

Crucian Carp (*Carassius carassius*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, September 2014
Revised, December 2018
Web Version, 3/18/2019



Photo: T. Østergaard. Licensed under Creative Commons BY-NC 3.0 Unported. Available: <https://www.fishbase.de/photos/PicturesSummary.php?StartRow=3&ID=270&what=species&ToRec=6>. (December 6, 2018).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2018a):

“Eurasia: North, Baltic, White, Barents, Black and Caspian Sea basins; Aegean Sea basin only in Maritza drainage; eastward to Kolyma drainage (Siberia); westward to Rhine and eastern drainages of England. Absent from North Sea basin in Sweden and Norway. In Baltic basin north to about 66°N.”

“There is a gradual but continuing extirpation in many water bodies, especially in Danube drainage and central Europe, possibly to due competition with introduced *Carassius gibelio* in non-optimal habitats [Kottelat and Freyhof 2007].”

“[In Azerbaijan:] Occurs in the Terek and Kuma rivers [Reshetnikov et al. 1997].”

“[In China:] Localized to the E-erqisi River [=Erigishi River], and is an endemic fish of Xinjiang [Institute of Hydrobiology, Academia Sinica, Shanghai Natural Museum and Ministry of

Agriculture of China 1993] [...]. Also recorded in Erqishi, Ulungur and Tarim [Walker and Yang 1999].”

“[In Kazakhstan:] Occurs in the Emba River [Reshetnikov et al. 1997].”

“[In Mongolia:] Known from Bulgan River but occurrence needs confirmation [Kottelat 2006].”

“[In Turkey:] Widely distributed in western, northern and eastern Turkey. Known from the European Black Sea watersheds, European Mediterranean Sea watersheds, Aegean Sea watersheds, Anatolian Mediterranean Sea watersheds, Anatolian Black Sea watersheds, and western and central Anatolian lake watersheds [Fricke et al. 2007].”

“[In Austria:] Present in Neusiedler See [Wolfram-Wais et al. 1999].”

“[In Czech Republic:] Occurs in Odra and Morava river basins [Hanel 2003].”

“[In Denmark:] Common throughout the country [Frier 1994].”

“[In Estonia:] Found in many small lakes and ponds rich in nutrients [Anonymous 1999]. Common in the Gulf of Riga and rare in the Gulf of Finland [Ojaveer and Pihu 2003].”

“[In Germany:] Rare in the Neckar [Günther 1853]. Found in the Elbe estuary [Thiel et al. 2003].”

“[In Norway:] Southern tip of Norway.”

“[In Russia:] Occurs in rivers of the Arctic Ocean basin from the northern Dvina and Pechora to the Indigirka and Kolyma in the east. Found in the upper reaches of the Urak River (the basin of the Sea of Okhotsk) and lower reaches of the Volga [Reshetnikov et al. 1997].”

“[In United Kingdom:] Regarded as native to southern England [Lever 1996].”

Status in the United States

From Schofield et al. (2018a):

“There are no recent reports of crucian carp in the U.S. An earlier report that either the crucian carp or a hybrid (with goldfish [*Carassius auratus*]) had been introduced into Texas (Howells 1992b; Fuller et al. 1999) is now considered unlikely. The introduction and status of this species remains uncertain.”

According to Schofield et al. (2018a), *Carassius carassius* was stocked in Chicago, Illinois in or before 1910 but there is no existing population at that location.

From Froese and Pauly (2018a):

“Established in Chicago in the 1900s but later died out [Welcomme 1988].”

From Schofield et al. (2018b):

“In Ohio, it is unlawful for any person to possess, import or sell live *Carassius carassius* and dead specimens must be headless, preserved in ethanol or formaldehyde, or eviscerated. Possessing, importing, purchasing, selling, propagating, transporting or introducing *Carassius carassius* is prohibited in Minnesota. There are no regulations on *C. carassius* in Ontario, New York, Michigan, Indiana, Illinois, or Wisconsin.”

Carassius carassius is listed as injurious under the Lacey Act (USFWS 2016).

Means of Introductions in the United States

Schofield et al. (2018a) list stocking as the potential pathway for the introduction in Illinois.

Remarks

A previous version of this ERSS was published in 2014.

From Schofield et al. (2018a):

“Because of this species' similarity to goldfish, and because of possible hybridization, characters may overlap and positive identification may be difficult. Similar to the goldfish, the crucian carp is known to hybridize with the common carp *Cyprinus carpio* (Berg 1964; Muus and Dahlstrom 1978; Wheeler 1978). Eddy and Underhill (1974) reported that both the goldfish and the crucian carp had been introduced into the United States, but they provided no additional details concerning the latter species. Welcomme (1988) reported that *C. carassius* was established in Chicago in the 1900s but later died out; however, he did not provide documentation for that record and we have found no additional information to support it.”

“There is some confusion in the literature surrounding the use of the names crucian carp and Prussian carp. Lever (1996) listed Prussian Carp as an alternative or local vernacular name sometimes used for the crucian carp; however, Berg (1964) and most others use the name Prussian carp for *Carassius auratus gibelio*. In the 1800s Baird witnessed fish taken out of the Hudson River, New York; Baird later wrote that these fish appeared to be "hybrids between goldfish and the Prussian carp" (Redding 1884). In that instance it is not certain as to which species Baird is referring to in using the term Prussian carp. Cole (1905) quoted from one of Baird's reports, in which Prussian carp is treated as synonymous with *Cyprinus carassius* (= *Carassius carassius*?).”

From CABI (2018):

“*Carassius carassius* has a long history of mis-identification, and its taxonomic status is reported to be confused. Throughout the scientific literature “crucian carp” is used to name species such as *Carassius auratus* (goldfish), *Carassius gibelio* (gibel carp) as well as *Cyprinus carpio* (common carp), with some authors including goldfish and gibel carp as a subspecies of *C. carassius*.”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to Fricke et al. (2018), *Carassius carassius* (Linnaeus 1758) is the valid name for this species. It was originally described as *Cyprinus carassius* (Linnaeus 1758).

From ITIS (2018):

“Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomta
Superclass Actinopterygii
Class Teleostei
Superorder Ostariophysii
Order Cypriniformes
Superfamily Cyprinoidea
Family Cyprinidae
Genus *Carassius*
Species *Carassius carassius* (Linnaeus, 1758)”

Size, Weight, and Age Range

From Froese and Pauly (2018a):

“Max length : 64.0 cm TL male/unsexed; [Koli 1990]; common length : 15.0 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 (2018a):

“Freshwater; brackish; demersal; potamodromous [Riede 2004]; depth range 5 - ? m [Allardi and Keith 1991]. [...]; 2°C - 22°C [assumed to be water temperature] [Riehl and Baensch 1991]; [...].”

“Can survive at high temperatures and at very low oxygen concentrations during summer and under ice cover [Kottelat and Freyhof 2007]. Tolerates cold, organic pollutants, and low oxygen levels in the water [Billard 1997].”

