

# A systematic study of the genus *Pseudopentameris* (Arundinoideae: Poaceae)

N.P. BARKER\*

**Keywords:** Arundineae, Arundinoideae, conservation, leaf anatomy, phenetics, phylogenetics, Poaceae, *Pseudopentameris*, systematics

## ABSTRACT

The genus *Pseudopentameris* Conert is examined morphologically and anatomically. A phenetic study of the morphologically variable species *P. macrantha* indicates that two taxa should be recognised. One of these, *P. caespitosa* N.P. Barker, is described as new. In addition, the study supports the inclusion of *Pentameris obtusifolia* in *Pseudopentameris*. The genus *Pseudopentameris* is re-delimited to accommodate the new taxa, and a key to species is provided. Details of the cytology, phylogeny and conservation status of taxa in the genus are also discussed.

## UITTREKSEL

Die genus *Pseudopentameris* Conert word morfologies en anatomies ondersoek. 'n Fenetiese ondersoek van die variërende spesie *P. macrantha* toon dat twee taksons erken moet word. Een van hulle, *P. caespitosa* N.P. Barker, word as nuut beskryf. Verder ondersteun die ondersoek die insluiting van *Pentameris obtusifolia* in *Pseudopentameris*. Die genus *Pseudopentameris* word heromgrens om die nuwe taksons te huisves, en 'n sleutel tot die spesies word verskaf. Besonderhede van die sitologie, filogenie en bewaringstatus van taksons in die genus word ook bespreek.

## INTRODUCTION

The genus *Pseudopentameris* Conert is endemic to the lowland fynbos of the southwestern Cape Province, South Africa. This genus was created by Conert (1971), who thought that two species of the genus *Danthonia* DC., *D. macrantha* Schrad. and *D. brachyphylla* Stapf, merited recognition as a separate genus. This new genus was characterised by unusually large spikelets which, while similar to both those of *Pentameris* P. Beauv. and *Danthonia*, differed in having many-nerved glumes. The nature of the fruit of these two species also set them apart.

Studies of the leaf anatomy (discussed below) provided further evidence of their singularity (De Wet 1956, 1960; Ellis 1985a). Ellis (1985b) observed that the leaf anatomy of the taxon he called *Pentameris sp. nov.*, bore a strong resemblance to the anatomy of the two known species of *Pseudopentameris*, and postulated a hybrid origin for this species. Additional studies on the fruit morphology (Barker 1986, 1989, 1993) and leaf anatomy (presented below) also suggested that this unusual species has close affinities with the other species of *Pseudopentameris*. Because of the nomenclatural confusion surrounding this taxon (see 1. *Pseudopentameris obtusifolia* below), past studies have referred to it by a number of names. Barker (1989) and Ellis (1985b) referred to it as *Pentameris sp. nov.* whereas Linder & Ellis (1990) refer to it as *Pentameris squarrosa* Stapf. Some herbaria (in particular PRE and STE) misapplied this name to the taxon now known as *Pentameris oerophila* N.P. Barker (1993), whereas BOL has used the synonym *Pentameris squarrosa* Stapf.

This study encapsulates all these observations, and documents the anatomical and morphological variation within the genus, and presents the relevant nomenclatural modifications that are required as a result of these observations.

## MORPHOLOGY

*Pseudopentameris* is unusual in having two species (*P. macrantha* and *P. obtusifolia*) with aerial stems that possess the anatomy of a rhizome (H.P. Linder unpublished). Until the anatomy and homology of these structures is better understood, the term 'stem' is used, as it serves to differentiate this structure from below-ground rhizomes and the annually produced flowering culm.

These stems are often branched, and the annual flowering culms are produced from their apical buds. Subsequent shoot growth takes place from what Linder & Ellis (1990) term caulescent innovation buds on the stems, which results in branched stems. This branching can lead to a shrub-like growth form in older plants. This type of growth form has also been described in some species of *Pentameris* (Barker 1993). In *Pseudopentameris obtusifolia* these branched aerial stems are scandent, spreading out from the base of the plant, over and between the other vegetation. Linder & Ellis (1990) illustrate this species (named in their work as *P. squarrosa*) and consider its unusual growth form to be an adaptation enabling the plant to survive long interfire periods that are characteristic of the fynbos biome. The two species which do not have these stems (*P. brachyphylla* and *P. caespitosa sp. nov.* described below) produce the annual flowering culm from an underground rhizome that can become fibrous or woody in older plants.

In *P. obtusifolia* the stems are covered by the persistent remains of the leaf sheaths, the dead leaf blades being

\* Department of Botany, University of Cape Town, Private Bag, Rondebosch 7700. Present address: Department of Botany, University of the Western Cape, Private Bag X17, Bellville 7535.  
Email: nigel@botany.uwc.ac.za  
MS. received: 1994-09-27.

