Walleye (*Sander vitreus*)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, April 2019
Revised, May 2019
Web Version, 10/24/2019

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1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2019a):

"North America: St. Lawrence-Great Lakes, Arctic, and Mississippi River basins from Quebec to Northwest Territories in Canada, and south to Alabama and Arkansas in the USA; possibly native to Mobile Bay basin."

"Known from Yukon Territory [Tonn et al. 2016] and from Northwest Territories and British Columbia to Quebec [Canada] [Coker et al. 2001]. Occurs in the Great Lakes [Lauer 2016]."

Status in the United States

From Fuller and Neilson (2019):

"Native Range: St. Lawrence-Great Lakes, […] and Mississippi River basins from Quebec to Northwest Territories [in Canada; western Vermont to eastern North Dakota in the United States], and south to Alabama and Arkansas (Page and Burr 1991)."

"Many states have had some success in establishing reproducing populations. Other states have maintained populations with annual stocking. Occurrences in Delaware are due to strays from Pennsylvania stockings (Raasch, personal communication). Extirpated in California (Hubbs et al. 1979; Dill and Cordone 1997). Dentler (1993) indicated that Walleye populations were spreading throughout the Columbia River basin. Walleye abundance in the Clark Fork and Pend Oreille rivers, and Lake Pend Oreille, doubled between 2011 and 2014 (Anonymous 2014)."

"The Walleye is a desirable sport and food fish. Although the species was thought to be native to a few drainages flowing into the Atlantic, Jenkins and Burkhead (1994) reviewed and evaluated the literature on the distribution of eastern populations and concluded that the populations on the Atlantic slope south of the St. Lawrence probably are introduced. […] The species' distribution in Alabama south of the Tennessee drainage was discussed by Brown (1962), who speculated that they are native to that region. Lee et al. (1980 et seq.) reported them as introduced. Billington and Maceina (1997) investigated the genetic status of Walleyes in Alabama, where the southern Walleyes are native but northern Walleyes from Ohio and Pennsylvania have been stocked. They concluded that transplanted female northern Walleyes did not survive to reproduce. However, because of the type of analysis done (mtDNA) they could not tell if any of the transplanted males survived."

"One especially problematic record comes from the Escambia drainage in Alabama (Brown 1962; Mettee et al. 1996). Only a single individual has ever been collected from the drainage. None have been taken downstream in the Florida portion of the drainage. Swift et al. (1986) reported it as introduced into the drainage. In discussions with Gilbert (personal communication), he believes the species was introduced to the Escambia based on the fact that only one specimen has been collected, the apparent lack of suitable habitat, and the fact that this sport-fish is more likely to be introduced than less desirable species. He also pointed out that Bailey et al. (1954) failed to include this species in their paper on the Escambia and that Mettee et al. (1996) did not find it in their survey work. He also believes that if the Walleye were native to the Escambia, it would be present in the lowermost (Florida) section because that is the stretch with the most suitable habitat. He likens the Walleye to *Crystallaria asprella*, which is found only in the lower section of the drainage (Gilbert 1992). However, JDW (author) believes it is native to the drainage because of the presence of several other native large-river fish and mussel species; the collection was before the state began stocking this species, the drainage has never been extensively sampled, and some sections do contain suitable habitat. Much habitat was lost when two dams were constructed on the river in the 1940s. Many large-river mussels suffered from these impoundments (JDW, personal observation) and Walleye could have done the same."

“Although Walleye have been introduced widely into the region, Starnes et al. (2011) discuss zooarcheological evidence suggesting that this species may actually be native to some mid-Atlantic Slope drainages (south to Albemarle Sound and Chesapeake Bay, including the Potomac River).”

Fuller and Neilson (2019) list non-native occurrences of *Sander vitreus* in Alabama since 1953, Arizona since 1880, Arkansas since 1950, California since 1874, Colorado since 1880, Connecticut since 1940, Delaware since 1974, Florida since 1960, Georgia since 1971, Idaho since 1951, Indiana since 1893, Iowa since 2001, Kansas since 1865, Kentucky since 1986, Louisiana since 1974, Maine since 1914, Maryland since 1969, Massachusetts since 1980, Mississippi since 1936, Missouri since 1988, Montana since 1933, Nebraska since 1884, Nevada since 1984, New Hampshire since 1927, New Jersey since 1890, New Mexico since 1957, New York since 1815, North Carolina since 1950, North Dakota since 1994, Ohio since 1939, Oklahoma since 1950, Oregon since 1967, Pennsylvania since 1889, South Carolina since 1971, South Dakota since 1950, Tennessee since 1993, Texas since 1953, Utah since 1880, Vermont since 1972, Virginia since 1962, Washington since 1950, West Virginia since 1984, and Wyoming since 1970.

