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An atlas of inflorescences, culm morphology and anatomy of Restionaceae in New South Wales, Australia

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Abstract

Restionaceae (Poales) are difficult to identify when plants are not fertile. Even when flowering, the accurate identification of Restionaceae remains difficult, especially for non-specialists. Several factors contribute to this challenge, including the dioecious nature of many species, pronounced sexual dimorphism, complex inflorescence structures, and the small size of flowers in some taxa. These morphological characteristics complicate both field and herbarium identification, requiring specialized knowledge and careful observation. Comparative culm morphology and anatomy of male and female plants of all 27 species of the family that occur in New South Wales, Australia were examined and imaged using scanning electron microscopy (SEM; JEOL JSM-6010LV) and light microscopy (LM; Nikon SMZ25 motorised stereomicroscope and Nikon 90i motorised compound microscope) to explore their utility for identification. This study, using SEM, includes observations on features not covered by earlier investigations of stem morphology in Restionaceae, providing valuable insights into the structural differences between species. By clearly highlighting these morphological distinctions, the findings contribute to a better understanding of the family and aid in the identification of its diverse species in New South Wales. Images are presented for each species that demonstrate that culm morphology (including epidermis micromorphology) and anatomy enabled the identification of Restionaceae specimens to genus in all cases, and to species in almost all cases. There were no major differences in the culm anatomy and morphology between male and female plants, except in *Baloskion longipes*. However, in most species, the dried culms of female plants had a more intense colour than those of the male plants. To complement the atlas, a novel character list and an associated Intkey dataset for interactive identification are presented. To complement the atlas, a novel character list and an associated Intkey dataset for interactive identification are presented.

Introduction

Restionaceae are primarily native to the southern hemisphere, with most occurring in southern Africa and temperate Australasia. As well as the many South African species, members of the family are native to southwest and southeast of Australia, with a few species in northern Australia, New Zealand, Madagascar, Southern America (coastal Chile) and from Malesia to Hainan Island (Meney and Dixon 1995; Linder *et al*. 1998; Linder 2000; Briggs 2001; Briggs *et al*. 2014; Clarke 2015). Restionaceae are commonly referred to as 'restios' and 'restiads' (Meney and Dixon 1995; Meney *et al*. 1999; Dorrat-Haaksma and Linder 2012), or occasionally as 'southern rushes' (Meney *et al*. 1999).

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Restionaceae are perennial rush-like flowering monocots, with leaves reduced to sheaths in adult plants (Linder *et al.* 1998; Meney *et al.* 1999; Linder 2000; Dorrat-Haaksma and Linder 2012; Briggs *et al.* 2014). They have many morphological similarities to grasses (Poaceae), including the arrangement of flowers in spikelets (an axis with sessile axillary flowers). However, Restionaceae are distinguished by the specific features of their inflorescences, such as often being dioecious (with separate male and female plants), flowers with a distinct perianth composed of two whorls arranged in 3+3 or 2+2 patterns, their flowers lacking specialized structures like the lemma and palea seen in Poaceae spikelets, and with reduced leaves (Linder *et al.* 1998; Pate and Meney 1999; Grass Phylogeny Working Group *et al.* 2001; Clarke 2015). They are also similar to Cyperaceae but are distinguished by open (Restionaceae) versus closed (Cyperaceae) leaf sheaths (Meney *et al.* 1999).

Publications on Australian Restionaceae by Brown (1810), Bentham (1878) and Mueller (1873) had been the main treatments for Restionaceae for more than 100 years (Briggs and Johnson 1999). Numerous more recent publications have focused on revised generic and species taxonomy of Restionaceae based on morphology, including Meney *et al.* (1996), de Lange *et al.* (1999), Linder (2001), Briggs and Johnson (2001b, 2004b), Briggs (2012) Linder and Helme (2015). Linder (1990), Linder and Vlok (1991) and Briggs and Johnson (2001a) used morphology and anatomy to distinguish species of *Rhodocoma* Nees, *Thamnochortus* P.J.Bergius and *Desmocladus* Nees, respectively. Cutler (1969), Linder (2000), Linder *et al.* (2003) and Briggs *et al.* (2014) made comparisons between African and Australian Restionaceae. Fomichev *et al.* (2019) investigated the morphology and development of female flowers in early-diverging dithecal restiids, including the genera *Anarthria* R.Br., *Lyginia* R.Br., and *Hopkinsia* W.Fitzg. Utilizing scanning electron microscopy, the study emphasized gynoecium reduction and floral anatomy, providing valuable insights into morphological traits and evolutionary pathways. However, its taxonomic implications were largely confined to molecular-based phylogenetic relationships. Fomichev *et al.* (2021) investigated the morphological diversity and molecular relationships within the *Anarthria gracilis* R.Br. complex, aiming to clarify species boundaries through microscopy and DNA analysis.

Many morphological and anatomical characteristics, especially of the culm, were used to develop the morphological phylogenies of Restionaceae (Linder 1991a; Eldenäs and Linder 2000; Linder *et al.* 2000). Briggs *et al.* (2000, 2010 and 2014), Eldenäs and Linder (2000), Briggs and Linder (2009), Wagstaff and Clarkson (2012) and Briggs *et al.* (2010, 2014) developed a molecular phylogeny to inform classification. Briggs and Johnson (2004a), Moline and Linder (2005) and Briggs (2014) also used molecular phylogeny to define new combinations of species in *Chordifex* B.G.Briggs & L.A.S.Johnson (Australia), *Elegia* L. (South Africa) and *Leptocarpus* R.Br. (Australia).

Several books have been written on Restionaceae, including 'Australian Rushes' by Meney and Pate (1999) and 'Restios of the Fynbos' by Dorrat-Haaksma and Linder (2012). Restionaceae also have dedicated treatments in several floras, textbooks and publications focused on monocots (Dahlgren *et al.* 1985; Goldberg 1989; Harden 1993; Kubitzki 1998; Judd *et al.* 1999; Wilson *et al.* 2000; Stuessy 2009). Few interactive keys have been developed for the identification of Restionaceae. Hollister and Thiele (2014) created a comprehensive interactive key for the Restionaceae of Western Australia, based on 70 characters of the culm (stem)s, rhizomes, inflorescence and fruit and an extensive set of images. Linder, at the Department of Systematic and Evolutionary Botany at the University of Zurich (see https://www.systbot.uzh.ch/en/Bestimmungsschluessel/Restionaceae.html), also created an interactive key for the African Restionaceae, based on 254 morphological, anatomical and ecological characters. Briggs (2020) provides a useful outline of Restionaceae and a comprehensive 'Flora of Australia' treatment, with comparative descriptions of the Australian genera and species of Restionaceae and a set of pseudo-interactive KeyBase keys adapted from various sources (see https://keybase.rbg.vic.gov.au/keys/show/667).

Economic importance

Certain species of Restionaceae have been used as garden ornamental plants, to build the walls of huts, in the dried flower industry and for producing brooms or building materials in some indigenous South African communities (Rourke 1974; Linder 1991b; Linder *et al.* 1998; Van Wyk and Gericke 2000; Lee *et al.* 2006; May *et al.* 2007; Dorrat-Haaksma and Linder 2012; Seaton *et al.* 2014). In Australia and New Zealand, some Restionaceae have contributed to the formation of the peat deposits that are now being exploited (Linder *et al.* 1998). If the species of Restionaceae found in a particular region are known, it is possible to determine the climate and soil moisture conditions of that region, as the species have very particular ecological requirements (Dorrat-Haaksma and Linder 2012).

Classification and phylogeny of Restionaceae

The classification of the Australasian Restionaceae has received considerable attention over the last six decades (see Chanda 1966; Johnson and Cutler 1973; Meney *et al.* 1996; Briggs and Johnson 1998, 1999, 2001a, 2001b, 2004a, 2004b; Briggs and Linder 2009; Briggs 2012, 2014; Briggs and Johnson 2014; Briggs *et al.* 2010, 2014; Givnish *et al.* 2018; Fomichev *et al.* 2021). Restionaceae, along with Anarthriaceae and Centrolepidaceae, constitute the restiid clade (Linder and Rudall, 2005; Briggs and Linder 2009). The restiid clade is a sister to the graminid clade, which comprises Joinvilleaceae, Flagellariaceae, Poaceae and Ecdeiocoleaceae (Linder and Rudall 2005; Briggs *et al.* 2010; Givnish *et al.* 2018). Sporadanthoideae, Restionoideae and Leptocarpoideae (Briggs and Linder 2009) are recognised as subfamilies within Restionaceae, which further was enlarged to include Centrolepidaceae based on well-supported clades from analysis of chloroplast DNA (Briggs *et al.* 2014). However, evidence from nuclear genes in the Genomics of Australian Plants (GAP) project supports the maintenance of Centrolepidaceae separate from Restionaceae (M.D. Barrett, pers. comm.). Hereafter, Restionaceae refer to the family without Centrolepidoideae. Anarthriaceae are considered a subfamily of Restionaceae by The Angiosperm Phylogeny Group (2016), and as a separate plant family, sister to Restionaceae, by others (e.g., Briggs and Linder 2009; Briggs *et al.* 2014).

Sporadanthoideae consists of three genera (*Calorophus* Labill., *Sporadanthus* F.Muell. and *Lepyrodia* R.Br.) and about 32 species, Leptocarpoideae includes c. 28 genera and more than 100

species. Restionoideae, the largest subfamily, has c. 17 genera and c. 350 species (Briggs and Linder 2009; Briggs *et al.* 2014; Clarke 2015). Most NSW genera of Restionaceae are classified as Leptocarpoideae except *Sporadanthus and Lepyrodia* (Briggs *et al.* 2014). The number of accepted genera and species varies due to taxonomic revision in accord with phylogenetic findings and the description of new species (Table 1).

Over the last 30 years, 16 new genera of Restionaceae have been described for Australia (Briggs and Johnson 1998), and more than 47 species (Briggs and Johnson 1998, 2001a, 2001b; Linder 2001; Briggs and Johnson 2004a, 2004b; Briggs 2012, 2014; Briggs and Johnson 2014). The majority of new genera and species described are from Western Australia, with only one genus (Briggs and Johnson 1998) and five species from Eastern Australia (Briggs and Johnson 2004a; Briggs 2012). Briggs (2012) also referred to putative hybrids in *Lepyrodia* in eastern Australia.

Table 1. Comparison of number and distribution of Restionaceae (excluding Centrolepidaceae and Anarthriaceae).

	Distribution	Linder *et al.* (1998)	Meney *et al.* (1999)	Dorrat-Haaksma and Linder (2000)	Linder (2000)	Linder *et al.* (2003)	Briggs (2004)	Dorrat-Haaksma and Linder (2012)	Briggs *et al.* (2014)	Clarke (2015)	Briggs (2020)	Quirico and Briggs (2022)
Genera	Worldwide genera (including Australian genera)	55		55	55	55		55	47 reduced to 42	30(–50)	c. 45	40
	Australian genera						31				29	24
Species	Species	490	>470	c. 486	490	c. 500		c. 513	c. 456	c. 550	c. 530	585
	Southern Africa		>300	c. 330		c. 350		c. 357				
	Australia		170	c. 150		146	145	c. 150			160	160
	New Zealand			4				4				
	Madagascar			1				1	1	1		
	Chile			1				1	1	1		
	New Guinea								few	4		
	Aru Islands									2		
	South East Asia (Malesia to Hainan Island)			1				1	1	1		

Note: Blank cells indicate that no data were available in the literature for these entries.

Restionaceae shoot morphology

A mature Restionaceae plant consist of shoots, which include both aerial culms (both flowering and non-flowering stems), rhizomes (creeping, storage stems), roots and leaves that have reduced laminae (Pate and Meney 1999; Dorrat-Haaksma and Linder 2012; Clarke 2015). Buds that emerge from the rhizome develop into herbaceous, green, photosynthetic culms with laminae that are reduced to short appendages (Linder *et al.* 1998; Pate and Meney 1999; Linder 2000; Dorrat-Haaksma and Linder 2012; Clarke 2015). Culms have a shorter lifespan than the rhizome system on which they are borne (Pate and Meney 1999). Inflorescences are of few to many flowers, in spikelets but spikelet structure sometimes is not obvious (Kircher 1986; Pate and Meney 1999; Ronse De Craene *et al.* 2001, 2002; Briggs, 2024).

African Restionaceae culms range in length, from 10 to 300 cm (Dorrat-Haaksma and Linder 2012), while Australian Restionaceae culms can range from 5 to 400 cm long (Conn BJ 1994; Meney *et al.* 1999). Culm diameter ranges about from 0.5 to 5 mm for Australian species (Harden 1993; Meney *et al.* 1999). Culm length and diameter can be useful for identification and classification (Linder and Vlok 1991). Each species may also have few- or multi-internode culms. The longest internodes of the culm can often be found in the mid-regions of multi-nodal species (Pate and Meney 1999). However, in some species of *Alexgeorgea* Carlquist, *Desmocladus* and *Chordifex*, the lowest internode is uncharacteristically slender and long (Pate and Meney 1999).

The portion of the aerial shoot below the inflorescence can be unbranched or branched, sometimes forming superficially verticillate dense groups of lateral shoots (Linder *et al.* 1998; Clarke 2015). Branched culms are characteristic of several genera, e.g. *Alexgeorgea*, *Desmocladus*, *Empodisma* L.A.S.Johnson & D.F.Cutler and *Hypolaena* R.Br., while simple culms are characteristic of several other genera, e.g. *Coleocarya* S.T.Blake, the vast majority of species in *Baloskion* Raf. and *Leptocarpus* (Linder *et al.* 2000, Meney and Pate 1999). Certain species, such as *Baloskion tetraphyllum* (Labill.) B.G.Briggs & L.A.S.Johnson, have a significant number of sterile branchlets at the nodes that enhance the photosynthetic capacity of the culms (Clarke 2015). Verticillate branches occur in several genera, e.g. *Rhodocoma*, *Desmocladus*, *Ischyrolepis* Steud. and *Elegia* (Linder *et al.* 1998).

The reduced leaves in Restionaceae have sheaths that are typically not green at maturity (Linder *et al.* 1998). Variation in leaf sheath morphology has substantial taxonomic value at the level of species and genus. Informative features of sheaths include colour, shape, texture and size, and tightness (Pate and Meney 1999).

The culms in Restionaceae are generally terete; quadrangular (four-angled) culms occur in *Lepidobolus quadratus* B.G.Briggs & L.A.S.Johnson and *Restio tetragonus* Thunb. (Linder *et al.* 1998; Dorrat-Haaksma and Linder 2012). Compressed culms have been observed in many genera (*Elegia*, *Desmocladus*, *Restio* L., *Lepyrodia*, *Platycaulos* H.P.Linder, *Hypodiscus* Nees, *Eurychorda* B.G.Briggs & L.A.S.Johnson, *Platychorda* B.G.Briggs & L.A.S.Johnson and *Tremulina* B.G.Briggs & L.A.S.Johnson); with variation in compression levels (between flat and terete) (Linder *et al.* 1998; Dorrat-Haaksma and Linder 2012).

There is considerable variation in culm epidermis micromorphology in Restionaceae with features including the presence of grooves and longitudinal ridges/ striations, tubercules/warts, pits and hairs (Linder *et al.* 1998; Pate and Meney 1999; Dorrat-Haaksma and Linder 2012; Clarke 2015). Tuberculate culms, which frequently have stomata located on the tubercles, occur in *Calopsis* Beauv. ex Juss., *Desmocladus* and *Restio* (Linder *et al.* 1998). Striations, due to various forms of culm surface, appear in both African and Australian taxa (Linder *et al.* 1998; Linder and Helme 2015). There is also considerable variation in colour and colouration; e.g. different shades of green (Meney *et al.* 1999; Clarke 2015) and marbling (Pate and Meney 1999).

The diversity of culm morphology in Restionaceae can be useful as the first step in the identification of plants at the genus level (Dorrat-Haaksma and Linder 2012). The shape, size and texture of the culm have been used to identify certain species in various identification tools (PlantNET; Quirico and Briggs 1993; Meney *et al.* 1999; Briggs 2014; Hollister and Thiele 2014; Clarke 2015). For example, *Lepyrodia leptocaulis* L.A.S.Johnson & O.D.Evans can be differentiated from other species of *Lepyrodia* based on culm height, width and texture (Quirico and Briggs 1993). Plants of *Lepyrodia verruculosa* B.G.Briggs & L.A.S.Johnson can be identified based on culm cross-section shape (flattened or elliptical) and surface (tuberculate surface when dried), whereas *Lepyrodia oligocolea* B.G.Briggs & L.A.S.Johnson has almost the same culm shape as *L. verruculosa* but *L. oligocolea* can be distinguished by its smooth to slightly rugose culm surface (Briggs 2012).

Despite such distinctive attributes of the culm (Linder *et al.* 1998), its characters generally have been underutilised in the identification of Restionaceae and for comparison of species, although Briggs (2012) compared culm features in three species of *Lepyrodia*.

Restionaceae culm anatomy

Major studies of culm anatomy in Restionaceae include Cutler (1969), Pate and Delfs (1999) and Linder (2000). Culm anatomy has been a useful source of data in characterising Restionaceae within Poales (Briggs *et al.* 2014). Characters include occurrence and differences in cell types, and they can be taxonomically informative in the classification and identification of genera and species (Cutler 1969, Linder *et al.* 1998; Linder 2000; Clarke 2015).

As seen in transverse sections of culms in Restionaceae, the basic structural organisation of the internodes of the culm is essentially concentric and cylindrical (Pate and Delfs 1999).

Specific terms are used for the 'unusual' cell structures and cell types in Restionaceae. Peg cells are chlorenchymatous cells that are palisade-like, with lines of projection that are peg-like and meet similar projections of the adjacent cells (Fig. 1I; Cutler 1969; Linder *et al.* 1998; Pate and Delfs 1999). pillar cells are palisade-like elongated cells of the parenchyma sheath. The cells originate from the parenchyma with lignified walls that divide the chlorenchyma into segments and extend to the epidermis (Fig. 1E) (Briggs *et al.* 2014). In the Australian genera, pillar cells are common in Leptocarpoideae (Cutler 1969; Linder *et al.* 2000; Briggs *et al.* 2014). Protective cells lignified with moderately thickened walls surround the substomatal cavity, forming a tube that extends to the chlorenchyma (Fig. 1D; Cutler 1969; Linder *et al.* 1998; Pate and Delfs 1999; Linder 2000). They are described by Linder *et al.* (1998) as modified chlorenchyma cells lining the substomatal cavity, while Pate and Delfs (1999) described them as a thick-walled type of parenchyma cell that lack chloroplasts even though the cells are derived from chlorenchyma.

In Australian Restionaceae, the epidermis is usually a single layer of cells, while there are two layers of epidermis in several genera of African Restionaceae (Linder *et al.* 1998; Pate and Delfs 1999). The epidermal cells in the culms of Restionaceae exhibit variability in shape and size across different species (Fig. 1; Linder *et al.* 1998; Pate and Delfs 1999). When the cells are variable in size within a plant, the largest cells are mostly between the stomata, next to the stomata or opposite the pillar cells (Pate and Delfs 1999).

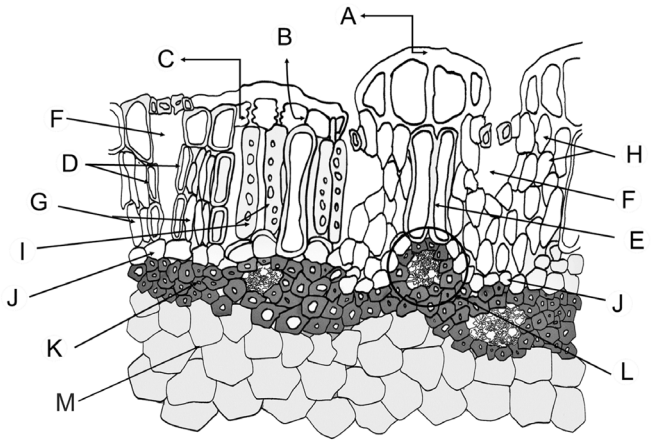

Fig. 1. Composite diagram of Restionaceae culm internode in cross-section illustrating anatomical features observed in the study group. A: outer epidermal walls. B & C: anticlinal epidermal walls either in a straight or wave form. D: protective cells. E: pillar cells. F: substomatal cavity. G, H & I: different types of chlorenchyma cells. I: pegs cells. J: parenchyma cells. K: sclerenchyma. L: sclerenchyma ridges or ribs opposite to vascular bundles. M: ground parenchyma of the pith. As this is a model, cell size may vary among species, but in all cases, cells are less than 100 µm. Modified by Ebtihal Shaldoom from a drawing by Catherine Wardrop (in Briggs *et al.* 2014, Taxon 63: 24–46).

The anticlinal walls of the epidermal cells are straight or wavy (sinuous; Fig. 1B & 1C) (Linder *et al.* 1998; Pate and Delfs 1999). Sinuous epidermal anticlinal cell walls can be seen across an entire genus or in some species of a genus (e.g., *Lepidobolus* Nees) (Pate and Delfs 1999). The anticlinal walls of the epidermis are often thickened (Linder *et al.* 1998).

The position of the stomata varies from superficial to sunken or is noticeably raised relative to the general level of the epidermis (Linder *et al.* 1998; Pate and Delfs 1999). Substomatal cavities may be present in different forms and size (Fig. 1F; Linder *et al.* 1998; Pate and Delfs 1999).

The epidermis of the culm connects directly to chlorenchyma tissue (Cutler 1969; Pate and Delfs 1999) and it consists of 1 to 4 layers of columnar cells. The chlorenchyma tissue can be formed of one type such as ('palisade-like') cells that have long axes oriented radially or irregular arranged cells (Cutler 1969; Pate and Delfs 1999). However, some species of *Lepyrodia* show two chlorenchyma forms, where an outer palisade-like layer is contrasted by an inner mesophyll-like layer made up of irregularly arranged cells with large air spaces in between (Cutler 1969; Pate and Delfs 1999). The form and number of rows of the chlorenchyma cells are taxonomically significant (Linder *et al.* 1998).

Cutler (1969) described two unusual tissue modifications that occur within the chlorenchyma zone of Restionaceae culms, namely peg cells and protective cells. In peg cells, every chlorenchyma cell initiates the growth of unique outward-extending structures called "pegs" on its anticlinal walls. Typically, each peg from a cell that interlocks perfectly with the pegs on the adjacent walls of neighbouring cells, helping to uphold structural rigidity as the culms dry out (Pate and Delfs 1999). Peg cells (Fig. 1) are typical for most genera, but they are not found in certain species of *Alexgeorgea, Dapsilanthus* B.G.Briggs & L.A.S.Johnson, *Hypolaena* and *Sporadanthus* (Pate and Delfs 1999). Protective cells may present in the lining of the substomatal cavity (Cutler 1969; Linder *et al.* 1998; Pate and Delfs 1999). Variation in protective cells, characteristic of different African genera, includes differences in development, lignification, and structural organization, such as the formation of strengthened basket-like arrangements (Linder *et al.* 1998).

Protective cells are found in about a quarter of Australian genera (common in Sporadanthoideae) and universally in the African genera of Restionaceae (Pate and Delfs 1999; Linder *et al.* 2000; Briggs *et al.* 2014). Protective cells and pillar cells are valuable anatomical features for the identification of Restionaceae (Pate and Delfs 1999; Briggs *et al.* 2014). The chlorenchyma is separated from a sclerenchyma ring by 2–5 layers of parenchyma cells (Fig. 1J; Cutler 1969; Linder *et al.* 1998; Pate and Delfs 1999). The parenchyma pillar cells may divide the chlorenchyma into segments (Cutler 1969; Meney and Pate 1999; Briggs *et al.* 2014).

The number of layers of sclerenchyma fibres is variable (Fig. 1K; Pate and Delfs 1999) and it may have girders. Girders are ridges of the sclerenchyma that are located alternate with or opposite small vascular bundles and extend from the sclerenchyma sheath to the chlorenchyma (Fig. 1L; Cutler and Shaw 1965; Linder *et al.* 1998; Pate and Delfs 1999; Linder 2000). In species with longitudinally striate culms, sclerenchyma ridges may reach the epidermis in some species such as *Anthochortus* Endl., *Hypodiscus* and *Willdenowia* Thunb. (Cutler 1969; Linder *et al.* 1998). The vascular bundles in Restionaceae are typically 'grass type' which is characteristic of monocotyledons. This means they are closed (lacking cambium) and scattered throughout the culm rather than arranged in a ring (Cutler 1969). The centre of the culm can be hollow or solid (Linder *et al.* 1998; Pate and Delfs 1999). In species with solid culms, these vascular bundles are distributed throughout the entire cross-section, including the pith (medulla) of the culm (Pate and Delfs 1999). whereas, species with hollow culms, the smallest bundles are located near (adherent) or embedded within the sclerenchyma ring, while the largest bundles are found close to the pith (Linder *et al.* 1998; Pate and Delfs 1999). Further, hollow culms can contain single or multiple cavities, which can be either circular or triangular in shape as seen in *Sporadanthus* (Meney *et al.* 1999).

Silica is found in the culms of Restionaceae either as sand or as crystals. The "sand" form, consisting of small, non-crystalline silica (amorphous silica) particles dispersed throughout the culm tissues, and the "crystals", larger, structured silica deposits with defined shapes, are not just different in their physical properties. They also highlight the diversity of culm structures, as silica can be deposited in various tissues (Cutler 1969; Linder *et al.* 1998). For example, silica can be in the epidermis (e.g., *Lepyrodia*), or parenchyma (e.g., *Ischyrolepis*). It can also be found as sand in the pith of sclerenchyma cells (Linder *et al.* 1998). Silica bodies may almost completely fill the parenchyma cells and the outer layers of sclerenchyma cells (Linder *et al.* 1998) (for more information about culm anatomy see Appendix 1).

Restionaceae in New South Wales

New South Wales Restionaceae, the focus of this study, include 9 genera and 27 species (Table 2; Meney *et al.* 1999; Quirico and Briggs 2022). Some of the NSW species are restricted to one Botanical Division (Table 2). Botanical Divisions of New South Wales divide the region into main divisions based on physiographic and climatic characteristics, including temperature, rainfall, soil type, and elevation (Anderson 1961; Harden 1993). They are useful for communicating plant distributions and have been used to evaluate the regional impacts on biodiversity (Anderson 1961; Harden 1993; Downey *et al.* 2010).

Aims

Many botanists, ecologists, land managers (including farmers and government agencies), and plant enthusiasts find it difficult to identify Restionaceae. Sterile plants usually present further challenges. If a means to facilitate identifying Restionaceae to species from culms alone could be developed, it could provide a valuable solution to these difficulties and challenges. This project is focused only on Restionaceae of New South Wales to provide a "proof of concept" that reliable and relatively tractable means of identification in Restionaceae is possible from morphology and anatomy alone. If this is the case, it will open the opportunity to extend the approach to the family. Therefore, we aim to:

- build an atlas of culm morphology (including epidermis micromorphology) and anatomy for all species of Restionaceae of New South Wales;
- provide species-level identification based on at least matching of images of culm surface and in transverse section of New South Wales Restionaceae species;
- explore whether there are morphological or anatomical differences between males and females of Restionaceae of New South Wales that can further aid their identification.

Table 2. Distribution of Restionaceae occurring in New South Wales based on State and Botanical Divisions within NSW. CC = Central Coast; CT = Central Tablelands; CWS = Central-West Slopes; NC = North Coast; NT = Northern Tablelands; NWS = North-West Slopes; SC = South Coast; ST = Southern Tablelands (Source: PlantNET 2021). Australian states: New South Wales = NSW; Victoria = VIC; Queensland = QLD; Western Australia = WA; South Australia = SA; Tasmania = TAS. Herbarium Code: AVH = Australasian Virtual Herbarium; NE = NCW Beadle Herbarium; NSW = National Herbarium of New South Wales.

No.	Species	Outside NSW	Within NSW			
		based on AVH	Subdivisions based on Meney *et al.* (1999)	Subdivisions represented in NE	Subdivisions based on PlantNET	Subdivisions based on AVH
1	*Baloskion australe* (R.Br.) B.G.Briggs & L.A.S.Johnson	TAS, VIC	CT, ST	CT, ST	CT, ST	CC, CT, SC, ST
2	*Baloskion fimbriatum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson	QLD	CC, SC, ST	CT, NC, NT	CC, CT, NT, SC, ST	CC, CT, NC, NT, SC, ST
3	*Baloskion gracile* (R.Br.) B.G.Briggs & L.A.S.Johnson	-	CC, CT, SC	CC, CT, NT	CC, CT, SC	CC, CT, SC, ST
4	*Baloskion longipes* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson	-	ST	ST	CT, ST	CT, ST
5	*Baloskion pallens* (R.Br.) B.G.Briggs & L.A.S.Johnson	QLD	CC, NC	CC, NC	CC, NC	CC, NC, NT
6	*Baloskion stenocoleum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson	QLD	NT	NT	CT, NC, NT	CT, NC, NT
7	*Baloskion tenuiculme* (S.T.Blake) B.G.Briggs & L.A.S.Johnson	QLD	NC	NC	NC	NC, NT
8	*Baloskion tetraphyllum* subsp. *meiostachyum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson	QLD	CC, NC, SC	CC, NC	CC, NC, SC	CC, NC, SC
9	*Baloskion tetraphyllum* subsp. *tetraphyllum* (Labill.) B.G.Briggs & L.A.S.Johnson	SA, TAS, VIC	* CC, NC, SC	-	SC	* CC, NC, SC
10	*Chordifex dimorphus* (R.Br.) B.G.Briggs	-	-	CC	CC	CC
11	*Chordifex fastigiatus* (R.Br.) B.G.Briggs	QLD	-	CC, CT	CC, CT, SC, ST	CC, CT, SC, ST
12	*Coleocarya gracilis* S.T.Blake	QLD	NC	NC	CC, NC	CC, NC
13	*Empodisma minus* (Hook.f.) L.A.S.Johnson & D.F.Cutler	QLD, SA, TAS, VIC	Widely distributed?	NC, NT, SC	CC, CT, NC, NT, SC, ST	CC, CT, NC, NT, SC, ST
14	*Eurychorda complanata* (R.Br.) B.G.Briggs & L.A.S.Johnson	QLD, SA, TAS, VIC	Widely distributed?	CC, NC	CC, CT, NC, SC	CC, CT, NC, SC
15	*Hypolaena fastigiata* R.Br.	QLD, SA, TAS, VIC, WA	Widely distributed?	CC, NC	CC, CT, NC, SC	CC, NC, SC
16	*Leptocarpus tenax* (Labill.) R.Br.	QLD, SA, TAS, VIC, WA	-	CC, NC	CC, CT, NC, NT, SC, ST	CC, CT, NC, NT, SC, ST
17	*Lepyrodia anarthria* F.Muell. ex Benth.	VIC	CC, NT, SC	NC, NT	CC, CT, NT, SC, ST	CC, CT, NT, SC, ST
18	*Lepyrodia cryptica* B.G.Briggs & L.A.S.Johnson	-	CC, CT, ST	CC, CT	CC, CT, ST	CC, CT, ST
19	*Lepyrodia imitans* B.G.Briggs & L.A.S.Johnson	QLD	NC	NC	NC	NC
20	*Lepyrodia leptocaulis* L.A.S.Johnson & O.D.Evans		CWS, NC, NT	NT, NWS	CWS, NC, NT, NWS	CWS, NC, NT, NWS
21	*Lepyrodia muelleri* Benth.	SA, TAS, VIC	CC, CT, NC, SC	CC, NC	CC, CT, NC, SC	CC, CT, NC, SC, ST
22	*Lepyrodia oligocolea* B.G.Briggs & L.A.S.Johnson	-	-	NC, NT	NT	NT

No.	Species	Outside NSW	Within NSW			
		based on AVH	Subdivisions based on Meney *et al.* (1999)	Subdivisions represented in NE	Subdivisions based on PlantNET	Subdivisions based on AVH
23	*Lepyrodia scariosa* R.Br.	QLD	CC, CT, NC, NT, SC, ST	CC, CT, NC	CC, CT, NC, NT, SC, ST	CC, CT, NC, NT, SC, ST
24	*Lepyrodia verruculosa* B.G.Briggs & L.A.S.Johnson	-	-	-	CC, SC, ST	CC, CT, SC, ST
25	*Sporadanthus caudatus* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson	QLD	NC	NC	NC	NC
26	*Sporadanthus gracilis* (R.Br.) B.G.Briggs & L.A.S.Johnson	-	CC, CT, ST	CC, CT	CC, SC, CT, ST	CC, SC, CT, ST
27	*Sporadanthus interruptus* (F.Muell.) B.G.Briggs & L.A.S.Johnson	QLD	NC	NC	NC	NC, CC

* Reported occurrences of *Baloskion tetraphyllum* subsp. *tetraphyllum* in NC and SC are thought to be misidentifications. Dash (-) means absent from region(s).

Materials and Methods

Study area

This study focuses on Restionaceae of New South Wales, which are mostly found on and to the east of the Great Divide (Fig. 2).

Study material

All available specimens at NE were examined in detail. The determination of each specimen examined at NE and at NSW were checked using PlantNET (2020). Initially, 54 specimens were selected and used for morphological and anatomical observation and analysis from NE, included eight additional specimens from NSW to fill gaps at NE (Table 3). Specimens were sampled on the basis that there was sufficient material for destructive sampling and the specimen identification could reliably be checked against the key and descriptions on PlantNET (2020). Both male and female plants of a single species were sampled to see whether there were any vegetative morphological differences between them. Where morphological differences were found between the male and female plants, 3–5 more specimens from NE and NSW were examined to investigate whether these features were constant for the male and female plants respectively.

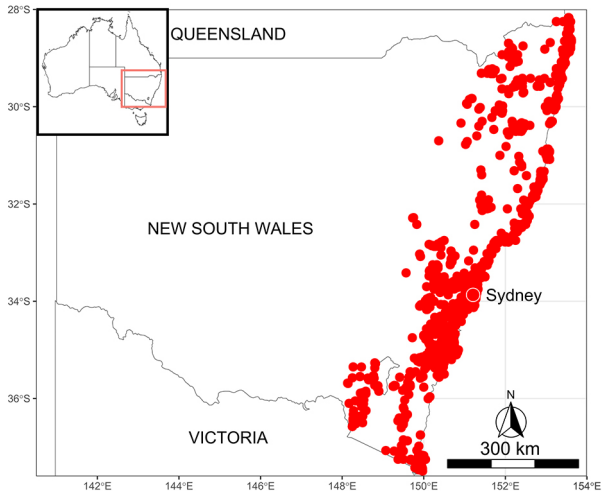

Fig. 2. Distribution of New South Wales Restionaceae. The red dots indicate the distribution of the native species. Retrieved from AVH, 15 Mar. 2024.

To examine variation in morphology between fresh and dried culm, new gatherings were made (vouchers and fresh culms for observation and analysis) of three morphologically diverse species of Restionaceae from one site on the Northern Tablelands of New South Wales (Table 3).

Sample Preparation

The mid-third of the culm was examined. For each specimen, 1–2 cm of the culm, up to half its diameter, was removed using half a double-sided razor blade, in a manner that some of the remaining portion of the culm below the sample remained connected with the intact culm above and below the sample. This approach caused minimal damage to the specimen and had the advantage that the gross anatomy of the culm was revealed on the specimen, making this 'window' into the culm available to subsequent viewers of the specimen.

Each portion of culm removed was trimmed so that the proximal end had a straight, perpendicular cut, and a rounded distal end, to allow consistent orientation of samples during sectioning and imaging. A portion of each sample was mounted on 12 mm diameter double-sided carbon tabs on 12.5 mm diameter Cambridge aluminium SEM stubs for examination first using a photomicroscope and then under a scanning electron microscope after sputter coating. A second portion of each sample was placed (1–2 cm portion of culm) in a small beaker in just boiled water with a drop of detergent, covered and left to rehydrate for 15 min. Using the rehydrated portions, thin hand-cut transverse sections were produced using one side of a double-sided razor blade for examination using a Leica MZ75 stereomicroscope (Leica Microsystems, Wetzlar, Germany).

Table 3. Examined specimens of Restionaceae of New South Wales. NE = NCW Beadle Herbarium; NSW = National Herbarium of New South Wales. F = female; M = male; * = sterile. Only the first collector given.

No.	Species	Voucher	Herbarium Code	Accession no.	Sex
1	*Baloskion australe*	*C.J. Skewes s.n.*, Jan. 1954	NE	29647	M
2	*Baloskion australe*	*E.F. Constable s.n.*, 21 Nov. 1961	NE	29646	F
3	*Baloskion australe*	*E.F. Constable s.n.*, 26 Nov. 1962	NE	29644	M
4	*Baloskion australe*	*E.F. Constable s.n.*, 7 Mar. 1961	NE	22688	F
5	*Baloskion fimbriatum*	*E.F. Constable s.n.*, 19 Jan. 1961	NE	29623	F
6	*Baloskion fimbriatum*	*K.A. McColl 2998*, 22 Jan. 1998	NE	68236	M
7	*Baloskion fimbriatum*	*T.H. Shaldoom 21*, 16 Nov. 2020	NE	111289	*
8	*Baloskion gracile*	*O.D. Evans s.n.*, 6 Dec. 1960	NE	29626	M
9	*Baloskion gracile*	*O.D. Evans s.n.*, 8 Dec. 1961	NE	71558	F
10	*Baloskion longipes*	*L.A.S. Johnson s.n.*, 8 Dec. 1968	NSW	112623	F
11	*Baloskion longipes*	*M. Gray 5665*, 14 Jan. 1965	NSW	77833	M
12	*Baloskion longipes*	*M.E. Phillips s.n.*, 18 Apr. 1961	NSW	55207	F
13	*Baloskion longipes*	*B.M. Wiecek 485*, 22 Mar. 1993	NSW	268095	M
14	*Baloskion longipes*	*M. Gray 5664*, 14 Jan. 1965	NSW	77832	F
15	*Baloskion longipes*	*M. Gray 5665*, 14 Jan. 1965	NSW	77833	M
16	*Baloskion pallens*	*E.F. Constable s.n.*, 6 Jan. 1961	NE	29631	F
17	*Baloskion pallens*	*E.F. Constable s.n.*, 6 Jan. 1961	NE	29630	M
18	*Baloskion stenocoleum*	*J.R. Hosking 4042*, 17 Jun. 2018	NE	106521	F
19	*Baloskion stenocoleum*	*Z. Growns 3*, 22 Feb. 2014	NE	104764	M
20	*Baloskion tenuiculme*	*E.F. Constable s.n.*, 24 Oct. 1961	NE	23006	F
21	*Baloskion tenuiculme*	*E.F. Constable s.n.*, 24 Oct. 1961	NE	29617	M
22	*Baloskion tetraphyllum* subsp. *meiostachyum*	*A.W. King 55*, 1 Feb. 2007	NE	90615	M
23	*Baloskion tetraphyllum* subsp. *meiostachyum*	*D. Warman DW14*, 3 Mar. 1999	NE	107128	F
24	*Baloskion tetraphyllum* subsp. *tetraphyllum*	*A.H.S. Lucas s.n.*, Jan. 1885	NSW	47950	M
25	*Baloskion tetraphyllum* subsp. *tetraphyllum*	*R. Melville 2880*, 14 Jan. 1953	NSW	368020	F
26	*Baloskion tetraphyllum* subsp. *tetraphyllum*	*J.H. Ross 2637*, 15 Dec. 1981	NSW	368027	M
27	*Baloskion tetraphyllum* subsp. *tetraphyllum*	*J.H. Ross 2640*, 15 Dec. 1981	NSW	368024	F
28	*Chordifex dimorphus*	*J.L. Boorman s.n.*, 6 Apr. 1906	NE	3001	F
29	*Chordifex dimorphus*	*J.H. Camfield s.n.*, Nov. 1896	NE	23005	M
30	*Chordifex fastigiatus*	*J.J. Bruhl 68*, 9 Jun. 1985	NE	61132	F
31	*Chordifex fastigiatus*	*K.G. Griffiths s.n.*, 5 Oct. 1957	NE	11867	M
32	*Coleocarya gracilis*	*S.J. Griffith s.n.*, 7 May 1990	NE	53868	M & F
33	*Coleocarya gracilis*	*J.B. Williams s.n.*, 15 Sep. 1982	NE	78828	M & F
34	*Empodisma minus*	*L.M. Copeland 1159*, 18 Feb. 1999	NE	68400	F
35	*Empodisma minus*	*B.G. Briggs 10047*, 4 Dec 1909	NE	47779	M
36	*Empodisma minus*	*S.J. Griffith s.n.*, 21 Apr. 1988	NE	99425	F
37	*Empodisma minus*	*J.R. Hosking 2830*, 23 Nov. 2006	NE	94717	M
38	*Empodisma minus*	*T.H. Shaldoom 21*, 16 Nov. 2020	NE	111290	*
39	*Eurychorda complanata*	*P. Rose 65*, 3 Dec. 2008	NE	93601	F
40	*Eurychorda complanata*	*E.F. Constable s.n.*, 11 Nov. 1959	NE	29650	M
41	*Hypolaena fastigiata*	*V. Klaphake s.n.*, 20 Jan. 1998	NE	68796	F
42	*Hypolaena fastigiata*	*V. Klaphake s.n.*, 20 Jan. 1998	NE	68796	M
43	*Leptocarpus tenax*	*A. Vossen 20*, 1 Apr. 2014	NE	104918	F
44	*Leptocarpus tenax*	*A. Vossen 19*, 1 Apr. 2014	NE	104917	M
45	*Lepyrodia anarthria*	*C.E. Nano 16*, 6 Feb. 1994	NE	59154	F
46	*Lepyrodia anarthria*	*C.E. Nano 3*, 4 Jan. 1997	NE	65833	M

No.	Species	Voucher	Herbarium Code	Accession no.	Sex
47	*Lepyrodia anarthria*	*T.H. Shaldoom 23*, 16 Nov. 2020	NE	111291	*
48	*Lepyrodia cryptica*	*V. Klaphake s.n.*, 1 Jan. 1998	NE	80916	F
49	*Lepyrodia cryptica*	*V. Klaphake s.n.*, 1 Jan. 1998	NE	80917	M
50	*Lepyrodia imitans*	*S.J. Griffith s.n.*, 29 Mar. 1988	NE	47800	F
51	*Lepyrodia imitans*	*D.R. Brooks 756*, 2 Nov. 1977	NSW	267583	M
52	*Lepyrodia imitans*	*D.R. Brooks 713*, 3 May 1977	NSW	267582	F
53	*Lepyrodia imitans*	*R.G. Coveny 9358*, 1 May 1977	NSW	266641	M
54	*Lepyrodia imitans*	*R.G. Coveny 9332a*, 29 Apr. 1977	NSW	746559	F
55	*Lepyrodia imitans*	*S.J. Griffith s.n.*, 22 Mar. 1988	NE	53867	M
56	*Lepyrodia leptocaulis*	*P.I. Forster 27458*, 14 Jul. 2001	NE	81032	M & F
57	*Lepyrodia muelleri*	*B.G. Briggs s.n.*, 19 Jan. 1962	NE	29653	M
58	*Lepyrodia muelleri*	*V. Stajsic 7658*, 3 Nov. 2015	NE	109615	F
59	*Lepyrodia muelleri*	*E.F. Constable s.n.*, 4 Apr. 1962	NSW	57456	M
60	*Lepyrodia muelleri*	*E. Cheel s.n.*, 15 Nov. 1899	NSW	48179	F
61	*Lepyrodia muelleri*	*L.A.S. Johnson 9229*, 5 Feb. 1992	NSW	250721	M
62	*Lepyrodia muelleri*	*L.A.S. Johnson 9230*, 5 Feb. 1992	NSW	250726	F
63	*Lepyrodia muelleri*	*J.B. Williams s.n.*, Oct. 1962	NE	40267	M
64	*Lepyrodia oligocolea*	*P.R. Williams 293*, 22 Feb. 1995	NE	65494	F
65	*Lepyrodia oligocolea*	*J.W. Green 2399*, 13 Aug. 1960	NE	40991	M
66	Lepyrodia oligocolea	*J.B. Williams 557*, Oct. 1959	NE	40266	F
67	*Lepyrodia oligocolea*	*P.R. Williams 293*, 22 Feb. 1995	NE	65494	M
68	*Lepyrodia oligocolea*	*J.W. Green 2779*, 25 Nov. 1960	NE	13192	F
69	*Lepyrodia scariosa*	*R.A. Clarke 3*, 3 Mar. 2011	NE	103169	F
70	*Lepyrodia scariosa*	*J.J. Bruhl 42*, 7 Jun. 1985	NE	61146	M
71	*Lepyrodia verruculosa*	*L.A.S. Johnson 8787*, 27Jun. 1964	NSW	65814	F
72	*Lepyrodia verruculosa*	*E.F. Constable 6207*, 2 Nov. 1993	NSW	91259	M
73	*Sporadanthus caudatus*	*S. Krauss 68*, 14 Oct. 1962	NSW	210689	F
74	*Sporadanthus caudatus*	*E.F. Constable 3006 b*, 24 May 1962	NSW	61209	M
75	*Sporadanthus gracilis*	*B.G. Briggs 9263*, 6 May 1993	NSW	270154	F
76	*Sporadanthus gracilis*	*B.G. Briggs 10041*, 11 Nov. 2009	NSW	797402	M
77	*Sporadanthus interruptus*	*J.B. Williams s.n.*, Sep. 1963	NE	87723	F
78	*Sporadanthus interruptus*	*J.B. Williams s.n.*, 5 Aug. 1967	NE	90815	M

Staining with Phloroglucinol–HCl

A solution of phloroglucinol was prepared by dissolving 0.125 g of dry phloroglucinol in 25 ml of 50% ethanol. Culm sections were placed on a slide and mixed with a drop of phloroglucinol solution. The excess regent was then absorbed with dry filter paper. After that, 1–2 drops of 36% hydrochloric acid were added to the culm sections on the slide for 1–2 min after the appearance of a cherry colour. The HCl was then removed using filter paper. A drop of glycerol was added over the sections, and the slide was covered with a cover slip.

Microscopy and imaging

The micromorphological characteristics were observed and imaged directly on mounted specimens in Herbarium NE using a Leica Wild M8 stereomicroscope equipped with a Plan Apo 1.0× lens and a Leica IC80 HD camera (Leica Microsystems 2010, Germany). The NE specimen sheets were imaged using a Nikon D700 digital single-lens reflex (DSLR) camera (Nikon Corporation 2008 Tokyo, Japan) equipped with a Nikkor 60 mm macro lens (Nikon Corporation Tokyo, Japan; Dozier 2015) via a PC using Digicam Control v. 2.1.2.0 software which supports a range of cameras (Duka 2015). The NSW specimen sheets were imaged using a Canon EOS 70D single-lens reflex (DSLR) camera (Canon Inc. 2013) with a Canon EF 50mm f/2.5 Macro lens (Canon Inc. 2013).

Photomicrographs of the portions of culms mounted on the stubs were obtained using a Nikon SMZ25 motorised stereomicroscope (Nikon Corporation 2013 Tokyo, Japan) with an SHR Plan Apo 1.0× lens (Nikon Corporation 2012 Tokyo, Japan) and the NIS-Element AR software (Nikon Corporation 2013 Tokyo, Japan) using Z-stack acquisition under bright field illumination. For SEM, the sections on the stubs were first sputter-coated with gold for three min before rotating them by 180° and coating them for another 3 min with a JEOL NeoCoater MP-19020NCTR (JEOL

Ltd. 2010 Tokyo, Japan). Coated specimens were examined using a JEOL SEM JSM-6010LV at 10 kV (JEOL Ltd. 2010 Tokyo, Japan; Plunkett *et al.* 2009). The distal (rounded) end was on the left side of the culm in the images, while the proximal (straight-cut) end was on the right side of the images in both stereomicroscope (SMZ25) and SEM (JEOL NeoCoater MP-19020NCTR).

Transverse section images of the culms were then obtained with a Nikon 90i motorised compound microscope, with a 2× and 20× objective and NIS-Element AR software (Nikon Corporation 2013 Tokyo, Japan), using Z-stack acquisition under a bright field illumination.

The background for all the images was removed using PhotoDirector 9 (Cyberlink 2017), and the images were then sharpened using an artificial intelligence tool known as Sharpen AI 2.1.3 (Topazlabs 2020), checked against the original images to ensure that no obvious artefacts were introduced. The colours of the NE specimens were determined by using Color Grab App 3.7.6 (loomatix 2020), and the culm colour palette (Fig. 3) was then created based on the result using PhotoDirector 9.

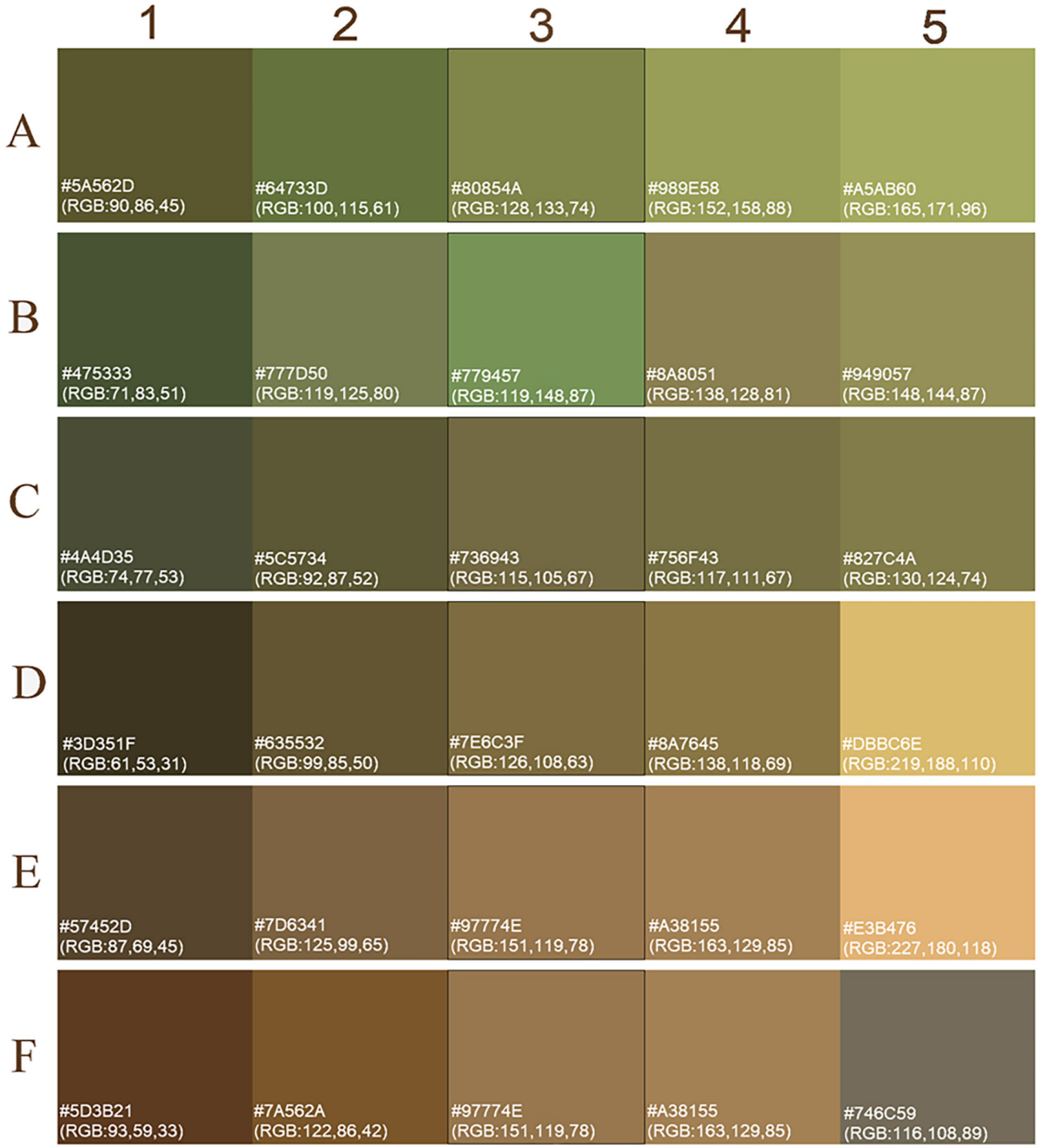

Fig. 3. Culm Colour Key of Dried Specimens of New South Wales Restionaceae. The dominant culm colour of dried Restionaceae specimens from New South Wales (NE collection) was determined using a standardized colour palette (see Materials and Methods). This culm colour key was subsequently applied to all dried specimens across New South Wales to ensure consistency in character scoring.

Characters

A total of 130 morphological characters were used. The character list includes 13 rhizome characters, 25 culm morphological characters, 23 culm anatomical characters, 11 sheath characters, 40 inflorescence characters, 4 fruit characters, 3 seed characters, 4 nomenclatural information, 3 ecological/geographic information, 2 commentary & illustrative support and 2 phenological characters. A majority of them were constructed based on the work of Linder (1991a), Meney *et al.* (1999), Linder *et al.* (2000), Eldenäs and Linder (2000), Plunkett *et al.* (2018), and Musili *et al.* (2018). Several novel culm morphological (Appendix 2) and anatomical characters (Appendix 3) were also added and scored.

Analysis, dataset and products

The numeric characteristics of the specimens in the images were measured using ImageJ v 1.52 (Abràmoff *et al.* 2004). Data were organised using Excel and later transferred manually to DEscription Language for TAxonomy (DELTA ver. 1.04) which is s a flexible and powerful system for recording taxonomic descriptions (Dallwitz 2005). DELTA (see http://delta-intkey.com) was used to develop a suitable character list and produce comparative descriptions for the New South Wales species of Restionaceae. The novel DELTA dataset was created specifically for this purpose. Intkey dataset (Appendix 4) was also produced by DELTA and Intkey (see http://delta-intkey.com).

Field collection

Three different species were collected adjacent to Point Lookout Rd, Ebor NSW (30°28'50.2"S 152°17'46.6"E). Vouchers were lodged with NE with replicates to be distributed at least to NSW.

Results

Annotated character list for the New South Wales species of Restionaceae produced and formatted automatically from the DELTA dataset (Appendices 2, 3)

This character list has been used to produce comparative descriptions of the subject species and for interactive identification using Intkey.

The images are included here primarily to clarify and exemplify the specific character states. They also serve to illustrate features of their respective species.

#1. **Basionym**:/

#2. **Other synonyms**:/

#3. **Misapplication< misidentifications>**:/

This character is included to reduce the risk of misidentifications with morphologically similar taxa. Close attention to [diagnostic feature(s)] helps prevent confusion and ensures accurate identification.

#4. **Common name**:/

#5. **Plants** <whether dioecious or monoecious>/

1. dioecious/
2. monoecious/

#6. Rhizome <diameter when mature; mm>/

mm diam./

#7. Rhizome <growth pattern; whether spreading or tufted; Fig. 4>/

1. spreading <i.e., long rhizomatous>/
2. tufted <i.e., short rhizomatous>

Fig. 4. Examples of spreading and tufted rhizomatous. A, spreading as in *Baloskion fimbriatum* (*T.H. Shaldoom 21*, 16 Nov. 2020); B, tufted as in *Lepyrodia anarthria* (*T.H. Shaldoom 23*, 16 Nov. 2020).

#8. Rhizome <whether ascending or creeping>/

1. ascending <includes more-or-less erect>/
2. creeping <i.e. more-or-less horizontal>/

#9. Rhizome <whether superficial or subterranean>/

1. subterranean <buried>/
2. superficial <i.e., at or above ground level>/

#10. Rhizome <when subterranean, depth below soil; cm>/

cm deep/

#11 Rhizome <when superficial, height above soil; cm>/

cm above ground/

#12. Rhizome <colour when fresh>/

1. orange-brown/
2. yellow-brown <straw coloured>/
3. grey-brown/
4. pale brown/
5. dark brown/
6. light brown/
7. reddish-brown/
8. grey/

#13. Rhizome <colour> when dry/

1. reddish-brown/
2. mid-brown/
3. dark brown/

4. yellowish/
5. yellowish-brown/

#14. Rhizome trichomes <presence>/

1. present/
2. absent/

#15. Rhizome trichomes <colour when fresh>/

1. brown when fresh/
2. grey when fresh/
3. pale ginger when fresh/
4. cream when fresh/

#16. Rhizome trichomes <colour when dry>/

1. cream <when dry>/
2. pale ginger <when dry>/
3. grey <when dry>/
4. brown <when dry>/

#17. Rhizome scales <presence>/

1. present/
2. absent/

#18. Rhizome scales <colour>/

1. grey/
2. light brown/
3. orange-brown <ginger colour>/
4. red-brown/
5. mid-brown/

#19. Culms arranged on the rhizome <whether closely spaced or widely spaced; Fig. 5>/

1. widely spaced <e.g., Fig. 5A>/
2. closely spaced <e.g., Fig. 5B>/

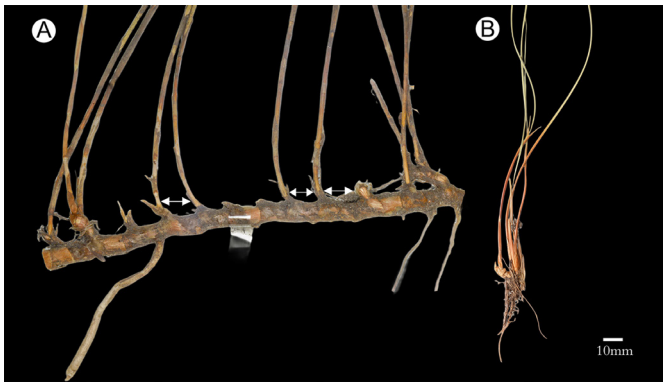

Fig. 5. Examples of culms closely spaced or widely spaced arranged on the rhizome. A, widely spaced as in *Baloskion australe* (*E.F. Constable s.n,* 9 Jun. 1961); B, closely spaced as in *Lepyrodia anarthria* (*T.H. Shaldoom 23*, 16 Nov. 2020). The double-headed arrow highlights the space separating the Culms on the rhizomes.

#20. Culms <length; mm>/

mm long/

Measured from the base of the aerial shoot portion up to the inflorescence. Data are from literature sources (Quirico and Briggs 1993; Meney and Pate 1999; Briggs 2012) and original observations. The smallest and largest lengths are included to cover variation within species.

#21. Culms <width; mm>/

mm diam./

Measured from the middle third of culm. Data are a combination of literature sources where the smallest and largest widths are included to show variation within species (Quirico and Briggs 1993; Meney and Pate 1999; Briggs 2012).

#22. Culms < shape in cross-section observed with or without a hand lens; Fig. 6>/

1. terete/
2. semi-terete <i.e., half terete or truncated terete>/
3. elliptical/
4. flattened <more or less linear in cross-section under low magnification, but may appear fusiform, narrowly elliptic, or narrowly oblong at higher magnification>/

Culms can be terete, quadrangular (square), compressed or flattened in the family (Linder *et al.* 1998; Dorrat-Haaksma 2012; Linder and Helme 2015). However, there are no Restionaceae with quadrangular culms in New South Wales.

#23. Culms <when dried, whether erect or arching>/

1. erect/
2. arching/

Culm can be erect or arching (Linder *et al.* 1998; Dorrat-Haaksma 2012; Clarke 2015; Linder and Helme 2015).

#24. Culms <whether branched or unbranched>/

1. branched/
2. unbranched/

Whether the culms are branched or unbranched below the inflorescence has been reported by Quirico and Briggs (1993); Meney and Pate (1999); and Briggs (2012).

#25. Sterile lateral branches <presence>/

1. present/
2. absent/

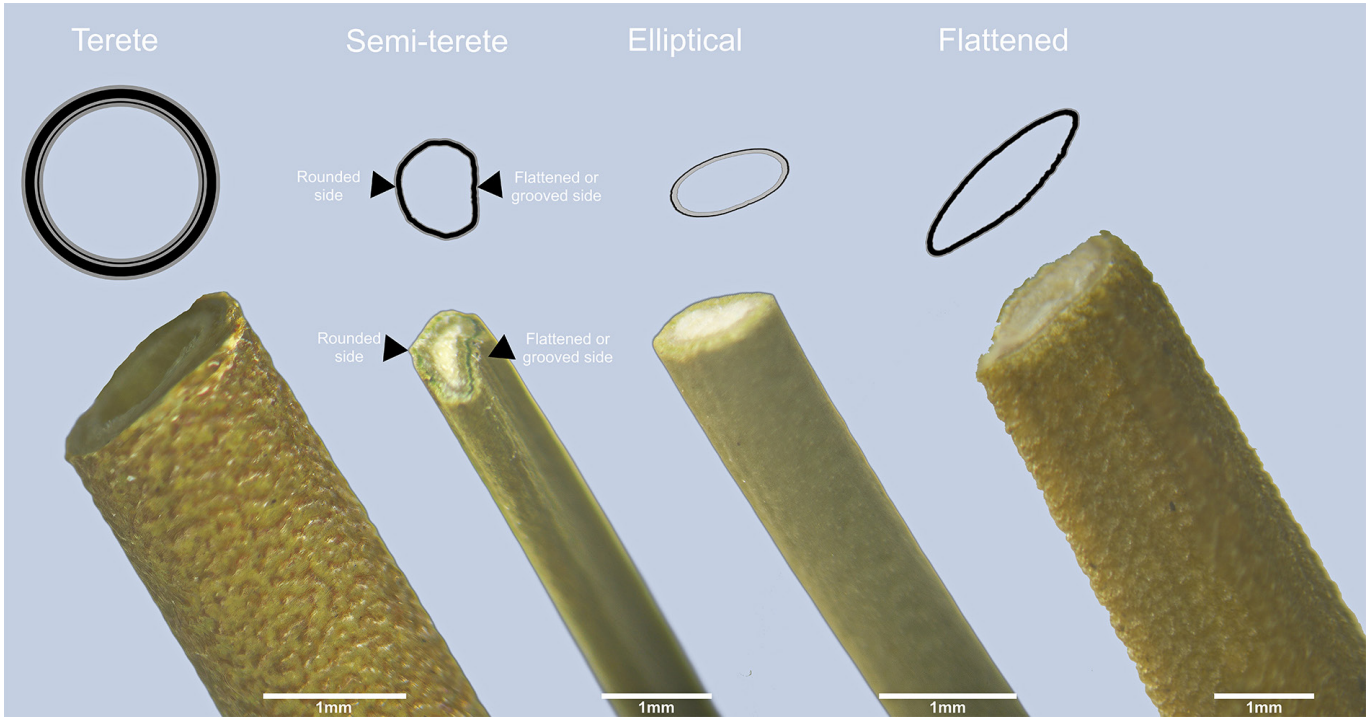

Fig. 6. Examples of culms shape in cross-section observed with or without a hand lens; Terete as in *Baloskion australe* (*E.F. Constable s.n.*, 21 Nov. 1961); Semi-terete as in *Empodisma minus* (*L.M. Copeland 1159*, 18 Feb. 1999); Elliptical as in *Lepyrodia anarthria* (*T.H. Shaldoom 23*, 16 Nov 2020); Flattened as in *Eurychorda complanata* (*P. Rose 65*, 3 Dec. 2008).

#26. Culm internodes <whether with one, few or many internodes; Fig. 7>/

1. one <one long internode is present, with no sheath from the base of the inflorescence to the sheaths of the rhizome. Rarely, one or two short internodes may occur at the base of the culm>/
2. few <3–10 internodes; at least one node located in the mid-third of the culm>/
3. many <i.e., similar to few but with more than 10 internodes per culm>/

The character has been mentioned in Pate and Meney (1999). The internodes of a specimen were counted from the base of the aerial shoot portion up to the inflorescence, ignoring the internodes of the rhizome.

#27. Culm surface <whether ribbed or not ribbed; character suitable only for identification>/

1. ribbed/
2. not ribbed/

This character is included primarily for identification purposes, where it has proven useful. Culm ribbing can, however, be influenced by several factors, such as intraspecific variation (e.g., differences in age, growth form, or habitat conditions) and the process of pressing and drying specimens. That can either accentuate or obscure ribbing, depending on the methods used by different herbaria. While these factors may limit its phylogenetic value, ribbing remains a valuable diagnostic feature for distinguishing specimens in an identification context.

#28. Culm surface <whether truly ribbed or artificially ribbed; character suitable only for identification>/

1. <ribbed> when fresh and when dried <specimen ribbed when fresh and dried specimens remain ribbed after rehydration>/
2. <ribbed> only when dried <specimen not ribbed when fresh; dried specimens ribbed, but ribs disappear upon rehydration>/

This character is included primarily for identification purposes, where it has proven useful. Culm ribbing can, however, be influenced by several factors, such as intraspecific variation (e.g., differences in age, growth form, or habitat conditions) and the process of pressing and drying specimens. That can either accentuate or obscure ribbing, depending on the methods used by different herbaria. While these factors may limit its phylogenetic value, ribbing remains a valuable diagnostic feature for distinguishing specimens in an identification context.

#29. Culm surface <pattern> at 40× <magnification; ignore stomata>/

1. smooth <without obvious ornamentation>/
2. tuberculate <covered or furnished with rounded, projecting lobes; more projecting than granulate, papillate, or pustulate>/
3. striate <striped with parallel longitudinal ridges or lines>/
4. bullate <surface blistered or puckered>/
5. coarsely rugose <wrinkled>/

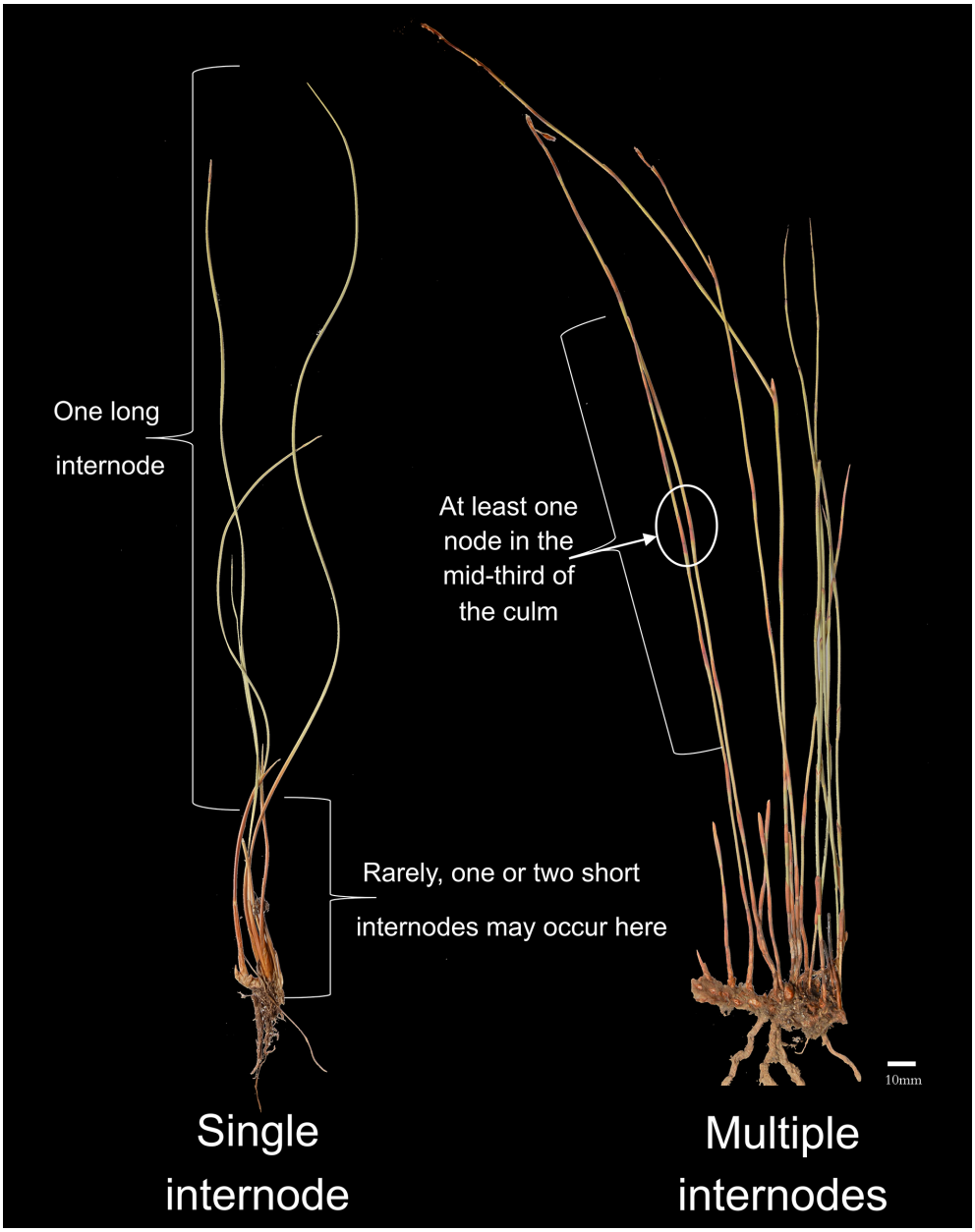

Fig. 7. Examples of single and multiple internodes. Single internode as in *Lepyrodia anarthria* (*T.H. Shaldoom 23*, 16 Nov. 2020); Multiple internodes as in *Baloskion fimbriatum* (*T.H. Shaldoom 21*, 16 Nov. 2020). Both 'few' and 'many' are multiple internodes; the distinction is in the number of internodes, with 'few' = 3–10 internodes, 'many' = more than 10.

6. minutely rugose <minutely wrinkled>/
7. areolate <surface pattern or venation, divided into many angular or squarish spaces>/

   This character is best observed at high magnification using a stereomicroscope (LM).

#30. Culm surface <pattern> at 300× <magnification; ignore stomata>/

1. smooth <without obvious ornamentation>/
2. tuberculate <covered or furnished with rounded, projecting multicellular outgrowths>/
3. striate <striped with parallel longitudinal ridges or lines>/
4. bullate <the surface blistered or puckered>/
5. rugose <wrinkled>/
6. minutely rugose <minutely wrinkled>/
7. areolate <divided into several small, irregular spaces>/
8. pitted <having numerous small depressions on the surface>/
9. sulcate <deeply furrowed or grooved>/

   This character is best observed under scanning electron microscopy (SEM).

#31. Culm texture <whether smooth or slightly rough in touch when dry>/

1. smooth to touch/
2. <slightly> rough to touch/

This character follows Briggs (2012) and Clarke (2015).

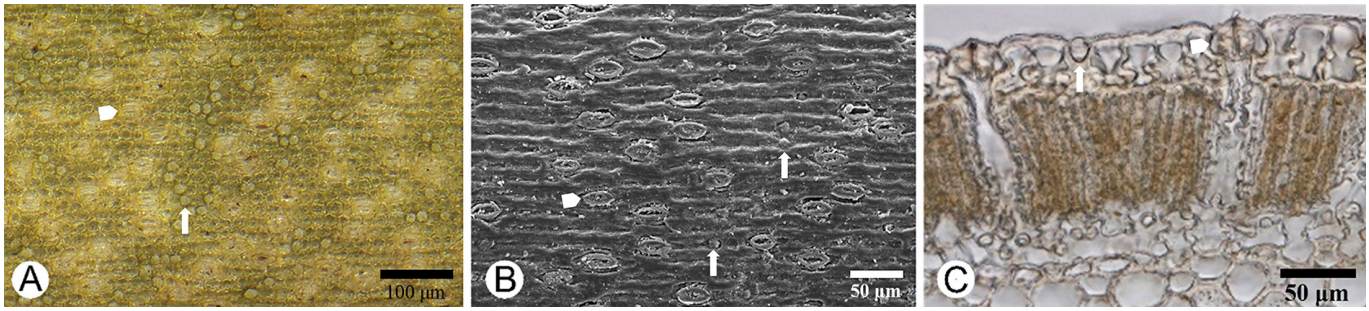

Fig. 8. Examples of culm warts presence. A, light micrographs of *Lepyrodia muelleri* culm surface (LM); B, electron micrographs (SEM) of *Lepyrodia muelleri* culm surface; C, cross-sections of *Lepyrodia oligocolea*. A–C show warts and stomata (arrowhead = stomate; arrow = wart). A & B, male plant (*B.G. Briggs s.n.*, 19 Jan. 1962). C, female plant (*P.R. Williams 293*, 22 Feb. 1995).

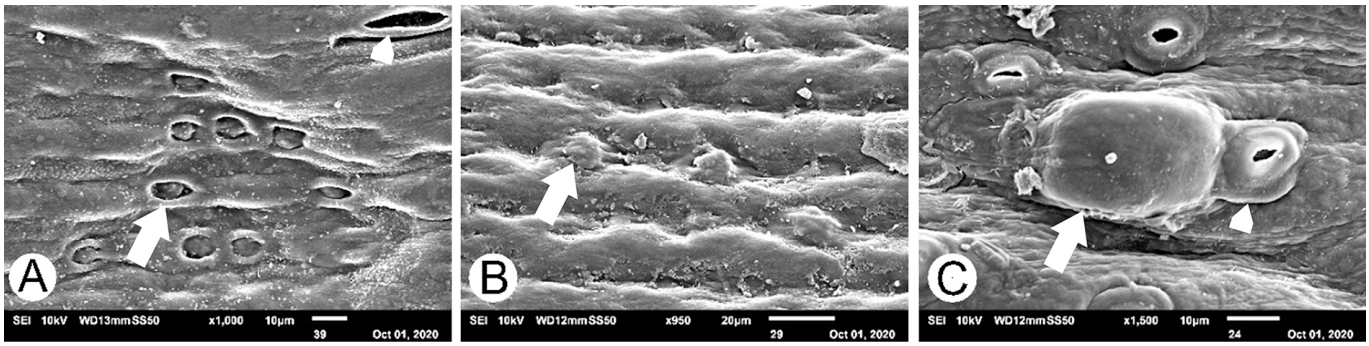

Fig. 9. Examples of different type of warts. A, hollow warts; B, dome-shaped warts; C, elongate warts. The arrow heads point to the stomata, while the arrows point to wart. A, *Lepyrodia anarthria* (*C.E. Nano 3*, 4 Jan. 1997). B, *Lepyrodia imitans* (*S.J. Griffith s.n.*, 22 Mar. 1988). C, *Empodisma minus* (*J.R. Hosking 2830*, 23 Nov. 2006).

#32. Culm trichomes <presence>/

1. present/
2. absent/

This character was studied by Linder *et al*. (2000). The results are based on the investigation of NE herbarium specimens. The culm trichomes can be seen under light microscopy (LM) and SEM.

#33. Culm warts <presence; Fig. 8>/

1. present/
2. absent/

This character is observed under LM and SEM.

#34. Culm warts <type; hollow, dome-shaped or elongate; Fig. 9>/

1. hollow/
2. dome-shaped/
3. elongate/

This character is observed under LM or SEM.

#35. Culm <colour when fresh>/

1. light green when fresh/
2. mid-green when fresh/
3. dark green when fresh/
4. pale green when fresh/
5. olive-green when fresh/
6. glaucous green when fresh/
7. yellow-green when fresh/

This character and the data are derived from Pate and Meney (1999) as well as personal observations.

#36. Culm <colour when dry; Fig. 3>/

1. dark green when dry (see Fig. 3 A1)/
2. mid-green when dry (see Fig. 3 A2)/
3. light green when dry (see Fig. 3 A3)/
4. light green when dry (see Fig. 3 A4)/
5. dark green when dry (see Fig. 3 B1)/
6. faded green when dry (see Fig. 3 B2)/
7. dark green when dry (see Fig. 3 C1)/
8. dark greenish when dry (see Fig. 3 C3)/
9. green when dry (see Fig. 3 C4)/
10. greenish brown when dry (see Fig. 3 D3)/
11. brown when dry (see Fig. 3 D4)/
12. yellowish when dry (see Fig. 3 D5)/
13. yellowish brown when dry (see Fig. 3 E3)/
14. dark brown when dry (see Fig. 3 F1)/
15. dark brown when dry (see Fig. 3 F2)/
16. greyish green when dry (see Fig. 3 F5)/

Colour of culms is captured using Colour Grab App 3.7.6 and matched against the colour palette (Fig. 3).

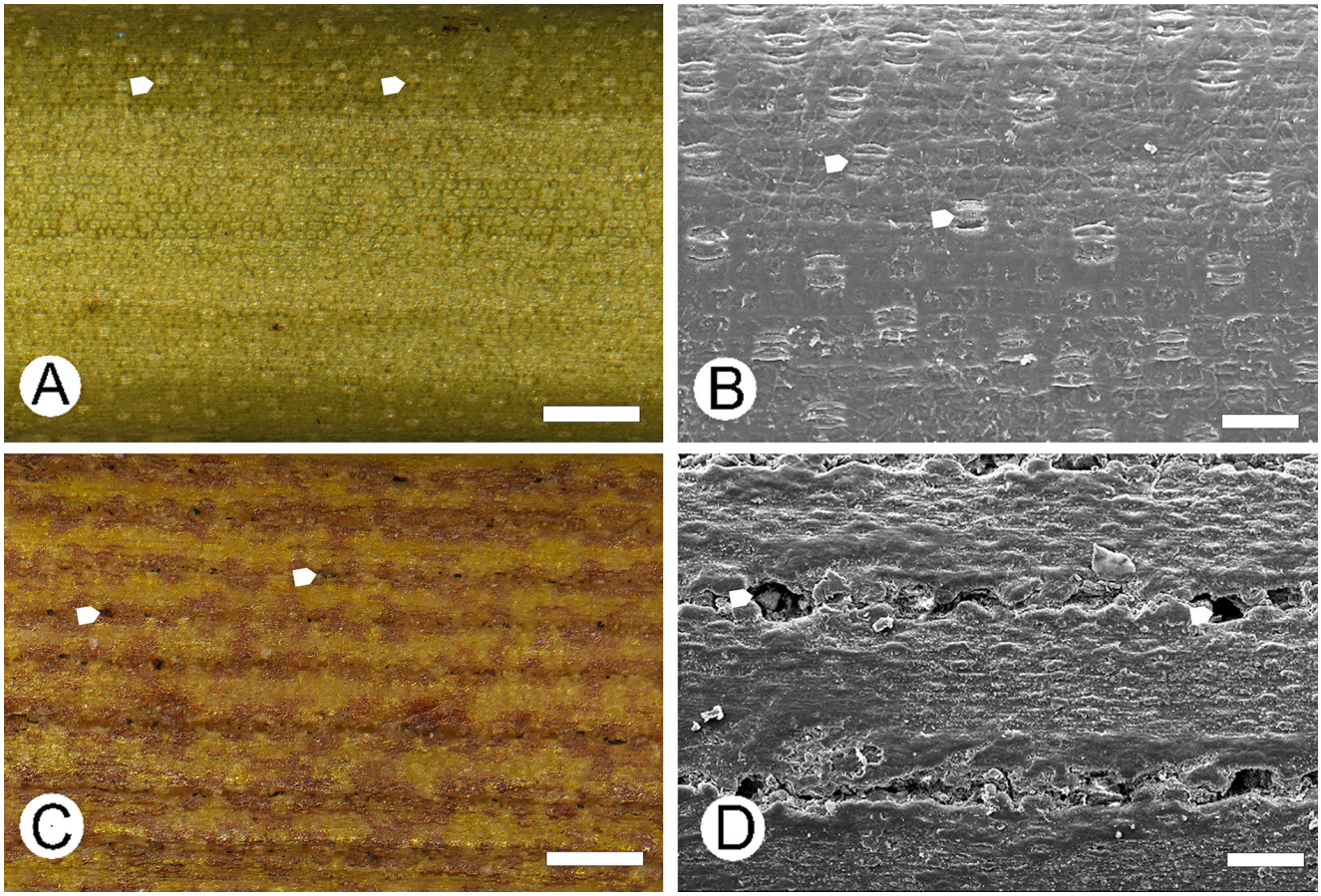

Fig. 10. Examples of culm superficial or in grooves stomata. A & C, light micrographs of culm surface (LM); B, electron micrographs (SEM) of culm surface. A & B show superficial stomata; C & D show stomata in grooves (arrowhead = stomate). A & B, *Coleocarya gracilis* S.T.Blake (*S.J. Griffith s.n.*, 7 May. 1990). C & D, *Chordifex fastigiatus* (R.Br.) B.G.Briggs (*J.J. Bruhl 68*, 9 Jun. 1985). Scale bars: A & C, 200 µm; B & D, 50 µm.

#37. Culms of female plants < when dry; intensity of colour relative to culms of male plants>/

1. more intense in colour than males/
2. less intense in colour than males/

Based on the observation, the intensity of colour of the culms of female and male plants is slightly different.

#38. Culm marbling <when dry, whether present or absent>/

1. present/
2. absent/

This character is observed under LM. The culm is considered marbled when a fine-scale mosaic of different colours is observed.

#39. Culm stomata <whether obvious or obscure>/

1. obvious <visible on the surface>/
2. obscured (covered) <not visible on the surface>/

This character is observed under LM.

#40. Culm stomata <whether in grooves or on the surface; Fig. 10>/

1. superficial <i.e. ± on the surface>/
2. in grooves/

#41. Culm stomata <pattern on culm surface>/

1. in rows <in lines horizontally or vertically>/
2. in ± rounded clusters/
3. dispersed <neither in rows nor in clusters>/

This character is best observed under LM.

