A Revision of the genus *Hyalosperma* (Asteraceae: Inuleae:Gnaphaliinae)

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Abstract

Wilson, Paul G. A revision of the genus *Hyalosperma* (Asteraceae: Inuleae: Gnaphaliinae). Nuytsia 7(1): 75-101 (1989). Characters used in discriminating genera within the Gnaphaliinae are noted. The application of the name *Helipterum* is discussed. The recognition of *Hyalosperma* Steetz as an Australian endemic genus distinct from *Helipterum* is proposed. Nine species are recognised; eight new species combinations are made. Three species previously reduced to synonymy under *Helipterum cotula* (Benth.) DC. are reinstated.

Introduction

During an investigation into the morphology of those Australian species that are included in *Helipterum*, *Helichrysum*, and related taxa it became very evident that the genera as currently constituted are not natural ones. Species that are closely related have been placed in different genera while within *Helipterum* Lindley, *Helichrysum* Miller, *Waitzia* Wendl., *Myriocephalus* Benth., *Podotheca* Cass., and *Ixiolaena* Benth. are distinct groups of species that have no close relationship to other groups in the same genus. Study of European and African species of *Helipterum* and *Helichrysum*, including the type species, indicate that neither name can be applied in the strict sense to Australian taxa and that the African and Eurasian species should not be considered congeneric with any in Australia.

A paper outlining a proposed classification of the Australian taxa in the *Helipterum-Helichrysum* group is in preparation. Some of the genera involved are being studied by taxonomists in other institutions and require a unified approach. In the meantime it appears desirable to publish revisional papers on a few of the segregate genera that are readily circumscribed and that do not impinge on the investigations being carried out elsewhere. The genus *Hyalosperma* is such an example; to follow will be papers on other similarly discrete groups.

The name *Helipterum*

The name *Helipterum* has always been attributed to Augustin de Candolle (1838), however, it was first published by John Lindley in "A Natural System of Botany" edn 2, 260 (1836). In this work Lindley listed several genera that were obtained from a manuscript copy of de Candolle's "Prodromus", to these he adds 'DC. Pr.' indicating the origin of the names. Among the accepted names was '*Helipterum* DC. Pr.'. In synonymy under it were *Argyrocome* Gaertn., *Damironia* Cass., *Syncarpha* DC., *Roccardia Neck.*, *Edmondia* Cass., and *Aphelexis* Don. The earliest of these names is *Argyrocome* Gaertn. (1791) with the type *A. retorta* (L.) Gaertn. This South African species is currently (Hilliard 1983) considered to belong to the genus *Helichrysum* P. Miller (1754). The name *Helipterum* DC. ex Lindley (1836) is therefore an illegitimate, superfluous name based on *Argyrocome retorta.*

In the year after the publication of Lindley's "Natural System of Botany" edn 2 and the year prior to the appearance of vol. 6 of de Candolle's "Prodromus", there appeared a work by Endlicher et al. (1837) in which George Bentham wrote up the Asteraceae collected by Karl Hügel in Western Australia and described, as new, *Helichrysum cotula.* Bentham included under this species a short discussion on its sectional or generic distinctiveness and on its possible future inclusion in de Candolle's seemingly unpublished genus *Helipterum* of which he had seen mention in Lindley's Natural System. edn 2 (to which work he refers) and evidently also in a manuscript copy of vol. 6 of de Candolle's "Prodromus".

In 1838, vol. 6 of de Candolle's "Prodromus" finally appeared; it included a description of the genus *Helipterum* but no reference under that name to the publication of Lindley (1836). De Candolle included in the text the types of a number of validly published genera of which the earliest is *Syncarpha* DC. (1810) which is based on the South African *S. gnaphalioides* (L.) DC., a species currently referred to *Helipterum* (Hilliard 1983). The type of the genus *Argyrocome* Gaertn. was specifically excluded by de Candolle and placed in *Helichrysum.*

Therefore *Helipterum* DC. ex Lindley (1836) is an illegitimate name and a synonym of *Helichrysum* while *Helipterum* DC. (1838) is an illegitimate name, a later homonym of *Helipterum* DC. ex Lindley (1836) and a synonym of *Syncarpha* DC. (1810). If it were to be argued that Bentham (1837) had published the name *Helichrysum* sect. *Helipterum* it would either have to be considered to be based on *Helipterum* DC. ex Lindley or it could be lectotypified on *Helichrysum cotula* Benth., a species which in this paper is placed in *Hyalosperma* Steetz.

Generic History

George Bentham (1837) described the first species, as *Helichrysum cotula*, that is now included in the genus *Hyalosperma*; he indicated it should possibly be placed in the genus *Helipterum*, a name which would be appearing in vol. 6 of Augustin de Candolle's "Prodromus" of which Bentham had evidently seen a manuscript copy. In the following year de Candolle (1838) transferred *Helichrysum cotula* to *Helipterum* and placed it in his section *Leucochrysum* along with three other Australian species which are now recognised as being conspecific under the name *Helipterum albicans* (A. Cunn.) DC.

The genus *Hyalosperma* was described by Steetz in 1845. He placed in it two new species, *H. strictum* and *H. glutinosum.* Steetz distinguished *Hyalosperma* from *Helipterum* on the basis of the former having plano-compressed achenes and a paleaceous pappus, characters that do not serve to distinguish the genus as it is here circumscribed. The genus was accepted without comment by Walpers (1846) and Lindley (1847). Asa Gray (1852) suggested that it was merely a section of *Helipterum* but he did not publish any new combinations.

Hyalosperma was next accepted as a genus by Sonder (1853) who described *Hyalosperma variabile* and included under one of its two varieties the two *Hyalosperma* species of Steetz.

At the time that Steetz (1845) described *Hyalosperma* he also published the name *Helipterum* sect. *Pachypterum*, placing in it *Helipterum cotula*, *Helipterum citrinum* (both of which = *Hyalosperma cotula*), *Helipterum simplex* (= *Hyalosperma simplex*), and *Helipterum niveum*; this last species belongs to a group of taxa quite unrelated to *Hyalosperma*. In 1851 Turczaninow referred *Helipterum pusillum* Turcz. (= *Hyalosperma pusillum*), a new species from Western Australia, to sect. *Pachypterum*, evidently recognising its affinity to *H. cotula*.

A further species, *Pteropogon demissus* Gray, was described in 1852 and placed by Gray in *Pteropogon* sect. *Pteropogonopsis* (a monotypic section) but with no mention of possible affinity to other species here included in *Hyalosperma*.

Neither the generic name *Hyalosperma* Steetz nor the sectional names of Steetz and of Gray have been taken up subsequent to Sonder (1853). All later authors who described or treated the species here included in *Hyalosperma* have placed them in the genus *Helipterum*, either under one or other of the various sectional names established by de Candolle (1838) or without indication of section.

Methods

Specimens of Australian species of *Helipterum* have been borrowed from all Australian State and Federal herbaria. Type specimens relevant to this study have been seen at the Royal Botanic Gardens, Kew (K), the British Museum (BM), and the Naturhistorisches Museum, Vienna (W). In addition material of some Australian *Helichrysum* species has been borrowed from the State Herbarium, Adelaide (AD) and the Tasmanian Herbarium (HO).

Achenes and dissections of florets of all Australian species of *Helipterum*, and of representative species of genera of other Australian Inuleae, have been mounted in Hoyer's solution (King & Robinson 1970) and examined under the microscope. Achenes have also been embedded in Spurr low-viscosity embedding media (Anonymous 1973) and sections stained in Toluidine Blue.

Morphological Characters

In addition to characters that have been classically used when describing members of the Asteraceae I have included some that have not been previously utilised, or have only recently come into prominence. A number of the characters require an explanation and are listed below along with a few of the more traditional ones. Further notes on some characters may be found in Hilliard & Burtt (1981).

Involucral bracts. The bracts usually consist of a claw and a lamina. The claw varies in shape from cylindrical to broad flat and hyaline; it usually contains a thickened median strip or stereome and a central vascular trace, or several traces, simple or branched. The central trace may terminate at the apex of the claw or may continue into the lamina.

In species of the *Helipterum-Helichrysum* group the leaves diminish in size beneath the capitulum and there is an abrupt or gradual transition from leaves to involucral bracts. In most species the transition takes the form of the terminal portion of the leaf becoming scarious and the lower, foliaceous portion, becoming smaller. However, in one group of five species, referred in an accompanying paper to the new genus *Erymophyllum* (Wilson 1989), the terminal portion remains

foliaceous and the base becomes scarious. This would appear to represent a substantial difference in the nature of the transition from one organ to another.

Receptacular bracts. These bracts are absent from most species of the *Helipterum* group; however they appear as hyaline scales in *H. maryonii* S. Moore and *H. tietkensii* F. Muell. Receptacular bracts are also found in *H. verecundum* S. Moore but this species is very distinct and better referred to the monotypic genus *Gilberta* as *G. tenuifolia* Turcz.

Corolla. Shape and arrangement of the cells of the adaxial epidermis: The side walls of the cells that make up the adaxial epidermis of the throat may be straight or slightly to strongly undulate. The shape of the cells on the adaxial surface of the lobes may vary from square to linear and their ends from truncate to acute. The surface of the adaxial epidermal cells of the throat or lobes may be flat, rounded, or papillate; the cells may be arranged either randomly or in transverse rows.

Vascular strands. There are typically 5 commissural vascular strands in the corolla tube. They may be fine and of a single row of tracheids or may be stout and several tracheids thick. The vascular strands may terminate in the tube, at the base of the lobes, along the margins of the lobes, or a pair of strands may unite at the apex of a lobe. Tracheids independent of vascular strands are sometimes present at the apex of corolla lobes.

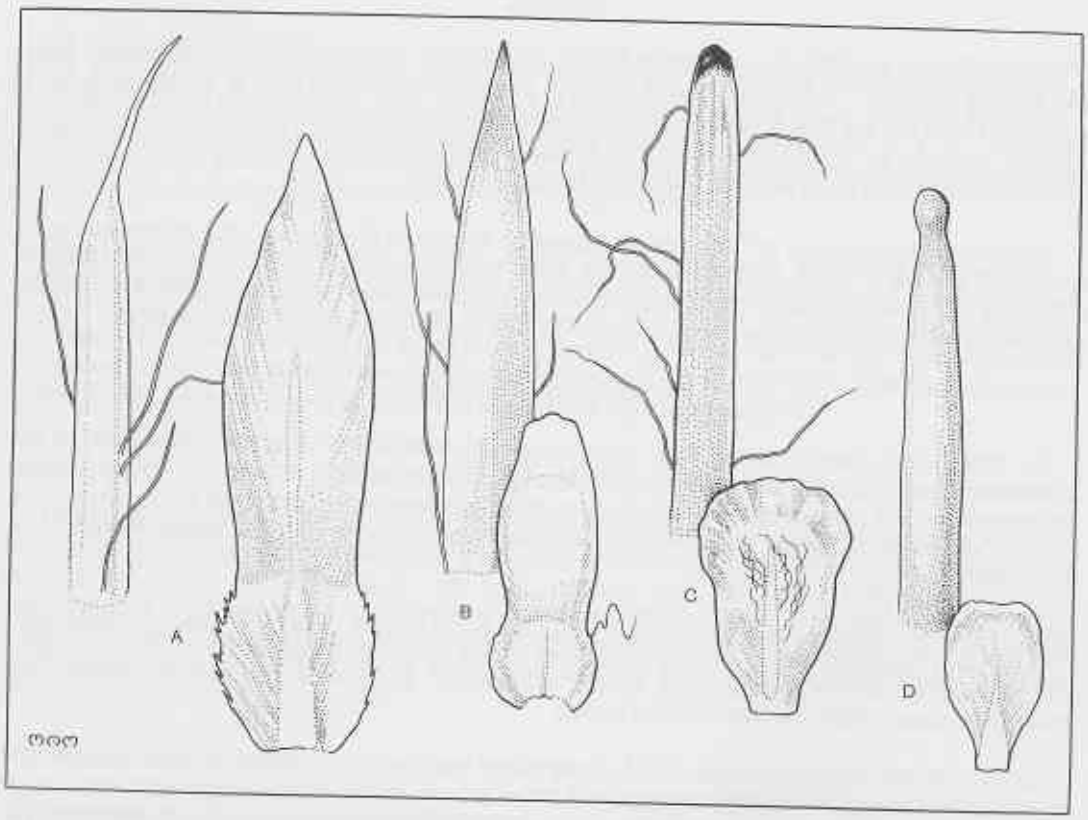

Figure 1. Innermost involucral bracts and apices of lower leaves. A - *Hyalosperma simplex.* B - *H. praecox.* C - *H. cotula.* D - *H. pusillum.* All x 17.

