



Gunnera spp. (*G. manicata* & *G. tinctoria*)



- Large clump-forming herbs which can grow up to 3m in height and 4m across.
- Popular ornamental plant in gardens.
- Naturalised in scattered locations in lowland GB.
- Prefers sheltered areas where the ground is permanently moist.
- Displaces native plants through shading and reduction in available nutrients.
- Blocks streams and drains increasing flood risk; difficult and costly to eradicate

History in GB
G. tinctoria was introduced into Britain in 1849 as an ornamental species, before escaping into the wild in the early 1900s. It is now considered naturalised in western parts of Cornwall. *G. manicata* was introduced in 1867 and first recorded in the wild in 1935. It is less common than *G. tinctoria*. A third species, *G. peltata*, has not yet been recorded in Britain.

<p>Native distribution</p> <p>Native to South America</p> <p><i>G. manicata</i> is native to Brazil.</p> <p><i>G. tinctoria</i> is native to an area from Columbia to Chile.</p> <p>[native range map currently unavailable]</p>	<p>Distribution in GB</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><i>G. manicata</i></p>  </div> <div style="text-align: center;"> <p><i>G. tinctoria</i></p>  </div> </div> <p style="text-align: right; font-size: small;">Source: NBN 2015</p>
---	--

Impacts

Environmental

- Large leaves exclude native flora by shading.
- Has a large rhizome system which reduces nutrient availability for native riparian species.

Economic

- Can block drains and streams, increasing the risk of local flooding when water levels are high.
- Can be difficult and costly to eradicate.

Introduction pathways
Ornamental - widely promoted and available as architectural herbs.

Spread pathways

Natural - seeds spread by water and birds. A single *G. tinctoria* can produce 250,000 seeds in a year. Can also spread by rhizome fragments.

Human - spread from gardens and ornamental plantings. *G. tinctoria* is a common garden plant and a nuisance.

Social

- None known

Summary

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

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 Assessment of: *Gunnera species (G. manicata & G. tinctoria)*

Author: Jonathan Newman & Manuel Duenas-Lopez

Version: Final (April 2016) – Draft 1 (March 2012), NNRAP 1st review (February 2013), Peer review (October 2013), Draft 2 (August 2014), NNRAP 2nd review (September 2014)

Signed off by NNRAP: September 2014

Approved by Programme Board: September 2015

Placed on NNSS website: November 2015

GB Non-native species Rapid Risk Assessment (NRR)

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 assess the risk of various *Gunnera* species to the RAA

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:

Gunnera manicata Linden ex André, Brazilian Giant-rhubarb, Rheonllys Pigog

Gunnera peltata Phil.

Gunnera tinctoria (Molina) Mirb. *Syn. Gunnera chilensis, Panke tinctoria*, Giant-rhubarb, Rheonllys Mawr

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

Response: Yes

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

Response:

Gunnera manicata - present at 68 sites

Gunnera peltata – no known records

Gunnera tinctoria – present at 111 sites

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

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

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: n/a

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

Response: Yes

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

Response: Yes

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):

Already present, except *G. peltata*. *Gunnera tinctoria* was introduced into Britain in 1849 as an ornamental species, and evidence of its escape into the wild in the early 1900s (Preston, Pearman & Dines 2002; Skeffington & Hall 2011).

The history of *G. tinctoria* invasions in Britain and Ireland is relatively poorly documented, but it is likely to have followed a 'naturalization invasion continuum', as described by Richardson *et al.* (2000).

The majority of hectads in which its presence was recorded (91%) were after 1987, with 40% after 1999, suggesting either an exponential growth after a long lag-phase and/or an under-recorded distribution prior to 1999, likely due to its alien status.

In western parts of Cornwall, where the majority of records in England are found and where it is now considered naturalized (Pilkington 2011). Naturalized or invasive populations are also found where the species is only a recent introduction. *G. tinctoria* does not seem to have formed naturalized or invasive populations in Wales, despite being common in large gardens (Gioria & Osborne, 2013).

