outeniqua Sandstone Fynbos	157386	100	157281,6	87197,11	55,4	23	159,65	LT	VU	more threatened	LT-VU	2014
Southern Cape Dune Fynbos	18644	47	8535,1	4839,01	56,7	36	130,30	LT	VU	more threatened	LT-VU	2016
Southern Cape Valley Thicket	17732	100	17730,0	10411,34	58,7	19	5,48	LT	VU	more threatened	LT-VU	2016
Swartland Alluvium Fynbos	46987	100	46541,0	12340,14	26,5	30	28,39	CR	CR			
Swartland Alluvium Renosterveld	6253	100	6309,6	2826,97	44,8	26	0,00	VU	VU			
Swartland Granite Renosterveld	94785	100	95397,0	10829,26	11,4	26	1,44	CR	CR (A1 & D1)			
Swartland Shale Renosterveld	494712	100	495223,5	31360,10	6,3	26	2,65	CR	CR (A1 & D1)			
Swartland Silcrete Renosterveld	9989	100	10124,6	658,32	6,5	26	0,78	CR	CR			
Swellendam Silcrete Fynbos	86785	100	86785,4	38023,54	43,8	30	16,01	VU	EN	more threatened	VU-EN	2016
Uniondale Shale Renosterveld	134130	53	71013,3	43172,36	60,8	29	0,49	LT	VU	more threatened	LT-VU	2014
Western Ruens Shale Renosterveld	118997	100	118997,0	7939,39	6,7	27	1,59	CR	CR			

3.3 Illegal and uncontrolled collection of material

Petersen *et al.* (2014) estimated that 279 tons of biological material are being extracted from Western Cape wild lands for traditional medicine use every year, with the majority of that figure being plant material. Unpermitted harvesting of cut flowers and valuable species such as honeybush tea are also prevalent. Additionally, threatened species are targeted by overseas collectors e.g. the 2015 arrest, sentencing and substantial fine of a Spanish couple was a high profile success for law enforcement and example of the meticulous preparation and scale of international trade in the endemic species of the Western Cape. Innovative ways of meeting these utilisation requirements whilst conserving source populations in Protected Areas are being sought.

3.4 Flawed fire regimes

By far the majority of the protected areas that CapeNature manage are located in mountain catchments where fynbos and transitional shrublands abound. As fynbos is a fire-driven ecosystem, all fynbos species are adapted to and dependent on periodic fires to maintain species richness and stimulate regeneration. Consequently, fires have a major influence on the composition of plant communities in fynbos. Variation in the intervals between successive fires, season of fires, intensity and fire size (i.e. the fire regime) can have significant influences on the species composition of fynbos (Bond, 1980, 1984; Bond *et al.,* 1984; Bond and Van Wilgen, 1996; Van Wilgen, 1981; Esler *et al.,* 2014; Kraaij and van Wilgen, 2014). Particularly, recurrent short-interval fires that occur before non-sprouting (often referred to as 'reseeders') species have matured and set seed can eliminate these species from the vegetation and cause dramatic structural changes in communities (van Wilgen, 1982; Kraaij and van Wilgen, 2014; Esler *et al.,* 2014). It has also been shown that increased fire frequency can benefit sprouting species (often referred to as 'resprouters') and that increases in resprouters lead to overall decreases in plant diversity (Vlok and Yeaton, 1999, 2000; Esler *et al.*, 2014) due to them out-competing reseeding species. Research results have suggested that when the sprouting species take over in abundance, it will have a negative impact on the water yield from the area. It is thus vital to retain tall, non-sprouting species of *Protea* and *Leucadendron* in fynbos, to keep high densities of sprouters at bay and to ensure that a high water run-off is maintained over a longer period after fire.

Figure 3 shows the areas within and adjacent to CapeNature-managed protected areas that have burnt twice (or more times) during the past 17 (indicated in blue), 12 (indicated in orange) and 7 (indicated in red) years. In the background all the recorded historic fires are mapped (in grey), indicating the 'burnable' veld. The large areas that have burnt repeatedly during these periods are alarming – particularly those that burnt twice in 12 and 7 years. The Cedarberg, Grootwinterhoek, Hexrivier, Boland Mountain, Riviersonderend and Swartberg World Heritage Site Complexes and Driftsands Nature Reserve have been subjected to such fires. Many of the areas that burnt twice during the last 12 years, had fire intervals of 5, 6, 7 or 8 years. Areas that burnt twice during the last 17 years had intervals of 9 – 13 years, and those that burnt twice during the last 7 years had intervals of (2-) 3-5 years.

An analysis of the fire regimes in fynbos protected areas of the Western Cape found that short-interval fires (≤6 years) are becoming more frequent and that there is some evidence that they are becoming larger (van Wilgen and Forsyth 2008a). In a study focussed on the fire history of the Boland area, Schutte-Vlok *et al.* (2012) found that there has been an increase in the number and sizes of fires over a 60 year period (1952-2011); that most fires were human-induced and that more than 80% of the area burnt every 10 years since 1992.

There is great concern about the ecological impacts of these repeated short interval fires. From a conservation point of view such fires are undesirable, as they may have a negative effect on populations of reseeding plant species because these species would not have adequate time to mature and set seed between fires (Van Wilgen, 2013). As the organisation mandated to promote and ensure biodiversity conservation in the Western Cape Province, CapeNature has to manage and monitor the effects of fires on biodiversity.

Efforts are underway to set the thresholds of potential concern for fire return interval for all catchment protected areas. Where they occur, slow-maturing obligate reseeding *Protea* species are used as indicator species for this purpose. Where possible, permanent *Protea* plot monitoring is being implemented to determine the juvenile periods of indicator species as a measure of minimum fire return interval. Furthermore, post-fire parent-seedling ratio monitoring of *Protea* indicator species is being done to determine the success of seedling recruitment after fire. Once thresholds of potential concern have been set, monitoring is implemented to assess whether these thresholds are being approached or exceeded. If so, management actions need to be identified and implemented to address this (Kraaij and van Wilgen, 2014).

