

# Giant reed (*Arundo donax*)

## Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, Web Version—11/27/2017



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## 1 Native Range and Status in the United States

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### Native Range

From GISD (2011):

“Afghanistan, Algeria, Azerbaijan, China, Cyprus, Egypt, Georgia, India, Indochina, Iran, Iraq, Israel, Japan, Jordan, Lebanon, Libya, Myanmar, Nepal, Pakistan, Saudi Arabia, Syria, Taiwan, Tunisia, Turkey, Turkmenistan, Ukraine, Uzbekistan”

From Lansdown (2013):

“According to the World Checklist of Selected Plant Families (Board of Trustees of the Royal Botanic Gardens, Kew), this species is native only to a fairly narrow area bounded by Cyprus, Kazakhstan and Turkmenistan in the west, the [Persian] Gulf States in the south and Japan south to Myanmar in the east.”

## **Status in the United States**

From USDA (2015):

“Texas: giant reed: Noxious plant”

*Arundo donax* has been introduced in at least 25 states and Puerto Rico (USDA 2015).

From CABI (2014):

“It was first introduced into the United States at Los Angeles, California in the early 1800's, and it escaped from cultivation as far north as Virginia and Missouri. It has been widely planted, often as an ornamental, throughout the warmer states of the USA, especially in the south-west where it was planted along ditches for erosion control since 1820. In California *A. donax* was first planted in the 1820's to provide roofing materials and for erosion control in the Los Angeles Basin area, from where it escaped and rapidly spread throughout the southern and southwestern United States (Hoddle and Goolsby, 2010).”

“Regulatory processes have been initiated in California to add it to the CDFG (California Department of Food and Agriculture) Noxious Weed List which may result in state-wide ordinances preventing sale or transfer of *A. donax*. The California Exotic Pest Plant Council puts *A. donax* on its 'List A: Most Invasive Wildland Pests'.”

## **Means of Introductions in the United States**

From The University of Georgia (2014):

“*Arundo donax* is native to India and was introduced into the United States in the early 1800s for ornamental purposes.”

## **Remarks**

From GISD (2011):

“Giant reed (*Arundo donax*) invades riparian areas, altering the hydrology, nutrient cycling and fire regime and displacing native species. Long ‘lag times’ between introduction and development of negative impacts are documented in some invasive species; the development of giant reed as a serious problem in California may have taken more than 400 years. The opportunity to control this weed before it becomes a problem should be taken as once established it becomes difficult to control.”

From NatureServe (2015):

“Kartesz (1994) recognized two varieties of *Arundo donax*; Kartesz (1999) no longer distinguishes between varieties.”

“A survey of 48 public agencies listed *arundo* as one of the top 53 weed species of concern (Armer 1964).”

## 2 Biology and Ecology

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### Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2015):

“Kingdom Plantae  
Subkingdom Viridiplantae  
Infrakingdom Streptophyta  
Superdivision Embryophyta  
Division Tracheophyta  
Subdivision Spermatophytina  
Class Magnoliopsida  
Superorder Lilianae  
Order Poales  
Family Poaceae  
Genus *Arundo*  
Species *Arundo donax* L.”

“Taxonomic Status: Current Standing: accepted”

### Size, Weight, and Age Range

From The University of Georgia (2014):

“*Arundo donax* is a perennial grass that can reach up to 20 ft. (6.1 m) in height.”

### Environment

From GISD (2011):

“*Arundo donax* is a hydrophyte, and grows best where water tables are near or at the soil surface. It establishes in moist places such as ditches, streams, and riverbanks, growing best in well drained soils where abundant moisture and sunlight is available. *A. donax* has also been demonstrated to prefer areas with enriched nitrogen levels. It tolerates a wide variety of conditions, including high salinity, and can flourish in many soil types from heavy clays to loose sands. It is well adapted to the high disturbance dynamics of riparian systems. *A. donax* inhabits USDA zones 6-11 (Benton et al, 2006; Ambrose & Rundel, 2007).”

## Climate/Range

From CABI (2014):

“*A. donax* is native to tropical and temperate regions of the Old World.”

