Butterfly Peacock Bass (*Cichla ocellaris*)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, January 2017
Revised, February 2017
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Photo: Karel Jakubec. Released to Public Domain.

1 Native Range and Status in the United States

Native Range

From Nico and Neilson (2015):

"Although the genus Cichla is widespread in the Amazon and Orinoco basins of South America, true *Cichla ocellaris* apparently is restricted to the Guianas (Kullander 1986; Kullander and Nijssen 1989)."

From CABI (2016):

"*C. ocellaris* is native to large areas of South America including French Guiana, Guyana, Suriname, Venezuela, Colombia, Peru, Bolivia and Brazil (Winemiller, 2001; Kullander and Ferreira, 2006; Willis et al., 2012; Espínola et al., 2015)."

Status in the United States

From Nico and Neilson (2015):

"A single fish, tentatively identified as this species, was caught by a fisherman in the Wellton-Mohawk Canal near Yuma, Arizona, in September 2010 (Gilbert 2010). Fish identified as this species were introduced into southeastern Florida in the early 1960s (Moe 1964; Courtenay et al. 1974; Courtenay and Robins 1989); additional stockings were carried out in canals in Broward and Miami-Dade counties, starting in 1984 (Larsen 1993; Shafland 1995). To date, it has been recorded from more than ten Florida canals and many of their lateral extensions, including C-51 Canal in Palm Beach County, Cypress Creek Canal (C-14 Canal), Middle River Canal (C-13 Canal), North New River Canal (G-15 Canal), South New River Canal (C-11 Canal); Snake Creek Canal (C-9 Canal), Biscayne Canal (C-8 Canal), Miami Canal (C-6 Canal), Snapper Creek Canal (C-2 Canal), Cutler Canal (C-100 Canal), Black Creek Canal (C-1 Canal), Princeton Canal (C-102 Canal), Mowry Canal (C-103 Canal), and Tamiami Canal (C-4 Canal), and from lakes near Miami International Airport (Clugston 1990; Larsen 1993; Hidalgo 1997; Shafland et al. 2008). It was discovered in Canal C-111 along the eastern border of Everglades National Park in early 1997 (Nico, unpublished data). Collected in a lake in Miami-Dade county [sic] (Klinkenberg 1993). The species also may be present north to Jupiter Inlet in Palm Beach County (Larsen 1993). In Hawaii, there were two or more releases into reservoirs on Kauai and Oahu, starting in 1961 (Maciolek 1984; Larsen 1993). This species is established in Wahiawa Reservoir, a 350-acre, privately owned irrigation reservoir on Oahu (Devick 1991, 1992; Larsen 1993). It was introduced along with speckled pavon *Cichla temensis* into five electropower plant reservoirs in Texas between 1978 and 1984: Alcoa Reservoir, Milam County; Lake Bastrop, Bastrop County; Coleto Creek Reservoir, Goliad County; Wilkes Reservoir, Upshur County; and Tradinghouse Creek Reservoir, McLennan County. All fish ultimately died as a result of temperature extremes (Garrett 1982; Clugston 1990; Howells and Garrett 1992)."

"Established in south Florida (Courtenay and Robins 1989; Shafland 1995), Guam (Welcomme 1988), Hawaii (Maciolek 1984), and Puerto Rico (Erd[s]man 1984). Shafland (1996) indicated that fishable populations of peacock cichlid in Florida exist in more than 500 km of canals, plus numerous urban lakes in the metropolitan Miami-Ft. Lauderdale area. The range of this species in Florida is limited by cold winters that restrict it to the southernmost counties and exclude it from much of the Everglades. Extirpated in Texas: some Cichla populations in Texas survived and reproduced for a brief period, but by 1992 all fish had died. For the most part, *Cichla* species are unable to survive cold winters, although evidence indicated fish in one Texas reservoir succumbed to high summer temperatures (Garrett 1982; Courtenay and Robins 1989; Howells and Garrett 1992). Unknown, but likely failed, in Arizona."

