

Species Action Plan

Green Salamander

(*Aneides aeneus*)

Purpose: This plan provides an initial five-year blueprint for the actions needed to attain near-term and, ultimately, long-term goals for the conservation and recovery of the Green Salamander in Pennsylvania. Given the complexity of managing and recovering this species, this plan will be continually updated to reflect progress toward the identified goals, and to incorporate new information. This Species Action Plan (SAP) also includes a description of the species natural history, distribution, and threats that have led to its rarity or imperilment.

Goals: The immediate goal is to maintain the extant populations of Green Salamander in the Commonwealth and to protect its remaining habitat. The secondary goal is to enhance extant populations by improving and increasing local habitat. Ultimately it is hoped the species will recover to the point where it can be removed from the Pennsylvania list of threatened species (58 Pa. Code §75.1).

Natural History

Taxonomy: Class Amphibia, Order Caudata (salamanders), Family Plethodontidae (lungless salamanders), Green Salamander (*Aneides aeneus*, Cope and Packard 1881).



Figure 1. Green Salamander (*Aneides aeneus*), Photo credit: Gary Pluto, 2016)

Description: *Aneides aeneus* is a small to medium-sized terrestrial species (Hulse et al. 2001), with adults typically 8.3-12.5cm in total length for both sexes (Powell et al. 2016). Dorsal coloration varies from brownish black to black with green lichen-like blotches extending onto appendages and sides. The ventral surface is typically light yellow to gray in color and unblotched. The chin has similar coloration to the ventral surface but is covered with numerous small light spots. The body is dorsoventrally flattened with long limbs and digits, and square-tipped toes. Tail length is equal in length or slightly longer than the body. Costal grooves number 14-15 (Hulse et al 2001). Green Salamanders have direct development, where young do not undergo metamorphosis and resemble adults in general appearance (Hulse et al. 2001). In older individuals, especially males, the temporal region of the head is greatly enlarged.

Habitat: Green Salamanders have specific and restrictive habitat requirements, primarily consisting of damp (but not wet) gaps and crevices in rock outcrops. Rock



outcrops are usually located in hemlock or mixed mesophytic hardwood forest slopes or ravines, often near streams, and are heavily shaded (Hulse et al. 2001).

Green Salamanders have also been found beneath loose bark and in cracks of standing or fallen trees and on rhododendron and mountain laurel (Barbour 1971; Waldron and Humphries 2005). Forest cover is an important factor in maintaining suitable humidity and as dispersal corridors between outcrop and boulder sites (Hamed and Smith 2020). Terrestrial movements may be dependent on cover provided by old growth logs and bark (Petranka 1998).

Life History: Green Salamanders brumate (hibernate) deep in rock crevices, typically entering hibernacula in early November (Thompson and Taylor 1985) and emerging in late March-early April (Hulse et al. 2001). Animals have been reported during day and night during the active season (Hulse et al. 2001). Home ranges as little as a few meters to several dozen meters in diameter have been reported. Yet, on occasion, dispersing plethodontids likely travel at least several hundred meters (Marvin 2001). Gordon (1952) reported a maximum distance moved of 98 m. Green salamanders are almost exclusively insectivorous with small beetles, ants, and mosquitoes identified as major prey items (Lee and Norden 1973). Courtship and mating have been observed in both the spring (Gordon 1952) and fall (Cupp 1971), with mating pairs observed together for as long as seven days (Canterbury and Pauley 1994). Females emerge from brumation with well-

developed ovarian eggs (Hulse et al 2001). Eggs are laid in early June (Gordon 1952, Thompson and Taylor 1985), deposited in rock crevices, and attached to the underside of rocks by mucous threads (Hulse et al. 2001). Average clutch size is 17 (10-26) eggs. Females remain with the eggs until hatching occurs in September after an average incubation time of 86 days (Hulse et al. 2001). Male and female Green Salamanders mature at 49 and 43 mm SVL, respectively (Hulse et al. 2001) at 7-8 years (Waldron and Pauley 2007).

Distribution and Status

National Distribution: *Aneides aeneus* ranges from southwestern Pennsylvania to northern Alabama and extreme northeastern Mississippi, in the Allegheny and Cumberland mountains. Disjunct populations occur in the southern Blue Ridge Mountains of North Carolina, South Carolina, and Georgia (Blue Ridge Escarpment), along the Ohio River in southwestern Ohio, and in central Tennessee and northeastern West Virginia (Hulse et al. 2001).



Figure 1. Distribution of *Aneides aeneus* in the eastern United States, based on data from 2021 (USGS 2023).

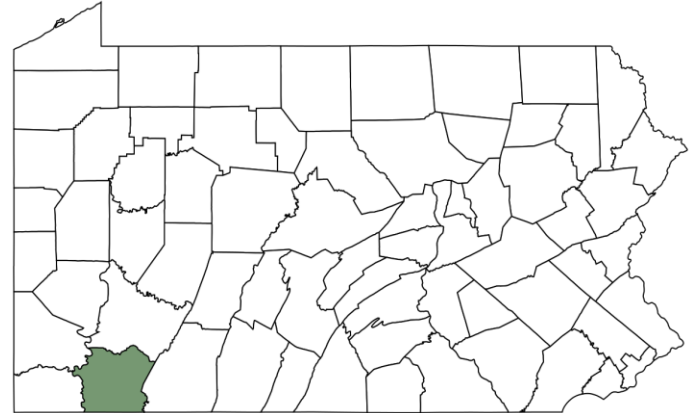


Figure 2. Current distribution of *A. aeneus* in Pennsylvania

Pennsylvania Distribution: Currently, *Aneides aeneus* is confirmed throughout much of Chestnut Ridge in Fayette County (PNHP Biotics Data). Additional undocumented populations may exist in the region.

