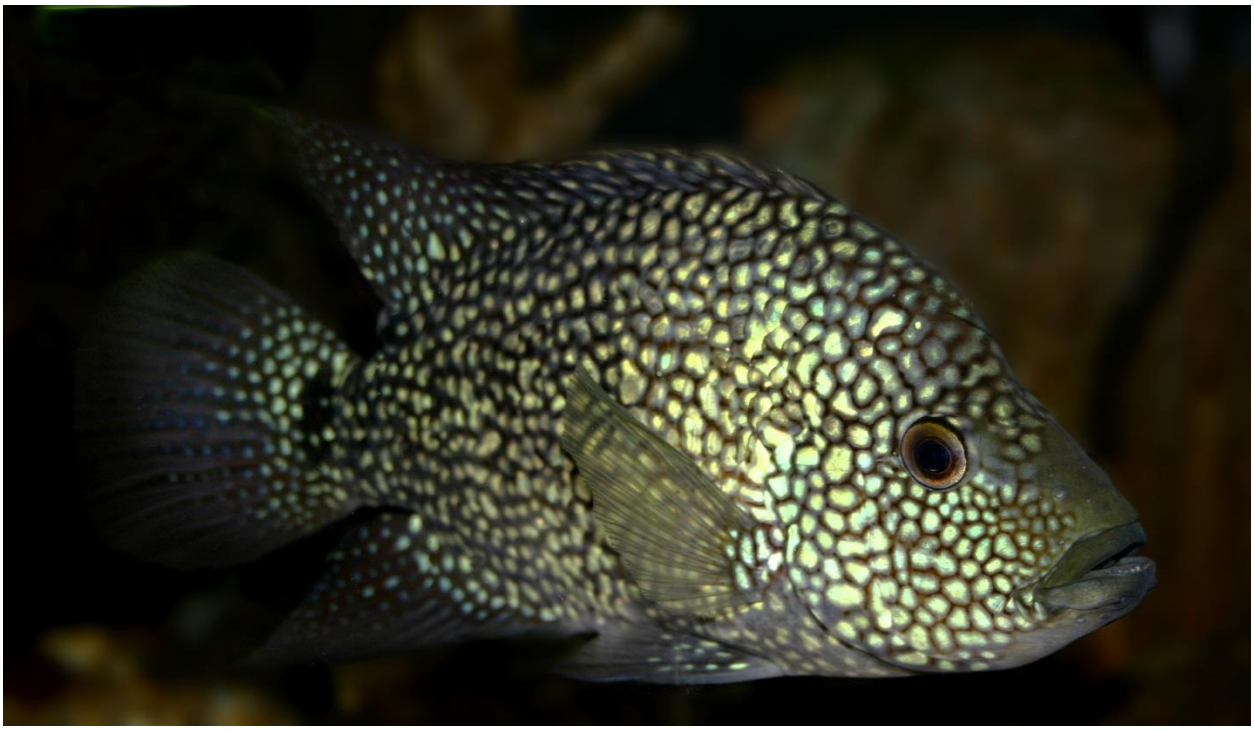
Rio Grande Cichlid (*Herichthys cyanoguttatus*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, May 2017
Revised, August 2017
Web Version, 12/8/2017



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1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2017):

"North America: originally restricted to the lower Rio Grande drainage in Texas, USA and south to northeastern Mexico."

Status in the United States

From NatureServe (2017):

"Native range includes the Nueces River and lower Rio Grande drainages in Texas […]."

From Nico et al. (2017):

