Prussian Carp (*Carassius gibelio*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, August 2012
Revised, February 2019
Web Version, 7/12/2019

Photo: A. Harka. Licensed under CC BY-SA 3.0 Unported. Available: https://commons.wikimedia.org/wiki/File:Carassius_gibelio_1.jpg. (February 2019)

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2019):

"Europe and Asia: usually considered as native from central Europe to Siberia or introduced to European waters from eastern Asia. Clear and definite data on original distribution in Europe are not available due to introduction, confusion with *Carassius auratus* and complex modes of reproduction. At present, widely distributed and commonly stocked together with *Cyprinus carpio* which is transported throughout Europe. Absent in northern Baltic basin, Iceland, Ireland, Scotland and Mediterranean islands."

According to CABI (2019) *Carassius gibelio* is native to China, Georgia (Republic of), Kyrgyzstan, Mongolia, Turkmenistan, Albania, Austria, Bosnia-Hercegovina, Bulgaria, Croatia, Greece, Hungary, Latvia, Lithuania, Moldova, the Netherlands, Romania, the Russian Federation, Serbia, Slovakia, and the Ukraine.

Status in the United States

No records of *Carassius gibelio* in the wild or in trade in the United States were found.

Carassius gibelio was officially listed as an injurious wildlife species in 2016 under the Lacey Act (18.U.S.C.42(a)(1)) by the U.S. Fish and Wildlife Service (USFWS 2016). The importation of Prussian carp into the United States, any territory of the United States, the District of Columbia, the Commonwealth of Puerto Rico, or any possession of the United States, or any shipment between the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, or any possession of the United States is prohibited.

Means of Introductions in the United States

No records of *Carassius gibelio* in the wild in the United States were found.

Remarks

A previous version of this ERSS was published in August 2012.

Carassius gibelio is closely related to Crucian Carp (*Carassius carassius*) and Goldfish (*Carassius auratus*) (Elgin et al. 2014).

From Elgin et al. (2014):

"Potential misidentification of *C. gibelio* and species level taxonomic uncertainty with other *Carassius* spp. is common (Japoshvili et al. 2013), particularly with *C. auratus* (L.), which is found in the Bow, Red Deer, and Old Man River basins in Alberta (Nelson and Paetz 1992; Government of Alberta 2014) and with *C. carassius*, which to our knowledge has not been identified in Alberta."

"Due to morphological similarities, the definition of species within the *Carassius* genus is not always certain, and is particularly true of *C. gibelio* and *C. auratus* where earlier research defined *C. gibelio* as the wild form of *C. auratus* (Kottelat and Freyhof 2007). Recent genetic studies have since shown that *C. gibelio* and *C. auratus* are distinct species (Rylkova et al 2010) and that *C. gibelio* may have two separate clades (Kalous et al 2012)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al. (2019):

"**Current status:** Valid as *Carassius gibelio* (Bloch 1782)."

From ITIS (2019):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cyprinoidea
Family Cyprinidae
Genus *Carassius*
Species *Carassius gibelio* (Bloch, 1782)"

Size, Weight, and Age Range

From Froese and Pauly (2019):

"Maturity: L_m 10.3, range 13 - ? cm
Max length : 46.6 cm TL male/unsexed; [Verreycken et al. 2011]; common length : 20.0 cm TL male/unsexed; [Muus and Dahlström 1968]; max. published weight: 3.0 kg [Muus and Dahlström 1968]; max. reported age: 10 years [Kottelat and Freyhof 2007]"

Environment

From Froese and Pauly (2019):

"Freshwater; brackish; benthopelagic; pH range: 7.1 - 7.5; dH range: 12 - ?; potamodromous [Riede 2004]; depth range 0 - ? m. […]; 10°C - 20°C [Baensch and Riehl 1991] [assumed to be recommended aquarium temperature];"

According to CABI (2019) *Carassius gibelio* can be found in lakes, reservoirs, rivers/streams, and estuaries.

From Ruppert et al. (2017):

"Prussian carp are a species recognized for their ability to thrive in habitats less suitable for most native freshwater species (i.e. hypoxia, environmental pollution, moderate salinity, turbidity and high levels of eutrophication) [Vetemaa et al. 2005; Leonardos et al. 2008; Liasko et al. 2011]. Such environmental extremes were encountered during our field survey, where we found 1492 Prussian carp surviving in a small pool with only 2% dissolved oxygen recorded."

