Yellow Perch (*Perca flavescens*)
Ecological Risk Screening Summary

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1 Native Range and Status in the United States

Native Range

From Fuller and Neilson (2019):

"Atlantic, Arctic, Great Lakes, and Mississippi River basins from Nova Scotia and Quebec west to Great Slave Lake, Northwest Territories, and south to Ohio, Illinois, and Nebraska; south in Atlantic drainages to Santee River, South Carolina (Page and Burr 1991). Goode (1884) reported the species east of the Alleghany Mountains as far south as Georgia."

Status in the United States

From Froese and Pauly (2019a):

"[Native to eastern regions of the United States and] Widely transplanted elsewhere. Collected from Lake Andrusia (Mississippi River), Beltrami County, Minnesota [Near 2002]. A popular fish sold in live fish markets. Found in 1 out of 6 live fish markets near the Lakes Erie and Ontario [Rixon et al. 2005]."

According to Fuller and Neilson (2019), nonindigenous occurrences of *Perca flavescens* have been reported in the following States, with range of years and hydrologic units in parentheses:

- Alabama (1964-2008; Apalachicola Basin, Guntersville Lake, Lower Chattahoochee, Lower Elk, Middle Chattahoochee-Lake Harding, Middle Chattahoochee-Walter F, Middle Tombigbee-Chickasaw, Middle Tombigbee-Lubbub, Mobile-Tensaw, Pickwick Lake, Upper Choctawhatchee, Wheeler Lake)
- Alaska (2000; Upper Kenai Peninsula)
- Arizona (1880-2004; Big Chino-Williamson Valley, Bill Williams, Canyon Diablo, Grand Canyon, Havasu Canyon, Lower Colorado Region, Lower Salt, Silver, Upper Verde)
- Arkansas (1905-2016; Buffalo, Bull Shoals Lake, Little Red, Lower Black)
- California (1873-2000; California Region, Honcut Headwaters-Lower Feather, Lower Klamath, Lower Sacramento, Middle Kern-Upper Tehachapi-Grapevine, Sacramento Headwaters, San Diego, Tulare Lake Bed, Upper Cache, Upper Klamath, Upper Yuba)
- Colorado (1880-2010; Alamosa-Trinchera, Animas, Big Thompson, Cache La Poudre, Clear, Colorado Headwaters, Colorado Headwaters-Plateau, Horse, Lower San Juan-Four Corners, McElmo, Middle South Platte-Cherry Creek, Middle South Platte-Sterling, Piedra, Purgatoire, Republican, Rio Grande Headwaters, Roaring Fork, Rush, San Luis, South Fork Republican, South Platte, St. Vrain, Uncompahgre, Upper Arkansas, Upper Arkansas-John Martin Reservoir, Upper Cimarron, Upper Dolores, Upper Gunnison, Upper San Juan, Upper South Platte)
- Florida (1957-2002; Apalachicola)
- Georgia (1948-2016; Altamaha, Lower Savannah, Middle Chattahoochee-Lake Harding, Middle Chattahoochee-Walter F, Middle Tennessee-Chickamauga, Savannah, South Atlantic-Gulf Region, Spring, Tugaloo, Upper Chattahoochee, Upper Ocmulgee, Upper Oconee)
- Idaho (1895-2009; American Falls, Beaver-Camas, Big Wood, Boise-Mores, Brownlee Reservoir, C.J. Strike Reservoir, Camas, Coeur d'Alene Lake, Goose, Idaho Falls, Kootenai, Lake Walcott, Lower Bear, Lower Boise, Lower Kootenai, Middle Bear, Middle Snake-Succor, North Fork Payette, Pacific Northwest Region, Payette, Pend Oreille Lake, Priest, Salmon Falls, Spokane, St. Joe, Upper Middle Fork Salmon, Upper Snake, Upper Snake-Rock, Upper Spokane)
- Indiana (1851-1968; Blue-Sinking)
- Iowa (1914; One Hundred and Two)
- Kansas (1885-1995; Delaware, Lower Kansas, Middle Kansas, Middle Neosho, Middle Verdigris, Upper Cimarron-Bluff)
- Kentucky (1980-2009; Kentucky Lake, Lower Cumberland, Middle Ohio-Laughery, Upper Cumberland)
- Maine (1993-2011; Big Black River-Saint John River, Maine Coastal, New England Region, Passamaquoddy Bay-Bay of Fundy)
- Maryland (1976; Monocacy)
- Massachusetts (1993; New England Region)

- Mississippi (1905-2006; Coldwater, Upper Chickasawhay, Upper Tombigbee)
- Missouri (1935-1997; Lower Chariton, Lower Gasconade, Lower Marais Des Cygnes, Lower Missouri-Moreau, Salt)
- Montana (1902-2014; Battle, Beaver, Big Dry, Big Horn Lake, Big Muddy, Big Sandy, Blackfoot, Boxelder, Brush Lake Closed Basin, Bullwhacker-Dog, Charlie-Little Muddy, Clarks Fork Yellowstone, Fisher, Flathead Lake, Flatwillow, Fort Peck Reservoir, Frenchman, Gallatin, Judith, Little Dry, Lodge, Lower Bighorn, Lower Clark Fork, Lower Flathead, Lower Milk, Lower Musselshell, Lower Tongue, Lower Yellowstone, Lower Yellowstone-Sunday, Marias, Middle Clark Fork, Middle Kootenai, Middle Milk, Milk, Missouri Headwaters, Missouri-Poplar, Musselshell, North Fork Flathead, O'Fallon, Pend Oreille, Peoples, Poplar, Prairie Elk-Wolf, Redwater, Rosebud, Sage, Smith, South Fork Flathead, Stillwater, Sun, Swan, Teton, Tongue, Upper Little Missouri, Upper Milk, Upper Missouri, Upper Missouri-Dearborn, Upper Tongue, Upper Yellowstone, Upper Yellowstone-Lake Basin, Upper Yellowstone-Pompeys Pillar, Whitewater, Willow, Yaak)
- Nebraska (1997-2000; Calamus, Cedar, Lower Lodgepole, Lower North Loup, Lower North Platte, Lower South Platte, Middle Niobrara, Middle North Platte-Scotts Bluff, Middle Platte-Buffalo, Niobrara Headwaters, Snake, South Fork Big Nemaha, Upper Elkhorn, Upper Middle Loup, Upper Niobrara, Upper North Loup, Upper Republican, Upper White)
- Nevada (1930-2001; Carson Desert, Central Lahontan, Lower Humboldt, Middle Carson, Spring-Steptoe Valleys, Thousand-Virgin, Truckee, Upper Carson, Walker Lake)
- New Mexico (1914-1990; Pecos Headwaters, Rio Grande-Albuquerque, Tularosa Valley, Upper Canadian, Upper Pecos, Upper San Juan, Zuni)
- New York (1975-1994; Ausable River, Black, Grass, Mohawk, Oswegatchie, Raquette, Sacandaga, Salmon, Saranac River, St. Regis, Upper Hudson)
- North Carolina (1955-2016; Cape Fear, Chowan, Hiwassee, Lower Catawba, Lower Pee Dee, Lower Tar, Lower Yadkin, Lumber, Neuse, Roanoke, Rocky, South Yadkin, Upper Broad, Upper Catawba, Upper Little Tennessee, Upper New, Upper Pee Dee, Upper Yadkin)
- Oklahoma (1952-1973; Bird, Black Bear-Red Rock, Middle Washita)
- Oregon (1905-2013; Alsea, Brownlee Reservoir, Bully, Coos, Goose Lake, Klamath, Lost, Lower Columbia, Lower Columbia-Clatskanie, Lower Columbia-Sandy, Lower Deschutes, Lower John Day, Lower Malheur, Lower Owyhee, Lower Willamette, Middle Columbia-Hood, Middle Columbia-Lake Wallula, Middle Willamette, Necanicum, Nehalem, Pacific Northwest, Powder, Siletz-Yaquina, Siltcoos, Silver, Siuslaw, Sixes, Sprague, Tualatin, Umatilla, Umpqua, Upper Grande Ronde, Upper Klamath Lake, Upper Malheur, Upper Rogue, Upper Willamette, Willamette, Willow, Yamhill)
- South Carolina (1953-2009; Lower Savannah, Middle Savannah, North Fork Edisto, Salkehatchie, Seneca, South Fork Edisto, Stevens, Tugaloo, Upper Savannah)
- South Dakota (1950-1993; Angostura Reservoir, Little White, Lower Belle Fourche, Middle Cheyenne-Elk, Middle Cheyenne-Spring, Rapid)
- Tennessee (1968-1999; Emory, Hiwassee, Kentucky Lake, Lower Clinch, Lower Little Tennessee, Pickwick Lake, Watts Bar Lake)

