Pampas grass (*Cortaderia selloana*)

- Large (up to 4m tall) tussock forming ornamental grass with large decorative flower heads that produce a silky hairy mass at fruiting
- Increasing its range in GB, particularly south and south-west England
- Tolerates a range of environmental conditions but prefers sandy, low pH soils
- Outcompetes native plants and alters habitats
- Considered a fire hazard, can block access routes and damage grazing land

Source: Cabi 2015

History in GB

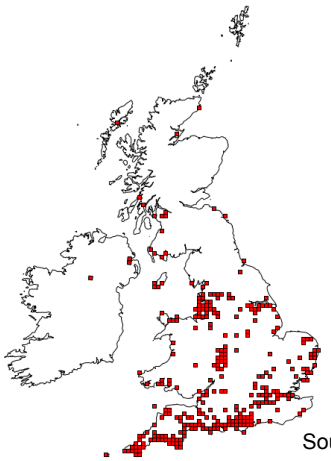
First British wild population recorded in 1925. Early records are from southern parts of England and Wales, particularly the coast of Cornwall, Dorset, Devon, Hampshire and the Isles of Scilly. From the 1980s, new records have been reported from further inland, as well as coastal areas of Scotland up to the Orkney Islands. In total this species has been recorded in 408 of the 2823 hectads within the risk assessment area.

Native distribution

Native to South America

[native range map unavailable]

Distribution in GB



Source: NBN 2015

Impacts

Environmental

- Outcompetes native plants and alters habitats
- Individual plants form large clumps up to 7m in diameter

Economic

- Has caused problems for forestry in New Zealand and Australia where it is invasive, through competition with forest growth and need for management. Similar impacts could occur in the risk assessment area if *C. selloana* were to establish in forest habitats

Social

- Potential for increased fire risk resulting from the dry leaves of tussocks
- Risk of minor injury from serrated leaves of the plant
- Aesthetic impacts through changes to the appearance of the landscape

Introduction pathways

Ornamental (very likely) - a popular ornamental garden plant

Spread pathways

Human mediated - through the horticultural trade
Natural - through dispersal of lightweight seeds and rhizome fragments which can regenerate and establish new plants

Summary

	Risk	Confidence
Entry	VERY LIKELY	VERY HIGH
Establishment	VERY LIKELY	VERY HIGH
Spread	RAPID	HIGH
Impacts	MAJOR	MEDIUM
Conclusion	HIGH	MEDIUM

Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity (CBD) emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain. It complies with the CBD and reflects standards used by other schemes such as the Intergovernmental Panel on Climate Change, European Plant Protection Organisation and European Food Safety Authority to ensure good practice.

Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

To find out more about the risk analysis mechanism go to: www.nonnativespecies.org

Common misconceptions about risk assessments

To address a number of common misconceptions about non-native species risk assessments, the following points should be noted:

- Risk assessments consider only the risks posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- Risk assessments are about negative impacts and are not meant to consider positive impacts that may also occur. The positive impacts would be considered as part of an overall policy decision.
- Risk assessments are advisory and therefore part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available. Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

*risk assessments are posted online at:
https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51
comments should be emailed to nnss@apha.gsi.gov.uk

Rapid Risk Assessment of: *Cortaderia selloana*, Pampas Grass
Author: Katharina Dehnen-Schmutz

Version: Final (April 2016) – Draft 1 (March 2014), Peer Review (January 2015), NNRAP 1st review (September 2014), Draft 2 (February 2015), NNRAP 2nd review (February 2015)
Signed off by NNRAP: February 2015
Approved by Programme Board: September 2015
Placed on NNSS website: November 2015

GB Non-native species Rapid Risk Assessment (NRRA)

Introduction:

The rapid risk assessment is used to assess invasive non-native species more rapidly than the larger GB Non-native Risk Assessment. The principles remain the same, relying on scientific knowledge of the species, expert judgement and peer review. For some species the rapid assessment alone will be sufficient, others may go on to be assessed under the larger scheme if requested by the Non-native Species Programme Board.

