

Naturalized species of *Cortaderia* (Poaceae) in southern Africa

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In the past, a single species of Pampas grass, *Cortaderia selloana* (J.A. & J.J. Schult.) Aschers. & Graebn., was thought to occur in southern Africa. This paper documents the occurrence of a second species (*Cortaderia jubata* (Lem.) Stapf) which is both more aggressive as an invasive and more frequently encountered than is *C. selloana*. The species are described and a key for their identification is presented.

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In die verlede is vermoed dat net een soort 'Pampasgras' (*Cortaderia selloana* (J.A. & J.J. Schult.) Aschers. & Graebn.) in suidelike Afrika voorkom. Hierdie artikel beskryf die voorkoms in suidelike Afrika van 'n tweede spesie (*Cortaderia jubata* (Lem.) Stapf) wat meer aggressief as indringerplant en meer algemeen as *C. selloana* is. Die spesie word beskryf en onderskeidende kenmerke waarmee die twee spesies uitgeken kan word, word voorsien.

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Introduction

Cortaderia (Tribe Arundineae) was described by Stapf in 1897. As presently recognized, it is a genus of some 24 species (Connor & Edgar 1974) occurring predominantly in South America and with a few species in New Zealand, New Guinea and the Falkland Islands. The larger species (commonly referred to as Pampas grass (Costas Lippmann 1976)) are widely grown as ornamentals (Hitchcock & Chase 1950; Chippindall 1955; Costas Lippmann 1976). Previously it was assumed that only *C. selloana* (J.A. & J.J. Schult.) Aschers. & Graebn. occurred in southern Africa (Chippindall 1955; Dyer 1976; Ross 1972) where it is grown as an ornamental and is also used to stabilize mine dumps on the Witwatersrand (James 1966). Published data indicated that this species was unlikely to become a serious invasive (Connor 1965; Costas Lippmann 1976, 1977) and therefore observations of naturalized Pampas grass populations spreading invasively on the Witwatersrand (Robinson 1983) were surprising. Field observations made during the 1982/83 summer and examination of material in the National Herbarium (PRE) and Moss Herbarium (J) confirmed that two species have been present in southern Africa for many years. From published descriptions (Costas Lippmann 1976, 1977; Connor & Edgar 1974) the second species was tentatively identified as *Cortaderia jubata* (Lem.) Stapf. Type specimens of both species as well as specimens cited by Connor & Edgar (1974) were examined. In addition, type and cited material of all other *Cortaderia* species which are in any way similar to these taxa (q.v.) were examined.

In view of the threat posed by *C. jubata* as an invasive, accurate identification of material of *Cortaderia* is essential. To this end a key is presented, the species are briefly described and distinguishing characteristics are emphasized.

Voucher material of both species is lodged with the Moss Herbarium (J) and the National Herbarium (PRE).

Key to and description of naturalized species

1. Leaves bright green, tips not setaceous, blade flat to only slightly V-shaped in cross-section. Foliage leaves do not reach more than $\frac{1}{2}$ the height of the culms. Populations composed solely of female plants. Flowering November – February (March). 3–5 florets per spikelet. Glume veins and rachillae purple *C. jubata*
2. Leaves glaucous-green, tip markedly setaceous, blade often V-shaped in cross-section. Foliage leaves usually more than $\frac{2}{3}$ the height of the culms. Populations with approximately equal numbers of female and hermaphrodite plants. Flowering (January) February – April. (5)6(7) florets per spikelet in females and 3 in hermaphrodites. Glume veins and rachillae white (colourless)
. *C. selloana*

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1. *C. jubata* (Lem.) Stapf in Hook.f. in Bot. Mag. t. 7607. 1898. Acevedo (1959); Conert (1961); Connor & Edgar (1974).

Gynerium jubatum Lem. in Carr. in Rev. Hort. 50: 449. 1878. Type: 'Gyn. jubatum sent to Lemoine of Nancy and collected at Chimborazo by the botanical collector Roedel' ex Herb. Munro (K, lecto.!)

= *Gynerium quila* Nees var. *pygmaeum* Nees in Nov. Act. Acad. Caes. Leop. - Carol. 19. Suppl. 1: 153. 1843. Meyen, Peru, Laguna de Titicaca. (B, holo.!)

