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REVISION OF THE CASSIINAE* IN AUSTRALIA. 2. *SENNA* MILLER SECT. *PSILORHEGMA* (J. VOGEL) IRWIN AND BARNEBY

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Abstract

The delimitation of sect. *Psilorhegma* is clarified by the exclusion of one non-Australian species Cassia divaricata Nees & Bl. A Gondwanic origin of the section is supported. Morphological characters are discussed in detail and three series are recognised. Detailed analyses of two hybrid swarms in ser. *Subverrucosae* lead to the specific and subspecific concepts adopted here. A possible history of this series is then discussed.

The taxonomic revision considers 44 taxa in 16 species, one of which is first described here. 10 new subspecies are described. Of those species previously described, 14 are transferred from *Cassia* to *Senna*, and 19 are reduced to subspecific rank, while 2 varieties are now recognised as subspecies.

New taxa are: *Senna* ser. *Oligocladae* Randell; *S. procumbens* Randell; *S. artemisioides* subspp. *filifolia* Randell; *petiolaris* Randell; *alicia* Randell; *quadrifolia* Randell; *glaucifolia* Randell; *stricta* Randell; and *symonii* Randell; *S. cardiosperma* subspp. *flexuosa* Randell; *gawlerensis* Randell; and *microphylla* Randell.

New combinations are: *Senna* ser. *Interglandulosae* (Benth.) Randell; and *Senna* ser. *Subverrucosae* (Benth.) Randell; *S. surattensis* subspp. *sulfurea* (Colladon) Randell; and *retusa* (J. Vogel) Randell; *S. acclinis* (F.Muell.) Randell; *S. odorata* (Morris) Randell; *S. aciphylla* (Benth.) Randell; *S. coronilloides* (Benth.) Randell; *S. costata* (J.F. Bailey and C. White) Randell; *S. glutinosa* (DC.) Randell; *S. glutinosa* subspp. *chatelainiana* (Gaudich.) Randell; × *luerssenii* (Domin) Randell; *pruinosa* (F. Muell.) Randell; *charlesiana* (Symon) Randell; and *ferraria* (Symon) Randell; *S. artemisioides* (DC.) Randell; *S. artemisioides* subspp. *circinnata* (Benth.) Randell; × *coriacea* (Benth.) Randell; *zygophylla* (Benth.) Randell; *oligophylla* (F. Muell.) Randell; *helmsii* (Symon) Randell; × *sturtii 7(R. Br.) Randell; and hamersleyensis* (Symon) Randell; *S. cardiosperma* (F. Muell.) Randell; *S. cardiosperma* subspp. *pilocarina* (Symon) Randell; *cuthbertsonii* (F. Muell.) Randell; *stowardii* (S. Moore) Randell; and *manicula* (Symon) Randell; *S. oligoclada* (F. Muell.) Randell; *S. goniodes* (A. Cunn. ex Benth.) Randell; *S. leptoclada* (Benth.) Randell; *S. heptanthera* (F. Muell.) Randell; *S. curvistyla* (J. Black) Randell; and *S. cladophylla* (W. Fitzg.) Randell.

* The present treatment of sect. *Psilorhegma* is the second in a series of revisions of the Australian members of the *Cassiinae* (see Randell 1988).

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Contents

1. Introduction

This paper revises *Senna* sect. *Psilorhegma*, an endemic group which is sparsely represented outside Australia. The species of the section are divided among three series, one of which is best developed in the arid zone.

The taxa within the arid zone ser. *Subverrucosae* are not easy to define (Bentham 1864, 1871; Symon 1966) probably because in most cases there are no morphological discontinuities between pairs of taxa. Breeding system studies demonstrate that most populations are in fact hybrid swarms, polyploidy is involved in the establishment of hybridization, and apomixis allows the perpetuation of the hybrid progeny (Randell 1970). A reappraisal of taxonomic concepts in this group is thus a pressing need and is given in detail in this paper.

In addition, recent collections especially in Western Australia, have included new species and subspecies which are here described and named.

2. Delimitation of the section

Vogel (1837) described the taxon thus:
"Sepala subobtusa. Stamina 10 fertilia: antherae subaequales, angustae, quadrangulari-lineares, apice in rima brevissime dehiscentes, rima inferne indehiscente et glabra. Legumen compressum, septis transversis completis aut incompletis multiloculare; semina verticalia." [Sepals subobtuse. Stamens 10 fertile; anthers subequal, narrow, linear but four angled, apical seams shortly dehiscent, lower seams indehiscent and glabrous. Pod compressed, transverse septae complete or incomplete, multiloculate; seeds vertical.] The seven species listed by Vogel are still accepted within the section.

Sect. *Psilorhegma* so defined, and accepted by Bentham (1864), Bentham and Hooker (1865), Symon (1966) and Irwin and Barneby (1982), is now known to include some 45 taxa in 16 species. These share the characters listed by Vogel, and some others, viz: anther filaments robust and subequal; perianth bilaterally symmetrical about the plane of the ovary; leaf rachis ending in a mucro.

At one time Bentham (1871) emended the description so as to include *Cassia divaricata* Nees & Bl. This species does have 10 fertile stamens but they are of two different lengths, the lower larger anthers are beaked and the filaments are of two different lengths. In addition the perianth is not symmetrical about the ovary, and the leaf rachis ends in a glandular appendage (De Wit 1955). Bentham (1871) commented on the obvious similarity between *C. divaricata* and *C. biflora* (syn. *S. pallida*, placed by Irwin and Barneby (1982) in sect. *Peiranisia*). It seems that the number of fertile anthers was the sole reason for the placement of *C. divaricata* in sect. *Psilorhegma*, Bentham giving more weight to this single character than to the numerous character differences listed above.

The danger associated with placing too much weight on the single character '10 fertile anthers' is demonstrated by two other unusual species.

2.1 *S. heptanthera* (F. Muell.) Randell agrees with other species of sect. *Psilorhegma* in all characters except that it has only 7 fertile anthers. This is not enough reason to exclude it from sect. *Psilorhegma*. [see discussion in taxonomic section of this paper.]

2.2 *S. tora* (L.) Roxb. agrees with other species of sect. *Chamaefistula* in most characters, including 7 fertile stamens (Randell 1988). However, some flowers of some plants of this species have 10 fertile stamens. This does not mean that those plants should be transferred to sect. *Psilorhegma*.

In this revision, the section is defined in the original sense of Vogel (1837) and thus *C. divaricata* and *S. tora* are excluded.

3. Geographical origin of the section

3.1 Primitive characteristics

When discussing Senna Miller, Irwin and Barneby (1982) listed a number of variable characteristics and then deduced those states which they considered were primitive for the genus. Table 1 demonstrates that the primitive condition of almost all of these characters is typical of sect. *Psilorhegma*, a fact not recognised by previous authors.

Thus sect. *Psilorhegma* can be characterised as a group of species sharing a large number of primitive characters. It is here considered that it is likely to be a natural and also an ancient group. Examination of its current distribution patterns may throw some light on its biogeographic history.

3.2 Geographical distributions of sect. *Psilorhegma*

The distributions of taxa in sect. *Psilorhegma* are given in Table 2. It is clear that the greatest genetic diversity occurs in Australia and probably the section has a very long history here. Its history outside Australia may be much shorter.

3.3 Sect. *Psilorhegma* — endemic or immigrant to Australia?

Two groups of workers have produced hypotheses which may describe the history of legumes in particular and *Senna* sect. *Psilorhegma* in particular. The first is that of Raven and Polhill (1981). From fossil evidence and because of present distributions of apparently primitive genera, they proposed that "Africa was a primary site for the evolution of tropical legumes", during the Cretaceous. Primary dispersal from Africa was northward through Laurasia, and legumes radiated from there to Asia, Europe and North America, until some 50 million years before the present (l.c., p.28).

However, after this time no further legumes reached Asia from Africa, for a variety of reasons:

3.3.1 There was a substantial water barrier between Africa and Eurasia following the Paleocene (c. 50 m.y.b.p.).

3.3.2 When Africa and Eurasia were rejoined after the Miocene (17 m.y.b.p.), the migration route was interrupted by the effects of spreading aridity, and the presence of ecologically competitive groups already in Eurasia.

3.3.3 India, though initially carrying many of the legumes of Africa, moved through unfavourable climates on the way to Asia, and suffered decimation of its flora, which is still poor in legumes.

Raven and Polhill (1981) believe that Australia's caesalpinioid genera are 'clearly derived from Asia', such Asian genera having arrived from Africa more than 50 m.y.b.p., while their descendents moved on to Australia 35 m.y. later, after contact between the Australian and Asian plates in the Miocene (c. 15 m.y.b.p.).

These authors would probably expect to find many primitive, widespread representatives in Asia/Malesia, and fewer, more advanced forms in Australia. Exactly the reverse of this situation holds in sect. *Psilorhegma*, (Table 2). Observed distribution patterns do not support the history hypothesised by Raven and Polhill (1981).

An alternative hypothesis was proposed by Johnson and Briggs (1981). They suggested that the three families Myrtaceae, Proteaceae, and Restionaceae have Gondwanic distribution i.e. with many species in the southern continents (South America, Africa and Australia) and poor representation outside those continents.

Table 1. Morphological characteristics found in sect. *Psilorhegma*, with primitive and advanced character states as determined by Irwin and Barneby (1982).

Character	Primitive state	Advanced state	Condition in sect. *Psilorhegma*
petiolar glands	present	absent	primitive
raceme insertion	in leaf axil	stem above axil	primitive
flower structure	regularly zygomorphic	irregular	primitive
fertile anthers	10	5-7(-10)	primitive
anther size	subequal	of different sizes	primitive
anther apex	truncate	beaked	primitive
anther dehiscence	biporose	uniporose	primitive
filament length	subequal	of different lengths	primitive
style	linear	dilated at stigma	primitive
style length	moderate	shortened	primitive
stigma	pointing upward	pointing inward	primitive
pod	flat	terete (?flat)	primitive
pod dehiscence	by both sutures	indehiscent or by one suture	primitive
ovule number	10-20	less than 10 or more than 20	variable 5-20
seed areole	present	absent	primitive
seed position	parallel to pod axis	perpendicular to pod axis	primitive

N.B. All characters clearly falling into primitive-advanced states have been included.

Table 2. Geographical distribution of taxa in sect. *Psilorhegma*.

Biogeography	Taxa
Australian endemics	40 taxa in 15 species
Australia, New Guinea, Malesia, Pacific isles, Asia (introduced?)	all 3 subspecies of 1 species

Senna Miller is well represented in the floras of South and Central America (Irwin & Barneby 1982), in South and Central Africa (Brenan 1967), and also in Australia (Symon 1966). It is poorly represented in North Africa (see Bentham 1871), in Asia (Irwin & Barneby 1982) and in North America where it is "predominantly of s. extremities of (United States of America)" (Isley 1974, p. 152). It is thus generally confined to southern temperate and tropical areas. It also exhibits Gondwanic distribution, as hypothesised for Myrtaceae, Proteaceae and Restionaceae.

In the Gondwanic Myrtaceae, fossils show that *Eucalyptus* was in Australia before the Miocene (Smith 1982). It is now largely confined to Australia, but a few species occur in New Guinea and some neighbouring islands. Migration probably took place after contact of the Australian and Asian plates following the Miocene (Pryor 1976).

In the Leguminosae, no fossils are known in Australia before Miocene times. However, it has been proposed (Pedley 1986) that *Racosperma* (*Acacia* p.p.) was present in Gondwanic Australia, but did not become widespread until the general drying of the continent in the Miocene. Most species of *Racosperma* are now confined to Australia, but some are found in the Phillipines and Taiwan, and were probably derived from an early emigrant from areas such as Queensland.

The parallels between the distribution patterns of *Eucalyptus* and *Racosperma* are so close that the same explanation has been proposed for both taxa, i.e. presence in Gondwanic Australia and later migration into northern areas after contact between the Australian and Asian plates after the Miocene.

In *Senna* sect. *Psilorhegma* no Australian fossils are known. Most species are confined to Australia. One species occurs in New Guinea and islands of the Pacific (Table 2), but its current distribution may reflect long cultivation by man as a drug plant (de Wit 1955).

Because of similarities with *Eucalyptus* and *Racosperma*, it is here proposed that the ancestor of sect. *Psilorhegma* was also present in Gondwanic Australia and that northward migration took place after contact between the Australian and Asian plates (15 m.y.b.p.).

None of the other infrageneric groupings within *Senna* Miller show such uneven specific distributions between Australia and Asia, so that it is not possible to make similar deductions about their history. But it is likely that related ancestral forms of other sections had similar distributions.

4. Diversity within sect. *Psilorhegma*

4.1 Morphological characteristics

Plants within sect. *Psilorhegma* are uniform in many features (Table 1) especially of flowers, fruit and general habit. Variation is restricted almost entirely to the leaves. Characters typical of the section are discussed below.

4.1.1 *Growth form*

This shows some variation between the series, e.g., in ser. *Interglandulosae*, plants of the closed forests tend to be scramblers or small trees (0.5-11 m, see Degener 1932, De Wit 1955); in ser. *Subverrucosae* low to tall shrubs (0.2-3 m, notes to various taxa in this paper); in ser. *Oligocladae*, prostrate to low shrubs (notes to various taxa, this paper).

Arid zone shrubs of *S. artemisioides* (ser. *Subverrucosae*) reach reproductive maturity at 3-5 years, and while the life span may exceed 50 years it probably does not reach 100 years (Silander 1983).

4.1.2 *Leaf structure*

As described above, the ancestor of sect. *Psilorhegma* probably occurred in Gondwanic Australia when most areas were covered with closed forests (Johnson and Briggs 1981). Species of ser. *Interglandulosae* which are still found in such forests show leaf characters which presumably reflect the ancestral condition, i.e., with terete flexible rachises, petioles 10 mm or longer, moderately dense epidermal hairs, stipitate foliar glands, persistent stipules, no wax deposits and many pairs of leaflets. However, many deviations from this pattern are found, such as those in taxa of ser. *Subverrucosae* in the arid zone.

4.1.2.1 *Rachises*

The most common (and primitive ?) form of rachis is terete, somewhat flexible, and bearing several pairs of leaflets. In a few cases, the rachis is very thick and robust (*S. glutinosa* subsp. *ferraria*), while in another it has become elongate and flexible (*S. cardiosperma* subsp. *flexuosa*). In one case, it is laterally compressed and photosynthetically active (*S. artemisioides*

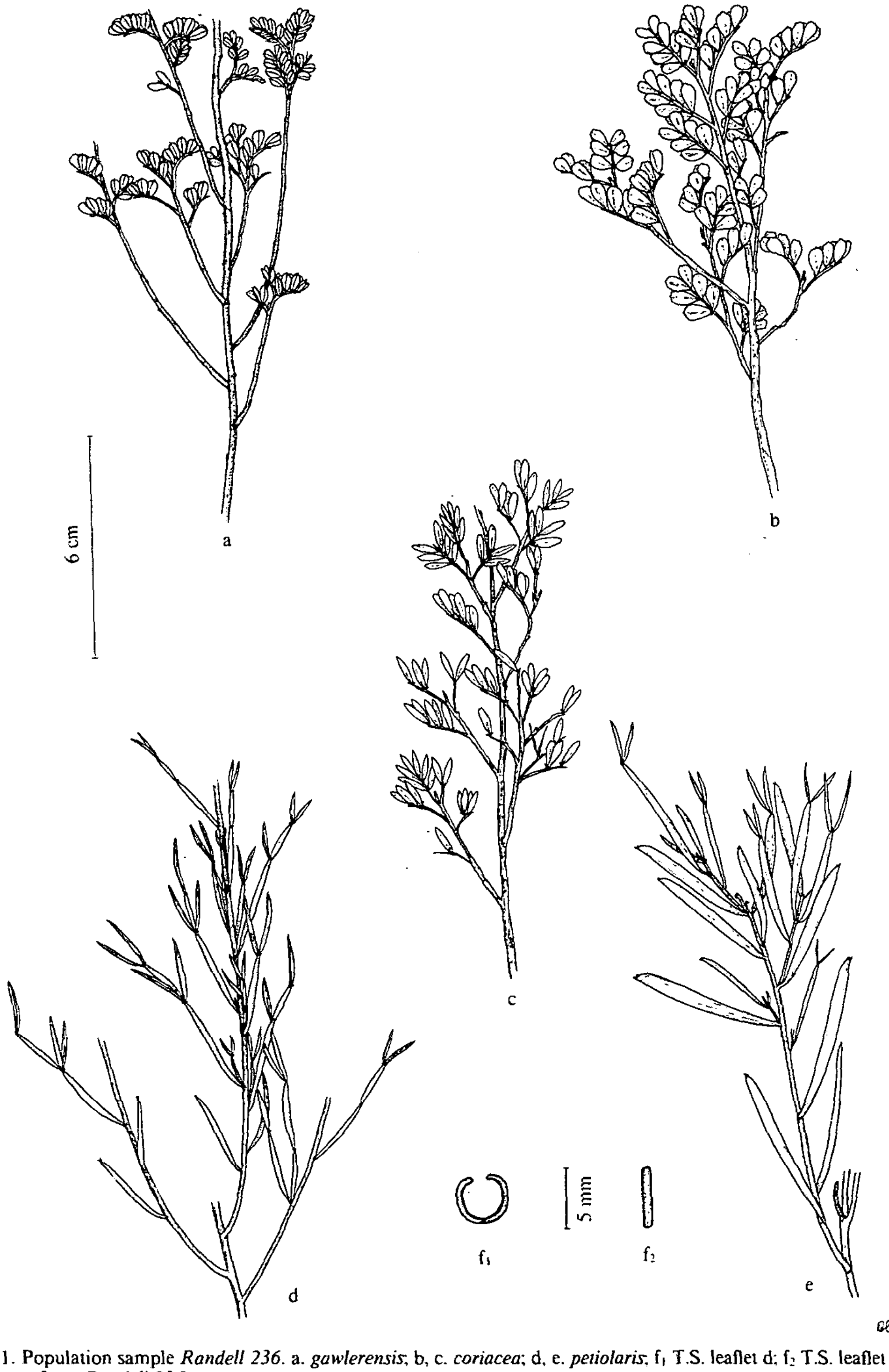


Plate 1. Population sample *Randell 236*. a. *gawlerensis*; b, c. *coriacea*; d, e. *petiolaris*; f_1 T.S. leaflet d; f_2 T.S. leaflet e, (all plants from *Randell 236*).

subsp. *petiolaris*). In others the rachis has remained terete in form, but is elongate and photosynthetically important in the absence of functional leaflets (*S. glutinosa* subsp. *charlesiana*; *S. artemisioides* subsp. *circinnata*).

The petiole (i.e. rachis below the lowest leaflets) is usually 6-15 mm long, though shorter forms occur in *S. cardiosperma*, and very elongate photosynthetic petioles occur (in *S. artemisioides* subsp. *petiolaris* and in *S. glutinosa* subsp. *charlesiana* to 6 cm and to 10 cm respectively).

4.1.2.2 *Separation of leaflets*

The distance between consecutive leaflet pairs is generally strongly correlated with the length of the petiole, i.e. plants with very short petioles have leaflets closely crowded together (subspp. of *S. cardiosperma*), while those with petioles 6-15 mm long have leaflets spaced a similar distance apart. However, those forms with extremely elongate petioles (*S. glutinosa* subsp. *charlesiana* and *S. artemisioides* subsp. *petiolaris*) usually have only one (terminal) pair of leaflets. Hybrid derivatives may have two pairs, but in that case the length of the petiole is usually reduced.

4.1.2.3 *Glands of the rachis*

The glands occur on the leaf rachis between one (the lowest) or more pairs of leaflets. In some plants of almost all taxa, but not regularly in any taxon, the rachis glands are apparently entirely absent.

These glands may be sessile on the rachis (e.g. all subspecies of *S. artemisioides*) or occur on stipes 1-3 mm long (some subspecies of *S. glutinosa*). The shape of the gland is also variable. Sessile glands may be flattened (rarely almost peltate), cylindrical and blunt-topped, or conical and ending in a fine point. Stalked glands may be cylindrical or conical. The distinction between blunt and pointed glands may not be taxonomically important, but may merely reflect the age of the gland, with pointed glands being those charged with nectar, and flat or blunt glands being those where secretion has either not been produced or has already been discharged.

To date few insects have been seen collecting secretions from these glands. This aspect needs to be investigated in the field.

Bentham (1871) recognized two series within sect. *Psilorhegma*, and defined them by the obvious presence (or absence) of foliar glands in different species. The present study has shown that glands are present in all species. However other characters have been identified which allow the continued recognition of the series.

4.1.2.4 *Stipules*

Stipules are regularly produced in all taxa of sect. *Psilorhegma*, but as a rule they are shed very early, and can only be observed on three or four leaves closest to the apex. Usually the stipules are acicular, and 2-4 mm in length.

In some taxa the stipules remain on the plant for a much longer time, and in a few cases (e.g. *S. glutinosa* subsp. *pruinosa*) may still be present on old branches. This form (*S. glutinosa* subsp. *pruinosa*) is also unusual in having much broader, falcate stipules (possibly with photosynthetic function).

4.1.2.5 *Leaf exudates*

Ancestral forms of sect. *Psilorhegma* are presumed to have lacked epidermal deposits of wax or other exudates. However, the character has been developed in the arid-zone ser. *Subverrucosae* perhaps as a mechanism to reduce transpiration. The deposit may take the form of a viscid semi-liquid (e.g. *S. glutinosa* subsp. *glutinosa*), a fine powder (*S. glutinosa* subsp. *pruinosa*), or most commonly a thick sheet over the photosynthetic surface.

4.1.2.6 *Indumentum*

The leaf epidermis of most taxa of sect. *Psilorhegma* is pubescent. The hairs may be sparse, stiff and erect (e.g. *S. costata*), soft and appressed in varying degrees of density (e.g. *S. artemisioides* subsp. × *artemisioides*), or long and woolly in varying degrees of density (e.g. *S. artemisioides* subsp. *helmsii*). Only rarely does a plant appear almost glabrous.

4.1.2.7 *Number of leaflets*

Most of the taxa in sect. *Psilorhegma* have 4-7 leaflet pairs to each leaf. However, there is great variation in this character, both within and between species, e.g. in *S. artemisioides* the number varies from 0 (subsp. *circinnata*), or 1 (subsp. *petiolaris*) to 8 (subspp. × *sturtii* and × *artemisioides*); in *S. cardiosperma* it varies from 2 (subsp. *cardiosperma*) to 14 (subsp. *flexuosa*); in ser. *Interglandulosae* from 7 to 17 pairs.

4.1.2.8 *Sclerophylly and the form of leaflets*

As noted above, the ancestor of sect. *Psilorhegma* probably occurred in closed forests. Species of ser. *Interglandulosae* are still to be found in this habitat. As a group their leaves are characterised by the absence of exudates or dense indumentum, and larger surface area. In the arid-zone ser. *Subverrucosae*, changes from this plan can be seen.

Many of these changes involve the production of scleromorphic characters such as reduction of leaf surface area by fewer large leaflets (e.g. in *S. artemisioides* subsp. *oligophylla*), or many smaller leaflets (e.g. in *S. cardiosperma* subspp.); protective exudates (e.g. in *S. glutinosa* subsp. *glutinosa*); protective hairs (e.g. in *S. artemisioides* subsp. *helmsii*); rigid leaflets (e.g. in *S. glutinosa* subsp. *ferraria*); or isobilateral leaflets (e.g. in *S. artemisioides* subsp. × *coriacea*).

Another change not directly related to scleromorphy but certainly associated with reduction in the loss of water by transpiration, is the displacement of photosynthesis from leaflets to rachises. This has occurred at least twice, once in the terete petioles of *S. glutinosa* subsp. *charlesiana*, and again in the laterally compressed petioles of *S. artemisioides* subsp. *petiolaris*.

Within one leaf, all the leaflets may be of equal length (*S. glutinosa*); may increase in size from the base of the rachis to the apex (some subspecies of *S. artemisioides*), or may decrease in size from the base to the apex (some subspecies of *S. cardiosperma).*

4.1.3 Inflorescence

The basic inflorescence in sect. *Psilorhegma* is a raceme arising in the axil of a leaf. The peduncle carries a bract at the base of each pedicel, but these are normally caducous at anthesis. A few specimens with more persistent bracts are found within several taxa e.g. *S. artemisioides* subsp. *oligophylla.*

In most taxa, the flowering axis (i.e. the peduncle above the level of the lowest pedicel) is much contracted, resulting in a sub-umbellate inflorescence. The true racemose situation is maintained in several taxa (e.g. ser. *Interglandulosae*) and in occasional specimens within other taxa (e.g. *S. artemisioides* subsp. *glaucifolia*).

The pedicels of the individual flowers are slender, without bracteoles and are articulate at the base (i.e. in the axil of the bract).

4.1.4 *Flowers*

Most species of *Senna* Miller are bee pollinated (Polhill, Raven and Stirton 1981). Each flower functions as a unit structure to permit this. Evolutionary changes in any single part of the flower could destroy the effective functioning of the whole flower, and thus would be disadvantageous in terms of selection. As expected, in sect. *Psilorhegma* the flowers are extremely uniform, with the only observed differences between the species involving size of petals (4-6 mm long in subspecies of *S. cardiosperma*, 7-10 mm long in subspecies of *S. artemisioides*, and 15-25 mm long in subspecies of *S. surattensis*); pubescence of petals (dorsally pubescent in *S. glutinosa* subspecies, glabrous in others); and in the number of fertile anthers (7 in *S. heptanthera*, 10 in all other taxa).

Photographic studies have shown that the petals of several taxa of sect. *Psilorhegma* are UV-reflective, while the stamens are UV-absorbing, thus ensuring that the androecium is clearly visible to insects (Randell unpubl.)

4.1.5 *Fruits*

Fruits of sect. *Psilorhegma* are always flat, dry and without any semblance of internal pulp, and are without true internal septae. In some taxa, the valves are undulate over the seeds, with ridges on the internal surface of the valves, thus creating the impression of septae (pseudo-septate, e.g. ser. *Interglandulosae*). However, these are not analagous with the septae seen in the terete or cylindrical pods in other sections of Senna.

Mature fruits are usually straight (rarely curved and crenate as in *S. costata*, or circinately coiled in *S. artemisioides* subsp. *circinnata*). They are normally glabrous, but in rare cases even mature fruits are pubescent (*S. cladophylla* and *S. cardiosperma* subsp. *cuthbertsonii*). Fruits in sect. *Psilorhegma* open by slow degeneration of both sutures, never by explosive means.

4.1.6 *Seed production and germination (subspecies of S. artemisioides)*

For several subspecies of *S. artemisioides*, Silander (1983) produced estimates of the yearly production of ovules, seeds and fruits by a single plant (Table 3).

Tests showed that not all of the seeds would germinate immediately. About 30% remained in the soil, viable for at least 1 year. Seed stored without water under natural conditions, did not appear to survive more than 10 years (Silander 1983).

Germination tests also showed the occurrence of polyembryony in many taxa (Braun 1859, Symon 1956, Randell 1970). Examination of the developing ovules showed that most embryos were derived asexually from nucellar tissue, and later invaded the embryo sac, competing with any sexual embryo also present. Survival of both embryo types was apparently dependent on the presence of endosperm, as unfertilized ovules degenerated (Randell 1970). Thus there must be strong selective pressure in favour of fertile pollen.

Most seedlings germinating are asexual and thus identical with the seed parent, but in rare cases non-identical twin seedlings are produced (Symon 1956). Such seedling pairs can only be explained if one is asexual and identical with the seedbearing parent, and the other is a sexually derived hybrid from a cross with a morphologically-dissimilar parent (Randell 1970).

Table 3. Propagule production in *S. artemisioides* subspecies (data from Silander 1983).

Propagule	Annual production
ovules	15 per pod
mature seeds	5 per pod
pods	1.8—2.6 x 1000 per plant
mature seeds	8—13 x 1000 per plant

4.1.7 *Chromosome numbers*

The basic chromosome number for sect. *Psilorhegma* is n=14 (Randell 1970) as a secondary diploid on an ancestral n=7 (Irwin and Turner 1960). There are now 8 records of n=14 for the group, and another of n=13, which, if verified, probably represents a case of aneuploid reduction. Tetraploids have been recorded in a large number of arid zone taxa (Table 4) and also in cultivated material of *S. surattensis* from India (Darlington and Wylie 1955).

Pollen fertility in the diploids is very high, ranging through 90-95%. That in the rare triploids (n=42/2) is very low, 3-60%. However fertility in tetraploids (n=28) is relatively high (80-90%) perhaps as a result of the dependence of even asexual embryos on endosperm, and thus in turn on successful pollination and fertilization (Randell 1970).

Examination of several populations containing triploid plants shows that these are rare, and apparently always of hybrid derivation, from diploid/tetraploid crosses (Randell 1970). This implies that the original tetraploids were derived from the somatic doubling of the chromosomes of diploids, perhaps via the asexual nucellar embryos described above. Endopolyploidy of nucellus cells has been described in other genera (Nagl 1978).

Table 4. Chromosome numbers of taxa in sect. *Psilorhegma* (full voucher citation in Randell 1970).

Species	Chromosome number				Author
aciphylla	n =	13			Abele in Symon (1966)
artemisioides subspp.					
alicia	n =	14,	42/2,	28	Randell
× *artemisioides*	n =		42/2,	28	"
circinnata	n =			28	"
× *coriacea*	n =		42/2,	28	"
filifolia	n =	14,	42/2,	28	"
helmsii	n =		42/2,	28	"
oligophylla	n =		42/2,	28	"
petiolaris	n =	14,	42/2	28	"
× *sturtii*	n =		42/2,	28	"
symonii	n =	14			"
cardiosperma subsp.					
gawlerensis	n =	14,	42/2,	28	"
costata	n =	14			"
glutinosa subspp.					
chatelainiana	n =	14			Turner in Symon* (1966)
glutinosa	n =		42/2,	28	Randell
aff. *luerssenii*	n =			c.28	Turner in Symon (1966)
pruinosa	n =			28	Randell
surattensis	2n =	28,		56	Darlington and Wylie (1955)

*Voucher located since 1970 viz. Brown Ra., S of Carnarvon Ra., W.A., *Turner 5412*, 25.viii.1965 (PERTH).

4.2 Series within sect. *Psilorhegma*

Within sect. *Psilorhegma* it is possible to recognise three groups of taxa, defined by a combination of fruit, seed and leaf characters. Each of these groups is here treated as a series.

4.2.1 Ser. *Interglandulosae*

The six species of this series are almost entirely restricted to higher-rainfall areas (e.g. of the eastern coast of Australia), but one species is widely distributed in New Guinea, Malesia, the Indian subcontinent and the Pacific Islands, probably reflecting its long history of cultivation as a drug plant. In this series, seeds are glossy, pods are pseudoseptate and usually plump, leaflets are not sclerophyllous, and leaf glands are stipitate.

4.2.2 Ser. *Subverrucosae*

The three species in this series have between them almost thirty subspecies. They are recognised by their highly adapted, sclerophyllous leaflets, long narrow and completely flat pods (not pseudoseptate), and dull seeds. Leaf glands may be stalked or sessile. Taxa in this series are widespread in the arid zone, are morphologically variable, and their breeding systems are compounded by the occurrence of polyploidy, polyembryony and hybridization (Randell 1970).

4.2.3 Ser. *Oligocladae*

This is a group of seven species, all restricted in distribution to monsoonal areas of north west Western Australia and northern parts of the Northern Territory. All have 2-3 pairs of leaflets, and short crenate pods which are wider than the length of the transverse dull seeds.

5. Biology of ser. *Subverrucosae*

5.1 Hybrid populations

Plants of ser. *Subverrucosae* are both very widespread and very common in the arid zone. Over large areas, these shrubs form a conspicuous part of the sclerophyll shrub layer. The plants may be scattered under an open tree canopy (species of *Acacia*, *Casuarina* or *Eucalyptus*), with sparse grass and herb cover. More often *Senna* shrubs occur in moderate to dense stands (density 9,000/ha, Randell, unpubl.; 10,000/ha, Batinoff & Burrows 1973), in populations sometimes containing several thousand plants. In these populations many of the individuals are seedlings and obviously will not survive to maturity. Similar early mortality strikes individuals of other species present, so that ground surface between the *Senna* shrubs is almost bare. Such populations tend to occur in sites that have been subjected to disturbance e.g. water scour, road building, overgrazing by rabbits, or fire. In other areas, there is no obvious evidence of disturbance.

The dense populations* of plants of sect. *Psilorhegma* described above are composed of plants exhibiting considerable morphological diversity. Field observations led to the suggestion that hybridization was the cause of these mixed populations (Symon 1955, 1966, Randell 1969, 1970). Since *Senna* plants are in fact bee-pollinated (Polhill, Raven and Stirton 1981), and outbreeders (Kalin Arroyo 1981), pollen transfer is not a surprising event. However, sterility barriers must have been overcome to allow such extensive hybridization to take place.

Investigation of many populations showed that they were composed predominantly of tetraploid plants. Apomixis (polyembryony) was also demonstrated in many (Randell 1970). Further, many taxa in *Cassia* sens. lat. in Western Australia are self-fertile (Keighery 1982), though it is not clear whether this is due to inbreeding or apomixis. Whatever the mechanism, individual plants are capable of self-replication.

In almost every case the diverse populations were found to be hybrid swarms. These may be simple, composed of two parents and their F1 hybrids. The majority of swarms are more complex that this, with 4-6 parental races, F1 hybrids of almost every possible parental combination, and in addition an extensive array of plants which are probably backcrosses either between F1s , or between F1s and one or other of the parents. These create an almost complete range of morphological types linking all pairs of parental races, with a notable absence of morphological disjunctions separating pairs of taxa.

* In this paper, 'population' is used to signify a group of plants which occupies one locality (generally about 100 m square). Interbreeding may or may not take place. Certainly it is unlikely that plants 100 m apart, on opposite sides of a dense population, will ever interbreed naturally (Ehrlich & Raven 1969, Grant 1981).

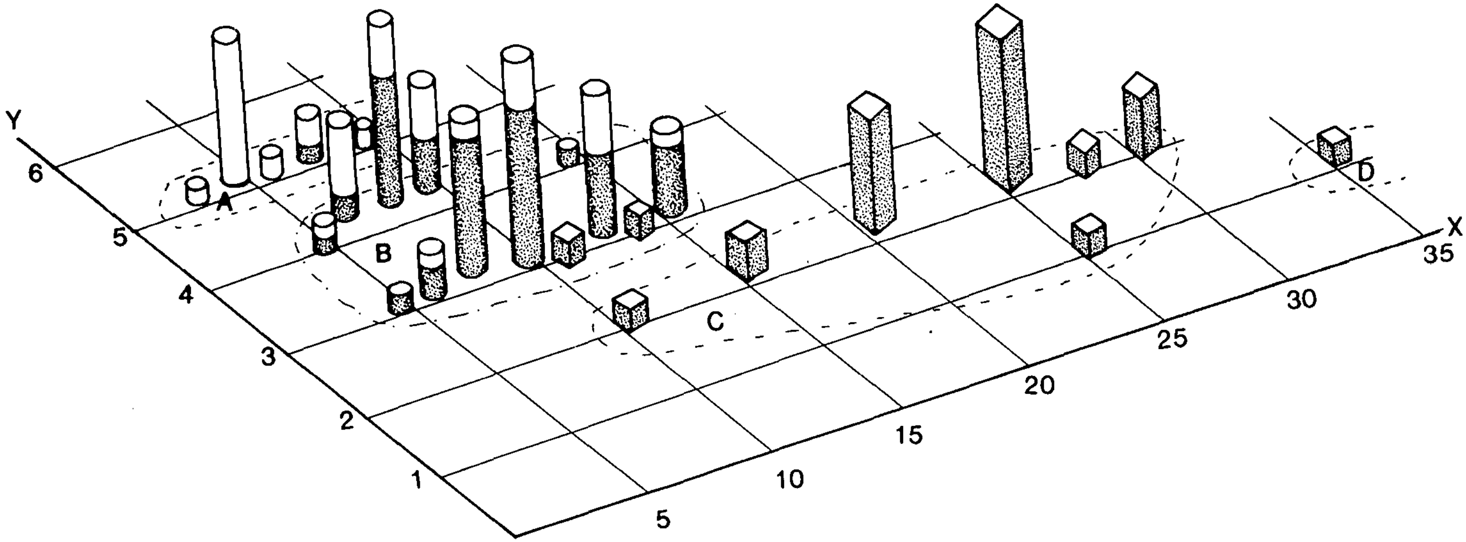


Plate 3. 3-Dimensional graph of morphological variation in population *Randell 236*. ○ terete petiole; □ laterally compressed petiole; stippling indicates wax deposit. Vertical height is proportional to number of individuals. Y axis-number of pairs of leaflets; X axis- petiole length (mm).

Plate 3 is a three dimensional graph of this population *Randell 236*. Three forms are easily recognized. Group D is distinctive in having laterally compressed petioles and also laterally compressed leaflets (straight in transverse section — see Plate 1). It is designated by the epithet *petiolaris*. Group A is distinctive in having 5 or more pairs of horizontally flattened leaflets on terete petioles. It is designated *gawlerensis*. Group B is intermediate between these extremes in several characters — leaflet number, petiole length, degree of wax deposit. It is designated *coriacea*. Group C is intermediate between A and D in petiole length, petiole breadth, and number of leaflets. The leaflets are horizontal, but inrolled (U shaped in transverse section, see Plate 1). Thus groups B and C bridge the morphological discontinuities between A and D.

The population can then be interpreted as a hybrid swarm linking parents *petiolaris* and *gawlerensis*, with the intermediates, *coriacea*, progeny of that hybridization. Further it is probable that Group C is the progeny of backcrossing between *petiolaris* and *coriacea*.

5.1.1.2 *Analysis of a complex population*

Randell 224, 300 km North West of Alice Springs, Northern Territory, just outside Yuendumu Settlement (sample Plate 4).

This population sample is composed of the amalgamation of several collections (*B.A. Barlow 1101*, *Barlow 1141* and *Randell 224*) as the three collections were made in the same population at different times of the year, in an attempt to collect as much cytological material as possible. A total of 120 samples was collected. However, it is possible that some plants were sampled more than once in the different collections, while other plants were totally excluded. This fact would affect the validity of mathematical analysis (e.g. by graphs) so this is not attempted here. Double sampling would not affect the conclusions drawn from 3-D graphs, as these are based on the presence of various morphological types, not on the frequency of occurrence.

Plate 5 is a three dimensional graph showing variation within the population sample. Several distinct forms are present (see also Plate 4).

In this population, Group A (*petiolaris*) contains many diploids, Group B (*artemisioides*) is only recorded as tetraploid, while there are no cytological records here for Group C (*glutinosa*). Group D (*helmsii*) is also unknown cytologically here, while both Group E (*filifolia*) and Group F (*alicia*) are known as diploids elsewhere but are not recorded here.

Other plants, which are more or less intermediate morphologically between pairs of these forms, can also be recognised. Group 1 is intermediate between *petiolaris* and *glutinosa*, and one plant is known to be triploid. This supports the suggestion that diploid *petiolaris* was one parent. Plants of Group 1 could be named *petiolaris* × *glutinosa*.

Group 2 is intermediate between *filifolia* and *artemisioides*, and again one plant is triploid. Probably diploid *filifolia* was one parent, and tetraploid *artemisioides* the other. These plants obscure the morphological disjunction between *filifolia* and *artemisioides*, and make it difficult to determine appropriate taxon boundaries.

Group 3 is intermediate between *alicia* and *artemisioides* or hybrids derived from it, and again it is difficult to recognise taxonomic boundaries. Plants would probably be named *alicia* × *artemisioides*.

The single plant in Group 4 is probably derived from *filifolia* × *glutinosa* hybridization.

The three remaining plants (Group 5) are very obscure. The narrow laterally compressed petioles indicate that *petiolaris* was involved somewhere in their ancestry. However, other taxa involved could have been *alicia*, *filifolia*, *artemisioides*, *glutinosa* or their hybrids. It is impossible to place these plants within any taxon, and they would most appropriately be named aff. *petiolaris*.

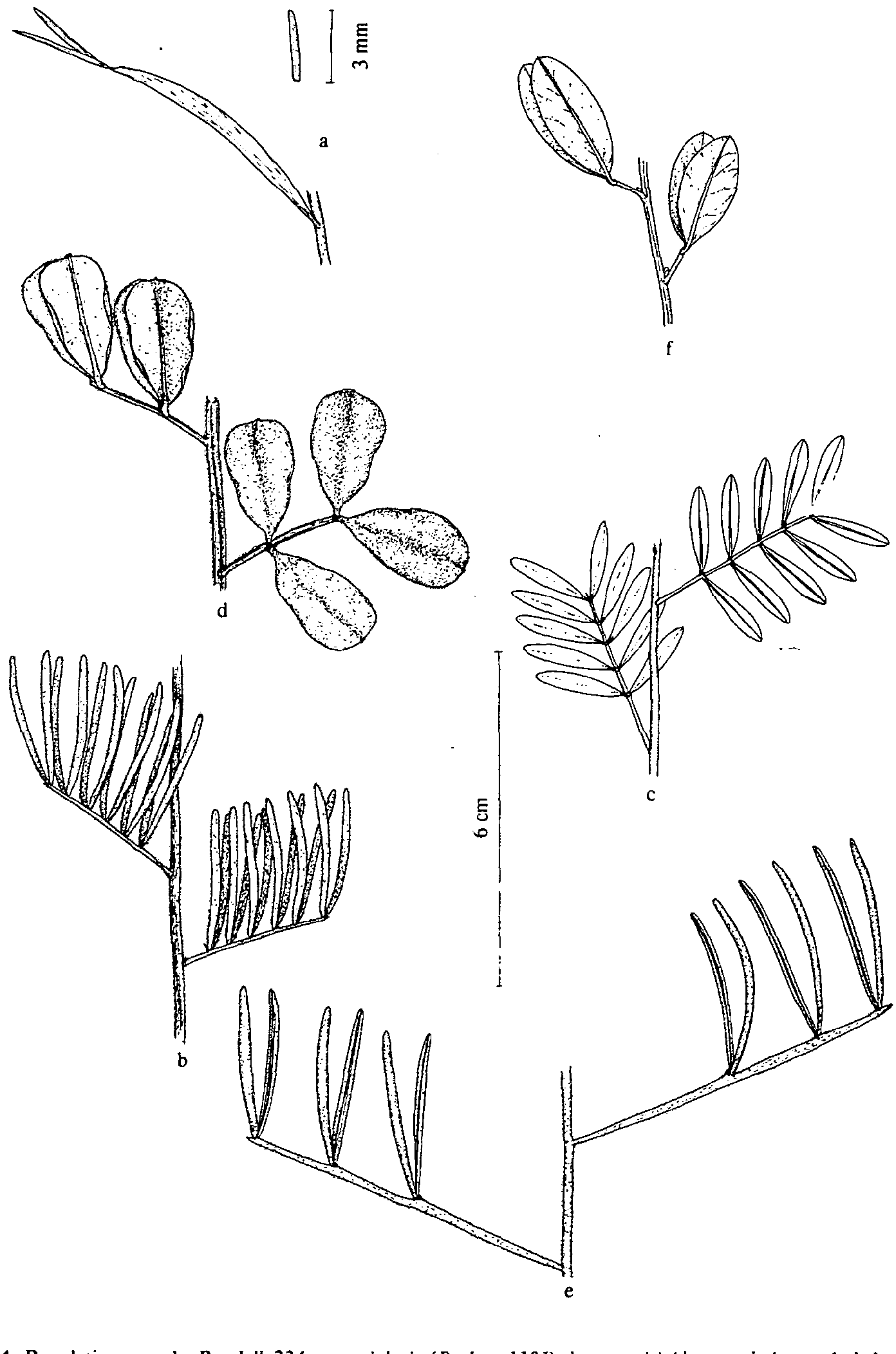


Plate 4. Population sample *Randell 224*. a. *petiolaris* (*Barlow 1101*); b. *artemisioides*; c. *glutinosa*; d. *helmsii* (all *Barlow 1141*); e. *filifolia* (*Randell 224*); f. *alicia* (*Barlow 1141*).

