Bleak (*Alburnus alburnus*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, July 2014
Revised, May 2019
Web Version, 10/16/2019

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1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2019a):

"Europe and Asia: most of Europe north of Caucasus, Pyrénées and Alps, eastward to Ural and Emba. Naturally absent from Iberian Peninsula, Adriatic and Aegean basins (except Maritza drainage), Italy, Ireland, Great Britain (except southeast), Norway and Scandinavia north of 67°N, Caspian basin south of Volga. In Anatolia, Marmara basin."

"Spread in the Europoean [*sic*] part of Turkey in the Meric river system, in Western Anatolia from Sapanca, Iznik, Ülübat and Kus Gölü to Bergama, Belive Gölü and Bafa Gölü in the south, also reported from the Sakarya river (Parali stream, Tuzla, Karasu); Marmara Basin, northwestern Anatolia [Çiçek et al. 2015]."

"Occurs in Odra and Morava river basins [in the Czech Republic] [Hanel 2003]."

"Common throughout the country [Denmark] [Frier 1994]."

"Abundant in the Gulf of Riga and common in the Gulf of Finland [in Estonia] [Ojaveer and Pihu 2003]."

"Occurs through the country [Finland] except North Lappland."

"Widely distributed [Billard 1997]. One of the most common species in France [Keith and Allardi 2001]."

"Recorded from the Strymonikos Gulf [in Greece] [Koutrakis et al. 2000]."

"[In Russia] Occurs in the basins of the Baltic Sea, the White Sea (from the Vyg to northern Dvina rivers), the Barents Sea (Lake Mogil'noe on Kildin I.) the Black Sea, the Sea of Azov and the Caspian Sea [Reshetnikov et al. 1997]."

"Very common throughout Serbia [Simonovic 2001]."

"Native and regular [in Sweden] [Kullander 1999]. Found in the southern Bothnian Sea [Thorman 1986]."

"In all major lakes [in Switzerland]."

"Found in England [Maitland and Lyle 1996]."

In addition to countries mentioned above, Froese and Pauly (2019a) list *Alburnus alburnus* as native in Iran, Andorra, Austria, Belarus, Belgium, Bulgaria, Germany, Hungary, Latvia, Liechtenstein, Lithuania, Luxembourg, Moldova, Netherlands, Poland, Romania, Slovakia, and Ukraine. CABI lists *A. alburnus* as native in Estonia and the United Kingdom.

Status in the United States

From Baker et al. (2015):

"Not established in North America […]"

From Fusaro et al. (2016):

"*Alburnus alburnus* is not a popular aquarium fish and is not available for purchase online. *Alburnus alburnus* is not available as live baitfish for online purchase in North America."

Means of Introductions in the United States

From Baker et al. (2015):

"Not established in North America […]"

Remarks

A previous version of this ERSS was published in July 2014. Revisions were done to incorporate new information and to bring the document in line with current standards.

From Almodóvar et al. (2012):

"Hybrids of invasive bleak *Alburnus alburnus* and native endemic calandino *Squalius alburnoides* complex and Southern Iberian chub *Squalius pyrenaicus* were found in the River Jarama (Tagus River basin, central Spain)."

From Baker et al. (2015):

"It is able to hybridize with other cyprinid genera including *Squalius*, *Blicca*, *Rutilus*, and *Abramis* (Maceda-Veiga et al. 2010; Blachuta and Witkowski 1984, Crivelli and Dupont 1987)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al. (2019):

"**Current status:** Valid as *Alburnus alburnus* (Linnaeus 1758)."

From ITIS (2019):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cyprinoidea
Family Cyprinidae
Genus *Alburnus*
Species *Alburnus alburnus* (Linnaeus, 1758)"

Size, Weight, and Age Range

From Froese and Pauly (2019a):

"Maturity: L_m 9.9, range 9 - ? cm"

"Max length : 25.0 cm TL male/unsexed; [Billard 1997]; common length : 15.0 cm TL male/unsexed; [Billard 1997]; max. published weight: 60.00 g [Billard 1997]"

From CABI (2019):

"[…] reaches sexual maturity at 2-3 years."

Environment

From Froese and Pauly (2019a):

"Freshwater; brackish; benthopelagic; pH range: 7.0 - ? ; dH range: 10 - ?; potamodromous [Riede 2004]; depth range 1 - ? m [Billard 1997]."

From Baker et al. (2015):

"It is a stenohaline fish that lives in brackish water with salinities of 8-10‰ (Linden et al. 1979). Cyprinidae fish such as *Alburnus alburnus* are strictly intolerant of sea water (Myers 1949). […] *Alburnus alburnus* cannot tolerate low-oxygen waters (Willemsen 1980), but is highly tolerant to pollution (Linden et al. 1979)."

From Vinyoles et al. (2007):

"[…] and its [water] temperature tolerance (from mountain lakes to the River Ebro with summer temperatures around 30ºC)."

