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DETERMINATION OF DIFFERENT *JUNCUS* (JUNCACEAE) SPECIES OCCURING IN SRI LANKA

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ABSTRACT

Three species of *Juncus*, *J.effusus*, *J. bufonius* and *J. prismatocarpus* have been recorded in Sri Lanka. A recent study on *Juncus*, in the Malesian region cites few voucher specimens collected from Sri Lanka, identified as *J. prismatocarpus* R.Br. during the revision of the Sri Lankan Flora under two other species, *J.wallichianus* Laharpe and *J. leschenaultii* J. Gay ex Laharpe. A study was carried out in order to ascertain the true composition of the genus *Juncus* that occur in Sri Lanka. Collections were made from all possible locations and the morphological characters were coded and analyzed statistically. The results revealed the presence of four different *Juncus* species in the island and they were identified as *J. effusus* L., *J. bufonius* L., *J. wallichianus* Laharpe and *J. leschenaultii* J. Gay ex Laharpe. *J. wallichianus* Laharpe and *J. leschenaultii* J. Gay ex Laharpe are here recorded in Sri Lanka for the first time. Further, it became evident that *J. prisamtocarpus* R.Br. does not occur in Sri Lanka and records of its occurrence were due to misidentification.

INTRODUCTION

Juncaceae is a widely distributed family throughout the world except in Antarctica. The species are concentrated in temperate and cold regions of both hemispheres. At tropical latitudes, the family is found only in the highlands (Balslev, 1996). Morphologically Juncaceae resembles Poaceae and Cyperaceae with narrow leaves and inconspicuous flowers in inflorescences (Hafliger *et al*, 1982). The family is commonly known as the rush family. According to Balslev (1996), the family contains 8 genera with about three hundred species and the largest genus is *Juncus* with over two hundred species. The family is represented in Sri Lanka by the genus *Juncus*.

The taxonomic treatment by Trimen (1898), in Handbook to the Flora of Ceylon recognizes two species of *Juncus* namely *J. effuses* L. and *J. prismatocarpus* R. Br. Thwaites (1864), has mistakenly mentioned *J. glaucus* in Sri Lanka due to its close resemblance to *J. effusus*. But *J. glaucus* differs from *J. effusus* by having 6 stamens and *glaucus* stems. In addition to *J. effuses* and *J. prismatocarpus,* the most recent taxonomic treatment by Harriman (1991), for the Revised Handbook to the Flora of Ceylon recognizes *J. bufonius* L. as occurring in Sri Lanka According to Wilson and Johnson (2001), *J. bufonius* L. belongs to the section Tanageia, *J. effusus* L. to section Juncotypus while *J. prismatocarpus* R. Br. falls under section Ozophyllum. A recent study of *Juncus*, in the Malesian region by Wilson and Johnson (2001) cites few voucher specimens collected from Sri Lanka, identified as *J. prismatocarpus* during the revision of the Sri Lankan Flora under two other species, *J. wallichianus* Laharpe and *J.leschenaultii* J. Gay ex Laharpe. This raises the question of the number and the identity of the *Juncus* species that occur in Sri Lanka. Therefore, the present study was undertaken to determine the identity of different Sri Lankan *Juncus* species.

Morphology and ecology of *Juncus* spp. that occur in Sri Lanka

Juncus species are annual or perennial, glabrous, tufted herbs resembling sedges (Figure 1; a). The culms are terete or compressed. The leaves are sheathing at base (in *J. effusus* where reduced leaves are present), blades flat, terete, channeled, compressed or reduced to a mucro-like blade on a sheath (a cataphyll in section Juncotypus, Figure 1; b) or internally septate with transverse and longitudinal septa. Lowest involucral bract is culm-like or leaf-like (Figure 1; c). Flowers are numerous, bisexual, three-merous and hypogynous, each flower subtended by two bracteoles (Figure 1; d) or ebracteolate. Inflorescences are terminal in *J. bufonius* and *J. prismatocarpus* while appearing lateral in *J. effusus*, where the lowest involucral bract is relatively long and erect simulating a continuation of the stem pushing the inflorescence to a side (Figure 1; e). Each, inflorescence branch is subtended by two floral bracts or by a two-keeled

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bract, prophyll which is at the base of the inflorescence adaxially to the lower most involucral bract. Tepals are green, brown or reddish brown, 6 in number and persistent in fruit. The number of stamens varies from 3 to 6. The fruit is a capsule, 1 to 3 locular, three-septate and dehiscent from above into three valves (Figure 1; f). Seeds are numerous, orange-yellow in colour (Figure 1; f) (Bentham and Ferdinand, 1878; Hooker, 1894; Backer, 1951; Soerjani *et al*, 1987; Harriman, 1991 and Wilson and Johnson, 2001).