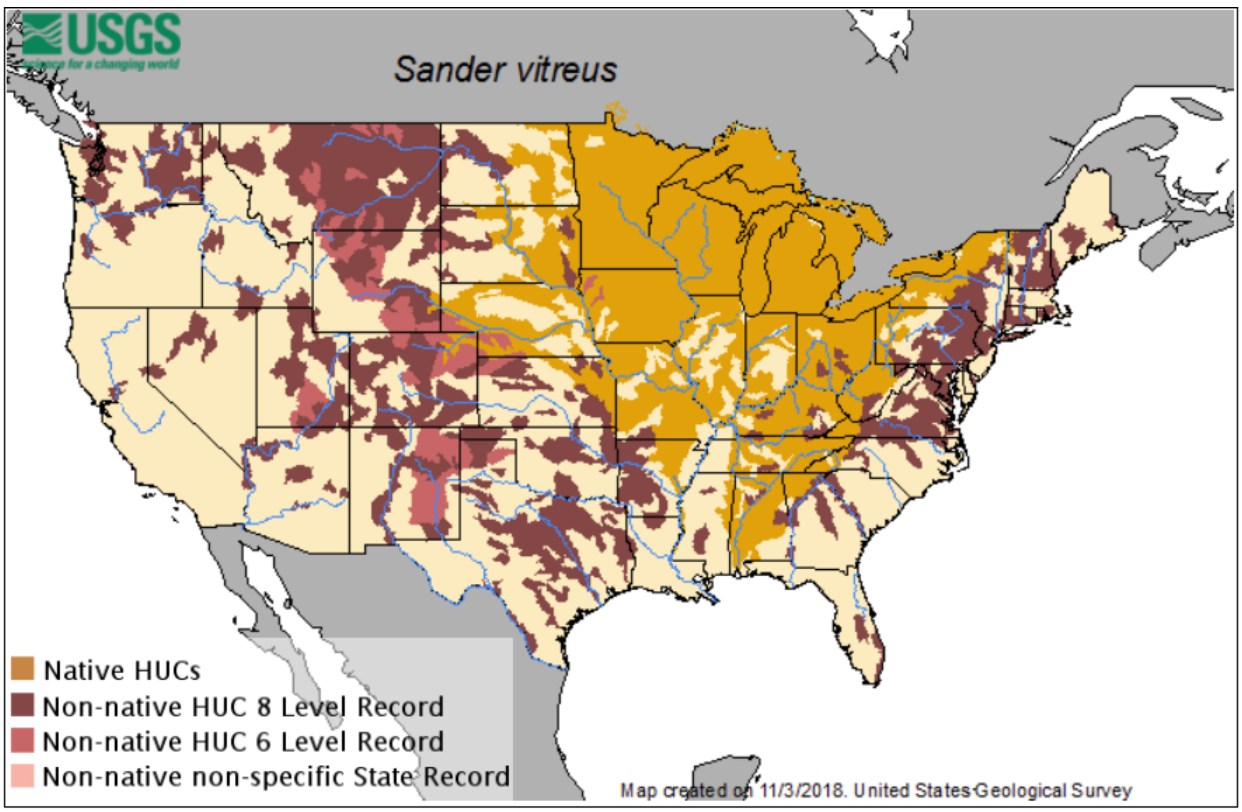

Figure 1. The native and non-native distribution of *Sander vitreus* by watershed in the United States. Map from Fuller and Neilson (2019).

Means of Introductions in the United States

Sander vitreus has been intentionally stocked outside its native range within the United States by State fishery managers to achieve fishery management objectives. State fish and wildlife management agencies are responsible for balancing multiple fish and wildlife management objectives. The potential for a species to become invasive is one important consideration when balancing multiple management objectives and advancing sound, science-based management of fish and wildlife and their habitat in the public interest.

From Fuller and Neilson (2019):

"Intentionally stocked as a food fish and for sportfishing. One of the earliest introductions occurred in 1874 when Livingston Stone gathered a small number of adult Walleye captured in Vermont and transported them to California where the fish were released into the Sacramento River (Smith 1896). According to Dill and Cordone (1997), in the 1890s the California Fish Commission applied to the U.S. Fish Commission for shipments of Walleye for use in controlling carp in Clear and Blue lakes; however, no Walleye were imported at the time. These same authors also noted that the state received Walleye eggs from Minnesota in 1959 and that these fish were to be used to control bluegill and support other sport fish in southern California reservoirs. In Idaho, Walleye may have been stocked accidentally with yellow perch *Perca flavescens* (Linder 1963). McMahon and Bennett (1996) state the first introduction into southern Idaho reservoirs was in 1974. The person or agency responsible for introducing the species into Washington is uncertain. The federal government may have introduced them in the early 1960s (Dentler 1993). A sport fishery had developed in Lake Roosevelt, Washington, by the 1960s (McMahon and Bennett 1996). Walleye was first reported in Wyoming in 1961 from Seminoe Reservoir in the upper North Platte River. The fish were swept downstream and are now established in a 450-km stretch of river (McMahon and Bennett 1996). Herke (1969) performed experimental stocking into private ponds to examine the survivability of this species in peninsular Florida. The Walleye was stocked illegally in Canyon Ferry Reservoir, Montana, and was found first circa 1991 (White, personal communication). More recently, the species also was illegally stocked in Noxon Reservoir on the Clark Fork of the Columbia River, Montana (McMahon and Bennett 1996). Illegal introductions seem to be a growing problem in western states (McMahon and Bennett 1996)."

From CABI (2019):

"There is also a history of accidental introductions due to walleye being stocked instead of yellow perch *Perca flavescens* (Linder, 1963)."

"Throughout the history of this species' introductions, walleye has been introduced into lakes and reservoirs predominantly as a sport fisheries target as well as a food fish; however, colonization of new waters beyond the point of release is a major concern, and regardless of many US state agencies initiating detailed environmental reviews to evaluate the risks and benefits of proposed introductions, illegal introductions of walleye continue (Vashro, 1990; 1995). Natural migration, as well as walleye being flushed downstream during years of high water, has allowed this species to colonize many downstream sections of rivers in the western USA (McMillan, 1984)."

