

**Bruneau Hot Springsnail
(*Pyrgulopsis bruneauensis*)**

**5-Year Review:
Summary and Evaluation**



**U.S. Fish and Wildlife Service/
Idaho Fish and Wildlife Office
Boise, Idaho
September 25, 2018**

5-YEAR REVIEW

Species reviewed: Bruneau hot springsnail (*Pyrgulopsis bruneauensis*)

5-YEAR REVIEW
Bruneau Hot Springsnail/ *Pyrgulopsis bruneauensis*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional or Headquarters Office: Pacific Regional Office, Portland, Oregon

Lead Field Office:

Idaho Fish and Wildlife Office (IFWO), Boise, ID; (208) 378-5243

Kristin Lohr, IFWO, Fish and Wildlife Biologist
Greg Burak, IFWO, Fish and Wildlife Biologist
Dave Hopper, IFWO, Fish and Wildlife Biologist
Tracy Melbihess, IFWO, Chief of Classification and Recovery
Kathleen Hendricks, IFWO, Assistant State Supervisor
Chris Swanson, IFWO, Deputy State Supervisor
Gregory M. Hughes, IFWO, State Supervisor

Cooperating Field Office(s): NA

Cooperating Regional Office(s): NA

1.2 Methodology used to complete the review:

In conducting this review, we (the U.S. Fish and Wildlife Service (Service)) utilized information obtained since the 2007 5-year status review for the species. This information includes peer-reviewed literature and numerous technical reports by various government agencies. These reports include species monitoring data collected by the Idaho Fish and Wildlife Office (IFWO); water quality data collected by the IFWO; water quantity and quality reports produced by the U.S. Geological Survey and Idaho Department of Water Resources; regulations and conservation measures produced by the Idaho Department of Water Resources; and, various other scientific literature regarding the species and its habitat requirements.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: February 12, 2016. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 76 Species in Hawaii, Oregon, Washington, Montana, and Idaho. 81 FR 7571.

1.3.2 Listing history

Original Listing

FR notice: FR 58: 5938-5946. Determination of endangered status for the Bruneau hot springsnail in Southwestern Idaho.

Date listed: January 25, 1993

Entity listed: Bruneau hot springsnail (*Pyrgulopsis bruneauensis*)

Classification: Endangered

Revised Listing, if applicable

FR notice: 63 FR 32981-32996. Notice of determination to retain endangered status for the Bruneau hot springsnail in Southwestern Idaho under the Endangered Species Act.

Date listed: June 17, 1998

Entity listed: Bruneau hot springsnail (*Pyrgulopsis bruneauensis*)

Classification: Endangered

The Bruneau hot springsnail was originally listed as endangered under the Endangered Species Act (Act) in 1993 (USFWS 1993). On May 7, 1993, the Idaho Farm Bureau Federation filed a complaint against the Service for declaratory and injunctive relief alleging violations of the Act and the Administrative Procedures Act (APA) with respect to listing the Bruneau hot springsnail as endangered under the Act. The U.S. District Court of Idaho determined that the Service committed “serious due process violations which caused the final rule to be arbitrary, capricious, an abuse of discretion, and otherwise not in accordance with the law” and was, therefore, set aside (*Idaho Farm Bureau Federation v. Babbitt*, Civil No 93-0168-E-HLR). However, on June 29, 1995, the U.S. Court of Appeals for the Ninth Circuit directed the Service to reconsider the 1993 listing (*Idaho Farm Bureau Federation v. Babbitt*, 58 F.3d 1392). Specifically, the Court directed the Service to provide the public with an opportunity to provide new information and for the Service to consider new information. Three public comment periods were granted, which totaled 218 days. A notice of determination was published on June 17, 1998, that upheld the 1993 listing as endangered (USFWS 1998). Since 1998, Bruneau hot springsnails have remained listed as endangered under the Act.

1.3.3 Associated rulemakings: NA

1.3.4 Review History: June 24, 2007. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*), 5-Year Review: Summary and Evaluation. Recommendation: No change in classification needed.

1.3.5 Species’ Recovery Priority Number at start of 5-year review: 2C

1.3.6 Recovery Plan or Outline

Name of plan or outline: Recovery Plan for the Bruneau Hot Springsnail

Date issued: September 30, 2002

Dates of previous revisions, if applicable: NA

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

Not applicable as the DPS policy only applies to vertebrates.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes

No

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

Yes

No

The criteria appropriately capture the importance of determining density of snails in each colony. However, the criteria do not specify the spatial extent over which these densities occur (e.g., high density populations/colonies may occur in extremely limited (small) areas and as such do not represent population wide densities). To measure the health of populations and colonies, both components are needed. Going forward we will adjust our monitoring protocol to begin addressing this issue, and will adjust our methods as appropriate in the future. See Section 4.0 - Recommendations for Future Actions, number 5 for further information.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

Yes

No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

The Recovery Plan for the Bruneau Hot Springsnail (Plan) outlines objective criteria and recovery measures considered necessary for recovery and/or protection of this species. The

Plan details the following criteria for reclassification from endangered to threatened status, and criteria for delisting (USFWS 2002, pp. 24–25):

Bruneau hot springsnails will be considered for reclassification from endangered to threatened, when it is demonstrated that:

1. *Criterion:* Groundwater and habitat management activities that provide for the protection of the Bruneau hot springsnail’s geothermal habitat are implemented.

Status: Idaho Department of Water Resources designated a Groundwater Management Area for the Grand View-Bruneau area in 1982; however, the geothermal habitat upon which Bruneau hot springsnails depend continues to decline. Furthermore, a management plan for this area has not been developed (Idaho Department of Water Resources (IDWR) 2017, p. 2). Therefore, this criterion has not been met.

2. *Criterion:* Following implementation of groundwater and habitat management activities, water levels in the geothermal aquifer (i.e., spring discharge) display an increasing trend over a period of 10 years toward the recovery goal of at least 815 meters (m) (2,674 feet (ft)) above sea level (as measured in October, annually, at U.S. Geological Survey well numbers 03BDC1, 03BDC2, and 04DCD1), and the number of geothermal springs has increased to approximately 165 seeps and are well distributed within the recovery area.

