Weed Risk Assessment for *Gladiolus undulatus* L. (Iridaceae) – Wavy gladiolus

United States Department of Agriculture

Animal and Plant Health Inspection Service

May 14, 2012

Version 1

Picture obtained from PBS (2011).

Agency Contact:

Plant Epidemiology and Risk Analysis Laboratory
Center for Plant Health Science and Technology

Plant Protection and Quarantine
Animal and Plant Health Inspection Service
United States Department of Agriculture
1730 Varsity Drive, Suite 300
Raleigh, NC 27606

Introduction Plant Protection and Quarantine (PPQ) regulates noxious weeds under the authority of the Plant Protection Act (7 U.S.C. § 7701-7786, 2000) and the Federal Seed Act (7 U.S.C. § 1581-1610, 1939). A noxious weed is "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (7 U.S.C. § 7701-7786, 2000). We use weed risk assessment (WRA) —specifically, the PPQ WRA model[1]—to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

Because our WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States or any area within it. We use a climate matching tool in our WRAs to evaluate those areas of the United States that are suitable for the establishment of the plant. We also use a Monte Carlo simulation to evaluate the consequences of uncertainty on the outcome of the risk assessment. For more information on the PPQ WRA process, please refer to the document, *Introduction to the PPQ Weed Risk Assessment Process*, which is available upon request.

	***Gladiolus undulatus* L. – Wavy gladiolus**
Species	Family: Iridaceae
Information	Initiation: On July 26, 2011, APHIS published a notice in the Federal Register announcing that *Gladiolus undulatus* has been proposed for listing in APHIS' Not Authorized Pending Pest Risk Analysis (NAPPRA) (APHIS, 2011). Plants in the NAPPRA category are potential quarantine pests that cannot be imported until they have been evaluated with a WRA. Depending on the results of the WRA, species may be either allowed entry or regulated as Federal Noxious Weeds. This WRA was initiated by the Plant Epidemiology and Risk Analysis Laboratory (PERAL).
	Foreign distribution: *Gladiolus undulatus* is native to South Africa (Goldblatt and Manning, 1998). Outside of its native range, it occurs in New Zealand, Australia (GBIF, 2011), and Portugal (Domingues de Almeida and Freitas, 2006).
	U.S. distribution and status: It has been present in the United States since at least 1930 (Bailey and Bailey, 1930), and possibly as early as 1795 (Childs, 1893). The actual distribution of *G. undulatus* in the United States is not well known. It is cultivated in California (PBS, 2011) and may also be present in other states as it is available for sale online. This species is not known to have naturalized in the United States (Kartesz, 2011; NRCS, 2011).
	WRA area: Entire United States, including territories

[1] Koop, A., L. Fowler, L. Newton, and B. Caton. 2012. Development and validation of a weed screening tool for the United States. Biological Invasions 14(2):273-294. DOI:10.1007/s10530-011-0061-4

1. *Gladiolus undulatus* analysis

Establishment/Spread Potential

Gladiolus undulatus is native to South Africa (Goldblatt and Manning, 1998). In Australia and New Zealand, it invades wetlands and riparian areas (Weber, 2003), as well as disturbed habitats such as drainage channels and roadsides (Richardson et al., 2006). However, in these countries it only reproduces vegetatively by cormels because its specialized pollinator does not occur there. Cormels are spread by streams and through the movement of soil. If produced, seeds are wind-dispersed. There was a low to moderate amount of uncertainty associated with this risk element.

Risk score = 11 Uncertainty index = 0.10

Impact Potential

Gladiolus undulatus invades natural riparian and wetland areas and forms dense populations that crowd out native species (Hussey et al., 2007; Weber, 2003). As such, it is may affect some Threatened and Endangered species in the United States. Officials in Western Australia control *G. undulatus* in natural environments by herbicide treatments and hand removal (Western Australian Herbarium, 2011). This species is not known to cause any impacts in cities or production systems, and is a cultivated and reportedly desirable plant in urban and suburban settings (Dave's Garden, 2011).