Robust, perennial, tussock grass, forming clumps to 3 m in diameter. Flowering culms to 3 m tall. *Leaf*: blade flat or only slightly V-shaped in cross-section; tip not setaceous; bright green in colour; 9–12 mm wide; 1000–1500 mm long; blade margins and midrib abaxial surface scabrid, cutting. Both surfaces generally without hairs, or scattered hairs may be found near collar on abaxial leaf surface; ligule of hairs. Leaf sheath varies widely in hairiness, some plants have almost glabrous sheaths and others have dense vestiture. Leaves $\frac{1}{4}$ to $\frac{1}{2}$ culm height. *Inflorescence* a dense panicle, 600–800 mm long, oblanceolate, with flexuous branches. Rachises, rachillae and glume veins purple in colour, and hence panicles appear dark or a dirty-white even when caryopses have been shed. All florets female. Spikelets have (1 or 2) 3–5 florets. *Caryopses* fall very easily; shed with portion of the rachilla, the lemma and the palea; callus with a tuft of hairs. Glumes approximately equal in length, 9–13 mm long; glabrous. Pedicels (0,5) 0,7 (1,0) long; with a tuft of hairs near base. Lemmas densely hairy (hairs 7–9 mm long); in many florets hairs arise to above level of palea tip, although hairs most numerous on lower $\frac{1}{3}$; lemma 8–11 (15) mm long, awn-like. Palea glabrous, 3–5 mm long. *Anthers* minute (less than 0,25 mm long), producing no pollen. *Gynoecium* functional; mature ovary to 3,5 mm long; styles exserted. Flowering November–February (March/April). Plants on the Witwatersrand somewhat susceptible to frost damage. *Chromosome number*: $2n = 108$ (Connor & Edgar 1974).

Widespread throughout southern Africa as a garden plant and isolated escape along roadsides, rivers and disturbed areas. Extensive naturalized populations found in a variety of habitats in the Pretoria-Witwatersrand-Vereeniging area. This species is spreading invasively in many localities.

Vouchers: Robinson 22/02/1983/001, Germiston, Transvaal, J!; 25/04/1984/001, Florida, Transvaal. J!; *Ruch s.n.* (PRE 34954), Roma, Lesotho. PRE!

No single floret or panicle on any of more than 2000 plants examined in the field has been found with functional anthers. However, in spite of the absence of pollen, stigmas are exserted in South African plants. Since fertile seed is produced (Robinson 1983), this species presumably reproduces by agamospermy. This is supported by observations showing that caryopses commonly develop before anthesis occurs, and caryopsis maturation may not follow an acropetal sequence; features indicating apomictic reproduction.

2. *C. selloana* (J.A. & J.J. Schult.) Asch. et Graebn. Syn. Mitteleuropa Fl. 2: 325. 1900. Chippindall (1955); Acevedo (1959); Conert (1961); Connor & Edgar (1974); Ross (1972); Dyer (1976).

Arundo dioeca Spreng. *syst.* 1: 361. 1825. non *dioeca* Lour. in Fl. Cochinch. ed. 1: 55. 1790.

A. selloana Schult. Mantissa 3 (Add. 1): 605. 1827.

Cortaderia dioeca (Spreng.) Speng. in Anal. Mus. nac. Buenos Aires 7: 194. 1902. Type: *Sellow 396*, Brasil (B. holo., not seen)

= *C. argentea* (Nees) Stapf in Gard. Chron. ser. 3. 22: 396. 1897.

Gynerium argenteum Nees Agrost. Bras.: 646. 1829.

Moorea argentea (Nees) Lemaire Ill. Hort. 2: 14. 1855. Type: *Sellow 570*, Brasil (B! — see Conert 1961 p.87).

Robust, perennial, tussock grass, with clumps to 3,5 m in diameter. Flowering culms 1,5–4 m in height. *Leaf*: blade markedly V-shaped in cross-section in many plants; tip narrowly setaceous, hence leaves appear pointed; glaucous-green, 8–10 mm wide and 800–1800 mm long; blade margins and abaxial midrib surface scabrid and somewhat cutting. Abaxial blade surface may be markedly hairy towards collar, or glabrous. Sheath variable in hairiness; culm leaf sheaths sometimes with an auriculate outgrowth (to 10 mm long) at collar. Leaves usually to more than $\frac{2}{3}$ culm height.

