African Jewelfish (*Hemichromis letourneuxi*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2011
Revised, February 2018, July 2018
Web Version, 7/30/2018

Photo: Noel M. Burkhead – USGS. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=457. (February 2018).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2018):

"Africa: Nile to Senegal and from North Africa to Côte d'Ivoire [Central African Republic, Chad, Egypt, Ethiopia, Gambia, Ghana, Guinea, Ivory Coast, Kenya, Senegal, Sierra Leone, South Sudan, Sudan; questionable in Algeria]."

From Nico et al. (2018):

"Tropical Africa. Widespread in northern, central, and west Africa (Loiselle 1979, 1992; Linke and Staeck 1994) in savannah and oasis habitats."

CABI (2018) reports *H. letourneuxi* as widespread and native in the following countries: Algeria, Burkina Faso, Cameroon, Chad, Egypt, Ethiopia, Gambia, Ghana, Ivory Coast, Kenya, Niger, Nigeria, Senegal, Sudan, and Uganda.

Status in the United States

From Eschmeyer et al. (2018):

"[…] established in Florida, U.S.A."

From Nico et al. (2018):

"Established in Florida. Prior to 1972, found only in Miami Canal and canals on western side of Miami International Airport (Hogg 1976a). Species is now abundant and spreading westward and northward."

"The species was first documented as occurring in south Florida in the Hialeah Canal-Miami River Canal system, Miami area, by Rivas (1965). It is now established and abundant in many canals in and around Miami-Dade County, and also in parts of the Everglades freshwater wetlands and tidal habitats (Courtenay et al. 1974; Hogg 1976a, b; Loftus and Kushlan 1987; Loftus et al. 2005, 2006; Kline et al. [2014]), into which it moved in the late 1990s and early 2000s. The species was taken from canals near fish farms in Palm Beach and Brevard counties in 1970 and 1983 (Smith-Vaniz, personal communication). Specimens also were taken from a mosquito ditch on Big Pine Key, Monroe County, on 10 May 1993 (museum specimens). There are unconfirmed reports that the species has occurred and is possibly established in Eureka Springs near Tampa, Hillsborough County (Courtenay et al. 1974), and other specimens have been taken in that county. There are reports from southwestern Florida (Charlotte Harbor NEP 2004; Idelberger et al. 2011) from the counties of Collier (Loftus et al. 2004) DeSoto, Lee, and Sarasota (museum specimens). This species has now been collected from the central Florida counties of Glades, Hardee, Hendry, and Indian River (museum specimens), and it was first collected in the Archbold Reserve, Highlands County, in 2008 (O'Connor and Rothermel 2013)."

Comments on an occurrence record for Puerto Rico say "Identifcation [*sic*] if [*sic*] tentative; either *H. bicmaculatus* [*sic*] or *H. letourneuxi*. Taxonomy is uncertain" (Nico et al. 2018).

Nico et al. (2018) also mention museum specimens of *H. letourneuxi* collected on the island of Oahu, Hawaii. These specimens have been reassigned as *Hemichromis elongatus* (Nico 2018).

From CABI (2018):

"Species of *Hemichromis* are popular aquarium fishes"

Means of Introductions in the United States

From Nico et al. (2018):

"This species was possibly introduced into Florida through aquarium release, perhaps in combination with escapes or releases from fish farms."

Remarks
From CABI (2018):

"*H. letourneuxi* has become established in aquatic habitats because of wide environmental tolerances, the ability to colonise disturbed habitats, trophic opportunism, fast growth rates and advanced parental care of offspring."

"Although the species has been present in Florida since the early 1960s, it was identified as *H. bimaculatus* until the 1990s (USGS NAS, 2016)."

Both the names *H. bimaculatus* and *H. letourneuxi* were used in searching for evidence of impacts to inform this report.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing
From ITIS (2018):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Labroidei
Family Cichlidae
Genus *Hemichromis*
Species *Hemichromis letourneuxi* Sauvage, 1880"

"Taxonomic Status: valid"

Size, Weight, and Age Range
From Nico et al. (2018):

"12 cm SL (Loiselle 1979)"

Environment
From Froese and Pauly (2018):

"Freshwater; brackish; benthopelagic; pH range: 6.0 - ? ; dH range: 5 - ?."

