Sailfin Molly (*Poecilia latipinna*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2024
Revised, July 2024
Web Version, 8/6/2024

Organism Type: Fish
Overall Risk Assessment Category: High

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1 Native Range and Status in the United States

Native Range

From Nico et al. (2024):

"Atlantic and Gulf Coast drainages from Cape Fear drainage, North Carolina, to Veracruz, Mexico. Restricted to coastal areas in most of range; found farther inland in Florida, Louisiana, and Texas (Page and Burr 1991)."

From Fofonoff et al. (2018):

"Sailfin Mollies (*Poecilia latipinna*) are native in freshwater, brackish and marine habitats from the Cape Fear River, North Carolina, to Veracruz, Mexico. They breed in marine and freshwater environments, but rarely occur more than 200 km from marine waters in their native range (Page and Burr 1991)."

Status in the United States

From Fofonoff et al. (2018):

"Sailfin Mollies (*Poecilia latipinna*) are native in freshwater, brackish and marine habitats from the Cape Fear River, North Carolina, to Veracruz, Mexico."

"Invasion History on the West Coast:
Sailfin Mollies (*Poecilia latipinna*) were found in 1977 in an un-named slough in Oxnard, California, near Port Hueneme (Swift et al. 1993). They were also found in Ballona Marsh, in Santa Monica, CA (1990, Swift et al. 1993; Torchin 2010); and in Sweetwater Marsh National Wildlife Refuge, on San Diego Bay in 1989 (San Diego Bay) (1989, Williams et al. 1998). These populations are considered established (Torchin 2010; Williams et al. 1998; [Nico et al. 2018])."

"Invasion History in Hawaii:
Sailfin Mollies (*Poecilia latipinna*) were first introduced into Moanalua Stream, in Oahu in 1985 for mosquito control. […] Sailfin Mollies are now established in brackish lagoons in Oahu, Hawaii, Maui, Kaui [sic], and Molokai (Brock 1960; Randall 1987; Carlton and Eldredge 2009). It is abundant in Pearl Harbor (Coles et al. 1999). […] They were also introduced as baitfish for a Skipjack Tuna (*Katsuwonus pelamis*) fishery, but this transplant to Kauai was unsuccessful (Randall 1987)."

"Sailfin Mollies (*Poecilia latipinna*) have been introduced to many locations in the interior of North America, including hot springs in […] Montana, and desert springs, streams, and reservoirs in California, Nevada, Utah, Colorado, and New Mexico, and inland rivers in Texas (Lever 1996; Dill and Cordone 1997; Moyle [1976]; USGS Nonindigenous Aquatic Species Program)."

"In the Caribbean, Sailfin Mollies have been reported from Puerto Rico. One record (of 4) was near the mouth of the Canovanillas River, on the north shore of the island (2007, [Nico et al. 2018])."

"On smaller Pacific islands they are established in Guam, […] and the Northern Mariana Islands (Maciolek 1984; Lever 1996; Koutsikos et al. 2018)."

From Nico et al. (2024):

"Established or locally established in Arizona (Minckley 1973), California (Swift et al. 1993), Colorado (Zuckerman and Behnke 1986), Montana (Holton [and Johnson 1996]), Nevada

(Deacon and Williams 1984), and Texas (Hubbs et al. 1991). Although established on most islands of Hawaii at one time (Devick [1991]), recent reports indicated the species may be disappearing in some localities (Yamamoto and Tagawa 2000; Mundy 2005)."

Poecilia latipinna is readily available in trade in the United States. Various *Poecilia* species, (*Poecilia latipinna* and likely hybrids of *Poecilia latipinna*) can be found online for purchase (e.g., Wild Fish Tank 2024; Dan's Fish 2024; Wet Spot 2024).

Regulations

Peocilia latipinna is a Conditionally Approved animal in Hawaii (HDOA 2019).

While effort was made to find all applicable regulations, this list may not be comprehensive.

Means of Introductions within the United States

From Nico et al. (2024):

"In most areas this species probably was introduced by way of aquarium releases. It was first brought to Hawaii from Texas in 1905 to test its effectiveness in controlling mosquitoes (Seale 1905; Van Dine 1907; Brock 1960). A failure in Hawaii at mosquito control, this fish has on occasion been used as a tuna baitfish in that state (Randall 1987)."

From Nico et al. (2024):

"[…] U.S. commercial breeders have released various domestically bred forms, including *P. latipinna* hybrids, into natural waters."

Remarks

From Nico et al. (2024):

"Records of this species in a few areas apparently are based on reports of the black molly, a hybrid, and not pure *P. latipinna* (Courtenay and Meffe 1989). Wischnath (1993) stated that U.S. commercial breeders have released various domestically bred forms, including *P. latipinna* hybrids, into natural waters. Contrary to Brown (1953) and Hubbs et al. (1991), Lee et al. (1980 et seq.) argued that *P. latipinna* found in inland waters of Texas were native. Improperly citing Van Dine (1907), Kanayama (1968) incorrectly used the name *Mollienesia latipes* for the species introduced to Hawaii."

From Maddern (2014):

"[…] *Poecilia* species readily interbreed and many ornamental varieties are hybrids of different species. For example, hybrids of *P. latipinna* X *P. velifera* are commonly available in the ornamental trade ([Nico et al. 2014]). Therefore, it is possible that nonindigenous populations originating from ornamental stock may be hybrids. Thus, the identification of different fishes and populations of molly species may not be definitive, even within the groups native range of North and Central America."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2024):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Cyprinodontiformes
Suborder Cyprinodontoidei
Family Poeciliidae
Subfamily Poeciliinae
Genus *Poecilia*
Species *Poecilia latipinna* (Lesueur, 1821)

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

Size, Weight, and Age Range

From Maddern (2014):

"The lifespan of *P. latipinna* is short, particularly in the case of the males, which may live less than one year once sexually mature (Robins, 2014). *P. latipinna* may mature and reproduce within one year under favourable environmental conditions. At one year of age males typically range in size from 15-51 mm in length (Robins, 2014), though mean male size is highly variable between *P. latipinna* populations (Trexler, 1989)."

