U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM
July 2023

ANIMAL GROUP AND FAMILY: Amphibians, Plethodontidae (lungless salamanders)

SCIENTIFIC NAME: *Eurycea wallacei*

COMMON NAME: Georgia Blind Salamander

LEAD REGION: Region 4

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DATE INFORMATION CURRENT AS OF: February 2023

STATUS/ACTION:
__X__Species petitioned for listing which we have determined does not warrant listing (does not meet the definition of a threatened or endangered species)

PETITION INFORMATION:
__X__ Petitioned; Date petition received: April 20, 2010
90-day substantial finding FR publication date: September 27, 2011(76 FR 59836)

PREVIOUS FEDERAL ACTIONS:

On April 20, 2010, we received a petition from the Center for Biological Diversity to list the Georgia blind salamander (*Eurycea wallacei*) as an endangered or threatened species under the Endangered Species Act of 1973, as amended (Act). On September 27, 2011, we published a 90-day finding (76 FR 59836) that the petition contained substantial information indicating listing may be warranted for the species. This document constitutes our 12-month finding on the April 20, 2010, petition to list the Georgia blind salamander under the Act.

GROUP AND FAMILY: AMPHIBIAN
Order: Caudata
Family: Plethodontidae

BIOLOGICAL INFORMATION:

To assess the viability of Georgia blind salamander, we conducted a species status assessment (SSA) using the three conservation biology principles of resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 306–311). Briefly, resiliency supports the ability of the species to withstand environmental and demographic stochasticity (for example, wet or dry, warm or cold years, variation in demographic rates), redundancy supports the ability of the species to withstand catastrophic events (for example, droughts, large pollution events), and representation supports the ability of the species to adapt to both near-term and long-term changes in its physical and biological environment (for example, climate change, disease). A species with a high degree of resiliency, representation, and redundancy is better able to adapt to novel changes and to tolerate environmental stochasticity and catastrophes. In general, species viability will increase with increases in resiliency, redundancy, and representation (Smith et al. 2018, entire). Using these principles, we identified the species' ecological requirements for survival and reproduction at the individual, population, and species levels, and described the beneficial and risk factors influencing the species' viability.

We use the SSA framework to assemble the best scientific and commercial data available for this species. The SSA framework consists of three sequential stages. During the first stage, we evaluate the species' needs. The next stage involves an assessment of the historical and current condition of the species' demographics and habitat characteristics, including an explanation of how the species arrived at its current condition (i.e., how threats and conservation actions have influenced the species). The final stage of the SSA framework involves assessing the species' plausible range of future responses to positive and negative environmental and anthropogenic influences. The SSA framework uses the best available information to characterize viability as the ability of a species to sustain populations in the wild over time and is used to inform our regulatory decision.

The SSA Report does not represent a decision by the Service on whether Georgia blind salamander should be listed under the Act. However, it does however provide the scientific basis that informs our regulatory decisions, which involve the further application of standards within the Act and its implementing regulations and policies. The SSA Report for the Georgia blind salamander (*Eurycea wallacei*) – November 2022, version 1.0 (SSA Report) is a summary of the information we have assembled and reviewed and incorporates the best scientific and commercial data available for this species. For more detailed information, please refer to the SSA Report (Service 2022a, entire).

Species Description

As described in Section 2.2 of the SSA Report (Service 2022a, pp. 4–5), the Georgia blind salamander is a relatively small, pinkish white, blind salamander with visible external gills (Carr 1939, p. 335) (Figure 1). Eyes are entirely lacking, except for dark eyespots (Pylka and Warren 1958, p. 336). The bodies of juveniles exhibit many small pigment spots that are uniformly distributed along the dorsal and lateral surfaces (Brandon 1967, p. 39.1), but are otherwise translucent, with blood vessels and viscera being visible through the body wall (Carr 1939, p. 335). Adults are similar in appearance, but lack body pigmentation, leaving them almost pure white apart from their gills (Moler 2022, pers. comm.). Lungs are also absent (Carr 1939, p. 335). Common prey items of the Georgia blind salamander include crustaceans (ostracods, amphipods, copepods, and isopods), but some insects and arachnids have also been found in salamander digestive tracts (Lee 1969, p. 175; Peck 1973, p. 16).

Figure 1. Georgia blind salamander (*Eurycea wallacei*). Photo Credit: Fenolio et al. 2013.

Taxonomy

As described in Section 2.1 of the SSA Report (Service 2022a, p. 4), Georgia blind salamander is a valid taxon. At the time of its discovery in 1939 in an artesian well near Albany, Georgia, it was classified as the single species within a new genus, *Haideotriton* (Carr 1939, p. 335). The original classification of *Haideotriton wallacei* was revised based on molecular evidence (Frost et al. 2006, pp. 10, 359), resulting in synonymy of *Haideotriton* with *Eurycea*. Therefore, the current taxonomic classification for the Georgia blind salamander is *Eurycea wallacei* (Frost et al. 2006, p. 359).

Habitat and Life History

As described in Sections 2.4 and 2.5 of the SSA Report (Service 2022a, pp. 6–8), habitat of the Georgia blind salamander consists primarily of subterranean waterways within the Upper Floridan Aquifer system (FAS), an extensively karstified aquifer system. Water within the FAS is typically clear, around 18-21 °C (64.4-69.8 °F), and ranges in pH from 7.6 to 8.2 (Fenolio et al. 2013, p. 104). Pools are typically around 1-2 meters (m) (3.28-6.56 feet (ft)) in depth but can range from just a few centimeters (cm) deep to over 30 m (98.43 feet (ft)) (Fenolio et al. 2013, p. 104). Divers have reported seeing more immature individuals in shallower areas near the surface of pools, while larger adults are often found at the bottom of deeper pools (Means 1992, p. 51).

Georgia blind salamanders lack metamorphosis, which makes it difficult to distinguish between juveniles and adults (Niemiller et al. 2012, p. 10; Valentine 1964, p. 100). Sexual maturity of adults has often been determined by an enlarged vent and gravid state (Valentine 1964, p. 100). Such individuals have been found during May and November, suggesting reproduction could occur much of the year (Means 1992, p. 50). A panel of species experts surveyed on species attributes for the Georgia blind salamander indicated it may have a short lifespan (that which is less than 25 years (Thurman et al. 2020a, unpaginated)), though confidence in this rating was low.

Historical and Current Range/Distribution

As described in Section 2.3 of the SSA Report (Service 2022a, pp. 5–6), in the Upper Floridian Aquifer, the historical records of the Georgia blind salamander principally occurred in northwest Florida, consisting of nine sites (Figure 2). Currently, locations where Georgia blind salamanders have been found include Jackson, Washington, and Calhoun Counties, Florida, as well as Dougherty and Decatur Counties, Georgia, in the Marianna Lowlands-Dougherty Plain physiographic region (NatureServe 2022, unpaginated; Moler, pers. comm. 2022).