"[…] 22°C - 25°C [Baensch and Riehl 1985; assumed to represent recommended aquarium water temperatures]"

From CABI (2018):

"Within its native range, *H. letourneuxi* is a savannah-associated species which prospers in a range of lentic habitats that include brackish water lagoons, large lakes and riverine flood plains. Within these habitats it occurs near vegetation beds and fringes of larger aquatic habitats (Froese and Pauly, 2016)."

"As an introduced species, *H. letourneuxi* occurs in shallow vegetated or rocky areas in marshes, along river banks and on the margins of mud and sand-bottomed canals and culverts."

"*H. letourneuxi* is tolerant of environmental variability and introduced populations in Florida have been found to be euryhaline, resistant to low dissolved oxygen (hypoxia) and low temperatures (Loftus et al., 2006). The species is particularly tolerant of hypoxia and it is though that this conveys an advantage against native fishes such as centrarchids and has assisted in its ability to exploit the seasonally inundated wetlands of south Florida (Schofield et al., 2007; Schofield et al., [2009])."

Climate/Range

From Froese and Pauly (2018):

"Tropical; […] 35°N - 4°N"

Distribution Outside the United States

Native

From Froese and Pauly (2018):

"Africa: Nile to Senegal and from North Africa to Côte d'Ivoire [Central African Republic, Chad, Egypt, Ethiopia, Gambia, Ghana, Guinea, Ivory Coast, Kenya, Senegal, Sierra Leone, South Sudan, Sudan; questionable in Algeria]."

From Nico et al. (2018):

"Tropical Africa. Widespread in northern, central, and west Africa (Loiselle 1979, 1992; Linke and Staeck 1994) in savannah and oasis habitats."

CABI (2018) reports *H. letourneuxi* as widespread and native in the following countries: Algeria, Burkina Faso, Cameroon, Chad, Egypt, Ethiopia, Gambia, Ghana, Ivory Coast, Kenya, Niger, Nigeria, Senegal, Sudan, and Uganda.

Introduced
From CABI (2018):

"*H. letourneuxi* […] is reportedly found in the Philippines (Froese and Pauly, 2016) and Europe (Gherardi et al., 2009). However, no further information is available regarding populations in the Philippines or Europe. In the Philippines, it is unclear whether the document referenced by Froese and Pauly (2016), refers to established nonindigenous populations and/or the presence of the species within the country (for example, present within the ornamental fish trade). Froese and Pauly (2016) also list introduced populations of *H. bimaculatus* as present within the Philippines and provide the collection information as "Introduced in the 1970's. Collected from Limnological Station, University of the Philippines Los Banos". Considering the historical tendency to label all *Hemichromis* species as *H. bimaculatus*, it is possible that this record may refer to other species. Nonetheless, as the status of *H. letourneuxi* in the Philippines is unclear, the Froese and Pauly (2016) reference is considered unreliable. Similarly, Gherardi et al. (2009) lists *H. letourneuxi* as "present" in Europe as an introduced species with no further details. Hanel et al. (2011) state that *H. fasciatus* and *H. guttatus* were established in a hot spring near Austrian Villach around 1970. It is unknown if Gherardi et al. (2009) refers to this record and thus the presence of *H. letourneuxi* in Europe is also considered unreliable."

Means of Introduction Outside the United States

From Froese and Pauly (2018):

"ornamental [Philippines]"

Short Description

From CABI (2018):

"*H.letourneuxi* [*sic*] is a small fish with a fairly long, slender body with a rounded caudal fin. Background body colouration is highly variable and can be green-yellow to red-brown or even dark (almost black) depending on various factors including, sex, season, habitat and disposition of fish. While breeding, males may develop red colouration on the gills and ventral surface. The species has limited blue "spangling" (small, brilliant blue iridescent spots or flecks) on the head, body and fins that may be more pronounced in breeding adults. There is a dark black lateral spot above the lateral line on the side of the fish and smaller blotches on opercular tab and caudal peduncle. Although the species grows to 12 cm standard length, the average size is much smaller, approximately 7 cm. There are 13-15 dorsal fin spines and three anal fin spines."

"Species of *Hemichromis* available within the ornamental fish industry are prized for (i) bright red colouration covering the whole body and (ii) blue "spangling" also covering much of the body. Neither of these traits are [*sic*] apparent in wild-type *H. letourneuxi*."

