Western Mosquitofish (*Gambusia affinis*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, May 2024
Revised, May 2024
Web Version, 6/5/2024

Organism Type: Fish
Overall Risk Assessment Category: High

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1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2024):

"North and Central America: Mississippi River basin from central Indiana and Illinois in USA south to Gulf of Mexico and Gulf Slope drainages west to Mexico."

From NatureServe (2024):

"This species is native to most of south-central United States, north to Indiana and Illinois, west to Texas, south to southern Mexico, east to Mobile River system. Populations in the drainages of the Chattahoochee and Savannah rivers (Lydeard and Wooten 1991) possibly are native (Page and Burr 2011)."

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Nico et al. (2024) reports nonindigenous occurrences of *G. affinis* in the following U.S. States and territories, with years of earliest and most recent observations and establishment status in the State in parentheses, followed by names of watershed subbasins where reported, if available:

- **Alaska** (1948-1948; failed)
- **Arizona** (1926-2019; established): Aguirre Valley; Bill Williams; Burro; Imperial Reservoir; Lake Mead; Lower Gila; Lower Lake Powell; Lower Salt; Lower San Pedro; Lower Verde; Middle Gila; Rillito; San Bernardino Valley; Santa Maria; Upper Gila-San Carlos Reservoir; Upper Salt; Upper San Pedro; Upper Santa Cruz; Upper Verde; Whitewater Draw
- **Arkansas** (1988-1997; established): Beaver Reservoir; Little Red; Middle White; Spring; Strawberry; Upper White-Village
- **California** (1922-2020; established): Aliso-San Onofre; Big-Navarro-Garcia; Calleguas; Central Coastal; Coyote; Crowley Lake; Cuyama; Death Valley-Lower Amargosa; Honcut Headwaters-Lower Feather; Imperial Reservoir; Lake Tahoe; Los Angeles; Lower American; Lower Colorado; Lower Pit; Lower Sacramento; Lower San Joaquin River; Mad-Redwood; Middle Kern-Upper Tehachapi-Grapevine; Middle San Joaquin-Lower Chowchilla; Mojave; Monterey Bay; Newport Bay; Pajaro; Russian; Salinas; Salton Sea; San Antonio; San Diego; San Francisco Bay; San Francisco Bay; San Francisco Coastal South; San Gabriel; San Jacinto; San Joaquin; San Joaquin Delta; San Luis Rey-Escondido; San Pablo Bay; Santa Ana; Santa Barbara Coastal; Santa Clara; Santa Margarita; Santa Maria; Santa Monica Bay; Santa Ynez; Seal Beach; South Fork Kern; Suisun Bay; Thomes Creek-Sacramento River; Tulare Lake Bed; Upper Amargosa; Upper Cache; Upper Coon-Upper Auburn; Upper Deer-Upper White; Upper Dry; Upper Pit; Upper Sacramento; Upper Stony; Upper Tule; Upper Tuolumne; Upper Yuba; Ventura; Ventura-San Gabriel Coastal; Whitewater River
- **Colorado** (1967-2005; established): Big Thompson; Cache La Poudre; Colorado Headwaters; Colorado Headwaters-Plateau; Lower Yampa; Middle South Platte-Cherry Creek; Piedra; Rio Grande Headwaters; San Luis; South Platte; St. Vrain; Upper Arkansas; Upper Arkansas-John Martin Reservoir; Upper Arkansas-Lake Meredith; Upper Cimarron; Upper Colorado; Upper San Juan
- **Connecticut** (1935-2010; established): Outlet Connecticut River; Quinnipiac
- Florida (1957-1992; failed): Cape Canaveral; Crystal-Pithlachascotee; Florida Southeast Coast; Manatee; Oklawaha; Tampa Bay; Vero Beach
- **Guam** (2004-2010; established)
- **Hawaii** (1905-2017; established): Hawaii; Kauai; Maui; Molokai; Oahu

- **Idaho** (1974-2007; established): C.J. Strike Reservoir; Clearwater; Lower Bear; Lower Boise; Middle Snake-Boise; Middle Snake-Succor; Upper Snake; Upper Snake-Rock
- **Illinois** (1923-2017; established): Chicago; Des Plaines; Flint-Henderson; Green; Lower Fox
- **Indiana** (1961-1992; established): Blue-Sinking; Lower East Fork White; Middle Ohio-Laughery
- **Iowa** (1987-2001; established): Flint-Henderson; Lower Iowa
- **Kansas** (1945-2006; established): Arikaree; Arkansas-Dodge City; Buckner; Chikaskia; Coon-Pickerel; Cow; Crooked; Delaware; Elk; Fall; Gar-Peace; Kaw Lake; Little Arkansas; Little Osage; Lower Big Blue; Lower Cottonwood; Lower Kansas, Kansas; Lower Marais Des Cygnes; Lower Republican; Lower Smoky Hill; Lower South Fork Solomon; Lower Walnut Creek; Lower Walnut River; Marmaton; Medicine Lodge; Middle Arkansas-Lake McKinney; Middle Kansas; Middle Neosho; Middle Smoky Hill; Neosho; Neosho Headwaters; Ninnescah; North Fork Ninnescah; Pawnee; Rattlesnake; South Fork Ninnescah; South Fork Republican; Upper Cimarron-Bluff; Upper Cimarron-Liberal; Upper Cottonwood; Upper Kansas; Upper Marais Des Cygnes; Upper Neosho; Upper Saline; Upper Salt Fork Arkansas; Upper Verdigris; Upper Walnut Creek; Upper Walnut River
- **Kentucky** (1975-1998; established): Kentucky; Licking; Little Sandy; Little Scioto-Tygarts; Lower Kentucky; Middle Ohio-Laughery; Ohio Brush-Whiteoak; Salt; South Fork Licking; Upper Cumberland
- **Massachusetts** (1961-1999; established): Cape Cod
- **Michigan** (1961-2013; established): Detroit; Lake Erie
- **Minnesota** (1958-1982; established): Lower Minnesota; Twin Cities; Upper Mississippi-Crow-Rum
- **Mississippi** (1948-1948; collected)
- **Missouri** (1961-2018; established): Bear-Wyaconda; Big Piney; Bourbeuse; Bull Shoals Lake; Cuivre; Current; Elk; Harry S. Truman Reservoir; Independence-Sugar; James; Lamine; Little Chariton; Lower Chariton; Lower Gasconade; Lower Missouri; Lower Missouri-Crooked; Lower Missouri-Moreau; Lower Osage; Meramec; North Fabius; North Fork White; Peruque-Piasa; Platte; Pomme De Terre; Salt; South Fabius; South Fork Salt; South Grand; Spring; The Sny; Upper Black; Upper Gasconade; Upper Grand
- **Montana** (1959-1999; established): Bullwhacker-Dog; Flathead Lake; Flint-Rock; Fort Peck Reservoir; Pend Oreille; Ruby; Upper Clark Fork; Upper Yellowstone
- **Nebraska** (1901-2019; established): Dismal; Harlan County Reservoir; Keg-Weeping Water; Loup; Lower Elkhorn; Lower Little Blue; Lower Niobrara; Lower North Platte; Lower Platte; Lower Platte-Shell; Lower Sappa; Lower South Platte; Medicine; Middle Niobrara; Middle North Platte-Scotts Bluff; Middle Platte; Middle Platte-Buffalo; Middle Platte-Prairie; Middle Republican; North Fork Republican; Red Willow; Republican; Salt; Tarkio-Wolf; Upper Elkhorn; Upper Little Blue; Upper North Loup; Upper Republican; West Fork Big Blue; Wood
- **Nevada** (1934-2023; established): Carson Desert; Central Lahontan; Havasu-Mohave Lakes; Imperial Reservoir; Lake Mead; Lake Tahoe; Las Vegas Wash; Lower Humboldt; Lower Quinn; Lower Virgin; Meadow Valley Wash; Middle Humboldt; Muddy; Ralston-Stone Cabin Valleys; Sand Spring-Tikaboo Valleys; Smoke Creek Desert; Truckee; Upper Amargosa; Walker; White
- **New Jersey** (1961-2023; established): Cohansey-Maurice

