Spring Pygmy Sunfish
(*Elassoma alabamae*)

5-Year Status Review:
Summary and Evaluation

Adult spring pygmy sunfish. Photo by USFWS

U.S. Fish and Wildlife Service
Southeast Region
Alabama Ecological Services Field Office
Daphne, AL

September 2024

5-YEAR STATUS REVIEW
Spring Pygmy Sunfish (*Elassoma alabamae*)

GENERAL INFORMATION

Current Classification: Threatened

Lead Field Office: Alabama Ecological Services Field Office

Review Author(s): Evan Collins, Alabama Ecological Services Field Office

Reviewers:
Lead Regional Office: Southeast Region, Carrie Straight

Wheeler National Wildlife Refuge: Nick Wirwa

Date of original listing: December 2, 2013 (78 FR 60766; October 2, 2013)

Critical Habitat: Critical habitat final rule: July 1, 2019 (84 FR 24987, May 30, 2019).

Methodology used to complete the review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants (50 CFR 424.11). The U.S. Fish and Wildlife Service (Service) evaluated the best available information about the spring pygmy sunfish's biology, habitat, and threats of to inform this status review.

We announced initiation of this review in the Federal Register on April 11, 2019 (84 FR 114669) with a 60-day comment period and received no comments. The primary sources of information used in this analysis were the 2012 proposed listing rule (Service 2012) 2013 final listing rule (Service 2013), 2019 critical habitat designation (Service 2019), unpublished survey data and reports, and personal communication with recognized experts. This review was completed by the U.S. Fish and Wildlife Service, Alabama Ecological Services Field Office, Daphne, Alabama. All literature and documents used for this review are on file at the Field Office. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the spring pygmy sunfish.

FR Notice citation announcing the species is under active review:
April 11, 2019 (84 FR 114669)

Species' Recovery Priority Number at start of 5-year review (48 FR 43098):
8. The spring pygmy sunfish is a species with a moderate degree of threat and a high recovery potential.

Review History:

This is the first 5-year status review for this species.

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature
We are not aware of any changes to the taxonomy of this entity, and it is still considered valid by the Service.

Distinct Population Segment (DPS) (61 FR 4722)
The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This species was not listed as a DPS, and we have no new information that would indicate the species should be listed as a DPS under the Service's 1996 DPS Policy.

Recovery Criteria

Recovery Plan or Outline
At the time of this review, recovery criteria for this species have not been finalized.

Biology and Habitat Summary

Descriptive information about the spring pygmy sunfish can be found in the proposed listing rule for the species (Service 2012).

The spring pygmy sunfish spawns opportunistically through the year with the majority of spawning events occur in spring (March through April) as evidenced by the majority of young of the year individuals (<10mm, <0.4 in) appear in the population in June and July though present throughout much of the year (AST Environmental 2020, 2021, 2022, 2023, 2024).

The current range of spring pygmy sunfish is restricted to two systems in northern Alabama (Figure 1). Two metapopulations of the spring pygmy sunfish are extant (Figure 1). One is located in the Beaverdam Spring/Swamp complex (herein called the Beaverdam Population or simply Beaverdam) and the other is in Blackwell Swamp (referred to as the Blackwell population or simply Blackwell). A third population was known to occur in Pryor Spring but has been considered extirpated since 2007.

The spring pygmy sunfish exhibits a metapopulation structure within the Beaverdam Creek system and, historically, in the adjacent and now-extirpated Pryor Branch system (Sandel 2008; Sandel 2011). A metapopulation is a group of individual populations that have some level of gene flow between them but are spatially isolated by unfavorable intervening habitat created naturally or anthropogenically (Akçakaya et al. 1999). With continued temporal isolation and lack of gene flow, some populations within a metapopulation may become extirpated. However, if extirpation occurs, there is a probability that the habitat patches will be recolonized by some members of the metapopulation (Levins 1968; Levins 1970; Gotelli 1991).

