

European Eel (*Anguilla anguilla*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2011
Revised, September 2018, January 2019
Web Version, 1/30/2019



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<https://www.inaturalist.org/photos/8569362>. (August 2018).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2018):

“Atlantic Ocean: Atlantic coast from Scandinavia to Morocco; Baltic, Black and Mediterranean Seas; rivers of North Atlantic, Baltic and Mediterranean seas [Deelder 1984; Rochard and Elie 1994].”

From Jacoby and Gollock (2014):

“*Anguilla anguilla* has been shown to be distributed from North Cape in Northern Norway, southwards along the coast of Europe, all coasts of the Mediterranean and on the North African Coast (Schmidt 1909, Dekker 2003). It very rarely enters the White and Barents seas, but it has been recorded eastward to the Pechora River in northwest Russia. The species occurs in low abundance in the Black Sea where it migrates east to the Kuban drainage (occasional individuals reach the Volga drainage through canals), in northern Scandinavia and eastern Europe. [...] It also widely occurs in most inland waters of Europe (e.g. lakes).”

Status in the United States

From Schofield and Fuller (2018):

“Reported from California but failed.”

“Because of potential impacts, California has made the importation, sale, or culture of live anguillids illegal. According to Williamson and Tabeta (1991), the Pacific Ocean near California does not seem to have an area suitable for *Anguilla* spawning, and, therefore, eels introduced into the western United States probably would not reproduce successfully.”

No information could be found about the trade status of this species in the United States.

Means of Introductions in the United States

From Schofield and Fuller (2018):

“Skinner (1971) suggested that some California anguillids may have arrived in ballast water of foreign ships. However, McCosker (1989) discounted ballast water as a vector. In general, eels caught in California waters are believed to have been imported by Japanese or Chinese restaurants, or by fish farms, and the eels either escaped or were released (McCosker 1989; Williamson and Tabeta 1991).”

Remarks

From Schofield and Fuller (2018):

“There is still some uncertainty associated with the identification of the two California *A. anguilla* specimens. Because each had 114 vertebrae, Williamson and Tabeta (1991) indicated that these fish cannot be reliably distinguished from *A. japonica*.”

From Jacoby and Gollock (2014):

“Red List Category & Criteria: Critically Endangered [applicable to the Eurasian countries where the species is native]”

“The causes of the declining recruitment rates [in the native range] are still not fully understood (Dekker 2007), and while there are many hypotheses, the significance of any single threat, or the synergy it may have with other threats is still poorly understood.”

“Concerns over the impact international trade was having on European Eel led to it being listed in Appendix II of CITES in 2007. This listing came into force on 13 March 2009 – since then any international trade in this species needs to be accompanied by a permit. In December 2010, however, the European Union (EU) decided to ban all imports and exports of European Eel to and from the EU, as authorities felt they were unable to determine that trade would not be detrimental to the conservation of the species (a requirement for issuance of permits for CITES Appendix II-listed species).”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

“Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Elopomorpha
Order Anguilliformes
Suborder Anguilloidei
Family Anguillidae
Genus *Anguilla*
Species *Anguilla anguilla* (Linnaeus, 1758)”

From Eschmeyer et al. (2018):

“Current status: Valid as *Anguilla anguilla* (Linnaeus 1758). Anguillidae.”

Size, Weight, and Age Range

From Froese and Pauly (2018):

“Maturity: Lm ?, range 45 - 65 cm
Max length : 122 cm TL male/unsexed; [Verreycken 2011]; 133.0 cm TL (female); common length : 35.0 cm TL male/unsexed; [Bauchot 1986]; common length :50 cm TL (female); max. published weight: 6.6 kg [Dekker et al. 1998]; max. published weight: 6.6 kg; max. reported age: 88 years [Bobick and Peffer 1993]”

“Average life span is usually 15-20 years [Narberhaus et al. 2012].”

From Jacoby and Gollock (2014):

“There is considerable geographic variation in mean length at metamorphosis of male and female European Eels (Vøllestad 1992). Dekker et al. (1998) produced a paper describing the extreme sizes in each of the life stages of the European Eel from data at a long term capture locality in the Netherlands (Sizes (cm): Min – Max, Glass eels: 5.4 – 9.2, Yellow: 6.9 – 133.0, Silver (M): 21.2 – 44.4, Silver (F): 26.4 – 101.0).”

“The age at which silver eels mature and undertake their spawning migration is hugely variable and dependent on latitude and temperature of the environment in which they have grown, physical barriers that block migration routes, growth rate and sex differences. From the data available, lower bound estimates for average length of the continental growth phase are approximately 3-8 years for males and 4-5 years for females and upper bound estimates approximately 12-15 years for males and 18-20 for females (Acou et al. 2003, Froese and Pauly 2005, Durif et al. 2009). Assessment of available data on generation length during the IUCN Red List process highlighted that defining a single figure for species such as eels was extremely difficult. Factors that can significantly affect this parameter include longitude and latitude, sex and habitat quality. Fifteen years was agreed upon after this analysis and it is important to indicate that this is inclusive of an estimated two year larval migration and 0.5 year spawning migration of silver eels.”