Status: Geothermal water levels measured in October 2016 in wells 03BDC1 and 04DCD1 average 809 – 810 m above sea level and are showing a declining trend (USFWS *in litt.* 2018; IDWR 2017, pp. 6, 17). This is 2 m lower than reported for the same wells in the 2007 5-year status review for the species (USFWS 2007, p. 5). Well 03BDC2 was intermittently dry between 2007 and 2012 and has been continuously dry since 2012 (IDWR 2017, p. 4). The total number of geothermal springs in 2017 was 72 (USFWS 2017, p. 2), down from 154 springs reported in the last 5-year status review (USFWS 2007, p. 5). Therefore, this criterion has not been met.

Bruneau hot springsnails will be considered for delisting when it is demonstrated that:

1. *Criterion:* Water levels in the geothermal aquifer are being maintained at 815 m (2,674 ft) above sea level (measured in October) at groundwater monitoring wells 03BDC1, 03BDC2, and 04DCD1.

Status: Geothermal water levels measured in October 2016 in wells 03BDC1 and 04DCD1 average 809–810 m above sea level and are showing a declining trend (USFWS *in litt.* 2018; IDWR 2017, pp. 6, 17). This is 2 m lower than reported for the same wells in the 2007 5-year status review for the species (USFWS 2007, p. 5). Well 03BDC2 was intermittently dry between 2007 and 2012 and has been continuously dry since 2012 (IDWR 2017, p. 4). Therefore, this criterion has not been met.

2. *Criterion:* The geothermal springs number more than 200 in October, and are well distributed throughout the recovery area. (This value approximates the 204 geothermal springs from 1996 surveys (Mladenka and Minshall 1996)).

Status: The total number of geothermal springs in 2017 was 72 (USFWS 2017, p. 2), down from 154 springs reported in the last 5-year status review (USFWS 2007, p. 5). Therefore, this criterion has not been met.

3. *Criterion:* Greater than two-thirds of available geothermal springs (approximately 131 geothermal springs) are occupied by medium- to high-density populations of Bruneau hot springsnails (1,650 to 10,000 snails/ square meters (m²)) (Rugenski and Minshall 2002).

Status: Of the 72 geothermal springs documented in 2017 (down from 154 springs documented in the last 5-year review), only 18 were occupied (USFWS 2017, p. 2). Of the 18 occupied springs, one was categorized as high density and three were categorized as medium density (USFWS 2017, pp. 7–10). Given that two-thirds of available geothermal springs are not currently occupied by medium- to high-density populations, this criterion has not been met.

4. *Criterion:* Regulatory measures are adequate to permanently protect groundwater against further reductions.

Status: Given that the geothermal aquifer and the number of geothermal springs are on a declining trend, regulatory mechanisms are inadequate or have not been implemented to protect the geothermal aquifer system from further reductions. Therefore, this criterion has not been met.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

No new information.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Bruneau hot springsnails are endemic to geothermal springs and seeps that occur along 8 kilometers (km) (5 miles(mi)) of the Bruneau River, including portions of Hot Creek (a tributary to the Bruneau River), in southwest Idaho (Fig.1). Since the time of listing in 1993, researchers have surveyed for the number, spatial extent, and location of geothermal springs, and the abundance of Bruneau hot springsnails in most years (1993, 1996, 1998, 2000, and 2002–2017). Snail density estimates at occupied geothermal springs are categorized as absent, low, medium, and high using visual estimates (Mladenka and Minshall 1996, pp. 2–3). Surveys are conducted

during early to late fall when river flows are at their lowest and most suitable for visually surveying for snails.

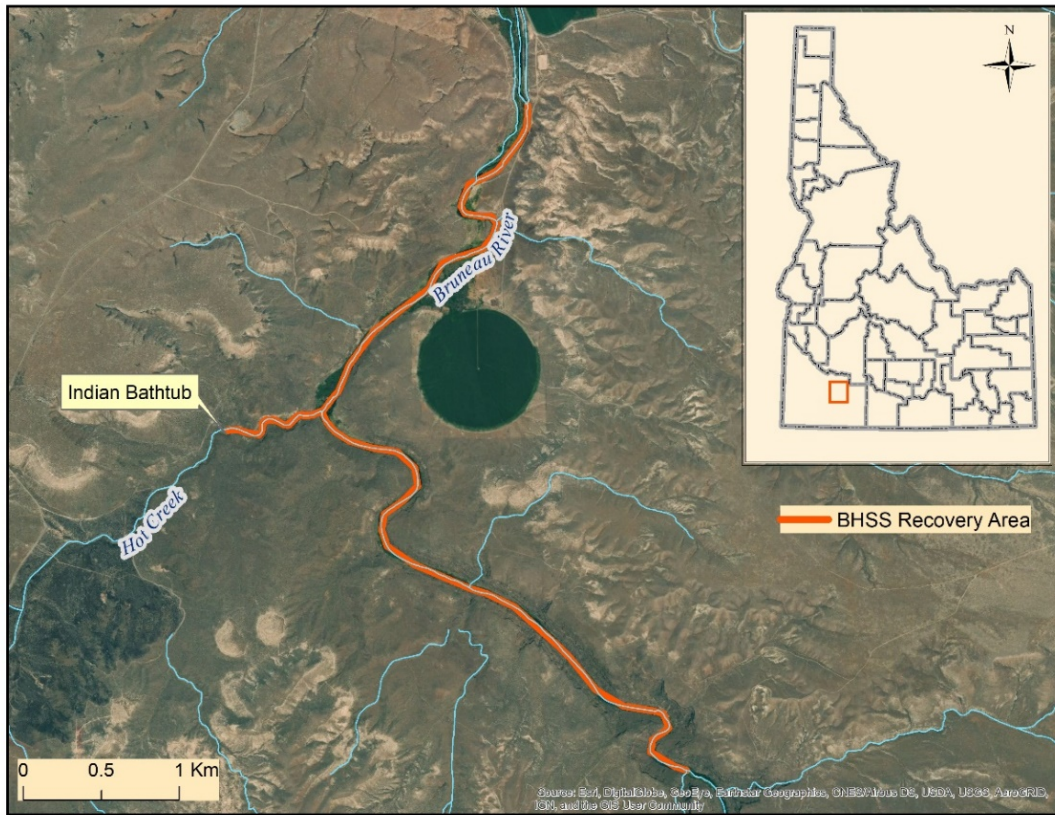


Figure 1: Recovery area and historical range (in orange) of the Bruneau hot springsnail in southwest Idaho. The species is no longer detected in an estimated 0.90 km of its upstream range where historic hot springs have declined and/or disappeared. The species has also been extirpated from the upper 400 m portion of Hot Creek which no longer receives spring inputs from the local geothermal aquifer.

