

Red Shiner (*Cyprinella lutrensis*)

Ecological Risk Screening Summary

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Photo: ©Marine discovery in Siriwardena (2014).

1 Native Range, and Status in the United States

Native Range

From Robins et al. (1991):

“North America: Mississippi River basin from southern Wisconsin and eastern Indiana to South Dakota and Wyoming and south to Louisiana, USA; Gulf drainages west of Mississippi River to Rio Grande in Texas, New Mexico and Colorado, USA... Also in northern Mexico.”

Status in the United States

From Robins et al. (1991):

“[Native to] North America: Mississippi River basin from southern Wisconsin and eastern Indiana to South Dakota and Wyoming and south to Louisiana, USA; Gulf drainages west of Mississippi River to Rio Grande in Texas, New Mexico and Colorado, USA. Widely introduced elsewhere in USA.”

From Nico et al. (2014):

“Established in areas outside their native range in Alabama, Arizona, California, Colorado, Georgia, Illinois, Nevada, New Mexico, North Carolina, Utah, and Wyoming. In contrast to Hubbs and Lagler's statement (1958), Becker (1983) found that there was no evidence to substantiate the presence of this species in lagoons of Lake Michigan at Chicago.”

“This species is known from the upper Tombigbee River, the Coosa River drainage, Lower Conasauga River, and reservoirs of the Chattahoochee River, Alabama (Boschung 1987, 1992, Mettee et al. 1996, Burkhead 2003); the Colorado River and its major tributaries in Arizona including the Gila and Virgin drainages and Montezuma Castle National Monument and Lake Mead National Recreation Area, Bill Williams River National Wildlife Refuge (Hubbs 1954, Miller and Lowe 1967, Minckley and Deacon 1968, Minckley 1973, Tyus et al. 1982, Greger and Deacon 1988, Stolzenburg 1992, USFWS 2005); the Colorado River, the San Joaquin River drainage, Salton Sea drainages, the Yolo Bypass, and the Los Angeles basin and certain surroundings areas in California (Hubbs 1954, Moyle 1976a, 1976b, Jennings and Saiki 1990, Swift et al. 1993, Dill and Cordone 1997, Sommer et al. 2001); the Colorado River and some of its tributaries in western Colorado (Everhart and Seaman 1971, Tyus et al. 1982, Woodling 1985); the Ocmulgee, Coosa, Etowah, Oostanaula, Coosawattee, and Chattahoochee river drainages in Georgia (Couch et al. 1995, Devivo and Freeman 1995, Burkhead et al. 1997, Burkhead 2003); in northeastern Illinois including lagoons of Lake Michigan in Chicago (Hubbs and Lagler 1958) and Channel Lake, Fox River drainage, in Lake County (Smith 1979); Silvio O. Conte National Fish and Wildlife Refuge (USFWS 2005) and Dickey Brook in New Salem, Massachusetts (Hartel et al. 1996); Boyer Chute National Wildlife Refuge, Washington County, Nebraska (USFWS 2005); portions of the Colorado River basin in Nevada including the lower Virgin River, Moapa River, and Lake Mead National Recreation Area (Bradley and Deacon 1967, Branson 1968, Cross 1975, Deacon and Williams 1984, Greger and Deacon 1988, Tilmant 1999, Vinyard 2001), and the Moapa River (Deacon and Bradley 1972, Cross 1976); portions of the Colorado River basin in New Mexico including the San Juan, Gila, and San Francisco drainages (Tyus et al. 1982, Sublette et al. 1990, Stolzenburg 1992); portions of Atlantic Coastal drainages in North Carolina including the Yadkin, Pee Dee, Haw and Roanoke river drainages (Moore et al. 1976, Hocutt et al. 1986, Menhinick 1991, W. Starnes, pers. comm); the Pee Dee River drainage in South Carolina (Hocutt et al. 1986); portions of the Colorado River basin in Utah including the Green, White, and Virgin river drainages, Arches and Canyonlands National Parks, Dinosaur National Monument, and Glen Canyon National Recreation Area (Holden and Stalnaker 1975b, Tyus et al. 1982, Deacon 1988, B. Schmidt, personal communication, Tilmant

1999); the Roanoke River drainage in Virginia (Hocutt et al. 1986); and from the Green River drainage, Colorado River basin, Wyoming (Tyus et al. 1982).”

