A synopsis of the annual species of Cyperaceae from central and southern Western Australia

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Abstract

Rye, B.L. A synopsis of the annual species of Cyperaceae from central and southern Western Australia. Nuytsia 11 (3): 383-423 (1997). A synopsis, keys and distribution maps are provided for all the annual species of Cyperaceae known from the Eremaean and South West Botanical Provinces of Western Australia. Selected species are illustrated. Some taxa are of conservation significance, including about six species each known from only one collection.

Introduction

The recent account of the family Cyperaceae in "Flora of the Kimberley Region" (Rye 1992) gives keys, descriptions and illustrations for species occurring in the Northern Botanical Province of Western Australia. For regions south of the Kimberley, there is no recent comprehensive treatment of the family, although there are keys available for most of the species belonging to *Fimbristylis* (Latz 1990) and genera related to *Scirpus* L. (Wilson 1981). The key to south-western Cyperaceae published by Blackall & Grieve (1954) has never been revised.

In order to determine which species of Cyperaceae from the less well documented areas of Western Australia should be placed on the Declared Rare and Priority Flora List, herbarium specimens from the Eremaean and South West Botanical Provinces were surveyed. Among the numerous perennials in the family, the proportion of species likely to be at risk of extinction seemed very small in comparison with many other plant families. Annual species of Cyperaceae appeared to be more in need of attention. Nine new annual taxa, nearly all in the genus *Schoenus*, were distinguished as a result both of this survey and recent curation by Karen Wilson (NSW). Three of these were named and described (Rye 1997); the others were allocated phrase names but considered to be too poorly known to name formally. Since then, a further new annual taxon has been discovered and given the phrase name *Schoenus* sp. *Waroona* (*G.J. Keighery* 12235).

This paper provides a synopsis, keys and distribution maps for the annual species of Cyperaceae occurring in the Eremaean and South West Botanical Provinces of Western Australia. As a further aid to identification of these plants, previously published illustrations are cited and new illustrations provided where required.

About half of the 156 species included in the Kimberley flora are annuals, including several genera that do not occur elsewhere in Western Australia. In the south-west most species are perennial; for example, in the area covered by "Flora of the Perth Region" less than a quarter of the species are annuals (Rye 1987). Many of the annual species are small and inconspicuous, as well as being absent altogether for part of each year, so tend to be poorly collected. Since the Perth regional flora was completed, eight additional annual species have been recorded in that region.

In many of the perennial species, maximum fruit set has been reduced to one or two nuts per spikelet, and vegetative spread by rhizomes is of great importance. Annual species need to produce a good seed crop each year to ensure future generations and almost invariably produce larger numbers of nuts per spikelet or condensed spike. Since fruiting quickly follows flowering in annuals, flowering and fruiting generally occur in the same months. The flowering and fruiting periods given here apply only to specimens collected in the study area, as do any measurements and other descriptions.

Distribution patterns and new records

Most species of Cyperaceae have wide distributions, often extending to other states of Australia and overseas. The annual species occur mainly in seasonally damp habitats, including the margins of watercouses, low-lying flats and rock crevices. Of the 48 named native species included here, 13 are endemic to the south-west and one to the Pilbara area of Western Australia. Five species (*Fimbristylis ammobia*, *Fuirena incrassata*, *F. nudiflora*, *Isolepis australiensis* and *Schoenus centralis*) are known from less than five localities in this State but have been collected more frequently from other parts of Australia, while the remaining species have been widely collected both in Western Australia and outside the State. The Western Australian distributions of all the species are shown in Figures 1-18, with each symbol indicating the presence of the taxon in a quarter degree latitude by quarter degree longitude area.

The number of named annual species recorded for Western Australia since the publication of the census and its most recent supplement (Green 1985, 1988) has increased by seven. Curation of the PERTH collection by Karen Wilson has led to the addition of the two native species *Fuirena incrassata* and *Isolepis australiensis* and the introduced species *Isolepis hystrix*. A further four species, named since the last supplement of the census, are *Fimbristylis simulans* (Latz 1990), *Schoenus badius*, *S. plumosus* and *S. variicellae* (Rye 1997).

One species previously recorded (Wilson 1981) for Western Australia, but now excluded, is *Isolepis platycarpa* (S.T. Blake) Soják. This species occurs in South Australia, New South Wales, Victoria, Tasmania and New Zealand, and might prove to be more widespread, but there are currently no specimens known to have been collected from Western Australia.

The descriptions given for all the annual species included in "Flora of the Perth Region" (Rye 1987) are accurate except that the one given under the name *Schoenus odontocarpus* actually applies to the new species *S. variicellae*. At the time the flora treatment was prepared, no specimens of true *S. odontocarpus* from the Perth region had been seen, but some have since been incorporated in the collection at PERTH. Other newly recorded native species for the region are *Isolepis congrua*, *I. hookeriana*, *Schoenus humilis*, *S. plumosus*, *S.* sp. *Bullsbrook* (*J.J. Alford* 915) and *S.* sp. *Waroona* (*G.J. Keighery* 12235). There is also one additional naturalized species, *Isolepis hystrix*.

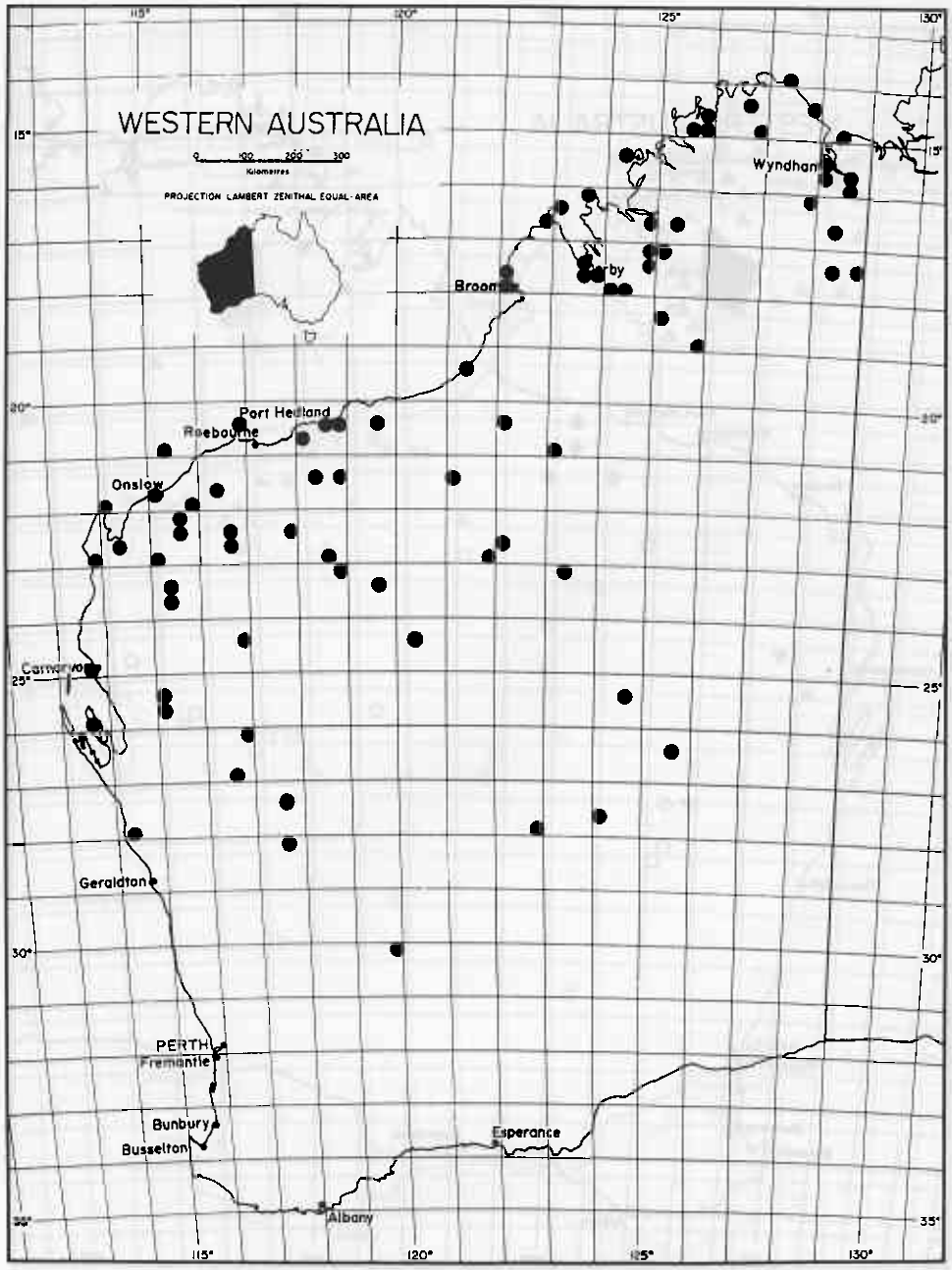

Figure 1. Distribution of *Bulbostylis barbata* in Western Australia.

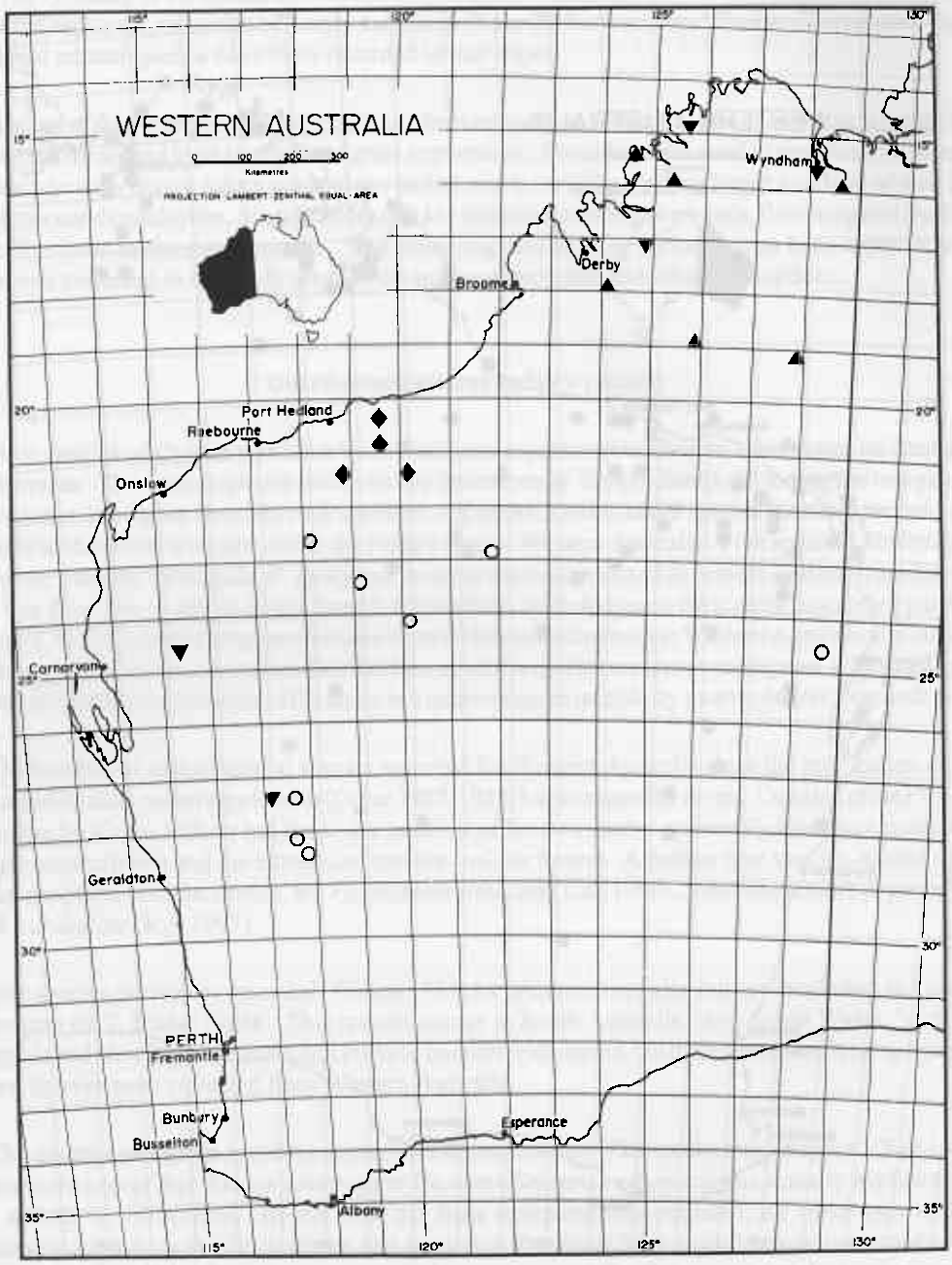

Figure 2. Full distribution of *Bulbostylis burbidgeae* ◆, and Western Australian distribution of *Bulbostylis turbinata* ○, atypical variant of *Cyperus castaneus* ▲ and typical variant of *Cyperus castaneus* ▼.

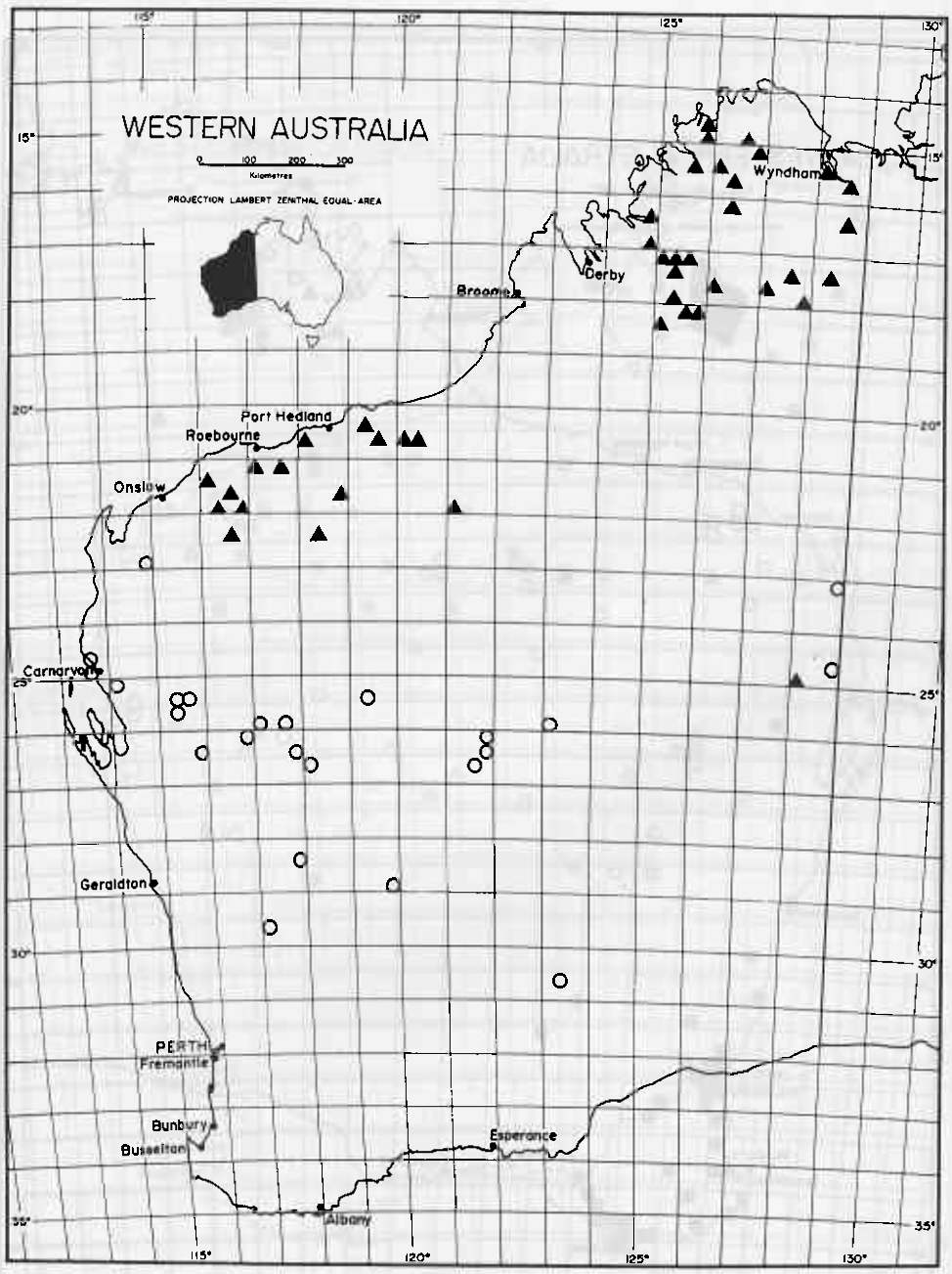

Figure 3. Western Australian distribution of *Cyperus difformis* ▲ and *Cyperus rigidellus* ○.

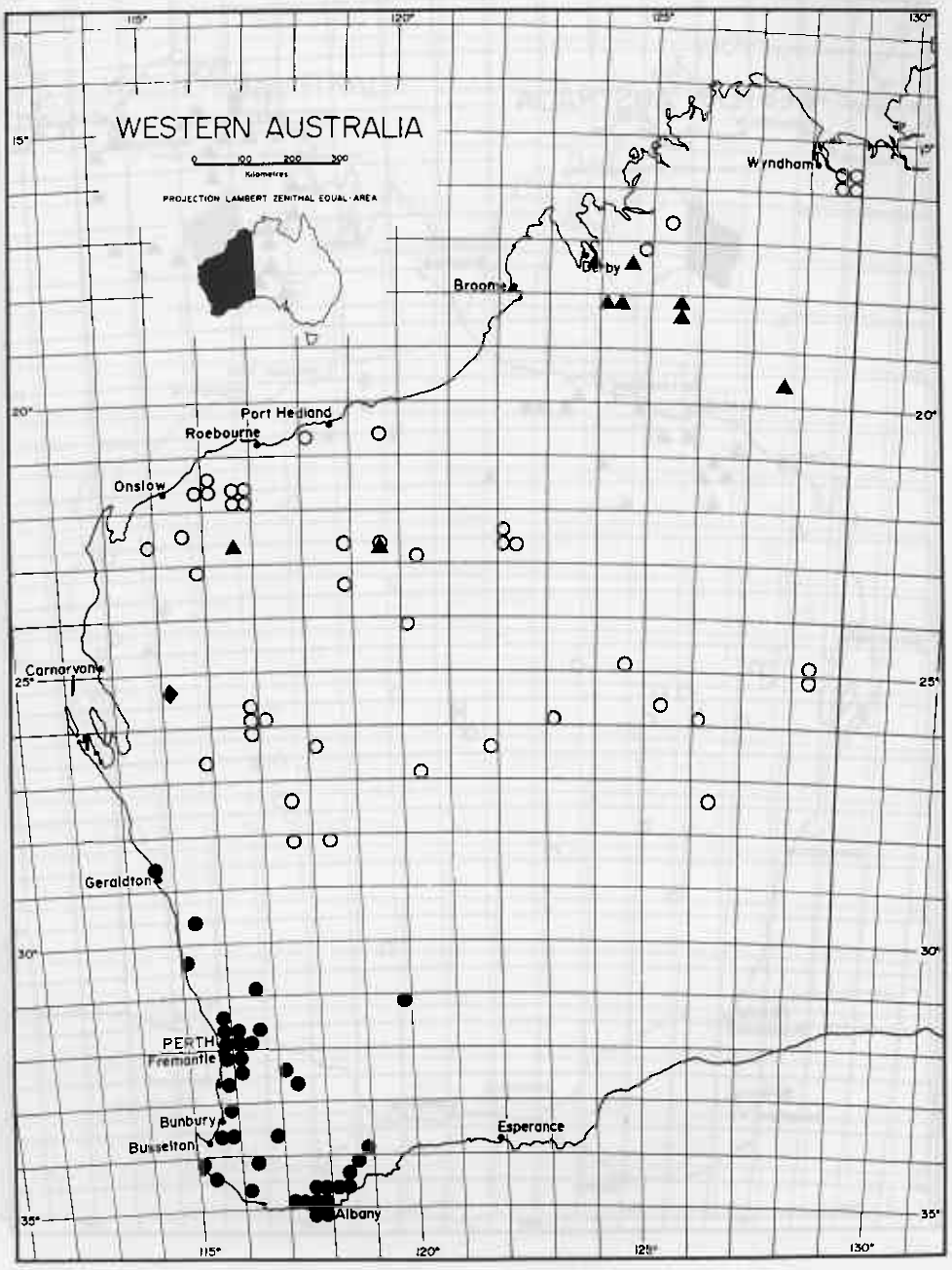

Figure 4. Western Australian distribution of *Cyperus hamulosus* ◆, *Cyperus iria* ○, *Cyperus pygmaeus* ▲ and *Cyperus tenellus* ●.

