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Vegetation type conservation targets, status and level of protection in KwaZulu-Natal in 2016

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Background: Systematic conservation planning aims to ensure representivity and persistence of biodiversity. Quantitative targets set to meet these aims provide a yardstick with which to measure the current conservation status of biodiversity features and measure the success of conservation actions.

Objectives: The conservation targets and current ecosystem status of vegetation types and biomes occurring in KwaZulu-Natal (KZN) were assessed, and their level of formal protection was determined, to inform conservation planning initiatives in the province.

Method: Land cover maps of the province were used to determine the amount of natural habitat remaining in KZN. This was intersected with the vegetation map and assessed relative to their conservation targets to determine the ecosystem status of each vegetation type in KZN. The proclaimed protected areas were used to determine the level of protection of each vegetation type.

Results: In 17 years (1994–2011), 19.7% of natural habitat was lost to anthropogenic conversion of the landscape. The Indian Ocean Coastal Belt and Grassland biomes had the least remaining natural habitat, the highest rates of habitat loss and the least degree of formal protection.

Conclusion: These findings inform conservation priorities in the province. Vegetation type targets need to be revised to ensure long-term persistence. Business-as-usual is no longer an option if we are to meet the legislative requirements and mandates to conserve the environment for current and future generations.

Introduction

Systematic conservation planning is used globally to identify priorities for biodiversity conservation and inform policy and legislation to facilitate the long-term conservation of biodiversity (Pressey et al. 2007). Conservation planning requires planning for whole landscapes, ensuring both representivity and persistence of species, habitat types, ecosystems and the processes that maintain and create diversity (Margules & Pressey 2000). A critical component of the planning process is to set quantitative targets for biodiversity features or conservation goals. Targets reflect the conservation value of existing protected areas, inform the selection of additional areas to meet conservation goals (Margules & Pressey 2000), measure the success of conservation actions (Desmet & Cowling 2004) and allow for accountability and defensibility of conservation decisions.

In South Africa (SA), vegetation types are used as higher order biodiversity feature surrogates for species and ecosystems (Lombard et al. 2003). This coarse-filter approach covers the entire landscape and reduces the spatial and taxonomic bias associated with species data (Lombard et al. 2003; Margules & Pressey 2000). Whilst vegetation types have been found to be good surrogates for arthropods (Schaffers et al. 2008), they are not good surrogates for specialised habitat or range-restricted species, rare or threatened species and vertebrates (Lombard et al. 2003). Using vegetation types in conservation planning is therefore complementary to species data and may fill a gap where species data are scarce.

Plant communities or vegetation types underpin trophic structure and functioning (Jewitt et al. 2015a) and sequester nutrients in most ecosystems (Giam et al. 2010). These habitats support essential ecological processes and provide ecosystem services, materials and food critical for human well-being (Giam et al. 2010). However, habitat loss and land cover change are currently the leading cause of biodiversity loss worldwide (Jetz, Wilcove & Dobson 2007; MEA 2005; Vitousek 1994). Indeed, in KwaZulu-Natal (KZN), SA, 7.6% (721 733 ha) of natural habitat was

lost to anthropogenic conversion in only 6 years (Jewitt et al. 2015b). Hence, there is an urgent need to assess the impact of habitat loss on vegetation types in KZN.

This article assesses the status of vegetation types and biomes in KZN based on two standardised quantitative indicators used in SA: ecosystem status (Driver et al. 2012) that compares the amount of a vegetation type remaining in a natural state to thresholds of conservation concern based on conservation targets; and levels that assess how much of each vegetation target is achieved in protected areas.

Research method and design

Study site

KwaZulu-Natal is a province on the east coast of SA. It has high levels of biodiversity and forms part of the Maputaland–Pondoland–Albany biodiversity hot spot with several centres of endemism [Maputaland, Pondoland (Mucina et al. 2006b), Midlands and Drakensberg Alpine (Mucina et al. 2006a)]. The KZN vegetation map provides greater detail on vegetation types and is mapped at a finer scale than the national vegetation map of Mucina and Rutherford (2006) and was used in this analysis. There are 101 vegetation types and subtypes (EKZNW 2011a) in the province and five biomes are recognised [Grassland, Savanna, Indian Ocean Coastal Belt (IOCB), Forests and Wetlands (azonal)]. Their historical extents are 4 583 855 ha, 3 259 341 ha, 891 092 ha, 202 879 ha and 393 628 ha, respectively (Figures 1 and 2a). The forest coverage reflects a more current extent, as their historical extents could not be accurately mapped. Zonal and azonal groups are recognised within the forest biome and wetlands are considered azonal. The provincial biome classification includes wetlands as a biome, which differs from the Mucina and Rutherford definition of a biome (Rutherford, Mucina & Powrie 2006). Wetlands form a major part of the landscape in KZN and have distinct floristic communities and were therefore included as a biome in this analysis.

