Roach (*Rutilus rutilus*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, August 2012
Revised, March 2019
Web Version, 8/27/2019

Photo: Karelj. Released to public domain by author. Available: https://commons.wikimedia.org/wiki/File:Rutilus_rutilus_Prague_Vltava_3.jpg. (March 2019).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2019):

"Europe: north to Pyrenees and Alps, eastward to Ural and Eya drainages (Caspian basin); Aegean basin in Pinios, Vardar, Vegoritis, Kastoria, Struma and Maritza drainages. Asia: Marmara basin and lower Sakarya in Anatolia, Aral basin, and Siberia from Ob eastward to Lena drainages. Naturally absent from Iberian Peninsula, Adriatic basin, Italy, Great Britain north of 56 N, Scandinavia north of 69° N."

According to GISD *Rutilus rutilus* is native to Afghanistan, Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia And Herzegovina, Bulgaria, China, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iran, Islamic

Republic Of, Isle Of Man, Jersey, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Moldova, Mongolia, Montenegro, Netherlands, Norway, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, Turkey, Ukraine, United Kingdom, Uzbekistan.

Status in the United States

No records of *Rutilus rutilus* in the wild or in trade in the United States were found.

Rutilus rutilus 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 the roach 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 *Rutilus rutilus* in the wild in the United States were found.

Remarks

A previous version of this ERSS was published in 2012. Revisions were done to incorporate new information and to bring the document in line with current standards.

From Freyhof and Kottelat (2008):

"Frequently produces fertile hybrids with *Abramis brama*."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al. (2019):

"**Current status:** Valid as *Rutilus rutilus* (Linnaeus 1758)."

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 *Rutilus*
Species *Rutilus rutilus* (Linnaeus, 1758)"

Size, Weight, and Age Range

From Froese and Pauly (2019):

"Maturity: L_m 14.0 […]
Max length : 50.2 cm TL male/unsexed; [Verreycken et al. 2011]; common length : 25.0 cm TL male/unsexed; [Muus and Dahlström 1968]; max. published weight: 1.8 kg [International Game Fish Association 1991]; max. reported age: 14 years [Wüstemann and Kammerad 1995]"

Environment

From Froese and Pauly (2019):

"Freshwater; brackish; benthopelagic; pH range: 7.0 - 7.5; dH range: 10 - 15; potamodromous [species migrates within freshwater only] [Riede 2004]; depth range 15 - ? m. […]; 10°C - 20°C [Riehl and Baensch 1991] [assumed to be recommended aquarium temperature]; […]"

From Freyhof and Kottelat (2008):

"In a wide variety of habitats, mainly in lowland areas. Most abundant in nutrient-rich lakes and large to medium sized rivers and backwaters. Takes advantage of channelization, damming and slight organic pollution. Known also from small lowland streams and from brackish coastal lagoons."

Climate/Range

From Froese and Pauly (2019):

"71°N - 36°N, 10°W - 155°E"

From USFWS (2016):

"The roach inhabits temperate climates (Riehl and Baensch 1991)."

Distribution Outside the United States

Native
From Froese and Pauly (2019):

"Europe: north to Pyrenees and Alps, eastward to Ural and Eya drainages (Caspian basin); Aegean basin in Pinios, Vardar, Vegoritis, Kastoria, Struma and Maritza drainages. Asia: Marmara basin and lower Sakarya in Anatolia, Aral basin, and Siberia from Ob eastward to Lena drainages. Naturally absent from Iberian Peninsula, Adriatic basin, Italy, Great Britain north of 56 N, Scandinavia north of 69° N."

According to GISD *Rutilus rutilus* is native to Afghanistan, Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia And Herzegovina, Bulgaria, China, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iran, Islamic Republic Of, Isle Of Man, Jersey, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Moldova, Mongolia, Montenegro, Netherlands, Norway, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, Turkey, Ukraine, United Kingdom, Uzbekistan.

Introduced

From Froese and Pauly (2019):

"Locally introduced in Spain; introduced and invasive in northeastern Italy. At least one country reports adverse ecological impact after introduction."

According to Froese and Pauly (2019) *Rutilus rutilus* has been introduced in Spain, Azores Island, Portugal, United Kingdom (lake districts), Australia, Ireland, Madagascar, Morocco, Kazakhstan, Cyprus, and Italy.

According to CABI (2019) *Rutilus rutilus* has been introduced to Australia, New South Wales, South Australia, Tasmania, and Victoria.

Means of Introduction Outside the United States

From CABI (2019):

"Roach were introduced into Ireland, along with dace, in 1889, when specimens brought from England as bait for pike accidentally escaped into the Co. Cork Blackwater (Went, 1950). By 1940 the entire River Blackwater system was colonised by both roach and dace. In 1905, the Baronscourt lakes on the Foyle system were stocked with roach, to provide food for pike (Hale 1958). These fish are thought to have been transferred from the original introduction site in the Cork Blackwater.