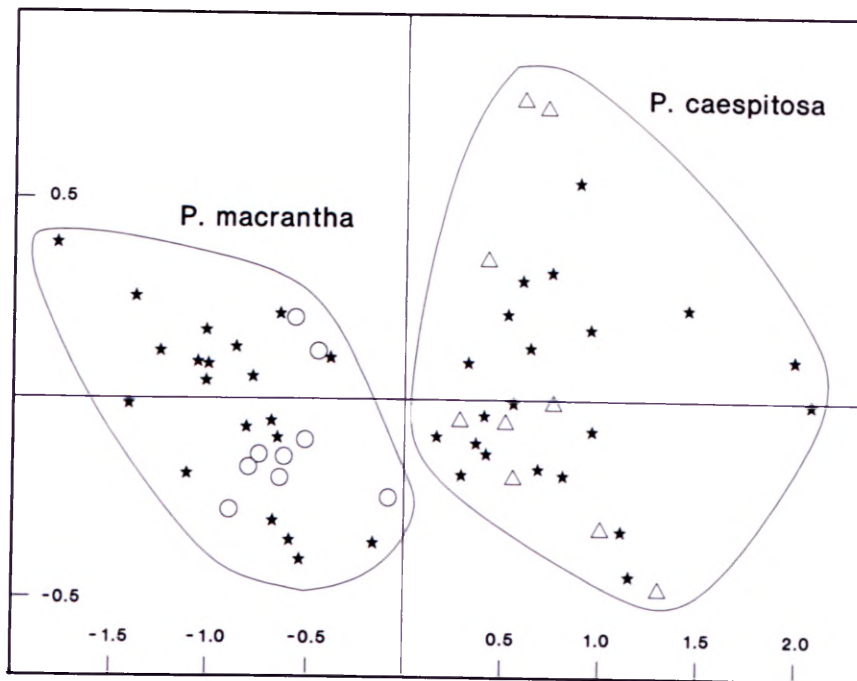


FIGURE 1.—First two axes of Principal Components Analysis (PCA) of 59 specimens matching the previous description of *Pseudopentameris macrantha*. Specimens measured for six floral characters. First axis: 81.7% of variation present in data. Second axis: 6.8%. Lines drawn around two groups were placed by eye. Each symbol represents an individual specimen. Specimens with rhizomatous growth form, *P. macrantha*, ○; specimens with caespitose growth form, *P. caespitosa*, △; specimens with no recorded growth form, ★.

deciduous. In the other species in the genus, the dead leaf blades are persistent, and in *P. brachyphylla* (Stapf) Conert they curl in a characteristic manner at the base of the plant. The living leaf blades are short, open to rolled and rigid in *P. obtusifolia*, but long, somewhat flexuous and open to rolled in the other species.

The inflorescence is a contracted panicle, which becomes somewhat lax during anthesis and comprises 8–80 spikelets. Spikelet size is variable between the species. The glumes are 3-nerved in *P. obtusifolia* (the lateral veins are visible only at the base of the glumes) and 5–9-nerved in the other species. The lemmas are variously pubescent, with a geniculate central awn. The lemma lobes are acuminate and variously adnate to the lateral bristle. The palea is bicarinate, bifid at the apex and longer than the lemma body. The lodicules are many-nerved (G.A. Verboom unpublished data), cuneate, glabrous or ciliolate. The latter condition is developed to the extreme in *P. obtusifolia*, which has densely ciliolate lodicules, the cilia being as long as the lodicule bodies.

Each floret has three large anthers (up to 9 mm). The ovaries of all taxa possess what Barker (1990, 1994) termed pseudostigmata. These structures have the appearance of stigmatic hairs, and arise from the region between the points of origin of the style branches, although the style branches themselves appear to be absent (or alternatively have stigmata along their entire length, from the apex of the ovary upwards). As the pseudostigmata are easily deciduous, they are seldom observed on mature fruit. Their presence may, however, explain the references by De Wet (1954b) and Tomlinson (1985) to hairs which are decurrent on the inner side of the caryopsis and join over the top of the ovary. A similar description of these structures is given by Chippindall (1955). These features, although not labelled as pseudostigmata, appear in the figures published by Barker (1986, 1990). The fruit is a caryopsis (Clayton & Renvoize 1986), up to 6 mm long, with a long, canaliculate hilum extending almost the full length of the fruit. The embryo is a quarter to a fifth the length

of the fruit (Conert 1971; Barker 1986, 1989, 1990). The surface of the caryopsis is reticulate (Barker 1986, 1989).

Barker (1990) noted substantial variation in the size of the floral parts in specimens identified as *P. macrantha*. This prompted an additional study in which measurements of six floral characters from 59 specimens were taken, including those examined in the earlier study. The phenetic package NTSYS-pc version 1.4 (Numerical Taxonomy and SYStematics package; Rohlf 1988) was used to perform a Principal Components Analysis (PCA).

The first three principal components (axes) account for 92.9% of the variation in the data. When the specimens are plotted out on the first two axes (accounting for 88.5% of the variation), two clusters are apparent (Figure 1). Each cluster contains specimens from a wide geographic area, and the geographic areas of the two clusters overlap extensively. Furthermore, specimens from each cluster have been observed to co-occur. Despite this sympatric distribution, a one-sided T-test showed that the differences in the means of each of the six characters from the two clusters were statistically significant at a 99.9% confidence interval. Table 1 presents the sample means and standard deviations of these characters in each cluster.

TABLE 1.—Sample means and standard deviations (mm) for six quantitative floral characters of two clusters of specimens corresponding to *P. macrantha* and *P. caespitosa*. A one-sided T-test shows that differences between means for all characters are significant at 99.9% confidence interval

Floral part	<i>P. macrantha</i>		<i>P. caespitosa</i>	
	Mean	Std. dev.	Mean	Std. dev.
Glume	37.14	5.747	46.16	5.755
Lemma	6.43	0.884	8.80	0.772
Awn: base-knee	8.03	1.488	13.30	2.049
Awn: knee-tip	14.58	2.220	23.38	4.286
Bristle	12.17	1.594	20.52	3.024
Palea	9.75	0.967	12.98	1.185



A character not included in the PCA, but overlaid onto the PCA plot, is that of growth form, as related to the presence of the branching stems. This feature was observed in the field for some of the specimens included in the PCA, and the position in the PCA plot of these specimens is shown in Figure 1 by means of open symbols. As can be seen from Figure 1, each cluster has a specific growth form. The cluster with the smaller floral parts includes specimens with branching stems, whereas the specimens with larger floral parts do not possess stems. These two clusters are considered here to be two species: *P. macrantha* and *P. caespitosa* N.P. Barker *sp. nov.* Descriptions and details on nomenclature of these two species appear below.

#### LEAF ANATOMY

*Pseudopentameris* has been well examined anatomically by De Wet (1956, 1960), Renvoize (1981), Ellis (1985a), Tomlinson (1985) and Barker (1990). The genus as a whole possesses a sclerophyllous type of arundinoid leaf anatomy (Ellis & Linder 1992). Ellis (1985a) found minor anatomical differences between *P. macrantha* and *P. brachyphylla*. The anatomy of *P. obtusifolia* is only slightly different from the former two species (Ellis 1985b). All the taxa share characters such as the presence

of large, inflated abaxial epidermal cells, dumbbell-shaped silica bodies and the absence of abaxial micro- and macrohairs. This knowledge was supplemented in this study by a Scanning Electron Microscope (SEM) survey of the leaf epidermides of all the species in the genus.