From Abu El-Regal and Al-Solami (2020):

"The sailfin molly is a small species, seldom exceeding 12.5 cm in length (Robins and Ray 1986); however it can attain lengths of 15 cm (Rohde et al. 1994)."

From Froese and Pauly (2024):

"Maturity: L_m 6.7, range 5 - 9.5 cm
Max length : 15.0 cm TL [total length] male/unsexed; [Page and Burr 1991]; 10.0 cm TL (female); common length : 3.4 cm TL male/unsexed; [Hugg 1996]"

Environment

From Fofonoff et al. (2018):

"Sailfin Mollies (*Poecilia latipinna*) are native in freshwater, brackish and marine habitats [...]. They breed in marine and freshwater environments, but rarely occur more than 200 km from marine waters in their native range (Page and Burr 1991)."

"Sailfin Mollies inhabit a wide range of environments from freshwater to hypersaline waters including, caves, canals, ditches, springs, lagoons, mangroves, marshes and swamps (Page and Burr 1991; Rohde et al. 1994; Nordlie 2006; Froese and Pauly 2018). Their native and introduced ranges are limited by low winter temperatures (~7.7 C), and a high temperature requirement for reproduction (22 C) (Froese and Pauly 2018; Koutsikos et al. 2018). Their preferred temperature range is 20-30 C, but they can tolerate extremes up to 41 C (Nordlie 2006; Bierbach et al. 2010). At the same time, this fish has a very wide salinity range, from freshwater to hypersaline conditions, 0-80 PSU (Simmons 1957; Nordlie 2006). Sailfin mollies prefer still or slow-flowing water that is densely vegetated."

From Maddern (2014):

"Fischer and Schlupp (2009) tested the upper and lower critical thermal tolerance limits of *P. latipinna* in the laboratory and recorded minima and maxima of approximately 6°C and 40°C, respectively."

"*P. latipinna* is euryhaline and occurs in salinities from freshwater to hypersaline conditions (i.e. 95 ppt) (Gonzalez et al., 2005; [Kumaraguru vasagam] et al., 2005; Robbins, 2005; [Bachman] and Rand, 2008; Hussain et al., 2009; Robins, 2014)."

"*P. latipinna* is tolerant of low oxygen levels and is able to utilize the oxygen rich layer directly under the water surface with their superior (i.e. upturned) mouth ([Nico et al. 2014]; Robins, 2014). The species may become acclimated to hypoxic conditions, with dissolved oxygen concentrations as low as 1 mg per liter (Timmerman and Chapman, 2004)."

Climate

From Froese and Pauly (2024):

"Subtropical; […] 40°N - 16°N, 103°W - 76°W [Florida Museum of Natural History 2005]"

From Maddern (2014):

"[…] *P. latipinna* naturally occurs over a wide subtropical and temperate latitudinal range […]."

Distribution Outside the United States

Native

Part of the native range of *Poecilia latipinna* occurs within the United States, see section 1 for a full description.

From Nico et al. (2024):

“Atlantic and Gulf Coast drainages from Cape Fear drainage, North Carolina, to Veracruz, Mexico.”

Introduced

From Fofonoff et al. (2018):

“The Sailfin Molly is also established in salt lakes on the Bahamas (1972, Barton 1995).Other Caribbean records are in the Dominican Republic and Venezuela (Koutsikows et al. 2018). In South America, Koutsikos et al. (2018) indicate records from the Pacific coast of Colombia and Brazil. There are multiple records from the Middle East, including coastal parts of the Persian Gulf, and the Shaat-Al-Arab estuary [Iraq] (2014, Esmaeilei et al. 2017; Koutsikos et al. 2018). Records in Asia include India, Thailand, Singapore, and China (Lever 1996; Kunlapapuk et al. 2015; Koutsikos et al. 2018). In the Philippines, it inhabits brackish ponds, where it was introduced for mosquito control (Lever 1996).”

“Sailfin Mollies were introduced to Australia around 1968 to creeks in Hervey Bay and in Sandgate Lagoon, Queensland, Australia, in 1969 as aquarium releases. Early reports refer to 'Black Mollies', so some of these fish may have been a cultivated color strain (Lever 1996). In Australia, Sailfin Mollies are legally treated as a pest species, and can be kept in aquaria, but cannot be used as bait or returned to the wild (Museums Victoria 2018). In New Zealand, it is found in geothermally heated Lake Taupo, where it was first released in 1967, but is unlikely to spread into colder waters (Lever 1967). On smaller Pacific islands they are established in […], Fiji, […] (Maciolek 1984; Lever 1996; Koutsikos et al. 2018).”

“In 2010, a population of Sailfin Mollies was discovered in a brackish, geothermally heated lagoon, Lake Vouliagmeni, near Athens, Greece. Many of the fish had black pigmentation, indicating a recent aquarium introduction, while others had a 'wild-type' coloration. This is the first established population of the Sailfin Molly in Europe (Koutsikos et al. 2017).”

From Thorburn et al. (2018):

“During the current study, the alien *Poecilia latipinna* (Sailfin Molly) was captured from the Fortescue River. This represents the first record of an introduced fish species from a river in the Pilbara region, and at the time of writing was the most northern catchment from which an alien fish species had been recorded in Western Australia (Morgan et al. 2014a, 2014b).”

From Maddern (2014):

“*P. latipinna* has been introduced to a number of countries in the Middle East. The species appears to be established in the Al-Hammar Marsh in Iraq though was only collected in one of twelve sampling events (Hussain et al., 2009). In Oman, the species is present in the estuaries in the Gulf of Oman though no further information is available (Randall, 1995; Froese and Pauly,

2014). *P. latipinna* is established in the Wadi Haneefah stream, Riyadh, Saudi Arabia since 2003 ([Alkahem] et al., 2007)."

"Introduced to north Java [Indonesia] through the pet/aquarium trade"

"Found in the lower reaches and river mouths over the southwestern part of Taiwan; First reported: pre 2009"

"Confined to hot springs in Banff National Park, Alberta [Canada]."