The last 5-year review (2007) reported an overall declining population trend in Bruneau hot springsnails, which was attributed to fragmentation or loss of geothermal springs (USFWS 2007, pp. 5–6, 12, 28). For this status review, we assessed data from 2007–2017. Since 2007, populations of springsnails have further declined due to an increase in loss and fragmentation of geothermal spring habitat (USFWS 2017, pp. 5–8) (Fig. 2 and 3).

Since 2007, the total number of hot springs detected range-wide has decreased by 45 percent. Of the 72 springs recorded in 2017, only 25 percent were occupied by springsnails. The general trend in densities has also declined, with colonies exhibiting medium densities declining by 50 percent (from six to three). One colony was categorized as high density in 2017, while no high density colonies were detected in 2007. High density colonies have always been of low abundance, never exceeding three since 2007.

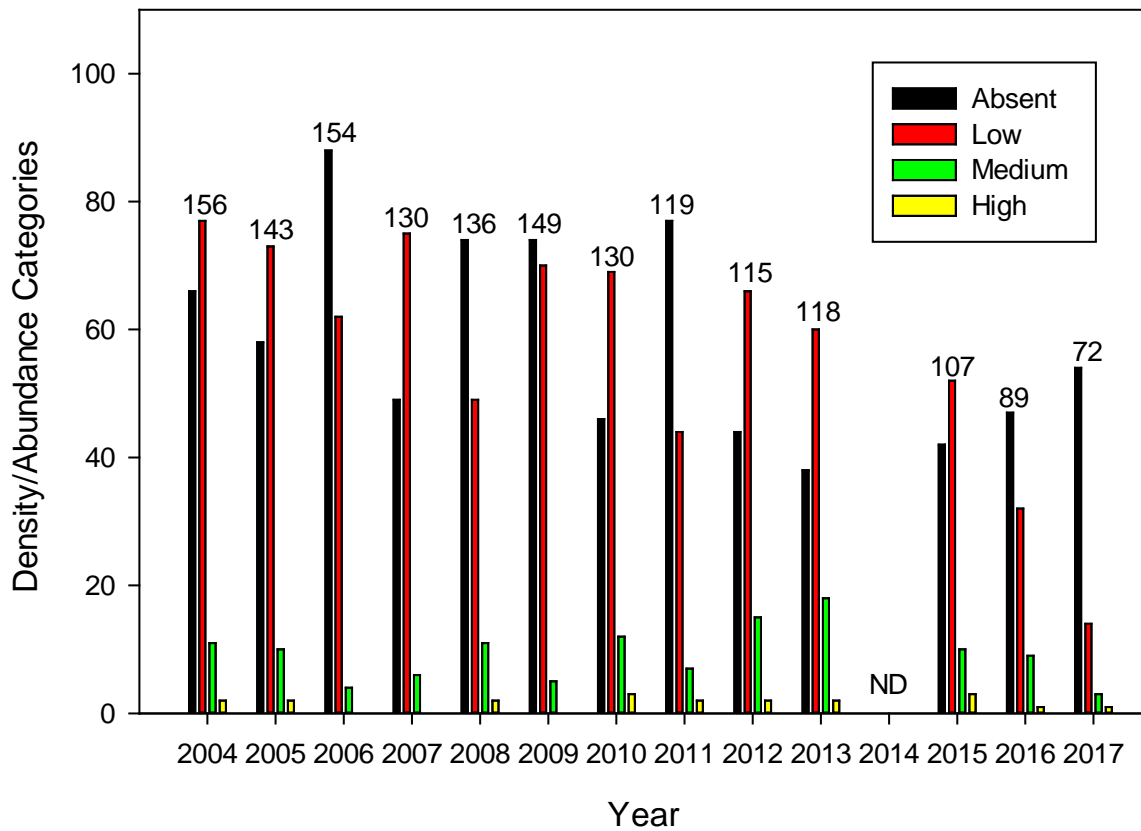


Figure 2. Bruneau hot springsnail presence and densities in geothermal springs over time (2004-2017) within the Bruneau hot springsnail recovery area along the Bruneau River in southwest Idaho. The values above each series of columns are the total number of geothermal springs (occupied and unoccupied) recorded during each respective monitoring year. In 2014, only the river upstream of Hot Creek was sampled due to early flooding of the Bruneau River during the survey period and does not represent a complete data set.

