European Smelt *(Osmerus eperlanus)*
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2015
Revised, January 2017
Web Version, 09/14/2017

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1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2016):

"North Atlantic: White Sea southward to western coasts of France including Baltic Sea, southern North Sea and British Isles [McAllister 1984]; the Gironde estuary is the southern limit of his distribution [Rochard and Elie 1994]. Landlocked populations in lakes of coastal areas of North, Baltic, White and Barents Sea. North to about 68° N in Scandinavia [Kottelat and Freyhof 2007]. The former nominal subspecies *Osmerus eperlanus eperlanus* is recorded from the coasts and drainage of White and Barents Seas westward through Baltic Sea to Denmark and it is primarily lacustrine [McAllister 1984]. The former subspecies *Osmerus eperlanus schonfoldi* (Rutty 1772) is sympatric with the nominate subspecies in parts of Poland, Denmark and the Baltic, and it is primarily anadromous [McAllister 1984]."

Status in the United States

From Nico and Fuller (1999):

"Smith (1833:148) described an early but unsuccessful introduction of smelt into a freshwater pond, but he does not mention the location, although it was likely in Massachusetts. He originally identified the fish as *Osmerus eperlanus*, but it is more likely that the species involved was what is currently recognized as rainbow smelt (*O. mordax*)."

From Froese and Pauly (2016):

"Alaska	ALK	questionable	[Quast and Hall 1972]"

Means of Introductions in the United States

No information available.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2017):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Protacanthopterygii
Order Osmeriformes
Suborder Osmeroidei
Superfamily Osmeroidea
Family Osmeridae
Genus *Osmerus* Linnaeus, 1758
Species *Osmerus eperlanus* (Linnaeus, 1758) – smelt"

"Current Standing: valid"

Size, Weight, and Age Range

From Froese and Pauly (2016):

"Maturity: L_m 12.8 range ? - ? cm

Max length : 45.0 cm TL male/unsexed; [McAllister 1984]; common length : 16.5 cm TL male/unsexed; [Muus and Dahlström 1967]; max. published weight: 178.00 g [Koli 1990]; max. reported age: 10 years [Muus and Dahlström 1967]

Environment

From Froese and Pauly (2016):

"Marine; freshwater; brackish; pelagic-neritic; anadromous [Riede 2004], usually ? - 50 m [McAllister 1984]"

From Fusaro et al. (2015):

"This species lives in pristine, oligotrophic habitats (Scandinavian inland lakes) as well as heavily-polluted habitats (lower Elbe River), though may have health issues (e.g., granulomas and physical deformities) in more polluted areas (Anders and Möller 1987, Pohl 1990). […] *Osmerus eperlanus* does poorly in eutrophic waters, in part because associated siltation may lead to inconsistent recruitment of fish through spawning grounds (Winfield et al. 1996, Kangur et al. 2007). *Osmerus eperlanus* can be sensitive to cyanobacteria blooms (Kangur et al. 2007) and do not tolerate low oxygen (<2 mg O2/l) in warm water temperatures (Kangur et al. 2007), low growth at <4.5 mg O2/l (Sepulveda 1994). However, they can inhabit turbid river stretches (Lyle and Maitland 1997), and this species been the dominant catch (91.8-100%) in eutrophic and turbid lakes in Finland (Reckel et al. 2003, Peltonen et al. 2006)."

Climate/Range

From Froese and Pauly (2016):

"Temperate, preferred 10°C [Cheung et al. 2013]; 70°N - 43°N, 9°W - 55°E"

From Fusaro et al. (2015):

"They […] are a coldwater species that does not tolerate surface water temperatures over 20°C for long periods (~80 days) (Kangur et al. 2007). However, these fish are able to migrate to deeper, cooler waters during the summer (Power and Attrill 2007)."