From Schofield et al. (2018a):

“Survival has been documented at water temperatures below 0°C, and individuals may even survive for a few days with a frozen integument (Szczerbowski and Szczerbowski, 2001). The ability to use anaerobic metabolism allows crucian carp to survive for several months in anoxic water at low temperatures, for example, in lakes frozen over with ice (Holopainen and Hyvärinen, 1984; Piironen and Holopainen, 1986).”

From CABI (2018):

“*C. carassius* is tolerant of high summer [water] temperatures (up to 35°C; Sollid et al., 2005) [...]”

Climate/Range

From Froese and Pauly (2018a):

“Temperate; [...]; 69°N - 35°N, 10°W - 169°E”

Distribution Outside the United States

Native

From Froese and Pauly (2018a):

“Eurasia: North, Baltic, White, Barents, Black and Caspian Sea basins; Aegean Sea basin only in Maritza drainage; eastward to Kolyma drainage (Siberia); westward to Rhine and eastern drainages of England. Absent from North Sea basin in Sweden and Norway. In Baltic basin north to about 66°N.”

“There is a gradual but continuing extirpation in many water bodies, especially in Danube drainage and central Europe, possibly to due competition with introduced *Carassius gibelio* in non-optimal habitats [Kottelat and Freyhof 2007].”

“[In Azerbaijan:] Occurs in the Terek and Kuma rivers [Reshetnikov et al. 1997].”

“[In China:] Localized to the E-erqisi River [=Erigishi River], and is an endemic fish of Xinjiang [Institute of Hydrobiology, Academia Sinica, Shanghai Natural Museum and Ministry of Agriculture of China 1993] [...]. Also recorded in Erqishi, Ulungur and Tarim [Walker and Yang 1999].”

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watersheds, Anatolian Mediterranean Sea watersheds, Anatolian Black Sea watersheds, and western and central Anatolian lake watersheds [Fricke et al. 2007].”

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“[In Czech Republic:] Occurs in Odra and Morava river basins [Hanel 2003].”

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“[In Germany:] Rare in the Neckar [Günther 1853]. Found in the Elbe estuary [Thiel et al. 2003].”

“[In Norway:] Southern tip of Norway.”

“[In Russia:] Occurs in rivers of the Arctic Ocean basin from the northern Dvina and Pechora to the Indigirka and Kolyma in the east. Found in the upper reaches of the Urak River (the basin of the Sea of Okhotsk) and lower reaches of the Volga [Reshetnikov et al. 1997].”

“[In United Kingdom:] Regarded as native to southern England [Lever 1996].”

Introduced

From Froese and Pauly (2018a):

“Widely introduced to Italy, England and France but possibly often confused with *Carassius gibelio* [Kottelat and Freyhof 2007].”

“[In Kenya:] Introduced to Kenya, but unknown if it is established in the wild [Seegers et al. 2003].”

“[In China:] [...] (naturally occurs in northern China but introduced to most parts of China) [Frimodt 1995]. [...] Introduced from its native range to other regions in the country for culture and stocking in all kinds of inland waters [Ma et al. 2003].”

“[In India:] Found in Kashmir Valley [Kullander et al. 1999] and Western Ghats [Sehgal 1999]. Present in Nainital Lake [Pal and Kundu 2011].”

“[In Nepal:] Commonly domesticated everywhere in pools and tanks at altitudes of 120-1350 m.”

“[In Turkey:] Introduced in Egirdir Lake in 1993-1994 and Lake Beysehir in 1995 [Innal and Erk'akan 2006].”

“[In France:] Occurs in the northeast, central and southwest France.”

“[In Italy:] Widely introduced but possibly often confused with *Carassius gibelio* [Kottelat and Freyhof 2007]. Species assumed for Italy, although there are no documented cases of its presence [Bianco 2013].”

“[In Russia:] This has been translocated to areas within the country for stocking in open waters where they have locally established self-sustaining populations [Bogutskaya and Naseka 2002].”

“[In Spain:] Southwest Spain. May have been introduced [Bartley 2006].”

“[In Switzerland:] Rarely found.”

“[In United Kingdom:] Widely introduced to England but possibly often confused with *Carassius gibelio* [Kottelat and Freyhof 2007].”

“[Questionable in Colombia:] A sporadic visitor to the coast of Colombia (Morrosquillo Gulf). Probably introduced into the area.”

“[In Algeria:] Recorded from the Ain Zada reservoir [but not established], probably part of the 2006 summer introduction of carps [Kara 2011].”

Froese and Pauly (2018a) list *Carassius carassius* as also introduced to Ethiopia, Cyprus, Iran, Israel, Philippines, Sri Lanka, Belgium, Croatia, Greece, and Chile. Introduced but not established in Thailand.

In addition to the countries listed above, FAO (2018) lists an introduction of *Carassius carassius* to Australia; no further information was given. Pagad et al. (2018) also lists an introduction in Mexico.

Means of Introduction Outside the United States

From CABI (2018):

“There is very little data on the introduction of this species outside of its native range, though Crivelli (1995) provides some information for the Mediterranean region and Innal (2011) reviews the three *Carassius* species present in Turkey, where *C. auratus* and *C. gibelio* are introduced and *C. carassius* was previously considered to be non-native (Innal and Erk’akan, 2006) but has since been classed as native (Innal, 2011). It has been shown that *C. carassius* is translocated within its native range, e.g. Slovenia (Povž and Sket, 1990) and the United Kingdom for angling amenity (Sayer et al., 2011), however there is little evidence of adverse impacts in the receiving waters.”

“The physical similarity between *C. carassius* and *C. gibelio* and the natural brown variety of *C. auratus* results in these species being introduced accidentally either in mixed consignments or as mis-identified consignments (Wheeler, 2000; Hickey and Chare, 2004; Innal and Erk’akan, 2006). Therefore, the two main introduction pathways are via fish stocking (for angling) and transfers of ornamental fish.”

Short Description

From Froese and Pauly (2018a):

“Dorsal spines (total): 3 - 4; Dorsal soft rays (total): 13-22; Anal spines: 2-3; Anal soft rays: 5 - 7; Vertebrae: 32. Diagnosed from its congeners in Europe by having the following characters: body golden-green shining color; last simple anal and dorsal rays weakly serrated; 23-33 gill rakers; lateral line with 31-36 scales; free edge of dorsal convex; anal fin usually with 6½ branched rays; and peritoneum white [Kottelat and Freyhof 2007]. Caudal fin with 18-20 rays [Spillman 1961]. No barbels. The third dorsal and anal-fin rays are strong and serrated posteriorly.”

From CABI (2018):

“The only positive identification is through DNA analysis (Hänfling et al., 2005). It is difficult but possible to differentiate *C. carassius* from congeneric species using head bone analysis (Masson et al., 2011) and meristic characters such as numbers of lateral scales and gill rakers but these methods are not reliable when hybrids are present.”