Environment

From Froese and Pauly (2018):

“Marine; freshwater; brackish; demersal; catadromous [Riede 2004]; depth range 0 - 700 m [Matallanas 2005]. [...] 4°C - 20°C [Baensch and Riehl 1991; assumed to be recommended aquarium temperature range]”

“Occurs at temperatures ranging from 0-30°C [Deelder 1984; water temperature range in the wild].”

Climate/Range

From Froese and Pauly (2018):

“Temperate; [...] 75°N - 8°N, 82°W - 45°E [Wolfram-Wais et al. 1999]”

Distribution Outside the United States

Native

From Froese and Pauly (2018):

“Atlantic Ocean: Atlantic coast from Scandinavia to Morocco; Baltic, Black and Mediterranean Seas; rivers of North Atlantic, Baltic and Mediterranean seas [Deelder 1984, Rochard and Elie 1994].”

From Jacoby and Gollock (2014):

“*Anguilla anguilla* has been shown to be distributed from North Cape in Northern Norway, southwards along the coast of Europe, all coasts of the Mediterranean and on the North African Coast (Schmidt 1909, Dekker 2003). It very rarely enters the White and Barents seas, but it has been recorded eastward to the Pechora River in northwest Russia. The species occurs in low abundance in the Black Sea where it migrates east to the Kuban drainage (occasional individuals reach the Volga drainage through canals), in northern Scandinavia and eastern Europe. [...] It also widely occurs in most inland waters of Europe (e.g. lakes).”

Introduced

From Froese and Pauly (2018):

“Continuous introductions to Asia and South and Central America.”

Froese and Pauly (2018) report that *Anguilla anguilla* has been introduced to Eritrea, Turkey, Slovakia, Kenya, Jordan, Israel, Iran, Romania, Finland, Japan, Taiwan, Brazil, Indonesia, and China. It is reported as either “not established” or “probably not established” in all these countries except for Turkey, Romania, and Finland (“established;” *A. anguilla* is also native to parts of all three countries), Iran (“probably established”) and China (“unknown”).

From Okamura et al. (2002a):

“We collected migrating silver European eels in the coastal waters of Japan [...].”

From Jacoby and Gollock (2014):

“For several decades prior to an EU-wide ban on export in 2010, *A. anguilla* was also exported to Asia for seed stock in eel farms (Ringuet et al. 2002). This species may well have been introduced in some parts of Asia (through escape or release from farms), however these are not thought to contribute to the population [...].”

From Seegers et al. (2003):

“Lake Victoria system; introduced in the catchment [...]; normally not reproducing and thus expected not to survive in the wild in the future; [...].”

Means of Introduction Outside the United States

Regarding introduction to Iran, Froese and Pauly (2018) report that *A. anguilla* is a “Recent immigrant through the Volga-Baltic waterway and also introduced.” Froese and Pauly (2018) also report that the purpose of introduction to Turkey was aquaculture.

From Seegers et al. (2003):

“Lake Victoria system; [...] (escaped some years ago from fish farms in Uganda); [...].”

From Okamura et al. (2002a):

“Only two eel species, *A. japonica* (Japanese eel) and *A. marmorata* (giant mottled eel), occur naturally in Japanese waters. Probably as a result of escape from aquaculture operations or intentioned release (Tabeta et al., 1977; Zhang et al., 1999), recently the silver European eel has also been found in these waters (Zhang et al., 1999; Aoyama et al., 2000; Okamura et al., 2001).”

Short Description

From Schofield and Fuller (2018):

“The body is elongate, cylindrical with small, slit-like gill openings. One pair of pectoral fins, no pelvic fins. No spines in the anal or dorsal fins. Vertebrae count 110-120. The lower jaw is slightly longer than the upper. The dorsal and anal fins are confluent around the caudal, generally with >500 soft rays. Berg (1964) gave the following fin-ray counts: 243-275 dorsal rays, 175-249 anal rays, 15-21 pectoral rays. Dorsal fin origin well behind pectoral fins. Anal fin origin slightly behind anus; well back from origin of dorsal fin. May attain 1.5 m.”

From Froese and Pauly (2018):

“Greenbrown colored [Rochard and Elie 1994].”

“Eel larvae (leptocephali) are transparent ribbon-like. [...] They are transformed into glass eels (6-8 cm length, cylindrical in shape and transparent to slightly pigmented in colour). [...] Yellow eels eventually lose their pigmentation, becoming dark dorsally and silver ventrally (called silver eels). Silver eels are also characterized by a clear contrasting black lateral line and enlarged eyes [Bauchot 1986].”

