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

U.S. Fish and Wildlife Service, February 2024
Revised, August 2025
Web Version, 2/4/2026

Organism Type: Fish
Overall Risk Assessment Category: High

Photo: Kaitlin Kovacs. U.S. Geological Survey. Public domain. Available:
https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=453 (February 2024).

1 Native Range and Status in the United States

Native Range
From Schofield et al. (2024):

"Tropical America. Atlantic Slope drainages from Río Coatzacoalcos basin in Mexico southward into Nicaragua, including Isla Mujeres and Yucatán Peninsula (Conkel 1993; Greenfield and Thomerson 1997)."

From Fricke et al. (2024):

"Southern North America and Central America: Atlantic watersheds (Mexico, Belize, Guatemala, Honduras and Nicaragua)."

Status in the United States

From Schofield et al. (2024):

"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et al. 2008); recent survey work in south Florida indicate the species is continuing to expand its range (Nico, unpublished data)."

From Robertson and Van Tassell (2024):

"Mayan Cichlids were first reported in Joe Bay, Everglades National Park, in 1982. They have expanded their range through southern Florida through canals and coastal waters, reaching Tampa Bay by 2004, and the Indian River Lagoon by 2006."

From Siriwardena (2021):

"Since then [1983] it [sic] range has increased and *C. urophthalmum* [*M. urophthalmus*] is currently found in many counties in Florida including Brevard, Broward, Charlotte, Collier, Lee, Martin, Miami-Dade, Monroe, Okeechobee, Osceola, Palm Beach, Pinellas and St. Lucie (Schofield et al., 2016)."

From GISD (2024):

"Mayan cichlids are a popular fish in the aquarium trade in the United States […]"

Regulations
No species-specific regulations on possession or trade were found within the United States.

Means of Introductions within the United States

From Siriwardena (2021):

"Schofield et al. (2016) speculated that introduced populations of *C. urophthalmum* in Florida are the result of release of specimens from private aquaria and/or commercial fish farms. The potential for the release of fish is correlated with the popularity of that species and its abundance among fish hobbyists. Although *C. urophthalmum* is translocated and kept as an ornamental fish species worldwide, it is not a particularly popular ornamental species."

"The further spread of *C. urophthalmum* by natural dispersal may occur in Florida where the species is already well established."

"Agriculturally-modified wetlands cover significant areas of south and central Florida and provide important habitat for many freshwater species. These wetlands are often highly interconnected via artificial canals and ditches (O'Connor and Rothermel, 2013). […] However, in the subtropical climate of south Florida, periodic extreme flooding events may eventually expose most of these wetlands to the exotic species that occur in the region, diluting the effect of ditch-mediated connectivity (O'Connor and Rothermel, 2013). Similarly, extensive flooding subsequent to hurricane events is likely to rapidly expand the range of euryhaline fishes."

Remarks

An ERSS for this species was previously published in November 2012 (as *Cichlasoma urophthalmum*) and in January 2020 (as *Mayaheros urophthalmus*). Revisions were completed to incorporate new information and conform to updated standards.

From NatureServe (2024):

"Rícan et al. (2016) conducted molecular and morphological analyses of Middle American cichlid fishes and found support for 31 genera in Middle America, six in South America, and one in the Greater Antilles as separate evolutionary lineages occupying separate adaptive zones. They describe nine new genera for species and species groups that have lacked a genus level name or were associated with other unrelated genera."

"[This species was] Placed in a newly described genus, *Mayaheros* Rícan and Piálek."

"Page et al. (2013) kept this species in the genus *Cichlasoma*, but noted that this was incorrect."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Froese and Pauly (2025):

Kingdom Animalia
  Phylum Chordata
    Subphylum Vertebrata
      Infraphylum Gnathostomata
       Parvphylum Osteichthyes
        Gigaclass Actinopterygii
         Superclass Actinopteri
        Class Teleostei
          Order Cichliformes
         Family Cichlidae
          Subfamily Cichlinae
           Genus *Mayaheros*
            Species *Mayaheros urophthalmus*

According to Fricke et al. (2024), *Mayaheros urophthalmus* is the current valid name for this species.

The following synonyms of *Mayaheros urophthalmus* from Fricke et al. (2024) were used to search for information for this report: *Cichlasoma urophthalmus, C. urophthalmum,* and *Heros urophthalmus*.

Size, Weight, and Age Range

From Siriwardena (2021):

"approximately 400 mm Total Length (TL) and 1.1 kg"

"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 [sic], *C. urophthalmum* may live at least 11 years (Robins, 2016)."

From Schofield et al. (2024):

"Size: 22 cm SL [standard length] (Miller et al. 2005)"

From Robertson and Van Tassell (2024):

"Reaches 38 cm, 1.135 kg."

Environment

From Siriwardena (2021):

"*C. urophthalmum* is euryhaline and tolerant of a wide range of salinities. While it is usually found in freshwater and brackish environments, the species can tolerate marine conditions and is capable of surviving abrupt changes in salinity (Schofield et al., 2009). It is tolerant to a wide [water] temperature range (14-39°C) and low oxygen (hypoxic) conditions (Faunce and Lorenz, 2000; Nico et al., 2007; Schofield et al., 2009; Froese and Pauly, 2016). The lower temperature tolerance limit of the species is approximately 14°C; however, introduced populations of *C. urophthalmum* may be evolving to be more tolerant of colder temperatures. An in situ mesocosm experiment conducted by Adams and Wolfe (2007) found that fish tolerated multiple days of water below 15°C (to 10°C). Currently in Florida, extreme cold events can cause massive declines in introduced populations of *C. urophthalmum*, leading to significant fluctuations in abundance of the species between years (Trexler et al., 2000)."

