U.S. Fish & Wildlife Service

Reed Mannagrass (*Glyceria maxima*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, June 2015
Revised, March 2018
Web Version, 8/16/2019

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1 Native Range and Status in the United States

Native Range

From CABI (2018):

"*G. maxima* is native to the north temperate zone of Europe and Asia. It is found as far eastward in Asia as Japan and the Kamchatka Peninsula (Anderson and Reznicek, 1994;USDA-ARS, 2009). Several references (DPIWE, 2009; ISSG, 2009) cite that *G. maxima* is invasive in the UK; however, Lambert (1947) claims that it is native flora of the UK. Additionally, Stace et al. (2009) states *G. maxima* is "common in most of England except North, scattered in Wales, Ireland and Scotland, 1 record in Guernsey, not in North or Northwest Scotland."

CABI (2018) lists *Glyceria maxima* as native in China, Japan, Kazakhstan, Turkey, Austria, Belarus, Belgium, Bulgaria, former Czechoslovakia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Moldova, Netherlands, Norway, Poland, Romania, Russian Federation, parts of Sweden, Switzerland, UK, Ukraine, and former Yugoslavia.

Status in the United States

USDA, NRCS (2018) lists *Glyceria maxima* as a potentially invasive, banned species in Connecticut and a prohibited species in Massachusetts.

From GISD (2018):

"The first record of *G. maxima* in the United States is during 1940 from a marsh on the edge of lake [*sic*] Ontario, several more populations were recorded between 1940 and 1952 in the same region."

From Berent and Howard (2018):

"*Glyceria maxima* was first found in the United States in the 1970s in Wisconsin's Racine and Milwaukee counties. Cultivated populations have also been documented in both Door and Wood Counties, and an un-vouchered specimen is noted from Calumet County. In the early 1990s it was found at three sites in Massachusetts' Ipswich River Wildlife Sanctuary in Essex county [sic]; these sites were subject to aggressive control measures, and only one site required re-treatment as of 2005.

New discoveries have occurred in recent years, with two new states reporting small infestations. In 2005, small population was detected in a residential pond near Monroe, Washington; control measures are planned for in 2007. In the fall of 2006, a dense circular patch was detected at Illinois Beach State Park, seemingly growing outward from a recently-replaced manhole cover. This population was treated in 2006 and monitoring will continue for a number of years (D. Nelson, pers. comm.).

Other stands occur in […] and Alaska."

"Status: Established in the Great Lakes region."

From NatureServe (2018):

"As of the year 2000, *Glyceria maxima* had been detected only at a few locations in Wisconsin and Massachusetts in the U.S. (Martin 2000). There may be other localized infestations such as the one in Snohomish County, Washington where it has been given the status Class A Noxious Weed by the Washington State Noxious Weed Control Board."

Means of Introductions in the United States

From Berent and Howard (2018):

"This species is thought to have been introduced intentionally as a forage species in some cases (Barkworth et al. 2000, USEPA 2008). Alternative pathways may include ornamental introductions or seeds hitchhiking with packing material, migrating waterfowl or workers and/or their equipment."

Remarks

No additional remarks.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

"Taxonomic Status:
Current Standing: accepted"

"Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Lilianae
Order Poales
Family Poaceae
Genus *Glyceria*
Species *Glyceria maxima* (Hartm.) Holmb."

Size, Weight, and Age Range

From Berent and Howard (2018):

"Size: up to 2.5m"

From GISD (2018):

"*Glyceria maxima* are terrestrial, perennial with a life span of 3-10 years."

Environment

From GISD (2018):

"Reaches best development both vegetatively and in production of flowering stems, in regions where summer water table is approximately at substrate level. […] At the same time they are largely limited or excluded by the mechanical conditions of the habitat, where a diurnal tidal rise and fall of 20-30cm is combined with a loose, shifting substrate. These plants are found in fully exposed situations but are tolerant to slight shade"."

From CABI (2018):

"Haslam (1978) states the nutrient requirements (p.p.m.) of *G. maxima* are:

Calcium: 100-150
Chloride: 40-60
Magnesium: 10-20
Nitrate-nitrogen: Poorly correlated
Ammonia-nitrogen: Poorly correlated
Phosphate-phosphorus: Below 1
Potassium: 20-40
Sodium: 40-60
Sulphate-sulphur: 80+
G. maxima is more likely to be found on soils high in total phosphorus and nitrogen (Loo et al., 2009a). Haslam (1978) found that the grass was phosphorus limited, so it will spread only into areas with adequate phosphorus levels. *G. maxima* is only tolerant of light shade (Lambert, 1947; Loo et al., 2009b)."

"It grows well in water up to 75 cm deep and satisfactorily even at depths of 1.5 m. In deeper water it often forms floating mats which remain attached to the banks of streams or ponds (Parsons and Cuthbertson, 1992)."

From NatureServe (2018):

"*Glyceria maxima* mostly invades wetland communities where ever it is reported to occur; however there is report of occurring in non-flooded roadsides in Tasmania which suggests it may not be restricted to wetlands."

Climate/Range

From CABI (2018):

"*G. maxima* is tolerant of waterlogging, fire and frost and of a wide range of climatic conditions, but prefers cooler, temperate regions (Weiss and Iaconis, 2000). It can establish in minor disturbed ecosystems of permanent and seasonal wetlands."

From GISD (2018):

"A limited number of planting experiments made in tropical Australia and New Guinea proved unsuccessful (Brown, 1929)."

