Largespring Gambusia (*Gambusia geiseri*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, July 2017
Revised, January 2018
Web Version, 7/6/2018

Photo: Jacob Stagg, some rights reserved. Available: https://www.inaturalist.org/photos/3225904 (January 2018).

1 Native Range and Status in the United States

Native Range

From Nico and Fuller (2018):

"Springs in the San Marcos and Guadalupe River systems, central Texas (Lee et al. 1980 et seq., Hubbs et al. 1991, Page and Burr 1991)."

Status in the United States

From Nico and Fuller (2018):

"Native Range: Springs in the San Marcos and Guadalupe River systems, central Texas (Lee et al. 1980 et seq.; Hubbs et al. 1991; Page and Burr 1991)."

"Nonindigenous Occurrences: The Largespring Gambusia has been introduced into several localities in Texas including Diamond Y Springs on Leon Creek (Pecos County); the Balmorhea springs complex including San Solomon, Giffin, East and West Sandia, and Phantom Cave springs, and irrigations ditches in that vicinity (Reeves County); Lazy Pond on Independence Creek, and nearby Chandler Springs (Terrel County); the headwaters of the Concho River at Head of the Run Ranch (formerly known as Anson Spring) south of Christoval (Tom Green County) (Hubbs et al. 1991, Hubbs, personal communication); and Comanche Springs (now desiccated) in Fort Stockton (Reeves County) [Rio Grande Fishes Recovery Team 1983]."

"Status: Locally established in Texas in the Balmorhea area springs. Extirpated at Comanche Springs which periodically becomes dry (Hubbs, personal communication)."

From TISI (2014):

"Contact local parks and wildlife authorities if a suspected largespring gambusia is identified outside of it's [*sic*] native habitat in the San Marcos and Guadalupe River systems."

Means of Introductions in the United States

From Nico and Fuller (2018):

"Means of Introduction: Stocks from San Marcos, Texas, were introduced into Comanche Springs and Balmorhea area in 1937 and 1956, respectively (Rio Grande Fishes Recovery Team 1983). Dates of other introductions are not known. Introductions into the springs at Balmorhea were separate introductions as the springs are not connected (Hubbs, personal communication). Hendrickson and Brooks (1991) indicated that *G. geiseri* was stocked into at least one site for conservation purposes, but the authors did not provide details or information on the locality."

From TISI (2014):

"Records of introduction to other locations indicate reasons of aesthetic purposes for stocking local ponds and streams."

From Sanchez et al. 2013:

"In the 1930s, *G. geiseri* was mistaken for its congener, *G. affinis*, and distributed throughout Texas for control of mosquitos (Hubbs and Springer 1957). Because *G. geiseri* is associated with spring systems (Hagen 1964, Page and Burr 1991), the only surviving individuals were those that either migrated to or were released directly into headwaters (Hubbs and Springer 1957). This resulted in the founding of multiple disjunct (human-introduced) populations of *G. geiseri* in various spring systems throughout much of central and western Texas (Hubbs and Springer 1957, Marsh-Matthews et al. 2005)."

Remarks

From TISI (2014):

"Largespring gambusia are similar to the mosquitofish (*Gambusia affinis*) and the Pecos gambusia (*Gambusia nobilis*), but the largespring gambusia can be differentiated by black spots along the sides."

"The largespring gambuisa is sympatric with the mosquitofish (*Gambusia affinis*) and the endandgered Pecos gambusia (*Gambusia nobilis*), creating the possibility of hybrid species".

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2017):

"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 Gambusia
Species *Gambusia geiseri* (Hubbs and Hubbs, 1957)

Current Standing: valid."

Size, Weight, and Age Range

From Froese and Pauly (2017):

"Max length : 4.4 cm TL male/unsexed; (Page and Burr 1991); common length : 2.5 cm TL male/unsexed; (Hugg 1996)"

From Fishes of Texas (2018):

"Age/size at maturation: Stevens (1977) reported first broods produced by females about 25 mm SL."

Environment
From Froese and Pauly (2017):

"Freshwater; benthopelagic; non-migratory."

From Sanchez et al. (2013):

"Several populations of *G. geiseri* occur in spring environments throughout central and western Texas and appear to be firmly established. Beyond these environments, however, *G. geiseri* do not persist."

