Mayan Cichlid (*Mayaheros urophthalmus*)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, November 2016
Revised, June 2019
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Photo: Kaitlin Kovacs, U.S. Geological Service. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=453. (July 2019).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2019a):

"Central America: Atlantic drainages from Mexico to Nicaragua [Belize, Guatemala, Honduras, Mexico, and Nicaragua]."

Status in the United States

From Schofield et al (2019):

"**Status:** Established in southern Florida (Loftus 1987; Lorenz et al. 1997; Shafland et al. 2008); recent survey work in south Florida indicate the species is continuing to expand its range (Nico, unpublished data)."

"Mayan cichlids occur in the mangrove fringe of Biscayne Bay (Serafy et al. 2003) and in high densities inland of northeastern Florida Bay in the southern Everglades (Faunce and Lorenz 2000). One larva (6.1 mm SL) is documented from Florida Bay (13%) downstream of Taylor Slough (Schofield and Powell 2005)."

From CABI (2019):

"Introduced populations of *C. urophthalmum* were first reported from Florida, USA in 1983, when the species was collected in the Everglades National Park (Schofield et al., 2016). *C. urophthalmum* is established in and around the Everglades National Park (Loftus, 1987; Kline et al., 2014) and the Big Cypress National Preserve (Loftus et al. 2014). It was collected in Lake Okeechobee and Lake Osborne, Palm Beach County in 2003 (Shafland et al., 2008). During the 2000s, the range of *C. urophthalmum* increased east and north with reports from the east-central Florida coast at St. Lucie County (Schofield et al., 2016) and from canals on Merritt Island, Brevard County in 2007 (Paperno et al., 2008). *C. urophthalmum* was collected in Charlotte Harbor in 2003 (Adams and Wolfe, 2007; Schofield et al., 2016). In 2005, *C. urophthalmum* was found to be established in Florida Panther National Wildlife Refuge, and in 2006 this species was collected in Mobbly Bayou in Tampa Bay (Paperno et al., 2008). According to Schofield et al. (2016), *C. urophthalmum* is currently found in many counties in Florida including Brevard, Broward, Charlotte, Collier, Lee, Martin, Miami-Dade, Monroe, Okeechobee, Osceloa, Palm Beach, Pinellas and St. Lucie."

Means of Introductions in the United States

From Schofield et al (2019):

"**Means of Introduction:** The origins and dates of actual Florida introductions are unknown (Loftus 1987). Fish were probably aquarium releases or fish-farm escapes."

From CABI (2019):

"The further spread of *C. urophthalmum* by natural dispersal may occur in Florida where the species is already well established. *C. urophthalmum* has expanded throughout southern and central Florida primarily due to three main environmental factors: (i) the interconnected nature of much of the natural and agricultural wetlands in southern/central Florida, (ii) seasonal hydrological regimes and inundation of these wetlands, and (iii) natural events such as hurricanes."

Remarks

A previous version of this ERSS was published in 2016. Revisions were done to incorporate new information and to bring the document in line with current standards.

Mayaheros urophthalmus was previously named *Cichlasoma urophthtalmus* and has also been referred as *Cichlasoma urophtalmum* and *Heros urophthalmus*; all names were used to conduct research for this assessment.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al (2019):

"**Current status:** Valid as *Mayaheros urophthalmus* (Günther 1862)."

From Froese and Pauly (2019b):

"Biota > Animalia (Kingdom) > Chordata (Phylum) > Vertebrata (Subphylum) > Gnathostomata (Superclass) > […] Actinopterygii (Class) > Perciformes (Order) > Labroidei (Suborder) > Cichlidae (Family) > Cichlinae (Subfamily) > *Mayaheros* (Genus) > *Mayaheros urophthalmus* (Species)"

Size, Weight, and Age Range

From Froese and Pauly (2019a):

"Maturity: L_m 11.7, range 10 - 19 cm
Max length : 39.4 cm TL male/unsexed; [IGFA 2001]; max. published weight: 1.1 kg [IGFA 2001]"

From CABI (2019):

"Research on introduced populations in the Everglades National Park (ENP) in Florida concluded that *C. urophthalmum* reached a maximum age of 7 years. In Captivity, *C. urophthalmum* may live at least 11 years (Robins, 2016)."

Environment

From Froese and Pauly (2019a):

"Freshwater; brackish; benthopelagic; depth range 2 - ? m [Conkel 1993]. […]; 20°C - 39°C [Martinez-Palacios and Ross 1992] [assumed to be recommended aquarium temperature] […]"

From Schofield et al (2019):

"Mayan cichlids are tolerant to a wide range of salinity (Martinez-Palacios et al. 1990), temperature (Stauffer and Boltz 1994) and can withstand virtual anoxia for > 2 h (Martinez-Palacios and Ross 1986)."