Regular survey data of the species since 2014 document variation of catch per unit effort (CPUE) over time. In both extant populations, monthly monitoring occurred between June 2019 and April 2021, and bi-monthly monitoring has been occurring since June 2021. Catch per unit effort was found to differ significantly between years (AST Environmental 2024). With catch per unit effort inferred to estimate abundance, the data indicate variability in abundance from year-to-year for each population (Table 1, Figure 2 and Figure 3). Additional years of data will be needed to assess any trend in abundance through time.

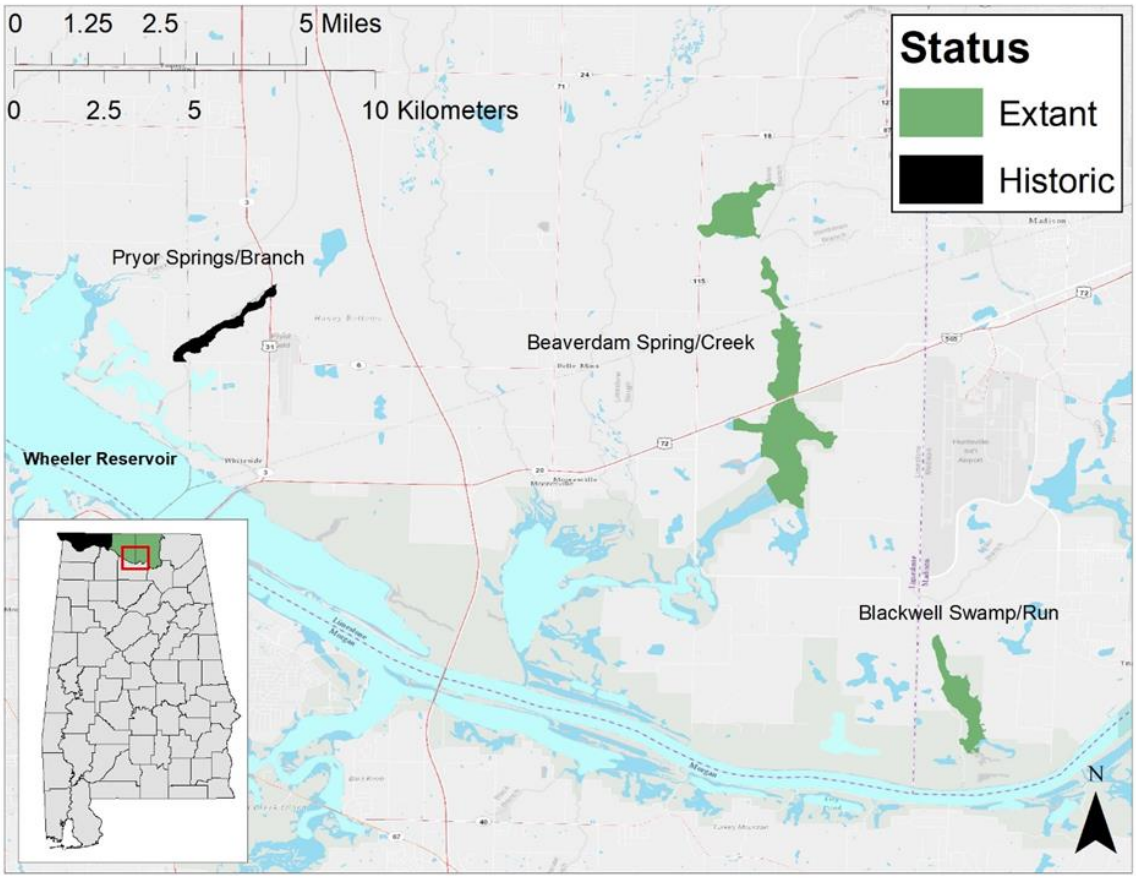

Figure 1. Current distribution of the spring pygmy sunfish in Limestone and Madison counties, Alabama, shown in green, and including the more recently extirpated Pryor Spring population indicated in black.