Risk score = 2.0 Uncertainty index = 0.18

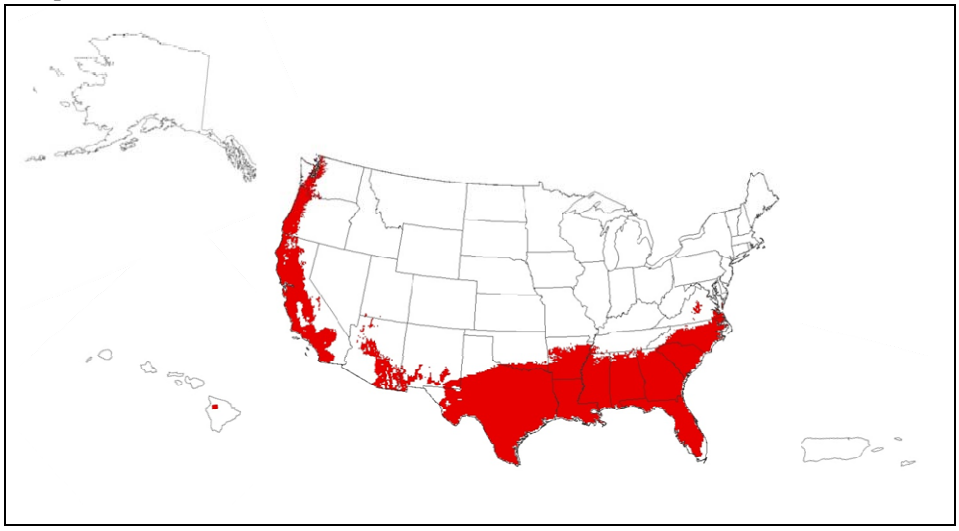
Geographic Potential

We estimate that about 20 percent of the United States is suitable for the establishment of this species (Fig. 1). We based that distribution on the species' known distribution elsewhere in the world, including point-referenced localities and areas of occurrence obtained primarily from GBIF (2011). The map for *G. undulatus* represents the joint distribution of USDA Plant Hardiness Zones 8-11, areas with 10-70 inches of annual precipitation, and the following Köppen-Geiger climate classes: steppe, mediterranean, humid subtropical, and marine west coast.

Entry Potential

Gladiolus undulatus is present in the United States, where it is cultivated in California (Bailey, 1917). Therefore, we did not need to assess its entry potential.

Figure 1. Predicted distribution of *Gladiolus undulatus* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.



2. Results and Conclusion

Model Probabilities: P(Major Invader) = 41.6%
P(Minor Invader) = 54.3%
P(Non-Invader) = 4.1%

Risk Result = High Risk

Secondary Screening = Not Applicable

Figure 2. *Gladiolus undulatus* risk score (black box) relative to the risk scores of species used to develop and validate the WRA model (other symbols). See Appendix A for the complete assessment.