Remarks

From NatureServe (2019):

“A range-wide analysis of genetic variation in *Sander vitreus* indicated that the "blue pike" (*S. v. glaucus*) is not a valid taxon (Haponski and Stepien 2014); previously, has been variously regarded as a full species (*S. glaucus*) or as a subspecies or color phase of *vitreus* (Robins et al. 1991). Hybridizes with *S. canadensis* (Lee et al. 1980).”

Although *Sander vitreus* is native to much of the contiguous United States, it is of concern to Alaska. As per the Service ERSS standard operating procedures, to determine the full extent of the fish’s risk to Alaska, an ERSS for the contiguous United States is completed before a more specific climate match can be completed for Alaska.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al. (2019):

“**Current Status:** Valid as *Sander vitreus* (Mitchill 1818).”

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 *Sander*
                          Species *Sander vitreus* (Mitchill, 1818)”

Size, Weight, and Age Range

From Froese and Pauly (2019a):

“Max length : 107 cm FL male/unsexed; [Scott and Crossman 1998]; common length : 54.0 cm TL male/unsexed; [Hugg 1996]; max. published weight: 11.3 kg [International Game Fish Association 1991]; max. reported age: 29 years [Hugg 1996]”

From NatureServe (2019):

"[…]; maximum age generally around 10 years (Bart and Page 1992)."

Environment

From Froese and Pauly (2019a):

"Freshwater; brackish; demersal; potamodromous [Riede 2004]; depth range ? - 27 m [Regier et al. 1969]."

"Prefers large, shallow lakes with high turbidity [Etnier and Starnes 1993; Frimodt 1995]. Rarely found in brackish waters [Scott and Crossman 1998]."

From NatureServe (2019):

"A pH of 8-9 is most suitable. Adults avoid temperatures above 24 C, if possible."

"Walleye have a relatively wide range of environmental tolerances, with an upper [water] temperature range of 29-34°C and a preferred range of 20-24°C in summer (DFO, 2011). This species is able to tolerate low oxygen (to 2 mg·L-1) but prefers levels greater than 5 mg·L-1."

Climate/Range

From Froese and Pauly (2019a):

"Subtropical; […]; 70°N - 30°N, 137°W - 69°W [Page and Burr 2011]"

Distribution Outside the United States

Native

Much of the native range for *Sander vitreus* is within the United States; see Section 1 for a full description of the native range.

From Froese and Pauly (2019a):

"North America: St. Lawrence-Great Lakes, Arctic, […] from Quebec to Northwest Territories in Canada, […]."

"Known from Yukon Territory [Tonn et al. 2016] and from Northwest Territories and British Columbia to Quebec [Canada] [Coker et al. 2001]. Occurs in the Great Lakes [Lauer 2016]."

Introduced

Froese and Pauly (2019a) list the presence of *Sander vitreus* in China as "questionable".

From CABI (2019):

"Welcomme (1988) reported that walleye were accidentally introduced into the inland waters of the UK, but this population failed to establish. It has more recently been introduced into China for aquaculture purposes (Ma et al., 2003)."

Pagad et al. (2018) list *Sander vitreus* as introduced to Portugal but give no further information about the introduction.

Means of Introduction Outside the United States

Froese and Pauly (2019a) list "accidental" and "aquaculture" as reasons for introduction to the United Kingdom and China.

Short Description

From Froese and Pauly (2019a):

"Dorsal spines (total): 13 - 17; Dorsal soft rays (total): 18-22; Anal spines: 2; Anal soft rays: 11 - 14; Vertebrae: 44 - 48. Nuptial tubercles absent. Differentiation of sexes difficult. Branchiostegal rays 7,7 or 7,8 [Scott and Crossman 1998]."

Froese and Pauly (2019a) also report 83-104 scales on lateral line, forked caudal fin, and 13-16 pectoral rays.

From CABI (2019):

"Walleye have a torpedo-shaped body, which ranges from dark olive brown to yellowish gold, and its sides are often marked with brassy flecks. The belly is whitish and paler than the back and sides. Ctenoid scales are extensive and well developed covering the back, sides, under-belly, and pectoral area. The opercular and preopercular areas are lightly scaled or naked (Hartman, 2009). The fins are well developed and contain spiny and soft rays. The two dorsal fins are clearly separated, with the anterior fin supported by 12 to 16 strong spines; the second dorsal is supported by one spine and 18 to 22 soft rays. The pectoral fins are rounded and without spines. The pelvic fins are supported by one spine and five rays (Scott and Crossman, 1973). The mouth is large and horizontal, with equal upper and lower jaws; the maxillary, forming the outer margin of the upper jaw, extends past the center of the eye. There are strong teeth on the maxillaries, premaxillaries, jaws, head of the vomer, and palatines. The canine teeth on the head of the vomer may be re-curved for effective predation. There are teeth on the inner and outer edges of the gill arches (Scott and Crossman, 1973). The head and teeth are well suited to predation. The head is armored with serrae on the preopercular bone and a spine on the opercle (Hartman, 2009)."

Biology

From Froese and Pauly (2019a):

"Occurs in lakes, pools, backwaters, and runs of medium to large rivers. Frequently found in clear water, usually near brush [Etnier and Starnes 1993]. […] Feeds at night, mainly on insects and fishes (prefers yellow perch and freshwater drum but will take any fish available) but feeds on crayfish, snails, frogs, mudpuppies, and small mammals when fish and insects are scarce [Scott and Crossman 1998]."

