Prussian Carp (*Carassius gibelio*)
Ecological Risk Screening Summary

Web Version – 8/14/2012


Photo: CAFS

1 Native Range, and Status in the United States

Native Range
From Froese and Pauly (2010):

"Asia, and in Europe. Usually considered as native from central Europe to Siberia."

Status in the United States
This species has not been reported in the United States.

Means of Introductions in the United States
This species has not been introduced to the United States.

Remarks
One of many common names associated with the species is "gibel carp."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2011):

"Kingdom Animalia
Phylum Chordata
Subphylum Vertebrata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cyprinoidea
Family Cyprinidae
Genus Carassius Nilsson, 1832 -- Crucian carps
Species Carassius gibelio (Bloch, 1782)

Taxonomic Status: Valid"

Size, Weight, and Age Range

From Froese and Pauly (2010):

"Max length: 35.0 cm SL male/unsexed; (Kottelat and Freyhof 2007 [cited by Froese and Pauly (2010) but not accessed for this report]); common length: 20.0 cm TL male/unsexed; (Muus and Dahlström 1968 [cited by Froese and Pauly (2010) but not accessed for this report]); max[imum] published weight: 3,000 g (Muus and Dahlström 1968 [cited by Froese and Pauly (2010) but not accessed for this report]); max[imum] reported age: 10 years (Kottelat and Freyhof 2007 [cited by Froese and Pauly (2010) but not accessed for this report]). Length at first maturity Lm 10.3, range 13 - ? cm."

Environment

From Froese and Pauly (2010):

"Benthopelagic; potamodromous (Riede 2004 [cited by Froese and Pauly (2010) but not accessed for this report]); freshwater; brackish; pH range: 7.1 - 7.5; dH range: 12 - ?; depth range 0 - ? m."

Climate/Range

From Froese and Pauly (2010):

"Temperate; 10°C - 20°C (Baensch and Riehl 1991 [cited by Froese and Pauly (2010) but not accessed for this report]); 62°N [Data provided in Froese and Pauly (2010) shows latitude ranges only to 59 °N]- 35°N, 10°W - 155°E."

Distribution Outside the United States

From Froese and Pauly (2010):

"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 [in Europe and Asia] and commonly stocked together with *Cyprinus carpio*, which is transported throughout Europe. Absent in northern Baltic basin, Iceland, Ireland, Scotland, and Mediterranean islands."

Means of Introductions Outside the United States

From Froese and Pauly (2010):

Aquaculture escapes, diffusion, and intentional stocking.

Short description

From Froese and Pauly (2010):

"Diagnosed from its congeners in Europe by having the following characters: body silvery-brown; 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 [cited by Froese and Pauly (2010) but not accessed for this report])."

Biology

From Froese and Pauly (2010):

"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 [cited by Froese and Pauly (2010) but not accessed for this report]). Lake dwelling individuals move into river mouths to avoid low oxygen water in winter (Kukuradze and Mariyash 1975 [cited by Froese and Pauly (2010) but not accessed for this report]). Feeding larvae and juveniles occur in high-complexity habitats, such as reed belts. Feeds on plankton, benthic invertebrates, plant material and detritus. Spawns in shallow, warm shores on submerged vegetation (Kottelat and Freyhof 2007 [cited by Froese and Pauly (2010) but not accessed for this report]). Able to reproduce from unfertilized eggs (gynogenesis) (Spratte and Hartmann 1997 [cited by Froese and Pauly (2010) but not accessed for this report]). Lifespan reaches up to about 10 years (Kottelat and Freyhof 2007 [cited by Froese and Pauly (2010) but not accessed for this report]). Eastern European or wild form of the goldfish (Welcomme 1988 [cited by Froese and Pauly (2010) but not accessed for this report])."

Human uses

From Froese and Pauly (2010):

"Fisheries: minor commercial."

Diseases

From Froese and Pauly (2010):

"*Thelohanellus* infection, Parasitic infestations (protozoa, worms, etc.)
Black Spot Disease, Parasitic infestations (protozoa, worms, etc.)"

Threat to humans

From Froese and Pauly (2010):

"Potential pest (Lusk et al. 2010)."

3 Impacts of Introductions

From Belgium Forum on Invasive Species (2011):

"The Prussian carp is a prolific fish species [that] is believed to be responsible for the decline of native fish, invertebrate and plant populations in different areas. Furthermore, it is notorious for increasing water turbidity because of its habit of stirring up bottom sediments during feeding. *C. gibelio* has the potential to hybridi[z]e with other *Carassius* species and *Cyprinus carpio*."