"Found in Darwin [Australia]"

"Santo Antônio creek, Vieiras municipality [Minas Gerais, Brazil]."

"Established in the Magdalena watershed [Colombia]."

From Abu El-Regal and Al-Solami (2020):

"The report of the sailfin molly from Lake Manzala [Egypt] is the first in the southern Mediterranean Sea and possibly in Africa. This extends the known introduction range of sailfin molly to a new geographic and climatic area. The reproduction of the species may indicate the establishment of the species as a new population."

Means of Introduction Outside the United States

From Fofonoff et al. (2018):

"In 2010, a population of Sailfin Mollies was discovered in a brackish, geothermally heated lagoon, Lake Vouliagmeni, near Athens, Greece. Many of the fish had black pigmentation, indicating a recent aquarium introduction, while others had a 'wild-type' coloration."

From Abu El-Regal and Al-Solami (2020):

"[*Poecilia latipinna*] has been introduced to many countries worldwide as biological control agent and through releases from aquarium hobbyists."

From Maddern (2014):

"The natural dispersal of populations of *P. latipinna* may be less constrained due to the species tolerance of high ranges of temperature, salinity and oxygen levels ([Nico et al. 2014])."

"In Australia, Corfield et al. (2008) listed the relative importance of *P. latipinna* as a commercial aquarium fish species in Australia as of high importance as an ornamental fish, with the volume of fish sold ranked as high (between 500,000 and 1,000,000 fish annually in Australia). […] Magalhães and Jacobi (2008) suggested that commercially important ornamental species, including *P. latipinna*, may be accidentally released from outdoor aquaculture ponds during drainage and/or flood events in the state of Minas Gerais, Brazil."

Short Description

From Robins (2024):

"Distinctive Features
The body of the sailfin molly is essentially oblong. The head is small and dorsally flattened, with a small, upturned mouth. The caudal peduncle is broad and the caudal fin is large, rounded, and sometimes tipped with black. The pelvic fins originate at a point anterior to the dorsal fin. The dorsal fin is greatly enlarged in mature males and somewhat enlarged in females. It is this conspicuous and attractive feature that lends the species its prevailing common name."

"Coloration
The body is generally light gray, although breeding males may be greenish-blue. Several rows of spots occur along the sides, back, and dorsal fin. Often times these spots blend together or are very close to one another, creating an appearance of stripes. Aquarists have developed many color variations in this species, and indeed much variation occurs naturally in the wild, with melanistic and speckled forms known."

From Abu El-Regal and Al-Solami (2020):

"The anal fin is modified into gonopodium, which is used as copulatory organ. Males are characterized by the presence of a large sail-like dorsal fin and distinctive coloration."

From Maddern (2014):

"The origin of the dorsal fin is positioned over or in advance of pelvic fin insertion. The dorsal fin has 12 or 13 to 16 rays. There are 16 scales around caudal peduncle and 23-28 lateral scales."

Biology

From Maddern (2014):

"*P. latipinna* has successfully colonized aquatic and estuarine habitats because of wide environmental tolerances, the ability to colonize anthropogenically disturbed habitats, trophic opportunism, fast growth rates and the ability to give birth to live offspring. Of particular note is that *P. latipinna* naturally occurs over a wide subtropical and temperate latitudinal range and therefore may be more cold tolerant than other invasive tropical ornamental fishes. Furthermore, *P. latipinna* is euryhaline and tolerant of freshwater to salinities much higher than seawater."

"*P. latipinna* may mature and reproduce within one year under favourable environmental conditions."

"The large dorsal fin of male fish plays a role in female mate choice (Robins, 2014). There is rudimentary courtship behaviour where the male displays swimming motions and fin postures (Farr, 1989). Fertilisation is internal and the male's gonopodium, a modified anal fin, transfers sperm into the female. Females may store sperm and produce subsequent broods independently of male fish (Farr and Travis, 1986). A study by Girndt et al. (2012) found that more than 70% of

broods were sired by at least two males. Males spend significantly less time with females under conditions of high turbidity (Heubel and Schlupp, 2006)."

"*P. latipinna* produces broods of 10 to between 100-300 young; though a more conservative maxima may be between 100-140 young (Wischnath, 1993; Yamamoto and Tagawa, 2000; Froese and Pauly, 2014; Robins, 2014). Brood size is correlated with female standard length, with larger fish producing larger broods (Girndt et al., 2012)."

"The gestation period is approximately three to four weeks and females may give birth on multiple occasions throughout the year, approximately eight to 10 weeks apart, depending upon environmental conditions (Wischnath, 1993; Yamamoto and Tagawa, 2000; Robins, 2014)."

"[…] gestation period is influenced by environmental factors, including temperature (Robins, 2014), ration level (Snelson et al., [1985]) and salinity (Trexler, 1989; [Kumaraguru vasagam] et al., 2005). Longer gestation periods are also correlated with larger broods (Travis, 1989)."

"*P. latipinna* is principally herbivorous, consuming plant and algal matter and also periphyton (including the common components of periphyton such as diatoms) and detritus (Harrington and Harrington, 1961; Harrington and Harrington, 1982; [Alkahem] et al., 2007; Scharnweber et al., 2011; [Alberici da Barbiano] et al., 2014; Jaffe, 2014; Robins, 2014). It will also consume aquatic invertebrates including mosquito larvae/pupae (Robins, 2014)."

From Abu El-Regal and Al-Solami (2020):

"Despite the ability of the species to spawn in all salinity gradients, production and growth of fry vary significantly among different salinity levels with the maximum fry production in 25 and growth in 10 PSU ([Kumaraguru vasagam] et al. 2005)."

Human Uses

From Maddern (2014):

"*P. latipinna* has been selectively bred into many different colour morphs for the ornamental aquarium trade."

"*P. latipinna* is a very popular ornamental fish worldwide (Rixon et al., 2005; Corfield et al., 2008; Magalhães and Jacobi, 2008; 2010; 2013)."