Distribution Outside the United States

Native

From Froese and Pauly (2016):

"North Atlantic: White Sea southward to western coasts of France including Baltic Sea, southern North Sea and British Isles [McAllister 1984]; the Gironde estuary is the southern limit of his distribution [Rochard and Elie 1994]. Landlocked populations in lakes of coastal areas of North, Baltic, White and Barents Sea. North to about 68° N in Scandinavia [Kottelat and Freyhof 2007]. The former nominal subspecies *Osmerus eperlanus eperlanus* is recorded from the coasts and drainage of White and Barents Seas westward through Baltic Sea to Denmark and it is primarily lacustrine [McAllister 1984]. The former subspecies *Osmerus eperlanus schonfoldi* (Rutty 1772) is sympatric with the nominate subspecies in parts of Poland, Denmark and the Baltic, and it is primarily anadromous [McAllister 1984].”

Introduced

From Korlyakov and Mukhachev (2009):

“In the 1930s and 1960s the smelt was introduced in 47 lakes in Karelia, the Kola Peninsula, and the South Urals. In the northwest it naturalized in Segozero, Seletskoe Lake, Vygozero, etc. (Burmakin, 1963; Smirnova Stefanovskaya, 1967). In the South Urals, the smelt was introduced from 1930 to 1935 in eight water bodies of the mountain forest zone: lakes Uvildy, Bolshoi Kasli, Bolshoi Kisegach, Turgoyak, Chebarkul, Bolshoe Miyassovo, Kuyash, and Agrazinskoe Reservoir (Karabak, 1930; Podlesnyi, 1939). […] The result of all introductions of the European smelt to water bodies of the South Urals was recognized as negative in spite of the catch in Bolshoi Kasli Lake of a one year old specimen (Tolchaniov, 1938; Podlesnyi, 1939). Later, the smelt occurred nowhere in catches. The smelt was not found in other hydrologically similar lakes of the Chelyabinsk oblast (Uvildy, Turgoyak) where it was repeatedly introduced. The introduction of smelt to the Iriklinskoe Reservoir (Orenburg oblast) in the 1960s also failed (Kozmin and Matyukhin, 1964) […] Today, the self-reproducing population of the European smelt in Kisegach Lake, where 2462500 eggs was transported in 1930, has existed for over 75 years (Korlyakov and Kolenova, 2005; Korlyakov and Rechkalov, 2007).”

From Fusaro et al. (2015):

“*Osmerus eperlanus* has been introduced into several Scandinavian lakes, but not elsewhere. This species has not been reported to spread from the landlocked lakes into which it has been introduced.”

Means of Introduction Outside the United States

From CABI (2017):

“There are relatively few records of intentional introductions of *O. eperlanus* for conservation or fishery development purposes.”

From Sterligova and Ilmast (2012):

“Smelt was introduced into some lakes as an object of feeding of predatory fish (Sterligova and Ilmast, 2009).”

Short Description

From Froese and Pauly (2016):

"Dorsal spines (total): 0; Dorsal soft rays (total): 9-12; Anal spines: 0; Anal soft rays: 12 - 16; Vertebrae: 55 - 62. Body long and slim [McAllister 1984]. Head rather pointed [McAllister 1984]. Snout pointed [McAllister 1984]. Upper jaw reaching to hind margin of eye, lower jaw projecting a little [McAllister 1984; Rochard and Elie 1994]. Teeth in lower jaw larger than those of upper, strong teeth on tongue and canines on vomer [McAllister 1984]. Dorsal fin origin behind base of pelvic fins [McAllister 1984]. Incomplete lateral line is developed near the head [Rochard and Elie 1994]. Dorsal side light olive green, flanks silver stripe, belly creamy white [McAllister 1984]."

Biology

From Froese and Pauly (2016):

"Inhabits marine waters, estuaries and large lakes [Kottelat and Freyhof 2007]. A midwater species, rarely far from shore, primarily anadromous in the west and lacustrine in the east; shoaling at least during spawning season [McAllister 1984]. The essential part of its life is spend in the estuarine zone, with just short incursions in the littoral zone [Rochard and Elie 1994]. The migratory form is grouping together in the estuarine zone for reproduction [Rochard and Elie 1994]. Enters the rivers for spawning on sandy or gravely bottoms [Kottelat 1997]. Spawns in tributaries of lakes or along shallow shores of lakes and rivers on sand, gravel, stones and plant material, preferably in fast-flowing water [Kottelat and Freyhof 2007]. Reproduction takes place between February and May, depending on the water-temperature [Rochard and Elie 1994]. Produces 8,000-50,000 yellow eggs with a diameter of 0.6-0.9 mm which adhere to the bottom [Rochard and Elie 1994; Kottelat 1997]. Eggs hatch in 3-5 weeks and the larvae descend to the estuarine zone [Rochard and Elie 1994; Kottelat 1997]. Feeds on shrimps and small crustaceans; larger individuals feed on small fish [Rochard and Elie 1994; Kottelat 1997]. […] Smells like cucumber [Bigelow et al. 1963; Rochard and Elie 1994]."