Biology

From Froese and Pauly (2018a):

“Adults occur in shallow ponds, lakes rich in vegetation and slow moving rivers. They burrow in mud in the dry season or during winter [Allardi and Keith 1991]. Usually restricted to densely vegetated backwaters and oxbows of lowland rivers. [...] Feeds all day but mainly at night on plankton, benthic invertebrates, plant materials and detritus. Usually does not occur in waters with rich ichthyofauna and abundant predatory species, but very abundant in the absence of other fish species. Spawns in dense submerged vegetation [Kottelat and Freyhof 2007].”

“Females spawn multiple times during the spawning period (Ref. 88808). Reproduction in May-June in shallow water with dense vegetation, eggs 130000-250000/female adhere to plants, hatch after 4-8 days [Allardi and Keith 1991]. Individual female spawn with several males. Males follow ripe females, often with much splashing. Eggs are sticky and are attached to water plants [Kottelat and Freyhof 2007].”

From Schofield et al. (2018a):

“The crucian carp is known for its remarkable hardiness (Muus and Dahlstrom 1978). Historical accounts report the species can live for hours out of the water (Seeley, 1886). [...] In their native range, feeding may stop for several months as the fish rest in a state of "suspended animation" during winter months when ponds become anoxic and covered with ice (Zhadin and Gerd, 1963; Penttinen and Holopainen, 1992).”

Human Uses

From Froese and Pauly (2018a):

“Marketed fresh and frozen; eaten fried, broiled and baked [Frimodt 1995].”

“Highly important sport fish in Japan (Mark Donachy, pers. comm., 2001).”

“Fisheries: highly commercial; aquaculture: commercial; gamefish: yes; aquarium: commercial; bait: occasionally”

“Its use as a bait fish is illegal [in Switzerland].”

From Cultured Aquatic Species Information Programme (2004):

“The culture of crucian carp was initiated in China. The earliest activity can be traced back to the East Han Dynasty (25-189 A.D.), according to archaeological studies, to the Song Dynasty (960-1279 A.D.) and according to written records. However, production was limited to a rather small scale. Aquaculture of this species was limited to China and Japan until the mid-1960s. Since then it has gradually expanded to many other countries and regions, including Taiwan Province of China, Belarus, Republic of Korea, and Uzbekistan. The major producer has always been China, whose production has expanded from less than 2000 tonnes in 1950 to nearly 1.7 million tonnes in 2002 (99.6 percent of the global total).”

“At present, crucian carp is basically a locally consumed product. Traditionally, crucian carp is consumed fresh. [...] Crucian carp has a moderate price that is affordable to middle- and low-income people.”

From Schofield et al. (2018b):

“Also, there is a great potential for laboratory culture and wide range of feeding habits make Crucian carp a suitable fish for species for routine ecotoxicological assays (Holopainen et al. 1997).”

Diseases

Spring viraemia of carp, koi herpes virus, and epizootic ulcerative syndrome are OIE-reportable diseases.

Cultured Aquatic Species Information Programme (2004) list *Aeromonas sobria*, *Aeromonas hydrophila* (flesh-eating bacteria), *Yersinia ruckeri*, *Vibrio* sp., *Pseudomonas punctata* f. *ascitae*, *Aeromonas punctata* sub. *punctata*, *Saprolegnia* spp., and *Achlya* spp. as diseases of *Carassius carassius*.

From Schofield et al. (2018b):

“Crucian Carp [*Carassius carassius*] are viable hosts for the fatal spring viraemia of carp virus.”

Kamilya and Baruah (2014) list *Carassius carassius* as susceptible to epizootic ulcerative syndrome.

Karvonen et al. (2005) list *Gyrodactylus carassii*, *Diplostomum spathaceum*, *Argulus foliaceus*, *Dactylogyrus formosus*, *Dactylogyrus intermedius*, *Dactylogyrus wegneri*, *Paradiplozoon homoion*, *Tylodelphus clavata*, *Raphidascaris acus*, *Acanthocephalus lucii*, *Neoechinorhynchus rutilus*, *Ergasilus* spp., and unknown glochidia as parasites of *Carassius carassius*.

From Sadler et al. (2008):

“How-ever, in another presentation at that same meeting (unpubl. data, Bergman, in Haenen & Hedrick 2006), the detection of KHV in goldfish and Crucian carp, *Carassius carassius* (L.), was reported at intervals between 7- and 365-days post-injection with the virus [koi herpes virus].”

From Froese and Pauly (2018a):

“Dactylogyrus Gill Flukes Disease, Parasitic infestations (protozoa, worms, etc.)
Trichodinosis, Parasitic infestations (protozoa, worms, etc.)
Skin Flukes, Parasitic infestations (protozoa, worms, etc.)
False Fungal Infection (*Epistylis* sp.), Parasitic infestations (protozoa, worms, etc.)
Turbidity of the Skin (Freshwater fish), Parasitic infestations (protozoa, worms, etc.)
SVC, Viral diseases”

Froese and Pauly (2018b) list *Carassius carassius* as a host for *Caryophyllaeus laticeps*, *Cathayacanthus exilis*, *Ergasilus briani*, *E. magnicornis*, *E. sieboldin*, *Gyrodactylus sporstonae*, *Lernaea cyprinacea* (anchor worm), *Neoergasilus japonicus*, and *Pseudosphaerostomum caudotestis*.

According to Poelen et al. (2014), *Carassius carassius* is also a host for *Thelohanellus hovarkai*, *Thelohanellus wuhanensis*, cyprinid herpesvirus, *Myxobolus wulii*, *Contracaecum rudolphii*, *Trypanosoma carassii*, *Gyrodactylus carassii*, *Ligula intestinalis*, *Dactylogyrus extensus*, *Paradilepis scolecina*, *Philometroides sanguinea*, *Neogryporhynchus cheilancristrotus*, *Khawia parva*, *Valipora campylancristrota*, *Streptocara crassicauda*, *Myxobolus pfeifferi*, *Myxobolus oviformis*, and *Cathayacanthus exilis*.

Threat to Humans

From Froese and Pauly (2018a):

“Potential pest [FAO 1997]”

3 Impacts of Introductions

The following details unconfirmed and potential impacts of *Carassius carassius* invasion:

From Wittenberg (2005:57):

“Competition with native fish species?”

“Community changes by increasing water turbidity?”

From Schofield et al. (2018b):

“Crucian Carp are viable hosts for the fatal spring viraemia of carp virus. This virus has the potential to affect native cyprinids as well as non-cyprinid species such as Northern Pike (*Esox lucius*), Largemouth Bass (*Micropterus salmoides*), and Bluegill Sunfish (*Lepomis macrochirus*) (Dixon and Stone 2017). Benthic feeding and disturbance of surface sediment may have an important effect on nutrient cycling and trophic dynamics (Holopainen et al. 1997).”