- Texas (1954-2016; Cedar, El Paso-Las Cruces, Lake Meredith, Middle Canadian-Spring, Pease, Rio Grande-Fort Quitman, Upper Neches, Upper Prairie Dog Town Fork Red, Upper Salt Fork Red, White)
- Utah (1880-2001; Fremont, Little Bear-Logan, Lower Sevier, Lower Weber, Middle Bear, Middle Sevier, Montezuma, Price, Provo, San Pitch, Strawberry, Upper Colorado-Dirty Devil, Utah Lake)
- Virginia (1986-1994; Kanawha, Middle New)
- Washington (1890-2005; Banks Lake, Colville, Deschutes, Dungeness-Elwha, Duwamish, Franklin D. Roosevelt Lake, Grays Harbor, Hangman, Hoh-Quillayute, Hood Canal, Lake Washington, Lewis, Little Spokane, Lower Columbia, Lower Columbia-Clatskanie, Lower Columbia-Sandy, Lower Cowlitz, Lower Crab, Lower Skagit, Lower Snake, Lower Snake-Tucannon, Lower Spokane, Lower Yakima, Middle Columbia-Hood, Middle Columbia-Lake Wallula, Moses Coulee, Nisqually, Nooksack, Okanogan, Pacific Northwest Region, Palouse, Pend Oreille, Puget Sound, Puyallup, Rock, San Juan Islands, Similkameen, Skykomish, Snohomish, Snoqualmie, Stillaguamish, Strait of Georgia, Upper Chehalis, Upper Columbia-Entiat, Upper Columbia-Priest Rapids, Upper Crab, Upper Spokane, Upper Yakima, Walla Walla, Wenatchee, Willapa Bay)
- West Virginia (1993; Little Muskingum-Middle Island, Middle New, Upper Kanawha)
- Wyoming (1880-1999; Big Horn, Big Horn Lake, Blacks Fork, Clear, Glendo Reservoir, Lower Wind, North Platte, Powder, Salt, South Platte, Upper Laramie)

From Fuller and Neilson (2019):

"Established in most areas where introduced. Extirpated in Arkansas."

"Although Yerger (1977) and Lee et al. (1980 et seq.) considered this species to be introduced into the Apalachicola River in Florida, it may actually be native. Because the Apalachicola drainage was not adequately sampled in early years, introduced status may be incorrectly assumed for some species. Yellow Perch was first collected in the Mobile basin circa 1850, long before any stocking took place, indicating the species was native to this region. This record was overlooked by Lee et al. (1980 et seq.). Hence, *Perca flavescens* may be native to eastern Gulf drainages in Alabama, Florida, and Georgia, not introduced. Populations in Atlantic coastal drainages of Georgia, such as the Altamaha and Savannah, have been reported (Dahlberg and Scott 1971b) to be introduced. In fact we believe these populations are more likely native. Dill and Cordone (1997) gave a detailed history of this species and its introduction into California."

From CABI (2019):

"*P. flavescens* was found in an undisclosed lake in the Kinai [*sic*] Peninsula, Alaska (Fay, 2002). This population was extirpated with rotenone by the Alaska Department of Fish and Game (Fay, 2002)."

Means of Introductions in the United States

From CABI (2019):

"The expansion of *P. flavescens* outside of its native range is due to its intentional introduction and stocking for sport fishing (Roberge et al., 2001), as well as further human-driven spread, such as bait bucket contamination (USGS NAS, 2015). Stocking of the species began in the late 19th century (Brown et al., 2009; DFO, 2011). In 1891 the first successful introduction in California took place, when 6000 specimens brought over from Illinois were placed in Lake Cuyamaca and Feather River (Dill and Cordone, 1997). Further introductions in California, as well as population transplantation, followed the initial stocking in that state. Similar stocking episodes took place along the Pacific Northwest of the USA, with stocking programs driven by the US Fish Commission (Brown et al., 2009). The species has been stocked in Washington, Utah, Oregon, New Mexico and Texas (Roberge et al., 2001)."

