

**Kearney's blue-star
(*Amsonia kearneyana*)
5-Year Review:
Summary and Evaluation**



Amsonia kearneyana – Photo credit Bill Radke, U.S. Fish and Wildlife Service

**U.S. Fish and Wildlife Service
Arizona Ecological Services Office
Tucson, Arizona
March 2022**

5-YEAR REVIEW
Kearney's blue-star (*Amsonia kearneyana*)

1.0 GENERAL INFORMATION

1.1 Listing History

Species: *Amsonia kearneyana*
Date listed: January 19, 1989
FR citation: 54 FR 2131
Classification: Endangered

1.2 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 5-year review is to assess each threatened species and endangered species to determine whether its status has changed, and it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology and status of Kearney's blue-star as part of the 2021 revision of the 1993 Recovery Plan and that information was used in support of this 5-year review. The original Kearney's blue star (*Amsonia kearneyana*) Recovery Plan was finalized in 1993 (Service 1993, entire). Since that time, the species has been in decline and new information has been gathered on the species' biology, distribution, and threats which allowed us to develop new objective and measurable downlisting and delisting criteria which, when met, would result in recovery of the species.

1.3 FR Notice citation announcing the species is under active review:

Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 36 Species in Arizona, New Mexico, Texas, Utah, and Mexico. July 26, 2019. 84 FR 36113.

2.0 REVIEW ANALYSIS

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 meets the definition of "endangered species" or "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 a species meets the definition of "endangered species" or "threatened species" due to any of the five factors described above.

The 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 assessing whether a species meets either definition, we must evaluate all identified threats by considering the expected response of 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 and 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 Service recommends 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 in the foreseeable future.

2.1 Updated Information and Current Species Status

In January 2021, a Recovery Plan First Revision for Kearney’s blue-star was released which contained an extensive review of the species biology, taxonomy, distribution, ecology, trends, and threats. Within this section, we provide new information not previously presented in the 2013 5-Year Review for the species, much of which is found within the 2021 Recovery Plan.

2.1.1 Biology and Habitat:

Abundance and Distribution

Kearney’s blue-star is a rare perennial herbaceous plant with a very limited distribution, found only in southern Arizona, United States. Occurring at nine sites within a single mountain range, the Baboquivari Mountains, we are currently aware of 334 individuals (Verwys pers. comm. February 24, 2022; Service 2021, p. 10; Radke 2019, p. 2). Surveys from 2017 of four previously occupied Bureau of Land Management sites revealed reduction in known plants at all four locations since previous surveys in 1998: 190 to 58, 50 to 38, 26 to 14, and 300 to 201 (Service 2021, p. 10). In 2019, surveys of the transplant population revealed 10 individuals, a reduction from 15 found in 2013 and 50 in 1988 (Service 2021, p. 10; Radke 2019, p. 2). Surveys from two historical populations on Tohono O’odham Nation lands in 2021 revealed 9 individuals at one site, down from 25 found in 1981, and 4 individuals at a second historical site where no previous population counts were taken (Verwys pers. comm. February 24, 2022). A third Tohono O’odham Nation site was not revisited. We have been denied access to the State Land-owned population and do not know the status of these plants.

In 2017, researchers spent 20 person-days searching for additional Kearney’s blue-star populations within suitable habitat of the Baboquivari and Coyote Mountains, but no new plants were found (Hazelton 2019, p.1). It is recommended that some areas with promising Kearney’s blue-star habitat within the Baboquivari and nearby ranges should be surveyed with a drone or technical climbing equipment. In 2019, a preliminary drone survey was conducted in Brown Canyon, and it was determined that the drone could detect Kearney’s blue-star while in flower (and presumably in the fall, when the foliage turns yellow), however a larger drone was needed for longer explorations (M. Radke pers. comm. April 22, 2019). Additional surveys are planned for the flowering and fall foliage seasons of 2022 and may involve drone work. The NatureServe database (Accessed 4-10-2019) indicates Kearney’s blue-star was discovered in Sonora, Mexico in 1996, citing a personal communication between R. Paredes to M. Martinez

in January of 1997. As there are no known herbarium collections from this discovery, the claim requires further investigation.

Reproduction

Although some small Kearney's blue-star individuals have been observed in the Baboquivari Mountains (e.g., Hazelton 2019, p. 1; Radke 2019, p. 6), these may be from ramets (genetically identical individuals sprouted from a parent plant) and it is generally believed that recruitment is low and limiting in the species. Many insects and hummingbird species have been detected on Kearney's blue-star, including a 2019 observation of a broad-billed hummingbird and a white-barred skipper seen nectaring at the transplant population (Service 2021, p. 2; Radke 2019, p. 7). Pollination, seed production, and dispersal do not seem to contribute to the limited number of seedlings observed (e.g., Reichenbacher pers. comm. February 24, 2019, p. 3-4; Hazelton pers. comm. May 24, 2018; McLaughlin pers. comm. May 10, 2018; B. Radke pers. comm. November 9, 2018; Yost and Stromberg 2016, p. 12; Yost 2015, p. 24-25).