The occurrence of *Juncus* is confined to more or less wet places at higher elevations, often in a few inches of standing water. *J.effusus*, *J. bufonius* and *J. prismatcarpus* have been recorded from the montane zone where the conditions are influenced by human activity. They are known to occur along roadsides and in gardens etc. Therefore, these species are commonly found at elevations of 1500 m and above in the montane zone. e.g. Nuwara Eliya, Horton Plains, Pidurutalagala, Loolkandura, Pussellawa etc.

MATERIALS AND METHODS

A thorough literature survey was carried out in order to identify characters of *J.prismatocarpus*. Much of the literature gives confusing descriptions about *J. prismatocarpus*. Therefore, the characters given in recent works by Wilson and Johnson (2001) and Snogerup *et al* (2002) were followed.

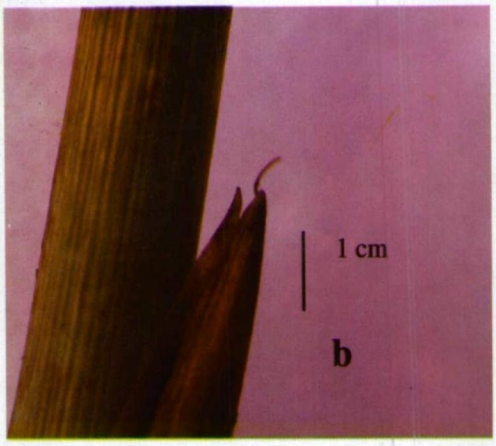
Collection of Materials

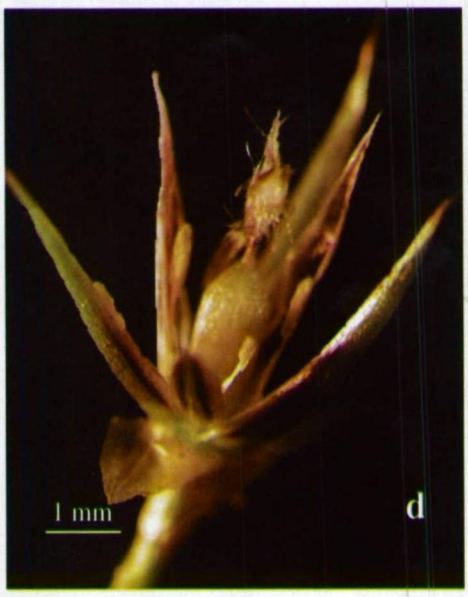
Live specimens of *Juncus* were collected from all the recorded locations in Sri Lanka. Further several other field collections were made in the areas at an elevation of 1500 m and above in order to cover a wide area, specially unrecorded locations.

No attempt was made to identify the specimens at the time of collection but inclusion of plants covering all character combinations was ensured. A few representative specimens were selected and were given specimen numbers for easy reference. The location, voucher specimen number and other details of a selected set of collected specimens are given in Table 1.

Table 1. The table of collected specimens and supporting information

Species	Locality	Voucher Number	Collecting Date
J. bufonius	Pidurutalagala-Pedro farm, ditch by the road	B1	25.04.2003
	Ambewela- Farm, ditch by the road	B2	20.01.2004
J. effusus	Ambewela –Farm, marshy land on either side of the main road	E1	28.01.2003
	Nuwara Eliya- Gregory lake	E2	05.05.2003
	Horton plains –Near Anderson bungalow, common by pool	E3	05.05.2003
	Pidurutalagala-Pedro farm, near pool	E4 E5	25.04.2003 20.01.2004
J. prismatocarpus (Collected from locations according to Harriman, 1991 and suspected possible locations)	Dayagama-in drains and ditches on either side of the road	P1,P2	28.01.2003
	Ambewela-marshland on side of the main road	P3	28.01.2003
	Pidurutalagala-Pedro farm, common in ditch	P4,P5	25.04.2003
	Lindula-ditch on a side of the main road	P6	25.04.2003
	Loolkandura estate-in drains	P7	15.05.2003
	Loolwatta estate- in drains near the main road	P8	20.06.2003
	Kobonilla estate- in drains near the main road	P9	20.06.2003
	Bambarella- in drains near the main road	P10	10.09.2003
	Adam's Peak- in drains	P11	01.02.2004