"Spawning occurs in small groups (a larger female and two smaller males or two females and up to six males) that engage in chasing, circular swimming, and fin erection. The group then ascends to shallow water, females roll on their side, and eggs and sperm are released. Deposition of eggs usually occurs in a single night [Scott and Crossman 1998]. Larvae pelagic [Balon 1990]."

From NatureServe (2019):

"Spawns in spring and (in north) early summer. Eggs hatch in 26 days at 4.4 C, 7 days at 14 C. Males sexually mature generally in 2-4 years, females in 3-8 years, depending on growth rate (Becker 1983, Scott and Crossman 1973). Females spawn a maximum of about 8 times in their lifetime; […]."

"Visual predator. Young up to 6 weeks old eat mainly copepods, Cladocera, and small fishes. Adults feed opportunistically on various fishes and larger invertebrates. In native range, yellow perch is preferred prey of adults and juveniles. Some populations feed almost exclusively on emerging larval and adult insects."

Human Uses

From Froese and Pauly (2019a):

"Although not widely farmed commercially for consumption, large numbers are hatched and raised for stocking lakes for game fishing [Frimodt 1995]. Utilized fresh or frozen; eaten pan-fried, broiled, microwaved and baked [Frimodt 1995]."

"Major commercial and sport fish in some provinces [Canada] [Scott and Crossman 1998]. Current fisheries restricted to by quota, minimum size and minimum mesh-size regulations [Scott and Crossman 1998]. Esteemed food fish [Scott and Crossman 1998]."

From NatureServe (2019):

"Popular and widely stocked game fish. Has been pond cultured for over 100 years."

From CABI (2019):

"Walleye have also been introduced into California as a biological control to help control nuisance species such as carp and bluegill as early as 1959 (Dill and Cordone, 1997)."

"The walleye is probably the most economically important sport and commercial species in Ontario and the Prairie Provinces. It is a major species in Quebec's recreational fishery (Fisheries and Oceans Canada, 2005). Although not a commercial species in the US, it is highly esteemed there."

Diseases

Infection with viral haemorrhagic septicaemia virus, and any *Ranavirus* sp. are OIE-reportable diseases.

EFSA (2007) lists *Sander vitreus* as a species naturally infected with viral haemorrhagic septicaemia virus.

From Duffus et al. (2015):

"Similarly, recent North American fish health surveys resulted in the isolation of FV3 [Frog virus 3, a species of *Ranavirus*] from healthy appearing fathead minnow (*Pimephales promelas*), walleye (*Sander vitreus*), and northern pike (Waltzek et al. 2014)."

From De Aguiar Saldanha Pinheiro (2015):

"Retroviruses from two proliferative skin lesions in walleye (*Sander vitreus*), walleye dermal sarcoma (WDS) and walleye epidermal hyperplasia (WEV), […]"

From CABI (2019):

"Walleyes may be infected with a wide range of diseases and parasites. Protozoan parasites that infect walleye include *Ichthyoptirius multillis*, Myxosporidia, copepod parasites including the many species of fish lice, and *Ergasilus centrachidarum* (Hartman, 2009). Three genera of nematode, *Contracaecum* sp. *Eustrongylides* sp. and *Rhaphidascaris* sp., and one species of acanthocephalan, *Neoechinorhynchus tenellum*, also parasitize walleyes (Dechtiar, 1972). Four genera of cestodes have also been identified as walleye parasites: *Bothriocephalus* sp., *Proteocephalus* sp., *Triaenophorus* sp. and *Diphyllobothrium* sp. (Poole and Dick, 1985).

The monogenean flukes *Cleidodiscus aculeatus* and *Urocleidus aculeatus* are external parasites that infect walleye. Walleye are susceptible to several bacterial diseases such as Columnaris disease. Lymphocistis is a common viral disease among walleye (Hartman, 2009)."

Froese and Pauly (2019b) list *Sander vitreus* as a host for the following additional pathogens: *Azygia angusticauda*, *Bothriocephalus cuspidatus*, *Centrovarium lobotes*, *Ergasilus caeruleus*, *E. celestis*, *E. luciopercarum*, *Gyrodactylus schmidti*, *Ichthyocotylurus platycephalus*, *Lernaea cyprinacea*, *Phyllodistomum superbum*, *Posorhynchoides pusillus*, *Sanguinicola occidentalis*, and *Triaenophorus stizostedionis*.

Poelen et al. (2014) list *Sander vitreus* as a host for the following additional pathogens: *Allacanthochasmus varius*, *Apophallus venustus*, *Bothriocephalus claviceps*, *Bucephalopsis* sp., *Bucephalus* sp., *Bunodera sacculata*, *Cammallanus ancylodirus*, *Capilaria* sp., *Clinostomum marginatum*, *Crassiphiala bulboglossa*, *Crepidostomum cooperi*, *Cryptogonimus chili*, *Cucullanellus cotylophora*, *Cystidicola stigmatura*, *Dichelyne bonacii*, Digenea spp., *Diphyllobothrium latum*, *Diplostomum spathaceum*, *Distomum* sp., *Echinorhynchus salmonis*, *Euthrium* sp., *Gyrodactylus mizellei*, *Hysterothylacium* sp., *Leptorhynchoides thecatus*, lymphocystis, *Myzobdella lugubris, Neoechinorhynchus crassus, N. strigosus, N. tenellus, N. cylindratus, N. rutili*, *Ornithodiplostomum ptychocheilus*, *Philometra* sp., *Phyllodistomum* sp., *Placobdella montifera*, *Posthodiplostomum minimum*, *Prosorhvnchoides pusilla*, *Proteocephalus luciopercae*, *P. microcephalus*, *P. ambloplitis*, *Raphidascaris acus*, *Ripidocotyle papillosa*, *Spinitectus* sp., *Taenia* sp., *Triaenophorus nodulosus*, *T. crassus*, *Tylodelphys scheuringi*, *Urocleidus* sp., and *Uvulifer amblopitis*.