From Fusaro et al. (2016):

"A study regarding lethal temperature for various fish species indicates that the *A. alburnus'* lethal temperature range is 37.7-40.6°C at acclimation temperatures from 25.0-27.8°C in a lake environment where temperature was gradually raised per hour (Horoszewicz 1973)."

"According to Souchon and Tissot (2012), 14°C is the minimum temperature tolerated for reproduction."

Climate/Range

From Froese and Pauly (2019a):

"Temperate; […]; 68°N - 35°N, 6°W - 60°E"

Distribution Outside the United States

Native

From Froese and Pauly (2019a):

"Europe and Asia: most of Europe north of Caucasus, Pyrénées and Alps, eastward to Ural and Emba. Naturally absent from Iberian Peninsula, Adriatic and Aegean basins (except Maritza drainage), Italy, Ireland, Great Britain (except southeast), Norway and Scandinavia north of 67°N, Caspian basin south of Volga. In Anatolia, Marmara basin."

"Spread in the Europoean [sic] part of Turkey in the Meric river system, in Western Anatolia from Sapanca, Iznik, Ülübat and Kus Gölü to Bergama, Belive Gölü and Bafa Gölü in the south, also reported from the Sakarya river (Parali stream, Tuzla, Karasu); Marmara Basin, northwestern Anatolia [Çiçek et al. 2015]."

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In addition to countries mentioned above, Froese and Pauly (2019a) list *Alburnus alburnus* as native in Iran, Andorra, Austria, Belarus, Belgium, Bulgaria, Germany, Hungary, Latvia, Liechtenstein, Lithuania, Luxembourg, Moldova, Netherlands, Poland, Romania, Slovakia, and Ukraine. CABI lists *A. alburnus* as native in Estonia and the United Kingdom.

Introduced

From Vinyoles et al. (2007):

"In 1972, the bleak was accidentally introduced with other fish species from Britain to Cyprus, where it was established and breeding (Lever, 1990). […] In June 1992, the bleak was collected for the first time in the River Noguera Ribagorzana, a tributary of the Ebro basin, where it became established (Elvira, 1995). Four years later, it was also collected in five rivers of this basin (Cinca, Segre, Jalón, Guadalope and Matarranya) (CHE, 1997). In 1997 it was recorded for the first time in river basins from the Eastern Pyrenees slope (Muga River, northeastern Spain) (Cardona *et al*., 2002) […]. […] Around 1999 the bleak appeared in two other major Iberian basins: the Douro in the north (Tormes River) (Velasco *et al*. 2005) and the Guadiana in the south (Campo Maior reservoir, Portugal), extending its range to the Spanish border (Pérez-Bote *et al*., 2004). According to Carol *et al*. (2003), in 2003 the bleak was also introduced into several reservoirs located on three basins of the Eastern Pyrenees (Foix, Llobregat and Ter; […]). More recently, the bleak was recorded from three reservoirs of the Douro basin (Velasco *et al*., 2005), in the Segura basin (southeastern Spain; Andreu-Soler *et al*., 2004) and in two additional reservoirs in the Guadiana basin in Spain (Pérez-Bote *et al*., 2004)."

"The results of the present work clearly show that the bleak is currently present in all major Iberian basins and is distributed over a large proportion of Iberian rivers."

From Froese and Pauly (2019a):

"Established as isolated or rare [in Cap Djinet dam, Algeria] [Kara 2012]."

From Reshetnikov et al. (2017):

"Thus, the bleak has widely dispersed in the drainages of the southern Ob tributaries in Altai krai [West Siberia], where the southernmost locality is at the upper reaches of the Aley River […]. In the Irtysh basin, however, this species occurs even more southward […]; it is recorded in the Shulbinskiy Reservoir and upstream of it (Kirichenko, 2012)."

From Clavero et al. (2015):

"Two non-native species were recorded for the first time in Morocco: stone moroko (*Pseudorasbora parva*) and bleak (*Alburnus alburnus*) (Mouslih, 1987; Azeroual et al., 2000; Azeroual, 2003). They occurred only in the Ghir basin […]"

In addition to countries mentioned above, Froese and Pauly (2019a) list *Alburnus alburnus* as introduced but needs confirmation in Italy.

Means of Introduction Outside the United States

From Vinyoles et al. (2007):

"New introductions seem to be the result of deliberate actions by anglers that use the bleak either as prey for piscivorous species or as live bait which is frequently released to the water after angling sessions."

From CABI (2019):

"The main pathway of fish introductions is through recreational fishing in many developed countries; therefore, angling is the main activity responsible for the presence of bleak in watersheds. Due to its high mobility, interconnections between watersheds also present a risk of further spread."

From Clavero et al. (2015):

"These three non-native species [includes *Alburnus alburnus*] had been recorded from Algeria (Kara, 2012), and so probably colonized Moroccan waters spreading from the neighbouring country, possibly from Djorf Torba reservoir. Supporting this, bleak and goldfish occurred at the two sites closest to the Djorf Torba reservoir."