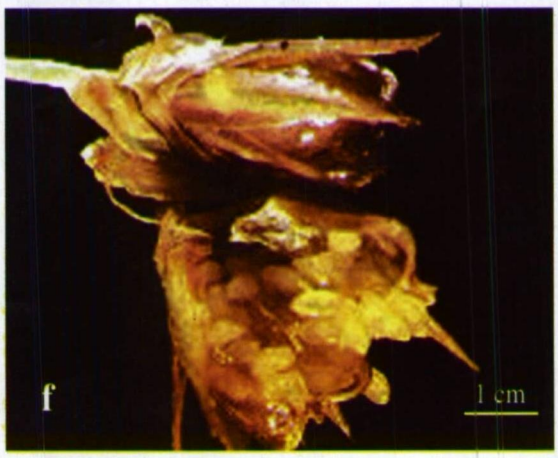


Figure 1. a) sedge like habit of *J. effusus*; b) a cataphyll of sect. Juncotypus; c) leaflike lowermost involucral bract of *Juncus*; d) a flower with distinct perianth, stamens and superior ovary; e) lateral inflorescence of *J. effusus*; f) a dehisced capsule exposing seeds which are yellow in colour and numerous.

Morphological studies

Fresh samples were dissected and observed with the naked eye as well as under magnification. Flowers were dissected and studied under the stereomicroscope. Dissecting was done cautiously due to the minute size of flower parts. The anatomy of the culm was observed using transverse sections stained in safranine following standard staining techniques, under the light microscope. Measurements of relatively large plant parts were made using a metre scale while the measurements of smaller parts were made using the calibrated eyepiece graticule. Accurate drawings were made where necessary with the help of a camera lucida.

Data analysis

Morphological characters were scored by reviewing previous work and searching for characters that had not been previously analyzed. The characters and their respective states are given in the Table 2. The characters were then coded into a data matrix (Table 3). Due to the variations in height, colour of various plant parts, inflorescence etc. a cluster analysis using Average method of SAS program, was carried out in order to identify the number groups of taxa with different character combinations.

RESULTS AND DISCUSSION

A total of 48 characters was scored for the analysis depending on the variations observed. The resulting dendogram from the cluster analysis is given in figure 2. Cluster analysis resulted in two major clusters at an average distance of 8.5 and each of these groups separated at a distance of 6.8 giving two other sub-groups. Considering the average distance of 6.8, the groups separating at this distance were used to identify taxa. Going through the character combination of each group, the first group consisting of B1 and B2 corresponds to the character combination of *J. bufonius*. The second group corresponded to the character combinations of *J. effusus*. The specimens collected with this character combination showed high variation during coding of characters, but the cluster analysis revealed only a single group at an acceptable distance of 6.8 being the average distance between clusters.

The second large group that separated early, i.e. at a distance of 8.5, encompassed all the taxa that were considered as *J.prismatocarpus* during previous taxonomic treatments. The character combination of the large group was a combination of characters that did not match unequivocally with a single species *J. prismatocarpus*, *J. wallichianus* or *J.leschenaultii*. But the character combination of the two groups separating within this group at a distance of 6.8 matched with the characters of *J. wallichianus* (P1 and P5) and *J. leschenaultii* (P2 – P 4 and P 6-P11). Character combinations of both species showed distinct variations from true *J. prismatocarpus*. A comparison of the characters of *J. wallichianus* and *J. leschenaultii* together with *J. prismatocarpus* is given in Table 4.

The characters such as robustness, culm colour and diameter, width of hyaline leaf sheath margin (Figure 3; c and d), length of auricles, flower cluster, stigma colour (Figure 3; e, and f), capsule length relative to tepals, capsule colour and capsule shape are non-overlapping characters that can be used to distinguish these two species from 'true *prismatocarpus*'. According to the literature (Wilson and Johnson, 2001) true *J. prismatocarpus* is a very robust species compared to the other species, *J.wallichianus* and *J. leschenaultii*. The non-robust species is the suspected *J. leschenaultii*, *J.wallichianus* being medium- robust.

The culms of *J. wallichianus* and true *J.prismatocarpus* are erect but *J. leschenaultii* is slightly decumbent. Culm colour also varies among the species where it is entirely mid green in *J. wallichianus* and yellow green with mid-green shades in *J. leschenaultii*. In true *J.prismatocarpus* it is entirely yellow green. The culm is compressed in *J. leschenaultii* and true *J.prismatocarpus*, but *J. wallichianus* differs in culm being terete. Culm diameter is another character to distinguish the other two species from true *J. prismatocarpus*. The culm of true *J.prismatocarpus* is 2-3 mm in width and it has the widest culm compared to the other two, *J.wallichianus* which is 1-1.25 mm in width and *J.leschenaultii* which is 1.3- 2.00 mm wide.

