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A contribution to the knowledge of floral variation in Acacia karroo in eastern South Africa

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SUMMARY

The authors have studied floral variation for plants of *Acacia karroo* from eastern South Africa. Ordinary capitate florets as well as involucellate ones borne on the peduncles were considered. Attention is drawn to other South African species bearing involucellate florets.

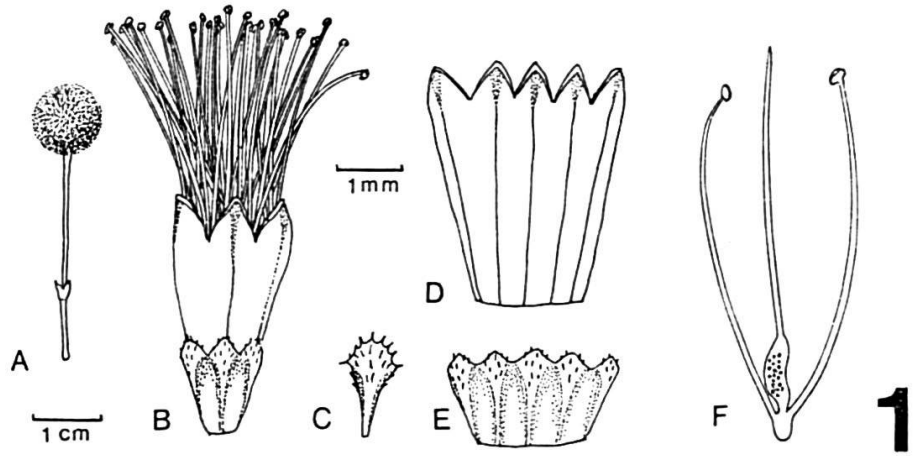
RÉSUMÉ

Les auteurs ont étudié la variation florale de quelques peuplements d'*Acacia karroo* provenant de l'Afrique du Sud orientale. Les fleurons ordinaires des capitules ainsi que ceux nés aux involucelles des pédoncules ont été pris en considération. D'autres espèces sud-africaines portant des fleurons pédonculaires sont aussi mentionnées.

Ross (1971a) referred to *Acacia karroo* Hayne as "... the most widespread *Acacia* in southern Africa": not only widespread, it is numerically well represented through most of its range, and exceedingly variable, especially in Natal where it is recorded from sea level to 1524 m at van Reenen's Pass over the Drakensberg mountains.

Six variants were recognized by Ross (op. c.) for Natal. None of these received formal infraspecific rank since all tended to grade, without clearly definable limits, into "the central *A. karroo* gene pool". The "trees with whitish bark, long white spines and long moniliform pods found along the Zululand coast" he regarded as "perhaps the most distinctive of all the variants...". Gerstner, a missionary with strong botanical interests, initially regarded this Zululand variant as a new species, but ultimately united it with white-barked, short-spined plants that, much earlier, had been described as *A. natalitia* by E. Meyer (1836) from specimens collected by Drège near Durban. Ross (1971a & b) did not maintain formal rank for *A. natalitia*, even infraspecifically, but he did regard it as an entity distinct from the long-spined Zululand variant.