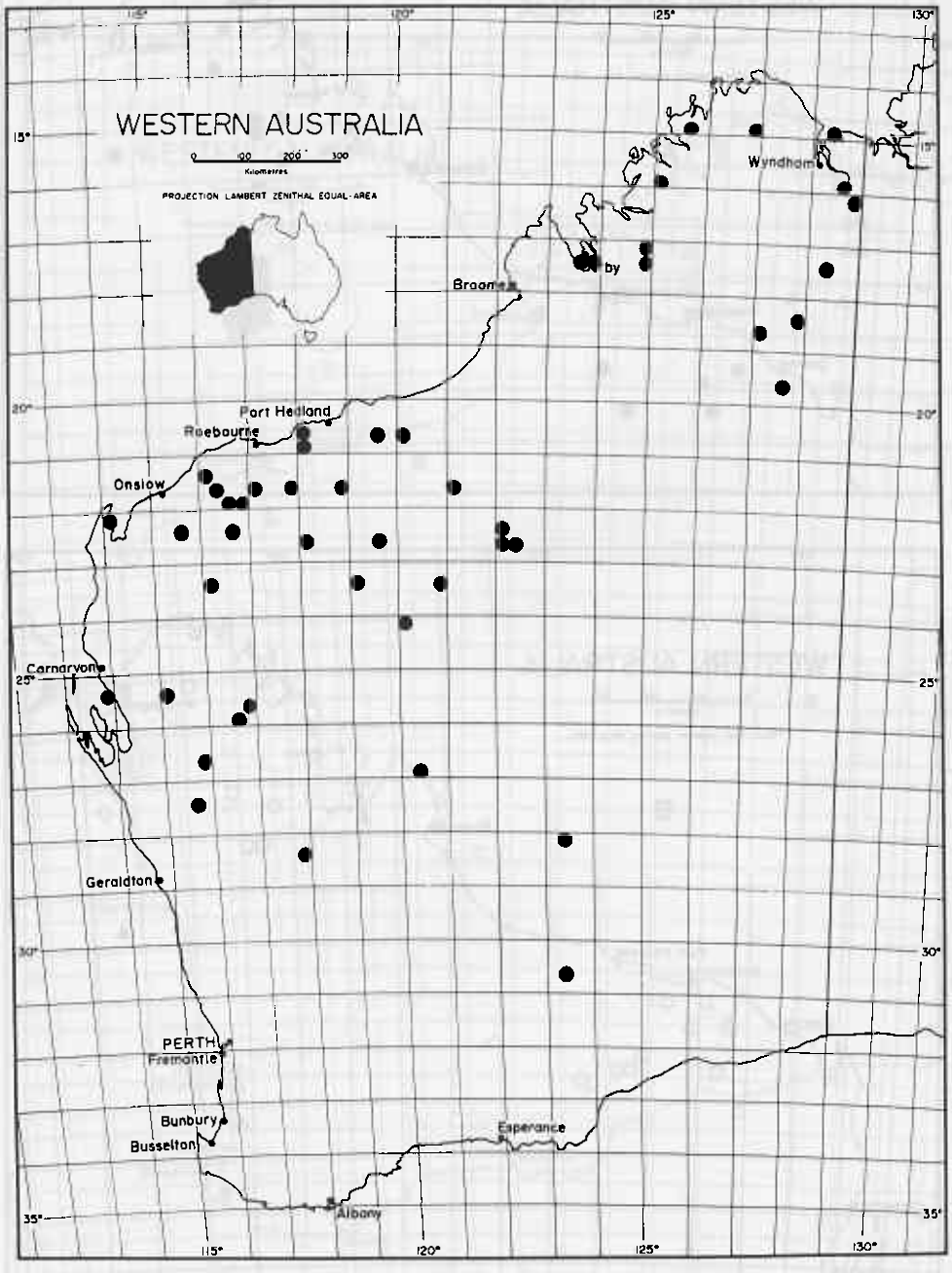

Figure 5. Distribution of *Cyperus squarrosus* in Western Australia.

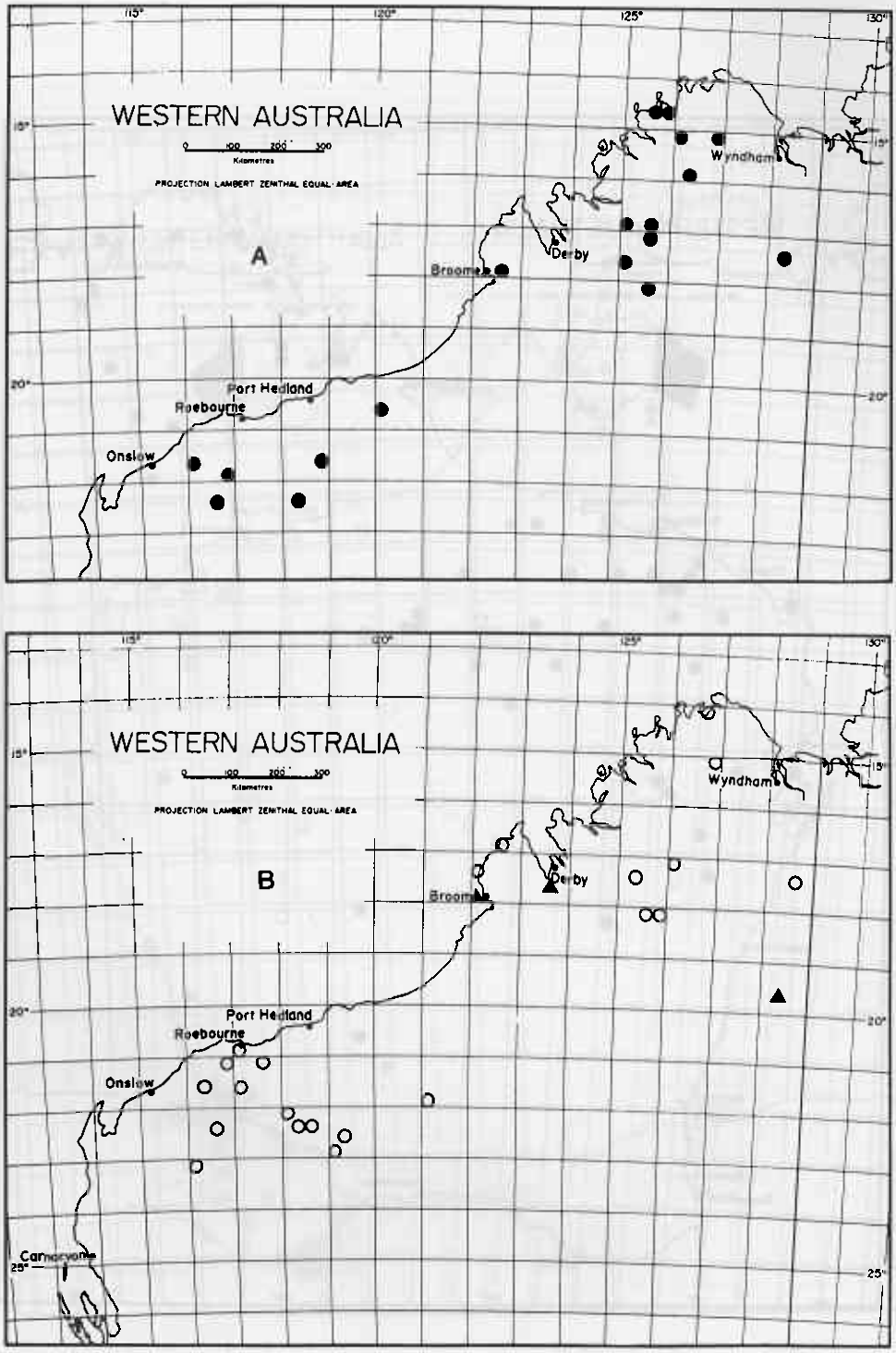

Figure 6. Distribution in Western Australia. A - *Eleocharis atropurpurea*; B - *Eleocharis geniculata* ○ and *Fimbristylis ammobia* ▲ .

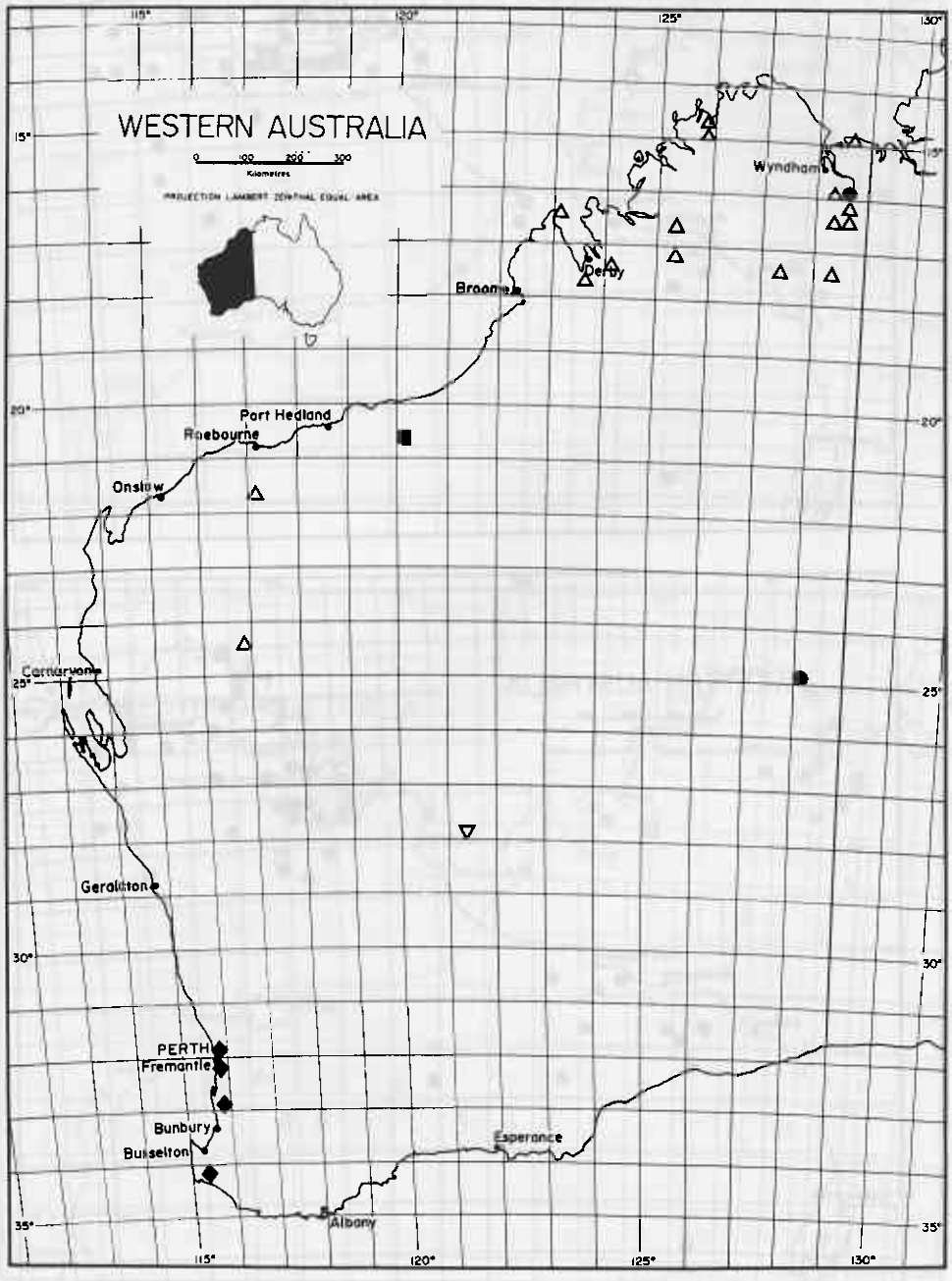

Figure 7. Western Australian distribution of typical variant of *Fimbristylis depauperata* △ , *Fimbristylis velata* ◆ and *Fuirena nudiflora* ● and full distribution of atypical variant of *Fimbristylis depauperata* ▽ , and *Fimbristylis* sp. *Shay Gap* ■ .

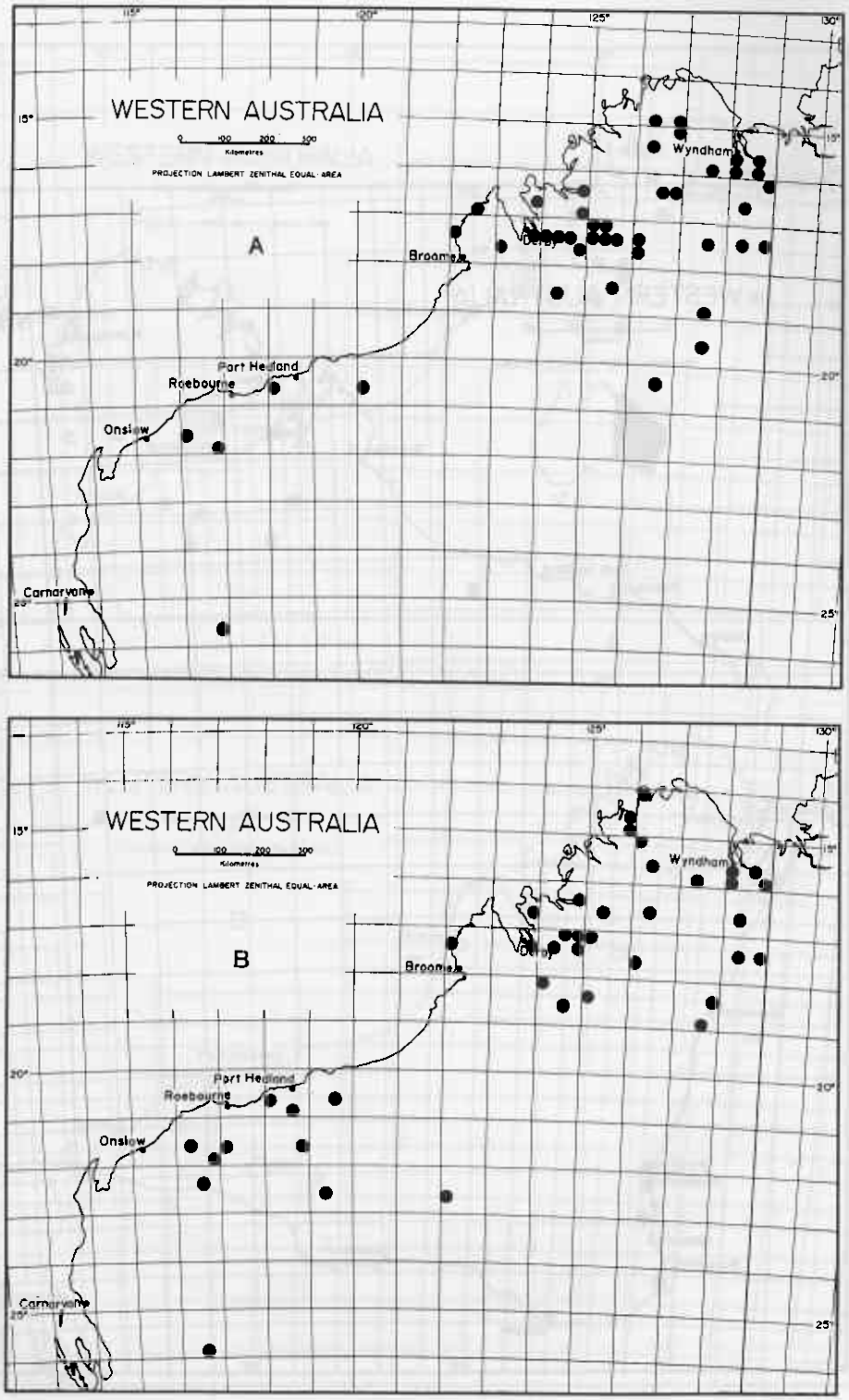

Figure 8. Distribution in Western Australia. A - *Fimbristylis littoralis*; B - *Fimbristylis microcarya*.