Inflorescence panicle 400–600(700) mm long, obovate to ovate. Panicle branches stiff and held at obtuse angles to axis. Rachises, rachillae and veins on lemmas are colourless (white), hence the panicles appear light coloured after florets are shed. (In some cases anthers are violet in colour, and entire inflorescence appears deep purple while florets are present). Florets female and morphologically (but NOT functionally) hermaphrodite; plants female or functionally male. Spikelets with (5) 6 (7) florets in female plants and (1 or 2) 3 (4) in hermaphrodites (functional males). *Caryopses* moderately readily shed; falling with part of the rachilla, the lemma and the palea. Glumes approximately equal in length, 8–15 mm, glabrous. Pedicels (0,8) 1 (1,3) mm long in hermaphrodites; (0,4) 0,8 (1,0) mm in females; with a few hairs near base. Lemmas of female florets densely hairy (hairs 7–12 mm long) with hairs originating all over the lemma. Lemmas of hermaphrodite florets without hairs or very sparsely hairy. Lemma of female floret 10–14 mm long; 12–15 mm long in hermaphrodites. Lemmas awn-like in both sexes. Palea glabrous in both sexes, 2,5–3,8 mm long in females and 3,5–5,5 mm long in hermaphrodites. *Anthers* of female florets minute (less than 0,2 mm long) and non-functional; in hermaphrodite florets anthers (1,5) 3–5 mm long and produce copious pollen. *Gynoecium* of female florets functional; ovary to 3,5 mm long, styles exserted. *Gynoecium* in hermaphrodites very reduced (ovary 0,25 mm long and style/stigma about 0,5 mm long, not exserted). Flowering (January) February – April (May). Plants appear frost tolerant. *Chromosome number*: $2n = 72$ (Connor & Edgar 1974).

Widespread as a garden plant in southern Africa; also as a ruderal in seasonally wet habitats. Invasive populations found in the Pretoria-Witwatersrand-Vereeniging area.

Vouchers: *Mills 275*, Pietermaritzburg, Natal, PRE!; Robinson 22/02/1983/001 and 22/02/1983/002, both Germiston, Transvaal, J!; 28/04/1984/002, Florida, Transvaal, J!

This species is gynodioecious (plants in natural populations are of two sex forms; one having perfect flowers and therefore being hermaphrodite, while the other has all flowers functionally female) according to Connor (1965; 1973), but no florets of South African hermaphrodite plants examined had functional gynoeceia — hence these plants are functionally male and the populations dioecious.

Discussion

Both species of *Cortaderia* found in southern Africa belong to Section *Cortaderia* as defined by Conert (1961). The most distinctive characteristics of this Section are the 3-nerved lemma, which is not divided into a conspicuous central awn with two lateral awn-like lobes (as found in Section *Bifida*) and the glabrous or sub-glabrous lemma of hermaphrodite florets in the gynodioecious species. Specimens of *Cortaderia bifida* and *C. roraimensis* were examined (see Appendix I) to verify the distinction between Sections *Bifida* and *Cortaderia*. Since no southern African material was found to have the characteristic lateral awn-like appendages on the lemmas, Section *Bifida* is not discussed any further.

Six species are included in Section *Cortaderia*: *C. araucana*, *C. atacamensis*, *C. jubata*, *C. rudiusscula*, *C. speciosa* and *C. selloana* (Connor & Edgar 1974). Herbarium material of all these species was examined.

Section *Cortaderia* can be divided into two groups on the basis of sex expression (Connor & Edgar, loc. cit.; this study).

1. Plants female and hermaphrodite . . . *C. araucana*, *C. selloana*.
Plants only female 2.
2. Lemma more than 2,5 × length of palea
. *C. jubata*; *C. rudiusscula*.
Lemma less than 2,5 × length of palea
. *C. atacamensis*; *C. speciosa*

C. selloana can be distinguished from *C. araucana* in having the lowermost floret enclosed within the upper glume and with the hairs on the lemma of female florets originating to above the level of the palea tip. This feature is found in South African material confirming that the dioecious species found here is indeed *C. selloana*.

The situation with *C. jubata* and *C. rudiusscula* is complicated by a variety of taxonomic problems. For instance, *C. jubata* has been confused with *C. rudiusscula* by Hitchcock & Chase (1950), and is often named *C. quila* (Nees) Stapf (see Connor & Edgar (1974) for a discussion of the nomenclature of *C. jubata*) leading to the misidentification of many specimens.

If the narrow circumscription of *C. rudiusscula* proposed by Acevedo (1959) and followed by Connor & Edgar (1974) is used, these species can be distinguished as follows (Connor & Edgar 1974: p.602): '*C. rudiusscula* differs from *C. jubata* in longer, narrower florets, shorter, less hairy callus and the absence of lemma hairs arising above the level of the top of the palea'. It was found that the specimens cited in the above publication, as well as the type material, varied in all these characters and specimens could not always be identified with certainty. South African material closely matches the type material of *C. jubata* (Lem.) Stapf in all characters and differs from the type material of *C. rudiusscula* Stapf, as emended by Acevedo, in having the MAJORITY of florets with hairs on the lemma back originating above the palea tip, even though a proportion of florets will only have hairs on the lemma arising below the palea tip. South African plants are therefore considered to belong to *Cortaderia jubata*.