Climate/Range

From Froese and Pauly (2019):

"Temperate; […]; 62°N - 35°N, 10°W - 155°E"

Distribution Outside the United States

Native

From Froese and Pauly (2019):

"Europe and Asia: usually considered as native from central Europe to Siberia or introduced to European waters from eastern Asia. Clear and definite data on original distribution in Europe are not available due to introduction, confusion with *Carassius auratus* and complex modes of reproduction. At present, widely distributed and commonly stocked together with *Cyprinus carpio* which is transported throughout Europe. Absent in northern Baltic basin, Iceland, Ireland, Scotland and Mediterranean islands."

According to CABI (2019) *Carassius gibelio* is native to China, Georgia (Republic of), Kyrgyzstan, Mongolia, Turkmenistan, Albania, Austria, Bosnia-Hercegovina, Bulgaria, Croatia, Greece, Hungary, Latvia, Lithuania, Moldova, the Netherlands, Romania, the Russian Federation, Serbia, Slovakia, and the Ukraine.

Introduced

From Elgin et al. (2014):

"Here, we present the first confirmed records of *C. gibelio* in open waters of North America. Our initial detection occurred during an annual sampling of shallow lakes in 2006. DNA sequences were used to verify identification. We subsequently compiled provincial and private fish surveys in Southern Alberta, Canada, which indicates that *C. gibelio*'s current distribution has rapidly expanded to two additional river basins."

"Our analysis indicates that records of occurrence began in 2006 and increased through 2012 […]. During the summer of 2006, we trapped three *C. gibelio* individuals in West Lake […], which is part of a chain of three lakes connected to the Western irrigation system in the Bow River basin. This was the first and only observation for 2006. Subsequent surveys in 2007 and 2008 revealed *C. gibelio* in all three lakes in the West Lake chain (West, East, and Long Lake). In 2007, we also discovered *C. gibelio* in nearby Bland Lake, within the Red Deer River basin. In 2012, we returned to the West Lake chain of lakes and Bland Lake, and found three specimens in Long Lake and none in Bland Lake. We also set baited fish traps in Barnett Lake in 2012, which has an ephemeral input from the irrigation canals 2 km northwest of West Lake, but did not catch *C. gibelio*. However, at ice break-up in the spring of 2013, we discovered a fish kill where hundreds of *C. gibelio* lined the shoreline of Barnett Lake. In 2014, seven additional individuals were caught in West Lake."

"The Government of Alberta and private data for southern Alberta suggest that *C. gibelio* are present in natural streams and irrigation canals in the Bow, Red Deer, and South Saskatchewan

River basins […]. In 2008, a contracted fish survey of one of the irrigation districts discovered ~5,000 individuals (total length range: 3–20 cm), and estimated 20,000–30,000 individuals in a pool within an irrigation canal in the Red Deer River basin (Haag and White 2008). In 2009, the same contractor found *C. gibelio* at the same site as 2008 and confirmed an additional finding in another pool within the canal system. Again, *C. gibelio* were found in high abundances (approximately 500 individuals; total length range: 3–20 cm) (Haag et al. 2010). Also in 2009, the Government of Alberta received 17 individuals from an unnamed tributary to the Medicine River. In a survey of small prairie streams in 2010, the Government of Alberta (2014) discovered and recorded *C. gibelio* in Spruce Creek in the Red Deer River basin […]. Subsequent government surveys in 2012 showed a wider distribution in seven more streams throughout southern Alberta, including sites in the Bow River basin and South Saskatchewan River basin […] (Government of Alberta 2014). Specimens from Rosebud Creek were aged by their otoliths and scales and revealed age classes from young-of-year to 3 years. Additional government surveys in 2013 verified *C. gibleio* in the CNR Reservoir, J Reservoir, and the Bow River. The CNR and J Reservoirs are part of the irrigation canal system in the Bow and Red Deer River basins (Paul Christensen, Alberta Environment and Sustainable Resource Development, pers. comm.)."

Froese and Pauly (2019) report *Carassius gibelio* as introduced to Switzerland, the Netherlands, Kyrgyzstan, Germany, France, Denmark, Austria, Poland, Uzbekistan, Turkey, Lithuania, Flanders, Japan, Estonia, Belarus, Slovakia, Israel, and Finland. In addition, CABI (2019) reports *C. gibelio* as introduced in Armenia, Uzbekistan, Belgium, Czech Republic, and Switzerland.