From GISD (2019):

"It is tolerant of a wide temperature range (14-39 °C) and of low oxygen (hypoxic) conditions (Faunce & Lorenz, 2000; Nico et al., 2007; FishBase, 2010; Schofield et al., 2009)."

"Physiological tolerance to such broad range environmental conditions have likely contributed to the spread of this species throughout Florida (Schofield et al., 2009)."

"Its lower temperature tolerance limit is reportedly around 14°C, and extreme cold events can cause massive declines in its abundance, leading to significant fluctuations in abundance between years (Trexler et al., 2000). However it is possible that *C. urophthalmus* in their invasive range are evolving to be more tolerant of colder temperatures, as fish in an outdoor tank experiment tolerated multiple days of water below 15 °C (to 10 °C) (Adams & Wolfe, 2007)."

Climate/Range

From Froese and Pauly (2019a):

"Tropical; […]; 27°N - 11°N, 98°W - 80°W [Florida Museum of Natural History 2005]"

Distribution Outside the United States

Native

From Froese and Pauly (2019a):

"Central America: Atlantic drainages from Mexico to Nicaragua [Belize, Guatemala, Honduras, Mexico, and Nicaragua]."

Introduced

According to Froese and Pauly (2019a), *M. urophthalmus* has been introduced and become established in Singapore, Thailand and Hagonoy, Bulacan [Philippines].

From Froese and Pauly (2019a):

"Recorded from Santa Monica, Iba, San Sebastian and Pugad [Hagonoy, Bulacan, Philippines]."

"Recorded from the Chao Phraya river delta region [Thailand]."

From CABI (2019):

"*C. urophthalmum* is established in Singapore and was collected by Ng and Tan (2010) between 2007 and 2008 in the Sungei Buloh Wetland Reserve. According to these researchers the species is found in brackish waters throughout the island."

"Nico et al. (2007) reported the discovery of introduced populations of *C. urophthalmum* in the brackish waters of the lower Chao Phraya River delta region, Thailand. The species was abundant in this aquatic system and it was considered likely that it would further disperse in the interconnected water bodies throughout the Chao Phraya delta."

From Ordoñez et al. (2015):

"The occurrence of the native Central American Mayan cichlid, *Cichlosoma urophthalmus*, is also putatively confirmed for the first time in Hagonoy, Bulacan."

"This is the first record of Mayan cichlid in the Philippines. […] The distribution and establishment of *C. urophthalmus* in the Philippines requires further assessment."

Means of Introduction Outside the United States

From Froese and Pauly (2019a):

"Has probably been ithroduced [sic] via the ornamental trade, farmed in fishponds and escaped during flooding events [Ordoñez et al 2015]."

From Ordoñez et al. (2015):

"When and how this species was introduced in the Philippines is unknown. We suspect that the fish was introduced through aquarium fish trade, deliberately farmed in fishponds and escaped during flooding events. At present, Mayan cichlid are sold as food fish in local market, often mixed with tilapia, milkfish and shrimp. […] A possible reason for its introduction is most likely for ornamental purposes since the locals identify it as "flowerhorn", an ornamental aquarium fish."

From Nico et al. (2007):

"The origin of the Thailand *C. urophthalmus* population is a mystery. This species has been in the ornamental fish trade many decades (Staeck and Linke 1995) and Mr. Helias suspects that the Thailand population resulted from an aquarium release."

From CABI (2019):

"Anthropogenic translocation and release may occur in peninsular Florida and Thailand, where the species is successfully established and widely dispersed. The fact that the species is considered a good table fish (Robins, 2016), and is cultured for human consumption in Mexico ([GISD], 2016), may provide motivation to translocate and release *C. urophthalmum*."

Short Description

From Schofield et al (2019):

"Adult and juvenile *C. urophthalmus* have a yellow to olive-brown body, with five to seven distinct vertical bars and a prominent dark ocellus ringed by blue at the base of the caudal fin. Dorsal fin XV-XVII (10-12); anal fin VI-VII (6-10), pectoral with 14 rays, pelvic fin I (5). Lateral line scales generally 26-31. The pelvic fins are under or posterior to pectoral-fin insertion. Characteristics of the mouth and gut were detailed by Martinez-Palacios and Ross (1988) and are summarized as follows: adult *C. urophthalmus* have a slightly protrusible mouth with three rows of unicuspid teeth in both the upper and lower jaw (illustrated in Martinez-Palacios and Ross 1988). The first row of teeth is more pronounced than the other two, and bear teeth differentiated as canines (two or three on each side). The pharyngeal bone is occupied by flattened, crushing-type teeth in the center, surrounded by smaller, fine teeth. The flat, short gill rakers generally range from nine to 11. The simple, sac-shaped stomach has no pyloric caecae. The length of the alimentary tract from the pharyngeal teeth to the anus is generally about 2.2 times the standard length."