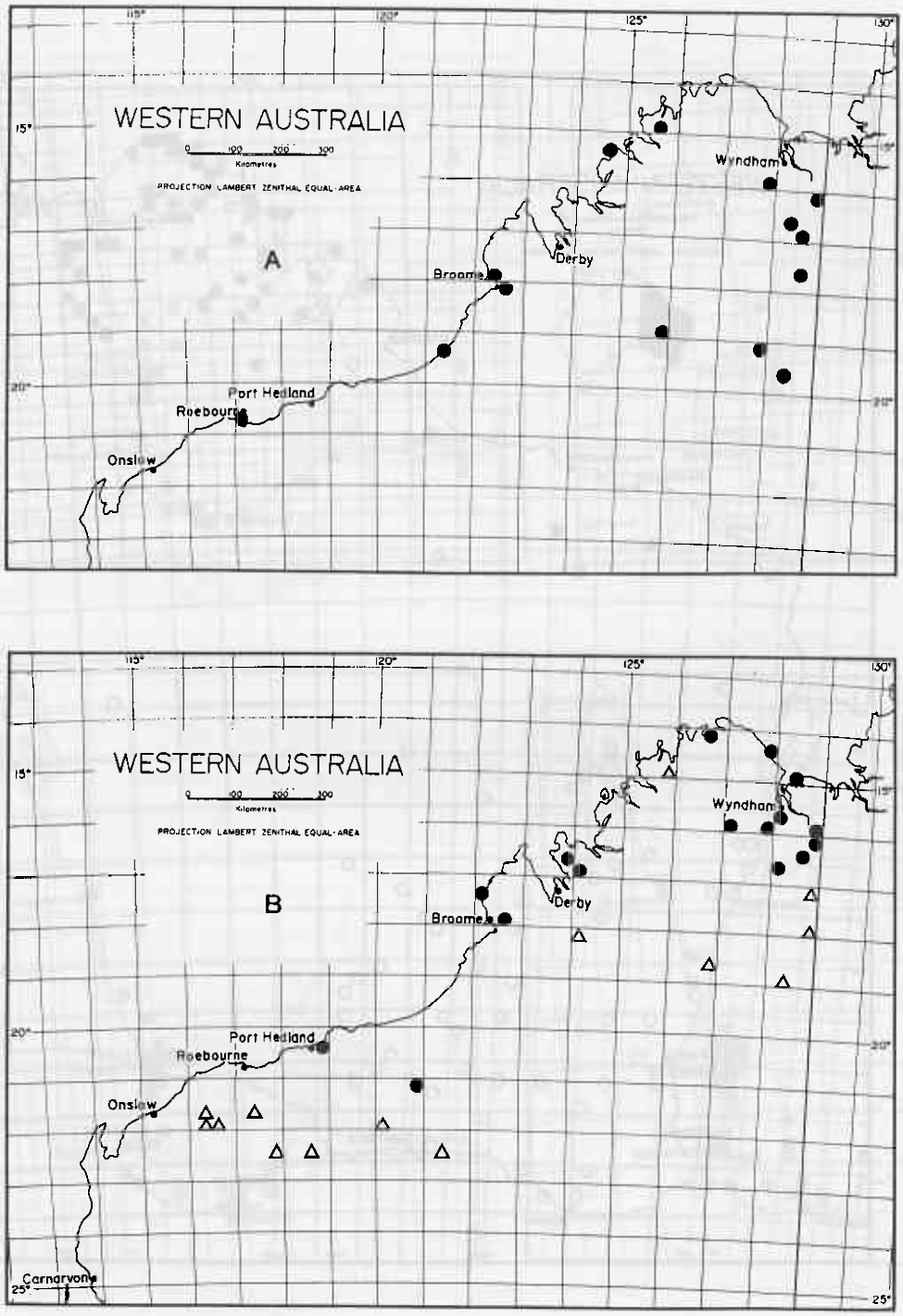

Figure 9. Distribution in Western Australia. A - *Fimbristylis oxystachya*; B - *Fimbristylis rara* ● and C - *Fimbristylis simulans* △ .

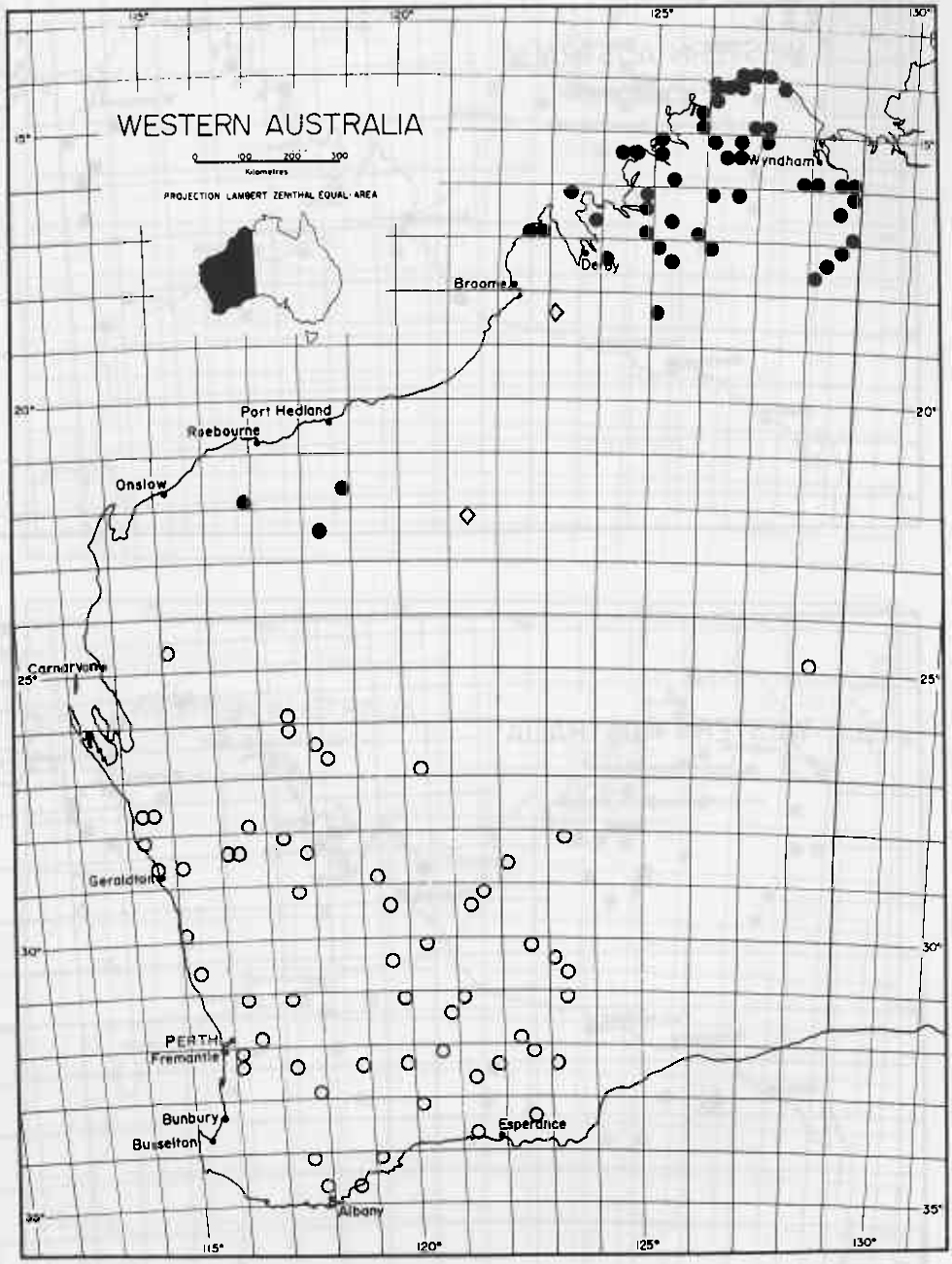

Figure 10. Western Australian distribution of *Fuirena ciliaris* ●, *Fuirena incrassata* ◇ and *Isolepis congrua* ○.

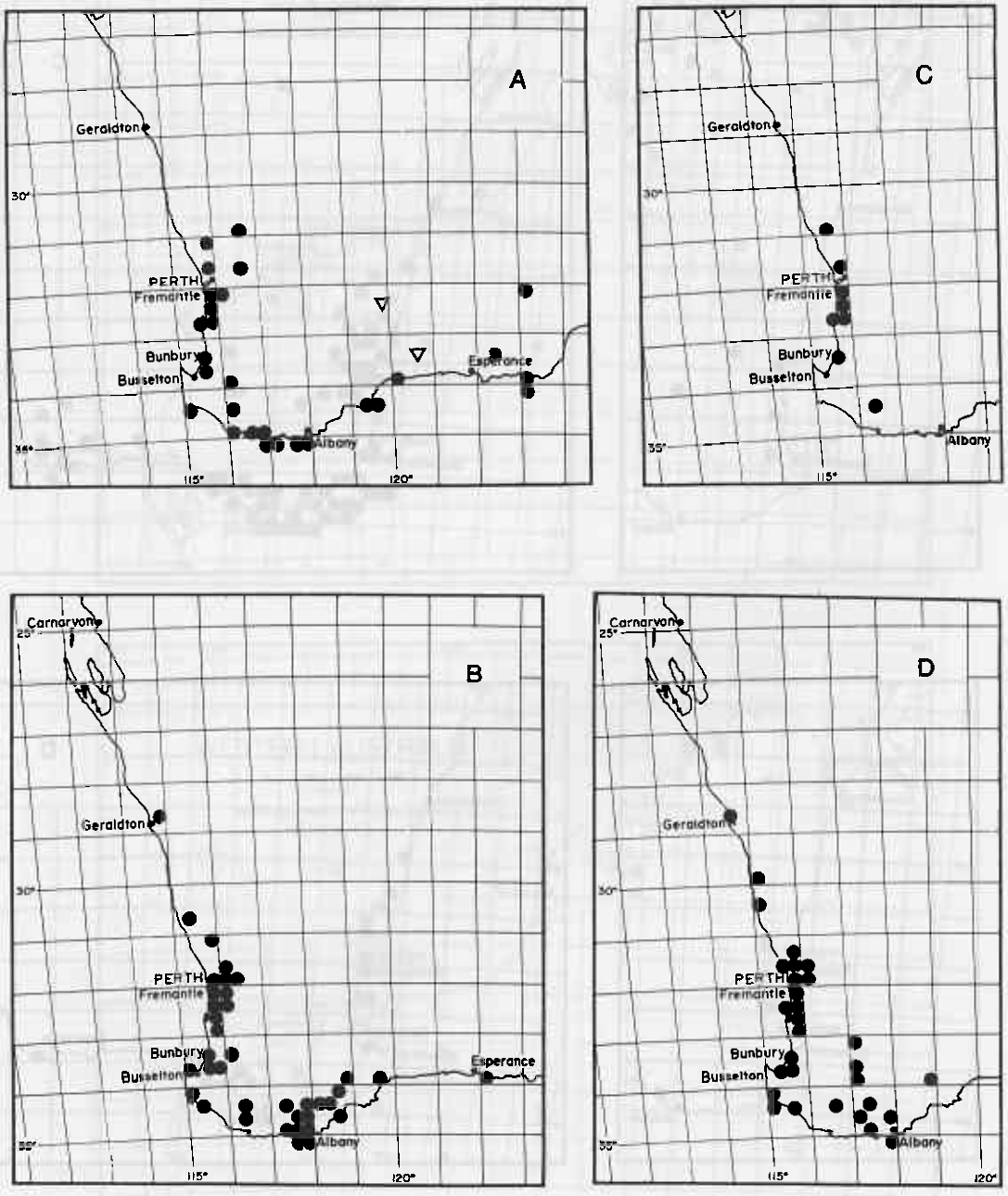

Figure 11. A - Western Australian distribution of *Isolepis australiensis* ∇ and *Isolepis cernua* ● ; full distribution of B - *Isolepis cyperoides*, C - *Isolepis oldfieldiana*, and D - *Isolepis setiformis*.

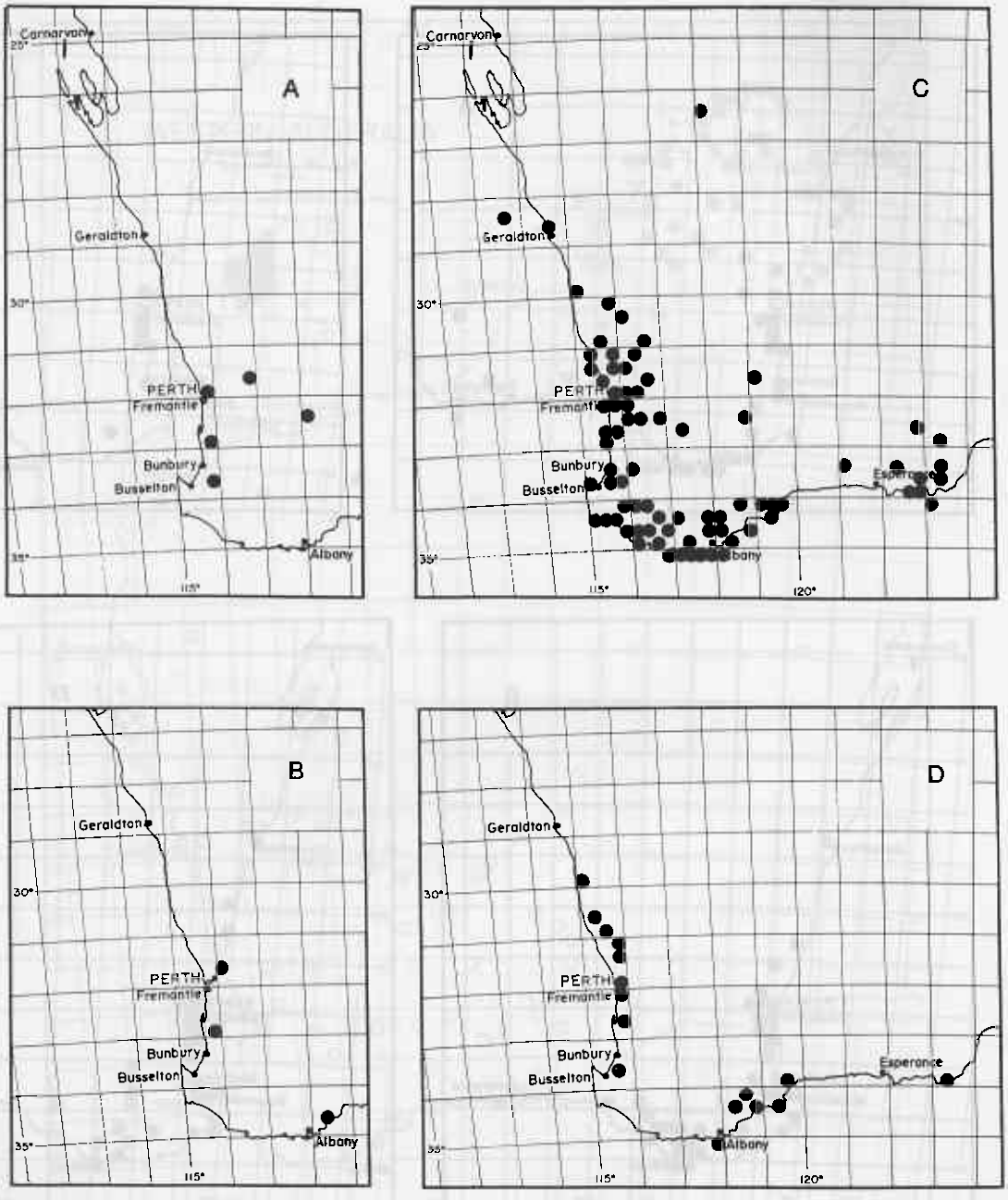

Figure 12. Distribution in Western Australia. A - *Isolepis hookeriana*; B - *Isolepis hystrix*; C - *Isolepis marginata*; D - *Isolepis stellata*.

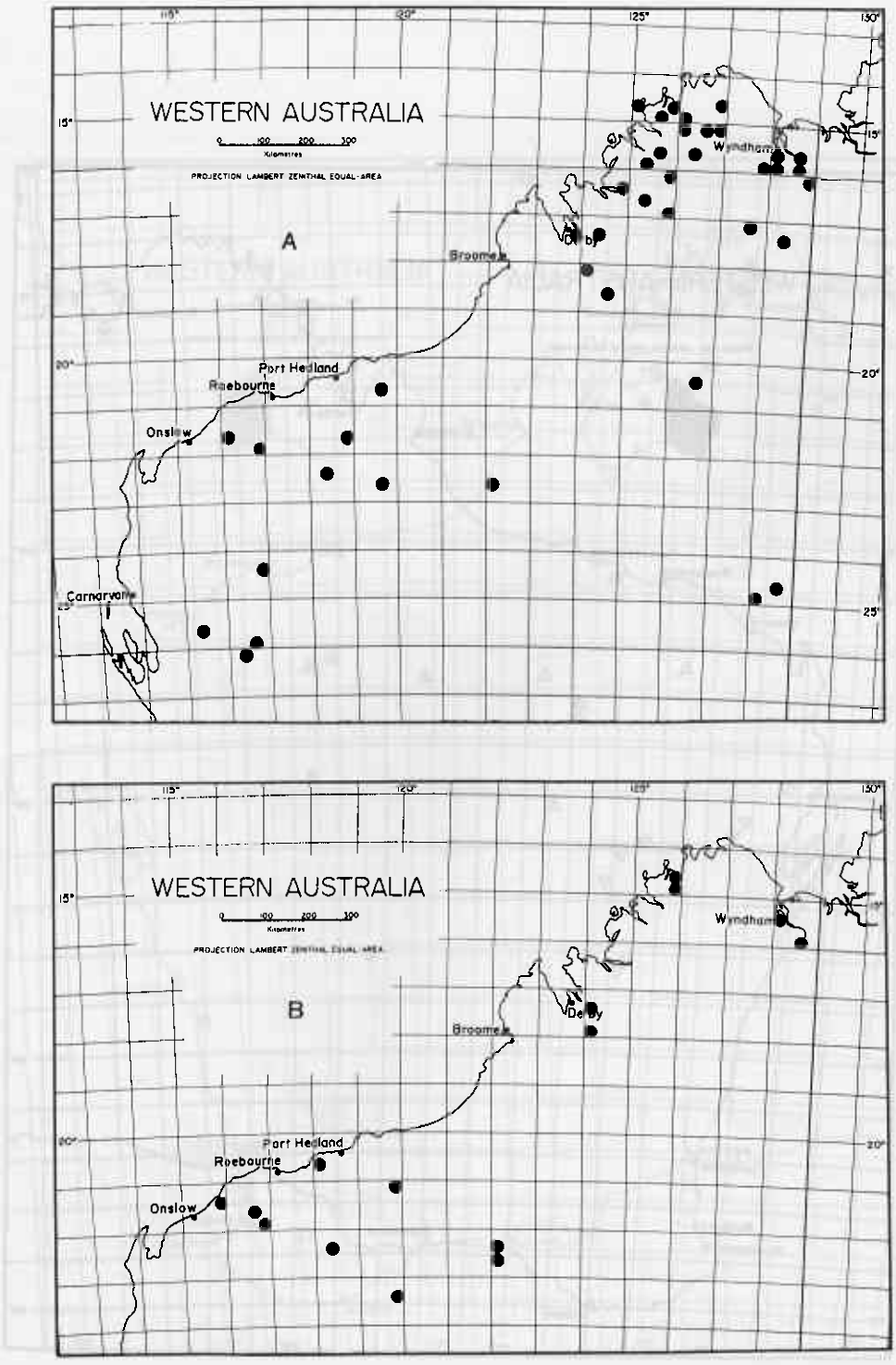

Figure 13. Distribution in Western Australia. A - *Lipocarpha microcephala*; B - *Schoenoplectus laevis*.