Surveys have been undertaken in the Boland area to determine the thresholds of potential concern for fire return interval, through collection of permanent and post-fire *Protea* data. Kruger and Lamb (1978) suggested that the minimum interval between fires should be equivalent to the time needed for at least 50% of the individuals in a population of the slowest-maturing reseeding species to have flowered and set seed three times. Monitoring data collected in the Boland area show that *Protea repens* reaches the ecological threshold at year 10, based on the Kruger and Lamb (1978) rule of thumb method, while *Protea neriifolia* reaches the threshold at around 13+ years, and *Protea laurifolia* and *Protea lepidocarpodendron* at 12+ years (Schutte-Vlok *et al.,* 2012). However, for *Protea stokoei*, a slow-maturing species endemic to the Boland Area and restricted to high altitudes, the ecological threshold for fire return interval (or fire frequency) is recommended at 17 years. This species is listed as Endangered in the Red List of South African Plants due to continuing declines in populations being recorded as a result of incorrect fire regimes, fire belt clearing and wild flower harvesting (Raimondo *et al.* 2009). Some populations of this species have been lost as a result of too frequent fires. Data collection in the Boland area is currently focussed on trying to refine the set thresholds especially in veld older than 12 years. Lack of data for this period is mainly due to the fact that there is very little veld that gets older than 9-10 years.

The map in Figure 3 clearly highlights the protected areas that need focussed action because of the occurrence of repeated short-interval fires. Predictions are that weather conditions conducive to the initiation and spread of fires will increase with global climate change (Kraaij and van Wilgen 2014). Although the adaptive management approach has been adopted in CapeNature, its implementation require a high and sustained level of support and commitment to carry out long-term monitoring and assessment programs.

Both operational and ecological thresholds need to be set to inform management. Operational thresholds investigate the proportional area occupied by different post-fire age classes, or the proportion of area burnt at different fire return intervals over the past few decades. Each age class or fire return interval class is assigned upper and lower thresholds. Exceeding these thresholds would trigger management action to bring the system back within thresholds (Kraaij and van Wilgen 2014). Ecological thresholds, as mentioned earlier, are based on data collected on selected indicator species (e.g. determining the proportion of populations that have flowered three or more seasons, proportions showing signs of senescence or trends in population size). If an ecological threshold is exceeded, steps need to be implemented to address the undesirable condition. As such, management would be adaptive because actions would be informed by new insights based on monitoring and assessment data (Kraaij and van Wilgen 2014).

3.5 Invasive Alien Plants

In the light of the serious water shortages and consequent regulatory restrictions in the Western Cape, the benefit of clearing invasive alien plants from water catchment areas is obvious. Invasive alien plants also pose the second largest threat to biodiversity in the province, after habitat destruction (Le Roux *et al.,* 2012). Information to adequately answer whether control measures are achieving progress against IAPs, is still not available for the entire province. Often progress is measured differently according to the outcomes desired. Some of these are biodiversity restoration, improved catchment water yield or simply a reduction in density and area occupied by IAPs. This further complicates the collation of data across the province. Since resources to address IAPs are limited, we discuss the prioritisation of areas to clear on reserves to achieve outcomes in terms of several criteria.