Climate

From Froese and Pauly (2024):

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

Distribution Outside the United States

Native

From Schofield et al. (2024):

"Tropical America. Atlantic Slope drainages from Río Coatzacoalcos basin in Mexico southward into Nicaragua, including Isla Mujeres and Yucatán Peninsula (Conkel 1993; Greenfield and Thomerson 1997)."

From Fricke et al. (2024):

"Southern North America and Central America: Atlantic watersheds (Mexico, Belize, Guatemala, Honduras and Nicaragua)."

Introduced

From Siriwardena (2021):

"*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 [Philippines]."

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

From Corpuz et al. (2024):

"There were 13 fish species that were observed to occur in both sampling rivers [Talisay and Bagac rivers, Philippines]. These include […] *Mayaheros urophthalmus*, […]".

From Chelapurath Radhakrishnan et al. (2020):

"We provide the first record of the Mayan Cichlid, *Mayaheros urophthalmus* from South Asia, based on specimens collected from the River Chalakudy in Kerala, India."

"Despite that there is no prima facie evidence of *M. urophthalmus* having established a breeding population in Chalakudy, there exist an increased risk of gradual establishment, given the length-range of the specimens recorded."

From Itsukushima et al. (2025):

"[…] we discuss the introduction pathways, ecological characteristics, and possible reasons for the successful establishment of two species frequently detected in urban [peninsular Malaysian] watersheds: *Poecilia sphenops* and *Mayaheros urophthalmus*."

Means of Introduction Outside the United States
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."

Short Description
From Robins (2025):

"It has a moderately compressed body with a pointed snout and between six and eight blue-black bars – often with narrow white to pale gray borders – on a brownish to olive background. The dorsal fin frequently has a red edge, and a white to metallic, blue-edged bar is present on the middle caudal fin base."

From Robertson and Van Tassell (2024):

"Tan; belly and throat or entire body may be red-brown; iris yellow; body with 5-8 dark green to blackish bars narrowly bordered with pale turquoise, first one extending obliquely onto nape, last one on tail base, 4th bar with a conspicuous central blotch with pearly marks on scales; a large black vertical oval blotch surrounded by a light turquoise halo on upper half of tail fin base; edges of dorsal and tail fins red."

From Schofield et al. (2024):

"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."

Biology

From Froese and Pauly (2024):

"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. (2024):

"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 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 Siriwardena (2021):

"*C. urophthalmum* has become established in aquatic habitats because of its wide environmental tolerances, ability to colonize disturbed habitats, trophic opportunism, fast growth rates and advanced parental care of offspring. […] When breeding, *C. urophthalmum* becomes aggressive as territories are established on the substrate and defended against intruders."

"*C. urophthalmum* is a monogamous, biparental substrate spawner with advanced parental care of offspring. During reproduction, both sexes develop intense red on the ventral side of their body. Males are aggressive to each other and to immature females (Martínez-Palacios, 1987). Both parents protect the spawning site, which has a territory of approximately 1 m^2 (Chavaz et al., 1983), after spawning and during larval development."

"*C. urophthalmum* is primarily a carnivore based on anatomical features that include a slightly protusible mouth and small caniform teeth for grasping prey, large pharyngeal tooth pads for the mastication of prey (particularly hard-shelled invertebrates), short flat gill rakers and a short intestine which reduces the efficiency of digesting large amounts of plant material (Martinez-Palacios and Ross, 1988; Ross and Martínez-Palacios, 1991; Robins, 2016)."

Human Uses

From GISD (2024):

"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* (causative agent of epizootic ulcerative syndrome) has been reported for *Mayaheros urophthalmus*. Epizootic ulcerative syndrome is a reportable disease listed by the World Organisation for Animal Health (2024).

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."

According to Siriwardena (2021), *Mayaheros urophthalmus* is susceptible to the following diseases and pathogens: Ichthyophthiriosis, lymphocystis, mycobacteriosis, *Bothriocephalus pearsei*, *Echinochasmus leopoldinae*, *Ichthyophthirius multifiliis*, Mycobacterium, Myxobolus, *Neoechinorhynchus golvani*, *Procamallanus rebecae*, Trichodina, and Vorticella.

Poelen et al (2014) list *C. urophthalmum* as a host of the following additional parasites: *Serpinema trispinosum, Glossocercus caribaensis, Gnathostoma binucleatum, Rhabdochona*

kidder, Southwellina hispida, Contracaecum multipapillatum, Oligogonotylus mayae,
Oligogonotylus manteri and *Crassicutis cichlasomae.*

From GISD (2024):

"*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)."

Threat to Humans
From Froese and Pauly (2024):

"Harmless"

3 Impacts of Introductions
From GISD (2024):

"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)."

From Schofield et al. (2024):

"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)."

"It is also one of the most abundant fish in angler catches in some Everglades canals (Shafland et al. 2008)."

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 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."

4 History of Invasiveness

Mayaheros urophthalmus has been introduced to several countries outside of its native range and is established in the United States (Florida), Singapore, Thailand, and Malaysia. Established populations in the United States have resulted in negative impacts documented in peer-reviewed literature including competition with and reduction of populations of native fish species. The History of Invasiveness is classified as High.

5 Global Distribution

Figure 1. Reported global distribution of *Mayaheros urophthalmus.* Map from GBIF Secretariat (2023). Observations are reported from Belize, Guatemala, Honduras, Costa Rica, Mexico, Nicaragua, Brazil, southern United States, India, Sri Lanka, Singapore, Malaysia, Philippines, Thailand, and Taiwan. Points located in the United States (Texas), northern Mexico, Brazil, India, Sri Lanka, and Taiwan were not used in the climate matching analysis as they were not found to represent established populations.

