

Article

Quantifying Long-Term Urban Grassland Dynamics: Biotic Homogenization and Extinction Debts

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Supplementary Material

Table S1. Species richness and percentage contributions (annual and perennial) for all comparable sites between the sampling periods (sites that could not be resampled in 2019 were excluded from previous surveys).

	Open grassland						Woody grassland					
	1995		2012		2019		1995		2012		2019	
	SR	%	SR	%	SR	%	SR	%	SR	%	SR	%
Total	186		133		142		180		159		160	
Exotic	18	10	13	10	15	11	23	13	31	19	30	19
E_grass	1	6	0	0	1	7	0	0	1	3	2	7
E_forb	17	94	13	100	13	87	17	74	22	71	22	73
E_shrub	0	0	0	0	1	7	4	17	4	13	3	10
E_tree	0	0	0	0	0	0	2	9	4	13	3	10
Indigenous	168	90	120	90	127	89	157	87	128	81	130	81
I_grass	41	24	34	28	39	31	33	21	31	24	35	27
I_forb	104	62	70	58	73	57	74	47	56	44	51	39
I_shrub	22	13	15	13	14	11	36	23	28	22	31	24
I_tree	1	1	1	1	1	1	14	9	13	10	13	10
Annual	36	20	22	17	23	16	29	16	31	19	26	16
A_grass	6	17	4	18	4	17	5	17	5	16	4	15
A_forb	27	75	16	73	18	78	21	72	25	81	20	77
A_shrub	3	8	2	9	1	4	3	10	1	3	2	8
Perennial	150	80	111	83	119	84	151	84	128	81	134	84
P_grass	36	24	30	27	36	30	28	19	27	21	33	25
P_forb	94	63	67	60	68	57	70	46	53	41	53	40
P_shrub	19	13	13	12	14	12	37	25	31	24	32	24
P_tree	1	1	1	1	1	1	16	11	17	13	16	12

Table S2. List of all the indigenous species recorded in the comparison sites for all sampling periods. The list includes the conservation status based on the Red List of South African Plants [82] and the number of plots in which the species occurred for each habitat type and sampling period. The bold text and dark grey fill indicate widespread species and the light grey rare species based on Gaston's Quartile Criterion [61]. Plant names according to the Red List [84] and Germishuizen et al. [83].

Species name	Status SA Redlist	lifespan	Lifeform	W1995	G1995	W2012	G2012	W2019	G2019
<i>Abutilon sonneratianum</i> (Cav.) Sweet	Least concern (LC)	perennial	shrub	4	0	3	0	3	0
<i>Acalypha angustata</i> Sond.	LC	perennial	herb	8	9	0	7	0	3
<i>Aerva leucura</i> Moq.	LC	perennial	herb	6	1	5	0	5	0
<i>Albuca setosa</i> Jacq.	LC	perennial	herb	0	1	3	2	3	2
<i>Aloe greatheadii</i> Schönland var. <i>davyana</i> (Schönland) Glen & D.S.Hardy	LC	perennial	herb	15	11	18	11	17	11
<i>Ancylobotrys capensis</i> (Oliv.) Pichon	LC	perennial	shrub	1	0	0	0	0	0
<i>Andropogon schirensis</i> Hochst. ex A.Rich.	LC	perennial	grass	0	1	0	0	2	7
<i>Anthephora pubescens</i> Nees	LC	perennial	grass	0	0	0	0	1	2
<i>Antizoma angustifolia</i> (Burch.) Miers ex Harv.	LC	perennial	herb	4	1	5	0	4	0
<i>Aptosimum elongatum</i> Engl.	LC	perennial	herb	1	0	0	0	0	0
<i>Aristida adscensionis</i> L.	LC	annual	grass	1	0	0	0	0	0
<i>Aristida bipartita</i> (Nees) Trin. & Rupr.	LC	perennial	grass	0	3	0	2	0	2
<i>Aristida canescens</i> Henrard subsp. <i>canescens</i>	LC	perennial	grass	5	5	3	3	4	6
<i>Aristida congesta</i> Roem. & Schult. subsp. <i>barbicollis</i> (Trin. & Rupr.) De Winter	LC	perennial	grass	0	0	0	0	0	1
<i>Aristida congesta</i> Roem. & Schult. subsp. <i>congesta</i>	LC	annual	grass	10	6	2	3	2	3
<i>Aristida diffusa</i> Trin. subsp. <i>burkei</i> (Stapf) Melderis	LC	perennial	grass	0	1	1	1	0	1
<i>Aristida stipitata</i> Hack.	LC	perennial	grass	0	0	1	0	0	0
<i>Asparagus africanus</i> Lam.	LC	perennial	shrub	5	0	6	0	7	0
<i>Asparagus laricinus</i> Burch.	LC	perennial	shrub	7	1	11	1	11	1
<i>Asparagus suaveolens</i> Burch.	LC	perennial	shrub	9	3	13	2	19	3
<i>Berkheya radula</i> (Harv.) De Wild.	LC	perennial	herb	0	4	0	3	0	3
<i>Bewsia biflora</i> (Hack.) Gooss.	LC	perennial	grass	0	2	0	0	0	4

