

# The genus *Juncus* (Juncaceae) in Malesia and allied septate-leaved species in adjoining regions

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## Abstract

K.L. Wilson and Johnson L.A.S. (Royal Botanic Gardens, Mrs Macquaries Road, Sydney NSW 2000, Australia) 2001. The genus *Juncus* (Juncaceae) in Malesia and allied septate-leaved species in adjoining regions. *Telopea* 9(2): 357–397. The Malesian species of the genus *Juncus* are reviewed. *Juncus durus* and *J. decipiens* subsp. **medianus** are described as new, and the new combination *J. decipiens* subsp. **sundaicus** is made. Distinctions between the Australasian *J. prismatocarpus* and allied Malesian and continental Asian septate-leaved species are outlined.

## Introduction

Backer (1951) published a treatment of the family Juncaceae in the *Flora Malesiana* series. He had published an account of the Javanese species in Dutch (Backer 1924) and subsequently an account for Java in English (Backer and Backhuizen f. 1968). Since then, there has been extensive collecting of and much research into the family in Malesia and neighbouring regions, particularly in Australia and New Zealand by E. Edgar and the late L.A.S. Johnson over the last 40 years. The first author (KLW) worked closely with LASJ on the study of the genus *Juncus* in Australia, New Zealand and New Guinea. The full Australasian study is still being prepared for publication, both as a separate paper and as part of the *World Flora* treatment of the family being coordinated by J. Kirschner (Pruhonice). It seemed useful to publish on the Malesian species separately from the Australian and New Zealand species since there are only eight species in Malesia and there is only one native species in common. *Juncus prismatocarpus* R. Br. is also discussed because of the persistent confusion of that Australian and New Zealand species with its allies in Malesia and Asia. Only the most relevant of the references mentioned in Backer (1951) are repeated here.

The subgeneric arrangement used is that of Kirschner et al. (1999). The subgroupings are largely the same as those used by Buchenau in his various publications (e.g. 1906), but with Buchenau's subgenera grouped as sections under two subgenera, which are based on his major informal subdivision of 'eprophyllati' and 'prophyllati'. These two informal subdivisions were based on the presence or absence of bracteoles (confusingly called prophylls by Buchenau — see Novara 1976 and discussion below) under each flower. Buchenau's subgeneric names are added in parentheses, so that those names can be correlated with the currently accepted names. Subgenus *Juncus* (Buchenau's 'Flores eprophyllati') is represented in Malesia by *Juncus leschenaultii* J. Gay ex Laharpe, *J. sandwithii* Lourteig and *J. wallichianus* Laharpe, which belong to sect. *Ozophyllum* (Buchenau's subgen. *Septati*). Subgenus *Poiophylli* (Buchenau's 'Flores prophyllati') is represented by the introduced *J. bufonius* L. sens. lat. in sect. *Tenageia* (subgen. *Poiophylli* p.p.) and a mixture of native (*J. decipiens* (Buchenau) Nakai, *J. durus* sp. nov. and *J. nupela* Veldkamp) and introduced (*J. inflexus* L.) species belonging to sect. *Juncotypus* (subgen. *Genuini*).

<sup>†</sup> Deceased 1 August 1997.

All collections cited have been seen unless otherwise indicated.

### Characteristics of the plants

The characteristics of the plants will be discussed more fully in the paper on Australian and New Zealand species. Here, only brief explanations of characters used in the key and species descriptions are given. Balslev (1996) gives a useful outline of morphological and anatomical characters in the family.

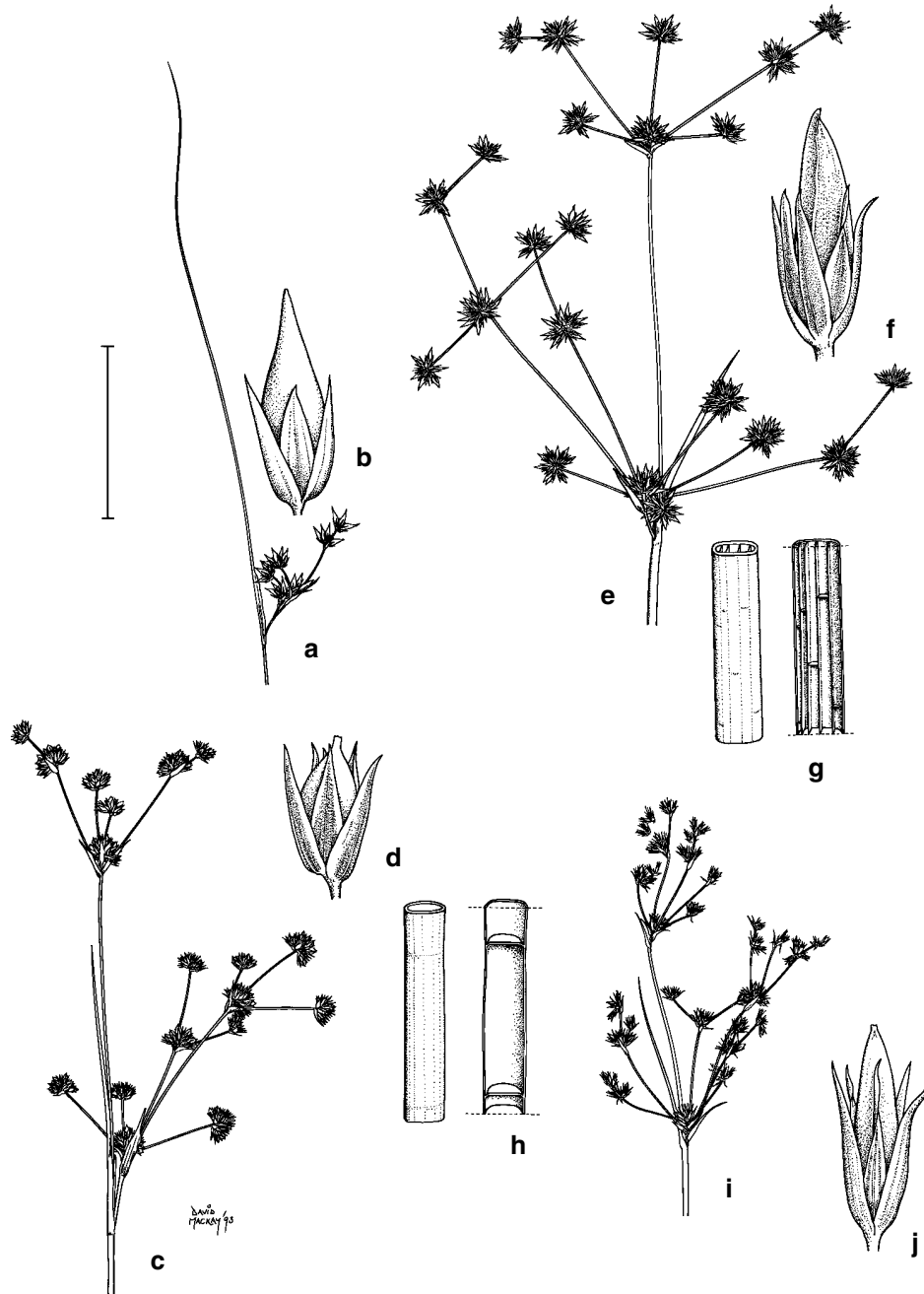
*Culm length* is measured from the base of a plant to the lowest involucre bract at the base of an inflorescence. This taken together with the inflorescence measurement gives an overall size for the plants. *Culm diameter* has been measured about halfway along the length of the culm, as have counts of number of longitudinal striations, and assessment of whether the pith is dense or loose, continuous, interrupted or absent, and whether septa (transverse or longitudinal) are present. *Culm hardness* is also assessed at that point by compressing the culm with the fingers; culms are often softer near their apex than their base. The surface *longitudinal striations*, which are the external reflection of the internal tissue patterns, are useful in separating species in section *Juncotypus*. They are more prominent when the plants are dried. *Pith density* is also characteristic for species in section *Juncotypus*. Density seems to be determined by the size of the stellate parenchymatous pith cells and the length of their arms: dense pith equating to small cells with short arms and loose pith to bigger cells with long arms. *Culm colour* is useful in discriminating taxa, but that is best assessed from fresh material, which has not been seen for all of the taxa dealt with here.

*Leaf blade form and diameter or width* are given in descriptions as seen about halfway along the lamina unless otherwise indicated. The transverse and longitudinal septa in species of section *Ozophyllum* (*J. leschenaultii*, *J. sandwithii* and *J. wallichianus*) are more obvious in dried specimens, but are best checked by splitting a leaf longitudinally to see the interior of the leaf. 'Unitubulose' leaves (Fig. 1h) are those with only transverse septa (also called 'perfect septa' by some authors), while 'pluritubulose' leaves (Fig. 1g) have both longitudinal and partial transverse septa ('imperfect septa'). Leaves in section *Juncotypus* consist of a minute mucro-like blade on a well-developed open sheath; such leaves are called cataphylls.

*Leaf sheaths* are more or less uniformly straw-coloured near the apex of the outer surface in all species, hence description of colour refers to the middle and basal portions, which range from pale yellowish to dark red-brown externally; all sheaths can become blackish in standing water. In section *Juncotypus*, the colour of the outer (abaxial) and of the inner (adaxial) surfaces of the cataphyll are diagnostic characters for a species. The adaxial surface has a whitish pearly sheen in most species, but some have darker adaxial surfaces that are darkish golden brown but still often with a pearly sheen. Whether the cataphylls in section *Juncotypus* tightly enclose the base of the subtended culm or are loose around it is characteristic for each species.

*Inflorescences* are terminal but appear lateral in the section *Juncotypus* because of the well-developed lowermost involucre bract that usually pushes the associated inflorescence to one side. Their structure is racemose in subgenus *Juncus* and cymose in subgenus *Poiophylli* (see discussion and references in Novara (1976) and Balslev (1996)), corresponding to the absence or presence of bracteoles under each flower.

Each branch of an inflorescence is subtended by a bract. The lowermost one or two *involucre bracts* in most species are much larger and more leaf-like in form than those higher in the inflorescence (which are often scale-like, and are termed *floral bracts* when they subtend the ultimate inflorescence branches, each bearing a flower). In section



**Fig. 1.** *Juncus sandwichii*: **a**, inflorescence; **b**, flower (from A.C. Beauglehole 25006 (NSW)). *J. wallichianus*: **c**, inflorescence; **d**, flower (R.D. Hoogland and R. Schodde 7478 (NSW)). *J. prismatocarpus*: **e**, inflorescence; **f**, flower; **g**, pluritubulose leaf and cross-section (e, f from C. Fraser (NSW 241448); g from L.A.S. Johnson 7621 et al. (NSW)). *J. holoschoenus*: **h**, unitubulose leaf and cross-section (from A. Meebold 21882 (NSW)). *J. leschenaultii*: **i**, inflorescence; **j**, flower (from J. Ohwi and T. Koyama NSM 310, Japan (NSW)). Scale bar = 4 cm (a, c, e, i), = 3.5 mm (b, d, f, j), = 7.5 mm (g, h).

*Juncotypus*, the lowest involucre bract is culm-like and appears to be a continuation of the culm. The length of these involucre bracts relative to the associated inflorescence is often characteristic for a species. A specialised 2-keeled bract, the *prophyll*, is present adaxially above the bract at the base of inflorescence branches. Prophylls are most readily seen on the main inflorescence branches of fresh specimens with expanded inflorescences.

*Flowers* are generally numerous in an inflorescence, but are occasionally reduced to just a few flowers, as in *J. sandwithii*; this, of course, can also be the case with depauperate individuals of other species. Flowers are solitary or in dense (many-flowered) or loose (few-flowered) clusters. There is some intraspecific variation in number of clusters and in number of flowers per cluster. Each flower is on a pedicel (ultimate inflorescence branch), which is subtended by a small rather papery floral bract. Besides the bract, two small, papery bracteoles are present below each flower in subgenus *Poiophylli* (represented in Malesia only by sections *Tenageia* and *Juncotypus*). These bracteoles are what Buchenau (1890, 1906 and other references therein) confusingly referred to as prophylls. In some species, there may appear to be three bracteoles below the flower, which Barnard (1958) explains as (2 bracteoles + 1 bract), resulting from abortion of a lateral branch below the flower leaving only the floral bract associated with that lateral branch. In other species, the number of 'extra' bracts below the flower may be as high as three (e.g. in the Australian *J. homalocaulis* F. Muell. ex Benth., pers. obs.). Inexperienced observers may even count the 2-keeled prophyll in small, crowded inflorescences as an extra bracteole since the keels are sometimes obscure and the prophyll is often of similar colour and texture to the bracts and bracteoles. Given the difficulty of interpretation, using bracteoles as a key character for identification may cause confusion and should not be relied on.

The six *tepals* are in two whorls, which often differ in their features. The outer three tepals tend to be somewhat convex and may be cucullate towards the apex, while the inner three tepals are usually more or less flat and are often broader and more obtuse than the outer. For the descriptions, the length of convex tepals is measured *around* the curve. Nearly all tepals begin green but by maturity have usually become straw-coloured (this is, of course, accentuated when dried) or in some species red-brown, rarely so dark as to appear black. Only colour at maturity is given in descriptions.

The loculidial *capsules* are unilocular (e.g. *J. leschenaultii*), 3-locular (e.g. *J. decipiens*) or 3-septate (i.e. incompletely 3-locular; *J. nupela* fide J.F. Veldkamp 1977), with corresponding parietal or axillary placentation (Satake 1933 and references therein). As pointed out by Balslev (1996), the septa (called placentas or partitions by some authors) occasionally develop late, so care is needed in interpreting the structure of immature capsules, especially when dried. In some species, the capsule is 3-locular but with the septa separating near the apex so that it looks 3-septate apically (as discussed and illustrated for *J. confusus* by Catling and Spicer 1987: fig. 7).

*Capsule length* relative to the tepals is characteristic for a species. The *apex of the capsule* is acute to obtuse and mucronate in most species, but in some species in section *Ozophyllum* (notably *J. leptospermus* Buchenau, *J. papillosus* Franch. & Sav., *J. prismatocarpus*, *J. sandwithi* and *J. wallichianus* p.p.) the capsule is elongated into a beak that often much exceeds the tepals.

All Malesian species are wind-pollinated so far as known, except that *J. bufonius* is mostly or possibly exclusively cleistogamous (Buchenau 1906: 27; Knuth 1909; Arber 1925; Snogerup 1985; Keighery 1985, fig. 1). Barros (1953: 286) and Keighery (1985) suggested that species are generally cross-pollinated, owing to flower development being usually protogynous (Müller 1883: 561) but that all are also capable of self-fertilization, particularly through cleistogamy. In practical terms, this can often be

inferred from the presence of old anthers adhering to the old stigmas near the apex of the capsule, the anthers having stuck to the moist papillate stigmas within the closed flower then having been ripped off the filaments by the enlargement of the ovary into the capsule — seen, for example, in *J. capillaceus* (pers. obs.) and noted in *J. bufonius* by Arber (1925: 187).

## The genus *Juncus* in Malesia

### Previous treatment

Backer (1951) recognised four *Juncus* species in Malesia: *J. bufonius* L., *J. effusus* L., *J. inflexus* L. and *J. prismatocarpus* R. Br.

As he noted, *J. bufonius* is probably an adventive species in that region. It is known only from a few disturbed localities on Mt Kinabalu (Borneo) and Mt Santo Tomas (Luzon).

He did not comment on the status of the occurrence of *J. inflexus* in eastern Java, but that is probably also an introduction, since the species has its main native distribution in Europe, northern Africa, southwestern and central Asia (it is sporadically adventive in Australia and New Zealand). He regarded some collections from eastern Java (Tengger and Jang Plateau, 2100–2300 m alt. (Backer 1924)) with continuous pith but otherwise like typical *J. inflexus* as possibly representing the hybrid *J. effusus* × *J. inflexus*, but with doubt since they produced abundant fruit (Backer and Backhuizen f. 1968).

*J. effusus* is a similarly widespread species in Europe, Western Asia and North America, and is also introduced in other parts of the world such as Australia and New Zealand. What Backer regarded as *J. effusus* in Malesia is here separated as *J. decipiens* (Buchenau) Nakai, a species native to continental Asia and Malesia.

Confusion has surrounded the limits of *J. prismatocarpus*, with a wide range of names treated as synonyms or as infraspecific taxa in Asia and Malesia, including at times both unitubulose and pluritubulose taxa, for example in Buchenau (1890, 1906) and Van Royen (1979). We regard *J. prismatocarpus* as a pluritubulose-leaved species restricted to Australia and New Zealand. The Malesian material that Backer put under that name is referable partly to *J. leschenaultii* J. Gay ex Laharpe (with pluritubulose leaves) and partly to *J. wallichianus* Laharpe (with unitubulose leaves). Both species are also in continental Asia. Given the confusion about the limits of *J. prismatocarpus*, a separate discussion of this and morphologically similar species in Malesia and continental Asia follows this Malesian treatment.

More recently, Veldkamp (1977) described a new species from Papua New Guinea, *J. nupela*, and recorded the occurrence of *J. bufonius* on Mt Kinabalu (Veldkamp 1982).

The only known collection of *J. sandwithii* from Papua New Guinea was made in 1974 by J. Croft. Wilson (1986) mentioned the occurrence of the species in that country but without giving any details since the collection was from a non-alpine locality and therefore not the subject of the paper.

### Key to species found in Malesia

Note. The non-Malesian *J. prismatocarpus* is included in the key for ease of comparison. This key is designed to be used with fertile, preferably fruiting, specimens. It is difficult to identify immature specimens of this genus when parts have not reached their maximum size. When bracteoles are present under a flower, the number is

constantly two (see discussion above under **Characteristics**), but this may be difficult to discern in small or dense inflorescences or where there has been abortion of some flowers leaving extra bracts on a branch.

- 1 Leaves flat, canaliculate, terete, or filiform, spread along the culms or all basal (if terete, leaves septate and spread along culms); inflorescence obviously terminal [capsules 1- or 3-locular]
- 2 Leaves neither septate nor loosely pith-filled, flat or slightly canaliculate, mostly basal; auricles absent but often with hyaline margins narrowing abruptly at top of sheath; annuals; flowers subtended by 2 bracteoles; capsule 3-locular ..... **(Section Tenageia) – 4. J. bufonius**
- 2\* Leaves septate (if filiform, septa are not obvious), hollow or with very loose pith between septa, terete or dorsiventrally flattened, spread along culms; auricles present; perennials; flowers not subtended by bracteoles; capsule 1-locular ..... **(Section Ozophyllum)**
- 3 Leaves unitubulose (i.e. with transverse septa only) and/or leaves less than 1 mm in diameter and therefore not easy to determine position of septa
  - 4 Stamens 6; dwarf plants with culms to c. 10 cm long at maturity; leaves more or less filiform, usually less than 1.0 mm diam., with septa usually not obvious; auricles 0.5–0.8 mm long; capsule golden brown, usually much exceeding tepals, with long, tapering beak 0.5–1.3 mm long ..... **1. J. sandwichii**
  - 4\* Stamens 3; plants with culms mostly 30–60 cm long; leaves 1.0–1.4 mm diam., with septa obvious; auricles 0.7–3 mm long; capsule golden brown to red-brown, shortly exceeding or equalling tepals, extending into a shortish beak (0.2–0.5 mm long) ..... **2. J. wallichianus**
- 3\* Leaves pluritubulose, more or less compressed [stamens 3 (rarely 6)]
  - 5 Capsule apex acute to broad-acute, without beak or with short beak to 0.2 mm long; capsule slightly exceeding (to 1 mm) or equalling tepals; upper margins of leaf sheaths more or less narrow (to 0.8 mm wide); culms 1.0–1.5 mm wide ..... **3. J. leschenaultii**
  - 5\* Capsule tapering more or less evenly to long-acuminate apex, with slender beak c. 0.3 mm long; capsule exceeding tepals by 1–3 mm (to twice as long); upper margins of leaf sheaths usually broad (to 1.5 mm wide); culms 1.3–3 mm wide ..... **9. J. prismatocarpus**
- 1\* Leaves reduced to basal sheathing non-septate cataphylls (but pseudo-leaf shoots [= sterile culms] can be long, terete and leaf-like); inflorescence apparently lateral, with the lowest involucre bract well-developed and appearing superficially to be a continuation of the culm; capsules 3-locular or 3-septate [flowers subtended by 2 bracteoles (bracteoles can appear to be more numerous by abortion of lateral flowers, leaving relictual bracts — see text); perennials] ..... **(Section Juncotypus)**
- 6 Culms glaucous, with few (10–22) broad striations, widely spaced (c. 0.2 mm apart) [pith interrupted or rarely continuous] ..... **6. J. inflexus**
- 6\* Culms not glaucous, with 20–c. 50 fine striations or striations not obvious (*J. nupela*), closely packed
  - 7 Culm striations obvious, strongly defined at least on the dried culm surface; tepals 2–4 mm long; stamens 3; capsules 3-locular
  - 8 Culms soft, easy to compress between the fingers; pith continuous; cataphylls dark red-brown at least near base abaxially ..... **5. J. decipiens**
  - 8\* Culms hard to compress between the fingers; pith interrupted; cataphylls dark golden brown abaxially ..... **7. J. durus**
- 7\* Culm striations faint, not clearly defined on culm surface; tepals 5.5–6 mm long; stamens 6; capsules 3-septate [pith continuous; cataphylls dark golden brown] ..... **8. J. nupela**

## Description of species found in Malesia

### *Juncus* L.

(Linnaeus 1753: 325; 1754: 152).

Type: *Juncus acutus* L.; lecto Coville in Britton and Brown (1913: 465).

Perennial or annual herbs. Culms terete or occasionally compressed. Leaves basal or occasionally 1–3 cauline, auriculate (except in reduced leaves and *J. bufonius*); blades flat, terete, channelled, compressed or reduced to a mucro on a sheath (a cataphyll; in sect. *Juncotypus*), internally septate or hollow or filled with loose pith. Lowest 1 or 2 involucre bracts leaf- or culm-like. Flowers bisexual or rarely unisexual (not in Malesia), clustered or solitary, subtended by 1 papery bract and a 2-keeled adaxial prophyll, with or without 2 papery bracteoles (may appear more numerous owing to abortion of lateral flowers). Outer whorl of tepals exceeding to shorter than inner whorl. Stamens 3–6. Capsule loculicidal, 1- or 3-locular or 3-septate. Seeds numerous, occasionally with appendages (not in Malesia). World: c. 300 spp., cosmopolitan. Rushes.

In Malesia: 6 native species (2 endemic), plus 2 introduced species.

