CHAPTER 10

CHECK LIST OF OBLIGATE AND NEAR-OBLIGATE CREMNOPHILOUS TAXA (220 TAXA, 203 SPECIES)

10.1 Introduction

Table 10.1 lists the 220 obligate or near-obligate succulent and bulbous succulent cremnophytes gathered in the study area. The two semisucculent taxa *Dewinteria* and *Stemodiopsis* were added as an outgroup. The total of 222 taxa belong to 16 plant families (ferns 1 family, 1 taxon; monocotyledons 3 families, 79 taxa; dicotyledons 10 families, 140 taxa; outgroup 2 families, 2 taxa). The families with the largest representation are the Crassulaceae (66 taxa, *Crassula* 38), followed by the Asphodelaceae (44 taxa, *Aloe* 18) and the Mesembryanthemaceae (44 taxa, *Conophytum* 19). These three are also the largest succulent plant families found in South Africa (Van Jaarsveld 1988a). Another family well represented by succulent plants in South Africa is the Asclepiadaceae. However, only four taxa that are obligate cremnophytes have been found in this family.

The check list has been compiled during the botanical survey of the succulent and bulbous succulent plants on cliff faces in South Africa and Namibia over more or less the past ten years. Propagation material (seed, cuttings or plants) was gathered from the native habitat and grown in a greenhouse at Kirstenbosch National Botanical Garden. The behaviour (morphological and reproductive) of the various plants was observed and the information extracted and documented.

10.2 Explanation of the check list

The fern is listed first, followed by the monocotyledons, dicotyledons and lastly the outgroup. Within a family, the genera and species follow an alphabetical arrangement. Each taxon was designated a number, which is used throughout the study. This was done to avoid repetition of author citations, which are given only in the check list and in Chapter 12 (Species treatment), thus saving space.

Each taxon has also been designated a growth formula, shown in the third column of Table 10.1. The symbols used in these growth formulae are explained in 9.1.2. A growth formula is merely a summary of the main characteristics (morphological and reproductive) of

the taxon in question. It classifies the taxon in one of the three main cremnophyte groups: cliff squatters, cliff hangers and cliff huggers. Other information such as occurrence, distribution, vegetation type, conservation status and environmental data (geology, aspect, altitude, rainfall) is also reflected in Table 10.1.

Plants were also grouped into three classes according to their weight: light = < 50 g; medium = 51–500 g; heavy = > 500 g. Within the various taxa, the weight of individuals varies according to size and the time of year. During sufficient rain, succulents become turgid, with a dramatic increase in weight; the opposite happens during periods of drought. Because of this variation in weight, it was decided to weigh the plants when fully turgid, during their rainy season. Average-sized mature plants were weighed. The weight of most taxa falls within the light- or medium-weight classes. Those below 50 g include mostly *Conophytum* and the smaller *Crassula* taxa. Only a few plants (five aloes) fall within the heavy-weight class.

10.3 The list is still growing

The check list in Table 10.1 represents plants found by the author as well as plants previously documented from cliffs in the study area. It is by no means a final list as many more species are continuously found on cliffs in southern Africa. The numbers are being updated as more information is gathered.

10.4 Layout of Table 10.1

Table 10.1 consists of 24 columns per taxon, each column summarising the particular attribute mentioned in the heading. Fitting all of this into A4 format has necessitated seven consecutively numbered pages for each set of species/infraspecific taxa, covering all 24 columns. For convenience and ease of reference, a guide to the seven-page clusters is supplied on the next page, i.e. the page preceding Table 10.1.

GUIDE TO THE LAYOUT OF TABLE 10.1

To fit in all the required columns, entries for each taxon are spread over seven consecutively numbered pages. Hence, to view all the information on a particular taxon (24 columns), consult all seven pages. The pages on which the various seven-page clusters can be found, each cluster covering the same set of taxa, are indicated below (for detailed treatment of each taxon, see Chapter 12).

TABLE 10.1—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Cremnophilous growth form See 9.1.2 for explanation of the symbols below	Degree of cliff occupation *** = strictly obligate cremnophyte, displaying cliff-adapted features ** = obligate cremnophyte * = predominantly on cliffs (80%)	Weight class light = < 50 g medium = 51–500 g heavy = >500 g
	FERNS			
	POLYPODIACEAE (1 species)			
	Pyrrosia Mirb. (1 species)			
1	*P. schimperiana* (Mett. ex Kuhn) Alston	A:S:Lper:Lc:Ts (p)	**	medium
	MONOCOTYLEDONS (3 families, 79 taxa, 76 species)			
	AMARYLLIDACEAE (2 genera, 11 species)			
	Cyrtanthus Aiton (8 species)			
2	*C. falcatus* R.A.Dyer	A:B:D:C:Lp (e) (vb) (eg)	***	medium-heavy
3	*C. flammosus* Snijman & Van Jaarsv.	A:B:Lper:So:La (r)	***	medium
4	*C. flanaganii* Baker	A:B:D:C:La (vb)	**	medium
5	*C. herrei* (F.M.Leight.) R.A.Dyer	A:B:Lper:C:La (e) (vb)	**	medium
6	*C. inaequalis* O'Brien	A:B:Lper:C:La (e) (vb)	*	medium
7	*C. junodii* P.Beauv.	A:B:D:C:La (e) (vb)	**	medium
8	*C. labiatus* R.A.Dyer	A:B:Lper:C:La (e) (vb)	***	medium
9	*C. montanus* R.A.Dyer	A:B:Lper:C:La (e) (vb)	***	medium
	Haemanthus L. (3 species)			
10	*H. albiflos* Jacq.	A:B:Lper:C:La (e) (vb)	**	medium
11	*H. humilus* Jacq. subsp. *humilis*	A:B:D:C:La (e) (vb)	**	medium
12	*H. pauculifolius* Snijman & A.E.van Wyk	A:B:Lper:C:La (e) (vb)	**	medium
	ASPHODELACEAE (5 genera, 50 taxa, 47 species)			
	Aloe L. (18 species)			
13	*A. arborescens* Mill. subsp. *mzimnyati* Van Jaarsv. & A.E.van Wyk	E:F:P:R:C:Ar (vb)	*	medium-heavy
14	*A. catengiana* Reynolds	E:F:P:R:C:Rls (vb)	**	medium-heavy
15	*A. challisii* Van Jaarsv. & A.E.van Wyk	E:F:P:R:C:Ar (vb) (eg)	***	light-medium
16	*A. corallina* I.Verd.	E:F:P:R:C:Ar (vb) (eg)	***	medium-heavy
17	*A. dabenorisana* Van Jaarsv.	E:F:P:R:C:Ar (vb) (eg)	***	medium-heavy
18	*A. dewinteri* Giess	A:S:Lper:R:So:La	***	heavy
19	*A. haemanthifolia* A.Berger & Marloth	A:S:Lper:R:C:La (vb)	***	heavy
20	*A. hardyi* Glen	E:F:P:R:C:Ar (vb) (eg)	***	heavy
21	*A. kouebokkeveldensis* Van Jaarsv. & A.B.Low	A:S:Lper:R:So:La	*	heavy
22	*A. meyeri* Van Jaarsv.	E:F:P:R:C:Rls: (vb) (eg)	***	medium-heavy
23	*A. mutabilis* Pillans	E:F:P:R:C:Ar (vb)	**	heavy
24	*A. nubigena* Groenew.	E:F:P:R:C:Ar (vb) (eg)	***	light-medium
25	*A. omavandae* Van Jaarsv.	E:F:P:R:C:Ar (vb) (eg)	***	medium-heavy
26	*A. pavelkae* Van Jaarsv., Swanepoel, A.E.van Wyk & Lavranos	E:F:P:R:C:Ar:(vb) (eg)	***	medium-heavy
27	*A. pictifolia* D.S.Hardy	A:S:Lper:R:C:La (vb)	**	medium
28	*A. reynoldsii* Letty	A:S:Lper:R:C:La (vb)	***	medium-heavy
29	*A. soutpansbergensis* I.Verd.	A:S:Lper:R:C:Lp (vb) (eg)	***	light-medium
30	*A. thompsoniae* Groenew.	A:S:Lper:R:C:La (vb)	*	light-medium

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Vegetative dispersal backup	Geology	Aspect
	FERNS			
	POLYPODIACEAE (1 species)			
	Pyrrosia Mirb. (1 species)			
1	*P. schimperiana* (Mett. ex Kuhn) Alston	dividing or proliferating clusters	sandstone	S
	MONOCOTYLEDONS (3 families, 79 taxa, 76 species)			
	AMARYLLIDACEAE (2 genera, 11 species)			
	Cyrtanthus Aiton (8 species)			
2	*C. falcatus* R.A.Dyer	dividing or proliferating clusters	mudstone	S
3	*C. flammosus* Snijman & Van Jaarsv.	solitary	sandstone	S
4	*C. flanaganii* Baker	dividing or proliferating clusters	basalt	N
5	*C. herrei* (F.M.Leight.) R.A.Dyer	dividing or proliferating clusters	sandstone, granite	E, S
6	*C. inaequalis* O'Brien	bulbils	sandstone	E, S
7	*C. junodii* P.Beauv.	dividing or proliferating clusters	sandstone	N
8	*C. labiatus* R.A.Dyer	bulbils	sandstone	N, E, S
9	*C. montanus* R.A.Dyer	bulbils	sandstone	N, E, S
	Haemanthus L. (3 species)			
10	*H. albiflos* Jacq.	dividing or proliferating clusters	sandstone, shale, mudstone	S, E, N
11	*H. humilus* Jacq. subsp. *humilis*	dividing or proliferating clusters	sandstone, shale	S
12	*H. pauculifolius* Snijman & A.E.van Wyk	dividing or proliferating clusters	quartz, mudstone	S
	ASPHODELACEAE (5 genera, 50 taxa, 47 species)			
	Aloe L. (18 species)			
13	*A. arborescens* Mill. subsp. *mzimnyati* Van Jaarsv. & A.E.van Wyk	dividing or proliferating clusters	sandstone	S, E, N
14	*A. catengiana* Reynolds	dividing or proliferating clusters	sandstone	E
15	*A. challisii* Van Jaarsv. & A.E.van Wyk	dividing or proliferating clusters	sandstone	W
16	*A. corallina* I.Verd.	dividing or proliferating clusters	dolomite	S, E
17	*A. dabenorisana* Van Jaarsv.	dividing or proliferating clusters	quartz	S
18	*A. dewinteri* Giess	solitary	dolomite	S,W
19	*A. haemanthifolia* A.Berger & Marloth	dividing or proliferating clusters	sandstone	W, N
20	*A. hardyi* Glen	active growth and rooting	dolomite	W, N
21	*A. kouebokkeveldensis* Van Jaarsv. & A.B.Low	solitary	sandstone	N, W
22	*A. meyeri* Van Jaarsv.	dividing or proliferating clusters	sandstone	S, E
23	*A. mutabilis* Pillans	dividing or proliferating clusters	sandstone	E, S, N
24	*A. nubigena* Groenew.	dividing or proliferating clusters	sandstone	E, S
25	*A. omavandae* Van Jaarsv.	dividing or proliferating clusters	sandstone	S, E
26	*A. pavelkae* Van Jaarsv., Swanepoel, A.E.van Wyk & Lavranos	dividing or proliferating clusters	sandstone	E, S
27	*A. pictifolia* D.S.Hardy	dividing or proliferating clusters	sandstone	E, W, N
28	*A. reynoldsii* Letty	dividing or proliferating clusters	mudstone	S, E, W
29	*A. soutpansbergensis* I.Verd.	dividing or proliferating clusters	sandstone	S
30	*A. thompsoniae* Groenew.	dividing or proliferating clusters	sandstone	W, E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Altitude (m)	Rainfall (mm per annum)	Rainfall seasonality S = summer W = winter W/S = any time of year	Deciduousness E = evergreen SA = summer-aestivating SD = summer-deciduous WD = winter-deciduous
	FERNS				
	POLYPODIACEAE (1 species)				
	Pyrrosia Mirb. (1 species)				
1	*P. schimperiana* (Mett. ex Kuhn) Alston	1400–1600	100–1250	S	E
	MONOCOTYLEDONS (3 families, 79 taxa, 76 species)				
	AMARYLLIDACEAE (2 genera, 11 species)				
	Cyrtanthus Aiton (8 species)				
2	*C. falcatus* R.A.Dyer	1100–1800	1000–1500	S	WD
3	*C. flammosus* Snijman & Van Jaarsv.	250–500	400–500	W/S	E
4	*C. flanaganii* Baker	2750–3000	1000–1500	S	WD
5	*C. herrei* (F.M.Leight.) R.A.Dyer	400–1500	150–250	W	E
6	*C. inaequalis* O'Brien	800–1200	200–300	W/S	E
7	*C. junodii* P.Beauv.	1500–2000	1500–1750	S	WD
8	*C. labiatus* R.A.Dyer	300–900	400–500	W/S	E
9	*C. montanus* R.A.Dyer	250–500	400–500	W/S	E
	Haemanthus L. (3 species)				
10	*H. albiflos* Jacq.	15–1500	300–1000	W/S	E
11	*H. humilus* Jacq. subsp. *humilis*	460–1400	400–1000	S	WD
12	*H. pauculifolius* Snijman & A.E.van Wyk	600–900	600–800	S	E
	ASPHODELACEAE (5 genera, 50 taxa, 47 species)				
	Aloe L. (18 species)				
13	*A. arborescens* Mill. subsp. *mzimnyati* Van Jaarsv. & A.E.van Wyk	700–1000	800–1000	S	E
14	*A. catengiana* Reynolds	1800–2000	300–500	S	E
15	*A. challisii* Van Jaarsv. & A.E.van Wyk	1800–2000	1500–1750	S	E
16	*A. corallina* I.Verd.	400–1200	75–150	S	E
17	*A. dabenorisana* Van Jaarsv.	700–1000	75–150	W/S	E
18	*A. dewinteri* Giess	600–1200	75–150	S	E
19	*A. haemanthifolia* A.Berger & Marloth	500–1675	800–1000	W	E
20	*A. hardyi* Glen	850–1350	300–400	S	E
21	*A. kouebokkeveldensis* Van Jaarsv. & A.B.Low	400–600	700–800	W	E
22	*A. meyeri* Van Jaarsv.	300–1200	75–150	W	E
23	*A. mutabilis* Pillans	800–1800	700–800	S	E
24	*A. nubigena* Groenew.	1450–2100	1500–2000	S	E
25	*A. omavandae* Van Jaarsv.	1600–1900	300–500	S	E
26	*A. pavelkae* Van Jaarsv., Swanepoel, A.E.van Wyk & Lavranos	700–800	50–125	W	E
27	*A. pictifolia* D.S.Hardy	250–500	400–500	W/S	E
28	*A. reynoldsii* Letty	150–1000	800–1250	S	E
29	*A. soutpansbergensis* I.Verd.	1525–1750	1500–2000	S	E
30	*A. thompsoniae* Groenew.	1650–2100	1500–2000	S	E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Fog *** = regular fog ** = occasional fog * = little fog – = no fog	Biomes IOCB = Indian Ocean Coastal Belt	Pollination
	FERNS			
	POLYPODIACEAE (1 species)			
	Pyrrosia Mirb. (1 species)			
1	*P. schimperiana* (Mett. ex Kuhn) Alston	*	Forest	wind
	MONOCOTYLEDONS (3 families, 79 taxa, 76 species)			
	AMARYLLIDACEAE (2 genera, 11 species)			
	Cyrtanthus Aiton (8 species)			
2	*C. falcatus* R.A.Dyer	*	Grassland	bird
3	*C. flammosus* Snijman & Van Jaarsv.	**	Albany Thicket	insect
4	*C. flanaganii* Baker	**	Grassland	bird
5	*C. herrei* (F.M.Leight.) R.A.Dyer	**	Succulent Karoo	bird
6	*C. inaequalis* O'Brien	*	Succulent Karoo	bird
7	*C. junodii* P.Beauv.	**	Grassland	insect
8	*C. labiatus* R.A.Dyer	–	Albany Thicket	bird
9	*C. montanus* R.A.Dyer	–	Albany Thicket	insect
	Haemanthus L. (3 species)			
10	*H. albiflos* Jacq.	–	Albany Thicket	insect
11	*H. humilus* Jacq. subsp. *humilis*	*	Grassland	insect
12	*H. pauculifolius* Snijman & A.E.van Wyk	–	Savanna	insect
	ASPHODELACEAE (5 genera, 50 taxa, 47 species)			
	Aloe L. (18 species)			
13	*A. arborescens* Mill. subsp. *mzimnyati* Van Jaarsv. & A.E.van Wyk	–	Savanna	bird
14	*A. catengiana* Reynolds	–	Savanna	bird
15	*A. challisii* Van Jaarsv. & A.E.van Wyk	**	Grassland	bird
16	*A. corallina* I.Verd.	–	Savanna	bird
17	*A. dabenorisana* Van Jaarsv.	–	Desert	bird
18	*A. dewinteri* Giess	–	Savanna	bird
19	*A. haemanthifolia* A.Berger & Marloth	*	Fynbos	bird
20	*A. hardyi* Glen	–	Savanna	bird
21	*A. kouebokkeveldensis* Van Jaarsv. & A.B.Low	–	Fynbos	bird
22	*A. meyeri* Van Jaarsv.	**	Succulent Karoo	bird
23	*A. mutabilis* Pillans	–	Savanna	bird
24	*A. nubigena* Groenew.	**	Grassland	bird
25	*A. omavandae* Van Jaarsv.	–	Savanna	bird
26	*A. pavelkae* Van Jaarsv., Swanepoel, A.E.van Wyk & Lavranos	***	Succulent Karoo	bird
27	*A. pictifolia* D.S.Hardy	–	Albany Thicket	bird
28	*A. reynoldsii* Letty	–	Savanna	bird
29	*A. soutpansbergensis* I.Verd.	**	Grassland	bird
30	*A. thompsoniae* Groenew.	**	Grassland	bird

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Seed dispersal	Conservation status LC = Least Concern NT = Not Threatened VU = Vulnerable	Light requirements BL = bright light DS = dappled shade FS = full sun
	FERNS			
	POLYPODIACEAE (1 species)			
	Pyrrosia Mirb. (1 species)			
1	*P. schimperiana* (Mett. ex Kuhn) Alston	wind	LC	DS, BL
	MONOCOTYLEDONS (3 families, 79 taxa, 76 species)			
	AMARYLLIDACEAE (2 genera, 11 species)			
	Cyrtanthus Aiton (8 species)			
2	*C. falcatus* R.A.Dyer	wind	LC	FS, DS, BL
3	*C. flammosus* Snijman & Van Jaarsv.	wind	LC	FS, BL
4	*C. flanaganii* Baker	wind	LC	FS
5	*C. herrei* (F.M.Leight.) R.A.Dyer	wind	LC	FS, BL
6	*C. inaequalis* O'Brien	wind	LC	BL, FS
7	*C. junodii* P.Beauv.	wind	LC	FS, DS
8	*C. labiatus* R.A.Dyer	wind	LC	FS, BL
9	*C. montanus* R.A.Dyer	wind	LC	FS, BL
	Haemanthus L. (3 species)			
10	*H. albiflos* Jacq.	bird	LC	FS, DS
11	*H. humilus* Jacq. subsp. *humilis*	bird	LC	FS, DS
12	*H. pauculifolius* Snijman & A.E.van Wyk	bird	LC	FS, DS
	ASPHODELACEAE (5 genera, 50 taxa, 47 species)			
	Aloe L. (18 species)			
13	*A. arborescens* Mill. subsp. *mzimnyati* Van Jaarsv. & A.E.van Wyk	wind	LC	FS, BL
14	*A. catengiana* Reynolds	wind	LC	FS, BL
15	*A. challisii* Van Jaarsv. & A.E.van Wyk	wind	LC	FS, BL
16	*A. corallina* I.Verd.	wind	LC	FS
17	*A. dabenorisana* Van Jaarsv.	wind	LC	BL
18	*A. dewinteri* Giess	wind	LC	FS
19	*A. haemanthifolia* A.Berger & Marloth	wind	LC	FS
20	*A. hardyi* Glen	wind	LC	FS
21	*A. kouebokkeveldensis* Van Jaarsv. & A.B.Low	wind	LC	FS
22	*A. meyeri* Van Jaarsv.	wind	LC	FS, BL
23	*A. mutabilis* Pillans	wind	LC	FS
24	*A. nubigena* Groenew.	wind	LC	FS, BL
25	*A. omavandae* Van Jaarsv.	wind	LC	FS, BL
26	*A. pavelkae* Van Jaarsv., Swanepoel, A.E.van Wyk & Lavranos	wind	LC	BL
27	*A. pictifolia* D.S.Hardy	wind	LC	FS, BL, DS
28	*A. reynoldsii* Letty	wind	LC	FS, BL
29	*A. soutpansbergensis* I.Verd.	wind	LC	FS, BL
30	*A. thompsoniae* Groenew.	wind	LC	FS, BL, DS

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Rich flowering *** = rich ** = exposed * = insignificant	Reduction in armament *** = margin without teeth ** = margin with smaller teeth * = no significant change, same as other non-cremnophytes	Cliff habitat C = coastal R = river E = escarpment M = mountain I = inselberg
	FERNS			
	POLYPODIACEAE (1 species)			
	Pyrrosia Mirb. (1 species)			
1	*P. schimperiana* (Mett. ex Kuhn) Alston	*	*	R
	MONOCOTYLEDONS (3 families, 79 taxa, 76 species)			
	AMARYLLIDACEAE (2 genera, 11 species)			
	Cyrtanthus Aiton (8 species)			
2	*C. falcatus* R.A.Dyer	**	*	E
3	*C. flammosus* Snijman & Van Jaarsv.	***	*	R, M
4	*C. flanaganii* Baker	**	*	E
5	*C. herrei* (F.M.Leight.) R.A.Dyer	**	*	E, M
6	*C. inaequalis* O'Brien	**	*	R
7	*C. junodii* P.Beauv.	**	*	E
8	*C. labiatus* R.A.Dyer	**	*	R, M
9	*C. montanus* R.A.Dyer	**	*	R, M
	Haemanthus L. (3 species)			
10	*H. albiflos* Jacq.	**	*	R, C
11	*H. humilus* Jacq. subsp. *humilis*	**	*	E, M
12	*H. pauculifolius* Snijman & A.E.van Wyk	**	*	E
	ASPHODELACEAE (5 genera, 50 taxa, 47 species)			
	Aloe L. (18 species)			
13	*A. arborescens* Mill. subsp. *mzimnyati* Van Jaarsv. & A.E.van Wyk	**	*	E, R, M
14	*A. catengiana* Reynolds	**	*	E
15	*A. challisii* Van Jaarsv. & A.E.van Wyk	**	*	E
16	*A. corallina* I.Verd.	**	***	R
17	*A. dabenorisana* Van Jaarsv.	**	**	R, I
18	*A. dewinteri* Giess	**	**	R, E
19	*A. haemanthifolia* A.Berger & Marloth	**	***	M
20	*A. hardyi* Glen	**	*	R
21	*A. kouebokkeveldensis* Van Jaarsv. & A.B.Low	**	*	M
22	*A. meyeri* Van Jaarsv.	**	**	M, R
23	*A. mutabilis* Pillans	**	*	M, R
24	*A. nubigena* Groenew.	**	***	E
25	*A. omavandae* Van Jaarsv.	**	**	E
26	*A. pavelkae* Van Jaarsv., Swanepoel, A.E.van Wyk & Lavranos	**	**	R, M
27	*A. pictifolia* D.S.Hardy	**	**	R, M
28	*A. reynoldsii* Letty	**	*	R
29	*A. soutpansbergensis* I.Verd.	**	*	M, I
30	*A. thompsoniae* Groenew.	**	*	E, M

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Occurrence W = widespread We = widespread but endemic to its vegetation region R = restricted	Endemism * = endemic Bots = Botswana Les = Lesotho Moz = Mozambique Nam = Namibia RSA = South Africa Swaz = Swaziland	Windows Lm = on leaf margin Mw = micro-windows O = other
	FERNS			
	POLYPODIACEAE (1 species)			
	Pyrrosia Mirb. (1 species)			
1	*P. schimperiana* (Mett. ex Kuhn) Alston	W	RSA	
	MONOCOTYLEDONS (3 families, 79 taxa, 76 species)			
	AMARYLLIDACEAE (2 genera, 11 species)			
	Cyrtanthus Aiton (8 species)			
2	*C. falcatus* R.A.Dyer	W	RSA*	
3	*C. flammosus* Snijman & Van Jaarsv.	R	RSA*	
4	*C. flanaganii* Baker	We	RSA*	
5	*C. herrei* (F.M.Leight.) R.A.Dyer	We	RSA, Nam	
6	*C. inaequalis* O'Brien	We	RSA*	
7	*C. junodii* P.Beauv.	R	RSA*	
8	*C. labiatus* R.A.Dyer	We	RSA*	
9	*C. montanus* R.A.Dyer	We	RSA*	
	Haemanthus L. (3 species)			
10	*H. albiflos* Jacq.	We	RSA*	
11	*H. humilus* Jacq. subsp. *humilis*	W	RSA*	
12	*H. pauculifolius* Snijman & A.E.van Wyk	We	RSA*	
	ASPHODELACEAE (5 genera, 50 taxa, 47 species)			
	Aloe L. (18 species)			
13	*A. arborescens* Mill. subsp. *mzimnyati* Van Jaarsv. & A.E.van Wyk	R	RSA*	
14	*A. catengiana* Reynolds	We	Nam	
15	*A. challisii* Van Jaarsv. & A.E.van Wyk	R	RSA*	Lm
16	*A. corallina* I.Verd.	We	Nam	
17	*A. dabenorisana* Van Jaarsv.	We	RSA*	
18	*A. dewinteri* Giess	We	Nam*	
19	*A. haemanthifolia* A.Berger & Marloth	We	RSA*	
20	*A. hardyi* Glen	R	RSA*	
21	*A. kouebokkeveldensis* Van Jaarsv. & A.B.Low	R	RSA*	
22	*A. meyeri* Van Jaarsv.	We	RSA, Nam	
23	*A. mutabilis* Pillans	We	RSA	
24	*A. nubigena* Groenew.	We	RSA*	Lm
25	*A. omavandae* Van Jaarsv.	R	Nam*	
26	*A. pavelkae* Van Jaarsv., Swanepoel, A.E.van Wyk & Lavranos	R	Nam*	
27	*A. pictifolia* D.S.Hardy	R	RSA*	
28	*A. reynoldsii* Letty	R	RSA*	
29	*A. soutpansbergensis* I.Verd.	R	RSA*	Lm
30	*A. thompsoniae* Groenew.	R	RSA*	