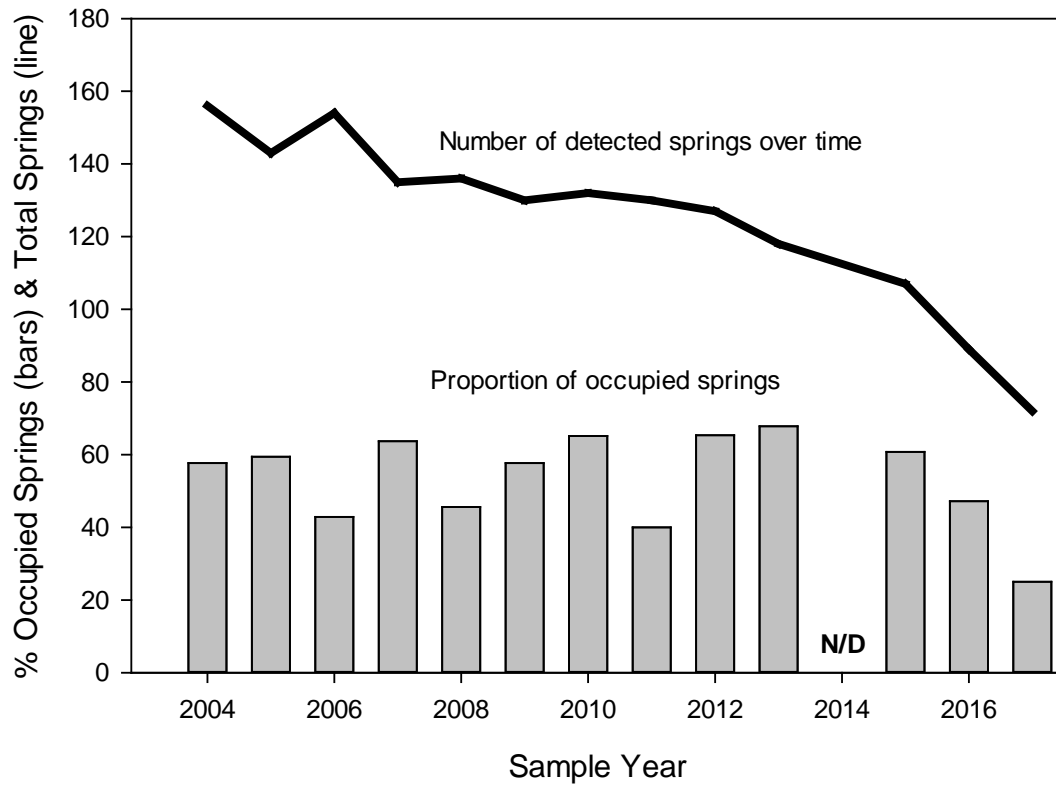


Figure 3. The percentage of occupied geothermal springs each year from 2004 through 2017 within the Bruneau hot springsnail recovery area along the Bruneau River in southwest Idaho. N/D: no data represents incomplete data set.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

In 2009, Bruneau hot springsnails were collected from six sites from both Hot Creek and the Bruneau River and analyzed for genetic differences (Hershler and Liu 2010, entire). Based on the results, the springsnail populations were found to be genetically diverse and consisted of two distinct groups. These groups could not be associated with a particular geographic area within the recovery area. Hershler and Liu (2010, pp. 5–6) recommended additional studies using microsatellites to more fully investigate the genetic structure of the species and begin to address gene flow and dispersal for future recovery purposes, such as translocation of the species. To date, further studies have not been conducted.

2.3.1.4 Taxonomic classification or changes in nomenclature:

No new information.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

The average number of geothermal springs in the upstream portion of the range has decreased by 29 percent since the last 5-year review. Some of this decline is attributable to the disappearance of the upper most geothermal springs along the west side of the Bruneau River that were last detected and measured in 2014 (USFWS 2016, p. 7). The loss of these springs represent a 300 m (5%) constriction of the species' total range. While the number of springs in the downstream portion of the species' range has also declined (58 %), the extent of the downstream range has remained the same since the last 5-year review. Bruneau hot springsnails are extremely small and likely have limited capabilities to actively move between geothermal springs because of their thermal requirements, especially those that are highly fragmented. Although Bruneau hot springsnails have been observed to drift into the Bruneau River when disturbed (Myler 2006, p. 8), this type of passive dispersal is less likely to result in successful colonization of more fragmented springs, but may provide some level of immigration from upstream colonies.

Overall, there has been a reduction in the spatial extent and quality of geothermal spring habitat for Bruneau hot springsnails, and a contraction in the upstream portion of the range since the last 5-year review.

Geothermal spring spatial extent and discharge rates are directly influenced by the geothermal aquifer. See section 2.3.1.6 below.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

The geographic range of Bruneau hot springsnails can be broken into two very different landscapes; upstream of Hot Creek and downstream of Hot Creek. The majority of land upstream of Hot Creek is Federal land administered by the Bureau of Land Management (BLM). The Bruneau River Canyon in this area is highly geologically confined with steep, basalt cliffs vertically extending hundreds of feet directly adjacent to the river channel. This area is only accessible by foot (walking up the river channel from downstream access points); or by floating by raft or kayak through greater than 48 km (>30 mi) of technical rapids, accessed from the Jarbidge River in northern Nevada. Therefore, this area receives very little human influence other than recreation (whitewater enthusiasts and hot spring bathers). At the confluence of Hot Creek, the confined canyon begins to open up into a less-confined floodplain. Property and the geothermal springs above the high water mark along the Bruneau River downstream of Hot Creek are mostly privately owned, with alfalfa/hay fields and livestock pastures characterizing the landscape. There are two major diversions in the recovery area (Harris Dam and Buckaroo Dam) that transfer the majority of the summer base flow from the Bruneau river into two canals, which are then used for irrigation.

Bruneau hot springsnail habitat is primarily affected by the underlying geothermal aquifer and flows within the Bruneau River. The Idaho Department of Water Resources (IDWR) manages a

groundwater-level monitoring network within the Grand View-Bruneau Groundwater Management Area (GWMA). This GWMA encompasses the range of the Bruneau hot springsnail. A recent analysis of wells within the monitoring network indicates that water levels in all wells exhibited a statistically significant downward trend over the 20-year and 10-year time frames, with a 0.88 feet per year median decline from 2008–2017 (IDWR 2017, p. 12). Geothermal well depths within this monitoring network and identified in the species recovery criteria have further declined since the time of listing (1993) and since the last 5-year review (2007) (Fig. 4a,b,c; IDWR 2017, entire; Adkins and Bartolino 2012, p. 1), and reflect the continuing decline and fragmentation of geothermal spring habitat for springsnails.

Geothermal springs within the Bruneau River can also be directly influenced by elevated river flows. High flows can scour benthic habitat and dislodge snails, which can affect Bruneau hot springsnail occupancy and densities (USFWS 2014, pp. 13–16). Presumably, snails can rebound and repopulate affected areas after one or more years of reduced river flows; therefore, the Bruneau hot springsnail has likely evolved to compensate for these periodic disturbances from high flows. Given that the occupied portion of the Bruneau River is unregulated (no water control devices, such as dams), changes in river flows will continue to affect the species and its geothermal habitat.

While we have recently documented unusually high river flows during unexpected times of the year (i.e., high river flows during mid to late fall; USFWS 2016, p. 6), additional information and analysis is needed to determine if flow regimes within the Bruneau River are, for example, becoming more frequent or erratic. Regardless of potential changes in river flow, if the range of the Bruneau hot springsnail further contracts, and its habitat and distribution becomes increasingly fragmented, disturbances from normal high river flows may have a larger impact to species persistence in the future.