Means of Introductions in the United States

From Nico and Neilson (2015):

"Peacock cichlids have been stocked by state agencies as a sport fish. The Florida Game and Fresh Water Fish Commission obtained breeding stock from several regions of South America. The progeny were released into open waters primarily as a sport fish, but also with the hope that it would prey on and thus control other introduced cichlids (Courtenay and Robins 1989; Shafland 1995). About 10,000 juveniles were released in the Fort Lauderdale area of Dade County, Florida, in 1964 (Moe 1964), but apparently those fish did not survive the cold winter of 1964-1965 (Courtenay et al. 1974; Courtenay and Robins 1989). More recent introductions into canals in Broward and Miami-Dade counties, starting in late 1984, resulted in established populations (Larsen 1993; Shafland 1995). The Hawaiian Division of Fish and Game obtained their broodstock from an aquatic supply dealer in New York, ca. 1957 (Kanayama 1968). These fish reportedly came from Guyana (Larsen 1993). The first Texas populations were released by the Texas Parks and Wildlife Department in 1978. Texas stock came from Colombia and possibly Brazil, and from the Florida Game and Fresh Water Fish Commission. The single fish reported from Arizona was likely an aquarium release or illegal stocking, as no authorized stocking of this fish has occurred in that state."

From Brooks and Jordan (2010):

"Second, while *T*[*ilapia*]. *mariae* densities have been reduced in the canal system because of the deliberate introduction of Butterfly Peacock (*Cichla ocellaris*) for biological control [in Florida], *C. ocellaris* is physiologically restricted to canals."

Remarks

From Nico and Neilson (2015):

"Currently, systematists recognize five *Cichla* species; however, taxonomic problems still exist, and several species require description (Kullander and Nijssen 1989). The genus is currently being revised by Sven Kullander of Sweden. Willis et al. (2007) published results of molecular inquiry into systematic relationships within *Cichla*. Many fish currently called *C. ocellaris* by state resource agencies may be members of another *Cichla* species or possibly hybrids. Photographs of *C. ocellaris*, or of closely related forms, appeared in Kullander and Nijssen (1989), Axelrod (1993), and in Larsen (1993)."

From Espínola et al. (2015):

"Further analysis based on genetics suggested that several of the species described by Kullander and Ferreira (2006) are actually *C. ocellaris* (Willis et al. 2012), a single species with extensive genetic introgression among geographic variants showing varying degrees of morphological differentiation. Here we follow the recommendation of Willis et al. (2012) and refer to the species from the Tocantins–Araguaia Basin as *C. ocellaris*."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2015):

"Taxonomic Status:
Current Standing: valid"

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Labroidei
Family Cichlidae
Genus *Cichla* Bloch and Schneider, 1801
Species *Cichla ocellaris* Bloch and Schneider, 1801"

Size, Weight, and Age Range

From Nico and Neilson (2015):

"Size: 70 cm TL."

From Froese and Pauly (2015):

"Max length: 74.0 cm TL male/unsexed; [IGFA 2001]; max. published weight: 6.8 kg [IGFA 2001]"

Environment

From GISD (2015):

"*Cichla ocellaris* occurs primarily in freshwater but can tolerate moderate salinities and brackish water. It inhabits aquatic environments ranging from rapids to quiet waters with medium depth (~5m) and rocky substrates. Through experimentation an upper salinity tolerance of 18 ppt has been reported."

From Frose and Pauly (2015):

"[…]; 24°C - 27°C [assumed to be recommended aquarium temperature] [Baensch and Riehl 1985]; […]"

Climate/Range

From GISD (2015):

"This species is not tolerant to cold waters and has a reported lower lethal temperature of 15.6-16°C and a higher lethal temperature of 37.9°C. Some studies have shown that some fish can survive temperatures of 13.5°C when salinity is raised to 10 ppt (Environmental Institute of Houston, 2004; FishBase, 2006; and Gulf States Marine Fisheries Commission, 2005)."

From Froese and Pauly (2015):

"Tropical; […]; 26°N - 9°S"

Distribution Outside the United States

Native

From Nico and Neilson (2015):

"Although the genus *Cichla* is widespread in the Amazon and Orinoco basins of South America, true *Cichla ocellaris* apparently is restricted to the Guianas (Kullander 1986; Kullander and Nijssen 1989)."

From CABI (2016):

"*C. ocellaris* is native to large areas of South America including French Guiana, Guyana, Suriname, Venezuela, Colombia, Peru, Bolivia and Brazil (Winemiller, 2001; Kullander and Ferreira, 2006; Willis et al., 2012; Espínola et al., 2015)."

