

# Analysis of the size and composition of the southern African flora

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## ABSTRACT

The southern African flora has been surveyed for the first time at species level in the *List of Species of Southern African Plants* (Gibbs Russell *et al.*, 1984). The numbers of taxa recorded for southern Africa are compared to the numbers reported from other parts of Africa, and the largest families in each area are listed and compared. The species richness of southern Africa is compared to that of other parts of the world. The numbers of genera, species and infraspecific taxa are given for each family in the southern African flora, and compared to previous counts by Dyer (1975, 1976) and Goldblatt (1978).

## INTRODUCTION

The remarkable diversity and high level of endemism in the southern African flora has been reported by a number of authors, notably Adamson (1938), Weimarck (1941), Levyns (1964) and Good (1974), and has been discussed in great detail by Goldblatt (1978). Until recently there was no modern inventory of the taxa on the subcontinent, but the publication of the *List of Species of Southern African Plants* (Gibbs Russell *et al.*, 1984) now provides for the first time a complete coverage of the entire flora. The components of the southern African flora can now be precisely analysed and comparisons can be made with floras of other parts of Africa and with previous estimates of the southern African flora. The relative importance of present studies can be assessed, and future work on the *Flora of Southern Africa* can be planned with a more accurate idea of the magnitude of the task.

## METHODS

The numbers of taxa reported here for southern Africa are taken from the PRECIS list of 30 June 1984, and some modifications have been made since the first edition of the *List of Species* went to press in October 1983. The taxa in the southern African flora were counted by computer, and have been verified by a manual count of the *List of Species*. Counts for other Floras in Africa were made by hand, as described in Gibbs Russell (1974).

Because the Floras considered for this study differ in the delimitation of families and in the level of recognition of species and infraspecific taxa, it was necessary to adopt a uniform treatment in order to compare them. Families are treated *sensu lato*, and the genus and species counts for the segregate families are added to give a single count in these cases. Notable examples of families treated in this way are Aizoaceae (includes Mesembryanthemaceae), Asclepiadaceae (includes Periplocaceae), Campanulaceae (includes Lobeliaceae), Fabaceae (includes Caesalpinioideae, Mimosoideae and Papilionoideae), Liliaceae (includes Alliaceae, Asparagaceae,

Asphodelaceae, Colchicaceae, Dracaenaceae, Eriosemaceae and Hyacinthaceae) and Scrophulariaceae (includes Selaginaceae). The alternative to a broad acceptance of these families would have been to split them apart in Floras which treat them as units. This was not done because an object of the study is to convey an overall picture of the southern African flora in relation to the floras of other parts of Africa, and it was therefore more consistent to accept these families in the broadest sense.

It was also necessary to adopt as far as possible a uniform treatment of the lower taxa, especially those of infraspecific rank. Because one author's species may be another author's subspecies or variety, the total species number for different accounts of the same group can differ considerably, and are not readily comparable. For this reason, combined totals of species plus infraspecific taxa were used on the tables below for purposes of comparison. For example, *Crassula* was revised for southern Africa by Tölken (1977), and this revision is followed in the *List of Species*. There are now 237 taxa, including 142 species with 47 subspecies, 39 varieties and 9 recognized hybrids. Examination of his treatment shows that the great majority of taxa now accepted by him at the infraspecific level were originally recognized as species. Of the 29 species given for the Cape Peninsula by Adamson & Salter (1950), 9 are accepted at the infraspecific level by Tölken (1977). If these treatments were compared at the level of species, 30% of the *Crassula* species in Adamson & Salter (1950) would not be counted in the *List of Species* that follows Tölken, thus giving the Adamson & Salter (1950) count a falsely high comparative value.

Just as the different Floras considered here cannot be directly compared because of differences in treatment, so the different parts of the *List of Species* itself vary widely in their ranking of taxa because the list is the result of taxonomic judgement by numerous individuals made over at least 80 years. A recently revised group such as *Crassula* may contain fewer species and more infraspecific taxa, while a group greatly in need of revision, such as the entire family Mesembryanthemaceae, presently has a great many species that will probably be reduced when they are critically studied. The numbers of species

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and infraspecific taxa is therefore used as a conservative 'lowest common denominator' making it possible to treat at more or less the same level the floras of different areas studied at different times by different individuals.

The problem of outright synonymy has been impossible to solve when working at a continental scale over a time span of several decades. The ideal would be to work through each of the Floras considered with the aid of the most recent taxonomic revisions and thus ensure that each taxon is recognized in the same way. However, this would be equivalent to revising the entire African flora before making the comparisons presented here. Because this is totally impracticable at present, each of the Floras covered is taken as it stands and the taxa accepted by the author of each treatment are accepted in this study, even though some of the taxa counted have been, or should have been, placed in synonymy. The use of species and infraspecific taxa when making the comparisons eases some of the discrepancies introduced by different levels of treatment at different times, but cannot eliminate them.

#### RESULTS AND DISCUSSION

##### *Total numbers of taxa in the southern African flora*

The numbers of taxa present in southern Africa are shown in Tables 1 & 2. Although it may appear to be a simple matter to determine total numbers of

taxa once a basic list is prepared, the total numbers can in fact be calculated in a number of ways depending on the emphasis that is required. Infraspecific, naturalized and well-known but as yet unpublished taxa may be included or excluded. The two most extreme of these different totals are used below to make comparisons with the floras of other areas. The total number of species and infraspecific taxa (including naturalized taxa, unpublished taxa, subspecies, varieties and recognized hybrids) is a 'high' total (Table 1), and the number of indigenous species is a 'low' total (Table 2).

The total number of species and infraspecific taxa is used to compare the Floras of different areas, and different parts of the *List of Species*, for the reasons of inconsistencies in level of taxonomic treatment given above. The 'high' total is also used to make estimates of the outstanding work for the *Flora of Southern Africa* because all infraspecific and naturalized taxa must be dealt with. In practical terms both of these can be time-consuming to cover for the *Flora*.

The total number of indigenous species must be used for biogeographical studies because the naturalized aliens, which have only recently become part of the African vegetation, are eliminated. This 'low' count is used to calculate species/area ratios to compare the diversity of the southern African flora to that of other parts of the world. It is also used to

TABLE 1. — Numbers of taxa present in southern Africa

	No. families	No. genera	No. species	+ No. infrasp. taxa	= Species & infrasp. taxa	+ Unpubl. taxa	= Total species & infrasp. taxa
Bryophyta	88	291	821	0	821	5	826
Pteridophyta	28	74	251	17	268	5	273
Gymnospermae	6	6	43	0	43	0	43
Monocotyledonae	37	502	4 491	429	4 920	209	5 129
Dicotyledonae	163	1 794	15 881	1 803	17 684	121	17 805
Total	322	2 667	21 487	2 249	23 736	340	24 076
Non-seed plants	116	365	1 072	17	1 089	10	1 099
Vascular plants	234	2 376	20 666	2 249	22 915	335	23 250
Seed plants	206	2 302	20 415	2 232	22 647	330	22 977
Flowering plants	200	2 296	20 372	2 232	22 604	330	22 934

TABLE 2. — Numbers of naturalized and indigenous families, genera and species in southern Africa

	No. families	No. naturaliz. families	= No. indigen. families	No. genera	No. naturaliz. genera	= No. indigen. genera	No. species	No. naturaliz. species	+ No. unpubl. species	= Total indigenous species
Bryophyta	88	0	88	291	0	291	821	0	5	826
Pteridophyta	28	1	27	74	4	70	251	9	5	247
Gymnospermae	6	1	5	6	1	5	43	6	0	37
Monocotyledonae	37	1	36	502	36	466	4 491	119	183	4 555
Dicotyledonae	163	8	155	1 794	189	1 605	15 881	514	21	15 388
Total	322	11	311	2 667	230	2 437	21 487	648	214	21 053
Non-seedplants	116	1	115	365	4	361	1 072	9	10	1 073
Vascular plants	234	11	223	2 376	230	2 146	20 666	648	209	20 227
Seedplants	206	10	196	2 302	226	2 076	20 415	639	204	19 980
Flowering plants	200	9	191	2 296	225	2 071	20 372	633	204	19 943

compare the current *List of Species* to the earlier estimates of Dyer (1975, 1976) and Goldblatt (1978), who published only species counts.

Previous estimates and counts for the number of indigenous species in Africa have been considerably smaller than the totals presented in the *List of Species*. For seed plants, Killick (1971) estimated 17 500 species, Dyer (1975, 1976) estimated about 18 400 species, and Goldblatt (1978) reported 18 532 species, whereas the count obtained from the *List of Species* (1984) is 19 980. A hand count of the indigenous species of vascular plants made by Wells *et al.* (1983) yielded 20 044 species, which is within 100 species of the count of 20 139 determined from the *List of Species*. This is independent confirmation of the accuracy of the computerization process. The count was obtained by different individuals using a different method for a different purpose, but working on the same herbarium collection at the same time.

#### *The largest families in the southern African flora*

The 38 families that comprise more than 100 species and constitute 0,5% or more of the total

flora are shown in Table 3. All these families are flowering plants, and account for over 82% of the entire flora, and 87% of the flowering plants. Twelve families have around 500 or more species and infraspecific taxa, with a break of nearly 100 taxa between the rest, which have fewer than 400 taxa. The 12 largest families account for over 58% of the total flora and over 60% of the flowering plants. As currently treated, the largest family is Mesembryanthemaceae, but it is believed that critical revision will bring the number of accepted taxa down to about 1 200 (Gibbs Russell & Glen, 1984). The family would then rank third, below Asteraceae and Fabaceae.