1 - What is the principal reason for performing the Risk Assessment? (Include any other reasons as comments)

Response: *To rapidly assess the risk associated with this species in Great Britain*

2 - What is the Risk Assessment Area?

Response: *Great Britain*

3 - What is the name of the organism (scientific and accepted common; include common synonyms and notes on taxonomic complexity if relevant)?

Response: *Cortaderia selloana* (Schult. & Schult.f.) Asch. & Graebn., Pampas grass

4 - Is the organism known to be invasive anywhere in the world?

Response: Yes.

Cortaderia selloana, a native of South America, is known to be invasive in North America, South Africa, Australia, New Zealand and Europe (CABI 2014), and is also on the Hawaii Noxious Weed List (Hawaii Invasive Species Council 2015).
In Europe, the species has been classified as invasive in Spain, Portugal, Italy and France (Brunel et al. 2010) and is listed among the "100 of the worst" in the DAISIE database (www.europe-aliens.org) .

5 - What is the current distribution status of the organism with respect to the Risk Assessment Area?

Response:

Cortaderia selloana was first recorded outside cultivation in Britain in 1925, and is considered a lowland species (Preston et al. 2002). All early records originate from southern parts of England and

Wales, particularly along the coasts of Cornwall, Dorset, Devon and Hampshire as well as the Isles of Scilly. From the 1980s onwards, new occurrences are reported also from further inland as well as coastal areas of Scotland up to the Orkney Islands (BSBI 2014). However, some of these records could be the result of misidentification with the more commonly planted species in northern areas, *C. richardii* (Endl.) Zotov. In total, the species has been recorded in 408 hectads (of 2823 comprising the entire Risk Assessment Area). No data are available on the extent of the planted occurrences of *Cortaderia selloana* in gardens which are not included in recording schemes.

6 - Are there conditions present in the Risk Assessment Area that would enable the organism to survive and reproduce? Comment on any special conditions required by the species?

Response: Yes.

Cortaderia selloana is already able to survive and reproduce in the Risk Assessment Area. It has been reported from roadsides, railway banks and rubbish dumps, and in rough grassland on sheltered sea-cliffs and sand dunes (Preston et al. 2002). Although most occurrences have been attributed to garden throw-outs and plantings outside gardens (Preston et al. 2002) reports about establishment from seeds are increasing (Clement 2005, Mitchell 2013). These include records of seedlings in reedbeds and willow swamps (Clement 2005). Outside the Risk Assessment Area the species is also reported from both sandy coastal habitats as well as inland wetlands, grasslands, abandoned agricultural land, and disturbed areas in forests (Parsons & Cuthbertson 2001, CABI 2014, Sauras-Mas & Lloret 2005). For germination of seedlings and establishment *C. selloana* needs open or disturbed habitats. Seedlings are the most vulnerable stage of the plant requiring a moist soil and are not drought tolerant (DiTomasio et al. 2010).

A key issue for the invasion success of this species seems to be the presence of both male and female plants to enable seed production. It is believed that in the past plants used as ornamentals have been exclusively female because they produce more showy plumes and propagation was therefore vegetatively only. This "female only" population provided some protection against establishment and spread of *C. selloana* outside cultivation. However, it appears that due to more recent nursery propagation by seeds (DiTomasio et al. 2010) male plants have also been sold resulting in the appearance of plants established from seeds outside cultivation that are of both sexes. With the appearance of more male plants the planting of female plants is no longer a safe prevention strategy.

7 - Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment Area or sufficiently similar for the organism to survive and thrive?

Response: Yes.

Climatic conditions within parts of the current distribution of the species are similar to the Risk Assessment Area, for example in the northwest of Spain, New Zealand, and in the northeast of North America. Horticultural hardiness zones are similar in parts of the north east of North America (Lord 2003) where *C. selloana* is also established.

8 - Has the organism established viable (reproducing) populations anywhere outside of its native range (do not answer this question if you have answered 'yes' to question 4)?