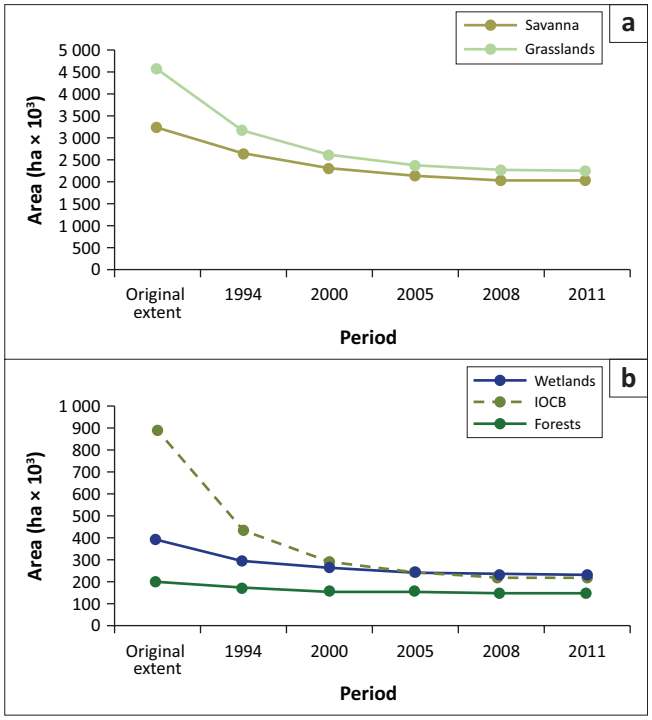

FIGURE 1: (a) The amount of natural habitat remaining per time period in the larger grassland and savanna biomes. (b) The amount of natural habitat remaining per time period in the Indian Ocean Coastal Belt (IOCB), Wetland and Forest biomes.

Input data: Land cover

Five different land cover maps were used to determine the extent of habitat conversion (non-natural categories) in KZN. The 1994 (Fairbanks et al. 2000) and 2000 (Van den Berg et al. 2008) land cover maps were national maps, whilst the 2005 (EKZNW 2011b; GTI 2008), 2008 (EKZNW 2013a; GTI 2010) and 2011 (EKZNW 2013b; EKZNW & GTI 2013) land cover maps were provincial maps developed by Ezemvelo KZN Wildlife. Based on a systematic land cover change analysis for KZN (Jewitt et al. 2015b), which demonstrated the extensive categorical swopping between land cover categories, anthropogenic habitat conversion that occurred in the province was accumulated, that is, a non-natural category was not permitted to become a natural category at some future point in time. This was done specifically to identify primary natural vegetation occurring in the province rather than secondary natural vegetation, which does not harbour the same level of biodiversity as primary natural habitat (Walters, Kotze & O'Connor 2006).

The land cover maps were projected, clipped to the 2008 vegetation extent to exclude the dynamic coastal rock and sand category and clipped to the 2010 provincial boundary (EKZNW 2010). Minor corrections were made to known errors in the land cover maps. To determine the amount of natural habitat remaining, two categories were created across the five land cover maps, namely natural vegetation and features (untransformed) and non-natural vegetation (transformed or anthropogenic features such as the built environment, cropped agriculture, timber plantations, dams and mines). These were intersected with the vegetation types and biomes to determine their degree of transformation or habitat loss.

Input data: Conservation targets for vegetation types

The conservation targets were a combination of the national targets used in the national protected area expansion strategy (Government of South Africa 2009), EKZNW vegetation targets (Jewitt 2009), forest targets (Berliner 2005) and the vegetation targets in Mucina and Rutherford (2006), using the higher target where applicable. The conservation targets for the non-forest vegetation types were determined using the species-area method developed by Desmet and Cowling (2004). The forest targets follow the method of Berliner (2005) where a baseline of 15% was adjusted upwards dependent on species diversity, rarity, patch fragmentation, historic reduction and location within regions or centres of endemism based on expert consultation.