Stamens.

Anther collar (Robinson & King 1977). This is the differentiated distal adaxially concave portion of the staminal filament and consists of cells with lignified walls. It varies in shape and length between different species or genera.

Anther tails. These are considered to be characteristic of members of the Inuleae (but occasionally are absent); they vary considerably in length and texture. This structure is useful for assessing relationships particularly at the sectional or generic level.

Endothecial thickening (see Dormer 1962). This character is not of generic significance in the *Helipterum* complex since the arrangement of the ribs in the endothecial tissue of the anther appears to be consistently of the 'radial' type.

Anther appendage. Detailed examination of the appendage in the *Helipterum-Helichrysum* assemblage has shown that it may vary in overall thickness (2 to several cells thick), in the presence or absence of a thickened central area, in the arrangement and shape of the constituent cells, and in the structure of the cells themselves. These characters are fairly constant within species clusters that may constitute genera or sections.

Style.

Style appendage. This varies in shape and in the arrangement and length of the hairs that surround it.

Vascular trace. Considerable variation is found in overall thickness between species groups; in addition, the trace may terminate in the style branch, in the appendage, or at the extreme tip; it may be uniform in thickness or become spatulate at the apex.

Achene.

Anatomy. A study of cleared whole mounts of achenes and of transverse sections has exhibited a variety of structures. In particular the nature of the pericarp and testa often differs markedly between members of different species groups. The position occupied by the vascular traces in the pericarp in relation to the cotyledons was considered by Short (1987) to be possibly of generic significance; this I have not been able to confirm in the groups that make up the *Helipterum* alliance.

Achenial hairs. In most species of the *Helipterum* alliance the hairs are of the duplex type (see Hilliard & Burtt 1981), that is with a basal cell and a pair of slender united cells that may separate slightly at the apex. In some cases (as in *Hyalosperma*) the twinned cells are lacking and the basal cells form a rounded papilla or collicule on the surface of the achene and are part of the epidermis of the pericarp. The duplex cells are often myxogenic, that is, when moistened they may burst at the tip and exude mucilage.

In some species duplex hairs and papillae are absent. The achene may then be glabrous or it may bear the type of compound hair commonly found on the corolla; this type of uniseriate or biseriate hair is sometimes found on the achenes of *Helichrysum davenportii* F. Muell. and some of its relatives.

Carpopodium. The term used for the structure that forms the abscission zone at the base of the achene (Haque & Godward 1984). In some species of *Helipterum* it is absent (e.g. in *H. uniflorum* J. Black) but in most is represented by a fairly well-defined multilayered series of thick-walled cells. The morphology of the carpopodium varies but is generally constant within a species group.

Nectary. The nectary takes the form of a lobed or entire cup that surrounds the base of the style. It may persist on the fruit or it may be deciduous with the corolla. In some species it is minute or apparently absent.

Mycorrhizal Associations. It has been shown by Warcup & McGee (1983) that the Australian species of *Helipterum* and *Helichrysum*, as these genera are currently circumscribed, may be divided almost equally into two groups: (1) those that form both ectomycorrhizas and vesicular-arbuscular mycorrhizas and (2) those that form only ectomycorrhizas. Further taxa were subsequently examined by Warcup (pers. comm. 1986) and these included four species (with one additional subspecies) that are here recognised as being members of *Hyalosperma*; each of the four species form both ecto- and vesicular-arbuscular mycorrhizas.

Evolution and Breeding Systems

As part of an investigation into the classification of the subtribe Gnaphaliinae some interesting comments were made by Short (1981) on breeding systems and on the recognition of derived versus ancestral characters. These observations are relevant to *Hyalosperma.*

Three of the nine species of *Hyalosperma* are small rounded ephemerals to 5 cm high, these are *H. zacchaeus, H. demissum*, and *H. stoveae.* Their involucres are dull coloured without radiant bracts; the flowers are small with colourless corollas that are very shortly 3-4-lobed, and the anthers included and relatively short (0.15-0.3 mm). These characters are all ones that suggest an autogamous breeding system. Short (1981) has indicated that *H. demissum* has a pollen-ovule ratio of 84.6 which corresponds to the ratio established for other inbreeding species in the subtribe. *Hyalosperma demissum* and *H. stoveae* are morphologically very similar and are presumably closely related while *H. zacchaeus* while of the same habit is quite distinct and evidently evolved its autogamous breeding system independently of the other two.

It is reasonable to postulate that the ancestral form of these species was a plant with pentamerous flowers and showy involucres such as is found in the other members of *Hyalosperma.*

The six species of *Hyalosperma* with showy radiant involucres have anther loculi ranging in length from 0.5 mm (*H. pusillum*) to 1.0 mm (*H. semisterile*), and 5-merous corollas lobed 1/5 - 2/5 of their length; they are presumably at least predominantly outbreeding. Within *H. glutinosum* can be observed a transition from a typical outbreeder to a semiautogamous plant. The putative ancestral outbreeder form is to be found in *H. glutinosum* subsp. *venustum* which has very showy involucral bracts (the yellow laminae to 15 cm long), deeply lobed corollas (lobes 1/3 - 1/2 length of corolla), and exserted anthers with relatively long loculi (average from five collections 0.9 mm). On the other hand in *H. glutinosum* subsp. *glutinosum* the laminae of the involucral bracts are relatively short (to 5 mm), the corolla is shortly lobed (c. 1/5 length of corolla), while the anthers remain in corolla tube and have shorter loculi (average from ten collections across Australia 0.7 mm). The subsp. *venustum* is restricted in its distribution to west-central Western Australia; however, subsp. *glutinosum* is found from the west coast of Western Australia to central New South Wales and Victoria.

A similar distribution pattern was noted by Short in closely related species pairs of which one (the putative ancestral form) was an outbreeder and the other an inbreeder.

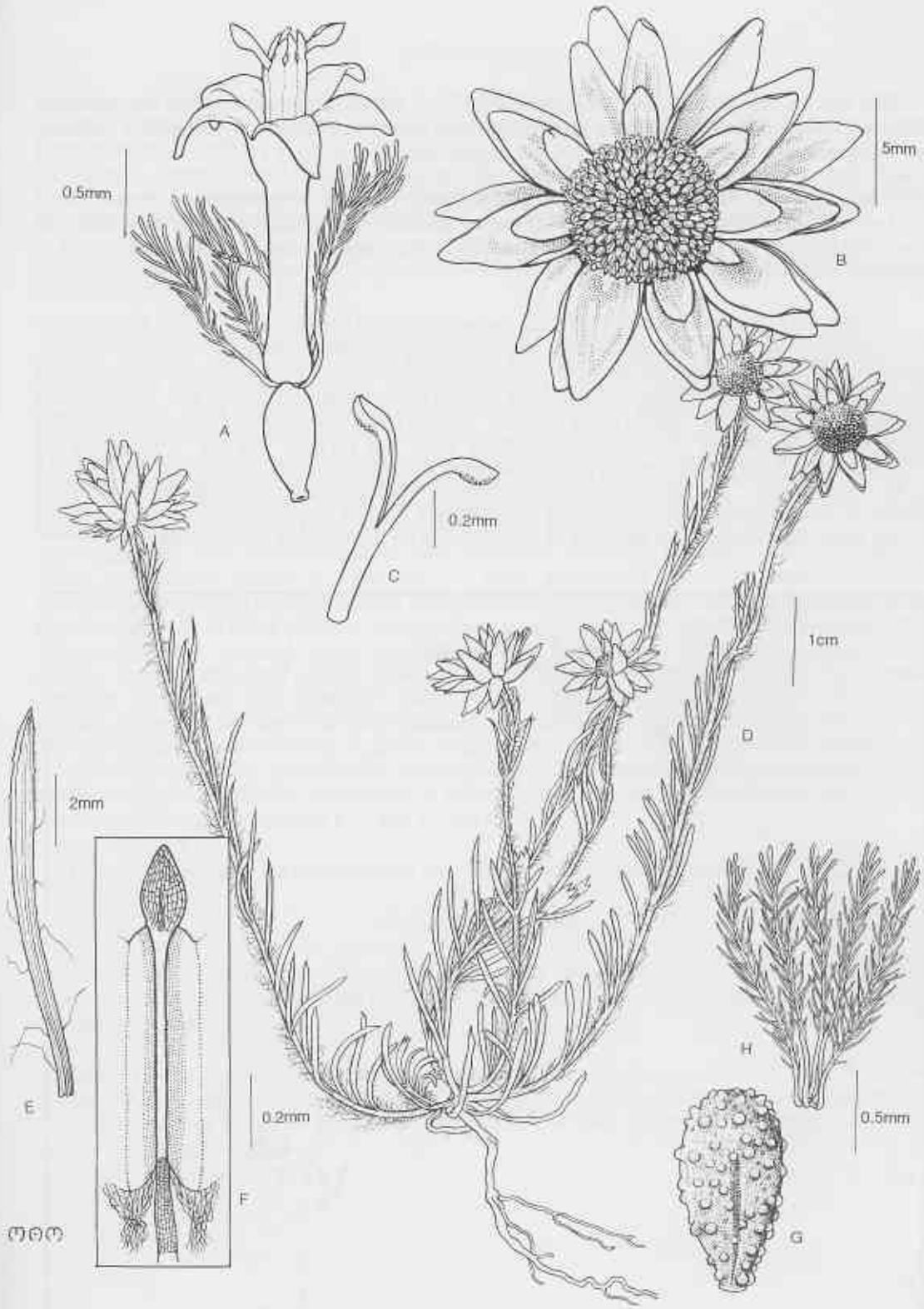

Figure 2. *Hyalosperma praecox*. A - Floret. B - Flower-head from above. C - Style branches. D - Habit of plant. E - Leaf. F - Anther. G - Achene. H - Pappus. All from *T.B. Muir* 6834 (PERTH).

Generic Affinities

The species here included within *Hyalosperma* form a homologous assemblage whose closest affinities in the *Helipterum* complex appear to be with members of the 'Achyroclinoides' alliance, an informal name based on *Pteropogon* sect. *Achyroclinoides* A. Gray (1852). In this alliance I place *Helipterum laeve* (A. Gray) Benth., *H. corymbosum* (A. Gray) Benth., *Helipterum polycephalum* (A. Gray) Benth., and *H. forrestii* F.Muell. *Hyalosperma* differs from *'Achyroclinoides'* in having terete (not flat) leaves, glabrous (not hirsute) achenes, uniseriate (not biseriate) hairs on the corolla, and smooth and straight (not papillose and undulate) walled cells in the inner epidermis of the corolla.