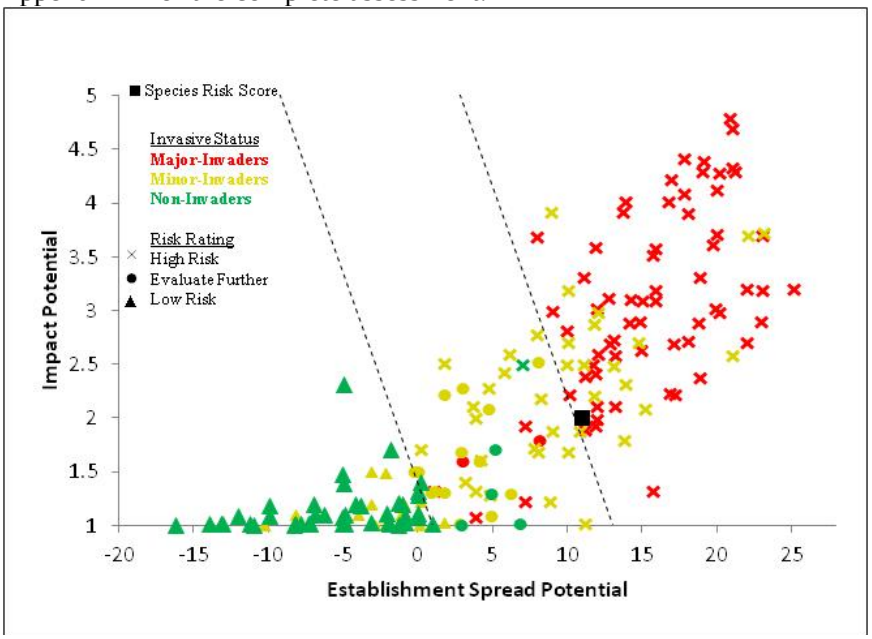
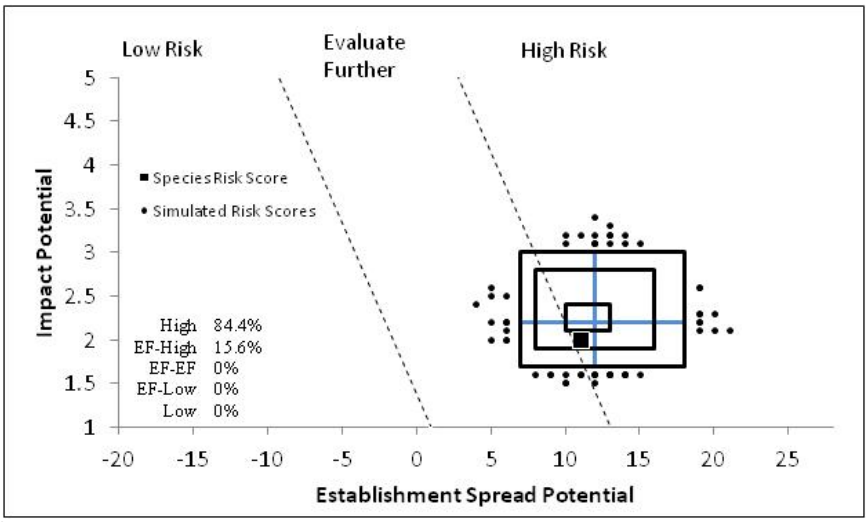


Figure 3. Monte Carlo simulation results (N=5000) for uncertainty around *Gladiolus undulatus*'s risk scores[a].



[a] The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The result of the weed risk assessment for *G. undulatus* is that the species is High Risk. Comparison of *G. undulatus* to the 204 plant species used in the validation study indicates that it shares many of the same traits and impacts as other low-scoring major-invaders and moderate-scoring minor-invaders (Fig. 2). Although a difference of a single point would have resulted in a determination of Evaluate Further by the predictive model, in the Monte Carlo uncertainty simulation the analysis always gave High Risk ratings (Fig. 3). *Gladiolus undulatus* poses a high risk potential because it invaded natural ecosystems in Australia and New Zealand, forming "extensive and dense populations that crowd out native vegetation and reduce species richness" (Weber, 2003). Even though *G. undulatus* requires specialized pollinators to set seed in its native habitat in South Africa (Goldblatt and Manning, 1999), it is invasive outside its native range due to its ability to vegetatively produce large numbers of cormels that can be dispersed in streams and flowing water (HerbiGuide, 2010; Weber, 2003).

In addition to its risk potential as an invasive weed, risk managers should consider the extent to which this species may be cultivated in the United States. It has been present in the United States since 1930 (Bailey and Bailey, 1930), and possibly since 1795 (Childs, 1893). It is cultivated in California (PBS, 2011) and possibly in other states as it is available for sale online (Telos, 2011). In a comment to the proposed rule (APHIS, 2011), Michael Mace, a member of the Pacific Bulb Society, stated that *G. undulatus* is grown by several members of the society with no reports of invasive tendencies (Mace, 2011). It is unknown why plants of *G. undulatus* in the United States have not displayed the same invasive behavior as those in Australia and New Zealand.