Biology

From Jacoby and Gollock (2014):

“The species is facultatively catadromous, living in fresh, brackish and coastal waters but migrating to pelagic marine waters to breed. While there is some understanding of the eel’s continental life history, relatively little is known about its marine phase. The migrations in the European Eel’s life cycle are the longest and most oceanographically complex of the anguillid species (Tsukamoto et al. 2002). There are a number of phases in an eel’s life that have specific terminology; the leaf-shaped marine larval stage is referred to as leptocephalus; these become glass eels as they reach brackish water, before developing into the pigmented, growth phase: the yellow eel. The final stage is the marine-migratory silver eel which is characterised by silvery counter-shading and large eyes.”

“Eel growth increases with temperature and growth rate is generally faster in saline water than fresh. Furthermore those individuals produced in saline waters usually contain lower loads of the swim bladder parasite, *Anguillicola crassus* and thus may have improved chances of reaching their spawning grounds (ICES/SGAESAW 2009). During maturation, dependent on size, European Eels feed off a variety of organisms including fish, amphipods and decapod

crustaceans. In saline muddy-bottomed habitats eels forage on bivalves, shrimp and polychaete worms.”

From Froese and Pauly (2018):

“Migrates to the depths of the Sargasso Sea to spawn [Deelder 1984; Rochard and Elie 1994]. Eel larvae (leptocephali) are transparent ribbon-like. They are brought to the coasts of Europe by the Gulf Stream in 7 to 11 months time [Rochard and Elie 1994] and can last for up to 3 years [Tesch 1977]. They are transformed into glass eels (6-8 cm length, cylindrical in shape and transparent to slightly pigmented in colour). They enter the estuaries and colonize rivers and lakes [Keith et al. 1992; Rochard and Elie 1994]; some individuals remain in estuaries and coastal waters to grow into adults [Narberhaus et al. 2012]. The glass eel stage is followed by a long feeding period (from the yellow to the silver eel stage) lasting 6-12 years in males [Bauchot 1986] and 9-20 years in females [Bauchot 1986]. Yellow and silver eels are benthic, found under stones, buried in the mud or in crevices [FAO and ICES 2009]. Yellow eels eventually lose their pigmentation, becoming dark dorsally and silver ventrally (called silver eels). Silver eels are also characterized by a clear contrasting black lateral line and enlarged eyes [Bauchot 1986]. At the end of their growth period, they become sexually mature, migrate to the sea and cover great distances during their spawning migration (5,000-6,000 km); with extensive daily vertical migrations between 200 m at night and 600 m during day time, possibly for predator avoidance [Aarestrup et al. 2009]. Gametogenesis occurs entirely during spawning migration.”

Human Uses

From Jacoby and Gollock (2014):

“The various life stages, ranging from glass eel to silver eel, of all *Anguilla* species are harvested and traded on a global scale for consumption - directly or after culture - and for stocking purposes, with current demand predominantly driven by East Asian markets, in particular Japan and mainland China.”

“Eel farming, which is responsible for over 90% of all *Anguilla* production worldwide (averaging at 280,000 tonnes per year since 2007; FAO 2013), is reliant on wild-caught juvenile eels or glass eels. Raising European eel larvae to the glass eel stage in captivity has never been achieved [...]”

“*Anguilla* spp. are traded internationally as live eels for farming and consumption, as fresh, frozen and smoked/prepared eels for consumption and as skins and leather products for fashion accessories. Global trade data collated by FAO for live, fresh, frozen and smoked/prepared *Anguilla* species (non-species specific) is available for the period 1976-2009. According to FAO data, global annual *Anguilla* exports averaged around 20,000 tonnes in the late 1970s (valued annually at 55-95 million US Dollars), after which annual exports showed a steady increase to a maximum of over 130,000 tonnes in 2000 (valued at over 1000 million US Dollars). Since then annual exports have been declining, to just over 80,000 tonnes in 2008 and 2009 (valued at over 800 million US Dollars). By weight, China and Taiwan are responsible for nearly 75% of these exports and Japan for over 75% of all imports (FAO 2013).”

“Due to a lack of species-specific Customs data, the actual quantities of European Eel in trade is still relatively unknown. However, East Asian Customs imports of live juvenile *Anguilla* eels from European eel range States for farming purposes (defined as “live eel fry” in East Asia) can provide a good indication of the amount of European glass eels in trade (due to their delicate nature and the need for quick transportation to their destination). Between 2003 and 2008, annual live eel fry imports from European eel range States to mainland China, Taiwan, Korea, Japan and Hong Kong fluctuated between ~36 and 70 tonnes. In 2009, annual imports dropped to ~9 tonnes, in 2010 they increased again to nearly 28 tonnes and in 2011 and 2012 were ~7 and ~5 tonnes respectively - these low numbers are a result of the EU ban in place since 2011.”

