U.S. Fish & Wildlife Service

Recovery Outline

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Species Name: Common Hay's spring amphipod, Latin *Stygobromus hayi*
Species Range: District of Columbia
Recovery Priority Number: 5
Listing Status: E; February 5, 1982
Lead Regional Office/Cooperating RO(s): Region 1 North Atlantic Appalachian
Lead Field Office/Cooperating FO(s): Chesapeake Bay Field Office
Lead Contact: Julie Slacum

1) Background

This document outlines a preliminary course of action for the recovery of Hay's spring amphipod. The Hay's spring amphipod is a medium sized, subterranean crustacean occurring in shallow ground water habitat located in the Piedmont physiographic region in the District of Columbia (DC). The species was listed as endangered on February 5, 1982. At that time the species was known to occur only in a small spring located at the south end of the National Zoological Park in DC. The species was then discovered in additional locations in nearby Rock Creek Park in 1998, 2001, 2003, and 2016. The species' known current distribution occurs over 2.5 miles (4.02 km) of the Lower Rock Creek watershed. Water quantity and water quality are the primary factors influencing the species range wide. We believe that development (stormwater runoff from impervious surface) has decreased conditions in both of these factors over time, resulting in potential extirpation of sites. Climate change may further exacerbate the impact of stormwater runoff through an increase in more severe storm events. The small number of populations and narrow range of the species also increase its vulnerability to stochastic and catastrophic events.

Type and Quality of Available Information to Date: The biological report (USFWS 2020) details the current information available for the species. The report assesses the viability of the Hay's spring amphipod by using the conservation biology principles of resiliency, redundancy, and representation (together, the 3Rs). Specifically, we identified the species' ecological requirements for survival and reproduction at the individual, population, and species levels, and described the factors, both positive and negative, influencing the species viability.

Important information gaps: We consider the current range of the species to be five sites that are extant, and two sites that are unknown. Despite repeated surveys conducted over time, individuals have not been observed at the type locality, Hay's Spring, since 1978 and Carter Barron Spring only has a record for the species from 2003, therefore, we consider the status of these two sites unknown. There are two sites that are probable but not confirmed through individual identification (an individual collected from interstitial sediments collected at Rock Creek near Rapid Bridge, and East Spring where one out of nine eDNA samples were positive for the species in 2016 but no individuals have been collected, to date). We consider Police Station Spring to be extant based on six out of eight eDNA samples collected in 2016 being positive for the species, however, the site is highly degraded and individuals have not been collected since 2001 (Niemiller et al. 2017). We will continue to conduct surveys to better understand the status of the species. Contemporary collections of the Hay's spring amphipod have typically been made during the winter and/spring months when the springs come to the surface (also referred to as a seepage spring) and amphipods can be collected by hand on the leaf litter. The species has also been collected using a Bou-Rouche pump (Culver and Sereg 2004, pg. 49). Sampling events that occur just where the water exits from underground likely serve as an indicator of presence rather than abundance. We therefore do not have an overall population estimate for the species. Furthermore, detection of the species may be low due to underlying, fractured bedrock which may be used by the species for feeding, breeding and sheltering, particularly if there is competition with larger, surface dwelling species that are more prevalent when water quality conditions are poor or if water levels are low.

Uncertainties:

- We assume that the species total range is represented by five current populations, two populations that are probable but not confirmed, and two unknown populations. If the unknown and probable sites are occupied or there are additional, undiscovered sites, we underestimate current resiliency, representation, and redundancy.
- There are no population data available for the species; while we do presume that individuals observed are part of a population, the size and structure of the presumed extant populations are unknown.
- We assume the species' has sufficient genetic diversity to adapt to relevant changes in its environment.
- We assume that the species has some adaptive capacity to deal with changes in water quantity by burrowing in clay, using water particles bound to sediment, or utilizing cracks and fissures in underlying bedrock. Persistence after decades of low to no surface flow at one site and long periods of drought support this assumption.
- We have no information on how stressors directly impact the Hay's spring amphipod; therefore, we primarily rely on literature on other aquatic systems (streams) and other fauna (fish and macroinvertebrates).