From NatureServe (2013):

"Habitat includes cool, clear, high-volume discharge springs near their emergence from underground limestone aquifers; this species is often in swift water (Lee et al. 1980, Page and Burr 2011)."

Climate/Range
From Froese and Pauly (2017):

"Subtropical, preferred ?; 31°N - 28°N"

Distribution Outside the United States
No occurrences of *Gambusia geiseri* exist outside of the United States.

Means of Introduction Outside the United States
No occurrences of *Gambusia geiseri* exist outside of the United States.

Short Description
From Fishes of Texas (2018):

"Coloration: Postanal streak prominent (darker than markings on scale pockets); dark markings on mouth; median row of spots on dorsal fin; lateral stripe thin and threadlike; caudal fin with prominent dark markings; markings on side rounded specks; dorsal and (in females) anal fins with yellow pigmentation (lost in preservation; Hubbs et al. 1991). Olive above, dark stripe along back to dorsal fin; iridescent blue and yellow on silver side (Page and Burr 1991)."

"External morphology: Terminal hook on 4th and 5th rays of gonopodium angular at tip; tip of anterior branch of 4th ray of male gonopodium extends as far as tip of posterior branch; pectoral fin of males with slight indention, shallower than widest pectoral fin ray; distal hook on 4th ray of gonopodium usually unsegmented; distal segments of anterior branch of 4th fin ray of gonopodium not coalesced to elbow; spines at tip of 3rd anal fin ray of male gonopodium 4-10 times longer than wide; origin of dorsal fin well behind origin of anal fin (Hubbs et al. 1991)."

Biology

From Sanchez et al. (2013):

"The largespring gambusia (*Gambusia geiseri*) is a livebearing fish"

From TISI (2014):

"Largespring gambusia have been observed to spawn year round even during unfavorable environmental conditions. This species has an usually high reproductive potential because females are capable of producing a high number of eggs. The average number of eggs carried for the size category 2.5-2.7 cm is 8 eggs, while the largespring gambusia is able to carry 16 eggs (average size female). Females have their first brood when they are 2.5 mm long, followed by the second brood when they are 3.0 mm."

From Fishes of Texas (2018):

"Spawning Behavior: Hubbs and Delco (1960) found *Gambusia geiseri* males to exhibit very low courtship activity for females of other species (*G. affinis*, *G. heterochir*, and *G. hurtadoi*), and suggested that this behavior may be due to its extensive sympatry with *G. affinis* in its natural range."

Human Uses

From Sanchez et al. 2013:

"In the 1930s, *G. geiseri* was mistaken for its congener, *G. affinis*, and distributed throughout Texas for control of mosquitos (Hubbs and Springer 1957). Because *G. geiseri* is associated with spring systems (Hagen 1964, Page and Burr 1991), the only surviving individuals were those that either migrated to or were released directly into headwaters (Hubbs and Springer 1957)."

Diseases

From Fishes of Texas (2018):

"Host Records: Cestoda (1), Trematoda (2), Nemata (4), Acanthocephala (2; Mayberry et al. 2000)."

Threat to Humans

From Froese and Pauly (2017):

"Harmless"

3 Impacts of Introductions

From Nico and Fuller (2018):

"Impact of Introduction: This species reportedly competes with another spring-dwelling species, the endangered Pecos gambusia *G. nobilis* and is considered a potential threat to that species' existence (Rio Grande Fishes Recovery Team 1983).

From Rio Grande Fishes Recovery Team (1983):

"The effects of competition on *G. nobilis* are well known and available data indicate that they are disappearing in the Balmorhea area because of the expansion of *G. geiseri*, a nonnative poecilid introduced to the springs in the early 1930s."

"The danger to *G. nobilis* from competition with *G. geiseri* may vary depending upon the salinity of the water (Echelle and Echelle 1980). *G. geiseri* is widespread in the freshwater springs and peripheral waters of the Balmorhea area with conductivities of 3500-5000 umhos/cm [*sic*], while in relatively saline waters of Leon Creek with conductivities near 15,000 umhos/cm [*sic*], *G. geiseri* occurs only in Diamond-Y Spring and its outflow. […] Thus, *G. nobilis* seems to outcompete *G. geiseri* in the saline waters of Leon Creek, while *G. geiseri* seems competitively superior in the freshwaters of the Balmorhea area (Echelle and Echelle 1980)."