"Spawns in lower reaches of streams, deeper parts of lake in sand bottoms [Muus and Dahlström 1967]. Spawning takes place with the melting of snow [Muus and Dahlström 1967]. Many individuals die after the spawning [Muus and Dahlström 1967]. Migratory form generally with rapid growth, more eggs, live longer; individuals feeding on fish grow bigger [Muus and Dahlström 1967]. Becomes sexually mature in 3-4 years (15-18 cm) in brackish populations, 1-2 years (8-10 cm) in freshwater."

From Fusaro et al. (2015):

"*Osmerus eperlanus* are opportunistic feeders, consuming copepods and cladocerans (Northcote and Hammar 2006). With increasing size and age, its food changes to larger crustaceans and in some cases to fish (Nilsson 1979, Svärdson et al. 1988). According to Sterligova (1979) Smelt also eats Vendace Whitefish larvae and fry (Jurvelius et al. 2005). Young *O. eperlanus* are efficient planktivorous fish that affect the size structure of the zooplankton community easily by size selective predation (van Densen 1985)."

"*O. eperlanus* exhibits relatively high rates of hermaphroditism: 2.6% of fish from the Elbe were hermaphroditic, and capable of self-fertilization, with other reports at 3.7% (Hutchinson 1983)."

From CABI (2017):

"There can be large variations in the year class abundance of *O. eperlanus*, depending largely on mortality rates during incubation and early development (Shpilev et al., 2005). Obtaining accurate population estimates are difficult for this species, particlarly given that they often move into spawning sites and leave quickly once that is completed. There are few data on actual population size but Lyle and Maitland (1997) estimated the adult population in the River Cree in the 1960s to be at least 60,000. Later studies, such as Ribbens and Graham (2004), estimated the same population to comprise >25,000 fish."

Human Uses

From Froese and Pauly (2016):

"Fisheries: commercial"

From CABI (2017):

"Several commercial fisheries for *O. eperlanus* still exist within the UK and these rely mainly on their vulnerability during the short spawning run to catch them (sometimes in enormous numbers) in traps and nets (Maitland, 2003). Only three populations are known to remain in Scotland, yet all have been the subject of fisheries until recently. On the River Cree in some years up to six tonnes were taken from the spawning run - probably a high percentage of the population there and undoubtedly a threat to its existence. In some parts of Europe *O. eperlanus* is caught in the estuaries in drift nets and trawls (Groot, 1989) and sold either fresh or smoked (Shpilev et al., 2005). In some countries, much of the catch is sold as bait for pike (*Esox lucius*)."

Diseases

From Fusaro et al. (2015):

"*Osmerus eperlanus* is a paratenic host for the parasitic nematode, *Anguillicola crassus* (causing swimbladder lesions); in Europe, *Osmerus eperlanus* transmits the parasite when preyed upon by eels (Haenen et al. 1994)."

"*Osmerus eperlanus* is the most important fish intermediate/transport host of the sealworm *Pseudoterranova dedpiens* in the Elbe estuary and probably also in adjacent coastal waters of the Wadden Sea (Rohlwing et al. 1998, Karl 2006)."