Well-trapping efforts have not proven to be successful for Georgia blind salamanders due to trap avoidance, crayfish predation, or other factors. Therefore, occurrences of the Dougherty Plain cave crayfish (*Cambarus cryptodytes*) were used as a surrogate in an attempt to supplement and inform range data, as this species inhabits similar habitats, often co-occurs with Georgia blind salamander, and is readily trapped in wells. The best available science indicates the Georgia blind salamander's potential range consists of 4,400,162 acres of surface area, the boundaries of which were derived based on the use of Dougherty Plain cave crayfish as a surrogate species and the best available hydrogeologic data for the region. A total of 58 sites are reported to have positive detections of either or both Georgia blind salamander and the Dougherty Plain cave crayfish. Site location and information was supplied by the Florida Fish and Wildlife Conservation Commission and the Georgia Department of Natural Resources Wildlife Resources Division. Of these 58 sites, 30 have positive Georgia blind salamander detections and 57 have positive Dougherty Plain cave crayfish detections. Sites were categorized as either being extant (E), historical (H), potential (PO) for Georgia blind salamander, or not known (NK) for sites for which there is positive detection, but no record adequate for categorization. Extant sites include those that have had a positive detection since 2000 (20 sites). Historical sites include those that have not been surveyed since before 2000 but have had positive detections in the past (9 sites). Potential sites include those that have not had a positive Georgia blind salamander detection during survey efforts but do include positive Dougherty Plain cave crayfish detections (28 sites) (Service 2022a, p.20).

It is important to note that the identified sites are only those that are accessible to humans and do not necessarily represent the entire distribution of the species. Also, many sites of co-occurrence are isolated wells, indicating both species are likely more widely distributed throughout the aquifer and associated springsheds than is evidenced by direct sightings alone (Moler et al. 2017, p. 5). It is likely the species is present in the Dougherty Plain portion of the Upper FAS (Means 1992, pp. 49-50; Opsahl and Chanton 2006, p. 89; Fenolio et al. 2013, p. 104).

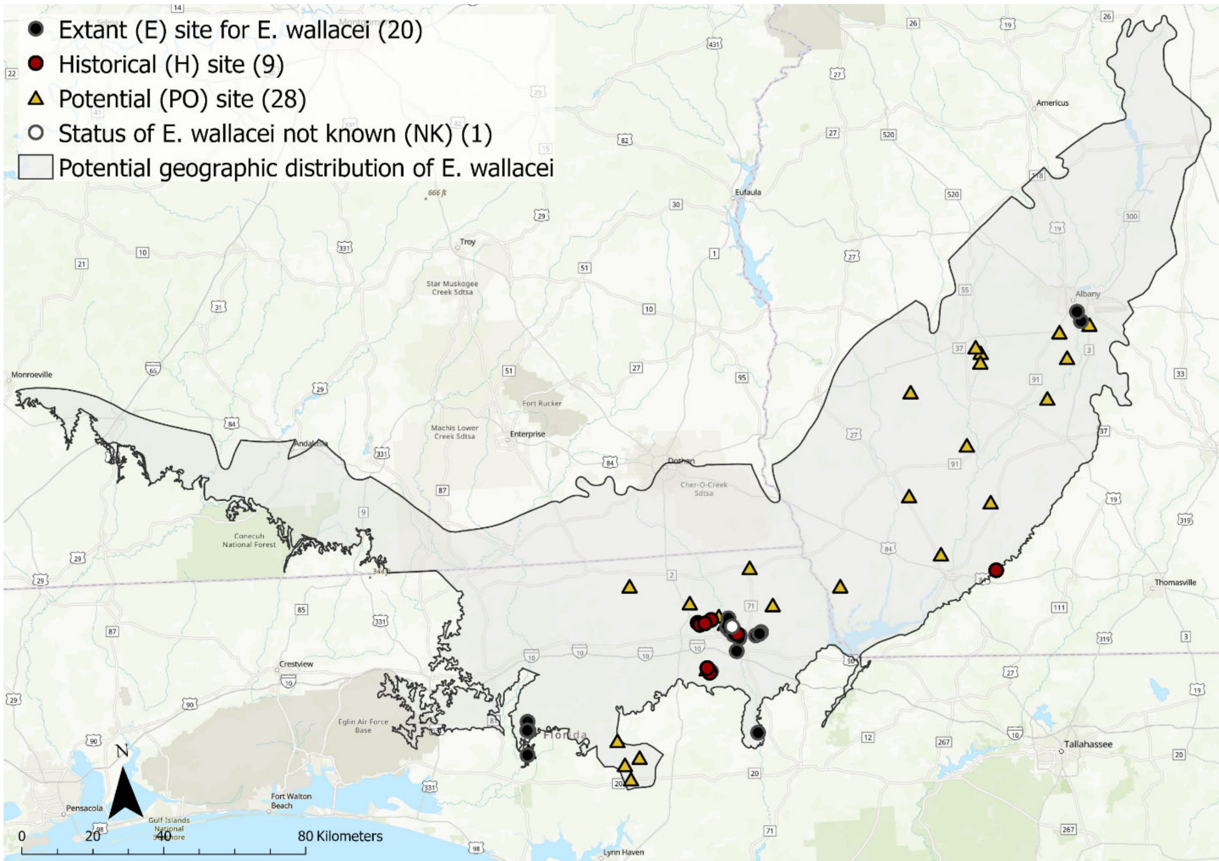

Figure 2. Distribution of Georgia blind salamander sites. Extant sites are those with a documented observation of *E. wallacei* since 2000, while historical sites have only documented observations from before 2000. Potential sites are based on the presence of a surrogate species, *C. cryptodytes*. The site with "not known" status does not have the time of observation documented to allow for classification as either extant or historical (Service 2022a, p.6).

<u>Population Needs</u>

As described in Section 3.2 of the SSA Report (Service 2022a, pp. 9–10), at the population level, resiliency is the ability to withstand stochastic disturbances. This stochasticity can include random variations in environmental conditions, demographics (population size/growth rate), and the occurrence of human disturbance events. In the case of the Georgia blind salamander, examples of potentially damaging stochastic events include varying rainfall patterns, fluctuations in mortality or fecundity rates, localized chemical pollution, groundwater extraction, and other harmful anthropogenic disturbances. For populations to be resilient to stochastic events, they must have an adequate number of reproducing individuals within a given area. Therefore, the individual needs outlined above must be met over a large enough spatial extent to support a resilient population.

<u>Species Needs</u>

As described in Section 3.3 of the SSA Report (Service 2022a, p. 10), at a species level, the Georgia blind salamander must also have an adequate number, distribution, and connectivity of populations (i.e., redundancy) as well as genetic or environmental diversity (i.e., representation) to survive catastrophic events, such as prolonged drought, severe flooding, large chemical spills, or cave collapses, or environmental challenges like climate change or pathogenic fungi. Georgia blind salamanders have been recorded from at least 30 different sites distributed across southwest Georgia and northwest Florida, and the best available science indicates the species' potential range consists of 4,400,162 acres (17,806.82 square kilometers) of surface area. This large extent of occurrence dilutes the risk of catastrophic events for this groundwater obligate species over a larger range.