#42. Culm stomata <whether covered with wax or uncovered>/

1. covered with wax/
2. not covered with wax/

#43. Culm stomata <whether covered with trichomes or uncovered>/

1. covered with trichomes/
2. not covered with trichomes/

#44. Culm cross-section <shape; Fig. 11>/

1. ±terete/
2. semi-terete <half terete or truncated terete>/
3. slightly compressed <terete but slightly compressed>/
4. compressed <elliptical or oval>/
5. strongly compressed <flattened, fusiform, narrowly elliptic, or narrowly oblong; ±linear in cross-section under low magnification>/

6. obtusely triangular <though may appear to be superficially terete>/

#45. Culm outer epidermal walls <in cross-section; whether straight or undulating>/

1. plane <i.e., flat, straight or even>/
2. undulating <sinuous>/

This character should be assessed using a compound microscope.

#46. Culm <outer epidermal walls in cross-sections, whether thick or thin; Fig. 12>/

1. thick/
2. thin/

This character should be assessed using a compound microscope. Outer epidermal walls are scored as thick when noticeably thicker than the other three epidermal cell walls visible in cross-section, and thin when it is equal or only slightly thicker than the other three walls.

#47. Epidermis <in cross-section; whether one or two layers>/

1. uniseriate <one layered>/
2. biseriate <two-layered>/

Character was studied by Linder *et al.* (2000).

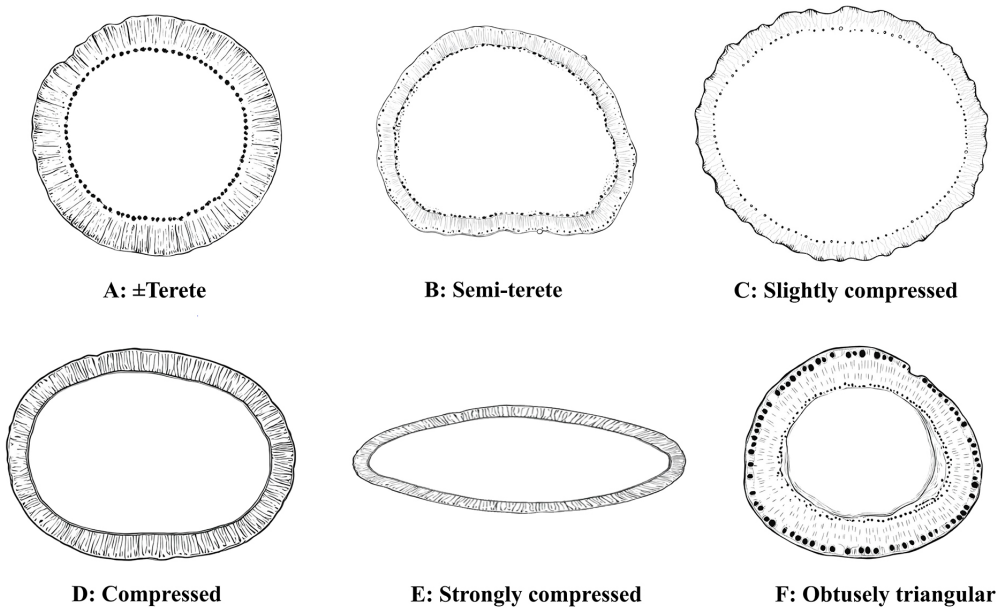

Fig. 11. Examples of culm cross-section shape found in NSW Restionaceae.

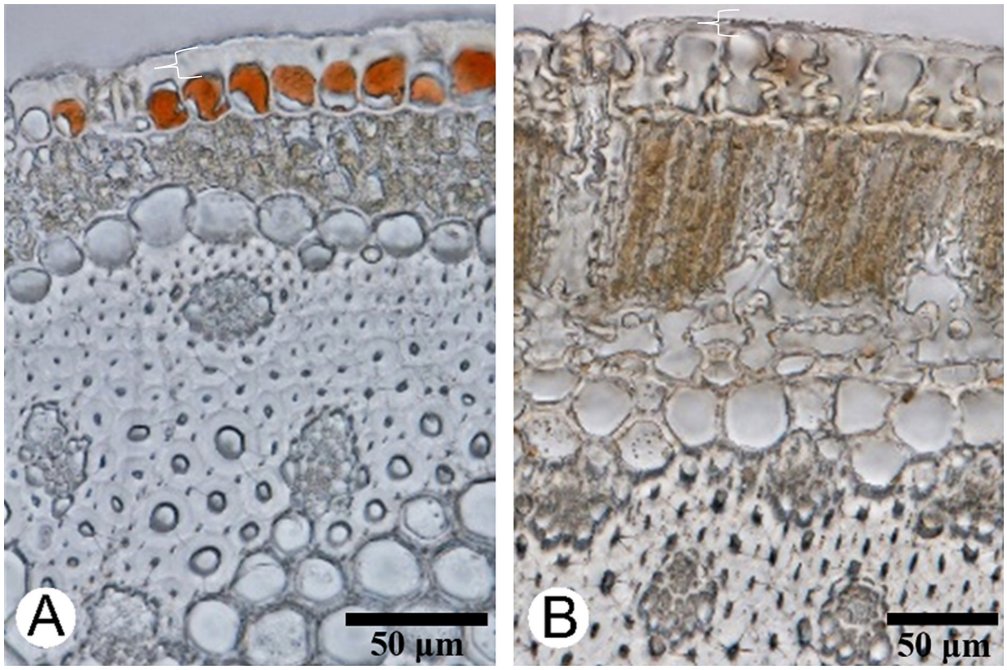

Fig. 12. Examples of outer epidermal thick or thin walls. (A) thick walls, as in *Baloskion longipes* (*M. Gray 5665*, 14 Jan. 1965); (B) thin walls, as in *Lepyrodia oligocolea* (*P.R. Williams 293*, 22 Feb. 1995).

#48. Culm stomata <position in cross-section; whether superficial or sunken; Fig. 13>/

1. superficial/
2. sunken/

This character was studied in Pate and Meney (1999).

#49. Chlorenchyma <presence; Fig. 1G & H>/

1. present/
2. absent/

All species included in this dataset have chlorenchyma in their culms. The character is included for descriptive purposes. This character was studied by Linder *et al.* (2000) and Pate and Meney (1999).

#50. <Chlorenchymatous> cells <type, whether slender or squat>/

1. slender/
2. squat/

The character and its states were obtained from Linder *et al.* (2000).

#51. <Chlorenchymatous> cells <in culm cross-section; whether in one, two or three layers; Fig. 14>/

1. in one layer/
2. in two layers/
3. in three layers/

The character was mentioned in Linder *et al.* (1998) and the number of rows and form of chlorenchyma cells is considered taxonomically significant (Linder *et al.* 1998).

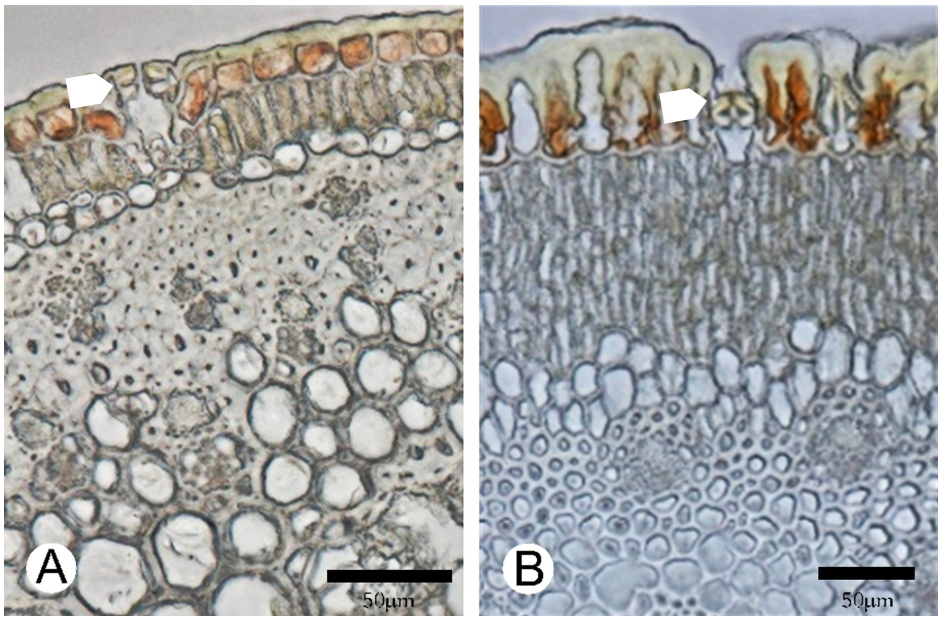

Fig. 13. Examples of superficial and sunken stomata. (A) superficial stomata, as in *Baloskion stenocoleum* (*Z. Growns* 3, 22 Feb. 2014); (B) sunken stomata, as in *Baloskion australe* (*C.J. Skewes s.n.*, Jan. 1954).

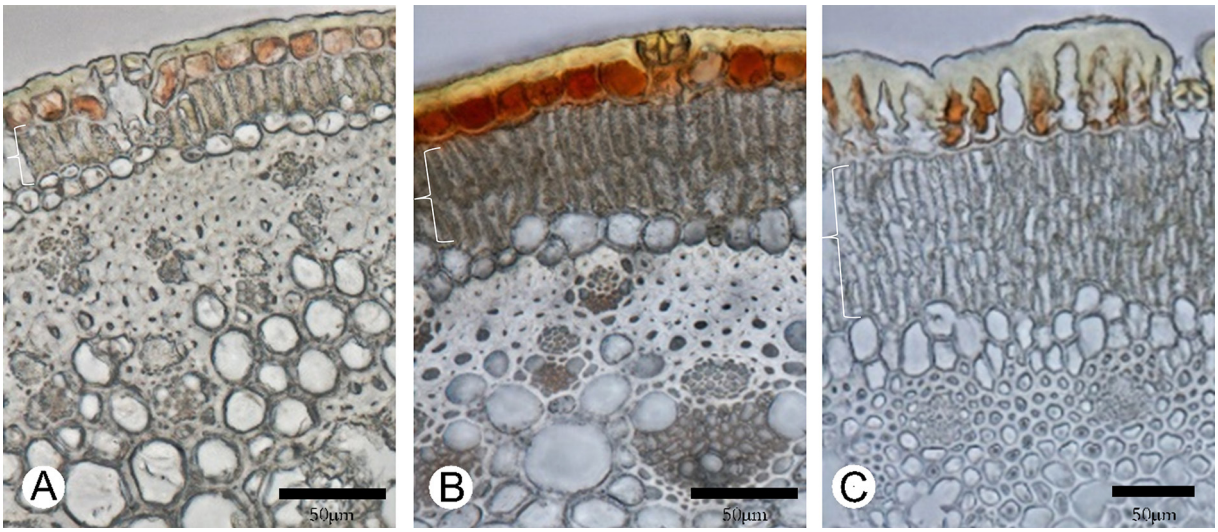

Fig. 14. Examples of chlorenchymatous cells. (A) Present in a single layer, as in *Baloskion stenocoleum* (*Z. Growns* 3, 22 Feb. 2014); (B) in two layers, as in *Baloskion fimbriatum* (*K.A. McColl* 2998, 22 Jan. 1998); (C) in three layers, as in *Baloskion australe* (*C.J. Skewes s.n.*, Jan. 1954).

#52. Peg cells <presence; Fig. 1I>/

1. present/
2. absent/

The character and its states are from Linder *et al.* (2000) and studied in Pate and Meney (1999). Peg cells are chlorenchyma cells that are palisade-like with lines of projections, which are peg-like and meet similar projections of adjacent cells (Linder *et al.* 1998; Pate and Delfs 1999).

#53. Peg cells **<**in cross-section; whether one or two layers; Fig. 1I**>** /

1. uniseriate <in one radial layer>/
2. biseriate <in two radial layers>/

This character was mentioned in Linder *et al.* (1998).

#54. Pillar cells <presence>/

1. present/
2. absent/

The character and its states have been obtained from in Linder *et al.* (2000) and Pate and Meney (1999). Pillar cells are palisade-like elongated cells of the parenchyma sheath. The cells originate from the parenchyma with lignified walls dividing the chlorenchyma into segments and extend to the epidermis (Briggs *et al.* 2014).

#55. Protective cells <presence>/

1. present/
2. absent/

The character and its states have been obtained from Linder *et al.* (2000) and Pate and Meney (1999). Protective cells are chlorenchymatous cells with lignified and moderately thickened walls that surround the stomatal cavity forming a tube that extends all through the chlorenchyma (Linder *et al.* 1998; Pate and Delfs 1999; Linder 2000).

#56. Parenchyma sheath <presence>/

1. present/
2. absent/

The character has been mentioned in Linder *et al.* (2000).

#57. Parenchyma cells <in cross-sections, whether in one or more than one layer; Fig. 15>/

1. uniseriate <in one layer>/
2. multiseriate <in more than one layer>/

The character has been observed under LM.

#58. Sclerenchyma sheath <presence; Fig. 1K>/

1. present/
2. absent/

The character was mentioned in Linder *et al.* (2000).

#59. Sclerenchyma ridges <presence; Fig. 16>/

1. present/
2. absent/

The character was studied by Linder *et al.* (2000).

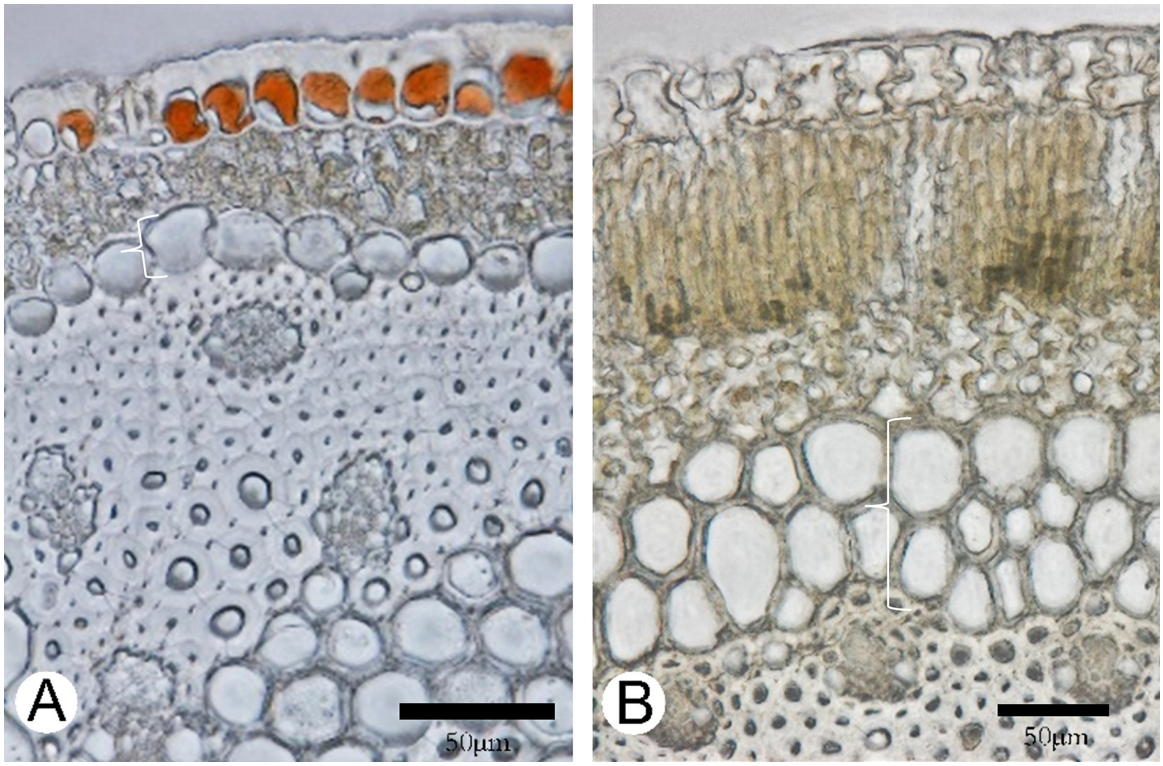

Fig. 15. Examples of parenchyma cells. (A) Present in a single layer, as in *Baloskion longipes* (*M. Gray 5665*, 14 Jan. 1965); (B) in two layers, as in *Lepyrodia imitans* (*S.J. Griffith s.n.*, 29 Mar. 1988).

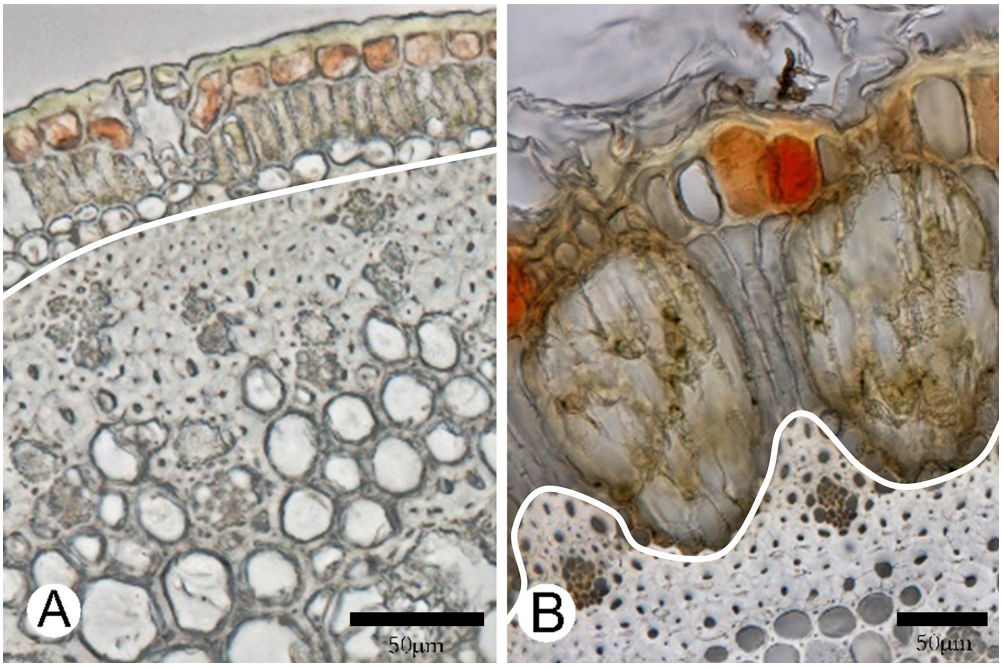

Fig. 16. Presence or absence of sclerenchyma ridges. (A) Absent, as in *Baloskion stenocoleum* (*Z. Growns 3*, 22 Feb. 2014); (B) Present as in *Hypolaena fastigiata* (*V. Klaphake s.n.*, 20 Jan. 1998).

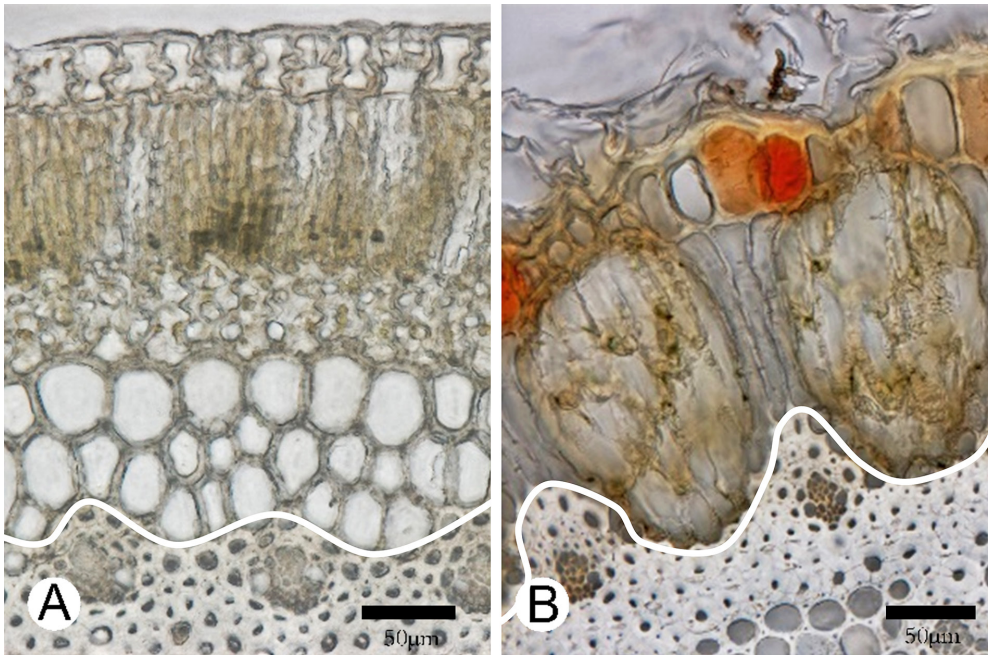

Fig. 17. Examples of sclerenchyma ridges. (A) slight, as in *Lepyrodia imitans* (*Z. Growns 3*, 22 Feb. 2014); (B) Partial as in *Hypolaena fastigiata* (*S.J. Griffith s.n.*, 29 Mar. 1988).

#60. Sclerenchyma ridges <whether obscure or obvious; Fig. 17>/

1. obscure <barely visible or absent>/
2. obvious <but never contiguous with the epidermis>/

Character is observed under LM.

#61. Sclerenchyma ridges opposite vascular bundles <presence>/

1. present/
2. absent/

This character and its states are from Linder *et al.* (2000).

#62. Culm central cavity <in cross-section, presence>/

1. present/
2. absent/

This character was studied by Linder *et al.* (2000) and mentioned in Pate and Meney (1999).

#63. Culm central cavity <type, in cross-sections, whether circular or triangular; Fig. 18>/

1. circular/

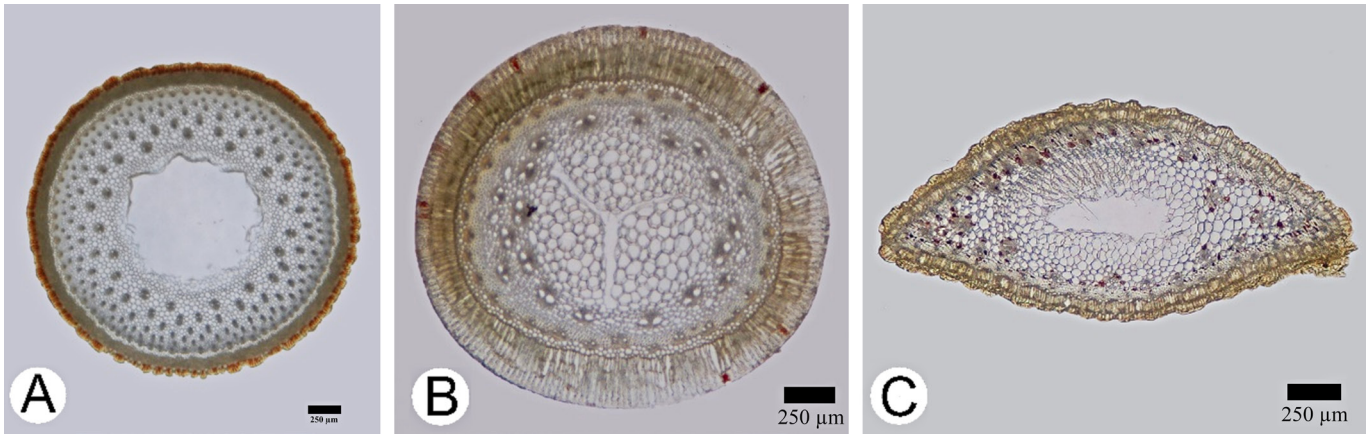

Fig. 18. Examples of central cavity type. A, circular as in *Baloskion australe* (*C.J. Skewes s.n.*, Jan. 1954). B, triangular as in *Sporadanthus caudatus* (*E.F. Constable 3006 b*, 24 May. 1962). C, oblong as in *Eurychorda complanata* (*E.F. Constable s.n.*, 11 Nov. 1959).

2. triangular/
3. oblong <i.e. narrow and flattened>/

This character was mentioned in Pate and Meney (1999).

#64. Silica <presence>/

1. present/
2. absent/

The data were obtained from Linder *et al.* (2000). See also Linder *et al.* (1998). In Restionaceae, silica can be found in two forms: either as amorphous, sand-like particles or as clearly defined crystalline deposits. This variation occurs across different species and types of tissue (Cutler 1969; Linder *et al.* 1998; Pate & Meney 1999; Meney *et al.* 1999). Silica formation and deposition can impact the rigidity of the culms, their mechanical strength, and how effectively they resist herbivory. This indicates that silica variation plays a significant role in the ecological and evolutionary strategies of these plants (Ma & Yamaji 2006; Massey *et al.* 2007; Currie & Perry 2007; Pate & Meney 1999).

#65. Silica stegmata <presence><i.e. cover cells; parenchyma sheath is a common place for them>/

1. present/
2. absent/

The definition of and data for this character are from Linder *et al.* (2000). Stegmata are specialized silica-containing cells associated with sclerenchyma, often surrounding vascular bundles. They usually contain one or sometimes two to three silica bodies per cell; the cells are often in axial files (Cutler 1969; Linder *et al.* 1998; Linder *et al.* 2000; Meney *et al.* 1999).

#66. Starch grains <presence>/

1. present/
2. absent/

The data have been derived from Pate and Meney (1999).

#67. <Additional notes on culms>/

This character provides additional observational information on culms that is not usually captured in the standard set of characters, but which highlights consistent features and may prove useful for taxonomic comparisons and future studies.

#68. Leaf sheath <whether usually appressed to or spreading from culm>/

1. appressed/
2. spreading/

#69. Leaf sheath <length; cm; excluding lamina>/

cm long/

#70. Leaf sheath <abaxial surface; whether dull or glossy; when viewed at 10 × magnification>/

1. dull/
2. glossy/

#71. Leaf sheath <abaxial micromorphology; when viewed at 10× magnification>/

1. smooth/
2. striate/
3. wrinkled/
4. muricate/
5. hairy <covered with trichomes>/

#72. Leaf sheath <abaxially; colour when fresh; Fig. 19>/

1. light brown (see Fig. 19) <colour within the range of A1 to A5>/
2. brown (see Fig. 19) <colour within the range of D1 & D2>/
3. dark brown <blackish brown> (see Fig. 19) <colour within the range of D3 to D5>/
4. red-brown (see Fig. 19) <colour within the range of C4 to C5>/
5. orange-brown <Copper> (see Fig. 19) <colour within the range of C1 to C3>/

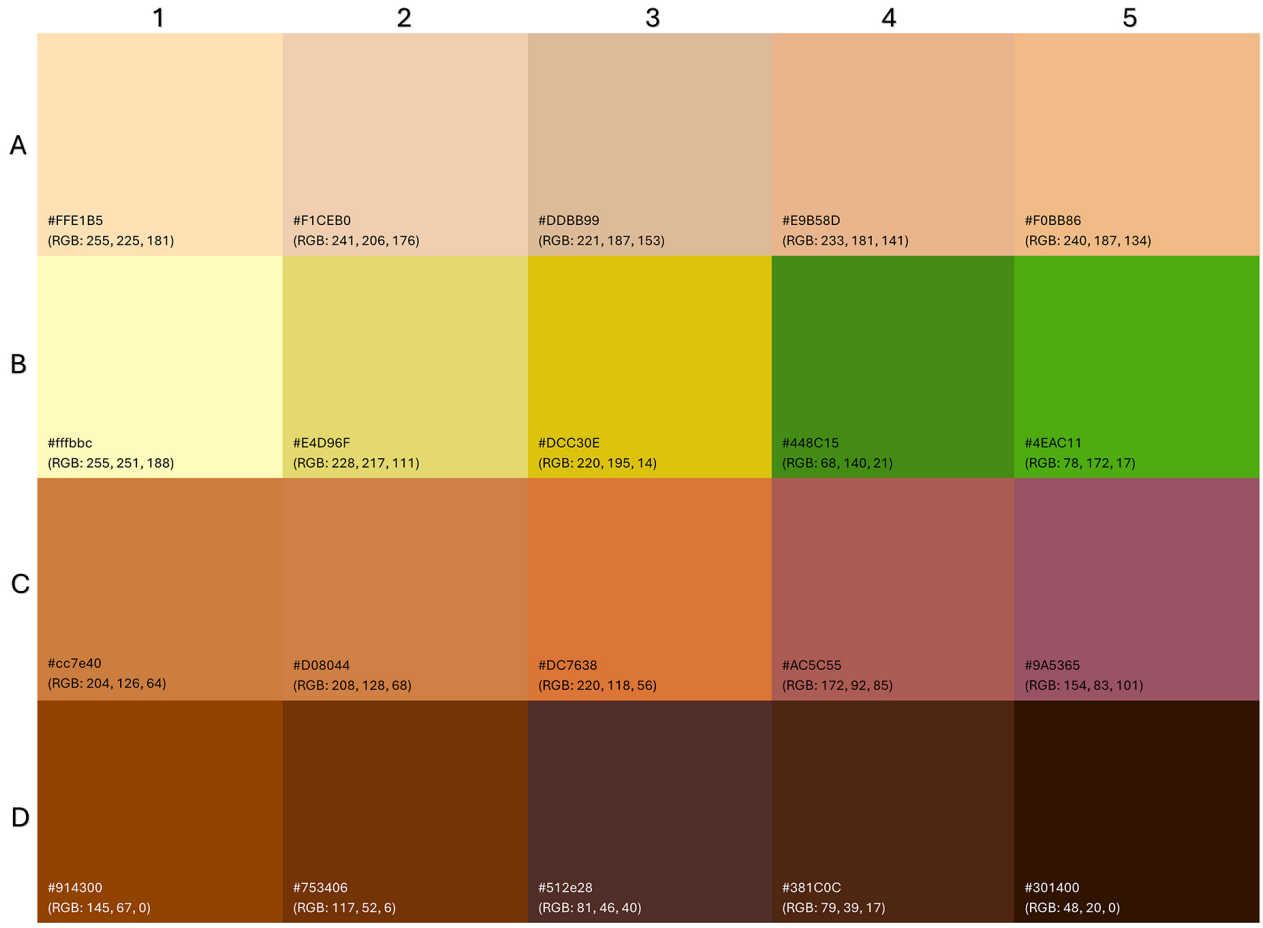

Fig. 19. Colour key for leaf sheath of fresh specimens of New South Wales Restionaceae. Colours observed were light brown (A1–A5), yellow-brown/straw-coloured (B1–B3), green (B4–B5), orange-brown/copper (C1–C3), red-brown (C4–C5), brown (D1–D2), and dark brown/blackish brown (D3–D5).

6. yellow-brown <straw-coloured> (see Fig. 19) <colour within the range of B1 to B3>/
7. green (see Fig. 19) <colour within the range of B4 to B5>/

#73. Leaf sheath apex <shape>/

1. finely pointed <acute>/
2. obtuse/
3. elongated <acuminate>/
4. rounded/

#74. Leaf sheath apex <whether hairy or glabrous>/

1. glabrous/
2. hairy <trichomes are restricted to edge so ciliate>/

#75. Leaf sheath apex trichomes <length; whether longer or shorter than 1 mm>/

1. >1 mm long/
2. <1 mm long/

#76. Leaf lamina <presence; any protuberance of the main vein beyond the sides of the sheath>/

1. absent/
2. present <i.e. includes sheaths mucronate, to aristate, and if leaves laminate>/

#77. Leaf lamina <length; mm>/

mm long/

#78. Leaf sheath margins <whether translucent; check young sheaths; viewed at 10 × magnification>/

1. translucent/
2. opaque/

Assess this character on young but well-developed sheaths

#79. Inflorescence bracts <shorter, equal, or longer than the spikelets; Fig. 20>/

1. shorter than the spikelets/
2. ± equal to the spikelets/
3. longer than the spikelets/

The distinctions (shorter, equal, or longer) are most evident in the lowest spikelets.

#80. Male inflorescence <length; mm; mature inflorescence>/

mm/

#81. Male inflorescence with spikelets<whether clustered or continuous>/

1. clustered/
2. dispersed <i.e., with spikelets more-or-less equally dispersed throughout the inflorescence>/

Fig. 20. Examples of inflorescence bracts shorter, or longer than the spikelets. Inflorescence bracts shorter than spikelets as present in *Baloskion fimbriatum* (*E.F. Constable s.n.*, 19 Jan. 1961) or longer than the spikelets as present in *Baloskion australe* (*E.F. Constable s.n.*, 21 Nov. 1961).

#82. <Male> spikelets <number per inflorescence; or flowers in some species>/

per inflorescence/

#83. <Male> spikelets <number per node of the inflorescence; Fig. 21>/

per node of the inflorescence/

In some species, the number of spikelets per node, appears to be restricted to a specific value. In contrast, in others, these features show a degree of variation.

#84. <Male> spikelet <reproductive unit; length; mm>/

mm long/

#85. <Male> spikelet <reproductive unit; shape; Fig. 22>/

1. ovoid/
2. globose/
3. oblong-cylindrical/

#86. <Male> flowers <number per culm>/

per culm/

An estimated range of flower number per culm

#87. <Male> flowers <number per spikelet>/

per spikelet/

#88. <Male> glumes <apex shape; Fig. 23>/

1. acuminate < including aristate>/
2. obtuse/
3. caudate/
4. cuspidate/
5. mucronate/

#89. <Male> glumes <margins>/

1. glabrous/
2. short trichomes/
3. long trichomes/

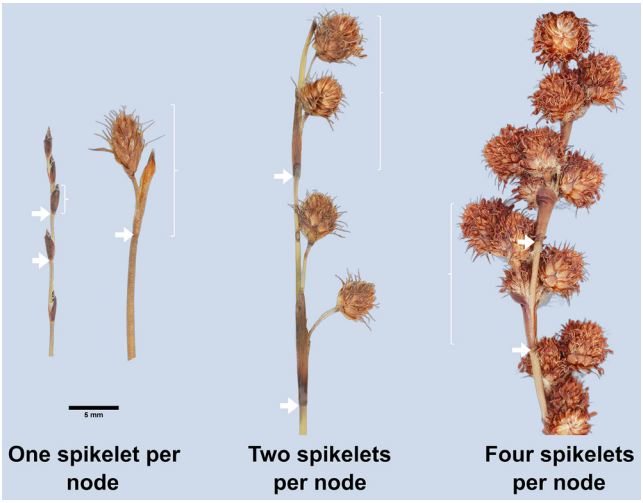

Fig. 21. Examples of spikelets number per node. One spikelet per node can be seen in *Chordifex fastigiatus* (*J.J. Bruhl 68*, 9 Jun. 1985; left) and *Baloskion australe* (*E.F. Constable s.n.*, 21 Nov. 1961; right); two spikelets per node as can be seen in *Baloskion stenocoleum* (*Z. Growns* 3, 22 Feb. 2014); in *Baloskion pallens* (*E.F. Constable s.n.*, 6 Jan. 1961), more than three spikelets per node can be present (in this case, four).

Fig. 22. Examples of spikelet shape; globose as present in *Baloskion gracile* male plant (*O.D. Evans s.n.*, 6 Dec. 1960). Ovoid as present in *Baloskion fimbriatum* (*E.F. Constable s.n.*, 19 Jan. 1961). Oblong-cylindrical as present in *Baloskion gracile* female plant (*O.D. Evans s.n.*, 8 Dec. 1961).

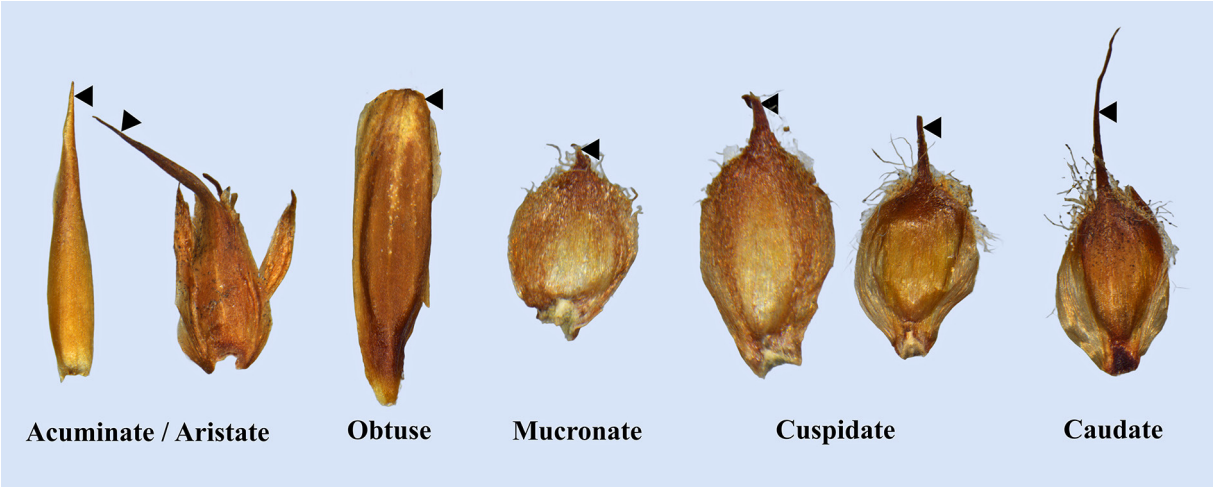

Fig. 23. Examples of glumes apex shape. Aristate as in *Baloskion australe* (*E.F. Constable s.n.*, 21 Nov 1961). Obtuse as in *Coleocarya gracilis* (*J.B. Williams s.n.*, 15 Sep. 1982). Mucronate and cuspidate as in *Baloskion tetraphyllum* subsp. *meiostachyum* (*G.J. White s.n.*, 15 Nov. 1977). Caudate as in *Baloskion fimbriatum* (*K.A. McColl 2998*, 22 Jan. 1998).

#90. <Male> tepals <number of tepals>/

#91. <Male> tepals <shape>/

1. lanceolate/
2. oblong lanceolate/
3. elliptic/
4. narrow ovoid/

#92. <Male> tepals <colour; Fig. 24>/

1. whitish or straw-coloured (see Fig. 24) <colour within the range of A1 to A3>/
2. yellow (see Fig. 24) <colour within the range of B1 to B3>/
3. yellow-brown (see Fig. 24) <colour within the range of C1 to C3>/
4. pale brown (see Fig. 24) <colour within the range of D1 to D3>/
5. brown (see Fig. 24) <colour within the range of E1 to E3>/

The colour key for this character is based on limited sources, including a few images, fresh specimens, and available literature, and should therefore be considered auxiliary rather than essential.

#93. Male tepals <whether outer tepals longer or shorter than inner>/

1. outer shorter than the inner <inner tepals longer>/
2. outer and inner ± similar in length <equal>/
3. inner shorter than the outer <outer tepals longer>/

#94. <Male>outer tepals <length; mm>/

mm long/

#95. <Male> inner tepals <length; mm>/

mm long/

#96. Stamens <number of stamens>/

#97. Anthers <length; mm>/

mm long/

#98. Female inflorescence <length; mm; mature flower>/

mm/

#99. Female inflorescence with spikelets<whether female flowers clustered or dispersed>/

1. clustered/
2. dispersed <i.e. with flowers more-or-less equally dispersed throughout the inflorescence>/

#100. Female spikelets <number per inflorescence>/

per inflorescence/

#101. Female spikelets <number per node of the inflorescence; Fig. 21>/

per node of the inflorescence/

#102. Female spikelet <reproductive unit; length; mm; mature flower>/

mm long/

#103. Female spikelet <reproductive unit; shape; Fig. 22>/

1. ovoid/
2. globose/
3. elongate<e.g. oblong-cylindrical>/

#104. Female flowers <number per culm>/

per culm/

An estimated range of flowers number per culm

#105. Female flowers <number per spikelet>/

per spikelet/

flowers per spikelet

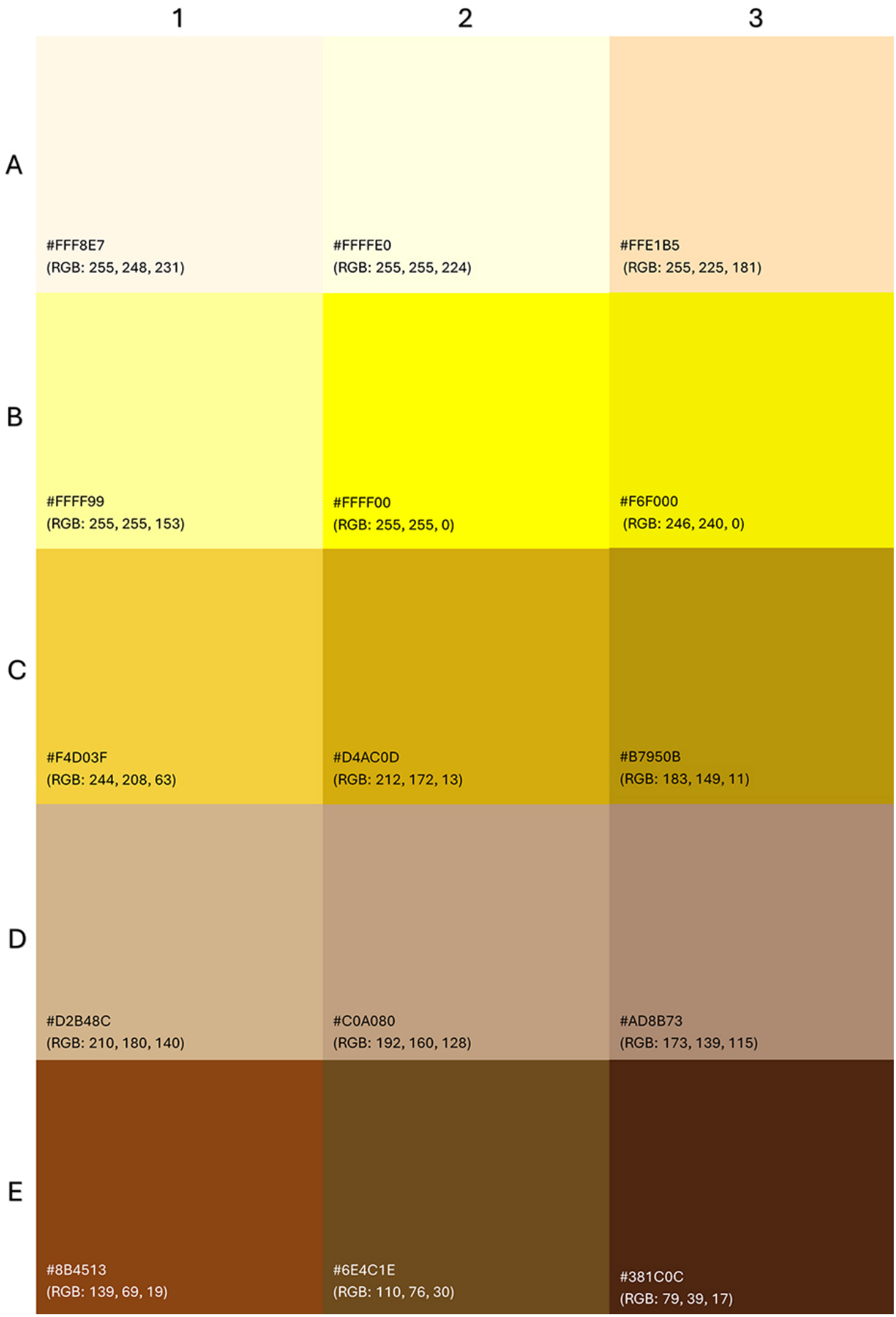

Fig. 24. Tepal colour key for New South Wales Restionaceae: Tepal colours with corresponding reference ranges: whitish or straw-coloured (A1–A3), yellow (B1–B3), yellow-brown (C1–C3), pale brown (D1–D3), brown (E1–E3).

#106. Female glumes <apex shape; Fig. 23>/

1. acuminate/
2. obtuse/
3. aristate/
4. caudate/
5. cuspidate/
6. mucronate/

#107. Female glumes <margins>/

1. glabrous/
2. short trichomes/
3. long trichomes/

#108. Female tepals <number of tepals>/

#109. Female tepals <shape>/

1. lanceolate/
2. oblong lanceolate/
3. elliptic/
4. narrow ovoid/

#110. Female tepals <colour; Fig. 24>/

1. whitish (see Fig. 24) <included straw-coloured; colour within the range of A1 to A3>/
2. yellow (see Fig. 24) <colour within the range of B1 to B3>/
3. yellow-brown (see Fig. 24) <colour within the range of C1 to C3>/
4. pale brown (see Fig. 24)<colour within the range of D1 to D3>/
5. brown (see Fig. 24) <colour within the range of E1 to E3>/

   The colour key for this character is based on limited sources, including a few images, fresh specimens, and available literature, and should therefore be considered auxiliary rather than essential.

#111. Female tepals <whether outer tepals longer or shorter than inner>/

1. outer shorter than the inner <inner tepals longer>/
2. outer and inner ± similar in length <equal>/
3. inner shorter than the outer <outer tepals longer>/

#112. Female tepals <outer tepals length; mm>/

mm long outer tepals/

#113. Female tepals <inner tepals length; mm>/

mm long inner tepals/

mm long

#114. Staminodes <number of staminodes>/

staminodes

#115. Ovary <shape in cross-section>

1. Flattened/
2. 3-angular <trigonous>/

#116. Style branches <number>

1. 1-locular/
2. 2-locular/
3. 3-locular/

#117. Stigmatic branches <number>/

#118. <Flowering season>/

1. autumn/
2. winter/
3. spring/
4. summer/

#119. <Flowering phenology; month of flowering; based on NE and NSW herbarium flowering specimens>/

1. January/
2. February/
3. March/
4. April/
5. May/
6. June/
7. July/
8. August/
9. September/
10. October/
11. November/
12. December/

    Flowering and fruiting phenology is based on the presence of an inflorescence as observed on herbarium specimens. It is not always easy to distinguish between flowering and fruiting stages. In addition to herbarium material, we also compared the records with AVH data to better capture the flowering period and to identify the most likely peak times. The selected period therefore represents the months in which the majority of specimens with flowers were recorded, based on both herbarium and AVH data. However, given the very broad distribution and large number of specimens across regions, flowering may also occur beyond the indicated months.

#120. Fruit <whether a nut or capsule>/

1. nut/
2. capsule/

#121. Fruit <if capsular; number of cavities>/

1. unilocular/
2. bilocular/
3. trilocular/

#122. Fruit <shape in side view>/

1. ovate/
2. oblong/

#123. Fruit <length; mm>/

mm long/

#124. Seeds <length; mm>/

mm long/

#125. Seeds <width; mm>/

mm wide/

#126. Seed maturation/

months/

#127. <Conservation status; whether common, uncommon or threatened >/

1. Common/
2. Uncommon/
3. Threatened/

The data are from Meney and Pate (1999).

#128. Distribution in N.S.W.: <i.e., New South Wales Botanical Districts >/

1. CC <Central Coast>/
2. CT <Central Tablelands>/
3. CWS <Central-west Slopes>/
4. NC <North Coast>/
5. NT <Northern Tablelands>/
6. NWS <North-west Slopes>/
7. SC <South Coast>/
8. ST <Southern Tablelands>/

Data were obtained from the Australasian Virtual Herbarium (accessed 15 Mar. 2024).

#129. Distribution outside N.S.W.: <Occurs outside New South Wales>

1. QLD <Queensland>/
2. SA <South Australia>/
3. TAS <Tasmania>/
4. VIC <Victoria>/
5. WA <Western Australia>/

#130. Figures/ <e.g., SEM, morphology and anatomy images>

This character records the types of figures available for each taxon, facilitating navigation through illustrated content and linking morphological descriptions to specific visual evidence.

Comparative descriptions produced and formatted automatically from the novel DELTA dataset

Baloskion australe (R.Br.) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio australis* R.Br.

Misapplication: *Baloskion gracile* (R.Br.) B.G.Briggs & L.A.S.Johnson.

Common name: Cord rush; mountain cord rush.

Figures 25, 26, 27, 28.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 3.5–10 mm diam.; spreading; ascending, or creeping; superficial; 0–2 cm above ground; when dry reddish-brown, or yellowish-brown. Rhizome trichomes present; pale ginger when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 30–100 mm long; 1.2–2 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes few, or many. Culm surface ribbed; when fresh and when dried; at 40× bullate; at 300× bullate. Culm texture rough to touch; trichomes absent; warts absent; light green when fresh; yellowish brown when dry (see Fig. 3 E3); culms of female plants more intense in colour than males; marbling present. Culm stomata obscured (covered); in grooves; dispersed; covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls undulating; thick. Epidermis uniseriate. Culm stomata sunken. Chlorenchyma present. Chlorenchymatous cells slender; in three layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells multiseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains absent.

Notes on culm. Culms of female plants have more bullate surface than in the males under LM. According to Meney and Pate (1999) the stomata are superficial and chlorenchyma is divided by pillar cells. However, in this study, stomata were observed to be sunken and pillar cells absent. All specimens in NE had the same features. Also, these observations are in accord with those of Johnson and Evans (1963).

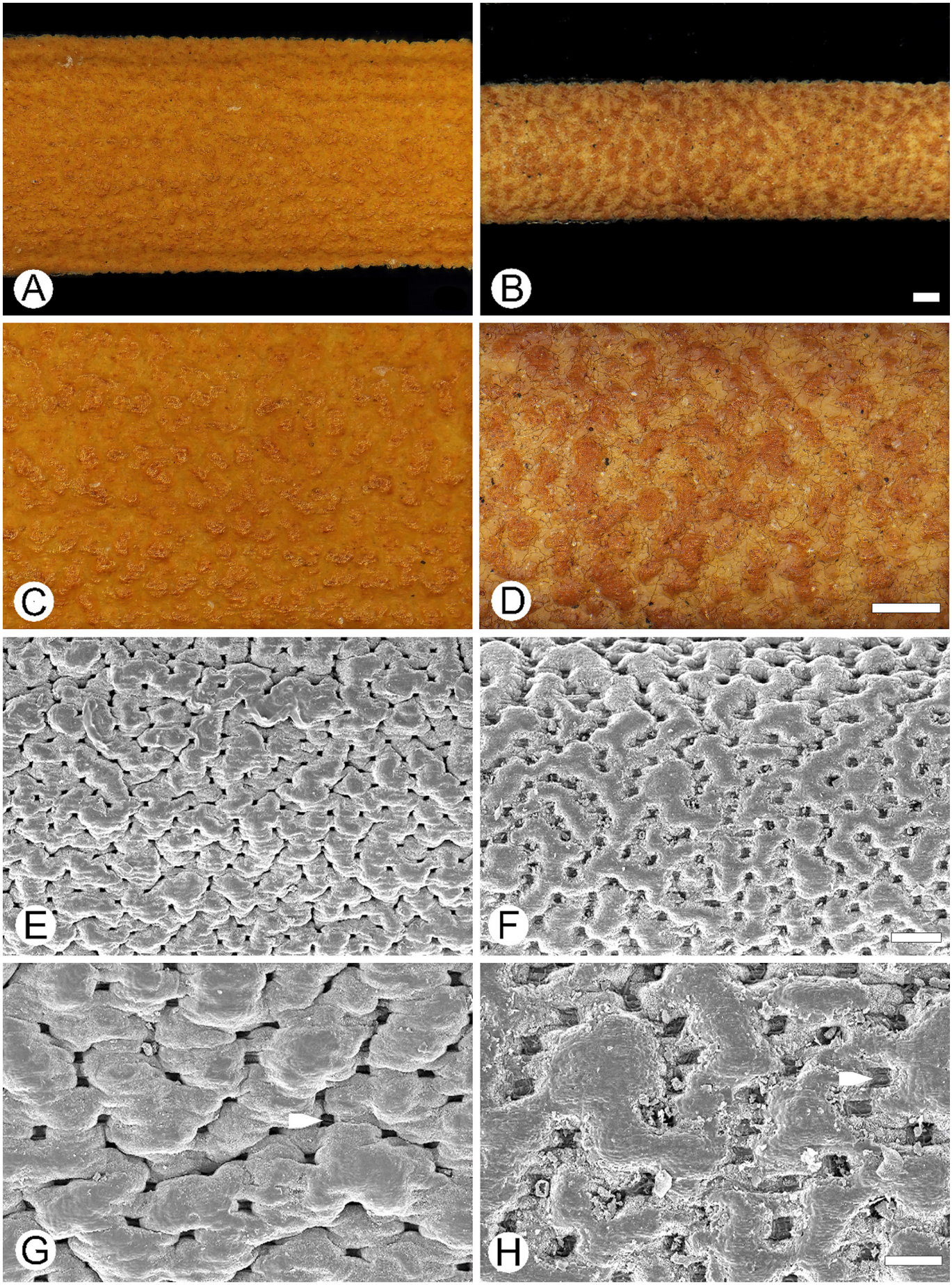

Fig. 25. *Baloskion australe* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*C.J. Skewes s.n.*, Jan. 1954). B, D, F & H, female plant (*E.F. Constable s.n.*, 21 Nov 1961). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

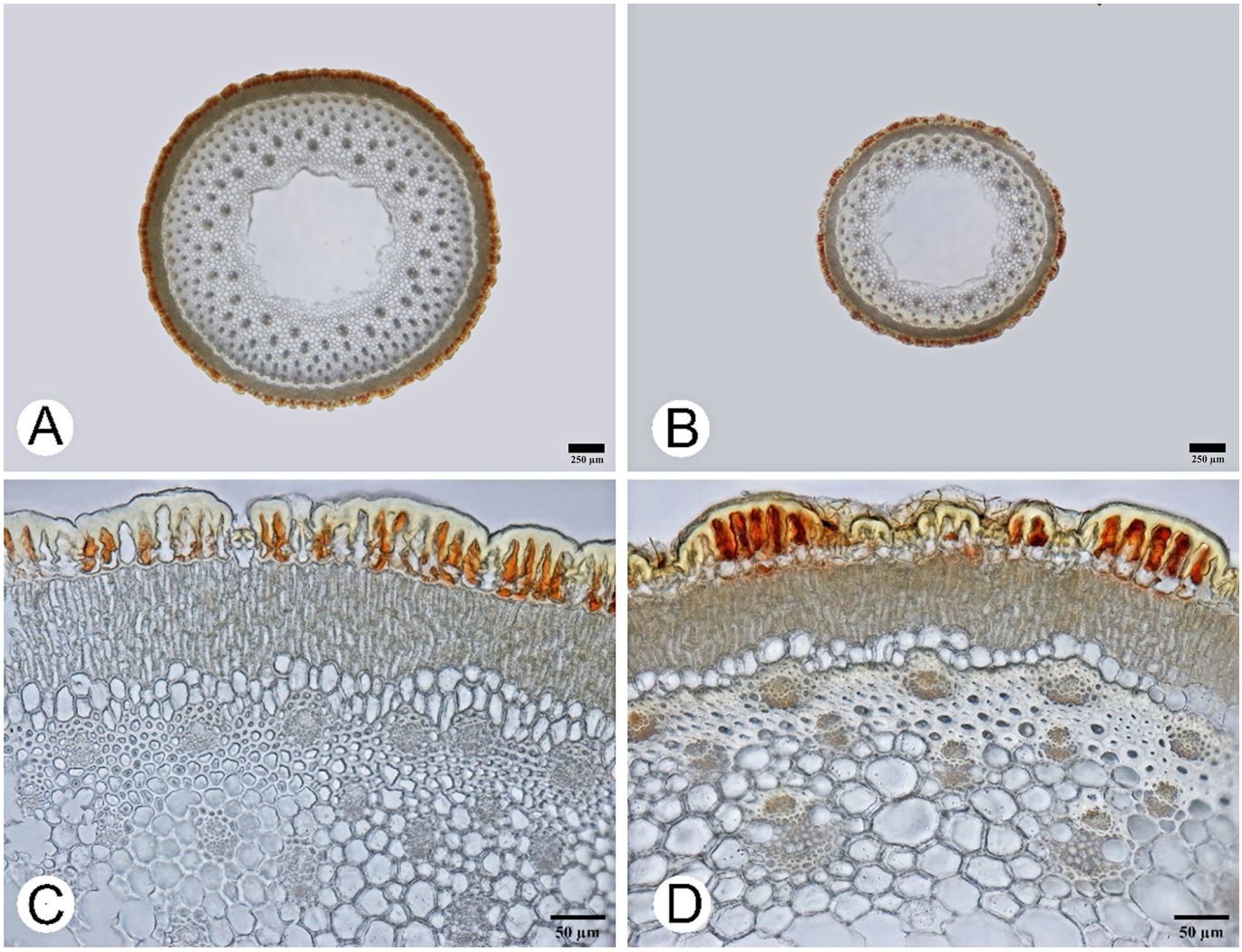

Fig. 26. *Baloskion australe* (R.Br.) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*C.J. Skewes s.n.*, Jan. 1954). B, D, female plant (*E.F. Constable s.n.*, 21 Nov 1961).

Leaf morphology. Leaf sheath appressed; 1–3.5 cm long; dull; striate; orange-brown (see Fig. 19); margins opaque. Leaf sheath apex finely pointed or rounded; hairy; hairs ≤ 1 mm long. Leaf lamina absent.

Inflorescence morphology. Inflorescence bracts longer than the spikelets. Male inflorescence 20–80 mm; with spikelets clustered or dispersed. Spikelets 4–8 per culm; 1–3 per node of the inflorescence. Spikelet 5–7 mm long. Spikelet ovoid, or globose. Flowers 90–300 per culm; 24–45 per spikelet. Glumes acuminate. Glumes glabrous, or short hairs. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2.2–2.4 mm long; inner tepals 2.2–2.4 mm long. Stamens 3. Anthers 0.8–1.2 mm long.

Female inflorescence 20–80 mm; with spikelets dispersed. Spikelets 1–7 per culm; 1–2 per node of the inflorescence. Spikelet 7–10 mm long. Spikelet ovoid. Flowers 25–500 per culm; 24–45 per spikelet. Glumes acuminate. Glumes glabrous, or short hairs. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2.2–2.6 mm long; inner tepals 2.2–2.6 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Summer.

Flowering phenology. January, February, March, November and December.

Fruit morphology. Fruit capsule; unilocular, or bilocular; ovate; 1.2–1.5 mm long.

Seed morphology. Seeds 1.2 mm long. Seed maturation 10–12 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, SC, ST. Distribution outside N.S.W.: TAS, VIC.

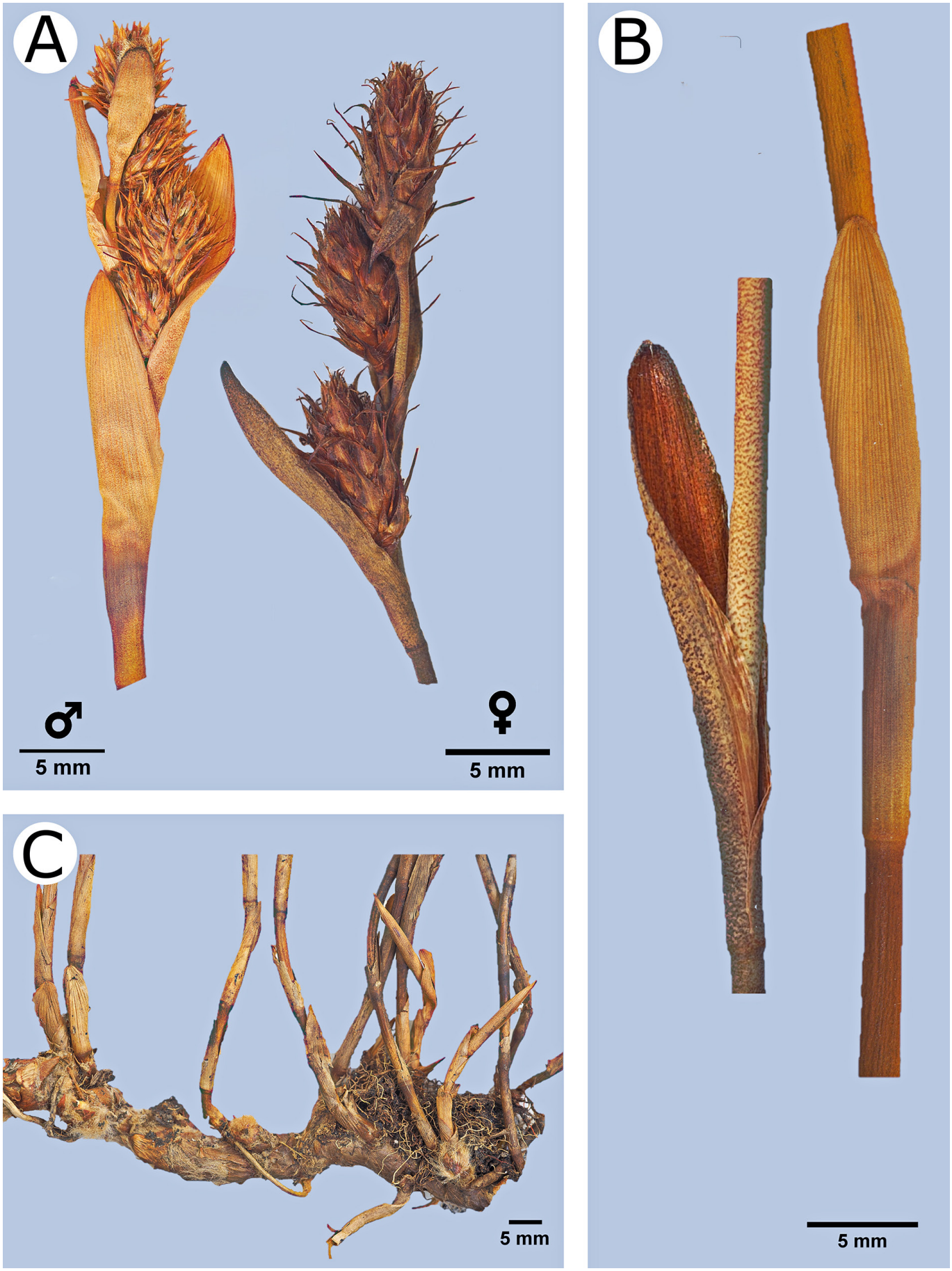

Fig. 27. *Baloskion australe* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male (right) and female (left). C, rhizomes. Male specimen (*C.J. Skewes s.n.*, Jan. 1954) and female specimen (*E.F. Constable s.n.*, 21 Nov 1961).

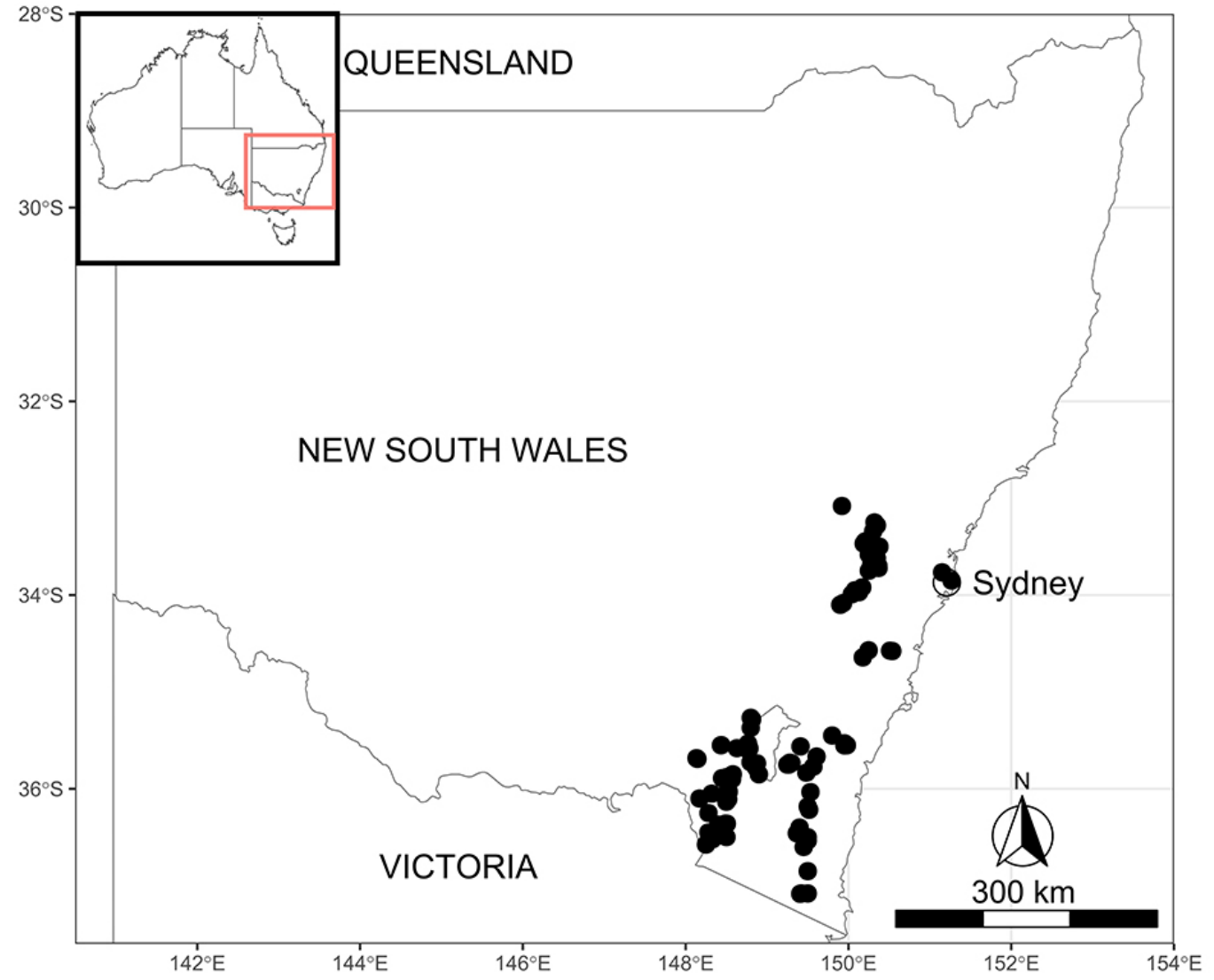

Fig. 28. Distribution of *Baloskion australe* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH.

Baloskion fimbriatum (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio fimbriatus* L.A.S.Johnson & O.D.Evans.

Figures 29, 30, 31, 32.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 3.25–7 mm diam.; spreading or tufted; ascending, or creeping; subterranean; more than 1 cm deep; reddish-brown; when dry reddish-brown. Rhizome trichomes present; pale ginger when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged closely or widely spaced. Culms 20–85 mm long; 0.5–1.2 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes many. Culm surface not ribbed; only when dried; at 40× smooth; at 300× minutely rugose. Culm texture smooth to touch; trichomes absent; warts absent; light green when fresh; dark greenish when dry (see Fig. 3 C3), or yellowish brown when dry (see Fig. 3 E3); culms of female plants more intense in colour than males; marbling present. Culm stomata obvious; superficial; in rows, or in ± rounded clusters; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains absent.

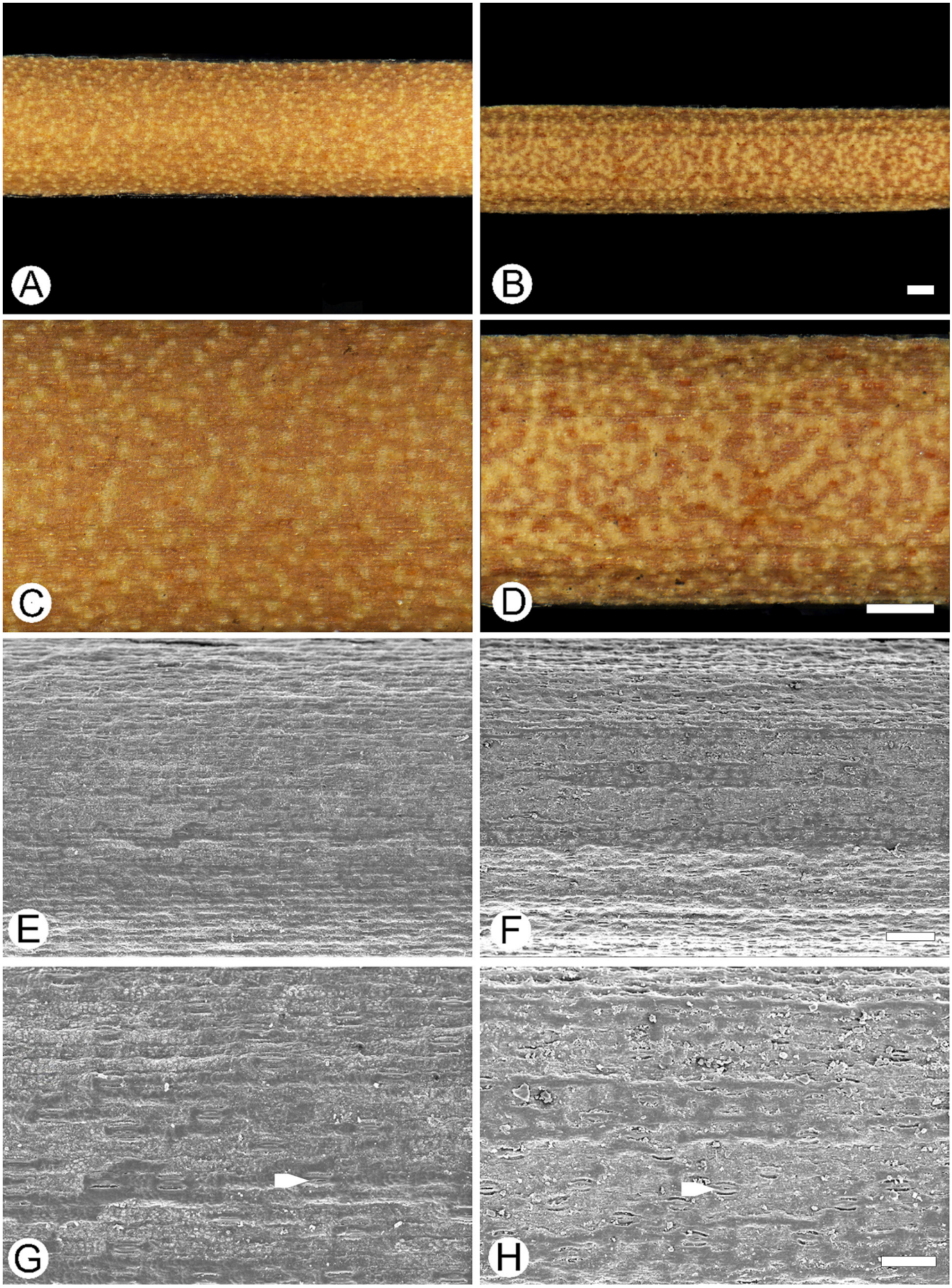

Fig. 29. *Baloskion fimbriatum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant. B, D, F, H female plant (*E.F. Constable s.n.*, 19 Jan. 1961). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

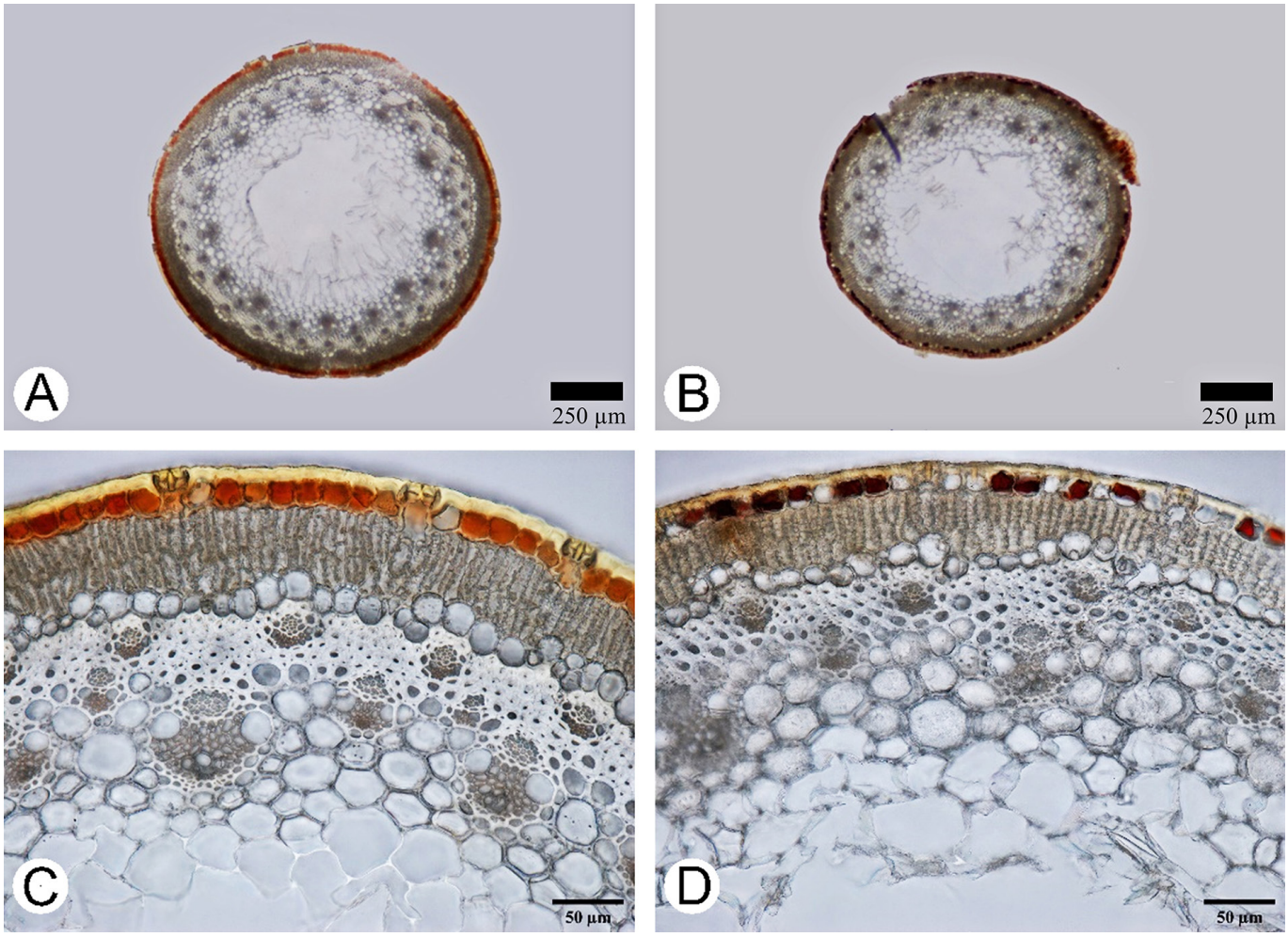

Fig. 30. *Baloskion fimbriatum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*K.A. McColl 2998*, 22 Jan. 1998). B, D, female plant (*E.F. Constable s.n.*, 19 Jan. 1961).

Leaf morphology. Leaf sheath appressed; 1–1.5 cm long; dull; smooth, or striate; light brown (see Fig. 19); margins opaque. Leaf sheath apex finely pointed; hairy; hairs > 1 mm long. Leaf lamina absent.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 8–45 mm; with spikelets dispersed. Spikelets 4–6 per culm; 1–2 per node of the inflorescence. Spikelet 6–8 mm long. Spikelet globose. Flowers 100–200 per culm; 25–35 per spikelet. Glumes acuminate, or caudate. Glumes long hairs. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1.8 mm long; inner tepals 1.8 mm long. Stamens 3. Anthers 1.1–1.3 mm long.

Female inflorescence 10–60 mm; with spikelets clustered or dispersed. Spikelets 1–7 per culm; 1–2 per node of the inflorescence. Spikelet 5–9 mm long. Spikelet ovoid. Flowers 25–700 per culm; 25–35 per spikelet. Glumes acuminate, or caudate. Glumes long hairs. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer shorter than the inner; outer tepals 1.5–2.4 mm long; inner tepals 2–2.7 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Spring and Summer.

Flowering phenology. January, February, March, October, November and December.

Fruit morphology. Fruit capsule; bilocular; ovate; 1–1.2 mm long.

Seed morphology. Seeds 0.8 mm long; 0.4 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, NT, NC, SC, ST Distribution outside N.S.W.: QLD.

Fig. 31. *Baloskion fimbriatum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*K.A. McColl 2998*, 22 Jan. 1998 and' (SO: ...1998) and female specimen (*E.F. Constable s.n.*, 19 Jan. 1961).

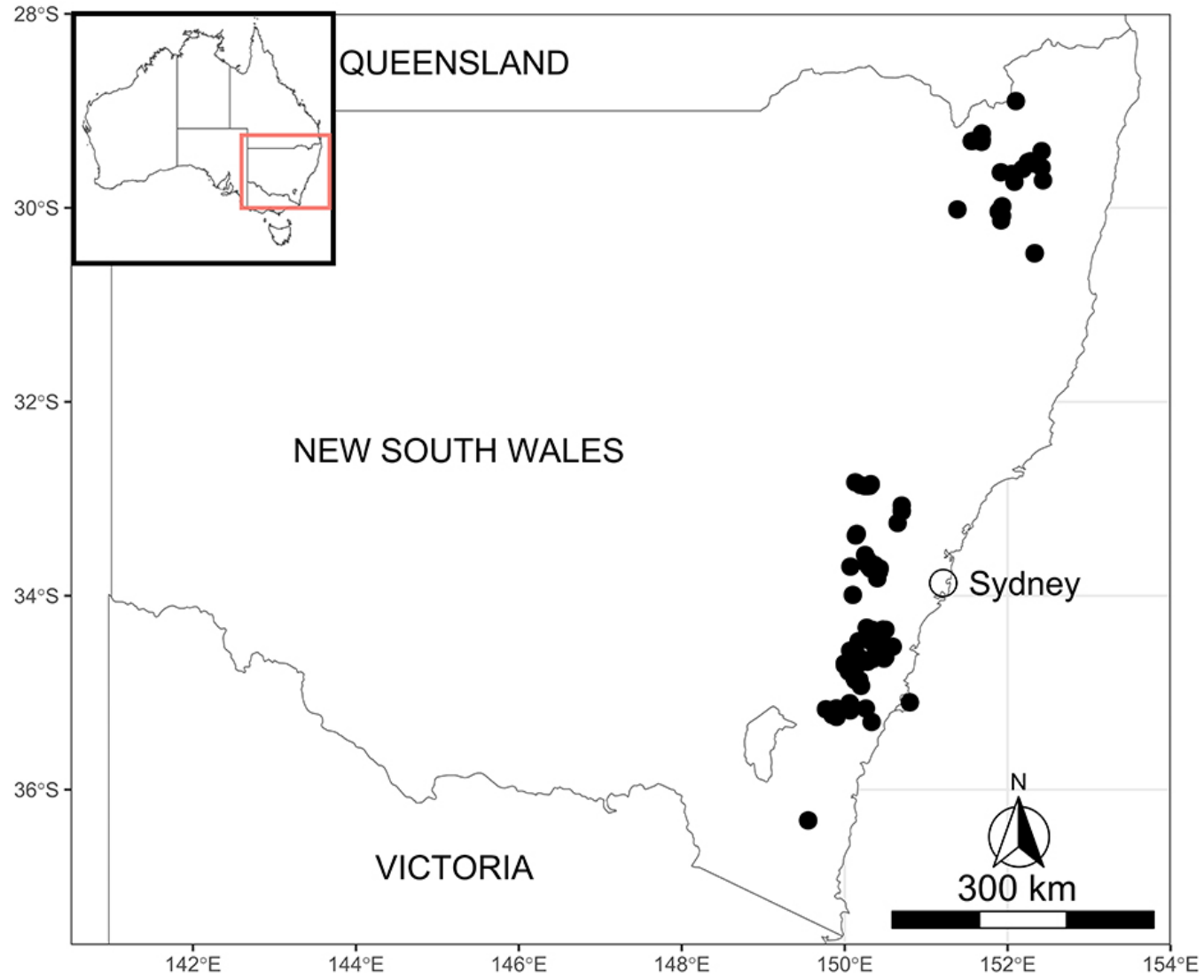

Fig. 32. Distribution of *Baloskion fimbriatum* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Baloskion gracile (R.Br.) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio gracilis* R.Br.

Misapplication: *Baloskion australe* (R.Br.) B.G.Briggs & L.A.S.Johnson.

Common name: Slender cord-rush.

Figures 33, 34, 35, 36.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 3–4.5 mm diam.; spreading or tufted; creeping; subterranean, or superficial; to 1 cm deep; orange-brown, or grey; when dry mid-brown. Rhizome trichomes present; cream when fresh; cream when dry. Rhizome scales present; red-brown.

Culm morphology. Culms on the rhizome arranged closely spaced. Culms 30–100 mm long; 0.75–1.5 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes many. Culm surface ribbed; when fresh and when dried; at 40× minutely rugose; at 300× striate, or minutely rugose. Culm texture smooth to touch; trichomes absent; warts absent; dark green when fresh; dark greenish when dry (see Fig. 3 C3), or yellowish brown when dry (see Fig. 3 E3); culms of female plants more intense in colour than males; marbling present. Culm stomata obvious; superficial; in rows, or in ± rounded clusters; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains absent.