From GISD (2019):

"Nico et al. (2007) list several important traits useful for distinguishing *C. urophthalmus*: 1) seven (rarely 8) prominent dark bars on body (the first an oblique [*sic*] along nape that crosses near the lateral line origin, and the seventh or posterior-most bar positioned on the caudal peduncle); 2) conspicuous, dark blotch centered above the caudal fin base and often outlined by a light halo (this blotch may be nearly round, oval square, or vertically elongate, and is noticeably blacker than the dark body bands); 3) caudal fin rounded; 4) anal-fin spines 5-7 (usually 6); 5) dorsal-fin spines 14-18 (usually16); and 6) well developed canine, unicuspid teeth in both jaws. Males and females are similar in appearance and are difficult to distinguish even during reproductive season, when both sexes develop intense red on the ventral side of their body. This species is however; highly variable in colour and anatomical features such as body proportion (Martinez-Palacios et al. 1993, Martinez-Palacios and Ross 1992 in Nico et al., 2007)."

Biology

From Froese and Pauly (2019a):

"Inhabit freshwater marshes and mangrove swamps. Adults prefer coastal lagoons and rivers and will tolerate marine conditions. Feed on small fishes and macro-invertebrates [Conkel 1993]. Spawn on the bottom in both fresh and brackish water [Martinez-Palacios and Ross 1992]."

From Schofield et al (2019):

"This species is widely distributed in rivers, lakes, ponds, marshes and estuaries in its native range. The spawning season occurs from late winter to autumn in the native range, at salinities from 0 to 38‰ and temperatures above 19°C (Miller et al. 2005). Spawning in south Florida occurs from March through the summer (Loftus 1987; Faunce and Lorenz 2000)"

“Mayan cichlids are biparental substrate spawners, and produce adhesive eggs. When the young hatch, they immediately swim toward the bottom, where they attach with adhesive head glands (illustrated in Martinez-Palacios 1987). The young begin free-swimming after about five to six days, but continue to be guarded by the parents for days thereafter (Martinez-Palacios 1987). Although Mayan cichlids often inhabit freshwater, they are known to spawn in estuarine and marine habitats. For example, Greenfield and Thomerson (1997) report *C. urophthalmus* spawning [sic] in sea water over sand/turtlegrass (*Thalassia*) in Belize. Spawning of *C. urophthalmus* was observed in Snook Creek, south Florida in salinities between 10-26 PSU (Loftus 1987). The reproductive biology of *C. urophthalmus* in the southern Everglades is detailed in Faunce and Lorenz (2000), from which the following is summarized: Nests consisted of shallow depressions in the spongy root mass of red mangroves, *Rhizophora mangle*. Nests were 10-45 cm in diameter and generally <10 cm deep. Spawning occurred primarily from April to June. Recently spawned broods, composed of fishes 5–19 mm, were guarded by the parents. Although the spawning season occurred during months of elevated salinities, Faunce and Lorenz (2000) concluded that salinity likely does not control the distribution of this species, and that rather reproduction of *C. urophthalmus* occurs at a time of increased temperatures and water levels that maximize juvenile survival.”

From GISD (2019):

“In Florida, in the late dry season (April) nests are excavated along shorelines. Nests consist of oblong, shallow depressions in the spongy root mass of red mangroves (*Rhizophora mangle*). Nests are less than 10 cm deep and between 10 to 45 cm at their widest. Nests are often found in close association with each other. Shortly after nest construction spawning takes place. Parents exhibit advanced parental care which involves guarding behaviour and calling displays to young. Typically the brood surrounds the female, while the male patrols nearby and defends against potential predators. After four to six weeks the level of parental care begins to decline. During this time water levels have risen, enabling young to disperse to warmer habitat that is mainly free of predators. Adults must then replenish energy reserves (Faunce & Lorenz, 2000). Where sufficient food is available some adults may be able to quickly return to breeding condition and reproduce a second time in the same season (Barlow, 1991 in Faunce & Lorenz, 2000). Declining water levels and temperatures during winter gradually force young fish into deeper habitats. In March, changes in the environment facilitate reproduction by mature fish and the cycle begins again.”

“Females produce a maximum of 600 eggs per spawning (FishBase, 2010).”

“The Mayan cichlid is a shallow-water fish usually found in lentic habitats including freshwater marshes and mangrove swamps. It is a highly adaptable species and may also occur in a wide range of natural and artificial inland and coastal environments, including small and large streams, canals, ditches, lakes, ponds, limestone sinkholes and connected caves, marshes, coastal lagoons, and mangrove swamps.”