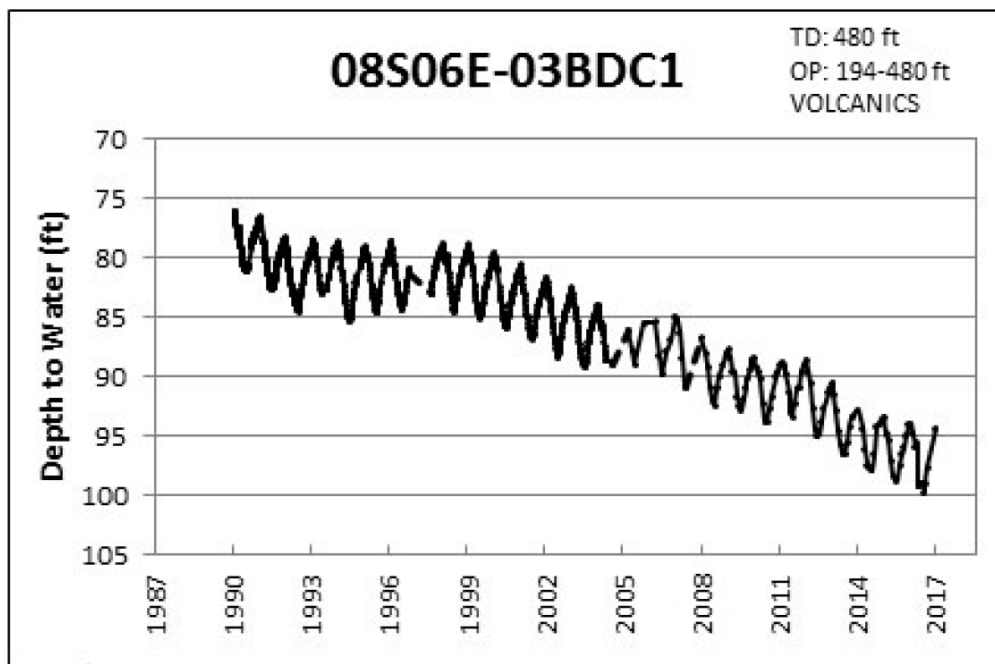


Figure 4a. Declining trend in geothermal well, 03BDC1 (from Appendix A, IDWR 2017, p. 17).

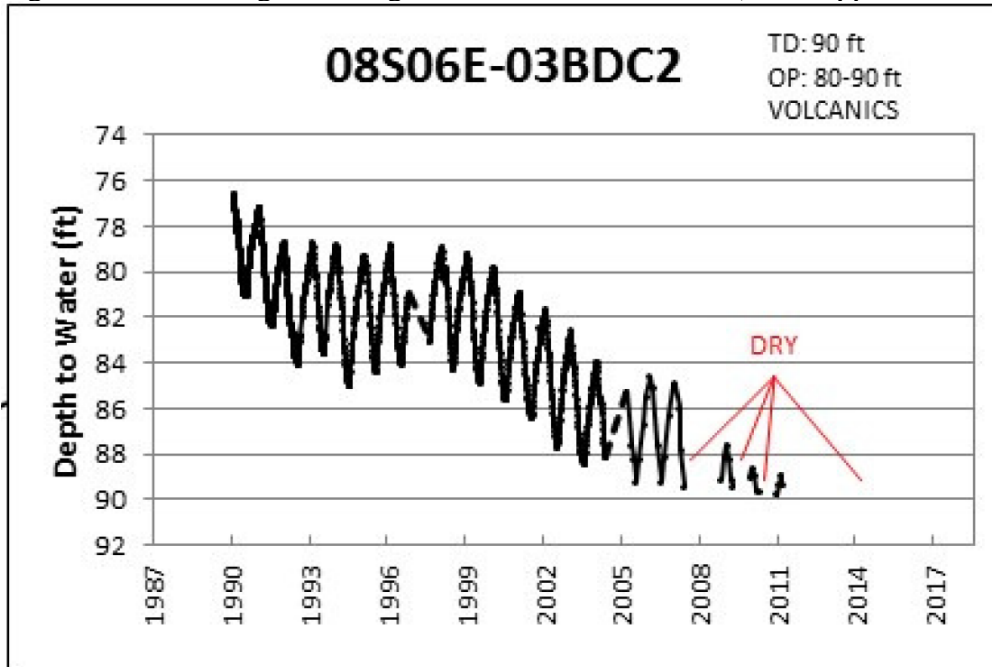


Figure 4b. Declining trend in geothermal well, 03BDC2 (from Appendix A, IDWR 2017, p. 17). Note the last overall reading was May 2012, after which the well is identified as continuously dry (IDWR 2017, p. 4).

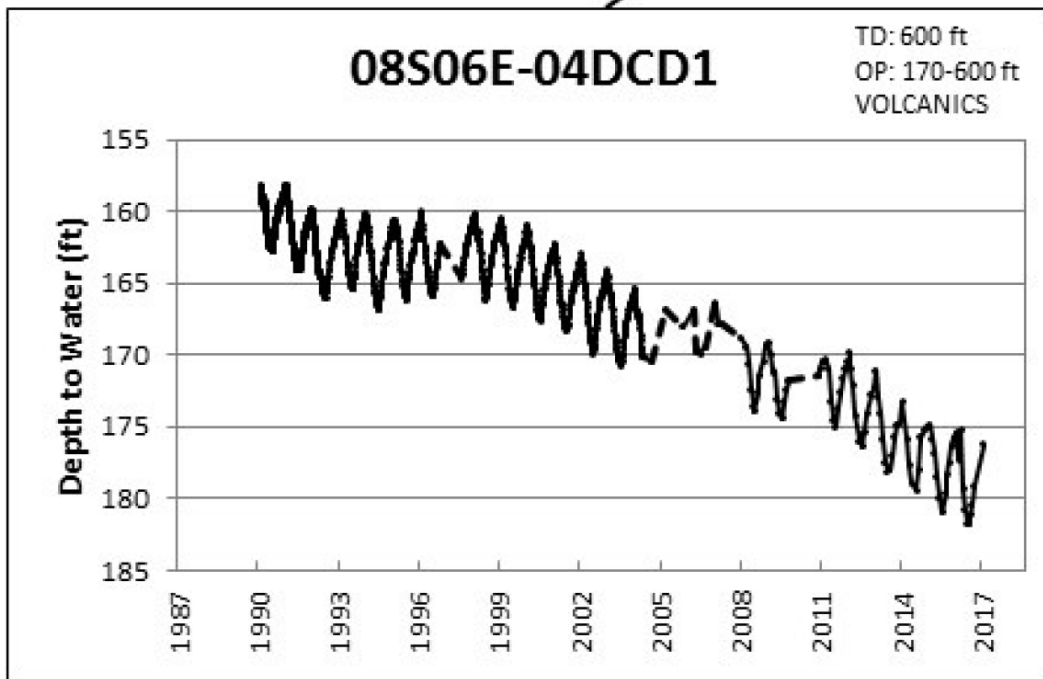


Figure 4c. Declining trend in geothermal well, 04DCD1 (from Appendix A, IDWR 2017, p. 17).