"*Gambusia nobilis* is known to hybridize with both *G. affinis* and *G. geiseri*; *G. nobilis* x *G. affinis* hybrids are most common."

From Sanchez et al. (2014):

"Researchers have closely monitored both *G. nobilis* and *G. geiseri* populations in the San Solomon Cienega since 2009 (Garrett, pers. comm.) and have observed mating between these two congeners (Deaton Haynes et al., unpublished data). This evidence may suggest potential hybridization between *G. geiseri* and *G. nobilis*, which could be detrimental to the integrity of current *G. nobilis* populations."

From Sanchez et al. (2013):

"*Gambusia geiseri* is quite successful within the bounds of its required parameters of habitat (Rehage et al. 2005) and thus, has the potential to outcompete sympatric congeners in these habitats (N. Vaughn and E. Marsh Matthews, pers. comm.). *Gambusia geiseri* exhibits some characteristics typical of invasive species. For example, *G. geiseri* shows highly symmetrical competition when exposed to a novel competitor and shows no response when in the presence of a novel predator (Rehage et al. 2005). *Gambusia affinis*, a highly invasive congener of *G. geiseri*, exhibits these same characteristics, suggesting the invasive potential of *G. geiseri*. However, because *G. geiseri* require very specific parameters of habitat, its success is limited to spring systems."

From Rehage and Sih (2004):

"We found species differences in boldness that provided mixed support for our hypothesis of how boldness should relate to invasiveness. Mosquitofish were significantly bolder than *G. hispaniolae*, but not *G. geiseri*. *G. geiseri* appeared as bold as invasive *Gambusia*. This result along with other data on the foraging behavior of *G. geiseri* in response to novel competition (Rehage and Sih, unpublished manuscript) suggests that *G. geiseri* fits the behavioral profile of a successful invader. However, *G. geiseri* is found only in two springs in central Texas and has been unsuccessful at spreading beyond points of introduction where introduced (C. Hubbs, pers. comm.). We suspect that other traits, particularly demographic parameters, and biotic and abiotic tolerances (Rehage and Sih, unpublished manuscript), severely limit its native distribution and its potential invasiveness. This result argues for a need to carefully analyze a range of potentially important traits in order to fully understand their respective contribution to invasion success."

4 Global Distribution

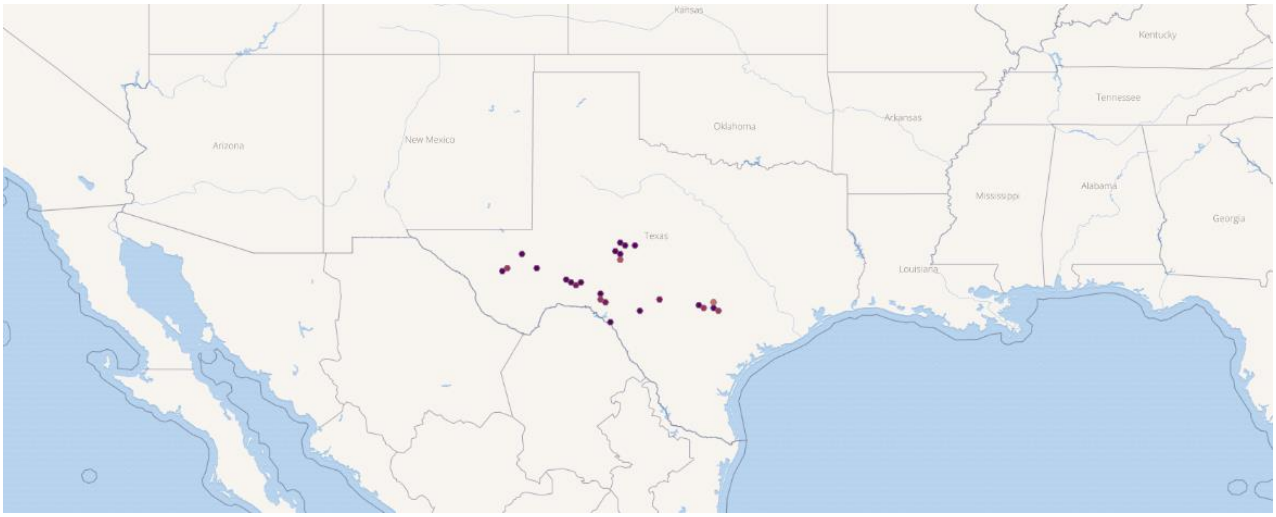

Figure 1. Known global distribution of *G. geiseri*, reported from central and western Texas. Map from GBIF (2017).

