

Weed flora of South Africa 2: power shifts in the veld

M. J. WELLS*, V. M. ENGELBRECHT**, A. A. BALSINHAS* and C. H. STIRTON*

ABSTRACT

This paper, the second in a series analysing data from the National Weed List, concentrates on weedy changes that affect the indigenous flora. The incidence of weediness and of threatened species is used as an indication of success or failure of families under prevailing conditions of disturbance. The resulting power shifts between indigenous families and the impact of exotic weeds on the situation are reviewed.

Many power shifts are taking place between indigenous species in the veld. Superficially it seems as though a relatively few invasive species are displacing a larger number of threatened species, but evidence from Natal points to more species increasing than decreasing under conditions of over-utilization.

Amongst small families power shifts are almost as prevalent and important as at species level. Seventeen small families have over 20% indigenous weed species. Thirty small families have over 20% threatened species, and 21 small families have had their species numbers bolstered by more than 20% by exotic weeds.

A very few large and medium-sized families contain over 50% of our weeds and our threatened species. It is mostly temperate (Cape) families that are under pressure relative to more tropical families. This trend is echoed at sub-family level within the Fabaceae.

RÉSUMÉ

LA FLORE DES PLANTES NUISIBLES D'AFRIQUE DU SUD 2: LEUR AGRESSIVITÉ DANS LE VELD

Ce document, le second d'une série analysant les données de la Liste nationale des Plantes Nuisibles, a trait à la substitution de la flore indigène par les plantes nuisibles. La présence relative des plantes nuisibles et des espèces menacées donne une indication sur la vitalité ou non des familles dans les conditions actuelles de perturbation. Les changements de dynamisme qui en résultent parmi les familles indigènes et l'impact des plantes nuisibles exotiques sur cette situation sont passés en revue.

Le dynamisme de nombreuses espèces indigènes du veld est en train de se modifier. A première vue, il semble qu'un grand nombre d'espèces menacées sont remplacées par un nombre relativement restreint d'espèces envahissantes, mais l'expérience acquise au Natal montre un accroissement plutôt qu'une diminution du nombre d'espèces dans des conditions d'agriculture intensive.

Les changements de dynamisme sont pratiquement aussi important au niveau des petites familles qu'au niveau spécifique. Dix-sept petites familles comptent plus de 20% d'espèces de plantes nuisibles indigènes. Trente petites familles comptent plus de 20% d'espèces menacées et vingt et une petites familles ont vu leur nombre d'espèces s'accroître de plus de 20% de plantes nuisibles exotiques.

Très peu de familles de moyenne et de grande importance contiennent plus de 50% de nos plantes nuisibles et de nos espèces menacées. Ce sont surtout les familles tempérées (du Cap) qui sont menacées, comparées aux familles tropicales qui sont plus nombreuses. Cette tendance se retrouve au niveau de la sous-famille chez les Fabacées.

1 INTRODUCTION

The veld, that 'ragged-brown carpet, vast and bare', that has served South Africa so well for so long is now becoming threadbare, leaving the way open to invasive weeds (Fig. 1).

Three main types of invasion by indigenous species take place (Wells & Stirton, 1981):

— On its higher, drier margins the retreating grassland is being invaded by small, xerophytic 'karroid' shrubs. This is referred to as the spread of the karoo.

— On its lower, moister margins grassland is being invaded by trees (followed by shrubs and herbs) from the adjacent wooded communities. This is referred to locally as 'bush encroachment'.

— In the heart of the grassland, particularly on the higher, wetter ridges, unpalatable grassland species, including tussocks and poisonous plants are on the increase.

These power shifts between physiognomically distinct communities are individually well known (Acocks, 1975), although it is doubtful if there is sufficient appreciation of their cumulative effect on the vulnerable grassland biome.

Power shifts between taxa, between exotics and indigenous plants, and between plants with different life cycles often take place within physiognomically homogeneous communities. Unless the plants involved are very distinctive, e.g. *Aloe* species increasing at the expense of grasses, these changes tend to go unnoticed. A case in point is the gradual infiltration of streambank communities by woody exotics, which has resulted in the almost total replacement of indigenous woody, streambank species in many places (Wells *et al.*, 1980; Duggan *et al.*, 1981).

In this paper we will try to throw more light on changes being brought about in the South African

*Botanical Research Institute, Department of Agriculture, Private Bag X101, Pretoria 0001, South Africa.