Means of Introductions in the United States

From Nico et al. (2014):

“The origin of most introduced red shiner populations can be attributed to bait bucket releases; however, initial introduction is often followed by the species' rapid multiplication, dispersal, and aggressive colonization (e.g., Hubbs and Lagler 1958, Minckley and Deacon 1968, Minckley 1973). In some areas dispersal of introduced populations has been aided by the presence of irrigation ditches and canals (e.g., Jennings and Saiki 1990). Koehn (1965) mentioned that the species has been introduced as a forage fish. According to Dill and Cordone (1997), it was introduced into northern California as forage, not as a bait minnow as Kimsey and Fisk (1964) had suggested. The introduction into the Yadkin drainage, North Carolina, was possibly the result of an aquarium release (Moore et al. 1976). Hubbs (1954) reported this species as established in the lower Colorado River basin by 1953. He attributed the source of the introduction to escapes from the Arizona Fish Farms in Ehrenburg, Arizona. There apparently has been more than one subspecies introduced into the southwestern United States. Hubbs (1954) also noted that red shiners found in the lower Colorado River basin were intergrades between the subspecies *N. l. lutrensis* and *N. l. suavis*. In contrast, Minckley (1973) reported that the Arizona specimens he examined more closely resembled the typical subspecies, *C. l. lutrensis*. Gilbert (1998) also referred it to the typical subspecies (*C. l. lutrensis*).”

From Siriwardena (2014):

“*C. lutrensis* is being used as an aquarium and farmed fish and hence, there is a risk of the species spreading through aquarium releases and escapes (Hubbs 1954, Moore et al. 1976, Jenkins and Burkhead 1994). Escape from the Arizona Fish Farms in Ehrenburg, Arizona has been attributed to the establishment of this species in the lower Colorado River basin by 1953 (Hubbs 1954). *C. lutrensis* is among some of the most thermally-tolerant minnows in North America and therefore, has the potential to spread to other hot environments in the United States (Brues 1928, Matthews and Hill 1979, Poulas et al. 2012). The predicted habitat is consistent with the wide-ranging habitat associations of this species in its current native and invaded ranges (Marsh-Matthews and Matthews 2000). Sites with mean minimum temperatures above freezing, high mean maximum summer air temperatures and a high summer heat index (August temperature/ summer precipitation) are potential sites for invasion by *C. lutrensis* ([Poulas] et al. 2012). In some areas dispersal of introduced populations has been aided by the presence of irrigation ditches and canals (e.g. Jennings and Saiki 1990).”

Remarks

From Nico et al. (2014):

“The red shiner is a widespread and commonly used bait fish; it is also in the aquarium trade (Becker 1983, Etnier and Starnes 1993). It has been marketed in a pet shop under the name "rainbow dace" (Moore et al. 1976). Several attempts have been made to eradicate the red shiner from a portion of the Virgin River as part of the recovery plan for woundfin and Virgin River

chubs. It was successfully eliminated from the river between Washington Fields Diversion and Johnson Diversion, but have re-invaded below Johnson Diversion (U.S. Fish and Wildlife Service 1995). Tyus et al. (1982) gave a distribution map of the this species in the upper Colorado basin. Swift et al. (1993) and Dill and Cordone (1997) detailed the history of this species in California. Marsh-Matthews et al. (2011) examined recruitment and survivorship of red shiners 'introduced' to native communities in mesocosm experiments, and found that predation by piscivorous fishes (e.g., centrarchids) can limit the ability of red shiners to establish itself within a community.”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2011):

“Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cyprinoidea
Family Cyprinidae
Genus *Cyprinella*
Species *Cyprinella lutrensis* (Baird and Girard, 1853)

Taxonomic Status: Valid.”

Size, Weight, and Age Range

From Robins et al. (1991):

“Maturity: Lm ? range ? - ? cm; Max length : 9.0 cm TL male/unsexed; (Page and Burr 1991); common length : 4.9 cm TL male/unsexed; (Hugg 1996); max. reported age: 3 years (Carlander 1969).”