Seeds, once thought to be commonly destroyed by the stink bug *Chlorochroa ligulata*, have been shown to be viable (Service 2021, p. 4; Souther pers. comm. March 1, 2022; Yost pers. comm. March 1, 2022). In greenhouse studies, it was determined that 66 percent shade was most conducive to Kearney's blue-star seedling survival and seed sewn on the surface yielded greatest germination (Yost 2015, pp. 55-56). Similarly, Radke (2019, p. 5) noted that in the transplant population, all plants remaining in 2019 had shade cover from larger vegetation or nearby rocks, suggesting they may have benefited during their initial years of growth from the increased humidity produced by this shade. While these findings suggest the plant may be poorly adapted to high severity disturbances, light to moderate disturbance may be beneficial to Kearney's blue-star to reduce competition (Reichenbacher pers. comm. February 24, 2019, p. 5; Service 2012, p. 5; Donovan 1998, p. 5).

The 2009 Elkhorn and 2016 Brown Fire, which burned through much of the Kearney's blue-star habitat, burned at mixed severity and, although surviving Kearney's blue-star plants appeared larger post-fire and have been observed to produce abundant seed, no seedlings have since been observed. This limited recruitment may also impact genetic diversity, thus reducing the plants' ability to adapt and recover from losses. There is ongoing research into Kearney's blue-star germination and recruitment requirements, which we hope will elucidate the role of shade, fire, nutrient, moisture, and disturbance level needed for optimal population health.

2.1.2 Threats Analysis (threats, conservation measures, and regulatory mechanisms):

Nonnative Plant Invasion

The invasion of nonnative plants into native plant populations may result in increased competition for space, nutrients, and water; alteration in vegetation structure and species composition; increased fire severity and frequency; and changes in soil chemistry, stabilization, and erosion (Service 2021, pp. 19-20). Nonnative plant

invasion has now been reported at both the Kearney's blue-star transplant site and within the largest grouping of plants in Upper Brown Canyon. Radke (2019, pp. 5-7) notes rose natal grass (*Melinis repens*) observed immediately downslope of the Kearney's blue-star plants in Upper Brown Canyon and that rose natal grass, Lehmann lovegrass (*Eragrostis lehmanniana*), Bermudagrass (*Cynodon dactylon*), Johnsongrass (*Sorghum halepense*), horehound (*Marrubium vulgare*), and London rocket (*Sisymbrium irio*) all occurred in the floodplain, on the slopes above, or near individual Kearney's blue-star plants at the Lower Brown Canyon transplant population. These nonnative plants may be directly impacting Kearney's blue-star through competition for space, light, water, and nutrients or indirectly through increased evaporation and reduced soil moisture and shade following vegetation community changes, making Kearney's blue-star reproduction less likely (Yost and Stromberg 2016, pp. 21, 35).

Drought and Climate Change

Climate change is likely to adversely affect the long-term survival and distribution of native plant species, including Kearney's blue-star, through changes in temperature and precipitation. In addition to low precipitation impacting Kearney's blue-star germination and growth, the increased severity of storms also impacts the species. Climatic projections for the southwestern United States indicate both increased summer drought coupled with more intense periodic rainfall events (Zhang et al. 2012, p. 390; Karl et al. 2009, p. 24). Such extreme rainfall is projected to increase runoff and soil erosion (Zhang et al. 2012, p. 390). Kearney's blue-star is known to be impacted by flooding, as evidenced by the loss of roughly 75 percent of the plants in the Lower Brown Canyon Introduction Site due to extreme flood events during the early 1990s (Reichenbacher et al. 1994, p. 2). In addition, in April 2019, it was reported the area around the transplant population is now more channelized and flashier (M. Radke pers. comm. April 22, 2019). An increase in the intensity of seasonal flooding could reduce or even remove Kearney's blue-star plants growing in canyon bottoms and severely damage slope-side plants due to erosion of their associated friable soils.