#### 1. *Juncus sandwithii* Lourteig

(Lourteig 1968: 44, figs 1E, 3B)

Type: Australia: Tasmania: Arthurs Lake, R. Gunn 1414, 17 Jan 1845; holo P; iso BM (n.v.), C (n.v.), HO, K, L (n.v.), P, S (n.v.), WU (fide J. Kirschner, pers. comm.).

Small, shortly rhizomatous perennial, more or less mat-forming. Culms terete, yellow-green, 1–10(–15) cm long, 0.3–0.8 mm diam. Leaves unitubulose, spread along culms, greater than or equalling or occasionally much exceeding culms (to three times as long), terete, 0.2–0.7(–1.2) mm diam.; auricles c. 0.5 (–0.8) mm long. Inflorescence terminal, 1–2(–9) cm long, diffuse, with flowers clustered or solitary, 2–4(–10) flowers per cluster and 1–4(–6) clusters per inflorescence, with branches to 3.5 cm long; 1 well-developed involucre bract, 0.4–5.0(–15) cm long, lateral, usually equalling to much exceeding inflorescence (occasionally shorter). Flowers without bracteoles. Tepals acute, straw-brown, occasionally red-tinged, usually with broad (c. 0.2 mm wide) hyaline to membranous margins; outer tepals (1.7–)2.0–3.3 mm long, slightly exceeding to slightly shorter than inner tepals. Stamens 6, shorter than outer tepals; anthers (0.4–)0.5–0.7 mm long, shorter than filaments. Capsule 1-locular, usually much exceeding outer tepals, ellipsoid to ovoid, golden brown, acuminate, very long-beaked (0.5–1.3 mm long). Seeds 0.4–0.5 mm long.

**Illustrations:** Fig. 1a, b; also Lourteig (1968: figs 1E, 3B); Wilson et al. (1993: 287).

**Distribution and habitat:** In Malesia, only one record from a swamp-grassland on the SE slopes of Mt Victoria (Papua New Guinea) at 2700 m altitude. It is recorded as growing there at the edge of water in a small stream. Its main distribution is in Australia (New South Wales, Victoria, Tasmania; Lourteig 1968: map 1); from Bald Rock on the Queensland–New South Wales border south, at higher altitudes including subalpine areas, to the Grampians in western Victoria; more widespread in Tasmania.

**Notes:** This dwarf species is distinctive in having the capsule about twice as long as the perianth, with a very long, tapering beak 0.5–1.3 mm long. It previously included the Australian species *J. curtisiae* L.A.S. Johnson, *J. thompsonianus* L. A.S. Johnson and *J. ratkowskyanus* L.A.S. Johnson (Johnson 1991).

The description is based on the full range of variation seen in this species. The flowers of the only New Guinean collection fall at the upper end of the size range, with tepals about 3 mm long, the anthers are about 0.6 mm long and the beak on the capsule about 1 mm long. Its culms are of middling height (3–5 cm) and the leaves exceed the culms by 3–6 cm.

**Selected collections examined: PAPUA NEW GUINEA:** SE end Iusani grassland, SE slopes to Mt Victoria, 2700 m, *J.R. Croft LAE 61840*, 6 July 1974 (A (n.v.), BISH (n.v.), BRI, CANB, E (n.v.), K, L (n.v.), LAE (n.v.), M (n.v.), NSW, US (n.v.)).

**AUSTRALIA: New South Wales:** c. 3.5 km S of Conways Gap, Wadbilliga National Park, *D. Albrecht 1706*, 27 Mar 1985 (MEL, NSW); Gloucester Tops, *R. Coveny s.n.*, 1 Jan 1967 (NSW 94865, P); Corin Dam road, near Kangaroo Creek, *M. Gray 5873*, 18 Jan 1966 (CANB, NSW); Luthers Creek, c. 15 km from Jenolan Caves, Kanangra Boyd National Park, *R. Coveny 17473*, *P. Jobson and M. Muasya*, 11 Jan 1997 (CANB, K, NSW, NY); Diggers Creek, Kosciusko district, *L. Johnson and E. Constable*, 26 Jan 1951 (NSW 19334, P); Prussian Creek, Kosciusko National Park, *J. Thompson 2455 p.p.*, 24 Jan 1976 (AD, BRI, CBG, CHR, HO, K, L, MEL, MO, NSW); NE edge of Bald Rock dome, Bald Rock National Park, *K. Wilson 6962*, 27 Nov 1986 (BRI, HO, NSW).

**Victoria:** Jimmys Creek, Grampians road, *A. Beauglehole 16432*, 12 Dec 1967 (MEL, NSW); Lake Catani, Mt Buffalo National Park, *E. Canning 1789*, 15 Jan 1969 (CANB, NSW); Cumberland Falls road, E of Marysville on Main Divide, *L. Johnson 7671 and A. Johnson*, 24 Apr 1973 (NSW); Upper Delegate River, near Bidwell, *R. Melville 2955*, *N. Wakefield and E. Hunter*, 19 Jan 1953 (K, NSW).

**Tasmania:** Scotts Peak Road E Fawcett Creek, *D. and A. Ratkowsky s.n.*, 25 Feb 1974 (HO, NSW 276209) of Lake Pedder, *W. Curtis s.n.*, 20 Feb 1970 (HO, NSW 276213); Mt Wellington, *D. Ratkowsky JS 111 and A. Ratkowsky*, 4 Jan 1974 (NSW); junction of Scotts Peak road and Condominium Creek, South West National Park, *P. Short 1798*, 21 Jan 1983 (MEL, NSW); Douglas Creek, just N of Arm River Track crossing, Cradle Mtn–Lake St Clair N.P., *K. Wilson 8308 a*, 24 Mar 1992 (HO, MEL, MO, NSW).

## 2. *Juncus wallichianus* Laharpe

(Laharpe 1825: 51 [1827: 139] )

*J. prismatocarpus* [var. *leschenaultii*] subvar.  $\beta$  *unitubulosus* Buchenau (Buchenau 1890: 311).

Type citation: 'envoyé du Napaul, par M. Wallich, à M. le professeur De Candolle'.

Type: Nepal, *Wallich*, 1821; holo LAU?; probable iso G, TI (n.v.), W (hb. Buchenau ex hb. E. Meyer). No number is cited for the Wallich collection but it is apparently a sheet of *Wallich 8999* (accepted as such by Buchenau (1885: 205, 1890: 312, 486) and J.F. Veldkamp, pers. comm.). One sheet is in the general herbarium at G, labelled as 'Herbier de Candolle' and determined by Buchenau in 1884 as '*J. wallichianus* Laharpe specimen authenticum'. Another sheet of this collection is the type of *J. indicus* (q.v. below).

?*J. sinensis* J. Gay ex Laharpe (Laharpe 1825: 49 [1827: 137]). Type citation: 'la Chine (*Staunton*, in herb. Lambert et DC.) et le Japon (*Thunberg* in hb. De Less.) ... (V.s.sp. in herb. DC. et De Lessert.)'. Types: China, *Staunton*; syn G (n.v.), P. Japan, *Thunberg*; syn G (n.v.). We have not seen the syntypes apart from one sheet of *Staunton* in P that is a possible isosyntype, and that is of *J. leschenaultii*. However, from the description, *J. sinensis* seems to fit within *J. wallichianus*, a view supported by its inclusion (with some doubt, owing to the poor specimens) by Buchenau (1906: 182) as a synonym under *J. prismatocarpus* subvar. *unitubulosus*.

*J. monticola* Steud. (Steudel 1855: 301). Type citation: 'Hb. Hohenkr. nr. 951. In montibus Nilagiri Ind. or. (Japon ? Hrbr. *Goering* nr. 136 sect. II).' Type: India: in montibus Nilagiri, *R.F. Hohenacker Pl. Indiae ... 951*, 1851; lecto (*here chosen*) P; isolecto K, L, P, W.

The *Goering* collection is cited in brackets and with a question mark, so it is appropriate to lectotypify the name on the Hohenacker collection. In Steudel's



herbarium in P there are three sheets of that collection and one of the Goering collection. The sheet chosen as lectotype is that fully labelled in Steudel's hand. There are five more sheets of the Hohenacker collection in P that are not identified as being from Steudel's herbarium.

*J. indicus* Royle ex D. Don (Don 1840: 323). Type citation: 'Juncus indicus ... Royle mss.  $\alpha$ . In Nepalia ad Katmandu (Wallich) ... (v.s.sp. in Herb. Wallich ...)'. Type: Nepal, Wallich 8999, 1821; syns G (n.v.), K (3 sheets; one shown on IDC microfiche 7394). Another sheet of this Wallich collection is the type of *J. wallichianus* (q.v. above). Don also cited a Royle specimen but referred it to his var. *nanus* (q.v. below under *J. leschenaultii*). *J. indicus* is often said to have been published in Don (1849: 10) under the wrong date of 1839, which was actually the date on which the paper was read to the Society (Raphael 1970).

*J. koidzumii* Satake (Satake 1936: 89). Type citation: 'Honsyu: Prov. Settu — circa Takarazuka (N. Ui, Aug. 4 1934 — Typus in Herb. Imperial Univ. Tokyo)'. Type: Japan: Honshu: Hyogo Pref., Takarazuka, N. Ui s.n., 4 Aug 1934; holo TI; iso K.

*J. ohwianus* M.T. Kao (in Kao and De Vol 1978: 150, pl. 1303). Type citation: 'Hsinchu: Supachian, Simada 1027 (Type in TAI)'. Type: Taiwan: Sintiki (18 sen[?]), Y. Simada 1027A, 12 Aug 1923; holo TAI.

*J. prismatocarpus* subsp. *teretifolius* K.F. Wu (Wu 1994: 456). Type citation: 'Guandong: Conghua, Sanjiao Shan, satis communis in arenosis et paludibus, 1932-05-31, W.T. Tsang 20636 (holotypus, IBSC)'. Type: China: Guandong (Kwangtung): Sam Kok Shan, Tsungfa-Lungmoon District, Kwangtung, W.T. Tsang 20636, 31 May 1932; holo IBSC (n.v.); iso K. Note that the transliteration of the Chinese ideograms for the locality is very different in 1932 and 1994, but the ideograms themselves are the same on the label and in the publication.

[*J. prismatocarpus* auct. non R. Br.: Backer 1951: 213 p.p.; Larsen 1972: 168, p.p.; Van Royen 1979: 815 p.p.]

Tufted or shortly rhizomatous perennial. Culms terete, ?mid-green, 30–60 cm long, 1.0–1.8 mm diam. Leaves unitubulose, spread along culm, more or less equalling culms, terete, 1.0–1.4 mm diam.; auricles 1.5–2.0 mm long. Inflorescence terminal, 1–12 cm long, diffuse, with flowers clustered, 4–40 per cluster and 6–20 clusters per inflorescence; 1 well-developed involucre bract, 2.5–7 cm long, lateral, shorter than inflorescence. Flowers without bracteoles. Tepals acuminate, the tips spreading to recurved at maturity, straw-brown (often red-tinged at apex) to red-brown, with more or less broad (0.1–0.2 mm wide) hyaline margins; outer tepals (2.3–)2.5–3.5(–3.7) mm long, more or less equalling inner tepals. Stamens 3, shorter than outer tepals; anthers 0.4–0.7 mm long, shorter than filaments. Capsule 1-locular, shortly (occasionally greatly) exceeding or equalling outer tepals, ovoid to narrow-ellipsoid, golden brown to red-brown, acute to broad-acute, with more or less short beak (0.2–0.5 mm long). Seeds 0.6–0.8 mm long.

**Illustrations:** Fig. 1c, d; also Kao and De Vol (1978: pl. 1303, as *J. ohwianus*).

**Distribution and habitat:** In Malesia, at higher altitudes (1500–2900 m) on the islands of New Guinea, Java (West and Central), Sumatra (West; only one collection); also in Sri Lanka, India, Bhutan, Nepal, Thailand, China (Yunnan), and Japan. Recorded also for North Korea, Eastern Manchuria, the Sachalin Islands and the Kuriles by Kitagawa (1979: 163), but we have seen no specimens from these regions. Recorded as growing in swamps and along small streams and ditches. According to Backer (1924: 44; Backer and Bakhuizen f. 1968: 451), '*J. prismatocarpus*' (that is, either *J. leschenaultii* or *J. wallichianus* or both in this context) occurs on the mountains in West, Central and East Java. However, Backer (1951: 214) does not mention East Java for this 'taxon' and

we have not seen specimens of either species from East Java. *J. wallichianus* seems to be more common in Central Java than in West Java and vice versa for *J. leschenaultii*.

**Notes:** Despite having unitubulose leaves, this species has been confused in New Guinea and elsewhere with the more robust, pluritubulose Australasian *J. prismatocarpus*. Buchenau also linked it with the more slender, pluritubulose *J. leschenaultii* as infraspecific taxa together under *J. prismatocarpus*. This species differs from both *J. prismatocarpus* and *J. leschenaultii* in having terete, unitubulose leaves and culms, tepals that are frequently reddish or red-tinged, and a broader capsule. It also differs from *J. leschenaultii* in being generally more robust, and having tepals with broader hyaline margins (especially so in New Guinea), usually broader (1–2 mm wide) yellowish membranous or chartaceous leaf margins (narrower and hyaline or whitish membranous in *J. leschenaultii*), and a capsule that is usually acute to broad-acute, contracting rather abruptly to a shortish beak.

This is a variable species, as currently recognised by us, including several possibly distinct forms in India, Nepal, Yunnan, Java and New Guinea. More material is needed to better assess the extent of this variation. The New Guinea material differs from much of the other material in having the capsule only slightly exceeding the tepals whereas elsewhere it often greatly exceeds the tepals. The New Guinea material has rather broader capsules and tepals 2.5–3 mm long. The Javan material matches material from southern India (equating to *J. monticola* Steud., if that taxon is ever separated from *J. wallichianus*), with the capsule usually exceeding or equalling the tepals, the capsule more or less long-acute, the tepals 3–3.7 mm long and pale. The concept of *J. monticola* has been confused in the literature by some authors who have used the name for a pluritubulose species, for example, Walker (1976) used it instead of *J. wallichianus*, putting the latter into its synonymy.

Satake (in Hara 1966: 403) cited his own species *J. koidzumii* Satake as a synonym of '*J. monticola*'. The type of *J. koidzumii* (seen on loan from TI) fits within the variation that we recognise here within *J. wallichianus*. It is proliferous, but that is not unusual in *J. wallichianus*, which often proliferates from the flower clusters.

**Selected collections examined: SUMATRA:** En route from Simpangtanjungnanempat to Danau (Lake) Talang, Kabupaten Solok, 1650–1740 m, *H. Nagamasu* 3738, 25 Feb 1989 (L).

**JAVA:** Dieng Plateau, *R. Brinkman* 877a, Apr 1938 (L); SE Java, *H. Forbes* 923, 1880–82 (BM, P); Marais de Dieng, 2050 m, *B. Hochreutiner* 2444, 6 Nov 1904 (L); s. loc., *T. Horsfield* 1074, – (BM); Dieng Plateau, Talaga Warna near Sulphur Springs, 2000 m, Central Java, *W. Meijer* 2778, 30 Apr–1 May 1954 (K, L); Res. Priangan, G. Papandajan, 2400 m, *C. van Steenis* 4090, 21 Jan 1930 (K).

**NEW GUINEA: West Papua:** 3225 m camp, Lake Habbema, *L. Brass* 9046, Aug 1939 (BRI, CANB, K, L); Wissel Lake region, 1750 m, *P. Eyma* 4388, 22 Jan 1939 (L); Angi Lakes, 7000 ft [1235 m], *L. Gibbs* 5927, Dec 1913 (BM, K); Arfak, Angigita Lake, 1800 m, Vogelkop, *A. Kostermans* 2209, 9–22 Oct 1948 (L); Baliem–Wamena river valley, N of Mt Trikora, grassland at 3100 m, *J.-F. Mangen* 617, 25 Aug 1983 (L); Anggi Gita Lake, Bivouac Noordpool, 1850 m, *H. Sleumer* BW 14019 and *W. Vink*, 9 Jan 1962 (CANB, L); E foot of Pekeglbaro, Kebo, Wissel Lakes, 1760 m, *W. Vink* BW 8960 and *F. Schram*, 28 May 1960 (CANB, L, LAE).

**Papua New Guinea:** Urunu, Vanapa Valley, *L. Brass* 4804, July–Aug 1933 (BRI); Kosipi, near Waitape, 1860 m, Central Distr., *L. Craven* 2805, 2829, 28 June 1974 (CANB); Lake Inim, 8300 ft [2660 m], *J. Flenley* ANU 2157, Dec 1964 (CANB, L); Ibiwara, Tari Gap, 8400 ft [2700 m], *A. Gillison* NGF 25104, 8 June 1966 (CANB, K, L, LAE (n.v.)), NGF 25169, 17 June 1966 (L, LAE (n.v.)); near Miru ma village, Upper Asaro Valley, c. 1800 m, Goroka Subdistrict, *R. Hoogland* and *R. Pullen* 5394, Jun 1956 (BM, BRI, CANB, K, L, MEL); near Tomba village, S slope of Mt Hagen Range, c. 2650 m, Hagen Subdistrict, *R. Hoogland* 6024 and *R. Pullen*, Aug 1956 (BM, BRI, CANB, L, MEL); along Komum River, E of Korn, Upper Wahgi Valley, c. 1500 m, Hagen Subdistrict, *R. Hoogland* 6244 and *R. Pullen*, Sep 1956 (CANB, L); Sugarloaf complex [along Wapu River], c. 9500 ft [c. 2900 m], Wabag Subdistrict, *R. Hoogland* 7176 and *R. Schodde*, July 1960 (CANB, L); Yobobos grassland area [source

of Lagaip River], Laiagam Subdistrict, *R. Hoogland* 7478 and *R. Schodde*, Aug 1960 (CANB, L, NSW); Mannasat, Cromwell Mtns, Huon Peninsula, Morobe District, *R. Hoogland* 9436, July 1964 (CANB, L); Kosipe Swamp, Wharton Range, 1936 m, Central Prov., *G. Hope* ANU 28035, 28 Dec 1979 (CANB); Manki Trig, Bulolo, Wau Subdistrict, *A. Kairo* NGF 30957 and *H. Streimann*, Dec 1967 (CANB, L, LAE (n.v.)); pass between Mt Ne and Mt Kerewa, 2905 m, Tari Subdistrict, *C. Kalkman* 4843, 11 July 1966 (CANB, K, L, LAE (n.v.)); Korfina, 6700 ft [2050 m], Goroka Subdistrict, *A. Millar* NGF 15947 and *P. Van Royen*, Aug 1963 (CANB, K, L, LAE (n.v.)); near Kusipi, N of Waitape, *K. Paijmans* 710, Aug 1970 (CANB); Ogelbeng–Gumanch road, c. 5000 ft [c. 1500 m], Hagen Subdistrict, *R. Robbins* 86, June 1957 (CANB, LAE, NSW); road above Tomba, 8000 ft [2450 m], Hagen Subdistrict, *R. Robbins* 273, July 1957 (CANB); Tambil, 7500 ft [2300 m], Kaugel Valley, Hagen Subdistrict, *R. Robbins* 379, July 1957 (CANB, L), 391, July 1957 (CANB, NSW); Sirunki, Lake Iviva, Wabag area, 8200 ft [2500 m], *R. Robbins* 3165, 3170, Aug 1960 (CANB); Kandep Valley, 7500 ft [2300 m], 20 miles [32 km] S of Laiagam, Wabag area, *R. Robbins* 3237, Aug 1960 (CANB); Soak Zone, Lake Onim, 2250 m, *A. Vinas* UPNG 2535, 9 Sep 1983 (L); Sirunki, c. 8400 ft [c. 2550 m], *D. Walker* ANU 381, July 1962, ANU 511, Aug 1962 (CANB, L, LAE (n.v.)); Lake Iviva, 8300 ft [2550 m], *J. Womersley* NGF 15295, July 1962 (L, LAE).

**CHINA:** S. Fukien, *H.H. Chung* 1706, 1923 (K); Hong Kong, *U. Faurie* 15823, 19 Mar 1895 (K); Yunnan, Sjemon, W. Mts, 5000 ft [1500 m], *A. Henry* 11920, – (K); Lin Yin Temple, Hang Chow, Chekiang Prov., *E.D. Merrill* 11297, 20 June 1922 (K); Canton, *T. Sampson*, 30 Apr 1884 (K); Haishan, Yuintaishan Ku, *Shantung University Collection*, Aug 1924 (K); Shiuchow Region, Kwong Tung P province, *To Kang P'eng* 2870 and *E.H. Groff*, Apr 1919 (K); Sam Kok Shan (Tsunga-Lungmoon Districts), *W.T. Tsang* 20636, 31 May 1932 (K, P).

**JAPAN:** Sado, *U. Faurie* 1794, 26 Sep 1898 (P); Plaine d'Hakodate, *U. Faurie* 3208, 18 Oct 1887 (K, P), *U. Faurie* 3343, 27 Sep 1888 (K); Hidaka, Fuyushima, Hokkaido, *H. Hara*, 10 Aug 1933 (TI); Aida, Prov. Higo, *K. Mayebar* 2042, 17 July 1927 (TI); Yokohama, Kiusiu, *C. Maximowicz*, *Iter Secundum*, 1863 (K ex LE, 2 sheets (2nd with Yokohama crossed out)); Naruto Shima, Prov. Kazusa, *H. Migo*, 4 July 1932 (TI); Hakodate, Yezo, Hokkaido, *T. Satow* 5311, 1926 (TI); Hyogo Pref., Takarazuka, Honshu, *N. Uii*, 4 Aug 1934 (TI); Kushi-mura, along Henoko River, Kunigami, Okinawa (Ryukyus), *E. Walker et al.* SIRI 6445, 7 Aug 1951 (L); Ikeda, Tokachi, *H. Yotoyama* 3189, 3 Aug 1936 (TI).

**THAILAND:** Chiang Mai: Doi Intanond, alt. 1400–1700 m, *K. Larsen and S. Larsen* 34514, 13 Sep 1974 (AAU (n.v.), P); Om Koi to Om Haet, 1100 m, *B. Hansen* 10857, *G. Seidenfaden and T. Smitinand*, 1964 (AAU (n.v.), L).

**LAOS:** Mau Cay Ep, TourbièreHo Trubach, — 645, 12 May 1967 (P).

**BHUTAN:** Rechi La, 10,000 ft [3050 m], Bhutan, *H.H. Haines* 2025, Sep 1904 (K; 2 sheets; very immature specimen).

**NEPAL:** Descent from Buje Danda to the Tamur River, 2000 m, *Kew–Edinburgh–Kathmandu Expedition* 130, 31 Aug 1989 (K); near Gurjakhani, alt. 8500 ft [2600 m], *Stainton, Sykes and Williams* 3681, 30 July 1954 (P ex BM); Nepal, *N. Wallich* 8999, 1821 (K, 2 sheets — type no. of *J. indicus*); Nepal, *N. Wallich* (W ex LE).