For the spring pygmy sunfish, migration and connectivity between spring pools is essential in maintaining the species' genetic diversity within the Beaverdam Creek system. Sandel (2008 and 2011) found that the spring pygmy sunfish population in Beaverdam Creek system is composed of isolated subpopulations within the spring pools and spring runs. These pools and runs are connected spatially and temporally with periods of isolation and connectivity that are dependent on the extent and composition of aquatic vegetation, water quality, water quantity, and other factors such as unintentional fish barriers at road crossings (e.g., clogged or perched pipe/culvert). The spring pygmy sunfish sub-populations within the population are intermittently connected via migration and recolonization after local extirpation events.

Table 1. Total number of spring pygmy sunfish captured during a report year. Note that a report year includes survey effort that begin in March or April of the preceding year and extend to February of the report year. Data provided from AST Environmental 2020, 2021, 2022, 2022, and 2024.

Population	2020	2021	2022	2023	2024
Beaverdam Population	3173	4022	4464	3688	4357
Blackwell Population	124	152	408	222	458

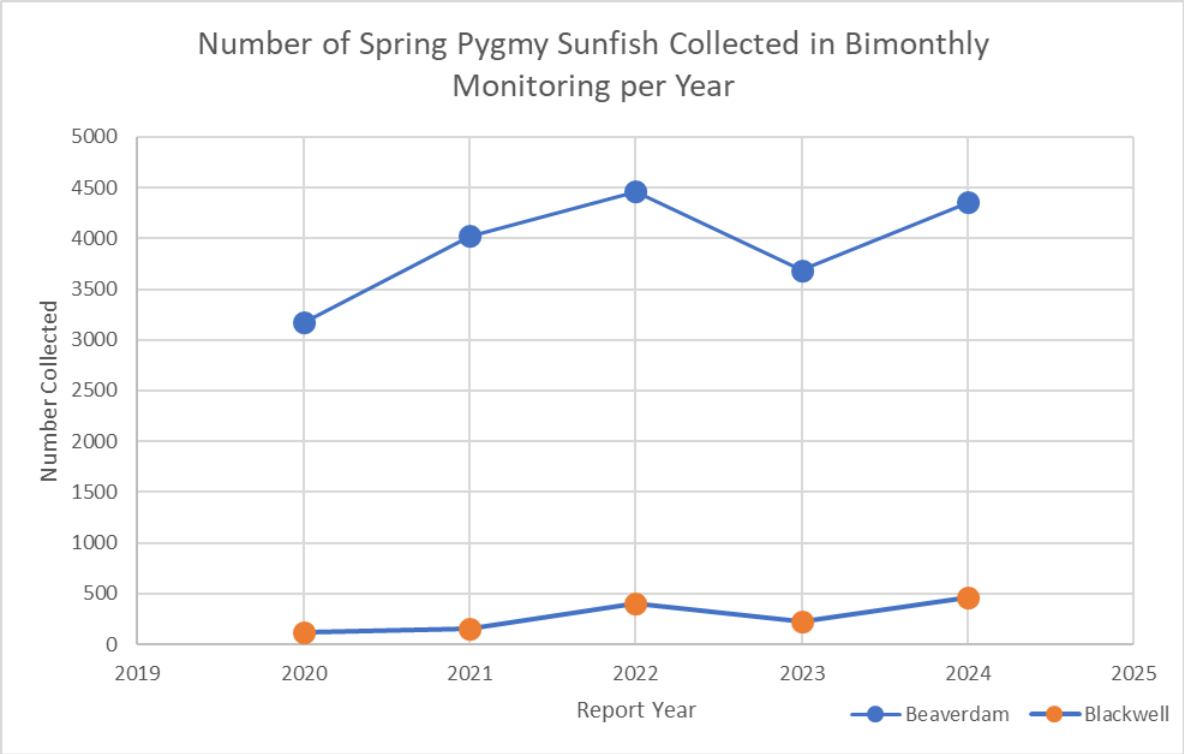

Figure 2. Total number of spring pygmy sunfish captured at the conclusion of yearly sampling. Note that a report year includes survey effort that begin in March or April of the preceding year and extend to February of the report year. Data provided from AST Environmental 2020, 2021, 2022, 2022, and 2024.