Distribution Outside the United States

Native

From CABI (2018):

"*G. maxima* is native to the north temperate zone of Europe and Asia. It is found as far eastward in Asia as Japan and the Kamchatka Peninsula(Anderson and Reznicek, 1994;USDA-ARS, 2009). Several references (DPIWE, 2009; ISSG, 2009) cite that *G. maxima* is invasive in the UK; however, Lambert (1947) claims that it is native flora of the UK. Additionally, Stace et al. (2009) states *G. maxima* is "common in most of England except North, scattered in Wales, Ireland and Scotland, 1 record in Guernsey, not in North or Northwest Scotland."

CABI (2018) lists *Glyceria maxima* as native in China, Japan, Kazakhstan, Turkey, Austria, Belarus, Belgium, Bulgaria, former Czechoslovakia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Moldova, Netherlands, Norway, Poland, Romania, Russian Federation, parts of Sweden, Switzerland, UK, Ukraine, and former Yugoslavia.

Introduced

GISD (2018) lists *Glyceria maxima* as alien, invasive, and established in Australia, Canada, New Zealand, Sweden, and the United Kingdom.

From GISD (2018):

"G. *maxima* is native to parts of Sweden but also occurs in areas where it is non-indigenous. In its introduced range it is seen to form dense stands which impact on native vegetation (Larson, 2003)."

CABI (2018) lists *Glyceria maxima* as introduced and invasive in Canada, Australia, New Zealand, and introduced but not currently present in Papua New Guinea.

DAISIE (2018) lists *Glyceria maxima* as alien and established in Faroes, Finland, Norway, and Sweden, and as alien and status unknown in Denmark.

From NOBANIS (2018):

"Native but deemed invasive [in Ireland] as it can form a monoculture with a suspended mat like root system which prevents light from penetrating the water column."

"Native to southern Sweden, introduced to Uppland, Norrbotten and other parts of Sweden, Rapidly spreading"

From Berent and Howard (2018):

"The first North American record of *Glyceria maxima* came from Cootes Paradise, at the far west end of Lake Ontario, in the mid 1940s (Wei & Chow-Fraser 2006). It subsequently spread to other areas of Ontario, where it has overtaken native cattails and other species."

Means of Introduction Outside the United States

From GISD (2018):

"*G. maxima* was imported as a coarse grass to provide feed for cattle in wet areas (Champion et al. 2002)."

"G. *maxima* was widely distributed on a commercial scale in Australasia by rootstock planting in the early twentieth century (Lambert, 1947). Allan (1940) gives 1904 as the date of the first printed records of its occurrence in New Zealand. Commercial planting saw *G. maxima* establish in various locations (notably Otago and Southland) on both the North and South Islands, where it spread sufficiently to block waterways (Allan, 1940). The original source of *G. maxima* in Australia was a few plants in Victoria grown from English seed."

Short Description

From GISD (2018):

"*Glyceria maxima* is bisexual, perennial and rhizomatous grass (Morisawa, 2000; USDA, NRCS. 2005). […] They are characterized as big in size, hairless, cespitous. Stems are unbranched and can erect to 100-250cm high (Morisawa, 2000; Peeters, 2005). Leaf sheaths have prominent midribs, visible transverse veins and are closed near the top (Morisawa, 2000). Leaf blades are flat but are a little bit rough when large (10-18mm) (Morisawa, 2000; Peeters, 2005). The leaf blades are shallowly grooved with prominent midribs (Morisawa, 2000). Leaves are short (3-6mm), cut and pointed in the middle (Peeters, 2005). Leaf margins have short, stiff hairs which are rough to the touch (Morisawa, 2000). Leaves are bright green but sometimes tinged with red (Lambert, 1947). […] The inflorescence branches also have short, stiff hairs similar to those of the leaf margins (Morisawa, 2000)."

From CABI (2018):

"Leaves glabrous, bright green, sometimes tinged with red when young, especially in the sheath. Sheaths predominantly cross-veined, distinctly keeled distally and broadly naviculate in cross section. Ligule membranous, 3-6 mm long, entire or slightly divided, truncate, but usually with a central point. Blade abruptly pointed, 30-60 cm long, 7-20 mm wide, rough on the margins and sometimes the lower surface.

Inflorescence a loose, later dense, oblong many branched panicle, 15-45 cm long. Spikelets yellow or green tinged with purple, slightly compressed, stalked, oblong, 5-12 mm long, 2-3.5 mm wide and 4 to 10 flowered.

Seed dark brown, 1.5-2 mm long, enclosed in persistent, hardened flowering glumes. Glumes unequal, lower 2-3 mm, upper 3-4 mm, membranous, usually obtuse. Lemmas 3-4 mm long, not keeled, but with usually seven very prominent nerves. Paleas equal to lemmas or slightly shorter, boat shaped, flanges scaberulous. Lodicules fairly large, more or less connate, though generally separable. Stamens 3, anthers up to 2 mm long, yellow or purple. Styles 2, appearing to arise laterally; naked proximally, branched distally.

Root fibrous, 1-2 mm diameter, several arising from each rhizome node, extending to depths of 1 m and giving raise to laterals 1-8 cm long (Lambert, 1947; Parsons and Cuthbertson, 1992)."

From Berent and Howard (2018):

"*Glyceria maxima* could be confused with large specimens of native [to the Great Lakes Baisn] *Glyceria grandis*, but that species typically only grows up to 1.5 m, has nodding (rather than upright) inflorescences, and has shorter glumes and lemmas (parts of the grass spikelet) (Boos et al. 2000). It could also be mistaken for *Puccinellia* because of their similar spikelet structure and preference for wet habitats, but *G. maxima* is distinguished by its inability to tolerate highly alkaline soils, typically more flexible panicle branches, closed leaf sheaths, and single-veined upper glumes."