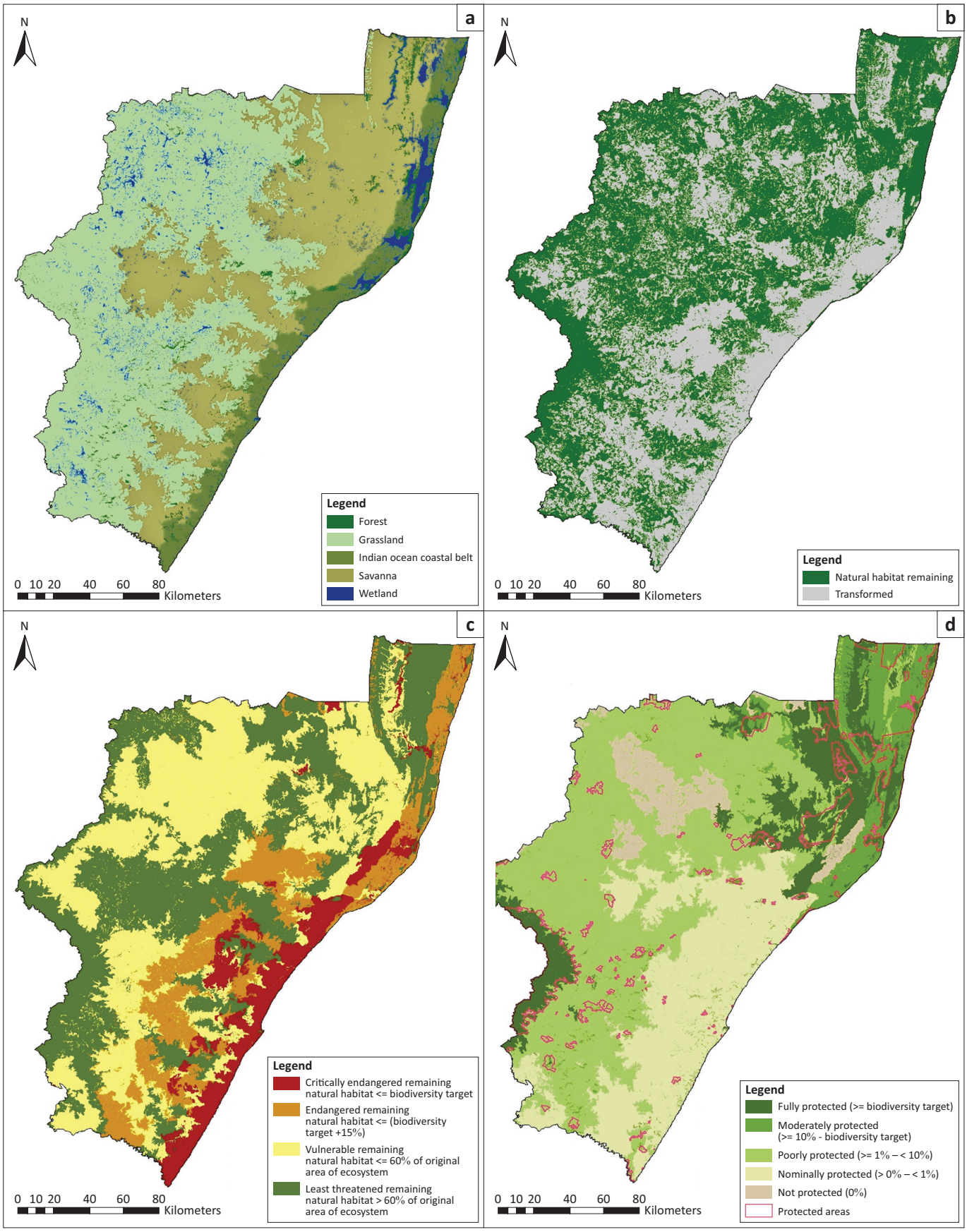

FIGURE 2: (a) The biomes of KwaZulu-Natal (KZN), (b) the remaining natural habitat in KZN in 2011, (c) the ecosystem status of vegetation types in 2011 and (d) the level of protection of vegetation types (January 2016) with Protected Areas shown in red.

Input data: Vegetation map

The provincial vegetation map of KZN was used in this analysis (EKZNW 2011a). It is mapped at a finer scale than the national vegetation map (Mucina & Rutherford 2006). The vegetation map was clipped with the provincial boundary (EKZNW 2010).

Input data: Protected Areas map

The provincial Protected Areas from 2015 (EKZNW 2015) and proclaimed Stewardship sites (*National Environmental Management: Protected Areas Act* [NEM:PA] 57 of 2003) as at January 2016 (EKZNW 2016) were used to determine the level of protection for the vegetation types. The Department of Environmental Affairs maintains a register of the country's conservation estate (the South African Protected Areas Database [SAPAD]). The Protected Areas map used here differs slightly from the SAPAD map as there is a lag period between the provincial Protected Area proclamation and updating of the Surveyor General cadastres and SAPAD at a national level. Game farms and municipal reserves were not included unless proclaimed under NEM:PA.

Analysis

The land cover, vegetation map, conservation targets and protected areas map were used to calculate ecosystem status and levels of protection as described in the National Biodiversity Assessment (Driver et al. 2012). The remaining natural habitat and conservation targets informed the conservation or ecosystem status of the vegetation types. Thresholds of concern are defined as follows: Critically Endangered (≤ biodiversity target), Endangered (≤ biodiversity target + 15%), Vulnerable (≤ 60%) and Least Threatened (> 60%). The threshold for Critically Endangered is based on the vegetation type conservation target described above. Below this threshold, the basic species representation target cannot be achieved.

The level of protection represents the area of a vegetation type within protected areas relative to the conservation target. In SA, conservation targets are the target for the amount of each vegetation type that should be represented within public and private proclaimed protected areas. The levels of protection thresholds of concern are defined as follows: Fully Protected (≥ biodiversity target), Moderately Protected (≥ 10% biodiversity target), Poorly Protected (≥ 1% – < 10%), Nominally Protected (0% – < 1%) and Not Protected (0%).

Notes on the analysis

Habitat patches smaller than 4 ha were removed with the exclusion of naturally fragmented vegetation types such as forests and wetlands, as well as Drakensberg–Amathole Afromontane Fynbos, Drakensberg Afroalpine Heathland, Basotho Montane Shrubland and Lebombo Summit Sourveld. Small patches were considered unable to support the natural processes that create and maintain biodiversity, for example fire. In addition, these small patches have an increased vulnerability to stochastic events, suffer from edge effects and increased disturbances (Doherty, Kearns & Barnett 2000), limiting their long-term persistence.