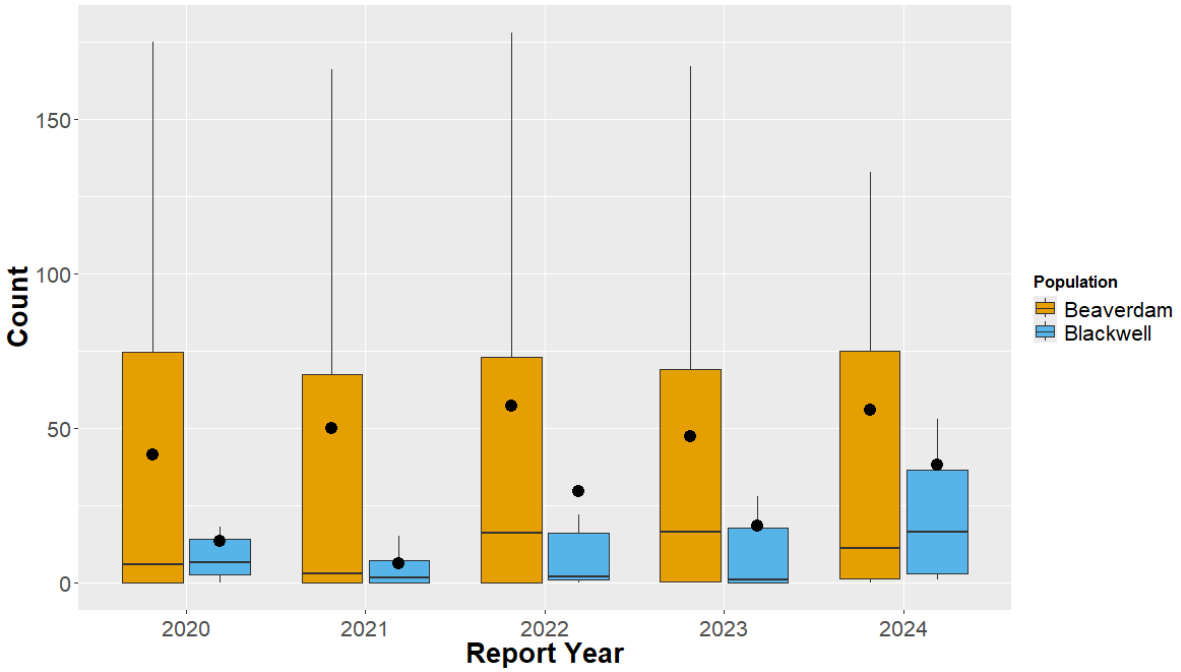

Figure 3. Boxplot representing summary statistics of number of spring pygmy sunfish caught per effort in two populations by report year. Black notes denote mean number captured, black bars denote the median number captured, lower and upper hinges correspond to 1st and 3rd quartiles, and whiskers indicate data 1.5 times the interquartile range. Outliers have been excluded. Note that a report year includes survey effort that begin in March or April of the preceding year and extend to February of the report year. Data provided from AST Environmental 2020, 2021, 2022, 2022, and 2024.

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. A summary of this assessment is detailed below.

Factor A: the present or threatened destruction, modification, or curtailment of its habitat or range. The final listing rule described threats to the spring pygmy sunfish that result in reductions in water quantity and water quality degradation caused by excessive groundwater usage, contamination within the spring recharge area, stormwater discharge from agricultural lands and urban sites, large scale residential and industrial developments, overgrazing by livestock, and land clearing (Service 2013). Recent information indicates that the severity and extent of some of these threats have changed since the time of listing. Shifts in land use have resulted in a decreased area in agriculture as farmland has been and continues to be converted into industrial and residential use. The City of Huntsville boundary surrounds Beaverdam Creek habitat and areas on all sides of Blackwell Swamp and is zoned primarily as residential, commercial industrial park, and planned industry district. As a result, threats emanating from agricultural lands such as overgrazing livestock are less likely to influence the species. However, as row-crop agricultural practices continue on lands adjacent to Beaverdam Creek, Blackwell Swamp and Pryor Spring, effects to water quality and quantity caused by agricultural activities such as water withdrawal and contaminated runoff from crop lands remain.