“Anatomical features of the Mayan cichlid suggest that it is primarily a carnivore. These include strong dentition; well developed canine unicuspid teeth; short, flat gill rakers; and a short intestine which reduces the efficiency of digesting large amounts of plant material (Martinez-

Palacios & Ross, 1988). Gut analysis of fish from its native range in Mexico found that it is a generalist predator, mainly feeding on invertebrates throughout all seasons. It also consumes some soft algae, although this may be consumed as a consequence of predation on small invertebrates, rather than as a deliberate food item. There was little difference between diet of small and large fish, although larger fish tended to feed on a more limited range of prey items and less plant material. The main identifiable animal consumed were palaemonid and penaeid shrimps (Martinez-Palacios & Ross, 1988). Diet analysis from a location in its introduced range (Big Cypress National Preserve, Florida) found that this species preferred similar prey items to that in its native range. Both small and large fish fed mainly on fishes and filamentous fungi, although younger fish preferred ostracods, while older fish preferred gastropods, decapods, Hymenoptera and adult Diptera (Bergman[n] & Motta, 2005)."

Human Uses

From Froese and Pauly (2019a):

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

From GISD (2019):

"Mayan cichlids have been cultured as a food fish in Mexico since at least the 1980s. It is a suitable aquaculture species due to its wide salinity tolerance, hardiness and high fecundity and can be reared at high stocking densities (Martinez-Palacios & Ross, 1986; Nico et al., 2007). It is also exploited as a game fish, and is commercially exploited in freshwater, brackish and marine environments throughout its native and introduced range. It is edible, attractive and aggressively takes baits and artificial lures. It is often preferred over exotic tilapias in local markets in its native range (Faunce & Lorenz, 2000; Martinez-Palacios & Ross, 1986). However anglers have mixed feelings towards this fish because it fights hard on light tackle and may interfere with pursuit of larger game fishes (Faunce et al., 2002)."

"Mayan cichlids are a popular fish in the aquarium trade in the United States and Europe, although the interest in Europe has declined in recent years (Nico et al., 2007)."

Diseases

Infection with *Aphanomyces invadans* (epizootic ulcerative syndrome) is an OIE-reportable disease (OIE 2019).

Poelen et al (2014) list *C. urophthalmum* as a host of the following parasites: *Serpinema trispinosum, Glossocercus caribaensis, Gnathostoma binucleatum, Rhabdochona kidder, Procamallanus rebecae, Southwellina hispida, Contracaecum multipapillatum*, *Oligogonotylus mayae, Neoechinorhynchus golvani, Oligogonotylus manteri* and *Crassicutis cichlasomae.*

Froese and Pauly (2019a) lists the following as diseases of *M. urophthalmus*: *Raillietnema* Infestation, Parasitic infestations (protozoa, worms, etc.); *Rhabdochona* Disease, Parasitic infestations (protozoa, worms, etc.); Yellow Grub, Parasitic infestations (protozoa, worms, etc.); *Helicometrina* Disease, Parasitic infestations (protozoa, worms, etc.); *Bothriocephalus* Infestation 2, Parasitic infestations (protozoa, worms, etc.); *Posthodiplostomum* Infestation 2, Parasitic infestations (protozoa, worms, etc.); *Goezia* Disease, Parasitic infestations (protozoa, worms, etc.); *Spiroxys* Infestation, Parasitic infestations (protozoa, worms, etc.); *Procamallanus* Infection 13, Parasitic infestations (protozoa, worms, etc.); *Rhabdochona* Infestation 5, Parasitic infestations (protozoa, worms, etc.); *Serpinema* Infestation, Parasitic infestations (protozoa, worms, etc.); *Crassicutis* Infection, Parasitic infestations (protozoa, worms, etc.); *Diptherostomum* Infection, Parasitic infestations (protozoa, worms, etc.); *Genarchella* Infection, Parasitic infestations (protozoa, worms, etc.); *Homalometron* Infection, Parasitic infestations (protozoa, worms, etc.); *Lecithochirium* Infestation 2, Parasitic infestations (protozoa, worms, etc.); *Oligogonotylus* Infection, Parasitic infestations (protozoa, worms, etc.); *Phyllodistomum* Infestation 6, Parasitic infestations (protozoa, worms, etc.); *Saccocoelioides* Infection, Parasitic infestations (protozoa, worms, etc.); *Rhabdochona* Infestation 6, Parasitic infestations (protozoa, worms, etc.); *Contracaecum* Disease (larvae), Parasitic infestations (protozoa, worms, etc.); *Gnathostoma* Disease (larvae), Parasitic infestations (protozoa, worms, etc.); *Tabascotrema* Infection, Parasitic infestations (protozoa, worms, etc.); *Apharyngostrigea* Disease, Parasitic infestations (protozoa, worms, etc.); *Ascocotyle* Infestation 1, Parasitic infestations (protozoa, worms, etc.); *Ascocotyle* Infestation 2, Parasitic infestations (protozoa, worms, etc.); *Ascocotyle* Disease, Parasitic infestations (protozoa, worms, etc.); Cladocystis Infection, Parasitic infestations (protozoa, worms, etc.); *Ascocotyle* Infestation 3, Parasitic infestations (protozoa, worms, etc.); *Diplostomum* Infection, Parasitic infestations (protozoa, worms, etc.); *Drepanocephalus* Infection, Parasitic infestations (protozoa, worms, etc.); *Echinochasmus* Infestation 2, Parasitic infestations (protozoa, worms, etc.); *Mesostephanus* Infection, Parasitic infestations (protozoa, worms, etc.); *Pelaezia* Infection, Parasitic infestations (protozoa, worms, etc.); *Perezitrema* Infection, Parasitic infestations (protozoa, worms, etc.); *Ribeiroia* Infection, Parasitic infestations (protozoa, worms, etc.); *Stunkardiella* Infection, Parasitic infestations (protozoa, worms, etc.); *Torticaecum* Infestation 2, Parasitic infestations (protozoa, worms, etc.); *Uvulifer* Infection, Parasitic infestations (protozoa, worms, etc.); *Sciadicleithrum* Infection 3, Parasitic infestations (protozoa, worms, etc.); *Bothriocephalus* Infestation 5, Parasitic infestations (protozoa, worms, etc.); *Glassocercus* Infestation, Parasitic infestations (protozoa, worms, etc.); *Capillaria* Infestation 2, Parasitic infestations (protozoa, worms, etc.); *Mexiconema* Infestation, Parasitic infestations (protozoa, worms, etc.); *Falcaustra* Infection (*Falcaustra sp.*), Parasitic infestations (protozoa, worms, etc.); *Pseudoterranova* Infection, Parasitic infestations (protozoa, worms, etc.); *Acanthocephalus* Infestation 2, Parasitic infestations (protozoa, worms, etc.); *Dollfusentis* Infection, Parasitic infestations (protozoa, worms, etc.); *Neoechinorhynchus* Infestation 6, Parasitic infestations (protozoa, worms, etc.); *Polymorphus* Infestation, Parasitic infestations (protozoa, worms, etc.); *Southwellina* Infestation, Parasitic infestations (protozoa, worms, etc.); *Procamallanus* Infection 13, Parasitic infestations (protozoa, worms, etc.); and *Rhabdochona* Infestation 6, Parasitic infestations (protozoa, worms, etc.).