From Alien Species in Swedish Seas (2011):

"*Carassius gibelio* grows rapidly, reproduces efficiently, and competes with native fishes for food and space. In some parts of central Europe, it has affected the range of other indigenous and commercially more valuable fish species."

"The species is able to reproduce by gynogenesis, a process that [mostly] gives rise to new females. The milt of male fish is needed to initiate development of the eggs, but when the embryos form, the chromosomes from the males are excluded. The offspring produced are thus copies of the female."

From Solarz (2005):

"Found all over Poland. Invaded ponds, eutrophic lakes, small water reservoirs, canals, lowland rivers. Tolerates oxygen deficit and high levels of pollution. Specifically affects limnophilous cyprinids."

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."

"However, gibel carp in Estonian coastal waters are of the gonochoristic form, with a nearly equal proportion of females and males, both with normally developed gonads. Further south in the Baltic Sea, gibel carp populations are also of the gonochoristic form."

"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 Tsoumani et al. (2006):

The gibel carp *Carassius gibelio* (Bloch, 1782 [cited by Tsoumani et al. (2006) but not accessed for this report]) is known as one of the most hazardous fish species for native fish communities (Crivelli 1995; Kalous et al. 2004 [cited by Tsoumani et al. (2006) but not accessed for this report]). It easily becomes one of the dominant species in stagnant and slow-running waters and may change the flow of nutrients in the entire ecosystem (Paulovits et al. 1998 [cited by Tsoumani et al. (2006) but not accessed for this report]). According to Crivelli (1995 [cited by Tsoumani et al. (2006) but not accessed for this report]), the turbidity of the water in Lake Mikri Prespa increased after the introduction of *C. gibelio*.

4. Global Distribution

Figure 1. Global distribution of *C. gibelio* according to Froese and Pauly (2010). Map from Google Earth (2011).

5 Distribution within the United States

This species has not been reported in the U.S.

6 CLIMATCH

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences 2010; 16 climate variables; Euclidean Distance) was high in the Great Lakes and scattered sections of the U.S. Medium matches occurred everywhere else except the Southeast. Climate 6 match indicated that the U.S. has a high climate match. The range for a high climate match is 0.103 and greater, climate match of *C. gibelio* is 0.427.

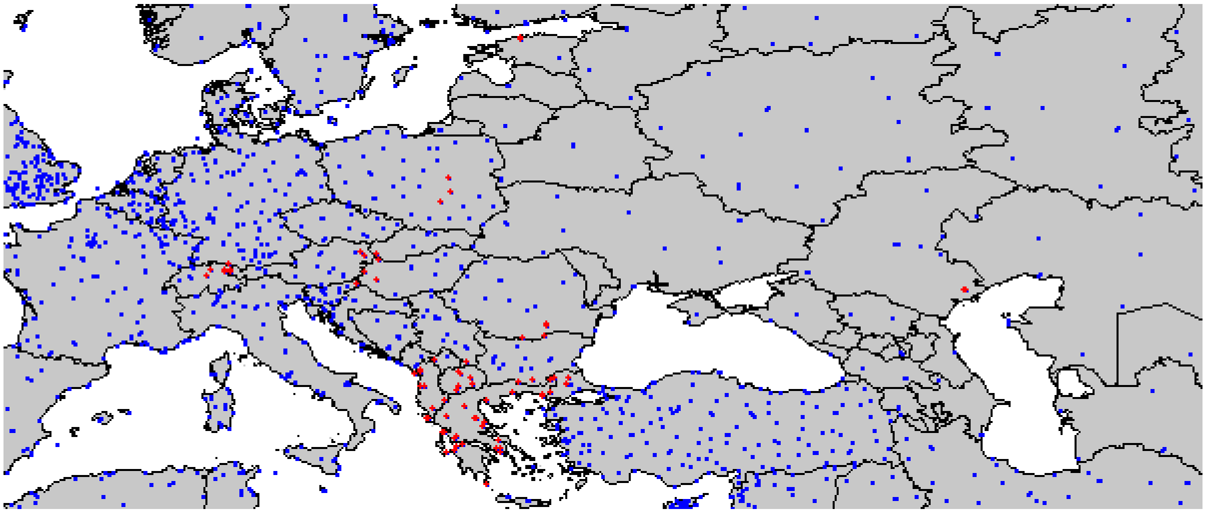

Figure 2. CLIMATCH (Australian Bureau of Rural Sciences 2010) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *C. gibelio* climate matching. Source locations from Froese and Pauly (2010).