Means of Introduction Outside the United States

From CABI (2019):

"*C. gibelio* have been introduced intentionally for the purposes of food production and unintentionally due to the similarity in appearance between *C. gibelio* and native *Carassius* spp."

"*C. gibelio* was intentionally introduced either to Belarus or Poland for stock enhancement, recreational and aquaculture purposes […].

In Belgium, *C. gibelio* is thought to have been introduced together with common carp, but there is no supporting archaeological or historical evidence and the species was probably present in Flanders at least by the seventeenth century. Now the most widespread non-indigenous fish in Flanders, *C. gibelio* occurs locally in high densities. The physical similarity of the brown variety of goldfish, *C. gibelio* and native crucian carp *Carassius carassius* has resulted in these species being commonly mistaken for native crucian carp (Wheeler, 2000; Vetemaa et al., 2005). This confusion led to many legal stockings of *C. gibelio*, instead of crucian carp, into Flemish public waters until the 1990s when the Flemish government prohibited the stocking of both species. Stocking with native crucian carp of known origin (from aquaculture facilities of the Flemish government) was reinstated in 2000. Despite the prohibition on *C. gibelio* stocking, the number of sites inhabited by *C. gibelio* carp increased significantly between 1996 and 2005 but in significantly decreasing relative densities. This suggests that *C. gibelio* carp are still in a dispersal and colonization phase, but that established populations are stabilizing within the invaded communities since stocking ceased (Verreycken et al., 2007).

C. gibelio dispersed into the river networks of the Czech Republic from the River Danube via the River Morava. The first recordings, around the confluence of the Morava and Dyje rivers, date from 1976. Over subsequent years, *C. gibelio* gradually invaded streams within drainage areas through natural dispersal, overcoming boundaries due to both the intentional and unintentional help of man, predominantly as an admixture to carp (*Cyprinus carpio*) stocking material. Within 15 years, *C. gibelio* had occupied all suitable habitats in the Czech Republic (Lusková et al., 2010), recognised as *C. a. gibelio* (see Notes on Taxonomy and Nomenclature). The first occupations in 1975-1985 were by triploid females. The occurrence of triploid males and tetraploid males and females is very scarce (Luskova et al., 2004; 2008).

C. gibelio are present in the Thrace region of Turkey. The path of entry is unknown although it is possible that the fish entered either through natural dispersal through river systems from Greece and Bulgaria, or were introduced by humans. Fishermen have admitted intentionally introductions from Kayali Dam to Büyükcekmece Dam Lake (Özulug et al., 2004)."

From Elgin et al. (2014):

"The irrigation canals may have inadvertently facilitated *C. gibelio*'s current widespread distribution throughout southern Alberta."

Short Description

From Froese and Pauly (2019):

"Diagnosed from its congeners in Europe by having the following characters: body silvery-brown in color; last simple anal and dorsal rays strongly serrated; 37-52 gill rakers; lateral line with 29-33 scales; freed edge of dorsal concave or straight; anal fin with 5½ branched rays; and peritoneum black [Kottelat and Freyhof 2007]."

From CABI (2019):

"The physical similarity of the brown variety of goldfish, *C. gibelio* and native crucian carp *Carassius carassius* has resulted in these species being commonly mistaken for native crucian carp (Wheeler, 2000; Vetemaa et al., 2005)."

Biology

From Froese and Pauly (2019):

"Inhabits a wide variety of still water bodies and lowland rivers, usually associated with submerged vegetation or regular flooding. Can strongly tolerate low oxygen concentrations and pollution [Kottelat and Freyhof 2007]. Lake dwelling individuals move into river mouths to avoid low oxygen water in winter [Kukuradze and Mariyash 1975]. Feeding larvae and juveniles occur in high-complexity habitats as reed belts. Feeds on plankton, benthic invertebrates, plant material and detritus. Spawns in shallow, warm shores on submerged vegetation [Kottelat and Freyhof 2007]. Able to reproduce from unfertilized eggs (gynogenesis) [Spratte and Hartman

1998]. Life span reaches up to about 10 years [Kottelat and Freyhof 2007]. Eastern European or wild form of the goldfish [Welcomme 1988]."