From Aguirre-Ayala and Vidal-Martínez (2015):

"*C. urophthalmus* can become infected with *A. invadans* during the first 30 days post-infection, even though this fish species does not develop pathological damage. This result has important implications for disease surveillance because fish can cross national borders as asymptomatic carriers. However, our results suggest that after 60 days post-infection, these fish clear the infection and no longer represent a risk for transmission."

"Whether those infected fish are able to transmit the disease to other fish remains to be determined."

Threat to Humans

From Froese and Pauly (2019a):

"Harmless"

3 Impacts of Introductions

From Schofield et al (2019):

"**Impact of Introduction:** Studies have shown native fish population reductions when Mayan cichlids increase in number, possibly through competition pressures for food and space (Trexler et al. 2000), or alternatively through predation effects (Ferriter et al. 2006; Porter-Whitaker et al. 2012). Trexler et al (2000) also report anecdotal evidence of nest predation and competitive interactions for space with other substrate-spawning natives (centrarchids)."

From GISD (2019):

"Predation: Nest predation of native centrarchids by Mayan cichlids has been observed in the Everglades National Park (Trexler et al., 2000). Presence of Mayan cichlids may affect prey behaviour. For example, a laboratory study of the native mosquitofish, *Gambusia holbrooki* in Florida found that this species reduced its use of tank microhabitats in the presence of Mayan cichlids (Rehage et al., 2009).
Competiton: Mayan cichlids compete with native substrate-spawning species, e.g. native largemouth bass (*Micropterus salmoides*), warmouth (*Chaenobryttus gulosus*) and spotted sunfish (*Lepomis punctatus*) in Everglades National Park. The catch of native species was found to vary inversely with the catch of Mayan cichlids. Although this pattern does not provide proof of a cause-and-effect relationship, further research in this habitat may provide evidence of community-level effects as a result of the Mayan cichlid invasion (Trexler et al., 2000).
Ecosystem change: There is concern that the interaction between Mayan cichlids and native fishes could alter the ecology of the Everglades and the Florida Bay region (Faunce et al., 2002).
Disease transmission: *Cichlasoma urophthalmus* is a potential vector of diseases and parasites. It was found to be an intermediate host to an unidentified member of the genus *Contracaecum*, a group of anisakid nematodes known to infect birds and mammals, including humans (Bergmann & Motta, 2004). Studies in Mexico have reported *C. urophthalmus* as host to a diverse range of parasites, including 71 helminth species (Salgado-Maldonado, 2006 in Nico et al., 2007), and the larvae of the nematode *Serpinema trispinosum*, which affects turtles (Moravec et al., 1998 in Nico et al., 2007)."

