SYSTEMATICS OF THE GENUS *CYCLOPIA* VENT. (FABACEAE, PODALYRIEAE)

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Cyclopia is a papilionaceous genus endemic to the Western and Eastern Cape Provinces of South Africa. The 23 species recognized within the genus have rather subtle differences, but characters of the leaves, bracts and calyces, as well as the adaptations to survive recurrent fires, are useful to distinguish between the species. Variations in morphological, cytological and chemical characters are discussed. A phylogenetic analysis of 21 characters by means of cladistic methodology produced a cladogram with five distinct groups. These are described as sections in the taxonomic part of the paper. One new species, *Cyclopia alopecuroides* A.L. Schutte, is described. The nomenclature, synonymy and typification of the taxa are presented, as well as full descriptions, illustrations and distribution maps.

Keywords. Chemistry, *Cyclopia alopecuroides*, *Cyclopia* sect. *Aequalis*, *Cyclopia* sect. *Cyclopia*, *Cyclopia* sect. *Marsupium*, *Cyclopia* sect. *Praegnans*, *Cyclopia* sect. *Truncatae*, morphology, phylogeny, South Africa.

CONTENTS

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INTRODUCTION

Endemic to the Cape Floristic Region of South Africa, *Cyclopia* Vent. is a genus of shrubby papilionoid legumes with trifoliolate leaves, unifloral inflorescences, bright yellow flowers and paired bracts, fused at the base around the pedicel. The name *Cyclopia* is derived from the Greek words 'cyclos', a circle, and 'pous', a foot, which refer to the circular depression at the base of the calyx, around the pedicel (Ventenat, 1808; Harvey, 1862; Stearn, 1970). This character is, however, not unique for *Cyclopia*, but is characteristic of several other Cape legume genera, for example *Hypocalyptus* Thunb., *Liparia* L., *Podalyria* Lam., *Stirtonanthus* B.-E. van Wyk & A.L. Schutte and *Virgilia* Poir. (Schutte & Van Wyk, 1994; Van Wyk & Schutte, 1994, 1995a, 1995b).

The delimitation of species in *Cyclopia* appears to have been uncertain and problematic ever since the genus was established by Ventenat in 1808. This is clearly reflected in the different number of taxa that have previously been recognized. Bentham (1843) included 12 species in his Enumeration of *Cyclopia*, which Harvey (1862) reduced to nine species with eight varieties. Hofmeyr & Phillips revised the genus in 1922 and recognized 12 species and four varieties. In the most recent treatment, Kies (1951) increased the number of taxa to 20 species with 12 varieties. Even the last revision has proved to be largely unsatisfactory, due to several species complexes in the genus and differences between the taxa being vague and imperceptible. Moreover, a detailed study of the genus has become a matter of urgency as some of the taxa are used commercially for the production of a herbal tea.

The aim of this paper is to present the results of an exhaustive taxonomic revision of *Cyclopia*, based on morphological, chemical and cytological evidence.

MATERIALS AND METHODS

Data on the morphological variation of the taxa were gathered from herbarium collections, as well as from fresh or preserved material collected during field trips. Geographical distribution maps were compiled from the information given on specimen labels. Herbarium material was obtained on loan from BM, BOL, C, G, JRAU, K, LD, LINN, NBG, P, PRE, S, SAM, SBT, STE, TCD, UPS, W, WU and Z (abbreviations as in Holmgren et al., 1981). All the mentioned European herbaria were visited during 1990, 1991 and 1992.

An introductory survey of character diversification proved that the genus is morphologically highly variable and it became evident that the uncertainties regarding species concepts could be resolved only through field studies. Extensive field trips

were undertaken to study the taxa in their natural habitats. Several populations of most taxa were visited and revisited over the last four years, in order to investigate the adaptations of these taxa to survive recurrent veld fires. The variations in growth form and leaf size, shape and vestiture at different stages of development – before and after fires – were examined and compared. Since most of the taxa have highly localized distributions and are often restricted to very high altitudes, considerable effort went into locating them.

The methods applied in the chemical analyses are described by De Nysschen et al. (1996). Voucher specimens of the material used are also listed therein.

Cladograms were generated using the computer software package Hennig 86 (Farris, 1988). Character states were polarized using the method of outgroup comparison. The "mhennig*", "bb*" and "ie" algorithms were applied to produce trees of minimal length. It is important to note that autapomorphies for the species have been omitted from the analyses, as they serve no purpose as grouping characters.

TRIBAL POSITION AND AFFINITIES

In Bentham's (1837, 1839) fundamental classification of the subfamily *Papilionoideae*, *Cyclopia* and *Podalyria* were placed in the tribe *Podalyrieae* on account of the free stamens and simple or trifoliolate leaves. Although their positions in the *Podalyrieae* have stayed unchanged ever since, their generic and tribal affinities have been unclear. Polhill (1976, 1981a, 1981b) added *Virgilia* to the tribe, when he proposed a biogeographic classification for the genistoid alliance, but remarked that the relationship between the *Podalyrieae* and the closely related tribe *Liparieae* needs to be examined. The *Liparieae*, as circumscribed by Polhill (1981b), differs from the *Podalyrieae* in the fused stamens and includes the genera *Amphithalea* Eckl. & Zeyh., *Coelidium* Vogel ex Walp., *Liparia* L., *Priestleya* DC. and *Hypocalyptus* Thunb.

Generic circumscriptions and affinities in the *Podalyrieae* and *Liparieae* have recently been studied in great detail (Schutte, 1995). In the *Liparieae*, the results led to important changes at the generic level, i.e. the inclusion of *Priestleya* in *Liparia* (Schutte & Van Wyk, 1994) and the reinstatement of the genus *Xiphotheca* Eckl. & Zeyh. (Schutte & Van Wyk, 1993). In the *Podalyrieae*, Van Wyk & Schutte (1994, 1995b) established a new genus, *Stirtonanthus* B.-E. van Wyk & A.L. Schutte, and added *Calpurnia* E. Mey. to the tribe by transferring it from the *Sophoreae* (Van Wyk & Schutte, 1995a).

Cladistic analyses of the phylogenetic relationships between the genera showed that the two tribes are monophyletic and, with the exception of *Hypocalyptus*, should be united (Van Wyk & Schutte, 1995a; Schutte, 1995). Within the monophyletic group, two distinct clades were generated (Schutte, 1995): (1) a *Xiphotheca* clade, with *Amphithalea* and *Coelidium*, and (2) a *Podalyria* clade, with *Liparia*, *Cyclopia*, *Stirtonanthus*, *Virgilia* and *Calpurnia*. In the latter clade, *Cyclopia* is situated close to *Liparia* and *Podalyria*, implicating a relationship with both. A paper discussing the generic relationships will be published elsewhere (Schutte & Van Wyk, 1997).

Even though *Cyclopia* is a well-defined genus with several autapomorphies (see below), it shares a number of characters with *Liparia*, *Podalyria*, *Stirtonanthus*, *Virgilia* and some species of *Calpurnia*, namely the intrusive calyx base, the rostrate or beaked keel and the dimorphic anthers. With *Liparia*, it shares also the decurrent leaf bases and the presence of sterile bracts at the base of the inflorescence. It has the more or less free stamens in common with *Podalyria*, *Stirtonanthus* and *Virgilia*, and the presence of distinct pockets on the keel and wing petals in common with the *Xiphotheca* group of genera.

MORPHOLOGICAL CHARACTERS

Habit

In *Cyclopia*, all the species are long-lived perennials, varying from tall, erect, tree-like shrubs to woody, virgate subshrubs or small, lax, sprawling shrublets. Adaptations to survive recurrent fires have had a major influence on the life-forms and habit of the taxa, as the genus is restricted to the fire-prone fynbos vegetation of the Cape (Le Maitre & Midgley, 1992). There are two main fire survival strategies: sprouters and non-sprouters. Sprouters have a woody rootstock from which new coppice shoots are produced after fire, resulting in a multi-stemmed appearance at ground level. Non-sprouters, on the other hand, lack a lignotuber. They are obligate reseeders after fire and are easily recognized by the presence of a single main stem, at least at ground level (Schutte et al., 1995).

Fire survival strategy has been totally neglected as a character in previous treatments of *Cyclopia*. At specific level in particular, it is a taxonomically important and very useful character. Species which appear to be morphologically similar may often be discerned by differences in their fire survival strategies, e.g. *Cyclopia meyeriana* (non-sprouter) and *C. glabra* (sprouter); *C. burtonii* (non-sprouter) and *C. sessiliflora* (sprouter); *C. subternata* (non-sprouter) and *C. intermedia* (sprouter).

Phylogenetically, the ability to sprout is regarded as apomorphic in the fynbos genera *Leucadendron* R. Br. (Proteaceae; Midgley, 1987) and *Rhodocoma* Nees (Linder & Vlok, 1991). Wells (1969), however, considers the non-sprouting attribute as an advanced trait, but James (1984) asserts that the ability to regenerate from a woody base may by itself be a highly specialized adaptation to recurrent fires. However, fire survival strategy is not included as a character in the cladistic analyses of *Cyclopia*, because it is a polymorphic character. In certain species, e.g. *C. bowieana* and *C. alopecuroides*, some populations are sprouters, while other populations consist of non-sprouting individuals. This clearly indicates that the non-sprouting/sprouting character is not homologous in *Cyclopia* and therefore cannot be used in cladistic analyses.

Leaves

Cyclopia has digitately trifoliolate leaves, with a broad and somewhat flattened petiole. Stipules are invariably present and fused with the petiole. The leaflets are

pinnately veined and tend to turn black when dry. Leaf bases are prominent and decurrent, a character shared with the genus *Liparia*.

Shape, size and vestiture of the leaflets, as well as the orientation of the margins, vary at infrageneric level. The shape varies from linear to elliptic to obovate or ovate, with the apex acute to obtuse and the base cuneate or cordate. Leaflets are either terete, with the margins strongly revolute (e.g. *C. aurescens*, *C. bolusii*, *C. maculata*, *C. squamosa*), or flat, with the margins only slightly recurved (e.g. *C. buxifolia*, *C. intermedia*, *C. longifolia*, *C. subternata*). In sprouting species, the leaves from young, actively growing coppice shoots are generally much larger than those on old mature branches. The leaves and stems of young plants are often hairy, but glabrescent with age. In *C. alopecuroides*, *C. aurescens*, *C. bolusii*, *C. bowieana*, *C. galioides*, *C. meyeriana* and *C. pubescens*, however, the vestiture is a significant diagnostic character. Some species, e.g. *C. latifolia* and *C. buxifolia*, have a conspicuous venation pattern on the lower leaf surface and the margins of the leaflets often erosed. Prominent and persistent petioles occur in *C. squamosa*.

Inflorescences

As mentioned above, inflorescences are single-flowered and situated in the axils of the upper leaves. Two, distinctly keeled, bracts occur, which are fused at the base around the pedicel, with the flower situated in the axil of the upper bract. Bracteoles are totally absent.

The presence of three bracts was used as a diagnostic character for *Cyclopia burtonii* by Hofmeyr & Phillips (1922), but close examination proved that this is an exceptional phenomenon, confined to a single specimen of the species. Other collections invariably have only two bracts per flower. I also noticed a similar feature on a specimen of *C. maculata*, where some flowers are subtended by four bracts. This seems to support the idea that the unifloral inflorescence in *Cyclopia* possibly originated as a result of the extreme reduction of a simple raceme, such as is found in *Liparia* (Schutte & Van Wyk, 1994; Van Wyk & Schutte, 1995a).

At specific level, the shape, size and vestiture of the bracts and the length of the pedicel are of crucial importance in identifying most of the species. Truncate bracts with recurved apices are characteristic of *C. filiformis*, *C. longifolia*, *C. plicata* and *C. pubescens*, and the latter two species are unique in having the bracts also distinctly plicate. Very small bracts occur in *C. sessiliflora* and *C. burtonii*. In *C. bowieana*, *C. meyeriana* and *C. glabra*, the pedicel is strongly reduced in length and the bracts so large that they cover (clasp) the base of the calyx. These three species, as well as *C. alopecuroides*, also have bright orange or yellow bracts. Bracts are either coriaceous as in *C. aurescens*, *C. intermedia* and related species, or chartaceous as in *C. buxifolia*, *C. subternata*, *C. laxiflora*, etc. In some instances, the vestiture on the inner surface of the bracts is highly significant to distinguish between species which look morphologically very similar on herbarium sheets, for example some specimens of *C. intermedia* and *C. subternata* or *C. bolusii* and *C. aurescens*. Although the type of vestiture

on the outer surface of the bracts is diagnostic for certain species (pubescent in *C. plicata*, *C. pubescens*; villous in *C. alopecuroides*, *C. aurescens*, *C. bolusii*, *C. bowieana*), the degree of hairiness varies within some of the species.

Flowers

Calyx. All species of *Cyclopia* have an intrusive calyx base and the upper two lobes fused higher up than the lower three lobes. There is considerable variation in the size, shape and vestiture of the calyx lobes within the genus. The carinal lobe is mostly longer than the upper four lobes (e.g. *C. bolusii*, *C. falcata*, *C. genistoides*, *C. latifolia*), but sometimes subequal to them, as in *C. burtonii*, *C. maculata*, *C. sessiliflora*, etc. Some species – *C. alopecuroides*, *C. bowieana*, *C. glabra* and *C. meyeriana* – have the upper lobes longer than the lateral lobes, but still distinctly shorter than the carinal lobe. In *C. plicata*, however, the upper two lobes are clearly longer than the lower three lobes.

The shape of the calyx lobes varies from lanceolate-acuminate as in *C. burtonii* and *C. pubescens*, to rounded and obtuse as in *C. bowieana* and *C. maculata*, or emarginate as in *C. plicata*. Most species have glabrous calyces, but in *C. plicata* and *C. pubescens* the calyces are pubescent and in *C. aurescens*, *C. bolusii* and allies, villous or hirsute. Thickly textured calyx lobes occur in *C. plicata* and *C. pubescens*. Patterns of clinal variation are evident in *C. intermedia*, where the size and shape of the calyx lobes tend to decrease and change from the inland mountains to the coastal mountains. Specimens from the inland mountains have long and lanceolate-acute calyx lobes, whereas those from the coastal mountains have short, rounded-obtuse lobes (see description and illustration of species in taxonomic treatment below).

Corolla. In *Cyclopia*, the basic structure of the corolla is constant and highly characteristic. All the species have sweetly scented and rigid, firmly textured flowers (Fig. 1), adapted to pollination by xylocopid bees (Schutte, pers. obs.). The corolla is bright yellow in the majority of species, except *C. sessiliflora*, which has a lemon-yellow flower colour. There are distinct grooves on the standard petal, that are strongly UV-absorbing and act as nectar guide marks against the UV-reflecting background of the standard petal (Kay, 1987; Schutte, unpubl. data). After fertilization, the standard fades to a reddish-brown colour and the flower is no longer visited by pollinators, although no changes in the UV-patterns can be detected (Schutte, unpubl. data). It seems as if the pollinators are deterred from visiting the flowers by some other factor, e.g. perhaps a change in odour.

The standard petal has an obovate to subcircular lamina, with callosities at the base and an emarginate or mucronate apex. Wing petals are oblong to narrowly-oblong and slightly longer than the keel. The shape of the keel petals varies from oblong-elliptic to semicircular, with a beaked and upwardly directed apex. Both the keel and wing petals are equipped with distinct pockets, which fit into each other to form a flexible pollination mechanism. At specific level, the pocket and tip of the

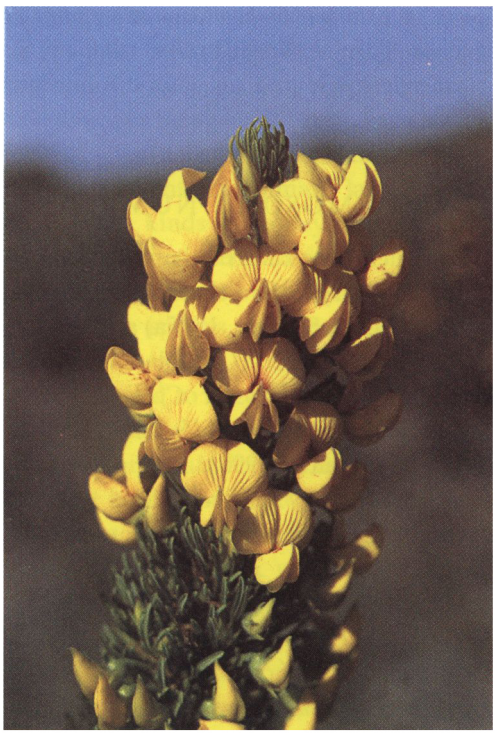

FIG. 1. Flowering branch of *Cyclopia pubescens*. Note the firmly textured flowers and prominent grooves on the standard petal.

keel are useful diagnostic characters. Modification occurs in the size of the pocket and shape of the keel apex, i.e. pocket longer than 5mm and apex shortly beaked in *C. latifolia*, *C. sessiliflora* and *C. squamosa*, in contrast to the shorter length of the pocket and the strongly beaked keel tip in the remainder of the genus.

Stamens. Each flower has ten stamens, which are free almost to the base. The filaments are thickened, especially at the base, where they are slightly fused on the inside of the tube. The two vexillary filaments are modified to form a nectar well at the proximal end. Anthers are strongly dimorphic and alternately short dorsifixed and long basifixed.

Pistil. The pistil is sessile and the style upwardly curved. In the majority of species the ovary is glabrous, but in *C. alopecuroides*, *C. aurescens*, *C. bolusii* and *C. meyeriana*, the margins are ciliate. The ovule number varies from three to ten, most species having five to seven ovules per ovary. There are, however, no clear-cut deviations.