These 38 families are only 12% of the total number of families, and the 8 families that contain about half the total flora are less than 3% of the total number of families. When the families are arranged according to the number of species they contain, it is found that over half of all families have fewer than 8 species and infraspecific taxa.

Good (1974) lists the 30 largest families in the world. Ten of the 12 largest families in southern

TABLE 3. — The 38 families of flowering plants with more than 100 species ranked by numbers of species and subspecific taxa

Rank	Family	No. spp. & infraspecific taxa	No. spp.	No. genera	Spp./gen.	% of total flora	Running total of spp. & infraspecific taxa	Running % of total flora	% of endem. spp. <sup>a</sup>	Rank in 30 largest world fams. <sup>b</sup>
1	Mesembryanthemaceae	2 684	2 408	123	19,5	11,2	2 684	11,2	98,0	—
2	Asteraceae	2 417	2 116	180+50*	11,7	10,1	5 101	21,3	86,0	1
3	Fabaceae	1 802	1 540	122+13*	12,6	7,5	6 903	28,8	74,5	3
4	Liliaceae	1 142	1 066	57+2*	18,7	4,8	8 045	33,5	88,5	11
5	Iridaceae	1 024	858	46+1*	18,6	4,3	9 069	37,8	96,5	—
6	Ericaceae	984	804	24	33,5	4,1	10 053	41,9	99,7	21
7	Poaceae	955	783	171+28*	4,6	4,0	11 008	45,9	44,4	4
8	Asclepiadaceae (s.s.)	892	769	58+1*	13,3	3,7	11 900	49,6	86,9	13
9	Scrophulariaceae (s.s.)	568	543	53+5*	10,2	2,3	12 468	52,6	86,8	8
10	Euphorbiaceae	526	461	43+5*	10,7	2,2	12 994	54,1	79,7	6
11	Cyperaceae	487	464	36	12,9	2,0	13 481	56,2	51,8	9
12	Orchidaceae	480	439	54	8,2	2,0	13 961	58,2	80,5	2
13	Proteaceae	392	366	13+1*	28,2	1,6	14 353	59,8	97,0	—
14	Acanthaceae	362	351	41	8,6	1,5	14 715	61,3	66,4	15
15	Crassulaceae	346	215	5	43,0	1,0	15 061	62,8	88,6	—
16	Rutaceae	306	291	20+1*	14,6	1,3	15 367	64,0	94,1	—
17	Restionaceae	301	282	12	23,5	1,3	15 668	65,3	94,1	—
18	Geraniaceae	279	267	5	53,4	1,2	15 947	66,5	96,3	—
19	Campanulaceae (s.s.)	273	256	12	21,3	1,1	16 220	67,7	92,1	—
20	Lamiaceae	257	225	32+5*	7,0	1,1	16 447	68,6	63,1	7
21	Oxalidaceae	243	195	2	97,5	1,0	16 720	69,6	98,0	—
22	Rubiaceae	236	207	59+1*	3,5	1,0	16 956	70,6	52,1	5
23	Aizoaceae	233	184	21	8,8	1,0	17 189	71,6	98,0	—
24	Apiaceae	221	176	35+7*	5,0	0,9	17 410	72,5	90,3	17
25	Selaginaceae	218	214	10	21,4	0,9	17 628	73,4	97,1	—
26	Polygalaceae	210	205	4	51,3	0,9	17 838	74,3	87,5	—
27	Amaryllidaceae	205	198	17	11,6	0,9	18 043	75,2	81,9	—
28	Rhamnaceae	203	159	8	19,9	0,9	18 246	76,1	92,3	—
29	Thymelaeaceae	199	189	9	21,1	0,8	18 445	76,9	95,0	—
30	Sterculiaceae	186	175	7	25,0	0,7	18 631	77,6	84,6	—
31	Lobeliaceae	181	141	6	23,5	0,7	18 812	78,4	(92)	—
32	Rosaceae	180	150	13+4*	11,5	0,7	18 992	79,1	94,0	24
33	Santalaceae	178	176	6	29,3	0,7	19 170	79,9	94,4	—
34	Brassicaceae	171	113	15+19*	7,5	0,7	19 341	80,6	91,7	—
35	Malvaceae	161	139	15+6*	9,3	0,7	19 502	81,3	32,0	—
36	Chenopodiaceae	150	129	13+2*	9,9	0,6	19 652	81,9	85,2	—
37	Convolvulaceae	130	104	14+1*	7,4	0,5	19 782	82,4	29,8	—
38	Anacardiaceae	120	106	10+4*	10,6	0,5	19 902	82,9	72,0	—

<sup>a</sup> Calculated from Goldblatt (1978)

<sup>b</sup> Good (1974)

\*Naturalized taxa

Africa are included in Good's list, but Mesembryanthemaceae and Iridaceae are not among the world's 30 largest families. The 38 most important southern African families include 18 of the largest families listed by Good.

The species/genus ratios of the families can reflect their phytogeographical affinities. The overall species/genus ratio for southern African seed plants is about 9.6. The families with a species/genus ratio more than twice the overall ratio are those known to have diversified extensively within southern Africa especially in Capensis: Mesembryanthemaceae, Liliaceae, Iridaceae, Ericaceae, Proteaceae, Crassulaceae, Restionaceae, Geraniaceae, Complanulaceae, Oxalidaceae, Selaginaceae, Rhamnaceae, Thymelaeaceae, Sterculiaceae, Lobeliaceae and Santalaceae. Families with a species/genus ratio about half the overall ratio of 9.6 are all families of worldwide distribution or with centres of diversity in the tropics or north temperate areas: Poaceae (worldwide), Rubiaceae (pantropical), and Apiaceae (north temperate) (Good, 1974).

All the families with a high species/genus ratio also have more than 88% of their species endemic to southern Africa. However, not all families with a high percentage of endemic species have a high species/genus ratio. In these exceptions, either more than half the genera in the family are endemic but each have a moderate number of species (Rutaceae, Apiaceae), or less than a fourth of the genera in the family are endemic but a few genera have a large number of endemic species (Brassicaceae — *Helio-philis*, Rosaceae — *Cliffortia*).

In Table 3, the families are ranked by the number of species and subspecific taxa. If the number of indigenous species is used for ranking instead, there is little change in the placing of the 38 largest families. Cyperaceae and Euphorbiaceae exchange places at

ranks 10 and 11, but there is only a difference of three species between them. Crassulaceae falls from 15th to 20th as a result of the large number of sub-specific taxa now accepted, and Apiaceae falls from 24th to 30th as a result of the high number of naturalized species. Polygalaceae and Thymelaeaceae each gain three places in comparative ranking, mainly because they have few naturalized species or infraspecific taxa, and therefore there is little difference between the total number of taxa and the total number of indigenous species.

The 21 families of flowering plants with more than 20 genera are listed in Table 4. Only one family, Amaranthaceae, does not also have more than 100 species. The ranking of the families by number of genera corresponds only roughly to the ranking by number of species and infraspecific taxa, but the 12 families with the most genera include ten of the largest families ranked by species and infraspecific taxa. Ericaceae and Cyperaceae have comparatively fewer genera, and Rubiaceae and Apiaceae have comparatively more.

The families in Table 4 can be divided into three groups on the basis of the percentage of their genera that occur in southern Africa related to their worldwide distribution. (a) Three families have from nearly half to virtually all their genera represented in southern Africa: Mesembryanthemaceae, the most strongly 'southern African' of all our families; Iridaceae, concentrated in the southern hemisphere; and Ericaceae, with the subfamily Ericoideae present in Europe but concentrated in southern Africa (Good, 1974). (b) All the families with a worldwide distribution described by Dyer (1975, 1976) as simply 'cosmopolitan' have between 20 and 40% of their genera represented in southern Africa. (c) The families with fewer than 20% of their genera occurring in southern Africa are distributed predominantly in climatic

TABLE 4. — The 21 families of flowering plants with more than 20 genera ranked by numbers of genera

Rank	Family	No. genera in sthn Africa	No. genera worldwide <sup>a</sup>	% of genera indigenous in sthn Afr.	Family rank in sthn Afr. by spp. & infraspp. taxa	Worldwide family distribution <sup>a</sup>
1	Asteraceae	180+50*	900	20.0	2	Cosmopolitan
2	Poaceae	171+28*	660	25.9	7	Cosmopolitan
3	Fabaceae	122+13*	600	20.0	3	Cosmopolitan
4	Mesembryanthemaceae	123	124	99.2	1	Southern Africa
5	Rubiaceae	59+1*	500	11.8	22	Cos., tropical
6	Liliaceae	57+2*	230	24.7	4	Cosmopolitan
7	Asclepiadaceae	58+1*	200	29.0	8	Cos., subtropical
8	Scrophulariaceae	53+5*	170	31.1	9	Cosmopolitan
9	Orchidaceae	54	725	7.4	12	Cos., absent dry area
10	Euphorbiaceae	43+5*	300	14.3	10	Cos., tropical
11	Iridaceae	46+1*	75	61.3	5	Cos., sthn hemisph.
12	Apiaceae	35+7*	260	13.5	24	Cos., temperate
13	Acanthaceae	41	250	16.4	14	Trop. & subtrop.
14	Lamiaceae	32+5*	170	18.8	19	Cos., warm temp.
15	Cyperaceae	36	90	40.0	11	Cosmopolitan
16	Brassicaceae	15+19*	370	4.1	34	Cos., northern temp.
17	Ericaceae	24	50	48.0	6	Cos., Europe & sthn Afr.
18	Amaranthaceae	22+2*	65	33.8	—	Cos., trop. & warm
19	Rutaceae	20+1*	150	13.3	15	Cos., warm & temp.
20	Aizoaceae	21	?	—	23	Cosmopolitan
21	Malvaceae	15+6*	75	20.0	35	Cos., trop. & subtrop.