- **New Mexico** (1950-2015; established): Carrizo Wash; Chaco; Middle San Juan; Mimbres; Pecos Headwaters; Rio Grande-Albuquerque; Rio Grande-Santa Fe; San Francisco; Taiban; Upper Gila; Upper Gila-Mangas; Upper Pecos; Upper Pecos-Black; Upper Pecos-Long Arroyo; Upper Rio Grande; Upper San Juan; Upper San Juan; Zuni
- **New York** (1961-2016; established): Long Island; Lower Hudson; Mohawk
- **North Carolina** (1975-1975; established): Albemarle
- **Ohio** (1947-2023; established): Black-Rocky; Licking; Little Miami; Little Muskingum-Middle Island; Little Scioto-Tygarts; Lower Great Miami, Indiana, Ohio; Lower Maumee; Lower Scioto; Muskingum; Ohio Brush-Whiteoak; Raccoon-Symmes; Sandusky; Tuscarawas; Upper Ohio-Shade; Upper Ohio-Wheeling; Upper Scioto; Walhonding
- **Oklahoma** (1967-2022; established): Bird; Black Bear-Red Rock; Caney; Lake O' The Cherokees; Lower Neosho; Lower Salt Fork Arkansas; Lower Verdigris; Middle Verdigris
- **Oregon** (1958-2012; established): Lower Malheur; Lower Rogue; Lower Willamette; Middle Willamette; Molalla-Pudding; North Umpqua; Pacific Northwest; Tualatin; Umpqua; Upper Rogue; Upper Willamette
- **Pennsylvania** (2010-2022; established): Lower Delaware; Lower Susquehanna
- **Puerto Rico** (1923-2007; established): Cibuco-Guajataca; Eastern Puerto Rico; Southern Puerto Rico
- **Tennessee** (1939-1993; established): Barren
- **Texas** (1959-1995; established): Delaware; East Galveston Bay; Lower Pecos-Red Bluff Reservoir; Pecos
- **Utah** (1931-2015; established): Great Salt Lake; Great Salt Lake; Jordan; Lower Colorado-Lake Mead; Lower Green; Lower Green-Desolation Canyon; Lower San Juan-Four Corners; Lower Weber; Southern Great Salt Lake Desert; Spanish Fork; Upper Colorado-Kane Springs; Upper Lake Powell; Upper Virgin; Utah Lake; Weber
- **Virginia** (1997-2021; established): Meherrin; Middle Potomac-Catoctin
- **Washington** (1961-2020; established): Lewis; Lower Columbia-Clatskanie; Lower Snake; Lower Yakima; Middle Columbia-Lake Wallula; Upper Columbia-Entiat; Upper Columbia-Priest Rapids
- **West Virginia** (1998-2012; established): Little Muskingum-Middle Island; Potomac; Upper Ohio-Shade
- **Wisconsin** (1961-2013; established): Grant-Little Maquoketa; Lake Michigan; Sugar
- **Wyoming** (1986-1994; established): Horse; Lower Laramie

From Fofonoff et al. (2018):

"Invasion History on the West Coast:
Western Mosquitofish (*Gambusia affinis*) from Texas were brought to California for mosquito control in 1922 and stocked in a lily pond at Sutter's Mill. In 1924-1926, they were stocked in 30 California counties. They were well-established in the San Francisco estuary watershed by the 1940s and were found in 27% of the sites sampled during a 1984 survey (Dill and Cordone 1997; Leidy 2007). In 1965, they were collected in Lake Merritt (Cohen and Carlton 1995), and they occur in Suisun Marsh (Matern [et al.] 2002). They are established in Los Penasquitos Lagoon (Nordby and Zedler 1991), upper Newport Bay (Horn and Allen 1981), Ballona Marsh (1981, USGS Nonindigenous Aquatic Species Program 2018); Malibu Lagoon (Ambrose and Meffert 1999), mouth of Ventura River (1975, USGS Nonindigenous Aquatic Species Program 2018);

Goleta Slough (1968, USGS Nonindigenous Aquatic Species Program 2018); Morro Bay (Feirstine et al. 1973), Elkhorn Slough (Kukowski 1973), and Humboldt Bay (2000, Boyd et al. 2002). These localized populations probably result from many separate introductions in nearby fresh waters. Dispersal of Mosquitofish through the ocean seems unlikely."

"Elsewhere on the West Coast, *G. affinis* occurs in tidal freshwater in the Coquille River estuary (2007, Silver et al. 2017); and the Columbia River near Portland, Oregon and Longview, Washington (1995, Systsma et al. 2004; USGS Nonindigenous Aquatic Species Program 2018)."

"Invasion History on the East Coast:
[…] Western Mosquitofish have been collected from the Bronx River (2000, Rachlin et al. 2007). [sic] from Sparkill Marsh, New Jersey on the Hudson River (1991, Mills et al. 1997) and Great South Bay, Long Island (1984-1986, Lent et al. 1990, cited by Briggs and Waldman 2002). In 1999, they were collected in a cranberry bog on the Quashnet River, a tributary of Waquoit Bay, Cape Cod. It is unknown if this population have survived freezing temperatures (Hartel et al. 2002, USGS Nonindigenous Aquatic Species Program 2018)."

"In the Great Lakes Basin Western Mosquitofish were introduced to the upper Illinois River around Chicago in 1923 and are still established (Mills et al. 1993). They have also been found near Toledo, in the Maumee River near Lake Erie (1980, USGS Nonindigenous Aquatic Species Program 2018)."

"Invasion History in Hawaii:
In 1905 Western Mosquitofish were introduced to Oahu, and subsequently stocked on all the major islands (Brock 1960; Calton and Eldredge 2009)."

From Nico et al. (2024):

"In 1934, *G. affinis* were also introduced into Fallon, Nevada. From Fallon, Nevada, *G. affinis* were introduced into the following areas of Nevada: Wabuska, Garrett, Parker Ranch, and Bonham Ranch in the late 1930s and early 1940s (Stockwell et al. 1996)."

Froese and Pauly (2024) report that *G. affinis* is established in American Samoa and the Northern Marianas Islands.

Gambusia affinis is widely available for sale online in the United States, including on Amazon (2024), Petco (2024), and eBay (2024), and from private sellers. The species is generally advertised as mosquito control.

Regulations

Gambusia affinis is regulated in the following states: Alaska (ADF&G 2023), Arkansas (AGFC 2022), Hawaii (HDOA 2019), Minnesota (Minnesota DNR 2022), New York (New York DEC 2022), South Dakota (South Dakota GFP 2022), and Wisconsin (Wisconsin DNR 2022).

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):

"Because of [its] reputation as mosquito-control […], *G. affinis* have been stocked routinely and indiscriminately in temperate and tropical areas around the world."

"[…] thought of as an effective and inexpensive means of combating malaria (Krumholz 1948)."

"When compared to other *Gambusia spp*., including *G. holbrooki*, Rehage and Sih (2004) found that *G. affinis* exhibited the greatest dispersal tendency and as a result was more likely to spread to other habitats after introduction."

"Pflieger (1997) noted that *Gambusia affinis* is more widespread and abundant in Missouri now than it was half a century ago. For instance, Pflieger indicated that, by the early 1980s, it had become established northward along the Mississippi River to Clark County, Missouri, and westward near the Missouri River to Andrew County, a range expansion attributed to a combination of natural dispersal and undocumented introductions."

Remarks

From Nico et al. (2024):

"*Gambusia affinis* and *G. holbrooki* were long considered subspecies of *G. affinis*, and were only recently recognized as separate species (Wooten et al. 1988; Rauchenberger 1989; Robins et al. 1991). Complicating matters of identification, most introductions occurred before the recent taxonomic change; furthermore, the origins of introduced stocks were usually unknown or unreported. In addition, both forms were widely available and thought to have been dispersed widely by humans. As a consequence, it often is not possible to determine if many of the earlier records represent introductions of *G. affinis* or of *G. holbrooki*."

