# Reed Canarygrass (*Phalaris arundinacea*)

## Ecological Risk Screening Summary

**U.S. Fish & Wildlife Service, September 2014**
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Photo: Sheri Hagwood – Bureau of Land Management. Public domain – U.S. government work. Available: https://plants.usda.gov/java/largeImage?imageID=phar3_006_avp.jpg.

# 1 Native Range and Status in the United States

## Native Range

GISD (2017) lists *Phalaris arundinacea* as native in Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Ex-Yugoslavia, Finland, France, Georgia, Germany, Greece, Hungary, Iran, Iraq, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Norway, Poland, Portugal, Romania, Russian Federation, Spain, Sweden, Switzerland, Tajikistan, Turkey, Turkmenistan, Ukraine, United Kingdom, and Uzbekistan.

CABI (2018) lists *P. arundinacea* as native in Albania, Algeria, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Canada, China, former Czechoslovakia, Denmark, Egypt, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iran, Iraq, Italy, Japan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Mongolia, Norway, Portugal, Romania, Russian Federation, South Korea, Spain, Sweden, Switzerland, Taiwan, Tajikistan, Tunisia, Turkey, Turkmenistan, United Kingdom, Ukraine, Uzbekistan, and Yugoslavia.

From CABI (2018):

"Although certainly native to Eurasia and probably native to North America (Merigliano and Lesica, 1998), this species currently appears to be undergoing a large expansion in range and density in these regions (Maurer and Zedler, 2002)."

"Häfliger and Scholz (1980) describe the distribution as: northern, south-eastern, south-central and western USA, Central America, southern, eastern and northern Africa, Iberian Peninsula, central, northern and south-eastern Europe, former USSR, Middle East, Indian sub-continent, south-east Asian sub-continent and Pacific Islands."

"In North America, the species is common throughout most of Alaska (USA) and Canada as well as all but the south-east part of the USA (Hitchcock et al., 1969)."

## Status in the United States

Different sources list *Phalaris arundincaea* as either native (CABI 2018) or status unknown (GISD 2017) in the United States. This assessment presents the data from different sources as clearly as possible.

From Sturtevant et al. (2018):

"There is both confusion and controversy surrounding the native range of reed canarygrass in North America (Waggy 2010). This species has both native and introduced populations in close proximity since it is both native to North America and has had European transplants cultivated for agricultural use (Waggy 2010). In general, *Phalaris arundinacea* is treated as a native species in North America (Waggy 2010) and in the Great Lakes region with gene influence from non-indigenous populations (Huffman et al. 1986, Reuter 1986, Howe 2000, Maurer et al. 2003, Czarapata 2005)."

"Its native range has been hard to decipher until recently when DNA samples confirmed the presence of distinct populations present in North America that are not present in Europe or Asia (Jakubowski et al. 2013). Jakubowski et al. (2013) solidified *Phalaris arundinacea* as a native to North America from Alaska through New Brunswick, Canada."

"*Phalaris arundinacea* has no federal designation within the United States or Canada. The important economic use of *Phalaris arundinacea* in agriculture leads to it being unregulated in many states."

“Wisconsin restricts this species’ use (NR 40); here it cannot be possessed, transported, transferred, or introduced without a permit. Wisconsin specifically restricts *Phalaris arundinacea* var. *picta* and other ornamental variegated varieties and cultivars but does not include the parent type- reed canary grass. This makes a distinction between the native and invasive *Phalaris arundinacea* with the native variety being unregulated.”

“Illlinois [sic] does not list *Phalaris arundinacea* on its “Aquatic Life Approved Species List” since some populations are native to Illinois. However, Illinois DNR does find this species needs to be restricted and finds it inappropriate for import, possession, or culture since it is an invasive species (Illinois DNR, pers. communication). *Phalaris arundinacea* is not listed in the Illinois Noxious Weed Act or the Illinois Exotic Weed act. However, it is managed across the state in natural areas and at restoration sites (Illinois DNR, pers. communication).”

“Other Great Lakes states monitor reed canarygrass and consider it an “invasive species” but do not have legislative restrictions on its movement. These include: Minnesota, Indiana, and Ohio. Currently, the Indiana Division of Entomology and Plant Pathology, which regulates plants in Indiana, is reviewing *Phalaris arundinacea* to consider restricting its transportation.”

According to USDA, NRCS (2018), *P. arundinacea* is listed as invasive but is not banned in Connecticut, is prohibited in Massachusetts, and is a Class C noxious weed in Washington.

GISD (2017) lists *P. arundinacea* as native status unspecified, established, and invasive in Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Hawaii, Idaho, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Puerto Rico, Rhode Island, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

CABI (2018) lists *P. arundinacea* as native in Alaska, Arizona, California, Connecticut, Delaware, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin; and as present with no indication of origin in Minnesota, and Puerto Rico.

From CABI (2018):

“Many cultivated varieties have been registered for seed and forage yield in the USA (Rincker and Carlson, 1983; Kalton et al., 1989a, b), others have been developed for erosion control or for their ornamental value (such as the variety or form 'Picta' with variegated leaf blades).”

“In North America, the species is common throughout most of Alaska (USA) […] as well as all but the south-east part of the USA (Hitchcock et al., 1969).”

"*P. arundinacea* is now a circumarboreal species (Larson, 1993). However, there is some debate as to whether it is native to North America (Harrison et al., 1996). It is likely that populations of *P. arundinacea* in the USA consist of a mixture of agronomic cultivars (introduced from Europe) and native varieties (Merigliano and Lesica, 1998). Distinguishing native strains in the USA is therefore very difficult (White et al., 1993). Baldini (1993) has looked at ploidy levels for this purpose."