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Cremnophilous growth form See 9.1.2 for explanation of the symbols below	Degree of cliff occupation *** = strictly obligate cremnophyte, displaying cliff-adapted features ** = obligate cremnophyte * = predominantly on cliffs (80%)	Weight class light = < 50 g medium = 51–500 g heavy = >500 g
	Bulbine Wolf (10 taxa)			
31	*B. cremnophila* Van Jaarsv.	A:S:Lper:R:C:Lp (eg)	***	light
32	*B. latifolia* (L.f.) Schult. & Schult.f. var. *curvata* Van Jaarsv.	E:F:P:R:So:Lp (eg)	***	medium
33	*B. meiringii* Van Jaarsv.	A:S:Lper:R:C:Lp (eg) (vb)	***	light
34	*B. natalensis* Baker	A:S:Lper:R:So:La	**	medium
35	*B. pendens* G.Will. & Baijnath	A:S:Lar:D:(vb) (eg)	***	light
36	*B. ramosa* Van Jaarsv.	A:S:Lper:R:C:La (vb)	**	light–medium
37	*B. retinens* Van Jaarsv. & S.A.Hammer	A:S:Lper:R:C:La (vb)	**	light–medium
38	*B. rupicola* G.Will.	A:S:Lper:R:C:La (vb)	**	light
39	*B. suurbergensis* Van Jaarsv. & A.E.van Wyk	E:F:P:R:C:Ar (vb)	***	medium
40	*B. thomasiae* Van Jaarsv.	A:S:Lper:R:C:Lp (eg) (vb)	***	light–medium
	Gasteria Duval (9 taxa)			
41	*G. batesiana* G.D.Rowley var. *batesiana*	A:S:Lper:R:C:La (vb)	***	medium
42	*G. batesiana* G.D.Rowley var. *dolomitica* Van Jaarsv. & A.E.van Wyk	A:S:Lper:R:C:La (vb)	***	medium
43	*G. croucheri* (Hook.f.) Baker subsp. *pendulifolia* (Van Jaarsv.) Zonn.	A:S:Lper:R:C:Lp (vb) (eg)	***	medium-heavy
44	*G. doreeniae* Van Jaarsv. & A.E.van Wyk	A:S:Lper:R:C:La (vb)	**	light–medium
45	*G. glauca* Van Jaarsv.	A:S:Lper:R:C:La (vb) (rd) (r)	***	light–medium
46	*G. glomerata* Van Jaarsv.	A:S:Lper:R:C:La (vb) (rd) (r)	***	light–medium
47	*G. pillansii* Kensit var. *ernesti-ruschii* (Dinter & Von Poelln.) Van Jaarsv.	A:S:Lper:R:C:La (vb)	*	light–medium
48	*G. rawlinsonii* Oberm.	E:F:P:R:C:Rls (eg)	***	medium-heavy
49	*G. tukhelensis* Van Jaarsv.	A:S:Lper:R:C:La (vb)	**	medium-heavy
	Haworthia Duval (12 taxa)			
50	*H. angustifolia* Haw. var. *baylissii* (C.L.Scott) M.B.Bayer	A:S:Lper:R:C:La (vb)	***	light
51	*H. attenuata* (Haw.) Haw. var. *attenuata*	A:S:Lper:R:C:La (vb)	**	light–medium
52	*H. cymbiformis* (Haw.) Duval var. *ramosa* (G.G.Sm.) M.B.Bayer	A:S:Lper:R:C:La (vb)	**	light–medium
53	*H. cymbiformis* (Haw.) Duval var. *setulifera* (Poelln.) M.B.Bayer	A:S:Lper:R:C:La (vb)	**	light–medium
54	*H. glabrata* (Salm-Dyck) Baker	A:S:Lper:R:C:La (vb)	**	light–medium
55	*H. gracilis* Poelln. var. *picturata* M.B.Bayer	A:S:Lper:R:C:La (vb)	***	light–medium
56	*H. marumiana* Uitewaal var. *batesiana* (Uitewaal) M.B.Bayer	A:S:Lper:R:C:La (vb)	***	light–medium
57	*H. marumiana* Uitewaal var. *marumiana*	A:S:Lper:R:C:La (vb)	**	light–medium
58	*H. mirabilis* (Haw.) Haw. var. *consanguinea* M.B.Bayer	A:S:Lper:R:C:La (vb)	**	light–medium
59	*H. scabra* Haw. var. *starkiana* (Poelln.) M.B.Bayer	A:S:Lper:R:C:La (vb)	**	medium
60	*H. turgida* Haw. var. *turgida*	A:S:Lper:R:C:La (vb)	**	light–medium
61	*H. zantneriana* Poelln.	A:S:Lper:R:C:La (vb)	**	light–medium
	Trachyandra Kunth (1 species)			
62	*T. tabularis* (Baker) Oberm.	A:S:Lper:R:C:Lp	***	medium

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Vegetative dispersal backup	Geology	Aspect
	Bulbine Wolf (10 taxa)			
31	*B. cremnophila* Van Jaarsv.	dividing or proliferating clusters	sandstone	N, S, E, W
32	*B. latifolia* (L.f.) Schult. & Schult.f. var. *curvata* Van Jaarsv.	solitary	sandstone	N, S, E, W
33	*B. meiringii* Van Jaarsv.	dividing or proliferating clusters	sandstone	S
34	*B. natalensis* Baker	solitary	sandstone, mudstone	S
35	*B. pendens* G.Will. & Baijnath	dividing or proliferating clusters	quartz	S, E
36	*B. ramosa* Van Jaarsv.	dividing or proliferating clusters	sandstone	S
37	*B. retinens* Van Jaarsv. & S.A.Hammer	dividing or proliferating clusters	sandstone	S, W, E, N
38	*B. rupicola* G.Will.	dividing or proliferating clusters	sandstone	S, W
39	*B. suurbergensis* Van Jaarsv. & A.E.van Wyk	dividing or proliferating clusters	sandstone	S, E, W
40	*B. thomasiae* Van Jaarsv.	dividing or proliferating clusters	mudstone	S
	Gasteria Duval (9 taxa)			
41	*G. batesiana* G.D.Rowley var. *batesiana*	proliferating clusters and leaf stolons	sandstone	S
42	*G. batesiana* G.D.Rowley var. *dolomitica* Van Jaarsv. & A.E.van Wyk	proliferating clusters and leaf stolons	dolomite	S
43	*G. croucheri* (Hook.f.) Baker subsp. *pendulifolia* (Van Jaarsv.) Zonn.	proliferating clusters and leaf stolons	sandstone	S
44	*G. doreeniae* Van Jaarsv. & A.E.van Wyk	proliferating clusters and leaf stolons	sandstone	S, W
45	*G. glauca* Van Jaarsv.	proliferating clusters and leaf stolons	sandstone	S, E
46	*G. glomerata* Van Jaarsv.	proliferating clusters and leaf stolons	sandstone	S
47	*G. pillansii* Kensit var. *ernesti-ruschii* (Dinter & Von Poelln.) Van Jaarsv.	proliferating clusters and leaf stolons	sandstone	S
48	*G. rawlinsonii* Oberm.	dividing or proliferating clusters	sandstone	S
49	*G. tukhelensis* Van Jaarsv.	proliferating clusters and leaf stolons	mudstone	S
	Haworthia Duval (12 taxa)			
50	*H. angustifolia* Haw. var. *baylissii* (C.L.Scott) M.B.Bayer	dividing or proliferating clusters	sandstone	S
51	*H. attenuata* (Haw.) Haw. var. *attenuata*	dividing or proliferating clusters	Enon Conglomerate	W, E
52	*H. cymbiformis* (Haw.) Duval var. *ramosa* (G.G.Sm.) M.B.Bayer	dividing or proliferating clusters	mudstone	S
53	*H. cymbiformis* (Haw.) Duval var. *setulifera* (Poelln.) M.B.Bayer	dividing or proliferating clusters	mudstone	S
54	*H. glabrata* (Salm-Dyck) Baker	dividing or proliferating clusters	shale	N
55	*H. gracilis* Poelln. var. *picturata* M.B.Bayer	dividing or proliferating clusters	sandstone	S
56	*H. marumiana* Uitewaal var. *batesiana* (Uitewaal) M.B.Bayer	dividing or proliferating clusters	shale	S
57	*H. marumiana* Uitewaal var. *marumiana*	dividing or proliferating clusters	sandstone	S
58	*H. mirabilis* (Haw.) Haw. var. *consanguinea* M.B.Bayer	dividing or proliferating clusters	sandstone	S
59	*H. scabra* Haw. var. *starkiana* (Poelln.) M.B.Bayer	dividing or proliferating clusters	sandstone	N, E
60	*H. turgida* Haw. var. *turgida*	dividing or proliferating clusters	sandstone	S
61	*H. zantneriana* Poelln.	dividing or proliferating clusters	sandstone	S
	Trachyandra Kunth (1 species)			
62	*T. tabularis* (Baker) Oberm.	dividing or proliferating clusters	sandstone	S

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Altitude (m)	Rainfall (mm per annum)	Rainfall seasonality S = summer W = winter W/S = any time of year	Deciduousness E = evergreen SA = summer-aestivating SD = summer-deciduous WD = winter-deciduous
	Bulbine Wolf (10 taxa)				
31	*B. cremnophila* Van Jaarsv.	400–1000	400–500	W/S	E
32	*B. latifolia* (L.f.) Schult. & Schult.f. var. *curvata* Van Jaarsv.	250–500	400–500	W/S	E
33	*B. meiringii* Van Jaarsv.	500–800	200–300	W/S	E
34	*B. natalensis* Baker	35–600	400–500	W/S	E
35	*B. pendens* G.Will. & Baijnath	300–800	75–150	W	SD
36	*B. ramosa* Van Jaarsv.	400-600	200-300	W/S	E
37	*B. retinens* Van Jaarsv. & S.A.Hammer	500–800	300–400	W/S	E
38	*B. rupicola* G.Will.	500–800	300–400	W/S	E
39	*B. suurbergensis* Van Jaarsv. & A.E.van Wyk	400–600	400–500	W/S	E
40	*B. thomasiae* Van Jaarsv.	200–800	500–600	S	E
	Gasteria Duval (9 taxa)				
41	*G. batesiana* G.D.Rowley var. *batesiana*	300–800	500–600	S	E
42	*G. batesiana* G.D.Rowley var. *dolomitica* Van Jaarsv. & A.E.van Wyk	450–600	400–600	S	E
43	*G. croucheri* (Hook.f.) Baker subsp. *pendulifolia* (Van Jaarsv.) Zonn.	100–400	1000–1250	S	E
44	*G. doreeniae* Van Jaarsv. & A.E.van Wyk	350–500	400–500	W/S	E
45	*G. glauca* Van Jaarsv.	400–800	500–600	W/S	E
46	*G. glomerata* Van Jaarsv.	400–700	300–400	W/S	E
47	*G. pillansii* Kensit var. *ernesti-ruschii* (Dinter & Von Poelln.) Van Jaarsv.	400–600	150–200	W	E
48	*G. rawlinsonii* Oberm.	300–700	200–300	W/S	E
49	*G. tukhelensis* Van Jaarsv.	350–400	500–700	S	E
	Haworthia Duval (12 taxa)				
50	*H. angustifolia* Haw. var. *baylissii* (C.L.Scott) M.B.Bayer	400–500	400–500	W/S	E
51	*H. attenuata* (Haw.) Haw. var. *attenuata*	400	300–400	S	E
52	*H. cymbiformis* (Haw.) Duval var. *ramosa* (G.G.Sm.) M.B.Bayer	400–500	250–400	W/S	E
53	*H. cymbiformis* (Haw.) Duval var. *setulifera* (Poelln.) M.B.Bayer	400–1500	800–1250	W/S	E
54	*H. glabrata* (Salm-Dyck) Baker	500–1000	800–1250	S	E
55	*H. gracilis* Poelln. var. *picturata* M.B.Bayer	400–1000	300–400	W/S	E
56	*H. marumiana* Uitewaal var. *batesiana* (Uitewaal) M.B.Bayer	500–1500	300–400	W/S	E
57	*H. marumiana* Uitewaal var. *marumiana*	300–1000	300–400	W/S	E
58	*H. mirabilis* (Haw.) Haw. var. *consanguinea* M.B.Bayer	1000–1500	600–800	W/S	E
59	*H. scabra* Haw. var. *starkiana* (Poelln.) M.B.Bayer	100–1500	200–300	W/S	E
60	*H. turgida* Haw. var. *turgida*	500–1500	250–500	W/S	E
61	*H. zantneriana* Poelln.	600–1500	250–400	W/S	E
	Trachyandra Kunth (1 species)				
62	*T. tabularis* (Baker) Oberm.	500–900	2000–3000	W	E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Fog *** = regular fog ** = occasional fog * = little fog – = no fog	Biomes IOCB = Indian Ocean Coastal Belt	Pollination
	Bulbine Wolf (10 taxa)			
31	*B. cremnophila* Van Jaarsv.	–	Albany Thicket	insect
32	*B. latifolia* (L.f.) Schult. & Schult.f. var. *curvata* Van Jaarsv.	–	Albany Thicket	insect
33	*B. meiringii* Van Jaarsv.	–	Albany Thicket	insect
34	*B. natalensis* Baker	–	Succulent Karoo	insect
35	*B. pendens* G.Will. & Baijnath	**	Succulent Karoo	insect
36	*B. ramosa* Van Jaarsv.	–	Succulent Karoo	insect
37	*B. retinens* Van Jaarsv. & S.A.Hammer	–	Albany Thicket	insect
38	*B. rupicola* G.Will.	–	Albany Thicket	insect
39	*B. suurbergensis* Van Jaarsv. & A.E.van Wyk	–	Albany Thicket	insect
40	*B. thomasiae* Van Jaarsv.	–	Savanna	insect
	Gasteria Duval (9 taxa)			
41	*G. batesiana* G.D.Rowley var. *batesiana*	–	Savanna	bird
42	*G. batesiana* G.D.Rowley var. *dolomitica* Van Jaarsv. & A.E.van Wyk	–	Savanna	bird
43	*G. croucheri* (Hook.f.) Baker subsp. *pendulifolia* (Van Jaarsv.) Zonn.	–	IOCB	bird
44	*G. doreeniae* Van Jaarsv. & A.E.van Wyk	–	Albany Thicket	bird
45	*G. glauca* Van Jaarsv.	–	Albany Thicket	bird
46	*G. glomerata* Van Jaarsv.	–	Albany Thicket	bird
47	*G. pillansii* Kensit var. *ernesti-ruschii* (Dinter & Von Poelln.) Van Jaarsv.	****	Succulent Karoo	bird
48	*G. rawlinsonii* Oberm.	–	Albany Thicket	bird
49	*G. tukhelensis* Van Jaarsv.	–	Savanna	bird
	Haworthia Duval (12 taxa)			
50	*H. angustifolia* Haw. var. *baylissii* (C.L.Scott) M.B.Bayer	–	Albany Thicket	insect
51	*H. attenuata* (Haw.) Haw. var. *attenuata*	–	Albany Thicket	insect
52	*H. cymbiformis* (Haw.) Duval var. *ramosa* (G.G.Sm.) M.B.Bayer	–	Albany Thicket	insect
53	*H. cymbiformis* (Haw.) Duval var. *setulifera* (Poelln.) M.B.Bayer	–	Savanna	insect
54	*H. glabrata* (Salm-Dyck) Baker	–	Savanna	insect
55	*H. gracilis* Poelln. var. *picturata* M.B.Bayer	–	Albany Thicket	insect
56	*H. marumiana* Uitewaal var. *batesiana* (Uitewaal) M.B.Bayer	–	Albany Thicket	insect
57	*H. marumiana* Uitewaal var. *marumiana*	–	Albany Thicket	insect
58	*H. mirabilis* (Haw.) Haw. var. *consanguinea* M.B.Bayer	–	Fynbos	insect
59	*H. scabra* Haw. var. *starkiana* (Poelln.) M.B.Bayer	–	Succulent Karoo	insect
60	*H. turgida* Haw. var. *turgida*	–	Albany Thicket	insect
61	*H. zantneriana* Poelln.	–	Albany Thicket	insect
	Trachyandra Kunth (1 species)			
62	*T. tabularis* (Baker) Oberm.	**	Fynbos	insect

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Seed dispersal	Conservation status LC = Least Concern NT = Not Threatened VU = Vulnerable	Light requirements BL = bright light DS = dappled shade FS = full sun
	Bulbine Wolf (10 taxa)			
31	*B. cremnophila* Van Jaarsv.	wind	LC	BL, DS
32	*B. latifolia* (L.f.) Schult. & Schult.f. var. *curvata* Van Jaarsv.	wind	LC	FS, BL
33	*B. meiringii* Van Jaarsv.	wind	LC	FS, BL
34	*B. natalensis* Baker	wind	LC	BL, DS
35	*B. pendens* G.Will. & Baijnath	wind	LC	BL, DS
36	*B. ramosa* Van Jaarsv.	wind	LC	FS, BL
37	*B. retinens* Van Jaarsv. & S.A.Hammer	wind	LC	FS, BL
38	*B. rupicola* G.Will.	wind	LC	BL, DS
39	*B. suurbergensis* Van Jaarsv. & A.E.van Wyk	wind	LC	BL, DS
40	*B. thomasiae* Van Jaarsv.	wind	LC	BL, DS
	Gasteria Duval (9 taxa)			
41	*G. batesiana* G.D.Rowley var. *batesiana*	wind	NT	BL, DS
42	*G. batesiana* G.D.Rowley var. *dolomitica* Van Jaarsv. & A.E.van Wyk	wind	VU	BL, DS
43	*G. croucheri* (Hook.f.) Baker subsp. *pendulifolia* (Van Jaarsv.) Zonn.	wind	VU	BL, DS
44	*G. doreeniae* Van Jaarsv. & A.E.van Wyk	wind	LC	BL, DS
45	*G. glauca* Van Jaarsv.	wind	LC	BL, DS
46	*G. glomerata* Van Jaarsv.	wind	LC	BL, DS
47	*G. pillansii* Kensit var. *ernesti-ruschii* (Dinter & Von Poelln.) Van Jaarsv.	wind	LC	BL, DS
48	*G. rawlinsonii* Oberm.	wind	LC	BL, DS
49	*G. tukhelensis* Van Jaarsv.	wind	LC	BL, DS
	Haworthia Duval (12 taxa)			
50	*H. angustifolia* Haw. var. *baylissii* (C.L.Scott) M.B.Bayer	wind	LC	BL, DS
51	*H. attenuata* (Haw.) Haw. var. *attenuata*	wind	LC	FS
52	*H. cymbiformis* (Haw.) Duval var. *ramosa* (G.G.Sm.) M.B.Bayer	wind	LC	BL, DS
53	*H. cymbiformis* (Haw.) Duval var. *setulifera* (Poelln.) M.B.Bayer	wind	LC	BL, DS
54	*H. glabrata* (Salm-Dyck) Baker	wind	LC	FS
55	*H. gracilis* Poelln. var. *picturata* M.B.Bayer	wind	LC	BL, DS
56	*H. marumiana* Uitewaal var. *batesiana* (Uitewaal) M.B.Bayer	wind	LC	BL, DS
57	*H. marumiana* Uitewaal var. *marumiana*	wind	LC	BL, DS
58	*H. mirabilis* (Haw.) Haw. var. *consanguinea* M.B.Bayer	wind	LC	BL, DS
59	*H. scabra* Haw. var. *starkiana* (Poelln.) M.B.Bayer	wind	LC	FS
60	*H. turgida* Haw. var. *turgida*	wind	LC	FS
61	*H. zantneriana* Poelln.	wind	LC	BL, DS
	Trachyandra Kunth (1 species)			
62	*T. tabularis* (Baker) Oberm.	wind	LC	FS, BL, DS

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Rich flowering *** = rich ** = exposed * = insignificant	Reduction in armament *** = margin without teeth ** = margin with smaller teeth * = no significant change, same as other non-cremnophytes	Cliff habitat C = coastal R = river E = escarpment M = mountain I = inselberg
	Bulbine Wolf (10 taxa)			
31	*B. cremnophila* Van Jaarsv.	**	*	R, M
32	*B. latifolia* (L.f.) Schult. & Schult.f. var. *curvata* Van Jaarsv.	**	*	R, M
33	*B. meiringii* Van Jaarsv.	**	*	R, M
34	*B. natalensis* Baker	**	*	R, M
35	*B. pendens* G.Will. & Baijnath	**	*	R, M
36	*B. ramosa* Van Jaarsv.	**	*	R, M
37	*B. retinens* Van Jaarsv. & S.A.Hammer	**	*	R, M
38	*B. rupicola* G.Will.	**	*	R, M
39	*B. suurbergensis* Van Jaarsv. & A.E.van Wyk	**	*	R, M
40	*B. thomasiae* Van Jaarsv.	**	*	R
	Gasteria Duval (9 taxa)			
41	*G. batesiana* G.D.Rowley var. *batesiana*	**	*	R
42	*G. batesiana* G.D.Rowley var. *dolomitica* Van Jaarsv. & A.E.van Wyk	**	*	R
43	*G. croucheri* (Hook.f.) Baker subsp. *pendulifolia* (Van Jaarsv.) Zonn.	**	*	R
44	*G. doreeniae* Van Jaarsv. & A.E.van Wyk	**	*	R, M
45	*G. glauca* Van Jaarsv.	***	*	R, M
46	*G. glomerata* Van Jaarsv.	***	*	R, M
47	*G. pillansii* Kensit var. *ernesti-ruschii* (Dinter & Von Poelln.) Van Jaarsv.	**	*	R, M
48	*G. rawlinsonii* Oberm.	**	*	R, M
49	*G. tukhelensis* Van Jaarsv.	**	*	R
	Haworthia Duval (12 taxa)			
50	*H. angustifolia* Haw. var. *baylissii* (C.L.Scott) M.B.Bayer	*	*	R, M
51	*H. attenuata* (Haw.) Haw. var. *attenuata*	*	*	R
52	*H. cymbiformis* (Haw.) Duval var. *ramosa* (G.G.Sm.) M.B.Bayer	*	*	R
53	*H. cymbiformis* (Haw.) Duval var. *setulifera* (Poelln.) M.B.Bayer	*	*	R
54	*H. glabrata* (Salm-Dyck) Baker	*	*	R
55	*H. gracilis* Poelln. var. *picturata* M.B.Bayer	*	*	R, M
56	*H. marumiana* Uitewaal var. *batesiana* (Uitewaal) M.B.Bayer	*	***	E
57	*H. marumiana* Uitewaal var. *marumiana*	*	*	R, M
58	*H. mirabilis* (Haw.) Haw. var. *consanguinea* M.B.Bayer	*	*	R, M
59	*H. scabra* Haw. var. *starkiana* (Poelln.) M.B.Bayer	*	*	R, M
60	*H. turgida* Haw. var. *turgida*	*	*	R, M
61	*H. zantneriana* Poelln.	*	*	R, M
	Trachyandra Kunth (1 species)			
62	*T. tabularis* (Baker) Oberm.	*	*	M

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Occurrence W = widespread We = widespread but endemic to its vegetation region R = restricted	Endemism * = endemic Bots = Botswana Les = Lesotho Moz = Mozambique Nam = Namibia RSA = South Africa Swaz = Swaziland	Windows Lm = on leaf margin Mw = micro-windows O = other
	Bulbine Wolf (10 taxa)			
31	*B. cremnophila* Van Jaarsv.	R	RSA*	
32	*B. latifolia* (L.f.) Schult. & Schult.f. var. *curvata* Van Jaarsv.	R	RSA*	
33	*B. meiringii* Van Jaarsv.	R	RSA*	O
34	*B. natalensis* Baker	We	RSA*	O
35	*B. pendens* G.Will. & Baijnath	R	RSA*	O
36	*B. ramosa* Van Jaarsv.	R	RSA*	O
37	*B. retinens* Van Jaarsv. & S.A.Hammer	R	RSA*	O
38	*B. rupicola* G.Will.	We	RSA*	O
39	*B. suurbergensis* Van Jaarsv. & A.E.van Wyk	R	RSA*	O
40	*B. thomasiae* Van Jaarsv.	R	RSA*	O
	Gasteria Duval (9 taxa)			
41	*G. batesiana* G.D.Rowley var. *batesiana*	We	RSA, Swaz	
42	*G. batesiana* G.D.Rowley var. *dolomitica* Van Jaarsv. & A.E.van Wyk	R	RSA*	
43	*G. croucheri* (Hook.f.) Baker subsp. *pendulifolia* (Van Jaarsv.) Zonn.	R	RSA*	
44	*G. doreeniae* Van Jaarsv. & A.E.van Wyk	R	RSA*	
45	*G. glauca* Van Jaarsv.	R	RSA*	
46	*G. glomerata* Van Jaarsv.	R	RSA*	
47	*G. pillansii* Kensit var. *ernesti-ruschii* (Dinter & Von Poelln.) Van Jaarsv.	R	RSA, Nam	
48	*G. rawlinsonii* Oberm.	We	RSA*	
49	*G. tukhelensis* Van Jaarsv.	R	RSA*	
	Haworthia Duval (12 taxa)			
50	*H. angustifolia* Haw. var. *baylissii* (C.L.Scott) M.B.Bayer	R	RSA*	
51	*H. attenuata* (Haw.) Haw. var. *attenuata*	R	RSA*	
52	*H. cymbiformis* (Haw.) Duval var. *ramosa* (G.G.Sm.) M.B.Bayer	R	RSA*	Mw, O
53	*H. cymbiformis* (Haw.) Duval var. *setulifera* (Poelln.) M.B.Bayer	We	RSA*	Mw, O
54	*H. glabrata* (Salm-Dyck) Baker	R	RSA*	
55	*H. gracilis* Poelln. var. *picturata* M.B.Bayer	R	RSA*	Mw, O
56	*H. marumiana* Uitewaal var. *batesiana* (Uitewaal) M.B.Bayer	We	RSA*	O
57	*H. marumiana* Uitewaal var. *marumiana*	We	RSA*	
58	*H. mirabilis* (Haw.) Haw. var. *consanguinea* M.B.Bayer	We	RSA*	Mw, O
59	*H. scabra* Haw. var. *starkiana* (Poelln.) M.B.Bayer	We	RSA*	
60	*H. turgida* Haw. var. *turgida*	We	RSA*	Mw, O
61	*H. zantneriana* Poelln.	We	RSA*	O
	Trachyandra Kunth (1 species)			
62	*T. tabularis* (Baker) Oberm.	R	RSA*	

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Cremnophilous growth form See 9.1.2 for explanation of the symbols below	Degree of cliff occupation *** = strictly obligate cremnophyte, displaying cliff-adapted features ** = obligate cremnophyte * = predominantly on cliffs (80%)	Weight class light = < 50 g medium = 51–500 g heavy = >500 g
	HYACINTHACEAE (5 genera, 18 taxa)			
	Albuca L. (6 species)			
63	*A. batteniana* Hilliard & B.L.Burtt	A:B:Lper:C:La (e) (vb) (r)	**	medium-heavy
64	*A. cremnophila* Van Jaarsv. & A.E.van Wyk	A:B:Lper:C:Lp (e) (vb) (eg)	***	medium
65	*A. crudenii* Archibald	A:B:D:C:Lp (e) (vb) (eg)	***	light
66	*A. kirstenii* (J.C.Manning & Goldblatt) J.C.Manning & Goldblatt	A:B:D:C:Lp (e) (vb)	**	light
67	*A. shawii* Baker	A:B:Lper:C:Lp (vb) (eg)	**	light
68	*A. thermarum* Van Jaarsv.	A:B:Lper:C:Lp (e) (vb) (eg)	***	medium
	Drimia Jacq. (5 species)			
69	*D . cremnophila* Van Jaarsv.	A:B:Lper:C:Lp (e) (vb)	***	light-medium
70	*D . flagellaris* T.J.Edwards, D.Styles & N.R.Crouch	A:B:Lper:C:Lp (e) (vb)	***	medium
71	*D . loedolffiae* Van Jaarsv.	A:B:Lper:C:Lp (e) (vb)	***	medium
72	*D . mzimvubuensis* Van Jaarsv.	A:B:Lper:C:Lp (e) (vb)	***	light-medium
73	*D. uniflora* J.C.Manning & Goldblatt	A:B:Lper:C:La (vb)	*	light
	Ledebouria Roth (3 species)			
74	*L. concolor* (Baker) Jessop	A:B:Lper:C:La (e) (vb) (rd)	**	medium
75	*L. cremnophila* S.Venter & Van Jaarsv.	A:B:Lper:C:La (e) (vb)	***	medium
76	*L . venteri* Van Jaarsv. & A.E.van Wyk	A:B:Lper:C:La (e) (vb)	*	medium
	Ornithogalum L. (3 taxa)			
77	*O. juncifolium* Jacq. var. *emsii* Van Jaarsv. & A.E.van Wyk	A:B:Lper:C:La (e) (vb)	***	light
78	*O. longibracteatum* Jacq.	A:B:Lper:C:La: (e) (vb)	**	medium
79	*O. pendens* Van Jaarsv.	A:B:D:C:Lp: (vb)	***	light
	Schizobasis Baker (1 species)			
80	*S. intricata* (Baker) Baker	A:B:D:C:La (e) (vb)	**	light-medium
	DICOTYLEDONS (10 families, 140 taxa)			
	ASCLEPIADACEAE (3 genera, 4 species)			
	Huernia R.Br. (1 species)			
81	*H. pendula* E.A.Bruce	E:Ex:P:St (vb) (eg)	***	light-medium
	Lavrania Plowes (1 species)			
82	*L. haagnerae* Plowes	E:Ex:De:St (vb)	***	medium-heavy
	Tromotriche Haw. (2 species)			
83	*T. baylissii* (L.C.Leach) Bruyns	E:Ex:P:Ss (vb) (eg)	***	light-medium
84	*T. choanantha* (Lavranos & H.Hall) Bruyns	E:Ex:P:Ss (vb) (eg)	***	light-medium
	ASTERACEAE (3 genera, 10 taxa)			
	Kleinia Mill. (1 species)			
85	*K. galpinii* Hook.f.	A:S:Lper:R:C:La (vb) (r)	**	medium
	Othonna L. (4 species)			
86	*O. armiana* Van Jaarsv.	A:S:Lar:D:Ca:La: (r)	***	light-medium
87	*O. capensis* L.H.Bailey	E:F:P:Els:E: (vb)	**	light-medium
88	*O. cremnophila* B.Nord. & Van Jaarsv.	E:F:As:S/H:Ca:D	***	medium
89	*O. triplinervia* DC.	E:F:As:S/H:Ca:Ev	***	medium