6 Distribution Within the United States
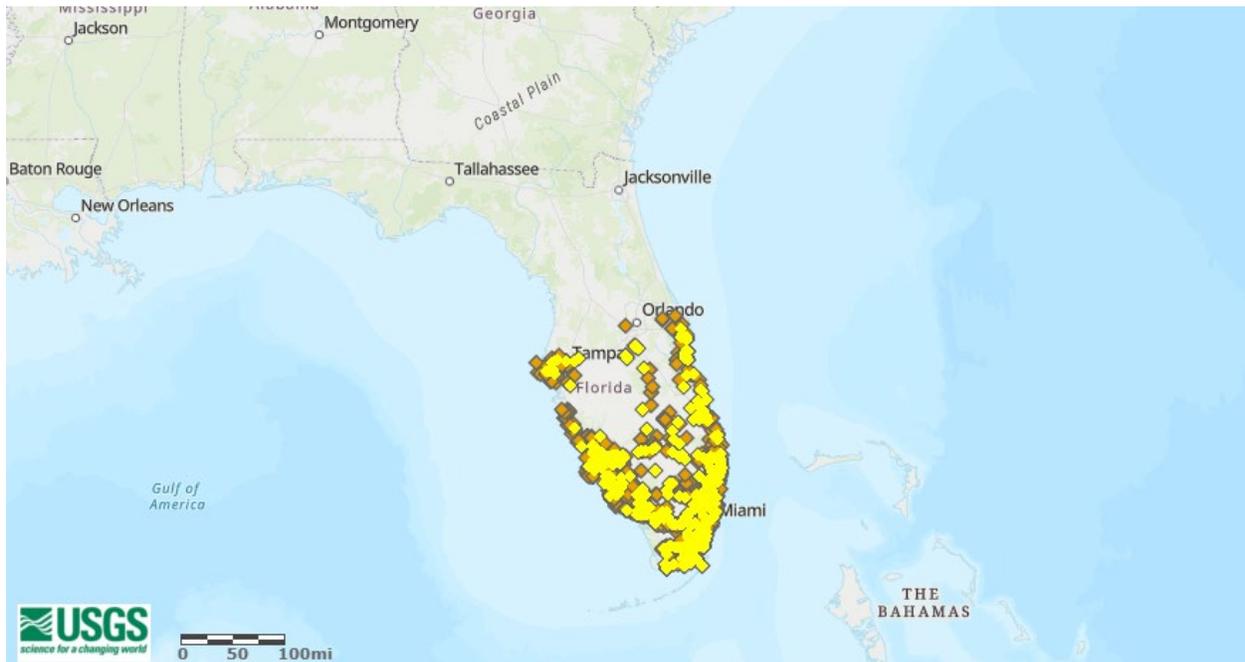
Figure 2. Reported distribution of *Mayaheros urophthalmus* in the United States. Map from Schofield et al. (2026). Observations are reported from Florida. Yellow diamonds denote observations representing established populations of *M. urophthalmus*. Orange diamonds indicate records of introduction with unknown establishment status. Only observations representing established populations were used in the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Mayaheros urophthalmus* to the contiguous United States was highest in Florida where this species is established. Additional, small areas of high match were found along the Gulf and southern Atlantic coasts. Areas of medium match were found in most Gulf and Atlantic coastal areas extending inland toward Missouri and West Virginia, as well as along the Mexican border and in southern California. The remainder of the contiguous United States had low climate matches. The overall Climate 6 score (Sanders et al. 2024; 16 climate variables; Euclidean distance) for the contiguous United States was 0.044, indicating that there is establishment concern for this species. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/ (count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in the contiguous United States under future climate scenarios are available for *Mayaheros urophthalmus* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.
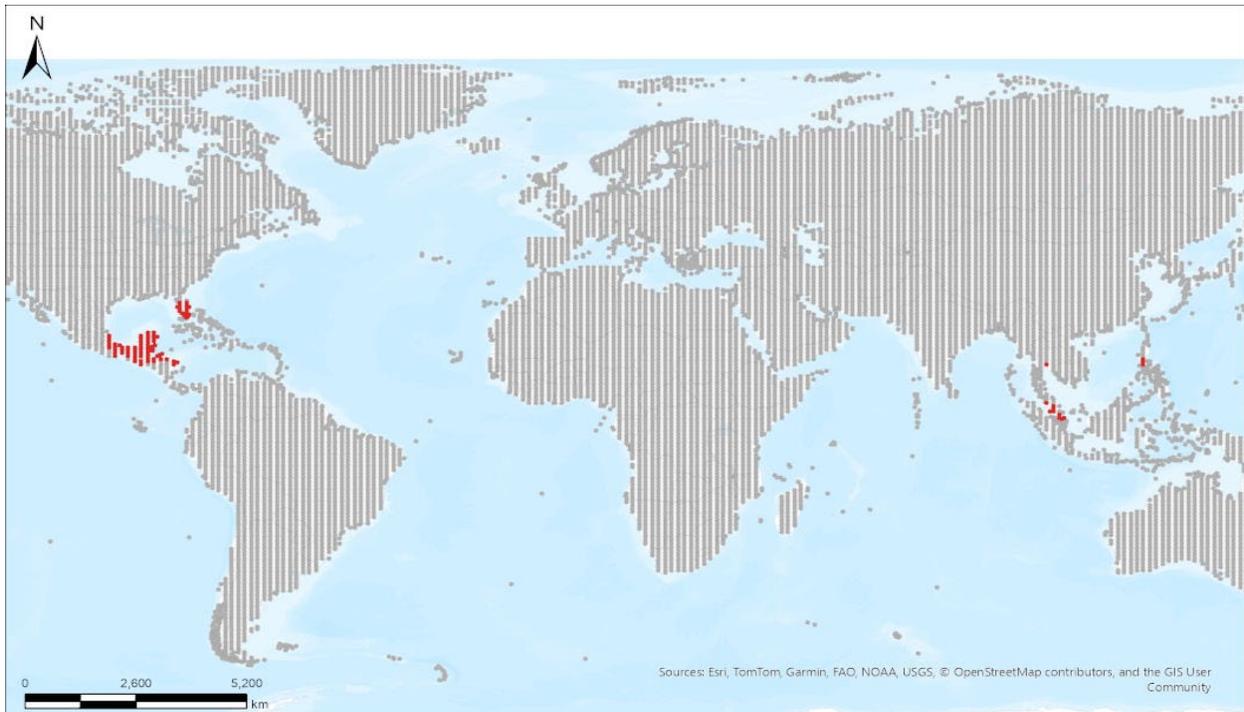