In Ireland, the majority of records in Ireland are since 1999 (Preston, Pearman & Dines 2002), confirming that the exponential invasion phase is a relatively recent phenomenon, despite the possible underestimation of its early distribution (Gioria & Osborne, 2013).

Establishment Summary

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

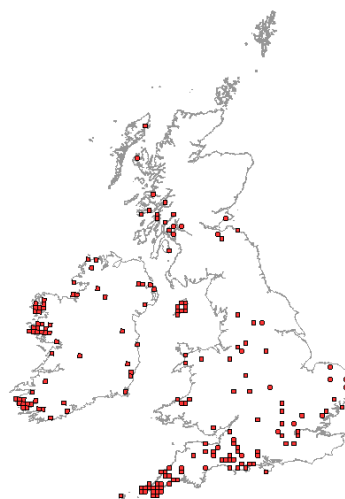
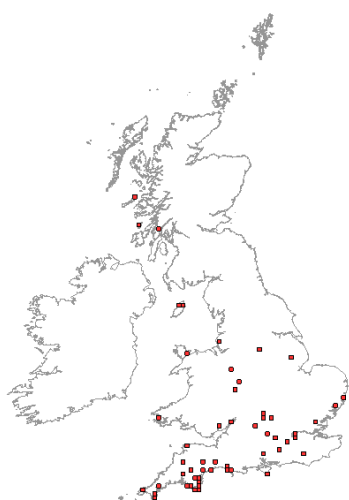
Response: *very likely*

Confidence: *very high*

Comments (state where in GB this species could establish in your comments, include map if possible):

Gunnera manicata

Gunnera tinctoria



The current distribution is in areas with higher temperatures than the average, as the south-west coast, so the south-east coast will be likely area for future spreading. The principal habitats for invasion are coastal cliffs and stream banks.

Gunnera manicata is able to grow in a wide range of climates and soil conditions. However, if winter conditions are severe *G. manicata* may die down - new leaves then grow in spring. *G. manicata* is tolerant of salt spray and is often grown near permanent water sources in areas with low rainfall. (Osborne *et al.*, 1991).

Gunnera tinctoria has been found in meadows, bogs, gardens, woodlands, sunny edges, and dappled shade. It requires moist soils in order to establish. Law (2003) reports *G. tinctoria* being found in riparian zones, wetland areas and coastal cliffs and is tolerant of salt spray and is found growing right up to the high tide mark (Williams *et al.*, 2005). The plant is seen to tolerate seasonally water logged wet soils and establishes less on excessively drained and drought-prone sandy or stony soil.

Spread Summary

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

Response: *intermediate*

Confidence: *high*

Comments (include list of spread pathways in your comments): Reproduction is predominantly by seed, with stochastic spread from gardens and ornamental plantings.

Gunnera manicata flowers are borne on a long stalk (up to 1m long). Inflorescences are mainly bisexual, are both symmetric and asymmetric and have well-developed sepals and petals. Staminate and pistillate flowers are located in different parts of the inflorescence. Flowers are then followed by tiny, globular (or slightly compressed) fruit. Fruit is abundant, with each seed head producing an excess of 80,000 seeds. The species is wind pollinated (Environment Waikato 2010; Wanntorp & Ronse De Craene 2005; Wilkinson & Wanntorp 2007). Fruit is dispersed by birds over relatively long distances, resulting in moderately rapid colonisation of new habitats adjacent to the original colony.

Law (2003) states that, "A single *G. tinctoria* may produce 250,000 seeds in a year, with the seeds being spread by water and by birds. The extensive seed bank allows *G. tinctoria* to easily re-colonize after mature plants have been removed. This species can also reproduce by rhizome fragments." Once established, vegetative growth can be rapid with rhizomes increasing by ~15cm annually (Hickey and Osborne, 1999).

Rich and Woodruff (1996) noted in their Table 2 an significant increase in the frequency of planted *Gunnera tinctoria* between 1960 and 1988, indicating significant anthropomorphic influence in the spread of this species.