4 Global Distribution

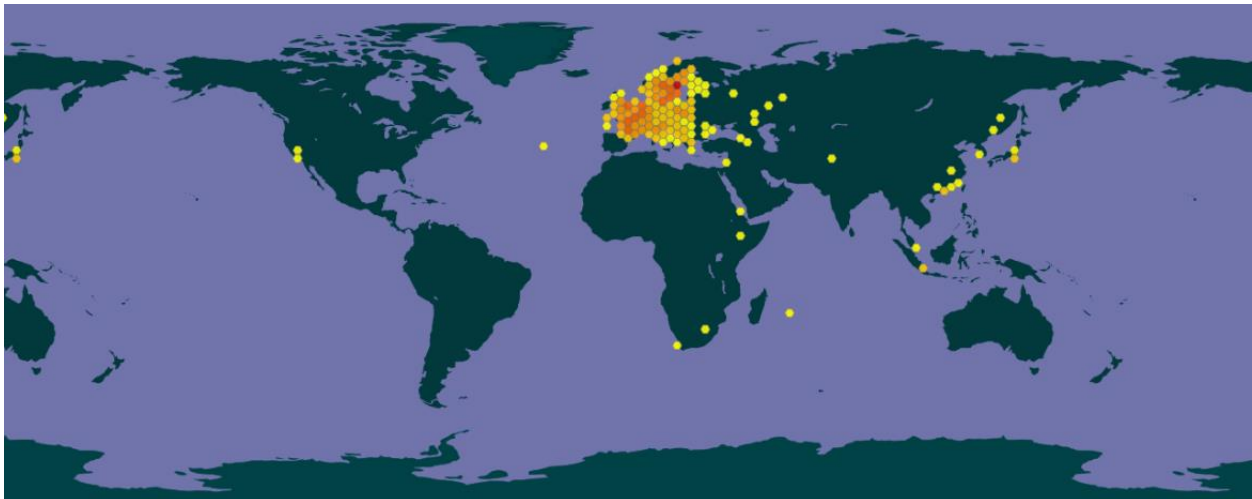


Figure 1. Known global distribution of *Carassius carassius*. Map from GBIF Secretariat (2018).

The location in the middle of the Atlantic Ocean (Figure 1) was not used as a source point for the climate match. It is on an island (GBIF Secretariat 2018) but no information was found to support a population at this location.

The locations in Eritrea (western Africa, north of Ethiopia; Figure 1) were not used as source points. One record was from a hybrid specimen and the other had a marine location recorded (GBIF Secretariat 2018).

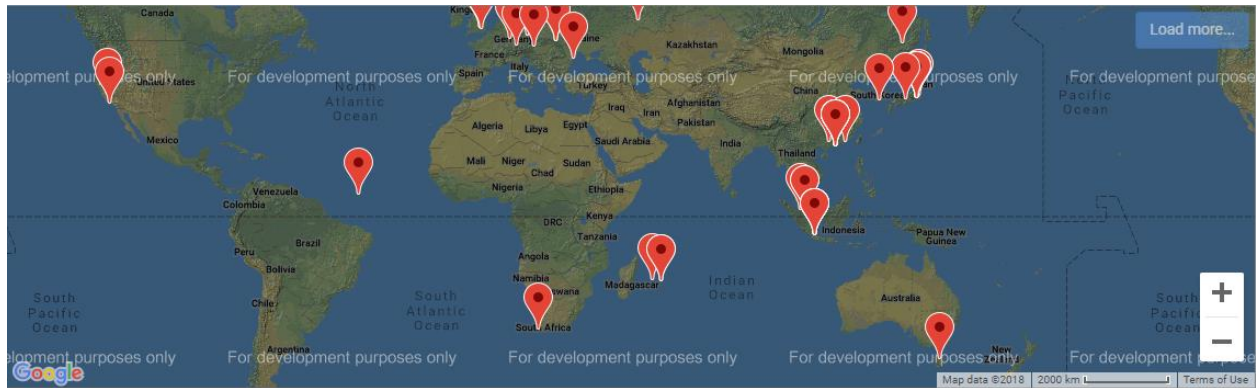


Figure 2. Additional known global distribution of *Carassius carassius*. Map from VertNet (2018).

The location in the Atlantic Ocean (Figure 2) was not used as a source point for the climate match. The location does not match the listed collection location in Ethiopia (VertNet 2018).

The locations in California (Figures 1, 2) were not used as source points in the climate match. The record information shows collections in 1977 and 1987 but no other source indicates an established population in these locations.

The locations in South Africa (Figures 1, 2) were not used as source points in the climate match. The records were not detailed (GBIF Secretariat 2018; VertNet 2018) and no other information was found to support the existence of established populations in this country.

The locations in Indonesia, Malaysia, and Singapore (Figures 1, 2) was not used as a source point in the climate match. No other information was found to indicate established populations in these locations and the collection records are from the mid to late 1800s (GBIF Secretariat 2018; VertNet 2018).

The location on Mauritius (east of Madagascar; Figures 1, 2) was not used as a source point in the climate match. No other information was found to indicate an established population in this location and the collection records are from 1830 (GBIF Secretariat 2018; VertNet 2018).

The location in Australia (Figure 2) was not used as a source point for the climate match. No other information was found indicating an established population in this location.

5 Distribution Within the United States

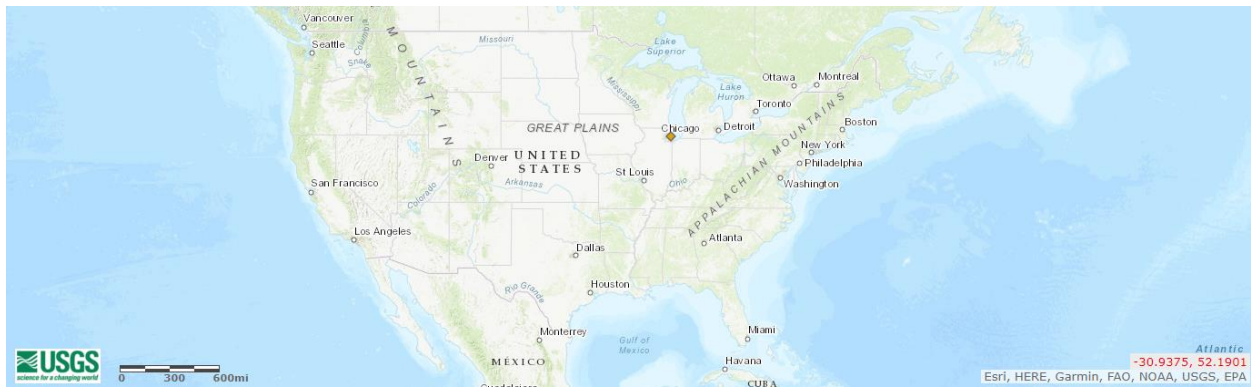


Figure 3. Known distribution of *Carassius carassius* in the United States. Map from Schofield et al. (2018a).