Figure 3. RAMP (Sanders et al. 2024) source map of the world showing weather stations in southern North America, Central America, southeast Asia (red; Belize, Guatemala, Honduras, Mexico, Nicaragua, United States (Florida), Singapore, Malaysia, Philippines, and Thailand) and non-source locations (gray) for *Mayaheros urophthalmus* climate matching. Map from GBIF Secretariat (2023). Locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.
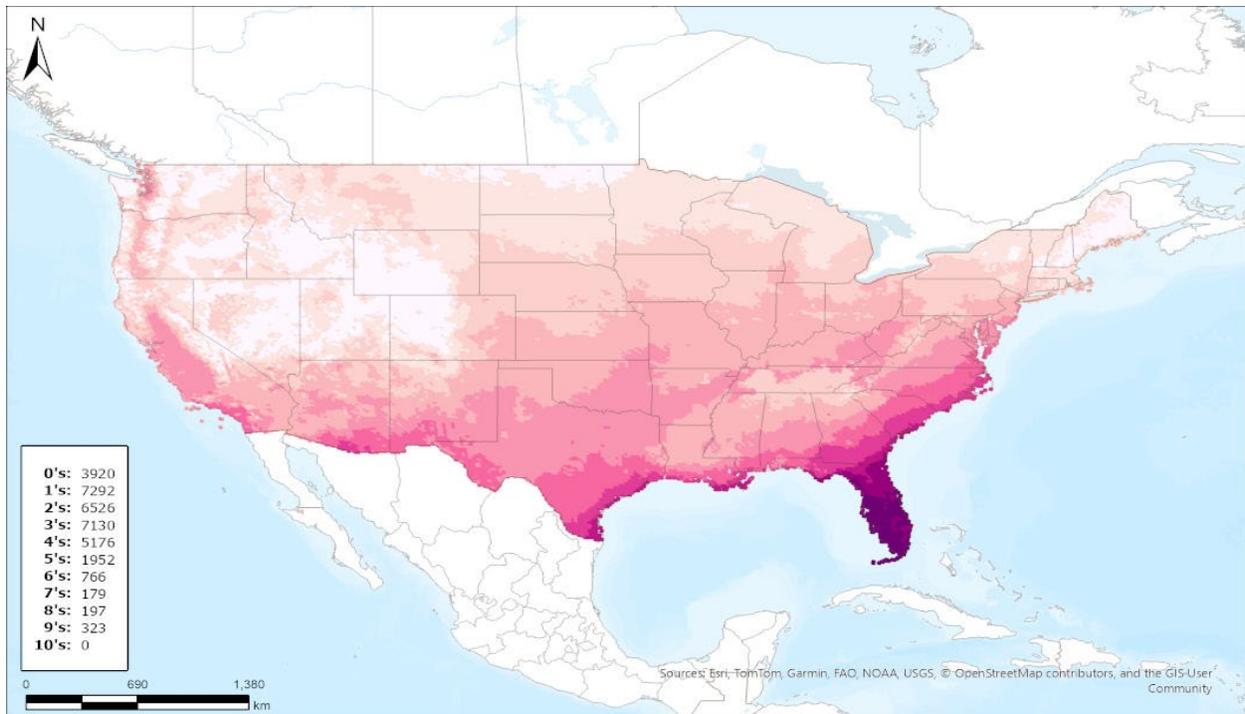
Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Mayaheros urophthalmus* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Mayaheros urophthalmus* is classified as High. Information on the biology, distribution, and impacts *M. urophthalmus* is readily available. Negative impacts from introductions of this species are adequately documented in the scientific literature. No further information is needed to assess the risk posed by this species to the contiguous United States.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Mayaheros urophthalmus, Mayan Cichlid, is a fish that is native to Atlantic slope waters from southeastern Mexico (including the Yucatán Peninsula) to the Rio Prinzapolka in Nicaragua. This species has been introduced to several countries outside of its native range, and has established populations in the United States, Singapore, Thailand, Malaysia, and the Philippines. *M. urophthalmus* is in the aquarium trade within the United States. The History of Invasiveness for *M. urophthalmus* is classified as High as established populations in the United States have resulted in negative impacts including competition with and reduction of populations of native