Outside the *Helipterum* complex affinities are possibly with *Blennospora* A. Gray which shares with *Hyalosperma* terete leaves, glabrous and sometimes myxogenic achenes, deciduous pappus, and similar style appendices and stamens. *Blennospora* differs from *Hyalosperma* in inflorescence characters, in the inner epidermal cells of the corolla being variably papillose and with undulate walls, and in hairs on the corolla being biseriate. Short (1987) has suggested that the crustaceous layer of the achene in *Blennospora* is formed from the pericarp but my observations on *B. drummondii* A. Gray indicate that it is formed from the integument and is therefore the testa as it is in *Hyalosperma*. Numerous homomorphic narrow-oblong crystals occur in the testa of the achene of *Blennospora*. They are absent in the mature seed of *Hyalosperma* (but present in the young seed); I am uncertain of the value of this character for ascertaining generic limits.

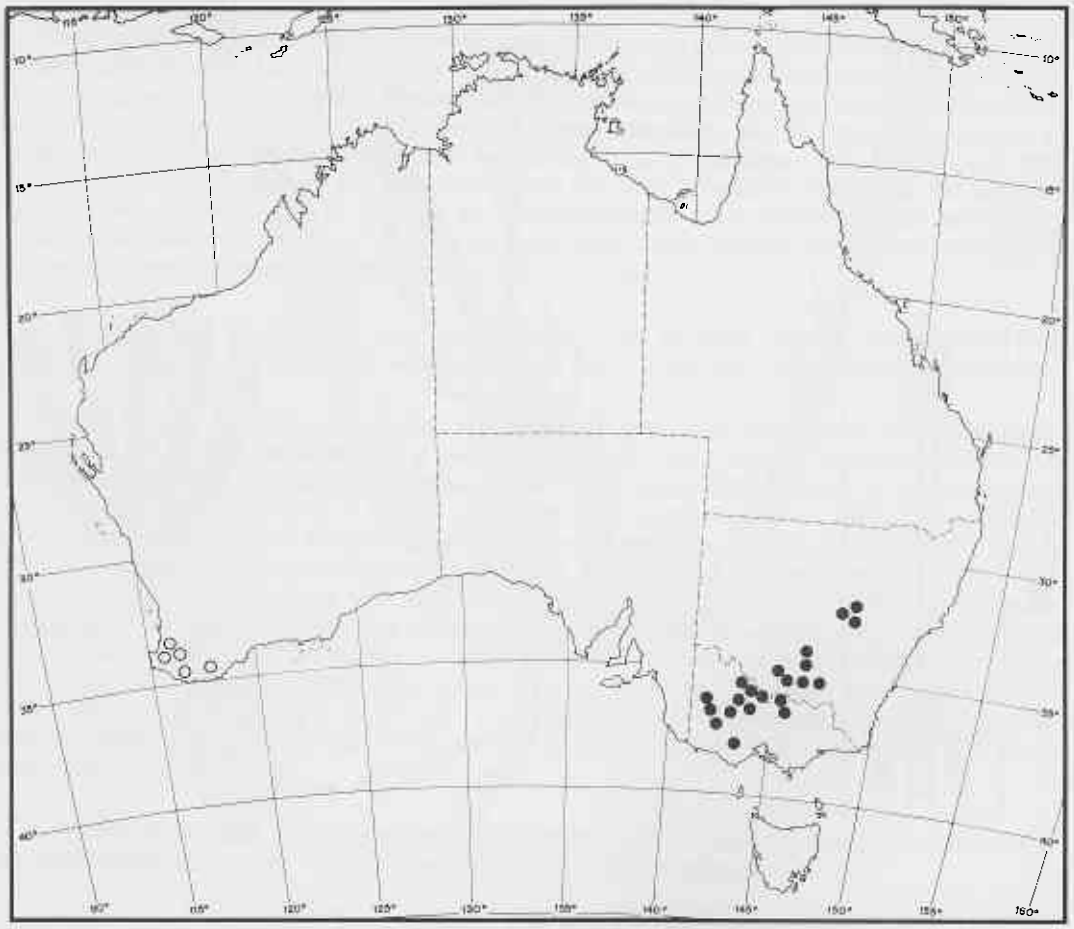

Figure 3. Distribution of *Hyalosperma pusillum* (○), and *H. praecox* (●).

Taxonomy

Hyalosperma Steetz in Lehm., Pl. Preiss. 1: 476 (1845); Walpers, Repert. Bot. Syst. 6: 242 (1846); Sonder, Linnaea 25: 519 (1853). *Lectotype: Hyalosperma glutinosum* Steetz, lecto nov. (see Nomenclatural Notes).

Helipterum sect. *Pachypterum* Steetz in Lehm., Pl. Preiss. 1: 473 (1845) p. pte. maj. and as to lectotype. *Lectotype*: *Helipterum cotula* (Benth.) DC., lecto nov. (see Nomenclatural Notes).

Pteropogon sect. *Pteropogonopsis* A. Gray, Hooker's J. Bot. Kew Gard. Misc. 4: 269 (1852). *Type: Pteropogon demissus* A. Gray.

Annual herbs, cottony to subglabrous. *Stem* slender, simple or branching at or above base. *Leaves* alternate or the lower ones opposite, slender, semiterete. *Flower heads* solitary, multiflowered, homogamous, discoid. *Involucral bracts* 3- to multi-seriate, glossy, glabrous or sparsely woolly; *claw* broad, hyaline on margin; *stereome* linear to narrow-oblong, hard, or thin and inconspicuous; *vascular strand* simple (unbranched), ending below apex of claw; *inner bracts* with a petaline lamina or this represented by a small opaque tip or absent. *Receptacle* convex to conical, glabrous, ebracteate, pitted. *Flowers* actinomorphic, bisexual or the innermost functionally male. *Pappus* caducous as a whole; *bristles* linear-acuminate or broad in lower half, united in a ring at base and in some species in lower half to form a short cylinder, plumose throughout (or only in upper half) with fine cilia, the terminal cilia sometimes clavate or inflated. *Corolla* cylindrical, usually pale yellow, broader in upper half, 3-5 lobed, glabrous or with a few minute uniseriate non-glandular hairs, not papillose within; *vascular strands* of corolla not continuing into lobes; cells of *inner epidermis* of lobes oblong to narrow-oblong, not in rows; cells of inner epidermis of throat with straight walls. *Anthers*: *apical appendages* acute, smooth, thin, 2-cells thick (except for *H. pusillum* in which the distal portion is thickened); *tails* fine and diaphanous. *Nectary cup* minute, persistent on achene. *Style branches: vascular trace* fine, terminating below apex. *Style apex* rounded or broad- to narrow-deltoid, minutely to prominently papillose. *Achene* ellipsoid to obovoid, or flattened and obovate, 1-2 mm long; *vascular strands* 2; *pericarp* soft and translucent, the epidermis smooth, or colliculate to verrucose due to depressed-globular duplex papillae, these usually myxogenic; *testa* thin, crustaceous or sclerenchymatous; *carpopodium* a minute narrow ring (annular). *Chromosome numbers* 8, 11, and 12 (see text).

This genus contains nine species which are endemic to temperate Australia.

Nomenclatural Notes

The genus *Hyalosperma* Steetz (1845) included two species, *H. strictum* Steetz and *H glutinosum* Steetz. In considering them to be conspecific I have retained the name *H. glutinosum* (see under this name).

Steetz (1845) placed four species in *Helipterum* sect. *Pachypterum*, these were *H. cotula* (Benth.) DC., *H. citrinum* Steetz, *H. simplex* Steetz, and *H. niveum* Steetz. I consider that, except for *H. niveum*, they belong to the genus *Hyalosperma* and have designated as lectotype *H. cotula*, the one listed first by Steetz.

Key to species

1. Inner involucral bracts without a radiating lamina or the lamina less than 1 mm long; plants 2-4 cm high, much branched; corolla 3-4-lobed.

    2. Involucre c. 5 mm long; inner involucral bracts with a small ovate pale brown lamina 0.5-1 mm long (W.A.) ..... 1. *H. zacchaeus*

    2. Involucre to 3 mm long; inner involucral bracts entirely hyaline or with a very short erect opaque apex.

        3. Leaves slender terete; plant very sparsely pilose ..... 2. *H. demissum*

        3. Leaves fleshy, elliptic to obovate; plant moderately pilose ..... 3. *H. stoveae*

1. Inner involucral bracts with a prominent white or yellow radiating lamina over 2 mm long; plants mostly 10-20 cm high; stem simple or branched; corolla 5-lobed.

    4. Involucre turbinate to cup-shaped, glossy, glabrous; radiating bracts with yellow lamina; achene warty.

        5. Involucre (excluding ray) turbinate to broadly cup-shaped, reddish brown; lower leaves with rounded apex; pappus bristles broad towards base and variably united into a sheath; achene broad-oblong, flattened, hyaline on margin (W.A. & Eastern States) ..... 4. *H. glutinosum*

        5. Involucre (excluding ray) broadly cup-shaped, silvery to pale brown; lower leaves obtuse to acute or acuminate; pappus bristles narrow in lower half and united only at base; achene narrow-obovoid, not hyaline on margin (Eastern States) ..... 5. *H. semisterile*

    4. Involucre spreading from base, somewhat woolly to subglabrous; radiating bracts with white or yellow lamina; achene warty or smooth.

        6. Leaves (middle and lower) blunt; innermost involucal bracts with very short rounded or truncate lamina 0.25-1.5 mm long.

            7. Receptable conical; innermost involucral bracts with extremely short (c. 0.25 mm) truncate white limb; pappus tips white, clavate (W.A., Bunbury southwards) ..... 9. *H. pusillum*

            7. Receptacle rounded; innermost involucral bracts with short (0.5-1.5 mm) white or yellow rounded lamina; pappus tips yellow, clavate (W.A., Geraldton southwards) ..... 6. *H. cotula*

        6. Leaves (middle and lower) acuminate; innermost involucral bracts with prominent (c. 5 mm) radiating lamina.

            8. Stem usually branched at and above base; receptacle rounded (W.A., Perth southwards) ..... 7. *H. simplex*

            8. Stem branching at base; receptacle conical (south-eastern Australia). ..... 8. *H. praecox*

1. **Hyalosperma zacchaeus** (S.Moore) Paul G. Wilson, comb. nov. — *Helipterum zacchaeus* S.Moore, J. Bot. 35: 166 (1897); B. Grieve & W. Blackall, How to know Western Austral. Wildfl., Pt. 4: 834 (1975). *Type:* Near Coolgardie, Aug. 1895, *S. Moore* (holo: BM; iso: K, MEL).

Helipterum guilfoylei Ewart, Proc. Roy. Soc. Victoria n.s. 20: 82, t. 12 (1907). *Lectotype:* Cowcowing, Aug. 1904, *M. Koch* 1097 (lecto: MEL 1539022; isolecto: NSW 179898, PERTH), lecto nov. *Lectoparatypes*: Cowcowing, Aug. 1904, *M. Koch* 1097 (MEL 1539023, NSW 179898, PERTH); Cowcowing Sept. 1904, *M. Koch* 1097 (MEL 1539023, BM, PERTH).