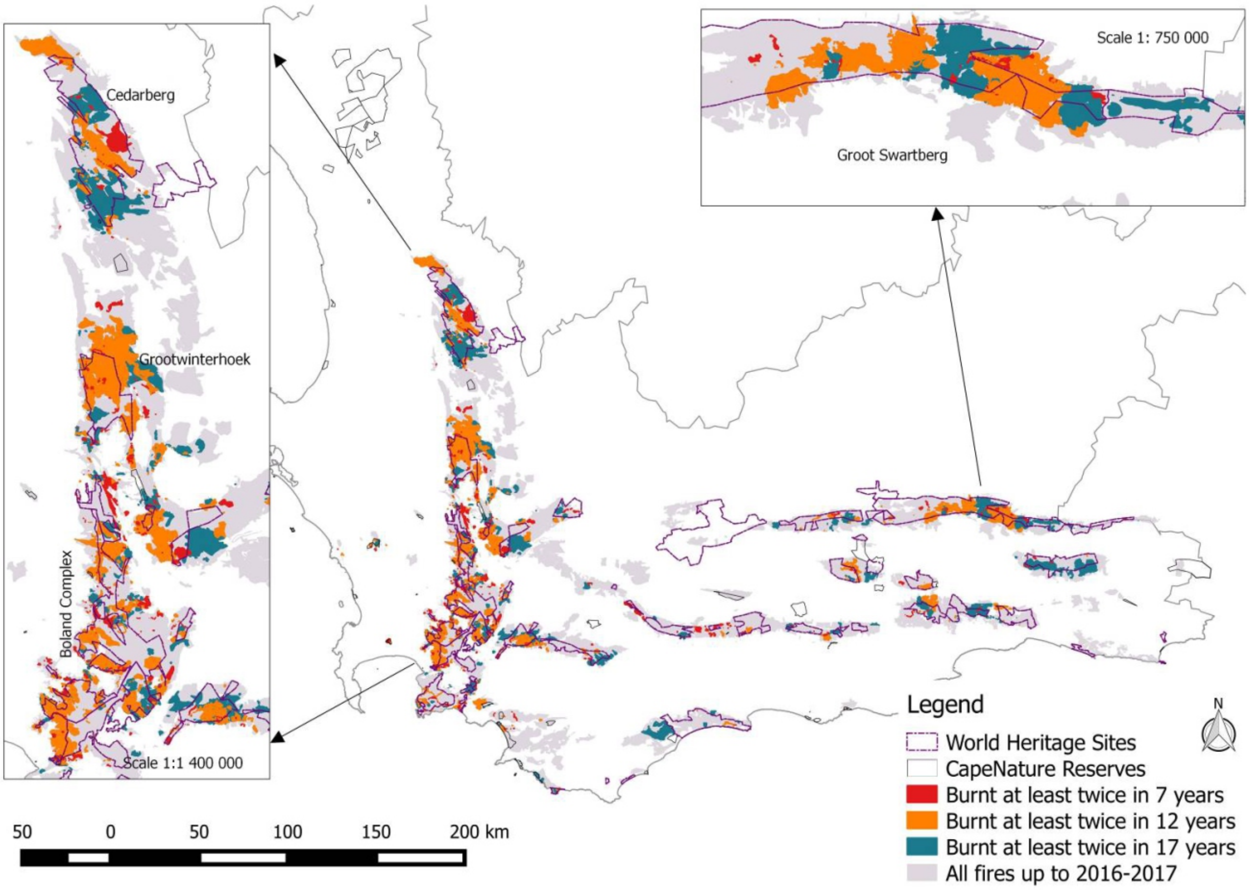

Figure 3: Areas within and adjacent to CapeNature managed World Heritage Sites and Nature Reserves that have burnt twice or more during the last 17 (in blue), 12 (in orange) and 7 (in red) years. All recorded historic fires are also shown (in grey), which indicates the 'burnable' veld.

Pines, *Acacia* and *Hakea* species are the major invaders on CapeNature reserves, but some areas have up to 27 recorded invasive species. Table 3 provides a breakdown of IAP infestation across the reserve clusters. Management of these species occurs via mechanical, chemical, biological control or a combination of these. It has often been stated that we need to take advantage of wild fires as a means to control and deplete seedbanks of invasive species, but thus far the ability to adapt within a short window period, has been mostly lacking. Strydom *et al.,* (2017) showed that for some *Acacia* spp., seed feeding biological control agents are not effective in reducing seedbanks in dense stands and recommended once again that mechanical clearing be conducted shortly after fire-stimulated recruitment events. Biocontrol is still, however, the most cost effective means of control (van Wilgen *et al.,* 2012) and while some releases of biological control agents has taken place on CapeNature reserves, monitoring of these populations and further releases need to be conducted to capitalise on the "best bang for your buck" control method. We have also requested a quantitative risk assessment of releasing a seed-feeding weevil for Mediterranean cluster pines (*Pinus pinaster*) in the WCP (see CapeNature Research Requests web page).

We are also investigating the possibility of applying highly directed streams of herbicide to the stem bark of pine trees from a helicopter which has provided a cost-effective means of controlling low density and difficult to reach pines in New Zealand (Gous *et al.*, 2014). This method requires careful evaluation of applicability in WCP conditions and research has also been requested to address this.

4. Responses to the threat of invasive alien species

4.1 Plant restoration after clearing (and secondary invasions)

Restoration of indigenous plant communities after clearing IAPs is a primary goal for CapeNature. Successful restoration in reserve clusters with extensive levels of invasion (Table 3) is particularly at risk. Fill *et al.* (2017a) found that vegetation recovery via passive restoration is not adequate to restore sites to reference diversity and canopy cover in a study in the Berg catchment where mainly pines are invasive. Galloway *et al.* (2017) showed that recovery potential was linked to the severity of the impacts caused by pines. CapeNature supports their recommendations that pine plantations be felled before it reaches 30 years old to improve native species recovery potential and ensure that indigenous seed banks are not depleted. Given these findings and the paucity of suitable long term data to monitor progress of IAP clearing in terms of desired outcomes, it is now essential that CapeNature implement monitoring and evaluation strategies and policies that would allow for adaptive management, hereby allowing for the optimisation of responses in dynamic conservation settings. The focus from here on will be on measuring the impact that IAP management has on indigenous biodiversity.

Successful indigenous vegetation recovery may be impeded by secondary plant invasions which can happen when changes in succession stage occur (e.g. fire, clearing) and invasive species are released from the competition pressures from primary invaders. Fill *et al.* (2017b) found that alien grass species invaded the cleared areas at Rondegat in the Cederberg. To maintain gains, sustained funding and the ability to adapt management decisions to treat secondary invaders, is necessary. A constraint is therefore that the national funding agency (WfW) only addresses a predetermined list of invasive species, overlooking other species. Innovative approaches will be needed to address secondary invasion as the success of clearing campaigns within current financial constraints depends on tightening the focus on certain species the focus should be on pine and hakea species (Van Wilgen *et al.* 2016).

Several lesser known invasive species have been recorded in the Western Cape recently. Vigilance and adaptive management is required to deal with these promptly when found in or near CapeNature reserves. These species are often misidentified, assumed indigenous or overlooked allowing spread and risk of primary or secondary invasion (Jacobs *et al.* 2017).

4.2 Water yield improvement

Another primary goal of IAP clearing is the improvement of catchment water yield. The Western Cape is currently experiencing its worst drought since 1904 and was declared a disaster zone in May 2017. There are high densities of invasive alien trees in the catchment area, particularly of *Pinus* spp. The impact of these invasive alien trees was reported on through a study done on the Western Cape Water Supply System (WCWSS) by Aurecon (Görgens and Howard, 2016). Theewaterskloof Dam supplies about 40% water to the City of Cape Town and many surrounding agricultural areas and smaller towns. The catchment area of the dam is a mountainous area with a very high recorded rainfall average of up to 3 000 mm per annum.