Environment

From Robins et al. (1991):

“Freshwater; benthopelagic; pH range: 7.0 - 7.5; dH range: 10 - 20.”

Climate/Range

From Robins et al. (1991):

“Temperate; 15°C - 25°C (Riehl and Baensch 1991); 44°N - 26°N.”

Distribution Outside the United States

Native

From Robins et al. (1991):

“North America: Mississippi River basin from southern Wisconsin and eastern Indiana to South Dakota and Wyoming and south to Louisiana, USA; Gulf drainages west of Mississippi River to Rio Grande in Texas, New Mexico and Colorado, USA. Widely introduced elsewhere in USA. Also in northern Mexico.”

Introduced

This species has not been reported as introduced outside of the United States.

Means of Introduction Outside the United States

This species has not been reported as introduced outside of the United States.

Short description

From Siriwardena (2014):

“*C. lutrensis* has a deep and compressed body and a sharp and compressed head (Mayden 1989, Hubbs et al. 1991). There is a tendency for large males to develop a sharply pointed snout that overhangs the terminal to slightly sub-terminal mouth (Miller and Robison 2004). It has an olive-green back, silver coloured sides and a whitish abdomen (Hassan-Williams and Bonner 2012, TWPD 2007). The scales on the back and sides are edged with melanophores, which are arranged in a narrow wedge-shaped pattern on the posterior to the upper end of the opercle and in a medial stripe on the gula (Hassan-Williams and Bonner 2012). The breeding male has red on the top of its head, a purple crescent behind the head and pinkish sides with some blue on the sides and back. It also has a dark dorsal fin and reddish-orange caudal, pelvic and pectoral fins (Sublette et al. 1990). The black median stripe on the lower jaw does not extend posteriorly through the isthmus and pigments are in inter-radial membranes of the dorsal fin (Hubbs et al. 1991). Peritoneum is silvery in colour with numerous large, dark chromatophores (Goldstein and Simon 1999).”

“It has diamond-shaped scales, outlined in a crosshatch pattern and a slightly de-curved lateral line that extends one third of the way forward (Hassan-Williams and Bonner 2012, ISSG 2012). There are 34-36 lateral line scales, 8 dorsal soft fin rays, 8 pelvic soft fin rays, and generally 9 (8-10) anal soft fin rays (Miller and Robison 2004). The beginning of the dorsal fin is close to the start of the pelvic fin (ISSG 2012). The nuptial tubercles, in the male are dense and scattered on the snout, top of the head, chin, edges of body scales, and fin rays. Whilst on the female, the weak tubercles are present on the head and on the midline of the back. Nuptial tubercles of the

caudal peduncle are largest on the anterior end of the scales. As spawning season progresses, tuberculation increases, progressing from a linear pattern to one that is scattered (Koehne 1965, Collette 1977, Sublette et al. 1990).”

“*C. lutrensis* typically has a pharyngeal teeth count of 0,4-4,0 but some individuals display 1,4-4,1, and has a short s-shaped intestine (Mayden 1989, Hubbs et al. 1991, Page and Burr 1991, Goldstein and Simon 1999).”

Biology

From Robins et al. (1991):

“Inhabits silty, sandy, and rocky pools and runs, sometimes riffles, of creeks and small to medium rivers. Tolerates siltation and high turbidity (Page and Burr 1991). Feeds on terrestrial and aquatic insects, and algae (Etnier and Starnes 1993).”

From GISD (2007):

“*Cyprinella lutrensis* populations are usually located where there are few other cyprinids. They can be found in turbid water, muddy river beds, and unstable banks (Douglas et al. 1994). It is rare for *C. lutrensis* to establish itself in undisturbed areas (Baltz and Moyle 1993). In Wyoming this species was found mostly at elevations of < 250m (Quist et al. 2004). It can also be found in backwaters, creek mouths, mid-sized streams with sandy and silty bottoms, rocky pools, and riffles (NatureServe 2006).”