Decumbent to erect rounded *annual* branching at and above base, c. 5 cm high, sparsely villous to very sparsely woolly. *Branches* slender. *Leaves* slender, semiterete 3-6 mm long, acute; *terminal leaves* clustered around capitulae and bearing short scarious appendages. *Heads* solitary, terminal to branches. *Involucre* broad cylindrical to urceolate, c. 5 mm high, 2.5 mm diameter. *Involucral bracts* c. 4-seriate, glossy, straw-coloured, glabrous; *outer bracts* broad-elliptic, c. 2.5 mm long, hyaline except for flat linear stereome, woolly ciliate on margin; *intermediate* and *inner bracts* similar to outer but c. 4 mm ong, eciliate and with a very small pale brown somewhat spreading lamina to 0.7 mm long; innermost bracts ovate, c. 3 mm long, eciliate and without a lamina. *Receptacle* slightly convex, c. 0.7 mm diameter, smooth. *Flowers* 5-10, all fertile or the inner with sterile ovaries. *Pappus: bristles* c. 10, c. 2 mm long; shaft narrow-linear acuminate, united in a ring at base, plumose throughout, colourless or the terminal cilia very pale yellow, basal cilia curled around those of other florets. *Corolla* narrow-tubular, c. 2 mm long, glabrous, very shortly 4-lobed. *Anthers* included; loculi c. 0.3 mm long. *Style tip* truncate, minutely papillose. *Achene* oblong to obovate, c. 2 mm long, colliculate due to the sessile depressed globular duplex papillae, myxogenic; *pericarp* reddish brown or colourless, translucent but filled with the reddish brown seed (testa); attachment minute, 0.1 mm diameter. *Chromosome number* n = 8 fide B.L. Turner (1970).

Specimens seen (selection only). WESTERN AUSTRALIA: Boorabbin, *K.R. Newbey* 8692 (PERTH); 30 miles S of Coolgardie, *B.L. Turner* 5291 (MEL, PERTH); Mongers Lake, *P.G. Wilson* 12302 (PERTH).

Distribution. Inland south-western Western Australia from Cowcowing in the west to Coolgardie and Fraser Range in the east. Figure 4.

Habitat. Sandy loam or gravel in open forest or exposed areas.

Lectotypification of Helipterum guilfoylei. No locality or collection was cited by Ewart; I have therefore designated as lectotype a specimen that was annotated by Ewart and was probably the basis for the illustration of the plant on plate 12 that accompanied the description.

2. **Hyalosperma demissum** *(A. Gray) Paul G. Wilson, comb. nov.* — *Pteropogon demissus* A. Gray, Hooker's J. Bot. Kew Gard. Misc. 4: 269 (1852). — *Helipterum demissum* (A. Gray) Druce, Bot. Exch. Club Soc. Brit. Isles 4: 627 (1917); Ewart, Fl. Vict. 1128 (1931); J. Willis, Handb. Pl. Victoria 2: 709 (1973); J. Black, Fl. South Australia edn 2, 906 (1957). *Type:* Swan River, *J. Drummond* 66 (holo: K).

Helipterum exiguum F. Muell., Trans. & Proc. Vict. Inst. Advancem. Sci. 1854-1855: 39 (1855); Benth., Fl. Austral. 3: 649 (1867). *Type citation:* 'In sandy stony declivities of the Grampians, the Serra and Victoria Ranges, near Gawlertown, and in the Bugle Ranges'. *Lectotype:* Mount Sturgeon, Victoria, November 1858, *F. Mueller* (lecto: MEL 1539027; isolecto: K, MEL 1539062), lecto. nov.

Much-branched rounded *annual* 5-20 mm high, sparsely villous to glabrous. *Branches* obscurely ribbed from the decurrent leaf bases. *Leaves* opposite and alternate, linear-triquetrous, acuminate, c. 5 mm long. *Heads* terminal to branches and subtended by foliage leaves. *Involucre*

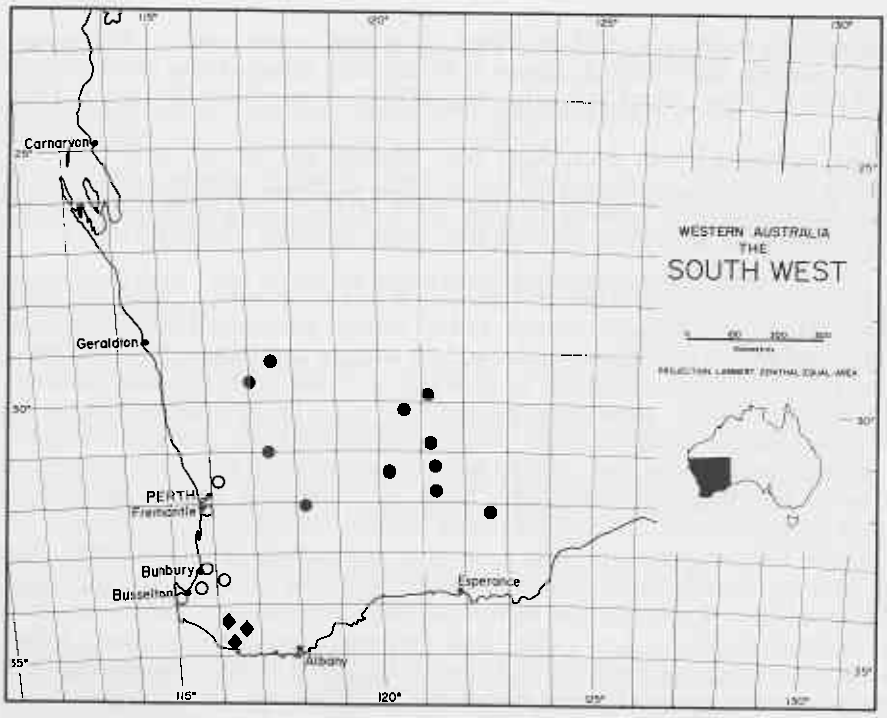

Figure 4. Distribution of *Hyalosperma zacchaeus* (●), *H. simplex* subsp. *simplex* (○), and *H. simplex* subsp. *graniticola* (◆).

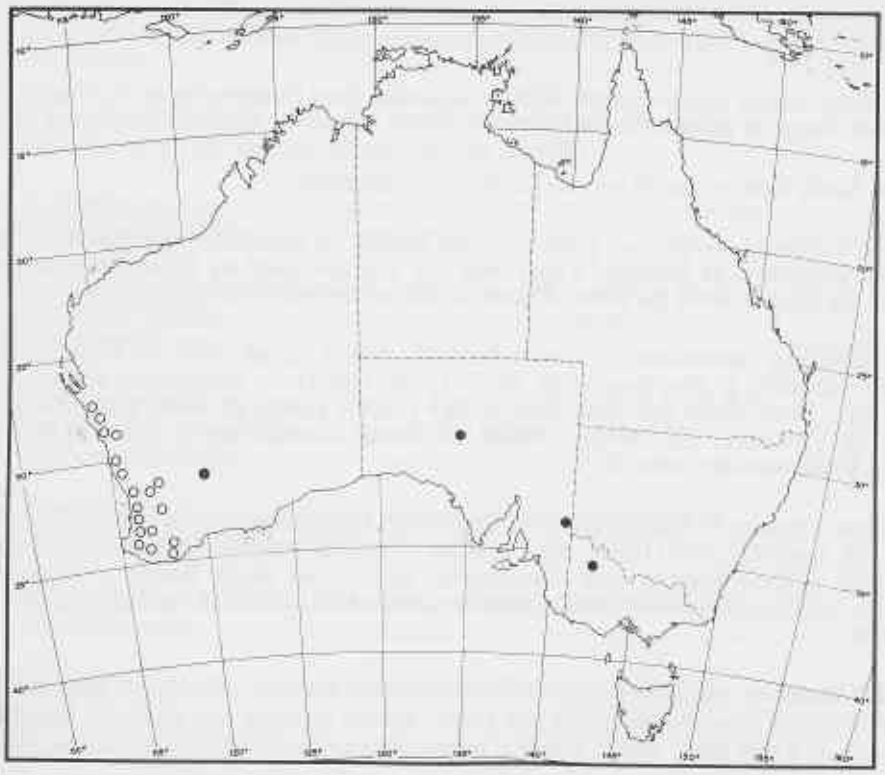

Figure 5. Distribution of *Hyalosperma cotula* (○), and *H. stoveae* (●).

urceolate to cup-shaped c. 3 mm long, 1.5 mm diameter, glabrous. *Involucral bracts* 3-4 seriate, pale green to straw-coloured or silvery glossy, ovate to broad oblong, 2-2.5 mm long, hyaline with flat linear stereome extending 1/2-2/3 the length; *inner bracts* with an erect short (c. 0.2 mm) rounded pale brown to off-white (rarely pale yellow) apex. *Receptacle* rounded to conical, c. 0.7 mm diameter. *Flowers* 15-25, fertile. *Pappus:* bristles c. 10, c. 1.5 mm long; shaft narrow-linear acuminate shortly united at base in a ring, plumose throughout with slender cilia, colourless. *Corolla* narrow-cylindrical, white or pale yellow, equal to pappus, glabrous, very shortly 3 or 4 lobed. *Anthers* included; *loculi* c. 0.3 mm long. *Style apex* minute, rounded, prominently papillose. *Achene* obovoid or somewhat compressed, c. 0.7 mm long, colliculate with sessile depressed globose duplex papillae, margaritaceous, myxogenic; *carpophore* minute, c. 0.06 mm diameter. Pappus and corolla attached to centre of apex of achene.

Specimens seen (selection only). WESTERN AUSTRALIA: Nippering, *T.B. Muir* 4457 (MEL); Boyagin Rock, *R. Ornduff* 9299 (PERTH); 65 km SW of Sandstone, *P.G. Wilson* 8894 (PERTH).
SOUTH AUSTRALIA: Hundred of Ramsay, *B.J. Blaylock* 1714 (AD); Fairview Conservation Park, P.E. Conrick 1219 (AD); 25 km ENE of Murray Bridge, *D.N. Kraehenbuehl* 4231 (AD).
VICTORIA: Mt Arapiles, *H.I. Aston* 1072 (MEL); Narrandera Range, *T.B. Muir* 6082 (MEL); You Yangs, Oct. 1976, *J.H. Willis* (MEL).
NEW SOUTH WALES: Jindera Gap, *E.J. McBarron* 36846 (NSW); Temora, Oct. 1915, *J.W. Dwyer* 690 (NSW); Narrandera Range, *T.B. Muir* 6082 (CBG, MEL).
TASMANIA: Hobart, *W.M. Curtis* (HO 52397); Lindisfarne, *L. Rodway* (NSW).

Distribution. Found in south-west Western Australia, southern South Australia, Victoria, southern New South Wales as far east as 147° longitude, and Tasmania. Figure 8.

Habitat. Grows in shallow soils in a variety of habitats, often in exposed situations.

Note. For the characters that serve to separate *H. demissum* from *H. stoveae* see under the latter species.

3. **Hyalosperma stoveae** (D.A. Cooke) Paul G. Wilson, comb. nov. — *Helipterum stoveae* D.A. Cooke in Jessop & Toelken, Fl. South Australia edn 4, 1546, 1548 f. 700C (1986). *Type:* c. 2.5 km S of 'Ingomar' Homestead, c. 1 km SSW of southern end of Birthday Swamp, South Australia, 15 Sept. 1978, *K. Stove* 655 (holo : AD).