<sup>a</sup> Dyer (1975, 1976)

\* Naturalized genera

TABLE 5. — The 35 genera of flowering plants with more than 100 species and infraspecific taxa

Rank	Genus	No. supp. & infrasp. taxa	No. indigen. spp.	Family	Family rank in sthn Afr. by spp. & infrasp. taxa
1	<i>Erica</i>	792	638	Ericaceae	6
2	<i>Ruschia</i>	372	352	Mesembryanthemaceae	1
3	<i>Conophytum</i>	362	301	Mesembryanthemaceae	1
4	<i>Aspalathus</i>	333	256	Fabaceae	3
5	<i>Senecio</i>	323	309	Asteraceae	2
6	<i>Euphorbia</i>	302	266	Euphorbiaceae	10
7	<i>Helichrysum</i>	260	241	Asteraceae	2
8	<i>Oxalis</i>	241	193	Oxalidaceae	21
9	<i>Lampranthus</i>	237	218	Mesembryanthemaceae	1
10	<i>Indigofera</i>	226	212	Fabaceae	3
11	<i>Pelargonium</i>	219	211	Geraniaceae	17
12	<i>Phytica</i>	190	147	Rhamnaceae	28
13	<i>Delosperma</i>	180	159	Mesembryanthemaceae	1
14	<i>Aloe</i>	175	152	Liliaceae	4
15	<i>Thesium</i>	168	166	Santalaceae	33
16	<i>Haworthia</i>	165	153	Liliaceae	4
17	<i>Hermannia</i>	155	146	Sterculiaceae	30
18	<i>Gladiolus</i>	148	107	Iridaceae	5
19	<i>Agathosma</i>	138	138	Rutaceae	15
20	<i>Crassula</i>	137	42	Crassulaceae	20
21	<i>Wahlenbergia</i>	136	135	Campanulaceae	18
22	<i>Cliffortia</i>	129	108	Rosaceae	32
23	<i>Sutera</i>	128	125	Scrophulariaceae	9
24	<i>Selago</i>	128	127	Selaginaceae	25
25	<i>Restio</i>	119	113	Restionaceae	16
26	<i>Drosanthemum</i>	119	111	Mesembryanthemaceae	1
27	<i>Muraltia</i>	119	116	Polygalaceae	26
28	<i>Stapelia</i>	119	88	Asclepiadaceae	8
29	<i>Schizoglossum</i>	117	97	Asclepiadaceae	8
30	<i>Lotononis</i>	114	104	Fabaceae	3
31	<i>Cheiridopsis</i>	111	103	Mesembryanthemaceae	1
32	<i>Sphalmanthus</i>	111	108	Mesembryanthemaceae	1
33	<i>Lobelia</i>	103	81	Lobeliaceae	31
34	<i>Euryops</i>	103	90	Asteraceae	1
35	<i>Disa</i>	101	90	Orchidaceae	12

areas not well represented in southern Africa: Orchidaceae (absent from dry areas), Brassicaceae (north temperate), Euphorbiaceae (tropical), Apiaceae (temperate), Acanthaceae (tropical and subtropical). Amaranthaceae and Rutaceae are exceptions. Brassicaceae is noteworthy because over half its genera in southern Africa are naturalized.

Two bryophyte families also have more than 20 genera, Pottiaceae (29) and Lejeuneaceae (28).

#### The largest genera in the southern African flora

Thirty-five genera in the southern African flora have more than 100 species and infraspecific taxa, as shown in Table 5. All of these genera occur in one of the 38 largest families, and 22 occur in one of the 12 families with over 500 species and subspecific taxa. Among the 12 largest families only two, Poaceae and Cyperaceae, do not have a genus with more than 100 species. According to Goldblatt (1978), only five of the large genera are endemic, three in Mesembryanthemaceae (*Ruschia*, *Conophytum* and *Lampranthus*), one in Fabaceae (*Aspalathus*) and one in Rutaceae (*Agathosma*).

Not surprisingly, the 12 largest families have the most large genera. Mesembryanthemaceae has 7 genera with over 100 taxa, Asteraceae and Fabaceae have 3 each, and Liliaceae and Asclepiadaceae 2

each. The other families each have only a single genus with more than 100 taxa.

#### Size and composition of the southern African flora compared to the floras of other parts of Africa

Since 1950, several complete accounts of the flora of various parts of Africa have been published, covering the areas shown in Fig. 1. The numbers of taxa, number of vegetation types, centres of endemism, and sizes of each of these areas can be compared to southern Africa, in order to place our flora into perspective with that of other parts of the continent, and with smaller areas inside southern Africa. The treatments considered for tropical Africa were: *Flora of West Tropical Africa*, 2nd edn (Keay, 1954, 1958; Hepper, 1963, 1968, 1972); *The flowering plants of the Anglo-Egyptian Sudan* (Andrews 1950, 1952, 1956) and *Enumeratio Plantarum Aethiopicarum Spermatophyta* (Cufodontis, 1953–1970, as listed by Meyer, 1973). For areas within southern Africa, the following treatments were considered: *Prodromus einer Flora von Südwestafrika* (Merxmüller, 1966–1970); *Flora of Natal* (Ross, 1972); *Flora of Lesotho* (Jacot Guillarmod, 1971); *Flora of Swaziland* (Compton, 1966, 1976); *Plants of the Cape Flora* (Goldblatt & Bond, 1984) and *Flora of the Cape Peninsula* (Adamson & Salter, 1950).

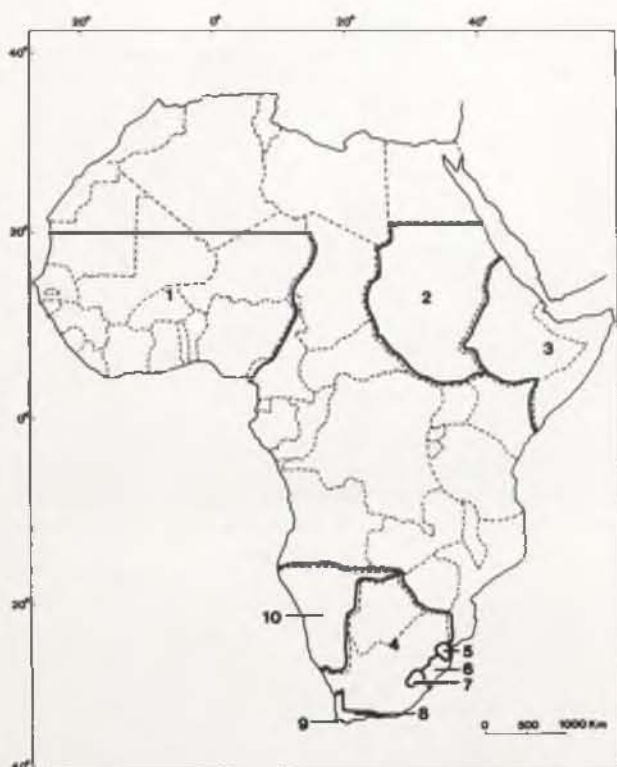


FIG. 1.—Parts of Africa covered by floras considered in this study. 1. Flora of West Tropical Africa; 2. the Flowering Plants of the Sudan; 3. Enumeratio Plantarum Aethiopicae Spermatophyta; 4. List of Species of Southern African Plants; 5. the Flora of Swaziland; 6. Flora of Natal; 7. Flora of Lesotho; 8. Plants of the Cape Flora; 9. Flora of the Cape Peninsula; 10. Prodrum einer Flora von Südwestafrika.

Tables 6, 7 & 8 compare numbers of families, genera and species plus infraspecific taxa for each of the ten floras, and Table 9 shows each of the floras ranked by numbers of taxa, area covered, number of

vegetation types and number of centres of endemism. Southern Africa has the largest number of families, genera, and species plus infraspecific taxa. Although it does not cover the largest area, it has the largest number of vegetation types and centres of endemism as mapped by White (1983). Although the west tropical African flora covers nearly twice the area of southern Africa, it has less than a third of the number of species and infraspecific taxa as southern Africa. The richness of the southern African flora is further emphasized when areas within it are compared to areas outside. The included Cape flora ranks second in number of species, with at least 1 500 taxa more than the third-ranking west tropical African flora, even though the area covered by the west tropical African flora is more than 53 times the area of the Cape flora. The included South West African/Namibian flora is similar to the Sudan flora in number of species and infraspecific taxa, even though Sudan has more than twice the number of vegetation types and nearly twice the area of South West Africa/Namibia.