Threat to Humans

From Froese and Pauly (2019a):

"Harmless"

3 Impacts of Introductions

From Bestgen et al. (2018):

"An influx of large and abundant walleye in the lower Green and Desolation-Gray Canyon river [Utah and Colorado] reaches was detected and likely occurred in 2010 or 2011. Walleye were abundant enough to reduce juvenile Colorado pikeminnow [*Ptychocheilus lucius*] abundance in those nursery reaches such that the large 2011 group of fish was largely undetectable in 2012 and 2013."

From Fuller and Neilson (2019):

"McMahon and Bennett (1996) recently reviewed the literature and presented a summary of impacts of Walleye in the Northwest. Overall, the effects of its introduction were considered complex and varied. The Walleye has been shown to prey on smolts of Pacific salmon, and therefore pose a threat to these already declining species in the Columbia River (Dentler 1993; McMahon and Bennett 1996). For instance, it is estimated that Walleye consume two million smolts annually in the Columbia River, about one third of total predation loss (McMahon and Bennett 1996). A study in Seminoe Reservoir, Wyoming, found Walleye stocking to result in a sharp decline in native minnows *Hybognathus* spp., darters *Etheostoma* spp., suckers *Catostomus* spp., rainbow trout *Oncorhynchus* mykiss, and crayfish *Orconectes obscurus*. For instance, most of the 500,000 trout fingerlings stocked annually were eaten within a few weeks. Consequently, there was a need to stock larger rainbow trout to avoid predation, an action that increased hatchery operation costs (McMahon and Bennett 1996). […] Numbers and health of brown trout *Salmo trutta* were found to decrease after introduced Walleyes consumed a large portion of the crayfish population, the brown trout's favorite food (McMahon and Bennett 1996). When the Walleye initially was introduced into Salmon Falls Creek Reservoir, Idaho, yellow perch *Perca flavescens* comprised 80% of the sport fish. However, 12 years later, Walleye made up 80% and perch only 1% of the fish in the reservoir (McMahon and Bennett 1996). Similar perch collapses also have happened at two other reservoirs in Wyoming (McMahon and Bennett 1996). A crash in the yellow perch population in Canyon Ferry Reservoir may be related to past Walleye introduction; studies are being conducted to look at the problem; […]. In many cases introduced Walleye deplete the forage base. As a consequence, the surviving Walleye population consists of stunted individuals and the species no longer serves as a valuable fishery (McMahon and Bennett

1996). Some states now prohibit the introduction of Walleye into certain waters. For instance, Walleye introductions are banned in the Snake River drainage in Idaho because of concern about predation on anadromous salmonids (McMahon and Bennett 1996). Further introductions in Oregon also are forbidden due to concern about predation on salmonid smolts in the Columbia River (McMahon and Bennett 1996). Although 40 million Walleye are stocked annually to maintain an important sport fishery in eastern Montana, the species has been banned from waters west of the Continental Divide in that state due to concern for important native and nonindigenous salmonid stocks (McMahon and Bennett 1996)."

