DRAFT: WRITTEN FINDINGS OF THE
WASHINGTON STATE NOXIOUS WEED CONTROL BOARD
DRAFT September 2014

Scientific name:	*Cortaderia jubata* (Lemoine ex Carrière) Stapf
Synonyms:	*Gynerium jubatum* Lemoine ex Carrière, *Cortaderia atacamensis* (Phil.) Pilg., *Gynerium quila* var. *pygmaeum* Nees
Common name:	jubata grass, purple pampas grass, Andean pampas grass, pampas grass, pink pampas grass
Family:	Poaceae
Legal Status:	Proposed Class C noxious weed

Left, *Cortaderia jubata* plant habit, image: John M. Randall, The Nature Conservancy; center, infestation of *C. jubata* on the California coast, image by Barry Rice, sarracenia.com; right, leaf sheath hairs, image by Joseph M. DiTomaso, University of California – Davis, all images from Bugwood.org.

Description and Variation:

Overall Habit:

Cortaderia jubata, commonly called jubata grass, is a large perennial grass that grows in basal clumps of long narrow leaves called tussocks. Flowering stems grow upward, generally at least twice as long as the tussock (Bossard et al. 2000). Plumes of flowers bloom at stem tips and range in color from deep violet to pinkish to creamy white. All flowers are female and can form seed without pollination.

Roots:

Plants have dense fibrous roots that grow from shallow, short lateral rhizomes (DiTomaso et al. 2013).

Stems:

Stems, called culms, are stiff and grow 6 to 13 feet (2 to 4 m) tall (Parsons and Cuthbertson 1992 in Drewitz and DiTomaso 2004), though some sources note stems growing as tall as 23 feet (Bossard et al. 2000, Allred 2003). Stems are 4 to 7 times as long as the panicles (Allred 2003).

Leaves:

Bright to deep green leaf blades are long and narrow, generally up to 6.6 ft (2 m) long by 0.8 to 1.2 inches (2 to 3 cm) wide. Upper and lower blade surfaces are typically hairless, though occasionally have hairs near the collar on the upper surface (Bossard et al. 2000). Leaf margins are scabrous and sharp--easily cutting skin. Leaf sheaths are densely hairy (Bossard et al. 2000).

Flowers:

Cortaderia jubata's inflorescence is a dense panicle, commonly referred to as a plume or plume-like, and occurs at stem tips. Inflorescences range in length from 1 to 3 feet (Bossard et al. 2000). Drewitz and DiTomaso (2004) found lengths on panicles they measured in California to range from 20.5 to 26.8 inches (52 to 68 cm). Inflorescences are deep violet when immature and then pinkish turning creamy white or tan at maturity (Bossard et al. 2000). All florets are female, with 3 to 5 in each spikelet, and each spikelet 0.6 inches (14 to 16 mm) in length. Florets are 0.12 to 0.2 inches (3 to 5 mm), glumes are purple, lemmas are hairy and awns are short, less than 1 mm (Hickman 1993, Robinson 1984 in Bossard et al. 2000).

Fruits and Seeds:

In the absence of pollen and fertilization, seeds are asexually formed by apomixis (somatic apospory) and are genetically identical to the parent plant (Connor 1973, Costas-Lippmann 1976, Philipson 1978 in Drewitz and DiTomaso 2004). Because its flowers are apomictic, *Cortaderia jubata* does not hybridize with other species.

The fruit is a caryopsis (a dry, one-seeded fruit), to 2.5 mm in size (Allred 2003). Drewitz and DiTomaso (2004) conducted seed counts on *Cortaderia jubata* plumes and found a range of 34,000 to 122,000 seeds produced per inflorescence. Plants that have a 1 meter squared tussock diameter, typically produced 5 to 20 inflorescences with an average of 14 (J. J. Drewitz unpublished data in Drewitz and DiTomaso 2004). Taking seed production and number of inflorescences produced per plant, Drewits and DiTomaso (2004) calculated total seed production per mature plant ranges between 300,000 and 1,300,000 seeds, with an average of 924,000.