Short Description

From Froese and Pauly (2019a):

"Dorsal spines (total): 2 - 4; Dorsal soft rays (total): 7-9; Anal spines: 3; Anal soft rays: 14 - 20; Vertebrae: 41 - 44. Diagnosed from congeners in Europe by the possession of the following characters: origin of anal fin below branched dorsal rays 4-5; lateral line with 45-48 + 3 scales; anal fin with 17-20½ branched rays; 16-22 gill rakers; ventral keel exposed from anus to pelvic base; lateral stripe absent in life, faint or absent in preserved specimens; and mouth slightly superior [Kottelat and Freyhof 2007]. Caudal fin with 19 rays [Spillman 1961]."

Biology

From Froese and Pauly (2019a):

"Inhabits open waters of lakes and medium to large rivers. Forms large aggregations in backwaters and other still waters during winter. Adults occur in shoals near the surface. Larvae live in littoral zone of rivers and lakes while juveniles leave shores and occupy a pelagic habitat, feeding on plankton, drifting insects or invertebrates fallen on the water surface [Kottelat and Freyhof 2007]. Feeds mainly on plankton, including crustaceans [Billard 1997] and insects [Vostradovsky 1973]. Spawns in shallow riffles or along stony shores of lakes, occasionally above submerged vegetation [Kottelat and Freyhof 2007]."

"Eggs hatch in about 4 days [Kottelat and Freyhof 2007]."

From Baker et al. (2015):

"*Alburnus alburnus* feeds during the day on zooplankton and insects in the eplimnion [sic] (Vašek and Kubecka 2004; Keckeis and Schiemer 1990; Maceda-Veiga et al. 2010). It also feeds on terrestrial insects that fall into lakes and subsequently excretes terrestrial derived nutrients, thereby subsidizing lake nutrient pools (Mehner et al. 2005). This species may affect water quality by feeding on cladocerans and other small invertebrates that directly affect water quality (Maceda-Veiga et al. 2010). The prey of this species is geographically widespread, allowing it to establish successfully outside its native range (Vinyoles et al. 2007). In comparison to another common fish (*Rutilus rutilus*), *Alburnus alburnus* has a relatively limited diet (Keckeis and Schiemer 1990)."

"It has a high reproductive rate and is able to hybridize with other cyprinids (Vinyoles et al. 2007). The larvae of this species inhabits the littoral zone of rivers and lakes, while juveniles inhabit the pelagic zones (Kottelat 2012)."

From Freyhof and Kottelat (2008):

"Spawns for the first time at 2-3 years. Usually spawns only one or two seasons. Spawns in May-August at temperatures above 15°C, 2-4 times at 1-2 week intervals, in early morning."

Human Uses

From Froese and Pauly (2019a):

"Excellent as bait for carnivorous fishes. May be captured using the smallest hook and a fly as bait. Its flesh is tasty [Billard 1997]. Of little interest to commercial or sport fisheries in its native range because of its small size [Welcomme 1988]. Scales were previously utilized in making Essence d''Orient, a coating for artificial pearls [Kottelat and Freyhof 2007]."

From CABI (2019):

"The bleak is without interest to the aquarium trade […]"

From Baker et al. (2015):

"This species may be commercially valuable as forage fish and baitfish (Pérez-Bote et al. 2007), and the artificial pearl trade (Denton and Nicol 1965). In Europe, it has been introduced into various reservoirs to benefit the populations of exotic fish predators such as the northern pike (*Esox Lucius* [sic]), largemouth bass (*Micropterus salmoides*), zander (*Sander lucioperca*), and wells catfish (*Silurus glanis*) (Maceda-Veiga et al. 2010). Establishment of *Alburnus alburnus* may increase productivity of predator fish in the Great Lakes, especially for predatory fish that do not have specific diets."

Diseases

No records of OIE-reportable diseases were found for *Alburnus alburnus* (OIE 2019).

From Koyun and Altunel (2007):

"*A. alburnus* were infected with the monogeans *Dactylogyrus fraternus, D. alatus* and *Paradiplozoon homoion* […]"

Molnár et al. (2009) lists *A. alburnus* as a host for *Myxobolus shahsromae* and *M. alburni*.

From Koyun (2011):

"Three of the Dactylogyrus species (*D. fraternus, D. alatus* and *D. minutus*) were recorded for *A. alburnus* […]"

Harris et al. (2004) list *A. alburnus* as a host for *Gyrodactylus ablurnoidesi, G. bliccensis, G. carassii, G. glaeseri, G. gracilihamatus, G. hronosus, G. katharineri, G. laevis,* and *G. vimbi*.

Kayis et al. (2009) list *A. alburnus* as a host for *Rhapdochona denudata*.

From Matras et al. (2019):

"However, we showed that during co-habitation an infective agent is transmitted from CEV [carp edema virus]-infected common carp to heterospecific fish of the bleak, […]"

"This preliminary study confirms this thesis that bleak, crucian carp, European perch, Prussian carp, roach and tench may play a role as animal vectors of CEV infection."