Timmins *et al.*, (2010) list *G. tinctoria* as a species that is a common garden plant and a nuisance. This type of plant is more likely to be dumped in garden waste than uncommon or tame plants. Having been dumped, weeds that can grow from fragments any time of the year are more likely to establish than species that can only establish from seeds at a specific time of the year.

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):

G. tinctoria may easily be confused with *G. manicata* which can grow even taller than its Chilean relation but it looks very similar and is often mistaken for it. *G. manicata* is not generally considered to be invasive and tends to be confined to areas where it was introduced and naturalized populations are scarce (Sykes 1969; Preston, Pearman & Dines 2002).

Gunnera are the only known angiosperms to have a symbiosis with nitrogen-fixing cyanobacteria (Johansson & Bergman 1994). Unlike most symbioses between plants and cyanobacteria, in the case of the Gunneraceae the cyanobacteria are located intercellularly. The nitrogen fixing ability the cyanobacteria impart *Gunnera* species, makes the dicot nitrogen-independent (Osborne & Sprent 2002). This may contribute to the invasiveness of the Gunneraceae *G. manicata* and *G. tinctoria* since the symbiosis can fulfil the plants' nitrogen needs in nitrogen-deficient soils, especially during early stages of growth (Osborne *et al.* 1991). This could also give these Gunneraceae an advantage over native species.

The impacts of these large species are primarily due to exclusion of native flora by shading. In addition the large rhizome system will reduce nutrient availability to native riparian species, resulting in a depauperate flora in colonised areas.

Gunnera manicata can reduce natural biodiversity and compete with native species. The large leaves of *G. manicata* can prevent native species from growing underneath them and it may also form dense stands. Law (2003) report that, "*G. tinctoria* shades out rare and endangered indigenous flora and fauna. The huge leaves of each *G. tinctoria* mean it can impact on a disproportionately large number of the comparatively small, native herbs. Areas that have been cleared of mature *G. tinctoria* can become re-colonized with numerous seedlings from the original plants, and pieces of the rhizomes that break off will also re-grow. In areas with harsh winter frosts, *G. tinctoria* is deciduous or semi-deciduous. Once established, it is very invasive and forms dense colonies that shade-out or suppress desirable flora. These characteristics have contributed to it being a serious threat to indigenous biodiversity values in areas it has invaded". J. Macfarlane (Cornwall County Council, Pers. comm.) reports that *G. tinctoria* can block drains and streams.

The negative impacts of *Gunnera* spp on plant diversity are well documented (Hickey & Osborne 2001; Gioria & Osborne 2008, 2009, 2010). The most ecologically valuable communities invaded by *G. tinctoria* in Ireland are *Salix cinerea*–*Galium palustre* woodlands, leading to the replacement of *Salix cinerea* L., and altering natural successional processes (Hickey & Osborne 2001). *Gunnera* has high capacity to alter the soil seed bank (Gioria & Osborne (2009, 2010) by reducing the diversity of native seeds bank and increasing the abundance of seeds of weeds and rushes, which has potential long-term implications on the composition of the native vegetation (Gioria & Osborne, 2013). Additional impacts associated with *G. tinctoria* invasions include considerable increases in above- and below-ground biomass (Hickey & Osborne 1998), alterations in the quantity and quality of litter, changes in water and biogeochemical cycles (Gioria 2007). Such ecosystem alterations may, in turn, facilitate its own growth or promote invasions by other species (Gioria, Dieterich & Osborne 2011). Soil erosion also represents a major issue, particularly in coastal areas and along the banks of rivers and streams, where it can create large areas of exposed ground (Williams *et al.* 2005; Gioria 2007) and may block drainage ditches and stream (Weedbusters, 2003).

The ecological impacts of this species are particularly severe where it becomes established in areas of high conservation value, with potential threat to native flora over all in coastal areas (Gioria & Osborne, 2013).