The SEM study of both adaxial and abaxial leaf anatomy was carried out on leaf blade material of nine herbarium specimens of *P. macrantha*, nine specimens of *P. caespitosa*, five specimens of *P. brachyphylla* and 11 specimens of *P. obtusifolia*. Leaf material was mounted on SEM stubs and then coated in gold-palladium. The specimens were examined using an ISI-SX-25 Scanning Electron Microscope.

The abaxial epidermis of all specimens examined lacked both microhairs and macrohairs and, as noted by Ellis (1985a), the abaxial epidermides of all the species are almost indistinguishable. However, occasional needle-like prickles were observed. Figure 2A illustrates the abaxial epidermis of *P. obtusifolia*.

The adaxial epidermides of *P. macrantha*, *P. caespitosa* and *P. brachyphylla* were almost identical (Figure 2B, C), but the epidermis of *P. obtusifolia* differed, in that it had a denser distribution of prickles (Figure 2D). In all the

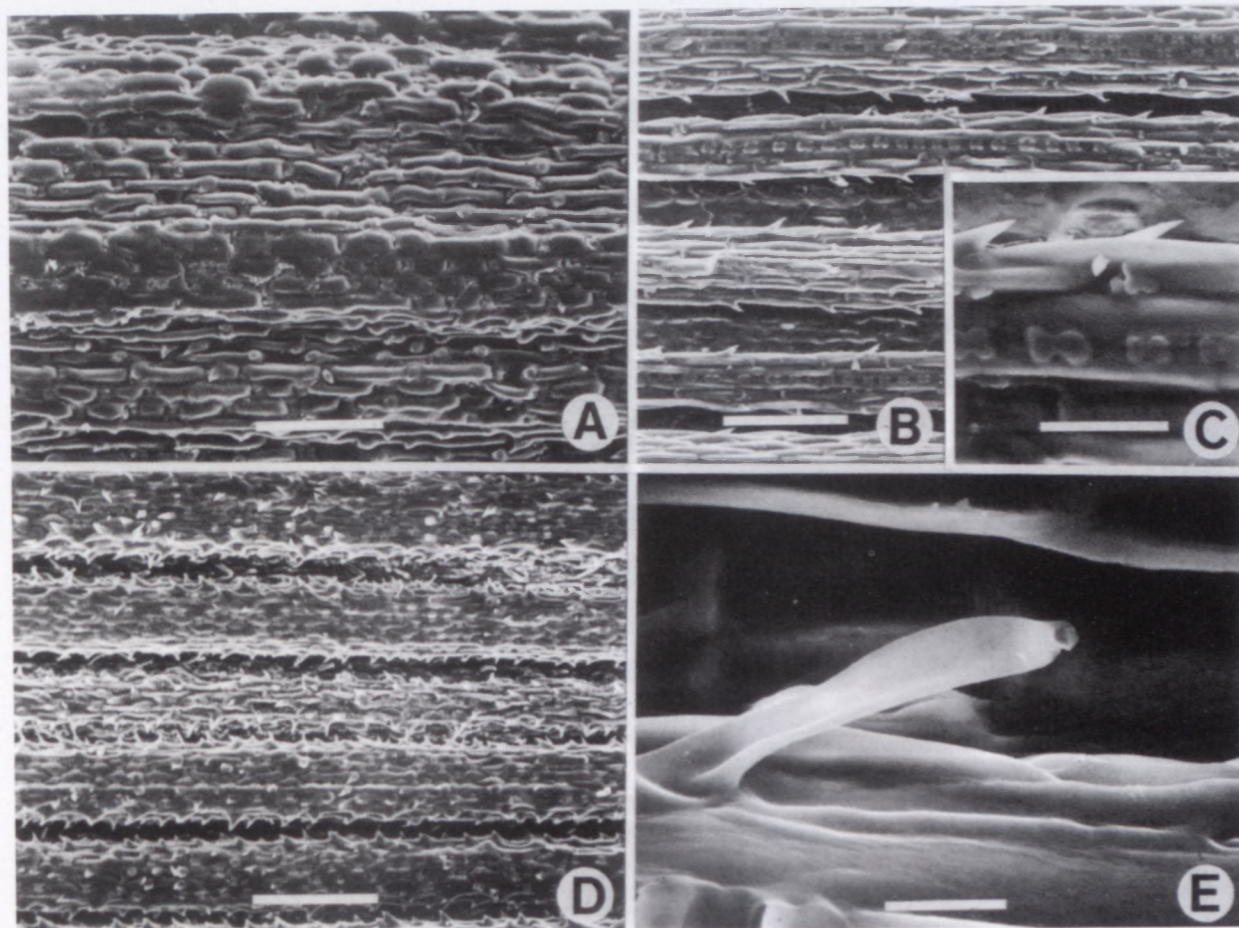


FIGURE 2.—Leaf blade SEM of *Pseudopentameris*. A, D, *P. obtusifolia*, Ellis 2342: A, abaxial epidermis showing large inflated epidermal cells and small prickles; D, deeply ribbed adaxial epidermis heavily adorned with prickles. B, *P. brachyphylla*, Boucher 357a, adaxial epidermis showing open furrows and ribs with prickles. C, E, *P. macrantha*, Ellis 2515: C, adaxial prickles, note also dumbbell-shaped silica bodies; E, microhair from adaxial epidermis, note minute apical cell. Scale bars: A, 225  $\mu$ m; B, 240  $\mu$ m; C, 115  $\mu$ m; D, 325  $\mu$ m; E, 17  $\mu$ m.



species, the prickles are needle-like and angled almost parallel to the epidermis. These prickles appear to be modifications of the epidermal cell surface (shown magnified in Figure 2C). These prickles are unlike those found in *Pentameris* (Barker 1993), *Pentaschistis* (Ellis & Linder 1992) and at least one species of *Merxmüllera* (Barker & Ellis 1991). The prickles of these latter taxa are slightly inflated basally, variable in length but longer than in *Pseudopentameris*, and protrude away from the epidermis.