From Bailly (2008):

"Host of *Caligus elongatus* von Nordmann, 1832 (parasitic: ectoparasitic)
Caligus macarovi Gusev, 1951 (parasitic: ectoparasitic)
Caligus rapax Milne Edwards, 1840 (parasitic: ectoparasitic)
Diphyllobothrium dendriticum (Nitzsch, 1824) (parasite)

Diphyllobothrium ditremum (Creplin, 1825) (parasite)
Ergasilus briani Markevich, 1933 (parasitic: ectoparasitic)
Ergasilus centrarchidarum Wright R., 1882 (parasitic: ectoparasitic)
Ergasilus osmeri Beneden, 1870 (parasitic: ectoparasitic)
Ergasilus sieboldi Nordmann, 1832 (parasitic: ectoparasitic)
Lepeophtheirus salmonis (Krøyer, 1837) (parasitic: ectoparasitic)
Lepeophtheirus stroemii (Baird, 1847) (parasitic: ectoparasitic)
Lernaeocera branchialis (Linnaeus, 1767) (parasitic: ectoparasitic)
Proteocephalus tetrastomus (Rudolphi, 1810) (parasite)"

From Korlyakov and Mukhachev (2009):

"In the smelt from Bolshoi Kisegach Lake and Ladoga lake, *Diplostomum spathaceum*, an obligate parasite, is found, and infestation was 80 and 100%, respectively. Besides, in the Ladoga smelt, nematodes and microsporidia are found."

From Sterligova and Ilmast (2012):

"Beginning from 1961, a considerable decrease in the numbers of the smelt was observed, and towards 1989, its catch declined to 20 t. It is possibly related to the infestation of smelt with parasite *Glugea*. In 1979, still another large smelt with parasite cysts was found, and since 1981, a 100% infestation was already recorded (Ieshko and Malakova, 1982). Our observations demonstrated that parasite *Glugea* is capable of causing a parasitic castration. For instance, if egg weight was 210 mg, cyst weight was 240 mg. The number of cysts on the eggs varied from 1 to 1000 (sample of 350 fish). Apparently, this parasite has become the basic regulator of smelt numbers in the water body. In the period of 1989 to 2003, smelt catches stabilized at a level of 50 t/year, and its infestation declined."

From Hanson et al. (2011):

"**Virus name (abbreviation), Common name (abbreviation)**	**Host(s)**	**Disease**	**Ref.**
European Smelt HV, Smelt papillomatous virus, HV of *Osmerus eperlanus*	European smelt *Osmerus eperlanus*	Papillomas and Hyperplastic skin lesions on dorsal fin- virions are comet shaped	[Anders and Moller 1985; Jakob et al. 2010]"

Threat to Humans

From Froese and Pauly (2016):

"Harmless"

From Fusaro et al. (2015):

"*Osmerus eperlanus* is the most important fish intermediate/transport host of the sealworm *Pseudoterranova dedpiens* in the Elbe estuary and probably also in adjacent coastal waters of the Wadden Sea (Rohlwing et al. 1998, Karl 2006). Sealworms are potentially capable of causing anisakiasis-like symptoms in humans (e.g. abdominal pain, nausea, fever) when consumed in lightly cooked or raw fish products (pseudoterranovosisi e.g. Rae 1963, Margolis 1977, Yu et al. 2001, McClelland 2002, Audicana and Kennedy 2008). However, this parasite requires seals to complete its life cycle (Kuhn et al. 2013)."

3 Impacts of Introductions

From Sterligova and Ilmast (2012):

"An increase in the smelt catch in Syamozero took place against the background of a decrease in the catch of coregonids (from 105 to 0.015 g). Smelt practically withdrew European cisco and whitefish from the water body, by eating their larvae. […] Beginning from 2005, catches of smelt began again to decrease, and in 2010 they comprised only 2 t, while catch of European cisco increased to 43 t. During recent years, in the drainage basin of Syamozero, ameliorative and agricultural works were stopped. The delivery of biogenes to the lake considerably decreased, which led to the improvement of the state of the whole ecosystem and positively affected conditions of reproduction of coregonids. European cisco having a shorter life cycle and earlier maturation (in the first to second years of life) began to rapidly restore its numbers. Whitefish population with a longer life cycle and later maturation (in the fourth to fifth years of life) is still in a depressed state."

"The introduction of smelt into the studied water bodies led to the rearrangement of food chains. In the feeding of predatory fish of Syamozero, European cisco dominated by weight (Balagurova, 1963) from 1935 to 1970, and smelt dominated from 1973 to 2000 (Popova, 1982; Sterligova et al., 2002). With the introduction of smelt, the main flow of substances and energy went along the planktonic pathway with the replacement of European cisco by smelt (Sterligova, 1979; Reshetnikov et al., 1982; Sterligova et al., 2001). Beginning from 2003 and up to the present time, European cisco again dominates."