From EDDMapS (2018):

"Nativity of this plant is debated; it is native to Europe and possibly parts of Asia, but it may also be native to the northwestern United States. Aggressive behavior that is exhibited in many parts of the central and western United States may be a result of escaped cultivars that were bred for vigor and quick growth."

## Means of Introductions in the United States

From Sturtevant et al. (2018):

"Human activity best explains the range expansion of *Phalaris arundinacea* in North America. It has been cultivated for use as hay and for forage for livestock (Hitchcock 1951). It has been extensively cultivated and is considered good forage for livestock, particularly cattle but its ability to survive under continuous grazing is questionable (Kilbride and Paveglio 1999). Reed canarygrass can be used for erosion control, shoreline stabilization, and pollutant filtration (Marten 1985). In the past, it has been recommended for revegetation of disturbed sites (e.g. pipeline corridors (Cody et al. 2000), firelines (Bolstad 1971), and recently burned sites (Slinkard et al. 1970))."

## Remarks

The delineation of the native range of *Phalaris arundinacea* has not been well established. Discrepancies about the distribution in databases and the literature were presented as accurately as possible to give as complete an accounting of the species range as possible.

From GISD (2017):

"It is generally thought that invasive populations of *P. arundinacea* are descendants of non-native cultivars or ecotypes (Apfelbaum & Sams 1987) or the vigorous result of crosses between cultivated varieties and native strains (Baker 1972, Barrett 1983, Merigliano & Lesica, 1998, in Lyons, 1998)."

# 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 *Phalaris*
Species *Phalaris arundinacea* L."

## Size, Weight, and Age Range

From Sturtevant et al. (2018):

"Size: Ranges from 0.6 to 2.8 meters in height. Leaf blades are 8 to 25 centimeters long and 65 to 190 mm in width."

## Environment

From GISD (2017):

"The "natural" varieties of *P. arundinacea* are well suited to periods of frequent and prolonged flooding, […] They grow especially well in clay/loam soil and in sand (if the water content is high enough) but do not do well in peaty soils. It is categorized as a hard water species (in Lyons, 1998). Snyder (1992) states that it occurs along brackish tidelands. The upper range of water pH tolerance been measured to 8.8. *P. arundinacea* is not shade tolerant but is moderately tolerant of drought and saline or alkaline soils."

From CABI (2018):

"It survives under complete anaerobiosis but does not show shoot extension (Barclay and Crawford, 1982) under this condition."

From Waggy (2010):

"Riparian plant community publications from Idaho [Anzinger and Radosevich 2008] and Montana [Hansen et al. 1995] and studies from Wisconsin [Klopatek and Stearns 1978] and Ohio [Miletti et al. 2005] indicate that reed canarygrass tolerates pH ranging from 6.0 to 8.1 in wetlands and riparian areas. In Tennessee, reed canarygrass was planted and survived on a site with soil pH as low as 5 [Foster and Wetzel 2005]. In Alberta, Canada, reed canarygrass occurred in oxbow lakes with water pH ranging from 8.4 to 8.8, but in one oxbow, pH fluctuated between 7.5 and 10 [van der Valk and Bliss 1971]."

"Reed canarygrass may tolerate mildly saline water [Kantrud et al. 1989] but is intolerant of hypersaline conditions [McWilliams et al. 2007]."

## Climate/Range

From Waggy (2010):

"Reed canarygrass is a circumboreal, cool-season grass [Hoffman and Kearns 1997; Green and Galatowitsch 2001] […]. Reed canarygrass is considered winter-hardy [U.S. Department of Agriculture 1948], although different strains may be less adapted to cold than others. European strains may survive colder temperatures than some North American strains [Klebesadel and Dofing 1991]. Reed canarygrass' net photosynthesis is maximized at [air] temperatures of about 68 °F (20 °C) and reduced to 80% of maximum at 100 °F (38 °C), suggesting it may not perform well in subtropical or tropical climates [Marten 1985]."

"A few localized examples illustrate that reed canarygrass tolerates a wide range of [air] temperature and precipitation regimes. In North America, reed canarygrass occurs in areas where average annual low temperatures range from 9.5 °F (-12.5 °C) [Morin et al. 1989] to 40.5 °F (4.7 °C) [Long and Whitlock 2002; Foster and Wetzel 2005] in the coldest month, and average annual high temperatures range from 59.2 °F (15.1 °C) [Long and Whitlock 2002] to 70 °F (21 °C) [van der Valk and Bliss 1971; Morin et al. 1989; Foster and Wetzel 2005] in the warmest month. Reported average annual precipitation on sites where reed canarygrass occurs range from 18 inches (450 mm) [van der Valk and Bliss 1971] to 80 inches (2,000 mm) [Steiger 1930; van der Valk and Bliss 1971; Clambey and Landers 1978; Morin et al. 1989; Howe 1995; Long and Whitlock 2002]. In North America, reed canarygrass occurs in locations where the majority of rainfall occurs seasonally [Steiger 1930; van der Valk and Bliss 1971; Clambey and Landers 1978; Long and Whitlock 2002; Foster and Wetzel 2005] but the time of the year is variable."

## Distribution Outside the United States

### Status Unknown

GISD (2017) lists *Phalaris arundinacea* as native status unspecified, established, and invasive in Afghanistan, Algeria, Argentina, Canada, China, Colombia, Egypt, Indonesia, Japan, Mauritania, Mongolia, New Zealand, North Korea, Russian Federation, South Korea, Taiwan, and Tunisia. It also lists *Phalaris arundinacea* as cryptogenic, established, and invasiveness unspecified in Australia, India, South Africa, and Sri Lanka.

CABI (2018) lists *P. arundinacea* as present with indication of origin in Afghanistan, Argentina, Australia, Chile, Colombia, Croatia, Falkland Islands, India, Indonesia, Lesotho, Mauritius, Mexico, Netherlands, New Zealand, South Africa, Sri Lanka, and Venezuela.