Biology

From CABI (2018):

"In its native range, *G. maxima* is found growing from the lowlands up to high altitudes in the mountain areas (Peeters, 2005). Lambert (1947) suggests that "these plants are typically a freshwater species and found in the bank of slow-flowing rivers. Exhibits a considerable vertical range in relation to water level, occur vigorously both as a reed swamp plant with roots and rhizomes immersed throughout the year. However, the presence of higher internal concentration of oxygen in the roots suggests for an immediate diphenylamine tests made on soil samples containing root fragments. Reaches best development both vegetatively and in production of flowering stems, in regions where summer water table is approximately at substrate level. When growing among other tall reed swamp species, they may produce excessively long vegetative stems. At the same time they are largely limited or excluded by the mechanical conditions of the habitat, where a diurnal tidal rise and fall of 20-30cm is combined with a loose, shifting substrate. These plants are found in fully exposed situations but are tolerant to slight shade"."

"Seeds germinate in spring and seedlings develop rapidly producing many vigorous shoots as well as a mat of creeping rhizomes in summer and autumn that contribute to spread beyond their periphery. During winter growth slows or ceases and then recommences in spring when both vegetative and flowering shoots are formed."

"Reproductive Biology
Reproduces by seed and rhizomes. Seeds germinate in spring and seedlings develop rapidly producing many vigorous shoots. Seeds are produced in the plants second and subsequent years. Flowering occurs in spring and summer and vast amounts of seeds are produced. These seeds have varying levels of dormancy, with the majority of seeds able to germinate immediately, whilst others are genetically bound to remain dormant for several years (Parsons and Cuthbertson, 1992; DPIWE, 2009). Only 1-9% of the florets set good grains (Dore, 1953 in Anderson and Reznicek, 1994) and the dense cover of the matted weed also hinders the establishment of seedlings (Weiss and Iaconis, 2000).

A mat of creeping rhizomes spreads in summer and autumn. During winter growth slows or ceases and then recommences in spring when both vegetative and flowering shoots are formed. A single plant may produce up to 100 shoots and 30 m of rhizome in its first 2 years of growth. The extensive root system of *G. maxima* can extend to depths of 1 m. A sprawling mass of rhizomes comprise 40-55% of the plant's total biomass. These rhizomes produce vast numbers of shoots to quickly expand the plants size (DPIWE, 2002). Plants in mature stands grow considerably slower and those in deep water, with a more anaerobic substrate, grow even more slowly and have reduced rhizome development (Parsons and Cuthbertson, 1992)."

From GISD (2018):

"*Glyceria* produces vast numbers of dark brown seeds throughout summer and autumn ([DPIWE], 2005). […] Majority of the seeds are able to germinate immediately while others remain dormant for several years ([DPIWE], 2005).

Lambert (1947) reports that "spikelets carrying well-developed caryopses in basal florets are generally detached entire above the non-flowering glumes as soon as caryopses are ripe; fertile florets subsequently easily separate from sterile florets above them. However, majority of the completely sterile spikelets remain attached to the panicle until it dies down at the end of the year"."

"Reproduction in dense stands of *Glyceria maxima* seems to be entirely by vegetative means rather than by seed; but no germination of grains yet observed in such stands (Lambert, 1947). The only well-established seedlings yet found in natural habitats are those which colonise wet bare mud and are often initiated by grains transported on feet of wading birds (Walker, 1946) as cited in (Lambert, 1947)."

From Berent and Howard (2018):

"The root system and rhizomes can extend 3 feet down into the soil (King County 2012). When growing near open water, reed mannagrass can form floating mats attached to the shore (King County 2012).

This species primarily reproduces vegetatively via rhizomes in North America (Campbell et al. 2010, Forest Health Staff 2006). Reed mannagrass emerges early in the year and concentrates up to 50% of its biomass in its root system (Westlake 1966). The energy stored in the roots and

rhizomes enable this species to produce new shoots through the growing season (Buttery and Lambert 1965). […]

Glyceria maxima also has florets that can bloom and produce viable seed (IPANE 2004). Individuals are in bloom between June and August. Once the inflorescences are mature, the panicle opens and rises above the other foliage (Campbell et al. 2010, Forest Health Staff 2006). […] Seeds dispersed in the fall will likely germinate the following spring; however, seeds can remain dormant and viable in the soil for several years (King County 2012).

During the winter, reed mannagrass becomes dormant. In early spring, regrowth occurs from rhizomes buds (King County 2012)."

Human Uses

From CABI (2018):

"In its natural range *G. maxima* can be readily consumed by cattle and is considered a nutritious fodder. *G. maxima* was commercially planted in its invaded range as a ponded pasture grass in and around farm swamps, dams and streams (Walsh, 1994)."

"*G. maxima* is used to treat sewage water in Europe and New Zealand because it has a high capacity to uptake nutrients (Ozimek and Klekot, 1979; Sundblad and Robertson, 1988; Sunblad and Wittgren, 1989; Tanner, 1996). As it slows water movement it can be useful for reducing erosion of riverbanks (Gippsland and Northern Co-operative Co. Ltd., 1940; DPIWE, 2009)."

From GISD (2018):

"*G. maxima* has been designated as a Surveillance Pest by the Auckland Regional Pest Management Pest Management [sic] Strategy 2002-2007."

"This species is a declared pest in the Southland region [New Zealand]."

"*G. maxima* (known as reed sweet grass) is classified as a "Nuisance Plant Pest" by Environment Waikato, which means it has been established for a considerable time and is probably widespread."

"Seeds are available by mail order from the native range (Seeds-by-size, 2009). Both nursery stock and seeds for sowing are permitted into Australia (AQIS, 2009)."

From Berent and Howard (2018):

"*Glyceria maxima* is sold and used as an ornamental plant (King County 2012)."