"Smelt has become an important object of feeding for predatory fish, mainly of zander. At the same time, it itself eats the eggs and juveniles of coregonids in considerable amounts."

From CABI (2017):

"Rainbow smelt *O. mordax*, introduced to the North American Great Lakes, has caused significant ecosystem shifts since its arrival there in the early part of the twentieth century (e.g. Rooney and Paterson, 2009). By contrast, introduced *O. eperlanus* has not shown the same negatively impacted native fish communities (Korlyakov and Mukhachev, 2009). However, one of the few waters where the introduction of *O. eperlanus* has caused problems is Syamozero Lake in Karelia, northwest Russia (Ieshko et al., 2000). Here, the accidental introduction led to the development of a large population and this caused serious changes in fish community structure and trophic relationships in this lake."

From Ieshko et al. (2000):

"The European smelt *Osmerus eperlanus* had been accidentally introduced into the ecosystem of the Syamozero Lake (Karelia). The population of this species has achieved a high density and caused serious changes in the structure and trophic relationships of fish community of the Syamozero ecosystem. The microsporidia *Glugea hertwigi* Weisenberg, 1921 has become a new and super-dominant parasite of the european smelt in this ecosystem. The invasion of microsporidia has caused a mass death of fishes, that has led to changes in population structure of the smelt and lowered a fish catch. The present study suggests to show a role of parasites in the ichthyocenosis structure regulation in freshwater ecosystem."

4 Global Distribution

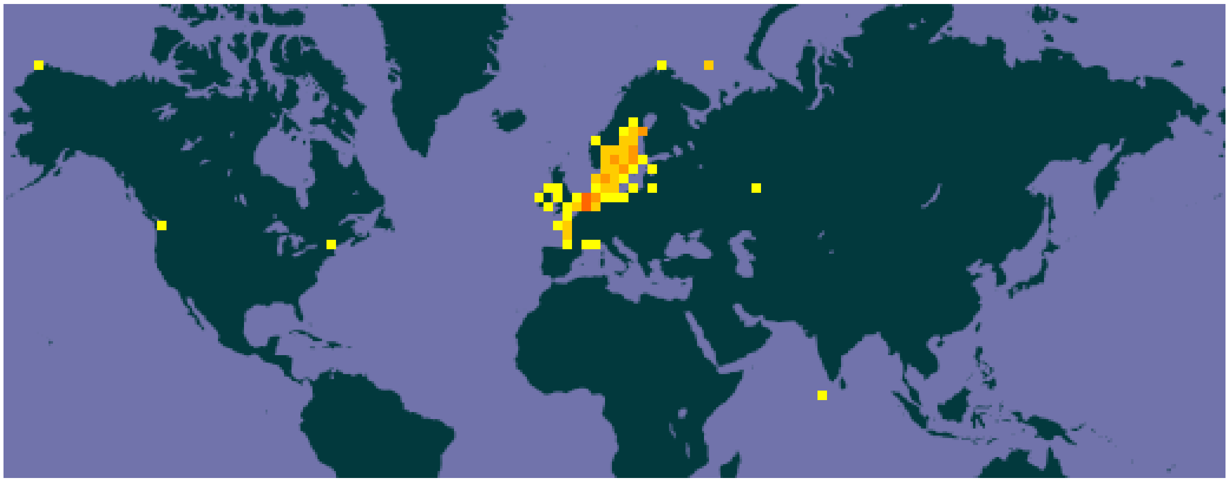

Figure 1. Known global established locations of *Osmerus eperlanus*. Map from GBIF (2016). Locations in the Indian Ocean, North America, the Barents and Mediterranean Seas, and on the north coast of Norway do not represent established populations (see Status in the United States, and Distribution Outside the United States, above) and were not included in climate matching.