Character		Character state
1.	Culm length	Less than 10cm, 11cm-40cm, 45cm-118cm,
2.	Culm diameter	Less than or equal to 0.375mm, 1.00mm- 1.25mm, 1.30mm-2.00mm,more than 2.00mm
3.	Culm shape	Terete, compressed
4.	Culm colour	Entirely mid green, yellow green with mid green shades, entirely yellow green
5.	Culm hardness	Hard, soft
6.	Longitudinal culm striations	Present, absent
7.	Leaf diameter	Less than 0.20mm, 0.40mm-0.50mm, 1.10mm-1.35mm, 1.40mm-2.50mm
8.	Leaf type	Tubular, non tubular
9.	Leaf shape	Flat, convex, terete, mucrolike thread
10.	Leaf septa	Septate, aseptate
11.	Type of septa	Transverse, both transverse and longitudinal, not applicable
12.	Leaf form	Unitubulose, pluritubulose, not applicable
13.	Cataphylls	Present, absent
14.	Hyaline Leaf sheath margin	Present, absent
15.	Width of hyaline margin	Less than 0.40mm,0.50mm-1.00mm, more than 1.5mm, not applicable
16.	Leaf sheath colour-inside	Straw brown, yellow green, whitish green
17.	Leaf sheath colour-outside	Maroonish brown, yellow green, mid green, yellowish green with maroon shades
18.	Point of attachment of leaves	From base of the culm, along the culm
19.	Auricles	Absent, present
20.	Length of auricles	less than 1.00mm, more than 1.00mm, not applicable
21.	Inflorescence position	Terminal, lateral
22.	Inflorescence length	1.00cm-4.00cm, 7.00cm-15.00cm
23.	Arrangement of inflorescence branches	Spread, slightly spread, compact to highly compact
24.	Number of flowers per head	1, 2-4, 6-15, 17-20
25.	Number of heads per inflorescence	8-17, 20-30, more than 30
26.	Involucral bract form	Leaf like, culm like
27.	Number of involucral bracts	1,2
28.	Specialized 2 keeled bract (prophyll)	Absent, present
29.	Floral bracts texture	All papery, only upper ones papery
30.	Bracteoles	Absent, present
31.	Respective lengths of inner and outer tepals	Inner and outer tepal length similar, outer tepals longer than inner tepals
32.	Hyaline margins of tepals	Very broad, medium broad, narrow
33.	Inner tepal colour	Green with brown stripes, mid green, yellow green to maroonish green, reddish green
34.	Outer tepal color	Yellow green, mid green, yellow green to maroonish green, reddish green
35.	Tip of the tepal	Acuminate, acute
36.	Number of stamens	3,4-6
37.	Length of filament	0.375mm- 0.45mm, 0.50mm-0.55mm,0.75mm, 0.80mm-1.125mm
38.	Stigma colour	Greenish yellow, dark pink, maroon
39.	Capsule colour	Brownish yellow, golden brown, golden brown with apex red
40.	Beak length	0.115mm - 0.125mm, 0.15mm-0.20mm, 0.25mm and above
41.	Capsular length relative to tepals	Shorter than tepals, equal to tepals, much longer than tepals
42.	Capsule shape	Ovoid, broadly ovoid, narrow oblong
43.	Seed colour	Light yellow to white, orange yellow, dark yellow with both ends maroon, orange yellow with one end in maroon colour
44.	Seed length	0.30mm or less, 0.325mm-0.375mm, 0.40mm and above
45.	Annual or perennial	Annual, perennial
46.	Leafy outgrowths of propagation	Present, absent
47.	Shape of transverse section of culm	Round, ovoid, ellipsoid
48.	Shape of pith cells	Round oval, stellate