fish species. The climate matching analysis for the contiguous United States indicates establishment concern for *Mayaheros urophthalmus*. Areas of high match were found in Florida and along the Gulf and southern Atlantic coasts. The Certainty of Assessment for this ERSS is classified as High. Information was available from reliable sources regarding biology, ecology, distribution, and history of invasiveness for this species. The Overall Risk Assessment Category for *M. urophthalmus* in the contiguous United States is High.

Assessment Elements
- **History of Invasiveness (see Section 4): High**
- **Establishment Concern (see Section 7): Yes**
- **Certainty of Assessment (see Section 8): High**
- **Remarks, Important additional information: Infection with *Aphanomyces invadans* (epizootic ulcerative syndrome) has been documented in *Mayaheros urophthalmus*; it is a reportable disease listed by the World Organisation for Animal Health.**
- **Overall Risk Assessment Category: High**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in section 11.

Aguirre-Ayala D, Vidal-Martínez VM. 2015. Experimental infection of the Mayan Cichlid *Cichlasoma urophthalmus* with the oomycete *Aphanomyces invadans*. Journal of Parasitology 101(4):485–487.

Chelapurath Radhakrishnan R, Kuttanelloor R, Raghavan R, Kutty R. 2020. First record of the Mayan Cichlid *Mayaheros urophthalmus* (Günther, 1862) in South Asia and its potential implications. Journal of Applied Ichthyology 36:699–704.

Corpuz MNC, Nacorda HME, Casal CME, Faustino-Eslava DV, Jaranilla-Sanchez PA, Vedra SA, Paguia HM, Espaldon MaVO. 2024. Ichthyofaunal diversity and water quality parameters in Talisay and Bagac river systems, Bataan, Luzon Island, Philippines. Biodiversity Journal 15:649–658.

Fricke R, Eschmeyer WN, van der Laan R, editors. 2024. Eschmeyer's catalog of fishes: genera, species, references. California Academy of Science. Available: https://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatget.asp?spid=16478 (February 2024).

Froese R, Pauly D, editors. 2024. *Mayaheros urophthalmus* (Günther, 1862). FishBase. Available: https://www.fishbase.us/summary/SpeciesSummary.php?ID=4798&genusname=Mayaheros&speciesname=urophthalmus&AT=Mayaheros+urophthalmus&lang=English. (February 2024).

Froese R, Pauly D, editors. 2025. *Mayaheros urophthalmus* (Günther, 1862)*.* World Register of Marine Species. Available: https://www.marinespecies.org/aphia.php?p=taxdetails&id=1253896 (August 2025).

GBIF Secretariat. 2023. GBIF backbone taxonomy: *Mayaheros urophthalmus* (Günther, 1862). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/9539561 (August 2025).

[GISD] Global Invasive Species Database. 2024. Species profile: *Cichlasoma urophthalmus*. Gland, Switzerland: Invasive Species Specialist Group. Available: https://www.iucngisd.org/gisd/species.php?sc=1692 (February 2024).

Harrison E. 2014. Analyzing invasion success of the Mayan cichlid (*Cichlasoma urophthalmus*; Günther) in southern Florida. Doctoral dissertation. Miami: Florida International University.

Itsukushima R, Adnan MS, Tomiyama Y, Kano Y, Otsu K, Zanorin MF. 2025. Impact of urbanization on stream fish fauna in tropical catchments of the Malay Peninsula. Ecological Indicators 178:113907.

NatureServe. 2024. *Mayaheros urophthalmus*. NatureServe Explorer: an online encyclopedia of life. Arlington, Virginia: NatureServe. Available: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.100022/Mayaheros_urophthalmus (February 2024).

Ordoñez JFF, Asis AMJM, Catacutan BJ, dela Pena J, Santos MD. 2015. First report on the occurrence of invasive Black-chin Tilapia *Sarotherodon melanotheron* (Ruppell, 1852) in Manila Bay and of Mayan Cichlid *Cichlasoma urophthalmus* (Gunther, 1892) in the Philippines. BioInvasions Records 4(2):115–124.

Poelen JH, Simons JD, Mungall CJ. 2014. Global Biotic Interactions: an open infrastructure to share and analyze species-interaction datasets. Ecological Informatics 24:148–159.

Porter-Whitaker AE, Rehage JS, Liston SE, Loftus WF. 2012. Multiple predator effects and native prey responses to two non-native Everglades cichlids. Ecology of Freshwater Fish 21:375–385.

Robertson R, Van Tassell J. 2024. Shorefishes of the Greater Caribbean: online information system. Balboa, Panama: Smithsonian Tropical Research Institute. Available: https://biogeodb.stri.si.edu/caribbean/en/thefishes/taxon/5852 (February 2024).

Robins RH. 2025. Mayan Cichlid. Florida Museum of Natural History. Available: https://www.floridamuseum.ufl.edu/discover-fish/species-profiles/mayan-cichlid/ (August 2025).

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

Schofield PJ, Nico LG, Fuller P, Neilson M, Loftus B. 2024, 2026. *Cichlasoma urophthalma* Günther, 1862. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=453 (February 2024, January 2026).

Siriwardena S. 2021. *Cichlasoma urophthalmum* (Mayan cichlid). In CABI Compendium. Wallingford, United Kingdom: CAB International. Available: https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.88479#:~:text=The%20 Mayan%20cichlid%20fish%2C%20Cichalsoma,also%20in%20Thailand%20and%20Sin gapore. (February 2024).

[USFWS] U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an "Ecological Risk Screening Summary." Version 3. Available: https://www.fws.gov/media/standard-operating-procedures-how-prepare-ecological-risk-screening-summary-2024 (December 2024).

World Organisation for Animal Health. 2024. Animal diseases. Paris: World Organisation for Animal Health. Available: https://www.woah.org/en/what-we-do/animal-health-and-welfare/animal-diseases/ (December 2024).

11 Literature Cited in Quoted Material

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.