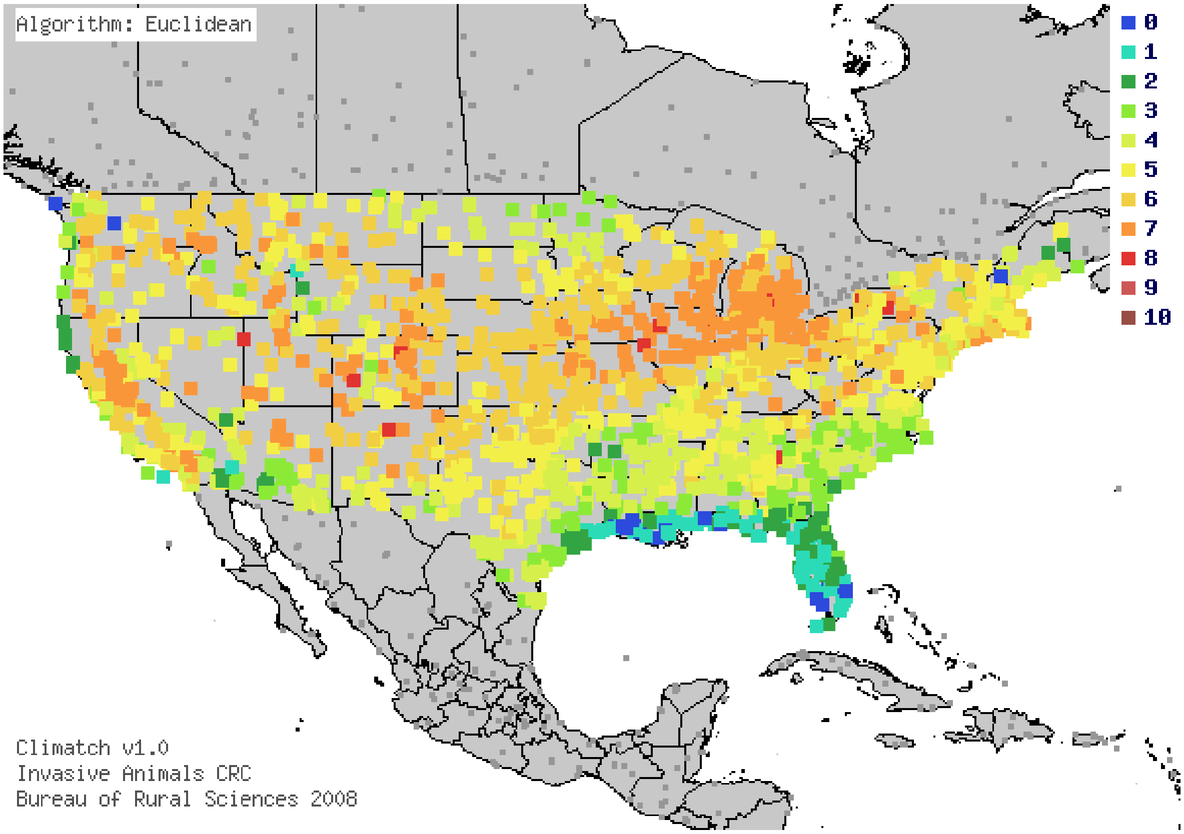

Figure 3. Map of CLIMATCH (Australian Bureau of Rural Sciences 2010) climate matches for *C. gibelio* in the continental United States based on source locations reported by Froese and Pauly (2010). 0= Lowest match, 10=Highest match.

Table 1. CLIMATCH (Australian Bureau of Rural Sciences 2010) climate match scores

CLIMATCH Score	0	1	2	3	4	5	6	7	8	9	10
Count	25	78	90	156	327	455	524	306	13	0	0
Climate 6 Proportion =		0.427	(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. Certainty of this assessment is high.

8 Risk Assessment

Summary of Risk to the Continental United States

C. gibelio is native to Europe and parts of Asia and has been widely introduced throughout those two continents for centuries. This species is responsible for the decline of some native cyprinid species, alteration of local habitats, and quickly establishing 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. Climate match is high within a large portion of the U.S.