"Females spawn with several other species, for example *Cyprinus carpio* and *Carassius carassius*, but the eggs just develop without being actually fertilized resulting in a female only population [Baensch and Riehl 1991]. In Europe, populations considered as triploid and only females. But in some populations, it should be possible to find up to 25% of males which should be diploid [Keith and Allardi 2001]. "There are also all-female populations in which all individuals are triploids. Triploids are sperm parasites of other cyprinid species such as *Cyprinus carpio*, *Rutilus rutilus* and *Abramis brama*. Older individuals spawn earlier in season than younger ones. Males move to spawning sites before females. Males follow ripe females, often with much splashing. Sticky eggs are attached to water plants or submerged objects"[Kottelat and Freyhof 2007]."

From CABI (2019):

"A major biological trait responsible for invasiveness in *C. gibelio* is its mode of reproduction. Invading populations are often triploid and composed of almost exclusively females that exhibit apomictic (gynogenetic) reproduction, using the sperm of other species to activate (but not fertilize) their own eggs."

"*C. gibelio* feeds on plankton, benthic invertebrates, plant material and detritus (Specziar et al., 1998; Kottelat and Freyhof, 2007)."

Human Uses

From Froese and Pauly (2019):

"Fisheries: minor commercial"

From Narščius (2012):

"Prussian carp has become so common in the Gulf of Riga that there is now a commercial fishery for the species in Estonian waters of the Gulf. The same is true of the Curonian Lagoon, the shallow sea area enclosed by a sand spit on the coast of Lithuania and the Russian province of Kaliningrad. Likewise, in the Gulf of Gdańsk on the Polish coast, the species has become so well established that there is a regular recreational fishery for it."

Diseases

No records of OIE-reportable diseases (OIE 2019) were found for *Carassius gibelio.*

According to Froese and Pauly (2019) *Carassius gibelio* can have black spot disease and *Thelohanellus* infections.

According to Poelen et al. (2014) *Carassius gibelio* is host to *Zschokkella nova*, *Filamoeba sinensis*, *Aeromonas sobria*, *Myxobolus lentisuturalis*, *Gyrodactylus longoacuminatus*, and

Gyrodactylus kobayashii. *Carassius gibelio* is also host to the parasites *Neogryporhynchus cheilancristrotus* and *Khawia parva*.

Wang et al. (2012):

"From 2011 to 2012, hematopoietic necrosis associated with Cyprinid herpesvirus 2 (CyHV-2) caused serious mortality of farmed Prussian carp (*Carassius gibelio*) in central China. Signs of diseased fish included lethargy and inappetence, gill hemorrhages, haemorrhagic spots on body surface. Internal gross pathology included hyperaemia, hepatic hypertrophy and splenomegaly."

Threat to Humans

From Froese and Pauly (2019):

"Potential pest [Lusk et al. 2010]"

3 Impacts of Introductions

From CABI (2019):

"*C. gibelio* has potential to cause economic and environmental damage by causing quantitative changes in community structure in becoming the dominant species and shifts in food chains, and by altering the physical and chemical properties of habitats."

"In aquaculture systems, *C. gibelio* is an unwelcome competitor with cultures of the major reared species. The occurrence of numerous populations of *C. gibelio* in fishponds causes considerable economic loss in the Czech Republic as there is no market for the species. Even when it can be sold, it reaches a considerably lower price (Lusková et al., 2010)."

"In a 6-year study in a mesotrophic reservoir in Turkey, Tarkan et al. (2012b) observed a relative decrease in native cyprinid density when *C. gibelio* density increased. This was attributed to a combination of degrading environmental conditions and reproductive competition by *C. gibelio*."

"**Impact outcomes**
Altered trophic level, Changed gene pool/ selective loss of genotypes, Damaged ecosystem services, Ecosystem change/ habitat alteration, Modification of natural benthic communities, Modification of nutrient regime, Negatively impacts aquaculture/fisheries, Reduced native biodiversity, Threat to/ loss of native species"

From Narščius (2012):

"Prussian carp has become so common in the Gulf of Riga that there is now a commercial fishery for the species in Estonian waters of the Gulf. The same is true of the Curonian Lagoon, the shallow sea area enclosed by a sand spit on the coast of Lithuania and the Russian province of Kaliningrad. Likewise, in the Gulf of Gdańsk on the Polish coast, the species has become so well established that there is a regular recreational fishery for it."