"Hubbs and Lagler (1958) reported that intergrades between *G. affinis* and *G. holbrooki* have been introduced into southern Michigan, but the stock did not become established."

From NatureServe (2024):

"Lynch (1992) reported that five or six populations from Georgia, Illinois, Tennessee and Texas were used for most introductions nationwide and worldwide. Within the United States, sources from Illinois, Tennessee and Texas were used to establish mosquitofish in the western half of the country. Therefore, most if not all populations in the western United States are *G. affinis* [not *G. holbrooki*]."

From Fofonoff et al. (2018):

"Populations in Europe and Australia have been identified as *G. holbrooki* (Eastern Mosquitofish, derived from stocks taken from Georgia (Pyke 2005; Pyke 2008; Cardona 2006). However, these Europe and Australia populations were referred to as *G. affinis* in older (pre-

1990s) papers. The species identity of many of the Mosquitofish stocks around the world is unknown (Lever 1996; Pyke 2005; Walton et al. 2012. [sic]"

"According to Briggs and Waldman (2002), all vouchered *Gambusia* from the Hudson River and Long Island Sound have been *G. affinis*."

From Bonham and Siriwardena (2010):

"Although widely introduced as mosquito control agents, recent critical reviews of the world literature on mosquito control have not supported the view that Gambusia are particularly effective in reducing mosquito populations or in reducing the incidence of mosquito-borne diseases (Courtenay and Meffe, 1989)."

This ERSS was previously published in November 2017. Revisions were completed to incorporate new information and conform to updated standards.

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 Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Acanthopterygii
Order Cyprinodontiformes
Suborder Cyprinodontoidei
Family Poeciliidae
Subfamily Poeciliinae
Genus *Gambusia*
Species *Gambusia affinis* (Baird and Girard, 1853)

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

Size, Weight, and Age Range

From Froese and Pauly (2024):

"Max length: 5.1 cm TL [total length] male/unsexed; [Koutrakis and Tsikliras 2003]; 7.0 cm TL (female); common length : 3.9 cm TL male/unsexed; [Hugg 1996]; max. reported age: 3.00 years [Beverton and Holt 1959]"

Environment

From Froese and Pauly (2024):

"Freshwater; brackish; benthopelagic; pH range: 6.0 - 8.0; dH range: 5 - 19; potamodromous."

"Inhabits standing to slow-flowing water; most common in vegetated ponds and lakes, backwaters and quiet pools of streams [Page and Burr 1991]. Most abundant in lower reaches of streams [Yamamoto and Tagawa 2000]. Frequents brackish water."

From NatureServe (2024):

"Habitat includes river channels, margins, backwaters; springs, marshes, and artificial habitats of all kinds (Minckley et al. 1991). Often this species occurs in shallow, often stagnant, ponds and the shallow edges of lakes and streams where predatory fishes are largely absent and temperatures are high. It is most abundant in shallow water with thick vegetation (Hubbs 1971). It also occurs in brackish sloughs and coastal saltwater habitats (Tabb and Manning 1961, Odum 1971). This fish is more tolerant of pollution than are most other fishes (Lewis 1970, Kushlan 1974). It tolerates dissolved oxygen levels as low as 0.18 mg/L (Ahuja 1964) but cannot tolerate extreme cold; temperature apparently limits the range northward (Hubbs 1971). However, some populations are known to overwinter under ice in Indiana and Illinois (Krumholz 1944)."

From Nico et al. (2024):

"Its establishment and spread in northern states is greatly restricted because the species are not, in general, cold tolerant. In most cases, overwintering in colder regions requires surfacing groundwater springs (e.g., Woodling 1985; but see Lynch [1988]). [In Nebraska,] the populations suffer heavy (up to 99%) winter mortality (Haynes 1983)."

From EDDMapS (2024):

"They occur in water temperatures from 0 to 45 °C, salinities 0 to 41 ppt, pH 4.5 to 9, dissolved oxygen 1 to 11 mg/L […]"

From Fofonoff et al. (2018):

"Mosquitofish are characteristic of shallow, enclosed fresh and brackish waters, including marshes and swamps, but can occur in lagoons with salinities of 20-40 PSU (Englund et al. 2000; Pyke 2005)."

Climate

From Froese and Pauly (2024):

"Subtropical; 12°C - 29°C [Pet Resources 2004]; 42°N - 26°N"

From Nico et al. (2024):

"[…] the species are not, in general, cold tolerant."

From EDDMapS (2024):

"Mainly found at lower elevations [Pyke 2008]."

Distribution Outside the United States

Native

Part of this species' native range is in the United States; see Section 1 for a full description of the native range.

From Froese and Pauly (2024):

"[…] Gulf of Mexico and Gulf Slope drainages west to Mexico."

Introduced

From Froese and Pauly (2024):

"One of the species with the widest range of introductions which acquired for itself a near pan-global distribution [Welcomme 1988]."

Froese and Pauly (2024) report that *G. affinis* has been introduced and is established in Afghanistan, Algeria, Argentina, Australia, Bolivia, Bulgaria, Cambodia, Canada, Chile, China, Central African Republic, Cook Islands, East Timor, Egypt, Federated States of Micronesia, Fiji, France, French Polynesia, Georgia, Greece, Hong Kong, Hungary, India, Iraq, Israel, Italy, Japan, Kazakhstan, Kiribati, Laos, Madagascar, Malaysia, Marshall Islands, Mexico, Morocco, New Zealand, Papua New Guinea, Peru, Philippines, Portugal, Romania, Russia, Singapore, Solomon Islands, South Africa, Spain, Sudan, Tahiti, Taiwan, Thailand, Uzbekistan, Vietnam, Western Samoa, Yugoslavia, and Zimbabwe.

Froese and Pauly (2024) report that *G. affinis* has been introduced and is probably established in Albania, Armenia, Kenya, Myanmar, Sri Lanka, Syria, and Turkey; introduced but the establishment status is unknown for Bangladesh, Bosnia, Côte d'Ivoire, Cyprus, Ghana, Haiti, Jordan River, Line Islands, Malta, Mauritius, Pakistan, Slovenia, and Ukraine; and introduced but did not establish in the Comoros, Indonesia, Rodrigues [Republic of Mauritius], or Zambia.

In contrast, Fofonoff et al. (2018) report that it was *G. holbrooki* and not *G. affinis* that was introduced in Europe and Australia. Srean (2015) reports that *G. holbrooki*, not *G. affinis*, is established in Afghanistan, Australia, Bulgaria, Egypt, France, Georgia, Greece, Hungary, Iraq, Kazakhstan, Madagascar, Malaysia, Morocco, Papua New Guinea, Portugal, Romania, Russia, Spain, Sudan, and Uzbekistan.

From Srean (2015):

"The two *Gambusia* species [*G. affinis* and *G. holbrooki*] have established in all continents except Antarctica, but *G. holbrooki* is present mainly in southern Europe, the Middle East, northern and western Africa, western Asia and Australia, and *G. affinis* is present mainly in the Americas, southern Africa and eastern Asia […]"

"Countries with *G. affinis* established: Argentina, Bangladesh, Bolivia, Botswana, Cambodia, Canada, Cape Verde, Chile, China, Democratic Republic of Congo, Dominican Republic, East Timor, Ecuador, Federated States of Micronesia, Fiji, Haiti, India, Israel, Italy, Japan, Jordan, Laos PDR, Marshall Islands, Mozambique, Myanmar, Nauru, Nepal, New Zealand, Pakistan, Palau, Peru, Philippines, Samoa, Singapore, Solomon Islands, South Africa, Sri Lanka, State of Palestine, Syrian Arab Republic, Taiwan, Thailand, Vanuatu, Viet Nam, Zambia, and Zimbabwe. Uncertain species but likely *G. affinis* for Central African Republic, Democratic Congo, Kiribati, Tanzania, The Bahamas."

Means of Introduction Outside the United States

From Nico et al. (2024):

"Western Mosquitofish have been widely introduced outside of the continential [*sic*] United States for mosquito control purposes (Krumholz 1948; Purcell et al. 2012)."