Results

Between 1994 and 2011 (17 years), 19.7% of natural habitat was converted to non-natural land classes, representing an average annual loss of 1.2% (109 906 ha per annum) and a decline from 73.3% to 53.6% remaining natural. Of the 53.5% remaining natural in 2011 (Figure 2b), 7.35% was considered degraded (in terms of aerial cover as detected from satellite imagery). These degraded areas do not support the full complement of biodiversity features.

The degree of habitat loss varied across vegetation types and biomes, as did the conservation targets that ranged between 19% and 31.3% for non-forest targets and 61.6% and 100% for forest targets. The resulting conservation status of the vegetation types are: 21 (20.8%) vegetation types are Critically Endangered, 14 (13.9%) are Endangered, 17 (16.8%) are Vulnerable and 49 (48.5%) Least Threatened (Table 1, Figure 2c).

The IOCB had the least remaining natural vegetation (24.9%) as of 2011, followed by grasslands (50.3%), wetlands (58.7%), savannas (63.7%) and forests (73.9%) (Figure 1). Similarly, the average annual rates of habitat loss in the biomes between 1994 and 2011 were 2.9%, 1.7%, 1.3%, 1.3% and 0.9% in the IOCB, grasslands, wetlands, savannas and forests, respectively.

At a landscape scale, 9.1% of the terrestrial landscape is protected. The degree of protection (Figure 2d) within the biomes (Table 2) varies significantly, with only 6.8% of grasslands protected, 8.2% of the IOCB protected, 9% of the savannas protected, 24.6% of wetlands protected and 40.2% of forests protected.

Compared to the national listed threatened ecosystems, this analysis identifies additional vegetation types that

TABLE 1: The number of KwaZulu-Natal vegetation types summarised by their conservation status per biome.

Biome	Critically Endangered	Endangered	Vulnerable	Least Threatened
Forests	11	5	0	7
Wetlands	4	2	5	15
Savanna	2	1	4	12
Indian Ocean Coastal Belt (IOCB)	2	2	1	1
Grassland	2	4	7	14
Total	21	14	17	49

are listed as Critically Endangered (e.g. Zululand Coastal Thornveld, Alluvial wetlands and Lowveld Riverine Forest) (Table 3). Similarly, a far greater proportion of vegetation types are listed as Vulnerable.

Discussion

We present the targets, remaining natural habitat, conservation and protection status of vegetation types and biomes in KZN. Only 46.2% of the province remains in a natural state once degraded areas are removed. This figure is conservative considering the extensive alien invasive plants that occur in KZN biomes (Van Wilgen et al. 2012). Currently, alien invasive plants are not detected and mapped on the land cover maps because of the scale and resolution at which the land covers are mapped. Further, it is not always possible to detect secondary vegetation, for example from abandoned agricultural fields, on satellite imagery. A further 7% of the landscape that is mapped as natural vegetation on the land cover maps is estimated to

TABLE 2: The number of KwaZulu-Natal vegetation types summarised by their protection status per biome.

Biome	Fully Protected	Moderately Protected	Poorly Protected	Nominally Protected	Not Protected
Forests	3	17	2	1	0
Wetlands	13	4	7	0	2
Savanna	4	4	3	5	3
Indian Ocean Coastal Belt (IOCB)	2	2	1	1	0
Grassland	6	1	11	3	6
Total	28	28	24	10	11

TABLE 3: KwaZulu-Natal (KZN) vegetation type conservation targets, extents, ecosystem status and level of protection based on 2011 accumulated transformation statistics and protected area (PA) proclamation as at January 2016.