Remarks

From Marsden et al. (1995):

"The yellow perch (*Perca flavescens* Mitchill) is widely distributed across North America and is a popular and economically important sport fish. In Europe and Asia, the Eurasian perch, *Perca fluviatilis* L., has equivalent life-history characteristics, geographic spread, and fishing popularity. Despite their absolute geographic isolation, the species status of these two percids has been questioned. Svetovidov and Dorofeeva (1963, cited in Collette and Banarescu, 1977) and McPhail and Lindsey (1970) considered them to be subspecies (*P. fluviatilis fuviatilis* and *P. f. flavescens*). Thorpe (1977[a]) compiled existing data on morphological, physiological, behavioral, and ecological characteristics of both forms and concluded that they were "biologically equivalent," a somewhat ambiguous term from a taxonomic standpoint. Bailey et al. (1970) and Binarescu (1960, cited in Thorpe, 1977[a]) listed them as separate species. The only known anatomical difference between the two perch is the position of the predorsal bone (Collette and Banarescu, 1977). In *P. flavescens*, this bone is located between the first and second neural spines, whereas in *P. fluviatilis* it lies anterior to the first neural spine. On the basis of this single difference, Collette and Banarescu hypothesized that the two perch must be separate species."

"Fixed allelic differences between two sympatric populations clearly indicate reproductive isolation; in cases where a high proportion of loci show fixed allele differences, species-level separation is warranted (e.g., Thorpe, 1983). The degree of differentiation between *P. flavescens* and *P. fluviatilis* found in this study is extensive and leaves little question that the two are indeed distinct species."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al. (2019):

"**Current status:** Valid as *Perca flavescens* (Mitchill 1814)."

From ITIS (2019):

“Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Percoidei
Family Percidae
Genus *Perca*
Species *Perca flavescens* (Mitchill, 1814)”

Size, Weight, and Age Range

From Froese and Pauly (2019a):

“Max length : 50.0 cm TL male/unsexed; [Frimodt 1995]; common length : 19.1 cm TL male/unsexed; [Hugg 1996]; max. published weight: 1.9 kg [IGFA 2001]; max. reported age: 11 years [Hugg 1996]”

From CABI (2019):

“*P. flavescens* has a relatively short lifespan, living no more than 7 to 8 years (Williamson et al., 1997; Animal Diversity Web, 2000).”

Environment

From Froese and Pauly (2019a):

“Freshwater; brackish; benthopelagic; depth range ? - 56 m [Thorpe 1977b], usually ? - 9 m [Scott and Crossman 1998]. […]; 0°C - 30°C [water temperature] [Beitinger and Bennett 2000]; […]”

From CABI (2019):

“The species exhibits a high tolerance for low oxygen levels as well as acidification and is known to survive winterkill (due to lack of dissolved oxygen). *P. flavescens* remains near the shore, between 1-10 m deep and close to vegetation. Turbid water bodies with high concentrations of suspended sediments are usually avoided, […].”

Climate/Range

From Froese and Pauly (2019a):

"Temperate; […]; 65°N - 30°N, 124°W - 59°W [Page and Burr 2011]"

Distribution Outside the United States

Native

Native range of *Perca flavescens* is partially within the United States, see Native Range in Section 1.

From Froese and Pauly (2019a):

"[In Canada,] Ranges from the Northwest Territories and British Columbia to Nova Scotia [Coker et al. 2001]. Occurs in the Great Lakes [Lauer 2016]."

Introduced

CABI (2019) lists *Perca flavescens* as introduced to British Columbia and Saskatchewan in Canada.

FAO (2019) list *Perca flavescens* as introduced but not established in Japan.

Means of Introduction Outside the United States

From CABI (2019):

"*P. flavescens* has also been introduced via illegal stocking, which together with range expansion may be responsible for the extensive spread of the species west of the Rockies in British Columbia (Roberge et al., 2001; Brown et al., 2009)."

Short Description

From CABI (2019):

"*P. flavescens* is a laterally compressed oblong fish with a distinct yellow to golden-yellow colour. It has 6-8 dark vertical stripes along either side, a green/olive back and a white belly. The lower fins tend to be yellow or red on adult males especially during spawning. The lateral line is curved with 51-61 scales and has a rough texture due to its characteristic ctenoid scales. This small to medium sized percid has an average size of 10.0-25.5 cm, with a maximum reported length of 50 cm in older specimens. The broad range of average length is due to the fact that populations vary in size from location to location. *P. flavescens* has two dorsal fins (with marked separation from one another), a frontal-spiny fin with 12-14 spines and a rear-soft fin with 12-13 soft rays and 2-3 spines. [Animal Diversity Web 2000; Mecozzi 2008; Brown et al. 2009; DFO 2011; Froese and Pauly 2015; MDNR 2015b]"

Biology

From Froese and Pauly (2019a):

"Inhabits lakes, ponds, pools of creeks, and rivers. Also found in brackish water and in salt lakes. Most commonly found in clear water near vegetation; tends to shoal near the shore during spring [Etnier and Starnes 1993; Frimodt 1995]. Feeds on immature insects, larger invertebrates, fishes and fish eggs during the day. Preyed upon by fishes and birds [Scott and Crossman 1998]. Spawns between February and July in the northern hemisphere and between August and October in the southern hemisphere [Collette et al. 1977]. Neither anterolateral glandular groove nor venom gland is present [Smith and Wheeler 2006]."

"Nonobligatory plant spawner."

From CABI (2019):

"The species is most abundant in clear water lakes and ponds near vegetation, and less abundant in rivers and streams, where it is mostly found in pools and areas resembling lentic habitats. […] Turbid water bodies with high concentrations of suspended sediments are usually avoided, as sediment adheres to the surface of fertilised eggs, reducing the rate of inwards oxygen-diffusion and resulting in delayed hatching."

"Spawning takes place in the spring months (April/May), when water temperatures range between 7 and 11°C (Williamson et al., 1997; Animal Diversity Web, 2000). The fish spawns in shallow waters in lakes or slow moving sections of rivers, such as tributaries (Williamson et al., 1997; Roberge et al., 2001; Brown et al., 2009;) [*sic*]. Sexual maturity of males is reached during their third year, whereas females reach maturity about a year later (MDNR, 2015b). Literature values of spawning depth for *P. flavescens* range from 0-13 m, but the majority of values are concentrated in the shallower range of depths above 3 m (Brown et al., 2009).

Male *P. flavescens* are the first to arrive at the spawning ground, with two to five accompanying a single female while she lays her eggs (Roberge et al., 2001; Brown et al., 2009). The female proceeds to deposit her egg mass, followed by the release of milt from up to two of the males, a process which takes five seconds. Thereafter the females immediately retreat from the spawning ground while the males remain for a short period of time (Brown et al., 2009).