"In Australia, Corfield et al. (2008) listed the relative importance of *P. latipinna* as a commercial aquarium fish species in Australia as of high importance as an ornamental fish, with the volume of fish sold ranked as high (between 500,000 and 1,000,000 fish annually in Australia)."

"Al-Akel et al. (2010) stated that *P. latipinna* is harvested for human consumption, however no further details are given. *P. latipinna* is also utilized as a biological research model in many disciplines including genetics, ecology and biochemistry (Yang et al., 2009)."

"The species was translocated and released as a mosquito biocontrol agent in Hawaii and Philippines at the beginning of the twentieth century though it was considered to be inefficacious (Maciolek, 1984; Juliano et al., 1989). Even while this endeavour was unsuccessful, some individuals may still positively associate the species with mosquito control."

From Fofonoff et al. (2018):

"They have also been released for insect biocontrol and raised as a baitfish for tuna (Randall 1987; Swift et al. 1993; Lever 1996; Koutsikos et al. 2018)"

Diseases

No information was found associating *P. latipinna* with any diseases listed by the World Organisation for Animal Health (2024).

According to Poelen et al. (2014), *P. latipinna* acts as a host of *Apiosoma amoeba*, *Ascocotyle leighi*, *Ascocotyle mcintoshi*, *Capillaria cyprinodonticola*, *Centrocestus formosanus*, *Eustrongylides ignotus*, *Ichtyophthirius multifiliis*, infectious spleen and kidney necrosis virus, *Procamallanus cricotus*, *Procerovum calderoni*, *Procerovum varium*, *Saccocoelioides sogandaresi*, *Transversotrema patialense*, *Trichodina* spp., and *Trichodina domerguei*.

Threat to Humans

From Froese and Pauly (2024):

"Potential pest"

3 Impacts of Introductions

From Schoenherr (1988):

"At the Salton Sea, pupfish [*Cyprinodon macularius*] were common in shoreline pools […] until they were replaced by sailfin mollies, *Poecilia latipinna*, which were introduced about 1964. In 1979 these euryhaline fishes were the most common fish. They represented 98% of those trapped along the shoreline, and 70% of those trapped in the drains (Black 1980). At that time, desert pupfish represented less than 5% of the fish sampled. Under pressure of interaction with sailfin mollies, pupfish apparently moved farther up the drains."

"Of primary concern, however, are *Poecilia latipinna* and *Tilapia zilli*. They have replaced pupfish in all habitats. The mechanism of this replacement is not thoroughly understood, but replacement by behavioral interaction appears to be important."

"Margaret Matsui (pers. comm.) described behavioral interactions by sailfin mollies and Zill's cichlid that interfere with reproduction of desert pupfish. Males of *Poecilia latipinna* court both male and female pupfish. In so doing, they directly interfere with courtship and reproduction."

From Fofonoff et al. (2018):

“Sailfin Mollies have a wide range of tolerances, and can colonize a wide range of habitats, including those inhabited by more specialized and localized species. They can be aggressive towards other species, such has California Killifish (*Fundulus parvipinnis*), Bahamas Pupfish (*Cyprinodon laciniatus*), and the Desert Pupfish *Cyprinodon macualrius* (Barton 1995; Dill and Cordone 1997; Williams et al. 1998). But young Sailfish Mollies also provide an extra food source tor the native fishes, such as California Killifish, which grew faster in the presence of Sailfin Mollies (Torchin 2010).”

“Male Sailfin Mollies in aquaria showed aggressive courtship behavior toward California Killifish (*Fundulus parvipinnis*) (Williams et al. 1998). They are also believed to be competing with the globally threatened Bahamas Pupfish (*Cyprinodon laciniatus*) in the Bahama [sic] (Barton [1995]) […]. Competitive effects with California Killifish were not seen in Ballona Marsh, California (Torchin 2010).”

From Nico et al (2024):

“Sailfin mollies, and other introduced poeciliids, have been implicated in the decline of native damselflies on Oahu, Hawaii. Often the distributions of the damselflies and introduced fishes were found to be mutually exclusive, probably resulting from predation of the fish on the insects (Englund 1999).”

From Abu El-Regal and Al-Solami (2020):

“Sailfin molly is presumed to be responsible for the decline of some fish species in the regions of introduction (Sigler and Sigler 1987; Englund 1999). Juliano et al. (1989) stated that this species competes with the native milkfish, *Chanos chanos* (Forsskål, 1775) for food in the Philippines. It was also responsible for the decline of the native damselfish, *Megalagerion* sp. on Oahu, Hawaii (Englund (1999) and the desert pupfish *Cyprinodon macularius* Baird & Girard, 1853 in California (Robins 2014).”

4 History of Invasiveness

The History of Invasiveness for *P. latipinna* is classified as High. There is adequate evidence from reliable sources that the species has established itself outside of its native range from nonnative introductions. There have also been demonstrated negative impacts to native fish species and invertebrate populations in areas of introduction.

5 Global Distribution

Figure 1. Reported global distribution of *P. latipinna*. Map from GBIF Secretariat (2023). Observations are reported from the United States, Mexico, Japan, Canda, Iraq, New Zealand, Australia, Thailand, Indonesia, Panama, Peru, the Philippines, the Bahamas, Guam, Jamaica, Puerto Rico, Singapore, Samoa, Belize, Cuba, Greece, Guatemala, and Venezuela. Observations in Japan, Panama, Peru, Jamaica, Samoa, Belize, Cuba, and Guatemala may not represent established populations and were not included in the climate matching analysis.

Georeferenced observations from the established range of *P. latipinna* in the Dominican Republic, Venezuela, Brazil, Colombia, India, and China could not be found.

Additional locations used to select source points for the climate matching analysis were found in Maddern (2014; northern Australia), Fofonoff et al. (2018; Fiji), and Abu El-Regal and Al-Solami (2020; Egypt).