<i>Blepharis integrifolia</i> (L.f.) E.Mey. ex Schinz var. <i>integrifolia</i>	LC	perennial	herb	2	4	2	4	4	6
<i>Blepharis serrulata</i> (Nees) Ficalho & Hiern	LC	perennial	herb	2	4	1	1	0	0
<i>Bonatea speciosa</i> (L.f.) Willd.	LC	perennial	herb	0	0	2	0	1	0
<i>Boophone disticha</i> (L.f.) Herb.	LC	perennial	herb	3	2	0	0	0	0
<i>Boscia albitrunca</i> (Burch.) Gilg & Gilg-Ben.	LC	perennial	tree	6	0	6	0	8	0
<i>Brachiaria eruciformis</i> (Sm.) Griseb.	LC	annual	grass	0	0	0	0	0	1
<i>Brachiaria nigropedata</i> (Ficalho & Hiern) Stapf	LC	perennial	grass	8	1	11	1	9	3
<i>Brachiaria serrata</i> (Thunb.) Stapf	LC	perennial	grass	0	5	0	8	1	11
<i>Bulbine abyssinica</i> A.Rich.	LC	perennial	herb	1	1	0	0	0	0
<i>Bulbine narcissifolia</i> Salm-Dyck	LC	perennial	herb	0	1	0	1	0	1
<i>Bulbostylis burchellii</i> (Ficalho & Hiern) C.B.Clarke	LC	perennial	herb	2	4	1	3	2	5
<i>Canthium</i> sp.	LC	perennial	shrub	0	0	0	0	1	0
<i>Celtis africana</i> Burm.f.	LC	perennial	tree	9	0	7	0	10	0
<i>Cenchrus ciliaris</i> L.	LC	perennial	grass	0	1	0	0	0	0
<i>Chaenostoma leve</i> (Hiern) Kornhall	LC	annual	herb	0	0	1	0	0	0
<i>Chamaecrista biensis</i> (Steyaert) Lock	LC	perennial	herb	1	10	0	2	0	7
<i>Chamaecrista mimosoides</i> (L.) Greene	LC	annual	herb	0	1	0	1	0	0
<i>Chascanum adenostachyum</i> (Schauer) Moldenke	LC	perennial	herb	0	4	1	3	3	4
<i>Chascanum hederaceum</i> (Sond.) Moldenke	LC	perennial	herb	4	7	1	1	0	1
<i>Cheilanthes viridis</i> (Forssk.) Sw.	LC	perennial	herb	4	0	1	0	1	0
<i>Chenopodium mucronatum</i> Thunb.	LC	annual	herb	7	0	6	0	7	0
<i>Chloris pycnothrix</i> Trin.	LC	annual	grass	0	1	0	0	0	0
<i>Chloris virgata</i> Sw.	LC	annual	grass	0	2	0	1	0	0
<i>Chlorophytum angulicaule</i> (Baker) Kativu	LC	perennial	herb	0	1	0	1	0	0
<i>Chlorophytum cooperi</i> (Baker) Nordal	LC	perennial	herb	0	1	0	0	0	0
<i>Clematis brachiata</i> Thunb.	LC	perennial	shrub	12	2	7	1	9	0
<i>Cleome rubella</i> Burch.	LC	annual	herb	1	0	0	0	0	0
<i>Commelina africana</i> L.	LC	perennial	herb	13	3	13	4	17	6
<i>Commelina benghalensis</i> L.	LC	annual	herb	1	0	2	1	2	0

<i>Convolvulus sagittatus</i> Thunb.	LC	perennial	herb	2	2	2	1	1	2
<i>Corchorus asplenifolius</i> Burch.	LC	perennial	herb	4	9	1	2	2	4
<i>Crabbea acaulis</i> N.E.Br.	LC	perennial	herb	0	2	0	1	1	1
<i>Crabbea angustifolia</i> Nees	LC	perennial	herb	1	5	0	2	0	2
<i>Crassula capitella</i> Thunb.	LC	perennial	herb	1	4	1	4	0	3
<i>Crassula lanceolata</i> (Eckl. & Zeyh.) Endl. ex Walp. subsp. <i>transvaalensis</i> (Kuntze) Toelken	LC	perennial	herb	0	0	0	0	0	2
<i>Crotalaria</i> sp.	LC	perennial	herb	0	1	0	0	0	1
<i>Crotalaria sphaerocarpa</i> Perr. ex DC. subsp. <i>sphaerocarpa</i>	LC	annual	herb	0	0	0	0	0	1
<i>Crotalaria virgulata</i> Klotzsch subsp. <i>grantiana</i> (Harv.) Polhill	LC	annual	herb	0	2	0	0	0	0
<i>Cryptolepis oblongifolia</i> (Meisn.) Schltr.	LC	perennial	shrub	0	0	1	0	0	0
<i>Cryptolepis</i> sp.	LC	perennial	shrub	0	0	0	0	1	0
<i>Cucumis zeyheri</i> Sond.	LC	perennial	herb	0	0	0	1	0	0
<i>Cyanotis speciosa</i> (L.f.) Hassk.	LC	perennial	herb	3	5	0	1	1	2
<i>Cymbopogon caesius</i> (Hook. & Arn.) Stapf	LC	perennial	grass	0	0	0	11	1	8
<i>Cymbopogon pospischilii</i> (K.Schum.) C.E. Hubb.	not in list	perennial	grass	6	8	3	2	4	3
<i>Cynodon dactylon</i> (L.) Pers.	LC	perennial	grass	10	3	12	5	9	6
<i>Cyperus</i> sp.	LC	perennial	herb	0	0	0	0	3	0
<i>Cyphia assimilis</i> Sond.	LC	perennial	herb	1	0	0	0	0	0
<i>Delosperma herbeum</i> (N.E.Br.) N.E.Br.	LC	perennial	herb	1	2	3	2	0	1
<i>Deverra burchellii</i> (DC.) Eckl. & Zeyh.	LC	perennial	herb	0	1	0	1	0	1
<i>Dianthus mooiensis</i> F.N.Williams	LC	perennial	herb	0	1	0	0	0	0
<i>Dicoma anomala</i> Sond.	LC	perennial	herb	1	2	0	2	0	1
<i>Dicoma macrocephala</i> DC.	LC	perennial	herb	0	2	0	0	0	0
<i>Digitaria eriantha</i> Steud.	LC	perennial	grass	17	0	16	0	15	0
<i>Digitaria ternata</i> (A.Rich.) Stapf	LC	annual	grass	0	1	0	1	0	1
<i>Diheteropogon amplexens</i> (Nees) Clayton var. <i>amplexens</i>	LC	perennial	grass	0	10	1	9	2	10