- The small number of sites and small range of the species in a highly urbanized setting will limit recovery options for the species. The species does occur entirely on Federal lands with cooperative landowners, so we can effectively manage the species within the Federal land boundaries, but we have less control of what is happening outside those boundaries from storm runoff.

Brief Life History: Based on observations from surveys, breeding likely occurs in early winter-early spring, and the presence of brood plates indicates reproduction occurs via eggs and also suggests the female provides limited care/protection via the brood pouch, which in amphipods is composed of a brood plate (Dick et al. 1998, p. 666). Young of the Potomac groundwater amphipod (*S.t. potomacus*), which this species co-occurs with at several sites, hatch from the egg and actively swim from the brood pouch, with days or even weeks passing between the hatching of the first and last young of a brood (Williams 2013, p. 10). The immature stages resemble the adults, and individuals undergo successive molts (usually between eight and nine) until maturity. Parthenogenesis, a form of asexual reproduction in which embryos develop without fertilization, also has been reported to be a possible life history strategy in *Stygobromus* species (Culver and Holsinger 1969, p. 631; Holsinger 1978, pp. 38, 59; Taylor and Holsinger 2011, p. 42). Males and females have been found in different collections but it remains unknown whether reproduction in the species is entirely sexual or whether asexual reproduction occurs as well. We also do not know at what age or size class individuals become sexually mature. Subterranean amphipod species like the Hay's spring amphipod may live for 4 to 6 years (Foltz and Jepson 2009, p. 2). The food requirements of the Hay's spring amphipod are currently unknown. Captive specimens of other amphipods in the genus *Stygobromus* have been observed feeding on protozoans, flatworms, organic debris, and plant material (Denton and Scott 2013, p. 42).

It is unknown whether this species uses a "swimmer" or "crawler" form of locomotion, which would likely affect its abilities to reside in certain sediments or respond to changing water levels (Stump and Hose 2013, p. 7). Both swimming and "walking" have been observed in the Potomac groundwater amphipod (Gilbert et al. 2018, p. 22). The Potomac groundwater amphipod also burrowed in clay when water was removed during an experiment (Gilbert et al. 2018, p. 22). The behavioral response of the Hay's spring amphipod to elevated flows, as might happen following a significant precipitation event, or to reduced flows, as might happen during a drought or other drop in water level, is likewise unknown.

Interspecific behaviors, such as predator-prey or competitive interactions, have not been observed. The Hay's spring amphipod has been known to be associated with other amphipods. It is found with the Kenk's amphipod (*Stygobromus kenki*), Potomac groundwater amphipod, and *Crangonyx* and *Caecidotea* spp. The Potomac groundwater amphipod was more commonly found in springs and seeps surveyed in the Piedmont physiographic province in Maryland and DC (pers. comm. D. Feller 2017), which may indicate that it could be a competitor at times when resources are more limited. *Crangonyx* and *Caecidotea spp.* are considered epigean species, which occur near the surface and are larger in size than *Stygobromus* species. There is the potential that these species could predate on the Hay's spring amphipod at times when it is near the surface.

Limiting Life History Characteristics: We assume based on surveys and literature that individual Hay's spring amphipods at all life stages require shallow water habitats, which provide space for feeding, breeding, and sheltering. We assume that individuals need sufficient

water quality to support breeding and sheltering. Springs or seeps that support *Stygobromus* sp. have water quality parameters that differ from those parameters of small surface waters by having higher conductivity and dissolved oxygen, and lower pH and temperature (Culver et al. 2012, pp. 5–6). An unpublished study (Culver and Chestnut 2006, pp. 1–3) found that sites supporting the genus *Stygobromus* had lower temperatures during spring and summer, higher dissolved oxygen, lower pH, and lower nitrate levels than other seepage springs (70 putative seepage springs) along the George Washington Memorial Parkway in Virginia. We believe that forest cover provides shade and contributes to maintaining water quality and water quantity by buffering non-point source pollutants from stormwater runoff, maintaining lower temperatures and higher dissolved oxygen, and helping to infiltrate precipitation. Forest cover also provides food through decaying leaves and organic matter, which individuals need to grow. The shallow ground water that occurs below springs and seeps is underlain by a clay layer, which we believe is used by individuals for food and sheltering at times when water quantity is limited (Gilbert et al. 2018, p. 22). There is also the potential that individuals shelter in fissures and cracks of bedrock. Because all life stages are dependent on sufficient water quality and water quantity, non-point source pollutants that originate from stormwater runoff can degrade the shallow water in which the species occurs.