Biology

From Froese and Pauly (2018):

"Savannah associated species which prospers in a range of lentic habitats that include brackish water lagoons, large lakes and riverine flood plains [Daget and Teugels 1991]. Occurs near vegetation beds and fringes. Feeds on *Caridina* and insects. Substrate spawner, ripe and spent fish are common early in the flood season [Bailey 1994]."

From CABI (2018):

"Once pairs of fish have formed, they are monogamous and will remain together for life. During reproduction both sexes will intensify in colour and a spawning site will be chosen; usually a flat rock. The male will vigorously pursue the female to initiate spawning. Spawning occurs in a similar fashion to many other cichlids, with the female laying a line of eggs before the male fertilises them. Up to 600 eggs may be laid and during this period the male will defend the spawning site while the female tends to the eggs. The eggs hatch in approximately 72 hours and the brood is moved into a shallow depression in the substrate near the spawning site."

"*H. letourneuxi* is an omnivore with a strong preference towards carnivory."

"Hogg (1976[a]) conducted the first investigation of the diet of *H. letourneuxi* in Florida and recorded filamentous algae, juvenile introduced cichlids including *H. letourneuxi*, assorted insect parts and predominantly plant material in the stomachs of 26 fish. O'Connor and Rothermel (2013) also concluded that their diet consisted primarily of fish and macroinvertebrates. The seasonal diet of *H. letourneuxi* was investigated in the Rocky Glades area of the Everglades National Park, Florida and was found to be primarily carnivorous and included small fishes, arthropods (shrimp and other crustaceans and insects) and varied according to prey availability which was mediated by seasonal water levels (Loftus et al., 2006). The heaviest feeding occurs during seasonally dry periods, when marshes begin to dry and prey becomes concentrated. Groundwater "solution holes" provide dry-season refuge to native and introduced aquatic fauna and within these specific environments *H. letourneuxi* preyed heavily upon the [native] Eastern mosquitofish, *Gambusia holbrooki* (Loftus et al., 2006)."

Human Uses

From CABI (2018):

"Pet/ aquarium trade; Research model"

Diseases

From Řehulková et al. (2013):

"Two new species of *Cichlidogyrus* are described from the gills of three species of African cichlids collected from the Gambia River basin in the Niokolo-Koba National Park, Senegal: *Cichlidogyrus dracolemma* n. sp. from *Hemichromis letourneuxi* and *Cichlidogyrus nageus* n. sp. from *Sarotherodon galilaeus* and *Tilapia guineensis*."

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

Threat to Humans

From Froese and Pauly (2018):

"Harmless"

3 Impacts of Introductions

From Nico et al. (2018):

"This cichlid may compete with native sunfishes for spawning sites. Loftus and Kushlan (1987) reported that this aggressive fish nests near the spawning areas of other introduced cichlids, including the spotted tilapia *Tilapia mariae* and black acara *Cichlasoma bimaculatum*. Lopez et al. (2012) examined life history traits of jewelfish at both established sites and the invasion front within Everglades National Park, finding that fishes along the invasion front generally had higher fitness, but were not bolder or better dispersers, than individuals from established populations. Langston et al. (2010) suggested that African jewelfish could use estuarine and coastal routes for dispersal because of the species' elevated salinity tolerance, a point confirmed by its occurrence in coastal waters of the Everglades and the Gulf Coast (Idelberger et al. 2011; Kline et al. [2014])."

"According to a study by Loftus et al. (2006), this species was shown to suppress the spawning of dollar sunfish [*Lepomis marginatus*] in mesocosm tanks because of strong agonistic behavior by the cichlid."

From CABI (2018):

"Dietary studies (Hogg, 1976; Loftus et al., 2006; Lopez et al., 2012; O'Connor and Rothermel, 2013), in situ mesocosm experiments (Porter-Whitaker et al., 2012; Rehage et al., 2012; Schofield et al., 2014), field surveys (Rehage et al., 2014) and ex situ laboratory behavioural and competition experiments (Dunlop-Haydon and Rehage, 2011; Porter-Whitaker et al., 2012) have inferred deleterious impacts of *H. Letourneuxi* [*sic*] on aquatic habitats and invertebrate, amphibian and fish communities. *H. letourneuxi* can reach high densities and numerically dominate the ichthyofauna in anthropogenically-modified habitats [a hydrologically altered agricultural landscape] in Florida (O'Connor and Rothermel, 2013). As a result, it is likely that the species will impact on aquatic invertebrate and fish communities and therefore affect broad scale environmental processes such as food webs and nutrient cycles (Schofield et al., 2014)."