SUMMARY OF BIOLOGICAL INFORMATION FOR THE FEDERAL REGISTER:

The Georgia blind salamander (*Eurycea wallacei*) is a relatively small, pinkish white, blind salamander with visible external gills, found primarily in subterranean waterways within the Upper FAS distributed across southwest Georgia and northwest Florida. It is reported to be extant in at least 20, but potentially 58, different sites throughout its range. However, it is important to note that these sites are only those that are accessible to humans and do not necessarily represent the entire distribution of the species. Additionally, more available information on the distribution of a co-occurring species, the Dougherty Plain cave crayfish (*Cambarus cryptodytes*), as a surrogate indicates a much wider distribution throughout the aquifer and springsheds than is evidenced by direct sightings alone, with a potential range consisting of 4,400,162 acres.

Georgia blind salamanders are dependent on the presence of subterranean water, either in the form of streams or pools. Locations where salamanders are found typically have water temperatures of 18-21 °C (64.4-69.8 °F), a pH between 7.6 and 8.2, and water flow rates no greater than 20 cubic meters per second. These salamanders rely almost exclusively on small, troglobitic crustaceans for food. Roosting bat colonies may also be important features of some cave systems, as they likely represent significant nutrient inputs through the deposition of guano (Fenolio et al. 2006, p. 440; Fenolio et al. 2013, p. 104). The salamander also lacks metamorphosis, which makes it difficult to distinguish between juveniles and adults. Observations of gravid adults during May and November, suggests reproduction much of the year. Uncertainty remains regarding the species' specific lifespan; however, best available science estimates it to be less than 25 years.

FACTORS INFLUENCING THE STATUS:

The Act directs us to determine whether any species is an endangered species or a threatened species because of any factors (or threats) affecting its continued existence (i.e., whether it meets the definition of a threatened species or an endangered species). We use the term "threat" to refer in general to actions or conditions that are known to or are reasonably likely to negatively affect individuals of a species. The term "threat" includes actions or conditions that have a direct impact on individuals, as well as those that affect individuals through alteration of their habitat or required resources. The term "threat" may encompass—either together or separately—the source of the action or condition, or the action or condition itself.

However, the mere identification of any threat(s) does not necessarily mean that the species meets the statutory definition of an "endangered species" or a "threatened species." In determining whether a species meets either definition, we must evaluate all identified threats by considering the expected response by the species, and the effects of the threats—in light of those actions and conditions that will ameliorate the threats—on an individual, population, and species level. We evaluate each threat and its expected effects on the species, then analyze the cumulative effect of all of the threats on the species as a whole. We also consider the cumulative effect of the threats in light of those actions and conditions that will have positive effects on the species—such as any existing regulatory mechanisms or conservation efforts. The Secretary determines whether the species meets the definition of an "endangered species" or a "threatened species" only after conducting this cumulative analysis and describing the expected effect on the species now and (if evaluating whether a species is a threatened species) in the foreseeable future.

Threats

Threats to the resiliency of the Georgia blind salamander fall into two main categories: 1) those that have impacts at the population or species level; and 2) those that have localized effects at the site level. Potential threats to the Georgia blind salamander include groundwater contamination, hydrologic change, climate change, saltwater intrusion, human use, as well as disease (Figure 3). See Chapter 4 of the SSA Report (Service 2022a, pp. 11–17) for more information.

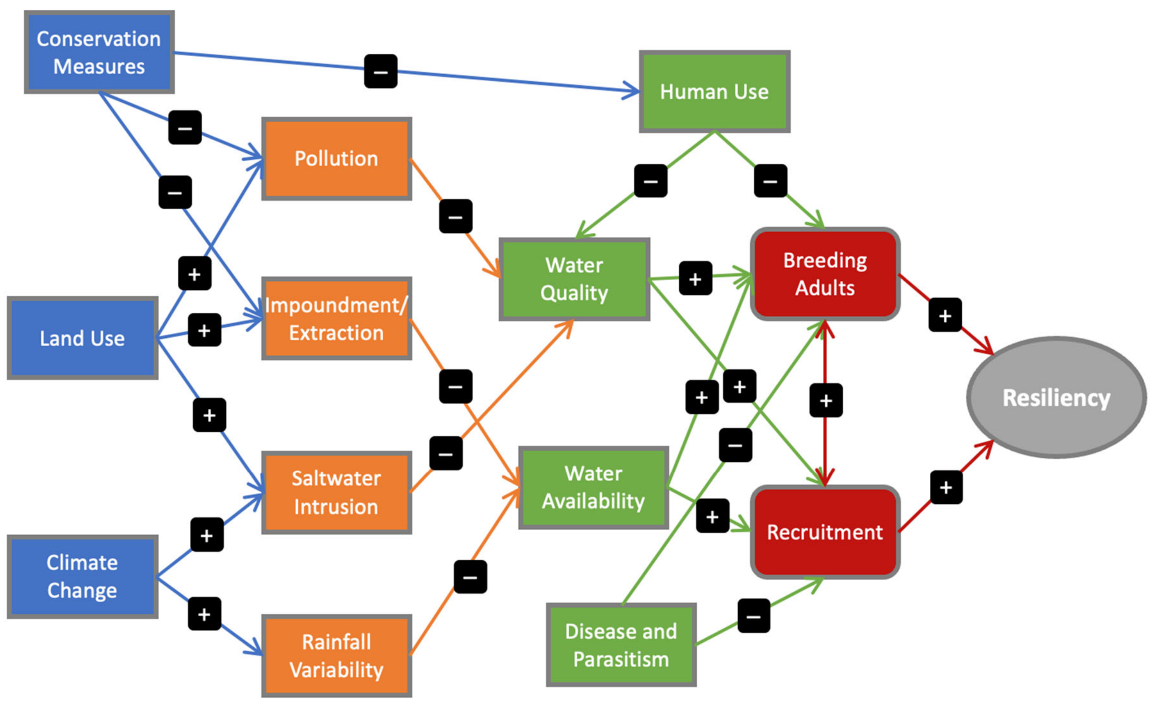

Figure 3. Influence diagram for the Georgia blind salamander. Influences are tiered based on the proximity of their effect on the species' resiliency.

Groundwater Contamination

One of the primary threats impacting Georgia blind salamanders is groundwater pollution (Means 1992, p. 52). Amphibians can be particularly sensitive to the concentrations of chemicals in their environment. Chemical pollution has been found to reduce survival and mass of stream-dwelling amphibians by an average of 14.3%, reduce mass by 7.5%, and increase the frequency of abnormalities by 535%, and these effects are primarily physiological, ranging from osmotic stress to carcinogenesis (Egea-Serrano et al. 2012, pp. 1382-1390).