“Furthermore, since 2009, species-specific CITES trade data for European eel has been reported. Between 2009 -2011, over 360 tonnes of live eels (including 20 tonnes of juvenile eels for farming) were reportedly exported from a number of European Eel range States. Exporters included Algeria, Belgium, Croatia, Denmark, France, Greece, Morocco, Norway, Spain, Switzerland, Tunisia and the UK, and [sic] importers included Armenia, mainland China, Denmark, France, Hong Kong, Italy, Macedonia, the Netherlands, Republic of Korea, Russian Federation, Spain, Sweden, Tunisia and Ukraine. During these three years, nearly 30,000 tonnes of *A. anguilla* meat and bodies were also reportedly exported (mostly from farms in mainland China), in addition to ~11,000 leather products and ~13,000 skins (mostly from Mexico, but originating in Korea) (UNEP-WCMC 2013). Since December 2010, illegal trade in European eel has been a concern – authorities have seized several European glass eel shipments destined for East Asian eel farms, in particular coming from Spain and France (TRAFFIC 2012, Crook in litt, 2013).”

Diseases

Poelen et al. (2014) list the following as parasites of *Anguilla anguilla*: *Cryptocotyle concavum*, *Gyrodactylus friendi*, *Bucephalus anguillae*, *Deropristis inflata*, *Nicolla gallica*, *Podocotyle atomon*, *Gyrodactylus anguillae*, *Acanthocephalus rhinensis*, *Proteocephalus macrocephalus*, *Bothriocephalus claviceps*, *Pomphorhynchus* sp., *Acanthocephalus anguillae*, *Cryptocotyle jejuna*, *Cryptocotyle lingua*, *Vibrio vulnificus*, *Diplostomum spathaceum*, *Acanthocephalus* sp., *Neoechinorhynchus rutili*, *Trypanosoma granulosum*, *Ergasilus gibbus*, *Neoechinorhynchus rutili*, *Apobolema rufoviride*, *Echinorhynchus angustatus*, *Distomum rufoviride*, *Lecithochirium gravidum*, *Anguillicola novaezelandiae*, *Paraquimperia tenerrima*, *Anguillicola papernai*, *Paratenuisentis ambiguus*, *Pseudocapillaria tomentosa*, *Echinorhynchus* sp., *Spinitectus inermis*, *Acanthocephalus lucii*, *Camallanus lacustris*, *Anguillicola crassus*, *Hysterothylacium aduncum*, *Acanthocephalus clavula*, and *Contracaecum rudolphii* (van Cleave 1921; Canning et al. 1973; Kennedy 1975; Strona et al. 2013; Urban et al. 2016; Benesh et al. 2017; Smithsonian Institution no date).

From Rockwell et al. (2009):

“In Europe, it is thought that *Anguillicoloides*, formerly *Anguillicola*] *crassus* was introduced accidentally into European eels, *A. anguilla*, via infected Japanese eels, *A. japonica*, from Asia in the early 1980s (Kennedy and Fitch, 1990; Evans and Matthews, 1999). *Anguillicoloides crassus* then spread throughout Europe and the Mediterranean region due to human activity, i.e., human transportation of live eels by road (Kennedy and Fitch, 1990).”

From Kirk (2003):

“*Anguillicola crassus* is a very successful colonizer and is now known to occur in four continents (Asia, Europe, Africa and America). The nematode can severely impair swimbladder function and has caused mortalities in both farmed and wild populations in the presence of other stressors. *Anguillicola crassus* may impair the capacity of European eels to complete the spawning migration, although direct evidence is not available to support this hypothesis.”

No OIE-reportable diseases have been documented for this species.

Threat to Humans

From Froese and Pauly (2018):

“Harmless”

From Schofield and Fuller (2018):

“The blood of the European eels is poisonous, but the poison is destroyed by cooking (Coad 2005).”

3 Impacts of Introductions

From Okamura et al. (2002a):

“Silver Japanese eels also occur in Mikawa Bay during autumn and winter (Okamura et al., 2002[b]). The migratory behavior of these eels is also affected by water temperature (or photoperiod), the lunar phase, and depressions, which mostly coincides with that of the European eels (Okamura et al., 2002[b]). Thus, the migration of silver European eels may have become synchronized physiologically with Japanese silver eels following the same environmental cues. Zhang et al. (1999) suggested that European eels would not migrate with Japanese eels to the spawning area of the latter in the Pacific Ocean and, therefore, could not genetically contaminate the populations of Japanese eels. However, our findings may not support this suggestion. We feel that it is possible for them to migrate together toward the open ocean, although whether the European eels reach the Japanese eels’ spawning ground is unknown. Aoyama et al. (2000) reported that a mature European eel was caught in the East China Sea at least 70 km from the nearest freshwater habitat, which also suggests the possibility of genetic contamination.”