Bonham and Siriwardena (2010) list ornamental purposes as a pathway.

From Bonham and Siriwardena (2010):

"Because of its reputation as a mosquito-control agent, *G. affinis* has been stocked routinely and indiscriminately in temperate and tropical areas around the world resulting in a wide distribution. Due to their hardiness, this species may now be the most widespread freshwater fish in the world (USGS, 2003)."

From Fofonoff et al. (2018):

"They are also imported as research animals or aquarium fishes."

From Khas et al. (2019):

"Also, in Iran, *G. affinis*, native of the Mississippi Valley, was first brought to be used as a larvivorous fish against anopheline vectors of malaria in 1928 [Zaim 1987]."

Short Description

From Froese and Pauly (2024):

“Dorsal spines (total): 0; Dorsal soft rays (total): 7-9; Anal spines: 0; Anal soft rays: 9 - 10. Origin of dorsal fin opposite 7th anal ray. Length of anal base much less than half distance from caudal. 8 horizontal scale rows between back and abdomen. Ventrals terminate immediately before anal fin. Pelvic fins reach ventrals.”

From Nico et al. (2024):

“Mosquitofish is a small, live-bearing fish, is dull grey or brown in color with no bars of bands on the sides, and has a rounded tail. Its body is short, its head flattened, and its mouth pointed upward for surface feeding.”

From GISD (2024):

“A stout little fish, the back a little arched in front of the dorsal fin and the belly deep in front of the anal. The head is large with a flattened upper surface, the mouth small, upturned and protrusible, and not reaching as far back as the front of the eyes. The eyes are very large relative to the body. The single, soft-rayed dorsal fin is short-based, high and rounded, while the caudal peduncle is long, deep and compressed, and the caudal fin is rounded. The head and trunk are covered with large scales and there is no lateral line. The back is a greenish olive to brownish, the sides grey with a bluish sheen, and the belly a silvery white. A well-defined black spot on the upper rear abdomen is surrounded by a golden patch above and behind the vent. In mature females there is also a black patch above and somewhat forward of the vent. The ventral surface of the head is a steely blue with a diagonal chin stripe below the eyes. The eyes are greyish to olive, the dorsal fin has small black spots, and the caudal fin has several indistinct cross rows of small black spots. The anal, pelvic and pectoral fins are a translucent pale amber. (McDowall, 1990).”

Biology

From NatureServe (2024):

“Mosquitofish have internal fertilization and are ovoviviparous (Sublette et al. 1990). Females can store sperm from one copulation and fertilize several broods sequentially (Krumholz 1948). After a gestational period of 21 to 28 days, the young are born alive at a size of approximately eight to nine mm total length (Krumholz 1948). Larger females produce more offspring (Krumholz 1948). Brood sizes of one to 315 young have been reported (Barney and Anson 1921, Moyle 1976). Females annually have four to five broods (Krumholz 1948). Sex ratios are 1:1 at birth, but in older cohorts, the number of males declines relative to the number of females (Krumholz 1948). Under optimal conditions females can become gravid at 6 weeks of age, produce 2-3 broods in first summer. Few individuals live more than 15 months (Moyle 1976).”

“Life history is flexible, varies with environmental conditions (Stearns 1983).”

“Opportunistic omnivore; eats mainly small invertebrates, often taken near water surface. Also eats small fishes and, in the absence of abundant animal food, algae and diatoms (Moyle 1976).”

“Mosquitofish are principally carnivorous, and have strong, conical teeth and short guts (Meffe et al. 1983, Turner and Snelson 1984). They are reported to feed on rotifers, snails, spiders, insect larvae, crustaceans, algae, and fish fry, including their own progeny (Barnickol 1941, Minckley 1973, Meffe and Crump 1987). Cannibalism has been documented by several authors (Seale 1917, Krumholz 1948, Walters and Legner 1980, Harrington and Harrington 1982). Plant material is taken occasionally (Barnickol 1941) and may make up a significant portion of the diet during periods of scarcity of animal prey (Harrington and Harrington 1982). Grubb (1972) showed that anuran eggs from temporary ponds were preferentially selected over those breeding in permanent systems. Several workers have documented changes in the prey community after mosquitofish introduction (Hurlbert et al. 1972, Farley and Younce 1977, Hurlbert and Mulla 1981, Walters and Legner 1980).”

From Nico et al. (2024):

“This species is also well known for its high feeding capacity. Chips (2004) observed maximum consumption rates of 42–167% of their body weight per day. These organisms also require a high density of refuges to maintain populations at or near their asymptotic density (Benoit et at. 2000).”

Human Uses

From Froese and Pauly (2024):

“Fisheries: minor commercial; aquarium: commercial”

From GISD (2024):

“Used as live food for carnivorous aquarium fishes and also used as mosquito control (FishBase, 2003).”

Gambusia affinis is widely available for sale online in the United States, including on Amazon (2024), Petco (2024), and eBay (2024), and from private sellers. The species is generally advertised as mosquito control.

Diseases

***Gambusia affinis* has been documented as susceptible to epizootic haematopoietic necrosis, a disease listed by the World Organisation for Animal Health (2024).**

Poelen et al. (2014) lists *Gambusia affinis* as a host to the following species: *Arhythmorhynchus brevis, Ascocotyle spp., Bothriocephalus spp., Clinostomum australiense, Contracaecum micropapillatum, Dioctophyma renale, Diplostomulum, Echinochasmus donaldsoni, Echinochasmus schwartzi, Eustrongylides ignotus, Glossocercus, Goussia piekarskii, Gyrodactylus gambusiae, Henneguya gambusia, Hysterothylacium, Ichthyophthirius multifiliis, Lacistorhynchus dollfusi, Lacistorhynchus tenuis, Myxobolus pharyngeus, Neoechinorhynchus* *spp.*, *Octospiniferoides chandleri*, *Paracapillaria philippinensis*, *Phagicola spp.*, *Posthodiplostomum spp.*, *Procamallanus laeviconchus*, *Salsuginus seculus*, *Stegodexamene callista*, *Tetrahymena*, *Trichodina spp.*, and *Valipora minuta*.

Threat to Humans

From Froese and Pauly (2024):

"Potential pest"

3 Impacts of Introductions

From Nico et al. (2024):

"According to Courtenay and Meffe (1989), mosquitofish have had the greatest ecological impact by far of any of the introduced poeciliids. […] Because of their aggressive and predatory behavior, mosquitofish may negatively affect populations of small fish through predation and competition (Myers 1967; Courtenay and Meffe 1989), and benefit mosquitos by decreasing competitive pressure from zoooplantion [*sic*] and predation pressure from predatory invertebrates (Blaustein and Karban 1990). In some habitats, introduced mosquitofish reportedly displaced select native fish species regarded as better or more efficient mosquito control agents (Danielsen 1968; Courtenay and Meffe 1989)."

"Introduced mosquitofish have been particularly destructive in the American West where they have contributed to the elimination or decline of populations of federally endangered and threatened species (Courtenay and Meffe 1989). Specific examples of their negative effects include a habitat shift and a reduction in numbers of the threatened Railroad Valley springfish *Crenichthys baileyi* in springs in Nevada (Deacon et al. 1964) and the local elimination of the endangered Sonoran topminnow *Poeciliopsis occidentalis* in Arizona (Moyle [1976]; Meffe et al. 1983, Meffe 1985). Western Mosquitofish use the same habitat as the plains topminnow *Fundulus sciadicus* and have displaced these topminnows and other species with their aggressive behavior (Whitmore 1997). The mosquitofish is also responsible for the elimination of the least chub *Iotichthys phlegethontis* in several areas of Utah (Whitmore 1997). Meffe (1983, 1985) found that mosquitofish are very aggressive, even toward larger fish. They often attack, shred fins, and sometimes kill other species. Mosquitofish are known to prey on eggs, larvae, and juveniles of various fishes, including those of largemouth bass and common carp; they are also known to prey on adults of smaller species (Meffe 1985; Courtenay and Meffe 1989)."