6 Distribution Within the United States

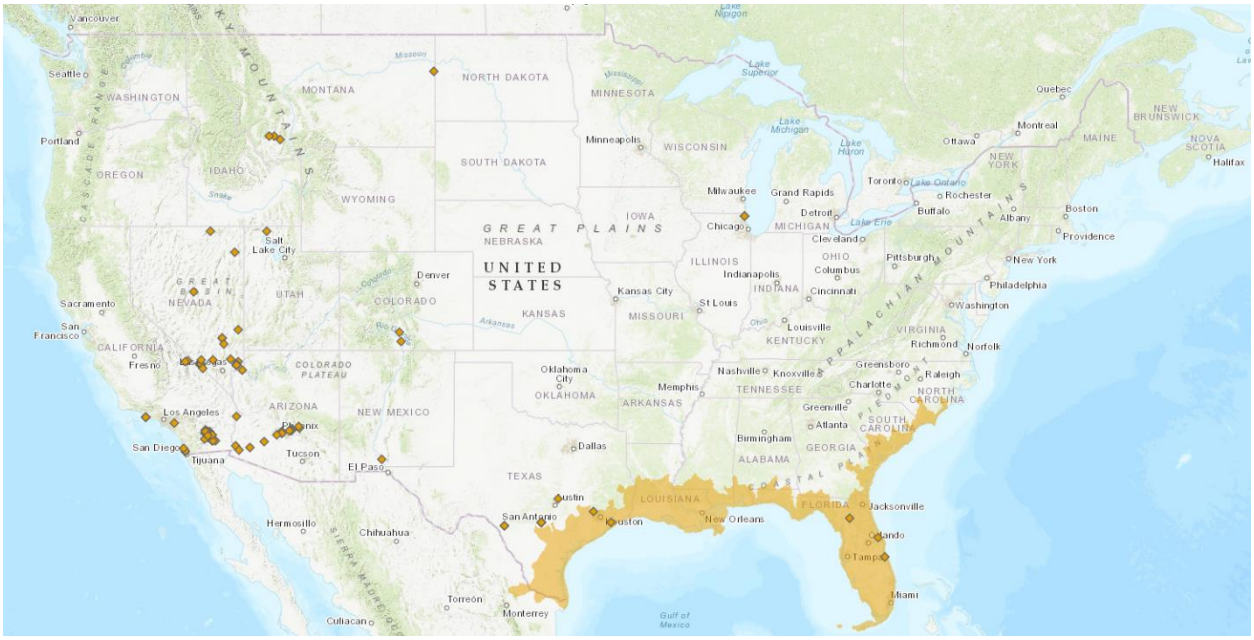

Figure 2. Reported distribution of *P. latipinna* in the United States. Map from Nico et al. (2024). Orange diamonds represent individual observations outside the native range. Orange shading represents the native range of *P. latipinna*. The observation in Illinois may not represent an established population and was not used to select source points for the climate matching analysis. The locations in Montana either represent records from a geothermal water source or may not represent an established population and were not used to select source points for the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The Southern Plains, Colorado Plateau, Southwest, Great Basin, and Southeast regions of the United States had a high climate match for *Poecilia latipinna*. These areas of high match included but also extended beyond the species' native range. The western and northern Great Plains, the Great Lakes, Northeast, and Mid-Atlantic regions had a medium climate match. The central and northern Pacific Coast and the Cascade-Sierra Ranges had a low climate match. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.930, indicating that Yes, there is establishment concern for this species outside its native range. 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). This species has a history of establishment in geothermally heated waters which may occur outside the areas of high or medium match indicated by the climate matching analysis.

Projected climate matches in the contiguous United States under future climate scenarios are available for *P. latipinna* (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.