No nest is prepared for the eggs, which are laid over sand or gravel substrates, in areas of dense rooted vegetation cover, with fallen trees and brush (Roberge et al., 2001; MDNR, 2015b). An average of 23,000 eggs are laid per female, which rapidly swell and harden after deposition (Animal Diversity Web, 2000). The eggs are deposited in a jelly-like buoyant spiral that adheres to vegetation and moves in the water column, increasing aeration of the eggs (Roberge et al., 2001; Brown et al., 2009). Hatching occurs 8-10 days after spawning (releasing fry 4-7 mm in length), after which the yolk is consumed during a period of five days followed by rapid growth of the young-of-the-year (Animal Diversity Web, 2000; Roberge et al., 2001; Brown et al., 2009)."

"*P. flavescens* is active during daylight hours. At daybreak it forms spindle-shaped schools of 50 to 200 similar sized fish (Mecozzi, 2008). The formation of schools is reportedly a mechanism to overcome their poor swimming ability and inability to accelerate quickly (Animal Diversity Web, 2000; Brown et al., 2009). Some older fish can be found traveling alone, not forming part of a school (Animal Diversity Web, 2000). When feeding, the schools concentrate near the bottom and thereafter can be found at varying depths (Mecozzi, 2008). Darkness drives the yellow perch closer to shore, and once the fish can no longer see each other the school dispersers and individuals move to the bottom to overnight, remaining motionless (Mecozzi, 2008).

The spawning of *P. flavescens* during spring brings them towards the shore, or upstream to calmer waters. This is followed by their return to deeper waters as water temperatures rise in the summer months (Piavis, 1991; Mecozzi, 2008). There is no evidence to suggest that *P. flavescens* undergoes migrations not related to its spawning behaviour. Piavis (1991) suggested that adult perch remain in the river systems in which they were born. Juvenile migration downstream from spawning locations has not been reported to be a synchronized migration event (Piavis, 1991)."

"The dietary composition and behaviour of *P. flavescens* changes markedly with fish developmental stage and exhibits strong monthly variations depending on prey species availability/community composition. From the larval stage to adulthood the feeding behaviour of *P. flavescens* will shift from planktivorous through benthivorous to piscivorous (even cannibalistic) (Iles and Rasmussen, 2005; Brown et al., 2009). Larval diet is mainly composed of zooplankton species, varying in species composition with location (Brown et al., 2009). In eastern US reservoirs, larval perch consumed copepods and cladocerans along with species of *Diaptomus* and *Diaphanosoma* (Brown et al., 2009). In Oregon, larvae have been reported to also prey on Daphnia (Brown et al., 2009).

P. flavescens increases in size with age and shifts towards bottom feeding, focusing mostly on benthic macrofauna (Brown et al., 2009). One year old yellow perch, in Lake Opinicon in Ontario, still fed on cladocerans, but most of their diet was composed of benthic Amphipoda, Ostracoda, Isopoda, Ephemeroptera, Zygoptera, Anysoptera and Chironomid larvae (Keast, 1977). Fish consumption began in second year-class specimens, with most of the consumption nearing the end of the summer (Keast, 1977). Keast (1977) observed that after their third year, *P. flavescens* had completely excluded cladocerans from their diet and the fraction of fish consumed became more pronounced."

Human Uses

From Froese and Pauly (2019a):

"Marketed fresh or frozen; eaten pan-fried, broiled or baked [Frimodt 1995]."

"A popular fish sold in live fish markets. Found in 1 out of 6 live fish markets near the Lakes Erie and Ontario [Rixon et al. 2005]."

"Used as live bait for northern pike and muskellunge and cut bait for various fishes [Scott and Crossman 1998]."

From CABI (2019):

"The *P. flavescens* commercial and recreational fisheries are of great economic importance in the Great Lakes (Brown et al., 2009) and in Chesapeake Bay (Piavis, 1991). The perch's widespread distribution and abundance led to it becoming an important commercial fishery in the USA and Canada (el-Zarka, 1959). The *P. flavescens* commercial fishery encompasses Lakes Erie, Huron and Michigan (Animal Diversity Web, 2000).

Commercial fish landings of *P. flavescens* have declined since their peak in stocks in the mid-twentieth century. Peak harvests in Lake Erie occurred during the early 1930s, the 1950s and early 1970s (Sepulveda-Villet et al., 2009). In 1954 the commercial *P. flavescens* fishery provided over 16 million tons of fish, comprising over 13% of all lake fish harvest (el-Zarka, 1959). In 1969 Lake Erie experienced its peak in commercial *P. flavescens* catch, at 13,546 tons (Animal Diversity Web, 2000). By 1976 the commercial catch had dropped to 3,175 tons, due to overfishing and water quality issues related to increased concentrations of organic compounds and higher phosphorous loadings (Sepulveda-Villet et al., 2009). Continued overexploitation, recruitment failure, introductions of exotic species and fluctuating phosphorus concentrations led to the stock's continuous decline into the 2000s (Sepulveda-Villet et al., 2009). In 1990 the Lake Michigan commercial fishery collapsed and has not yet recovered (Sepulveda-Villet et al., 2009).

A similar chain of events was observed in the Chesapeake Bay fishery, where harvests fell from over one million pounds at the turn of the twentieth century to annual catches of a little over 40,000 pounds in the 1990s (Piavis, 1991). The annual fishing income of a *P. flavescens* fisherman in Chesapeake Bay was estimated at around $20,000 (USD) in 1990 (Piavis, 1991).

Despite the decrease in landings and the precipitous fish stock decline the *P. flavescens* fishery still plays an important economic role. In 2002 a total landing of over 3,600 tons in Canada was valued at over $16 million (CAD), and the fish remains the most valuable commercial catch in Ontario."

"*P. flavescens* is sought after in Canada and the USA for sport fishing (Brown et al., 2009). The fish is easy to catch (Piavis, 1991) and its white meat is considered very good to eat (Brown et al., 2009). Piavis (1991), estimating that the willingness of a fisherman to pay $0.50 (USD) to catch a *P. flavescens* in Maryland, gave a hypothetical sport-fishery value for *P. flavescens* of $120,000 in the state of Maryland."

Diseases

Infection with viral haemorrhagic septicaemia, spring viraemia of carp virus, and infectious heamatopoietic necrosis are OIE-reportable diseases (OIE 2019).

According to Algers et al. (2008), *Perca flavescens* may be a host and susceptible to viral haemorrhagic septicaemia.

From Palmer and Emmenegger (2014):

"This is the first study to test the susceptibility levels of Yellow Perch and Koi after experimental exposure to IHNV [infectious hematopoietic necrosis virus]. […] Yellow Perch also appear to be resistant to disease in these experimental conditions but have a higher incidence of infection and persistence. This suggests that although the probability is extremely low, Yellow Perch may serve as potential virus carriers or hosts for adaptation if exposed continuously, similar to what occurred in Rainbow Trout."