2.3.1.7 Other: N/A

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

All threats to the Bruneau hot springsnail still exist as previously documented and described in the 2007 5-year status review for the species (Table 1; USFWS 2007, pp. 21–27). The primary threat to the Bruneau hot springsnail continues to be springflow reduction due to groundwater withdrawal, which has resulted in the continued decline of geothermal habitat for the species. Furthermore, current state regulations are inadequate to address this threat. A secondary threat is predation from nonnative fishes. Low-ranking threats continue to be livestock grazing, surface water diversions, and recreation.

2.3.2.1 A. Present or threatened destruction, modification or curtailment of its habitat or range:

Groundwater withdrawal and springflow reduction

Groundwater withdrawal from the geothermal aquifer continues to negatively affect the spatial extent and quality of geothermal springs on which Bruneau hot springsnails depend. Beginning in 2008, the IFWO allocated \$201,500 towards water conservation projects on behalf of the springsnail. Most of the funding was used to work with the Bruneau River Soil and Water Conservation District to pay participating private landowners a supplemental incentive to upgrade existing irrigation systems to increase water efficiency or to replace flood irrigation systems with overhead sprinkler systems. As of 2015, the IFWO had provided cost-share funding for 37 individual thermal-water conservation projects with an estimated total water savings of approximately 2500 acre feet/annually. Despite these water-saving actions, most of the projects occurred outside of the Bruneau hot springsnail's range, and therefore, did not have an effect on geothermal habitat within the recovery area (USFWS *in litt.* 2017a). Because of the continuing decline of the geothermal aquifer and the resulting negative impact to geothermal spring habitat, we consider this threat to be increasing since the last 5-year review.

Livestock grazing

Prior to 1998, livestock grazing was considered a threat that affected some occupied Bruneau hot springsnail habitat near Hot Creek. In the 1990s, the BLM constructed fences to exclude livestock grazing from Hot Creek and all geothermal spring habitats along the Bruneau River upstream of Hot Creek. Riparian vegetation has rebounded and is providing stream cover, as well as a defense against instream erosion. In this 5-year review, we consider livestock grazing to be a low-ranking threat to Bruneau hot springsnails and the geothermal habitat they occupy in Hot Creek and along the Bruneau River upstream of Hot Creek.

Surface water diversion

Surface water withdrawals and diversions only occur along the Bruneau River downstream of Hot Creek. Within the recovery area, which extends approximately 2 km (1.2 mi) downstream of Hot Creek, there are two major diversions dams, Harris Dam and Buckaroo Dam. These dams divert water from the Bruneau River into two canals used for irrigation in the lower Bruneau

Valley. It is not known how Bruneau hot springsnails disperse between geothermal springs; however, they have been observed to drift into the Bruneau River when disturbed (Myler 2006, p.8). Therefore, removing the majority of the flow downstream of Hot Creek may impede the ability of this species to migrate or disperse to other geothermal springs located downstream. Surface water diversion is a low-ranking threat that only applies to habitat along the Bruneau River downstream of Hot Creek.

Recreation

Recreation continues to occur periodically at geothermal springs where small dams have been constructed to form pools for bathing. The 1998 Notice of Determination determined that recreational use of thermal springs was not a significant threat to the Bruneau hot springsnail or its geothermal spring habitat (USFWS 1998, p. 32994). Since the last 5-year status review, the IFWO has documented two additional geothermal springs modified for recreational use, one in 2011 and another in 2017 (Fig. 5a and 5b). Regardless, recreational use of the geothermal springs and seeps is not widespread and occurs sporadically. Therefore, we still consider it a low-ranking threat to the springsnail. However, as the geothermal aquifer continues to decline and geothermal springs change in their spatial extent and distribution, additional bathing pools constructed in occupied springsnail habitat may have a greater negative impact to the species.



Figure 5a. This geothermal spring was modified by recreationists to form a soaking pool in 2011 along the lower, west segment of the recovery area along the Bruneau River (USFWS 2011, p. 14).



Figure 5b: Geothermal springs within the Bruneau hot springsnail recovery area that were modified sometime in 2017 to support recreational use (USFWS *in litt.* 2017b).

2.3.2.2 B. Overutilization for commercial, recreational, scientific, or educational purposes:

In the last 5-year review, Factor B was no longer considered a threat to the species. Since the last 5-year review, we are not aware of any commercial or recreational use of the species. The Service regulates collections for scientific or educational purposes through issuance of Section 10(a)(1)(A) recovery permits. Existing permits are limited, and we do not anticipate an increased demand in future requests to collect this species.

2.3.2.3 C. Disease or predation:

There is currently no information regarding the threat of disease to the continued existence of Bruneau hot springsnails. However, two nonnative fish species, redbelly Tilapia (*Tilapia zilli*) and mosquito fish (*Gambusia affinis*), inhabit Hot Creek (where they were likely introduced via the pet trade) and geothermal springs along the Bruneau River. Both fishes were documented consuming Bruneau hot springsnails in a laboratory study (Myler and Minshall 1998, pp. 13–14), and Myler’s 2000 research illustrated the negative impact these nonnative fishes have on springsnail abundance (pp. 25-42). Although we lack nonnative fish abundance and distribution data for this 5-year review, these nonnative fishes continue to be observed in geothermal spring habitat in Hot Creek and the Bruneau River.