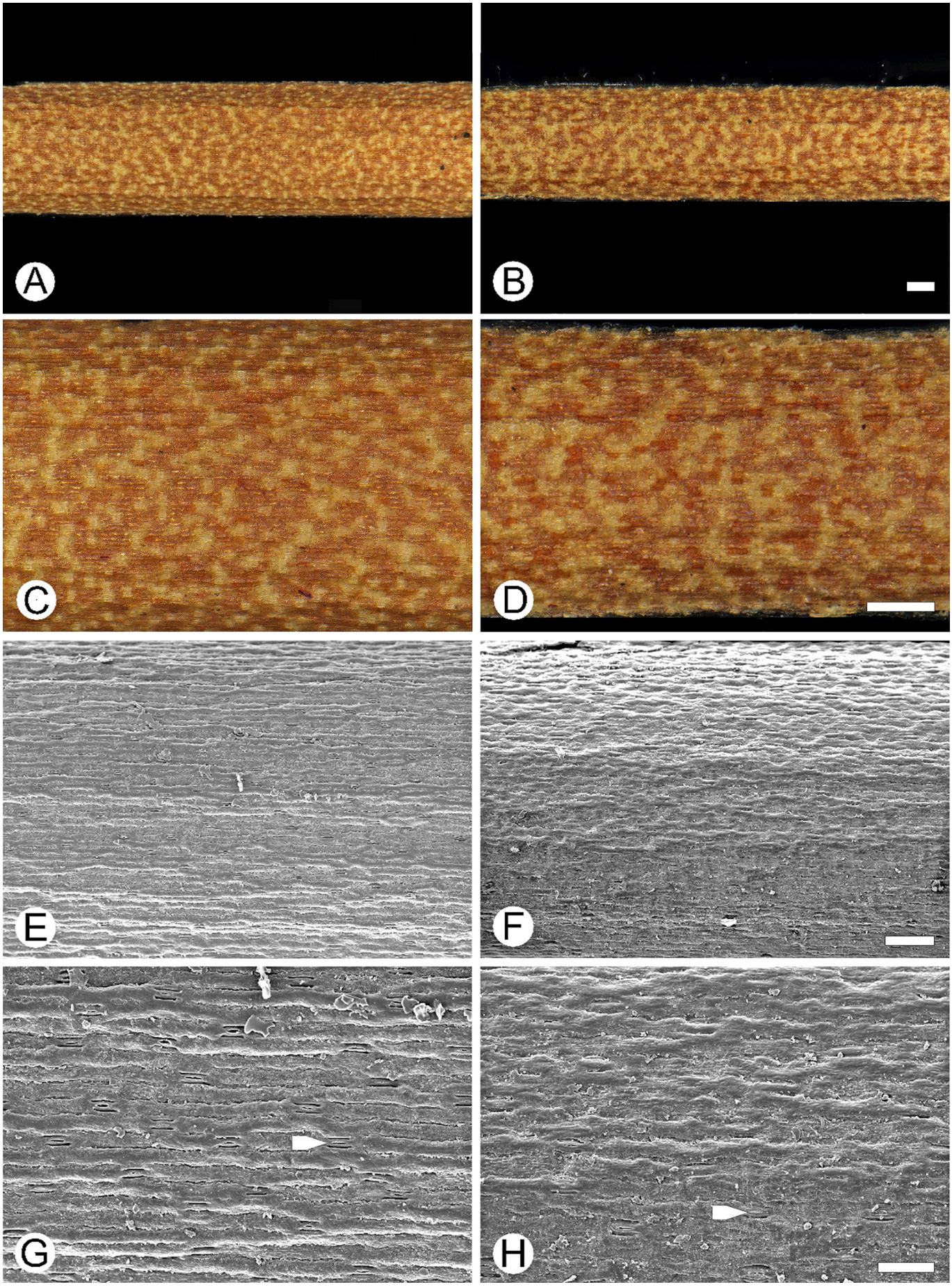

Fig. 33. *Baloskion gracile* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*O.D. Evans s.n.*, 6 Dec. 1960). B, D, F, H female plant (*O.D. Evans s.n.*, 8 Dec. 1961). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

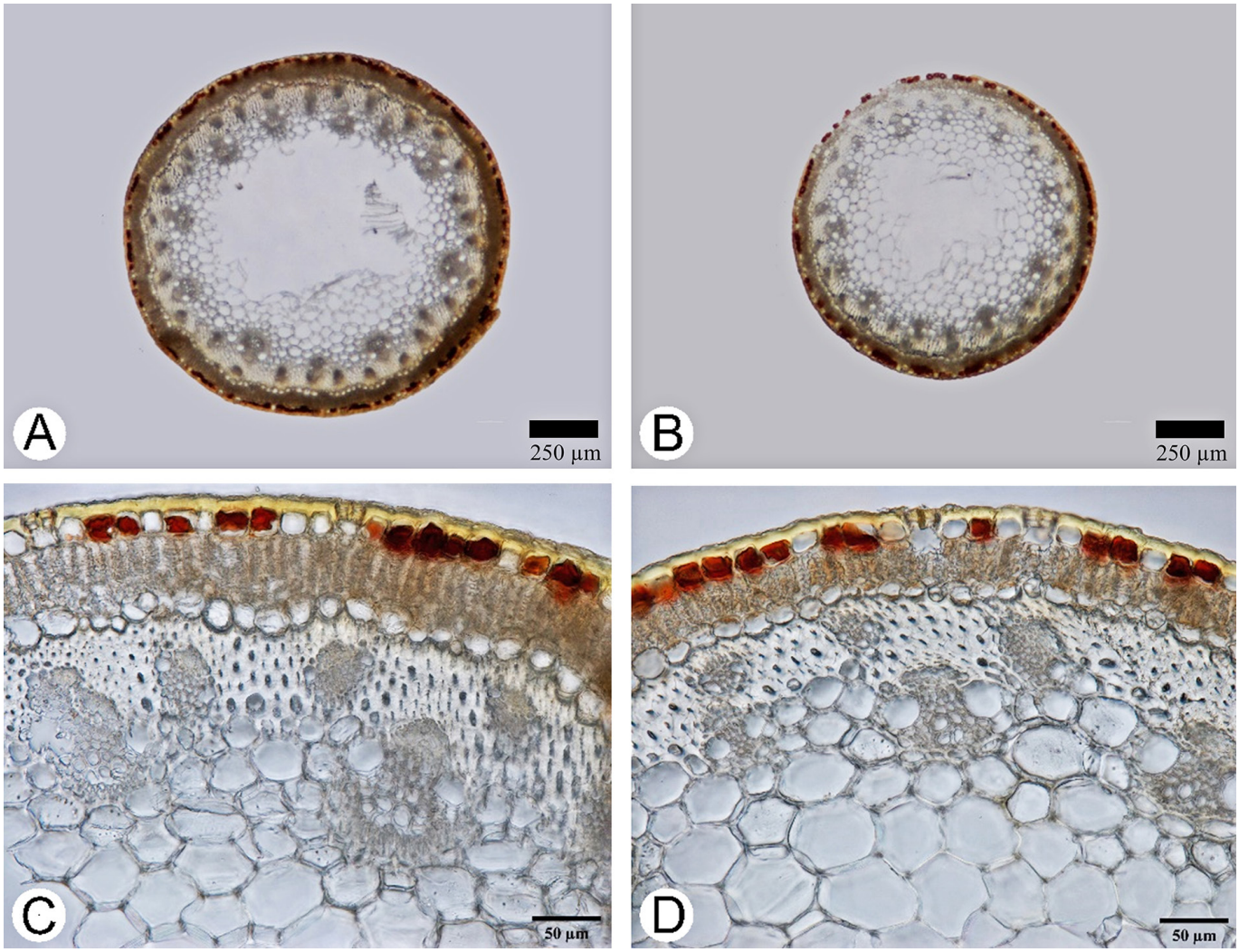

Fig. 34. *Baloskion gracile* (R.Br.) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*O.D. Evans s.n.*, 6 Dec. 1960). B, D, female plant (*O.D. Evans s.n.*, 8 Dec. 1961).

Leaf morphology. Leaf sheath appressed; 2–3 cm long; dull; smooth, or striate; light brown (see Fig. 19); margins opaque. Leaf sheath apex elongated or rounded; glabrous; hairs > 1 mm long. Leaf lamina absent.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 40–90 mm; with spikelets dispersed. Spikelets 4–12 per culm; 2–3 per node of the inflorescence. Spikelet 5–8 mm long. Spikelet globose. Flowers 70–250 per culm; 18–24 per spikelet. Glumes caudate, or cuspidate. Glumes glabrous. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2–2.5 mm long; inner tepals 2–2.5 mm long. Stamens 3. Anthers 1.5–2 mm long.

Female inflorescence 25–80 mm; with spikelets dispersed. Spikelets 2–9 per culm (14); 2–3 per node of the inflorescence. Spikelet 8–13 mm long. Spikelet oblong-cylindrical. Flowers 25–200 per culm; 14–24 per spikelet. Glumes caudate, or cuspidate. Glumes glabrous. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2–2.5 mm long; inner tepals 2–2.5 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Spring and Summer.

Flowering phenology. January, February, September, October, November and December.

Fruit morphology. Fruit capsule; bilocular; ovate; 1.2–1.5 mm long.

Seed morphology. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, SC, ST.

Fig. 35. *Baloskion gracile* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*O.D. Evans s.n.*, 6 Dec. 1960) and female specimen (*O.D. Evans s.n.*, 8 Dec. 1961).

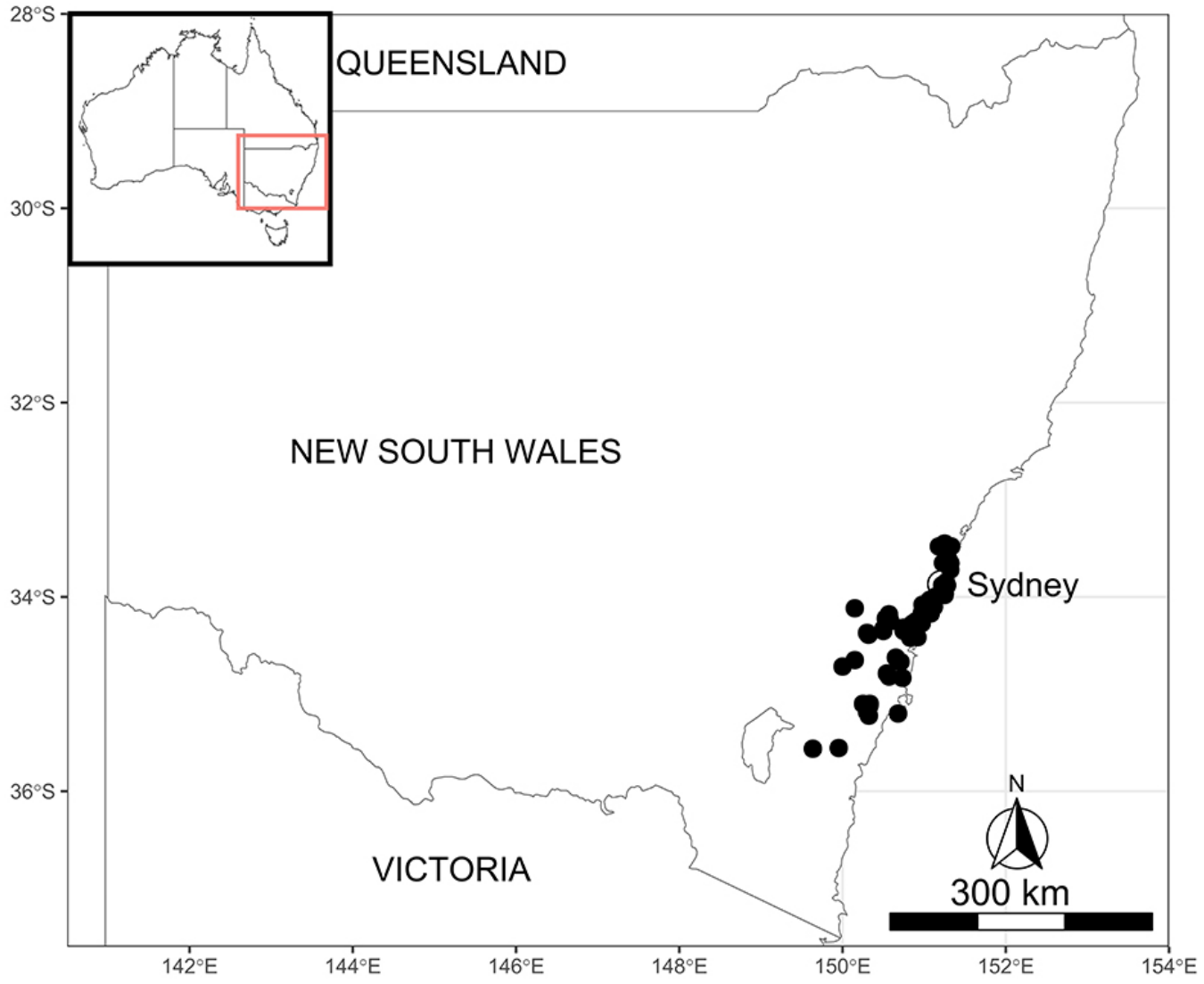

Fig. 36. Distribution of *Baloskion gracile* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Baloskion longipes (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio longipes* L.A.S.Johnson & O.D.Evans.

Figures 37, 38, 39, 40.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 7–10 mm diam.; spreading; ascending, or creeping; subterranean; 1–2 cm deep; when dry mid-brown, or yellowish-brown. Rhizome trichomes pale ginger when dry. Rhizome scales present; red-brown.

Culm morphology. Culms on the rhizome arranged closely spaced. Culms 90–150 mm long; 2–2.5 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes many. Culm surface ribbed; when fresh and when dried; at 40× smooth; at 300× bullate. Culm texture smooth to touch; trichomes absent; warts absent; dark brown when dry (see Fig. 3 F2); marbling present. Culm stomata obvious; superficial, or in grooves; in rows, or in ± rounded clusters; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls undulating; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present.

Notes on culm. The culms of the females are more obviously bullate than the males in *Baloskion longipes*, as seen under SEM (Fig. 31).

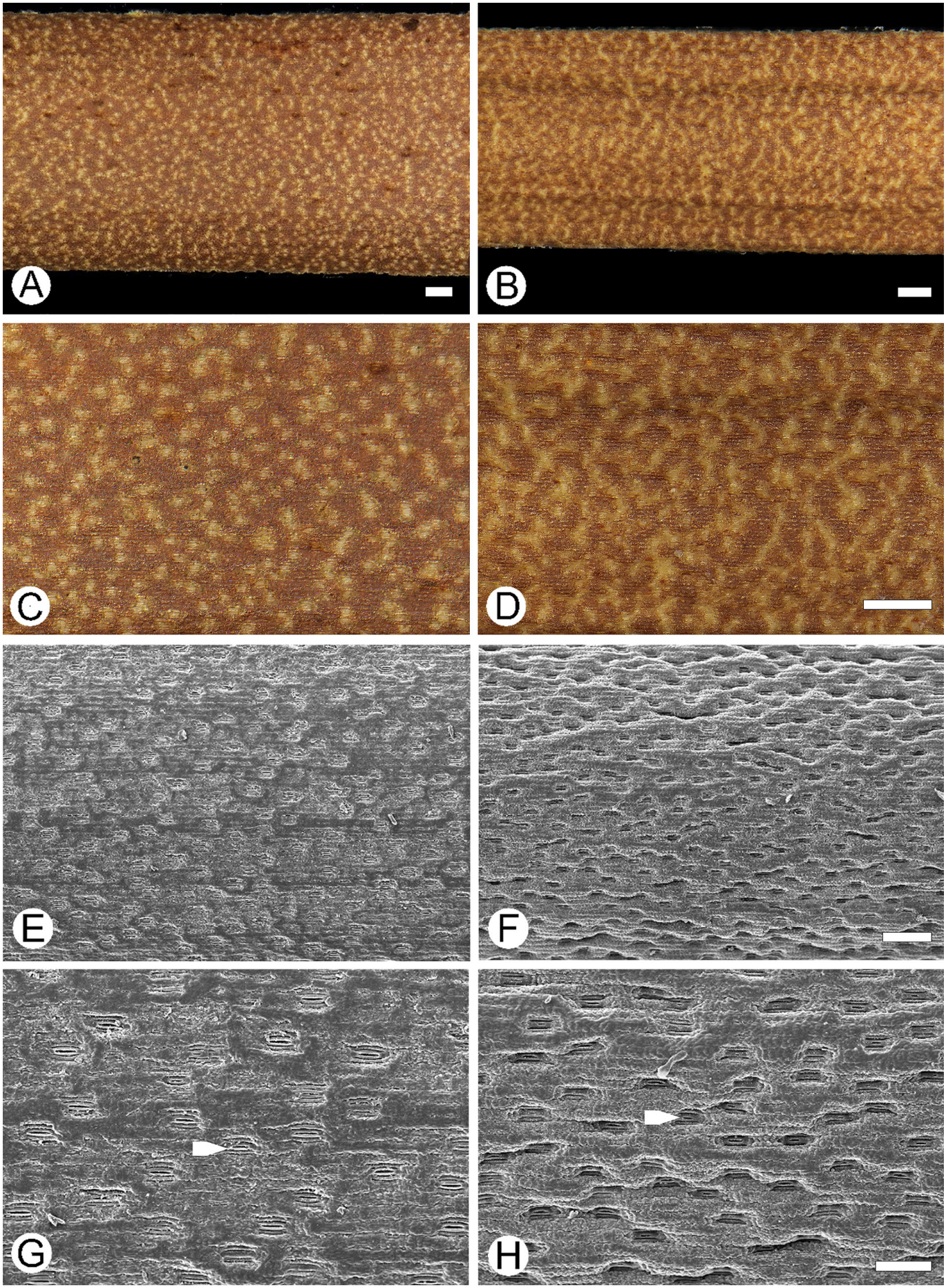

Fig. 37. *Baloskion longipes* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*M. Gray 5665*, 14 Jan. 1965). B, D, F, H female plant (*L.A.S. Johnson s.n.*, 8 Dec. 1968). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

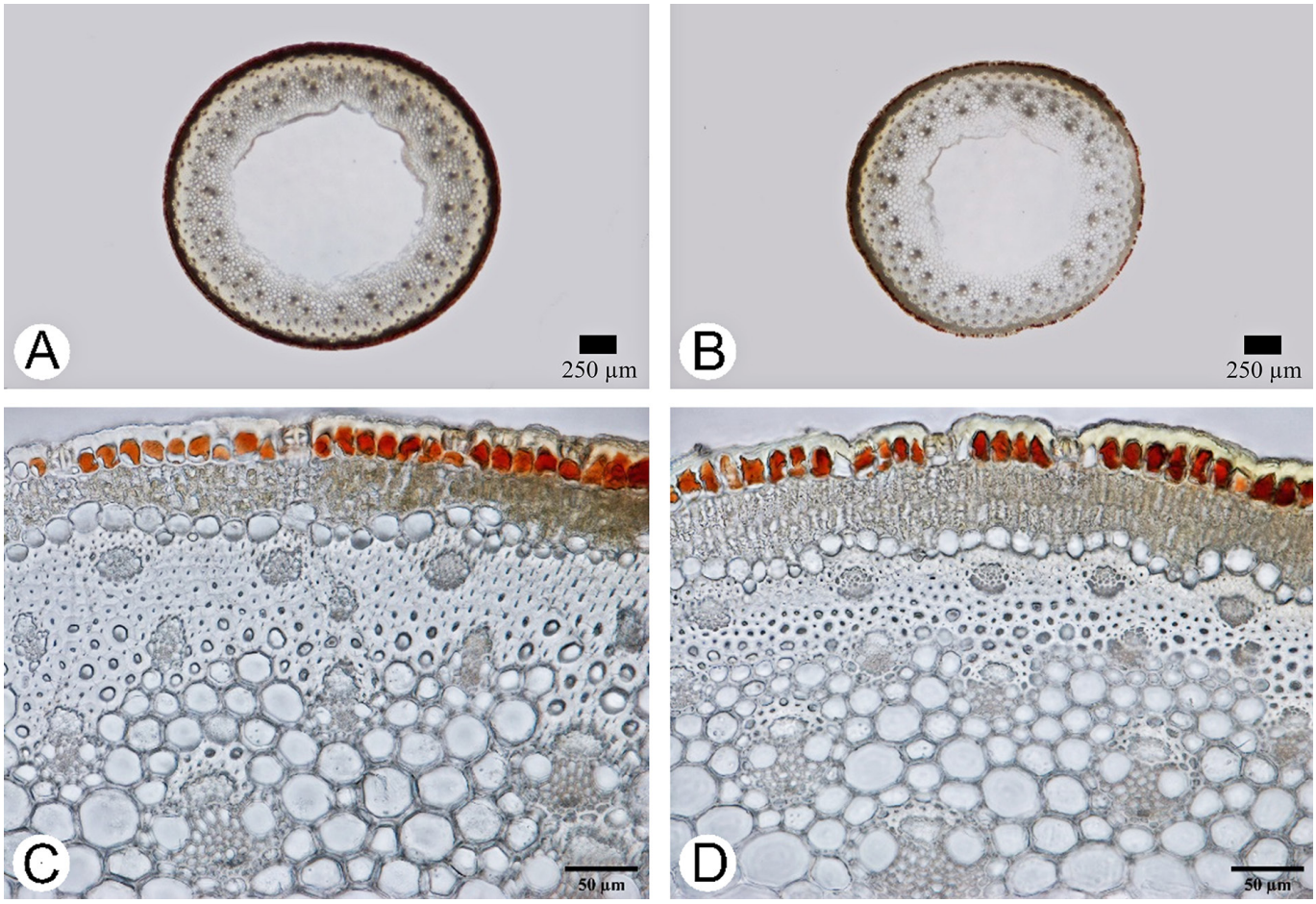

Fig. 38. *Baloskion longipes* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*M. Gray 5665*, 14 Jan. 1965). B, D, female plant (*L.A.S. Johnson s.n.*, 8 Dec. 1968).

Leaf morphology. Leaf sheath appressed; 2–3 cm long; dull; smooth, or striate; margins opaque. Leaf sheath apex rounded; glabrous; hairs > 1 mm long. Leaf lamina absent.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 50–60 mm; with spikelets clustered or dispersed. Spikelets 6–25 per culm; 1–4 per node of the inflorescence. Spikelet 4–8 mm long. Spikelet ovoid, or globose. Flowers 150–1000 per culm; 25–40 per spikelet. Glumes caudate, or cuspidate. Glumes glabrous. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1.8–2.2 mm long; inner tepals 1.8–2.2 mm long. Stamens 3. Anthers 1.2–1.5 mm long.

Female inflorescence 75–180 mm; with spikelets clustered or dispersed. Spikelets 12–15 per culm; 1–4 per node of the inflorescence. Spikelet 8–10 mm long. Spikelet ovoid. Flowers 250–500 per culm; 22–34 per spikelet. Glumes caudate, or cuspidate. Glumes glabrous, or short hairs. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2–2.2 mm long; inner tepals 2–2.2 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Autumn and Summer.

Flowering phenology. January, February, March, April and December.

Fruit morphology. Fruit capsule; bilocular; ovate.

Seed morphology. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CT, ST.

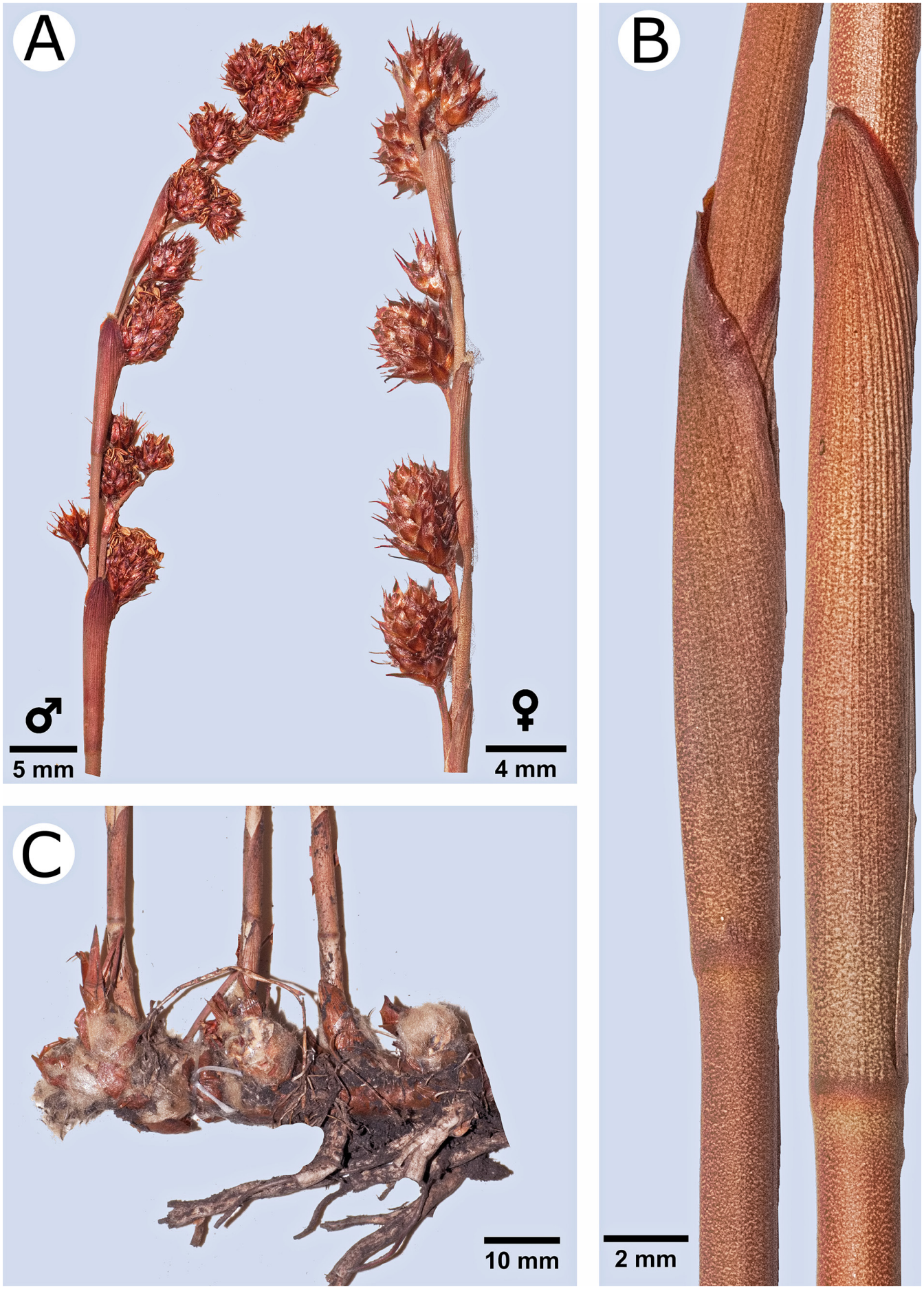

Fig. 39. *Baloskion longipes* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*M. Gray 5665*, 14 Jan. 1965) and female specimen (*L.A.S. Johnson s.n.*, 8 Dec. 1968).

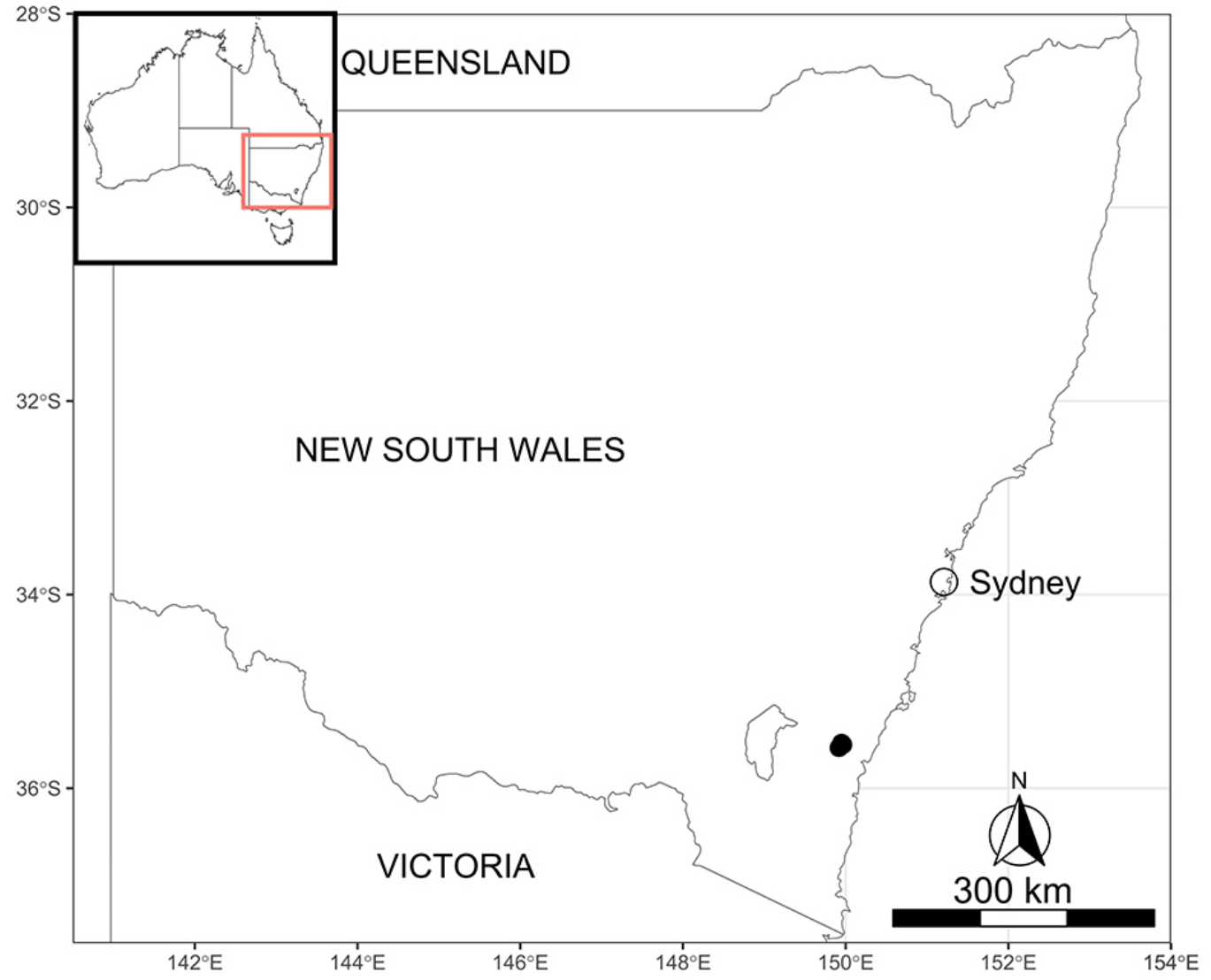

Fig. 40. Distribution of *Baloskion longipes* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Baloskion pallens (R.Br.) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio pallens* R.Br.

Figures 41, 42, 43, 44.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 5–8.5 mm diam.; spreading; creeping; subterranean; to 2 cm deep; when dry mid-brown. Rhizome trichomes present; pale ginger when fresh; pale ginger when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 45–100 mm long; 1.5–2.5 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes many. Culm surface ribbed; when fresh and when dried; at 40× smooth; at 300× striate. Culm texture smooth to touch; trichomes absent; warts absent; greenish-brown when dry (see Fig. 3 D3), or dark brown when dry (see Fig. 3 F2); marbling present. Culm stomata obvious; superficial; in rows, or in ± rounded clusters; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete or slightly compressed; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; partial; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains absent.

Leaf morphology. Leaf sheath appressed; 1–2 cm long; dull; smooth, or striate; light brown (see Fig. 19); margins opaque. Leaf sheath apex rounded; glabrous. Leaf lamina absent.

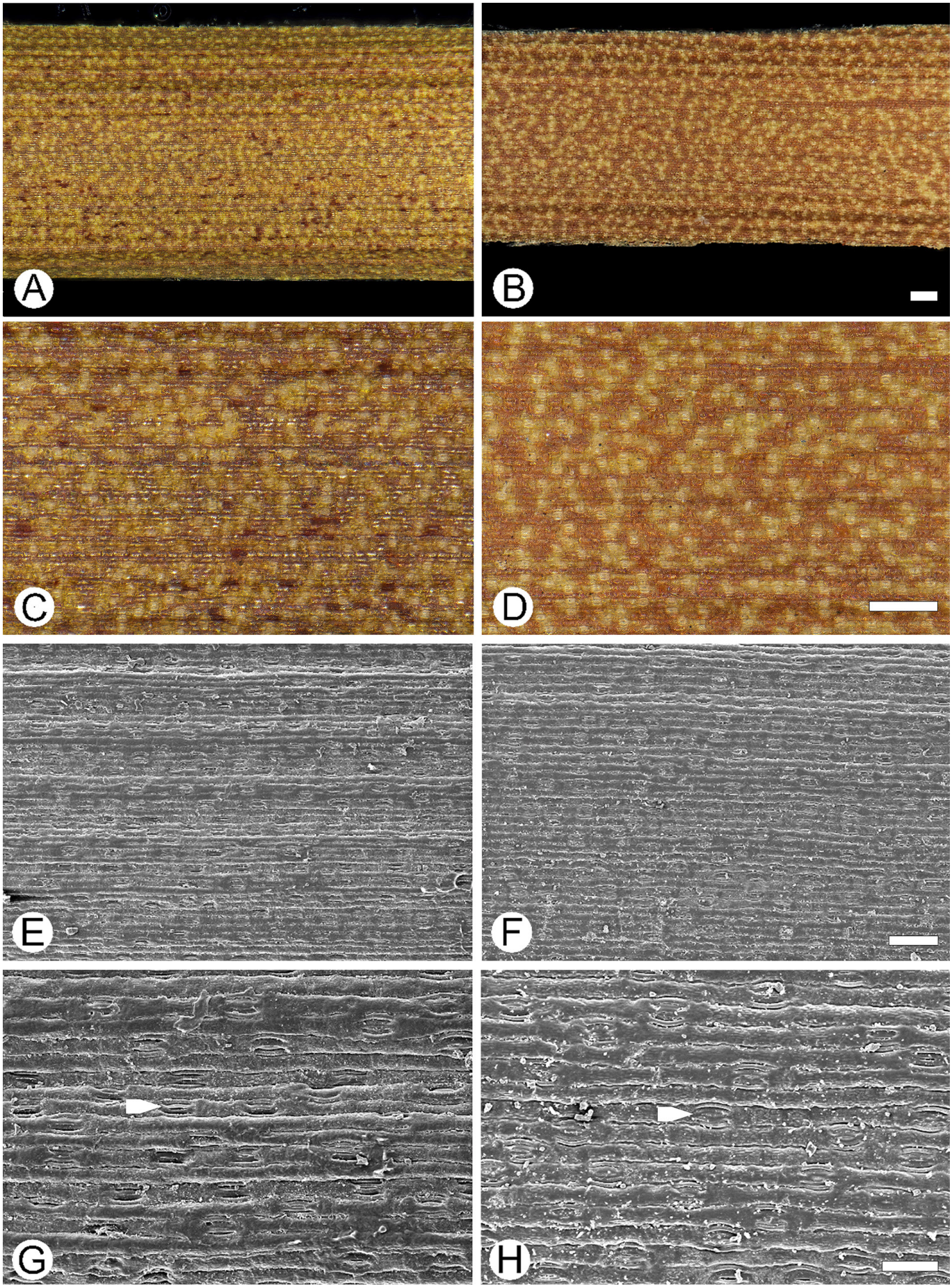

Fig. 41. *Baloskion pallens* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*E.F. Constable s.n.*, 6 Jan. 1961). B, D, F, H female plant (*E.F. Constable s.n.*, 6 Jan. 1961). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

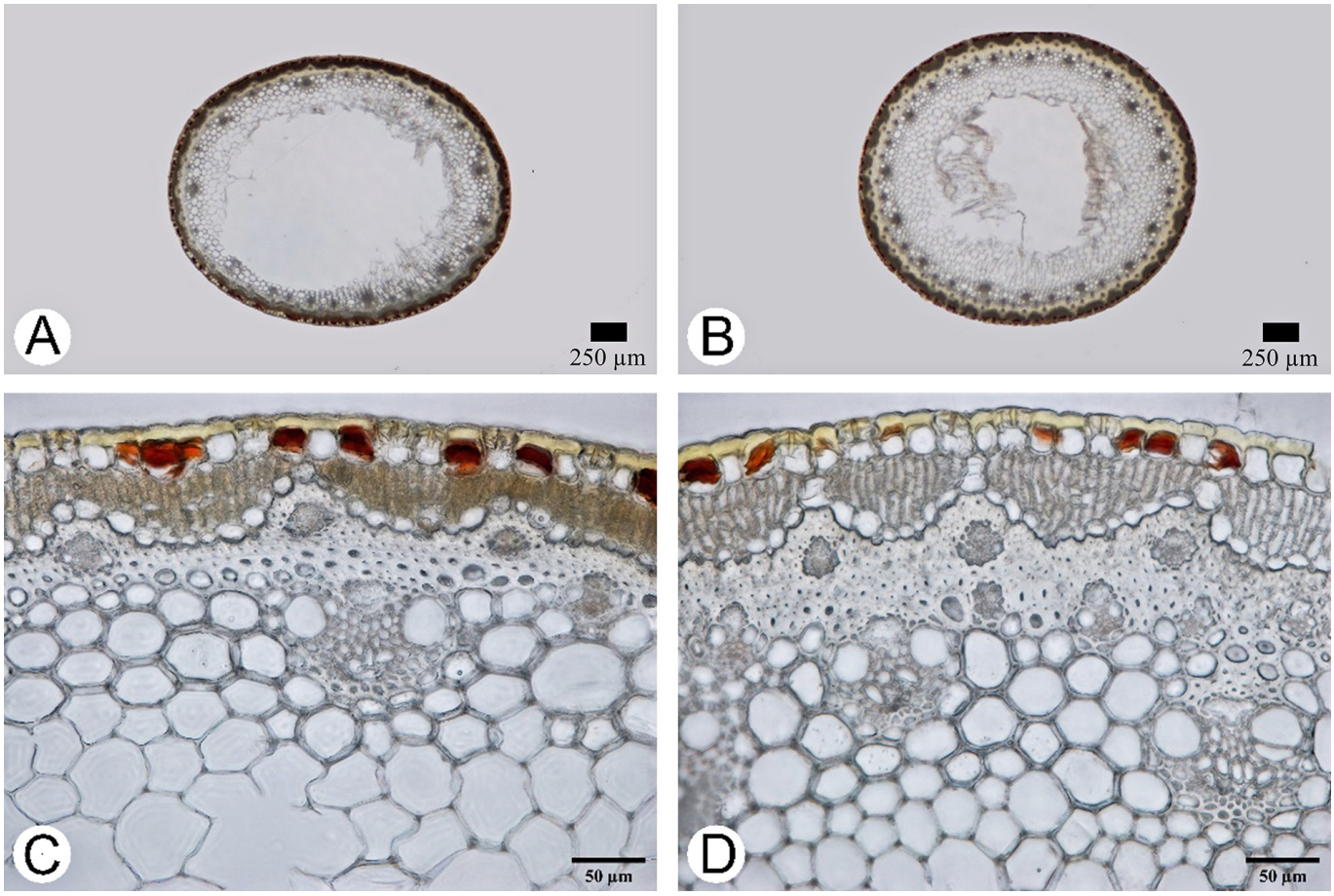

Fig. 42. *Baloskion pallens* (R.Br.) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*E.F. Constable s.n.*, 6 Jan. 1961). B, D, female plant (*E.F. Constable s.n.*, 6 Jan. 1961).

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 10–90 mm; with spikelets clustered or dispersed. Spikelets 13–60 per culm; 4–6 per node of the inflorescence. Spikelet 5–7 mm long. Spikelet globose. Flowers 300–900 per culm; 24–30 per spikelet. Glumes cuspidate. Glumes glabrous, or long hairs. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer shorter than the inner; outer tepals 1.4–1.8 mm long; inner tepals 1.8–2 mm long. Stamens 3. Anthers 0.8–1 mm long.

Female inflorescence 10–20 mm; with spikelets clustered or dispersed. Spikelets 11–30 per culm; 3–7 per node of the inflorescence. Spikelet 5–7 mm long. Spikelet ovoid. Flowers 300–500 per culm; 25–32 per spikelet. Glumes cuspidate. Glumes glabrous, or long hairs. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer shorter than the inner; outer tepals 1.7–2.4 mm long; inner tepals 2–2.5 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Summer.

Flowering phenology. January, February and December.

Fruit morphology. Fruit capsule; bilocular; ovate; 1.6–1.8 mm long.

Seed morphology. Seeds 0.5 mm long; 0.25 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, NC, NT. Distribution outside N.S.W.: QLD.

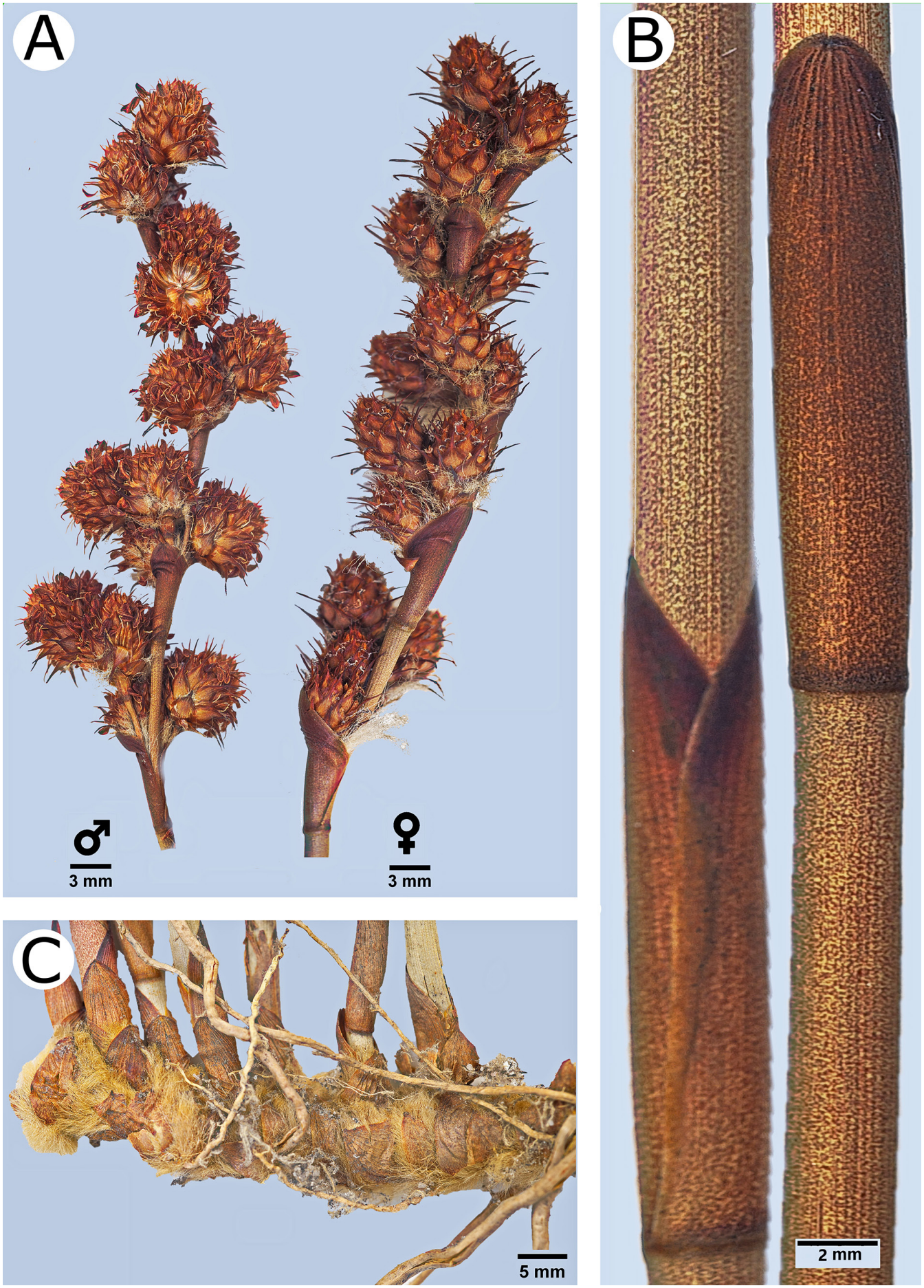

Fig. 43. *Baloskion pallens* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*E.F. Constable s.n.*, 6 Jan. 1961) and female specimen (*E.F. Constable s.n.*, 6 Jan. 1961).

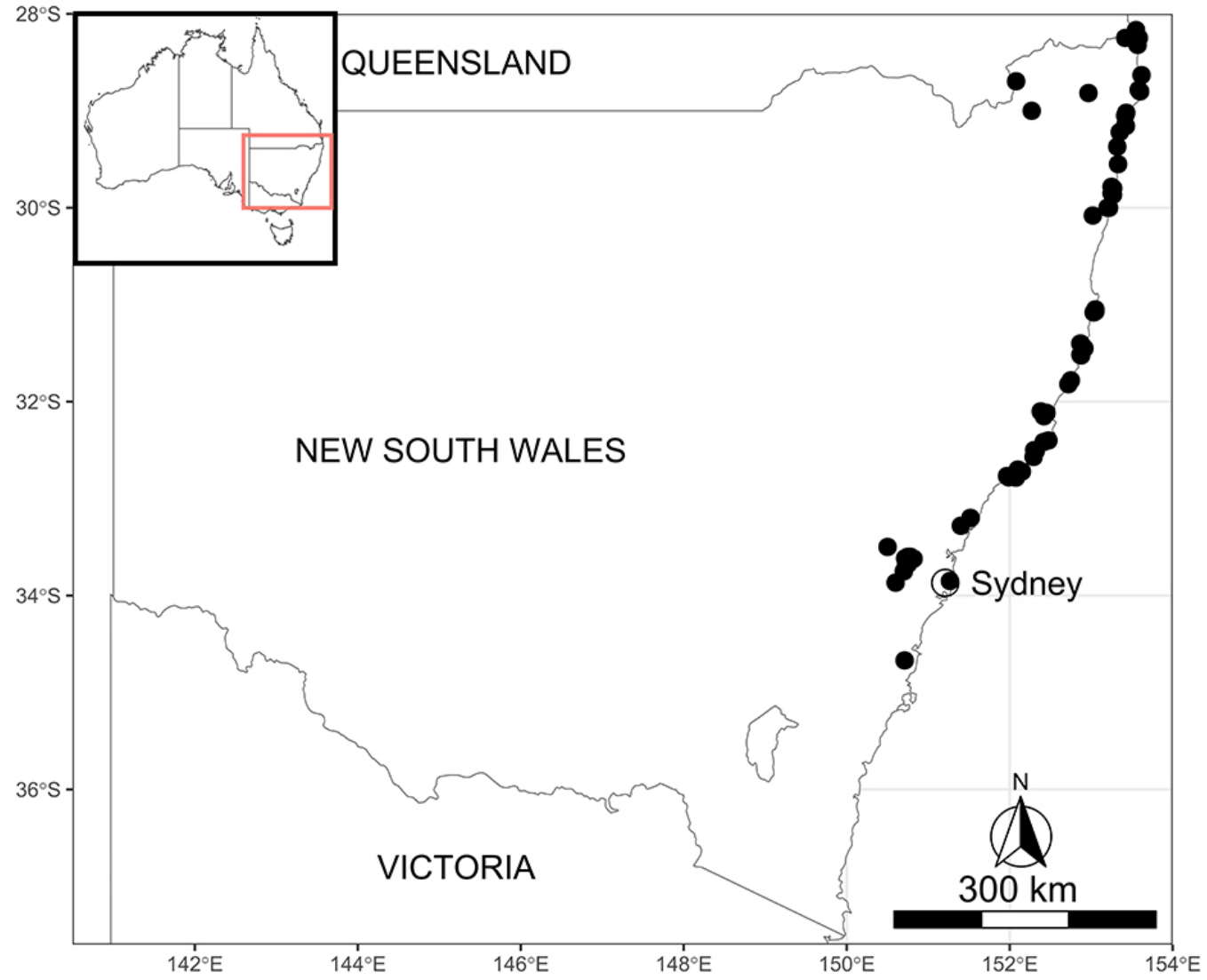

Fig. 44. Distribution of *Baloskion pallens* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Baloskion stenocoleum (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio stenocoleus* L.A.S.Johnson & O.D.Evans.

Figures 45, 46, 47, 48.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 5.5–9 mm diam.; spreading; creeping; subterranean; 3–5 cm deep; when dry mid-brown. Rhizome trichomes present; pale ginger when fresh; pale ginger when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 50–150 mm long; 1–3 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes many. Culm surface not ribbed; at 40× smooth; at 300× smooth. Culm texture smooth to touch; trichomes absent; warts absent; yellow-green when fresh; yellowish brown when dry (see Fig. 3 E3), or dark brown when dry (see Fig. 3 F2); culms of female plants more intense in colour than males; marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity present; circular. Silica present; stegmata present. Starch grains present.

Leaf morphology. Leaf sheath appressed; 1.5–4 cm long; dull; striate; red-brown (see Fig. 19); margins opaque. Leaf sheath apex finely pointed; hairy; hairs ≤ 1 mm long. Leaf lamina absent.

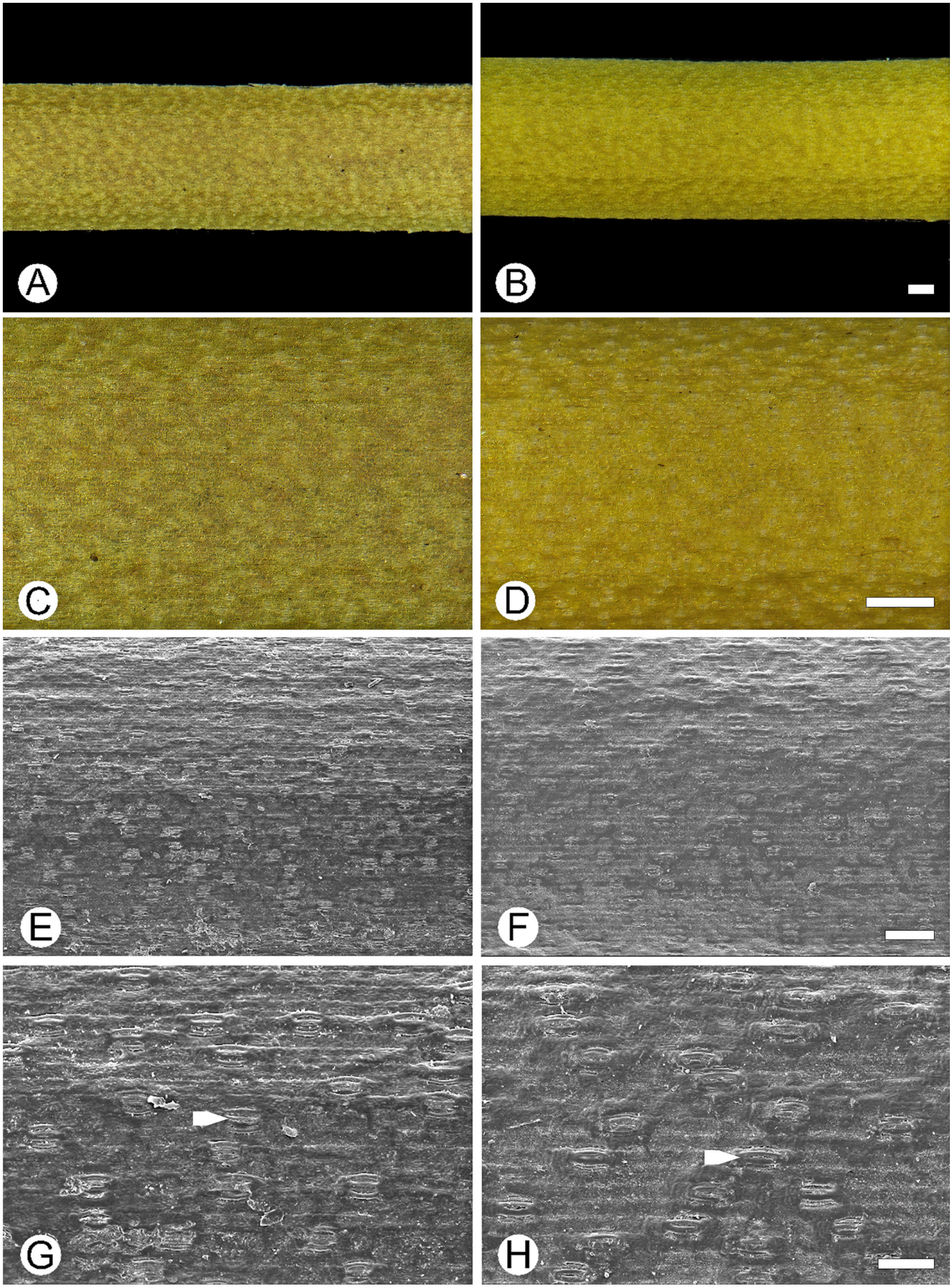

Fig. 45. *Baloskion stenocoleum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*Z. Growns 3*, 22 Feb. 2014). B, D, F, H, female plant (*J.R. Hosking 4042*, 17 Jun. 2018). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

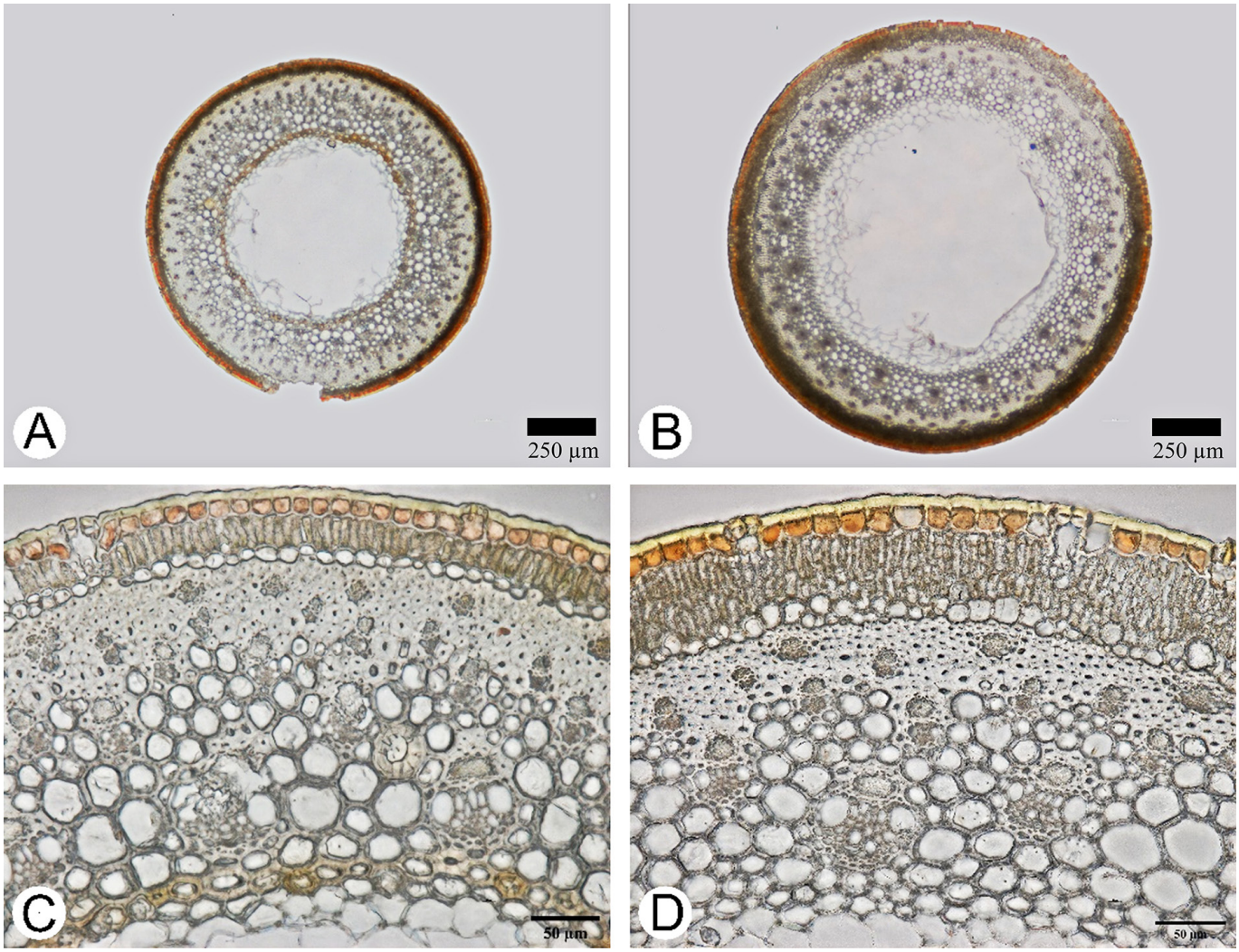

Fig. 46. *Baloskion stenocoleum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*Z. Growns 3*, 22 Feb. 2014). B, D, female plant (*J.R. Hosking 4042*, 17 Jun. 2018).

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 25–45 mm; with spikelets clustered or dispersed. Spikelets 5–15 per culm; 2–3 per node of the inflorescence. Spikelet 5–10 mm long. Spikelet ovoid, or globose. Flowers 100–400 per culm; 25–30 per spikelet. Glumes caudate, or cuspidate. Glumes short hairs. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2–2.5 mm long; inner tepals 2–2.5 mm long. Stamens 3. Anthers 1.2–1.4 mm long.

Female inflorescence 30–120 mm; with spikelets clustered. Spikelets 5–12 per culm; 2–4 per node of the inflorescence. Spikelet 5–10 mm long. Spikelet ovoid. Flowers 100–500 per culm; 25–35 per spikelet. Glumes caudate, or cuspidate. Glumes short hairs. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2–2.3 mm long; inner tepals 1.6–2.6 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Spring and Summer.

Flowering phenology. January, February, March, October, November and December.

Fruit morphology. Fruit capsule; bilocular; ovate; 0.8–1 mm long.

Seed morphology. Seeds 1 mm long; 0.5 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CT, NC, NT. Distribution outside N.S.W.: QLD.

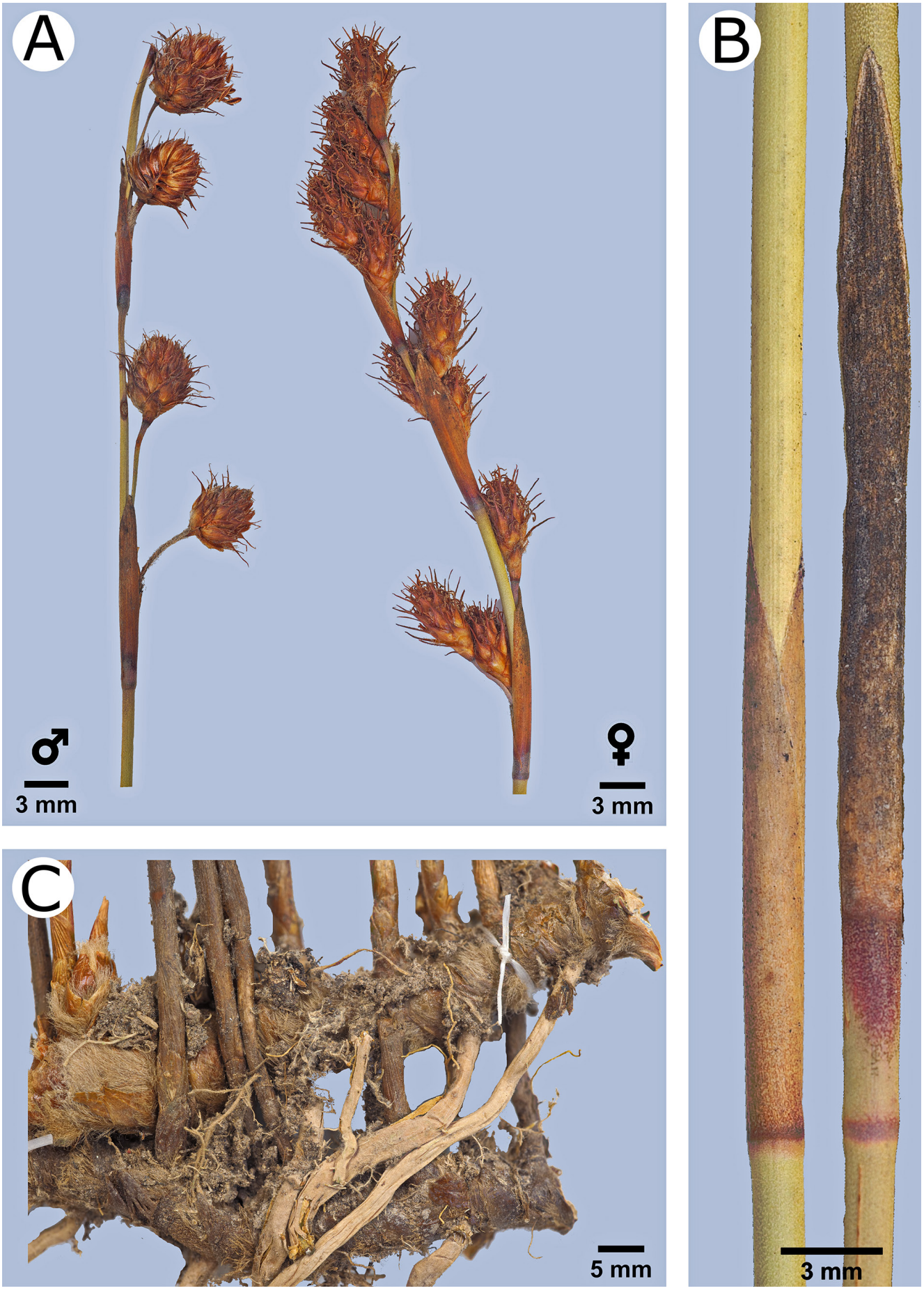

Fig. 47. *Baloskion stenocoleum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male (right) and female (left) plants. C, rhizomes. Male specimen (*Z. Growns 3*, 22 Feb. 2014) and female specimen (*J.R. Hosking 4042*, 17 Jun. 2018).

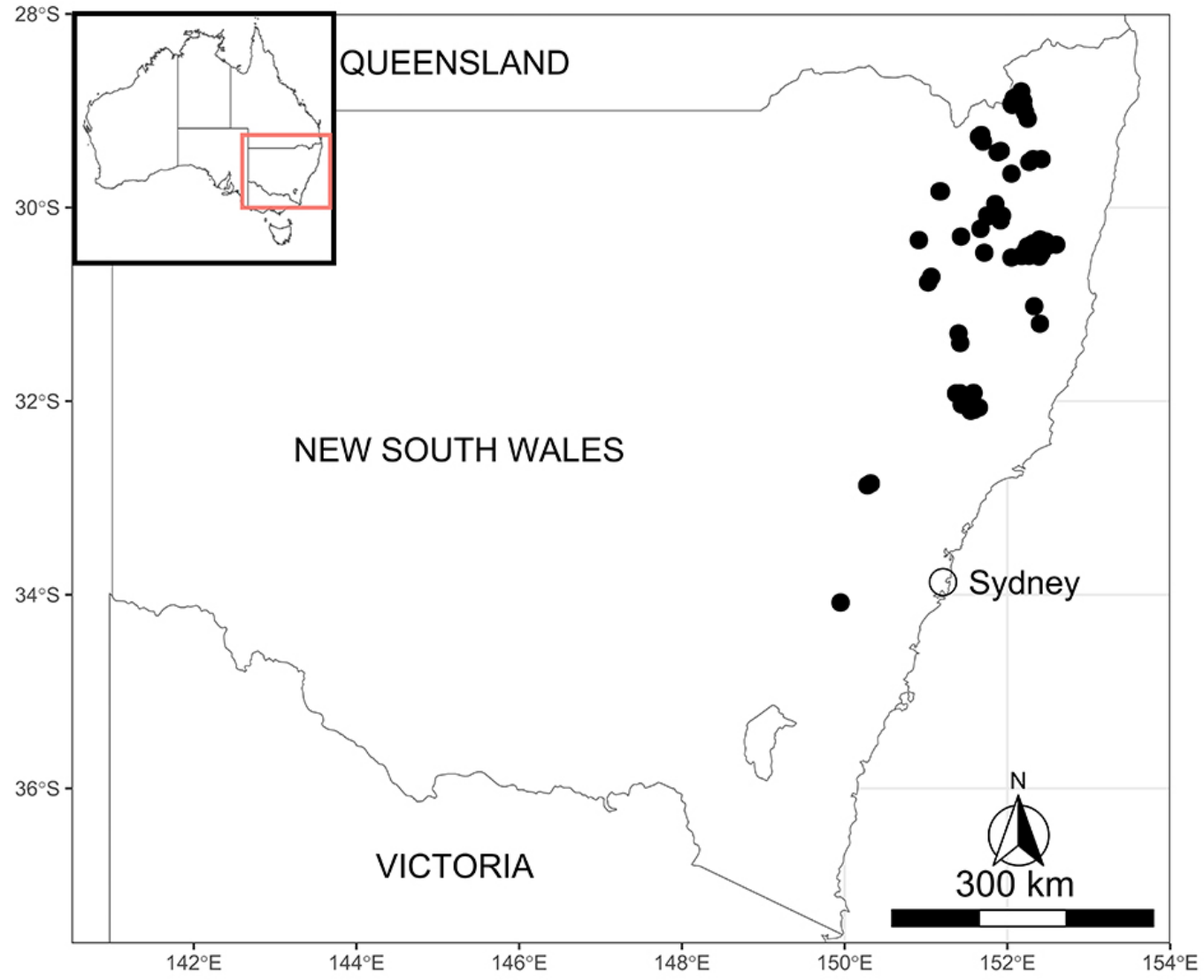

Fig. 48. Distribution of *Baloskion stenocoleum* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Baloskion tenuiculme (S.T.Blake) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio tenuiculmis* S.T.Blake.

Figures 49, 50, 51, 52.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 3–4.5 mm diam.; tufted; ascending, or creeping; subterranean; to 1 cm deep; orange-brown; when dry mid-brown, or yellowish-brown. Rhizome trichomes present; cream when fresh; cream when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged closely spaced. Culms 15–40 mm long; 0.6–0.8 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes few. Culm surface ribbed; when fresh and when dried; at 40× coarsely rugose; at 300× rugose. Culm texture smooth to touch; trichomes absent; warts absent; light green when fresh; dark brown when dry (see Fig. 3 F2); culms of female plants more intense in colour than males; marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete or slightly compressed; outer epidermal walls undulating; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains present.

Leaf morphology. Leaf sheath appressed; 0.7–1.1 cm long; dull; smooth, or striate; dark brown (see Fig. 19); margins opaque. Leaf sheath apex elongated; hairy; hairs > 1 mm long. Leaf lamina present; 0.5–0.9 mm long.

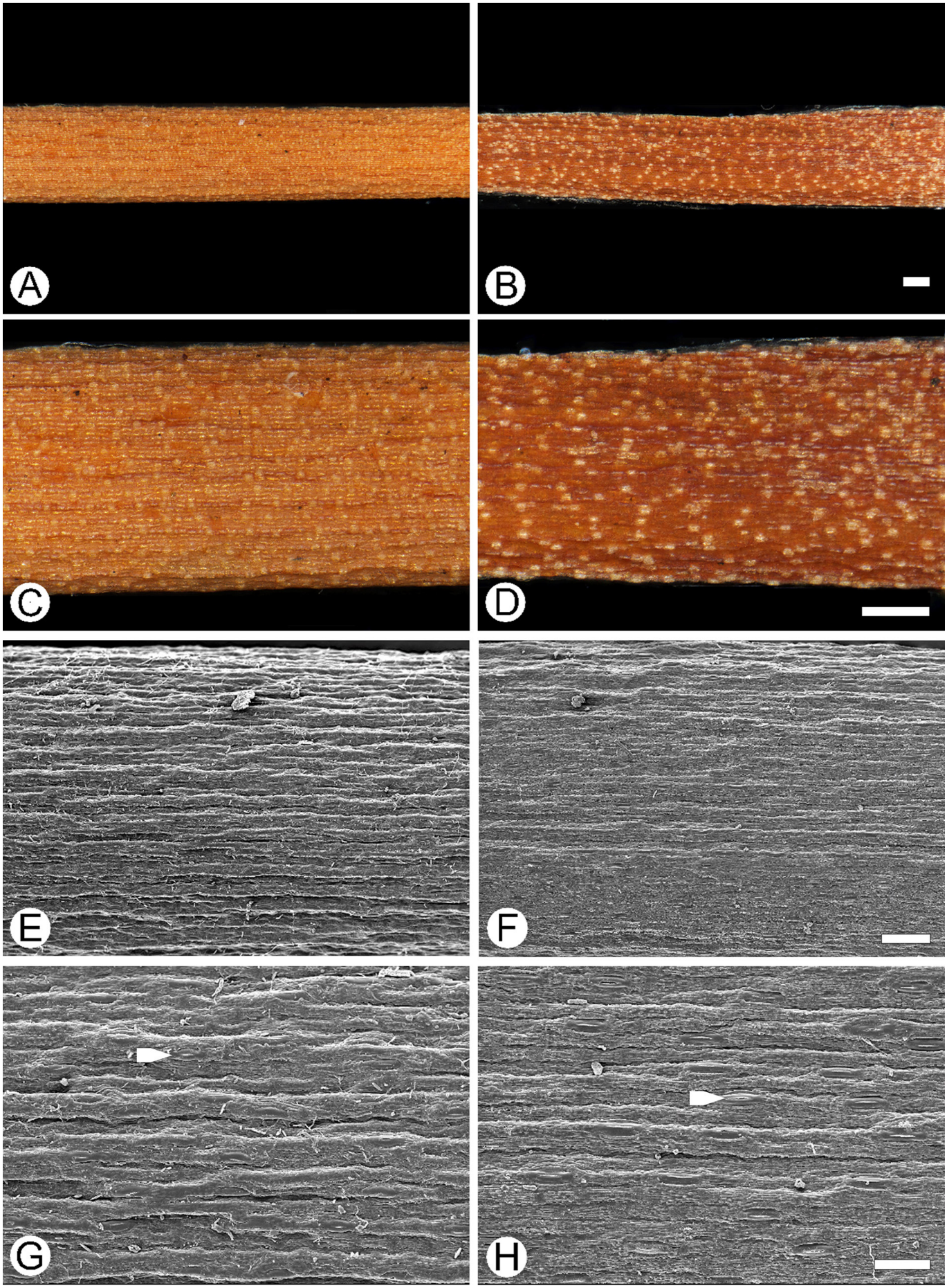

Fig. 49. *Baloskion tenuiculme* (S.T.Blake) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*E.F. Constable s.n.*, 24 Oct. 1961). B, D, F, H female plant (*E.F. Constable s.n.*, 24 Oct. 1961). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

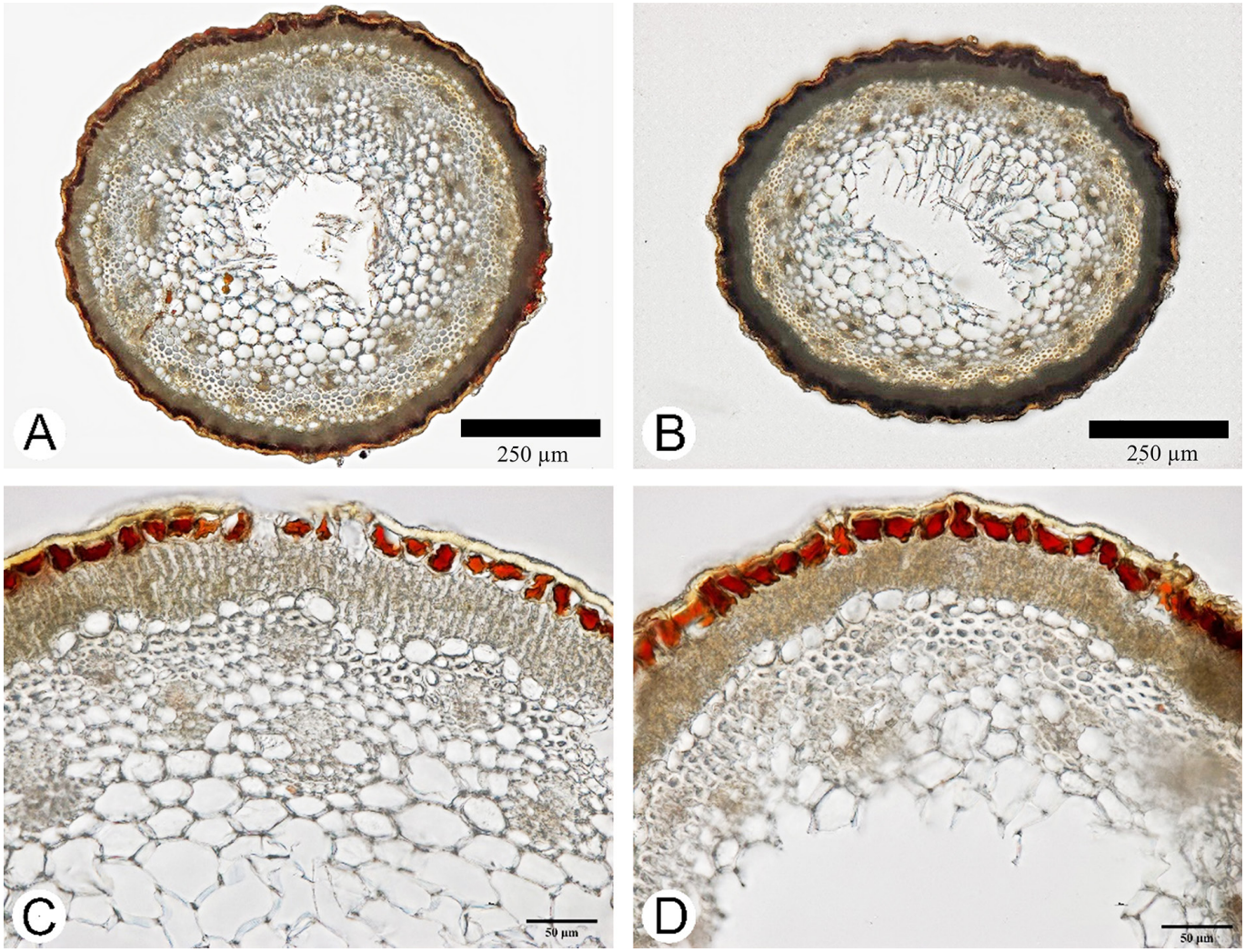

Fig. 50. *Baloskion tenuiculme* (S.T.Blake) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*E.F. Constable s.n.*, 24 Oct. 1961). B, D, female plant (*E.F. Constable s.n.*, 24 Oct. 1961).

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 10–45 mm; with spikelets dispersed. Spikelets 1–6 per culm; 1–3 per node of the inflorescence. Spikelet 4–6 mm long. Spikelet ovoid, or globose. Flowers 20–120 per culm; 17–45 per spikelet. Glumes acuminate, or cuspidate. Glumes short hairs, or long hairs. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1.6–2 mm long; inner tepals 1.6–2 mm long. Stamens 3. Anthers 1–1.4 mm long.

Female inflorescence 15–25 mm; with spikelets dispersed. Spikelets 1–6 per culm; 1–3 per node of the inflorescence. Spikelet 4–8 mm long. Spikelet ovoid. Flowers 20–120 per culm; 5–18 per spikelet. Glumes acuminate, or cuspidate. Glumes short hairs, or long hairs. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1.8–2 mm long; inner tepals 1.8–2 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Spring.

Flowering phenology. October and November.

Fruit morphology. Fruit capsule; bilocular; ovate; 1 mm long.

Seed morphology. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: NC, NT. Distribution outside N.S.W.: QLD.

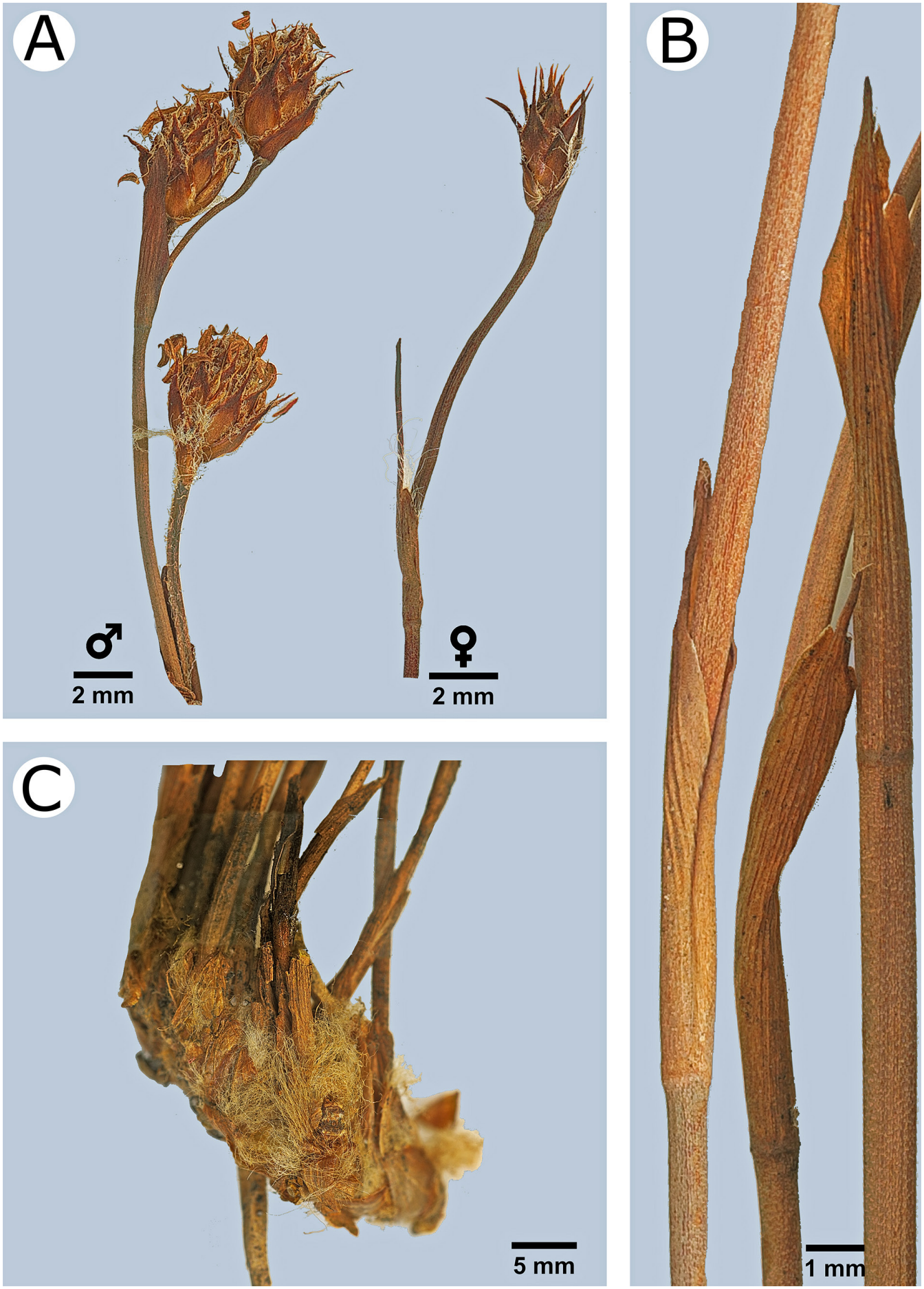

Fig. 51. *Baloskion tenuiculme* (S.T.Blake) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*E.F. Constable s.n.*, 24 Oct. 1961). B, D, female specimen (*E.F. Constable s.n.*, 24 Oct. 1961).

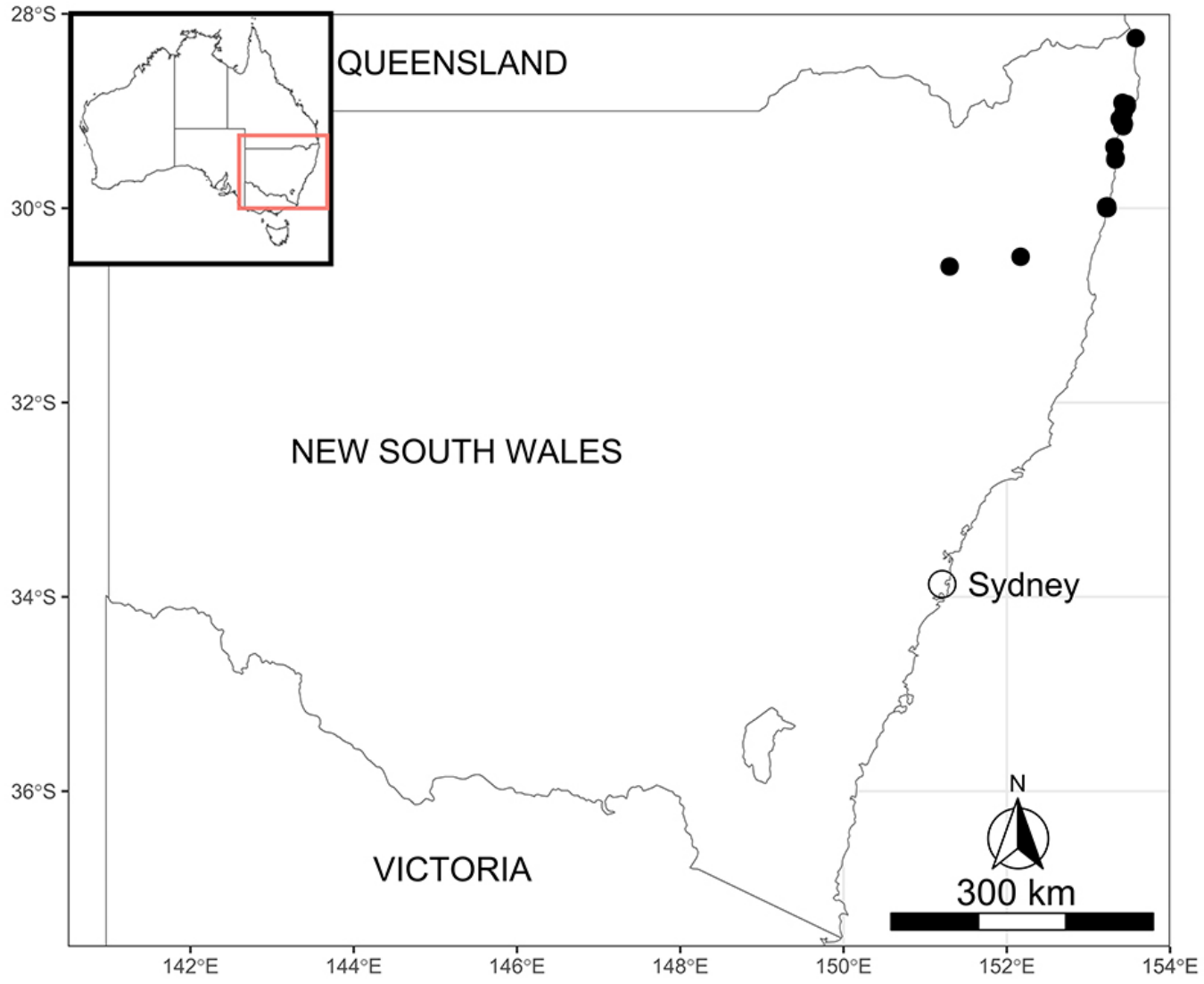

Fig. 52. Distribution of *Baloskion tenuiculme* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Baloskion tetraphyllum subsp. ***meiostachyum*** (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio tetraphyllus* subsp. *meiostachyus* L.A.S.Johnson & O.D.Evans.