As described above, agricultural lands continue to be converted into residential and industrial land uses. Residential and industrial land uses are expected to also negatively influence the quantity and quality of water that ultimately recharges the aquifers supporting springs inhabited by the spring pygmy sunfish. Increases in impervious surfaces such as parking lots, roads, and roofs are expected to prevent infiltration of rainfall. Surface water that does ultimately recharge the aquifer from developed lands is expected to carry contaminants and increase water temperatures. Further, impervious surfaces can lead to dramatic fluctuations (more frequent and higher magnitude flooding) in water flow (Ferguson and Suckling 1990, May et al. 1998, Wang et al. 2001), which causes increased erosion and sedimentation of streams. As stated in the final listing rule: "excessive sediment runoff during stormwater events decreases water clarity, which reduces light penetration needed for plant growth and results in impacts to the spring pygmy sunfish's spawning and feeding sites" (Service 2013). Similarly, land clearing within watersheds occupied by the spring pygmy sunfish can substantially contribute to excessive sedimentation in streams as large areas of soils are exposed. Land clearing remains pervasive as the area continues to rapidly develop.

Since the time of listing, 1,100 acres of the Beaverdam Creek system have been protected as a "Conservation Corridor". Lands within the "Conservation Corridor" have been transferred to two designated land trusts, the Land Trust of North Alabama and the Forever Wild Land Trust (https://www.landtrustnal.org/2020/06/22/beaverdam-swamp-protected/), which maintain the property in perpetuity to support the biological integrity, diversity, and environmental health of the habitat. The "Conservation Corridor" cannot be used for agriculture, ranching, silviculture, mining (or other extractive uses), development, or any other ground disturbing activities except for habitat enhancement projects (Mazda Toyota Manufacturing U.S.A, Inc. and Center for Biological Diversity 2018). Similarly, the Blackwell Swamp population of the spring pygmy sunfish occurs entirely on Wheeler National Wildlife Refuge. Land management of the "Conservation Corridor" and Wheeler National Wildlife Refuge are expected to benefit the species and moderate some of the threats to the species. However, activities conducted on neighboring properties have been seen to directly affect both waterbodies directly and are expected to impact the recharge area of supporting aquifers.

Recent information shows that many of water quality and quantity threats identified in the final listing rule remain ongoing, occur throughout the species range, and are expected to continue in the future as the region continues to urbanize. While land ownership and management priorities surrounding much of the habitat occupied by the spring pygmy sunfish is expected to moderate the severity of some threats, activities adjacent to conservation lands are still expected to affect water quality and quantity in the recharge area and have been observed to directly affect habitats within conservation lands via streamflow from adjacent properties.

Factor B: overutilization for commercial, recreational, scientific, or educational purposes. The final listing rule (Service 2013) did not consider this a threat, and we have no new information that would indicate this factor has become a significant threat for the species in the time since listing.

Factor C: disease or predation. The final listing rule (Service 2013) did not consider this a threat, and we have no new information that would indicate this factor has become a significant threat for the species in the time since listing.

Factor D: the inadequacy of existing regulatory mechanisms. The 2013 final listing rule detailed that the sunfish and its habitat were afforded limited protection from degradation of habitat and surface water input under several Federal, State, and County statutes and regulations (Service 2013). However, large volumes of groundwater and surface water continued to be removed and those reductions were expected to threaten the aquifer that supplies water to the spring pygmy sunfish's habitat. Furthermore, degradation of habitat within the recharge area within the range of the spring pygmy sunfish continued despite the laws and regulations identified. Therefore, the listing rule determined that the existing regulatory mechanisms were inadequate to reduce or eliminate threats to the sunfish.