Low numbers and limited distribution

Kearney's blue-star has a very restricted geographic range with a small number of known subsites ranging in size from a 14 to 201 individuals (Figure 12; Hazelton 2018, p. 4; Yost and Stromberg 2013, p. 5) and limited recruitment through sexual reproduction, making the species more susceptible to extinction due to catastrophic events (e.g., wildfire or severe drought). Small, reproductively isolated populations are also more susceptible to the loss of genetic diversity, genetic drift (a change in the frequencies of alleles in a population over time), and inbreeding depression (the loss of fitness among offspring of closely related individuals). Furthermore, while some stressors (e.g., trampling, erosion, creation of firebreaks, maintenance of recreational trails, freezing and flooding events) may not necessarily have large effects by themselves, in combination with small population size and limited distribution, they have the potential to lead to extirpation of plants throughout the range of the species (Service 2021, p. 24).

2.2 Synthesis:

Kearney's blue-star is a species with limited range and a small number of individuals. There is a great deal of uncertainty about the relationship of individuals, subpopulations, and populations, and about the species' ability to respond to disturbances such as fire and drought. Threats, such as nonnative invasion, drought, and high severity fire, have increased since the previous 5-Year Review in 2013 (Service 2013, entire). All groups of plants known historically have been reduced in size and little recruitment has been documented. Therefore, the species continues to be in danger of extinction throughout its narrow range for the foreseeable future, and thus meets the definition of endangered at this time. Recovery actions remain largely unfunded and unimplemented.

3.0 RESULTS

3.1 Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist

No change is needed

3.2 New Recovery Priority Number:

No change

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

A full suite of recovery actions is included in the 2021 Kearney's Blue Star (*Amsonia kearneyana*) Final Recovery Plan First Revision (Service 2021, entire). The status of the species is still precarious, and we continue to recommend all the actions be implemented to recover the species. In addition to these needed actions, the Kearney's blue-star continues to have many information gaps that, if known, could aid in its recovery. The following is a list of known information gaps and research needs for Kearney's blue-star.

- i. Surveys - Additional Kearney's blue-star surveys in Arizona and Mexico are needed to determine distribution and status across the entire range. Donovan (1998, p. 4) states the species does not appear to be habitat limited and that there is a high possibility that more plants occur on the TON. Difficulty, however, lies in the inaccessibility of both the remote and rugged terrain, as well as, in attaining permission to access to lands administered by the ASLD, the TON, and possibly sites in Mexico. It is possible that the use of drones, scent detection dogs, or other innovative methods may assist in this endeavor, given landowner permissions are attained.
- ii. Biology - Basic Kearney's blue-star biology studies are needed. For example, what is the lifespan of Kearney's blue-star? Are flowers self-compatible, obligate outcrosser, or facultative (e.g., greenhouse studies to see if selfing produces viable seed)? Also, a map of the daily production of nectar, the receptivity of stigmatic surfaces, and the dehiscence of anthers, would be useful in determining pollinator effectiveness. How do populations of known pollinators vary across habitat types and conditions in the site?

- iii. Genetics - Studies of Kearney's blue-star genetics within and between subsites are needed to determine the functioning and structure of populations, the level of genetic diversity, if inbreeding depression is occurring, and how frequently sexual vs. vegetative reproduction is required to maintain or improve genetic diversity. Given human induced changes to the environment that occur more rapidly than historical changes, sexual reproduction may become more important than it was in the past in order to adapt more rapidly (Fehlberg pers. comm. February 28, 2019).
- iv. Threats - Studies on the effects to Kearney's blue-star from nonnative plant competition, livestock use of habitat, shade and nurse tree reduction, and fire frequency and severity shifts are necessary to better understand how these impact Kearney's blue-star germination, growth, and reproduction. For example, how does regular low severity fire vs. irregular high severity fire impact the species? Does the loss of shade trees to fire and drought impact moisture, humidity, and Kearney's blue-star germination and survival? Is smoke a germination cue that is missing?
- v. Introductions - Studies of the best methods for Kearney's blue-star introduction are needed to create new viable populations. For example, what is the best introduction location for this species? Can plants be grown in the field with direct seeding under protective wire mesh? How can seed germination be improved when seed availability must coincide with wet years for germination and initial seedling survival?
- vi. Management – Determine the best management practices for optimal habitat and pollinator health.

5.0 REFERENCES

- Donovan, J. 1998. Current Distribution and Status of the Kearney Blue-star in the Baboquivari Mountains, Arizona. A report submitted to the Bureau of Land Management.
- Fehlberg, S. 2019. Email correspondence from Shannon Fehlberg, Desert Botanical Garden, to Julie Crawford, U.S. Fish and Wildlife Service. February 28, 2019.
- Hazelton, A. 2019. Survey and mapping of Kearney blue-star (*Amsonia kearneyana*, Apocynaceae) populations, Pima County, Arizona. Section 6 Report. 31 pp.
- Hazelton, A. 2018. Survey and mapping of Kearney blue-star (*Amsonia kearneyana*, Apocynaceae) populations, Pima County, Arizona. Report to the Bureau of Land Management. 15 pp.
- Hazelton, A. 2018. E-mail correspondence from Andrea Hazelton, private botanist, to Julie Crawford, U.S. Fish and Wildlife Service. May 24, 2018.
- Karl, T., J. Melillo, and T. Peterson. 2009. Global Climate Change Impacts in the United States. Cambridge University Press New York, NY. 196 pp.