Code	KZN vegetation-type name	KZN biome	Conservation target (%)	Original extent (ha)	Remaining natural (ha)	Remaining natural less fragments (ha)	Ecosystem status	Total PA (ha)	Level of protection
1	Drakensberg-Amathole Afromontane Fynbos	Grassland†	27§	1427	1425	1425	LT	1020	FP
2	Amersfoort Highveld Clay Grassland	Grassland	27§	13 253	8493	8412	LT	0	N
3	Drakensberg Afroalpine Heathland	Grassland	27§	6410	6354	6354	LT	5522	FP
4	Drakensberg Foothill Moist Grassland	Grassland	23§	360 071	223 583	221 516	LT	29 285	PP
5	Basotho Montane Shrubland	Grassland	28§	2760	2483	2483	LT	0	N
6	Dry Coast Hinterland Grassland	Savanna	25¶	276 406	125 199	122 677	V	1950	NP
7	East Griqualand Grassland	Grassland	23§	134 232	67 256	66 360	V	366	NP
8	Eastern Free State Sandy Grassland	Grassland	24§	4119	3758	3729	LT	0	N
10	Income Sandy Grassland	Grassland	23§	437 810	198 948	194 765	V	0	N
11	Ithala Quartzite Sourveld	Grassland	27§	82 024	67 675	67 261	LT	11 159	MP
12	KaNgwane Montane Grassland	Grassland	24§	8265	2352	2228	E	0	N
13	KwaZulu-Natal Sandstone Sourveld	Grassland	25§	179 668	19 954	17 978	CE	194	NP
14	Lebombo Summit Sourveld	Grassland	24§	11 763	3260	3260	E	172	PP
15	Lesotho Highland Basalt Grassland	Grassland	27§	1134	1120	1103	LT	898	FP
16	Low Escarpment Moist Grassland	Grassland	23§	134 083	117 759	117 463	LT	3547	PP
17	Mabela Sandy Grassland	Grassland	23§	440	25	12	CE	0	N
18	Maputaland Wooded Grassland	IOCB	25§	107 929	39 643	39 172	E	19 109	MP
19	Maputaland Coastal Belt	IOCB	25§	221 194	78 535	76 799	E	37 176	MP
20	Midlands Mistbelt Grassland	Grassland	23§	547 445	130 599	126 355	E	13 697	PP
21	Moist Coast Hinterland Grassland	Grassland	25¶	437 556	157 573	153 031	E	873	NP
22	Mooi River Highland Grassland	Grassland	23§	266 938	144 071	142 047	V	13 719	PP
24	Northern Drakensberg Highland Grassland	Grassland	27§	70 706	69 096	69 044	LT	38 473	FP
25	Northern KwaZulu-Natal Moist Grassland	Grassland	24§	696 920	391 958	387 698	V	10 854	PP
26	Northern Zululand Mistbelt Grassland	Grassland	23§	52 896	22 594	22 251	V	931	PP
27	Paulpietersburg Moist Grassland	Grassland	24§	284 058	120 957	118 688	V	8420	PP
28	Pondoland-Ugu Sandstone Coastal Sourveld	IOCB	30.3§§	37 245	7165	6773	CE	2247	PP
29	KwaZulu-Natal Coastal Belt Grassland	IOCB	25§	411 500	45 543	40 613	CE	3890	NP
30	Southern Drakensberg Highland Grassland	Grassland	27§	89 808	88 501	88 471	LT	57 719	FP
31	Southern KwaZulu-Natal Moist Grassland	Grassland	23§	231 823	96 778	94 713	V	9800	PP
32	uKhahlamba Basalt Grassland	Grassland	27§	120 155	119 924	119 905	LT	106 550	FP

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TABLE 3 (Continues...): KwaZulu-Natal (KZN) vegetation type conservation targets, extents, ecosystem status and level of protection based on 2011 accumulated transformation statistics and protected area (PA) proclamation as at January 2016.

Code	KZN vegetation-type name	KZN biome	Conservation target (%)	Original extent (ha)	Remaining natural (ha)	Remaining natural less fragments (ha)	Ecosystem status	Total PA (ha)	Level of protection
33	Wakkerstroom Montane Grassland	Grassland	27§	131 688	113 395	113 070	LT	4123	PP
34	Delagoa Lowveld	Savanna	19§	8770	1084	1069	CE	0	N
35	Eastern Valley Bushveld	Savanna	25§	313 748	211 707	210 176	LT	906	NP
36	Granite Lowveld	Savanna	19§	3656	1228	1188	E	0	N