## Native

Part of the native range of *Phalaris arundinacea* is within the United States. See Section 1 for a full description of the native range.

GISD (2017) lists *P. arundinacea* as native in Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Ex-Yugoslavia, Finland, France, Georgia, Germany, Greece, Hungary, Iran, Iraq, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Norway, Poland, Portugal, Romania, Russian Federation, Spain, Sweden, Switzerland, Tajikistan, Turkey, Turkmenistan, Ukraine, United Kingdom, and Uzbekistan.

CABI (2018) lists *P. arundinacea* as native in Albania, Algeria, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Canada, China, former Czechoslovakia, Denmark, Egypt, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iran, Iraq, Italy, Japan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Mongolia, Norway, Portugal, Romania, Russian Federation, South Korea, Spain, Sweden, Switzerland, Taiwan, Tajikistan, Tunisia, Turkey, Turkmenistan, United Kingdom, Ukraine, Uzbekistan, and Yugoslavia.

From CABI (2018):

"Although certainly native to Eurasia and probably native to North America (Merigliano and Lesica, 1998), this species currently appears to be undergoing a large expansion in range and density in these regions (Maurer and Zedler, 2002)."

"Häfliger and Scholz (1980) describe the distribution as: […] Central America, southern, eastern and northern Africa, Iberian Peninsula, central, northern and south-eastern Europe, former USSR, Middle East, Indian sub-continent, south-east Asian sub-continent and Pacific Islands."

## Introduced

GISD (2018) lists *Phalaris arundinacea* as alien, established, and invasiveness unspecified in the Falkland Islands.

From GISD (2017):

"*Phalaris arundinacea* Picta commonly known as ribbon grass, was a deliberate introduction [to the Falkland Islands]. It is reported to be present in one, 10km square.

CABI (2018) lists *P. arundinacea* as introduced in Ethiopia, Kenya, Tanzania, Uganda

According to NOBANIS (2018), *P. arundinacea* was intentionally introduced into Iceland in 1972 but it did not result in an established population.

## Means of Introduction Outside the United States

From GISD (2017):

"CNCPP (1998) states that *P. arundinacea* is the most popular species for irrigation with pollution control sewage effluent from municipal and industrial sources as practice. CNCPP (1998) states that farmers have planted *P. arundinacea* because it produces nutritious, palatable, succulent herbage for pasture, silage, and hay."

## Short Description

From CABI (2018):

"*P. arundinacea* is a stout, erect perennial reed growing 0.6-2 m high with far creeping rhizomes. Leaves flat, smooth, acuminate. Blade 10-35 cm long, 6-25 mm wide (approximately 20 times as long as wide), flat, linear. Ligule membranous, truncate, or occasionally acuate, 6-10 mm; sheaths smooth. Culm erect or geniculate, not branching. Panicle lobed lanceolate, 7-40 cm long, 1-4 cm wide, composed of branches up to 5 cm long, spreading only at flowering. Spikelets 3.5-7.5 mm long, subsessile. Glumes lanceolate, acuminate, keeled but not winged. Lemmas broadly lanceolate, acute; L1 and L2 1.2-2.3 mm long, short-hairy, sterile; L3 fertile, 2.9-4.5 mm long, 5-nerved, short-hairy. Caryopses light brown, 2-3 mm long."

"It is a highly variable species, varying in height, size and shape of inflorescence, and coloration (Apfelbaum and Sams, 1987). The sturdy, often hollow stems can be up to 13 mm in diameter, with some reddish coloration near the top."

## Biology

From GISD (2017):

"Seeds are short-lived when inundated with water. Seeds germinate more readily immediately after maturation. Rates of germination decrease through winter and are poor the following summer. The most effective method to increase germination rates was soaking seeds in water at 50°C. Lyons (1998) states that water may dilute or rinse away water-soluble dormancy-enforcing compounds. Mechanical damage, increased light, and oxygen also successfully broke seed dormancy. Temperature changes had little effect on germination."

"*Phalaris arundinacea* can be classified as growing in semi-open and open habitats. Riparian habitats are at the greatest risk of being invaded and dominated by *P. arundinacea*, but any moist, fertile habitat provides good conditions for this species. It is considered a serious threat in wet meadows, wetlands, marshes, fens, old fields, floodplains, wet prairies, roadsides, ditchbanks. Streambanks, lakeshores, and shore swales also support the species. Invasion is promoted by disturbance, such as ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, overgrazing, and intentional planting. Natural disturbances, such as scouring floods and low water conditions also promote invasion."

"*Phalaris arundinacea* shoots emerge from rhizomes or seeds and grow vertically through the soil surface during the first 5-7 weeks of spring. It has two periods of growth, one prior to seed

maturation and one after. As the plants age they have more roots per node, while tillers [auxiliary stalks] per plant, total axillary shoot length, and node diameter decrease. After the second growth period, culms collapse and form dense, impenetrable mounds (in Lyons, 1998). Snyder (1992) states that rhizomes grow into dense mats within 1 year, and up to 74 percent of new shoots are believed to arise from rhizomes."

From CABI (2018):

"Flowering in *P. arundinacea* requires exposure to short day-length conditions for primary floral induction and long day-length conditions (13-15 h) for secondary induction (Heide, 1994). The species flowers in June and July in the Pacific Northwest, USA (Hitchcock et al., 1969; Weinmann et al., 1984)."

"Reproduction in this species is via seeds, rhizomes and tillers (Wells et al., 1986; Ito et al., 1990). It will also produce roots and shoots from the nodes of freshly cut, well jointed culms (Marten and Heath, 1973; Corley, 1989). Dethioux (1986) has demonstrated that stem cuttings of this species are a viable means of propagation. Gifford et al. (2002) have strong evidence that *P. arundinacea* reproduces primarily clonally in North America."