The far larger number of taxa recorded for southern Africa may be ascribed to four factors:

1. southern Africa has the largest number of vegetation types of all the floras considered. None of the vegetation types are shared between southern Africa and the tropical floras north of the equator except the habitat-limited and comparatively small aquatic, halophytic, mangrove and afro-montane vegetation types. The southern African vegetation includes the Cape flora, with over 8 500 species and the karroid vegetation types, also rich in species,

2. southern Africa has four centres of endemism (White, 1983) and a very high percentage of endemic taxa (Goldblatt, 1978). Two of the centres of ende-

TABLE 6.— Comparison of numbers of families in African floras

	Tropical floras N. of equator			Entire sthn Afr. flora	Included sthn African floras					
	W trop Afr.	Sudan	Ethiopia		Swaziland	Natal	Lesotho	Cape flora	Cape Penins.	SWA/Namibia
Gymnosperms	3	4	3	6	2	4	0	4	3	1
Monocotyledons	40	32	32	37	21	34	17	32	19	26
Dicotyledons	159	135	143	163	111	141	78	116	96	127
Total seed plants	202	171	178	206	134	179	95	152	118	154
Pteridophytes	27	—	—	28	13	—	18	—	11	12
Total vascular plants	229	—	—	234	147	—	113	—	129	166

TABLE 7.— Comparison of numbers of genera in African floras

	Tropical floras N. of equator			Entire sthn Afr. flora	Included sthn African floras					
	W trop Afr.	Sudan	Ethiopia		Swaziland	Natal	Lesotho	Cape flora	Cape Penins.	SWA/Namibia
Gymnosperms	3	4	3	6	2	4	0	4	3	1
Monocotyledons	c.368	255	296	502	200	311	159	282	209	205
Dicotyledons	1 298	878	1 090	1 794	558	918	367	700	459	481
Total seed plants	1 669	1 137	1 389	2 302	760	1 233	526	986	671	687
Pteridophytes	72	—	—	74	36	—	28	—	28	16
Total vascular plants	1 741	—	—	2 376	796	—	554	—	699	703

TABLE 8.— Comparison of numbers of species and infra specific taxa in African floras

	Tropical floras N. of equator			Entire sthn Afr. flora	Included sthn African floras					
	W trop Afr.	Sudan	Ethiopia		Swaziland	Natal	Lesotho	Cape flora*	Cape Penins.	SWA/Namibia
Gymnosperms	4	4	4	43	8	14	0	11	6	1
Monocotyledons	1 810	817	1 527	5 129	566	1 304	485	2 075	846	740
Dicotyledons	5 200	2 393	4 792	17 805	1 515	3 500	1 052	6 418	1 713	2 384
Total seed plants	7 014	3 215	6 323	22 977	2 089	4 818	1 537	8 504	2 565	3 125
Pteridophytes	312	—	—	273	73	—	54	c.75	57	43
Total vascular plants	7 326	—	—	23 250	2 162	—	1 591	8 579	2 622	3 168

\*Species only. Bond & Goldblatt (1984) did not include infraspecific taxa.

TABLE 9.— Ranking of floras by numbers of taxa of seed plants, area, number of vegetation types and number of centres of endemism

Rank	Families	Genera	Spp. & infraspecific taxa	Approx. area (km <sup>2</sup> )	No. vegetation types <sup>a</sup>	No. centres of endemism <sup>b</sup>
1	Sthn Afr. 206	Sthn Afr. 2 302	Sthn Afr. 22 977	W. trop. Afr. 4 836 700	Sthn Afr. 28	Sthn Afr. 4
2	W trop. Afr. 202	W trop. Afr. 1 669	Cape flora 8 504 <sup>b</sup>	Sthn Afr. 2 573 000	W trop. Afr. 24	W trop. Afr. 3
3	Natal 179	Ethiopia 1 389	W trop. Afr. 7 014	Sudan 2 505 800	Sudan 18	Ethiopia 3
4	Ethiopia 178	Natal 1 233	Ethiopia 6 323	Ethiopia 1 696 450	Ethiopia 17	SWA 2
5	Sudan 171	Sudan 1 137	Natal 4 818	SWA 825 200	SWA 10	Cape flora 2
6	SWA 154	Cape flora 986	Sudan 3 215	Cape flora 90 000	Natal 7	Sudan 2
7	Cape flora 152	Swaziland 760	SWA 3 125	Natal 86 000	Cape flora 4	Natal 1
8	Swaziland 134	SWA 687	Cape Penins. 2 565	Lesotho 30 276	Lesotho 4	Lesotho 1
9	Cape Penins. 118	Cape Penins. 671	Swaziland 2 089	Swaziland 17 363	Swaziland 3	Cape Penins. 1
10	Lesotho 95	Lesotho 526	Lesotho 1 537	Cape Penins. 470	Cape Penins. 1	Swaziland 0

<sup>a</sup> White (1983).

<sup>b</sup> Species only. Bond & Goldblatt (1984) did not include infraspecific taxa.

mism, the Cape and the Karoo-Namib, occur only within southern Africa (except for a small extension of the Karoo-Namib into southern Angola), and although the Zambezi centre lies mostly outside southern Africa, it is not covered by any of the Floras considered except the *List of Species of Southern African Plants*. Only the afro-montane centre of endemism is shared with other Floras considered. Goldblatt (1978) estimates that 80% of the southern African species are endemic, and the levels of endemism in many of the largest families are considerably higher than 80%, as shown in Table 2. Brenan (1978) calculated an area/endemic index for various parts of tropical Africa. This index estimated for the whole of southern Africa is 161 (i.e.  $20\,000 \times 0.8 = 16\,000$  estimated endemic seed plant species;  $2\,573\,000 \text{ km}^2 \div 16\,000 \text{ endemic species} = 161 \text{ area/endemic}$ ). This indicates higher levels of endemism for southern Africa than for anywhere in tropical Africa, where Brenan reports strongest ende-

mism in Gabon (239) and Cabinda (251). In comparison, he reports that Sudan, with a similar area to southern Africa, has an area/endemic index of 50 000. At the other extreme, the area/endemic index calculated for the Cape flora using the figures of Bond & Goldblatt (1984) is 15.

3. the counts for the southern African flora as a whole and for the Cape flora are of more recent date than any of the others. Many more taxa are probably known for each of the areas now than appear in the Floras considered, most of which are over ten years old. For example, the numbers of seed plant taxa reported by Jacot Guillarmod (1971) for Lesotho were 526 genera and 1 591 species and infraspecific taxa. A listing from PRECIS of all Lesotho specimens made in 1984 showed 702 genera and 2 726 species and infraspecific taxa, an increase of 25% and 42% respectively in 13 years. Similarly, White (1983) estimates 8 000 species for the Guineo-Con-

golan centre of endemism, which forms only a part of the area of the west tropical African flora,

4. the southern African flora is being studied primarily by botanists working in the region, whereas the floras of west tropical Africa, Sudan and Ethiopia have been studied primarily by botanists working in Europe. This undoubtedly increases the proportion of the existing flora that has been collected. Even within southern Africa, mapping the numbers of specimens per quarter degree square has shown that collecting intensity is greatest in easily accessible locations (Gibbs Russell, Retief & Smook, 1984).

The individual floras included in the entire southern African area each has only a fraction of the total number of taxa in the region, and only a small proportion of the 28 vegetation types present in the whole area. Nevertheless, only the three karroid vegetation types are not covered by at least one of the included Floras considered.

The ten largest families in each of the Floras are compared in Table 10. All the ten largest families in the entire southern African flora are also among the largest families in at least one other Flora considered. Each of the 24 families concerned is represented in southern Africa, and only Apocynaceae and Annonaceae do not have over 100 species and infra-specific taxa in southern Africa. Among the floras considered, these two families are a major component only of the west tropical African flora.

Only two families, Asteraceae and Fabaceae are among the ten largest in all the floras. Asteraceae ranks first or second in all the included southern African floras, and if Mesembryanthemaceae were critically revised (Gibbs Russell & Glen, 1984) Asteraceae would be the largest family in the entire southern African flora as well. In the tropical floras Asteraceae is not as outstanding, ranking below Fabaceae and Poaceae. In contrast, Fabaceae is of first or second rank in the tropical floras, but ranks only from second to fourth in the southern African floras.

Poaceae is among the ten largest families in all the floras considered except the Cape flora, and it has a much lower ranking in southern Africa as a whole than in the tropical floras or in the included floras of southern Africa. Nevertheless, in absolute numbers there are more taxa recorded for Poaceae in southern Africa than for the tropical floras even though the ranking in southern Africa is lower. This comparatively lower rank for southern Africa as a whole may result from two factors. Firstly, the many widespread grass species are counted separately for the smaller included floras, but only once for the entire southern African flora. Secondly, the Cape flora has a very low number of grasses in comparison to Aizoaceae (s.l.), Liliaceae (s.l.), Iridaceae and Ericaceae. The large numbers of taxa in these families in the Cape flora give the Poaceae a lower ranking in the southern African flora as a whole. Cyperaceae is the only family that is a major component of all floras considered except the entire southern African flora and the Cape flora. Its absence from the ten largest families in these two floras is probably the

result of the same factors that give the Poaceae a comparatively low ranking in the same floras.

Three families show differences between the major components of the tropical and southern African floras. Acanthaceae and Rubiaceae are among the ten largest families both in the tropical floras north of the equator and in the included floras of tropical affinity within southern Africa, namely South West Africa/Namibia, Natal and Swaziland. Asclepiadaceae is the only family that is a major component of all (extra-Capensis) southern African floras but not of the tropical floras north of the equator.

Lamiaceae shows a difference between eastern Africa and the rest of the continent. In Africa, this family has its greatest importance in eastern Africa, from Sudan and Ethiopia south to Swaziland and Natal (where it ranks 11th).