Microhairs with minute, deflated apical cells were observed at the bottom of the adaxial furrows (Figure 2E). These bicellular microhairs are similar, except in size, to those reported in *Pentameris* (Barker 1993). Microhair size ranged from 55–67 µm, with a mean of 64.8 µm (five samples), and (unlike in *Pentameris*) no species level size differences were apparent. No microhairs were observed on the abaxial leaf surface.

The presence, distribution and nature of microhairs in this genus has been a contentious issue. De Wet (1956, 1960) implies that, as *Pseudopentameris* has a panicoid epidermis, bicellular hairs (microhairs) would be present, presumably on the abaxial surface. In contrast, Renvoize (1981) considered microhairs to be absent, but later he described 'long slender papillae, which in a few instances appear to bear the remains of a thin-walled apical cell' which were associated with the adaxial surface (Renvoize 1986). This description matches the structure shown in Figure 2E, and it appears that these papillae are in fact microhairs.

#### CYTOLOGY

The cytology of the genus *Danthonia* was examined by De Wet (1953, 1954a, b), who was of the opinion that the base chromosome number of this group is  $x = 6$ . The subsequent division of the genus *Danthonia* resulted in limited cytological knowledge for each of the segregate genera. Additional research by Spies & Du Plessis (1988) and Du Plessis & Spies (1988) has increased cytological knowledge about the *Danthonia* segregates but no chromosome counts of the species of *Pseudopentameris* have been published. From analyses of the relationship between stomatal size and chromosome counts, De Wet (1954a) predicted a count of  $2n = 24$ . This figure is credible, as many of the African arundinoid genera display intraspecific polyploidy (see the study on *Chaetobromus* by Spies *et al.* 1990).

#### CONSERVATION STATUS

Two species in the genus are mentioned in local conservation texts. *Pseudopentameris obtusifolia* (under the name of *Pentameris obtusifolia*) is listed by Hall *et al.* (1980) as a threatened species, the conservation status of which is given as 'uncertain'. However, owing to the nomenclatural difficulties experienced with this taxon (discussed below and in Barker 1993) and the lack of voucher citations, the exact identity of this taxon is not certain. *Pseudopentameris brachyphylla* is considered by Bond & Goldblatt (1984) to be rare, as it is restricted to the Caledon area. Both these species are restricted to relatively small areas at a low to mid altitude. Therefore, although

not presently under threat, their narrow habitat range places them in a category that may best be described as 'potentially threatened'.

#### PHYLOGENETIC RELATIONSHIPS

The genus *Pseudopentameris* now contains four species. These species are united by an unusual fruit morphology and the presence of pseudostigmata (described above). This fruit morphology is rare in the southern African Arundineae. The only other arundinoid taxon with a similar fruit type is *Chaetobromus* Nees, the fruit of which are somewhat smaller, but similar in all other respects except the possession of pseudostigmata (Barker 1994). The close relationship between these two genera is further supported by DNA-based molecular studies (Barker *et al.* in prep.). As *Pseudopentameris* has both anatomical and morphological autapomorphies (the presence of inflated abaxial epidermal cells and the presence of the pseudostigmata on the apex of the ovary) the genus is distinct from *Chaetobromus*, and the two genera ought not to be combined. Autapomorphies for *Chaetobromus* include spikelets which disarticulate below the glumes and dimorphic florets. In *Pseudopentameris*, and many other arundinoid genera, the spikelets disarticulate above the glumes. *Chaetobromus* is the only arundinoid genus which has dimorphic florets: the basal ones are glabrous, the upper ones variously hirsute.

Affinities between *Pseudopentameris* and other 2-flowered arundinoids, *Pentameris* and *Pentaschistis*, have also been postulated (e.g. Ellis 1985b; Ellis & Linder 1992). *Pentameris* is presently defined by fruit characters (an achene with an apical crown of hairs; Barker 1993), whereas *Pentaschistis*, as presently defined, has no obvious autapomorphy, and may include both *Pentameris* and *Prionanthium* Desv. (H.P. Linder pers. comm.). While the presence of 2-flowered spikelets may indicate some degree of relationship of *Pseudopentameris* to these genera, other features such as the sclerophyllous type of arundinoid leaf anatomy suggest that these relationships extend beyond these taxa to genera such as *Merxmüllera*. The assessment of phylogenetic relationships of *Pseudopentameris* and other arundinoid taxa therefore needs to be done in the broadest possible context, and should include all taxa and not be restricted to the southern African genera. Such a study is presently under way (H.P. Linder *et al.* in prep.).

#### TAXONOMY

***Pseudopentameris* Conert** in Mitteilungen der Botanischen Staatssammlung, München 10: 304 (1971). Type species: *Pseudopentameris macrantha* (Schrad.) Conert.

Plants perennial; caespitose, scandent or sometimes branched. Stems 0.4–1.4(–2) m long, woody and persistent or herbaceous from woody base; flowering culms up to 0.8 m long. Leaves: sheaths appressed to culm, persistent; sheath mouth sometimes auriculate; ligule a fringe of hairs; leaf blades linear, 25–500 mm long, rigid or soft, open and flat to rolled and rigid. Inflorescence paniculate, lanceolate and somewhat contracted. Spikelets 6–80, laterally compressed, 2-flowered, highly reduced third floret