The reduction in streamflow to the Theewaterskloof Dam due to invasions were simulated and captured into the WCWSS yield model. The model was generated for various scenarios; whether clearing was done or not (Görgens and Howard, 2016). It was determined that the current invasion reduces the water supply by 38 million m^3 per annum, which is equivalent to the full capacity of the Wemmershoek Dam. Should no clearing be done, the reduction in water supply in 45 years will be 130 million m^3 per annum. This is equivalent to the full capacity of the Berg River Dam (Görgens and Howard, 2016). The WCP simply cannot afford these losses of water. Reduction of IAP density and invaded area dare iscussed below for IAPs on CapeNature reserves.

4.3 Invasive species management plans

Invasive Species Control (ISC) plans are required according to section 76 of the National Environmental: Biodiversity Act, 10 of 2004, (NEMBA), and the Alien and Invasive Species (AIS) Regulation and Lists (Oct 2014). This ISC plan must contain a status report on (i) the current measures to monitor control efforts and the eradication of invasive species, as well as (ii) indicators on measuring progress and success. CapeNature is currently formulating these plans in accordance with the legislative requirements, while at the national scale, the first status report is being compiled and should be published later this year.

NEMBA Sections 75 and 76 are very specific in terms of who must develop these Invasive Species Monitoring, Control and Eradication Plans, what the plans must include and how they should be implemented, i.e.:

4.4 Control and eradication of listed invasive species

75.

(1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.

(2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.

(3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

(4) The Minister must ensure the coordination and implementation of programmes for the prevention, control or eradication of invasive species.

(5) The Minister may establish an entity consisting of public servants to coordinate and implement programmes for the prevention, control or eradication of invasive species.

4.5 Invasive species control plans of organs of state

76.

(1) The management authority of a protected area preparing a management plan for the area in terms of the Protected Areas Act must incorporate into the management plan an invasive species control and eradication strategy.

(2) (a) All organs of state in all spheres of government must prepare an invasive species monitoring, control and eradication plan for land under their control, as part of their environmental plans in accordance with section 11 of the National Environmental Management Act. "

(b) The invasive species monitoring, control and eradication plans of municipalities must be part of their integrated development plans.

(3) The Minister may request the Institute1 to assist municipalities in performing their duties in terms of subsection (2).

(4) An invasive species monitoring, control and eradication plan must include -

(a) a detailed list and description of any listed invasive species occurring on the relevant land;

(b) a description of the parts of that land that are infested with such listed invasive species;

(c) an assessment of the extent of such infestation;

(d) a status report on the efficacy of previous control and eradication measures

(e) the current measures to monitor, control and eradicate such invasive species; and

(f) measurable indicators of progress and success, and indications of when the Control Plan is to be completed."

4.6 Prioritisation and control of Invasive Alien Plants on CapeNature reserves

The available resources to address IAPs cannot fully meet the requirements to restore all protected areas to a pristine state. Therefore funding needs to be prioritised in order to maximise beneficial ecological outcomes and efficiency in resource allocation.

Mapping of IAP and clearing are done according to reserve centres. A reserve centre often includes the adjacent mountain catchment areas. These reserve centres are divided into compartments/NBALs (Natural Biological Alien) and referred to only as compartments from here onwards. The boundaries of the compartments were established using natural features, including river streams, mountain ridges, trails, and roads. The sizes of the compartments were determined by the level of invasion. The compartments were given NBAL numbers as assigned by the Working for Water Information Management System.

For each of these compartments, baseline data was collected for the five dominant IAPs occurring in each compartment. This layer are referred to as the "IAP wall2wall map". The first map was compiled in 2010 and have been updated annually. The most recent survey done at the time of this report was in 2016 (Figure 4). The estimated percentage cover of each dominant IAP species in each compartment was captured in collaboration with experienced reserve staff, using a range of products, including high-resolution satellite imagery, aerial photography, and GoogleEarth. In some cases, where there was uncertainty about the estimates, they were verified in the field.

The IAP clearing of the compartments are prioritised using results of scientific studies and expert knowledge. A priority list of IAP species were developed during comprehensive expert workshops using decision-weighting software (Van Wilgen *et al.*, 2008b, Forsyth *et al.*, 2009). The two top species listed as priority were *Pinus* spp. and *Acacia mearnsii* (black wattle), based on the extent of invasion and impact on water resources. Even though *Hakea* spp. is also widely distributed, it received a lower priority because biological control is available for these species. For clearing prioritisation on CapeNature

Table 3: Levels of infestation of invasive alien plants (IAPs) on CapeNature Reserve clusters. Invasion level cut-offs follow Blackburn *et al.* (2014). Some taxa were not identified to species level, e.g. *Eucalyptus* sp., *Pinus* sp., *Quercus* sp. In these cases, the number of IAP species per reserve cluster may be underestimated.