<i>Diospyros lycioides</i> Desf. subsp. <i>guerkei</i> (Kuntze) De Winter	LC	perennial	shrub	1	0	0	0	0	0
<i>Dombeya rotundifolia</i> (Hochst.) Planch. var. <i>rotundifolia</i>	LC	perennial	tree	6	0	7	0	7	0
<i>Dyschoriste costata</i> (Nees) Kuntze	LC	perennial	herb	1	3	2	3	0	2
<i>Ehretia rigida</i> (Thunb.) Druce subsp. <i>nervifolia</i> Retief & A.E.van Wyk	LC	perennial	shrub	15	0	13	0	11	0
<i>Elephantorrhiza elephantina</i> (Burch.) Skeels	LC	annual	shrub	1	6	0	5	0	4
<i>Elionurus muticus</i> (Spreng.) Kunth	LC	perennial	grass	2	5	4	8	0	7
<i>Enneapogon cenchroides</i> (Licht. ex Roem. & Schult.) C.E.Hubb.	LC	annual	grass	4	0	1	0	3	0
<i>Enneapogon scoparius</i> Stapf	LC	perennial	grass	2	0	3	0	0	0
<i>Eragrostis barbinodis</i> Hack.	LC	perennial	grass	1	0	0	0	0	0
<i>Eragrostis chloromelas</i> Steud.	LC	perennial	grass	11	7	15	7	11	11
<i>Eragrostis gummiflua</i> Nees	LC	perennial	grass	0	2	1	1	1	0
<i>Eragrostis lehmanniana</i> Nees var. <i>lehmanniana</i>	LC	perennial	grass	9	0	4	0	3	0
<i>Eragrostis micrantha</i> Hack.	LC	perennial	grass	0	1	0	0	0	0
<i>Eragrostis nindensis</i> Ficalho & Hiern	LC	perennial	grass	0	0	0	0	0	1
<i>Eragrostis obtusa</i> Munro ex Ficalho & Hiern	LC	perennial	grass	6	2	0	1	0	2
<i>Eragrostis plana</i> Nees	LC	perennial	grass	1	1	0	1	1	2
<i>Eragrostis racemosa</i> (Thunb.) Steud.	LC	perennial	grass	3	10	0	9	0	6
<i>Eragrostis superba</i> Peyr.	LC	perennial	grass	7	3	0	0	8	3
<i>Eragrostis trichophora</i> Coss. & Durieu	LC	perennial	grass	3	2	2	0	6	0
<i>Euclea crispa</i> (Thunb.) Gürke subsp. <i>crispa</i>	LC	perennial	shrub	1	0	0	0	0	0
<i>Euclea undulata</i> Thunb.	LC	perennial	tree	10	0	6	0	4	0
<i>Euphorbia inaequilatera</i> Sond.	LC	annual	herb	5	8	0	2	0	3
<i>Eustachys paspaloides</i> (Vahl) Lanza & Mattei	LC	perennial	grass	8	3	3	0	8	5
<i>Falkia oblonga</i> Bernh. ex C.Krauss	LC	perennial	herb	0	1	0	1	0	1
<i>Felicia muricata</i> (Thunb.) Nees subsp. <i>muricata</i>	LC	perennial	shrub	1	5	7	3	3	5
<i>Gazania krebsiana</i> Less. subsp. <i>serrulata</i> (DC.) Roessler	LC	perennial	herb	0	0	0	0	0	1
<i>Gladiolus crassifolius</i> Baker	LC	perennial	herb	1	1	0	1	0	0

<i>Gladiolus permeabilis</i> D.Delaroche subsp. <i>edulis</i> (Burch. ex Ker Gawl.) Oberm.	LC	perennial	herb	1	2	1	0	0	1
<i>Gomphocarpus fruticosus</i> (L.) Aiton f.	LC	perennial	shrub	0	1	0	0	0	1
<i>Grewia flava</i> DC.	LC	perennial	shrub	19	0	16	0	20	0
<i>Grewia occidentalis</i> L. var. <i>occidentalis</i>	LC	perennial	shrub	4	0	3	0	3	0
<i>Gymnosporia buxifolia</i> (L.) Szyszyl.	LC	perennial	shrub	3	0	4	0	4	0
<i>Gymnosporia tenuispina</i> (Sond.) Szyszyl.	LC	perennial	shrub	0	0	1	0	1	0
<i>Haplocarpha scaposa</i> Harv.	LC	perennial	herb	0	2	0	0	0	0
<i>Helichrysum caespitium</i> (DC.) Harv.	LC	perennial	herb	0	1	0	0	0	0
<i>Helichrysum nudifolium</i> (L.) Less. var. <i>nudifolium</i>	LC	perennial	herb	0	6	0	3	0	6
<i>Helichrysum rugulosum</i> Less.	LC	perennial	herb	0	0	0	2	0	2
<i>Hermannia depressa</i> N.E.Br.	LC	perennial	herb	2	5	2	5	2	5
<i>Heteropogon contortus</i> (L.) Roem. & Schult.	LC	perennial	grass	12	9	9	3	3	7
<i>Hibiscus aethiopicus</i> L.	LC	perennial	herb	1	0	0	0	0	0
<i>Hibiscus engleri</i> K.Schum.	LC	perennial	herb	1	0	1	1	3	1
<i>Hibiscus pusillus</i> Thunb.	LC	perennial	herb	7	3	1	3	2	3
<i>Hibiscus trionum</i> L.	not in list	annual	herb	0	1	0	0	0	2
<i>Hilliardiella oligocephala</i> (DC.) H.Rob.	LC	perennial	herb	5	6	7	7	9	6
<i>Hyparrhenia hirta</i> (L.) Stapf	LC	perennial	grass	3	3	4	5	1	3
<i>Hypoxis hemerocallidea</i> Fisch., C.A.Mey. & Avé-Lall.	LC	perennial	herb	1	2	0	0	0	0
<i>Hypoxis rigidula</i> Baker	LC	perennial	herb	1	2	0	1	0	1
<i>Indigofera daleoides</i> Benth. ex Harv. var. <i>daleoides</i>	Not Evaluated	perennial	herb	1	1	0	2	1	2
<i>Indigofera filipes</i> Benth. ex Harv.	LC	perennial	herb	1	0	1	0	0	1
<i>Indigofera hedyantha</i> Eckl. & Zeyh.	LC	perennial	herb	0	0	0	0	1	0
<i>Indigofera heterotricha</i> DC.	LC	perennial	herb	12	10	9	10	9	10
<i>Indigofera oxytropis</i> Benth. ex Harv.	LC	perennial	herb	1	2	0	1	0	0
<i>Indigofera rhytidocarpa</i> Benth. ex Harv. subsp. <i>rhytidocarpa</i>	LC	annual	herb	0	5	0	2	0	1
<i>Indigofera</i> sp.	LC	perennial	herb	0	0	0	0	1	1
<i>Indigofera spicata</i> Forssk. var. <i>spicata</i>	LC	perennial	herb	1	0	0	0	0	0