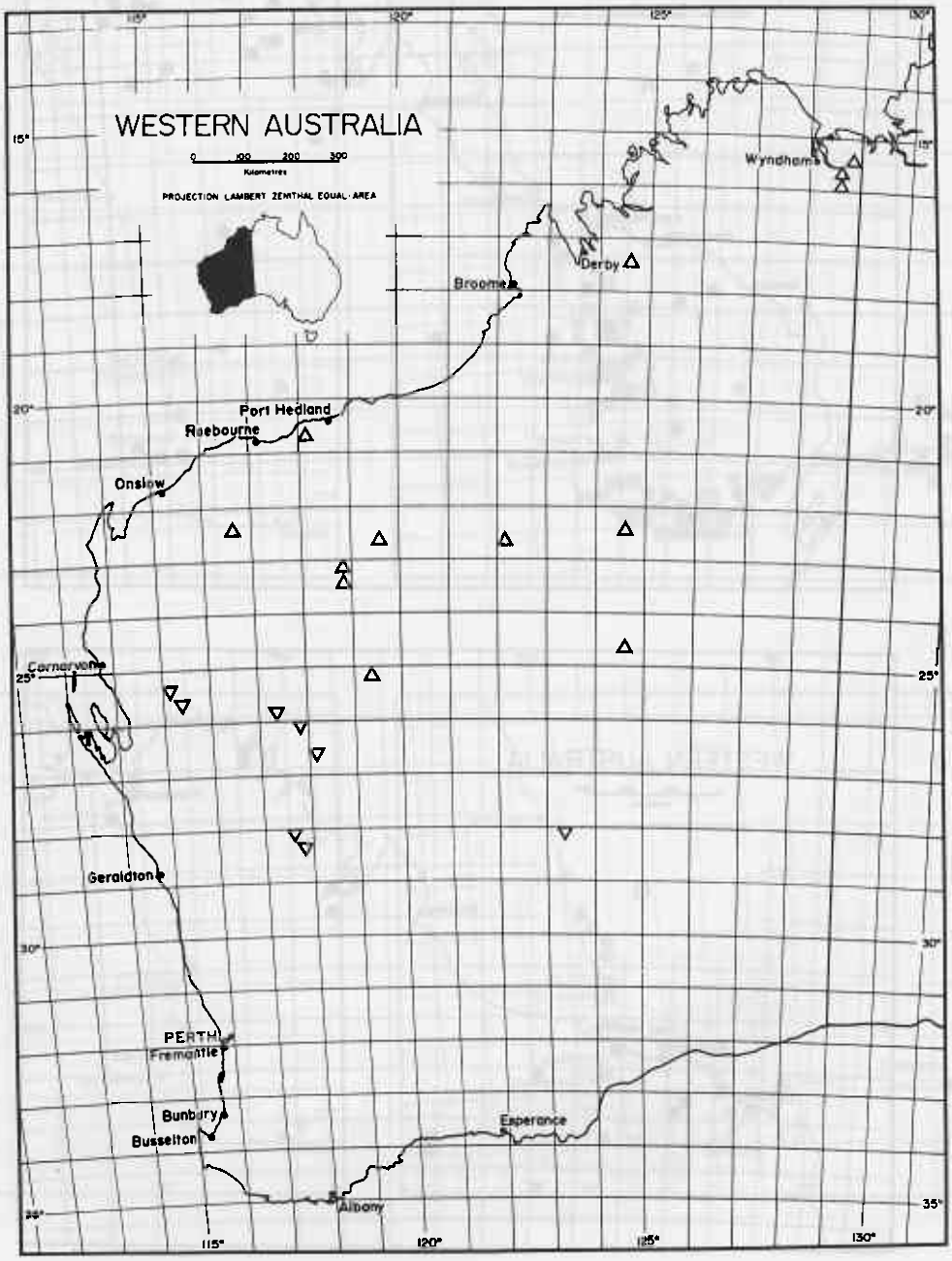

Figure 14. Distribution of *Schoenoplectus dissachanthus* in Western Australia, typical variant △ and trimerous variant ▽ .

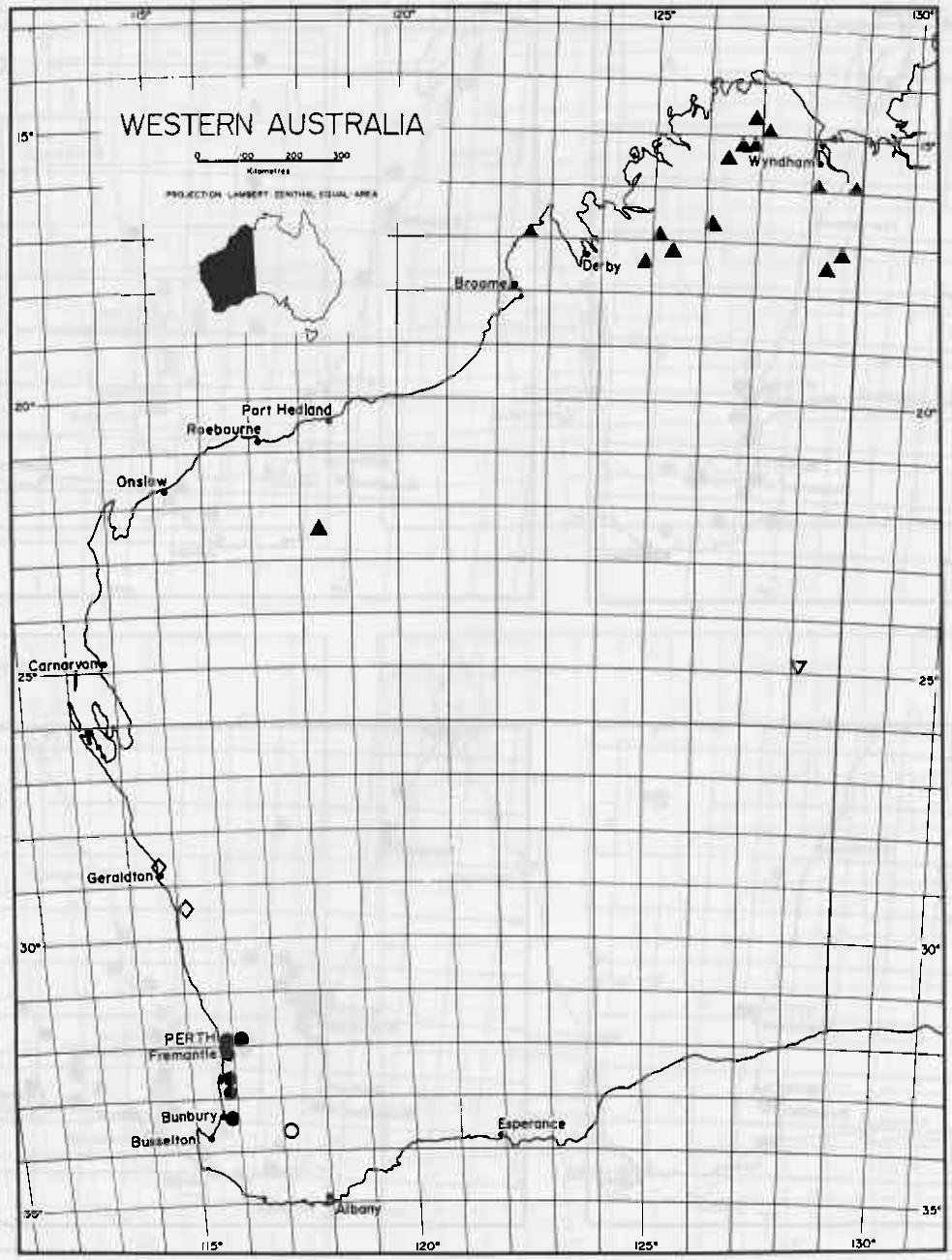

Figure 15. Western Australian distribution of *Schoenoplectus lateriflorus* ▲ and *Schoenus centralis* ▽ and full distribution of *Schoenus badius* ◇ , inland variant of *Schoenus capillifolius* ○ and typical variant of *Schoenus capillifolius* ● .

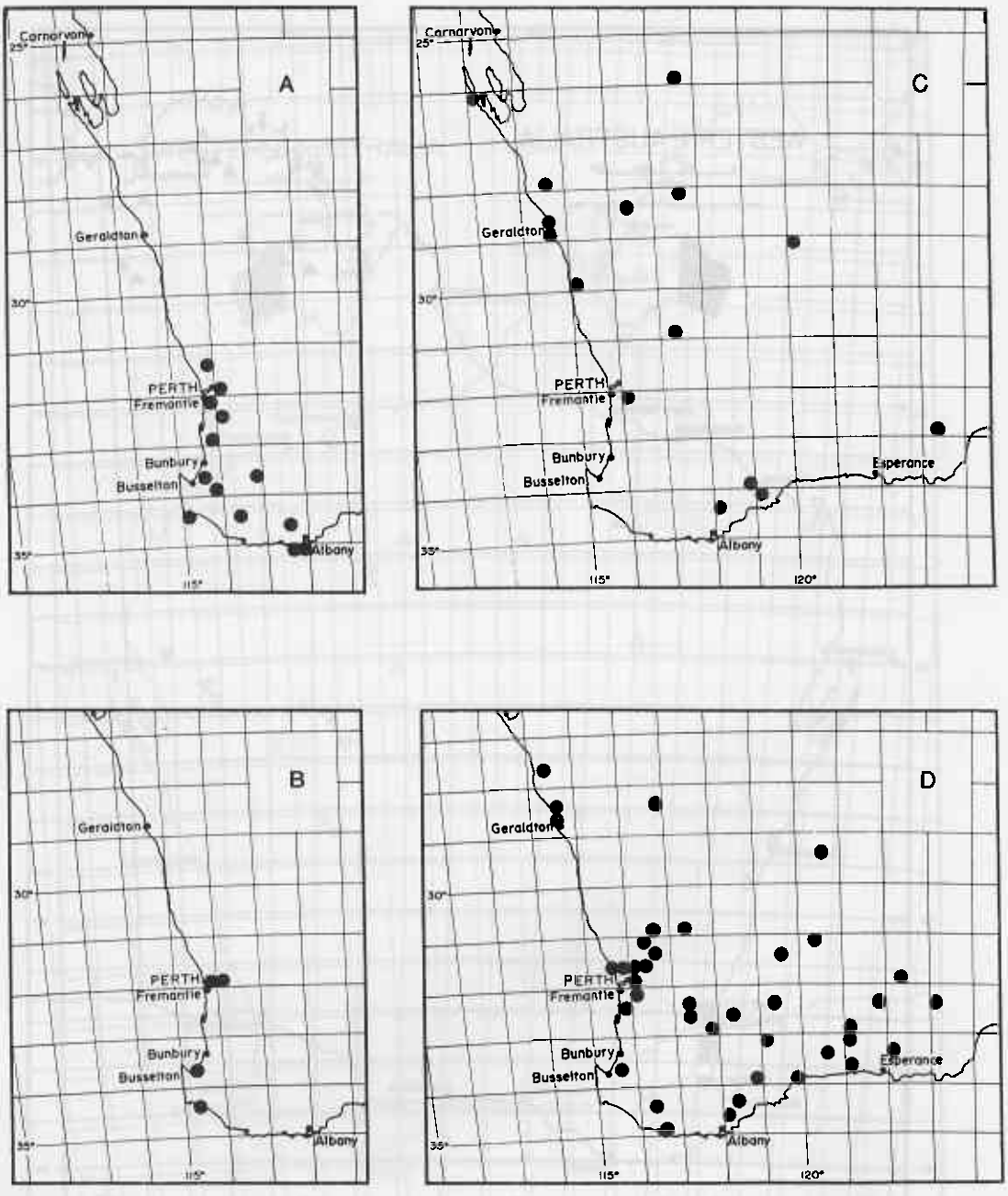

Figure 16. A - Western Australian distribution of *Schoenus discifer*; B - full distribution of *Schoenus elegans*; C - full distribution of *Schoenus humilis*; D - Western Australian distribution of *Schoenus nanus*.

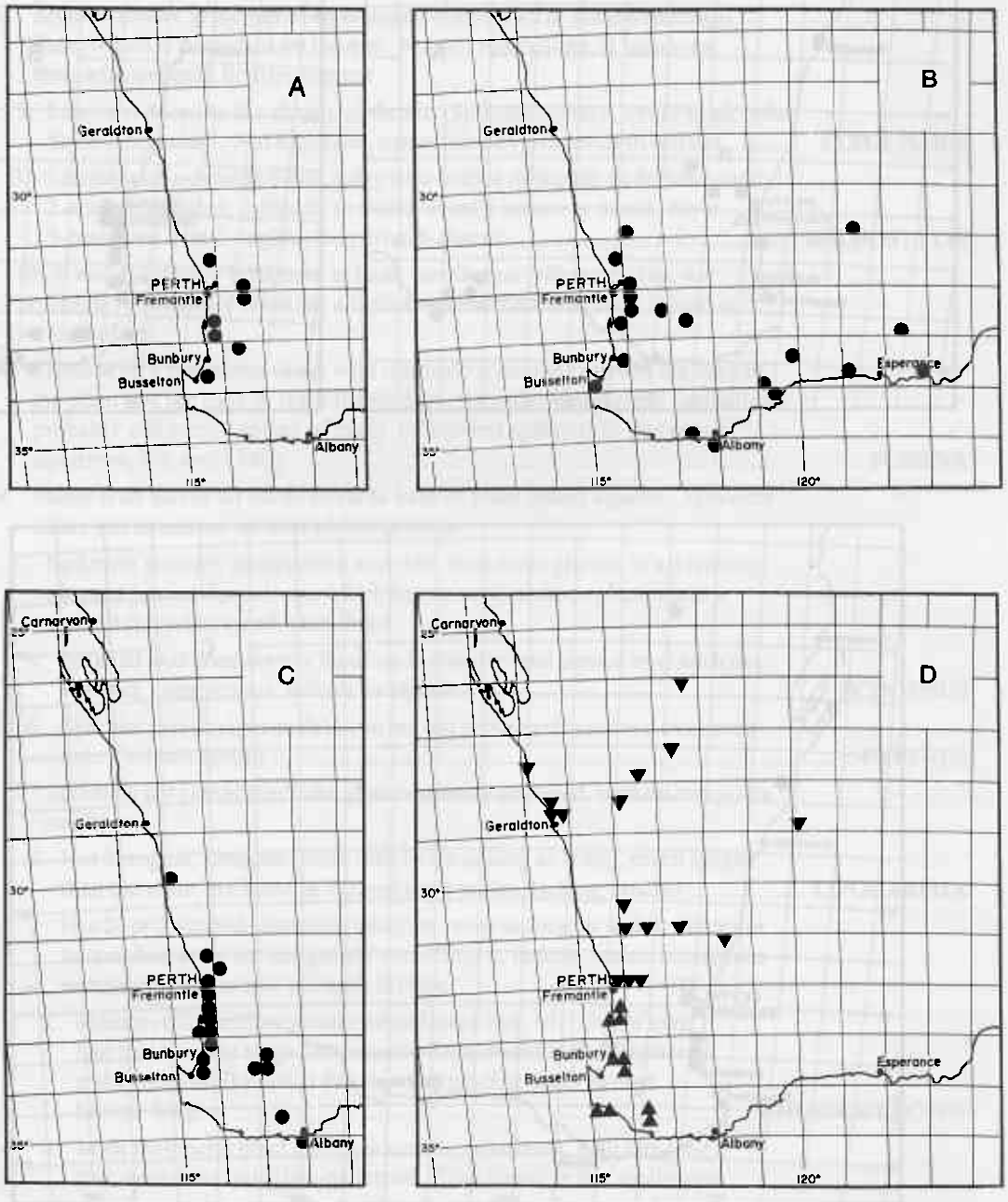

Figure 17. Geographical distribution. A - *Schoenus natans*; B - *Schoenus odontocarpus*; C - *Schoenus plumosus*; D - *Schoenus variicellae*, typical variant ▼ and southern variant ▲ .

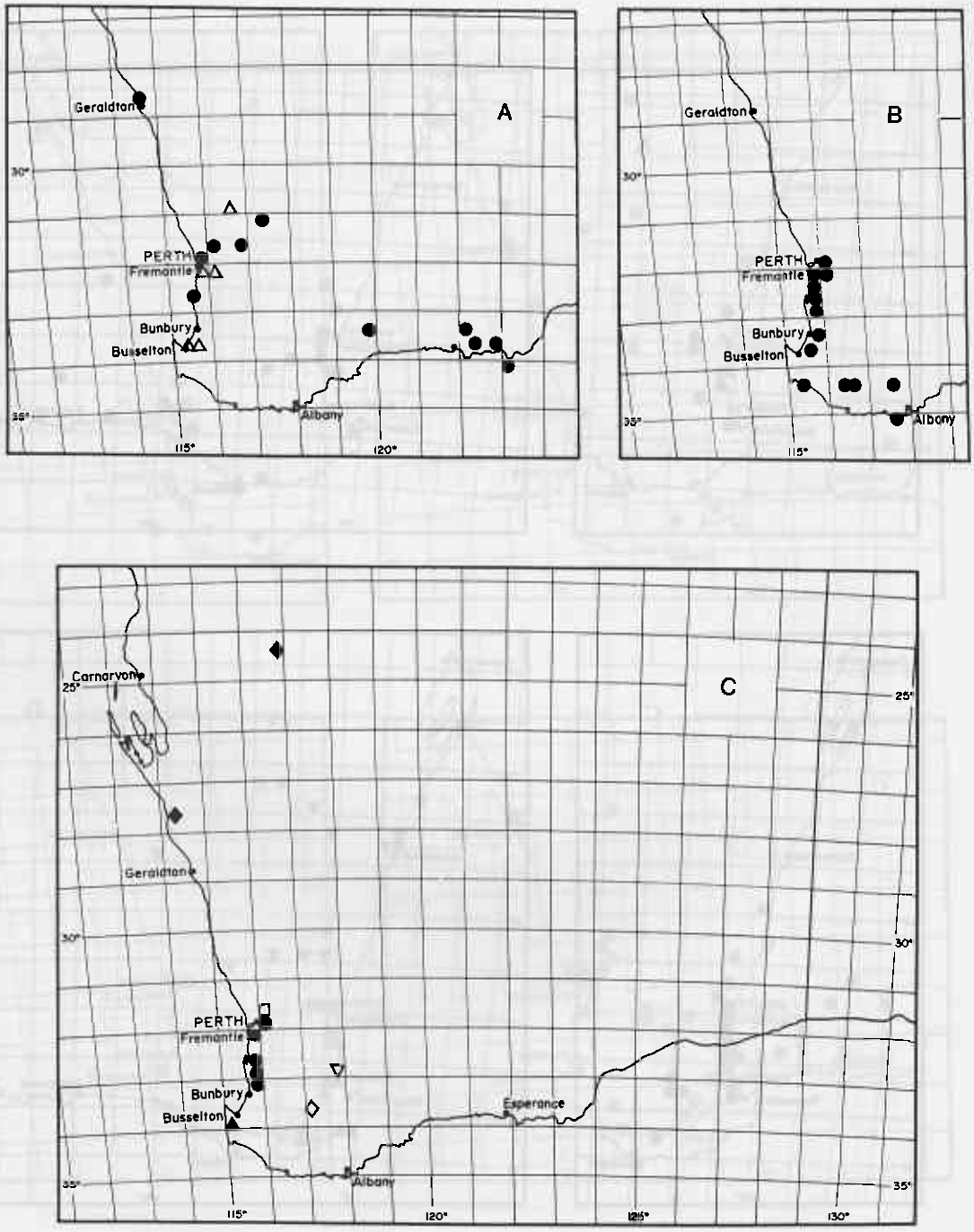

Figure 18. A - Full distribution of *Schoenus pennisetis* △ and Western Australian distribution of *Schoenus sculptus* ● ; B - Western Australian distribution of *Schoenus tenellus*; C - full distribution of *Schoenus* sp. *Beaufort* ◇ , *Schoenus* sp. *Bullsbrook* □ , *Schoenus* sp. *Harrismith* ▽ , *Schoenus* sp. *Jindong* ▲ , *Schoenus* sp. *Kalbarri* ◆ and *Schoenus* sp. *Waroona* ● .