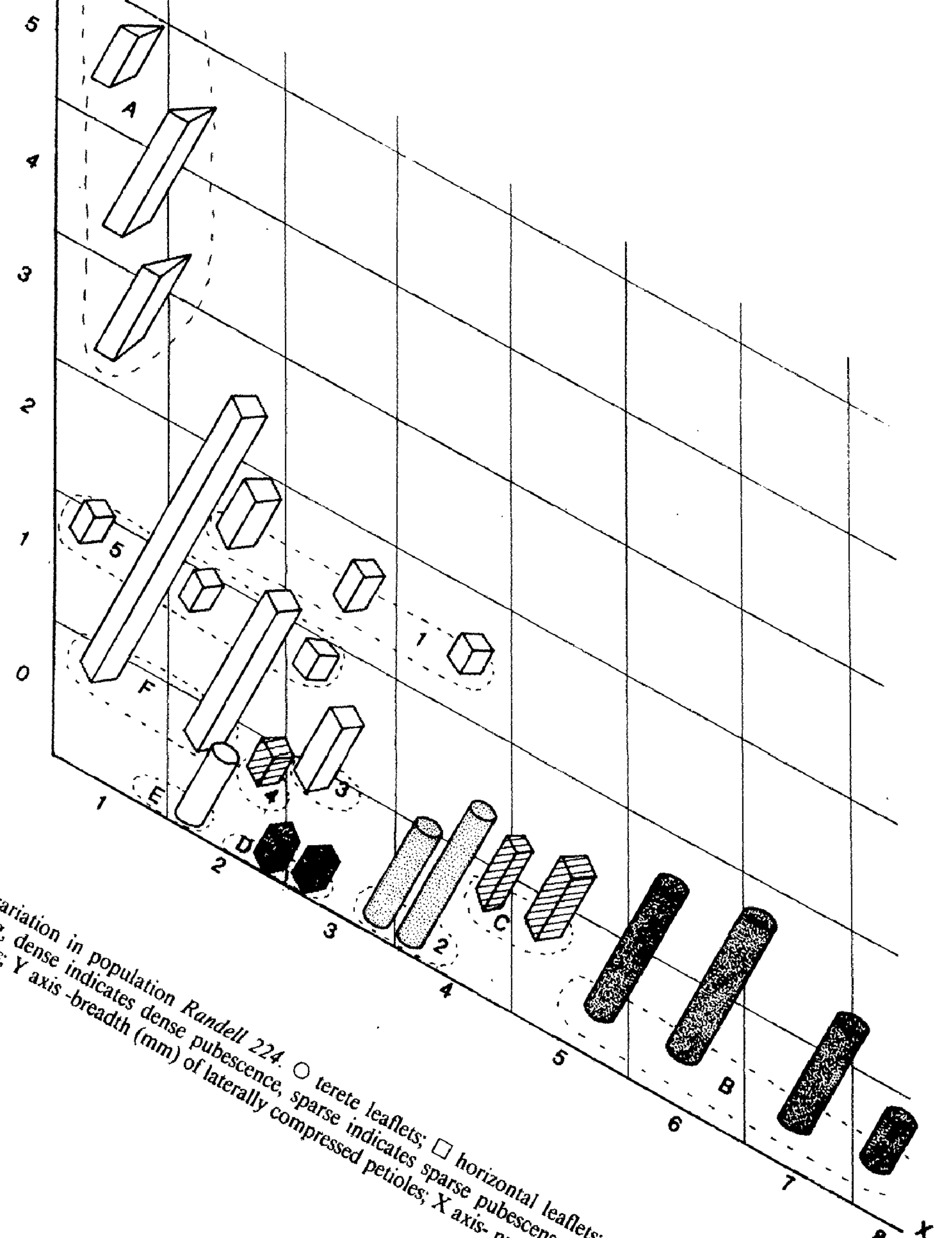


Plate 5. 3-Dimensional graph of morphological variation in population *Randell 224*. ○ terete leaflets; □ horizontal leaflets; Δ laterally co
hatching indicates glutinous epidermis; for stippling, dense indicates dense pubescence, sparse indicates sparse pubescense, absence indi
vertical height is proportional to number of individuals; Y axis -breadth (mm) of laterally compressed petioles; X axis- number of pairs

Population *Randell 224* is thus a hybrid swarm containing 6 parental races, 4 identifiable F1 hybrid groups, and also plants of obscure derivation which do not fall within any recognisable taxon.

The two populations described are typical of the approximately 100 examined. Plate 6 summarises all hybridizations observed between all taxa, during the years 1966-86.

5.1.2 *Experimental proof of hybridization*

The hypothesis of widespread hybridization between taxa in the arid zone could be verified in several ways. Hybrids deduced from population studies could be reproduced experimentally. This exercise would be time consuming in a woody group like *Senna*. However, an apparently insurmountable problem arises from the occurrence in many taxa and hybrids of facultative apomixis, as any plant produced by experimental crosspollination could be either a sexually-derived hybrid or an asexual offspring of the seed-bearing plant. The possibility of rare hybridization could not be excluded by the more frequent production of non-hybrid asexual offspring.

It would probably be easier to verify the hypothesis by electrophoretic analysis of enzyme extracts from the population samples. This has not been attempted.

However, an absolute proof of hybridization is the production of non-identical twin seedlings within a single seed (one a sexual hybrid, one an asexual embryo), a phenomenon which has already been recorded (Symon 1956).

5.1.3 *Taxonomic consequences of hybridization*

Since the initial formation of autotetraploids, successful hybridization between tetraploids of different taxa has created a vast array of plants which must be alloploid in structure. Backcrossing in hybrid populations has even created plants with morphology very similar to what the autoploids may have been. However, it has not been possible to identify chromosomal or morphological markers to determine whether individual plants are autoploids or alloploids. Taxonomically this has led to the bridging of morphological disjunctions between taxa (Plate 7) and explains the great difficulties faced by taxonomists in ser. *Subverrucosae.*

5.2 *Taxonomy of the hybridizing forms*

Many plant groups contain parental races and hybrid derivatives, and several taxonomic treatments of such groups have now been published in eg. *Gilia*, *Hieracium*, *Betula*, and *Crataegus*. There are also sections in the Code of Botanical Nomenclature which give advice on the formation of names for hybrid individuals and taxa. However, a wide search of the literature has not located any treatment dealing with a situation quite as complex as that encountered in ser. *Subverrucosae.*

The usual taxonomic approach is to name the parents as individual taxa, and to name a hybrid as a separate taxon defined by a particular combination of parents. This may be done when there are morphological or cytological features which permit recognition of the hybrid or parental nature of the majority of plants eg. when parents are largely allopatric (so that the morphology of the 'pure race' can be described), and hybrids are restricted to an area in which the parents are sympatric, and where abnormal morphology can be recognised.

In ser. *Subverrucosae* however, most of the parental forms are sympatric with a number of other forms over most of their range, and hybridize with them at every opportunity. In most cases there is no possibility of describing the 'pure race'. The only exceptions occur in the relict populations of diploids of various forms, but even here the situation is confused by the presence nearby of morphologically-similar polyploids, some of which may be autoploids but where the majority must be alloploids (see Plate 7).

A hybrid is usually assumed to be defined by a particular combination of parental forms. However, in ser. *Subverrucosae* the same morphological form may be derived from a number of parental combinations (Randell 1970, and notes to various taxa below), or an individual plant may give evidence of having been derived from hybridization and backcrossing involving more than two parental forms (eg. Group 3 in Plate 5 above). Moreover, these hybrid individuals, which are rare or anomalous in other groups, here form the largest proportion of the plants encountered either in the field or in the herbarium.

In most groups, hybrids are of reduced fertility and contribute little progeny to the taxon as a whole. In ser. *Subverrucosae* the hybrids have high pollen fertility (see above) and their ability to produce fertile egg-cells is attested by the frequency with which backcrosses are encountered. In addition, hybrids are fully capable of self-replication by means of asexual seed production. They are thus very important in the biology of the whole series.

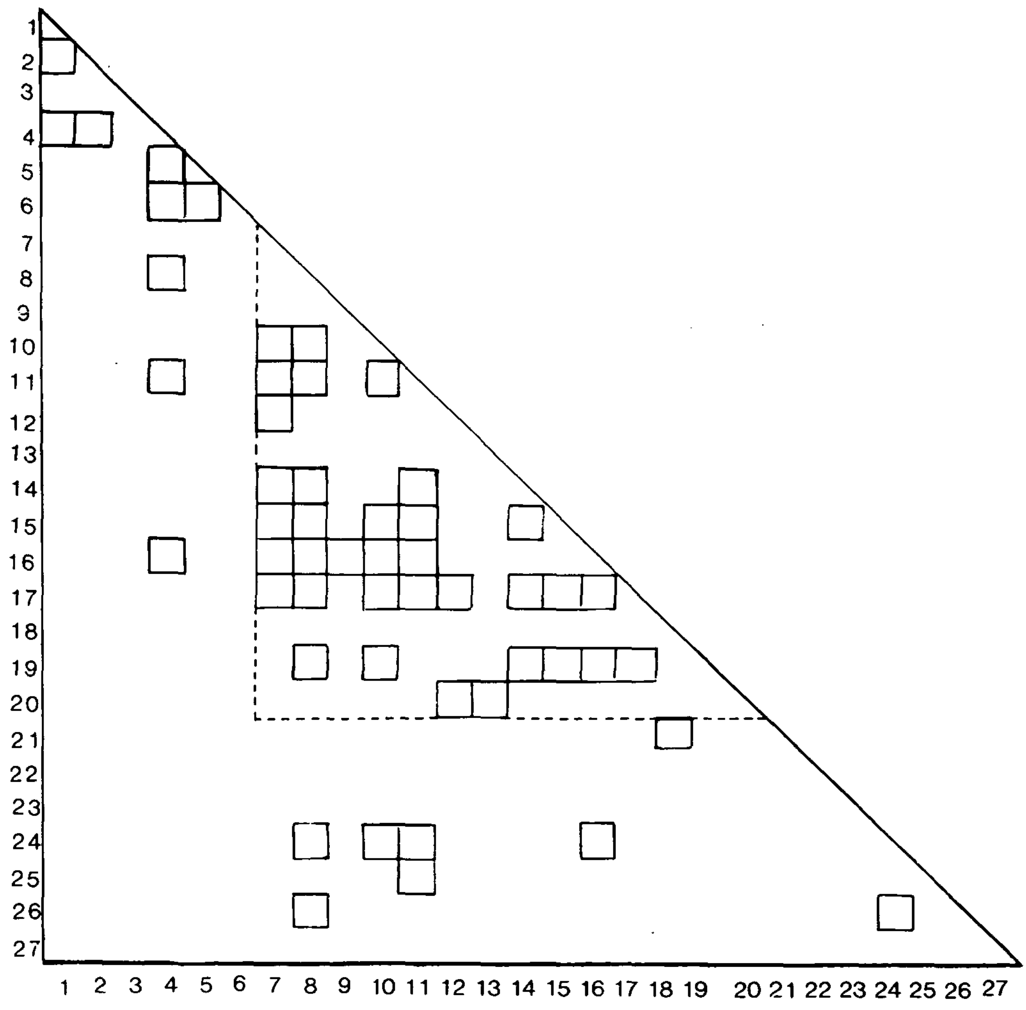


Plate 6. Diagrammatic representation of all observed combinations of taxa which act as parents in hybrid swarms. Taxa: 1. *charlesiana* 2. *chatelainiana* 3. *ferraria* 4. *glutinosa* 5. *luerssenii* 6. *pruinosa* 7. *alicia* 8. *artemisioides* 9. *circinnata* 10. *coriacea* 11. *filifolia* 12. *glaucifolia* 13. *hamersleyensis* 14. *helmsii* 15. *oligophylla* 16. *petiolaris* 17. *quadrifolia* 18. *stricta* 19. *sturtii* 20. *symonii* 21. *cardiosperma* 22. *cuthbertsonii* 23. *flexuosa* 24. *gawlerensis* 25. *manicula* 26. *microphylla* 27. *pilocarina*.

As emphasised above, the high frequency and widespread occurrence of hybridization in this group means that in most cases there are no morphological discontinuities between pairs of taxa e.g. *filifolia* and *artemisioides* are distinguishable in population *Randell 224* by the number of leaflets and their numbers of hairs (Plates 4, 5). But even within this population, there are plants which are morphologically intermediate between the taxa. Examination of many hundreds of herbarium specimens (usually lacking any information of population structure) has revealed a continuous range of specimens linking the two forms. Overall there are no morphological discontinuities between *filifolia* and *artemisioides*.

Similarly, there are continuous ranges of specimens linking pairs of taxa such as *artemisioides* and *sturtii*, *sturtii* and *helmsii*, *helmsii* and *oligophylla*, *oligophylla* and *coriacea*, etc. etc.

These important characteristics make it very clear that the traditional taxonomic approach cannot be applied in ser. *Subverrucosae*, and that a new approach must be developed. This development is constrained by several external factors:

1. The absolute necessity of producing an approach which will be of practical use to taxonomists, ecologists, naturalists and others working in many fields.
2. The absolute necessity of adopting a treatment which does not conflict with the rules of ICBN, however much it differs from that usually applied by plant taxonomists.
3. The desirability of producing a treatment which reflects (in a greatly simplified manner) the true biological situation in the group.

The species concept developed using this new approach is obviously imperfect, and will no doubt be improved when other workers encounter situations as complex as that in ser. *Subverrucosae*.

5.2.1 *Three possible approaches to the recognition of taxa*

The recognition of taxa in this group could be approached in a number of ways. Three are discussed below.

a. All the forms linked by unbroken ranges of intermediate plants could be united into a single species, with no infraspecific taxa recognised because of the absence of morphological gaps between forms. This would produce one extremely large, extremely variable, extremely widespread species. Some twenty species would disappear into synonomy, even though they are recognisable morphological forms.

This approach has been rejected, as much important information on the morphology, cytology, and distribution of the constituent forms would be lost.

b. Despite the absence of morphological gaps between forms, each could be treated as a separate species, with specific limits set arbitrarily. This is equivalent to the approach of Bentham (1864, 1871) and Symon (1966). This approach leads to the situation where a single population, which is obviously a hybrid swarm, can contain 6 parental species, and other species of hybrid derivation, with none of the species being separable by morphological gaps (see discussion of population *Randell 224* above).

This approach has also been rejected as information about the relationships between various forms (shown by the relative frequency of hybridization) would be lost.

c. All the forms could be treated as separate subspecies. In this case, each of the constituent forms would retain taxonomic status, and information on their cytology, morphology and distribution would be accessible. However, there are still no morphological disjunctions between forms, and limits would have to be set arbitrarily. This flaw is probably more acceptable at the subspecific than the specific level, and it is this compromise which has been adopted.

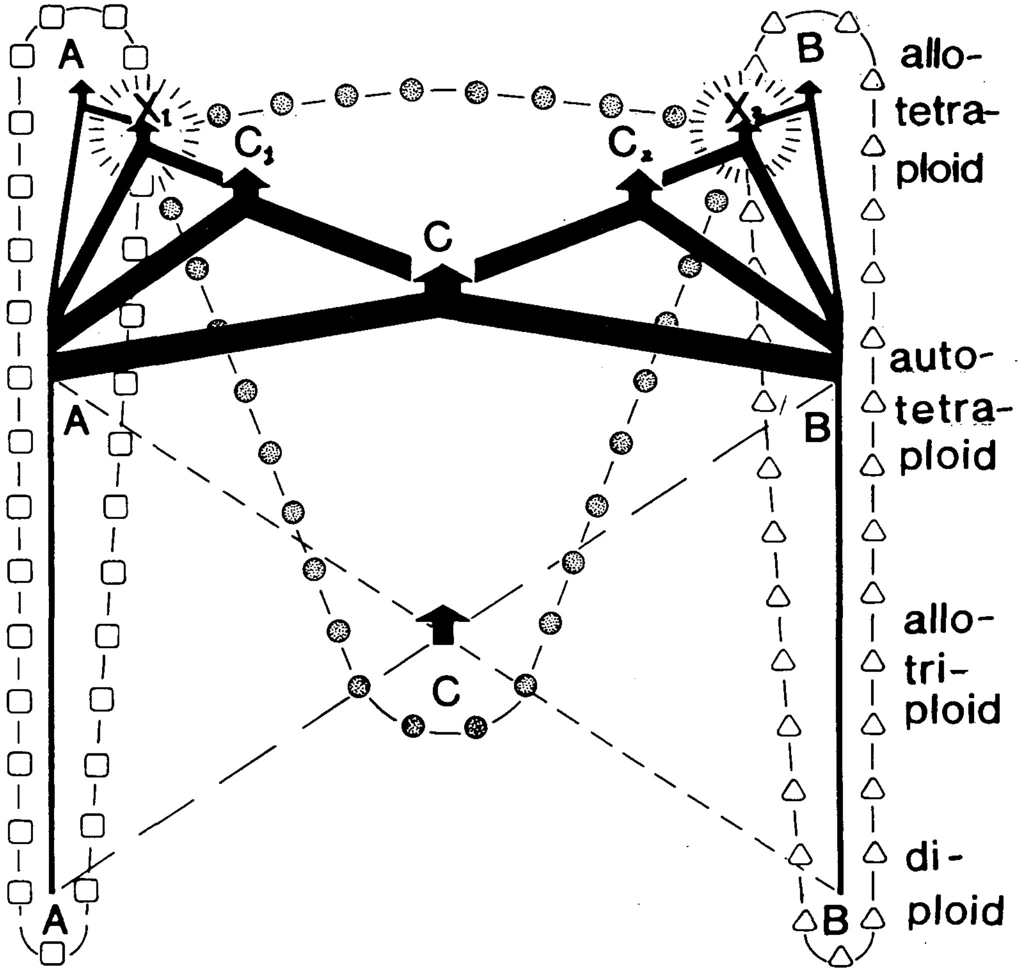


Plate 7. Illustration of the consequences of hybridization and repeated backcrossing between two hypothetical taxa A and B, which have both diploid and autotetraploid races, and their hybrid taxon C, which is triploid and allotetraploid. Width of bars proportional to frequency of crossing. Limits of morphological taxa – □ – □ – A; – Δ – Δ – B; – O – O – C; X area of taxonomic uncertainty. Within this last area, morphological taxon limits must be set arbitrarily if there are no morphological or cytological characters available to separate autotetraploids from allotetraploids (i.e. X1 = either A or C, X2 = either B or C).

Populations of ser. *Subverrucosae* frequently contain plants referable to A/A1, X1, C1, C, C2, X2, and B1/B, and as there are no characters available to separate autoploids from alloploids, morphological limits must be set arbitrarily.

Many populations contain even more than 2 parental races (eg. *Randell 224*), so that the number of parental combinations and parental-hybrid combinations becomes too large and complex to illustrate on a 2-dimensional figure.

When this approach is followed, the subspecies are seen to fall into three natural groups, which are ranked as species because they are recognisable by a number of morphological characters (Table 5). However, the morphological disjunctions between them are not complete, being obscured by relatively infrequent interspecific hybridization. On the other hand, infraspecific hybridization is much more frequent (Plate 6).

Use of the subspecific level, not previously applied in this section, has had the unexpected advantage of removing constraints of priority on the choice of subspecific epithets. In most cases, the epithet currently most widely applied to the taxon has been retained at the new level, but misleading, misapplied or previously confused epithets have been avoided.

Table 5. Morphological characteristics of three species of ser. *Subverrucosae*.

S. glutinosa	petals 11—15 mm long, pubescent
S. artemisioides	petals 7—10 mm long, glabrous
S. cardiosperma	petals 4—6 mm long, glabrous

5.2.2 *The species concept adopted in ser. Subverrucosae*

The species concept adopted here may be summarised as follows:

a. Subspecies are recognised for a number of reasons.

a.1. Morphologically recognisable races which are known to contain diploids are subspecies. They usually also contain morphologically-similar tetraploids. Morphological limits are set arbitrarily.

a.2. Morphologically recognisable races which contain extremes of variation and are probably derived from unrecorded diploids are subspecies. Morphological limits are set arbitrarily. (Most of these taxa are closely correlated with species recognised by earlier authors.)

a.3. Morphologically recognisable races which are always of hybrid derivation (even when acting as parents of hybrid swarms), which are frequently encountered, which have wide distribution and may be derived from several parental combinations, are hybrid subspecies. Morphological limits are set arbitrarily. (Many of these are closely correlated with taxa recognised by previous authors.)

In the majority of cases, there are no morphological disjunctions between subspecies, and taxon limits must be set arbitrarily (see Plate 7 for explanation).

b. Species are groups of subspecies, and are separated by morphological disjunctions. They are recognised by a number of morphological characters (Table 5). However, interspecific hybridization may obscure the gaps between species.

c. Hybrid forms which are not frequently encountered are named by either of the following:

c.1. a combination of the names of the parents, if these are readily identifiable.

c.2. indicating affinity with a single parent, when the other (or others) is not readily identifiable.

However, despite the large number of taxa recognised as being involved in the tetraploid hybrid swarms, there are still some plants which cannot be assigned to any taxon (see discussion of population *Randell 224* above).

5.2.3 *A comparable situation in another genus*

In the species *Epilobium billardierianum* a somewhat similar but simpler situation exists. In New Zealand, there are two entities which are always separated by morphological disjunctions and which do not usually hybridize. They have, understandably, been treated as separate species. However, in Australia these same taxa hybridize widely and freely, with the production of stable intermediates. The taxa are treated as subspecies in Australia (ie. *E. billardierianum* subspp.) and therefore the New Zealand taxa are also treated as subspecies, despite their morphological distinction there (Raven and Raven 1976).

In addition the Australian hybrid progeny are numerous, widespread and apparently stable in the wild. They have been treated as a third, hybrid, subspecies of *E. billardierianum* (Raven and Raven l.c.)

Although the situation described is much simpler than that in ser. *Subverrucosae*, these authors have taken a similar approach in recognising parental and hybrid taxa as subspecies of the one species.

6. Suggested history of ser. *Subverrucosae* in the arid-zone

(cognisant of current knowledge of biology and biogeography).

Three species *S. glutinosa*, *S. cardiosperma* and *S. artemisioides* are widespread in the eremean zone. Each of them comprises a number of sclerophyllous morphological forms and in each some forms are known to exhibit polyploidy, hybridization and polyembryony. Their success in the arid zone is probably associated with these characteristics (Randell 1970), which are not known elsewhere in Senna.

6.1 Origin of scleromorphy

Early discussions of the sclerophyllous habit assumed that it was an adaptation allowing plants to survive in semi-arid or arid conditions. In recent years this simplistic view has been questioned. Beadle (1954, 1966) showed that the development of sclerophylly is associated with growth in soils deficient in phosphorous. Johnson and Briggs (1981) accepted this hypothesis. They suggested that sclerophylly arose in Australian plants on a number of different occasions, one of them among plants of closed forests and nutrient-deficient soils of mid-cretaceous Gondwanaland. These plants were then pre-adapted to later, more arid, conditions of reduced or seasonal rainfall.

In sect. *Psilorhegma*, morphologically unspecialised plants are currently found in closed forests of the eastern coast of Australia (ie. ser. *Interglandulosae*), probably reflecting the occurrence of the ancestor. Scleromorphic forms of ser. *Subverrucosae* probably arose first in similar closed forests, on areas of poorer soil.

6.2 Expansion from closed forests

Subsequent to the Cretaceous, large areas of Australia underwent periods of aridity (Quilty 1984), these still occurring in the Quaternary (Bowler 1982). This aridity reduced the extent of the closed forests, opening up tracts of land for invasion by scleromorphic forms. Plants of ser. *Subverrucosae* were probably present among these scleromorphs, and became widespread in arid Australia.

6.3 Isolation of relict populations

Some relict populations of diploid races of ser. *Subverrucosae* (eg. *S. cardiosperma* subsp. *gawlerensis*, *S. artemisioides* subsp. *filifolia*, and *S. glutinosa* subsp. *chatelainiana*) have been located. These populations are always associated with rocky upland areas.

During some post-cretaceous period of intense aridity (Bowler 1982), populations of the widespread scleromorphic ancestors of ser. *Subverrucosae* suffered intense selective pressures. Probably most of those occupying plains were eliminated, while some populations of rocky crests and upper slopes took advantage of surface water trapped there (Mabbut 1984) and were able to survive. As periods of intense aridity recurred over the past 500 000 years (Bowler 1982), it is possible that these relict populations were isolated at different times.

6.4 Evolution in relict populations

Thus ser. *Subverrucosae* was represented by a number of small isolated populations in different upland areas. Each such relict population carried a different sample of the parental gene-pool and was subject independently to the combined effects of selection and genetic drift.

Surviving relict populations underwent rapid morphological changes due to these genetic forces, thus producing a number of new morphological taxa. However, each would have retained gene combinations which were important for survival e.g. structural adaptations of the flower allowing bee pollination (Polhill, Raven and Stirton 1981).

Kalin Arroyo (1981) showed that self-incompatibility is the most common breeding-system in the Caesalpinioideae. If it was operative in these small populations, there would have been greatly reduced probability of successful seed-set, due to the reduced number of compatible style/pollen tube combinations.

There would have been great selective advantage for mechanisms which bypassed the need for sexual reproduction (i.e. vegetative reproduction or apomixis), or which upset the genetic controls of self-incompatibility (e.g. polyploidy). It seems probable that the only relict populations to survive would be those which evolved a mechanism such as apomixis or polyploidy.

A comparable situation has been reported in Western Australian populations of *Stylidium crassifolium* R. Br. Diploids carry a system of lethal genes which enforce self-incompatibility. Whenever very small populations of this species have been located, analysis has shown the plants to be polyploid (Banyard and James 1979).

6.5 Expansion of the taxa from relict populations

During the Quaternary, the climate has oscillated between very arid and less arid periods (Bowler 1982). During the less arid periods the new taxa expanded from their refugia, and many became widespread over the previously denuded plains. This expansion must have taken place not later than 18 000 y.b.p. as at that time a major expansion of the sand dunes took place (Bowler 1982) and many taxa now exhibit disjunct distributions around these sand areas (Randell and Symon 1976). However, it could have taken place much earlier.

Later fluctuations in climate with arid period succeeding less arid (Bowler 1982, Williams 1984) were probably associated with later contractions and expansions of the surviving taxa.

6.6 Hybridization between taxa — the current situation

As described above, most of these new taxa of the plains carry genetic mechanisms for polyploidy and/or asexual seed set. Polyploidy not only overcame genetic systems enforcing self-incompatibility within taxa, it also overcame chromosomal incompatibility barriers between taxa, permitting hybridization. Currently this is frequent whenever taxa are sympatric. Hybrid individuals produced are usually self-perpetuating, as the mechanism for asexual seed-set is also widespread. Thus dense and complex hybrid swarms are established over much of central Australia (Randell 1970).

Relict populations may have been partially reproductively isolated in the diploid state (Randell 1970) and were thus incipient species. However, hybridization between these taxa is now so frequent that none of them can be regarded as a good species. The appropriate taxonomic level was discussed previously.

This postulated history of ser. *Subverrucosae* may be summarised as follows:

a) a non-sclerophyllous ancestor was present in closed forests of Gondwanic Australia.
b) sclerophyllous forms evolved in areas of poorer soils.
c) sclerophyllous forms became widespread when rainfall was reduced.
d) relict populations were isolated during periods of intense aridity. Polyploidy and apomixis became established.
e) new taxa evolved during periods of isolation.
f) taxa expanded in less arid periods, and hybridization took place when taxa became sympatric.
g) the contraction- expansion- hybridization cycle may have been repeated a number of times during the last million years.

7. The taxonomic revision

A standardised format has been followed in the following revision.

For each monotypic species a full description is given together with an illustration of the form of the species. Flowers, fruit, androecia and habit are shown.

For those species with several subspecies, the species heading includes a full description of flowers and fruit, and these are also illustrated. The description of individual subspecies is restricted to vegetative details, as it is in these that they vary, and only the leaf structure of each is illustrated.

When establishing new taxa, I have sometimes listed paratypes. These may be considered as syntypes but have no nomenclatural significance.

In many older taxa, lectotypes have had to be chosen. All available syntypes have been checked against the protologue, and any not agreeing with it were excluded from consideration. If several agreed with it, the final choice was influenced by the state of the specimens i.e. whether fragmentary, fruiting only, flowering and fruiting etc. Decisions influenced by other factors are mentioned in the text.

Within the taxa of ser. *Subverrucosae*, the presumed autotetraploid ('parental') form is that described and illustrated. Specimens for citation are also chosen from 'parental' plants.

More frequently encountered and more widely distributed are allotetraploid or hybrid plants. These are neither described, illustrated, nor cited unless fewer than 20 specimens of the taxon were seen. However keys have been written to include these hybrid plants. Any plant encountered should be identified either (i) to a single taxon name, or (ii) to a position between the names of 2 taxa.

I have endeavoured to demonstrate the full extent of the distribution range. Where the taxon has been collected less than 20 times, individual localities are mapped. Where the taxon has been collected 21-500 times, only general areas are indicated on the distribution map.

I have also attempted to cite at least one 'parental' specimen of each taxon in each major Australian Herbarium.

After describing each taxon, and giving information on its distribution and cytology, I have included some notes. These list related taxa, suggest methods of naming intermediate plants, and also make suggestions about the need for future research.

Senna sect. *Psilorhegma*

Senna sect. **Psilorhegma** (J. Vogel) Irwin & Barneby Mem. New York Bot. Gard. 35: 77 (1982).

Lectotype species: *Cassia glauca* Lam. syn. *Senna surattensis* (Burman f.) Irwin & Barneby subsp. *sulfurea* (Colladon) Randell, fide Symon, *Trans. Roy. Soc. S. Australia* 90: 77 (1966).

Synonyms

1. Cassia sect. *Psilorhegma* J. Vogel, Gen. Cass. syn. 8: 47 (1837); Benth., *Fl. Austral.* 2: 284 (1864). *Cassia* [subgen. Senna (Miller) Benth.] sect. *Psilorhegma* (J. Vogel) Benth., *Trans. Linn. Soc. London*, 27: 513, 554 (1871); Symon, *Trans. Roy. Soc. S. Australia* 90: 77 (1966).

Lectotype: as above.

2. *Cassia* subgen. *Psilorhegma* (J. Vogel) Baker in Hook., *Fl. Brit. Ind.* 2: 265 (1878).

Lectotype: as above.

3. *Psilorhegma* (J. Vogel) Britton and Rose, *N. Amer. Fl.* 23: 255 (1930).

Lectotype: as above.

Description

Shrubs or small trees; *leaves* 2-20 cm long, once-pinnate, alternate; *leaflets* 1-16 pairs, (occasionally all caducous and then petioles functioning as phyllodes), terete to broad elliptic, glabrous or pubescent; *inflorescence* axillary, racemose but often appearing subumbellate because of the contraction of the rachis; *sepals* 5, obovate, green or brown; *petals* 5 obovate, clawed, 5-35 mm long, yellow or golden, glabrous or pubescent dorsally; *anthers* 10, all fertile, shorter than the petals, all of one size or 1-3 slightly longer, oblong, truncate, dehiscent only by apical pores; *filaments* shorter than anthers, all one length or 1-3 slightly longer, robust; *ovary* slightly longer than anthers, curved, pubescent or glabrous, with 5-12 ovules; *style* short; *stigma* terminal, punctiform; *pod* linear, flat, without pith between the seeds, valves papery, dehiscent by degeneration of both sutures; *seeds* oval, dark, dull or glossy, with an areole on each face; *funicle* filiform.

Distribution and ecology

Occurs in closed forests to open, semi-arid shrublands.

Note

As discussed in the introduction, Bentham (1871) recognised two series within sect. *Psilorhegma*, and defined them by the presence or absence of foliar glands in the constituent species. The present study has shown that glands are present in all species, and Bentham's definition cannot be maintained. However, groups of species, roughly corresponding with those of Bentham, can be recognised by a combination of seed and fruit characters, and are retained as series. In addition a third series, also defined by fruit characters, is recognised here.

Key to the series of sect. *Psilorhegma*

1. Seeds glossy; pods flat or plump, with ridges on the inner faces of the valves; leaves not usually sclerophyllous .... a. ser. *Interglandulosae*

1. Seeds dull; pods flat without ridges on the inner faces of the valves; leaves usually highly modified and/or sclerophyllous:

  2. Leaflets 4-16 pairs .... b. ser. *Subverrucosae*

  2. Leaflets (0-) 1-3 pairs only:

    3. Inflorescences along the stems; pods curved, crenate .... c. ser. *Oligocladae*

    3. Inflorescences at the end of the stems; pods straight, or coiled, entire .... b. ser. *Subverrucosae*

a. Ser. *Interglandulosae*

a. Senna Miller [sect. *Psilorhegma* (J. Vogel) Irwin & Barneby] ser. **Interglandulosae** (Benth.) Randell, comb. nov.

Basionym: *Cassia* L. [subg. *Senna* (Miller) Benth. sect. *Psilorhegma* (J. Vogel) Benth.] ser. *Interglandulosae* Benth., *Trans. Linn. Soc. London* 27: 554 (1871) p.p., excluding *C. leptoclada*, *C. goniodes*, *C. divaricata*, and *C. chatelainiana.*

Lectotype species: *S. surattensis* (Burman f.) Irwin & Barneby subsp. *sulfurea* (Colladon) Randell as it is the lectotype of the section.

Description

Shrubs or small trees, *leaves* 3-20 cm long; *leaflets* 2-16 pairs, not usually sclerophyllous; *glands* 1-many, stipitate; *petals* obovate, 15-30 mm long; *pods* 8-15 cm long, 5-15 mm broad, with ridges on the inner surfaces of the valves; *seeds* glossy black.

Distribution and ecology

Most species are restricted to wet sclerophyll or subtropical rainforests of Australia and the Pacific Islands. However two species have extended their range into Australian grasslands, usually under *Eucalyptus* species.

Key to the species of ser. *Interglandulosae*

1. Petioles 2-15 mm long; leaflets appearing crowded:
   2. Peduncles 10-20 (-30) mm long; glands 1-2 .... 5. *S. coronilloides*
   2. Peduncles 30-50 (-100) mm long; glands 3-many:
      3. Petioles 2-5 mm long; leaflets linear usually revolute, to 6 mm broad; usually pubescent .... 4. *S. aciphylla*
      3. Petioles 6-10 mm long; leaflets elliptic to obovate, rarely revolute, 5-10 mm broad; not obviously pubescent .... 3. *S. odorata*
1. Petioles 15-40 mm long; leaflets not appearing crowded:
   4. Pods narrow (5-10 mm broad), oval in section:
      5. Leaflets narrow-elliptic, 3-8 mm broad; pods curved or coiled ½-¾ circle; flowers 5-8 per peduncle .... 6. *S. costata*
      5. Leaflets broad elliptic, 10-15 mm broad; pod curved through ¼ circle; flowers 2-5 per peduncle .... 2. *S. acclinis*
   4. Pods broad (10-25 mm broad), quite flat .... 1. *S. surattensis*

1. **S. surattensis** (Burman f.) Irwin & Barneby, *Mem. New York Bot. Gard.* 35: 79 (1982).

Basionym: *Cassia surattensis* Burman f., *Fl. indica* 97 (1768); De Wit, *Webbia* 11: 269 (1955); Symon, *Trans. Roy. Soc. S. Australia* 90: 100 (1966); Verdcourt, *Botany Bulletin* 11, P.N.G. (1979).

Holotype: not seen, cited by Irwin & Barneby (l.c., p.79) as "G, originally labelled *C. sumatrensis* but the epithet corrected in an old hand to '*surattensis*'".

The above basionym applies to both the species and the type subspecies. All synonyms are listed under the subspecies to which they apply.

Description

Low shrub or small tree, reaching 7 m in New Guinea, and 11 m in Hawaii; *leaves* 5-15 (-20) cm long; *leaflets* (2-) 3-10 pairs, elliptic, oblong, oblanceolate, or oval to obovate, the longest 2-7 (-10) cm long, increasing in size from the base of the rachis, apex obtuse to emarginate, indumentum variable, sometimes golden pubescent on both surfaces, or glabrescent, or almost glabrous on one or both surfaces; *glands* 1-5, stipitate, to 4 mm long, between lower leaflet pairs; *stipules* acicular, usually deciduous, rarely more or less persistent; *petioles* 10-40 (-65) mm long, channelled above; *inflorescences* in the axils of upper leaves; *peduncles* 20-60 mm long; *pedicels* 15-30 mm long, solitary; *bracts* more or less persistent, acicular to obovate, 5-8 x 1-3 mm (occasionally a stipitate gland appearing beside a pedicel in the axil of a bract); *petals* subequal 10-30 mm long in different subspecies, pubescent or glabrous dorsally; *anthers* 10, all fertile; *filaments* 1-2 mm long (rarely one abaxial filament to 5 mm), robust; *ovary* sparsely to densely hairy; *pod* 8-15 cm x 10-15 mm, straight, broad, quite flat, somewhat compressed between the seeds; *seeds* oval, with linear areoles.

Distribution

A species widespread through eastern and northern Australia, New Caledonia, New Guinea, Malesia, and Pacific Islands as far east as the Hawaiian group. Widely cultivated as a drug plant in Malesia and on the Indian subcontinent, so that the natural limits of distribution are now obscured.

Notes

This is a very critical group, whose classification has long given rise to problems, not least because of long cultivation of some of its members as drug plants (De Wit 1955, Irwin & Barneby 1982). However, the Australian origin of the complex, as part of sect. *Psilorhegma*, is now beyond question (see above) and this has allowed a new perspective to study of the whole group, instead of a piecemeal approach considering separately the specimens from individual geographical areas.

Bentham (1871) also considered the whole range of material available, but there were very few collections at that time. He recognized four separate species, *C. retusa* from Australia, *C. gaudichaudii* from Hawaii, *C. deplanchii* from New Caledonia, and *C. glauca* as a single name for the two constituent taxa "*C. glauca*" and "*C. suffruticosa*" which he was unable to separate consistently. However, part of his problem was due to the inclusion of specimens of *S. acclinis* from eastern Australia within this material.

De Wit (1955) dealt only with materials occurring in Malesia and hence excluded *C. gaudichaudii* and *C. deplanchii* from his study. He recognized two species, *C. surattensis* (syn. *C. glauca* sensu Bentham) and *C. retusa*. This approach was followed by Symon when considering the Australian material in 1966. However, in New Guinea, Verdcourt (1979) did not recognize *C. retusa* as a separate species, including all specimens within an extremely variable *C. surattensis*.

Irwin & Barneby (1982) dealt only with the forms naturalized in the Americas, which were all referable to *C. glauca* sensu Bentham. Within their material, they were able to recognize two taxa, *C. surattensis* Burman f., and *C. sulfurea* Colladon, roughly equivalent to the subgroups Bentham had been unable to separate.

The present study has shown Australian specimens which are intermediate between the two 'species' recognized by Irwin and Barneby. Similarly, Verdcourt (1979) described New Guinea specimens which fall between the species boundaries recognized in America. It is obvious that the separation possible in American material cannot be extrapolated to cover Asian/ Australian materials. Nevertheless, materials from Australia and Malesia (*C. glauca* sensu Bentham) are extremely variable, and the extremes are very different from each other. The present revision treats the extremes as subspecies of the one species, an approach comparable with that adopted for other polytypic species later in this paper. Intermediates are placed with the subspecies they most resemble.

Irwin & Barneby (1982) did not consider materials from the "*retusa* - *gaudichaudii* - *deplanchii*" group, as these do not occur in the Americas. Present study indicates few differences between the types of *C.retusa* and *C. deplanchii*, and they are not separable at the species level. The taxon *C. gaudichaudii* is itself rather variable (Degener 1932), and Bentham (1871) noted its similarity to *C. deplanchii*. It is probable that these three names apply to variable materials from different parts of the range of a single widespread taxon. As this variable taxon is very similar to *C. glauca* sensu Bentham, and there are apparently intermediate specimens in Malesia and New Guinea (De Wit 1955, Verdcourt 1979), it is treated as a third subspecies of the same species.

Key to the subspecies of *S. surattensis*

1. Leaflets 6-10 pairs, elliptic to oblong to ovate, discolourous .... 1. subsp. *surattensis*
1. Leaflets 2-5 (-6) pairs, oblong to oval to obovate, concolourous:
    2. Leaflets (2-) 3-5 (-6) pairs, the longest 20-50 (-60) mm long; petioles 10-30 mm long; longest petals 10-15 mm long .... 3. subsp. *retusa*
    2. Leaflets 4-6 pairs, the longest 40-70 (-100) mm long; petioles 20-40 mm long; longest petals 15-30 mm long .... 2. subsp. *sulfurea*

1.1 subsp. **surattensis.**

Basionym and *holotype*: as for the species.

Synonyms

1. *Cassia fastigiata* Vahl, *Symb. bot.* 3: 57 (1794).

Holotype: not seen, cited by Irwin & Barneby (l.c., p. 79) thus "caret in hb. Vahl., C, but the protologue decisive."

2. *Cassia suffruticosa* Roth, Nov. sp. pl. 213 (1821); Benth., *Fl. Austral.* 2: 285 (1864).

Holotype: not seen, cited by Irwin & Barneby (l.c., p. 79) thus "no typus found, but the protologue decisive."

3. *Senna speciosa* Roxb., *Fl. ind.* ed. 2: 347 (1832).

Holotype: K (photo).

4. *C. glauca* sensu Bentham, *Trans. Linn. Soc., London* 27: 555 (1871), non Lam.

5. *C. glauca* var. *koenigii* Kurz, *J. Asiatic Soc. Bengal* 45(2): 284 (1876).

Holotype: not seen, name listed by Irwin & Barneby (l.c.) as equivalent to *C. suffruticosa* Roth, but possibly closer to *C. gaudichaudii*, as it was not discussed by De Wit (1955), when dealing with Asian materials.

6. *C. glauca* var. *suffruticosa* (Roth) Baker in Hook. f., *Fl. Brit. India* 2: 265 (1878) (nom. illeg. as var. *koenigii* has priority).

7. *Psilorhegma suffruticosa* (Roth) Britton & Rose, *N. Amer. Fl.* 23(4): 255 (1930).

8. *C. surattensis* subsp. *suffruticosa* (Roth) K. & S. Larsen, *J. Nat. Hist. Soc. Siam* 25 (3-4): 205 (1974).

9. *S. surattensis* var. *suffruticosa* (Roth) Isley, *Mem. New York Bot. Gard.* 25(2): 129, 209 (1975).

Description

Leaflets 6-10 pairs, oblong to obovate, the largest (20-) 25-45 (-50) mm long, apex obtuse, epidermis pubescent or glabrous; *petiole* 30-40 mm long; *petals* 16-24 mm long. Plate 8f.

Distribution and ecology

Probably restricted to closed forests, but natural distributions now wholly obscured by a

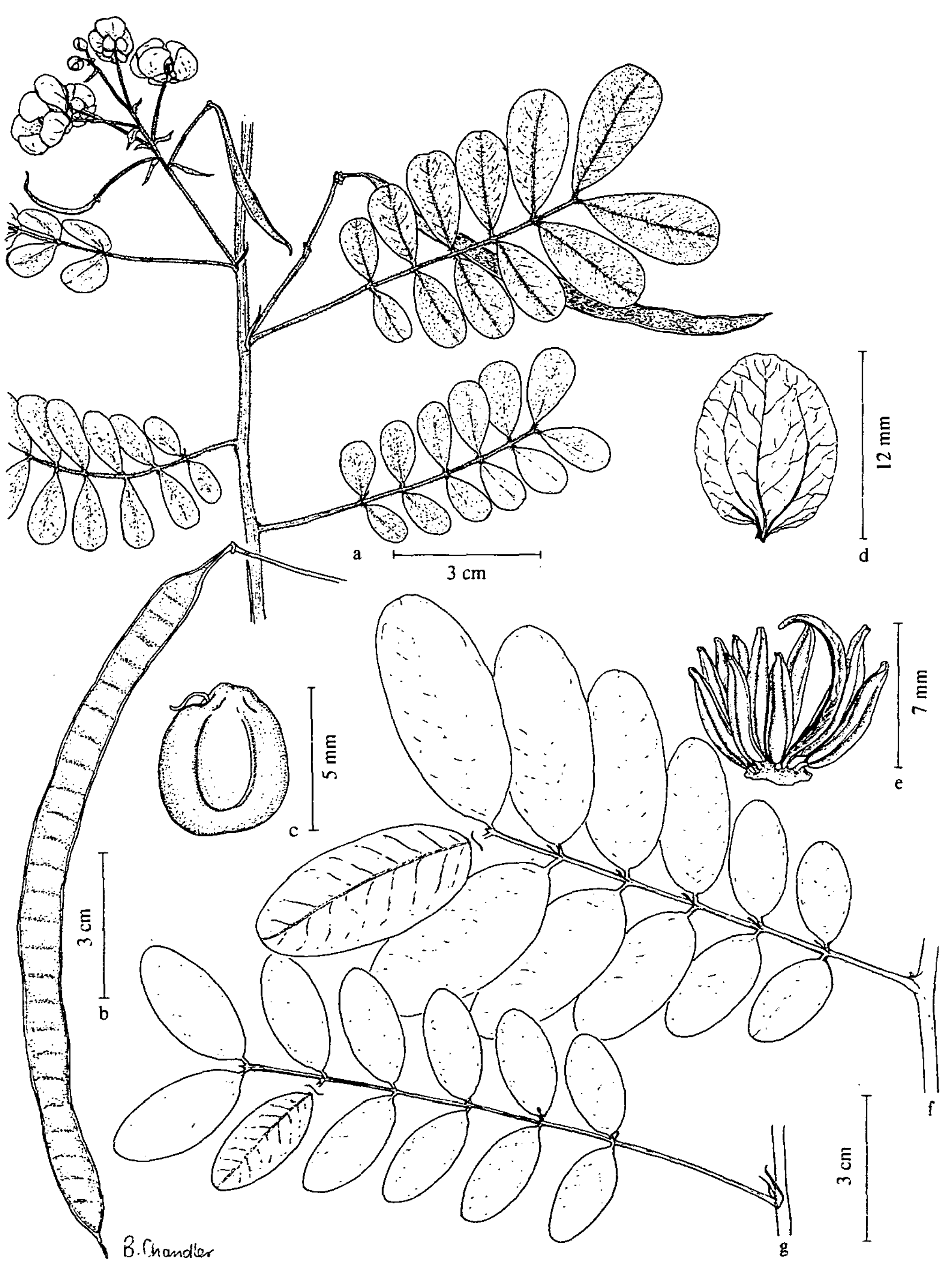


Plate 8. *S. surattensis* subsp.; a-e subsp. *retusa*; a. habit, *Gray s.n.*, July 1976; b. pod, c. seed, both from *Johnson s.n.* 1891; d. largest petal, e. anthers, both from *Gray s.n.*, July 1976; f. subsp. *sulfurea*, *Lullfitz 6102*; g. subsp. *surattensis*, *Holtz s.n.* Queensland. f and g leaves showing abaxial surface of one disconnected leaflet.

long history of cultivation as a drug plant. Previously recorded from tropical Asia, the Phillipine and Malesian Islands, Australia and islands of the Pacific (Roxburgh 1832, Bentham 1871, De Wit 1955, Symon 1966, Isley 1974, Irwin & Barneby 1982, Venkata Raju & Pullaiah 1986). In Australia, early collections indicate scattered distributions in closed tropical forests, these now largely cleared. Map 1, p. 199.