**INDIA:** Pykaia, Nilgiris District, 6000 ft [1830 m], Madras, *J.S. Gamble* 12050, June 1883 (K); Pl. Indiae or. (M. Nilagiri), *R.F. Hohenacker* 951 – *Juncus monticola* Steud. var. *capitulis nudis* (K, L, NSW, P, W); in montibus Nilagiri, Madras, *R.F. Hohenacker* 951a – *Juncus monticola* Steud. var. *capitulis foliolata-proliferis*, 1851 (K, P, W); Sikkim, 9–10,000 ft [2750–3050 m], *J.D. Hooker*, 3 Aug 1849 (K); Khasia, 4–6000 ft [1220–1830 m], *J.D. Hooker and T. Thomson* (K, W); Lailynkat, Khasi Hills, c. 6000 ft [1830 m], Assam, *Thakur Rup Chand* 1819A, 16 July 1949 (L ex MICH); Kodaikanal [Palni Hills – SW Peninsula], 5000 ft [1500 m], *B. Nijalingappa* 36, 30 Dec 1966 (K); Shembaganur, 6000 ft [1830 m], Madras, *A. Saulière* 2, 20 May 1913 (K).

**SRI LANKA:** Horton Plains, stream near Farr Inn, Badulla District, 2300 m, Province of Uva, *D. Clayton* 5518, 27 Jan 1970 (K); Central Province, Horton Plains, 7000 ft [2100 m], *G. Davidse* 7605, 17 Oct 1974 (K); Ceylon, *Gardner* 927 (K, 2 sheets); Ceylon, 6000 ft [1830 m], *Col. Walker* 99, – (K–hb. Hook. 1867).

### 3. *Juncus leschenaultii* J. Gay ex Laharpe

(Laharpe 1825: 49 [1827: 137])

*J. prismatocarpus* var.  $\beta$  *leschenaultii* (Laharpe) Buchenau (Buchenau 1885: 205).  
*J. prismatocarpus* [var.  $\beta$  *leschenaultii*] subvar.  $\alpha$  *pluritubulosus* Buchenau (Buchenau 1890: 311).

Type citation: India: 'Recueillie dans les montagnes de Nelly-gerry (presqu'île occidentale de l'Inde) par M. Leschenault ... (V. s. sp. in herb. Mus. Par).'

Type: India: les montagnes de Nelly-gerry [Nilgiri Mountains], *Leschenault*; holo P; iso K.

?*J. indicus* var.  $\beta$  *nanus* D. Don (Don 1840: 323). Type citation: ' $\beta$  in Emodi montibus ad Mussooree, Royle ... (v.s.sp. ... in Herb. ... Royle).' Type: Nepal, *Royle*; holo LIV? (n.v.); ?iso K. We have not seen the holotype but the probable isotype in K is *J. leschenaultii* (it is labelled as 'NW India, Hb. Royle'). This agrees with Buchenau's opinion (1890: 313; 1906: 181) that this and *J. unibracteatus* were examples of 'subvar. *pluritubulosus*' flowering in the first year of growth. On the other hand, the description suggests that this is possibly a small example of *J. wallichianus*, as implied by Don himself in the protologue in likening it to a small example of *J. indicus*. The holotype needs to be examined to solve this.

?*J. unibracteatus* Griff. (Griffith 1851a: 232; 1851b: pl. CCLXX fig. 8a–e). Type citation: 'Mogur, every where about in the sands of the Brahmaputra. March 29th, 1835.' Type: India, W. Griffith, 29 Mar 1839; holo K? (n.v.). From the description (especially the membranous, hyaline leaf margins), this name may be a synonym of *J. leschenaultii*, as indicated by Buchenau (1906: 181) who placed it as a synonym of *J. prismatocarpus* subvar. *pluritubulosus*. However, the illustrations for this species are on a plate (pl. CCLXX, fig. 8) that mainly shows floral development in another species, *Philydrum lanuginosum*. Figure 8 is a cross-section of an ovule, plus two floral diagrams without captions: the right-hand diagram is triangular in outline with three stamens, while the left-hand diagram has a hexagonal outline and four stamens. The former could refer to a *Juncus* sp. but the other refers to an unknown plant. The type needs to be found and checked to be certain of this synonymy.

*J. leschenaultii* var.  $\beta$  *major* Miq. (Miquel 1867a: 164; also issued as *Prolusio Florae Japonicae*: 328 (1867b)). Type citation: 'Legerunt Siebold et Buerger; similia e Khasia habeo.'

We have not seen either of the Japanese specimens collected by Siebold and Bürger or the Indian specimen (collector unknown) cited by Miquel. However, J.F. Veldkamp has seen the Siebold collection and regards it as satisfactory as a lectotype, which he designates here.

Lectotype (**here designated by J.F. Veldkamp**): *Von Siebold s.n.*; L sheet 904.144-388. Note by Veldkamp: 'This collection was seen by Buchenau on 9 Sep 1883, but the name was not cited, although he did give a reference to Miquel's paper (Buchenau 1890: 310). This name automatically created the autonym 'var. *leschenaultii*', which when the two are regarded as synonymous has priority, hence *J. prismatocarpus* var. *leschenaultii* may be correct.'

*J. leschenaultii* var. *radicans* Franch. & Sav. (Franchet and Savatier 1879: 533). Type citation: 'in uliginosis, circa Yokoska'. Type: Japan: circa Yokoska, *Savatier 1356*; ?holo P. The Savatier sheet in P is annotated as '*Juncus leschenaultii* varietas' (?by Savatier or Franchet) and is a slightly proliferous plant of *J. leschenaultii*. It has been annotated in 1994 by Miyamoto as possibly the type of the varietal name. There are two other sheets of *Savatier 1356* in P but neither is annotated in the same way, nor is the sheet in K.

*J. prismatocarpus* [var. *leschenaultii*] subvar.  $\gamma$  *thermalis* Buchenau (Buchenau 1890: 312). Type citation: 'In den Saanschen heissen Quellen auf Kamschatka; gesammelt von Rieder.' Type: Kamchatka, *J.G. von Rieder*; syn ?E, ?FI, ?LE, ?W (n.v.).

?*J. yakeisidakensis* Satake (Satake 1933: 189, fig. 21). Type citation: 'Honsyu: Mt Yakeisidake, prov. Rikutyu (*H. Iwabuchi*, 1931 — type in Herb. Imperial Univ. Tokyo).' Type: Japan: Mt Yakeisidake, Honshu, *H. Iwabuchi*, 1931; holo TI (n.v.).

*J. latior* Satake (Satake 1936: 90). Type citation: 'Honsyu: Prov. Sagami — circa Zimmuzi (*Y. Momiyama*, Jun. 6, 1929, no. 454 — Typus).' Type: Japan: Zimmuzi, Honshu, *Y. Momiyama* 454, 6 June 1929; holo TI? (n.v.); iso K.

[*J. prismatocarpus* auct. non R. Br.: Backer 1951: 213 p.p.; Larsen 1972: 168; Van Royen 1979: 815; Harriman 1991: 389; Noltie 1994: 254]

Tufted perennial. Culms compressed to more or less terete, ?yellow-green, 8–15(–30) cm long, 0.7–1.5 mm diam. Leaves pluritubulose, spread along culms, shorter than to exceeding culms, compressed to more or less terete, acute to obtuse, 0.7–1.5 mm diam.; auricles to 0.5 mm long. Inflorescence terminal, 1–5 cm long, diffuse, with flowers clustered, 3–8[–20] per cluster and 3–9 clusters per inflorescence, often proliferating; 1 well-developed involucre bract, 1.5–4 cm long, lateral, shorter than or equalling inflorescence. Flowers without bracteoles. Tepals acute to acuminate, the tips spreading to recurved at maturity, straw-brown to slightly red-tinged, with more or less broad hyaline margins; outer tepals 2.8–4.0(–4.5) mm long, more or less equalling inner tepals. Stamens 3 (rarely to 6), shorter than outer tepals; anthers 0.3–0.8 mm long, shorter than filaments. Capsule 1-locular, slightly exceeding (to 1 mm) or occasionally equalling outer tepals, very narrow-ellipsoid to narrow-ovoid, golden brown, acute to broad-acute, not or shortly beaked (to 0.2 mm long). Seeds 0.3–0.4 mm long.

**Illustrations:** Fig. 1e, f; also Backer (1951: fig. 2a); Van Steenis (1972: pl. 24-2); Van Royen (1979: fig. 279); all as *J. prismatocarpus*.

**Distribution and habitat:** In Malesia, in the Cameron Highlands of Peninsular Malaysia and on the islands of Sumatra (North and West), Java (West and Central), Philippines (Luzon and Mindanao) and New Guinea; also from India and Sri Lanka to China, Kamchatka and Japan. Adventive in Mauritius in one area (Coode 1978: 3). In Malesia, only at higher altitudes (1400–3200 m) in swamps and on stream banks. No collections have been seen from Mindanao, but Backer (1951) included this island in its distribution (as *J. prismatocarpus*). According to Backer (1924: 44; Backer and Bakhuizen f. 1968: 451), '*J. prismatocarpus*' (that is, either *J. leschenaultii* or *J. wallichianus* or both, in this context) occurs on the mountains in West, Central and East Java. However, Backer (1951: 214) does not mention East Java for this 'taxon' and we have not seen specimens of either species from East Java. In fact, *J. wallichianus* seems to be more common in Central Java than in West Java and vice versa for *J. leschenaultii*.

The Cameron Highlands records are all relatively recent (1956 and later), but Kern (1958; as *J. prismatocarpus*) argues convincingly that the species is just as likely to be native there as introduced, surmising that the species has spread more widely there since the area has been cleared as a holiday area. This would be similar to the situation with many native *Juncus* species in Australasia, which seem to have spread much more widely thanks to human disturbance in the last two centuries (Johnson 1991).

**Notes:** Plants may proliferate from the flowers, as seen also in *J. wallichianus*; this is illustrated by Van Royen (1979: fig. 279). This species has been confused in Malesia and elsewhere (see, e.g., Backer 1951, Noltie 1994) with *J. prismatocarpus*, which is a more robust pluritubulose species that is confined to Australia and New Zealand.

From its description, *J. yakeisidakensis* Satake is probably a synonym of *J. leschenaultii*. Ohwi (1965: 277) accepted *J. yakeisidakensis* (as '*yakeishidakensis*'). We have not seen the type, but we have seen other collections determined as this species by Satake himself, and they are referable to *J. leschenaultii*.

Most of the collections from the Philippines (e.g. *Merrill 4517*, *Ramos and Edaño BS 40417*, and *Mearns BS 4261*) are very slender and weak, looking like they might have been growing in water. They superficially resemble rather coarse plants of *J. sandwithii* but differ in being proliferous, having pluritubulose leaves (so far as seen in the slender leaves) and in having a much less angled and shorter, broader capsule. The septa are hard to see in the slender leaves and the compressed state is not obvious (in fact, they are terete at the apex), but the presence of longitudinal striations as well as the transverse septa is indicated externally by the more striate appearance of the leaves (at least when dry). In general, the leaves of *J. wallichianus* have a much smoother (less striate) appearance than in *J. leschenaultii* and *J. prismatocarpus*. Duistermaat (manuscript at Leiden; Veldkamp pers. comm.) planned to recognise the slender material as a variety (var. *luzoniensis* [sic] ined.) but that has never been published. In our view this is not justified since the slender Philippines collections are similar to other material of *J. leschenaultii* (see, for example, *Li et al. 1243* from China) and seem to be no more than a montane form of that taxon, and merely show convergent resemblance to *J. sandwithii*.

**Selected collections examined: MALAYSIA: Pahang:** Summit Batu Brinchang, 6660 ft [2030 m], Cameron Highlands, *H.M. Burkill 783*, 1 Sep 1956 (K, L, SING (n.v.)); Break Pressure Tank Hill, 4900 ft [1500 m], Cameron Highlands, *H.M. Burkill 823*, 5 Sep 1956 (K, L, SING (n.v.)); Gunong Brinchang, Cameron Highlands, 6100 ft [1850 m], *M.E.D. Poore 470*, 15 Nov 1960 (K); Gunong Batu Brinchang, 6666 ft [2030m], Cameron Highlands, *J. Sinclair 9935*, 4 Nov 1958 (E (n.v.), K, L, SING (n.v.)).

**SUMATRA:** Hariarapintu, S of Sidikalang, Res. Tapanuli, *A.H.G. Alston 14895*, 28 Mar 1954 (BM); Lalang bench [sic] S of Asahan River, Tapianoeli, *H.H. Bartlett 7771*, 14–27 May 1927 (L, NY ex MICH and US); Gunung Batu Lopang, c. 10 km ESE of Prapat (Lake Toba), 1400–1500 m, *W.J.J.O. de Wilde 13521* and *B.E.E. de Wilde-Duyffes*, 8 July 1972 (K, L); Sibolangit, 1300 m, *J. Loerzing 6020*, 28 Aug 1918 (L); Karo Plateau, Berastagi, 1350–1450 m, *J. Loerzing 15059*, 27 Jan 1929 (K ex BO, L); Alakan Panjang, 5000 ft [1500 m], *C.G. Matthew*, Jan 1914 (K); Danau Kota Baru, N of Bukittinggi, *W. Meijer 5688*, 29 Apr 1957 (L); Pintu Angin above P. Tinggi – Lubuh Selasih, *W. Meijer 6013*, 15 July 1956 (L); Aek Na Oeli, 1200 m, Distr. Prapat, *L. Otto-Surbeck 84*, 31 Jan 1954 (L); Aek Riman, Toba (a stream E of Loemban Lobo), Res. Tapianoeli, *Rahmat Si Boeea 10902*, 13 Nov–14 Dec 1936 (L, NY ex MICH); Toetoeapan, Res. Tapianoeli, Subdiv. Toba, Distr. Toetoeapan, *Rahmat Si Boeea 6000*, 4–11 Nov 1933 (L); Berastagi Marsh, *H.N. Ridley*, 8 Feb 1921 (K); by the hot sulphurous stream from volcano Sibayak Berastagi, *H.N. Ridley*, 11 Feb 1921 (K).

**JAVA:** Gunung Patoeha, 2200–2300 m, *C. Backer 12653*, 26 Mar 1914 (L); Ondern. Tjigoea, Beuzenbo ['Preanger boven' was intended here, fide J.F. Veldkamp] Tji Reunghas, *C. Backer 15114*, 1914 (K, L ex BO); Garoet, *W. Burck 32*, 20 June 1891 (K ex BO); Java, *H. Forbes 923*, 1880–82 (L); Java, *F. Junghuhn 496*, – (L); Res. Priangan, Gunung Papandajan, Tegal Pandjang, 2041 m, *C. van Steenis 4258*, 29 Mar 1930 (L); Res. Priangan, G. Papandajan, 2400 m, *C. van Steenis 4100*, 21 Jan 1930 (L).

**NEW GUINEA: West Papua:** Camp V1b (Utakwa Expedition to Mt Carstensz), *C. Boden-Kloss s.n.*, 9 Jan 1913 (BM, K); 9 km NE of Lake Habbema, *L. Brass 10737*, Oct 1938 (BRI, L); Wissel Lake region, Ekkadide–Koempa in Arandora, *P. Eyma 4579*, 23 Feb 1939 (K, L); Wolo, *J. Raynal 17055*, 9 Apr 1973 (L); Vogelkop Peninsula, Arfak Mtns, Anggi Gigi Lake, Soere rei village, 1920 m, *H. Sleumer BW 4363* and *W. Vink*, 21 Jan 1962 (K, L); Wissel Lake region, A rupa, c. 1750 m, *C. Versteegh BW 3047*, 23 Mar 1955 (BRI, CANB ex LAE, K, L, NSW); Enarotali, Wissel Lakes, 1760 m, *W. Vink BW 8587* and *F. Schram*, 12 May 1960 (CANB, L, LAE).

**Papua New Guinea:** Marafunga, c. 20 miles [32 km] NW of Goroka, E Highlands, *T. Hartley 13242*, 11 Oct 1964 (CANB, K, L, LAE (n.v.)); Suongot near Telefomin, 5500 ft [1670 m], Sepik District, *E. Henty NGF 20875*, 10 Jan 1965 (BRI, CANB, L, LAE (n.v.)); near Miruma village, Upper Asaro Valley, c. 1900 m, Goroka Subdistrict, E Highlands, *R. Hoogland 5392* and *R. Pullen*, June 1956 (A, BM, BRI, CANB, G, K, L, LAE (n.v.), MEL, NSW); near Poio village, middle Tale Valley, c. 7000

ft [c. 2100 m], Wabag Subdistrict, *R. Hoogland 6767* and *R. Schodde*, 25 Jun 1960 (CANB); Sugarloaf Complex (along Wapu River), Wabag Subdistrict, *R. Hoogland 7177* and *R. Schodde*, 20 Jul 1960 (A, BH (n.v.), CANB, L, LAE (n.v.)); Tigibi, 1600 m, Tari Subdistrict, *C. Kalkman 5225*, 30 Aug 1966 (L); Telabo area, Haibuga Marsh, 5200 ft [1580 m], Tari Subdistrict, *J.M. Powell UPNG 2460*, 20 June 1972 (CANB, UPNG (n.v.)); road above Tomba, 8000 ft [2400 m], Hagen Subdistrict, *R. Robbins 280*, 6 Jul 1957 (CANB, L, LAE (n.v.), NSW); near Ebenda, Anga Valley, c. 6500 ft [c. 2000 m], S Highlands District, *R. Schodde 1646*, 28 Jul 1961 (A, BM, CANB, K, L, LAE (n.v.)); Mt Giluwe, above Klareg, c. 8800 ft [c. 2670 m], S Highlands District, *R. Schodde 2056*, 30 Aug 1961 (A, CANB, L, LAE (n.v.)); Mt Giluwe, c. 9700 ft [c. 2950 m], S Highlands District, *R. Schodde 2007*, 25 Aug 1961 (A, BM, BRI, CANB, L, LAE, MEL); Guru nigl, 1970 m, Simbu Prov., Gembogl Subprov., *J. Sterly 1645*, 29 Sep 1983 (L); Mt Kerigomna, 3180 m, Goroka Subdistrict, E Highlands, *P. Stevens LAE 54657* and *P. Grubb*, 24 Jun 1971 (CANB, L, LAE (n.v.)); Sirunke, inflow stream to Lake Iviva, c. 8300 ft [c. 2550 m], *D. Walker ANU 616*, 28 Aug 1962 (CANB, L, LAE (n.v.)); 12 miles [19 km] N of Wabag, 7000 ft [2100 m], *J. Womersley NGF 11 2 0 3*, Jul 1959 (BRI, K, L, LAE (n.v.), NSW).

**PHILIPPINES: Luzon:** Pauai, Benguet Prov., *M. Mearns BS 4261*, July 1907 (L, 2 sheets); 'Haights in the Oaks' (7000 ft [2130m]), Benguet, Luzon, *M. Mearns BS 4261*, July 1907 (NY); Pagio, Benguet, *A. Lohrer*, – (K); Mt Data, Lepanto District, *E.D. Merrill 4517*, Nov 1905 (K, L, NSW, NY, P); Panai, Benguet Province, *E.D. Merrill 4739*, Oct–Nov 1905 (K, NY); Mt Natoo, Benguet Sub-province, *M. Ramos and G. Edaña BS 40417*, Sep 1921 (K, L, P); Baguio, Benguet, *R.S. Williams 1974 bis*, 5 Oct 1904 (NY).

**TAIWAN:** In sulfuris Hokuto, Formosa, *U. Faurie 150*, Sep 1914 (P); Lu-su-tann, near Kan-kou to Msiao-ko-tou, 600–400 m, Taipei Co., *Chien-chang Hsu 5333*, 11 May 1969 (TAI); Chu-chih, Taipei, *M.T. Kao 9751*, 23 May 1982 (TAI); Prov. Taihoku, Mt Schchiseizan, *J. Ohwi 2040*, May 1933 (K); Formosa, *R. Oldham 579*, 1864 (K, P); Fuhsing, Taoyuan Co., *Yang 2680*, 10 May 1979 (TAI).

**CHINA:** Chiu Hua Shan, Anhwei Province, *R.C. Ching 8482*, 28 June 1925 (K); Yenping: Cha-ping, 730 m, Fukien, *H.H. Chung 2836*, 31 July 1924 (K); marshy meadows in the Mingkwong Valley, 7000 ft [2130 m], *G. Forrest 8453*, June 1912 (K); Patung district, *A. Henry 2471*, 1887 (K, P); Ma Liu Shui Hill, Hong Kong, *Shiu Ying Hu 11577*, 29 Feb 1972 (K); Tai Hon, Hainan, *F.A. McClure CCC 9224*, 21 Apr 1922 (K, P); Pakhoi, South China, *G.M.H. Playfair 50*, Apr 1883 (K); Fang Shan, Nanking, Kiangsu Province, *A.N. Steward 2102*, 3 June 1922 (K); Pin Shan Shue, Fung Muk Shan (Taam Chau District), Hainan, *W.T. Tsang 217 u.u.*, 16962, 3 May 1928 (K); Naam Kwan Shan (Tsengshing District), Kwangtung, *W.T. Tsang 20071*, 3 Apr 1932 (K, TI); Tai-po, Hong Kong New Territories, *M.M. Whiting 251* and *K.J. Stewart*, 12 Mar 1935 (K).

**KOREA:** Ouen-san, *U. Faurie 896*, Aug 1901 (P); Quelpaert [Island = Cheju-Do], *E. E. Taquet 1861*, 9 Nov 1908 (K), *E. E. Taquet 1869*, 12 Aug 1908 (K); Tsu-sima Island, St. of Corea, *C. Wilford 809*, May 1859 (K).

**RUSSIA: Kamchatka** : Peninsula Kamczatka, *V.L. Komarov Iter Kamczaticum I*, 25 Aug 1908 (K, P); Syd – Kamtchatka – the hot springs at Sikir River, 29.5 m, *E. Hultén 3046*, 5 Sep 1921 (K).