Reserve cluster	IAP infestation (Condensed area (ha))	% of area infested	Invasion level	Number of IAP species
Anysberg	1754.4	2.6	Minor	18
Cederberg	1451.6	1.4	Minor	20
Dassenberg	21.7	7.8	Moderate	4
De Hoop	8216.3	25.9	Extensive	16
De Mond	0.5	0.0	Minimal	3
Driftsands	93.9	10.5	Moderate	5
Dyer Island	-	0.4	Minimal	-
Gamkaberg	169.6	0.2	Minimal	18
Ganzekraal	1213.7	19.4	Moderate	5
Genadendal (Riviersonderend)	3816.1	5.0	Minor	12
Geelkrans	504.0	40.3	Extensive	4
Goukamma	117.1	5.5	Moderate	6
Grootvadersbosch	17782.2	27.9	Extensive	11
Grootwinterhoek	449.6	0.9	Minor	15
Hottentots Holland	9716.8	27.6	Extensive	11
Jonkerhoek	4225.7	25.4	Extensive	17
Kammanassie	596.8	1.2	Minor	3
Keurbooms	1.7	0.2	Minimal	6
Kogelberg	2182.4	4.4	Minor	27
Knersvlakte	803.4	0.7	Minor	7
Limietberg	9045.1	9.6	Moderate	18
Marloth	2725.3	8.2	Moderate	10
Matjiesrivier	748.1	2.0	Minor	21
Outeniqua	8687.6	19.0	Moderate	13
Riverlands	363.9	21.2	Moderate	10
Robberg	0.4	0.3	Minimal	2
Rocherpan	0.2	0.0	Minimal	5
Swartberg	776.8	0.4	Minimal	20
Vrolijkheid	16.0	0.8	Minor	4
Waterval	6732.0	12.1	Moderate	19
Walker Bay	2171.2	34.7	Extensive	11

reserves, *Prosopis* spp. were used for reserves in drier areas, such as Anysberg and Knersvlakte. General principles of efficient clearing were also incorporated, such as clearing from sparse to dense and effectively integrating IAP clearing and fires.

The single biggest factor for CapeNature was cost of clearing, which is determined by clearing method. The following criteria are driving prioritisation once veld age maps and IAP density maps are integrated:

- Taking on areas straight after a fire while non-mechanical and non-chemical clearing methods can be used, which are cheaper,
- Clearing areas before they can set seed,
- Clear older veld where the risk of wild fires occurring is increasing.
- Different criteria were set for the different IAP species.

In addition to the densities and veld age criteria, accessibility was also considered. The accessibility directly affect the costs of clearing. Accessibility is determined by slope (the steeper the slope, the more specialised the teams must be and thus the more expensive the clearing) and the walking distance to the site. Sites within 3 km of a road were given higher priorities because that is the approximate distance the clearing teams can manage to walk in two hours with equipment in rough terrain.

The IAP clearing prioritisation maps (Figure 5) are then generated to support the compilation of annual plan of operation for clearing. These maps are generated annually using the annual updated IAP wall2wall densities map and the annual veld age map.

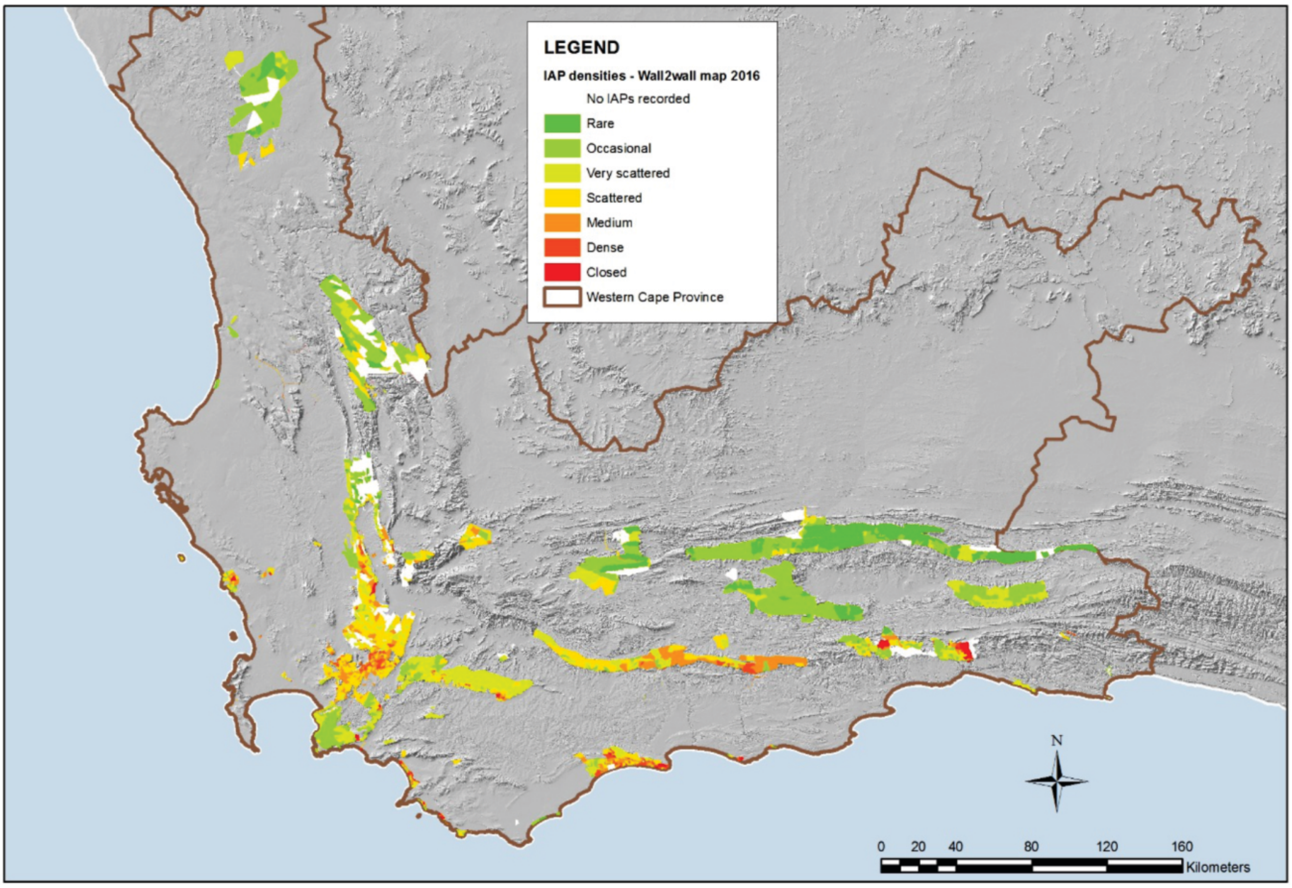

Figure 4. Invasive alien plants (IAP) densities mapped in 2016 for the land managed by CapeNature in the Western Cape Province. The densities are indicated using the seven standard categories used by Working for Water (WfW).