Introduced

From GISD (2015):

"Alien Range: Belize, Bolivia, Dominican Republic, Ecuador, France, Guam, Panama, Peru, Puerto Rico, Singapore, United States'

From FAO (2015):

"*Cichla ocellaris* introduced to Kenya from South Africa, Date of introduction: 1968 […] Status of the introduced species in the wild: Probably not established"

From Rahim et al. (2013):

"As one prominent example, the peacock bass or *Cichla ocellaris* species was deliberately introduced in Peninsular Malaysia and was released into a lake made from a former mining area by irresponsible anglers in the early 1990s for sport fisheries (Khairul Adha, 2006)."

Cichla ocellaris listed as introduced to Viet Nam from Africa via Singapore. No further location information is given (Binh et al. no date).

Means of Introduction Outside the United States

From Nico and Neilson (2015):

"Peacock cichlids have also been stocked for sport fishing throughout farm ponds and reservoirs in Puerto Rico, including the Toa Vaca Reservoir and La Plata Reservoir (Erdsman 1984; Welcomme 1988), and were stocked in Guam in 1966 (Welcomme 1988)"

From FAO (2015):

"Reasons of Introduction: 1) other pest control"

"Reasons of Introduction: 1) aquaculture"

"Reasons of Introduction: 1) ornamental"

From CABI (2016):

"Upon introduction to favourable environments, populations of *C. ocellaris* may disperse rapidly through interconnected river systems and aquatic habitats. Three examples include the introduction of the species to Lake Gatun in Panama (Zaret and Paine, 1973), the drainage canals of southern Florida (Shafland, 1995; Shafland, 1996) and tributaries of the Parana River in south-eastern Brazil (Espínola et al., 2015)."

"Although a number of individuals have apparently claimed responsibility for the introduction of *C. ocellaris* into Lake Gatun in Panama, the most likely initial introduction of the species was accidental (Zaret and Paine, 1973). Fingerlings were imported from Columbia and placed in an impoundment that was formed by damming a small tributary of the Rio Gatuncillo. It is likely that the impoundment overflowed during the rainy season releasing fish into the tributary and ultimately Lake Gatun (Zaret and Paine, 1973)."

Short Description

From GISD (2015):

"*Cichla ocellaris* have a sloping forehead and elongate bodies that typically reach 50-60cm in length (91cm is the current record) with a deeply notched dorsal fin. Males are larger than females. Their mouth is large, the lower jaw projects beyond the upper jaw. They have a characteristic large black spot encircled by a silver coloured halo on their caudal fin. Their colouration is olive-green dorsally fading to yellow-white ventrally, with three broad transverse stripes, between which are a series of dark spots. The first dorsal, upper caudal, and pectoral fins are gray or black, the anal, pelvic and the lower caudal fins are red. White spots are present on the second dorsal and the upper lobe of the caudal fin. Large adults have a yellow-orange stripe, which extends from their mouth to their caudal fin. Their iris is red (Environmental Institute of Houston, 2004; Gulf States Marine Fisheries Commission, 2005; and Mongabay Tropical Fish, 2006)."

From Forese and Pauly (2015):

"Distinguished from all other species of *Cichla* except *C. nigromaculata*, *C. intermedia*, *C. piquiti*, and *C. melaniae*, by presence of bars 1a and 2a. Lateral band abbreviated in juveniles. Distinguished from its congeners with abbreviated lateral band by lateral line usually continuous (vs. discontinuous or nearly always discontinuous in *orinocensis* and *nigromaculata*; scales in E1 row (67-) 70-80 (-82) (vs. 84-93 in *pleiozona*); occipital bar absent or indistinct (vs. emphasized in adults of *monoculus*, *kelberi*, and *pleiozona*); abdominal blotches present (vs. absent in *orinocensis*); vertical bars present at adult size (vs. three midlateral ocellated blotches in *orinocensis*), except that an ocellated blotch consistently formed in dorsal portion of bar 3; absence of small black blotches on dorsum (vs. present in *nigromaculata*); vertical bars about equally wide across side (vs. wide, occasionally confluent dorsally, and tapering ventrad in *nigromaculata*, *monoculus*, *kelberi*, and *pleiozona*. Distinguished from *C. intermedia*, *C. piquiti*, and *C. melaniae* by abbreviated vs. complete juvenile lateral band, less scales in E1 row (67-82 vs. (78) 83-108), and presence of ocellated blotch in dorsal portion of bar 3 vs. absence [Kullander and Ferreira 2006]."