From Emmenegger et al. (2016):

"Our study establishes that SVCV [spring viraemia of carp virus], a rhabdovirus of the *Sprivivirus* genus, can also infect yellow perch, induce mortality in fry, and persist in survivors of injection challenge for 28 days."

Froese and Pauly (2019b) list *Perca flacescens* as a host for *Apophallus brevis*, *Bunodera luciopercae*, *Centrovarium lobotes*, *Clinostomum gracile*, *Clinostomum complanatum*, *Ergaslius arthrosis*, *Ergasilus caeruleus*, *Ergasilus luciopercarum*, *Gyrodactylus freemani*, *Henneguya dorri*, *Lissorchis kritskyi*, *Metorchis conjunctus*, *Microphallus opacus*, *Myxidium percae*, *Myxobolus percae*, *Myxosoma neruophilus*, *Myxobolus scleroperca*, *Posthodiplostomum cuticola*, *Phulometra cylindracea*, *Phyllodistomum superbum*, *Podocotyle reflexa*, and *Sanguinicola occidentalis*.

Poelen et al. (2014) list *Perca flavescens* as a host for the following parasites and pathogens: *Acanthocephalus dirus*, *Apophallus venustus*, *A. americanus*, *Argulus* sp., *Azygia angusticauda*, *A. longa*, *Bothriocephalus claviceps*, *Bucephalus elegans*, *Bunodera sacculata*, *Camallanus lacustris*, *Capilaria* sp., *Cleidodiscus* sp., *Clinostomum marginatum*, *Contracaecum* sp., *Crassiphiala bulboglossa*, *Crepidostomum cooperi*, *C. cornutum*, *C. solidum*, *C. metoecus*, *Creptotrema funduli*, *Cryptogonimus chili*, *Cucullanus serrata*, *Cucullanellus cotylophora*, *Cyathocephalus truncatus*, *Dacnitoides cotylophora*, *Dichelyne cotylophora*, *D. bonacii*, *Digenea* sp., Fish tapeworm (*Diphyllobothrium latum*), *Diplostomulum huronense*, *D. scheuringi*, *Diplostomum baeri*, *D. adamsi*, *D. spathaceum*, *Distomum* sp., *Echinorhynchus lateralis*, *E. salmonis*, *Eudistoma* sp., *Eustrongylides tubifex*, *Fessisentis tichiganensis*, *F. vancleavei*, *Flavobacterium columnare*, *Hysterothylacium* sp., *Ichthyocotylurus pileatus*, *I. erraticus*, *Ichthyonema cylindraceum*, *Leptorhynchoides thecatus*, *Leuceruthrus micropteri*, *Ligula intestinalis*, Lymphocystis disease virus, *Microphallus medius*, *Myxobolus neurophilus*, *Myzobdella lugubris*, *Neascus* sp., *Neoechinorhynchus cylindratus*, *N. rutili*, *N. strigosus*, *N. tenellus*, *N. pungitius*, *Ornithodiplostomum ptychocheilus*, *Philometra* sp., *Philonema* sp., *Podocotyle olssoni*, *Pomphorynchus* sp., *Posthodiplostomum minimum*, *Prosorhynchoides pusilla*, *Proteocephalus dubius*, *P. percae*, *P. ambloplitis*, *Proterometra autraini*, *Raphidascaris acus*, *Rhabdochona ovifilamenta*, *R. Canadensis*, *Rhipidocotyle papillosa*, *Schistocephalus solidus*, *Spinitectus carolini*, *Spiroxys* sp., *Strigeidae* sp., *Tetracotyle* sp., *Triaenophorus nodulosus*, *T. crassus*, *Tylodelphys scheuringi*, *Urocleidus adspectusi*, and *Uvulifer ambloplitis*.

Threat to Humans

From Froese and Pauly (2019a):

"Harmless"

3 Impacts of Introductions

From Shrader (2000):

"Distinct changes in the zooplankton community species and size structure were seen in 1999 [after expansion of *Perca flavescens* population] as compared to 1994. Cyclopoid copepods, which are a much smaller species of zooplankton and almost non-existent in the gamefish diet, composed a much higher percentage of the zooplankton community in Phillips Reservoir [Oregon] than they had in previous sampling […]. Calanoid copepods and *Daphnia*, which together comprised the majority of the zooplankton eaten by gamefish, declined from 15% and 39% of the zooplankton in June of 1994 to 2% and 24%, respectively, in June 1999. Calanoid copepods, present throughout 1994, were not found in reservoir sampling in August 1999. Additionally, the size frequency distribution of *Daphnia* shifted significantly toward smaller individuals in 1999 […]."

"Although the effects of changes in the zooplankton community composition and size structure on gamefish feeding and life history are not directly evident, the circumstantial evidence is highly suggestive. The density of yellow perch has increased by 245% since 1994, while, concurrently, black crappie and smallmouth bass densities are only 4 and 18%, respectively, of their 1994 levels […]. Additionally, recruitment of bass and crappie has been intermittent since 1994."

"Chironomids, diptera and *Daphnia* were seasonally important prey items for black crappie during 1994 and 1999 […]. In 1994, black crappie of all ages consumed *Daphnia* on all sampling occasions; the lowest volume eaten was 14.5'% of the diet by age-1 black crappie in August […]. In contrast, in June 1999, none of the black crappie sampled had consumed *Daphnia* […], even though zooplankton densities were much higher than in 1994. This could be due to the fact that the average size of *Daphnia* in the reservoir (0.88 mm) was much smaller than size preferred by black crappie. […]The overlap between black crappie and older yellow perch was biologically significant in August 1999 […]."

From Brown et al. (2009):

"In Gardom Lake, a small system of the Okanagan drainage in southern BC [British Columbia, Canada], local naturalists claim that the lake's faunal community has changed since the introduction of yellow perch in the 1990's. Fewer bird species and amphibians are observed (B. Jantz, B.C. Ministry of Environment, pers. comm., undated)."

"Experimental outplanting of brook trout, splake, and rainbow trout in a small Ontario lake prior to and after the establishment of introduced yellow perch demonstrated the dramatic impact of yellow perch on trout species (Fraser 1978). Following the establishment of yellow perch, the salmonids drastically changed their food habits, and growth rates were reduced more than 50%. The biomass of trout available after competing with yellow perch was less than the biomass of introduced trout. Fraser (1978) concluded that the salmonids could not compete successfully with yellow perch for the available food supply. Thus, following the establishment of yellow perch in small lakes, even hatchery intervention by out-planting of trout is unlikely to be effective."

"In Lake Sammamish, WA, yellow perch had not been considered a major predator on salmonid smolts because of their size in relation to the out-migrating fish. However, following sampling in 2001, 40% of yellow perch contained chinook smolts in spring. Yellow perch may have had the ability to affect chinook migration because of their large population. In May, chinook smolts represented over 50% of yellow perch diet by weight."