Figures 53, 54, 55, 56.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 8–10 mm diam.; spreading; creeping; subterranean; to 2 cm deep; when dry mid-brown. Rhizome trichomes present; grey when fresh; cream when dry. Rhizome scales present; light brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 50–160 mm long; 1.5–5 mm diam; terete; erect; unbranched. Sterile lateral branches present. Culm internodes many. Culm surface ribbed; only when dried; at 40× smooth; at 300× striate. Culm texture smooth to touch; trichomes absent; warts absent; light green when fresh, or dark green when fresh; yellowish brown when dry (see Fig. 3 E3), or dark brown when dry (see Fig. 3 F2); culms of female plants more intense in colour than males; marbling present. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains present.

Notes on culm. Culm is finely heavily branched.

Leaf morphology. Leaf sheath appressed; 1.5–3 cm long; glossy; striate; red-brown (see Fig. 19); margins opaque. Leaf sheath apex finely pointed; hairy; hairs ≤ 1 mm long. Leaf lamina absent, or present; 3–3.8 mm long.

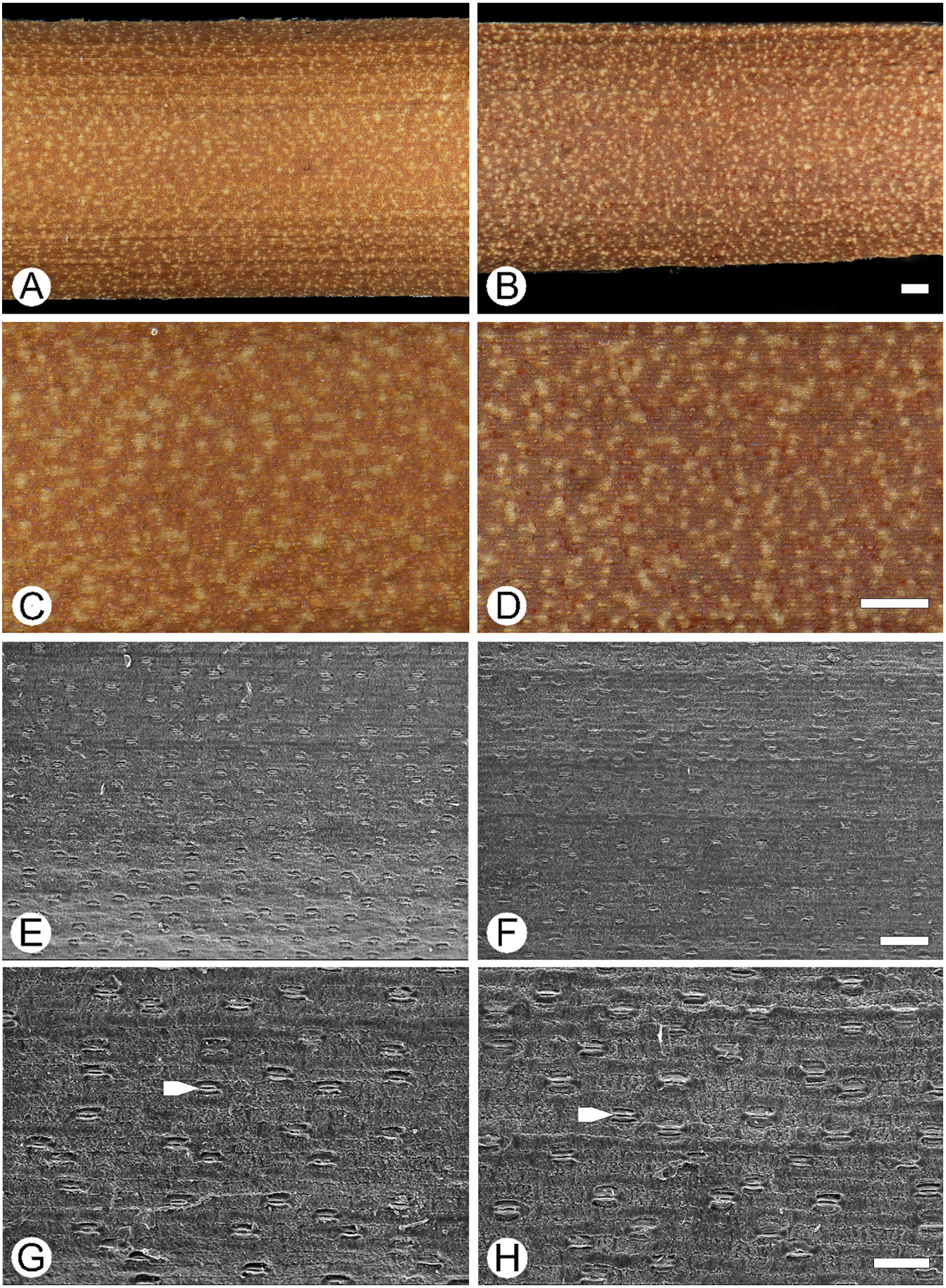

Fig. 53. *Baloskion tetraphyllum* subsp. *meiostachyum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*A.W. King 55*, 1 Feb. 2007). B, D, F, H female plant (*D. Warman DW14*, 3 Mar. 1999). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

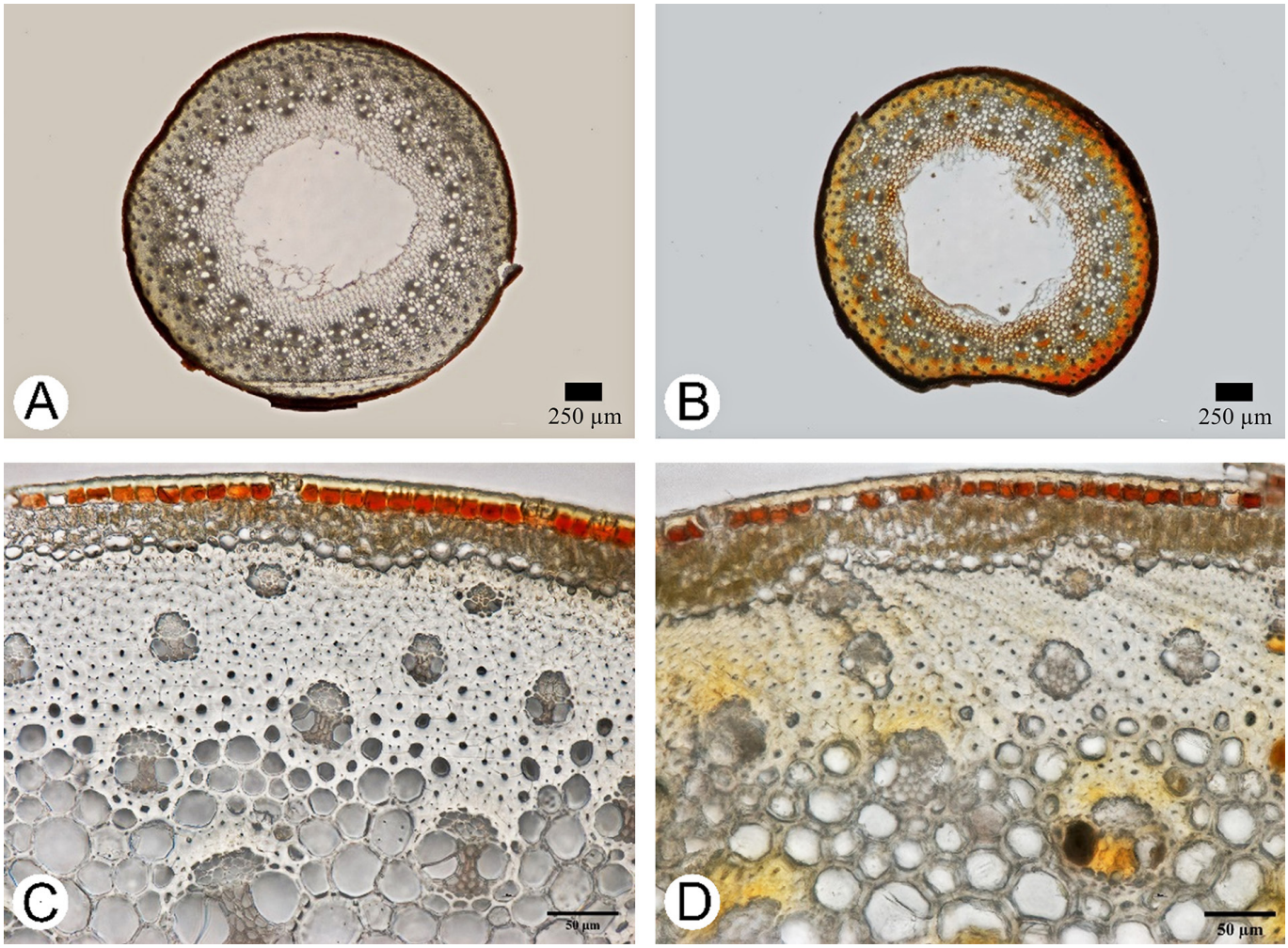

Fig. 54. *Baloskion tetraphyllum* subsp. *meiostachyum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*A.W. King 55*, 1 Feb. 2007). B, D, female plant (*D. Warman DW14*, 3 Mar. 1999).

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 250–350 mm; with spikelets clustered or dispersed. Spikelets 200–450 per culm; 3–5 per node of the inflorescence. Spikelet 2–5 mm long. Spikelet globose. Flowers 3000–10000 per culm; 15–23 per spikelet. Glumes cuspidate, or mucronate. Glumes glabrous. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1.8–2 mm long; inner tepals 1.8–2 mm long. Stamens 3. Anthers 0.8–1.2 mm long.

Female inflorescence 100–380 mm; with spikelets clustered or dispersed. Spikelets 200–450 per culm; 3 per node of the inflorescence. Spikelet 3.5–6 mm long. Spikelet ovoid. Flowers 3000–10000 per culm; 15–23 per spikelet. Glumes cuspidate, or mucronate. Glumes glabrous. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1.3–1.5 mm long; inner tepals 1.3–1.5 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Spring and Summer.

Flowering phenology. January, February, March, October, November or December.

Fruit morphology. Fruit capsule; bilocular; ovate; 1.2–1.5 mm long.

Seed morphology. Seeds 0.7 mm long; 0.35 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, NC, SC. Distribution outside N.S.W.: QLD.

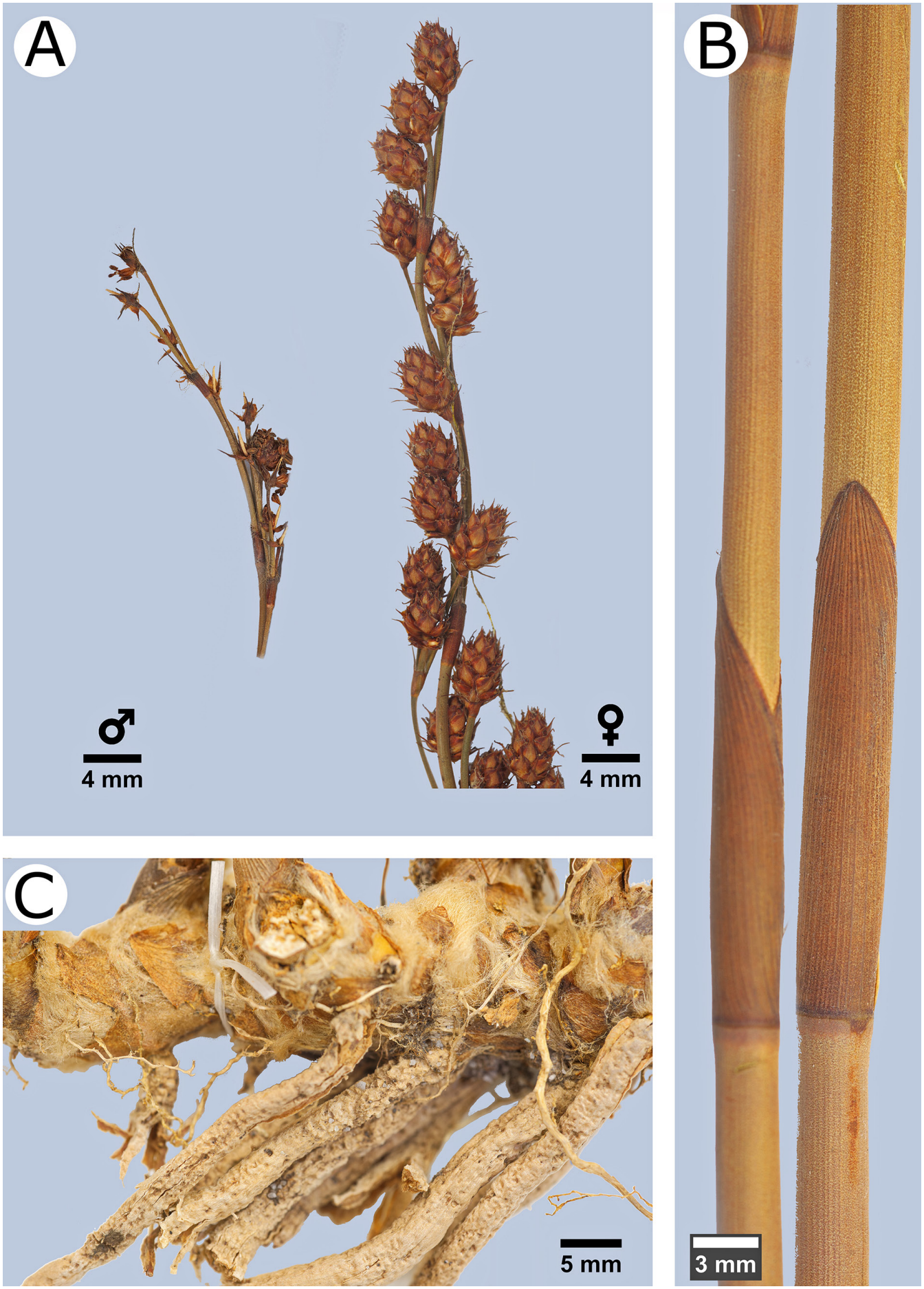

Fig. 55. *Baloskion tetraphyllum* subsp. *meiostachyum* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*A.W. King 55*, 1 Feb. 2007) and female specimen (*D. Warman DW14*, 3 Mar. 1999).

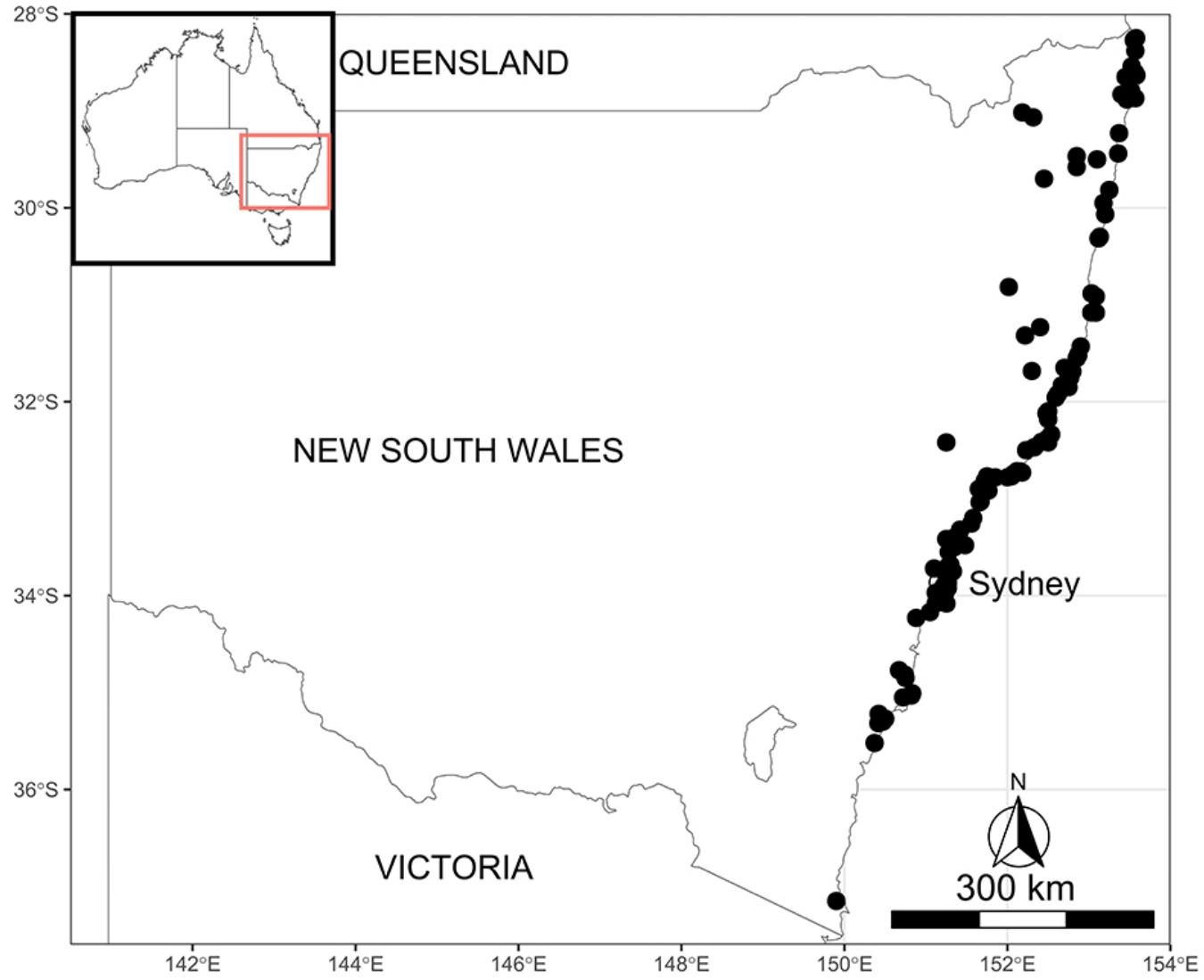

Fig. 56. Distribution of *Baloskion tetraphyllum* subsp. *meiostachyum* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Baloskion tetraphyllum subsp. ***tetraphyllum*** (Labill.) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio tetraphyllus* Labill. subsp. *tetraphyllus*.

Common name: Tassel cord-rush.

Figures 57, 58, 59, 60.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 8–10 mm diam.; spreading; creeping; subterranean; to 2 cm deep; when dry mid-brown. Rhizome trichomes present; grey when fresh; cream when dry. Rhizome scales present; light brown.

Culm morphology. Culms on the rhizome arranged closely spaced or widely spaced. Culms 50–160 mm long; 1.5–5 mm diam; terete; erect; unbranched. Sterile lateral branches present. Culm internodes many. Culm surface ribbed; only when dried; at 40× smooth; at 300× smooth. Culm texture smooth to touch; trichomes absent; warts absent; light green when fresh, or dark green when fresh; yellowish brown when dry (see Fig. 3 E3), or dark brown when dry (see Fig. 3 F2); culms of female plants more intense in colour than males; marbling present. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains present.

Notes on culm. Culm is finely heavily branched.

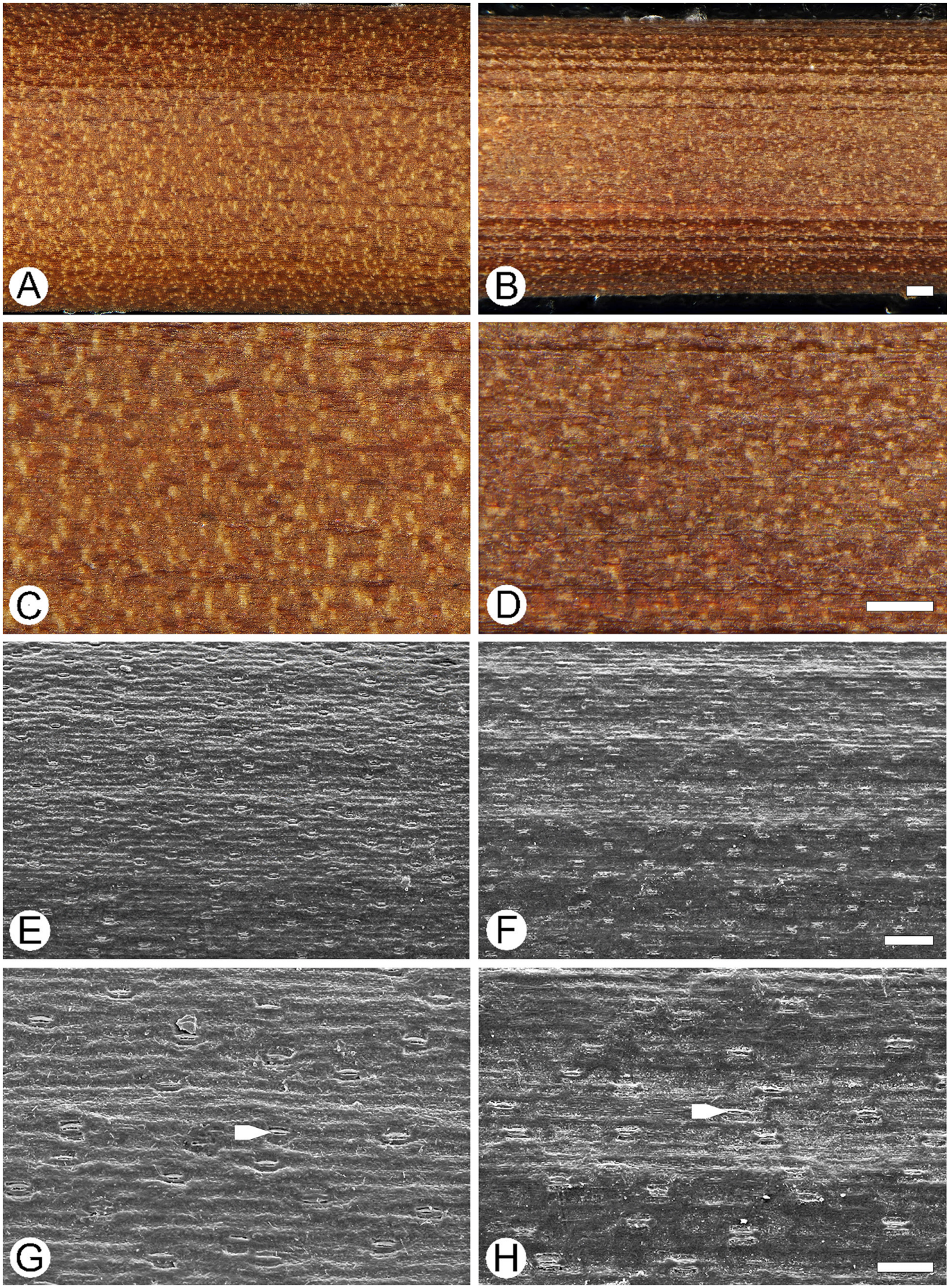

Fig. 57. *Baloskion tetraphyllum* subsp. *tetraphyllum* (Labill.) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*A.H.S. Lucas s.n.*, Jan. 1885). B, D, F, H female plant (*R. Melville 2880*, 14 Jan. 1953). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

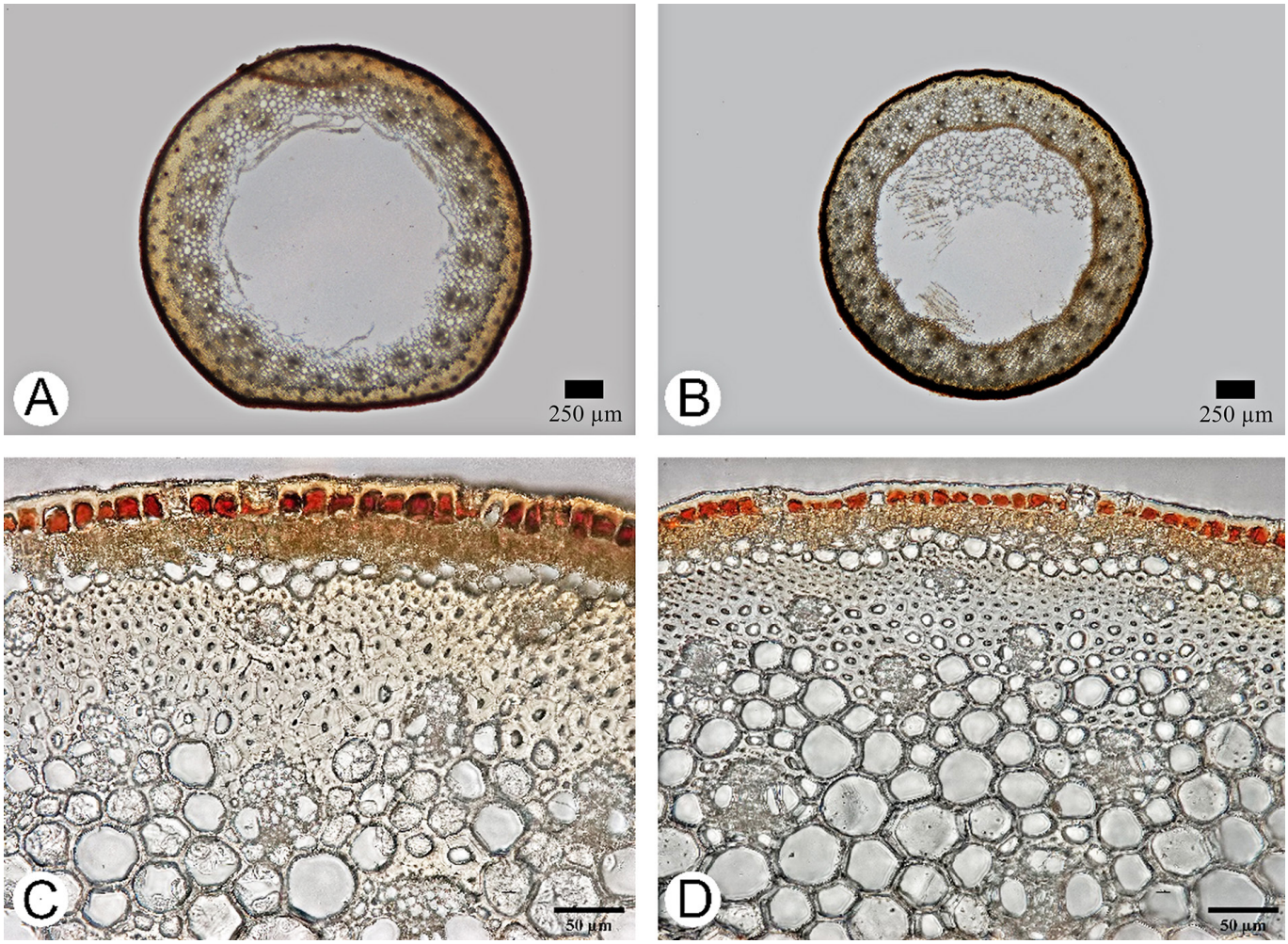

Fig. 58. *Baloskion tetraphyllum* subsp. *tetraphyllum* (Labill.) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*A.H.S. Lucas s.n.*, Jan. 1885). B, D, female plant (*R. Melville 2880*, 14 Jan. 1953).

Leaf morphology. Leaf sheath appressed; 1.5–3 cm long; glossy; striate; red-brown (see Fig. 19); margins opaque. Leaf sheath apex finely pointed; hairy; hairs ≤ 1 mm long. Leaf lamina absent.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 200–450 mm; with spikelets dispersed. Spikelets 15–200 per culm; 1–8 per node of the inflorescence. Spikelet 4–7 mm long. Spikelet ovoid. Flowers 300–6000 per culm; 20–40 per spikelet. Glumes cuspidate, or mucronate. Glumes glabrous. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1.5–2 mm long; inner tepals 1.5–2 mm long. Stamens 3. Anthers 1–1.5 mm long.

Female inflorescence 100–320 mm; with spikelets dispersed. Spikelets 40–90 per culm; 1–8 per node of the inflorescence. Spikelet 8–10 mm long. Spikelet ovoid. Flowers 800–30000 per culm; 20–40 per spikelet. Glumes cuspidate, or mucronate. Glumes glabrous. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2–2.5 mm long; inner tepals 2–2.5 mm long. Staminodes 2. Ovary flattened. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Spring and Summer.

Flowering phenology. January, February, March, October, November and December.

Fruit morphology. Fruit capsule; bilocular; ovate; 1.2–1.5 mm long.

Seed morphology. Seeds 1 mm long; 0.4 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: SC. Distribution outside N.S.W.: SA, TAS, VIC.

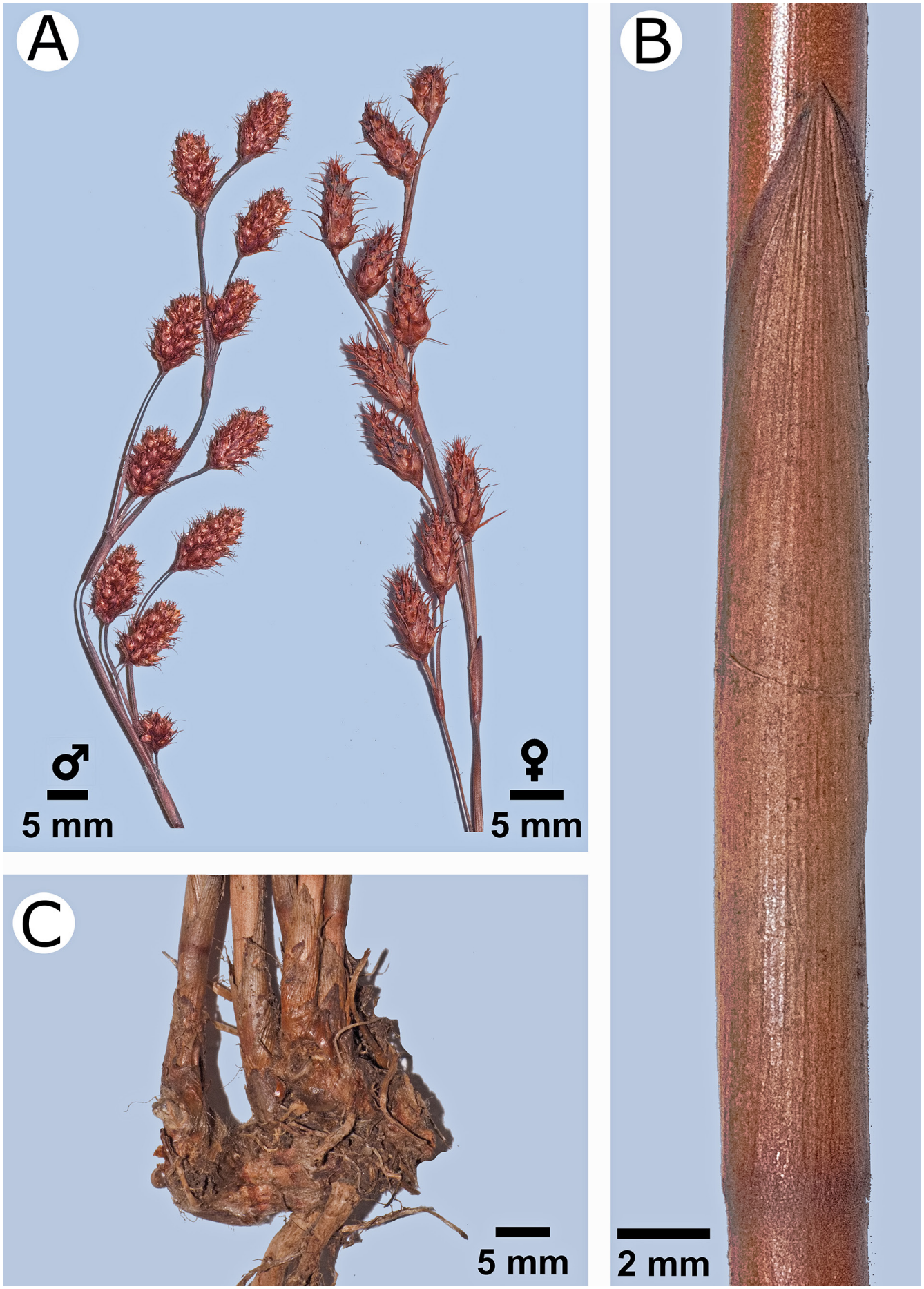

Fig. 59. *Baloskion tetraphyllum* subsp. *tetraphyllum* (Labill.) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*A.H.S. Lucas s.n.*, Jan. 1885) and female specimen (*R. Melville 2880*, 14 Jan. 1953).

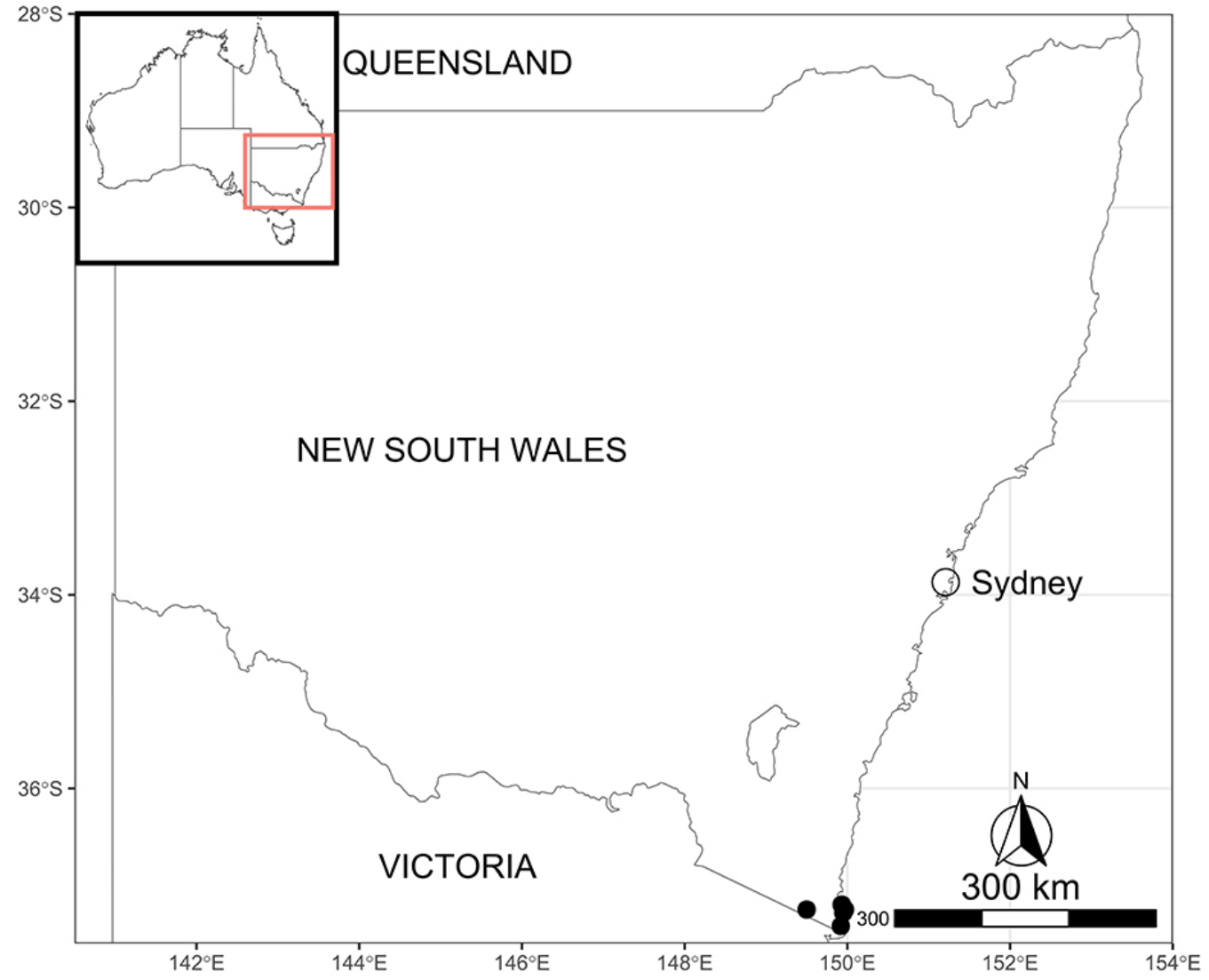

Fig. 60. Distribution of *Baloskion tetraphyllum* subsp. *tetraphyllum* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Chordifex dimorphus (R.Br.) B.G.Briggs

Basionym: *Restio dimorphus* R.Br.

Other synonyms: 1. *Guringalia dimorpha* (R.Br.) B.G.Briggs & L.A.S.Johnson.

2. *Baloskion dimorphum* L.A.S.Johnson & B.G.Briggs, nom. inval., pro syn.

Figures 61, 62, 63, 64.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 3–4.5 mm diam.; spreading; ascending, or creeping; subterranean; 1 cm deep; when dry mid-brown, or dark brown. Rhizome trichomes present; pale ginger when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 30–100 mm long; 1–1.3 mm diam; terete; arching; branched. Sterile lateral branches absent. Culm internodes few. Culm surface ribbed; only when dried; at 40× striate; at 300× pitted. Culm texture smooth to touch; trichomes absent; warts absent; light green when fresh; dark green when dry (see Fig. 3 A1), or light green when dry (see Fig. 3 A4); culms of female plants more intense in colour than males; marbling absent. Culm stomata obscured (covered); in grooves; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata sunken. Chlorenchyma present. Chlorenchymatous cells in one layer. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity present; circular. Silica present; stegmata present. Starch grains absent.

Notes on culm. Most specimens at NE have kept their colour for over 80 years.

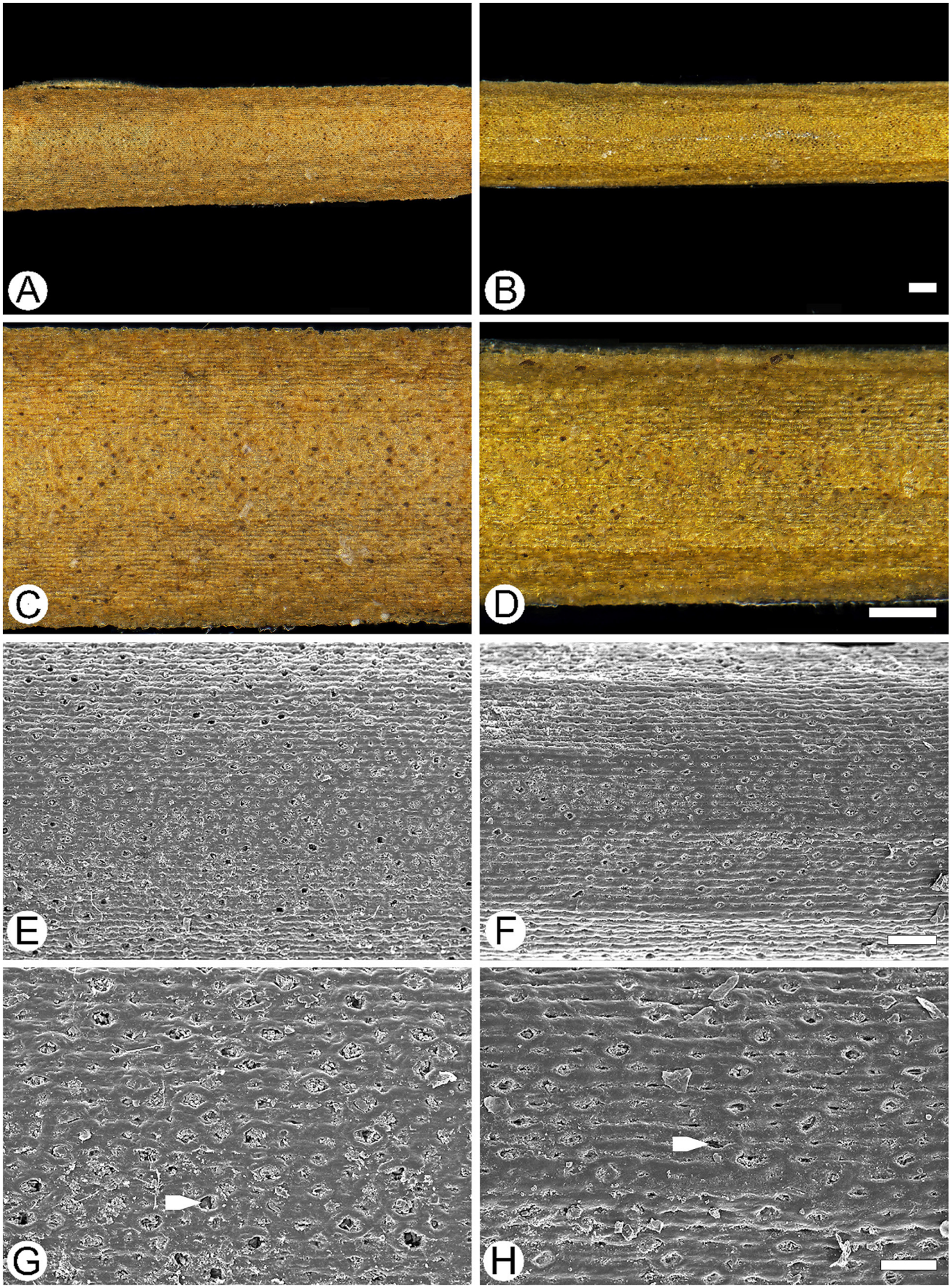

Fig. 61. *Chordifex dimorphus* (R.Br.) B.G.Briggs. A, C, E & G, male plant (*J.H. Camfield s.n.*, Nov. 1896). B, D, F, H female plant (*J.L. Boorman s.n.*, 6 Apr. 1906). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate covered and hidden in grooves. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

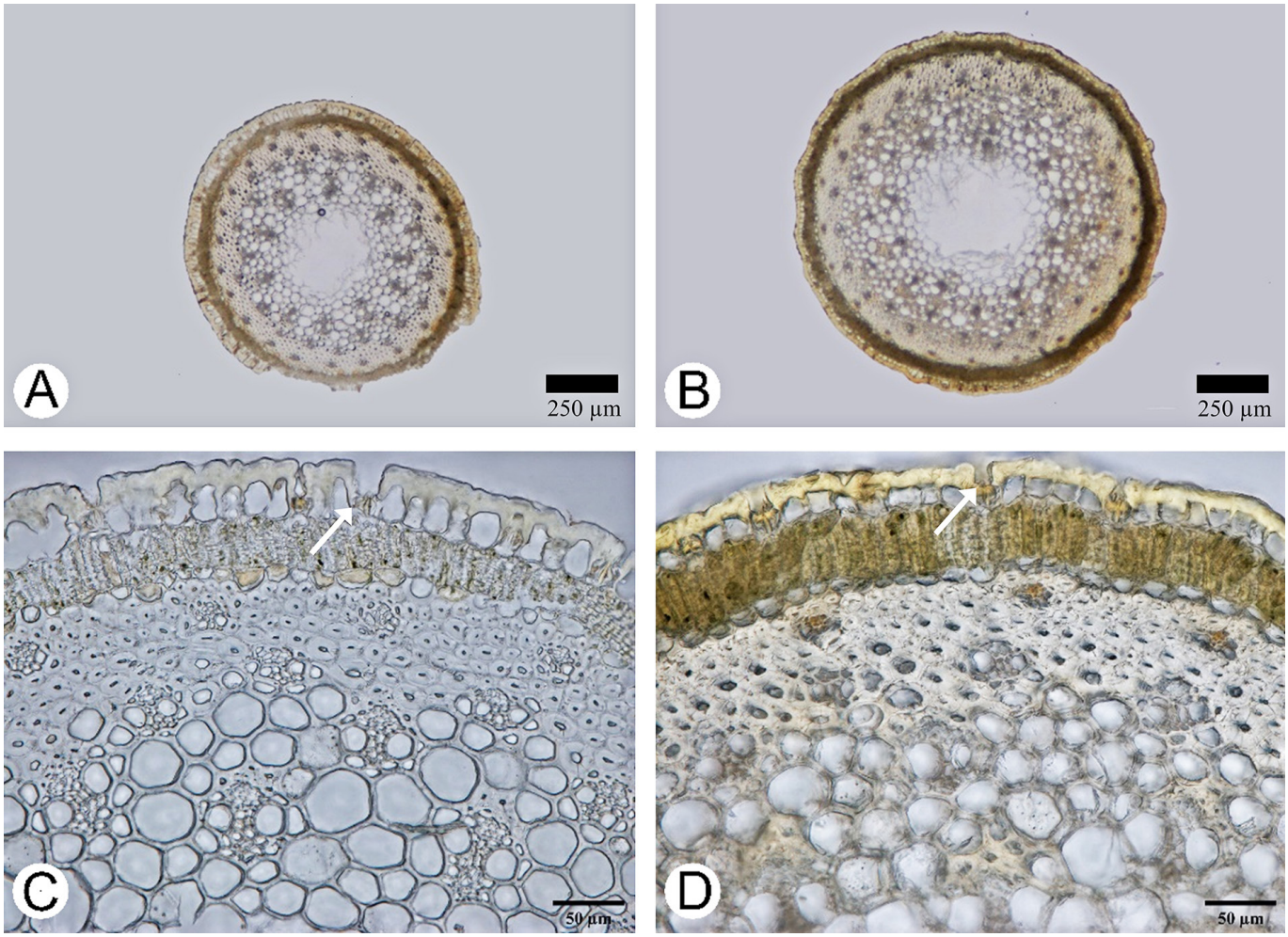

Fig. 62. *Chordifex dimorphus* (R.Br.) B.G.Briggs. Internode cross-section of the culm. A, C, male plant (*J.H. Camfield s.n.*, Nov. 1896). B, D, female plant (*J.L. Boorman s.n.*, 6 Apr. 1906). The arrows point at sunken stomata.

Leaf morphology. Leaf sheath spreading; 0.9–1.3 cm long; dull; smooth, or striate; yellow-brown (see Fig. 19); margins opaque. Leaf sheath apex elongated; glabrous; hairs ≤ 1 mm long. Leaf lamina present; 0.9–1.4 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 19–300 mm; with spikelets dispersed. Spikelets 5–11 per culm; 1–3 per node of the inflorescence. Spikelet 4.5–6 mm long. Spikelet ovoid. Flowers 15–80 per culm; 3–8 per spikelet. Glumes acuminate, or caudate. Glumes glabrous, or short hairs. Tepals 6; oblong lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 2.2–2.8 mm long; inner tepals 2.2–2.5 mm long. Stamens 3. Anthers 1.4–1.8 mm long.

Female inflorescence 120–130 mm; with spikelets dispersed. Spikelets 3–35 per culm; 2–3 per node of the inflorescence. Spikelet 4–7 mm long. Spikelet oblong-cylindrical. Flowers 30–2000 per culm; 3–6 per spikelet. Glumes acuminate, or caudate. Glumes glabrous, or short hairs. Tepals 6; oblong lanceolate; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 3–3.2 mm long; inner tepals 3–3.2 mm long. Staminodes 3. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, February, September, October, November and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 2.3–2.5 mm long.

Seed morphology. Seeds 1.5 mm long; 1 mm wide.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC.

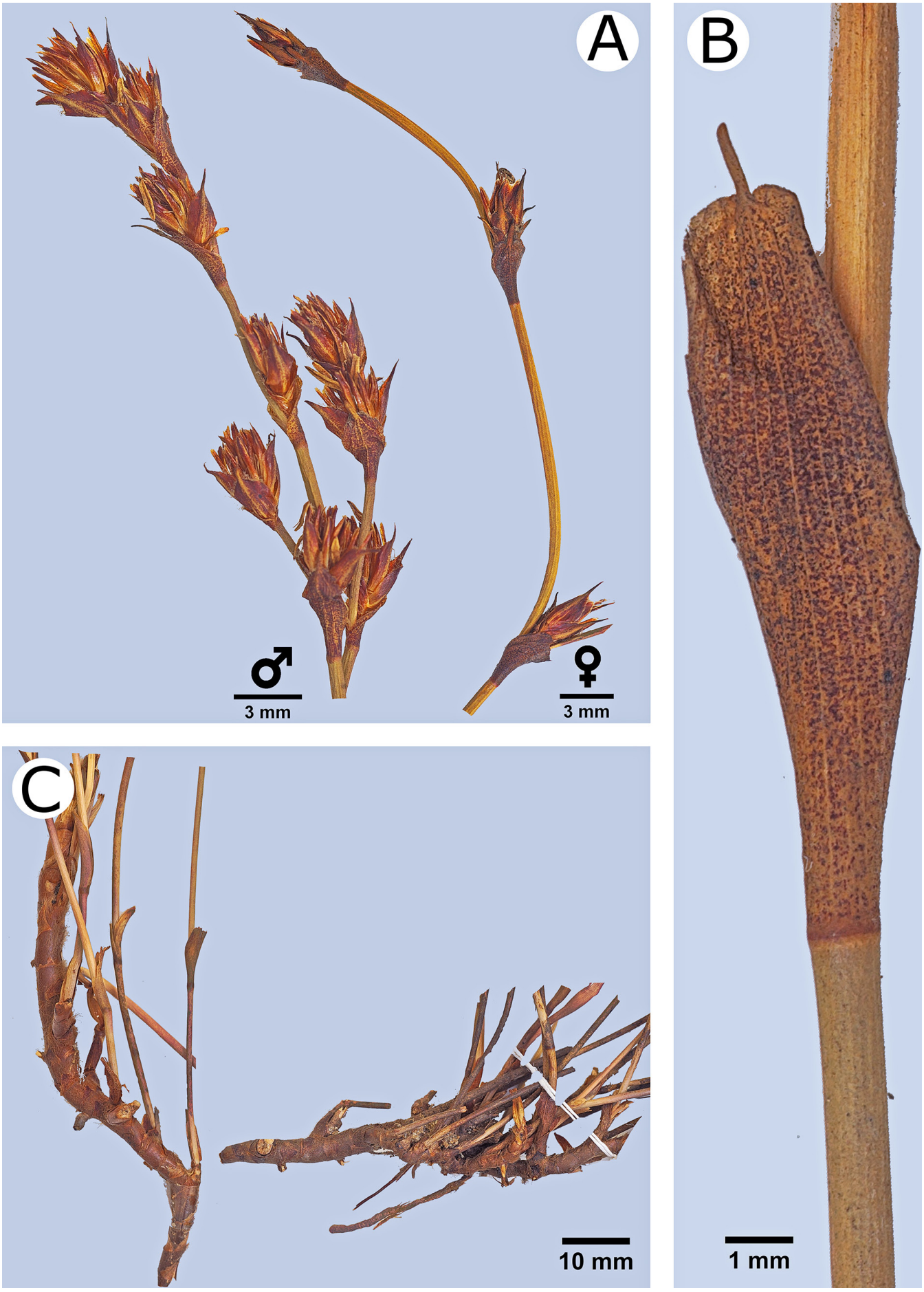

Fig. 63. *Chordifex dimorphus* (R.Br.) B.G.Briggs. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*J.H. Camfield s.n.*, Nov. 1896) and female specimen (*J.L. Boorman s.n.*, 6 Apr. 1906).

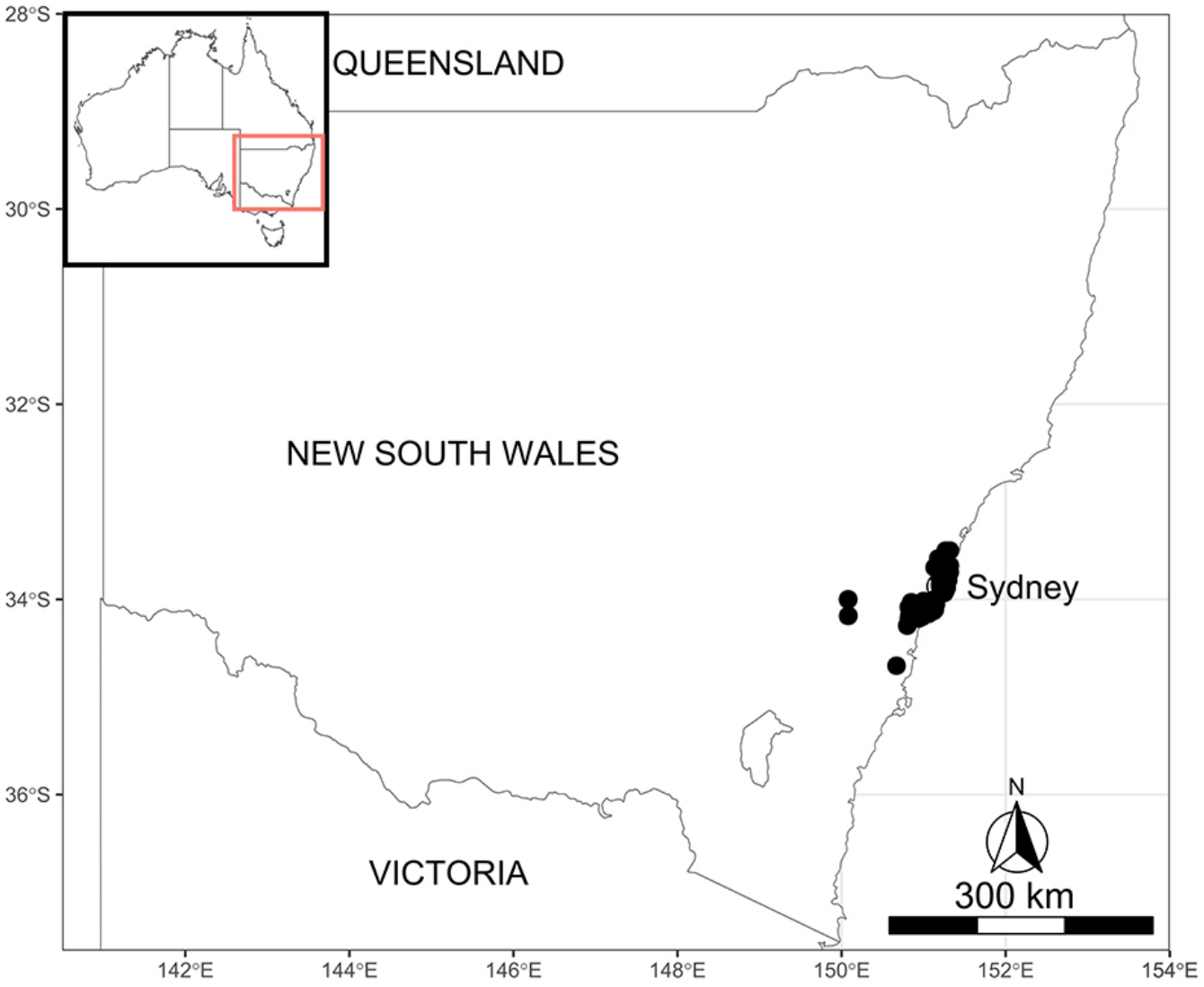

Fig. 64. Distribution of *Chordifex dimorphus* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Chordifex fastigiatus (R.Br.) B.G.Briggs

Basionym: *Restio fastigiatus* R.Br.

Other synonyms: 1. *Calorophus sieberianus* Steud.

2. *Calorophus sieberanus* L.A.S.Johnson & O.D.Evans, orth. var.

3. *Baloskion fastigiatum* L.A.S.Johnson & B.G.Briggs, nom. inval., pro syn.

4. *Saropsis fastigiata* (R.Br.) B.G.Briggs & L.A.S.Johnson.

Figures 65, 66, 67, 68.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 4–5 mm diam.; spreading; creeping; subterranean; 1 cm deep; when dry mid-brown. Rhizome trichomes present; cream when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 30–100 mm long; 1–2 mm diam; terete; arching; branched. Sterile lateral branches absent. Culm internodes few. Culm surface not ribbed; at 40× striate; at 300× sulcate. Culm texture smooth to touch; trichomes absent; warts absent; dark greenish when dry (see Fig. 3 C3); culms of female plants more intense in colour than males; marbling absent. Culm stomata obscured (covered); in grooves; in rows; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata sunken. Chlorenchyma present. Chlorenchymatous cells in one layer. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; partial; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains absent.

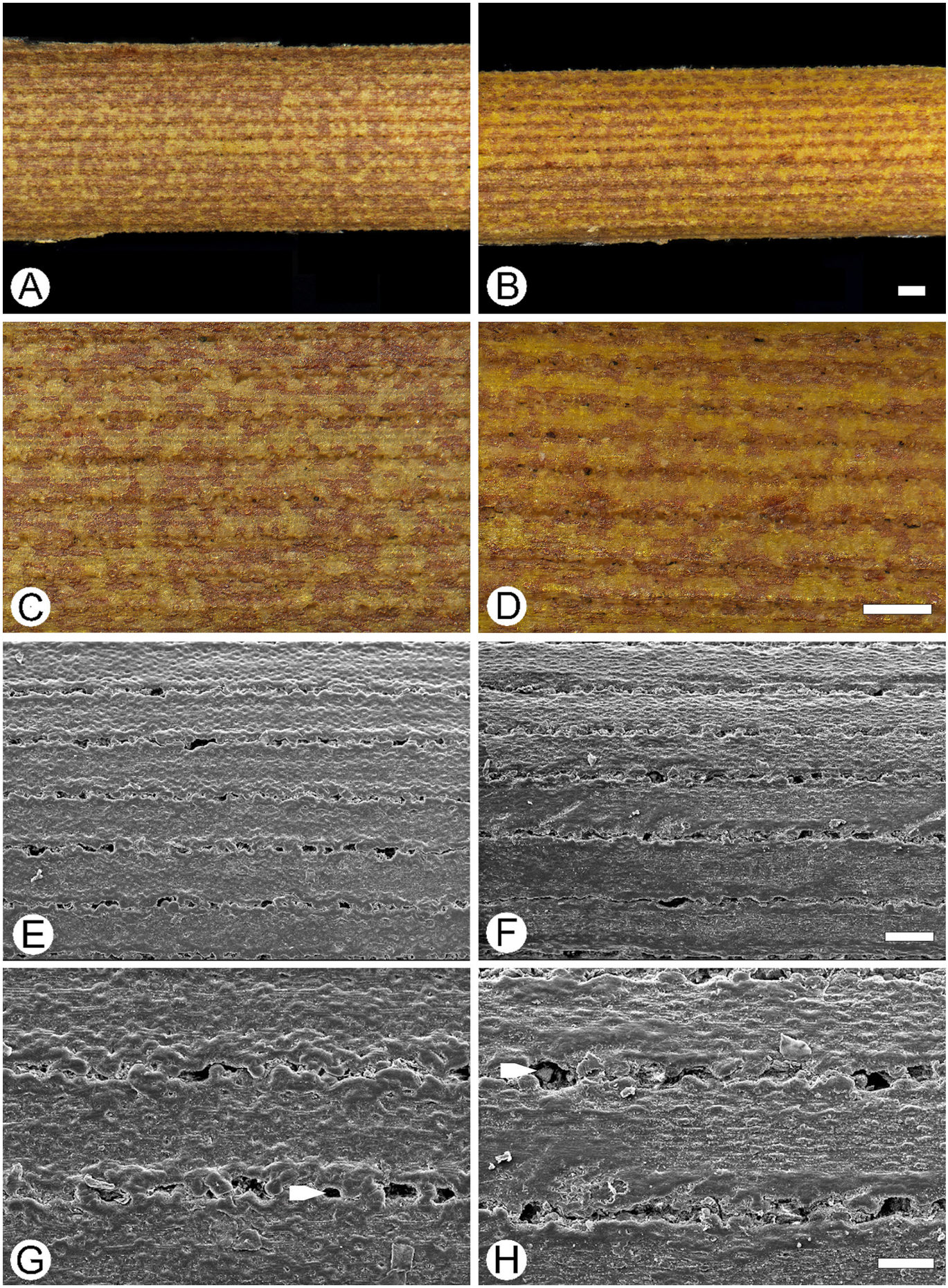

Fig. 65. *Chordifex fastigiatus* (R.Br.) B.G.Briggs. A, C, E & G, male plant (*K.G. Griffiths s.n.*, 5 Oct. 1957). B, D, F, H female plant (*J.J. Bruhl 68*, 9 Jun. 1985). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate covered and hidden in grooves. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

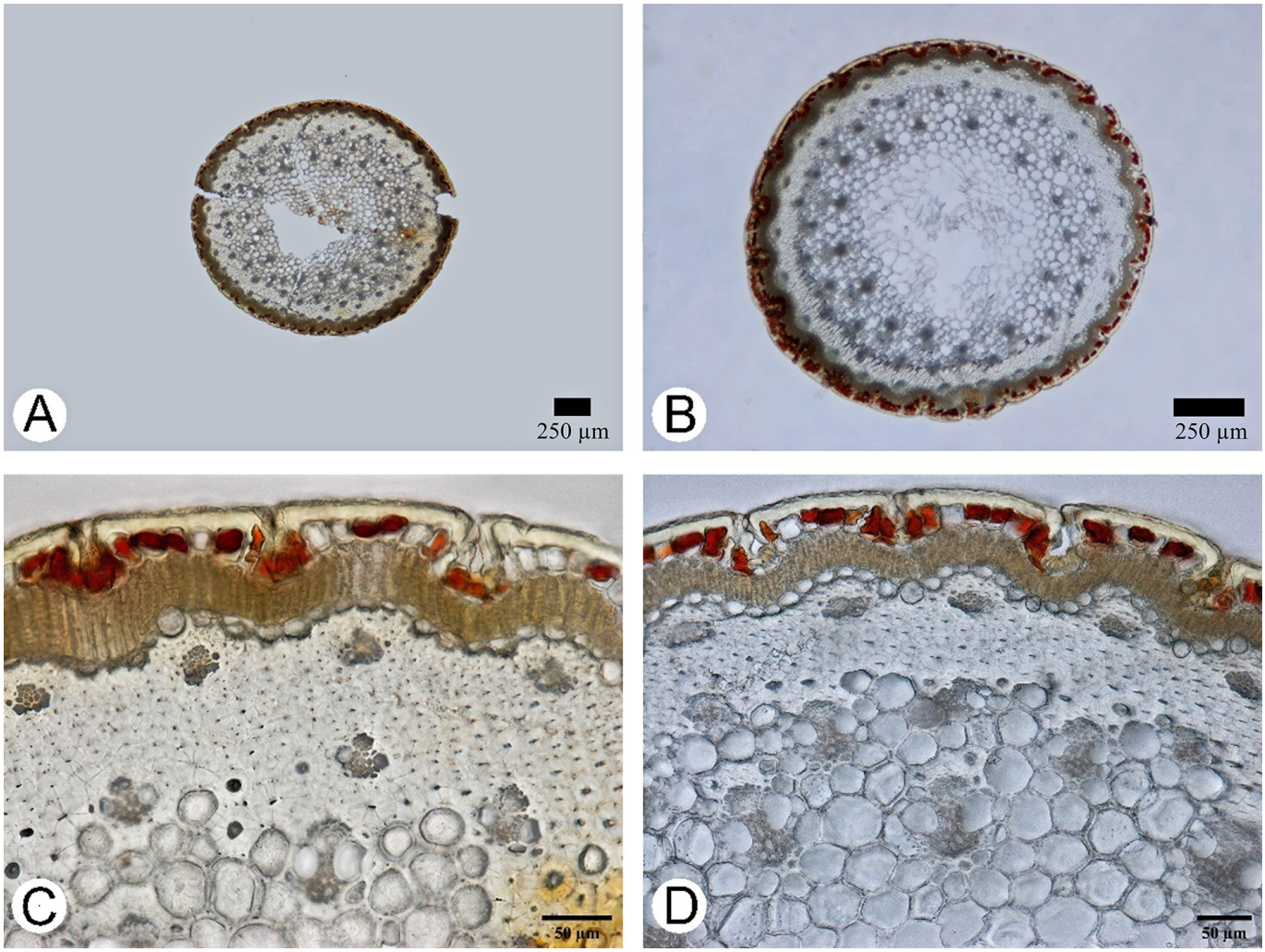

Fig. 66. *Chordifex fastigiatus* (R.Br.) B.G.Briggs. Internode cross-section of the culm. A, C, male plant (*K.G. Griffiths s.n.*, 5 Oct. 1957). B, D, female plant (*J.J. Bruhl 68*, 9 Jun. 1985).

Notes on culm. Most specimens at NE have kept their colour for over 80 years.

Leaf morphology. Leaf sheath appressed; 0.3–1.5 cm long; dull; smooth, or striate; red-brown (see Fig. 19); margins opaque. Leaf sheath apex elongated; glabrous. Leaf lamina present; 0.5–1.5 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 120–220 mm; with spikelets dispersed. Spikelets 12–360 per culm; 1 per node of the inflorescence. Spikelet 4–6 mm long. Spikelet oblong-cylindrical. Flowers 30–1000 per culm; 2–4 per spikelet. Glumes mucronate. Glumes short hairs. Tepals 6; elliptic; brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2.8–4 mm long; inner tepals 2.8–4 mm long. Stamens 3. Anthers 1.6–2 mm long.

Female inflorescence 120–300 mm; with spikelets dispersed. Spikelets 12–360 per culm; 1 per node of the inflorescence. Spikelet 2.5–6 mm long. Spikelet oblong-cylindrical. Flowers 10–400 per culm; 1 per spikelet. Glumes mucronate. Glumes short hairs. Tepals 6; elliptic; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 2–4 mm long; inner tepals 2.5–4 mm long. Staminodes 3. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Autumn and Spring.

Flowering phenology. July, August, September, October and November.

Fruit morphology. Fruit capsule; trilocular; ovate; 1.4 mm long.

Seed morphology. Seeds 1.5 mm long; 0.5 mm wide.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, SC, ST. Distribution outside N.S.W.: QLD.

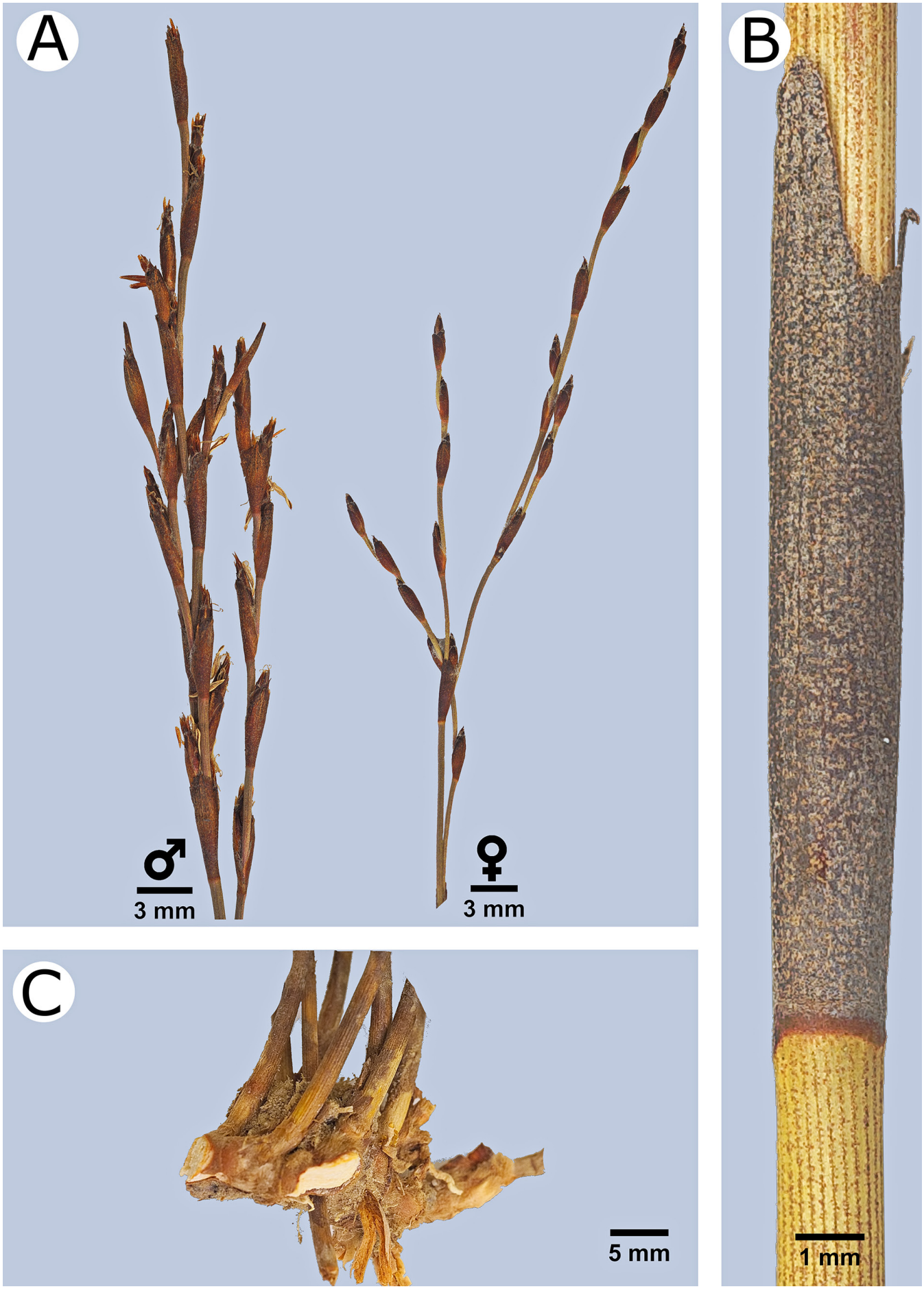

Fig. 67. *Chordifex fastigiatus* (R.Br.) B.G.Briggs. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*K.G. Griffiths s.n.*, 5 Oct. 1957) and female specimen (*J.J. Bruhl 68*, 9 Jun. 1985).

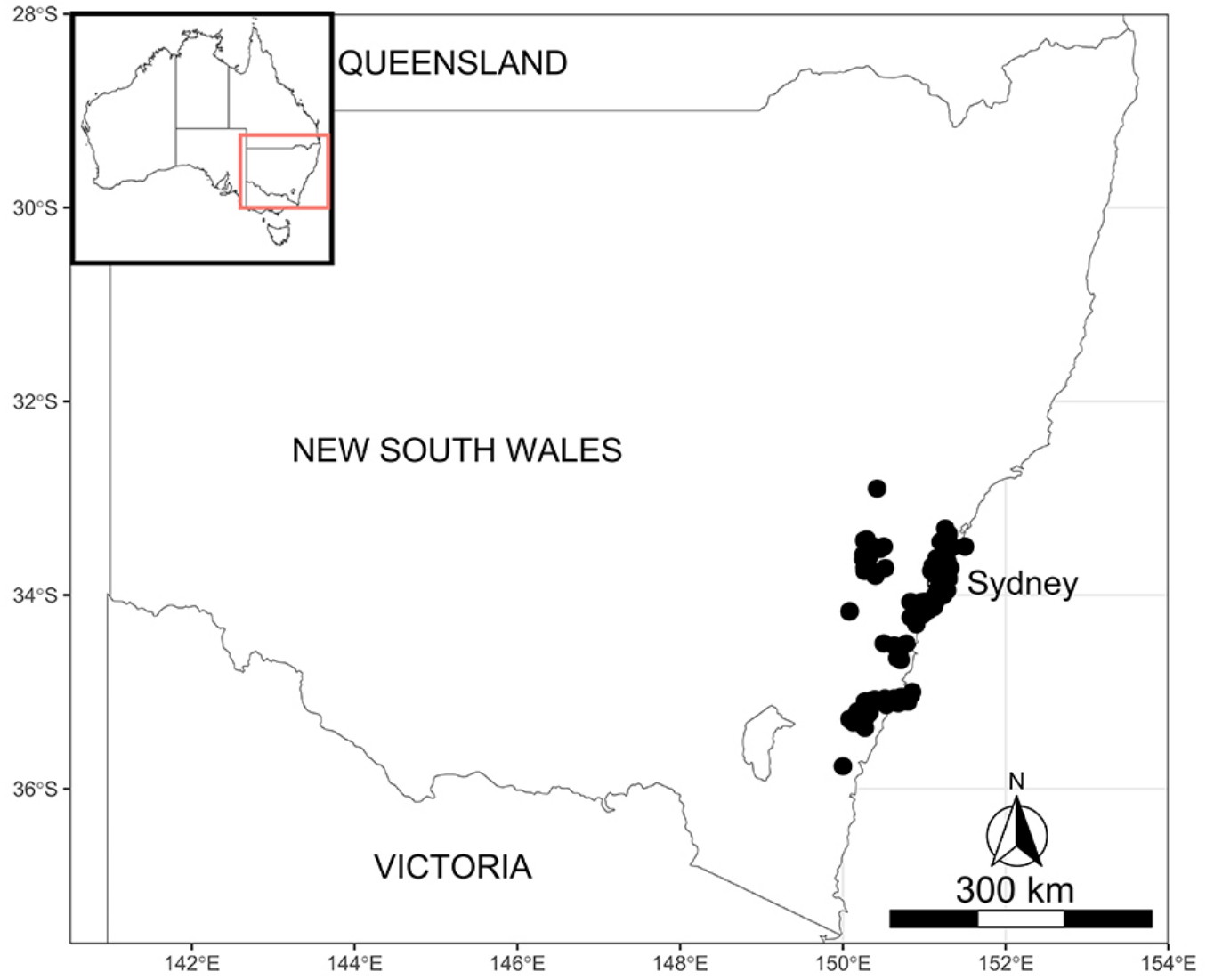

Fig. 68. Distribution of *Chordifex fastigiatus* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Coleocarya gracilis S.T.Blake

Figures 69, 70, 71.

Reproduction. Plants monoecious.

Rhizome morphology. Rhizome 2.5–3.5 mm diam.; spreading; ascending, or creeping; subterranean, or superficial; to 2 cm deep; light brown; when dry mid-brown. Rhizome trichomes present; brown when fresh; cream when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 15–60 mm long; 1 mm diam; terete; arching; branched, or unbranched. Sterile lateral branches absent. Culm internodes few. Culm surface ribbed; when fresh and when dried; at 40× areolate; at 300× smooth. Culm texture smooth to touch; trichomes absent; warts absent; light green when fresh; light green when dry (see Fig. 3 A4), or yellowish when dry (see Fig. 3 D5); marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity absent. Silica present; stegmata present. Starch grains present.

Notes on culm. Most specimens at NE have kept their colour for over 80 year.

Leaf morphology. Leaf sheath spreading; 0.8–1.2 cm long; dull; smooth, or striate; yellow-brown (see Fig. 19); margins opaque. Leaf sheath apex elongated; glabrous. Leaf lamina present; 1–2 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets, or longer than the spikelets. Male inflorescence 7–8 mm; with spikelets dispersed. Spikelets 1–3 per culm; 1 per node of the inflorescence. Spikelet 7–10 mm long. Spikelet ovoid. Flowers 5–7 per culm; 5–7 per spikelet. Glumes obtuse, or mucronate. Glumes glabrous, or short hairs. Tepals 6; oblong lanceolate, or narrow ovoid; whitish or straw-coloured (see Fig. 24); outer and inner ± similar in length; outer tepals 2.5–3 mm long; inner tepals 2.5–3 mm long. Stamens 3. Anthers 1.8–2.2 mm long.

Female inflorescence 9–34 mm; with spikelets dispersed. Spikelets 2–5 per culm; 1 per node of the inflorescence. Spikelet 10–11 mm long. Spikelet oblong-cylindrical. Flowers 1 per culm; 1 per spikelet. Glumes obtuse, or mucronate. Glumes glabrous, or short hairs. Tepals 6; narrow ovoid; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 5–5.2 mm long; inner tepals 5–5.2 mm long. Staminodes 3. Ovary 1-locular. Stigmatic branches 1.

Flowering season. Spring and Summer.

Flowering phenology. January, February, September, October, November and December.

Fruit morphology. Fruit nut; unilocular; oblong; 4 mm long.

Seed morphology. Seed maturation 6–8 months.

Conservation status. Uncommon.

Distribution. Distribution in N.S.W.: CC, NC. Distribution outside N.S.W.: QLD.

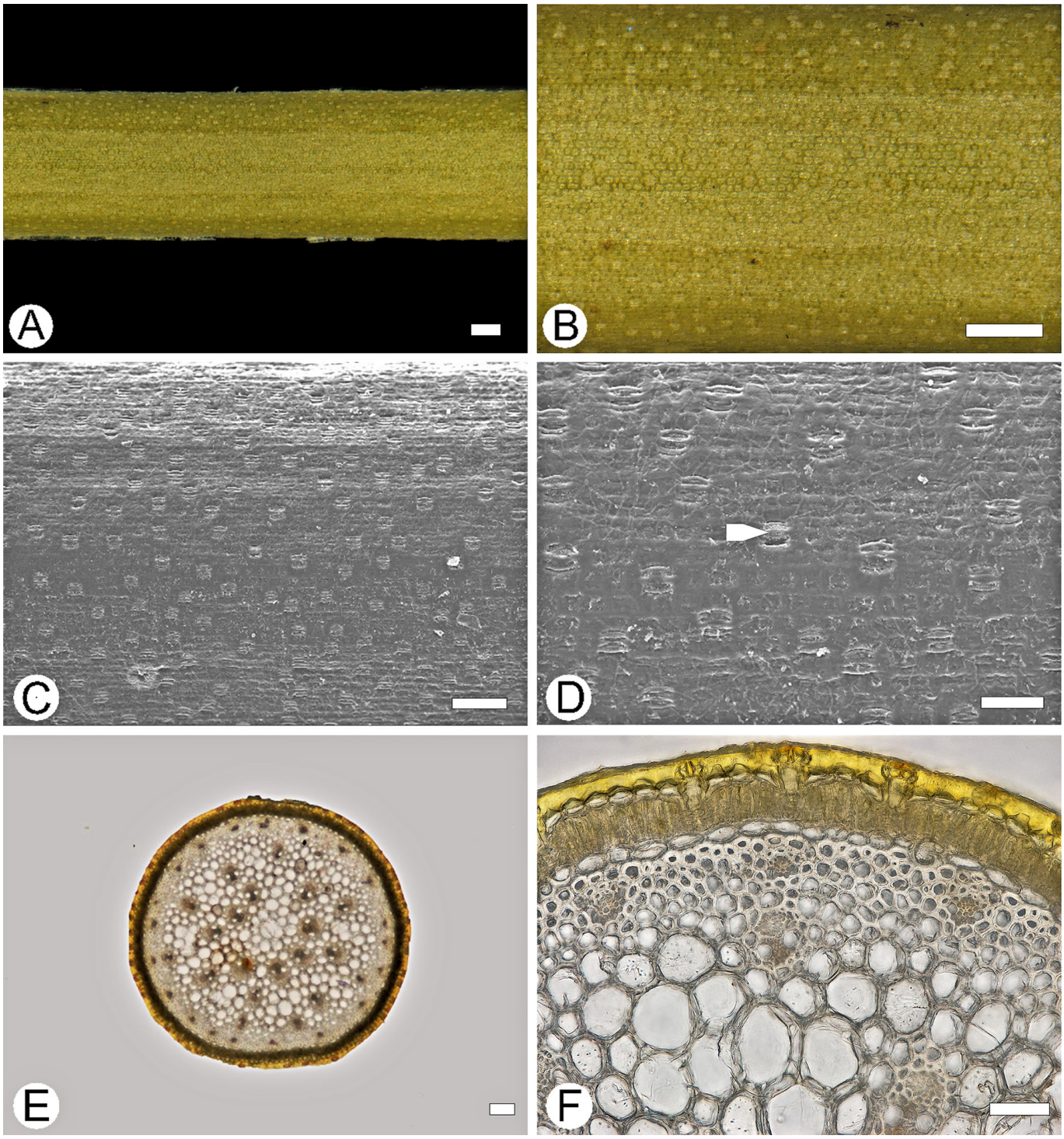

Fig. 69. *Coleocarya gracilis* S.T.Blake. Monoecious specimen (*S.J. Griffith s.n.*, 7 May 1990). A–D middle-third of culm surface and E–F Internode cross-section of the culm. C–D, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–B, 200 µm; C, 100 µm; D, F, 50 µm; E, 250 µm.