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Vegetative dispersal backup	Geology	Aspect
	HYACINTHACEAE (5 genera, 18 taxa)			
	Albuca L. (6 species)			
63	*A. batteniana* Hilliard & B.L.Burtt	dividing or proliferating clusters	mudstone	S
64	*A. cremnophila* Van Jaarsv. & A.E.van Wyk	dividing or proliferating clusters	sandstone	S
65	*A. crudenii* Archibald	dividing or proliferating clusters	sandstone	S
66	*A. kirstenii* (J.C.Manning & Goldblatt) J.C.Manning & Goldblatt	dividing or proliferating clusters	sandstone	E
67	*A. shawii* Baker	dividing or proliferating clusters	sandstone, shale	S
68	*A. thermarum* Van Jaarsv.	dividing or proliferating clusters	sandstone	S
	Drimia Jacq. (5 species)			
69	*D . cremnophila* Van Jaarsv.	proliferating clusters and bulb scale proliferation	shale	S
70	*D . flagellaris* T.J.Edwards, D.Styles & N.R.Crouch	proliferating clusters and bulb scale proliferation	sandstone	S, E
71	*D . loedolffiae* Van Jaarsv.	dividing or proliferating clusters	shale	W, E, S
72	*D . mzimvubuensis* Van Jaarsv.	proliferating clusters and bulb scale proliferation	shale	S
73	*D. uniflora* J.C.Manning & Goldblatt	dividing or proliferating clusters	sandstone	S, E
	Ledebouria Roth (3 species)			
74	*L. concolor* (Baker) Jessop	dividing or proliferating clusters	sandstone	S
75	*L. cremnophila* S.Venter & Van Jaarsv.	dividing or proliferating clusters	quartz	S
76	*L . venteri* Van Jaarsv. & A.E.van Wyk	dividing or proliferating clusters	sandstone	E, W, S
	Ornithogalum L. (3 taxa)			
77	*O. juncifolium* Jacq. var. *emsii* Van Jaarsv. & A.E.van Wyk	dividing or proliferating clusters and bulbils	shale	S
78	*O. longibracteatum* Jacq.	dividing or proliferating clusters and bulbils	sandstone, shale	N, W, E, S
79	*O. pendens* Van Jaarsv.	dividing or proliferating clusters	sandstone	S
	Schizobasis Baker (1 species)			
80	*S. intricata* (Baker) Baker	dividing or proliferating clusters	sandstone, quartz	S
	DICOTYLEDONS (10 families, 140 taxa)			
	ASCLEPIADACEAE (3 genera, 4 species)			
	Huernia R.Br. (1 species)			
81	*H. pendula* E.A.Bruce	active growth and rooting	shale	S
	Lavrania Plowes (1 species)			
82	*L. haagnerae* Plowes	active growth and rooting	dolomite	S
	Tromotriche Haw. (2 species)			
83	*T. baylissii* (L.C.Leach) Bruyns	active growth and rooting	sandstone	S
84	*T. choanantha* (Lavranos & H.Hall) Bruyns	active growth and rooting	sandstone	S
	ASTERACEAE (3 genera, 10 taxa)			
	Kleinia Mill. (1 species)			
85	*K. galpinii* Hook.f.	dividing or proliferating clusters	sandstone	E, N
	Othonna L. (4 species)			
86	*O. armiana* Van Jaarsv.	solitary	diabase	S
87	*O. capensis* L.H.Bailey	active growth and rooting	sandstone	S
88	*O. cremnophila* B.Nord. & Van Jaarsv.	solitary	quartz	S
89	*O. triplinervia* DC.	active growth and rooting	sandstone	S

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Altitude (m)	Rainfall (mm per annum)	Rainfall seasonality S = summer W = winter W/S = any time of year	Deciduousness E = evergreen SA = summer-aestivating SD = summer-deciduous WD = winter-deciduous
	HYACINTHACEAE (5 genera, 18 taxa)				
	Albuca L. (6 species)				
63	*A. batteniana* Hilliard & B.L.Burtt	25–800	700–800	S	E
64	*A. cremnophila* Van Jaarsv. & A.E.van Wyk	300–600	200–300	W/S	E
65	*A. crudenii* Archibald	350–400	400–600	W/S	SD
66	*A. kirstenii* (J.C.Manning & Goldblatt) J.C.Manning & Goldblatt	200–300	300–400	W/S	SD
67	*A. shawii* Baker	533–2400	800–1500	S	WD
68	*A. thermarum* Van Jaarsv.	400–800	200–300	W/S	E
	Drimia Jacq. (5 species)				
69	*D . cremnophila* Van Jaarsv.	50–600	800–1000	S	WD
70	*D . flagellaris* T.J.Edwards, D.Styles & N.R.Crouch	250–800	100–1250	S	E
71	*D . loedolffiae* Van Jaarsv.	300–500	600–1250	S	E
72	*D . mzimvubuensis* Van Jaarsv.	300–500	600–1250	S	E
73	*D. uniflora* J.C.Manning & Goldblatt	500–3000	100–1250	W/S	E
	Ledebouria Roth (3 species)				
74	*L. concolor* (Baker) Jessop	300–800	300–500	S	E
75	*L. cremnophila* S.Venter & Van Jaarsv.	400–600	500–700	S	E
76	*L . venteri* Van Jaarsv. & A.E.van Wyk	600–800	300–400	S/W	E
	Ornithogalum L. (3 taxa)				
77	*O. juncifolium* Jacq. var. *emsii* Van Jaarsv. & A.E.van Wyk	500–600	300–400	W/S	E
78	*O. longibracteatum* Jacq.	300–500	300–1000	W/S	E
79	*O. pendens* Van Jaarsv.	400–500	100–250	W	SD
	Schizobasis Baker (1 species)				
80	*S. intricata* (Baker) Baker	250–2000	800–1000	W/S	WD
	DICOTYLEDONS (10 families, 140 taxa)				
	ASCLEPIADACEAE (3 genera, 4 species)				
	Huernia R.Br. (1 species)				
81	*H. pendula* E.A.Bruce	400–800	300–800	S	E
	Lavrania Plowes (1 species)				
82	*L. haagnerae* Plowes	700–900	50–150	S	E
	Tromotriche Haw. (2 species)				
83	*T. baylissii* (L.C.Leach) Bruyns	250–900	200–300	W/S	E
84	*T. choanantha* (Lavranos & H.Hall) Bruyns	400–600	200–300	W/S	E
	ASTERACEAE (3 genera, 10 taxa)				
	Kleinia Mill. (1 species)				
85	*K. galpinii* Hook.f.	600–1525	1250–2000	S	E
	Othonna L. (4 species)				
86	*O. armiana* Van Jaarsv.	800–900	100–150	W	SD
87	*O. capensis* L.H.Bailey	20–1220	300–500	W/S	E
88	*O. cremnophila* B.Nord. & Van Jaarsv.	600–1000	75–150	W	SD
89	*O. triplinervia* DC.	400–700	300–500	W/S	E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Fog *** = regular fog ** = occasional fog * = little fog – = no fog	Biomes IOCB = Indian Ocean Coastal Belt	Pollination
	HYACINTHACEAE (5 genera, 18 taxa)			
	Albuca L. (6 species)			
63	*A. batteniana* Hilliard & B.L.Burtt	–	Albany Thicket	insect
64	*A. cremnophila* Van Jaarsv. & A.E.van Wyk	–	Albany Thicket	insect
65	*A. crudenii* Archibald	–	Albany Thicket	insect
66	*A. kirstenii* (J.C.Manning & Goldblatt) J.C.Manning & Goldblatt	–	Albany Thicket	insect
67	*A. shawii* Baker	–	Grassland	insect
68	*A. thermarum* Van Jaarsv.	–	Succulent Karoo	insect
	Drimia Jacq. (5 species)			
69	*D . cremnophila* Van Jaarsv.	–	Savanna	insect
70	*D . flagellaris* T.J.Edwards, D.Styles & N.R.Crouch	–	IOCB	insect
71	*D . loedolffiae* Van Jaarsv.	–	Savanna	insect
72	*D . mzimvubuensis* Van Jaarsv.	–	Savanna	insect
73	*D. uniflora* J.C.Manning & Goldblatt	**	Fynbos, Savanna, Succulent Karoo, Albany Thicket, Nama-Karoo, Grassland	insect
	Ledebouria Roth (3 species)			
74	*L. concolor* (Baker) Jessop	–	Albany Thicket	insect
75	*L. cremnophila* S.Venter & Van Jaarsv.	–	Savanna	insect
76	*L . venteri* Van Jaarsv. & A.E.van Wyk	–	Albany Thicket	insect
	Ornithogalum L. (3 taxa)			
77	*O. juncifolium* Jacq. var. *emsii* Van Jaarsv. & A.E.van Wyk	–	Albany Thicket	insect
78	*O. longibracteatum* Jacq.	–	Albany Thicket	insect
79	*O. pendens* Van Jaarsv.	**	Succulent Karoo	insect
	Schizobasis Baker (1 species)			
80	*S. intricata* (Baker) Baker	–	Savanna	insect
	DICOTYLEDONS (10 families, 140 taxa)			
	ASCLEPIADACEAE (3 genera, 4 species)			
	Huernia R.Br. (1 species)			
81	*H. pendula* E.A.Bruce	–	Savanna	insect
	Lavrania Plowes (1 species)			
82	*L. haagnerae* Plowes	–	Desert	insect
	Tromotriche Haw. (2 species)			
83	*T. baylissii* (L.C.Leach) Bruyns	–	Albany Thicket	insect
84	*T. choanantha* (Lavranos & H.Hall) Bruyns	–	Albany Thicket	insect
	ASTERACEAE (3 genera, 10 taxa)			
	Kleinia Mill. (1 species)			
85	*K. galpinii* Hook.f.	–	Grassland	insect
	Othonna L. (4 species)			
86	*O. armiana* Van Jaarsv.	–	Succulent Karoo	insect
87	*O. capensis* L.H.Bailey	–	Albany Thicket	insect
88	*O. cremnophila* B.Nord. & Van Jaarsv.	–	Succulent Karoo	insect
89	*O. triplinervia* DC.	–	Albany Thicket	insect

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Seed dispersal	Conservation status LC = Least Concern NT = Not Threatened VU = Vulnerable	Light requirements BL = bright light DS = dappled shade FS = full sun
	HYACINTHACEAE (5 genera, 18 taxa)			
	Albuca L. (6 species)			
63	*A. batteniana* Hilliard & B.L.Burtt	wind	LC	FS, BL, DS
64	*A. cremnophila* Van Jaarsv. & A.E.van Wyk	wind	LC	FS, BL, DS
65	*A. crudenii* Archibald	wind	LC	BL, DS
66	*A. kirstenii* (J.C.Manning & Goldblatt) J.C.Manning & Goldblatt	wind	LC	FS, BL, DS
67	*A. shawii* Baker	wind	LC	BL, DS
68	*A. thermarum* Van Jaarsv.	wind	LC	FS, BL, DS
	Drimia Jacq. (5 species)			
69	*D . cremnophila* Van Jaarsv.	wind	LC	BL, DS
70	*D . flagellaris* T.J.Edwards, D.Styles & N.R.Crouch	wind	LC	FS, BL, DS
71	*D . loedolffiae* Van Jaarsv.	wind	LC	BL, DS
72	*D . mzimvubuensis* Van Jaarsv.	wind	LC	BL, DS
73	*D. uniflora* J.C.Manning & Goldblatt	wind	LC	BL
	Ledebouria Roth (3 species)			
74	*L. concolor* (Baker) Jessop	autochory	LC	FS, BL, DS
75	*L. cremnophila* S.Venter & Van Jaarsv.	autochory	LC	BL, DS
76	*L . venteri* Van Jaarsv. & A.E.van Wyk	autochory	LC	FS, BL, DS
	Ornithogalum L. (3 taxa)			
77	*O. juncifolium* Jacq. var. *emsii* Van Jaarsv. & A.E.van Wyk	wind	LC	FS, BL, DS
78	*O. longibracteatum* Jacq.	wind	LC	FS, BL, DS
79	*O. pendens* Van Jaarsv.	wind	LC	BL, DS
	Schizobasis Baker (1 species)			
80	*S. intricata* (Baker) Baker	wind	LC	FS, BL, DS
	DICOTYLEDONS (10 families, 140 taxa)			
	ASCLEPIADACEAE (3 genera, 4 species)			
	Huernia R.Br. (1 species)			
81	*H. pendula* E.A.Bruce	wind	LC	FS, BL, DS
	Lavrania Plowes (1 species)			
82	*L. haagnerae* Plowes	wind	LC	FS, BL
	Tromotriche Haw. (2 species)			
83	*T. baylissii* (L.C.Leach) Bruyns	wind	LC	BL, DS
84	*T. choanantha* (Lavranos & H.Hall) Bruyns	wind	LC	BL, DS
	ASTERACEAE (3 genera, 10 taxa)			
	Kleinia Mill. (1 species)			
85	*K. galpinii* Hook.f.	wind	LC	FS
	Othonna L. (4 species)			
86	*O. armiana* Van Jaarsv.	wind	LC	FS
87	*O. capensis* L.H.Bailey	wind	LC	FS
88	*O. cremnophila* B.Nord. & Van Jaarsv.	wind	LC	FS
89	*O. triplinervia* DC.	wind	LC	FS, BL

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Rich flowering *** = rich ** = exposed * = insignificant	Reduction in armament *** = margin without teeth ** = margin with smaller teeth * = no significant change, same as other non-cremnophytes	Cliff habitat C = coastal R = river E = escarpment M = mountain I = inselberg
	HYACINTHACEAE (5 genera, 18 taxa)			
	Albuca L. (6 species)			
63	*A. batteniana* Hilliard & B.L.Burtt	***	*	C
64	*A. cremnophila* Van Jaarsv. & A.E.van Wyk	**	*	R, M
65	*A. crudenii* Archibald	**	*	R, M
66	*A. kirstenii* (J.C.Manning & Goldblatt) J.C.Manning & Goldblatt	**	*	R
67	*A. shawii* Baker	**	*	R, M
68	*A. thermarum* Van Jaarsv.	**	*	R, M
	Drimia Jacq. (5 species)			
69	*D . cremnophila* Van Jaarsv.	*	*	R
70	*D . flagellaris* T.J.Edwards, D.Styles & N.R.Crouch	*	*	R
71	*D . loedolffiae* Van Jaarsv.	*	*	R
72	*D . mzimvubuensis* Van Jaarsv.	*	*	R
73	*D. uniflora* J.C.Manning & Goldblatt	*	*	R, M
	Ledebouria Roth (3 species)	*	*	
74	*L. concolor* (Baker) Jessop	*	*	R, M
75	*L. cremnophila* S.Venter & Van Jaarsv.	*	*	R, M
76	*L . venteri* Van Jaarsv. & A.E.van Wyk	*	*	R, M
	Ornithogalum L. (3 taxa)			
77	*O. juncifolium* Jacq. var. *emsii* Van Jaarsv. & A.E.van Wyk	**	*	R
78	*O. longibracteatum* Jacq.	**	*	R, M, C
79	*O. pendens* Van Jaarsv.	**	*	R
	Schizobasis Baker (1 species)			
80	*S. intricata* (Baker) Baker	*	*	R
	DICOTYLEDONS (10 families, 140 taxa)			
	ASCLEPIADACEAE (3 genera, 4 species)			
	Huernia R.Br. (1 species)			
81	*H. pendula* E.A.Bruce	**	*	R
	Lavrania Plowes (1 species)			
82	*L. haagnerae* Plowes	**	*	R, M
	Tromotriche Haw. (2 species)			
83	*T. baylissii* (L.C.Leach) Bruyns	**	*	R, M
84	*T. choanantha* (Lavranos & H.Hall) Bruyns	**	*	R, M
	ASTERACEAE (3 genera, 10 taxa)			
	Kleinia Mill. (1 species)			
85	*K. galpinii* Hook.f.	***	*	E, M
	Othonna L. (4 species)			
86	*O. armiana* Van Jaarsv.	***	*	M, I
87	*O. capensis* L.H.Bailey	**	*	E, R
88	*O. cremnophila* B.Nord. & Van Jaarsv.	**	*	M
89	*O. triplinervia* DC.	**	*	R

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Occurrence W = widespread We = widespread but endemic to its vegetation region R = restricted	Endemism * = endemic Bots = Botswana Les = Lesotho Moz = Mozambique Nam = Namibia RSA = South Africa Swaz = Swaziland	Windows Lm = on leaf margin Mw = micro-windows O = other
	HYACINTHACEAE (5 genera, 18 taxa)			
	Albuca L. (6 species)			
63	*A. batteniana* Hilliard & B.L.Burtt	We	RSA*	
64	*A. cremnophila* Van Jaarsv. & A.E.van Wyk	We	RSA*	O
65	*A. crudenii* Archibald	R	RSA*	
66	*A. kirstenii* (J.C.Manning & Goldblatt) J.C.Manning & Goldblatt	We	RSA*	
67	*A. shawii* Baker	W	RSA*	
68	*A. thermarum* Van Jaarsv.	R	RSA*	
	Drimia Jacq. (5 species)			
69	*D . cremnophila* Van Jaarsv.	We	RSA*	
70	*D . flagellaris* T.J.Edwards, D.Styles & N.R.Crouch	We	RSA*	O
71	*D . loedolffiae* Van Jaarsv.	We	RSA*	O
72	*D . mzimvubuensis* Van Jaarsv.	R	RSA*	O
73	*D. uniflora* J.C.Manning & Goldblatt	W	RSA, Swaz	
	Ledebouria Roth (3 species)			
74	*L. concolor* (Baker) Jessop	We	RSA*	
75	*L. cremnophila* S.Venter & Van Jaarsv.	R	RSA*	
76	*L . venteri* Van Jaarsv. & A.E.van Wyk	We	RSA*	
	Ornithogalum L. (3 taxa)			
77	*O. juncifolium* Jacq. var. *emsii* Van Jaarsv. & A.E.van Wyk	R	RSA*	
78	*O. longibracteatum* Jacq.	W	RSA*	
79	*O. pendens* Van Jaarsv.	R	RSA*	
	Schizobasis Baker (1 species)			
80	*S. intricata* (Baker) Baker	W	RSA, Swaz, Bots	
	DICOTYLEDONS (10 families, 140 taxa)			
	ASCLEPIADACEAE (3 genera, 4 species)			
	Huernia R.Br. (1 species)			
81	*H. pendula* E.A.Bruce	We	RSA*	
	Lavrania Plowes (1 species)			
82	*L. haagnerae* Plowes	We	Nam*	
	Tromotriche Haw. (2 species)			
83	*T. baylissii* (L.C.Leach) Bruyns	We	RSA*	
84	*T. choanantha* (Lavranos & H.Hall) Bruyns	We	RSA*	
	ASTERACEAE (3 genera, 10 taxa)			
	Kleinia Mill. (1 species)			
85	*K. galpinii* Hook.f.	We	RSA*	
	Othonna L. (4 species)			
86	*O. armiana* Van Jaarsv.	R	RSA*	
87	*O. capensis* L.H.Bailey	W	RSA*	
88	*O. cremnophila* B.Nord. & Van Jaarsv.	R	RSA*	
89	*O. triplinervia* DC.	We	RSA*	

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Cremnophilous growth form See 9.1.2 for explanation of the symbols below	Degree of cliff occupation *** = strictly obligate cremnophyte, displaying cliff-adapted features ** = obligate cremnophyte * = predominantly on cliffs (80%)	Weight class light = < 50 g medium = 51–500 g heavy = >500 g
	Senecio L. (5 taxa)			
90	*S. medley-woodii* Hutch.	E:F:As:S/H:Es (vb)	***	medium
91	*S. muirii* L.Bolus	E:F:P:Els:(vb) (eg)	***	medium
92	*S. pondoensis* Van Jaarsv. & A.E.van Wyk	E:F:As:S/H:Es (vb)	***	medium
93	*S. serpens* G.D.Rowley	E:F:As:S/H:Es (vb)	**	medium
94	*S. talinoides* Sch.Bip. subsp. *talinoides*	E:F:As:S/H:Es (vb)	**	medium
	CACTACEAE (1 taxon)			
	Rhipsalis Gaertn. (1 taxon)			
95	*R. baccifera* (J.Mill.) Stearn subsp. *mauritiana* (D.C.) Barthlott	E:Ex:P:St (vb) (eg)	***	medium
	CRASSULACEAE (4 genera, 66 taxa)			
	Adromischus Lem. (10 taxa, 8 species)			
96	*A. cristatus* (Haw.) Lem. var. *mzimvubuensis* Van Jaarsv.	A:S:Lper:Lc:Ts (vb)	**	light-medium
97	*A. cristatus* (Haw.) Lem. var. *schonlandii* (E.Phillips) Toelken	A:S:Lper:Lc:Ts (vb)	***	light-medium
98	*A. cristatus* (Haw.) Lem. var. *zeyheri* (Harv.) Toelken	E:F:P:Els (vb)	***	light-medium
99	*A. diabolicus* Toelken	A:S:Lper:Lc:Ts (vb)	***	light-medium
100	*A. fallax* Toelken	E:F:As:S/H:Es (vb)	**	light-medium
101	*A. leucophyllus* Uitewaal	E:F:P:Els (vb)	**	light
102	*A. liebenbergii* Hutchison subsp. *orientalis* Van Jaarsv.	E:F:S/H:As:Es (vb)	**	light-medium
103	*A. schuldtianus* (Poelln.) Poelln. subsp. *brandbergensis* B.Nord. & Van Jaarsv.	A:S:Lper:Lc:Ca (vb)	**	light
104	*A. subdistichus* Makin ex Bruyns	E:F:P:Els E (vb)	**	light
105	*A. umbraticola* C.A.Sm. subsp. *ramosus* Toelken	A:S:Lper:Lc:Ts (vb)	**	light
	Cotyledon L. (4 taxa)			
106	*C. barbeyi* Schweinf. var. A	E:F:As:S/H:Es (vb)	**	light-medium
107	*C. eliseae* Van Jaarsv.	E:F:As:S/H:Es: (vb)	***	light-medium
108	*C. pendens* Van Jaarsv.	E:F:P:Els (eg) (vb) (r)	***	light-medium
109	*C. tomentosa* Harv. subsp. *tomentosa*	E:F:As:S/H:Es (vb)	***	light-medium
	Crassula L. (38 taxa)			
110	*C. alba* Forssk. var. *pallida* Toelken	A:S:Lper:R:C:La (vb)	**	light-medium
111	*C. atropurpurea* (Harv.) D.Dietr. var. *anomala* (Schönland & Baker f.) Toelken	E:F:As:S/H:Es (vb)	**	light
112	*C. aurusbergensis* G.Will.	A:S:Lper:R:C:La (vb)	***	light
113	*C. badspoortense* Van Jaarsv.	E:F:P:Els: (vb)	***	light-medium
114	*C. brachystachya* Toelken	A:S:Lper:R:C:La (vb)	***	light
115	*C. capitella* Thunb. subsp. *thyrsiflora* (Thunb.) Toelken	A:S:Lper:R:C:La (vb)	**	light
116	*C . cremnophila* Van Jaarsv. & A.E.van Wyk	A:S:Lper:R:C:La (vb) (rd) (r)	***	light

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Vegetative dispersal backup	Geology	Aspect
	Senecio L. (5 taxa)			
90	*S. medley-woodii* Hutch.	dividing or proliferating clusters	sandstone, shale	S, N, W, E
91	*S. muirii* L.Bolus	active growth and rooting	sandstone, shale	S
92	*S. pondoensis* Van Jaarsv. & A.E.van Wyk	active growth and rooting	sandstone	S
93	*S. serpens* G.D.Rowley	active growth and rooting	sandstone	S, E, N, W
94	*S. talinoides* Sch.Bip. subsp. *talinoides*	active growth and rooting	sandstone, shale	S
	CACTACEAE (1 taxon)			
	Rhipsalis Gaertn. (1 taxon)			
95	*R. baccifera* (J.Mill.) Stearn subsp. *mauritiana* (D.C.) Barthlott	active growth and rooting	sandstone	S
	CRASSULACEAE (4 genera, 66 taxa)			
	Adromischus Lem. (10 taxa, 8 species)			
96	*A. cristatus* (Haw.) Lem. var. *mzimvubuensis* Van Jaarsv.	proliferating clusters and leaf stolons	shale	N, W, E
97	*A. cristatus* (Haw.) Lem. var. *schonlandii* (E.Phillips) Toelken	proliferating clusters and leaf stolons	sandstone	N, W, E
98	*A. cristatus* (Haw.) Lem. var. *zeyheri* (Harv.) Toelken	proliferating clusters and leaf stolons	sandstone	S
99	*A. diabolicus* Toelken	proliferating clusters and leaf stolons	quartz	S
100	*A. fallax* Toelken	proliferating clusters and leaf stolons	shale	S
101	*A. leucophyllus* Uitewaal	proliferating clusters and leaf stolons	sandstone	S, W, E
102	*A. liebenbergii* Hutchison subsp. *orientalis* Van Jaarsv.	proliferating clusters and leaf stolons	shale	N, S, E
103	*A. schuldtianus* (Poelln.) Poelln. subsp. *brandbergensis* B.Nord. & Van Jaarsv.	proliferating clusters and leaf stolons	granite	S
104	*A. subdistichus* Makin ex Bruyns	proliferating clusters and leaf stolons	sandstone	S
105	*A. umbraticola* C.A.Sm. subsp. *ramosus* Toelken	proliferating clusters and leaf stolons	sandstone	N, E
	Cotyledon L. (4 taxa)			
106	*C. barbeyi* Schweinf. var. A	solitary	sandstone	W
107	*C. eliseae* Van Jaarsv.	solitary	sandstone	S
108	*C. pendens* Van Jaarsv.	active growth and rooting	shale	S
109	*C. tomentosa* Harv. subsp. *tomentosa*	solitary	sandstone	N, S, E, W
	Crassula L. (38 taxa)			
110	*C. alba* Forssk. var. *pallida* Toelken	dividing or proliferating clusters	sandstone	N, E
111	*C. atropurpurea* (Harv.) D.Dietr. var. *anomala* (Schönland & Baker f.) Toelken	proliferating clusters and leaf stolons	sandstone	N, S, E, W
112	*C. aurusbergensis* G.Will.	proliferating clusters and leaf stolons	sandstone	S
113	*C. badspoortense* Van Jaarsv.	solitary	sandstone	S
114	*C. brachystachya* Toelken	proliferating clusters and leaf stolons	sandstone	S
115	*C. capitella* Thunb. subsp. *thyrsiflora* (Thunb.) Toelken	proliferating clusters and leaf stolons	sandstone	S
116	*C . cremnophila* Van Jaarsv. & A.E.van Wyk	proliferating clusters and leaf stolons	sandstone	S