<i>Ipomoea oblongata</i> E.Mey. ex Choisy	LC	perennial	herb	4	1	2	0	3	0
<i>Ipomoea obscura</i> (L.) Ker Gawl. var. <i>obscura</i>	LC	perennial	herb	3	8	1	5	2	8
<i>Ipomoea oenotheroides</i> (L.f.) Raf. ex Hallier f.	LC	perennial	shrub	0	1	0	0	0	0
<i>Jamesbrittenia aurantiaca</i> (Burch.) Hilliard	LC	perennial	herb	1	5	1	6	2	6
<i>Kalanchoe rotundifolia</i> (Haw.) Haw.	LC	perennial	shrub	0	0	1	0	2	0
<i>Kalanchoe</i> sp.	LC	perennial	shrub	0	0	1	0	0	0
<i>Kalanchoe thyrsiflora</i> Harv.	LC	perennial	shrub	1	0	0	1	0	0
<i>Kohautia amatymbica</i> Eckl. & Zeyh.	LC	annual	herb	0	0	0	1	0	0
<i>Kohautia caespitosa</i> Schnizl. subsp. <i>brachyloba</i> (Sond.) D.Mantell	LC	annual	herb	0	1	0	0	0	0
<i>Kohautia cynanchica</i> DC.	LC	annual	herb	0	1	0	3	0	1
<i>Kyphocarpa angustifolia</i> (Moq.) Lopr.	LC	annual	herb	0	2	0	0	0	1
<i>Lactuca inermis</i> Forssk.	LC	perennial	herb	0	2	1	1	0	1
<i>Lantana rugosa</i> Thunb.	LC	perennial	shrub	0	0	3	0	2	0
<i>Lasiosiphon caffer</i> Meisn.	LC	perennial	shrub	2	4	0	2	0	2
<i>Lasiosiphon capitatus</i> (L.f.) Burt Davy	LC	perennial	shrub	0	2	0	3	0	2
<i>Lasiosiphon sericocephalus</i> (Meisn.) J.C.Manning & Boatwr.	LC	perennial	shrub	0	2	0	2	0	5
<i>Ledebouria ovatifolia</i> (Baker) Jessop subsp. <i>ovatifolia</i>	LC	perennial	herb	1	1	1	0	0	0
<i>Ledebouria revoluta</i> (L.f.) Jessop	LC	perennial	herb	2	6	1	5	4	9
<i>Leobordea divaricata</i> Eckl. & Zeyh.	LC	perennial	herb	0	0	0	1	0	0
<i>Lepidium africanum</i> (Burm.f.) DC.	LC	perennial	herb	0	0	0	0	2	0
<i>Lepidium</i> sp.	LC	annual	herb	3	0	2	0	0	0
<i>Lippia scaberrima</i> Sond.	LC	perennial	herb	8	6	5	5	1	4
<i>Listia heterophylla</i> E.Mey.	LC	perennial	herb	0	2	0	1	0	1
<i>Loudetia simplex</i> (Nees) C.E.Hubb.	LC	perennial	grass	0	0	0	1	0	0
<i>Macledium zeyheri</i> (Sond.) S.Ortiz subsp. <i>zeyheri</i>	LC	perennial	herb	0	0	0	3	0	2
<i>Maerua cafra</i> (DC.) Pax	LC	perennial	shrub	1	0	0	0	0	0
<i>Melinis nerviglumis</i> (Franch.) Zizka	LC	perennial	grass	3	5	5	7	4	9
<i>Melinis repens</i> (Willd.) Zizka	LC	annual	grass	7	4	11	1	12	7

<i>Monsonia angustifolia</i> E.Mey. ex A.Rich.	LC	annual	herb	5	3	0	2	0	1
<i>Mundulea sericea</i> (Willd.) A.Chev. subsp. <i>sericea</i>	LC	perennial	shrub	0	1	0	0	0	0
<i>Mystroxyton aethiopicum</i> (Thunb.) Loes. subsp. <i>burkeanum</i> (Sond.) R.H.Archer	LC	perennial	shrub	10	0	7	0	7	0
<i>Neorautanenia ficifolia</i> (Benth. ex Harv.) C.A.Sm.	LC	perennial	herb	0	0	0	1	0	0
<i>Nidorella anomala</i> Steetz	LC	annual	herb	0	0	6	2	1	3
<i>Nidorella hottentotica</i> DC.	LC	annual	herb	0	2	1	5	0	3
<i>Nidorella podocephala</i> (DC.) J.C.Manning & Goldblatt	LC	perennial	herb	1	5	2	3	4	6
<i>Nolletia ciliaris</i> (DC.) Steetz	LC	perennial	shrub	0	1	0	0	0	0
<i>Nolletia rarifolia</i> (Turcz.) Steetz	LC	perennial	shrub	0	1	0	2	0	4
<i>Ocimum angustifolium</i> Benth.	LC	perennial	herb	0	0	0	0	0	1
<i>Oldenlandia herbacea</i> (L.) Roxb. var. <i>herbacea</i>	LC	annual	herb	2	0	2	0	0	0
<i>Olea europaea</i> L. subsp. <i>africana</i> (Mill.) P.S.Green	LC	perennial	tree	6	0	3	0	1	0
<i>Osteospermum muricatum</i> E.Mey. ex DC. subsp. <i>muricatum</i>	LC	perennial	herb	1	0	0	1	0	1
<i>Osteospermum scariosum</i> DC.	LC	perennial	herb	0	2	0	2	0	2
<i>Osyris lanceolata</i> Hochst. & Steud.	LC	perennial	shrub	3	0	1	0	2	0
<i>Oxygonum dregeanum</i> Meisn.	LC	annual	herb	0	1	0	0	0	0
<i>Pachycarpus schinzianus</i> (Schltr.) N.E.Br.	LC	perennial	herb	0	0	0	0	0	4
<i>Panicum coloratum</i> L. var. <i>coloratum</i>	LC	perennial	grass	0	1	0	3	1	4
<i>Panicum maximum</i> Jacq.	LC	perennial	grass	8	1	15	0	18	0
<i>Pappea capensis</i> Eckl. & Zeyh.	LC	perennial	tree	4	0	2	0	1	0
<i>Pavetta zeyheri</i> Sond. subsp. <i>zeyheri</i>	LC	perennial	shrub	7	0	7	0	8	0
<i>Pavonia burchellii</i> (DC.) R.A.Dyer	LC	perennial	shrub	1	0	1	0	2	0
<i>Pavonia senegalensis</i> (Cav.) Leistner	LC	annual	herb	0	0	0	0	1	0
<i>Pearsonia cajanifolia</i> (Harv.) Polhill subsp. <i>cajanifolia</i>	LC	perennial	herb	0	1	0	0	0	1
<i>Pearsonia uniflora</i> (Kensit) Polhill	LC	perennial	herb	0	1	0	0	0	0
<i>Pellaea calomelanos</i> (Sw.) Link var. <i>calomelanos</i>	LC	perennial	herb	7	3	8	2	8	3
<i>Pentarrhinum insipidum</i> E.Mey.	LC	perennial	herb	9	2	13	1	15	0
<i>Phyllanthus incurvus</i> Thunb.	LC	perennial	herb	0	1	0	0	0	0