Look-alikes:

Another *Cortaderia* species, *Cortaderia selloana*, pampas grass, looks very similar to *C. jubata* and the two species can be difficult to tell apart, especially when young or not in flower. *Cortaderia selloana* is also being considered for a 2015 Class C noxious weed listing (see *Cortaderia selloana* written findings for a detailed description). *Cortaderia selloana* tussocks typically grow larger than *Cortaderia jubata* and have a more fountain-like appearance (DiTomaso et al. 2013). The plumes of the two species are similar in size, though *C. jubata* often has a more purplish tinge compared to *C. selloana* (DiTomaso et al. 2013). The "Grass Manual of the Flora of North America" (Allred 2003) separates the two species in a dichotomous key as follows:

> 1a: Sheaths hairy; panicles elevated well above the foliage; culms 4-5 times as long as the panicles . . . *C. jubata*
>
> 1b: Sheaths glabrous or sparsely hairy; panicles elevated only slightly, if at all, above the foliage; culms 2-4 times as long as the panicles . . . *C. selloana*


Images of *Cortaderia selloana*, left: mature plant in bloom, image credit John Ruter, University of Georgia, Bugwood.org; center left, inflorescences in bloom; center right, close up of female inflorescence; right, leaves and sheaths, last three images by Joseph M. DiTomaso, University of California - Davis, Bugwood.org.

Another species that is somewhat similar in appearance to *Cortaderia jubata* is Ravenna grass, *Saccharum ravennae*, a species that is being considered for a 2015 Class A noxious weed listing. *Saccharum ravennae* appears to have a limited distribution in Washington State, with escaped plants known to exist in Benton County, around the cities of Richland and Kennewick and with a few escaped plants in Yakima and Franklin Counties. *Saccharum ravennae* can be purchased in nurseries and online so it may also be found in planted landscapes. *Saccharum ravennae* is also a tussock-forming grass with tall stems having inflorescences at the tips, but it does have traits that differentiate it from *C. jubata* including:

- Reddish coloring on the flowering stems
- Leaves with serrated edges that are not as sharp or cutting as *C. jubata*
- Dense hairs at the base of the leaves that are on the top of the leaf blade: though it is noted that *C. jubata* may occasionally have hairs on top of the leaf blade at the base, this is a consistent trait for *S. ravennae*.

Please see the written findings for Ravenna grass, *Saccharum ravennae,* for further information.


Images of *Saccharum ravennae*, Ravenna grass. Left, plant in September with blooming flowers; center, leaf sheath and base of sheath showing hairs; right, red coloring on flowering stems, all images WSNWCB.

Habitat:
Cortaderia jubata is commonly found along the California coast, growing in areas with a strong marine influence that provides cool, wet winters with little frost and moderate summer temperatures (Drewitz and DiTomaso 2004). In this range it grows in a variety of habitats such as coastal scrub, coastal sage scrub, north coastal coniferous forest, closed cone pine forest, redwood forest and chaparral (Drewitz and DiTomaso 2004). It also grows in disturbed open areas such as roadside cuts, ditch banks, forest clearcuts, mudslides or burned areas (Bossard et al. 2000). It is typically found on sandy soil, but can survive on other soil types, even serpentine (Bossard et al. 2000).

Cortaderia jubata does not appear to tolerate winter frost, hot summer temperatures, intense sunlight, or drought (Costas-Lippman 1977 in Bossard et al. 2000). In California, it is intolerant of the state's hot and dry inland conditions, being restricted to coastal habitats (Stanton and DiTomaso 2004 in DiTomaso et al. 2008)

Geographic Distribution:
Worldwide, *Cortaderia jubata* has naturalized in:

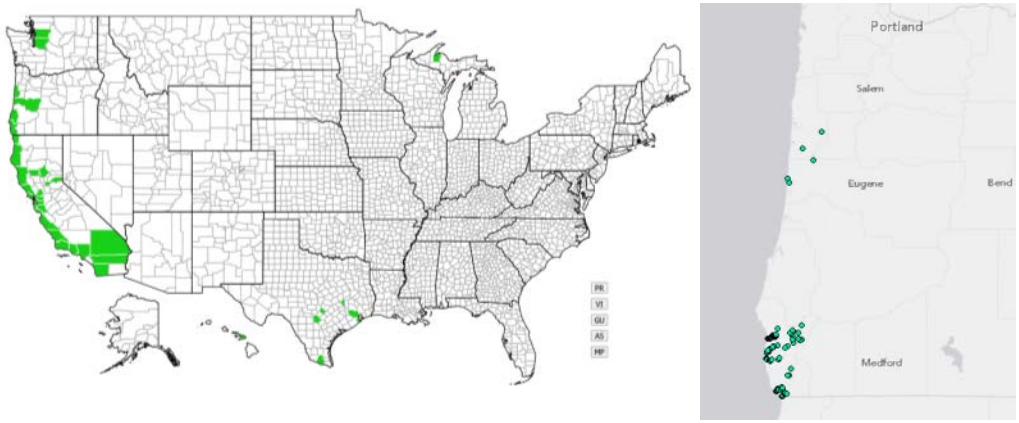
- Africa - South Africa-Free State, Gauteng, Western Cape
- Australia - New South Wales, Queensland, Tasmania, Victoria, Western Australia
- New Zealand

(USDA ARS 2014).

Madison (1992) believes it was introduced to the horticultural trade through France, being introduced by the Lemoine Nursery in Nancy. This is thought to have occurred around 1876 (Carrieré 1878, Hooker 1989 in Okada et al. 2009).

Native Distribution:
Cortaderia jubata is native to South America, in Bolivia, Ecuador, Peru, Chile and parts of Argentina (USDA ARS 2014). It grows in a wide elevation range, from sea level to nearly 14,000 feet (Lambrinos 2004). It is a colonizing plant that grows on talus and slides and other bare areas in the mountains (Madison 1992).

Distribution in North America:
The USDA ARS PLANTS Database (2014) documents *C. jubata* in Washington, Oregon, California and Hawaii. It isn't known what year *Cortaderia jubata* was introduced to the United States, but it is thought to have been imported by the horticultural industry as a type of pampas grass (*Cortaderia selloana*) (Lippmann 1977 in DiTomaso et al. 2008). Lambrinos (2004) notes that L.H. Bailey wrote of *C. jubata* being only occasionally cultivated in California in 1924. It appears that in California there was a lack of awareness for some time that *C. jubata* was a different species from *C. selloana*. Madison (1992) documents that Sunset's "Western Garden Book" only acknowledges jubata grass in editions after 1976, and that in other earlier sources it was also not mentioned.

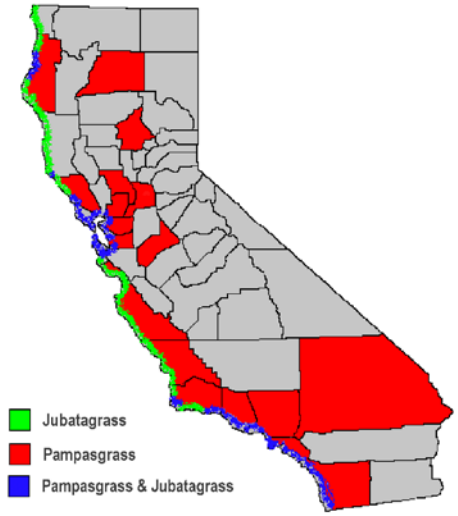


Left, EDDMapS (2014) county distribution map of *C. jubata*; right, Oregon Weed Mapper records of *C. jubata* along the Oregon coast, image ODA 2014.