5 Distribution Within the United States

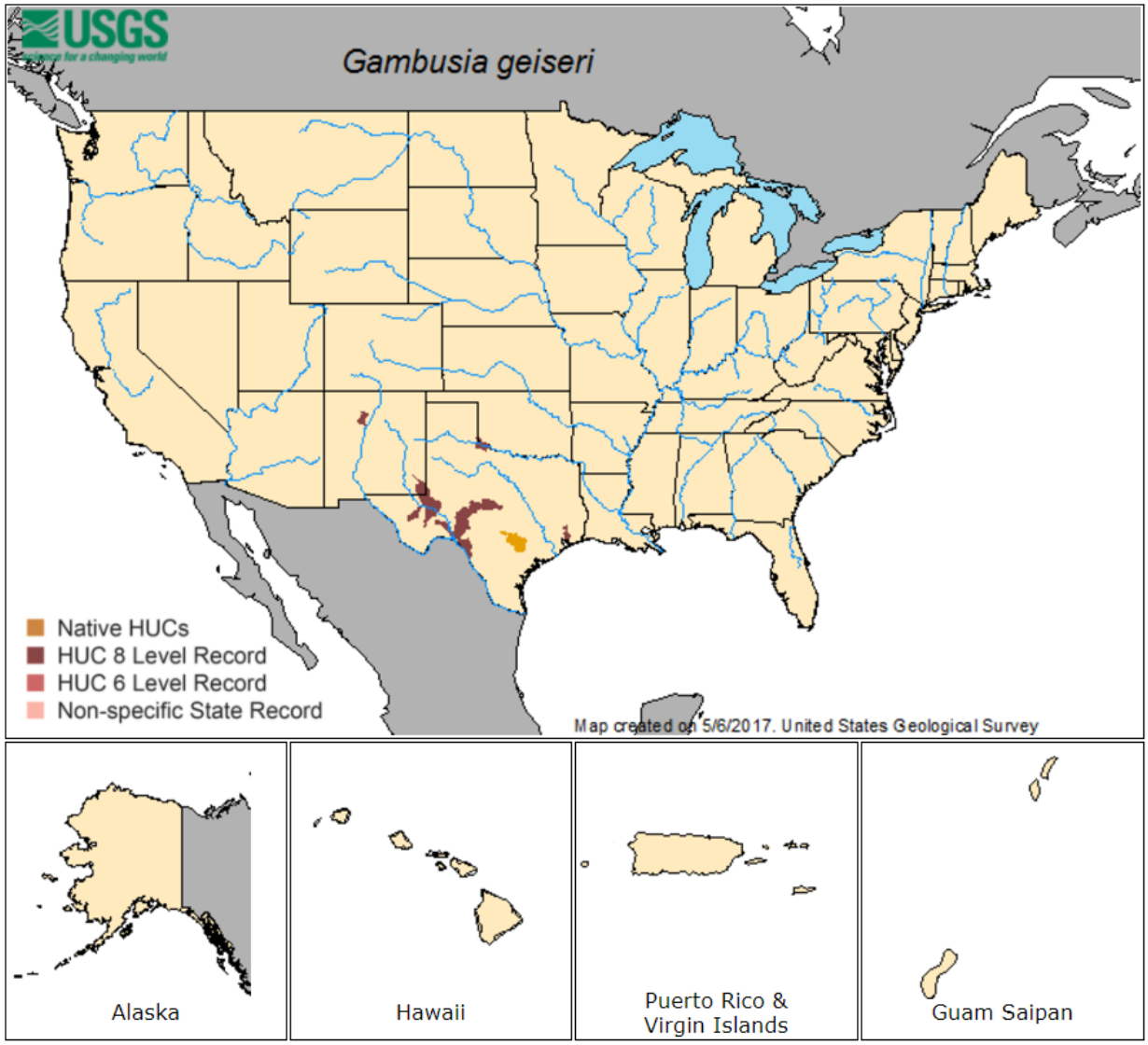

Figure 2. Known distribution of *G. geiseri* in the United States, reported from Texas and New Mexico. Map from Nico and Fuller (2018).