“*C. lutrensis* spawns from spring into fall. The peak is during the mid-summer months. The actual spawning occurs "on riffles, on or near submerged, over vegetation beds, or in association with sunfish nests (TPWD 2007). The eggs hatch at a temperature of 24.5°C. The offspring will be sexually mature in 1-2 years (NatureServe 2006).”

“*C. lutrensis* is considered an invertivore because it feeds on small [invertebrates] such as insects and crustaceans (NatureServe 2006). According to Wang (1986), plant leaves were found in the stomachs of young *C. lutrensis*.”

Human uses

From Robins et al. (1991):

“Aquarium: commercial.”

From GISD (2007):

“*Cyprinella lutrensis* is commonly used as a bait fish (TPWD 2007).”

Diseases

There are no known OIE-reportable diseases for this species.

Carries Asian tapeworm (Nico et al. 2014).

Threat to humans

Harmless.

3 Impacts of Introductions

From Nico et al. (2014):

“The red shiner is very aggressive and where introduced may dilute the gene pools of native *Cyprinella* via hybridization (Mayden 1989, Burkhead 2003). The red shiner is hybridizing with the blacktail shiner *C. venusta stigmatura* in Alabama (Mettee et al. 1996, Burkhead 2003).”

“The red shiner has also affected the distribution and abundance of native fishes. For example, populations in the Moapa and Virgin rivers, Nevada, have been implicated in the decline of the native fish of this region, including spinedace *Meda fulgida*, woundfin *Plagopterus argentissimus*, and Virgin River chub *Gila seminuda* (Moyle 1976, Deacon 1988, U.S. Fish and Wildlife Service 1990, 1995). Members of this species may compete with and affect adversely young Colorado pikeminnow *Ptychocheilus lucius*, an endangered species (Karp and Tyus 1990). The introduced reidside shiner *Richardsonius balteatus* declined when the red shiner became common in the Green River near the boundary of Dinosaur National Monument, Utah, in 1971 (Holden and Stalnaker 1975). In degraded streams in Georgia, introduced red shiners have become one of the most abundant species (Devivo and Freeman 1995). The introduction of red shiners into Utah was probably the means by which the Asian tapeworm entered the Virgin River; subsequent tapeworm infestation of woundfin *Plagopterus argentissimus*, an endangered species, may be primarily responsible for the woundfin's decline during the 1980s (Deacon 1988). Dill and Cordone (1997) called the red shiner the second greatest threat to the welfare of indigenous southwestern fishes, after the mosquitofish.”

From Siriwardena (2014):

“*Cyprinella lutrensis*, commonly known as the red shiner, is a small minnow native to northern Mexico and certain states of central USA. The red shiner is a habitat generalist, primarily occurring in creeks and small rivers (Poulos et al. 2012). It is well known to prey on eggs and larvae of native fish and is an opportunistic drift feeder (Sublette 1975, Ruppert et al. 1993). It is a fish species of special concern in the United States as it has been implicated in the decline of native fish populations in the areas to which it has been introduced. *C. lutrensis* occupies nursery habitats of young native fishes, including the Red River pupfish (*Cyprinodon rubrofluviatilis*), Colorado pikeminnow (*Ptychocheilus lucius*), spinedace (*Meda fulgida*) and razorback sucker (*Xyrauchen texanus*), most of which are endangered. They are also adapted to thrive in a variety of environments and as generalists are better able to persist in disturbed habitats than the native species of those areas. They are tolerant of harsh environmental conditions, including low or

intermittent flows, excessive turbidity and sedimentation, and natural physiochemical extremes (Poulos et al. 2012). Initial introduction is often followed by the species rapid population growth, dispersal, and aggressive colonization (Hubbs and Lagler 1964, Minckley and Deacon 1968, Minckley 1973).”