The location in Illinois (Figure 3) was not used as a source point in the climate match. It does not represent an established, wild population (Schofield et al. 2018a).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Carassius carassius* was medium for much of the contiguous United States. Areas of high match stretched from eastern Massachusetts across the Great Lakes region to the upper Midwest. Peninsular Florida had a high match. There were also areas of high match through the Great Plains, inland California, and around the Puget Sound. There were areas of low match inland from the Gulf Coast, in southern Arizona, and the northern Pacific Coast. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.612, high. All States had high individual climate scores except for Alabama and Maine which had medium individual scores and Louisiana and Mississippi which had low individual scores.

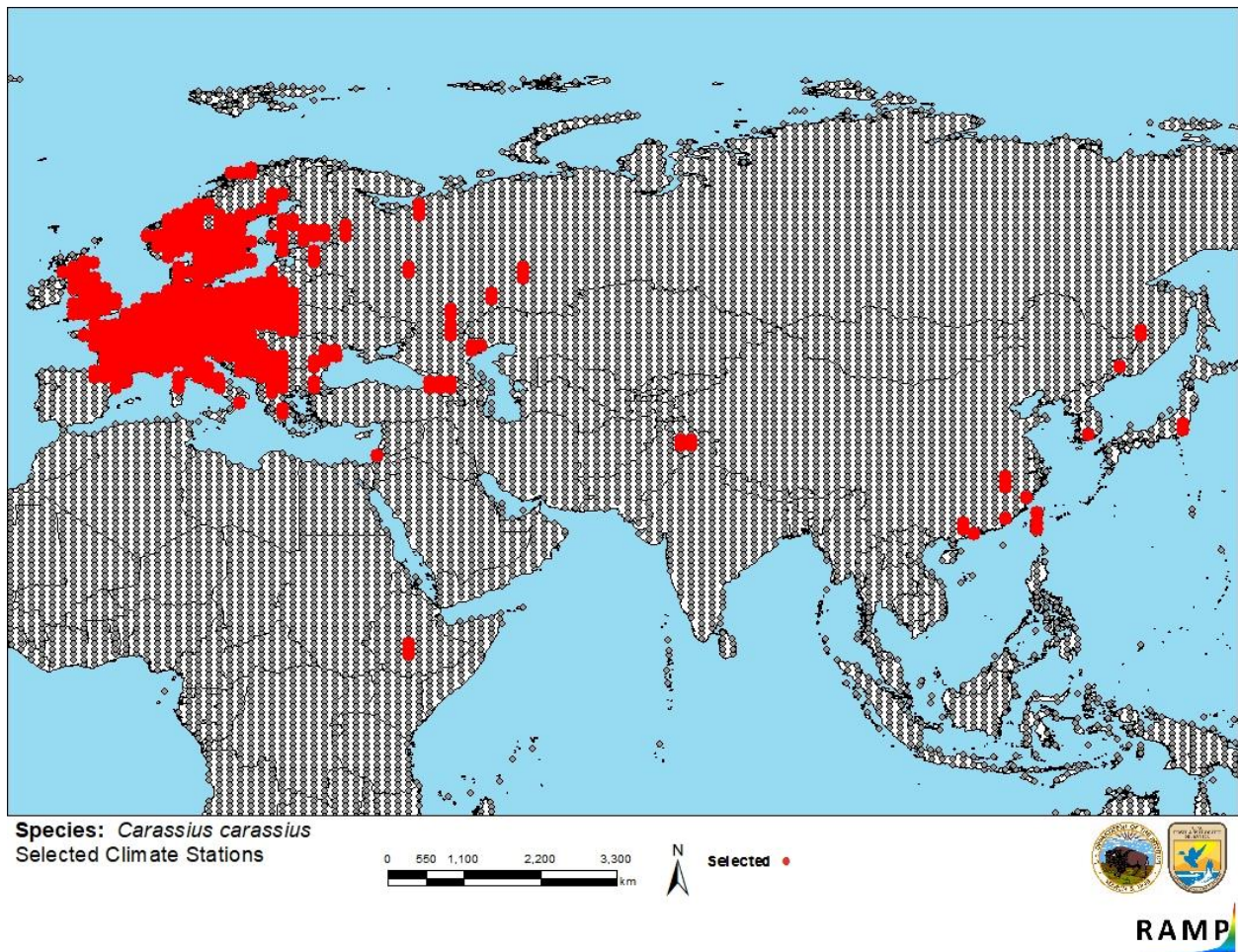


Figure 4. RAMP (Sanders et al. 2018) source map showing weather stations in Europe, Asia, and Africa selected as source locations (red) and non-source locations (gray) for *Carassius carassius* climate matching. Source locations from GBIF Secretariat (2018) and VertNet (2018).