"**Nonindigenous Occurrences**: Two young cichlids (tentatively identified as *H. cyanoguttatum*) were taken from a canal in Tempe, Maricopa County, **Arizona**, prior to 1973 (Minckley 1973). Specimens were taken from several locations in the Tampa, **Florida**, area, some as early as the 1940s. It is established in several areas in Florida including Six Mile Creek in Hillsborough County (Burgess 1958), a phosphate pit in Mulberry in Polk County (Courtenay et al. 1974), Lake Seminole in Pinellas County (Courtenay and Hensley 1979), and in canals near fish hatcheries in Brevard (died out) and Indian River counties (Smith-Vaniz and J. D. Williams, personal communication). Conkel (1993) reported on a population in the Alafia River in Tampa. Populations have been established locally in Blue Hole at Key Deer National Refuge on Big Pine Key, Monroe County, since about 1971 (Smith-Vaniz, personal communication). This cichlid was recorded as present and presumably reproducing in heated power plant effluents in Powerton Lake near Pekin, **Illinois** (Illinois River drainage), Tazewell County, after having been released accidentally in the mid-1980s (Burr 1991; Page and Laird 1993). A single specimen was taken from Irish Bayou, Lake Pontchartrain, Orleans Parish, **Louisiana**, in June 1996 (Burr, personal communication). Several more were taken from the lake area in 1997 (R. Cashner, personal communication). Another fish was found in a roadside canal in Kenner in 1999 (Chandler, unpublished), and it has been collected from bayous and canals in the New Orleans metropolitan area (Lorenz and O'Connell 2011). Found in a reservoir south of Lincoln **Nebraska** in the Salt River drainage (Rasmussen 1998). It was in Roger's Spring near Lake Mead, Clark County, **Nevada**, in 1983 (Courtenay and Deacon 1983; Deacon and Williams 1984). A single specimen was found in a pool on the Olentangy River, **Ohio** on the west bank below the 5th Avenue dam (Kibbey personal comm. 2000). A specimen was collected from a reservoir south of Lincoln, **Nebraska** (Rasmussen 1998). In **Puerto Rico**, it has become established in the Loiza Reservoir (Grana personal comm. 2007). It has been widely introduced and reported as established in the Rio Frio, Colorado, San Antonio, San Marcos, Guadalupe, and Comal rivers in the Edwards Plateau region of central **Texas** (Brown 1953; Hubbs et al. 1978; USGS; Birkhead (1980); Martin 2000). The San Gabriel River, in the Brazos River system, contains the state's northernmost established population (Hubbs et al. 1991). It has also been introduced into the Concho, Nueces, lower Brazos, and San Marcos Rivers and Town Resaca Lake, Cameron; Town Lake Reservoir, in southeast Austin; Lake Houston; West Matagorda Bay; Simms Bayou; San Fernando, just north of Baffin Bay; the Placid Reservoir, near San Antonio; and the Navidad, Lavaca, and Cibolo drainages (Birkhead 1980; Martin 2000; Texas Parks and Wildlife Department 2001). Most recently, the species has been reported just south of Houston (Martin 2000). Established in Six Mile Creek in Hillsborough county (Courtenay 1979)."

"**Status**: Introduced and established or locally established in parts of Florida, Louisiana, and Texas. It was established locally in a power plant lake in Illinois but the species no longer is thought to be reproducing in that state (Laird and Page 1996). It was reported from Arizona and Nebraska. Formerly established in Nevada, but now considered extirpated in that state."

Means of Introductions in the United States

From Nico et al. (2017):

"*Herichthys cyanoguttatum* was brought to the Guadalupe River drainage by the Fish Cultural Station, part of the U.S. Fish and Wildlife Service, at San Marcos, Texas, in 1928 and released into waters on the Edwards Plateau between 1928 and 1941 or 1943 (Brown 1953; Hubbs et al. 1978). Presumably, San Antonio River stocks came from near Mission, Texas (Hubbs et al. 1978). The species reportedly was introduced first into Florida from Texas stocks around 1941 by a private individual from Mulberry, Polk County. [T]he same individual is reported as having made additional introductions at Mulberry over a period of several years (Courtenay and Hensley 1979). A fish farm may have been the source of introduction into Six Mile Creek, Hillsborough County, Florida, because this species was cultured as an aquarium fish during the 1940s and early 1950s under the trade name "Texas bluespot" (Burgess 1958; Courtenay and Hensley 1979). Some Florida introductions supposedly were due to flooding of resident fish farms (Conkel 1993). Introductions elsewhere were most likely the result of aquarium releases or fish farm escapes."

From CABI (2017):

"The further spread of *H. cyanoguttatus* by natural dispersal may occur in the USA. Lorenz (2008) stated that the species was further dispersed in bayous in the New Orleans area in Louisiana by hurricane Katrina during 2005."

Remarks

From CABI (2017):

"The internationally preferred common name of *H. cyanoguttatus* is the Rio Grande cichlid, though the species is commonly referred to in aquarium literature as the Texas cichlid (e.g. Berg, 2010; Seriously Fish, 2015). In Australia, the species is only known as the Texas cichlid."

"Within the ornamental fish industry, strains of *H. cyanoguttatus* are available that include the blue Texas cichlid, green Texas cichlid and red Texas cichlid (Berg, 2010). These common names may refer to colour variants of *H. cyanoguttatus* as well as to hybrids and entirely different species."

From NatureServe (2017):

"Formerly this species was included in the genus *Cichlasoma*; Page and Burr (2011) included it in the genus *Herichthys*."