“Red shiner are known to prey on the eggs and larvae of native fish, such as the Red River pupfish (*Cyprinodon rubrofluviatilis*) and have been implicated with the decline of a number of threatened species as listed by the IUCN. These species include the Colorado pikeminnow (*Ptychocheilus lucius*), spikedace (*Meda fulgida*), razorback sucker (*Xyrauchen texanus*), two threatened species of woundfin (*Plagopterus argentissimus*) and Virgin River chub (*Gila seminude*). Predation of eggs and larvae and direct competition for habitat use with red shiner are the leading causes of decline for many of these threatened species (Moyle 1976, Deacon 1988). Douglas et al. (1994) demonstrated that biotic interactions between spikedace and red shiner involved interference competition for space, and that spikedace were displaced to less favourable habitats in the presence of this invader. Mooney and Cleland (2001) have suggested that such niche displacement of natives by exotic fishes can have major evolutionary consequences on native populations. Invasive competitiveness may even lead to native fish extinction (Ricciardi and Rasmussen 1998, Ricciardi et al. 1998, Poulas et al. 2012).”

“*C. lutrensis* are capable of hybridizing with native *Cyprinella* species (Mettee et al. 1996, Fuller et al. 1999). It is reported that such hybridizations has caused a dilution of the gene pool of the blacktail shiner (*Cyprinella venusta stigmatura*), a native species found in the Coosa River (Burkhead and Huges 2002).”

“According to Poulas et al. (2012), the potential spread of this species both eastward and westward beyond its native and currently invaded ranges could threaten the stability of native US minnow populations with similar habitat requirements because of red shiner’s ability to outcompete and hybridize with natives (Burr and Page 1986, Greger and Deacon 1988, Larimore and Bayley 1996). Overlaps in the potential distribution of red shiner and native minnow species richness occur predominantly in the western United States, with the areas of highest minnow diversity and red shiner habitat suitability occurring in Arizona, New Mexico, and southern California (NatureServe 2004). This suggests that cyprinid congeners in these areas may be the most heavily impacted by red shiner spread (Poulas et al. 2012). Walters et al. (2008) demonstrated that red shiner success can be facilitated through infiltration of genes in locations where congeners are present. Red shiner establishes first in locations with congeners, and then its subsequent expansion is driven primarily by hybrid minnows into new habitats (Poulas et al. 2012).”