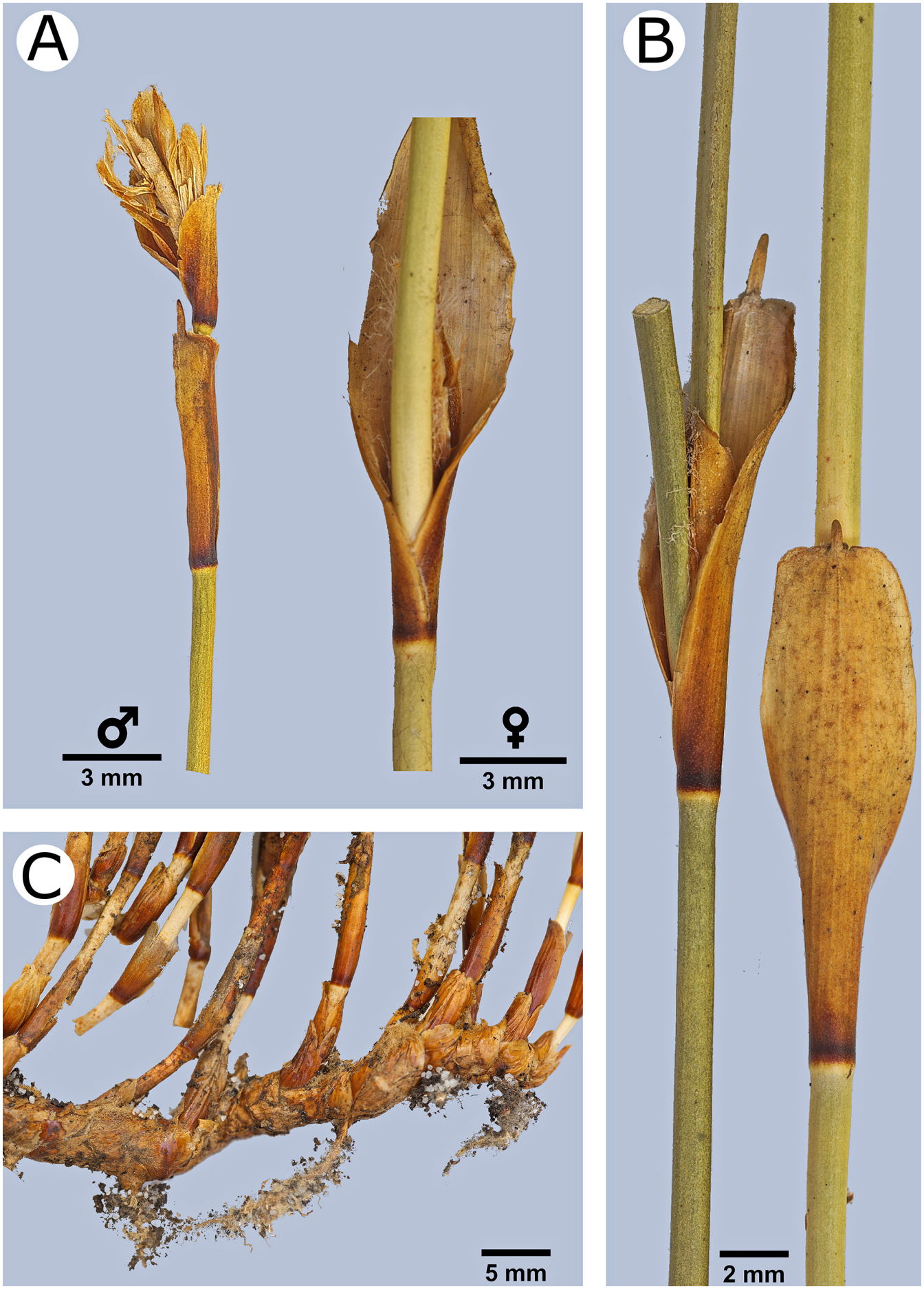

Fig. 70. *Coleocarya gracilis* S.T.Blake. A, male (left) and female (right; the single spikelet is hidden behind the culm) inflorescences B, a portion of the aerial shoot (sheaths) C, rhizomes. Monoecious specimen (*S.J. Griffith s.n.*, 7 May 1990).

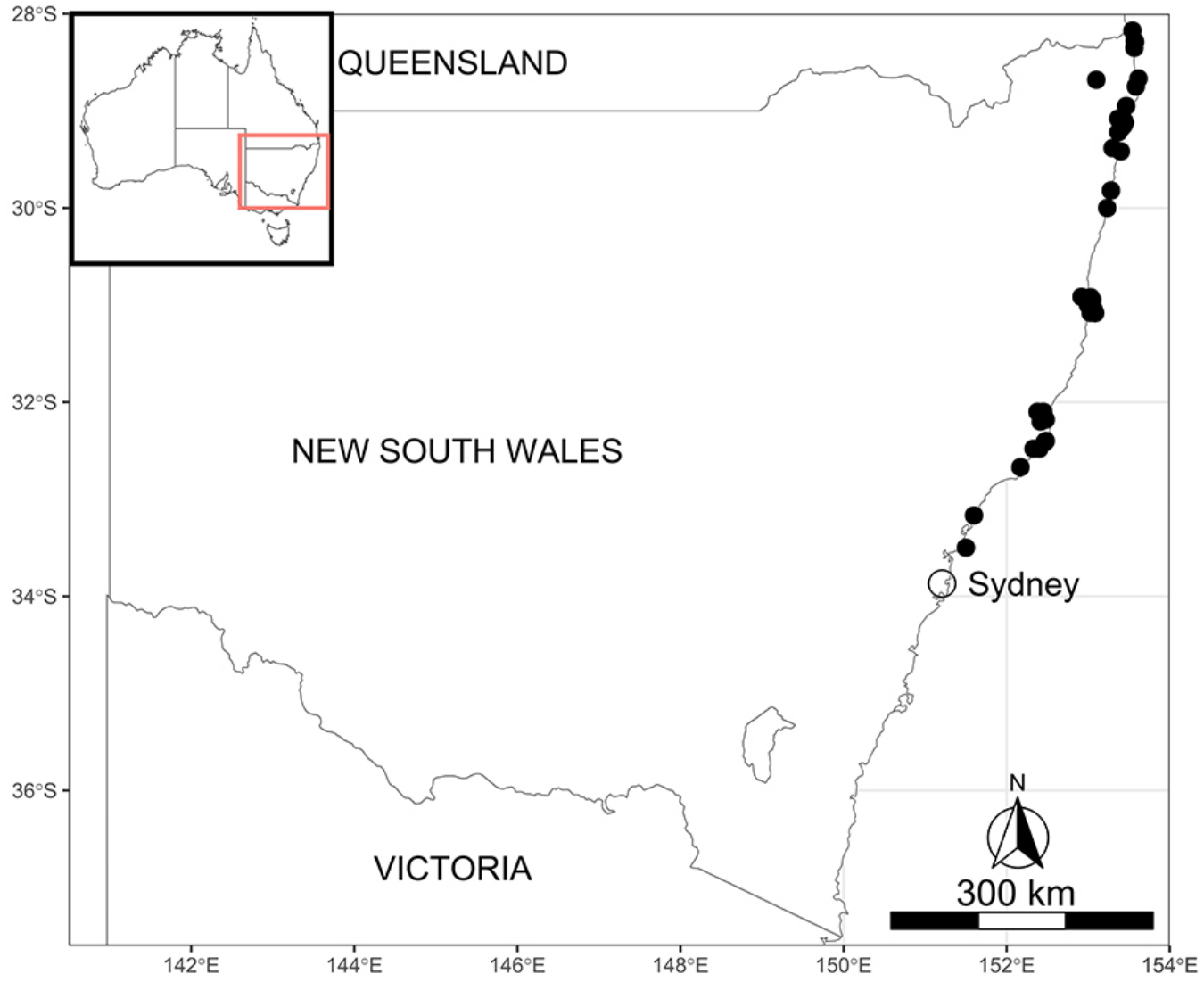

Fig. 71. Distribution of *Coleocarya gracilis* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Empodisma minus (Hook.f.) L.A.S.Johnson & D.F.Cutler

Basionym: *Calorophus minor* Hook.f.

Other synonyms: 1. *Calorophus elongatus* var. *minor* (Hook.f.) Hook.f.

2. *Hypolaena lateriflora* var. *minor* (Hook.f.) Cheeseman.

3. *Leptocarpus squarrosus* Nees.

4. *Hypolaena lateriflora* Benth., nom. illeg.

Common name: Rope rush.

Figures 72, 73, 74, 75.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 1.5–2.5 mm diam.; spreading or tufted; creeping; subterranean; 3–5 cm deep; dark brown; when dry dark brown. Rhizome trichomes absent, or present; pale ginger when dry. Rhizome scales absent.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 15–200 mm long; 1–2 mm diam; semi-terete; arching; branched. Culm internodes many. Culm surface ribbed; when fresh and when dried; at 40× coarsely rugose; at 300× rugose. Culm texture smooth to touch; trichomes absent; warts present; warts elongate; dark green when fresh; dark green when dry (see Fig. 3 B1), or dark brown when dry (see Fig. 3 F1); marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section semi-terete; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; uniseriate. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity absent. Silica present; stegmata present. Starch grains present.

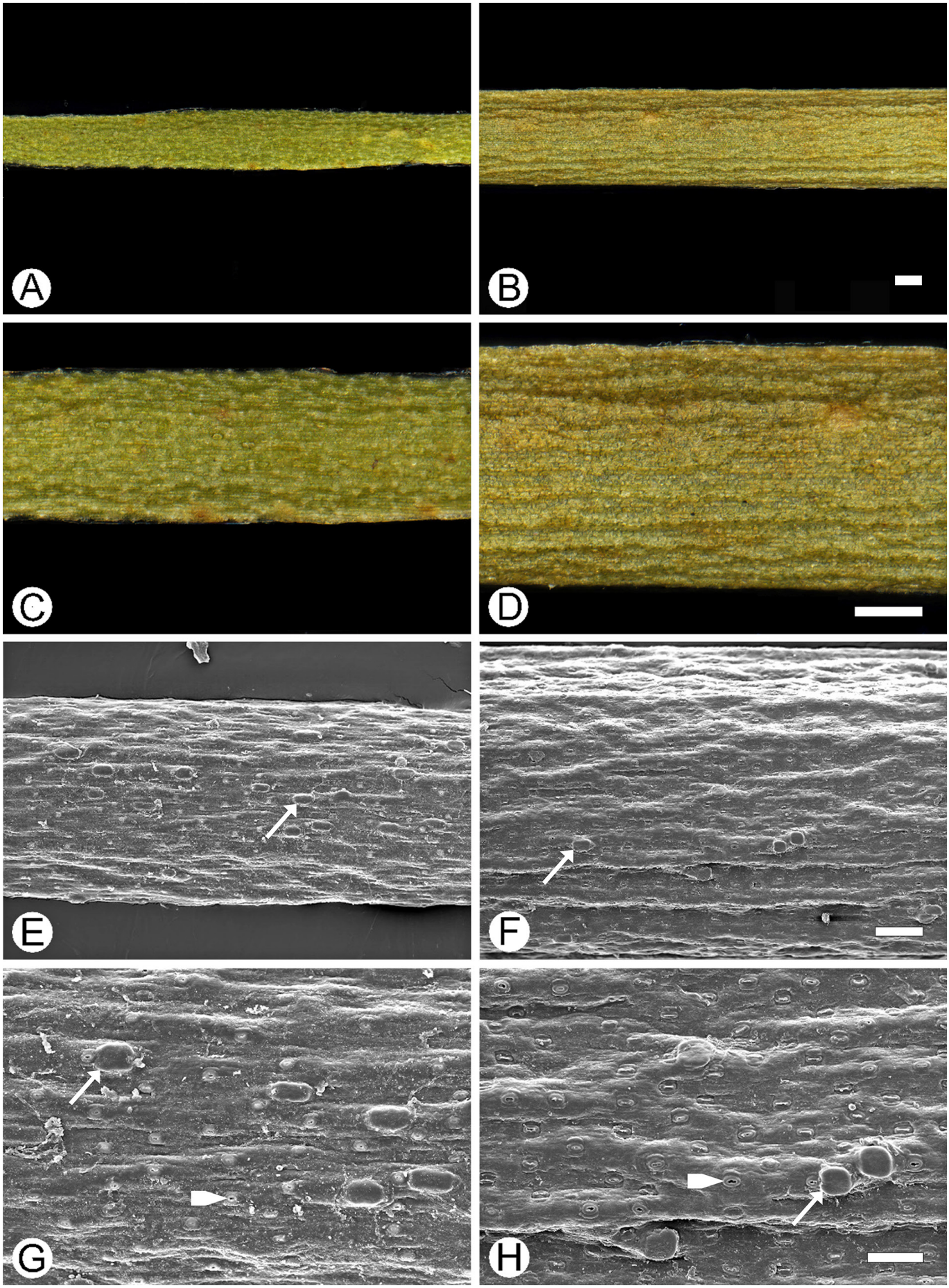

Fig. 72. *Empodisma minus* (Hook.f.) L.A.S.Johnson & D.F.Cutler. A, C, E & G, male plant (*J.R. Hosking 2830*, 23 Nov. 2006). B, D, F, H female plant (*L.M. Copeland 1159*, 18 Feb. 1999). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate; arrow = elongate wart. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

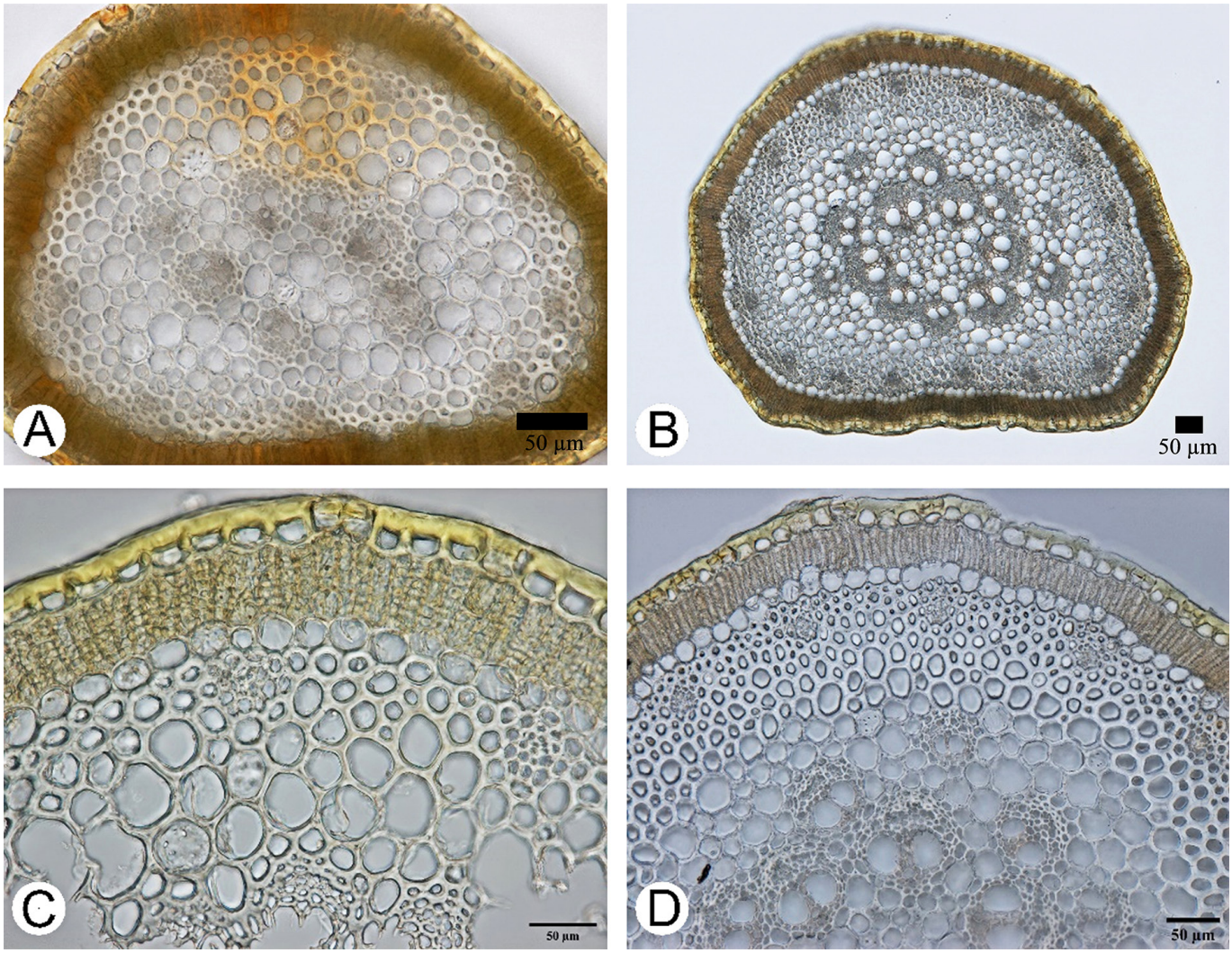

Fig. 73. *Empodisma minus* (Hook.f.) L.A.S.Johnson & D.F.Cutler. Internode cross-section of the culm. A, C, male plant (*J.R. Hosking 2830*, 23 Nov. 2006). B, D, female plant (*L.M. Copeland 1159*, 18 Feb. 1999).

Notes on culm. According to Meney and Pate (1999), the mid-region culm is hollow. However, in this study, the mid-third of culm was found to be solid, without cavity, and the vascular bundles gathered in the middle. These features were constant in all specimens examined at NE (Table 3). *Empodisma minus* has a wide range of length (15–200 cm) and width (1–2 mm), so it may get hollow when it gets taller or wider. Further investigation of morphological, anatomical and taxonomic variation in the species is warranted.

Leaf morphology. Leaf sheath appressed; 0.5–1.2 cm long; glossy; wrinkled; green (see Fig. 19); margins opaque. Leaf sheath apex elongated; hairy; hairs > 1 mm long, or ≤ 1 mm long. Leaf lamina present; 1–6 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets, or ± equal to the spikelets. Male inflorescence 40–80 mm; with spikelets dispersed. Spikelets 1–45 per culm; 1 per node of the inflorescence. Spikelet 4–8 mm long. Spikelet oblong-cylindrical. Flowers 3–200 per culm; 3–5 per spikelet. Glumes mucronate. Glumes glabrous, or short hairs. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2.2–2.5 mm long; inner tepals 2.2–2.5 mm long. Stamens 3. Anthers 1.5–2.5 mm long.

Female inflorescence 18–35 mm; with spikelets dispersed. Spikelets 5–25 per culm; 1 per node of the inflorescence. Spikelet 4–8 mm long. Spikelet oblong-cylindrical. Flowers 5–25 per culm; 1 per spikelet. Glumes acuminate, or mucronate. Glumes glabrous, or short hairs. Tepals 4–6; elliptic; whitish or straw-coloured (see Fig. 24); outer and inner ± similar in length; outer tepals 3–3.2 mm long; inner tepals 3–3.2 mm long. Staminodes 0. Ovary 1-locular. Stigmatic branches 2–3.

Flowering season. Spring and Summer.

Flowering phenology. January, February, August, September, October, November and December.

Fruit morphology. Fruit nut; unilocular; ovate; 2 mm long.

Seed morphology. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, NC, NT, SC, ST. Distribution outside N.S.W.: QLD, SA, TAS, VIC.

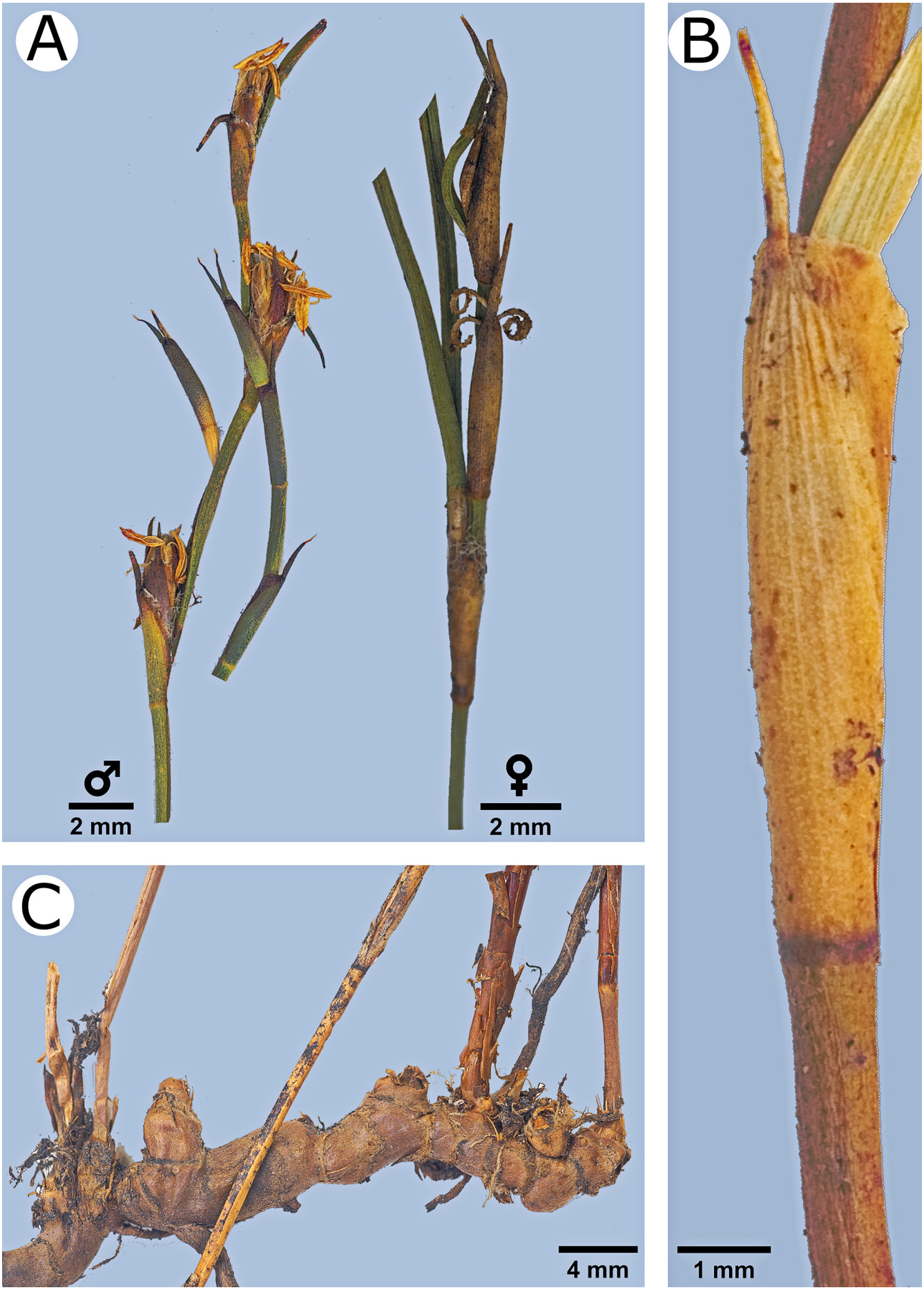

Fig. 74. *Empodisma minus* (Hook.f.) L.A.S.Johnson & D.F.Cutler. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*J.R. Hosking 2830*, 23 Nov. 2006) and female specimen (*L.M. Copeland 1159*, 18 Feb. 1999).

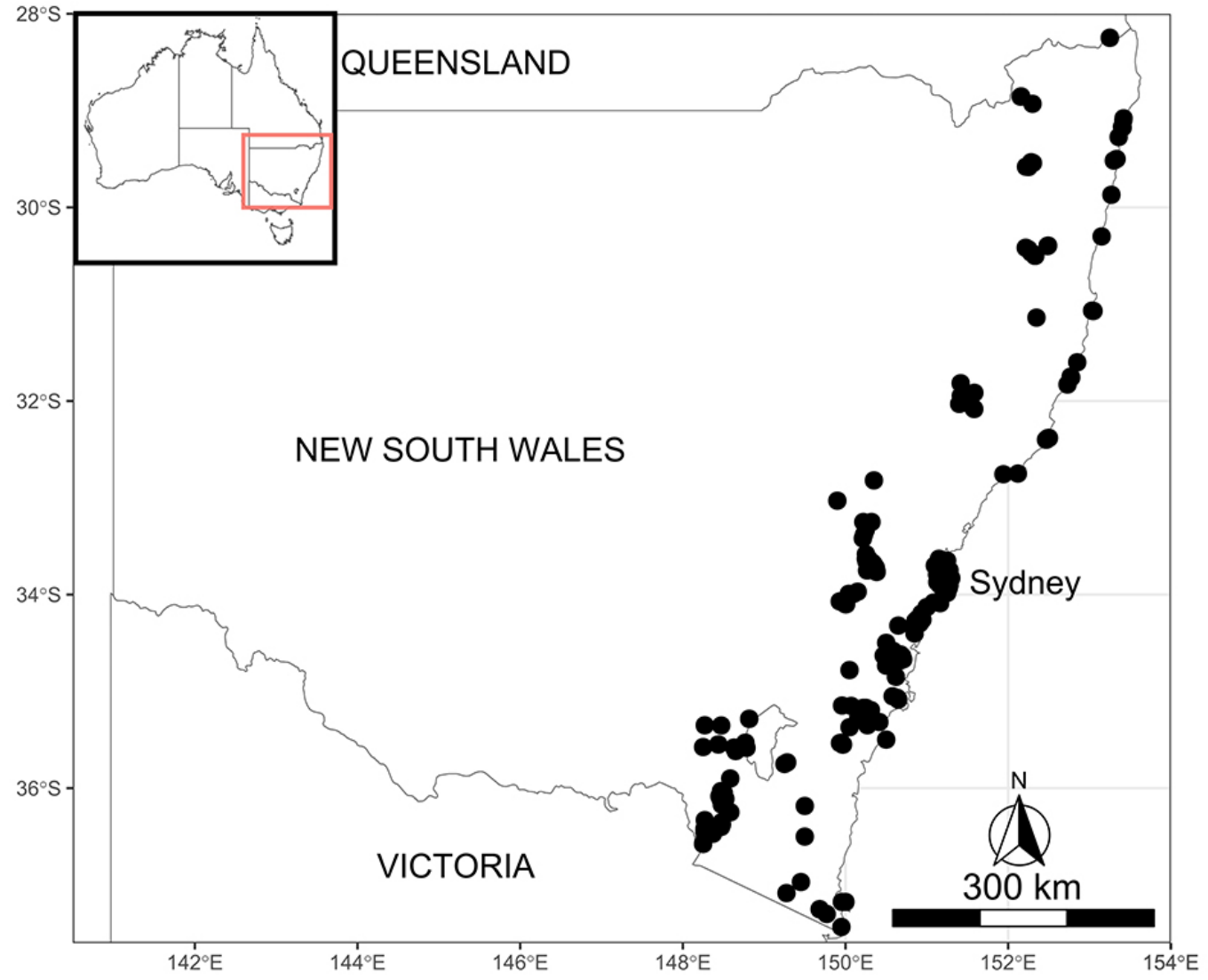

Fig. 75. Distribution of *Empodisma minus* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Eurychorda complanata (R.Br.) B.G.Briggs & L.A.S.Johnson

Basionym: *Restio complanatus* R.Br.

Common name: Flat cord-rush.

Figures 76, 77, 78, 79, 80.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 0–1 mm diam.; tufted; ascending, or creeping; subterranean, or superficial; to 1 cm deep; when dry dark brown. Rhizome trichomes present; cream when dry. Rhizome scales present; light brown.

Culm morphology. Culms on the rhizome arranged closely spaced. Culms 20–120 mm long; 0.8–3.5 mm diam; flattened; erect; unbranched. Sterile lateral branches absent. Culm internodes few. Culm surface ribbed; when fresh and when dried; at 40× striate; at 300× striate, or rugose. Culm texture smooth to touch; trichomes absent; warts absent; faded green when dry (see Fig. 3 B2); culms of female plants more intense in colour than males; marbling present, or absent. Culm stomata obscured (covered); superficial; dispersed; covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section strongly compressed; outer epidermal walls undulating; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; uniseriate. Pillar cells present. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; narrow and flattened. Silica present; stegmata present. Starch grains absent.

Notes on culm. Culm surface of males and females are different under SEM. Culm shape in cross-sections also differs between sexes. There was also a noticeable difference in shape and size of the lamina of the basal leaf (Fig. 76). However, *Eurychorda* is mono-specific (*Eurychorda complanata*) (Harden 1993; Meney and Pate 1999). Further study of the species is warranted to explore the variation in features observed.

Leaf morphology. Leaf sheath appressed; 1–2 cm long; dull; smooth, or striate; light brown (see Fig. 19); margins opaque. Leaf sheath apex finely pointed, or obtuse; glabrous. Leaf lamina absent.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 15–80 mm; with spikelets clustered or dispersed. Spikelets 6–36 per culm; 1–5 per node of the inflorescence. Spikelet 5–10 mm long. Spikelet ovoid, or globose. Flowers 350–500 per culm; 25–30 per spikelet. Glumes cuspidate, or mucronate. Glumes short hairs. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2.2–2.5 mm long; inner tepals 2.2–2.5 mm long. Stamens 2. Anthers 0.8–1.2 mm long.

Female inflorescence 15–80 mm; with spikelets clustered. Spikelets 1–15 per culm; 1–5 per node of the inflorescence. Spikelet 5–10 mm long. Spikelet ovoid. Flowers 8–15 per spikelet. Glumes cuspidate, or mucronate. Glumes short hairs. Tepals 4; elliptic; yellow-brown (see Fig. 24); outer shorter than the inner; outer tepals 2.2–2.6 mm long; inner tepals 2.5–2.8 mm long. Staminodes 2. Ovary 2-locular. Stigmatic branches 2.

Flowering season. Spring and Summer.

Flowering phenology. January, February, March, August, September, October, November and December.

Fruit morphology. Fruit capsule; bilocular; ovate; 1.6–1.8 mm long.

Seed morphology. Seeds 0.8–1.2 mm long; 0.6 mm wide. Seed maturation 10–12 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, NC, SC. Distribution outside N.S.W.: QLD, SA, TAS, VIC.

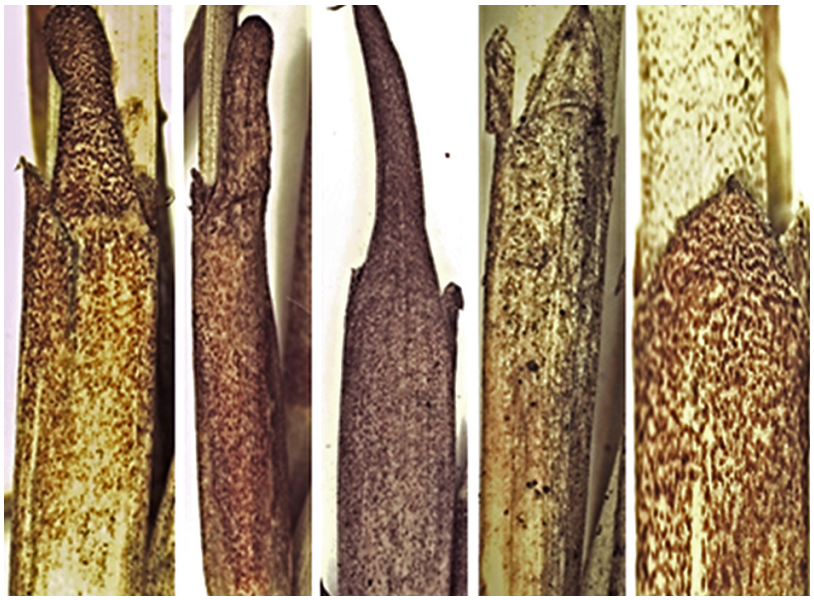

Fig. 76. *Eurychorda complanata* (R.Br.) B.G.Briggs & L.A.S.Johnson. Variation in size and shape of Apex of leaf sheath of basal leaf.

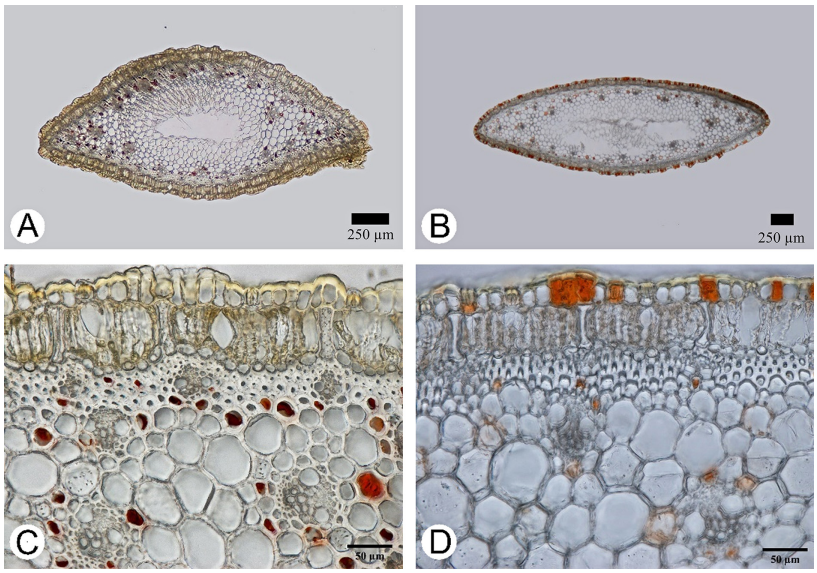

Fig. 77. *Eurychorda complanata* (R.Br.) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*E.F. Constable s.n.*, 11 Nov. 1959). B, D, female plant (*P. Rose 65*, 3 Dec. 2008).

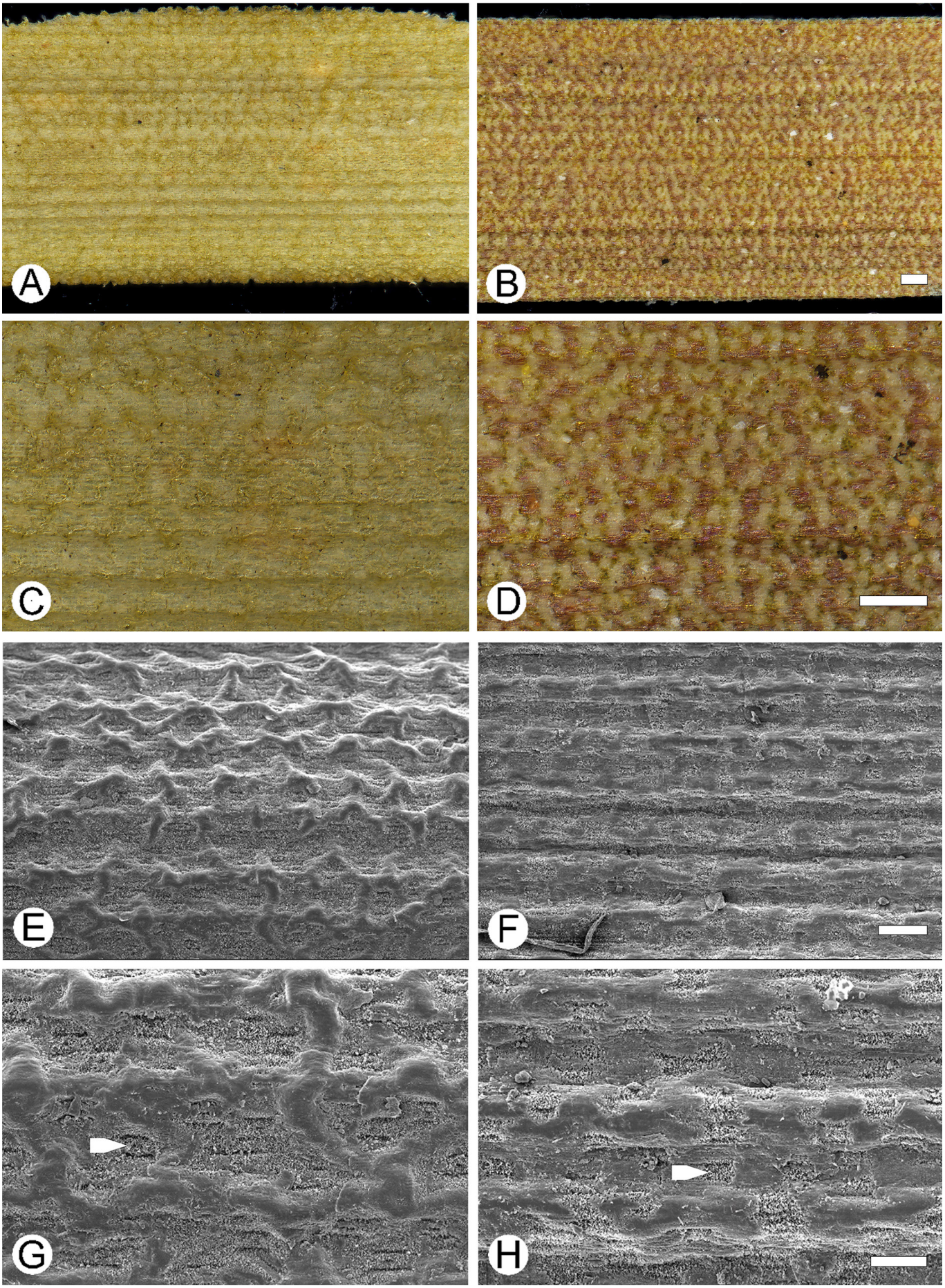

Fig. 78. *Eurychorda complanata* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*E.F. Constable s.n.*, 11 Nov. 1959). B, D, F, H female plant (*P. Rose 65*, 3 Dec. 2008). E–H, micrographs (SEM) of culm surface. arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

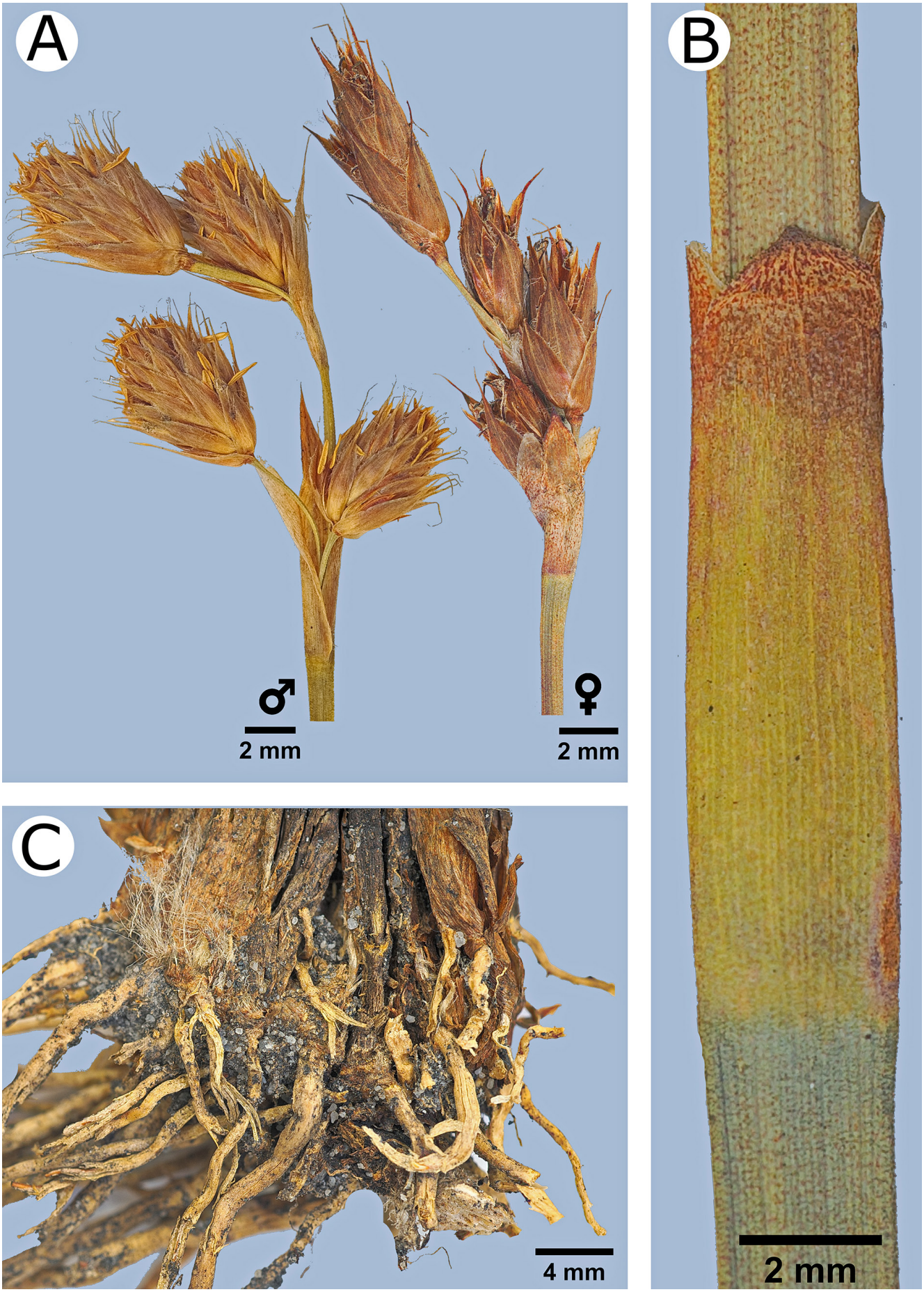

Fig. 79. *Eurychorda complanata* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*E.F. Constable s.n.*, 11 Nov. 1959) and female specimen (*P. Rose 65*, 3 Dec. 2008).

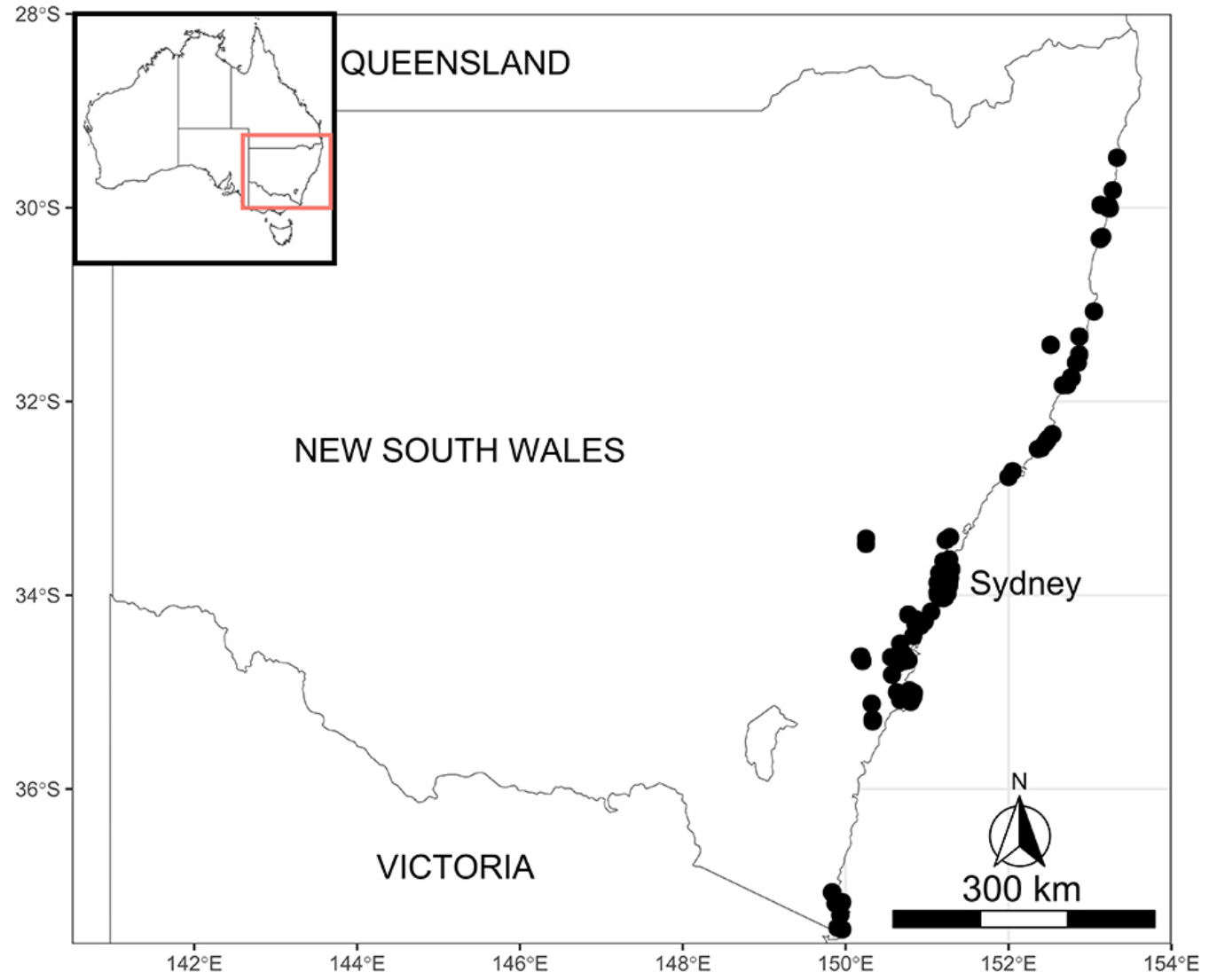

Fig. 80. Distribution of *Eurychorda complanata* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Hypolaena fastigiata R.Br.

Other synonyms: 1. *Calorophus fastigiatus* (R.Br.) F.Muell.

2. *Calostrophus fastigiatus* F.Muell.

Common name: Tassel rope-rush; bundled rope bush.

Figures 81, 82, 83, 84.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 2–5 mm diam.; spreading; creeping; subterranean; 2–4 cm deep; when dry dark brown. Rhizome trichomes absent, or present; cream when dry. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 20–70 mm long; 1–1.5 mm diam; terete; erect, or arching; branched. Culm internodes many. Culm surface ribbed; when fresh and when dried; at 40× striate; at 300× striate. Culm texture rough to touch; trichomes present; warts absent; glaucous green when fresh; greyish green when dry (see Fig. 3 F5); marbling absent. Culm stomata obscured (covered); in grooves; not covered with wax; covered with trichomes.

Culm anatomy. Culm cross-section slightly compressed; outer epidermal walls undulating; thick. Epidermis uniseriate. Culm stomata sunken. Chlorenchyma present. Chlorenchymatous cells squat; in three layers. Peg cells absent. Pillar cells present. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; partial; opposite vascular bundles present. Culm central cavity absent. Silica present; stegmata present. Starch grains absent.

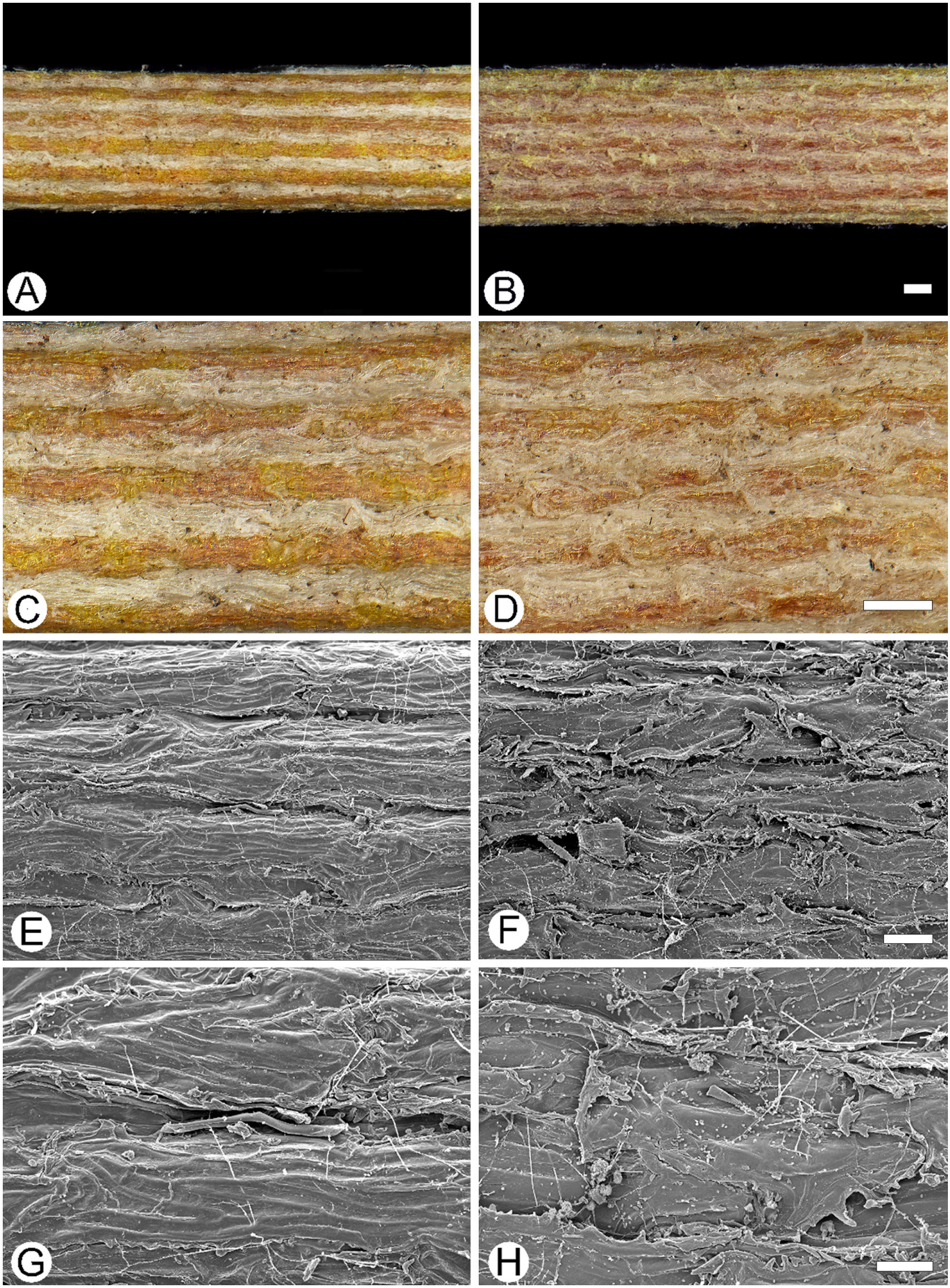

Fig. 81. *Hypolaena fastigiata* R.Br. A, C, E & G, male plant (*V. Klaphake s.n.*, 20 Jan. 1998). B, D, F, H female plant (*V. Klaphake s.n.*, 20 Jan. 1998). E, F, G and H covered by appressed hairs. E–H, micrographs (SEM) of culm surface. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

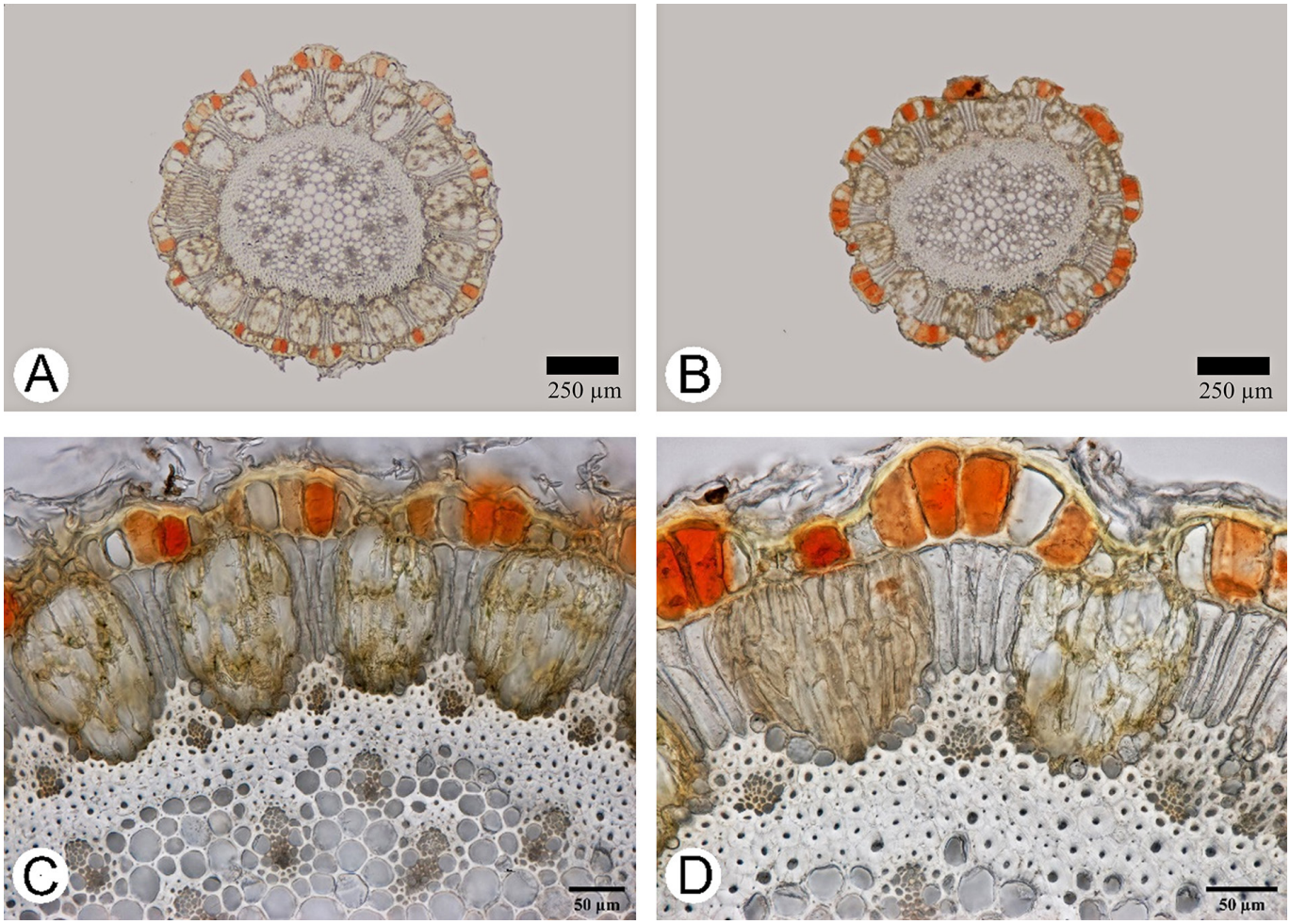

Fig. 82. *Hypolaena fastigiata* R.Br. Internode cross-section of the culm. A, C, male plant (*V. Klaphake s.n.*, 20 Jan. 1998). B, D, female plant (*V. Klaphake s.n.*, 20 Jan. 1998).

Leaf morphology. Leaf sheath appressed; 0.8–1.5 cm long; dull; hairy; light brown (see Fig. 19); margins translucent. Leaf sheath apex finely pointed or elongated; glabrous. Leaf lamina present; 1–5 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets, or ± equal to the spikelets. Male inflorescence 16–50 mm; with spikelets dispersed. Spikelets 45–80 per culm; 1–2 per node of the inflorescence. Spikelet 5–8 mm long. Spikelet ovoid. Flowers 400–900 per culm; 8–12 per spikelet. Glumes cuspidate. Glumes glabrous. Tepals 6; elliptic; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1.5–1.8 mm long; inner tepals 1.5–1.8 mm long. Stamens 3. Anthers 0.8–1.2 mm long.

Female inflorescence 6–25 mm; with spikelets clustered. Spikelets 1–40 per culm; 1 per node of the inflorescence. Spikelet 6–12 mm long. Spikelet oblong-cylindrical. Flowers 1 per spikelet. Glumes cuspidate. Glumes glabrous. Tepals 6; oblong lanceolate; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 0.4–0.7 mm long; inner tepals 0.4–0.7 mm long. Staminodes 0. Ovary 1-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, February, August, September, October, November and December.

Fruit morphology. Fruit nut; unilocular; ovate; 3.5–4 mm long.

Seed morphology. Seed maturation 10–12 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, NC, SC. Distribution outside N.S.W.: QLD, SA, TAS, VIC, WA.

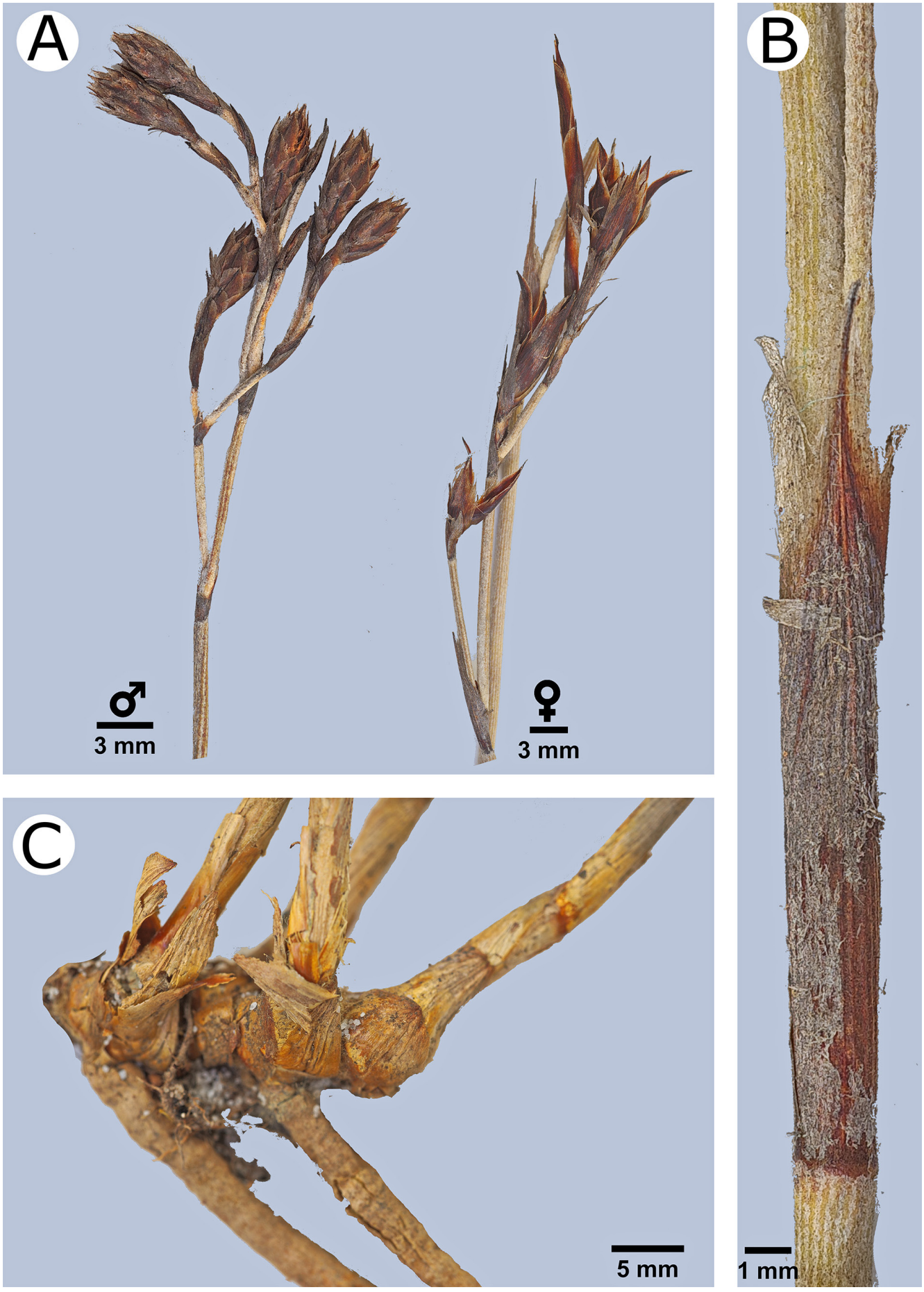

Fig. 83. *Hypolaena fastigiata* R.Br. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*V. Klaphake s.n.*, 20 Jan. 1998). B, D, female specimen (*V. Klaphake s.n.*, 20 Jan. 1998).

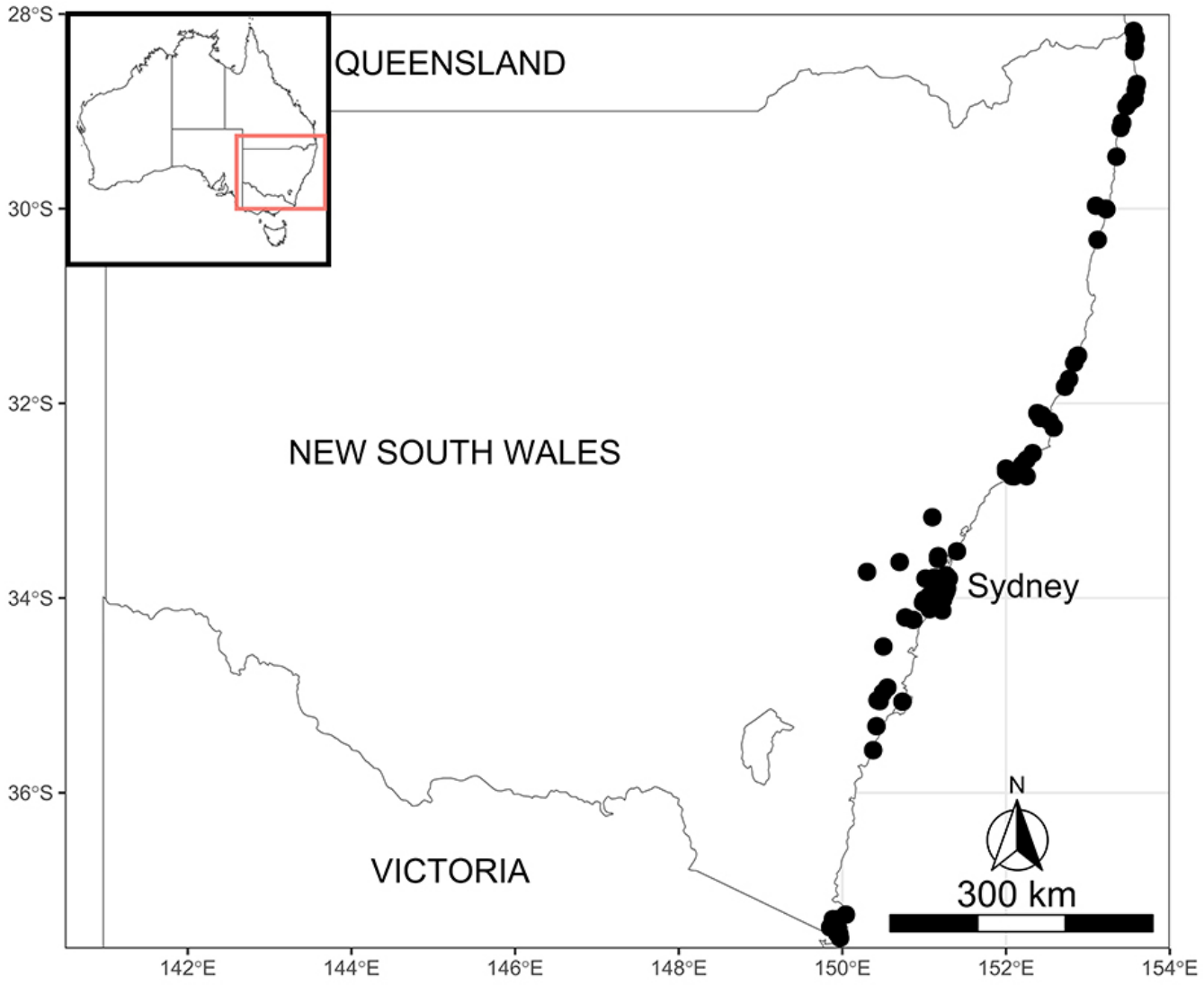

Fig. 84. Distribution of *Hypolaena fastigiata* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Leptocarpus tenax (Labill.) R.Br.

Basionym: *Schoenodum tenax* Labill.

Other synonyms: 1. *Restio setuligerus* Nees, orth. var.

2. *Restio setuliger* Nees.

3. *Leptocarpus setuligerus* F.Muell., orth. var.

4. *Leptocarpus setuliger* (Nees) F.Muell.

5. *Leptocarpus thamnochortoides* F.Muell.

6. *Restio cinerascens* Nees ex Mast., nom. illeg.

7. *Lyginia symphyonema* F.Muell., nom. illeg.

8. *Lyginia tenax* (Labill.) Steud.

9. *Lygynia tenax* Steud., orth. var.

10. *Lyginia tenax* (Labill.) C.A.Gardner, nom. illeg.

Figures 85, 86, 87, 88.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 4–5.5 mm diam.; spreading; creeping; subterranean; 2–4 cm deep; pale brown; when dry yellowish-brown. Rhizome trichomes absent. Rhizome scales absent; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 50–130 mm long; 1–2 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes few, or many. Culm surface not ribbed; at 40× smooth; at 300× smooth. Culm texture smooth to touch; trichomes present; warts absent; dark green when fresh; dark green when dry (see Fig. 3 C1), or dark greenish when dry (see Fig. 3 C3); marbling absent. Culm stomata obvious; in grooves; dispersed; not covered with wax; covered with trichomes.

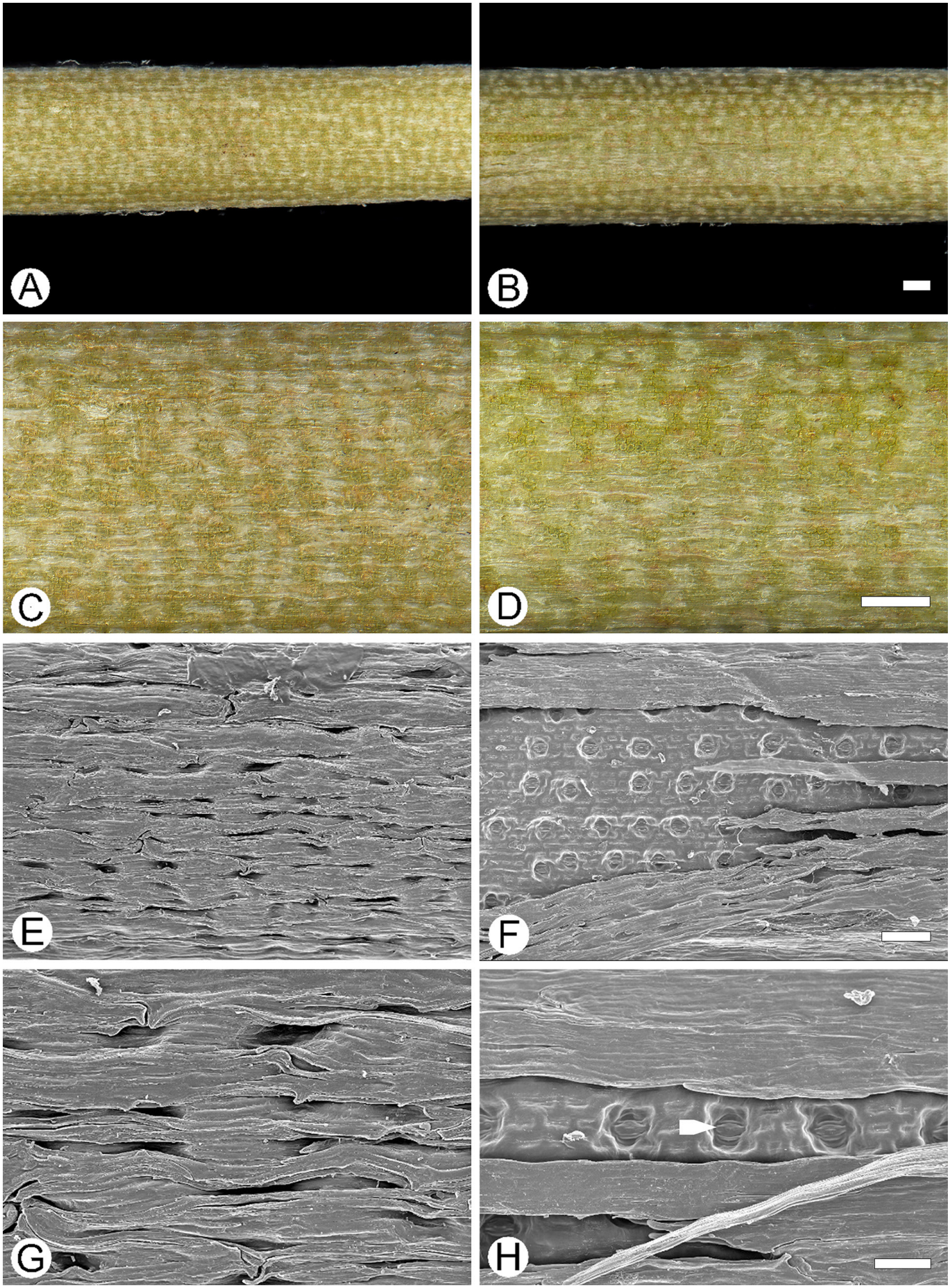

Fig. 85. *Leptocarpus tenax* (Labill.) R.Br. A, C, E & G, male plant (*A. Vossen 19*, 1 Apr. 2014). B, D, F, H female plant (*A. Vossen 19*, 1 Apr. 2014). E–H, micrographs (SEM) of culm surface. Appressed hairs in E and G and partially covered in F and H. Arrowhead = stomata. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

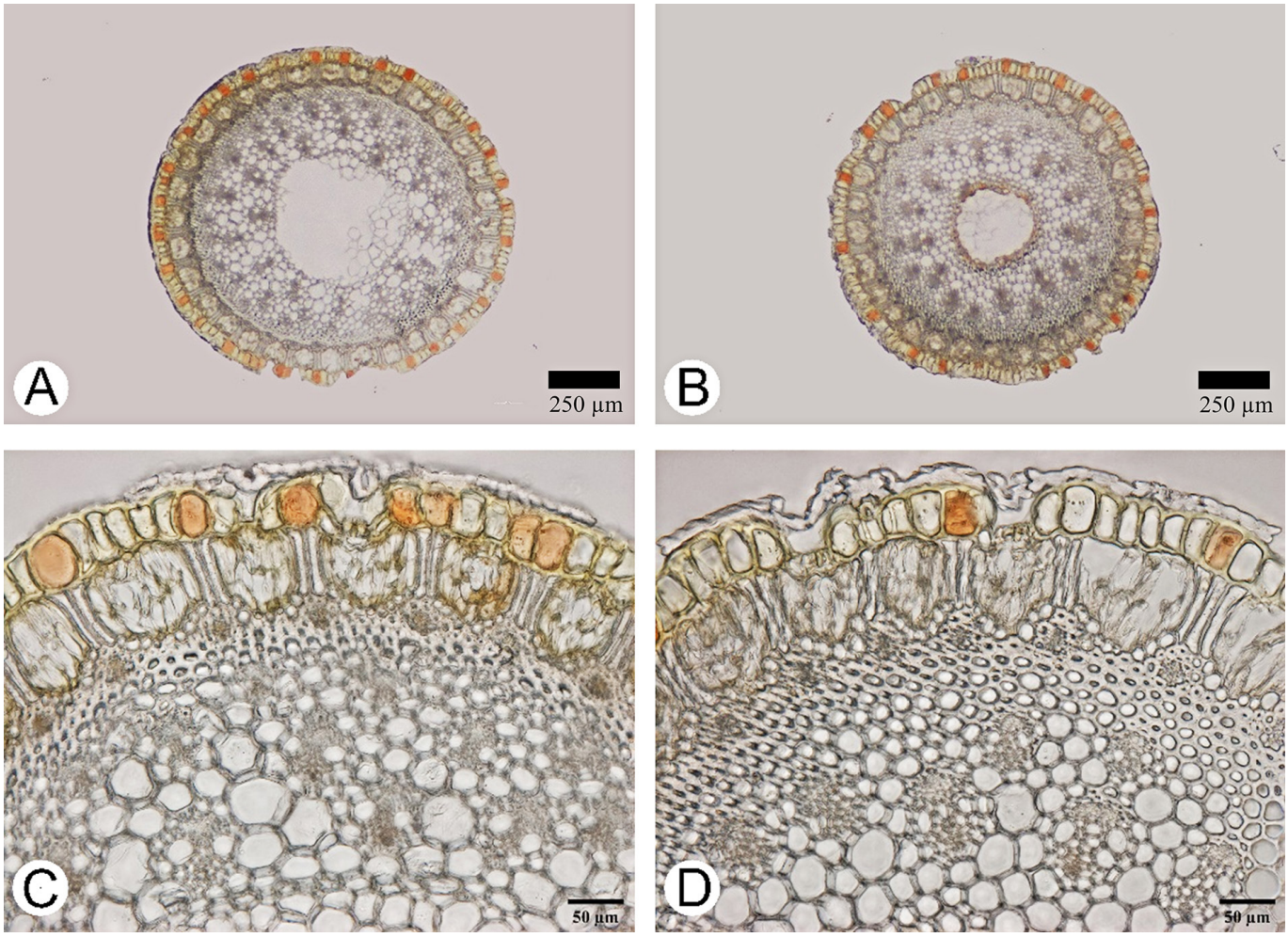

Fig. 86. *Leptocarpus tenax* (Labill.) R.Br. Internode cross-section of the culm. A, C, male plant (*A. Vossen 19*, 1 Apr. 2014). B, D, female plant (*A. Vossen 19*, 1 Apr. 2014).

Culm anatomy. Culm cross-section ±terete; outer epidermal walls undulating; thin. Epidermis uniseriate. Culm stomata sunken. Chlorenchyma present. Chlorenchymatous cells squat; in two layers. Peg cells absent. Pillar cells present. Protective cells absent. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; partial; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains absent.

Leaf morphology. Leaf sheath appressed; 0.5–1.5 cm long; glossy; striate; red-brown (see Fig. 19); margins translucent. Leaf sheath apex finely pointed or elongated; glabrous. Leaf lamina present; 1.5–2.5 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets, or ± equal to the spikelets. Male inflorescence 60–115 mm; with spikelets dispersed. Spikelets 30–150 per culm; 1 per node of the inflorescence. Spikelet 2–4 mm long. Spikelet ovoid. Flowers 5–9 per spikelet. Glumes acuminate, or mucronate. Glumes glabrous. Tepals 6; narrow ovoid; whitish or straw-coloured (see Fig. 24), or pale brown (see Fig. 24); outer and inner ± similar in length; outer tepals 1–1.2 mm long; inner tepals 1–1.2 mm long. Stamens 3. Anthers 0.8–1 mm long.

Female inflorescence 10–30 mm; with spikelets dispersed. Spikelets 2–14 per culm; 1 per node of the inflorescence. Spikelet 10–40 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 10–200 per culm; 4–20 per spikelet. Glumes acuminate, or mucronate. Glumes glabrous. Tepals 4; elliptic; yellow-brown (see Fig. 24), or brown (see Fig. 24); outer and inner ± similar in length; outer tepals 3.7–5.2 mm long; inner tepals 3.7–5 mm long. Staminodes 0, or 3. Ovary 1-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, August, September, October, November and December.

Fruit morphology. Fruit nut; unilocular; oblong; 1–3 mm long.

Seed morphology. Seeds 2 mm long; 0.8 mm wide. Seed maturation 2–3 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, NC, NT, SC, ST. Distribution outside N.S.W.: QLD, SA, TAS, VIC, WA.

Fig. 87. *Leptocarpus tenax* (Labill.) R.Br. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) male plant. C, rhizomes. Male specimen (*A. Vossen 19*, 1 Apr. 2014) and female specimen (*A. Vossen 19*, 1 Apr. 2014).

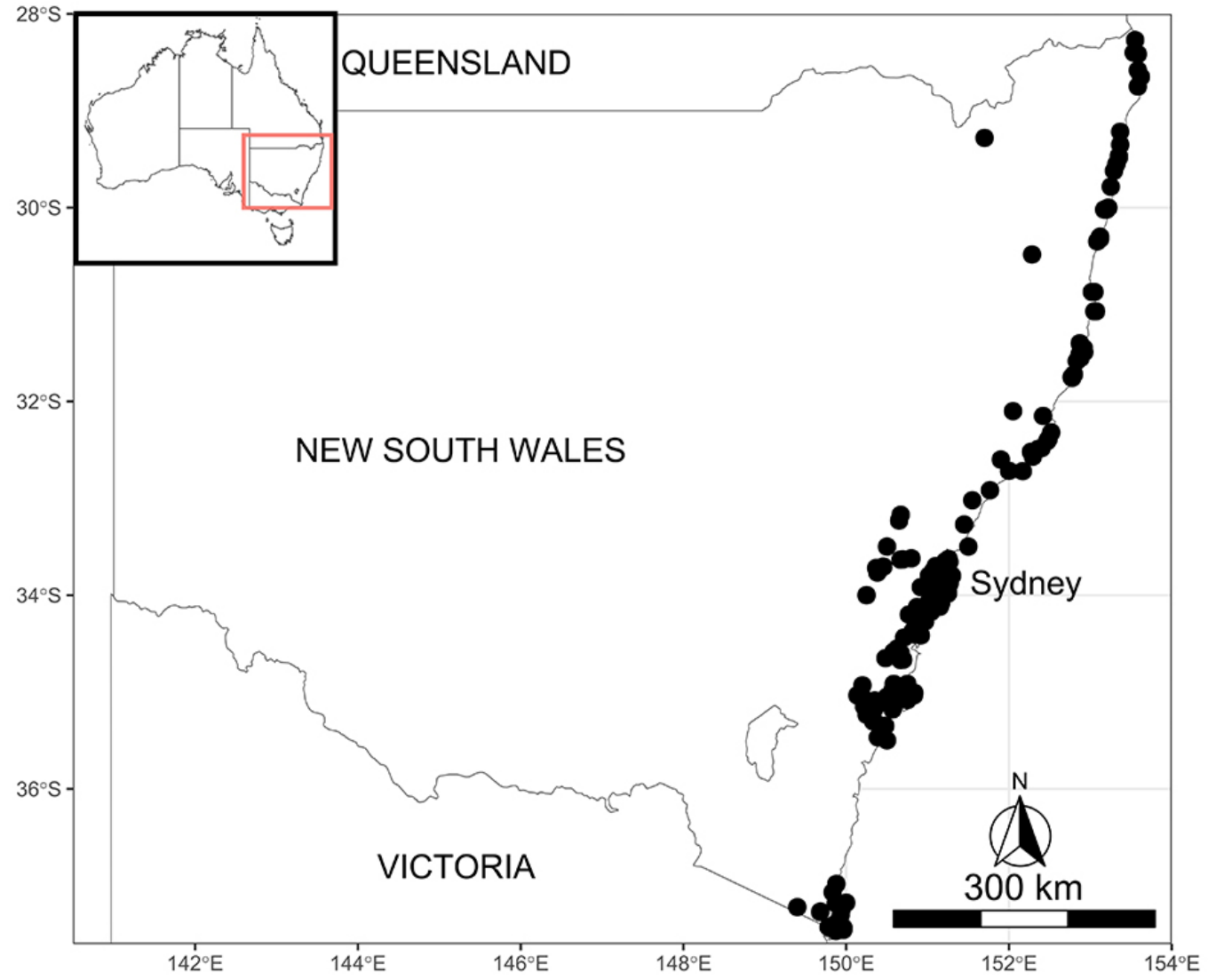

Fig. 88. Distribution of *Leptocarpus tenax* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Lepyrodia anarthria F.Muell. ex Benth.

Other synonyms: *1. Lepyrodia anarthria* F.Muell., nom. inval., nom. prov.

2. Anarthria gracilis Nees ex Benth., nom. illeg.

Misapplication: *Anarthria gracilis* R.Br.

Common name: Scale rush.

Figures 89, 90, 91, 92.

Reproduction. **Plants** dioecious.

Rhizome morphology. Rhizome 2–8 mm diam.; spreading or tufted; creeping; subterranean; 2–5 cm deep; when dry mid-brown, or dark brown. Rhizome trichomes absent. Rhizome scales present; light brown, or orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 30–80 mm long; 0.8–2 mm diam; elliptical; erect; unbranched. Sterile lateral branches absent. Culm internodes one. Culm surface not ribbed; at 40× smooth; at 300× minutely rugose. Culm texture smooth to touch; trichomes absent; warts present; warts hollow; green when dry (see Fig. 3 C4), or yellowish when dry (see Fig. 3 D5); marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section compressed; outer epidermal walls plane; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; biseriate. Pillar cells absent. Protective cells present. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity absent. Silica present; stegmata present.