Since the species was listed, land use has rapidly changed as farmland has been converted into residential and industrial sites. As a result, there has been a decrease in demand for water from Beaverdam Creek for irrigation and direct water withdrawal for this purpose has reduced. However, along with increases in industry and residential use, we expect to see corresponding increases and water demand for other purposes. Specifically, municipal water supplies will need to accommodate increasing populations and industry in the area. Municipal water is supplied from a variety of sources including the Tennessee River, Elk River, and wells that withdraw water from Tuscumbia-Fort Payne Aquifer (Limestone County Water and Sewer Authority 2022; Madison County Water Department 2023). As habitat of the spring pygmy sunfish is fed by groundwater from the Tuscumbia-Fort Payne Aquifer, increased use of this supply is expected to affect water quantity for the species in the future. Among industrial sites in the area, manufacturing and logistics facilities are prominent which have the potential to introduce pollutants into local waterways and create large amounts of impervious surfaces. Because the dominant rock-types in the area are limestone and chert, quarry development is another industry that occurs in the vicinity of habitat for the spring pygmy sunfish. Quarries have the potential to negatively affect water quality and quantity (Langer 2001; Dobbins et al. 2013). Limestone, marble, and dolomite operations are specifically exempted in Alabama from Alabama Department of Labor oversight which generally oversees all other non-fuel mining operations (Alabama Surface Mining Act of 1969, as amended), though any discharges from these site still require a National Pollutant Discharge Elimination System (NPDES) permit pursuant to sections 318, 402, and 405 of the Clean Water Act (33 U.S.C 1251 et seq.)

Shifts in land use from agriculture to residential and industrial uses corresponds to a shift in stressors and existing regulatory mechanisms remain inadequate to fully address threats that arise from the landscape such as non-point source pollution, increases in impervious surface cover in the groundwater recharge area, and lowering water tables. Therefore, threats arising from inadequacy of regulatory mechanisms to protect the species and its habitat remain ongoing, severe, occur throughout the species range, and are expected to continue in the future as the region continues to urbanize.

Factor E: other natural or manmade factors affecting its continued existence. The final listing rule identified climate change and habitat fragmentation and its effects on gene flow and population demographics as other natural or manmade factors affecting the spring pygmy sunfish's continued existence (Service 2013). Threats arising from Factor E are expected to increase in magnitude in the future as these threats will act across these species' range and negatively affect subpopulations to a degree that would be difficult for them to naturally rebound.

Annual average temperature in Alabama is projected to increase in the future and these increases in temperature will increase the likelihood of intensive droughts (Runkle et al. 2022). Increased average temperatures are also expected to increase evapotranspiration rates, increase aridity, deepen water table depths, and decrease groundwater storage (Likens 2009; Condon et al. 2020). As increased temperature affects plant transpiration, human demands for groundwater increases and is expected to further stress reduced groundwater storage (McDonald and Girvetz 2013). The effects of these processes would likely result in the deepening of the Tuscumbia-Fort Payne Aquifer which will decrease water quantity for the spring pygmy sunfish. As water levels decrease, the spring pygmy sunfish will become more concentrated and less able to seek refuge from predators and exposed to declines in water quality such as decreased dissolved oxygen and increased water temperature. Further, the deepening water table could result in complete drying out of locations currently and previously occupied by spring pygmy sunfish which would remove habitat and prevent movement between occupied sites.

It is unclear to what degree rising ambient temperatures will influence groundwater temperature and how any effects may be exacerbated by increases in impervious cover within recharge zones. However, given the very limited temperature range spring pygmy sunfish can tolerate (see discussions in Service 2012 and 2013), it is expected to respond negatively to even small changes in groundwater temperature.

Increases in extreme precipitation event are also projected for the future in Alabama (Runkle et al. 2022). However, extreme rainfall events may not sufficiently recharge groundwater as intense rainfall is likely to exceed the rate at which the soil can absorb water and much of the rainfall become runoff. This runoff is expected to increase turbidity and carry pollutants and excess nutrients into streams, especially where disturbed riparian areas and impervious surface cover are prevalent (Lall et al. 2018). Subsequent declines in water quality are likely to negatively affect individuals of the spring pygmy sunfish and aquatic plants on which it depends to seek food and shelter.