Specimens examined

NORTHERN TERRITORY: Morgans Island (as *C. glauca*), *R. Brown 22*, 21.i.1803 (NSW); "Islands in Malay Road" (as *C. graveolens*), *R. Brown s.n.*, 26.ii.1803 (NSW); North Coast Islets, N of Inglis Islands, *R. Brown s.n.*, 26.ii.1803 (MEL); Port Darwin, *Holtze 113*, 1890 (BRI; MEL).

QUEENSLAND: Palmerston, *Holtz s.n.*, s.d., (AD); Roberts Plateau, Lamington National Park, *White 6036*, 28.v.1929 (BRI); Iron Range, Cape York Pen., *Brass 19233*, 17.vi.1948 (BRI; GH); Shire of Murgon, *Phillips s.n.*, 6.iv.1977 (BRI); Pialba, *Forster 2844*, 2.i.1986 (BRI).

1.2 subsp. **sulfurea** (Colladon) Randell, comb. nov.

Basionym: *Cassia sulfurea* DC. ex Colladon, *Hist. nat. med. Casses* 84 (1816).

Holotype: not seen, cited by Irwin & Barneby (1982) thus: "no typus found at G, MPU, or P but the plant in G-DC labelled 'Cassia sulfurea Ile de France ou de Bourbon, Museum de Paris, 1821' is considered authentic."

Synonyms

1. *Cassia glauca* Lam., *Encycl.* 1: 647 (1785); Colladon, *Hist. nat. med. Casses* 102 (1816); Benth., *Trans. Linn. Soc., London* 27: 555 (1871), p.p.; (non *Senna glauca* Roxb., *Fl. ind.* ed 2: 351 (1832), syn. *C. timoriensis* DC.).
Holotype: not seen, cited by Irwin & Barneby (l.c., p. 79) as "P. LAMK".

2. *Cassia arborescens* Vahl, *Symb. bot.* 3: 56 (1794).
Holotype: not seen, cited by Irwin & Barneby (l.c., p. 79) thus: "C (hb. Vahl)" (nom. illeg., non *C. arborescens* Miller, *Gard. Dict. abr.* ed. 8, 1768).

3. *Senna arborescens* (Vahl) Roxb., *Fl. ind.* ed. 2: 345 (1832).

4. *Cassia enneaphylla* Koenig ex R. Wight & Arn., *Prod. Fl. Pen. Ind.* 1: 289 (1834), pro. syn.
Holotype: none stated.

5. *C. suffruticosa* sensu Benth., *Fl. Austral.* 2: 285 (1864), p.p., non Roth.

6. *C. surattensis* sensu De Wit, *Webbia* 11: 269 (1955), p.p.; Symon, *Trans. Roy. Soc. S. Australia* 90: 100 (1966), p.p.; Verdcourt, *Botany Bulletin* 11, P.N.G. (1979), p.p.; non Burman f.

7. *C. surattensis* subsp. *surattensis* sensu K. & S. Larsen, *J. Nat. Hist. Siam. Soc.* 25: 205 (1974), non Burman f.

8. *C. surattensis* var. *surattensis* sensu Isley, *Mem. New York Bot. Gard.* 25: 129, 209 (1975), non Burman f.

9. *Senna sulfurea* (Colladon) Irwin & Barneby, *Mem. New York Bot. Gard.* 35 (1): 79 (1982).

Description

Leaflets 4-6 (-7) pairs, oblong to obovate, the largest 4-7 (-10) cm long, golden pubescent or glabrous; *petiole* 20-40 (-65) mm long; *petals* (10-) 15-30 mm long. Plate 8e.

Distribution and ecology

Natural distribution now obscured and confused by cultivation. Previously recorded from tropical Asia, Malesia, and Australia (Roxburg 1832, Bentham 1871, Kurz 1876, De Wit 1955, Symon 1966, Irwin & Barneby 1982). Early collections in Australia indicate distribution in tropical and subtropical forests, now greatly restricted due to clearing activities.

Specimens examined

WESTERN AUSTRALIA: Mitchell Plateau north end, *Beard 8455*, 26.ii.1929 (PERTH): Parry Harbour, *Lullfitz 6102*, 16.vi.1968 (PERTH); Pt Warrender, N. Kimberley, *Beard 7001*, 8.vi.1974 (AD; PERTH); Caravan Creek, Mitchell Plateau, W. Kimberley, *Kenneally 5192*, 21.vi.1976 (NSW); Pt Warrender, *Kenneally 6681*, 18.v.1978 (PERTH); 7819, 20.i.1982 (PERTH).

NORTHERN TERRITORY: Nightcliff, Darwin, along sandy beaches, *Specht 25*, 20.iii.1948 (NSW, PERTH).

QUEENSLAND: Pt Denison, *Fitzalan s.n.*, 1874 (MEL); Mt Dryander, *Kilner & Fitzalan s.n.*, s.d. (MEL); North Australia, *Tenison Woods & Holtze s.n.*, 1886 (MEL); Rosewood, *White s.n.*, -.v.1917 (BRI); Helsey Ck, Proserpine, *Michael 1502*, 16.i.1923 (BRI); Gundiah, 24 miles N Gympie, *Kajewski s.n.*, -.xii.1923 (BRI); Little Mt Alford, *Michael 2232*, 15.vii.1935 (BRI); Hoya, Fassifern Dist., *Michael 2214*, 28.iv.1935 (BRI); Eungella Nat. Park, *Pearson 6*, -.ii.1985 (BRI).

1.3. subsp. **retusa** (J. Vogel) Randell, comb. nov.

Basionym: *Cassia retusa* J. Vogel, *Linnaea* 15: 72 (1841); Benth., *Fl. Austral.* 2: 285 (1864); Benth., *Trans. Linn. Soc. London* 27: 555 (1871); Symon, *Trans. Roy. Soc. S. Australia* 90: 101 (1966).

Lectotype: Bustard Bay, N.S.W., *Banks & Solander s.n.*, 1770, BM (photo), lectotype here designated; *isolecto.* BRI!. *Syntypes*: Shoalwater Bay, Broad Sound, and Thirsty Sound, *R. Brown*, not located.

Synonyms

1. *Cassia gaudichaudii* Hook. & Arn., *Bot. Beechey Voy.* 2: 81 (1832).

Holotype: Oahu, *Beechey s.n.*, s.d., K (photo).

2. *Cassia horsfieldii* Miq., *Fl. Ned. Ind.* 1(1): 99 (1855).

Holotype: not located.

Bentham considered this a synonym of *C. glauca* (subsp. *sulfurea* herein), but it was not cited in synonymy by Irwin & Barneby (1982), so presumably they agree with De Wit (1955) in equating it with *C. retusa* J. Vogel which they did not discuss.

3. *Cassia deplanchei* Benth., *Trans. Linn. Soc. London* 27: 555 (1871).

Holotype: New Caledonia, *Deplanche 342*, 1861-67, K (photo).

4. *Cassia retusa* var. *glabrata* Domin, *Biblioth. Bot.* 89: 794 (1926).

Lectotype: Percy Isles, *A. Cunningham 168* (cited as 160), 1819, BM (photo), lectotype here designated; *isolecto.*: K (photo).

Syntypes: i) Mungana near Chillagoe, Qld, *K. Domin s.n.*, s.d., not located; ii) Pt Mackay, *A. Dietrich 673*, s.d., p.p., not located (see also var. *typica*, as the same collection number included types of two varieties).

5. *Cassia retusa* var. *dietrichiae* Domin, *Biblioth. Bot.* 89: 794 (1926).

Holotype: Brisbane River, *A. Dietrich 2841*, s.d., not located.

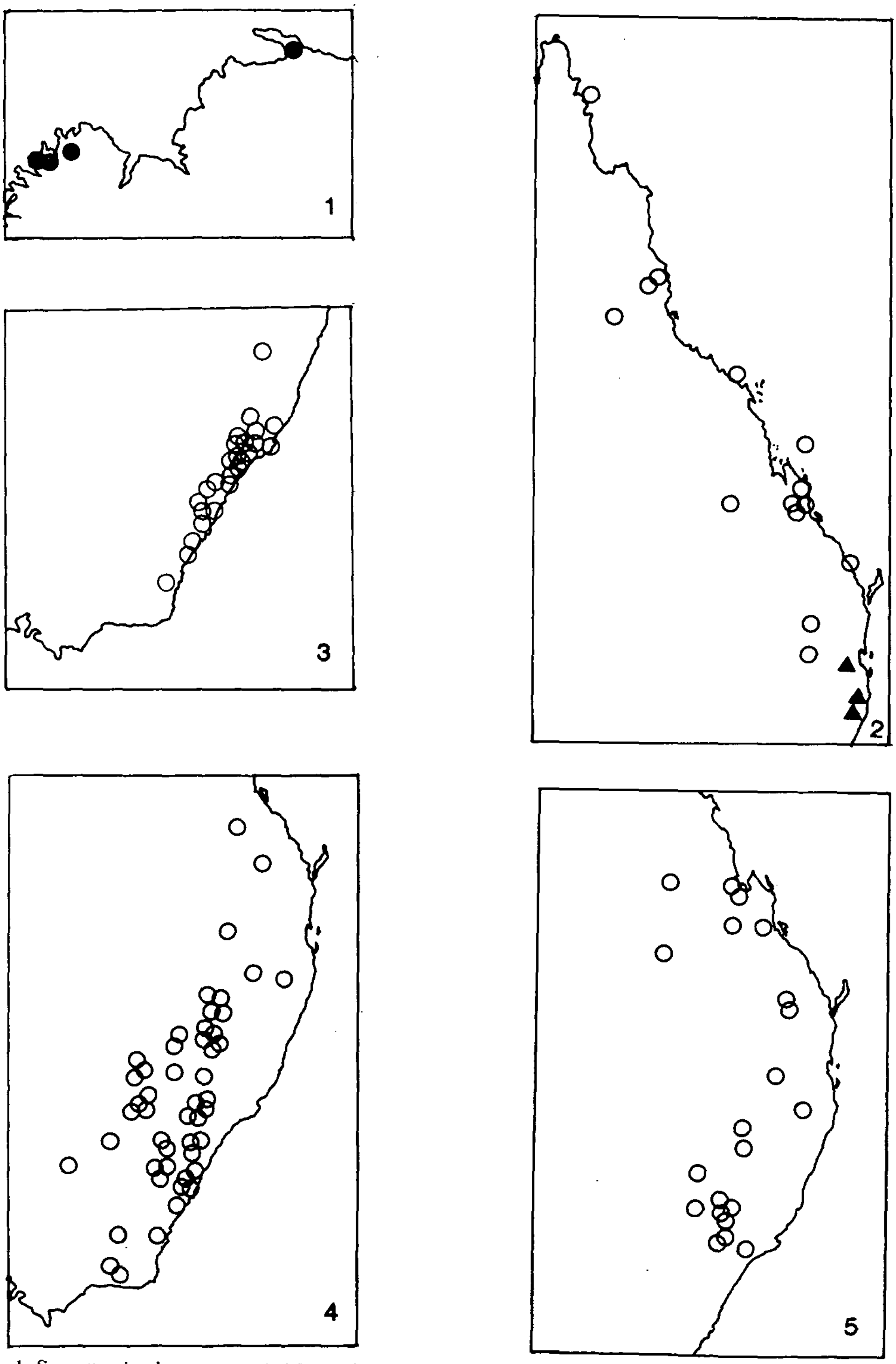
6. *Cassia retusa* var. *typica* Domin, *Biblioth. Bot.* 89: 794 (1926).

Lectotype: Rockhampton, *A. Dietrich 910*, s.d., NSW !, lectotype here designated.

Syntypes: Rockhampton, *A. Dietrich 672*, s.d., NSW !; Port Mackay, *A. Dietrich 673* p.p., s.d., not located (see also var. *glabrata* as the same collection number included types of two varieties).

7. *Psilorhegma gaudichaudii* (Hook. & Arn.) Degener, *New Illustr. Fl. Hawaiian Islands*, Fam. 169b (1932).

8. *Senna gaudichaudii* (Hook. & Arn.) Irwin & Barneby, *Mem. New York Bot. Gard.* 35: 80 (1982).



Map 1. *S.surattensis* subsp. *surattensis*. Map 2. ○ *S. surattensis* subsp. *retusa*; ▲ *S. acclinis*. Map 3. *S. odorata*. Map 4. *S. aciphylla*. Map 5. *S. coronilloides*.

Description

Leaflets (2-) 3-5 (-6) pairs, oblong, oval or obovate, largest 20-50 (-60) mm long, apex obtuse to emarginate, epidermis golden pubescent or glabrescent; *petiole* 10-30 mm long; *petals* 10-15 mm long. Plate 8a-d.

Distribution and ecology

Apparently not cultivated, so the distribution currently seen may approach that natural for the taxon. Previously recorded from Asia, Malesia, Australia, and the Pacific islands, (Hooker & Arnott 1832, Miquel 1855, Bentham 1871, Hillebrand 1888, De Wit 1955, Symon 1966). Australian collections indicate distribution in tropical and subtropical closed forests of the East coast. Map 2, p. 199.

Specimens examined

QUEENSLAND: Don R. near Edgecombe Bay, *Weld Birch s.n.*, 1886 (AD, MEL); Stuart R., *Johnson, s.n.*, 1891 (AD, MEL); Bouldercombe, *Smith s.n.*, -.x.1906 (BRI, NSW); Bundaberg, *Boorman s.n.*, -.vii.1912 (NSW); Rockhampton, *Boorman s.n.*, -.viii.1912 (NSW); Pine Inlet Percy Island, *Lazarides 5680*, 2.ii.1956 (CANB, NSW); 46 miles NNE Capella, *Story & Yapp 60*, 22.vi.1962 (NSW); 62 miles NW Rockhampton, *Lazarides 6873*, 29.vi.1963 (NSW); 25 miles N Dalby, *Telford s.n.*, -.v.1967 (NSW); 6 miles E Mt Surprise, *Symon 4899*, 26.v.1967 (AD, BRI, CANB); 40 mile scrub, Atherton, *Hyland 5871*, 1.ii.1972 (AD); 8 miles S of Lockhart R., Iron Ra., *Jones & Gray s.n.*, 20.ix.1976 (AD); near Tinneroo Falls Dam, Atherton Tableland, *Gray s.n.*, -.vii.1976 (AD).

2. S. **acclinis** (F. Muell.) Randell, comb. nov.

Basionym: *Cassia acclinis* F. Muell., Phragm. 4: 13 (1863).

Lectotype: Ipswich, *J. Nernst s.n.*, s.d., MEL! lectotype here designated.

Syntypes: a) Hastings R., *Dr Beckler s.n.*, s.d., K (photo); b) Fitzroy R., *A. Thozet s.n.*, s.d., cited by Symon as MEL? and P, not located; c) Edgecombe Bay, *E. Fitzalan s.n.*, s.d., MEL! (photo), K (photo), P.

Synonyms

1. Cassia glauca sensu Benth., *Trans. Linn. Soc. London* 27: 555 (1871), p.p., as for *C. acclinis* F. Muell., non Lam.

2. *Cassia retusa* sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 101 (1966), p.p., as for *C. acclinis* F. Muell., non J. Vogel.

Description

Shrubs to 3 m; *leaves* to 15 cm long, spreading; *leaflets* 5-7 pairs, elliptic, the largest to 5 cm long and to 15 mm broad, 10-20 mm apart on the rachis, increasing in size from the base of the rachis, apex obtuse and without a mucro, glabrous and glaucous, bicolorous; *glands* 1 (-2) between lowest pairs of leaflets, stipitate, to 3 mm long; *stipules* acicular, caducous or persistent; *petioles* 2-4 cm long, terete; *inflorescences* in the axils of the terminal leaves, racemose but subumbellate due to the contraction of the rachis; *peduncle* 2-4 cm long, bearing 2-5 flowers; bracts sometimes persistent at anthesis; *pedicels* 10 mm long, solitary; *sepals* subequal 2-4 mm long, brown; *petals* subequal, 12-15 mm long, glabrous; *anthers* 10, all fertile; *filaments* subequal, 1 mm long or slightly longer; *ovary* usually glabrous; *fruiting pedicel* 10-15 mm; *pod* 12-15 cm x 6-8 mm, dark, curved, oval in section due to the plump seeds; *seeds* with broad oval areole. Plate 9 f-k.

Distribution and ecology

Apparently restricted to rainforest margins in northern New South Wales, and southern Queensland. Map 2, p. 199.

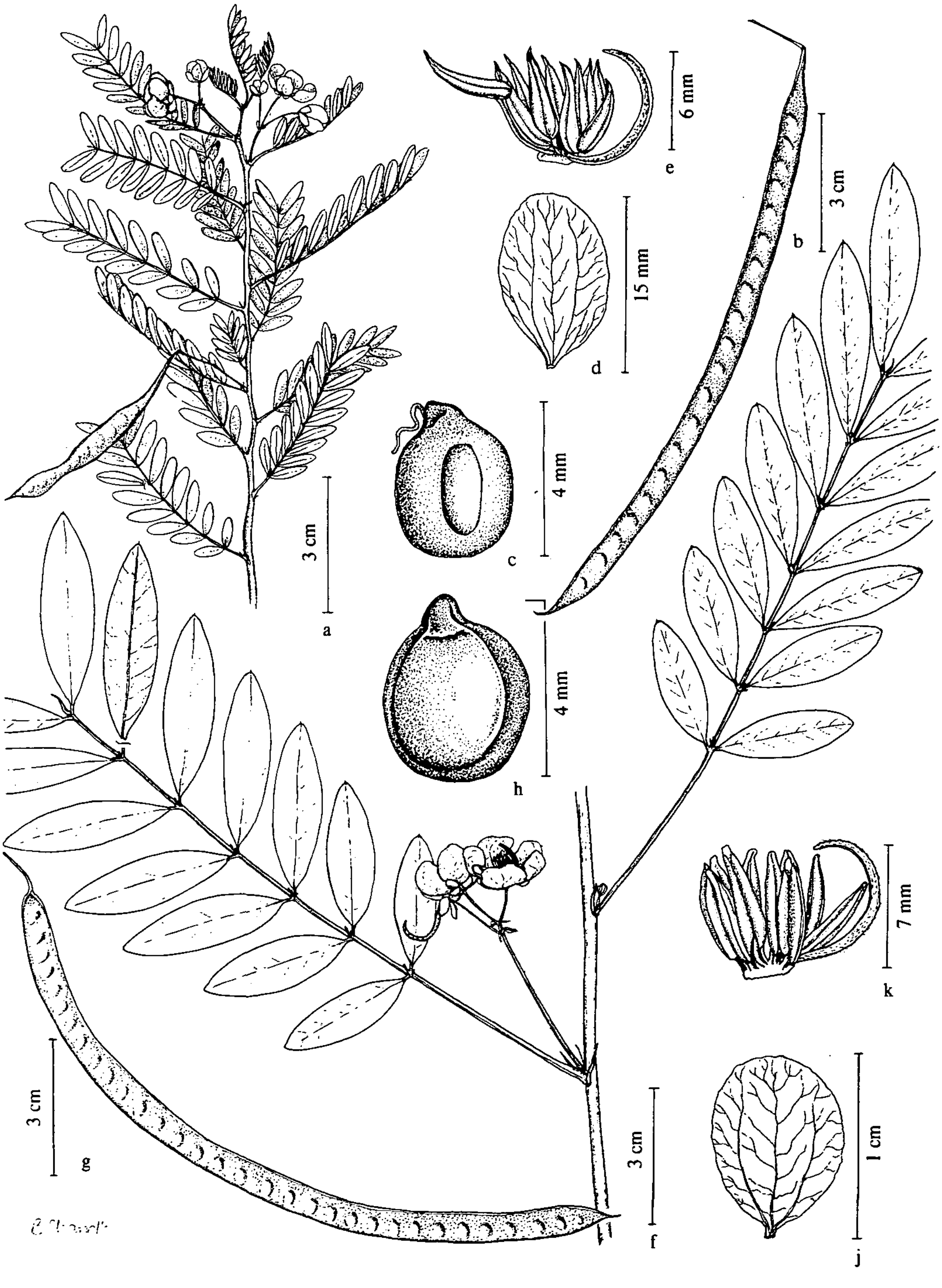


Plate 9. a-e *S. coronilloides*; a. habit, *Beauglehole 3608*; b. pod, c. seed, both from *Adams 1020*; d. largest petal *Hando s.n.*; e. anthers *Atkins 1*; f-k *S. acclinis*, f. habit *Bäuerlen s.n.*, Oct, 1891; g. pod, h. seed, both from *Bäuerlen s.n.*, May 1895; j. petal, k. anthers, both from *Bäuerlen s.n.*, Oct. 1891.

Notes

An apparently rare species, certainly rarely collected. An unsuccessful attempt has been made to relocate material at Mt Warning. It seems likely that the continued survival of the taxon depends on the maintenance of large stands of rainforest in the area.

Specimens examined

QUEENSLAND: Cleveland Bay, *Johnson s.n.*, 1877 (MEL); Brookfield, *Field Naturalists Assoc. s.n.*, -.xii.1888 (BRI); near Brisbane, *Bailey 16*, s.d. (NSW); Yarraman to Nanango, *White s.n.*, 16.v.1924 (BRI); Gladstone, *Hedley s.n.*, s.d. (BRI).

NEW SOUTH WALES: Lismore, *Bäuerlen 509*, -.x.1891 (NSW); Chincoggin Mt, Mullumbimy, *Bäuerlen s.n.*, -.v.1895 (PERTH, 2 sheets); Bungwahl Road, Bulladelah, *Rupp s.n.*, -.v.1924 (MEL); Mt Warning, W of Murwillumbah, Beamish 100, 4.ix.1971 (NSW).

3. **S. odorata** (Morris) Randell, comb. nov.

Basionym: *Cassia odorata* Morris, *Fl. conspic. t.* 57 (1826); Symon, *Trans. Roy. Soc. S. Australia* 90: 102 (1966).

Lectotype: The cited plate (photo), lectotype here designated, as no holotype located.

Synonyms

1. *Cassia australis* Sims, *Curtis's Bot. Mag.* t. 2676 (1826); J. Vogel, *Gen. Cass. syn.* 48 (1837); Benth., *Fl. Austral.* 2: 285 (1864); Benth., *Trans. Linn. Soc. London* 27: 555 (1871), non *S. australis* (Vellozo) Irwin & Barneby l.c., see Wiersema, Taxon 38: 652 (1989).

Lectotype: The cited plate (photo), lectotype here designated, as no holotype located .

2. *Cassia barrenfieldii* Colla, *Hortus Ripul. App.* 2: 343 (1827); J. Vogel, *Gen. Cass. syn.* 48 (1837).

Holotype: fide Symon (1966) "TO, grown from seed from New Holland" not seen, but there is in Kew a sheet transferred from Turin and labelled "Cassia barrenfieldii Colla ex. H. Ripl. 1828" which is presumably a syntype. In the absence of other material, it should be treated as the lectotype (photo). (*C. fieldii* cited by Bentham 285: 1864 was a nomen nudum).

3. *Cassia schultesii* Colla, *Hortus Ripul. App.* 2: 344 (1827); J. Vogel, *Gen. Cass. syn.* 48 (1837).

Holotype: fide Symon (1966) "TO, grown from seed from New Holland", not seen, but there is in Kew a sheet transferred from Turin and labelled "Cassia schultesii Colla ex H.S. Seb & Spin. 1828", which is presumably a syntype. In the absence of other material, it should be treated as the lectotype (photo).

4. *Cassia umbellata* Reichb., *Iconogr. bot. exot.* t. 206 (1830).

Lectotype: The cited plate (photo), lectotype here designated,as no holotype known . The material was grown in the Botanic Garden Dresden, from seed from New Holland.

(N.B. Though the name on the plate is *Cassia umbellata*, in the text the plant is treated as *Cassia australis* Sims.)

5. *C. fraseri* A. Cunn. ex J. Vogel, *Gen. Cass. syn.* 48 (1837), nomen nudum, cited as synonym of *Cassia australis* Sims.

6. *C. australis* var. *pedunculata* Benth., *Fl. Austral.* 2: 286 (1864).

Lectotype: St. George's River, *R. Brown 4259*, s.d., BM (photo), lectotype here designated.

Syntype: Blue Mountains, N.S.W., *A. Cunningham s.n.*, s.d., not located, cited by Symon (1966) as K.

7. *Cassia riedellii* Benth. in *Martius, Fl. Bras.* 15: 122 (1870).

Holotype: *Riedel 651*, LE, fide Irwin and Barneby, *Mem. New York Bot. Gard.* 35: 59 (1982).

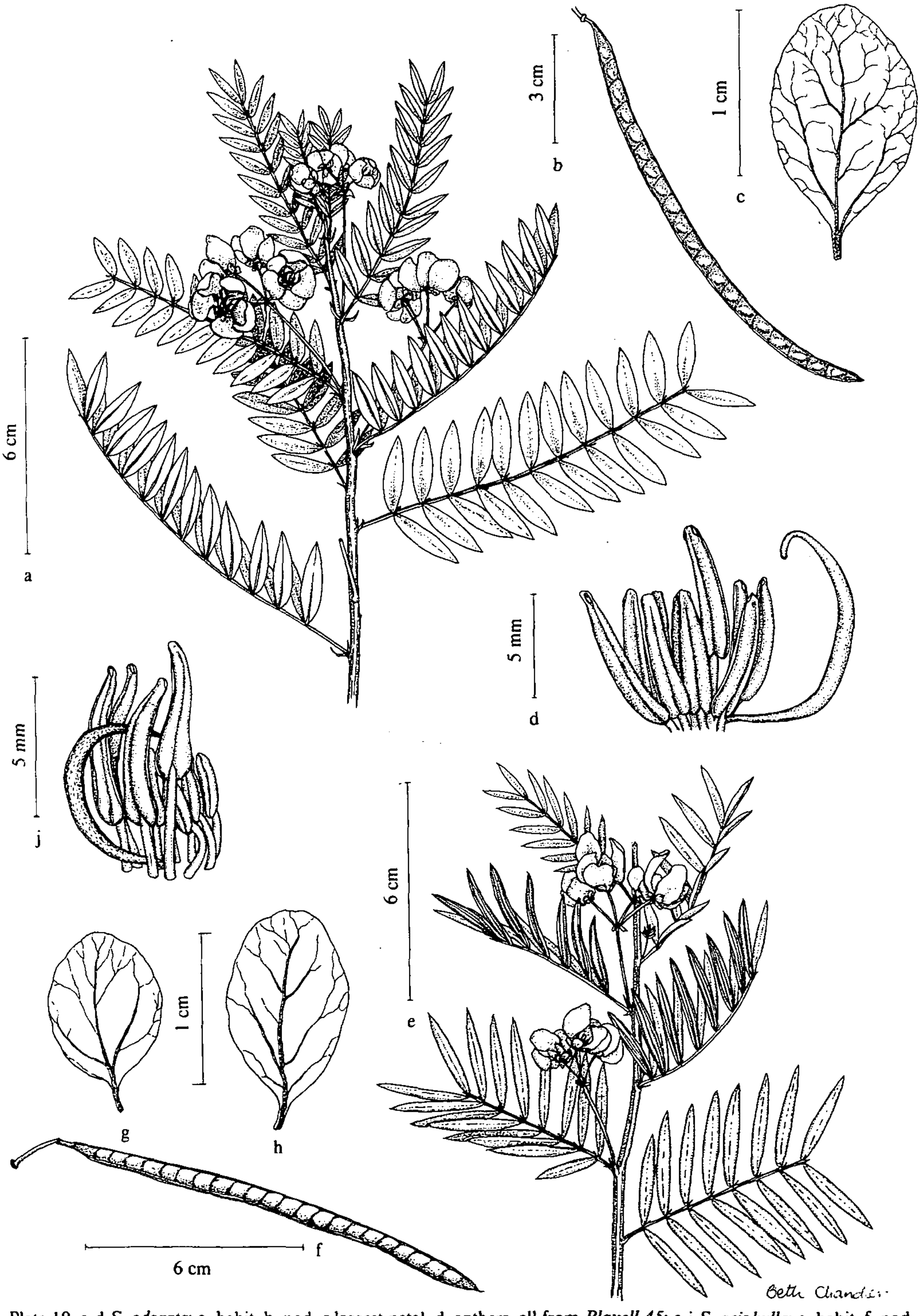


Plate 10. a-d *S. odorata*; a. habit, b. pod, c.largest petal, d. anthers, all from *Blaxell 45*; e-j *S. aciphylla*; e. habit, f. pod, g. smallest petal, h. largest petal, j. anthers, all from material cult. Adelaide Botanic Garden *Randell 345*.

Description

Shrub 1-3 m tall. *Leaves* 8-15 cm long, spreading in dim light, ascending in full sun; *leaflets* 8-13 pairs, lanceolate to elliptic, 5-8 mm apart on the rachis (this often with slight lateral wings), the longest 10-30 mm, the broadest 5-10 mm, increasing in size from the base of the rachis but sometimes the subterminals the longest, rarely the edges slightly recurved, the apex acute to obtuse, mucronate, apparently glabrous but with a few sparce hairs below; *glands* between all leaflet pairs, stipitate, pointed, to 3 mm long; *stipules* acicular, early caducous; *petiole* 6-14 mm long, terete or winged; *inflorescences* in the axils of terminal leaves, racemose but appearing subumbellate due to the contraction of the rachis; *peduncle* 3-9 cm long, with 3-5 flowers; *bracts* caducous at anthesis; *pedicels* solitary 10-20 mm long; *sepals* subequal, 4-6 mm long, brown with pale margins; *petals* subequal, the longest 12-20 mm long, glabrous; *anthers* 10, all fertile, 4 mm long or slightly longer; *filaments* about 1 mm long, subequal or 1-3 slightly longer; *ovary* glabrous or slightly hairy; *fruiting* pedicel 15-20 mm long; *pod* 8-12 cm x 5-6 mm, oval in section due to the plump seeds; *seeds* oval, 3 x 4 mm, with narrow linear areole. Plate 10 a-d.

Distribution and ecology

Occurs in wet sclerophyll or subtropical rainforest areas of New South Wales. Map 3, p. 199.

Notes

Bentham (1864) recognised the variety '*pedunculata*' for plants with peduncles much longer than the leaves. Examination of many specimens has shown that the character varies within one population [Liverpool Cemetary, *McBarron 11473*, 29.x.1965, (NSW), and *McBarron 13205*, 3.x.1966, (NSW)]; is not expressed consistently on one plant [Nepean River, *Constable 6216*, 12.x.1965, (NSW), where one plant has peduncles 5-9 cm long]; and shows no recognisable pattern of geographic distribution. The character is thus not taxonomically useful.

Selection of specimens examined (c. 50 seen)

NEW SOUTH WALES: Nepean R., *Cunningham s.n.*, -.x.1825 (NSW); NW Bowral, *Rodway 2197*, 3.xi.1935 (K, NSW); Tanja near Bega, *Floyd s.n.*, 30.x.1951 (NSW); Nowendoc R., *Johnson s.n.*, 17.x.1953 (NSW); Nepean R., 6 miles E Picton, *Constable 6216*, 12.x.1965 (NSW); 3.5 miles ENE Gloucester Tops, *Briggs 2449*, 2.xi.1968 (NSW); Bells Trail, 6 km NW Copeland, *Randell 284*, 16.xii.1985 (AD); 4 km W Barnard R. bridge between Gloucester and Nowendoc, *Randell 291*, 17.xii.1985 (AD).

4. **S. aciphylla** (Benth.) Randell, comb. nov.

Basionym: *Cassia aciphylla* Benth. in A. Gray, *U.S. Exploring Expedition during years 1838-1842*, 15: 465 (1854); Benth., *Trans. Linn. Soc. London* 27: 556 (1871); Symon, *Trans. Roy. Soc. S. Australia* 90: 104 (1966).

Holotype: Hunter River, *A. Cunningham s.n.*, s.d., K (photo). Note that the type sheet carries another specimen from Glen Findlay, which is not part of the type collection.

Synonyms

1. *Cassia revoluta* F. Muell., *Trans. & Proc. Victorian Inst. Advancem. Sci.* 1854-1855: 120 (1855).

Lectotype: Along the Avon River in Victoria, *Mueller s.n.*, s.d., K, upper left specimen of three on sheet (photo), lectotype here designated; *isolectotypes* MEL! (2 sheets, both photos), BM, E, TCD.

2. *Cassia australis* var. *revoluta* (F. Muell.) Benth., *Fl. Austral.* 2: 286 (1864).

Description

Shrub 1-3 m tall, spreading or erect, pubescent or glabrous; *leaves* 3-5 cm long, ascending; *leaflets* (5-) 8-12 pairs, linear, 1-5 mm apart on rachis, the longest 20-25 (-45) mm x 1-4 mm, increasing in size from the base of the rachis, apex acuminate, mucronate, often almost pungent, edges usually obviously revolute, (but this character less developed at latitudes higher than 30°S, often pubescent, especially north of 30°S; *glands* stipitate, to 3 mm long, between all leaflet pairs; *stipules* acicular, caducous or persistent; *petioles* 2-5 (-8) mm, terete, rarely with lateral wings; *inflorescence* in the axil of terminal leaf, racemose but subumbellate by contraction of the rachis, peduncles 20-50 mm long, bearing 2-3 flowers; *pedicels* 10-15 mm long, solitary; *bracts* sometimes persistent after anthesis; *sepals* obovate, 5 mm long; *petals* 10-15 mm long, glabrous; *anthers* 10, all fertile, subequal, 4 mm or one slightly longer; *filaments* subequal, 1 mm long or slightly longer; *ovary* white pubescent to sparsely hairy; *fruiting* pedicel 10-15 mm long; *pod* pubescent or not, 6-8 cm x 5-6 mm, oval in section from the plump enclosed seeds; *seeds* oval, with a narrow linear areole. n=13, but voucher not retained (Symon 1966). Plate 10 e-j.

Distribution and ecology

Shrub of wet or dry sclerophyll forests of southeastern Queensland and eastern New South Wales and Victoria. Map 4, p. 199.

Selection of specimens examined (c. 70 seen)

QUEENSLAND: Texas, *Boorman s.n.*, -.ix.1910 (NSW); 18 miles SW Theodore, *Everist 8072*, 28.ix.1968 (NSW); 5.5 km E Kogan, *Randell 279*, 6.ix.1985 (AD).

NEW SOUTH WALES: Tamworth, *Rupp s.n.*, -.xi.1904 (NSW); Scone, *Cambage 1644*, 31.viii.1907 (NSW); 15 miles ENE Capertee, *Constable 7214*, 28.x.1966 (NSW, PERTH); Glen Davis, *Coveny 9277*, 24.iv.1977 (A, K, L, MO, NSW, PRE, RSA); 5.5 km SSW of Manobalai, *Coveny 9600*, 26.ix.1977 (A, K, L, MO, NSW, PRE, RSA).

VICTORIA: East Gippsland, *Prescott s.n.*, 1900 (NSW); East Gippsland, Suggan Buggan, *Willis s.n.*, 16.i.1948 (MEL, NSW); Tubbut to Deddick, *Gray 5614*, 30.x.1964 (NSW).

5. S. **coronilloides** (Benth.) Randell, comb. nov.

Basionym: *Cassia coronilloides* Benth. in Mitchell, *Journal of an Expedition into the Interior of Tropical Australia* 384 (1848).

Lectotype: St George's Bridge Camp on the Balonne River, Qld, *T.L. Mitchell 426*, 11.xi.1846, CGE (photo), lectotype here designated; *isolecto*: BM, K (photo), TCD.

[*Note*, the second twig on the lectotype sheet, *Mitchell 235*, 1846, is *Senna costata* (J.F. Bailey & C.White) Randell.]

Description

Shrub 1-3 m tall, erect and straggling; *leaves* 5-9 cm long, spreading; *leaflets* 9-12 pairs, elliptic, the longest 10-20 mm long, the broadest 3-8 mm wide, all even sized, apex obtuse and mucronate, edges not recurved, glabrous or sparsely hairy, not glaucous; *glands* 1 rarely 2 between lowest pairs of leaflets, stipitate, to 3 mm long; *stipules* acicular, caduous or persistent; *petioles* 5-10 mm long, terete or slightly winged; *inflorescence* in the axils of terminal leaves, racemose but sub-umbellate by the contraction of the rachis, peduncles 10-20 (-30) mm long, bearing 3-5 flowers; *pedicels* 10 mm long, solitary; *bracts* caducous before anthesis; *sepals* subequal, 5 mm long, golden-brown with a paler margin; *petals* subequal, 10-13 mm long, glabrous; *anthers* 10, all fertile, subequal, 4 mm long or slightly longer; *filaments* subequal, 1 mm long, or one slightly longer; *ovary* glabrous or sparsely hairy; *fruiting* pedicel 10 mm long; *pod* glabrous, 6-8 cm x 4-6 (-8) mm, oval in section due to the plump seeds; *seeds* oval, 4 x 3 mm, areole linear. Plate 9 a-e.

Distribution and ecology

Occurs in dry sclerophyll areas, often under *Acacia harpophylla* in south-eastern Queensland and eastern New South Wales. Map 5, p. 199.

Notes

Previous treatments have considered the possibility of uniting the last three species (*S. odorata*, *aciphylla* and *coronilloides*) as parts of a single species, usually *C. australis* Sims, however, *S. australis* is superfluous (see under synonymy of *S. odorata*). Discussed below are reasons why this approach has not been adopted here.

(i) All three taxa have been examined in living populations, and none shows any evidence of abnormal behaviour such as hybridization or vegetative reproduction.

(ii) It is possible to define three taxa using the macromorphological characters suggested in the key. Some variations are still obvious, but these are within taxa and do not obscure the boundaries between them.

(iii) The taxon 'aciphylla' is defined by long peduncles (cf. short in *coronilloides*) and short petioles (cf. longer in *odorata*). Many specimens have flat obtuse leaflets, so that the specific epithet is unfortunately not always apposite. Previous revisions have put too much emphasis on the supposed revolute and acicular characteristics of the leaflets.

Selection of specimens examined (c. 30 seen)

QUEENSLAND: Broad Sound, *R. Brown 59*, 15.ix.1802 (NSW); Eidsvold, *Bancroft s.n.*, -.x.1919 (NSW); 43 miles SSW Nebo township, *Story & Yapp 71*, 23.vi.1962 (PERTH); 8 miles W of Avon Downs Stn, *Adams 1053*, 13.vii.1964 (CANB, NSW); Salvator Rosa National Park, *Blaxell 1497 & Armstrong*, 31.viii.1977 (NSW); Rifle Range Reserve, Chinchilla, *Randell 280*, 6.ix.1985 (AD).

NEW SOUTH WALES: Narribri, *Maiden s.n.*, -.xi.1899 (NSW); Warialda, *Rodway 2195*, -.x.1916 (NSW); 10 miles from Scone, *White s.n.*, -.x.1920 (NSW); Mt Terrible, Werris Ck, *Rodd 3334*, 8.iii.1978 (NSW).

6. **S. costata** (J.F. Bailey & C. White) Randell, comb. nov.

Basionym: *Cassia costata* J.F. Bailey & C. White, *Queensland Agric. Jour.* 4: 287 (1915); Symon, *Trans. Roy. Soc. S. Australia* 90: 104 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2: 62 (1970); Symon in Jessop, *Fl. Central Australia* 108 (1981).

Lectotype: 'Woolgar Queensland', *E.W. Bick s.n.*, -.viii.1915 BRI!, sheet with handwritten label, BRI negative 9224, lectotype here designated, (photo); *isotypes*: BRI! (photo), K (photo).

Synonym

C. australis var. *glaucescens*, Benth. *Fl. Austral.* 2: 286 (1864).

Holotype: Hooker's Creek, Northern Territory, *F. Mueller s.n.*, s.d., K (photo).

Description

Shrub or small tree, 1-2 m high. *Leaves* 4-6 cm long, including petiole; *leaflets* 4-5 rarely 6 pairs, elliptic, 20-40 mm x 3-8 mm, almost even sized, indumentum of stiff and erect hairs, dense, sparse or almost absent, cuticular wax not obvious; *glands* 1-3 between leaflet pairs, stalked, elongate and pointed; *stipules* acicular, caducous; *petioles* terete or winged, to 20 mm

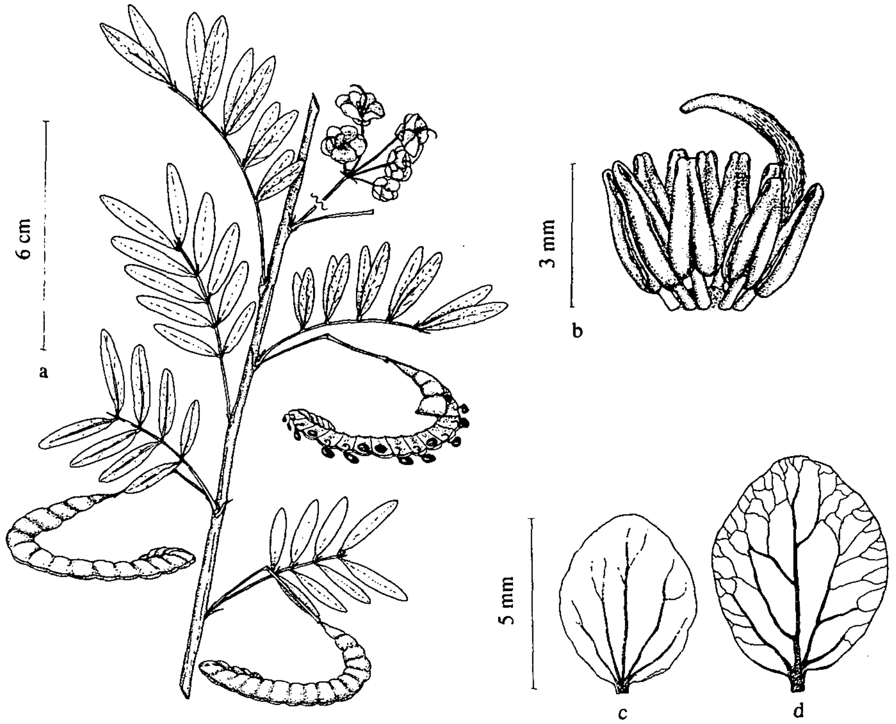
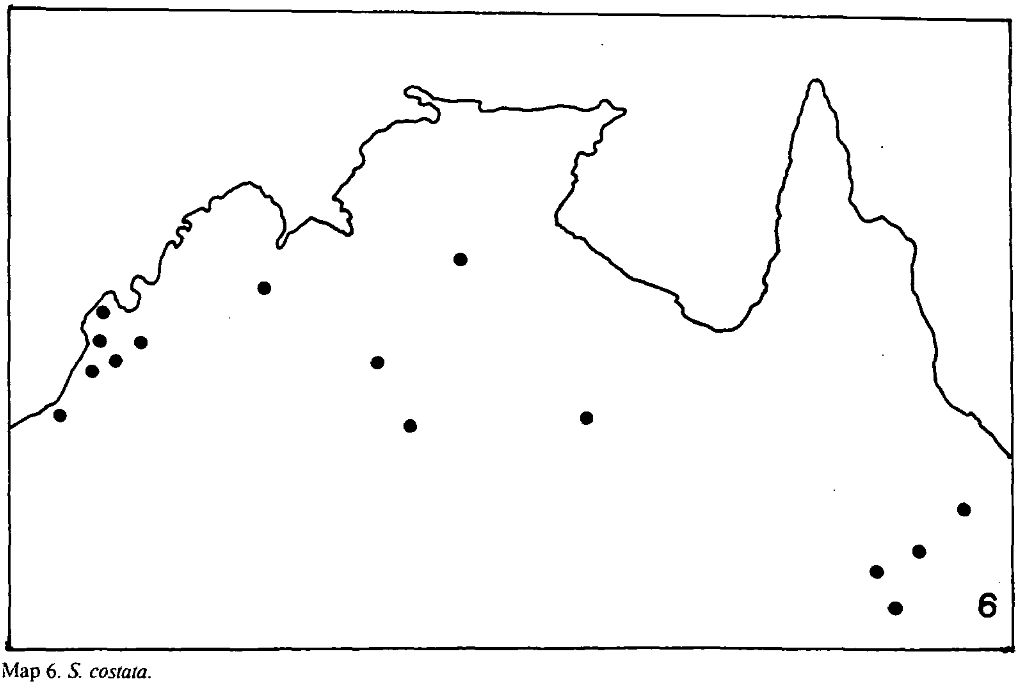


Plate 11. *S. costata*; a. habit, b. anthers, c and d. smallest and largest petals, all from *Scrymgeour s.n.*, 25.v.1967.



Map 6. *S. costata*.

long; *inflorescence* a subumbellate raceme in the axils of leaves near the end of branches, 5-8 flowered; *bracts* usually caducous at anthesis; sepals 4-5 mm long, subequal; *petals* 7-10 mm long, glabrous; *anthers* 10, all fertile, subequal, 3 mm long; *filaments* subequal, 1 mm long, 3 sometimes longer to 3 mm long; *ovary* 4 mm long, densely hairy; *pod* flat, 7-8 cm long, 8-10 mm broad, straight or usually strongly curved ½ to ¾ circle, with seed funicles attached to long outer edge, yellow when fresh to rich brown on drying; *seeds* to 5 mm long, to 20 per pod, frequently hanging from open pods by the funicles. n=14 (Randell 1970). Plate 11a-d.

Distribution and ecology

Scattered among grasses under *Acacia* and *Eucalyptus* species across northern Western Australia, Northern Territory and Queensland. Map 6, p. 207.

Notes

Despite its wide geographical distribution, the species is apparently rare and not frequently collected. Its relationship with east coast species is shown by the glossy seeds and the position of funicle attachment.