From Lusk et al. (2010):

"Established in natural waters. Migrated from the Danube to the confluence of the Dyje and Morava rivers after 1975. Has competed heavily for food and space with *C. carassius* populations, *Tinca tinca*, *Leucaspius deliniatus*, and other native cyprinids thereby decreasing their populations. Presently the most dominant fish species in lentic and slowly running aquatic habitats."

From Vetemaa et al. (2005):

"*Carassius gibelio* (Bloch) was first introduced into fish ponds and small lakes of Estonia in 1948–49, and first detected in Estonian brackish waters (Gulf of Riga) in 1985. Since the mid-1990s, the species has spread along the entire Estonian Baltic coastline. Growth rate in the brackish water population does not differ much from freshwater populations, but the freshwater populations are gynogenetic (or show high dominance of females) in contrast to the Baltic Sea population, which presents a normal sex ratio. The recent explosion of this species in the Baltic Sea could be explained by unusually warm summers during the 1990s and by the low abundance of predatory fish."

"Amongst the most invasive species of introduced freshwater fish is the gibel (or Prussian) carp *Carassius gibelio* (Bloch), which was introduced to Europe from Asia in the 17th century and is now widely distributed in Estonia. Indeed, rapid increases in abundance of this species have been reported in many areas, including southern Russia, Greece, and the Danube River. A major biological trait responsible for invasiveness in gibel carp is its reproduction. Invading populations are often triploid and composed of almost exclusively females, which exhibit apomictic (gynogenetic) reproduction — using the sperm of other species to activate (but not fertilize) their own eggs; other populations are gonochoristic and include both diploid females and males. European freshwater populations of gibel carp seem to be predominantly gynogenetic. Indeed, 10 of the 11 Estonian freshwater populations of gibel carp consisted exclusively of females, or the proportion of males was very low (8%). Some bisexual populations have been described, but female gibel carp are often predominant, for example ranging from 79% to 97% in three Mongolian populations and from 88% to 97% in the Eravno-Charigniskije ozera lake system of Russia. However, the presence of males does not mean that they always participate in spawning, as their gonads may not be developed enough to render milt. This appears to be the case in freshwater populations of Estonia, as the males showed a low frequency of full sexual development and only one population (Lake Jalase) from 11 in fresh waters (Lake Jalase) had normally developing gonads, and this was limited to about 50% of the males observed."

"The expansion of gibel carp populations in Estonia and the surrounding Baltic Sea is worthy of concern. Although there are no indications yet to demonstrate that the invasion of gibel carp has had a detrimental impact on the Baltic coastal ecosystem or on its fisheries (e.g. due to the competition with native species), the high abundance of gibel carp in some areas (e.g. Hää demeeste) and the slow growth of adult gibel carp suggests that the species may already be reducing its own food supply, and therefore that of the coastal food web."

From Ruppert et al. (2017):

"In this study, we found evidence that Prussian carp are capable of restructuring native communities of both fish and benthic invertebrates. Specifically, we documented declines of brook stickleback and fathead minnow alongside their invasion […]. Further, when Prussian carp abundance was higher, we found significantly less abundance of brook stickleback, fathead minnow, lake chub and white sucker […]. These findings may result from Prussian carp having similar diet and habitat preferences to brook stickleback, fathead minnow and white sucker, suggesting that Prussian carp may be introducing novel competition [Docherty et al. 2017]. The negative impact on native species is surprising given that it can often take many years before community-level effects are detected [Mooney and Cleland 2001]; however, the fact that Prussian carp do have community-level effects already demonstrates that they can be a potent invader."

"We found that fathead minnow and lake chub, which are both minnow species, demonstrate significant declines in abundance where Prussian carp were highly abundant […]. It is also possible they may be more adversely affected due to reproductive interference, because their sperm may be parasitized by the gynogenetic reproduction of Prussian carp. However, we cannot be certain whether these declines in native species abundances are related to reproductive interference or increased competition for habitat and resources [Carpenter et al. 1985]."

"We also note that the abundance of white suckers showed a significant decrease in response to increases in Prussian carp abundance in the GLMM [generalized linear mixed model], which adds more weight to the notion that white suckers may be adversely impacted by Prussian carp establishment."