<i>Phyllanthus maderaspatensis</i> L.	LC	perennial	herb	4	4	1	0	0	0
<i>Phyllanthus parvulus</i> Sond.	LC	perennial	herb	0	0	2	0	0	3
<i>Plumbago auriculata</i> Lam.	LC	perennial	shrub	6	0	7	0	6	0
<i>Pogonarthria squarrosa</i> (Roem. & Schult.) Pilg.	LC	perennial	grass	1	4	0	1	1	1
<i>Pollichia campestris</i> Aiton	LC	perennial	herb	7	8	5	8	5	6
<i>Polydora poskeana</i> (Vatke & Hildebr.) H.Rob.sens.lat.	LC	annual	herb	0	1	0	0	0	0
<i>Polygala amatymbica</i> Eckl. & Zeyh.	LC	perennial	herb	2	2	0	0	0	0
<i>Polygala hottentotta</i> C.Presl	LC	perennial	herb	0	1	0	3	0	2
<i>Pseudognophalium</i> sp.	LC	annual	herb	0	2	17	4	1	0
<i>Pupalia lappacea</i> (L.) A.Juss. var. <i>lappacea</i>	LC	annual	herb	2	0	1	0	3	0
<i>Ranunculus multifidus</i> Forssk.	LC	perennial	herb	0	1	0	0	0	0
<i>Raphionacme hirsuta</i> (E.Mey.) R.A.Dyer	LC	perennial	herb	2	2	0	0	0	0
<i>Raphionacme velutina</i> Schltr.	LC	perennial	herb	0	2	0	2	1	2
<i>Rhynchosia nervosa</i> Benth. ex Harv.	LC	perennial	herb	1	1	0	0	1	0
<i>Rhynchosia nitens</i> Benth. ex Harv.	LC	perennial	shrub	1	0	0	1	0	0
<i>Rhynchosia totta</i> (Thunb.) DC. var. <i>fenchelii</i> Schinz	LC	perennial	herb	1	0	0	0	0	0
<i>Rhynchosia totta</i> (Thunb.) DC. var. <i>totta</i>	LC	perennial	herb	1	3	0	1	0	0
<i>Rubia horrida</i> (Thunb.) Puff	LC	perennial	herb	0	0	0	0	2	0
<i>Salvia runcinata</i> L.f.	LC	perennial	herb	1	2	0	0	0	1
<i>Sansevieria aethiopica</i> Thunb.	LC	perennial	herb	1	1	0	0	0	0
<i>Scabiosa columbaria</i> L.	LC	perennial	herb	0	3	0	2	0	0
<i>Schistostephium crataegifolium</i> (DC.) Fenzl ex Harv.	LC	perennial	shrub	1	0	0	0	0	0
<i>Schizachyrium sanguineum</i> (Retz.) Alston	LC	perennial	grass	1	8	2	9	1	9
<i>Searsia lancea</i> (L.f.) F.A.Barkley	LC	perennial	tree	2	0	2	0	4	0
<i>Searsia leptodictya</i> (Diels) T.S.Yi, A.J.Mill. & J.Wen	LC	perennial	tree	13	0	11	0	12	0
<i>Searsia magalismontana</i> (Sond.) Moffett subsp. <i>magalismontana</i>	LC	perennial	shrub	3	6	3	5	2	4
<i>Searsia pyroides</i> (Burch.) Moffett var. <i>pyroides</i>	LC	perennial	tree	6	0	6	0	5	0
<i>Searsia rigida</i> (Mill.) F.A.Barkley	LC	perennial	shrub	2	0	1	0	1	0
<i>Searsia undulata</i> (Jacq.) T.S.Yi, A.J.Mill. & J.Wen	LC	perennial	shrub	2	0	0	0	0	0

<i>Selago densiflora</i> Rolfe	LC	perennial	herb	1	3	1	0	0	0
<i>Senecio achilleifolius</i> DC.	LC	perennial	herb	0	1	0	0	0	0
<i>Senecio coronatus</i> (Thunb.) Harv.	LC	perennial	herb	0	1	0	0	0	0
<i>Senecio inornatus</i> DC.	LC	perennial	herb	0	2	0	2	1	2
<i>Senecio oxyriifolius</i> DC. subsp. <i>oxyriifolius</i>	LC	perennial	herb	1	0	0	1	0	0
<i>Senecio venosus</i> Harv.	LC	perennial	herb	0	10	0	6	0	4
<i>Senegalia caffra</i> (Thunb.) P.J.H.Hurter & Mabb.	LC	perennial	tree	17	0	15	0	13	0
<i>Setaria incrassata</i> (Hochst.) Hack.	LC	perennial	grass	1	0	0	2	0	2
<i>Setaria lindenbergiana</i> (Nees) Stapf	LC	perennial	grass	0	0	1	0	1	0
<i>Setaria nigrirostris</i> (Nees) T.Durand & Schinz	LC	perennial	grass	0	1	0	0	0	0
<i>Setaria pumila</i> (Poir.) Roem. & Schult.	LC	annual	grass	0	0	1	0	0	0
<i>Setaria sphacelata</i> (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. <i>torta</i> (Stapf) Clayton	LC	perennial	grass	8	9	7	4	11	10
<i>Setaria verticillata</i> (L.) P.Beauv.	LC	annual	grass	2	0	2	0	3	0
<i>Sida rhombifolia</i> L. subsp. <i>rhombifolia</i>	LC	annual	shrub	1	1	1	1	1	0
<i>Sida spinosa</i> L. var. <i>spinosa</i>	LC	annual	herb	3	3	5	0	7	2
<i>Solanum campylacanthum</i> Hochst. ex A.Rich. subsp. <i>panduriforme</i> (Drège ex Dunal) J.Samuels	LC	perennial	herb	3	1	2	0	1	0
<i>Solanum lichtensteinii</i> Willd.	LC	perennial	shrub	2	2	1	0	2	1
<i>Solanum supinum</i> Dunal var. <i>supinum</i>	LC	perennial	shrub	0	2	0	0	1	0
<i>Sporobolus fimbriatus</i> (Trin.) Nees	LC	perennial	grass	5	0	4	2	5	2
<i>Stachys hyssopoides</i> Burch. ex Benth.	LC	perennial	herb	1	0	1	0	0	0
<i>Stoebe plumosa</i> (L.) Thunb.	LC	perennial	shrub	0	1	0	0	0	0
<i>Striga asiatica</i> (L.) Kuntze	LC	annual	herb	4	2	1	0	0	0
<i>Striga bilabiata</i> (Thunb.) Kuntze subsp. <i>bilabiata</i>	LC	annual	herb	0	1	0	0	0	0
<i>Talinum arnotii</i> Hook.f.	LC	annual	shrub	2	1	0	0	8	0
<i>Talinum caffrum</i> (Thunb.) Eckl. & Zeyh.	LC	annual	herb	0	0	1	0	3	0
<i>Tephrosia burchellii</i> Burt Davy	LC	annual	herb	0	1	0	0	0	0
<i>Tephrosia longipes</i> Meisn. subsp. <i>longipes</i> var. <i>longipes</i>	Not Evaluated	annual	herb	0	2	0	0	0	0