The Floridan aquifer system (FAS), which encompasses the cave systems where the Georgia blind salamanders are found, has been designated by the US Geological Survey as at-risk for fertilizer contamination (Nolan et al. 1998 as cited in Fenolio et al. 2013, p. 106). This is because the aquifer largely lies below agricultural land (Fenolio 2015, p. 3), and contamination by pollutants flows directly into the groundwater via porous karst limestone (FWC 2011b, p. 4). Agricultural land, and areas of residential development, can lead to reduced water quality in the FAS and are therefore designated as "incompatible land use." By using the National Land Cover Dataset (NLCD) (2019) to assess, the total area of incompatible land cover present within the range of the Georgia blind salamander accounts for 1,812,866 acres (41.2 percent) of the total range. Of this, developed area accounted for 6.6 percent of the total area, cultivated crops for 31.1 percent, and hay/pasture for 3.5 percent. A majority of the known species locations lie underneath agricultural lands, and a few are near urban development in the Albany, Georgia area. The presence of developed and agricultural lands across approximately 41 percent the known range of the Georgia blind salamander may increase the risk of a decline in water quality or quantity and therefore potentially reduces the resiliency of the species. However, loss of water quantity does not seem to be having a large impact on this aquifer currently, as drawdowns, even in drought conditions, are not impacting water levels in the aquifer.

While fertilizer runoff is one of the greatest concerns regarding water quality, the FAS is also susceptible to other potential contaminants. These include pesticides, other agricultural wastes, septic tank effluent, hazardous wastes, oils, any other chemical spills, and siltation caused by recreationalists (Brandt and Jackson 2003 as cited in FWC 2019, p. 3). High concentrations of chemical pollutants (alone or in combination) within the FAS could lead to local extirpation or extinction of species (Fenolio et al. 2015, p. 3; FWC 2011b, p. 4). However, impacts to survival have not been documented for Georgia blind salamander.

Overall, 24 sites of the 30 sites where Georgia blind salamanders have been documented are not on protected lands, resulting in varying management techniques and associated pollution risk. While all springs within the range of the Georgia blind salamander are regulated by either the Florida Department of Environmental Protection or the Environmental Protection Division of the Georgia Department of Natural Resources (FWC 2013, p. 6), protection for privately-owned areas may be limited, and no monitoring programs are in place to detect changing animal populations within any part of the aquifer (Fenolio et al. 2013, p. 106). Illegal dumping on lands above or near the aquifer also is a possibility regardless of ownership (FWC 2019, p. 3). Although there may be varying management and pollution risk, at this time, these 24 sites are extant for GA blind salamander.

Another source for groundwater contamination is from Superfund sites. There are six Superfund sites within the range of the Georgia blind salamander and above the FAS: Camilla Wood Preserving Company (Camilla, GA); Firestone Tire & Rubber Co. (Albany, GA); Marine Corps Logistics Base (Albany, GA); Sapp Battery Salvage (Cottondale, FL); T.H. Agriculture & Nutrition Co. (Albany, GA); and United Metals, Inc. (Marianna, FL). Cleanup efforts at each of the sites have included the containment or removal of contaminated soils and groundwater monitoring programs (EPA 2022, unpaginated). Currently, the Environmental Protection Agency (EPA) considers the statuses of the six sites to all be protective of human health and the environment either by the removal of contaminants or the lack of completed exposure pathways (EPA 2022, unpaginated). The EPA considers "protective of human health" to mean that either the contaminants have been removed or there is no complete exposure pathway to humans. However, according to the 5-year reviews for multiple sites, it is likely that the groundwater at these sites still contains some level of contaminants. They are either at low enough concentrations or isolated to a small enough area to not pose a risk to humans. Some of the contaminant levels were reported to be above the site's clean-up goals, but according to the review for the Sapp Battery Salvage site, the EPA's policy does not expect to restore the groundwater under a waste management area (EPA 2022, unpaginated). In addition, the salamander continues to occupy these areas indicating that the threats to water quality are not impacting the species.

Hydrologic Change

Anthropogenic activities such as stream impoundment can cause hydrologic change by raising the local water table and water level within caves (Fenolio et al. 2013, p. 106; Means 1992, p. 52). This rise in water level can have significant negative impacts on Georgia blind salamanders by changing hydrological patterns, altering gas concentrations in the groundwater, reducing the availability of nutrients, and potentially providing predators new access to their habitats (Fenolio et al. 2013, p. 106). No incidents of impacts on Georgia blind salamander have been documented at this time.

Since groundwater extraction for agriculture and drinking water occur in the range of the species, the lowering of local water tables through extraction of groundwater from wells by humans is likely to result in more immediate detrimental effects (Fenolio et al. 2013, p. 106; FWC 2011a, p. 3; Means 1992, p. 52), including loss of habitat (FWC 2013, p. 8), reduced nutrient flow into caves (FWC 2013, p. 8), and in more extreme cases, direct mortality of salamanders (Lee 1969, p. 176). Such negative effects are expected to worsen with increases in human population and associated urban sprawl (Fenolio et al. 2013, p. 106; FWC 2013, p. 8). However, loss of water quantity does not seem to be having a large impact on this aquifer. Even in drought conditions, extractions are not impacting water levels in the aquifer.

Climate Change

Species sensitive to changes in water levels, like the Georgia blind salamander, are likely affected by changing weather patterns associated with climate change. The general trend for the Gulf Coast region, where the Upper Floridan aquifer occurs, is projected to shift towards generally warmer and wetter conditions (Neupane et al. 2018, p. 2240), which in turn is expected to lead to increased surface runoff. Variable and intense precipitation events may not only result in intermittent flooding, but droughts as well (FWC 2013, p. 4; Karl 2009 as cited in Foster et al. 2014, p. 226). Prolonged drought and the shifting coastline can bring the saltwater interface (the diffuse zone of mixing between the freshwater of the aquifer system and the intruded saltwater) inland. Extended dry periods not only limit the recharge of the aquifer but often also encourage increased use of groundwater by humans, both of which contribute to aquifer drawdown.

Despite generally wetter conditions, streamflows are expected to decrease, especially during the summer when water demand is greatest (Neupane et al. 2018, p. 2240); a variable climate may reduce groundwater levels through changes in aquifer recharge and by necessitating the use of groundwater for irrigation or other purposes (Thomas and Famiglietti 2019, p. 1). Saltwater intrusion into the FAS can occur as a result of groundwater extraction near saline surface waterbodies such as coastal bays and estuaries (NWFWMD 2018, p. 19). Pumping near the coastline contributes to aquifer drawdown (the lowering of local water tables), inducing the inland flow of saltwater through the aquifer, which increases the concentration of sodium ions, chloride ions, and total dissolved solids in the groundwater negatively affecting the overall water chemistry (pH) (NWFWMD 2018, p. 19). These changes in water chemistry have the potential for serious effects on the Georgia blind salamander, which can be very sensitive to ion concentrations (Fenolio pers. comm. 2022). However, these effects due to changes in water chemistry have not been documented in Georgia blind salamander to date.