Conclusions

Two species of *Cortaderia* occur in southern Africa. At present they differ in the way they are invading natural

vegetation and, to a lesser extent, the habitats that are affected. They can be distinguished on the basis of growth form, leaf morphology, inflorescence form, sex expression, floral morphology and flowering time.

Southern African material corresponds with data reported by Costas Lippmann (1976; 1977) for Californian populations of *C. jubata* and *C. selloana*, in most respects. A major difference between southern African and North American populations is the season of flowering: in southern Africa *C. jubata* flowers in early to midsummer and *C. selloana* flowers from midsummer to early autumn. In California *C. jubata* is autumn flowering and *C. selloana* spring flowering.

The study of material of *C. rudiusscula* Stapf and *C. jubata* indicates that these species are poorly distinguished on floral characters.

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Appendix I. Cited specimens

Section *Cortaderia*

Cortaderia araucana Stapf.

Cuming 368, Chile, W13420!

***Cortaderia atacamensis* (Phil.) Pilg.**

Philippi 337, Chile, W39629!; *Philippi s.n.*, Chile, W!;

***Cortaderia jubata* (Lem.) Stapf**

Meyen, Chile, B nr.1733/15! (holo., *Gynerium quila* Nees); *Bang* 26, Bolivia, W1541!; *Benoist* 4083, Ecuador, P!; *Buchtein* 850, Bolivia, W25264!; *D'Orbigny* 206, Bolivia, W11950!; *D'Orbigny* 856, Bolivia, W119949!; *Dombey* 141, Peru, P!; Karsten, Chile, W!; *Lorentz & Hieronymus* 78, Argentina, B!; *M. Costas Lippmann* 101, California, PRE!; *Martinet* 94, Peru, P!; *Raimondi* 1863, Peru, P!; *Shepard* 167, Bolivia, P!;

***Cortaderia pilosa* (D'Urv.) Hack.**

D'Urville, Falkland Is., P., lecto.!; Neger, Chile, M! (holo., *C. minima* Conert); *Gunckel* 12222, Chile, US no. 2014950!; Wilkes Exped. 2, Chile, US No. 899908!; *Dusen* 591, Chile, W39625!, W25267!; *Skottsberg* 137, Chile, W1649!; Neger, Chile, W5945! W5946!; *Fuentes*, Chile, W38218!; *Skottsberg*, Falkland Is., W25265!; *Dusen* 615, Chile, W25266!; *Seibold* 2970, Chile, W!;

***Cortaderia rudiuscula* Stapf**

Cuming 368, W! (mounted with Poppig, Antuco); *Dombey* 142, Peru, P!; *Gay* 980, Chile, P!;

***Cortaderia selloana* (Schult.) Aschers. et Graebn.**

Arechavaleta, Uruguay, W25247!, W25251!, W25253!; Berro, Uruguay, W35012!, W35013!; *Gibert*, Uruguay, W23791!, W23792!, W23793!, W23810!; *Jurgens* 40, Brasil, B!; *Sellow* 570, Brasil, B!; *L.B. Smith* 2026, Brasil, P!; *Stuckert* 8765, Argentina, W25261!, W25262!; *Stuckert* 20061, Argentina, W39399!; *Wetmore* 2, Argentina, US no. 1066063!.

***Cortaderia speciosa* (Nees) Stapf**

Meyen 1834, Chile, B lecto.!; *Kurtz* 7045, Argentina, W25260!; *Kurtz* 8594, Argentina, W25257!; *Kurtz* 9096, Argentina, W25263!; *Schulz* 6275, Argentina, W7677!; *Troll* 2912, Bolivia, B!.

Section Bifida***Cortaderia bifida* Pilg.**

Weberbauer 1328, Peru, US 81785, holo.! ex B); *Weberbauer* 1328, Peru, B nr. 1733/2, holo.!; *Buchtein* 2574, Bolivia, W38891!; *Buchtein* 2576, Bolivia, W38892!; *Buchtein* 2575, Bolivia, L!; *Cuatrecasas* 5376, Chile, US 2014950!; *Herzog* 2194, Bolivia, L!; *Kersten s.n.*, (intermixed), W!; *Pinto* 285, Colombia, P!; *R.E. Schultes* 1005 (II), Colombia, US 1980615!; *Weberbauer* 3349, Peru, B!;

***Cortaderia roraimensis* (N.E. Brown) Pilg.**

Humbert 26794, Venezuela, P!