Pods and seeds

Cyclopia has coriaceous pods with an oblong to obliquely ovate shape and a strongly beaked distal end. Most of the species have laterally compressed pods, but in *C.*

alopecuroides, *C. aurescens*, *C. bolusii*, *C. bowieana*, *C. glabra* and *C. meyeriana* they are inflated. The fruits generally have three or more seeds per pod. Seeds are oblong-reniform, with a punctate micropyle and an elliptic hilum surrounded by a fleshy collar-like aril.

CHROMOSOME NUMBER

Goldblatt (1981a) proposed a chromosome base number of $x=9$ for the *Podalyrieae*. Within the tribe, *Cyclopia* and *Virgilia* are the only known polyploids, the latter a hexaploid with $2n=54$ (Van Wyk & Schutte, 1995a) and the former with an apparent polyploid range of $2n=36$, 54 and ± 126 (Goldblatt, 1981b; Schutte, 1995). There are, however, only a few counts known for *Cyclopia*: *C. maculata* with $2n=36$ (Goldblatt, 1981b), *C. subternata* with $2n=54$ (Schutte, 1995) and *C. intermedia* and *C. meyeriana* with $2n=\pm 126$ (Schutte, 1995).

Chromosome number undoubtedly exhibits great potential as a phylogenetic character, but a wider survey is needed in which more counts are recorded, before it can be used in the cladistic analysis.

CHEMICAL CHARACTERS

Unlike the other genera of the *Podalyrieae*, no alkaloids could be detected in *Cyclopia* (Van Wyk & Schutte, 1995a).

A study of the major phenolic compounds in the leaves of the genus indicated the presence of two flavanones, hesperitin and isosakuranetin, and a xanthone, mangiferin (De Nysschen et al., 1996). These constituents appear to be totally absent in the remainder of the *Podalyrieae* and are therefore significant autapomorphies for *Cyclopia*. At infrageneric level, however, the distribution patterns of these compounds have very little taxonomic value as there is no correlation with the proposed phylogeny for the genus.

COMMERCIAL POTENTIAL AND CONSERVATION CONSTRAINTS

Since the 19th century, several species of *Cyclopia* have been used for the production of honeybush tea. This tea is considered to be a healthy herbal drink, as it does not contain caffeine and also in most cases no tannins, and is said to have medicinal qualities, especially for treating intestinal disorders and skin diseases (Watt & Breyer-Brandwijk, 1962; Viljoen, 1994).

At present, some 20 tonnes of honeybush tea are produced annually (Anonymous, 1993). Most of the tea is harvested in the southern region of the Cape, of which *C. intermedia* and *C. subternata* from the Tsitsikamma and Outeniqua Mountains are the main sources, whilst large amounts of *C. sessiliflora* are gathered in the Langeberg region. Small-scale collecting, mainly for household needs, of *C. aurescens*, *C. bur-*

tonii, *C. buxifolia*, *C. genistoides*, *C. maculata* and *C. meyeriana* has also been recorded (Hofmeyr & Phillips, 1922; Kies, 1951). Up to now, all the tea has been harvested from the wild.

The fashionable trend towards being health conscious has increased the popularity of this tea, and the demand for it from international markets, particularly Japan, has grown. This has triggered the interest of many landowners throughout the fynbos region to harvest the different kinds of honeybush teas from their land. It soon became clear that the international demand is far in excess of supply from wild populations and would lead to over-exploitation of natural populations and ultimately the extinction of some species, as most species have extremely localized distributions.

A project was recently launched to encourage the establishment of honeybush tea orchards by fynbos farmers. Although this step would reduce the pressure on natural populations, it is feared that this could lead to the loss of pristine fynbos vegetation and private water catchment land in order to establish such orchards. Furthermore, the establishment of orchards is likely to encourage some landowners to introduce foreign genetic material, which might mix with local natural genetic material. No work has been done on the possible hybridization of *Cyclopia* species, but since it is known that polyploids are highly adaptable (Levyns, 1934; Stirton, 1981), this fear is not unfounded. It is evident that more cytological work is required and that farming practices need to be carefully monitored by conservation organizations.

INFRAGENERIC PHYLOGENY

Cyclopia is a monophyletic genus, with a unique set of autapomorphies: (1) trifoliolate leaves; (2) unifloral inflorescences; (3) paired, fused bracts; and (4) a total absence of alkaloids.

For the phylogenetic analysis of *Cyclopia*, *Liparia* was chosen as outgroup, since it has several characters in common with the genus (see tribal position and affinities above). A data set was compiled using 24 taxa and 21 characters (Table 1). A single partially resolved topology resulted from the analysis (Fig. 2), with a length of 28 and a consistency index of 78. From the cladogram it is evident that there are five distinct groups: (A) the *C. burtonii*-group, supported by a single character (which is shared with *C. sessiliflora*); (B) the *C. pubescens*-group, with one apomorphy; (C) the *C. sessiliflora*-group, subtended by two apomorphies; (D) the *C. genistoides*-group, supported by one apomorphy; and (E) the *C. bowieana*-group, with two apomorphies. These infrageneric groups are formally described as sections in the taxonomic treatment below.

SPECIES CONCEPT

As mentioned earlier, the genus is morphologically extremely variable and, as a result, I had enormous difficulty in deciding what rank to apply to taxonomically

TABLE 1. Characters and character states used for the cladistic analysis of the genus *Cyclopia*. The partially resolved cladogram generated from this data set is shown in Fig. 2.

Taxa	Character states																					
LIPARIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. alopecuroides	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	
C. alpina	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	
C. aurescens	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	
C. bolusii	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	
C. bowieana	1	1	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	
C. burtonii	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
C. buxifolia	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	
C. falcata	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	
C. filiformis	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
C. galioides	1	0	0	0	0	0	0	0	1	1	0	0	2	1	0	0	0	0	0	0	0	
C. genistoides	0	0	0	0	0	0	0	0	1	1	0	0	2	1	0	0	0	0	0	0	0	
C. glabra	1	1	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	
C. intermedia	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	
C. latifolia	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	
C. laxiflora	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	
C. longifolia	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
C. maculata	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	
C. meyeriana	1	1	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	
C. plicata	0	0	1	0	0	1	1	0	1	0	1	1	0	0	0	0	0	1	0	0	0	
C. pubescens	0	0	1	0	0	1	1	0	1	0	0	1	0	0	0	0	0	1	0	0	0	
C. sessilifolia	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	0	0	0	0	
C. squamosa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	
C. subternata	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	

Characters

1. *Stems and leaves*: not hirsute (0); hirsute (1).
2. *Bracts*: not clasping the base of the calyx (0); clasping the base of the calyx (1).
3. *Bract structure*: not plicate (0); plicate (1).
4. *Bract apices*: not recurved (0); recurved (1).
5. *Bract colour*: brown (0); orange (1).
6. *Bract margin*: not incurved (0); incurved (1).
7. *Bract shape*: not truncate (0); truncate (1).
8. *Bract size*: large (0); small (1).
9. *Calyx texture*: chartaceous (0); coriaceous (1).
10. *Calyx lobes*: ±equal (0); carinal lobe longer (1).
11. *Calyx lateral lobes*: as long as upper lobes (0); shorter than upper lobes (1).
12. *Calyx lobes*: not thickened at base (0); thickened at base (1).
13. *Calyx lobes*: apices not apiculate (0); apices shortly apiculate (1); apices long apiculate (2).
14. *Calyx lobes*: not falcate (0); falcate (1).
15. *Keel shape*: strongly beaked (0); shortly beaked (1).
16. *Keel pocket*: less than 5mm long (0); 6mm long or longer (1).
17. *Leaf venation*: indistinct (0); distinct (1).
18. *Pedicels*: not pubescent (0); pubescent (1).
19. *Pods*: narrow upper suture (0); broad upper suture (1).
20. *Pods*: not inflated (0); inflated (1).
21. *Pods*: margins glabrous (0); margins hairy (1).

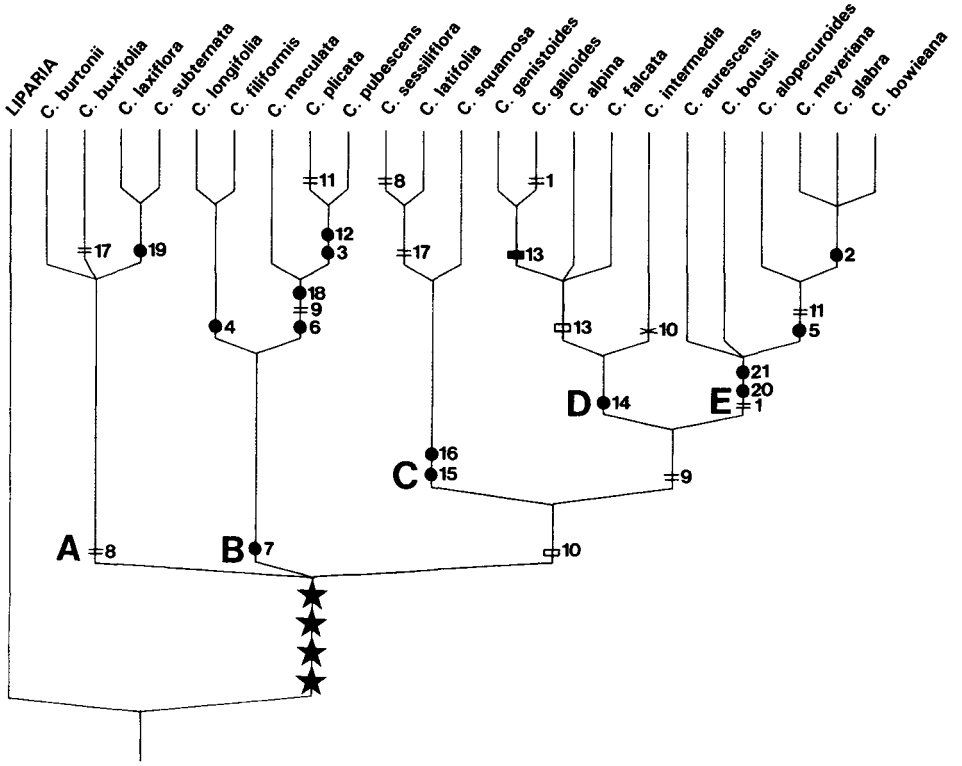

FIG. 2. Partially resolved cladogram of relationships in the genus *Cyclopia*, based on the data set in Table 1. ●, an apomorphy without homoplasy; ▭, an apomorphy with subsequent reversal or successive states of a multistate character; =, a convergence; ×, a reversal; ★, generic autapomorphies (see text).

different units. Levyns (1934) encountered similar problems in the genus *Lobostemon* Lehm. (Boraginaceae), where she mentions that it is possible to create large numbers of species based on herbarium specimens alone. I finally decided to use the taxonomic species concept as a basis for defining taxa. The units recognized here are therefore taxonomic species, based on groups of morphologically similar individuals (Radford, 1986).

Despite the variation in leaflet size and shape, I found that the bracts, calyx and keel petals provide very useful characters to distinguish between the different taxa. I have refrained from recognizing any infraspecific taxa, since this would result in a proliferation of splinter taxa which would unnecessarily complicate the taxonomy of the genus.

Most species are well defined, with unique apomorphies, e.g. *C. burtonii*, *C. falcata*, *C. galioides*; *C. genistoides*, *C. latifolia*, *C. maculata*, *C. plicata*, *C. pubescens*, *C. sessiliflora* and *C. squamosa*. Others, such as *C. aurescens* and *C. bolusii*, are obviously very closely related, but are quite easily recognized by a combination of characters.

C. intermedia exhibits patterns of clinal variation, yet no unambiguous discontinuities could be found to separate the forms.

A few taxa still require more research, particularly the species in which both sprouting and non-sprouting growth forms occur, viz. *C. bowieana* and *C. alopecuroides*. These species should perhaps be split up, but no additional characters could be found to support the dissimilarity in growth form. *C. alpina* and *C. buxifolia* have disjunct distribution patterns, with several populations in the west and only one or two in the south. In both species, the southern populations exhibit slight differences in leaflet shape. Whether these different forms justify formal taxonomic rank can only be ascertained once more populations of especially the western form have been studied in the wild. *C. filiformis* and *C. laxiflora* may merely be aberrant forms of *C. longifolia* and *C. subternata* respectively, yet they need to be rediscovered in the wild, before this can be established. Similarly, it is also possible that *C. glabra* and *C. meyeriana* are conspecific and that the former is simply a glabrous form of *C. meyeriana* with a sprouting growth form, but more field work is required.

TAXONOMIC TREATMENT

Cyclopia Vent., Dec. Gen. Nov. 8 (1808); R. Br. in Ait., Hort. Kew. 3: 5 (1811); DC., Prodr. 2: 101 (1825), Mém. Lég. 167 (1826); Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839); Walp. in Linnaea 13: 453 (1839); Benth. in Hook., Lond. J. Bot. 2: 432 (1843); Harv. in Harv. & Sond., Fl. Cap. 2: 6 (1862); Benth. in Benth. & Hook., Gen. Pl. 1: 466 (1865); Baill., Hist. Pl. 2: 348 (1870); Taubert in Engler & Prantl, Nat. Pflanzenfam. 3(3): 203 (1891); Hofmeyr & E. Phillips in Bothalia 1: 106 (1922); E. Phillips, Gen. S. Afr. Fl. Pl. ed. 2, 401 (1951); Kies in Bothalia 6: 162 (1951); Hutch., Gen. Fl. Pl. 1: 343 (1964); Dyer, Gen. 1: 246 (1975); Polhill in Polhill & Raven, Adv. Leg. Syst. 1: 397 (1981); Van Wyk & Schutte in Crisp & Doyle, Adv. Leg. Syst. 7: 304 (1995). Type: *C. genistoides* (L.) R. Br.
Syn.: *Ibbetsonia* Sims in Bot. Mag. t. 1259 (1810). Lectotype (designated here): *I. genistoides* (L.) Sims [= *Cyclopia genistoides* (L.) R. Br.].

Woody shrubs or subshrubs. *Leaves* alternate, palmately trifoliolate, often becoming black when dry; leaflets linear, elliptic, obovate or cordate, flat, concave or terete, distinctly pulvinate; margins slightly to strongly revolute; petioles 1–2mm long, often persistent; stipules less than 1mm long, fused with the petiole. *Inflorescences* axillary, 1-flowered. *Bracts* paired, fused at the base around the pedicel, with flower situated in axil of upper bract, keeled. *Bracteoles* absent. *Calyx* intrusive at base; upper two lobes fused higher up than lower three lobes; carinal lobe as long as or longer than the other lobes; upper two lobes rarely longer than the lower three lobes. *Corolla* firmly textured, bright yellow, glabrous. *Standard petals* obovate to subcircular, with calluses at base of lamina; apex emarginate or mucronate. *Wing petals* oblong to narrowly-oblong, slightly longer than the keel, with a distinct pocket. *Keel petals* oblong elliptic to semicircular, with a distinct pocket; apex shortly to strongly beaked. *Stamens* 10, filaments free, thickened near base; anthers strongly dimorphic,

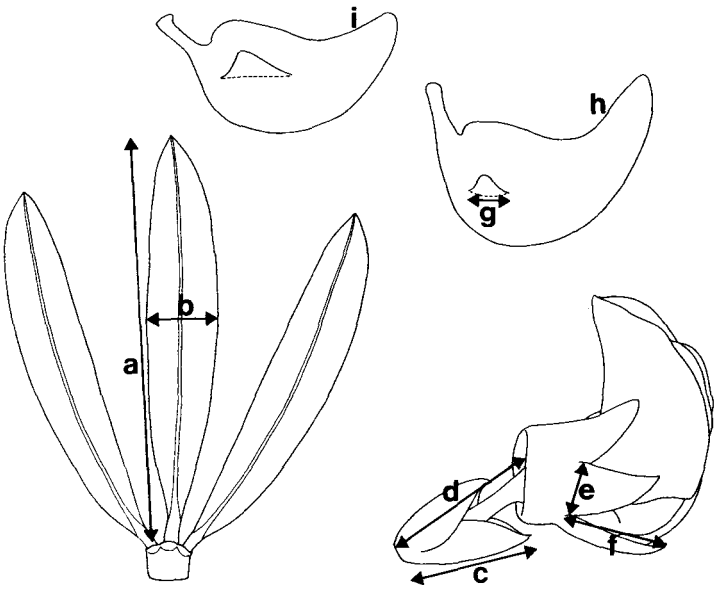

FIG. 3. Schematic representation indicating how measurements of leaflets and floral parts should be taken. a, length of leaflet; b, width of leaflet; c, length of bract; d, length of pedicel; e, width of lateral calyx lobe; f, length of carinal calyx lobe; g, length of pocket on keel petal; h, keel strongly beaked; i, keel shortly beaked.

alternately short dorsifixed and long basifixed. *Pistil* sessile; style curved upwards, glabrous; ovary glabrous, rarely ciliate on margins. *Pods* coriaceous, oblong to obliquely ovate, beaked; 3–several seeded. *Seeds* oblong-reniform; hilum elliptic, surrounded by a fleshy collar-like aril. *Chromosome number* $2n = 36$, 54, 126?. 23 species.

Cyclopia is endemic to the Flora Capensis region of southern Africa. Its distribution range stretches from the Cedarberg Mountains north of Citrusdal southwards to the Cape Peninsula and eastwards to Port Elizabeth.

In order to facilitate accurate identification of species it is important to examine flowers at *anthesis*, since the length of pedicels tends to differ from budding to flowering and fruiting stages. Measurements of leaflets and floral parts should be done according to Fig. 3. It will be necessary to dissect one or two flowers to determine the vestiture on the inner surfaces of bracts, shape of keel petals, size of keel pockets, vestiture of the ovary and number of ovules. Knowledge of the growth form and provenance of the taxon will be most useful.