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Altitude (m)	Rainfall (mm per annum)	Rainfall seasonality S = summer W = winter W/S = any time of year	Deciduousness E = evergreen SA = summer-aestivating SD = summer-deciduous WD = winter-deciduous
	Senecio L. (5 taxa)				
90	*S. medley-woodii* Hutch.	460–800	1000–1250	S	E
91	*S. muirii* L.Bolus	300–800	300–400	W/S	E
92	*S. pondoensis* Van Jaarsv. & A.E.van Wyk	200–250	1000–1250	S	E
93	*S. serpens* G.D.Rowley	400–1800	100–1250	W	E
94	*S. talinoides* Sch.Bip. subsp. *talinoides*	300–1000	500–700	WS	E
	CACTACEAE (1 taxon)				
	Rhipsalis Gaertn. (1 taxon)				
95	*R. baccifera* (J.Mill.) Stearn subsp. *mauritiana* (D.C.) Barthlott	100–1750	1000–1250	S	E
	CRASSULACEAE (4 genera, 66 taxa)				
	Adromischus Lem. (10 taxa, 8 species)				
96	*A. cristatus* (Haw.) Lem. var. *mzimvubuensis* Van Jaarsv.	460–800	400–700	S	E
97	*A. cristatus* (Haw.) Lem. var. *schonlandii* (E.Phillips) Toelken	100–1500	300–400	S/W	E
98	*A. cristatus* (Haw.) Lem. var. *zeyheri* (Harv.) Toelken	50–800	300–700	S/W	E
99	*A. diabolicus* Toelken	300–800	50–100	S/W	E
100	*A. fallax* Toelken	800–1500	300–400	S	E
101	*A. leucophyllus* Uitewaal	500–1000	300–400	W/S	E
102	*A. liebenbergii* Hutchison subsp. *orientalis* Van Jaarsv.	300–800	600–1000	S	E
103	*A. schuldtianus* (Poelln.) Poelln. subsp. *brandbergensis* B.Nord. & Van Jaarsv.	500–2200	200–300	S	E
104	*A. subdistichus* Makin ex Bruyns	500–2000	300–400	W/S	E
105	*A. umbraticola* C.A.Sm. subsp. *ramosus* Toelken	1500–1700	600–800	S	E
	Cotyledon L. (4 taxa)				
106	*C. barbeyi* Schweinf. var. A	400–600	350–400	S	E
107	*C. eliseae* Van Jaarsv.	200–300	300–400	W/S	E
108	*C. pendens* Van Jaarsv.	300–400	1000–1250	S	E
109	*C. tomentosa* Harv. subsp. *tomentosa*	300–700	300–400	W/S	E
	Crassula L. (38 taxa)				
110	*C. alba* Forssk. var. *pallida* Toelken	400–2000	1000–1500	S	E
111	*C. atropurpurea* (Harv.) D.Dietr. var. *anomala* (Schönland & Baker f.) Toelken	800–2000	450–800	W	E
112	*C. aurusbergensis* G.Will.	900–1050	50–75	W	E
113	*C. badspoortense* Van Jaarsv.	500–800	250–300	W/S	E
114	*C. brachystachya* Toelken	1300–2000	200–400	W/S	E
115	*C. capitella* Thunb. subsp. *thyrsiflora* (Thunb.) Toelken	300–1000	200–300	W/S	E
116	*C . cremnophila* Van Jaarsv. & A.E.van Wyk	500–800	200–300	W/S	E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Fog *** = regular fog ** = occasional fog * = little fog – = no fog	Biomes IOCB = Indian Ocean Coastal Belt	Pollination
	Senecio L. (5 taxa)			
90	*S. medley-woodii* Hutch.	–	Savanna	insect
91	*S. muirii* L.Bolus	–	Albany Thicket	insect
92	*S. pondoensis* Van Jaarsv. & A.E.van Wyk	–	IOCB	insect
93	*S. serpens* G.D.Rowley	–	Fynbos	insect
94	*S. talinoides* Sch.Bip. subsp. *talinoides*	–	Savanna	insect
	CACTACEAE (1 taxon)			
	Rhipsalis Gaertn. (1 taxon)			
95	*R. baccifera* (J.Mill.) Stearn subsp. *mauritiana* (D.C.) Barthlott	–	IOCB	insect
	CRASSULACEAE (4 genera, 66 taxa)			
	Adromischus Lem. (10 taxa, 8 species)			
96	*A. cristatus* (Haw.) Lem. var. *mzimvubuensis* Van Jaarsv.	–	Savanna	insect
97	*A. cristatus* (Haw.) Lem. var. *schonlandii* (E.Phillips) Toelken	–	Albany Thicket	insect
98	*A. cristatus* (Haw.) Lem. var. *zeyheri* (Harv.) Toelken	–	Albany Thicket	insect
99	*A. diabolicus* Toelken	**	Desert	insect
100	*A. fallax* Toelken	*	Albany Thicket	insect
101	*A. leucophyllus* Uitewaal	–	Succulent Karoo	insect
102	*A. liebenbergii* Hutchison subsp. *orientalis* Van Jaarsv.	–	Savanna	insect
103	*A. schuldtianus* (Poelln.) Poelln. subsp. *brandbergensis* B.Nord. & Van Jaarsv.	–	Desert	insect
104	*A. subdistichus* Makin ex Bruyns	–	Albany Thicket	insect
105	*A. umbraticola* C.A.Sm. subsp. *ramosus* Toelken	–	Savanna	insect
	Cotyledon L. (4 taxa)			
106	*C. barbeyi* Schweinf. var. A	–	Savanna	bird
107	*C. eliseae* Van Jaarsv.	–	Albany Thicket	bird
108	*C. pendens* Van Jaarsv.	–	Savanna	bird
109	*C. tomentosa* Harv. subsp. *tomentosa*	–	Albany Thicket	bird
	Crassula L. (38 taxa)			
110	*C. alba* Forssk. var. *pallida* Toelken	–	Grassland	insect
111	*C. atropurpurea* (Harv.) D.Dietr. var. *anomala* (Schönland & Baker f.) Toelken	–	Albany Thicket	insect
112	*C. aurusbergensis* G.Will.	–	Succulent Karoo	insect
113	*C. badspoortense* Van Jaarsv.	–	Succulent Karoo	insect
114	*C. brachystachya* Toelken	–	Succulent Karoo	insect
115	*C. capitella* Thunb. subsp. *thyrsiflora* (Thunb.) Toelken	–	Thicket	insect
116	*C . cremnophila* Van Jaarsv. & A.E.van Wyk	–	Albany Thicket	insect

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Seed dispersal	Conservation status LC = Least Concern NT = Not Threatened VU = Vulnerable	Light requirements BL = bright light DS = dappled shade FS = full sun
	Senecio L. (5 taxa)			
90	*S. medley-woodii* Hutch.	wind	LC	FS, BL, DS
91	*S. muirii* L.Bolus	wind	LC	FS, BL, DS
92	*S. pondoensis* Van Jaarsv. & A.E.van Wyk	wind	LC	FS, BL
93	*S. serpens* G.D.Rowley	wind	LC	FS
94	*S. talinoides* Sch.Bip. subsp. *talinoides*	wind	LC	FS
	CACTACEAE (1 taxon)			
	Rhipsalis Gaertn. (1 taxon)			
95	*R. baccifera* (J.Mill.) Stearn subsp. *mauritiana* (D.C.) Barthlott	bird	LC	FS, BL, DS
	CRASSULACEAE (4 genera, 66 taxa)			
	Adromischus Lem. (10 taxa, 8 species)			
96	*A. cristatus* (Haw.) Lem. var. *mzimvubuensis* Van Jaarsv.	wind	LC	FS, BL
97	*A. cristatus* (Haw.) Lem. var. *schonlandii* (E.Phillips) Toelken	wind	LC	FS, BL
98	*A. cristatus* (Haw.) Lem. var. *zeyheri* (Harv.) Toelken	wind	LC	FS, BL
99	*A. diabolicus* Toelken	wind	LC	FS, BL
100	*A. fallax* Toelken	wind	LC	FS, BL
101	*A. leucophyllus* Uitewaal	wind	LC	FS, BL
102	*A. liebenbergii* Hutchison subsp. *orientalis* Van Jaarsv.	wind	LC	FS, BL
103	*A. schuldtianus* (Poelln.) Poelln. subsp. *brandbergensis* B.Nord. & Van Jaarsv.	wind	LC	FS, BL
104	*A. subdistichus* Makin ex Bruyns	wind	LC	FS, BL
105	*A. umbraticola* C.A.Sm. subsp. *ramosus* Toelken	wind	LC	FS, BL
	Cotyledon L. (4 taxa)			
106	*C. barbeyi* Schweinf. var. A	wind	LC	FS, BL
107	*C. eliseae* Van Jaarsv.	wind	LC	FS, BL
108	*C. pendens* Van Jaarsv.	wind	LC	FS, BL
109	*C. tomentosa* Harv. subsp. *tomentosa*	wind	LC	FS, BL
	Crassula L. (38 taxa)			
110	*C. alba* Forssk. var. *pallida* Toelken	wind	LC	FS, BL
111	*C. atropurpurea* (Harv.) D.Dietr. var. *anomala* (Schönland & Baker f.) Toelken	wind	LC	FS, BL
112	*C. aurusbergensis* G.Will.	wind	LC	FS, BL
113	*C. badspoortense* Van Jaarsv.	wind	LC	FS, BL
114	*C. brachystachya* Toelken	wind	LC	FS, BL
115	*C. capitella* Thunb. subsp. *thyrsiflora* (Thunb.) Toelken	wind	LC	FS, BL
116	*C . cremnophila* Van Jaarsv. & A.E.van Wyk	wind	LC	BL, DS

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Rich flowering *** = rich ** = exposed * = insignificant	Reduction in armament *** = margin without teeth ** = margin with smaller teeth * = no significant change, same as other non-cremnophytes	Cliff habitat C = coastal R = river E = escarpment M = mountain I = inselberg
	Senecio L. (5 taxa)			
90	*S. medley-woodii* Hutch.	***	*	R
91	*S. muirii* L.Bolus	*	*	R
92	*S. pondoensis* Van Jaarsv. & A.E.van Wyk	*	*	R
93	*S. serpens* G.D.Rowley	*	*	M
94	*S. talinoides* Sch.Bip. subsp. *talinoides*	*	*	R
	CACTACEAE (1 taxon)			
	Rhipsalis Gaertn. (1 taxon)			
95	*R. baccifera* (J.Mill.) Stearn subsp. *mauritiana* (D.C.) Barthlott	*	*	R
	CRASSULACEAE (4 genera, 66 taxa)			
	Adromischus Lem. (10 taxa, 8 species)			
96	*A. cristatus* (Haw.) Lem. var. *mzimvubuensis* Van Jaarsv.	*	*	R
97	*A. cristatus* (Haw.) Lem. var. *schonlandii* (E.Phillips) Toelken	*	*	R
98	*A. cristatus* (Haw.) Lem. var. *zeyheri* (Harv.) Toelken	*	*	R
99	*A. diabolicus* Toelken	*	*	R, M
100	*A. fallax* Toelken	*	*	E
101	*A. leucophyllus* Uitewaal	*	*	R, M
102	*A. liebenbergii* Hutchison subsp. *orientalis* Van Jaarsv.	*	*	R
103	*A. schuldtianus* (Poelln.) Poelln. subsp. *brandbergensis* B.Nord. & Van Jaarsv.	*	*	I
104	*A. subdistichus* Makin ex Bruyns	*	*	M, R
105	*A. umbraticola* C.A.Sm. subsp. *ramosus* Toelken	*	*	R, M
	Cotyledon L. (4 taxa)			
106	*C. barbeyi* Schweinf. var. A	**	*	R, M
107	*C. eliseae* Van Jaarsv.	***	*	R
108	*C. pendens* Van Jaarsv.	**	*	R
109	*C. tomentosa* Harv. subsp. *tomentosa*	***	*	R
	Crassula L. (38 taxa)			
110	*C. alba* Forssk. var. *pallida* Toelken	**	*	E
111	*C. atropurpurea* (Harv.) D.Dietr. var. *anomala* (Schönland & Baker f.) Toelken	**	*	M
112	*C. aurusbergensis* G.Will.	**	*	I
113	*C. badspoortense* Van Jaarsv.	**	*	R, M
114	*C. brachystachya* Toelken	**	*	M
115	*C. capitella* Thunb. subsp. *thyrsiflora* (Thunb.) Toelken	**	*	R
116	*C . cremnophila* Van Jaarsv. & A.E.van Wyk	***	*	R, M

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Occurrence W = widespread We = widespread but endemic to its vegetation region R = restricted	Endemism * = endemic Bots = Botswana Les = Lesotho Moz = Mozambique Nam = Namibia RSA = South Africa Swaz = Swaziland	Windows Lm = on leaf margin Mw = micro-windows O = other
	Senecio L. (5 taxa)			
90	*S. medley-woodii* Hutch.	We	RSA*	
91	*S. muirii* L.Bolus	We	RSA*	O
92	*S. pondoensis* Van Jaarsv. & A.E.van Wyk	R	RSA*	O
93	*S. serpens* G.D.Rowley	We	RSA*	O
94	*S. talinoides* Sch.Bip. subsp. *talinoides*	We	RSA*	O
	CACTACEAE (1 taxon)			
	Rhipsalis Gaertn. (1 taxon)			
95	*R. baccifera* (J.Mill.) Stearn subsp. *mauritiana* (D.C.) Barthlott	W	RSA	
	CRASSULACEAE (4 genera, 66 taxa)			
	Adromischus Lem. (10 taxa, 8 species)			
96	*A. cristatus* (Haw.) Lem. var. *mzimvubuensis* Van Jaarsv.	We	RSA*	
97	*A. cristatus* (Haw.) Lem. var. *schonlandii* (E.Phillips) Toelken	We	RSA*	
98	*A. cristatus* (Haw.) Lem. var. *zeyheri* (Harv.) Toelken	W	RSA*	
99	*A. diabolicus* Toelken	We	RSA*	
100	*A. fallax* Toelken	We	RSA*	
101	*A. leucophyllus* Uitewaal	We	RSA*	
102	*A. liebenbergii* Hutchison subsp. *orientalis* Van Jaarsv.	We	RSA*	
103	*A. schuldtianus* (Poelln.) Poelln. subsp. *brandbergensis* B.Nord. & Van Jaarsv.	R	Nam*	O
104	*A. subdistichus* Makin ex Bruyns	We	RSA*	
105	*A. umbraticola* C.A.Sm. subsp. *ramosus* Toelken	W	RSA*	
	Cotyledon L. (4 taxa)			
106	*C. barbeyi* Schweinf. var. A	R	RSA*	
107	*C. eliseae* Van Jaarsv.	R	RSA*	
108	*C. pendens* Van Jaarsv.	We	RSA*	
109	*C. tomentosa* Harv. subsp. *tomentosa*	We	RSA*	
	Crassula L. (38 taxa)			
110	*C. alba* Forssk. var. *pallida* Toelken	We	RSA, Swaz	
111	*C. atropurpurea* (Harv.) D.Dietr. var. *anomala* (Schönland & Baker f.) Toelken	We	RSA*	
112	*C. aurusbergensis* G.Will.	R	Nam*	
113	*C. badspoortense* Van Jaarsv.	We	RSA*	
114	*C. brachystachya* Toelken	We	RSA*	
115	*C. capitella* Thunb. subsp. *thyrsiflora* (Thunb.) Toelken	We	RSA*	
116	*C . cremnophila* Van Jaarsv. & A.E.van Wyk	R	RSA*	

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Cremnophilous growth form See 9.1.2 for explanation of the symbols below	Degree of cliff occupation *** = strictly obligate cremnophyte, displaying cliff-adapted features ** = obligate cremnophyte * = predominantly on cliffs (80%)	Weight class light = < 50 g medium = 51–500 g heavy = >500 g
117	*Crassula cymbiformis* Toelken	A:S:Lper:R:C:La (vb)	***	light
118	*C. exilis* Harv. subsp. *cooperi* (Regel) Toelken	A:S:Lper:R:C:La (vb)	**	light
119	*C. exilis* Harv. subsp. *exilis*	A:S:Lper:R:C:La (vb)	**	light
120	*C. exilis* Harv. subsp. *sedifolia* (N.E.Br.) Toelken	A:S:Lper:R:C:La (vb)	**	light
121	*C. expansa* Dryand. subsp. *fragilis* (Baker) Toelken	E:F:P:Els: (vb)	*	light
122	*C. foveata* Van Jaarsv.	A:S:Lper:R:C:La (vb)	*	light
123	*C. intermedia* Schönland	A:S:Lper:R:C:La (vb)	**	light
124	*C. lanuginosa* Harv. var. *lanuginosa*	E:F:P:Els: (vb)	**	light
125	*C. montana* Thunb. subsp. *montana*	A:S:Lper:R:C:La (vb)	***	light
126	*C. montana* Thunb. subsp. *quadrangularis* (Schönland) Toelken	A:S:Lper:R:C:La (vb)	***	light
127	*C. nemorosa* (Eckl. & Zeyh.) Endl. ex Walp.	A:S:Lar:D (vb)	*	light
128	*C. orbicularis* L.	A:S:Lper:R:C:La (vb)	*	light
129	*C. peculiaris* (Toelken) Toelken & Wickens	E:F:P:Els: (vb)	**	light
130	*C. pellucida* L. subsp. *spongiosa* Toelken	E:F:P:Els: (vb)	***	light
131	*C. perforata* Thunb. subsp. *kougaensis* Van Jaarsv. & A.E.van Wyk	E:F:P:Els: (vb) (eg)	***	light
132	*C. perforata* Thunb. subsp. *perforata*	E:F:P:Els: (vb)	*	light-medium
133	*C. pseudohemisphaerica* Friedrich	A:S:Lper:R:C:La (vb)	**	light
134	*C. pubescens* Thunb. subsp. *rattrayi* (Schönland & Baker f.) Toelken	A:S:Lper:Lc:Ts (vb)	**	light
135	*C. rupestris* Thunb. subsp. *marnieriana* (H.E.Huber & H.Jacobsen) Toelken	E:F:P:Els: (vb)	***	light-medium
136	*C. rupestris* Thunb. subsp. *rupestris*	E:F:P:Els: (vb)	**	light-medium
137	*C. sediflora* (Eckl. & Zeyh.) Endl. & Walp var. *sediflora*	E:F:P:Els: (vb)	**	light
138	*C. sericea* Schönland var. *sericea*	A:S:Lper:Lc:Ts (vb)	**	light
139	*C. setulosa* Harv. var. *jenkinsii* Schönland	A:S:Lper:R:C:La: (vb)	*	light
140	*C. setulosa* Harv. var. *longiciliata* Toelken	A:S:Lper:R:C:La (vb)	**	light
141	*C. setulosa* Harv. var. *setulosa*	A:S:Lper:R:C:La: (vb)	*	light
142	*C. sladenii* Schönland	E:F:P:Els: (vb) (e)	***	medium
143	*C. smithii* Van Jaarsv., D.G.A.Styles & G.McDonald	A:S:Lper:R:C:La (vb)	*	light-medium
144	*C. socialis* Schönland	A:S:Lper:R:C:La (vb)	**	light
145	*C. streyi* Toelken	E:F:As:S/H:Es (vb)	*	medium
146	*C. tabularis* Dinter	A:S:Lper:R:C:La (vb)	*	light
147	*C. tomentosa* Thunb. var. *glabrifolia* (Harv.) Toelken	A:S:Lper:R:C:La (vb) (r)	**	light

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Vegetative dispersal backup	Geology	Aspect
117	*Crassula cymbiformis* Toelken	proliferating clusters and leaf stolons	sandstone, quartz	S
118	*C. exilis* Harv. subsp. *cooperi* (Regel) Toelken	proliferating clusters and leaf stolons	shale	S
119	*C. exilis* Harv. subsp. *exilis*	proliferating clusters and leaf stolons	quartz	S
120	*C. exilis* Harv. subsp. *sedifolia* (N.E.Br.) Toelken	proliferating clusters and leaf stolons	quartz	S
121	*C. expansa* Dryand. subsp. *fragilis* (Baker) Toelken	proliferating clusters and leaf stolons	sandstone	S
122	*C. foveata* Van Jaarsv.	proliferating clusters and leaf stolons	shale	N, E, S, W
123	*C. intermedia* Schönland	proliferating clusters and leaf stolons	sandstone	S
124	*C. lanuginosa* Harv. var. *lanuginosa*	proliferating clusters and leaf stolons	shale	S
125	*C. montana* Thunb. subsp. *montana*	proliferating clusters and leaf stolons	sandstone	S
126	*C. montana* Thunb. subsp. *quadrangularis* (Schönland) Toelken	proliferating clusters and leaf stolons	sandstone	S
127	*C. nemorosa* (Eckl. & Zeyh.) Endl. ex Walp.	proliferating clusters and leaf stolons	shale, sandstone	S
128	*C. orbicularis* L.	proliferating clusters and leaf stolons	shale, sandstone	S
129	*C. peculiaris* (Toelken) Toelken & Wickens	proliferating clusters and leaf stolons	sandstone	S
130	*C. pellucida* L. subsp. *spongiosa* Toelken	active growth and rooting	sandstone	S
131	*C. perforata* Thunb. subsp. *kougaensis* Van Jaarsv. & A.E.van Wyk	active growth and rooting	sandstone, shale	S, E, W, N
132	*C. perforata* Thunb. subsp. *perforata*	active growth and rooting	sandstone	S, E, W, N
133	*C. pseudohemisphaerica* Friedrich	proliferating clusters and leaf stolons	sandstone, shale	S
134	*C. pubescens* Thunb. subsp. *rattrayi* (Schönland & Baker f.) Toelken	proliferating clusters and leaf stolons	shale	S
135	*C. rupestris* Thunb. subsp. *marnieriana* (H.E.Huber & H.Jacobsen) Toelken	active growth and rooting	sandstone	S, E, N, W
136	*C. rupestris* Thunb. subsp. *rupestris*	active growth and rooting	shale, sandstone	N, E
137	*C. sediflora* (Eckl. & Zeyh.) Endl. & Walp var. *sediflora*	active growth and rooting	sandstone	S, E
138	*C. sericea* Schönland var. *sericea*	active growth and rooting	quartz	S, E
139	*C. setulosa* Harv. var. *jenkinsii* Schönland	proliferating clusters and inflorescence propagules	quartz	N, W, E
140	*C. setulosa* Harv. var. *longiciliata* Toelken	proliferating clusters and inflorescence propagules	sandstone	N, W, E
141	*C. setulosa* Harv. var. *setulosa*	proliferating clusters and inflorescence propagules	sandstone, basalt	N, W, E
142	*C. sladenii* Schönland	active growth and rooting	dolomite, sandstone	S, E
143	*C. smithii* Van Jaarsv., D.G.A.Styles & G.McDonald	dividing or proliferating clusters	sandstone	S
144	*C. socialis* Schönland	proliferating clusters and leaf stolons	shale	S
145	*C. streyi* Toelken	dividing or proliferating clusters	sandstone	S, E, W
146	*C. tabularis* Dinter	proliferating clusters and leaf stolons	sandstone, mudstone	S
147	*C. tomentosa* Thunb. var. *glabrifolia* (Harv.) Toelken	proliferating clusters and leaf stolons	sandstone	S

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Altitude (m)	Rainfall (mm per annum)	Rainfall seasonality S = summer W = winter W/S = any time of year	Deciduousness E = evergreen SA = summer-aestivating SD = summer-deciduous WD = winter-deciduous
117	*Crassula cymbiformis* Toelken	1000–1750	700–800	S	E
118	*C. exilis* Harv. subsp. *cooperi* (Regel) Toelken	900–1500	500–1000	S	E
119	*C. exilis* Harv. subsp. *exilis*	900–1100	100–200	W	E
120	*C. exilis* Harv. subsp. *sedifolia* (N.E.Br.) Toelken	500–900	200–300	SW	E
121	*C. expansa* Dryand. subsp. *fragilis* (Baker) Toelken	50–1800	450–1000	S	E
122	*C. foveata* Van Jaarsv.	300–800	800–1000	S	E
123	*C. intermedia* Schönland	50–500	400–1000	S	E
124	*C. lanuginosa* Harv. var. *lanuginosa*	1000–3000	200–450	S	E
125	*C. montana* Thunb. subsp. *montana*	200–2000	200–300	W/S	E
126	*C. montana* Thunb. subsp. *quadrangularis* (Schönland) Toelken	1000–1400	200–300	W/S	E
127	*C. nemorosa* (Eckl. & Zeyh.) Endl. ex Walp.	200–1800	200–450	W	SD
128	*C. orbicularis* L.	50–1800	400–1000	W/S	E
129	*C. peculiaris* (Toelken) Toelken & Wickens	1200–1800	800–2000	W/S	E
130	*C. pellucida* L. subsp. *spongiosa* Toelken	800–1600	800–2000	W	E
131	*C. perforata* Thunb. subsp. *kougaensis* Van Jaarsv. & A.E.van Wyk	300–800	400–800	W/S	E
132	*C. perforata* Thunb. subsp. *perforata*	300–800	400–800	W/S	E
133	*C. pseudohemisphaerica* Friedrich	50–900	100–300	W	E
134	*C. pubescens* Thunb. subsp. *rattrayi* (Schönland & Baker f.) Toelken	800–1500	300–400	W/S	E
135	*C. rupestris* Thunb. subsp. *marnieriana* (H.E.Huber & H.Jacobsen) Toelken	800–2000	250–350	W/S	E
136	*C. rupestris* Thunb. subsp. *rupestris*	400–700	400–1000	W/S	E
137	*C. sediflora* (Eckl. & Zeyh.) Endl. & Walp var. *sediflora*	350–950	700–1000	S	E
138	*C. sericea* Schönland var. *sericea*	100–1000	75–250	S	E
139	*C. setulosa* Harv. var. *jenkinsii* Schönland	1000–1800	500–1000	S	E
140	*C. setulosa* Harv. var. *longiciliata* Toelken	1000–3000	1000–1500	S	E
141	*C. setulosa* Harv. var. *setulosa*	200–3000	800–2000	S	E
142	*C. sladenii* Schönland	500–1100	75–200	W	E
143	*C. smithii* Van Jaarsv., D.G.A.Styles & G.McDonald	800–1300	700–800	S	E
144	*C. socialis* Schönland	800–1200	300–400	W/S	E
145	*C. streyi* Toelken	50–250	800–1000	S	E
146	*C. tabularis* Dinter	1200–2000	300–400	S	E
147	*C. tomentosa* Thunb. var. *glabrifolia* (Harv.) Toelken	400–1700	75–300	W	E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Fog *** = regular fog ** = occasional fog * = little fog – = no fog	Biomes IOCB = Indian Ocean Coastal Belt	Pollination
117	*Crassula cymbiformis* Toelken	*	Grassland	insect
118	*C. exilis* Harv. subsp. *cooperi* (Regel) Toelken	*	Grassland	insect
119	*C. exilis* Harv. subsp. *exilis*	*	Succulent Karoo	insect
120	*C. exilis* Harv. subsp. *sedifolia* (N.E.Br.) Toelken	*	Desert	insect
121	*C. expansa* Dryand. subsp. *fragilis* (Baker) Toelken	–	Savanna	insect
122	*C. foveata* Van Jaarsv.	–	Savanna	insect
123	*C. intermedia* Schönland	–	Albany Thicket	insect
124	*C. lanuginosa* Harv. var. *lanuginosa*	–	Grassland	insect
125	*C. montana* Thunb. subsp. *montana*	–	Fynbos	insect
126	*C. montana* Thunb. subsp. *quadrangularis* (Schönland) Toelken	*	Albany Thicket	insect
127	*C. nemorosa* (Eckl. & Zeyh.) Endl. ex Walp.	*	Albany Thicket	insect
128	*C. orbicularis* L.	–	Albany Thicket	insect
129	*C. peculiaris* (Toelken) Toelken & Wickens	**	Fynbos	insect
130	*C. pellucida* L. subsp. *spongiosa* Toelken	**	Fynbos	insect
131	*C. perforata* Thunb. subsp. *kougaensis* Van Jaarsv. & A.E.van Wyk	–	Savanna	insect
132	*C. perforata* Thunb. subsp. *perforata*	*	Albany Thicket	insect
133	*C. pseudohemisphaerica* Friedrich	**	Succulent Karoo	insect
134	*C. pubescens* Thunb. subsp. *rattrayi* (Schönland & Baker f.) Toelken	*	Albany Thicket	insect
135	*C. rupestris* Thunb. subsp. *marnieriana* (H.E.Huber & H.Jacobsen) Toelken	–	Albany Thicket	insect
136	*C. rupestris* Thunb. subsp. *rupestris*	–	Fynbos	insect
137	*C. sediflora* (Eckl. & Zeyh.) Endl. & Walp var. *sediflora*	*	Grassland	insect
138	*C. sericea* Schönland var. *sericea*	**	Succulent Karoo	insect
139	*C. setulosa* Harv. var. *jenkinsii* Schönland	*	Grassland	insect
140	*C. setulosa* Harv. var. *longiciliata* Toelken	**	Grassland	insect
141	*C. setulosa* Harv. var. *setulosa*	**	Grassland	insect
142	*C. sladenii* Schönland	***	Succulent Karoo	insect
143	*C. smithii* Van Jaarsv., D.G.A.Styles & G.McDonald	*	Grassland	insect
144	*C. socialis* Schönland	–	Albany Thicket	insect
145	*C. streyi* Toelken	–	IOCB	insect
146	*C. tabularis* Dinter	–	Nama-Karoo	insect
147	*C. tomentosa* Thunb. var. *glabrifolia* (Harv.) Toelken	*	Fynbos	insect