From Rockwell et al. (2009):

“Once introduced into freshwater and estuarine environments, *Anguillicoloides crassus* has been documented to spread rapidly among eel populations (Machut and Limberg, 2008). Prevalences increase from 10% to 50% within a year (Belpaire et al., 1989; Koops and Hartmann, 1989) and may even reach 100% prevalence within 1 yr (Kennedy and Fitch, 1990). Dispersal of *A. crassus* within aquatic systems is generally through the natural movements of

infected definitive, intermediate, and paratenic hosts (Machut and Limberg, 2008). Spread between distant localities is generally through human transport of infected eels.”

Rockwell et al. (2009) also describe the presence of *A. crassus* in North America:

“*Anguillicoloides crassus* was first documented in North America from American eels, *A. rostrata*, reared in a south Texas aquaculture facility in 1995 (Johnson et al., 1995; Fries et al., 1996). It is thought that elvers (juvenile stock) supplied by an east coast grower carried the parasite. The history of the *A. crassus* spread in North America, and now into Cape Breton [Nova Scotia, Canada], is not well understood.”

The importation, sale, or culture of live anguillids is illegal in California (Schofield and Fuller 2018).

4 Global Distribution

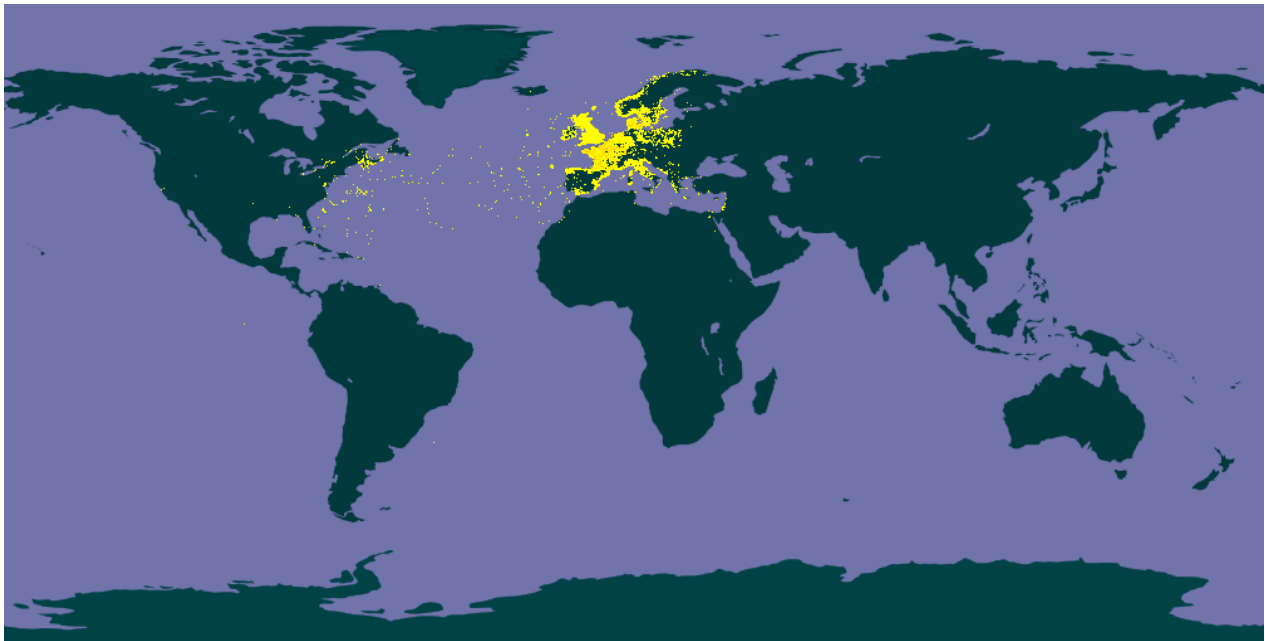


Figure 1. Known global distribution of *Anguilla anguilla*. Map from GBIF Secretariat (2017). Because the climate matching analysis is not valid for marine waters, no marine occurrences were used in the climate matching analysis. Established inland freshwater occurrences are documented for this species’ range in Europe, North Africa, and Southwest Asia. Points in North America either represent specimens of *Anguilla rostrata* or do not represent established populations of *Anguilla anguilla*, and therefore were not included in climate matching analysis. No georeferenced occurrences were available for the species native range in the Black Sea or the introduced range in Iran.