In South Africa, *A. karroo* has a long flowering season, each plant generally producing a series of flushes of open florets massed in capitate heads that are arranged in pseudo-panicles terminating the ends of branches. Each head consists of numerous sessile, bracteated florets, some bisexual, some male, bright yellow in colour and consisting of a short 5-lobed calyx subtending a longer 5-lobed corolla. These whorls surround numerous stamens within which there is often, but certainly not always, a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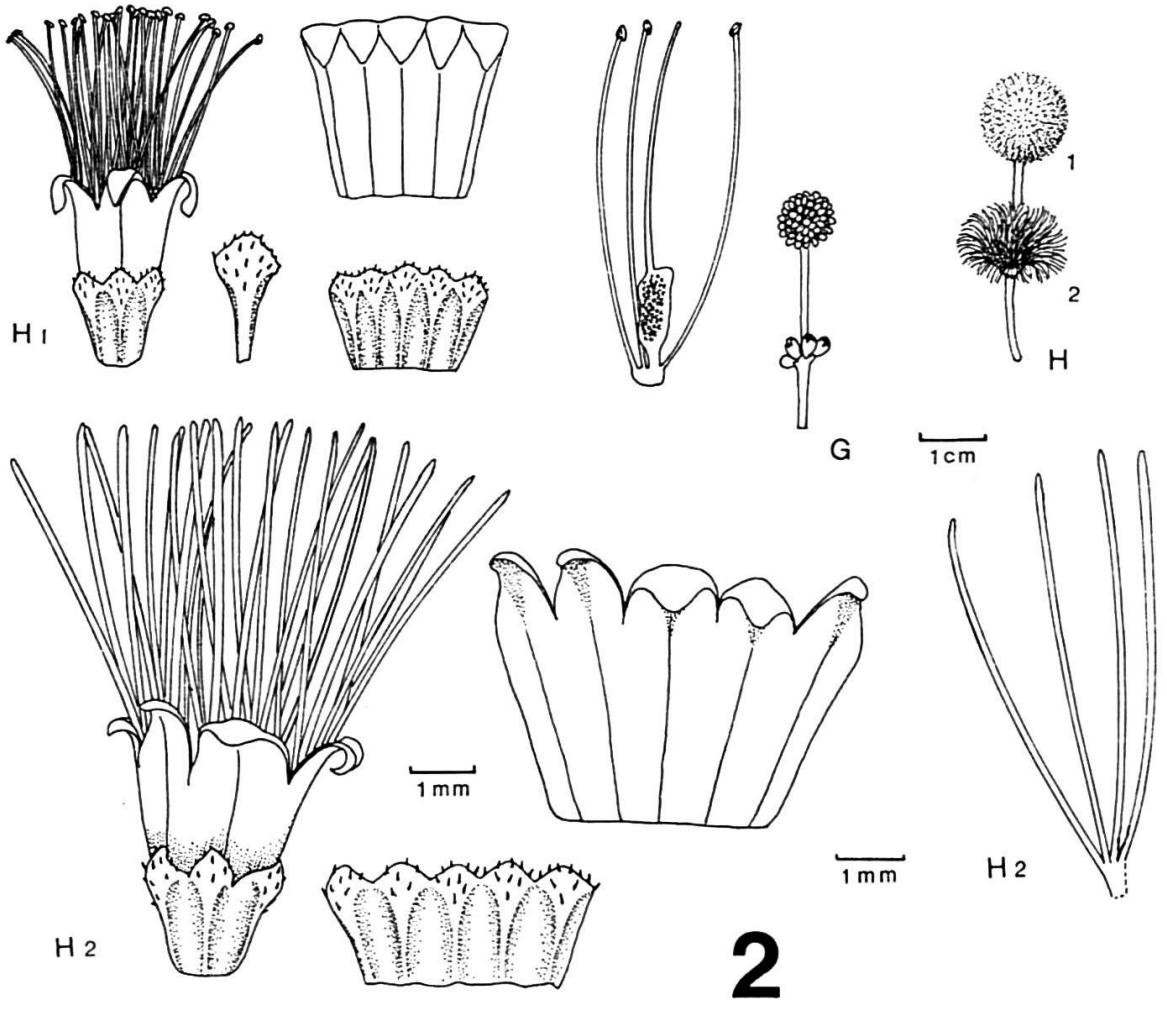
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gynoecium with a glandular, many seeded ovary (Fig. 1). Each head is borne on a jointed peduncle: a single ring of bracts, the involucel, develops at the joint. The involucel is generally empty and dries and abscises as the florets of the head open.

There is a tendency within the species, however, for one or more florets to develop within the involucel. This has been observed by several workers and was commented upon by Ross (1971a), who regarded these florets as "apparently sterile, but requiring further investigation": this author found that structurally a rudimentary gynoecium might occasionally be present, more often it was entirely lacking.

The purpose of this paper is to report further on florets developed within involucels in *Acacia karroo* in eastern South Africa, to describe their structure, and to compare this with the structure of florets developed in the capitate heads of the same inflorescences. Mention will also be made of other South African species in which florets have been observed within the involucel or along the distal portion of the peduncle.