Selection of specimens examined (c. 25 seen)

WESTERN AUSTRALIA: between De Grey R. and Legrange Bay, *Forrest s.n.*, 1879 (MEL); 22 miles E Broome, *Gardner 7044*, 5.v.1944 (PERTH); 20 miles S Derby, *Barlow 1224*, 24.vi.1967 (AD); 74 km SSW Derby at Manguel Ck, *Beauglehole 53033*, 16.vi.1976 (AD); Cape Bertholet South, Dampier Peninsula, *Kenneally 6120*, 22.iv.1977 (CANB, PERTH); 67 km NE Legrange Aboriginal Mission turnoff, *Beauglehole 59194*, 1.ix.1978 (PERTH); 86 km NE Sandfire Roadhouse, *Beauglehole 59307*, 2.ix.1978 (PERTH); 5 km SSE Chattur Bay, Dampier Peninsular, *Maslin 4939*, 23.vi.1981 (AD).

NORTHERN TERRITORY: near Newcastle Waters, *Hill 455*, 7.vii.1911 (MEL); Elsey Falls, E of Mataranka, *Burbidge 5067*, 8.iv.1956 (AD, CANB); 10 miles N Elliot, Stuart Highway, *Latz 97*, 7.vii.1968 (MEL); 31.5 km NW Granites, *Beauglehole s.n.*, 20.vi.1976 (AD); Tanami Desert, *Beauglehole 50938*, 20.v.1976 (AD).

QUEENSLAND: Barcaldine, *MacGillivray s.n.*, -.viii.1928 (AD); Jerico and vicinity Central Queensland, *Clemens s.n.*, 1946 (AD).

b. ser. *Subverrucosae*

b. Senna Miller [sect. *Psilorhegma* (J. Vogel) Irwin and Barneby] ser. **Subverrucosae** (Benth.) Randell, comb. nov.

Basionym: *Cassia* L. [subg. *Senna* (Miller) Benth.] ser. *Subverrucosae* Benth., *Trans. Linn. Soc. London* 27: 555 (1871).

Lectotype species: *C. glutinosa* DC. syn. *S. glutinosa* (DC.) Randell subsp. *glutinosa*, lectotype here designated.

Description

Shrubs or small trees; *leaves* 1-10 cm long; *leaflets* 0-14 pairs, variable in shape, size and indumentum, usually sclerophyllous; *glands* 1-many, sessile or stipitate; *petals* obovate 4-14 mm long, glabrous or pubescent dorsally; *pods* 3-10 cm x 5-20 mm, without ridges on the inner surface; *seeds dull black.*

Distribution and ecology

Plants found in wide range of habitats from rocky hillsides to deep desert sands, in inland areas of Australia.

Notes

The series as recognised here does not include *C. oligoclada* nor *C. leptoclada*, both listed by Bentham (1871). This author included one species, *C. leptoclada*, in both his series *Interglandulosae* and *Subverrucosae*, probably in error.

Key to the species of ser. *Subverrucosae*

1. Petals 11-15 mm long, pubescent dorsally .... 7. *S. glutinosa*

1. Petals 4-8 mm long, glabrous dorsally:

 2. Petals 4-8 mm long; petioles 1-4 (-8) mm long; leaflets 1-5 mm apart on the rachis .... 9. *S. cardiosperma*

 2. Petals 7-10 mm long; petioles 5-15 (-60) mm long; leaflets 5-15 mm apart on the rachis .... 8. *S. artemisioides*

7. S. **glutinosa** (DC.) Randell, comb. nov.

Basionym: *Cassia glutinosa* DC., Prodr. 495 (1825); Benth., *Fl. Austral.* 2: 286 (1864); Benth., *Trans. Linn. Soc. London* 27: 556 (1871); Symon, *Trans. Roy. Soc. S. Australia* 90: 127 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2: 62 (1970); Erikson et al., *Fl. & Pl. Western Australia* 206, 209 (1979); Symon in Jessop, *Fl. Central Australia 113 (1981).*

Holotype: In Novae-Hollandiae ora orientali, (probably in error (Symon 1966) for 'ora occidentalis' which matches the true distribution) probably collected by Leschenault on Baudin's voyage. There is in P, a specimen annotated 'Nouvelle Hollande Cote Occidentale, Port Jackson, Voyage aux Terres Australes Capitaine Baudin 1801', which is probably the holotype. P (photo).

The basionym and holotype apply to the species and the type subspecies. All synonyms are listed under the subspecies to which they apply.

Description

Medium shrub to small tree, 1.5-3 m tall; *leaflets* 1-7 pairs, spaced more than 6 mm apart, variable in form and surface wax; *indumentum* usually almost absent; *petiole* more than 6 mm long; *glands* sessile or stalked, flat cylindrical or pointed; *inflorescence* a subumbellate raceme near the end of branches; *bracts* usually caducous at anthesis; *sepals* oval, 8-10 mm long, greenish yellow; *petals* oval, 11-15 mm long, yellow, pubescent on abaxial surface; *anthers* 10, all fertile, 4-5 mm long; *filaments* subequal, 7 adaxial 2 mm, 3 abaxial 3 mm long; *ovary* 5-7 mm, glabrous or pubescent; *pod* 5-7 cm x 10-20 mm , straight, glabrous; *seed* oval, dark, 6 mm long. Plates 12, 13.

Distribution and ecology

This species is widespread in central and northern arid areas of Australia.

Notes

This species differs from other species in the group in the distinctly larger petals which are frequently sparsely hairy on the outside, especially when immature. The individual subspecies of *S. glutinosa* are more widespread than those of *S. cardiosperma*, but hybridization is not as frequent as between subspecies of *S. artemisioides*. Thus it may be assumed that *S. glutinosa* is intermediate between the other species in success in the Eremean conditions.

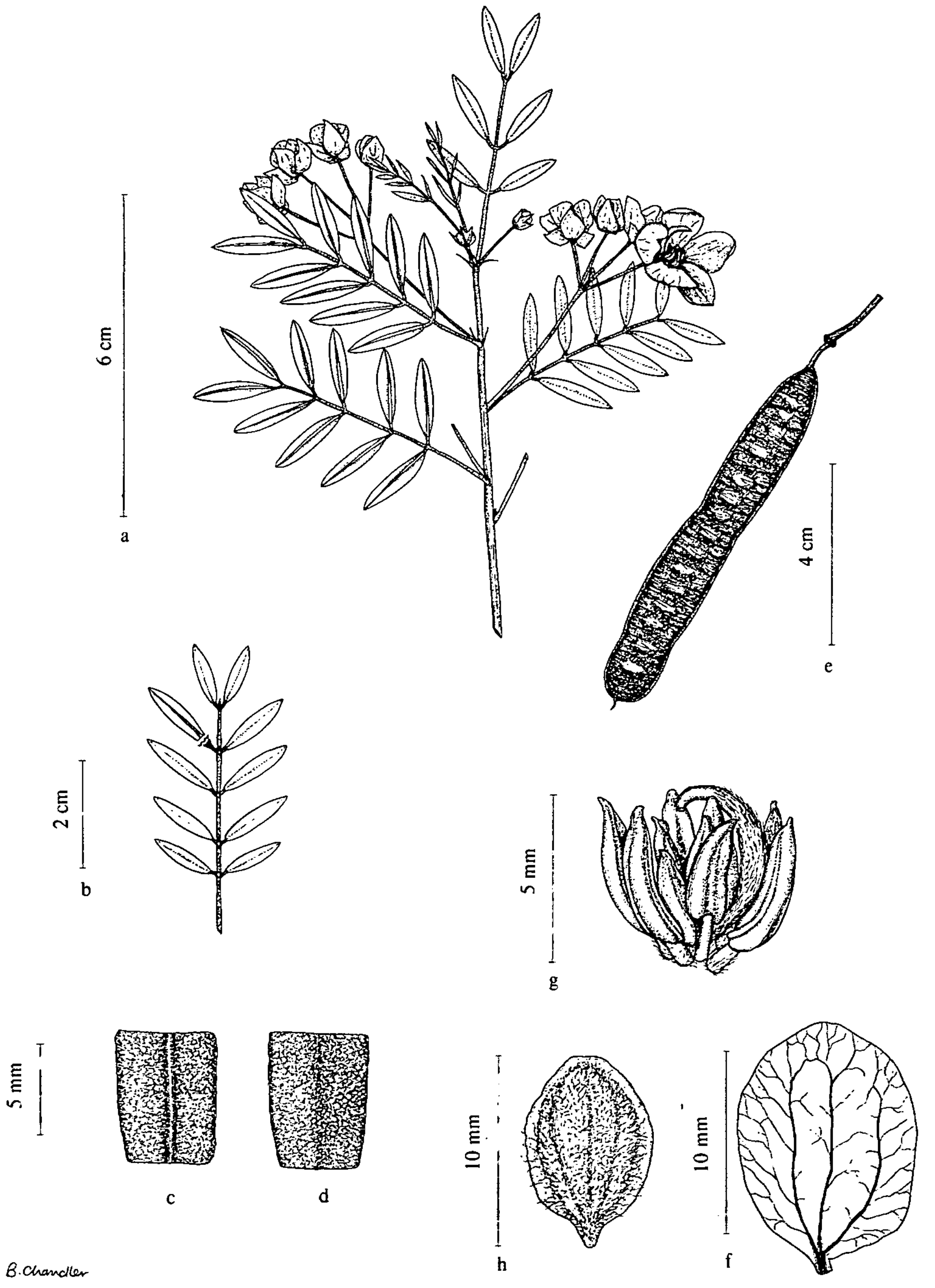


Plate 12. a-f. *S. glutinosa* subsp. *glutinosa*; a. habit, b. leaf detail, c. leaflet abaxial surface, d. leaflet adaxial surface, e. pod, all from *George 14458*; f. largest petal abaxial surface, from *Carr 4695*; g-h. *S. glutinosa* subsp. *charlesiana*; g. anther group, h. adaxial immature petal showing pubescence, both from fresh material cultivated in Adelaide Botanic Garden *Randell 346*.

Key to the subspecies of *S. glutinosa*

1. Petioles >45 mm long .... 5. subsp. *charlesiana*

1. Petioles >45 mm long:

 2. Petioles robust 2 mm in diameter; midrib prominent below; leaflets 20-40 x 10-15 mm .. 6. subsp. *ferraria*

 2. Petioles slender 1 mm diameter; midribs obscure below:

  3. Epidermis of leaflets, petioles, peduncles, pods etc. viscid; and leaflets elliptic, 4-6 pairs; and glands sessile; and leaflets not glaucous .... 1. subsp. *glutinosa*

  3. Character combination not as above:

   4. Leaflets 4-6 pairs, linear to elliptic; and stipules acicular somewhat persistent; and glands stalked and pointed; and epidermis neither viscid nor pruinose . . . 2. subsp. *chatelainiana*

   4. Character combination not as above:

    5. Leaflets 3-5 pairs, broad elliptic; and stipules falcate persistent; and glands sessile and flat; and epidermis pruinose .... 4. subsp. *pruinosa*

    5. Variable, but usually with leaflets 4-6 pairs, narrow elliptic; stipules acicular to subfalcate, caducous or persistent; glands sessile or stalked; epidermis glutinous or subpruinose or unmodified........................ 3. subsp. × *luerssenii*

7.1 subsp. **glutinosa**

Basionym and holotype: as for the species.

Synonym

C. glutinosa DC. var β, J. Vogel, *Gen. Cass. syn.* 47 (1837).

Holotype: "in Nova Holl. et in Ins. Admiralitatis", P (photo).

Description

Leaflets 4-6 pairs, elliptic, 10-25 mm x 3-6 mm; *epidermis* completely glabrous; *cuticular wax* a thick viscid secretion on leaflets, petioles, peduncles, young stems and pods; *petioles* to 15 mm long; *stipules* acicular, usually soon deciduous; *glands* sessile and flat. Triploid n=42/2, tetraploid n=28, few records of both (Randell 1970). Plate 12a-f.

Distribution and ecology

Scattered occurrence in arid shrublands of inland Western Australia, Northern Territory and South Australia. Map 7, p. 212.

Notes

There is some variation in the degree of development of the viscid secretion in different specimens, and this may be a reflection of the season in which the specimen was collected. In addition, there is some variation in the width of leaflets.

Some hybridization has been observed, linking subspp. *glutinosa*, *pruinosa*, *chatelainiana* and × *luerssenii*, but subsp. *glutinosa* is less frequently involved than are other subspecies. The parental role of subsp. *glutinosa* is usually deduced from the occurrence of viscid epidermis in some of the intermediates. Most of these intermediates are collected under subsp. × *luerssenii*, so that viscid epidermis is not solely diagnostic of subsp. *glutinosa*. Vegetatively subsp. *glutinosa* strongly resembles *S. artemisioides* subsp. *glaucifolia* from which it may be separated by the glabrous, viscid epidermis (which is never glaucous), and the larger flowers of subsp. *glutinosa*.

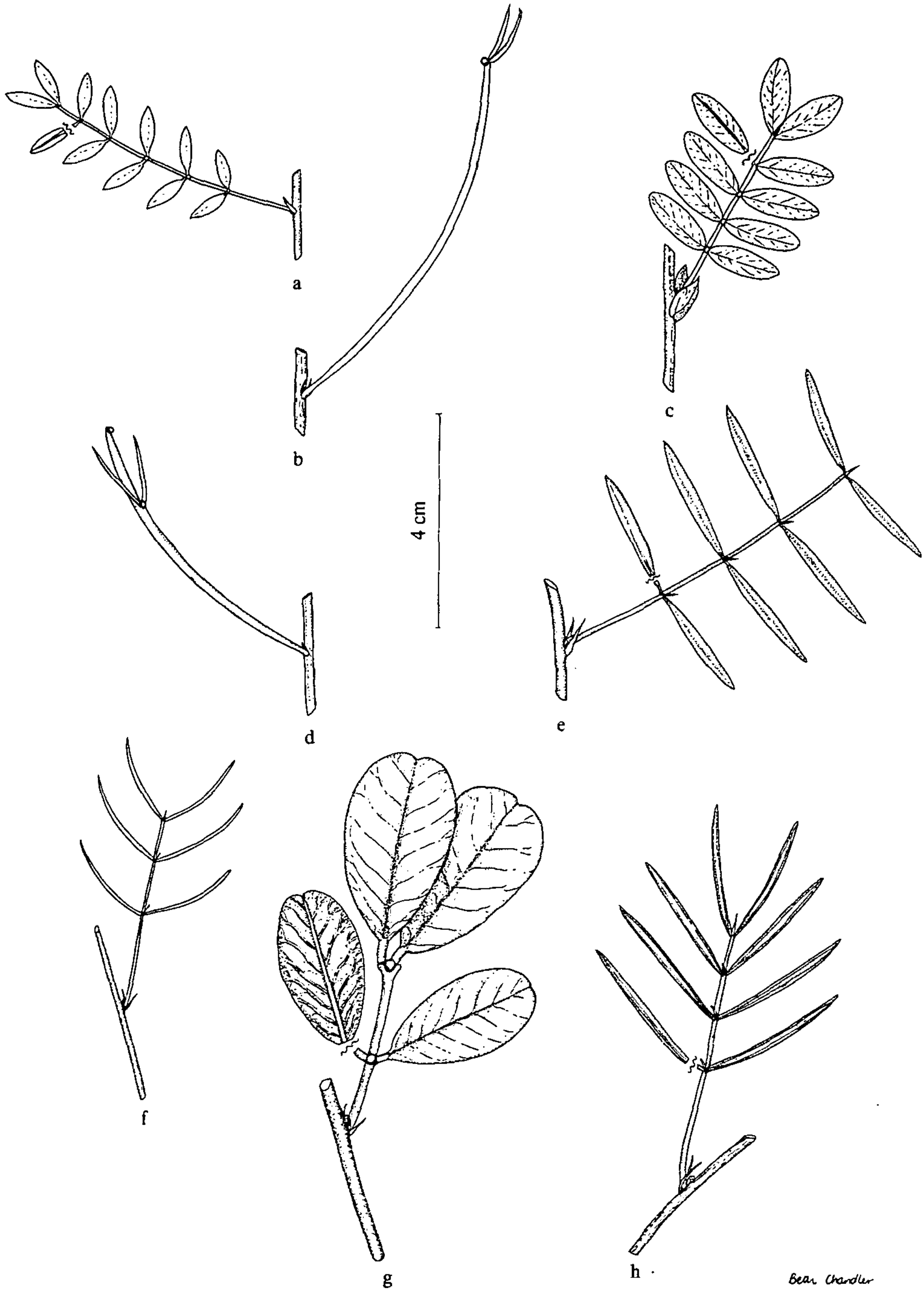


Plate 13. *S. glutinosa* subspecies. Leaf structure. a. subsp. × *luerssenii*, *George 5570*; b. subsp. *charlesiana*, *Lullfitz L2013*; c. subsp. *pruinosa*, *Carr 4662*; d. form *falcata*, *Cummings 1216*; e. subsp. *chatelainiana*, *Aplin 3179*; f. form *acifolia*, *Symon s.n.*, -.viii.1961; g. subsp. *ferraria*, *Walker 135*; h. form *aplinii*, *Aplin 2406* (a, c, e, g, h all with one leaflet reversed).

Selection of specimens examined (c. 60 seen)

WESTERN AUSTRALIA: Blackstone Mining Camp, c. 630 km SW Alice Springs, *Hill & Lothian 920*, 11.vii.1958 (AD, K, PERTH); 18 miles E Margaret R. Station, Kimberleys, *Lazarides 6323*, 13.vii.1959 (AD, CANB); Pass of the Abencerrages, Rawlinson Ra., *Symon 2486*, 4.viii.1962 (AD); 4 miles W Margaret R. turnoff, SW Halls Creek, *Barlow 1211*, 21.vi.1967 (AD); rim, Wolf Ck Meteorite Crater, *Crisp 385*, 20.vii.1975 (AD); Little Sandy Desert, *Mitchell 605*, 23.iv.1979 (AD, DNA, PERTH); Anketell Ridge, *Mitchell 1142*, 14.v.1979 (AD, DNA, PERTH); Radio Hill Paraburdoo, *Boomsma 652*, 10.vii.1980 (AD).

NORTHERN TERRITORY: Macdonald Station, c. 170 km NE Alice Springs, *Ising 3167*, 2.ix.1933 (AD); 40 miles NW Cockatoo Ck, *Cleland s.n.*, 22.viii.1936 (AD); 14 miles N Inverway Stn, *Perry 2347*, 4.vii.1949 (AD, CANB); Palm Valley area, c. 110 km SW Alice Springs, *Caulfield & Hill s.n.*, -.vii.1953 (AD); Woodgreen Station c. 125 km N Alice Springs, *Lothian 512*, 1954 (AD, DNA, K); 36 miles N Wauchope township, *Lazarides 5848*, 26.viii.1956 (AD, CANB); between Three Ways and Frewena, *Lovett 78*, 10.viii.1969 (AD).

SOUTH AUSTRALIA: nickel mine near Mt Davies, NW Aboriginal Reserve, *Pastoral Board s.n.*, 24.ix.1955 (AD); Dulgunia Hill, Tomkinson Ra., *Weber 5395*, 4.ix.1978 (AD, MO).

7.2 subsp. **chatelainiana** (Gaudich.) Randell, comb. nov.

Basionym: *Cassia chatelainiana* Gaudich. in Freycinet, *Botanique du voyage autour du mode:* 485, t. 3 (1826); Benth., *Fl. Austral.* 2: 286 (1864); *Trans. Linn. Soc. London* 27: 556 (1871); Blackall & Grieve, *How to Know Western Austral. Wildfl.* 1: 183 (1954); Symon, *Trans. Roy. Soc. S. Australia* 90: 127 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn.* 2: 62 (1970); Gardner, *West Austr. Wildf. Vol. A*, 52t (1972); Symon in Jessop, *Fl. Central Australia* 112 (1981).

Holotype: In Novae-Hollandiae ora occidentali baie des Chiens — Marins [Shark's Bay, Western Australia]. P (photo).

Description

Leaflets 4-6 pairs, elliptic, 10-20 mm x 2-4 mm; *indumentum* almost absent, of soft appressed hairs; *cuticular wax* not obviously present; *petiole* terete to 15 mm long; *stipules* acicular somewhat persistent; *glands* 1-4, stalked pointed. Diploid n=14, near Carnarvon, Western Australia (Randell 1970). Plate 13e.

Distribution and ecology

Scattered in arid shrubland of north-west of Western Australia. Map 8, p. 212.

Notes

Considerable variation is known. The number of glands may vary even on leaves of the same plant. Leaflets show considerable variation in length/breadth ratio from about 10 (for long thin leaflets) to about 5 (for broad short leaflets).

Hybridization is relatively frequent between subsp. *chatelainiana* and subsp. *pruinosa*, with relatively frequent collections of intermediates (classed as subsp. × *luerssenii*). An arbitrary separation of the three subspecies has been made on the basis of leaflet characters, as below.

1. Having at least 3 of the following characters:
   glands stalked; stipules acicular deciduous; epidermis not pruinose; leaflets narrow elliptic . . . subsp. *chatelainiana*
2. Having at least 3 of the following characters:
   glands sessile; stipules falcate persistent; epidermis pruinose; leaflets broad elliptic . . . . subsp. *pruinosa*
3. Having any other combination of these characters . . . . subsp. × *luerssenii*

Vegetatively *S. glutinosa* subsp. *chatelainiana* resembles *S. artemisioides* subsp. *stricta*, from which it may be separated by the longer hairy petals, and green leaflets of subsp. *chatelainiana*.

Selection of specimens examined (c. 100 seen)

WESTERN AUSTRALIA: near Payne's Find, *Blackall 3891*, 10.ix.1938 (PERTH); Yandel, near Lake Darlot, *Blackall s.n.*, -.ix.1939 (PERTH); 30 miles S Leonora, *Brockway s.n.*, 8.x.1947 (PERTH); Glenorn near Malcolm, *Cleland s.n.*, 31.viii.1948 (AD); 107 miles N Carnarvon, *Aplin 1584*, 27.v.1962 (PERTH); Meekatharra Racecourse, *Aplin 2470*, 24.viii.1963 (AD); near Mt Gibson (Tea Chest turnoff), *Gardner 14362*, 25.viii.1963 (PERTH); S Mullewa (c. 86 km NNE Geraldton), *Ashby 329*, 6.ix.1963 (AD); 2 miles S Meekatharra, *Fairall & Lullfitz 2576*, 12.x.1963 (PERTH); S Howatharra (c. 45 km N Geraldton), *Ashby 1579*, 6.viii.1965 (AD); Brown Ra., S Carnarvon, *Turner 5412*, 25.viii.1965 (chromosome voucher n=14, PERTH); Landor Stn, E Carnarvon on road to Meekatharra, *O'Farrell 53*, -.vii.1967 (PERTH); near James Pool, Windidda Station, *Chinnock 826*, 6.ix.1973 (AD, PERTH); Dirk Hartog Is., *Beard 7082*, 17.x.1974 (PERTH); Callatharra Springs, *Cranfield 2130*, 27.iv.1982 (PERTH).

The following two forms may be good subspecies of *S. glutinosa* or may be groupings of hybrid plants derived from subsp. *chatelainiana*. Only population studies will clarify this problem.

(i) form '**acifolia**'

Description

Leaflets 3-5 pairs, terete or linear, 6-20 mm x 1 mm ; *indumentum* sparse of soft appressed hairs; *cuticular wax* of thick sheets; *petioles* terete, to 20 mm long; *stipules* acicular, always persistent; *glands* 1-2, stalked, elongate and pointed. Plate 13f.

Specimens examined

WESTERN AUSTRALIA: Lake Darlot, N Malcolm, *Gardner & Blackall s.n.*, s.d. (PERTH); Wongawol Ck, Eremean Province, *Speck 1292*, 22.ix.1958 (PERTH); Teutonic minesite, *Cumming 1269*, 20.viii.1981 (PERTH).

(ii) form '**aplinii**'

Description

Leaflets usually 4 pairs, narrow elliptic, 20-25 mm x 2 mm; *indumentum* sparse, of soft appressed hairs; *cuticular wax* in thick sheets; *petioles* terete to 25 mm long; *stipules* acicular, long persistent; *glands* stalked or sessile, elongate and pointed. Plate 13h.

Specimens examined

WESTERN AUSTRALIA: 21 miles S Wiluna, *Aplin 2406*, 20.viii.1963, (PERTH); 104 km from Mt Magnet towards Mullewa, *Chadwick 726*, -.vii-viii.1963, (PERTH); Woolawarra ? (sic), *DG. W s.n.*, s.d., no flowers, (PERTH).

7.3 subsp. × **luerssenii** (Domin) Randell, comb. nov.

Basionym: *Cassia luerssenii* Domin, *Biblioth. Bot.* 89: 794 (1926); Symon, *Trans. Roy. Soc. S. Australia* 90: 128 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2: 62 (1970); Symon in Jessop, *Fl. Central Australia* 113 (1981).

Holotype: Nordwest-Australien: zwichen Ashburton — und De Grey River, *E. Clement s.n.*, PR; *isotype*: K (photo), fide Symon (1966).

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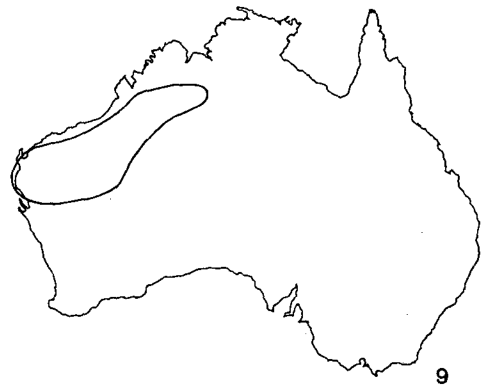

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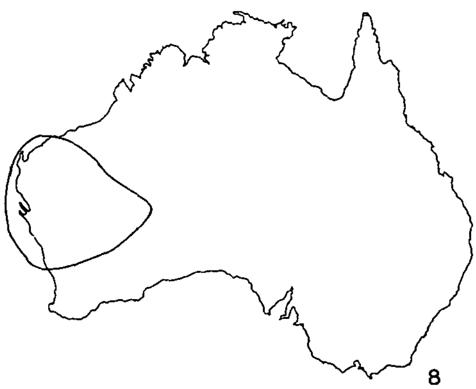

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Map 7. *S. glutinosa* subsp. *glutinosa*. Map 8. *S. glutinosa* subsp. *chatelainiana*. Map 9. *S. glutinosa* subsp. × *luerssenii*. Map 10. *S. glutinosa* subsp. *pruinosa*.

Description

Very variable; *leaflets* 4-6 pairs, narrow elliptic, 10-15 mm x 1-2.5 mm; *indumentum* almost absent; *cuticular wax* present either as thick sheets, powder, flakes or glutinous semi-liquid; *petioles* terete, to 15 mm long; *stipules* acicular to falcate, to 3 mm broad, sometimes persistent; *glands* usually sessile and flat, rarely stalked. Tetraploid only, n= c. 24 (Turner, cited in Symon 1966). Plate 13a.

Distribution and ecology

Scattered in arid shrublands of north-west of Western Australia. Map 9, p. 212.

Notes

Differs from other subspecies in having petals usually more than 11 mm, rarely only 7-10 mm long.

Subsp. × *luerssensii* is here regarded as a taxon of convenience, containing hybrids derived from the combinations subspp. *chatelainiana*, *pruinosa* and/or *glutinosa*, in many different populations in many different places. It is thus not surprising that it does contain individual specimens exhibiting considerable variation from each other. However, the specimens are united by their large flowers, their narrow elliptic leaflets, their usually sessile foliar glands, and the fact that leaflets are often shorter than the distance between pairs of leaflets. However, specimens are readily found bridging the discontinuity between all these subspecies, and an arbitrary decision on separating the subspecies has been made (see under subsp. *chatelainiana*).

Selection of specimens examined (c. 60 seen)

WESTERN AUSTRALIA: 40miles S Nicholson Stn, *Perry 2436*, 13.vii.1946 (AD, CANB); 9 miles N Wongawol, Nullagine Hills, *Speck 1277*, 22.viii.1958 (AD, CANB); Dampier Archipelago, near Roebourne, *Royce 7323*, 10.vi.1962 (PERTH); Sir Frederick Ra., *Symon 2247*, 1.viii.1962 (AD); Pass of the Abencerrages, Rawlinson Ra., *Symon 2485*, 4.viii.1962 (AD); Mt William Lambert, Gibson Desert, *George 5457*, 26.vii.1963 (PERTH); 10-20 miles N Nullagine, *Beard 2829*, 15.viii.1963 (PERTH); 546 mile peg N Meekatharra, *Lullfitz & Fairall 2606*, 14.x.1963 (PERTH); Camballin, *Power 735*, *-.v.1970 (CANB, PERTH); Canning Stock Route between Weld Spring and Pierre Spring (750-800 km NE Geraldton), Ashby 3523*, 2-14.viii.1970 (AD); Mulgul c. 490 km E Carnarvon, *Ashby 3350a*, 8.viii.1970 (AD); Mt Augustus c. 325 km ENE Carnarvon, *Ashby 3350b*, 9.viii.1970 (AD); c. 155 km from Nanutarra (c. 105 km SSE Onslow), *Ashby 4120*, 3.viii.1971 (AD); c. 112 km by road N Kumarina Roadhouse, *Jackson 2904*, 17.viii.1977 (AD); 34 km SE Mt Vernon Hstd, *Toelken 6360*, 24.ix.1979 (AD, MTJB); plains within Hamersley Ra., creek 4 km N Paraburdoo, *Boomsma 575*, 24.vi.1980 (AD).

7.4 subsp. **pruinosa** (F. Muell.) Randell, comb. nov.

Basionym: *Cassia pruinosa* F. Muell., *Phragm.* 3: 48 (1862); Benth., *Fl. Austral.* 2: 286 (1864); *Trans. Linn. Soc. London* 27: 556 (1871); Symon, *Trans. Roy. Soc. S. Australia* 90: 129 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2: 63 (1970); Erickson et al., *Fl. & Pl. Western Australia* 159, 206, 209 (1979); Symon in Jessop, *Fl. Central Australia* 113 (1981).

Lectotype: In rocky hills at the mouth of Nickol Bay, Western Australia, Pemb. Walcott s.n., P (photo), lectotype here designated; *isolecto*: MEL! (fragmentary).

Description

Leaflets 3-5 pairs, broad elliptic, 10-20 mm x 4-7 (-12) mm; *indumentum* almost absent; *cuticular wax* rarely in thick sheets or absent, usually as dense powder or flakes; *petioles* terete, 10 mm long; *stipules* broad-falcate, 2-4 mm broad, persistent; *glands* sessile and flat. Tetraploid n=28, one record (Randell 1970). Plate 13c.

Distribution and ecology

Scattered in arid shrublands of north-west Western Australia, and central Northern Territory. Map 10, p. 212.

Notes

Rare specimens (e.g. on Barrow Is. and Dampier Archipelago) show no development of cuticular wax and thus appear green. Either the character has been lost since the isolation of these populations on the offshore islands, or these plants represent the ancestral character state in subsp. pruinosa. No evidence is available to solve this problem. Hybrids are frequent. See under subsp. *chatelainiana* for discussion.

Selection of specimens examined (c. 60 seen)

WESTERN AUSTRALIA: Woodstock, *Ealey E/115*, s.d. (AD, CANB, PERTH); West Lewis Is., Dampier Archipelago, *Royce 7407*, 13.vi.1962 (PERTH); 10-20 miles N Nullagine, *Beard 2826*, 15.viii.1963 (PERTH); Cape Ra., *Beard 3573*, 22.vii.1964 (PERTH); Robe R., between Onslow and Roebourne, *Butler 14*, 27.viii.1966 (PERTH); Sir Frederick Ra., N Rawlinson Ra., *George 8325*, 5.x.1966 (PERTH); 11 miles N Mulga Downs turnoff, S Pt Hedland, *Barlow 1147/a*, 29.vi.1967 (AD); Newman area, *Walker 144*, 4.viii.1980 (PERTH); Barrow Is., *Buckley 6937*, -.x.1980 (PERTH).

NORTHERN TERRITORY: Macdonald Stn, c. 170 km NE Alice Springs, *Ising 3150*, -.viii.1933 (AD); hill near Yuendumu, c. 270 km NW Alice Springs, *Cleland s.n.*, 24.viii.1951 (AD); 8 miles N Barrow Creek Telegraph Stn, *Forde 210*, 4.vii.1956 (AD, DNA); Haasts Bluff Reserve, c. 210 km WNW Alice Springs, *Cleland s.n.*, 16.viii.1956 (AD); Highland Rock area, Maconochie 1091, 31.vii.1970 (AD, DNA); Andado Stn, *Latz 6809*, 15.iv.1977 (AD, BRI, DNA).

QUEENSLAND: 13 miles S Dajarra township, *Perry 4054*, 4.ix.1953 (AD, CANB); Mt Isa, *J. & M. Pocock s.n.*, 30.vii.1968 (AD).

SOUTH AUSTRALIA: Lyndhurst, c. 50 km NE Leigh Ck, *Koch 265*, -.ix.1898 (AD); Pedirka, *Ising 3118*, 29.viii.1932 (AD); Granite Downs, *S.A. Pastoral Board s.n.*, 11.x.1958 (AD); Emery Ranges, c. 22 km E Pedirka, *Lothian 4799*, 27.vii.1968 (AD); SE Welbourne Hill, *Conrick 751*, 13.vii.1982 (AD).

7.5 subsp. **charlesiana** (Symon) Randell, comb. nov.

Basionym: *Cassia charlesiana* Symon, *Trans. Roy. Soc. S. Australia* 90: 126 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2: 62 (1970).

Holotype: One mile north of Pintharuka, W.A., *C.A. Gardner 7540*, 29.viii.1945, PERTH!.

Description

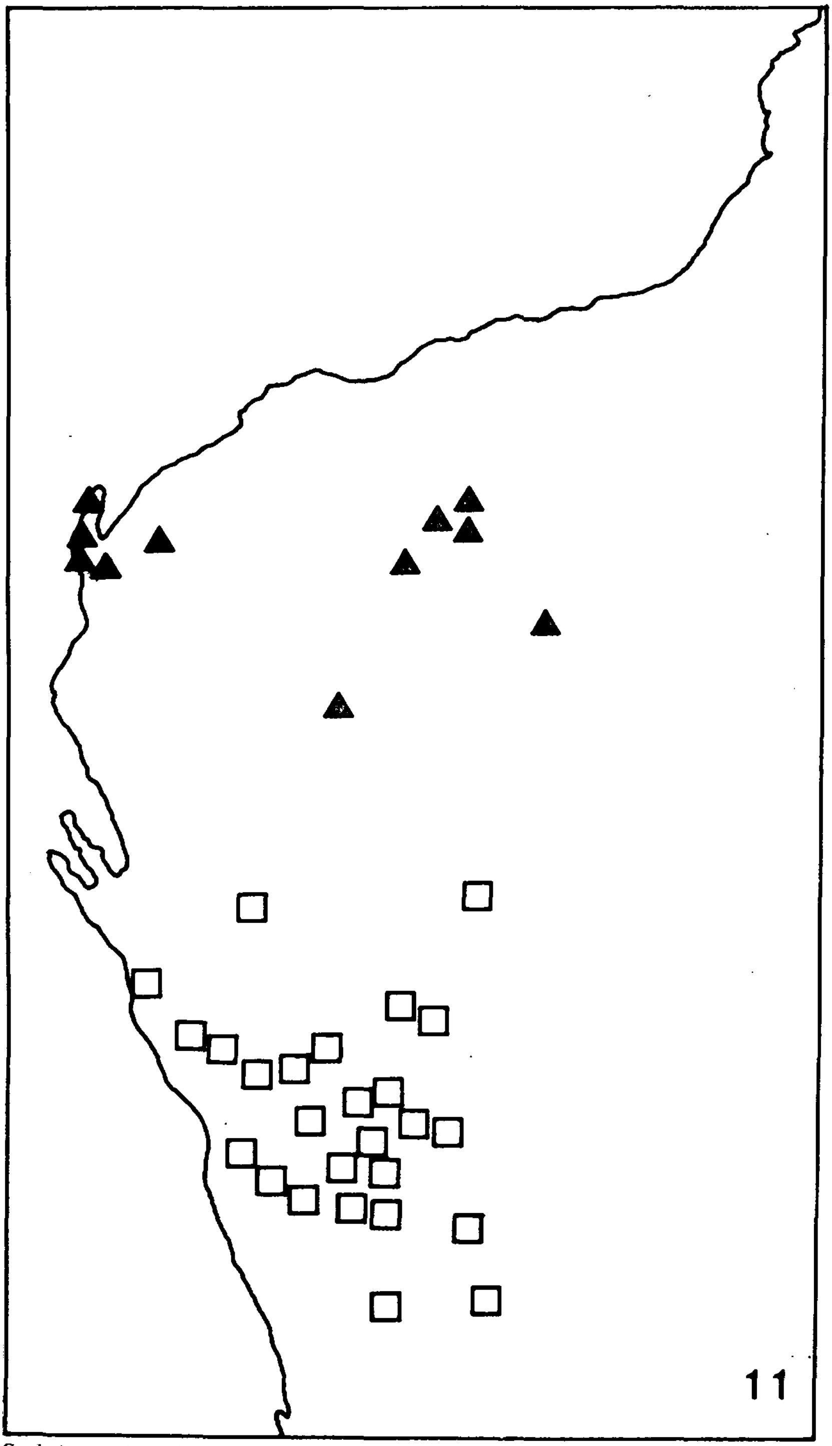
Leaflets 0-2 pairs, terete 5-20 mm long, 1 mm diameter; *indumentum* almost absent, of soft and appressed hairs; *cuticular wax* in thick sheets; *petioles* terete, to 100 mm long; *stipules* acicular more or less caducous; *glands* sessile and flat. Plates 12g-h, 13b.

Distribution and ecology

Scattered in arid shrublands of southern inland Western Australia. Map 11, p. 218.

Selection of specimens examined (28 seen)

WESTERN AUSTRALIA: Murchison, *Tunney 146*, -.viii.1899 (PERTH); Carnamah, Victoria District, *Morrison 16355*, 30.x.1906 (PERTH); Merredin, *Gardner 720*, 30.viii.1920 (PERTH); between Wongan Hills and Morawa, *Blackall 2828*, 25.ix.1932 (PERTH); Mt Singleton, *Gardner s.n.*, -.viii.1953 (PERTH); Jibberding (?), *Gardner 12084*, 8.ix.1953 (PERTH); 16 miles S Mt Magnet, *Lange s.n.*, 26.vii.1958 (PERTH); Dowerin, *Rosier 70*, -.vii.1959 (PERTH); 22 km from Mt Magnet on Geraldton road, *Goodall 839*, 8.xi.1963 (PERTH); Tenindewa (c. 70 km ENE Geraldton), *Ashby 1057*, 29.viii.1964 (AD); Morawa, *Rennie 3*, -.x.1964 (PERTH); 61 miles NE Wubin, *Newbey 650808*, -.viii.1965 (PERTH); E Yuna Reserve, NE Geraldton, *Burns 40*, 23.viii.1967 (PERTH); 1.4 miles E Payne's Find, *Scrymgeour 2124*, 20.ix.1967 (K, PERTH); Bindoo Hill Reserve, 27 km WNW Mullewa, *Muir 453*, 18.x.1976 (PERTH); 2 miles from Kalbarri, *Wemm 1169*, 3.ix.1978 (PERTH).



Map 11. □ *S. glutinosa* subsp. *charlesiana;* ▲ *S. glutinosa* subsp. *ferraria.*

The following form probably comprises hybrids derived from subsp. *charlesiana*. Alternatively it may represent another subspecies of *S. glutinosa*. Only information on the breeding structure of the populations in which it occurs will clarify this point.

i) form '**falcata**'

Description

Leaflets 1-2 pairs, terete or laterally compressed, 20-30 mm x 2 mm; *indumentum* sparse, of soft appressed hairs; *cuticular wax* in thick sheets; *petioles* laterally compressed, 50-60 mm long, 2-4 mm broad; *stipules* acicular, deciduous; *glands* sessile or stalked, flat. Plate 13d.

Specimens examined

WESTERN AUSTRALIA: 19 km S Wiluna on Agnew rd, *Beauglehole 59577*, 13.ix.1978 (PERTH); Teutonic airstrip, *Cummings 1216*, 2.viii.1981 (PERTH).

The Teutonic Airstrip site was revisited during 1986. The "population" consisted of 2 shrubs of form 'falcata' beside an eroded stream bed, and it was obvious that seeds had been derived from a source higher up the stream. The shrubs were 1-1.5 m tall, indicating that they were several years old, but the absence of younger plants beneath the two shrubs, (in contrast to the situation in populations of other taxa in the same general area) suggested that few viable seeds were being set. This evidence suggests a hybrid origin for form 'falcata'.

Several plants of *S. artemisioides* subsp. × *sturtii* were found within 100 m, but there was no evidence for interbreeding.

7.6 subsp. **ferraria** (Symon) Randell, comb. nov.

Basionym: *Cassia ferraria* Symon, *Trans. Roy. Soc. S. Australia* 90: 130 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2: 62 (1970); Erickson et al., *Fl. & Pl. Western Australia* 211 (1979).

Holotype: Hamersley Ranges Western Australia, over the iron ore body at Mt Tom Price, *M.M. Cole WA5104*, 1963, PERTH!; *isotype*: K.

Description

Leaflets (2-) 3 (-4) pairs, broad elliptic to oblanceolate, (20-) 30-40 (-50) mm x 10-15 mm; *indumentum* sparse of soft appressed hairs; *cuticular wax* in thick sheets, sometimes glaucous; *petiole* terete, 5-15 mm long, robust (1.5-2.0 mm diameter); *stipules* acicular somewhat persistent; *glands* sessile, large flat and dark. Plate 13g.

Distribution and ecology

Scattered in arid shrublands of north western Western Australia. Map 11, p. 218.

Notes

Specimens from Hamersley Range area have broader obovate leaflets, while specimens from Cape Range have narrower, elliptic-obovate leaflets with obtuse apices. However, they all share the robust petioles and prominent orange-brown lower midrib of the type.

Specimens from Hamersley Range have been confused with *S. artemisioides* subsp. *oligophylla* from which they may be separated by the longer hairy petals and the prominent abaxial leaflet midribs of subsp. *ferraria*.

Comparison with other, better known, taxa suggests that cytological examination might reveal a diploid race.

Selection of specimens examined (12 seen)

WESTERN AUSTRALIA: Yampire Gorge, Hamersley Ra., *Gardner 12280*, -.viii.1959 (PERTH); 1 mile E Yanrey Hstd, *George 1170*, 24.viii.1960 (PERTH); Cape Ra., *George 1329*, 30.viii.1960 (PERTH); 1 mile S Vlaming Head Lighthouse, *George 2578*, 3.vi.1961 (PERTH); above Dale's Gorge, *Blockley 416*, 14.ix.1969 (PERTH); Hamersley Ra. Natl Pk., *Beauglehole 48784*, ii.viii.1974 (AD); Newman area, *Walker 135*, 4.viii.1980 (PERTH).

8. **S. artemisioides** (DC.) Randell, comb. nov.

Basionym: *Cassia artemisioides* DC., *Prodr.* 2: 495 (1825); J. Vogel, *Gen. Cass. syn.* 47 (1837); Benth., *Fl. Austral.* 2: 188 (1864); *Trans. Linn. Soc. London* 27: 556 (1871); Symon, *Trans. Roy. Soc. South Australia* 90: 117 (1966).

Lectotype: Novae Hollandiae interioribus legit cl Fraser (vs. in h Gaudichaud), *Fraser 100*, E, (photo), fide Symon, *Trans. Roy. Soc. S. Australia* 90: 117 (1966).

Syntypes: (i) 'N. Holl., 163 Fraser (Cassia flindersii)' K (photo) on a sheet of two collections, the second labelled 'Mt Flinders, (Cassia glaucescens) without collection details' and (ii) 'Pt Jackson, N. Holl., *C.Gaudichaud* [Cassia (teretifolia)]', P, (photo).

The above basionym and lectotype apply to the species and type subspecies. All synonyms are listed under the subspecies to which they apply.

Description

Medium to tall shrub 1-3 m tall, usually with several stems; *leaflets* 0-8 pairs, more than 5 mm apart on rachis (less in subsp. *symonii*), variable in form and indumentum, all equal or increasing in size from the base of the petiole; *glands* sessile and flat; *petiole* 6-14 mm long (except subsp. *symonii* 1-5 mm, and subsp. *petiolaris* to 60 mm), terete or laterally compressed (and then longer); *stipules* acicular, caducous; *inflorescence* an axillary subumbellate raceme near the end of branches; *bracts* usually caducous at anthesis, rarely persistent (in eg. subsp. *oligophylla*); *sepals* oval 6-8 mm long; *petals* 7-10 mm long (rarely 4-6 mm in subsp. *filifolia* and subsp. × *coriacea*), usually glabrous (rarely pubescent dorsally in hybrid forms); *anthers* 10, 4-5 mm long; *filaments* subequal, 7 adaxial 1 mm long, 3 abaxial 2 mm long; *ovary* 5-6 mm long; *pod* 5-10 cm x 8-15 mm, straight or circinately coiled, glabrous; *seed* about 6 mm long. Plates 14, 15, 16.

Notes

The author citation of *C. artemisioides* Gaud. in DC., cited by Symon (1966) is here changed to Gaud. ex DC., indicating that De Candolle was responsible for the publication of the work (confirmed R. Brummitt, N. Lauder pers. comm.)

This species is very widespread in the central, northern and southern arid areas. Frequently seen are single populations containing 3 or more of the subspecies here recognized, and these are interpreted as hybrid swarms (Symon 1955; Randell 1969, 1970, this paper). In addition, some hybrids with subspecies of *S. glutinosa* and *S. cardiosperma* are also known (see notes to various subspecies).