**JAPAN:** Yokohama, *J. Bisset 407*, June 1876 (K); Ile de Sado, *U. Faurie 1794*, 26 July 1898 (K), 1795 (P); Miyagi Pref., (Pro v. Kikuzen), Mt Kurikoma, Honshu, *H. Kiriyaama 17*, 9 July 1932 (TI); Kiusiu, Ko-isi-wara, *C. Maximowicz, Iter Secundum*, 1863 (K, P ex LE); Kawamura, Prov. Higo, *K. Mayebara 2048*, 30 May 1926 (TI); Fukushima Pref., Ozegahara, Shimotashiro, *M. Mizushima*, 15 July 1950 (TI); Narutoshima, Prov. Kayusa, *H. Migo*, 4 July 1932 (TI); between Kuji and Kudadon, alt. 10 m, Amami-ohshima, Ryukyus, *Noguchi 3461*, 25 Jan 1957 (L); Doai in Kotsuke, Hondo, *J. Ohwi and T. Koyama NSM 310*, 24 Aug 1951 (K, L, NSW, TI); Nagasaki, *R. Oldham 897*, June 1862 (K, P); Okinawa, *Sonohara et al. SIRI 6271* (L, 2 sheets); Yokoska, *P. Savatier 1356*, 1866–74 (K, P); Iwakura, north of Kyoto, Pref. Kyoto, *M. Tagawa 3228*, 22 May 1950 (TI); Loo-Choo Islands, Ryukyus, *C. Wright 329*, 1853–56 (K).

**VIETNAM:** Pro v. Kon Tum, District Dak Gley, c. 12 km to N of Dak Gley town (24 km by road), near Mang Khen village, 1100–1200 m alt., *L. Averyanov et al. VH1791*, 17 Nov 1995 (P); Hanoi, *B. Balansa 2829*, 29 May 1886 (K, P).

**CAMBODIA:** Mont de l'Eléphant, *E. Poilane 23114*, 5 Dec 1933 (K ex P).

**THAILAND:** Chiang Mai; Doi Intanon, alt. 1400–1700 m, *K. Larsen and S. Larsen 34513*, 13 Sep 1974 (AAU (n.v.), P); 5 km W of Bo Luang, 1100 m, *B. Hansen, G. Seidenfaden and T. Smitinand 10967*,



**Fig. 2.** *Juncus bufonius*: **a**, habit; **b**, flower (from M.D. Tindale (NSW 18459)). *J. decipiens* subsp. *medianus*: **c**, inflorescence; **d**, flower (from L.A.S. Johnson (NSW 75499)). *J. inflexus*: **e**, inflorescence; **f**, flower (from D.E. Albrecht 1594 (NSW)). *J. durus*: **g**, inflorescence; **h**, flower (from R.D. Hoogland 7595 and R. Schodde (NSW)). *J. nupela*: **i**, inflorescence; **j**, flower (from J.F. Veldkamp 6369 (NSW)). Scale bar = 6 cm (a), = 3.5 mm (b, d, f, h, j), = 4 cm (c, e, g, i).



29 Jan 1964 (AAU (n.v.), K); Ban Pong Yeng, 750 m, *A. Kerr* 3587, 1 Apr 1915 (BM, K, L); Doi Intanon, 2100 m, *T. Sorenson* 3316, *K. Larsen and B. Hansen*, 9 May 1958 (AAU (n.v.), L, P); env. Ban Pha Mon (Chom Thong), Prov. Chiang Mai, 900 m, *J. Vidal, Y. Vidal and C. Niyomdham* 6254, 31 May 1979 (P).

**LAOS:** Entre Tafa et Ban Hosei Sai, *E. Poilane* 24425, 4 June 1936 (K ex P).

**BURMA:** Birma [sic], *Hb. Griffith* 5460, – (K – hb. of late East India Company no. 5460; distributed at Kew 1863–64).

**BHUTAN:** Bootan [sic], *Hb. Griffith* 5459, — (K; distributed by K 1863–4).

**NEPAL:** Above Sukhet village 6 miles [10 km] NW Pokhara, 3600 ft, *Sir Colville Barclay* 2201 and *P.M. Synge*, 22 May 1971 (K).

**INDIA:** Sowra, Khasia, 4000 ft [1220 m], *C.B. Clarke* 15163, 26 Nov 1871 (K); Mt Bani (main coast range c. 25 km from Tourane), Annam, *M. S. Clemens* 4076, May–July 1927 (P); forest by Pamba Reservoir, 1100 m, Prov. Quilon, Kerala State, *C.D.K. Cook* 199, *E.M. Rix and J. Schneller*, 11 Sep 1973 (K); Sikkim, 8–10,000 ft [2450–3050 m], *J.D. Hooker and T. Thomson*, – (K, L); Panchaki, Chota Nagpur, 2600 ft [790 m], Jashpur State, *H.F. Mooney* 2216, 9 May 1943 (K); Kamaleswarpur, Mainpat, 3600 ft [1100 m], Surguja State, *H.F. Mooney* 2228, 5 June 1943 (K); Kasipur, S. Kalahandi, 2900 ft [880 m], Orissa, *H.F. Mooney* 3242, 26 Jan 1949 (K); Shillong Lake, Assam, *G. Panigrahi* 3925, 20 May 1957 (L); near Uchangi, Hassan District, Mysore, *T.P. Ramamoorthy HFP* 1294, 26 Jan 1971 (K, P); NW India, *Hb. Royle*, – (K – hb. Hook. 1867); Nilghiris, *Schmidt* 51, – (K); Shillong, Khasi Hills, 5500 ft [1670 m], Assam, *Thakur Rup Chand* 7546, 15 Apr 1954 (L ex MICH).

**SRI LANKA:** Ascent to Horton Plains, Nuwara Eliya District, 2000 m, *M. Jayasuriya* 184 and *L.C. Wheeler*, 20 May 1971 (K ex US); Tothulagalle Estate above Haputale, 1600 m, *A. Kostermans* 23383A, 7 May 1969 (L); Kandy District, Central Province, Knuckles Range (Wet Zone Highlands), 1815 m, *M. Lazarides* 7203, 3 Sep 1970 (K ex CANB, US (n.v.)); c. 2 miles [3 km] from Rasagulla, Patnapura district, Sabaragamuwa Prov., *S. Sohmer and S. Waas* 10497, 9 Nov 1975 (P); s. loc., *Thwaites* CV844, – (K, P); Enselwatte, Matara District, Southern Province, c. 1000 m, *S. Waas* 1487, 14 Feb 1976 (K).

**\*MAURITIUS:** Le Pétrin, 650 m, *K. Lye* 5979, 13 Apr 1971 (K).

#### 4. *Juncus bufonius* L. sens. lat.

(Linnaeus 1753: 328)

Type: Europe, *Herb. Van Royen s.n., L sheet* 904, 145–433; lecto (Cope and Stace 1978: 121) L (image on Leiden website (through <http://nhncml.leidenuniv.nl/rhb/#collection>) and microfiche IDC BT-341).

*J. plebeius* R. Br. (Brown 1810: 259). Type: Australia: New South Wales: Port Jackson, *R. Brown (Bennett)* 5783, 1803; holo BM, photo NSW; iso BRI.

Tufted annual. Culms terete, pale yellow-green, 2–20(–40) cm long, 0.4–1.0(–2.0) mm diam. Leaves basal and cauline, shorter than culms, flat or slightly canaliculate, 0.2–1.2 mm wide; auricles absent; sheaths pale yellow or occasionally red-brown. Inflorescence terminal, 2–25 cm long (often much longer than culm), diffuse, with flowers solitary or clustered (2–4 per cluster), 4–60 flowers per inflorescence; 1 or occasionally 2 well-developed involucre bracts, 2.5–7 cm long, lateral, generally shorter than or equalling inflorescence. Flowers with 2 bracteoles. Tepals straw-brown, occasionally with red-brown bands beside midrib, with broad hyaline margins; outer tepals 4.0–9(–12) mm long, much exceeding inner, long-acuminate, often excurved; inner tepals acute, erect. Stamens 3 (–4–6), shorter than outer tepals; anthers (0.2–)0.5–1.0 mm long, shorter than or equalling filament length or occasionally (as in Sabah, fide J.-F. Veldkamp) to 1.8 times as long as filaments. Capsule 3-locular, shorter than inner tepals, obovoid to narrow-ellipsoid, straw-brown to dark red-brown, obtuse to acute, umbonate to shortly beaked (to 0.2 mm long). Seeds 0.3–0.5 mm long.

**Illustrations:** Fig. 2a, b; also Podlech (1979: fig. 203a, b); Snogerup (1985: fig. 1(22); Keighery (1985: fig. 1); Brooks and Kuhn (1986: figs 22, 23); Balslev (1996: fig. 11E, F [SEM of seed], fig. 38F, G); Wilson et al. (1993: 274).

**Anatomy illustrated:** Buchenau (1890: pl. 2, fig. 3, pl. 3, fig. 5); Cutler (1969: fig. 2A–D; Fernández-Carvajal (1982b: figs 67–71).

**Distribution and habitat:** Most probably adventive in the Philippines, where it is only known from Mt Santo Tomas on Luzon, at 1900 m altitude, along bridle-trails in mossy forests (Backer 1951). Also recorded from Mt Kinabalu (Borneo), where it is most probably also adventive, growing at 3500 m altitude in cleared areas beside huts. Now a cosmopolitan weed, but probably originally native to Europe, the Mediterranean region, temperate Asia and perhaps eastern North America (Cope and Stace 1978).

**Notes:** The above description is based on the full range of variation seen in this very variable, cosmopolitan taxon. The plants are often up to about 30 cm high, the inflorescence being about  $\frac{3}{4}$  of this height, as in the Sabah specimens. The Philippines collection fits well within this range, but the Sabah specimens are extreme in having strongly excurved tepals 6–12 mm long (some to 20 mm fide Veldkamp), and anthers 0.6–1.8 times as long as filaments (Veldkamp 1982 and pers. comm.). The extremely long tepals result from the tendency to proliferation and the ‘conversion’ of the tepals into a more leaf-like form as in, for example, a few Australian collections that we have seen (e.g. *F. Rodway s.n.*, Nowra, Sep 1929 (K)). This extreme morphology may result from isolation and enforced inbreeding instead of facultative inbreeding. As described by Veldkamp, these plants may become prostrate and proliferate at the nodes. Cope and Stace (1978) found that proliferation could be induced by crowding in experimental populations, although not found by them in the wild.

Various forms have been recognised at infraspecific or specific level, in part based on ploidy level (Cope and Stace 1978, 1983, 1985; Snogerup 1971, 1985). However, there is not a wholly satisfactory treatment as yet, perhaps because it has been spread so widely around the world, making it difficult to distinguish native from naturalised forms and occurrences. Thus, even though the Sabah specimens are morphologically extreme, neither J.F. Veldkamp (pers. comm.) nor we have considered it appropriate to describe the Sabah variation under a formal name at this time.

The species is often (?usually) cleistogamous (Buchenau 1906: 27; Knuth 1909; Snogerup 1985; Keighery 1985: fig. 1), with its stamens, stigmas and styles seldom exposed. Müller (1883) quoted studies suggesting that it was cleistogamous in Russia but in Germany was generally out-breeding, with some terminal cleistogamous flowers in an inflorescence. Arber (1925) considered it to be always cleistogamous. Cope and Stace (1985) suggested that it tends more to cleistogamy in colder regions.

**Collections examined: BORNEO: Sabah:** Between Carson’s Camp and Panalaban, 2700–3400 m, *M. Hotta* 3905, 16 Jan 1969 (L ex KYO (n.v.)); southern slope of Mt Kinabalu, 11,000 ft [3500 m], *J.M.B. Smith s.n.*, 12 Aug 1967 (K); Panar Laban ‘old’ huts, 3300 m, *J.M.B. Smith* 464, 28 Jul 1978 (L ex KLU (n.v.)); Sayat-Sayat Hut, 3760 m, *J.M.B. Smith* 520, 29 Jul 1978 (L ex KLU (n.v.)).

**PHILIPPINES: Luzon:** Mt Santo Tomas, Benguet Subprovince, Luzon, *E.D. Merrill* 7794, May 1911 (BM, K).

## 5. *Juncus decipiens* (Buchenau) Nakai

(Nakai 1928: 35).

*J. effusus* var. *decipiens* Buchenau (Buchenau 1890: 229). Type citation: ‘Japan (prope Yokohama, Nagasaki et Hakodate leg. cel. C.J. Maximowicz; Yokoska, Nippon; Savatier, 1353 (!; forma intermedia).’

Types: Japan: Yokohama, C. Maximowicz, *Iter Secundum*; syn ?LE, ?W (n.v.). Nagasaki, C. Maximowicz, *Iter Secundum*, 1863; syn K, L (2 sheets), ?LE, P, ?W (n.v.). Hakodate, C. Maximowicz, *Iter Secundum*; syn ?LE, ?W (n.v.). Yokoska, P. Savatier 1353, P, ?W (n.v.).

A specimen of Maximowicz annotated by Buchenau should be chosen as lectotype since Buchenau clearly indicated in two places in the text that he considered the Savatier specimen to be intermediate between *J. decipiens* and *J. effusus* sens. strict., that is, not typical. Duplicates of the Nagasaki collection, made in 1863 by Maximowicz, are held in L (L sheet 904,130-575 ex LE) and P but they are not annotated by Buchenau.

Nakai's paper is written completely in Japanese (including page numbers) except for the title, photograph captions and plant names. It does not give any indication of basionym for *J. decipiens* Nakai, which is not surprising given that it is an ecological paper. The combination is valid despite this, since the rules about citing basionyms only apply from January 1953 (ICBN Article 33.2).

[*J. effusus* auct. non L.: Backer 1951: 211]

Shortly rhizomatous perennial. Culms terete, soft, mid-green, 20–120 cm long, 1.1–2.2(–3.0) mm diam.; striations 20–50; pith continuous, very loose. Sterile leaf-like culms present but real leaves reduced to cataphylls 3–19 cm long, more or less tightly clasping the culm, abaxially pale straw-coloured above to darkish red-brown at least at base, shining towards base but more or less dull above, adaxially whitish with a pearly sheen. Inflorescence 2–9 cm long, diffuse, with numerous solitary flowers; lowest involucre bract 5–35 cm long, apparently continuous with culm, exceeding inflorescence. Flowers with 2 bracteoles. Tepals acuminate to acute, straw-coloured, often with a dark red-brown stripe on each side of midrib, with narrow to more or less broad hyaline margins; outer tepals 1.7–4.0(–4.5?) mm long, greater than or equalling inner tepals. Stamens 3, shorter than outer tepals; anthers 0.3–0.8 mm long, shorter than to exceeding filament length. Capsule 3-locular, slightly shorter than to slightly exceeding outer tepals, narrow-ellipsoid to ovoid or occasionally obovoid, golden brown to very dark red-brown, obtuse, not or scarcely beaked. Seeds 0.4–0.6 mm long.

**Distribution and habitat:** In Malesia: in Peninsular Malaysia and on the islands of Sumatra (Aceh province), Java, Borneo (Sabah), Philippines (Luzon and Mindanao), and New Guinea. Also in eastern Asia: Japan, China, Taiwan, Korea, Thailand, and eastern India (Assam). Found in wet places, at higher altitudes in the tropical areas: in Malesia from 1400 to 3300 m. As pointed out by Hämet-Ahti (1980), this species does not occur in North America; what has been identified there as *J. decipiens* are slender collections of *J. pylaei* Laharpe.

**Notes:** This species is similar to *J. effusus* sens. strict., with continuous, loose pith in the culms. It differs in having slightly more close-packed /dense pith than in *J. effusus*, and in being generally more slender than that species. The cataphylls have shining surfaces abaxially in *J. decipiens*, at least at the base and are adaxially whitish with a pearly sheen (dull abaxially, and adaxially golden to copper-coloured in *J. effusus*). *J. decipiens* has 20–50 striations around the circumference of the culms while *J. effusus* has 35–65 striations. *J. decipiens* differs from *J. inflexus* in having non-glaucous culms with continuous pith and more closely packed culm striations.

Three intergrading subspecies are here recognised. The type subspecies is found in eastern Asia (eastern India, China, Korea, Japan, Thailand) and possibly in Peninsular Malaysia (one incomplete specimen seen), the other two are in other parts of Malesia (Philippines, Borneo, New Guinea, Java and Sumatra) and subsp. *medianus* is also in Taiwan. The subspecies can be keyed out as follows:

- 1 Tepals 1.7–3.0 mm long, straw-coloured, occasionally with red-brown bands beside the midrib; capsule golden brown to red-brown; cataphylls straw-coloured for  $\frac{1}{4}$ – $\frac{3}{4}$  of their length, red-brown only near the base
- 2 Tepals 1.7–2.2 mm long; capsule golden to dark golden brown; cataphylls straw-coloured for upper  $\frac{1}{2}$ – $\frac{3}{4}$  of their length. (Eastern Asia, ?Peninsular Malaysia) ..... **subsp. decipiens**
- 2\* Tepals 2.1–3.1 mm long; capsule dark golden brown to red-brown; cataphylls straw-coloured for upper  $\frac{1}{4}$ – $\frac{1}{2}$  of their length. (Taiwan, Philippines, Borneo, Java, New Guinea) ..... **subsp. medianus**
- 1\* Tepals 3.0–4.0(?–4.5) mm long, straw-coloured with dark red-brown bands beside midrib; capsule very dark red-brown; cataphylls straw-coloured in upper  $\frac{1}{4}$ – $\frac{1}{3}$  but usually red-brown for rest of their length. (Sumatra) ..... **subsp. sundaicus**

### J. decipiens subsp. decipiens

Culms 30–80 cm long, 1.0–2.0 mm diam.; striations c. 20–50. Cataphylls 8–16 cm long, abaxially straw-coloured for  $\frac{1}{2}$ – $\frac{3}{4}$  of their length above to red-brown at base. Inflorescence 2–3 cm long; lowest involucral bract 8–20 cm long. Tepals acuminate to acute, straw-coloured, with more or less broad hyaline margins; outer tepals 1.9–2.2 mm long. Anthers 0.3–0.5 mm long, shorter than filament length. Capsule slightly exceeding to equalling outer tepals, narrow-ellipsoid to ovoid, golden brown to dark golden brown, umbonate. Seeds 0.4–0.5 mm long.

Illustrations: Makino (1964: 821, 822, as *J. effusus* var. *decipiens* and forma *utilis* respectively); Kao and De Vol (1978: pl. 302, as *J. effusus* var. *decipiens*).

Distribution: Eastern Asia (Thailand, eastern India, China, Korea, Japan). It is possibly in the Cameron Highlands of Peninsular Malaysia, but only one incomplete specimen (*Sinclair* 4956) purportedly from there has been seen. It is known only from a couple of higher altitude localities in northern Thailand (Larsen 1972).

Notes: This has usually been treated in Asian Floras as *J. effusus* var. *decipiens*, for example, in Ohwi (1965: 275) and Kao and De Vol (1978).

This typical subspecies has shorter tepals than the other two subspecies, lacks red coloration on the capsule, and has less red coloration on the external (abaxial) surface of the cataphylls than in the other subspecies. It is used for making tatami mats in Japan and also as a source of medicinal drugs in China and Malaysia (Walker 1976: 302; Burkill 1935: 1272). In Malaysia, Burkill (1935) regarded material of this species as being imported from China by merchants.

**Selected collections examined: ?MALAYSIA:** Cameron Highlands, *Sinclair* 4956, – (L).

**CHINA:** Hong Kong, Tai Mo Shan Peak, *Shiu Ying Hu* 7607, 17 May 1969 (K); Flora of Chumbi, Too-li-la, *Dr King's Collector* 607, 28 May 1884 (MEL); near the White Cloud Monastery, Canton, *T. Sampson* 843, 4 May 1879 (MEL); Din Shum Tso, P'ing T'ou Shan, T'ang Wan Village, Hunan, *W.T. Tsang* 23609, 17–30 Apr 1934 (NSW); Tsun-Wan, New Territory, *W.T. Tsang* 29767, 29 Apr 1940 (UC).

**JAPAN:** Hakodate, *O. Menzel*, 1861 (NSW 451169); Honshu, Yamanashi Pref., Uchino-mura, Minamitsuru-gun, 950 m alt., *M. Togashi* 38, 29 July 1985 (K ex TNS); Honshu, Mt Zaozan in Echigo, *M. Togashi* TNS 1757, 13 June 1958 (K, NSW, P ex TNS); Simoda, *Tolkien*, – (MEL ex LE).

**KOREA:** Quelpaert, *U. Faurie* 2246, Aug 1907 (P); ?loc., *Gilbert*, 1903 (UC); c. 1000 yards [1 km] S of Imjan River, *J. Smail*, 3–4 June 1952 (NSW 451168).

**THAILAND:** Doi Ngao Ng Chen, c. 1200 m, *A.F.G. Kerr* 5438, 13 May 1921 (BM, K, L); Doi Pakom Pok, Ng Fang, c. 1600 m, *A.F.G. Kerr* 5185, 2 Apr 1921 (BM, K, L).

**LAOS:** Muang Cha, Chingkwang, c. 1100 m, *A.F.G. Kerr* 20989, 9 Apr 1932 (BM, K); Phou San, Prov. Xieng Khiuang, *J. Vidal* 1584, 8 Apr 1952 (P).

**INDIA:** Cherrapunjee, Khasi Hills, 4000 ft [1220 m], *Thakur Rup Chand* 5500, 28 Apr 1952 (L).

**J. decipiens subsp. medianus** L.A.S. Johnson et K.L. Wilson, **subsp. nov.**

Inter ambas subspecies ceteras intermedius ut videtur; a subspecie typica tepalis longioribus, cataphyllis rufioribus differt; a subspecie *sundaica* tepalis brevioribus, cataphyllis distaliter stramineis non nisi basi rufis, differt.

Type: Papua New Guinea: J. Leahey's mill site, Goroka Subdistrict, 7,300 ft [2200 m], A.G. Floyd and J.S. Womersley 6297, 18 Nov 1954; holotype NSW; isotypes CANB, K, L, LAE.

Culms 25–120 cm long, 1.1–2.5(–3.0) mm diam.; striations 23–47. Cataphylls 3–19 cm long, abaxially straw-coloured or pale red-brown for  $\frac{1}{4}$ – $\frac{1}{2}$  of its length grading to red-brown or dark red-brown towards base. Inflorescence 2–9 cm long; lowest involucre bract 9–35 cm long. Tepals acute to acuminate, straw-coloured, often with darker yellow-brown or red-brown band on each side of midrib, with broad hyaline margins; outer tepals 2.1–2.7(–3.1) mm long. Anthers 0.4–0.8 mm long, shorter than to exceeding filament length. Capsule slightly shorter than to slightly exceeding outer tepals, ellipsoid to oblong or ovoid, dark golden brown to red-brown, umbonate. Seeds 0.4–0.5 mm long.

**Illustrations:** Fig. 2c, d; also Backer (1951: fig. 1); Kao and De Vol (1978) (as *J. effusus* var. *decipiens*); Van Steenis (1972: pl. 24-3).

**Distribution:** In Malesia found at higher altitudes (1,200–3,000 m) on the islands of New Guinea (West Papua and Papua New Guinea), Philippines (Luzon and Mindanao), Borneo (only Mt Kinabalu so far as known), Java (West and Central); also in Taiwan.