5 Distribution Within the United States

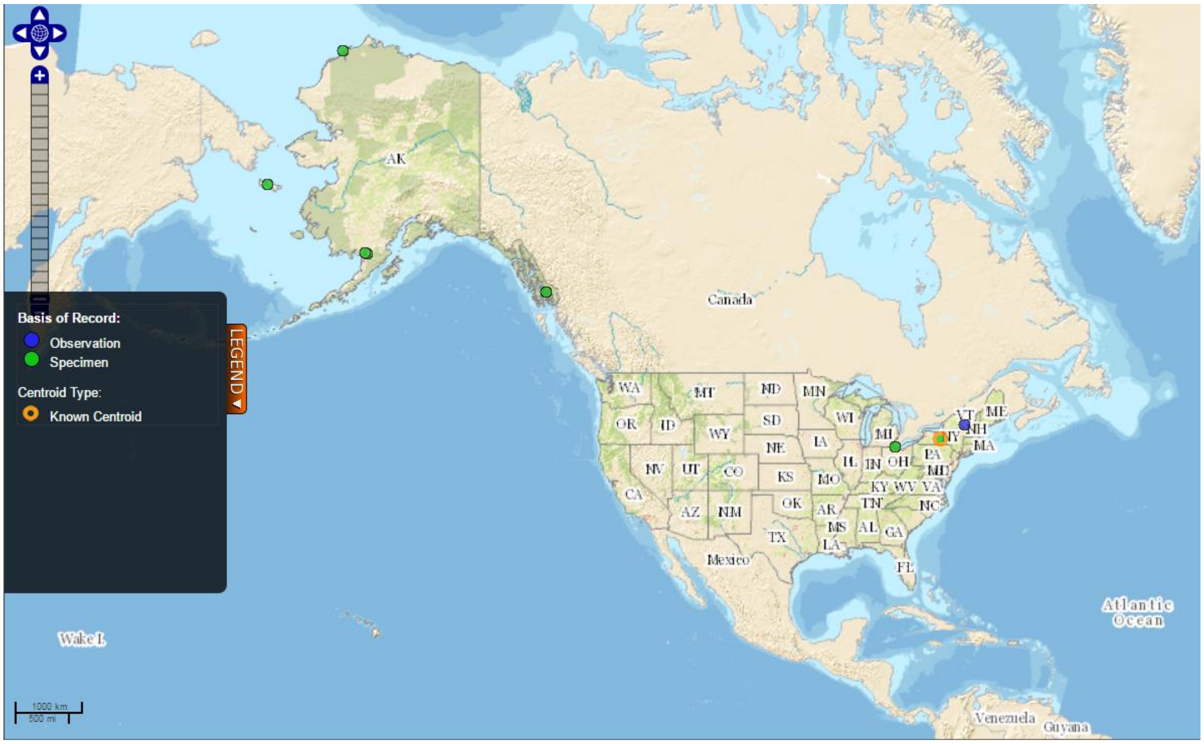

Figure 2. Known occurrences of *Osmerus eperlanus*. Map from USGS (2016). None of the points represent confirmed established populations (see Status in the United States, above) and they were not included in climate matching.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2014; 16 climate variables; Euclidean Distance) was high in the north-central U.S. as far east as the Great Lakes Superior and Michigan, the northern Washington coastline, and the eastern Rocky Mountains. Medium matches covered the north from western New England to the eastern Pacific Northwest. The climate match was low in the South and along the West Coast. Climate 6 proportion indicated that *O. eperlanus* has a high climate match with the contiguous United States. Proportions >0.103 represent a high climate match; the Climate 6 proportion of *O. eperlanus* was 0.181.