4. Literature Cited

APHIS. 2011. Plants for planting whose importation is not authorized pending

pest risk analysis: Notice of availability of data sheets for taxa of plants for planting that are quarantine pests or hosts of quarantine pests. Federal Register 76(143):44572-44573. Last accessed September 12, 2011, http://www.gpo.gov/fdsys/.

Auckland Council. 2007. Wild gladiolus: *Gladiolus undulatus* Auckland Council, Auckland, New Zealand. Last accessed September 30, 2011, http://www.arc.govt.nz/albany/index.cfm?63E0F20E-14C2-3D2D-B905-50098EBBE4B9&plantcode=Glaund.

Bailey, L. H. 1917. The Standard Cyclopedia of Horticulture (Vol. 3). The MacMillan Company, London.

Bailey, L. H., and E. Z. Bailey. 1930. Hortus: A Concise Dictionary of Gardening, General Horticulture and Cultivated Plants in North America. The MacMillan Company, New York. 352 pp.

BEing Plants. 2011. Store front: South African seeds: *Gladiolus undulatus* 10 seeds BEing Plants International seed supplier. Last accessed September 15, 2011, http://beingplants.com/zen/index.php?main_page=product_info&cPath=63&products_id=2175.

Burrows, G. E., and R. J. Tyrl. 2001. Toxic Plants of North America. Wiley-Blackwell, Hoboken, New Jersey. 1340 pp.

Childs, J. L. 1893. The Gladiolus: Its History, Species and Cultivation. John Lewis Childs, Floral Park, NY, U.S.A. 30 pp.

Colasante, M., G. Corazzi, and R. Mortellaro. 1999. Cyperaceae, Iridaceae, and Commelinaceae as weeds. 5th International Conference, Ecology of Invasive Alien Plants, La Maddalena, Sardinia, Italy.

Dave's Garden. 2011. PlantFiles. Dave's Garden. Last accessed September 15, 2011, from http://davesgarden.com/guides/pf/.

Domingues de Almeida, J., and H. Freitas. 2006. Exotic naturalized flora of continental Portugal – A reassessment. Botanica Complutensis 30:117-130.

GBIF. 2011. GBIF, Online Database. Global Biodiversity Information Facility (GBIF). http://data.gbif.org/welcome.htm. (Archived at PERAL).

Goldblatt, P., and J. Manning. 1998. Gladiolus in southern Africa. Fernwood Press, Vlaeberg, Cape Town, South Africa.

Goldblatt, P., and J. C. Manning. 1999. The long-proboscid fly pollination system in *Gladiolus* (Iridaceae). Annals of the Missouri Botanical Garden 86(3):758-774.

HerbiGuide. 2010. Wavy Gladiolus: *Gladiolus undulatus* L. HerbiGuide Online. Last accessed September 29, 2011, http://www.herbiguide.com.au/Descriptions/hg_Wavy_Gladiolus.htm.

Hussey, B. M. J., G. J. Keighery, J. Dodd, S. G. Lloyd, and R. D. Cousens. 2007. Western Weeds: A Guide to the Weeds of Western Australia (2nd ed.). The Weeds Society of WA, Inc., Victoria Park, WA, Australia. 294 pp.

Kartesz, J. T. 2011. North American Plant Atlas [maps generated from Kartesz, J.T. 2010. Floristic Synthesis of North America, Version 1.0. Biota of North America Program (BONAP). (in press)]. The Biota of North America Program (BONAP), Chapel Hill, N.C. http://www.bonap.org/MapSwitchboard.html. (Archived at PERAL).