From Post and Cucin (1984):

"The littoral zone groups, Amphipoda, Hirudinia, and Pelycopoda, were all significantly reduced in mean weight and biomass after perch [*Perca flavescens*] introduction […]. None of these groups showed a significant decline in density, although trends are evident in zone 1 for amphipods and pelycopods. […] We suggest that the abundance of pelycopods was reduced by predation to the point they were infrequently available to predators. The species composition of the Hirundinea group changed after yellow perch introduction. In 1966 and 1967 the leeches captured were the free-swimming parasitic species whereas in 1979 only scavanger species were collected."

"The larval insects, Odonata, Trichoptera, and Ephemeroptera, were all significantly reduced in mean weight in zone 1 in 1979 […]. Trends in biomass reduction were nonsignificant. Trichoptera density increased after perch introduction, suggesting a compensatory increase in the smaller species."

"The benthic diptera all showed changes in 1979 when compared with the pre-perch years […]. The biomass of Chironomidae in zone 1 was significantly reduced as was mean weight in zone 4. Density increased in zones 3 and 4. Chaoboridae mean weight was reduced significantly in zones 2, 3, and 4 with no change in density. Ceratopogonidae biomass and mean weight were reduced significantly in zone 1 and mean weight in zone 2, but there was not density change."

"In summary, in the epilimnetic zones after yellow perch introduction, five of nine taxa decreased significantly in biomass, eight decreased significantly in mean weight, and one increased significantly in density […]. In the profundal zones, there were no significant changes in biomass, two taxa were significantly decreased in mean weight, and two taxa increased significantly in density […]."

From NatureServe (2019):

"Illegal introductions of yellow perch and bluegill led to demise of trout fishery in reservoir in northern Utah (Pettengill and Knight 1987)."

Any species of the genus *Perca*, except Eurasian perch (*P. fluviatilis*), are listed as uncategorized alien species in Japan and also are required to have a certificate attached during import that verifies type (Invasive Alien Species Act 2004).

4 Global Distribution

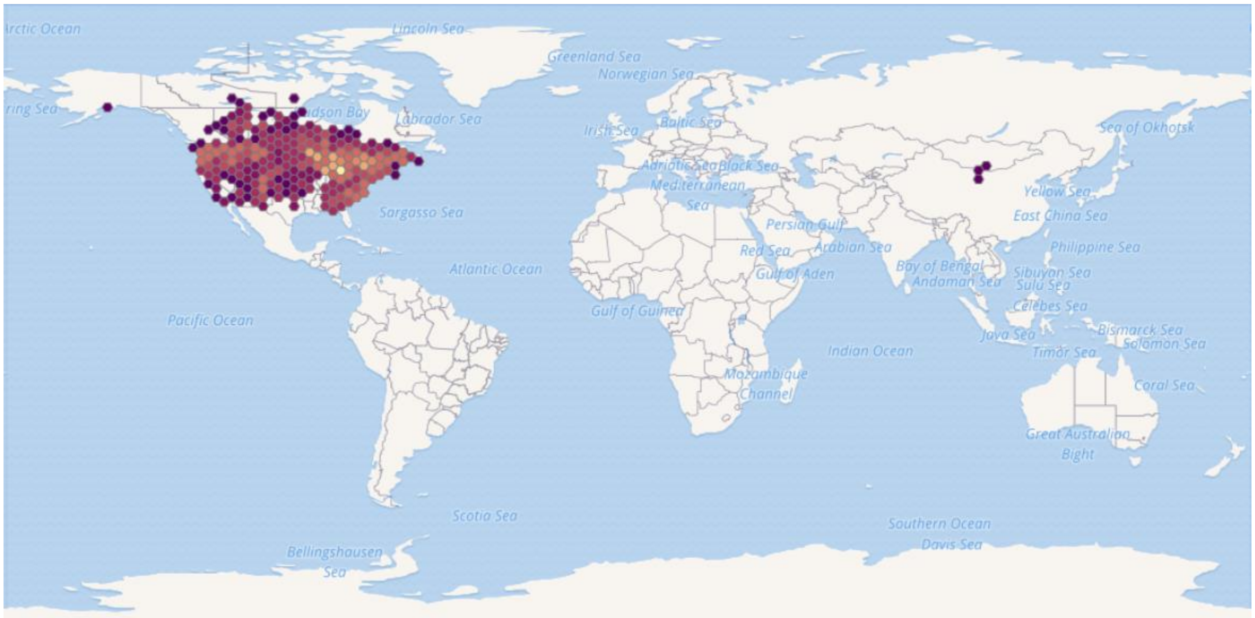

Figure 1. Known global distribution of *Perca flavescens*. Map from GBIF Secretariat (2019). The location in Alaska was not used to select source locations for the climate match; it does not represent an established population. The locations in China were not used to select source locations for the climate match; the coordinates do not match the recorded collection location.

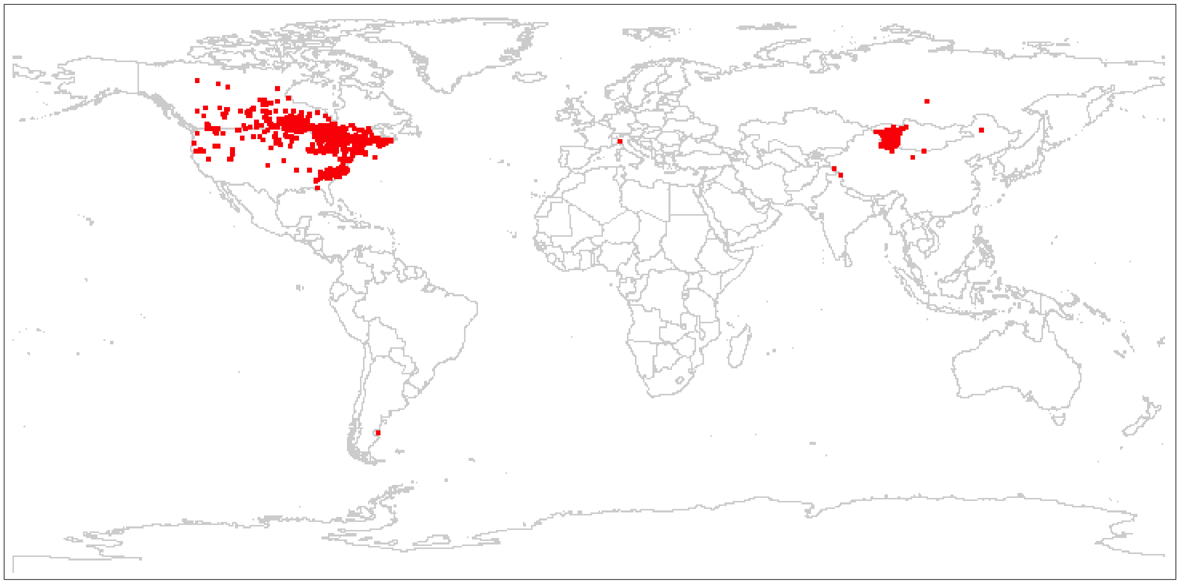

Figure 2. Additional known global distribution of *Perca flavescens*. Map from Froese and Pauly (2019). The locations in Asia, Europe, and South America were not used to select source locations for the climate match. There are no records of *Perca flavescens* populations in those locations.