4 Global Distribution

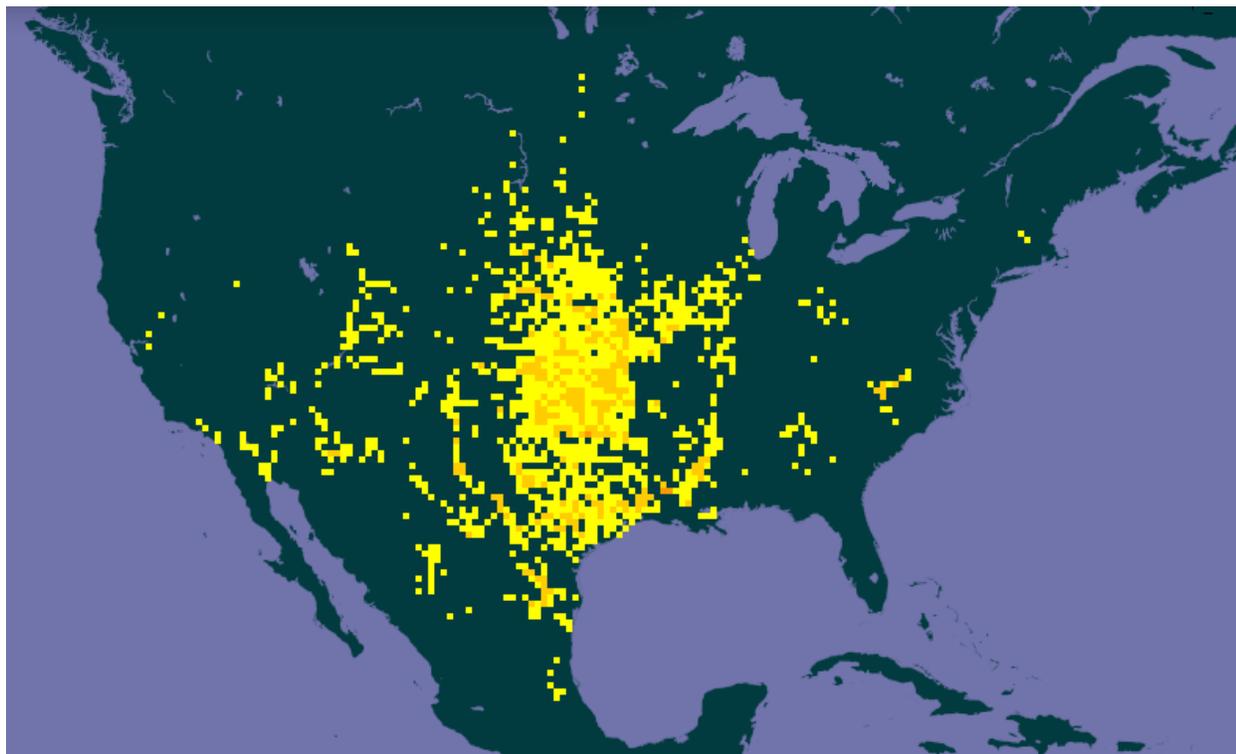


Figure 1 Map of known global distribution of *Cyprinella lutrensis*. Map from GBIF (2014).

5 Distribution within the United States

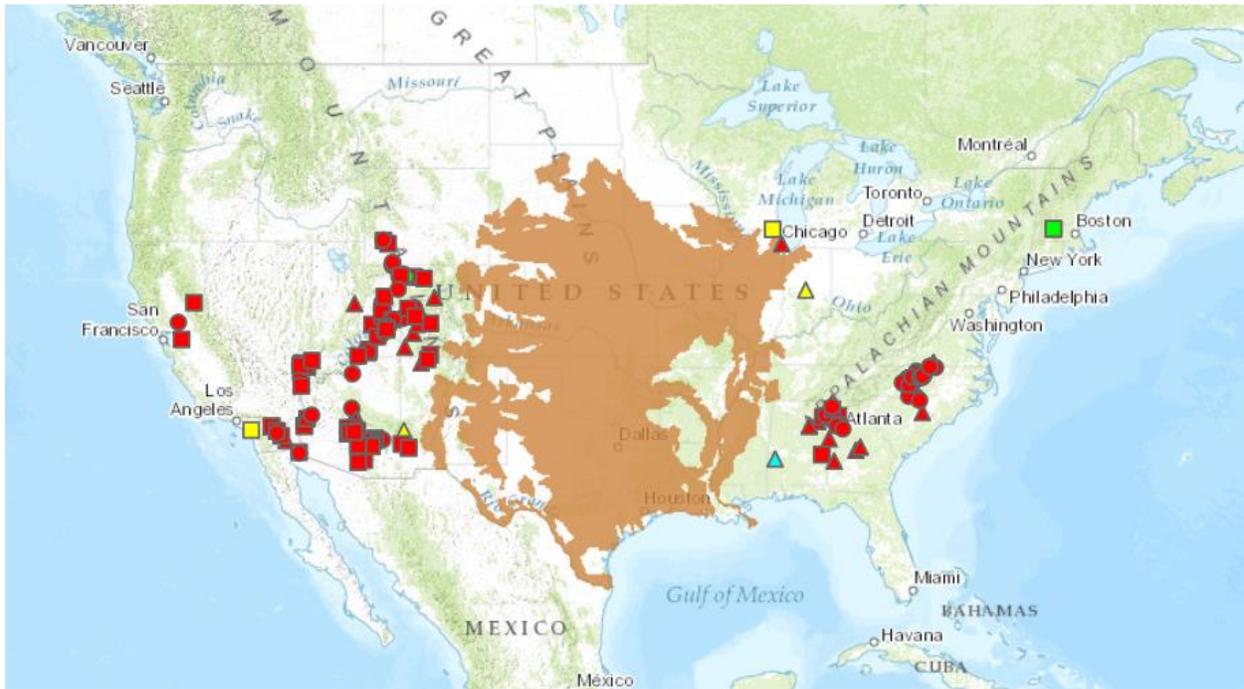


Figure 2. Distribution of *Cyprinella lutrensis* in the United States. Map from Nico et al. (2014).