In Oregon, the earliest herbarium record of *Cortaderia jubata* is from 1959, collected south of Cape Perpetua on the coast highway (OSC101992, Consortium of PNW Herbaria 2014). After that there is not another herbarium collection (that is available online), until 1997, collected north of Cape Blanco (UTC#233969, Oregon Flora Project 2014). Since then there are collections along or near the coast in 2004 and 2008.

In California, *C. jubata* is found invading and spreading along the coast. A herbarium specimen of naturalized *C. jubata* was first collected in 1946, growing along San Antonio Creek in Ventura County (Lambrinos 2001). It was first noted as a weed in the 1960's in logged redwood forests in Humboldt County (Fuller 1976 in DiTomaso et al. 2008). *Cortaderia jubata* has spread rapidly both north and south in the state along the coast, without forming distinct centers of expansion, and has not spread inland (Lambrinos 2001). At the time of Madison's (1992) article on *Cortaderia* , *C. jubata* was still being planted in Los Angeles County by landfill operators and highway crews who were using it to fill large banks of earth, and seedlings were beginning to spread from these plantings.

To gain a better understanding of the introduction of invasive *C. jubata* plants in California, Okada et al. (2009) conducted genetic testing of escaped *C. jubata* and compared them to *C. jubata* growing in its native range. Escaped plants from California, Maui and New Zealand were found to be from the same single clone that looks to have originated from a single introduced genotype (Okada et al. 2009). This invasive clone matched one of the native genotypes from southern Ecuador, from the southern part of Chimborazo province, where the horticultural stock is thought to have originated.



Left, distribution map of *Cortaderia selloana* (in red), *C. jubata* (in green) and their overlap (in blue) in California (Okada and Jasieniuk 2013); right, *C. jubata* infestation along the California coast, image by Mandy Tu, The Nature Conservancy, Bugwood.org.

Listings:

- Listed as a noxious weed in Hawaii.
- Listed on California's noxious weed list and on the California Invasive Plant Council Inventory as High Invasiveness
- Oregon's noxious weed list as a Class B
- Colorado's watch list

History and Distribution in Washington:

The first escaped records of *Cortaderia jubata* are from Nov. 1, 2001 in King County along I-5, growing in waste ground (P. F. Zika 16721 and A. L. Jacobson, WTU) and in a gravel ditch in Snohomish County on October 12, 2000 (Zika 15565, WTU) (Zika and Jacobson 2005). Currently these are still the only records of *C. jubata* escaped in Washington State. In 2007, *Cortaderia selloana* and *C. jubata* were added to the WSNWCB's monitor list (grouped together as *Cortaderia* spp.) to track new and expanding naturalized populations. There was concern about *C. jubata*'s ability to naturalize and spread in Washington given how it was naturalizing in California.

Biology:

Growth and Development:

Germination can occur in fall after the first rains, though is typically in the spring (DiTomaso et al. 2013, Bossard et al. 2000). Seeds prefer sandy soil, ample moisture, light and temperatures between 55 and 70 degrees F (13 to 21 C) for germination (Drewitz and DiTomaso unpubl. data in Bossard et al. 2000). Growth is initially slow, but is rapid once plants are established (Bossard et al. 2000). *Cortaderia jubata* plants can flower their first year and typically bloom from late July to September (Madison 1992). Plants can survive for fifteen years (Moore 1994 in Bossard et al. 2000).

Reproduction:

Reproduction is by asexual means only. Although all plants produce only female flowers, viable seeds develop from unfertilized ovules (apomixis), so pollination isn't necessary (Bossard et al. 2000). Seeds are very small and do not last long in the soil seedbank. Seeds typically survive for less than 6 months in

field conditions, and a persistent seedbank does not accumulate (Drewitz and DiTomaso 2004, DiTomaso et al. 2013). On average, plants have a 26% germination rate for the seeds they produce (Drewitz and DiTomaso 2014). For a mature plant with a diameter of around 1 meter squared, estimated germinable seed production would range between 78,000 and 338,000 per plant (Drewitz and DiTomaso 2004). In an experiment by Drewitz and DiTomaso (2004), the percentage of germinable seed was not significantly different from the percentage of viable seeds, suggesting that *C. jubata* seeds do not have primary dormancy. While seeds can germinate when not exposed to light (8% germination rate), seeds germinated at a significantly higher rate when exposed to light (26%) and is 3.3 times higher in high light than in dark conditions (Drewitz and DiTomaso 2004). Seeds are very light and can be dispersed in the wind and by human activity (DiTomasto et al. 2013). Some sources have noted wind carrying seed great distances, up to 20 km in some cases (DiTomaso et al. 1999).