Key to genera

1. Style thickened at the base, articulate above or below the enlarged base
   2. Style articulate at summit of ovary, fully deciduous, the thickened base acutely angled or very compressed at summit. Nut usually either tuberculate and 3-angled or smooth and biconvex; perianth absent ..... **FIMBRISTYLIS**
   2. Style articulate at the top of an enlarged button-like to almost spherical base, which is persistent on the nut. Nut not tuberculate, if biconvex then with perianth bristles present
      3. Leaves reduced to the sheath, glabrous. Spikelet solitary, ovoid to globular. Style 2-branched. Nut biconvex, surrounded by 6-8 perianth bristles ..... **ELEOCHARIS**
      3. Leaves with a definite blade, hairy near orifice of sheath. Spikelets usually 2 or more together, cylindric to ovoid, usually narrowly ovoid. Style 3-branched. Nut 3-angled, the perianth absent ..... **BULBOSTYLIS**
1. Style not or scarcely thickened at base, continuous with ovary (i.e. not articulate) but usually breaking a little above the base leaving a 'point' at summit of nut
   4. Stems with a few nodes (each with one leaf) scattered between the base of the plant and the base of the inflorescence, terrestial. 'Spikelets' (actually probably condensed spikes of many 1-flowered spikelets in this genus) squarrose, the awns hairy ..... **FUIRENA**
   4. Stems with leaves all borne towards base of plant unless aquatic. Spikelets either not squarrose or with glabrous awns
      5. Spikelets strongly compressed and with distichous glumes in all species except *Cyperus hamulosus*, which has spiro-distichous glumes and a distinct curry-like smell when dried
         6. Spikelet axis prominently flexuose at maturity and curved over each nut. Perianth conspicuous, minute or absent ..... **SCHOENUS**
         6. Spikelet axis straight or flexuose but not prominently curved over each nut. Perianth absent ..... **CYPERUS**
      5. Spikelets not compressed, the glumes spirally arranged, with no curry-like smell
         7. Nut 3-angled, elongate (more than twice as long as wide), much longer than the style, enclosed in 2 translucent scales, lacking bristles ..... **LIPOCARPHA**
         7. Nut 2- or 3-angled, compact (less than twice as long as wide), shorter or longer than style but not greatly exceeding it, lacking scales, sometimes surrounded by up to 7 perianth bristles
            8. Main involucral bract prominent and stem-like, 40-120 mm long. Nut transversely ridged or smooth. Distributed in the Northern and Eremaean Botanical Provinces extending south to near Mount Magnet ..... **SCHOENOPLECTUS**
            8. Main involucral bract inconspicuous to prominent, 1-30 mm long. Nut smooth or reticulate-patterned. Distributed in the south-west, with *I. congrua* extending north to Lyons River Station and Rawlinson Range ..... **ISOLEPIS**

Synopsis and keys to species

Bulbostylis Kunth

1. Spikelets usually few to many in a head, rarely solitary. Stamens 1(2) ..... **B. barbata**
1. Spikelets in a simple umbel or rarely solitary. Stamens 3
   2. Involucral bracts long, at least one exceeding inflorescence, hairy. Glumes with hairs *c.* 0.3 mm long; apical mucro 1.5-2 mm long. Nut not transversely ridged ..... **B. burbidgeae**
   2. Involucral bracts all shorter than inflorescence or rarely the basal one longer, subglabrous or with minute hairs. Glumes subglabrous or with hairs less than 0.1 mm long; apical mucro less than 0.5 mm long. Nut transversely ridged ..... **B. turbinata**

Bulbostylis barbata (Rottb.) C.B. Clarke - occurs from the coast to far inland, in a variety of damp habitats, including shallow soil over rock or in rock crevices, the margins of watercourses and low-lying flats. Widespread in the northern half of Western Australia, extending from the far north of the Kimberley Region around the coast to Kalbarri National Park in the South West Botanical Province, south to Hunt Range in the South-western Interzone and inland to near Gahnda Rockhole (east of Warburton) in the Eremaean Botanical Province. Also occurs in Northern Territory, South Australia, Queensland and New South Wales. Widely distributed in warm parts of the world. Flowers and fruits: mainly February-September. Plants 20-350 mm high; stems 0.2-0.6 mm diam. *Bulbostylis eustachii* J.M. Black, *Fimbristylis barbata* (Rottb.) Benth., *Scirpus barbatus* Rottb. (Jessop & Weber 1986: Figure 923A; Rye 1992: Figure 311B; Sharp 1989: Figure 43A; Wilson 1994: 381)

Bulbostylis burbidgeae K.L. Wilson - apparently endemic to the Eremaean Botanical Province of Western Australia, recorded from the base of cliffs or associated with granite outcrops, on Mulyie Station, Gorge Range, Abydos-Woodstock Reserve and Mt Edgar Station. Flowers and fruits: March, June-August. Plants 30-200 mm high; stems 0.2-0.4 mm diam. **Priority 3** (Figure 19A-C)

Bulbostylis turbinata S.T. Blake - occurs along watercourses, in depressions, rockholes and other damp habitats in the Eremaean Botanical Province, extending from Karijini National Park south to near Mount Magnet and east to Walter James Range. Also occurs in Northern Territory, Queensland and possibly South Australia. Flowers and fruits: February-April. Plants 50-150 mm high; stems 0.2-0.6 mm diam. (Jessop & Weber 1986: Figure 923B; Latz & Wilson 1981: Figure 640)

Cyperus L.

Note. The two species keyed first, *C. hamulosus* and *C. squarrosus*, belong to a different species group from the other species included here and might be better placed in a distinct genus as discussed by Wilson (1981: 171).

1. Plants with a distinct curry-like smell when dried. Spikelets either terete (the glumes spirally arranged) or squarrose with points (0.5)0.7-1.2 mm long
   2. Spikelets more or less terete; glumes spiro-distichous, with 1 or 2 prominent veins on each side and a recurved mucro 0.3-0.4 mm long ..... ***C. hamulosus**
   2. Spikelets flat; glumes distichous, with 2-4 prominent veins on each side and a prominently recurved mucro (0.5)0.7-1.2 mm long ..... **C. squarrosus**

1. Plants lacking a curry-like smell. Spikelets flat (the glumes distichous), not squarrose but sometimes with points 0.2-0.3(0.4) mm long
   3. Stems filiform, 0.1-0.2 mm diam., with a solitary spikelet or 2-4 spikelets in a pseudo-lateral cluster. Occurs in the South West Botanical Province ..... ***C. tenellus**
   3. Stems slender to robust, 0.2-2.5 mm diam., with usually many spikelets in a simple or compound umbel of clusters or in a head, the inflorescence rarely reduced to a single cluster of spikelets or solitary spikelet. Occurs in the Northern and Eremaean Botanical Provinces
      4. Stamens 3 or (in *C. iria*) sometimes 2. Nut 1.2-2.5 mm long
         5. Glumes 2-4 mm long, mucronate. Fruiting axis narrowly to broadly winged. Anthers 3, 0.3-0.5 mm long ..... **C. rigidellus**
         5. Glumes 1.3-1.7 mm long, emarginate. Fruiting axis not winged. Anthers 2 or 3, 0.2-0.3 mm long ..... **C. iria**
      4. Stamens 1 or 2. Nut 0.5-1 mm long
         6. Spikelets in a dense head surrounded by 3 or more long involucral bracts greatly exceeding inflorescence. Anthers 0.3-0.5 mm long ..... **C. pygmaeus**
         6. Spikelets in a lateral or stellate cluster or in multiple clusters arranged in umbels, sometimes subtended by 1(2) long bracts greatly exceeding inflorescence. Anthers 0.1-0.3 mm long
            7. Spikelets 3-8 mm wide. Glumes *c.* 0.6 mm long, almost truncate. Nut broadly elliptic-obovate in outline ..... **C. difformis**
            7. Spikelets 1-1.5 mm wide. Glumes 0.7-1.5 mm long, with a mucro exceeding the membranous sides. Nut obovate in outline ..... **C. castaneus**

Cyperus castaneus Willd. - fairly widespread in the Kimberley Region from Kunmunya Hill southwards, with three records from claypans and other damp habitats in the Eremaean Botanical Province at Wolf Creek Crater, Towrana Station and near Mount Magnet. Also occurs in Northern Territory, Queensland, New South Wales and from India east to Indonesia. Flowers and fruits: February-April, July. Plants 0.01-0.05 m (10-50 mm) high; stems 0.2-0.4 mm diam. There are two named varieties, which apparently intergrade (K.L. Wilson pers. comm.) and are no longer recognized. The typical variety occurs throughout the range of the species. The other variety, distinguished by its smaller glumes with a shorter mucro and smaller nuts, is apparently restricted to northern Australia. *Cyperus castaneus* var. *brevimucronatus* Kük. (Figure 19D-F; Latz & Wilson 1981: Figure 637K; Sharp 1989: Figure 46F)

Cyperus difformis L. - occurs mainly along watercourses. Extends from near Wyndham in the Kimberley Region south-east to Duck Creek Station in the Eremaean Botanical Province, with an isolated record far inland at Rawlinson Range. Also occurs in Northern Territory, South Australia, Queensland, New South Wales, Victoria and from southern Europe and Africa east to Japan and the western Pacific islands. Flowers and fruits: mainly May-September, also recorded February. Plants 0.15-0.6 m high; stems 1.0-2.8 mm diam. (Jessop & Weber 1986: Figure 927J, 928A; Latz & Wilson 1981: Figure 637D; Rye 1992: Figure 313B; Sharp 1989: Figure 46D)

***Cyperus hamulosus** M. Bieb. - naturalized in Western Australia, recorded from the edge of a lake on Towrana Station in the Eremaean Botanical Province. Also naturalized in Northern Territory, South Australia and Victoria. Native to Africa and central Asia. Flowers and fruits: April-May. Plants *c.* 0.05 m (50 mm) high; stems *c.* 0.4 mm diam. *Mariscus hamulosus* (M. Bieb.) S.S. Hooper, *Scirpus hamulosus* (M. Bieb.) Steven (Jessop & Weber 1986: Figure 927P; Latz & Wilson 1981: Figure 638M)

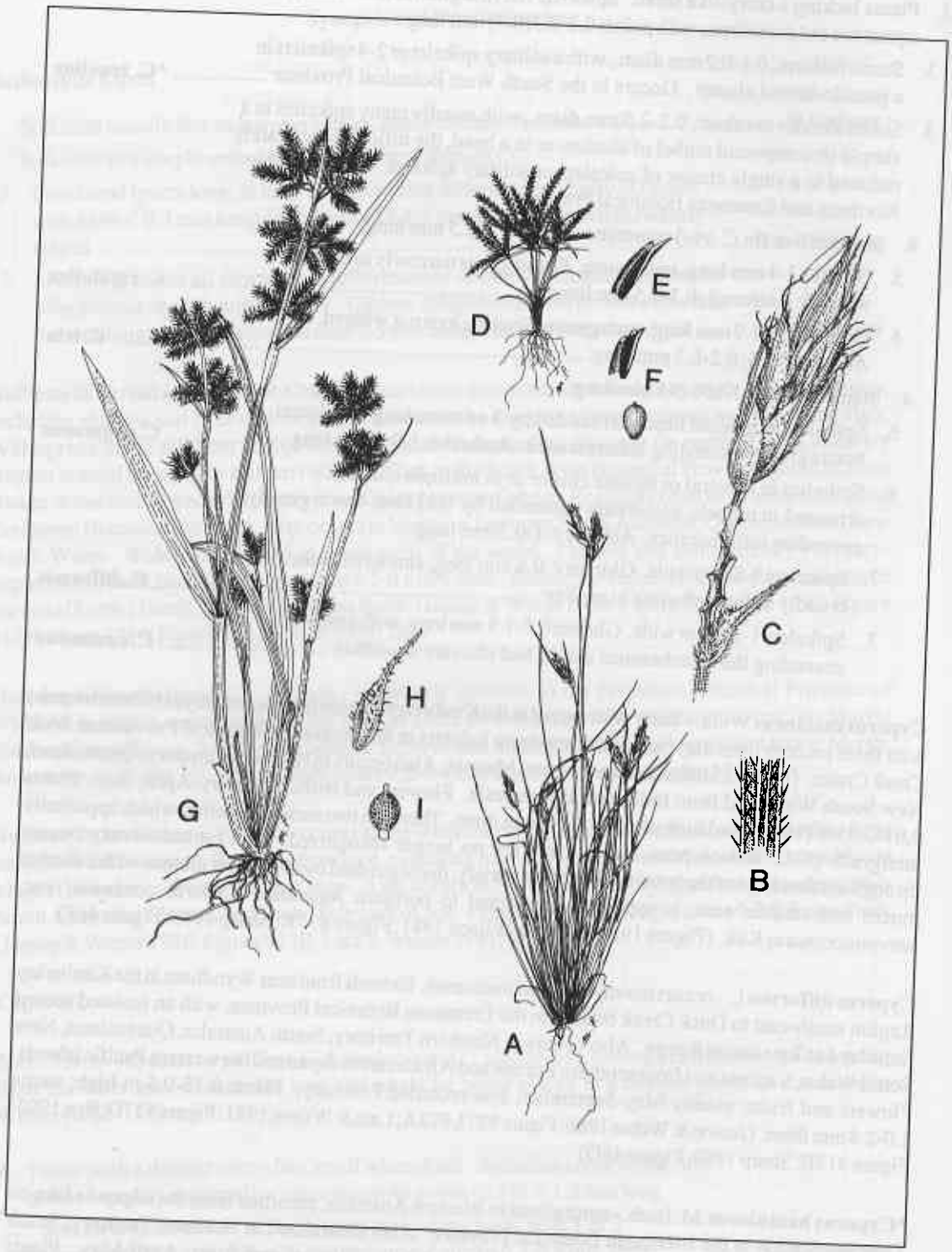

Figure 19. A-C *Bulbostylis burbidgeae* A - whole flowering plant (x1), B - stem (x1), C - spikelet (x6); D-F *Cyperus castaneus* D - whole plant of typical variant (x1), E - glume of typical variant (x10), F - glume and nut of atypical variant (x10); G-I *Fuirena nudiflora* G - whole plant (x1), H - glume (x10), I - nut (x10). Drawn from *N.T. Burbidge* 1102 (A-C), *R.J. Cranfield* 2084 (D,E), *G.W. Carr* 3600 & *A.C. Beauglehole* 47378 (F), *A.S. George* 8801 (G-I).

Cyperus iria L. - occurs in claypans, along drainage lines and watercourses and in other damp habitats. Extends from Kununurra in the Kimberley Region south-west to Yanrey Station (south of Onslow) and near Mount Magnet and inland to Rawlinson Range in the Eremaean Botanical Province. Also occurs in Northern Territory, South Australia, Queensland, New South Wales and from tropical Africa through southern Asia to Japan. Flowers and fruits: February-August. This species might sometimes be perennial. Plants 0.05-0.7 m high; stems 0.2-2.5 mm diam. (Jessop & Weber 1986: Figure 927R, 928D; Latz & Wilson 1981: Figure 637J; Rye 1992: Figure 314A; Sharp 1989: Figure 45D)

Cyperus pygmaeus Rottb. - Occurs along watercourses and in claypans in two main areas, one extending from Derby in the Kimberley Region south-east to Sturt Creek in the far north of the Eremaean Botanical Province. The other area is in the Pilbara, with three records from Billiluna Station, Duck Creek and Roy Hill Station (north of Newman). Also occurs in Northern Territory, South Australia, Queensland, New South Wales, Victoria and from the Mediterranean region and southern Africa through southern Asia to the Philippines and New Guinea. Flowers and fruits: July-August. Plants *c.* 0.05 m (50 mm) high; stems 0.7-1.4 mm diam. *Cyperus michelianus* subsp. *pygmaeus* (Rottb.) Asch. & Graeb. (Jessop & Weber 1986: Figure 927V; Latz & Wilson 1981: Figure 637M; Sharp 1989: Figure 46P)

Cyperus rigidellus (Benth.) J.M. Black - occurs along watercourses, on floodplains, in claypans and other damp habitats, extending from Uaroo Station and Carnarvon east to Walter James Range in the Eremaean Botanical Province and south-east to Cundeelee in the South-western Interzone, with a single record from Geraldton in the South West Botanical Province. Also occurs in Northern Territory, South Australia, Queensland, New South Wales and Victoria. Flowers and fruits: April-October. A species in need of further study, with several variants; it is sometimes perennial. Plants 0.05-0.4 m high or rarely smaller; stems 0.5-1.3 mm diam. *Cyperus gracilis* var. *rigidellus* Benth., *C. subpinnatus* Kük., *C. subpinnatus* var. *subrigidellus* Kük., *Mariscus rigidellus* (Benth.) C.B. Clarke (Jessop & Weber 1986: Figure 927W, 928F; Sharp 1989: Figure 47F; Wilson 1991: Figure 30a-f)

Cyperus squarrosus L. - occurs along watercourses, drainage lines, in claypans and other damp habitats. Extends from the north of the Kimberley Region south-west to Edagee Station and near Mount Magnet in the Eremaean Botanical Province and south to Cundeelee Mission in the South-western Interzone. Also occurs in Northern Territory, South Australia, Queensland, New South Wales, Victoria, North and South America, Africa and southern Asia. Flowers and fruits: February-August. Plants 0.03-0.25 m high; stems 0.3-1.4 mm diam. *Cyperus aristatus* Rottb., *Mariscus squarrosus* (L.) C.B. Clarke (Jessop & Weber 1986: Figure 927Y; Latz & Wilson 1981: Figure 638L; Rye 1992: Figure 314B; Sharp 1989: Figure 46H)

***Cyperus tenellus** L.f. - naturalized on the margins of swamps, rockpools on granite, and in other damp habitats, extending around the coast from near Geraldton to near Green Range in the South West Botanical Province and inland to Mt Clara (east of Southern Cross) in the South-western Interzone. Also naturalized in South Australia, New South Wales, Victoria, Tasmania and New Zealand. Apparently native to South Africa. Flowers and fruits: mainly September-November. Plants 0.02-0.12 m (20-120 mm) high; stems 0.1-0.2 mm diam. *Eucyperus tenellus* (L.f.) Palla (Jessop & Weber 1986: Figure 927Z; Wilson 1994: Figure 61e,f)

Eleocharis R. Br.