4 Global Distribution

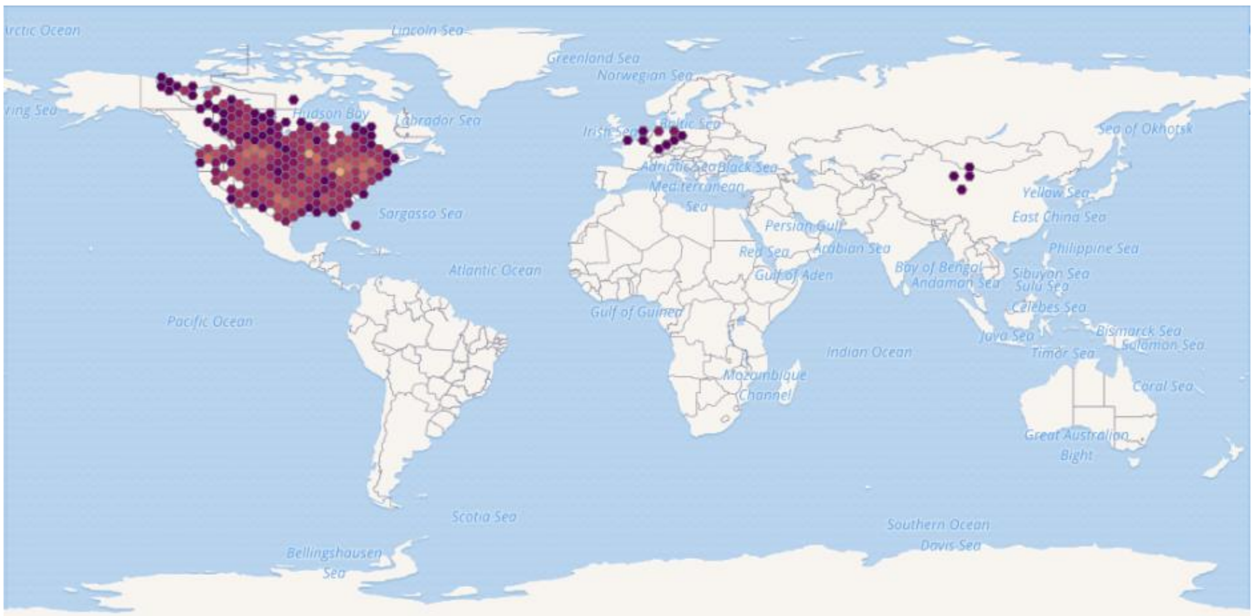

Figure 2. Known global distribution of *Sander vitreus*. Map from GBIF Secretariat (2019). The locations in the United Kingdom, Poland, Belgium, Germany, and the Netherlands are all from questionable citizen science observations (GBIF Secretariat 2019). No images were available to the assessor to determine if these observations were actually of *Sander vitreus* and not a related species of *Sander*. A few of the locations in Germany were observations from other sources (GBIF Secretariat 2019) but the information given in the records was too sparse to determine the validity of the record. The presence of *S. vitreus* in these locations is not corroborated by any other sources and the observations were not used to selected source locations for the climate match. The locations in China are the result of incorrect coordinates for specimens collected in Kansas and Nebraska (GBIF Secretariat 2019). These locations were not used to selected source points for the climate match.

5 Distribution Within the United States

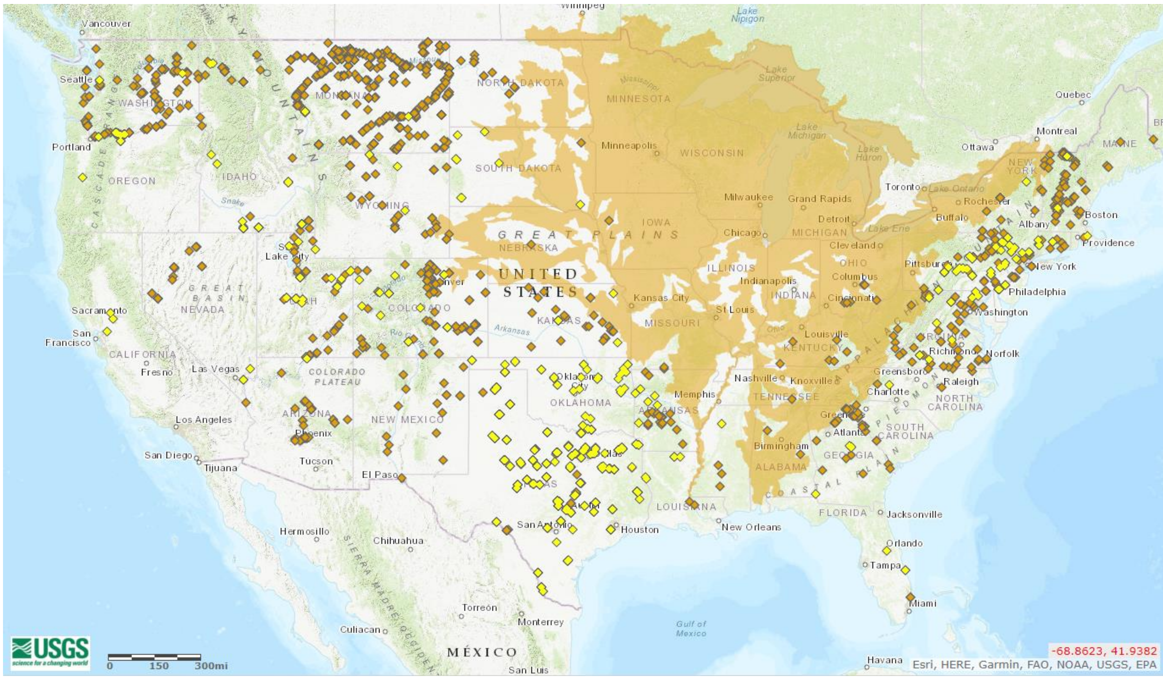

Figure 3. Known distribution of *Sander vitreus* in the United States. Map from Fuller and Neilson (2019). Orange shading across the Great Lakes and Mississippi basin indicates the native range of *S. vitreus*. Orange diamonds indicate established populations, yellow diamonds indicate observations that do not represent an established population. Only the established populations, represented by orange diamonds, were used to select source points for the climate match.