37	KwaZulu-Natal Highland Thornveld	Grassland	23§	500 487	307 803	303 496	LT	9073	PP
38	KwaZulu-Natal Hinterland Thornveld	Savanna	25§	152 542	99 029	97 918	LT	740	NP
39	Makatini Clay Thicket	Savanna	19§	32 327	26 671	26 415	LT	12 760	FP
40.1	Maputaland Pallid Sandy Bushveld	Savanna	25§§	61 429	46 460	46 074	LT	9815	MP
40.2	Muzi Palm Veld and Wooded Grassland	Savanna	25¶	52 931	41 211	40 744	LT	3535	PP
41	KwaZulu-Natal Coastal Belt Thornveld	Savanna	25¶	111 926	49 582	48 218	V	611	NP
42	Northern Zululand Sourveld	Savanna	19§	470 422	306 996	304 135	LT	34 585	PP
44	Southern Lebombo Bushveld	Savanna	24§	116 567	97 350	96 830	LT	11 972	MP
45	Swaziland Sour Bushveld	Savanna	19§	50 517	42 378	42 161	LT	12 009	FP
47	Tembe Sandy Bushveld	Savanna	19§	110 678	85 880	85 139	LT	17 707	MP
48	Thukela Thornveld	Savanna	25§	215 907	163 740	162 188	LT	6580	PP
49	Thukela Valley Bushveld	Savanna	25§	268 482	191 381	189 374	LT	1255	NP
50	Western Maputaland Clay Bushveld	Savanna	19§	152 693	57 032	54 458	V	31 248	FP
51	Western Maputaland Sandy Bushveld	Savanna	19§	15 132	9895	9664	LT	2819	MP
52	Zululand Coastal Thornveld	Savanna	19§	67 137	11 181	10 630	CE	0	N
53	Zululand Lowveld	Savanna	19§	665 917	375 813	372 083	V	135 475	FP
55	Subtropical Coastal Lagoons: Estuary	Azonal Wetland	24§	40 090	39 188	39 188	LT	35 224	FP
57	Drakensberg Montane Forests	Forest	63.5††	6393	6077	6077	LT	3665	MP
59	Eastern Mistbelt Forests	Forest	66.5††	44 474	29 933	29 933	E	8127	MP
60.1	Eastern Scarp Forests: Ngome-Nkandla Scarp Forest	Forest	61.6††	8593	3785	3785	CE	2911	MP
60.2	Eastern Scarp Forests: Northern Coastal Scarp Forest	Forest	61.6††	5632	4408	4408	LT	3693	FP
60.3	Eastern Scarp Forests: Northern Zululand Lebombo Scarp Forest	Forest	61.6††	7656	6785	6785	LT	3418	MP
60.4	Eastern Scarp Forests: Southern Coastal Scarp Forest	Forest	61.6††	11 378	8804	8804	LT	570	PP
61	Pondoland Scarp Forests	Forest	61.6††	4889	3998	3998	LT	2015	MP
62.1	KwaZulu-Natal Coastal Forests: Dukuduku Moist Coastal Lowlands Forest	Forest	71.7††	8478	5781	5781	CE	7283	FP
62.2	KwaZulu-Natal Coastal Forests: Maputaland Dry Coastal Lowlands Forest	Forest	71.7††	2406	2053	2053	E	1440	MP
62.3	KwaZulu-Natal Coastal Forests: Maputaland Mesic Coastal Lowlands Forest	Forest	71.7††	8962	7218	7218	E	5814	MP
62.4	KwaZulu-Natal Coastal Forests: Maputaland Moist Coastal Lowlands Forest	Forest	71.7††	13 655	10 833	10 833	E	8491	MP
62.5	KwaZulu-Natal Coastal Forests: Southern Mesic Coastal Lowlands Forest	Forest	71.7††	10 705	5925	5925	CE	1415	MP
62.6	KwaZulu-Natal Coastal Forests: Southern Moist Coastal Lowlands Forest	Forest	71.7††	3174	1600	1600	CE	280	PP
63.1	KwaZulu-Natal Dune Forests: East Coast Dune Forest	Forest	69.2††	2497	1313	1313	CE	451	MP
63.2	KwaZulu-Natal Dune Forests: Maputaland Dune Forest	Forest	69.2††	16 390	13 051	13 051	E	10 898	MP
64.1	Licuati Sand Forests: Eastern Sand Forest	Forest	69††	25 478	23 461	23 461	LT	10 143	MP
64.2	Licuati Sand Forests: Western Sand Forest	Forest	69††	909	903	903	LT	870	FP
65	Lowveld Riverine Forests	Azonal Forest	100††	10 039	6134	6134	CE	4592	MP
66.1	Swamp Forests: *Barringtonia* Swamp Forest	Azonal Forest	100††	94	47	47	CE	47	MP
66.2	Swamp Forests: *Ficus trichopoda* Swamp Forest	Azonal Forest	100††	7722	5156	5156	CE	3570	MP
66.3	Swamp Forests: *Raphia* Swamp Forest	Azonal Forest	100††	370	172	172	CE	68	MP