"Introducing mosquitofish also can precipitate algal blooms when the fish eat the zooplankton grazers (Hurlbert et al. 1972), or in an increase in the number of mosquitoes if the fish eat the invertebrate predators (Hoy et al. 1972, Bence 1988). Introduced fishes, including mosquitofish, are likely at least partially responsible for the decline of the Chiricahua leopard frog *Rana chiricahuensis* in southeastern Arizona (Rosen et al. 1995). In California, *Gambusia affinis* has been documented to prey heavily on California newt *Taricha torosa* larvae (Gamradt and Kats 1996) and Pacific treefrog *Hyla regilla* tadpoles (Goodsell and Kats 1999)."

“Mosquitofish […] 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).”

“Introductions of Western Mosquitofish have been implicated in the current restricted distribution of plains topminnow in Nebraska and may be affecting populations in Wyoming (Rahel and Thel 2004; Wyoming Fish and Game Department 2010). Schumann et al. (2015) examined the impacts of mosquitofish on populations of plains topminnow and plains killifish (*Fundulus kansae*) in Nebraska using mesocosm trials, finding increased fundulid mortailty [sic] through direct predation on larval fishes and aggression towards juveniles, as well as alteration in activity patterns and microhabitat use by the native species in the presence of mosquitofish.”

From EDDMapS (2024):

“Economic Impacts: Western mosquitofish compete directly with similar-sized native fish for food and also prey on the eggs and larvae of native fishes [Zander et al. 2017]. Mosquitofish can [be] very aggressive of [sic] larger fish by shredding fins [Zander et al. 2017]. The decline of native sportfish populations could have impacts on recreation and tourism.”

“Environmental Impacts: Western mosquitofish can negatively impact populations of similar-sized fish via predation and competition for food resources. Mosquitofish prey on the eggs and juveniles of native fishes. Mosquitofish can also negatively affect trophic relationships of aquatic communities by the consumption of zooplankton and invertebrates [Zander et al. 2017].”

“Sociological Impacts: The transformation of native aquatic communities results in the intrinsic loss of natural capital and enjoyment of natural areas.”

From GISD (2024):

“Mosquito fish are potential hosts of helminth parasites, which have been transmitted to native fishes (FishBase, 2003).”

“Recent work has found mosquito fish are likely responsible for the decline of the Vulnerable (VU) dwarf inanga (see *Galaxias gracilis* in IUCN Red List of Threatened Species) in Northland dune lakes [New Zealand].”

From NatureServe (2024):

“Myers (1965) wrote that almost everywhere introductions have been made, mosquitofish have gradually eliminated or reduced populations of small native fishes. For example, mosquitofish have been instrumental in eliminating native populations of *Poeciliopsis occidentalis* in the southwestern U.S. (Sublette et al. 1990); *P. occidentalis* may be effectively eliminated in 1-3 years (Meffe 1984). Evermann and Clark (1931) reported that mosquitofish in the Salton Sea, California, drove out *Cyprinodon macularius* less than 10 years after introduction to the state. The mechanism for many of these reductions is believed to be predation (Meffe 1985, Courtenay and Meffe 1989). Myers (1965) reported that mosquitofish have even reduced largemouth bass

(*Micropterus salmoides*) and carp (*Cyprinus carpio*) populations due to predation on larvae. Another problem is caused when mosquitofish hybridize with other *Gambusia* species (Yardley and Hubbs 1976, Rutherford 1980). Intergradation then corrupts the genome of the native species."

"Introduced mosquitofish also prey heavily on amphibian larvae (Goodsell and Kats 1999) and potentially negatively impact salamander and frog populations (Lawler et al. 1999)."

From Fofonoff et al. (2018):

"In brackish lava-rock pools in Hawaii, *G. affinis* competed with a native shrimp, *Halocaridina rubra* for algal food (Capps et al. 2009)."

4 History of Invasiveness

The History of Invasiveness for *Gambusia affinis* is classified as High. There is a long and well documented history of nonnative introductions of the species resulting in established populations. Nonnative populations have caused negative economic and ecological impacts that have been reported by numerous reliable sources.

5 Global Distribution

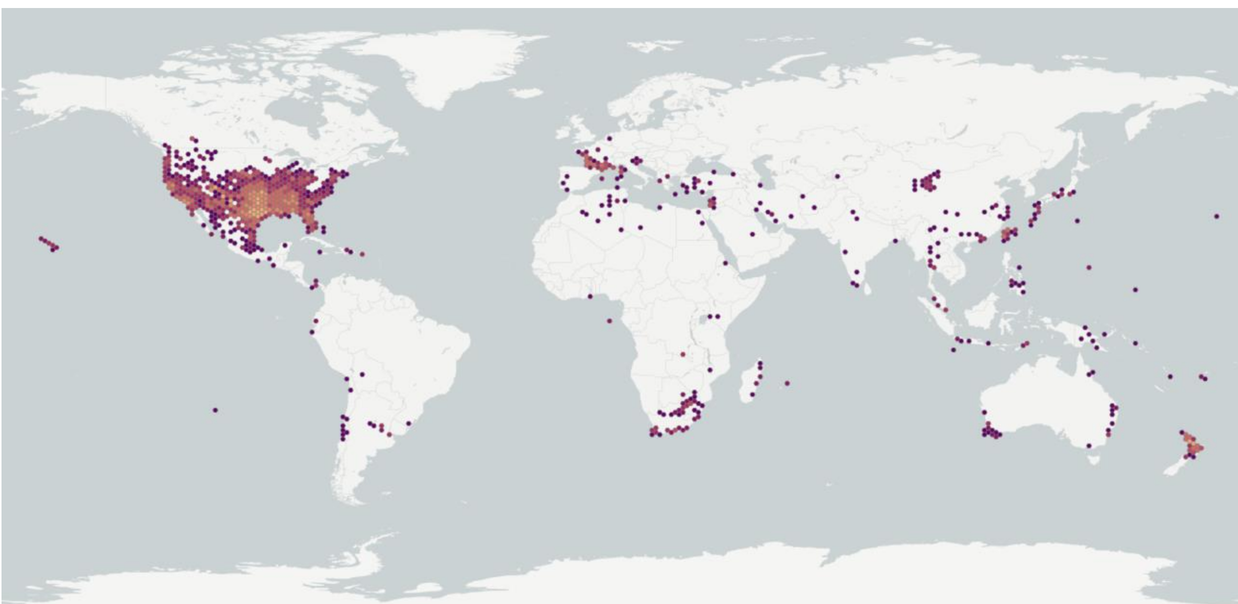

Figure 1. Reported global distribution of *Gambusia affinis*. Map from GBIF Secretariat (2023). Observations are reported in abundance from the United States, as well as from parts of Central and South America, southern Africa, throughout Europe, across Asia, and throughout Oceania.

Occurrences to the west of the native range of *G. affinis* (figure 3) were assumed to represent introductions of *G. affinis*, along with occurrences from the Hudson River and Long Island Sound (Fofonoff et al. 2018). Other eastern U.S. occurrences reported for *G. affinis* were assumed to be occurrences of *G. holbrooki* (see Remarks) and were not used to select source points for climate matching.

Most observations from southern Europe, the Middle East, northern and western Africa, western Asia and Australia are likely observations of *Gambusia holbrooki* rather than *Gambusia affinis* (Srean 2015; Fofonoff et al. 2018), so occurrences in these areas were not used to select source points for climate matching with the exception of Cape Verde, Israel, Italy, Syria, and the Palestinian Territories (where *G. affinis* is reported as established; Srean 2015). In addition, establishment has not been confirmed for *G. affinis* in Brazil, Eritrea, Indonesia, Kenya, Madagascar, Malawi, Malaysia, Mauritius, Panama, or Papua New Guinea, so occurrences in these areas were not used to select source points for climate matching.