Human Use

Irresponsible and unmanaged use of cave systems by humans can have negative effects on Georgia blind salamanders through habitat disturbance or destruction, or collection of individuals (Fenolio et al. 2013, pp. 106-108). Unregulated collection for the pet trade has the potential to cause the decline or extirpation of salamanders from affected localities (Fenolio et al. 2013, p. 108). While there is currently no indication that the species is suffering from over-collection, other similar cave species have become popular in the pet trade (Fenolio et al. 2013, p. 108).

Other activities such as caving and cave diving can disturb or alter Georgia blind salamander habitat (FWC 2013, p. 7) if not properly regulated. These activities can disrupt and displace beneficial bat roosting colonies, which overall provide important nutrient resources to the cave ecosystem (Fenolio et al. 2013, p. 106; FWC 2013, p. 7); the Georgia blind salamander occasionally cohabitates with the southeastern bat (*Myotis austroriparius*) and tri-colored bat (*Perimyotis subflavus*; P. Moler, K. Morris, pers. comm. 2022), whose guano could serve as an important source of nutrients for the salamanders or their prey, as it does for other cave salamander species (Fenolio et al. 2013, p. 106; FWC 2013, p. 7). We have proposed to list the tricolored bat as an endangered species under the Act; if the listing is finalized, it may indirectly provide some overlapping protections for the Georgia blind salamander through possible land acquisition efforts and potentially more access restrictions and better management of cave ecosystems where there are Georgia blind salamanders present.

Conservation Measures and Existing Regulatory Mechanisms

The Georgia blind salamander is afforded legal protection under state law throughout its range as a threatened species in both Florida and Georgia. Additionally, Florida and Georgia state laws are in place to prevent the vandalism of caves, intentional harm or removal of cave life, and pollution or littering within caves (Florida Statutes 2022 unpaginated; O.C.G.A. 2022, unpaginated). However, 62 percent of the documented sites in Florida are on private lands (Service 2022a, p. 12). Protection for these privately-owned areas may be limited, and no monitoring programs are currently in place to detect changing animal populations within any part of the aquifer (Fenolio et al. 2013, p. 106). While only 10.8 percent of the total surface area of the potential range for the Georgia blind salamander falls into protected areas (475,192 out of 4,400,159 acres) and receives conservation benefits the above measures provide, the inaccessibility of most sites of occurrence provides an additional, indirect form of protection and may limit threats from human use, such as caving (Table 1).

Table 1. Summary of protected areas within the range of the Georgia blind salamander. The third column gives the quantity of land of each type of protected area as a percentage of the total surface area of the species range, which is 4,400,159 acres. (Service 2022a, p. 16).

Protected Area Type	Total Area (acres)	Percent of Total Range
Designation	48,148	1.1
Easement	132,562	3
Fee	237,629	5.4
Proclamation	56,853	1.3
ALL	**475,192**	**10.8**

Cumulative Effects

When potential stressors occur together, one factor may exacerbate the effects of another, causing effects not accounted for when factors are analyzed individually (Brook et al. 2008, entire). We note that, by using the SSA framework to guide our analysis of the scientific information documented in the SSA report, we have not only analyzed individual effects on the species, but we have also analyzed their potential cumulative effects. We incorporate the cumulative effects into our SSA analysis when we characterize the current and future condition of the species. Our assessment of the current and future conditions encompasses and incorporates the threats individually and cumulatively. Our assessment of current and future conditions is iterative because it accumulates and evaluates the effects of all the factors that may be influencing the species, including threats and conservation efforts. Because the SSA framework considers not just the presence of the factors, but to what degree they collectively influence risk to the entire species, our assessment integrates the cumulative effects of the factors and replaces a standalone "cumulative effects" analysis.

CURRENT CONDITION:

Details of the current condition analysis can be found in Chapter 5 of the SSA Report (Service 2022a, pp. 18–33).

Resiliency

To assess the species' current condition, we considered factors currently affecting the resiliency, redundancy, and representation of the Georgia blind salamander. For the purposes of our assessment, the complete range extent is considered as a single population. At the time of our SSA, there was not enough information available regarding the connectivity within the Upper FAS to inform a proper delineation of any smaller analysis units. The potential range extent of the Georgia blind salamander was estimated as a subset of the Upper FAS based on geological data, including the presence of confining layers (formations which are relatively impermeable to water) and the availability of limestone formations likely to have fractures and openings suitable for salamanders (Floyd pers. comm.2022), and the extent of known species locations and potential locations (using the Dougherty Plain cave crayfish, which often occupies the same habitat, as a surrogate). As shown in Figure 5-1 of the SSA report, the Upper FAS can be unconfined (upper confining unit and surficial aquifer are absent or very thin), thinly confined (upper confining unit is generally less than 100 feet thick, breached, or both), or confined (upper confining unit is generally greater than 100 feet thick and unbreached; Williams and Kuniansky 2016, p. 39). Areas that are considered confined are considered less suitable for the Georgia blind salamander due to their limited recharge and detrital input.

The locations of confirmed and potential Georgia blind salamander sites were used in conjunction with information regarding the primary threats to the species to characterize its viability. Given the lack of studies of the species and its habitat and distribution, a qualitative description of its resiliency, redundancy, and representation is more appropriate than a categorical ranking.

The threats to the resiliency of the Georgia blind salamander fall into two main categories: 1) those that have impacts at the population or species level and 2) those that have localized effects at the site level. At present, 41.2 percent of the potential range of the Georgia blind salamander lies under either agricultural lands or urban development, which may negatively influence the resiliency of the species. Of the 58 known or potential species locations, the majority are likely affected by some level of these threats. Given the uncertainty regarding the connectivity and population structure of Georgia blind salamander sites, threats evaluated at the site level do not facilitate a direct assessment of resiliency. As such, the magnitudes of all threats were scored (low = 2, moderate = 1, and high = 0) and compiled into a single groundwater contamination vulnerability index (Table 2). This index is meant to represent the likelihood of a site being exposed to contaminants that will negatively affect the salamanders living there, with lower overall scores corresponding to higher vulnerability and vice versa. Of the 58 total sites, 13 (22 percent) were defined as being most vulnerable to threats (score of 0-3), 36 (62 percent) as being moderately vulnerable to threats (4-6), and 9 (16 percent) as being least vulnerable to threats (7-10; Figure 5-9). However, these sites most vulnerable to contaminant spills also overlap areas where we have records of the species, as these areas are the only ones that provide accessibility for abundance surveys. Therefore, this vulnerability index may overestimate the impact to the species overall. The single Georgia blind salamander population currently has moderate to high resilience (78 percent of sites).