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TABLE 3 (Continues...): KwaZulu-Natal (KZN) vegetation type conservation targets, extents, ecosystem status and level of protection based on 2011 accumulated transformation statistics and protected area (PA) proclamation as at January 2016.

Code	KZN vegetation-type name	KZN biome	Conservation target (%)	Original extent (ha)	Remaining natural (ha)	Remaining natural less fragments (ha)	Ecosystem status	Total PA (ha)	Level of protection
66.4	Swamp Forests: *Voacanga thouarsii* Swamp Forest	Azonal Forest	100††	462	36	36	CE	2	NP
67	Mangrove Forests	Azonal Forest	100††	2522	2382	2382	CE	1798	MP
68	Subtropical Seashore Vegetation	IOCB	20§	52	42	23	V	23	FP
69	Subtropical Dune Thicket	IOCB	20§	1245	1195	1188	LT	1083	FP
70.1	Freshwater Wetlands: Drakensberg Wetlands	Azonal Wetland	24§	5759	4256	4256	LT	2405	FP
70.2	Freshwater Wetlands: Lesotho Mires	Azonal Wetland	24§	1	1	1	LT	1	FP
72.1	Freshwater Wetlands: Eastern Temperate Wetlands	Azonal Wetland	24§	44 743	24 702	24 702	V	502	PP
72.2	Freshwater Wetlands: Eastern Temperate Wetlands: Lakes & Pans	Azonal Wetland	24§	41	35	35	LT	10	FP
75.1	Alluvial Wetlands: Subtropical Alluvial Vegetation	Azonal Wetland	31§	17 088	5805	5805	E	1478	PP
75.3	Alluvial Wetlands: Subtropical Alluvial Vegetation: Lowveld Floodplain Grasslands	Azonal Wetland	31§	22 957	6078	6078	CE	3038	MP
75.4	Alluvial Wetlands: Subtropical Alluvial Vegetation: Lowveld Floodplain Grasslands: Tall Reed Wetland	Azonal Wetland	31§	2535	1424	1424	V	753	MP
75.5	Alluvial Wetlands: Subtropical Alluvial Vegetation: Lowveld Floodplain Grasslands: Short Grass/Sedge Wetland	Azonal Wetland	31§	7612	2087	2087	CE	434	PP
76.1	Freshwater Wetlands: Subtropical Freshwater Wetlands	Azonal Wetland	24§	13 949	6260	6260	V	2129	MP
76.2	Freshwater Wetlands: Subtropical Freshwater Wetlands: Tall Grassland/Sedge/ Reed Wetlands	Azonal Wetland	24§	14 809	14 442	14 442	LT	11 203	FP
76.3	Freshwater Wetlands: Subtropical Freshwater Wetlands: Short Grass/Sedge Wetlands	Azonal Wetland	24§	47 001	38 525	38 525	LT	15 182	FP
76.4	Freshwater Wetlands: Subtropical Freshwater Wetlands: Short Grass/Sedge Wetlands: Dune Slack	Azonal Wetland	24§	275	144	144	V	112	FP
76.5	Freshwater Wetlands: Subtropical Freshwater Wetlands: Short Grass/Sedge Wetlands: Coastal Plain Depression	Azonal Wetland	24§	782	649	649	LT	57	PP
76.7	Freshwater Wetlands: Subtropical Freshwater Wetlands: Coastal Lakes & Pans	Azonal Wetland	24§	7595	7097	7097	LT	6166	FP
76.8	Freshwater Wetlands: Subtropical Freshwater Wetlands: Coastal Lakes & Pans: Endorheic	Azonal Wetland	24§	6999	6977	6977	LT	6247	FP
76.9	Freshwater Wetlands: Subtropical Freshwater Wetlands: Coastal Lakes & Pans: Lacustrine	Azonal Wetland	24§	1	0		CE	0	N
77.1	Inland Saline Wetlands: Subtropical Salt Pans	Azonal Wetland	24§	2556	2277	2277	LT	1553	FP
77.2	Inland Saline Wetlands: Subtropical Salt Pans: Floodplain Pans (Open)	Azonal Wetland	24§	2086	1731	1731	LT	1198	FP
77.3	Inland Saline Wetlands: Subtropical Salt Pans: Rain fed (Endorheic) Pans (Closed)	Azonal Wetland	24§	538	328	328	LT	0	NP
78.1	Alluvial Wetlands: Temperate Alluvial Vegetation	Azonal Wetland	24§§	147 288	62 161	62 161	V	5604	PP
78.2	Alluvial Wetlands: Temperate Alluvial Vegetation: Midland Alluvial Woodland & Thicket	Azonal Wetland	24§§	207	42	42	CE	18	PP
78.3	Alluvial Wetlands: Temperate Alluvial Vegetation: Midland Floodplain Grasslands	Azonal Wetland	24§§	1780	1228	1228	LT	274	MP
79.1	Marine Saline Wetlands	Azonal Wetland	24§§	1761	427	427	E	22	PP
79.2	Marine Saline Wetlands: Saline Reed & Sedge Beds	Azonal Wetland	24§§	964	944	944	LT	942	FP
79.3	Marine Saline Wetlands: Saline Grassland & Mud Flats	Azonal Wetland	24§§	4212	2912	2912	LT	2366	FP

†, this vegetation type has Fynbos affinities but for the purposes of statistical reporting has been included in the Grassland biome.

Conservation targets were based on ††, Berliner (2005); §, Government of South Africa (2009); ¶, Mucina and Rutherford (2006); §§, Jewitt (2009).

Ecosystem status abbreviations are: CE, Critically Endangered: E, Endangered; V, Vulnerable; LT, Least Threatened.

Level of protection abbreviations are: N, Not Protected; NP, Nominally Protected; PP, Poorly Protected; MP, Moderately Protected; FP, Fully Protected.

be historical agricultural fields (circa 1960/1970), which are depauperate in their species complement especially in terms of specialised species and geophytic plants (Jewitt et al. 2017). Hence, estimates of natural habitat remaining are conservative. It is therefore essential that high diversity, primary natural vegetation sites are identified and secured

via Protected Area expansion and Stewardship programmes. These sites need to be appropriately managed to maintain their biodiversity value. High livestock stocking rates, unsustainable indigenous resource harvesting and alien invasive plant species are contributing to the degradation of intact ecosystems and are a major concern for the future.

The vegetation types occurring along the coast and the midlands have the largest loss of natural habitat and are thus the most threatened vegetation types in the province. The IOCB and grassland biomes have the least amount of natural habitat remaining and have the highest annual rates of habitat loss. They also have the least amount of formal protection. These vegetation types and biomes require urgent conservation action. To ensure representivity, each vegetation type should be adequately protected and have the target amount of habitat formally protected. The current distribution of the Protected Area network is biased. Future Protected Areas should be created in vegetation types without any protection or which are nominally or poorly protected. The Drakensberg, Zululand and Maputaland areas have a better Protected Area network than north-western and south-eastern KZN. Rates of habitat loss in the forest biome were the lowest but this may reflect the more recent mapping extent of forests rather than their actual habitat loss.

The indices reported here may help to inform land use planning and Protected Area expansion by spatially depicting vegetation types under greatest threat or requiring Protected Area expansion. These maps may be used in provincial conservation plans, spatial development frameworks, Protected Area expansion strategies and other land use planning initiatives. Whilst Protected Areas have increased in extent since 1994, the rate of habitat loss is continuing unsustainably, limiting the options to expand the Protected Area network and increasing the threat status of vegetation types. The rates of habitat loss have slowed over successive time periods, but this could be related to the sluggish economy (Jewitt et al. 2015b) or other factors and could potentially increase in future.