6 Distribution Within the United States

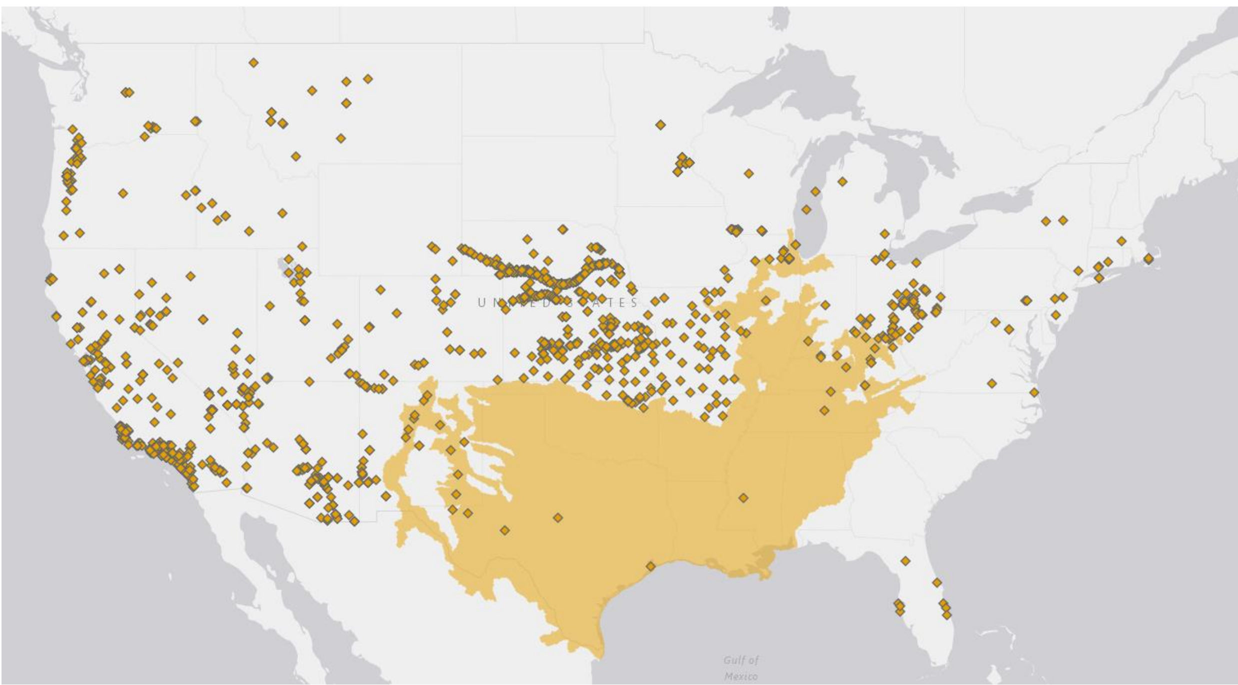

Figure 3. Reported distribution of *Gambusia affinis* in the United States. Map from Nico et al. (2024). Observations are reported from the western United States, the Great Basin and Colorado Plateau regions, the southwestern United States, the Southern Plains, and the Appalachian Range. The orange shading represents the native range.

Occurrences to the west of the native range of *G. affinis* were assumed to represent introductions of *G. affinis*, along with occurrences from the Hudson River and Long Island Sound (Fofonoff et al. 2018). Other eastern U.S. occurrences reported for *G. affinis* were assumed to be occurrences of *G. holbrooki* (see Remarks) and were not used to select source points for climate matching.

Figure 4. Reported distribution of *Gambusia affinis* in Hawaii. Map from Nico et al. (2024).

Figure 5. Reported distribution of *Gambusia affinis* in Puerto Rico. Map from Nico et al. (2024).

7 Climate Matching

Summary of Climate Matching Analysis

The entire contiguous United States had a high climate match for *Gambusia affinis*, except for a few scattered areas of medium match throughout the West and in northern New England. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.998, 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).

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

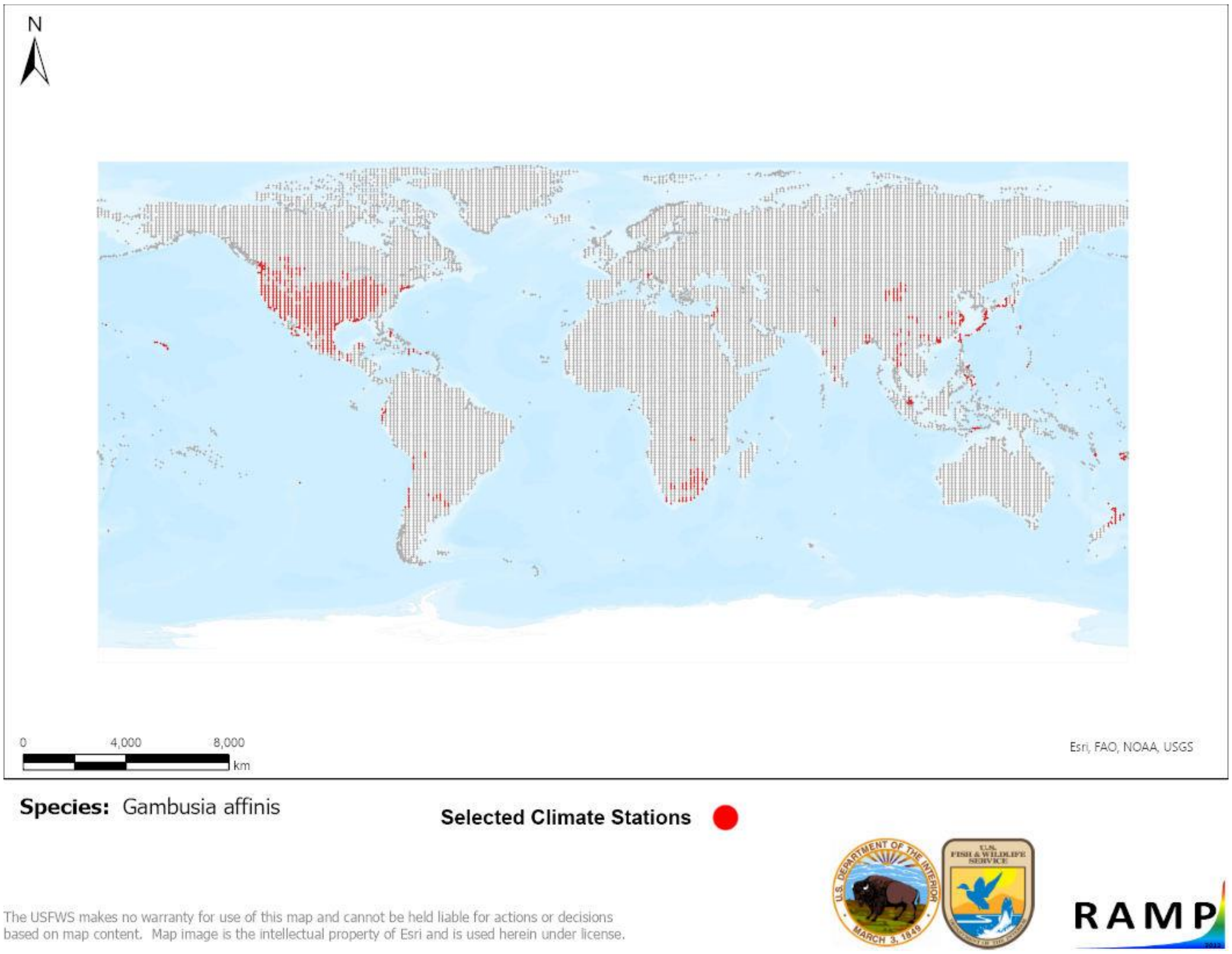

Figure 6. RAMP (Sanders et al. 2023) global source map showing weather stations as source locations (red; South Africa, Democratic Republic of the Congo, Israel, Syria, Italy, India, Bangladesh, China, Laos, Myanmar, Thailand, Malaysia, Singapore, Taiwan, Japan, Philippines, Guam, Northern Mariana Islands, Solomon Islands, Fiji, New Zealand, Micronesia, Italy, Chile, Argentina, Bolivia, Peru, Ecuador, Dominican Republic, Puerto Rico, the Bahamas, Mexico, Canada, and the United States) and non-source locations (gray) for *Gambusia affinis* climate matching. Source locations from 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.