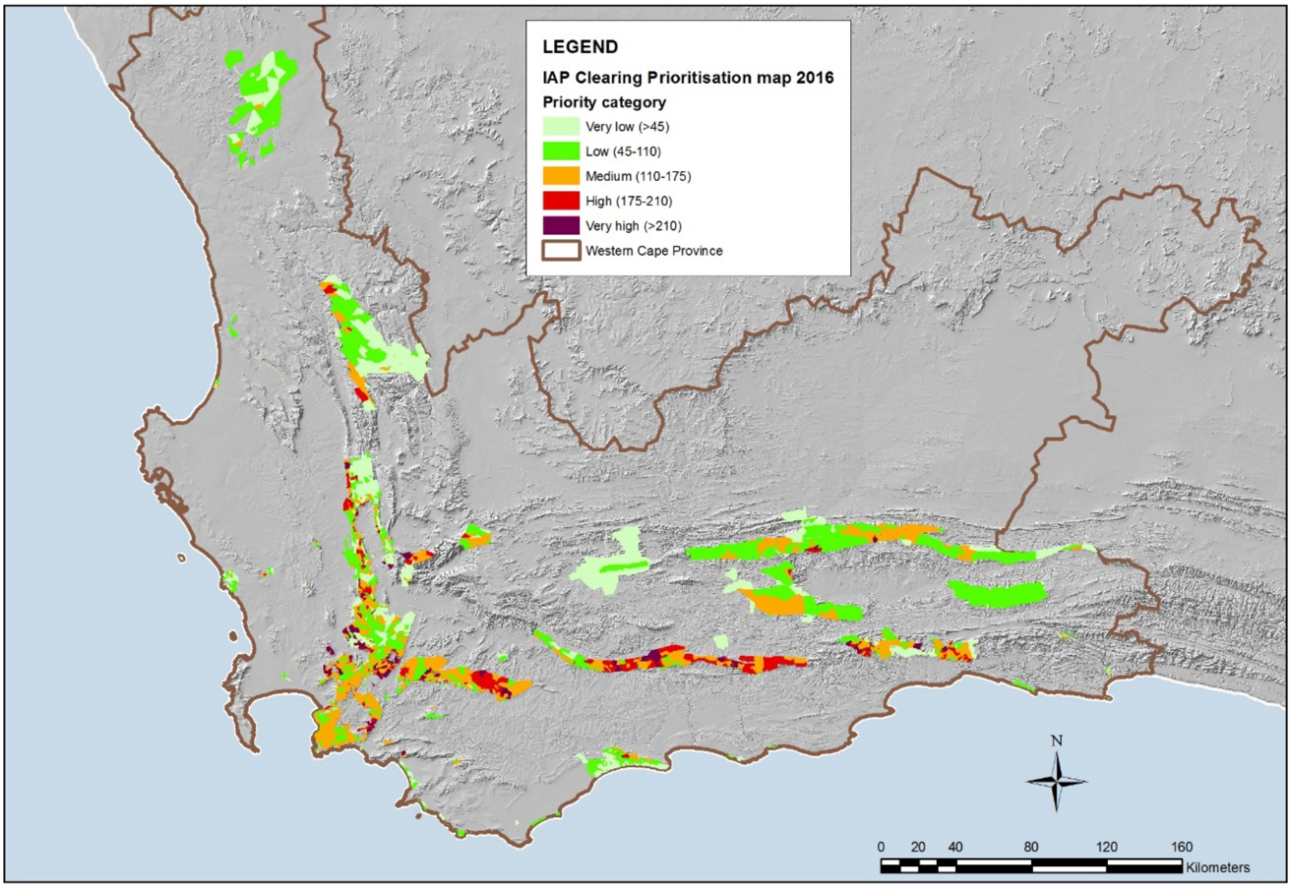

Figure 5. Invasive alien plants (IAP) clearing prioritisation map for 2016 for the land managed by CapeNature in the Western Cape. The clearing priorities are indicated using five categories. These annual IAP wall2wall maps over a period of six years can now be used to illustrate efficacy of clearing by subtracting the recorded IAP densities from each other (Figure 6). However, this analysis does not replace the need for a scientifically rigorous study on assessing the impact of IAP densities on biodiversity at a reserve level.