Primary Threats: The primary threats to the species is degradation of water quality, water quantity in its shallow groundwater habitat from stormwater runoff from impervious surface.

Current Biological Status of the Species:

Overview: The population size of the Hay's spring amphipod is unknown. Its entire range is limited to 2.5 miles (4.02 km) of the Lower Rock Creek watershed in DC with seven extant populations (redundancy), and two populations that are probable but unconfirmed. The species has been collected from three habitat types (representation).

3 Rs: What is the current status of the 3 Rs for this species?

Demographic information from surveys was evaluated in addition to factors that influence water quality and water quantity for seven analytical units (the extant springs and associated recharge area). Two of seven analytical units are in high condition which aids the species in withstanding stochastic events (resiliency). We assume that due to the high level of development (the primary driver influencing habitat quality and quantity) that has occurred in DC and surrounding areas over time, the species retains much less resiliency, little to no redundancy, and decreased representation from the historical condition. Overall, resiliency is currently low due to the low number of sites (seven) with only four sites in high or moderate condition, and the remaining three in low condition. There is little redundancy, as all of the sites occur in the same 12-digit HUC watershed. Representation is also extremely limited by the small range of the species.

We do not expect an increase in impervious surface in the Lower Rock Creek watershed which is highly developed (40.2 percent impervious surface), and resiliency could increase slightly at three sites where a bioretention project was recently constructed to improve water quality and water quantity. However, climate change in the future could lead to more frequent storm events, which could increase the magnitude and severity of threats to the species by further impacting water quality and water quantity. We also assume that the probability of a catastrophic event occurring increases over time, leading to a higher risk of decreased viability due to the species lack of redundancy. The species displays adaptive capacity through the use of different habitat types and the ability to disperse to wet microclimates under drought conditions. This adaptive

capacity is likely to help the species sustain populations at the sites that are considered to be in high or moderate condition (four sites) into the future. Key uncertainties associated with this conclusion are provided in chapter 5 of the biological report (USFWS 2020).

Conservation Actions to Date: National Park Service has been an active partner in working with the Service to fund and implement surveys and research for the species, and to implement activities to reduce threats to the species. In 2020, a bioretention project was completed for an 11-acre impervious area (Carter Barron amphitheater and tennis stadium) (DDOE 2018b). The project will restore natural hydrology, reduce erosion, and improve water quality for a 30-acre area, which includes the Carter Barron site, and both Kennedy Street sites. We will continue to evaluate the species' response to improved water quality, water quantity, and habitat quality for the three sites near the bioretention project. The NPS also continues to control deer at the park to help maintain high quality forest, and ensures trails are not built near existing sites to help reduce foot traffic and erosion.

Recovery Priority Number: *5*

Brief Rationale: This species continues to be subject to a high degree of threat with low recovery potential. Water quantity and water quality are the primary factors influencing the species range wide. We believe that development (impervious surface) has decreased conditions in both of these factors over time, resulting in potential extirpation of sites. Changes in water quality could potentially change species composition in springs, leading to decreased fitness and declines in resiliency rangewide. We do not expect an increase in impervious surface in the Lower Rock Creek watershed, which is highly developed (40.2 percent impervious surface), and resiliency could increase slightly at three sites where a bioretention project was recently constructed to improve water quality and water quantity. However, climate change in the future could lead to more frequent storm events, which could increase the magnitude and severity of threats to the species by impacting water quality and water quantity.