Much-branched semi-prostrate *annual* to 50 mm diameter, sparsely villous. *Branches* slender. *Leaves* subopposite, fleshy; lower leaves narrow-oblong, c. 5 mm long; upper leaves elliptic to narrow-obovoid, c. 3 mm long; uppermost leaves c. 4, ovate to broad-ovate, c. 2.5 mm long and surrounding the solitary sessile capitulum. *Involucre* broadly cup-shaped, c. 1.7 mm high, 2 mm diameter. *Involucral bracts* not radiating, 2-seriate, obovate with rounded apex, c. 2 mm long, hyaline with the apex sometimes semiopaque, glabrous; *stereome* linear, flat, hard, c. 1/2 length of bract. *Receptacle* convex to broad-conical, c. 0.7 mm diameter. *Florets* numerous, fertile. *Pappus bristles* 6-8, c. 1.2 mm long; *shaft* narrow-linear acuminate, plumose from near base with slender cilia, united in a short ring at base, colourless. *Corolla* narrow-cylindrical, glabrous outside and inside, very shortly 3-lobed, equal to pappus. *Anthers* 3, included; loculi c. 0.15 mm long; base acute; tails short and diaphanous; apiculum triangular; collar linear, equal in length to anther. *Style apex* acuminate the lobes very short and scarcely separable, papillose. *Achene* very broadly obovoid, c. 0.5 mm long, rounded at apex, smooth, not myxogenic, colourless to pale brown; *carpophore* a minute ring c. 0.08 mm diam. Pappus and corolla excentrically attached to achene.

Specimens seen. WESTERN AUSTRALIA: Perrinvale Station, *R.J. Cranfield* 7187 (PERTH).
SOUTH AUSTRALIA: Canopus, 33° 30' S, 140° 42' E, *K.M. Alcock* 36 (AD).
VICTORIA: Wyperfeld N.P., 0.5 km SW of Eastern Lookout, 35° 36' S, 142° 06' E, *T.B. Muir* 5891 (MEL).

Distribution. Found in south-central region of Western Australia, the Lake Eyre and Murray Regions of South Australia and in western Victoria. Figure 5.

Habitat. Acacia aneura woodland (Lake Eyre region, South Australia) and mallee woodland (western Victoria).

Notes. Hyalosperma stoveae is very similar in appearance to *H. demissum*; it differs from the latter species in having somewhat more villous branches, broader leaves, and a smooth achene on which the corolla is excentrically attached. Although *H. stoveae* is small and certainly easily overlooked, it must be more rare than *H. demissum* since, although evidently widely distributed, only four collections have been seen in Australian herbaria, all collected between 1978 and 1988.

4. **Hyalosperma glutinosum** Steetz in Lehm., Pl. Preiss. 1: 477 (1845); — *Helipterum glutinosum* (Steetz) Druce, Bot. Exch. Club Brit. Isles 1916: 627 (1917); Domin, Vestn. Kral. Ceske Spolecn. Nauk. Tr. Mat.-Prir. 2: 118 (1923) nom. illeg. non Hook. (1848). *Type citation*: 'In solo sublimoso prope oppidulum York, d. 4. Sept. 1839. Herb. *Preiss.* No. 19.' *Type:* K, MEL 1538987, 1538988, 1538989 (see Notes).

Hyalosperma strictum Steetz in Lehm., Pl. Preiss 1: 47745). *Type citation*: 'In calculosis apricis lateris orientalis montis Brown et montis Lehmann, d. 4 Sept. 1839. Herb. *Preiss.* No. 20.' *Type:* (MEL 1538985, MEL 1538986).

Hyalosperma variabile Sond., Linnaea 25: 519 (1853), nom. illeg. (both *H. strictum* Steetz and *H. glutinosum* Steetz were cited in synonymy of an included variety) — *Helipterum variabile* Ostenf., Biol. Meddel. Kongel. Danske Vidensk. Selsk. 3(2): 141 (1921), comb. illeg. (an earlier epithet available).

Hyalosperma variabile Sonder var. *preissii* Sonder, Linnaea 25: 519 (1853), based on types of *H. strictum* Steetz and *H. glutinosum* Steetz.

Helipterum hyalospermum F. Muell. ex Benth., Fl. Austral. 3: 644 (1867), based on types of *Hyalospermum strictum* Steetz and *H. glutinosum* Steetz, non *Helipterum strictum* (Lindley) Benth. (1867) nec *Helipterum glutinosum* Hook. (1848).

Helipterum venustum S. Moore, J. Linn. Soc. Bot. 45: 180 (1920). Type citation: 'Mt Magnet district, Youanne; *Maryon.*' *Type*: (holo: BM).

[*Hyalosperma variabile* Sonder. var. *muelleri* Sonder., Linnaea 25: 519 (1853) p.pte. as to 'Burra Burra' not as to lectotype.] See Notes.

Erect *annual herb* 10-20 cm high, simple or branching at and above base. *Branches* slender weakly sinuous, glabrous or very sparsely woolly, inconspicuously ribbed by the narrow green leaf decurrencies. *Leaves* alternate, filiform, 5-40 mm long, glabrous to sparsely woolly with obtuse to rounded apex, abruptly diminishing and bract-like in upper portion of branches and there with short scarious appendages. *Heads* solitary, terminal to branches. *Involucre* turbinate becoming hemispherical at maturity with radiating laminae, 5-10 mm high and wide (excluding rays). *Involucral bracts* multiseriate; *outer bracts* glossy, pale to dark brown, almost glabrous, broad-elliptic with flat lanceolate stereome, grading downwards into upper cauline bracts; *inner bracts:* claw broad-elliptic to suborbicular, c. 3-4 mm long, hyaline, membranous, woolly ciliate, with narrow-oblong thin flat stereome extending throughout length; lamina oblong-elliptic, acute, 3-15 mm long, yellow; innermost series of bracts similar to inner or with very reduced lamina. *Receptacle* convex, 2-5 mm diameter, prominently pitted. *Flowers* numerous, fertile except for some in centre. *Pappus* colourless or towards apex yellow; bristles c. 12; shaft linear-acuminate, broader in lower half, 2.5 mm long, variably united towards base into a sheath, plumose in upper

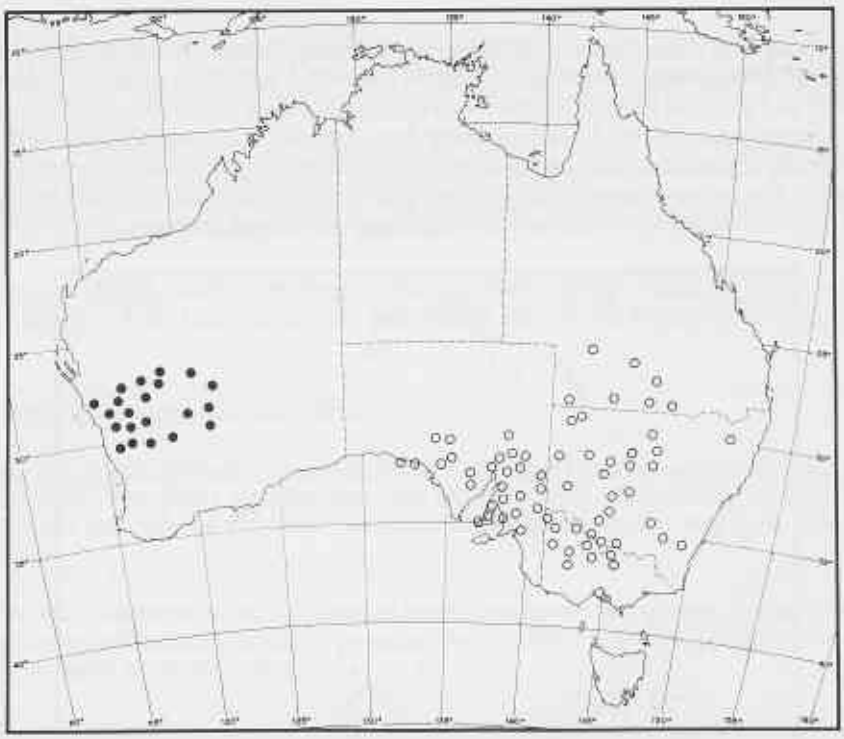

Figure 6. Distribtuion of *Hyalosperma glutinosum* subsp. *venustum* (●), and *H. semisterile* (○).

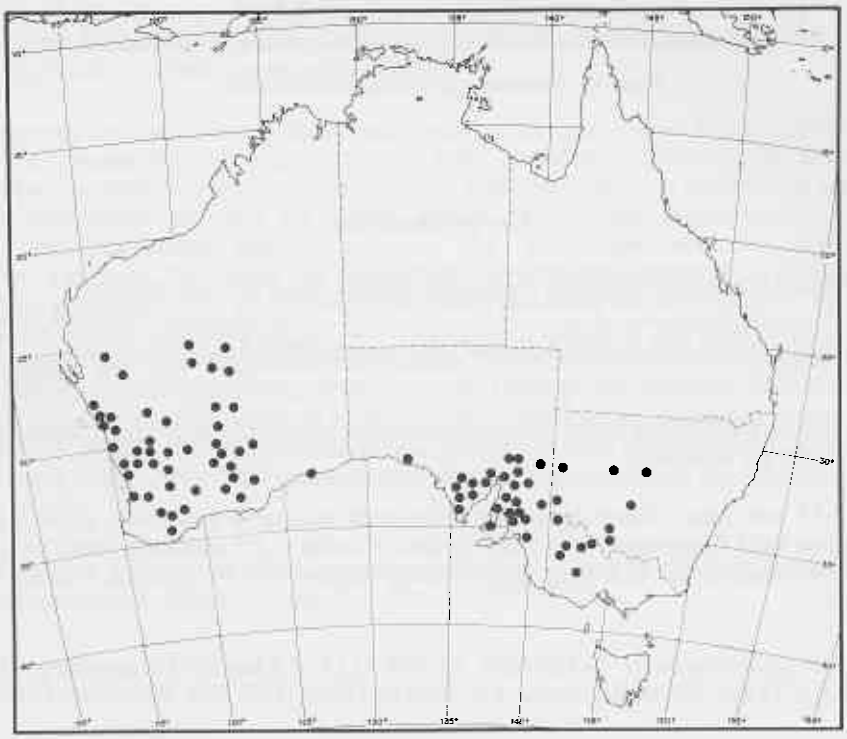

Figure 7. Distribution of *Hyalosperma glutinosum* subsp. *glutinosum*.

half, the terminal cilia filamentous or in those of the central florets clavate to obovoid. *Corolla* tubular, narrow in lower half, somewhat broader in upper, 2.5 mm long, glabrous, yellow, 5-lobed to between 1/5 and 1/2 of its length. *Anther loculi* 0.7-0.9 mm long. *Style apex* very broadly deltoid, papillose. *Achene* broad-oblong, 1.5-2.5 mm long, base rounded, apex truncate and slightly concave in centre; pericarp translucent, soft, brown or colourless, densely colliculate with small low rounded duplex papillae that are myxogenic; *seed* occupying central portion of achene, testa brown; margins of achene hollow, translucent; *carpophore* inconspicuous, c. 0.2 mm diameter.