The roach subsequently disappeared from the Baronscourt lakes, but some must have moved downstream to the River Strule, giving rise to populations in the Rivers Strule and Fairywater. The Cork Blackwater and Foyle system Strule/Fairywater populations remained isolated for some time, until in 1931 roach were deliberately transferred into Galbally Lake, on the Erne system. In 1960 dredging of the outflow of this lake allowed fish to escape to the River Erne.

The first roach in the Erne river system were noted in coarse fishing competitions in 1963, and by 1966 roach were a common feature of anglers' catches (Mercer, 1968; Kennedy and Fitzmaurice, 1973). By 1973 they had colonised the entire upper Erne system, and rapidly became the dominant fish by biomass in the whole system (Cragg- Hine, 1973; Rosell, 1994). From the Upper Erne system roach passed, possibly via the (then semi-derelict) Ballyconnell canal to the Shannon system, then spreading throughout the 1970s to a wide range of sites, assisted by transport as anglers live bait for pike. By the early 1980s they were widespread

throughout Ireland, including the Foyle, Shannon, L. Neagh/River Bann, Boyne, Shannon, Corrib and Lee systems (Fitzmaurice, 1981).

During the late 1980s and 1990s spread continued and by 2000 the roach had reached every major river catchment in Ireland, probably being absent only from a few montane or small coastal systems without recreational pike fisheries. The latest new site is Lough Melvin, Co Leitrim, where Roach/rudd hybrids were noted in 2002 (Delanty and O'Grady, 2002)

In north and central Italy, roach was introduced for game fishing (Gandolfi et al, 1991). It has recently been introduced in Tuscany (in the 1990s) and in the Padano-Veneto area; but is probably not established (Amori et al, 1993).

In France, roach has a minor commercial importance (FAO, 1992), and is used in aquaculture (FAO, 1997; Garibaldi, 1996). It is the most popular fish caught in freshwater by anglers and is the centre of attraction during angling competitions. Roach are caught with animal bait during cold seasons, and with plant bait in summer. The flesh is bony but is highly esteemed. Commonly grown in ponds for restocking (Billard, 1997). Introduced in Brittany and in the south-west of France.

In Germany, it was common in the Neckar in 1850 (Günther, 1853) and is found in the Elbe estuary (Thiel et al, 2003). Muus and Dahlström (1968) also report its distribution in Germany. Found in freshwater and brackish waters.

In the United Kingdom, it may have been introduced (Bartley, 2006). It is used for commercial angling (Maitland, 1974)."

Short Description

From Froese and Pauly (2019):

"Dorsal spines (total): 3; Dorsal soft rays (total): 9-12; Anal spines: 3; Anal soft rays: 9 - 13; Vertebrae: 39 - 41. The only species of the genus in Atlantic basin north of Pyrénées which can be distinguished from its congeners in Black and Caspian Sea basins and Apennine Peninsula by the combination of the following characters: 39-41 + 2-3 (41-44 total) scales along lateral line; dorsal and anal fins with 10½ branched rays; body laterally compressed, depth 25-35% SL; mouth terminal; snout pointed; iris from yellow in juveniles to deep red in adults; pectoral, pelvic and anal fins orange to red; and no midlateral stripe. Differs from its congeners in Balkan Peninsula by uniquely possessing 10½ branched anal rays [Kottelat and Freyhof 2007]. Caudal fin with 18-19 rays [Spillman 1961]."

From CABI (2019):

"Roach is a benthopelagic potadromous fish. The maximum length reported is 50.0 cm SL male/unsexed (Freyhof and Kottelat, 2007), but the average size is 25.0 cm TL male/unsexed (Muus and Dahlstrøm, 1968). Scales on lateral line: 39-48. Scale rows above lateral line: 7-10; scale rows below lateral line: 3-5. Total gill rakers: 9-14; total vertebrae: 37-43. One dorsal fin (no finlets; 3-3 total spines; 8-12 total soft-rays); absent adipose fin; forked caudal fin; 1 anal fin

(3-3 total spines; 8-13 total soft-rays); pectoral fins with 1 spine and (13) 14-18 soft-rays; pelvic fins in abdominal position (beneath origin of D1) with 2 spines and 7-8 soft rays (Berg, 1949; Zhukov, 1965; Movchan and Smirnov, 1981; Keith and Allardi, 2001)."