From Rehage et al. (2014):

"Our field experiment showed that African jewelfish can be an important source of mortality for small-bodied native taxa. Only 38 % of mosquitofish survived short term co-occurrence with jewelfish in experimental cages, and this mortality rate was higher than the mortality mosquitofish experienced in abiotic stress trials during any individual week (max ~30 %).

Although the cages may have artificially enhanced risk for prey in our experiment, our findings at minimum show that predation by African jewelfish can be an important source of mortality, in agreement with studies that show that predation is an important mechanism by which nonnative taxa impact natives (Schlaepfer et al. 2005; Sih et al. 2010). While mosquitofish were used in this experiment are a representative of native prey due to their abundance and ubiquitous distribution, their position in the water column (surface-dwelling) relative to jewelfish (bottom-dwelling) does not make them ideal jewelfish prey throughout much of the hydrologic year (Porter-Whitaker et al. 2012), and suggests experiment predation estimates may be conservative."

From Schofield et al. (2014):

"In an 8-month mesocosm experiment, we examined how a simulated Everglades aquatic community of small native fishes, snails, and shrimp changed with the addition of either a native predator (dollar sunfish *Lepomis marginatus*) or a non-native predator (African jewelfish *Hemichromis letourneuxi*) compared to a no-predator control. Two snail species (*Planorbella duryi*, *Physella cubensis*) and the shrimp (*Palaemonetes paludosus*) displayed the strongest predator-treatment effects, with significantly lower biomasses in tanks with *Hemichromis*. One small native fish (*Heterandria formosa*) was significantly less abundant in *Hemichromis* tanks, but there were no significant treatment effects for *Gambusia holbrooki, Jordanella floridae,* or *Pomacea paludosa* (applesnail). Overall, there were few treatment differences between native predator and no-predator control tanks. The results suggest that the potential of *Hemichromis* to affect basal food-web species that link primary producers with higher-level consumers in the aquatic food web, with unknown consequences for Florida waters."

4 Global Distribution

Figure 1. Known global occurrences of *Hemichromis letourneuxi*. Map from GBIF Secretariat (2017). The occurrence reported in Mali was not a precise location, so this occurrence was excluded from the climate matching analysis. An unpictured occurrence reported in the ocean west of India was also excluded from the climate matching analysis because this species is not marine. Although *H. letourneuxi* is not reported as established in Benin, occurrences in Benin were included in the climate matching analysis because they were from a river along the border with Burkina Faso (where *H. letourneuxi* is established) that flows into Ghana (where *H. letourneuxi* is established), and there is no indication in the range description (Froese and Pauly 2018) that the species should be absent from Benin.