Assessment Elements

- **History of Invasiveness (See Section 3):** High
- **Climate Match (See Section 6):** High
- **Certainty of Assessment (See Section 7):** High
- **Important additional information:** Reproduction via gynogenesis
- **Overall Risk Assessment Category: High**

Table 1. Generalized, projected impacts of *C. gibelio* on natural resources of the continental United States. The climate match is high between the native/established ranges of *C. gibelio* and that of the continental United States. Therefore, details of impacts are too numerous to list in this screening report. Specific details of impacts will depend on local ecological structure (i.e., fish species composition, population abundance, and community structure; food resource biomass and community structure; and habitat variables).

Threat	Projected Level of Impact to Wildlife Resources of the U.S.	Description of Impact	Projections of impacts to Wildlife Resources of the U.S.

Habitat Degradation	High	The increased turbidity caused by *C. gibelio* sediment perturbation degraded habitats (Crivelli 1995). Two of five locations in the Baltic Sea area were "moderately to strongly impacted" [impacts included those to habitats] by *C. gibelio* (Zaiko et al. 2010).	*C. gibelio* impacts on water quality are projected to be greatest in lakes/rivers/streams with submerged aquatic vegetation and soft bottom sediments.
Species Extirpation/Extinction	Low	*C. gibelio* has been responsible for numerous native species population reductions in Europe as a result of habitat degradation, and competition for food (Lusk et al. 2010). However, no extirpations or extinctions were documented.	Species likely to be impacted most directly are native cyprinid species that will be outcompeted when abundance of *C. gibelio* is high (See also the Competition section). This species is able to hybridize with other cyprinid species (*C. auratus*, *C. carassius*, and *Cyprinus carpio*) in Europe. However, risk of hybridization with native cyprinids in the U.S. has not been scientifically assessed.
Food Web Disruption	High	Food webs are at risk of disruption due to competition with native fishes (Paulovits et al. 1998 (see also Competition section), and increased turbidity caused by sediment perturbation by *C. gibelio* (Crivelli 1995).	Scientific study results documented that *C. gibelio* does compete with native fishes for food (see Competition section). *C. gibelio* feeds on plankton, benthic invertebrates, and plant material. If native species decline significantly, then food web disruption will result. Increased turbidity will risk disruption of food webs in ecosystems where the *C. gibelio* becomes abundant.

Degradation of Fish Stocks	High	Species most likely to be degraded will be limnophilous [strong affinity or preference for living in lakes or freshwater marshes] cyprinids (Solarz 2005). Degradation of fish stocks is projected to be greatest from impacts of competition and habitat degradation (see Competition and Habitat Degradation sections).	See projected impacts to U.S. wildlife resources listed in the Species Extirpation/Extinction and Competition sections.
Competition	High	Competes with other cyprinid species, and after establishment can become the most common species in a system (Lusk et al. 2010).	Cyprinid species in lentic (lake and marsh) and slowly running aquatic habitats are most likely to be impacted after establishment of *C. gibelio* populations.
Predation (with special emphasis on native fishes)	Low	*C. gibelio* is omnivorous and feeds on detritus, zooplankton, zoobenthos and macrophytes (Specziar et al., 1997).	*C. gibelio,* where established, can outcompete and replace similar species in a habitat's trophic structure. This may increase predation pressure on species of invertebrates. The most likely impacts of predation on native fishes will be on egg and benthic larval stages.
Reproductive Interference with Native fishes	Medium	*C. gibelio* can potentially hybridize with other cyprinid species [*C. auratus*, *C. carassius*, *and Cyprinus carpio*] (Belgium Forum on Invasive Species	Hybridization constitutes a large threat to any cyprinid species whose numbers may already be declining. Successful hybridization between *C. gibelio* and cyprinid species native to the U.S. has not been documented in literature. Reproduction interference is a risk where *C.*

		2011).	*gibelio* competition and habitat impacts reduce abundance of native fishes low enough to impact their recruitment.

Table 2. Generalized, projected impacts of *C. gibelio* on natural resources of the connected Great Lakes Basin (i.e., Great Lakes, connecting channels, and tributaries). The climate match is high between the native/established ranges of *C. gibelio* and that of the connected Great Lakes Basin. Therefore, details of impacts are too numerous to list in this screening report. Specific details of impacts will depend on local ecological structure (i.e., fish species composition, population abundance, and community structure; food resource biomass and community structure; and habitat variables).