From Ferguson (2008):

"The roach is a deep-bellied freshwater fish of the carp family. Typically the fish can grow to 30cm in length with fish of over 40cm and 1.5kg having been recorded. Roach can live for up to 15 years. The back is greenish- or bluish-brown with large silvery scales on the side. The fins, especially the pelvic and anal ones, are orange or red in colour, as is the iris of the eye in older fish. Roach looks superficially similar to the rudd. The two can normally be told apart by the relative positions of the dorsal (back) and pelvic fins (rear paired fins). In the roach the front of the dorsal fin is directly above the base of the pelvic fins, whereas in the rudd the front of the dorsal fin is behind the base of the pelvic fins. However, the roach interbreeds readily with both rudd and bream producing fertile hybrids, and in some waters hybrids are more numerous than the parental species. Hybrids can be difficult to identify without detailed morphological or genetic analysis. There is also confusion due to the fact that rudd are referred to as roach in some parts of Ireland."

Biology

From Froese and Pauly (2019):

"Found in a wide variety of habitats, mainly in lowland areas. Most abundant in nutrient-rich lakes and large to medium sized rivers and backwaters. Also recorded from small lowland streams and from brackish coastal lagoons. In fast-flowing rivers, confined to stretches where backwaters or shelters allow for overwintering. Larvae and juveniles live in wide variety of littoral habitats. Preys predominantly on benthic invertebrates, zooplankton, plant material and detritus. May shift from littoral to pelagic habitats and between benthic food and zooplankton when abundance of a specific food item is high or for avoidance of predation and/or competition. Breeds among dense submerged vegetation in backwaters or lakes, flooded meadows or in shallow, fast-flowing river habitats on plant or gravel bottom. Undertakes short spawning migrations. Stays in backwaters or in deep parts of lakes to overwinter. Produces fertile hybrids with *Abramis brama* [Kottelat and Freyhof 2007]. Pale yellow eggs are found attached to vegetation and tree roots [Pinder 2001]."

"Spawns in shoals among dense among dense submerged vegetation in backwaters or lakes, flooded meadows or in shallow, fast-flowing river habitats on plant or gravel bottom. Eggs are sticky and hatch in about 12 days [Kottelat and Freyhof 2007]. Pale yellow eggs are attached to vegetation and tree roots [Pinder 2001]."

From Freyhof and Kottelat (2008):

"Males reproduce for the first time at 2-3 years, females one year later, usually at about 100 mm SL. Undertakes short spawning migrations, sometimes starting as early as September, usually with a peak at temperatures above 9°C in spring. Spawns in April-May, when temperature rises above 12°C. Usually, a whole population spawns within a period of 5-10 days. […] Eggs are

sticky and hatch in about 12 days. […] Populations predominantly feeding on detritus are often stunted (stunted populations may also be associated with strong year classes). […] The decision whether to stay in open water or among littoral vegetation is often described as a trade-off between food uptake and predator avoidance. When growing, there is an energetic need to switch from zooplankton to benthic food (chironomids, molluscs). Individuals able to feed on Dreissena mussels increase their growth rate but do not exploit this food source until they have reached about 120 mm SL (at which size they are able to crush the mussels). In some area [*sic*] (Volga reservoirs), pelagic and benthic roach can be distinguished by life-history traits (spawning time, spawning sites). Overwinters in backwaters or in deep parts of lakes."

From CABI (2019):

"Its swimming type consists of movements of body and/or caudal fin and is classified as subcarangiform according to swimming mode (Palomares, 1991)."

"Egg diameter is about 1–1.5 mm (Zhukov, 1965). In Lake Gardno the average egg diameter was 1.295 mm and in Lake Lebsko 1.374 mm (Hornatkiewicz-Zbik, 2003). Immediately after hatching, the larvae, by means of their adhesive glands, adhere to vegetation and remain fairly immobile because the fins are still not well developed (Billard, 1997). Yolk is absorbed at 6.5-7.0 mm. Pigmentation: Pigment present on the dorsal and lateral lines. Yolk-sac larvae development is placed in close association with substrate. It has not got oil globules, and melanophores are placed on the trunk (Pinder, 2001)."

"*R. rutilus* is a dioecious species and fertilizes externally. Reproductive guild: non-guarders, open water/substratum egg scatterers. […] Usually, a whole population spawns within a period of 5-10 days. The roach fecundity range is 700–77000 eggs (Zhukov, 1965)."

"In the United Kingdom the presence of larvae is recorded from May until July (Pinder, 2001)."

"Facultative schooling fish (Schiemer and Wieser, 1992). Large fish are solitary or congregate in small groups of up to 8 fish (Haberlehner, 1988). Specimens ranging from 1.1 - 3.59 cm start exogenous feeding on pollen grains and vegetal cells (Reyes-Marchant et al, 1992)."