**Notes:** The epithet is taken from the Latin *medius* (neo-Latin *medianus*), the middle [adjective]; referring to the apparently intermediate position of this taxon morphologically between the type subspecies and subsp. *sundaicus*. For example, the tepals of subsp. *medianus* are intermediate in length between those of the other subspecies, although the hyaline to membranous tepal margins differ in being usually slightly broader (to 0.2 mm wide) than in either other subspecies. The cataphylls are also intermediate between the other subspecies in the extent of red coloration (the upper  $\frac{1}{4}$ – $\frac{1}{2}$  is straw-coloured in this subspecies).

**Selected collections examined:** **JAVA:** s. loc., P. Goering 344, 1851 (P); s. loc., T. Horsfield 1070, – (BM); Dieng, F. Junghuhn 602, – (L); Preanger, Pangentjongan, S. Koorders 26505, 26 Jan 1897 (K, L); Priangan, Tegal Kirinjoe, Papandajan, 2060 m, L. van der Pijl 567, 17 May 1936 (K); Preanger River, Afd. Tjikakapa v.d. Gouv. Kina Ond., 2000 m alt., D. van Slooten 751, 3 Jan 1923 (K, L ex BO); Preanger, boven Bergtuin Tjibodas, Rawa Gajongjong, 1700 m, C. van Steenis 12331, 9–16 Nov 1940 (L).

**NEW GUINEA: West Papua:** 9 km NE of Lake Habbema, 2800 m, L. Brass 10745, Oct 1938 (BRI, K, L); Bele River 18 km NE of Lake Habbema, 2200 m, L. Brass 11473, Nov 1938 (BRI, K, L); Saruwaged-Gebirge, 2400–3000 m, C. Keysser s.n. (BM); Wamena, Baliem River, 1800 m, A. Kostermans 813, 30 Aug 1966 (L ex BO); N of Mt Trikora, 3040 m, Baliem-Wamena river valley to the east, J.-F. Mangen 734, 25 Aug 1983 (L); Vogelkop Peninsula, Arfak Mountains, Anggi Gigi Lake, Soererei village, 1920 m, H. Sleumer and W. Vink BW 4358, 21 Jan 1962 (K, L); Wamena, 1701 m, Ir. Soehoed Sosrodihardjo 58, 6 Apr 1973 (L ex BO); Arupa, Wissel Lake region, C. Versteegh BW 3020, 22 Mar 1955 (CANB, L, LAE (n.v.)).

**Papua New Guinea:** Lake Onim, Subdistrict Ialibu, 2300 m, M. Andrew LAE 57133, Dec 1972 (L, LAE (n.v.), NSW); Murray Pass, Wharton Range, Central Division, NG, L. Brass 4699, June-Sep 1933 (BRI); above Aijura, B. Conn and Akakauaro 404, 24 July 1977 (L); Lake Myola No. 1, Subdistrict Kokoda, J. Croft et al. LAE 61941, July 1974 (K, L, LAE (n.v.), NSW); Mt Kenive (Nisbet), Subd. Kokoda, J. Croft LAE 65172, Aug 1974 (K, L, LAE (n.v.), NSW); Chimbu district, ridges c. 10 km SSE of Kundiawa, c.1900 m, P. Heyligers 1868 and J. Saunders, 16 Apr 1971 (CANB); Mannasat, Cromwell Mountains, Huon Peninsula, R. Hoogland 9445, July 1964 (CANB, L, LAE (n.v.), US); Momanemambuno, Mt Wilhelm, 2650 m, G. Hope ANU 10638, 1970 (CANB); Goroka subdistrict, 10 km SE of Mt Kerigomna, 2500 m, K. Pajmans 1293, 16 Apr 1971 (CANB); western grasslands of

Mt Giluwe, c. 9700 ft [3000 m], *R. Schodde 2008* (BRI, CANB, K, L, LAE); Pengagl Valley, near Mt Wilhelm track, *J. Smith ANU 15199*, 30 Sep 1971 (CANB, K, L); Gembigl ambi nigl, 1970 m, Simbu Prov, Gembogl Subprov., *J. Sterly 1655*, 30 Oct 1983 (L); Chimbu Valley, Konatna, 2080 m, *J. Sterly 80–160*, 29 Aug 1980 (L); Chimbu Valley, Aragli, 2200 m, *J. Sterly 75–456*, 4 Jan 1976 (L); Bomkane, 2150 m, Simbu Prov., Gembogl Subprov., *J. Sterly 1666*, 29 Nov 1983 (L); Milne Bay District, Pumpunipon, Mt Suckling complex, 2015 m, *P. Stevens and J. Veldkamp LAE 54156*, 20 Jun 1972 (CANB, L, LAE (n.v.)); Kegsugl to Mt Wilhelm, along Pengagl Creek, c. 8500 ft [2600 m], *J.H. Willis*, 2 July 1970 (MEL).

**PHILIPPINES:** Manille (Mont Igorrotes), *M. Calléry*, 1840 (P); Mt Apo, Mindanao, *M.S. Clemens BS 15665*, June 1924 (MEL), nearly 10,000 ft [3000 m], *M.S. Clemens BS 15651*, 7 June 1924 (BM, UC); Mt Pulog and vicinity, Benguet Province, Luzon, *M.S. Clemens 5075*, 24–27 Feb 1925 (UC); Pauai Benguet to Mt Data, Bontoc Province, Luzon, *M.S. Clemens 16259B*, Dec 1925 (UC); Baguio, Benguet Prov., Luzon, *A. Elmer 5763*, Mar 1904 (K, L (n.v.), NSW, P); Todaya, Mt Apo, *A. Elmer 11436*, Aug 1909 (BM, K, L (n.v.), NSW); Mt Pulog, 2350–2450 m, Luzon, *M. Jacobs 7063*, 22 Jan 1968 (K ex L); Pauai, c. 2100 m, Luzon, *R.C. McGregor BS 8413*, June 1909 (MEL, NSW); Suyoc to Pau, Prov. Benguet, Luzon, *E. Merrill 4763*, Oct–Nov 1905 (P); Mt Data, Lepanto subprovince, Luzon, *M. Ramos and G. Edaña BS 40202*, Sep 1921 (BM, K, MEL, NSW, UC); Mt Pulog, *M. Ramos and G. Edaña BS 45007*, Feb–Mar 1925 (BM, UC); Pauai, Luzon, *J. Santos BS 31864*, Apr–June 1918 (NSW).

**BORNEO:** **Sabah:** Mosilau, district Ranau, *Amin et al. SAN 123533*, 5 Sep 1988 (K ex SAN); Mesilau [as Masilau] River, upper Mt Kinabalu, 7000–8000 ft [2100–2450 m], *J. and M.S. Clemens 51674*, 26 Dec 1933 (BM, K, L, UC).

**TAIWAN:** Keelung, *U. Faurie 152*, Mar 1914 (P); Mt Ta-tung, Taipei Co., *H.O. Lee and M.T. Kao K3951*, 11 Jan 1961 (L); Prov. Taihoku, Mt Shichiseizan, *J. Ohwi 2034*, May 1933 (K); Tamsuy, *R. Oldham 580*, 1864 (K, P); Mt Ali, 2200 m, Central Formosa, *C. van Steenis 20833*, 12 Aug 1966 (L).

***J. decipiens* subsp. *sundaicus* (Ridley) L.A.S. Johnson et K.L. Wilson, **comb. nov.****

Basionym: *Juncus sundaicus* Ridley (1935: 342).

Type: Indonesia: Sumatra: Korinchi Peak [now Mt Kerinci], 7300 ft [2225 m], *H.C. Robinson and C.B. Kloss*, 25 May 1914; holo K; iso BM. The K sheet is a duplicate distributed from BM, and there are two minor differences in label information that probably result from transcription errors between the original and duplicate: the BM sheet bears a collectors' number '82' and the month of collection is given as April. However, all other details tally and the material appears to have come from the same collection, so it is assumed that the BM sheet is indeed an isotype.

Culms 20–50 cm long, 1.0–2.0 mm diam.; striations c. 20–30. Cataphylls 5–10 cm long, abaxially more or less evenly red-brown to dark red-brown. Inflorescence 2–4 cm long; lowest involucre bract 7–15 cm long. Tepals acuminate, straw-coloured centrally with a broad darker red-brown band each side of midrib, and with broad to more or less narrow hyaline to whitish margins; outer tepals 3.0–4.0(–4.5?) mm long. Anthers c. 0.5 mm long, shorter than filament length. Capsule slightly shorter than to equalling outer tepals, obovoid to narrow-ellipsoid, very dark red-brown, scarcely beaked. Seeds c. 0.6 mm long.

**Illustrations:** Backer (1951: fig. 2b), as *J. effusus*.

**Distribution:** Endemic to Malesia: probably only on the island of Sumatra (Aceh Province). Ridley cited four collections from Java, three of which we consider to be referable to subsp. *medianus* or to *J. inflexus*, while the fourth is an incomplete cultivated specimen from West Java (*Clemens 30421*) — see below.

**Notes:** Ridley (1935) clearly designated the type specimen, which is a good example of this taxon. However, he had a mixed concept of the taxon, as indicated by the range of collections cited in the protologue. Of the other four collections cited by him, all from Java, three have been seen on loan from K. Of these, *Koorders 26505* (mis-cited by Ridley as '26550B') is referable to *J. decipiens* subsp. *medianus* and *Koorders 37457*

(mis-cited by Ridley as '3745') is *J. inflexus*. *Clemens 30421* is a poor and not readily assigned collection. It has the long (3.5 mm), more strongly red-brown tepals and red-brown capsules of subsp. *sundaicus* but lacks bases to check the cataphylls. We have not seen this last collection side by side with the supposed original voucher for these cultivated plants (see below) so we cannot at this time resolve the question of whether this *Clemens* collection is indeed this subspecies, cultivated in Java, or is instead subsp. *medianus*, which is native in Java.

The fourth collection (*van Steenis*, Papandayan, Java) was not seen in K but apparently equates to *Van Steenis 12331* (J.F. Veldkamp, pers. comm.), which we have seen in L and which is also referable to subsp. *medianus*. That collection from Mt Papandayan was cultivated at Mt Gedeh, which plants in turn were the source of *Clemens 30421* according to the annotation on the latter sheet by Van Steenis. He did not indicate the number of his original Papandayan specimen, but J.F. Veldkamp (pers. comm.) confirms that the specimen cited by Ridley, *Van Steenis 12331*, and the source of the cultivated plants are one and the same collection.

As noted in the key to subspecies, this subspecies differs from the others in having longer tepals that consistently have dark red-brown bands of colour beside the midrib (bands only occasionally present, a very dark red-brown capsule and cataphylls that are usually red-brown for most of their length).

**Selected collections examined: SUMATRA:** Gunung Bandahara, Camp 4, 2400–2600 m, Camp 6, *W. de Wilde and D. de Wilde-Duyffes 15174*, 22 Feb 1975 (K, L), 2600 m, *W. de Wilde and D. de Wilde-Duyffes 13328*, 24 June 1972 (K, L); Gunung Leuser West top, camp 1, 2000–2300 m, *W. de Wilde and D. de Wilde-Duyffes 15944*, 31 Mar 1975 (K, L), camp 2–3, 2300–2600 m, *W. de Wilde and D. de Wilde-Duyffes 16029B*, 2 Apr 1975 (K, L); Laut Poepandji, Atjeh, *C. van Steenis 6396*, 3–5 Sep 1934 (K ex BO, L); Mt Losir, c. 2200 m, *C. van Steenis 8411*, 28 Jan 1937 (L); Gaju and Alas Lands, Mt Kemiri, east slope, 3250–3314 m, *C. van Steenis 9605*, 7 Mar 1937 (L).

?\***JAVA:** cult. Mt Gedeh [plants originally collected on Mt Papandayan, by *C. van Steenis*, fide annotation by Van Steenis; voucher for those original live plants is *Van Steenis 12331*, fide J.F. Veldkamp, pers. comm.], *J. and M.S. Clemens 30421*, 7 Sep 1932 (K).

## 6. \**Juncus inflexus* L.

(Linnaeus 1753: 326)

Type citation: 'southern Europe'.

Shortly rhizomatous perennial. Culms terete, more or less soft, blue-green to grey-green, glaucous, 25–70[–120] cm long, 1.0–1.5(–2.0) mm diam.; striations [10–]17–22; pith regularly interrupted, moderately dense, rarely continuous. Sterile leaf-like culms present but real leaves reduced to cataphylls 6–10 cm long, more or less loose around culms, abaxially pale brown at apex to very dark red-brown or blackish at base, adaxially pale straw-coloured above to dark golden brown towards base. Inflorescence 3–9 cm long, diffuse, with numerous solitary flowers; lowest involucral bract 12–20 cm long, apparently continuous with culm, exceeding inflorescence. Flowers with 2 bracteoles. Tepals acuminate, straw-brown, often with red-brown bands each side of midrib, usually with narrow (less than 0.2 mm wide) hyaline margins; outer tepals [2.5–]3.0–4.0 mm long, exceeding inner tepals. Stamens 6, shorter than outer tepals; anthers 0.7–1.2 mm long, generally greater than or equalling filament length. Capsule 3-locular, slightly shorter than to slightly exceeding outer tepals, elliptic to narrow-ovate, dark red-brown to blackish, acute, shortly beaked (c. 0.3 mm long). Seeds 0.4–0.6 mm long.

**Illustrations:** Fig. 2e, f; also Edgar (1964: figs 13, 27); Podlech (1979: figs 188, 189); Healy and Edgar (1980: fig. 17); Snogerup (1985: fig. 1(8)); Clemants (1990: 9).

**Anatomy illustrated:** Buchenau (1890: pl. 3, figs 8, 13, as *J. glaucus*); Cutler (1969: fig. 4H–K, pl. 1A); Nilsson and Snogerup (1971: fig. 52G); Fernández-Carvajal (1982a: figs 25–28).

**Distribution and habitat:** In Malesia, it is only known from wet places at 2100–2700 m altitude on three mountains in eastern Java. Backer (Backer 1924, 1951; Backer and Backhuizen f. 1968) did not comment on its status in eastern Java, but it seems likely to have been introduced there, as it is also in Australia and New Zealand. Its native range includes Europe, Africa, southwestern and central Asia. Neither we nor J.F. Veldkamp (pers. comm.) have seen any specimens from Mt Kawi, which is west of Mt Tengger and Jang Plateau; Backer (1924) mentioned that the species (as *J. glaucus* Ehrh.) occurred there but without citing any specimens.

Backer regarded some collections from far eastern Java (Tengger and Jang Plateaux, 2100–2300 m alt.; Backer 1924, 1951) that had continuous pith in the culm but otherwise were like typical *J. inflexus* as possibly representing the hybrid *J. effusus* × *J. inflexus*, but he was doubtful since they produced abundant fruit (Backer and Backhuizen f. 1968). This doubt is reinforced by Nilsson and Snogerup's comment (1971: 184) that this hybrid does not produce viable seed in its native Europe. Podlech (1979: 364) describes *J. inflexus* as occasionally having continuous pith in Europe. The three collections that we have seen from Java, cited below, have interrupted pith, including Koorders 43479, which was originally named as *J. effusus* × *J. glaucus* [= *J. inflexus*]. We have not seen any Javan collections with continuous pith.

**Notes:** Differs from other species in the region in having glaucous culms with very broad, flat striations that are widely separated (by 0.1–0.2 mm; versus up to 0.1 mm in the other species in section *Juncotypus*); very dark red-brown, glossy cataphylls; and very dark red-brown to blackish capsules.

**Selected collections examined:** **JAVA:** prope Ngadisari, 2300 m, S.H. Koorders 37457, 24 Oct 1899 (K, L (n.v.)); Besoeki, Jangplateau, c. 2100 m, S.H. Koorders 43479, 11 Aug 1916 (K, L (n.v.), P); Besoeki, Jang Plateau, Lake Tondjoeng, SW of Sekassor, 1900 m, C. van Steenis 11000, 17 July 1938 (K, L (n.v.), NY).

**IRELAND:** Casteldaly, Co. Clare, L. Johnson 8285, July 1976 (NSW).

**ENGLAND:** Fetcham, Surrey, A. Melderis 541, 19 July 1953 (NSW ex BM).

**DENMARK:** Jestehaven, Kalø, S. Jeppesen 577, 7 Aug 1969 (NSW ex AAU).

**IRAN:** Chalus Gorge, B. Briggs 6252, 18 Aug 1975 (NSW).

\***AUSTRALIA: Victoria:** c. 1 km directly SW of Sheeppyard Flat, D. Albrecht 1563, 27 Jan 1985 (MEL, NSW).

\***NEW ZEALAND: North Island:** Te Mata Peak, Havelock North, 800 ft [240 m], A. Druce CHR 16543, Jan 1967 (CHR); near Taradale, A. Healy 50/101, Feb 1950 (CHR, NSW).

**South Island:** Marsden, A. Healy 61/81, Jan 1961 (CHR); Kokonga, A. Healy 58/379, Feb 1958 (CHR, NSW); above Cromwell, road to Loburn Gully, E. Edgar CHR 149591, Nov 1964 (CHR).

### 7. *Juncus durus* L.A.S. Johnson et K.L. Wilson, **sp. nov.**

Inter species in sectione *Juncotypi* characterum combinatione sequenti distinguitur: culmi rigidissimi, medulla culmis lacunis bene interrupta, stomata superficialia, stamina 3.

Type: Papua New Guinea: Western Highlands: Yobobos grassland area (source of Lagaip River), Laiagam subdistrict, c. 8,500 ft [2,590 m], R.D. Hoogland and R. Schodde 7595, 25 Aug 1960; holo NSW; iso BM, CANB, L, LAE.



Shortly rhizomatous perennial. Culms terete, hard, mid-green?, 120–145 cm long, 1.8–3.0 mm diam.; culm striations c. 50; pith strongly interrupted, dense. Sterile leaf-like culms present but real leaves reduced to cataphylls 15–20 cm long, lax, shiny (less so towards apex), abaxially yellow-brown to very dark golden brown towards base, adaxially dark golden brown. Inflorescence 2–5 cm long, diffuse, with more or less densely clustered flowers, 5–10 per cluster and 2–10 clusters per inflorescence; lowest involucre bract 13–18 cm long, apparently continuous with culm, exceeding inflorescence. Flowers with 2 bracteoles. Tepals acute to acuminate, straw-brown, with more or less broad hyaline margins; outer tepals 2.0–2.5 mm long, slightly longer than or equalling inner tepals. Stamens 3, shorter than outer tepals; anthers c. 0.4 mm long, shorter than filament length. Capsule 3-locular, equalling or slightly exceeding outer tepals, elliptic to obovate, golden brown, acute to obtuse, not or scarcely beaked. Seeds c. 0.5 mm long.

**Illustrations:** Fig. 2g, h.

**Distribution and habitat:** Known only from two collections from the Yobobos grassland area of the Western Highlands, Papua New Guinea; in treefern grasslands at about 2,600 m altitude.

**Notes:** The epithet is derived from the Latin *durus*, hard, referring to the tough culms.

Apparently related to the Australian *J. gregiflorus* L.A.S. Johnson and New Zealand *J. edgariae* L.A.S. Johnson & K.L. Wilson. All three species have tough culms with dense pith (variously interrupted) and loose cataphylls that are dark golden brown both abaxially and adaxially. *J. durus* differs from *J. edgariae* in having finer culm striations (about 0.05 mm wide) that are all similar (in the latter, the striations are mostly broader (to about 0.1 mm wide) but mixed with some finer as well). The striations in *J. gregiflorus* are similar to those of *J. durus*. The pith in *J. durus* culms has larger lacunae than in *J. edgariae*, while the pith in *J. gregiflorus* differs from both in being usually much reduced to mere septa-like plates of pith separating very large lacunae.

It differs from *J. decipiens*, its closest relative in New Guinea, in having more rigid, thicker culms with much denser pith, which is frequently interrupted, and with lax dark golden brown cataphylls.

The local name in the Enga language (Kepilan) is given as Guli on the label of the type collection.

**Collection examined:** PAPUA NEW GUINEA: Yobobos grassland area (source of Laiagam River), c. 8,500 ft [2590 m], R. Hoogland and R. Schodde 7460, 17 Aug 1960 (CANB, LAE).

## 8. *Juncus nupela* Veldkamp

(Veldkamp 1977: 415)

Type: Papua New Guinea: Star Mountains, West Sepik, Tel Basin, Camp 2, 2900 m, J.F. Veldkamp 6369, 8 Apr 1975; holo L; iso LAE (n.v.), NSW.

Rhizomatous perennial. Culms terete, soft, grey-green?, 35–60 cm long, 1–1.5 mm diam.; striations 30–50; pith continuous, more or less dense. Sterile leaf-like culms present but real leaves reduced to cataphylls c. 10 cm long, lax, abaxially dark golden brown, adaxially golden brown. Inflorescence c. 1–3 cm long, diffuse, with flowers solitary or loosely clustered, c. 6 flowers per inflorescence; lowest involucre bract 5–8 cm long, apparently continuous with culm, exceeding inflorescence. Flowers with 2 bracteoles. Tepals long-acute, red-brown on sides, green or straw-brown on midrib, with very narrow hyaline margins; outer tepals 5.5–6.0 mm long, greater than or equalling inner tepals. Stamens 6, shorter than outer tepals; anthers 1.5–1.8 mm long, exceeding filament length. Capsule 3-septate; mature features unknown.

**Illustrations:** Fig. 2i, j.

**Distribution and habitat:** Endemic in New Guinea (known only from the type from the Star Mountains). Said to be growing on the bank of a rivulet in tall grassland, where it was locally common. The culms were described on the label as being 'single flattened, sometimes twisted, culms from the rootstock.'

**Notes:** Compared to the other species of section *Juncotypus* in New Guinea, this species is easily distinguished by its long, slender tepals and fine, much less prominent striations that are irregular along the length of the culms (in the other species, the striations are prominent and usually in a straight line along the length of the culms).

It is apparently related to a Eurasian–American group of species (*J. arcticus* Willd., *J. balticus* Willd., etc.) rather than to the other New Guinean species or those of Australia and New Zealand. In that group it seems closest to the North American *J. ater* Rydb. from North America and *J. haenkei* E. Mey. (found from northeastern Asia to Alaska and the NW coast of North America), and could even be conspecific with one of those species although its pith is rather denser than in those two taxa. Veldkamp considered that the whole population was possibly sterile (no capsules were seen by him), which may indicate a single, relatively recent introduction or possibly even a hybrid origin. Veldkamp (pers. comm.) regards this as most likely to be native there since that very remote area had had very few visitors from other parts of the world before his visit in 1975. There are various species in a range of other families with a similar disjunct distribution in high altitude regions in Malesia as well as in temperate eastern Asia or Australia, or in all three regions. One such example is *J. sandwithii*, which has its main distribution in higher altitude mountain areas of south-eastern mainland Australia and at various altitudes in Tasmania. Other examples include *Carpha alpina* R. Br. (Wilson 1986) and 21 species of *Carex* (Kern and Nootboom 1979) in the family Cyperaceae, also grasses such as *Anthoxanthum redolens* Vahl (Schouten and Veldkamp (1985: 343) and *Trisetum bifidum* (Thunb.) Ohwi (Veldkamp and Van der Have 1983).