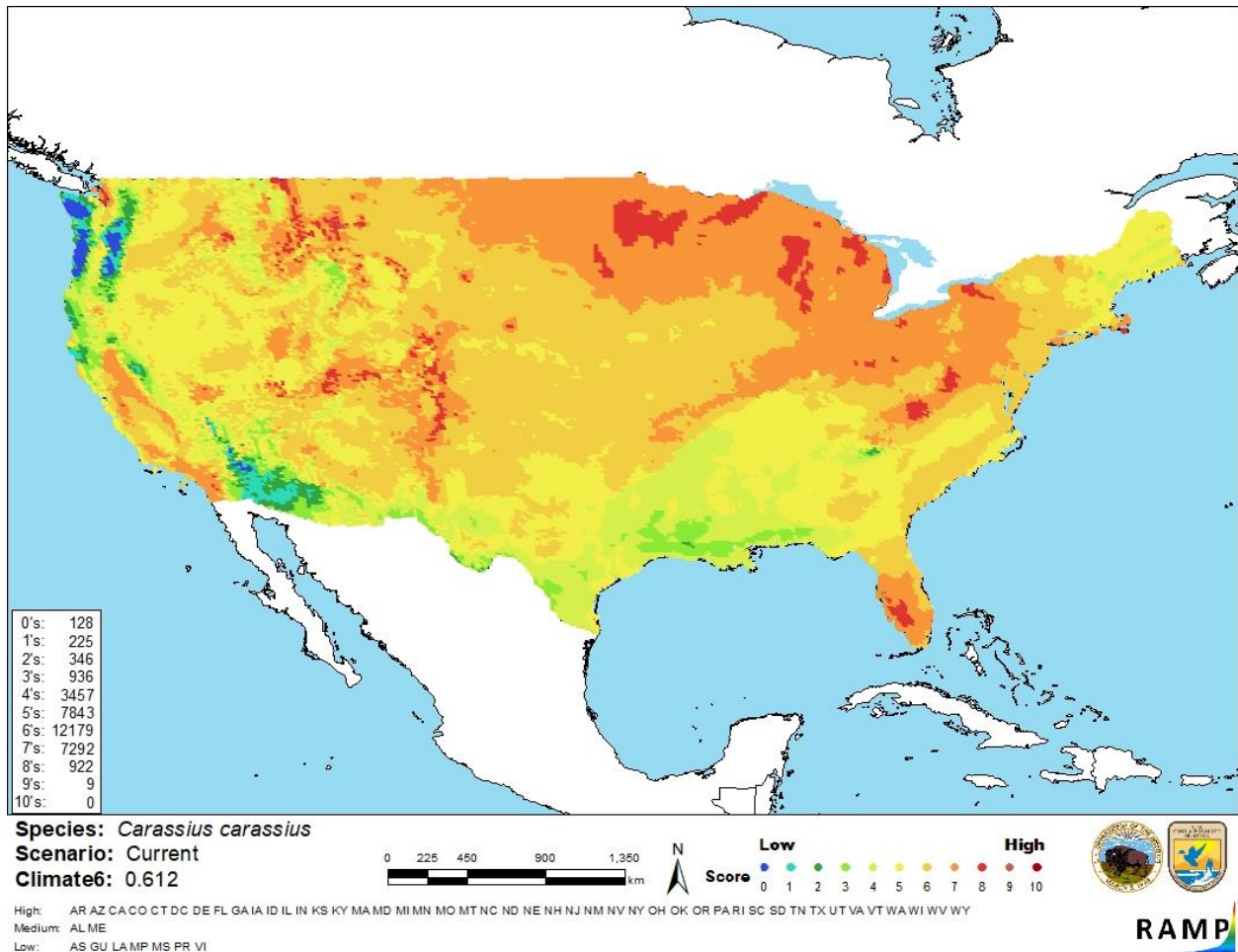


Figure 5. Map of RAMP (Sanders et al. 2018) climate matches for *Carassius carassius* in the contiguous United States based on source locations reported by GBIF Secretariat (2018) and VertNet (2018). 0 = Lowest match, 10 = Highest match.

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

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

7 Certainty of Assessment

The certainty of assessment is medium. There is quality information on the biology and ecology of the species, as well as having traits that lead to invasiveness. Many records of introduction were found with some established populations. No records of documented impacts were found in peer-reviewed literature. The species is cryptic with other species of the genus making confident identification difficult in many cases.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Crucian carp (*Carassius carassius*) is native to the northern areas of Europe and Asia. It has been used throughout history as a food fish and continues to be used as a food source and sport fish. Crucian carp are hosts of pathogens that cause three OIE-reportable diseases. *C. carassius* is physically similar to several other species, and can hybridize with those species, which may lead to identification problems. The history of invasiveness has not been documented. Records of introduction were found resulting in established populations. *C. carassius* is reported to possibly impact native fish species and cause other community changes through increasing turbidity through its feeding behaviors but there is no peer-reviewed support of these impacts. *C. carassius* was introduced in Chicago in the early 1900s but this population has been extirpated. The climate match is high. Most of the contiguous United States had a medium or high match. Areas of low match were found only inland along the Gulf Coast, southern Arizona, and along the northern Pacific Coast. The certainty of assessment is medium. The cryptic nature of the species and lack of impact information reduces the confidence. The overall risk assessment category is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Medium**
- **Remarks/Important additional information:** A previous version of this ERSS was published in 2014. Hosts of pathogens for spring viraemia of carp, koi herpes virus, and epizootic ulcerative syndrome which are OIE-reportable diseases. *Carassius carassius* is listed as injurious under the Lacey Act.
- **Overall Risk Assessment Category: Uncertain**

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.

CABI. 2018. *Carassius carassius* (crucian carp) [original text by M. Godard, and G. Copp]. In Invasive Species Compendium. CAB International, Wallingford, U.K. Available: <https://www.cabi.org/ISC/datasheet/90564>. (December 2018).

Cultured Aquatic Species Information Programme. 2004. *Carassius carassius*. FAO Fisheries and Aquaculture Department, Cultured Aquatic Species Information Programme, Rome.

FAO (Fisheries and Agriculture Organization of the United Nations). 2018. Database on introductions of aquatic species. FAO, Rome. Available: <http://www.fao.org/fishery/introsp/search/en>. (December 2018).

- Fricke, R., W. N. Eschmeyer, and R. van der Laan, editors. 2018. Catalog of fishes: genera, species, references. Available: <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>. (December 2018).
- Froese, R., and D. Pauly, editors. 2018a. *Carassius carassius* (Linnaeus, 1758). FishBase. Available: <https://www.fishbase.de/summary/Carassius-carassius.html>. (December 2018).
- Froese, R., and D. Pauly, editors. 2018b. *Carassius carassius*. In World Register of Marine Species. Available: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=154297>. (December 2018).
- GBIF Secretariat. 2018. GBIF backbone taxonomy: *Carassius carassius* (Linnaeus, 1758). Global Biodiversity Information Facility, Copenhagen. Available: <https://www.gbif.org/species/2366645>. (December 2018).
- ITIS (Integrated Taxonomic Information System). 2018. *Carassius carassius* (Linnaeus, 1758). Integrated Taxonomic Information System, Reston, Virginia. Available: https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=163352#null. (December 2018).
- Kamilya, D., and A. Baruah. 2014. Epizootic ulcerative syndrome (EUS) in fish: history and current status of understanding. *Reviews in Fish Biology and Fisheries* 24:369–380.
- Karvonen, A., A. M. Bagge, and E. T. Valtonen. 2005. Parasite assemblages of crucian carp (*Carassius carassius*) – is depauperate composition explained by lack of parasite exchange, extreme environmental conditions or host unsuitability? *Parasitology* 131:273–278.
- Lacey Act. 1900. U.S. Code, volume 18, section 42.
- Pagad, S., P. Genovesi, L. Carnevali, D. Schigel, and M. A. McGeoch. 2018. Introducing the Global Register of Introduced and Invasive Species. *Scientific Data* 5:170202.
- Poelen, J. H., J. D. Simons, and C. J. Mungall. 2014. Global Biotic Interactions: an open infrastructure to share and analyze species-interaction datasets. *Ecological Informatics* 24:148–159.
- Sadler, J., E. Marecaux, and A. E. Goodwin. 2008. Detection of koi herpes virus (CyHV-3) in goldfish, *Carassius auratus* (L.), exposed to infected koi. *Journal of Fish Diseases* 31:71–72.
- Sanders, S., C. Castiglione, and M. Hoff. 2018. Risk assessment mapping program: RAMP, version 3.1. U.S. Fish and Wildlife Service.