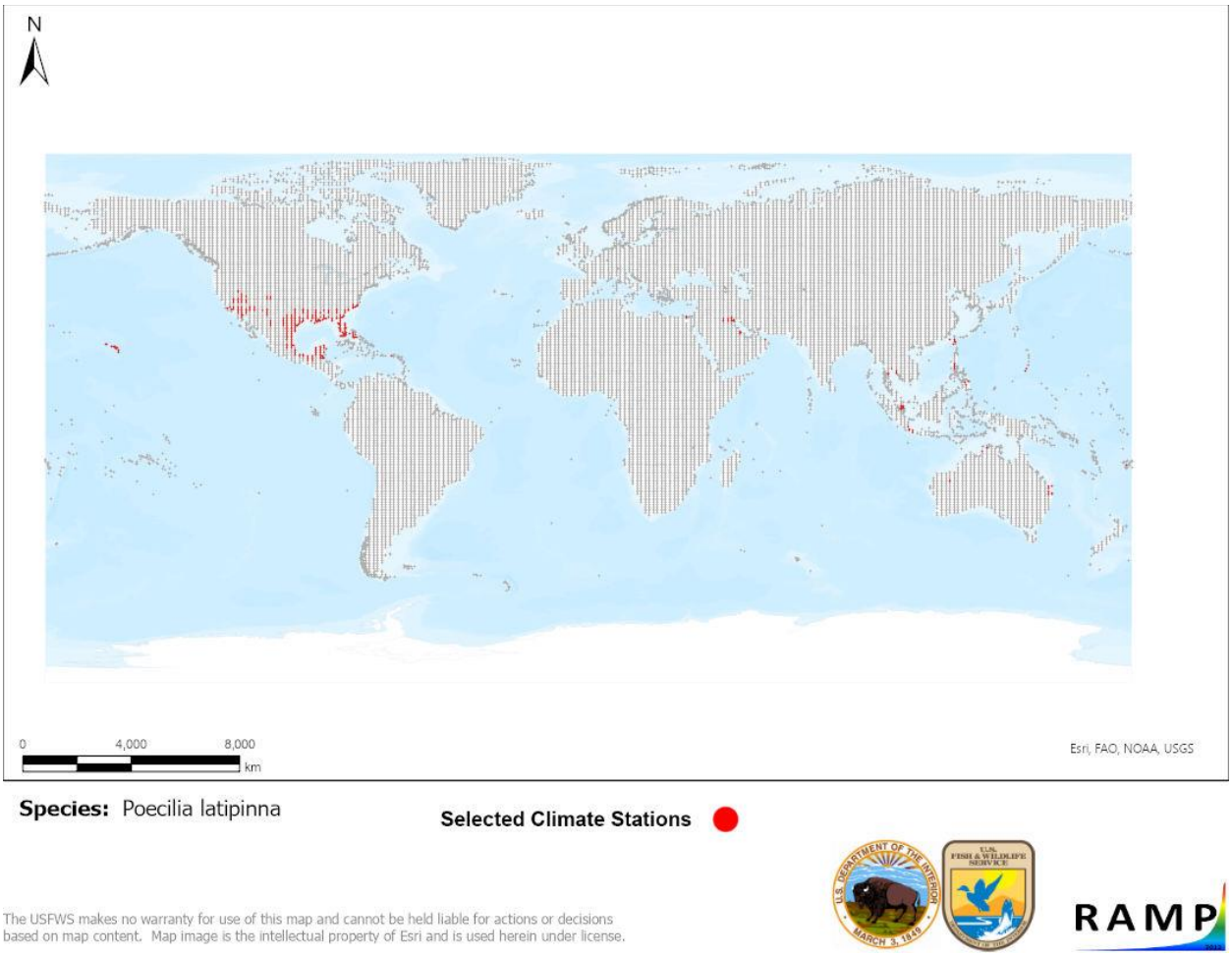

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations across the globe selected as source locations (red; United States, Mexico, Egypt, Saudi Arabia, Oman, Iraq, Australia, Guam, Fiji, Indonesia, and the Philippines) and non-source locations (gray) for *P. latipinna* climate matching. Source locations from Maddern (2014), Fofonoff et al. (2018), Abu El-Regal and Al-Solami (2020), and GBIF Secretariat (2023). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

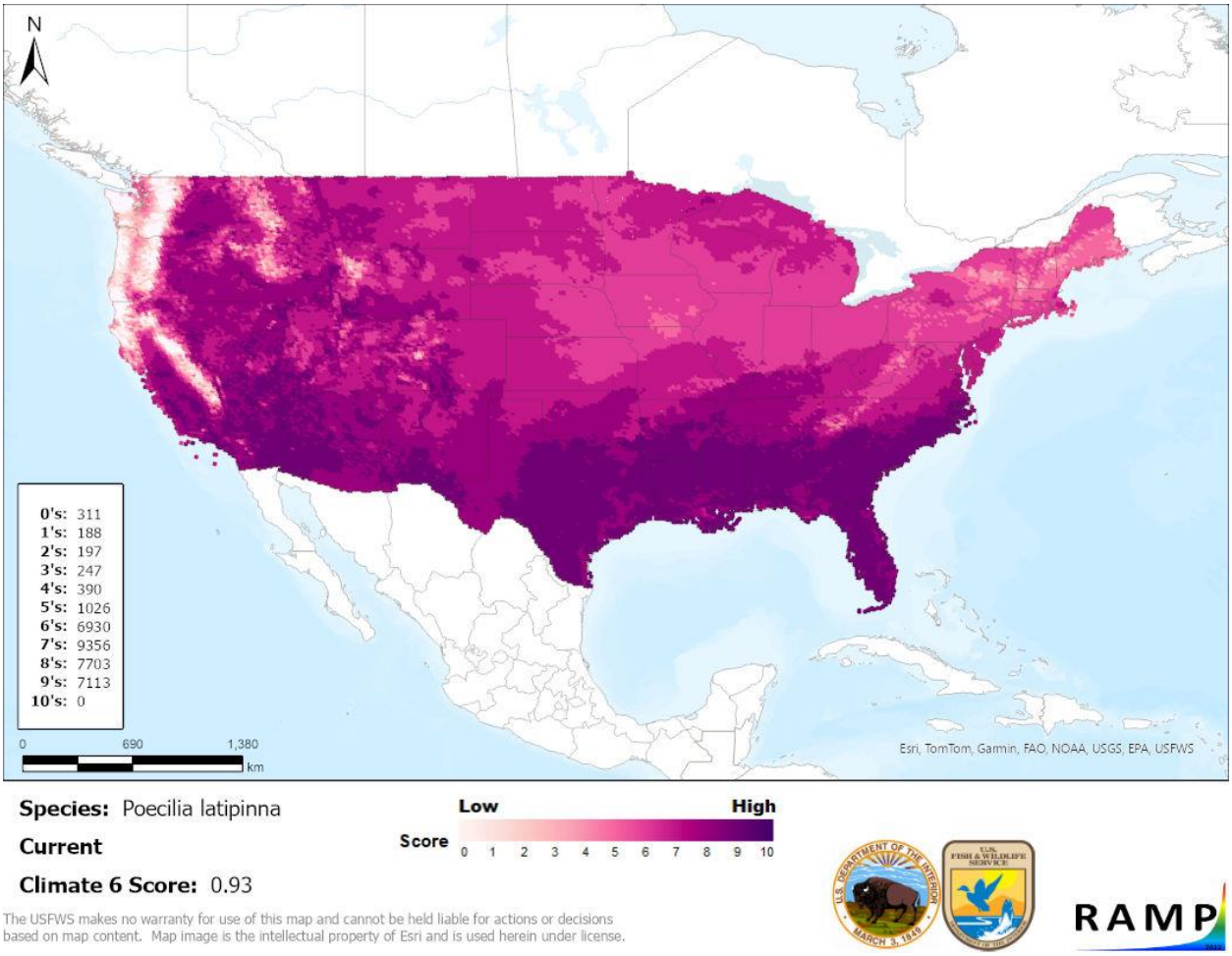

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *P. latipinna* in the contiguous United States based on source locations reported by Maddern (2014), Fofonoff et al. (2018), Abu El-Regal and Al-Solami (2020), and GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *P. latipinna* is classified as High. There were adequate peer reviewed sources that provided information on the biology, ecology, distribution, and history of invasiveness of *P. latipinna*. Negative impacts of *P. latipinna* introductions have been described by multiple sources.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Poecilia latipinna, Sailfin Molly, is a fish native to the southeastern United States and Mexico. *P. latipinna* has a wide range of environmental tolerances and can thrive in habitats with large ranges of temperature, salinity, and oxygen levels. This species is a popular ornamental aquarium fish, has been previously thought to act as mosquito control, and has been used as a bait fish. These pathways have led to global introductions and establishment of nonnative populations.