5 Distribution Within the United States

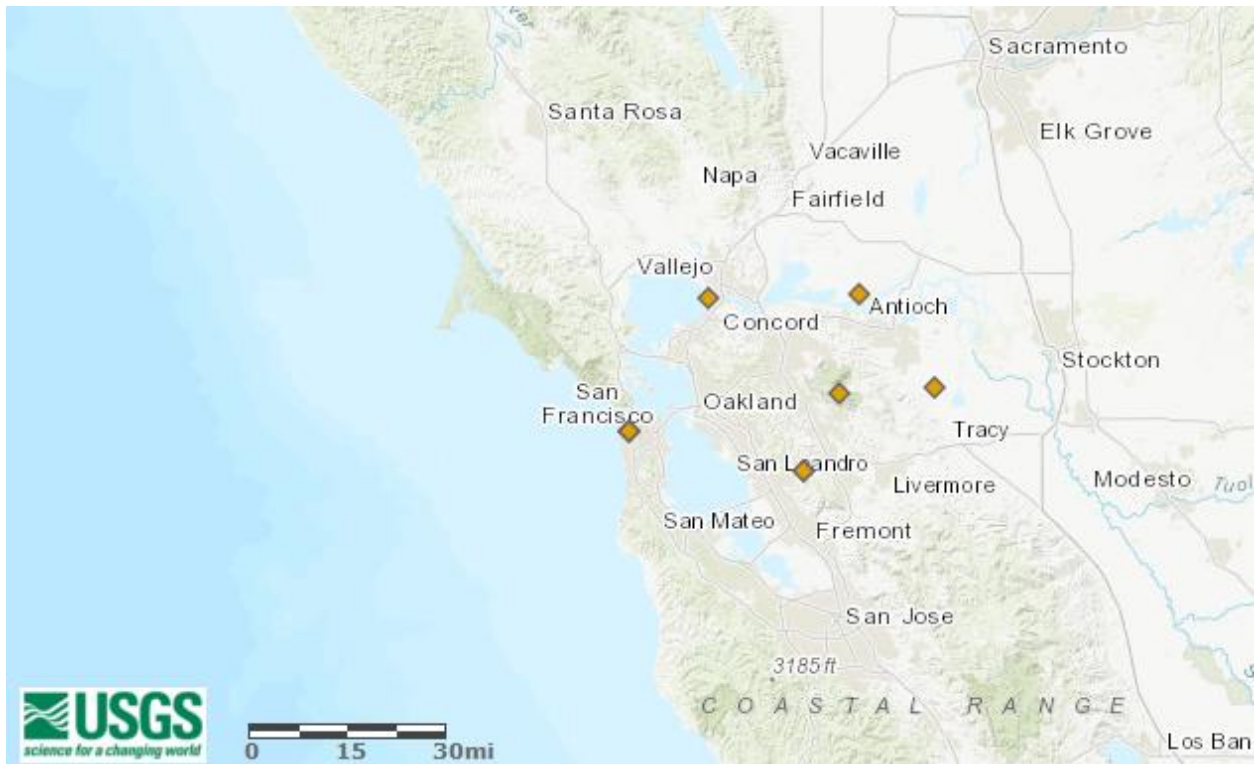


Figure 2. Known distribution of *Anguilla anguilla* in the United States showing points in the San Francisco Bay Area. Map from Schofield and Fuller (2018). All points represent failed populations.

6 Climate Matching

Summary of Climate Matching Analysis

The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.381, which is a high climate match. A Climate 6 score of 0.103 or above indicates a high climate match. Overall, most of the contiguous United States has a medium to medium-high climate match. Areas of especially high match were located in California, the Great Lakes Basin, the Ohio River basin, the central Appalachian Mountains, the Puget Sound, and scattered areas in the Rocky Mountain States. Areas of low climate match were present along the Gulf Coast from Louisiana to Florida and in the coastal Pacific Northwest. This climate match is only valid for where the species could survive in brackish or freshwater. It does not apply to saltwater environments where *Anguilla anguilla* reproduces and juvenile stages live.