From ITIS (2017):

"Synonym(s): *Cichlasoma cyanoguttatum* (Baird and Girard, 1854)"

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 Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Labroidei
Family Cichlidae
Genus *Herichthys*
Species *Herichthys cyanoguttatum* Baird and Girard, 1854"

From Eschmeyer et al. (2017):

"Current status: Valid as *Herichthys cyanoguttatus* Baird & Girard 1854. Cichlidae: Cichlinae."

From CABI (2017):

"Preferred Scientific Name
Herichthys cyanoguttatus Baird and Girard, 1854"

"Other Scientific Names […]
Herichthys cyanoguttatum Baird and Girard, 1854"

Size, Weight, and Age Range

From Froese and Pauly (2017):

"Max length : 30.0 cm TL male/unsexed; [Page and Burr 1991]; common length : 11.3 cm TL male/unsexed; [Hugg 1996]"

Environment

From Froese and Pauly (2017):

"Freshwater; benthopelagic; pH range: 6.5 - 7.5; dH range: 5 - 12. […] 20°C - 33°C [Conkel 1993; assumed to be aquarium water temperature range]"

From CABI (2017):

"*H. cyanoguttatus* is known as a pollution-tolerant species that has been observed to dominate in degraded habitats. It is used by San Antonio River Authority biologists as a biological indicator of unbalanced or stressed ecosystems (Gonzales and Moran, 2005)."

"Lorenz (2008) reported that salinities up to 16 ppt had no significant effect on the growth of *H. cyanoguttatus*. It has been recorded at salinities as high as 27 psu, but long-term survival (one year) was poor at 16 psu (Lorenze, unpublished data)."

"Introduced populations of *H. cyanoguttatus* occur in estuarine environments in the New Orleans area (Lake Pontchartrain) of Louisiana. They have been observed to spawn there in salinities as high as 8 psu (OT Lorenz, Georgia Southwestern State University, USA, personal communication, 2015)."

Climate/Range

From Froese and Pauly (2017):

"Subtropical; […] 32°N - 25°N"

From CABI (2017):

"*H. cyanoguttatus* is one of the most cold-tolerant cichlids. Lee et al. (1980) (referencing Hubbs, 1951) reported a lower temperature tolerance of between 14°C and 19°C for fish at Colorado River in Austin, Texas, USA."

"Low water temperatures probably restrict the northern spread of *H. cyanoguttatus* in the USA. Tomelleri and Eberle (1990) report that the species can only survive cool winters in the 'cooling lakes' of power plants or in rivers near the outlets of warm springs at the northern limit of its distribution in the Edwards Plateau, Texas, USA."

"The temperature tolerance of *H. cyanoguttatus* goes below 7°C in outdoor artificial ponds and it can be active at 10°C (Lorenz, unpublished data). Shafland and Pestrak (1982), reported a lower lethal temperature of 5°C under experimental conditions."

Distribution Outside the United States

Native

From NatureServe (2017):

"Native range includes the […] lower Rio Grande drainages in […] northeastern Mexico, excluding the Rio Conchos basin (Miller 2005, Page and Burr 2011) and extends southward into the upper Rio Soto la Marina in Mexico (Miller 2005)."

Introduced
From Froese and Pauly (2017):

"Introduced […] Verde River basin (La Media Luna region), Mexico [Kullander 2003]."

"To: Philippines […]
From: Unknown […]
Year: 1970 […]
Established in the wild: unknown, […]"

Xiong et al. (2015), citing Mu et al. (2008), report *Herichthys cyanoguttatus* as present in China. However, they also report its status as uncertain.

Means of Introduction Outside the United States

From Froese and Pauly (2017):

"Reason: ornamental"

From Xiong et al. (2015):

"Aquarium"

Short Description

From CABI (2017):

"Its morphology and colour pattern vary greatly across its natural and introduced range (Miller et al., 2005)."

"Juvenile *H. cyanoguttatus* are pearly grey with white dots on the body and fins and two characteristic black spots on the centre of the body and the caudal fin base (Berg, 2010)."

"Adults are dusky to olive above with 4-6 dark blotches (1st blotch most prominent) along the rear half of the body and a black blotch on caudal fin base. There are numerous small white to blue spots on blue-green or grey sides. There are iridescent blue-green spots or wavy lines on head, body and fins. Females are generally less colourful than males (Page and Burr, 1991). Breeding adults have a white head and front half of the body, and the rear half of the body, particularly the ventral surface, is black (Page and Burr, 1991; Berg, 2010)."