Mace, M. 2011. Comment on notice: Plants for planting whose importation is Not Authorized Pending Pest Risk Analysis; Notice of availability of

data sheets for taxa of plants for planting that are quarantine pests or hosts of quarantine pests (Docket ID: APHIS-2011-0072) Personal communication to United States Department of Agriculture - Animal and Plant Health Inspection Service on September 26, 2011, from Michael Mace (Document ID: APHIS-2011-0072-0022).

NGRP. 2011. Germplasm Resources Information Network (GRIN). United States Department of Agriculture, Agricultural Research Service, National Genetic Resources Program (NGRP). http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl?language=en. (Archived at PERAL).

NRCS. 2011. The PLANTS Database. United States Department of Agriculture, Natural Resources Conservation Service (NRCS), The National Plant Data Center. http://plants.usda.gov. (Archived at PERAL).

PBS. 2011. Southern African Gladiolus Nine. Pacific Bulb Society (PBS). Last accessed September 29, 2011, http://www.pacificbulbsociety.org/pbswiki/index.php/SouthernAfrican GladiolusNine.

Randall, J. M. 2007. The introduced flora of Australia and its weed status. CRC for Australian Weed Management, Department of Agriculture and Food, Western Australia, Australia. 528 pp.

Rareplants. 2011. *Gladiolus undulatus*. Last accessed September 15, 2011, www.rareplants.de (archived at PERAL).

Richardson, F. J., R. G. Richardson, and R. C. H. Shepherd. 2006. Weeds of the south-east: An identification guide for Australia. Everbest Printing Co. Ltd, Victoria, Australia. 438 pp.

Ricketts, T. H., E. Dinerstein, D. M. Olson, and C. J. Loucks. 1999. Terrestrial ecoregions of North America: A conservation assessment. Island Press. 485 pp.

Surf Coast Shire. 2002. Environmental Weeds: Invaders of the Surf Coast Shire. Surf Coast Shire and Anglesea, Aireys Inlet Society for the Protection of Flora and Fauna (ANGAIR) Victoria, Australia.

Telos. 2011. Telos Rare Bulbs. Telos Rare Bulbs. Last accessed October 28, 2011, http://www.telosrarebulbs.com/index.html.

Weber, E. 2003. Invasive Plant Species of the World: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK. 548 pp.

Western Australian Herbarium. 2011. FloraBase - The Western Australia Flora. Department of Environment and Conservation, Australia. Last accessed August 31, http://florabase.dec.wa.gov.au/.