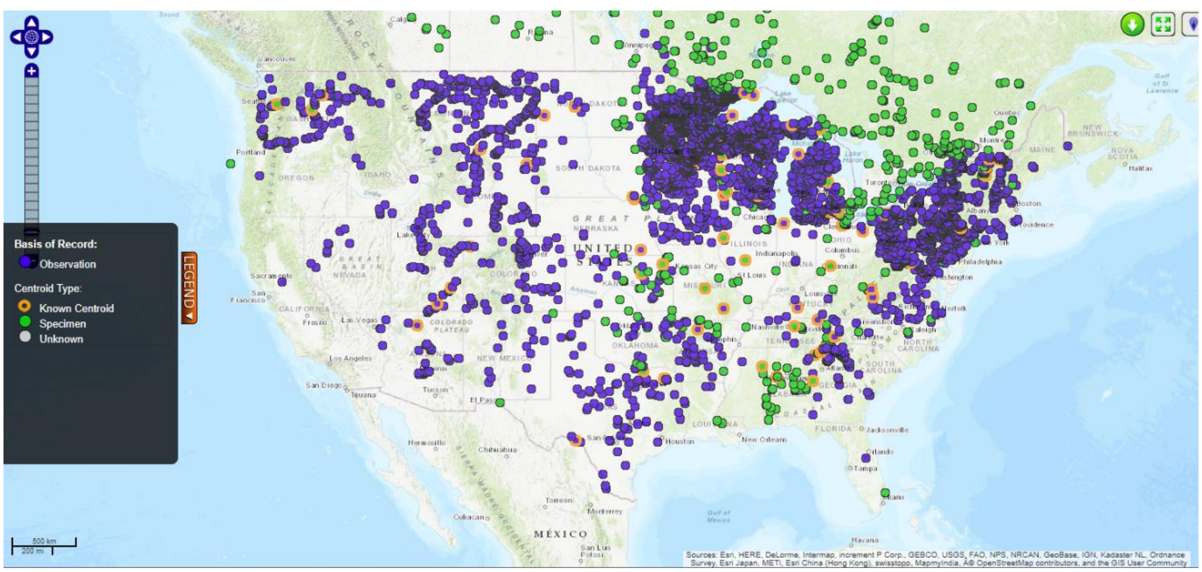

Figure 4. Additional known distribution of *Sander vitreus* in the United States. Blue dots represent an obsevation of the species and green dots represent a location that where a specimen was collected. Map from BISON (2019).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Sander vitreus* was generally very high in its native range in the Great Lakes and Mississippi Rivers. However, it was also high across much of the rest of the contiguous United States. There were areas of medium match in extreme southern Texas and along the Pacific Coast. There were small areas of low match on the Olympic Peninsula, the southern coast of California and inland in northern California. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for contiguous United States was 0.983, high (scores 0.103 and greater are classified as high). All States had high individual Climate 6 scores.

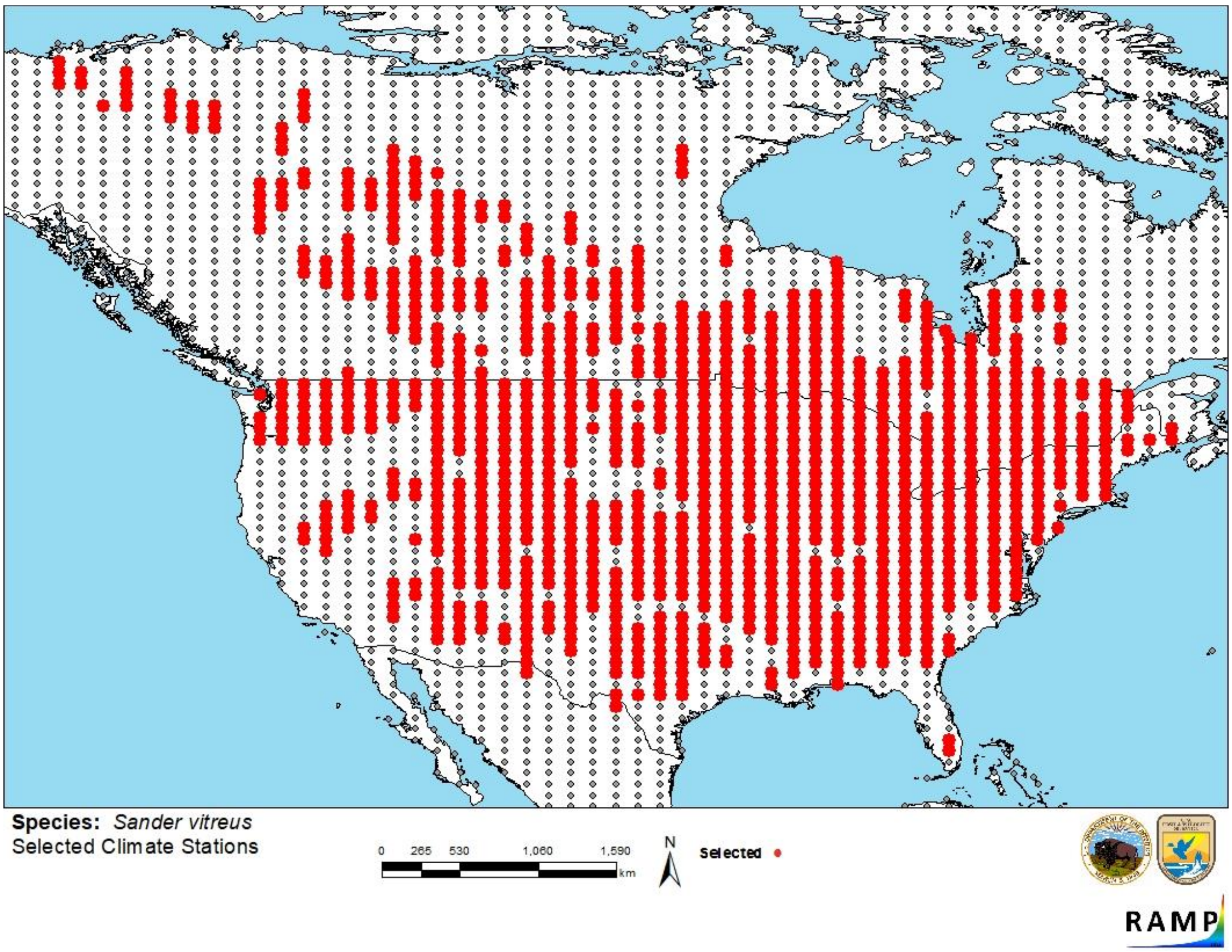

Figure 5. RAMP (Sanders et al. 2018) source map showing weather stations in North America selected as source locations (red; Canada, United States) and non-source locations (gray) for *Sander vitreus* climate matching. Source locations from BISON (2019), Fuller and Neilson (2019), and GBIF Secretariat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