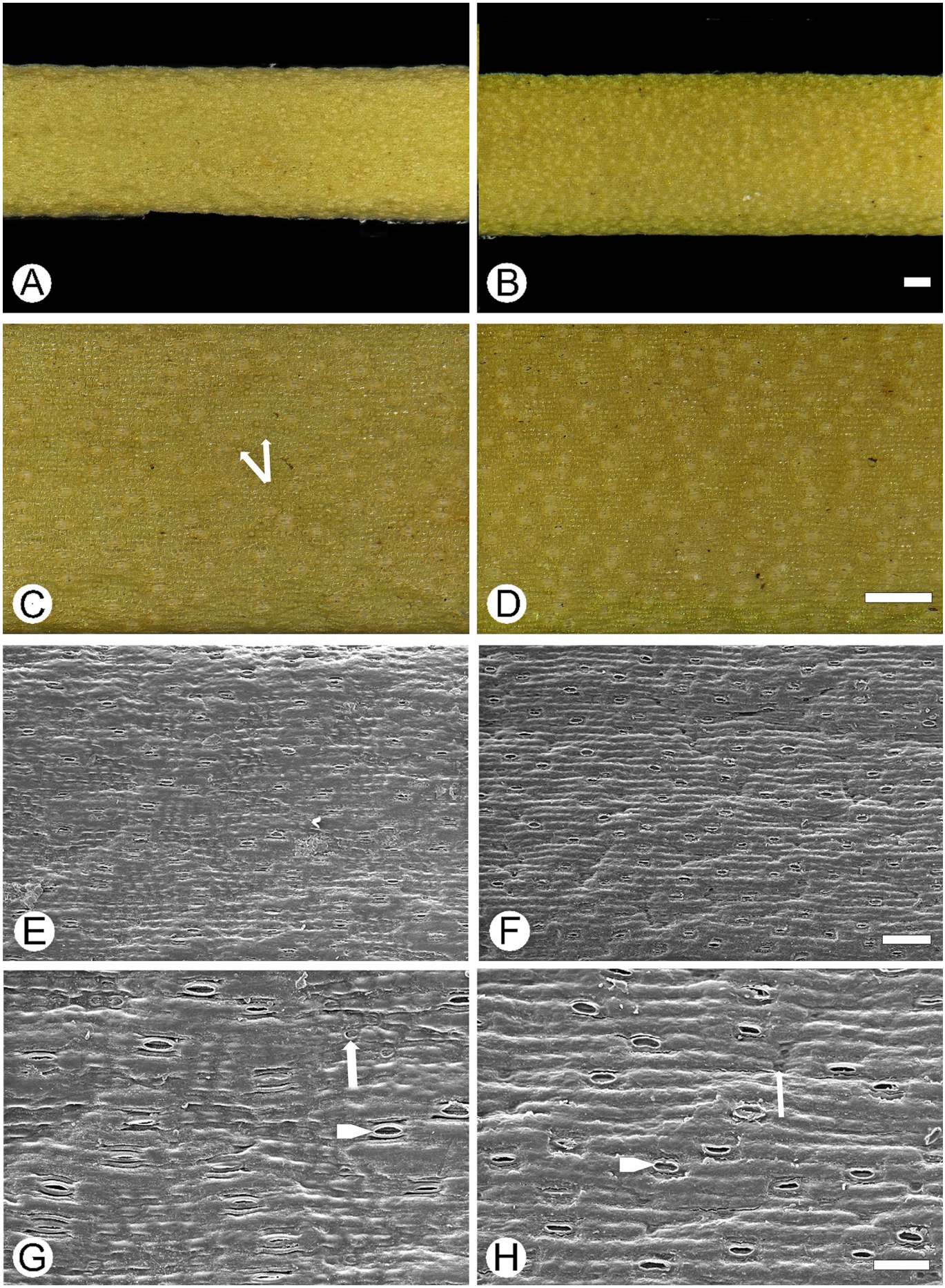

Fig. 89. *Lepyrodia anarthria* F.Muell. ex Benth. A, C, E & G, male plant (*C.E. Nano 3*, 4 Jan. 1997). B, D, F, H female plant (*C.E. Nano 16*, 6 Feb. 1994). E–H, micrographs (SEM) of culm surface. Arrowhead = stomata; arrow = wart. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

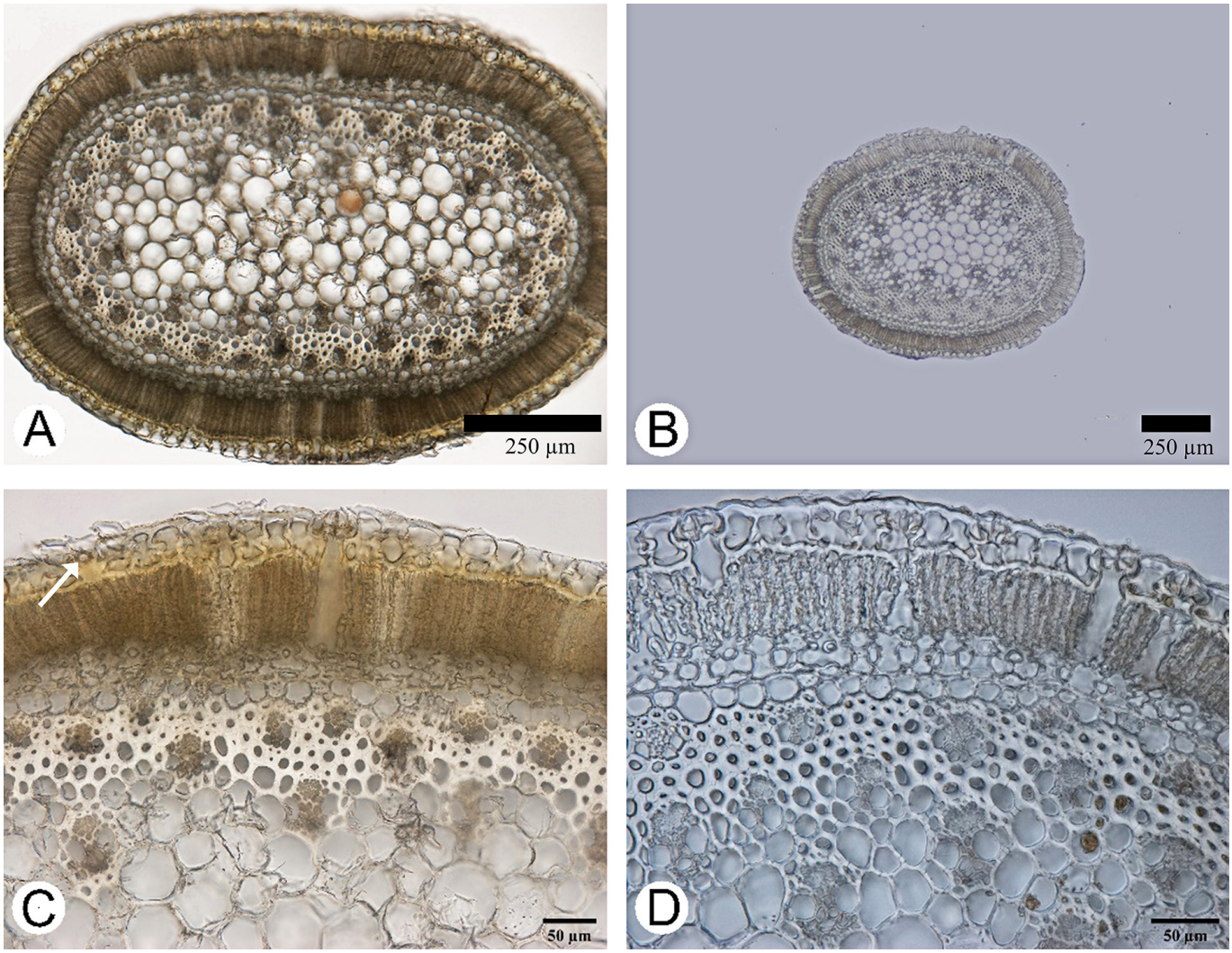

Fig. 90. *Lepyrodia anarthria* F.Muell. ex Benth. Internode cross-section of the culm. A, C, male plant (*C.E. Nano 3*, 4 Jan. 1997). B, D, female plant (*C.E. Nano 16*, 6 Feb. 1994). The arrow points to a wart in cross-sections.

Notes on culm. According to Meney and Pate (1999), the mid-region of the culm is hollow. However, in this study it was found to be solid, without a cavity. Culms in *Lepyrodia anarthria* vary in length (30–80 cm) and width (0.8–2 mm), so further study is needed to explore whether hollows develop with age or size of culm, or whether there is morphological and anatomical variation across the three disjunct distributions (two in NSW and one in Victoria) of the species across Australia and whether such variation merits taxonomic status.

Leaf morphology. Leaf sheath margins translucent. Leaf sheath apex glabrous. Leaf lamina present; 2–4.5 mm long.

Inflorescence morphology. Male inflorescence 10–35 mm; with spikelets dispersed. Spikelet 3–4 mm long. Spikelet oblong-cylindrical. Flowers 7–30 per culm. Glumes glabrous. Tepals 6; lanceolate, or narrow ovoid; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 2.8–3.8 mm long; inner tepals 2.4–3.2 mm long. Stamens 3. Anthers 0.8–1.2 mm long.

Female inflorescence 10–40 mm; with spikelets dispersed. Spikelet 3–4 mm long. Spikelet oblong-cylindrical. Flowers 5–25 per culm. Tepals 6; lanceolate, or narrow ovoid; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 2.8–3.8 mm long; inner tepals 2.4–3.2 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, February, August, September, October, November and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 0.7–2 mm long.

Seed morphology. Seeds 0.9 mm long; 0.5–0.6 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, NT, SC, ST. Distribution outside N.S.W.: VIC.

Fig. 91. *Lepyrodia anarthria* F.Muell. ex Benth. A, male (left) and female (right) inflorescences. B, rhizomes. Male specimen (*C.E. Nano 3*, 4 Jan. 1997) and female specimen (*C.E. Nano 16*, 6 Feb. 1994).

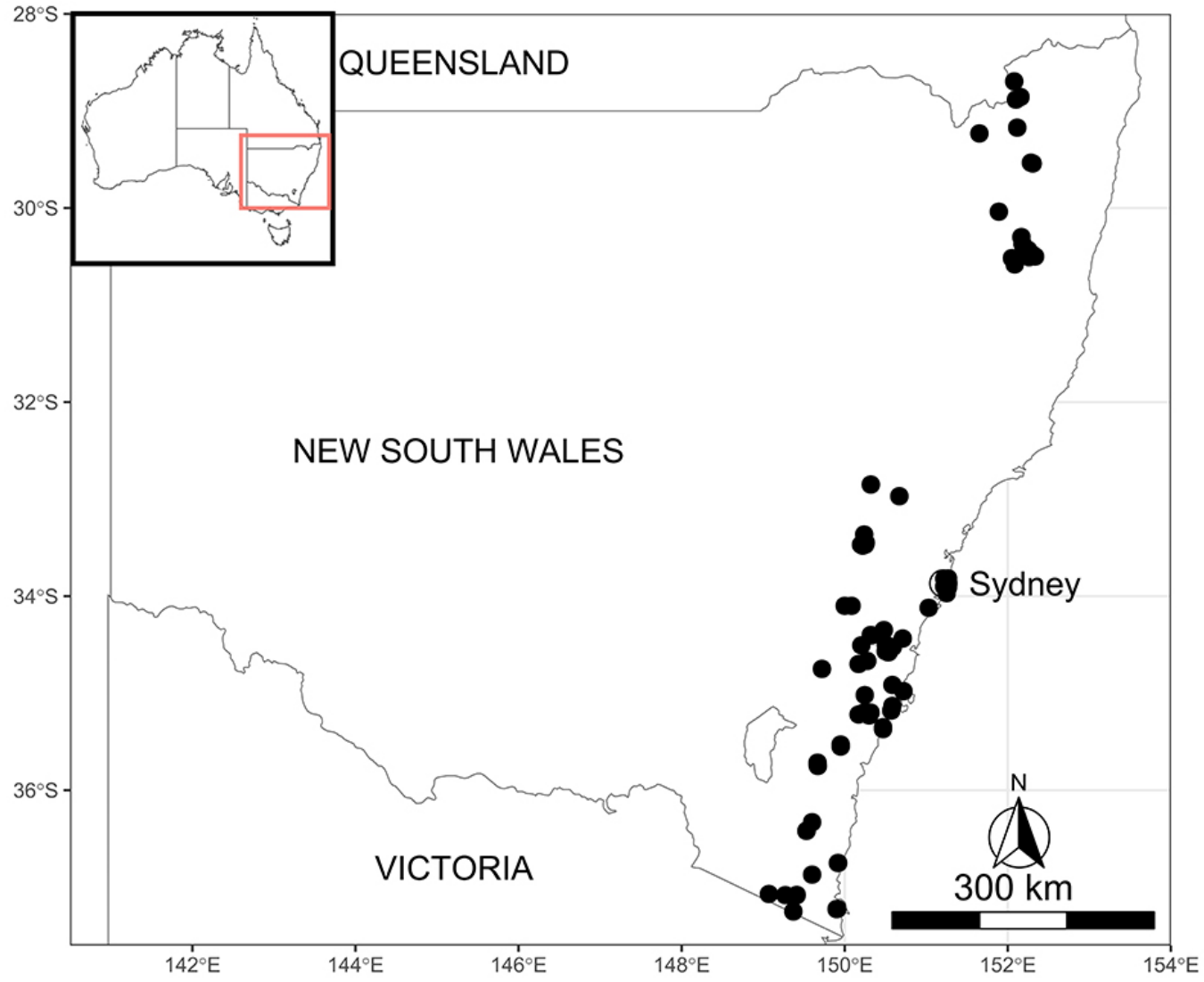

Fig. 92. Distribution of *Lepyrodia anarthria* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Lepyrodia cryptica B.G.Briggs & L.A.S.Johnson

Figures 93, 94, 95, 96.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 3.5–5 mm diam.; spreading; creeping; subterranean; 1–2 cm deep; when dry mid-brown. Rhizome trichomes absent. Rhizome scales present; grey.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 40–90 mm long; 0.6–1.8 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes few. Culm surface not ribbed; at 40× minutely rugose; at 300× pitted. Culm texture smooth to touch; trichomes absent; warts present; warts dome-shaped; green when dry (see Fig. 3 C4); marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section slightly compressed; outer epidermal walls plane; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; biseriate. Pillar cells absent. Protective cells present. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity present, or absent; circular. Silica present; stegmata present.

Notes on culm. Culm surface features observed for *Lepyrodia cryptica* in this study accord with previous research (Briggs 2012).

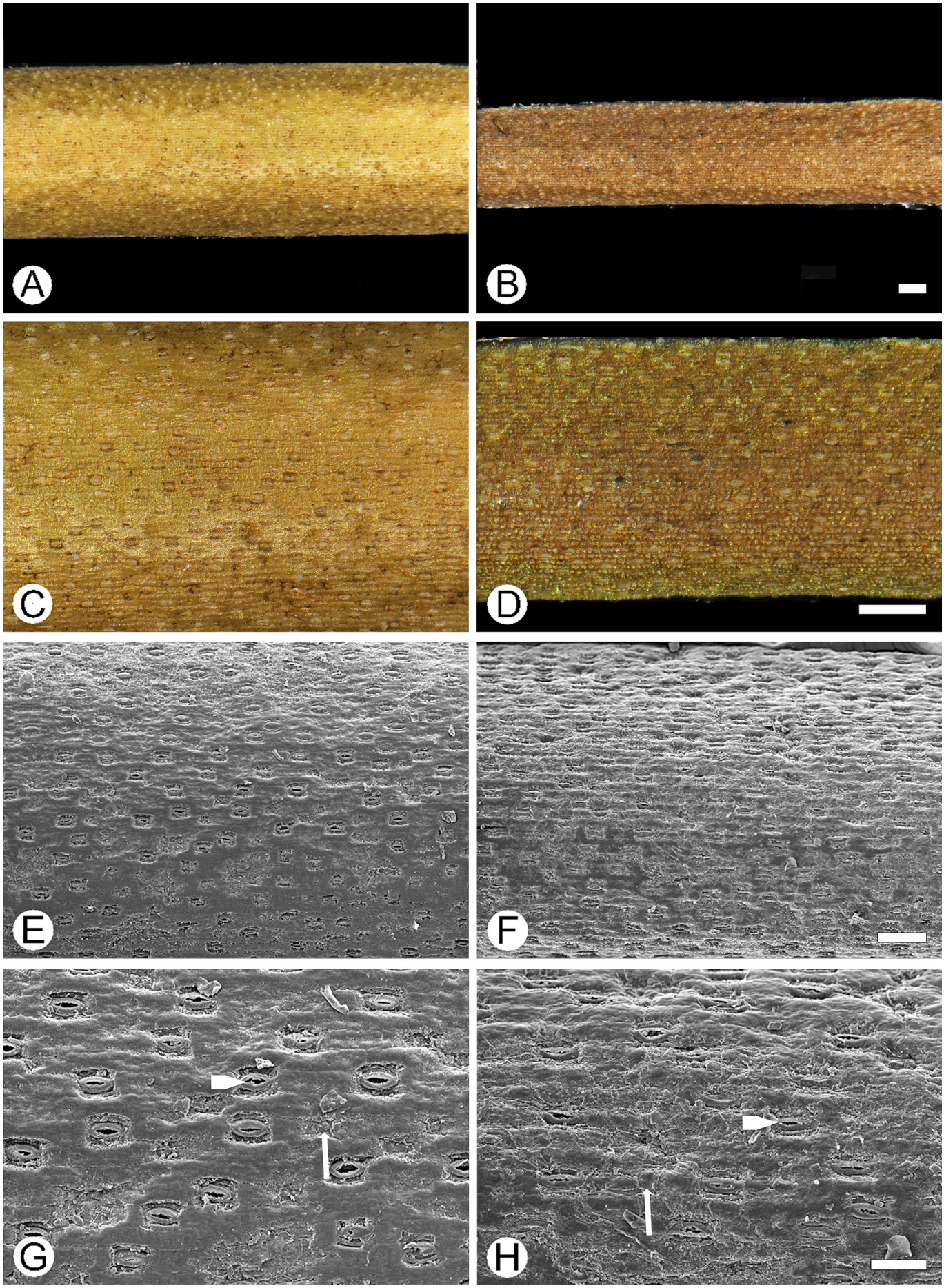

Fig. 93. *Lepyrodia cryptica* B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*V. Klaphake s.n.*, 1 Jan. 1998). B, D, F, H female plant (*V. Klaphake s.n.*, 1 Jan. 1998). E–H, micrographs (SEM) of culm surface. Arrowhead = stomata; arrow = wart. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

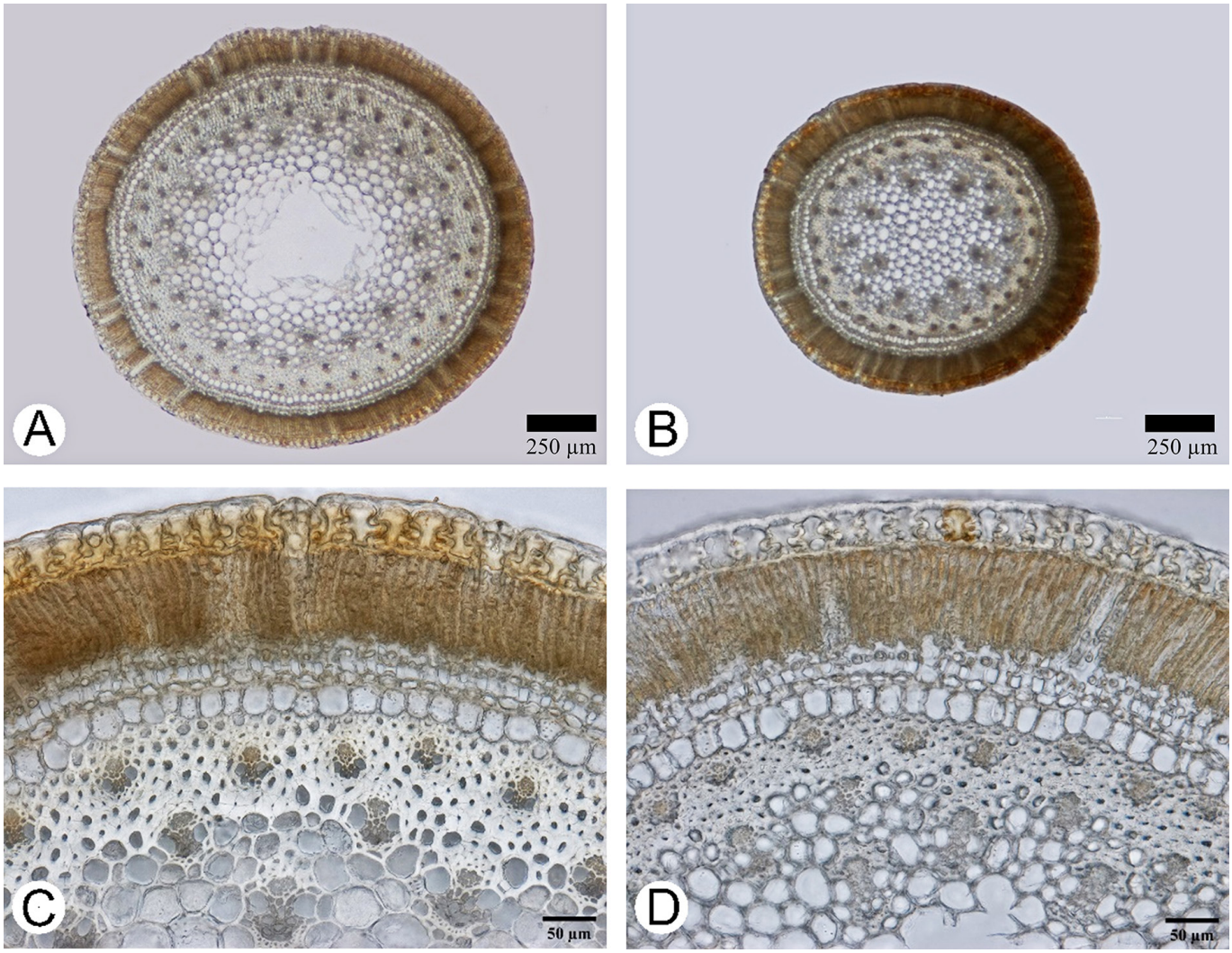

Fig. 94. *Lepyrodia cryptica* B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*V. Klaphake s.n.*, 1 Jan. 1998). B, D, female plant (*V. Klaphake s.n.*, 1 Jan. 1998).

Leaf morphology. Leaf sheath spreading; 1.2–3 cm long; dull; striate; light brown (see Fig. 19), or red-brown (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 2–3.5 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 25–110 mm; with spikelets clustered. Spikelet 3–4 mm long. Spikelet oblong-cylindrical. Flowers 30–120 per culm. Tepals 6; lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 3.2–4 mm long; inner tepals 2.9–3.5 mm long. Stamens 3. Anthers 1.5–2 mm long.

Female inflorescence 25–110 mm; with spikelets clustered. Spikelet 3–5 mm long. Spikelet oblong-cylindrical. Flowers 5–50 per culm. Tepals 6; lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 3–4.2 mm long; inner tepals 2.5–3.5 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, September, October, November and December.

Fruit morphology. Fruit capsule; trilocular.

Seed morphology. Seeds 1.2 mm long; 0.7 mm wide.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, ST.

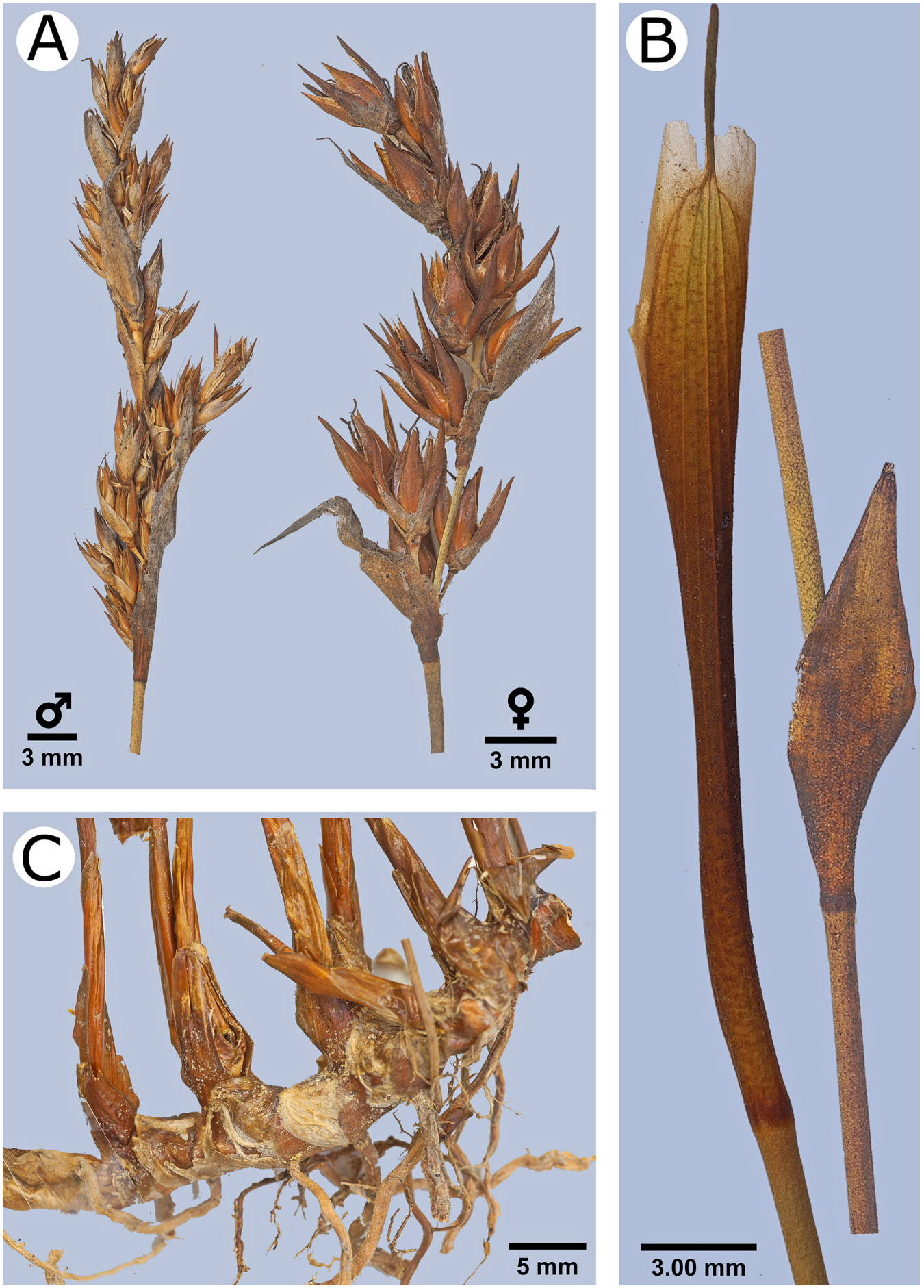

Fig. 95. *Lepyrodia cryptica* B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*V. Klaphake s.n.*, 1 Jan. 1998) and female specimen (*V. Klaphake s.n.*, 1 Jan. 1998).

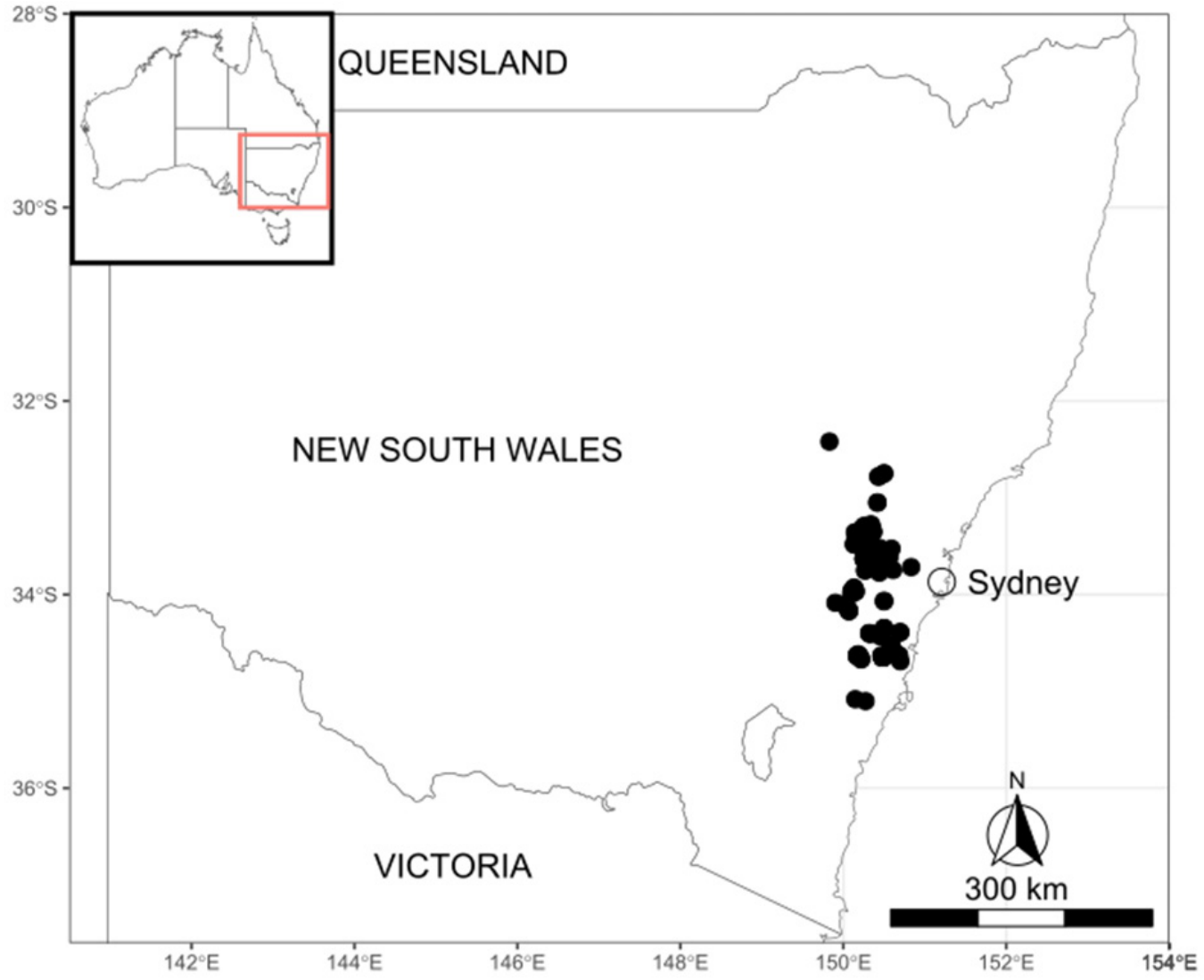

Fig. 96. Distribution of *Lepyrodia cryptica* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Lepyrodia imitans B.G.Briggs & L.A.S.Johnson

Other synonyms: 1. *Lepyrodia* sp. A (Quirico & Briggs 1993).

2. *Lepyrodia* sp. (Dunwich F.M.Bailey AQ108089).

Figures 97, 98, 99, 100.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 2–4 mm diam.; spreading; creeping; subterranean; 3–5 cm deep; grey-brown; when dry dark brown. Rhizome trichomes present. Rhizome scales present; light brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 45–110 mm long; 1.2–2.8 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes few. Culm surface not ribbed; at 40× minutely rugose; at 300× minutely rugose. Culm texture smooth to touch; trichomes absent; warts present; warts dome-shaped; yellow-green when fresh; mid-green when dry (see Fig. 3 A2); marbling absent. Culm stomata obvious; superficial; in rows; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section slightly compressed; outer epidermal walls plane; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; biseriate. Pillar cells absent. Protective cells present. Parenchyma sheath present; cells multiseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present, or absent; circular. Silica present; stegmata present. Starch grains absent.

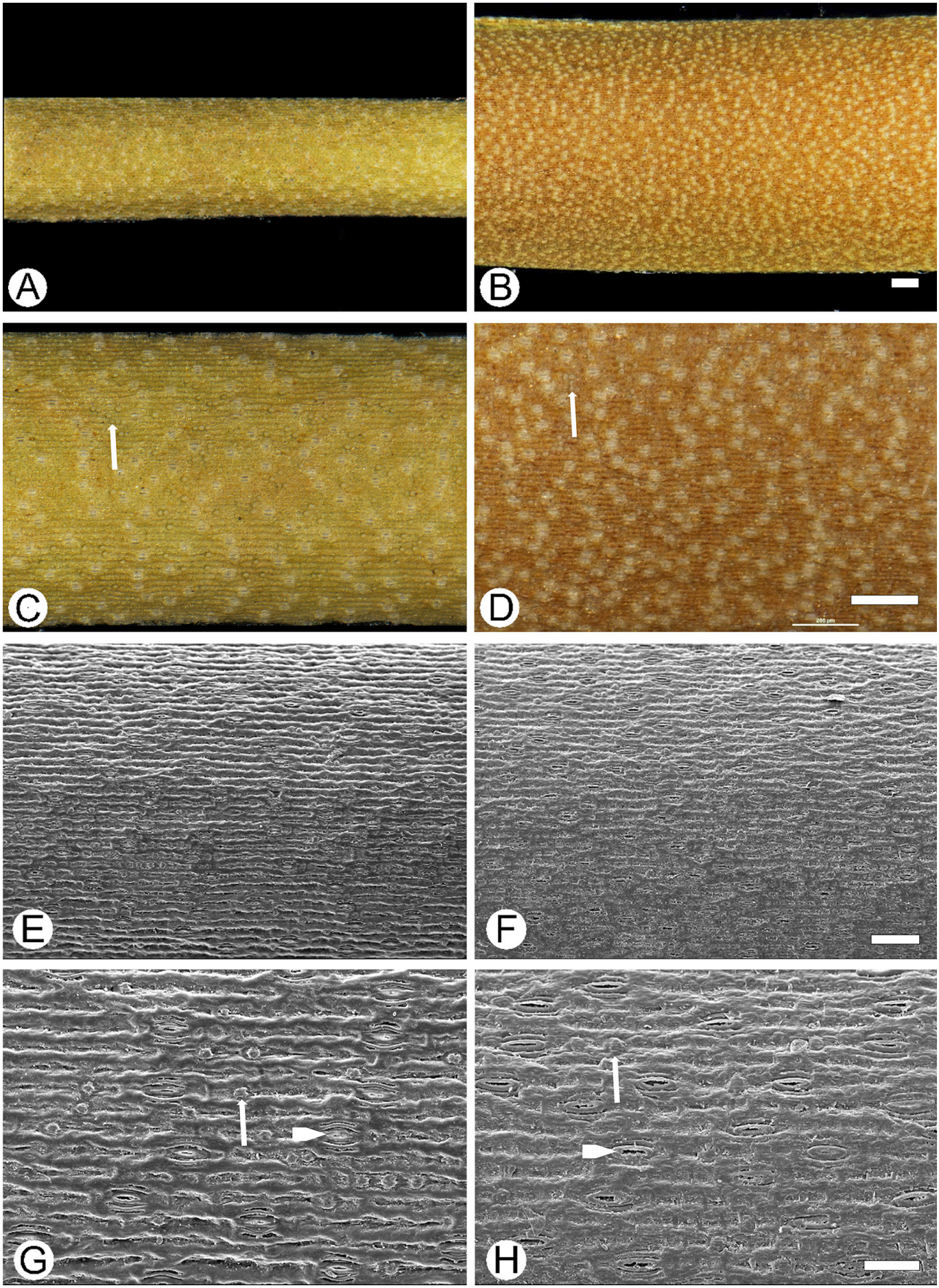

Fig. 97. *Lepyrodia imitans* B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*S.J. Griffith s.n.*, 22 Mar. 1988). B, D, F, H female plant (*S.J. Griffith s.n.*, 29 Mar. 1988). The arrows point at wart. E–H, micrographs (SEM) of culm surface. Arrowhead = stomata; arrow = wart. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

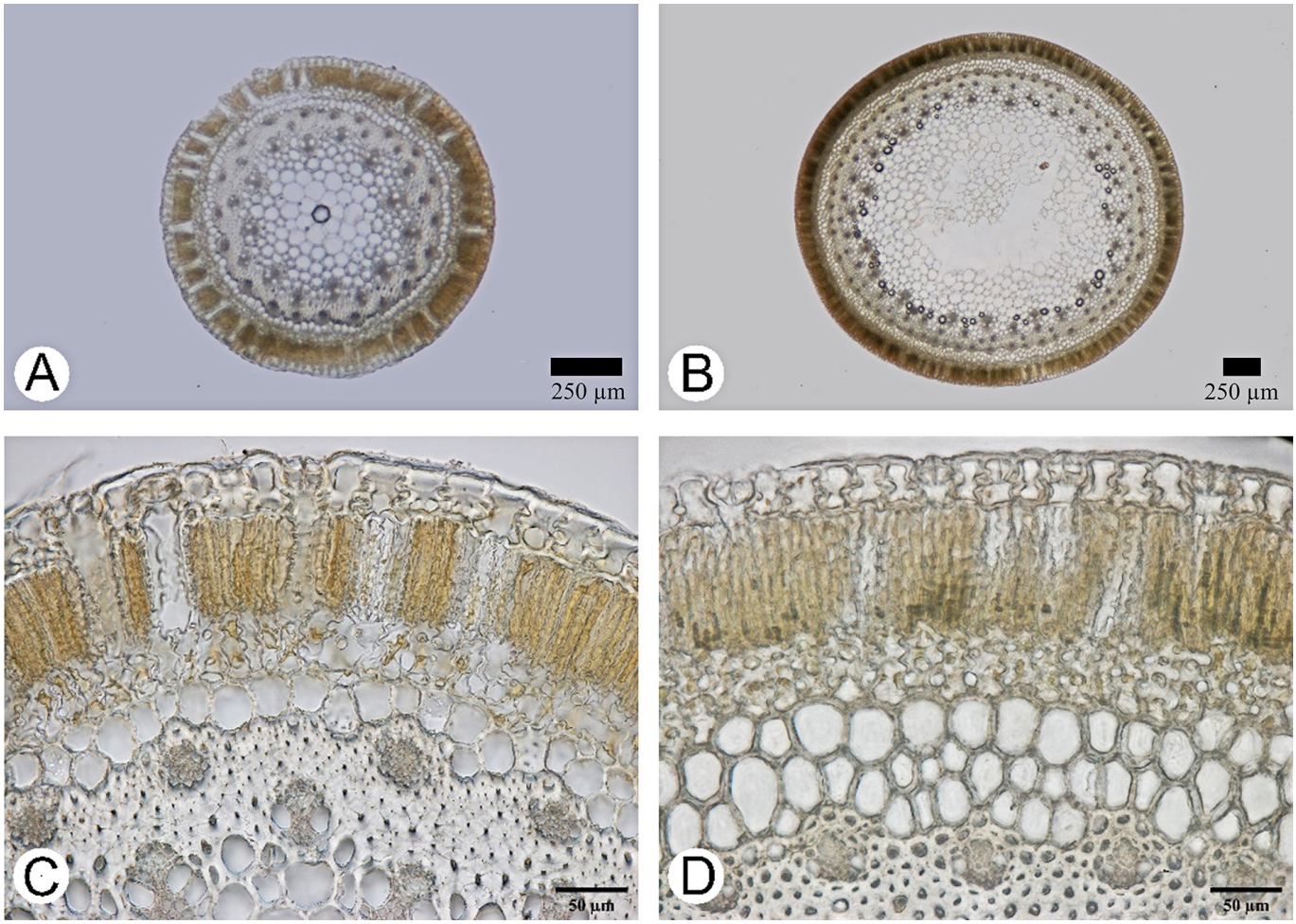

Fig. 98. *Lepyrodia imitans* B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*S.J. Griffith s.n.*, 22 Mar. 1988). B, D, female plant (*S.J. Griffith s.n.*, 29 Mar. 1988).

Leaf morphology. Leaf sheath spreading; 1.5–4 cm long; dull; wrinkled; light brown (see Fig. 19), or dark brown (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 3.5–5.5 mm long.

Inflorescence morphology. Inflorescence bracts longer than the spikelets. Male inflorescence 4.5–100 mm; with spikelets dispersed. Spikelet 2.2–4 mm long. Spikelet oblong-cylindrical. Flowers 40–200 per culm. Glumes glabrous. Tepals 6; oblong lanceolate; pale brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2.3–3.3 mm long; inner tepals 2.3–3.3 mm long. Stamens 3. Anthers 1–1.3 mm long.

Female inflorescence 45–100 mm; with spikelets dispersed. Spikelet 2.2–4 mm long. Spikelet oblong-cylindrical. Flowers 80–200 per culm. Tepals 6; oblong lanceolate; pale brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2.3–3.3 mm long; inner tepals 2.3–3.3 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Summer.

Flowering phenology. January, February, March and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 1.1–1.2 mm long.

Seed morphology. Seeds 0.7–0.8 mm long; 0.4–0.6 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: NC. Distribution outside N.S.W.: QLD.

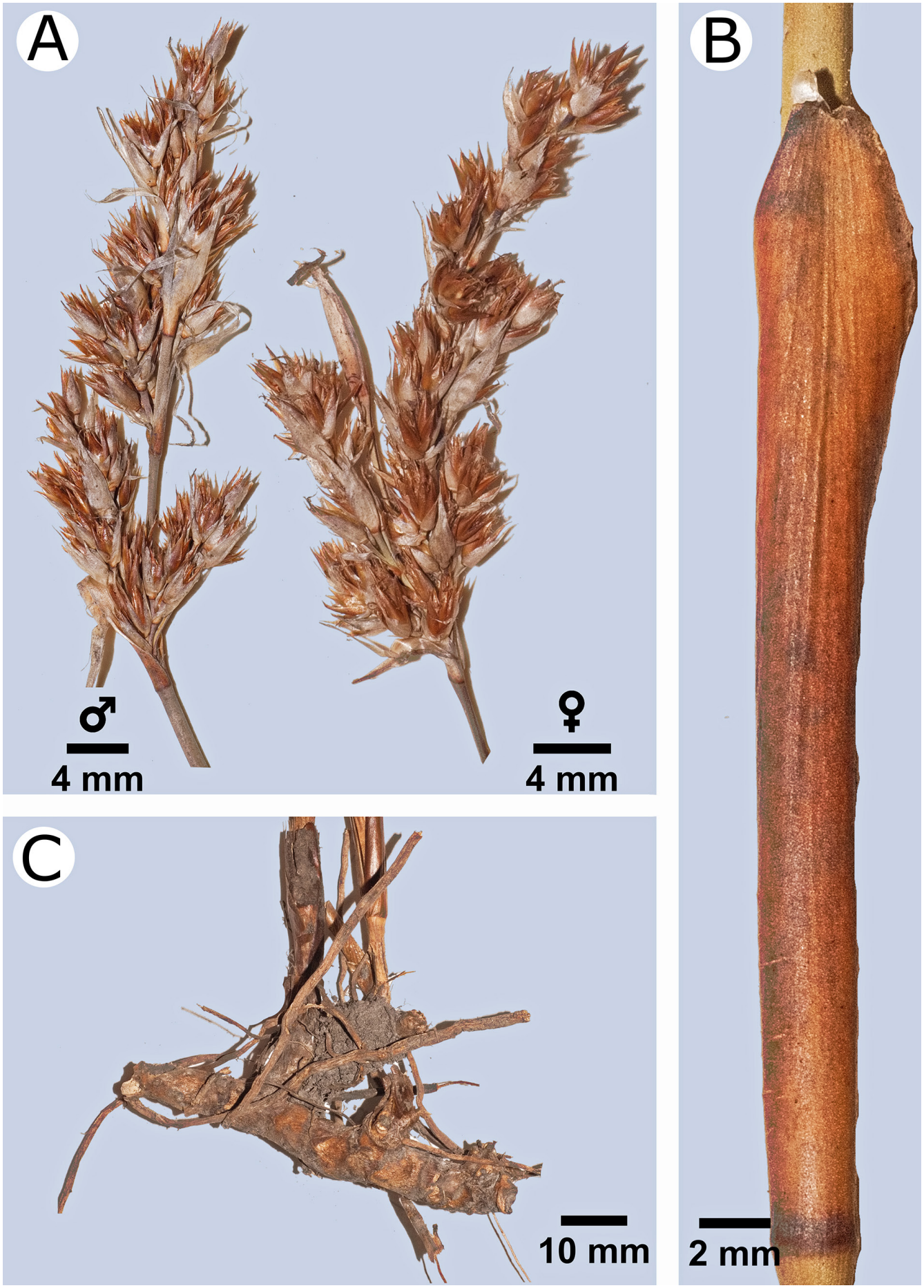

Fig. 99. *Lepyrodia imitans* B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*S.J. Griffith s.n.*, 22 Mar. 1988). B, D, F, H female specimen (*S.J. Griffith s.n.*, 29 Mar. 1988).

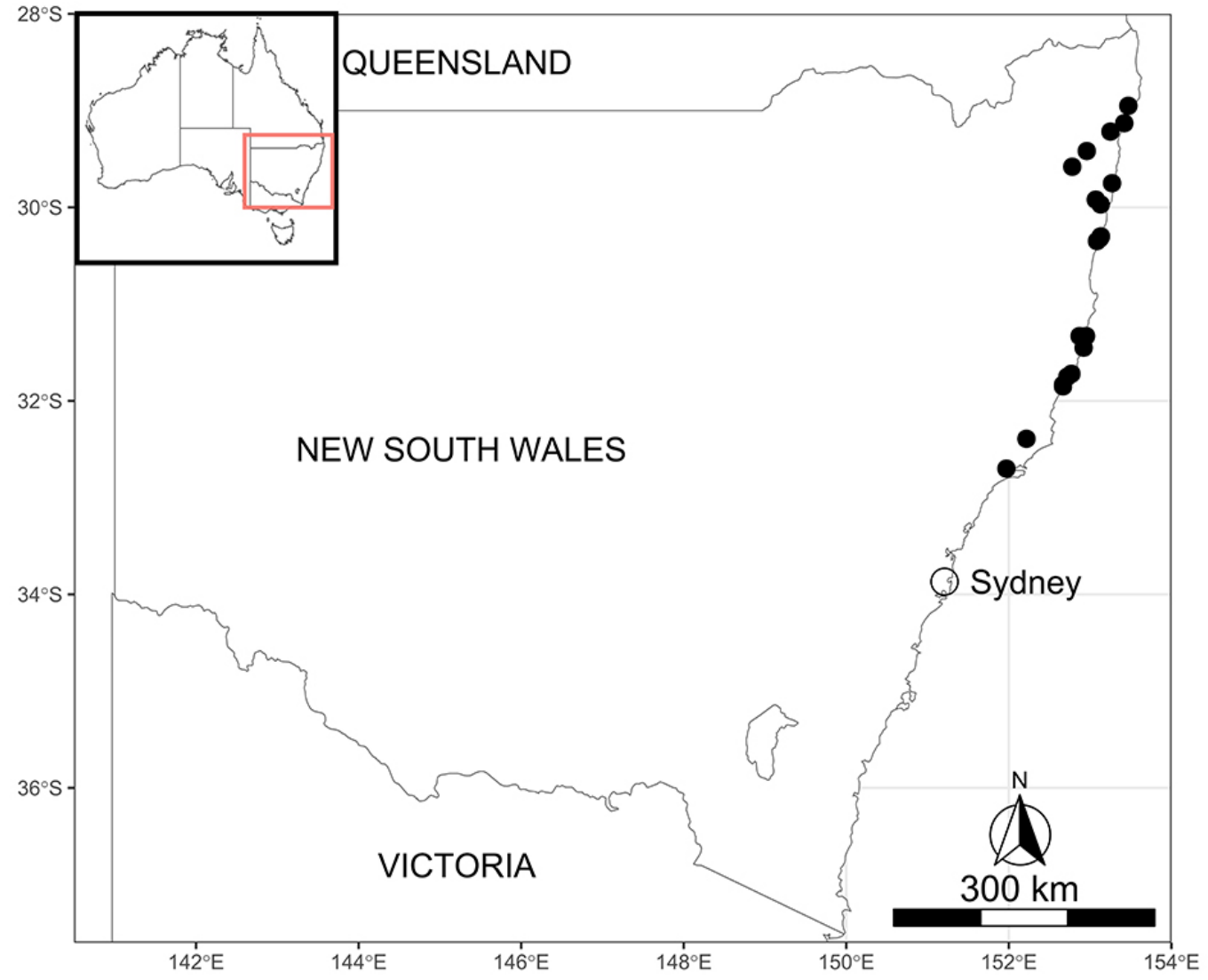

Fig. 100. Distribution of *Lepyrodia imitans* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Lepyrodia leptocaulis L.A.S.Johnson & O.D.Evans

Figures 101, 102, 103.

Reproduction. Plants monoecious.

Rhizome morphology. Rhizome 3–4.5 mm diam.; spreading or tufted; creeping; subterranean, or superficial; to 2 cm deep; light brown; when dry reddish-brown. Rhizome trichomes absent. Rhizome scales present; light brown, or orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 15–50 mm long; 0.5–0.9 mm diam; terete; erect; branched. Sterile lateral branches absent. Culm internodes few. Culm surface ribbed; when fresh and when dried; at 40× minutely rugose; at 300× minutely rugose. Culm texture smooth to touch; trichomes absent; warts present; warts dome-shaped; light green when fresh; light green when dry (see Fig. 3 A4); marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section slightly compressed; outer epidermal walls plane; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; biseriate. Pillar cells absent. Protective cells present. Parenchyma sheath present; cells multiseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; circular. Silica present; stegmata present. Starch grains present.

Leaf morphology. Leaf sheath appressed; 0.5–1 cm long; dull; smooth or wrinkled; yellow-brown (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 0.75–6 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 25–150 mm; with spikelets clustered. Spikelet 4–5 mm long. Spikelet oblong-cylindrical. Flowers 5–30 per culm. Glumes glabrous. Tepals 6; lanceolate, or elliptic; yellow (see Fig. 24); inner shorter than the outer; outer tepals 2.5–3.5 mm long; inner tepals 2.2–3.1 mm long. Stamens 3. Anthers 1.2–1.6 mm long.

Female inflorescence 25–150 mm; with spikelets clustered. Spikelet 4–5 mm long. Spikelet oblong-cylindrical. Flowers 5–30 per culm. Tepals 6; lanceolate, or elliptic; yellow (see Fig. 24);

inner shorter than the outer; outer tepals 1.6–2.6 mm long; inner tepals 1.4–2.4 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Summer.

Flowering phenology. January, February, October, November and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 1–1.5 mm long.

Seed morphology. Seeds 0.8 mm long; 0.5 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CWS, NC, NT, NWS.

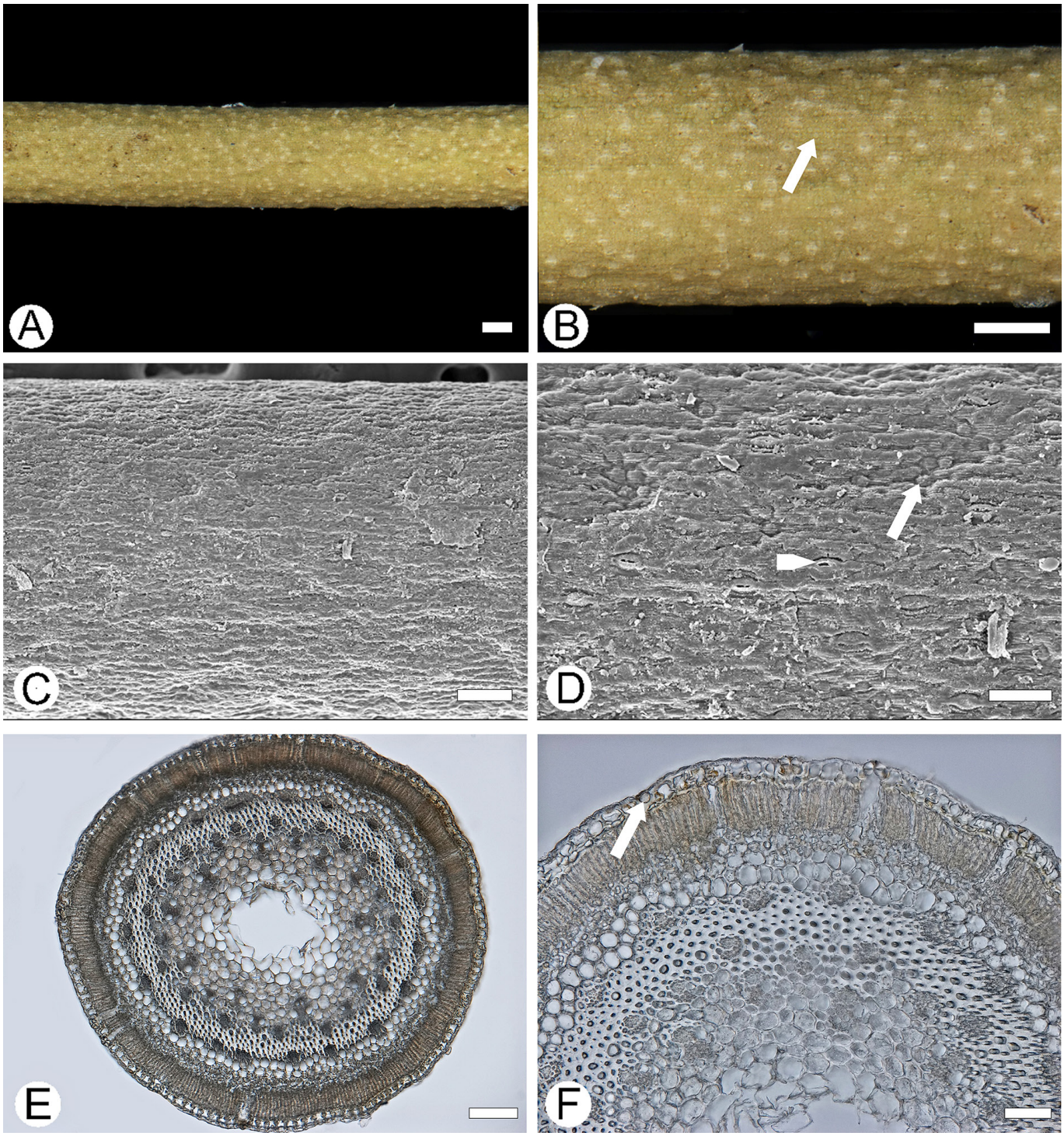

Fig. 101. *Lepyrodia leptocaulis* L.A.S.Johnson & O.D.Evans. Monoecious specimen (*P.I. Forster 27458*, 14 Jul. 2001). A–D, middle-third of culm surface and E–F, Internode cross-section of the culm. C–D, micrographs (SEM) of culm surface. Arrowhead = stomata; arrow = wart. Scale bars: A–B, 200 µm; C, 100 µm; D&F, 50 µm; E, 250 µm.

Fig. 102. *Lepyrodia leptocaulis* L.A.S.Johnson & O.D.Evans. A, male (left) and female (right) inflorescences B, a portion of the aerial shoot (sheaths) C, rhizomes. Monoecious specimen (*P.I. Forster 27458*, 14 Jul. 2001).

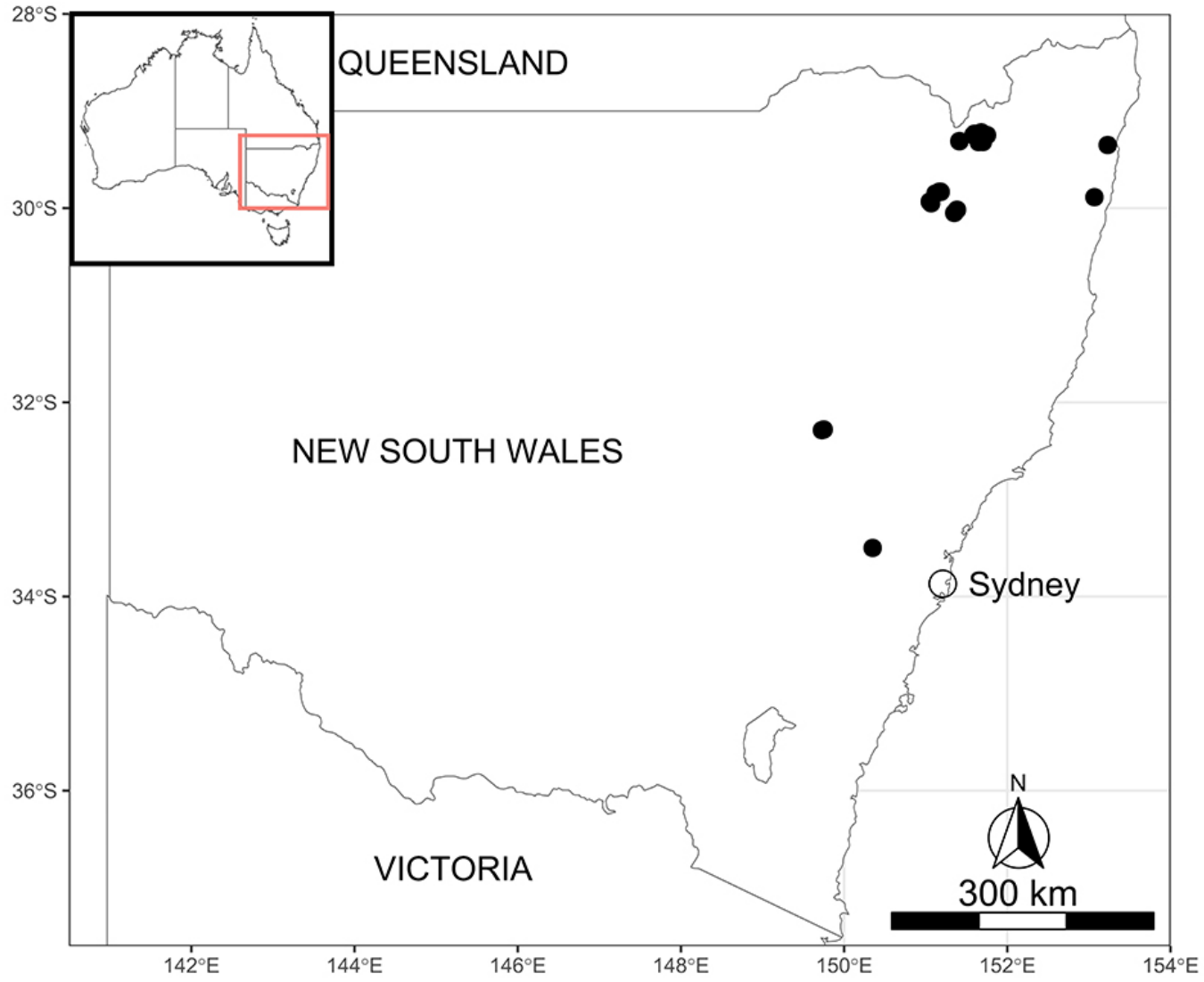

Fig. 103. Distribution of *Lepyrodia leptocaulis* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Lepyrodia muelleri Benth.

Misapplication: *Lepyrodia scariosa* R.Br.

Common name: Erect scale-rush; common scale-rush.

Figures 104, 105, 106, 107.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 2–5 mm diam.; spreading; creeping; subterranean; 3–5 cm deep; pale brown; when dry reddish-brown. Rhizome trichomes absent. Rhizome scales absent; orange-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 40–70 mm long; 2 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes many. Culm surface at 40× minutely rugose; 300× minutely rugose. Culm texture smooth to touch; trichomes absent; warts present; warts dome-shaped; light green when fresh; mid-green when dry (see Fig. 3 A2); marbling present, or absent. Culm stomata obvious; superficial; in rows, or in ± rounded clusters; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section compressed; outer epidermal walls plane; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present. Pillar cells absent. Protective cells present. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity present; circular. Silica present; stegmata present. Starch grains absent.

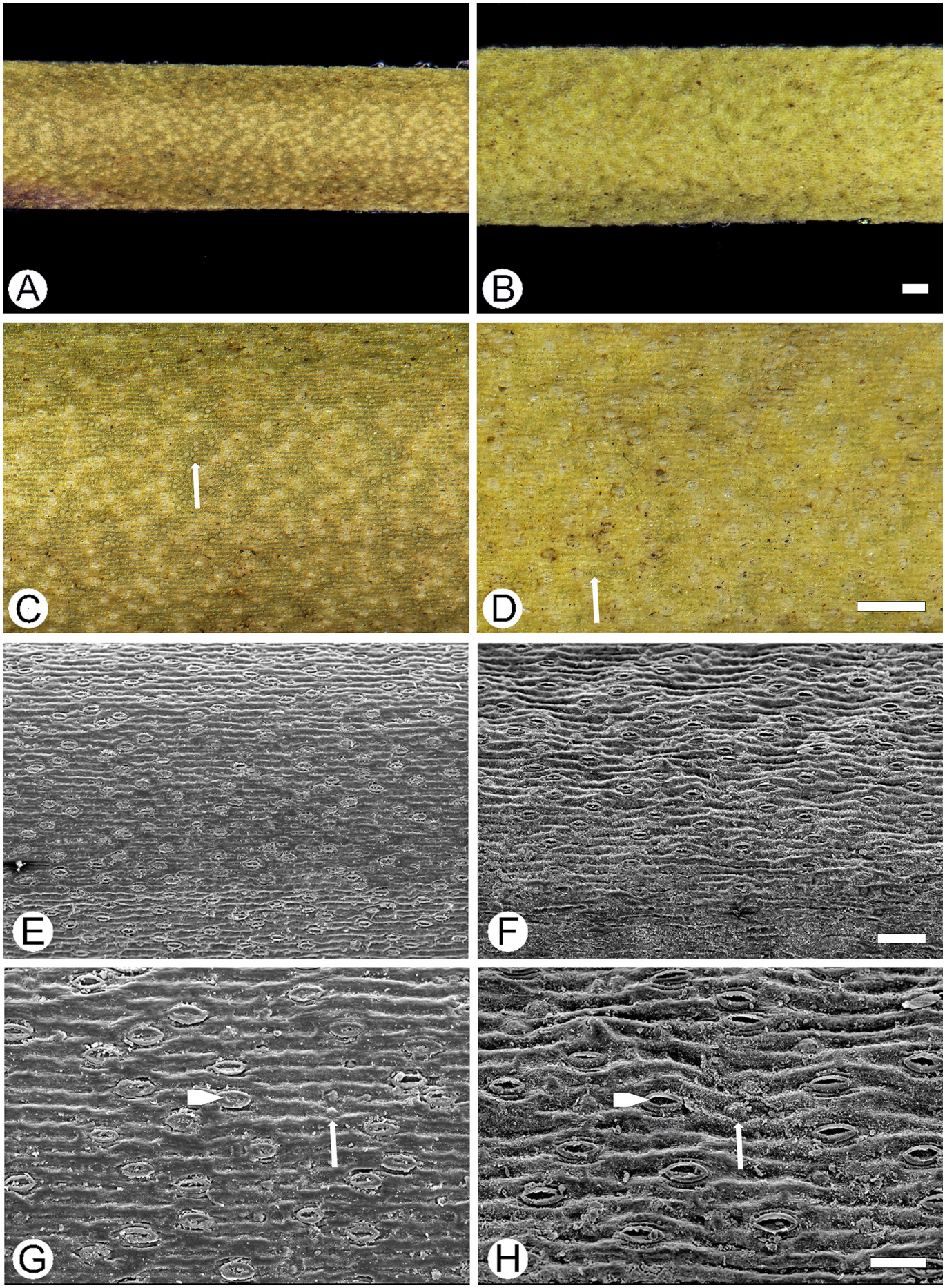

Fig. 104. *Lepyrodia muelleri* Benth. A, C, E & G, male plant (*B.G. Briggs s.n.*, 19 Jan. 1962). B, D, F, H female plant (*V. Stajsic 7658*, 3 Nov. 2015). E–H, micrographs (SEM) of culm surface. Arrowhead = stomata; arrow = wart. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

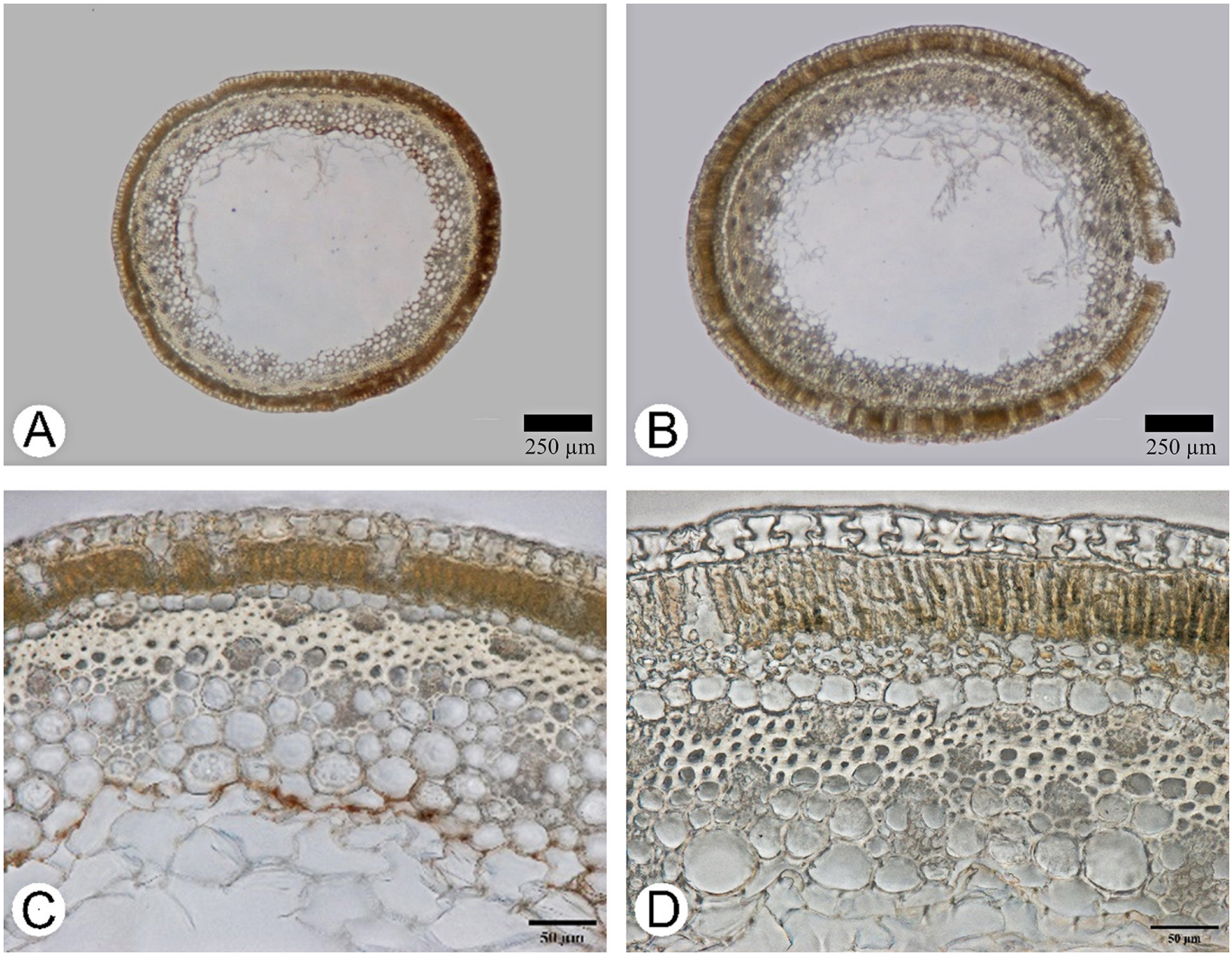

Fig. 105. *Lepyrodia muelleri* Benth. Internode cross-section of the culm. A, C, male plant (*B.G. Briggs s.n.*, 19 Jan. 1962). B, D, female plant (*V. Stajsic 7658*, 3 Nov. 2015).

Leaf morphology. Leaf sheath appressed; 1–2 cm long; dull; smooth or wrinkled; light brown (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 2–5 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 20–150 mm; with spikelets clustered. Spikelet 2–3.5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 10–100 per culm. Tepals 6; lanceolate; whitish or straw-coloured (see Fig. 24); inner shorter than the outer; outer tepals 2.7–3.5 mm long; inner tepals 2.3–3 mm long. Stamens 3. Anthers 1.5–1.8 mm long.

Female inflorescence 20–150 mm; with spikelets clustered. Spikelet 2–3.5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 5–100 per culm. Tepals 6; lanceolate; whitish or straw-coloured (see Fig. 24); inner shorter than the outer; outer tepals 2.2–2.6 mm long; inner tepals 1.8–2.2 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Summer.

Flowering phenology. January, February and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 1.3–1.8 mm long.

Seed morphology. Seeds 0.7–0.8 mm long; 0.4–0.5 mm wide. Seed maturation 6–8 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, NC, SC, ST. Distribution outside N.S.W.: SA, TAS, VIC.

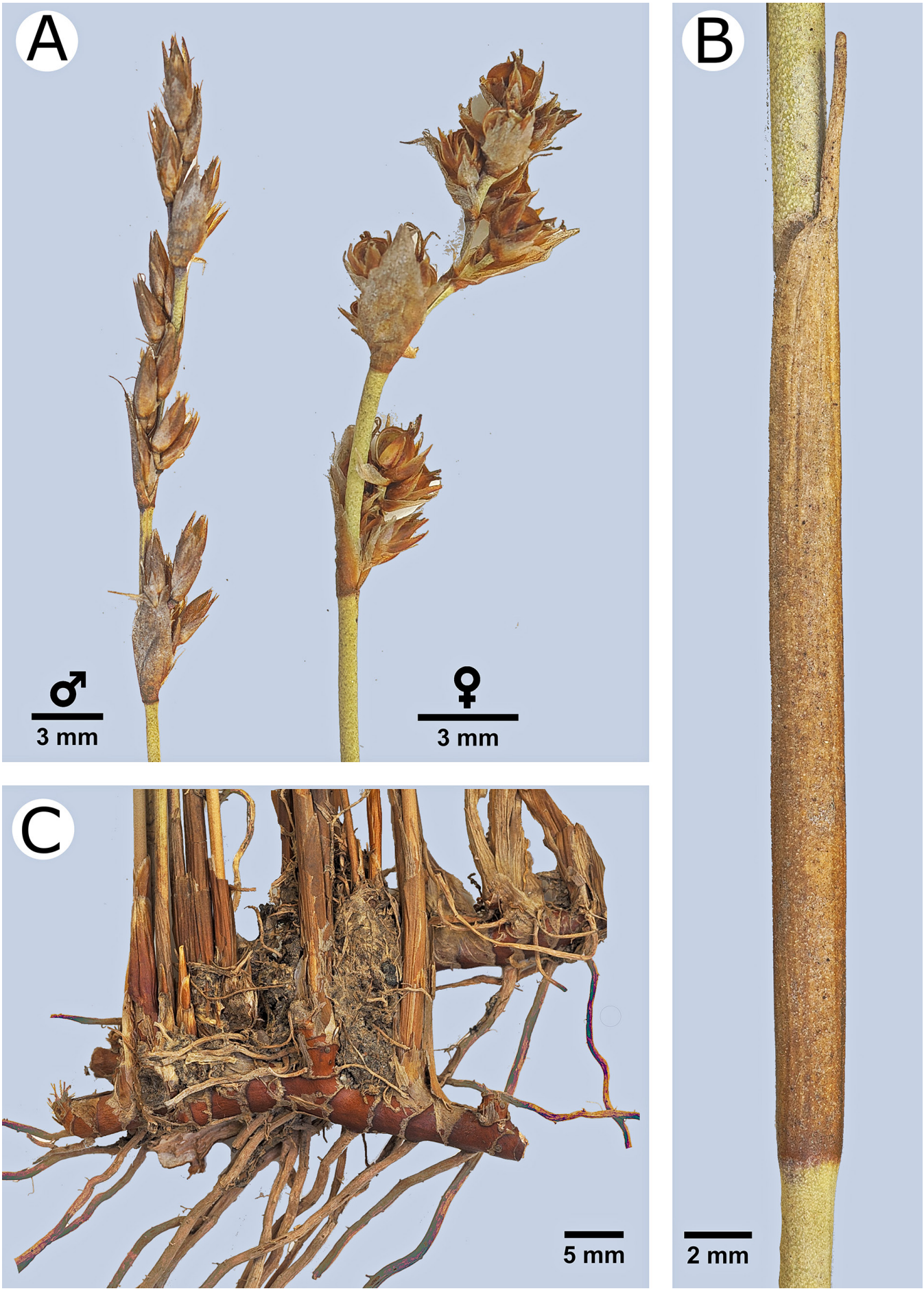

Fig. 106. *Lepyrodia muelleri* Benth. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*B.G. Briggs s.n.*, 19 Jan. 1962) and female specimen (*V. Stajsic 7658*, 3 Nov. 2015).

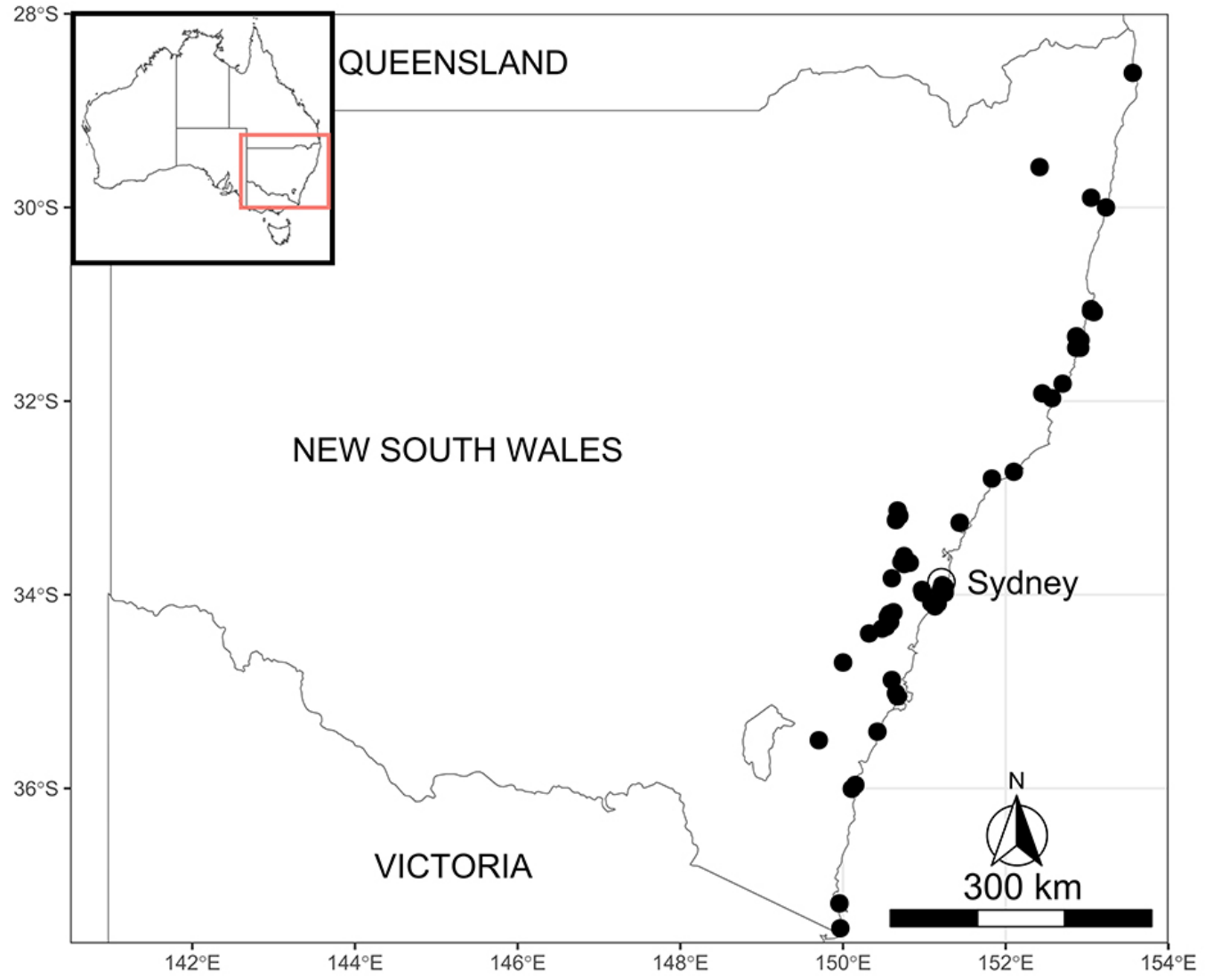

Fig. 107. Distribution of *Lepyrodia muelleri* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Lepyrodia oligocolea B.G.Briggs & L.A.S.Johnson

Figures 108, 109, 110, 111.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 5–6 mm diam.; spreading or tufted; creeping; subterranean; 1–2 cm deep; when dry mid-brown, or dark brown. Rhizome trichomes absent. Rhizome scales present; light brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 25–100 mm long; 1.1–1.6 mm diam; elliptical; erect; unbranched. Sterile lateral branches absent. Culm internodes few. Culm surface not ribbed; at 40× minutely rugose; at 300× pitted. Culm texture smooth to touch; trichomes absent; warts present; warts dome-shaped; mid-green when dry (see Fig. 3 A2), or light green when dry (see Fig. 3 A4); marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section compressed; outer epidermal walls plane; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; biseriate. Pillar cells absent. Protective cells present. Parenchyma sheath present. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity absent. Silica present; stegmata present.

Notes on culm. The culm surface of male and female plants in Fig. 108 were distinctly different. In other gatherings examined (Table 3) of this species the culm surface of male and female specimens appears uniformly similar, as seen in the female culm surface (Fig. 108 F&H) of *P.R. Williams 293*, 22 Feb. 1995. Also, the surface appearance of the female culm shown in this study is consistent with previous research (Briggs 2012). Further study of the odd male specimen (*P.R. Williams 293*, 22 Feb. 1995) and the species is warranted to explore the variation observed.

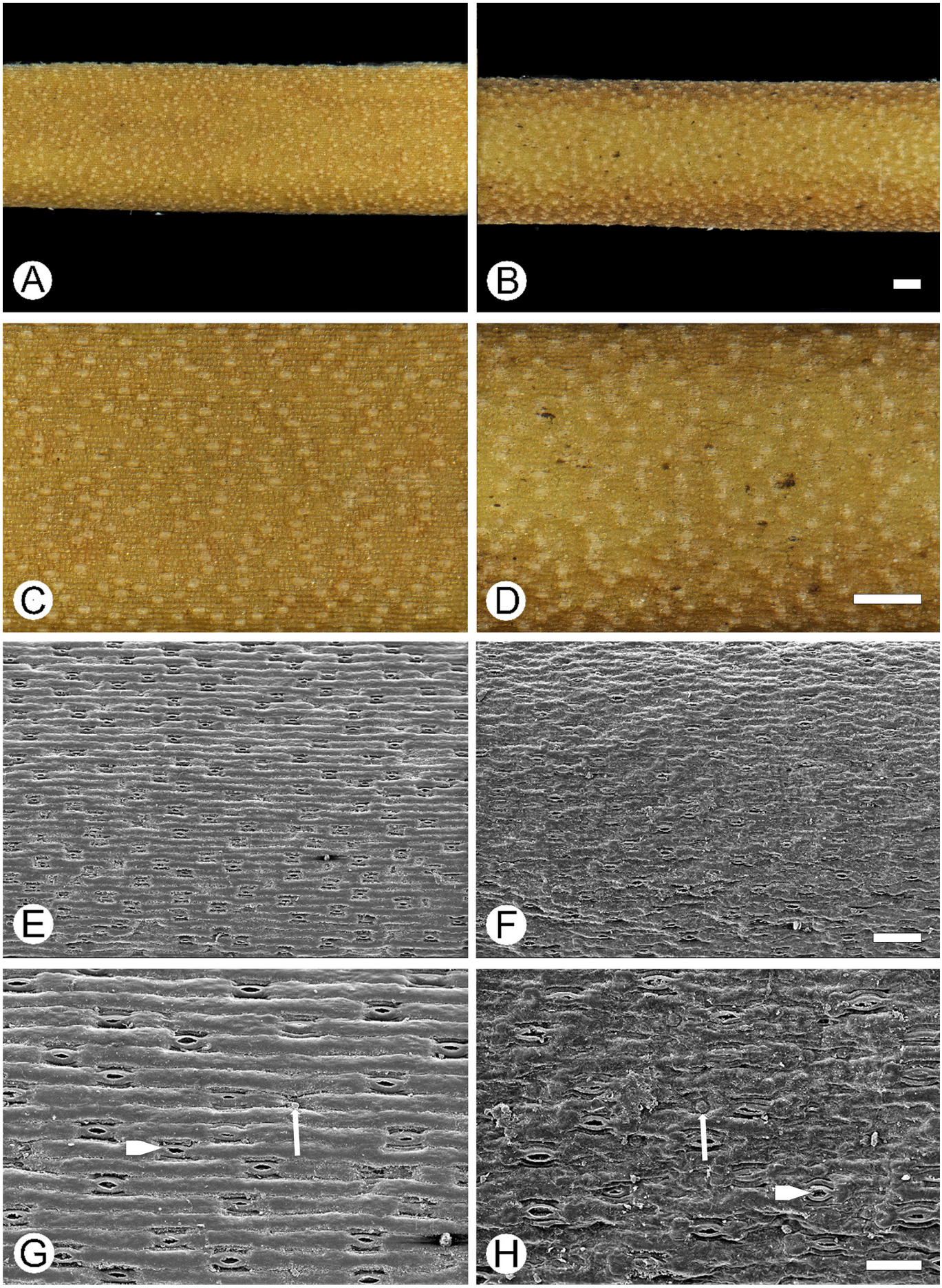

Fig. 108. *Lepyrodia oligocolea* B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*P.R. Williams 293*, 22 Feb. 1995). B, D, F, H female plant (*P.R. Williams 293*, 22 Feb. 1995). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate; arrow = wart. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

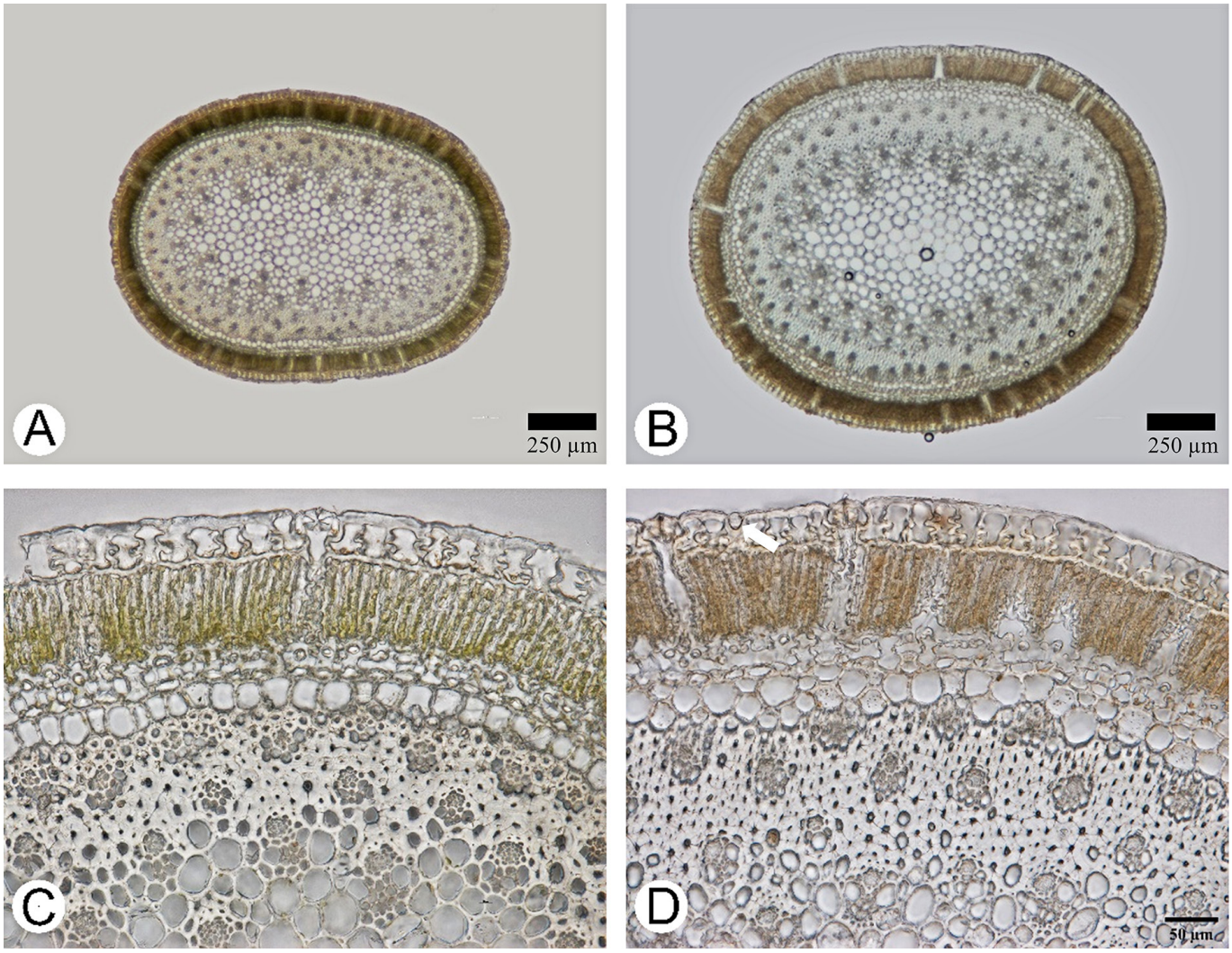

Fig. 109. *Lepyrodia oligocolea* B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*P.R. Williams 293*, 22 Feb. 1995). B, D, female plant (*P.R. Williams 293*, 22 Feb. 1995). The arrow points to a wart in cross-sections.