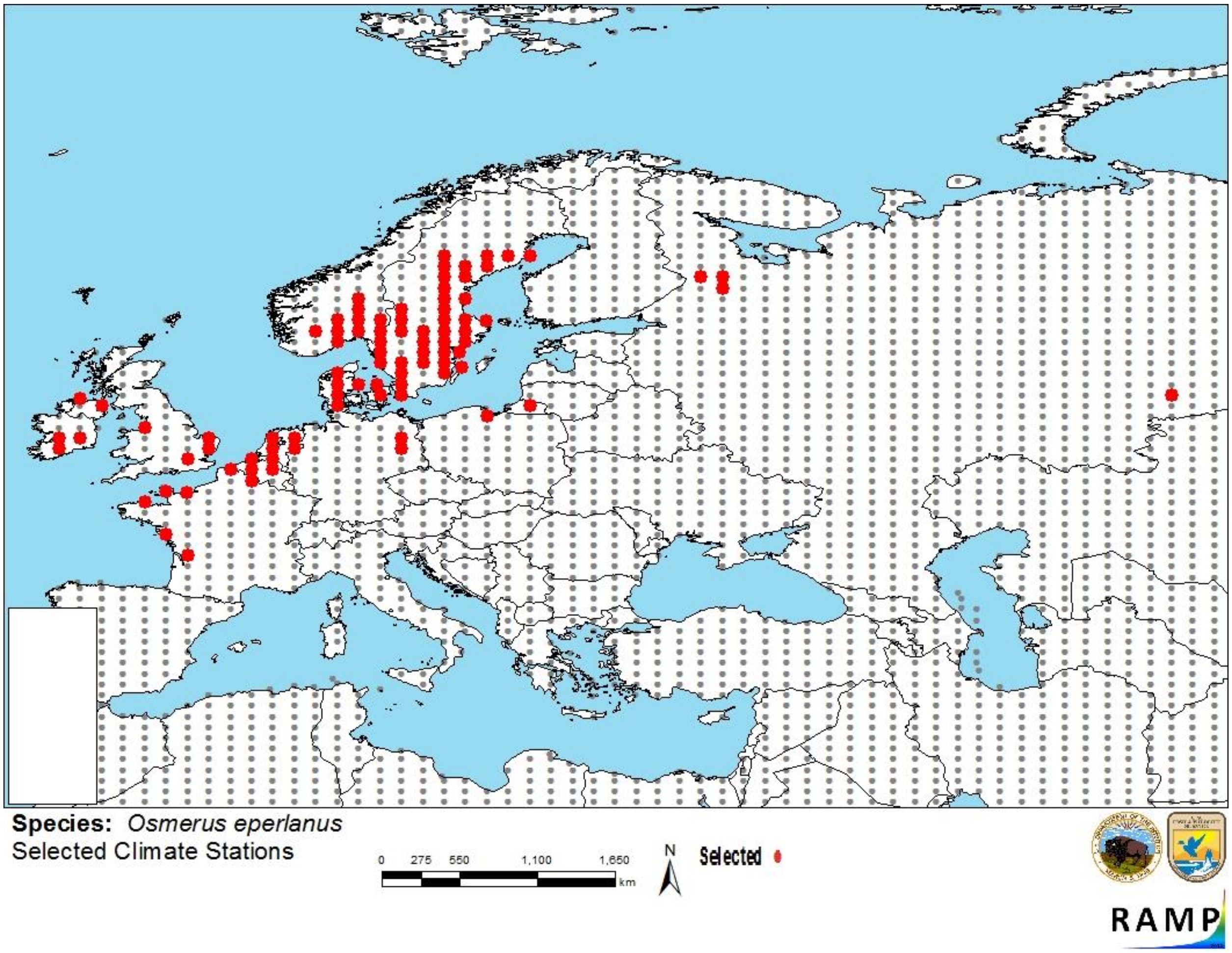

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *Osmerus eperlanus* climate matching. Source locations from GBIF (2016) and Sterligova and Ilmast (2012; northwestern Russia).