From Öktener et al. (2006):

"To date in Turkey, *A.*[*Argulus*] *foliaceus* has been recovered from several host species belonging to two families, Cyprinidae and Siluridae: *Abramis brama, Alburnus alburnus*, […]"

Froese and Pauly (2019b) list *A. alburnus* as a host for *Caligus lacustris, Carypohyllaeus laticeps, Cucullanus dogieli, Eragsilus briani, E. seiboldi, Lernaea cyprinacea, Neoergasilus japonicas, Paraergasilus rylovi, Phyllodistomum bychowskii, P. dogieli, Sphaerostoma bramae,* and *Tylodelphys calvata*.

Poelen et al. (2014) list *Acanthocephalus anguillae, Allocreadium isoporum, A. markewitschi, Anguillicola crassus, Apophallus muehlingi, A. donicus, Asymphylodora imitans, Bothriocephalus acheilognathi, Bucephalus polymorphus, Camallanus lacustris, Caryophyllaeides fennica, Caryophyllaeus fimbriceps, C. brachycollis, C. laticeps, Contracaecum squalii, C. micropapillatum, C. microcephalum, Cotylurus pileatus, Crowcrocaecum skrjabini, Cystidicoloides tenuissima, Dactylogyrus crucifer, D. fallax, D. micracanthus, D. similis, D. sphyrna, D. chranilowi,* D. *chalcalburni, D. cordus, D. suecicus, D. tissensis, D. tuba, D. nanus, D. parvus, D. rarissimus, D. minor, D. finitimus, D. vistulae,*

Desmidocercella numidica, *Digramma interrupta*, *Diphyllobothrium latum*, *Diplostomum pseudospathaceum*, *D. clavatum*, *D. rutili*, *D. pungitii*, *D. helveticum*, *D. spathaceum*, *Diplozoon paradoxum*, *Echinorhynchus truttae*, *Goezia ascaroides*, *Gryporhynchus cheilancristrotus*, *Gyrodactylus leucisci*, *G. euzeti*, *G. gasterostei*, *G. alburnensis*, *G. cernuae*, *G. decorus*, *G. prostae*, *Ichthyocotylurus platycephalus*, *I. pileatus*, *Ligula intestinalis*, *L. colymbi*, *Metagonimus yokogawai*, *Metorchis albidus*, *Molnaria intestinalis*, *Neoechinorhynchus rutili*, *Neogryporhunchus cheilancristrotus*, *Opisthorchis felineus*, *Paracoenogonimus ovatus*, *Paradilepis scolecina*, *Paradiplozoon alburni*, *P. zeller*, *Philometra rischta*, *P. ovata*, *P. abdominalis*, *Phyllodistomum folium*, *P. elongatum*, *Pomphorhynchus bosniacus*, *P. laevis*, *Posthodiplostomum cuticola*, *Proteocephalus torulosus*, *P. percae*, *Pseudamphistomum truncatum*, *Pseudocapillaria tomentosa*, *Rabdochona denudata*, *Raphidascaris acus*, *Rhipidocotyle illense*, *R. fennica*, *R. campanula*, *Sanguinicola volgensis*, *Sphaerostomum bramae*, *S. globiporum*, *Sterliadochona* sp., *Telosentis exiguus*, *Triaenophorus nodulosus*, *Tylodelphys clavata*, and *Valipora campylancristrota* as additional parasites and pathogens of *A. alburnus*.

Threat to Humans

From CABI (2019):

"Introduced *A. alburnus* does not represent a risk for humans […]"

3 Impacts of Introductions

From Almedia and Grossman (2012):

"Bleak has displaced endemic fishes in Spain, such as Ebro nase, *Parachondrostoma miegii* (Steindachner), because the abundance of the native species had declined precipitously over a short time period in several locations where bleak abundance had increased exponentially (R. Miranda, unpublished data). In laboratory experiments using direct observations of bleak and Ebro nase, bleak were found to produce significant decreases in voracity, activity levels and intra-specific aggressive interactions, whereas gregariousness increased (Vinyoles et al. 2009). […] However, the presence of Ebro nase did not affect bleak behaviour, suggesting that the invasive species was dominant. Hence, bleak appears to out compete Ebro nase through interference interactions, which could reduce foraging behaviour and food consumption in the native species."

From Welcomme (1988):

"Stunted populations: May serve as a useful forage fish but large numbers create nuisance."

From Horppila and Kairesalo (1992):

"Enclosure experiments in the field showed the impacts of planktivorous bleak on water quality; in an enclosure with a density of 1 fish m^{-2} average daily algal production (1370 mg C m^{-2}) and chlorophyll-a concentration (50-90 μg l^{-1}) were more than twice that in an enclosure without fish."

"The field studies suggested that a bleak population can increase algal productivity and biomass."