5 Distribution Within the United States

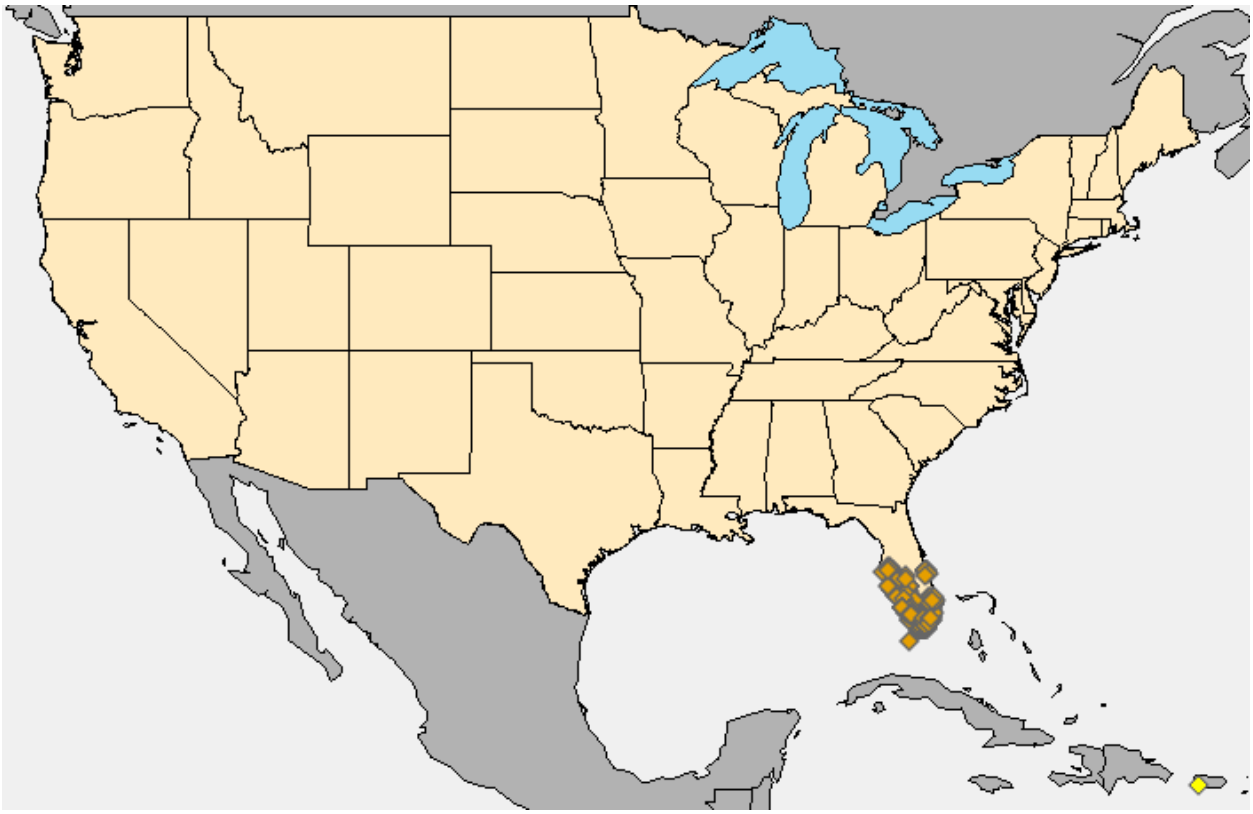

Figure 2. Distribution map of *Hemichromis letourneuxi* within the contiguous United States and Puerto Rico. The yellow dot in Puerto Rico represents a reported occurrence and was removed from climate match analysis because the taxonomy was uncertain. Map from Nico et al. (2018).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2018; 16 climate variables; Euclidean Distance) for *Hemichromis letourneuxi* in the contiguous United States is medium overall, represented by a Climate6 proportion of 0.042. The range of proportions classified as medium match is from 0.005 to 0.103. Locally, Florida showed the highest match, with all of peninsula Florida showing a high match. Parts of southern California, southern Nevada, northwestern Arizona, and southern Georgia also had high match areas. Medium match areas extended in a band along the Atlantic coast from North Carolina to Georgia, along the Gulf Coast from the Florida panhandle to Texas and along the border with Mexico from Texas to California. The climate match was also medium in areas surrounding the areas of high match in the Southwest. The rest of the contiguous United States had a low match.