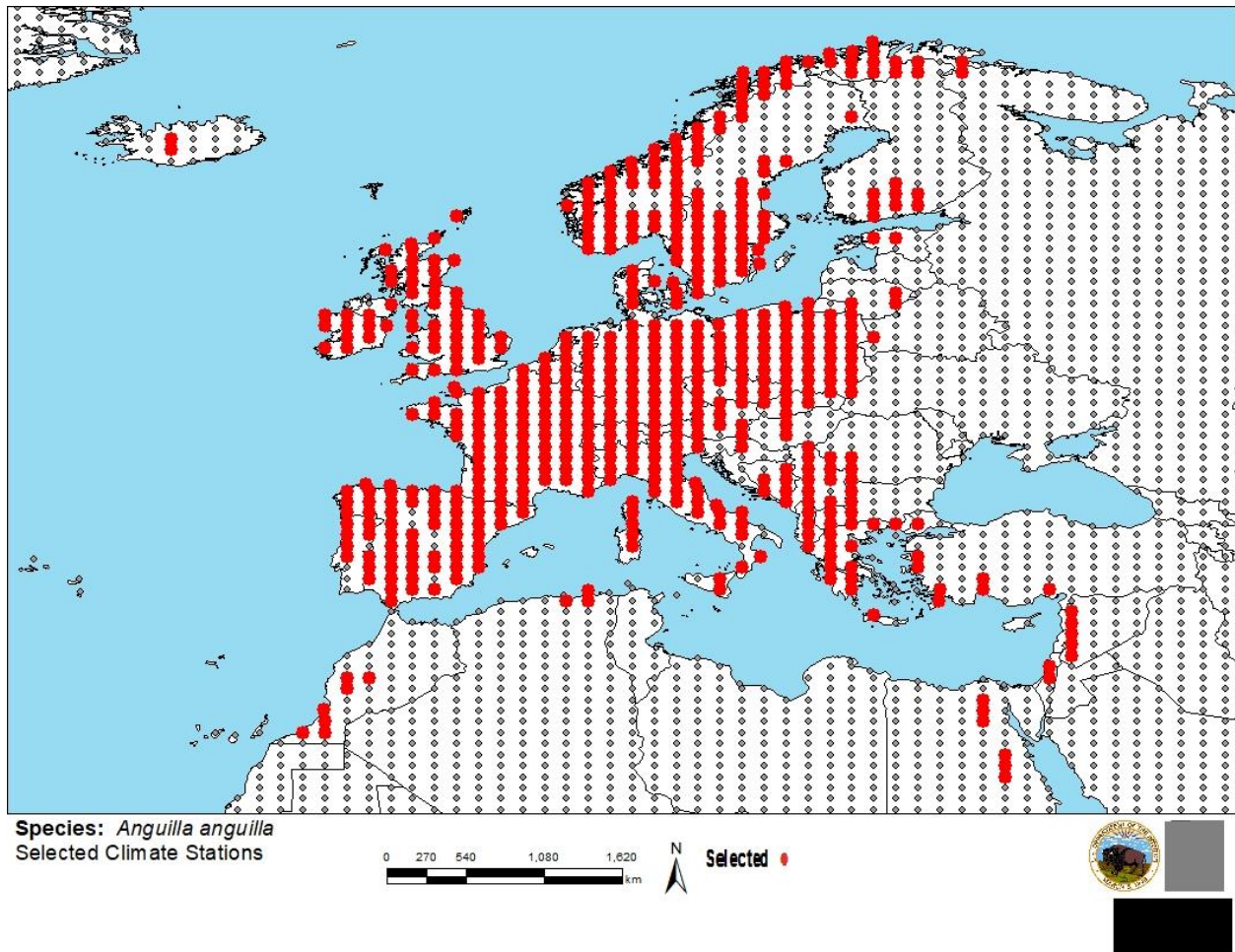


Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; Albania, Algeria, Austria, Belarus, Belgium, Bosnia and Herzegovina, Croatia, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Lithuania, Macedonia, Montenegro, Morocco, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Syria, Turkey, United Kingdom) and non-source locations (gray) for *Anguilla anguilla* climate matching. Source locations from GBIF Secretariat (2017).