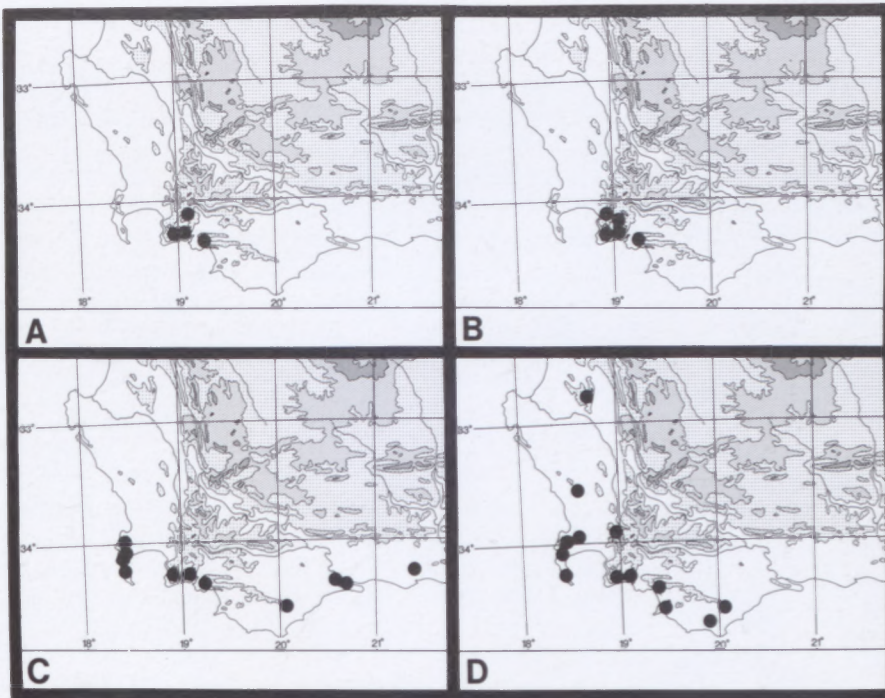


FIGURE 3.—The distribution of *Pseudopentameris* spp. in the southwestern Cape, South Africa. A, *P. obtusifolia*; B, *P. brachyphylla*; C, *P. macrantha*; D, *P. caespitosa*.

rarely present; *glumes* two, more or less equal, 18–60 mm long, 3–7(–9)-nerved, chartaceous, minutely scabrid or glaucous; *lemma body* chartaceous to cartilaginous, variously pubescent, 4.5–11.0 mm long, 7–9-nerved, nerves anastomosing into awn base and 8–27 mm long lateral bristle; *lemma lobes* 1.5–4.5 mm long, acute to acuminate, partly to fully adnate to bristles; *central awn* geniculate, scabrid, contorted basally, 5–17 mm long from base to knee, 12–34 mm long from knee to tip; *palea* longer than lemma body, bifid at apex. *Lodicules* two, glabrous, sparsely to densely ciliolate. *Stamens* three, 4.5–9.0 mm long. *Ovary* glabrous, with apical pseudostigmata, styles short to absent. *Fruit* a caryopsis, 4–6 mm long, hilum  $\frac{7}{8}$  as long as fruit, embryo  $\frac{1}{5}$  as long as fruit, surface reticulately sculptured.

### Key to species

- 1a Lower glumes 18–25 mm long, 3-nerved basally, central nerve extending the length of glume; lodicules densely ciliolate ..... 1. *P. obtusifolia*
- 1b Lower glumes (27–)35–60 mm long and (3–)5–9-nerved; lodicules sparsely ciliolate or glabrous:
  - 2a Lemmas pubescent over entire abaxial surface ..... 2. *P. brachyphylla*
  - 2b Lemmas basally glabrous, apically pubescent, including lemma lobes:
    - 3a Lemma body 5–8 mm long; awn (knee to tip) 11–18 mm long; lemma bristle 9–15 mm long; plants with branched above-ground stems, especially in older plants ..... 3. *P. macrantha*
    - 3b Lemma body 8–10 mm long; awn (knee to tip) 17–27 mm long; bristle 15–30 mm long; plants with woody or fibrous underground base, branched above-ground stems absent ..... 4. *P. caespitosa*

### 1. *Pseudopentameris obtusifolia* (Hochst.) N.P. Barker

*Danthonia obtusifolia* Hochst. in Flora 29: 120 (1846); Stapf: 536 (1899). *Pentameris obtusifolia* (Hochst.) Schweick.: 91 (1938); N.P. Barker in Gibbs Russell et al.: 252 (1990). Type: Pr. b. spei, Ludwig s.n. (OXF, iso.(?!)).

*Avena rigida* Steud.: 482 (1829), non *A. rigida* M. Bieb. (1808). *Danthonia rigida* Steud.: 243 (1855). Type: Pr. b. spei, Ludwig s.n. (OXF, holo. or iso.!).

*Pentameris squarrosa* Stapf: 515 (1899); Linder & Ellis: 91–103 (1990). Type: Caledon Div., Nieuw Kloof in Houw Hoek Mountains, Burchell 8076 (K, holo.; PRE, iso.!).

*Pentameris* sp. nov., Ellis: 567 (1985b); Barker: 136 (1989).

Plants perennial; scandent, sometimes branched. *Stems* branching, 0.4–1.5(–3.0) m long, woody and persistent, flowering culms produced annually from apical growth points. *Leaves*: sheaths appressed to culm, persistent; sheath mouth slightly bearded; leaf blades linear, 25–120 mm long, somewhat rolled and rigid. *Inflorescence* panicle, lanceolate and contracted. *Spikelets* 8–45, laterally compressed, 2-flowered; *glumes* two, more or less equal, 18–25 mm long, chartaceous, minutely scabrid, 3-nerved basally, central nerve extending to glume apex; *lemma body* uniformly pubescent, 4.5–6.0 mm long, 9-nerved, nerves anastomosing into awn base and a 8–12 mm long lateral bristle; *lemma lobes* 1.5–3.0 mm long, acute to acuminate, partly to fully adnate to bristles; *central awn* geniculate, scabrid, contorted basally, 7.5–11.0 mm long from base to knee, 12–16 mm long from knee to tip; *palea* longer than lemma body, bifid at apex. *Lodicules* two, densely ciliolate, cilia as long as lodicule body. *Stamens* three, 4.5–7.5 mm long. *Ovary* glabrous, with apical pseudostigmata, styles short to absent. *Fruit* 4 mm long. Flowering time November to January. The known distribution of this species is indicated in Figure 3A.

Schweickhardt (1938) points out that Steudel (1829) and Hochstetter (1846) probably described new taxa from duplicate material collected by Baron von Ludwig. Hochstetter called his species *Danthonia obtusifolia* Hochst., whereas Steudel named the material *Avena rigida* Steud. Schweickhardt showed that the name *Avena rigida* had been used earlier by Marschall von Bieberstein (1808) and therefore Steudel's later homonym is rejected. The Ludwig specimen at OXF bears the name *Avena rigida*, and is considered to be the



holotype or perhaps an isotype of this name. The specimen seen by Hochstetter was not traced, so the same specimen (Ludwig specimen at OXF) is considered to be probably the isotype of the name *Danthonia obtusifolia*. Hochstetter's (1846) *D. obtusifolia* has priority over Stapf's (1897) *D. squarrosa*. Schweickerdt notes that had Stapf seen the type material on which Steudel had based his description, he would have been able to identify his species as *Danthonia obtusifolia* Hochst.