## Human Uses

From CABI (2018):

"Some strains of *P. arundinacea* (i.e., those low in toxic compounds) are used as fodder crops. This species has been an important component of lowland fodder in a number of countries for some time, particularly in Europe, the USA and Russia. It has been the subject of much agricultural research (for example, see Alway, 1931; Hitchcock, 1950; Hitchcock et al., 1969; Tasi and Barcsak, 2001; Struzhkina, 2002)."

"Trials by Vassileva and Jingov (1988) showed this species to offer effective soil conservation properties on strongly eroded soils."

"*P. arundinacea* has also been the subject of much research into biomass/energy crops (for example, Bullard et al., 2001; Gylling, 2001) and, as such, this crop is considered to have a relatively low environmental impact in northern Europe (Pedersen, 1997)."

"It is also grown in Europe for its short fibres which are suitable for high-quality paper production (Pedersen, 1997)."

"It also has ornamental value as a landscaping plant and for dried flowers (Corley, 1989; Urbanski, 1997). The variegated form 'Picta' is popular."

From GISD (2017):

"*Phalaris arundinacea* produces nutritious, palatable, succulent herbage for pasture, silage, and hay. It is the most popular species for irrigation with pollution control sewage effluent from

municipal and industrial sources as practice. It has also been planted on streambeds, gully bottoms, sloughs, pond banks, swamplands.

Seed is used for birdseed. Snyder (1992) states that prairie chickens use it for cover in winter; however, commercial value is limited as seeds of the inflorescence shatter asynchronously and do not germinate readily or regularly (Griffith & Harrison 1954, in Lyons, 1998). *P. arundinacea* is also used for cover by muskrats and fish, and farmers have also used it for goose grazing areas."

## Diseases

Poelen et al. (2014) list *Anagrus incarnatus*, *Ascochyta graminicola*, *Aspergillus flavipes*, *Blumeria graminis*, *Chrysocharis pentheus*, *Chrysocharis polyzo*, *Chrysocharis submutica*, *Chlorosytus breviscapus*, *Chlorocytus phalaridis*, *Cirrospilus pictus*, *Cirropilus vittatus*, *Cladophialophora boppii*, *Diglyphus albiscapus*, *Eurytoma phalaridis*, *Hemiptarsenus unguicellus*, *Macroglenes paldudum*, *Merismus megapterus*, *Merismus splendens*, *Mesopolobus graminum*, *Mesopolobus myetiolae*, *Mucor hiemalis*, *Paecilomyces marquandii*, *Pediobius phalaridis*, *Penicillium citrinum*, *Penicillium purpurogenum*, *Pnigalio agraules*, *Pnigalio longulus*, *Pnigalio pectinicornis*, *Pnigalio soemius*, crown rust of oats (*Puccinia coronata*), *Puccinia sessilis*, *Pythium debaryanum*, *Selenophoma donacis*, *Semiotellus fumipennis*, *Subanguina radicicola*, *Stagonospora arenaria*, *Tetramesa brevicornis*, *Tetramesa longicornis*, *Tetrastichus temporalis*, *Tilletia menieri*, *Ustilago echinata*, *Ustilago* sp., and *Ustilago striiformis* as parasites or pathogens of *Phalaris arundinacea*.

## Threat to Humans

From CABI (2018):

"When in flower, the species produces abundant pollen and chaff, which aggravate hay fever and allergies (Weinmann et al., 1984)."

From Sturtevant et al. (2018):

"Pollen from dense stands can inflare allergies and asthma for human health."

# 3 Impacts of Introductions

From Barnes (1999):

"*Panicum virgatum*, *Eragrostis pectinacea* Michx., *Polygonum hydropiper* L., and *Vernonia fasiculata* Michx. are the major species displaced by *P. arundinacea* (Fig. 3 [in source material]). The first three species occurred primarily at low elevations in 1981 and have since almost disappeared. *P. virgatum* was distributed over the entire island in 1981 but now is absent from most low elevation sites."

From Rojas and Zedler (2015):

"All seven Pa [*Phalaris arundinacea*] stands had lower intercepts (indicating lower species richness at the 1-m scale) than Cs [*Carex stricta*] stands."

"Pa [*Phalaris arundinacea*] decreased species richness by an average of 48 % fewer species than Cs [*Carex stricta*] stands at all four plot sizes; 43 % at 0.25 $m^2$, 49 % at 1 $m^2$, 50 % at 4 $m^2$, and 49 % at 16 $m^2$."

"Pa [*Phalaris arundinacea*] is consistently associated with lower species richness, as well as fewer conservative species, lower Mean C [coefficient of conservatism], lower floristic quality (FQI), and lower diversity (H'). Despite considerable variation in soils and vegetation across site, the responses to Pa were consistent and clear—native vegetation was degraded in richness and quality."

From Sturtevant et al. (2018):

"Current research suggests that *Phalaris arundinacea* is a superior competitor for nutrients and light with native species (Kercher 2007). Reed canarygrass displaces rare plants (Peter 1997) and native plants. If established in an area for a long period of time, seed banks are devoid of native species (Apfelbaum and Sams 1987). […] Reed canarygrass can exploit disturbances due to its genetic and morphological plasticity (Kercher 2007) and is able to hybridize with native strains (Lavergne and Molofsky 2004)."

"Lower soil insect diversity and trophic groups of insects have been reported in reed canarygrass monocultures (Lavergne and Molofsky 2004). Displacement of woody vegetation can reduce the number of arthropods foraging in riparian areas which can then cause bottom up effects in the food web (Miller et al. 2008)."