Appendix A. Weed risk assessment for *Gladiolus undulatus* L. (Iridaceae). The following information was obtained from the species' risk assessment which was conducted on a Microsoft Excel platform. The information shown below was modified to fit on the page. The original Excel file, the full questions, and the guidance to answer the questions are available upon request.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Establishment/Spread Potential			
ES-1 (Invasiveness elsewhere)	f - low	5	"*G. undulatus*…is increasing very rapidly on road verges, creek banks, wetlands and estuarine sites bushland in Australia" (Hussey et al., 2007). Invades "grassland, forest edges, riparian habitats, seasonal freshwater wetlands" (Weber, 2003). Naturalized in Portugal (Domingues de Almeida and Freitas, 2006). Alternate answer is e.
ES-2 (Domesticated to reduce weed potential)	n - low	0	No evidence of breeding. Plant is identified at the species level where sold (BEing Plants, 2011; Rareplants, 2011).
ES-3 (Weedy congeners)	n - mod	0	*Gladiolus italicus* and *G. byzantinus* are listed as weeds of wheat grown in Italy (Colasante et al., 1999). Several exotic *Gladiolus* species have naturalized in Australia, but no evidence of impact is given (Hussey et al., 2007).
ES-4 (Shade Tolerance)	n - low	0	"Not shade tolerant" (Auckland Council, 2007). Requires full sun to partial shade (Dave's Garden, 2011).
ES-5 (Climbing or smothering growth form)	n - negl	0	No evidence of a climbing or smothering growth habit. Plant is in the family Iridaceae (NGRP, 2011).
ES-6 (Dense Thickets)	y - low	2	Forms "extensive and dense populations that crowd out native vegetation" (Weber, 2003).
ES-7 (Aquatic)	n - negl	0	Terrestrial plant in the family Iridaceae (NGRP, 2011).
ES-8 (Grass)	n - negl	0	This plant is in the family Iridaceae (NGRP, 2011).
ES-9 (N2-fixer)	n - negl	0	Herbaceous plant in the family Iridaceae (NGRP, 2011; Western Australian Herbarium, 2011). No species within the Iridaceae is known to fix nitrogen.
ES-10 (Viable seeds)	y - negl	1	Can be propagated by seed (BEing Plants, 2011; Rareplants, 2011).
ES-11 (Self-compatible)	n - negl	-1	"*G. undulatus* ha[s] been shown experimentally to be self-incompatible" (Goldblatt and Manning, 1999).
ES-12 (Special Pollinators)	y - low	-1	In its native habit in South Africa, *G. undulatus* is pollinated by long-proboscid flies with specialized elongated mouthparts (Goldblatt and Manning, 1999). *G. undulatus* does not set seed in Australia where the long-proboscid flies are not present (Western Australian Herbarium, 2011).
ES-13 (Min generation time)	b - high	1	"Annually renewed corm" (Western Australian Herbarium, 2011). "Annual leaves, stems and flowers with a perennial corm….Corms are dug 4-6 weeks after harvest, cleaned, cured and stored at 3-70C for more than 6 weeks before replanting" (HerbiGuide, 2010). This information seems to indicate that a

Question ID	Answer - Uncertainty	Score	Notes (and references)
			cormlet will grow and produce new cormlets in one year, but high uncertainty because no specific information was found detailing the actual generation time in nature. Alternate answers are a, then c
ES-14 (Prolific reproduction)	? - max	0	No information found on quantity of seeds produced.
ES-15 (Unintentional dispersal)	y - low	1	"Spread by corms and cormels in garden refuse and soil from earthmoving" (HerbiGuide, 2010). "Cormels [sic] spread via fill material, roading machinery, water in drains & waterways" (Auckland Council, 2007).
ES-16 (Trade contaminant)	n - mod	-1	No evidence.
ES-17 (#Natural dispersal vectors)	2 -	0	0
ES-17a (Wind dispersal)	y - low		Seeds are winged (Goldblatt and Manning, 1998).
ES-17b (Water dispersal)	y - negl		*Gladiolus undulatus* grows in riparian areas and wetlands, and bulbils are dispersed by streams (Weber, 2003). "Many tiny cormels spread by water flows" (HerbiGuide, 2010).
ES-17c (Bird dispersal)	n - low		No evidence. Seed is a winged capsule (Goldblatt and Manning, 1998) and not likely to be dispersed by birds. No evidence that cormels are dispersed by birds.
ES-17d (Animal external dispersal)	n - mod		No evidence that seeds or cormels are dispersed externally on animals. Seeds are winged for wind dispersal and cormels are only known to disperse in water and soil.
ES-17e (Animal internal dispersal)	n - mod		No evidence that seeds or cormels are dispersed internally by animals. No evidence that animals consume *G. undulatus* seeds or cormels.
ES-18 (Seed bank)	y - low	1	Seedbank persistence of 1-5 years (Western Australian Herbarium, 2011).
ES-19 (Tolerance to loss of biomass)	y - low	1	"Fire tends to reduce the number of adult plants and facilitate germination of previously dormant cormels, resulting in a significant increase in juveniles" (Western Australian Herbarium, 2011).
ES-20 (Herbicide resistance)	n - mod	0	No evidence.
ES-21 (# Cold hardiness zones)	4	0	
ES-22 (# Climate types)	4	2	
ES-23 (# Precipitation bands)	6	0	
Impact Potential			
General Impacts			
Imp-G1 (Allelopathic)	n - mod	0	No evidence.
Imp-G2 (Parasitic)	n - negl	0	Non-parasitic plant in the family Iridaceae (NGRP, 2011).
Impacts to Natural Systems			
Imp-N1 (Ecosystem processes)	n - mod	0	No evidence.
Imp-N2 (Community structure)	n - mod	0	No evidence of changes to community structure (NGRP, 2011; Western Australian Herbarium, 2011).
Imp-N3 (Community composition)	y - low	0.2	Forms "extensive and dense populations that crowd out native vegetation and reduce species richness" (Weber, 2003). *Gladiolus undulatus* "displace[s] our indigenous vegetation" (Surf Coast Shire, 2002). "Out-competes native species" (Auckland Council, 2007)