Threat	Projected Level of Impact to Wildlife Resources of the Connected Great Lakes Basin	Description of Impact	Projections of impacts to Wildlife Resources of the Connected Great Lakes Basin
Habitat Degradation	High	The increased turbidity caused by *C. gibelio* sediment perturbation degraded habitats (Crivelli 1995). Two of five locations in the Baltic Sea area were “moderately to strongly impacted” [impacts included those to habitats] by *C. gibelio* (Zaiko et al. 2010).	Increases in turbidity levels will probably most impact nearshore and coastal habitats in the Great Lakes. Reduced light levels in habitats are projected to decrease habitat for fishes that are best adapted to clear water for feeding. Reductions in native aquatic vegetation within nearshore and coastal waters will impact species that rely on that vegetation for spawning, nursery habitat, cover, and food. Coastal habitats in the Great Lakes have been among the most heavily impacted (by a variety of stressors) of all habitats there, so establishment of *C. gibelio* populations risks further degradation of those habitats. At greatest risk of impact from *C.*

			gibelio are fishes that rely on that submerged aquatic vegetation for spawning and nursery habitats in nearshore and coastal waters.
Species Extirpation/Extinction	Low	*C. gibelio* has been responsible for numerous native species population reductions in Europe (Lusk et al. 2010). However, no documentation of extirpations or extinctions was found.	Great Lakes species most likely to be impacted are native cyprinids as the result of: 1) resource competition – cyprinid species with similar habitat and food requirements are projected to be most impacted, and 2) hybridization – *C. gibelio* is able to hybridize with other cyprinid species (*C. auratus*, *C. carassius*, and *Cyprinus carpio*) in Europe. Cyprinid fishes are abundant in coastal and nearshore habitats of all the Great Lakes, and in more extensive habitats within Lake Erie. Thus, impacts are projected to be greatest on cyprinids in those habitats (See also the Competition section). Native cyprinid species whose abundances are at historic lows are at risk of additional impact from *C. gibelio* competition and habitat alteration. Risk of hybridization with native cyprinids in the Great Lakes has not been scientifically assessed.
Food Web Disruption	High	Food webs are at risk of disruption due to changes in nutrient flow caused by *C. gibelio* (Paulovits et al. 1998), and increased turbidity caused by *C. gibelio* sediment perturbation (Crivelli 1995).	Research has shown that *C. gibelio* does compete for resources with similar species (see the Competition section). The species feeds on plankton, benthic invertebrates, and plant material. Therefore, if those resources are limiting, then competition with native species for those resources will result. Increased turbidity will risk disruption of food webs in ecosystems where the species becomes abundant. Disruption of

			food webs due to water quality degradation is projected to be greatest in some Great Lakes tributaries, connecting channels, and nearshore and coastal habitats.
Degradation of Fish Stocks	High	Species most likely to be degraded will be limnophilous cyprinids (Solarz 2005).	See projected impacts to U.S. wildlife resources listed in Species Extirpation/Extinction above.
Competition	High	Competes heavily with other cyprinid species and after establishment can become the most common species in a system (Lusk et al. 2010).	Cyprinid species in lentic and slowly running aquatic habitats are likely to be impacted by the introduction of *C. gibelio*. In the Great Lakes, species occupying some Great Lakes tributaries, connecting channels, and nearshore and coastal habitats will be the most likely to be impacted.
Predation (with special emphasis on native fishes)	Low	It is omnivorous and feeds on detritus, zooplankton, zoobenthos and macrophytes (Specziar et al., 1997).	*C. gibelio* outcompetes and replaces similar species in a habitat's trophic structure. This may increase predation pressure on species of invertebrates. Predation pressure on native fishes in the Great Lakes will most likely be restricted to nearshore and coastal habitats, and the species that spawn there. Predation by *C. gibelio* on fish eggs and benthic larvae in those habitats is a risk. For example, yellow perch (*Perca flavescens*) spawns on vegetation. Predation on yellow perch eggs, and impacts to recruitment of some stocks, is a clear risk.
Reproductive Interference with Native Great Lakes fishes	Medium	*C. gibelio* can potentially hybridize with other cyprinid species [*C. auratus, C. carassius, and*	The risk of hybridization between *C. gibelio* and Great Lakes native cyprinids cannot be scientifically projected, because no studies have been conducted to evaluate risk of hybridization.

		Cyprinus carpio] (Belgium Forum on Invasive Species 2011).	Reproduction interference is a risk if impacts of *C. gibelio* competition, habitat degradation, and predation (on eggs and larvae) reduces abundance of native fish stocks low enough to impact recruitment.

9 References

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