<i>Tephrosia</i> sp.	LC	perennial	herb	0	0	0	0	0	1
<i>Teucrium trifidum</i> Retz.	LC	perennial	herb	7	3	5	1	4	1
<i>Themeda triandra</i> Forssk.	LC	perennial	grass	14	14	12	13	10	11
<i>Thesium</i> sp.	Species within genus differ	perennial	herb	1	3	2	8	1	2
<i>Trachyandra</i> sp.	Species within genus differ	perennial	herb	3	4	2	0	0	0
<i>Trachypogon spicatus</i> (L.f.) Kuntze	LC	perennial	grass	0	1	0	4	0	3
<i>Tragia rupestris</i> Sond.	LC	perennial	herb	0	0	7	0	7	0
<i>Tragus berteronianus</i> Schult.	LC	annual	grass	0	1	0	0	0	0
<i>Tribulus terrestris</i> L.	LC	annual	herb	0	1	0	0	0	0
<i>Trichodesma angustifolium</i> Harv. subsp. <i>angustifolium</i>	LC	perennial	herb	0	1	0	0	0	0
<i>Trichoneura grandiglumis</i> (Nees) Ekman	LC	perennial	grass	0	6	0	1	0	0
<i>Triraphis andropogonoides</i> (Steud.) E.Phillips	LC	perennial	grass	3	7	5	5	4	4
<i>Tristachya leucothrix</i> Trin. ex Nees	LC	perennial	grass	0	0	0	1	0	1
<i>Triumfetta sonderi</i> Ficalho & Hiern	LC	perennial	shrub	2	7	0	7	0	7
<i>Urochloa mosambicensis</i> (Hack.) Dandy	LC	perennial	grass	4	1	2	0	3	3
<i>Vachellia hebeclada</i> (DC.) Kyal. & Boatwr. subsp. <i>hebeclada</i>	LC	perennial	shrub	2	0	1	0	0	0
<i>Vachellia karroo</i> (Hayne) Banfi & Gallaso	LC	perennial	tree	18	5	17	4	17	5
<i>Vachellia robusta</i> (Burch.) Kyal. & Boatwr. subsp. <i>robusta</i>	LC	perennial	tree	12	0	10	0	7	0
<i>Vangueria infausta</i> Burch. subsp. <i>infausta</i>	LC	perennial	shrub	5	0	7	0	8	1
<i>Vangueria parvifolia</i> Sond.	LC	perennial	tree	4	0	3	0	2	0
<i>Vangueria pygmaea</i> Schltr.	LC	perennial	shrub	0	4	0	0	0	0
<i>Viscum rotundifolium</i> L.f.	LC	perennial	shrub	2	0	0	0	2	0
<i>Wahlenbergia undulata</i> (L.f.) A.DC.	LC	perennial	herb	0	2	0	0	0	0
<i>Withania somnifera</i> (L.) Dunal	LC	perennial	shrub	0	0	0	0	1	0
<i>Xenostegia tridentata</i> (L.) D.F.Austin & Staples subsp. <i>angustifolia</i> (Jacq.) Lejoly & Lisowski	LC	perennial	herb	1	0	0	0	1	1

<i>Xysmalobium undulatum</i> (L.) Aiton f.	LC	perennial	herb	0	2	0	0	0	0
<i>Zanthoxylum capense</i> (Thunb.) Harv.	LC	perennial	shrub	8	0	5	0	6	0
<i>Ziziphus mucronata</i> Willd. subsp. <i>mucronata</i>	LC	perennial	tree	1	0	0	0	0	0
<i>Ziziphus zeyheriana</i> Sond.	LC	perennial	shrub	10	10	8	7	5	6
<i>Zornia capensis</i> Pers. subsp. <i>capensis</i>	LC	perennial	herb	0	3	0	0	0	0
<i>Zornia linearis</i> E.Mey.	LC	perennial	herb	0	0	0	0	0	2

Table S3. List of all the exotic species recorded in the comparison sites for all sampling periods. The list includes the invasive status based on the Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983) (CARA) amended in 2001 and the National Environmental Management: Biodiversity Act (10/2004) (NEMBA): Draft Alien and Invasive Species Lists, 2014 categories. Also listed is the number of plots in which the species occurred for each habitat type and sampling period. The bold text and dark grey fill indicate widespread species and the light grey rare species based on Gaston's Quartile Criterion [61]. Plant names according to Germishuizen et al. [83].