"Carbon and nitrogen sequestration are lower in monospecific reed canarygrass stands than in diverse native wet prairie communities (Herr-Turoff and Zedler 2005)."

"Pollen from dense stands can inflare allergies and asthma for human health. There is potential for *Pharlaris arundinacea* can constrict waterways which could result in closure of water for recreational activities. Silt deposits, emergent stems, and leaves of reed canarygrass reduce the volume of water that a channel can carry and impede water flow (Comes et al. 1981). *Phalaris arundinacea* prevents forest regeneration and establishes thick monocultures in wetlands where it establishes reducing perceived aesthetics and natural value where it occurs."

From Waggy (2010):

"Reed canarygrass impacts ecosystems by reducing plant diversity [Lesica 1997; Barnes 1999; Bartels and Wilson 2001; Kercher et al. 2004; Perkins and Wilson 2005; Fierke and Kauffman 2006], and may degrade wildlife habitat [Suring and Vohs 1979; Carrasco 2000; Heutte et al. 2003; Miller et al. 2008; Ringold et al. 2008], interfere with wetland restoration [Kline 1992;

Preuninger and Umbanhowar 1994; Antieau 2000; Tu and Salzer 2005], impede water flow [Comes et al. 1981; Heutte et al. 2003], and/or influence succession."

"Reed canarygrass is widely considered a threat to native wetland plant communities [Dore and McNeill 1980; Magee et al. 1999; Antieau 2000; Kellogg and Bridgham 2002; Borgmann and Jonas 2003; Maurer et al. 2003; Houlahan and Findlay 2004; Schooler et al. 2006], and several studies document a loss of diversity in invaded communities [Lesica 1997; Barnes 1999; Bartels and Wilson 2001; Kercher et al. 2004; Perkins and Wilson 2005; Fierke and Kauffman 2006]. In an Oregon riparian forest, increasing reed canarygrass abundance was correlated with decreasing species richness ($R^2$=0.2455) and understory species diversity ($R^2$ =0.327) in stands older than 7 years [Fierke and Kauffman 2006]. In coastal wetlands in Oregon, high reed canarygrass cover near beaver impoundments was associated with a significant (P=0.01) reduction in species richness when compared to sites with low reed canarygrass cover [Perkins and Wilson 2005]. In Wisconsin, Kercher and others [Kercher et al. 2004] noted 21% fewer species in wetland plots containing reed canarygrass compared to reference plots, and 52% fewer species on sites where natural hydrological regimes had been altered."

"Reed canarygrass may displace rare plants like Nelson's checkerbloom (*Sidalcea nelsoniana*) in Oregon [Bartels and Wilson 2001] and water howellia (*Howellia aquatilis*) in the inland Northwest [Lesica 1997]."

"In a survey of 12 western states, biotic integrity—based on vertebrate and macroinvertebrate occurrence— was significantly (P<0.001) lower on sites in mountainous regions where reed canarygrass occurred than where it was absent [Ringold et al. 2008]. In western Washington, 158 coho salmon (an endangered species) migrating upstream during a high flood event became stranded and died in a field of reed canarygrass and pale-yellow iris (*Iris pseudacorus*) when flood waters receded quickly. Carrasco [2000] speculated that dense stands of reed canarygrass and pale-yellow iris made escape from the field more difficult for the coho salmon, especially where the canal was ill-defined. The displacement of woody vegetation by reed canarygrass may reduce the number of arthropods foraging in riparian areas, which may in turn deprive juvenile salmon of an important food source (review by [Miller et al. 2008])."

"One review suggested that reed canarygrass impacts hydraulic characteristics of surface waters by clogging ditches and streams with thick thatch [Antieau 2000]. Comes and others [Comes et al. 1981] speculated that roots and rhizomes of reed canarygrass come in contact with water and moist soil, collecting silt and rapidly forming berms at the water's edge. Silt deposits and the emergent stems and leaves of reed canarygrass reduce the volume of water that a channel can carry and thus impede water flow [Comes et al. 1981]. An invasive plant guide from Alaska claims that reed canarygrass may slow stream flow and eliminate the scouring action needed to maintain salmon habitat [Heutte et al. 2003]."

From CABI (2018):

"Where the species invades short perennial grasses such as *Agrostis alba* or *Festuca rubra* (species typically planted along irrigation ditches), it inhibits their growth within 3-5 months, eventually eliminating them (Apfelbaum and Sams, 1987)."

“Hovin et al. (1980) report that the alkaloid concentration in most of the accessions studied was high enough to adversely affect the performance of ruminants.”

“However, there is considerable evidence that at least some strains have a negative impact upon cattle and sheep when included in feed. *P. arundinacea* can contain a number of harmful alkaloids including tryptamine-carboline and gramine (Marten, 1973; Marten et al., 1976); selenium can also be present at 0.005 p.p.m. (Susaki et al., 1980).”

“In one study, only herbs and smaller grasses growing less than 1 m above the maximum water level were outcompeted by *P. arundinacea*. The species growing above this level remained unaffected (Barnes, 1999). Wetzel and Valk (1998) have shown that *P. arundinacea* can outcompete and overshadow other typical riparian plant species such as *Carex stricta* and *Typha latifolia*. Unlike many other invasive species in North America, *P. arundinacea* does reduce native plant biodiversity in undisturbed as well as disturbed wetland habitats (Harrison et al., 1996; Lesica, 1997). Areas that have existed as monocultures of this species for extended periods may have seedbanks that are devoid of native plant species (Apfelbaum and Sams, 1987).”

“Dense stands of *P. arundinacea* have lower wildlife value than native vegetation: few species can feed on this plant, and the stems grow too densely to provide suitable cover for mammals and waterfowl (Maia, 1994).”