Table 2. Summary of threats to Georgia blind salamander sites. Under status: E = extant, H = historical, PO = Potential, and NK = not known. The magnitude of each threat is categorized and scored (L = low, 2; M = moderate, 1; and H = high, 0). The total score is an index (0-10) representing vulnerability to groundwater contamination with lower scores given to more vulnerable sites. (Service 2022a, pp. 29–30)

Site Name	Status of *E. wallacei*	Recharge zone productivity	Road density	Major spills	Pollutant discharge permits	Sinkhole hotspot	TOTAL
Albany Field Well 8	PO	H	M	H	L	H	3
Baby Salamander Cave	E	H	H	H	M	H	1
Bennetts Cave	E	H	M	H	L	H	3
Black Hole Spring	E	H	L	M	L	H	5
Blue Hole Spring	PO	H	M	M	L	H	4
Blue Sink	H	H	L	M	L	H	5
Bozell Spring	E	H	M	M	L	H	4
Chameleon Spring	E	H	H	H	H	H	0
Chickasawhatchee Swamp WMA Well # 6 & USGS Well 10k005	PO	H	L	M	L	L	7
Chickasawhatchee Swamp WMA Well # 7	PO	H	L	M	L	L	7
Chickasawhatchee Swamp WMA Well # 18	PO	H	L	L	L	L	8

Cave-in-Woods	H	H	M	M	L	H	4
China Cave	NK	H	M	M	L	H	4
Climax Cave	H	M	L	M	L	H	6
Coffin Spring	PO	H	M	M	L	H	4
Devils Hole	PO	H	M	L	L	H	5
Double Springs	PO	H	M	L	L	H	5
Ellis Cave	E	H	M	H	L	H	3
Fears Cave	H	H	L	M	L	H	5
Galloway Spring	E	H	L	L	L	H	6
Gerards Cave	E	H	M	M	L	H	4
Geromes Cave	PO	H	M	M	L	H	4
Highway 69 Well	PO	H	M	M	L	H	4
Hole-in-the-Wall Cave	E	H	M	M	L	H	4
Hollow Ridge Cave	E	H	H	H	M	H	1
Jackson Blue Spring	E	H	M	M	L	H	4
Judges Cave	H	H	H	H	L	H	2
Maddachalk Spring	E	H	L	M	L	H	5
Maund Spring	E	H	H	H	L	H	2
Millers Cave	H	H	M	M	L	H	4
Millers Ferry Spring	E	M	L	L	L	H	7
“Near Malone”	PO	H	M	M	L	H	4
Otter Springs Cave	PO	H	H	H	M	H	1
Pond Cave	E	H	M	M	L	H	4
Potter Spring	PO	M	L	L	L	H	7
Pottery Cave	PO	H	M	M	L	H	4
Radium Springs	E	H	H	H	H	H	0
Ray’s Cave	H	H	M	M	L	H	4
Sandbag Spring	E	H	H	H	L	H	2
Sec 20 Well	PO	H	M	L	L	H	5
Skipper Spring	E	M	L	L	L	H	7
Soda Straw Cave	PO	H	M	M	L	H	4
Springboard Spring	H	H	M	M	L	H	4
Tacoma Street Well	PO	H	M	M	L	H	4
Twin Spring Cave	E	H	M	M	L	H	4
USGS Well 06F001	PO	H	L	M	L	H	5
USGS Well 08G001	PO	H	L	M	L	L	7
USGS Well 08K001	PO	M	L	M	L	L	8
USGS Well 09F520	PO	H	M	H	L	H	3
USGS Well 10G313	PO	H	M	M	L	H	4
USGS Well 10H009	PO	H	M	M	L	H	4
USGS Well 12K014	PO	H	M	M	L	L	6
USGS Well 13L012	PO	H	H	H	L	H	2
Waddells Mill Cave	PO	H	L	M	M	L	6

Washed Out Cave	H	H	M	M	L	H	4
Washington Blue Spring	E	M	L	L	L	L	9
Well 2-mi S Graceville	PO	H	M	M	L	L	6
Williford Spring	PO	H	L	L	M	H	5

Redundancy

Georgia blind salamanders have been recorded at a total of at least 30 different sites across southwest Georgia and northwest Florida and are potentially at an additional 28 sites (sites where the surrogate species was found), for a total of 58 sites used in the SSA analysis. Additionally, there are 20 sites where the Georgia blind salamander is currently extant. As previously noted, these sites may not represent the complete range of the species, as the salamanders can only be detected in portions of the FAS that are accessible to humans, such as cave openings and wells. The potential range of the Georgia blind salamander consists of 4,400,162 acres of surface area. The boundaries of this area were derived based on the use of Dougherty Plain cave crayfish as a surrogate species and the best available hydrogeologic data for the region. The lack of information regarding the connectivity of the aquifer between sites also complicates the division of the complete range into smaller units for analysis. Therefore, this assessment considers the entire range of the species as representing a single population. In this context, it is very difficult to determine how large the extent of the impact of a catastrophic event may be (for example, which areas or species sites will be affected by a single event) or if immigration from neighboring areas could later lead to the reestablishment of salamanders. In lieu of this, we described the current threats to redundancy, and not a complete assessment of the species' redundancy.

The primary factor affecting the redundancy of the Georgia blind salamander is the threat of major contaminant spills, which have the potential to extirpate salamanders from the affected area. This factor was again assessed through the density of major highways, railroads, and pipelines, all of which increase the risk of high-magnitude spills. According to this methodology, 13 species sites were in areas at high risk of catastrophic spills, 35 were in moderate-risk areas, and 10 were in low-risk areas. It is important to note that the sites identified as most vulnerable to contaminant spills also overlap areas where we have records of the species, as these areas are the only ones that provide accessibility for abundance surveys. Therefore, this methodology may overestimate the impact to the species overall.

Representation

As described previously, we consider all known occurrences of the Georgia blind salamander as belonging to a single population. As such, the species lacks multiple representative units, precluding it from the application of a more traditional analysis of representation. Further, a comprehensive genetic study of the species is ongoing as of the writing of this report, and no data are yet available. As an alternative approach, we considered several attributes that act as a surrogate for the adaptive capacity of the Georgia blind salamander as a measure of its representation. Adaptive capacity is defined as the ability of a species or constituent populations to cope with or adjust to environmental change (Thurman et al. 2020, p. 520). Ecological, evolutionary, and extrinsic factors (natural or anthropogenic) can all affect a species' adaptive capacity. Please refer to the SSA Report for further discussion.

The Georgia blind salamander currently exhibits low adaptive capacity, with 8 out of 12 of its core attributes ranked as such. As a groundwater obligate species, the Georgia blind salamander is unable to "shift in space" (Thurman et al. 2020, p. 522) and is vulnerable to any anthropogenic or climatic changes in its current environment. This limitation greatly reduces the species' adaptive capacity, therefore also limiting its representation in the context of this assessment.

FUTURE CONDITION:

Details of the future condition analysis can be found in Chapter 6 of the SSA Report (Service 2022a, pp. 34–41).

To assess the future condition of the Georgia blind salamander in terms of its resiliency, redundancy, and representation (the 3 Rs), we evaluated the three Rs qualitatively, with a greater focus given to the description of the threats likely to impact the future viability of the Georgia blind salamander. Again, the entire range extent of the species is treated as belonging to a single population due to the lack of data on both the dispersal of the species and the connectivity of the groundwater it inhabits.