"*Glyceria maxima* has been used to treat the wastewater from swine farms in integrated constructed wetlands (ICW) in Ireland. During an 18-month study, the ICW successfully removed 98.1-99.9% of the ammonia-nitrogen (Harrington et al. 2012)."

Diseases

No information on pathogens or parasites of *Glyceria maxima* was found.

Threat to Humans

No information on threats to humans from *Glyceria maxima* was found.

3 Impacts of Introductions

From Clarke et al. (2004):

"However, the abundance of dominant taxa differed markedly between stream sections that were invaded or uninvaded by *G. masima* [*G. maxima*]. Uninvaded sections comprised a wide range of taxa, including trichopteran families senditive [sic] to anthropogenic disturbance (Stream Invertebrate Grade Number Average Level, version 2 (SIGNAL2) – score 8; Chessman 2003) whereas invaded sections had only a small selection of mostly dipteran families tolerant to disturbance (SIGNAL2 – score 3; Chessman 2003)."

"By converting stream sections into swamp sections, *G. maxima* may act as an autogenic ecosystem engineer (Jones et al. 1997). Furthermore, *G. maxima* growth may greatly alter the dynamics of nutrients, principally phosphorus and nitrogen, in streams (e.g. Jansson et al. 1994). Mats of *G. maxima* are active sites of nutrient assimilation, processing and retention and the plant is extensively used for nutrient removal in wastewater lagoons (Ozimek and Klekot 1979, Sundblad and Wittgren 1989). By generating a root-mat swamp, *G. maxima* establishes a nutrient processing capacity with positive feedback for further growth. By trapping nutrients, plant growth is stimulated resulting in growth of more roots to assimilate more nutrients. Extensive biofilm growth and nutrient processing may also facilitate secondary invasions, as illustrated by the success of *P. antipodarum* in 'Noojee' Creek (Simberloff and Von Holle 1999)."

From Berent and Howard (2018):

"*Glyceria maxima* has a moderate environmental impact in the Great Lakes.

Realized:
Glyceria maxima invades numerous wetland ecosystems: swamps, lakes, ponds, slow-moving rivers and creeks, ditches, and wet meadows (Boos et al. 2010). Early emergence in spring and rapid growth enables this species to outcompete other wetland plants (Buttery and Lambert 1965, King County 2012). *Glyceria maxima* can form monospecific stands and reduce plant diversity along the shore to a depth of about 15 cm (Andersson 2001, Boos et al. 2010, Forest Health Staff 2006). Reed mannagrass is not a suitable food source or nesting site for many wetland species. Expansion of G. maxima degrades the ecological dynamics in the wetland (Forest Health Staff 2006). The displacement of native vegetative often leads to an altered macroinvertebrate community, which can impact the entire food web for the ecosystem (King County 2012).

Glyceria maxima has an extensive system of roots and rhizomes (King County 2012). Dense populations of this species create rhizomal mats that can trap sediment faster than native species.

This increased sedimentation can alter the flow of water, restrict or clog small waterway and drainages, and cause flooding (Forest Health Staff 2006, King County 2012).

Potential:
The availability of organic material and denitrifying capacity is high in *G. maxima* dominant ecosystems (Kallner Bastviken et al. 2007). *Glyceria maxima* also uptakes available ammonium, which further decreases nitrifying activities (Bodelier et al. 1998). As *G. maxima* increases in a habitat, the availability of nitrogen in the soil could decrease.

Glyceria maxima may also be a competitive threat to native species of mannagrass. Native species listed as threatened or endangered in at least one Great Lakes state include *G. acutiflora* Torr., *G. arkansana* Fernald, *G. borealis* (Nash) Batchelder, *G. grandis* S. Watson, and *G. obtusa* (Muhl.) Trin (PLANTS Team 2012).

There is little or no evidence to support that *Glyceria maxima* has significant socio-economic impacts in the Great Lakes.

Realized:
Glyceria maxima has been used as forage, however cattle may experience cyanide poisoning if allowed to graze on young shoots (Boos et al. 2010, King County 2012).

Potential:
Large populations of *G. maxima* can impede water flow, alter hydrology, and restrict access to natural waterways, irrigation, and drainage channels. Reduced flow rates in waterways from siltation and debris build-up also creates breeding habitat for mosquitoes. In Tasmania, populations of *G. maxima* have created so much additional silt (from reduced water flow) that shallow dams have become useless (Department of Primary Industries 2012).

There is little or no evidence to support that *Glyceria maxima* has significant beneficial effects in the Great Lakes.

Realized:
Glyceria maxima is sold and used as an ornamental plant (King County 2012).
In areas where *G. maxima* begins growth early in the season, it can out-compete *Phragmites australis* (Studer-Ehrenseberger et al. 1993)."

From GISD (2018):

"*Glyceria maxima* can be a troublesome drainage weed and although palatable it has been implicated in the cyanide poisoning of livestock (NIWA, 2005). *G. maxima* has been intentionally introduced as livestock forage in seasonally inundated pastures, to temperate North America, New Zealand and Australia. In its native distribution in Europe, *G. maxima* forms monocultures in wetlands that reduce plant species diversity. In areas of introduction, including North America and Australia, it also forms monocultures and is now of conservation concern. The large, dense monospecific stands are capable of crowding out native wetland vegetation (Clarke et al. 2004). Because it is both a poor food source and a poor nesting substrate for

wetland wildlife, it has a significant potential to negatively affect wetland habitat dynamics (NIWA, 2005)."