Human Uses

From Froese and Pauly (2019):

"Fisheries: commercial; aquaculture: commercial; gamefish: yes"

"There is only little commercial fishing for this species, but valued for recreational fishing. Utilized fresh and dried or salted; can be pan-fried, broiled and baked [Frimodt 1995]."

From CABI (2019):

"It is the most popular fish caught in freshwater by anglers and is the centre of attraction during angling competitions. […]"

"It is used for commercial angling (Maitland, 1974)."

Diseases

No records of OIE-reportable diseases (OIE 2019) were found for *Rutilus rutilus*.

According to Froese and Pauly (2019), *R. rutilus* is a host to worm cataract and black spot disease.

According to Poelen et al (2014), *R. rutilis* is host to *Nuclearia pattersoni, Dactylogyrus caballeroi, Gyrodactylus rutilensis, Gyrodactylus pomeraniae, Gyrodactylus ouluensis, Pleistophora mirandellae, Eimeria rutili, Myxobolus elipsoides, Myxobolus sommervillae, Myxobolus rutili, Myxobolus fundamentalis, Myxobolus diversicapsularis, Enterobacter amnigenus, Myxobolus pseudodispar, Trypanosoma carassii, Aeromonas salmonicida, Naegleria fultoni, Rahnella aquatilis, Dactylogyrus crucifer, Dactylogyrus fallax, Dactylogyrus similis, Dactylogyrus sphyrna, Dactylogyrus nanus, Dactylogyrus rarissimus, Dactylogyrus rutili, Paradiplozoon homoion, Gyrodactylus lucii, Gyrodactylus prostate, Pseudamphistomum truncatum, Diplostomum baeri, Myxosoma, Ligula intestinalis. Caryophyllaeides fennica, Caryophyllaeus laticeps, Ligula monogramma, Dactylogyrus nasalis, Gyrodactylus laevis, Philometra obturans, Avioserpens mosgovoyi, Paradilepis scolecina, Contracaecum micropapillatum, Philometra ovata, Valipora campylancristrota, Pseudocapillaria tomentosa, Pomphorhynchus laevis, Acanthocephalus anguillae, Echinorhynchus cinctulus,* eel swimbladder nematode*, Rhabdochona denudata, Gongylonema pulchrum, Archigetes sieboldin, Streptocara crassicauda, Dioctophyma renale, Caryophyllaeus laticeps, Endoparasite Philometra obturans, Endoparasite Avioserpens mosgovoyi, Dactylogyrus vistulae, Tyrodelphys clavata, Allocryptobia, Diplostomum spathaceum, Acanthocephalus clavula, Argulus* foliaceus, and *Trichodina*.

Threat to Humans

From Froese and Pauly (2019):

"Potential pest [Kottelat and Freyhof 2007]"

3 Impacts of Introductions

From Hayden et al. (2014):

"*Rutilus rutilus* is currently among the most abundant fish on the island [Ireland] and dominates the fish communities of many lakes and rivers, including systems containing species with threatened conservation status (Harrod et al., 2001). Resource competition with *R. rutilus* has been proposed as a cause of local extinction of Arctic charr, *Salvelinus alpinus* (L. 1758), populations in Irish lakes (Igoe & Hammar, 2004). In addition, dietary niche overlap observed between invasive *R. rutilus* and resident *A. brama* has been associated with a reduction in population size of *A. brama* (Hayden et al., 2010, 2011)."

From Griffiths (1997):

"Other species, introduced from mainland Britain and spread mainly by anglers, have potentially larger impacts. For example, roach (*Rutilus rutilus* L.) is believed to have been introduced into the River Blackwater, Co. Cork, in 1889 by an angler using it as live bait. It has subsequently spread throughout Ireland, and has become common wherever it occurs. In the 1981 World Angling Competition, the winners caught 94 kg in the Upper Bann River and 117 kg in Lough [Lake] Erne in 5 h: these catches were almost exclusively roach (V. Refausse, personal communication). Roach comprised 70% of fish biomass in a 1991 survey of Lower Lough Erne (Rosell 1994). It was first reported in the Lough Neagh catchment in 1971 and is now probably the most common species within the Lough. There are insufficient data to say whether this increase has had a deleterious effect on the populations of most species in Lough Neagh, with the exception of rudd (*Scardinius eryrhrophthabnus* L.). This species was encountered until the late 1980s but not since and it is believed that hybridization with roach has been responsible for its disappearance, though both species coexist in a gravel pit pond a few metres from the lough. Ferguson (1986), in describing Lough Melvin's possibly unique postglacial salmonid community, notes with concern the appearance of rudd in the Lough, again presumably introduced by anglers."