Key to the species

1a. Bracts clasping the base of the calyx ——— 2
1b. Bracts not clasping the base of the calyx ——— 4

2a. Inner surface of bracts covered with long straight hairs, often only along the fold, bracts 4–5mm wide ——— **23. C. bowieana**

2b. Inner surface of bracts glabrous (except for a few hairs at the base), bracts less than 4mm wide — 3

3a. Calyx glabrous, except for ciliate margins; stems ± glabrous — **22. C. glabra**
3b. Calyx hairy; stems hairy, even when old — **21. C. meyeriana**

4a. Leaflets broad and flat, sometimes with slightly recurved margins — 5
4b. Leaflets narrow and terete, with strongly revolute margins — 15

5a. Bracts with recurved apices — 6
5b. Bracts not with recurved apices — 7

6a. Calyx lobes acuminate, carinal lobe up to 2mm long; keel shortly beaked — **6. C. filiformis**
6b. Calyx lobes acute, carinal lobe longer than 3mm; keel strongly beaked — **7. C. longifolia**

7a. Keel petals with pocket 6mm or longer — 8
7b. Keel petals with pocket less than 5mm long — 9

8a. Bracts 4–7mm long; leaflets ovate with cordate bases, 5–14mm wide, margins often erosed (not smooth) — **11. C. latifolia**
8b. Bracts 2.0–2.5mm long; leaflets linear to narrowly elliptic, with bases cuneate, 2–5mm wide, margins smooth — **12. C. sessiliflora**

9a. Bracts 8–10mm long, usually as long as or longer than the pedicel — **14. C. falcata**
9b. Bracts less than 8mm long, usually distinctly shorter than the pedicel (rarely as long as) — 10

10a. Bracts ovate, acute, coriaceous, inner surface and margins densely long pubescent; calyx lobes acute to obtuse — **13. C. intermedia**
10b. Bracts lanceolate, acuminate, chartaceous, inner surface sparsely puberulent, margins glabrous or sparsely ciliate; calyx lobes acuminate to acute — 11

11a. Lateral calyx lobes less than 1.5mm wide at base, narrowly triangular, tapering, acuminate; crest of Great Swartberg Mountains — **1. C. burtonii**
11b. Lateral calyx lobes more than 1.5mm wide at base, triangular-acute or lanceolate-acuminate; not on the Great Swartberg Mountains — 12

12a. Ovules 4–6; keel shortly beaked (see Fig. 3) — **15. C. alpina**
12b. Ovules 6 or more; keel strongly beaked (see Fig. 3) — 13

13a. Leaflets oblanceolate, margins smooth; bracts with glabrous margins; southern coastal mountain ranges — 14
13b. Leaflets obovate to elliptic, margins often erosed; bracts with sparsely ciliate margins; rarely southern coastal mountain ranges — **2. C. buxifolia**

14a. Leaflets very narrow, 1.5–2.5mm wide; bracts 2.5–3.5mm long ——— **4. C. laxiflora**
14b. Leaflets broad, 3–7(–10)mm wide; bracts 4–6mm long ——— **3. C. subternata**

15a. Bracts plicate ——— 16
15b. Bracts not plicate ——— 17

16a. Calyx lobes rounded, emarginate ——— **8. C. plicata**
16b. Calyx lobes tapering, acuminate ——— **9. C. pubescens**

17a. Keel petals, with pocket 6–8mm long, apex not strongly beaked ——— **10. C. squamosa**
17b. Keel petals, with pocket less than 5mm long, apex strongly beaked ——— 18

18a. Stems and leaves ± glabrous ——— 19
18b. Stems and leaves distinctly hairy ——— 20

19a. Keel shortly beaked; standard claw less than 1mm long; pedicels mostly ± twice as long as the bracts or longer; low, sprawling shrublets; high altitude alpine species ——— **15. C. alpina**
19b. Keel strongly beaked; standard claw longer than 1mm; pedicels as long as or slightly longer than the bracts; robust shrublets; mid slope species ——— **16. C. genistoides**

20a. Bracts and calyx totally glabrous outside (except margins sometimes ciliate) ——— 21
20b. Bracts and calyx hairy outside ——— 22

21a. Bracts truncate; calyx lobes rounded, obtuse, not falcate ——— **7. C. maculata**
21b. Bracts acuminate; calyx lobes lanceolate, acute, falcate, apiculate ——— **17. C. galioides**

22a. Bracts 9–11mm long, inner surface pilose along fold, glabrous towards margins; carinal calyx lobe longer than 8mm ——— **20. C. alopecuroides**
22b. Bracts less than 8mm long, inner surface not as above; carinal calyx lobe less than 8mm long ——— 23

23a. Inner surface of bracts entirely tomentose; shrubs rigid, robust ——— **18. C. aurescens**
23b. Inner surface of bracts ± glabrous, with only a few hairs at the base; shrubs lax, sprawling ——— **19. C. bolusii**

Sect. 1. Aequalis A.L. Schutte **sect. nov.**; sectio *Cyclopiae* similis, a qua lobis et tubo calycis aequalibus et bracteis brevis differt.
Type: *C. subternata* Vogel.
Syn.: *Cyclopia* sect. *Eucyclopia* Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839) *nom. illeg.*; Benth. in Lond. J. Bot. 2: 432 (1843).

This section is characterized by short, chartaceous bracts and the length of the calyx lobes being equal to the calyx tube. Four species are included in this section.

1. Cyclopia burtonii Hofmeyr & E. Phillips in Bothalia 1: 107 (1922); Kies in Bothalia 6: 167 (1951). Type: Western Cape, Oudtshoorn division, 'Zwarteberg Mountains', *Burton* s.n. sub PRF 2914 (holo. PRE!). **Fig. 4.**

Erect, robust shrubs, up to 0.8m tall, not sprouting after fire; woody rootstock absent; twigs puberulent when young, soon becoming glabrous. *Leaflets* 7–14mm long, 2.0–5.5mm wide, elliptic, flat; margins sometimes slightly recurved; glabrous. *Bracts* 3.5–4.5mm long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins short ciliate; inner surface densely pubescent. *Pedicels* 4–7mm long; glabrous. *Calyx* lobes narrowly triangular, acuminate; carinal lobe 2.5–3.0mm long, slightly longer than the other lobes; glabrous,

FIG. 4. A–E: *Cyclopia laxiflora*; F–J: *C. subternata*; K–O, U–Z: *C. buxifolia*; P–T: *C. burtonii*. A, F, K, P, U, V: leaves, abaxial view; B, G, L, Q, W: leaflets in transverse section to show orientation of margins; C, H, M, R, X: longitudinal section of bracts showing vestiture on the inner surface; D, I, N, S, Y: flowers in lateral view; E, J, O, T, Z: keel petals. A–E: *Alexander* s.n.; F, G: *Schutte* 503; H–J: *Esterhuysen* 27325; K–O: *Thorne* s.n.; P–T: *Fellingham* 1240; U, W: *Malan* 151; V, X–Z: *Compton* 16230. Scale in mm.

margins ciliate. *Keel* shortly beaked; pocket 3mm long. *Ovary* 5 or 6-ovuled; glabrous. *Pods* obliquely oblong, laterally compressed.

This species is a rare endemic to the Great Swartberg Mountains in the southern part of the Western Cape (Fig. 5), where it occurs in rocky sandy soil on the crest and upper slopes at 1600–2070m above sea level.

It is easily identified by its small, narrow calyx lobes and bracts.

ADDITIONAL SPECIMENS EXAMINED. Oudtshoorn: Great Swartberg Mountains, near top of pass, *Schutte* 747 (JRAU), *Stokoe* s.n. (SAM 66042, NBG), *Vlok & Schutte* 189 (MO); Great Swartberg Mountains, Swartberg Pass area, *Stokoe* 9020 (BOL); Great Swartberg Mountains, Blesberg, upper northern slopes, *Vlok* 2540 (JRAU).

2. Cyclopia buxifolia (Burm.f.) Kies in Bothalia 6: 168 (1951) excl. syn. *C. latifolia* DC., *C. cordifolia* Benth. & *C. latifolia* Benth. **Fig. 4.**
Basionym: *Genista buxifolia* Burm.f., Fl. Cap. Prodr. 21 (1768). Type: 'Caput bonei Spei', *anon.* s.n. sub Herb. Burmann (lecto. G!, designated here).
Syn.: *Cyclopia aurescens* Kies var. *glauca* Kies in Bothalia 6: 164 (1951). Type: Western Cape, Ceres division, *Bolus* s.n. sub BOL 15447 (lecto. BOL!, designated here).

Cyclopia falcata (Harv.) Kies var. *ovata* Kies in Bothalia 6: 168 (1951). Type: Western Cape, Ceres division, Michells Pass, *Esterhuysen* 6167 (lecto. K!, designated here).

Cyclopia dregeana Kies in Bothalia 6: 169 (1951). Type: Western Cape, 'Ad montes Dutoitskloof, altit. 2000–3000 ped.', *Drége* s.n. (lecto. P!, designated here; isolecto. K!).
Misappl.: *Cyclopia latifolia* sensu E. Mey., Comm. 1: 3 (1836), non DC.

Cyclopia brachypoda var. *brachypoda* sensu Hofmeyr & E. Phillips in Bothalia 1: 108 (1922), non Benth.

Erect, robust shrubs, up to 2m tall, or prostrate, multi-stemmed shrubs, up to 0.3m tall, sprouting from a woody rootstock after fire; twigs glabrous, except for a few sparse hairs in leaf axils. *Leaflets* 8–25(–30)mm long, 1.5–5.5(–8.0)mm wide, elliptic to obovate, ± flat to subterete, with venation faintly distinct on lower surface of large leaflets; margins slightly recurved to revolute, erosed; glabrous. *Bracts* 2.5–7.0mm long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins sparsely ciliate; inner surface sparsely puberulent. *Pedicels* 4–9mm long; glabrous. *Calyx* lobes triangular, acute, auriculate at base; carinal lobe 3–6mm long, slightly longer than the other lobes; glabrous, margins short ciliate. *Keel* strongly beaked; pocket 2.5–3.0mm long. *Ovary* 6–8-ovuled; glabrous. *Pods* obliquely oblong, laterally compressed.

The distribution of *C. buxifolia* includes the Skurweberg, Great Winterhoek, Hex River, Du Toits Kloof, French Hoek, Hottentots Holland, Rivier Sonder End,

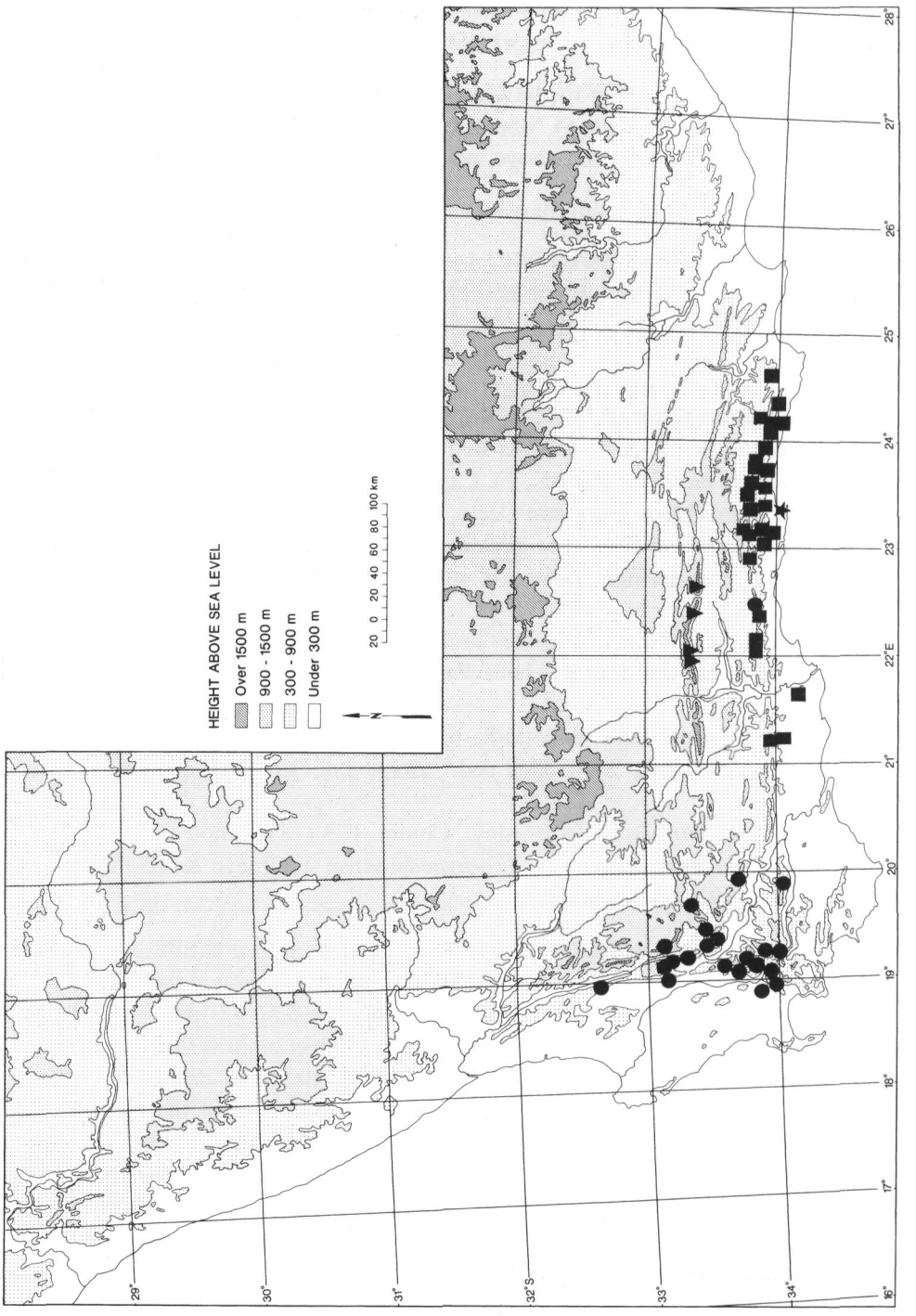

FIG. 5. The known geographical distribution of *Cyclopia burtonii* (▼), *C. buxifolia* (●), *C. laxiflora* (★) and *C. subternata* (■).

Langeberg and Outeniqua Mountains (Fig. 5). It occurs in rocky, humic, sandy soil at 830–1670m above sea level.

Apart from the shape of the leaflets (narrowly elliptic with acute apices in *C. dregeana*; obovate with obtuse apices in *C. buxifolia*), there is no other character to distinguish between the two taxa. *C. dregeana* falls completely within the variation range of *C. buxifolia*. I have studied several populations of both and am convinced that the two taxa are conspecific.

SELECTED ADDITIONAL SPECIMENS. *Form with broad leaves*: Ceres: Slab Peak, Mitchell's Pass, southeastern slopes, *Esterhuysen* 6167 (BOL, P). Stellenbosch: Jonkershoek, Lang River, *Kerfoot* 5416 (NBG), *Schutte* 544, 602–606 (JRAU). Caledon: Rivier Sonder End area, Pilaarkop, southern slopes, *Dahlgren & Strid* 3818 (LD). *Form with narrow leaves*: Ceres: Schurfteberg Pass, *Compton* 16230 (NBG). Paarl: Du Toits Kloof Pass, *Malan* 151 (NBG), *Walter* 1233 (NBG).

3. Cyclopia subternata Vogel in Linnaea 10: 595 (1836) excl. syn. *Lebeckia subternata* Lk.; Benth. in Lond. J. Bot. 2: 432 (1843) p.p.; Walp., Rep. Bot. Syst. 2: 831 (1852) p.p.; Hofmeyr & E. Phillips in Bothalia 1: 107 (1922) p.p.; Kies in Bothalia 6: 170 (1951) excl. var. *laxiflora* (Benth.) Kies; *Cyclopia vogelii* Harv. var. *subternata* (Vogel) Harv. in Harv. & Sond., Fl. Cap. 2: 6 (1862). Type: Western Cape, 'Ad montes prope Kneisna et sinum Plettenbergsbay', *Mund & Maire* s.n. (lecto. K!, designated here). **Fig. 4.**
Syn.: *Cyclopia grandiflora* A. DC., Huitième Not. Pl. Rar. Genève 29 (1840). Type: Cultivated plant, *Grenier* s.n. (lecto. G!, designated here).

Erect, single-stemmed shrubs, up to 3.2m tall, not sprouting after fire; woody rootstock absent; twigs glabrous, sometimes with a few hairs in leaf axils and on upper surface. *Leaflets* (8–)14–28(–32)mm long, 3–7(–10)mm wide, obovate to oblanceolate, ± flat, with venation sometimes distinct on lower surfaces of large leaflets; margins slightly recurved; glabrous. *Bracts* 4.0–5.5mm long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins glabrous, except at apices; inner surface puberulent. *Pedicels* 4–12mm long, glabrous. *Calyx* lobes triangular, acute, chartaceous; carinal lobe 2–4mm long, subequal to the other lobes; glabrous, margins ciliate. *Keel* strongly beaked; pocket ± 2.5mm long. *Ovary* 6–8-ovuled; glabrous. *Pods* obliquely oblong, laterally compressed, upper suture 1.0–1.5mm wide.

The known geographical distribution of *C. subternata* is illustrated in Fig. 5. It is widely distributed along the coastal mountain ranges (Tsitsikamma, Outeniqua and Langeberg Mountains), where it occurs on the southern slopes in well-drained, stony loamy soil at altitudes between 160 and 1000m.

This species is remarkably constant in its morphological variation, the only deviations occurring in the size of the leaflets and the length of the pedicels. *C. subternata* may sometimes be confused with *C. intermedia*, but is recognized by its non-sprouting growth form, lanceolate, acuminate bracts with puberulent inner surfaces and char-

taceous calyx lobes. (*C. intermedia* has a sprouting growth form, rounded, obtuse bracts with pubescent inner surfaces and coriaceous calyx lobes.)