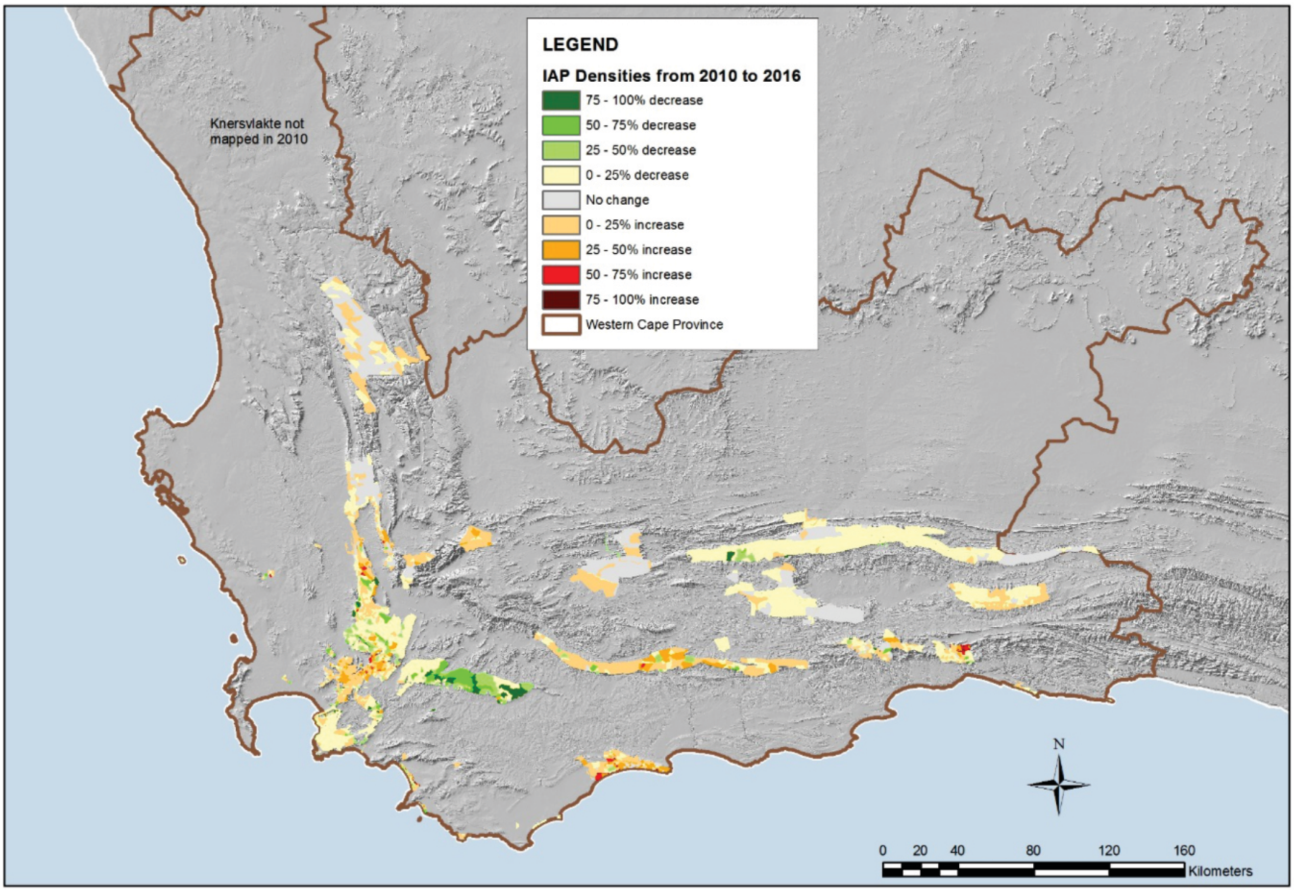

Figure 6. Areas indicating the percentage increase or decrease in invasive alien plants (IAP) densities over a seven year period for the land managed by CapeNature in the Western Cape Province. A decline in IAP densities in the Riviersonderend catchment is commended, especially as a number of these compartments were identified as priorities, while the slight increases in most of the Langeberg catchments are a concern. Changes in IAP densities may also be due to inaccuracies of density estimates. The major water catchment area for the City of Cape Town seems to indicate an increase in IAP densities, even though it has a long history of clearing. This is seriously problematic in the current drought.

4.7 Rare and Threatened Plant monitoring

Monitoring of populations of threatened plant species in the Western Cape is largely being done by plant specialists and CREW (Custodians of Rare and Endangered Wildflowers) citizen science programme that is coordinated by the Threatened Species Programme within SANBI. The local CREW group in the East Region, known as the 'Outramps', is exceptionally well organised and collaborating closely with CapeNature and SANParks. They plan their outings annually according to a 'hitlist' of species of conservation concern and aim to locate and monitor as many species on- and off-reserve areas as possible. The Outramps team consists of a variety of citizen scientists who specialise in specific plant families and are keen to share knowledge and learn from others. An important function this group and other similar CREW groups serve is knowledge exchange, specifically when local field rangers join them on field trips.

Since 2012 a total of 1 962 plant species of conservation concern have been monitored by the Outramps group. Initially the species were captured on CREW Excel data sheets, but since 2014 information and data collected during field trips are being captured on SANBI's iSpot website. About 385 of the plant species that have been recorded over the five year period were previously unknown to the Outramps team. iSpot provided a space to create project of specific topics and/or areas; the Outramps have three main projects where their site sheets are uploaded, namely inland mountains and sites (http://www.ispotnature.org/projects/outramps-crew-site-sheets-for-the-karoo-region); coast and coastal mountains – (http://www.ispotnature.org/projects/crew-site-sheets-for-the-southern-cape-coast-and-the-coastal-mountains); and all the site sheets combined – (http://www.ispotnature.org/projects/crew-species). This volunteer team is truly remarkable and an asset to CapeNature (Figure 7). They are always keen and willing to assist where and whenever possible and have in the last year expanded as far west as De Hoop Nature Reserve.

In the West Region, the 'BotAtlas' surveys are conducted in the Knersvlakte Nature Reserve to improve baseline plant data. In addition, Dr Ute Schmiedel (University of Hamburg) carries out BIOTA monitoring annually in the reserve and the local field rangers often participate in this event. Other monitoring involves tracking rehabilitation efforts of *Phragmites australis* (fluitjiesriet) at Rocherpan and Matjiesrivier Nature Reserves and the recovery of the old agricultural fields on Matjiesrivier Nature Reserve where annual seed harvesting and planting takes place. CREW monitoring is focussed mainly on specific threatened or rare species, such as *Leucadendron chamaelaea* (CR) and *Erica leucosiphon* (R) on

Grootwinterhoek Nature Reserve, *Sorocephalus imbricatus* (CR) and *Babiana odorata* (EN) on Waterval Nature Reserve, and *Marasmodes defoliata* (CR), *Disa barbata* (CR), *Skiatophytum flaccidifolium* (CR), *Serruria brownii* (EN) and *Metalasia distans* (CR) at Riverlands and Pella Nature Reserves. Demographic monitoring of *Marasmodes defoliata* is currently on hold due to potential sensitivity to trampling but the benefits of keeping an eye on this reserve endemic include being able to notice a significant decrease in a patch of plants in 2016. This is possibly due to herbivory by rodents.