From Winfield et al. (2007):

"The Arctic charr populations of Windermere face significant environmental pressures from eutrophication, climate change and potentially from competition with an increased roach population. Current Arctic charr abundance in the north basin, where eutrophication is limited and the local roach population has increased only recently, is comparable with that of the near pristine lake of the 1940s. In contrast, the situation is becoming critical in the south basin where eutrophication is much more developed, with associated deepwater hypoxia, and the local roach population increased earlier. Continued lake management in the form of nutrient control to address in particular the problem of deepwater hypoxia is essential to ensure survival of the local Arctic charr populations."

From CABI (2019):

"The main ecological problems associated with *Rutilus rutilus* invasion are trophic competition, hybridization and alteration of the nutrient cycle. Its spread is favoured by hydrological alterations such as weirs and dams that create large extensions of limnophilous habitat otherwise scarce in some river typologies. *R. rutilus* is an omnivorous species that is able to adapt its diet to whatever is available, and it has high fecundity (Volta and Jepsen, 2008). It spawns earlier than other native species, so that roach larvae are able to use the seasonal lake production earlier than competitors (Volta and Jepsen, 2008). There is also evidence that roach compete for the same benthic food as tufted duck in Ireland (Winfield et al., 1992)."

"In England and Wales, roach is one of the preferred target species amongst coarse (non-salmonid) anglers (39% in 1969/70, 28% in 1994) (Hickley and Tompkins, 1998). In Poland, it also predominates along with carp (*Cyprinus carpio*) and bream (*Abramis brama*) (Wolos et al,

1998). In the Azores islands its introduction might also have caused some socio-economic benefits (Azevedo et al, 2004)."

"Roach can have severe ecological consequences, particularly when lakes become enriched from mesotrophic to eutrophic conditions. Their ability to reach a large biomass and heavily graze zooplankton can exacerbate the algal blooms associated with nutrient enrichment in lakes. They can apparently accelerate the switch from clear water mesotrophy to a turbid water eutrophic state, effectively altering their environment to their own requirements. Biomanipulation experiments in Finland have shown significant water quality benefits following large-scale roach removal (Horppila, 1994). It is probable that the high biomass reached by roach in Irish lakes has contributed to the effects of eutrophication (Rosell and Gibson, 2000).

Roach frequently produces hybrids with other Cyprinidae such as rudd (*Scardinius erythrophthalmus*) and bream (*Abramis brama*) in Ireland to the detriment of both species (Fitzmaurice, 1981). It may also compete with other species such as native fauna occupying the same ecological niche, causing a deleterious effect on them."

"Fishing as tourism is a particularly important component of the recreational fisheries economy in some countries. It can be a specific species, rather than fishing in a particular region or country, that provides anglers with the motivation for fishing away from home. Freshwater angling tourists visit Ireland seeking high quality roach (Hickley and Tompkins, 1998)."

From Ferguson (2008):

"Roach can have a significant impact on water quality through accentuating the effects of nutrient enrichment. The abundance of roach and its feeding habits mean that it competes both directly and indirectly with other freshwater fish for food and quickly becomes the dominant fish species. Roach has been shown to reduce Atlantic salmon and brown trout numbers. The introduction of roach has been linked to the extinction of the Arctic charr (*Salvelinus alpinus*) in Lough Corrib and to the severe decline in pollan [*Coregonus pollan*] numbers in Lower Lough Erne. It has led to reduction in numbers of rudd, an alien fish species introduced sometime prior to roach. In Lough Neagh competition for food with roach has been found to reduce the numbers of overwintering tufted duck (*Aythya fuligula*). However, the numbers of great crested grebes (*Podiceps cristatus*) increased, presumably as a result of the increased availability of small fish as food. Movement of roach could potentially result in the introduction of diseases and parasites."

From Stokes et al. (2006):

"In Ireland, the introduction of the roach *Rutilus rutilus* has been implicated in the reduction of populations of several fish species through competitive superiority (Johannson and Persson 1986). Native Atlantic salmon and brown trout *Salmo trutta* may be affected (Kennedy and Strange 1978), rudd *Scardinius erythropthalmus* species have been displaced (Cragg- Hine 1973) and perch *Perca fluviatilis* populations are highly susceptible to roach introductions (Johannson and Persson 1986). The roach has, however, improved feeding for birds, to the extent that great crested grebe *Podiceps cristatus* and cormorant *Phalacrocorax carbo* populations have increased

(Winfield et al. 1994). However, increased winter feeding for cormorants in Lough Neagh has been implicated in increasing predation pressures by these birds on young salmonids in the River Bush (Kennedy and Greer 1988), an example of hyperpredation."

"Initially, roach were not thought likely to have any major impact on other native or previously introduced fish (Went 1950). This assessment proved, however, to be wrong. Following roach population explosion in Lower Lough Erne, rudd, a much earlier introduction to Ireland, disappeared (Cragg-Hine 1973), and this pattern has been repeated everywhere roach have been introduced to large lakes containing rudd. Rudd are now largely confined to small, isolated lakes without roach or to densely weeded sites where they are apparently more able to compete with Roach (Winfield 1986)."