P. latipinna exhibits fast growth rates and gives birth to live offspring, allowing for quick colonization. The History of Invasiveness for *Poecilia latipinna* is classified as High due to multiple records of establishment from nonnative introductions that caused negative impacts, including competition with the globally threatened Bahamas Pupfish (*Cyprinodon laciniatus*) and the endangered Desert Pupfish (*Cyprinodon macularius*). The climate matching analysis for the contiguous United States indicates establishment concern outside its native range. Except for the northern and central Pacific Coast and the Sierra Nevada and Cascade Mountains, medium to high climate matches occurred throughout the contiguous United States. The Certainty of Assessment for this ERSS is classified as High due to the quantity and quality of information available regarding the biology, ecology, distribution, and impacts of the species. The Overall Risk Assessment Category for *Poecilia latipinna* 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: *P. latipinna* and other molly species regularly hybridize.**
- **Overall Risk Assessment Category: High**

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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 Maddern (2014), Fofonoff et al. (2018), Abu El-Regal and Al-Solami (2020), and GBIF Secretariat (2023).

Under the future climate scenarios (figure A1), on average, high climate match for *Poecilia latipinna* was projected to occur in the Appalachian Range, California, Colorado Plateau, Great Basin, Gulf Coast, Mid-Atlantic, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, and Southwest regions of the contiguous United States. An area of low climate match was projected to occur in the Northern Pacific Coast region. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.822 (model: MPI-ESM1-2-HR, SSP5, 2085) to a high of 0.949 (model: GFDL-ESM4, SSP5, 2085). 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 (0.930, 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 Northeast saw a large increase in the climate match relative to current conditions. Additionally, areas within the Appalachian Range, Great Lakes, Mid-Atlantic, and Southeast saw a moderate increase in the climate match relative to current conditions. Under one or more time step and climate scenarios, areas within California, the Colorado Plateau, Great Basin, Gulf Coast, Northern Plains, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. No large decreases were observed regardless of time step and climate scenarios. Very small areas of large or moderate change may be visible on the maps (figure A3).

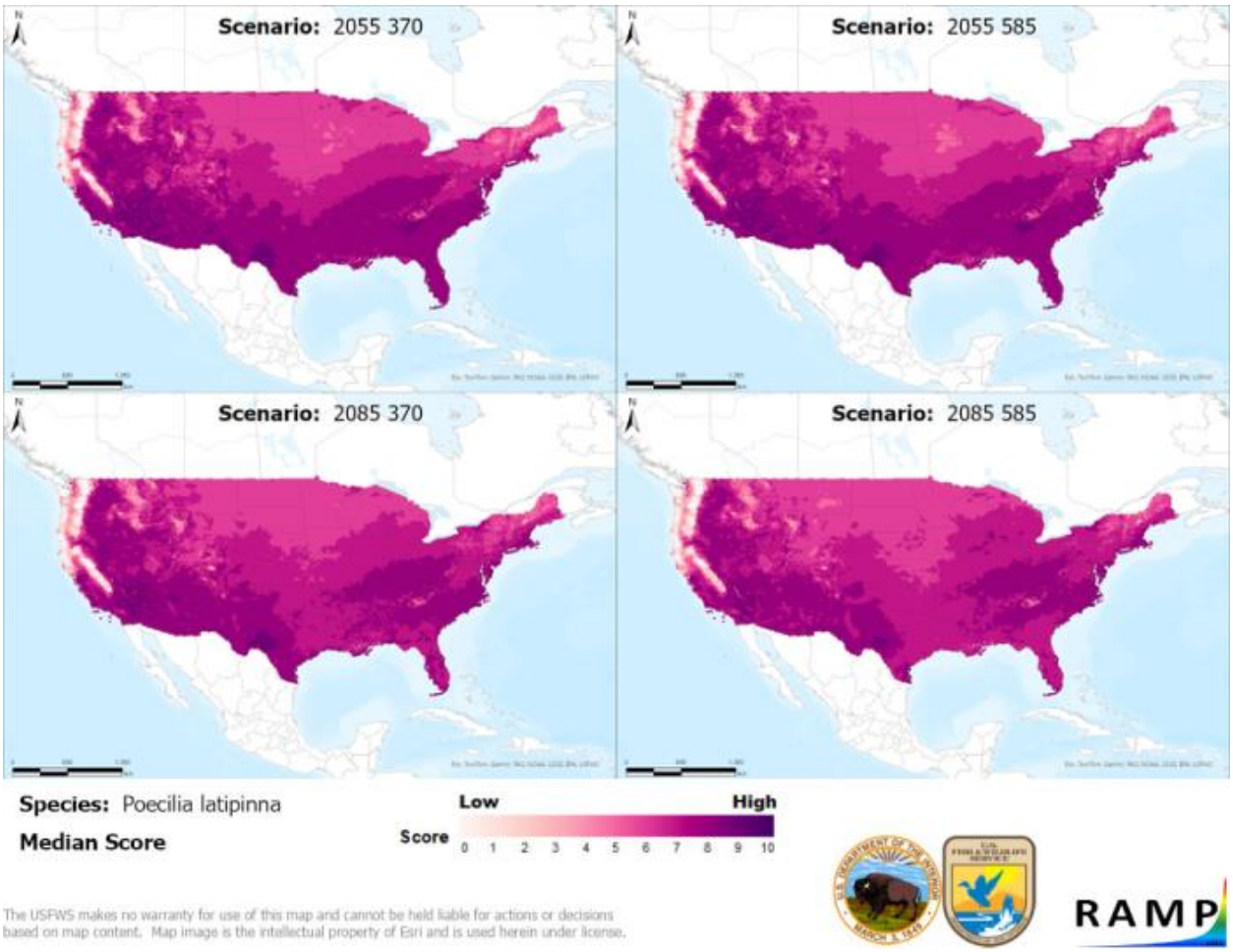

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Poecilia latipinna* in the contiguous United States. Climate matching is based on source locations reported by Maddern (2014), Fofonoff et al. (2018), Abu El-Regal and Al-Solami (2020), and 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.