The subspecies of *S. artemisioides* vary considerably in leaflet form, number, and indumentum; but are united by the length of the petiole (more than 5 mm), and the spacing of the leaflets (6-16 mm apart). In addition, most specimens have petals of medium length, though variations are known. Some hybrids derived from crosses with subspecies of *S. cardiosperma* have petals less than 6 mm long, as do some specimens of *S. artemisioides* subsp. *filifolia* from the Simpson Desert.

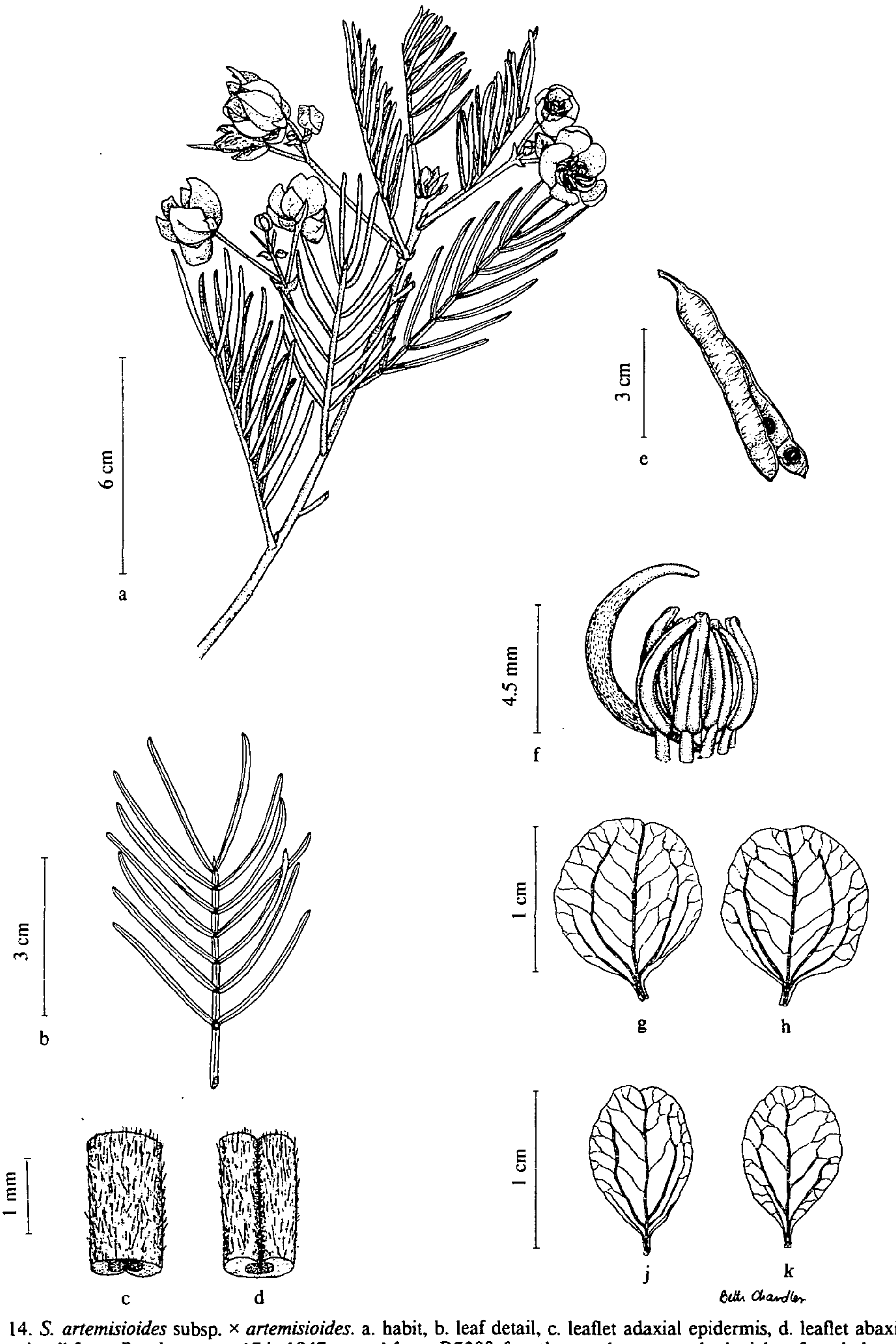


Plate 14. *S. artemisioides* subsp. × *artemisioides*. a. habit, b. leaf detail, c. leaflet adaxial epidermis, d. leaflet abaxial epidermis, all from *Brockway s.n.*, 17.ix.1947. e. pod from *D7208*; f. anthers, g. largest petal adaxial surface, h. largest petal abaxial surface, j. smallest petal adaxial surface, k. smallest petal abaxial surface, all from living material cultivated Adelaide Botanic Garden, *Randell 396*.

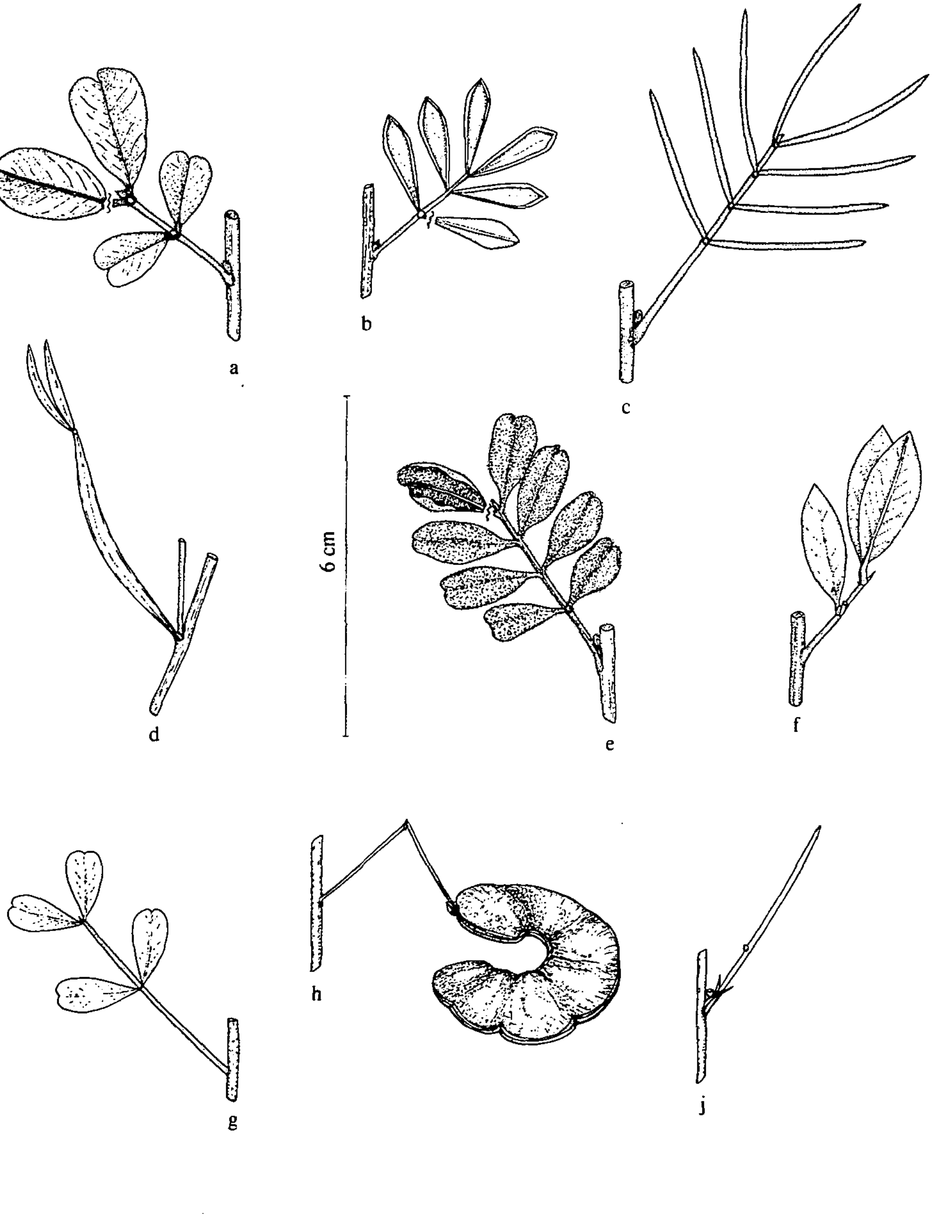


Plate 15. *S. artemisioides* subspecies. Leaf structure. a. subsp. *oligophylla*, *Barker 1985*; b. subsp. × *coriacea*, *Donner 1618*; c. subsp. *filifolia*, *Sim s.n.*, -.viii.1955; d. subsp. *petiolaris*, *Randell 224/230*; e. subsp. *helmsii*, *Conrick 976*; f. subsp. *alicia*, *Randell 221/116*; g-j. subsp. *circinnata*; g. seedling leaf, *Symon 11518* (cult. W.A.R.I.); h. pod, j. mature leaf, both from *Symon s.n.*, -.v.1964. (a, b, e with one leaflet reversed; f with one leaflet removed).

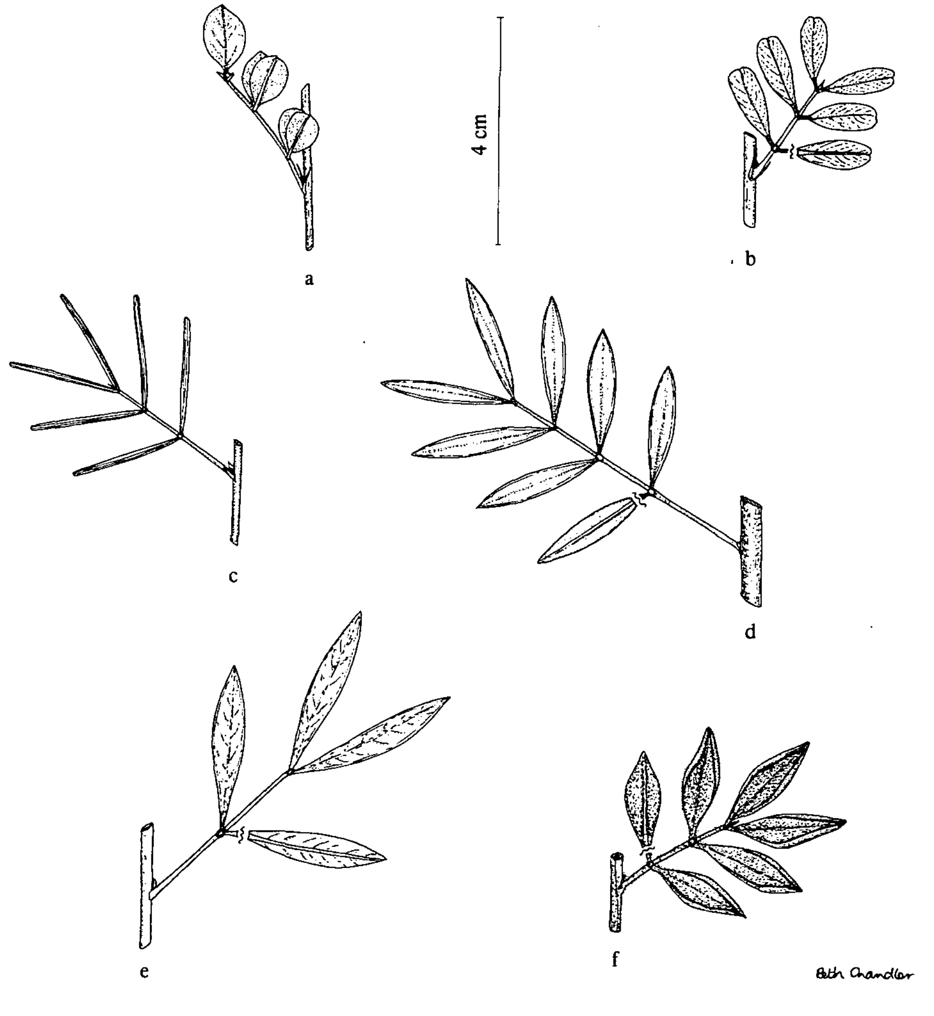


Plate 16. *S. artemisioides* subspecies. Leaf structure. a. subsp. *hamersleyensis*, *Cranfield s.n.*, 6.viii.1981; b. subsp. *symonii*, *Burbidge 1142*; c. subsp. *stricta*, *Kuhl s.n.*, -.x.1967; d. subsp. *glaucifolia*, *Hill 1366*; e. subsp. *quadrifolia*, *Turner s.n.*, 4.ix.1960; f. subsp. × *sturtii*, *Mitchell 76/9*. (a. one leaflet removed, b, d, e, f each with one leaflet reversed).

Cytology

Diploid races are known in 4 of the 15 subspecies, while triploids and/or tetraploids are known in 9. The widespread variable, polyploid subspp. × *artemisioides*, *filifolia*, *petiolaris* and × *coriacea* are involved in the bulk of the hybrid swarms within *S. artemisioides* as well as virtually all the hybridizations with other species.

Key to the subspecies and subspecies groups of *S. artemisioides*

[Note: In arid areas of Australia , many populations are encountered which contain several of the subspecies recognised here, as well as plants of intermediate morphology.]

1. Petioles laterally compressed .... 3. subsp. *petiolaris*
1. Petioles terete:
  2. Leaflets 0, or quite terete, or laterally compressed .... group A
  2. Leaflets dorsiventrally compressed:
    3. Leaflets conspicuously hairy .... group B
    3. Leaflets without conspicuous hairs .... group C

Key to subspecies of group A

1. Mature leaves without leaflets:
  2. Petioles laterally compressed .... 3. subsp. *petiolaris*
  2. Petioles terete .... 4. subsp. *circinnata*
1. Mature leaves with leaflets:
  3. Petioles laterally compressed .... 3. subsp. *petiolaris*
  3. Petioles terete:
    4. Leaflets 1 pair, or 2-4 pairs and petioles 16 mm or longer; glabrous to sparsely hairy .... 2. subsp. *filifolia*
    4. Leaflets 2-8 pairs; petioles less than 15 mm long; sparsely to densely hairy ... 1. subsp. × *artemisioides*

Key to the subspecies of group B

1. Leaflets obovate to oval:
  2. Leaflets densely woolly hairy .... 9. subsp. *helmsii*
  2. Leaflets silky hairy:
    3. Peduncles much longer than leaves; plant almost prostrate, to 0.2 m tall ... 15. subsp. *hamersleyensis*
    3. Peduncles shorter than leaves; plant erect, 0.5-2 m tall:
      4. Petiole 3-8 mm long; leaflets 8-20 mm long, 1-8 mm apart .... 14. subsp. *symonii*
      4. Petiole 5-15 mm long; leaflets 20-40 mm long, 15-25 mm apart .... 8. subsp. *oligophylla*
1. Leaflets linear to elliptic:
  5. Leaflets linear and inrolled so that upper surface is not visible .... 1. subsp. × *artemisioides*
  5. Leaflets with upper surface exposed:
    6. Petiole 15-25 mm long .... 11. subsp. *quadrifolia*
    6. Petiole <15 mm long:
      7. Leaflets densely silky to woolly hairy; never glaucous .... 10. subsp. × *sturtii*
      7. Leaflets glabrous to sparcely hairy; glaucous:
        8. Petiole 3-8 mm long; restricted distribution NW W.A. .... 14. subsp. *symonii*
        8. Petiole 5-15 mm long; widespread and very variable; southern and eastern W.A., N.T., N.S.W., Vict., S.A. .... 5. subsp. × *coriacea*

Key to subspecies of group C

1. Leaflets obovate to oval:
    2. Petiole 3-8 mm long; leaflets 8-20 mm long, 1-8 mm apart .... 14. subsp. *symonii*
    2. Petiole 5-15 mm long; leaflets 20-40 mm long, 15-25 mm apart .... 8. subsp. *oligophylla*
1. Leaflets linear to elliptic to obovate:
    3. Leaflets >5 times longer than broad:
        4. Leaflets 4-5 pairs, 1-2 mm broad; W.A. .... 13. subsp. *stricta*
        4. Leaflets 1-2 pairs, 2-4 mm broad; N.S.W., Qld .... 6. subsp. *zygophylla*
    3. Leaflets (5 times longer than broad
        5. Leaflets 1-2 pairs; members of each leaflet pair carried more or less vertically, with adaxial surfaces opposed .... 7. subsp. *alicia*
        5. Leaflets 1-4 pairs, members of each leaflet pair carried more or less horizontally:
            6. Leaflets 3-4 pairs, acute, 10-25 mm long, reddish glaucous .... 12. subsp. *glaucifolia*
            6. Leaflets 1-6 pairs, obtuse, 8-30 mm long, blue-grey glaucous:
                7. Petiole 3-8 mm long; restricted distribution NW of W.A. .... 14. subsp. *symonii*
                7. Petiole 5-15 mm long; widespread and very variable; southern and eastern W.A., N.T., N.S.W., Vict., S.A. .... 5. subsp. × *coriacea*

8.1 subsp. × **artemisioides**

Basionym and lectotype: as for the species

Synonyms

1. *Cassia teretifolia* A. Cunn. ex Lindley in Mitchell, *Three Expeditions into the interior of Eastern Australia* 1: 286 (1838).

Holotype: 'This plant was found by Mr Cunningham in 1817 on Mt Flinders when he called it Cassia teretifolia', *Cunningham 184*, K (photo).

2. *Cassia teretiscula* F. Muell., *Linnaea* 25: 389 (1853).

Holotype: 'In stony hills near Cudnaka (Flinders Ranges, Sth Australia)', *F. Mueller s.n.*, MEL! (photo).

Description

Leaflets 3-8 pairs, terete or linear and tightly inrolled, 15-25 mm long, 1 mm diameter; *indumentum* sparse to dense, of straight or woolly hairs; *petioles* terete, 6-15 mm long. Triploid n=42/2 restricted (near Alice Springs, N.T., and Flinders Ranges, S.A.), tetraploid n=28 widespread (Randell 1970). Plate 14a-k.

Distribution and ecology

Widely distributed in many different situations from rocky hillsides to deep desert sand, in inland areas of all mainland states. Map 12, p. 226.

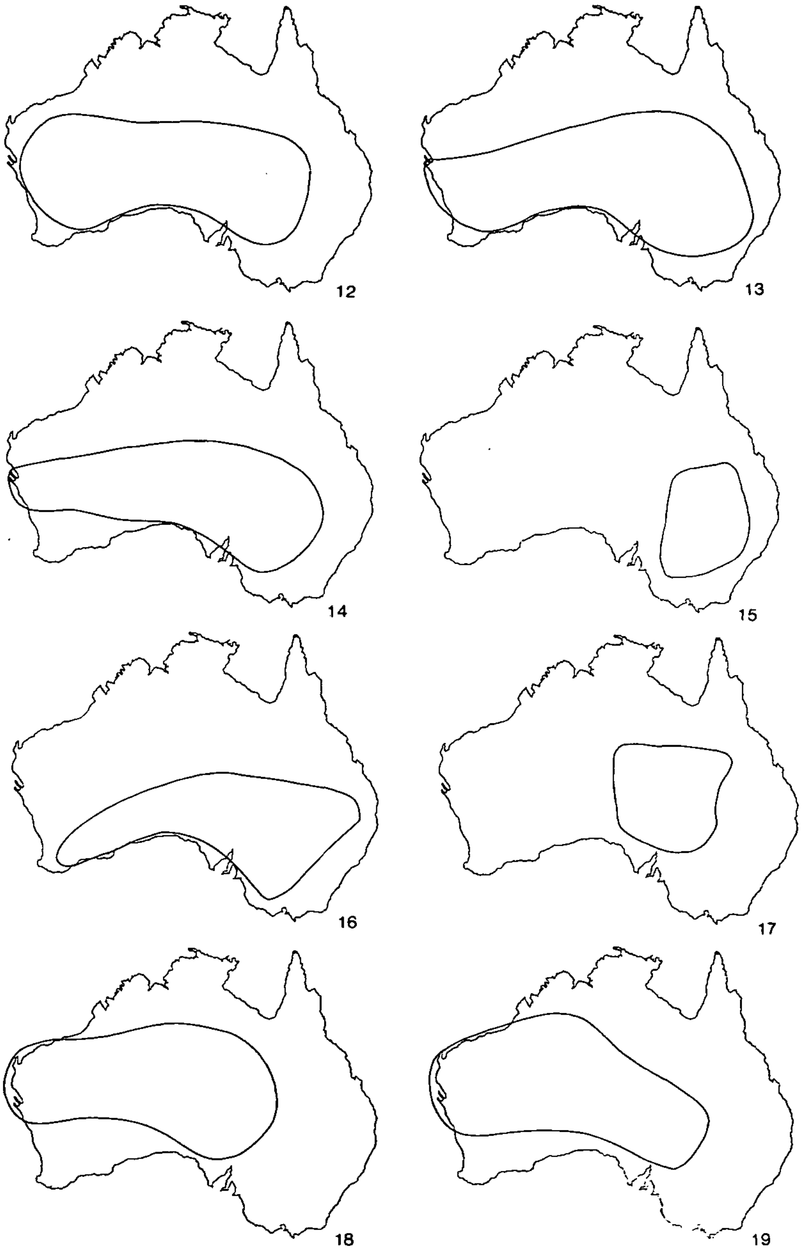
Notes

Symon (1966) made an arbitrary decision separating the two terete-leaflet forms on the number of leaflets, with those having 3 or more leaflet pairs placed in *C. artemisioides* and those with 1-2 in *C. nemophila.*

Examination of many specimens has revealed that though there is still a series of intermediate forms, a better separation results if an arbitrary separation is made placing emphasis on the length of the petiole thus:

Leaflets 2-8 pairs, petiole 6-14 mm long ....subsp. × *artemisioides*

Leaflets 1 pair, or petiole more than 15 mm long ....subsp. *filifolia*



Map 12. *S. artemisioides* subsp. × *artemisioides.* Map 13. *S. artemisioides* subsp. *filifolia.* Map 14. *S. artemisioides* subsp. *petiolaris.* Map 15. *S. artemisioides* subsp. *circinnata.* Map 16. *S. artemisioides* subsp. × *coriacea.* Map 17. *S. artemisioides* subsp. *alicia.* Map 18. *S. artemisioides* subsp. *oligophylla.* Map 19. *S. artemisioides* subsp. *helmsii.*

Previously, diploids of both *C. artemisioides* and *C. nemophila* var. *nemophila* were recorded for a single population (Randell 223) outside Alice Springs (Randell 1970). Under the present system, the two closely related forms both fall within subsp. *filifolia*.

A second series of intermediates links subsp. × *artemisioides* with subsp. × *sturtii* and then with subsp. *helmsii*. It has been suggested (Randell 1970) that subsp. × *sturtii* is always of hybrid derivation, and the present study has not produced evidence to refute this.

The taxon subsp. × *artemisioides* itself forms the intermediate link in a series of forms linking *S. cardiosperma* subsp. *microphylla* and *S. artemisioides* subsp. *filifolia*, as it is intermediate in several vegetative characters viz. leaflet numbers, leaflet length, indumentum density, petiole length, spacing between leaflets. From this evidence it is suggested that subsp. × *artemisioides* itself is also of hybrid derivation and is thus a taxon of convenience, not a natural taxon. No diploids have been recorded within subsp. × *artemisioides* as here circumscribed.

Besides those already mentioned, subsp. × *artemisioides* is known to be associated in hybrid swarms with the following subspecies: *S. artemisioides* subspp. *oligophylla*, × *coriacea*, *quadrifolia*, *petiolaris*, *S. cardiosperma* subsp. *gawlerensis*, and *S. glutinosa* subsp. *glutinosa*.

Selection of specimens examined (c. 500 seen)

WESTERN AUSTRALIA: Lawlers, *Burbidge 4820*, 14.xii.1955 (AD, CANB); 5 miles W Meekatharra, *Speck 577*, 3.ix.1956 (AD, CANB); c. 890 km from Perth on Inland Highway, *Ashby 4219*, 7.viii.1971 (AD, DNA, UMO, UWM); 77 km W Serpentine Lakes, c. 250 km N Deakin, *Donner 3948*, 18.vii.1972 (AD, LASCA, TI, W, Z) ; 8.2 km S Yamarna, *Toelken 6052*, 8.ix.1979 (AD, MCT-F).

NORTHERN TERRITORY: Palm Valley, c. 125 km SW Alice Springs, *Beauglehole 10333*, 7.vi.1965 (AD, AS, CANB, NSW); Alice Springs to Hamilton Downs rd, c. 40 km WNW Alice Springs, *Orchard 681*, 5.vii.1968 (AD, C, DNA, P) ; c. 5 km SE Alice Springs, *Weber 890*, 6.vii.1968 (AD, PE, PR) ; Standley Chasm, c. 49 km W Alice Springs, *Orchard 832*, 14.vii.1968 (AD, H, HO, TI, WC); Mt Cavenagh, c. 20 km SW of Kulgera Hstd, *Munir 5087*, 20.viii.1973 (AD, BRI, DNA); Cadney Bore, Hamilton Downs Stn, *Conrick 1400*, 1.iv.1983 (AD, IASO, LSN, NLN).

QUEENSLAND: c. 45 km N Adavale, *Wollaston s.n.*, 1.vii.1967 (AD).

NEW SOUTH WALES: Cobar, *Cleland s.n.*, 4.ix.1911 (AD); Broken Hill, *Reed s.n.*, 21.viii.1921 (AD); near Broken Hill, *Ashby s.n.*, 11.vii.1934 (AD); Fowler's Gap, c. 110 km N Broken Hill, *Richley F2*, 20.ix.1973 (AD).

SOUTH AUSTRALIA: 9 km W Tarcoola, *Conrick 455*, s.d. (AD, NSW); small hill just south Mt Gairdner c. 55 km WNW Nonning, c. 120 km W Pt Augusta, *Carrick 2370*, 29.ix.1969 (AD, BRI, CHR, COLO, TI); Angepena, Flinders Ranges, *Conrick AD114*, 20.viii.1977 (AD, MEL); unnamed conservation park, 53.5 km W Vokes Corner, *Donner 7466*, 27.viii.1980 (AD, DNA, OSAKA, OSH, P); 2 km SE Anna Creek Hstd, *Badman 1162*, 3.vi.1984 (AD, CMG, MEL).

8.2 subsp. **filifolia** Randell, subsp. nov.

Subsp. artemisioidi affinis sed foliolis teretibus paucioribus (1-4-jugis) et petiolis longioribus (plus quam 1.6 cm) differt.

(Affinities with subsp. × *artemisioides*, but differs in fewer leaflets (1-4 pairs) and longer petioles (more than 1.6 cm long).

Holotype: 20 miles NW Alice Springs, *Randell 223/117*, 30.viii.1967, AD.

Paratypes: *Randell 223/14*; *223/13*; *223/120*; *223/237*; *223/241*, all AD.

Synonyms

No name has ever been given to this form with few, strictly terete leaflets. The epithet previously applied (i.e. 'eremophila') belongs to forms with dorsi-ventrally flattened leaflets (see under subsp. × *coriacea*). Names incorrectly applied are listed below.

1. *Cassia eremophila* sensu Benth., *Fl. Austral.* 2: 287 (1864); *Trans. Linn. Soc. London* 27: 556 (1871); Bailey, *Fl. Queensland* 461 (1900); Black, *Fl. S. Australia* 431 (1948); Blackall & Grieve, *How to Know Western Austral. Wildfl.* 1: 183 (1954); non A. Cunn. ex J. Vogel.

2. *Cassia nemophila* var. *nemophila* sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 120 (1966); Willis, *Handb. Pl. Victoria* 246 (1972); Symon in Jessop, *Fl. Central Australia* 111 (1981); Stanley & Ross, *Fl. South East Queensland* 391 (1983).

3. *Cassia eremophila* var. *eremophila* sensu Cunningham et al., *Pl. W. New South Wales* 379 (1981).

Description

Leaflets 1-4 pairs, terete, 20-40 mm long, 1 mm diameter; *indumentum* very sparse on young leaves, becoming glabrous; *petiole* terete, 15-25 mm long. Diploid n=14 , triploid n=42/2 (both Alice Springs), tetraploid n=28 widespread (Randell 1970). Plate 15c.

Distribution and ecology

Widespread in a variety of habitats, from rocky slopes to deep sand, through wide areas of all mainland states. Map 13, p. 226.

Notes

The name chosen here describes the filiform leaflets.

In this taxon, petals are usually glabrous, but rarely are sparsely pubescent in hybrids derived from crosses with *S. glutinosa* subspecies. They are usually 7-10 mm long, rarely 4-6 mm long in specimens from the Simpson Desert.

See under subsp. × *artemisioides* for discussion on intergradation between terete-leaflet forms. A second series of intermediates links subsp. *filifolia* with broad-leaflet taxa (e.g. subspp. × *coriacea* or *quadrifolia*). Arbitrary decisions are made to separate the taxa as follows:

Leaflets terete, petiole more than 15 mm long. . . . . subsp. *filifolia*
Leaflets flat, petiole less than 15 mm long . . . . subsp. × *coriacea*
Leaflets flat, petiole more than 15 mm long . . . . subsp. *quadrifolia*

Hybrid swarms involving subsp. *filifolia* have also been seen to include the following taxa: *S. artemisioides* subspp. *helmsii*, *oligophylla*, *alicia*, × *sturtii*, and *petiolaris*; also *S. cardiosperma* subsp. *gawlerensis*, and *S. glutinosa* subsp. *glutinosa*.

Selection of specimens examined (c. 800 seen).

WESTERN AUSTRALIA: Kalgoorlie to Coolgardie, *Ashby 179*, 7.viii.1963 (AD); 100 km S Balladonia [sic.], *Wilson 2888*, 10.ix.1964 (AD, PERTH, S); 70 km S Leonora, *Donner 4522*, 3.ix.1973 (AD, PERTH).

NORTHERN TERRITORY: MacDonnell Ranges, hill 8 miles past Tea Tree Well, *Lothian 389*, vii-viii.1954 (AD, G, IA, K, L, P); 28 miles ENE Hermannsburg Mission, *Lazarides 5315*, 16.v.1955 (AD, CANB); Chambers Pillar, *Lothian 4419*, 22.vii.1968 (AD, PRE); Atcherie Ck crossing by road Ammaroo-Elkedra, c. 3.7 km by road N Honeymoon Bore, *Donner 6254*, 15.viii.1978 (AD, M, MEL).

QUEENSLAND: Carcory waterhole, Birdsville, *South Aust. Pastoral Board s.n.*, 26.vi.1953 (AD); 12 miles SW Moray Downs Stn, *Adams 1182*, 24.vii.1964 (AD, CANB); 19.5 km NNW turnoff to Kyabra Stn at Thylongra Hstd, main Quilpie-Windorah road, *Donner 6097*, 4.viii.1978 (AD, UGWV, US); Bedourie road, 6 km N Birdsville, *Grandison 85*, 31.viii.1978 (AD).

NEW SOUTH WALES: Pilliga Scrub c. 80 km NE Coonamble, *Cleland s.n.*, -.x.1918 (AD); Broken Hill, *Pidgeon & Vickery 3523*, 20.viii.1939 (AD, NSW); 64 miles (40 km) [sic] NE Broken Hill, *Sikkes & Telford 271*, 28.x.1972 (AD, K); 3 km E Mt Wambo (21 km WSW Singleton), *Coveny 5619*, 17.ix.1974 (AD, NSW); Fowlers Gap near Broken Hill, *Jacobs 2234*, 7.x.1975 (AD, NSW).

VICTORIA: Junction of Murray Valley Hway and park entrance road, Hattah-Kulkyne Natl Park, 4.5 km E Hattah, *Cameron 8709*, 30.viii.1977 (AD); 4 km SW Sunset Tank, *Corrick 6616*, 28.ix.1980 (AD, MEL).

SOUTH AUSTRALIA: near Heartbreak Well, c. 30 km W Everard Park Hstd, *Whibley 1192*, 16.ix.1963 (AD, E); c. 20 km NW Port Kenny, E of road to Streaky Bay, *Eichler 19475*, 13.x.1967 (AD, AK, PERTH); Saunders Ck gorge, *Blaylock 1314*, 26.vii.1969 (AD, KRA); near NW branch of Coopers Ck, S Coongie Lake, *Donner 5222*, 21.viii.1975 (AD, K, KRA, KW, MEL); Brookfield Conservation Park, c. 34 km E Truro, *Donner 7841*, 26.viii.1981, (AD, KRA).

8.3 subsp. **petiolaris** Randell, subsp. nov.

Subsp. × artemisioidi affinis sed foliolis paucioribus (1-jugis) sine laminae, et petiolis costisque lateraliter compressis differt.

(Affinities with subsp. × *artemisioides* but has fewer leaflets (1 pair) without laminas, and the petiole and midrib laterally compressed.)

Holotype: 16 km SE Yuendumu, c. 270 km NE Alice Springs, *Randell 224A*, 31.viii.1967, AD. *Paratypes*: (all same locality and date) *Randell 224/229, 224/287, 224/248, 224/283, 224/B*, all AD.

Synonyms

The type specimens of all the following names are derived, hybrid forms. For this reason, all the names they typify are reduced to synonymy.

1. *C. heteroloba* Lindley in Mitchell, *Three Expeditions into the interior of eastern Australia* 121 (1838).

Holotype: near Gol Gol Creek, New South Wales, *Mitchell 168*, 6.vi.1836, CGE, (photo), has horizontally flattened leaflets.

2. *C. platypoda* R. Br. in Sturt, *Expedition into Central Australia Vol.II, Botanical Appendix* 78 (1849).

Holotype: Murray Scrub, *Mrs. Grey No. 9*, 27.xi.1841, BM (photo) has narrow phyllodes and horizontally flattened leaflets.

3. *C. phyllodinea* R. Br. in Sturt, *Expedition into Central Australia Vol.II, Botanical Appendix* 78 (1849); Bailey, *Fl. Queensland* 460 (1900); Black, *Fl. S. Australia edn* 2: 431 (1948); Blackall and Grieve, *How to know Western Austral. Wildfl.* 1: 183 (1956); Symon, *Trans. Roy. Soc. S. Australia* 90: 115 (1966); Cunningham et al., *Pl. W. New South Wales* 381 (1981).

Lectotype: Inlet XII, South Coast in arenos steril versus montes. *R. Brown 4253*, (as *C. simplicifolia*), BM, (photo) lectotype here designated, as Inlet XII is near the base of Spencer's Gulf (Protologue: 'ad fundum sinus Spencer's Gulf'); *isolectotypes*: MEL, E, K. These have narrow phyllodes and no leaflets.

Syntype: I also have a photo of a sheet of three twigs in BM, one of which is labelled in an old hand 'Cassia phyllodinea Br. in Sturt Centr. Austr. Append. p.12, no locality' and annotated 'Type'.

4. *C. eremophila* Benth. var. *platypoda* (R. Br.) Benth., *Fl. Austral.* 2: 288 (1864); Bailey, *Fl. Queensland* 460 (1900); Black, *Fl. S. Australia edn* 2: 431 (1948); Cunningham et al., *Pl. W. New South Wales* 380 (1981).

5. *C. artemisioides* DC. var. *phyllodinea* (R. Br.) F. Muell., *Botanical Teachings* 31 (1877).

6. *C. artemisiodes* DC. var. *eremophila* (A. Cunn. ex J.Vogel) F. Muell., *Botanical Teachings* 31 (1877).

The figures illustrating the last two names both show laterally compressed petioles. However, the second is a misapplication of the epithet 'eremophila' which was originally applied to forms with terete petioles (see under subsp. × *coriacea*).

7. *C. sturtii* R. Br. in Sturt var. *planipes* J. Black, *Trans. Roy. Soc. S. Australia* 48: 256 (1924).

Lectotype: Cordillo Downs, South Australia, *J.B. Cleland s.n.*, v.1924, AD!, lectotype here designated, has narrow phyllodes and horizontally flattened leaflets; *isolectotype*: K.

8. *C. desolata* F. Muell. var. *planipes* (J. Black) Symon, *Trans. Roy. Soc. S. Australia* 90: 114 (1966); in Jessop, *Fl. Central Australia* 112 (1981).

9. *C. nemophila* var *platypoda* sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 122 (1966); Willis, *Handb. Pl. Victoria* 247 (1972); Symon in Jessop, *Fl. Central Australia* 110 (1981).

Description

Leaflets in the type laterally compressed, 15-25 mm x 2-4 mm, in 1 pair; in derived forms often horizontally flattened, elliptic, 0-3 pairs, 10-25 mm x 1-8 mm; *indumentum* of sparse straight hairs or almost absent, or glabrous; *petiole* 20-60 mm long, laterally compressed, 2-8 mm broad, straight to upcurved. Diploids n=14 (Alice Springs), triploids n=42/2 (Kingoonya, S. Australia), tetraploids n=28 widespread (Randell 1970). Plate 15d.

Distribution and ecology

Widespread in a variety of habitats from rocky slopes to deep sand, over wide areas of all mainland states. Map 14, p. 226.

Notes

An extremely variable taxon across its wide distribution. Forms from the east of the range (previously *C. phyllodinea*) rarely have leaflets when mature, are waxy, and often hairy. Forms in Central Australia (where the diploid occurs) have laterally compressed leaflets, little wax, and no hairs.

In Western Australia, specimens from the eastern border resemble Central Australian types, while those from the western areas have shorter phyllodes, (rarely) laterally compressed leaflets, and thick scurfy wax.

In South Australia, specimens are green, glabrous, and with 1-2 pairs of horizontally flattened leaflets. Similar forms are widespread in western Queensland, New South Wales and Victoria.

Much of this variation is probably due to hybridization with other taxa — subspp. *filifolia*, × *coriacea* and × *artemisioides*. When an extensive collection of specimens is examined, intermediates can be found linking all the extremes of this range. For this reason, all forms have been placed together within one subspecies.

However it is possible to informally recognise some extremes, e.g. 'eastern form' for hairy types, 'central form' for those with laterally-compressed leaflets, 'western form' for those with scurfy wax, 'southern form' for those with horizontal leaflets. Hybrids and intermediates observed involve the following taxa: *S. artemisioides* subspp. × *artemisioides*, *filifolia*, × *coriacea*, *quadrifolia*, *alicia*, × *sturtii*(?)., and *S. cardiosperma* subsp. *gawlerensis*.

The name chosen emphasises the importance of the petiole in defining the taxon.

Selection of specimens examined (c. 700 seen)

NORTHERN TERRITORY: Hermannsburg mission, *Lothian 237*, vii.1954 (AD, BM, M, USSR); 37 miles SE Yuendumu Native Settlement, *Lazarides 6005*, 16.xi.1956 (AD, CANB); c. 50 km W Henbury Stn, *Schodde 455*, 1.ix.1957 (AD, BM, CANB, K, P); c. 3 km E Ayers Rock, *Donner 4378*, 23.vii.1973 (AD, DNA, LASCH).

QUEENSLAND: near Mt Grey, between Merakee and Emmet, *Burbidge 5507*, 8.ix.1956 (AD, CANB); Nockatunga Pastoral Lease, *Hughes s.n.*, 10.x.1975 (AD); dune 23 km N Birdsville, to W of Bedourie Road, *Grandison 115*, 2.ix.1979 (AD); Gravelpit Road 14 km N Birdsville, 2 km E Bedourie road, *Grandison 136*, s.d. (AD).

NEW SOUTH WALES: Wentworth — junction of Darling and Murray Rivers, *Cleland s.n.*, 29.viii.1962 (AD); 63 miles (39 km) [sic] NE Broken Hill towards Mootwingee, *Sikkes & Telford 259*, 28.x.1972 (AD, AK, L); 41 miles (25 km) [sic] W Ivanhoe towards Menindee, *Sikkes & Telford 385*, 29.x.1972 (AD, L); c. 28 km ESE Whyjonta Bore, *Jackson 2867*, 12.v.1977 (AD,PE); at 90 km Wentworth post c. 11 km E S.A. border, c. 8.5 km NNE Cal Lal, *Barker 4173*, 9.ix.1980 (AD).

VICTORIA: roadside, Renmark to Mildura, *Cleland s.n.*, 27.viii.1962 (AD); 25 km NE Cowangie, Sunset Country, *Corrick 6399*, 3.x.1979 (AD, MEL); c. 18 km NE Campbell Tank, main N-S road in Sunset Country, *Short 1260*, 28.ix.1981 (AD, MEL).

SOUTH AUSTRALIA: roadside, Wiltunga, *Copley 785*, 18.x.1966 (AD, RSA, TI); c. 40 km NE Minnipa, road to Yardea, Gawler Ranges, *Orchard 2311*, 27.ix.1969 (AD, BRI, KRA, MEL, OSHKOSH, WRSL); Durkin Outstation, c. 15 km W Mulgathing, *Weber 2858*, 28.ix.1971 (AD, CAI, CAL, MEL, SYD); c. 15 km W Murray Bridge, Kinchina Gorge, *Carrick 3854*, 2.x.1974 (AD, SYD); 1 mile from Birdsville Track on road to Coongie, *Donner 5190*, 17.viii.1975 (AD, BISH, BRI).

8.4 subsp. **circinnata** (Benth.) Randell, comb. nov.

Basionym: *Cassia circinnata* Benth. in Mitchell, *Journal of an Expedition into the interior of Tropical Australia* 284 (1848); Benth., *Fl. Austral.* 2: 286 (1864); *Trans. Linn. Soc. London* 27: 556 (1871); Bailey, *Fl. Queensland* 460 (1900); Symon, *Trans. Roy. Soc. S. Australia* 90: 116 (1966). Cunningham et al., *Pl. W. New South Wales* 378 (1981); Symon in Jessop, *Fl. Central Australia* 111 (1981); Stanley & Ross, *Fl. South East Queensland* 391 (1983).

Lectotype: Camp at St. Georges Bridge on the Balonne River, 28°S, 148° 50'E, Qld, between November 5-9, 1846. *T.L. Mitchell 418*, K (photo), lectotype here chosen; *isolectotype*: MEL !

Description

Leaflets 1-3 pairs, obovate, usually absent at maturity; *indumentum* almost absent; *petioles* terete, 15-50 mm long, 1 mm diameter, rarely slightly flattened. Tetraploid n=28, one record (Randell 1970). Plate 15g-j.

Distribution and ecology

Scattered in arid shrublands of western Queensland and New South Wales. Map 15, p. 226.

Notes

Notable for its pod, which is flat, to 10 mm broad, and circinate forming 1-2 coils, with seed funicles attached to short inner edge. Some specimens may intergrade with subsp. *petiolaris*, eastern form.

Selection of specimens examined (c. 30 seen)

QUEENSLAND: Blackall, *McGillivray s.n.*, -.viii.1928 (AD); 14 miles SE Blackall, *Smith and Everist 892*, 20.x.1940 (MEL); 10 miles N Augathella, *Jones 1899*, 16.iv.1961 (AD, CANB).

NEW SOUTH WALES: near Silverton, *Miss Irvine s.n.*, -.viii.1889 (MEL); Gular, *Cleland s.n.*, 30.x.1911 (AD); 15 miles S Bourke towards Cobar, *Moore 3868*, 20.vii.1966 (MEL); 14 miles S Bourke, *Randell 205*, 3.vi.1967 (AD); 13 km W Cobar towards Wilcannia, *Sikkes & Telford AS188*, 26.x.1972 (A, AD, L); 22 km S Bourke towards Cobar, *Rodd and Hardie 4582*, 29.iv.1985 (AD).

SOUTH AUSTRALIA: Cult. Waite Institute, *Southcott 11650*, 30.i.1959, (AD).

8.5 subsp. × **coriacea** (Benth.) Randell, comb. nov.

Basionym: *Cassia sturtii* R. Br. var. *coriacea* Benth. *Fl. Austral.* 2: 288 (1864); Black, *Fl. S. Australia edn* 2, 2: 431 (1948).

Lectotype: Mt Flinders. NSW interior, Oxley's first Expedition. *Cunningham 185*, BM, sheet of 2 twigs, left shoot, (photo), lectotype here designated; *isolectotypes*: (i) sheet with one twig as above, others collected *Cl Fraser s.n.*, NSW, 1817, BM, (photo), (ii) sheet of two twigs labelled 'Base of Mt Flinders', Ex herb. Hook., K, (photo).

Syntype: Inlet XII, South Coast. *R. Brown 4334*, 1802, BM, sheet of 4 mixed twigs (photo), others cited by Bentham not seen.

Synonyms

1. *C. eremophila* A. Cunn. ex J. Vogel, *Gen. Cass. syn.* 47 (1837) as *C. nemophila.*

N.B. Cunningham's journal June 7th, 1817 states: 'I gathered flowering specimens of Cassia which is now the greatest ornament of these deserts and might be termed eremophila, from it being found in such places'. Thus the name 'nemophila' can be regarded as a typographical error, as pointed out by Bentham (1864).

Neotype: (fide Symon 1966) *Cunningham 183*, BM, *isoneotype*: NSW ! as no specimens known to have been seen by Vogel have been located.

This epithet (and its variant nemophila) have long been misapplied to terete-leaflet forms, and for this reason I reduce it to synonomy as a nomen confusum.

2. *C. eremophila* (A. Cunn. ex J. Vogel) var. *coriacea* (Benth.) Symon, *Trans Roy. Soc. S. Australia* 90: 124 (1966) as *C. nemophila* var *coriacea*; Willis, *Handb. Pl. Victoria* 246 (1972); Symon in Jessop, *Fl. Central Australia* 112 (1981); Cunningham et al., *Pl. W. New South Wales* 379 (1981).

Description

Leaflets (1-) 2-6 pairs, linear, elliptic, oblong or obovate, 7-15 (-30) mm x 2-6 mm; *indumentum* very sparse of soft appressed hairs; *petiole* terete 6-10 (-15) mm long. Triploids n=42/2 (restricted to Flinders Ranges, South Australia), tetraploids n=28 widespread, (Randell 1970). Plate 15b.