"There are 5 or 6 anal fin spines; 15-18 dorsal fin spines; 10-12 dorsal rays and 9-10 anal rays (Hubbs et al., 1991; Page and Burr, 1991). There is one nostril opening on each side of the head and an interrupted lateral line (Itzkowitz and Nyby, 1982) that is doubled for a short distance on the caudal peduncle (Tomelleri and Eberle, 1990). Breeding males have a prominent nuchal hump (Page and Burr, 1991), and males are typically larger than females (Itzkowitz and Nyby, 1982)."

Biology

From CABI (2017):

"Parental care of offspring exhibited by cichlid fishes greatly increases offspring survival rates. *H. cyanoguttatus* is a biparental substrate spawner/brooder with preferred spawning sites usually solid substrates (rocks) in shallow water (Itzkowitz and Nyby, 1982). Pair formation occurs before territory establishment and pairs will actively defend their territory to defend the eggs and fry. Both parents are active in guarding the eggs and fry though the male and female alternate in the performance of parental responsibilities. Males appear to spend more time patrolling the pair's territory, whereas females spend more time in close proximity to and attending the eggs/fry. Although breeding pairs will attack most other fishes in the vicinity of the nest, attacks are more pronounced against conspecifics. Itzkowitz and Nyby (1982) reports that established pairs will travel up to 3 m to harass newly formed pairs/conspecifics."

"Seriously Fish (2015) states that eggs hatch in 23 days and the parents immediately move the fry to a pre-excavated pit in the substrate where the fry remain until the yolk sac is absorbed. The fry will become free swimming in 45 days. Buchanan (1971) reported that in the San Marcos River, Texas, *H. cyanoguttatus* reproduced from March to August with peak activity in April." "The species matures at approximately 100 mm standard length (SL), after one year of growth (Buchanan, 1971)."

"*H. cyanoguttatus* is diurnal and nonmigratory (Froese and Pauly, 2015)."

"*H. cyanoguttatus* is omnivorous with great variation observed in diets of specimens in differing locales. Tomelleri and Eberle (1990) report that the dentition of the species suggests a chiefly carnivorous diet that may include fish eggs, insects and small fishes."

"Buchanan (1971) reported that fish from indigenous populations in the Rio Grande valley (south Texas) were omnivorous, whereas introduced populations from the San Marcos River (Edwards Plateau, central Texas) were almost exclusively herbivorous. Buchanan (1971) suggested the competitive interactions between *H. cyanoguttatus* and a diverse assemblage on centrarchids resulted in a more diverse diet in native populations."

"Darnell (1962) and Birkhead (1980) recorded that populations from northeastern Mexico were detritivorous."

"Mills and Vevers (1989) report a diet of worms, crustaceans, insects and plant matter."

Human Uses

From CABI (2017):

"*H. cyanoguttatus* is a moderately popular ornamental fish species maintained by hobbyists worldwide."

"*H. cyanoguttatus* is captured by recreational anglers and the species is considered very palatable (Mardon, 2012; Texas Parks and Wildlife, 2015). In Louisiana, USA, they are often eaten and

are popular with fly fishermen (OT Lorenz, Georgia Southwestern State University, USA, personal communication, 2015). In Mexico, *Herichthys* species, including both *H. cyanoguttatus* and *H. carpintis,* are considered legitimate food fish."

"*H. cyanoguttatus* is used by San Antonio River Authority biologists as an indicator of unbalanced or stressed ecosystems as it is pollution tolerant (Gonzales and Moran, 2005)."

Diseases

From Froese and Pauly (2017):

"List of diseases for *Herichthys cyanoguttatus* […]
Cryptobia Infestation (*Cryptobia iubilans*.), Parasitic infestations (protozoa, worms, etc.)
Crassicutis Infection, Parasitic infestations (protozoa, worms, etc.)
Genarchella Infection, Parasitic infestations (protozoa, worms, etc.)
Rhabdochona Infestation 6, Parasitic infestations (protozoa, worms, etc.)"

From CABI (2017):

"Salgado-Maldonado et al. (2004) listed *H. cyanoguttatus* as host to the following parasites: *Crassicutis cichlasomae*, *Centrocestus formosanus*, *Clinostomum complanatum*, *Diplostomum* sp., *Posthodiplostomum minimum*, *Bothriocephalus acheilognathi*, *Neoechinorhynchus golvani*, *Rhabdochona kidderi* and *Contracaecum* sp."