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Seed dispersal	Conservation status LC = Least Concern NT = Not Threatened VU = Vulnerable	Light requirements BL = bright light DS = dappled shade FS = full sun
117	*Crassula cymbiformis* Toelken	wind	LC	FS, BL
118	*C. exilis* Harv. subsp. *cooperi* (Regel) Toelken	wind	LC	BL, DS
119	*C. exilis* Harv. subsp. *exilis*	wind	LC	BL, DS
120	*C. exilis* Harv. subsp. *sedifolia* (N.E.Br.) Toelken	wind	LC	BL, DS
121	*C. expansa* Dryand. subsp. *fragilis* (Baker) Toelken	wind	LC	BL, DS
122	*C. foveata* Van Jaarsv.	wind	LC	FS, BL, DS
123	*C. intermedia* Schönland	wind	LC	BL, DS
124	*C. lanuginosa* Harv. var. *lanuginosa*	wind	LC	FS, BL, DS
125	*C. montana* Thunb. subsp. *montana*	wind	LC	BL, DS
126	*C. montana* Thunb. subsp. *quadrangularis* (Schönland) Toelken	wind	LC	BL, DS
127	*C. nemorosa* (Eckl. & Zeyh.) Endl. ex Walp.	wind	LC	BL, DS
128	*C. orbicularis* L.	wind	LC	BL, DS
129	*C. peculiaris* (Toelken) Toelken & Wickens	wind	LC	BL, DS
130	*C. pellucida* L. subsp. *spongiosa* Toelken	wind	LC	BL, DS
131	*C. perforata* Thunb. subsp. *kougaensis* Van Jaarsv. & A.E.van Wyk	wind	LC	FS, BL
132	*C. perforata* Thunb. subsp. *perforata*	wind	LC	FS, DS, BL
133	*C. pseudohemisphaerica* Friedrich	wind	LC	BL, DS
134	*C. pubescens* Thunb. subsp. *rattrayi* (Schönland & Baker f.) Toelken	wind	LC	FS, BL
135	*C. rupestris* Thunb. subsp. *marnieriana* (H.E.Huber & H.Jacobsen) Toelken	wind	LC	FS, BL
136	*C. rupestris* Thunb. subsp. *rupestris*	wind	LC	FS, BL
137	*C. sediflora* (Eckl. & Zeyh.) Endl. & Walp var. *sediflora*	wind	LC	FS, BL
138	*C. sericea* Schönland var. *sericea*	wind	LC	FS, BL
139	*C. setulosa* Harv. var. *jenkinsii* Schönland	wind	LC	FS, BL
140	*C. setulosa* Harv. var. *longiciliata* Toelken	wind	LC	FS, BL
141	*C. setulosa* Harv. var. *setulosa*	wind	LC	FS, BL
142	*C. sladenii* Schönland	wind	LC	FS, BL
143	*C. smithii* Van Jaarsv., D.G.A.Styles & G.McDonald	wind	LC	FS, BL
144	*C. socialis* Schönland	wind	LC	FS, BL
145	*C. streyi* Toelken	wind	LC	BL, DS
146	*C. tabularis* Dinter	wind	LC	FS, BL
147	*C. tomentosa* Thunb. var. *glabrifolia* (Harv.) Toelken	wind	LC	BL, DS

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Rich flowering *** = rich ** = exposed * = insignificant	Reduction in armament *** = margin without teeth ** = margin with smaller teeth * = no significant change, same as other non-cremnophytes	Cliff habitat C = coastal R = river E = escarpment M = mountain I = inselberg
117	*Crassula cymbiformis* Toelken	**	*	M
118	*C. exilis* Harv. subsp. *cooperi* (Regel) Toelken	**	*	M
119	*C. exilis* Harv. subsp. *exilis*	**	*	M
120	*C. exilis* Harv. subsp. *sedifolia* (N.E.Br.) Toelken	**	*	M
121	*C. expansa* Dryand. subsp. *fragilis* (Baker) Toelken	**	*	R
122	*C. foveata* Van Jaarsv.	**	*	R
123	*C. intermedia* Schönland	**	*	R, M
124	*C. lanuginosa* Harv. var. *lanuginosa*	**	*	E
125	*C. montana* Thunb. subsp. *montana*	**	*	M, R
126	*C. montana* Thunb. subsp. *quadrangularis* (Schönland) Toelken	**	*	R
127	*C. nemorosa* (Eckl. & Zeyh.) Endl. ex Walp.	**	*	M, R
128	*C. orbicularis* L.	**	*	M, R
129	*C. peculiaris* (Toelken) Toelken & Wickens	**	*	M
130	*C. pellucida* L. subsp. *spongiosa* Toelken	**	*	M
131	*C. perforata* Thunb. subsp. *kougaensis* Van Jaarsv. & A.E.van Wyk	**	*	R, M
132	*C. perforata* Thunb. subsp. *perforata*	*	*	R
133	*C. pseudohemisphaerica* Friedrich	**	*	M, R
134	*C. pubescens* Thunb. subsp. *rattrayi* (Schönland & Baker f.) Toelken	**	*	E
135	*C. rupestris* Thunb. subsp. *marnieriana* (H.E.Huber & H.Jacobsen) Toelken	**	*	R, M
136	*C. rupestris* Thunb. subsp. *rupestris*	**	*	M, R
137	*C. sediflora* (Eckl. & Zeyh.) Endl. & Walp var. *sediflora*	**	*	M, R
138	*C. sericea* Schönland var. *sericea*	**	*	R
139	*C. setulosa* Harv. var. *jenkinsii* Schönland	**	*	E, M
140	*C. setulosa* Harv. var. *longiciliata* Toelken	**	*	E
141	*C. setulosa* Harv. var. *setulosa*	**	*	E, M
142	*C. sladenii* Schönland	**	*	M, R
143	*C. smithii* Van Jaarsv., D.G.A.Styles & G.McDonald	**	*	M
144	*C. socialis* Schönland	**	*	R
145	*C. streyi* Toelken	**	*	R
146	*C. tabularis* Dinter	**	*	M
147	*C. tomentosa* Thunb. var. *glabrifolia* (Harv.) Toelken	***	*	M, R

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Occurrence W = widespread We = widespread but endemic to its vegetation region R = restricted	Endemism * = endemic Bots = Botswana Les = Lesotho Moz = Mozambique Nam = Namibia RSA = South Africa Swaz = Swaziland	Windows Lm = on leaf margin Mw = micro-windows O = other
117	*Crassula cymbiformis* Toelken	R	RSA*	
118	*C. exilis* Harv. subsp. *cooperi* (Regel) Toelken	We	RSA*	
119	*C. exilis* Harv. subsp. *exilis*	We	RSA*	
120	*C. exilis* Harv. subsp. *sedifolia* (N.E.Br.) Toelken	We	RSA, Nam	
121	*C. expansa* Dryand. subsp. *fragilis* (Baker) Toelken	W	RSA, Swaz, Moz	
122	*C. foveata* Van Jaarsv.	We	RSA*	
123	*C. intermedia* Schönland	W	RSA*	
124	*C. lanuginosa* Harv. var. *lanuginosa*	We	RSA, Les	
125	*C. montana* Thunb. subsp. *montana*	W	RSA*	
126	*C. montana* Thunb. subsp. *quadrangularis* (Schönland) Toelken	We	RSA*	
127	*C. nemorosa* (Eckl. & Zeyh.) Endl. ex Walp.	W	RSA, Nam	
128	*C. orbicularis* L.	W	RSA*	
129	*C. peculiaris* (Toelken) Toelken & Wickens	R	RSA*	
130	*C. pellucida* L. subsp. *spongiosa* Toelken	We	RSA*	
131	*C. perforata* Thunb. subsp. *kougaensis* Van Jaarsv. & A.E.van Wyk	We	RSA*	
132	*C. perforata* Thunb. subsp. *perforata*	We	RSA*	
133	*C. pseudohemisphaerica* Friedrich	We	RSA, Nam	
134	*C. pubescens* Thunb. subsp. *rattrayi* (Schönland & Baker f.) Toelken	We	RSA*	
135	*C. rupestris* Thunb. subsp. *marnieriana* (H.E.Huber & H.Jacobsen) Toelken	We	RSA*	
136	*C. rupestris* Thunb. subsp. *rupestris*	W	RSA*	
137	*C. sediflora* (Eckl. & Zeyh.) Endl. & Walp var. *sediflora*	We	RSA*	
138	*C. sericea* Schönland var. *sericea*	We	RSA*	
139	*C. setulosa* Harv. var. *jenkinsii* Schönland	W	RSA*	
140	*C. setulosa* Harv. var. *longiciliata* Toelken	W	RSA*	
141	*C. setulosa* Harv. var. *setulosa*	W	RSA, Les, Swaz	
142	*C. sladenii* Schönland	We	RSA, Nam	
143	*C. smithii* Van Jaarsv., D.G.A.Styles & G.McDonald	R	RSA*	
144	*C. socialis* Schönland	We	RSA*	
145	*C. streyi* Toelken	We	RSA*	
146	*C. tabularis* Dinter	We	RSA, Nam	
147	*C. tomentosa* Thunb. var. *glabrifolia* (Harv.) Toelken	We	RSA*	

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Cremnophilous growth form See 9.1.2 for explanation of the symbols below	Degree of cliff occupation *** = strictly obligate cremnophyte, displaying cliff-adapted features ** = obligate cremnophyte * = predominantly on cliffs (80%)	Weight class light = < 50 g medium = 51–500 g heavy = >500 g
	Tylecodon Toelken (14 taxa)			
148	*T. aurusbergensis* G.Will. & Van Jaarsv.	E:F:As:S/H:Ca:D (vb)	**	light
149	*T. bleckiae* G.Will.	E:F:As:S/H:Ca:D (vb)	**	light-medium
150	*T. bodleyae* Van Jaarsv.	E:F:As:S/H:Ca:D (vb)	**	light-medium
151	*T. bruynsii* Van Jaarsv. & S.A.Hammer	E:F:As:S/H:Ca:D (vb)	***	light-medium
152	*T. buchholzianus* (Schuldt. & P.Stephan) Toelken var. *fasciculatus* G.Will.	E:F:As:S/H:Ca:D (vb)	**	light-medium
153	*T. cordiformis* G.Will.	E:F:As:S/H:Ca:D (vb) (ft)	**	light
154	*T. decipiens* Toelken	A:S:Lar:D (vb)	**	light-medium
155	*T. ellaphieae* Van Jaarsv.	A:S:Lar:D (vb) (ft)	***	light-medium
156	*T. longipes* Van Jaarsv. & G.Will.	A:S:Lar:D (vb)	***	light-medium
157	*T. petrophilus* Van Jaarsv. & A.E.van Wyk	A:S:Lar:D (vb)	***	medium
158	*T. singularis* (R.A.Dyer) Toelken	A:S:Lar:D (ft)	*	light
159	*T. sulphureus* (Toelken) Toelken var. *armianus* Van Jaarsv.	E:F:As:S/H:Ca:D (vb)	**	light
160	*T. torulosus* Toelken	E:F:As:S/H:Ca:D (vb)	***	light-medium
161	*T. viridiflorus* (Toelken) Toelken	E:F:As:S/H:Ca:D (vb)	**	light-medium
	GERANIACEAE (2 species)			
	Pelargonium L'Her. (2 species)			
162	*P. mutans* Vorster	E:F:As:S/H:Es (vb)	**	medium
163	*P. vanderwaltii* Van Jaarsv.	E:F:As:S/H:Es (vb)	**	medium
	GESNERIACEAE (1 species)			
	Streptocarpus Lindl. (1 species)			
164	*S. kentaniensis* L.L.Britten & Story	A:S:Lper:Lc:Ts (vb)	***	medium
	LAMIACEAE (3 genera, 9 taxa)			
	Aeollanthus Mart. ex Spreng. (2 species)			
165	*A. haumannii* Van Jaarsv.	E:F:As:S/H:Es (vb)	*	light-medium
166	*A. rydingianus* Van Jaarsv. & A.E.van Wyk	E:F:AS:S/H:Es (vb)	*	medium
	Plectranthus L'Her. (6 taxa)			
167	*P. dolomiticus* Codd	E:F:P:Els (vb)	*	light-medium
168	*P. ernstii* Codd	E:F:As:S/H:Ca:Ev (vb)	***	light-medium
169	*P. mutabilis* Codd	E:F:P:Els (vb)	**	light-medium
170	*P. mzimvubuensis* Van Jaarsv.	E:F:As:S/H:Es (vb)	**	medium-heavy
171	*P. purpuratus* Harv. subsp. *purpuratus*	E:F:As:S/H:Es (vb)	**	light
172	*P. saccatus* Benth. subsp. *pondoensis* Van Jaarsv. & Milstein	E:F:P:Els (vb)	**	medium-heavy
	Tetradenia Benth. (1 species)			
173	*T. kaokoensis* Van Jaarsv. & A.E.van Wyk	E:F:As:W:D	***	medium

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Vegetative dispersal backup	Geology	Aspect
	Tylecodon Toelken (14 taxa)			
148	*T. aurusbergensis* G.Will. & Van Jaarsv.	active growth and rooting	quartz	S
149	*T. bleckiae* G.Will.	active growth and rooting	sandstone	S
150	*T. bodleyae* Van Jaarsv.	active growth and rooting	quartz	S, E
151	*T. bruynsii* Van Jaarsv. & S.A.Hammer	active growth and rooting	quartz	S
152	*T. buchholzianus* (Schuldt. & P.Stephan) Toelken var. *fasciculatus* G.Will.	active growth and rooting	quartz	E, S
153	*T. cordiformis* G.Will.	active growth and rooting	quartz	E
154	*T. decipiens* Toelken	active growth and rooting	quartz	S
155	*T. ellaphieae* Van Jaarsv.	active growth and rooting	quartz	S
156	*T. longipes* Van Jaarsv. & G.Will.	active growth and rooting	quartz	S
157	*T. petrophilus* Van Jaarsv. & A.E.van Wyk	active growth and rooting	quartz	S
158	*T. singularis* (R.A.Dyer) Toelken	solitary	dolomite	S
159	*T. sulphureus* (Toelken) Toelken var. *armianus* Van Jaarsv.	active growth and rooting	quartz	S
160	*T. torulosus* Toelken	active growth and rooting	quartz	E
161	*T. viridiflorus* (Toelken) Toelken	active growth and rooting	quartz	S
	GERANIACEAE (2 species)			
	Pelargonium L'Her. (2 species)			
162	*P. mutans* Vorster	active growth and rooting	dolomite, sandstone	S, N
163	*P. vanderwaltii* Van Jaarsv.	active growth and rooting	granite	S
	GESNERIACEAE (1 species)			
	Streptocarpus Lindl. (1 species)			
164	*S. kentaniensis* L.L.Britten & Story	proliferating clusters and leaf stolons	shale	S
	LAMIACEAE (3 genera, 9 taxa)			
	Aeollanthus Mart. ex Spreng. (2 species)			
165	*A. haumannii* Van Jaarsv.	active growth and rooting	granite	S
166	*A. rydingianus* Van Jaarsv. & A.E.van Wyk	active growth and rooting	sandstone	S
	Plectranthus L'Her. (6 taxa)			
167	*P. dolomiticus* Codd	active growth and rooting	dolomite	S, E
168	*P. ernstii* Codd	active growth and rooting	sandstone	S
169	*P. mutabilis* Codd	active growth and rooting	sandstone, dolomite	S, E, W
170	*P. mzimvubuensis* Van Jaarsv.	active growth and rooting	shale	S
171	*P. purpuratus* Harv. subsp. *purpuratus*	active growth and rooting	sandstone	S
172	*P. saccatus* Benth. subsp. *pondoensis* Van Jaarsv. & Milstein	active growth and rooting	sandstone	S, E
	Tetradenia Benth. (1 species)			
173	*T. kaokoensis* Van Jaarsv. & A.E.van Wyk	solitary	dolomite, sandstone, granite	S, E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Altitude (m)	Rainfall (mm per annum)	Rainfall seasonality S = summer W = winter W/S = any time of year	Deciduousness E = evergreen SA = summer-aestivating SD = summer-deciduous WD = winter-deciduous
	Tylecodon Toelken (14 taxa)				
148	*T. aurusbergensis* G.Will. & Van Jaarsv.	900–1082	50–75	W	SD
149	*T. bleckiae* G.Will.	600–900	50–150	W	SD
150	*T. bodleyae* Van Jaarsv.	350–470	50	W	SD
151	*T. bruynsii* Van Jaarsv. & S.A.Hammer	700–900	50–125	W	SD
152	*T. buchholzianus* (Schuldt. & P.Stephan) Toelken var. *fasciculatus* G.Will.	50–700	25–50	W	SD
153	*T. cordiformis* G.Will.	400–600	50–75	W	SD
154	*T. decipiens* Toelken	300–480	50–75	W	SD
155	*T. ellaphieae* Van Jaarsv.	400–1200	50–150	W	SD
156	*T. longipes* Van Jaarsv. & G.Will.	400–800	50–75	W	SD
157	*T. petrophilus* Van Jaarsv. & A.E.van Wyk	400–500	100–250	W	SD
158	*T. singularis* (R.A.Dyer) Toelken	800–1100	50–75	W	SD
159	*T. sulphureus* (Toelken) Toelken var. *armianus* Van Jaarsv.	700–1100	50–100	W	SD
160	*T. torulosus* Toelken	300–500	50–75	W	SD
161	*T. viridiflorus* (Toelken) Toelken	600–900	50–100	W	SD
	GERANIACEAE (2 species)				
	Pelargonium L'Her. (2 species)				
162	*P. mutans* Vorster	400–1000	800–1000	S	E
163	*P. vanderwaltii* Van Jaarsv.	1800–1900	150–250	S	WD
	GESNERIACEAE (1 species)				
	Streptocarpus Lindl. (1 species)				
164	*S. kentaniensis* L.L.Britten & Story	100–200	1000–1250	S	E
	LAMIACEAE (3 genera, 9 taxa)				
	Aeollanthus Mart. ex Spreng. (2 species)				
165	*A. haumannii* Van Jaarsv.	1500–1900	150–250	S	E
166	*A. rydingianus* Van Jaarsv. & A.E.van Wyk	1600	250–300	S	E
	Plectranthus L'Her. (6 taxa)				
167	*P. dolomiticus* Codd	800–1000	500–500	S	E
168	*P. ernstii* Codd	200–350	1000–1250	S	E
169	*P. mutabilis* Codd	1000–2230	600–1250	S	E
170	*P. mzimvubuensis* Van Jaarsv.	300–800	1000–1250	S	E
171	*P. purpuratus* Harv. subsp. *purpuratus*	460–795	1000–1250	S	E
172	*P. saccatus* Benth. subsp. *pondoensis* Van Jaarsv. & Milstein	300–600	1000–1250	S	E
	Tetradenia Benth. (1 species)				
173	*T. kaokoensis* Van Jaarsv. & A.E.van Wyk	1600–2000	200–250	S	WD

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Fog *** = regular fog ** = occasional fog * = little fog – = no fog	Biomes IOCB = Indian Ocean Coastal Belt	Pollination
	Tylecodon Toelken (14 taxa)			
148	*T. aurusbergensis* G.Will. & Van Jaarsv.	***	Succulent Karoo	insect
149	*T. bleckiae* G.Will.	***	Succulent Karoo	insect
150	*T. bodleyae* Van Jaarsv.	***	Succulent Karoo	insect
151	*T. bruynsii* Van Jaarsv. & S.A.Hammer	***	Succulent Karoo	insect
152	*T. buchholzianus* (Schuldt. & P.Stephan) Toelken var. *fasciculatus* G.Will.	***	Succulent Karoo	insect
153	*T. cordiformis* G.Will.	***	Succulent Karoo	insect
154	*T. decipiens* Toelken	***	Succulent Karoo	insect
155	*T. ellaphieae* Van Jaarsv.	***	Succulent Karoo	insect
156	*T. longipes* Van Jaarsv. & G.Will.	***	Succulent Karoo	insect
157	*T. petrophilus* Van Jaarsv. & A.E.van Wyk	**	Succulent Karoo	insect
158	*T. singularis* (R.A.Dyer) Toelken	***	Succulent Karoo	insect
159	*T. sulphureus* (Toelken) Toelken var. *armianus* Van Jaarsv.	*	Desert	insect
160	*T. torulosus* Toelken	***	Succulent Karoo	insect
161	*T. viridiflorus* (Toelken) Toelken	***	Succulent Karoo	insect
	GERANIACEAE (2 species)			
	Pelargonium L'Her. (2 species)			
162	*P. mutans* Vorster	–	Savanna	insect
163	*P. vanderwaltii* Van Jaarsv.	–	Desert	insect
	GESNERIACEAE (1 species)			
	Streptocarpus Lindl. (1 species)			
164	*S. kentaniensis* L.L.Britten & Story	–	Savanna	insect
	LAMIACEAE (3 genera, 9 taxa)			
	Aeollanthus Mart. ex Spreng. (2 species)			
165	*A. haumannii* Van Jaarsv.	*	Desert	insect
166	*A. rydingianus* Van Jaarsv. & A.E.van Wyk	*	Savanna	insect
	Plectranthus L'Her. (6 taxa)			
167	*P. dolomiticus* Codd	–	Savanna	insect
168	*P. ernstii* Codd	*	IOCB	insect
169	*P. mutabilis* Codd	*	Savanna	insect
170	*P. mzimvubuensis* Van Jaarsv.	–	Savanna	insect
171	*P. purpuratus* Harv. subsp. *purpuratus*	*	IOCB	insect
172	*P. saccatus* Benth. subsp. *pondoensis* Van Jaarsv. & Milstein	–	IOCB	insect
	Tetradenia Benth. (1 species)			
173	*T. kaokoensis* Van Jaarsv. & A.E.van Wyk	*	Desert	insect

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Seed dispersal	Conservation status LC = Least Concern NT = Not Threatened VU = Vulnerable	Light requirements BL = bright light DS = dappled shade FS = full sun
	Tylecodon Toelken (14 taxa)			
148	*T. aurusbergensis* G.Will. & Van Jaarsv.	wind	LC	BL, DS
149	*T. bleckiae* G.Will.	wind	LC	BL, DS
150	*T. bodleyae* Van Jaarsv.	wind	LC	BL, DS
151	*T. bruynsii* Van Jaarsv. & S.A.Hammer	wind	LC	BL
152	*T. buchholzianus* (Schuldt. & P.Stephan) Toelken var. *fasciculatus* G.Will.	wind	LC	BL, DS
153	*T. cordiformis* G.Will.	wind	LC	BL, DS
154	*T. decipiens* Toelken	wind	LC	BL, DS
155	*T. ellaphieae* Van Jaarsv.	wind	LC	BL, DS
156	*T. longipes* Van Jaarsv. & G.Will.	wind	LC	BL, DS
157	*T. petrophilus* Van Jaarsv. & A.E.van Wyk	wind	LC	BL, DS
158	*T. singularis* (R.A.Dyer) Toelken	wind	LC	BL, DS
159	*T. sulphureus* (Toelken) Toelken var. *armianus* Van Jaarsv.	wind	LC	BL, DS
160	*T. torulosus* Toelken	wind	LC	BL, DS
161	*T. viridiflorus* (Toelken) Toelken	wind	LC	BL, DS
	GERANIACEAE (2 species)			
	Pelargonium L'Her. (2 species)			
162	*P. mutans* Vorster	wind	LC	FS, BL, DS
163	*P. vanderwaltii* Van Jaarsv.	wind	LC	FS, BL
	GESNERIACEAE (1 species)			
	Streptocarpus Lindl. (1 species)			
164	*S. kentaniensis* L.L.Britten & Story	wind	LC	BL, DS
	LAMIACEAE (3 genera, 9 taxa)			
	Aeollanthus Mart. ex Spreng. (2 species)			
165	*A. haumannii* Van Jaarsv.	autochory	LC	BL, DS
166	*A. rydingianus* Van Jaarsv. & A.E.van Wyk	autochory	LC	BL, DS
	Plectranthus L'Her. (6 taxa)			
167	*P. dolomiticus* Codd	autochory	LC	BL, DS
168	*P. ernstii* Codd	autochory	LC	BL, DS
169	*P. mutabilis* Codd	autochory	LC	BL, DS
170	*P. mzimvubuensis* Van Jaarsv.	autochory	LC	BL, DS
171	*P. purpuratus* Harv. subsp. *purpuratus*	autochory	LC	BL, DS
172	*P. saccatus* Benth. subsp. *pondoensis* Van Jaarsv. & Milstein	autochory	LC	BL, DS
	Tetradenia Benth. (1 species)			
173	*T. kaokoensis* Van Jaarsv. & A.E.van Wyk	wind	LC	FS, BL, DS

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Rich flowering *** = rich ** = exposed * = insignificant	Reduction in armament *** = margin without teeth ** = margin with smaller teeth * = no significant change, same as other non-cremnophytes	Cliff habitat C = coastal R = river E = escarpment M = mountain I = inselberg
	Tylecodon Toelken (14 taxa)			
148	*T. aurusbergensis* G.Will. & Van Jaarsv.	**	*	I
149	*T. bleckiae* G.Will.	**	*	M
150	*T. bodleyae* Van Jaarsv.	**	*	M
151	*T. bruynsii* Van Jaarsv. & S.A.Hammer	**	*	R
152	*T. buchholzianus* (Schuldt. & P.Stephan) Toelken var. *fasciculatus* G.Will.	**	*	M
153	*T. cordiformis* G.Will.	**	*	M
154	*T. decipiens* Toelken	**	*	R
155	*T. ellaphieae* Van Jaarsv.	***	*	M
156	*T. longipes* Van Jaarsv. & G.Will.	**	*	R
157	*T. petrophilus* Van Jaarsv. & A.E.van Wyk	**	*	R
158	*T. singularis* (R.A.Dyer) Toelken	**	*	M
159	*T. sulphureus* (Toelken) Toelken var. *armianus* Van Jaarsv.	**	*	R, I
160	*T. torulosus* Toelken	**	*	R, M
161	*T. viridiflorus* (Toelken) Toelken	**	*	M
	GERANIACEAE (2 species)			
	Pelargonium L'Her. (2 species)			
162	*P. mutans* Vorster	**	*	R, M
163	*P. vanderwaltii* Van Jaarsv.	**	*	I
	GESNERIACEAE (1 species)			
	Streptocarpus Lindl. (1 species)			
164	*S. kentaniensis* L.L.Britten & Story	**	*	R
	LAMIACEAE (3 genera, 9 taxa)			
	Aeollanthus Mart. ex Spreng. (2 species)			
165	*A. haumannii* Van Jaarsv.	**	*	I
166	*A. rydingianus* Van Jaarsv. & A.E.van Wyk	**	*	E
	Plectranthus L'Her. (6 taxa)			
167	*P. dolomiticus* Codd	**	*	R
168	*P. ernstii* Codd	**	*	R
169	*P. mutabilis* Codd	**	*	M, R
170	*P. mzimvubuensis* Van Jaarsv.	**	*	R
171	*P. purpuratus* Harv. subsp. *purpuratus*	**	*	M, R
172	*P. saccatus* Benth. subsp. *pondoensis* Van Jaarsv. & Milstein	**	*	R, M
	Tetradenia Benth. (1 species)			
173	*T. kaokoensis* Van Jaarsv. & A.E.van Wyk	***	*	E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Occurrence W = widespread We = widespread but endemic to its vegetation region R = restricted	Endemism * = endemic Bots = Botswana Les = Lesotho Moz = Mozambique Nam = Namibia RSA = South Africa Swaz = Swaziland	Windows Lm = on leaf margin Mw = micro-windows O = other
	Tylecodon Toelken (14 taxa)			
148	*T. aurusbergensis* G.Will. & Van Jaarsv.	R	Nam*	
149	*T. bleckiae* G.Will.	R	RSA, Nam	
150	*T. bodleyae* Van Jaarsv.	R	RSA*	
151	*T. bruynsii* Van Jaarsv. & S.A.Hammer	R	Nam*	
152	*T. buchholzianus* (Schuldt. & P.Stephan) Toelken var. *fasciculatus* G.Will.	R	RSA*	
153	*T. cordiformis* G.Will.	R	RSA*	
154	*T. decipiens* Toelken	R	RSA*	
155	*T. ellaphieae* Van Jaarsv.	R	RSA*	
156	*T. longipes* Van Jaarsv. & G.Will.	R	RSA*	
157	*T. petrophilus* Van Jaarsv. & A.E.van Wyk	R	RSA*	
158	*T. singularis* (R.A.Dyer) Toelken	We	Nam*	
159	*T. sulphureus* (Toelken) Toelken var. *armianus* Van Jaarsv.	We	RSA*	
160	*T. torulosus* Toelken	R	RSA*	
161	*T. viridiflorus* (Toelken) Toelken	We	RSA*	
	GERANIACEAE (2 species)			
	Pelargonium L'Her. (2 species)			
162	*P. mutans* Vorster	We	RSA*	
163	*P. vanderwaltii* Van Jaarsv.	R	Nam*	
	GESNERIACEAE (1 species)			
	Streptocarpus Lindl. (1 species)			
164	*S. kentaniensis* L.L.Britten & Story	We	RSA*	
	LAMIACEAE (3 genera, 9 taxa)			
	Aeollanthus Mart. ex Spreng. (2 species)			
165	*A. haumannii* Van Jaarsv.	R	Nam*	
166	*A. rydingianus* Van Jaarsv. & A.E.van Wyk	R	Nam*	
	Plectranthus L'Her. (6 taxa)			
167	*P. dolomiticus* Codd	R	RSA*	
168	*P. ernstii* Codd	We	RSA*	
169	*P. mutabilis* Codd	W	RSA*	
170	*P. mzimvubuensis* Van Jaarsv.	R	RSA*	
171	*P. purpuratus* Harv. subsp. *purpuratus*	We	RSA*	
172	*P. saccatus* Benth. subsp. *pondoensis* Van Jaarsv. & Milstein	We	RSA*	
	Tetradenia Benth. (1 species)			
173	*T. kaokoensis* Van Jaarsv. & A.E.van Wyk	We	Nam*	