Biology

From Nico and Neilson (2015):

"Members of the genus *Cichla* are large, diurnal piscivores that consume a wide variety of prey (Winemiller et al. 1997). *Cichla ocellaris* is a pair-forming substrate spawner, with spawning occurring on flat surfaces and newly hatched larvae moved by the parents to nests in small shallow depressions in the sediment or on rocks or logs (Zaret 1980)"

From GISD (2015):

"*Cichla ocellaris* are piscivorus and feed during the day while remaining inactive at night. Prey is caught typically through high-speed pursuit. Fish consumed include atherinids, poecilids, characids, eleotrids and other cichlids. Spotted tilapia, *Tilapia mariae*, Mozambique tilapia, *Oreochromis mossambicus*, and bluegill, *Lepomis macrochirus* also constitute major prey items (Environmental Institute of Houston, 2004; and Gulf States Marine Fisheries Commission, 2005)."

"The *Cichla ocellaris* is a biparental substrate spawner, spawning approximately 2000-3000 eggs per brood. Spawning, with rare exceptions, takes place on a flat, horizontal surface which is either bare to begin with, or cleared of algae or other vegetation during the spawning activities. The female moves forward laying a single row of eggs and the male follows exuding sperm over each row. Once the eggs have hatched, the parents transport the larvae in their mouths to one of the depression nests. Breeding pairs guard their clutch for approximately nine weeks, at which time the fry move from open waters to areas rich vegetation along banks. As is the case with most cichlids, breeding pairs are highly territorial and aggressive (FishBase, 2006; and Gulf States Marine Fisheries Commission, 2005)."

From Forese and Pauly (2015):

"Not considered ideal for aquaculture due to its highly predatory habits [Welcomme 1988]."

Human Uses

From GISD (2015):

"In Miami, there is an estimated $15.5 million dollar market attributed to sportfishing, of which most is contributed by anglers fishing for *C. ocellaris* and largemouth bass (*Micropterus salmoides*). The *C. ocellaris* received 56% more fishing effort than largemouth bass, and their estimated annual asset value was $6.6 million (Shafland and Stanford, 1999)."

From Forese and Pauly (2015):

"Fisheries: minor commercial; aquaculture: commercial; gamefish: yes; aquarium: commercial"

From CABI (2016):

"*C. ocellaris* was extensively released not only to create a sport-fishery, but also to control introduced fishes such as *Tilapia mariae*, the spotted Tilapia (Shafland, 1999b; Robins, 2015). *C. ocellaris* may also be caught for their meat."

Diseases

No records of OIE reportable diseases were found.

From Forese and Pauly (2015):

"Eustrongylides Disease, Parasitic infestations (protozoa, worms, etc.)
Goezia Disease 5, Parasitic infestations (protozoa, worms, etc.)"

Threat to Humans

From Forese and Pauly (2015):

"Potential pest"

From CABI (2016):

"As such, the elimination of small invertebrate-feeding fishes as a consequence of *C. ocellaris* introduction resulted in more mosquito larvae and a higher incidence of malaria around the lake (Zaret and Paine, 1973)."

3 Impacts of Introductions

From Nico and Neilson (2015):

"Largely unknown. Introduced *Cichla* in Florida include native fishes in their diets (Nico, unpublished data) although Shafland (1999[a]) claimed no evidence for adverse effects on native communities. There is some evidence that it may exclude largemouth bass from spawning aread [sic] in Florida canals. The introduction of peacock cichlids into Lake Gatun, Panama, was followed by largescale changes in food-web structure and aquatic community composition (Zaret and Paine 1973)."

From GISD (2015):

"The introduction of *Cichla ocellaris* mainly occurs in altered environments, where the community of fishes is already in decline. The presence of these highly adapted and quickly proliferating predators causes serious damage to these communities by predation, competition, and cascade effects throughout the whole trophic chain (Gomiero and Braga, 2004). This species is a voracious piscivore capable of greatly modifying ecosystems where introduced. Some studies have reported as much as a 25% decline of forage fish from canals in which *C. ocellaris* have been introduced. There is speculation that if *C. ocellaris* continues to expand its range throughout southern Florida, faunas of less altered waters, such as those of the Everglades, could be at risk (Gulf States Marine Fisheries Commission, 2005)."