From Harrison (2014):

"Assemblage structure of small fishes differed between estuarine sites with abundant Mayan Cichlids and sites with few Mayan Cichlids. These differences were mirrored by temporal changes in native fishes at the two sites with abundant Mayan Cichlids; as the density of Mayan

Cichlids increased between winters with strong cold fronts, the density of several non-native species declined, only to resurge when the cold fronts depleted the number of cichlids. This pattern repeated several times during the course of the study, and independently at two widely separated study sites. We believe this combination of information provides strong support for the hypothesis that Mayan Cichlids were responsible for these changes. Furthermore, the per capita impact of Mayan Cichlids varied among species of small-bodied native fish, but in all cases was well described by a simple linear model with slope of less than 0 but greater than -1.0 […]. This suggests that the per capita effect on native fishes of adding Mayan Cichlids did not diminish as predicted by simple predator-prey models."

From Froese and Pauly (2019a):

"Believed to have caused the decline in catch of other important food-fish due to competition for food and space, although not much evidence is available regarding their negative impact [Ordoñez et al 2015]."

From Porter-Whitaker et al. (2012):

"We examined predator–prey interactions among two non-native predators, a recent invader, the African jewelfish, and the longer-established Mayan cichlid, and a native Florida Everglades prey assemblage. Using field enclosures and laboratory aquaria, we compared predatory effects and antipredator responses across five prey taxa. Total predation rates were higher for Mayan cichlids, which also targeted more prey types. The cichlid invaders had similar microhabitat use, but varied in foraging styles, with African jewelfish being more active. The three prey species that experienced predation were those that overlapped in habitat use with predators. Flagfish were consumed by both predators, while riverine grass shrimp and bluefin killifish were eaten only by Mayan cichlids. In mixed predator treatments, we saw no evidence of emergent effects, since interactions between the two cichlid predators were low. Prey responded to predator threats by altering activity but not vertical distribution."

From CABI (2019):

"Impacts on native fish populations include competition for food and space, predation, behavioural modification and potentially disease transmission. Schofield et al. (2016) noted that *C. urophthalmum* has the potential to be one of the most damaging introduced cichlids in Florida and the species is one of the most widespread and successful introduced cichlids after only three decades in Florida."

4 Global Distribution

Figure 1. Known global distribution of *Mayaheros urophthalmus*. Map from GBIF Secretariat (2019). The location in Brazil does not represent an established population and was not used to select source locations for the climate match due to no additional information or supporting literature that *M. urophthalmus* has been introduced there.

5 Distribution Within the United States

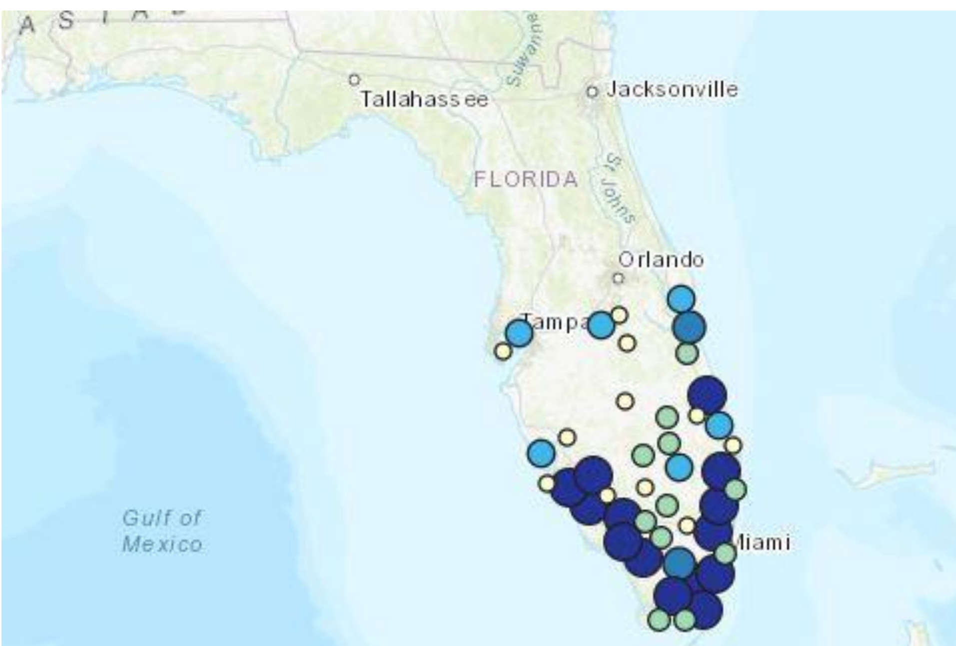

Figure 2. Known distribution of *Mayaheros urophthalmus* in the United States. Map from Schofield et al (2019).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for the contiguous United States was generally low for *Mayaheros urophthalmus.* Areas of medium match were found along the southern border of the United States and along the south east coast of the country. Areas of high match were found in the south eastern states as well as Texas. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for contiguous United States was 0.030, a medium score (scores greater than 0.005, but less than 0.103 are classified as medium). Florida, Georgia, and South Carolina all received high individual Climate 6 scores; Louisiana, North Carolina, and Texas received medium individual Climate 6 scores, while all remaining States received low individual Climate 6 scores.