**Plant Protection Research Institute, Department of Agriculture, Private Bag X134, Pretoria 0001, South Africa.

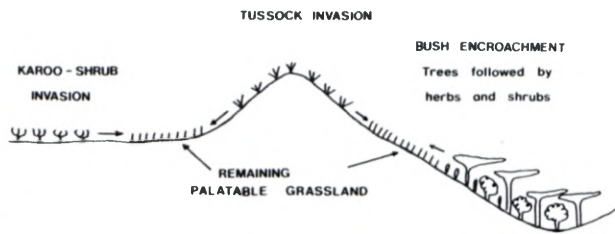


FIG. 1.—Diagrammatic representation of the three main types of invasion of the grassland.

flora as a result of weed invasion, and to answer the questions:

— ‘What power shifts are taking place between indigenous vascular plant taxa?’ and

— ‘How are exotics affecting the situation?’

To answer these questions we need to know not only what taxa are showing expansionist tendencies, but also which are giving way. In the absence of specific and wholly compatible data on the subject, we have taken:

— inclusion in the National Weed List (Balsinhas *et al.*, in press) as an indication of maintained or increasing success; and

— inclusion in lists of threatened species (Hall *et al.*, 1980; Arnold *et al.*, unpubl.) as an indication of lack of or decreasing success.

2 POWER SHIFTS BETWEEN TAXA

Power shifts have been analysed at species and at family level.

2.1 Species level

At present, of the 20 044 species of indigenous vascular plants recognized in South Africa:

— 879 (4,4%) are regarded as weeds, including 485 (2,4%) weeds of natural pastures;

— 2 347 (11,7%) are regarded as threatened; and the remaining

— 16 818 (83,9%) have not been placed in either category, and presumably fall somewhere in-between.

2.1.1 Indigenous weed species

Some of the weeds of natural pastures have been so classified because they are poisonous or carry burs, rather than because they are invasive and contribute to power shifts.

There is even one species, *Harpagophytum procumbens* (the grapple plant), a classic weed, that could soon be on the threatened plant list, as a result of over-utilization for medicinal purposes. However, most of the indigenous weeds of natural pastures are woody, unpalatable species that are increasing their range and numbers as a result of disturbance.

In some cases a single species, such as the unpalatable *Aristida junciformis* (ngongoni) replaces not only the previous dominant (*Themeda triandra*), but suppresses most other indigenous plants in the area, forming almost pure stands over thousands of hectares (Edwards *et al.*, 1980). In this particular case, the power shift is serious because it is difficult to reverse by means of management techniques.

In other cases e.g. *Chrysocoma tenuifolia* (the bitter karoo bush) the invasive species are regarded as weeds because they are unpalatable, or even poisonous, but they spread by colonizing bare areas rather than by suppressing other species. They therefore also have a caretaker rôle, providing shade and shelter, binding the soil and acting as a buffer against degeneration (Acocks, 1971). Most power shifts involving caretaker species can be reversed fairly easily using management techniques, provided that the environmental conditions have not degenerated too far.

2.1.2 Threatened species

Some of these species are naturally rare or localized and even those whose numbers are decreasing are not all the victims of plant invaders. However, the vigour and adaptability of other plants in the vicinity (even caretaker species) must contribute to the competitive pressures exerted on those that are less resilient.

At present far more indigenous species are considered to be threatened (Hall *et al.*, 1980; Arnold *et al.*, 1980) than are considered to be weeds (Balsinhas *et al.*, 1982). Superficially, it would appear that a relatively few vigorous, invasive, indigenous species are strengthening their positions at the expense of a much greater number of species that either are or will become threatened. In view of this, the lack of knowledge about so many species, their success rate and status, gives cause for concern.

2.1.3 The species inbetween

Information about the success or failure rate of species that are neither considered to be weeds, nor threatened, is very fragmentary. Foran *et al.*, (1978) have developed a method for assessing conditions in grassland which measures decreaser species that decline in abundance with bad management, increaser-I species which increase with under-utilization and increaser-II species which increase with over-utilization. Tainton *et al.*, 1978 suggest the addition of an increaser-III group to include species encouraged by selective grazing. Westfall (1981) has expanded the method to include woody vegetation, and there is a good prospect that increaser and decreaser species will be recorded on a countrywide basis during the course of a natural resources survey which is being carried out by the state Department of Agriculture & Fisheries (Edwards, 1981).

It is of interest that Foran *et al.* (*l.c.*), recorded more increaser than decreaser species under conditions of over-utilization and the overall effect of power shifts between indigenous species is far from clear.