Status: Pennsylvania Legal Status: Threatened

Federal Status: None

State Rank: S1 – Critically Imperiled (last reviewed 2015)

Global Status: G3G4 –Near Threatened (last reviewed 2004) G3 Vulnerable (NatureServe 2020)

Management Status

Aneides aeneus is reported as widely, but patchily distributed in the Appalachian Mountains region and considered uncommon throughout most of its range (Petranka 1998). Subpopulations that are isolated, disjunct, or at the periphery of the



range tend to be threatened or declining. Better information on status is needed for many areas throughout the range of the green salamander. On July 11, 2012, U.S. Fish and Wildlife Service (USFWS) received a petition requesting that 53 species of reptiles and amphibians, including the green salamander, be listed as endangered or threatened and critical habitat be designated under the Endangered Species Act and found that the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted (USFWS 2015). The range-wide number of extant occurrences (subpopulations) is unknown but likely exceeds 100, with global abundance estimated between 2,500 and 100,000 individuals.

Population trends: Long-term, range-wide trends suggest that extent of occurrence has not changed much, but area of occupancy, number of subpopulations, and especially abundance have declined significantly over the past several decades (NatureServe 2020). Disjunct Blue Ridge Escarpment (BRE) populations exhibited a dramatic decline in abundance after the early 1970s (Mitchell et al. 1999, Corser 2001). Snyder (1991) reported that the BRE populations appeared to be recovering, but Corser (2001) determined that three out of six populations first discovered in 1991 crashed in 1996-1997.

Threats

The restricted geographic range in Pennsylvania and stringent habitat requirements make Green Salamanders extremely vulnerable to local extinction. The total range of the Green Salamander is fragmented into several disjunct populations, and such isolated populations are continually at risk of extirpation.

- 1) Habitat loss by anthropogenic alteration and destruction.
 - a. Habitat destruction impairs dispersal of Green Salamanders (Riedel et al. 2006). Busy roads and large streams act as barriers to migration and gene flow between populations.
 - b. Habitat fragmentation and disturbance can also lead to excess predation and increased nonnative plant invasions. Dense stands of invasive plants can reduce available nesting habitat.
 - c. Excess reduction in canopy cover can lead to lower humidity, drying out habitat (Snyder 1991, Hulse et al 2001) used for foraging and nesting, (Petranka 1998). Road cuts and other large corridors adjacent to emergent rocks and outcrops can result in an increase in airflow and greater solar



- exposure, thus increasing temperatures and decreasing moisture (Pauley and Wilson 2005).
- d. Increased recreational rock climbing and bouldering has resulted in removal of lichens and moss on rocky habitat and further loss of woody vegetation near occupied sites and pose a significant threat to *A. aeneus* habitat (Hamed and Smith 2020; Eichelberger pers. comm. 2021).
- 2) Roads
 - a. Isolation of populations
 - b. Road-kill of dispersing salamanders
- 3) Pesticides
- 4) Illegal collection (exploitation)
- 5) Diseases such as Chytrid fungus, *Batrachochytrium dendrobatidis* (Mitchell et al. 1999, Corser 2001, Niemiller et al 2020)
- 6) Severe drought and prolonged cold periods (Snyder 1991)
- b. Maintain/establish suitable canopy cover and vegetation structure
- c. Control invasive vegetation at/near occupied and potentially suitable sites
- d. Identify/establish/maintain potential dispersal corridors between occupied sites.
- 2) Assess and monitor populations
 - a. Obtain population demographic data.
 - b. Assess general salamander health and presence of pathogens
 - c. Develop monitoring program at sites undergoing habitat changes to measure population response.
 - i. Monitor sites where anthropogenic activities occur
 - 1. Determine impact of these activities on microhabitat conditions
 - 2. Determine impact of these activities on *A. aeneus* population
 - ii. Monitor sites identified for Green Salamander habitat management
 - 1. Monitor habitat response to management
 - 2. Monitor *A. aeneus* response to habitat management

Conservation and Recovery

Conservation Actions:

- 1) Develop habitat management plans for occupied *Aneides aeneus* sites on state lands.
 - a. Meet with other state agencies and respective landowners to develop these management plans
- 3) Continue and expand ongoing protection measures for *Aneides aeneus* populations.
 - a. Review and comment on permit applications that involve proposed temporary and/or



- permanent disturbances to known *A. aeneus* habitat.
 - b. Coordinate with PA Game Commission and Department of Conservation and Natural Resources on land-use regulations and permitting in areas where *A. aeneus* are currently or historically known to occur.
 - c. Develop and implement Best Management Practices (BMPs) to reduce impacts from forestry practices, pipeline projects, and recreational activities.
- 4) Continue to survey for undocumented populations of *A. aeneus* within Pennsylvania.
- a. Evaluate protocol for surveys
 - i. Habitat Assessment/Habitat predictability modeling
 - ii. Presence/Absence Surveys
 - b. Target surveys in likely habitats
 - c. Collect ad-hoc PA Amphibian and Reptile Survey (PARS) reports
 - d. Apply species protection measures to new populations identified in surveys
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