"As such, we detected significant concordance between changes in the fish and benthic invertebrate community with the time since invasion, where there are increases in Chironomidae (larvae and pupae), Simuliidae (larvae and pupae) and Caenidae alongside Prussian carp invasion […]. While we cannot disentangle whether changes in the benthic invertebrate community were due to the Prussian carp invasion or habitat selection, we cannot rule out that Prussian carp may be impacting benthic invertebrates, due to their diet and role as a known bioturbator (a species that reworks soils or sediments) [Richardson et al. 1995; Meyer et al. 1998]."

4 Global Distribution

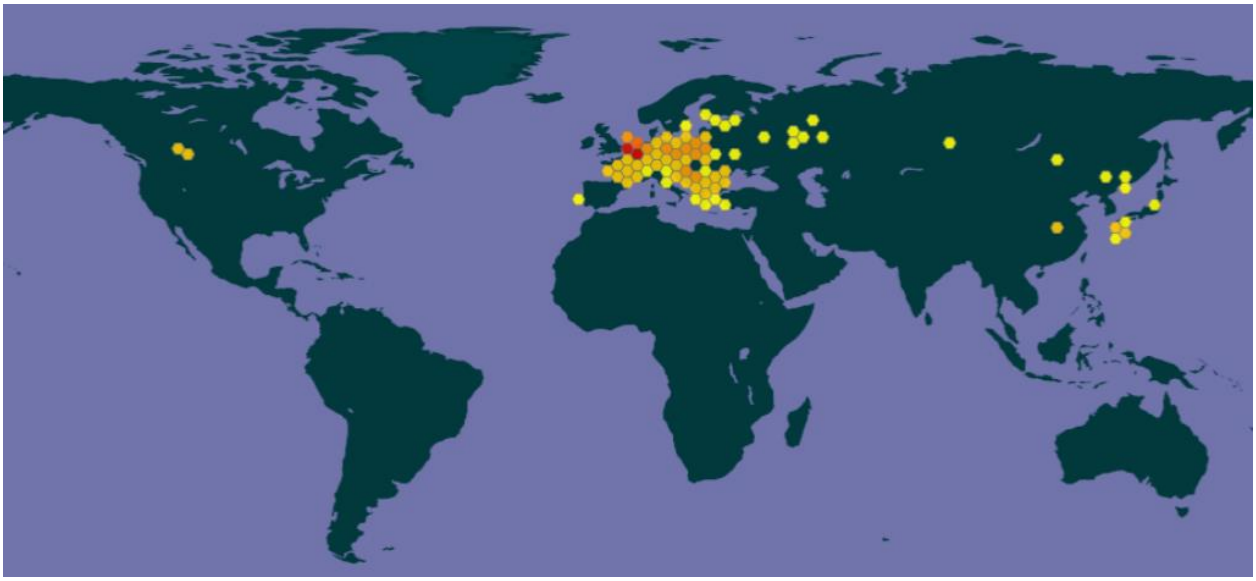

Figure 1. Known global distribution of *Carassius gibelio*. Map from GBIF Secretariat (2019).

No georeferenced observations were available for the parts of *Carassius gibelio*'s range in the following countries: Armenia, Belarus, Denmark, Georgia, Israel, Kyrgyzstan, Latvia, Lithuania, Moldova, Turkey, Turkmenistan, and Uzbekistan.

5 Distribution Within the United States

No wild populations of *Carassius gibelio* are currently found in the United States.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Carassius gibelio* was medium to high for most of the contiguous United States. The climate match was high around the Great Lakes, upper Midwest, and in much of the Great Plains. There were some patches of low match in southeast Florida, along the Gulf Coast, and along the northwestern coast. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.586, which indicates a high overall climate match (scores of 0.103 and greater are considered high). All States had high individual Climate 6 scores except for Alabama, Florida, and Texas which had medium individual Climate 6 scores, and Louisiana and Mississippi which had low individual Climate 6 scores.