# 4 Global Distribution

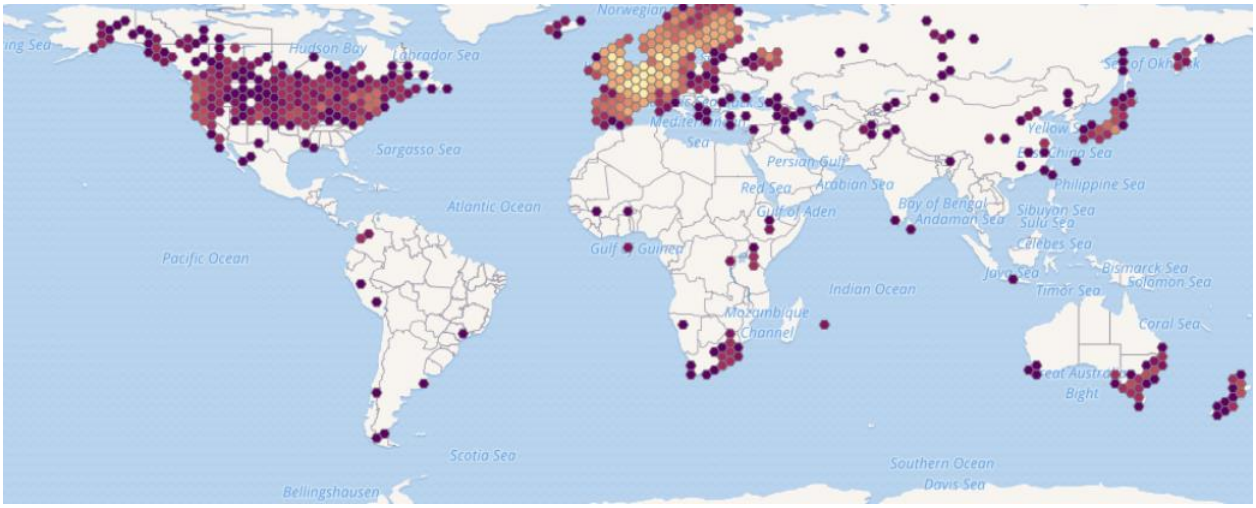


**Figure 1**. Known global distribution of *Phalaris arundinacea*. Map from GBIF Secretariat (2018).

# 5 Distribution Within the United States

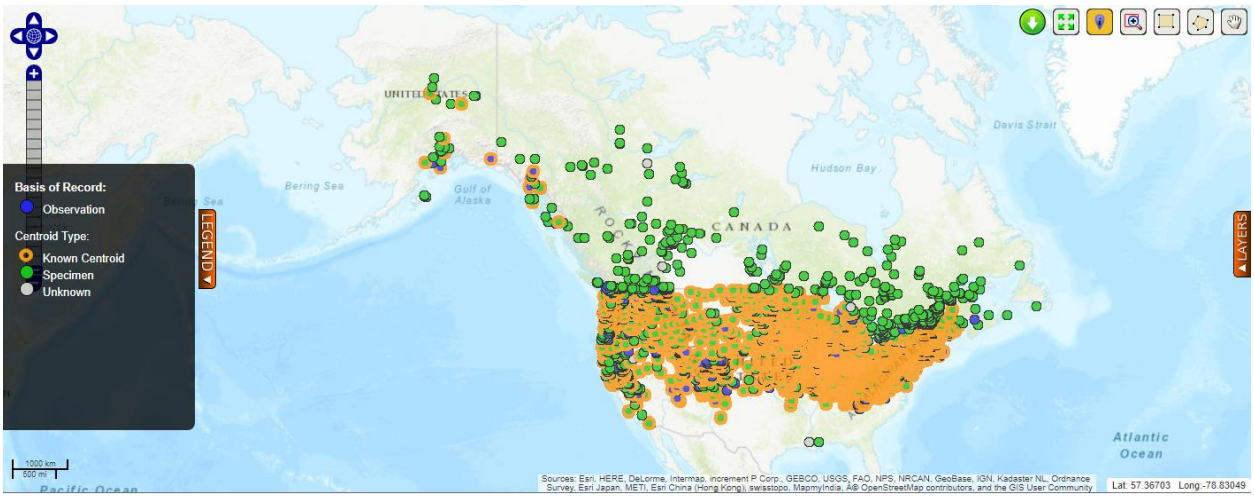


**Figure 2**. Known distribution of *Phalaris arundinacea* in the United States. Map from BISON (2018).

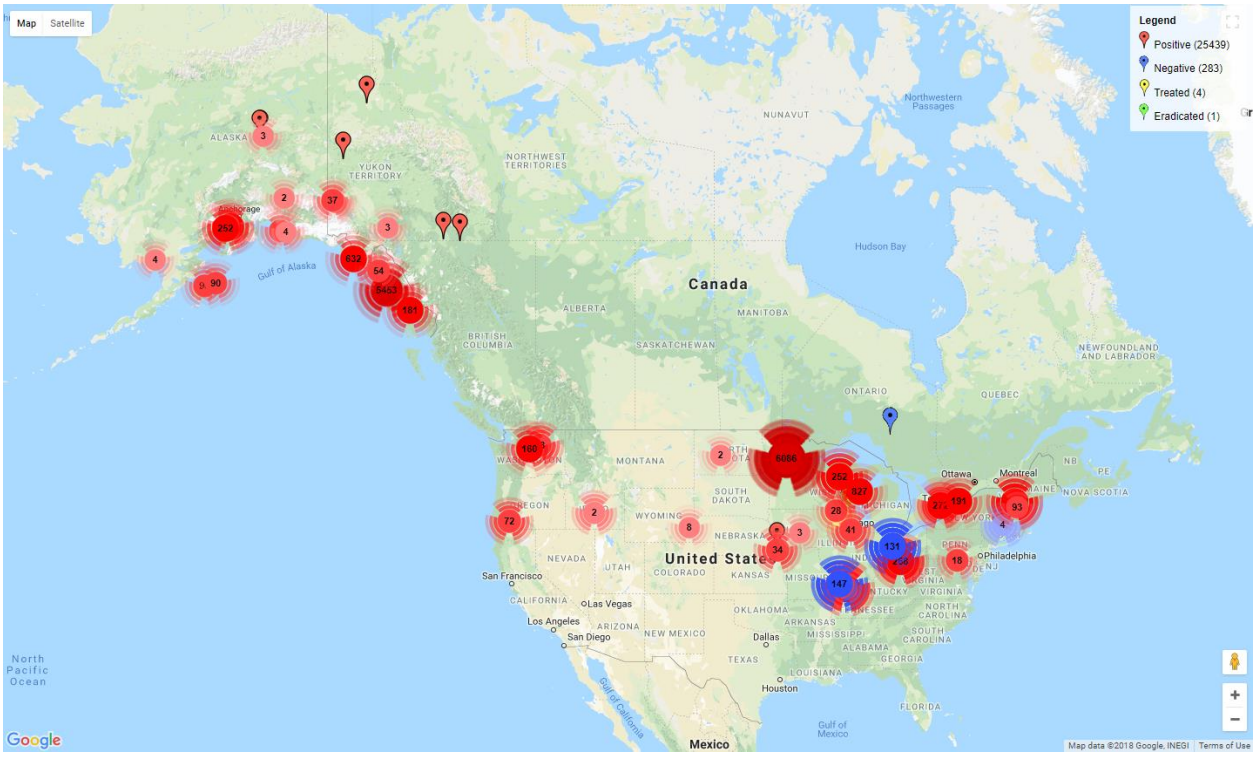


**Figure 3**. Known distribution of *Phalaris arundinacea* in the United States. Red locations are positive reports of *P. arundinacea*, blue locations are negative reports of *P. arundinacea*. Map from EDDMapS (2018).