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-N4 (T&E species)	y - mod	0.1	*Gladiolus undulatus* is able to invade riparian habitats and freshwater wetlands (Weber, 2003), so this plant could have an impact on Threatened and Endangered species adapted to these environments.
Imp-N5 (Globally outstanding ecoregions)	y - mod	0.1	*Gladiolus undulatus* is able to invade natural areas such as riparian habitats and freshwater wetlands (Weber, 2003), so this plant may be able to invade similar globally outstanding ecoregions in the United States (Ricketts et al., 1999), such as in riparian and wetland habitats in the southeast.
Imp-N6 (Natural systems weed)	c - low	0.6	Officials in Western Australia have developed a management calendar for herbicide treatments and the physical removal of *G. undulatus* in the natural environment (Western Australian Herbarium, 2011). "*G. undulatus*...is increasing very rapidly on road verges, creek banks, wetlands and estuarine sites... invading bushland adjacent to these disturbed sites" (Hussey et al., 2007). Randall lists *G. undulatus* as a weed of the natural environment in Australia (Randall, 2007). Alternate answer is b.
Impact to Anthropogenic areas (cities, suburbs, roadways)			
Imp-A1 (Affects property, civilization, ...)	n - mod	0	No evidence.
Imp-A2 (Recreational use)	n - mod	0	No evidence.
Imp-A3 (Affects ornamental plants)	n - mod	0	No evidence.
Imp-A4 (Anthropogenic weed)	a - mod	0	No evidence that *G. undulatus* is a weed in urban/suburban settings. This plant is cultivated and desirable in urban/suburban settings (Dave's Garden, 2011). Alternate answer is b.
Impact to Production systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Crop yield)	n - mod	0	No evidence.
Imp-P2 (Commodity Value)	n - mod	0	No evidence.
Imp-P3 (Affects trade)	n - mod	0	No evidence that *G. undulatus* would contaminate any commodities in trade.
Imp-P4 (Irrigation)	n - mod	0	No evidence.
Imp-P5 (Animal toxicity)	? - max		"Not recorded as toxic" (HerbiGuide, 2010). "Parts of plant are poisonous if ingested" (Dave's Garden, 2011). Some members of the genus *Gladiolus* are known to cause digestive irritation in livestock (Burrows and Tyrl, 2001).
Imp-P6 (Production system weed)	a - mod	0	No evidence that *G. undulatus* is a weed in production systems. Alternate answer is b.
Geographic Potential			Note, where used below, p.s. refers to point source data and occur. refers to occurrence.
Plant cold hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	No evidence.
Geo-Z2 (Zone 2)	n - negl	N/A	No evidence.
Geo-Z3 (Zone 3)	n - negl	N/A	No evidence.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-Z4 (Zone 4)	n - negl	N/A	No evidence.
Geo-Z5 (Zone 5)	n - negl	N/A	No evidence.