Table 3. Data Matrix of morphological character used in the cluster analysis

	Culm length	Culm diameter	Culm shape	Culm color	Culm hardness	Longi. Culm striations	leaf diameter	Leaf type	Leaf shape	Leaf septa	Type of septa	Leaf form	Cataphylls	Hyaline leaf sheath margin	Width of hyaline margine	Leaf sheath color - inside	Leaf sheath color - outside	Point of occurrence of leaves	Auricles	Length of auricles	Inflorescence position	Inflorescence length	Arrangement of infl. Branches	# of flowers per head	# of heads per infl.	Involucral bract form	# of involucral bracts	Prophyl	Floral bract form	bracteoles	Respective lengths - Tepals	Hyaline margins - Tepals	Inner tepal color	Outer tepal color	Tip of the tepal	# of stamens	Length of filament	Stigma colour	Capsule color	Beak length	Capsule length w.r.t. tepals	Capsule shape	Seed color	Seed length	Annuals or perennials	Leafy outgrowths, propagations	Shape of transverse sections	Shape of pith cells
B1	0	0	0	2	0	1	1	1	0	1	2	2	1	0	1	1	1	1	0	2	0	1	1	1	1	0	0	0	1	1	0	0	0	0	1	2	0	0	1	0	0	1	0	0	0	0
B2	0	0	0	2	0	1	1	1	0	1	2	2	1	0	1	1	1	1	0	2	0	1	1	1	1	0	1	1	0	1	0	0	0	0	1	1	2	0	0	0	0	1	0	0	0	0
P1	1	1	0	0	0	1	2	0	2	0	0	0	1	0	3	2	2	1	1	1	0	1	0	3	0	0	0	0	0	1	0	0	1	3	3	1	0	3	2	2	2	1	0	3	1	1	0	1	0
P2	1	2	1	1	1	1	3	0	1	0	1	1	1	0	2	2	1	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	2	2	2	1	0	0	0	1	1	2	2	0	1	1	0	2	0
P3	1	2	1	1	1	1	3	0	1	0	1	1	1	0	2	2	1	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	2	2	2	1	0	0	0	1	1	2	2	0	1	1	0	2	0
P4	1	2	1	1	1	1	3	0	1	0	1	1	1	0	2	2	3	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	2	2	2	1	0	0	0	2	1	2	2	0	2	1	0	2	0
P5	1	1	0	0	0	1	2	0	2	0	0	0	1	0	3	2	2	1	1	1	0	1	0	3	0	0	0	0	0	1	0	0	1	3	3	1	0	3	2	2	2	1	0	3	1	1	0	1	0
P6	1	2	1	1	1	1	3	0	1	0	1	1	1	0	2	2	1	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	1	2	2	1	0	0	0	1	1	2	2	0	2	1	0	2	0
P7	1	2	1	1	0	1	3	0	1	0	1	1	1	0	2	2	3	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	2	2	2	1	0	0	0	2	1	2	2	0	2	1	0	2	0
P8	1	2	1	1	1	1	3	0	1	0	1	1	1	0	2	2	3	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	2	2	2	1	0	0	0	2	1	2	2	0	1	1	0	2	0
P9	1	2	1	1	0	1	3	0	1	0	1	1	1	0	2	2	3	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	1	2	2	1	0	0	0	2	1	2	2	0	2	1	0	2	0
P10	1	2	1	1	0	1	3	0	1	0	1	1	1	0	2	2	3	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	2	2	2	1	0	0	0	1	1	2	2	0	2	1	0	2	0
P11	1	2	1	1	0	1	3	0	1	0	1	1	1	0	2	2	3	1	1	0	0	1	0	2	0	0	0	0	0	1	0	0	2	2	2	1	0	0	0	1	1	2	2	0	1	1	0	2	0
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E3	2	3	0	0	1	0	0	1	3	1	2	2	0	1	0	0	0	0	0	0	2	1	0	2	0	2	1	0	1	0	1	0	1	1	1	1	1	0	0	1	1	0	1	1	2	1	1	1	0	1
E4	1	1	0	0	1	0	0	1	3	1	2	2	0	1	0	0	0	0	0	0	2	1	0	2	0	2	1	0	1	0	1	0	1	1	1	1	0	0	0	1	1	0	1	1	2	1	1	1	0	1
E5	2	3	0	0	1	0	0	1	3	1	2	2	0	1	0	0	0	0	0	0	2	1	0	2	0	2	1	0	1	0	1	0	1	1	1	1	0	0	0	1	1	0	1	1	2	1	1	1	0	1