"However, other studies report beneficial effects of this species introudction [sic] into Florida's waterways such as attributed increases to native fish because *C. ocellaris* feeds on non-indigenous fish that have previously caused other native fish declines. Also, this species attracts recreational fishermen (Gomiero and Braga, 2004), which has accounted for a very large boon to the sport fishing industry in Florida. And some analyses and estimates reveal no major deleterious effects attributable to *C. ocellaris*, and indicate native fishes continue to exist satisfactorily with them (Shafland, 1999[a]; and Shafland and Stanford, 1999)."

From Espínola et al. (2015):

"Zaret and Paine (1973) examined the spatial and temporal dynamics of successful invasions by *C. ocellaris* in Lake Gatún, Panama. They recorded how the species had invaded this reservoir in the Panama Canal Zone from the Chagres River and had spread through nearly the entire lake in just two years. The *Cichla* [*ocellaris*] invasion was followed by major changes in native fish populations and food web structure. Near Barro Colorado Island, seven of eight native fish species declined by 50–100%, and sites invaded by *Cichla* yielded seven native fish species in surveys compared with 13 at sites where *Cichla* were not present."

From McNeely and Schutyser (2003):

"[…] and the reduction in the bird community around Lake Atitlan as a result of the introduction of the predatory fish species *Cichla ocellaris* which dramatically altered the trophic structure of the lake (Zaret and Paine, 1973)."

From CABI (2016):

"After the introduction of *C. ocellaris* into Lake Gatun, Panama, largescale changes in food-web structure and aquatic community composition were recorded (Zaret and Paine, 1973). For example there was a reduction in almost all secondary consumers. The reduction in the planktivore *Melaniris chagresi* (Atherinidae) resulted in a reduction in tertiary-consumer populations including tarpon, black terns, kingfishers and herons in addition to changes within the zooplankton community. Near Barro Colorado Island in Lake Gatun, seven of eight native fish species declined by 50–100% and sites occupied by *C. ocellaris* contained seven native fish species in surveys compared with 13 fish species at sites where *C. ocellaris* was not present (Zaret and Paine, 1973)."

"In the Parana River in south-eastern Brazil, *C. ocellaris*, are well dispersed throughout the region and are considered the greatest threat to the native fish diversity (Agostinho et al., 2008; Pelicice and Agostinho, 2009). Kovalenko et al. (2010) conducted mesocosm experiments in sections of the Parana River to determine if the direct and indirect effects of introduced *C. ocellaris* on native prey were mitigated by the presence of aquatic vegetation. It was concluded that aquatic plants provided very limited protection to native prey and are therefore unlikely to slow down the decline in biodiversity resulting from the introduction and spread of species of *Cichla* including *C. ocellaris* (Kovalenko et al., 2010). A study by Pelicice and Agostinho (2009) in the Rosana Reservoir, Brazil, found that due to the introduction of *C. ocellaris*, the diversity of the reservoir changed dramatically with mean fish density decreasing by 95% and richness by 80%."

"The introduction of *C. ocellaris* to southern Florida is the only documented example of positive environmental impacts following introduction of the species. It is important to note that the success of the introduction and the limitation of deleterious environmental impacts are largely due to the confinement of *C. ocellaris* to artificial drainage canals and lakes in the southern extremity of Florida where temperatures restrict the spread of this species. Shafland (1999b) determined that *C. ocellaris* primarily consumed the introduced cichlid Tilapia mariae and there was little dietary overlap between *C. ocellaris* and the native predator Micropterus salmoides. *C. ocellaris* also feeds on other non-native species present in the waters and the impact on native species is limited."

"As such, the elimination of small invertebrate-feeding fishes as a consequence of *C. ocellaris* introduction resulted in more mosquito larvae and a higher incidence of malaria around the lake (Zaret and Paine, 1973)."

4 Global Distribution

Figure 1. Known global distribution of *Cichla ocellaris*. Map from GBIF Secretariat (2015).