From NatureServe (2015):

“*A. DONAX* can survive very low temperatures when dormant but is subject to serious damage by frosts after the start of spring growth (Perdue 1958).”

## Distribution Outside the United States

Native

From GISD (2011):

“Afghanistan, Algeria, Azerbaijan, China, Cyprus, Egypt, Georgia, India, Indochina, Iran, Iraq, Israel, Japan, Jordan, Lebanon, Libya, Myanmar, Nepal, Pakistan, Saudi Arabia, Syria, Taiwan, Tunisia, Turkey, Turkmenistan, Ukraine, Uzbekistan”

From Lansdown (2013):

“According to the World Checklist of Selected Plant Families (Board of Trustees of the Royal Botanic Gardens, Kew), this species is native only to a fairly narrow area bounded by Cyprus, Kazakhstan and Turkmenistan in the west, the Gulf States in the south and Japan south to Myanmar in the east.”

Introduced

From GISD (2011):

“Argentina, Australia, Bangladesh, Bermuda, Bolivia, Brazil, Cayman Islands, Chile, Cook Islands, Costa Rica, Dominican Republic, Ecuador, El Salvador, Fiji, French Polynesia (Polynésie Française), Gibraltar, Guam, Guatemala, Haiti, Indonesia, Italy, Kiribati, Mexico, Micronesia, Namibia, Nauru, New Caledonia (Nouvelle Calédonie), New Zealand, Nicaragua, Norfolk Island, Palau, Peru, Portugal, Samoa, South Africa, Suriname, Swaziland, Tonga, United States (USA), Uruguay, Venezuela”

From CABI (2014):

“It is believed that *A. donax* was introduced from Asia via the Middle East to the entire Mediterranean basin in prehistory. It was only later exported from the Mediterranean by early French and Spanish colonialists, and widely dispersed, largely by man into all the subtropical and warm temperate areas of the world. In many areas it has become well established. In its native range, it is abundant in India, ascending to elevations of 2500 m in the Himalayas, and is found throughout China and South-East Asia. The species has been successfully introduced into northern, central and southern parts of Africa. In South Africa, *A. donax* was first recorded in

1953 (Foxcroft et al., 2007). It has been introduced into Australia and many islands of the Pacific and Atlantic oceans. In Australia it was first collected in Queensland in 1912.”

## Means of Introduction Outside the United States

From GISD (2011):

“Nursery trade: Canes traditionally cultivated for variety of uses - fencing, thatch, framing, musical instruments and woodwind reeds; carried esp. by Spanish colonists.”

From Hyde et al. (2017):

“Planted for the manufacture of baskets [in Zimbabwe]”

## Short Description

From GISD (2011):

“*Arundo donax* is a very tall and robust bamboo-like, perennial grass with large, spreading clumps of thick culms to 6.1 m tall. The numerous leaves are about 5 cm wide and 30.5-61 cm long, and arranged conspicuously in two opposing ranks on the culms. The leaves look like those of a corn plant. Their margins are sharp to the touch and can cut careless hands. The inflorescence, appearing in late summer, is a 0.3-0.6 m long purplish, aging to silver, plume that stands above the foliage. Giant reed spreads from thick, knobby rhizomes. Once established, it tends to form large, continuous, clonal root masses, sometimes covering several acres. These root masses can be more than 1 m thick. The foliage dries to light brown in the winter and rattles in the wind.”

## Biology

From GISD (2011):

### “Nutrition

*Arundo donax* photosynthesizes through C3 fixation which requires abundant sunlight and moisture. It has also been demonstrated to prefer areas with enriched nitrogen levels (Lewandowski et al, 2003; Benton et al, 2006; Ambrose & Rundel, 2007).”