1. Glumes 0.8-1.5 mm long, becoming patent in fruit. Anthers 0.2-0.4 mm long ..... **E. atropurpurea**
1. Glumes 1.5-2 mm long, appressed to antrorse. Anthers 0.5-0.7 mm long ..... **E. geniculata**

Eleocharis atropurpurea (Retz.) Kunth - occurs along watercourses and around swamps and lakes, extending from Mitchell Plateau and Drysdale River National Park in the Kimberley Region south-west to Duck Creek Station in the Pilbara area of the Eremaean Botanical Province. Also occurs in Northern Territory, Queensland and widely distributed in warm regions of the world. Flowers and fruits: April-August. Plants 0.03-0.1 m high; stems 0.1-0.3 mm diam. *Eleocharis atropurpurea* var. *setiformis* Benth., *Scirpus atropurpureus* Retz. (Rye 1992: Figure 310E)

Eleocharis geniculata (L.) Roem. & Schult. - occurs along watercourses, commonly on the margins of permanent pools. Extends from the far north and east of the Kimberley Region south-west to Harding River in the Eremaean Botanical Province. Also occurs in Northern Territory, South Australia, Queensland, New South Wales and widespread in warm regions of the world. Flowers and fruits: mainly May-October, also January-February. Many specimens appear to be perennial, others apparently annual. Plants 0.1-0.4 m high; stems 0.3-1 mm diam. *Eleocharis capitata* R.Br., *E. caribaea* (Rottb.) S.T. Blake, *Scirpus caribaeus* Rottb., *S. geniculatus* L. (Jessop & Weber 1986: Figure 930C; Rye 1992: Figure 310I; Sharp 1989: Figure 42F; Wilson 1993: 376)

Fimbristylis Vahl

1. Style flat, 2-branched. Nut biconvex, neither tuberculate nor transversely ridged
   2. Stamen 1. Style base with very long reflexed hairs ..... **F. velata**
   2. Stamens (2)3. Style base glabrous or ciliolate ..... **F. depauperata**
1. Style triquetrous, 3-branched. Nut 3-angled in cross-section, usually either tuberculate or transversely ridged (except in *F. microcarya*, which often has a smoother nut)
   3. Spikelet solitary, compressed, the glumes distichous at first. Nut *c.* 2.5 mm long ..... **F. oxystachya**
   3. Spikelets 1-many, more or less terete, the glumes spirally arranged. Nut 0.6-1.5 mm long
      4. Inflorescence of 1 or rarely 2 or 3 spikelets, simple. Glumes 2.5-5 mm long. Nut 1-1.5 mm long, if 1-1.2 mm long then with prominent transverse ridges
         5. Glumes 2.5-3 mm long. Nut with 7-10 prominent transverse ridges ..... **F. ammobia**
         5. Glumes 4-5 mm long. Nut longitudinally 3-ridged, tuberculate towards apex ..... **F. simulans**
      4. Inflorescence of (3)4-many spikelets, simple, compound or decompound. Glumes 1-2.5 mm long. Nut 0.6-1 mm long, not transversely ridged
         6. Glumes 2-2.5 mm long. Stamens 3. Style ciliate along the angles of undivided portion
            7. Glumes fairly broad, each side 0.5-0.6 mm wide. Anthers 0.5-0.6 mm long .. **F.** sp. **Shay Gap**
            7. Glumes very broad, each side 1-1.2 mm wide. Anthers 1.2-1.7 mm long ..... **F. rara**
         6. Glumes 1-1.5(2) mm long. Stamens 1 or 2. Style glabrous on undivided portion
            8. Spikelets obtuse; axis (visible after fruits shed) slightly winged. Anthers 0.4-0.8 mm long ..... **F. littoralis**
            8. Spikelets acute; axis (visible after fruits shed) prominently winged. Anthers 0.2-0.4 mm long ..... **F. microcarya**

Fimbristylis ammobia Latz - occurs from Broome to Derby in the Kimberley Region, with a single record from red sand on Yaramin Station (east of Sturt Creek) in the Eremaean Botanical Province. Also occurs in Northern Territory. Flowers and fruits: July. Plants 0.1-0.2 m high; stems *c.* 0.5 mm diam. (Latz 1979: Figure 2; Latz & Wilson 1981: Figure 636A-D; Rye 1992: Figure 316A)

Fimbristylis depauperata R. Br. - fairly widespread in the Kimberley Region, extending from Mitchell Plateau south-west to One Arm Point and near Derby, east to Long Spring and south-east to Bungle Bungle Range, with isolated records in the Eremaean Botanical Province from drainage lines in Chichester Range National Park and at Mt Augusta. Also occurs in Northern Territory, Queensland, Lesser Sunda Island, South Moluccas and New Guinea. Flowers and fruits: March-April, August. Plants 0.1-0.3 m high; stems 0.4-1 mm diam. *Fimbristylis dichotoma* subsp. *depauperata* (R. Br.) Kern, *F. dichotoma* f. *depauperata* (R. Br.) Ohwi, *F. diphylla* var. *depauperata* (R. Br.) C.B. Clarke, *F. spirostachya* F. Muell., *Iria depauperata* (R. Br.) Kuntze (Rye 1992: Figure 315F; Sharp 1989: Figure 43V)

Fimbristylis littoralis Gaudich. - extends from Drysdale River National Park in the Kimberley Region south to Southesk Tablelands and south-east to Erong Springs Station in the Eremaean Botanical Province, recorded along watercourses. Also occurs in Northern Territory, Queensland and widespread in the tropics. Flowers and fruits: February-July. Plants 0.05-0.4 m high; stems 0.5-1.4 mm diam. (Rye 1992: Figure 318C)

Fimbristylis microcarya F. Muell. - occurs along watercourses and drainage lines, with one record from a claypan. Extends from the far north of the Kimberley Region south-west to Milly Milly Station (near upper Murchison River) in the Eremaean Botanical Province. Also occurs in Northern Territory and Queensland. Flowers and fruits: February-August. Plants 0.05-0.4 m high; stems 0.4-1.2 mm diam. Most specimens have only 1 stamen in each flower but the specimen from Milly Milly Station (*R.J. Cranfield* 5324) has 2 stamens. *Fimbristylis autumnalis* var. *microcarya* (F. Muell.) Kük., *F. complanata* var. *microcarya* (F. Muell.) C.B. Clarke, *Iria microcarya* (F. Muell.) Kuntze (Rye 1992: Figure 318D; Sharp 1989: Figure 43Q)

Fimbristylis oxystachya F. Muell. - extends from Mitchell Plateau in the Kimberley Region south-west to near Roebourne and south-east to Yaramin Station (east of Sturt Creek) in the Eremaean Botanical Province, occurring in red sand. Also occurs in Northern Territory and Queensland. Flowers and fruits: April-July. Plants 0.2-0.35 m high; stems 0.5-0.7 mm diam. *Iria oxystachya* (F. Muell.) Kuntze (Rye 1992: Figure 316H)

Fimbristylis rara R. Br. - extends from the far north of the Kimberley Region south-west to near Port Hedland and to a claypan near upper Oakover River in the Eremaean Botanical Province. Also occurs in Northern Territory and Queensland. Flowers and fruits: May. Plants 0.05-0.35 m high; stems 0.5-0.8 mm diam. (Rye 1992: Figure 317I)

Fimbristylis simulans Latz - extends from Mitchell Plateau in the Kimberley Region south-west to Hamersley Range and south-east to Yaramin Station (east of Sturt Creek) in the Eremaean Botanical Province, occurring in rock crevices and in skeletal sand over a variety of rock types. Also occurs in Northern Territory. Flowers and fruits: February-August. Plants 0.1-0.3 m high; stems 0.2-0.4 mm diam. (Latz 1990: Figure 2G-I; Rye 1992: Figure 316N)

Fimbristylis velata R. Br. - occurs along watercourses and in other damp habitats in the South West Botanical Province, extending from Ellen Brook south to Medina, with an isolated record from Blackwood

River. Also occurs in Northern Territory, South Australia, Queensland, New South Wales, Victoria and from Asia to Polynesia. Flowers and fruits: December-May. Plants 0.04-0.15 m high; stems 0.4-0.6 mm diam. *Fimbristylis squarrosa* var. *esquarrosa* Makino, *F. squarrosa* var. *velata* (R. Br.) Cheeseman, *Iria velata* (R. Br.) Kuntze (Sharp 1989: Figure 43M; Wilson 1993: 378)

Fimbristylis sp. **Shay Gap** (*K.R. Newbey* 10293) - apparently endemic to the Eremaean Botanical Province of Western Australia, known from a single collection from sandy soil on a drainage line near Shay Gap. Flowers and fruits: June-July. Plants *c.* 0.15 m high; stems *c.* 0.7 mm diam. **Priority 1**

Fuirena Rottb.

1. Perianth absent. Stamen 1 ..... **F. nudiflora**
1. Perianth consisting of 3 bristles and 3 prominently clawed scales. Stamens usually 3 (but sometimes hidden)
2. Perianth scales prominently 3-veined but otherwise unthickened throughout the body, with a shallow lobe or tooth on each side of a thickened incurved apical point, the apical point *c.* 0.2 mm long ..... **F. ciliaris**
2. Perianth scales prominently 3-veined in basal part and prominently thickened in distal part of body, the apex broadly obtuse and with a slender awn *c.* 0.6 mm long ..... **F. incrassata**

Fuirena ciliaris (L.) Roxb. - widespread in the Kimberley Region. Occurs along watercourses in the Hamersley Ranges and along Yule River in the Eremaean Botanical Province. Also occurs in Northern Territory, Queensland, New South Wales and from tropical Africa north-east to Japan. Flowers and fruits: April-August. Plants 0.1-0.35 m high; stems 0.5-1.2 mm diam. *Fuirena glomerata* Lam., *Scirpus ciliaris* L. (Kern 1974: 32; Latz & Wilson 1981: Figure 642; Sharp 1989: Figure 42A; Wilson 1993: 369)

Fuirena incrassata S.T. Blake - one record from Edgar Range in the far south of the Kimberley Region and another from Googhenama Rockhole on upper Oakover River in the Eremaean Botanical Province. Also occurs in Northern Territory, Queensland and New South Wales. Flowers and fruits: May-August. Plants 0.1-0.3 m high; stems 0.7-1.7 mm diam. This species is widespread but uncommon across northern Australia and has been included on the Priority Flora List for Western Australia. It is probably poorly collected rather than at risk; it is easily overlooked because it resembles its common relation *F. ciliaris*. **Priority 3** (Sharp 1989: Figure 42B; Wilson 1993: 369)

Fuirena nudiflora S.T. Blake - one record from near Kununurra in the Kimberley Region, and one record from a rocky creek bed in a valley of Rawlinson Range in the Eremaean Botanical Province. Also occurs in Northern Territory and Queensland. Flowers and fruits: June. Plants 0.05-0.2 m high; stems 0.3-1.0 mm diam. Like the previous species, *F. nudiflora* has been included on the Priority Flora List for Western Australia, although it has a large range in Australia. It is probably poorly collected, perhaps mostly overlooked because of its much more common relation, *F. ciliaris*. **Priority 1** (Figure 19G-I)

Isolepis R. Br.

1 Glumes 2.3-3.7 mm long. Style branches 2. Nut very compressed, shallowly biconvex, 1.4-1.8 mm long
2. Spikelets 1-5, 1.5-2.5 mm diam. at first, up to 3.5 mm diam. in fruit. Glumes with a short or long, rather straight mucro. Nut usually broadly obovate to broadly elliptic but sometimes almost circular in outline ..... **I. cyperoides**

2. Spikelet 1, 3-4 mm diam. at first, up to 5 mm diam. in fruit. Glumes with a short incurved mucro. Nut almost circular in outline ..... **I. oldfieldiana**

1. Glumes 1.0-2.1 mm long. Style branches 3 except in most *I. setiformis* specimens. Nut circular in cross-section to compressed 3-angled or plano-convex in cross-section, 0.4-1.3 mm long

3. Nut circular in cross-section, prominently reticulate-patterned ..... **I. hookeriana**

3. Nut 3-angled to plano-convex in cross-section, smooth to minutely patterned

4. Spikelets either prominently angular or squarrose, with boat-shaped or awned glumes

5. Spikelets squarrose, each glume with an awn at least as long as its body Stamens 1 or 2 ..... ***I. hystrix**

5. Spikelets angular, not squarrose, with rigid boat-shaped incurved glumes. Stamens 3 ..... ***I. marginata**

4. Spikelets more or less smoothly terete, not squarrose, with glumes more or less convex on abaxial surface

6. Stamens 2 or 3; anther 0.7-1.3 mm long. Nut with abaxial angle absent or obtuse

7. Flowers usually all with 3 stamens and a 3-branched style, rarely some flowers of the spikelet with a 2-branched style. Nut usually 3-angled ..... **I. cernua**

7. Flowers all with 2 stamens and a 2-branched style or sometimes some flowers of the spikelet with a 3-branched style. Nut usually biconvex ..... **I. setiformis**

6. Stamens 1(2); anther 0.2-0.3 mm long. Nut with abaxial angle acute

8. Spikelets 1-4(6), forming an open or irregularly shaped cluster, some spikelets often protruding further than others. Glumes with a keel 0.15-0.2 mm wide on each side of midvein. Nut 0.4-0.6 mm long

9. Glumes 0.8-1.2 mm long, with hyaline margins more or less reaching the scarcely pointed apex ..... **I. australiensis**

9. Glumes (1.2)1.4-2 mm long, with hyaline margins tapering below a distinct apical point ..... **I. congrua**

8. Spikelets 3-8, in a dense globular cluster. Glumes with a broad keel *c.* 0.3 mm wide on each side of midvein. Nut 0.6-0.7 mm long ..... **I. stellata**

Isolepis australiensis (Maiden & Betche) K.L. Wilson - occurs in the South West Botanical Province of Western Australia, recorded from sandy clay beside a pool near Lake Cronin (east of Hyden) and from near Coujinup Hill (north-east of Ravensthorpe). Also occurs in Northern Territory, South Australia, Queensland, New South Wales, Victoria and possibly New Zealand. Flowers and fruits: June, September. Plants 30-55 mm high; stems 0.2-0.3 mm diam. *Scirpus australiensis* (Maiden & Betche) S.T. Blake, *S. cernuus* var. *australiensis* Maiden & Betch **Priority 2** (Jessop & Weber 1986: Figure 934A; Wilson 1994: Figure 63c,d)

Isolepis cernua (Vahl) Roem. & Schult. - commonly occurs in winter-wet depressions or associated with granite, in sand or clay soils, mainly in the South West Botanical Province, extending around the coast from north of Gingin to Cape Arid National Park and inland to Wongan Hills, Manjimup and Kau Rocks (north-east of Esperance), with a single record from the South-western Interzone north-east of Newman Rock (east of Frazer Range). Also occurs in South Australia, Queensland, New South Wales, Victoria,

Tasmania and most regions of the world. Flowers and fruits: August-March. Plants 20-200(300) mm high; stems 0.2-0.6 mm diam. Annual or apparently annual specimens are much less common than perennial ones, and a particularly robust perennial variant from the south coast has been named *Scirpus psammophilus* S.T. Blake. There may be two or more species or infra-specific taxa included here, with one species or variant being distinguished by having a black (rather than brown) nut; the variation in this complex needs further study throughout the world. *Scirpus cernuus* Vahl (Jessop & Weber 1986: Figure 934B; Sharp 1989: Figure 41L; Wilson 1994: Figure 65a-c)

Isolepis congrua Nees - commonly associated with granite outcrops, also in other damp locations such as the margins of watercourses and winter-wet depressions. Widespread in the South West Botanical Province (except for the extreme south-west corner), South-western Interzone and adjacent parts of the Eremaean Botanical Province, extending from Lyons River Station and Kalbarri south-east to Porongurup Range National Park and east to Dadyum Rockhole (east of Laverton), with an isolated record from Rawlinson Range. Also occurs in Northern Territory, South Australia, New South Wales and Victoria. Flowers and fruits: July-October. Plants 15-180 mm high; stems 0.15-0.35 mm diam. *Scirpus congruus* (Nees) S.T. Blake (Jessop & Weber 1986: Figure 934C; Wilson 1994: Figure 63e,f)

Isolepis cyperoides R. Br. - endemic to the South West Botanical Province, occurring in clay in winter-wet depressions and other damp habitats, extending around the coast from near Nanson (north of Geraldton) to near Cape Le Grand National Park and inland to Stirling Range. Flowers and fruits: mainly September-February. Plants (when apparently annual) 35-150 mm high, more commonly perennial and up to 300 mm high; stems 0.3-1.3 mm diam. Closely related to *I. oldfieldiana*, which has broader, usually more obtuse spikelets. *Scirpus brunonianus* S.T. Blake, *S. cyperoides* (R. Br.) Spreng. (Figure 20A,B)

Isolepis hookeriana Boeck. - occurs in the South West Botanical Province, recorded on winter-wet flats in sandy clay, known from at least five scattered localities extending from Meenaar south to Lowden (possibly also Stirling Range) and east to near Corrigin. Also occurs in South Australia, Queensland, New South Wales, Victoria and Tasmania. Flowers and fruits: September-November. Plants 30-150 mm high; stems 0.1-0.25 mm diam. Although this species is widespread, it appears to be uncommon, with few plants at each population (K.L. Wilson pers. comm.) *Scirpus calocarpus* S.T. Blake, *S. hookerianus* (Boeck.) S.T. Blake **Priority 3** (Jessop & Weber 1986: Figure 934E; Sharp 1989: Figure 41E; Wilson 1994: Figure 64a,b)

***Isolepis hystrix** (Thunb.) Nees - naturalized in the South West Botanical Province, recorded from winter-wet flats in the Waroona area and near Green Range (north-east of Albany). Also naturalized in South Australia, New South Wales and Victoria. Native to South Africa. Flowers and fruits: November. Plants *c.* 25 mm high; stems 0.3-0.4 mm diam. *Scirpus hystrix* Thunb. (Jessop & Weber 1986: Figure 934F)

***Isolepis marginata** (Thunb.) A. Dietr. - commonly occurs in shallow soil over granite, limestone or other types or rocks, also in winter-wet depressions and other damp habitats. Widespread in the South West Botanical Province, extending around the coast from Abrolhos Islands to Recherche Archipelago and inland into the South-western Interzone near Mt Hampton (south of Southern Cross) and Mt Willgonarinya (south of Balladonia), with an isolated record from Belele Station in the Eremaean Botanical Province. Probably naturalized in Australia. Also occurs in South Australia, New South Wales, Victoria, Tasmania and New Zealand. Native to South Africa. Flowers and fruits: mainly August-December, also January-February. Plants 15-220 mm high; stems 0.2-0.5 mm diam. *Isolepis cartilaginea* R. Br., *Scirpus marginatus* Thunb. (Jessup & Weber 1986: Figure 934H, 935A; Wilson 1994: Figure 65j-l)