"Roach can have severe ecological consequences, particularly when lakes become enriched from mesotrophic to eutrophic conditions. Their ability to reach a large biomass and heavily graze zooplankton can exacerbate the algal blooms associated with nutrient enrichment in lakes. They can apparently accelerate the switch from clear water mesotrophy to a turbid water eutrophic state, effectively altering their environment to their own requirements. Biomanipulation experiments in Finland have shown significant water quality benefits following large-scale roach removal (Horppila et al. 1994). It is probable that the high biomass reached by roach in Irish lakes has contributed to the effects of eutrophication. (Rosell and Gibson 2000)."

"The latest invasive introduction to Irish freshwater, the Zebra Mussel, may now act to control roach populations by removing some of its plankton food source. This may not, however come with any significant benefit to any of the native species affected by roach and/or eutrophication. In the long term, it is probable that the only viable roach (and Zebra mussel) control strategy likely to maintain elements of the affected native biodiversity is maintenance of low trophic status through effective control of nutrient loads to freshwater (Minchin et al. 2003)."

"There is also evidence that roach compete for the same benthic food as tufted duck, with reductions in the populations of duck being causally linked to roach population increases (Winfield et al. 1992; Winfield et al. 1994)."

4 Global Distribution

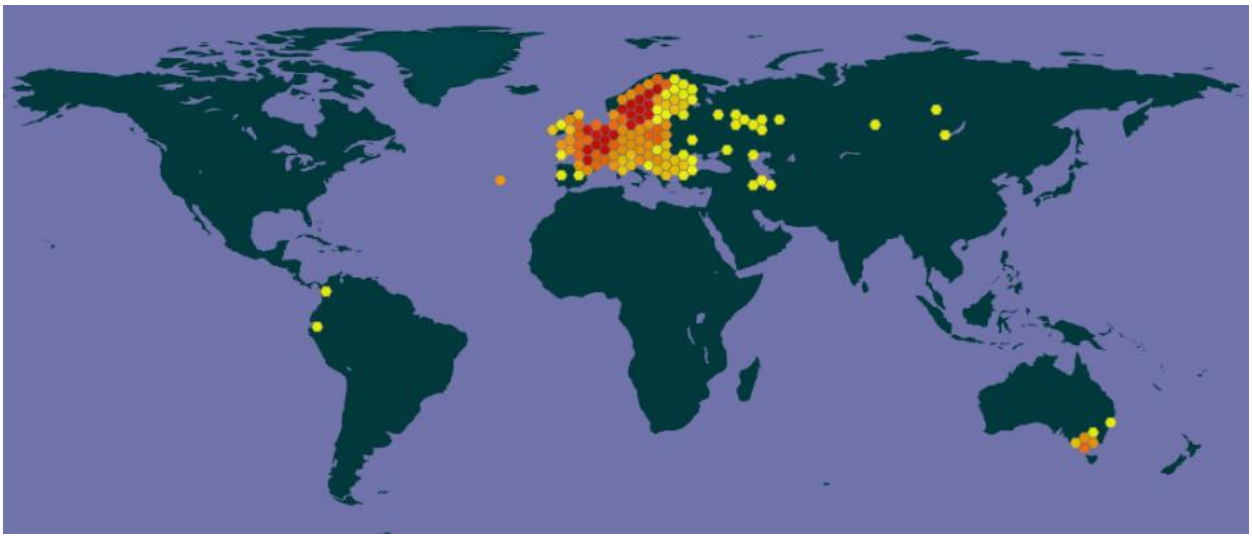

Figure 1. Known global distribution of *Rutilus rutilus*. Map from GBIF Secretariat (2019). The point that looks to be located in the northern Atlantic Ocean off of the coast of Europe is actually on an island belonging to Portugal and was used to select source locations for the climate match. The points located in Colombia and Peru in South America were not used to select source locations in the climate match; they do not represent established populations.

5 Distribution Within the United States

No records of *Rutilus rutilus* in the wild or in trade in the United States were found.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Rutilus rutilus* for the contiguous United States was generally high except for parts in the northwest and southern portions of Arizona. The climate match was high throughout the Northeast and to the northern border of the Midwest. The Midwest out to the West Coast tended to have a medium climate match, except for some low patches in Oregon, Washington, and northern California. There was a small patch of low to medium match in the southern portion of Arizona, the southern tip of Texas, and in peninsular Florida. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.447, high (scores 0.103 and greater are classified as high). All States had high individual Climate 6 scores, except for Georgia, Kansas, Texas, and South Carolina, which had medium scores. Alabama, Florida, and Mississippi all had low scores.