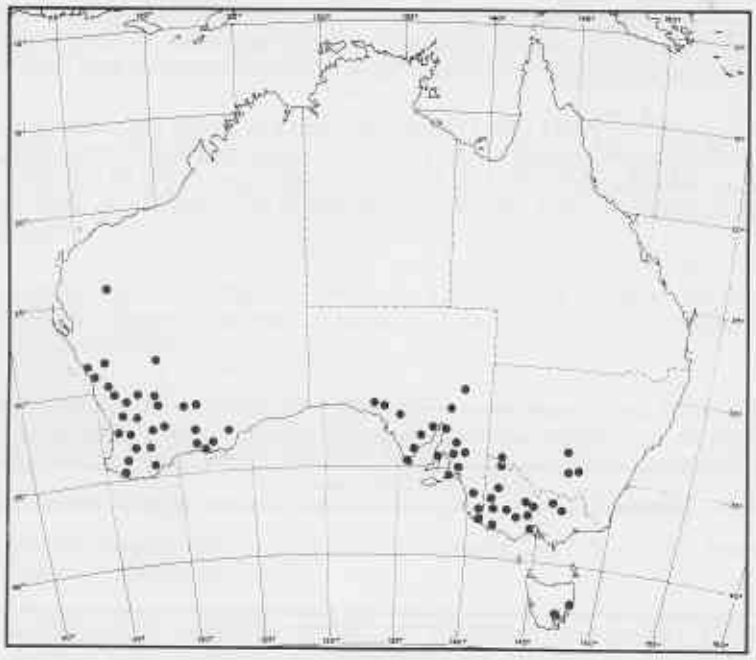

Figure 8. Distribtuion of *Hyalosperma demissum*.

Key to subspecies

1. Inner involucral bracts with lamina to 5 mm long; corolla lobed to c. 1/5 of length ..... a. subsp. *glutinosum*

1. Inner involucral bracts with lamina 5-15 mm long; corolla lobed 1/3 to 1/2 of length ..... b. subsp. *venustum*

4a. **Hyalosperma glutinosum** Steetz subsp. **glutinosum**; synonymy as for the species, except for the name *Helipterum venustum*.

Leaves 5-15 mm long. *Inner involucral bracts* with lamina -5 mm long. *Inner florets* with terminal pappus hairs filamentous or slightly clavate. Corolla c. 2.5 mm long, lobed to c. 1/5 of its length. *Anther loculi* c. 0.7 mm long. *chromosome number* n = 11 fide B.L. Turner in sched. (*Turner* 5339).

Specimens seen (selection only). WESTERN AUSTRALIA: 4.1 km N of Piawanning, *H. Demarz* 7410 (PERTH); 33 km SW of Rawlinna, *A.S. George* 11890 (PERTH); Woodline, *G.J. Keighery*

2952 (PERTH); 3 miles S of Mindalla, *B.L. Turner* 5339 (MEL).

SOUTH AUSTRALIA: Mambray Creek, *G. Coombe* 210 (AD); Yardea Homestead to Scrubby Peak, *N.N. Donner* 3368 (AD); Wilpena Chalet, D.E. Symon 557; SE of Carrappee Hill, *D.E. Symon* 9040 (AD).

VICTORIA: Wyperfeld N.P., *A.C. Beauglehole* 28940 (MEL); N.W. Yarrara State Forest, *T. Henshall* 891 (MEL); Timberoo Forest, *T.B. Muir* 1145 (MEL).

NEW SOUTH WALES: Mt Waabalong, *P.L. Milthorpe* and *G.M. Cunningham* 1289 (NSW); 'Myalla', NW of Hillston, *W. Semple* 1786 (NSW).

Distribution. South-western Western Australia south of 25° latitude, and west of 124° longitude, southern South Australia, central and western New South Wales, north-western Victoria. Figure 7.

Habitat. Exposed situations in a wide variety of soils.

Notes. Type specimens of *Hyalosperma glutinosum*, of which I have seen several, are covered by a resinous secretion. The plants are otherwise very similar to type specimens of *H. strictum.* I have not observed this secretion on any other collection of the species and it may have been caused by insect predation.

Hyalosperma glutinosum subsp. *glutinosum* sometimes grows in the same area as *H. semisterile;* the two species are sufficiently similar to be sometimes confused in the field, collected together, and mounted on the same herbarium sheet.

The material that Sonder included under the name *Hyalosperma variabile* b. *muelleri* consisted of plants of both *H. glutinosum* and *H. semisterile* (F. Muell.) Paul G. Wilson. A 'Burra Burra' collection that was cited by Sonder (MEL 1539189) bears an invalid name *Jessenia heterocarpa* in Mueller's handwriting and, above it, the name *'Hyalosperma variable* b. Mulleri Sond.' in Sonder's. This specimen is of *H. glutinosum* Steetz. The name *'Jessenia heterocarpa* F. Muell.' was cited by Sonder l.c. as a nomen pro syn. under *Hyalosperma variabile.* A further collection of Mueller's from Burra Burra, (MEL 1538904) has been correctly determined by Mueller as *'Helipterum jesseni'* (= *Hyalosperma semisterile).*

Hyalosperma strictum Steetz (1845) and *Hyalosperma glutinosum* Steetz (1845) were first stated to be conspecific by Sonder (1853) who provided an illegitimate nomen novum *'Hyalosperma variabile'* for the combined names. Bentham (1867) on transferring the combined species to *Helipterum* provided the nomen novum *'Helipterum hyalospermum'* which was legitimate since the earlier epithets *'strictum'* and *'glutinosum'* were not available under *Helipterum.* Druce in 1917 made the illegitimate combination *Helipterum glutinosum* (Steetz) Druce (a later homonym of *H. glutinosum* Hook. 1848) indicating that it replaced *H. hyalospermum* Benth. but he did not cite either of the two *Hyalosperma* names of Steetz in synonymy. Domin (1923) published the same illegitimate combination *'Helipterum glutinosum* (Steetz) Domin' but cited in synonymy both *Hyalosperma glutinosum* and *Hyalosperma strictum;* he was therefore the first to choose one of the two names as having priority when they are combined (Intern. Code Bot. Nom. Art. 57.2, 1983). The name *Hyalosperma glutinosum* must therefore be used if the two are treated as being conspecific. This is unfortunate since its type specimens are aberrant and possibly diseased.

4b. **Hyalosperma glutinosum** subsp. **venustum** (S. Moore) Paul G. Wilson, comb. et stat. nov. *Helipterum venustum* S. Moore, J. Linn. Soc. Bot. 45: 180 (1920).

Leaves filiform, 10-40 mm long. *Inner involucral bracts* with lamina 5-15 mm long. *Inner florets* with some of the terminal pappus hairs clavate to obovoid. *Corolla* 3.5-4 mm long, lobed l/3 to l/2 of length. *Anther loculi* c. 0.9 mm long.

Specimens seen (selection only). WESTERN AUSTRALIA: 10 km N of Mt Magnet, *P. Copley* 1237 (AD); Watheroo Rabbit Fence, *M. Koch* 1333 (AD); 1 km S of Murchison R. bridge, *P.S. Short* 1595 (AD, MEL); 26 km W of 'Warriedar' Homestead, *P.G. Wilson* 12271 (PERTH); 2 km S of Wongan Hills township, *P.G. Wilson* 12355 (PERTH).

Distribution. From near the west coast of Western Australia lat. 27° (near Ajana) to 30° (near Badgingarra) east to long. 122° (near Leonora). Figure 6.

Habitat. Often found in *Acacia* scrub in sand or loam.

Notes. This subspecies occurs within the distribution of subspecies *glutinosum* with which it has close affinity and possibly intergrades. The two may be distinguished by the characters indicated above.

5. **Hyalosperma semisterile** (F. Muell.) Paul G. Wilson, comb. nov. — *Helipterum semisterile* F. Muell., Fragm. 2: 157 (1861). *Type*: Darling Desert [near Lake Pamamaroo fide J.H. Willis, 1962], 31 Oct. 1860, *H. Beckler* (holo: MEL 108292).

Hyalosperma variabile var. *muelleri* Sonder, Linnaea 25: 519 (1853). *Type citation*: 'Gawler-town, Sept. Burra Burra et in regionibus interioribus frequens et gregatim crescens.'. *Lectotype:* Gawler-town, Sept. 1848, *F. Mueller* (lecto: MEL 1538937; isolecto: MEL 603653), lecto nov. (see Notes.)

Helipterum jessenii F. Muell., Victorian Naturalist 7: 48 (1890); Maiden & E. Betche, Census New South Wales Pl. 203 (1916); Ewart, Fl. Vict. 1129 (1931); J. Black, Fl. South Australia edn 2, 903 (1957); J. Willis, Handb. Pl. Vict. 2: 708 (1973). *Lectotype*: Port Augusta, 1885, *Mrs Ann Richards* (MEL 1538889), lecto nov. (see Notes.)

[*Helipterum hyalospermum* auct. non Benth.; Benth., Fl. Austral. 3: 644 (1867) p.pte.]

Erect *annual herb* to 15 cm high, branching at and above base. *Branches* slender, sparsely cottony or glabrous. *Leaves* alternate slender semiterete 5-15 mm long, obtuse to acute, sparsely pilose or glabrous, terminal leaves much reduced and bract-like with hyaline appendages. *Heads* solitary, terminal. *Involucre* broadly hemispherical, c. 4 mm high, 8 mm wide (excluding ray). *Involucral bracts* multiseriate, glabrous; outer and intermediate bracts glossy, silvery to stramineous with pale brown apices, *claw* suborbicular hyaline, membranous, c. 2.5 mm long and wide, with a short flat, triangular stereome; *inner bracts:* claw suborbicular, hyaline, membranous, c. 3 mm long and wide with a flat narrow-oblong stereome extending length; *lamina* ovate, obtuse, 2-5 mm long, bright yellow. *Receptacle* convex c. 2 mm diameter, somewhat pitted. *Flowers* numerous, fertile except for those in centre. *Pappus:* bristles c. 12; shaft narrow-linear acuminate, c. 2.5 mm long, evenly plumose (terminal cilia not clavate), united in ring at base, clear or pale yellow towards apex. *Corolla* narrow cylindrical, broader in upper half, c. 2.5 mm long, 5-lobed to l/3-2/5 length, glabrous. *Anther loculi* c. 0.9 mm long. *Style apex* broad deltoid, papillose. *Achene* compressed obovoid, c. 1.5 mm long; pericarp clear, totally filled by seed, verrucose due to the sessile depressed globular duplex papillae, myxogenic. *Chromosome number* n = 7 or 8 fide B.L. Turner (1970).

Specimens seen (selection only). SOUTH AUSTRALIA: Between Hartley and Langhorn's Creek, *D. Hunt* 2704 (AD); Mannum, *D.E. Symon* 6758 (AD); Druid Range, *G.F. Telfer* 42 (AD).
VICTORIA: 30.6 km SE of Walpeup, *M.G. Corrick* 6687 (MEL); Berribee Tank, 29 Aug. 1948, *J.H. Willis* (MEL); Lake Hindmarsh, 1889, *H. Worsley* (MEL).

NEW SOUTH WALES: 23 km ENE of Goolgowie, *L. Haegi* 1339 (NSW); Pimpara Ck., *S. Jacobs* 1056 (NSW); Near Hebel, *P.L. Milthorpe* and *G.M. Cunningham* 3839 (NSW).
QUEENSLAND: 100.8 km SSW of Noccundra, *D.E. Boyland* 3072 (BRI); Elmina Stn, *S.L. Everist* 3111 (BRI); 50 km E of Adavale, *C. Sandercoe* 582 (BRI).

Habitat. Found on a variety of soils, e.g. heavy clay, silty loam, saltmarsh, sand, and on granite outcrops, in woodland or exposed situations.

Distribution. Southern central and eastern Australia, south of 26° latitude and east of 131° longitude, absent from south-eastern South Australia, south and east Victoria, eastern New South Wales (except for isolated localities), and Tasmania. Figure 6.

Notes. The name *Hyalosperma variabile* var. *muelleri* Sonder is lectotypified on a collection from Gawler town that is conspecific with *H. semisterile.* The syntype from Burra Burra is *H. glutinosum* Steetz, q.v. It is probably due to this confusion that Sonder did not follow Mueller's suggestion (in sched.) and recognise the two taxa as distinct species. This confusion may also account for the new specific epithet *'variabile'* that was given by Sonder to his broadly based species.