Leaf morphology. Leaf sheath spreading; 2.5–6 cm long; dull; striate; dark brown (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 4–6 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 35–130 mm; with spikelets clustered or dispersed. Spikelet 2.5–3.5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 10–70 per culm. Tepals 6; lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 2.9–4.4 mm long; inner tepals 2.5–3.4 mm long. Stamens 3. Anthers 1.8–2 mm long.

Female inflorescence 35–130 mm; with spikelets clustered or dispersed. Spikelet 2.5–3.5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 10–50 per culm. Tepals 6; lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 2.8–3.5 mm long; inner tepals 2.8–3 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, February, October, November and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 1.8–2.2 mm long.

Seed morphology. Seeds 1–1.2 mm long; 0.6–0.7 mm wide.

Conservation status. Common.

Distribution. Distribution in N.S.W.: NT.

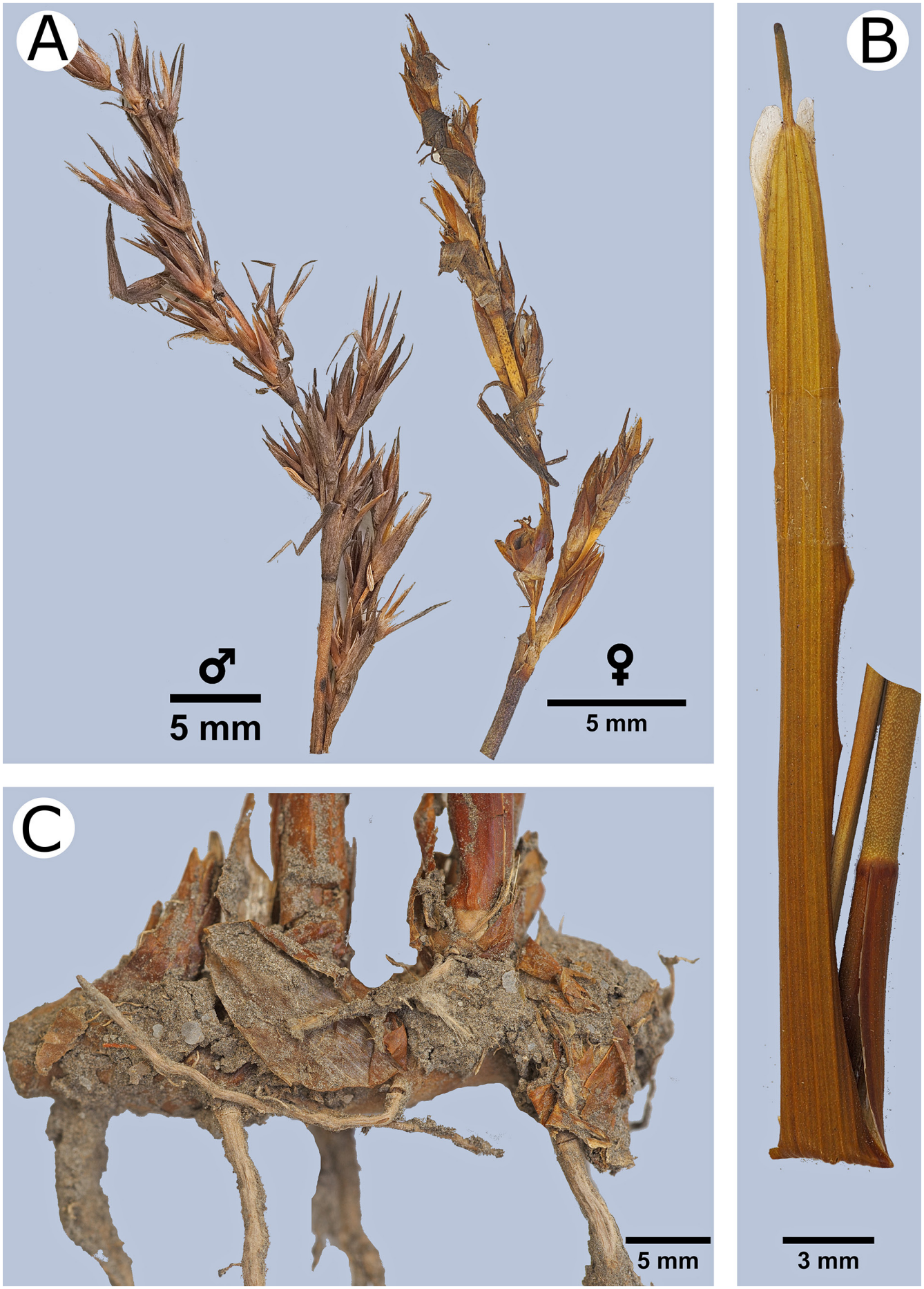

Fig. 110. *Lepyrodia oligocolea* B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*P.R. Williams 293*, 22 Feb. 1995) and female specimen (*P.R. Williams 293*, 22 Feb. 1995).

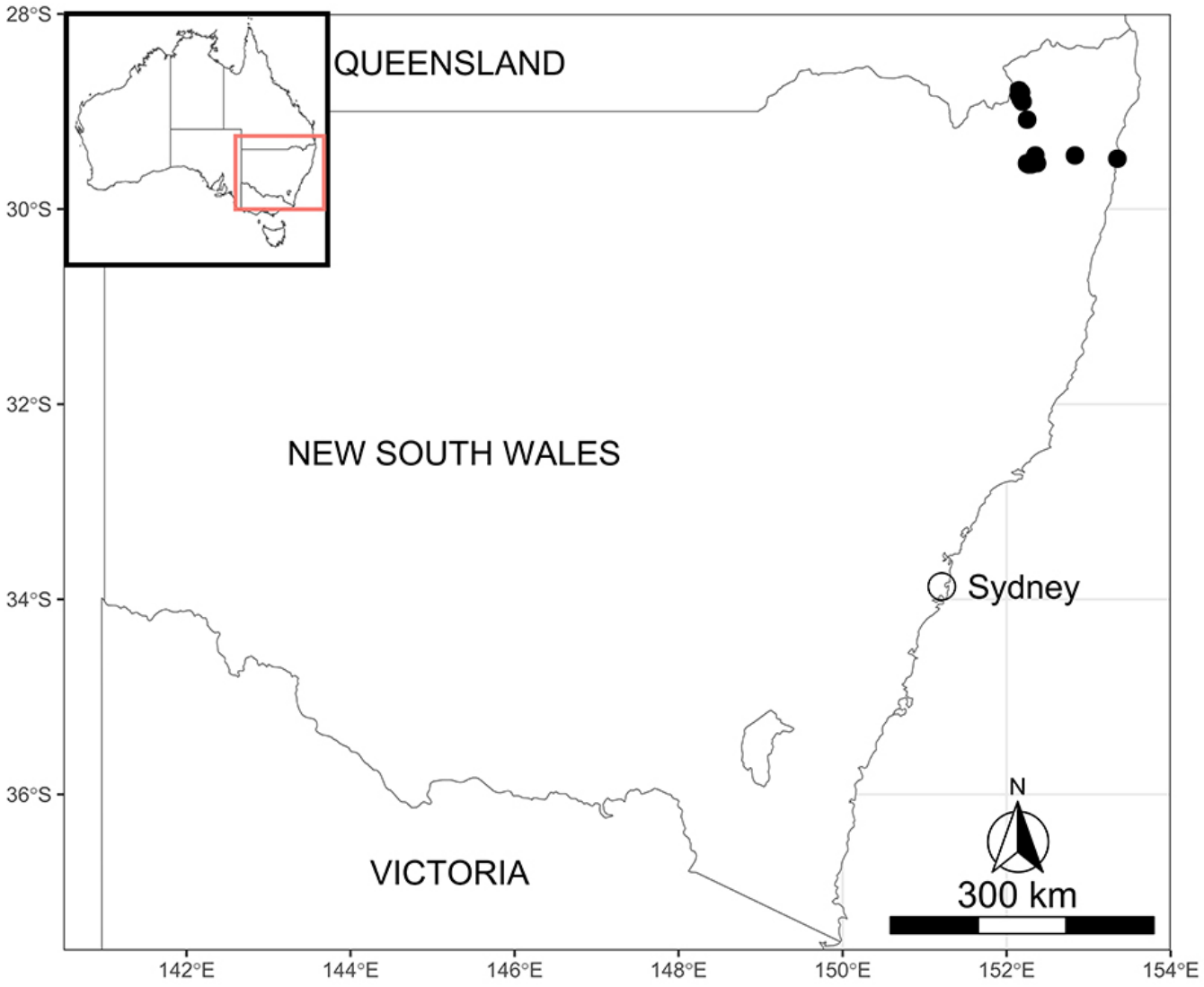

Fig. 111. Distribution of *Lepyrodia oligocolea* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Lepyrodia scariosa R.Br.

Misapplication: *Lepyrodia muelleri* Benth.

Common name: Chaffy scale-rush.

Figures 112, 113, 114, 115.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 3.5–6 mm diam.; spreading; creeping; subterranean; 1–2 cm deep; when dry dark brown. Rhizome trichomes absent. Rhizome scales present; red-brown.

Culm morphology. Culms on the rhizome arranged closely spaced. Culms 30–90 mm long; 0.8–1.8 mm diam; terete; erect; branched, or unbranched. Sterile lateral branches absent. Culm internodes few. Culm surface not ribbed; at 40× minutely rugose; at 300× pitted. Culm texture smooth to touch; trichomes absent; warts present; warts dome-shaped; light green when fresh; mid-green when dry (see Fig. 3 A2), or light green when dry (see Fig. 3 A4); marbling absent. Culm stomata obvious; superficial; in rows; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section compressed; outer epidermal walls plane; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; biseriate. Pillar cells absent. Protective cells present. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles absent. Culm central cavity present, or absent; circular. Silica present; stegmata present. Starch grains absent.

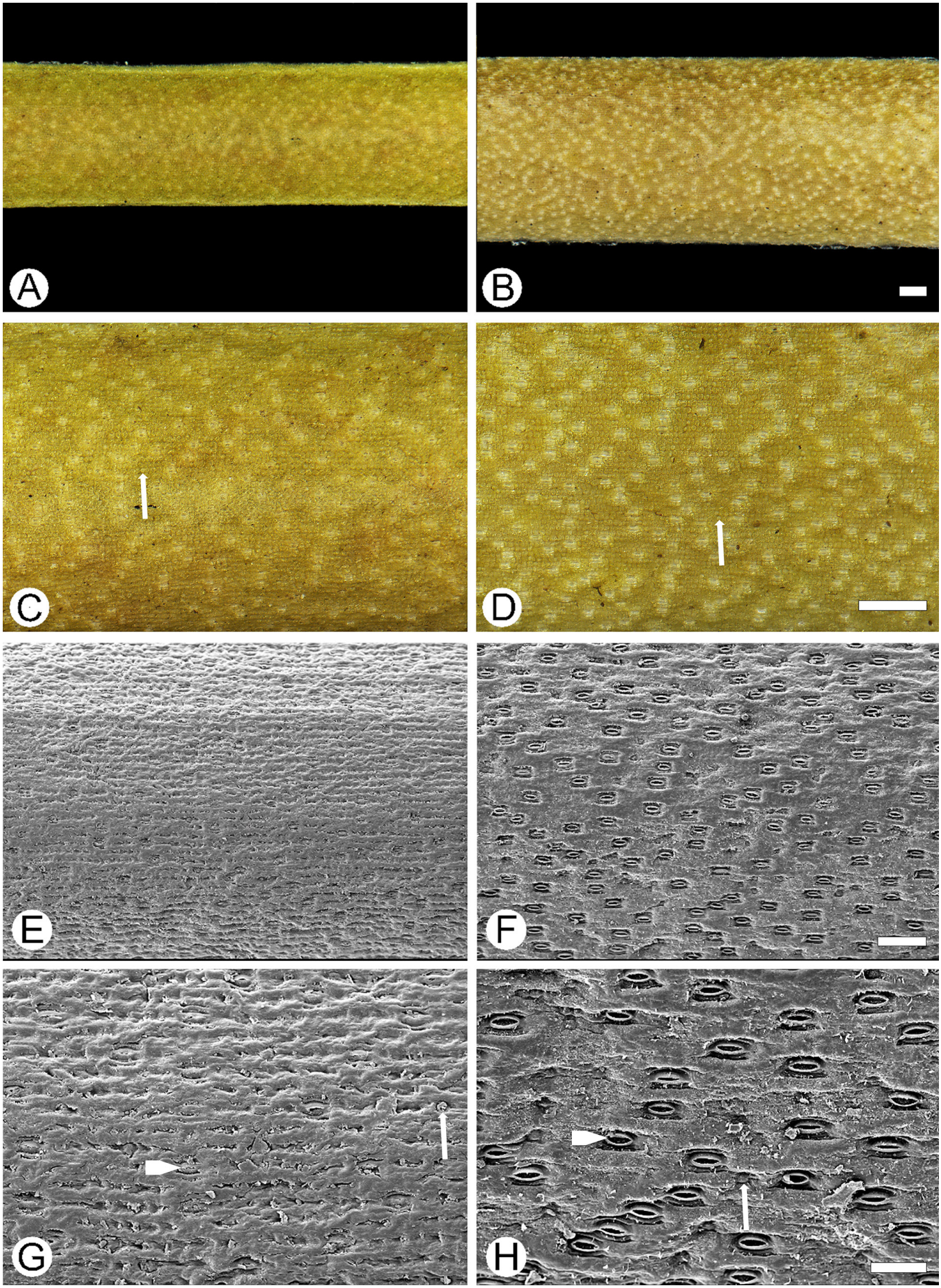

Fig. 112. *Lepyrodia scariosa* R.Br. A, C, E & G, male plant (*J.J. Bruhl 42*, 7 Jun. 1985). B, D, F, H female plant (*R.A. Clarke 3*, 3 Mar. 2011). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate; arrow = wart. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

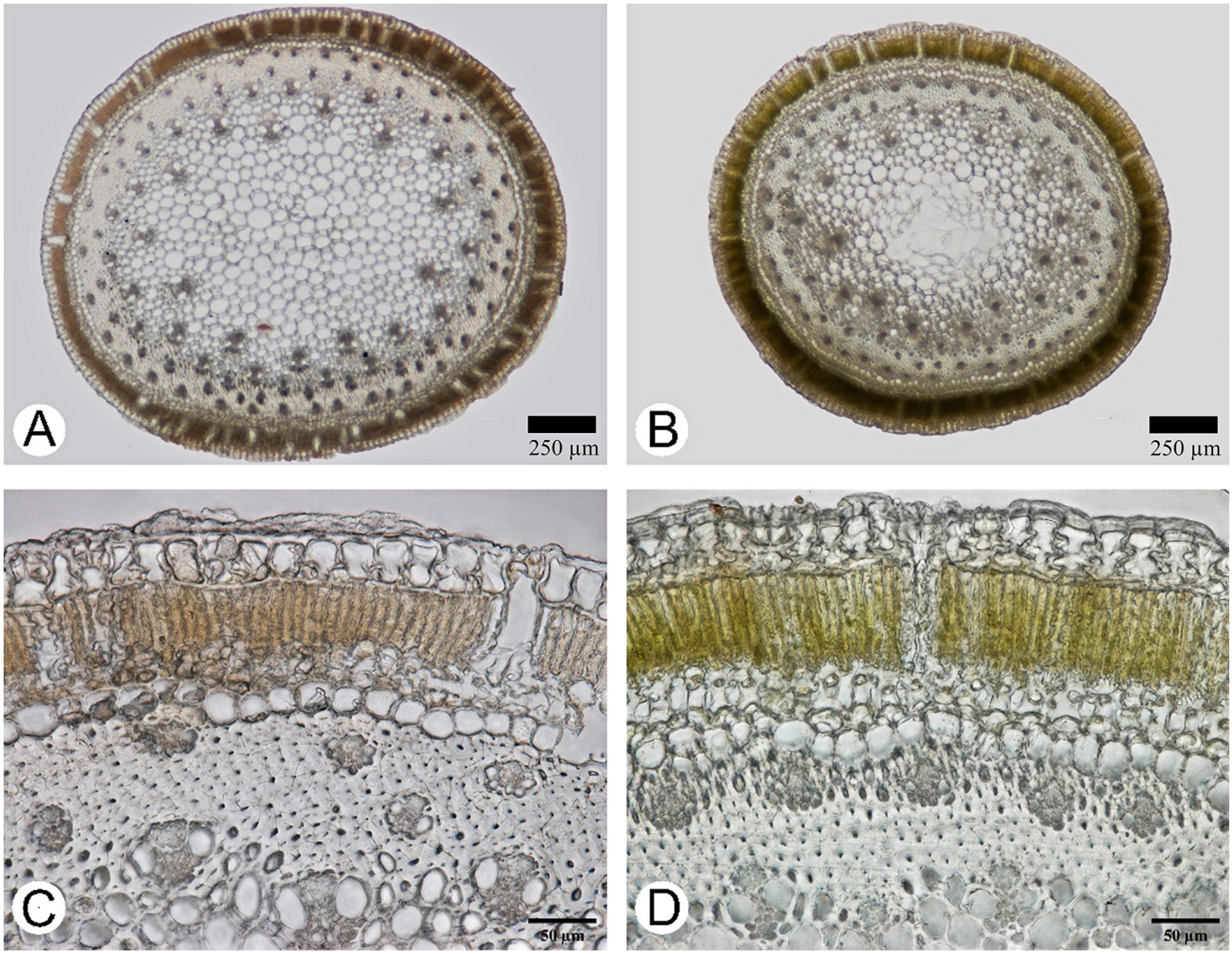

Fig. 113. *Lepyrodia scariosa* R.Br. Internode cross-section of the culm. A, C, male plant (*J.J. Bruhl 42*, 7 Jun. 1985). B, D, female plant (*R.A. Clarke 3*, 3 Mar. 2011).

Leaf morphology. Leaf sheath spreading; 1.5–3.5 cm long; dull; striate; margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 5–8 mm long.

Inflorescence morphology. Inflorescence bracts ± equal to the spikelets, or longer than the spikelets. Male inflorescence 40–180 mm; with spikelets dispersed. Spikelet 3–5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 20–60 per culm. Tepals 6; lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 3.2–4.6 mm long; inner tepals 2.8–4 mm long. Stamens 3. Anthers 1.5–1.8 mm long.

Female inflorescence 40–180 mm; with spikelets dispersed. Spikelet 3–5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 15–100 per culm. Tepals 6; lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 3.2–4.6 mm long; inner tepals 2.8–4 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, February, August, September, October, November and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 1–1.3 mm long.

Seed morphology. Seeds 1–1.2 mm long; 0.4–0.6 mm wide.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, NC, NT, SC, ST. Distribution outside N.S.W.: QLD.

Fig. 114. *Lepyrodia scariosa* R.Br. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*J.J. Bruhl 42*, 7 Jun. 1985) and female specimen (*R.A. Clarke 3*, 3 Mar. 2011).

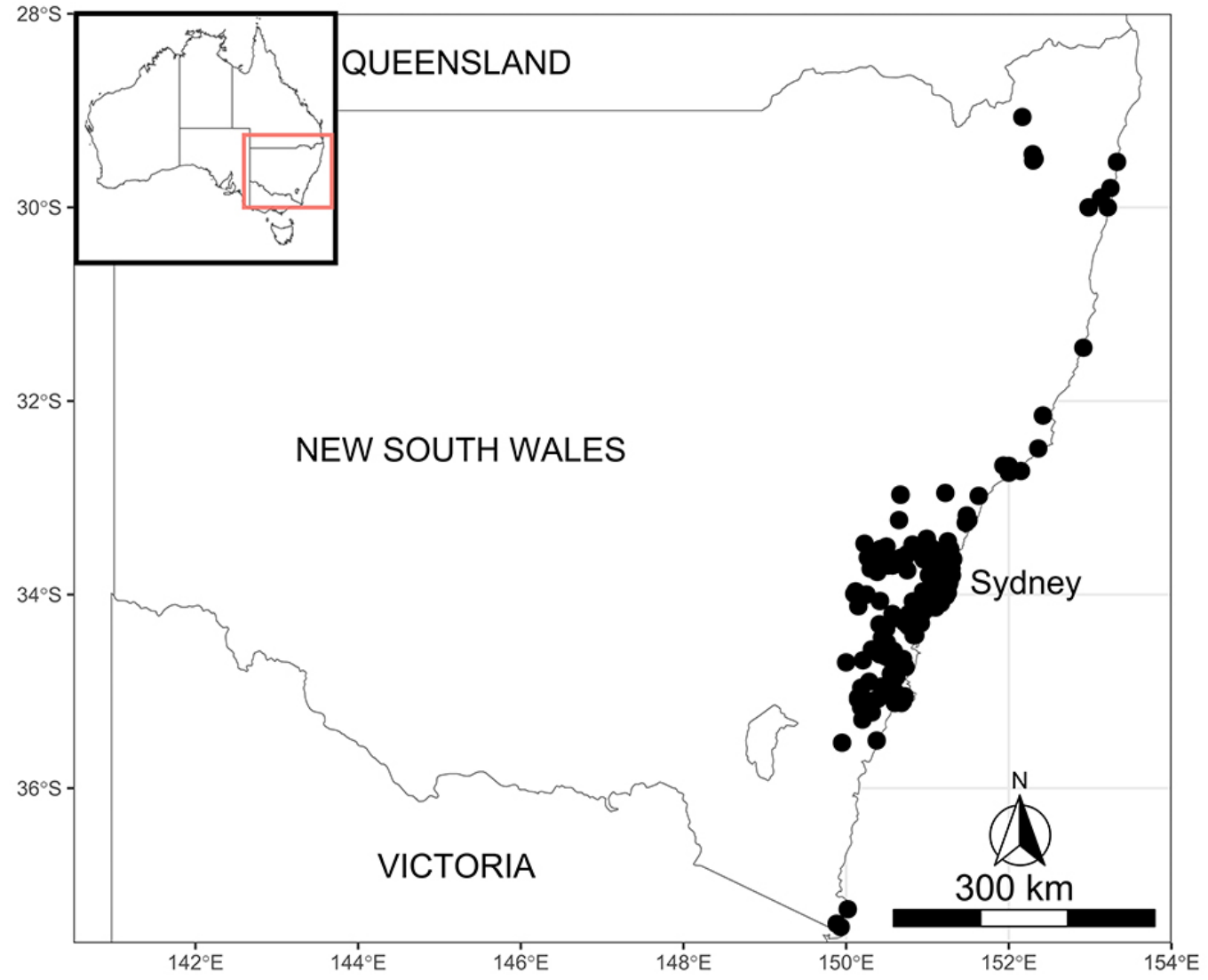

Fig. 115. Distribution of *Lepyrodia scariosa* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Lepyrodia verruculosa B.G.Briggs & L.A.S.Johnson

Figures 116, 117, 118, 119.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 5–7 mm diam.; spreading or tufted; creeping; subterranean; 1–2 cm deep; when dry reddish-brown, or dark brown. Rhizome trichomes absent. Rhizome scales present; grey, or red-brown.

Culm morphology. Culms on the rhizome arranged closely spaced. Culms 40–65 mm long; 1.3–2.1 mm diam; elliptical; erect; unbranched. Sterile lateral branches absent. Culm internodes few. Culm surface not ribbed; at 40× tuberculate; at 300× tuberculate. Culm texture rough to touch; trichomes absent; warts absent; brown when dry (see Fig. 3 D4); marbling absent. Culm stomata obvious; superficial; in rows, or in ± rounded clusters; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section compressed; outer epidermal walls undulating; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer. Peg cells present; biseriate. Pillar cells absent. Protective cells present. Parenchyma sheath present; cells uniseriate. Sclerenchyma sheath present. Sclerenchyma ridges absent; opposite vascular bundles absent. Culm central cavity absent. Silica present; stegmata present.

Notes on culm. Culm surface features observed for *Lepyrodia verruculosa* in this study accord with previous research (Briggs 2012).

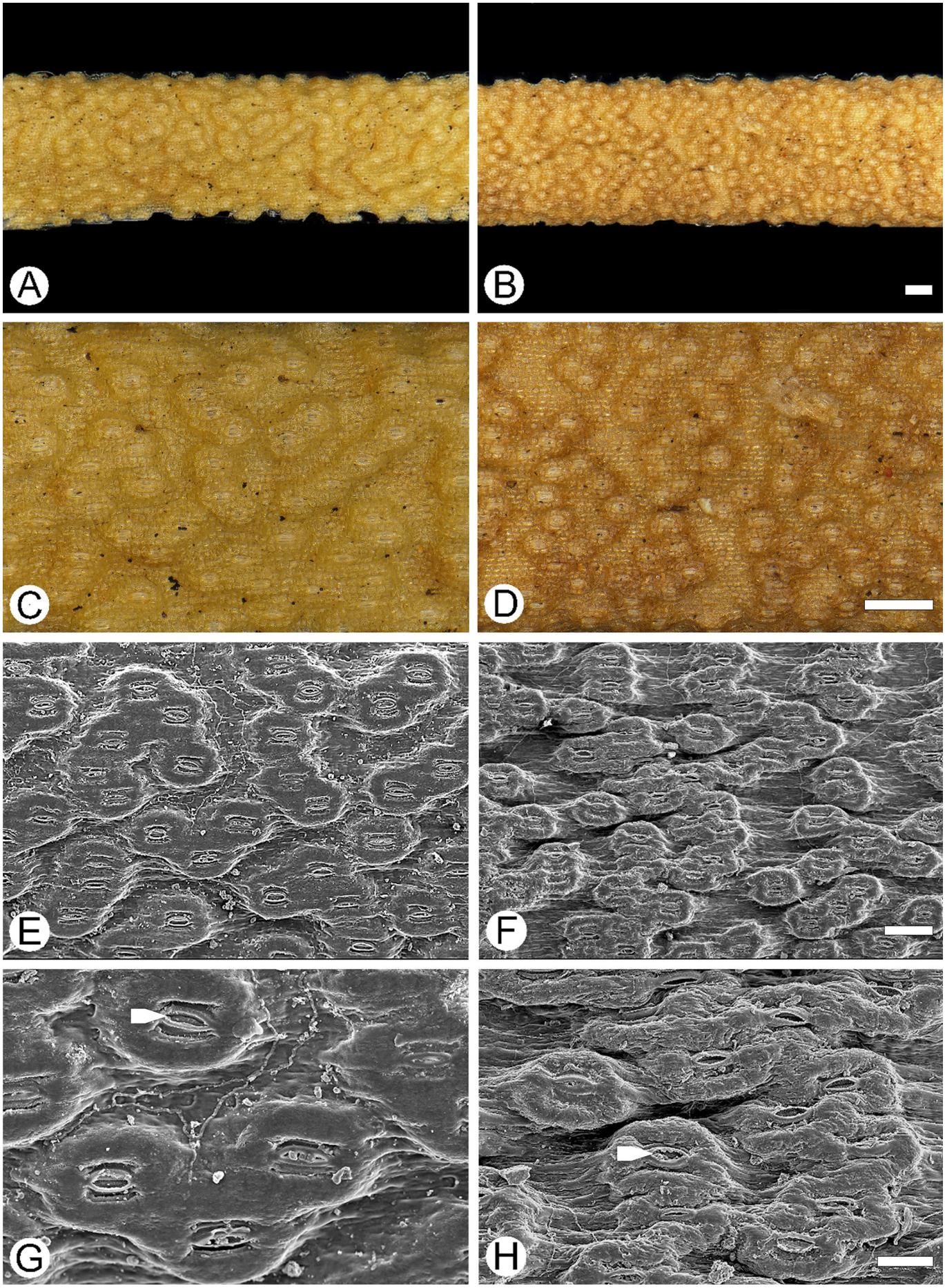

Fig. 116. *Lepyrodia verruculosa* B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*E.F. Constable 6207*, 2 Nov. 1993). B, D, F, H female plant (*L.A.S. Johnson 8787*, 27 Jun. 1964). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

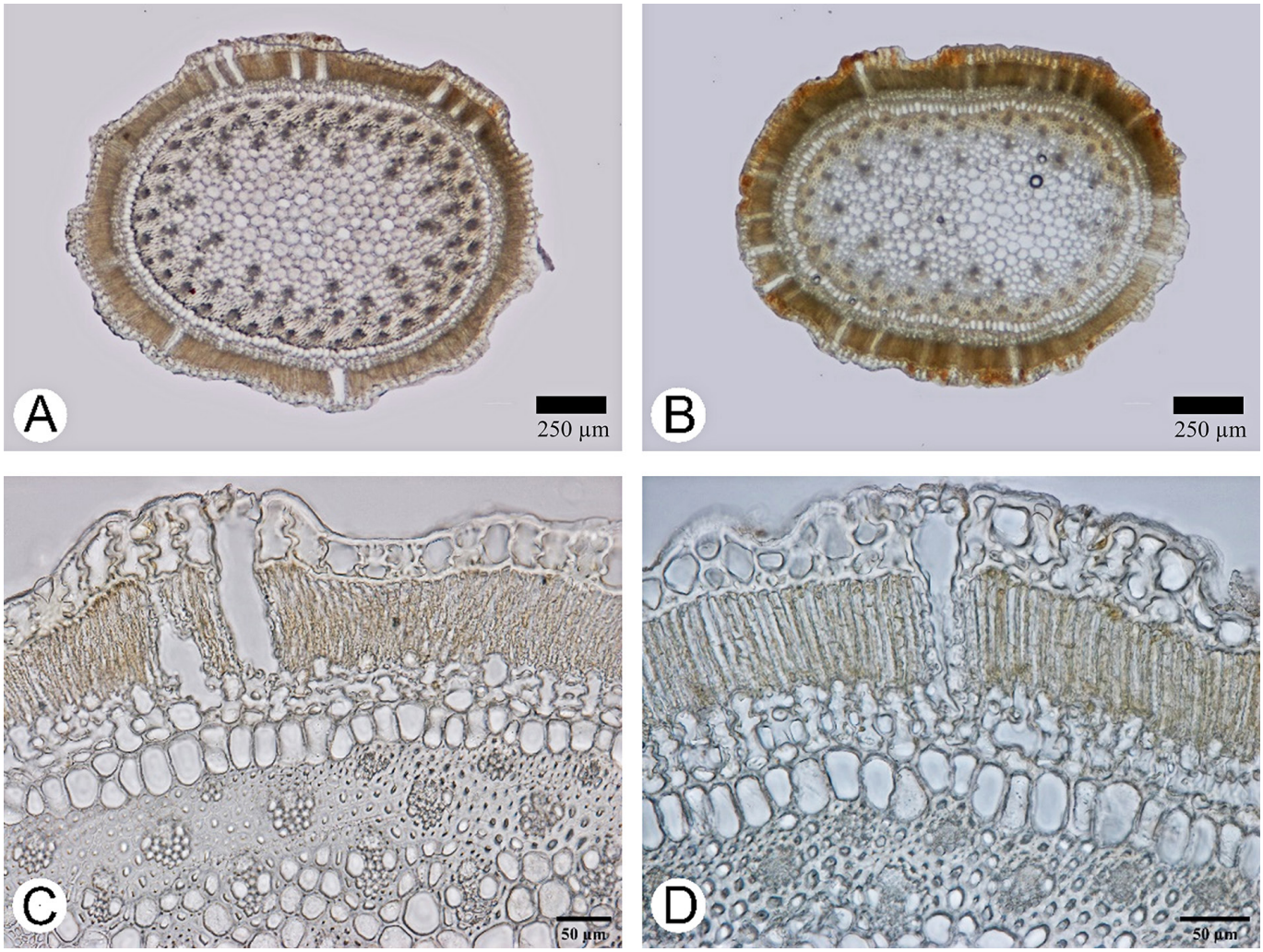

Fig. 117. *Lepyrodia verruculosa* B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*E.F. Constable 6207*, 2 Nov. 1993). B, D, female plant (*L.A.S. Johnson 8787*, 27 Jun. 1964).

Leaf morphology. Leaf sheath 2–3 cm long; dull; smooth, or striate; light brown (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 5 mm long.

Inflorescence morphology. Male inflorescence 20–60 mm; with spikelets clustered. Spikelet ovoid, or oblong-cylindrical. Flowers 10–70 per culm. Tepals 6; lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 3–3.6 mm long; inner tepals 2.5–3 mm long. Stamens 3. Anthers 1.4–1.7 mm long.

Female inflorescence 25–110 mm; with spikelets clustered. Spikelet 3.5–4.5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 10–90 per culm. Tepals 6; lanceolate; yellow-brown (see Fig. 24); inner shorter than the outer; outer tepals 2.6–3.9 mm long; inner tepals 2.6–3.5 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, February, October, November and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 1.5–2 mm long.

Seed morphology. Seeds 1.2 mm long; 0.7 mm wide.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, SC, ST.

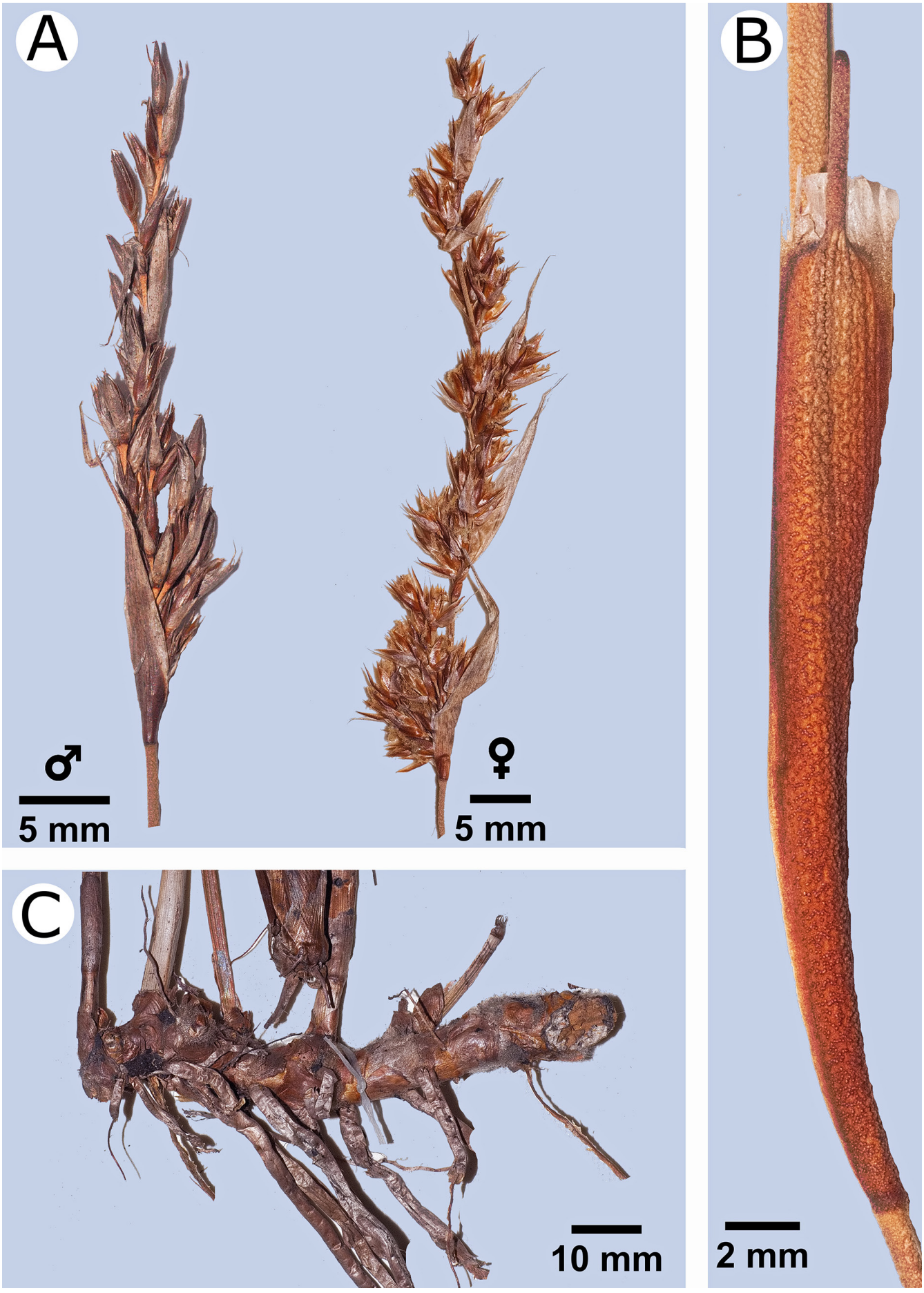

Fig. 118. *Lepyrodia verruculosa* B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*E.F. Constable 6207*, 2 Nov. 1993) and female specimen (*L.A.S. Johnson 8787*, 27 Jun. 1964).

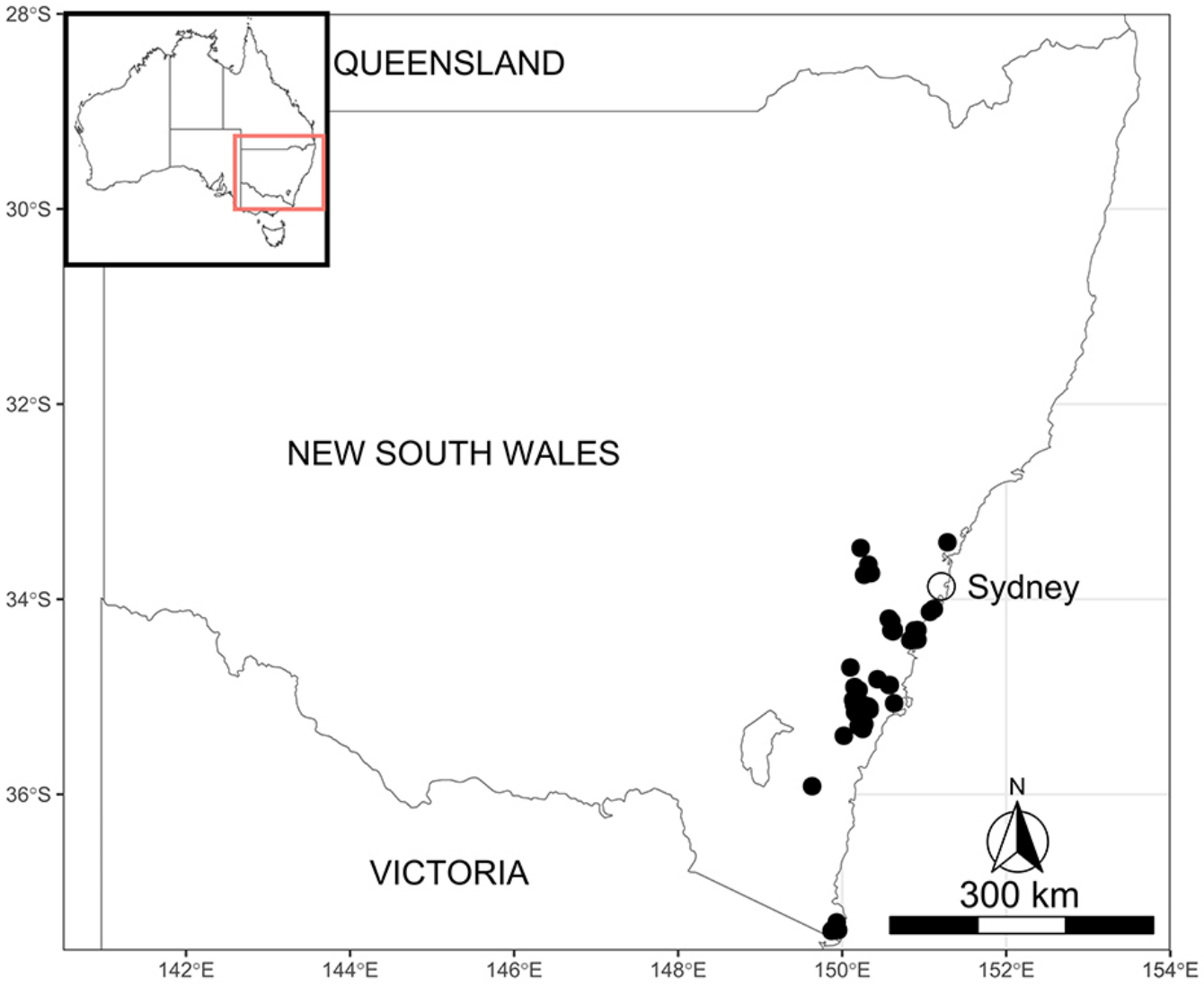

Fig. 119. Distribution of *Lepyrodia verruculosa* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Sporadanthus caudatus (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson

Basionym: *Lepyrodia caudata* L.A.S.Johnson & O.D.Evans.

Figures 120, 121, 122, 123.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 6–9 mm diam.; spreading; creeping; subterranean; 3–5 cm deep; pale brown; when dry mid-brown, or dark brown. Rhizome trichomes absent. Rhizome scales present; red-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 55–200 mm long; 3–5 mm diam; terete; erect; unbranched. Sterile lateral branches absent. Culm internodes many. Culm surface not ribbed; at 40× smooth; at 300× pitted. Culm texture smooth to touch; trichomes absent; warts absent; olive-green when fresh; light green when dry (see Fig. 3 A3), or yellowish brown when dry (see Fig. 3 E3); marbling absent. Culm stomata obvious; superficial; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section ±terete; outer epidermal walls plane; thin. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in one layer, or in two layers. Peg cells present. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells multiseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; triangular. Silica absent; stegmata present. Starch grains absent.

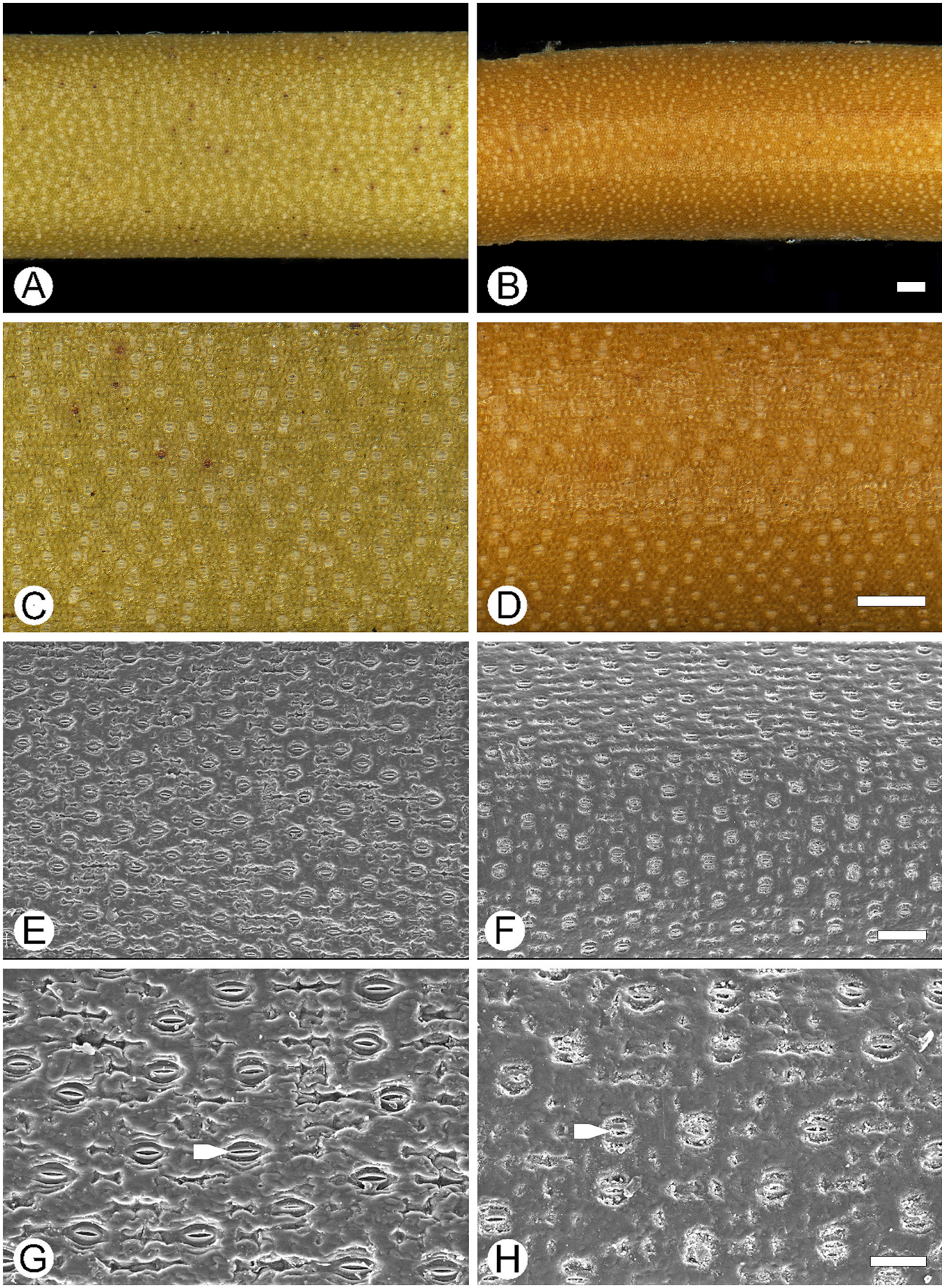

Fig. 120. *Sporadanthus caudatus* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*E.F. Constable 3006 b*, 24 May. 1962). B, D, F, H female plant (*S. Krauss 68*, 14 Oct. 1962). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

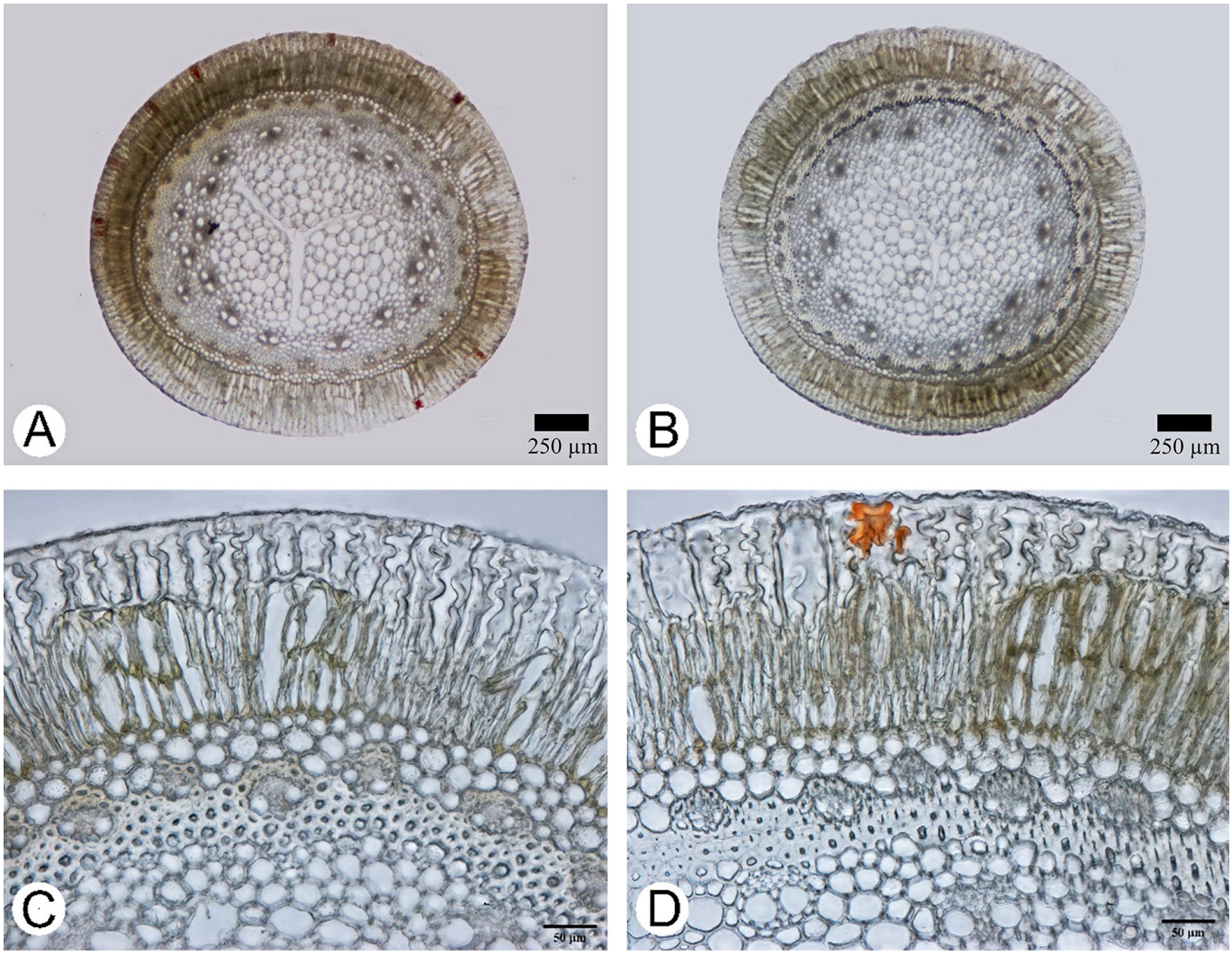

Fig. 121. *Sporadanthus caudatus* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*E.F. Constable 3006 b*, 24 May. 1962). B, D, female plant (*S. Krauss 68*, 14 Oct. 1962).

Leaf morphology. Leaf sheath appressed; 5–10 cm long; glossy; smooth; light brown (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 3–15 mm long.

Inflorescence morphology. Inflorescence bracts longer than the spikelets. Male inflorescence 20–100 mm; with spikelets clustered. Spikelet 2.5–6.5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 25–90 per culm. Tepals 6; oblong lanceolate; whitish or straw-coloured (see Fig. 24); outer and inner ± similar in length; outer tepals 2.5–4 mm long; inner tepals 2.5–4 mm long. Stamens 3. Anthers 1–1.2 mm long.

Female inflorescence 20–100 mm; with spikelets clustered. Spikelet 2.5–6.5 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 20–100 per culm. Tepals 6; oblong lanceolate; whitish or straw-coloured (see Fig. 24); outer and inner ± similar in length; outer tepals 2.5–4 mm long; inner tepals 2.5–4 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring.

Flowering phenology. August, September, October and November.

Fruit morphology. Fruit capsule; trilocular; ovate; 1.4–1.6 mm long.

Seed morphology. Seeds 0.8 mm long; 0.6 mm wide. Seed maturation 10–12 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: NC. Distribution outside N.S.W.: QLD.

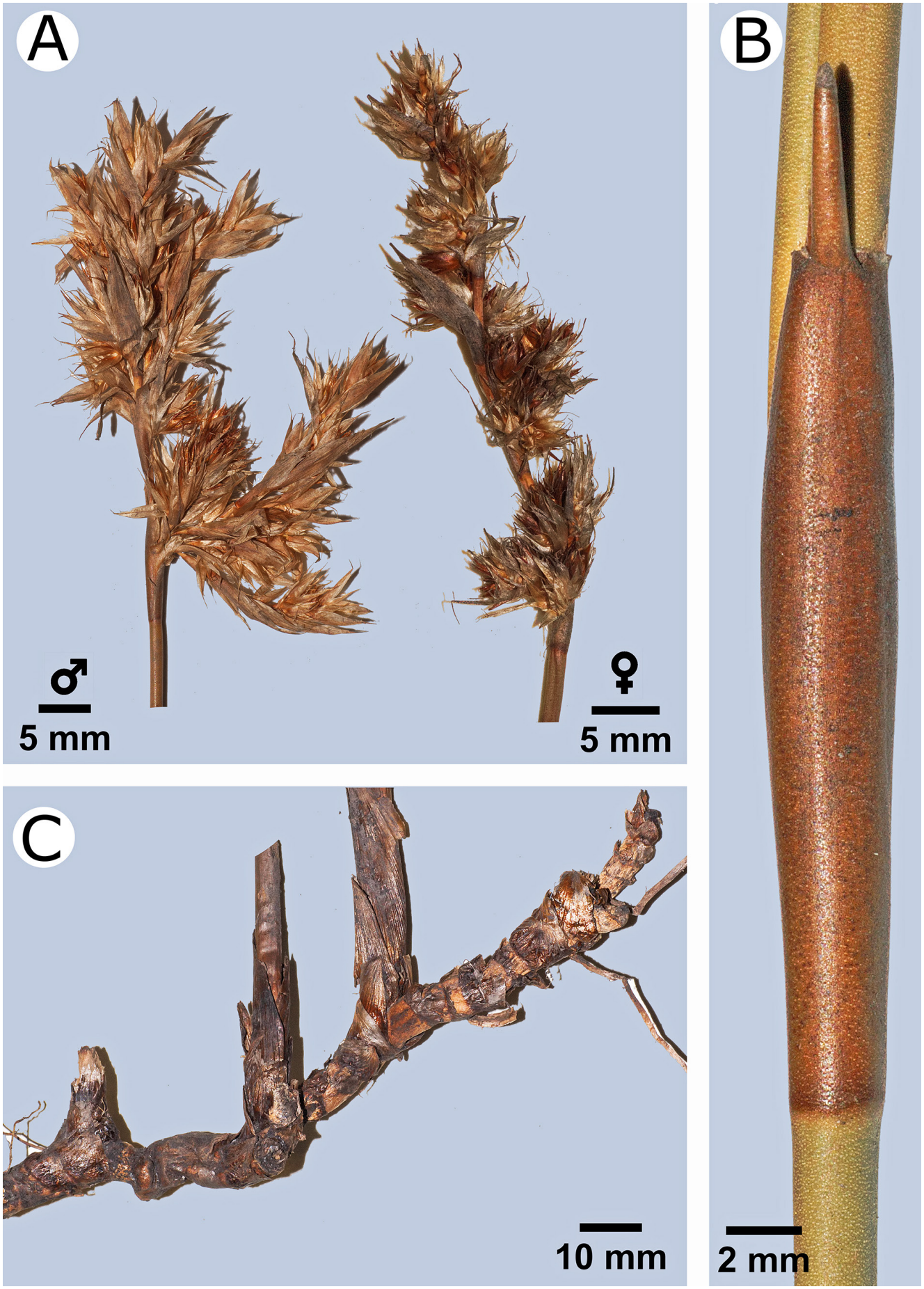

Fig. 122. *Sporadanthus caudatus* (L.A.S.Johnson & O.D.Evans) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*E.F. Constable 3006 b*, 24 May. 1962) and female specimen (*S. Krauss 68*, 14 Oct. 1962).

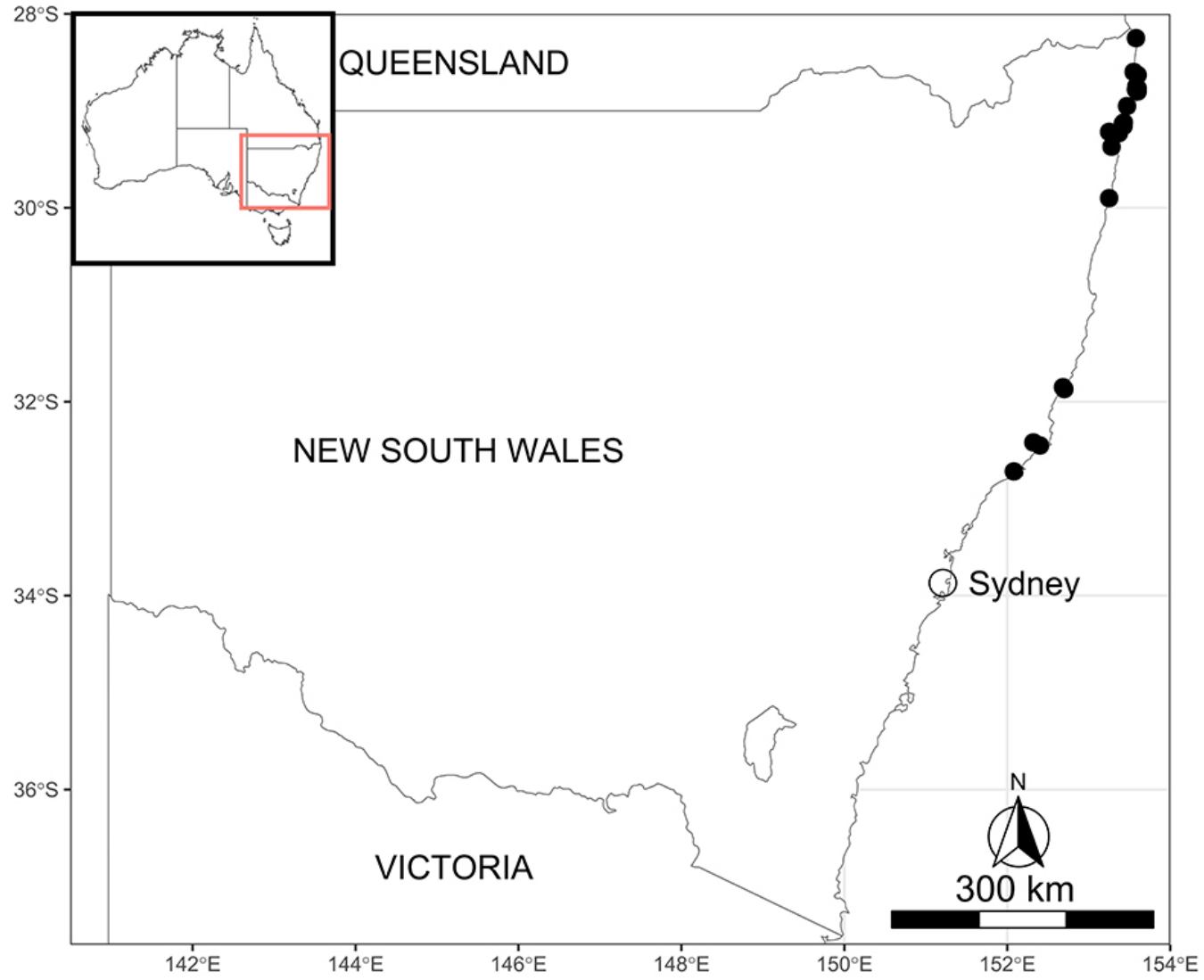

Fig. 123. Distribution of *Sporadanthus caudatus* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Sporadanthus gracilis (R.Br.) B.G.Briggs & L.A.S.Johnson

Basionym: *Lepyrodia gracilis* R.Br.

Figures 124, 125, 126, 127.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 2–4 mm diam.; spreading; creeping; subterranean; 3–5 cm deep; yellow-brown; when dry mid-brown, or dark brown. Rhizome trichomes absent. Rhizome scales present, or absent; mid-brown.

Culm morphology. Culms on the rhizome arranged widely spaced. Culms 30–150 mm long; 1–2 mm diam; terete; erect; branched. Sterile lateral branches absent. Culm internodes many. Culm surface not ribbed; at 40× areolate; at 300× smooth. Culm texture smooth to touch; trichomes absent; warts absent; mid-green when fresh; dark greenish when dry (see Fig. 3 C3); culms of female plants more intense in colour than males; marbling present. Culm stomata obvious; superficial; in rows; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section slightly compressed; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in two layers. Peg cells absent. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells multiseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; triangular. Silica absent; stegmata present. Starch grains absent.

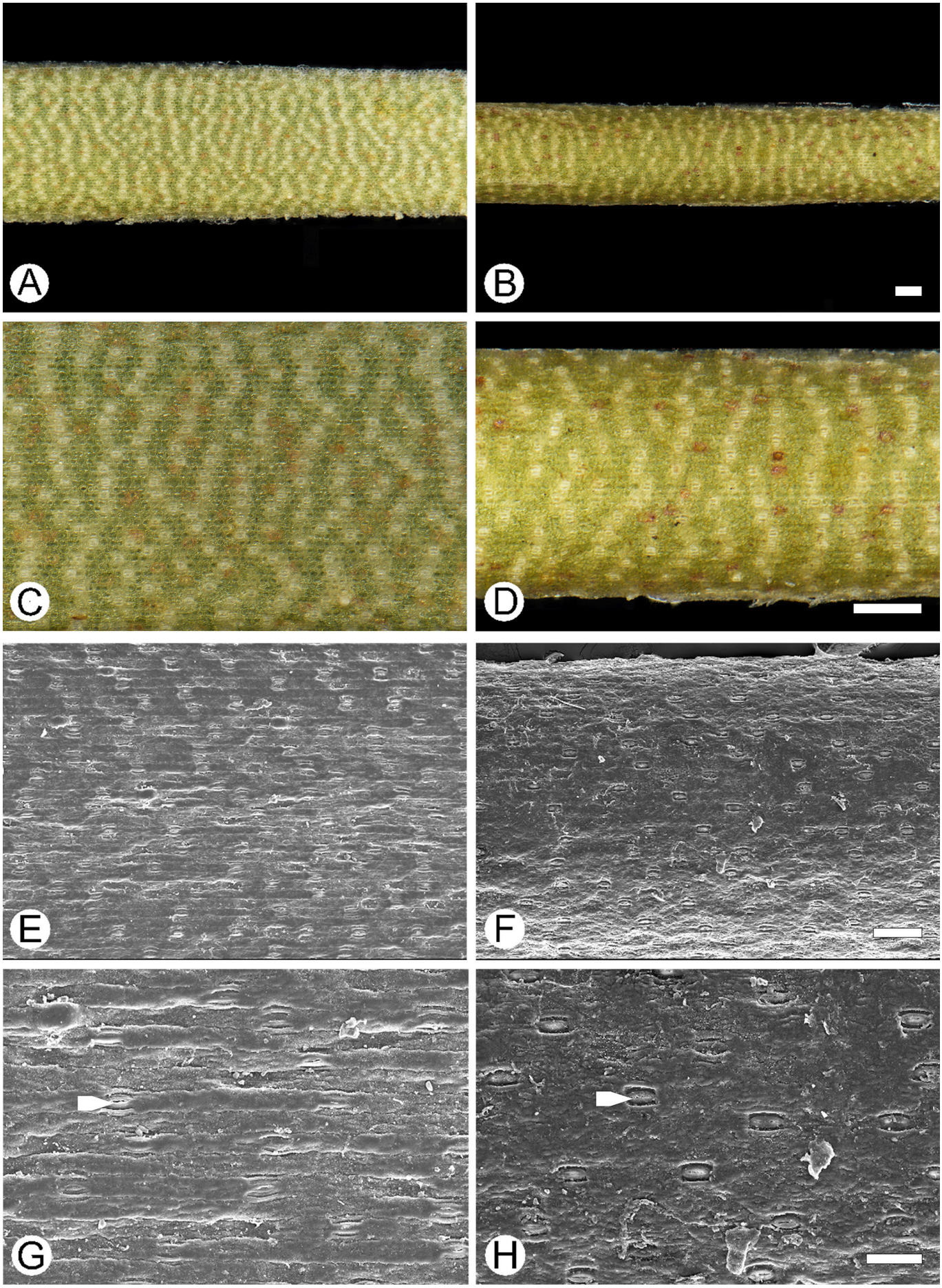

Fig. 124. *Sporadanthus gracilis* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*B.G. Briggs 10041*, 11 Nov. 2009). B, D, F, H female plant (*B.G. Briggs 9263*, 6 May 1993). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

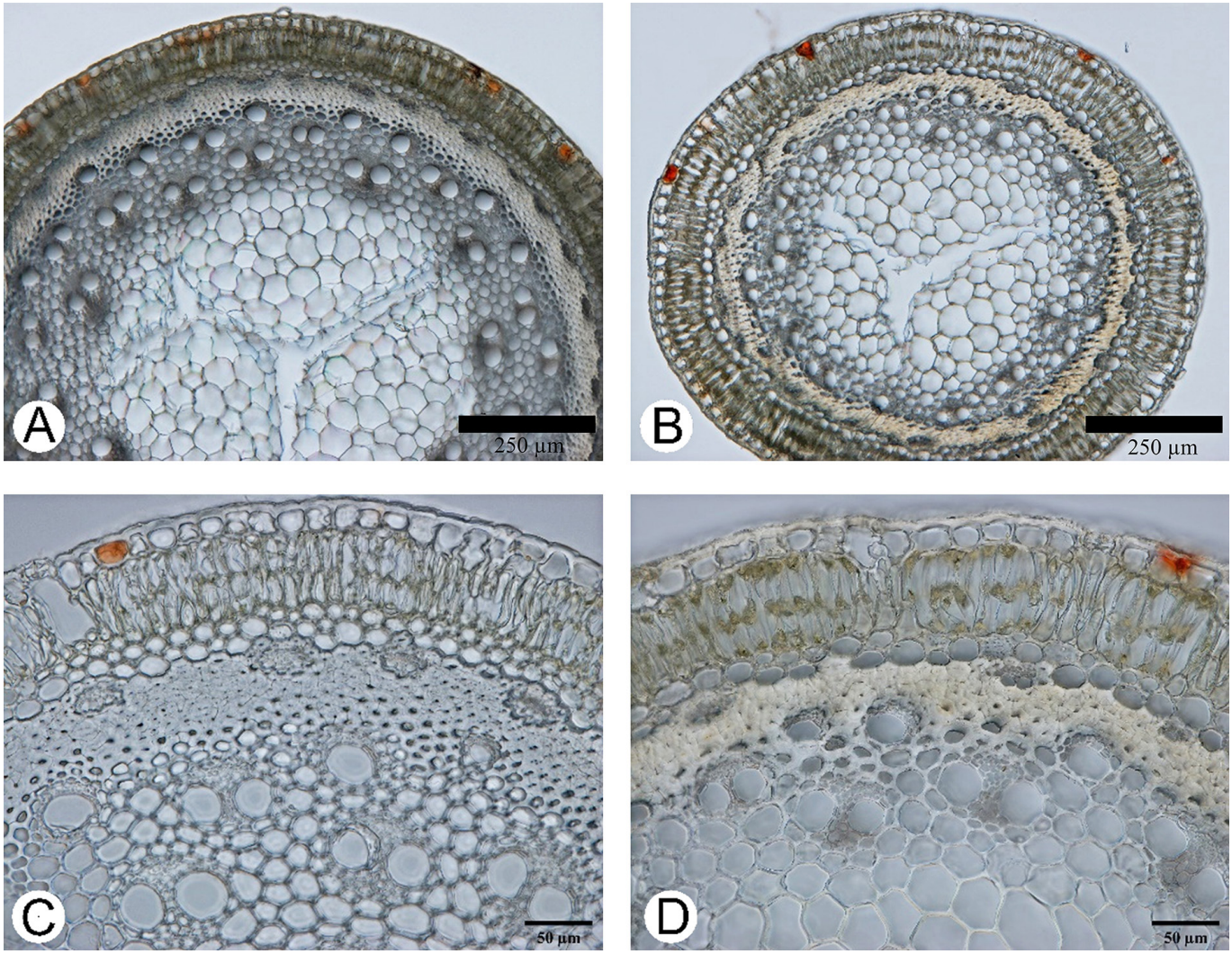

Fig. 125. *Sporadanthus gracilis* (R.Br.) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*B.G. Briggs 10041*, 11 Nov. 2009). B, D, female plant (*B.G. Briggs 9263*, 6 May 1993).

Notes on culm. The culm surface of male and female plants in Fig. 124 were distinctly different. In other gatherings examined (Table 3) of this species the culm surface of male and female specimens appears uniformly similar, as seen in the female culm surface of *B.G. Briggs 9263*, 6 May. 1993. Further study of the odd male specimen (*B.G. Briggs 10041*, 11 Nov. 2009) and the species is warranted to explore the variation observed.

Leaf morphology. Leaf sheath appressed; 0.7–3 cm long; glossy; smooth; light brown (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 1–3 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 30–100 mm; with spikelets clustered. Spikelet 2.5–3.5 mm long. Spikelet oblong-cylindrical. Flowers 20–60 per culm. Tepals 6; oblong lanceolate; yellow-brown (see Fig. 24); outer shorter than the inner; outer tepals 1.6–2.3 mm long; inner tepals 2–2.7 mm long. Stamens 3. Anthers 0.8–1 mm long.

Female inflorescence 30–100 mm; with spikelets clustered. Spikelet 2.5–3.5 mm long. Spikelet oblong-cylindrical. Flowers 15–40 per culm. Tepals 6; oblong lanceolate; yellow-brown (see Fig. 24); outer shorter than the inner; outer tepals 1.6–2.3 mm long; inner tepals 1.6–2.7 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. August, September, October, November and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 1.7–3.5 mm long.

Conservation status. Common.

Distribution. Distribution in N.S.W.: CC, CT, SC, ST.

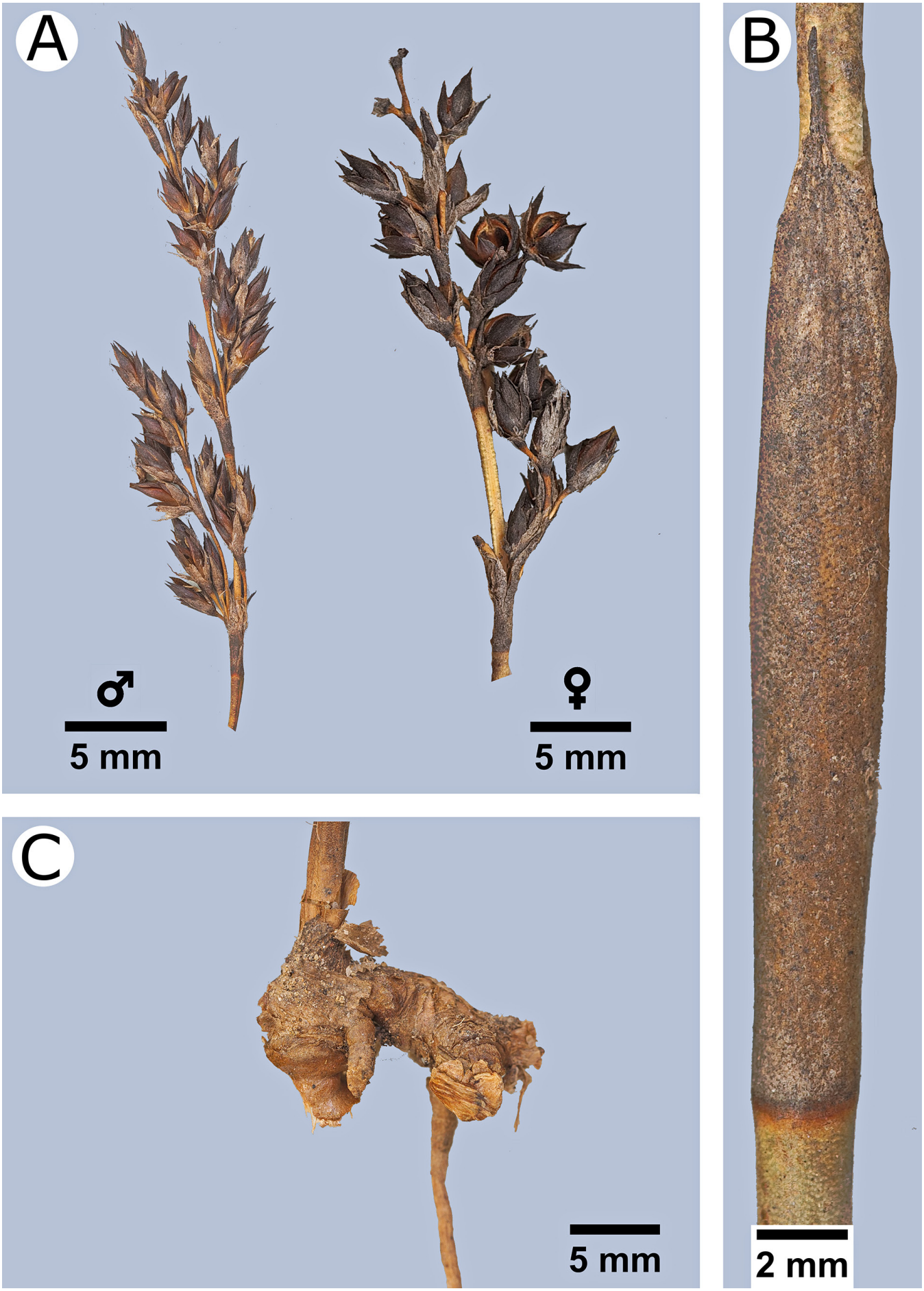

Fig. 126. *Sporadanthus gracilis* (R.Br.) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences B, a portion of the aerial shoot (sheaths) C, rhizomes. Male specimen (*B.G. Briggs 10041*, 11 Nov. 2009). B, D, female specimen (*B.G. Briggs 9263*, 6 May 1993).

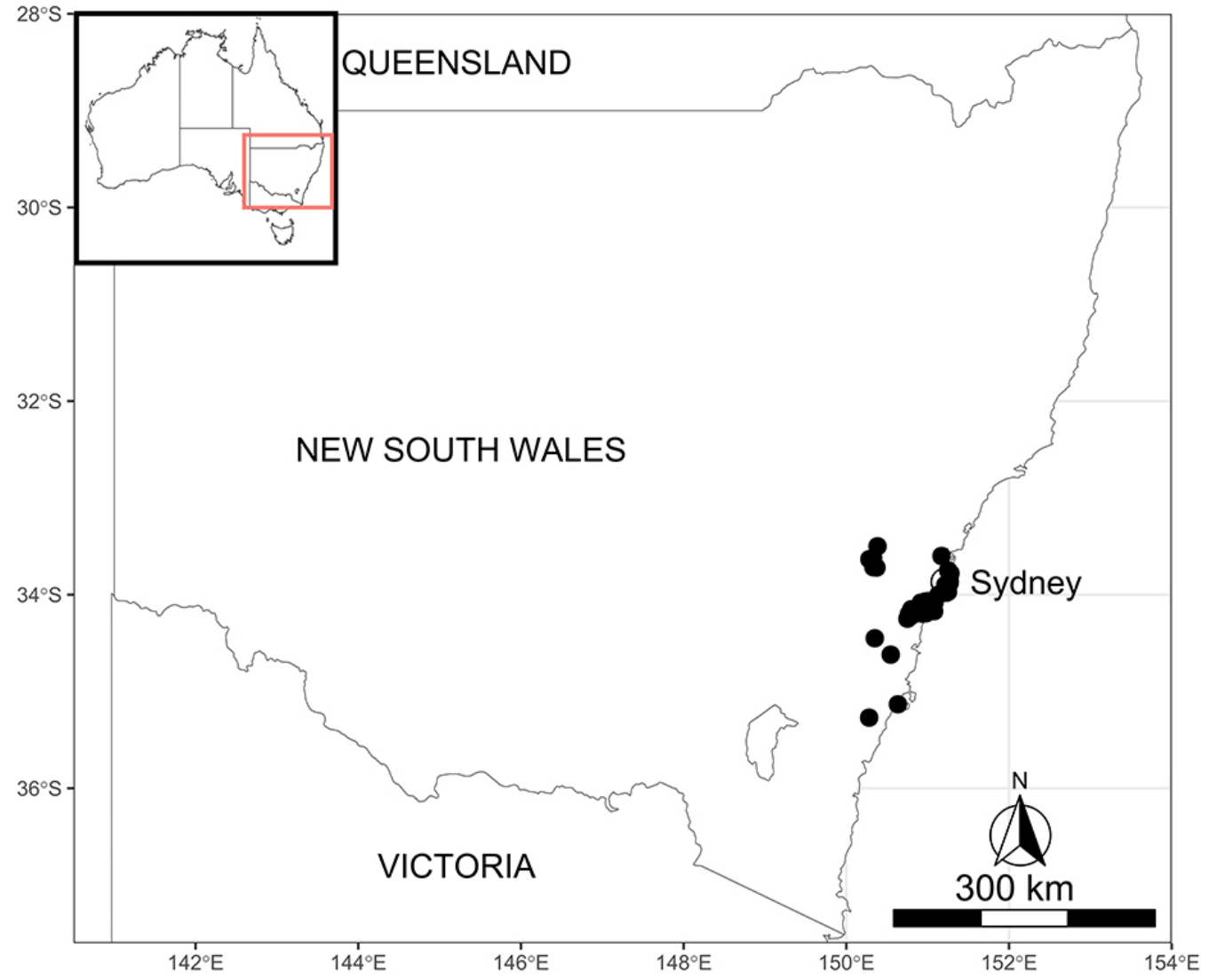

Fig. 127. Distribution of *Sporadanthus gracilis* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Sporadanthus interruptus (F.Muell.) B.G.Briggs & L.A.S.Johnson

Basionym: *Lepyrodia interrupta* F.Muell.

Figures 128, 129, 130, 131.

Reproduction. Plants dioecious.

Rhizome morphology. Rhizome 3–5 mm diam.; spreading or tufted; ascending, or creeping; subterranean; 3–5 cm deep; when dry mid-brown, or dark brown. Rhizome trichomes absent. Rhizome scales present; orange-brown.

Culm morphology. Culms on the rhizome arranged closely spaced. Culms 15–80 mm long; 0.5–1 mm diam; terete; erect; branched. Sterile lateral branches absent. Culm internodes few, or many. Culm surface not ribbed; at 40× areolate; at 300× minutely rugose. Culm texture smooth to touch; trichomes absent; warts absent; pale green when fresh; light green when dry (see Fig. 3 A3), or dark greenish when dry (see Fig. 3 C3); marbling absent. Culm stomata obvious; superficial; dispersed; not covered with wax; not covered with trichomes.

Culm anatomy. Culm cross-section obtusely triangular; outer epidermal walls plane; thick. Epidermis uniseriate. Culm stomata superficial. Chlorenchyma present. Chlorenchymatous cells slender; in two layers. Peg cells absent. Pillar cells absent. Protective cells absent. Parenchyma sheath present; cells multiseriate. Sclerenchyma sheath present. Sclerenchyma ridges present; slight; opposite vascular bundles present. Culm central cavity present; triangular. Silica absent; stegmata present. Starch grains absent.