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Cremnophilous growth form See 9.1.2 for explanation of the symbols below	Degree of cliff occupation *** = strictly obligate cremnophyte, displaying cliff-adapted features ** = obligate cremnophyte * = predominantly on cliffs (80%)	Weight class light = < 50 g medium = 51–500 g heavy = >500 g
	MESEMBRYANTHEMACEAE (12 genera, 45 taxa)			
	Carruanthus (Schwantes) Schwantes (1 species)			
174	*C. peersii* L.Bolus	E:F:P:Els (vb) (r)	***	light-medium
	Conophytum N.E.Br. (19 taxa)			
175	*C. auriflorum* Tischer subsp. *turbiniforme* (Rawe) S.A.Hammer	A:S:Lar:Lf (vb) (r)		light-medium
176	*C. bolusiae* Schwantes subsp. *bolusiae*	A:S:Lar:Lf (vb) (r)	***	light-medium
177	*C. carpianum* L.Bolus	A:S:Lar:Lf (vb) (r)	***	light-medium
178	*C. danielii* Pavelka	A:S:Lar:Lf (vb) (ft) (r)	***	light
179	*C. ernstii* S.A.Hammer subsp. *ernstii*	A:S:Lar:Lf (vb) (r) (ft)	***	light-medium
180	*C. francoiseae* (S.A.Hammer) S.A.Hammer	A:S:Lar:Lf (vb) (r)	***	light-medium
181	*C. fulleri* L.Bolus	A:S:Lar:Lf (vb) (r)	***	light-medium
182	*C. hanae* Pavelka	A:S:Lar:Lf (vb) (r)	**	light
183	*C. luckhoffii* Lavis	A:S:Lar:Lf (vb) (r)	**	light
184	*C. marginatum* Lavis subsp. *haramoepense* (L.Bolus) S.A.Hammer	A:S:Lar:Lf (vb) (r)	***	light
185	*C. marginatum* Lavis subsp. *littlewoodii* (L.Bolus) S.A.Hammer	A:S:Lar:Lf (vb) (r)	***	light
186	*C. obscurum* N.E.Br. subsp. *sponsaliorum* (S.A.Hammer) S.A.Hammer	A:S:Lar:Lf (vb) (r)	***	light
187	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *densipunctum* (L.Bolus) S.A.Hammer	A:S:Lar:Lf (vb)	**	light
188	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *quaesitum* var. *rostratum* (Tischer) S.A.Hammer	A:S:Lar:Lf (vb)	**	light
189	*C. ricardianum* Loesch & Tischer subsp. *ricardianum*	A:S:Lar:Lf (vb) (r) (ft)	***	light-medium
190	*C. stephanii* Schwantes subsp. *stephanii*	A:S:Lar:Lf (vb) (ft) (r)	***	light
191	*C. tantillum* N.E.Br. subsp. *amicorum* S.A.Hammer & Barnhill	A:S:Lar:Lf (vb) (r)	***	light
192	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *ernianum* (Loesch & Tischer) de Boer ex S.A.Hammer	A:S:Lar:Lf (vb) (r)	***	light
193	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *rosynense* S.A.Hammer	A:S:Lar:Lf (vb) (r)	***	light
	Delosperma N.E.Br. emend Lavis (12 taxa)			
194	*Delosperma* sp. A	E:F:P:Els (vb)	*	light-medium
195	*Delosperma* sp. B	E:F:P:Els (vb)	**	medium
196	*D. esterhuyseniae* L.Bolus	E:F:P:Els (vb)	**	light
197	*D. knox-daviesii* Lavis	E:F:P:Els (vb)	**	light
198	*D. laxipetalum* L.Bolus	E:F:As:S/H:Es (vb)	**	medium
199	*D. nubigenum* (Schltr.) L.Bolus	E:F:P:Els (vb)	**	medium
200	*D. saxicola* Lavis	E:F:P:Els (vb)	***	light-medium
201	*D. subpetiolatum* L.Bolus	E:F:P:Els (vb)	**	light-medium
202	*D. tradescantioides* (A.Berger) L.Bolus	E:F:P:Els (vb)	**	medium
203	*D. velutinum* L.Bolus	E:F:P:Els (vb)	**	medium
204	*D. waterbergense* L.Bolus	E:F:P:Els (vb)	**	light
205	*D. zoutpansbergense* L.Bolus	E:F:P:Els (vb)	**	light

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Vegetative dispersal backup	Geology	Aspect
	MESEMBRYANTHEMACEAE (12 genera, 45 taxa)			
	Carruanthus (Schwantes) Schwantes (1 species)			
174	*C. peersii* L.Bolus	active growth and rooting	sandstone	E
	Conophytum N.E.Br. (19 taxa)			
175	*C. auriflorum* Tischer subsp. *turbiniforme* (Rawe) S.A.Hammer	dividing or proliferating clusters	quartz	S
176	*C. bolusiae* Schwantes subsp. *bolusiae*	dividing or proliferating clusters	quartz	E, S
177	*C. carpianum* L.Bolus	dividing or proliferating clusters	granite	S
178	*C. danielii* Pavelka	dividing or proliferating clusters	granite	S
179	*C. ernstii* S.A.Hammer subsp. *ernstii*	dividing or proliferating clusters	quartz	S, W
180	*C. francoiseae* (S.A.Hammer) S.A.Hammer	dividing or proliferating clusters	quartz	E, S
181	*C. fulleri* L.Bolus	dividing or proliferating clusters	quartz	S
182	*C. hanae* Pavelka	dividing or proliferating clusters	gneiss	S
183	*C. luckhoffii* Lavis	dividing or proliferating clusters	sandstone	S
184	*C. marginatum* Lavis subsp. *haramoepense* (L.Bolus) S.A.Hammer	dividing or proliferating clusters	quartz	S
185	*C. marginatum* Lavis subsp. *littlewoodii* (L.Bolus) S.A.Hammer	dividing or proliferating clusters	quartz	S
186	*C. obscurum* N.E.Br. subsp. *sponsaliorum* (S.A.Hammer) S.A.Hammer	dividing or proliferating clusters	quartz	S
187	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *densipunctum* (L.Bolus) S.A.Hammer	dividing or proliferating clusters	quartz	S
188	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *quaesitum* var. *rostratum* (Tischer) S.A.Hammer	dividing or proliferating clusters	quartz	S
189	*C. ricardianum* Loesch & Tischer subsp. *ricardianum*	dividing or proliferating clusters	quartz	S
190	*C. stephanii* Schwantes subsp. *stephanii*	dividing or proliferating clusters	quartz	S
191	*C. tantillum* N.E.Br. subsp. *amicorum* S.A.Hammer & Barnhill	dividing or proliferating clusters	quartz	S
192	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *ernianum* (Loesch & Tischer) de Boer ex S.A.Hammer	dividing or proliferating clusters	quartz	S
193	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *rosynense* S.A.Hammer	dividing or proliferating clusters	quartz	S
	Delosperma N.E.Br. emend Lavis (12 taxa)			
194	*Delosperma* sp. A	active growth and rooting	sandstone	S, E, W
195	*Delosperma* sp. B	active growth and rooting	sandstone	E, S
196	*D. esterhuyseniae* L.Bolus	active growth and rooting	sandstone	S
197	*D. knox-daviesii* Lavis	active growth and rooting	quartz	E
198	*D. laxipetalum* L.Bolus	active growth and rooting	sandstone	E, S
199	*D. nubigenum* (Schltr.) L.Bolus	active growth and rooting	basalt	N
200	*D. saxicola* Lavis	active growth and rooting	sandstone	W
201	*D. subpetiolatum* L.Bolus	active growth and rooting	sandstone	S, E
202	*D. tradescantioides* (A.Berger) L.Bolus	active growth and rooting	shale	E, W, S
203	*D. velutinum* L.Bolus	active growth and rooting	sandstone	N
204	*D. waterbergense* L.Bolus	active growth and rooting	quartz	S
205	*D. zoutpansbergense* L.Bolus	active growth and rooting	quartz	S

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Altitude (m)	Rainfall (mm per annum)	Rainfall seasonality S = summer W = winter W/S = any time of year	Deciduousness E = evergreen SA = summer-aestivating SD = summer-deciduous WD = winter-deciduous
	MESEMBRYANTHEMACEAE (12 genera, 45 taxa)				
	Carruanthus (Schwantes) Schwantes (1 species)				
174	*C. peersii* L.Bolus	800–1200	200–300	W/S	E
	Conophytum N.E.Br. (19 taxa)				
175	*C . auriflorum* Tischer subsp. *turbiniforme* (Rawe) S.A.Hammer	540–860	100–200	W	SA
176	*C. bolusiae* Schwantes subsp. *bolusiae*	500–750	50–100	W	SA
177	*C. carpianum* L.Bolus	900–1160	50–100	W	SA
178	*C. danielii* Pavelka	1000–1150	100–200	W	SA
179	*C. ernstii* S.A.Hammer subsp. *ernstii*	400–1200	50–100	W	SA
180	*C. francoiseae* (S.A.Hammer) S.A.Hammer	350–580	50–100	W	SA
181	*C. fulleri* L.Bolus	980–1150	50–100	W	SA
182	*C. hanae* Pavelka	1000–1300	100–200	W	SA
183	*C. luckhoffii* Lavis	100–980	400–500	W	SA
184	*C. marginatum* Lavis subsp. *haramoepense* (L.Bolus) S.A.Hammer	940–1200	50–100	W	SA
185	*C. marginatum* Lavis subsp. *littlewoodii* (L.Bolus) S.A.Hammer	750–1200	50–100	W	SA
186	*C. obscurum* N.E.Br. subsp. *sponsaliorum* (S.A.Hammer) S.A.Hammer	680	50–100	W	SA
187	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *densipunctum* (L.Bolus) S.A.Hammer	1050–1200	25–50	W	SA
188	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *quaesitum* var. *rostratum* (Tischer) S.A.Hammer	700–1200	50–100	W	SA
189	*C. ricardianum* Loesch & Tischer subsp. *ricardianum*	300–900	50–100	W	SA
190	*C. stephanii* Schwantes subsp. *stephanii*	600–1169	25–50	W	SA
191	*C. tantillum* N.E.Br. subsp. *amicorum* S.A.Hammer & Barnhill	850	150–250	W	SA
192	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *ernianum* (Loesch & Tischer) de Boer ex S.A.Hammer	850–1400	50–200	W	SA
193	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *rosynense* S.A.Hammer	600–1200	50–100	W	SA
	Delosperma N.E.Br. emend Lavis (12 taxa)				
194	*Delosperma* sp. A	200–250	1000–1250	S	E
195	*Delosperma* sp. B	150–250	1000–1250	S	E
196	*D. esterhuyseniae* L.Bolus	400–1200	200–300	W/S	E
197	*D. knox-daviesii* Lavis	1500	700–800	S	E
198	*D. laxipetalum* L.Bolus	550–1100	400–500	W/S	E
199	*D. nubigenum* (Schltr.) L.Bolus	3000–3400	1000–1500	S	E
200	*D. saxicola* Lavis	50–100	700–800 m	W/S	E
201	*D. subpetiolatum* L.Bolus	1000–1400	1000–1200	S	E
202	*D. tradescantioides* (A.Berger) L.Bolus	400–1440	600–800	S	E
203	*D. velutinum* L.Bolus	100–1530	700–800	S	E
204	*D. waterbergense* L.Bolus	1500–1800	700–800	S	E
205	*D. zoutpansbergense* L.Bolus	1500–1730	1250–1500	S	E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Fog *** = regular fog ** = occasional fog * = little fog – = no fog	Biomes IOCB = Indian Ocean Coastal Belt	Pollination
	MESEMBRYANTHEMACEAE (12 genera, 45 taxa)			
	Carruanthus (Schwantes) Schwantes (1 species)			
174	*C. peersii* L.Bolus	–	Albany Thicket	insect
	Conophytum N.E.Br. (19 taxa)			
175	*C . auriflorum* Tischer subsp. *turbiniforme* (Rawe) S.A.Hammer	***	Succulent Karoo	insect
176	*C. bolusiae* Schwantes subsp. *bolusiae*	***	Succulent Karoo	insect
177	*C. carpianum* L.Bolus	***	Succulent Karoo	insect
178	*C. danielii* Pavelka	***	Succulent Karoo	insect
179	*C. ernstii* S.A.Hammer subsp. *ernstii*	***	Succulent Karoo	insect
180	*C. francoiseae* (S.A.Hammer) S.A.Hammer	***	Succulent Karoo	insect
181	*C. fulleri* L.Bolus	*	Succulent Karoo	insect
182	*C. hanae* Pavelka	*	Succulent Karoo	insect
183	*C. luckhoffii* Lavis	**	Fynbos	insect
184	*C. marginatum* Lavis subsp. *haramoepense* (L.Bolus) S.A.Hammer	***	Succulent Karoo	insect
185	*C. marginatum* Lavis subsp. *littlewoodii* (L.Bolus) S.A.Hammer	***	Succulent Karoo	insect
186	*C. obscurum* N.E.Br. subsp. *sponsaliorum* (S.A.Hammer) S.A.Hammer	***	Succulent Karoo	insect
187	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *densipunctum* (L.Bolus) S.A.Hammer	*	Succulent Karoo	insect
188	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *quaesitum* var. *rostratum* (Tischer) S.A.Hammer	**	Succulent Karoo	insect
189	*C. ricardianum* Loesch & Tischer subsp. *ricardianum*	***	Succulent Karoo	insect
190	*C. stephanii* Schwantes subsp. *stephanii*	***	Succulent Karoo	insect
191	*C. tantillum* N.E.Br. subsp. *amicorum* S.A.Hammer & Barnhill	***	Succulent Karoo	insect
192	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *ernianum* (Loesch & Tischer) de Boer ex S.A.Hammer	***	Succulent Karoo	insect
193	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *rosynense* S.A.Hammer	***	Succulent Karoo	insect
	Delosperma N.E.Br. emend Lavis (12 taxa)			
194	*Delosperma* sp. A	–	IOCB	insect
195	*Delosperma* sp. B	–	IOCB	insect
196	*D. esterhuyseniae* L.Bolus	*	Albany Thicket	insect
197	*D. knox-daviesii* Lavis	**	Grassland	insect
198	*D. laxipetalum* L.Bolus	–	Albany Thicket	insect
199	*D. nubigenum* (Schltr.) L.Bolus	**	Grassland	insect
200	*D. saxicola* Lavis	*	Fynbos	insect
201	*D. subpetiolatum* L.Bolus	*	Grassland	insect
202	*D. tradescantioides* (A.Berger) L.Bolus	–	Savanna	insect
203	*D. velutinum* L.Bolus	*	Savanna	insect
204	*D. waterbergense* L.Bolus	*	Grassland	insect
205	*D. zoutpansbergense* L.Bolus	**	Grassland	insect

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Seed dispersal	Conservation status LC = Least Concern NT = Not Threatened VU = Vulnerable	Light requirements BL = bright light DS = dappled shade FS = full sun
	MESEMBRYANTHEMACEAE (12 genera, 45 taxa)			
	Carruanthus (Schwantes) Schwantes (1 species)			
174	*C. peersii* L.Bolus	water	LC	FS, BL
	Conophytum N.E.Br. (19 taxa)			
175	*C . auriflorum* Tischer subsp. *turbiniforme* (Rawe) S.A.Hammer	water	LC	BL
176	*C. bolusiae* Schwantes subsp. *bolusiae*	water	LC	BL
177	*C. carpianum* L.Bolus	water	LC	BL
178	*C. danielii* Pavelka	water	LC	BL
179	*C. ernstii* S.A.Hammer subsp. *ernstii*	water	LC	BL
180	*C. francoiseae* (S.A.Hammer) S.A.Hammer	water	LC	BL
181	*C. fulleri* L.Bolus	water	LC	BL
182	*C. hanae* Pavelka	water	LC	BL
183	*C. luckhoffii* Lavis	water	LC	BL
184	*C. marginatum* Lavis subsp. *haramoepense* (L.Bolus) S.A.Hammer	water	LC	BL
185	*C. marginatum* Lavis subsp. *littlewoodii* (L.Bolus) S.A.Hammer	water	LC	BL
186	*C. obscurum* N.E.Br. subsp. *sponsaliorum* (S.A.Hammer) S.A.Hammer	water	LC	BL
187	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *densipunctum* (L.Bolus) S.A.Hammer	water	LC	BL
188	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *quaesitum* var. *rostratum* (Tischer) S.A.Hammer	water	LC	BL
189	*C. ricardianum* Loesch & Tischer subsp. *ricardianum*	water	LC	BL
190	*C. stephanii* Schwantes subsp. *stephanii*	water	LC	BL
191	*C. tantillum* N.E.Br. subsp. *amicorum* S.A.Hammer & Barnhill	water	LC	BL
192	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *ernianum* (Loesch & Tischer) de Boer ex S.A.Hammer	water	LC	BL
193	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *rosynense* S.A.Hammer	water	LC	BL
	Delosperma N.E.Br. emend Lavis (12 taxa)			
194	*Delosperma* sp. A	water	LC	FS, BL
195	*Delosperma* sp. B	water	LC	FS, BL
196	*D. esterhuyseniae* L.Bolus	water	LC	FS, BL
197	*D. knox-daviesii* Lavis	water	LC	FS, BL
198	*D. laxipetalum* L.Bolus	water	LC	FS, BL
199	*D. nubigenum* (Schltr.) L.Bolus	water	LC	FS, BL
200	*D. saxicola* Lavis	water	LC	FS, BL
201	*D. subpetiolatum* L.Bolus	water	LC	FS, BL
202	*D. tradescantioides* (A.Berger) L.Bolus	water	LC	FS, BL
203	*D. velutinum* L.Bolus	water	LC	FS, BL
204	*D. waterbergense* L.Bolus	water	LC	FS, BL
205	*D. zoutpansbergense* L.Bolus	water	LC	FS, BL

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Rich flowering *** = rich ** = exposed * = insignificant	Reduction in armament *** = margin without teeth ** = margin with smaller teeth * = no significant change, same as other non-cremnophytes	Cliff habitat C = coastal R = river E = escarpment M = mountain I = inselberg
	MESEMBRYANTHEMACEAE (12 genera, 45 taxa)			
	Carruanthus (Schwantes) Schwantes (1 species)			
174	*C. peersii* L.Bolus	***	*	R, M
	Conophytum N.E.Br. (19 taxa)			
175	*C. auriflorum* Tischer subsp. *turbiniforme* (Rawe) S.A.Hammer	***	*	E
176	*C. bolusiae* Schwantes subsp. *bolusiae*	***	*	M
177	*C. carpianum* L.Bolus	***	*	M
178	*C. danielii* Pavelka	***	*	M
179	*C. ernstii* S.A.Hammer subsp. *ernstii*	***	*	M, R
180	*C. francoiseae* (S.A.Hammer) S.A.Hammer	***	*	M
181	*C. fulleri* L.Bolus	***	*	M, I
182	*C. hanae* Pavelka	***	*	M
183	*C. luckhoffii* Lavis	***	*	M
184	*C. marginatum* Lavis subsp. *haramoepense* (L.Bolus) S.A.Hammer	***	*	M
185	*C. marginatum* Lavis subsp. *littlewoodii* (L.Bolus) S.A.Hammer	***	*	M
186	*C. obscurum* N.E.Br. subsp. *sponsaliorum* (S.A.Hammer) S.A.Hammer	***	*	M
187	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *densipunctum* (L.Bolus) S.A.Hammer	**	*	M
188	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *quaesitum* var. *rostratum* (Tischer) S.A.Hammer	**	*	M
189	*C. ricardianum* Loesch & Tischer subsp. *ricardianum*	***	***	M
190	*C. stephanii* Schwantes subsp. *stephanii*	***	*	M
191	*C. tantillum* N.E.Br. subsp. *amicorum* S.A.Hammer & Barnhill	***	*	M
192	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *ernianum* (Loesch & Tischer) de Boer ex S.A.Hammer	***	*	M
193	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *rosynense* S.A.Hammer	***	*	M
	Delosperma N.E.Br. emend Lavis (12 taxa)			
194	*Delosperma* sp. A	***	*	R
195	*Delosperma* sp. B	**	*	R
196	*D. esterhuyseniae* L.Bolus	***	*	M, R
197	*D. knox-daviesii* Lavis	**	*	E
198	*D. laxipetalum* L.Bolus	**	*	R, M
199	*D. nubigenum* (Schltr.) L.Bolus	***	*	E
200	*D. saxicola* Lavis	**	*	C
201	*D. subpetiolatum* L.Bolus	***	*	E
202	*D. tradescantioides* (A.Berger) L.Bolus	**	*	R
203	*D. velutinum* L.Bolus	**	*	R, M
204	*D. waterbergense* L.Bolus	***	*	M, I
205	*D. zoutpansbergense* L.Bolus	**	*	M, I

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Occurrence W = widespread We = widespread but endemic to its vegetation region R = restricted	Endemism * = endemic Bots = Botswana Les = Lesotho Moz = Mozambique Nam = Namibia RSA = South Africa Swaz = Swaziland	Windows Lm = on leaf margin Mw = micro-windows O = other
	MESEMBRYANTHEMACEAE (12 genera, 45 taxa)			
	Carruanthus (Schwantes) Schwantes (1 species)			
174	*C. peersii* L.Bolus	R	RSA*	
	Conophytum N.E.Br. (19 taxa)			
175	*C. auriflorum* Tischer subsp. *turbiniforme* (Rawe) S.A.Hammer	R	RSA*	Mw
176	*C. bolusiae* Schwantes subsp. *bolusiae*	R	RSA*	Mw
177	*C. carpianum* L.Bolus	R	RSA*	Mw
178	*C. danielii* Pavelka	R	RSA*	Mw
179	*C. ernstii* S.A.Hammer subsp. *ernstii*	We	RSA*	Mw
180	*C. francoiseae* (S.A.Hammer) S.A.Hammer	R	RSA*	Mw
181	*C. fulleri* L.Bolus	We	RSA*	Mw
182	*C. hanae* Pavelka	We	RSA*	Mw
183	*C. luckhoffii* Lavis	R	RSA*	Mw
184	*C. marginatum* Lavis subsp. *haramoepense* (L.Bolus) S.A.Hammer	We	RSA*	Mw
185	*C. marginatum* Lavis subsp. *littlewoodii* (L.Bolus) S.A.Hammer	We	RSA*	Mw
186	*C. obscurum* N.E.Br. subsp. *sponsaliorum* (S.A.Hammer) S.A.Hammer	R	RSA*	Mw
187	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *densipunctum* (L.Bolus) S.A.Hammer	We	Nam*	Mw
188	*C. quaesitum* (N.E.Br.) N.E.Br. subsp. *quaesitum* var. *rostratum* (Tischer) S.A.Hammer	We	RSA, Nam	Mw
189	*C. ricardianum* Loesch & Tischer subsp. *ricardianum*	R	Nam*	Mw
190	*C. stephanii* Schwantes subsp. *stephanii*	We	RSA*	Mw
191	*C. tantillum* N.E.Br. subsp. *amicorum* S.A.Hammer & Barnhill	We	RSA*	Mw
192	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *ernianum* (Loesch & Tischer) de Boer ex S.A.Hammer	R	Nam*	Mw
193	*C. taylorianum* (Dinter & Schwantes) N.E.Br. subsp. *rosynense* S.A.Hammer	R	RSA*	Mw
	Delosperma N.E.Br. emend Lavis (12 taxa)			
194	*Delosperma* sp. A	We	RSA*	
195	*Delosperma* sp. B	R	RSA*	
196	*D. esterhuyseniae* L.Bolus	We	RSA*	
197	*D. knox-daviesii* Lavis	We	RSA*	
198	*D. laxipetalum* L.Bolus	We	RSA*	
199	*D. nubigenum* (Schltr.) L.Bolus	We	RSA*	
200	*D. saxicola* Lavis	R	RSA*	
201	*D. subpetiolatum* L.Bolus	We	RSA*	
202	*D. tradescantioides* (A.Berger) L.Bolus	We	RSA*	
203	*D. velutinum* L.Bolus	We	RSA*	
204	*D. waterbergense* L.Bolus	R	RSA*	
205	*D. zoutpansbergense* L.Bolus	R	RSA*	

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Cremnophilous growth form See 9.1.2 for explanation of the symbols below	Degree of cliff occupation *** = strictly obligate cremnophyte, displaying cliff-adapted features ** = obligate cremnophyte * = predominantly on cliffs (80%)	Weight class light = < 50 g medium = 51–500 g heavy = >500 g
	Drosanthemum Schwantes (3 species)			
206	*D. anemophilum* Van Jaarsv. & S.A.Hammer	E:F:As:W:Ev	**	medium
207	*D. expersum* (N.E.Br.) Schwantes	E:F:P:Els (vb)	***	light
208	*D. inornatum* (L.Bolus) L.Bolus	E:F:P:Els:D (vb) (eg)	***	light
	Erepsia N.E.Br. (1 species)			
209	*E. heteropetala* (Haw.) Schwantes	E:F:As:W:Ev	*	light-medium
	Esterhuysenia L.Bolus (1 species)			
210	*E. stokoei* (L.Bolus) H.E.K.Hartmann	E:F:P:Els (vb)	***	light
	Jensenobotrya A.G.J.Herre (1 species)			
211	*J. lossowiana* A.G.J.Herre	E:P:F:Els (vb) (ft)	***	heavy
	Lampranthus N.E.Br. (1 species)			
212	*L. affinis* L.Bolus	E:F:As:W:Ev (r)	**	medium
	Machairophyllum Schwantes (1 species)			
213	*M. brevifolium* L.Bolus	A:S:Lper:R:C:La (vb) (r)	***	light-medium
	Oscularia Schwantes (1 species)			
214	*O. cremnophila* Van Jaarsv., Desmet & A.E.van Wyk	E:F:P:Els (vb)	***	medium-heavy
	Ruschia Schwantes (2 species)			
215	*R. knysnana* (L.Bolus) L.Bolus	E:F:As:W:Ev (vb)	**	light-medium
216	*R. promontorii* L.Bolus	E:F:P:Els:Ev (vb)	**	light-medium
	Scopelogena L.Bolus (2 species)			
217	*S. bruynsii* Klak	E:F:As:W:Ev (vb)	**	medium-heavy
218	*S. verruculata* (L.) L.Bolus	E:F:As:W:Ev (vb)	***	medium-heavy
	OXALIDACEAE (1 species)			
	Oxalis L. (1 species)			
219	*Oxalis pocockiae* L.Bolus	A:B:D:C:La (vb)	**	light
	PORTULACACEAE (1 species)			
	Anacampseros L. (1 species)			
220	*A. scopata* G.Will.	A:S:Lper:Lc:Ca:(vb) (ft)	***	light
	SEMISUCCULENT AND HERBACEOUS OUTGROUPS			
	PEDALIACEAE (outgroup)			
	Dewinteria Van Jaarsv. & A.E.van Wyk			
221	*D. petrophila* (De Winter) Van Jaarsv. & A.E.van Wyk	E:F:As:S/H:Es (vb) (r) (fn)	***	light-medium
	SCROPHULARIACEAE (outgroup)			
	Stemodiopsis Engl.			
222	*S. rivae* Engl.	E:F:As:S/H:Es (vb) (fn)	***	light