From Moravec et al. (2012):

"Moravec & Huffman (1988) described conspecific nematodes from the cichlids *Herichthys cyanoguttatus* and *Oreochromis mossambicus* (Peters) […] from central Texas, USA, for which they established an independent subspecies, *Rhabdochona kidderi texensis* Moravec & Hoffman [*sic*], 1988 […]"

From Salgado-Maldonado and Pineda-López (2003):

"[*Bothriocephalus*] *acheilognathi* [Asian fish tapeworm] is reported from Mexico for the first time in […] *Cichlasoma cyanoguttatum* [synonym of *Herichthys cyanoguttatus*] […] Given its wide distribution among Mexican freshwater fish species, the abundance of the parasite and its high pathogenicity, parasitological data for *B. acheilognathi* should be considered as an important factor in native fish conservation policies. Biological changes in the freshwater habitats in Mexico caused by the introduction of exotic fish species and their parasites are virtually ubiquitous and extremely difficult to eradicate once established. As such, they should be considered as one of the most serious threats to native fish conservation."

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

Threat to Humans

From Froese and Pauly (2017):

"Harmless"

3 Impacts of Introductions

From CABI (2017):

"Laboratory intraspecific behavioural studies have shown that *H. cyanoguttatus* is aggressive as an invader into the territory of heterospecifics, and also as a territorial holder or resident (Turner, 1994, Draud et al., 2004). These research findings are supported by Lorenz (2008) and Lorenz et al. (2011) who conducted interspecific behavioural experiments to examine potential agonistic interactions between *H. cyanoguttatus* and the US native centrarchid bluegill *Lepomis macrochirus*. It was found that *H. cyanoguttatus* was highly aggressive both as a territory holder and also entering the territory of *L. macrochirus* indicating potential competition for space with native centrarchids. These authors concluded that these behaviours may suggest a mechanism for the continued range expansion of *H. cyanoguttatus* in Louisiana, USA. Both Courtenay et al. (1974) and the personal observations of Lorenz (2008) support the proposition that *H. cyanoguttatus* competes with *L. macrochirus* for breeding sites in Florida and Louisiana, respectively."

"Lorenz (2008) also provided anecdotal field observations of agonistic behaviour between *H. cyanoguttatus* and largemouth bass (*Micropterus salmoides*), western mosquitofish (*Gambusia affinis*), sailfin mollies (*Poecilia latipinna*) and blue crabs (*Callinectes sapidus*). Similarly, Lorenz (2008) cited anecdotal evidence of the decline of *Gambusia affinis, Poecilia latipinna* and *Heterandria formosa* in areas of Louisiana where *H. cyanoguttatus* has become well established."

"Mire (2001, referenced in Lorenz, 2008) recorded that agonistic behaviour of *H. cyanoguttatus* may cause the reproductive failure of native sheepshead minnows (*Cyprinodon variegatus*) in experimental pools."

"San Antonio River Authority biologists in Texas have observed that *H. cyanoguttatus* will displace native Centrarchidae in stressed habitats and dominate the ecosystem (Gonzales and Moran, 2005)."

"*H. cyanoguttatus* may predate on aquatic invertebrate communities (Lorenz et al., in review)."

From Espinosa-Pérez and Ramírez (2015):

"Some authors mentioned that this species has already hybridized with a native closely related species in Cuatro Cienegas, Coahuila, however this has not been well documented ([Hulsey] et al. 2003)."