Field observations

During the spring/summer season of late 1973/early 1974, occasional plants of *A. karroo* growing on the coast of Natal produced many inflorescences in each of which a ring of robust florets developed within the involucel. These florets opened before those of the capitate head to reveal stout staminodes (filament-like structures lacking any apical anther or gland). They were paler in colour than the florets of the head and larger in size (Fig. 2). This initial observation led to a survey of Natal plants of *A. karroo* and to some consideration of populations growing in the Nelspruit and White River areas of the eastern Transvaal, in an endeavour to determine how widespread was the development of florets within the involucel in a particular season, and how varied was their structure. Wherever plants were found to carry florets in the involucels, representative inflorescences were preserved for later laboratory study. At least twenty inflorescences taken usually from several, occasionally from only one, tree in a locality constituted a sample. Voucher herbarium specimens were also prepared and colour photographs taken.

Results

Results for populations that represented extremes among those studied are given in Table 1.

Fig. 1. — *A. karroo* dry valley scrub form.

A, single inflorescence (note absence of florets within the involucel); *B*, bisexual floret from capitate head; *C*, bract subtending bisexual floret; *D*, corolla of bisexual floret; *E*, calyx; *F*, gynoecium and two of the many stamens.

Fig. 2. — *A. karroo*, Zululand coast form.

G, inflorescence, florets in bud; *H*, inflorescence, florets open: 1 — capitate head, 2 — florets within involucel; H_1, bisexual floret of capitate head and dissection showing its parts (subtending bract included); H_2, floret from within involucel and dissection showing its parts (note absence of gynoecium and subtending bract).

Locality and grid reference	*Nature of sample*	*Number of florets per involucel*		
		Range	*Mode*	*Mean*
1. N coast of Zululand: Kosi Lake system, 26°59′S; 32°51′E.	20 inflorescences from 4 plants	6-11	10	8.3
2. S coast of Natal: Domba Valley near Anerley, 39°39′S; 30°28′E.	20 inflorescences from 4 plants	5-11	7.8	8.7
3. S coast of Natal: Mgwili stream of Ifafa R., 30°23S; 30°35′E.	20 inflorescences from 2 plants	6-9	8	7.6
4. Zululand: Ubisana Game Ranch, Mzinene Valley, 28°01′S; 32°13′E.	20 inflorescences from 5 plants	0-4	0	0.5

Table 1. — *Acacia karroo.* Extreme populations bearing involucellate florets.

Plants with the highest numbers of involucellate florets were from the northern coast of Zululand. Morphologically these plants were long spined and whitish-barked and eventually bore long moniliform pods, so that they were examples of Ross' Zululand coast variant. These florets were uniformly sterile (Fig. 2, H_2), each consisting of a perfectly formed 5-merous calyx and corolla subtending a large number of stout staminodes resembling filaments, but more robust than these and lacking any development of apical anther and gland. No trace of a gynoecium was seen in any floret dissected.

Plants bearing inflorescences with an almost similar range of involucellate florets were from the south coast of Natal (Domba and Mgwili). Both these groups of plants were whitish-barked, but the spines were short and thus they were representative of the variant named at one time, *A. natalitia* E. Mey. Structurally the involucellate florets were the same as those from the Zululand coast.

A population from Zululand that was not coastal (Ubisana Game Ranch) produced few involucellate florets (in an additionnal sample of 300 inflorescences taken from these trees, only 8 carried florets within the involucels). These florets differed structurally, for while they lacked gynoecia, the filaments bore fully formed anthers and glands typical of those of the florets of the capitate heads, except for an occasional few or one that was staminodal and enlarged. (The functional efficiency of these anthers as producers of viable pollen was not determined, however.) These florets were also smaller, equalling in size those of the capitate heads. These plants grew on basaltic soils in a valley sloping to a river and were representative of the small trees with dark, rough bark that usually grow in dry valley scrub or thornveld (variant 1 of Ross, 1971a: 391).

For these four populations, the florets of the capitate heads of each of five inflorescences taken indiscriminately from the sample of twenty were counted, examined microscopically to study structure, and scored so that percentages of bisexual and male florets could be calculated. The results obtained are given in Table 2.

While it is appreciated that a sample of five inflorescences only is statistically unsound, the parameters obtained are probably indicative of variation possible within *A. karroo.* Worthy of further study are trees of the Kosi Lake System and Mgwili populations, for while both produce sterile staminodal involucellate florets, those of the capitate heads were 55.6% bisexual in the one case and 0% bisexual in

the other. It remains to be determined whether these figures will be substantiated in a second and subsequent seasons, or whether they are merely examples within a fluctuating range.