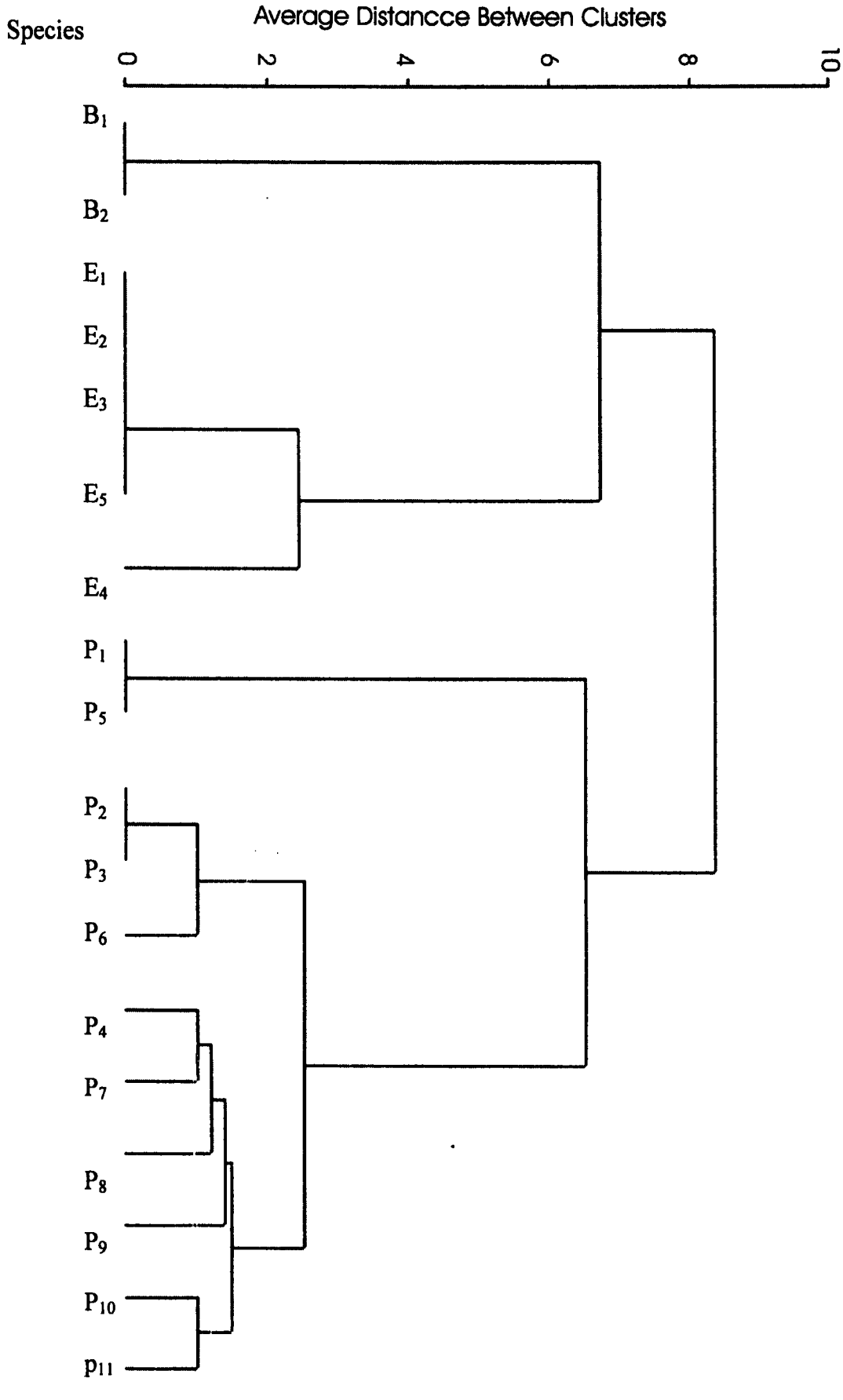

Figure 2.The dendogram obtained from cluster analysis.

Table 4.Table of character variations in the three species; *J. prismatocarpus, J. leschenaultii* and *J. wallichianus*. The characters/states in bold are non-overlapping.

Character	*J. prismatocarpus*	*J. wallichianus*	*J. leschenaultii*
Robustness	**Very robust**	**Medium robust**	**Not robust**
Habit of the culm	Erect	Erect	Slightly decumbent
Culm colour	**Entirely yellow green**	**Mid green**	**Yellow green with mid green shades**
Culm shape	Compressed	Terete	Compressed
Culm diameter	**2-3mm**	**1-1.25mm**	**1.3-2.00mm**
Leaf form (Figure 3, a and b)	Pluritubulose	Unitubulose	Pluritubulose
Leaf septa type (Figure 3, a and b)	Both transverse and longitudinal septa	Only transverse septa	Both transverse and longitudinal septa
Width of hyaline leaf sheath margin (Figure 3, c and d)	**0.8-1.5mm**	**More than 1.5mm**	**0.5-1.00mm**
Length of auricles	**0.5-1.00mm**	**1.5-2.00mm**	**0.5-0.8mm**
Flower cluster	**Very dense (about 25 flowers per cluster)**	**Medium dense (17- 20 flowers per cluster)**	**Loosely flowered (8-15)**
Stigma colour (Figure 3, e and f)	**Not given in publication**	**Maroon**	**Greenish yellow**
Capsule length relative to tepals	**Exceed tepals by 1-3mm to twice as long as tepals**	**Equal to or slightly exceed tepals**	**Exceed tepals slightly or by 1mm**
Capsule color	**Golden brown**	**Golden brown with reddish shades**	**Golden brown with apex reddish sometimes**
Capsule shape	**Strongly elongated, very narrow**	**Ovoid**	**Narrow oblong**