4 Global Distribution

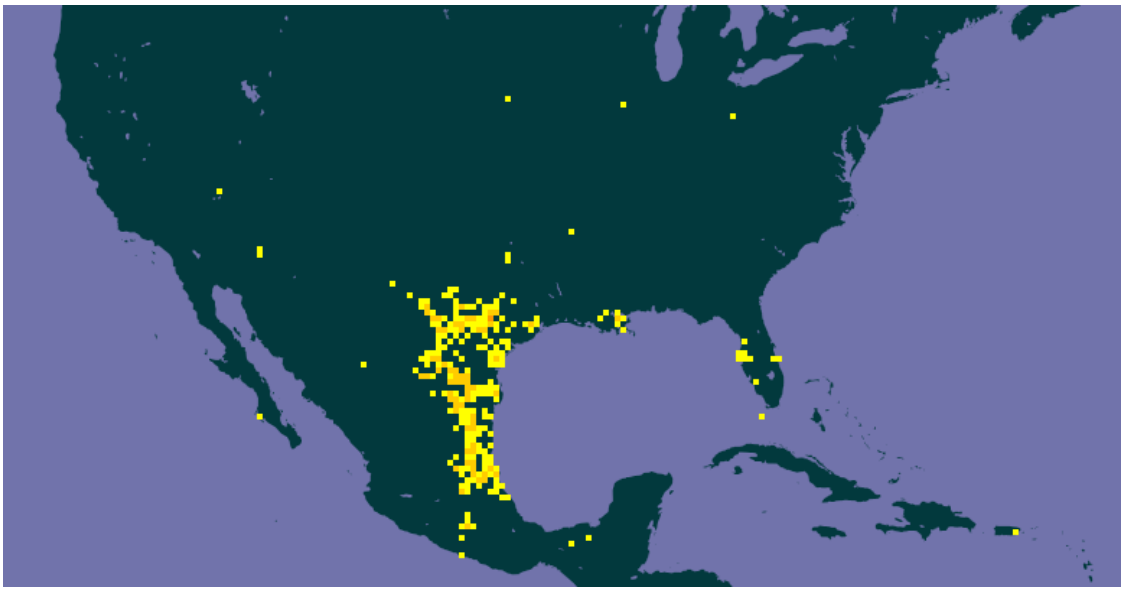

Figure 1. Known global distribution of *Herichthys cyanoguttatus*. Map from GBIF (2016). In the United States, populations are established only in Florida, Louisiana, and Texas. Similarly, populations are not reported to be established in the state of Tabasco, Mexico. Only established populations were used for climate matching.

5 Distribution Within the United States

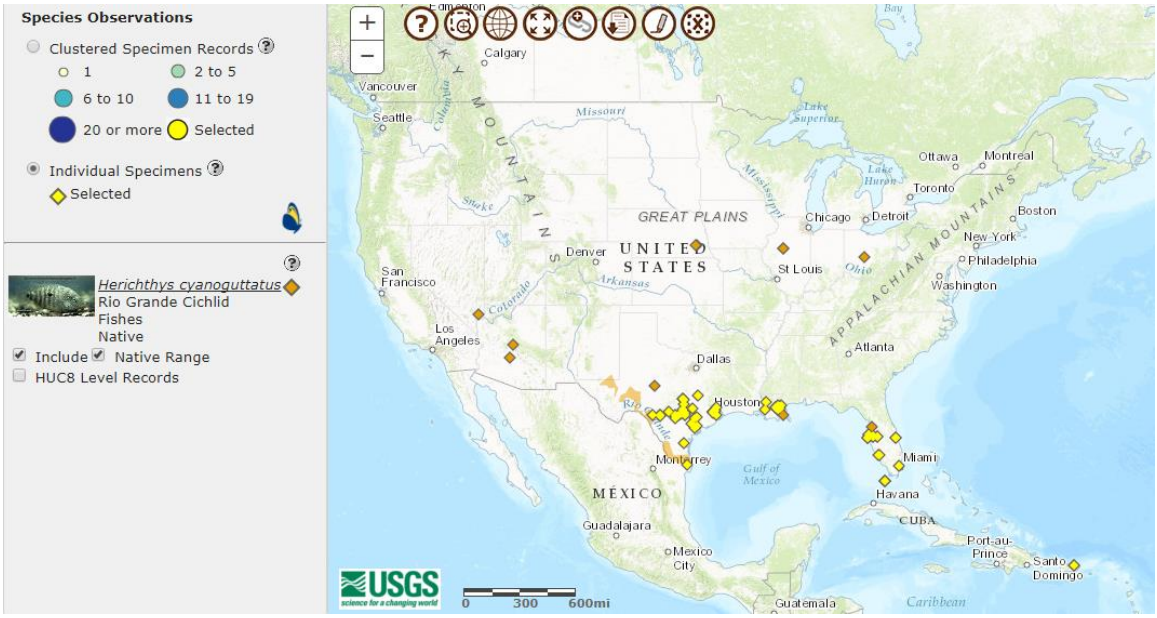

Figure 2. Known distribution of *Herichthys cyanoguttatus* in the United States. Map from Nico et al. (2017). Yellow diamonds represent established populations, orange diamonds represent occurrences, and orange polygons represent the species' native range.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2014; 16 climate variables; Euclidean distance) was high in all Gulf Coast states, medium throughout the rest of the southern U.S. from New Jersey to central California, and low across the northern contiguous U.S. and through the West as far south as Colorado and Utah. Climate 6 score suggested a high climate match overall for the contiguous U.S. Scores of 0.103 and above indicate a high match; Climate 6 score for *H. cyanoguttatus* was 0.303.