Climate Change

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

Response: *low*

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):

Both species are reported as cool climate species (Williams *et al.*, 2005) which, if temperatures increase may restrict the species to coastal locations where temperatures are usually slightly lower. However, these habitats are complex and often contain rare species (Williams *et al.*, 2006), which would imply that their impact would be relatively greater in these type of habitats.

Conclusion

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

Response: *medium*

Confidence: *low*

Comments:

Where Chilean rhubarb invades native grasslands in Ireland, the once dense, species-rich native grassland is replaced by a sparse cover of dicotyledonous species not found in uninfested grasslands (Hickey & Osborne 1998). Chilean rhubarb also replaces grey willow (*Salix cinerea*) and thus alters the process of natural vegetation succession (Hickey & Osborne 1998).

G. tinctoria seriously compromises the conservation values of the coastal cliffs that are the habitat of a number of threatened and uncommon native plant species (Williams *et al.*, 2006)

The very high seed production and effective dispersal mechanisms, combined with continued availability of mature plants through horticulture indicate that plant will remain a high risk. It is also likely that both species are at an early stage of infestation in the RAA and that control should be undertaken in priority areas to limit further spread, eventually leading to eradication efforts.

Management options (brief summary):

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

Response: Yes. Not very effective.

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

Response:

Williams *et al.*, (2006) state that Chilean rhubarb can be controlled by mechanical means, but it is imperative to remove the entire rhizome because small pieces of live rhizome can re-sprout. Young Chilean rhubarb can readily be killed with chemical and spraying must be done early in the season using mixtures of glyphosate and metsulfuron methyl. Mature plants can be harder to kill because it is difficult to apply sufficient chemical to kill the stout rhizome. Higher application rates give better results than lower rates, especially for plants with large rhizomes. Where it has been possible to reach Chilean rhubarb on foot, cutting the leaves and flower stalks against the rhizomes, and then applying 5% glyphosate by hand, has been the most effective method. It is essential to check all treated plants within a year; any surviving plants must be re-treated and all seedlings removed or sprayed.

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

Response:

Restriction of trade, most effective as both species are deliberately planted and spread from garden plantings into the wider environment

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

Response:

Rapidly in the case of new infestations, but carefully and considerately in the case of established populations primarily to reduce spread.

References

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

List:

- Armstrong Hernandez, C., University College Dublin. School of, B., and Environmental, S. (2009), "Development of Control Measures and Distribution Mapping of *Gunnera tinctoria* on Achill Island, Co. Mayo, Ireland," Thesis. University College Dublin.
- Campbell, G. J., and Osborne, B. A. (1990), "*Gunnera tinctoria* (Molinia) Mirbel in Western Ireland," *The Irish Naturalists' Journal*, 23, 222-223.
- Doyle, M. F., and Scogin, R. (1988), "Leaf Phenolics of *Gunnera manicata* (Gunneraceae)," *Aliso*, 12, 77-80.
- Ehrenfeld, J. G. (2004), "Implications of Invasive Species for Belowground Community and Nutrient Processes" *Weed Technology*, 18, 1232-1235.
- Fennell, M., Gallagher, T., and Osborne, B. (2010), "Patterns of Genetic Variation in Invasive Populations of *Gunnera tinctoria*: An Analysis at Three Spatial Scales," *Biological Invasions*, 12, 3973-3987.
- Fennell, M., Murphy, J. E., Armstrong, C., Gallagher, T., and Osborne, B. (2012), "Plant Spread Simulator: A Model for Simulating Large-Scale Directed Dispersal Processes across Heterogeneous Environments," *Ecological Modelling*, 230, 1-10.
- Fuller, D. Q., and Hickey, L. J. (2005), "Systematics and Leaf Architecture of the Gunneraceae," *The Botanical Review*, 71, 295-353.
- Gioria, M. & Osborne, B. (2008) The soil seed bank of two invasive species, *Gunnera tinctoria* and *Heracleum mantegazzianum*, in Ireland. Plant Invasions: Human Perception, Ecological Impacts and Management (eds B. Tokarska-Guzik, J. Brock, G. Brundu, L. Child, C. Daehler & P. Pyšek), pp. 217–233. Backhuys Publishers, Leiden, the Netherlands.
- Gioria, M. & Osborne, B. (2013). Biological Flora of the British Isles: *Gunnera tinctoria*. *Journal of Ecology*, 101: 243–264.
- Gioria, M. (2007) The impact of three invasive species on soil seed bank communities. PhD Thesis, University College Dublin, Dublin, Ireland.
- Gioria, M., and Osborne, B. (2009), "The Impact of *Gunnera tinctoria* (Molina) Mirbel Invasions on Soil Seed Bank Communities," *Journal of Plant Ecology*, 2, 153-167.
- Gioria, M., and Osborne, B. (2010), "Similarities in the Impact of Three Large Invasive Plant Species on Soil Seed Bank Communities," *Biological Invasions*, 12, 1671-1683.
- Gioria, M., Dieterich, B. & Osborne, B. (2011) Battle of the giants: primary and secondary invasions by large herbaceous species. *Biology and Environment, Proceedings of the Royal Irish Academy*, 3, 177–193.
- Heenan, P. B., et al. (2009), "Additional Records of Indigenous and Naturalised Plants with Observations on the Distribution of *Gunnera tinctoria*, on Stewart Island, New Zealand," *New Zealand journal of botany.*, 47, 1-8.
- Hickey, B. & Osborne, B. (2001) Natural seed-banks, seedling growth, and survival in areas invaded by *Gunnera tinctoria* (Molina) Mirbel. Plant Invasions: Species Ecology and Ecosystems Management (eds G. Brundu, J. Brock, I. Camarda, L. Child & M. Wade), pp. 105–114. Backhuys Publishers, Leiden, the Netherlands.
- Hickey, E. P. (2002), "*Changes in Community Processes Associated with the Introduced and Invasive Species Gunnera tinctoria (Molina) Mirbel*," Thesis. University College Dublin.
- Hickey, E.P., and Osborne, B.A. (1998) Effect of *Gunnera tinctoria* (Molina) Mirbel on semi-natural grassland habitats in the west of Ireland. Pp. 195–208. in Starfinger, U.; Edwards, K.; Kowarik, I.; Williamson, M. (Eds): Plant invasions: ecological mechanisms and human responses. Backhuys Publishers, Leiden.
- Johansson, C., and Bergman, B. (1994), "Reconstitution of the Symbiosis of *Gunnera manicata* Linden: Cyanobacterial Specificity," *New Phytologist*, 126, 643-652.
- Kellerman, W. A. (1881), "*Die Entwicklungsgeschichte Der Bluche Von Gunnera chilensis, Lam.*"
- Law (2003) Law, C. 2003. Giant problems for Taranaki. Taranaki Regional Council: Protect 2003.
- Manawatu-Wanganui . Horizons Regional, C. (2006), *Gunnera (Chilean Rhubarb), Gunnera tinctoria and manicata : Plant Pests : Everyone's Responsibility*, Palmerston North, N.Z.: Horizons Regional Council.
- Mariotti, K. C., et al. (2011), "Study of Acute Toxicity and Investigation of the Presence of 032-N-Methylamino-L-Alanine in the *Gunnera manicata* L. A Species Native to Southern Brazil," *Brazilian Journal of Pharmaceutical Sciences*, 47, 623-628.
- New Zealand. Dept. of Conservation (2006), *Chilean Rhubarb: Shading Our Natives*, Wellington, N.Z.: Dept. of Conservation.
- Osborne, B. A., Cullen, A., Jones, P. W., and Campbell, G. J. (1992), "Use of Nitrogen by the Nostoc-*Gunnera tinctoria* (Molina) Mirbel Symbiosis," *New Phytologist*, 120, 481-487.