The leaf is another morphological character to differentiate the three species. Leaf form is pluritubulose in true *J. prismatocarpus* and *J. leschenaultii* while in *J. wallichianus* it is unitubulose. Similarly, the former 2 species have both longitudinal and transverse septa while in *J.wallichianus* only transverse septa are present. Width of hyaline leaf sheath margin of true *J.prismatocarpus* is intermediate between the suspected species. Length of auricles also behaves in the same manner.

Flower clusters of true *J.prismatocarpus* are very dense compared to those of other 2 species, containing about 25 flowers per cluster. In *J. wallichianus* it is medium dense while *J. leschenaultii* is loosely flowered. Stigma colour is also distinct between the two species; where in *J. wallichianus* the stigma was maroon in colour while in *J.leschenaultii* it was greenish yellow in colour. Unfortunately, stigma colour for true *J.prismatocarpus* was not given in any publication.

The capsule of true *J. prismatocarpus* is twice as long as the tepals while in other two species it is less than twice as long. The colour of the capsule is also variable among the species. In true *J. prismatocarpus* it is golden brown in colour while in *J. wallichianus* it is golden brown with a reddish apex. In *J. leschenaultii* the capsule is golden brown with an apex, which is not always reddish. The capsule is strongly elongated and very narrow in true *J.prismatocarpus* but it is not so elongated in the other two species (Figure 4). In *J. wallichianus* the capsule is ovoid in shape while in *J.leschenaultii* it is narrow oblong in shape.

Both species *J. leschenaultii* and *J.wallichianus* have characters that overlap with true *J. prismatocarpus*. For example, leaf form and characters of the culm of *J. leschenaultii* overlap with true *J. prismatocarpus*. Further, the culms in

Figure 3. a) unitubulose leaf with only transverse septa of *J. wallichianus*; b) pluritubulose leaf with both transverse and longitudinal septa of *J. leschenaultii*; c) relatively narrow hyaline leaf sheath margin of *J. leschenaultii*; d) relatively broad hyaline leaf sheath margin of *J. wallichianus*; e) maroon stigma of *J. wallichianus* and f) yellowish green stigma of *J.leschenaultii*.

J. wallichianus and true *J.prismatocarpus* are both erect, while in *J.leschenaultii* the culm is slightly decumbent. But most characters differ among the species.

The characters listed under *J.prismatocarpus* in the Revised Handbook to the Flora of Ceylon are a combination of characters of *J. wallichianus* and *J. leschenaultii* and are different from the characters of true *J. prismatocarpus*. Further, most of the characters have not been studied or listed during the revision, e.g. colour of the culm, auricles, hyaline margins of leaf sheaths and capsule shape. Certain characters of *J.prismatocarpus* in the Revised Handbook to the Flora of Ceylon are given in Table 5. According to the character comparison in Table 5, a combination of characters of *J. wallichianus* and *J.leschenaultii* is given under *J.prismatocarpus*. From those characters, again the capsule length can be used to separate the species. It distinguishes true *J. prismatocarpus* from other two species as well as from the *J.prismatocarpus* as described in the Flora.

Considering the above comparison of character combinations, it is confirmed that *J.wallichianus* and *J. leschenaultii*, are two distinct species that occur in Sri Lanka. Further, true *J.prismatocarpus* does not occur in Sri Lanka. Citation of *J. prismatocarpus* as a species that occur in Sri Lanka is due to a misidentification. According to the literature *J. prismatocarpus*, *J.wallichianus* and *J. leschenaultii* are three species that closely resemble each other but are distinct and could be un-mistakably identified through close examination. Furthermore, *J.prismatocarpus* occurs only in Australia and New Zealand (Wilson and Johnson, 2001).

The voucher herbarium specimens that are deposited at the National Herbarium, National Botanical Gardens, Peradeniya identified as *J. prismatocarpus* are either belong to *J. wallichianus* or *J. leschenaultii*.