The families that are peculiarly southern African, recognized in Table 3 by their high species/genus ratios and percentage of endemism, are also clearly shown in Table 10. Aizoaceae, Ericaceae, Iridaceae and Restionaceae are among the ten largest families in the Cape flora, and through it, of southern Africa as a whole. Proteaceae and Rutaceae are among the ten largest families only in the Cape flora. Amaryllidaceae and Campanulaceae are major components only of the high-altitude Lesotho flora, although Campanulaceae ranks 11th in the Cape flora. Again, one family exhibits an opposite pattern: Euphorbiaceae is one of the ten largest families in all floras except the Cape and Lesotho.

Convolvulaceae and Malvaceae are major components of the flora only in Sudan, although they have more than 100 species in southern Africa.

Three families show patterns of distribution that do not coincide with any others. Liliaceae (s.l.) is one of the ten largest families in southern and eastern Africa, but not of west tropical Africa and Sudan. Orchidaceae, although the second largest family in the world, is not among the major components of the floras of South West Africa/Namibia, Sudan or Ethiopia, perhaps because of the considerable arid areas in these countries. In Capensis, Orchidaceae ranks 12th in the Cape flora as a whole and 7th in the Cape Peninsula. Scrophulariaceae is the most unusual in its areas of importance. It is among the ten largest families in the Cape flora (temperate and winter rainfall), South West Africa/Namibia and Sudan (both tropical and arid), Natal (of tropical affinity and mesic to arid), and Lesotho (high altitude).

#### *Species richness of the southern African flora compared to floras of other parts of the world*

The richness of the southern African flora compared to floras of other large regions of the world, both tropical and temperate, is shown in Table 11. The species/area ratio for the whole of tropical Africa is similar to that of its included parts, Sudan and west tropical Africa. The ratio for southern Africa is about five times as great, illustrating the comparative poverty of the tropical African flora discussed in detail by Brenan (1978). Two other tropical areas, Brazil in tropical South America and tropical Asia, are widely separated geographically



TABLE 10. — Comparison of numbers of species and infraspecific taxa in the 10 largest families in all floras considered. The top number is the rank of the family in the flora and the bottom number is the number of species and infraspecific taxa. A dash in the top position shows that the family is not among the ten largest in that flora

	Tropical floras N of equator			Entire sthn Afr. flora	Included sthn African floras					
	W trop. Afr.	Sudan	Ethiopia		Swazi- land	Natal	Lesotho	Cape flora <sup>a</sup>	Cape Penins.	SWA/ Namibia
Acanthaceae	8 178	7 98	4 273	—(14) (362)	10 64	— (108)	— (6)	— (27)	— 0	7 118
Aizoaceae (s.l.)	— 0	— 0	— (25)	1 2 917	— (9)	— (6)	— (18)	2 769	9 94	4 191
Amaryllidaceae	— (17)	— (15)	— (19)	—(27) (205)	— (39)	— (54)	10 34	— (83)	— (27)	— (17)
Annonaceae	10 112	— (13)	— (8)	— (13)	— (2)	— (6)	— 0	— (0)	— 0	— (4)
Apocynaceae	9 132	— (23)	— (33)	— (41)	— (12)	— (25)	— 0	— (6)	— (1)	— (10)
Asclepiadaceae (s.l.)	— (94)	— (59)	— (150)	8 915	5 96	5 207	7 60	— (135)	— (21)	8 114
Asteraceae	6 291	3 208	3 565	2 2 417	1 223	1 546	1 302	1 986	1 292	2 341
Campanulaceae (s.l.)	— (27)	— (16)	— (36)	—(13) (454)	— (21)	— (75)	9 35	— (222)	— (68)	— (26)
Convolvulaceae	— (76)	8 77	— (85)	—(37) (130)	— (22)	— (52)	— (13)	— (18)	— (9)	— (44)
Cyperaceae	5 312	4 152	7 232	—(11) (487)	7 71	7 168	6 83	— (203)	5 133	6 122
Ericaceae	— (3)	— (3)	— (7)	6 984	— (9)	— (32)	— (15)	3 672	8 119	— 0
Euphorbiaceae	7 272	6 131	6 235	10 506	8 70	8 146	— (17)	— (98)	— (235)	10 89
Fabaceae (s.l.)	1 725	1 390	2 659	3 1 802	2 179	2 420	4 94	4 644	2 191	1 264
Iridaceae	— (15)	— (9)	— (27)	5 1 024	— (36)	— (92)	10 34	5 612	4 154	— (23)
Lamiaceae	— (96)	9 74	5 242	—(19) (257)	9 68	— (117)	— (26)	— (44)	— (15)	— (47)
Liliaceae (s.l.)	— (65)	— (57)	8 220	4 1 142	4 122	4 226	5 83	6 419	6 123	5 139
Malvaceae	— (78)	— (71)	10 152	—(35) (161)	— (28)	— (60)	— (13)	— (27)	— (13)	— (56)
Poaceae	2 612	2 387	1 704	7 955	3 173	3 410	2 170	— (181)	3 181	1 344
Proteaceae	— (6)	— (3)	— (1)	—(13) 392	— (9)	— (16)	— (4)	7 320	— (47)	— (1)
Orchidaceae	4 403	— (49)	— (123)	—(12) (480)	6 77	6 206	8 54	— (206)	7 121	— (9)
Restionaceae	— 0	— 0	— 0	—(16) (301)	— (1)	— (6)	— (1)	8 310	10 86	— 0
Rubiaceae	3 557	5 152	9 204	—(22) (236)	— (62)	9 130	— (18)	— (54)	— (16)	— (41)
Rutaceae	— (28)	— (9)	— (23)	—(16) 306	— (8)	— (13)	— (2)	10 259	— (23)	— (3)
Scrophulariaceae	— (93)	10 64	— (133)	9 786	— (53)	10 127	3 121	9 310	— (60)	9 (100)
Total no. spp. & infrasp. taxa in 10 largest families	3 594	1 733	3 486	13 468	1 143	2 586	1 070	5 301	1 494	1 822
% of total flora (seed plants) in 10 largest families	51	54	55	59	55	54	69	62	58	58

<sup>a</sup>Species only. Bond & Goldblatt (1984) did not include subspecific taxa.

TABLE 11. — Species/area ratios for several regions of the world with areas of over  $\pm 2\,500\,000\text{ km}^2$ 

Region	No. species	Area (km <sup>2</sup> )	Species/Area
Tropical Africa	30 000 <sup>a</sup>	20 000 000	0,0015
West tropical Africa	7 300	4 500 000	0,0016
Sudan	3 200	2 505 800	0,0013
Brazil	40 000 <sup>b</sup>	8 456 500	0,0047
India, Pakistan, Bangladesh, Burma	20 000 <sup>b</sup>	4 885 280	0,0041
Australia	25 000 <sup>c</sup>	7 716 000	0,0032
Eastern North America	4 425 <sup>d</sup>	3 238 000	0,0014
Southern Africa	20 000	2 573 000	0,0078
Southern Africa (excluding Capensis)	14 200 <sup>e</sup>	2 483 000	0,0057

<sup>a</sup>Brenan (1978).<sup>b</sup>Good (1974).<sup>c</sup>Ride (1978) quoted in Goldblatt (1978).<sup>d</sup>Goldblatt (1978).<sup>e</sup>Calculated from Gibbs Russell *et al.* (1984) and Bond & Goldblatt (1984).

but have similar species/area ratios. Although tropical areas are known to have high concentrations of species, the species/area ratio for southern Africa is about 1,7 times greater than either. The Australian flora is sometimes compared to that of southern Africa because both are southern hemisphere areas with tropical and temperate vegetation elements and both have high levels of endemism. However, the species/area ratio for southern Africa is nearly 2,5 times that of Australia. The ratio for eastern North America, in the north-temperate zone, is also far below that of southern Africa. Even if the extremely diverse Cape flora is eliminated from the determination of the species/area ratio for southern Africa, the ratio is nevertheless higher than that for tropical South America or Asia.

#### *Size and composition of the southern African flora reported in the List of Species compared to previous recent treatments*

Table 12 shows the numbers of genera and species recorded for each family in the *List of Species* (1984), Dyer (1975, 1976) and Goldblatt (1978). Families that are treated differently in the three sources are shown both *sensu stricto* and *sensu lato* so that comparisons can be made. For seed plants, the count of Goldblatt and the estimate based on Dyer agree within 50 species. They date from the same period, but Dyer's work was carried out primarily at PRE, whereas Goldblatt's count was determined from several herbaria, literature, and consultation with experts in various groups. The closeness of the final count confirms both as being reasonable determinations for that time.

The *List of Species* count is about 215 indigenous genera and 1 450 species higher than Goldblatt's count. This discrepancy is the result of different numbers of species recorded in a number of families. For 63 families (30% of the number of families of seed plants) the *List of Species* has a higher number of species than either of the other counts, and 27 families exceed Dyer's and Goldblatt's counts by more than 5 species. Over a third of the species are in Mesembryanthemaceae, which has been previously mentioned as having in reality far fewer species than are presently recognized. Three other families differ

by more than 100 species, Asclepiadaceae, Fabaceae and Liliaceae. In each of these families, certain genera are under revision but others are still in need of treatment. Goldblatt's count has only three families for which the highest number of species is recorded, Orchidaceae, Restionaceae and Rubiaceae. All three of these families have had recent changes in species numbers as a result of taxonomic revision.