SELECTED ADDITIONAL SPECIMENS. Riversdale: Garcias Pass, *Phillips* 341 (SAM), *Dekenah* s.n. (NBG 13502); Garcias Pass, c.1km west of pass on Sleeping Beauty Hiking trail, *Schutte* 637 (JRAU). Mossel Bay: Robinson Pass, *Schutte* 651 (MO). George: Outeniqua Pass, near top, *Schutte* 638, 639, 690 (JRAU, MO). Uniondale: Prince Alfreds Pass, Avontuur side, *Schutte* 672 (JRAU).

4. Cyclopia laxiflora Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839), Lond. J. Bot. 2: 433 (1843). *Cyclopia vogeli* Harv. var. *laxiflora* (Benth.) Harv., in Harv. & Sond., Fl. Cap. 2: 7 (1862). *C. subternata* Vogel var. *laxiflora* (Benth.) Kies in Bothalia 6: 170 (1951). Type: Western Cape, 'In montibus ad sinum Plettenbergsbay', *Mund* s.n. (lecto. SAM 15160!, designated here; isolecto. SAM 31156!, specimen to the left). **Fig. 4.**
Misappl.: *Cyclopia latifolia* sensu Eckl. & Zeyh., Enum. 2: 155 (1836), non DC.

Erect shrubs, not sprouting after fire?; woody rootstock absent?; twigs glabrous. *Leaflets* 11–25mm long, 1.5–2.5mm wide, linear-oblanceolate, flat, with pulvini 1.0–1.5mm long; margins only slightly recurved; glabrous. *Bracts* 2.5–3.5mm long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins glabrous; inner surface puberulent. *Pedicels* 6–8mm long; glabrous. *Calyx* lobes triangular, acute; carinal lobe 2.0–2.5mm long, subequally to the other lobes; glabrous, margins shortly ciliate. *Keel* strongly beaked; pocket $\pm$ 3mm long. *Ovary* 7–8(–10)-ovuled; glabrous. *Pods* obliquely ovate, laterally compressed, upper suture 1mm broad.

This is yet another rare species of *Cyclopia*, recorded only from the Knysna-Plettenberg Bay area (Fig. 5).

C. laxiflora is closely related to *C. subternata* and should possibly be included therein, but I retain it as a separate species until it is rediscovered in its natural habitat and more field studies can be undertaken.

ADDITIONAL SPECIMENS EXAMINED. Knysna: 'Ad montes prope K'Neisna et sinum Plettenbergsbay', *Ecklon & Zeyher* 1149 (BOL, S). Without locality: *Alexander* s.n. (SAM).

Sect. 2. Truncatae A.L. Schutte **sect. nov.**; sectio bracteis truncatis a congeneribus diversa.
Type: *C. maculata* (Andrews) Kies.

This section differs from all other sections in its truncate bracts. It consists of five species.

5. Cyclopia longifolia Vogel in Linnaea 10: 595 (1836); Walp. in Linnaea 13: 453 (1839); Benth. in Lond. J. Bot. 2: 433 (1843); Walp., Rep. Bot. Syst. 1: 564 (1849); Harv. in Harv. & Sond., Fl. Cap. 2: 7 (1862); Kies in Bothalia 6: 167 (1951). Type: Western Cape, 'Cap. b. Sp.', *Mund & Maire* s.n. (lecto. W!, designated here; isolecto. K!). **Fig. 6.**

Erect, lax, single-stemmed shrubs, up to 3.5m tall, not sprouting after fire; woody rootstock absent; twigs pubescent when young, glabrescent. *Leaflets* (15–) 25–34(–40)mm long, 1.5–3.0mm wide, linear-oblanceolate, flat with pulvini 1.0–1.5mm long; margins sometimes slightly recurved; sparsely pubescent on upper surface when young, glabrescent. *Bracts* 2–4mm long, oblong, obtuse, mucronulate, apices recurved, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins ciliate at apices; inner surface puberulent along fold, glabrous towards margins. *Pedicels* 9–11mm long. *Calyx* lobes triangular, acute; carinal lobe 3.5–4.5mm long, subequal to the other lobes; glabrous, margins ciliate. *Keel* strongly beaked; pocket ± 2.5mm long. *Ovary* 8–10-ovuled; glabrous. *Pods* oblong, laterally compressed.

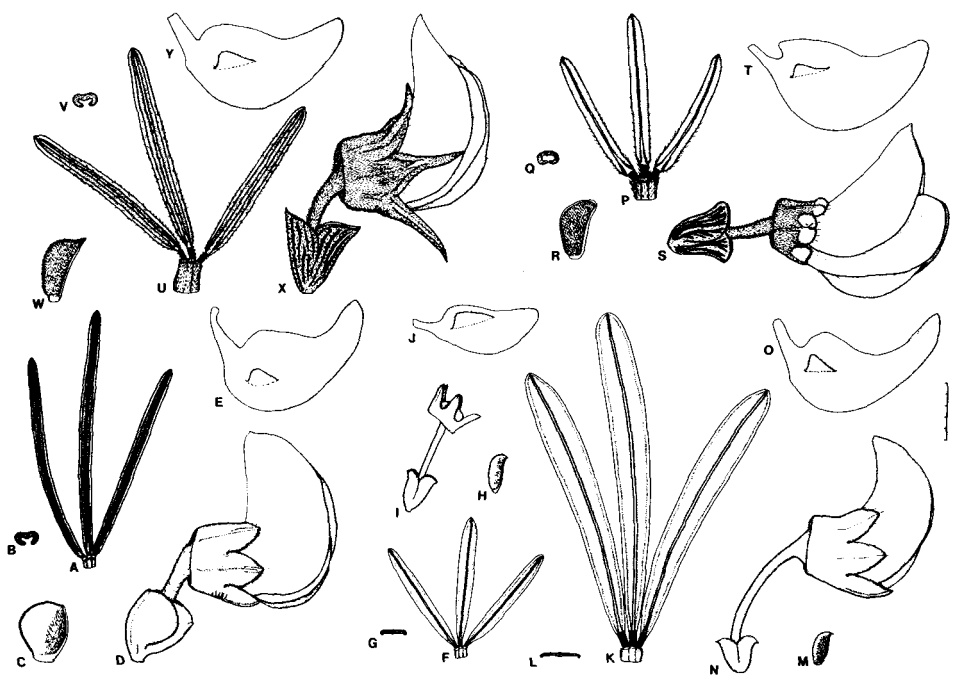

FIG. 6. A–E: *Cyclopia maculata*; F–J: *C. filiformis*; K–O: *C. longifolia*; P–T: *C. plicata*; U–Y: *C. pubescens*. A, F, K, P, U: leaves, abaxial view; B, G, L, Q, V: leaflets in transverse section to show orientation of margins; C, H, M, R, W: longitudinal section of bracts showing vestiture on the inner surface; D, I, N, S, X: flowers in lateral view; E, J, O, T, Y: keel petals. A–E: *Esterhuysen* 11914; F–J: *Kennedy* 336; K–O: *Gray* s.n.; P–T: *Esterhuysen* 6466; U–Y: *Holland* 3864. Scale in mm.

This is a rare and highly localized species, known only from the Vanstadens River Mountains, near Port Elizabeth (Fig. 7), where it occurs on moist sandy soil along the banks of the river at an altitude of 300–360m. Its existence is being threatened by afforestation in the area. This matter has been brought to the attention of SAFCOL (South African Forestry Company Limited) and they have since put a lot of effort into removing the alien vegetation and pine plantations and in having the area proclaimed a Natural Heritage Site.

The triangular-acute calyx lobes and strongly beaked keel distinguish this species from *C. filiformis*, where the calyx lobes are triangular acuminate and the keel shortly beaked.

ADDITIONAL SPECIMENS EXAMINED. Port Elizabeth: Banks of the Vanstadens River, *Bolus* 1604A (BOL); Longmore Forest Reserve, Helsekloof, *Yates* s.n. (MO); Longmore State Forest, Bulk River, *Gray* s.n. (JRAU).

6. Cyclopia filiformis Kies in Bothalia 6: 167 (1951). Type: Western Cape, Port Elizabeth division, Vanstadens River, *Kennedy* 336 (holo. K!). **Fig. 6.**

Erect, woody? shrubs, not sprouting after fire?; woody rootstock absent?; twigs puberulent, glabrescent. *Leaflets* 12–20mm long, 1.5–2.5mm wide, linear, flat; margins slightly recurved; glabrous, except for a few hairs in leaf axils. *Bracts* 3mm long, oblong, obtuse, mucronulate, apices slightly recurved, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins glabrous; inner surface sparsely puberulent along fold, glabrous towards margins. *Pedicels* 5–6mm long; glabrous. *Calyx* lobes triangular, acuminate; carinal lobe 1.5–2.0mm long, subequal to the other lobes; totally glabrous. *Keel* shortly beaked; pocket 3mm long. *Ovary* 6 or 7-ovuled; glabrous. *Pods* unknown.

C. filiformis is known only from the type specimen, collected at the Vanstadens River near Port Elizabeth (Fig. 7) at an altitude of 100m. Several attempts to relocate the species have been unsuccessful.

See discussion under *C. longifolia*.

7. Cyclopia maculata (Andrews) Kies in Bothalia 6: 166 (1951). **Fig. 6.**
Basionym: *Gompholobium maculatum* Andrews, Bot. Rep. 6: 427 (1805). Type: "*Gompholobium maculatum*", Andrews, Bot. Rep. 6, pl. 427 (1805) (lecto., designated here).
Syn.: *Cyclopia tenuifolia* Lehm., Ind. Sem. Hort. Hamb. 16 (1828), in Linnaea 5: 373 (1830); Eckl. & Zeyh., Enum. 2: 155 (1836); Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839); Walp. in Linnaea 13: 454 (1839); Dietr., Syn. Pl. 2: 1500 (1840); Benth. in Lond. J. Bot. 2: 433 (1843); Walp., Rep. Bot. Syst. 1: 564 (1849); Harv. in Harv. & Sond., Fl. Cap. 2: 7 (1862); Hofmeyr & E. Phillips in Bothalia 1: 108 (1922). Type: Western Cape, 'In promontorio Bonae Spei', *anon.* s.n. (lecto. WU!, designated here).

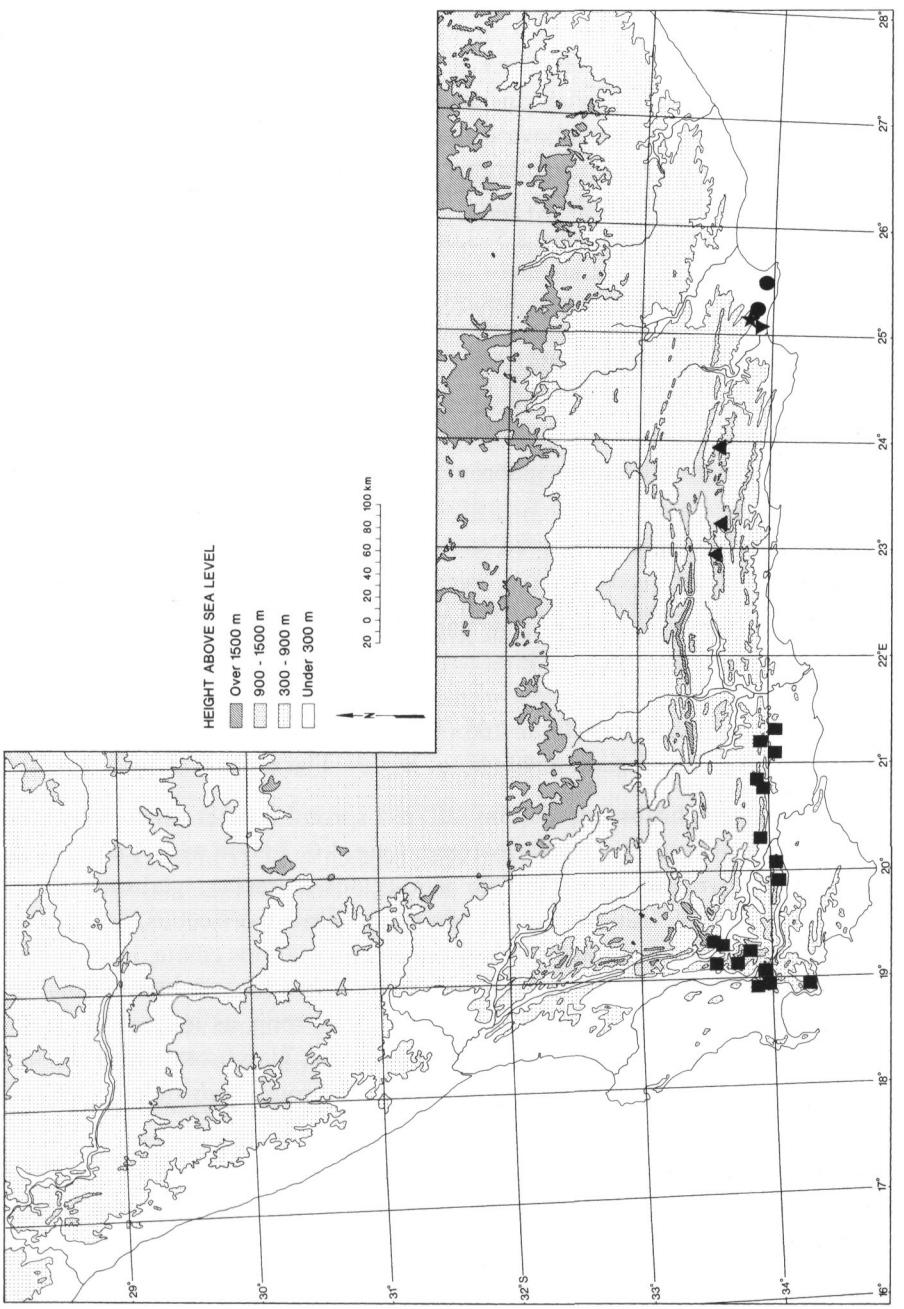

FIG. 7. The known geographical distribution of *Cyclopia filiformis* (▼), *C. longifolia* (★), *C. maculata* (■), *C. plicata* (▲) and *C. pubescens* (●).

Cyclopia laricina E. Mey., Comm. 1: 153 (1836). Type: Western Cape, 'Outniqualand', *Drége* s.n. (lecto. P!, designated here; isolecto. C!, G!, UPS!).
Misappl.: *Cyclopia genistoides* sensu E. Mey., Comm. 1: 3 (1836), non (L.) R. Br.

Erect, single-stemmed shrubs, up to 3.5m tall, not sprouting after fire; woody rootstock absent; twigs pubescent when young, glabrescent. *Leaflets* (20–)30–45mm long, 0.5–1.0mm wide, linear, terete; margins strongly revolute; pubescent when young, glabrescent. *Bracts* 4–8mm long, obovate, truncate, coriaceous, not clasping the base of the calyx; outer surface glabrous; margins glabrous; inner surface pubescent along fold, glabrous towards the margins. *Pedicels* 7–13mm long; sparsely pubescent. *Calyx* lobes rounded, obtuse; carinal lobe 2.5–3.0mm long, subequal to the other lobes; glabrous, margins ciliate. *Keel* strongly beaked; pocket ± 3mm long. *Ovary* 8 or 9-ovuled; glabrous. *Pods* oblong, laterally compressed.

C. maculata occurs sporadically along riverbanks and streamsides in the southwestern and southern regions (Fig. 7), where it grows in wet peaty soil at 150–830m above sea level.

This species is recognized by its glabrous, truncate bracts and rounded, acute calyx lobes.

SELECTED ADDITIONAL SPECIMENS. Stellenbosch: Banhoek Kloof, *Stokoe* s.n. (SAM 57815); Jonkershoek State Forest Reserve, Swartbrug, *Schutte* 545, 609–611, 712 (JRAU, MO). Montagu: between Goedgeloof Peak and Leeurivierberg, southern slopes, *Esterhuysen* 35004 (BOL). Riversdale: next to Kafferkuils River, at Broom, *Vlok* 2677 (JRAU); Garcias State Forest, *Schutte* 634–636 (JRAU).

8. Cyclopia plicata Kies in Bothalia 6: 168 (1951). Type: Western Cape, Uniondale division, Hoopsberg, *Esterhuysen* 6549 (holo. BOL!). **Fig. 6.**

Erect, single-stemmed shrubs, up to 1.5m tall, not sprouting after fire; woody rootstock absent; twigs pubescent. *Leaflets* 8–16mm long, 1.0–1.5mm wide, linear, terete; margins strongly revolute; upper surface villous, lower surface glabrous. *Bracts* 4.5–5.0mm long, oblong, truncate, apices recurved, plicate, coriaceous, not clasping the base of the calyx; outer surface sparsely pubescent; margins ciliate; inner surface entirely pubescent. *Pedicels* 7–8mm long; pubescent. *Calyx* lobes rounded, emarginate, base auriculate, thickened; carinal lobe 0.5–1.0mm long, as long as the lateral lobes, but shorter than the upper two lobes; pubescent, glabrescent. *Keel* strongly beaked; pocket ± 3mm long. *Ovary* 6 or 7-ovuled; glabrous. *Pods* oblong, laterally compressed.

C. plicata is a rare species, recorded only from the Kammanassie and Kouga Mountains in the southern region (Fig. 7). It is found on shale bands in loamy rocky soil, at altitudes of 1000–1700m.

The thickened and rounded, emarginate calyx lobes are diagnostic for *C. plicata*.