Distribution and ecology

Occurs in a very wide range of habitats from rocky hillsides to deep sands, over extensive southern inland areas of all mainland states. Map 16, p. 226.

Notes

In this taxon, cuticular wax occurs in thick sheets, and is sometimes glaucous.

An extremely variable taxon across its wide distribution, with individuals probably of hybrid derivation from *S. cardiosperma* subsp. *gawlerensis* and one or more of *S. artemisioides* subspp. × *artemisioides*, *filifolia*, and *petiolaris* (Randell 1970). *S. cardiosperma* subsp. *gawlerensis* has numerous (8-10 pairs) small leaflets (3-6 mm long) and is restricted in distribution to Eyre Peninsular and Flinders Ranges of South Australia. Hence collections of subsp. × *coriacea* from these areas also tend to have many smaller leaflets. They then resemble *S. cardiosperma* subsp. *stowardii*, but this does not occur in South Australia.

In northern South Australia, subsp. × *coriacea* intergrades with *S. artemisioides* subspp. *alicia*, *quadrifolia* and *oligophylla*, all of which have fewer larger leaflets. Hence subsp. × *coriacea* in this area also tends to have fewer larger leaflets, but there is a complete range of intermediates linking all four subspecies. The arbitrary separation developed is based on petiole length and leaflet size (see under subsp. *alicia* for details).

In western Queensland, New South Wales and Victoria , subsp. × *coriacea* intergrades with subspp. *filifolia*, *petiolaris* and *zygophylla*. In southern South Australia, and Western Australia some forms are morphologically very similar to *S. artemisioides* subsp. *symonii* which is restricted to the NW of Western Australia.

S. artemisioides subsp. × *coriacea* is believed to be always of hybrid derivation and is thus not a "natural" taxon, merely a convenient grouping of plants with similar morphology.

Selection of specimens examined (c. 600 seen)

WESTERN AUSTRALIA: Israelite Bay, *Brooke s.n.*, -.x.1901 (AD); Dumbleyung, *Gardner 6501*, 10.viii.1942 (AD); 5 miles N Ravensthorpe, *George 287*, 12.ix.1959 (AD); 98 miles E Norseman, *Aplin 1747*, 5.ix.1962 (AD); 0.8 miles W Bandalup Ck., *Lullfitz 5494*, 6.viii.1966 (AD); Lake Cronin area, *Kessell 507*, 25.viii.1966 (AD); W Lake Grace, *Ashby 1938*, 7.ix.1966 (AD); 10 miles W Pt Culver, *Brooker 3703*, 30.x.1973 (AD); Coolgubbin c. 16 km S Neale's Junction, *Crisp 37*, 20.v.1974 (AD).

NORTHERN TERRITORY: Beddome Ra., *Latz 5241*, 2.v.1974 (AD, DNA, NY).

QUEENSLAND: Gravel Pit road, 14 km N Birdsville, 24 km E Bedourie road, *Grandison 137*, 4.ix.1979 (AD).

NEW SOUTH WALES: Broken Hill, *Morris 36*, -.vi.1920 (AD); Thackaringa Hills, E Broken Hill, *Reed s.n.*, 20.viii.1921 (AD); Sayers Lake, *Milthorpe 227*, 1.xi.1970 (AD); The Veldt, c. 130 km NNE Broken Hill, *Richley 1156*, 12.ix.1973 (AD); Fowlers Gap, N Broken Hill, *Jacobs 2274*, 9.x.1975 (AD, NSW); Gol Gol Forest between Sturt Hway and Murray River, E Merbein, *Corrick 7400*, 1.ix.1981 (AD, MEL).

VICTORIA: beside Borung Hway, 7 km WNW Litchfield, *Muir 5759*, 17.viii.1978 (AD, MEL); Far NW, c. 2 km SE Mt Crozier, *Corrick 6646*, 30.ix.1980 (AD, MEL); on Calder Hway just N Redcliffs, *Corrick 7351*, 31.viii.1981 (AD, MEL); sandhill c. 10.5 km from Sunset Tank on road to Cowangie, *Short 1275*, 29.ix.1981 (AD, MEL).

SOUTH AUSTRALIA: c. 15 km S Bute on road to Adelaide, *Weber 50*, 12.x.1966 (AD, PH, SI); around Angorichina Hostel, c. 95 km NNE Hawker, *Kuchel 2441*, 1.ix.1967 (AD, BRI, C, CANB, CHR); Chowilla Stn, c. 24 km NNE Renmark, *Wheeler 439*, 17.ix.1967 (AD, LI, MEL, NBG); small hill just S Mt Gairdner c. 55 km WNW of Nonning, *Carrick 2371*, 29.ix.1969 (AD, BRI, KRA, MEL, WRSL); Emu, c. 250 km N Watson, *Brooks 15*, 14.ix.1972 (AD, DNA, NSW).

8.6 subsp. **zygophylla** (Benth.) Randell, comb. nov.

Basionym: *Cassia zygophylla* Benth. in Mitchell, *Journal of an Expedition into the interior of tropical Australia* 288 (1848).

Lectotype: No locality, *Mitchell 276*, 31.viii.1846, annotated 'C. zygophylla Benth. in Mitchell Trop. Aust., p. 288', K (photo), lectotype here designated; *isolectotype*: CGE (photo).

Syntype: No locality, *Mitchell 268*, 29.viii.1846, annotated 'Fl., 6 ft, sheltered gullies sub tropic New Holland' K (photo).

Synonyms

1. *C. canaliculata* R. Br. in Sturt, *Expedition into central Australia Vol. II, Botanical Appendix* 78 (1849).

Holotype: In the bed of the creeks of the Barrier Range, about 36 miles from the Darling, in lat. 32°S. *C. Sturt no. 2*, BM (photo). Note that this specimen has (slightly) flattened petioles, indicating that subsp. *petiolaris* occurs somewhere in its ancestry.

2. *C. eremophila* (A. Cunn. ex J. Vogel) var. *zygophylla* (Benth.) Benth. *Fl. Austral.* 2: 288, (1864); *Trans. Linn. Soc. London* 27: 556 (1871); Bailey, *Fl. Queensland* 461 (1900); Cunningham et al., *Pl. W. New South Wales* 380 (1981).

3. *C. nemophila* (A. Cunn. ex J. Vogel) var. *zygophylla* sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 123 (1966).

Description

Leaflets 1-2 pairs, linear to narrow elliptic, 18-40 mm x 2-4 mm, 5-10 times as long as broad; *indumentum* absent; *petiole* 8-12 mm long.

Distribution and ecology

Occurs in a range of habitats from rocky hills to sandy slopes in inland southern Queensland, New South Wales and northern Victoria.

Notes

Cuticular wax is thick and glaucous in this taxon, which intergrades in various parts of its distribution with the following subspecies: in southern areas, subsp. × *coriacea*; in the west, × *sturtii*, and in the north-west subsp. *quadrifolia*. In addition, some forms of subsp. *petiolaris* are obviously derived from subsp. *zygophylla* as second parent.

Several collections differ in having 4 pairs of leaflets. eg. Warialda, *Rupp s.n.*, -.vii.1905, (NSW); roadside between Mullaly and Coonabarrabran, *Anon*, 7.iv.1968, (NSW). They may represent a variant of subsp. *zygophylla*, or a new subspecies not formally recognised here.

Selection of specimens examined (c. 200 seen)

QUEENSLAND: Otley's Stn, *Leichardt s.n.*, -.v.1843 (NSW); Inglewood, *Boorman s.n.*, -.ix.1910 (NSW); Chinchilla, *Shirley s.n.*, 29.x.1917 (NSW); 11 miles E Comet township, *Lazarides and Story 135*, 12.ix.1961 (NSW); 35 km SE Blackwater, *Henderson 1190*, 14.ix.1971 (NSW).

NEW SOUTH WALES: Gilgandra, *Cambage s.n.*, 14.x.1904 (NSW); Warialda, *Browne s.n.*, -.viii.1933 (NSW); Wollar to Merriwa road, *Constable 4015*, 8.viii.1962 (NSW); Gurley nr Moree, *McBarron 15792*, 20.ix.1968 (NSW); 16 km SW Cowra, *McBarron 21019*, 29.ix.1973 (NSW).

VICTORIA: Werribee Gorge, *Williamson s.n.*, -.x.1915 (NSW); Wycheproof, *Watts s.n.*, -.x.1917 (NSW); Katunga, *Muir 4612*, 26.x.1967 (NSW).

8.7 subsp. **alicia** Randell, subsp. nov.

Subsp. oligophyllae affinis sed foliolis angustioribus, ellipticis et verticalibus dispositis pro paginis adaxialibus foliolorum oppositorum sibiparallelis et approximatis differt.

(Affinities with subsp. *oligophylla* but leaflets narrower, elliptical and placed vertically, such that the adaxial surfaces of opposite leaflets are parallel to each other and close together.).

Holotype: 6 miles SE of Alice Springs, *Randell 222/257*, 29.viii.1967, AD.

Paratypes: c. 3 km S of Alice Springs, *Randell 221/116*, *Randell 221/308*, *Randell 221/80*, 28.viii.1967, all AD.

Synonyms

This form has not previously been given a name. Epithets applied in error are:

1. *Cassia oligophylla* sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 112 (1966) p.p. as for 'plants for which F. Mueller has used the unpublished varietal names unijuga and monozyga'.

2. *Cassia nemophila* var. *coriacea* sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 124 (1966) p.p. as for specimens which 'connect with *C. oligophylla* in north central areas'.

Description

Leaflets 1-3 pairs, narrow elliptic and acute, or broader, oblanceolate and obtuse, 15-30 mm x 5-8 (-12) mm; *indumentum* sparse or absent, of soft appressed hairs; *petioles* 8-10 mm long. Diploid n=14, triploid n=42/2 and tetraploid n=28, all near Alice Springs, Northern Territory (Randell 1970). Plate 15f.

Distribution and ecology

Occupies a variety of habitats from rocky slopes to deep sand, in southern Northern Territory, southwestern Queensland, northwestern New South Wales, and northern South Australia. Map 17, p. 226.

Notes

In this taxon cuticular wax is thick and very glaucous, drying bluish or reddish.

Around Alice Springs there is a group of specimens having narrow elliptic, acute leaflets borne vertically and with adaxial surfaces of members of each pair in apposition. These form the core of the taxon, and the diploids are found among these specimens. However, a range of specimens with broader, longer leaflets are found near Alice Springs in hybrid swarms together with typical subsp. *alicia*, and are apparently derived from subsp. *alicia* as a parent. They are also designated as part of subsp. *alicia*.

In northern South Australia, herbarium specimens present a range of forms linking subspp. *oligophylla*, *quadrifolia*, × *coriacea* and another resembling this large-leaflet form of subsp. *alicia*.

Arbitrary decisions have been made on the character combination used to separate the subspecies, but the result is not entirely satisfactory, viz.

Petiole robust, 5-15 mm long; leaflets glaucous or pubescent . . . . subsp. *oligophylla*
Petiole slender, more than 11 mm long; leaflets not glaucous . . . . subsp. *quadrifolia*
Petioles slender, less than 10 mm long; leaflets longer than 15 mm . . . . subsp. *alicia*
Petioles slender, less than 10 mm long; leaflets less than 15 mm long . . . . subsp.× *coriacea*

This separation leaves subsp. *alicia* comprising forms ranging from narrow-elliptic leaflets (to 5 mm broad) to broad-oblanceolate leaflets (to 12 mm broad). Further work may reveal the desirability of separating these forms as separate taxa.

The name of the subspecies is derived from its occurrence around Alice Springs.

Selection of specimens examined (c. 100 seen)

NORTHERN TERRITORY: 4 miles N Ooratippra Hstd, *Chippendale 2503*, 14.viii.1956 (AD, DNA); 14 miles SW Barrow Creek township, *Lazarides 5811*, 23.viii.1956 (AD, CANB); 13 miles SE Ringwood Hstd, *Chippendale 4957*, 25.ix.1958 (AD, DNA); 5 miles E Coniston Hstd, *Chippendale 6432*, 11.viii.1959 (AD, DNA); 5 miles W Stuart Hway, Hamilton Downs road, *Maconochie 116*, 9.v.1967 (AD, DNA).

QUEENSLAND: Stony flats near Camp 23, c. 65 km NW Birdsville, Simpson Desert Expedition, *Crocker s.n.*, 4.vii.1939 (AD); 4 miles S Hughenden on Muttaburra road, *Burbidge 5367*, 9.v.1956 (AD, CANB); Urandangi to Camooweal road, c. 2.5 km N of middle turnoff to Barkly Downs Hstd, *Donner 6129*, 7.viii.1978 (AD, T, WKSL, Z); Gravel Pit road, 14 km N Birdsville, 2 km E Bedourie road, *Grandison 132*, 4.ix.1979 (AD).

NEW SOUTH WALES: The Veldt, c. 130 km NNE Broken Hill, *Richley 1154*, 12.ix.1974 (AD); W side McDonald Peak, c. 2.5 km ESE Binerah Downs, *Donner 5666*, 9.v.1977 (AD, F, G); 5 km E Tibooburra, *Donner 5722*, 11.v.1977 (AD).

SOUTH AUSTRALIA: c. 50 km E Copley, *Lothian 2577*, 27.ix.1963 (AD, PRE); c. 80 km NNE Tarcoola, *Lay 48*, 6.vii.1970 (AD, GZU, HL, LE); c. 120 km NNW Kingoonya, *Lay 298*, 5.vi.1971 (AD, GOET, NY); "Lake View", SW shore Lake Frome basin, *Callen 29*, 15.vi.1972 (AD, BAB).

8.8 subsp. **oligophylla** (F. Muell.) Randell. comb. nov.

Basionym: *Cassia oligophylla* F. Muell., *Fragm.* 3: 49 (1862); Bailey, *Fl. Queensland* 462 (1900); Symon, *Trans. Roy. Soc. S. Australia* 90: 112 (1966); Erickson et al., *Fl. and Pl. of Western Australia* 209 (1979); Cunningham et al., *Pl. W. New South Wales* 380 (1981); Symon in Jessop, *Fl. Central Australia* 109 (1981).

Lectotype: In Sandy Places at Nichol Bay, W.A., leg. *P. Walcott s.n.*, sub expeditione Francisci Gregorii, K (photo), lectotype here designated; *isolectotype*: MEL! (photo) is fragmentary.

Synonym

C. oligophylla F. Muell. var. *sericea* Symon, *Trans. Roy. Soc. S. Australia* 90: 113 (1966).

Holotype: The Granites, N.T., *J.B. Cleland s.n.*, 14.viii.1936, AD! (photo).

Description

Leaflets 2-3 pairs, obovate to ovate, 10-30 mm x 10-20 mm, usually quite flat; *indumentum* sparse to dense, of erect or silky appressed hairs; *petiole* 6-10 mm long, robust, 1.5 mm diameter. Triploid n=42/2, restricted (Marree, South Australia); tetraploid n=28 widespread (Randell 1970). Plate 15a.

Distribution and ecology

Occurs in a variety of habitats from rocky hillsides to deep sand, over wide areas of inland Western Australia, Northern Territory, Queensland, and South Australia. Only one collection is known from New South Wales. Map 18, p. 226.

Notes

In this taxon, cuticular wax is sometimes glaucous.

As here defined subsp. *oligophylla* does not show much variability, but there is considerable intergradation with other taxa. An intractable problem occurs in northern areas of South Australia where intergradation occurs between subspp. × *coriacea*, *alicia*, and *oligophylla*. Arbitrary separations are made on the following character combinations:

Petioles robust (1-2 mm diam.); leaflets 20-40 mm long .... subsp. *oligophylla*

Petioles slender (<1 mm diam.); leaflets shorter than 15 mm .... subsp. × *coriacea*

Petioles slender (<1 mm diam.); leaflets 2-3 pairs, longer than 16 mm .... subsp. *alicia*

This is not entirely satisfactory (see further discussion under subsp. *alicia*). Besides this intergradation, intermediates are known between subsp. *oligophylla* and subspp. *helmsii*, *quadrifolia*, *filifolia* and × *sturtii*. In Western Australia a few specimens show larger, more persistent floral bracts.

Population studies in northern South Australia would clarify relationships between subspp. *oligophylla*, *alicia* and × *coriacea*. Cytological studies might locate a diploid race in the Hamersley Ranges of Western Australia, as it is here that the most uniform specimens are located.

Selection of specimens examined (c. 300 seen)

WESTERN AUSTRALIA: 9 miles ESE Calwynyardah Stn, Kimberleys, *Lazarides 6506*, 5.ix.1959 (AD, CANB); c. 400 km N Giles, SW Lake Mackay (on W.A.-N.T. border), *Kuchel 168*, 2.viii.1962 (AD, SI); c. 30 km N Gascoyne R., Onslow rd, *Ashby 1874*, 10.viii.1966 (AD, F, G, GOET); Cape Ra. Natl Park, c. 11km WNW Exmouth to Carnarvon rd, *Jackson 3062*, 29.viii.1977 (AD, PRE, UMO); plains within Hamersley Ra., Paraburdoo, *Boomsma 547*, 21.vi.1980 (AD).

NORTHERN TERRITORY: 33 miles NW Wauchope township, *Lazarides 5861*, 27.viii.1956 (AD, CANB); base of Ayers Rock, *Hill & Lothian 737*, 2.vii.1958 (AD, MEL, NSW, NY); Mt Davidson, Tanami Sanctuary, *Maconochie 1010*, 23.v.1970 (AD, DNA); 25 miles N of Barkly Hway on Borroloola rd, *Henry 180*, 11.vi.,1971 (AD, DNA).

QUEENSLAND: 20 miles NE Dajarra township, *Blake 4036*, 3.ix.1953 (AD, CANB); Stuarts Ck, *Pastoral Board S.A. s.n.*, 17.ix.1966 (AD); Simpson Desert, near Lake Muncoonie, *Crisp 192*, -.vi.1974 (AD).

NEW SOUTH WALES: Purnanga, *Richley 1383*, 17.ii.1974 (NSW), only collection seen.

SOUTH AUSTRALIA: road from Arrabury Hstd to Innamincka, *Donner 5369*, 28.viii.1975 (AD, K, W); Krewinkel Hill, c. 75 km directly NW Mt Lindsay, *Stove 362B*, 2.ix.1978 (AD); W end Gawler Ranges, Kokatha, *Bates 210*, -.vii.1978 (AD, DNA); river chasm, 61 km E Dalhousie Springs, *Lothian 1904*, 12.viii.1963 (AD, BRI).

8.9 subsp. **helmsii** (Symon) Randell, comb. nov.

Basionym: *Cassia helmsii* Symon in Eichler, *Suppl., J. Black's Flora* 180 (1965); Symon, *Trans. Roy. Soc. S. Australia* 90: 110 (1966); Erickson et al., *Fl. and Pl. Western Australia* 210 (1979); Symon in Jessop, *Fl. Central Australia* 109 (1981); Cunningham et al., *Pl. W. New South Wales* 380 (1981).

Holotype: 5 miles E of Coniston Homestead, N.T., *Chippendale 6428*, 11.viii.1959, AD! (photo); *isotypes*: DNA, NSW.

Synonyms

1. *C. sturtii* R. Br. var. *tomentosa* Benth., *Fl. Austral.* 2: 289 (1864).

Lectotype: Mt Murchison NSW, *J. Dallachy s.n.*, MEL! lectotype here designated; *isolectotype*: K (photo).

2. *C. sturtii* R. Br. var. *involucrata* J. Black, *Trans. Roy. Soc. S. Australia* 47: 370 (1923); J. Black, *Fl. S. Australia edn* 1, 2: 293 (1924).

Holotype: Birksgate Range, far NW of S.A., Camp 15, *R. Helms s.n.*, 6.vii.1891, AD!; *isotypes*: NSW!, K, MEL.

3. *C. desolata* F. Muell. var. *involucrata* (J. Black) J. Black, *Fl. S. Australia edn* 2, 2: 430 (1948); Blackall and Grieve, *How to know Western Austral. Wildfl.* 1: 183 (1954).

Description

Leaflets 2-4 pairs, obovate, woolly-hairy, 10-25 mm x 6-12 mm, edges recurved; indumentum of thick woolly hairs; petiole to 15 mm long. Triploids n=42/2 restricted (Flinders Ranges, South Australia), tetraploids n=28 widespread. Plate 15e.

Distribution and ecology

Occurs in a variety of habitats from rocky slopes to deep sands in inland areas of Western Australia, Northern Territory, Queensland, New South Wales and South Australia. Map 19, p. 226.

Notes

In this taxon cuticular wax is thick below the hairs, and tends to become dark and discoloured at maturity.

Subsp. *helmsii* in itself does not show much variability, but there is considerable intergradation with other taxa. Subsp. × *sturtii* is presumably of hybrid derivation from subsp. *helmsii* as one parent, and there are certainly many specimens intermediate between the two taxa. An arbitrary separation may usually be made between specimens with elliptic, incurved leaflets (subsp. × *sturtii*) and those with obovate recurved leaflets (subsp. *helmsii*) though even this simple correlation sometimes breaks down.

Hybrid swarms have also been observed linking subspp. *helmsii* and *oligophylla*, the latter also with obovate leaflets but silky hairs. Again intermediates occur, and an arbitrary separation may usually be made between those with recurved leaflets and fine petioles (subsp. *helmsii*) and those with flat leaflets and robust petioles (subsp. *oligophylla*). Intermediate forms are known to exist linking subsp. *helmsii* with subspp. × *artemisioides*, *filifolia*, × *sturtii*, *quadrifolia* and *alicia*.

Cytological studies might locate a diploid race in the Hamersley Ranges of Western Australia, as it is here that many uniform specimens are found.

Selection of specimens examined (c. 250 seen)

WESTERN AUSTRALIA: 5 miles NW Murchison Downs, Eremean Prov., *Speck 1307*, 28.viii.1958 (AD, CANB); Giles settlement, Rawlinson Ra., c. 70 km W Northern Territory border, *Hill 1374*, 29.vii.1964 (AD, BM); Coolgubbin, c. 16 km S Neales Junction, *Crisp 48*, 21.v.1974 (AD); 23 km NE Earaheedy Hstd, *Toelken 6273*, 17.ix.1979 (AD, NSW).

NORTHERN TERRITORY: Horseshoe Bend, c. 170 km S Alice Springs, *Ising 3133*, 24.viii.1931 (AD); Ayers Rock, NE side near base, *Donner 4636*, 23.viii.1973 (AD, DNA); NW Simpson Desert, *Henry 1005*, 1.x.1973 (AD, DNA, MO); Tanami Desert, c. 9 km NNW Ferdies Bore, c. 40 km WNW Mongrel Downs Hstd, *Donner 6306*, 19.viii.1978 (AD, OSA, OSHKOSH, P).

QUEENSLAND: 7 miles SE Gypsy Plains Stn, *Speck 4794*, 6.viii.1954 (AD, CANB); Simpson Desert, *Crisp 185*, -.vii.1974 (AD); Simpson Desert, stony rise near Lake Muncoonie, *Crisp 191*, -.vii.1974 (AD); Nockatunga Pastoral Lease, *Hughes, s.n.*, 10.x.1975 (AD).

NEW SOUTH WALES: Umberumberka, c. 25 km NW Broken Hill, *Ising s.n.*, 14.x.1921 (AD); near Milparinka, c. 6 km SW Mt Shannon, *Jackson 2812*, 6.v.1977 (AD, ZT).

SOUTH AUSTRALIA: Mt Norwest Station, *Hill 63*, 16.vii.1955 (AD); near Cooper Ck crossing on rise about 2 miles above crossing, *Lothian 2027*, 23.ix.1956 (AD, Shallert, SI, US); c. 5 miles WNW Cordillo Downs Hstd, *Lothian & Francis 645*, 29.viii.1960 (AD, E); Mt Fink, c. 55 km SW Tarcoola, *Bates 265*, -.viii.1978 (AD, DNA); between Deering Hills and Mann Ranges, c. 18 km NE Mt Cooperinna, *Barker 3401*, 8.ix.1978 (AD, DNA).

8.10 subsp. × **sturtii** (R. Br.) Randell, comb. nov.

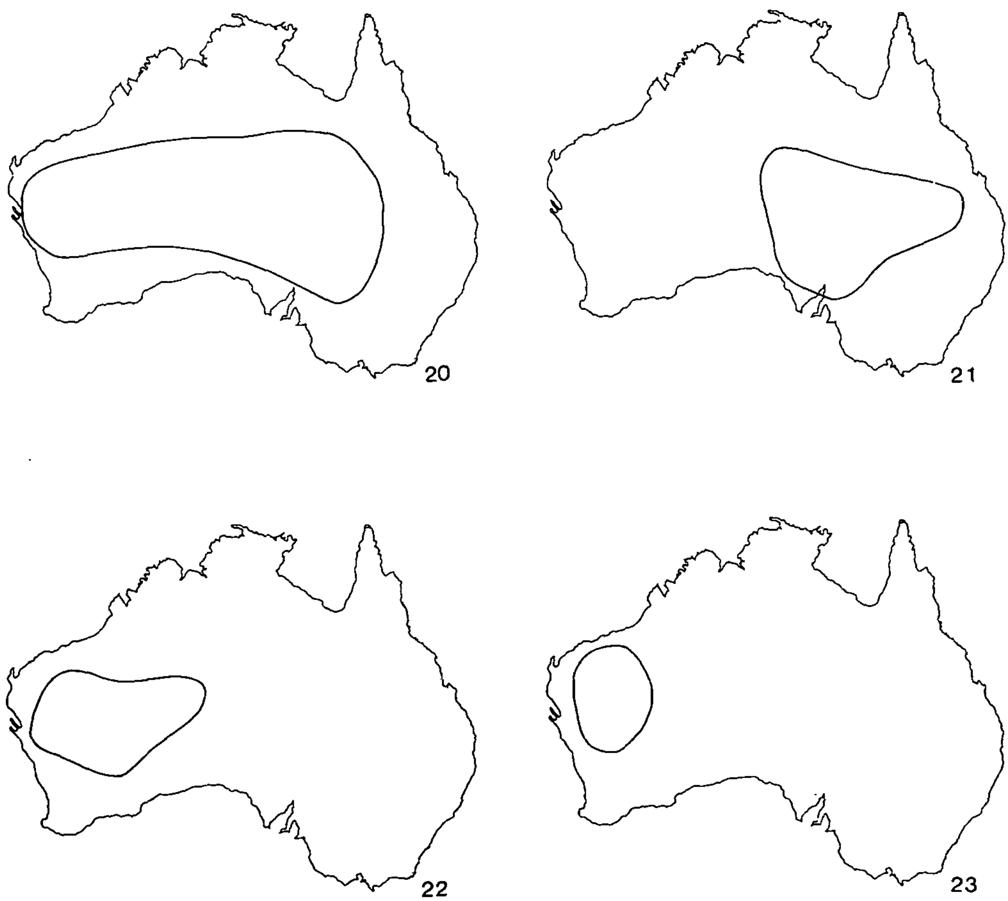
Basionym: *Cassia sturtii* R. Br. in Sturt, *Expedition into central Australia Vol. II, Botanical Appendix* 77 (1849); Bailey, *Fl. Queensland* 461 (1900); J. Black, *Fl. S. Australia edn* 2, 2: 431 (1948); Blackall & Grieve, *How to know Western Austral. Wildfl.* 1: 183 (1954); Symon, *Trans. Roy. Soc. S. Australia* 90: 113 (1966); in Jessop, *Fl. Central Australia* 111 (1981); Cunningham et al., *Pl. W. New South Wales* 382 (1981).

Holotype: In sandy brushes of the Western Interior, Sturt 25, BM (photo).

Synonym

C. desolata F. Muell., *Linnaea* 25: 389 (1853); Bailey, *Fl. Queensland* 462 (1900); J. Black, *Fl. South Australia edn* 2, 2: 430 (1948); Symon, *Trans. Roy. Soc. S. Australia* 90: 113 (1966); in Jessop, *Fl. Central Australia* 110 (1981); Cunningham et al., *Pl. W. New South Wales* 378 (1981).

Holotype: In sunny undulating, dry clayey soil between Arkaba and Wulpina (Wilpina) Flinders Ranges SA, *F. Mueller s.n.*, MEL! (photo).



Map 20. *S. artemisioides* subsp. × *sturtii.* Map 21. *S. artemisioides* subsp. *quadrifolia.* Map 22. *S. artemisioides* subsp. *glaucifolia.* Map 23. *S. artemisioides* subsp. *stricta.*

Description

Leaflets 2-8 pairs, linear to elliptic, concave, 15-25 mm x 2-8 mm; *indumentum* of sparse to dense woolly (rarely straight) hairs; *petioles* 6-10 mm long. Triploids n=42/2 restricted (Alice Springs, N.T.); *tetraploids* n=28, widespread (Randell 1970). Plate 16f.

Distribution and ecology

Occurs in a variety of habitats from rocky hillsides to deep sand over wide areas of inland Western Australia, Northern Territory, Queensland, New South Wales and South Australia. Map 20, p. 238.

Notes

Specimens in this taxon are believed to be of hybrid origin, from crosses between subspp. *helmsii* or *oligophylla* on the one hand, and subspp. × *artemisioides* or *filifolia* on the other. Thus in different populations, subsp. × *sturtii* has different combinations of parental genomes, and it is not surprising that the taxon here defined comprises much variability. It also follows that is not expected that a diploid race will ever be discovered.

It is not generally possible to describe geographical trends in variation, as the variation occurs between populations, rather than between areas. As stated in the description, there is considerable difference in the form, and number of leaflets, and in their size. However, they are united by their elliptic shape, and the generally dense woolly indumentum. Intermediates exist with subsp. *helmsii* (see discussion there), and with subsp. × *artemisioides*. In the latter case an arbitrary separation may usually be made with those specimens with obviously flattened leaflets placed in subsp. × *sturtii*.

Intermediates have also been observed with the following taxa: *S. artemisioides* subspp. × *artemisioides*, *filifolia*, *helmsii*, *oligophylla*, *petiolaris*, × *coriacea* and *quadrifolia*.

Population studies on the form *C. desolata* var. *planipes* (J. Black) Symon (here transferred to subsp. *petiolaris*), are needed to clarify its relationships to several subspecies of *S. artemisioides*.

Selection of specimens examined (c. 300 seen)

WESTERN AUSTRALIA: Gap in Rawlinson Ra., c. 6.5 km N Giles, *Hill and Lothian 867*, 8.vii.1958 (AD); Yaringa North, Shark Bay, *Galbraith s.n.*, 10.viii.1964 (AD); Yalgoo, c. 150 km NE Mingenew, *Ashby 2979*, 3.ix.1969 (AD, OSAKA, OSHKOSH); Mulyajingle Peak, c. 15 km SW Byro, *Weber 5061*, 11.x.1975 (AD, NBG); 14 km SE Edagee Hstd turnoff, c. 90 km SE Carnarvon, *Jackson 3104*, 1.ix.1977 (AD, BRI, COLO).

NORTHERN TERRITORY: Cockatoo Ck, c. 240 km NW Alice Springs, *Cleland s.n.*, 18.viii.1931 (AD); Woodgreen Stn c. 160 km NE Alice Springs, *Lothian 525*,1954 (AD); Mt Solitaire, Alice Springs to Hamilton Downs rd, c. 31 km WNW Alice Springs, *Orchard 716*, 5.vii.1968 (AD, COLO, DNA, H, M, Tripoli); Central Mt Stuart, c. 200 km N Alice Springs, *Weber 1011*, 18.vii.1968 (AD, C, K, M); 6 km E Hawk's Nest Well, Welbourne Hill Stn, *Henshall 3013*, 19.v.1980 (AD, CBG, DNA); Chambers Pillar, *Wollaston s.n.*, 27.v.1981 (AD).

QUEENSLAND: SW Nappermerrie, *Jackson 419*, 12.viii.1962 (AD).

NEW SOUTH WALES: Broken Hill, *Morris 277*, 20.vii.1920 (AD); 40 km N Tibooburra, Wittabrenna Ck flood plain, *Conrick 641*, 5.ix.1981 (AD).

SOUTH AUSTRALIA: De Rose Hill, on main road between Coober Pedy and Alice Springs, *Caulfield & Hill s.n.*, -.vii.1953 (AD); Lake Harry, Clayton R. crossing, *Hill 296*, 29.vii.1955 (AD, M); 1-3 miles S of Wertaloona Hstd, W Lake Frome, *Weston 1609*, 1.viii.1965 (AD, UC); c. 15 km S Ooldea, *Lothian 5442*, 11.vii.1972 (AD, BRI); NE Yarloo, *Brown s.n.*, 28.ix.1978 (AD); E end, Yudnamutana Gorge, N Flinders Ranges, *Copley 452*, 22.vii.1980 (AD).

8.11 subsp. **quadrifolia** Randell, subsp. nov.

Subsp. × *sturtio affinis sed foliolis paucioribus (2-jugis), pilis rectis sparsis et petiolis longioribus (plus quam 1.5 cm) differt.* (Affinities with subsp. × *sturtii* but leaflets fewer (2 pairs), hairs straight and sparse, and petiole longer (more than 1.5 cm)).

Holotype: 9 km N of Watson on West side of Maralinga road intersection, *Lothian 5516*, 14.vii.1972, AD; *isotype*: F.

Paratypes: Watson — Maralinga, *Pastoral Board s.n.*, 1.vii.1967, 2 sheets, AD.

Synonym

C. oligophylla sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 112 (1966) as for "specimens with narrower leaflets may connect the species with *C. nemophila* var. *zygophylla*."

Description

Leaflets 2 rarely 3 pairs, narrow elliptic, 20-50 mm x 2-10 mm; *indumentum* of sparse erect or appressed hairs; *petioles* terete 15-25 mm long. Plate 16e.

Distribution and ecology

Occurs in a variety of habitats from rocky hillsides to deep sand in inland Northern Territory, Queensland, New South Wales, and South Australia. Map 21, p. 238.

Notes

This taxon has thick cuticular wax under the hairs, but is never glaucous. It has previously been confused with *C. zygophylla* Benth., but the type of this (K, photo) has one pair of leaflets and shorter petioles, and represents a group which is usually glabrous.

Within the taxon variability is limited. However, some intergradation with other taxa has been observed. Intermediates with subsp. *filifolia* have narrower leaflets than most specimens (2-3 mm broad), and intermediates with subsp. *alicia* have leaflets with surfaces tending to be glaucous (see under subsp. *alicia*). In the latter case, an arbitrary separation is made on the length of the petiole, those with petioles longer than 15 mm being called subsp. *quadrifolia*. Intermediates with subsp. × *sturtii* may also occur, and these may usually be separated by the long petioles of subsp. *quadrifolia*.

The name derives from the usual occurrence of 4 leaflets per leaf.

Selection of specimens examined (c. 150 seen)

NORTHERN TERRITORY: 14 miles E MacDonald Downs, c. 175 km NE Alice Springs, *Cleland s.n.*, 24.viii.1930 (AD); Haast Ra., c. 210 km WNW Alice Springs, *Lothian 272*, 1954 (AD); Nawietooma Hstd, *Maconochie 47*, 4.iv.1967 (AD, DNA); Hamilton Downs rd , 20 miles NW Alice Springs, *Nelson 1719*, 8.viii.1968 (AD, DNA); 80 miles S Alice Springs near Finke R., *Driver M312*, 15.viii.1972 (AD, DNA); NW Simpson Desert, *Henry 974*, 30.ix.1973 (AD, CANB, DNA).

QUEENSLAND: Carnarvon, c. 65 km SSW Springsure, *Jordan s.n.*, -.viii.1953 (AD); 18 miles ESE Rolleston township, *Lazarides & Story 20*, 30.viii.1961 (AD, CANB); 11 miles E Comet township, *Lazarides & Story 135*, 12.ix.1961 (AD, CANB); 2.5 miles NW Mt Coolon township, *Adams 1107*, 17.vii.1964 (AD, CANB); Bedourie rd, 23 km N Birdsville, *Grandison 93*, 31.viii.1978 (AD).

SOUTH AUSTRALIA: Mt Eba, c. 50 km E Tarcoola, *Cleland s.n.*, 28.vi.1962 (AD); c. 40 km W Mabel Ck woolshed along Tallaringa Well track, *Lothian 2788*, 8.v.1964 (AD, DNA, MEL, NSW); c. 8 km E Frome Downs Stn, *Weber 2052*, 21.vii.1971 (AD, BRI, KRA, MEL, RSA, W, WRSL); 29 km SE Pedirka rail siding on track to Macumba Stn, *Lazarides 8270*, 5.v.1977 (AD, CANB); NNE Nent Oura Research Stn, 8 km ENE Mt Fitton ruin, *Mollenmans 1106*, 7.x.1981 (AD).

8.12 subsp. **glaucifolia** Randell, subsp. nov.

Subsp. quadrifoliae affinis sed foliolis pluribus (3-5-jugis) glabris ceraceis glaucis differt.

(Affinities with subsp. *quadrifolia* but leaflets more numerous (3-5 pairs), glabrous, waxy and glaucous.)

Holotype: Giles Settlement, in Rawlinson Range, c. 70 km W of Northern Territory Border, *R. Hill 1366*, 29.vii.1964, AD; *isotypes*: COLO, CHR.

Paratypes: 112 km N of Kumarina roadhouse, on Great Northern Hway to Newman, *Jackson 2903*, 17.viii.1977, AD, GEOT, GZU; East of Bonython Range, *Butler 159*, -.iv.1967, PERTH.

Description

Leaflets 2-4 pairs, elliptic, 10-26 mm x 3-8 mm, acute; *indumentum* of sparse soft and appressed hairs; *petioles* 10-15 mm long, terete. Plate 16d.

Distribution

Occurs in a wide range of habitats in central arid areas of Western Australia and Northern Territory. Map 22, p. 238.

Notes

This taxon in which cuticular wax is thick and always glaucous, was previously confused with *S. glutinosa* subsp. *glutinosa*, from which it differs in its lack of glutinous epidermis and its smaller flowers.

Specimens within this taxon show some variation e.g. in the length of leaflets. The type material has leaflets considerably longer than those of specimens from further west. The type material also has an open appearance due to the spreading character of the leaflets, which is less obvious in western material. However, the specimens are united by the acute elliptic leaflets, and the obvious glaucous nature of the surface. Some forms of subsp. × *coriacea* closely resemble subsp. *glaucifolia* in leaflet morphology. However, subsp. *glaucifolia* has not been recorded in hybrid populations, while subsp. × *coriacea* is known only from such hybrid swarms. In addition, these glaucous forms of subsp. × *coriacea* usually have leaflets obtuse at the apex, not acute as in subsp. *glaucifolia.*

Another problem involves the separation of subsp. *glaucifolia* and subsp. *symonii*, in which diploids occur in the Kimberley Ranges, while derived forms reach the Hamersley Ranges and may thus be almost sympatric with subsp. *glaucifolia*. Once again, the leaflet apex in subsp. *symonii* is usually rounded or obtuse, thus allowing separation from subsp. *glaucifolia*, and specimens of subsp. *symonii* usually have leaflets obovate in outline (see discussion under subsp. *symonii*).

Observations on population structure would clarify some remaining problems on the relationships between subspp. *glaucifolia*, *alicia*, and *quadrifolia*.

The name chosen reflects the conspicuous glaucous quality of the leaflets.

Selection of specimens examined (c. 50 seen)

WESTERN AUSTRALIA: Glenorn Stn, Malcolm, *Burbidge E174*, -.viii.1938 (PERTH); between Oakover R. and Canning Stock Route, *Casey s.n.*, 1954 (PERTH); 16 miles SW Nannine, *Speck 727*, 8.ix.1957 (AD, CANB); Giles area around settlement, *Hill 897*, 8.vii.1958 (AD, K, MEL); 14 miles S the W end Hopkins Lake, *Symon 2367*, 2.viii.1962 (AD); 27 miles W Wiluna, *Aplin 2438*, 22.viii.1963 (PERTH); Warburton, *de Graaf s.n.*, 22.x.1963 (PERTH); Blythe Ck c. 115 km NNW Warburton Mission, *Ashby s.n.*, 2-14.viii.1970 (AD); ; rocky hill c. 2 km N Leonora, *Weber 4769*, 19.ix.1975 (AD, KW); 50 km N Mingah Springs, *Mitchell 282*, 16.x.1976 (PERTH); 55 km E Meekatharra, on Wiluna Road, *Beauglehole 59389 and Erroy 3089*, 12.ix.1978 (PERTH); Teutonic Admin. Site, *Cumming 1390*, 20.ix.1981 (PERTH).

NORTHERN TERRITORY: 15 km W Angas Downs Stn, c. 230 km SW Alice Springs, *Schodde 462*, 1.ix.1957 (AD, CANB, K); road to Mulga Park Hstd, c. 120 km W Cavenagh Hstd, *Donner 4309*, 21.viii.1973 (AD, DNA, NSW).

8.13 subsp. **stricta** Randell, subsp. nov.

Subsp. × artemisioidi affinis sed foliolis linearibus glabris et ferrugineo-glaucis differt.

(Affinities with subsp. × *artemisioides* but leaflets linear, glabrous, and reddish glaucous.)

Holotype: Great Northern Highway, 22.5 km N of Roy Hill, Fortescue District, Western Australia, *Carr 4696 and Beauglehole 48474*, PERTH.

Description

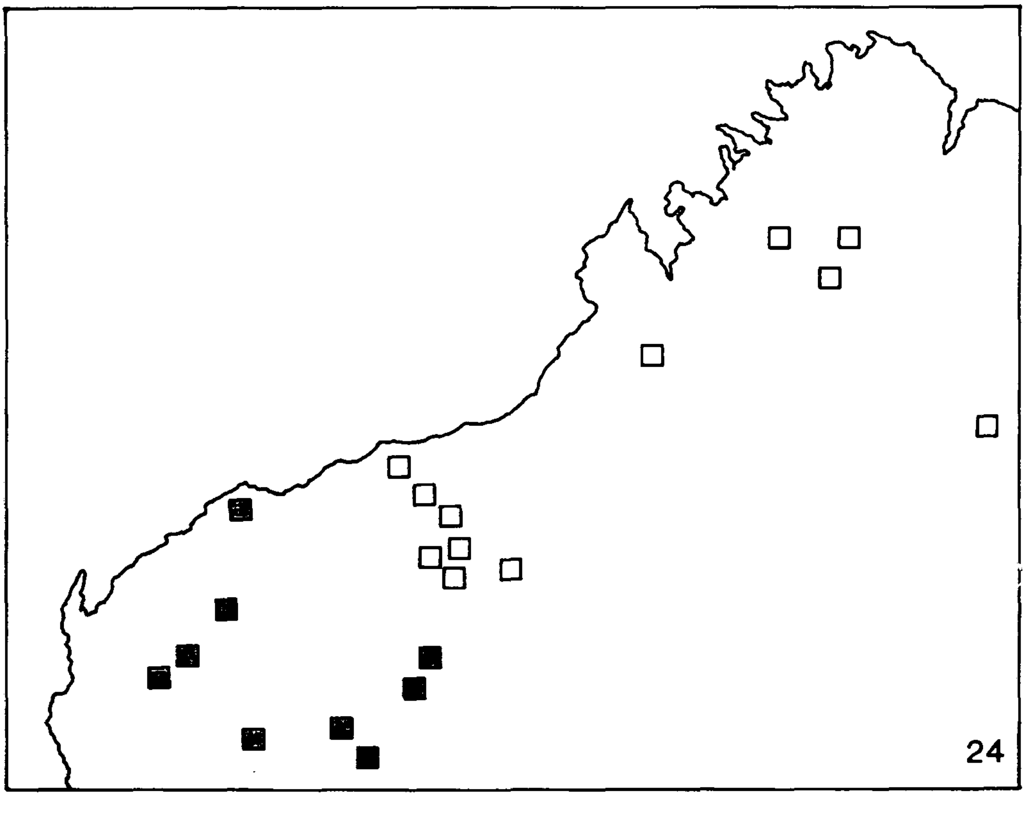
Leaflets 3-5 pairs elongate, linear, 10-25 mm x 1-2 mm, length always more than 15x breadth; *indumentum absent; petiole* 6-10 mm long. Plate 16c.

Distribution

Restricted to south western areas of Western Australia. Map 23, p. 238.

Notes

This taxon, with its thick glaucous reddish cuticular wax, was previously confused with *S. glutinosa* subsp. *chatelainiana*, but is obviously separated by its smaller flowers. Vegetatively it resembles *S. cardiosperma* subsp. *stowardii*, but this always has shorter petioles (1-5 mm long) and even smaller flowers.



Map 24. □ *S. artemisioides* subsp. *symonii*. ■ *S. artemisioides* subsp. *hamersleyensis*.

Selection of specimens examined (c. 100 seen)

WESTERN AUSTRALIA: 30 miles from Meekatharra, *Gardner & Blackall 221*, 18.vii.1931 (PERTH); Barlee Ra., Henry R., *Royce 6510*, 17.viii.1961 (PERTH); between Boolgeeda and Mt Turner, Ashburton, *Blockley 342*, 1.viii.1966 (PERTH); Gary Highway (between Gunbarrel Hway and Windy Corner), *Beard 4826*, 23.vii.1967 (PERTH); Beacon, *Kuhl s.n.*, -.x.1967 (PERTH); Mt Augustus Stn, *Wilcox 58*, -.viii.1969 (PERTH); Port Hedland area, *Stone A*, -.viii.1972 (PERTH); 3 km W Horrigan's Pool on Turrel Creek Stn, *Mitchell 76/70*, 19.vi.1976 (PERTH); 50 km N Ashburton Downs Hstd, *Mitchell 442*, 5.vii.1977 (PERTH); Wiluna - Meekatharra road, c. 10 km NE Killara Hstd turnoff, *Jackson 2888*, 16.viii.1977 (AD); Little Sandy Desert, *Mitchell 677*, 25.iv.1979 (DNA, PERTH); Puri Bardu Ck, Paraburdoo, *Boomsma 591*, 26.vi.1980 (AD); Newman area, *Walker 149*, 5.viii.1980 (PERTH).