Response: NA

9 - Can the organism spread rapidly by natural means or by human assistance?

Response: Yes.

Cortaderia selloana can spread rapidly by natural means and human assistances. The lightweight seeds can be dispersed by wind, and distances of up to 25 km have been measured (Parsons & Cuthbertson 2001). As a popular ornamental garden plant the species is also transported over long distances by the horticultural trade.

10 - Could the organism itself, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment Area?

Response: Yes.

In California, the species is outcompeting native species in particular in coastal dune habitats (DiTomasio et al. 2010) and similar observations have been made in coastal habitats in the north of Spain where the species' presence is increasing (Sanz-Elorza et al. 2004) The plants also increase fire risk and the saw-toothed leaves can cause injury to humans (DiTomasio et al. 2010). Negative impacts on forest growth as well as aesthetic impacts on recreation have been described from Australia (Parsons & Cuthbertson 2001). Furthermore, control and management of the species is very expensive as established plants are very difficult to remove.

Entry Summary

Estimate the overall likelihood of entry into the Risk Assessment Area for this organism (comment on key issues that lead to this conclusion).

Response: *very likely*

Confidence: *very high*

Comments (include list of entry pathways in your comments):
Cortaderia selloana has been introduced into the Risk Assessment Area in 1848 and was first recorded outside cultivation in 1925 (Preston et al. 2002). The main pathway is the horticultural trade. *C. selloana* is a popular ornamental garden plant as underlined by the fact that 13 nurseries in the current edition of the Royal Horticultural Society's Plant Finder are offering the species (RHS 2015). The Plant Finder also includes 19 cultivars of the species, with some of them sold by even more nurseries than the species itself. Furthermore, seeds of the species including various cultivars are sold online by seed merchants as well as on consumer-to-consumer and business-to-consumer e-commerce platforms. A study in California found *C. selloana* cultivars to contribute to the genetic variation of invasive populations (Okada et al. 2007). The species has also been introduced and planted for erosion control or as fodder plant elsewhere (DiTomasio et al. 2010), but there is no indication that this has been the case for the Risk Assessment Area, and it seems unlikely that these could be possible pathways in the future.

Establishment Summary

Estimate the overall likelihood of establishment (comment on key issues that lead to this conclusion).

Response: *very likely*

Confidence: *very high*

Comments (state where in GB this species could establish in your comments, include map if possible):
C. selloana is alredy considered established in the Risk Assessment Area with most records attributed to garden throw-outs or deliberate planting (Preston et al. 2002). Distributional data provided do not distinguish establishment from these sources and from seeds, however, it seems likely that the majority of the more recent records are self-seeded as reports of establishment from seeds are increasing. The first confirmed records of establishment from seeds are from Surrey (1978) and on cliffs and dunes in South Devon in 1994 (Ryves et al. 1996). Clement (2005) reports the more frequent occurrence of seedling also from walls, along railway lines, and swamps. The occurrence of self-sown seedlings has also been confirmed from St Andrews, Scotland (Mitchell 2013) and Wisley (Armitage 2012). Successful establishment from seeds is only possible in open or frequently disturbed habitats (Pausas et al. 2006). Further establishment is most likely to occur in areas where the species is already present and where these occurrences are producing seeds. These are mainly coastal areas in southern England and Wales; however, more recent records from northern England and Scotland indicate suitable conditions for establishment also from these parts of the Risk Assessment Area even though some of these records may be the result of misidentifications. Further inland, urban areas have already seen an increase in records in recent years and this trend is likely to continue due to the possibly high propagule pressure from planted occurrences in garden and parks as well as from suitable microclimatic conditions and availability of habitats with high levels of disturbance. Areas of higher altitudes seem to be less suitable. There is also a risk of *C. selloana* starting to establish in habitats in which it has not been recorded frequently in the Risk Assessment Area up to now. These include wetland habitats, roadsides and forest plantations, in all of which the species has been reported elsewhere (Global Invasive Species Database 2006). In its native S America it grows in rocky gullies, on riverbeds and along roads, as well as being widely cultivated (Cope & Gray 2009).