ADDITIONAL SPECIMENS EXAMINED. Uniondale: Kammanassie Mountains, Mannetjiesberg, *Vlok & Schutte* 128 (JRAU), *Schutte* 756 (JRAU), *Taylor* 1478 (PRE);

Hoopsberg, *Schutte* 517, 670 (JRAU), *Esterhuysen* 6466 (BOL); Mountains north of Klein River, *Esterhuysen* 7036 (BOL). Joubertina: Peak east of Smutsberg, *Esterhuysen* 7035 (BOL).

9. Cyclopia pubescens Eckl. & Zeyh., Enum. 2: 154 (1836); Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839); Dietr., Syn. Pl. 2: 1500 (1840); Benth. in Lond. J. Bot. 2: 433 (1843); Walp., Rep. Bot. Syst. 1: 564 (1849); Harv. in Harv. & Sond., Fl. Cap. 2: 8 (1862); Hofmeyr & E. Phillips in Bothalia 1: 108 (1922); Kies in Bothalia 6: 165 (1951). Type: Western Cape, Uitenhage division, 'Inter frutices planitiei prope Krakakamma et in montium lateribus Van Stadensriviersberge', *Ecklon & Zeyher* 1146 (lecto. S!, designated here; isolecto. BOL!, C!, G!, K!, W!). **Fig. 6** (see also Fig. 1).

Erect, single-stemmed shrubs, up to 1.7m tall, not sprouting after fire; woody rootstock absent; twigs pubescent. *Leaflets* 17–25mm long, 0.5–2.5mm wide, linear, terete; margins strongly revolute; upper surface pubescent, sparsely so below. *Bracts* 7–8mm long, truncate, mucronate, apices recurved, coriaceous, not clasping the base of the calyx; outer surface pubescent; margins ciliate; inner surface entirely pubescent. *Pedicels* 13–15mm long; pubescent. *Calyx* lobes triangular, tapering, acuminate, base auriculate; carinal lobe 5–7mm long, subequal to the other lobes; pubescent. *Keel* strongly beaked; pocket 3–4mm long. *Ovary* 8-ovuled; glabrous. *Pods* oblong.

This is a rare and highly localized species, which has been recorded only from the foot of the Vanstadens River Mountains west of Port Elizabeth (Fig. 7), where it grows in marshy areas at 300m above sea level. At present it is known only from a single locality just outside Port Elizabeth, where it is seriously threatened by urban development. I have, however, notified the town council and they have committed themselves to taking special care not to disturb its habitat.

The shape of the calyx lobes is unlike any other species in the genus.

ADDITIONAL SPECIMENS EXAMINED. Port Elizabeth: Near Port Elizabeth, *Schutte* 502, 685–689 (JRAU, MO), *Van Wyk* 2596 (JRAU); Flats below Witteklip, *Holland* 3864 (BOL); Banks of the Vanstadens River, *Bolus* 1604 (BOL).

Sect. 3. Marsupium A.L. Schutte **sect. nov.**; sectio carinis brevirostris cum marsupiis longis a congeneribus diversa.
Type: *C. squamosa* A.L. Schutte.

The shortly beaked keel equipped with an extended pocket is characteristic of this section. It comprises three species, two of which are highly localized.

10. Cyclopia squamosa A.L. Schutte in Bothalia 22: 190 (1992). Type: Western Cape, Paarl district, Wemmershoek Peak, on cliff and at base of cliff, on steep southern slope, *Esterhuysen* 35695 (holo. BOL; iso. C, K, S). **Fig. 8.**

Woody shrubs; twigs sparsely villous. *Leaflets* (6–)12–20mm long, 0.5–1.0mm wide, linear, terete; margins strongly revolute; villous, glabrescent. *Bracts* 6mm long, lan-

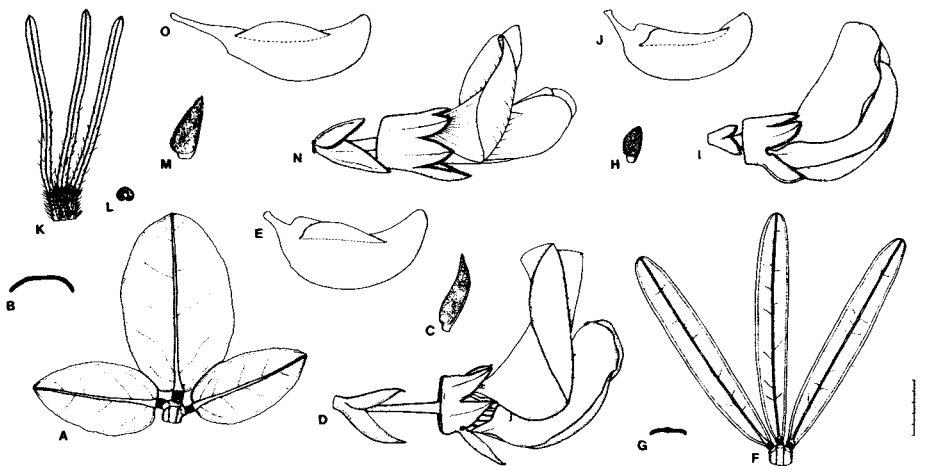

FIG. 8. A–E: *Cyclopia latifolia*; F–J: *C. sessiliflora*; K–O: *C. squamosa*. A, F, K: leaves, abaxial view; B, G, L: leaflets in transverse section to show orientation of margins; C, H, M: longitudinal section of bracts showing vestiture on the inner surface; D, I, N: flowers in lateral view; E, J, O: keel petals. A–E: *Bodkin* s.n.; F–J: *Vlok* 2627; K–O: *Esterhuysen* 35695. Scale in mm.

ceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins long ciliate; inner surface entirely pubescent. *Pedicels* 6–7mm long; glabrous. *Calyx* lobes triangular, acute; carinal lobe 5mm long, longer than the other lobes; glabrous, margins ciliate. *Keel* shortly beaked; pocket ± 6mm long. *Ovary* 5–7-ovuled; glabrous. *Pods* ovate, laterally compressed.

C. squamosa is a rare species, known only from the type locality on the Wemmershoek Mountains in the southwestern region (Fig. 9; Schutte, 1992).

The shape of the keel, size of the keel pocket, prominent persistent leaf bases and leaflet shape are diagnostic for *C. squamosa*.

SPECIMEN EXAMINED. French Hoek: Wemmershoek Mountains, ledge at base of cliff, *Esterhuysen* 35764 (BOL, C).

11. Cyclopia latifolia DC. in Ann. Sci. Nat. (Paris) 4: 98 (1825) non Eckl. & Zeyh., nec E. Mey.; DC., Prodr. 2: 101 (1825) excl. syn.; Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839) excl. syn.; Dietr., Syn. Pl. 2: 1500 (1840); Benth. in Lond. J. Bot. 2: 432 (1843); Walp., Rep. Bot. Syst. 2: 831 (1852); Harv. in Harv. & Sond., Fl. Cap. 2: 6 (1862); Hofmeyr & E. Phillips in Bothalia 1: 107 (1922). Type: Western Cape, 'ad Caput Bon. Spei', *Puerari* s.n. (lecto. G-DC!, designated here). **Fig. 8.**
Syn.: *Cyclopia cordifolia* Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839); Walp., Rep. Bot. Syst. 1: 564 (1849). Type: Western Cape, 'Crecit in Promontorio bonae Spei', *Scholl* s.n. (lecto. W!, designated here; isolecto. K!).

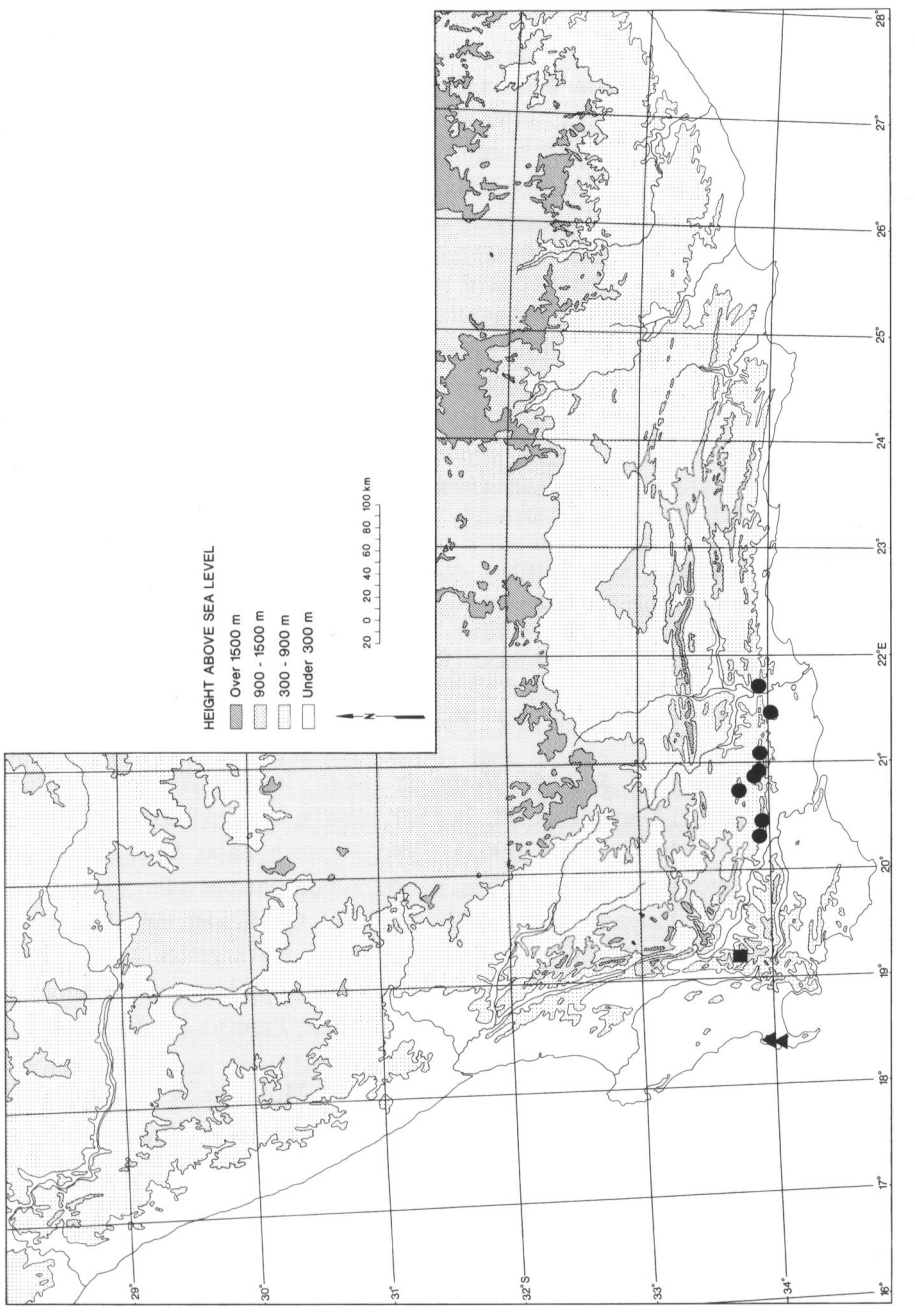

FIG. 9. The known geographical distribution of *Cyclopia latifolia* (▲), *C. sessiliflora* (●) and *C. squamosa* (■).

Erect shrubs, up to 1m tall, not sprouting after fire?; woody rootstock absent?; twigs glabrous. *Leaflets* 8–23mm long, 5–14mm wide, cordate, ± flat; margins slightly recurved, erosed; glabrous. *Bracts* 4–7mm long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins glabrous; inner surface entirely puberulent. *Pedicels* 3–9mm long; glabrous. *Calyx* lobes triangular, acuminate, base auriculate; carinal lobe 3.5–5.0mm long, longer than the other lobes; glabrous, margins ciliate. *Keel* shortly beaked; pocket ± 7mm long. *Ovary* 6 or 7-ovuled; glabrous. *Pods* obliquely ovate, laterally compressed.

This is a rare and highly localized species, known only from Constantiaberg and Table Mountain in the Cape Peninsula (Fig. 9), where it is found in marshy, rocky areas at altitudes between 900 and 1000m. Several recent attempts to relocate *C. latifolia* in its natural habitat have been unsuccessful.

C. latifolia may be confused with *C. buxifolia*, but has a shortly beaked keel with a long pocket, whilst the latter has a strongly beaked keel with a short pocket.

SELECTED ADDITIONAL SPECIMENS. Cape Town: Table Mountain, eastern side, *Esterhuysen* 4014 (BOL); Table Mountain, top of Fountain Ravine, *Compton* 6588 (NBG); Constantiaberg, in rock gully on southern slope, *Esterhuysen* 28650a (BOL, S); Constantiaberg, near cave, *Wolley-Dod* 3450 (BOL, PRE); Waai Vley, *Wolley-Dod* 3399 (BOL, K).

12. Cyclopia sessiliflora Eckl. & Zeyh., Enum. 2: 154 (1836) non E. Mey.; Walp. in Linnaea 13: 453 (1839); Dietr., Syn. Pl. 2: 1501 (1840); Walp., Rep. Bot. Syst. 1: 564 (1849); Kies in Bothalia 6: 169 (1951). Type: Western Cape, Swellendam division, 'In summis montium declivitatibus prope villam Puspasvalley', *Ecklon & Zeyher* 1147 (lecto. S!, designated here; isolecto. BOL!, G!, K!, P!, W!). **Fig. 8.**
Syn.: *Cyclopia brachypoda* Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839), in Lond. J. Bot. 2: 432 (1843) *nom. superfl. Cyclopia vogelii* Harv. var. *brachypoda* (Benth.) Harv. in Harv. & Sond., Fl. Cap. 2: 6 (1862). Type as for *C. sessiliflora* Eckl. & Zeyh.
Misappl.: *Cyclopia brachypoda* var. *intermedia* sensu Hofmeyr & E. Phillips in Bothalia 1: 108 (1922), non (E. Mey.) Hofmeyr & E. Phillips (1922) *nomen sed non planta.*

Erect, multi-stemmed, robust shrubs, up to 1m tall, sprouting from a woody rootstock after fire; twigs glabrous. *Leaflets* 12–22mm long, 2–5mm wide, linear to narrowly-elliptic, ± flat; margins slightly recurved; glabrous. *Bracts* 2–3mm long, ovate, acute, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins ciliate; inner surface entirely puberulent. *Pedicels* 2–3mm long; glabrous. *Calyx* lobes triangular, acute; carinal lobe 3–4mm long, subequal to the other lobes; glabrous, margins ciliate. *Keel* shortly beaked; pocket 6–7mm long. *Ovary* 5 or 6-ovuled, glabrous. *Pods* obliquely oblong, laterally compressed.

The distribution of *C. sessiliflora* is limited to the Langeberg Mountains and Warmwaterberg in the southern region (Fig. 9). It is found on well-drained, loamy, sandy soil at altitudes ranging between 300 and 1500m.

C. sessiliflora is recognized by its very small bracts and long pocket on the shortly beaked keel petals.

SELECTED ADDITIONAL SPECIMENS. Swellendam: Marloth Nature Reserve, *Haynes* 622 (NBG); Lemoenshoek, southern slopes, *Esterhuysen* 10443 (BOL, PRE). Heidelberg: Boosmansbos Wilderness Area, Langeberg, near Helderfontein, *McDonald* 1141 (NBG). Riversdale, Langeberg Mountains, next to Gysmanshoek Pass, north of farm Kortefontein, *Vlok* 2627 (JRAU); On farm Aan De Valsrivier, *Vlok* 2678 (JRAU).

Sect. 4. Cyclopia

Syn.: *Cyclopia* sect. *Ibbetsonia* (Sims) Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839); Walp. in Linnaea 13: 453 (1839); Benth. in Lond. J. Bot. 2: 432 (1843).

The diagnostic character for this section is the falcate calyx lobes, which are much longer than the calyx tube. Only the eastern forms of *C. intermedia* have the length of the calyx lobes almost equal to the tube. Five species constitute this section.

13. Cyclopia intermedia E. Mey., Comm. 1: 3 (1836) p.p.; Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839) p.p.; Dietr., Syn. Pl. 2: 1501 (1840) p.p.; Benth. in Lond. J. Bot. 2: 432 (1843) p.p.; Walp., Rep. Bot. Syst. 1: 564 (1849) p.p.; Kies in Bothalia 6: 169 (1951). *Cyclopia vogelii* Harv. var. *intermedia* (E. Mey.) Harv. in Harv. & Sond., Fl. Cap. 2: 6 (1862). *Cyclopia brachypoda* Benth. var. *intermedia* (E. Mey.) Hofmeyr & E. Phillips in Bothalia 1: 108 (1922) *nomen sed non planta.* Type: Western Cape, 'In saxosis montium prope Zwellendam et Keureboomsrivier, altit. 2000–3000 ped.', *Drège* s.n. sub a. (lecto. P!, designated here; isolecto. G!, K!, P!, PRE!, S!). **Fig. 10.**

Syn.: *Cyclopia aurea* Fourc. in Trans. Roy. Soc. S. Afr. 21: 92 (1932). Type: Western Cape, Humansdorp division, N slope of Zuur Anys Hills, west of De Jager's Farm, *Fourcade* 3049 (lecto. BOL 50210!, designated here; isolecto. BOL 50211!, K!, NBG!, PRE (×2)!).

Misappl.: *Cyclopia subternata* sensu Hofmeyr & E. Phillips in Bothalia 1: 107 (1922), non Vogel p.p.