Although Dyer's estimate has the lowest total number of species, curiously there are 15 families for which his species counts are the highest. Two of these families, Asteraceae and Crassulaceae, differ from the *List of Species* by more than 100 species. A number of genera in Asteraceae and the whole of Crassulaceae have been revised since 1975. Similarly, Poaceae and Sterculiaceae are recorded with over 50 species more by Dyer, but work done for the FTEA (Clayton & Renvoize, 1982) and a more accurate determination of naturalized species has reduced species number in Poaceae and revisionary work in *Hermannia* has reduced species numbers for Sterculiaceae.

It appears therefore, that differences in counts of species in a number of families are due to revisions completed or in progress between the time of completion of Dyer, Goldblatt and the *List of Species*. However, the substantially higher counts in the *List of Species* for Apiaceae, Chenopodiaceae, Cyperaceae, Euphorbiaceae, Fabaceae, Liliaceae and Scrophulariaceae cannot be solely attributed to the result of further study in these families. Furthermore, even though revisionary work has resulted in a lower count of species in families such as Poaceae and Crassulaceae, and in such genera as *Helichrysum*, where 283 taxa (260 species) were recognized at PRE in 1981, but only 260 taxa (241 species) were recognized after Hilliard's treatment of the genus for the *Flora of Southern Africa*, revision does not necessarily result in the recognition of a smaller number of species. The revision of *Asparagus* currently being completed for the Flora now recognizes two genera and 77 species where previously one genus with 44 species was recognized (A. A. Obermeyer, pers. comm.). C. H. Stirton (pers. comm.) predicts that there may be ultimately a total of 2 000

TABLE 12.—Comparison of numbers of taxa per family. Families are listed alphabetically within each group (Bryophyta, Pteridophyta, Gymnospermae, Angiospermae). The difference between counts in the List of Species (1984), Dyer (1975, 1976) and Goldblatt (1978) is indicated when there is a difference of more than 5 species. Naturalized families and genera are indicated by an asterisk. This table runs from p. to p.

Family	List of Species (1984)			Dyer (1975,76) <sup>a</sup>		Goldblatt (1978)		
	Genera	Species & infrasp. taxa	Indigen. species	Genera	Species	Genera	Species	Difference
<b>Bryophyta</b>								
Acrobolbaceae	3	4	4	-	-	-	-	
Adelanthaceae	2	3	3	-	-	-	-	
Amblystegiaceae	6	8	8	-	-	-	-	
Andreaeaceae	1	4	4	-	-	-	-	
Aneuraceae	1	9	9	-	-	-	-	
Antheliaceae	1	1	1	-	-	-	-	
Anthocerotaceae	2	7	7	-	-	-	-	
Archidiaceae	1	11	11	-	-	-	-	
Arnellaceae	1	3	3	-	-	-	-	
Aulacomniaceae	1	1	1	-	-	-	-	
Aytoniaceae	4	12	12	-	-	-	-	
Bartramiaceae	6	17	17	-	-	-	-	
Brachytheciaceae	5	13	13	-	-	-	-	
Bryaceae	10	43	43	-	-	-	-	
Bryobartramiaceae	1	1	1	-	-	-	-	
Calymperaceae	4	10	10	-	-	-	-	
Calypogejaceae	1	5	5	-	-	-	-	
Cephaloziaceae	2	5	5	-	-	-	-	
Cephaloziellaceae	1	13	13	-	-	-	-	
Cleveaceae	1	1	1	-	-	-	-	
Codoniaceae	1	8	8	-	-	-	-	
Cryphaeaceae	2	2	2	-	-	-	-	
Dicranaceae	14	42	42	-	-	-	-	
Ditrichaceae	7	14	14	-	-	-	-	
Encalyptaceae	1	2	2	-	-	-	-	
Entodontaceae	4	12	12	-	-	-	-	
Ephemeraeae	1	3	3	-	-	-	-	
Erpodiaceae	2	4	4	-	-	-	-	
Eustichiaceae	1	1	1	-	-	-	-	
Exormothecaceae	1	3	3	-	-	-	-	
Fabroniaceae	6	12	12	-	-	-	-	
Fissidentaceae	1	30	30	-	-	-	-	
Fontinalaceae	1	1	1	-	-	-	-	
Funariaceae	6	13	13	-	-	-	-	
Gigaspermaceae	3	3	3	-	-	-	-	
Grimmiaceae	3	8	8	-	-	-	-	
Gymnomitriaceae	3	4	4	-	-	-	-	
Hedwigiaceae	4	4	4	-	-	-	-	
Herbertaceae	1	1	1	-	-	-	-	
Hookeriaceae	9	12	12	-	-	-	-	
Hylocomiaceae	1	2	2	-	-	-	-	
Hypnaceae	5	20	20	-	-	-	-	
Jubulaceae	1	15	15	-	-	-	-	
Jungermanniaceae	7	21	21	-	-	-	-	
Lejuncunaceae	28	64	64	-	-	-	-	
Lembophyllaceae	1	1	1	-	-	-	-	
Lepicoleaceae	1	1	1	-	-	-	-	
Lepidoziaceae	9	20	20	-	-	-	-	
Leskeaceae	4	9	9	-	-	-	-	
Leucodontaceae	3	4	4	-	-	-	-	
Lophocoleaceae	3	12	12	-	-	-	-	
Lunulariaceae	1	1	1	-	-	-	-	
Marchantiaceae	2	6	6	-	-	-	-	
Meteoriaceae	5	5	5	-	-	-	-	
Metzgeriaceae	1	13	13	-	-	-	-	
Mniaceae	1	1	1	-	-	-	-	
Monocarpaceae	1	1	1	-	-	-	-	
Nanobryaceae	1	1	1	-	-	-	-	
Neckeraceae	4	7	7	-	-	-	-	
Orthotrichaceae	6	27	27	-	-	-	-	
Oxymitriaceae	1	1	1	-	-	-	-	
Pallaviciniaceae	2	6	6	-	-	-	-	
Phyllogoniaceae	1	1	1	-	-	-	-	
Plagiochilaceae	3	17	17	-	-	-	-	
Plagiotheciaceae	2	8	8	-	-	-	-	

Family	List of Species (1984)			Dyer (1975,76) <sup>a</sup>		Goldblatt (1978)		
	Genera	Species & infraspecific taxa	Indigenous species	Genera	Species	Genera	Species	Difference
Polytrichaceae	4	12	12	-	-	-	-	-
Porellaceae	1	5	5	-	-	-	-	-
Pottiaceae	29	73	73	-	-	-	-	-
Prionodontaceae	1	1	1	-	-	-	-	-
Pterobryaceae	4	6	6	-	-	-	-	-
Ptychomitriaceae	2	9	9	-	-	-	-	-
Racopilaceae	1	2	2	-	-	-	-	-
Radulaceae	1	9	9	-	-	-	-	-
Rhabdoweisiaceae	2	2	2	-	-	-	-	-
Rhachitheciaceae	1	1	1	-	-	-	-	-
Rhizogoniaceae	1	2	2	-	-	-	-	-
Ricciaceae	2	37	37	-	-	-	-	-
Riellaceae	1	5	5	-	-	-	-	-
Schistochilaceae	1	2	2	-	-	-	-	-
Seligeriaceae	1	1	1	-	-	-	-	-
Sematophyllaceae	6	11	11	-	-	-	-	-
Sphaerocarpaceae	1	1	1	-	-	-	-	-
Sphagnaceae	1	9	9	-	-	-	-	-
Splachnaceae	1	1	1	-	-	-	-	-
Targioniaceae	2	5	5	-	-	-	-	-
Thuidiaceae	6	9	9	-	-	-	-	-
Trachypodaceae	2	2	2	-	-	-	-	-
Wardiaceae	1	1	1	-	-	-	-	-
<b>Pteridophyta</b>								
Adiantaceae	9	63	52	-	-	-	-	-
Aspidiaceae	10	22	22	-	-	-	-	-
Aspleniaceae	2	32	29	-	-	-	-	-
Athyriaceae	5+1*	6	5	-	-	-	-	-
Azollaceae	1	3	2	-	-	-	-	-
Blechnaceae	2	10	7	-	-	-	-	-
Cyatheaceae	1	2	2	-	-	-	-	-
Davalliaceae	4	6	4	-	-	-	-	-
Dennstaedtiaceae	5	6	6	-	-	-	-	-
Equisetaceae	1	1	1	-	-	-	-	-
Gleicheniaceae	2	3	3	-	-	-	-	-
Grammitidaceae	2	2	2	-	-	-	-	-
Hymenophyllaceae	2	11	11	-	-	-	-	-
Isoetaceae	1	11	11	-	-	-	-	-
Lindsaeaceae	1	1	1	-	-	-	-	-
Lomariopsidaceae	2	9	9	-	-	-	-	-
Lycopodiaceae	1	10	9	-	-	-	-	-
Marattiaceae	1	1	1	-	-	-	-	-
Marsiliaceae	1	16	16	-	-	-	-	-
Ophioglossaceae	1	8	8	-	-	-	-	-
Osmundaceae	2	2	2	-	-	-	-	-
Polypodiaceae	6+1*	15	13	-	-	-	-	-
Psilotaceae	1	1	1	-	-	-	-	-
Salviniaceae*	1*	1	0	-	-	-	-	-
Schizaeaceae	4	7	7	-	-	-	-	-
Selaginellaceae	1	6	6	-	-	-	-	-
Thelypteridaceae	2+1*	12	11	-	-	-	-	-
Vittariaceae	1	1	1	-	-	-	-	-
<b>Gymnospermae</b>								
Cupressaceae	1	3	3	1	3	1	3	-
Pinaceae*	1*	2	0	1	0	-	-	-
Podocarpaceae	1	4	4	1	4	1	4	-
Stangeriaceae	1	1	1	1	1	1	1	-
Welwitschiaceae	1	1	1	1	1	1	1	-
Zamiaceae	1	28	28	1	30	1	25	-
<b>Angiospermae</b>								
Acanthaceae	41	362	351	43	353	41	355	-
Achariaceae	3	3	3	3	4	3	3	-
Aizoaceae (s.s.)	21	233	184	22	172	-	-	-
Aizoaceae (s.l.) (see Mesembryanthemaceae)	(144)	(2 917)	2 592	(144)	(2 476)	135	2 021	SL (+571)
Alismataceae	4+1*	6	6	4	4	3	3	-
Amaranthaceae	22+2*	81	55	23	52	20	53	-
Amaryllidaceae	17	205	198	16	221	17	199	D (+23)
Anacardiaceae	10+4*	120	105	13	93	10	93	SL (+12)