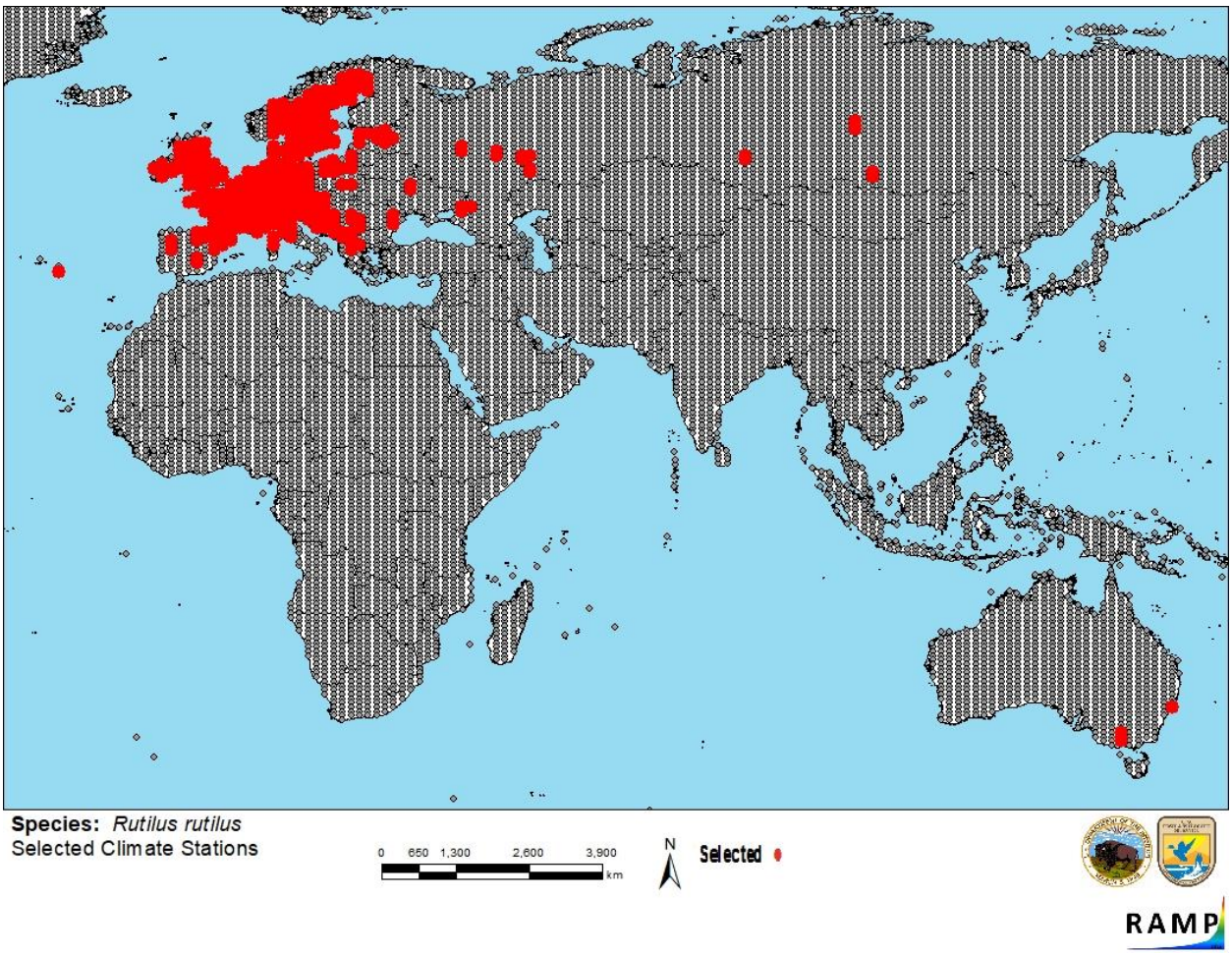

Figure 2. RAMP (Sanders et al. 2018) source map showing weather stations in Europe, Asia, and Australia selected as source locations (red) and non-source locations (gray) for *Rutilus rutilus* climate matching. Source locations from GBIF Secretariat (2019). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