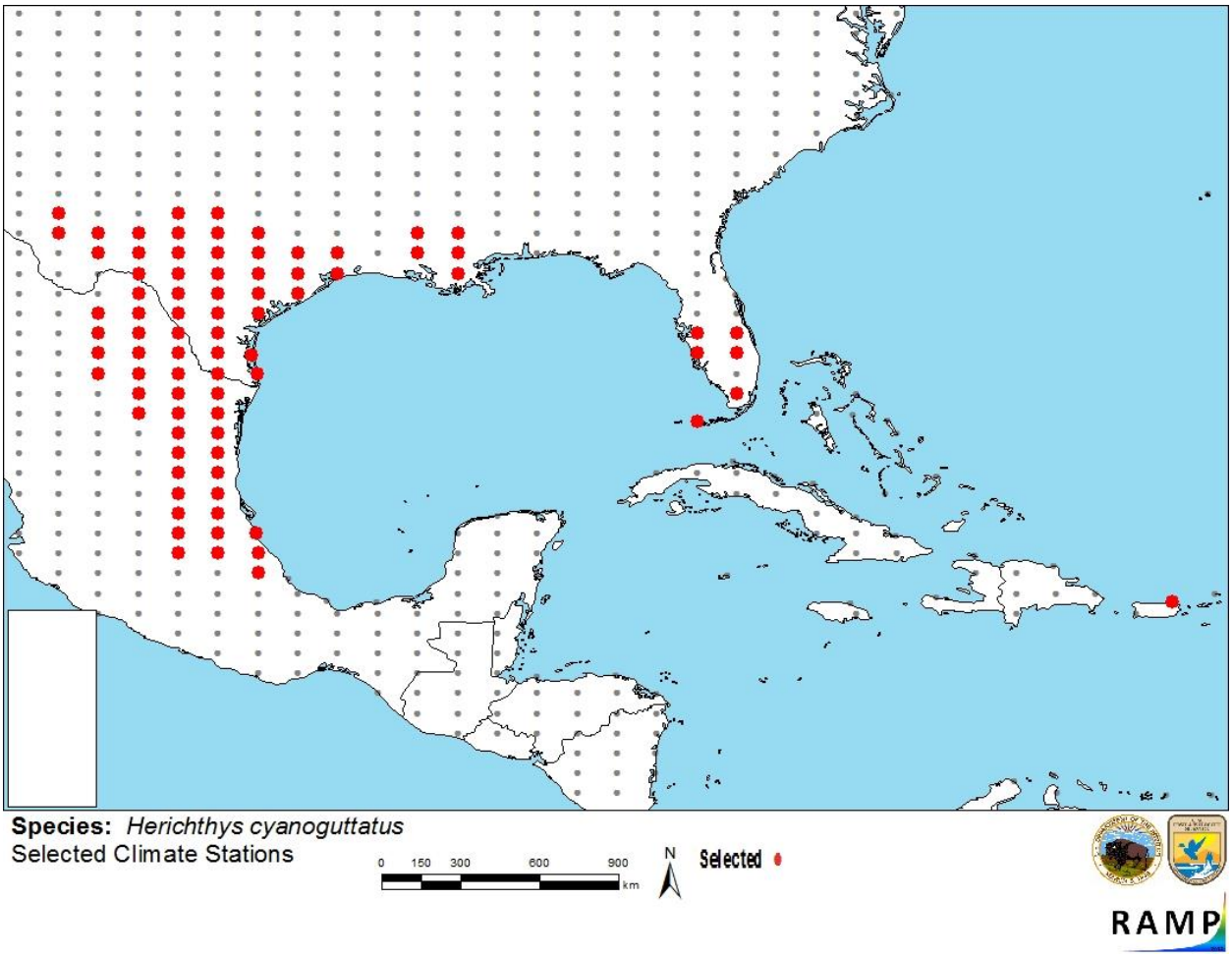

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *Herichthys cyanoguttatus* climate matching. Source locations from GBIF (2016) and Nico et al. (2017).