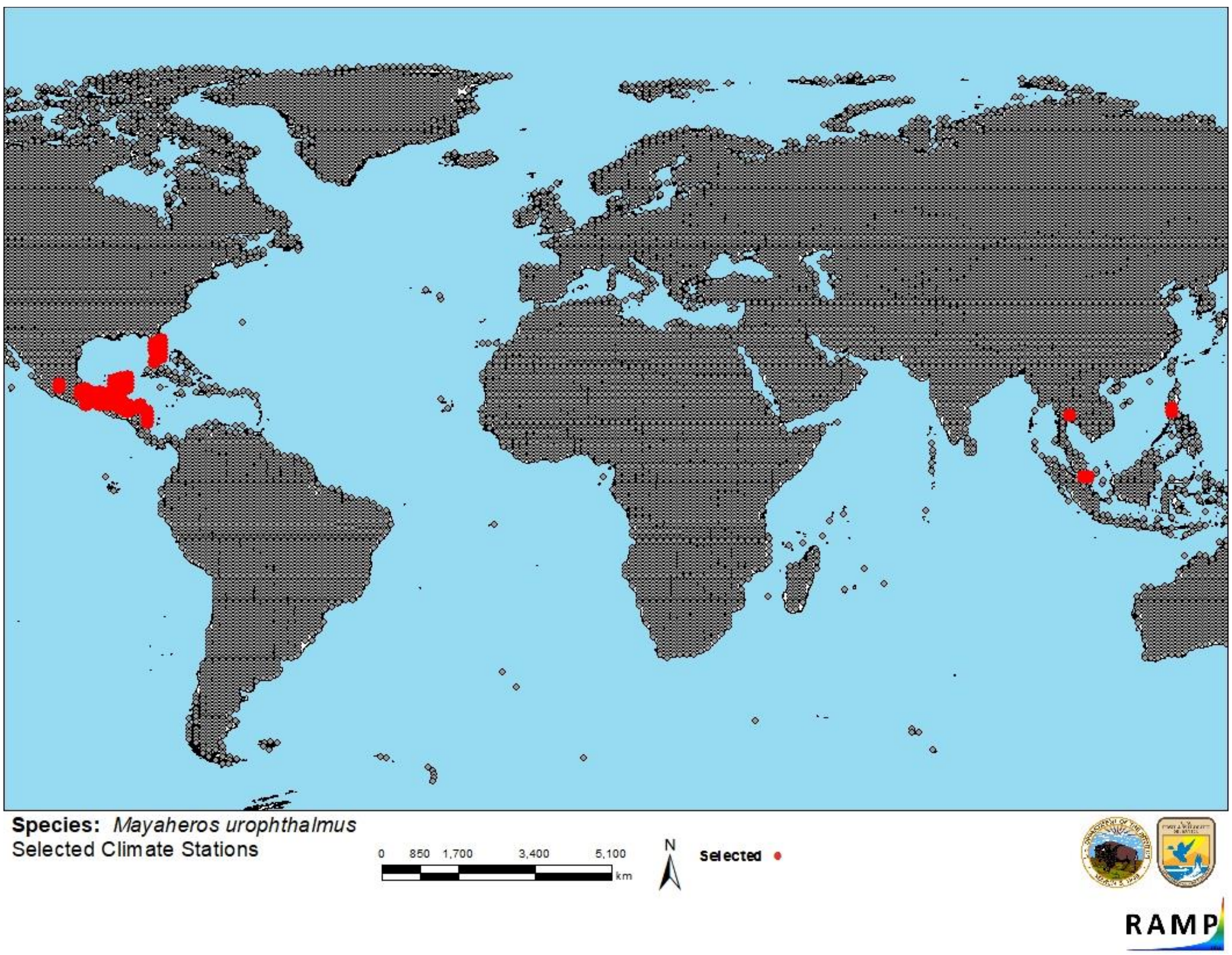

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations in Belize, Guatemala, Honduras, Mexico, Nicaragua, Philippines, Singapore, Thailand, and the United States selected as source locations (red) and non-source locations (gray) for *Mayaheros urophthalmus* climate matching. Source locations from GBIF Secretariat (2019). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