Adams A, Wolfe K. 2007. Occurrence and persistence of non-native *Cichlasoma urophthalmus* (family Cichlidae) in estuarine habitats of south-west Florida (USA): environmental controls and movement patterns. Marine and Freshwater Research 58:921–930.

Bergmann GT, Motta PJ. 2005. Diet and morphology through ontogeny of the nonindigenous Mayan cichlid *Cichlasoma (Nandopsis) urophthalmus* (Gunther 1862) in southern Florida. Environmental Biology of Fishes 72(2):205–211.

Conkel D. 1993. Cichlids of North and Central America. Neptune City, New Jersey: Tropical Fish Hobbyist Publications.

Faunce C, Lorenz J. 2000. Reproductive biology of the introduced Mayan cichlid, *Cichlasoma urophthalmus*, within an estuarine mangrove habitat of southern Florida. Environmental Biology of Fishes 58(2):215–225.

Ferriter A, Doren B, Goodyear C, Thayer D, Burch J, Toth L, Bodle M, Lane J, Schmitz D, Pratt P, Snow S. 2006. The status of nonindigenous species in the South Florida environment.

Palm Beach: Florida Department of Environmental Protection, South Florida Water Management District.

Florida Museum of Natural History. 2005. Biological profiles: Mayan cichlid. Ichthyology at the Florida Museum of Natural History: Education-Biological Profiles. Available: http://www.flmnh.ufl.edu/fish/Gallery/Descript/MayanCichlid/MayanCichlid.html.

Froese R, Pauly D, editors. 2016. *Mayaheros urophthalmus* (Günther, 1862). FishBase. Available: https://www.fishbase.us/summary/SpeciesSummary.php?ID=4798&genusname=Mayaheros&speciesname=urophthalmus&AT=Mayaheros+urophthalmus&lang=English.

Greenfield M, Thomerson E. 1997. Fishes of the continental waters of Belize. Gainesville: University Press of Florida.

Loftus F. 1987. Possible establishment of the Mayan cichlid, *Cichlasoma urophthalmus* (Günther) (Pisces: Cichlidae) in Everglades National Park, Florida. Florida Scientist 50:1–6.

Lorenz J, McIvor C, Powell N, and Frederick C. 1997. A drop net and removable walkway used to quantitatively sample fishes over wetland surfaces in the dwarf mangroves of the southern Everglades. Wetlands 17:346–359.

Martínez-Palacios C. 1987. Aspects of the biology of *Cichlasoma urophthalmus* (Gunther) with particular reference to its culture. Doctoral thesis. Stirling, UK: University of Stirling.

Martinez-Palacios CA, Ross LG. 1986. The effects of temperature, body weight and hypoxia on the oxygen consumption of the Mexican mojarra, *Cichlasoma urophthalmus* (Günther). Aquaculture and Fisheries Management 17:243–248.

Martinez-Palacios CA, Ross LG. 1988. The feeding ecology of the Central American cichlid *Cichlasoma urophthalmus* (Günther). Journal of Fish Biology 33:665–670.

Martinez-Palacios C, Ross G. 1992. The reproductive biology and growth of the Central American cichlid *Cichlasoma urophthalmus* (Günther). Journal of Applied Ichthyology 8(1-4):99–109.

Miller RR, Minckley WL, Norris SM. 2005. Freshwater fishes of Mexico. Chicago: The University of Chicago Press.

Moravec et al. 1998. [Source material did not provide complete citation.]

Ng TH, Tan HH. 2010. The introduction, origin and life-history attributes of the non-native cichlid *Etroplus suratensis* in the coastal waters of Singapore. Journal of Fish Biology 76:2238–2260.

Nico G, Beamish H, Musikasinthorn P. 2007. Discovery of the invasive Mayan cichlid fish *"Cichlasoma" urophthalmus* (Günther 1862) in Thailand, with comments on other introductions and potential impacts. Aquatic Invasions 2(3):197–214.

O'Connor J, Rothermel B. 2013. Distribution and population characteristics of African jewelfish and brown hoplo in modified wetlands in South Florida. The American Midland Naturalist 170 :52–65.

Page LM, Espinosa-Pérez H, Findley LT, Gilbert CR, Lea RN, Mandrak NE, Mayden RL, Nelson JS. 2013. Common and scientific names of fishes from the United States, Canada, and Mexico. Seventh edition. Bethesda, Maryland: American Fisheries Society. Special Publication 34.

Rícan O, Piálek L, Dragová K, Novák J. 2016. Diversity and evolution of the Middle American cichlid fishes (Teleostei: Cichlidae) with revised classification. Vertebrate Zoology 66:1–102.

Robins RH. 2016. Mayan cichlid. Florida Museum of Natural History. Available: https://www.floridamuseum.ufl.edu/discover-fish/species-profiles/mayan-cichlid/.

Ross G, Martínez-Palacios C. 1991. The biology and culture of *Cichlasoma urophthalmus*. Technical Manual. Mexico City: CINVESTAV/ODA.

Salgado-Maldonado G. 2006. Checklist of helminth parasites of freshwater fishes from Mexico. Zootaxa 1324:1–357.

Schofield P, Loftus W, Fontaine A. 2009. Salinity effects on behavioural response to hypoxia in the non-native Mayan cichlid *Cichlasoma urophthalmus* from Florida Everglades wetlands. Journal of Fish Biology 74:1245–1258.

Schofield P, Nico L, Fuller P, Neilson M, Loftus B. 2016. *Cichlasoma urophthalmus*. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=453.

Shafland L, Gestring B, Stanford S. 2008. Florida's exotic freshwater fishes - 2007. Florida Scientist 71(3):220–245.