Population	*Florets of the capitate head*		
	Range in number per head	*% Bisexual*	*% Male*
Kosi Lake System	93-102	55.6	44.4
Domba	72-102	43.3	56.7
Mgwili	85-116	0	100
Ubisana	105-121	48.7	51.3

Table 2. — *Acacia karroo*. Florets of capitate heads. (Study based on five inflorescences from the samples of twenty mentioned in Table 1.)

In the results given so far intermediate populations have not been included, but intermediates were encountered. In these the florets within the involucels were intermediate numerically and also structurally. Staminodes bearing no anthers, but one, two or three apical glands occurred, as did staminodes with rudimentary anthers and usually a single gland. In many cases staminodes variable in form were mingled within a floret, sometimes with normal apparently fertile stamens.

The capitate heads each comprised varying proportions of bisexual and male florets. Some male florets lacked any vestiges of gynoecia while in others minute rudimentary ovaries with short styles and imperfectly developed stigmas were present. The bisexual florets were aggregated distally in the head; male florets lacking any vestiges of gynoecia were clustered round the peduncle. Between these extremes were florets with varying expressions of gynoecial development. Thus there is a gradient of "femaleness" within the capitate heads.

Conclusions

From this survey covering only a single season certain tentative conclusions may be drawn.

1. *Acacia karroo*, in South Africa, may produce inflorescences in which florets may be borne within the involucel. A range in number, size and structure of these florets has been recorded.
2. The extremes of this range are represented by (a) florets that are numerous (up to 11 per involucel); larger than the florets of the capitate head; sterile, with filaments enlarged into robust staminodes lacking any vestige of anther or gland. (b) florets that are few (from 0-4 per involucel, usually 0); equalling in size and structure those of the capitate heads; functionally male, or sterile (?).
3. Extreme (a) was produced by plants on the Natal coast, namely the Zululand coast variant,[1] and the white-barked, short-spined variant (*A. natalitia* E. Mey.)[2] (see Ross, 1971a: 391), which some authorities suggest should be combined as a single taxonomic entity.

[1] Applies to all trees in the population as far as could be ascertained on inspection.

[2] Applies to many trees in the population (some plants produced fewer involucellate florets).

4. The fewer the florets produced within an involucel, the greater appears to be the likelihood that these will be comparable in size and in structure with staminate florets of the capitate head.
5. No gynoecia, even rudimentary ones, have been found in involucellate florets.
6. The phenomenon of development of florets within the involucel is not confined to Natal populations. Plants from the eastern Transvaal also developed these, but all samples studied showed only few florets per involucre.
7. The capitate heads usually comprise bisexual and male florets in varying proportions, but they may be exclusively male. No example of exclusively bisexual florets was encountered. The male florets may lack any vestige of a gynoecium, or a minute, or a larger ovary, always lacking a perfectly formed style and stigma, may be present. The bisexual florets are distal in the head: male florets without vestigial gynoecia are proximal: between these extremes the florets carry imperfectly developed gynoecia suggesting that a gradient in "femaleness" exists within the heads. This should be studied further to determine whether it is seasonally influenced within a single plant.

It is suggested that, opening as they do before the florets of the capitate head, and being both visually and olfactorily attractive, the numerous, sterile, involucellate florets may *perhaps* attract pollinating animals to the plants that bear them, so that "visiting patterns" are already established by time the bisexual florets of the capitate head open. Should animals, that lay eggs within the young flowers so that the larvae may later feed upon the developing ovules, be attracted to the florets of the involucel rather than to those of the head, it is possible that viable seed production from plants with these florets may be greater than from those in which they are rare or lacking.

It remains to be shown that the phenomenon of the development of such florets by an individual plant is repeated from flowering season to flowering season.

Other South African species of the genus *Acacia* that have been observed to produce occasional florets within the involucel or along the distal length of the peduncle are *A. nilotica* (L.) Willd. ex Delile subsp. *kraussiana* (Bentham) Brenan; *A. robusta* Burch. subsp. *clavigera* (E. Mey.) Brenan and *A. davyi* N. E. Br.

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