### “Reproduction

Reproduction of *Arundo donax* is primarily vegetative by way of rhizomes which root and sprout readily and layering in which stems touching the ground sprout roots. Layering has been demonstrated to expand *A. donax* as much as 7.4 times faster than spread by rhizomes but is thought to only occur within flood zones. *A. donax* tends to form large, continuous, clonal root masses, sometimes covering several acres. It very rarely produces seeds and very little is known about its sexual reproduction (Benton et al, 2006; Boland, 2006; McWilliams, 2004)”

## Human Uses

From GISD (2011):

“*Arundo donax* is grown as an ornamental for the its [sic] striking appearance, purplish stems, and for the huge feather-like panicles of purplish flowers. It is the largest and tallest ornamental grass other than bamboo, and the tallest grass that can be grown outside the tropics. The large, thick and fluffy flower plumes are used in floral arrangements. *A. donax* is also used to make reeds for woodwind instruments and were once used for organ pipes. Giant reed is commonly planted in wet soils to reduce erosion (Christman, 2003).

In folk medicine [sic], the rhizome or rootstock of *Arundo donax* is used for dropsy. Boiled in wine with honey, the root or rhizome has been used for cancer. This or other species of *Arundo* is also reported to be used for condylomata and indurations of the breast. The root infusion is regarded as antilactagogue, depurative, diaphoretic, diuretic, emollient, hypertensive, hypotensive, and sudorific (Duke, 1997).”

From CABI (2014):

“However, *A. donax* growth and productivity is also being studied to assess its suitability for the production of biomass for energy, paper pulp, and the construction of building materials which would ultimately lead to the establishment of more *A. donax* plantations and an economic industry based on it.”

From Benton et al. (2009):

“Primitive pipe organs were made from it and the reeds for woodwind instruments are still made from its culms, for which no satisfactory substitutes are known. It is also used in basketry, for fishing rods, livestock fodder, medicine, and soil erosion control.”

From NatureServe (2015):

“Giant reed has played an important role in the culture of the western world through its influence on the development of music, which can be traced back 5000 years. The basis for the origin of the most primitive pipe organ, the Pan pipe or syrinx, was made from *A. DONAX*. Reeds for woodwind musical instruments are still made from the culms and no satisfactory substitutes have been developed (Perdue 1958).

Even before its musical qualities were appreciated, Egyptians used giant reed as early as 5000 B.C. to line underground grain storage. Mummies of the Fourth Century A.D. were wrapped in arundo leaves. Other uses for giant reed include: basket-work, garden fences and trellises, chicken pens, crude shelters, fishing rods, arrows, erosion control, livestock fodder, pulp and ornamental plants. Medicinally, the rhizome has been used as a sudorific, a diuretic, as an antilactant and in the treatment of dropsy (Perdue 1958).”

## Diseases

From CABI (2014):

“*Microsphaeropsis arundinis*, Pathogen; *Puccinia arundinis-donaeis*, Pathogen; *Puccinia torosa*, Pathogen”

## Threat to Humans

Indirect threats through altering fire regimes and flooding patterns (GISD 2011).

From GISD (2011):

“Their margins are sharp to the touch and can cut careless hands.”

## 3 Impacts of Introductions

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From GISD (2011):

“Dense populations of *Arundo donax* affect riversides and stream channels, compete with and displace native plants, interfere with flood control, and is extremely flammable increasing the likelihood and intensity of fires. It may establish a [sic] invasive plant-fire regime as it both causes fires and recovers from them 3-4 times faster than native plants. It is also known to displace and reduce habitats for native species including the Federally endangered Least Bell's Vireo (*Vireo bellii*).

Its long, fibrous, interconnecting root mats of giant reed form a framework for debris behind bridges, culverts, and other structures that can effect their function and disturb ecosystems. Its rapid growth rate, estimated 2-5 times faster than native competitors, and vegetative reproduction, it is able to quickly invade new areas and form pure stands. Once established, *A. donax* has the ability to outcompete and completely suppress native vegetation, reduce habitat for wildlife, and inflict drastic ecological change (Benton et al, 2006; McWilliams, 2004; Ambrose and Rundel, 2007; Rieger & Keager, 1989).”

From CABI (2014):

“This species represent [sic] a serious concern in arid and semiarid habitats because it outcompete native vegetation in the access to soil-water. It uses more water than native plants, lowering groundwater tables. *A. donax* is highly flammable and can change fire regimes in invaded areas (USDA-ARS, 2014).”