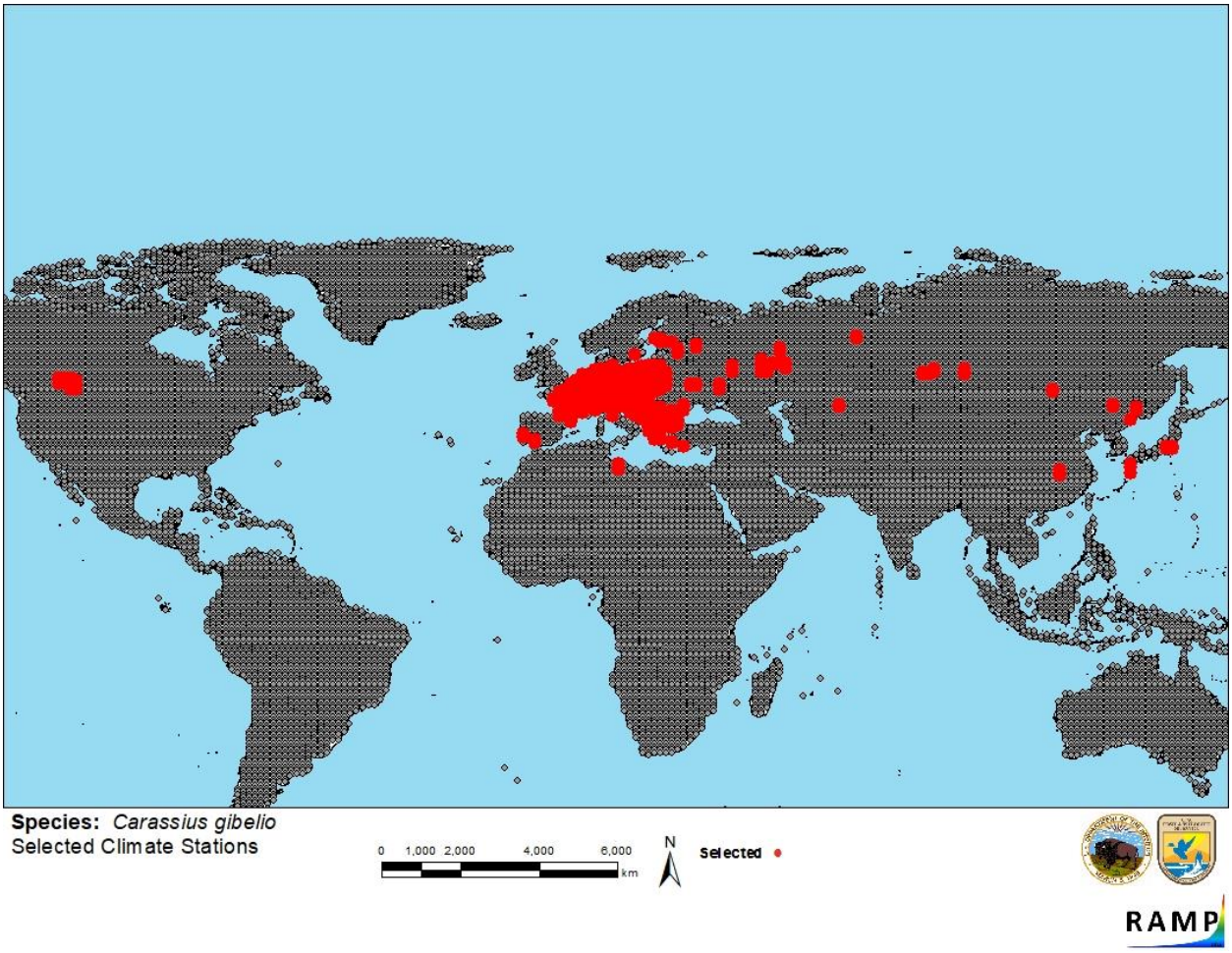

Figure 2. RAMP (Sanders et al. 2018) source map showing weather stations in Canada, throughout Europe, Russia, and Asia, selected as source locations (red) and non-source locations (gray) for *Carassius gibelio* climate matching. Source locations from GBIF Secretariat (2019).