**Collection examined:** PAPUA NEW GUINEA: Known only from the type collection.

### ***Juncus prismatocarpus* and allied species in continental Asia and Malesia**

In revising the species of this genus in Australia, New Guinea and New Zealand, it was necessary to look at various taxa in Asia and Malesia that have been either confused with the Australasian *J. prismatocarpus* R. Br. or said to be allied to it. Many Flora treatments have used this name in a very broad sense, including Buchenau (1890, 1906), Hooker (1892), Backer (1951), Makino (1964), Backer and Bakhuizen f. (1968), Larsen (1972), Harriman (1991) and Wu (1994), although others have recognised species such as *J. leschenaultii* and *J. wallichianus* as being separate from *J. prismatocarpus*. We reviewed all the Asian and Australasian septate species lacking seed-appendages that were covered under '*Junci septati*' by Buchenau (1906), plus other names that had been published subsequently in this group. The Australasian species will be covered in a separate paper. Here we summarise our (sometimes tentative) conclusions about the Asian and Malesian species, based on examination of the literature and of specimens in B, BM, BRI, CANB, K, L, MEL, NSW, P, TAI, TI and W.

Careful study and comparison of morphological characters suggest that about 12 septate-leaved species without appendages to the seeds should be recognised in Asia and Malesia (the number depends in part on further study of the variation in *J. leschenaultii* and *J. wallichianus*). The following synoptic key to these taxa indicates

what we see as critical characteristics in separating them, but it is not intended as a practical key for identifying all specimens because we have not seen much material of some Asian species, our focus having been on Malesian species. However, we regard this as an opportunity to provide an interim discussion of taxa to stimulate further regional studies. A description of *J. prismatocarpus* is included here to facilitate comparison; descriptions of *J. leschenaultii*, *J. sandwithii* and *J. wallichianus* are given above.

### Key to species

- 1 Pluritubulose leaves; culms more or less compressed (?occasionally unitubulose or apparently so in very slender *J. leschenaultii*)
  - 2 Stamens 3
    - 3 Plants robust with culms 2–3 mm wide below the inflorescence; leaf sheaths usually with broad (0.8–1.5 mm wide) hyaline to membranous margins; flower clusters usually with numerous (10–30) flowers, occasionally fewer; tepals 0.8–1.0 mm wide.
      - 4 Capsule very narrow and strongly elongated, tapering evenly to the short apical beak (Australia and New Zealand) ..... **9. *J. prismatocarpus***
      - 4\* Capsule relatively broader and shorter, contracting more sharply near the short apical beak ..... **12. *J. diastrophanthus***
    - 3\* Plants slender with culms 0.7–1.5 mm wide below the uppermost node; leaf sheaths usually with narrow (to 0.8 mm wide) hyaline to membranous margins; flower clusters usually with few (3–8) flowers; tepals 0.5–0.7 mm wide ..... **3. *J. leschenaultii***
  - 2\* Stamens 4–6
    - 5 Culms strongly flattened and winged; capsule more or less acute (to obtuse), dark golden brown, often with a reddish tinge; tepals 2.5–3(–3.5?) mm long, with 3 more or less prominent veins ..... **10. *J. alatus***
    - 5\* Culms usually not winged (rarely winged); capsule rather elongated-acute to broad-acute, straw-coloured or slightly reddish; tepals 2.7–4 mm long, with only 1 more or less faint vein, longer and narrower than in *J. alatus* ..... **3. *J. leschenaultii***
- 1\* Unitubulose leaves; culms more or less terete
  - 6 Plants dwarf (culms less than 10 cm long) ..... **1. *J. sandwithii***
  - 6\* Plants may be slender but culms more than 10 cm long (commonly 20–50 cm)
    - 7 Ultimate branches of inflorescence short, so that flower-clusters are themselves clustered; tepals more or less incurved and broad, [2–3.2 mm long]; stamens (3–)4–6 ..... **13. *J. krameri***
    - 7\* Flower-clusters spread out more or less remotely on branches in inflorescence; tepals more or less erect or excurved; stamens 3 (occasionally 4 in *J. virens*)
      - 8 Capsules usually red-brown to dark red-brown; [tepals 2–3(–3.5) mm long;] stamens 6 ..... **11. *J. articulatus***
      - 8\* Capsules usually straw-coloured to dark golden brown, occasionally with reddish tinges; stamens 3(–4 in *J. virens*)
        - 9 Tepals 1.5–2.3(–2.6 in *J. papillosus*) mm long
          - 10 Inner tepals narrow, acuminate, with very narrow hyaline margins; tepals reddish; capsule very long-acuminate and slender, with slender beak 0.5–0.7 mm long ..... **15. *J. papillosus***
          - 10\* Inner tepals broad-acute to more or less obtuse, with broad hyaline margins; tepals straw-coloured; capsule abruptly acuminate with short beak 0.2–0.3 mm long ..... **16. *J. virens***
        - 9\* Tepals (2.3–)2.5–3.7 mm long

- 11 Leaf sheath margins broad, yellow, chartaceous; tepals (2.3–)2.5–3.7 mm long, all of similar length; capsule acute to broad-acute with beak 0.2–0.5 mm long, exceeding (occasionally greatly so) to equalling tepals ..... **2. J. wallichianus**
- 11\* Leaf sheath margins more or less narrow, yellow, chartaceous; tepals 2.4–3 mm long, outer tepals shorter (occasionally much shorter) than to equalling inner tepals; capsule long-acuminate with beak 0.5–0.7 mm long, much exceeding tepals ..... **14. J. leptospermus**

A description of the Australasian pluritubulose-leaved *J. prismatocarpus* is provided here since there has been so much confusion over its limits. This is followed by a brief enumeration of the Asian septate-leaved species mentioned in the synoptic key above. The three species that occur in Malesia are treated above.

In a recent paper on Chinese species of *Juncus*, Wu (1994) recognised two new species in 'Subgen. *Septati* sect. *Articulati* ser. *Articulati*' — *J. sphaerocephalus* K.F. Wu and *J. auritus* K.F. Wu — of which we have seen no material. From the descriptions and illustrations, these probably both fall within the variation of *J. wallichianus* as recognised by us. He described a new subspecies, *J. prismatocarpus* subsp. *teretifolius* K.F. Wu, of which we have seen a duplicate of the type number (*Tsang 20636*) in K; that specimen belongs to *J. wallichianus*.

We have not seen type material of *J. bombonanzensis* Satake (from Taiwan; type in TI?). This name was given as a synonym of *J. wallichianus* by Kao and De Vol (1978), but that seems unlikely since Satake (1933: 182) described it as having imperfectly septate (= pluritubulose) leaves. This suggests that it is referable to *J. leschenaultii*, as does the elongated capsule illustrated by Satake (1933: fig. 18), and the habit (1933: pl. 1) is reminiscent of *J. leschenaultii*.

### 9. *Juncus prismatocarpus* R. Br.

(Brown 1810: 259)

*J. prismatocarpus* var. *α genuinus* Buchenau (Buchenau 1885: 204), nom. inval.

Type: Australia: New South Wales: Port Jackson, *R. Brown* (*Bennett 5784*); holo BM, photo NSW.

*Juncus commutatus* Steud. (Steudel 1855: 301). Type citation: '*Juncus prismatocarpus* Sieb. nr. 431 Hrb. n. H. [Nov. Holl.] et 630 hrb. mixt. et R. S. Syst. VII 213.' Type: New South Wales: *Sieber Herb. Nov. Holl. 431*; lecto (*here designated*) P (herb. Steudel); isolecot BM, BREM (n.v.), K, L (sheet 904.144–370), MEL. Residual syntype: *Sieber Herb. Mixt. 630*; syn L, P (herb. Steudel).

The sheet of *Sieber 431* that is in Steudel's herbarium bears elongated but not quite mature capsules. Steudel had named this sheet as *J. prismatocarpus*. Despite being in not particularly good condition, it is more suitable as a lectotype than *Sieber Herb. Mixt. 630* since it is much more mature than the latter and therefore more recognisable. This choice is supported by Steudel's description of capsules for this taxon (the other specimen is too immature to have capsules). Sheets of *431* seen in other herbaria are generally in better condition. In L, there is one sheet of *431* (sheet 904.144–373) that bears an immature specimen of a unitubulose species (perhaps the Australian *J. fockei* Buchenau or *J. holoschoenus* R. Br.) that obviously does not belong to *J. prismatocarpus*. The plants on the sheets of *Sieber Herb. Mixt. 630* in P and L are pluritubulose but very immature; that number has not been seen elsewhere. Steudel had named the sheet in P as *J. commutatus*.

Tufted perennial. Culms more or less flattened, yellow-green, 10–40 cm long, 1.3–3.0 mm diam. Leaves pluritubulose, spread along culms, shorter or equalling culms, compressed, 1.3–3.2 mm wide; auricles 0.3–1.0 mm long. Inflorescence terminal, 5–17 cm long, diffuse, with flowers clustered, 5–25 per cluster and 4–40 clusters per inflorescence; 1 well-developed involucral bract, 3–14 cm long, shorter than or rarely as long as inflorescence. Tepals acuminate, often spreading to recurved at maturity, straw-brown to red-brown, with narrow hyaline margins; outer tepals 2.5–3.5(–4.1) mm long, more or less equalling inner tepals. Stamens 3, shorter than outer tepals; anthers 0.4–0.7 mm long, shorter than filaments. Capsule exceeding outer tepals by 1–3 mm (to twice as long), very narrow-ovoid, golden brown, long-acuminate, tapering evenly then narrowing abruptly at apex into slender beak c. 0.3 mm long. Seeds 0.4–0.5 mm long.

**Illustrations:** Fig. 1e–g; also Buchenau (1906: fig. 89) as var. *genuinus*; Wilson et al. (1993: 289).

**Anatomy illustrated:** Buchenau (1906: fig. 89C); Cutler (1969: fig. 7J, K).

**Distribution and habitat:** In Australia, found in temperate regions of Queensland, New South Wales, Victoria, Tasmania and South Australia. There is one old specimen purportedly from Western Australia – Murchison River, *Oldfield* – but that is regarded as a doubtful record. In New Zealand, this is widespread on the North Island, scattered on the South Island, in swampy situations. Introduced in Hawaii. Widespread in wet sites: margins of dams, swamps, marshes and creeks.

**Notes:** Confused with *J. leschenaultii* and *J. wallichianus* in Malesia and Asia (see, e.g., Backer 1951). It differs from both species in its very long, acuminate capsule, which is up to about twice as long as the tepals. For other differences, see the comments above under the treatments of those two taxa and the key.

**Selected collections examined:** **AUSTRALIA: Queensland:** Windsor Tableland, N of Mt Carbine, A. Bean 4562, 7 June 1992 (BRI, NSW); Rainbow Creek, Blackdown Tableland, L. Johnson and D. Blaxell 741, 26 Nov 1972 (NSW); near Beenleigh, c. 1 mile [1.6 km] along Waterford Road, L. Smith 12236, 4 Nov 1964 (BRI, NSW).

**New South Wales:** Bell Bird Creek, 4 miles (6.5 km) N of Eden, R. Melville 2742 and N. Wakefield, 8 Jan 1953 (K, NSW); Busbys Flat Road 27 km SW of Casino, in Royal Camp State Forest, K. Wilson 8553, 22 Oct 1992 (BRI, K, NE, NSW); Etoo Creek 7 km along Kellys Lane from Pilliga – Gwabegar Road, K. Wilson 6042, 15 Nov 1984 (CHR, NSW); NW side of Castlereagh State Forest, SE of Londonderry, K. Wilson 7997, L. Johnson and P. Bankoff, 5 Feb 1992 (CHR, NSW).

**Victoria:** Woori Yallock Picnic Ground, c. 0.5 km NW of Yellingbo, A. Beauglehole 50411, 22 Mar 1976 (MEL, NSW); Reedy Creek, 5 km by road E of Cann River, L. Johnson 7438 and E. Edgar, 21 Oct 1971 (NSW); 4 Mile Creek, near Warburton, R. Melville 3832, 3 May 1953 (K, NSW); c. 4 km from Genoa on Mallacoota road, K. Wilson 2214, 8 Feb 1979 (MEL, NSW).

**Tasmania:** S. Esk River at Perth, W. Curtis s.n. and Cameron, 7 Feb 1979 (HO, NSW 241536).

**South Australia:** Myponga, J.M. Black, Mar 1923 (AD).

**NEW ZEALAND: North Island:** Scott Point, North Cape, Kelly, Apr 1967 (CHR 178242); Bethells Swamp, Waitakere Range, R. Gardner 888, 10 May 1974 (AKU, NSW); Rotokare, near New Plymouth, A. Druce CHR 158503, Feb 1964 (CHR); Palmerston North waterworks, Zotov, Dec 1932 (CHR 4547).

**South Island:** Pakihi E of Collingwood–Rockville road, R. Mason and N. Moar, Feb 1957 (CHR 95785); near Lake Rotoiti, R. Mason and N. Moar, Feb 1957 (CHR 95995); Marsden, Healy 61/73, Mar 1961 (CHR); near lower Wairau River, R. Mason 3098, Jan 1955 (CHR).

**\*HAWAII:** Kohala Mountains, Kahua Ranch, 3300 ft [1000 m], P. Rubtsoff, 2 Aug 1956 (NY ex CAS).

**10. *Juncus alatus* Franch. et Sav.**

(Franchet and Savatier 1877–78: 98, 534)

Type citation: 'In orizetis: Nippon media, ad Simoda (*Savatier*, n. 1357); ad pedem montis Fudsi yama (id., n. 3477).'Types: *P. Savatier* 1357; syn ?K, ?P (*Savatier s.n.*, Simoda). *P. Savatier* 3477; syn ?K, ?P (*Savatier s.n.*, ad pedem montis Fudsi yama ).**Illustrations:** Makino (1964: 823).

This pluritubulose-leaved species is native to China and Japan. It has very strongly winged, flattened culms (commonly 3–4 mm wide), 6 stamens, and the capsule only shortly exceeding the tepals. The capsule shape is broader and less elongated than that of *J. prismatocarpus* and *J. diastrophanthus* and there are generally fewer flowers per cluster than in those species. The capsule shape is similar to that of *J. leschenaultii* but that species has much narrower, scarcely winged culms and stamens usually 3 (occasionally to 6).

**Selected collections examined: CHINA:** Nanking, Spirit-Valley, Kiangsu Province, *C.Y Chiao* 14895, 3 Feb 1927 (K, 2 sheets); Su-tchuen oriental, district de Tchen-Kéou-Tin, alt. 2500 m, *R. Farges* 1256, 3 July 1899 (P); Patung district, *A. Henry* 1794, 1887 (K); Lushan, Lulin (Jiangxi), 900 m, *Nie M.-X.* 92152, 31 May 1992 (K ex PE); Tai Pei Shan, *W. Purdom*, 1910 (K); Tai pai Shan – Shansi, *W. Purdom*, – (K); Kewkiang, *Dr Shearer*, 1873 (K); P'ing T'ou Shan, T'ang Wan Village (Yi Chang district), Hunan, *W.T. Tsang* 23760, 1–13 May 1934 (NSW, P ex A); Si Chuan, Guan Xian, Qishuping, 1350 m, *Wang Z. – T. et al.* 870221, 29 July 1987 (NSW ex PE).

**JAPAN:** Japan, *F.V. Dickins*, July 1876 (K); Japan, *U. Faurie* 1808, 1898 (K, P); Kiusiu, *Maximowicz Iter Secundum*, 1862 (K, P); Ogura prope Kyoto, Hondo, *J. Ohwi* 9198, 13 June 1937 (K); Simoda, *Savatier Plantae Japonicae 1866–1871 (series prima) no. 1978*, – (P); Akabane, Bank of River Arakawn, Tokyo, Hondo, *S. Suzuki* 438–1, 30 May 1937 (K).

**KOREA:** Quelpaert, *U. Faurie* 2251, Aug 1907 (P).

**11. \**Juncus articulatus* L.**

(Linnaeus 1753: 327)

Type: Europe.

*J. lampocarpus* Ehrh. ex Hoffm. (Hoffmann 1800: 166). Type citation: Ehrhart 'gram. 126'.

Note that the 1791 edition of this work includes brief but adequate treatments of various species but not of *J. lampocarpus*. In the 1800 edition, *J. lampocarpus* is described in a note following *J. acutiflorus* on p. 166. The epithet has often been misspelt as 'lamprocarpus'.

**Illustrations:** Nilsson and Snogerup (1972: fig. 74); Snogerup (1985: fig. 1(32)); Clemants (1990: 43); Wilson et al. (1993: 286).

This unitubulose-leaved species is probably native to Europe, Central and Southwest Asia, northern Africa, and temperate North America but introduced very widely in other regions, including eastern Asia, Australia (Queensland, New South Wales, Victoria, Tasmania, South Australia, Western Australia) and New Zealand (North Island, South Island, Stewart Island, Chatham Islands, Auckland Island, Campbell Island). It has 6 stamens, whereas the native unitubulose Asian species have 3 stamens except *J. krameri* Franch. & Sav., which often has 6 stamens. The capsule of *J. articulatus* is usually red-brown to dark red-brown, with an acuminate to obtuse apex, and shortly exceeding the tepals. This combination of features is not seen in the native species.

**Selected collections examined:** \*CHINA: Yunnan, prope Lichiang, 3100 m, *C. Schneider* 2832, Oct 1914 (K); Tibet, ravine above Sungnam, Kanawar, 12-1400 feet [3600-4200 m], *T. Thomson*, 22 Aug 1847 (K); Shansi, Huohsien, Kuo-yueshan, *T. Wang* 3949, 30 Sep 1935 (K).

**BHUTAN:** Paro, 2286 m, *Ramesh Bedi* 698, 18 Aug 1971 (K).

**PAKISTAN:** Gumbar Ravine, below Kasauli, *J. Drummond* 5001, 13 Mar 1886 (K); near Madian, Swat State, c. 5000 feet [1500 m], *R. Rodin* 5527, 15 Aug 1952 (K).

**TURKMENISTAN:** Pr. Ashabad, Bogyr, *D. Litvinov* 2139, 25 June 1898 (NSW ex LE).

**TADJIKISTAN:** Siyakukh Research Station, Gissar Range below Anzob Pass, *L. Johnson and B. Briggs*, July 1975 (NSW 451170).

**LEBANON:** Dschebel Sannin, *E. Hartmann, Kneucker* 85, 27 July 1900 – Sep 1901 (NSW).

**TURKEY:** Prov. of Rize, Baskoy (Cimil)-Cermanin Y., *D. Davis* 21037, 28 Aug 1952 (NSW ex BM).

**HUNGARY:** Herkulesbad im Banat, *L. Richter, Kneucker* 85a, 21 Aug 1901 (NSW).

**GERMANY:** Kahlberg, *R. Gross*, July 1902 (NSW 541172).

**FINLAND:** Tarttila village, Saarioisjarvi Lake, *R. Thorne* 47025 and *R. Alava*, 13 July 1975 (NSW ex RSA).

**CANADA:** Shawnigan Lake, British Columbia, *J. Anderson* 766, 18 Aug 1897 (NSW).

**U.S.A.:** Orono, Maine, *M. Fernald* 188, 29 July 1908 (NSW).

\*AUSTRALIA: **New South Wales:** Armidale, *R. Coveny* 16379 and *A. Whalen*, 19 Jan 1993 (BRI, CHR, NE, NSW); Cave Creek via Blue Waterholes fire trail, Kosciuszko National Park, *P. Kodela* 412, *P. Jobson and R. Coveny*, 26 Jan 1997 (CANB, MO, NE, NSW); Wentworth Falls, *K. Wilson* 7987a, *L. Johnson and P. Bankoff*, 5 Feb 1992 (B, MO, NSW).

**Victoria:** Crawford River crossing of the Hotspur-Condah Road, *D. Albrecht* 32, 16 Dec 1983 (NSW, AD, BRI, CANB, HO, MEL, ); Central Little Desert National Park, *A. Beaglehole* 87738 and *Huebner*, 17 Dec 1986 (NSW, MEL); Wonwondah East, *K. Wilson* 1065 and *L. Johnson*, 16 Feb 1975 (NSW).

**Tasmania:** Outskirts of Hobart, Knocklofty, *A. Orchard* 5009, 16 Apr 1978 (HO, NSW); 3 miles [4.8 km] E of Hastings, *P. Raven* 25929, *T. Engelhorn and D. Morris*, 21 Feb 1970 (MO, CHR, NSW); c. 9 km E of Low Head town, *K. Wilson* 6440, 19 Feb 1986 (NSW, CHR, HO, MEL).

**South Australia:** Wellington, mouth of River Murray, *Hj. Eichler* 15672, 26 Jan 1959 (AD, NSW); near Furner, *D. Symon* 1205, 9 Mar 1961 (ADW, CANB, B, K, NSW).

**Western Australia:** 1.5 miles [2.4 km] S on Lake Muir turnoff (on Rocky Gully-Manjimup road), *A. and J. McComb* 1727, 27 Dec 1971 (UWA, NSW).

\*NEW ZEALAND: **North Island:** Waitakere Ranges, *B. Briggs*, Jan 1966 (NSW 90870).

**South Island:** Lake Lyndon, W of Christchurch, *B. Briggs*, 6 Feb 1966 (NSW 90848); Motueka Valley, *T. Cheeseman* 24, Jan 1881 (K); Eyre Creek, *R. Melville* 6472, Feb 1962 (CHR, K); Ship Creek, near Haast on the road to Fox Glacier, *M. Tindale* 7041 and *W. Sykes*, 13 Feb 1983 (CHR, NSW).

## 12. *Juncus diastrophanthus* Buchenau

(Buchenau 1890: 309)

Type citation: 'Hakodate, Japan; gesammelt von Prof. Maximowicz und Dr Albrecht.'

Type: Hakodate, *C. Maximowicz, Iter Secundum*, 1861; syn K ex LE, W ex LE. Circa Hakodate, *Dr Albrecht*, 1861-63; syn W ex LE. Both syntypes in W came there as part of Buchenau's herbarium. The Maximowicz collection in K was determined by Buchenau as *J. prismatocarpus* rather than *J. diastrophanthus* but, despite this, it is probably a duplicate of the W collection, which Buchenau had first determined as *J. prismatocarpus* and later as *J. diastrophanthus*.