Text-based introduction records for Asia and Africa did not provide enough information to determine point locations.

5 Distribution Within the United States

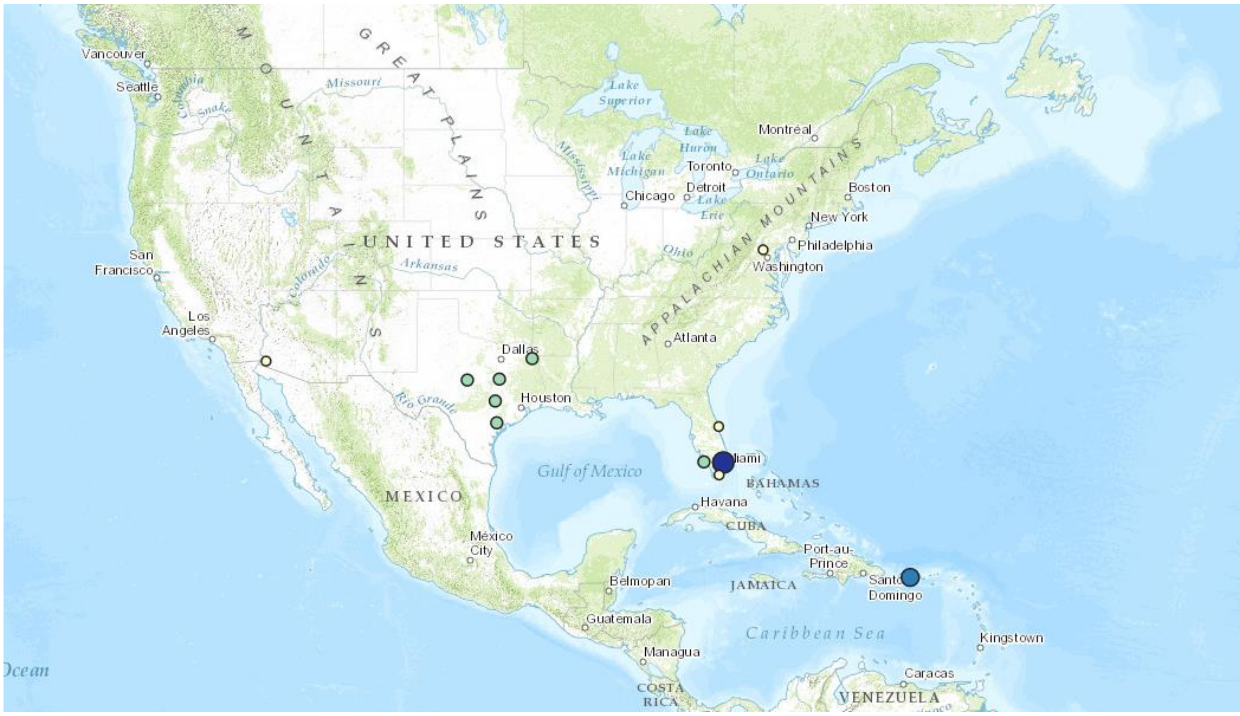

Figure 2. Known distribution of *Cichla ocellaris* in the United States and Puerto Rico. Map from Froese and Pauly (2015).

The locations in Maryland and Texas were removed as source points from the climate match due to the failure of the introduction to produce a self-sustaining population (Nico and Neilson 2015). The location in Arizona is the result of a single specimen (Nico and Neilson 2015) and there are no records indicating an established population in the state. That point was not used as a source point for the climate match.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Cichla ocellaris* was high for Florida, parts of the extreme southern Atlantic coast and a small part of Texas' Gulf Coast. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the contiguous United States was 0.029, medium, and individually high in Florida, Georgia, and South Carolina.