6 Climate Matching

Summary of Climate Matching Analysis

G. geiseri is native to central Texas. Therefore, the highest matches are located throughout Texas and the southern United States. In addition, medium climate matches occur in the Midwest and southeast coast of the United States.

The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the U.S. was 0.188 which is categorically high.

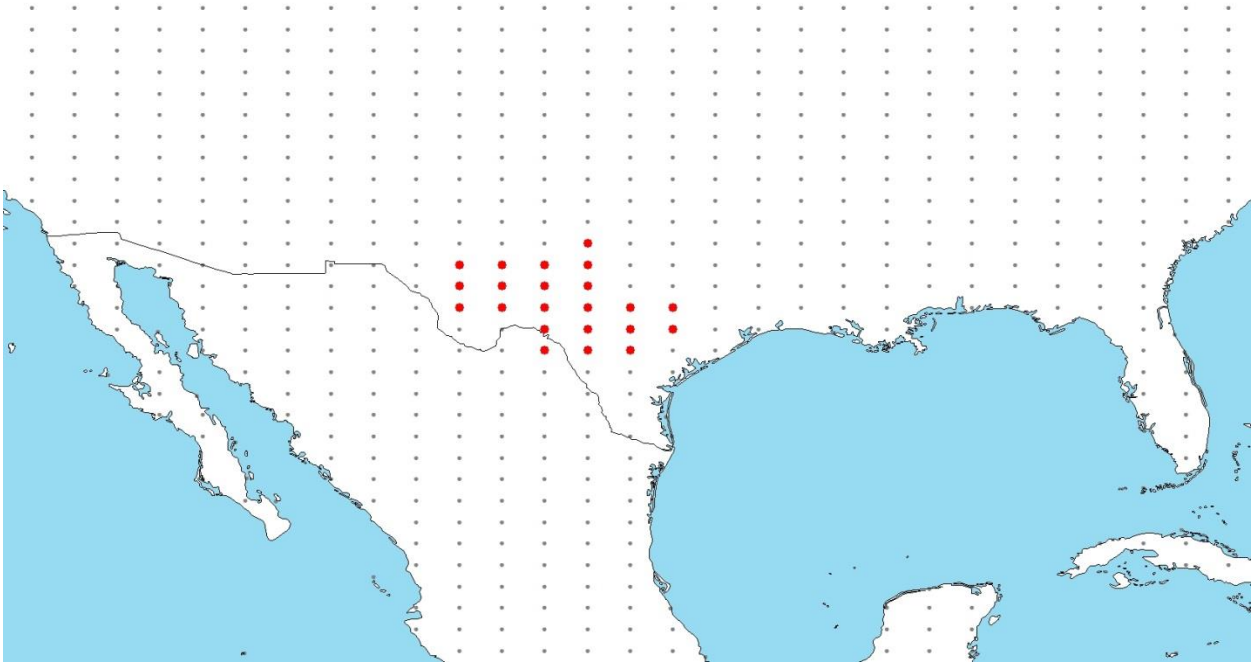

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations in the southern United States selected as source locations (red) and non-source locations (gray) for *G. geiseri* climate matching. Source locations from GBIF (2017).