2) Interim Recovery Program

Interim Recovery Strategy: The primary threat to the species is stormwater runoff from impervious surface. The Service does not believe that there are actions we can take to increase representation and redundancy of the species. Extensive survey effort has occurred since the 1990s to understand the distribution of *Stygobromus* species in DC, Maryland, and Virginia (Culver et al. 2012). It is likely that the geographic distribution of this species was much larger at one time but has decreased over time due to destruction of springs for development in DC and surrounding areas. Its remaining presence at Rock Creek Park is likely due to the extensive, mature forest that remains there. The Service does believe that we can try to increase resiliency at the remaining extant sites, and there could be discovery of new sites in Rock Creek Park. This was the case in 2016 when a new seep was discovered that had Hay's spring amphipod. There were also some interesting results from an eDNA study that was conducted in 2016. It may be that this species has such a low detection probability that surveys paired with eDNA will provide more certainty of presence. The Service will continue to work with the National Park Service, Smithsonian Institution, and DC Department of Environment to see how we can further decrease impacts from stormwater runoff and address aging infrastructure to increase resiliency and habitat quality at sites.

Action Plan: This interim recovery strategy is based on the need to:

1. Maintain resiliency at the 4 populations that are in high/medium condition

2. Increase resiliency at the 3 populations with low condition

3. Evaluate/confirm whether there are additional populations through surveys and eDNA to determine whether the species has greater representation and/or redundancy than is currently known.

Interim Recovery Action Plan – Prioritized in order of need for the species' recovery.

Preliminary Recovery Actions		
Recovery Actions	***Threats Addressed***	***Contributions to Recovery***
1. Evaluate additional conservation actions or projects that might be implemented adjacent to recharge areas recently delineated by the Service to further improve water quality and quantity.	*Water quality and quantity degradation*	*Prevent further declines in species' demographic trends; improve resiliency*
2. Work with the National Park Service and Smithsonian Institution to ensure that recreational activities and construction activities (e.g. new trails, increases in impervious surface, forest clearing), and activities adversely affecting water quality and quantity in recharge areas are discouraged (i.e., application of pesticides, changes in surface or subsurface flows).	*Water quality and quantity degradation*	*Prevent further declines in species' demographic trends; improve resiliency*
3. Support management actions conducted by the National Park Service, such as deer management, which result in maintenance of mature, forest habitat.	*Water quality and quantity degradation*	*Prevent further declines in species' demographic trends*
4. Continue to investigate the extent of ground water watersheds at each spring to get a more accurate representation of drainage areas. This will help	*Habitat loss, distribution, quality*	*Conserve recovery options for the future*

with review of projects under Section 7 of the Endangered Species Act.		
5. Conduct surveys at all of the extant sites and at the two sites with "unknown" status and the two sites with "probable" status in FY21 and FY22.	*Information gaps/uncertainty related to species status*	*Conserve recovery options for the future*
6. Continue to collect specimens for genetic analysis, including the closely related *S. Alleghensis* to improve the ability to use eDNA as a way to detect presence of the species in addition to surveys (collection by hand).	*Information gaps/uncertainty related to species status*	*Conserve recovery options for the future*
7. Conduct surveys (collection by hand) every 5 years to better evaluate the results of management actions on population status.	*Information gaps/uncertainty related to species status*	*Conserve recovery options for the future*
8. Implement water quality monitoring to evaluate the results of management actions.	*Reduced fitness due to poor health and potential changes in species composition from degraded water quality.*	*Prevent further declines in species' demographic trends*

3) Preliminary Steps for Recovery Planning

Will a recovery plan be developed? Yes, a recovery plan will be developed.

Type of recovery plan: Single species.

Who will develop the recovery plan: Endangered species program at the Chesapeake Bay Field Office with assistance from the National Park Service.

Plan for stakeholder role/involvement: The Service will invite the DC Department of Energy and Environment, National Park Service, Smithsonian Institution, and academic experts to participate in the development of a recovery plan.

Recovery Planning milestones:

September 2020 – Send invitations to partners to participate in recovery planning.

October 2020 – Hold initial recovery planning meeting with partners.

July 2021 – Complete a draft recovery plan for internal review.

October 2021 – Publish in the Federal Register a Notice of Availability of the draft plan for public comment. Solicit peer review of the draft plan.

October 2022 or earlier – Issue a final recovery plan.

Signed: WENDI WEBER Digitally signed by WENDI WEBER Date: 2020.09.16 12:56:24 -04'00' Date_____

Wendi Webber, Regional Director
North Atlantic-Appalachian Region

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