6 CLIMATCH

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences 2008; 16 climate variables; Euclidean Distance) was high in almost the entire contiguous U.S. Medium and low matches occur along the northern west coast, Florida, and northeastern United States. Climate 6 match indicated that the contiguous U.S. has a high climate match. The range for a high climate match is 0.103 and greater; climate match of *Cyprinella lutrensis* is 0.914.

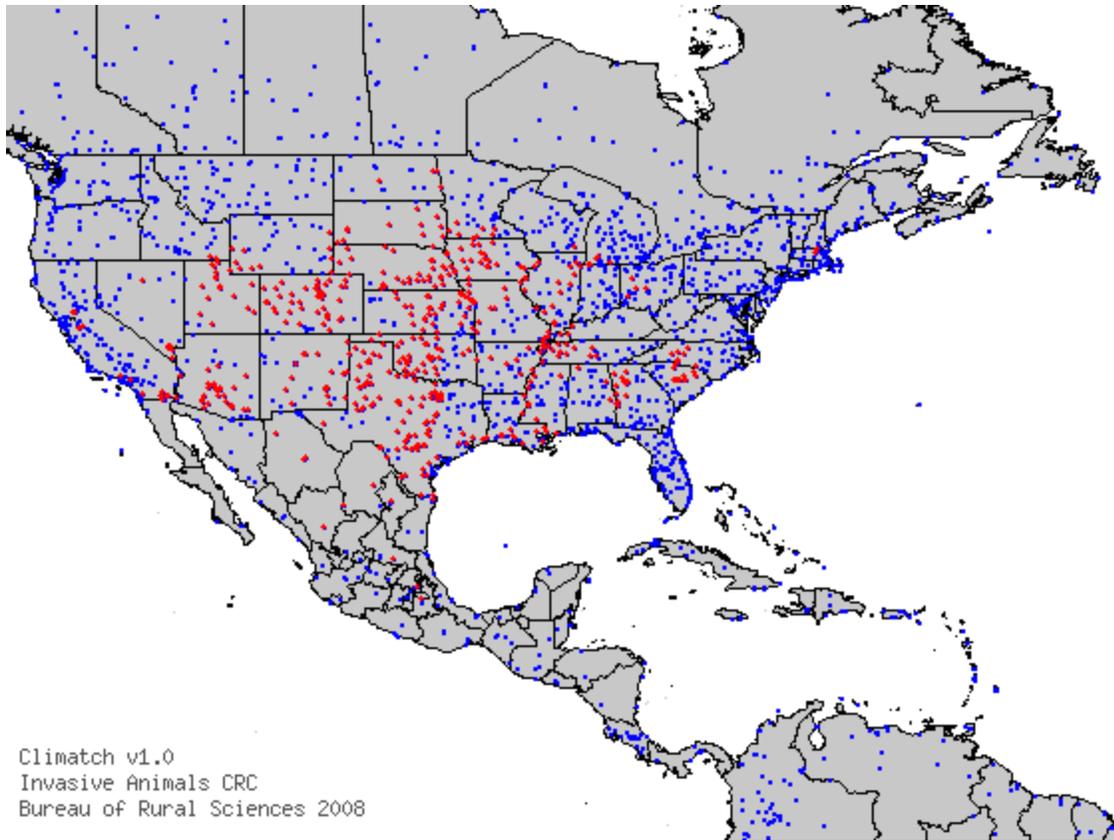


Figure 3. CLIMATCH (Australian Bureau of Rural Sciences 2008) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *Cyprinella lutrensis* climate matching. Source locations from GBIF (2014) and Nico et al. (2014).