8.14 subsp. **symonii** Randell, subsp. nov.

Subsp. hamersleyensi affinis sed petiolis brevioribus (3-8 mm longis), foliolis aggregatis (rhachide inter pares successiva foliolorum 1-8 mm longa) et pedunculis brevioribus (10-30 mm longis) differt.

(Affinities with subsp. *hamersleyensis* but petioles shorter (3-8 mm long), leaflets crowded (with rachis between successive pairs 1-8 mm long), and peduncles shorter (10-30 mm long)).

Holotype: Road to Mt House, by Precipice Range, King Leopold Range, (c. 300 km NE of Broome), B.A. Barlow 1227, 25.vi.1967, AD.

Description

Leaflets 2-3 pairs, obovate, 8-13 (-20) mm x 5-7 mm, apex obtuse or rounded; *indumentum* of sparse to dense soft and appressed hairs; *petioles* short, 3-8 mm long, leaflets crowded, 1-8 mm apart. Diploid n=14 (holotype), from Kimberley area (Randell 1970). Plate 16b.

Distribution

Restricted to upland areas of northwest Western Australia. Map 24.

Notes

In this taxon, the cuticular wax is thick and glaucous.

Forms from Hamersley Range have larger leaflets and may intergrade with subsp. *glaucifolia*, from which they are separated by the obtuse leaflet apex, shorter petiole and crowded leaflets of subsp. *symonii*. Population studies and cytological examinations are needed here to clarify these relationships.

Morphologically some specimens are almost identical with some forms of subsp. × *coriacea*, with which they are certainly not sympatric. Subsp. *symonii* is restricted to northern and western areas of Western Australia, while the corresponding forms of subsp. × *coriacea* occur in hybrid populations on Eyre Peninsula of South Australia.

The name commemorates Mr D.E. Symon, who last revised the group in Australia in 1966.

Specimens examined

WESTERN AUSTRALIA: Base of Mt Brennan, *Fitzgerald 1188*, -.vi.1905 (PERTH); Nullagine Road, S of Mt Edgar Stn, *Burbidge 1164*, 12.vi.1941 (PERTH); Warralong Siding, Marble Bar, *Burbidge 1226*, 20.vi.1941 (PERTH); c. 41 km from Roebourne turnoff on Wittenoom Road, at head of gorge, *Ashby 4170*, 5.viii.1971 (AD, ODU); 4 km E Fitzroy R., c. 178 km WNW Halls Creek, *Beauglehole 53754*, 25.vi.1976 (PERTH); Edgar Ranges, *Kenneally 5542*, 9.viii.1976 (PERTH); Fig Tree Soak, 10 km SW into Yampire Gorge from Wittenoom, Roy Hill road, *Jackson 2914*, 18.viii.1977 (AD, TAI, TI); 22.1 km from Shay Gap on the Goldsworthy road, *Chinnock 3857*, 2.ix.1977 (AD, BAB); gravelly creeks, Bee Hill Mine area, *Davis 69*, 1.vi.1979 (PERTH); plains near Paraburdoo, *Boomsma 558*, 21.vi.1980 (AD); 270 km NE Port Hedland, *Conrick 1037*, 13.viii.1982 (AD).

8.15 subsp. **hamersleyensis** (Symon) Randell, comb. nov.

Basionym: *Cassia hamersleyensis* Symon, *Trans. Roy. Soc. S. Australia* 90: 108 (1966); Beard, *Descr. Cat. Western Austral. Pl.* 62 (1970).

Holotype: The flood plain of Wild Duck Creek, between Brockman and Mt Pyrton in the Hamersley Ranges, W.A., *M.M. Cole 5019*, 1963, PERTH!; *isotype*: K.

Description

Leaflets 2-4 pairs, oval to obovate, 5-12 mm x 4-12 mm; *indumentum* sparse, of soft appressed hairs; *petioles* 3-6 mm long. Plate 16a.

Distribution

Very restricted in central Western Australia. Map 24.

Notes

In this taxon, which is apparently always low-growing, cuticular was is glaucous and in thick sheets, while peduncles (to 90 mm long), are consistently longer than leaves.

Specimens examined are morphologically very uniform, suggesting that this could well be a relict diploid taxon.

Specimens examined

WESTERN AUSTRALIA: Marra-Mamba to Duck Ck, Hamersley Ra., *Blockley 284*, 23.vi.1966 (PERTH); Mt Augustus, *Wilcox s.n.*, 7.vii.1970 (PERTH); near Mulgul, *Ashby 3352*, 8.ix.1970 (AD, PERTH); Karratha, near Dampier, *Jurat s.n.*, -.vi.1974 (PERTH); 60 km N Mt Vernon Hstd, Upper Ashburton, *Mitchell 250*, -.xi.1976 (PERTH); 100 km S Newman along Great Northern Hway, *Mitchell 342*, 31.v.1977 (PERTH); 40 km NE Ashburton Downs Hstd, *Mitchell 441*, 5.vii.1977 (PERTH); Newman Area, *Walker 119*, 31.vii.1980 (PERTH); Mordabia paddock, Towers Stn, *Cranfield 1795*, 6.viii.1981 (PERTH); Salt Windmill paddock, Towers Stn, *Cranfield 1810*, 7.viii.1981 (PERTH).

9. **S. cardiosperma** (F. Muell.) Randell, comb. nov.

Basionym: *Cassia cardiosperma* F. Muell., *Fragm.* 10: 50 (1876); Beard, *Descr. Cat. Western Austral. Pl. edn* 2, 62 (1970).

Holotype: In eremo virgultosa inter Victoria Spring & Ularing, W.A., *Young s.n.*, 7-9.x.1875, MEL! (photo).

The above basionym applies to both the species and the type subspecies. Synonyms are listed under the subspecies to which they apply.

Description

Low to medium shrub, or rarely small tree, 0.4-2 m tall; *leaflets* (2-) 6-14 pairs, variable in form and indumentum, crowded (less than 5 mm apart), less than 15 mm long, all equal or decreasing in size from the base of the rachis; *glands* sessile or stalked, flat, cylindrical or pointed; *petiole* short, 1-5 mm long; *inflorescence* a subumbellate raceme near the end of branches; *bracts* usually caducous at anthesis; *sepals* oval, 3-5 mm long, greenish yellow; *petals* oval, 4-6 (-8) mm long, usually glabrous; *anthers* 10, 2-3 mm long; *filaments* subequal, 7 adaxial 1 mm long, 3 abaxial 2 mm long; *ovary* 4-6 mm long, glabrous or hairy; *pod* 3-5 cm x 6-8 mm, straight or curved, glabrous or hairy; *seeds* oval, dark, c. 4 mm long. Plates 17, 18.

Distribution

A species widespread in arid areas of southern Western Australia, southern Northern Territory, and South Australia.

Notes

S. cardiosperma differs from the other members of this series in the smaller, generally more numerous and crowded leaflets, and in the smaller flowers. Apparently it has not been as successful as has *S. artemisioides* as a high proportion of its included taxa are known only from a few collections, and very few appear to be involved in hybridization. This may be the result of either less efficient adaptation leading to restricted distribution and few sympatric contacts, or some reproductive isolation still operative when the forms are sympatric (e.g. subspp. *cardiosperma* and *stowardii*). In most cases, geographic distribution would seem to be the important factor.

Key to the subspecies of *S. cardiosperma*

1. Leaflets terete or linear and tightly recurved:
    2. Leaflets 3-4 pairs, sparsely hairy .... 8. subsp. *manicula*
    2. Leaflets 8-10 pairs, densely woolly-hairy .... 7. subsp. *microphylla*
1. Leaflets horizontally flattened:
    3. Leaflets densely hairy below, glabrous above .... 3. subsp. *cuthbertsonii*
    3. Leaflets not as above:
        4. Leaves 3-5 cm long; leaflets ovate 10-13 pairs .... 4. subsp. *flexuosa*
        4. Leaves shorter:
            5. Leaflets spathulate, 5-6 pairs .... 2. subsp. *pilocarina*
            5. Leaflets not as above:
                6. Leaflets obovate, 7-10 pairs .... 5. subsp. *gawlerensis*
                6. Leaflets linear to elliptic:
                    7. Leaflets 5-14 pairs; flowers 3-5 per peduncle .... 6. subsp. *stowardii*
                    7. Leaflets 2-4 pairs; flowers 2-3 per peduncle .... 1. subsp. *cardiosperma*

9.1 subsp. **cardiosperma**

Basionym and holotype: as for the species.

Description

Leaflets 2-4 pairs, linear to obovate, 8-15 mm x 1-3 mm; *indumentum* sparse or almost absent, of soft appressed hairs; *cuticular wax* thick and opaque, glaucous; *glands* sessile, elongate and pointed. Plate 17a-k.

Distribution and ecology

Occurs on rocky hillsides, in restricted areas around Kalgoorlie, Western Australia. Map 25.

Specimens examined

WESTERN AUSTRALIA: Goongarrie, *Maiden s.n.*, -.ix.1909 (AD); Laverton, *Maiden s.n.*, -.ix.1909 (AD); nr Laverton, *Hamilton Fisher s.n.*, -.vi.1922 (PERTH); Glenorn Stn, *Burbidge s.n.*, -.viii.1938 (PERTH); between Menzies and Comet Vale, *Blackall 4179*, -.ix.1939 (PERTH); between Leonora and Menzies, *Blackall 4141*, -.ix.1939 (PERTH); Laverton, *Gardner and Blackall 3951*, 9.viii.1951 (PERTH); 5 miles S Menzies, *Green 1673*, 30.viii.1957 (PERTH); 8 miles S Menzies, *George 2717*, 21.viii.1961 (PERTH); 8 miles SW Coolgardie, *Beard 3398*, 28.v.1964 (PERTH); SW Coolgardie, *Davies 488*, -.ix.1964 (PERTH); Lord Bobs road, S Coolgardie, *Bale 284*, -.viii.1965 (PERTH); 24 miles N Perrin Vale Stn, *Symon 5470*, 5.viii.1967 (AD); 45 km E Edjudina Hstd, *Wilson 7566*, 1.ix.1968 (AD, PERTH); 9 miles SW Coolgardie, *Phillips s.n.*, 6.ix.1968 (AD); Cosmo Newberry, *Demarz 7273*, 20.xi.1978 (PERTH); 15 km S Laverton toward Mt Weld, *Randell 315*, 14.iv.1986 (AD).

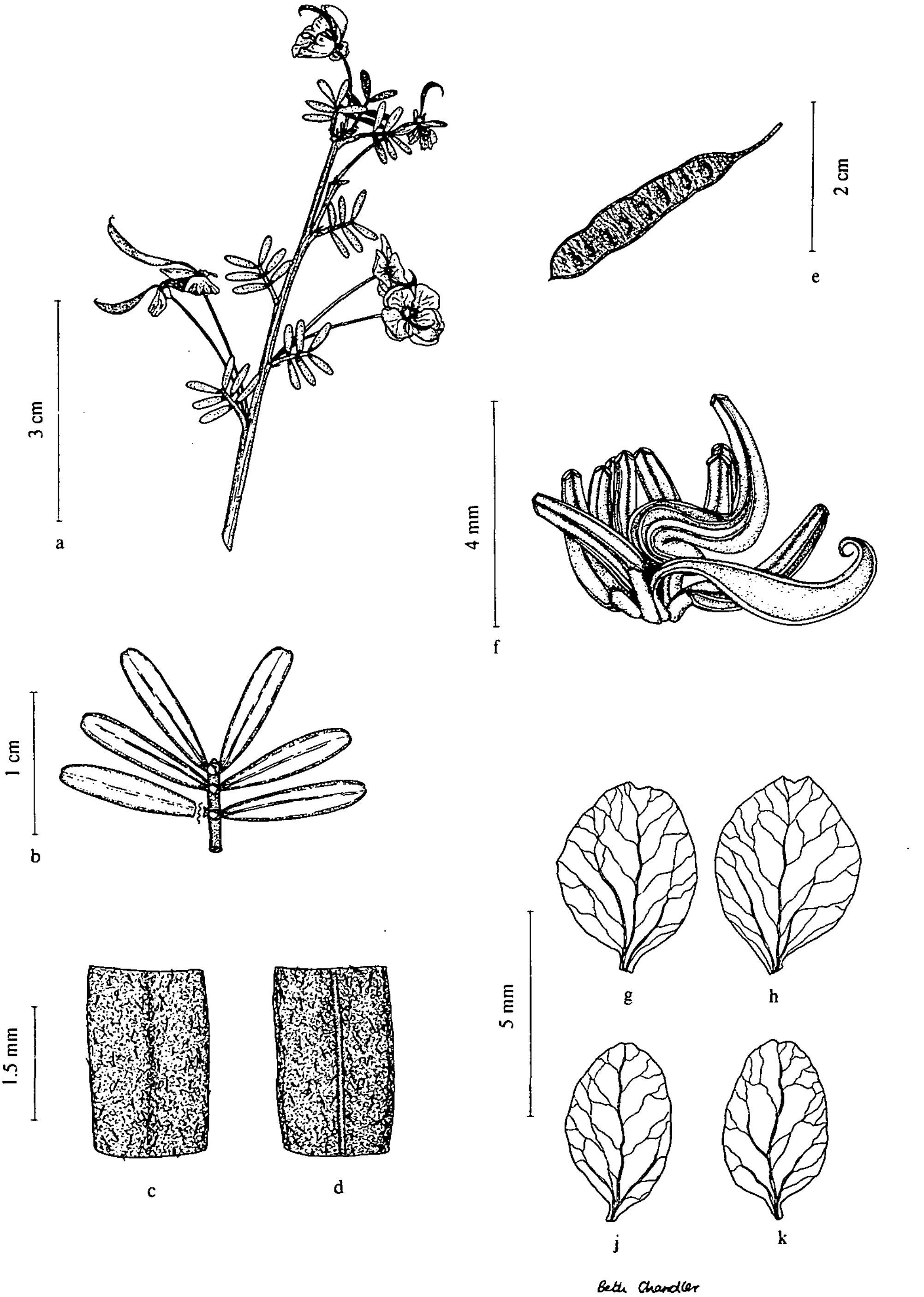


Plate 17. *S. cardiosperma* subsp. *cardiosperma*. a. habit, b. leaf detail, c. leaflet abaxial epidermis, d. leaflet adaxial epidermis, all from *Green 1673*; e. pod, from *Cummings 1673*; f. anther group, g. largest petal adaxial surface, h. largest petal abaxial surface, j. smallest petal adaxial surface, k. smallest petal abaxial surface, all from *Gardner & Blackall 395*.

9.2 subsp. **pilocarina** (Symon) Randell, comb. nov.

Basionym: *Cassia pilocarina* Symon, *Trans. Roy. Soc. S. Australia* 90: 109 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2, 62 (1970) as *C. pilocasina*; Erickson et al., *Fl. & Pl. Western Australia* 210 (1979).

Holotype: South Barlee Range, W.A.; *A. Robinson s.n.*, 7.ix.1959, PERTH! (photo).

Description

Leaflets 5-6 pairs, spathulate, flat or concave, 8-12 mm x 1-3 mm; *indumentum* sparse, of stiff erect hairs; *cuticular wax* thick; *glands* sessile, but elongate and pointed. Plate 18f.

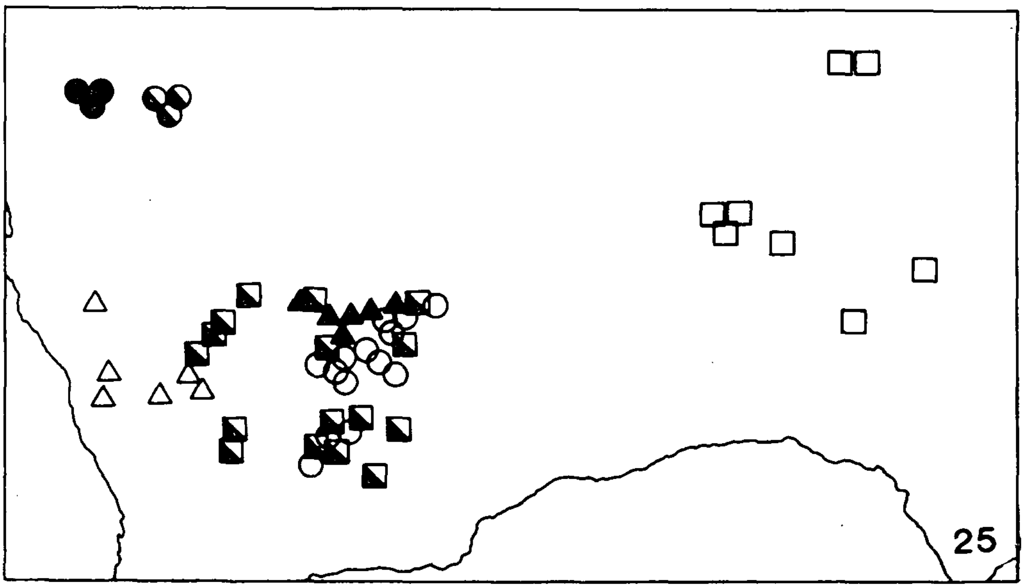
Distribution

Very restricted in distribution in northwest of Western Australia. Map 25, Map 247.

Specimens examined

WESTERN AUSTRALIA: Ullawarra Stn, *Royce 6477*, 16.viii.1961 (PERTH); Wanna, *Beard 6066*, 20.viii.1970 (PERTH); Ullawarra Stn, *Mitchell 586*, 7.vi.1978 (PERTH); Amelia Stn, *Mitchell 595*, 12.vi.1978 (PERTH).

[N.B. The specimen Barlee Ra., *Royce 6590*, 19.viii.1961 (PERTH), cited by Symon (1966) has not been seen and has apparently been mislaid.]



Map 25. ○ *S. cardiosperma* subsp. *cardiosperma*; ● *S. cardiosperma* subsp. *pilocarina*; ◐ *S. cardiosperma* subsp. *cuthbertsonii*; △ *S. cardiosperma* subsp. *flexuosa*; ◪ *S. cardiosperma* subsp. *stowardii*; □ *S. cardiosperma* subsp. *microphylla*; ▲ *S. cardiosperma* subsp. *manicula*.

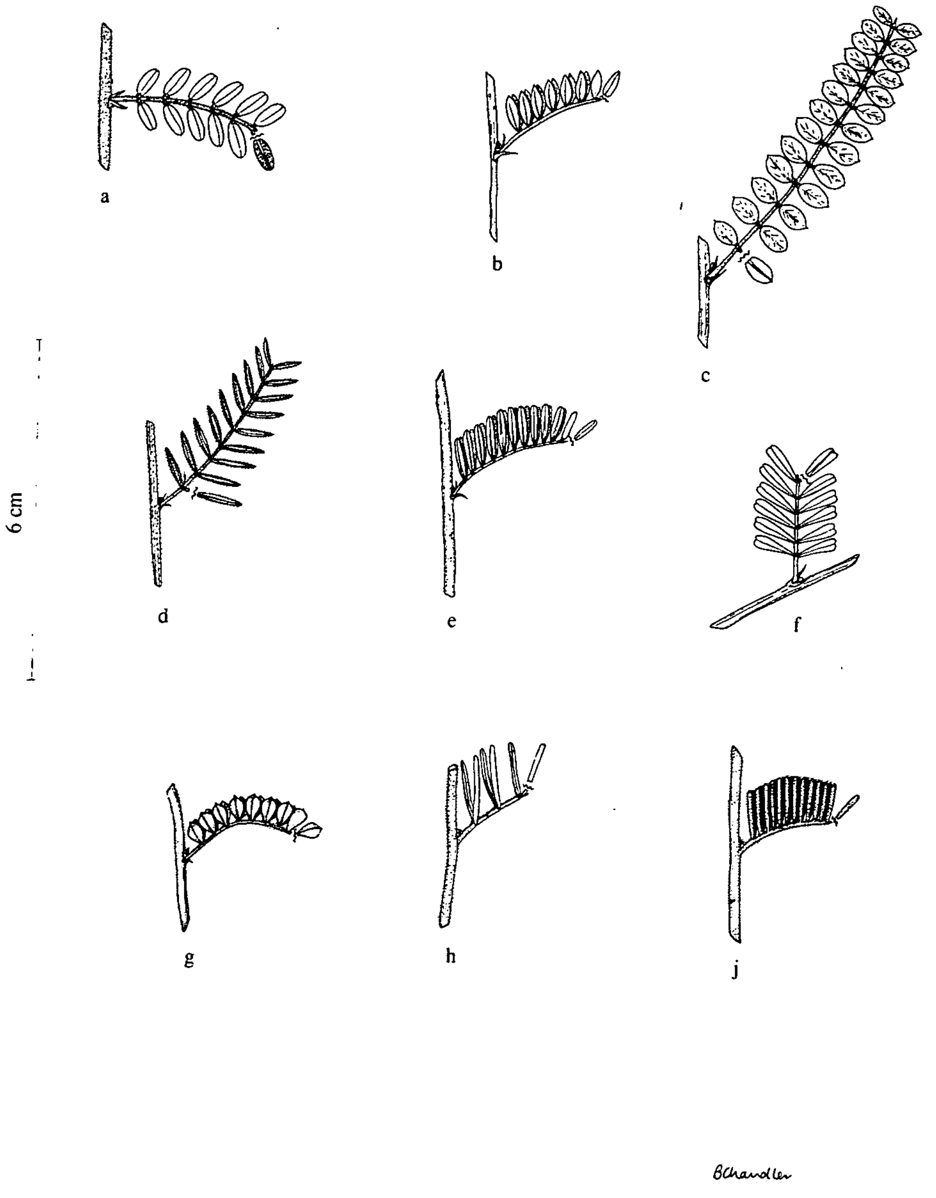


Plate 18. *S. cardiosperma* subspecies. Leaf structure. a. subsp. *cuthbertsonii*, *Mitchell 242*; b. subsp. *stowardii*, *Wilson 7435*; c. subsp. *flexuosa*, *Mason s.n.*, -.xi.1959; d. subsp. *stowardii*, *Symon 5472*; e. subsp. *stowardii*, *Beard 6480*; f. subsp. *pilocarina*, *Beard 6066*; g. subsp. *gawlerensis*, *Williams 9417*; h. subsp. *manicula*, *Wittwer 1326*; j. subsp. *microphylla*, *Helms s.n.*, 30.vi.1881, (all with one leaflet reversed).

9.3 subsp. **cuthbertsonii** (F. Muell.) Randell, comb. nov.

Basionym: *Cassia cuthbertsonii* F. Muell., *Victorian Nat.* 5: 75 (1888); Symon, *Trans. Roy. Soc. S. Australia* 90: 110 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2: 62 (1970).

Lectotype: on the Upper Ashburton River, Western Australia, *W. Cuthbertson s.n.*, 1888, MEL!, lectotype here designated; *isolectotype*: K (photo).

Description

Leaflets 5-9 pairs, elliptic to obovate, 6-11 mm x 3-6 mm; *indumentum* absent on adaxial surface, of dense woolly hairs on the abaxial surface; *cuticular wax* thick, reddish glaucous on adaxial surface; *glands* sessile, elongate and pointed. Plate 18a.

Distribution

Known from the type, and several further collections also on the Ashburton R., northwest of Western Australia. Map 25, p. 247.

Notes

Both ovaries and mature pods are densely pubescent in this taxon. A single collection from 20 km NW of Prairie Downs Hstd, Upper Ashburton (*Mitchell 325*, 26.iv.1977, PERTH), differs in having dense indumentum on both surfaces of the leaflets.

Specimens examined:

WESTERN AUSTRALIA: Teeaila R. area, *Setter 425*, 12.x.1973 (AD); 4 miles NNW Woolgatharra Pool, Mt Augustus Stn, *Setter s.n.*, 13.x.1973 (AD); 50 km N Mulgul Stn, *Mitchell 76/194*, 30.vi.1976 (PERTH); 50 km N Mulgul Stn, *Mitchell 242*, 22.ix.1976 (PERTH).

9.4. subsp. **flexuosa** Randell, subsp. nov.

Subsp. cuthbertsonio affinis sed foliolis pluribus (10-13-jugis) et pilis in paginis abaxialibus sparsis differt.

(Affinities with subsp. *cuthbertsonii* but leaflets more numerous (10-13 pairs), and hairs sparse on abaxial surface).

Holotype: Jibberding W.A., *C.A. Gardner 12095*, 7.ix.1953, PERTH!.

Description

Leaflets 10-13 pairs, oval to ovate, 4-10 mm x 2-4 mm; *indumentum* sparse, of stiff and erect, or soft and appressed hairs; *cuticular wax* in thick sheets; *glands* 1-2, flat and sessile. Plate 18c.

Distribution

Very restricted distribution in subcoastal areas of southern Western Australia. Map 25, p. 247.

Notes

Little variation observed except in type of hairs. However, this subspecies is somewhat different from other subspecies within *S. cardiosperma*, in the larger flowers (petals 7-10 mm long), and longer petioles (3-8 mm long). Thus, subsp. *flexuosa* is in some respects intermediate between *S. cardiosperma* and *S. artemisioides*.

Specimens examined

WESTERN AUSTRALIA: Carnamah, Victoria District, *Morrison 16356*, 30.x.1906 K (photo); 13 km N of Carnamah, *Chapman s.n.*, s.d. (PERTH); Wannana [sic], *Mason 12283*, -.11.1959 (PERTH); Edah Stn, *Malcolm s.n.*, 21.x.1964 (PERTH); track to Mt Churchman, *Demarz 5393*, 5.ii.1974 (PERTH); 8 km N Yuin Stn, *Mitchell 925*, -.ii.1981 (PERTH).

9.5 subsp. **gawlerensis Randell, subsp. nov.**

Subsp. microphyllae affinis sed foliolis obovatis, non teretibus et sparsim pubescentibus differt.

(Affinities with subsp. *microphylla*, but leaflets obovate not terete, and sparsely pubescent.)

Holotype: Yandoolka Well, c. 10 km W of Lake Everard Hstd, *V. Jaegermann 147*, 29.ix.1972, AD.

Paratypes: i) c. 19 km NE of Port Augusta; *Randell 226/435*; *226/425*; *226/480*, 11.x.1967, all AD; ii) c. 3 km W of Nonning Hstd, *Randell 162/3*, 8.x.1966, AD.

Description

Leaflets 7-10 pairs, obovate, 3-6 mm x 2-4 mm; *indumentum* sparse, of soft appressed hairs; *cuticular wax* in thick sheets, glaucous; *glands* single, inconspicuous. Diploid n=14, triploid n=42/2, tetraploid n=28, all scattered on Eyre Peninsular, S.A. (Randell 1970). Plate 18g.

Distribution and ecology

Occurs in a variety of habitats from rocky hillsides to sand. Currently restricted to Eyre Peninsular and north western South Australia, but hybrid swarms suggest that it may have been removed from the Flinders Ranges since European settlement. Map 26.

Notes

Little variation observed within the taxon. However, many hybrid swarms are seen linking subsp. *gawlerensis* with subspp. *filifolia*, *petiolaris* and × *artemisioides*, and including subsp. × *coriacea* among the intermediates. The following arbitrary decisions separate the subspecies.

Leaflets terete:

Petioles >15 mm long .... subsp. *filifolia*

Petioles <15 mm long .... subsp. × *artemisioides*

Leaflets flattened:

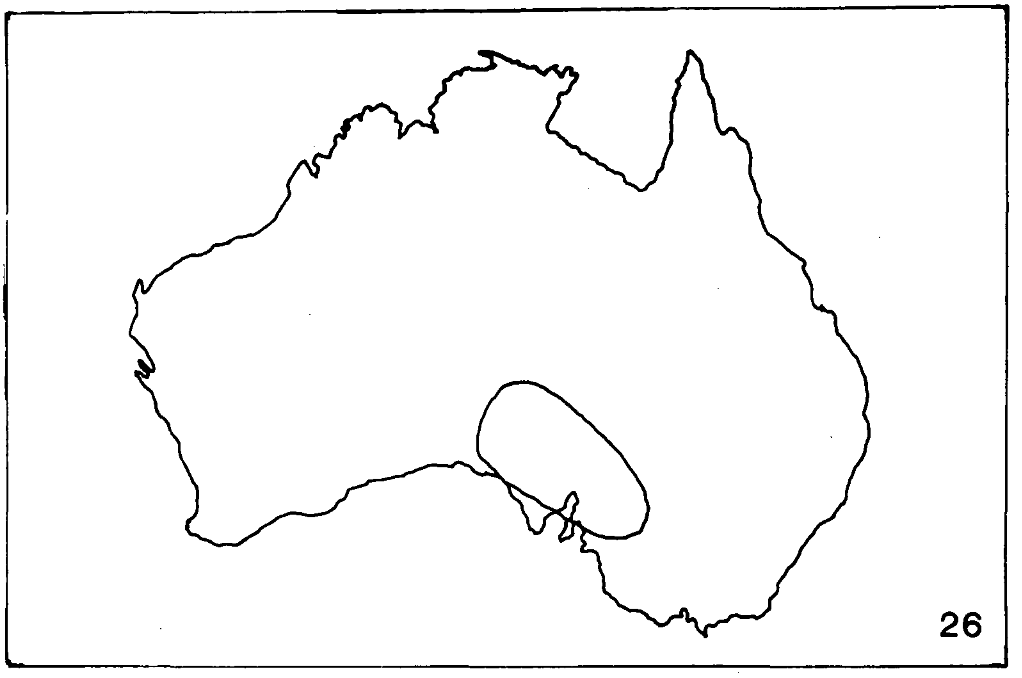
Petioles >6 mm long; leaf rachis straight .... subsp. × *coriacea*

Petioles <5 mm long; leaf rachis recurved .... subsp. *gawlerensis*

The following fruiting specimen seems to be related to subsp. *gawlerensis*, but could even be another subspecies of *S. cardiosperma* not recognised here. However, flowering material is needed to establish with certainty that it is *Senna*. Top of Mt Woodroffe, *E.C. Black s.n.*, 18.iv.1950, 2 sheets, (AD).

Selection of specimens examined (c. 100 seen)

SOUTH AUSTRALIA: 16 miles W Mabel Ck Hstd, *Forde 314*, 23.viii.1956 (AD, CANB); roadside, base of Middleback Ra., 45 km WSW Whyalla, *Whibley 263*, 2.x.1958 (AD, M, TI, UC); on Peterlumba and near Buckleboo Stn, c. 50 km NW Kimba, *Rohrlach 414*, 15.viii.1959 (AD, B, BM); c. 35 km N Watson, near Maralinga, *Wilson 1740*, 18.ix.1960 (AD, BM, G, K, P); c. 22 km E Ooldea, *Wilson 1838*, 24.ix.1960 (AD, IA); 22 mi W McDouall Pk Stn, *Symon 1076*, 5.xii.1960 (AD); Mabel Ck, *S.A. Pastoral Board, s.n.*, 23.ix.1966 (AD); c. 70 km E Yardea Hstd, *Copley 2106*, 31.viii.1968 (AD); c. 16 km SE Kokatha Stn, between Lakes Gairdner and Everard, *Spooner 188*, -.ix.1968 (AD); c. 5 km S Wheehole Bore, Lake Everard Stn, *Spooner 2427*, 4.ix.1972 (AD); c. 10 km N Emu, *Brooks 28*, 16.ix.1972 (AD, NY, OSHKOSH); c. 19 km E Emu, *Brooks 31*, 18.ix.1972 (AD, RSA, SYD); along vermin fence, 15 km WNW Kondoolka Hstd, *Weber 3150*, 25.x.1972 (AD); Canopus Stn, c. 95 km N Renmark, *Mrs P. Foreman 31*, 25.iii.1978 (AD); Mt Finke road, *Bates 208*, -.viii.1978 (AD, DNA); 3 km S Dingo Flat gate, Commonwealth Hill Stn, *Sinclair & Bird 9*, -.iv.1981 (AD).



Map 26. *S. cardiosperma* subsp. *gawlerensis*.

9.6 subsp. **stowardii** (S. Moore) Randell, comb. nov.
Basionym: *Cassia stowardii* S. Moore, *J. Linn. Soc. London* 55: 171 (1920).
Holotype: Mt Marshall, W.A., *F. Stoward 386*, 1916, BM (photo).

Description

Leaflets (5-) 9-14 pairs, linear, obtuse, (4-) 6-10 mm x 1-4 mm; *indumentum* sparse, of soft appressed hairs; *cuticular wax* in sheets; *glands* sessile and pointed, rarely elongate. Plate 18b,d,e.

Distribution and ecology

Restricted to erosional faces of breakaways north and northwest of Kalgoorlie, Western Australia. Map 25, p. 247.

Notes

Resembles *S. cardiosperma* subsp. *cardiosperma* in small flowers and small crowded leaflets, but differs in having more leaflets (5-14 pairs) and more flowers per peduncle (3-5). Vegetatively it resembles *S. artemisioides* subsp. *stricta* in the elongate leaflets which dry with a reddish glaucous appearance, but differs in the small flowers (petals 4-6 mm long), the short petioles (1-4 mm long) and the crowded appearance of the leaflets.

Selection of specimens examined (c. 30 seen)

WESTERN AUSTRALIA: Fraser Ra., E Norsemann, *Helms s.n.*, 21.x.1891 (AD); Southern Cross, *Maiden s.n.*, -.x.1909 (AD); Coolgardie, *Gardner 841*, 2.x.1920 (PERTH); Calooli, *Brockway 56*, 13.x.1939 (PERTH); Woolgangie, *Cough 138B*, 19.ix.1963 (PERTH); 16 km N Kalgoorlie on old Menzies road, *Symon 5473*, 6.vii.1967 (AD); Cundeelee, *Boswell R78*, 1967 (PERTH); Von Truer tableland, *Wilson 7435*, 28.viii.1968 (PERTH); Walyahmoning Rock, *Baynes Museum 68*, -.x.1972 (PERTH); Teutonic exploration site, *Cumming 1246*, 16.viii.1981 (PERTH); 20 km S Windimurra Hstd, *Mitchell 1019*, 16.viii.1982 (AD); Granite Peak Stn, *Mitchell s.n.*, 22.vi.1985 (AD); roadside 5 km S Leonora, *Randell 305*, 13.iv.1986 (AD); 11.4 km E Laverton on old Warburton road, *Randell 313*, 14.iv.1986 (AD); 10 km N Laverton on new Leonora road, *Randell 314*, 14.iv.1986 (AD); 15 km S Laverton on Mt Weld Road, *Randell 315*, 14.iv.1986 (AD); 33.4 km N Leonora on Wiluna road, *Randell 317*, 15.iv.1986 (AD); 16.9 km NE Leonora on Mertondale road, *Randell 325*, 15.iv.1986 (AD); 5 km W Yuinmery Hstd on Youanmi road, *Randell 326*, 16.iv.1986 (AD); 47.1 km SW Paynes Find on slopes of Mt Singleton, *Randell 328*, 17.iv.1986 (AD).

9.7 subsp. **microphylla** Randell, subsp. nov.

Subsp. maniculae affinis sed foliolis pluribus (8-10-jugis), brevioribus et indumento densolanato tectis differt.

(Affinities with subsp. *manicula* but leaflets more numerous (8-10 pairs), shorter, and with densely woolly tomentum.)

Holotype: Far North-West, Head of Arckaringa Creek, Elder Exploring Expedition, Camp 12, *R. Helms s.n.*, 30.vi.1891, AD; *isotypes* AD!, NSW!

Paratype: c. 80 km SE of Mt Lindsay, *R.B. Major 10*, 1966, AD.

Description

Leaflets 8-10 pairs, terete, 8-12 mm long, 1 mm diameter; *indumentum* of densely woolly hairs; *cuticular wax* not obvious; *glands* inconspicuous. Plate 18j.

Distribution

Restricted to the far NW of South Australia, and S of N.T. Map 25, p. 247.

Notes

Herbarium specimens from NW of South Australia show the existence of a range of specimens linking subsp. *microphylla* with subsp. × *artemisioides* which is assumed to be of hybrid derivation from this parent. An arbitrary separation can be made on the length of petioles and distance between leaflets.

Petiole <5 mm long, leaflets crowded .... subsp. *microphylla*

Petiole >6 mm long, leaflets >6 mm apart .... subsp. × *artemisioides*

Another series of specimens from the same geographic area suggests intergradation with specimens of subsp. × *coriacea* and subsp. *gawlerensis*, which both have broad leaflets. Again the separation can be made on the basis of petiole length and leaflet morphology.

Leaflets terete, petiole <5 mm long .... subsp. *microphylla*

Leaflets flat, petiole <5 mm long .... subsp. *gawlerensis*

Leaflets flat, petiole >6 mm long .... subsp. × *coriacea*

Population studies would test the hypothesis of the derivation of subsp. × *artemisioides* from subsp. *microphylla* as parent.

Specimens examined

NORTHERN TERRITORY: Glen Helen, MacDonnell Ranges, *Cleland s.n.*, 18.viii.1929 (AD); Palm Valley, *Cleland s.n.*, 31.viii.1956 (AD); Palm Valley, *Hill & Lothian 937*, 15.vii.1958 (AD, DNA, K).

SOUTH AUSTRALIA: Victoria Desert, Camp 54, *Helms s.n.*, 17.ix.1891 (MEL); Mt Willoughby, c. 130 km SW Oodnadatta, *Ising s.n.*, 1.viii.1951 (AD); c. 95 km E Tallaringa Well, *Donner 3844*, 13.vii.1972 (AD, G, TI, Z); c. 16 km NE Moolalpinna Hill, c. 5 km ESE Ampeinna Hills, *Barker 2863/2*, 26.viii.1978 (AD, LUN, M, MO); eastern slopes Mt Lindsay inselberg, *Whibley 6565*, 31.viii.1978 (AD).

9.8 subsp. **manicula** (Symon) Randell, comb. nov.

Basionym: *Cassia manicula* Symon, *Trans. Roy. Soc. S. Australia* 90: 119 (1966); Beard, *Descr. Cat. West Austral. Pl. edn* 2, 62 (1970).

Holotype: Diorite King, Western Australia, *S. Davies s.n.*, 11.vii.1960, PERTH! (photo).

Description

Leaflets 3-4 pairs, linear but edges tightly recurved, 6-10 mm long, 1 mm diameter; *indumentum* sparse, of soft appressed hairs; *cuticular wax* thick, not glaucous; *glands* inconspicuous. Plate 15h.

Distribution and ecology

Restricted to rocky hillsides around Kalgoorlie, Western Australia. Map 25, p. 247.

Notes

Little variability observed. Some forms have thinner wax and fewer hairs, and thus appear greener than the type. Population studies show no evidence of hybridization, and suggest the differences in appearance are due to genetic variability within subsp. *manicula* itself.

Specimens examined

WESTERN AUSTRALIA: Lake Barlee, *Forrest s.n.*, 1869 (MEL); Lawlers, *Cleland s.n.*, 1914 (AD); Mt Fouracre, NW Leonora, *Gardner & Blackall 341*, 25.vii.1931 (PERTH); 10 miles from Leonora towards Laverton, *Blackall 368*, 6.viii.1931 (PERTH); 13 miles N Leonora, *Davies s.n.*, 11.vii.1960 (PERTH); Old Telegraph Line, 17.5 miles W Hammersley R., *George 7101*, 31.x.1965 (PERTH); 6 miles E Caiguna, *Aplin & Trudgen 5838*, -.vi.1974 (CANB, PERTH); 62 miles N Leonora, *Wittwer W1326*, 9.viii.1974 (PERTH); Teutonic exploration camp, *Cumming 1219*, 12.viii.1981 (PERTH); Wilson's Ck, 3 km W Teutonic, *Cumming 1247*, 16.viii.1981 (PERTH); 2 km N Leonora, *Randell 307*, 13.iv.1986 (AD); 29.8 km E Malcolm, *Randell 312*, 14.iv.1986 (AD).

c. ser. *Oligocladae*

c. **Senna** Miller [sect. *Psilorhegma* (J. Vogel) Irwin and Barneby] ser. **Oligocladae** Randell, ser. nov.

Folioli 1-3-juga; semina impolita; legumina brevia, paginae interiora valvis sine porcis.

(Leaflets 1-3 pairs; seeds dull; pods short, interior surface of valves without ridges.)

Type species: *S.oligoclada* (F. Muell.) Randell

Synonyms

1. *Cassia* [subgen. *Senna* (Miller) Benth. sect. *Psilorhegma* (J. Vogel) Benth.] ser. *Interglandulosae* Benth., *Trans. Linn. Soc. London* 27: 554 (1871), p.p., as for *C. leptoclada* and *C. goniodes*.

2. *Cassia [subgen. Senna* (Miller) Benth. sect. *Psilorhegma* (J. Vogel) Benth.] ser. *Subverrucosae* Benth., *Trans. Linn. Soc. London* 27: 556 (1871), p.p., as for *C. oligoclada* and *C. leptoclada*.

Description

Low shrubs or perennial herbs, sometimes with a persistent underground rootstock; *leaves 20-80 mm long; leaflets* 1-3 pairs, elliptic to ovate, pubescent or glabrous, not obviously sclerophyllous; *glands* sessile or stalked; *petals* 4-14 mm long; *pods* short, curved, crenate, glabrous or pubescent; *seeds* oval, dark, dull.

Distribution and ecology

Restricted to far north and northwest of the Northern Territory and Western Australia. Occupies a range of habitats from deep desert sand, to swampy grassland, or dry sclerophyll forests.

Key to the species of ser. *Oligocladae*

1. Pedicels 1-2 mm long; petals 4-6 mm long .... 15. *S. curvistyla*
1. Pedicels >2 mm long; petals >7 mm long:
    2. Petals 7-10 mm long; plant ± pubescent:
        3. Stipules cordate, pubescent, persistent .... 16. *S. cladophylla*
        3. Stipules acicular, caducous:
            4. Peduncles bearing 8-10 flowers; leaflets broad lanceolate .... 13. *S. heptanthera*
            4. Peduncles bearing 2-5 flowers; leaflets narrow to broad elliptic:
                5. Peduncles with (2-) 3-5 flowers; petioles 8-15 mm long .... 10. *S. oligoclada*
                5. Peduncles with 2-3 flowers; petioles 4-10 mm long .... *S. goniodes*
    2. Petals 11 mm or longer; plant glabrous:
        6. Peduncles with 2-3 flowers .... 12. *S. leptoclada*
        6. Peduncles with 5-8 flowers .... 14. *S. procumbens*

10. **S. oligoclada** (F. Muell.) Randell, comb. nov.

Basionym: *Cassia oligoclada* F. Muell., *Fragm.* 3: 49 (1862); Bailey, *Fl. Queensland* 2: 462 (1900); Ewart & Davies, *Fl. Northern Territory* 134 (1917); Symon, *Trans. Roy. Soc. S. Australia* 90: 106 (1966); Beard, *Descr. Cat. Western Austral. Pl. edn* 2: 62 (1970); Symon in Jessop, *Fl. Central Australia* 109 (1981).

Lectotype: 'In locis arenoso-rupestribus secus ripus ostium Victoriae versus nec nor ad rivum Sturt's Creek. *F. Mueller s.n.*', K, mixed sheet of four fragments (photo), large central twig, lectotype here designated, [Note: the left fragment on the type sheet is probably *S. curvistyla* (J. Black) Randell, the two fragments on the right are *S. cladophylla* (W. Fitzg.) Randell]; *isolectotypes*: a) MEL! fragmentary (photo); b) K mixed sheet with *R. Brown 4252*, (*S. oligoclada*) (photo).

Syntype: 'prope Attack Creek, N.T., *J. McD. Stuart, 1862*' MEL ! (photo).

[*Note*: Symon (1966) mistakenly listed 3 syntype localities for the basionym, as he assumed that 'Victoria River' and 'Sturts Creek' referred to two different collections. However, the protologue, using the wording given here, definitely gives only two localities.]

Synonyms

1. *C. oligoclada* F. Muell. var. *gracilis* Benth., *Fl. Austral.* 2: 289 (1864).

Holotype: Attack Creek, *J. McD. Stuart*, 1862, MEL! (photo).

2. *C. neurophylla* C.T. White & W.D. Francis, *Proc. Roy. Soc. Queensland* 37: 156 (1926).

Lectotype: Sandstone Ranges, Settlement Creek, Queensland, *L. Brass 274*, -.ii.1923, BRI! (photo), lectotype here designated; *isolectotype*: K, 2 sheets (photos).