5 Distribution Within the United States

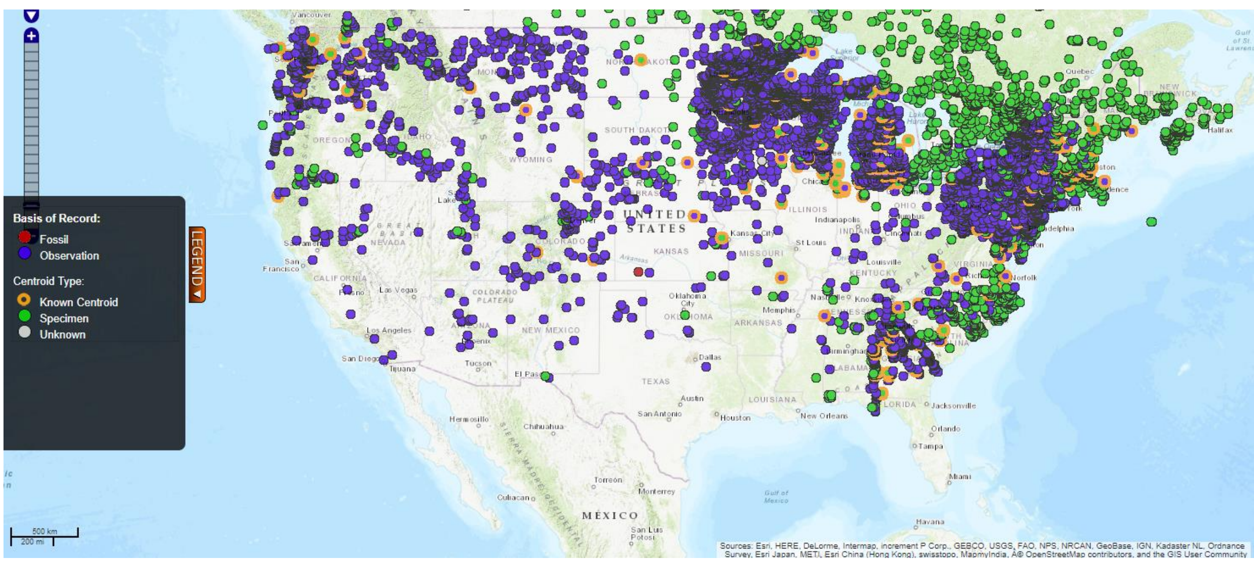

Figure 3. Known distribution of *Perca flavescens* in the contiguous United States. Map from BISON (2019). Locations in Arkansas were not used to select source points in the climate match; *P. flavescens* is extirpated in the State. The location in southwestern Kansas that is marked as a fossil record and was not used to select source locations in the climate match.

Figure 4. Known occurrence of *Perca flavescens* in Alaska. Map from BISON (2019). The location in Alaska was not used to select source locations for the climate match; it does not represent an established population.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Perca flavescens* was high across virtually all of the contiguous United States. There were areas of medium match in southern Florida, southern Texas, and small areas along the Pacific Coast. There were no areas of low match. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for contiguous United States was 0.992, high (scores 0.103 and greater are classified as high). All States had high individual Climate 6 scores.