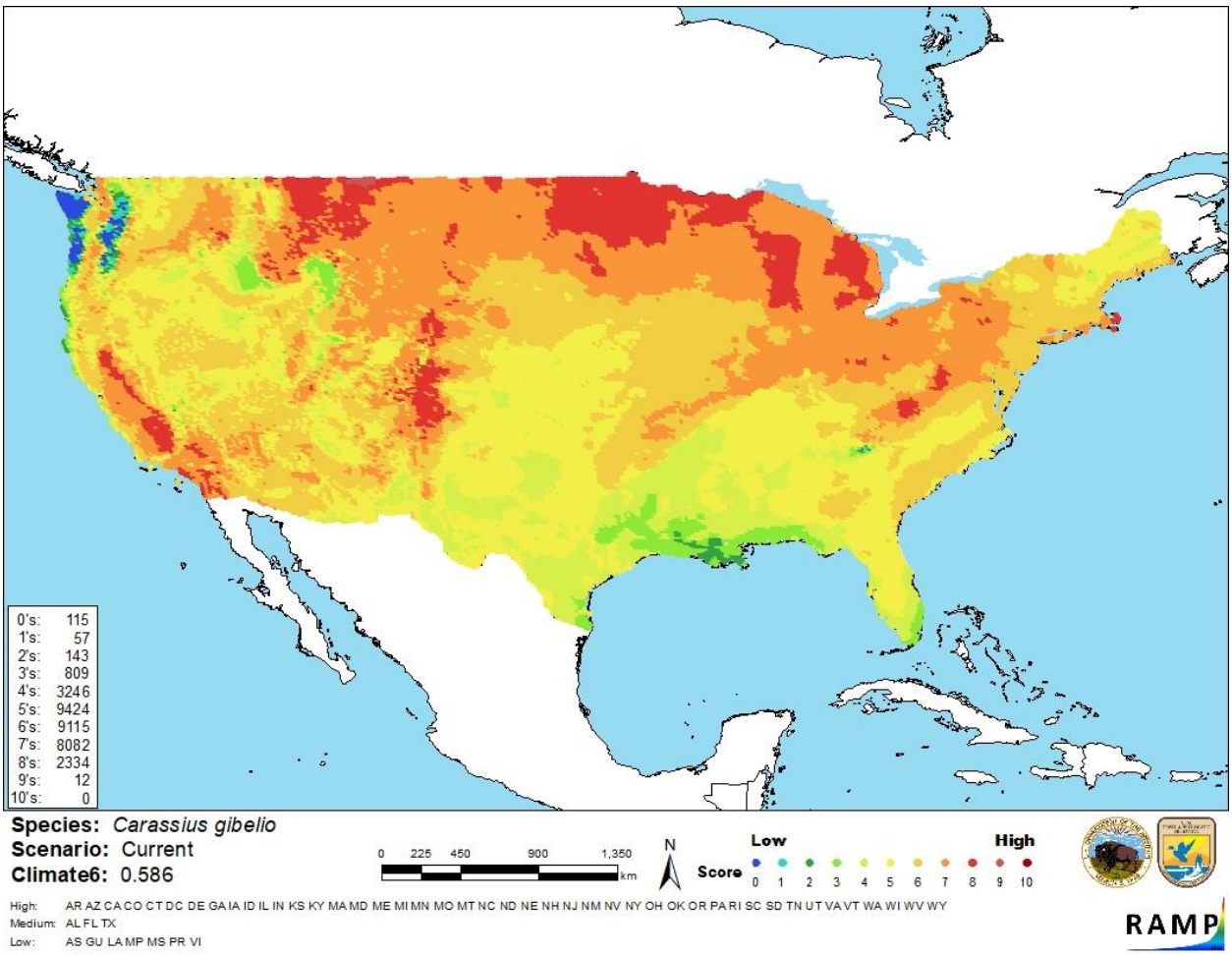

Figure 3. Map of RAMP (Sanders et al. 2018) climate matches for *Carassius gibelio* in the contiguous United States based on source locations reported by GBIF Secretariat (2019). 0 = Lowest match, 10 = Highest match.

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
≥0.103	High

7 Certainty of Assessment

Information on the biology, invasion history, and impacts of this species is sufficient to give an accurate description of the risk posed by this species. The impacts of introduction are apparent and well documented. Certainty of this assessment is high.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Prussian Carp (*Carassius gibelio*) is native to Europe and parts of Asia and has been widely introduced throughout those two continents for centuries. The history of invasiveness is high. This species is responsible for the decline of some native cyprinid species and quickly establishes itself in new habitats as the result of a high reproductive rate. Its ability to reproduce via gynogenesis increases risk of rapid spread and rapid population increases. *C. gibelio* was listed as an injurious wildlife species in 2016 under the Lacey Act by the U.S. Fish and Wildlife Service, thereby prohibiting its importation. The climate match score was high within the contiguous United States. There were very few locations of low match, primarily around the Gulf Coast and Pacific Northwest. 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:** Listed as injurious species in United States. Able to reproduce from unfertilized eggs (gynogenesis).
- **Overall Risk Assessment Category: High**

9 References

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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