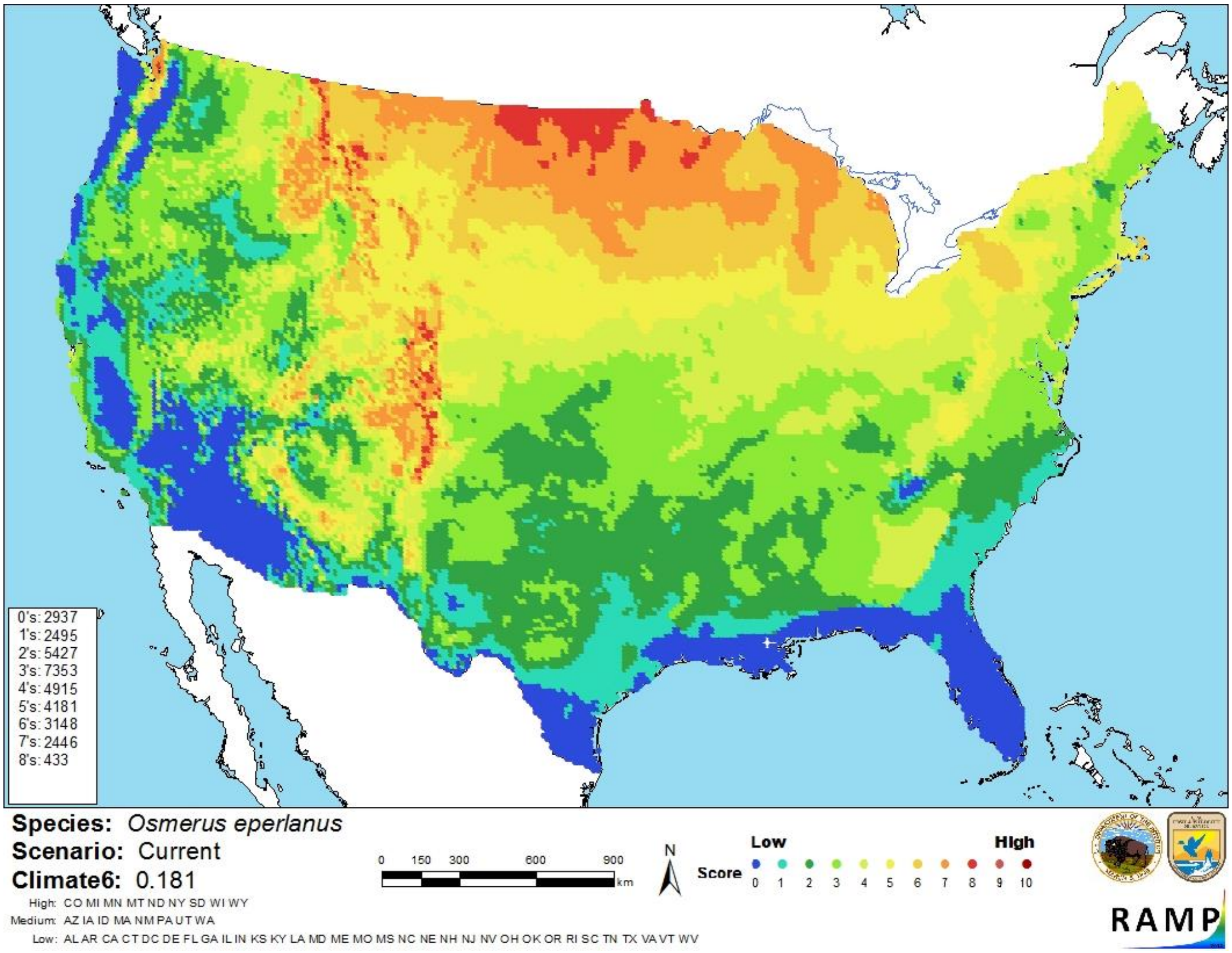

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Osmerus eperlanus* in the continental United States based on source locations reported by GBIF (2016) and Sterligova and Ilmast (2012; northwestern Russia). 0=Lowest match, 10=Highest match. Counts of climate match scores are tabulated on the left.

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

Information on the biology of *Osmerus eperlanus* is readily available and the species distribution is well-described in Europe. However, there is little information available on occurrences in the U.S. Two peer-reviewed studies were located that describe impacts of introduction; most other introductions have failed, providing no further information on impacts. Certainty of this assessment is medium.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Osmerus eperlanus is a species of smelt native to northern and northwestern Europe and the British Isles. Most populations are anadromous, but landlocked populations also exist. This species has a documented history of invasiveness in deep cold lacustrine systems in Russia. In one Russian lake, substantial predation of *O. eperlanus* on coregonid larvae initially reduced the coregonid catch by a factor of almost 1000, and the whitefish population has still not recovered even though the population of *O. eperlanus* has declined. In another lake, introduction of *O. eperlanus* caused substantial changes to fish community structure and trophic relationships. However, most attempts at introduction of *O. eperlanus* have failed. Some sources suggest a small number of occurrences in the U.S., but no detailed information is available on these occurrences and they do not appear to represent established populations. Climate matching indicated the contiguous U.S. has a high climate match with established *O. eperlanus* populations. Overall risk posed by this species is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Medium**
- **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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10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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