Change in land use within the range of the Georgia blind salamander is expected to be one of the most impactful factors affecting its future resiliency. Increasing development or agriculture are likely to further reduce the water quality within the FAS. Groundwater extraction, point source pollution, non-point source pollution, and the probability of major spills are all likely to increase at some level as a result of further human development. Our assessment considered future conditions based on projections from the FORESCE (FOREcasting SCEnarios of Land-use Change) modeling framework, which provides spatially explicit, thematically detailed, scenario-based projections of future land use and land cover change (Sohl et al. 2014, p. 1016). Within this framework, the four scenarios are based on the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES), with land use-land cover data from the period of 1992-2005 acting as a historical baseline. This assessment considers the A1B (worst-case) scenario and the B2 (best-case) scenario to project changes in development and agriculture (cultivated crops and hay/pasture) land cover. Both scenarios were evaluated using FORESCE for the years 2030 and 2070 when changes in land use were projected to impact the species' resiliency (Table 3). The percent changes over time for each scenario and time step were calculated relative to the 2005 baseline data and then applied to the NLCD 2019 land cover data to better estimate the total coverage of each land cover type in the future. For the A1B scenario, development and cultivated crops are projected to increase with a slight decrease in hay/pasture. Under the B2 scenario, development and hay/pasture are projected to increase with a decrease in cultivated crops. Both scenarios are likely to negatively impact water quality at local sites for the species; however, the A1B scenario is projected to have greater impacts on species' water quality compared to B2 scenario (Service 2022a, pp. 38–39).

Table 3. Summary of changes in both future scenarios at year 2030 and year 2070. Resiliency is evaluated qualitatively based on increases in development, agriculture, and pollutant permit hotspots, with downward arrows indicating a reduction (Table 6-3; Service 2022a, pp. 38–39).

Scenario/Time	Development	Croplands	Hay/Pasture	NPDES Permits*	Resiliency
A1B 2030	+78.0% ↗	+1.9% →	–1.5% →	→	↘
A1B 2070	+158.7% ↗↗	+22.2% ↗	–13% ↘	→	↘↘

B2 2030	+46.7% ↗	–3.5% →	+2.4% →	→	→
B2 2070	+63.9% ↗	–47.3% ↘	+30.3% ↗	→	↘

* The number and location of National Pollutant Discharge Elimination System (NPDES) permit hotspots did not change, but the total number of permit locations will increase over time.

Overall, the resiliency of the Georgia blind salamander is expected to either decrease or remain approximately the same as the current condition in the future. Both scenarios show a decrease in resiliency by the year 2070, especially under the A1B scenario, which includes more aggressive development (Table 3). Under the less aggressive land use scenario the resiliency of the Georgia blind salamander expected to show no change by 2030 and a decrease in resiliency by 2070.

As with the current condition, redundancy was assessed according to the risk of a major contaminant spill across its range, based on the density of major highways, railroads, and pipelines. The density of these features can be expected to increase into the future as development increases, which is projected under both scenarios considered in this assessment. Increasing future development, and therefore the increasing risk of a major spill, is most likely to occur near areas of existing development, such as urban centers (Albany, Georgia). Given the uncertainty involved with relating increasing development with increasing risk of a major spill, there is also a great deal of uncertainty on how these risks would have on the full range of the species in the future. However, it should be noted that the risk of a catastrophic event, even if the daily probability of such an event is very low, will increase as the timeframe over which the risk is evaluated increases. That is, even a low probability event has a high probability of occurring if given a long enough time scale.

In summary, based on these projections, the overall resiliency of the population of the species is likely to decline over time with increasing human development, especially under the A1B scenario. Future redundancy is very difficult to assess given what little data are available but is also likely to decline as the risk of a major contaminant spill increases, again due to increasing development. This effect is likely to be most prevalent near areas of existing development (Albany, Georgia). Representation is similarly difficult to project into the future due to a lack of data. However, as a groundwater obligate species that is essentially “trapped” in the FAS, the Georgia blind salamander is not likely to have a high capacity to adapt in the face of environmental changes such as those due to climate change.

FINDING

Regulatory Framework

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for determining whether a species is an “endangered species” or a “threatened species.” The Act defines an endangered species as a species that is “in danger of extinction throughout all or a significant portion of its range,” and a threatened species as a species that is “likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” The Act requires that we determine whether any species is an “endangered species” or a “threatened species” because of any one or a combination of the following factors:

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;

(B) Overutilization for commercial, recreational, scientific, or educational purposes;
(C) Disease or predation;
(D) The inadequacy of existing regulatory mechanisms; or
(E) Other natural or manmade factors affecting its continued existence.

These factors represent broad categories of natural or human-caused actions or conditions that could have an effect on a species' continued existence. In evaluating these actions and conditions, we look for those that may have a negative effect on individuals of the species, as well as other actions or conditions that may ameliorate any negative effects or may have positive effects.

The Act does not define the term "foreseeable future, which appears in the statutory definition of "threatened species." Our implementing regulations at 50 CFR 424.11(d), as revised in 2019, set forth a framework for evaluating the foreseeable future on a case-by-case basis. The term "foreseeable future" extends only so far into the future as we can reasonably determine that both the future threats and the species' responses to those threats are likely. In other words, the foreseeable future is the period of time in which we can make reliable predictions. "Reliable" does not mean "certain"; it means sufficient to provide a reasonable degree of confidence in the prediction. Thus, a prediction is reliable if it is reasonable to depend on it when making decisions.

It is not always possible or necessary to define the foreseeable future as a particular number of years. Analysis of the foreseeable future uses the best scientific and commercial data available and should consider the timeframes applicable to the relevant threats and to the species' likely responses to those threats in view of its life-history characteristics. Data that are typically relevant to assessing the species' biological response include species-specific factors such as lifespan, reproductive rates or productivity, certain behaviors, and other demographic factors.

Status Assessment

The biological information that serves as the basis for our finding is presented in detail in our SSA Report for Georgia blind salamander (Service 2022a, entire) and is summarized above under the **BIOLOGICAL INFORMATION** section of this Species Assessment Form. In our SSA, we evaluated all threats to Georgia blind salamander, which we generally identified as falling under Factor A of section 4(a)(1) of the Act, and include activities that result in habitat loss and modification. We evaluated the impacts of collection (Factor B) and the effects of climate change (Factors A and E), and determined that they had little to no measurable impact on the species over the time period analyzed.

To make the determination whether Georgia blind salamander warrants protection as an endangered or threatened species under the Act, we evaluated the current condition of the species and future conditions using future scenarios analyses in which we predicted the effects of a range of plausible projected future threat scenarios on the species. As described below, we first evaluated whether Georgia blind salamander is in danger of extinction throughout its range (an endangered species). Second, we evaluated whether the species is likely to become in danger of extinction throughout its range within the foreseeable future (a threatened species). Third and finally, we considered whether Georgia blind salamander is an endangered or threatened species throughout a significant portion of its range.