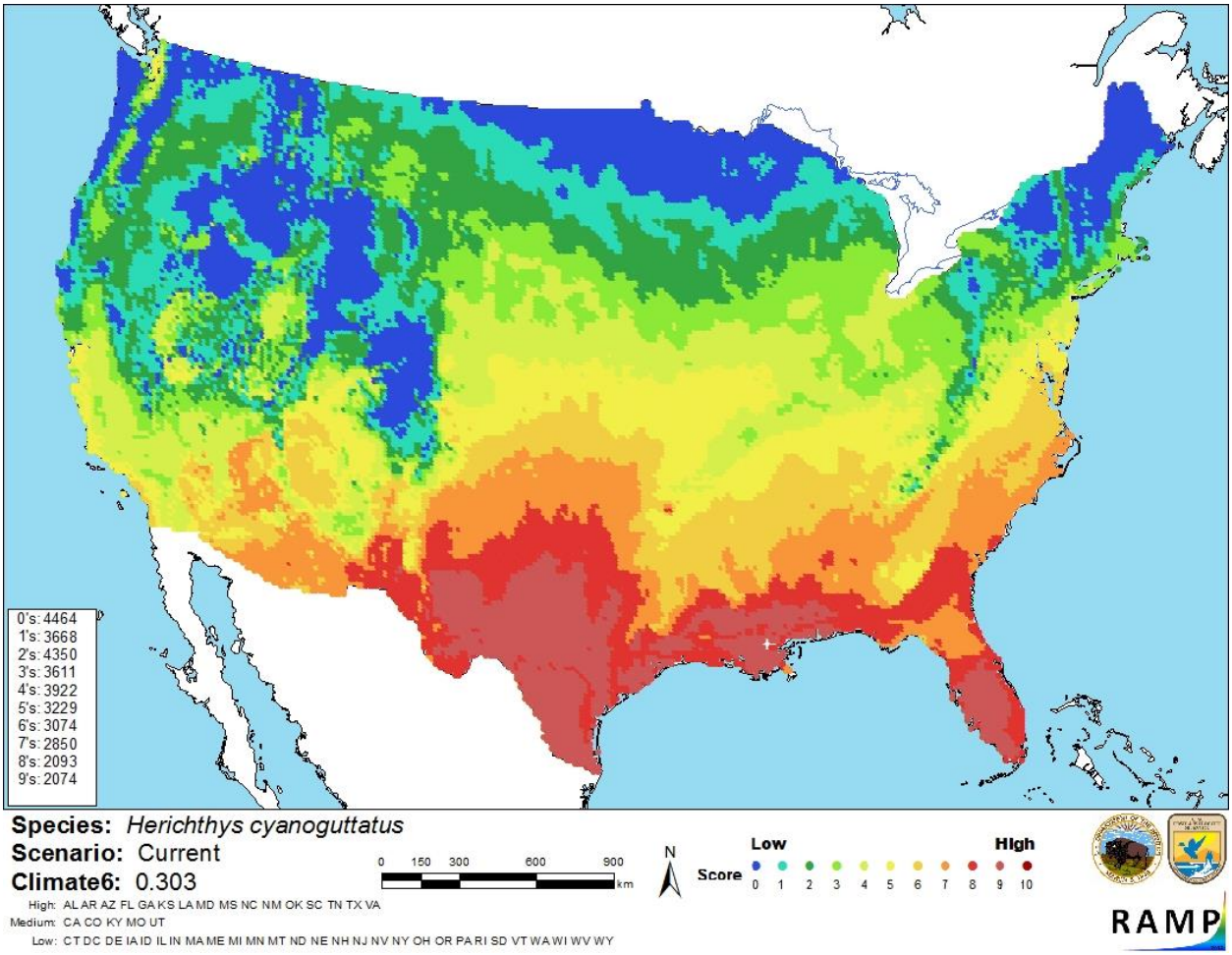

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Herichthys cyanoguttatus* in the contiguous United States based on source locations reported by GBIF (2016) and Nico et al. (2017). 0=Lowest match, 10=Highest match.

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≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

The biology and distribution of *Herichthys cyanoguttatus* are adequately documented by multiple sources. Multiple introductions of this species outside of its native range have been reported. Multiple potential negative impacts of introductions of *H. cyanoguttatus*, including competition with native species and decreased reproductive success, have been proposed.

Despite this, there are few peer-reviewed publications showing definitive harm this species has caused to native ecosystems. Certainty of this assessment is medium.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Herichthys cyanoguttatus is a cichlid native to Mexico and southern Texas. This species is established widely outside of its native range, with aquaculture and the aquarium trade being the predominant pathways for introductions. *H. cyanoguttatus* has a high climate match with the contiguous U.S. overall, with highest matches occurring in the Gulf Coast states and lowest matches occurring in most northern and western states. Existing research has confirmed the aggressive behavior of *H. cyanoguttatus* towards native species, with implications for the reproductive success and population trends of native species. Hybridization with native species has also been reported. However, the existing scientific publications have not adequately quantified the long-term impacts of introduced populations of *H. cyanoguttatus*, highlighting a need for further research into the risk this species poses. Overall risk assessment category is high with medium certainty.

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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