Prior to and early on in its listing history, the Bruneau hot springsnail were common or reached high densities in portions of Hot Creek (Hershler 1990, pp. 811-814; Myler 2000, p. 5). With the alteration of Hot Creek from beavers, habitat conditions have become ideal for these nonnative fish species. So long as these nonnative fishes occur and thrive in Hot Creek, it will not be able to support a robust population of Bruneau hot springsnails.

In 2012, the Service contracted with the U.S. Geological Survey for a laboratory study investigating the use of carbon dioxide as a lethal control agent for these nonnative fishes (Layhee et al. 2012, entire). Although the results of this study confirmed that carbon dioxide was effective as a lethal control agent for nonnative fish in the laboratory, further field studies are needed before lethal nonnative fish control actions can be implemented in Bruneau hot springsnail habitat.

2.3.2.4 D. Inadequacy of existing regulatory mechanisms:

The IDWR regulates water development in the Grand View-Bruneau area, which encompasses the range of the Bruneau hot springsnail. The area was declared a Ground-Water Management Area in 1982 by IDWR due to increases and projected increases in groundwater withdrawal and declines in springflows from the geothermal aquifer system (IDWR 1982, entire). A GWMA is all or part of a ground water basin that may be approaching the conditions of a Critical Ground Water Management Area (CGMA). A CGMA is defined as all or part of a ground water basin that does not have sufficient ground water to provide a reasonably safe supply for irrigation or other uses at the current or projected rates of withdrawal (IDWR 1999, p. 1). Present management and regulations that govern water use affecting the geothermal aquifer have not been adequate in reversing the declining trend of the geothermal aquifer.

2.3.2.5 E. Other natural or manmade factors affecting its continued existence:

Invasive species

Dioecious hydrilla (*Hydrilla verticillata*), an invasive aquatic plant typically found in the southern United States, has the ability of forming dense monocultures that restrict water flow, degrade water quality, impede recreation, and outcompete native species (Haller and Sutton 1975 in Idaho State Department of Agriculture (ISDA) 2017, p. 2). It was first identified in the Bruneau River in 2007 (ISDA 2017, p. 3) and covered an approximately 12-mile stretch of the Bruneau River downstream of Hot Creek, within the lower portion of the Bruneau hot springsnail recovery area. Within this area, it is largely restricted to areas of geothermal influence (ISDA 2017, p. 4).

An aggressive eradication program was initiated in 2008 by ISDA. This program was developed through multi-stakeholder and agency involvement including the ISDA, Idaho Department of Environmental Quality, Idaho Office of Species Conservation, USFWS, US Bureau of Land Management, US Department of Agriculture, and private landowners (ISDA 2017, p. 5). Control efforts through 2017 have led to a 99 percent reduction in the overall hydrilla population within the Bruneau River (ISDA 2017, p. 7).

Effects of hydrilla on Bruneau hot springsnails are unknown, but have the potential to affect the species and its habitat. While the quick response and control of this infestation has been largely successful, additional hydrilla monitoring and control will likely be required to keep this invasive species from reestablishing in the future. Suction dredging has been used to control hydrilla in portions of the Bruneau River (ISDA in litt. 2010). This method of control has the potential to harm populations of Bruneau hot springsnail (through crushing of individual snails and dislodging them from suitable habitat) and its uses should only be considered in extreme instances of hydrilla invasion. However, in its current status we do not consider hydrilla to be a current threat to the Bruneau hot springsnail, but it should be continually monitored and assessed.

Table 1: Threats to Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) at the time of listing (1993), 2007 5-year status review, and 2018 5-year status review. X denotes a threat.

Threats	Listing Factor	1993 (Time of Listing)	2007 5-Year Status Review	2018 5-Year Status Review	Summary
Groundwater withdrawal and springflow reduction	A	X	X	X	Increasing threat – no significant change in groundwater withdrawals resulting in continued springflow reductions.
Livestock grazing	A	X	X	X	Determined a low-ranking threat in 2007 5-year review. Continues to be a low-ranking threat.
Surface water diversion	A	X	X	X	Determined a low-ranking threat in 2007 5-year review for the downstream portion of the range. Continues to be a low-ranking threat.
Recreation	A	X	X	X	Determined a low-ranking threat in 2007 5-year review. Continues to be a low-ranking threat.
Over collection	B	X			Determined a potential threat at the time of listing, but not in the 2007 or 2018 5-year reviews.
Predation from introduced fishes	C	X	X	X	Continued threat
Inadequate state regulations	D	X	X	X	Continued threat
Flash flood sedimentation	E	X			No longer considered a threat.

2.4 Synthesis

Since the last 5-year review (2007), complete surveys for Bruneau hot springsnails and their geothermal spring habitat have been conducted every year, except for a partial survey in 2014. Declines in the geothermal aquifer have led to the continuing loss and fragmentation of

geothermal spring habitat, which has had a direct, negative impact on springsnail populations. Currently, Bruneau hot springsnail occupied springs and springsnail abundance are at the lowest recorded since the last 5-year review and since the time of listing (USFWS 2017, pp. 5–12; Fig. 3).

At the time of listing, threats to Bruneau hot springsnails were identified as groundwater withdrawal and springflow reduction; livestock grazing; surface water diversion; recreation; over collection; predation from introduced fishes; inadequate state regulations; and flash flood sedimentation (Hot Creek). Since the last 5-year review, overcollection and flash flood sedimentation are no longer considered threats.

The 2002 recovery plan for the endangered Bruneau hot springsnail detailed objective and measurable criteria for delisting:

- 1) water levels in the geothermal aquifer are being maintained at 815m (2,674ft) above sea level...;
- 2) the geothermal springs number more than 200 in October and are well distributed throughout the recovery area;
- 3) greater than two-thirds of available geothermal springs (approximately 131 geothermal springs) are occupied by medium to high density populations; and
- 4) regulatory measures are adequate to permanently protect groundwater against further reductions.

To date, none of these criteria have been met, and we are further from criteria objectives than at the time of listing (1993). Furthermore, as Bruneau hot springsnail habitat and populations continue to decline, the species is subject to reduced resiliency (ability of the species to withstand random disturbances, e.g. trampling, recreational use of geothermal springs) and redundancy (ability of the species to withstand catastrophic events, e.g. flash floods, high river flows) inherent in small populations.