- Schofield, P. J., L. G. Nico, and P. Fuller. 2018a. *Carassius carassius* (Linnaeus, 1758). U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, Florida. Available: <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=509>. (December 2018).
- Schofield, P. J., L. G. Nico, P. Fuller, A. Fusaro, A. Davidson, K. Alame, M. Gappy, W. Conard, P. Alsip, and R. Sturtevant. 2018. *Carassius carassius* (Linnaeus, 1758). U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, Florida, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, Michigan. Available: <https://nas.er.usgs.gov/queries/greatLakes/FactSheet.aspx?SpeciesID=60&Potential=Y&Type=2&HUCNumber=DGreatLakes>. (December 2018).
- USFWS 2016. Injurious Wildlife Species; Listing 10 Freshwater Fish and 1 Crayfish. 81 FR 67899. September 30.
- VertNet. 2018. VertNet. Available: <http://portal.vertnet.org/search?q=%22Carassius+carassius%22>. (December 2018).
- Wittenberg, R., editor. 2005. An inventory of alien species and their threat to biodiversity and economy in Switzerland. CABI Bioscience Switzerland Centre report to the Swiss Agency for Environment, Forests and Landscape. The environment in practice 0629. Federal Office for the Environment, Bern, Switzerland.

10 References Quoted But Not Accessed

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.

- Allardi, J., and P. Keith. 1991. Atlas préliminaire des poissons d'eau douce de France. Coll. Patrimoines Naturels, volume 4. Secrétariat Faune Flore, Muséum national d'Histoire naturelle, Paris.
- Anonymous. 1999. Systematic list of Estonian fishes. Online. (January 2000).
- Bartley, D. M., editor. 2006. Introduced species in fisheries and aquaculture: information for responsible use and control (CD-ROM). FAO, Rome.
- Berg, L. S. 1964. Freshwater fishes in the U.S.S.R. and neighbouring countries, volume 2, 4th edition. Translated from Russian by Israel Program for Scientific Translations, Jerusalem.
- Bianco, P. G. 2013. An update on the status of native and exotic freshwater fishes of Italy. *Journal of Applied Ichthyology* 2013:1–15.
- Billard, R. 1997. Les poissons d'eau douce des rivières de France. Identification, inventaire et répartition des 83 espèces. Lausanne, Delachaux & Niestlé.

- Bogutskaya, N. G., and A. M. Naseka. 2002. An overview of nonindigenous fishes in inland waters of Russia. *Proceedings of the Zoological Institute Russian Academy of Sciences* 296:21–30.
- Cole, L. J. 1905. The German carp in the United States. Pages 523–641 *in* Report of the Bureau of Fisheries for 1904. U.S. Department of Commerce and Labor. Government Printing Office, Washington, D.C.
- Crivelli, A. J. 1995. Are fish introductions a threat to endemic freshwater fishes in the northern Mediterranean region? *Biological Conservation* 72:311–319.
- Dixon, P., and D. Stone. 2017. *Fish viruses and bacteria: pathobiology and protection*. CABI. (Accessed through Google Books).
- Eddy, S., and J. C. Underhill. 1974. *Northern fishes, with special reference to the Upper Mississippi Valley*, 3rd edition. University of Minnesota Press, Minneapolis.
- FAO. 1997. *FAO database on introduced aquatic species*. FAO Database on Introduced Aquatic Species, FAO, Rome.
- Fricke, R., M. Bilecenoglu, and H. M. Sari. 2007. Annotated checklist of fish and lamprey species (Gnathostoma and Petromyzontomorphi) of Turkey, including a Red List of threatened and declining species. *Stuttgarter Beiträge zur Naturkunde A (Biologie)* 706:1–172.
- Frier, J.-O. 1994. Danmark. Danske ferskvandsfisk og deres udbredelsesområde. Pages 4–6, 83–99 *in* J.-O. Frier, editor. *Truede ferskvandsfiskearter i Norden*. TemaNord. Nordisk Ministerråd, København. (In Danish.)
- Frimodt, C. 1995. *Multilingual illustrated guide to the world's commercial coldwater fish*. Fishing News Books, Osney Mead, Oxford, England.
- Fuller, P. L., L. G. Nico, and J. D. Williams. 1999. *Nonindigenous fishes introduced into inland waters of the United States*. American Fisheries Society, Special Publication 27, Bethesda, Maryland.
- Günther, A. 1853. *Die Fische des Neckars*. Verlag von Ebner & Seubert, Stuttgart, Germany.
- Haenen, O., and R. Hedrick. 2006. Koi herpesvirus workshop. *Bulletin of the European Association of Fish Pathologists* 26:26–37.
- Hanel, L. 2003. The ichthyofauna of the Czech Republic: development and present state. *Matthias Belivs University Proceedings* 3(1):41–71.

- Hänfling, B., P. Bolton, M. Harley, and G. R. Carvalho. 2005. A molecular approach to detect hybridisation between Crucian Carp (*Carassius carassius*) and non-indigenous carp species (*Carassius* spp. and *Cyprinus carpio*). *Freshwater Biology* 50(3):403–417.
- Hickley, P., and S. Chare. 2004. Fisheries for non-native species in England: angling or the environment? *Fisheries Management and Ecology* 11:203–212.
- Holopainen, I. J., and H. Hyvärinen. 1984. Ecology and physiology of Crucian Carp (*Carassius carassius* L.) in small Finnish ponds with anoxic conditions in winter. *Verhandlungen. Internationale Vereinigung für theoretische und angewandte Limnologie* 22(4):2566–2570.
- Holopainen, I. J., W. M. Tonn, and C. A. Paszkowski. 1997. Tales of two fish: the dichotomous biology of Crucian Carp (*Carassius carassius* (L.)) in northern Europe. *Annales Botanici Fennici* 34:1–22.
- Howells, R. G. 1992b. Guide to identification of harmful and potentially harmful fishes, shellfishes and aquatic plants prohibited in Texas. Texas Parks and Wildlife Department Special Publication, Austin.
- Innal, D. 2011. Distribution and impacts of *Carassius* species (Cyprinidae) in Turkey: a review. *Management of Biological Invasions* 2:57–68.
- Innal, D., and F. Erk'akan. 2006. Effects of exotic and translocated fish species in the inland waters of Turkey. *Reviews in Fish Biology and Fisheries* 16:39–50.
- Institute of Hydrobiology, Academia Sinica, Shanghai Natural Museum and Ministry of Agriculture of China. 1993. The freshwater fishes of China in coloured illustrations, volume 3. Institute of Hydrobiology, Academia Sinica and Shanghai Natural Museum and Ministry of Agriculture of China.
- Kara, H. M. 2011. Freshwater fish diversity in Algeria with emphasis on alien species. *European Journal of Wildlife Research* 58(1):243–253.
- Koli, L. 1990. Suomen kalat. Werner Söderström Osakeyhtiö. Helsinki. (In Finnish.)
- Kottelat, M. 2006. Fishes of Mongolia. A check-list of the fishes known to occur in Mongolia with comments on systematics and nomenclature. The World Bank, Washington, D.C.
- Kottelat, M., and J. Freyhof. 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland, and Freyhof, Berlin.
- Kullander, S. O., F. Fang, B. Delling, and E. Åhlander. 1999. The fishes of the Kashmir Valley. Pages 99–167 in L. Nyman, editor. *River Jhelum, Kashmir Valley: impacts on the aquatic environment*.