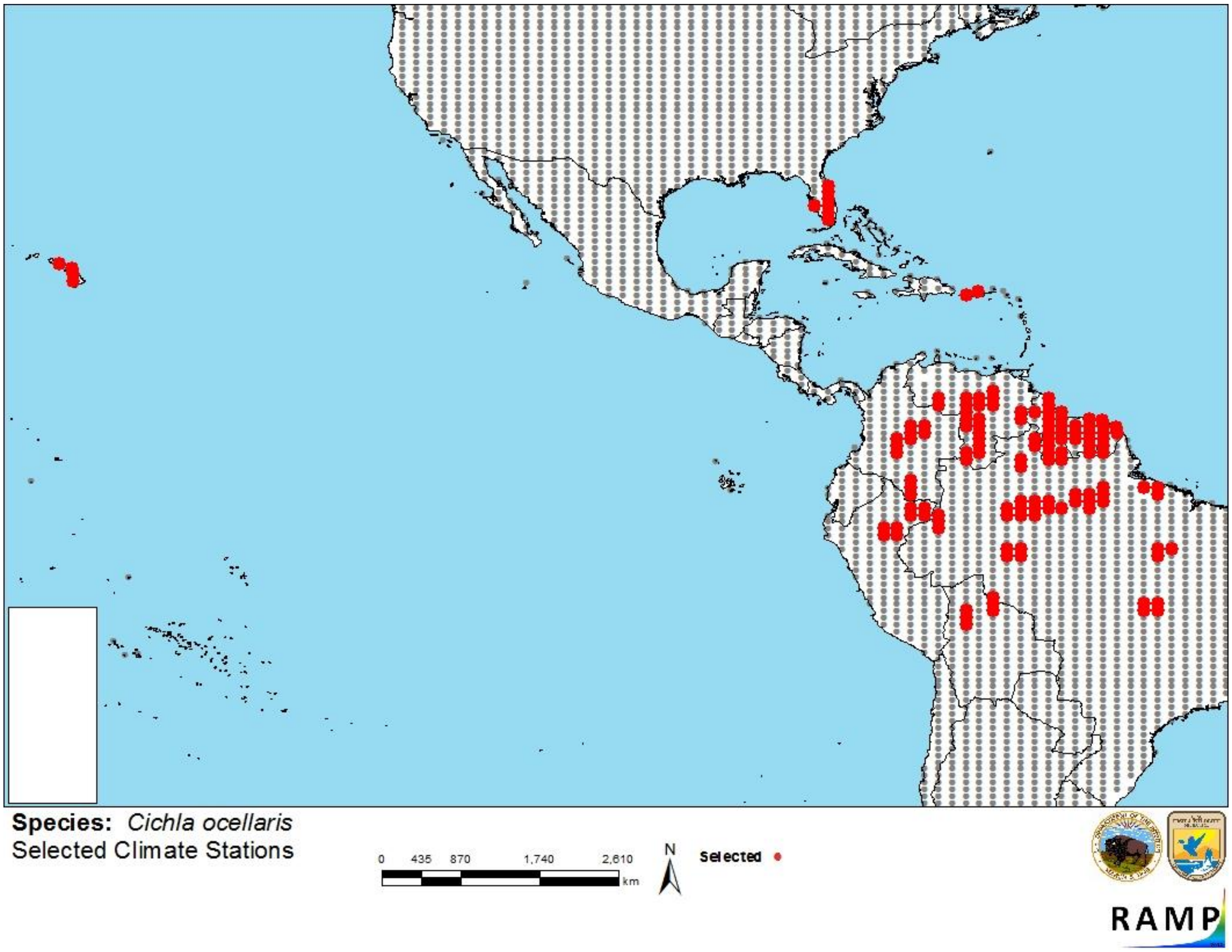

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected in North America, Hawaii, Puerto Rico, and South America as source locations (red) and non-source locations (grey) for *Cichla ocellaris* climate matching. Source locations are from Froese and Pauly (2015), GBIF Secretariat (2015), and Nico and Neilson (2015).