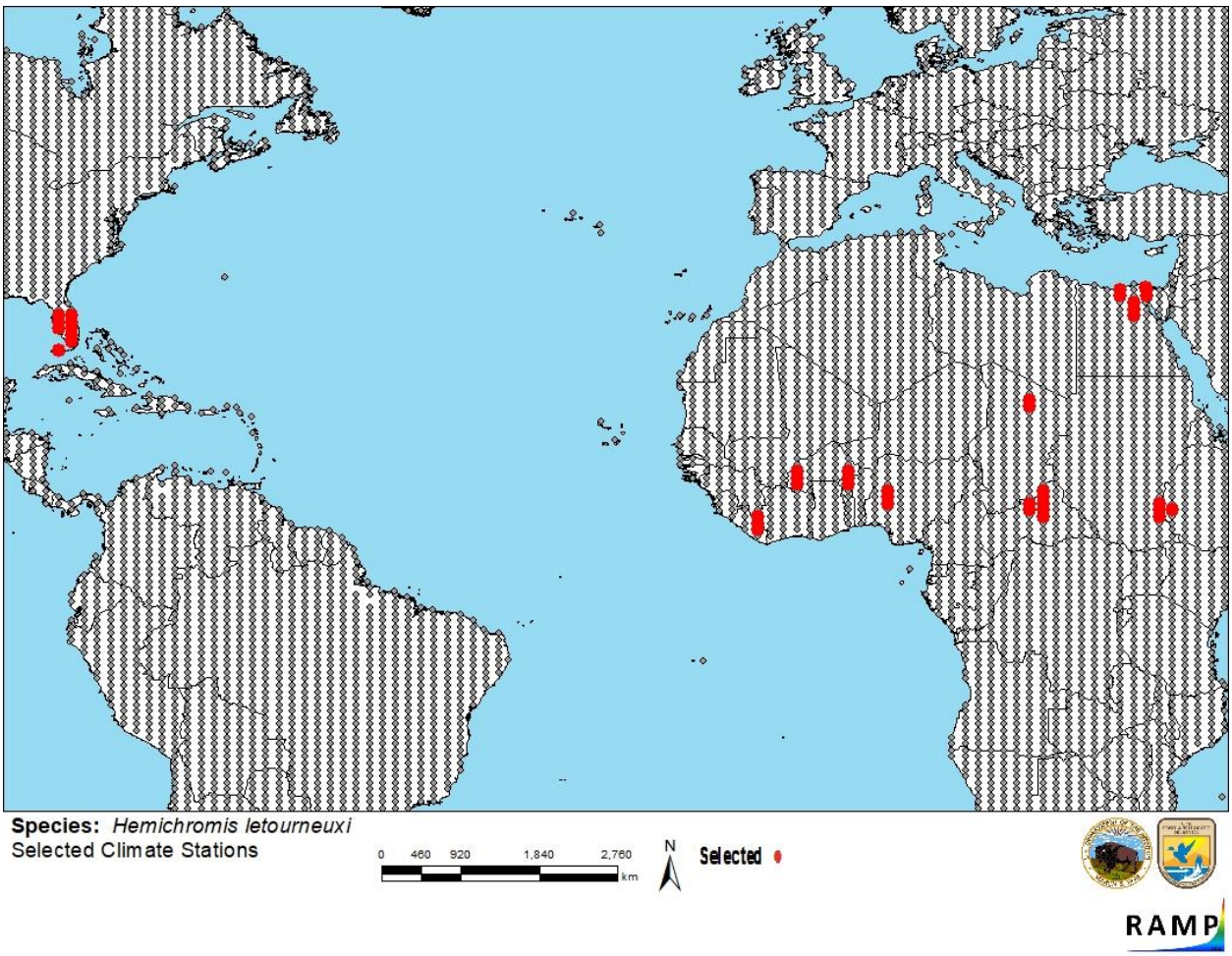

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; United States, Ivory Coast, Burkina Faso, Benin, Nigeria, Central African Republic, Chad, Ethiopia, and Egypt) and non-source locations (gray) for *H. letourneuxi* climate matching. Source locations from GBIF Secretariat (2017).