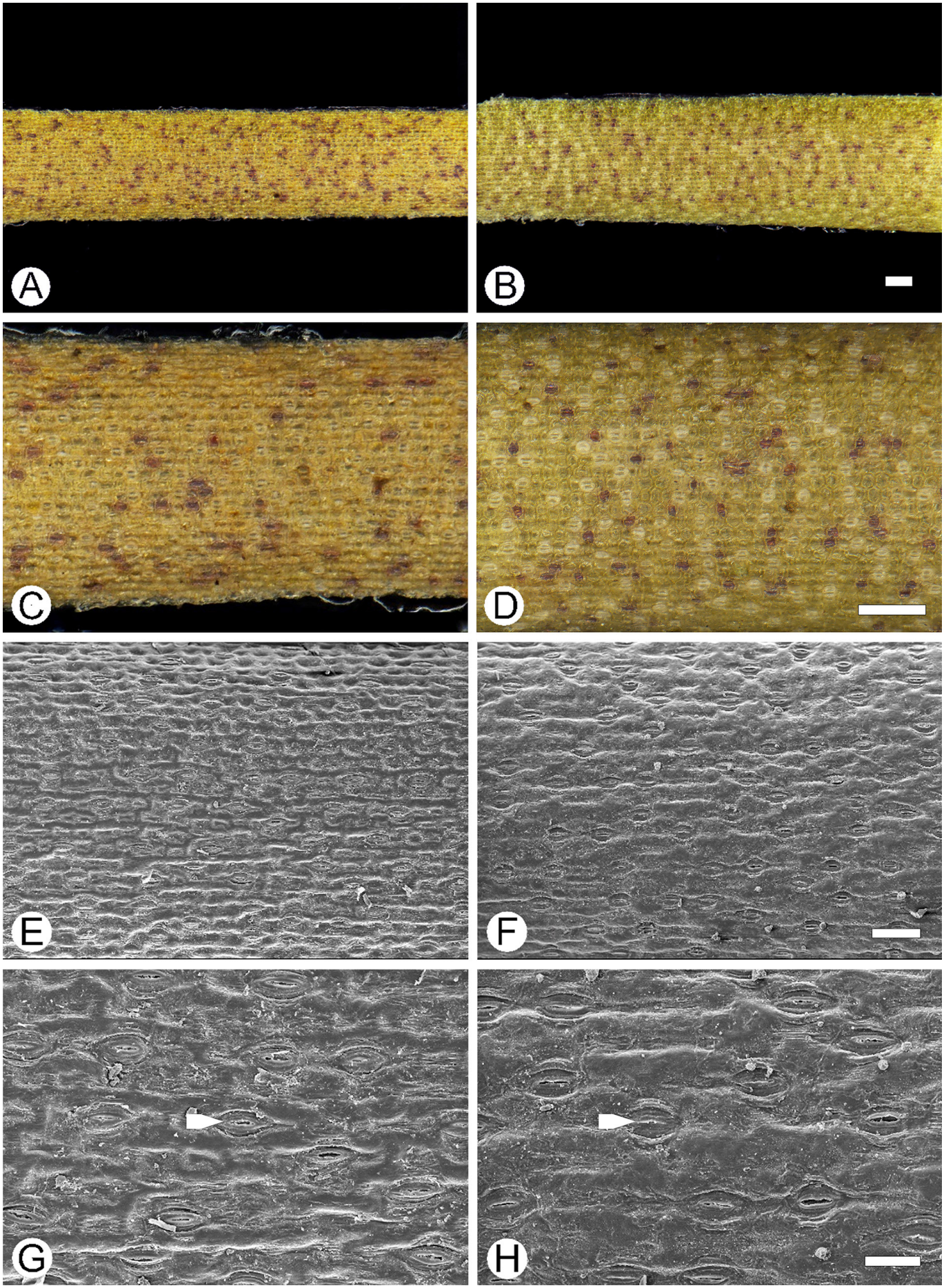

Fig. 128. *Sporadanthus interruptus* (F.Muell.) B.G.Briggs & L.A.S.Johnson. A, C, E & G, male plant (*J.B. Williams s.n.*, 5 Aug. 1967). B, D, F, H female plant (*J.B. Williams s.n.*, Sep. 1963). E–H, micrographs (SEM) of culm surface. Arrowhead = stomate. Scale bars: A–D, 200 µm; E–F, 100 µm; G–H, 50 µm.

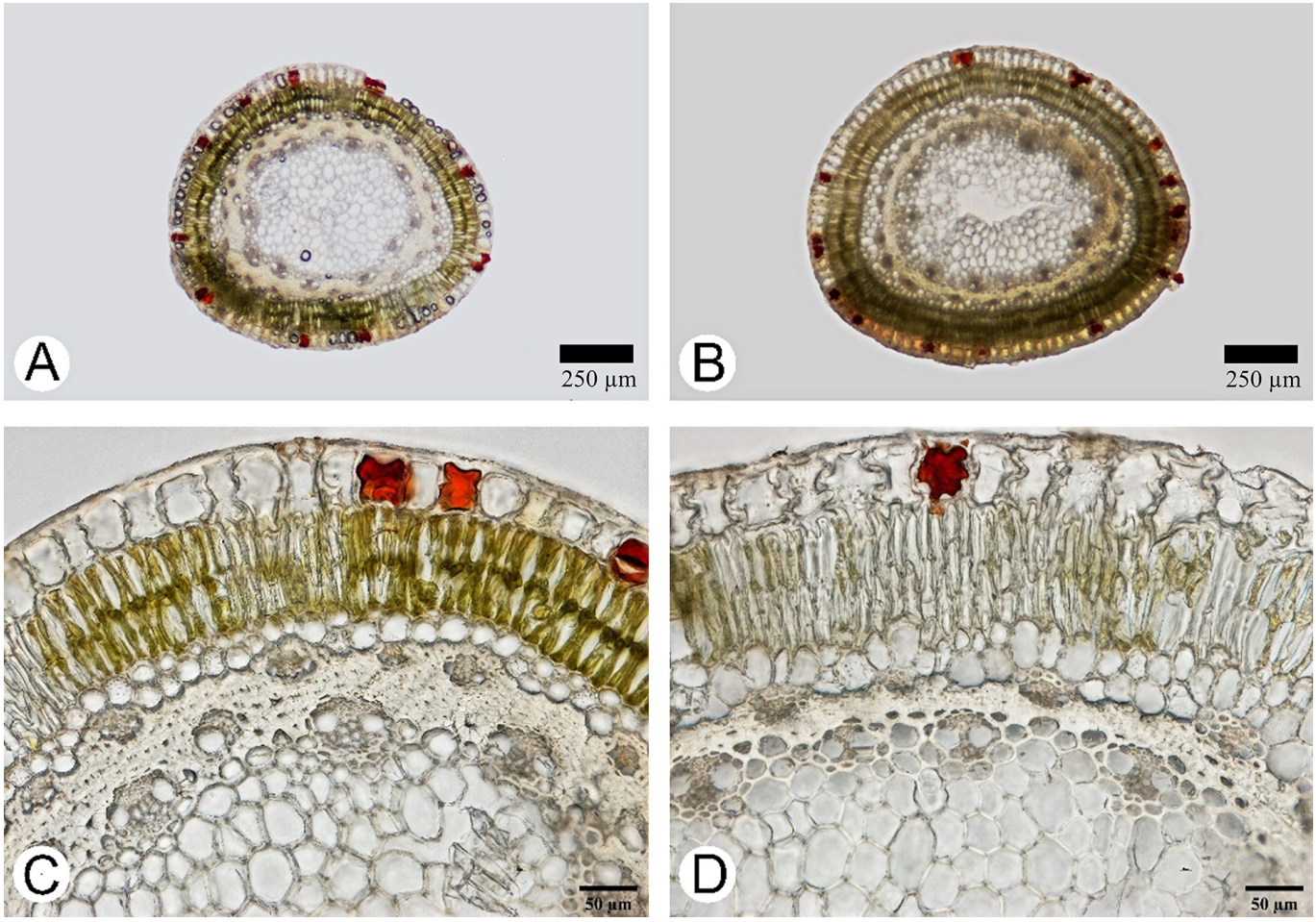

Fig. 129. *Sporadanthus interruptus* (F.Muell.) B.G.Briggs & L.A.S.Johnson. Internode cross-section of the culm. A, C, male plant (*J.B. Williams s.n.*, 5 Aug. 1967). B, D, female plant (*J.B. Williams s.n.*, Sep. 1963).

Leaf morphology. Leaf sheath appressed; 0.5–1.5 cm long; glossy; smooth; green (see Fig. 19); margins translucent. Leaf sheath apex elongated; glabrous. Leaf lamina present; 1–20 mm long.

Inflorescence morphology. Inflorescence bracts shorter than the spikelets. Male inflorescence 7–65 mm; with spikelets clustered. Spikelet 1.5–3 mm long. Spikelet ovoid, or oblong-cylindrical. Flowers 5–50 per culm. Tepals 6; oblong lanceolate; yellow-brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2–3.5 mm long; inner tepals 2–3.5 mm long. Stamens 3. Anthers 1.5–1.6 mm long.

Female inflorescence 7–65 mm; with spikelets clustered. Spikelet 1.5–3 mm long. Spikelet oblong-cylindrical. Flowers 5–25 per culm. Tepals 6; oblong lanceolate; brown (see Fig. 24); outer and inner ± similar in length; outer tepals 2–3.5 mm long; inner tepals 2–3.5 mm long. Staminodes 3. Ovary 3-angled. Ovary 3-locular. Stigmatic branches 3.

Flowering season. Spring and Summer.

Flowering phenology. January, August, September, October, November and December.

Fruit morphology. Fruit capsule; trilocular; ovate; 1 mm long.

Seed morphology. Seed maturation 10–12 months.

Conservation status. Common.

Distribution. Distribution in N.S.W.: NC. Distribution outside N.S.W.: QLD.

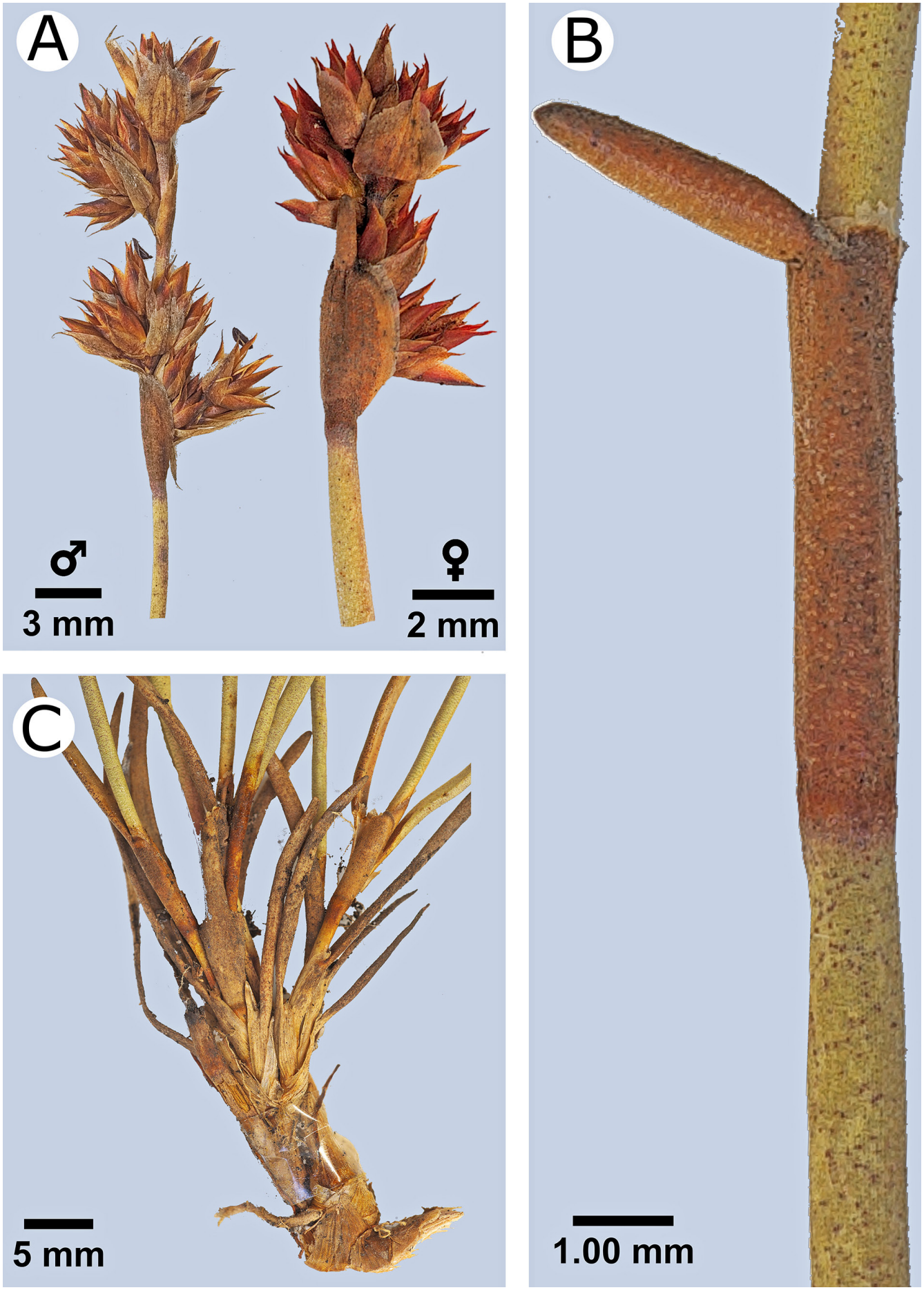

Fig. 130. *Sporadanthus interruptus* (F.Muell.) B.G.Briggs & L.A.S.Johnson. A, male (left) and female (right) inflorescences. B, a portion of the aerial shoot (sheaths) female plant. C, rhizomes. Male specimen (*J.B. Williams s.n.*, 5 Aug. 1967) and female specimen (*J.B. Williams s.n.*, Sep. 1963).

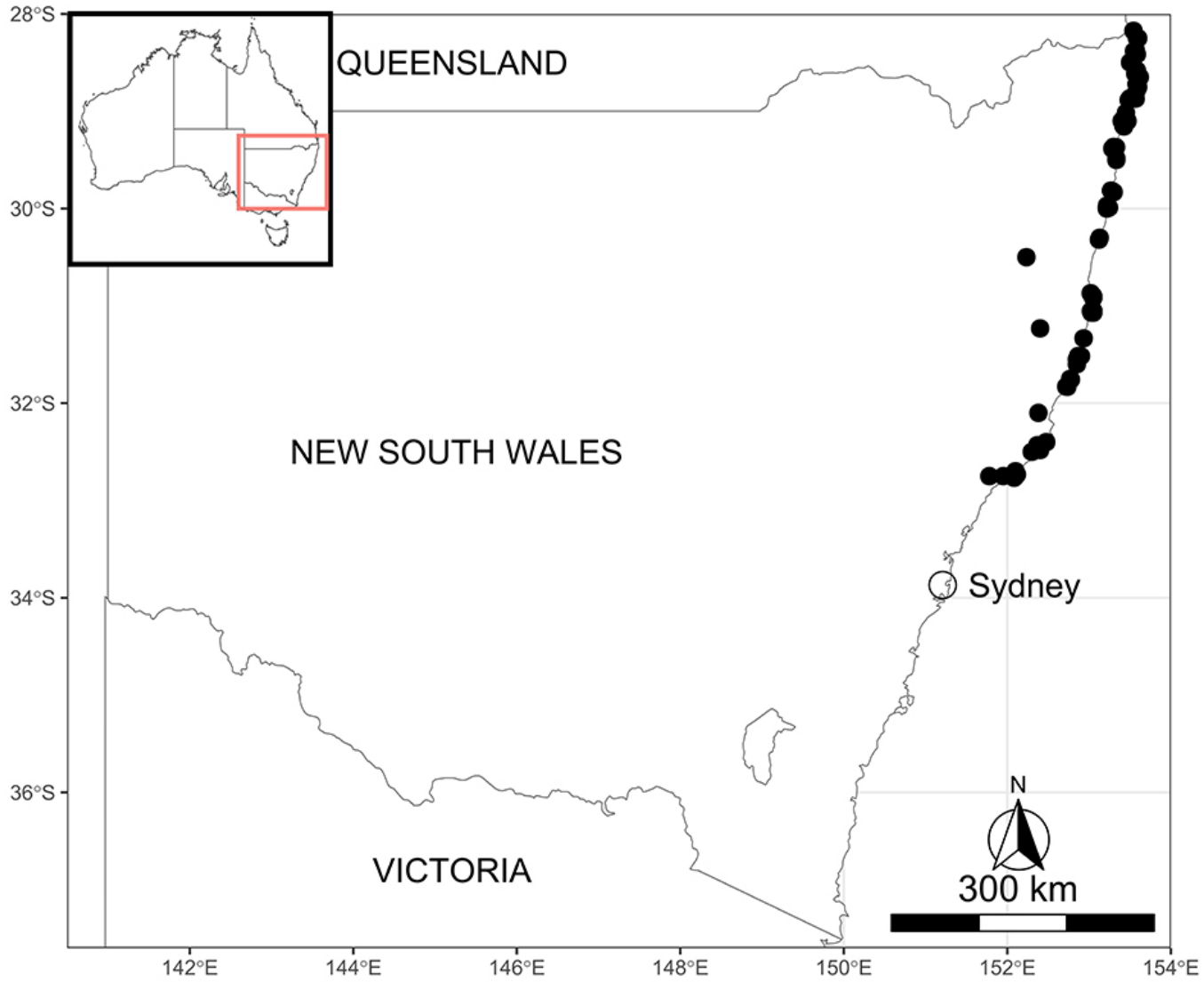

Fig. 131. Distribution of *Sporadanthus interruptus* in New South Wales. Dots indicate natural occurrences. Retrieved from AVH, 15 Mar. 2024.

Comparison of culm stomata in NSW

In all NSW Restionaceae the culm epidermis has paracytic stomata each with a pair of non-oblique (the majority) or oblique (the minority) lateral subsidiary cells. However, they differ in that the culm stomata of each species, such as whether the stomata are superficial or sunken, whether they are covered or open the appearance of their surrounding area (Figs 132, 133, 134). Sunken stomata can only be seen in *Baloskion australe*, *Chordifex dimorphus*, *Chordifex fastigiatus*, *Hypolaena fastigiata* and *Leptocarpus tenax*. However, the difference between them is that the culm stomata of *Hypolaena fastigiata* and *Leptocarpus tenax* are covered with culm hair, and that of *Baloskion australe* and its surrounding area are covered with wax crystals. Further, the area around the culm stomate of *Chordifex dimorphus* is slightly furrowed. There are also certain superficial stomata that are covered with wax crystals, such as those of *Eurychorda complanata*, or the area around the stomate has wax crystals, as in *Lepyrodia oligocolea*.

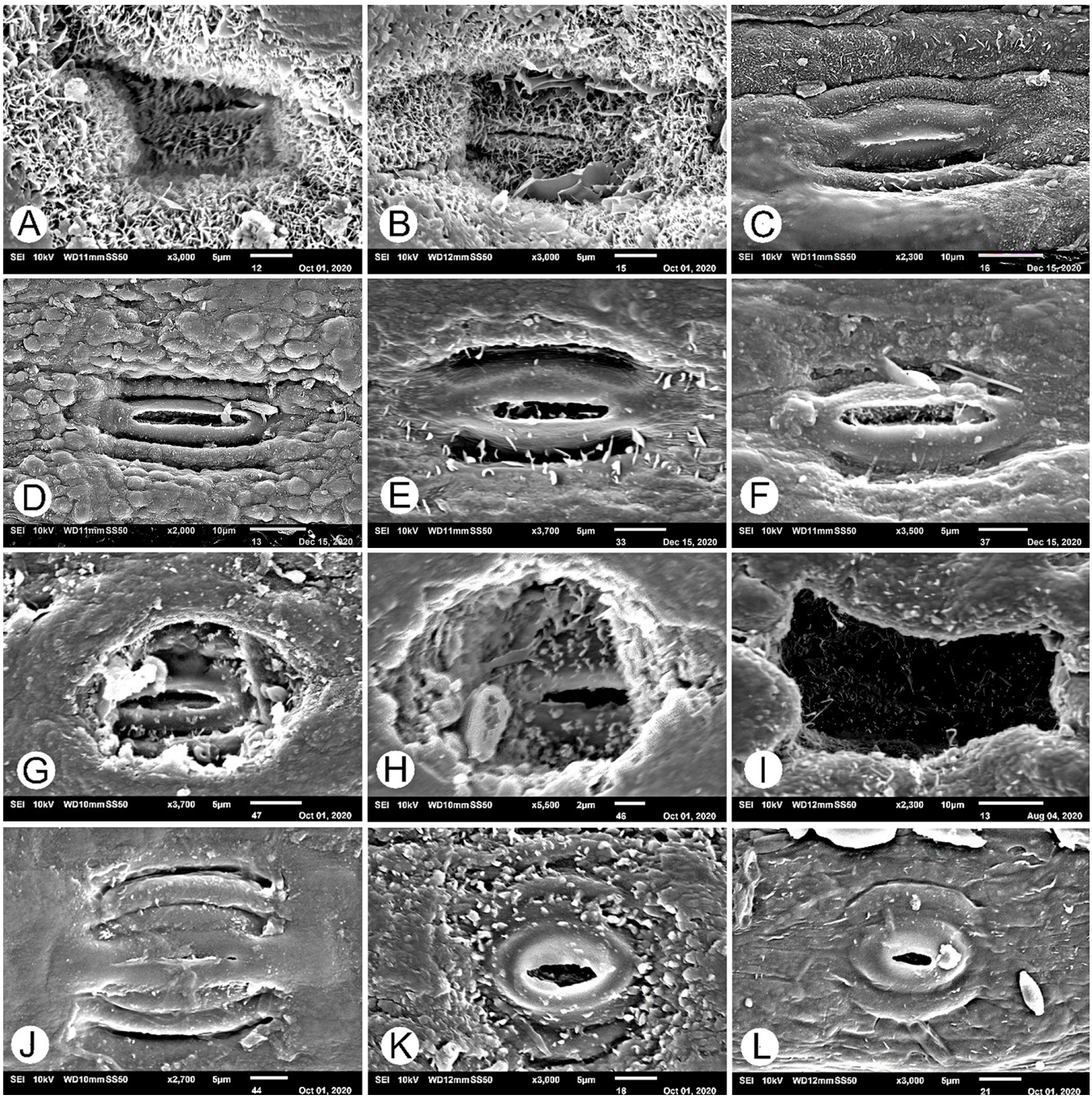

Fig. 132. Culm stomata of Restionaceae of New South Wales. A & B, *Baloskion australe* (*E.F. Constable s.n.*, 21 Nov. 1961 & *E.F. Constable s.n.* 26 Nov. 1962). C & D, *Baloskion longipes* (*M. Gray 5665*, 14 Jan. 1965 & *L.A.S. Johnson s.n.*, 8 Dec. 1968). E & F, *Baloskion tetraphyllum* subsp. *tetraphyllum* (*A.H.S. Lucas s.n.*, Jan. 1885 & *J.H. Ross 2640*, 15 Dec. 1981). G & H, *Chordifex dimorphus* (*J.H. Camfield s.n.*, Nov. 1896 & *J.L. Boorman s.n.*, 6 Apr. 1906). I, *Chordifex fastigiatus* (obscure; *K.G. Griffiths s.n.*, 5 Oct. 1957). J, *Coleocarya gracilis* (*S.J. Griffith s.n.*, 7 May. 1990). K & L, *Empodisma minus* (*S.J. Griffith s.n.*, 21 Apr. 1988 & *B.G. Briggs 10047*, 4 Dec. 1909).

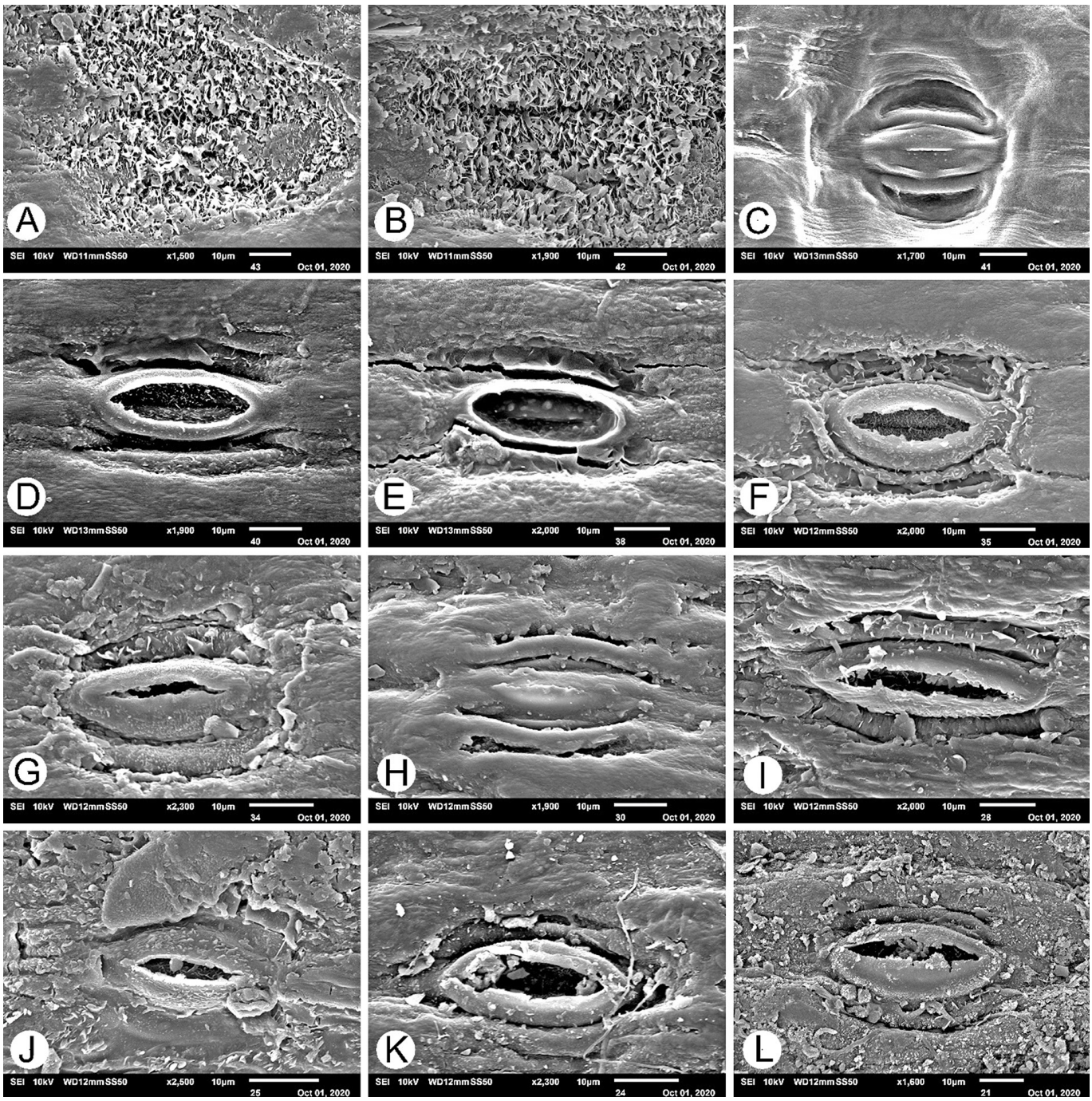

Fig. 133. Culm stomata of Restionaceae of New South Wales. A & B, *Eurychorda complanata* (*E.F. Constable s.n.*, 11 Nov. 1959 & *P. Rose 65*, 3 Dec. 2008). C, *Leptocarpus tenax* (*A. Vossen 20*, 1 Apr. 2014). D & E, *Lepyrodia anarthria* (*C.E. Nano 3*, 4 Jan. 1997 & *C.E. Nano 16*, 6 Feb. 1994). F & G, *Lepyrodia cryptica* (*V. Klaphake s.n.*, 1 Jan. 1998 & *V. Klaphake s.n.*, 1 Jan. 1998). K & L, *Lepyrodia imitans* (*S.J. Griffith s.n.*, 22 Mar. 1988 & *S.J. Griffith s.n.*, 29 Mar. 1988). J, *Lepyrodia leptocaulis* (*P.I. Forster 27458*, 14 Jul. 2001). K & L, *Lepyrodia muelleri* (*B.G. Briggs s.n.*, 19 Jan. 1962 & *V. Stajsic 7658*, 3 Nov. 2015).

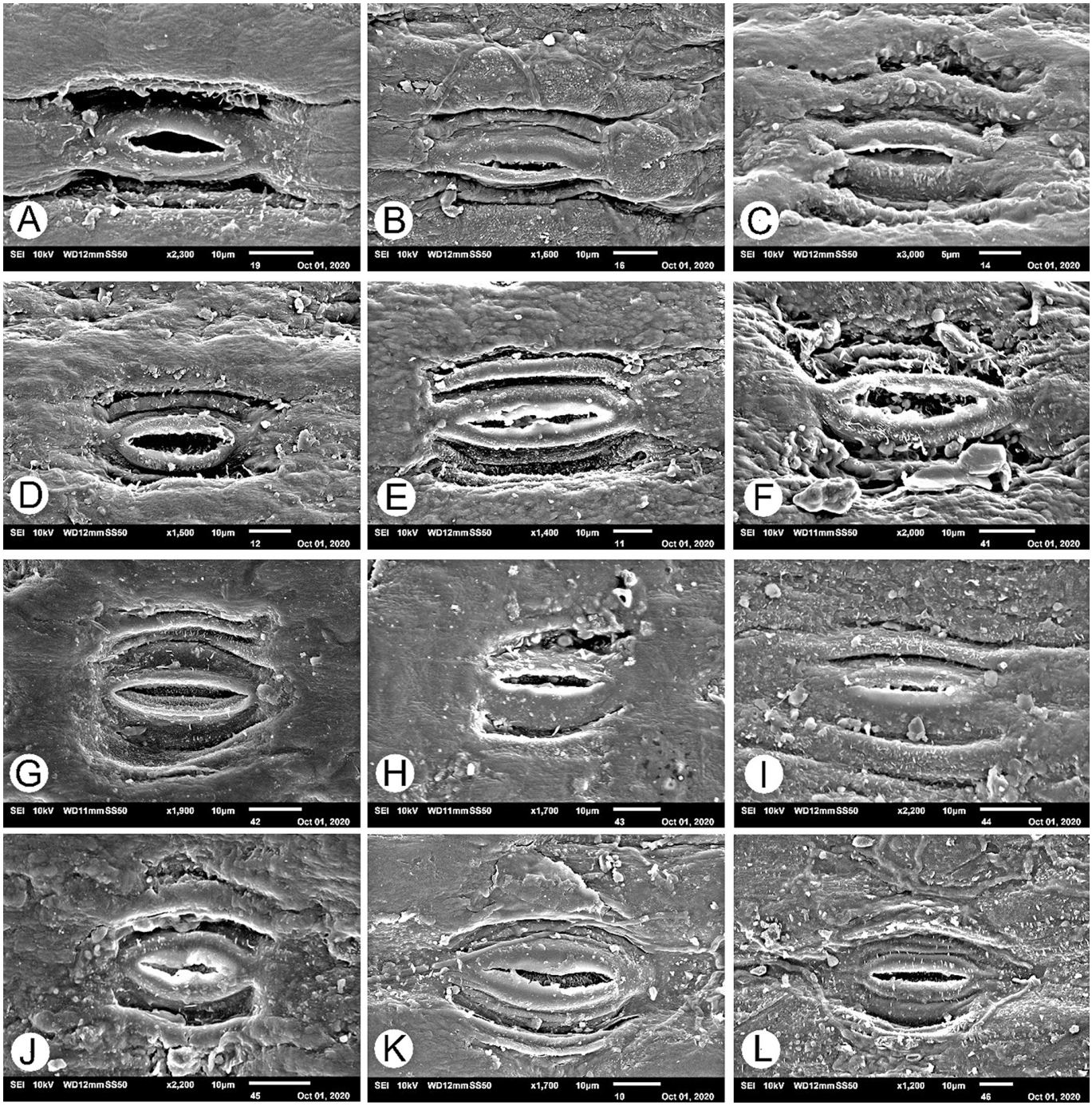

Fig. 134. Culm stomata of Restionaceae of New South Wales. A & B, *Lepyrodia oligocolea* (*P.R. Williams 293*, 22 Feb. 1995). C & D, *Lepyrodia scariosa* (*J.J. Bruhl 42*, 7 Jun. 1985 & *R.A. Clarke 3*, 3 Mar. 2011). E & F, *Lepyrodia verruculosa* (*E.F. Constable 6207*, 2 Nov. 1993 & *L.A.S. Johnson 8787*, 27 Jun. 1964). G & H, *Sporadanthus caudatus* (*E.F. Constable 3006 b*, 24 May 1962 & *S. Krauss 68*, 14 Oct. 1962). I & J, *Sporadanthus gracilis* (*B.G. Briggs 10041*, 11 Nov. 2009 & *B.G. Briggs 9263*, 6 May. 1993). K & L, *Sporadanthus interruptus* (*J.B. Williams s.n.*, 5 Aug. 1967 & *J.B. Williams s.n.*, Sep. 1963).

Comparison of warts in New South Wales *Lepyrodia*

The majority of species of *Lepyrodia* have small bumps or excrescences (no bigger than 20 µm) on the surface (LM & SEM) and in cross-sections (Fig. 135). In this study, these bumps are referred to as warts because it was difficult to find an appropriate name for these in the literature. However, as *Lepyrodia* has been said to contain silica in its epidermis (Linder *et al.* 1998), warts could be a result of the presence of silica. *Empodisma minus* also has elongate warts (ranging from 30 to 40 µm in size) (Fig. 135).

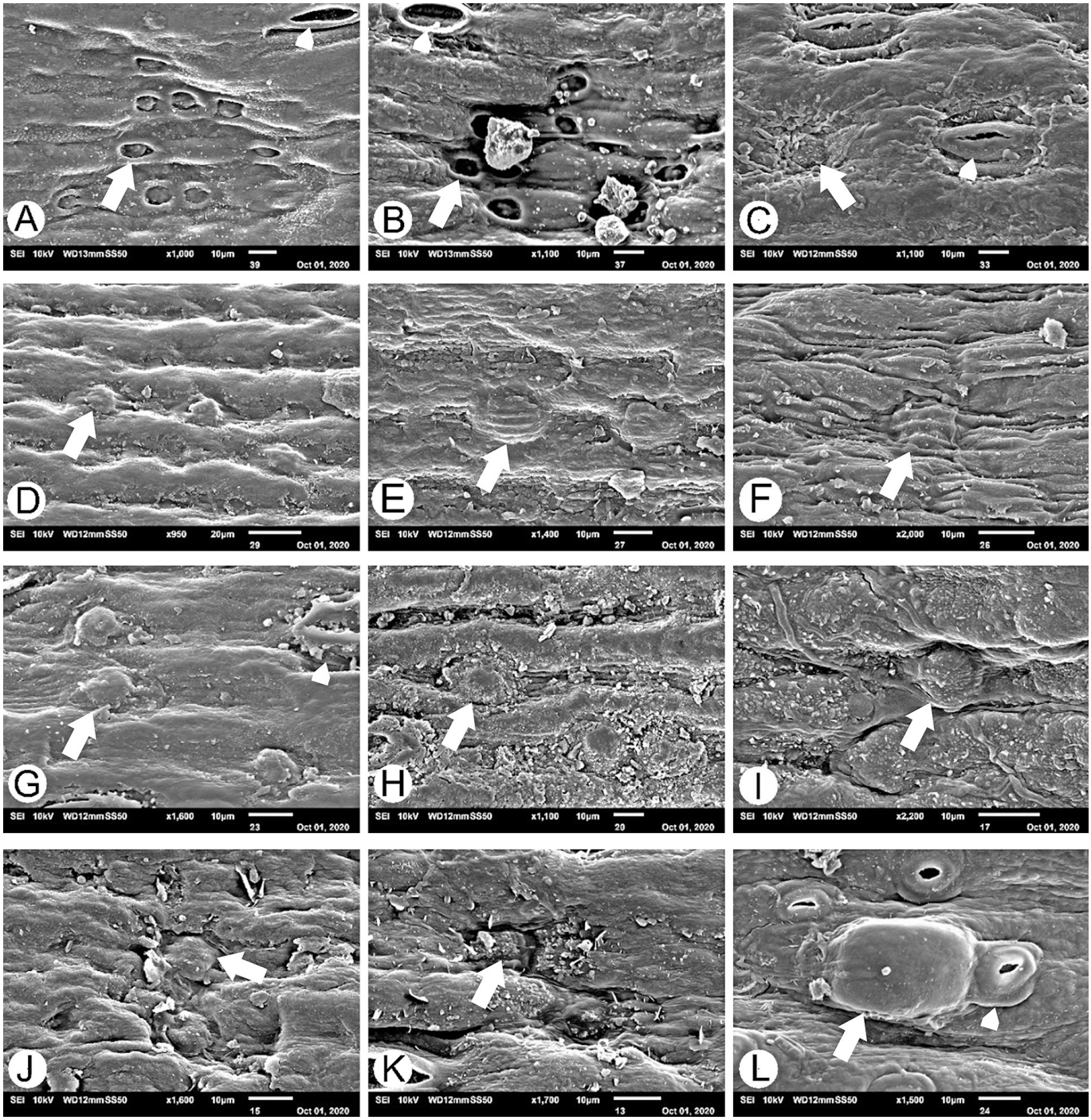

Fig. 135. Culms warts in New South Wales *Lepyrodia*. The arrows head point to a stomate, while the arrows point to a wart. A & B, *Lepyrodia anarthria* (*C.E. Nano 3*, 4 Jan. 1997 & *C.E. Nano 16*, 6 Feb. 1994). C, *Lepyrodia cryptica* (*V. Klaphake s.n.*, 1 Jan. 1998). D & E, *Lepyrodia imitans* (*S.J. Griffith s.n.*, 22 Mar. 1988 & *S.J. Griffith s.n.*, 29 Mar. 1988). F, *Lepyrodia leptocaulis* (*P.I. Forster 27458*, 14 Jul. 2001). G & H *Lepyrodia muelleri* (*B.G. Briggs s.n.*, 19 Jan. 1962 & *V. Stajsic 7658*, 3 Nov. 2015). I, *Lepyrodia oligocolea* (*P.R. Williams 293*, 22 Feb. 1995). J & K, *Lepyrodia scariosa* (*J.J. Bruhl 42*, 7 Jun. 1985 & *R.A. Clarke 3*, 3 Mar. 2011). L, elongate warts in *Empodisma minus* (*J.R. Hosking 2830*, 23 Nov. 2006).

Discussion

Almost no difference in the culm anatomy and morphology between male and female plants was observed, except in *Baloskion longipes*. In this species the culms of female plants were noticeably more bullate than those of the male plants as observed under SEM. Unexpectedly, in most species, the dried culms of female plants had a more intense colour than those of the male plants.

The culm surface can be used easily to identify Restionaceae to genus and to species in seven of the nine genera of New South Wales; viz., *Chordifex*, *Coleocarya*, *Empodisma*, *Eurychorda*, *Hypolaena, Leptocarpus and Sporadanthus*. However, the situation is somewhat challenging for a few species of *Baloskion* (*B. fimbriatum, B. gracile* and *B. tetraphyllum*) and *Lepyrodia* (*L. muelleri* and *L. oligocolea*). Adding more morphological culm characteristics, such as culm shape, number of internodes and whether the culm is branched or unbranched, allowed identification of most of these species. The use of culm anatomy supported the morphological identification of many genera and species.

Distinctive culm features (probable autapomorphies) facilitated identification of various species of Restionaceae. For example, small warts on the culm surface were characteristic of species of *Lepyrodia*, and elongated warts were found only in *Empodisma minus*. Two New South Wales species had hairs on their culms: *Hypolaena fastigiata*, in which appressed fan hairs formed vertical lines, and *Leptocarpus tenax*, in which a layer of appressed fan hairs covers the culm. These observations are in agreement with those of Linder *et al.* (1998, 2000).

Protective cells were seen in *Lepyrodia*. Pillar cells in *Eurychorda*, *Hypolaena* and *Leptocarpus*. Pegs cells in one layer were observed in *Baloskion*, *Chordifex*, *Coleocarya*, *Empodisma* and *Eurychorda* and in two layers in *Lepyrodia*. These anatomical differences are taxonomically significant, as they provide useful characters for distinguishing between genera.

Outer epidermal walls can be thick, such as in *Baloskion*, *Chordifex*, *Coleocarya*, *Empodisma, Eurychorda* and *Hypolaena*, or thin, such as in *Leptocarpus, Lepyrodia* and *Sporadanthus*. The epidermal anticlinal walls were straight in most genera and sinuous (waving) in *Lepyrodia* and *Sporadanthus* (Fig. 136). However, this may represent an artefactual effect, as the anticlinal walls appear higher in *Lepyrodia* and *Sporadanthus* than in other species (Fig. 136), which could account for the apparent waving pattern. Because this feature may not represent a genuine structural difference, it was excluded from the character list and species descriptions pending further study. Nevertheless, all relevant data have been documented and are available in Appendix 3. A similar case of Substantial Cavity Size can also be found in Appendix 3.

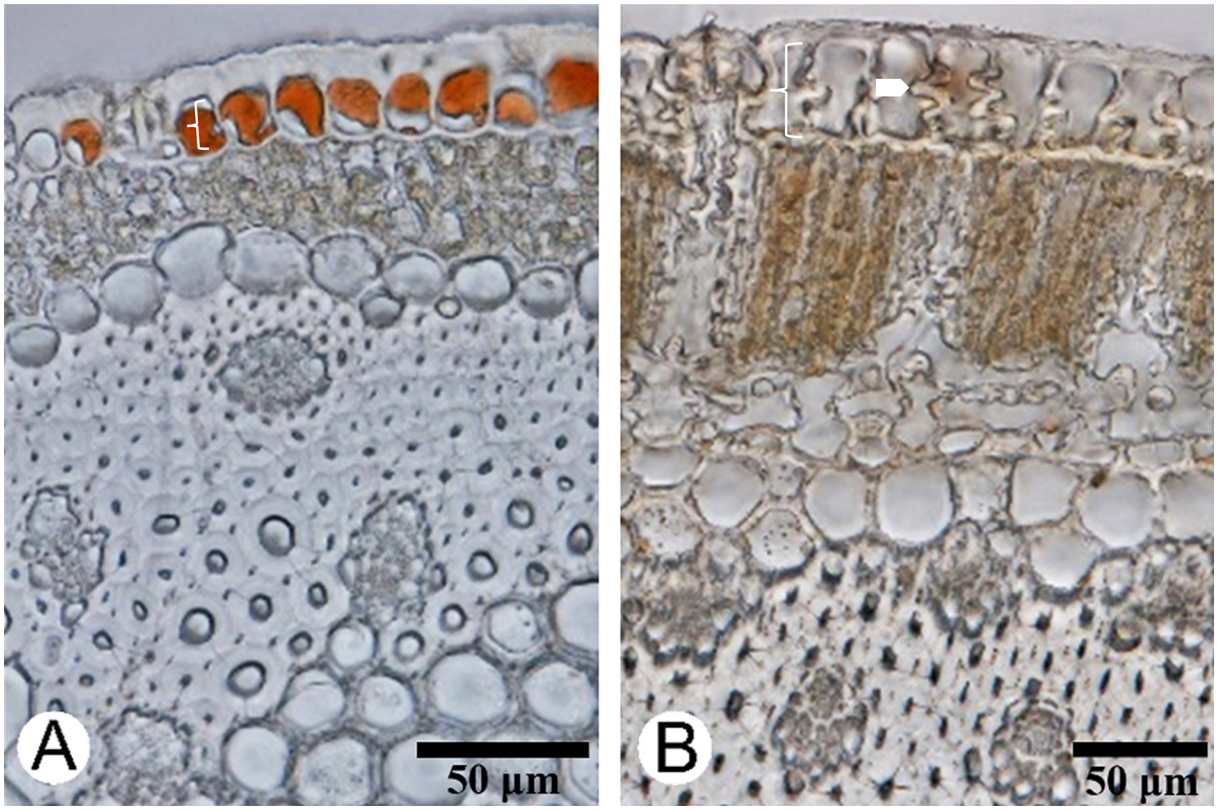

Fig. 136. Examples of epidermal anticlinal straight or sinuous walls. (A) straight walls, as in *Baloskion longipes* (*M. Gray 5665*, 14 Jan. 1965); (B) sinuous walls, as in *Lepyrodia oligocolea* (*P.R. Williams 293*, 22 Feb. 1995). Arrowhead = sinuous walls; brace = height of anticlinal walls.

Some anomalies have been found across a few specimens in *Eurychorda, Lepyrodia* and *Sporadanthus,* including deviations in culm anatomy and atypical leaf morphology. These cases merit further investigation and may represent new species. For example, in *Eurychorda complanata*, variation occurs in the size and shape of the lamina of basal leaves, including differences in the apex of the leaf sheath (e.g. Fig. 76). In cross-section, the culm may appear fusiform, narrowly elliptic, or narrowly oblong at higher magnification (e.g. Fig. 78 A, B). These cases merit further investigation and may represent new species.

The atlas produced here provides useful features of culm anatomy and morphology, and will facilitate identification of Restionaceae species in New South Wales, especially when the plants are not fertile. The outcomes of this project will benefit conservation practitioners, land managers and naturalists across New South Wales and the adjacent regions of Queensland and Victoria by provision of the images and related resources for identification.

Fresh culms from our field collections were easily identified via comparison with the atlas of images prepared from dried and rehydrated specimens. Some New South Wales species look different when they dried, such as *Lepyrodia verruculosa* (rough when fresh; asperous and finely tuberculate when dry) (Briggs 2012). Our findings indicated that the image atlas presented should be particularly well suited as a reference for identification of dried/herbarium material, and satisfactory for identification of fresh material.

Future studies

The culm colour of the female and male plants is slightly different. Therefore, a sophisticated machine, such as a Digital Chlorophyll Meter Analyser (Instruments SPAD502PLUS) (Ramos and Tallada 2016), should be used to detect these differences. This machine could be used in the field, which may help determine a colour match for males and females. The spectral determination of chlorophylls *a* and *b* for male and female specimens can be detected using spectrophotometers (Wellburn 1994). Both these approaches could help obtain an accurate result that can indicate whether there are any differences in the colour of male and female plants, which may aid their identification.

We are well underway in expanding the current DELTA Intkey for culm morphology and anatomy to a broader dataset for enhanced interactive identification and data retrieval (Appendix 4). Beyond well-established approaches to interactive identification, there is scope and considerable potential to explore artificial intelligence to identify Restionaceae (Wäldchen and Mäder 2018; Patel and Patel 2019; Islam *et al.* 2020). Such an approach could have considerable broader utility. Image AI could also be a useful approach to identification of Restionaceae, though from our experience of online queries of graminoid monocots (e.g., New South Wales Plant Identification group on Facebook), in the short term, most users will struggle to take adequate images to facilitate an image match using AI.

Acknowledgments

The study was undertaken using the facilities of N.C.W. Beadle Herbarium (NE), Botany and the SEM at the University of New England. Most samples were obtained from the NE with additional samples from the National Herbarium of N.S.W. (NSW). We thank Ebtihal Shaldoom for preparing figure 1; Malcom Lambert (UNE) for guidance on using the research microscopes, scanning electron microscope and sputter coater; and Armidale Regional Council for permission to collect samples and vouchers from land they manage. Many thanks to Saudi Arabian Government; the School of Environmental and Rural Science, UNE; and the Hans Wissmann Scientific Research Fund for Systematic Botany funds to THS. THS also gives special thanks to his parents and JJB for their help and encouragement outside the learning process during the Covid-19 pandemic.

Author Contributions

This study represents the primary research work of THS conducted as part of his Master's project under the supervision of JJB and RLB. THS performed laboratory work and conducted morphological and anatomical data, prepared figures and tables, and wrote the manuscript. JJB conceived the original idea and designed the study and contributed to data interpretation. THS and JJB conducted fieldwork. The determination of each specimen examined at NE was verified by THS, and those examined at NSW were checked by RLB. The NE specimen sheets were imaged by THS, and the NSW specimen sheets were imaged by RLB. THS and BGB examined and scored data from NE and NSW specimens, respectively, for the DELTA dataset and Intkey. JJB, RLB and BGB provided feedback on revisions of the manuscript. All authors read and approved the final version of the manuscript.

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Appendices

Appendix 1. Characters and states of NSW Restionaceae genera used from the literature. Missing data were absent in the publications cited.

Reference	Character state	*Baloskion*	*Chordifex*	*Coleocarya*	*Empodisma*	*Eurychorda*	*Hypolaena*	*Leptocarpus*	*Lepyrodia*	*Sporadanthus*
(Linder *et al.* 2000)	Culm branching	Simple	Branching	Simple	Branching	Branching	Branching	Simple	Branching	Simple
	Hair type on culms	Absent	Undifferentiated	Absent	Absent	Absent	Leptocarpus-type hairs	Leptocarpus-type hairs	Absent	Absent
	Plants	Dioecious	Dioecious	Monoecious	Dioecious	Dioecious	Dioecious	Dioecious	Dioecious	Dioecious
	Epidermis layers	One	One	One	One	One	One	One	One	One
	Epidermal radial walls	Straight	Straight	Tapering	Straight	Straight	Straight	Straight	Straight	Straight
	Epidermal radial walls	Straight	Straight	Wavy	Straight	Straight	Straight	Straight	Straight	Straight
	Epidermal end walls	Square	Square	Square	Square	Square	Square	Square	Square	Square
	Central ground tissue bundle arrangement	?	Scattered	Scattered	Scattered	Scattered	Scattered	Scattered	Scattered	Scattered
	Central ground tissue cavities	Single or absent	Single or absent	Multiple cavities	Single or absent	Single star-shaped	Single or absent	Single or absent	Single or absent	Single or absent
	Ribs alternating with vascular bundles	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
	Protective cells	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
	Chlorenchyma	Slender	Squat	Slender	Slender	Slender	Squat	Squat	Slender	Slender
	Silica	Present	Present	Present	Present	Present	Present	Present	Present	Absent
	Silica stegmata	Present	Present	Present	Present	Present	Present	Present	Present	Present
	Chlorenchyma pegs	Present	Absent	Present	Present	Present	Absent	Absent	Present	Absent
	Pillar cells	Absent	Present	Absent	Absent	Present	Present	Present	Absent	Absent
	Ribs opposite to vascular bundles	Present	Present	Absent	Absent	Present	Present	Present	Absent	Absent
	Undifferentiated protective cells	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Present
	Parenchyma sheath	Present	Present	Present	Present	Present	Present	Present	Present	Present
	Sclerenchyma sheath	Present	Present	Present	Present	Present	Present	Present	Present	Present
	Procyanidins	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
(Linder *et al.* 1998)	Culm simple or branched	Simple		Simple or occasionally branched	Branched and often flexuose	Simple, erect	Branched	Simple or branched		
	Culm shape		Terete		Thin and wiry	Strongly compressed			Terete or slightly compressed	

Reference	Character state	*Baloskion*	*Chordifex*	*Coleocarya*	*Empodisma*	*Eurychorda*	*Hypolaena*	*Leptocarpus*	*Lepyrodia*	*Sporadanthus*
	Culm surface pattern		Striate	Slightly tuberculate	Glabrous	Striate, edges of culms minutely scabrid	Glabrous or pubescent with appressed or spreading fan hairs	Striate, covered with a layer of appressed fan hairs	Smooth or minutely rugose	Smooth or minutely rugose
(Meney *et al.* 1999)	Culm air cavity						Solid or with one air-filled cavity	Solid or with one air-filled cavity	Circular in outline	Angular in outline
	Culm marbled or not marbled								Not marbled	With fine green or white marbling
(Briggs and Johnson 1998)	Chlorenchyma	Continuous								
	Pillar cells	Absent	Present			Present				
	Epidermal cells	Girders or enlarged	Girders or enlarged epidermal cells			Girders or enlarged epidermal cells				
	Culm surface pattern	Usually not striate	Culm usually longitudinally striate			Culm usually longitudinally striate				
	Culm shape		Terete			Flattened				

Appendix 2. Morphological characters of New South Wales species of Restionaceae obtained from this study.

		Culm branched or unbranched	Culm cross section shape	Culm erect or arching when dry	Culm internode number	Culm colour when dry	Culm surface (LM)	Culm surface (SEM)	Culm surface furrowed or not	Culm texture smooth or rough to touch when dry	Culm marbled or not under LM, when dry	Stomata visible or obscure	Stomata superficial or sunken	Stomata in clusters or not	Trichome presence and type, or absence	Warts present or absent
1	*Baloskion australe*	Unbranched	Terete	Erect	8–13	Yellowish-brown (E3)	Bullate	Bullate	Falsely furrowed	Slightly rough	Marbled	Not visible/ obscure	Sunken (SEM)	Not clusters	Absent	Absent
2	*Baloskion fimbriatum*	Unbranched	Terete	Erect	8–13 (most 12)	Yellowish-brown (E3) and dark greenish (C3)	Smooth	Minutely rugose	Falsely furrowed	Smooth	Marbled	Visible	Superficial	In line groups or in clusters	Absent	Absent
3	*Baloskion gracile*	Unbranched	Terete	Erect	9–11	Yellowish-brown (E3) and dark greenish (C3)	Minutely rugose	Part of the culm is striate while part is minutely rugose	Falsely furrowed	Smooth	Marbled	Visible	Superficial	In line groups or in clusters	Absent	Absent
4	*Baloskion longipes*	Unbranched	Terete	Erect	11 one specimen	Dark brown (F2)	Smooth	Minutely bullate	Falsely furrowed	Smooth	Marbled	Visible	Slightly sunken	In line groups or in clusters	Absent	Absent
5	*Baloskion pallens*	Unbranched	Terete	Erect	13–20 (most 17)	Upper half dark brown (F2), lower half greenish brown (D3)	Smooth	Striate	Falsely furrowed	Smooth	Marbled	Visible	Superficial	In line groups or in clusters	Absent	Absent
6	*Baloskion stenocoleum*	Unbranched	Terete	Erect	11–14 (most 13)	Yellowish-brown (E3) to dark brown (F2)	Smooth	Smooth	Not furrowed	Smooth	Not	Visible	Superficial and slightly raised (SEM)	Not clusters	Absent	Absent
7	*Baloskion tenuiculme*	Unbranched	Terete	Erect	5–7 (most 7)	Dark brown (F2)	Rugose	Rugose	Furrowed	Smooth	Not	Visible	Superficial	Not clusters	Absent	Absent
8	*Baloskion tetraphyllum*	Finely heavily branched	Terete	Erect	17–27 (most 25) (most 17 to base of inflorescence)	Yellowish-brown (E3) to dark brown (F2)	Smooth	Minutely striate	Falsely furrowed	Smooth	Marbled	Visible	Superficial	Not clusters	Absent	Absent
9	*Baloskion tetraphyllum* subsp. *tetraphyllum*	Finely heavily branched	Terete	Erect		Yellowish-brown (E3) to dark brown (F2)	smooth	smooth	Falsely furrowed	Smooth	Marbled	Visible	Superficial	Not clusters	Absent	Absent
10	*Chordifex dimorphus*	Branched	Terete	Arching	16–22 (most 18)	Light (A4) to dark green (A1)	Striate with dark spots	Pitted	Falsely furrowed	Smooth	Not	Obscure	Sunken	Not clusters	Absent	Absent

		Culm branched or unbranched	Culm cross section shape	Culm erect or arching when dry	Culm internode number	Culm colour when dry	Culm surface (LM)	Culm surface (SEM)	Culm surface furrowed or not	Culm texture smooth or rough to touch when dry	Culm marbled or not under LM, when dry	Stomata visible or obscure	Stomata superficial or sunken	Stomata in clusters or not	Trichome presence and type, or absence	Warts present or absent
11	*Chordifex fastigiatus*	Branched	Terete	Arching	10–12 before branching to many with branching	Dark greenish (C3)	Striate with vertical lines	Sulcate	Not furrowed	Smooth	Striate	Obscure	Sunken	In line groups	Absent	Absent
12	*Coleocarya gracilis*	±Unbranched (some branched)	Terete	Arching	5	Upper half mostly green (A4), lower half yellowish (D5).	Areolate	Smooth	Furrowed, one long sulcate	Smooth	Not	Visible	Superficial	Not clusters	Absent	Absent
13	*Empodisma minus*	Branched	Semi-terete	Arching	Small and short internodes and usually more than 25	Upper half dark green (B1), lower half dark brown (F1)	Rugose	Rugose	Furrowed	Smooth	Not	Visible	Superficial	Not clusters	Absent	Scattered elongate warts
14	*Eurychorda complanata*	Unbranched	Strongly compressed	Erect	5–7	Faded green (B2)	Striate	Striate & rugose	Furrowed	Smooth	Marbled or not	Invisible	Superficial	Not clusters	Absent	Absent
15	*Hypolaena fastigiata*	Branched	Terete	Erect or arching	16–17	Greyish green (F5)	Striate vertically with alternate lines of culm hairs	Striate vertically with alternate lines of culm hairs	Furrowed	Slightly rough	Not	Obscure	Sunken under the culm hairs		Appressed fan hairs	Absent
16	*Leptocarpus tenax*	Unbranched	Terete	Erect	12–19	Light (C3) to dark green (C1)	Smooth	Smooth	Not furrowed	Smooth	Not	Visible	Sunken	Not clusters	Covered with a layer of appressed fan hairs	Absent
17	*Lepyrodia anarthria*	Unbranched	Strongly compressed	Erect	One long internode and then two in the inflorescence	Upper half green (C4), lower half yellowish (D5)	Smooth	Wavily minutely rugose	Not furrowed	Smooth	Not	Visible	Superficial	Not clusters	Absent	Small, hollow warts
18	*Lepyrodia cryptica*	Unbranched	±Terete	Erect	7–9 (most 8)	Green (C4) when dry	Minutely rugose	Pitted	Not furrowed	Smooth	Not	Visible	Superficial	Not clusters	Absent	Small dome-shaped warts
19	*Lepyrodia imitans*	Unbranched	±Terete	Erect	6–8	Green colour (C4)	Minutely rugose	Minutely rugose	Not furrowed	Smooth	Not	Visible	Superficial	Horizontal undulating lines	Absent	Small dome-shaped warts
20	*Lepyrodia leptocaulis*	Branched	±Terete	Erect	6–10	Mostly green (A2)	Minutely rugose and pitted	Minutely rugose and pitted	Furrowed	Smooth	Not	Visible	Superficial	Not clusters	Absent	Small dome-shaped warts

		Culm branched or unbranched	Culm cross section shape	Culm erect or arching when dry	Culm internode number	Culm colour when dry	Culm surface (LM)	Culm surface (SEM)	Culm surface furrowed or not	Culm texture smooth or rough to touch when dry	Culm marbled or not under LM, when dry	Stomata visible or obscure	Stomata superficial or sunken	Stomata in clusters or not	Trichome presence and type, or absence	Warts present or absent
21	*Lepyrodia muelleri*	Unbranched	±Terete	Erect	10–13	Light green (A4)	Minutely rugose	Minutely rugose		Smooth	Marbled or not	Visible	Superficial	In line groups or in clusters	Absent	Small dome-shaped warts
22	*Lepyrodia oligocolea*	Unbranched	Strongly compressed	Erect	4–6	Light to dark green (A2 & A4)	Minutely rugose	Pitted	Not furrowed	Smooth	Not	Visible	Superficial	Not clusters	Absent	Small dome-shaped warts
23	*Lepyrodia scariosa*	Unbranched	±Terete	Erect	7–9 (most 7)	Light to dark green (A2 & A4)	Minutely rugose	Pitted	Not furrowed	Smooth	Not	Visible	Superficial	Horizontal undulating lines in clusters	Absent	Small dome-shaped warts
24	*Lepyrodia verruculosa*	Unbranched	Strongly compressed		3–4 from JSTOR	Light to dark brown (D4)	Tuberculate	Tuberculate	Not furrowed	Rough	Not	Visible	Superficial	In line groups or in clusters	Absent	Absent
25	*Sporadanthus caudatus*	±Unbranched	Terete		8–10 from JSTOR	Light green (A3) to brown (E3)	Smooth	Pitted	Not furrowed	Smooth	Not	Visible	Superficial		Absent	Absent
26	*Sporadanthus gracilis*	±Branched	Terete	Erect		Dark green (C3)	Areolate	Smooth	Not furrowed	Smooth	Marbled	Visible	Superficial	Horizontal undulating lines	Absent	Absent
27	*Sporadanthus interruptus*	±Branched	Terete	Erect	5–12	Light to dark green	Areolate	Minutely rugose		Smooth	Not	Visible	Superficial	Not clusters	Absent	Absent

Appendix 3. Anatomical characters of New South Wales species of Restionaceae novel in this study.

		Culm cross-sections	Epidermal cells shape	Outer epidermal walls	Outer epidermal walls	Anticlinal epidermal walls	Stomata	Substomatal cavity	Chlorenchyma	Peg cells	Chlorenchyma layers	Parenchyma	Parenchyma sheath straight or undulating	Sclerenchyma	Ribs opposite vascular bundles	Pillar cells	Protective cells	Culm central ground tissue cavities
1	*Baloskion australe*	±Terete	Elliptical	Thick	Undulating	Straight to a slightly undulating	Sunken	Half the size of the epidermal cells' cavity	Slender	Present	3	1 or 2	Undulating	Slightly ridged	Present	Absent	Absent	A single cavity
2	*Baloskion fimbriatum*	±Terete	Square	Thick	Straight	Straight	Superficial	Larger than epidermal cells' cavity	Slender	Present	1 or 2	1	Straight to slightly undulating	Slightly ridged	Present	Absent	Absent	A single cavity
3	*Baloskion gracile*	±Terete	Square	Thick	Straight	Straight	Superficial	Equal or slightly larger than epidermal cells' cavity	Slender	Present	1 or 2	1	Straight to slightly undulating	Slightly ridged	Present	Absent	Absent	A single cavity
4	*Baloskion longipes*	±Terete	Elongate cells	Thick	Slightly undulating	Straight	Superficial	Substomatal cavity smaller than epidermal cells' cavity	Slender	Present	1 or 2	1	Slightly undulating	Slightly ridged	Present	Absent	Absent	A single cavity
5	*Baloskion pallens*	Slightly compressed	Square	Thick	Straight	Straight	Superficial	Same size as epidermal cells' cavity	Slender	Present	1 or 2	1	Strongly undulating	Partial ridged	Present	Absent	Absent	A single cavity
6	*Baloskion stenocoleum*	±Terete	Square	Thick	Straight	Straight	Superficial	Equal or a slightly larger than epidermal cells' cavity	Slender	Present	1 or 2	1	Straight	No ridges	Absent	Absent	Absent	A single cavity
7	*Baloskion tenuiculme*	Slightly compressed		Slightly thick	Undulating	Slightly undulating	Superficial	Slightly larger than the epidermal cells' cavity	Slender	Present	1 or 2	1	Striate to slightly undulating	Slightly ridged	Present	Absent	Absent	A single cavity
8	*Baloskion tetraphyllum*	±Terete		Thick	Straight	Straight	Superficial	Smaller than epidermal cells' cavity	Slender	Present	1 or 2	1	Undulating	Slightly ridged	Present	Absent	Absent	A single cavity
9	subsp. *tetraphyllum*	±Terete		Thick	Straight	Straight	Superficial	Smaller than epidermal cells' cavity	Slender	Present	1 or 2	1	Undulating	Slightly ridged	Present	Absent	Absent	A single cavity
10	*Chordifex dimorphus*	Terete to slightly compressed		Thick	Straight	Straight	Sunken	Obscure		Present	1	1	Straight	No ridges	Absent	Absent	Absent	A single cavity
11	*Chordifex fastigiatus*	Terete to slightly compressed		Thick	Straight	Straight	Sunken	Obscure		Present	1	1	Undulating	Partially ridged	Present	Absent	Absent	A single small cavity
12	*Coleocarya gracilis*	±Terete		Very thick	Straight	Straight	Superficial	Larger than epidermal cells' cavity	Slender	Present	1	1	Straight	No ridges	Absent	Absent	Absent	Solid
13	*Empodisma minus*	Semi-terete		Thick	Straight	Straight and thick	Superficial	Obscure	Slender	Present	1	1	Straight	No ridges	Absent	Absent	Absent	Solid
14	*Eurychorda complanata*	Strongly compressed		Thick	Wavy	Straight	Superficial	Equal to chlorenchyma sheath apex	Slender	Present	1	1	Slightly undulating	Slightly ridged	Present	Present	Absent	A single cavity

		Culm cross-sections	Epidermal cells shape	Outer epidermal walls	Outer epidermal walls	Anticlinal epidermal walls	Stomata	Substomatal cavity	Chlorenchyma	Peg cells	Chlorenchyma layers	Parenchyma	Parenchyma sheath straight or undulating	Sclerenchyma	Ribs opposite vascular bundles	Pillar cells	Protective cells	Culm central ground tissue cavities
15	*Hypolaena fastigiata*	Slightly compressed		Thick	Wavy	Straight	Sunken	Half length of chlorenchyma sheath	Squat	Absent	3	1	Strongly undulating	Partially ridged	Present	Present	Absent	Solid
16	*Leptocarpus tenax*	±Terete		Thin	Divided into segments	Straight	Sunken	Small on the chlorenchyma sheath	Squat	Absent	2	1	Strongly undulating	Partially ridged	Present	Present	Absent	A single cavity
17	*Lepyrodia anarthria*	Compressed		Thin	Straight	Wavy	Superficial	Equal to chlorenchyma sheath apex	Slender	Present in two layers	1	1	Straight	No ridges	Absent	Absent	Present	Solid
18	*Lepyrodia cryptica*	Slightly compressed		Thin	Straight	Wavy	Superficial	Equal to chlorenchyma sheath apex	Slender	Present in two layers	1	1	Straight	No ridges	Absent	Absent	Present	Solid or with a single cavity
19	*Lepyrodia imitans*	Slightly compressed		Thin	Straight	Wavy	Superficial	Equal to chlorenchyma sheath apex	Slender	Present in two layers	1	2–4	Straight	Slightly ridged	Present	Absent	Present	Solid or with a single cavity
20	*Lepyrodia leptocaulis*	Slightly compressed		Thin	±Straight	Wavy	Superficial	Equal to chlorenchyma sheath apex	Slender	Present in two layers	1	2	Slightly undulating	Slightly ridged	Present	Absent	Present	A small cavity
21	*Lepyrodia muelleri*	±Compressed		Thin	±Straight	Wavy	Superficial	Equal to chlorenchyma sheath apex	Slender		1	1	Straight	No ridges	Absent	Absent	Present	A cavity
22	*Lepyrodia oligocolea*	±Compressed		Thin	±Straight	Wavy	Superficial	Equal to chlorenchyma sheath apex	Slender	Present in two layers	1	1 or 2	Straight	No ridges	Absent	Absent	Present	Solid
23	*Lepyrodia scariosa*	±Compressed		Thin	±Straight	Wavy	Superficial	Equal to chlorenchyma sheath apex	Slender	Present in two layers	1	1	Slightly undulating	Slightly ridged	Absent	Absent	Present	Solid or with a single cavity
24	*Lepyrodia verruculosa*	Compressed		Thin	Undulating	Undulating	Superficial	Equal to chlorenchyma sheath apex	Slender	Present in two layers	1	1	Straight	No ridges	Absent	Absent	Present	Solid
25	*Sporadanthus caudatus*	±Terete		Thin	Straight	Wavy	Superficial	Half length of chlorenchyma sheath			1 or 2	2 or 3		Slightly ridged	Present	Absent	Absent	A triangular cavity
26	*Sporadanthus gracilis*	Slightly compressed		Thick	Straight	Wavy	Superficial			Absent	2	1–3		Slightly ridged	Present	Absent	Present	A triangular cavity
27	*Sporadanthus interruptus*	Triangular terete		Thick	Straight	Straight or undulating		Equal size to epidermal cells' cavity		Absent	2	1 or 2	Straight	Slightly ridged	Present	Absent	Present	A triangular cavity

Appendix 4. Intkey dataset for interactive identification and data retrieval for the New South Wales species of Restionaceae.

This novel Intkey tool includes the copious images from the present study. The following link provides access to the Intkey dataset, which requires installation of Intkey (download from https://www.delta-intkey.com/ or from https://downloads.ala.org.au/p/Open%20DELTA). Updated versions will be provided with a new version number and date stamp.

Data Availability

The Restionaceae DELTA Intkey dataset is available from the following repositories:

- GitHub (public repository): https://github.com/taregt12/Restionaceae_DELTA_Intkey
- Google Drive (archival copy): https://drive.google.com/drive/folders/11oE5kJBXuOCukDrF3Xkvj2BldXRbgt6Y?usp=sharing
- DELTA Databases (all datasets): https://www.delta-intkey.com/www/data.htm

In case the primary links become inactive, the dataset can also be accessed via these dynamic QR codes:

Appendix 5. Staining with Phloroglucinol-HCl.

Lignin is present in several tissues, particularly in sclerenchyma cells across all species; however, the degree of staining varies among species (Fig. 137). Pillar cells were lignified in those species where they occur, and in *Lepyrodia anarthria*, lignin was also detected in the inner epidermal walls (Fig. 137).

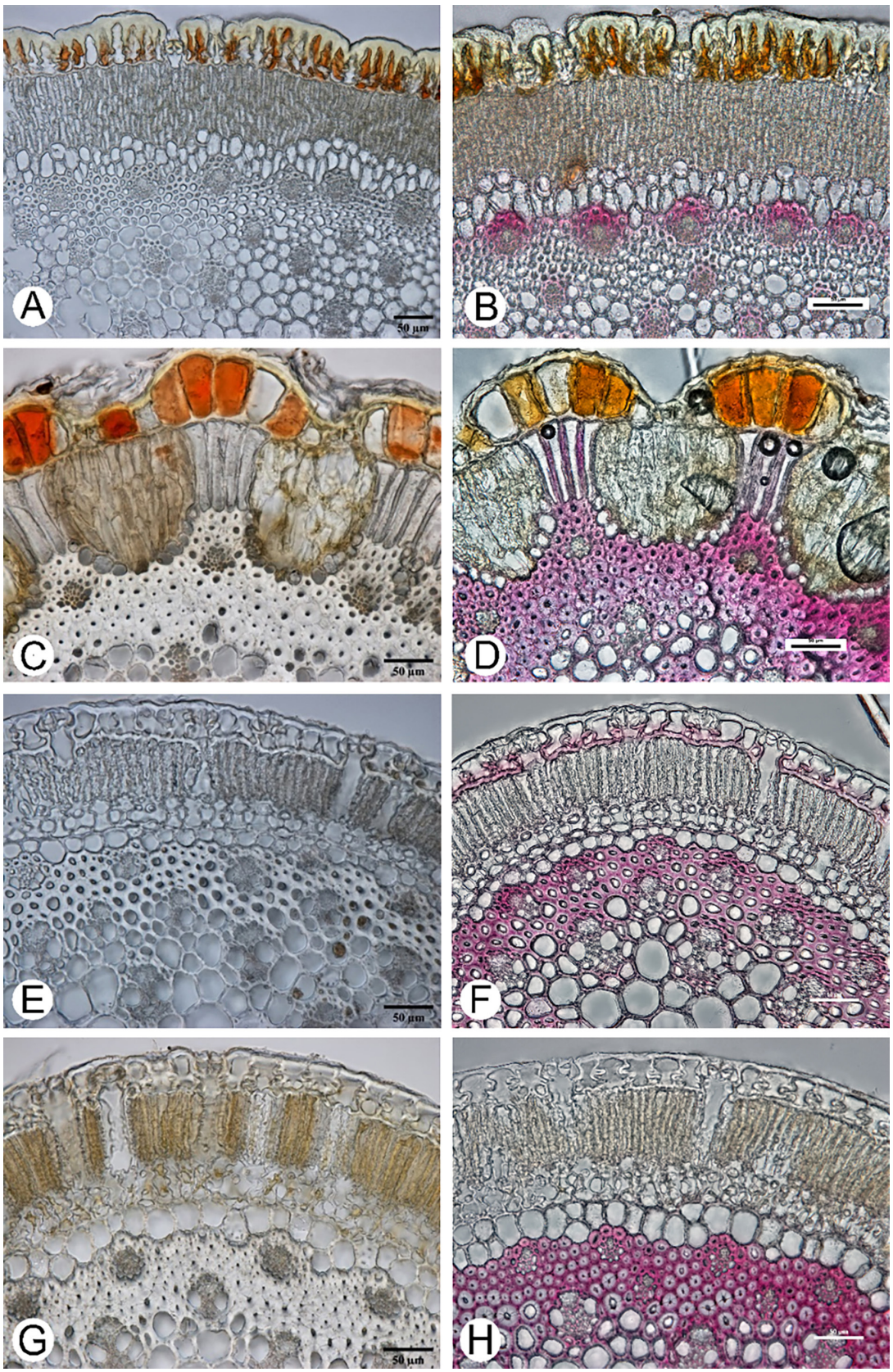

Fig. 137. Detailed anatomy of culms cross-sections of *Baloskion australe* (A & B), *Hypolaena fastigiata* (C & D), *Lepyrodia anarthria* (E & F) and *Lepyrodia imitans* (G & H). A, C, E and G culms without staining. B, D, F and H culms cross-sections with Phloriglucinol-HCl staining. A & B, Male specimen (*C.J. Skewes s.n.*, Jan. 1954). C & D, female specimen (*V. Klaphake s.n.*, 20 Jan. 1998). E & F, female specimen (*C.E. Nano 16*, 6 Feb. 1994). G & H, Male specimen (*S.J. Griffith s.n.*, 22 Mar. 1988).

Appendix 6. Culm characters and states for New South Wales species of Restionaceae derived from the literature.

		Length cm (Meney *et al.* 1999)	Width mm (Meney *et al.* 1999)	Length cm (Quirico and Briggs 1993)	Width mm diam (Quirico and Briggs 1993)	Erect (Quirico and Briggs 1993)	Hollow or solid (Meney *et al.* 1999)	Branched or unbranched (Meney *et al.* 1999)	Shape (Meney *et al.* 1999)	Colour of the culm (Meney *et al.* 1999)	Culms-anticlinal epidermal walls (Meney *et al.* 1999)	Stomata position (Meney *et al.* 1999)	Peg cells (Meney *et al.* 1999)	Chlorenchyma (Meney *et al.* 1999)	Starch (Meney *et al.* 1999)	Protective cells	Culm surface	Other notes (Meney *et al.* 1999)
1	*Baloskion australe*	30–80	1.2–2	40–100	1.2–2		Hollow	Unbranched	Semi-flattened	Light green	Straight	Superficial	Present	Divided by pillar cells	Absent			
2	*Baloskion fimbriatum*	30–80	0.5–1.2	20–85	0.5–1.2	Erect	Hollow	Unbranched	Slender	Light green		Superficial	Present		Absent			Culm thin and wiry (Quirico and Briggs 1993)
3	*Baloskion gracile*	30–100	0.7–1.5	35–100	0.75–1.5	Erect	Hollow	Unbranched		Dark green		Superficial	Present		Absent			
4	*Baloskion longipes*	90–150	2–2.5	90–150	2–2.5	Erect	Hollow	Unbranched				Superficial						Endodermoid sheath and aerenchyma present
5	*Baloskion pallens*	45–100	1.5–2.5	50–100	1.5–2.5	Erect	Hollow	Unbranched				Superficial	Present		Absent			Culm straight. Partial sclerenchyma ridge present
6	*Baloskion stenocoleum*	50–100	1–3	50–150	1–3	Erect	Hollow	Unbranched		Yellow-green		Superficial	Present		Present			
7	*Baloskion tenuiculme*	15–40	0.6–0.8	15–40	0.6–0.8	Erect	Hollow	Unbranched	Slender	Light green		Superficial	Present		Present			
8	*Baloskion tetraphyllum*	50–160	1.5–5.0	50–160	1.5–5.0	Erect to arching (Clarke 2015)	Hollow	Finely-branched		Light green, dark green in young plants		Superficial	Present		Present			Whorled, finely divided lateral sterile branches (Quirico and Briggs 1993)
9	subsp. *tetraphyllum*																	
10	*Chordifex dimorphus*			30–100	1.0–1.3		Hollow	Branched in upper regions		Light green		Sunken	Present		Absent		Glabrous	Culm arching
11	*Chordifex fastigiatus*	40–70	1–2	30–100	1–2	Arching, with erect upper branches (Meney *et al.* 1999)	Hollow				Wavy	Sunken in grooves	Present		Absent			Partial sclerenchyma ridge
12	*Coleocarya gracilis*	15–60	1	15–60	1	Erect	Solid	Simple or branched	Terete to furrowed (Quirico and Briggs 1993)	Light green		Superficial	Present		Dense			Some epidermal cells extend down to chlorenchyma layer
13	*Empodisma minus*	15–200	1–2				Hollow	Branched		Dark green		Superficial	Present		Present			
14	*Eurychorda complanata*	30–100	1.5–2	20–120	0.8–3.5	Erect	Hollow	Unbranched	Strongly compressed			Superficial	Present	Divided by pillar cells	Absent		Glabrous	Edges of culms minutely scabrid (Linder *et al.* 1998)

		Length cm (Meney *et al.* 1999)	Width mm (Meney *et al.* 1999)	Length cm (Quirico and Briggs 1993)	Width mm diam (Quirico and Briggs 1993)	Erect (Quirico and Briggs 1993)	Hollow or solid (Meney *et al.* 1999)	Branched or unbranched (Meney *et al.* 1999)	Shape (Meney *et al.* 1999)	Colour of the culm (Meney *et al.* 1999)	Culms-anticlinal epidermal walls (Meney *et al.* 1999)	Stomata position (Meney *et al.* 1999)	Peg cells (Meney *et al.* 1999)	Chlorenchyma (Meney *et al.* 1999)	Starch (Meney *et al.* 1999)	Protective cells	Culm surface	Other notes (Meney *et al.* 1999)
15	*Hypolaena fastigiata*	20–70	1–1.5	20–65	1.0–1.3	Erect or ascending	Solid	Usually many-branched	Slender (Clarke 2015)	Glaucous green		Sunken	Absent	Divided by pillar cells and partial sclerenchyma ridges	Absent		Minutely white-tomentose when young, greyish and ±glabrous at maturity (Meney *et al.* 1999)	Tallest epidermal cells between stomata and opposite pillar cells. Usually with flexuose side branches
16	*Leptocarpus tenax*	50–90	0.9–1.5	50–130	1–2	Erect	Hollow	Usually unbranched, sometimes sparsely branched		Dark green		Sunken		Divided by pillar cells and partial sclerenchyma ridges	Absent			Tallest epidermal cells between stomata and opposite pillar cells
17	*Lepyrodia anarthria*	30–80	0.8–1	30–80	0.8–2		Hollow	Unbranched										Culms numerous, thin and weak, or if stouter then fewer (Quirico and Briggs 1993)
18	*Lepyrodia cryptica*	40–90	0.6–1.8	40–90 (Briggs 2012)	0.6–1.8 (Briggs 2012)	Erect (Briggs 2012)		Simple	Terete to slightly flattened (Briggs 2012)								Smooth to slightly rugose (Briggs 2012)	
19	*Lepyrodia imitans*	45–100	1.2–2.8	70–110	1.2–2.8	Erect	Hollow	Simple or infrequently branched (Briggs 2012)	±Terete (Briggs 2012)	Yellow-green		Superficial	Present in 2 layers		Absent	Present	Smooth to sub-rugose (Briggs 2012)	
20	*Lepyrodia leptocaulis*	15–50	0.5–0.9	15–50	0.5–0.9		Hollow	Branched		Light green		Superficial	Present in 2 layers		Present	Present	Minutely wrinkled or pitted (Quirico and Briggs 1993)	Culms thin and wiry (Quirico and Briggs 1993)
21	*Lepyrodia muelleri*	40–70					Hollow	Mostly unbranched		Light green		Superficial	Present		Absent	Present		
22	*Lepyrodia oligocolea*			25–100 (Briggs 2012)	1.1–1.6 (Briggs 2012)	Erect (Briggs 2012)		Simple (Briggs 2012)	Slightly flattened								Slightly rugose when dry (Briggs 2012)	
23	*Lepyrodia scariosa*	30–90	0.8–1.8	35–90	0.8–1.8		Solid or hollow	Simple or sometimes branched	Terete (Quirico and Briggs 1993)	Light green		Superficial	Present in 2 layers		Absent	Present		

		Length cm (Meney *et al.* 1999)	Width mm (Meney *et al.* 1999)	Length cm (Quirico and Briggs 1993)	Width mm diam (Quirico and Briggs 1993)	Erect (Quirico and Briggs 1993)	Hollow or solid (Meney *et al.* 1999)	Branched or unbranched (Meney *et al.* 1999)	Shape (Meney *et al.* 1999)	Colour of the culm (Meney *et al.* 1999)	Culms-anticlinal epidermal walls (Meney *et al.* 1999)	Stomata position (Meney *et al.* 1999)	Peg cells (Meney *et al.* 1999)	Chlorenchyma (Meney *et al.* 1999)	Starch (Meney *et al.* 1999)	Protective cells	Culm surface	Other notes (Meney *et al.* 1999)
24	*Lepyrodia verruculosa*			40–65 (Briggs 2012)	1.3–2.1 × 0.8–1.5 (Briggs 2012)	Erect (Briggs 2012)		Simple	Flattened (ellipsoid in cross-section)								Slightly rough when fresh, asperous and finely tuberculate when dry (Briggs 2012)	
25	*Sporadanthus caudatus*	55–200	3–5	55–200	up to 5	Erect (Quirico and Briggs 1993; Meney *et al.* 1999)	Hollow, with triangular air space	Unbranched or sparsely branched		Olive-green		Superficial	Present		Absent		Marbled (Briggs 2012), mostly smooth (Quirico and Briggs 1993)	
26	*Sporadanthus gracilis*	130–150	1–2	30–150	1–2	Erect to sprawling	Hollow, air cavity triangular	With few to many angular branches		Green with fine brown marbling		Superficial	Absent		Absent	Present	Surface smooth and glabrous (Quirico and Briggs 1993)	
27	*Sporadanthus interruptus*	15–80	0.5–1	15–80	0.5–1	Erect	Hollow, air cavity angular	Sparsely branched		Pale green with fine marbling		Superficial	Absent		Absent	Present		