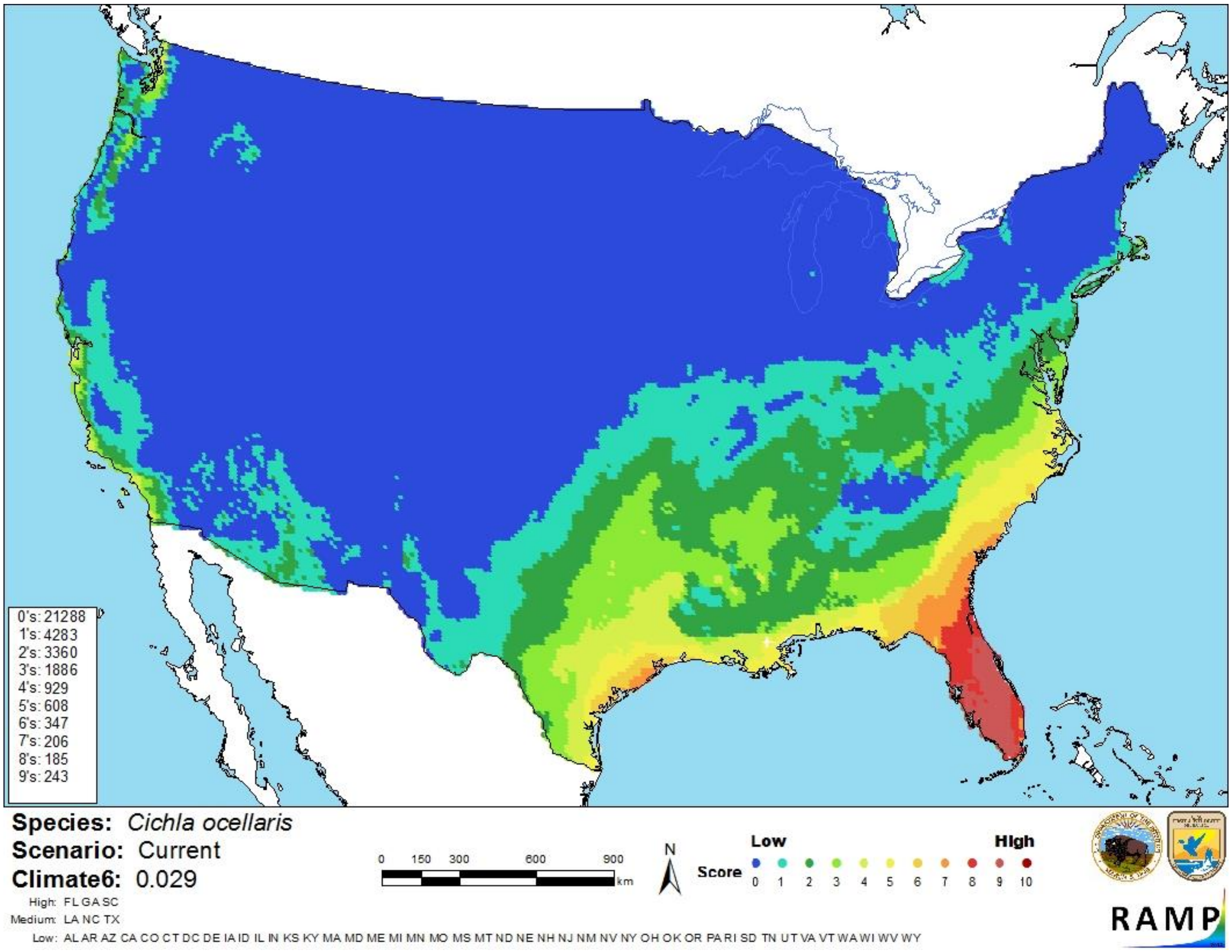

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Cichla ocellaris* in the contiguous United States based on source locations reported by Froese and Pauly (2015), GBIF Secretariat (2015), and Nico and Neilson (2015). 0 = Lowest match, 10 = Highest match. Counts of climate match scores are tabulated on the left side of the map.

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 this assessment is medium. There are many reported introductions for *Cichla ocellaris*; most were the result of intentional stocking programs. There are records of negative and neutral ecological impact and positive economic impacts. Some distribution information was unclear, adding uncertainty to the results of the climate match.

8 Risk Assessment

Summary of Risk to the Contiguous United States

The history of invasiveness is high. There are established populations outside the native range of *Cichla ocellaris*. Many of those are the result of intentional introductions. There are some records of negative, neutral, and positive ecological impacts, mostly from an introduction in Panama, along with some reports of positive economic impacts. *C. ocellaris* has been used as a successful biocontrol for *Tilapia mariae* in Florida. The climate match is medium. The results of the climate match could change if more detailed information was available about the world-wide distribution of *C. ocellaris*, particularly the introduced populations in Africa and Asia. The certainty of assessment is medium. The overall risk assessment category is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): Medium**
- **Certainty of Assessment (Sec. 7): Medium**
- **Remarks/Important additional information** No additional remarks.
- **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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