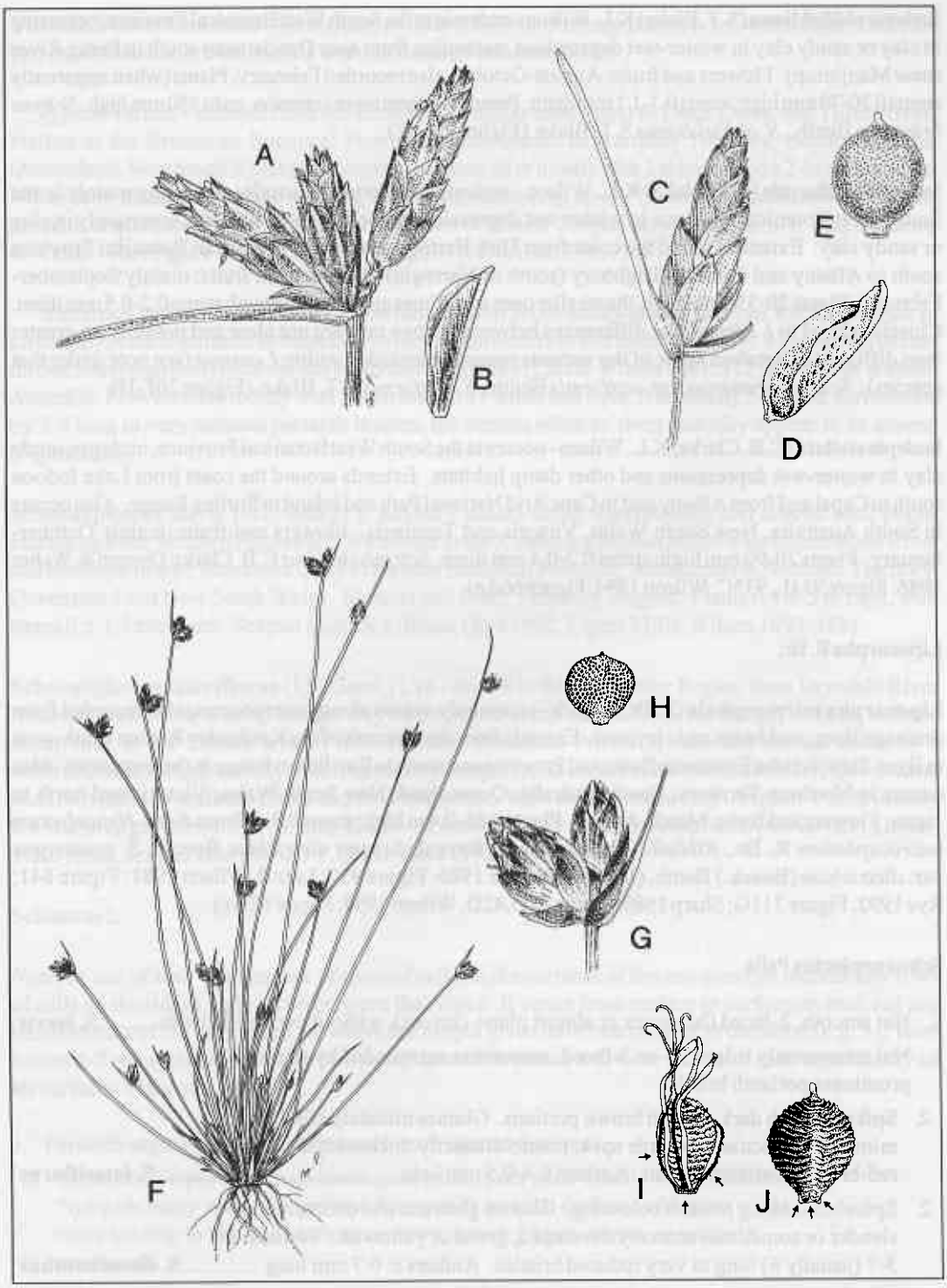

Figure 20. A,B *Isolepis cyperoides* A - inflorescence (x4), B - glume (x10); C-E. *Isolepis oldfieldiana* C - inflorescence (x4), D - glume (x7), E - nut (x10); F-H *Isolepis setiformis* F - whole plant (x1), G - inflorescence (x6), H - nut (x10); I,J Trimerous variant of *Schoenoplectus dissachanthus* I - young nut with three stamen filaments, 3-branched style and fairly long perianth segments (arrowed) (x10), J - mature nut with very reduced perianth segments (arrowed) (x10). Drawn from *M. Koch* 1790 (A,B), *S.T. Blake* 17995 (C,D), *G.J. Keighery* 11366 (E), *R.J. Cranfield* 1410 (F,G), *K.F. Kenneally* 5857 (H), *N.H. Speck* 639 (I) and *R.J. Cranfield* 2171 (J).

Isolepis oldfieldiana (S.T. Blake) K.L. Wilson - endemic to the South West Botanical Province, occurring in clay or sandy clay in winter-wet depressions, extending from near Dandaragan south to Perup River (near Manjimup). Flowers and fruits: August-October, also recorded February. Plants (when apparently annual) 20-70 mm high; stems 0.3-1.1 mm diam. Perennial plants more common, up to 350 mm high. *Scirpus brizoides* Benth., *S. oldfieldianus* S.T. Blake (Figure 20C-E)

Isolepis setiformis (S.T. Blake) K.L. Wilson - endemic to Western Australia, occurring mainly in the South West Botanical Province in winter-wet depressions and other damp habitats, commonly in clay or sandy clay. Extends around the coast from Dirk Hartog Island in the Eremaean Botanical Province south to Albany and inland to Highbury (south of Narrogin). Flowers and fruits: mainly September-February. Plants 20-350 mm high, the smaller ones sometimes apparently annual; stems 0.2-0.5 mm diam. Closely related to *I. cernua*; the differences between the two taxa are not clear and possibly no greater than differences between some of the variants presently included within *I. cernua* (see note under that species). *Scirpus arenarius* var. *setiformis* Benth., *S. setiformis* S.T. Blake (Figure 20F-H)

Isolepis stellata (C.B. Clarke) K.L. Wilson - occurs in the South West Botanical Province, in clay or sandy clay in winter-wet depressions and other damp habitats. Extends around the coast from Lake Indoon south to Capel and from Albany east to Cape Arid National Park and inland to Stirling Range. Also occurs in South Australia, New South Wales, Victoria and Tasmania. Flowers and fruits: mainly October-January. Plants 20-90 mm high; stems 0.2-0.4 mm diam. *Scirpus stellatus* C.B. Clarke (Jessop & Weber 1986: Figure 934L, 935C; Wilson 1994: Figure 66d,e)

Lipocarpha R. Br.

Lipocarpha microcephala (R. Br.) Kunth - commonly occurs along watercourses, also recorded from drainage lines, rockholes and claypans. Extends from the far north of the Kimberley Region south-west to Byro Station in the Eremaean Botanical Province and south to Rawlinson Range in the Eremaean. Also occurs in Northern Territory, South Australia, Queensland, New South Wales, Victoria and north to Japan. Flowers and fruits: March-August. Plants 0.05-0.4 m high; stems 0.3-0.9 mm diam. *Hypaelyptum microcephalum* R. Br., *Rikliella australiensis* J. Raynal, *Scirpus dietrichiae* Boeck., *S. squarrosus* var. *dietrichiae* (Boeck.) Benth. (Jessop & Weber 1986: Figure 937; Latz & Wilson 1981: Figure 641; Rye 1992: Figure 311G; Sharp 1989: Figure 41O,42D; Wilson 1994: Figure 62a-c)

Schoenoplectus Palla

1. Nut smooth, 2-faced (biconvex or almost plano-convex), without perianth bristles ..... **S. laevis**
1. Nut transversely ridged, 2- or 3-faced, sometimes surrounded by minute to prominent perianth bristles
   2. Spikelets with dark reddish brown portions. Glumes minutely ciliolate or minutely denticulate towards apex; mucro distinctly thickened, usually dark red-brown. Perianth absent. Anthers 0.4-0.5 mm long ..... **S. lateriflorus**
   2. Spikelets lacking reddish colouring. Glumes glabrous and entire; mucro slender or sometimes scarcely developed, green or yellowish. Perianth of 3-7 (usually 6) long to very reduced bristles. Anthers *c.* 0.7 mm long ..... **S. dissachanthus**

Schoenoplectus dissachanthus (S.T. Blake) J. Raynal - occurs along watercourses, around rockpools and in claypans, extending from Weaber Plain in the Kimberley Region south-west to near Mount Magnet. Also occurs in Northern Territory, South Australia, Queensland, New South Wales and

Victoria. Flowers and fruits: April-October. Plants 0.07-0.35 m high; stems 0.7-1.4 mm diam. There are two main variants, which slightly overlap in range and intergrade.

typical variant - extends from the Kimberley Region south-west to Duck Creek and Three Rivers Station in the Eremaean Botanical Province. Also occurs in Northern Territory, South Australia, Queensland, New South Wales and Victoria. Flowers all or mostly with 2 stamens and a 2-branched style. Nut usually biconvex or plano-convex, usually surrounded by up to 7 (usually 6) medium-sized to long perianth bristles, rarely with bristles very reduced or absent. *Scirpus dissachanthus* S.T. Blake (Jessop & Weber 1986: Figure 938A; Rye 1992: Figure 319A; Wilson 1993: 368)

trimerous variant - extends from Towrana Station south-south-east to Dadyun Rockhole (east of Laverton) in the Eremaean Botanical Province. Also occurs in Northern Territory. This variant occurs further south than the typical variant in Northern Territory (Latz & Wilson 1981: 512) and also in Western Australia. Flowers all or mostly with 3 stamens and a 3-branched style. Nut usually 3-angled, surrounded by 3-6 long to very reduced perianth bristles, the bristles often so short that they appear to be absent. (Figure 20I,J)

Schoenoplectus laevis (S.T. Blake) J. Raynal - occurs along watercourses and around rock pools, extending from Mitchell Plateau and Wyndham in the Kimberley Region south-west to near Robe River and Newman in the Pilbara area of the Eremaean Botanical Province. Also occurs in Northern Territory, Queensland and New South Wales. Flowers and fruits: February-August. Plants 0.1-0.5 m high, with stems 0.5-1.3 mm diam. *Scirpus laevis* S.T. Blake (Rye 1992: Figure 319B; Wilson 1993: 368)

Schoenoplectus lateriflorus (J.F. Gmel.) Lye - occurs in the Kimberley Region from Drysdale River National Park south-west to Beagle Bay Mission and south-east to Osmond Range, with an isolated occurrence in the Pilbara area of the Eremaean Botanical Province, recorded several times by a watercourse at a single locality in the Hamersley Ranges. Also occurs in Northern Territory, Queensland and from India to southern China and the Philippines. Flowers and fruits: July-August. Plants usually 0.1-0.4 m high; stems 0.5-1.1 mm diam. *Schoenoplectus supinus* subsp. *lateriflorus* (J.F. Gmel.) T. Koyama, *Scirpus lateriflorus* J.F. Gmel. (Rye 1992: Figure 319C)

Schoenus L.

Note for use of key. The number of rows of cells on the surfaces of the nut does not include any rows of cells on the ridges, only those between the ridges. It varies from surface to surface on each nut and between nuts of the same plant, so where the ranges given have one number in common (e.g. 3-5 rows versus 5-7 rows) there is actually no overlap as neither choice will have 5 rows of cells consistently on all surfaces of the nut.

1. Perianth segments absent or minute (much shorter than nut)
2. Spikelets 1-6 per stem in an interrupted spike, each node usually with 1spikelet. Nut with many rows of narrowly oblong cells on each surface (with parts of the rows tending to become black at maturity, forming black stripes or patches) or smooth
3. Largest glume 4-6 mm long, shiny. Nut *c.* 1.5 mm long ..... **S. discifer**
3. Largest glume 2-3.5 mm long, usually dull. Nut *c.* 0.8 mm long

4. Aquatic or semi-aquatic plant 35-110 mm high, with very slender lax leaves. Spikelets at 2-6 nodes per stem; lowest bract 3-6 mm long ..... **S. tenellus**

4. Tiny terrestrial plant 15-55 mm high, with firm leaves. Spikelets at 1-4 nodes per stem; lowest bract 10-25 mm long ..... **S.** sp. **Waroona**

2. Spikelets several to many in a terminal cluster on each stem or in several pairs or clusters, sometimes also with solitary spikelets at some nodes. Nut with few to many rows of almost isodiametric or transversely elongate cells on each surface.

5. Nut 3-horned, with each of the 3 ridges shortly produced at the summit into a small rounded projection

6. Spikelets 4-6-flowered, with 1 empty basal glume. Nut 1.1-1.5 mm long, with *c.* 10 rows of cells on each surface and a prominent apical beak. Occurs in central Australia ..... **S. centralis**

6. Spikelets 2-5-flowered, with 2(3) empty basal glumes. Nut 0.6-1.0 mm long, with 3-7 rows of cells on each surface and a small apical point. Occurs in south-western Australia

7. Floral glumes (2.5)3-4 mm long. Anthers 1.2-2.4 mm long. Nut with 3-5 rows of cells on each surface, the central row(s) usually with very large cells ..... **S. variicellae**

7. Floral glumes 1.5-2.5 mm long. Anthers 0.5-0.8 mm long. Nut with 5-7 rows of cells of relatively uniform size on each surface ..... **S. odontocarpus**

5. Nut not horned, with each of the 3 ridges smoothly rounded at the summit

8. Nut with a prominent beak a quarter to a third as long as body of nut, with 3 or 4(5) rows of cells on each surface, the central rows with large almost isodiametric cells ..... **S. sculptus**

8. Nut with beak or apical point less than a quarter as long as the body of nut, with 4-16 rows of cells on each surface, the central rows with cells either small or transversely narrowly oblong

9. Anthers 0.5-1.5 mm long

10. Mature upper glumes 5-6 mm long. Anthers over 1 mm long. Nut with 12-16 rows of cells on each surface ..... **S.** sp. **Jindong**

10. Mature upper glumes 3.5-4.5 mm long. Anthers less than 1 mm long. Nut with 5-7 rows of cells on each surface ..... **S.** sp. **Harrismith**

9. Anthers 2.5-3.5 mm long

11. Glumes with apex similar in colour to remainder of glume. Nut with 6-8 rows of cells on each surface, all rows with square to transversely oblong cells ..... **S.** sp. **Kalbarri**

11. Glumes deeply coloured at apex but not elsewhere. Nut with 4-6 rows of cells on each surface, all or at least the central rows with transversely narrowly oblong cells ..... **S. elegans**

1. Perianth segments well developed, about half as long as to exceeding nut, hair-like to plumose

12. Spikelets solitary (sometimes basal and largely hidden by the leaves) or rarely 2 superposed per stem, 1- or 2-flowered

13. Plants with tufted leaves around elongate basal spikelets, rarely also with erect emergent non-leafy stems bearing exposed spikelets. Basal spikelets 1(2)-flowered, with glumes 4-10 mm long; exposed spikelets 1 or 2 per stem, 2- or 3-flowered, with glumes 2.5-4.5 mm long ..... **S. capillifolius**

13. Plants with long lax leafy aquatic stems with terminal spikelets. Basal spikelets absent; exposed spikelets solitary, 2-flowered, with glumes 3-4 mm long ..... **S. natans**

12. Spikelets either 3 or more per stem or with 3 or more flowers

14. Nut with a fine reticulate pattern of many (over 10) rows of cells or papillae on each surface, or sometimes appearing smooth

15. Semi-aquatic plants with leaves much more slender and lax than the stems. Spikelets solitary or rarely 2 per stem, 2.5-3.5 mm long ..... **S.** sp. **Beaufort**

15. Terrestrial plants with leaves similar in width to the stems. Spikelets several per stem, 4-6 mm long ..... **S. pennisetis**

14. Nut more obviously reticulate-patterned, with 3-8 rows of cells on each surface

16. Nut with 3-5 rows of cells on each surface, the cells of the central row(s) large, usually much larger than the rest

17. Spikelets borne at 2-many levels up each stem, with often only one spikelet at each level. Floral glumes (3.5)4-5.5 mm long ..... **S. plumosus**

17. Spikelets all borne in a terminal cluster on each stem. Floral glumes 1.5-3 mm long ..... **S. nanus**

16. Nut with 5-8 rows of medium-sized cells on each surface

18. Perianth segments hair-like in distal half and with long antrorse hairs in basal half. Nut 3-lobed about a small pointed apex ..... **S. badius**

18. Perianth segments hair-like or plumose throughout. Nut tapering to the beaked apex, not lobed

19. Perianth segments hair-like ..... **S. elegans**

19. Perianth segments plumose

20. Floral glumes 6-7 mm long. Anthers *c.* 3 mm long. Nut shed with the perianth segments attached ..... **S.** sp. **Bullsbrook**

20. Floral glumes 2.5-5 mm long. Anthers usually 0.4-1 mm long. Nut shed leaving perianth attached to plant ..... **S. humilis**

Schoenus badius Rye - endemic to the South West Botanical Province, recorded from Moresby Range and near Mt Adams (east of Dongara) in damp habitats. Flowers and fruits: August-September. Plants 50-120 mm high; stems *c.* 0.3 mm diam. **Priority 2** (Rye 1997: Figure 1A-C)

Schoenus capillifolius D.A. Cooke - endemic to the South West Botanical Province, aquatic or semi-aquatic, usually submerged in swamps, rooted in clay. Occurs on the coastal plain from the Upper Swan area of Perth south to Waterloo, also recorded inland near Beaufort River. Flowers and fruits: September-November. This species sometimes appears to have stolons connecting the tufted plants so may be perennial in some or most cases. There are two variants. **Priority 2**

typical variant - extends from Upper Swan south to Waterloo. Fully or partially submerged tufted plants with very slender lax leaves 20-115 mm long with a blade 0.1-0.2 mm wide, and basal 1-flowered spikelets with a solitary stamen. (Figure 21A)