- Lever, C. 1996. Naturalized fishes of the world. Academic Press, California.
- Linnaeus, C. 1758. Systema Naturae, Ed. X. (Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Tomus I. Editio decima, reformata.) Holmiae 1:1-824.
- Ma, X., X. Bangxi, W. Yindong, and W. Mingxue. 2003. Intentionally introduced and transferred fishes in China's inland waters. *Asian Fisheries Science* 16(3-4):279–290.
- Masson, L., D. Almeida, A. S. Tarkan, B. Önsoy, R. Miranda, M. J. Godard, and G. H. Copp. 2011. Diagnostic features and biometry of head bones for identifying *Carassius* species in faecal and archaeological remains. *Journal of Applied Ichthyology* 27:1286–1290.
- Muus, B. J., and P. Dahlström. 1968. Süßwasserfische. BLV Verlagsgesellschaft, München.
- Muus, B. J., and P. Dahlstrom. 1978. Collins guide to the freshwater fishes of Britain and Europe. Collins, London, England.
- Ojaveer, E., and E. Pihu. 2003. Estonian natural fish waters. Pages 15–27 in E. Ojaveer, E. Pihu, and T. Saat, editors. *Fishes of Estonia*. Estonian Academy Publishers, Tallinn, Estonia.
- Pal, M., and N. Kundu. 2011. Freshwater ecosystem services and biodiversity values at Nainital, Uttarakhand. Pages 191–250 in Report on highland aquatic ecosystem services and biodiversity values, including livelihoods, trade, policy and conservation oriented inputs to two global online databases. Highland Aquatic Resources Conservation and Sustainable Development Project. Deliverable 3.1, Project 213015 of the European Community's Seventh Framework Programme, Work Package 3 Report, Centre For Environmental Management And Participatory Development, and Institute Of Environmental Studies And Wetland Management, Kolkata, India.
- Penttinen, O.-P., and I. J. Holopainen. 1992. Seasonal feeding activity and ontogenetic dietary shifts in Crucian Carp, *Carassius carassius*. *Environmental Biology of Fishes* 33(1-2):215–221.
- Piironen, J., and I. J. Holopainen. 1986. A note on seasonality in anoxia tolerance of Crucian Carp (*Carassius carassius* [L.]) in the laboratory. *Annales Zoologici Fennici* 23:335–338.
- Povž, M., and B. Sket. 1990. Naše Sladkovodne Ribe. Mladinska knjiga 370, Ljubljana, Slovenia.
- Redding, J. D. 1884. Character of the carp introduced by Capt. Henry Robinson about 1830. *Bulletin of the U.S. Fish Commission* 4(1884):266–267.
- Reshetnikov, Y. S., N. G. Bogutskaya, E. D. Vasil'eva, E. A. Dorofeeva, A. M. Naseka, O. A. Popova, K. A. Savvaitova, V. G. Sideleva, and L. I. Sokolov. 1997. An annotated checklist of the freshwater fishes of Russia. *Journal of Ichthyology* 37(9):687–736.

- Riede, K. 2004. Global register of migratory species - from global to regional scales. Federal Agency for Nature Conservation, Final Report, R&D-Projekt 808 05 081, Bonn.
- Riehl, R., and H. A. Baensch. 1991. Aquarien atlas. Band. 1. Melle: Mergus, Verlag für Natur- und Heimtierkunde, Germany.
- Sayer, C. D., G. H. Copp, D. Emson, M. J. Godard, G. Ziaedilla~ba, and K. J. Wesley. 2011. Towards the conservation of Crucian Carp *Carassius carassius*: understanding the extent and causes of decline within part of its native English range. *Journal of Fish Biology* 79(6):1608–1624.
- Seegers, L., L. De Vos, and D. O. Okeyo. 2003. Annotated checklist of the freshwater fishes of Kenya (excluding the lacustrine haplochromines from Lake Victoria). *Journal of East African Natural History* 92:11–47.
- Seeley, H. G. 1886. The freshwater fishes of Europe. Cassell and Company, London.
- Sehgal, K. L. 1999. Coldwater fish and fisheries in the western Ghats, India. Pages 103–121 in T. Petr, editor. *Fish and fisheries at higher altitudes: Asia*. FAO, Fisheries Technical Paper 385, Rome.
- Sollid, J., P. De Angelis, K. Gundersen, and E. Nilsson. 2003. Hypoxia induces adaptive and reversible grossmorphological changes in Crucian Carp gills. *The Journal of Experimental Biology* 206:3667–3673.
- Spillman, C.-J. 1961. Faune de France: Poissons d'eau douce. Fédération Française des Sociétés Naturelles, Tome 65, Paris.
- Szczerbowski, J. A., and A. J. Szczerbowski. 2001. *Carassius carassius* (Linnaeus, 1758). Pages 43–78 in P. M. Bănărescu, and H.-J. Paepke, editors. *The freshwater fishes of Europe*, volume 5/III; Cyprinidae 2/III and Gasterosteidae. AULA-Verlag GmbH Wiebelsheim.
- Thiel, R., H. Cabral, and M. J. Costa. 2003. Composition, temporal changes and ecological guild classification of the ichthyofaunas of large European estuaries - a comparison between the Tagus (Portugal) and the Elbe (Germany). *Journal of Applied Ichthyology* 19(5):330–342.
- Walker, K. F., and H. Z. Yang. 1999. Fish and fisheries in western China. FAO Fisheries Technical Paper 385:237–278.
- Welcomme, R. L. 1988. International introductions of inland aquatic species. Food and Agriculture Organization of the United Nations, Fisheries Technical Paper 294, Rome.
- Wheeler, A. 1978. Key to the fishes of northern Europe. Frederick Warne, London, England.

- Wheeler, A. C. 2000. Status of the Crucian Carp, *Carassius carassius* (L.), in the UK. *Fisheries Management and Ecology* 7:315–322.
- Wittenberg, R., editor. 2005. An inventory of alien species and their threat to biodiversity and economy in Switzerland. CABI Bioscience Switzerland Centre report to the Swiss Agency for Environment, Forests and Landscape. The environment in practice 0629. Federal Office for the Environment, Bern, Switzerland.
- Wolfram-Wais, A., G. Wolfram, B. Auer, E. Mikschi, and A. Hain. 1999. Feeding habits of two introduced fish species (*Lepomis gibbosus*, *Pseudorasbora parva*) in Neusiedler See (Austria), with special reference to chironomid larvae (Diptera: Chironomidae). *Hydrobiologia* 408/409:123–129.
- Zhadin, V. I., and S. V. Gerd. 1963. Fauna and flora of the rivers lakes and reservoirs of the U.S.S.R. Israel Program for Scientific Translations, Jerusalem.