Species name	Lifespan	Lifefor m	W199 5	G199 5	W201 2	G201 2	W201 9	G201 9	CAR A	NEMBA
<i>Achyranthes aspera</i> L.	perennia l	herb	3	0	3	0	4	0	1	
<i>Alternanthera pungens</i> Kunth	perennia l	herb	3	1	2	0	1	0		
<i>Amaranthus hybridus</i> L.	annual	herb	0	0	1	0	1	0		
<i>Ambrosia psilostachya</i> DC.	perennia l	herb	0	1	0	1	0	1		
<i>Araujia sericifera</i> Brot.	perennia l	herb	0	0	1	0	1	0	1	1b
<i>Atriplex semibaccata</i> R.Br. var. <i>typica</i> Aellen	annual	herb	1	1	1	0	0	0		
<i>Atriplex</i> sp.	perennia l	herb	0	0	0	0	1	0		
<i>Bidens bipinnata</i> L.	annual	herb	19	2	15	1	17	3		
<i>Bidens pilosa</i> L.	annual	herb	0	0	3	0	6	1		
<i>Cichorium intybus</i> L. subsp. <i>intybus</i>	perennia l	herb	0	0	0	1	0	0		
<i>Cirsium vulgare</i> (Savi) Ten.	annual	herb	0	0	1	0	0	0	1	1b
<i>Conyza bonariensis</i> (L.) Cronquist	annual	herb	1	0	11	2	3	2		
<i>Cuscuta campestris</i> Yunck.	annual	herb	1	0	2	0	0	0	1	1b
<i>Datura stramonium</i> L.	annual	herb	0	0	0	0	1	0	1	1b
<i>Dichondra micrantha</i> Urb.	perennia l	herb	0	0	0	1	0	1		
<i>Euphorbia hirta</i> L.	annual	herb	0	2	0	0	0	0		
<i>Flaveria bidentis</i> (L.) Kuntze	annual	herb	1	0	0	0	0	0		1b

<i>Gomphrena celosioides</i> Mart.	perennia l	herb	3	4	2	0	1	1		
<i>Guilleminea densa</i> (Willd. ex Roell. & Schult.) Moq.	perennia l	herb	0	0	3	0	0	0		
<i>Ipomoea purpurea</i> (L.) Roth	annual	herb	1	0	1	0	4	0	3	3. Sterile cultivars or hybrids not listed.
<i>Lantana camara</i> L.	perennia l	shrub	1	0	0	0	0	0	1	1b
<i>Ligustrum lucidum</i> W.T. Aiton	perennia l	tree	1	0	1	0	1	0	3	1b in Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga, North-West & Western Cape. 3 in Free State, Gauteng & Northern Cape. Sterile cultivars or hybrids not listed.
<i>Malvastrum coromandelianum</i> (L.) Garcke	perennia l	herb	2	0	1	0	1	0		1b
<i>Medicago sativa</i> L.	perennia l	herb	0	1	0	0	0	1		
<i>Melia azedarach</i> L.	perennia l	tree	0	0	3	0	1	0	3	1b & 3 in Urban areas
<i>Melilotus alba</i> Desr.	annual	herb	0	0	0	1	0	1		
<i>Modiola caroliniana</i> (L.) G. Don	annual	herb	0	1	0	0	0	0		

										1b. Spineless cactus pear cultivars and selections are not listed. The fruit of the sweet prickly pear is not listed if used for human consumption.
<i>Opuntia ficus-indica</i> (L.) Mill.	perennia I	shrub	3	0	4	0	2	0	1	
<i>Opuntia imbricata</i> (Haw.) DC.	perennia I	shrub	1	0	4	0	4	0	1	
<i>Oxalis corniculata</i> L.	annual	herb	0	3	0	0	1	1		
<i>Paspalum dilatatum</i> Poir.	perennia I	grass	0	1	0	0	1	1		
<i>Pennisetum clandestinum</i> Hochst. ex Chiov.	perennia I	grass	0	0	1	0	1	0		1b in Protected Areas and wetlands in which it does not already occur. Not listed elsewhere.
<i>Physalis viscosa</i> L.	perennia I	herb	3	2	7	4	8	5		
<i>Plantago lanceolata</i> L.	perennia I	herb	0	2	0	3	0	0		
<i>Prunus armeniaca</i> L.	perennia I	tree	0	0	1	0	0	0		
<i>Pyracantha angustifolia</i> (Franch.) C.K.Schneid.	perennia I	shrub	1	0	1	0	0	0	3	1b; Sterile cultivars or

										hybrids not listed
<i>Robinia pseudoacacia</i> L.	perennia l	tree	1	0	1	0	1	0	2	1b
<i>Salvia tiliifolia</i> Vahl	annual	herb	1	0	1	0	1	0		1b
<i>Schkuhria pinnata</i> (Lam.) Cabrera	annual	herb	13	1	2	1	3	2		
<i>Solanum elaeagnifolium</i> Cav.	perennia l	shrub	0	0	1	0	7	1	1	1b
<i>Solanum nigrum</i> L.	annual	herb	2	0	0	0	0	0		
<i>Solanum sisymbriifolium</i> Lam.	perennia l	herb	1	0	0	0	0	0	2	1b
<i>Tagetes minuta</i> L.	annual	herb	23	1	18	1	17	3		
<i>Taraxacum officinale</i> Weber, aggregate species	perennia l	herb	0	1	0	0	0	0		
<i>Tragopogon dubius</i> Scop.	perennia l	herb	0	1	1	1	0	0		
<i>Verbena aristigera</i> S. Moore	perennia l	herb	0	3	1	1	3	0		
<i>Verbena bonariensis</i> L.	annual	herb	0	1	3	1	3	1		1b
<i>Zinnia peruviana</i> (L.) L.	annual	herb	2	0	2	0	1	0		

Table S4. Results of the GLM model for 2019. Model coefficients (\pm SE) are presented, as well as p values. Model intercept (Int), altitude (ALT), age of urbanization (AGE), percentage natural area (PN), road network density of natural areas (RNDN), density of dwellings (CD), Shannon's diversity index of landscape diversity (H'). Akaike's information criterion (AIC) for the model with the highest AIC value (and year), and the model with the lowest AIC (and year, in bold). GLM model coefficients and SE and p values presented here are from models with the lowest AIC values. L2 and L3 represent the second and third levels of a variable classified as a factor.