From Almodóvar et al. (2012):

"Hybrids of invasive bleak *Alburnus alburnus* and native endemic calandino *Squalius alburnoides* complex and Southern Iberian chub *Squalius pyrenaicus* were found in the River Jarama (Tagus River basin, central Spain)."

"As far as we know, this is the first evidence of interspecific hybridization between a fish hybrid complex and an invasive exotic fish. This is also the first case of intergeneric hybridization between endemic and exotic fish species in Iberian rivers. […] Further, hybridization took place in a short time scale, because bleak occurrence was first documented in the Tagus River basin in 2004.

The observed hybridization event is highly problematic for other Iberian endemic Leuciscinae species that are currently in contact with bleak. The Iberian Peninsula holds a high number of endemic cyprinids and hybridization contributes to some extent to the observed patterns of genetic diversity in several genera, such as *Achondrostoma* and *Pseudochondrostoma* (e.g. Elvira et al. 1990), *Barbus* (e.g. Almodóvar et al. 2008) and *Squalius* (e.g. Alves et al. 2001). The destruction of reproductive habitat by human activities probably makes easier the simultaneous spawning of endemic and exotic related cyprinids.

The abundant introduced bleak can produce irreversible genetic swamping of scarce endemic species. […] It is clear that the long-term conservation of *Squalius* species and other endemics closely related to bleak (e.g. *A. hispanica*) requires to reliably identify the parental hybrid taxa and to know the current extent and distribution of gene flow between endemic species and bleak."

From Fusaro et al. (2016):

"There are import restrictions regarding the transport of *Alburnus alburnus* to the United Kingdom (Clarke 2006)."

4 Global Distribution

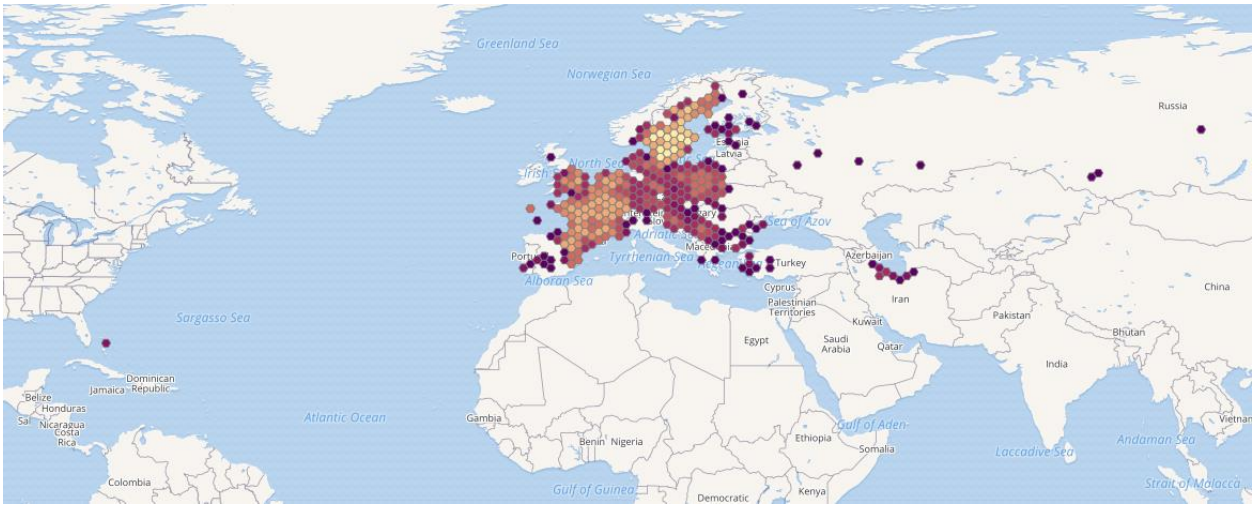

Figure 1. Known global distribution of *Alburnus alburnus*. Map from GBIF Secretariat (2019). The location in the Bahamas was not used to select source points for the climate match; the records are from 1908 and do not represent an established population.