- McLaughlin, S. 2018. E-mail correspondence from Steve McLaughlin to Julie Crawford, U.S. Fish and Wildlife Service. Re: *Amsonia kearneyana* grow out at Sunnyside and lack of cattle grazing. May 10, 2018.
- NatureServe database. 2019. NatureServe Explorer. An online encyclopedia of life. <http://explorer.natureserve.org>. Accessed 4-10-2019.
- Radke, B. 2018. Email from B. Radke, Buenos Aires National Wildlife Refuge, to Julie Crawford, U.S. Fish and Wildlife Service. November 9, 2018.
- Radke, M. 2019. Kearney's blue-star monitoring in Brown Canyon, Baboquivari Mountains. Bureau of Land Management Report. 9 pp.
- Radke, M. 2019. Email from M. Radke, Bureau of Land Management, to Julie Crawford, U.S. Fish and Wildlife Service. April 22, 2019.
- Reichenbacher, F. 2019. Personal Communication - Review of Kearney's Blue-Star Draft Recovery Plan, Amendment 1. February 24, 2019. 7 pp.
- Reichenbacher, F., L. Clifford-Reichenbacher, and J. Taiz. 1994. Transplantation and Monitoring of the Kearney blue star in Brown Canyon, Baboquivari Mountains April 20, 1994. Report submitted to the U.S. Fish and Wildlife Service.
- Souther, S. 2022. E-mail correspondence from Sara Souther, assistant research professor Northern Arizona University, to Julie Crawford, U.S. Fish and Wildlife Service. March 1, 2022.
- U.S. Fish and Wildlife Service. (Service). 2021. Kearney's Blue-Star (*Amsonia kearneyana*) Final Recovery Plan, First Revision. Southwest Region, Tucson, Arizona, USA. 75 pp.
- U.S. Fish and Wildlife Service. (Service). 2019. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 36 Species in Arizona, New Mexico, Texas, Utah, and Mexico. Federal Register 84 FR 361134pp.
- U.S. Fish and Wildlife Service (Service). 2013. *Amsonia kearneyana* Kearney blue-star 5-Year Review: Summary and Evaluation. 33 pp.
- U.S. Fish and Wildlife Service (Service). 2012. Field Notes – *Amsonia kearneyana* in upper Brown Canyon, BLM lands. Internal report dated April 25, 2012.
- U.S. Fish and Wildlife Service (Service). 1993. Kearney's blue star (*Amsonia kearneyana*) Recovery Plan. 31 pp.
- U.S. Fish and Wildlife Service (Service). 1989. Endangered and Threatened Wildlife and Plants; Determination of *Amsonia kearneyana* to be an endangered species. Federal Register 54(12):2131-2134.

- Verwys, E. 2022. E-mail correspondence from Eric Verwys, ecologist, to Julie Crawford, U.S. Fish and Wildlife Service. February 24, 2022.
- Yost, T. 2022. E-mail correspondence from Tyna Yost, biologist, to Julie Crawford, U.S. Fish and Wildlife Service. March 1, 2022
- Yost, T. 2015. *Amsonia kearneyana* (Apocynaceae) Kearney's blue star: new insights to inform recovery. M.S. Thesis Arizona State University. 99 pp.
- Yost, T. and J. Stromberg. 2016. Dynamics of *Amsonia kearneyana* in four habitat types: Final report for U.S. Fish and Wildlife Service Section 6 grants. January 28, 2016. 42 pp.
- Yost, T. and J. Stromberg. 2013. Abundance, seed production, and seedling establishment of *Amsonia kearneyana*. Interim Performance Report, Section 6 Grant, March 13, 2013.
- Zhang, Y., M. Hernandez, E. Anson, M. Neiring, H. Wei, J. Stone, and P. Heilman. 2012. Modeling climate change effects on runoff and soil erosion in southeastern Arizona rangelands and implications for mitigation with conservation practices. *Journal of Soil and Water Conservation*. 67(5): 390-405.

U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW of Kearney's blue-star (*Amsonia kearneyana*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service, Arizona Ecological Services Office

Approve