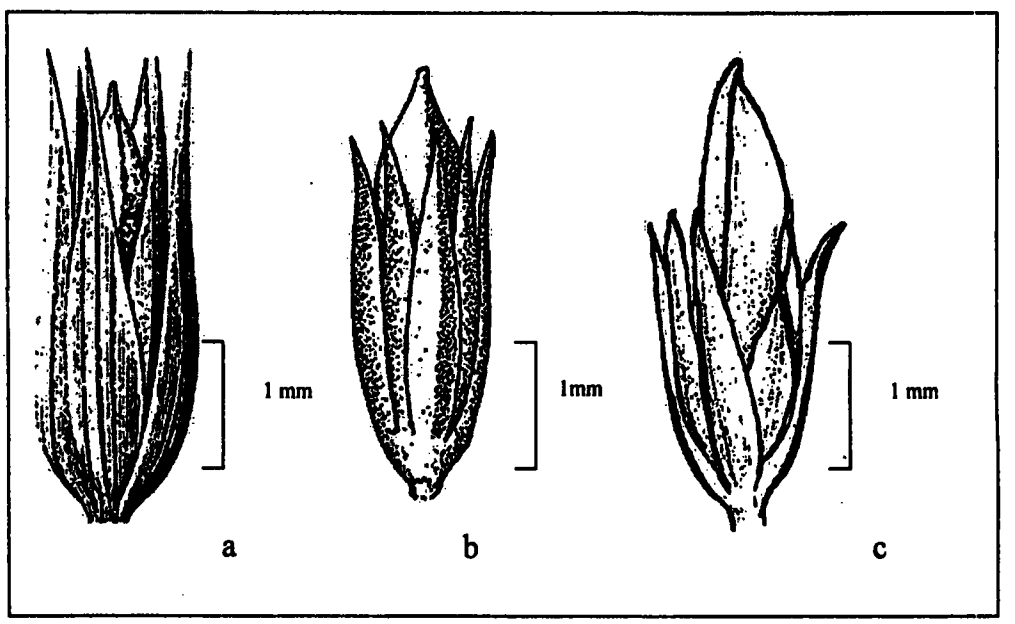

Figure 4. Capsules of different species; a) capsule of *J. wallichianus*; b) capsule of *J. leschenaultii*; c) capsule of *J. prismatocarpus*

Table 5. Table of character comparison with *J. prismatocarpus* in the Revised Hand Book to the Flora of Ceylon (Harriman, 1991).

J. prismatocarpus (Harriman, 1991).	*J. wallichianus*	*J. leschenaultii*	*J. prismatocarpus.* Wilson and Johnson (2001)
Septate leaves i.e. transverse septate species and species with both transverse and longitudinal septa in one group	Only transverse septate leaves	Both types of septa (transverse and longitudinal) present in leaves	Both types of septa (transverse and longitudinal) present in leaves
Capsule exceed tepals by 1mm (Figure 4)	Capsule exceeds slightly or equal to tepals	Capsule exceeds tepals by 1mm	Capsule exceeds tepals by 1-3mm to twice as long as tepals

The voucher specimens, D.Clayton 5518 and G. Davidse 7605 are specimens belonging to *J.wallichianus* while M. Jayasuriya 184 and L.C Wheeler and M. Lazarides 7203 are the speceimens of *J. leschenaultii.* However, the other voucher specimens cited in Wilson and Johnson, (2001) were not found at the herbarium.

The Taxonomic position of *J. wallichianus* and *J. leschenaultii.*

Snogerup *et al.* (2002) consider *J. leschenaultii* as a subspecies of *J. prismatocarpus* (*J. prismatocarpus* R.Br. subsp. *Leschenaultii* (Laharpe) Kirschner, leaving *J. wallichianus* untreated. Examining the characters based on the present study, there are equally convincing reasons to recognize *J. wallichianus* also as a subspecies under *J. prismatocarpus*. Wilson and Johnson (2001) recognize both *J. wallichianus* Laharpe and *J. leschenaultii* J. Gay ex Laharpe at species level. During the present study, *J. wallichianus* Laharpe and *J. leschenaultii* J. Gay ex Laharpe have been recognized as two distinct species.

In Conclusion, the careful study and comparison of cluster analysis results and morphological characters revealed the occurrence 4 species of *Juncus* in Sri Lanka. They are *J. bufonius* L., *J. effuses* L, *J. wallichianus* Laharpe and *J. leschenaultii* J. Gay ex Laharpe. *J. wallichianus* Laharpe and *J. leschenaultii* J. Gay ex Laharpe are here recorded in Sri Lanka for the first time.Further, it became evident that *J. prisamtocarpus* R.Br. does not occur in Sri Lanka and records of its occurrence in Trimen (1896) and Harriman (1991) are due to misidentifications.

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