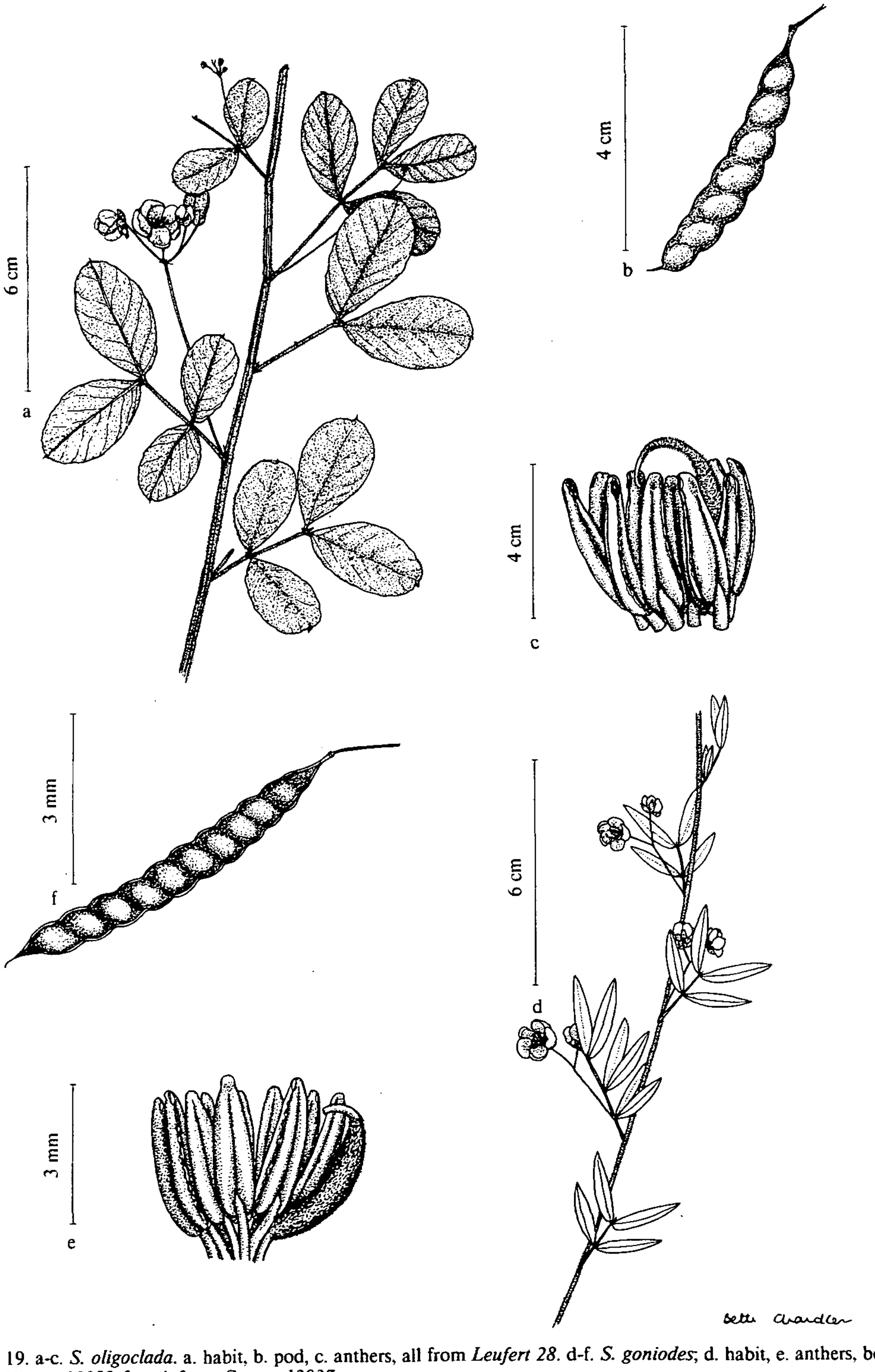


Plate 19. a-c. *S. oligoclada*. a. habit, b. pod, c. anthers, all from *Leufert 28*. d-f. *S. goniodes*; d. habit, e. anthers, both from *Wilson 11292*; f. pod, from *George 12837*.

Description

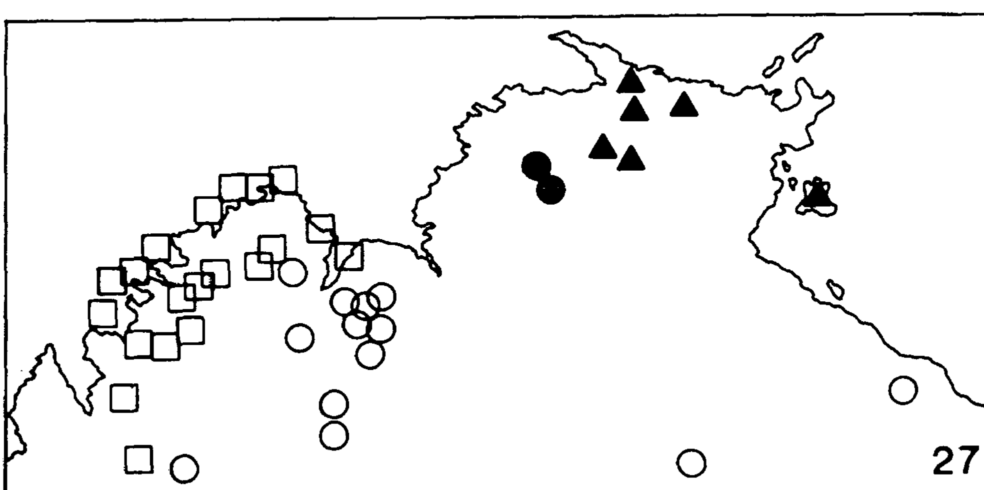
Shrub 1-3 m high, pilose on all vegetative parts; *leaves* 3-6 cm long including petioles; *leaflets* 1-3 pairs, elliptic to oblong to obovate, 10-15 mm apart on the rachis, the largest 20-35 mm x 8-15 mm, increasing in size from the base of the rachis, apex rounded obtuse or acute, mucronate, base unequal cuneate, pilose, veins obscure above, prominent below, epidermal wax sometimes conspicuous; *glands* sessile erect; *stipules* acicular, usually caducous; *petiole* terete 8-15 mm long; *inflorescences* scattered along the branches, (2-) 3-5 flowered; *peduncles* 30-50 mm long; bracts *caducous at anthesis; pedicels* of open flowers 12-18 mm long; *sepals* obovate, shorter than petals, pubescent; *petals* obovate, 8-10 mm long, yellow, glabrous; *anthers* 10, usually all fertile, subequal, truncate; *filaments* subequal; *ovary* pilose; *pod* short 30-50 mm x 10 mm, curved, crenate, pilose; *seeds* 6-8, transverse, not as long as pod is wide. Plate 19a-c.

Distribution and ecology

Perhaps associated with sandy watercourses in far north west of Western Australia. Distribution is not coastal (contrasting with *S. goniodes*). Map 27, p. 256.

Notes

Closely related to *S. goniodes* from which it differs in the number of flowers on the peduncle, and in the generally broader, more rounded leaflets.



Map 27. ○ *S. oligoclada;* □ *S. goniodes;* ▲ *S. leptoclada;* ● *S. procumbens.*

Specimens examined

WESTERN AUSTRALIA: Roebuck Bay, *Tepper 287*, -.i.1890 (MEL, PERTH); Denham R., *Fitzgerald 1634*, -.x.1906 (NSW); Leonard R., Kimberleys, *Edwards s.n.*, -.iii.1922 (PERTH); Drysdale Mission, Napier Broome Bay, *Gardner 938*, s.d. (PERTH); Ord R., *Durack s.n.*, -.iv-v.1945 (PERTH); Deception Ra., E. Kimberley, *Langfield 355 and 357*, 1.xii.1954 (both PERTH); Cockatoo Sands, E Kimberley, *Langfield 369*, 27.ii.1955 (PERTH); St Georges Ra., *Gardner 12403*, 4.v.1960 (PERTH); Kununurra, *Leufert 28*, 15.xii.1967 (PERTH); Argyll Stn, *Black 56*, 26.ii.1972 (PERTH); W Argyll Downs Stn, *Aplin s.n.*, 21.v.1973 (PERTH); Broiga Falls, Drysdale R. Natl Park, *Kenneally 3047*, 4.viii.1975 (PERTH); the Grotto, 30 km SSE Wyndham, *Beauglehole 54040*, 29.vi.1976 (PERTH); Kimberlite Pipe Gap, SW Lake Argyle, *Weston 12317*, 6.v.1980 (PERTH).

NORTHERN TERRITORY: 16 miles W El Sharana, Pine Creek road, *Mertensz & Schodde AE 480*, 22.i.1973 (AD).

11. **S. goniodes** (A. Cunn. ex Benth.) Randell, comb. nov.

Basionym: *Cassia goniodes* A. Cunn. ex Benth. in Hook., *Icones plant. ser.* 3, 1: 48, t. 1061 (1870); *Trans. Linn. Soc. London* 27: 554 (1871).

Lectotype: Usbornes Harbour, voyage of the Beagle 1837-38, *A. Cunningham s.n.*, K, lectotype here designated (photo).

Syntypes: 1. Greville Is., Regent R., voyage of Bathurst, *Cunningham 225*, 1821-22, K (on sheet with lectotype) (photo), BM (photo). 2. York Sound, voyage of the Mermaid, *Cunningham 210*, 1820, K (on sheet with lectotype) (photo), BM, (photo).

Synonyms

1. *Cassia oligoclada* sensu F. Muell., *Fragm.* 10: 9 (1876), p.p., as for *C. goniodes* A. Cunn. ex Benth.; Symon, *Trans. Roy. Soc. S. Australia* 90: 106 (1966), p.p., as for *C. goniodes* A. Cunn. ex Benth.

2. *C. neurophylla* W. Fitzg. *J. Proc. Roy. Soc. Western Australia* 3: 147 (1918).

Holotype: Edkins Ra., hills near Barker R., Western Australia, *Fitzgerald s.n.*, 1905, NSW (photo). There is also in BRI a sheet of two twigs collected 'Artesian Range Kimberley', *Fitzgerald s.n.*, May 1905, determined as *C. neurophylla* W. Fitzg., which is probably part of the type collection.

3. *C. oligoclada* var. *goniodes* (A. Cunn. ex Benth.) Domin, *Biblioth. Bot.* 89: 796 (1926).

4. *C. oligoclada* var. *subsinguliflora* Domin, *Biblioth. Bot.* 89: 796 (1926).

Holotype: between the Ashburton and De Grey Rivers, W.A., *E. Clement s.n.*, not seen, cited doubtfully by Symon (1966) as K. Placed here because of the description "foliola acuta vel subacuta, flores solitarii vel interdum bini".

Description

Shrub to 1 m tall, with all vegetative parts pilose with pale hairs; *leaves* 3-5 cm long, including petiole 4-10 mm long; *leaflets* 2-3 pairs, narrow elliptic to elliptic, 8-15 mm apart on the rachis, the largest 20-40 mm x 8-12 mm, increasing in size from the base of the rachis, apex acute mucronate, base acute somewhat unequal, midrib obscure above, prominent below, epidermis sometimes waxy; *glands* sessile erect; *stipules* acicular usually caducous; *petioles* terete; *inflorescence* cymose, axillary, along the branches, bearing 2(3) flowers; *peduncles* (20-) 30-50 mm long; *bracts* caducous; *pedicel* 10-15 mm long; *sepals* subequal, shorter than petals; *petals* glabrous, 8-10 mm long including the claw; *anthers* 10, all fertile, subequal, on stout subequal filaments; *ovary* pilose; *pods* short 30-50 mm x 8-10 mm, curved, usually crenate, pilose; *seeds* 4-8, flat, lying transversely, shorter than pod is wide. Plate 19d-f.

Distribution and ecology

Distribution may be related to watercourses in coastal areas of far northwest Western Australia. Map 27, p. 256.

Notes

S. goniodes differs from *S. oligoclada* in having consistently fewer flowers per peduncle (2-3, where *S. oligoclada* has 3-5), and in having narrow elliptic, acute tipped leaflets. However, some specimens of *S. oligoclada* also have narrow acute leaflets, making identification difficult in the absence of floral material. The taxon may be better treated as a subspecies of *S. oligoclada*.

Specimens examined

WESTERN AUSTRALIA: Prince Regents R., *Gardner 877* or *1377*, 14.vi.1921 (PERTH); Isdell R., 10 miles from mouth, *Davis s.n.*, 26.viii.1943 (PERTH); Prince Regents R., *Gardner 9640*, 14.vii.1950 (PERTH); Nerrima Stn, *Beard 4216*, 25.v.1965 (PERTH); Augustus Is., Bonaparte Archipelago, *Wilson 10851*, 18.v.1972 (MEL, PERTH); Champagny Is., Bonaparte Archipelago, *Wilson s.n.*, 27.v.1972 (PERTH); 20 km S Kimberley Downs Hstd, *Aplin 5072*, 18.vi.1972 (CANB, PERTH); Sir Graham Moore Is., *Wilson 11190*, 30.vi.1973 (PERTH); Cape Anjo, *Wilson 11292*, 2.vii.1973 (PERTH); Wood Is. Nth, *Wilson 11536*, 13.vii.1973 (PERTH); Gariyeli Creek, Prince Regent R. Reserve, *George 12837*, 30.viii.1974 (CANB, PERTH); SE Cape Londonderry, *George 13368*, 5.viii.1975 (CANB, PERTH); Drysdale R., above Mogurnda Creek, *George 13450*, 6.viii.1975 (PERTH); Mogurnda Creek, near Drysdale R., *George 13587*, 9.viii.1975 (PERTH); Mitchell R. Plateau, c. 200 km W Wyndham, *Beauglehole 51928*, 2.vi.1976 (PERTH); Cone Hill, Cape Domett, *Hartley 14745*, 22.iii.1978 (PERTH); headwaters, Helby R., *Hartley 14817*, 27.iii.1978 (DNA, PERTH).

12. S. **leptoclada** (Benth.) Randell, comb. nov.

Basionym: *Cassia leptoclada* Benth., *Fl. Austral.* 2: 290 (1864); Bailey, *Fl. Queensland* 2: 462 (1900); Ewart & Davies, *Fl. Northern Territory* 135 (1917); *Symon, Trans. Roy. Soc. S. Australia* 90: 105 (1966).

Lectotype: Carpentaria Islands, *R. Brown 4254*, 21.i.1803, (No. 22 Descr.), BM (photo), lectotype here chosen; *isolectotypes*: K and E (Symon 1966), MEL !

Description

Shrub 1-3 m high with slender sometimes drooping branches, and greenish-yellow bark; whole plant apparently glabrous; *leaves* 3-7 cm long including petiole 10-25 mm; *leaflets* (1-) 2 (-3) pairs, broad elliptic to oval, 10-20 mm apart on the rachis, largest 15-30 mm x 8-20 mm, increasing in size from the base of the rachis, apex rounded to obtuse, not mucronate, base obtuse to cuneate, somewhat unequal, epidermis without conspicuous wax, sometimes discolourous, midrib obscure above, conspicuous below; *glands* sessile, erect and conical, between all leaflet pairs; *inflorescences* axillary along branches, 2 or 3 flowered; *peduncles* 5-15 mm long; *bracts* caducous at anthesis; *pedicels* 10-20 mm long; *sepals* shorter than petals; *petals* glabrous, 11-14 mm long; *stamens* 10, all fertile, subequal, subequal filaments; *ovary* glabrous; *pod* short, 10-50 mm x 10 mm, straight, crenate, light brown; *seeds* (2-) 6-8, transverse, shorter than the pod is broad. Plate 20a-c.

Distribution

Very restricted distribution in Arnhemland, Northern Territory, perhaps associated with limestone. Map 27, p. 256.

Note

Bentham first described this taxon from restricted material. Further collections indicate that both peduncles and pods can be longer than stated in his description. The taxon has obvious affinities with *C. oligoclada*.

Specimens examined

NORTHERN TERRITORY: near Western Creek, Borroloola, *Hill 754*, 15.ii.1912 (AD, DNA, MEL); Arnhem Land, *Basedow 60a*, -.-.1928 (AD); 15 miles SE Mt Basedow, *Lazarides 7977*, 3.iii.1973 (AD); c. 9.5 miles SW Mt Gulruth, *Lazarides 8010*, 4.iii.1973 (PERTH); WNW Nabalek, *Dunlop 4970*, 10.vii.1978 (AD, BRI, CANB, DNA, K); site 73, Kakadu Natl Park, *Lazarides 9071*, 29.v.1980 (AD, DNA); site 92, Kakadu Natl Park, *Craven 6266*, 2.vi.1980 (CANB, MEL); 2 km S Muralidbar Creek crossing on Gerfelli-Maninguda [sic] road, *Henshall 3831*, 17.x.1981 (AD, CANB, DNA); 6 km S Mt Gilruth, Arnhem Land, *Wightman & Craven 1344*, 26.iii.1984 (AD, BRI, CANB, DNA, K, L, MEL, PERTH)

QUEENSLAND: NE Mt Isa, *Beauglehole 55094*, 17.vii.1976 (MEL).

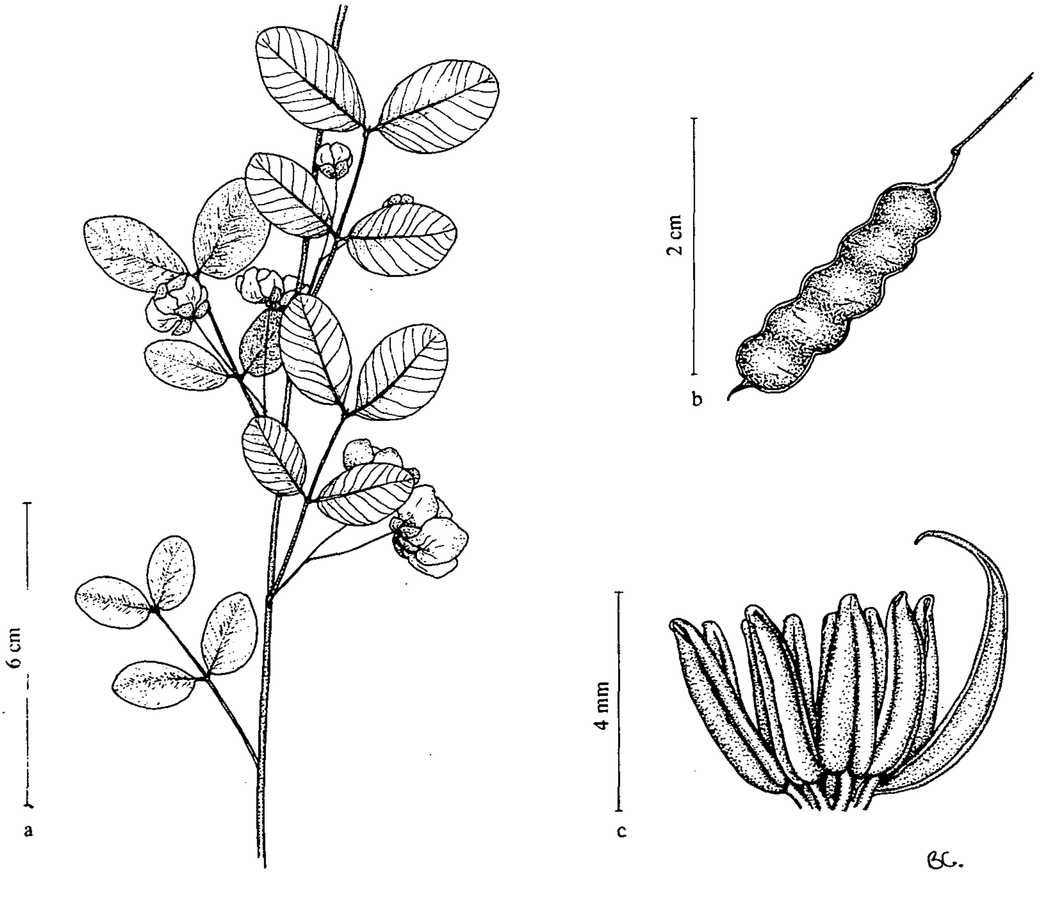


Plate 20. *S. leptoclada*. a. habit, b. pod, both from *Wightman 1344*; c. anthers from *Lazarides 9071*.

13. **S. heptanthera** (F. Muell.) Randell, comb. nov.

Basionym: *Cassia heptanthera* F. Muell., *Fragm.* 10: 8 (1876).

Lectotype: Liverpool R. [N.T.], *B. Gulliver*, qui plantum sub itinere Cadelli legit, MEL!, lectotype here designated; *isolectotype*: K (photo).

Synonym

C. oligoclada sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 106 (1966), p.p., as for *C. heptanthera* F. Muell.

Description

Creeping perennial; stems, petioles, peduncles, and stipules all with dense erect pale hairs; *leaves* to 60 mm long, including the petiole; *leaflets* 1-2 pairs, broad lanceolate to ovate, to 20 mm apart on the rachis, the largest 20-50 mm x 20-40 mm, slighty decreasing in size from the base of the rachis, apex obtuse and mucronate, base very unequal, glabrous above but pilose on the lower veins and ciliolate on the margins, veins conspicuous below; *gland* single, sessile, erect and pointed; *stipules* caducous; *petiole* terete, to 15 mm long; *inflorescence* near end of branches, bearing 8-10 flowers; *peduncle* 30-40 mm long; *pedicel* to 15 mm long; *sepals* subequal, to 5 mm long, brownish, pubescent dorsally, ciliolate; *petals* obovate, subequal, to 10 mm long, yellow, glabrous; *stamens* 7 (3 adaxial missing), all fertile, to 4 mm long, lanceolate, truncate, the 6 laterals with filaments 1 mm long, the single abaxial with filament 2 mm long; *ovary* 5 mm long, densely pilose with short curved and naked style; *immature pod* flat, pubescent, 25 mm x 6 mm; *ovules* 5 or 6; *fruiting pedicel* 18 mm long, becoming more robust; *seed* not seen. Plate 21a-d.

Distribution

Very restricted distribution in northern Arnhemland, Northern Territory.

Specimens examined

NORTHERN TERRITORY: 26 miles NNE Oenpelli Mission, *Lazarides 7729*, 16.ii.1973 (AD, BRI); 22 km NE Oenpelli Mission, *Adams 2995*, 17.ii.1973 (AD); Nabarlek, *Rankin 2226*, 23.iv.1979 (DNA); Workshop road, Murganella, *Wightman 1062*, 8.ii.1984 (DNA); Murganella camp, *Smith 2018*, 11.iii.1987 (DNA).

14. **S. procumbens** Randell, sp. nov.

S. heptanthera affinis sed antheris 10 et foliolis angustis ellipticis differt.

(Affinities with *S. heptanthera* but anthers 10 and leaflets narrow elliptic.)

Holotype: 10 miles N Pine Creek, N.T., *N. Byrnes 1321*, 30.i.1969, AD.

Paratypes: (i) 147 miles S Darwin, *George 6510*, 4.iv.1965, PERTH; (ii) Lloyd Creek, Stuart Hway, N.T., *Byrnes 1800*, 5.v.1970, AD, NT; (iii) 8 miles N Pine Creek, N.T., Byrnes 2035, 21.i.1971, AD.

Description

Prostrate herb or shrublet, whole plant apparently glabrous except for a few hairs on young petioles and peduncles; *leaves* 5-8 cm long, including petiole; *leaflets* 2-3 pairs, stiff, narrow-elliptic or lanceolate, 8-12 mm apart on the rachis, the largest 4-5 cm x 10-15 mm, almost equal on each leaf, apex obtuse mucronate, base unequal, veins obscure above, prominent below, cuticular wax not obvious; *foliar glands* replaced by glandular hairs; *stipules* acicular, persistent, 6 mm x 2 mm; *petiole* 10-12 mm long, with wings to 2 mm broad at the base; *inflorescences* subumbellate, 5-8-flowered, near the end of branches; *peduncles* 3-6 cm long;

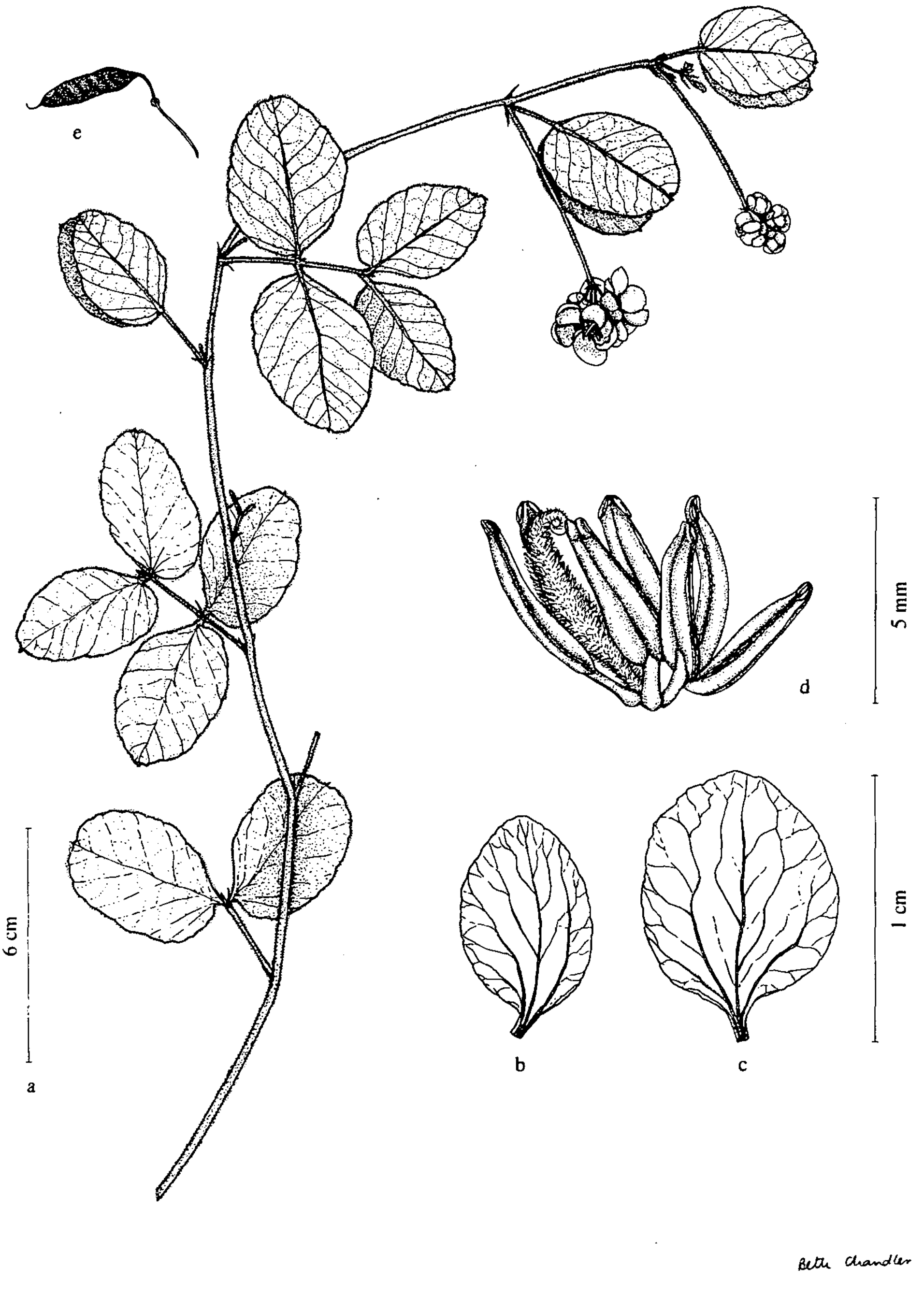


Plate 21. *S. heptanthera.* a. habit, b. smallest petal, c. largest petal, d. anthers, e. immature pod, all from *Lazarides 7729.*

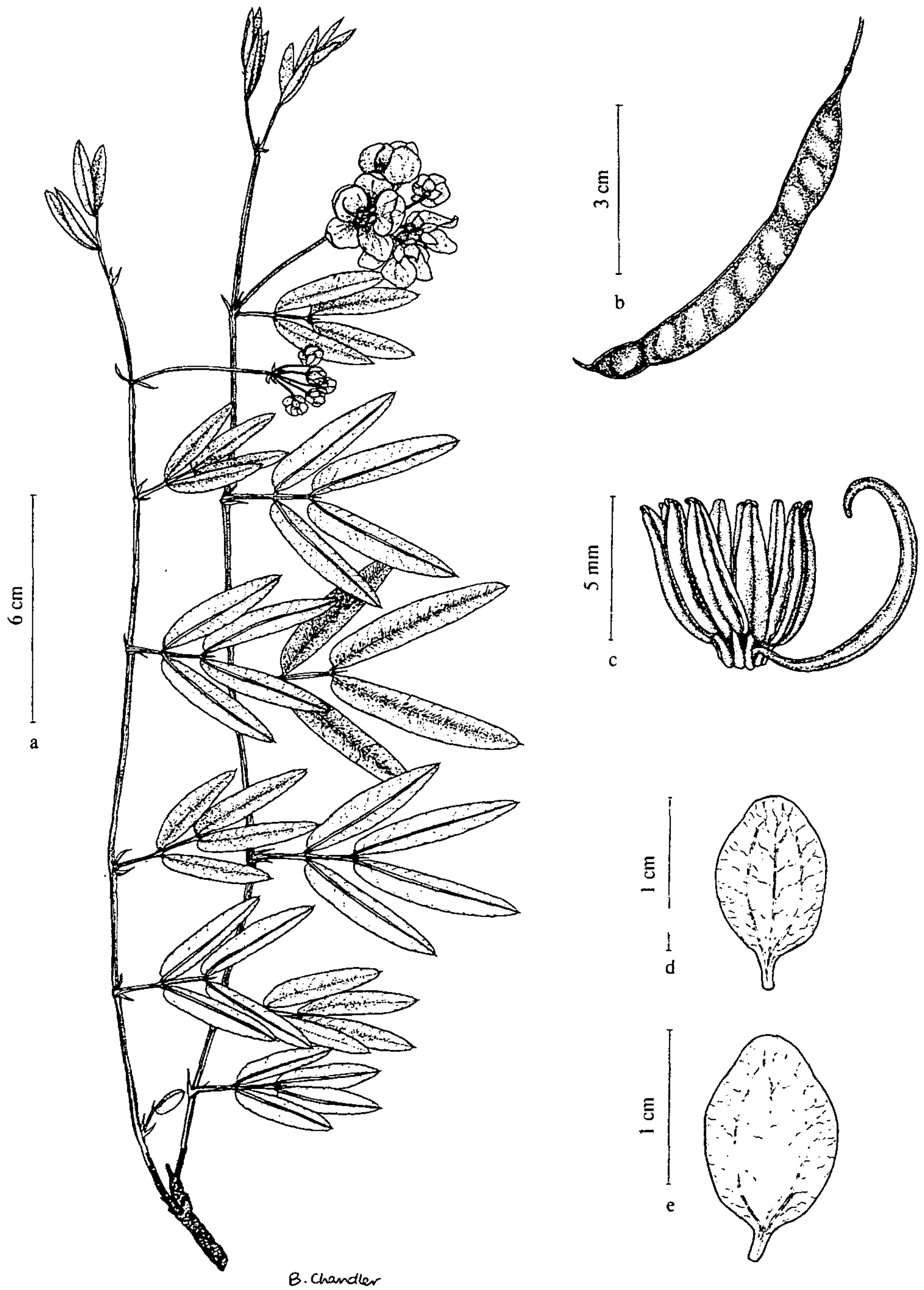


Plate 22. *S. procumbens*. a. habit, b. pod, c. anthers, d. smallest petal, e. largest petal, all from *Byrnes 1321*.

bracts sub-persistent, falling after anthesis; *pedicels* 15-20 mm long; *sepals* shorter than petals; *petals* glabrous, 11-13 mm long; *anthers* 10, all fertile, on subequal filaments; *ovary* glabrous; *pod* 50-70 mm x 8 mm, dark, straight or slightly curved, edges not crenate; *ovules* 7-10, transverse; *seeds* not seen. Plate 22a-e.

Distribution and ecology

Growing among tall grasses in swamps or open mixed forest in very restricted areas of Northern Territory. Map 27, p. 256.

Notes

Known only from the 4 specimens cited above. The prostrate habit is unique in Australian *Senna*. N. Byrnes suggests (pers. comm.) that it may regenerate from a lignotuber.

15. **S. curvistyla** (J. Black) Randell, comb. nov.

Basionym: *Cassia curvistyla* J. Black, *Trans. Roy. Soc. S. Australia* 62: 354 (1938).

Lectotype: West of Mt Davenport, N.T., *Ben Nicker 1938*, AD!, lectotype here designated.

Syntype: Twenty miles S of Granites, N.T., *Cleland s.n.*, -.viii.1936, AD!; *isosyntypes*: K (photo), MEL!

Synonym

Cassia oligoclada sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 106 (1966), as for *C. curvistyla* J. Black.

Description

Small shrubs 10-30 cm tall, all vegetative parts pilose with pale erect hairs; *leaves* 20-30 mm long including petiole 3-6 mm long; *leaflets* 2-3 pairs, narrow-elliptic to elliptic, 4-10 mm apart on the rachis, the largest 5-15 mm x 3-5 mm, increasing in size from the base of the rachis, apex obtuse and without mucro, base rounded, slightly unequal, midvein obscure above, prominent below, cuticular wax not conspicuous; *glands* stalked; *stipules* acicular, persistent; *inflorescence* axillary, along stems, 2-flowered; *peduncles* 10-20 mm long; *bracts* usually caducous; *pedicels* very short, 2 mm long; *sepals* shorter than petals; *petals* glabrous, 4 mm long; *stamens* 10, all fertile, subequal filaments; *ovary* pilose; *pods* 20-25 mm x 10 mm, flat, straight, not crenate, with persistent style; *seeds* 2-4, transverse, shorter than pod is broad. Plate 23a-e.

Distribution and ecology

Occurs on deep red desert sand. Rootstock often enlarged just below ground level, probably allowing quick regeneration after fire. Map 28, p. 265.

Notes

Resembles *S. cardiosperma* in the short petioles and small flowers, but differs in the leaflets which increase in size from the base of the petiole.

There is in K the lectotype sheet for *S. oligoclada* (F. Muell.) Randell, on which appears a fragment of *S. curvistyla*, with the locality given as 'Upper Victoria River'.

Specimens examined

WESTERN AUSTRALIA: 19 miles N Sandy Creek, No 1 Rabbit Fence, *Royce 1679*, 15.v.1947 (PERTH); 20 miles N Sandy Creek, No 1 Rabbit Fence, *Royce 1682*, 15.v.1947 (PERTH); 7 miles W Mt Beadell, Gibson Desert, *George 5396*, 25.vii.1963 (PERTH); Sahara Track, 60 miles E Telegraph Line, *George 9160*, 1.viii.1967 (CANB, K, PERTH); Upper Rudall R., *George 10821*, 23.v.1971 (CANB, K, PERTH); Tanami Track, Great Sandy Desert, 2 km W of N.T. border, *Beauglehole 50994*, 21.v.1976 (PERTH); Edgar Ranges, *Kenneally 5642*, 13.viii.1976 (PERTH); *Kenneally 5613*, 12.viii.1976 (PERTH); 82 km ESE Telegraph Line, *George 14820*, 13.viii.1977 (CANB, DNA, K, PERTH).

NORTHERN TERRITORY: 30 miles SSW Wavehill Stn, *Perry 2208*, 21.vi.1949 (PERTH); 17 miles NE Lake Mackay, *Chippendale 3412*, 17.vi.1957 (DNA, PERTH); Campbell Ra., *Latz 2081*, 17.i.1972 (DNA, PERTH); Stuart Hway, 100 km S Elliott, *Conrick 1171*, 28.viii.1982 (AD).

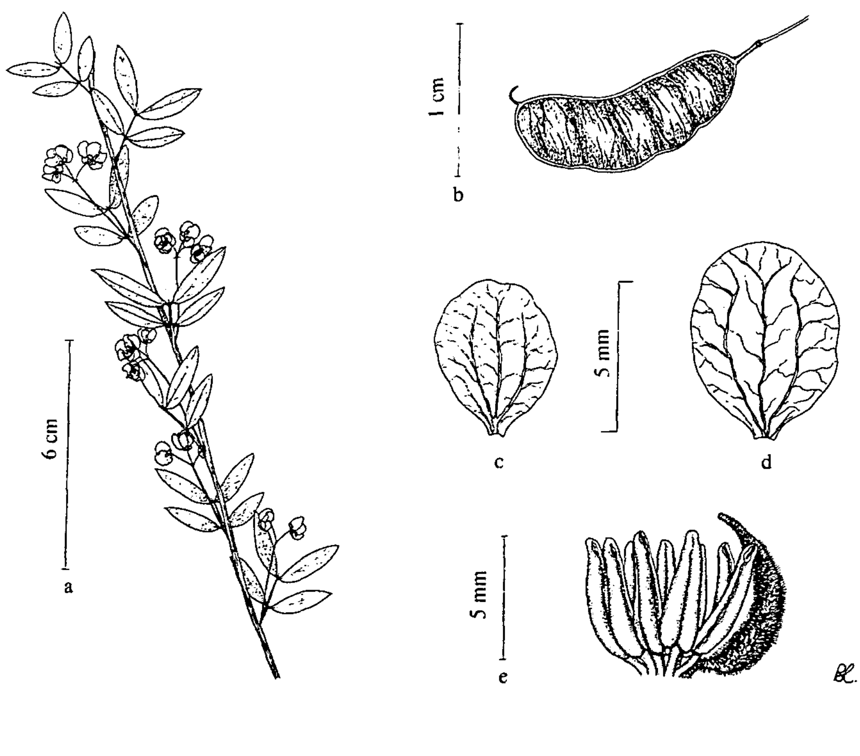


Plate 23. *S. curvistyla*. a. habit, b. pod, c. smallest petal abaxial surface, d. largest petal abaxial surface, e. anther group, all from *Conrick 1171*.

16. **S. cladophylla** (W. Fitzg.) Randell, comb. nov.

Basionym: *Cassia cladophylla* W. Fitzg., *J. Proc. Roy. Soc. W. Australia* 3: 147 (1918).

Lectotype: hills near the junction of the Hann and Barnett Rivers, *Fitzgerald s.n.*, 1905, PERTH! lectotype here designated; *isolectotype*: NSW (photo).

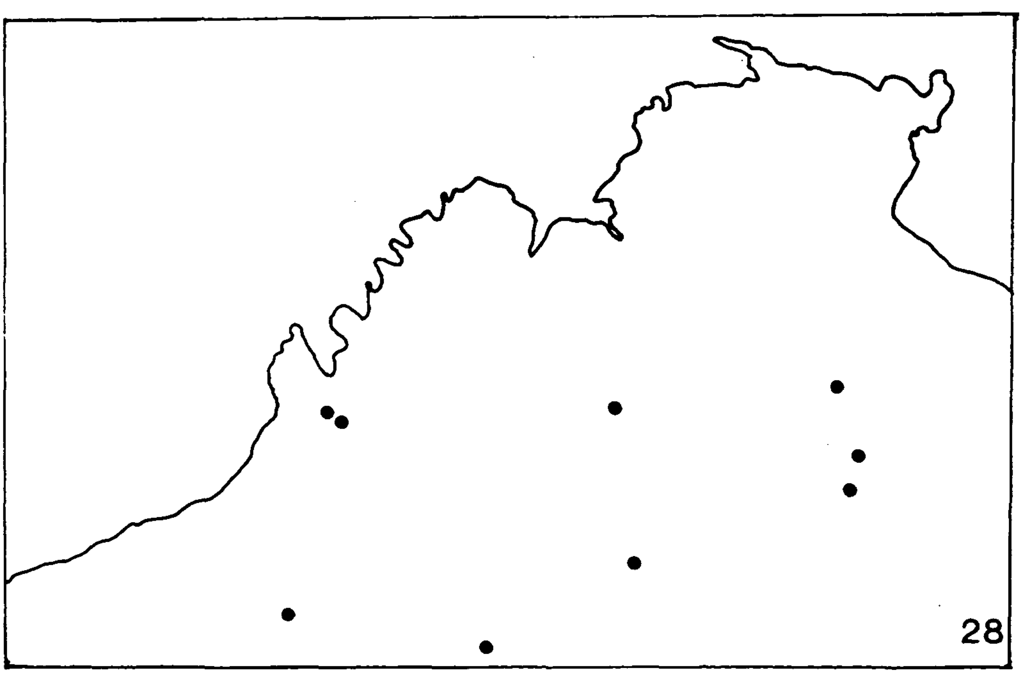
Syntypes: 1. Edkins Range, (as Erskines Range), E (Symon 1966); 2. Dillen's Springs, not located.

Synonym

C. oligoclada sensu Symon, *Trans. Roy. Soc. S. Australia* 90: 106 (1966) p.p. as for *C. cladophylla* W. Fitzg.

Description

Herb or shrublet, c. 30 cm high, all vegetative parts pilose with erect pale hairs; *leaves* 30-50 mm long including petiole; *leaflets* 2-3 pairs, broad elliptic, 5-10 mm apart on the rachis, the largest 12-15 mm x 8-10 mm, increasing in size from the base of the rachis, apex obtuse mucronate, base rounded, slightly unequal, cuticular wax not obvious, midvein obscure above, prominent below; *glands* 1-2, stalked, elongate and pointed; *stipules* persistent, cordate or auriculate, to 6 mm x 6 mm; *petioles* terete, 5-8 mm long; *inflorescences* along the stem, 2-flowered; *peduncles* 25-30 mm long, usually longer than leaf; *bracts* caducous before anthesis; *pedicels* 10-12 mm long; *sepals* shorter than petals; *petals* glabrous, 6-8 mm long; *anthers* 10, subequal, on subequal filaments; *ovary* densely pilose; *pods* short, 25-40 mm x 8 mm, flat, slightly curved, pilose, edges not crenate; *seeds* 4-8, transverse, shorter than pod is wide. Plate 24a-b.



Map 28. *S. curvistyla*.

Distribution and ecology

Grows in moist rocky soil in localised areas of northern Western Australia and Northern Territory. Map 29.

Notes

This species is distinguished by its conspicuous broad persistent stipules.

There is in K the lectotype sheet for *S. oligoclada* (F. Muell.) Randell, on which appears two fragments of *S. cladophylla*, with the locality given as 'Upper Victoria River'.

Specimens examined

WESTERN AUSTRALIA: 50 miles SW Wyndham Pumping Station, *Bennett 1766*, 19.v.1967 (PERTH); Packsaddle Creek, N. Carr Boyd Ranges, *Hartley 14343*, 7.iii.1978 (AD, CANB, PERTH); Dead Horse Spring, Lake Argyll, *Pullen 10673*, s.d. (PERTH Ref. Coll.).

NORTHERN TERRITORY: 50 miles SW Willeroo Hstd, *Chippendale 6841*, 9.v.1960 (PERTH); Victoria R., *Byrnes 714*, 7.v.1968 (AD); Edith Falls, *Henry 901*, 6.vii.1973 (AD, DNA).

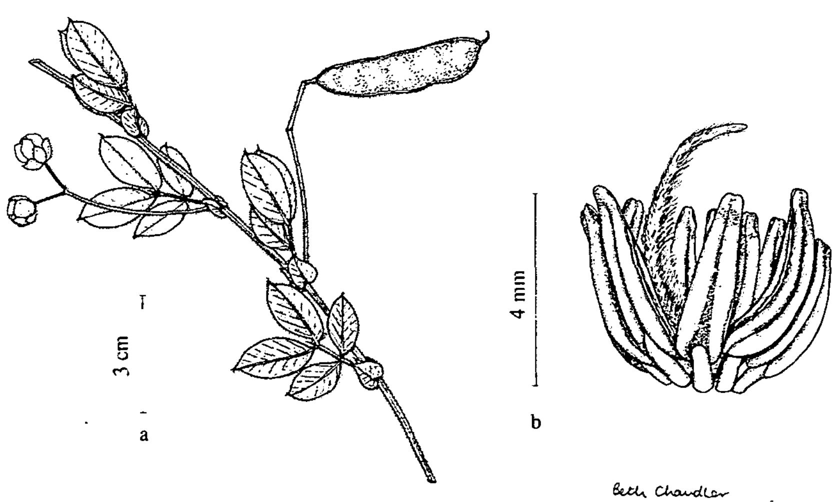
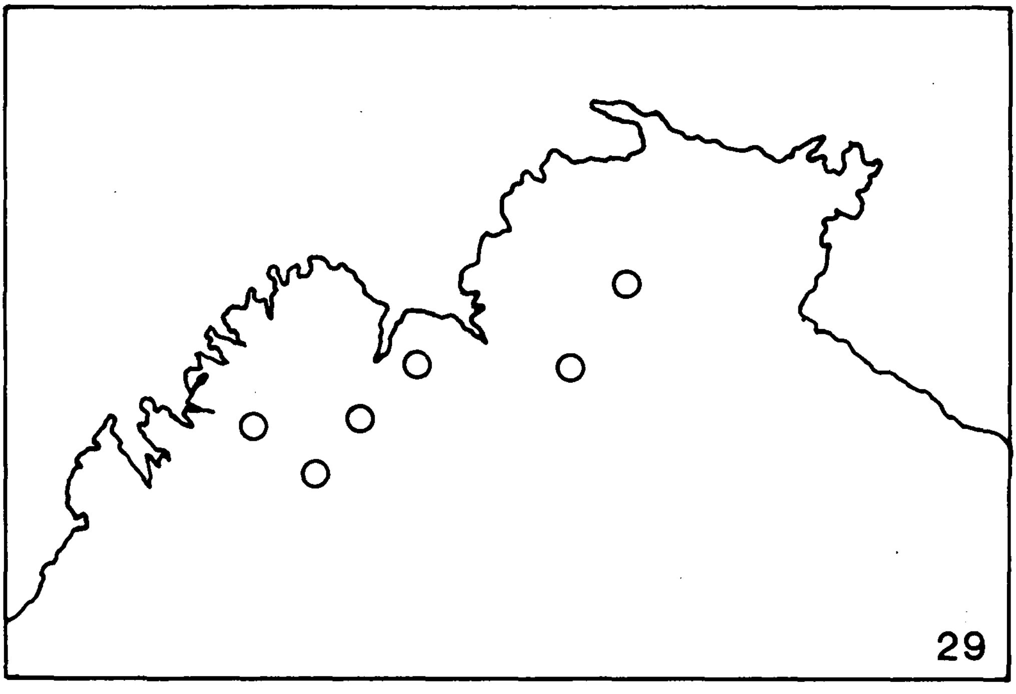


Plate 24. *S. cladophylla*. a.habit, b. anthers, both from *Hartley 14343*.



Map 29. *S. cladophylla.*

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Names

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