Synthesis

The spring pygmy sunfish is a diminutive fish (typically less than one inch (25mm) long) that only occurs in springs and spring systems along the Tennessee River in northern Alabama. There are currently two extant and isolated populations of spring pygmy sunfish consisting of eleven subpopulations and one extirpated population. Population and individual numbers of the species appear to fluctuate by season and year as indicated by recorded catch per unit effort. Populations are isolated from one another while subpopulations exhibit some geneflow. However, geneflow among subpopulations has been reduced due to the history of adjacent land use practices and habitat alterations. While much of the lands surrounding occupied habitat of the spring pygmy sunfish are currently owned and managed for conservation, the threats of incompatible land use continue in the surrounding areas and are expected to affect recharge of the aquifers that support springs inhabited by the spring pygmy sunfish. In addition, water quality and quantity are likely to respond negatively to projections of future climatic conditions in the area. Given the species adaptation to very stable conditions, small changes in water quality parameters are expected to negatively affect the species. Because of ongoing threats and the current condition of the species, this species continues to meet the definition of a threatened species.

RECOMMENDED FUTURE ACTIVITIES

This species does not have a final recovery plan. While completing this status review, we have identified the following potential recovery activities which are included below.

Recovery Activities

- Protect and enhance habitat using available mechanisms including land acquisition programs, conservation agreements, and management agreements.
- Work with the current owners of Pryor Spring and initiate efforts to reestablish a population at Pryor Spring through captive propagation and/or translocation.
- Develop a watershed management plan with partners like the City of Huntsville, the North Alabama Land Trust, local subdivisions, and surrounding industries to reduce negative effects to the recharge area of springs that support the spring pygmy sunfish.
- Continue working with industry leaders like, Toyota/Mazda, the Land Trust of North Alabama, and local landowners to identify and implement management activities that promote conditions for the spring pygmy sunfish (e.g., manage canopy cover to promote aquatic vegetation and maintain cooler water temperatures).
- Restore stream channels that flow into spring pygmy sunfish habitat to natural conditions.

Monitoring and Research Activities

- Research the relationship between species' presence, abundance, and demographics and water quality parameters and pollutants. Use this information to identify and alleviate water quality stressors contributing to population declines.
- Conduct life history and demographic studies.
- Conduct research on the species population genetics.
- Monitor populations to assess long-term trends while considering and minimizing negative effects to habitat. Population monitoring should include habitat assessments.
- Use tracer techniques to better describe groundwater that supply springs where the spring pygmy sunfish occurs. This work would better define the recharge area and flow patterns.
- Research sedimentation (i.e., sources, frequency of events, thresholds) to determine relative contribution of specific stressors to declines; identify and implement solutions for eliminating excessive sedimentation and restoring habitat quality.
- Regularly monitor water quality parameters and identify and implement solutions to improve water quality into ranges suitable to the spring pygmy sunfish.
- Conduct a comprehensive threats analysis in currently occupied spring systems.
- Conduct field surveys to identify whether additional populations exist, better define range extent and estimate abundance of existing populations using traditional and environmental DNA methods, and search for new areas for potential reintroduction.

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RESULTS / SIGNATURES

U.S. Fish and Wildlife Service
Status Review of Spring Pygmy Sunfish

Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist:
____ *The species is extinct*
The species does not meet the definition of an endangered or threatened species
____ *The species is recovered.*
____ *New information indicates the species does not meet the definition of an endangered or threatened species.*
____ *The listed entity does not meet the statutory definition of a species.*
_X_ No change needed

FIELD OFFICE APPROVAL:

Field Supervisor, Alabama Ecological Services Field Office, Fish and Wildlife Service

Approve WILLIAM PEARSON Digitally signed by WILLIAM PEARSON Date: 2024.10.08 13:27:38 -05'00'

LEAD REGIONAL OFFICE APPROVAL:
Acting for **Assistant Regional Director – Ecological Services, Fish and Wildlife Service**

Approve AARON VALENTA Digitally signed by AARON VALENTA Date: 2024.09.26 14:22:30 -04'00'