- Osborne, B., Doris, F., Cullen, A., McDonald, R., Campbell, G., & Steer, M. (1991), "*Gunnera tinctoria*: An Unusual Nitrogen-Fixing Invader," *BioScience*, 41, 224-234.
- Osborne, B.A. and Sprent, J.A. (2002) Ecology of the *Nostoc-Gunnera* symbiosis. Chapter 13 in *Cyanobacteria in symbiosis* Eds. Rai, A.N, Bergman, B and Rasmussen, U.. Kluwer, p 233-251
- Parra, L. E., and Ibarra-Vidal, H. (2002), "A New Species of Eupithecia (Lepidoptera: Geometridae) from the Juan Fernandez Islands," *Annals of the Entomological Society of America*, 95, 9-15.
- Pilkington, S. (2011) Giant rhubarb, *Gunnera tinctoria*. Online publication GB Non-native species secretariat. Available: <http://secure.fera.defra.gov.uk/nonnativespecies/home/index.cfm> (accessed 27 September 2011).
- Preston, C.D., Pearman, D.A. & Dines, T.D. (2002) *New Atlas of the British and Irish Flora*. Oxford University Press, Oxford, UK.
- Rich, T. C. G. & Woodruff, E. R. (1996) Changes In The Vascular Plant Floras Of England And Scotland Between 1930-1960 And 1987-1988: The BSBI Monitoring Scheme Biological Conservation 75:217-229
- Richardson, D.M., Pyšek, P., Rejmánek, M., Barbour, M.G., Panetta, F.D. & West, C.J. (2000) Naturalization and invasion of alien plants: concepts and definitions. *Diversity and Distributions*, 6, 93–107.
- Ronse De Craene, L. P., and Wanntorp, L. (2006), "Evolution of Floral Characters in Species. *Gunnera* (Gunneraceae)," *Systematic Botany*, 31, 671-688.
- Silva, L., Tavares, J. & Pena, A.(1996). Ecological basis for the control of *Gunnera tinctoria* (Molina) Mirbel (Gunneraceae) in São Miguel Island. *Proceedings Second International Weed Control Congress Copenhagen, Denmark* (ed. H. Brown), pp. 233–239.
- Skeffington, S.M. & Hall, K. (2011) The ecology, distribution and invasiveness of *Gunnera* L. species in Connemara, western Ireland. *Biology and Environment, Proceedings of the Royal Irish Academy*, 3, 157–175
- Stapf, O. (1919), "*Gunnera manicata* and *G. Brasiliensis*," *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)*, 1919, 376-378.
- Timmins, S.M., James, A, Stover, J. and Plank, M. (2010) Is garden waste dumping really a problem? *Proceedings of the Seventeenth Australian Weeds Conference, Christchurch, New Zealand*, 26 - 30 September 2010, pp 455 - 458
- Wanntorp, L. (2003), "Origin and Identity of the Cultivated *Gunnera manicata*," *Plantsman -London-*, 2, 221-225.
- Wanntorp, L., and Ronse de Craene, L. P. (2005), "The *Gunnera* Flower: Key to Eudicot Diversification or Response to Pollination Mode?," *International Journal of Plant Sciences*, 166, 945-953.
- Wanntorp, L., Wanntorp, H.-E., and Mari, K. I. (2002), "The Identity of *Gunnera manicata* Linden Ex Andre: Resolving a Brazilian-Colombian Enigma," *Taxon*, 51, 493-497.
- Weedbusters, 2003. Chilean rhubarb. News article, January 1st. Web site of Weedbusters, a component of the New Zealand Biodiversity Strategy. http://www.weedbusters.co.nz/about_weedbusters/index.asp
- Williams, P. A., Ogle, C.C., Timmins, S.M., Lacock, G.D. and Clarkson, J. (2005), *Chilean Rhubarb (Gunnera tinctoria) : Biology, Ecology, and Conservation Impacts in New Zealand*, DOC Research & Development Series 210, Wellington, N.Z., Dept. of Conservation. 26 pp.