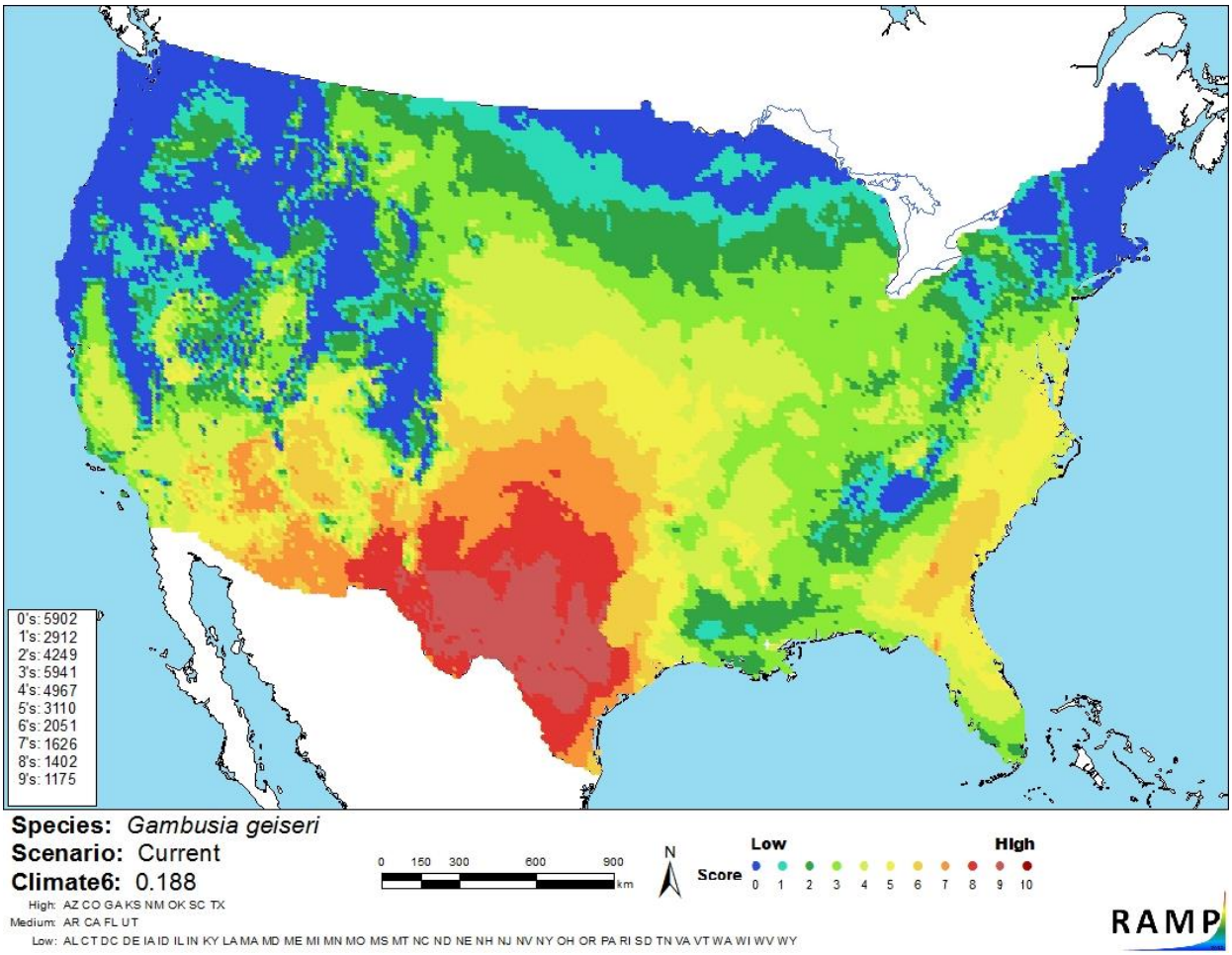

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *G. geiseri* in the contiguous United States based on source locations reported by GBIF (2017). 0= Lowest match, 10=Highest match."

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

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

7 Certainty of Assessment

G. geiseri is established outside its native range and several reports indicate that this species competes (or has the potential to compete) with native species. However, these reports are largely anecdotal. *G.geiseri* is known to hybridize with an endangered fish, *G. nobilis. G. geiseri* has a high climate match in the contiguous United States, and its distribution is well-documented. However, *G. geiseri* is limited to spring systems and specific habitat parameters have yet to be quantified to better understand its effective range. More research is needed to

determine the full impact of *G. geiseri* on native species and ecosystem function, so the certainty of this assessment is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Gambusia geiseri is a poecilid fish native to large springs in central Texas. Mistaken for *G. affinis* (mosquitofish), *G. geiseri* was spread to other springs in Texas as a method of mosquito control in the 1930s, and has established in some of those locations. *G. geiseri* is often compared to invasive mosquitofish, and has been found to have many of the same characteristics that promote invasiveness. Anecdotal reports by scientists suggest that *G. geiseri* can outcompete native species where introduced, including the endangered *G. nobilis*. *G. geiseri* can hybridize with *G. nobilis*, which could pose a further threat to this species. However, clear and defensible data on impacts to native species is lacking. *G. geiseri* has a high climate match in the contiguous United States, but this species is believed to be limited to large spring systems. Certainty of this assessment is low due to uncertainty about the ability of this species to establish in new environments, and due to the anecdotal and sometimes speculative information available about its impacts. Until further clarity about impacts and barriers to spread can be attained, overall risk for this species is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): Uncertain**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Low**
- **Overall Risk Assessment Category: Uncertain**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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