"An inanga [*Galaxias maculatus*] spawning habit survey was conducted by NIWA in 2001 of streams and rivers in the western part of the Wellington Region, the authors observe that *G. maxima* which was recorded in a number of areas does not provide the right kind of micro-habitat required for inanga spawning. The weed clogs waterways. It has been recorded in the South Island where it has displaced tall fescue grass from riparian zones which would have been suitable for inanga spawing.

The authors state that *G. maxima* is proving to be a national threat to inanga spawning grounds as it best suited to wet riparian habitats which are the ideal spawning habitat (Taylor and Kelly, 2001)."

"It rapidly became established in Victoria, New South Wales, Tasmania and Western Australia where it proved vigorous enough to out-compete indigenous swamp vegetation in suitable habitats (Brown, 1929)."

From CABI (2018):

*"*In its natural range *G. maxima* can be readily consumed by cattle and is considered a nutritious fodder. However, in southeastern Australia and New Zealand it accumulates toxic levels of hydrocyanic acid which has resulted in the cyanide poisoning of livestock (Barton, 1983; Parsons and Cuthbertson, 1992). In South Gippsland both beef and dairy cattle deaths in spring have been attributed to *G. maxima*. Cyanic compounds are highly present in the vegetative tillers of the plant, only slightly in the flowering culms and not in the seeds (Barton, 1983). Additionally, Sharman (1968; cited in Barton 1983) found that the cyanide content of *G. maxima* varied greatly with season, peaking in spring when the grass was growing fastest and rising again in autumn. Given that *G. maxima* is not a preferred fodder source in Australasia, infestations result in a loss of area for nutritious fodder. Livestock have also become bogged down and drowned when attempting to reach water through dense infestations (Melbourne Water, 2003).

G. maxima can adversely affect water quality by making the water putrid and unusable. Farmers have had to relocate pumps after infested springs become polluted and cattle refuse to drink the water (Melbourne Water, 2003).The holding capacity of farm dams can be significantly reduced due to siltation. In dense stands it severely impedes water flow in canals, drainage ditches and streams, often causing local flooding (Parsons and Cuthbertson, 1992). There can be significant costs to landholders and waterway managers trying to control *G. maxima* using either chemical control or mechanical removal."

"Impact on Biodiversity

The ability of this vigorous invader to create monocultures is of conservation concern even in its native range (Lambert, 1947). The spread of *G. maxima* in England, UK, reduced the number of seed-producing plants (particularly of the Cyperaceae and Polygonaceae) available to winter

feeding ducks. *G. maxima* is reported to be a poor food plant for grazing waterfowl and a poor nesting substrate for many common wetland species (Burgess et al., 1990).”

“*G. maxima* is unlikely to have any serious affect on cultural heritage sites, but dense infestations may have a negative visual effect, ruining the aesthetic appeal of waterbodies. Clarke et al. (2004) recorded that *G. maxima* may convert sections of fast-flowing streams into anaerobic, swampy environments. Such a dramatic change could affect recreational fishing as downstream fish habitat would be significantly affected by reduced water flow. Dense infestations may also diminish recreational opportunities as swimming, boating, fishing and other recreational activities may be restricted.”

4 Global Distribution

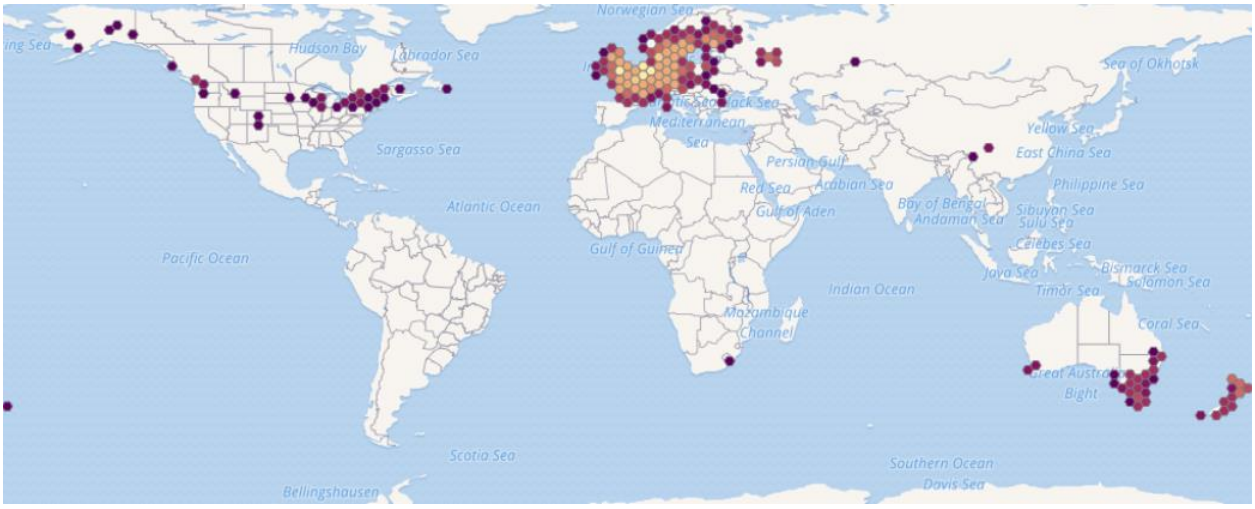

Figure 1. Known global distribution of *Glyceria maxima*. Map from GBIF Secretariat (2018).

The locations in northern Colorado (Figure 1) were not used as a source point for the climate match. The records are from the mid-late 1800s (BISON 2018; GBIF Secretariat 2018) and no other sources indicte an established population in Colorado. The location in southern Colorado was used as a soruce point; the record indicated that it was collected in the wild in the 1980s (GBIF Secretariat 2018).