Stanton and DiTomaso (2004) point out that the apomictic breeding system of *C. jubata* is likely advantageous in founding populations, when colonizing new areas, since one plant is all that is needed to start an infestation. On the other hand, *C. jubata* has little opportunity for adaptation to new environments through genetic recombination; thus its ability to expand beyond its coastal distribution may be limited.

Bossard et al. (2000) also note that plants can reproduce vegetatively from fragmented tillers that produce adventitious roots in moist soils.

Control:

When working with *Cortaderia jubata*, it is important to protect yourself when handling the plants. The leaf edges are very sharp, so make sure to wear leather gloves and protective clothing. Persistence is key for control of *Cortaderia jubata,* as plants that are missed during control efforts can reinvade due to their high seed production and successful germination (Madison 1992). Seed germination and seedling establishment is more likely to occur in disturbed areas (Drewitz and DiTomaso 2004), so disturbance caused by control methods should be minimized as much as possible and follow up monitoring will be needed. Plant or seed bare ground with native or non-invasive, nonnative plants to provide competition (DiTomaso et al. 2013).

Unless noted otherwise, control recommendations are from DiTomaso et al. (2013).

Mechanical Methods:

Cut and bag inflorescences prior to mechanical control to prevent spreading seed (Harradine 1991). Pulling or hand-grubbing seedlings can provide effective control. For larger plants, a Pulaski, mattock or shovel are the safest and most effective tools for removing established clumps. The entire crown and top section of the roots will need to be removed to prevent resprouting. A large chainsaw or weed eater can expose the base of the plant and allow for better access. DiTomaso et al. (2013) note that detached plants left lying on the soil surface may take root and reestablish under moist soil conditions. Some managers recommend turning the removed clump upside down so the roots dry out in the air and don't touch the soil. Also, monitor area for seedlings that may germinate after control has taken place.

Using volunteers to control *Cortaderia* species in California has been shown to be effective. Manual control performed by volunteers in remote places of California's Santa Cruz Mountains has been very successful (Moore 2000).

Excavation equipment has been used in New Zealand on plants, and while effective, did damage surrounding desirable plants, so these tools may be better suited for use outside of sensitive habitats (Gosling et al. 2000).

If it isn't possible to remove all plants before flowers develop, consistently removing plumes before seed matures will help to prevent population expansion (Bossard et al. 2000, Harradine 1991). However, plants that have had plumes removed may develop more plumes during the flowering season, so follow up plume-removal may be needed. Bag and remove pulled plumes to prevent seed developing on site.

Cultural Methods:
Soil disturbance that creates bare ground can promote *Cortaderia* invasion, so it is important to minimize disturbance or provide competition to seedlings. Apply mulch to exposed bare ground to smother seeds and prevent germination. Also, planting or seeding desirable, non-invasive plants can provide competition to reduce germination and seedling establishment. Oversowing seeds of pasture species following logging or site preparation is commonly used to control weeds such as *Cortaderia* spp. in New Zealand plantation forests (Gosling et al. 2000).

Cortaderia jubata can resprout from burning (Bossard et al. 2000), so fire alone cannot be used to control infestations. The growing points of the grass are protected by the leaves during a fire and can rapidly resprout following a burn (Bossard et al. 2000).