The type of Stapf's *Pentameris squarrosa* is a Burchell specimen, Burchell 8076. There is a fragment of this specimen in PRE, which originates from Kew. The envelope is annotated by Schweickerdt, who wrote 'a fair match of the type of *Avena rigida* Steud. in the Herb. Fielding, Oxford'. This fragment, consisting of two leaves and two spikelets, comprises sufficient material to allow comparison on the basis of a number of characters. It is a good match of the type specimen of *Avena rigida*. It can therefore be confirmed that *Pentameris squarrosa* is a synonym of *Pseudopentameris obtusifolia*.

This nomenclatural confusion is reflected in past studies and curatorial practices (cited above). The use of these confusing names without voucher citations in red data books (e.g. Hall *et al.* 1980) results in further confusion and renders the information in such texts meaningless. In order to assist in the identification and curation of specimens of this taxon, an extended list of voucher specimens is provided. The herbarium code JF is used for the herbarium at Jonkerhoek Forestry Station.

Vouchers: *N. Barker* 300, 331, 332, 333 (PRE); Burchell 8076 (PRE); Ellis 2342 (PRE); Esterhuysen 29029, 35396 (BOL, PRE); Esterhuysen 35416 (BOL); Haynes 770 (JF, PRE, STE); Hilton-Taylor 350, 351, 352, 353 (PRE); Kruger KR565 (JF); Levyns 10460 (BOL); Macdonald 634 (PRE, STE); Stokoe 7197 (BOL); Taylor 3023 (PRE, STE).

**2. *Pseudopentameris brachyphylla* (Stapf) Conert** in Mitteilungen der Botanischen Staatssammlung, München 10: 304 (1971); N.P. Barker in Gibbs Russell *et al.* 278 (1990). Type: Locality unknown, Zeyher 1826 $\alpha$  (K, holo.).

*Danthonia brachyphylla* Stapf: 520 (1899).

Plants perennial, caespitose, bases woody and fibrous. *Stems* absent. *Culms* 400–750 mm long. *Leaves*: sheaths appressed to culm, persistent; sheath mouth slightly auriculate; leaf blades 45–150 mm long, open and flat or folded. *Inflorescence* paniculate, lanceolate and contracted. *Spikelets* 8–20, laterally compressed, 2-flowered, highly reduced third floret rarely present; *glumes* two, more or less equal, 27–37 mm long, 5–7-nerved, chartaceous, minutely scabrid; *lemma body* cartilaginous, uniformly pubescent, 5.5–6.5 mm long, 7–9-nerved, nerves anastomosing into awn base and 12–20 mm long lateral bristle; *lemma lobes* 2.0–3.5 mm long, acute to acuminate, partly to completely adnate to bristles; *central awn* geniculate, scabrid, contorted basally, 7.5–11.0 mm long from base to knee, 12–20 mm long from knee to tip; *palea* longer than lemma body, bifid at apex. *Lodicules* two, glabrous or sparsely ciliolate. *Stamens* three, 5–8 mm long. *Ovary* glabrous, with apical pseudostigmata, styles short to absent. *Fruit* 4.5–6.0 mm long. Flowering time

September–October. The distribution of this species is given in Figure 3B.

The holotype, Zeyher 1826 $\alpha$  housed at Kew is accompanied by drawings and annotations in Stapf's hand. Conert (1971) also cites this specimen, and it carries a 'det. slip' bearing his signature. Although the type locality is not known, PRE has a Zeyher collection of the same taxon, Zeyher 1825 $\beta$ , collected at Hemel en Aarde, Swellendam. Although speculative, it is possible that these consecutively numbered Zeyher specimens were both collected from this locality.

Vouchers: *N. Barker* 731 (PRE); Burman 1180 (BOL); De Vos 1401 (STE); Esterhuysen 33258 (BOL, PRE); Williams 2542 (NBG, PRE).

**3. *Pseudopentameris macrantha* (Schrader) Conert** in Mitteilungen der Botanischen Staatssammlung, München 10: 304 (1971); N.P. Barker in Gibbs Russell *et al.* 279 (1990). Type: Table Mountain above Kirstenbosch, White 5518 (PRE, neo.! here designated).

*Danthonia macrantha* Schrad. in J.A. Schultes: 385 (1824); Trinius: t. 63 (1827); *Pentameris macrantha* (Schrader) Nees: 312 (1832). Type: P.B.S., Hesse, s.n. (not traced).

Plants perennial, basally woody, caespitose, becoming shrub-like with age. *Stems* branched, 0.5–1.4 m long, covered in persistent leaf sheaths. *Culms* 0.5–0.8 m long. *Leaves*: sheaths appressed to culm, persistent; sheath mouth somewhat auriculate; leaf blades 45–350 mm long, open and flat or rolled and filiform. *Inflorescence* paniculate, lanceolate and somewhat contracted. *Spikelets* 10–25(–50), laterally compressed, 2-flowered, highly reduced third floret rarely present; *glumes* two, more or less equal, chartaceous, minutely scabrid or glaucous, 22–50 mm long, 5(–7)-nerved; *lemma body* cartilaginous, apically pubescent, basally glabrous, 5–8 mm long, 9–11-nerved, nerves anastomosing into awn base and 9–15 mm long lateral bristle; *lemma lobes* 1.5–3.5 mm long, acute to acuminate, partly to fully adnate to bristles; *central awn* geniculate, scabrid, contorted basally, 5.5–11.0 mm long from base to knee, 11–18 mm long from knee to tip; *palea* longer than lemma body, bifid at apex. *Lodicules* two, glabrous or sparsely ciliolate. *Stamens* three, 5.0–7.5 mm long. *Ovary* glabrous, with apical pseudostigmata, styles short to absent. *Fruit* 4.5–6.0 mm long. Flowering time August to September. The distribution of this species is shown in Figure 3C.