Erect, multi-stemmed, robust shrubs, up to 2m tall, sprouting from a woody root-stock after fire; twigs pubescent when young, glabrescent. *Leaflets* 18–28(–40)mm long, 2–5(–8)mm wide, oblanceolate, ± flat; margins slightly recurved; glabrous, except for a few hairs on upper surface when young. *Bracts* 4–8mm long, ovate to lanceolate, acute to obtuse, shiny, coriaceous, not clasping the base of the calyx; outer surface glabrous; margins long ciliate; inner surface entirely densely pubescent. *Pedicels* 6–11mm long; glabrous. *Calyx* lobes rounded to lanceolate, acute to obtuse, base auriculate; carinal lobe 3.5–7.0mm long, slightly longer than the other lobes;

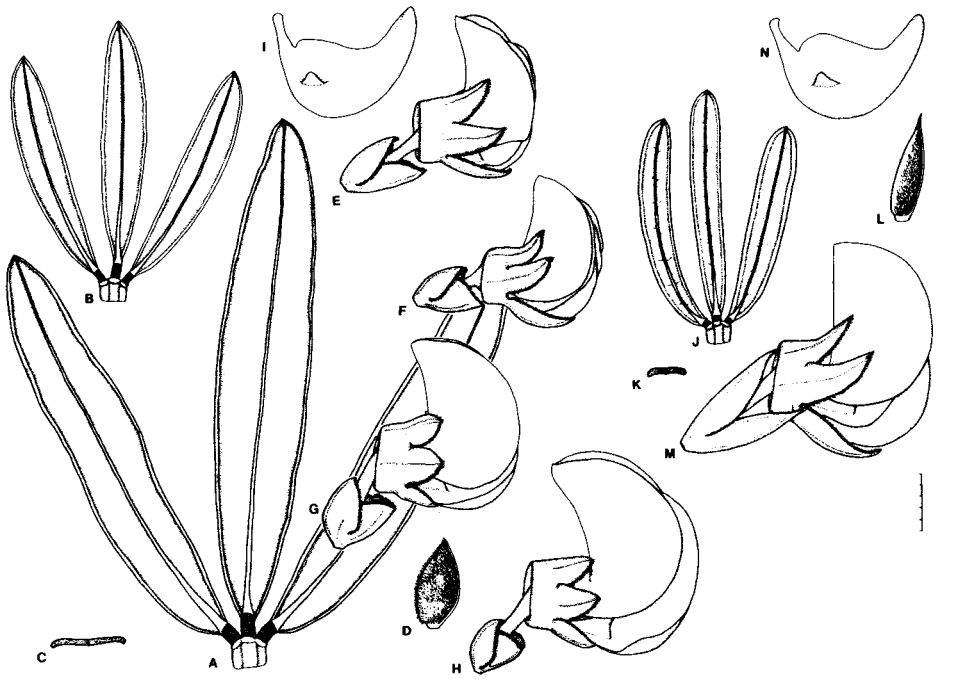

FIG. 10. A–I: *Cyclopia intermedia*; J–N: *C. falcata*. A, B, J: leaves, abaxial view; C, K: leaflets in transverse section to show orientation of margins; D, L: longitudinal section of bracts to show the vestiture on the inner surface; E, F, G, H, M: flowers in lateral view (note variation in size and shape of calyx lobes); I, N: keel petals. A, C: *De Lange* 24; B, E: *Schutte* 645; F, I: *Wurts* 1214; G: *Thompson* 3320; H: *De Lange* 24; J–N: *Esterhuysen* 14629. Scale in mm.

glabrous, margins ciliate. *Keel* strongly beaked; pocket 2–3mm long. *Ovary* 5 or 6-ovuled; glabrous. *Pods* obliquely oblong, laterally compressed.

C. intermedia is the most widespread species in the genus; its distribution range includes the Witteberg, Anysberg, Swartberg, Touwsberg, Rooiberg, Kammanassie, Kouga, Baviaanskloof, Langeberg, Outeniqua, Tsitsikamma and Vanstadens Mountains (Fig. 11). The species is found on rocky, loamy, sandy soil at altitudes ranging between 500 and 1700m.

The variation in the shape and size of the calyx lobes and bracts is considerable. Specimens from the inland mountains (Witteberg, Anysberg, Swartberg, Touwsberg, Rooiberg and Kammanassie) have lanceolate and acute calyx lobes and bracts, whilst those from the Kouga- and coastal mountains have rounded and obtuse calyx lobes and bracts. The species is, however, easily identified by its shiny, coriaceous (leathery) bracts, which have densely pubescent inner surfaces and ciliate margins. See also discussion under *C. falcata*.

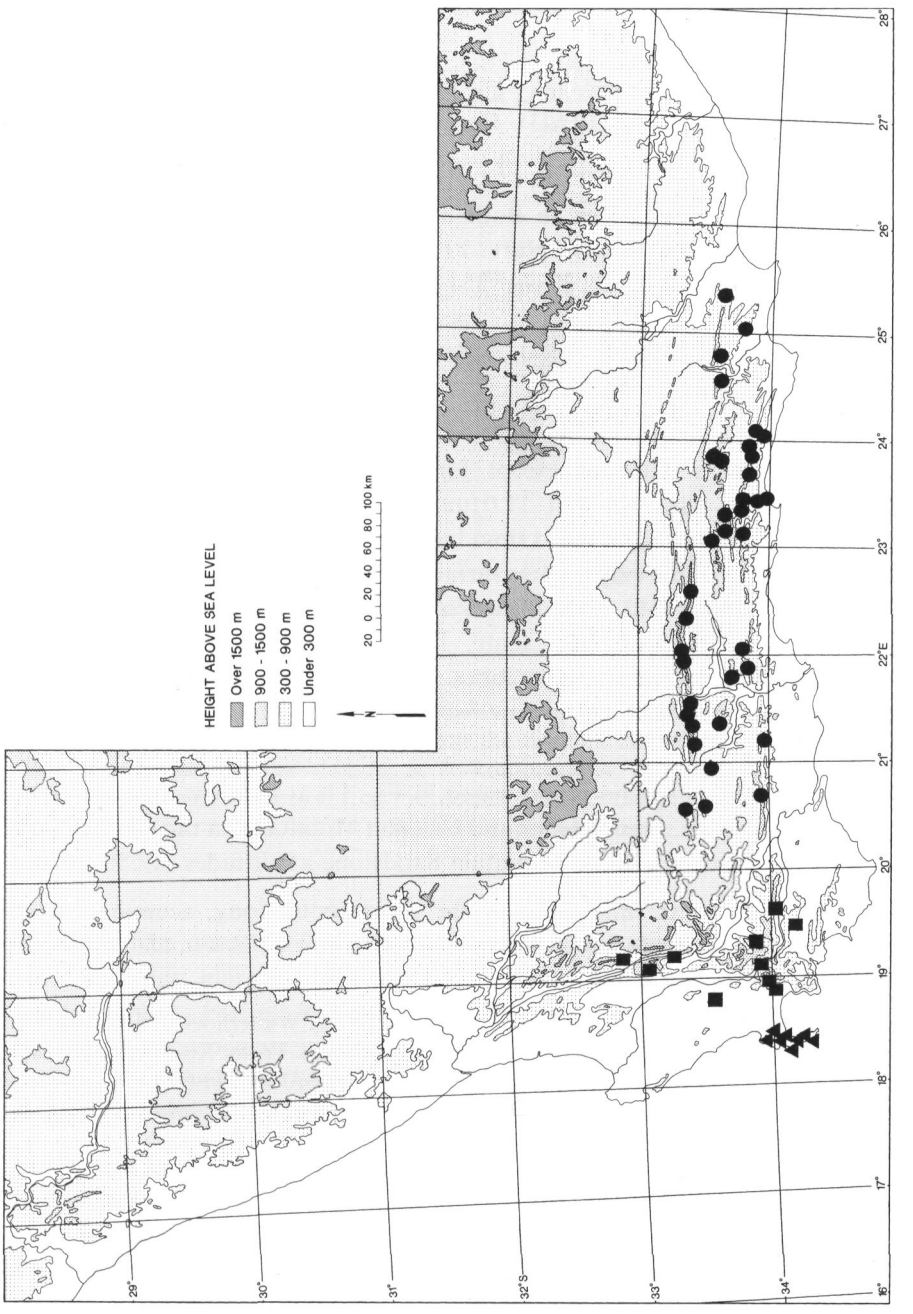

FIG. 11. The known geographical distribution of *Cyclopia falcata* (■), *C. galioides* (▲) and *C. intermedia* (●).

SELECTED ADDITIONAL SPECIMENS. Laingsburg: Witteberg, southern slope, *Compton* 21126, 12175 (NBG). Ladismith: Anysberg, along jeep track on lower eastern slopes, *Koekemoer* 304 (JRAU), *Schutte* 678–680 (JRAU, MO). Riversdale: Garcias Pass, *Schutte* 530, 531, 637 (JRAU), *Bolus* 11249 (BOL, K), *Phillips* 341 (NBG). Oudtshoorn: Swartberg Pass, southern side, *Schutte* 724 (JRAU). Humansdorp: Blueberg, Loerie Plantation, *Dix* 3 (BOL).

14. Cyclopia falcata (Harv.) Kies in Bothalia 6: 168 (1951) excl. var. *ovata* Kies. *Cyclopia vogelii* Harv. var. *falcata* Harv. in Harv. & Sond., Fl. Cap. 2: 7 (1862). Type: Western Cape, Witzenberg, *Zeyher* 354 (lecto. SAM!, designated here; isolecto. K!). **Fig. 10.**

Misappl.: *Cyclopia brachypoda* sensu Hofmeyr & E. Phillips in Bothalia 1: 108 (1922), non Benth. p.p.

Erect, robust, multi-stemmed shrubs, up to 1.5m tall, sprouting from a woody rootstock after fire; twigs glabrous except for a few hairs in leaf axils. *Leaflets* (13–)22–27(–33)mm long, 1.5–4.0(–11.0)mm wide, linear to elliptic, flat; margins slightly revolute; glabrous. *Bracts* 8–11mm long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins short ciliate; inner surface puberulent along fold, glabrous towards margins. *Pedicels* 9.5–15.0mm long; glabrous. *Calyx* lobes lanceolate, acute, falcate, base auriculate; carinal lobe 6.5–8.0mm long, longer than the other lobes; glabrous, margins ciliate. *Keel* strongly beaked; pocket ± 2.5mm long. *Ovary* 6 or 7-ovuled; glabrous. *Pods* obliquely oblong, laterally compressed.

The distribution of this species is illustrated in Fig. 11. It is fairly common on the Witzenberg, Winterhoek, French Hoek and Caledon Mountains in the Western Cape. *C. falcata* occurs on clayey Table Mountain Sandstone at altitudes of 550–1600m.

C. falcata differs from *C. intermedia* by the chartaceous, long, acuminate bracts (coriaceous, short and acute in *C. intermedia*) and from *C. genistoides* by the flat leaflets (terete in *C. genistoides*).

SELECTED ADDITIONAL SPECIMENS. Porterville: Great Winterhoek Wilderness Area, Voorberg, *Schutte* 598 (JRAU, MO). Stellenbosch: Jonkershoek Forest Reserve, ridge east of Swartboschkloof, *De Kock* 26 (NBG); Helderberg, *Esterhuysen* 14629 (BOL). French Hoek: French Hoek Pass, Villiersdorp side, *Schutte* 543, 612 (JRAU). Caledon, Zwarteberg, *Schlechter* 5583 (Z).

15. Cyclopia alpina A.L. Schutte **nom. et stat. nov. Fig. 12.**

Basionym: *Cyclopia genistoides* (L.) R. Br. var. *ovalifolia* Kies in Bothalia 6: 166 (1951). Type: Western Cape, Caledon division, Sneeukop, *Esterhuysen* 2635 (lecto. BOL!, designated here; isolecto. K!, PRE!).

Sprawling or prostrate, lax, multi-stemmed shrubs, up to 0.3m tall, sprouting from a woody rootstock after fire; twigs glabrous. *Leaflets* 3–11mm long, 0.5–1.0mm wide, linear, terete, or 7–9mm long, 2–3mm wide, oblanceolate, ± flat with margins slightly erosed; margins strongly revolute or rarely only slightly recurved. *Bracts* 4.5–9.0mm

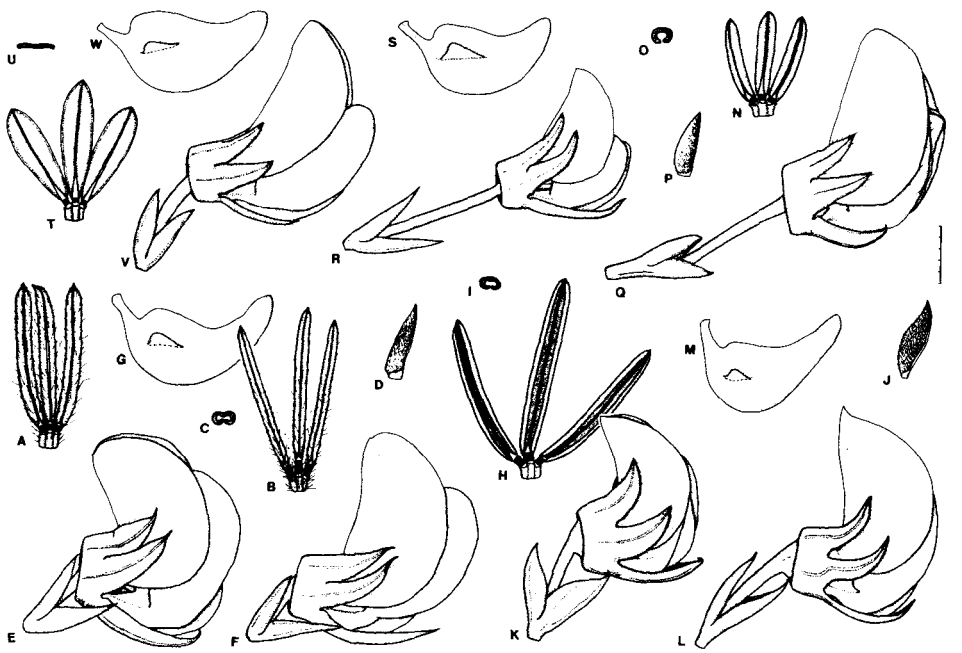

FIG. 12. A–G: *Cyclopia galioides*; H–M: *C. genistoides*; N–W: *C. alpina*. A, B, H, N, T: leaves, abaxial view; C, I, O, U: leaflets in transverse section to show orientation of margins; D, J, P: longitudinal section of bracts to show the vestiture on the inner surface; E, F, K, L, Q, R, V: flowers in lateral view; G, M, S, W: keel petals. A, E: *Pillans* 3421; B, C, D, F, G: *Leighton* 1616; H–I: *Schutte* 614; J, K, M: *Barker* 4214; L: *Compton* 15335; N–Q, S: *Vlok & Schutte* 250; R: *Esterhuysen* 11277; T–W: *Esterhuysen* 6469. Scale in mm.

long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins glabrous; inner surface pubescent along fold, glabrous towards margins. *Pedicels* 9–17mm long; glabrous. *Calyx* lobes lanceolate, falcate, acuminate, base auriculate; carinal lobe 4.5–7.5mm long, longer than the other lobes; glabrous, margins ciliate. *Keel* shortly beaked; pocket 2–4mm long. *Ovary* (4–)6 or 7-ovuled; glabrous. *Pods* obliquely oblong, laterally compressed.

C. alpina is a rare subalpine species known only from the summits and upper slopes of the Hottentots Holland, Hex River and Wemmershoek Mountains in the western region and the Kammanassie Mountains in the southern region (Fig. 13), where it is found in rocky sandy soil at altitudes of 1170–2070m.

Although closely allied to *C. genistoides*, this species is quite different in its long thin pedicels, non-apiculate calyx lobes, shortly beaked keel and short standard claw, as well as the margins of the leaflets, which may be both strongly revolute and slightly recurved on the same plant. Specimens from the Kammanassie Mountains have almost totally flat leaflets. *C. genistoides* has shorter and thicker pedicels, apiculate

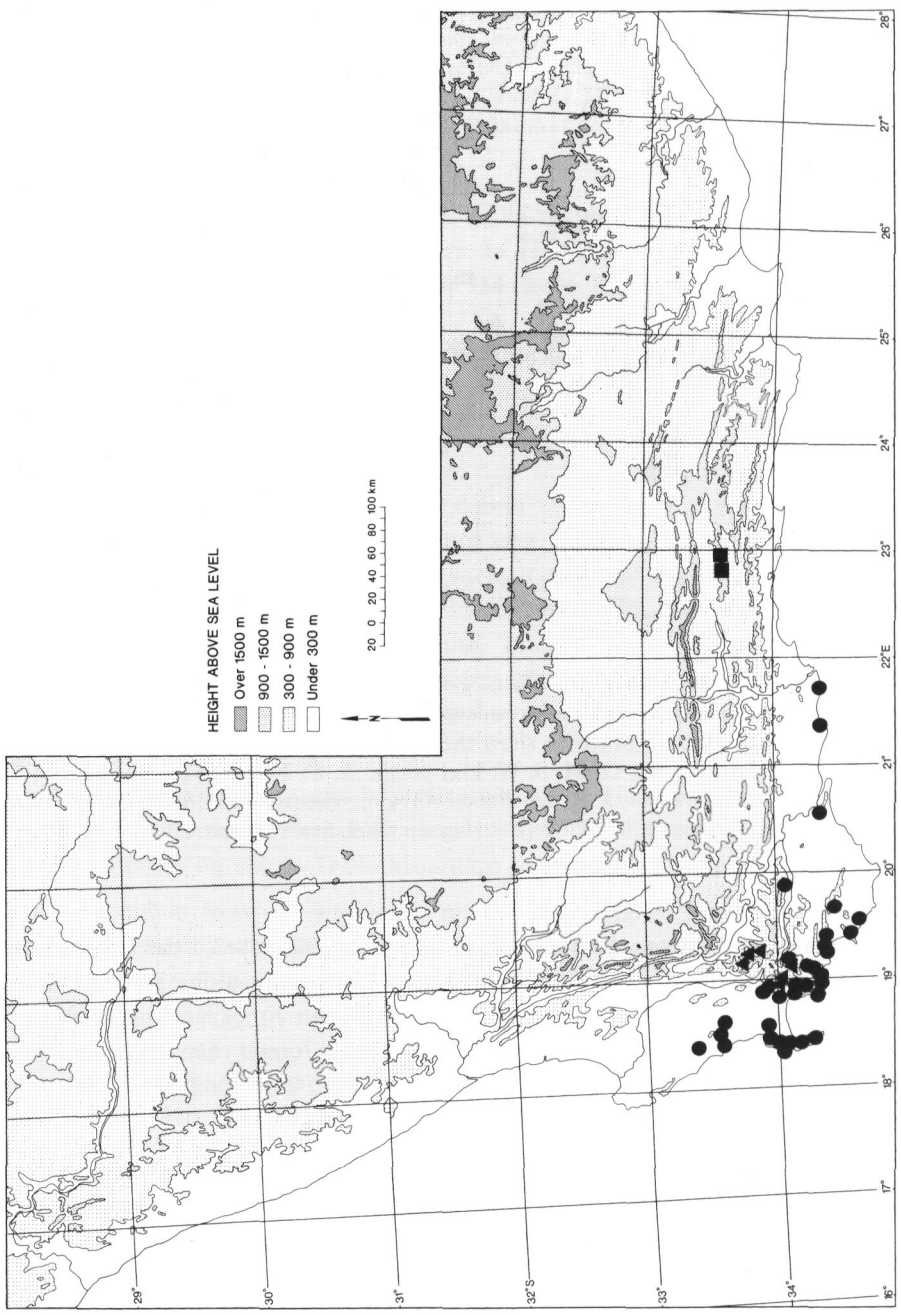

FIG. 13. The known geographical distribution of *Cyclopia alpina* (western form ▲, southern form ■) and *C. genistoides* (●).

calyx lobes, a strongly beaked keel and a longer standard claw. The margins of the leaflets are invariably strongly revolute.