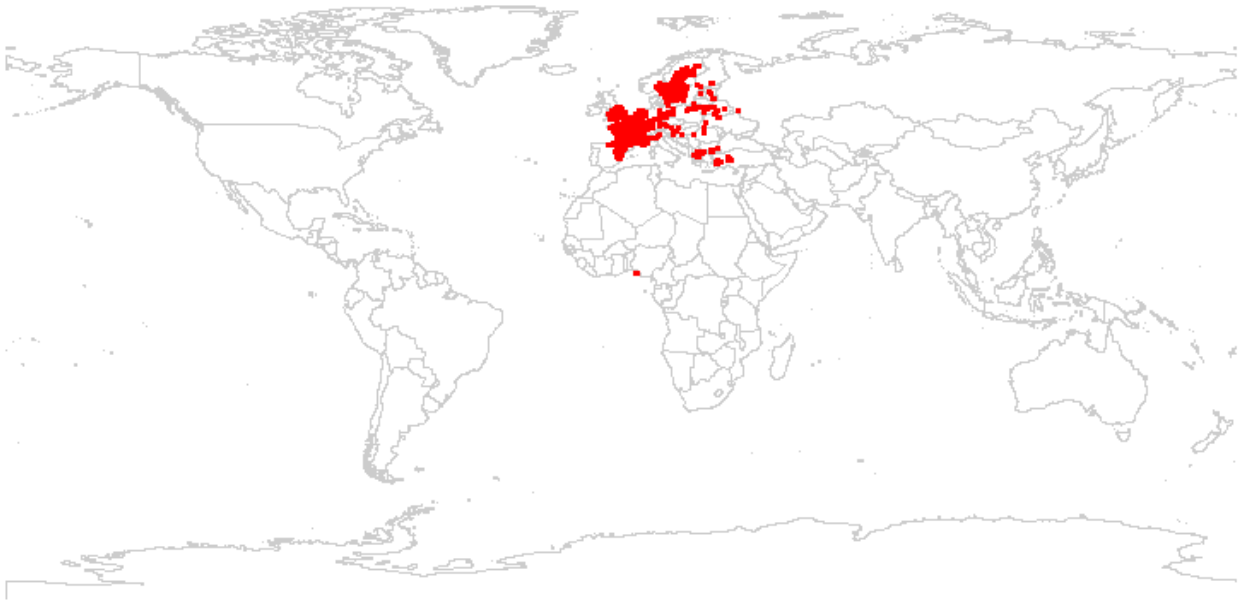

Figure 2. Additional global distribution of *Alburnus alburnus*. Map from Froese and Pauly (2019a). The location in eastern Africa was not used to select source points for the climate match. The presence of *Alburnus alburnus* at this location could not be confirmed.

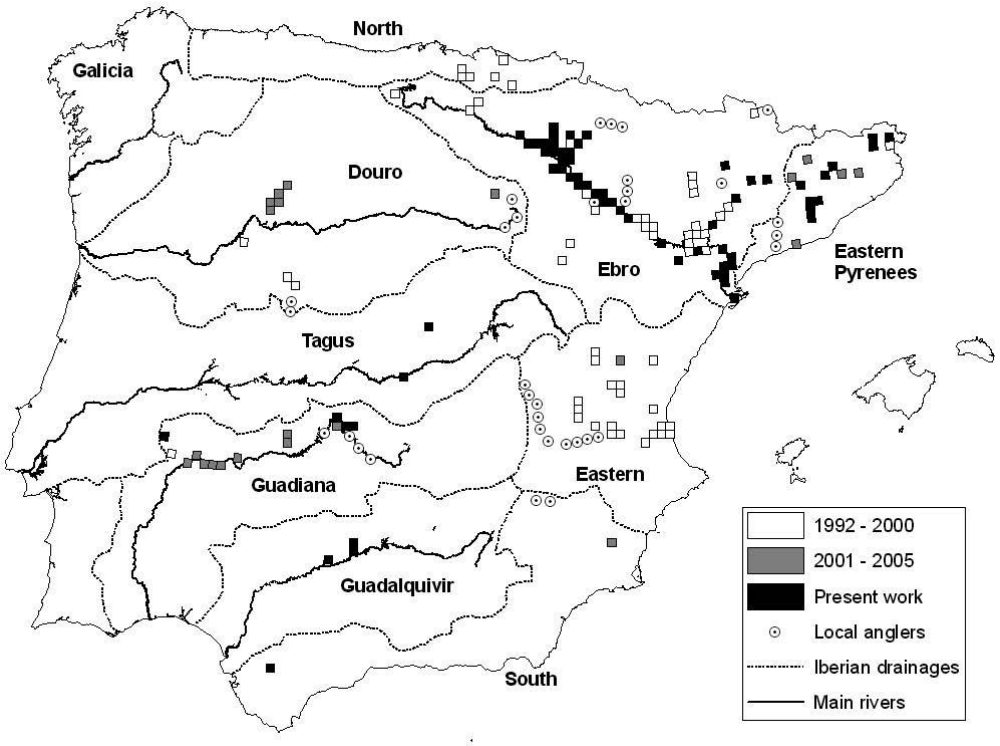

Figure 3. Additional known distribution of *Alburnus alburnus* on the Iberian Peninsula (Spain and Portugal). Map from Vinyoles et al. (2007); licensed under Creative Commons BY 4.0.

Additional locations are reported in West Siberia by Reshetnikov et al. (2017) and in Morocco and Algeria by Clavero et al. (2015).

5 Distribution Within the United States

From Baker et al. (2015):

"Not established in North America"

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Alburnus alburnus* to the contiguous United States was high in the Great Lakes region, southern parts of New England, the upper Midwest, patches of the Great Plains and Rocky Mountains, and the southern Pacific Coast. Southern Atlantic Coast and most of the Gulf Coast had low matches, as well as some areas of the Pacific Northwest. All other areas had medium matches. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.535, high (scores of 0.103 and greater are categorized as high). All States had high individual climate scores except for Georgia, Kansas, North Carolina, Oklahoma, Tennessee, and Texas which had medium scores, and Alabama, Florida, Louisiana, Mississippi, and South Carolina which had low scores.