Trexler C, Loftus F, Jordan F, Lorenz J, Chick H, Kobza M. 2000. Empirical assessment of fish introductions in a subtropical wetland: an evaluation of contrasting views. Biological Invasions 2:265–277.

Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2023).
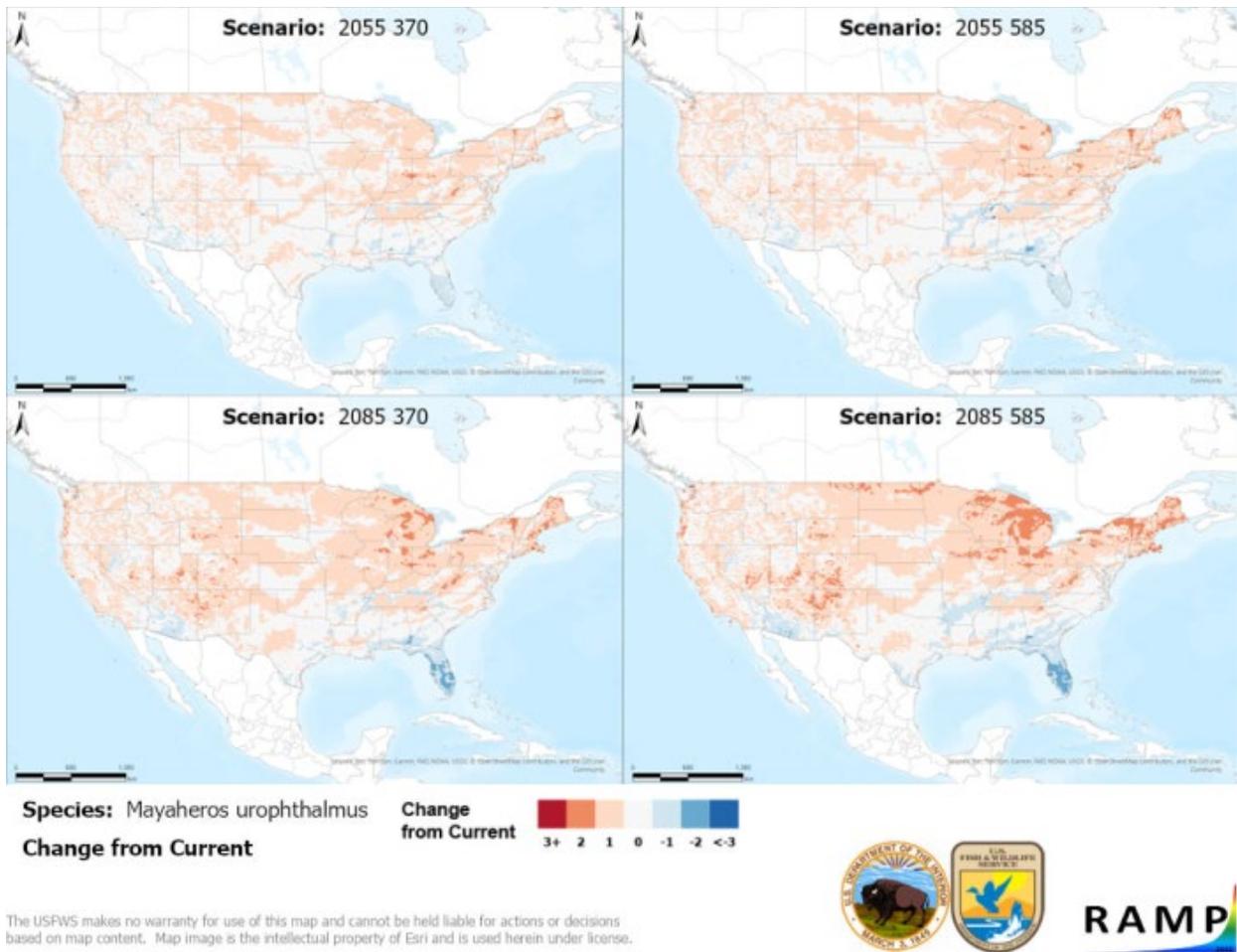
Under the future climate scenarios (figure A1), on average, high climate match for *Mayaheros urophthalmus* was projected to occur in Southern Florida within the contiguous United States. Areas of low climate match were projected to occur in the Colorado Plateau, Great Basin, Great Lakes, Northeast, Northern Pacific Coast, Northern Plains, and Western Mountains regions. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.030 (model: IPSL-CM6A-LR, SSP5, 2085) to a high of 0.060 (model: MRI-ESM2-0, SSP3, 2055). All future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future scenarios. The Climate 6 score for the current climate match (0.044, figure 4) falls within the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085, the most extreme climate change scenario. Under one or more time step and climate scenarios, areas within the Appalachian Range, Colorado Plateau, Great Basin, Great Lakes, Northeast, Northern Pacific Coast, and Northern Plains saw a moderate increase in the climate match relative to current conditions. No large increases were observed regardless of