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Vegetative dispersal backup	Geology	Aspect
	Drosanthemum Schwantes (3 species)			
206	*D. anemophilum* Van Jaarsv. & S.A.Hammer	solitary	sandstone	N
207	*D. expersum* (N.E.Br.) Schwantes	active growth and rooting	sandstone	S
208	*D. inornatum* (L.Bolus) L.Bolus	active growth and rooting	dolomite	S
	Erepsia N.E.Br. (1 species)			
209	*E. heteropetala* (Haw.) Schwantes	active growth and rooting	sandstone	S, E
	Esterhuysenia L.Bolus (1 species)			
210	*E. stokoei* (L.Bolus) H.E.K.Hartmann	active growth and rooting	sandstone	S
	Jensenobotrya A.G.J.Herre (1 species)			
211	*J. lossowiana* A.G.J.Herre	active growth and rooting	sandstone	S, W
	Lampranthus N.E.Br. (1 species)			
212	*L. affinis* L.Bolus	active growth and rooting	sandstone	S, E, W, N
	Machairophyllum Schwantes (1 species)			
213	*M. brevifolium* L.Bolus	solitary	conglomerate	S
	Oscularia Schwantes (1 species)			
214	*O. cremnophila* Van Jaarsv., Desmet & A.E.van Wyk	active growth and rooting	sandstone	S
	Ruschia Schwantes (2 species)			
215	*R. knysnana* (L.Bolus) L.Bolus	solitary	sandstone	W
216	*R. promontorii* L.Bolus	active growth and rooting	sandstone	E, W, N
	Scopelogena L.Bolus (2 species)			
217	*S. bruynsii* Klak	active growth and rooting	sandstone, granite	
218	*S. verruculata* (L.) L.Bolus	active growth and rooting	sandstone	S, E, W
	OXALIDACEAE (1 species)			
	Oxalis L. (1 species)			
219	*Oxalis pocockiae* L.Bolus	winged bulbils	sandstone	E, S, W
	PORTULACACEAE (1 species)			
	Anacampseros L. (1 species)			
220	*A. scopata* G.Will.		quartz	E, S
	SEMISUCCULENT AND HERBACEOUS OUTGROUPS			
	PEDALIACEAE (outgroup)			
	Dewinteria Van Jaarsv. & A.E.van Wyk			
221	*D. petrophila* (De Winter) Van Jaarsv. & A.E.van Wyk	dual dispersal, autochory and other, seed cloning	granite	S, E
	SCROPHULARIACEAE (outgroup)			
	Stemodiopsis Engl.			
222	*S. rivae* Engl.	autochory, infructescence bending back	sandstone	S

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Altitude (m)	Rainfall (mm per annum)	Rainfall seasonality S = summer W = winter W/S = any time of year	Deciduousness E = evergreen SA = summer-aestivating SD = summer-deciduous WD = winter-deciduous
	Drosanthemum Schwantes (3 species)				
206	*D. anemophilum* Van Jaarsv. & S.A.Hammer	800–1000	200–300	W/S	E
207	*D. expersum* (N.E.Br.) Schwantes	1200–2000	1000–1500	W	E
208	*D. inornatum* (L.Bolus) L.Bolus	800–1100	50–75	W	SD
	Erepsia N.E.Br. (1 species)				
209	*E. heteropetala* (Haw.) Schwantes	400–1300	1000–1500	W	E
	Esterhuysenia L.Bolus (1 species)				
210	*E. stokoei* (L.Bolus) H.E.K.Hartmann	800–1500	1000–1500	W	E
	Jensenobotrya A.G.J.Herre (1 species)				
211	*J. lossowiana* A.G.J.Herre	10–300	15	W	E
	Lampranthus N.E.Br. (1 species)				
212	*L. affinis* L.Bolus	300–1050	400–500	W/S	E
	Machairophyllum Schwantes (1 species)				
213	*M. brevifolium* L.Bolus	500–600	200–300	W/S	E
	Oscularia Schwantes (1 species)				
214	*O. cremnophila* Van Jaarsv., Desmet & A.E.van Wyk	50–100	300–400	W	E
	Ruschia Schwantes (2 species)				
215	*R. knysnana* (L.Bolus) L.Bolus	50–650	600–700	W/S	E
216	*R. promontorii* L.Bolus	120–400	300–400	W	E
	Scopelogena L.Bolus (2 species)				
217	*S. bruynsii* Klak	800–2000	120–400	W	E
218	*S. verruculata* (L.) L.Bolus	100–1000	1000–1500	W	E
	OXALIDACEAE (1 species)				
	Oxalis L. (1 species)				
219	*Oxalis pocockiae* L.Bolus	350–600	750–2000	W	SD
	PORTULACACEAE (1 species)				
	Anacampseros L. (1 species)				
220	*A. scopata* G.Will.	350–450	25–50	W	E
	SEMISUCCULENT AND HERBACEOUS OUTGROUPS				
	PEDALIACEAE (outgroup)				
	Dewinteria Van Jaarsv. & A.E.van Wyk				
221	*D. petrophila* (De Winter) Van Jaarsv. & A.E.van Wyk	900–1500	50–150	S	E
	SCROPHULARIACEAE (outgroup)				
	Stemodiopsis Engl.				
222	*S. rivae* Engl.	400–1675	300–400	S	E

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Fog *** = regular fog ** = occasional fog * = little fog – = no fog	Biomes IOCB = Indian Ocean Coastal Belt	Pollination
	Drosanthemum Schwantes (3 species)			
206	*D. anemophilum* Van Jaarsv. & S.A.Hammer	–	Succulent Karoo	insect
207	*D. expersum* (N.E.Br.) Schwantes	**	Fynbos	insect
208	*D. inornatum* (L.Bolus) L.Bolus	***	Succulent Karoo	insect
	Erepsia N.E.Br. (1 species)			
209	*E. heteropetala* (Haw.) Schwantes	*	Fynbos	insect
	Esterhuysenia L.Bolus (1 species)			
210	*E. stokoei* (L.Bolus) H.E.K.Hartmann	*	Fynbos	insect
	Jensenobotrya A.G.J.Herre (1 species)			
211	*J. lossowiana* A.G.J.Herre	***	Desert	insect
	Lampranthus N.E.Br. (1 species)			
212	*L. affinis* L.Bolus	–	Albany Thicket	insect
	Machairophyllum Schwantes (1 species)			
213	*M. brevifolium* L.Bolus	–	Succulent Karoo	insect
	Oscularia Schwantes (1 species)			
214	*O. cremnophila* Van Jaarsv., Desmet & A.E.van Wyk	***	Fynbos	insect
	Ruschia Schwantes (2 species)			
215	*R. knysnana* (L.Bolus) L.Bolus	–	Fynbos	insect
216	*R. promontorii* L.Bolus	**	Fynbos	insect
	Scopelogena L.Bolus (2 species)			
217	*S. bruynsii* Klak	*	Succulent Karoo	insect
218	*S. verruculata* (L.) L.Bolus	*	Fynbos	insect
	OXALIDACEAE (1 species)			
	Oxalis L. (1 species)			
219	*Oxalis pocockiae* L.Bolus	–	Fynbos	insect
	PORTULACACEAE (1 species)			
	Anacampseros L. (1 species)			
220	*A. scopata* G.Will.	***	Succulent Karoo	insect
	SEMISUCCULENT AND HERBACEOUS OUTGROUPS			
	PEDALIACEAE (outgroup)			
	Dewinteria Van Jaarsv. & A.E.van Wyk			
221	*D. petrophila* (De Winter) Van Jaarsv. & A.E.van Wyk	**	Desert	insect
	SCROPHULARIACEAE (outgroup)			
	Stemodiopsis Engl.			
222	*S. rivae* Engl.	–	Savanna	insect

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Seed dispersal	Conservation status LC = Least Concern NT = Not Threatened VU = Vulnerable	Light requirements BL = bright light DS = dappled shade FS = full sun
	Drosanthemum Schwantes (3 species)			
206	*D. anemophilum* Van Jaarsv. & S.A.Hammer	wind	LC	FS
207	*D. expersum* (N.E.Br.) Schwantes	water	LC	FS, BL
208	*D. inornatum* (L.Bolus) L.Bolus	water	LC	FS, BL
	Erepsia N.E.Br. (1 species)			
209	*E. heteropetala* (Haw.) Schwantes	water	LC	FS, BL
	Esterhuysenia L.Bolus (1 species)			
210	*E. stokoei* (L.Bolus) H.E.K.Hartmann	water	LC	FS, BL
	Jensenobotrya A.G.J.Herre (1 species)			
211	*J. lossowiana* A.G.J.Herre	water	LC	FS, BL
	Lampranthus N.E.Br. (1 species)			
212	*L. affinis* L.Bolus	water	LC	FS, BL
	Machairophyllum Schwantes (1 species)			
213	*M. brevifolium* L.Bolus	water	LC	FS
	Oscularia Schwantes (1 species)			
214	*O. cremnophila* Van Jaarsv., Desmet & A.E.van Wyk	water	LC	FS, BL
	Ruschia Schwantes (2 species)			
215	*R. knysnana* (L.Bolus) L.Bolus	water	LC	FS
216	*R. promontorii* L.Bolus	water	LC	FS
	Scopelogena L.Bolus (2 species)			
217	*S. bruynsii* Klak	water	LC	FS, BL
218	*S. verruculata* (L.) L.Bolus	wind	LC	FS, BL
	OXALIDACEAE (1 species)			
	Oxalis L. (1 species)			
219	*Oxalis pocockiae* L.Bolus	wind	LC	FS, BL
	PORTULACACEAE (1 species)			
	Anacampseros L. (1 species)			
220	*A. scopata* G.Will.	wind	LC	BL, DS
	SEMISUCCULENT AND HERBACEOUS OUTGROUPS			
	PEDALIACEAE (outgroup)			
	Dewinteria Van Jaarsv. & A.E.van Wyk			
221	*D. petrophila* (De Winter) Van Jaarsv. & A.E.van Wyk	wind & autochory	LC	BL, DS
	SCROPHULARIACEAE (outgroup)			
	Stemodiopsis Engl.			
222	*S. rivae* Engl.	autochory	LC	FS, DS, BL

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Rich flowering *** = rich ** = exposed * = insignificant	Reduction in armament *** = margin without teeth ** = margin with smaller teeth * = no significant change, same as other non-cremnophytes	Cliff habitat C = coastal R = river E = escarpment M = mountain I = inselberg
	Drosanthemum Schwantes (3 species)			
206	*D. anemophilum* Van Jaarsv. & S.A.Hammer	**	*	M
207	*D. expersum* (N.E.Br.) Schwantes	***	*	M
208	*D. inornatum* (L.Bolus) L.Bolus	*	*	M
	Erepsia N.E.Br. (1 species)			
209	*E. heteropetala* (Haw.) Schwantes	**	*	M
	Esterhuysenia L.Bolus (1 species)			
210	*E. stokoei* (L.Bolus) H.E.K.Hartmann	***	*	M
	Jensenobotrya A.G.J.Herre (1 species)			
211	*J. lossowiana* A.G.J.Herre	**	***	C
	Lampranthus N.E.Br. (1 species)			
212	*L. affinis* L.Bolus	***	*	R, M
	Machairophyllum Schwantes (1 species)			
213	*M. brevifolium* L.Bolus	***	*	M
	Oscularia Schwantes (1 species)			
214	*O. cremnophila* Van Jaarsv., Desmet & A.E.van Wyk	***	*	M
	Ruschia Schwantes (2 species)			
215	*R. knysnana* (L.Bolus) L.Bolus	**	*	C, M
216	*R. promontorii* L.Bolus	**	*	C, M
	Scopelogena L.Bolus (2 species)			
217	*S. bruynsii* Klak	***	*	M
218	*S. verruculata* (L.) L.Bolus	***	*	M
	OXALIDACEAE (1 species)			
	Oxalis L. (1 species)			
219	*Oxalis pocockiae* L.Bolus	**	*	M, C
	PORTULACACEAE (1 species)			
	Anacampseros L. (1 species)			
220	*A. scopata* G.Will.	*	*	M
	SEMISUCCULENT AND HERBACEOUS OUTGROUPS			
	PEDALIACEAE (outgroup)			
	Dewinteria Van Jaarsv. & A.E.van Wyk			
221	*D. petrophila* (De Winter) Van Jaarsv. & A.E.van Wyk	***	*	E, M
	SCROPHULARIACEAE (outgroup)			
	Stemodiopsis Engl.			
222	*S. rivae* Engl.	**	*	M

TABLE 10.1 (continued)—Check list of obligate and near-obligate cremnophilous taxa (220 taxa, 203 species)

No.	Taxon	Occurrence W = widespread We = widespread but endemic to its vegetation region R = restricted	Endemism * = endemic Bots = Botswana Les = Lesotho Moz = Mozambique Nam = Namibia RSA = South Africa Swaz = Swaziland	Windows Lm = on leaf margin Mw = micro-windows O = other
	Drosanthemum Schwantes (3 species)			
206	*D. anemophilum* Van Jaarsv. & S.A.Hammer	R	RSA*	
207	*D. expersum* (N.E.Br.) Schwantes	We	RSA*	
208	*D. inornatum* (L.Bolus) L.Bolus	R	Nam*	
	Erepsia N.E.Br. (1 species)			
209	*E. heteropetala* (Haw.) Schwantes	We	RSA*	
	Esterhuysenia L.Bolus (1 species)			
210	*E. stokoei* (L.Bolus) H.E.K.Hartmann	We	RSA*	
	Jensenobotrya A.G.J.Herre (1 species)			
211	*J. lossowiana* A.G.J.Herre	R	Nam*	
	Lampranthus N.E.Br. (1 species)			
212	*L. affinis* L.Bolus	We	RSA*	
	Machairophyllum Schwantes (1 species)			
213	*M. brevifolium* L.Bolus	We	RSA*	
	Oscularia Schwantes (1 species)			
214	*O. cremnophila* Van Jaarsv., Desmet & A.E.van Wyk	R	RSA*	
	Ruschia Schwantes (2 species)			
215	*R. knysnana* (L.Bolus) L.Bolus	We	RSA*	
216	*R. promontorii* L.Bolus	We	RSA*	
	Scopelogena L.Bolus (2 species)			
217	*S. bruynsii* Klak	We	RSA*	
218	*S. verruculata* (L.) L.Bolus	We	RSA*	
	OXALIDACEAE (1 species)			
	Oxalis L. (1 species)			
219	*Oxalis pocockiae* L.Bolus	We	RSA*	
	PORTULACACEAE (1 species)			
	Anacampseros L. (1 species)			
220	*A. scopata* G.Will.	R	RSA*	
	SEMISUCCULENT AND HERBACEOUS OUTGROUPS			
	PEDALIACEAE (outgroup)			
	Dewinteria Van Jaarsv. & A.E.van Wyk			
221	*D. petrophila* (De Winter) Van Jaarsv. & A.E.van Wyk	We	Nam*	
	SCROPHULARIACEAE (outgroup)			
	Stemodiopsis Engl.			
222	*S. rivae* Engl.	We	RSA	

CHAPTER 11

GENERAL DISCUSSION AND CONCLUSIONS

11.1 General observations

This study revealed that cliffs in South Africa and Namibia represent a pristine habitat with a uniquely adapted obligate cremnophilous succulent flora. This flora represents 6% of the total succulent flora of the subregion. The cremnophytes are confined to cliffs along the main drainage lines (river systems) and to cliffs along the Great Escarpment, on inselbergs, inland mountain ranges and coastal cliffs. Centres of diversity are located along the larger river systems, notably the Gourits, Gamtoos and Orange Rivers.

The cliffs investigated, showed very few non-succulent obligate cremnophytes among higher plants (with a few exceptions as in the Drakensberg and Western Cape), suggesting that succulence in seasonally dry climates is an essential element for survival on a cliff. Non- or semisucculent species demand modified strategies to ensure their survival, clearly shown by the two semisucculent obligate cremnophytes *Dewinteria petrophila* [221] and *Stemodiopsis rivae* [222] and by others such as members of *Ficus*, used for comparative purposes as an 'outgroup'. Succulent plants on cliffs display various adaptive morphological features (traits) that vary from highly specialised to subtle. Among them are plants with elongated stems (cliff hangers), shrublets (cliff squatters) and the clustered growth form (cliff huggers). Some cliff huggers also have pendent leaves.

The 220 species of cremnophytes identified in this study belong to 14 families of vascular plants (ferns one species; monocotyledons three families; dicotyledons ten families) (Tables 11.1 and 11.2). Most of these species and infraspecific taxa are local endemics, only a few extending beyond the borders of South Africa and Namibia. Plants encountered represent presumably highly specialised palaeoendemic taxa such as *Gasteria rawlinsonii* [48] and *G. glomerata* [46] as well as more recent, less modified neoendemic taxa such as *Delosperma* spp. About a quarter of the plants documented (51 taxa) were new to science. This shows that not only in South Africa or Namibia, but throughout the world, cliffs represent a pristine but grossly neglected or underrated habitat with a highly specialised flora (Larson *et al*. 2000). If this trend continues, it is foreseen that many more cremnophytes will still be discovered. Further

research should therefore prove worthwhile, not only at the taxonomic and adaptive level, but also relating to the general ecology of cliffs in the subregion and elsewhere.

Cliffs are a habitat not only for obligate cremnophytes, but also for many other succulent plants and biodiversity in general. Cliffs are an important and well-known refuge and habitat for various animals such as chacma baboons (*Papio ursinus*) and rock dassies (*Procavia capensis*), but especially also for birds and they are furthermore a safe haven for many reptiles such as lizards. Humans have also been associated with cliffs throughout the ages (Larson *et al*. 2000). Masada in Israel, surrounded by cliffs, was a well-known mountain refuge and stronghold for the Israelites during Roman occupation in Biblical times.

Caves and cliffs have been used as shelters for hominids throughout the ages. Even today, hikers often find shelter under overhangs at the base of a cliff. The remains of hominid fossils, rock art and stone artefacts are well associated with cliffs and overhangs in South Africa, and there is hardly an overhang without some form of Stone Age tools. Larson *et al.* (2000) proposed the 'Urban cliff hypothesis' according to which humans today are creating their own cliff and cave shelters and refuge sites (houses, buildings and skyscrapers). Just like cremnophytes, we are free from competition and threats from wild animals today and energy can be spent on other matters. We have transformed our ancient habitat into a safe environment, with the focus now on other issues such as crop-growing, medical and other research and occupations involving in the arts.

The cliff as a shelter for hominids in the past created a safe 'stepping stone' for cultural development, for current advancement in science and ultimately for our present relatively safe (compared with past ages) human society. Competition from other species has effectively been removed. However, it was replaced by competition within human society. Man's greatest threat is its numbers, which are out of control; the species has become its own greatest threat. Perhaps we are heading for a cul-de-sac, like some of the highly modified obligate cremnophytes. Has science as a human tool produced the answers? Or is it becoming our greatest threat?

In the study area, cliffs represent a pristine, stable habitat and vital refuge for succulent and bulbous obligate cremnophytes as well as for local flora and biodiversity in general and should therefore be protected globally. This agrees with observations elsewhere in the world that cliffs are ancient, stable habitats (Klötzli 1991; Larson & Kelly 1991; Larson *et al.* 2000).

One of the main questions at the beginning of the study was: 'Do cremnophytes display a decrease in defence and an increase in cliff-adapted features?' In theory, cremnophytes should be adapted to grow on a vertical plane—less thorny (mechanical defence), less bitter (chemical defence) and not well camouflaged. Another question was: 'How is reproduction of cremnophytes affected on the cliff?'

11.2 Main findings of this study

At the onset of this study it was stated that cliffs are one of the least disturbed and least known terrestrial habitats on earth. Also, that the particular nature of cliffs requires a particular adjustment (or shift) of obligate succulent or semisucculent cremnophytes in both morphology and reproduction. This study confirmed that cliffs not only harbour a highly adapted flora, but also provide stable long-term refugia for biodiversity. The cliff-face flora in the study area is diverse, representing various vascular plant families, usually typical for each subregion.

11.2.1 Obligate or near-obligate cremnophytes

This study revealed 220 species and infraspecific taxa (about 6% of region's more or less 3 500 succulent plant taxa) as being obligate or near-obligate succulent cremnophytes (Table 11.1). Of the 220 cremnophilous taxa, 103 (46%) were strictly obligate (more than 98% confined to the cliff habitat), 94 (43%) were obligate (90–98% confined to the cliff habitat) and 23 (10%) near-obligate cremnophytes (80–90% of population confined to the cliff habitat).

11.2.2 New taxa

Of the 220 taxa, 57 were recorded as new to science and were named by the author or in collaboration with co-authors. The new taxa represent 26% of the total number of cremnophytes documented during the study (see Appendices 1 and 2).

11.2.3 Growth modification traits (morphological adjustment to the cliff habitat)

Growth modification traits identified vary from subtle to very distinct growth forms, and are the result of the cliff habitat (vertical terrain, aspect, high run-off, rainy season and absence of larger herbivores on the cliff). This has resulted not only in adjusted water-storage ability but also in modifications in growth form (stem length, direction of growth and deciduousness) and in adaptations to sun radiation and defence mechanisms.

11.2.3.1 Increase in succulence and other drought-adapted traits

This includes a clear increase in succulence and xeromorphic features (compared to close non-cremnophilous relatives). Leaves of some species tend to be more compact (abbreviated internodes), forming a cylindrical body (*Crassula perforata* subsp. *kougaensis* [131] and *Crassula rupestris* subsp. *marnieriana* [135]) (Table 11.2). This study also revealed that most obligate cremnophilous succulent elements are confined to shady south-facing cliffs where moisture is retained longer (owing to less solar radiation). Although most obligate cremnophytes are evergreen, some do become deciduous during the dry season (Table 11.3).

11.2.3.2 Decrease in size and weight

There is a general reduction in size (compared to close non-cremnophilous relatives). Cremnophytes tend to be more compact and some species display dwarfism (winter-rainfall regions and at higher altitudes), consequently with less weight tax (Tables 11.4, 11.5, 11.6 and 11.7).

11.2.3.3 Adjustment of growth form

Two distinct growth forms were identified—126 taxa with abbreviated stems (representing 57%) and 94 with extended stems (43%). Of the 126 taxa with abbreviated stems, 17 (8% of total) have leaves that become pendent. Of the 94 taxa with extended stems, 55 (26% of all cremnophytes in study area) have pendent stems. If the taxa with pendent elements (leaves or stems) are combined, there are 72 taxa (55 or 25% with pendent stems and 17 or 8% with pendent leaves). The remaining 39 (18%) (extended stems, cliff squatters) are small shrublets (often short) with one exception, *Drosanthemum anemophilum* [206], a spindly shrub (see Table 11.1).

Growth form adaptations to the vertical habitat thus represent three distinct traits. Firstly, compact cluster or mat-forming plants (cliff huggers) are associated with cliffs in the south and also at higher altitudes (above 1000 m) in the north. The second adaptive growth form is represented by dwarf shrublets (cliff squatters), including ascending but reduced shrublets. Thirdly there are the pendent-stemmed cliff hangers, which can be divided into plants with distinct leaf rosettes (aloes and aloe-related), plants with widely spread leaves (*Delosperma*, *Senecio*) and plants with leafless stems (especially of the Asclepiadaceae) (see Table 11.8). Plants on cliffs often show pendent growth as a result of epinasty—there are 26 taxa (12% of total) displaying epinastic growth (see Table 11.8). Cliff huggers, especially the bulbous ones, sometimes have distinctly drooping leaves, which can be attributed to both

gravity and epinastic growth. Bulbous obligate cremnophytes usually have bulbs with epigeous growth. Another trait among the plants with pendent stems is an increase in flexibility (Table 11.9).

11.2.3.4 Leaves and sun radiation

On south-facing aspects the leaves of aloes re-curve, exposing as much surface as possible to the light. Additional adaptations include various windows for maximum penetration of light (Table 11.10). Fewer species were found to be confined to north-facing aspects; plants restricted to this aspect tend to have mitriform rosettes and firm leaves with a grey-green surface.

11.2.3.5 Decrease in defence (armament)

There is furthermore a decrease in armour, especially noticeable in aloes with marginal teeth, which are either absent or highly reduced (Table 11.11). There is also a reduction in the bitterness of the leaf sap in aloes (see Table 11.12). Camouflage of some of these plants also seems to be less obvious (Table 11.13). In *Conophytum* species, there tends to be an increase in fragility (Table 11.14).

11.2.4 Reproductive traits

Reproduction on the cliff includes modifications such as rich flowering and a shift towards wind-dispersed seed. For long-term survival on the cliff face, cremnophytes often display backup mechanisms of reproduction (see Table 11.1). In addition to sexual reproduction, most succulent cremnophytes have a local vegetative dispersal mode. This includes propagules, runners, rooting of stems in clusters, and bulbils. Non-succulent or partially succulent obligate cremnophytes are clearly in a minority. All three species identified in the present study have additional or adjusted dispersal methods such as amphicarpy or autochory. They are the semisucculent *Dewinteria petrophila* [221], the non-succulent *Stemodiopsis rivae* [222] and *Colpias molle*. It is clear that succulence is a great advantage and necessity for the long-term survival of most cremnophytes.

11.2.4.1 Vegetative reproduction

Most succulent cremnophytes have a vegetative dispersal backup. This has been recorded in 193 (89%) taxa. Vegetative dispersal ranges from distinct bulbils to branches rooting where they touch the substrate, or it can simply entail vegetative clustering. Two partially succulent cremnophilous taxa, *Dewinteria petrophila* [221] and *Stemodiopsis rivae* [222], have

additional reproductive backup adaptations, namely amphicarpy or autochory, and they were used for comparative purposes (as outgroups). This proves that succulence is an essential element for survival on the cliff.

11.2.4.2 Rich flowering

The study revealed 32 (15% of total) taxa that produce large, conspicuous flowers in comparison to plant size. This phenomenon, called rich flowering, was first noticed by Snogerup (1971) in obligate cremnophytes in the Mediterranean region—an increase in floral size in comparison to plant size as a strategy for attracting pollinators.

11.2.4.3 Seed dispersal

The seeds of no less than 162 (74%) of the cremnophilous taxa in the study area are dispersed by the wind. This is clearly the majority, making use of wind turbulence so frequently encountered on cliffs. Although there is a shift to dispersal of seed by wind in cremnophilous mesembs (strictly obligate), the seeds of most cremnophilous mesembs are water-dispersed. This includes 42 taxa (19%). There is furthermore an increase in seed size and texture (epidermis tubercled) in *Conophytum*, aiding establishment in crevices. Some species (11 taxa, 5%) disperse their seed locally through a mechanism known as autochory. Animal dispersal plays a minor role as the seeds of only three taxa (not strictly obligate) are dispersed by frugatory birds.

11.2.5 Taxonomic representation

Of the 220 obligate or near-obligate cremnophytes, 79 taxa (36%) are monocotyledons, 140 taxa (64%) are dicotyledons and one species (*Pyrrosia schimperiana* [1]) is a succulent fern (see Table 11.2). Of these, 29 taxa (13%) are succulent bulbous plants and 190 taxa (86%) are more conventional succulent plants. The bulbous component (29 taxa) represents 37% of the monocotyledons. Most (66 taxa, 30%) of the dicotyledons belong to the Crassulaceae, with *Crassula* the largest genus. This is followed by the Mesembryanthemaceae (45 taxa, 20%), Asteraceae (10 taxa, 5%), Lamiaceae (9 taxa, 4%) and Asclepiadaceae (4 taxa, 2%). The remaining five families have two or fewer taxa each. Among the monocotyledons, the Asphodelaceae is the largest group, with 50 members (23%), followed by the Hyacinthaceae (18 taxa, 8%) and Amaryllidaceae (11 taxa, 5%).

Of the 220 taxa, 182 (83%) are endemic to South Africa. The 18 taxa that are endemic to Namibia represent 60% of the 30 cremnophilous taxa found in that country (Tables 11.15, 11.16 and 11.17).

11.2.6 Representation of cremnophytes in the various biomes

The Albany Thicket Biome (mainly Eastern Cape) and Succulent Karoo have the highest representation of cremnophytes, with 58 taxa (26%) each, Savanna 40 taxa (18%), Grassland 25 taxa (11%), Indian Ocean Coastal Belt 11 taxa (4%), Desert 10 taxa (5%) and the Nama-Karoo and Forest one taxon each (see Table 11.1). Although most cliffs are associated with the Drakensberg (Grassland Biome), this part of the Great Escarpment has only 25 obligate cremnophytes. The river valleys below the cliffs of the Great Escarpment (especially the in the southeast and east of the study area) are also are well represented. There is a clear concentration of cremnophytes in the Albany Thicket as well as Succulent Karoo Biomes, but these plants are also well represented in the Savanna Biome (Table 11.1).

11.2.7 Representation of cliffs

Cliffs are well represented throughout the mountainous areas of South Africa and Namibia, especially along the Great Escarpment. Riverine or near-riverine cliffs yielded 108 taxa (50%) during the study, Cape Fold Belt and other mountains 72 taxa (33%), followed by the Great Escarpment which yielded 29 taxa (13%), inselbergs five taxa (2%) and coastal cliffs four taxa (2%).

11.3 Conclusions

11.3.1 Adaptation to the cliff habitat

Adaptations of cremnophytes to the cliff-face habitat vary from remarkable, almost evolutionary ‘cul-de-sac’ features to subtle and hardly noticeable differences. Their success rate as obligate cremnophytes is due to their adaptive or evolutionary plasticity. The main driving forces (stress factors) are lack of a regular water supply, the vertical habitat and absence of disturbance. The end result is an array of various succulent life forms shaped by the habitat (environmental variables). The lack of sufficient moisture has resulted in an increase in succulent storage tissue. The response to gravity is either surrendering to this force (cliff hangers) or compact, clustered growth (cliff huggers) or small squat shrublet growth (cliff squatters) close against the cliff face.