Geo-Z6 (Zone 6)	n - negl	N/A	No evidence.
Geo-Z7 (Zone 7)	n - mod	N/A	No evidence.
Geo-Z8 (Zone 8)	y - negl	N/A	Australia (GBIF, 2011 p.s.)
Geo-Z9 (Zone 9)	y - negl	N/A	Australia (GBIF, 2011 p.s.), Portugal (Domingues de Almeida and Freitas, 2006 occur.)
Geo-Z10 (Zone 10)	y - negl	N/A	Australia, New Zealand (GBIF, 2011 p.s.)
Geo-Z11 (Zone 11)	y - negl	N/A	South Africa (GBIF, 2011 p.s.).
Geo-Z12 (Zone 12)	n - mod	N/A	No evidence.
Geo-Z13 (Zone 13)	n - low	N/A	No evidence.
Koppen-Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	No evidence.
Geo-C2 (Tropical savanna)	n - negl	N/A	No evidence.
Geo-C3 (Steppe)	y - low	N/A	South Africa (Goldblatt and Manning, 1998 p.s.).
Geo-C4 (Desert)	n - negl	N/A	No evidence.
Geo-C5 (Mediterranean)	y - negl	N/A	Australia, South Africa (GBIF, 2011 p.s.).
Geo-C6 (Humid subtropical)	y - negl	N/A	Australia (GBIF, 2011 p.s.)
Geo-C7 (Marine west coast)	y - negl	N/A	Australia, New Zealand (GBIF, 2011 p.s.)
Geo-C8 (Humid cont. warm sum.)	n - low	N/A	No evidence.
Geo-C9 (Humid cont. cool sum.)	n - low	N/A	No evidence.
Geo-C10 (Subarctic)	n - negl	N/A	No evidence.
Geo-C11 (Tundra)	n - negl	N/A	No evidence.
Geo-C12 (Icecap)	n - negl	N/A	No evidence.
10-inch precipitation bands			
Geo-R1 (0-10")	n - low	N/A	No evidence.
Geo-R2 (10-20")	y - negl	N/A	Australia (GBIF, 2011), South Africa (Goldblatt and Manning, 1998 p.s.).
Geo-R3 (20-30")	y - negl	N/A	Australia, South Africa (GBIF, 2011 p.s.).
Geo-R4 (30-40")	y - negl	N/A	Australia (GBIF, 2011 p.s.).
Geo-R5 (40-50")	y - negl	N/A	Australia (GBIF, 2011 p.s.).
Geo-R6 (50-60")	y - negl	N/A	No direct evidence found for this precipitation zone, but *G. undulatus* occurs in Australia and New Zealand in areas where 40-50 inches of rainfall occur and 60-70 inches of rainfall occur, respectively, so it follows that *G. undulatus* would grow in areas where 50-60 inches of rainfall occurs.
Geo-R7 (60-70")	y - negl	N/A	New Zealand (GBIF, 2011 p.s.).
Geo-R8 (70-80")	n - mod	N/A	No evidence.
Geo-R9 (80-90")	n - mod	N/A	No evidence.
Geo-R10 (90-100")	n - mod	N/A	No evidence.
Geo-R11 (100"+)	n - mod	N/A	No evidence.
Entry Potential			
Ent-1 (Already here)	y - low	1	*Gladiolus undulatus* is present in California (PBS, 2011).
Ent-2 (Proposed for entry)	-	N/A	
Ent-3 (Human value & cultivation/trade	-	N/A	

Question ID	Answer - Uncertainty	Score	Notes (and references)
status)			
Ent-4 (Entry as a Contaminant)			
Ent-4a (In MX, CA, Central Amer., Carib., or China)	-	N/A	
Ent-4b (Propagative material)	-	N/A	
Ent-4c (Seeds)	-	N/A	
Ent-4d (Ballast water)	-	N/A	
Ent-4e (Aquaria)	-	N/A	
Ent-4f (Landscape products)	-	N/A	
Ent-4g (Container, packing, trade goods)	-	N/A	
Ent-4h (Commodities for consumption)	-	N/A	
Ent-4i (Other pathway)	-	N/A	
Ent-5 (Natural dispersal)	-	N/A	