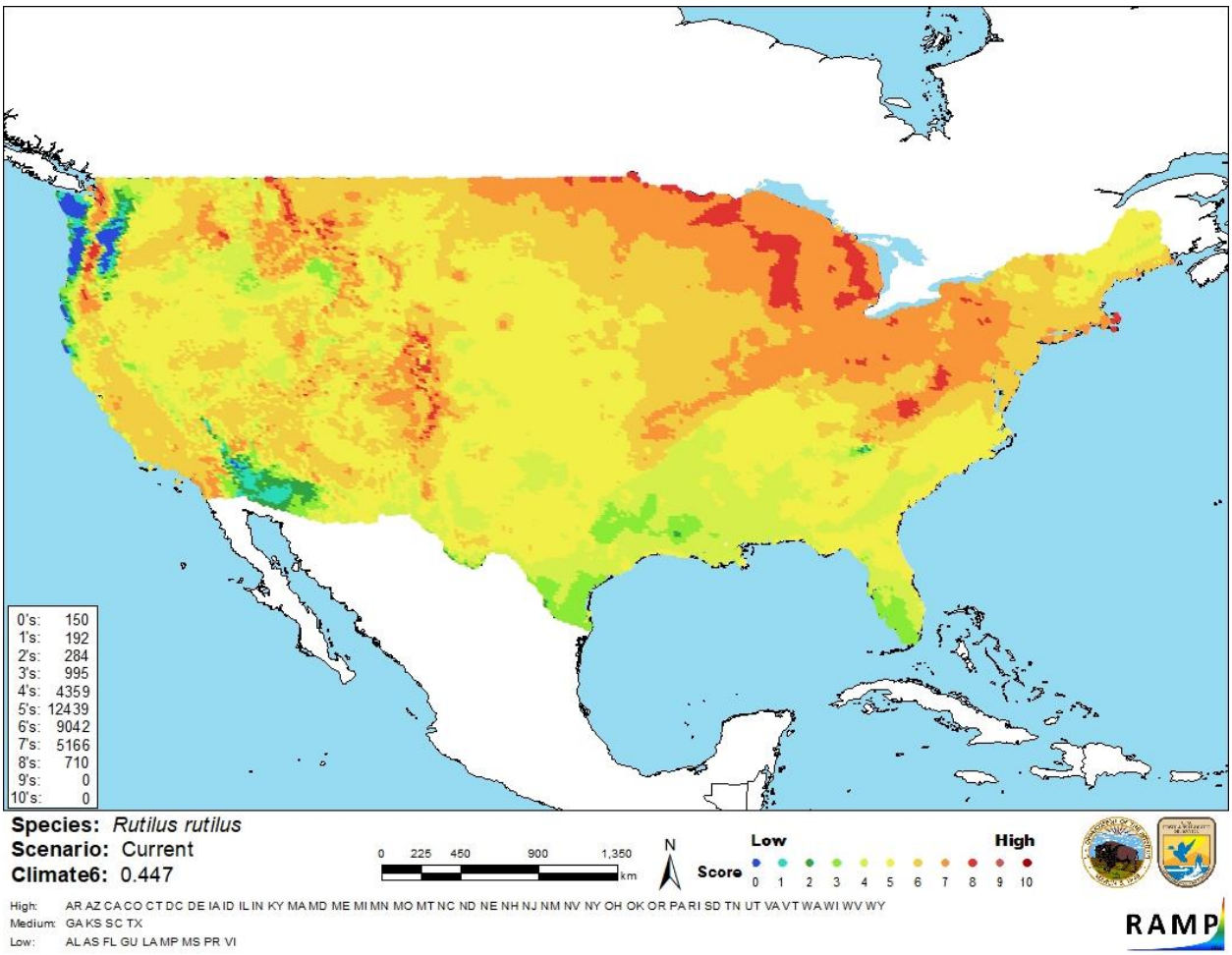

Figure 3. Map of RAMP (Sanders et al. 2018) climate matches for *Rutilus rutilus* in the contiguous United States based on source locations reported by GBIF Secretariat (2019). 0 = Lowest match, 10 = Highest match.

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

Certainty of assessment for *Rutilus rutilus* is high. Information on the biology, distribution, and impacts of this species is readily available from peer-reviewed sources. Multiple records of introduction resulting in established populations were found. Information about impacts to multiple species was available from peer-reviewed and scientifically defensive sources.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Roach (*Rutilus rutilus*) is a freshwater fish native throughout Europe and in Russia. The species generally feeds on benthic invertebrates, zooplankton, plant material, and detritus in both its native and introduced range. Humans have been known to use this fish as live bait, which has been recorded as the main vector for introductions. *R. rutilus* has become a prized fish by many fishermen. The history of invasiveness is high. This species has been introduced and spread. This fish has been known to impact populations of brown trout (*Salmo trutta),* rudd (*Scardinius erythropthalmus),* and perch (*Perca fluviatilis),* along with being a direct competitor for food with the tufted duck. *R. rutilus* 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 with the contiguous United States is high. Most areas had medium matches with areas of high match found mainly around the Great Lakes region. The certainty of assessment is high. The biology, distribution, and history of invasiveness of the species is well documented. Overall risk for this species 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.
- **Overall Risk Assessment Category: High**

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

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