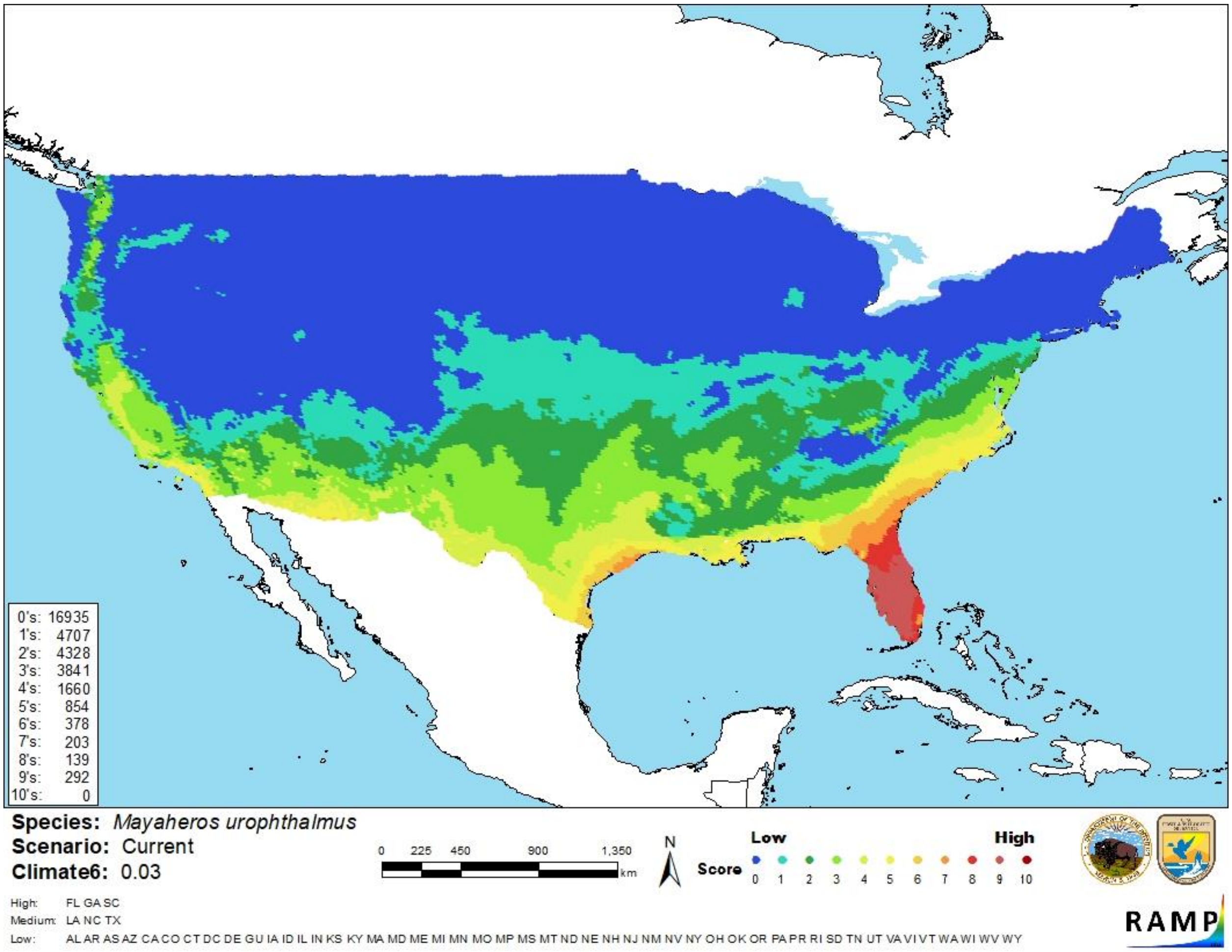

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Mayaheros urophthalmus* in the contiguous United States based on source locations reported by GBIF Secretariat (2019). Counts of climate match scores are tabulated on the left. 0 = Lowest match, 10 = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

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

7 Certainty of Assessment

The certainty of assessment is high. Peer-reviewed literature on the biology, ecology, and distribution associated with *Mayaheros urophthalmus* as well as information on its history of invasiveness is available.

8 Risk Assessment

Summary of Risk to the Contiguous United States

The Mayan Cichlid (*Mayaheros urophthalmus*) is a medium sized cichlid native to the Atlantic drainages of Central America. *Mayaheros urophthalmus* is a popular ornamental and food fish. This species is tolerant to a wide range of salinity and temperature. The history of invasiveness is high. *M. urophthalmus* has become established in multiple new locations creating negative impacts for native species such as: competition for food and space, nest predation, behavioral modification, and potentially transmitting *Aphanomyces invadans*, which is an OIE-reportable disease. The Mayan Cichlid has already successfully invaded Florida, where it continues to disperse. The climate match for the contiguous United States is medium, with Florida, Georgia, and South Carolina having high individual climate scores. The certainty of assessment is high. The overall risk assessment category for *Mayaheros urophthalmus* is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): Medium**
- **Certainty of Assessment (Sec. 7): High**
- **Remarks/Important additional information:** Host for epizootic ulcerative syndrome, an OIE-reportable disease.
- **Overall Risk Assessment Category: High**

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