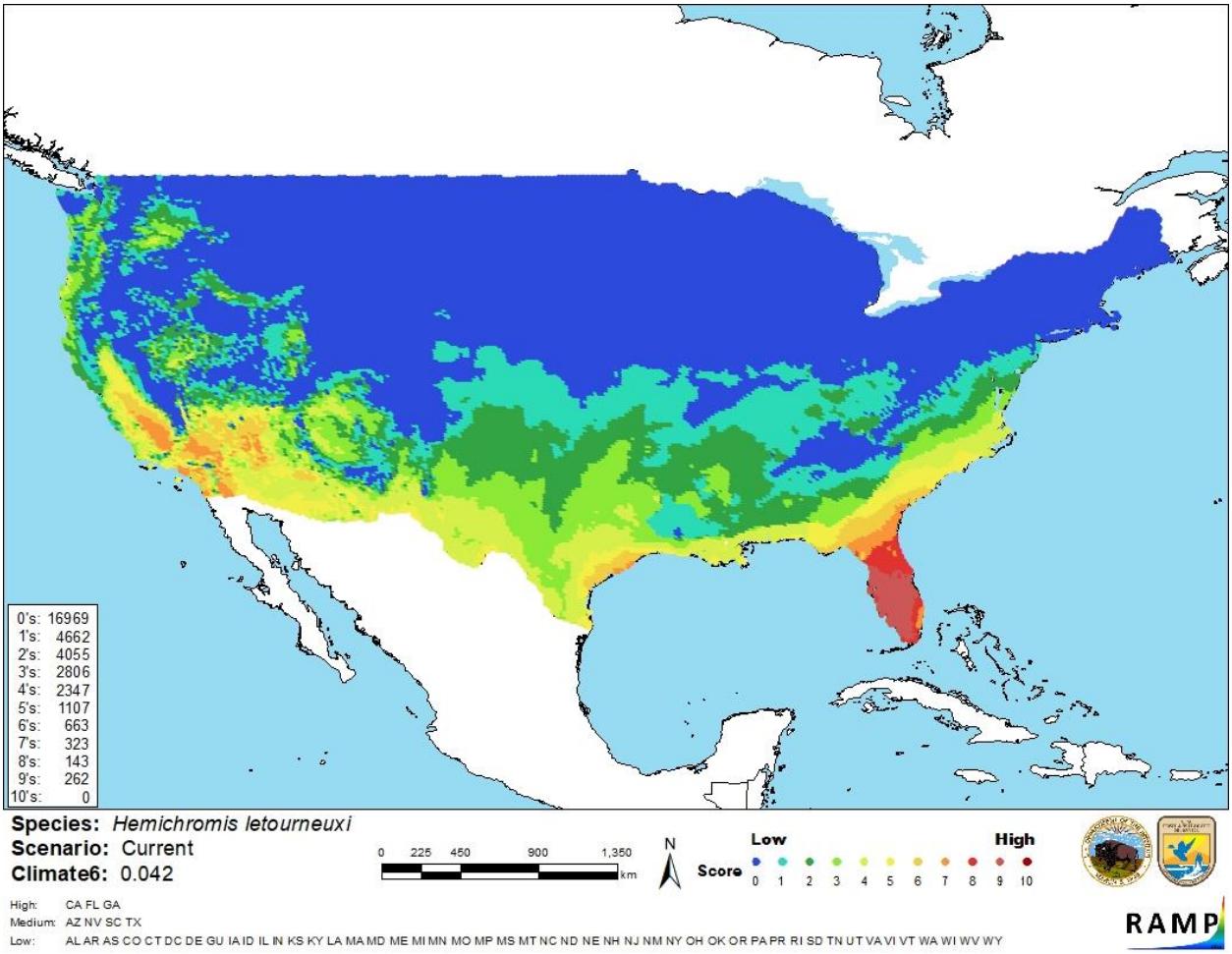

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Hemichromis letourneuxi* in the contiguous United States based on source locations reported by GBIF Secretariat (2017). 0=Lowest match, 10=Highest match.

The "High", "Medium", and "Low" climate match categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

A fair amount information on the biology, ecology, and distribution of *Hemichromis letourneuxi* is available for review, although some gaps do exist. Introductions and established populations outside its native range have been reported in Florida. Additional reports of introductions in the Philippines, Europe, and Puerto Rico could not be confirmed. CABI (2018) describes the reports from the Philippines and Europe as "unreliable," and the report from Puerto Rico states that the taxonomy is uncertain. The evidence for negative impacts of introductions relies mainly on

mesocosm experiments, and it is possible that impacts may be different in natural settings than what was found in these experiments. Given these gaps, certainty of this assessment is medium.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Native to northern, central, and western Africa, *Hemichromis letourneuxi*, or African jewelfish, is a fish species that can thrive in fresh and brackish waters. It is a resilient species that is tolerant of highly saline and oxygen deficient environments. A popular ornamental hobbyist fish, the species was first documented as introduced in south Florida in the Hialeah Canal-Miami River Canal system, Miami area, by Rivas in 1965. It has rapidly expanded in recent decades and can now be found throughout the southern half of the Florida peninsula. No other established populations have been confirmed outside of the contiguous United States and the native range. Results from mesocosm studies show that *H. letourneuxi* increases mortality rate of native fish, snails, and shrimp relative to a native predator or abiotic stressors. In another mesocosm study, *H. letourneuxi* suppressed native sunfish (*Lepomis marginatus*) spawning through its aggressive behavior. It is hypothesized that *H. letourneuxi* may compete with native sunfishes for spawning sites, but detailed evidence is lacking at present. Climate match for the contiguous United States is medium, with Florida representing the highest match. Given the history of negative impacts of introduction and the medium climate match to the contiguous United States, the overall risk assessment category for *H. letourneuxi* is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): Medium**
- **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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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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