? × *J. togakushiensis* Lévillé (1912: 352). Type citation: 'Togakushi, septembr. 1898 (Urb. Faurie, 1796)'. Type: Togakushi, *U. Faurie 1796*, Sep 1898; holo E (n.v.; cited by McKean 1988: 156); iso? K, P.

**Illustrations:** Makino (1964: 825).

This pluritubulose-leaved species has rather broad, strongly flattened leaves and culms, similar to those of *J. prismatocarpus* and *J. alatus*, all three of them being coarser than in *J. leschenaultii*. The capsule of *J. diastrophanthus* is very narrow and elongated like that of *J. prismatocarpus*; the capsule in *J. leschenaultii* and *J. alatus* is shorter and relatively broader. There is some variation in number of flowers per cluster and therefore of perceived density of the clusters in the material of this species seen. The two syntypes are relatively few-flowered, as is much other material, but some other collections differ in having much denser clusters and often rather more elongated capsules (e.g. *U. Faurie 1796* (K, P)). That Faurie collection is the type number for × *J. togakushiensis* Lévillé. However, neither of the sheets seen by us (in K and P) has been annotated by Lévillé, and we have not yet seen the holotype sheet (which is cited by McKean (1988: 156) as being in E with the rest of Lévillé's herbarium). It seems unlikely to be a hybrid of *J. leschenaultii* with the distantly related *J. ensifolius* Wikstr. (*J. xiphoides* auct.) as suggested by the original author. McKean identified the holotype specimen as being *J. ensifolius*. We have not seen the holotype but the two probable isotypes seen by us in K and P are *J. diastrophanthus*.

**Selected collections examined:** JAPAN: Kuroishi, *U. Faurie 1292 p.p.*, 29 Sep 1889 (K, P); Togakushi, *U. Faurie 1796*, 17 July 1898 (K, P); Tidesan, *U. Faurie 1798*, 30 Aug 1898 (K); Aomori Pref., Tsugaru Peninsula, Nishitsugaru-gun, Kakure-numa, *H. Hara et al.*, 15 Sep 1974 (K); Omagari, Tanabu-machi, Shimokita Peninsula, Prov. Matsu, Hondo, *M. Mizushima 1650*, 4 Aug 1955 (TI); Aomori Pref., Simokitagun, Saimura, *H. Mora 16689*, 22 Sep 1956 (K); Hakodate, Yezo, *T. Satow 5324*, 1926 (TI); Komazawa, Setagaya, Tokyo, Hondo, *S. Suzuki 438-2*, 18 Aug 1937 (K); Shiramine in Kaga, Honshu, *M. Togasi TSM 1077*, 6 Sep 1954 (NSW ex TNS); Yunokawa, Prov. Osima, *I. Yamamoto 8377*, 6 Aug 1937 (TI).

### 13. *Juncus krameri* Franch. et Sav.

(Franchet and Savatier 1877–78: 99, 534).

Type citation: 'In orizetis: Nippon, circa Simoda (*Savatier*, n. 1354).'

Type: Japan: Simoda, *P. Savatier 1354*; holo K?, P? (n.v.).

**Illustrations:** Makino (1964: 824).

This unitubulose-leaved species is native to Japan and China. It is also recorded for Korea and the Kuriles by Kitagawa (1979: 162). It is distinctive in having a more compact inflorescence, i.e. with more densely clustered flower-clusters, and more strongly incurved tepals than the other species discussed here. Its culms are distinctive in looking minutely but strongly punctulate and somewhat scaberulous (at least when dried). Franchet and Savatier (1877–78: 535) described the culms and leaves as being covered in 'petites aspérités blanches papilleuses'. We have not seen live plants of this taxon, but cross-sectioning dried culms shows that stomates have large air-spaces under them, so the external appearance of the culm is apparently owing to the 'collapse' of tissues into the air-spaces at least when dried (see also discussion under *J. papillosus* below). The capsule of *J. krameri* shortly exceeds the tepals, as in *J. articulatus*, *J. wallichianus* and *J. virens* Buchenau. Stamens are usually 4–6 (rarely 3), whereas *J. articulatus* has 6 stamens and the other species have 3 stamens (occasionally 4 in *J. virens*).



**Selected collections examined: CHINA:** Tai Ping Kung, Lao Shan, 600 m, Shantung, C.Y. Chiao 2823, 18 July 1930, (K).

**JAPAN:** Niigata, U. Faurie 1805, 24 Sep 1898 (K); Asamayama, U. Faurie 1806, 14 July 1898 (K); Ile de Kunashiri, U. Faurie 5134, 8 Oct 1889 (K, P); Hondo, Katakai in Kadzusa, I. Ito and T. Koyama TSM 973, 10 Sep 1953 (K, NSW ex TNS); Hakodate Mohidzi, Maximowicz *Iter Secundum*, 1861 (K ex LE); Tokyo, T. Terasaki, Aug 1905 (K, 2 sheets).

#### 14. *Juncus leptospermus* Buchenau

(Buchenau 1885: 203)

Type citation: 'Assam (Khasia) am unteren Brahmaputra; 4–6000 Fuss; gemässigte Region; J.D. Hooker und T. Thomson; – von C.B. Clarke daselbst an verschiedenen Orten in Höhen von 4000 bis 5500 Fuss im Oktober mit entwickelten Früchten gesammelt. – East Bengal (vielleicht ist damit dieselbe Gegend gemeint); gesammelt von Griffith (Herbarium of the late East-India-Company, Nr. 5455 et pro pte 5459).'

Types: India: Khasia, 4–6000 ft, J.D. Hooker and T. Thomson; syn K. Khasia, 4000–5500 ft, C.B. Clarke; syn ?K (n.v.). East Bengal, Griffith 5455; syn ?K (n.v.). East Bengal, Griffith 5459; syn ?K, L (n.v.).

**Illustrations:** Buchenau (1906: fig. 95).

We have only seen a few collections of this unitubulose-leaved species, from the eastern part of India and Yunnan, but Noltie (1994) records it also for Bhutan. The collections from Yunnan have rather more strongly mucronate tepals than the Indian specimens but do not differ in other ways. The *Hooker and Thomson* syntype in K was determined by Buchenau as *J. leptospermus*. The *Clarke 18607* collection in K cited below was not determined personally by Buchenau but presumably Clarke sent a duplicate to him since it is labelled in Clarke's script '*leptospermus* Buchenau fide Buchenau', and this number is cited as the basis of Buchenau's figure cited above. The capsule of *J. leptospermus* usually much exceeds the tepals, as also in *J. papillosus* (q.v.), differing from that species in its long, usually reddish tepals and generally darker (golden to red-brown) capsule.

**Collections examined: CHINA:** Yunnan, river near Zhongdian (Chungtien), alt. 3240 m, *Chungtien–Lijiang–Dali Expedition 258*, 27 Sep 1990 (K); Yunnan, Yulong Shan, above the Lan gon Lake, 3200 m, *Chungtien–Lijiang–Dali Expedition 1140*, 11 Oct 1990 (K).

**INDIA:** Mairung, 4,500 ft [1370 m], Khasia C.B. Clarke 16089, 30 Oct 1871 (K); Mairung, 4,000 ft [1200 m], C.B. Clarke 16103, 30 Oct 1871 (K); Madphlang [spelling?], Khasia, 5500 ft [1670 m], C.B. Clarke 18607, 19 Oct 1872 (K).

#### 15. *Juncus papillosus* Franch. et Sav.

(Franchet and Savatier 1877–78: 98, 533).

Type citation: 'In montibus Hakone (*Savatier*, n. 1355); circa Yokoska, in scrobibus (*Savatier*, n. 2521).'

Types: Japan: Hakone, P. Savatier 1355; syn K? (n.v.), P. Yokoska, P. Savatier 2521; syn K? (n.v.), P.

*J. niponensis* Buchenau (Buchenau 1890: 340). Type citation: 'von Maximowicz bei Yokohama, von Professor Yatabé bei Tokyo gesammelt, warscheinlich auch auf Yesso (Maries in hb. Kew).'

Types: Japan: Yesso, *Maries*; syn K. Yokohama, C. Maximowicz *Iter Secundum*; syn ?LE (n.v.), P, ?W (n.v.). Tokyo, *Yatabi*; syn ?LE (n.v.), ?W (n.v.).

?*J. niponensis* var. *hakodatensis* Léveillé (Léveillé 1912: 352). Type citation: 'Japonia; Yezo, circa Hakodate, 29 sept. 1902 (Urb. Faurie, 5236)'. Type: Japan: Yezo near Hakodate, U. Faurie 5236, 29 Sep 1902; holo E? P? (n.v.).

**Illustrations:** Krechetovich and Goncharov (1935, pl. 30 fig. 8), as *J. niponensis*; Makino (1964: 824).

Satake (1933) reported this slender, wiry, unitubulose-leaved species as occurring in Japan and also in 'Manchuria, China and Amur'. Kitagawa (1979) also mentions Korea and the Kuriles. Its capsule is about twice as long as the tepals (tepals c. 1.5–2 mm long), similar to that of *J. leptospermus* (q.v.), whereas the capsule only shortly exceeds the tepals in *J. krameri*, *J. virens* and *J. wallichianus*. Franchet and Savatier (1877–78: 533) named this species because of its supposed white papillae on leaves and culms, but in the discussion they accepted that this was not a feature unique to this species and that it was variable with age of plants. The surface resembles the irregular, scaberulous surface seen in other species such as *J. krameri*, *J. striatus* Schousboe ex E. Mey. (illustrated by Cutler 1969: fig. 6G, H) and various species in sect. Graminifolii. Buchenau (1890: 341) equated the supposed papillae with the stomates, which occur in longitudinal rows and which appear to be on prominent longitudinal ridges when a specimen is dried. We have not sectioned all of the relevant species but, in this species and at least some of the others, cross-sectioning of leaves and culms shows that the 'white-papillose' appearance relates more to variation in size of epidermal cells (generally large) and to large stomates that often have large air-spaces underlying them rather than to actual protuberances on the surface. On drying, irregularities are emphasized by collapse of these large cells, as is the 'whiteness' of the epidermal cells and stomates in contrast to other denser cells.

The only probable syntype of *J. niponensis* that we have seen has not been annotated by Buchenau, so it is not appropriate to select it as lectotype without further searching, at least in W. It is a specimen of *J. papillosus*. Similarly, the *Maries* specimen was only cited with doubt by Buchenau; he annotated it as 'probably *J. niponensis*'. It is an immature specimen of *J. papillosus*. *J. niponensis* was regarded as a synonym of *J. papillosus* by Satake (1933: 186), Ohwi (1965: 278) and Kitagawa (1979: 162). Buchenau (1890) had not seen the type of *J. papillosus* when he described *J. niponensis* – he listed *J. papillosus* under 'Species dubia', as possibly just a young plant of *J. niponensis* flowering in the first year (Franchet and Savatier (1877–78: 533) had described it as being an annual). He still had not seen this type some years later (Buchenau 1906).

Léveillé's *J. niponensis* var. *hakodatensis* was described as differing in being more slender than the typical form and more pallid in colour, with yellow seeds. McKean (1988: 157) did not find the type amongst Léveillé's herbarium in E, nor have we seen the type. The description does not seem to differ in significant detail from that of *J. papillosus*.

**Selected collections examined: JAPAN:** Kuroishi, U. Faurie 1292 p.p., 1248, 29 Sep 1889 (K, P); Plaine d'Hakodate, U. Faurie 1411, 25 Sep 1886 (K, P); Sendai, U. Faurie 1800, 14 Oct 1898 (K); au pied du Fujiyama, U. Faurie 6556, 10 Aug 1890 (K, P); to Toga from Kamo Toga-machi Oga-shi, Pref. Akita, Hondo (Prov. Ugo), M. Furuse 26741, 28 Sep 1953 (K); Tomakomai-shi, Yufutsu Hokkaido, H. Hara, S. Kurosawa and Y. Tateishi, 6 Sep 1974 (TI); Honshu, Pref. Hyogo, Tonomine-hills, Ohkawauchi-cho, Kanzaki-gun, 800 m, K. Iwatsuki and T. Koyama PJE 798, 17 Oct 1966 (K, NSW, P ex KYO); Hondo, Yamanakako in Kai, K. Okamoto NSM 585, 3 Aug 1952 (K, NSW, P ex TNS); Saitama Pref., Hiki-gun, Ogawa-machi, Uchide-Kuriyama, 100–400 m, Hokkaido, Y. Tateishi 456 and J. Murata, 1 Nov 1974 (TI); Kyushu, Nakatsu in Buzen, M. Togasi TNS 1412, Oct 1956 (K, NSW, P ex TNS).

**CHINA:** Manchuria, D. Litvinov 3408, 23 July 1903 (K); Deutsch China, Zimmerman 512, 1901 (P).

**KOREA:** Ouen-san, U. Faurie 895, Aug 1901 (P); Quelpaert, U. Faurie 2250, June 1907 (P), 700 m, E. Taquet 1962, 4 Sep 1908 (K), 1600 m, E. Taquet 1998, 7 Sep 1908 (K).

**RUSSIA:** Prov. Austro-Ussuriensis, in paludosis ad Paschkowa, Manchuria Rossica, V.L. Komarov *Fl. Manshuriae* 354, 29 July 1895 (K, P ex LE); distr. Chabarowsk, I.W. Kusnezow, *Iter Bolon-Odshalense* 687, 22 Aug 1910 (NSW ex LE).

### 16. *Juncus virens* Buchenau

(Buchenau 1906: 220)

Type citation: 'bei Blagowjestschensk im Amurgebiete (7 August 1898, F. Karo n. 89).'

Type: Blagowjestschensk im Amurgebiete, F. Karo 89, 7 Aug 1898; holotype W (n.v.); iso K, L (n.v.), LE (n.v.). The label on the sheet in L states that the collection date was 'VII. VIII', i.e. July–August (Veldkamp, pers. comm.).

**Illustrations:** Krechetovich and Goncharov (1935: pl. 30, fig. 3).

This slender, unitubulose-leaved species is apparently restricted to the Russian Far East. Its capsule usually only shortly exceeds the tepals (occasionally much exceeding them), and is relatively short and broad as in *J. articulatus*, *J. wallichianus* and *J. krameri* (q.v.). Its tepals are shorter than in the more robust *J. wallichianus*, while its capsule is not red-brown as in the introduced *J. articulatus*, and the inflorescence has longer branches and is therefore less clustered than in *J. krameri*.

**Collections examined: RUSSIA: Manchuria:** circa Blaurestschenksk, Provincia Amurensis, F. Karo 353, July 1905 (K); Blagowjestschensk, Amur, F. Karo s.n., July 1899 (NSW); Bergweisen um Zea, F. Karo s.n., July 1900 (NSW).

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## References

- Arber, A. (1925) *Monocotyledons – A morphological Study*. (University Press: Cambridge, Mass.)
- Backer, C.A. (1924) Juncaceae. Pp. 43–44 in *Handboek voor de Flora van Java* vol. 3 (Ruygrok and Co, Batavia)
- Backer, C.A. (1951) Juncaceae. Pp. 210–215 in C.G.G.J. van Steenis (ed.), *Flora Malesiana* ser. 1, vol. 4(3). (Noordhoff-Kolff: Djakarta)
- Backer, C.A. and Bakhuizen f., R.C. (1968) *Flora of Java*, vol. 3. (Noordhoff: Groningen)
- Balslev, H. (1996) *Flora Neotropica Monograph 68 — Juncaceae*. (New York Botanical Garden: New York)
- Barnard, C. (1958) Floral histogenesis in the monocotyledons. III The Juncaceae. *Austral. J. Bot.* 6: 285–298.
- Brooks, R.E. and Kuhn, C. (1986) Seed morphology under SEM and light microscopy in Kansas *Juncus* (Juncaceae). *Brittonia* 38: 201–209.
- Brown, R. (1810) *Prodromus Florae Novae Hollandiae*.
- Buchenau, F. (1885) Die Juncaceen aus Indien, insbesondere die aus dem Himalaya. *Bot. Jahrb. Syst.* 6: 187–231.
- Buchenau, F. (1890) Monographia Juncacearum. *Bot. Jahrb. Syst.* 12 (1): 1–498.

- Buchenau, F. (1906) Juncaceae. Pp. 1–284 in A. Engler (ed.), *Das Pflanzenreich* IV 36, Heft 25. (Willhelm Engelmann: Leipzig)
- Burkill, I.H. (1935) *A Dictionary of the Economic Products of the Malay Peninsula*. (Crown Agents for the Colonies: London)
- Clemants, S.E. (1990) *Juncaceae (rush family) of New York State*. New York State Mus. Bull. 475.
- Coode, M.J.E. (1978) 188. Joncacées. In J. Bosser et al. (eds), *Flores Mascareignes*. (Sugar Industry Research Institute: Mauritius /ORSTOM: Paris /Royal Botanic Gardens: Kew)
- Cope, T.A. and Stace, C.A. (1978) The *Juncus bufonius* aggregate in western Europe. *Watsonia* 12: 113–128.
- Cope, T.A. and Stace, C.A. (1983) Variation in the *Juncus bufonius* aggregate in western Europe. *Watsonia* 14: 263–272.
- Cope, T.A. and Stace, C.A. (1985) Cytology and hybridization in the *Juncus bufonius* L. aggregate in western Europe. *Watsonia* 15: 309–320.
- Coville, F.C. (1913) Juncaceae. Pp. 465–485 in N. Britton and A. Brown, *Illustrated Flora of the Northern United States, Canada*, edn 2, 1. (C. Scribner's Sons: New York)
- Cutler, D.F. (1969) *Juncals*. In C.R. Metcalfe (ed.), *Anatomy of the Monocotyledons*, vol. 4 (Clarendon Press: Oxford)
- Don, D. (1840) An account of the Indian species of *Juncus* and *Luzula*. *Trans. Linn. Soc. London* 18: 317–326.
- Edgar, E. (1964) The leafless species of *Juncus* in New Zealand. *New Zealand J. Bot.* 2: 177–204.
- Fernández-Carvajal, M. del C. (1982a) Revision del genero *Juncus* L. en la Peninsula Iberica. II. Subgeneros *Juncus* y *Genuini* Buchenau. *Anal. Jard. Bot. Madrid* 38: 417–467.
- Fernández-Carvajal, M. del C. (1982b) Revision del genero *Juncus* L. en la Peninsula Iberica. III. Subgeneros *Subulati* Buchenau, *Pseudotenageia* Krecz. & Gontsch. y *Poiophylli* Buchenau. *Anal. Jard. Bot. Madrid* 39: 79–151.
- Franchet, A. and Savatier, P. (1877–78) *Enumeratio Plantarum in Japoniae sponte crescentium*, vol. 2 [Pp. 1–256 publ. 1877; pp. 257–624 in 1878].
- Griffith, W. (1851a) *Notulae ad Plantas Asiaticas*, part 3.
- Griffith, W. (1851b) *Icones Plantarum Asiaticum*, part 3.
- Hämet-Ahti, L. (1980) The *Juncus effusus* aggregate in eastern North America. *Ann. Bot. Fenn.* 17: 183–191.
- Hara, H. (1966) *The Flora of Eastern Himalayas*. (University of Tokyo Press: Tokyo)
- Harriman, N.A. (1991) Juncaceae. Pp. 387–390 in M.D. Dassanayake and F.R. Fosberg (eds), *A Revised Handbook to the Flora of Ceylon*, vol. 7. (Amerind Publishing: New Delhi)
- Healy, A.J. and Edgar, E. (1980) *Flora of New Zealand*, vol. 3 (Govt Printer: Wellington)
- Hoffmann, G.F. (1800) *Deutschlands Flora*, edn 2 vol. 1.
- Hooker, J.D. (1892) *Flora of British India*, vol. 6.
- Johnson, L.A.S. (1991) New Australian taxa in *Juncus* (Juncaceae). Pp. 35–46 in M.R. Banks et al. (eds), *Aspects of Tasmanian botany — a tribute to Winifred Curtis* (Royal Soc. Tas.: Hobart)
- Kao, M.-T. and De Vol, C.E. (1978) Juncaceae. Pp. 148–156 in H.-L. Li (ed.) *Flora of Taiwan*, vol. 5. (Epoch Publishing: Taiwan)
- Keighery, G.J. (1985) Breeding systems of the Western Australian flora IV. *Juncus* and *Luzula* (Juncaceae). *Bot. Jahrb. Syst.* 105: 279–283.
- Kern, J.H. (1958) Juncaceae, a new family record for Malaya. *Gardens Bull. Singapore* 17 (1): 91–92.
- Kern, J.H. and Nootboom, H.P. (1979) Cyperaceae — II. Pp. 107–187 in C.G.G.J. van Steenis (ed.), *Flora Malesiana, ser. 1, Spermatophyta*, vol. 9 (1). (Noordhoff: Leiden)
- Kirschner, J., Novara, L.J., Novikov, V.S., Snogerup, S., and Kaplan, Z. (1999) Supraspecific division of the genus *Juncus* (Juncaceae). *Folia Geobot. Phytotax.* 34: 377–390.
- Kitagawa, M. (1979) *Neo-Lineamenta Florae Manshuricae*. (J. Cramer: Vaduz)
- Knuth, P. (1905) *Handbook of Flower Pollination*. (Translated by J.R. Ainsworth Davis) (Clarendon Press: Oxford)
- Krechetovich, V.I. and Goncharov, N.F. (1935 [English translation 1985]) Juncaceae. Pp. 504–576 in Shiskin, B.K. (ed.), *Flora of the USSR*, vol. 3. (Ed. Acad. Sci. URSS: Leningrad) [pp. 400–455 in English edition (Bishen Singh Mahendra Pal Singh/Koeltz: Dehra Dun /Koenigstein)]
- Laharpe, J.J.C. de (1825) *Essai d'une monographie des vraies Joncées*. [Preprint read 18 March 1825 (with separate pagination 1–93) of paper published in *Mém. Soc. Hist. Nat. Paris* ser. 2, 3: 89–181 (1827)]
- Larsen, K. (1972) Juncaceae. Pp. 167–169 in T. Smitinand and K. Larsen (eds), *Flora of Thailand*, vol. 2(2). (Applied Sci. Research Corp. Thailand: Bangkok)