Jewitt et al. (2015b) identified the dominant drivers of transformation, or loss of natural habitat, as cultivated agriculture, timber plantations, the built environment, mining and dams. These represent the key sectors that should be engaged with to guide appropriate land use change. Rouget et al. (2003) recommend considering future land use changes to identify future threats and enable the search for alternative options. For instance, the Carbon Tax Policy, scheduled to come into effect in 2017, may have a significant effect on industries such as agriculture (Agri SA Commodity Chamber 2017). This could have the advantage of encouraging farmers to take up sustainable land management practices or it could drive significant land use changes in the agricultural landscape to remain economically viable.

South Africa has good environmental legislation (e.g. the Constitution of the Republic of South Africa and the *National Environmental Management Act* 107 of 1998) and is also a signatory to many different global conventions such as the Convention on Biological Diversity (CBD). These demand the conservation of landscapes, ecosystems and species for current and future generations. The intentions of the legislation and conventions are good, yet the loss of natural habitat and species declines continue, resulting in the high number of threatened ecosystems. A third of the vegetation types in the province are Endangered or Critically Endangered. The National List of Ecosystems that are Threatened and in need of protection (Act No. 1002 of 2011) was established to protect threatened ecosystems. This analysis demonstrates that several ecosystems have since attained a worse conservation status (based only on Criteria A1 or loss of habitat). This analysis identifies 8.5% of KZN as Critically Endangered compared to zero in the Threatened Ecosystem legislation. Similarly, 15.5% is listed as Endangered compared to 5% in the legislation. However, the legislation only became effective in 2011, meaning that future land cover maps will allow an assessment of the efficacy of the Threatened Ecosystem legislation. If current legislation, or perhaps the lack of implementation thereof, is not sufficient to protect ecosystems and species, a new model for conservation and sustainability must urgently be found. Indeed, the calls for acknowledging and implementing what is ultimately required to sustain life on the Earth are increasing (Noss et al. 2012). It is recognised that humanity is pushing ecosystems beyond their capacity to support life and time is running out to change the current failing trajectory (Ripple et al. 2017).

Targets

The targets used here may differ from national targets. Differences may arise because of the phytosociological data available at the time of the analysis, the differences between calculated targets and extrapolated targets and the finer scale of the provincial vegetation map compared to the national vegetation map. Similarly, the conservation status may differ because of revised vegetation boundaries at the time of the analysis, dates of land cover maps used and vegetation types that may extend beyond the boundary of KZN compared to KZN endemic vegetation types. Processes are in place to include finer scale mapping initiatives into the national vegetation map, facilitating a hierarchical level of mapping from broad scale to fine scale (Dayaram et al. 2017).

The targets provide an estimation of the area required to represent a single occurrence of 75% of the plant species occurring within the vegetation type (Desmet 2004). The targets do not consider ecological processes. Hence, the targets are conservative and will not ensure adequate representivity or persistence of all species, but they represent an important first step in securing representative habitats in the province. Recent conservation plans based on composite sets of biodiversity targets aimed at achieving biodiversity persistence require 60%–65% of the area (Noss et al. 1999).

It is well known that larger areas conserve more species (Desmet & Cowling 2004) and are essential for ecological resilience. The probability of species extinctions is less in larger areas (Cumming 2011). Given climate change predictions, larger areas that are more resilient to environmental perturbations are critical. Noss et al. (2012) suggested that 50% of landscapes should be managed in a conservation-friendly manner so that species, populations and communities are conserved into the future. Similarly, Soulé and Sanjayan (1998) estimated that 50% of the landscape is required to maintain functional integrity and ensure biological persistence. Flather and Bevers (2002) found that there was a rapid decline in the probability of landscapes supporting viable populations once less than 50% of habitat remained. Plant pollination is significantly negatively impacted once 50% of the habitat is lost (Traveset et al. 2018). It is recommended that the current vegetation type targets, both provincial and national, should be revised to accommodate ecological and evolutionary processes, ensure essential ecosystem services are provided, maintain landscape connectivity and provide resilience to climate change impacts and other threats to maintain viable populations and ensure long-term persistence. It is recommended that the targets should be closer to 50% (Locke 2013) – significantly higher than the current targets.

KwaZulu-Natal has less than the recommended target amount of natural habitat remaining. As the province's ecological infrastructure is lost, an increasing proportion of species extinctions can be expected. The long-term social cost of losing this infrastructure is likely far greater than the short-term cost of preventing further loss of natural habitat in the landscape.

Conclusion

The evaluation of the conservation and protection status of vegetation types in KZN informs conservation priorities in the province. The rapid rate of habitat loss is creating an urgency to protect the remaining natural habitat, especially because the remaining primary, intact vegetation is below the recommended target of 50%. Restoration efforts are required in the Critically Endangered and Endangered vegetation types. Awareness campaigns are required amongst all stakeholders, highlighting the rapid loss of natural habitat and the legislative need to protect the environment. This would be enhanced by demonstrating the value and benefits of the natural environment to society. Agreements need to be secured amongst all government sectors to halt further conversion of primary habitat and rather intensify development on existing non-natural land. Business-as-usual is no longer an option if we are to meet the legislative requirements and mandates to conserve the environment for current and future generations.

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Competing interests

The author declares that she has no financial or personal relationships that may have influenced her in writing this article.

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