When describing *Helipterum jessenii* twenty five collections were cited by Mueller of which I have seen twenty two, all except one of these are of *H. semisterile.* The exception is the collection 'Port Gregory, *Oldfield*' (MEL 1538982) which is *Hyalosperma cotula.*

Hyalosperma semisterile is similar to, and often found growing with, *Hyalosperma glutinosum* subsp. *glutinosum*, as was noted by F. Mueller in the protologue of *Helipterum jessenii.*

Hyalosperma semisterile (as *Helipterum jessenii*) has been recorded as being present in Western Australia (Gardner 1930, Beard 1970, Grieve & Blackall 1975, Green 1985) but these records have been principally based on a misidentification of specimens of *Gilberta tenuifolia* Turcz. [syn. *Helipterum verecundum* S. Moore and *Myriocephalus gracilis* (A. Gray) Benth.]. This latter species is superficially similar to *Hyalosperma semisterile* but differs considerably in the structure of the capitulum, the achene, and the anthers; it would appear to be best recognised as the only member of this distinct genus.

6. **Hyalosperma cotula** (Benth.) Paul G. Wilson, comb. nov. — *Helichrysum cotula* Benth. in Endl. et al., Enum. Pl. Hueg. 65 (1837); - *Helipterum cotula* (Benth.) DC., Prodr. 6: 215 (1838); Benth., Fl. Austral. 3: 644 (1867) p.pte min. *Type*: Fremantle, *C. Huegel* (holo: W).

Helipterum cotula var. *ramosissimum* Steetz in Lehm., Pl. Preiss. 1: 474 (1845), nom. illeg. (includes type of *H. cotula*).

Helipterum cotula var. *simplex* Steetz, loc. cit. *Type citation*: 'In solo sublimoso glareoso interioris sinus regis Georgii III. d. 7 Nov. 1840. Herb. *Preiss.* No. 17. *Types*: (MEL 108296, 108301).

Helipterum citrinum Steetz, loc. cit. Type citation: 'In arenosis planitiei ad fluvium Canning. d. 2 Nov. 1839. Herb. *Preiss.* No. 21' *Types*: (MEL 604824, 108373, W).

[*Helipterum jessenii* F. Muell., Vict. Naturalist 7: 45 (Aug. 1890) p.pte min. as to syntype 'Port Gregory, *Oldfield*' (MEL 1538982) not as to lectotype.]

Erect *annual herb* to 25 cm high, simple or branching at and above the base. Branches slender, sparsely cottony below, woolly towards apex. *Leaves* alternate or the lower opposite, slender terete, 5-15 mm long, moderately to sparsely cottony, narrowed to a blunt reddish-brown resinous apex or

the upper ones acute; uppermost leaves much reduced and with a hyaline appendage. *Heads* solitary, terminal to branches. *Involucre* at first almost hemispherical (the bracts spreading from base), to 2 cm diameter eventually becoming constricted in a ring that forms at a level halfway up the inner involucral bracts. *Involucral bracts* multiseriate; outer bracts elliptic, scarious, very pale brown, uniform in texture apart from the hard narrow-triangular stereome in lower third, sparsely woolly at base; *intermediate bracts:* claw broad-oblong, c. 2 mm long, scarious, pale brown, slightly woolly with hard linear stereome throughout its length: lamina narrow-elliptic, papery, 5-10 mm long, white or yellow; *innermost bracts*: similar to intermediate but with very short white or yellow lamina rounded at apex, 0.5-1.5 mm long. *Receptacle* rounded, slightly pitted, 3-4 mm diameter. *Flowers* numerous, fertile except for a few in the centre. *Pappus*: bristles c. 10, c. 2 mm long; shaft linear-acuminate, contiguous below, united in a ring at base, plumose, the terminal cilia shorter, clavate and yellow, lower cilia fine acute, and colourless. *Corolla* equal to pappus, narrow-tubular in lower half narrow-turbinate in upper, shortly (1/4-1/5) 5-lobed, glabrous, pale yellow. *Anther loculi* c. 0.6 mm long. *Style tips* deltoid to ovate, shortly papillose. *Achene* obloid to obovoid, c. 1 mm long, colliculate, glabrous, pale brown, glossy; attachment minute; duplex cells sessile, depressed globular, myxogenic. *chromosome number* n = 12 fide B.L. Turner (1970). Figure 1.

Specimens seen (selection only). WESTERN AUSTRALIA: Howatharra, *A.M. Ashby* 2510 (PERTH); Calingiri road, *R.J. Cranfield* 4362 (PERTH); 12 mi W of Northam, *J.W. Green* 536 (PERTH); 17.5 km NE of Eneabba, *N. Hoyle* 173 (PERTH).

Distribution. South-western Western Australia from Northampton in the North to Albany in the south. Figure 5.

Habitat. In periodically damp situations on a variety of substrates, jarrah or wandoo woodland, heath, or in pockets of soil on granite outcrops.

Notes. This species has been confused with *H. pusillum* and *H. simplex* from Western Australia, and with *H. praecox* from eastern Australia; it is most similar to *H. simplex* and shares with that species the possibility of having either yellow or white involucral bracts. The very short innermost involucral bracts may be either white or yellow irrespective of the colour of the inner bracts. *Hyalosperma cotula* may be distinguished from *H. simplex* by having the lower and middle leaves obtuse to rounded at the apex (not acute to acuminate), the innermost involucral bracts with a very short rounded lamina (not similar to the inner bracts), and the terminal cilia of the pappus short and clavate or obovoid (not of normal length and slender).

Bentham (1867) and subsequent Australian authors, included in *Helipterum cotula* several species here recognised as distinct, i.e. *H. praecox* F. Muell., *H. semisterile* F. Muell., and *H. pusillum* Turcz.; Bentham also included in synonymy *Helichrysum oldfieldii* F. Muell. the type of which is referable to *Waitzia citrina* (Benth.) Steetz.

7. **Hyalosperma simplex** (Steetz) Paul G. Wilson, comb. nov. — *Helipterum simplex* Steetz in Lehm., Pl. Preiss. 1: 475 (1845). Type citation: 'In uliginosis arenosisque sylvae haud procul ab oppidulo Guildford. d. 31 Aug. 1839. Herb. *Preiss.* No. 18' *Types*: MEL, W.

[*Helipterum cotula* auct. non (Benth.) DC.; Benth., Fl. Austral. 3: 644 (1867) p.pte.; B.J. Grieve & W.E. Blackall, How to know Western Austral. Wildfl. 829 (1975) p.pte.]

Erect *annual herb* 10-15 cm high; *stem* simple or sparsely branched at lower nodes, slender, very sparsely cottony. *Leaves* opposite below otherwise alternate, slender, semiterete, c. 10 mm long, acute to acuminate, very sparsely cottony to glabrous; upper leaves shorter and more widely spaced with slender scarious apex and grading abruptly into involucral bracts. *Heads* solitary,

terminal. *Involucre* almost hemispherical (the bracts spreading from base), 2-3 cm diameter. *Involucral bracts* multiseriate, either yellow with outer ones pale yellowish brown, or white with outer ones pale brown or pale mauve; outer bracts broad-ovate, sessile, c. 3 mm long, scarious, glossy, slightly woolly at base; *intermediate bracts*: claw broad oblong-elliptic c. 3 mm long with broad scarious sparsely woolly margin and narrow-oblong thin stereome extending length of claw, *lamina* elliptic 5-8 mm long papery; innermost bracts similar to (but slightly shorter than) intermediate series. *Receptacle* rounded, c. 3 mm diameter, slightly pitted. *Flowers* numerous, fertile except for a few in centre. *Pappus*: bristles c. 10, 2-3 mm long; shaft linear-acuminate, united in a ring at base, plumose throughout, the terminal cilia shorter and slightly clavate, very pale yellow, lower cilia fine and colourless. *Corolla* equal to pappus, narrow tubular in lower half, narrow-turbinate in upper, shortly 5-lobed, glabrous, pale yellow. *Anther loculi* c. 0.6 mm long. *Style apex* broad-elliptic, obtuse, shortly papillose. *Achene* obloid to obovoid, 1-2 mm long, colliculate or smooth, dark reddish brown, attachment minute, c. 0.15 mm diameter; duplex papillae sessile, depressed globular, myxogenic, or absent. Figure 1.

Notes. This species differs from *Hyalosperma cotula*, with which it has been united, in having acute to acuminate leaves and in the innermost involucral bracts being similar to, and only slightly smaller than, the intermediate bracts.

Recent collections suggest that the most northerly distribution of this species is near Wooroloo in the Darling Range east of Perth, however, one pre-1867 collection by *A. Oldfield* (MEL 108198) is stated to have come from the Murchison River which is over 500 km north of Perth.

Key to subspecies

1. Achene verrucose c. 1 mm long ..... a. subsp. *simplex*
1. Achene smooth 1-2 mm long ..... b. subsp. *graniticola*

7a. **Hyalosperma simplex** (Steetz) Paul G. Wilson subsp. **simplex**

Intermediate and inner *involucral bracts* white or yellow. *Achene* c. 1 mm long, verrucose with sessile rounded duplex papillae.

Specimens examined (selection only). WESTERN AUSTRALIA: 16 km S of Williams, *M. Davis* 760 (AD); 9 km N of Capel, *G.J. Keighery* 5676 (PERTH); Benger, *R.D. Royce* 4376 (PERTH); W of Manjimup, *E. Wittwer* 1162 (PERTH).

Distribution. South-western Australia from the coastal plain and Darling Range east of Perth south to Augusta district. Figure 4.

Habitat. Moist or marshy situations in loam over granite, in woodland or meadows.

7b. **Hyalosperma simplex** subsp. **graniticola** Paul G. Wilson, subsp. nov.

Achenium 1-2 mm longum, laeve, papillis duplicibus carentibus.

Typus: 2 km NW of Shannon township, Western Australia; in moss sward over granite, 12 Nov. 1986, *P.G. Wilson* 12374 (holo: PERTH; iso: CANB, K, MEL).

Intermediate and inner *involucral bracts* white. *Achene* 1-2 mm long, smooth, without duplex papillae. *Chromosome number* n = 11 fide B.L. Turner in sched. (*Turner* 5499).

Specimens seen (selection only). WESTERN AUSTRALIA: Cape Naturaliste road, *L.A.R. Haegi* 2509 (MEL); Tone River, Oldfield 59 (MEL); 44 mi NW of Walpole, *S. Paust* 326 (PERTH); 1 mi (1.6 km) NW of Shannon River Mill, *B.L. Turner* 5499 (MEL); 24 km SE of Pemberton, *P.G. Wilson* 6294 (PERTH).

Distribution. South-western Western Australia from near Busselton south-east to Albany. Figure 4.

Habitat. Loamy soil, frequently on granite rocks.

Notes. The distributions of the two subspecies overlap in the region south of Busselton. However, it would appear that in that area they are allopatric.

A number of collections examined have achenes that are not in a condition suitable for allocating the plant to a subspecies; the distribution data is therefore incomplete.

The character of smooth versus verrucose for the achenes would appear to suggest a specific difference. In this case the colliculae are formed from round sessile duplex papillae; the difference between the achenes is therefore the presence or absence of these duplex papillae. In different collections of subsp. *simplex* the density of the colliculae varies and it is possible that with further collections a clinal variation between the two subspecies will become apparent.