The Ganzekraal staff have had regular "training visits" from the CapeNature Botanist (Rupert Koopman) in 2017 and these are opportunities to get into the Ganzekraal Reserve Conservation Area and collect baseline data. The staff also accompanied the Mamre community when collecting flowers and specimens for the 2017 Mamre Flower show and recorded localities of threatened species on the Mamre property. The Friends of the Tygerberg Hills (FOTH) CREW group, Friends of Blouberg Conservation Area and the Darling CREW group have also conducted trips to the greater DCCP area, often accompanied by Ganzekraal CA staff. FOTH are also instrumental in collecting SCC data in Stewardship sites and priority lowland vegetation remnants across the Boland, Swartland and City of Cape Town.

Further east, the Kogelberg CREW group have been operating in and around the Kogelberg Nature reserve. Members of Swellendam CREW have collected data on SCC in Marloth and Grootvadersbosch Nature Reserves. In the Central Region, *Protea holosericea* (EN) monitoring is being carried out annually and a CREW team has visited Vrolijkheid Nature Reserve during 2016 to monitor *Brunsvigia josephinae* (VU). *Protea stokoei* (EN) populations are being monitored on Hottentots Holland Nature Reserve annually. The Hottentots Holland CREW group assisted in the 2016 count of the single locality species *Leucadendron elimense* subspecies *vyeboomense* (CR).

Addressing Target 5 of the National Plant Conservation Strategy (Raimondo 2015), namely 5.1, important areas for plant diversity in South Africa identified based on botanical richness and endemism patterns and 5.2, important areas for plant diversity incorporated into biodiversity planning processes and protected area expansion strategies, a recent mapping exercise (Ebrahim & Von Staden, 2017) set out to quantify and map highly restricted plant taxa as an input to a new Landuse Screening tool.

The criteria for a highly restricted species (HRS) are those which are known from less than 50 individuals, have a Range (Extent of Occurrence) of less than 10 km^2, are known from one subpopulation or are known from one location. Nationally there are 538 HRS and 350 (65%) of those are in the Western Cape. South Africa's richest HRS area is Pilaarkop in the Riviersonderend Nature Reserve, which has 9 species (Ebrahim and Von Staden, 2017). This is also an area with a serious pine infestation and it is critical that efforts to manage this spread are improved. It is of concern that many of these sites have repeatedly been identified as priorities for species conservation but have not yet received any formal protection.

4.8 Capacity

In 2012, lack of botanical capacity was identified as an obstacle within CapeNature. Over the past 5 years the situation has worsened, with only one dedicated Botanist post in the organisation that is responsible for conserving a world-renowned flora. This capacity gap will now, however, be addressed. Another positive response in the reporting period has been the improved collaboration with partners and stakeholders in achieving conservation outputs.

Increased quality of spatial products means that priority habitats and species information is available to guide CapeNature activities, however, more specialised staff are required in order to implement the monitoring required to provide CapeNature with the baseline data required to track changes caused by threats such as climate change and water abstraction from the Table Mountain Group aquifer amongst other sources.

5. Conclusions and recommendations

The rate of loss of natural vegetation through habitat loss has not abated, as seen in Table 3 and including a significant loss of Critical Biodiversity Areas (Chapter 1). Additional extension services and improvement in the enforcement of illegal clearing contraventions is required to help slow down rates of conversion of natural areas in the Province.

Conservation of plant species and ecosystems in the WCP has largely focussed on the reduction and mitigation of the threats facing these species and ecosystems. Continued rolling out and awareness of planning tools is necessary to ensure we aren't losing irreplaceable habitats, given that some habitat loss is inevitable. Innovative ways of meeting the plant utilisation requirements whilst conserving source populations in Protected Areas are being sought. Thresholds of potential concern need to be identified for all reserves, with long term monitoring and assessment programme. Continued efforts in conjunction with partners is necessary to ensure conservation of threatened lowland species and ecosystems at DCCP area.

The improved IAP prioritisation process has enabled CapeNature to better track gains or losses against invasive species for our reserves. Thus, we recommend that planning of clearing projects strictly focus on the areas identified as priorities in that analysis. Monitoring the impact of IAPs on biodiversity within an adaptive management framework is also imperative and we recommend that this be formulated and implemented as soon as possible. Innovative pine management tools look

Figure 7: The Outramps CREW team following a field visit in burnt veld. (Photo: Di Turner).

promising and should be high on the to-do lists for the next five years. It is critical to slow the spread of pines and hereby maintain or reduce the threat to Red Listed species, especially those that are highly restricted. Biodiversity restoration, although vital, can be resource intensive, but investigation to explore options is feasible over the next period. Biological control agent releases should also be increased.

Although CapeNature is limited in our ability to alleviate climate change, the mitigation of the other threats and proper planning in conjunction with partners will go a long way to ensure conservation of our diverse and highly endemic flora.

6. Acknowledgements

The authors would like to acknowledge all stakeholders and partners that contributed to the data presented here. In particular, we would like to thank SANBI's Threatened Species Programme and Directorate of Biological Invasions, the Centre for Invasion Biology and CSIR for their inputs, discussions and edits that influenced this report.

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IXIA MONADELPHA

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