2.1.4 Exotic weed species

Indigenous weeds have been supplemented by 694 exotic weed species, of which 481 are naturalized in the veld and compete directly with indigenous species. Many of these, such as: *Acacia saligna* (Port Jackson wattle), *Hakea sericea* (silky hakea), *Lantana camara* (tickberry), *Opuntia ficus-indica* (prickly pear), *Pinus pinaster* (cluster pine), *Prosopis glandulosa* (mesquite) and *Stipa trichotoma* (nassella tussock) form closed stands excluding

TABLE 1.—The families that supply most of our indigenous species, weeds and threatened species

*Families which between them contain approximately 50% of the species	All indigenous species	Indigenous weed species	Indigenous natural pasture weed species	Indigenous threatened species	Exotic naturalized (flora weed) species	All exotic weed species recorded in South Africa
Mesembryanthemaceae	2527*	9	8	73	0	0
Asteraceae	2115*	133*	100*	187*	53*	90*
Fabaceae	1522*	83*	54*	91*	66*	74*
Liliaceae	1006*	28*	25*	141*	0	3
Iridaceae	811*	15	8	227*	0	0
Poaceae	809*	155*	36*	67	101*	120*
Ericaceae	782*	0	0	92*	0	0
Asclepiadaceae	702*	6	5	118*	1	3
8 Families* supply	10274*					
out of total of	20044					
indigenous species						
Cyperaceae	455	63*	26*	1	0	3
5 Families* supply		464*				
out of total of		879				
indigenous weed species						
Rubiaceae	237	19	17*	15	1	4
6 Families* supply			259*			
out of a total of			485			
indigenous natural pasture weed species						
Proteaceae	365	0	0	140*	6	6
Orchidaceae	466	1	0	118*	0	0
Santalaceae	176	2	2	79*	0	0
9 Families* supply				1182*		
out of a total of				2347		
indigenous threatened species						
Solanaceae	71	13	9	1	21*	31*
4 Families* supply					241*	
out of a total of					481	
exotic flora weed species						
Brassicaceae	111	6	2	47	9	25*
5 Families* supply						340*
out of a total of						694
all exotic weed species						

entire communities of indigenous plants (Stirton, 1978).

2.2 Family level

Of the 227 indigenous vascular plant families in South Africa: 156 families (69%) supply 1 000 (5%) of the species; 63 families (27%) supply 8 770 (44%) of the species; 8 families (4%) supply 10 274 (51%) of the species.

2.2.1 Small families

The 156 small families contain an average of only 6.4 indigenous species each, and include 46 families with only a single indigenous species. In such small families the success or failure of a single species or a very few species has a profound effect on the fortunes of the family. Power shifts are almost as prevalent and important as they are at species level.

TABLE 2.—The distribution of weeds and threatened species in the three sub-families of the Fabaceae

Sub-family	(A) Total indig. spp.	Indig. weed spp.		(D) Threatened spp.	Exotic weeds		(G) Total change C + D + E in veld
		(B) Total	(C) Natural pastures		(E) Flora weeds	(F) Total	
Caesalpinioideae	53	12 (23%)	8 (15%)	5 (9%)	11 (21%)	12 (23%)	24 (45%)
Mimosoideae	76	25 (33%)	25 (33%)	13 (17%)	17 (22%)	23 (30%)	55 (72%)
Papilionoideae	1 393	45 (3%)	20 (1%)	73 (5%)	31 (2%)	39 (3%)	124 (9%)
Total (Fabaceae)	1 522	82 (6%)	53 (3%)	91 (6%)	59 (4%)	74 (5%)	203 (15%)

There are 17 small families that contain over 20% indigenous weed species. They include the water-plant families: Lemnaceae, Hydrocharitaceae, Potamogetonaceae and Aponogetonaceae, whose species are taking advantage of habitats provided by man-made dams as well as the enriched conditions in natural water bodies.

Thirty of the small families contain over 20% threatened species. These include Rhizophoraceae (50%), Penaeaceae (52%), Arecaceae (67%), and 12 single-species families.

In twenty-one of the small families naturalized exotics have bolstered the species present by more than 20%. These include: the water-plant families Lemnaceae (27%), Hydrocharitaceae (27%), Azollaceae (100%) and Hydrophyllaceae (100%); and terrestrial plant families such as Onagraceae (27%), Passifloraceae (29%), Nyctaginaceae (31%), Plantaginaceae (44%), Myrtaceae (48%), Phytolacaceae (50%), Salicaceae (71%) and Cactaceae (1 700%).