time step and climate scenarios. Under one or more time step and climate scenarios, areas within the Gulf Coast, Southern Atlantic Coast, and Southern Florida saw a moderate decrease in the climate match relative to current conditions. No large decreases were observed regardless of time step and climate scenarios. The magnitude of change from current conditions was more pronounced in time step 2085 than in time step 2055 under both scenarios, SSP3 and SSP5. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).
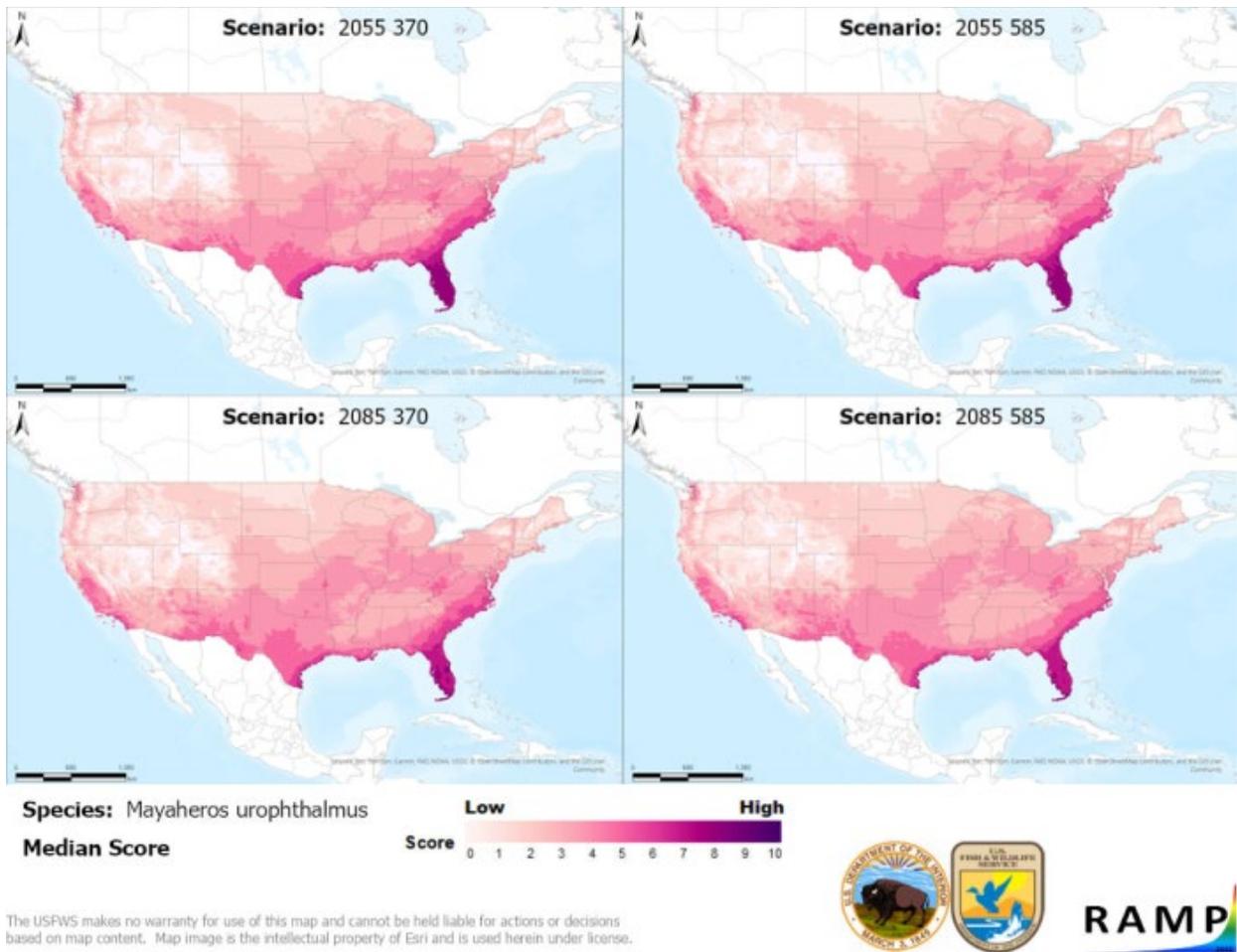
Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Mayaheros urophthalmus* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.
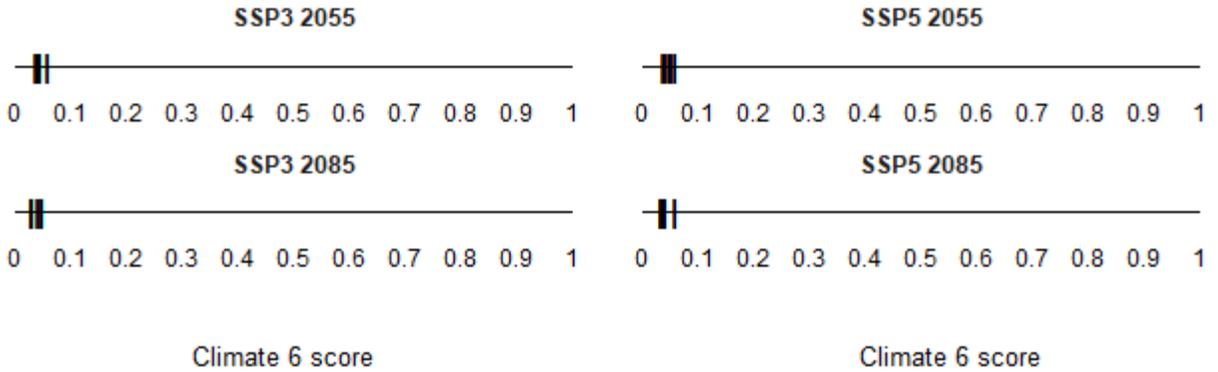
Figure A2. Comparison of projected future Climate 6 scores for *Mayaheros urophthalmus* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Mayaheros urophthalmus* based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

Literature Cited

GBIF Secretariat. 2023. GBIF backbone taxonomy: *Mayaheros urophthalmus* (Günther, 1862). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/9539561 (August 2025).

[IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M. 2018. Data from: Climatologies at high resolution for the earth's land surface areas. EnviDat. Available: https://doi.org/10.16904/envidat.228.v2.1.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.