- Léveillé, H. (1912) *Decades plantarum novarum LXXIII / LXXIV. Feddes Repert. Spec. Nov. Regni Veg.* 10: 348–352.
- Linnaeus, C. (1753) *Species Plantarum*, edn 1.
- Linnaeus, C. (1754) *Genera Plantarum*, edn 5.
- Lourteig, A. (1968) Révision de *Juncus* subgenus *Septati* Buch. section 29 Buch. *Bull. Comité Nat. Français Recherches Antarctiques, Biologie* 23: 33–49.
- McKean, D. R. (1979) Catalogue of the names published by Hector Léveillé: XX. *Notes Royal Botanic Garden Edinburgh* 45: 153–159.
- Makino, T. (1964) *New illustrated Flora of Japan* (Hokuryukan Co.: Tokyo)
- Miquel, F.A.W. (1867) *Annales Musei Botanici Lugduno-Batavi*, vol. 3. [Published with separate pagination as *Prolesio Florae Japonicae*, part 3 (1867)]
- Müller, H. (1883) *The Fertilisation of Flowers*.
- Nakai, T. (1928) *Report on the vegetation of Kamikochi of the Province of Shinano* [In Japanese except for English titles and photograph captions and plant names — seen Leiden]
- Nilsson, O. and Snogerup, S. (1971) Drawings of Scandinavian plants 45–64: *Juncus* L. *Bot. Not.* 124: 1–8, 179–186, 311–316; 435–441.
- Nilsson, O. and Snogerup, S. (1972) Drawings of Scandinavian plants 65–80: *Juncus* L. *Bot. Not.* 125: 1–8, 131–138, 203–211.
- Noltie, H.J. (1994) *Flora of Bhutan*, vol. 3(1). (Royal Botanic Garden: Edinburgh)
- Novara, L.J. (1976) Contribucion al conocimiento de las inflorescencias de *Juncus* y su significacion taxonomica. *Kurtziana* 9: 41–61.
- Ohwi, J. (1965) *Flora of Japan* (Smithsonian Institution: Washington)
- Podlech, D. (1979) Juncaceae. Pp. 347–416 in G. Hegi's *Illustrierte Flora von Mittel-europa*, edn 3 Band II Teil 1 (Paul Parey: Berlin)
- Ridley, H.N. (1935) Malayan species of *Juncus*. *J. Bot.* 73: 342–343.
- Satake, Y. (1933) Systematic and anatomical studies on some Japanese plants, II. *J. Fac. Sci., Tokyo, sect. 3, Bot.* 4: 131–223.
- Satake, Y. (1936) Trivial notes in Japanese plants (I). *J. Jap. Bot.* 12: 88–91
- Schouten, Y. and Veldkamp, J.F. (1985) A revision of *Anthoxanthum* including *Hierochloë* (Gramineae) in Malesia and Thailand. *Blumea* 30: 319–351.
- Schultes, J.A. and Schultes, J.H. (1829) *Systema Vegetabilium*, vol. 7, part 1.
- Snogerup, S. (1971). Juncaceae. In K.H. Rechinger (ed.), *Flora Iranica*, no. 75. (Akad. Druck- u. Verlag.: Graz)
- Snogerup, S. (1985) *Juncus*. Pp. 1–25 in P.H. Davis (ed.), *Flora of Turkey*, vol. 9 (Edinburgh Univ. Press: Edinburgh)
- Steenis, C.G.G.J. van (1972) *Mountain Flora of Java*. (Brill: Leiden)
- Steudel, E.G. (1855) *Synopsis Plantarum Glumacearum*, part 2.
- Van Royen, P. (1979) *Alpine Flora of New Guinea*, vol. 2. (J. Cramer: Vaduz)
- Veldkamp, J.F. (1977) A new *Juncus* from New Guinea (Juncaceae). *Blumea* 23: 415–416.
- Veldkamp, J.F. (1982) 158. *Juncus bufonius* Linné (Juncaceae) on Mt Kinabalu, Sabah. *Reinwardtia* 10: 25–26.
- Veldkamp, J.F. and Have, J.C. van der (1983) The genus *Trisetum* (Gramineae) in Malesia and Taiwan. *Gard. Bull. Singapore* 36: 125–135.
- Walker, E.H. (1976) *Flora of Okinawa and the Southern Ryukyu Islands*. (Smithsonian Institution: Washington)
- Wilson, K.L. (1986) Alpine species of Cyperaceae and Juncaceae. Pp. 471–488 in B.A. Barlow (ed.), *Origin and Evolution of the Australasian Alpine Biota*. (CSIRO/Brill: Melbourne)
- Wilson, K.L., Johnson, L.A.S. and Bankoff, P. (1993) *Juncus*. Pp. 266–289 in G.J. Harden (ed.), *Flora of New South Wales*, vol. 4 (University of New South Wales Press: Sydney)
- Wu, K.F. (1994) A study on the genus *Juncus* Linn. from China. *Acta Phytotaxonomica Sinica* 32(5): 433–466.

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ALA = *J. alatus*

ART = *J. articulatus*

BUF = *J. bufonius*

DEC = *J. decipiens* subsp. *decipiens*

DIAS = *J. diastrophanthus*

DMED = *J. decipiens* subsp. *medianus*

DSUN = *J. decipiens* subsp. *sundaicus*

DUR = *J. durus*

INF = *J. inflexus*

KRA = *J. krameri*

LEP = *J. leptospermus*

LES = *J. leschenaultii*

NUP = *J. nupela*

PAP = *J. papillosus*

PRIS = *J. prismatocarpus*

SAND = *J. sandwithii*

VIR = *J. virens*

WALL = *J. wallichianus*

*Albrecht, D.*, 32 (ART), 1563 (INF), 1706 (SAND); *Albrecht, Hakodate* (DIAS); *Alston* 14895 (LES); *Amin et al.* SAN 123533 (DMED); *Anderson* 766 (ART); *Andrew LAE* 57044 (LES), 57133 (DMED); *Averyanov et al.* VH1791 (LES).

*Backer* 15114 (LES), 12653 (LES); *Balansa* 2829 (LES); *Barclay* 2201 & *Synge* (LES); *Barnes* F9953 (DMED); *Bartlett* 7771 (LES); *Bean* 4562 (PRIS); *Beauglehole* 50411 (PRIS), 16432 (SAND); *Beauglehole* 87738 & *Huebne* (ART); *Bisset* 407 (LES); *Black, Mar* 1923 (PRIS); *Boden-Kloss*, 9 Jan 1913 (LES); *Brass* 4699 (DMED), 4804 (WALL), 9046 (WALL), 10737 (LES), 10745 (DMED), 11473 (DMED), 30651 (DMED); *Briggs* 6252 (INF), NSW 90848 (ART), NSW 90870 (ART); *Brinkman* 877a (WALL); *Brown (Bennett 5783)* (BUF), (*Bennett* 5784) (PRIS); *Burck* 32 (LES); *Burkill* 783 (LES), 823 (LES).

*Calléry*, 1840 (DMED); *Canning* 1789 (SAND); *Cheeseman* 24 (ART); *Chiao, C.Y.* 2823 (KRA), 14895 (ALA); *R.C. Ching* 8482 (LES); *Chung* 1706 (WALL), 2836 (LES); *Chungtien-Lijiang-Dali Expedition* 258 (KRA), 1140 (KRA); *Clarke* 15163 (LES), 16089 (LEP), 16103 (LEP), 18607 (LEP), *Khasia* (LEP); *Clayton* 5518 (WALL); *Clayton and Weerasooriya* 6067 (LES); *Clemens* 4076 (LES), 4481 (DMED), 5075 (DMED), 16259B (DMED), 30421 (?DSUN), 51674 (DMED) BS 15651 (DMED), BS 15665 (DMED); *Clunie et al.* LAE 63455 (WALL); *Conn & Akakauaro* 404 (DMED); *Coode et al.* NGF 40308 (WALL); *Cook* 199, *Rix & Schnelle* (LES); *Copeland* 1021 (DMED); *Coveny et al.* 16379 (ART), 17473 (SAND); *Coveny* NSW 94865 (SAND); *Craven* 2805 (WALL), 2829 (WALL), 2849 (DMED); *Croft and Lelean* NGF 34663 (DMED), 34669 (WALL); *Croft et al.* LAE 61840 (SAND), LAE 61941 (DMED), LAE 65172 (DMED); *Cruttwell* 1072 (DMED), 1315 (DMED); *Curtis* NSW 276213 (SAND); *Curtis s.n. & Cameron* (PRIS).

*Davidse* 7605 (WALL), 8323 (LES); *Dickins, July* 1876 (ALA), Oct 1881 (PAP); *Dodds* *Davis* 21037 (ART); *Drummond* 5001 (ART); *Druce* CHR 16543 (INF), CHR 158503 (PRIS).

*Eberhardt* 1839 (WALL), 1847 (WALL); *Edgar* CHR 149591 (INF); *Eichler* 15672 (ART); *Elmer* 5763 (DMED), 11436 (DMED); *Eyma* 4388 (WALL), 4579 (LES), 5057 (LES).

*Farges* 1256 (ALA); *Faurie* 150 (LES), 152 (DMED), 895 (PAP), 896 (LES), 1248 (PAP), 1292 (DIA, PAP), 1355 (PAP), 1411 (PAP), 1794 (LES, WALL), 1795 (LES), 1796 (DIAS), 1798 (DIAS), 1800 (PAP), 1805 (KRA), 1806 (KRA), 1808 (ALA), 2246 (DEC), 2250 (PAP), 2251 (ALA), 2521 (PAP), 3208 (WALL), 3343 (WALL), 5134 (KRA), 6556 (PAP), 15823 (WALL); *Fernald* 188 (ART); *Flenley* ANU 2157 (WALL), 2165 (DMED), 2519 (DMED); *Floyd & Womersley* 6296 (DMED), 6297 (DMED); *Forbes* 923 (LES); *Forbes* 923 (WALL); *Forrest* 8453 (LES); *Frodin* NGF 32104 (LES); *Furuse* 26741 (PAP), 42479 (PAP).

*Gamble* 1205 (WALL); *Gardner* 888 (PRIS); *Gardner* 927 (WALL); *Gibbs* 5927 (WALL); *Gilbert*, 1903 (DEC); *Gillison* NGF 25104 (WALL), NGF 25169 (WALL); *Gjellerup* 1186 (DMED); *Goering* 344 (DMED), *s.n.* (WALL); *Gray* 5873 (SAND); *Griffith* 5455 (LEP), 5459 (LEP), *Hb. Griffith* 5459 (LES), 5460 (LES); *Gross* NSW 451172 (ART); *Gunn* 1414 (SAND).

*Haines* 2025 (WALL); *Hansen* 10857, *Seidenfaden & Smitinand* (WALL), 10967 (LES); *Hara et al.* 6 Sep 1974 (PAP), 15 Sep 1974 (DIAS); *Hara*, 10 Aug 1933 (WALL); *Hartley* 13242 (LES); *Hartmann, Kneucker* 85 (ART); *Healy* 50/101 (INF), 58/379 (INF), 61/81 (INF), 61/73 (PRIS); *Henry* 1794 (ALA), 2471(LES), 2518(LES), 11920 (WALL); *Henty* NGF 20875 (LES); *Heyligers* 1868 & *Saunder* (DMED); *Hochreutiner* 2444 (WALL); *Hohenacker Pl. Indiae* 951 (WALL), 951a (WALL); *Hoogland & Schodde* 6767 (LES), 7176 (WALL), 7177 (LES), 7460 (DUR), 7478 (WALL), 7595 (DUR); *Hoogland & Pullen* 5268 (DMED), 5392 (LES), 6024 (WALL), 6244 (WALL); *Hoogland* 5394 (WALL), 9436 (WALL), 9445 (DMED); *Hooker & Thomson, Khasia* (LEP), *Khasia* (WALL), *Sikkim* (LES); *Hooker*, 3 Aug 1849 (WALL); *Hope* ANU 10638 (DMED), ANU 28035 (WALL); *Horsfield* 1070 (DMED), 1074 (WALL); *Hotta* 3905 (BUF); *Hsu* 5333 (LES); *Hu Shiu Ying* 7607 (DEC); *Hultén* 3046 (LES).

*Ito & Koyama* TSM 973 (KRA); *Iwatsuki & Koyama* PJE 798 (PAP).

*Jacobs* 7244 (DMED), 7063 (DMED); *Jayasuriya* 184 & *Wheeler* (LES); *Jeppesen* 577 (INF); *Johns et al.* 7915 (DMED), 7935 (WALL), 7968 (DMED); *Johnson & Blaxell* 741 (PRIS); *Johnson* 8285 (INF); *Johnson et al.* 7438 (PRIS), 7671 (SAND), NSW 19334 (SAND); *Johnson & Briggs* NSW 451170 (ART); *Junghuhn* 496 (LES), 602 (DMED).

*Kairo* NGF 30957 & *Streimann* (WALL); *Kalkman* 4843 (WALL), 5225 (LES); *Kao* 9751 (LES); *Karo* 89 (VIR), 353 (VIR), July 1899 (VIR), July 1900 (VIR); *Katik and Henty* LAE 70837 (DMED); *Kelly* CHR 178242 (PRIS); *Kerr* 3587 (LES), 5185 (DEC), 5438 (DEC), 20989 (DEC); *Kew-Edinburgh-Kathmandu Expedition* 130 (WALL); *Keysser*, Saruwaged-Gebirge (DMED); *King's Collector* 607 (DEC); *Kiryama* 17 (LES); *Kodala* 412, *Jobson & Coveny* (ART); *Komarov Fl. Manshuriæ* 354 (PAP), *Iter Kamczaticum I*, 25 Aug 1908 (LES); *Koorders* 26505 (DMED); *Koorders* 37457 (INF), 43479 (INF); *Kostermans* 813 (DMED), 2209 (WALL), 23383A (LES); *Kusnezow*, *Iter Bolon-Odshalense* 687 (PAP).

*Larsen and Larsen* 34513 (LES), 34514 (WALL); *Lazarides* 7203 (LES); *Lee & Kao* K3951 (DMED); *Leschenault*, montagnes de Nelly-gerry (LES); *Litvinov* 2139 (ART), 3408 (PAP); *Loerzing* 6020 (LES), 15059 (LES); *Loher*, *Pagio* (LES), 1765 (DMED), 1965 (DMED); *Lye* 5979 (LES).

*McKee* 1181 (DMED), 1251 (DMED), 1252 (DMED), 1260 (DMED), 1391 (DMED); *McKee and Floyd* 6381 (DMED); *Mangen* 617 (WALL), 734 (DMED); *Maries s.n.* (PAP), *s.n.*(DIAS); *Mason* 3098 (PRIS); *Mason & Moar* CHR 95785 (PRIS), CHR 95995 (PRIS); *Matthew*, Jan 1914 (LES); *Maximowicz Iter Secundum*, Hakodate, 1861 (DIAS, KRA), Kiusiu, 1862 (ALA), Kiusiu, 1863 (LES), Nagasaki, 1863 (DEC), Yokohama, 1862 (PAP), Yokohama, 1863 (WALL); *Mayebara* 2042 (WALL), 2048 (LES); *McClure* CCC 9224 (LES); *McComb & McComb* 1727 (ART); *McGregor* BS 8413 (DMED); *Mearns* BS 4261 (LES); *Meijer* 2778 (WALL), 5688 (LES), 6013 (LES); *Melderis* 541 (INF); *Melville* 647 (ART), 3832 (PRIS); *Melville et al.* 2742 (PRIS), 2955 (SAND); *Menzel* NSW 451169 (DEC); *Merrill* 4517 (LES), 4739 (LES), 4763 (DMED), 7794 (BUF), 11297 (WALL); *Migo*, 4 July 1932 (LES), 4 July 1932 (WALL); *Millar & Van Royen* NGF 15933 (DMED), 15947 (WALL); *Mizushima*, 1650 (DIAS), 15 July 1950 (LES); *Moi* 179 (DMED); *Mooney* 2216 (LES), 2228 (LES), 3242 (LES); *Mora* 16689 (DIAS).

*Nagamasu* 3738 (WALL); *Nie M.-X.* 92152 (ALA); *Nijalingappa* 36 (WALL); *Noguchi* 3461 (LES).

*Ohwi* 2034 (DMED), 2040 (LES), 9198 (ALA); *Ohwi & T. Koyama* NSM 310 (LES); *Okamoto* NSM 585 (PAP); *Oldham* 579 (LES), 580 (DMED), 897 (LES); *Orchard* 5009 (ART); *Otto-Surbeck* 84 (LES).

*Paijmans* 710 (WALL), 1293 (DMED); *Panigrahi* 3925 (LES); *Playfair* 50 (LES); *Poilane* 23114 (LES), 24425 (LES); *Poore* 470 (LES); *Powell* UPNG 2460 (LES); *Purdom*, 1910 (ALA), *Tai pai Shan – Shansi* (ALA).

*Rahmat Si Boea* 1090 (LES), 6000 (LES); *Ramamoorthy* HFP 1294 (LES); *Ramesh Bedi* 698 (ART); *Ramos & Edaño* BS 40202 (DMED), BS 40417 (LES), BS 45007 (DMED); *D. Ratkowsky* NSW 276209 (SAND), JS 111 & *A. Ratkowsky* (SAND); *Rau* 18 (DMED); *Raven* 25929, *Engelhorn & Morris* (ART); *Raynal* 17055 (LES); *Richter*, *Kneucker* 85a (ART); *Ridley*, 8 Feb 1921 (LES), 11 Feb 1921 (LES); *Robbins* 86 (WALL), 273 (WALL), 379 (WALL), 280 (LES), 3165 (WALL), 3237 (WALL); *Robinson & Kloss*, 25 May 1914 (DSUN); *Rodin* 5527 (ART); *Hb. Royle*, NW India (LES); *Rubtzoff*, 2 Aug 1956 (PRIS).

*Sampson* 843 (DEC), 30 Apr 1884 (WALL); *Santos* BS 31864 (DMED); *Satow* 532 (DIAS), 5311 (WALL); *Saulière* 2 (WALL); *Savatier* 1353 (DEC), 1354 (KRA), 1355 (PAP), 1356 (LES), 1978 (ALA), 2521 (PAP); *Schmidt* 51 (LES); *Schneider* 2832 (ART); *Schodde* 205 (LES), 1646 (LES), 2007 (LES), 2008 (DMED); *Shantung University Collection*, Aug 1924 (WALL); *Shearer*, 1873 (ALA); *Shiu Ying Hu* 11577 (LES); *Short* 1798 (SAND); *Sieber*



*Herb. Mixt.* 630 (PRIS), *Herb. Nov. Holl.* 431 (PRIS); *Siebold s.n.* (LES); *Simada* 1027A (WALL); *Sinclair* 4956 (DEC), 9935 (LES); *Sleumer & Vink* BW 4358 (DMED), 4363 (LES), BW 14019 (WALL); *Smail* NSW 451168 (DEC); *Smith, L.*, 3020 (ART); *Smith, J.M.B.*, 464 (BUF), 520 (BUF), ANU 15199 (DMED), 12 Aug 1967 (BUF); *Smitinand and Alsterlund* 6688 (LES), 6721 (LES); *Soehoed Sosrodihardjo* 58 (DMED); *Sohmer et al.* LAE 75534 (LES); *Sohmer and Waas* 10497 (LES); *Sonohara et al.* SIRI 6271 (LES); *Sorenson* 3316, *Larsen & Hansen* (LES); *Sterly* 1645 (LES), 1655 (DMED), 1666 (DMED), 75-456 (DMED), 80-160 (DMED); *Stainton, Sykes and Williams* 3681 (WALL); *Stevens* LAE 54156 & *Veldkamp* (DMED); *Stevens* LAE 54657 & *Grubb* (LES); *Steward* 2102 (LES); *Suzuki* 438-1 (ALA), 438-2 (DIAS); *Symon* 1205 (ART).

*Tagawa* 3228 (LES); *Takeuchi* 5888 (DMED); *Taquet* 1861 (LES), 1869 (LES), 1962 (PAP), 1998 (PAP); *Tateishi* 456 & *J. Murata* (PAP); *Terasaki*, Aug 1905 (KRA); *Thakur Rup Chand* 1819A (WALL), 5500 (DEC), 7546 (LES); *Thompson* 2455 p.p. (SAND); *Thomson*, Aug 1847 (ART); *Thorne* 47025 & *Alava* (ART); *Thwaites* CV844 (LES); *Tindale* 7041 & *Sykes* (ART); *To Kang P'eng* 2870 & *E.H. Groff* (WALL); *Togashi* 38 (DEC); *Togasi* TNS 1412 (PAP), TNS 1757 (DEC); *Tolkin, Simoda* (DEC); *Tsang* 20071 (LES), 20636 (WALL), 217 u.u. 16962 (LES), 23609 (DEC), 23760 (ALA), 29767 (DEC).

*Ui*, 4 Aug 1934 (WALL).

*Van Balgooy* 388 (DMED); *Van der Pijl* 567 (DMED); *Van Slooten* 751 (DMED); *Hb. Van Royen* L sheet 904,145-433 (BUF); *Van Steenis* 4090 (WALL), 4100 (LES), 4258 (LES), 6396 (DSUN), 8411 (DSUN), 9605 (DSUN), 11000 (INF), 12331 (DMED), 20833 (DMED); *Veldkamp* 6369 (NUP); *Verdcourt* 5182 (WALL), 5188 (WALL); *Versteegh* BW 3020 (DMED), BW 3047 (LES); *Vidal* 1584 (DEC); *Vidal et al.* 6254 (LES); *Vinas* UPNG 2535 (WALL); *Vink* 16452 (DMED); *Vink* 8587 & *Schram* (LES), BW 8960 (WALL).

*Waas* 1487 (LES); *Walker, D.*, ANU 381 (WALL), ANU 511 (WALL), ANU 554 (DMED), ANU 616 (LES); *Walker, Col.*, 99 (WALL); *Walker, E., et al.* SIRI 6445 (WALL); *Wallich* 8999 (WALL), 1821 (WALL); *Wang, T.* 3949 (ART); *Wang Z.-T. et al.* 870221 (ALA); *Whiting* 251 & *Stewart* (LES); *Widjaja* EAW 4479 (DMED); *Widjaja et al.* EAW+EW6375 (DMED); *de Wilde, W.J.J.O. & de Wilde-Duyffes* 13328 (DSUN), 13521 (KLES), 15174 (DSUN), 15944 (DSUN), 16029B (DSUN); *Wilford* 809 (LES); *Williams* 1974 bis (LES); *Willis*, 2 July 1970 (DMED); *Wilson* 2214 (PRIS), 6042 (PRIS), 6440 (ART), 6962 (SAND), 8308a (SAND), 8553 (PRIS); *Wilson et al.* 1065 (ART), 7987a (ART), 7997 (PRIS); *Womersley* NGF 11203 (LES), NGF 15295 (WALL), NGF 15298 (MDEC); *Wright* 329 (LES).

*Yamamoto* 8377 (DIAS); *Yang* 2680 (LES); *Yao* 8713 (LES); *Yotoyama* 318 (WALL); *Zotov* CHR 4547 (PRIS).

*Zimmerman* 512 (PAP).