2.2.2 Large and medium-sized families

A very few families supply most of our weeds and threatened species (see Table 1).

Of the 8 largest families that supply most of our species, only 4 (Poaceae, Asteraceae, Fabaceae and Liliaceae) together with one medium-sized family (Cyperaceae) supply over 50% of our indigenous weed species. Apart from Liliaceae (most of whose weed species are poisonous rather than invasive), these families appear to be strengthening their position relative to the remaining large families Mesembryanthemaceae, Iridaceae, Ericaceae and Asclepiadaceae.

If we ignore the vast areas of crop and wasteland covered by agrestal and ruderal weeds, and concentrate on the remaining areas of veld, we find that 50% of the weed species of natural pastures are supplied by the same five families that supplied most weeds of all kinds, plus one medium-sized family Rubiaceae. A further change is that the weedy rôle of indigenous Poaceae is much lower in natural pastures than in adjacent crop and wastelands. This may well reflect vegetation changes shown in Fig. 1, where grass-dominated communities are giving way to karroid and arborescent communities in which most species are drawn from Asteraceae and Fabaceae.

Most indigenous families, even the weedy ones, contain more threatened species than weeds. The threatened species are more evenly distributed, 50% of them being supplied by 9 families: 6 large families (Iridaceae, Asteraceae, Liliaceae, Asclepiadaceae, Ericaceae and Fabaceae), together with 3 medium-sized families (Proteaceae, Orchidaceae and Santalaceae). The overall tendency seems to be for the large families to maintain or strengthen their positions relative to the smaller families.

As with indigenous weeds, the exotic weeds are concentrated in very few families. Practically 50% of all exotic weed species, and more than 50% of exotic species naturalized in the veld are provided by only 4 families: 3 large families — Poaceae, Asteraceae and Fabaceae, and one medium-sized family Solanaceae.

Three different patterns of success or failure within large and medium-sized families emerge from Table 1.

Pattern 1: large families containing many weeds and many threatened species, with the weedy side of the family being re-inforced by many exotics (Asteraceae, Poaceae and Fabaceae). Amaranthaceae, not shown in Table 1, exhibits a very similar pattern.

Pattern 2: large and medium-sized families containing few or no invasive indigenous or exotic weeds, but many threatened species (Iridaceae, Asclepiadaceae, Liliaceae, Mesembryanthemaceae, Ericaceae, Proteaceae, Orchidaceae and Santalaceae). Other families, not included in Table 1, that show this pattern, are: Rutaceae, Amaryllidaceae, Restionaceae, Bruniaceae, Crassulaceae, Campanulaceae, Polygalaceae, Rhamnaceae, Lobeliaceae, Portulacaceae and Zamiaceae.

Pattern 3: medium-sized families with very few indigenous weeds and threatened species, being supplemented by many exotic weed species (Solanaceae). Other families not included in Table 1, that show this pattern, are: Apiaceae and Polygonaceae (and many small families).

A fourth pattern, not represented here, is that of the 10 exotic families which between them supply 21 weed species, all of which are naturalized in the veld.

There are many variations of and intermediates between these patterns, but those shown here illustrate the main power shifts i.e. away from families showing pattern 2, (mostly centred in the

Cape) and towards those showing patterns 1, 3 and 4 (mostly centred in the more tropical parts of the country).

2.3 Sub-family level

An analysis of Fabaceae, one of the large families with many weeds as well as many threatened species, shows interesting differences at sub-family level (Table 2).

If the percentages in columns C, D and E are added (column G) it is seen that there is far less stress and expansion (9%) in the large sub-family Papilionoideae than in the other sub-families (Caesalpinioideae 45%, Mimosoideae 72%). In Papilionoideae the ratio of threatened species to weeds $\frac{C+E}{D}$ is also very different (0,7), compared to 3,8 in caesalpinioideae and 3,3 in Mimosoideae. There would appear to be a strong shift away from the more temperate, herbaceous Papilionoideae in favour of the other two more tropical and woody sub-families.

3 CONCLUSIONS

Many power shifts are taking place between indigenous species in the veld. Superficially, it seems as though a relatively few invasive species are displacing a larger number of threatened species, but evidence from Natal points to more species increasing than decreasing under conditions of over-utilization.

Amongst small families power shifts are almost as prevalent and important as at species level. Seventeen small families have over 20% indigenous weed species. Thirty small families have over 20% threatened species, and 21 small families have had their species numbers bolstered by more than 20% by exotic weeds.

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