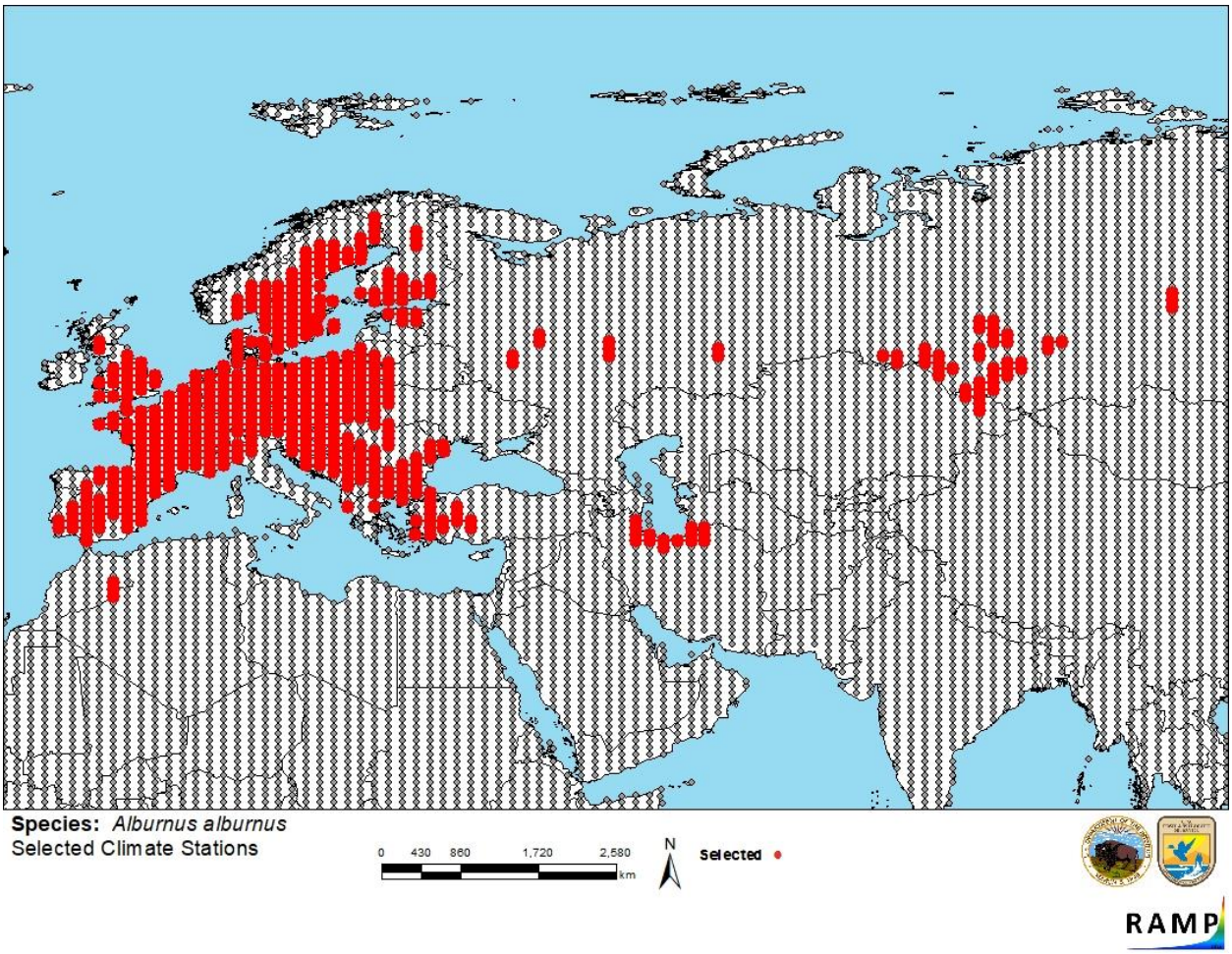

Figure 4. RAMP (Sanders et al. 2018) source map showing weather stations in Europe, Asia, and northern Africa selected as source locations (red) and non-source locations (gray) for *Alburnus alburnus* climate matching. Source locations from Vinyoles et al. (2007), Clavero et al. (2015), Reshetnikov et al. (2017), Froese and Pauly (2019a), 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.