Conert (1971) combined *Pentameris macrantha* Nees and *Danthonia macrantha* Schrad. The Hesse s.n. specimen on which Schrader (1824) based his original description of *Danthonia macrantha* has not been traced, and it is not known if this specimen was seen by Conert (1971). A neotype is designated here in its place.

The absence of a type specimen, and thus accurate floral measurement data, caused some problems in the allocation of the epithet *macrantha* to the relevant cluster in the PCA study. Despite the lack of the type specimen, Schrader's (1824) description includes the spikelet length, given as 1.5 inches (37.5 mm). As the glumes extend well beyond any floret parts except the awns, this spikelet measurement is interpreted to equate to that of the glumes. As this figure (37.5 mm) is close to the mean glume size

(37.14 mm) for one of the two clusters distinguished by the PCA, this cluster is allocated the epithet *macrantha* (Figure 1).

In contrast to the paucity of information provided by Schrader, Trinius (1827) provides an elegant description of this species, referring to an elongate woody rhizome and a branched culm. This description is accompanied by a detailed illustration showing a well-developed rhizome. These characters clearly match the morphology of the specimens in the rhizomatous cluster of the PCA, which Schrader's description implies represents *P. macrantha*. Unfortunately, although citing Schrader's description, Trinius does not provide a collector and number for the specimen on which his description or illustration is based, and mentions no type specimen. Therefore the link between his clear description and the Hesse specimen on which Schrader's description was based is tenuous at best.

The Trinius herbarium is presently housed at St Petersburg (Leningrad). The grass collection, including Trinius's types and the material on which his illustrations are based, have recently been databased (R. Soreng, Cornell University pers. comm). Computer records indicate that these include several specimens of *Danthonia macrantha*, although the type status of these is not certain. All attempts to communicate with this herbarium have failed, and thus the unsatisfactory solution of neotypification has been implemented. The second cluster in the PCA is considered to be a new species and is described below.

Vouchers: Adamson 1251 (BOL); Boucher 2661 (STE); Ellis 2308 (PRE); Morely 176 (STE); White 5518 (PRE).

**4. *Pseudopentameris caespitosa* N.P. Barker sp. nov.** a *P. macrantha* habitu caespitoso, culmis simplicibus, partibus floralibus grandioribus, glumis 33–60 mm longis, arista centrali lemmatis 27–45 mm longa differt.

Plants perennial with woody or fibrous basal underground parts, caespitose. *Stems* absent. *Culms* annual, 0.7–1.0 m long, sometimes decumbent. *Leaves*: sheaths basal, persistent, often purple, appressed to culm; sheath mouth somewhat auriculate; leaf blades 45–500 mm long, open and flat or rolled. *Inflorescence* paniculate, lanceolate and contracted, upper culm and panicle branches purple. *Spikelets* 10–20, laterally compressed, 2-flowered, highly reduced third floret rarely present; *glumes* two, more or less equal, 33–60 mm long, 5–9-nerved, chartaceous, minutely scabrid or glaucous, dark purple when young; *lemma body* cartilaginous, apically pubescent, basally glabrous, 8–10 mm long, 9–11-nerved, nerves anastomosing into awn base and 15–30 mm long lateral bristle; *lemma lobes* 2–4 mm long, acute to acuminate, partly to fully adnate to bristles; *central awn* geniculate, scabrid, contorted basally, 10–18 mm long from base to knee, 17–27 mm long from knee to tip; *palea* longer than lemma body, bifid at apex. *Lodicules* two, glabrous or sparsely ciliolate. *Stamens* three, up to 9 mm long. *Ovary* glabrous, with apical pseudostigmata, styles short to absent. *Fruit* 5–6 mm long. Flowering time October–November. The known distribution of this species is shown in Figure 3D.

**TYPE.**—Western Cape, 3419 (Caledon): Bredasdorp, (–DC), eastern corner of Farm Buffeljagt, 19-10-1987, Linder 4362 (BOL, holo.).

This species is characterised by both its larger floral structures and its caespitose, unbranched growth form, hence the specific epithet. The glumes, culms and panicle branches are often dark purple when young, turning a dark brown biscuit colour with age, in comparison to the pale yellow of the glumes of *P. macrantha*. Although occurring with *P. macrantha* in some localities (e.g. Cape Point Nature Reserve, where they have been observed growing within a metre of each other), *P. caespitosa* flowers substantially later than *P. macrantha*, thus precluding any possible hybridisation.

In addition to the morphological differences described above, certain differences in the leaf anatomy have also been observed. In a phenetic study on a limited number of anatomical samples, Barker (1990) noted that specimens of what was then named *P. macrantha* were separable into two groups on the basis of three anatomical characters. One of these groups corresponds to the taxon here named *P. macrantha* and has a leaf which is V-shaped in cross section, with narrow furrows between the ribs and prickles distributed over the exposed adaxial rib surface. The other group corresponds to *P. caespitosa* (described above) in which the leaf is U-shaped, the furrows are open and the prickles are restricted to the edges of the adaxial ribs.

Vouchers: N. Barker 24 (PRE); Boucher & Shepard 4821 (STE); Ellis 1171, 2515 (PRE); Esterhuysen 31747 (BOL).

#### ACKNOWLEDGEMENTS

I would like to extend my thanks and appreciation to Mrs A. Romanowski (National Botanical Institute, Pretoria) and R. Carelse (University of Cape Town) for the photographic work, Dr J. Rourke (NBI, Kirstenbosch) for the Latin translation and nomenclatural advice, Drs E.R. Robinson (University of the Witwatersrand), R.P. Ellis (Roodeplaat Grasslands Institute), and Prof. H.P. Linder (University of Cape Town) for their comments on various aspects of this work. The curators of B. BOL, G. GRA, K. NBG, OXF, PH, PRE, S. SAM and STE are thanked for assisting in the tracing and loan of type material. Most of this work was undertaken for an M.Sc. study at the University of the Witwatersrand, and was carried out while the author was in the employ of the National Botanical Institute, Pretoria.