Aspect is important and cooler southern aspects have a marked increase in diversity of cremnophilous species (due to a much higher moisture-holding capacity than northern aspects). Northern aspects are more sunny and exposed, with few obligate cremnophytes.

Local environmental conditions also play a major role. For example, some cremnophytes follow regular fog, their distribution clearly tracking the mist belt along the west coast or the mist zone of the eastern Great Escarpment mountains.

The stable and almost disturbance- and predator-free cliff habitat has led to a relaxation of defence features (see Tables 11.14–11.16), resulting in a fragile habit and a lack of distinctive mechanical defences in the plants. The vertical habitat furthermore requires an efficient reproductive system. Apart from effective pollination (rich flowering), vegetative reproductive strategies for long-term survival are common among cremnophytes.

There is also a shift in seed dispersal, with wind the major role player. Most cremnophilous mesembs have rain-dispersed seed but when the light capsules become detached, they can also be dispersed by wind. The cliff-face flora of each region is clearly related to the local (prevailing) flora, suggesting a local derivation for the specialised cremnophytes.

11.3.2 Isolation of the cliff habitat

The cliff-face flora often occurs as isolated islands within the greater landscape. These sites display the same isolation as oceanic islands. In common with islands, there is often an absence of predators, fewer taxa (compared to larger continental land surfaces) and a higher proportion of endemism. Taxa present in such isolated places are often taxonomically distinct (Hooker 1867; Darwin 1872; Wallace 1892; Gulick 1932; Good 1947; Runemark 1970).

Gasteria rawlinsonii [48] in the Baviaanskloof occurs in deep kloofs of the Baviaanskloof and Kouga Mountains. Although in close proximity, each kloof is isolated from the next and often house distinct forms (e.g. in Geelhoutboskloof, Gertsmitskloof). This clearly shows the ‘island isolation effect’ of local gene exchange. Most succulent cremnophytes are exiles to the cliff face. They have a low competitive ability and hence occupy a habitat where other plants perform poorly. Therefore, succulent cremnophytes are specialist and poorly understood taxa, often at a dead end or cul-de-sac should they lose their

cliff-face habitat. Cliffs should be seen as part of a specialised habitat of great evolutionary significance and conservation value within the greater biosphere. Hence cliffs and their biota should be protected by law on a global scale.

11.3.3 Cliffs as refugia

'He hideth my soul in the cleft of the rock', 'Rock of all ages', 'Rock of my salvation'—all well-known phrases among Jews and Christians, associating the rock face with a refuge and a stable, safe habitat. Throughout the ages, cliffs have served as refuges and during disasters and climate change they still serve this purpose. Facultative and obligate cremnophytes (succulent and other) from such sites can re-establish on non-cliff terrain when favourable conditions prevail. Cliffs and their associated steep ground are also the habitat of many other organisms. South Africa and Namibia has a rich and diverse obligate succulent cremnophyte flora that is widespread on cliffs throughout the region. Most cremnophytes, however, are associated with river valleys, concentrated in the Albany Thicket and Succulent Karoo Biomes in the south and west. Cliff faces are important stable habitats and often represent ancient refugia of biodiversity.

11.3.4 Cliffs as living laboratories

Owing to their stability and pristine vegetation, cliffs are among the last virgin habitats on earth. They can serve as living laboratories that may throw light not only on the historical past but also on the evolutionary adaptive plasticity of species when under constant long-term stress from a lack of moisture and the challenges of the vertical terrain. The different adaptive structural features that are due to the various environmental variables (latitude, altitude, rainfall aspect, geology) can be studied in detail.

11.3.5 The vertical habitat as a driving force in evolution

Cliffs are extreme habitats with three constant stress factors—aridity, the vertical habitat and the absence of disturbance or predation. These features have led to particular cliff-dependent adaptations. There is a clear increase in structural adaptive 'fine-tuning' or local specialisation such as an increase in succulence, pendent features or compact growth coping with gravity, and modifications in reproductive behaviour. There are a general decrease in size (and weight) and an increase in compact cluster forms. Vegetative backup propagules or vegetative proliferation are essential survival elements on the cliff. Semisucculent or non-succulent obligate cremnophytes show specialist reproductive behaviour such as amphicarpy or

autocarpy. Their specialised adaptations reveal information on plant behaviour and evolution (morphological and reproductive). Succulence not only enables plants to survive in hyper-arid environments, but it also allows obligate succulent cremnophytes to grow and survive where most plants would perish. The increase in succulence and other xeromorphic features are clearly adaptations to this dry habitat.

Cremnophytes are subject to little competition in the absence of disturbances by megaherbivores and fire. The resultant relaxation in defence and increase in adaptations to a vertical habitat with its variables lead to the conclusion that predation and competition are important driving forces in evolution and in the shaping of plants. Runemark (1970) suggested small isolated populations (as in many cremnophytes) may be in a creative phase (subject to random fixation of non-adaptive characters) as a result of genetic drift. This is well demonstrated in *Gasteria rawlinsonii*: e.g., leaves in a rosette and large marginal teeth (Geelhoutboskloof; in shady conditions) as to populations with leaves remaining distichous and with small marginal teeth (Gertsmitskloof; open shade, and dryer conditions).

Obligate cremnophilous vegetation is still poorly known and requires further research. If almost 20% of the obligate cremnophytes recorded during the present study were new to science, then further research may uncover many more such specialised species on local cliffs as well as in other parts of the world.

11.3.6 Horticultural application and conservation

Most obligate cremnophytes are not only horticulturally appealing, but are also suitable to fill a specialist niche on artificial ‘cliff’ sites such as window sills, roof gardens, steep embankments and vertical walls. Cremnophytes have been successfully used in hanging baskets, flower boxes on window sills and in other containers. Some are also in demand by specialist connoisseur growers. Cremnophytes showing horticultural appeal include many species of *Aloe*, *Bulbine*, *Cyrtanthus*, *Gasteria*, *Haworthia*, *Crassula*, *Conophytum* and *Delosperma* (Van Jaarsveld 1997b, 2006b). Horticultural subjects include all three major growth forms, namely cliff hangers, cliff huggers and cliff squatters. Their local adaptability ensures long-term survival in the artificial cliff environment. Many of these species are already well established in cultivation, their vegetative backup mode and ease of growth further enhancing their popularity in the ‘neo-urban cliff environment’.

TABLE 11.1—Adaptations to the cliff habitat among South African and Namibian cremnophilous succulent and succulent bulbous plants (220 taxa, 41 genera)

Issue	Monocotyledons	Dicotyledons	Ferns	Total of all cremnophytes studied
Numbers	79 taxa (36%)	140 taxa (64%)	1	220 taxa
Bulbous	29 (37% of monocots, 13% of all cremno-phytes)	1	–	30 (13%)
Succulent (bulbous excluded)	50 (63% of monocots, 23% of total)	139 (63% of total)	1	190 (86%)
Pendent stems	14	42	–	56 (25%)
Pendent leaves from cluster	27	1	1	29 (13%)
Abbreviated growth (clustered or short-stemmed)	65	60	1	126 (57%)
Extended stems	14	80	–	94 (43%)
Ascending (decumbent or erect)	65	98	1	164 (75%)
Epinastic growth	21	8	–	29 (13%)
Vegetative backup	72	130	1	203 (92%)
Rich flowering	3	25	–	28 (15%)
Fynbos	3	18	–	21 (10%)
Succulent Karoo	12	46	–	58 (26%)
Nama-Karoo	1	1	–	2 (1%)
Desert	1	10	–	10 (5%)
Grassland	10	15	–	25 (11%)
Savanna	20	18	–	40 (18%)
Forest	–	–	1	1
Albany Thicket	32	26	–	58 (26%)
Indian Ocean Coastal Belt (IOCB)	2	9	–	11 (4%)
Fog trap	–	9 (Succulent Karoo)	–	9 (4%)
Caudiciform	–	15 (14 Succulent Karoo, 1 IOCB)	–	15 (7%)
Strictly obligate cremnophytes	42	61	–	103 (47%)
Quartz/sandstone	62	113	–	175 (80%)
Shale/mudstone	17	21	–	38 (17%)
Dolomite	3	8	–	11 (5%)
Granite	1	8	–	9 (3%)
Conglomerate	1	1	–	2 (1%)
Wind dispersal (seed)	76	86	1	163 (74%)
Water dispersal (seed)	–	44	–	44 (20%)
Avian dispersal (seed)	3	1	–	4 (2%)
Autochory	3	12	–	15 (5)
Succulents in study region (3 500)	414	3 085	1	220 (6%)
Winter rain	9	54	–	63 (29%)
Summer rain	32	49	1	82 (37%)
All-year-rain	37	31	–	68 (31%)
Light weight	11	58	–	80 (36%)
Light/medium weight	24	48	–	72 (33%)
Medium weight	25	24	1	50 (23%)
Medium weight/heavy	13	6	–	19 (9%)

Issue	Monocotyledons	Dicotyledons	Ferns	Total of all cremnophytes studied
Heavy	5	1	–	6 (3%)
Evergreen	77	98	1	176 (80%)
Winter-deciduous	7	2	–	9 (4%)
Summer-deciduous (or -aestivating)	4	19	–	23 (10%)
Southern aspect	65	119	1	185 (84%)
Strictly southern aspect	39	84	1	124 (56%)
Northern aspect	13	21	–	34 (15%)
Strictly northern aspect	2	3	–	5 (2%)

TABLE 11.2—South African and Namibian cremnophilous succulent and bulbous succulent plants

Group	Number of cremnophilous taxa		
	Total	Succulent	Bulbous succulent
Monocotyledons	79	50	29
Dicotyledons	140	139	1
Ferns	1	1	–
Total	220	190	30

TABLE 11.3—Summer and winter deciduousness among South African and Namibian cremnophilous succulent and bulbous succulent plants

Group	Number of taxa			
	Total	Summer-deciduous	Winter-deciduous	Evergreen
Monocotyledons	79	4	7	68 (31%)
Dicotyledons	140	38	2	100 (46%)
Ferns	1	–	–	1
Total	220	42 (19%)	9 (5%)	169 (77%)

TABLE 11.4—Weight of the 222 obligate succulent and bulbous succulent cremnophytes occurring in the nine biomes (average weight of mature, fully turgid plants)

Biome	Number of taxa					
	Light (1–50 g)	Light / medium	Medium (51–500 g)	Medium / heavy	Heavy (> 500 g)	Total
Fynbos	9	6	2	2	2	21
Succulent Karoo	25	21	9	3	–	58
Albany Thicket	19	22	15	2	–	58
Savanna	4	12	11	7	3	40
Grassland	13	6	5	1	–	25
Forest	–	–	1	–	–	1
Nama-Karoo	1	–	–	–	–	1
Desert	3	2	2	2	1	10
Indian Ocean Coastal Belt	1	2	5	3	–	11

TABLE 11.5—Comparison of plant size between cremnophytes and related non-cremnophytes (groups of closely related taxa separated by thick lines)

Taxon	Size	Cliff habitat	Other habitat	Locality
Cotyledon barbeyi	large shrub 500 mm tall, leaves 150 mm long		×	Hanglip, Waterberg
C. barbeyi var. A [106]	small shrublet up to 100 mm tall, leaves 30–50 mm long	×		Wyllies Poort, cliffs, Soutpansberg
C. tomentosa subsp. *ladismithiensis*	shrublet, dense rounded growth up to 300 mm tall, hairy but not as markedly tomentose		×	Ladismith
C. tomentosa subsp. *tomentosa* [109]	compact shrublet up to 150 mm tall, leaves shorter, markedly tomentose	×		Gert Smitskloof, Baviaanskloof
C. pendens [108]	flaccid drooping stems, leaves markedly swollen	×		Bashee River
C. woodii	woody shrub up to 0.7 m, leaves dorsiventrally compressed		×	Kouga Dam
Crassula capitella subsp. *thyrsiflora*	leaves up to 50 mm long		×	Oudtshoorn, Little Karoo
C. capitella subsp. *thyrsiflora* (= *C. turrita*) [115]	leaves dwarf-sized, 5–12 mm long, symmetrically arranged	×		Kouga Dam cliffs
Ornithogalum longibracteatum (rocky outcrop forms) [78]	bulbs 20–50 mm in diameter	×		Bashee River cliff forms
O. longibracteatum	bulbs 100–120 mm in diameter		×	non-cliff, Knysna
Aloe arborescens subsp. *arborescens*	large rounded shrubs 1–1.5 m tall		×	Swellendam
A. arborescens subsp. *mzimnyati* [13]	small shrubs 300–500 mm high	×		Buffalo River, near Thukela River
A. meyeri [22]	rosettes 100–150 mm in diameter	×		Rosyntjieberg
A. perfoliata	rosettes 300–450 mm in diameter		×	Du Toit's Kloof
Bulbine latifolia var. *latifolia*	rosettes 200–300 mm in diameter, leaves broadly ovate-triangular		×	Hankey
B. latifolia var. *curvata* [32]	rosettes about 100 mm in diameter with linear-lanceolate leaves drawn together	×		Kouga Dam
Gasteria pillansii var. *pillansii*	rosettes large, leaves ascending, 100–200 × 25–50 mm		×	Clanwilliam Dam
G. pillansii var. *ernesti-ruschii* [47]	rosettes small, leaves 20–70 mm long, patent	×		Sonberg, southern Namibia
Othonna herrei	erect shrublet 100–150 mm tall		×	Jenkins Kop, Richtersveld
O. armiana [86]	compact, clustered heads up to 20 mm high	×		Rooiberg, Eksteenfontein
O. triplinervia [89]	with caudex, sprawling to decumbent stems up to 500 mm long	×		Kouga Dam
O. triplinervia	erect shrubs 1.5 m tall		×	Hankey

TABLE 11.6—Average leaf dimensions and internode length in cremnophilous and non-cremnophilous forms of *Crassula rupestris* and *C. perforata*

***Crassula* taxon**	**Leaf dimensions (mm)**	**Length of internode (mm)**	**Stems**	**Cliff habitat**	**Flat ground**	**Specimens examined**
C. rupestris	22 × 18 × 5	10	woody		×	*Van Jaarsveld 851/96*
C. rupestris subsp. *marnieriana* [135]	5 × 7 × 3.5	2–3	flaccid	×		*Van Jaarsveld 17431* (Zorgvliet, Ladismith)
C. rupestris subsp. *rupestris* [136]	10 × 6 × 4	4–5	flaccid	×		*Van Jaarsveld 16950* (Dwarsrivier)
C. perforata	14 × 21 × 4	10	woody		×	*Van Jaarsveld 17119* (Kouga Dam)
C. perforata subsp. *kougaensis* [131]	7 × 7 × 3	3	flaccid	×		*Van Jaarsveld 17097* (Kouga Dam)
C. perforata subsp. *perforata* [132]	10 × 8 × 6	5	flaccid	×		*Van Jaarsveld 17835* (Enon cliffs)

TABLE 11.7—Average size and stem characters of closely related cremnophilous and non-cremnophilous taxa of *Othonna*, *Plectranthus* and *Tylecodon*

***Othonna*/*Plectranthus*/*Tylecodon* taxon**	**Succulent caudex**	**Stem length**	**Erect**	**Spreading**	**Stem diameter (mm)**	**Cremnophilous**	**Non-cremnophilous**
O. armiana [86]	×	25 mm	×	×	3–10, caudex up to 70	×	
O. herrei		150–250 mm	×		15–30		×
O. triplinervia [89] (cliff form)	×	100–200 mm		×	15	×	
O. triplinervia		2–3 m	×		70–80		×
O. cremnophila [88]	×	150–250 mm	×		3.5–9	×	
O. cyclophylla		1.0–1.5 m	×		30		×
P. ernstii [168]	×	50–200 mm		×	35–50	×	
P. strigosus		100–250 mm		×	2–3		×
P. saccatus subsp. *pondoensis* [172]		1 m		×	4–8	×	
P. saccatus subsp. *saccatus*		1 m	×		10–25		×
T. buchholzianus var. *fasciculatus* [152]	×	60–150 mm	×	×	5–8	×	
T. buchholzianus var. *buchholzianus*	×	300 mm	×		3–6		×
T. cordiformis [153]	×	20–50 mm		×	12	×	
T. bayeri	×	200 mm		×	2		×
T. decipiens [154]	×	40–80 mm		×	10	×	
T. schaeferianus	×	40–80 mm		×	4–5		×

TABLE 11.8—South African and Namibian cremnophilous succulent and bulbous succulent plants with pendent elements (220 taxa, 41 genera)

Pendent element	**Number of taxa**			
	Mono-cotyledons	**Di-cotyledons**	**Other groups (fern)**	**Total cremnophytes**
Pendent leaves	18	–	–	18 (8%)
Bulbous plants with pendent leaves	11	–	–	11
Cluster-forming succulent plants with pendent leaves (bulbs excluded)	7	–	–	7
Pendent stems	14	41	–	55 (25%)
With rudimentary foliage	–	4	–	4
Foliated stems	–	37	–	37
Apical rosettes	11	–	–	11
Apical rosette extending into leafy stem	3	–	–	3
Epinastic growth	21	8	–	29 (13%)

TABLE 11.9—Stem flexibility among cremnophilous species and their close non-cremnophilous relatives (groups of closely related taxa separated by thick lines)

Taxon	**Stem flaccid, decumbent or becoming pendent**	**Stem sturdy, erect**	**Cremnophilous**	**Non-cremnophilous**
Gasteria rawlinsonii [48]	×		×	
G. bicolor		×		×
Aloe challisii [15]	×		×	
A. chortolirioides		×		×
Cotyledon pendens [108]	×		×	
C. woodii		×		×
Huernia pendula [81]	×		×	
Most *Huernia* spp.		×		×
Tromotriche baylissii [83], *T. choanantha* [84]	×		×	
Most other *Tromotriche* spp.		×		×
Plectranthus mutabilis [169]	×		×	
P. hadiensis		×		×
P. saccatus subsp. *pondoensis* [172]	×		×	
P. saccatus subsp. *saccatus*		×		×
Senecio medley-woodii [90]	×		×	×
S. pyramidatus		×		×

TABLE 11.10—Occurrence of windows in leaves of some cremnophytes (mainly on shady south-facing aspects)

Taxon	Shape and position of windows						
	Lines	Central band	Dots	Margin	Adaxial	Abaxial	Leaf apex
Albuca cremnophila [64]		×				×	
Aloe challisii [15]				×			
Conophytum ernstii subsp. *ernstii* [179]			×				
C. fulleri [181]							×
C. marginatum var. *haramoepense* [184]			×				
C. taylorianum subsp. *rosynense* [193]			×				
Drimia flagellaris [70]	×						
D. loedolffiae [71]	×						
D. mzimvubuensis [72]		×			×		
Haworthia cymbiformis var. *setulifera* [53]	×				×	×	×
H. gracilis var. *picturata* [55]	×				×	×	×
H. mirabilis var. *consanguinea* [58]	×		×	×	×	×	×
Ornithogalum pendens [79]		×				×	
Senecio muirii [91]	×					×	

TABLE 11.11—Comparison of spine size and distance between spines in related cremnophilous and non-cremnophilous species of *Aloe* (Van Jaarsveld 1981a,b, 1982a,b; Reynolds 1982) (groups of closely related taxa separated by thick lines)

Aloe taxon	Spines		Cremno-philous	Non-cremno-philous	Locality
	Size (mm), texture	Distance apart (mm)			
A. corallina [16]	1 × 1	10	×		Otjiboronbongo, Namibia
A. dewinteri [18]	1 × 1	8–12	×		Sesfontein, Namibia
A. asperifolia	2 × 1.5	10		×	central Namib, Namibia
A. omavandae [25]	1.0–1.5 × 1	10–15	×		Omavanda, Namibia
A. esculenta	2–3 × 2–3	15–20		×	Ondangua, Namibia
A. littoralis	4 × 4	15–20		×	Windhoek, Namibia
A. meyeri [22]	1–2 × 1–2	3–5	×		Rosyntjieberg, Northern Cape
A. dabenorisana [17]	1.5 × 1.5	10	×		Pella, Northern Cape
A. pavelkae [26]	1.5 × 1.5	4–8	×		Kuamsibberg, southern Namibia
A. perfoliata	3 × 3	7–10	×	×	widespread, Western Cape
A. hardyi [20]	2 × 2	15–20	×		Olifants River, Mpumalanga
A. mutabilis [23]	2 × 2	15–25	×		Witpoortjie, Gauteng
A. arborescens subsp. *mzimnyati* [13]	2 × 2	10	×		Buffalo River, KwaZulu-Natal
A. arborescens	3–5 × 3–5	20	×	×	widespread, Ugi, Eastern Cape
A. pictifolia [27]	1 × 0.5	2–3	×		Kouga Dam, Eastern Cape
A. microstigma	2–4 × 2–4	5–10		×	Worcester, Western Cape
A. nubigena [24]	leaf margin entire	–	×		Graskop, Mpumalanga
A. verecunda	leaves usually with small, soft spines	2–7		×	Witwatersrand, Gauteng

TABLE 11.12—Comparison of bitterness of leaf sap in cremnophilous and related non-cremnophilous species of *Aloe* (Van Jaarsveld 1981a,b, 1982a,b; Reynolds 1982) (groups of closely related taxa separated by thick lines) (0 = not bitter; 1 = slightly bitter to bitter; 2 = distinctly bitter)

***Aloe* taxon**	**Leaf sap: rating of bitterness**	**Cremno-philous**	**Non-cremno-philous**	**Locality**
A. corallina [16]	1	×		Otjiboronbongo, Namibia
A. dewinteri [18]	1	×		Sesfontein , Namibia
A. asperifolia	2		×	central Namib, Namibia
A. omavandae [25]	1	×		Omavanda, Namibia
A. esculenta	2		×	Ondangua, Namibia
A. littoralis	2		×	Windhoek, Namibia
A. meyeri [22]	1	×		Rosyntjieberg, Northern Cape
A. dabenorisana [17]	1	×		Pella, Northern Cape
A. pavelkae [26]	1	×		Kuamsibberg, southern Namibia
A. perfoliata	2	×	×	widespread, Western Cape
A. hardyi [20]	1	×		Olifants River, Mpumalanga
A. mutabilis [23]	1	×		Witpoortjie, Gauteng
A. arborescens subsp. *mzimnyati* [13]	1	×		Buffalo River, KwaZulu-Natal
A. arborescens	2	×	×	widespread, Ugi, Eastern Cape
A. pictifolia [27]	1	×		Kouga Dam, Eastern Cape
A. microstigma	2		×	Worcester, Western Cape
A. nubigena [24]	0	×		Graskop, Mpumalanga
A. thompsonii [30]	0	×		Wolkberg, Limpopo
A. soutpansbergensis [29]	0	×		Soutpansberg, Limpopo
A. challisii [15]	0	×		Steenkampsberg, Mpumalanga
A. ecklonis	1		×	garden material
A. reynoldsii [28]	0	×		Bashee River, Eastern Cape
A. kouebokkeveldensis [21]	0	×		Cold Bokkeveld, Western Cape
A. buhrii	0		×	northeast of Vanrhynsdorp, Northern Cape

TABLE 11.13—Leaf colour in cremnophilous species of *Gasteria* and *Ledebouria* and their non-cremnophilous relatives

***Gasteria*/*Ledebouria* taxon**	**Leaves spotted**	**Leaves immaculate**	**Leaves glaucous**	**Cremnophilous**	**Non-cremno-philous**
G. glomerata [46]		×	×	×	
G. baylissiana	×				×
G. glauca [45]		×	×	×	
G. ellaphieae	×				×
G. rawlinsonii [48]		×		×	
G. bicolor	×				×
L. venteri [76]		×		×	
Other Ledebouria spp.	×				×
L. concolor [74]		×		×	

TABLE 11.14—Comparison of plant fragility in related cremnophytes and non-cremnophytes (from Hammer 1993, 2002; Bayer 1999) (groups of closely related taxa separated by thick lines)

Taxon	Armament	Cliff habitat	Other habitat	Locality
Conophytum ricardianum subsp. *richardianum* [189]	epidermis soft, fragile	×		Sonberg, Namibia
C. wettsteinii	epidermis firm		×	Sonberg, Namibia
Haworthia mirabilis var. *consanguinea* [58]	leaves soft, fragile, ascending-spreading	×		Dwarswaterskloof, Caledon district
H. mirabilis var. *mirabilis*	leaves firm, retuse		×	Mierkraal, Bredasdorp
H. cymbiformis var. *setulifera* [53]	epidermis fragile	×		Bashee River
H. decipiens	leaves firm		×	Prince Albert, Willowmore
H. emelyae	leaves firm		×	Uniondale
H. gracilis var. *picturata* [55]	leaves fragile	×		Kouga Dam (Hankey)
H. heidelbergensis	leaves firm		×	Heidelberg, Western Cape
H. marumiana var. *batesiana* [56]	leaves soft, entire	×		Graaff-Reinet
H. marumiana var. *dimorpha*	leaves firm, spinescent		×	Montagu
H. arachnoidea	leaves firm		×	widespread, succulent karoo
H. glabrata [54]	leaves firm, but more fragile than most in sect. Hexangularis	×		Bashee River
H. attenuata	leaves firm		×	Port Elizabeth
Bulbine latifolia var. *latifolia*	leaves firm		×	Hankey
B. natalensis [34]	leaves fragile, soft (translucent)	×		Kouga Dam
B. thomasiae [40]	leaves fragile, soft (translucent)	×		Bashee River, Collywobbles
B. suurbergensis [39]	leaves fragile, soft (translucent)	×		Suurberg
Senecio pondoensis [92]	leaves soft, fragile, pruinose	×		Mzamba River
S. talinoides	leaves firm, glaucous		×	widespread, Eastern Cape

TABLE 11.15—South African and Namibian cremnophilous succulent and bulbous succulent plants: ranking of plant families by size (220 taxa, 41 genera)

Family	Number of taxa	Largest genus	Number of species	Number of genera
FERNS				
Polypodiaceae	1	*Pyrrosia*	1	1
SEED PLANTS				
Monocotyledons (3 families)	79 (36%)			
Asphodelaceae	50 (23%)	*Aloe*	18	5
Hyacinthaceae	18 (8%)	*Albuca*	6	5
Amaryllidaceae	11 (5%)	*Cyrtanthus*	8	2
Dicotyledons (10 families)	140 (64%)			
Crassulaceae	66 (30%)	*Crassula*	38	4
Mesembryanthemaceae	45 (20%)	*Conophytum*	19	11
Asteraceae	10 (5%)	*Senecio*	5	3
Lamiaceae	9 (4%)	*Plectranthus*	6	3
Asclepiadaceae	4 (2%)	*Tromotriche*	2	2
Geraniaceae	2 (1%)	*Pelargonium*	2	1
Cactaceae	1	*Rhipsalis*	1	1
Gesneriaceae	1	*Streptocarpus*	1	1
Oxalidaceae	1	*Oxalis*	1	1
Portulacaceae	1	*Avonia*	1	1

TABLE 11.16—Endemism in South African cremnophilous succulent and bulbous succulent plants

Family	Number of taxa	Number of endemic taxa	% endemic taxa	Number of genera
FERNS				
Polypodiaceae	1	–	–	1
SEED PLANTS				
Monocotyledons (3 families)	79 (36%)	67	85%	12
Amaryllidaceae	11 (5%)	10	90%	2
Asphodelaceae	50 (23%)	41	82%	5
Hyacinthaceae	18 (8%)	16	89%	5
Dicotyledons (10 families)	140 (64%)	115	82%	30
Asclepiadaceae	4 (2%)	3	75%	3
Asteraceae	10 (5%)	10	100%	3
Cactaceae	1	–	–	1
Crassulaceae	66 (30%)	51	77%	4
Geraniaceae	2 (1%)	1	50%	1
Gesneriaceae	1	1	100%	1
Lamiaceae	9 (4%)	6	67%	3
Mesembryanthemaceae	45 (20%)	41	91%	12
Oxalidaceae	1	1	100%	1
Portulacaceae	1	1	100%	1
Total	220	182	83%	42

TABLE 11.17—Endemism in Namibian cremnophilous succulent and bulbous succulent plants

Family	Number of taxa	Number of endemic taxa	% endemic taxa	Number of genera
Monocotyledons (2 families)	8	3	38%	3
Amaryllidaceae	1	–	–	1
Asphodelaceae	7	3	43%	2
Dicotyledons (5 families)	22	15	68%	10
Asclepiadaceae	1	1	100%	1
Crassulaceae	11	5	45%	3
Geraniaceae	1	1	100%	1
Lamiaceae	3	3	100%	2
Mesembryanthemaceae	6	5	83%	3
Total	30	18	60%	13