Spread Summary

Estimate the overall potential for spread (comment on key issues that lead to this conclusion).

Response: *rapid*

Confidence: *high*

Comments (include list of spread pathways in your comments):
The distribution of *C. selloana* in the Risk Assessment Area has increased considerably since the 1980s. Records increased from 8 hectads before 1986 to 183 by 1999 (Preston et al. 2002) to 408 today (including a few records that may have disappeared or not be re-confirmed in the meantime) (BSBI 2014). It seems likely that this trend will continue in the future as there are more suitable habitats available and established occurrences outside cultivation as well as in cultivated areas are likely to act as sources for further spread.

Spread of the *C. selloana* can be through several pathways:

1. Human mediated spread: the most rapid pathway is the horticultural trade that distributes the plant and it's seeds through retail outlets and mail-order throughout the whole of the Risk Assessment Area.

2. Natural spread: established seed producing plants in gardens, parks and outside cultivation can be sources for natural spread through the dispersal of the lightweight seeds with distances to up to 25 km (Parsons & Cuthbertson 2001).

3. Vegetative spread: rhizome fragments dispersed for example with machinery or plant disposal can take root and establish new plants. For Australia, Parsons and Cuthbertson (2001) estimated this to be the most common dispersal mechanism after the horticultural trade.

Impact Summary

Estimate overall severity of impact (comment on key issues that lead to this conclusion)

Response: *major*

Confidence: *medium*

Comments (include list of impacts in your comments):

1. Environmental impacts: the main impacts of *C. selloana* are environmental. Of particular concern is the establishment of the species in natural and semi-natural habitats like sand dunes, rocky seashores and inland wetlands in the Risk Assessment Area and the resulting impacts on native biodiversity. In 2009, *C. selloana* was reported from 6 sites in a survey of 39 dune and shingle habitats in England, Scotland and Wales and was among the 15 most frequently occurring alien species in these habitats (Edmondson 2009). However, potential impacts in the Risk Assessment Area have not been investigated or documented up to now. Occurrences of the species in its alien range elsewhere have resulted in documented negative impacts on native plants including a decline in species richness, diversity and growth forms (Domènech et al. 2006) and it is likely that similar impacts will be found in the Risk Assessment Area. Individual plants of *C. selloana* form large clumps up to 7 m in diameter that are highly competitive mainly through shading and resource competition through their extensive root system (Parsons & Cuthbertson, 2001).

2. Economic: In New Zealand and Australia the species is causing problems in forestry, mainly for

management and by competition with forest growth (Global Invasive Species Database 2006, Parsons & Cuthbertson 2001). Similar impacts could occur in the Risk Assessment Area should the species become widely established in forest habitats.

3. An increased fire risk resulting from the dry leaves of the extensive tussocks has also been reported (Parsons & Cuthbertson, 2001, DiTomasio et al. 2010), and warmer and drier summers in Britain could increase that risk.

4. There is also a potential health impact from the risk of injury of the serrated leaves of the plant.

5. Aesthetic impacts: for example by changing the appearance of landscapes.

Climate Change

What is the likelihood that the risk posed by this species will increase as a result of climate change?

Response: *high*

Confidence: *medium*

Comments (include aspects of species biology likely to be effected by climate change (e.g. ability to establish, key impacts that might change and timescale over which significant change may occur):

C. selloana has already increased in recent years and this increase in records could be partly attributed to climate change (Clement 2005) making it likely this trend will continue over the coming years. Furthermore, those regions in the global non-native range of *C. selloana* where the species is classified as invasive and having negative environmental impacts are mostly in warmer Mediterranean climates (California, Spain, South Africa, Australia) indicating that existing establishments in the Risk Assessment Area could become more problematic as the result of a warmer climate in the future. Warmer and drier summers could also result in an increased fire risk.

Conclusion

Estimate the overall risk (comment on the key issues that lead to this conclusion).