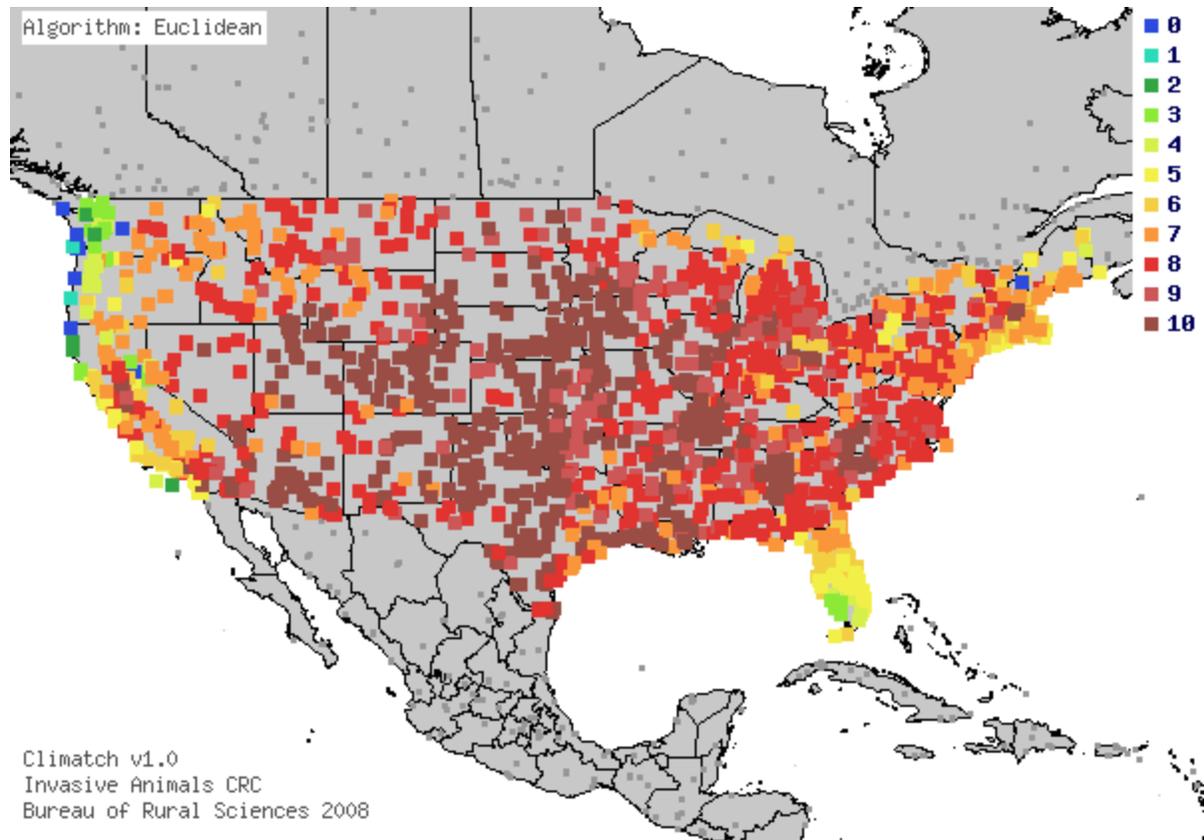


Figure 4. Map of CLIMATCH (Australian Bureau of Rural Sciences 2008) climate matches for *Cyprinella lutrensis* in the contiguous United States based on source locations reported by GBIF (2014) and Nico et al. (2014). 0= Lowest match, 10=Highest match.

Table 1. CLIMATCH (Australian Bureau of Rural Sciences 2008) climate match scores.

CLIMATCH Score	0	1	2	3	4	5	6	7	8	9	10
Count	9	2	9	28	35	86	118	292	608	215	572
Climate 6 Proportion =		0.914									

7 Certainty of Assessment

The biology and ecology of *Cyprinella lutrensis* are well-known. Negative impacts from introductions of this species are adequately documented in the scientific literature. No further information is needed to evaluate the negative impacts the species is having where introduced. Certainty of this assessment is high.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Cyprinella lutrensis is a freshwater fish native to the central U.S. and northern Mexico. Introductions to other areas throughout the United States are occurring via bait fish movement, aquarium releases, and fish movement through watersheds. Red Shiners are known to displace native species, as well as dilute the gene pool for native shiners via hybridization. Climate match with the contiguous U.S. is high. Overall risk for this species is high.

Assessment Elements

- **History of Invasiveness (Sec. 3):** High
- **Climate Match (Sec.6):** High
- **Certainty of Assessment (Sec. 7):** High
- **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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