Status Throughout All of Its Range

After evaluating threats to the species and assessing the cumulative effect of the threats under the section 4(a)(1) factors, we evaluated the current status of the Georgia blind salamander to determine if it is in danger of extinction throughout its range. The single Georgia blind salamander population currently has moderate to high resilience (78 percent of sites); water quality and quantity are the primary factors influencing the species range-wide, although the underlying aquifer has exhibited relatively stable conditions over time; and the species is presumed to occur across the aquifer. It is reported to be extant in at least 20, but potentially 58, different sites throughout its range. Of the 58 total sites, 13 (22 percent) were defined as being most vulnerable to threats, 36 (62 percent) as being moderately vulnerable to threats, and 9 (16 percent) as being least vulnerable to threats. The sites identified as most vulnerable to contaminant spills also overlap areas where there are records of the species, as these areas are the only ones that provide accessibility for abundance surveys, so this is an overestimation of the impacts to the species overall.

The best available science indicates that this is a single population with connectivity, and there is no information indicating a catastrophic event in one area would affect the species across its range. Thus, the threats appear to have low imminence and magnitude to the overall 4.4-million-acre habitat such that they are not significantly affecting the species' current viability. We therefore conclude that the Georgia blind salamander is not in danger of extinction throughout all of its range. Next, we proceed with determining whether Georgia blind salamander is likely to become an endangered species within the foreseeable future throughout all of its range.

In considering the foreseeable future as it relates to the status of Georgia blind salamander, we considered the relevant risk factors (threats/stressors) acting on the species and the extent to which we could draw reliable predictions about the species' response to these factors. We considered whether we could reliably assess the risk posed by the threats to the species, recognizing that our ability to assess risk is limited by the variable quantity and quality of available data about effects to Georgia blind salamander and its response to those effects.

The SSA Report's analysis of future condition to 2070 encompasses the best available information for future projections of land-use change under two different scenarios (worst case-A1B and best case-B2), as well as pollutant discharge permits and effects of climate change (for example, sea level rise and drought). The timeframe considered enabled us to analyze the threats/stressors acting on the species and draw reliable predictions about the species' response to these factors. Land-use change and other anthropogenic activities, may impact Georgia blind salamander habitat through threats identified as factors influencing species viability, such as water quality and quantity. Given the future scenarios, the resiliency of the Georgia blind salamander population is projected to decline or remain approximately the same in the future. However, with the vast size (4,400,162 acres of surface area) and stability of habitat, as well as the species' single population well-distributed across the aquifer, and projected limited future impacts from threats to local sites regarding contaminant spills, increases in agriculture and development, we determined that the scale of impacts projected in the future will not impact the species such that the species is likely to become an endangered species in the foreseeable future. Thus, after assessing the best available information, we determine that Georgia blind salamander is not in danger of extinction now or likely to become so in the foreseeable future throughout all of its range.

Status Throughout a Significant Portion of Its Range

Under the Act and our implementing regulations, a species may warrant listing if it is in danger of extinction or likely to become so in the foreseeable future throughout all or a significant portion of its range. Having determined that the Georgia blind salamander is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range, we next considered whether it may be in danger of extinction or likely to become so in the foreseeable future in a significant portion of its range—that is, whether there is any portion of the species' range for which it is true that both (1) the portion is significant; and (2) the species is in danger of extinction now or likely to become so in the foreseeable future in that portion. Depending on the case, it might be more efficient for us to address the "significance" question or the "status" question first. We can choose to address either question first. Regardless of which question we address first, if we reach a negative answer with respect to the first question that we address, we do not need to evaluate the other question for that portion of the species' range.

In undertaking this analysis for Georgia blind salamander, we chose to address the status question first. We began by identifying portions of the range where the biological status of the species may be different from its biological status elsewhere in its range. For this purpose, we considered information pertaining to the geographic distribution of (a) individuals of the species, (b) the threats that the species faces, and (c) the resiliency condition of populations.

We evaluated the range of the Georgia blind salamander to determine if the species is in danger of extinction now or likely to become so in the foreseeable future in any portion of its range. Because the range of a species can theoretically be divided into portions in an infinite number of ways, we focused our analysis on portions of the species' range that may meet the definition of an endangered species or a threatened species. For Georgia blind salamander, we considered whether the threats or their effects on the species are greater in any portion of the species' range such that the species is in danger of extinction now or likely to become so in the foreseeable future in that portion. We examined the greatest threats to this species, which are those impacting water quality and water availability.

Because this species occupies a habitat that is not easily accessible or sampled, with few existing records, it is assumed to be well distributed evenly across its interconnected 4.4-million-acre range. While it is considered one population, we identified sinkhole hotspots around Albany, GA and Marianna, FL to be most vulnerable to the threats due to these spots close proximity to developed areas and potential lingering effects from Superfund sites. These portions are also vulnerable to potential catastrophic spills compared to the overall range. Given the fact that spills have occurred, and the salamander remains in high to moderate condition in these areas indicates that the threats to water quality and quantity are not impacting the species such that it has a different status in these portions compared the rest of the range. Additionally, while we acknowledge the possibility for an increase in catastrophic spills and increased pressure on the aquifer due to development near these sites, we have no information indicating the scale of these future impacts in these areas are such that the species would be in danger of extinction in the foreseeable future. For these reasons, the sinkhole hotspots portions around Albany, GA and Marianna, FL were not determined to have a different status now or in the foreseeable future

Therefore, we determine, that the species is not in danger of extinction now or likely to become so in the foreseeable future in any significant portion of its range. This does not conflict with the courts' holdings in *Desert Survivors v. Department of the Interior*, 321 F. Supp. 3d

1011, 1070-74 (N.D. Cal. 2018), and *Center for Biological Diversity v. Jewell*, 248 F. Supp. 3d 946, 959 (D. Ariz. 2017) because, in reaching this conclusion, we did not apply the aspects of the Final Policy on Interpretation of the Phrase "Significant Portion of Its Range" in the Endangered Species Act's Definitions of "Endangered Species" and "Threatened Species" (79 FR 37578; July 1, 2014), including the definition of "significant" that those court decisions held to be invalid.

Determination of Status

Our review of the best available scientific and commercial information indicates that the Georgia blind salamander does not meet the definition of an endangered species or a threatened species in accordance with sections 3(6) and 3(20) of the Act. Therefore, we find that listing the Georgia blind salamander is not warranted at this time.

COORDINATION WITH STATES:

While conducting the SSA for Georgia blind salamander, we closely coordinated with the Georgia Department of Natural Resources and Florida Fish and Wildlife Conservation Commission. We received and incorporated valuable feedback from Florida A&M University, and the University of Tennessee into the SSA. Reviewers provided many constructive comments, and all were easily addressed.

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All SAFs supporting 12-month findings or candidate notices of review will be signed by the Director. SAFs should continue to be surnamed by Regional and Headquarters staff and leadership.

WENDI WEBER

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Date: 2023.08.11 16:44:11 -04'00'

Date:
Wendi Weber,
Acting Director,
U.S. Fish and Wildlife Service

Date of annual review: September 28, 2022
Conducted by: Jonathan Wardell