Family	List of Species (1984)			Dyer (1975,76) <sup>a</sup>		Goldblatt (1978)		
	Genera	Species & infras. taxa	Indigen. species	Genera	Species	Genera	Species	Difference
Annonaceae	8	13	13	7	14	8	13	
Apiaceae	35+7*	221	176	37	142	32	155	SL (+34)
Apocynaceae	16+2*	41	38	17	39	16	39	
Aponogetonaceae	1	9	7	1	5	1	7	
Aquifoliaceae	1	1	1	1	1	1	1	
Araceae	6	18	16	5	12	5	13	
Araliaceae	3	11	11	3	10	3	11	
Arecaceae	5	6	6	5	6	5	6	
Aristolochiaceae	1	2	1	1	2	1	1	
Asclepiadaceae (s.s.)	58+1*	892	769	54	700	-	-	
Asclepiadaceae (s.l.) (see Periplocaceae)	(66+1*)	(915)	(790)	(61)	(725)	60	605	SL (+185)
Asteraceae	180+50*	2417	2116	206	2335	174	2072	D (+219)
Balanitaceae	1	4	4	1	3	1	3	
Balanophoraceae	2	4	4	2	4	2	3	
Balsaminaceae	1	5	5	1	4	1	4	
Basellaceae	1+1*	2	1	2	1	1	1	
Begoniaceae	1	6	6	1	8	1	5	
Bignoniaceae	6	11	11	6	11	6	11	
Bombacaceae	1	1	1	1	1	1	1	
Boraginaceae	13+3*	105	92	15	85	13	81	SL (+11)
Brassicaceae	15+19*	171	113	33	117	15	109	
Bruniaceae	12	78	77	12	76	12	75	
Burmanniaceae	1	1	1	1	1	1	1	
Bursceraceae	1	33	33	1	20	1	31	
Butomaceae	1	1	1	-	-	-	-	
Buxaceae	1	2	2	1	2	1	2	
Cabombaceae	1	1	1	1	1	1	1	
Cactaceae	1+3*	13	1	3	1	1	1	
Callitrichaceae	1	3	3	1	3	1	2	
Campanulaceae (s.s.)	12	273	256	13	257	-	-	
Campanulaceae (s.l.) (see Lobeliaceae)	18	454	397	18	397	18	380	SL (+17)
Canellaceae	1	1	1	1	1	1	1	
Cannabaceae*	1*	1	0	1	0	-	-	
Cannaceae*	1*	2	0	-	-	-	-	
Capparaceae	8	63	50	8	47	8	49	
Caryophyllaceae	8+9*	66	39	17	47	8	40	D (+8)
Casuarinaceae*	1*	1	0	1	0	-	-	
Celastraceae	12	59	56	12	64	12	58	D (+8)
Ceratophyllaceae*	1*	1	0	1	1	-	-	
Chenopodiaceae	13+2*	150	129	14	80	12	108	SL (+49)
Clusiaceae (s.s.)	-	-	-	-	-	1	2	
Clusiaceae (s.l.) (see Hypericaceae)	2	11	9	2	10	2	8	
Combretaceae	5	49	41	5	35	5	35	SL (+6)
Commelinaceae	7+1*	41	36	8	25	6	28	SL (+11)
Connaraceae	2	2	2	2	2	2	2	
Convolvulaceae	14+1*	130	107	15	107	15	94	SL (+13)
Cornaceae	1	1	1	1	1	1	1	
Crassulaceae	5	246	115	9	261	5	219	D (+146)
Curcubitaceae	18	77	72	17	69	17	67	
Cunoniaceae	2	2	2	2	2	2	2	
Cyperaceae	36	487	464	33	385	30	421	SL (+79)
Dichapetalaceae	2	3	3	2	4	2	3	
Dioscoreaceae	1	22	20	1	18	1	17	
Dipsacaceae	2	23	23	2	18	2	24	
Droseraceae (s.s.)	-	-	1	2	19	2	19	
Droseraceae (s.l.) (see Roridulaceae)	3	21	21	3	21	3	21	
Ebenaceae	2	51	35	2	40	2	34	
Elatinaceae	2	12	11	2	12	2	11	
Ericaceae	24	984	804	24	792	24	799	
Eriocaulaceae	2	14	13	2	11	2	11	
Erythroxylaceae	2	6	6	2	5	2	5	
Escalloniaceae	1	1	1	1	1	1	1	
Euphorbiaceae	43+5*	526	461	48	384	41	389	SL (+77)
Fabaceae	122+13*	1802	1540	133	1378	115	1495	SL (+162)
Flacourtiaceae	13	26	26	13	28	13	25	
Flagellariaceae	1	1	1	1	1	1	1	
Frankeniaceae	1	3	3	1	3	1	3	
Fumariaceae	4+1*	8	7	5	6	-	-	

Family	List of Species (1984)			Dyer (1975,76) <sup>a</sup>		Goldblatt (1978)		
	Genera	Species & infraspecific taxa	Indigenous species	Genera	Species	Genera	Species	Difference
Geissolomaceae	1	1	1	1	1	1	1	
Gentianaceae	11	90	76	10	65	7	62	SL (+14)
Geraniaceae	5	279	267	5	265	5	271	
Gesneriaceae	2	52	44	2	47	2	43	
Goodeniaceae	1	2	2	1	2	1	2	
Greyiaceae	1	3	3	1	3	1	3	
Grubbiaceae	1	6	3	1	4	1	3	
Gunneraceae	-	-	-	1	1	1	1	
Haemodoraceae	4	12	12	4	12	4	12	
Haloragaceae (s.s.)	-	-	-	2	4	2	3	
Haloragaceae (s.l.) (see Gunneraceae)	3	5	3	3	5	3	4	
Hamamelidaceae	1	3	3	1	4	1	3	
Hernandiaceae*	1*	1	0	1	1	1	1	
Hydnoraceae	1	3	3	1	3	1	3	
Hydrocharitaceae	4	11	11	4	11	4	11	
Hydrophyllaceae	1+1*	3	2	2	2	1	2	
Hydrostachyaceae	1	1	1	1	1	1	1	
Hypericaceae	-	-	-	-	-	1	7	
Hypoxidaceae	6	86	80	5	91	6	83	D (+11)
Icacinaceae	3	6	6	3	6	3	6	
Illecebraceae	3+2*	13	7	5	8	4	9	
Iridaceae	46+1*	1 024	858	43	879	44	846	D (+21)
Juncaceae	3	23	20	3	38	3	19	D (+18)
Juncaginaceae	1	2	2	1	2	1	2	
Lamiaceae	32+5*	257	225	37	256	31	225	D (+31)
Lauraceae	4+1*	13	12	5	12	4	11	
Lecythydaceae	1	1	1	1	1	1	1	
Lemnaceae	4	10	10	6	9	6	9	
Lentibulariaceae	2	20	19	2	16	2	18	
Liliaceae	57+2*	1 142	1 066	60	949	54	907	SL (+159)
Linaceae	2	5	5	2	6	2	6	
Loasaceae	1	1	1	1	1	1	1	
Lobeliaceae	6	181	141	5	141	-	-	
Loganiaceae	5	24	24	5	22	5	24	
Loranthaceae (s.s.)	11	42	40	-	-	-	-	
Loranthaceae (s.l.) (see Viscaceae)	12	61	58	2	48	12	54	
Lythraceae	6+1*	49	43	7	27	7	35	SL (+16)
Malpigiaceae	3	17	13	3	12	3	13	
Malvaceae	15+6*	161	139	21	116	14	122	SL (+23)
Martyniaceae*	2*	2	0	1	0	-	-	
Melastomataceae	4	11	9	4	9	4	9	
Meliaceae	7+2*	17	14	9	15	6	12	
Melanthaceae	2	13	13	2	12	2	14	
Menispermaceae	7+1*	15	13	7	14	7	13	
Mesembryanthemaceae	123	2 684	2 408	122	2 304	-	-	
Montiniaceae	1	1	1	1	1	1	1	
Moraceae	4	28	28	4	27	4	27	
Moringaceae	1	1	1	1	1	1	1	
Musaceae (s.s.)	1	1	1	1	1	1	1	
Musaceae (s.l.) (see Strelitziaceae)	2	6	6	2	6	2	6	
Myoporaceae*	1*	2	0	1	0	-	-	
Myricaceae	1	9	9	1	9	1	9	
Myrothamnaceae	1	1	1	1	1	1	1	
Myrsinaceae	4	8	8	4	7	4	7	
Myrtaceae	4+3*	29	24	6	21	4	8	SL (+16)
Najadaceae	1	3	3	1	3	1	3	
Nyctaginaceae	4+1*	16	10	5	11	4	10	
Nymphaeaceae	1	4	4	1	4	1	4	
Ochnaceae	2	15	14	2	11	2	13	
Olaceae	2	4	2	2	3	2	3	
Oleaceae	5	27	22	5	22	5	22	
Oliniaceae	1	4	4	1	3	1	4	
Onagraceae	2+2*	34	12	4	11	3	11	
Opiliaceae	1	1	1	1	1	1	1	
Orchidaceae	54	480	439	54	439	54	461	G (+22)
Orobanchaceae*	1*	2	0	1	1	-	-	
Oxalidaceae	2	243	195	2	200	2	203	
Papaveraceae	1+2*	7	1	2	1	5	7	