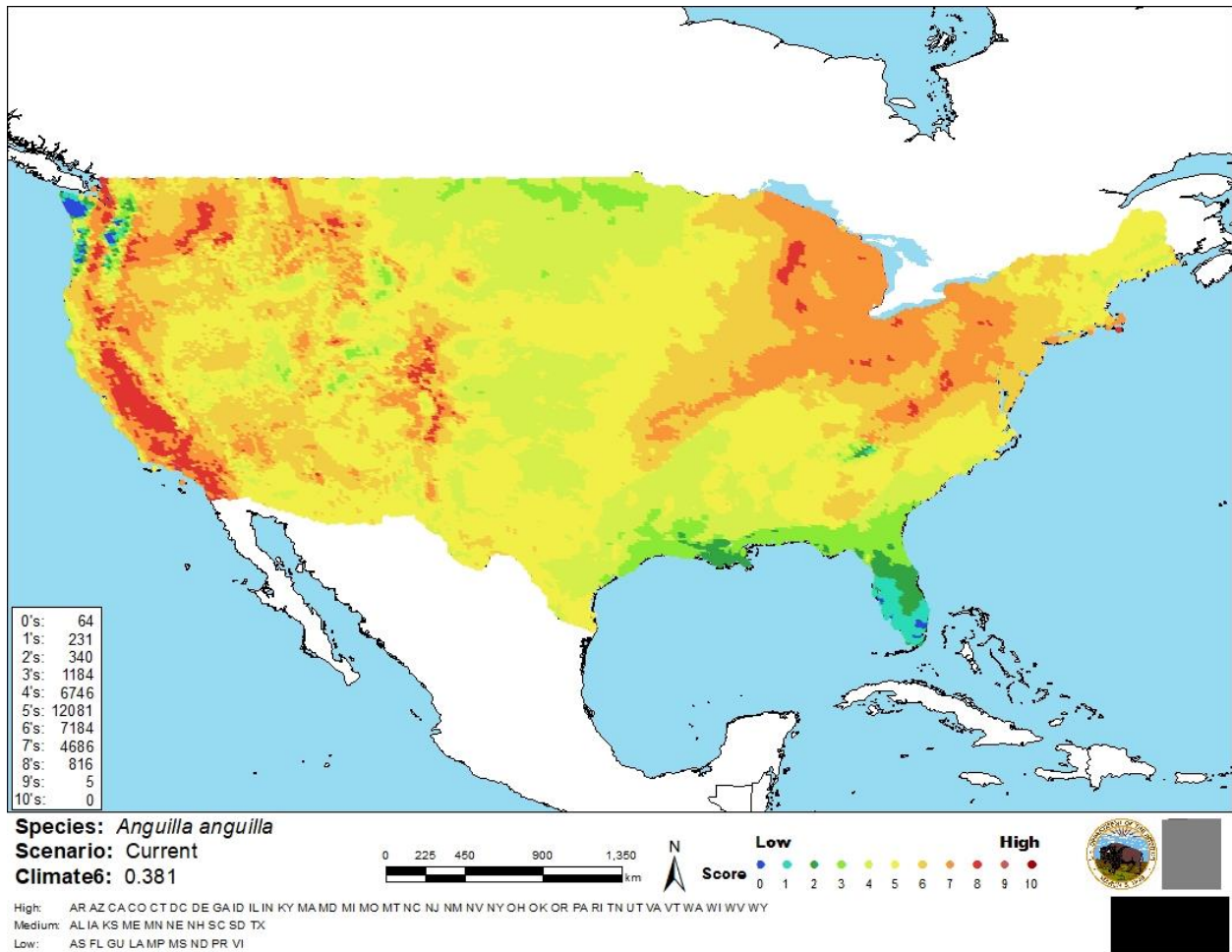


Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Anguilla anguilla* in the contiguous United States based on source locations reported by GBIF Secretariat (2017). 0= Lowest match, 10= Highest match.

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

7 Certainty of Assessment

Due to its high economic value, there is abundant information on the biology of *Anguilla anguilla*. Its life history has been well-studied, and the pathway of its introduction outside of its native range is well-understood. *A. anguilla* has been reported as introduced outside of its native range, but impacts of these introductions have not been adequately studied to confirm the ability of this species to hybridize or transmit diseases to native eels. The climate match model does not include marine environments. Since *A. anguilla* requires marine environments to reproduce, the

climate match cannot be fully determined, increasing the uncertainty about where the species would be able to establish within the contiguous United States. Certainty of this assessment is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Anguilla anguilla, the European Eel, is an eel species native to inland waters of Europe, as well as the Atlantic Ocean and coastal areas from northwestern Russia to North Africa. *A. anguilla* is used for aquaculture and human consumption, as well as for leather and skins to make fashion accessories. *A. anguilla* travels great distances to complete its life cycle and has been reported as introduced outside of its native range in multiple countries. It has become established in Turkey, and probably in Iran through natural range expansion. The predominant pathway of introduction outside of Europe and western Asia is through aquaculture escapes. It has been reported as introduced to California, likely through imports for the food industry, but it did not become established there. The importation, sale, or culture of live anguillids is illegal in California. *A. anguilla* is susceptible to numerous parasites, including the nematode *Anguillicoloides crassus* that was introduced to Europe from Japan and has had substantial impacts on *A. anguilla* populations there. *A. crassus* is not widespread in North America, but more information on transmission of the parasite and its impacts on native eels would be necessary to justify high history of invasiveness. Therefore, history of invasiveness is assessed as “none documented.” *A. anguilla* has a high climate match with the contiguous United States. This climate match is only valid for the freshwater and brackish life stages of *A. anguilla*. It does not apply to the marine environments where *A. anguilla* breed, and thus reduces the ability of this assessment to predict where *A. anguilla* can establish in the contiguous United States. Further information is needed to assess the invasive potential of this species and suitability of climate in the United States, so the overall risk assessment category is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Low**
- **Important additional information: Classified as endangered within its native range on the IUCN Red List. Susceptible to numerous parasites including the parasitic nematode *Anguillicoloides crassus*.**
- **Overall Risk Assessment Category: Uncertain**

9 References

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

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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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