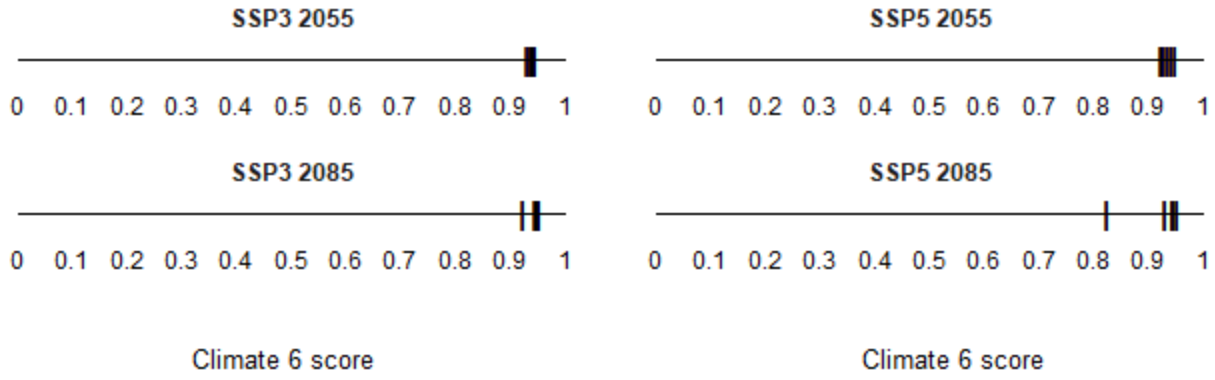

Figure A2. Comparison of projected future Climate 6 scores for *Poecilia latipinna* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; 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.

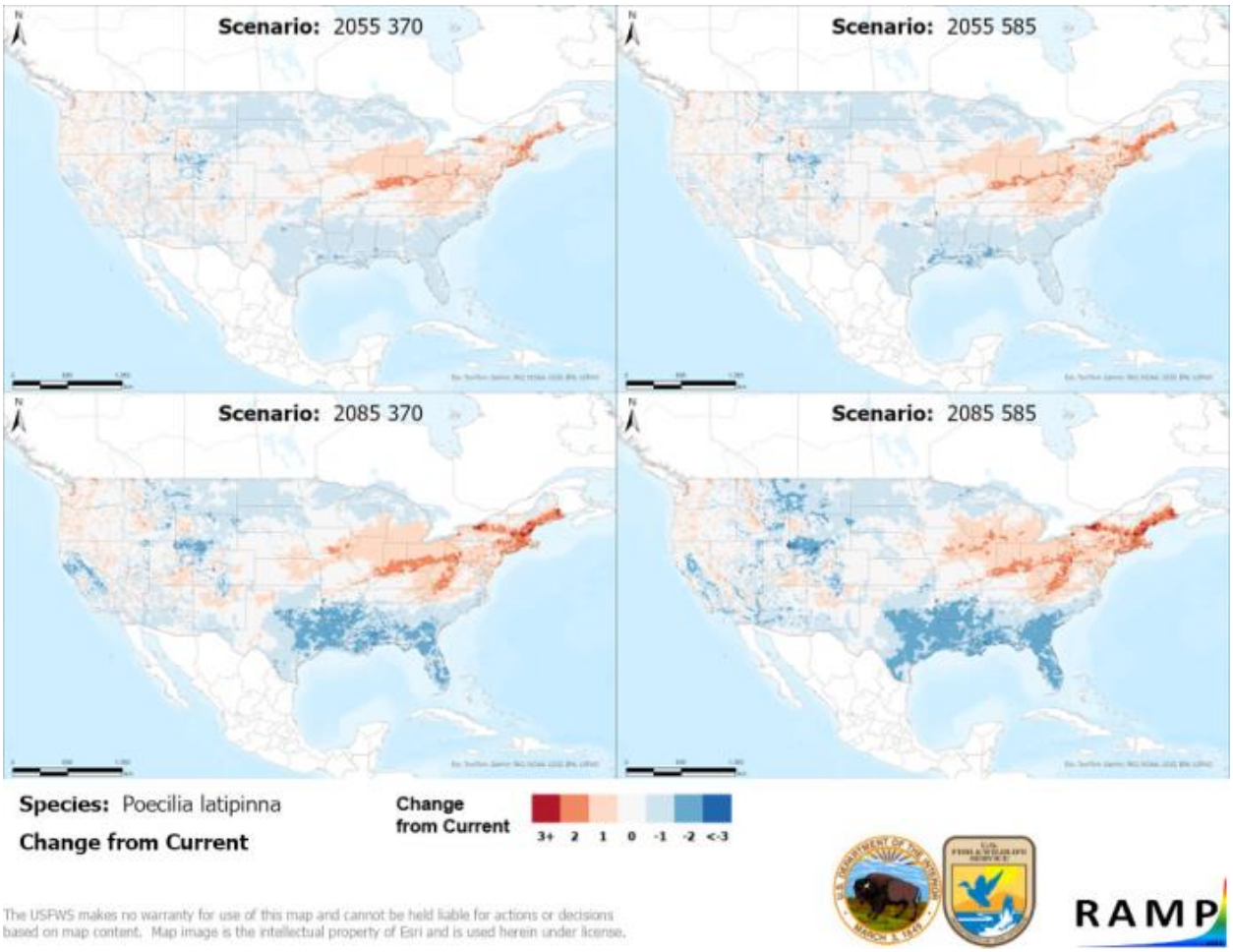

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Poecilia latipinna* based on source locations reported by Maddern (2014), Fofonoff et al. (2018), Abu El-Regal and Al-Solami (2020), and 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.

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