Family	List of Species (1984)			Dyer (1975,76) <sup>a</sup>		Goldblatt (1978)		
	Genera	Species & infraspecific taxa	Indigen. species	Genera	Species	Genera	Species	Difference
Passifloraceae	4+1*	28	18	4	16	4	17	
Pedaliaceae	8	43	34	8	30	8	29	
Penaeaceae	7	26	21	7	21	7	21	
Periplocaaceae	8	23	21	7	25	-	-	
Phytolaccaaceae	2+1*	7	5	3	4	2	5	
Piperaceae	2	5	5	2	6	2	6	
Pittosporaceae	1	3	3	1	1	1	1	
Plantaginaceae	1	11	4	1	10	1	10	D & G (+6)
Plumbaginaceae	3	27	24	3	23	3	21	
Poaceae	171+28*	955	783	192	840	169	743	D (+57)
Podostemaceae	4	5	5	4	4	4	4	
Polygalaceae	4	210	205	4	207	4	201	
Polygonaceae	4+4*	49	35	6	32	4	31	
Pontederiaceae	3+1*	5	3	3	3	3	3	
Portulacaceae	5	65	64	5	62	5	56	SL (+8)
Potamogetonaceae	1	7	7	1	7	1	7	
Primulaceae	3	8	8	3	8	3	7	
Proteaceae	13+1*	392	366	14	365	14	336	SL (+30)
Ptaeroxylaceae	1	1	1	1	1	1	1	
Punicaceae*	1*	1	0	-	-	-	-	
Rafflesiaceae	1	2	2	1	3	1	3	
Ranunculaceae	7	30	24	7	25	7	25	
Resedaceae	1+1*	5	3	2	2	1	3	
Restionaceae	12	301	282	12	193	12	316	G (+34)
Retziaceae	1	1	1	1	1	1	1	
Rhamnaceae	8	203	159	8	173	9	156	D (+14)
Rhizophoraceae	4	8	8	4	8	4	8	
Roridulaceae	-	-	-	1	2	1	2	
Rosaceae	13+4*	180	150	16	145	9	133	SL (+17)
Rubiaceae	59+1*	236	207	58	232	59	234	G (+27)
Ruppiaceae	1	2	2	1	2	1	2	
Rutaceae	20+1+	306	291	21	270	23	271	SL (+21)
Salicaceae	1+1*	10	6	2	5	1	5	
Salvadoraceae	2	4	3	2	3	2	3	
Santalaceae	6	178	176	6	163	6	144	SL (+32)
Sapindaceae	13	29	29	13	25	13	23	
Sapotaceae	7	14	14	7	13	7	14	
Scrophulariaceae	53+5*	568	543	53	495	51	515	SL (+48)
Selaginaceae	10	218	214	9	206	10	210	
Simaroubaceae	1	3	3	1	3	1	3	
Solanaceae	4+5*	98	68	6	50	3	59	SL (+18)
Sphenocleaceae	1	1	1	1	1	1	1	
Sterculiaceae	7	186	175	6	229	6	169	D (+54)
Stilbaceae	5	12	12	5	10	5	13	
Strelitziaceae	1	5	5	1	5	-	-	
Tamaricaceae	1	3	2	1	1	1	1	
Tecophilaceae	2	10	8	2	10	2	10	
Thymelaeaceae	9	199	189	9	165	8	179	SL (+24)
Tiliaceae	4	61	56	4	48	4	49	SL (+8)
Trapaceae	1	2	1	1	1	1	1	
Trimeniaceae (also Monimiaceae)	1	1	1	1	1	-	-	
Turneraceae	4	11	10	4	8	4	9	
Typhaceae	1	2	2	1	1	1	1	
Ulmaceae	3	5	5	3	5	3	5	
Urticaceae	11+1*	28	24	12	26	11	27	
Vahliaceae	1	7	2	1	1	1	2	
Valerianaceae	2	2	2	2	2	2	2	
Velloziaceae	2	9	9	2	7	2	9	
Verbenaceae	10+3*	78	60	13	67	9	55	D (+7)
Violaceae	3	10	9	3	8	3	8	
Viscaceae	1	19	18	-	-	-	-	
Vitaceae	5	55	52	5	49	5	48	
Xyridaceae	1	7	7	1	10	1	10	
Zannichelliaceae	5	5	5	4	5	4	5	
Zingiberaceae	2	4	3	1	2	1	2	
Zosteraceae	1	1	1	1	1	1	1	
Zygophyllaceae	8+1*	55	53	7	62	7	46	D (+9)
TOTAL (seed plants only)	2076 +226*	22647	19776 +204*	1853	18369	1859	18327	

<sup>a</sup> Dyer (1975, 1976) omitted species counts for a number of genera. These were estimated from PRECIS lists dating from those years.

\* Naturalized genera

• Undescribed species

species in Fabaceae, an increase of about 400 species in this family.

#### CONCLUSIONS

The number of species of seed plants estimated for the southern African flora has increased by roughly 2 300 in the past fourteen years. The question arises whether the present total, based on the *List of Species of Southern African Plants* (1984) will be just as quickly outdated. There are three sources of changes in the numbers of recognized taxa: lumping and splitting of presently recognized taxa, which can either increase or decrease the total; 'finding' taxa in the Herbarium as a result of correctly identifying existing specimens as undescribed taxa or as records of taxa not previously known from southern Africa, which will increase the total; and collecting new or newly-recorded taxa in the field, which will also increase the total.

The present trend in taxonomy is generally toward reduction in the number of species recognized (Brenan, 1978). Certain families, particularly Mesembryanthemaceae, are likely to have their numbers of taxa greatly reduced when they are critically revised. There could be a reduction of over 1 000 taxa in Mesembryanthemaceae alone. However, the cases of *Asparagus* and Fabaceae show that although there may be a general trend toward reduction, and great reductions in some families, not every group will have its number of taxa reduced when it is revised.

The numbers of unpublished species and taxa given in Tables 1 and 2 are only those which are so well known that they have a 'manuscript name' awaiting publication, and they account for only 1.4% of the total number of known taxa. Observation of the PRE herbarium shows that there are a great many specimens in 'spp.' folders which await critical work by experts, and many will probably prove to be new or newly-recorded taxa. Doubtless the same situation exists in other herbaria with large holdings of southern African plants. Even if only one genus in ten contains a new species, there could be a further 250 species now represented by Herbarium specimens.

Overall, southern Africa is reasonably well covered by plant collections. PRECIS records show that every whole degree square has some specimens recorded, and since the PRECIS records represent only about 16% of the total of Herbarium specimens in southern Africa, the true coverage is probably better than the sample shown by PRECIS (Gibbs Russell, Retief & Smook, 1984). Nevertheless, the arid central and western parts of southern Africa require much greater collecting efforts in order for their plants to be as well represented in herbaria as those of the more mesic south and east. Because of the lower collecting intensity in the dry areas, it is likely that there are more new taxa awaiting discovery there than in the better-known mesic areas.

For these reasons, changes in the numbers of taxa known for the southern African flora are bound to occur as a result of the basic taxonomic activities of plant collecting, herbarium curation and revision. In the future, these changes can be easily monitored

and recorded by updating the *List of Species* in PRECIS, so that complete or partial lists can be printed by computer, and total numbers determined. The total now recognized is so large that even a change of 1 000 taxa represents only 4% of the total flora. The comparisons made here thus may change in detail, but the overall perspective is unlikely to alter.

The comparative picture outlined here emphasizes the richness of the southern African flora in terms of high species/area ratios, many vegetation types and high levels of endemism, especially in some of the largest families and genera. This richness is unequalled anywhere else in the world on a subcontinental scale, and demands that a high priority be given to the systematic study necessary to understand it.

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#### UITTREKSEL

*Die flora van Suider-Afrika is vir die eerste keer tot by spesies vlak in die List of Species of Southern African Plants (Gibbs Russell et al., 1984) ondersoek. Die aantal taksa wat vir Suider-Afrika opgeteken is word vergelyk met dié van taksa wat vir ander dele van Afrika aangegee is, en die grootste families in elke streek word gelys en vergelyk. Die rykdom van spesies in Suider-Afrika word met dié van ander dele van die wêreld vergelyk. Die aantal genera, spesies en subspecies vir elke familie in die Suider-Afrikaanse flora word gegee net met vorige tellings deur Dyer (1975, 1976) en Goldblatt (1978) vergelyk.*

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