#### REFERENCES

- BARKER, N.P. 1986. The shape and ultrastructure of the caryopsis of *Pentameris* and *Pseudopentameris* species (Arundinoideae, Poaceae). *Bothalia* 16: 65–69.
- BARKER, N.P. 1989. The caryopsis surface of *Pentameris* and *Pseudopentameris* (Arundinoideae, Poaceae) revisited. *Bothalia* 19: 134–136.
- BARKER, N.P. 1990. *The taxonomy of Pentameris P. Beauv. and Pseudopentameris Conert*. M.Sc. thesis, University of the Witwatersrand.
- BARKER, N.P. 1993. A biosystematic study of the genus *Pentameris* (Arundineae, Poaceae). *Bothalia* 23: 25–47.
- BARKER, N.P. 1994. External fruit morphology of southern African Arundineae (Arundinoideae: Poaceae). *Bothalia* 24: 55–66.



- BARKER, N.P. & ELLIS, R.P. 1991. A new species of *Merxmüllera* (Arundinoideae, Poaceae) from South Africa. *Bothalia* 21: 27–34.
- BOND, P. & GOLDBLATT, P. 1984. Plants of the Cape Flora. A descriptive catalogue. *Journal of South African Botany* Supplementary Vol. 13: 1–455.
- CHIPPINDALL, L.K.A. 1955. A guide to the identification of grasses in southern Africa. In D. Meredith, *The grasses and pastures of South Africa*. Central News Agency, Cape Town.
- CLAYTON, W.D. & RENVOIZE, S.A. 1986. *Genera graminum. Grasses of the World*. Her Majesty's Stationery Office, London.
- CONERT, H.J. 1971. The genus *Danthonia* in Africa. *Mitteilungen der Botanischen Staatssammlung, München* 10: 299–308.
- DE WET, J.M.J. 1953. Nucleoli numbers in *Danthonia* polyploids. *Cytologia* 18: 229–234.
- DE WET, J.M.J. 1954a. Stomatal size as a cytological criterion in *Danthonia*. *Cytologia* 19: 176–181.
- DE WET, J.M.J. 1954b. The genus *Danthonia* in grass phylogeny. *American Journal of Botany* 41: 204–211.
- DE WET, J.M.J. 1956. Leaf anatomy and phylogeny in the tribe Danthoneae. *American Journal of Botany* 43: 175–182.
- DE WET, J.M.J. 1960. Leaf anatomy and morphology in South African species of *Danthonia*. *Bothalia* 7: 303–310.
- DU PLESSIS, H. & SPIES, J.J. 1988. Chromosome studies on African plants. 8. *Bothalia* 18: 119–122.
- ELLIS, R.P. 1985a. Leaf anatomy of the South African Danthoneae (Poaceae). X. *Pseudopentameris*. *Bothalia* 15: 561–566.
- ELLIS, R.P. 1985b. Leaf anatomy of the South African Danthoneae (Poaceae). XI. *Pentameris longiglumis* and *Pentameris* sp. nov. *Bothalia* 15: 567–571.
- ELLIS, R.P. & LINDER, H.P. 1992. Atlas of the leaf anatomy in *Pentastachis* (Arundineae: Poaceae). *Memoirs of the Botanical Survey of South Africa* No. 60.
- GIBBS RUSSELL, G.E., WATSON, L., KOEKEMOER, M., SMOOK, L., BARKER, N.P., ANDERSON, H.M. & DALLWITZ, M.J. 1990. Grasses of southern Africa. *Memoirs of the Botanical Survey of South Africa* No. 58.
- HALL, A.V., DE WINTER, M., DE WINTER, B. & VAN OOSTERHOUT, S.A.M. 1980. *Threatened plants of southern Africa*. South African National Scientific Programmes Report No. 45. CSIR, Pretoria.
- HOCHSTETTER, C.H. 1846. Pflanzen des Cap- und Natal-landes, gesammelt und zusammengestellt von Dr. Ferdinand Krauss. *Flora* 29: 113–128.
- LINDER, H.P. & ELLIS, R.P. 1990. Vegetative morphology and interfire survival strategies in the Cape Fynbos grasses. *Bothalia* 20: 91–103.
- MARSCHALL VON BIEBERSTEIN, F.A. 1808. *Flora taurico-caucasica*. Vol. 1. Charkow.
- NEES AB ESSENBECK, C.G. 1832. *Plantae Ecklonianae*. *Linnaea* 7: 273–339.
- RENOVOIZE, S.A. 1981. The subfamily Arundinoideae and its position in relation to a general classification of the Gramineae. *Kew Bulletin* 36: 85–102.
- RENOVOIZE, S.A. 1986. A survey of leaf blade anatomy in grasses VIII. Arundinoideae. *Kew Bulletin* 41: 323–338.
- ROHLF, F.J. 1988. *NTSYS-pc. Numerical taxonomy and multivariate analysis system*. Exeter Publishing, Setauket, New York.
- SCHULTES J.A. 1824. *Mantissa plantarum* 2. In J.J. Roemer & J.A. Schultes, *Systematis vegetabilium Caroli a Linné*. Stuttgart.
- SCHWEICKERDT, H.G. 1938. Descriptions and notes on South African grasses. *Feddes Repertorium* 43: 88–92.
- SPIES, J.J. & DU PLESSIS, H. 1988. Chromosome studies on African plants. 6. *Bothalia* 18: 111–114.
- SPIES, J.J., DU PLESSIS, H., BARKER, N.P. & VAN WYK, C. 1990. Cytogenetic studies in the genus *Chaetobromus* (Poaceae: Arundineae). *Genome* 33: 646–658.
- STAPF, O. 1899. Gramineae. *Flora capensis* 7. Reeve, London.
- STEUDEL, E.G. 1829. Bemerkungen ueber einige Cyperaceen und Gramineen vom Vorgebirge der guten Hoffnung. *Flora* 12: 481–492.
- STEUDEL, E.G. 1855. *Synopsis plantarum graminearum*. Metzler, Stuttgart.
- TOMLINSON, K.L. 1985. Comparative anatomical studies in *Danthonia* sensu lato (Danthoneae: Poaceae.). *Aliso* 11: 97–114.
- TRINIUS, C.B. 1827. *Species graminum* 6: t. 63. Petropoli.