5 Distribution Within the United States

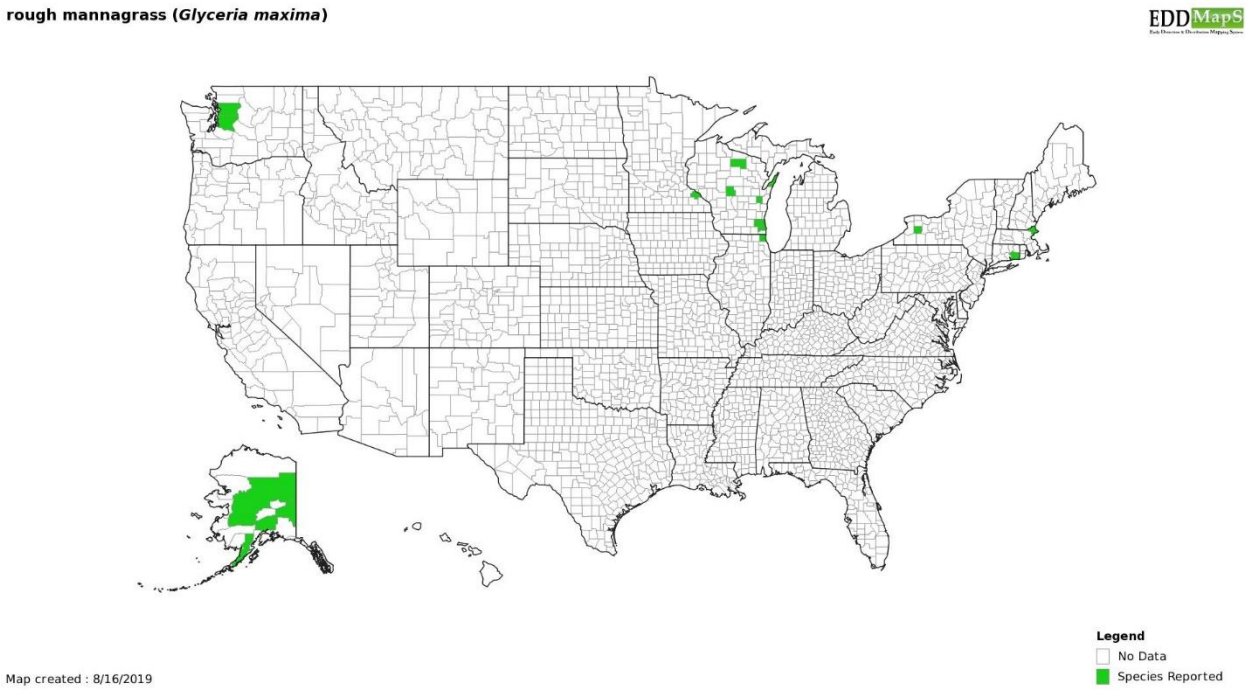

Figure 2. Known distribution of *Glyceria maxima* in the United States. Map from EDDMapS (2018).

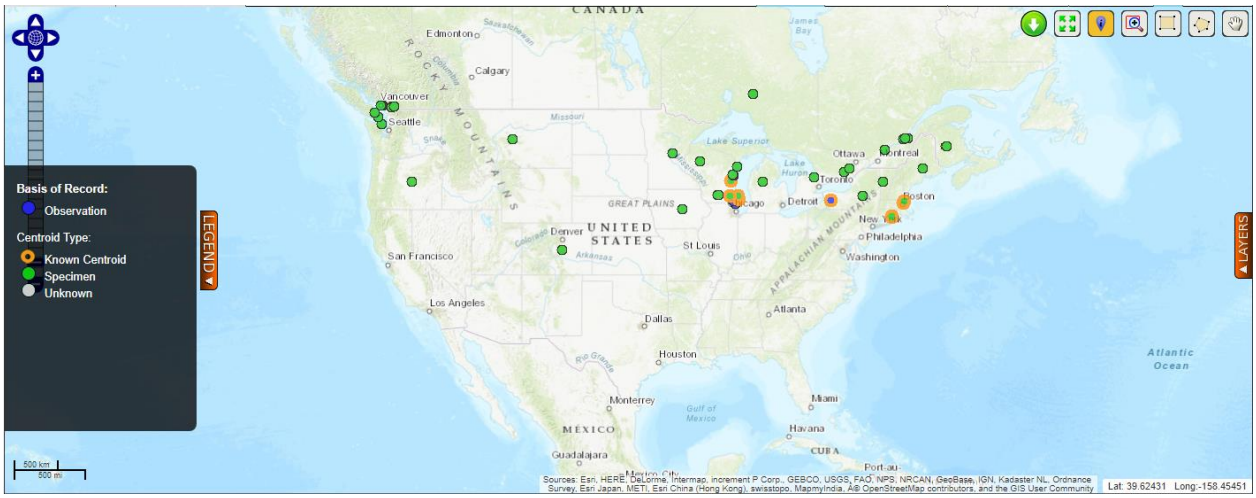

Figure 3. Known distribution of *Glyceria maxima* in the contiguous United States and Canada. Map from BISON (2018).

The location in Colorado (Figure 3) was not used as a source point for the climate match. The records are from the mid-late 1800s (BISON 2018; GBIF Secretariat 2018) and no other sources indicte an established population in Colorado.

The location in the middle of Oregon (Figure 3) was not used as a source point for the climate match. There is no collection date in the record and the information in the record casts doubt on the given location (BISON 2018).

