Conservation Needs of the Jollyville Plateau, Georgetown, and Salado Salamanders
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Introduction

On August 22, 2012, the U.S Fish and Wildlife Service (Service) published a proposal to list the Austin blind salamander (*Eurycea waterlooensis*), Jollyville Plateau salamander (*Eurycea tonkawae*), Georgetown salamander (*Eurycea naufragia*), and Salado salamander (*Eurycea chisholmensis*) as endangered under the Endangered Species Act of 1973, as amended (ESA), and to designate critical habitat (77 FR 50768). Three of the four central Texas salamanders are found in aquatic habitats within the Northern Segment of the Edwards Aquifer which extends from the Colorado River in Travis County to the Lampasas River in Bell County. The Austin blind salamander is found in Barton Springs in Austin, Texas. These springs are fed by the Barton Springs Segment of the Edwards Aquifer which covers an area extending from southern Travis County south to northern Hays County. These springs are also home to the federally listed Barton Springs salamander (*Eurycea sosorum*), and therefore the Service believes that an interim conservation strategy for the Austin blind salamander should mirror the recovery strategy set forth in the Barton Springs Salamander Recovery Plan (Service 2005, pp. 2.1-1-2.4-1). Therefore, the conservation strategy outlined in this paper will focus on efforts related to the Jollyville Plateau, Georgetown, and Salado salamanders (salamanders).

The Service drafted this paper in order to share our thoughts on the long-term conservation needs of three of the salamanders currently proposed for listing. In proposing the species for listing, the Service has identified habitat modification in the form of degraded water quality and quantity and disturbance at spring sites as the primary threats to the species either now or in the future. As part of the listing process, the Service must look at current threats as well as those expected to occur in the foreseeable future and use the best available science to make a final listing determination for the salamanders. We are encouraged by the efforts to survey and monitor these species and protect their aquatic habitats in Williamson, Travis, and Bell Counties. However, more information related to the salamanders needs to be collected and more conservation efforts need to occur to ensure the threats to these species' long-term survival have been reduced or removed to the point that listing under the ESA is no longer needed. Therefore, we are presenting this document to our partners to consider as guidance for the development of additional local or regional conservation efforts. The Service will continue to update our approach to the conservation of the salamanders as new information becomes available.

Conservation Strategy

The Service has developed a preliminary long-term conservation strategy that represents the overall objectives and actions that we believe are needed to conserve the salamanders. The purpose of the strategy is to provide initial guidance for conservation and threat alleviation. In general, this includes measures aimed at reducing or removing threats to the species and ensuring self-sustaining populations remain in the wild. The following sections of this document describe our recommendations for meeting the objectives of our conservation strategy.

Maintain Healthy, Self-sustaining Salamander Populations Levels

The Service believes that protecting multiple populations across the landscape is essential for the long-term survival of the salamanders (Shaffer and Stein 2000, pp. 307, 309-310; Groves *et al.* 2002, p. 506) in order to provide a margin of safety for a species to withstand catastrophic events by decreasing the chance of any one event affecting the entire species. We have identified population goals to strengthen the possibility that the variability found within a species (spatial distribution, diversity) and thus the ability of each of the salamander species to adapt to changing environments is conserved. Protecting multiple populations of a species across its range also contributes to the species ability to recover from periodic disturbance (76 FR 76994).

The Service believes that in order to maintain healthy, self-sustaining salamander populations the conservation of the salamanders will require the following:

1. At least three populations of each species be protected within each occupied watershed (12-digit hydrologic unit codes); and
2. Ten populations of the Jollyville Plateau salamander be protected within the Bull Creek watershed due to higher densities in this area.

The Service also believes that additional populations of salamanders should be protected based on the unique requirements of each species (spatial distribution or population numbers) and the different environments (surface/subsurface or hydrology) within which they are found. For example, some populations occur in both spring and cave sites. We believe it is important to protect populations that are representative of both environments as a strategy to ensure genetic representation, adaptive capability, and conservation of the species.

The health and stability of salamander populations and their prey base should be regularly monitored. To provide population trend information, salamander surveys should be conducted at occupied sites on a regular basis. The Service also recommends conducting surveys at potential sites (caves and springs) within the watersheds currently occupied by the species, because salamanders may exist in other locations that have not previously been surveyed. These data should be analyzed and the results used to determine whether the objective of maintaining an adequate number of healthy, self-sustaining populations for each species is occurring.

Protect Water Quality

All three of the salamanders are entirely aquatic and breathe through external gills (Chippindale *et al.* 2000, p. 1). Therefore, the availability of an adequate supply of clean water is extremely important to the long-term conservation of these species. Unfortunately, many of the regulatory mechanisms currently in place (77 FR 50792-50793; SWCA 2012, pp. 34-50) within the range of the salamanders were not developed with the protection and conservation of aquatic salamanders or their prey base in mind. In addition, water quality degradation is not believed to occur through the action of only one or even a few constituents, but it is more likely the result of a gradual shift in the physical, chemical, and eventually biological characteristics of springs as land use changes from natural to agricultural, urban, industrial, or other uses. This gradual shift in water quality is much more difficult to detect and quantify. However, there is a strong link between the amount of impervious cover in a watershed and the multiple stressors that affect aquatic ecosystems (Coles *et al.* 2012, pp. 65, 85; 77 FR 50774-50775). The use of impervious

cover as a surrogate to measure the intensity of these stressors is an approach that has been implemented in parts of the country where complex and unspecified water quality problems existed (Coles *et al.* 2012, p. 85). We believe a similar approach to the protection of salamander habitat in the Northern Segment of the Edwards Aquifer may be appropriate.