# 6 Climate Matching

## Summary of Climate Matching Analysis

The climate match for *Phalaris arundinacea* was high across the contiguous United States. There were small areas of medium match along the southern border, Gulf Coast, and Pacific Coast. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.972, high. All states in the contiguous United States had high individual climate scores.

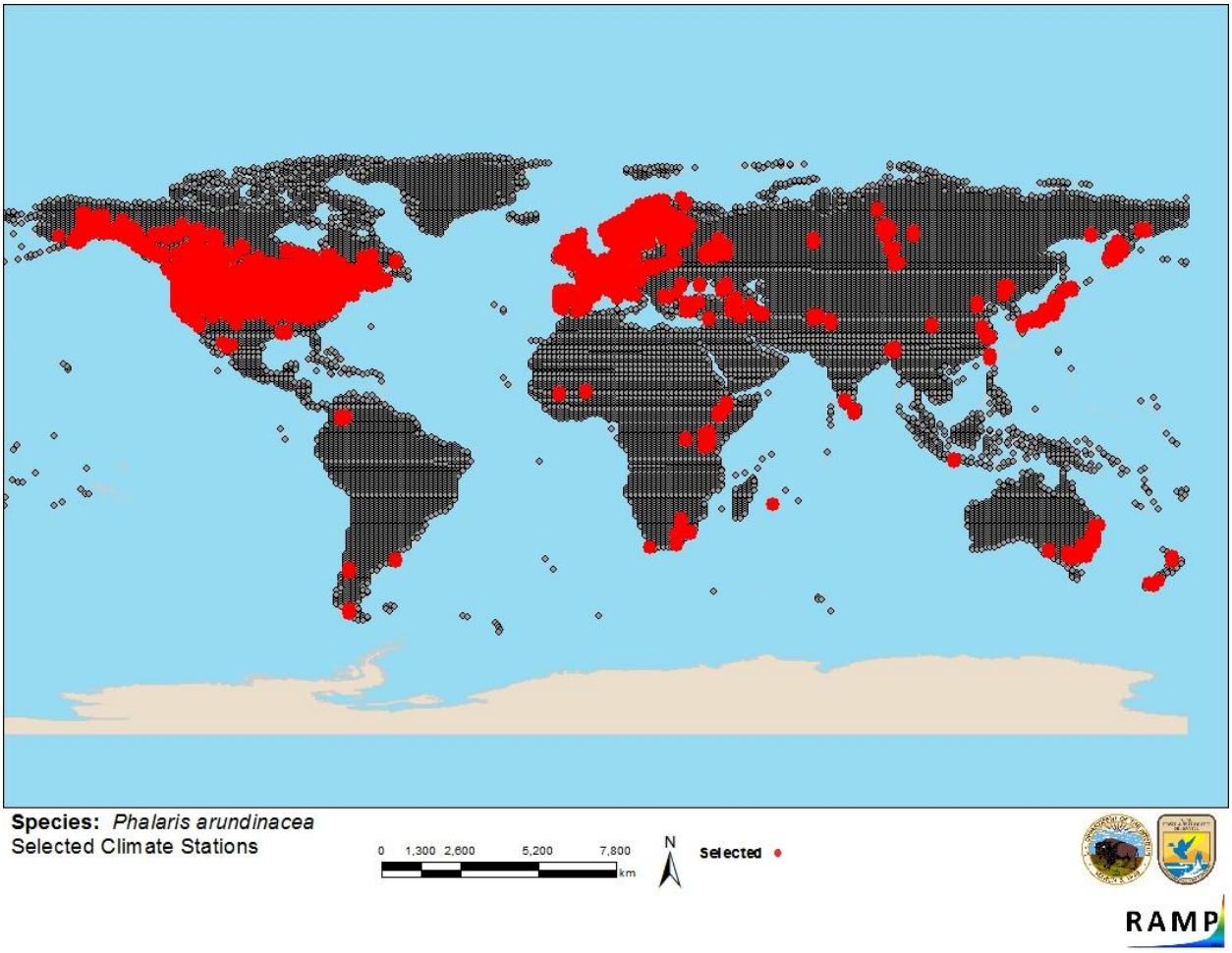


**Figure 4**. RAMP (Sanders et al. 2018) source map showing global weather stations selected as source locations (red) and non-source locations (gray) for *Phalaris arundinacea* climate matching. Source locations from BISON (2018), EDDMapS (2018), and GBIF Secretariat (2018).