The subspecific epithet *graniticola* refers to the habitat on which this plant frequently occurs.

8. **Hyalosperma praecox** *(F. Muell.) Paul G. Wilson, comb. nov.* — *Helipterum praecox* F. Muell., Trans. & Proc. Vict. Inst. Advancem. Sci. 1854-1855: 38 (1855); G.M. Cunningham et al., Pl. Western New South Wales 697 (1981); S. Jacobs & J. Pickard, Pl. New South Wales 80 (1981). Type citation: 'Abundant on the less fertile plains and low ridges along the Avoca, Avon, Wimmera, and Richardson River'. *Lectotype*: In planitiebus humidis et siccis ad fl. Avoca, 3 Dec. 1853, *F. Mueller* (lecto: MEL 653826, isolecto: MEL 653827, W), lecto nov.

[*Helipterum cotula* auct. non (Benth.) DC.; Benth., Fl. Austral. 3: 644 (1867) as to Victorian specimen cited; F. Muell., Key Syst. Vict. Pl. 1: 319 (1888); J.H. Willis, Handb. Pl. Victoria 2: 707 (1973).]

Erect *annual herb* 10-20 cm high simple or branching at base. Stem slender, sparsely cottony. *Leaves* alternate, slender, semiterete, acuminate, 10-15 mm long, glabrous or very sparsely cottony, the uppermost shorter and piliferous or with a narrow scarious appendage. *Heads* solitary, terminal. *Involucre* almost hemispherical (the bracts radiating from base), 15-25 mm diameter. *Involucral bracts* either all white or all yellow (usually the former), multiseriate; outer bracts: claw very short and broad, woolly ciliate, lamina narrow-elliptic, acute, c. 5 mm long; inner bracts: claw very broadly oblong-elliptic, c. 2 mm long, scarious, woolly ciliate, with a faint narrow-linear stereome throughout its length; lamina narrow-elliptic, acute, 7-10 mm long; *innermost bracts* similar to inner bracts but with a shorter lamina. *Receptacle* conical, pitted. *Flowers* numerous, fertile except for a few in centre. *Pappus:* bristles 4-6, well-separated, c. 1.5 mm long (shorter than corolla), shaft narrow-linear acuminate, united in a ring at base, plumose, uniformly very pale yellow or clear, the terminal cilia somewhat thicker than the rest but similar in length. *Corolla* c. 2 mm long, narrow-tubular in lower half, turbinate above, 5-lobed to c. 1/4 length of corolla, yellow, attached slightly excentrically to achene. *Anther loculi* c. 0.7 mm long. *Style apex* rhombic, papillose. Achene obovoid, c. 1 mm long, smooth to verrucose, glabrous, pale brown; carpopodium minute, c. 0.15 mm diameter; duplex papillae, when present, depressed globular. Figures 1,2.

Specimens seen (selection only). VICTORIA: Minyip, *J.P. Eckert* 131 (MEL); Ulupna Island, *T.B. Muir* 6834 (MEL); Nathalia, Oct. 1932, *J.H. Willis* (MEL 108339).

NEW SOUTH WALES: 9 mi N of Moama, *R.B. Filson* 5406 (NSW); Womboota, *C.W.E. Moore* (CANB 542ll); Near Conargo, *W.E. Mulham* 824 (NSW).

Distribution. Central and south Western Slopes and South Western Plains of New South Wales, the Grampians east to central Victoria. Listed by D.A. Cooke in Jessop & Toelken (1986) (as *Helipterum cotula*) as possibly occurring in South Australia but I am unable to confirm this suggestion. One collection (*Dwyer*, Sept. 1931, CBG) purports to have come from Broken Hill but since the original label with this specimen has been altered this record may be incorrect. That locality is well outside its range as otherwise known. Figure 3.

Habitat. Fairly open situations in sand or heavy loam.

Notes. Hyalosperma praecox is similar to *H. simplex*, it differs most noticeably in the conical receptacle and in the shorter pappus with only about half the number of bristles.

The duplex papillae that form the rounded tubercles in *H. praecox* have the same form as those found in *H. simplex* subsp. *simplex* and in *H. cotula*. In the last two taxa these papillae are myxogenic whereas this character has not been observed by me in seeds from a number of collections of *H. praecox*. It appears probable that in this species the duplex cells only tardily exude mucilage or possibly only after being subjected to certain physical conditions.

9. **Hyalosperma pusillum** *(Turcz.) Paul G. Wilson, comb. nov.* — *Helipterum pusillum* Turcz., Bull. Soc. Imp. Naturalistes Moscou 24: 80 (1851). *Type*: [Western Australia], anno 1849, *J. Drummond* 5th coll. n. 384 (holo: KW, photo seen; iso: MEL, PERTH, W).

[*Helipterum cotula* auct. non (Benth.) DC.; Benth., Fl. Austral. 3: 644 (1867) p.pte at least as to '*Drummond* 5th coll. n. 384' and 'King George's Sound.....to Swan River, *Oldfield*'.]

Erect *annual herb* to 20 cm high; stem simple or branching above the base, sparsely cottony. *Leaves* opposite below otherwise alternate, sometimes present up to capitulum, slender, semiterete, c. 10 mm long, blunt, the uppermost leaves with a scarious appendage, glabrous or very sparsely cottony. Heads solitary, terminal. *Involucre* almost hemispherical or the lower portion broadly turbinate, 1-2 cm diameter. *Involucral bracts* multiseriate; outer bracts: claw very broad, c. 1.5 mm long and wide, scarious except for an indefinite linear stereome, woolly ciliate, lamina narrow-elliptic, c. 2-3 mm long, white; intermediate bracts similar to outer but with lamina 5-10 mm long, spreading; *innermost bracts* with broad claw c. 2 mm long bordered by a white very short broadly rounded to truncate erect lamina c. 0.2 mm long. *Receptacle* conical, pitted. *Flowers* numerous, fertile. *Pappus bristles* c. 10, c. 1.8 mm long; shaft linear-acuminate, shortly plumose, the terminal cilia congested, clavate, and white. *Corolla* colourless (or purple, at least on drying), equal to pappus, tubular (slightly broader in upper half), very sparsely puberulous with a few scattered short simple hairs, shortly 5-lobed. *Anther-tails* very short and somewhat twisted; loculi c. 0.6 mm long. *Style tips* narrow-deltoid, obtuse, shortly papillose. *Achene* narrow-obovoid or obloid, c. 1 mm long, compressed, rounded at base and apex, not verrucose, minutely tesselate, not myxogenic, reddish brown; carpophore minute, c. 0.15 mm diam. Figure 1.

Specimens seen (selection only). WESTERN AUSTRALIA: S of Northcliffe, *A.M. Ashby* 2703 (PERTH); Porongurup Range, *T.B. Muir* 3947 (MEL); Balingup, s. dat. *R.H. Pulleine* (NSW 179918); Waterloo, *P.G. Wilson* 12133 (PERTH).

Distribution. South-west Western Australia from near Bunbury to Albany. Figure 3.

Habitat. Usually in seasonally waterlogged situations in sand over clay or in heavy loam.

Notes. Although this species has been synonymized under *Helipterum cotula* since Bentham's (1867) treatment it is very distinct. The white pappus tips and the very short and broad innermost row of involucral bracts enable it to be clearly distinguished.

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References

Anonymous (1973). Spurr low-viscosity embedding media. Polysciences Inc., Data Sheet no. 127.

Beard, J.S. (1970). "West Australian Plants." Edn 2. (Society for Growing Australian Plants: Picnic Point.)

Bentham, G. (1837). Compositae. In S.L. Endlicher et al., "Enumeratio Plantarum." (Beck University Biblio.: Vienna.)

Bentham, G. (1867). "Flora Australiensis." Vol. 3. (Lovell Reeve & Co.: London.)

Candolle, A.P. de (1838). "Prodromus systematis naturalis regni vegetabilis." Vol. 6. (Treuttel & Wurtz: Paris.)

Dormer, K.J. (1962). The fibrous layer in the anthers of the Compositae. New Phytol. 61: 150-163.

Gardner, C.A. (1930-1931). "Enumeratio Plantarum Australiae Occidentalis." (Government Printer: Perth.)

Gray, A. (1852). Characters of some south-west Australian Compositae, principally of the Subtribe Gnaphalieae. Hooker's J. Bot. Kew Gard. Misc. 4: 225-232.

Green, J.W. (1985). "Census of the Vascular Plants of Western Australia." Edn 2. (Western Australian Herbarium: Perth.)

Grieve, B.J. & Blackall, W.E. (1975). "How to know Western Australian Wildflowers." Part IV. (University of Western Australia Press: Perth.)

Haque, M.Z. & Godward, M.B.E. (1984). New records of the Carpopodium in Compositae and its taxonomic use. J. Linn. Soc. Bot. 89: 321-340.

Hilliard, O.M. (1983). " Flora of Southern Africa. Vol. 33 Asteraceae. Part 7, Inuleae fascicle 2, Gnaphaliinae (first part)." 1-325. (Department of Agriculture: Pretoria.)

Hilliard, O.M. & Burtt, B.L. (1981). Some generic concepts in Compositae-Gnaphaliinae. J. Linn. Soc., Bot. 82: 181-232.

Jessop, J.P. and Toelken, H.R. (1986). "Flora of South Australia." (South Australian Government: Adelaide.)

King, R.M. and Robinson, H. (1970). The new synantherology. Taxon 19: 6-11.

Lindley, J. (1836). "A Natural System of Botany." Edn 2. (Longman: London.)

Lindley, J. (1847). " The Vegetable Kingdom." Edn 2. (Bradbury & Evans: London.)

Nordenstam, B. (1978). Taxonomic studies in the tribe Senecioneae (Compositae). Opera Bot. 44: 1-84.

Robinson, H. & King, R.M. (1977). Eupatorieae - systematic review. In V.H. Heywood & B.L. Turner (eds). "The Biology and Chemistry of the Compositae." (Academic Press: London.)

Short, P.S. (1981). Pollen-ovule ratios, breeding systems and distribution patterns of some Australian Gnaphaliinae (Compositae: Inuleae). Muelleria 4: 395-417.

Short, P.S. (1987). A revision of *Blennospora* A. Gray (Compositae: Inuleae: Gnaphaliinae). Muelleria 6: 349-358.

Sonder, O.W. (1853). Plantae Muellerianae. Linnaea 25: 449-530.

Steetz, J. (1845). Compositae. In J.G.C. Lehmann, "Plantae Preissianae." Vol. 1. (Meissner: Hamburg.)

Turczaninow, N. (1851). Synanthereae quaedam hucusque indescriptae. Bull. Soc. Imp. Naturalistes Moscou 24(2): 59-95.

Turner, B.L. (1970). Chromosome numbers in the Compositae. XII Australian species. Amer. J. Bot. 57: 382-389.

Walpers, W.G. (1846). "Repertorium Botanices Systematicae." Vol. 6. (Fr Hofmeister: Leipzig.)

Warcup, J.H. & McGee, P.A. (1983). The mycorrhizal associations of some Australian Asteraceae. New Phytol. 95:667-672.

Willis, J.H. (1962). The botany of the Victoria Exploring Expedition (September 1860-June 1861) and of relief contingents from Victoria (July 1861-November 1862). Proc. Roy. Soc. Victoria 75: 247-268.

Wilson, Paul G. (1989). *Erymophyllum* (Asteraceae: Inuleae: Gnaphaliinae), a new Australian genus in the *Helipterum* complex. Nuytsia 7: 101-116.

Index to scientific names

New names are given in bold type. Other accepted names in Roman. Synonyms are in italics.