There is considerable variation in the size of the leaves, flowers and calyx lobes, which seems to be correlated with the exposure and age of the plant. Old plants, growing in the open, generally have small flowers, long calyx lobes and terete leaves, whilst young and vigorously sprouting individuals have large flowers, short calyx lobes and ovate leaves, with only slightly recurved margins.

SELECTED ADDITIONAL SPECIMENS. *Western region*: Paarl: Wemmershoek Peak, *Stokoe* s.n. (SAM 56321), *Esterhuysen* 11277 (BOL, NBG, PRE, SAM). Caledon: Hottentots Holland Mountains, top end of Landdrost Kloof, *Vlok & Schutte* 250 (JRAU, MO); Somerset Sneeuwkop, *Stokoe* s.n. (SAM 56018, SAM 56019). Worcester: Du Toits Peak, upper slopes along ridge, *Esterhuysen* 30556 (BOL); Ridge between Goudini Sneeukop and Deception Peak, *Esterhuysen* 33447 (BOL). *Southern region*: Uniondale: Kammanassie Mountains, Mannetjiesberg, *Schutte* 754 (JRAU), *Vlok & Schutte* 351 (MO); Kammanassie Mountains, Buffelsdrif, *Bond* 1643 (NBG, PRE).

16. Cyclopia genistoides (L.) R. Br. in Ait., Hort. Kew. 3: 5 (1811) excl. syn. *Gompholobium maculatum*; DC., Prodr. 2: 101 (1825); Spreng., Syst. Veg. 4: 171 (1827); E. Mey. in Linnaea 7: 145 (1832) p.p.; Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839); Walp. in Linnaea 13: 454 (1839) excl. syn. *Cyclopia galioides*; Dietr., Syn. Pl. 2: 1500 (1840); Benth. in Lond. J. Bot. 2: 434 (1843); Walp., Rep. Bot. Syst. 1: 564 (1849); Harv. in Harv. & Sond., Fl. Cap. 2: 7 (1862); Hofmeyr & E. Phillips in Bothalia 1: 108 (1922); Kies in Bothalia 6: 166 (1951). **Fig. 12.**

Basionyms: *Sophora genistoides* L., Sp. Pl. 1: 373 (1753), Syst. Nat. ed. 10, 2: 1015 (1759), Sp. Pl. ed. 3, 1: 534 (1764); Berg., Descr. Pl. Cap. 140 (1767); Burm.f., Fl. Cap. Prodr. 12 (1768); Houtt., Handleiding Plantk. 5: 5 (1776), Pflanzensyst. 3: 499 (1778); Reichard, Syst. Pl. 2: 242 (1779) excl. var. ß; J.F. Gmel., Syst. Nat. 664 (1791); Thunb., Prodr. Pl. Cap. 1: 79 (1794); Poir., Encycl. 5: 488 (1804); Vent., Dec. Gen. Nov. 8 (1808); Richt., Codex Bot. Linn., 390 (1840) excl. var. ß. *Ibbetsonia genistoides* (L.) Sims, Curtis's Bot. Mag. t. 1259 (1810) excl. syn. *Gompholobium maculatum*. *Podalyria genistoides* (L.) Willd., Sp. Pl. ed. 4, 2: 502 (1799). *Galega genistoides* (L.) Thunb., Prodr. Pl. Cap. 2: 192 (1800), Fl. Cap. 600 (1823). Type: Without locality, *anon.* s.n. (lecto. LINN 522.11!, designated here).

Syn.: *Cyclopia genistoides* (L.) R. Br. var. *linearifolia* Eckl. & Zeyh., Enum. 2: 154 (1836). Type: Western Cape, Stellenbosch division, 'Prope pagum Somerset', *Ecklon & Zeyher* 1143 B (lecto. S!, designated here; isolecto. BOL!, S!).

Cyclopia teretifolia Eckl. & Zeyh., Enum. 2: 154 (1836); Dietr., Syn. Pl. 2: 1500 (1840). *Cyclopia genistoides* (L.) R. Br. var. *teretifolia* (Eckl. & Zeyh.) Kies in Bothalia 6: 166 (1951). Type: Western Cape, Caledon division, 'In locis lapidosis et humidiusculis laterum montium prope ostium fluminis Klynrivier', *Ecklon & Zeyher* 1145 (lecto. S!, designated here; isolecto. C!, G!, K!, P!, S!, SAM!, W!).

Cyclopia heterophylla Eckl. & Zeyh., Enum. 2: 154 (1836); Dietr., Syn. Pl. 2: 1501 (1840). *Cyclopia genistoides* (L.) R. Br. var. *heterophylla* (Eckl. & Zeyh.) Harv. in Harv. & Sond., Fl. Cap. 2: 8 (1862); Kies in Bothalia 6: 166 (1951). Type: Western Cape, Swellendam division, 'In montium lateribus secundum flumen Rivier Zonder Einde supra villas Linde et Ecksteen', *Ecklon & Zeyher* 1148 (lecto. S!, designated here; isolecto. C!, G!, K!, P!, S!).

Erect, multi-stemmed, robust shrubs, up to 2m tall, sprouting from a woody rootstock after fire; twigs glabrous, except for a few hairs in leaf axils. *Leaflets* (8–)14–20(–30)mm long, 1–2mm wide, linear, terete; margins strongly revolute; glabrous. *Bracts* 6–9mm long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface glabrous; margins short ciliate at apices or glabrous; inner surface pubescent. *Pedicels* 7–13mm long; glabrous. *Calyx* lobes lanceolate, falcate, apiculate, base auriculate; carinal lobe 6.5–8.5mm long, longer than the other lobes; glabrous, margins ciliate. *Keel* strongly beaked; pocket 1.5–2.5mm long. *Ovary* 5 or 6-ovuled; glabrous. *Pods* obliquely oblong, laterally compressed.

This species is known from the Malmesbury-Darling area, the hills and mountains on the Cape Peninsula and Cape Flats, Grabouw, Kogelberg, Betty's Bay, Hermanus, Bredasdorp, De Hoop, Swellendam and eastwards to Albertinia in the southern region (Fig. 13). It grows in sandy soil at altitudes of 60–1170m.

Apart from variation in the length of the leaves, other morphological characters are remarkably constant within the species. It is generally recognized by the long falcate, apiculate calyx lobes and the glabrous stems and leaves.

SELECTED ADDITIONAL SPECIMENS. Malmesbury: near Bokbaai, *Esterhuysen* 3829 (BOL). Cape Town: Top of Constantiaberg, *Schutte* 614 (JRAU); Caledon: Klein River Mountains, east of Rocklands Peak, *Stokoe* s.n. (SAM 55907); River Sonder Einde, *Stokoe* s.n. (BOL 9004). Bredasdorp: De Hoop, Potberg, *Van Wyk* 2088 (JRAU).

17. Cyclopia galioides (P.J. Bergius) DC., Prodr. 2: 101 (1825); Spreng., Syst. Veg. 4: 171 (1827); E. Mey. in Linnaea 7: 145 (1832); Eckl. & Zeyh., Enum. 2: 154 (1836); E. Mey., Comm. 1: 4 (1836), excl. specimens; Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839); Dietr., Syn. Pl. 2: 1500 (1840); Benth. in Lond. J. Bot. 2: 434 (1843); Harv. in Harv. & Sond., Fl. Cap. 2: 8 (1862); Hofmeyr & E. Phillips in Bothalia 1: 109 (1922); Kies in Bothalia 6: 164 (1951). **Fig. 12.**
Basionym: *Sophora galioides* P.J. Bergius, Descr. Pl. Cap. 141 (1767). *Sophora genistoides* var. *galioides* (P.J. Bergius) Richt., Codex Bot. Linn., 390 (1840). Type: Western Cape, "e. Cap. b. Spei", *Grubb* s.n. (holo. SBT!).
Syn.: *Galega genistoides* (L.) Thunb. var. *ß*, Thunb., Fl. Cap., 600 (1823).

Cyclopia capensis T.M. Salter in J. S. Afr. Bot. 5: 71 (1939); Kies in Bothalia 6: 165 (1951). Type: Western Cape, Cape Peninsula, Paulsberg Range, near Kanonkop, *Salter* 8035 (holo. BOL!; iso. K!, SAM!).

Erect, multi-stemmed, robust shrubs, up to 1m tall, sprouting from a woody rootstock after fire; twigs densely villous when young, glabrescent but with tufts of hair remaining in leaf axils. *Leaflets* 8–27mm long, 1–2mm wide, linear, terete; margins strongly revolute; long villous, glabrescent. *Bracts* 7–9mm long, lanceolate, acuminate, apiculate, chartaceous, mostly longer than pedicels but not clasping the base of the calyx; outer surface glabrous; margins glabrous; inner surface entirely puberulent. *Pedicels* 4–8mm long; glabrous. *Calyx* lobes triangular, falcate, acuminate, apiculate, base distinctly auriculate; not clasping the base of the calyx; carinal lobe 9–11mm long, distinctly longer than the other lobes; totally glabrous. *Keel* strongly beaked; pocket 2.5–3.0mm long. *Ovary* 5-ovuled; glabrous. *Pods* oblong-ovate, laterally compressed.

This species is restricted to the Cape Peninsula (Fig. 11), where it occurs at altitudes between 160 and 700m in rocky sandy Table Mountain Sandstone.

C. galioides is easily identified by the presence of long villous trichomes on the leaves and stems, as well as the glabrous and distinctly long, apiculate calyx lobes.

SELECTED ADDITIONAL SPECIMENS. Cape Town: Above Table Mountain reservoir, *Wolley-Dod* 875 (BOL). Simons Town: Noord Hoek Mountain, *Compton* 14538 (NBG); Swartberg, *Oliver* 8669 (NBG, PRE); Smith's Farm, *Compton* 10638 (NBG); Cape Point, Kanon Kop, *Compton* 14473 (NBG).

Sect. 5. Praegnans A.L. Schutte **sect. nov.**; sectio leguminibus inflatis brevis et marginalibus hirsutis a congeneribus diversa.
Type: *C. meyeriana* Walp.

Sect. *Praegnans* is unique in having short swollen pods, with hairy margins. This section consists of six subalpine species.

18. Cyclopia aurescens Kies in Bothalia 6: 164 (1951) excl. var. *glauca* Kies. Type: Western Cape, Seven Weeks Poort Mountains, *Primos* 33 (lecto. PRE!, designated here; isolecto. NBG!). **Fig. 14.**

Erect, robust shrubs, up to 0.7m tall and 2m wide, sprouting from a woody rootstock after fire; twigs villous when young, glabrescent. *Leaflets* 8–22(–28)mm long, 1–2mm wide, linear, terete; margins strongly revolute; villous when young, glabrescent. *Bracts* 4–7mm long, lanceolate, acuminate, coriaceous, not clasping the base of the calyx; outer surface villous to glabrous, often shiny; margins densely villous; inner surface entirely tomentose. *Pedicels* 5–8mm long; villous. *Calyx* lobes triangular, acute; carinal lobe 5–7mm long, longer than the other lobes; villous. *Keel* strongly beaked; pocket 3mm long. *Ovary* 5-ovuled; ciliate on upper and lower margins. *Pods* obliquely ovate, laterally inflated.

C. aurescens is known only from the crest and upper slopes of the Klein Swartberg Mountains north of Ladismith (Fig. 15), where it occurs at altitudes above 1800m in rocky sandy soil.

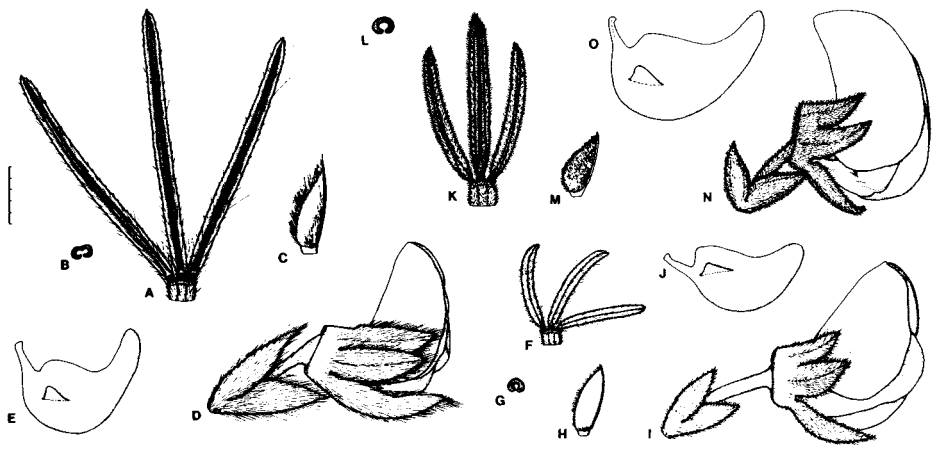

FIG. 14. A–E: *Cyclopia alopecuroides*; F–J: *C. bolusii*; K–O: *C. aurescens*. A, F, K: leaves, abaxial view; B, G, L: leaflets in transverse section to show orientation of margins; C, H, M: longitudinal section of bracts to show the vestiture on the inner surface; D, I, N: flowers in lateral view; E, J, O: keel petals. A–E: *Bond* 1620; F–J: *Vlok* 1243; K–O: *Vlok & Schutte* 274. Scale in mm.

This species is closely related to *C. bolusii*, but can be discerned by the entirely tomentose inner surface of the bracts and the robust, erect growth form (bracts ± glabrous on the inner surface and growth form lax and sprawling in *C. bolusii*).

ADDITIONAL SPECIMENS EXAMINED. Ladismith: Klein Swartberg Mountains, *Vlok & Schutte* 176, 274 (JRAU); Klein Swartberg Mountains, crest of mountain above Sandrivier, *Schutte* 771–775 (JRAU); Seven Weeks Poort Berg, *Barnard* s.n. (SAM 46295); Klein Swartberg Mountains, west of Klein Swartberg Peak, *Andreae* 1255 (BOL); Klein Swartberg Mountains, Towerkop, *Esterhuysen* 26781 (BOL).

19. Cyclopia bolusii Hofmeyr & E. Phillips in Bothalia 1: 109 (1922); Kies in Bothalia 6: 163 (1951). Type: Western Cape, Oudtshoorn division, in stony places at summit of the Swartberg Pass, *Bolus* 11465 (holo. BOL!, iso. K!). **Fig. 14.**

Lax, sprawling shrublets, up to 0.3m tall, sprouting from a woody rootstock after fire; twigs villous when young, glabrescent. *Leaflets* 6–13mm long, 1mm wide, linear, terete; margins strongly revolute; villous when young, glabrescent. *Bracts* 7.5–8.0mm long, lanceolate, acuminate, chartaceous, not clasping the base of the calyx; outer surface villous; margins villous; inner surface ± glabrous with a few hairs at base. *Pedicels* 9–10mm long; glabrous. *Calyx* lobes ovate, acute, villous; carinal lobe 7.0–7.5mm long, distinctly longer than other lobes; tube ± glabrous. *Keel* shortly beaked; pocket 3mm long. *Ovary* 7-ovuled; ciliate on both margins. *Pods* obliquely ovate; laterally inflated.