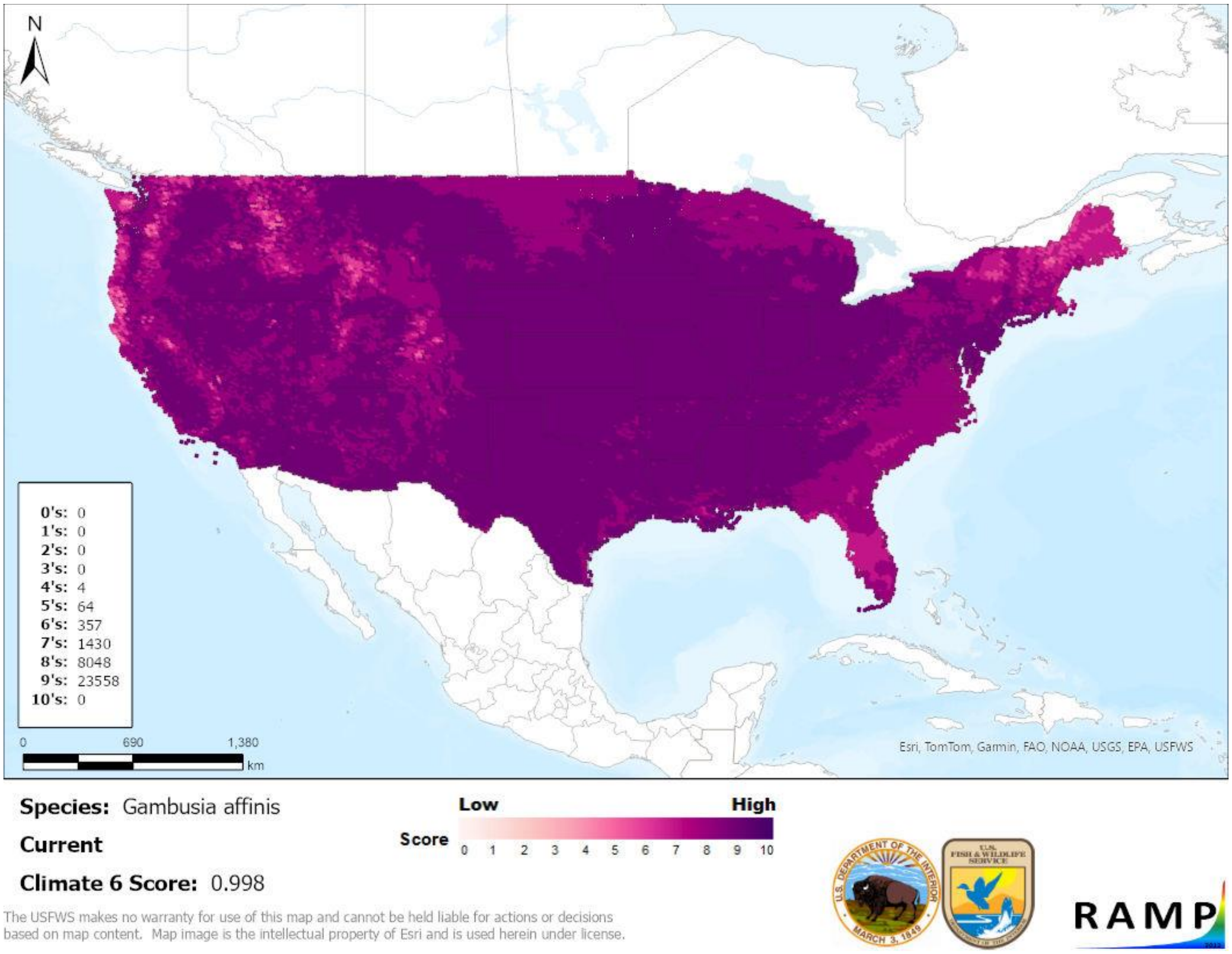

Figure 7. Map of RAMP (Sanders et al. 2023) climate matches for *Gambusia affinis* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Gambusia affinis* is classified as High. The species has a long history of nonnative introductions. Information regarding the history of invasiveness of this species is abundantly available from scientifically defensible sources. Literature has largely reached a consensus on the negative impacts of nonnative introductions of *Gambusia affinis.* Although there is still work to be done to clarify where *G. affinis* is established versus its congener *G. holbrooki*, the information currently available is sufficient to be confident in the risk categorization of *G. affinis* for this report.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Gambusia affinis, the western mosquitofish, is a fish native to the Mississippi River basin from central Indiana and Illinois, south to the Gulf of Mexico, and the Gulf Slope drainages west to Mexico. *Gambusia affinis* has been routinely introduced and stocked around the world for mosquito control. The species has also been reported as an import for research or aquaria. The life history of *Gambusia affinis* is flexible. The fish is an opportunistic omnivore, viviparous, and has a strong dispersal tendency. The History of Invasiveness for *Gambusia affinis* is classified as High. Well documented nonnative introductions have led to established populations with negative impacts to native species and environments through predation and competition. The climate matching analysis for the contiguous United States indicates establishment concern for this species outside its native range. The entirety of the contiguous United States had a high climate match for *G. affinis*. The Certainty of Assessment for this ERSS is classified as High due to the wide availability of reliable information regarding *Gambusia affinis*. The Overall Risk Assessment Category for *Gambusia affinis* 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: Susceptible to epizootic haematopoietic necrosis. Recent split of *G. affinis* and *G. holbrooki* into separate species has led to uncertainty about the identity of some populations.**
- **Overall Risk Assessment Category: High**

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

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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 GBIF Secretariat (2023).

Under the future climate scenarios (figure A1), on average, high climate match for *Gambusia affinis* was projected to occur across nearly all regions of the contiguous United States, including in the Appalachian Range, California, Colorado Plateau, Great Basin, Great Lakes, Gulf Coast, Mid-Atlantic, Northeast, Northern Plains, Southeast, Southern Plains, Southwest, and Western Mountains. Under the SSP5, 2085 scenario, the climate match was slightly lower, but still medium-high, in the Northern and Southern Plains, Southeast, and north along the Atlantic Coast; hints of this trend also appeared under the SSP3, 2085 scenario. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.971 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.999 (model: GFDL-ESM4, 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 (0.998, figure 7) 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 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 Appalachian Range, California, Colorado Plateau, Great Basin, Gulf Coast, Mid-Atlantic, Northeast, Northern Pacific Coast, Northern Plains, Southeast, 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, although additional, very small areas of large or moderate change may be visible on the maps (figure A3). Across scenarios, the estimated magnitude of change increased from SSP3 to SSP5 and from 2055 to 2085.