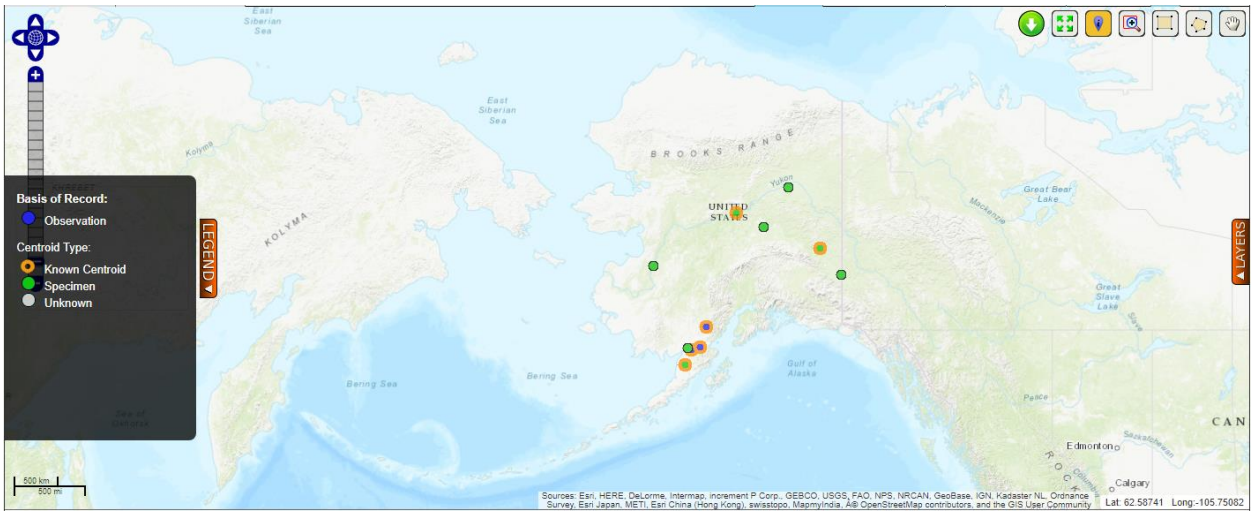

Figure 4. Known distribution of *Glyceria maxima* in Alaska. Map from BISON (2018).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Glyceria maxima* was generally high for the contiguous United States. There were areas of low match along the central Gulf Coast, the southwest, and a small area in the Pacific Northwest. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the contiguous United States was 0.664, high (scores 0.103 and greater are classified as high). All States had high individual Climate 6 scores except for Alabama and South Carolina, which had medium scores, and Louisiana and Mississippi, which had low scores.

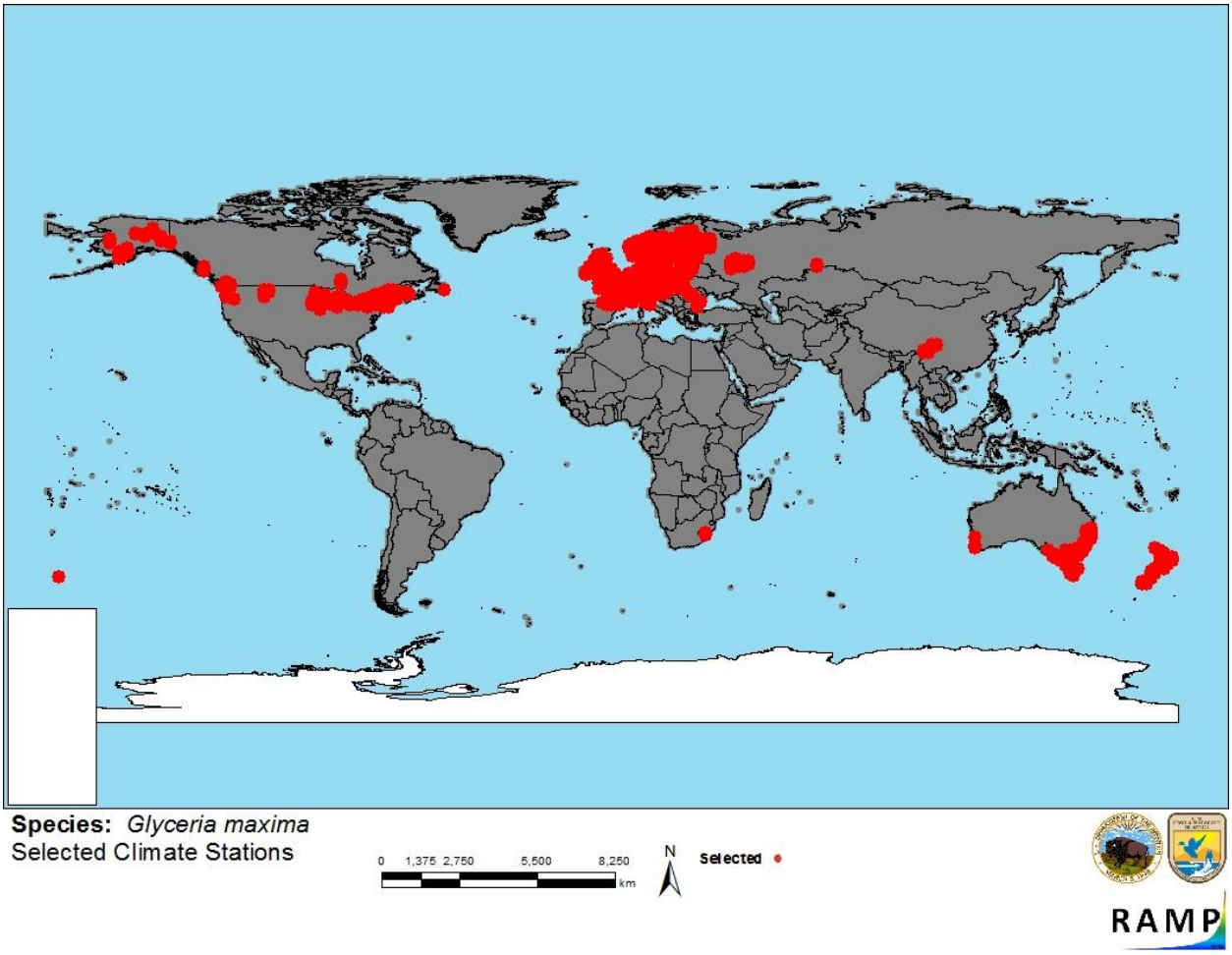

Figure 5. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *Glyceria maxima* climate matching. Source locations from BISON (2018) and GBIF Secretariat (2018). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