	Int	ALT	AGE	PN	RNDN	CD	H'	AIC (model year)
Open grasslands								
ISR	-27.266 (5.360) <0.001	0.023 (0.004) <0.001	0.017 (0.003) <0.001	-0.018 (0.005) <0.001	-34.734 (8.575) <0.001			115.12 (1938) → 102 (2010)
DSR	2.09 (0.362) <0.001			-0.014 (0.007) 0.035				62.878 (1999) → 61.834 (2010)
Woody grasslands								
ISR	3.244 (0.049) <0.001					-0.209 (0.11) 0.057(L2) -0.759 (0.174) <0.001 (L3)		163.08 (1938) → 154.74 (1970)
DSR	-0.603 (0.977) 0.537			0.022 (0.009) 0.011			1.332 (0.826) 0.107	115.83 (1994) → 111.74 (2010)

Table S5. List of the range of variation for each calculated urban landscape measure for all time periods. The listed measures are altitude (ALT), age of urbanization (AGE), percentage natural area (PN), road network density of natural areas (RNDN), density of dwellings (CD) and landscape diversity (H').

Measure	<i>min</i>	<i>max</i>
ALT	1349.67	1430.88
PN 1938	87.58	100
PN 1961	64.34	100
PN 1970	58.45	100
PN 1994	47.84	100
PN 1999	43.81	96.99
PN 2006	27.21	95.99
PN 2010	14.46	96.03
PN 2019	10.81174	95.9699
RNDN 1938	0.001155	0.007335
RNDN 1961	0.001076	0.012414
RNDN 1970	0.001489	0.013649
RNDN 1994	0.002631	0.019111
RNDN 1999	0.003075	0.02363
RNDN 2006	0.005035	0.034074
RNDN 2010	0.009365	0.080273
RNDN 2019	0.003327	0.019068
CD 1938	0	5
CD 1961	0	51
CD 1970	0	195
CD 1994	0	633
CD 1999	0	757
CD 2006	0	1105
CD 2010	0	2086
CD 2019	0	2043
H' 1938	0	0.396778
H' 1961	0	0.679844
H' 1970	0	0.703567
H' 1994	0	0.759092
H' 1999	0.097878	0.768248
H' 2006	0.154358	0.778768
H' 2010	0.158616	0.956898
H' 2019	0.173257	0.906501
AGE 1938	0	1
AGE 1961	0	23
AGE 1970	0	32
AGE 1995	0	57
AGE 1999	0	61
AGE 2006	0	68
AGE 2010	0	72
AGE 2019	0	81

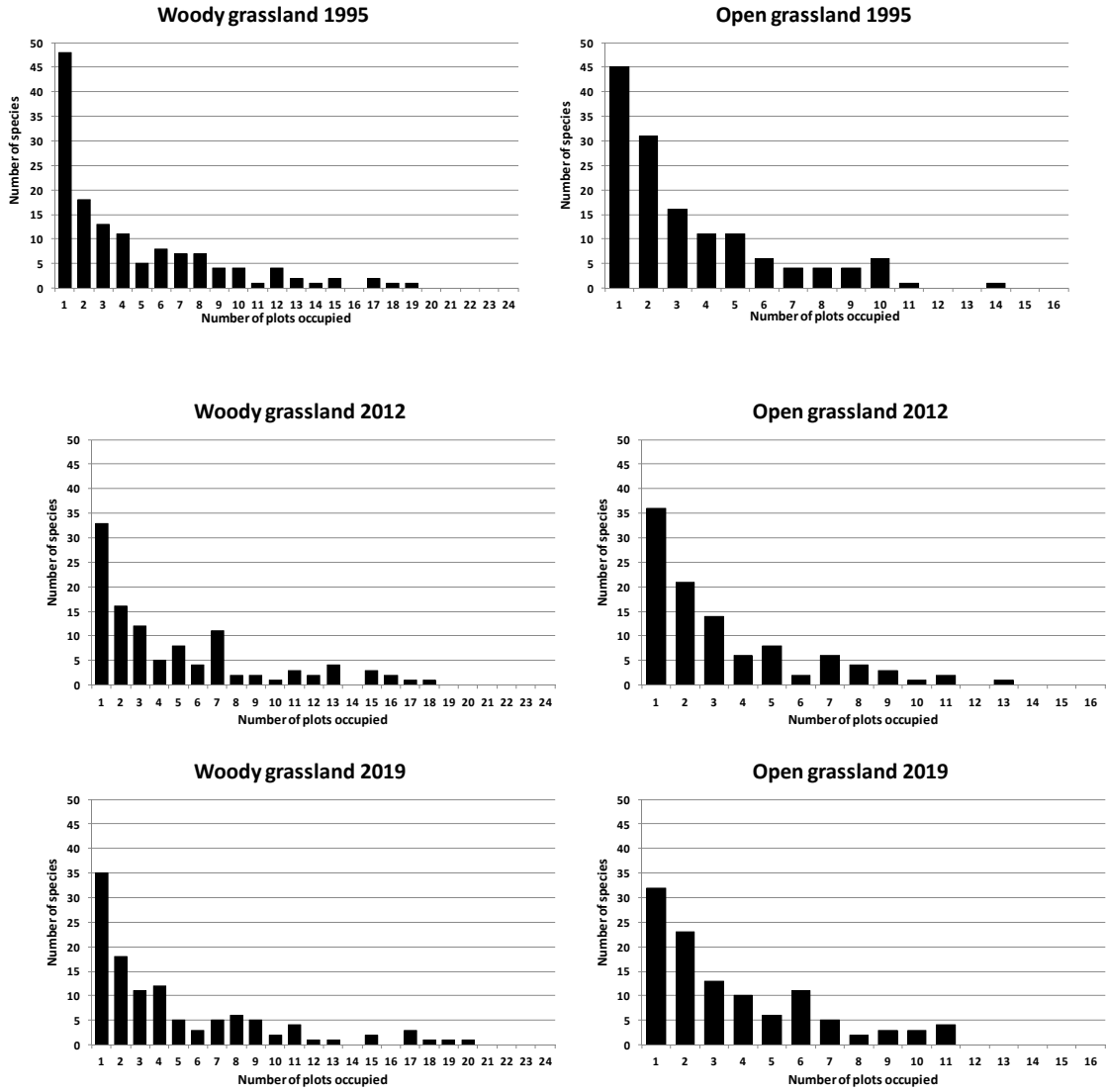


Figure S1. Distribution of species occupancy histograms for open and woody grasslands for all sampling periods indicating unimodal distributions.



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