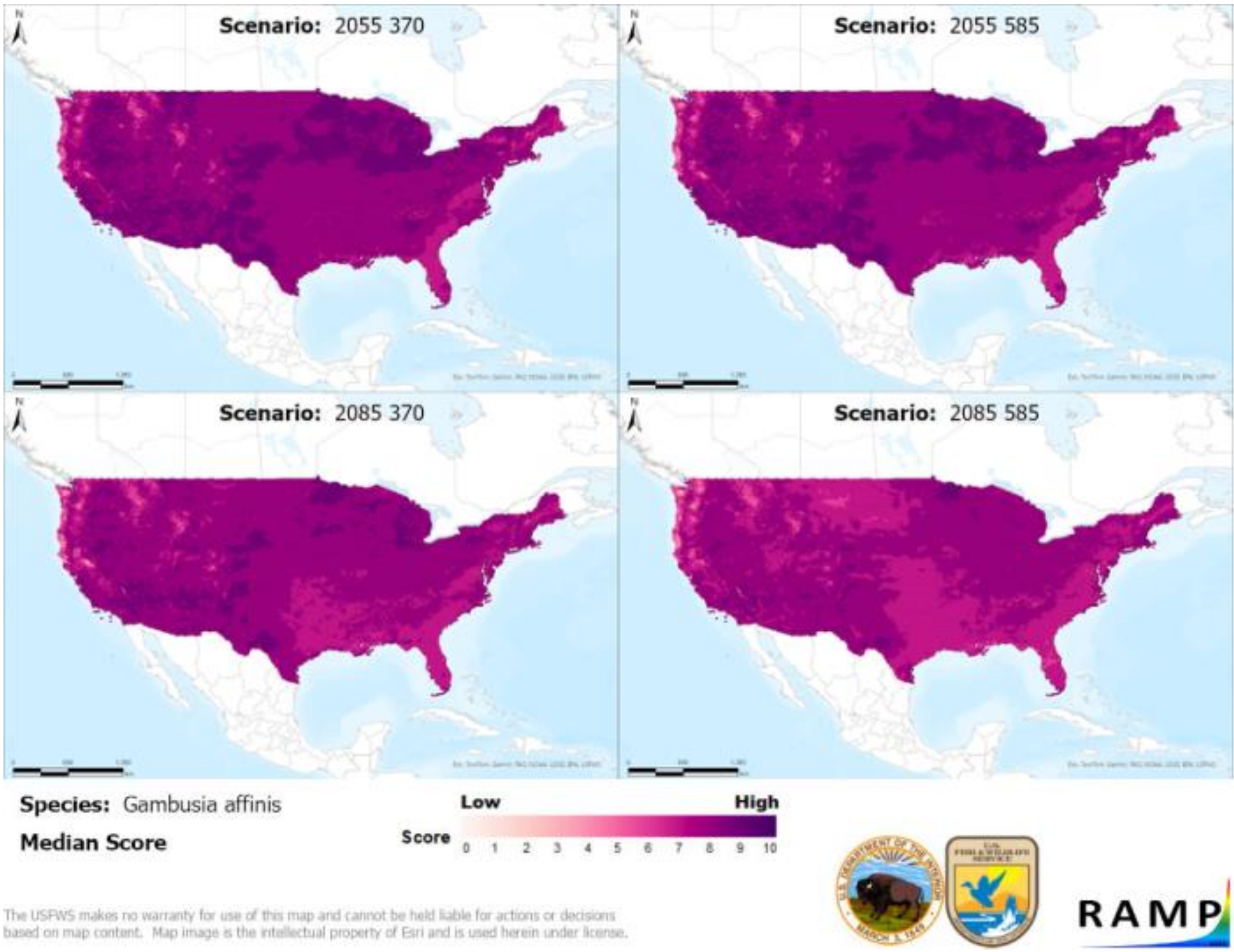

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Gambusia affinis* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic 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.

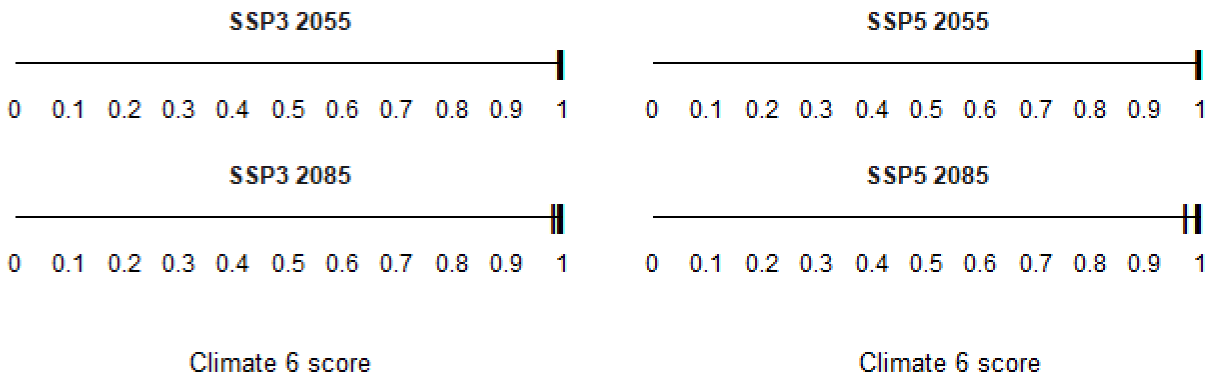

Figure A2. Comparison of projected future Climate 6 scores for *Gambusia affinis* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC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

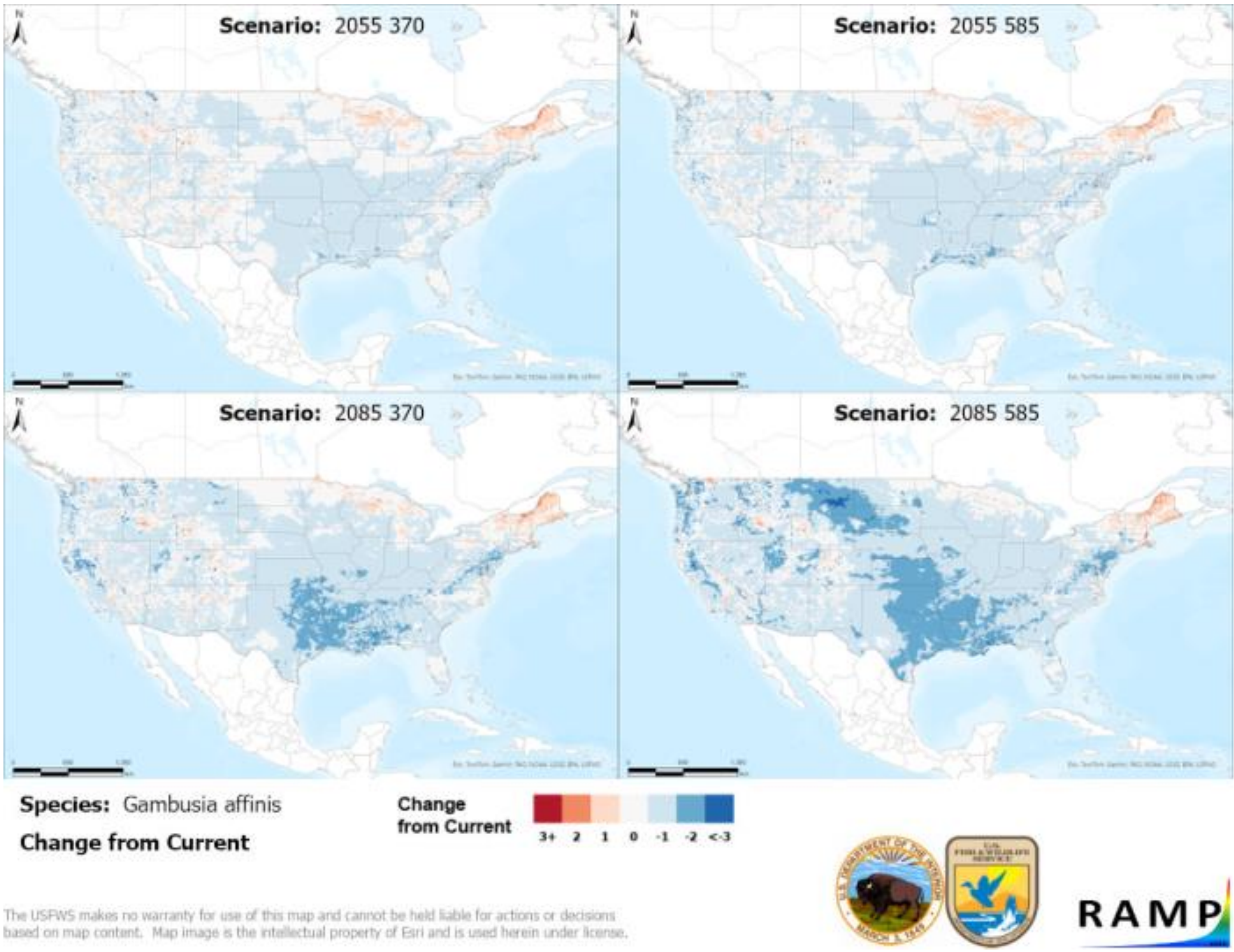

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Gambusia affinis* based on source locations reported by GBIF 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.

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