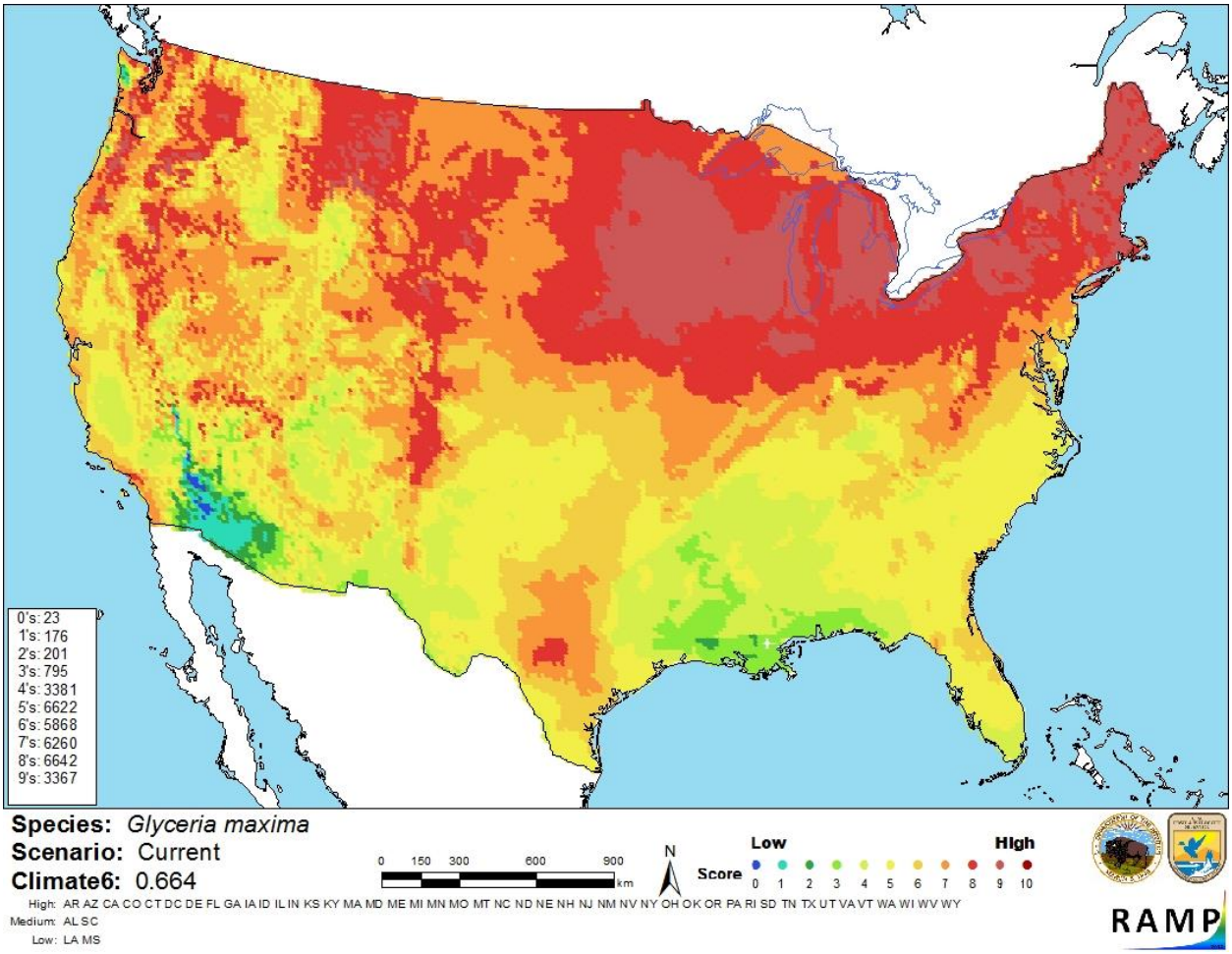

Figure 6. Map of RAMP (Sanders et al. 2014) climate matches for *Glyceria maxima* in the contiguous United States based on source locations reported by BISON (2018) and GBIF Secretariat (2018). Counts of climate match scores are tabulated on the left. 0 = Lowest match, 10 = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

Certainty of this assessment is high. Information on the biology, invasion history and impacts of this species is available, with some peer-reviewed literature. There is enough information available to describe the risks posed by this species.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Glyceria maxima is a wetland plant native to Eurasia and has become established in a number of countries around the world. *G. maxima* has broad climate suitability and prolific reproductive output. The history of invasiveness is high. The plant has been introduced as grazing forage for livestock but has also caused livestock deaths in Australia. This species directly impacts a native species of concern in New Zealand by destroying the microhabitat needed for successful reproduction. Monocultures of *G. maxima* have negative impacts on insect and bird diversity and ecosystem services. The climate match for the contiguous United States is high with only four states that did not have individually high climate scores. The certainty of assessment is high. The overall risk assessment category is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): High**
- **Remarks/Important additional information** No additional information.
- **Overall Risk Assessment Category: High**

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