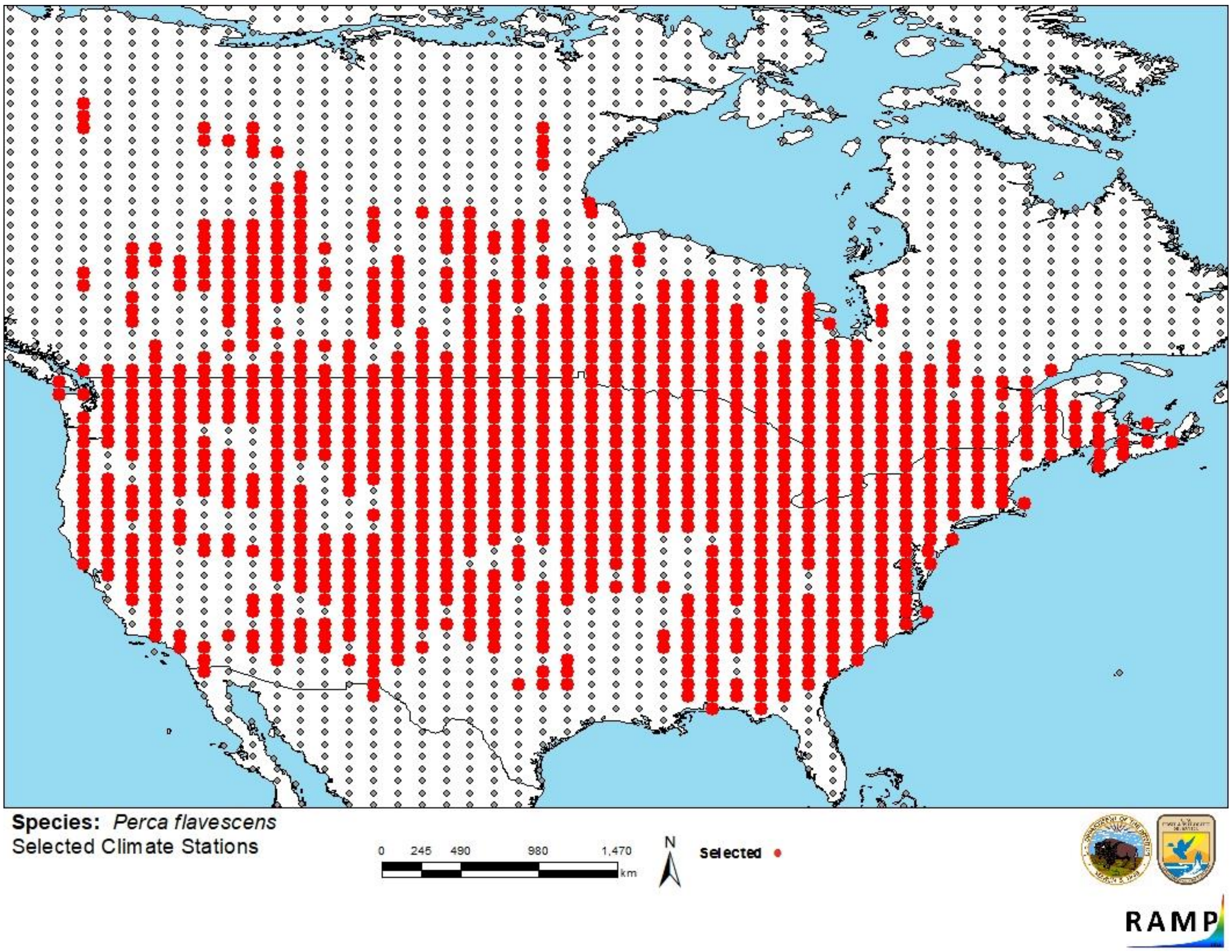

Figure 5. RAMP (Sanders et al. 2018) source map showing weather stations in North America selected as source locations (red; United States, Canada) and non-source locations (gray) for *Perca flavescens* climate matching. Source locations from BISON (2019), GBIF Secretariat (2019), and Froese and Pauly (2019). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

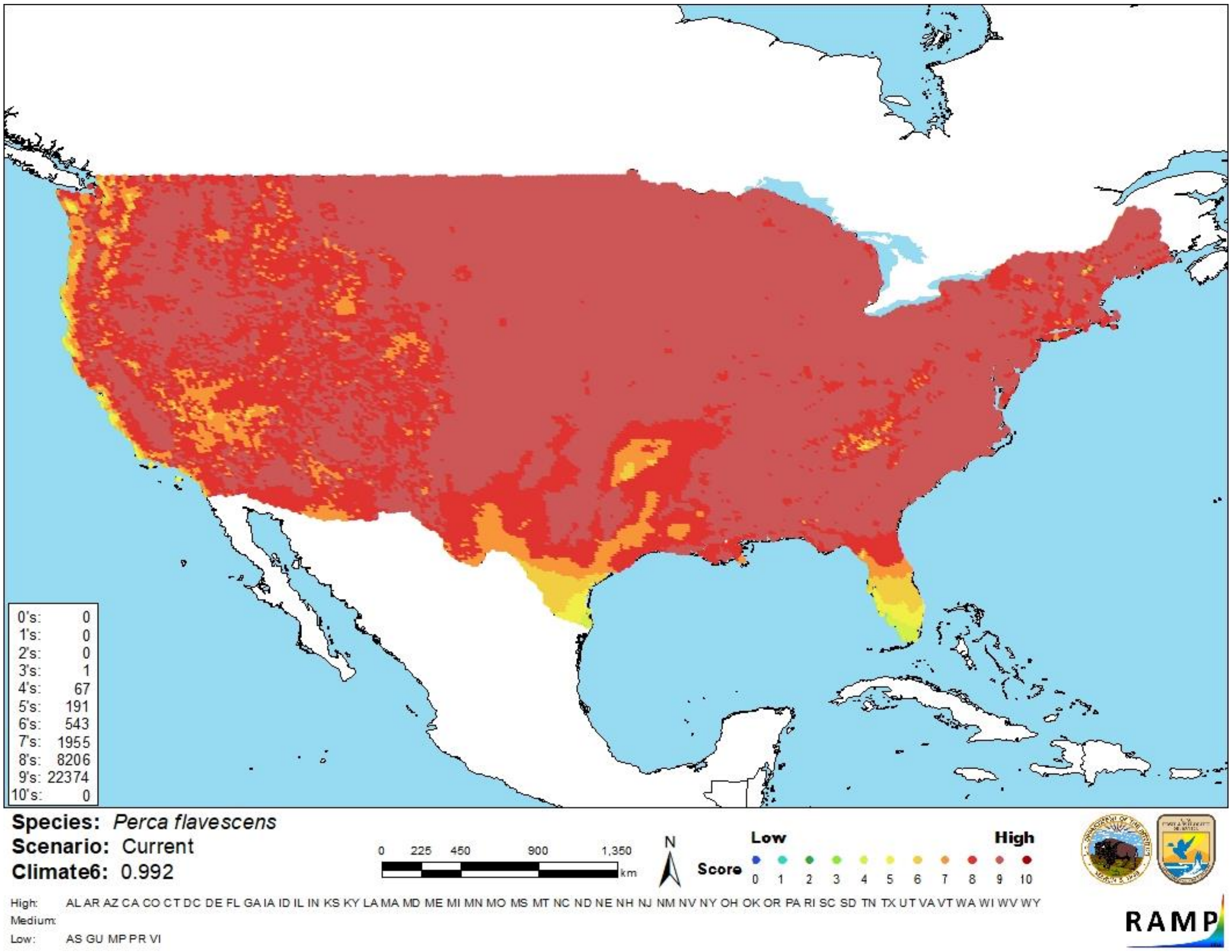

Figure 5. Map of RAMP (Sanders et al. 2018) climate matches for *Perca flavescens* in the contiguous United States based on source locations reported by BISON (2019), GBIF Secretariat (2019), and Froese and Pauly (2019). 0 = Lowest match, 10 = Highest match.

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
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

The certainty of assessment for *Perca flavescens* is high. Quality biological and ecological information is available. Records of introduction and records of impacts are available from peer-reviewed sources.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Yellow Perch (*Perca flavescens*) is a freshwater fish native to much of the eastern United States and Canada. It is one of the most popular sport fishes, sustaining a recreational fishery with economic value in excess of $100,000. There are also commercial fisheries for this species in the Great Lakes with the fishery in Canada estimated at $16 million CAD. *P. flavescens* can be a host for three OIE-reportable diseases: viral haemorrhagic septicaemia, spring viraemia of carp virus, and infectious heamatopoietic necrosis. It is also a host for many other parasites and pathogens. The history of invasiveness for *P. flavescens* is high. There are records of introduction resulting in established populations outside of the native range in Canada and the United States. Its import into Japan, where there has been an introduction but no establishment, is regulated. Where nonnative populations have established, *P. flavescens* has been shown to have an impact on the community structure of zooplankton. These changes have, in some cases, led to significant reductions in native fish species. They also eat chinook smolts. The climate match is high. Almost the entire contiguous United States had a high match with only a few small areas having a medium match. The certainty of assessment is high. The overall risk assessment 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:** Host for three OIE-reportable diseases.
- **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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