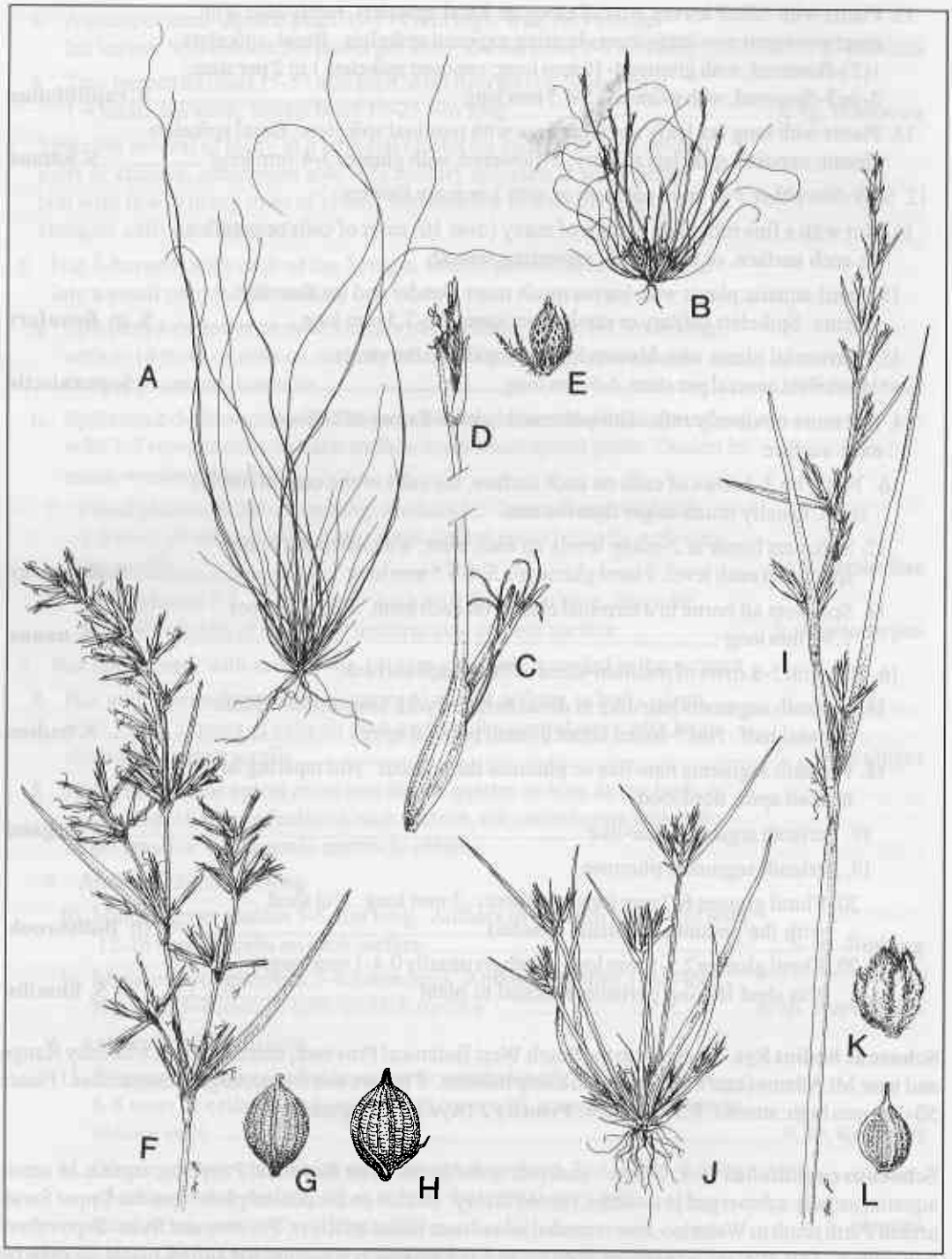

Figure 21. A - Typical variant of *Schoenus capillifolius*, whole plant (x1); B-E Inland variant of *Schoenus capillifolius* B - whole plant (x1), C - basal spikelet (x7), D - aerial spikelet (x5), E - nut with perianth segments, from aerial spikelet (x8.5); F-H *Schoenus elegans* F - inflorescence (x1), G - nut without perianth (x13); H nut and perianth segments (x13); I-L *Schoenus humilis* I - stem from large variant (x1), J - whole plant of small variant (x1), K - nut with perianth segments (x10), L - nut (x10). Drawn from *A. Kelly & A. Spooner* 90/63 (A), *G.J. Keighery* 6291A (B-E), *J. Seabrook* 437 (F,G), *G.J. Keighery* 1905 (H), *G.J. Keighery* 3307 (I) and *A.S. George* 11610 (J-L).

inland variant - known only from Beaufort River (*G.J. Keighery* 6291A, 6377). Partially submerged plants 30-40 mm high with firm stems 0.3-0.4 mm wide and with 2- or 3-flowered exposed spikelets present in addition to the longer basal spikelets. The nut is inconspicuously patterned with many rows of narrowly oblong cells. (Figure 21B-E)

Schoenus centralis Latz - recorded from a rocky creek bed in a valley in Rawlinson Range in the Eremaean Botanical Province. Also occurs in Northern Territory. Flowers and fruits: July. Plants commonly 110-200 mm high; stems 0.7-1.0 mm diam. A specimen from Northern Territory is *c.* 400 mm high. **Priority 1** (Latz 1979: Figure 4; Latz & Wilson 1981: Figure 635)

Schoenus discifer Tate - occurs on the margins of winter-wet depressions in the South West Botanical Province, extending around the coast from near Gingin south to Scott National Park and south-east to Albany. Also occurs in South Australia. Flowers and fruits: September-December. Plants 20-80 mm high; stems 0.5-1.1 mm wide. (Jessup & Weber 1986: Figure 939F)

Schoenus elegans S.T. Blake - habitat unknown except for one record from very shallow wet sandy soil over ironstone. Endemic to the South West Botanical Province, extending from Bayswater and Helena Valley (Perth) south to Scott River. Flowers and fruits: October-November. Plants 50-300 mm high; stems 0.5-1.5 mm diam. Some specimens lack a perianth and others have hair-like bristles which may be very short or about half as long as the nut. Most plants are 150-300 mm high but plants collected from Scott River (*G.J. Keighery* 1905) are only *c.* 55 mm high. (Figure 21F-H)

Schoenus humilis Benth. - endemic to the South West Botanical Province, occurring in a variety of damp habitats including the margins of watercourses and lakes and on granite. Extends from Dirk Hartog Island and Moorarie Station (upper Murchison River) south-east to near Stirling Range and Ponier Rock (south of Balladonia). Flowers and fruits: August-November. Plants 30-200 mm high; stems 0.5-1.4 mm wide. Very variable in habit, varying from large specimens with many spikelets borne singly or in small clusters along the stems (e.g. *G.J. Keighery* 3307) to very small specimens with basal spikelets and a cluster of terminal spikelets as in a specimen from a salt lake on Dirk Hartog Island (*A.S. George* 11610). A specimen from Wattle Grove (*R. Coveny* 8261) has unusually large glumes. (Figure 21I-L)

Schoenus nanus (Nees) Benth. - occurs commonly in clay soils in winter-wet depressions towards the coast, but more commonly on granite outcrops or sheets inland. Widespread in the South West Botanical Province, from Kalbarri National Park to the south coast and south-west to Mt Burdett, also extending inland to Yellowdine (east of Southern Cross), near Lake Cowan and Boingaring Rock (west of Balladonia) in the South-western Interzone. Also occurs in South Australia and Victoria. Flowers and fruits: August-November. Plants 10-80 mm high; stems 0.2-0.4 mm diam. *Chaetospora nana* Nees (Jessop & Weber 1986: Figure 939J; Wilson 1994: Figure 53j)

Schoenus natans (F. Muell.) Benth. - endemic to the South West Botanical Province, aquatic, fully submerged in small pools in seasonally wet flats or larger swamps, extending along the coastal plain from near Gingin south to Ludlow and inland to swamps near the upper reaches of Helena and Darkin Rivers and on Collie Plain. Flowers and fruits: August-November. Plants with very slender lax stems and leaves 75-250 mm long; stems *c.* 0.1 mm diam. *Chaetospora natans* F. Muell. **Declared Rare** (Figure 22A-C)

Schoenus odontocarpus F. Muell. - occurs mainly on granite outcrops or slabs inland and in winter-wet depressions on the coastal plain. Endemic to the south-west of Western Australia, occurring in the South West Botanical Province from Gillingarra south to Wicher Range and Albany, south-east to Howick Hill, and east (inland) to Wallaroo Rock in the South-western Interzone. Flowers and fruits: August-November. Plants 20-95 mm high; stems 0.15-0.3 mm diam. (Rye 1997: Figure 1D,E)

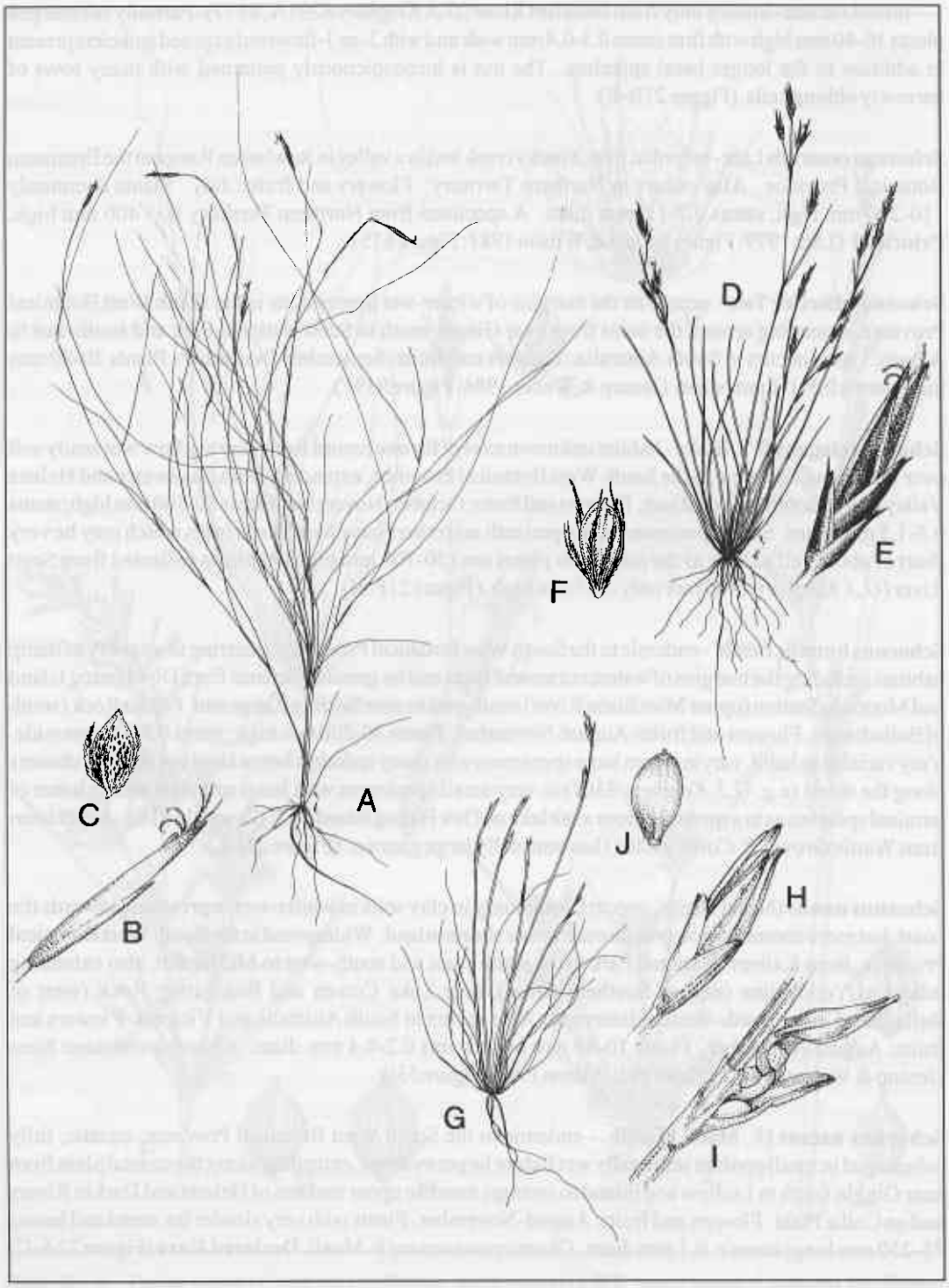

Figure 22. A-C *Schoenus natans* A - whole plant (x1), B - spikelet (x8), C - nut with perianth segments (x10); D-F *Schoenus pennisetis* D - whole plant (x1), E - spikelet (x8), F - nut with perianth segments (x10); G-J *Schoenus tenellus* G - whole plant (x1), H - fruiting spikelet (x8), I - fruiting axis (x8), J - nut (x14). Drawn from *B.J. Keighery & N. Gibson* 015 (A,B), *B.J. Keighery & N. Gibson* 019 (C), *G.J. Keighery* 9183 (D,E), *A. Kelly & A. Spooner* 90/116 (F), *G.J. Keighery* 3594 (G) and *H. Butler* Oct. 1948 (H-J).

Schoenus pennisetis S.T. Blake - endemic to the South West Botanical Province, recorded from Wongan Hills and from sandy clay in winter-wet depressions on the eastern side of the coastal plain in Perth suburbs and near Ruabon (south of Capel). Flowers and fruits: August-December. Plants 70-130 mm high; stems 0.2-0.4 mm diam. **Priority 1** (Figure 22D-F)

Schoenus plumosus Rye - occurs on the margins of winter-wet depressions and watercourses and in other damp habitats. Endemic to the South West Botanical Province, extending from Lake Indoon south to near Capel and south-east to Albany. Flowers and fruits: September-November. Plants 70-180 mm high; stems 0.5-1.2 mm diam. (Rye 1997: Figure 1J-M)

Schoenus sculptus (Nees) Boeck. - occurs in the South West Botanical Province from near Geraldton south to near Mandurah and south-east to Recherche Archipelago. Recorded mainly in winter-wet depressions in the western part of its range from Howatharra Hill Reserve south to Mandurah and inland to Meenaar. Recorded on granite, low-lying flats and salt lake margins in the eastern area from Lake King east to Recherche Archipelago. Also occurs in South Australia and Victoria. Flowers and fruits: September-November. Plants 20-100 mm high; stems 0.4-0.9 mm diam. The western specimens are larger and apparently more erect than the eastern specimens. *Elynanthus sculptus* Nees (Jessop & Weber 1986: Figure 939M; Wilson 1994: Figure 53k)

Schoenus tenellus Benth. - endemic to the South West Botanical Province, usually partially submerged near the margins of pools on claypans, also recorded from one sandy swamp. Extends from Upper Swan south to Scott River and south-east to Albany. Flowers and fruits: September-December. Plants 35-110 mm high; stems 0.2-0.4 mm diam. *Schoenus fluitans* var. *tenellus* (Benth.) Kük. (Figure 22G-J)

Schoenus variicellae Rye - occurs mainly in clay soils in winter-wet depressions or associated with laterite or granite. Endemic to Western Australia, occurring mainly in the South West Botanical Province from Kalbarri National Park south to the Scott River area and Perup River, also extending inland to Koonmara Station in the Eremaean Botanical Province and to Walling Rock Station in the South-western Interzone. Flowers and fruits: August-November. Plants 30-160 mm high; stems 0.3-0.4 mm diam. A variant from the southern part of the species range has shorter anthers than the typical variant. (Rye 1997: Figure 1G-I)

Schoenus sp. **Beaufort** (*G.J. Keighery* 6291B) - endemic to the South West Botanical Province, semi-aquatic, known from a single collection, in a winter-wet claypan near Beaufort River, north of Kojonup. Flowers and fruits: October. Plants *c.* 40 mm high; stems 0.2-0.3 mm diam. **Priority 1**

Schoenus sp. **Bullsbrook** (*J.J. Alford* 915) - endemic to the South West Botanical Province, known from a single collection from sandy soil over clay, in a winter-wet depression, on a nature reserve near Bullsbrook, north of Perth. Flowers and fruits: October-November. Plants *c.* 140 mm high; stems *c.* 0.7 mm diam. **Priority 2**

Schoenus sp. **Harrismith** (*G.J. Keighery* 6475) - endemic to the South West Botanical Province, known from a single collection from a winter-wet flat near Harrismith. Flowers and fruits: October. Plants *c.* 120 mm high; stems 0.8-1.2 mm diam. **Priority 1**

Schoenus sp. **Jindong** (*R.D. Royce* 2485) - endemic to the South West Botanical Province, known from a single collection from the bank of a stream at Jindong, south of Busselton. Flowers and fruits: October-November. Plants *c.* 100 mm high; stems *c.* 0.8 mm diam. **Priority 1**

Schoenus sp. **Kalbarri** (*K.R. Newbey* 9352) - recorded from sandy soil along drainage lines or watercourses. Endemic to Western Australia, known from a single collection from Kalbarri National Park in the north of the South West Botanical Province. Another specimen possibly belonging to the same species is from Mt Augustus in the Eremaean Botanical Province. The Mt Augustus specimen (*K.R. Newbey* 11692) shows a number of differences in overall appearance, glumes and patterning on the nut surface but appears to occur in the same habitat. Flowers and fruits: August-October. Plants *c.* 90 mm high; stems *c.* 1 mm diam. Apparently related to *Schoenus elegans.* **Priority 2**

Schoenus sp. **Waroona** (*G.J. Keighery* 12235) - endemic to the South West Botanical Province, extending from eastern suburbs of Perth south to near Harvey. Occurs in clay or sandy clay on winter-wet flats on the eastern side of the coastal plain. Flowers and fruits: October-November. Plants 15-30 mm high; stems 0.35-0.6 mm wide. Closely related to *S. discifer* and *S. tenellus* but a smaller plant than both these species and with shorter anthers. **Priority 3**

Discussion

Of all the genera included here, only *Bulbostylis* and *Lipocarpha* are fully covered for Western Australia. The other genera have perennial members and some also have annual members from the Kimberley Region that do not extend into the study area. Some small perennial species, such as *Eleocharis pusilla* R. Br. and *Schoenus latitans* S.T. Blake, could easily be mistaken for annual species, but true annuals can generally be distinguished readily by their shallow multi-rooted base with no rhizome or bulbs. Most perennial species have a short to long rhizome connecting the densely clustered to scattered bases of the stems.

There is some overlap between the annuals and perennials as a few species appear to vary in lifeform according to the environmental conditions or according to their variant. For example, *Cyperus rigidellus*, *Eleocharis geniculata* and four of the *Isolepis* species (*I. cernua, I. cyperoides, I. oldfieldiana* and *I. setiformis*) appear to be perennial more often than annual. *Cyperus polystachyos* Rottb. is often described as being either annual or perennial, but is usually a robust perennial. This species is native in the Kimberley Region and other tropical or subtropical areas and has become naturalized in the South West Botanical Province, recorded from lawns, drains, swamps and other damp habitats in the Perth and Bunbury areas. It was not included here because all the naturalized specimens examined were perennial.

It is unlikely that all annual taxa occurring in the study area have been covered here. Some Western Australian species presently known only in the Kimberley Region might eventually be collected further south, and some new taxa may still be awaiting discovery. A possible new species in *Fimbristylis* is the southernmost specimen (*E.M. Mattiske & D. True* 12/105) of those included under *F. depauperata,* which is quite atypical. This taxon is known from incomplete material and could possibly be perennial.

Five named Western Australian endemics (*Bulbostylis burbidgeae, Schoenus badius, S. capillifolius, S. natans* and *S. pennisetis*) and all of the taxa known by phrase names are currently included on the Declared Rare and Priority Flora List. In view of the usually wide distributions of other members of the family, it is likely that additional populations of at least some of these taxa will be discovered over fairly wide distributions. The small inconspicuous nature of these plants would certainly have contributed to the paucity of collections, although there is no doubt that they are much rarer than their frequently collected relatives. It is intended that, as the new taxa become known from multiple collections, they will be described and illustrated.

Acknowledgements

I would like to thank Karen Wilson for taxonomic advice on the Cyperaceae and Amanda Spooner and Terena Lally for assistance with preparing distribution maps. The line illustrations were drawn by Margaret Pieroni.

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