“Economic Impact:

When flooding occurs in areas heavily populated by *A. donax*, it forces flood waters out of the primary channels and into critical banks, bridges and other physical structures. In addition, its stems and rhizomes break off in the flood currents and flow with the flood. These rhizomes and stems deposit themselves in drainage systems, along small agricultural ditches, under bridges and in other flood control systems where it can quickly re-establish itself in these new locations. This leads to costly clean-up operations to un-block obstructed waterways, and quite possibly structural damage and hazards when trapped behind bridges and other structures. This can put an

economic strain on areas inundated with *A. donax*. Costs of removal vary but can be in excess of US\$10,000/ha, and areas are rapidly re-infested if sustained control efforts are not maintained over many years. *A. donax* stands collect sediments from stream flow. As the sediment surface under the *A. donax* stands rise, it can force the stream water into new paths which then interact with other infestations downstream or across the stream. The result is accelerated erosion of stream banks, lost property, and expensive repairs to the property.

#### Environmental Impact

*A. donax* is an aggressive species with an ability to reproduce quickly, allowing it to out-compete native plant species. It displaces native plants and wildlife as a consequence of the massive stands it forms but the exact mechanism of competition is not yet known. Unlike native riparian plants, *A. donax* provides little shading to the in-stream habitat, leading to increased water temperatures, lower oxygen and reduced habitat quality for aquatic wildlife (Hoshovsky, 1987; Team Arundo del Norte, 2002). *A. donax* is also known to interfere with the management of flood defences [sic] and wildlife habitat management. *A. donax* is also thought to alter hydrological regimes and reduce groundwater availability by transpiring large amounts of water from semi-arid aquifers and layers of permeable rock (Iverson, 1994) consuming three times more water than native plants. It also causes substantial alterations to water flow during storm events leading to increased erosion.

*A. donax* infestations are threatening native riparian vegetation in California, USA. In the Santa Ana River of Southern California, for example, it is estimated that 68% of the riparian vegetation is comprised of *A. donax* (Dudley, 2000). *A. donax* has displaced native vegetation which provides nesting sites for native species such as the Least Bell's Vireo (*Vireo bellipusillas*), a federally endangered species, the Willow Flycatcher (*Empidonax trailliieximos*), a federally threatened species, and the Yellow Cuckoo (Bell, 1993). *A. donax* is also known to be a habitat for the invasive Norway rat (*Rattus norvegicus*) which has caused/contributed to the extinction/range reduction of native mammals, birds, reptiles and invertebrates through predation and competition. *A. donax* displaces native riparian vegetation, forming huge monocultures which can cover hundreds of hectares and provide poor habitats for terrestrial insects and wildlife. It crowds out native plants that shade streams, resulting in warmer water that harms aquatic life. Unpalatability of *A. donax* to native fauna could then impact on wildlife which depend on insects normally supported by the native vegetation. With the invasion of *A. donax*, what was once a complex food web becomes simplified, leaving fewer species that can survive in its presence.”

From Lambert et al. (2010):

“Invasion in riparian areas alters the native vegetative structure (Herrera and Dudley 2003) and rapid growth after floods or wildfire leads to competitive displacement of native riparian vegetation such as cottonwood/ willow woodlands (Coffman 2007). This dominance reduces arthropod diversity and abundance (Herrera and Dudley 2003) and also leads to decline in avian diversity and abundance (Kisner 2004).”