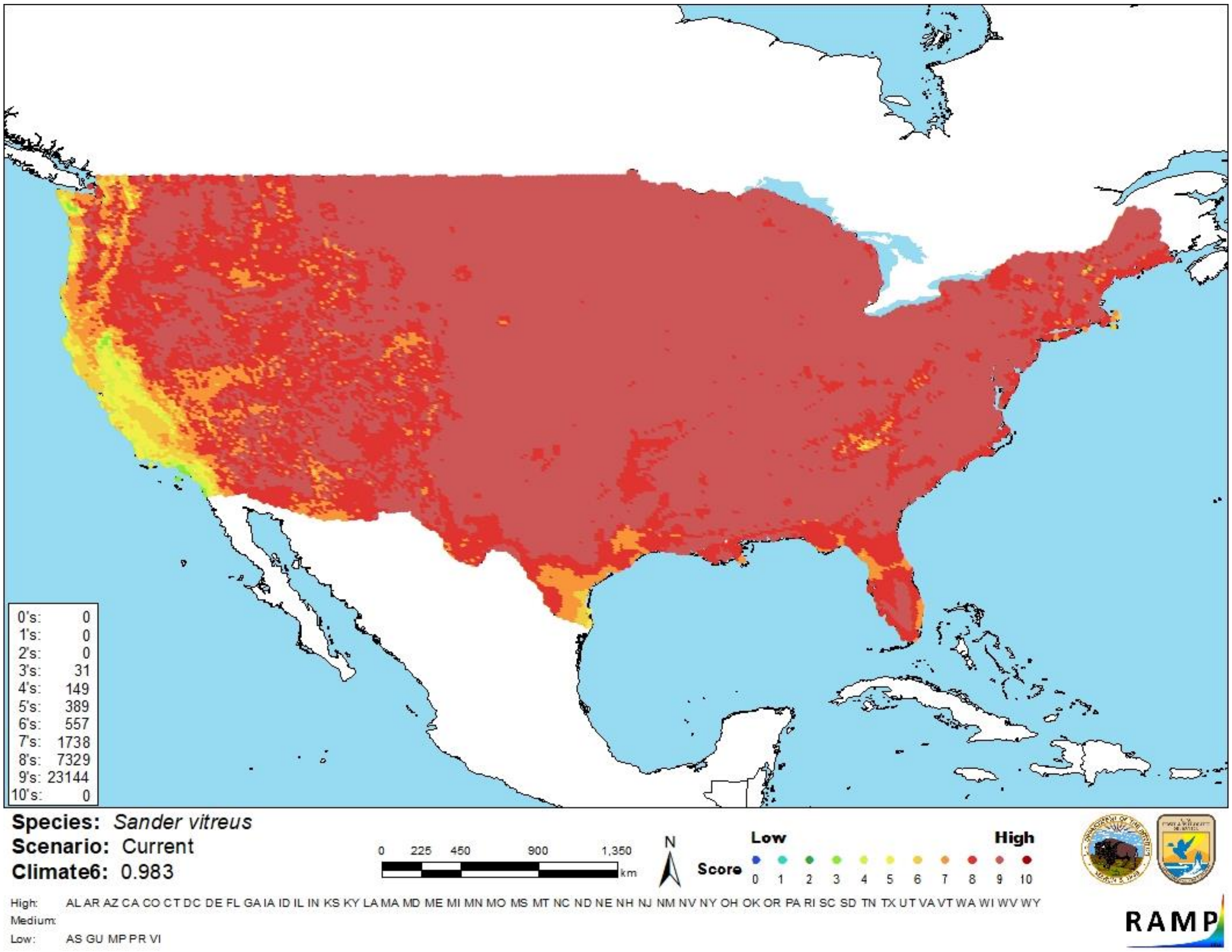

Figure 6. Map of RAMP (Sanders et al. 2018) climate matches for *Sander vitreus* in the contiguous United States based on source locations reported by BISON (2019), Fuller and Neilson (2019), and GBIF Secretariat (2019). Counts of climate match scores are tabulated on the left. 0 = Lowest match, 10 = 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

The certainty of assessment is high. There is quality information available from scientific and peer-reviewed sources regarding the biology, ecology, introduction history, and impacts of introduction for *Sander vitreus*. The global distribution of the species is well documented.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Walleye (*Sander vitreus*) is a large predatory fish native to the Arctic, Great Lakes, and Mississippi River basins in North America. It is a highly prized recreational species which has resulted in intentional non-native introductions in the United States. There is some aquaculture of this species and it is susceptible to viral haemorrhagic septicaemia virus and can be a carrier for *Ranavirus* sp., both of which are OIE-reportable diseases. The history of invasiveness is high. There is a long history of intentional (legal and illegal) introductions, contamination of other intentional introductions, and spread from initial introduction areas outside of the native range in North America. In the western United States, *S. vitreus* has had a negative impact on native fish and crayfish species, some of which are under recovery plans. The overall climate match is high, both in its native range in the Great Lakes and Mississippi Rivers, and in areas outside its native range. There were very few areas in the contiguous United States that did not have a high climate match. The certainty of assessment is high. The overall risk assessment category is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): High**
- **Remarks/Important additional information:** Infection with viral haemorrhagic septicaemia virus, and Ranavirus sp. Refer to "Means of Introduction in the United States" in Section 2 for a caveat on stocking by State fishery managers to achieve fishery management objectives.
- **Overall Risk Assessment Category: High**

9 References

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

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