Response: *high*

Confidence: *medium*

Comments:

C. selloana is already present and well established in the Risk Assessment Area. Records of the species have been increasing considerably in recent years and it seems likely that this trend will continue in the future. *C. selloana* is a popular garden plant with these plantings providing potential seed sources with the increased occurrence of male plants. It seems that C. selloana has reached the end of a lag phase were it was not spreading to the point where it is now able to establish and spread outside cultivation frequently. This seems to be related to the fact that more seed producing plants have been planted. The ornamental trade is also selling seeds of the plants which will result in even more seed producing plants in gardens acting as seed sources. Among the habitats affected already are natural and semi-natural habitats of high conservation value, for example rocky seashores and sand dunes and occurrences in these habitats are likely to increase. There is a risk that *C. selloana* could also establish itself in forests, wetlands and riverbanks, habitats in which it is known to cause negative impacts in other regions of its

non-native range. Climate change is likely to increase further establishment and spread of *C. selloana* in the Risk Assessment Area. Impacts are mainly on native biodiversity and aesthetic on landscapes. Forest management and growth could also be severely affected if the species manages to establish in woodlands. Control is difficult and costly, and eradication will be almost impossible because of these difficulties and because it is so widely planted. The species is known to be a highly damaging invasive species in other parts of its non-native range and listed as a noxious weed in several regions (e.g. several states in Australia and the USA, New Zealand, Spain).

Management options (brief summary):

1 - Has the species been managed elsewhere? If so, how effective has management been?

Response: Yes. The species is managed in most regions where it is considered invasive, for example in Spain, California, and New Zealand. Control is generally labour intensive and the effectiveness varies depending on the methodology used and site conditions.

2 - List the available control / eradication options for this organism and indicate their efficacy.

Response:
1. Manual – pull or dig out. This approach seems to be effective for seedlings only. The manual digging up of mature plants was found to cause negative impacts on surrounding vegetation as well as creating new sites for establishment of seedlings through disturbance (Gosling et al. 2000).
2. Chemical contol with herbicides (glyphosate): this is generally effective (DiTomasio et al. 2010) but may not be possible in protected areas. Follow-up treatment may be necessary (Gosling et al. 2000).
3. Heavy machinery – rip out with winches or digging up. Effective if roots are also removed but could have negative impacts on surrounding vegetation and depends on accessibility of sites.
4. Grazing with cattle several times per year has been used for control in forests in New Zealand (Gosling et al. 2000).

3 - List the available pathway management options (to reduce spread) for this organism and indicate their efficacy.

Response:
1. A general cessation in trading and planting *C. selloana* – very effective to prevent creating further potential sources for further spread.
2. To sell and plant female plants only (no propagation from seeds) – effective to prevent spread from seeds, but only effective if no male plants are present in an area.
3. Raising awareness for the potential problem – for example by providing information on how to distinguish male and female plants and advice on how to remove plants.
4. Identify and destroy seed producing and male plants – effective to prevent spread from seeds. Advice on how to distinguish hermaphrodite and female plants and a listing of cultivars by sex can be found in Armitage, J.D. (2012)
5. Advice on control and disposal of plants should include instruction on how to avoid spread of root fragments with machinery and equipment.

4 - How quickly would management need to be implemented in order to work?

Response:
Management should start as soon as plants are detected in habitats where they are not wanted. Seedlings and young plants are much easier to remove than established plants, and if the establishment was from seeds it will also prevent further spread by seeds. If plants are well established and immediate removal is not possible the cutting and burning of flowerheads as soon as they appear has been reommendet to prevent further spread (Parsons & Cuthbertson, 2001).

References

Provide here a list of the references cited in the course of completing assessment

Armitage, J.D. (2012) Notes from Wisley (v.c. 17): the sex forms of *Cortaderia selloana*. *BSBI News* **119**: 57-58

Brunel, S., G. Schrader, G. Brundu, Fried, G. (2010). Emerging invasive alien plants for the Mediterranean Basin. Bulletin OEPP/EPPO Bulletin **40**:219-238.