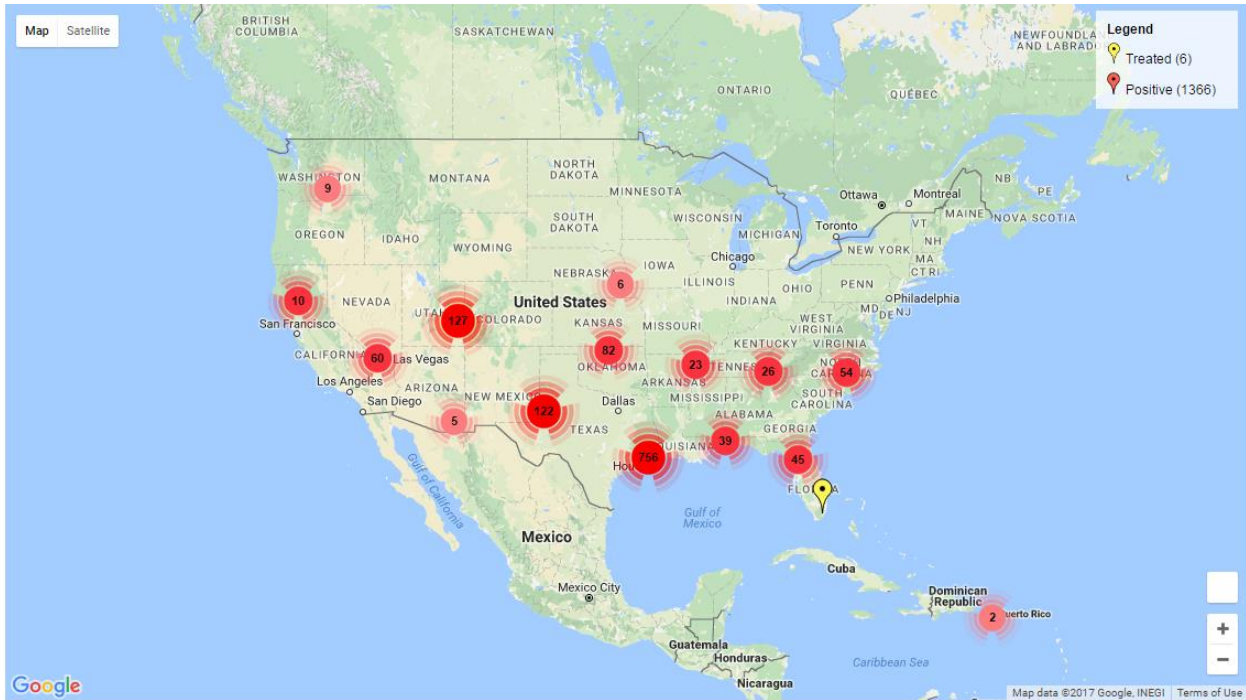
## 4 Global Distribution

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**Figure 1.** Known global distribution of *Arundo donax*. Map from GBIF Secretariat (2017). Locations in the open ocean, not on islands, were considered erroneous and not included in the climate matching.