The Service recommends that additional mechanisms (such as laws, rules, regulations, programs, ordinances, city planning, and cooperative agreements) be instituted to ensure the long-term protection of water quality in the areas that provide water from surface and subsurface sources to known salamander populations. For example, protecting water quality within the Northern Segment of the Edwards Aquifer could be achieved through the development of a regional plan that identifies sources of water quality degradation, characterizes and alleviates the specific threats to water quality, and includes a comprehensive water quality monitoring program. Development limits should be considered for areas closely tied by surface or subsurface flows to protected salamander populations.

The Service recommends implementing water quality protection measures that improve or prevent further reduction of the quality of surface water and the underlying aquifer, through the following actions:

- Development is planned so as to not result in water pollutant loads to springs where salamanders occur greater than pre-development conditions;
- Development is designed, constructed, and maintained at a level and in such a manner that does not alter the form, functions, and hydrology of the surface and groundwater drainage or creek system; and
- Water quality constituents are maintained within the range of natural aquifer conditions at levels that allow for the long-term survival of the salamanders and their prey in their natural environment (White *et al.* 2006, pp. 51-54).

The Edwards Aquifer is at risk from a variety of sources of pollutants (Ross 2011, p. 4), including pesticides, fertilizers, and the spillage of hazardous materials, resulting in contamination of both surface and groundwater resources (Service 2005, pp. 1.6-14-1.6-15; 77 FR 50782). The conservation strategy identifies the need for comprehensive regional plans and site specific plans to address procedures for avoiding or containing spills in areas of salamander habitat. Where possible, planning for emergency response to spills within the range of the salamanders should be part of existing emergency response plans pertinent to Travis, Williamson, and Bell Counties. In addition, to minimize the effects of a contaminant spill on individual salamanders, the Service recommends the development of contingency plans that identify facilities for holding salamanders, procedures for assessing the health of salamanders impacted by a spill, and protocols for transporting and maintaining salamanders.

Provide Adequate Water Quantity

The Northern Segment of the Edwards Aquifer is the primary source of water for the salamanders' habitat, although there may be some influence from the Trinity Aquifer (Cole 1995, p. 33; TPWD 2011, p. 3). This segment of the Edwards Aquifer has, in general, been described as localized, small, and highly susceptible to drying and draining (Chippindale *et al.* 2000, p. 36). Rapid population growth in this area is likely to be accompanied by rapid growth in demand for groundwater. In fact, groundwater availability modeling conducted by the Texas

Water Development Board concluded that "the general trend over time indicates gradual water-level declines in the southern part of the model area, especially in the Pflugerville-Georgetown area" (TWDB 2003, pp. 55-58). Although decreases in water quantity and spring flows have previously been cited as threats to salamanders (Corn *et al.* 2003, p. 36; Bowles *et al.* 2006, p. 11), some of these species also exhibit behaviors that have allowed them to adapt to the periodic loss of surface flows. The salamanders apparently spend some portion of their life history below ground when subsurface aquatic habitats are available and have the ability to retreat there when surface flows decline (Bendik 2011a, pers. comm.). We do not fully understand the relative importance of the surface and subsurface habitats to salamander populations. However, the best available scientific evidence suggests that surface habitats are important for prey availability and individual growth. In addition, studies have shown a negative growth rate for Jollyville Plateau salamanders during a 10-month period of retreating to the subsurface (Bendik and Gluesenkamp 2012, pp. 2-4).

The Service recommends implementing measures that protect underground habitats and provide adequate spring flow for the salamanders. For example, an analysis of the effects (particularly cumulative effects) of all drilling, boring, digging, or any other subsurface activities on the salamanders and their subsurface and surface habitats should be conducted prior to the initiation of any of these activities. Protective measures related to these activities should be outlined in a comprehensive plan and implemented to prevent the interruption of groundwater flow paths, alteration or disruption of the recharge or transmissive properties of the aquifer, dewatering of underground aquifer reserves or subsurface voids, and the loss of spring flow into salamander habitat.

Additional information needs to be gathered to ensure that long-term spring flow levels are protected for the salamanders and their habitats. The Service recommends the development of partnerships for sharing resources in a comprehensive effort to better understand the aquifer characteristics, underground flow paths, and recharge patterns so that the conservation strategy can be adaptively modified as new information becomes available. Baseflow evaluations, baseline water quality monitoring, and biological monitoring should be conducted to help further our understanding of the complex hydrogeological and biological mechanisms affecting water quality, habitat conditions, and ecosystem health.

Protect Surface Habitat around Salamander Spring and Cave Sites

The Service recommends that actions be implemented to protect salamander habitats from disturbance (feral hog, livestock, and human disturbance, etc.). The quality and quantity of water discharging from springs as well as other habitat components (such as substrate and interstitial spaces) within salamander habitat can be affected by various forms of disturbance. Frequent human visitation associated with areas occupied by these salamanders may negatively affect the species by altering the substrate and interstitial spaces (the space between the rocks) within their habitats. Unobstructed interstitial space is critical to salamander habitat because it provides hiding space from predators and habitat for macroinvertebrate prey items (Bendik 2011b, pp. 31-32). When these spaces are filled with fine sediment or become compacted, the amount of available foraging habitat and protective cover is reduced (Welsh and Ollivier 1998, p. 1,128).

The surface habitat around salamander populations should be monitored on a regular basis and managed to protect them from various forms of disturbance. Monitoring data should be used to modify management actions to protect salamander habitat, if necessary.

Moving Forward with Salamander Conservation

The Service recognizes that conservation of the salamanders requires a collaborative approach among our Federal, State, and local partners. We appreciate the opportunity to provide guidance on conservation strategies that the Service believes will address the threats to the species and assist in their long-term conservation. If our efforts are successful, we will improve and conserve the water and springs associated with the Edwards Aquifer, thereby helping to ensure a healthy future for the communities and the species dependent upon them.

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