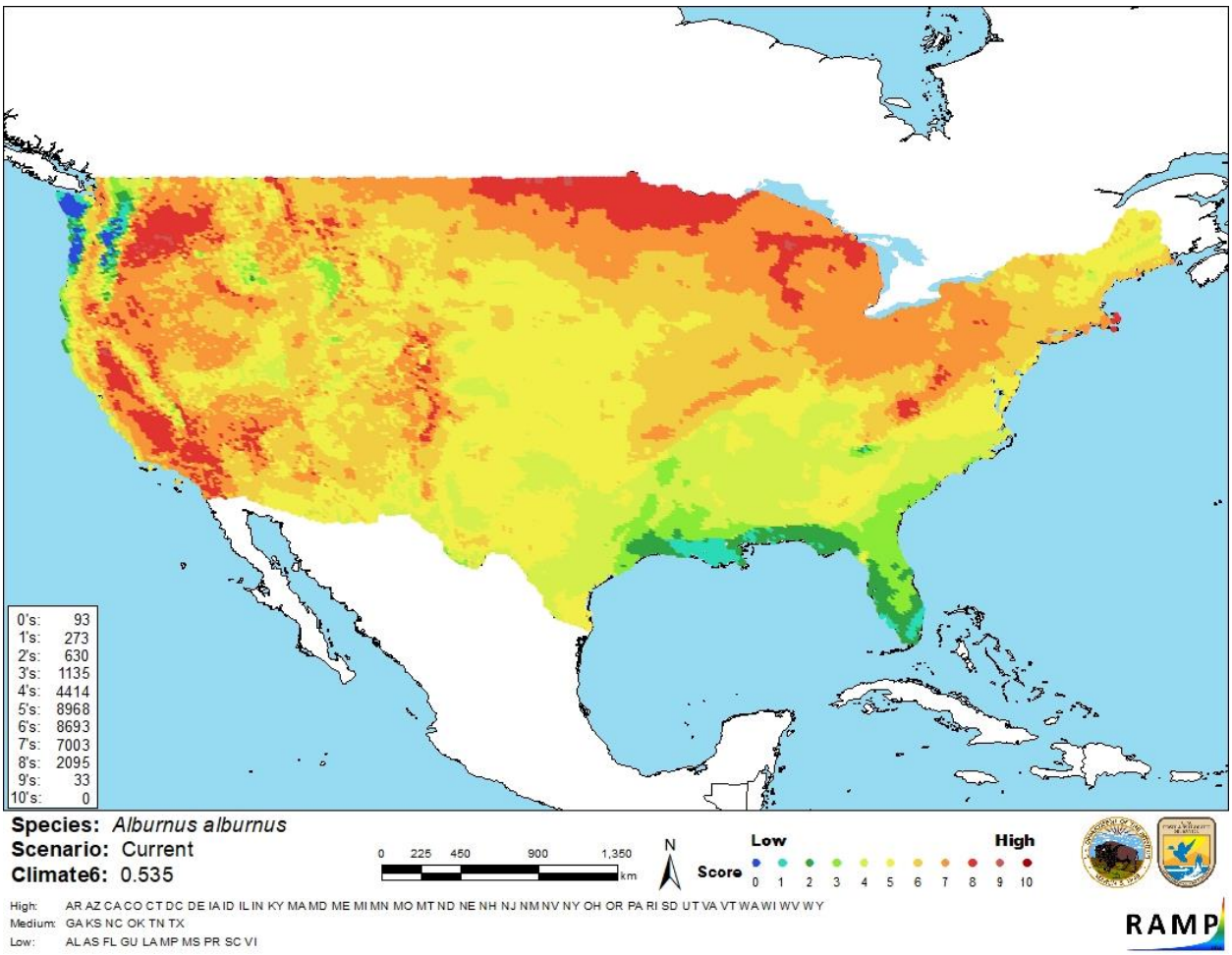

Figure 5. Map of RAMP (Sanders et al. 2018) climate matches for *Alburnus alburnus* in the contiguous United States based on source locations reported by Vinyoles et al. (2007), Clavero et al. (2015), Reshetnikov et al. (2017), Froese and Pauly (2019a), and GBIF Secretariat (2019). Counts of climate 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 for *Alburnus alburnus* is medium. There is solid information available on the natural history and range of *Alburnus alburnus,* including information from peer-reviewed sources. Some information is available regarding impacts of introduction, including peer-reviewed sources.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Bleak (*Alburnus alburnus*) is a freshwater and brackish water fish native to parts of Europe and western Asia. The fish primarily consumes invertebrates and is a forage species for larger, predatory fish. This species can form high-density shoals. The history of invasiveness is high. This species has established populations in several countries outside of its native range including Spain, Italy, and Cyprus. The spread of this species has been facilitated by stream modifications and by intentional transportation to new areas for use as bait or forage fish for sport fish. In some areas this species is reported to compete with native fish for resources, directly causing a decline in a native fish. The study underlying that report has not been peer-reviewed. Other impacts reported include changes in water quality and interfering in the genetic integrity of endemic species through hybridization. The climate match to the contiguous United States is high. There are many areas of high match stretching from southern New England to the Pacific Coast. The certainty of assessment is medium. Information on documented impacts of introduction is lacking peer-review. 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): Medium**
- **Remarks/Important additional information:** No additional remarks.
- **Overall Risk Assessment Category: High**

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