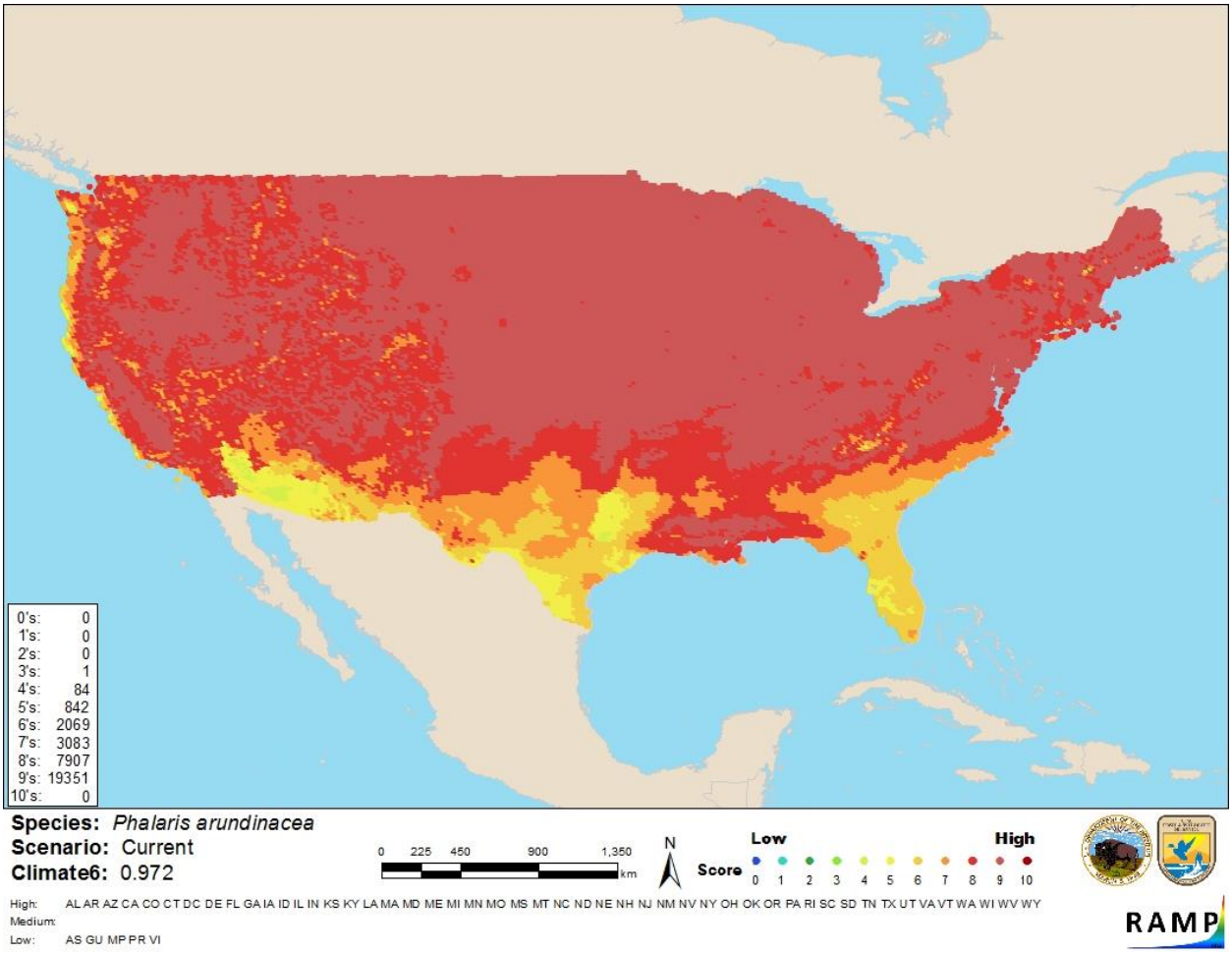


**Figure 5**. Map of RAMP (Sanders et al. 2018) climate matches for *Phalaris arundinacea* in the contiguous United States based on source locations reported by BISON (2018), EDDMapS (2018), and GBIF Secretariat (2018). 0 = Lowest match, 10 = Highest match. Counts of climate match scores are tabulated on the left.

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≤X≤0.005 | Low |
| 0.005<X<0.103 | Medium |
| ≥0.103 | High |

# 7 Certainty of Assessment

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

# 8 Risk Assessment

## Summary of Risk to the Contiguous United States

*Phalaris arundinacea* is a perennial grass native to Eurasia and areas of the United States. The history of invasiveness is high. The species has been introduced for livestock forage, erosion control on banks, and as an ornamental species. It has had negative impacts on native species where it forms large stands. Climate matching indicated the contiguous United States has a high climate match. There are established populations of *P. arundinacea* in most of the contiguous United States The certainty of assessment is high. Substantial peer reviewed literature is available for this invasive species. 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:** There are established populations of *P. arundinacea* in most of the contiguous United States.
- **Overall Risk Assessment Category: High**

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