## 5 Distribution Within the United States



**Figure 2.** Known distribution of *Arundo donax* in the United States and Mexico. Map from EDDMapS (2017).

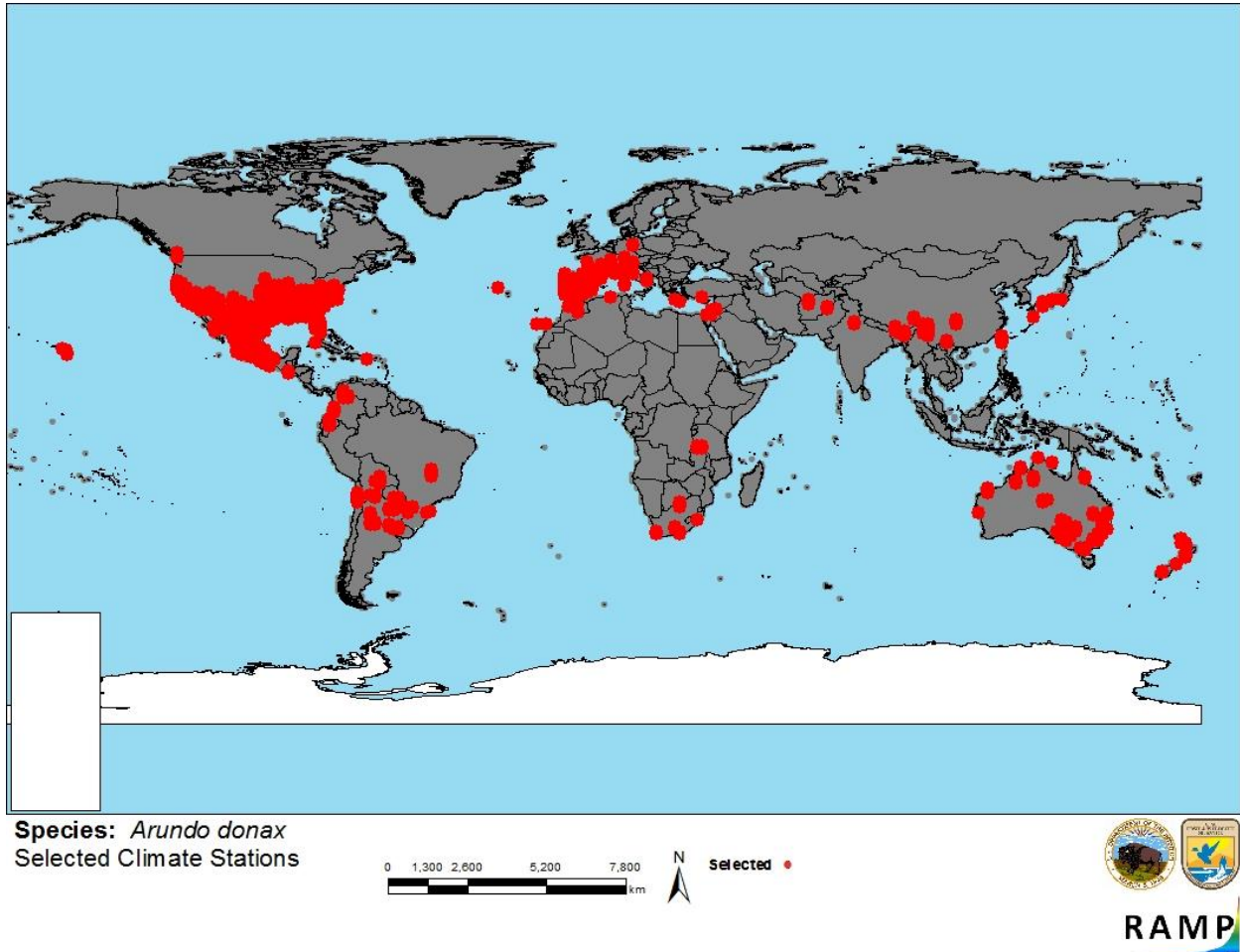


**Figure 3.** Known distribution of *Arundo donax* in the United States. Map from BISON (2017).

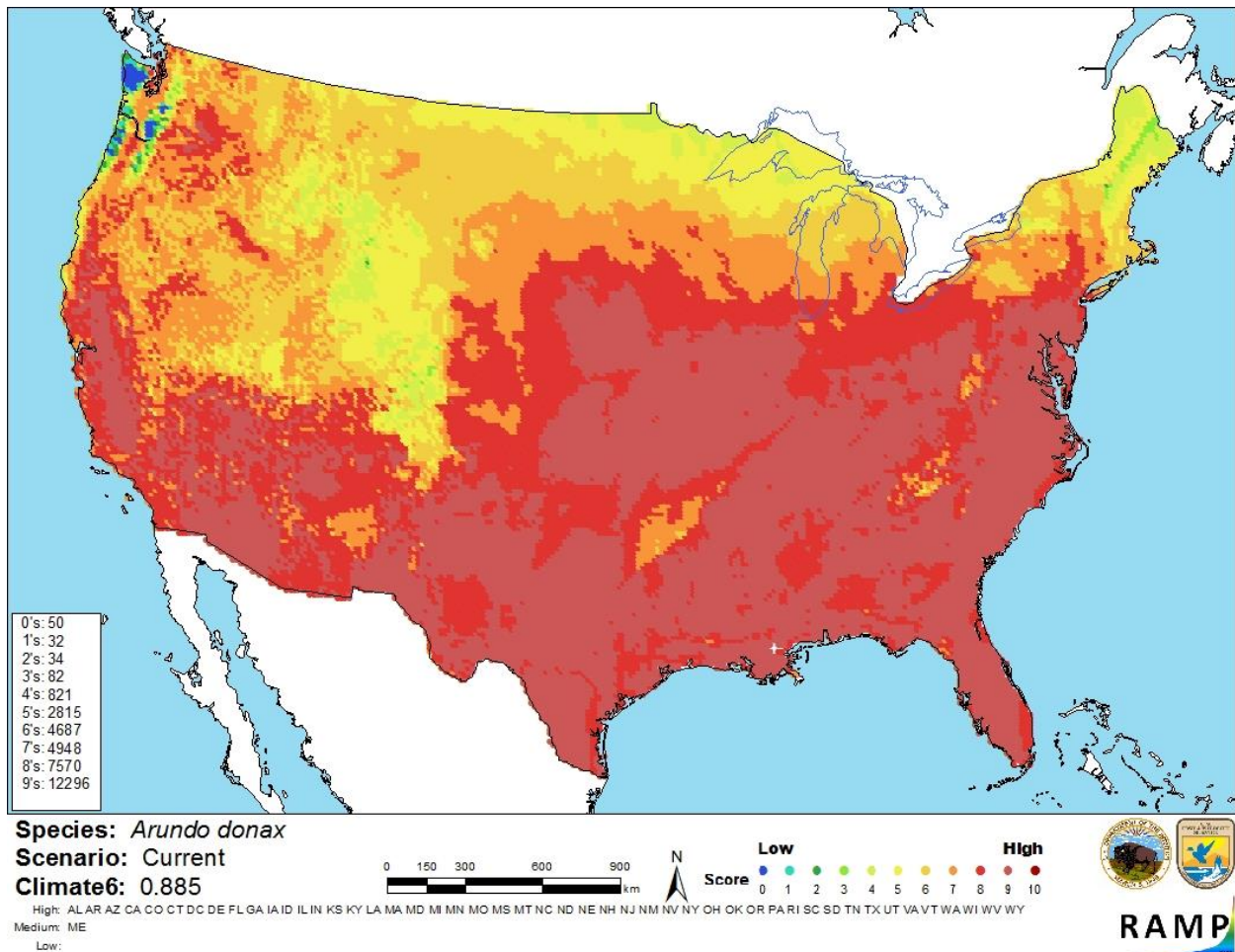
## 6 Climate Matching

### Summary of Climate Matching Analysis

The climate match for *Arundo donax* was low for northern New England, very small pockets of the upper mid-west, and small parts of western Washington and Oregon. It was medium for the rest of New England and parts of the Midwest and Great Plains. It was high everywhere else. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the Continental U.S. was 0.885, high, and individually high in every state except for Maine.



**Figure 4.** RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (grey) for *Arundo donax* climate matching. Source locations from BISON (2017), EDDMapS (2017), and GBIF Secretariat (2017).



**Figure 5.** Map from RAMP (Sanders et al. 2014) of a current climate match for *Arundo donax* in the continental United States based on information provided by BISON (2017), EDDMapS (2017), and GBIF Secretariat (2017). 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
$0.000 < X < 0.005$	Low
$0.005 < X < 0.103$	Medium
$\geq 0.103$	High

## 7 Certainty of Assessment

The certainty of assessment is high. There is a plethora of quality ecological information available for *Arundo donax*. *A. donax* has spread to every continent except Antarctica and many studies have been conducted concerning its biology, invasiveness, impacts, and control methods.

## 8 Risk Assessment

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### Summary of Risk to the Contiguous United States

History of invasiveness is high. *Arundo donax* is established with measurable negative impacts on every continent except Antarctica. This species is already established, with negative impacts, in the southern half of the continental United States. The climate match is 0.885, high. The climate match was very high, as expected when *A. donax* is already established in a large portion of the country. The climate match does indicate that suitable conditions exist in many parts of the country without current populations of *A. donax*. The certainty of assessment is high. The overall risk assessment is high. *A. donax* is already present in the United States and has the potential to spread to the rest of the country. Control, eradication, and remediation efforts can be very costly and are not very effective; further spread of *A. donax* would have significant economic impacts as well as ecological ones.

### 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 remarks.
- **Overall Risk Assessment Category: High**

## 9 References

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**Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.**

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## 10 References Quoted But Not Accessed

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**Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.**

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