BSBI (2014). Botanical Society of Britain and Ireland, BSBI maps scheme. http://www.bsbimaps.org.uk/atlas/map_page.php?spid=4392.0&dateorder=ASC, accessed February 2014

CABI (2014). Cortaderia selloana [original text by M. Vila 2009]. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc. http://www.cabi.org/isc/datasheet/11872

Clement, E. J. (2005). *Cortaderia selloana* does self-sow abundantly in Britain. BSBI News 99: 47-48

Cope, T. & Gray, A. (2009). *Grasses of the British Isles. B.S.B.I Handbook No. 13.* London: BSBI

DiTomaso, J. M., Healy, E., Bell, C. E., Drewitz, J. & Stanton, A. (1999). Pampasgrass and jubatagrass threaten California coastal habitats. WRIC Leaflet 99-1 01/1999 (edited 01/2010). http://wric.ucdavis.edu/PDFs/pampasgrass%20and%20jubatagrass%20WRIC%20leaflet%2099-1.pdf

Domènech, R., Vilà, M., Gesti, J., & Serrasolses, I. (2006). Neighbourhood association of *Cortaderia selloana* invasion, soil properties and plant community structure in Mediterranean coastal grasslands. Acta Oecologica, 29(2), 171-177.

Edmondson, S. (2009) Focus on alien species. UK Sand Dune and Shingle Network. Newsletter No.7. http://coast.hope.ac.uk/media/liverpoolhope/contentassets/documents/coast/media,25616,en.pdf

Global Invasive Species Database, (2006). *Cortaderia selloana*. Available from: http://www.issg.org/database/species/ecology.asp?si=373&fr=1&sts=sss&lang=EN [Accessed February 2014].

Gosling, D. S., Shaw, W. B., & Beadel, S. M. (2000). Review of control methods for pampas grasses in New Zealand. Science for Conservation 165, 32.

Hawaii Invasive Species Council (2015) Examples of invasive species in Hawaii: Pampas Grass. Online ressource, accessed January 2015, http://dlnr.hawaii.gov/hisc/info/species/pampas-grass/

Lord, T. (2003) Flora. The gardener's bible., pp. 1584. Cassell, London.

Mitchell, B. (2013). Plant of the month November 2013: Cortaderia selloana. St Andrews Botanic Garden webpage: http://www.st-andrews.ac.uk/~gdk/stabg_new/poms/2013/nov13pom.htm, accessed February 2014

Okada, M., R. Ahmad, Jasieniuk, M. (2007). Microsatellite variation points to local landscape plantings as sources of invasive pampas grass (*Cortaderia selloana*) in California. Molecular Ecology **16**:4956-4971. doi: 10.1111/j.1365-294X.2007.03568.x

Parsons, W. T., & Cuthbertson, E. G. (2001). *Noxious weeds of Australia*. CSIRO publishing.

Pausas, J. G., Lloret, F., & Vila, M. (2006). Simulating the effects of different disturbance regimes on *Cortaderia selloana* invasion. Biological Conservation, 128(1), 128-135.

Preston, C. D., D. A. Pearman, Dines, T. D. (2002). New Atlas of the British and Irish Flora. Oxford University Press, Oxford.

RHS (2015). *Royal Horticultural Society Horticultural Database:* RHS Plant Finder, *available at* www.rhs.org.uk *(accessed February 2015).*

Ryves, T. B., E. J. Clement, Foster, M.C. (1996). Alien grasses of the British Isles. Botanical Society of the British Isles, London.

Sanz-Elorza, M., Dana, E.D. & Sobrino, E. (2004) *Atlas de las plantas alóctonas invasoras de España*. Dirección General para la Biodiversidad, Madrid, Spain.

Saura-Mas, S., & Lloret, F. (2005). Wind effects on dispersal patterns of the invasive alien *Cortaderia selloana* in Mediterranean wetlands. Acta Oecologica, 27(2), 129-133.