This species is a rare and highly localized endemic of the Great Swartberg Mountains

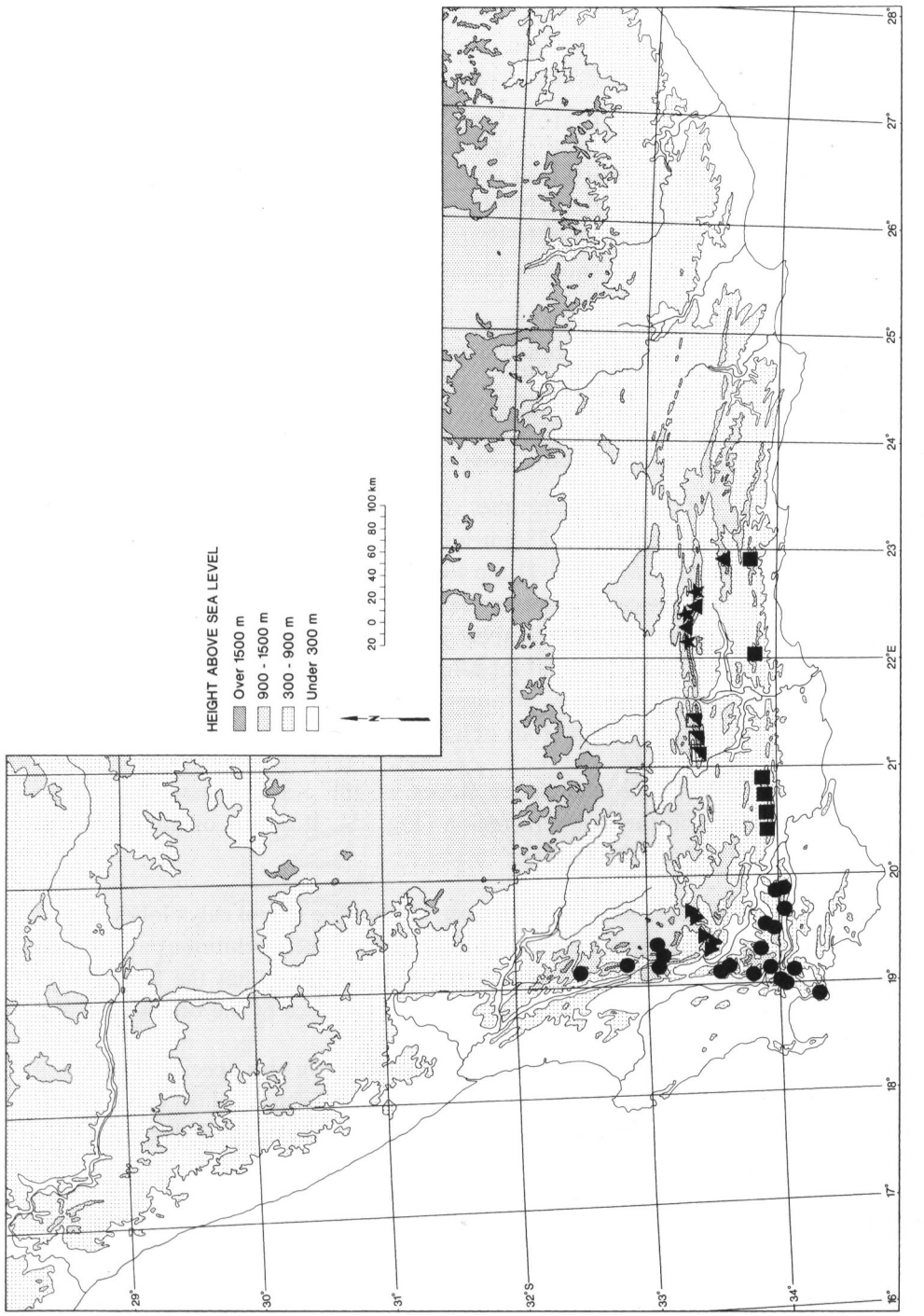

FIG. 15. The known geographical distribution of *Cyclopia alopecuroides* (▲), *C. aurescens* (◪), *C. bolusii* (★), *C. bowieana* (■), *C. glabra* (▼) and *C. meyeriana* (●).

in the southern region (Fig. 15). It grows in moist, humic, sandy soil in cracks in rocks at an altitude of 1900–2270m.

See discussion under *C. aurescens*.

SELECTED ADDITIONAL SPECIMENS. Oudtshoorn: Great Swartberg Mountains, trail to Bothashoek, east of Swartberg Pass, *Schutte* 749 (JRAU); Great Swartberg Mountains, near the summit of Swartberg Pass, *Stokoe* s.n. (SAM 66044); Great Swartberg Mountains, Swartberg Pass, *Stokoe* 8788 (BOL); Great Swartberg Mountains, on crest near Witberg, *Vlok* 1243 (JRAU); Great Swartberg Mountains, near crest of Blesberg, *Vlok* 2539 (JRAU).

20. Cyclopia alopecuroides A.L. Schutte **sp. nov.**; *C. bolusii* Hofmeyr & E. Phillips affinis, a qua lobis calycis longis, bractearum interiorium pilosis faciebus et habitu erectu differt. **Fig. 14.**
Type: Western Cape, Uniondale, Kammanassie Mountain, Mannetjiesberg, *Vlok & Schutte* 129 (holo. BOL, iso. NBG).

Erect shrublets, up to 0.6m tall; sometimes sprouting from a woody rootstock after fire; twigs velutinous. *Leaflets* 10–28mm long, 1mm wide, linear, terete; margins strongly revolute; hirsute. *Bracts* 9–11mm long, lanceolate, acuminate, coriaceous, not clasping the base of the calyx; outer surface hirsute; margins hirsute; inner surface velutinous at base, glabrous towards apex. *Pedicels* 8–11mm long; hirsute. *Calyx* lobes rounded, acute, hirsute; carinal lobe 8.5–10.5mm long, distinctly longer than other lobes; tube ± glabrous. *Keel* strongly beaked; pocket ± 2mm long. *Ovary* 5-ovuled; ciliate on upper margin. *Pods* obliquely ovate, laterally inflated.

This species is restricted to the upper slopes of the Kammanassie and Great Swartberg Mountains in the southern region (Fig. 15). It occurs on shalebands at altitudes between 1500 and 2000m.

C. alopecuroides is closely related to *C. bolusii*, but has the lateral calyx lobes shorter than the upper two lobes and the inner surface of the bracts velutinous at the base and along the fold and glabrous towards the apex. *C. bolusii* has the lateral calyx lobes longer than the upper two lobes and the inner surface of the bracts glabrous.

Both sprouting and non-sprouting growth forms occur in this species. The populations on the Kammanassie Mountain do not sprout after fire, whilst those on the Swartberg do. This difference may be significant, but to assign specific status would require more research.

ADDITIONAL SPECIMENS EXAMINED. *Swartberg form*: Oudtshoorn: Great Swartberg Mountains, Botha's track, pass north of Tierberg, *Bond* 1620 (NBG, PRE); Great Swartberg Mountains, Spitzkop, Meiringspoort, *Thorne* s.n. (SAM 51847, SAM 51448); Great Swartberg Mountains, ridge north of Spitzkop, *Schutte* 824 (NBG). *Kammanassie form* Uniondale: Mannetjiesberg, southern slopes, *Rourke* 866 (NBG, PRE), *Vlok* 2715 (NBG).

21. Cyclopia meyeriana Walp. in Linnaea 13: 454 (1839); Dietr., Syn. Pl. 2: 1501 (1840); Walp., Rep. Bot. Syst. 1: 564 (1849); Kies in Bothalia 6: 165 (1951). Type: Western Cape, 'In rupestribus humidis montis Dutoitskloof, altit. 3000–4500 ped.', *Drége* s.n. (lecto. P!, designated here; isolecto. BM!, K!, P!, S!). **Fig. 16.**
Syn.: *Cyclopia sessiliflora* E. Mey., Comm. 1: 4 (1836) non Eckl. & Zeyh.; Benth. in Ann. Wiener Mus. Naturgesch. 2: 67 (1839); Meisn. in Lond. J. Bot. 2: 61 (1843); Benth. in Lond. J. Bot. 2: 434 (1843); Harv. in Harv. & Sond., Fl. Cap. 2: 8 (1862); Hofmeyr & E. Phillips in Bothalia 1: 109 (1922). Type as above. [Note: Walpers (1839) noticed that Meyer's (Feb. or later, 1836) *Commentariorum* was published later than Ecklon & Zeyher's (Jan. 1836) *Enumeratio* and therefore proposed a new name for the species.]

Cyclopia montana Hofmeyr & E. Phillips var. *montana* in Bothalia 1: 109 (1922); Kies in Bothalia 6: 165 (1951). Type: Western Cape, Tulbagh division, Sneeuwgat Valley, Great Winterhoek, *Phillips* 1673 (lecto. SAM 11131!, designated here). [Note: The type collection number (*Phillips* 1693) published by Hofmeyr & Phillips (1922) is probably a printing error, since it could not be traced in any

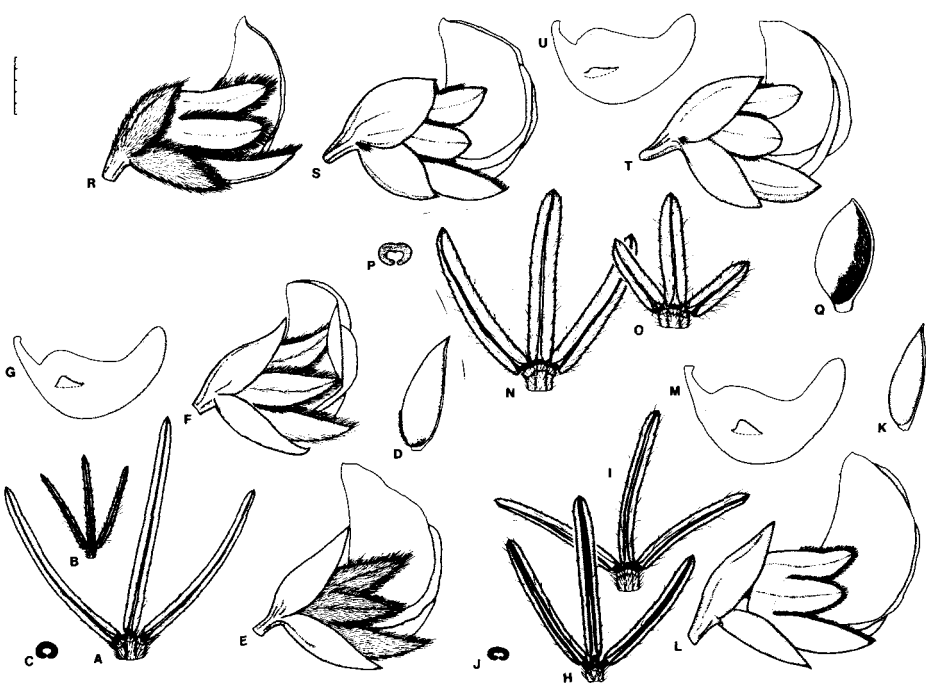

FIG. 16. A–G: *Cyclopia meyeriana*; H–M: *C. glabra*; N–U: *C. bowieana*. A, B, H, I, N, O: leaves, abaxial view; C, J, P: leaflets in transverse section to show orientation of margins; D, K, Q: longitudinal section of bracts to show the vestiture on the inner surface; E, F, L, R, S, T: flowers in lateral view; G, M, U: keel petals. A, C, D, E: *Taylor* 8653; B, *Stokoe* s.n.; F, *Barnard* s.n.; G, *Esterhuysen* 15610; H, *Schutte* 557; I–M: *Esterhuysen* 11012; N–P: *Schutte* 526; Q, S: *McDonald* 1408; R, U: *McDonald* 1534; S, *Wurts* 426. Scale in mm.

herbarium. However, the specimen in SAM (*Phillips* 1673) has a description in Phillips' hand and is therefore chosen as type.]

Erect, single-stemmed shrubs, up to 2m tall, not sprouting after fire; woody rootstock absent; twigs villous when young, glabrescent with age. *Leaflets* 10–22mm long, 0.5–1.0mm wide, linear, terete; margins strongly revolute; villous, glabrescent. *Bracts* 8–13mm long, 2.0–3.5mm wide, lanceolate, acuminate, coriaceous, clasping the base of the calyx; outer surface glabrous; margins ciliate to glabrous; inner surface entirely glabrous, except for a few hairs at the base. *Pedicels* 3–4mm long; villous. *Calyx* lobes lanceolate, acute-acuminate; carinal lobe 8–10mm long, longer than the other lobes; lateral lobes shorter than the upper two; sparsely to densely villous, margins villous. *Keel* strongly beaked; pocket 2–3mm long. *Ovary* 5 or 6-ovuled; margins sparsely villous to glabrous. *Pods* obliquely ovate; laterally inflated.

C. meyeriana is widely distributed on the Cedarberg, Koue Bokkeveld, Winterhoek, Du Toits Kloof, Hottentots Holland and Rivier Sonder End Mountains in the Western Cape (Fig. 15), where it is found along streamsides at high altitudes (1000–1800m).

See discussion under *C. glabra*.

ADDITIONAL SPECIMENS EXAMINED. Ceres: Koue Bokkeveld, Vredelus, *Esterhuysen* 29674 (BOL); Great Winterhoek, Sneeuwgat Valley, *Phillips* s.n. (BOL 50334), *Thorne* s.n. (SAM 50397). Paarl: Witteberg, *Esterhuysen* 8677, 9466 (BOL). Worcester: neck between Cossack Peaks, *Taylor* 6600 (PRE). Caledon: Rivier Sonder Einde Peak, *Thorne* s.n. (SAM 45793), *Barnard* s.n. (SAM 27377).

22. Cyclopia glabra (Hofmeyr & E. Phillips) A.L. Schutte **stat. nov. Fig. 16.**
Basionym: *Cyclopia montana* Hofmeyr & E. Phillips var. *glabra* Hofmeyr & E. Phillips in Bothalia 1: 109 (1922); Kies in Bothalia 6: 165 (1951). Type: Western Cape, Ceres division, Matroosberg, *Phillips* 1943 (lecto. SAM!, designated here).

Robust, much-branched shrubs, up to 1.2m tall, sprouting from a woody rootstock after fire; twigs villous when young, glabrescent. *Leaflets* 7–19mm long, 1.0–1.5mm wide, linear, terete; margins strongly revolute; sparsely villous when young, glabrescent. *Bracts* 10–12mm long, 3–4mm wide, lanceolate, acuminate, coriaceous, clasping the base of the calyx; outer surface glabrous; margins glabrous; inner surface glabrous. *Pedicels* 3–4mm long; glabrous. *Calyx* lobes rounded, acute-obtuse; carinal lobe 7.5–8.5mm long, longer than the other lobes; lateral lobes shorter than the upper two; glabrous, margins ciliate. *Keel* strongly beaked; pocket $\pm$2mm long. *Ovary* 5-ovuled; glabrous. *Pods* obliquely ovate, laterally inflated.

This species has been recorded only from the crest and upper slopes of the Hex River Mountains in the Western Cape (Fig. 15). *C. glabra* grows amongst rocks in well-drained Table Mountain Sandstone at 1670–2250m above sea level.

Apart from the glabrous calyx and inner surface of the bracts, as well as the multi-stemmed growth form, it is almost impossible to distinguish *C. glabra* from *C. meyeriana*. The two species are closely related and should perhaps be amalgamated, but more field studies are required to confirm this with certitude.

SELECTED ADDITIONAL SPECIMENS. Worcester: Waaihoek Mountains, *Stokoe* s.n. (SAM 56030); Milner Peak, eastern aspect, *Esterhuysen* 8707 (BOL); Groothoek Peak, *Esterhuysen* 27685 (BOL); Matroosberg, *Schutte* 557 (JRAU, MO), *Esterhuysen* 14221 (BOL), *Winter* 238 (NBG); Fonteintjiesberg, *Esterhuysen* 8767, 30418 (BOL).

23. Cyclopia bowieana Harv. in Harv. & Sond., Fl. Cap. 2: 9 (1862); Kies in Bothalia 6: 164 (1951). Type: Western Cape, 'On the Traduberg', *Bowie* s.n. sub Herb. Hook. (holo. K!, iso. BM!). **Fig. 16.**
Syn.: *Cyclopia ashtonii* Hofmeyr & E. Phillips in Bothalia 1: 109 (1922). Type: Western Cape, Swellendam division, Langeberg Mountains, *Ashton* s.n. sub PRF 2843 (holo. PRE!).

Erect, robust shrubs, up to 2m tall and 1.5m wide; sometimes sprouting from a woody rootstock after fire; twigs villous when young, glabrescent. *Leaflets* 7–18mm long, 1.0–2.0(–2.5)mm wide, linear to lanceolate to obovate, terete or sometimes somewhat flattened; margins usually strongly revolute, sometimes only slightly so; villous. *Bracts* 8–11mm long, 4–5mm wide, ovate, acute, bright orange, coriaceous, clasping the base of the calyx; outer surface glabrous to villous; margins ciliate to glabrous; inner surface silky canescent, often only along fold, glabrous towards margins. *Pedicels* 3mm long; glabrous, except for a few hairs at the base. *Calyx* lobes rounded, obtuse, sparsely villous or glabrous, margins ciliate; carinal lobe 8–10mm long, longer than the other lobes; lateral lobes shorter than the upper two. *Keel* strongly beaked; pocket 2–3mm long. *Ovary* 4 or 5-ovuled; glabrous. *Pods* obliquely ovate, laterally inflated.

The distribution of *C. bowieana* is limited to the upper slopes of the Langeberg and Outeniqua Mountains in the southern region (Fig. 15). It is found at altitudes of 1220–1840m in rocky sandy Table Mountain Sandstone.

There are two growth forms of *C. bowieana*: a non-sprouting, single-stemmed form from the Langeberg which grows up to a height of almost 2m, and a multi-stemmed, sprouting growth form from the Outeniqua which can grow up to 1.2m tall and 1.5m wide.

ADDITIONAL SPECIMENS EXAMINED. *Langeberg form*: Swellendam: Langeberg, south facing slope of Twelve O'Clock Peak, *McDonald* 1408 (NBG, PRE). Heidelberg: Langeberg Mountains, Grootvadersbos Nature Reserve, *Vlok & Schutte* 206 (MO), *McDonald* 1534, 1220 (NBG), *Stirton* 10244 (NBG, PRE). *Outeniqua form*: Mossel Bay: Ruitersberg, *Bond* 1580 (PRE), *Schutte* 526 (JRAU). Knysna: Outeniqua Mountains, Millwood Nature Reserve, *Vlok* 2568 (JRAU).

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