Biological Control:
There are no known biological controls for *Cortaderia jubata.* Grazing is not recommended for control in California as plants will resprout (DiTomaso et al. 1999), though cattle have been used in New Zealand and Australia to control populations (Harradine 1991). In New Zealand, cattle provided control if they were introduced at an early stage in tree rotation of plantation forests and grazed the stand three or four times per year (New Zealand Forest Service 1985 in Gosling et al. 2000) Grazing can be limited by a number of factors including terrain, fencing, access to water and the availability of suitable livestock (Gosling et al. 2000).

Chemical methods:
A combination treatment of cutting or burning plants to remove the top growth and then treating the regrowth when it's about 7 to 8 inches (20 cm) tall with a systematic herbicide can be effective (Harradine 1991). This method can reduce the amount of herbicide used compared to using herbicide alone (DiTomaso et al. 1999).

The active ingredient glyphosate provides the most consistent control of *Cortaderia jubata* on plants of all sizes in fall and early summer. Treatments that can be used successfully are a broadcast spray at 2 to 3.3 qt product/acre (2.25 to 3.7 lb a.e./acre), a high-volume spray to wet treatment (2% v/v solution) or a low-volume (8 to 10% v/v solution of product) or a wiper treatment (33 to 50% of concentrated product).

Monitor sites as mature plants may resprout and need follow up control after their initial treatment (Gosling et al. 2000).

Currently, herbicide treatment information on *Cortaderia jubata* is not available in the Pacific Northwest Weed Management handbook, but check back as information is continually updated. Contact your county noxious weed control board or weed district coordinator with questions about control.

Economic Importance:

Detrimental:
Infestations of both *Cortaderia selloana* and *C. jubata* can cause detrimental impacts such as crowding out native plants, altering wildlife habitat, reducing access to recreational areas and creating potential fire hazards (Lambrinos 2000 in Stanton and DiTomaso 2004, Herradine 1991). New Zealand has documented *Cortaderia* species invading a wide range of sensitive habitats (Gosling et al. 2000). Large coastal infestations of *C. jubata* in California crowd out native plant communities, particularly in sensitive coastal dune areas (Cowan 1976 in Bossard et al. 2000). In southern California, *C. jubata* has affected Burton Mesa chaparral, a regionally endemic variant of maritime chaparral, shifting the community type to a perennial grassland (Lambrinos 2000 in Lambrinos 2002). *Cortaderia jubata* is structurally less complex than chaparral and Lambrinos (2000) found arthropod abundance and order diversity were lower in plots that were dominated by *C. jubata* than in adjacent chaparral as well as differences in small mammal populations.

Cortaderia jubata can also impact forestry operations. In cut-over coastal redwood forests in northern CA, *C. jubata* suppressed reestablishment of seedling conifers (Madison 1992 in Bossard et al. 2000). In the 1960s, Georgia Pacific had to abandon 1,100 acres in California's Humboldt County to *C. jubata* as there was no economical way to control it. At that time 7,000 additional acres were severely infested. (Madison 1992). In some areas, large clumps can prevent access to fires or present a fire hazard themselves (DiTomaso et al. 1999).

Cortaderia species also reduces the aesthetic and recreational values of natural areas. Hornback (1994) likened the infestations of *C. jubata* along the California coast to monotonous prairies of dun-colored plumes that look like old dishrags on sticks.

Beneficial:
Flower plumes historically were used in fresh or dried flower arrangements and plants are occasionally used in landscapes.

Rationale for Listing:
Cortaderia jubata is a nonnative species that is a known invader in California, is escaped in Oregon and is documented in Washington. Last year, escaped populations of *C. selloana* were discovered in Washington State, with one infestation having almost 500 plants. Due to the similarity in appearance of *C. jubata* and *C. selloana,* and that *C. jubata* is a listed noxious weed in California and Oregon, *C. jubata* is proposed for listing as a Class C noxious weed. This listing would increase awareness about *C. jubata*, and provide information on how to control it. Adding *C. jubata* to the state noxious weed list would also give county noxious weed boards the option to require control.

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