Based on the downward trend of springsnail abundance and their habitat, and the increasing or continuing threats of habitat loss from groundwater withdrawal, predation by nonnative fishes, livestock grazing, and recreational use of geothermal springs, we recommend that the species remains endangered under the Act.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist**
 - Extinction*
 - Recovery*
 - Original data for classification in error*
- No change is needed**

3.2 New Recovery Priority Number:

No change is needed.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

1. In the long term, stabilization of the geothermal aquifer is needed to conserve Bruneau hot springsnails. Adkins and Bartolino (2012, p. 23) indicated that decreasing geothermal aquifer pumping closer to the geothermal reach of the Bruneau River would be the most effective groundwater conservation effort. We recommend the Service place elevated emphasis on working with the State of Idaho (e.g., IDWR, OSC, Bruneau River Soil and Water Conservation District) and private landowners to explore possible opportunities to strategically conserve geothermal groundwater. These efforts would not only benefit the species and these unique habitats, but would help sustain the local aquifers for their long-term use and sustained economic contribution to the community.
2. Aside from groundwater conservation, it is critical to investigate other possible conservation actions to ensure the species' survival. Based on early reports, springsnail densities were highest in Hot Creek. While the 1991 flood and ongoing groundwater declines have had irreversible impacts to the habitat in Hot Creek, the creek has changed over the past seven years and conservation options in Hot Creek should be reassessed. For example, removal of nonnative fishes from Hot Creek could be a significant conservation gain for the Bruneau hot springsnail and should be elevated as a conservation objective for the species.
3. Should the downward trends in springs and springsnails continue, the Service and its partners should consider other long-term options such as assisted migration to unoccupied and secure hot spring habitats elsewhere in the Bruneau River watershed.
4. In 2005, the Service obtained both LiDAR and infrared thermal imaging for the Bruneau hot springsnails' recovery area in order to remotely assess geothermal spring distributions. The intent of that effort was to provide a snap-shot of geothermal influences within the recovery area, with the recommendation that similar thermal imaging be conducted periodically (5-year intervals) to better assess geothermal spring trends and, by extrapolation, available geothermal spring habitat for springsnails. This effort was repeated in December 2017 with the use of unmanned drones. We recommend completing the spatial analysis of thermal imaging data between 2005 and 2017 to further refine geothermal habitat availability for the species.
5. There is a need to revise Bruneau hot springsnail monitoring methods to better quantify population and colony size that more appropriately assesses Recovery Criterion 3 (for the species to be considered for delisting – See Section 2.2.3). As defined in current monitoring methods, high density populations/colonies may occur

in extremely limited (small) areas (60.8 square centimeter circle, Myler 2006, p. 2), and as such do not represent population wide densities. Therefore, monitoring methods should be reevaluated and modified to better estimate density across entire populations/colonies. Additional monitoring parameters will be developed and modified as necessary to address this need, and incorporated to provide greater resolution to future criteria.

6. While the invasive aquatic plant hydrilla has been successfully reduced to small numbers, continued monitoring and control will be needed to keep this highly competitive invasive species from reestablishing itself within habitat occupied by the Bruneau hot springsnail.
7. With the declining trend in both Bruneau hot springsnail abundance and their habitat, we recommend completing a Population Viability Analysis to determine the extinction probability of this species and the timeframe associated with it.

5.0 REFERENCES

- Adkins, C.B. and J.R. Bartolino. 2012. Historical and potential groundwater drawdown in the Bruneau area, Owyhee County, southwestern Idaho: U.S. Geological Survey Scientific Investigations Report 2012-5119, 26pp.
- Hershler, R. and H.P. Liu. 2010. Bruneau hot springsnail genetic survey. Report to the U.S. Fish and Wildlife Service, Boise, Idaho. 16pp.
- Idaho Department of Water Resources (IDWR). 1982. Order Establishing the Grand View – Bruneau Groundwater Management Area. 2pp.
- Idaho Department of Water Resources (IDWR). 1999. Ground Water Management Areas in Idaho: Overview as of 1998. Open-File Report. 66pp.
- Idaho Department of Water Resources (IDWR). 2017. Summary of groundwater levels in the Grand View-Bruneau groundwater monitoring network–2017 update. Idaho Department of Water Resources: Open-file report. Boise, Idaho. 17pp.
- Idaho State Department of Agriculture (ISDA). 2017. Hydrilla Management – Strategies and Techniques Aimed at Eradication in Idaho Populations. End of Year Report. 22pp.
- Layhee, M., A. Ray and A. Sepulveda. 2012. Carbon dioxide as a potential control agent for exotic fish impacting Bruneau hot springsnails (*Pyrgulopsis bruneauensis*) in the lower Bruneau River, Idaho. U.S. Geological Survey Final Report. 30pp.
- Mladenka, G.C. and G.W. Minshall. 1996. Report on the re-survey of the Bruneau hot springsnail sites. Report to the U.S. Fish and Wildlife Service, Boise, Idaho. 13pp.
- Myler, C.D. 2000. Habitat Improvement for an Endangered Springsnail in Southwest Idaho. M.S. Thesis, Idaho State University, Pocatello, Idaho. September 2000. 45 pp.
- Myler, C. 2006. Bruneau Hot Springsnail (*Pyrgulopsis bruneauensis*) 2005 and 2006 Range Wide Surveys. U.S. Fish and Wildlife Service, Boise, Idaho. 10 pp.
- Myler, C.D. and G.W. Minshall. 1998. 1998 Monitoring report: Bruneau hot springsnail (*Pyrgulopsis bruneauensis*). Report to the Bureau of Land Management, Boise, Idaho. 64pp.
- Rugenski, A. and G.W. Minshall. 2002. 2002 annual monitoring report for the Bruneau hot springsnail (*Pyrgulopsis bruneauensis*). Report to the U.S. Fish and Wildlife Service, Boise, Idaho. 61pp.
- U.S. Fish and Wildlife Service (USFWS). 1993. Endangered and threatened wildlife and plants; notice of determination to retain endangered status for the Bruneau hot springsnail in southwestern Idaho under the Endangered Species Act. Federal Register 58:5938–5946.

U.S. Fish and Wildlife Service (USFWS). 1998. Endangered and threatened wildlife and plants; notice of determination to retain endangered status for the Bruneau hot springsnail in southwestern Idaho under the Endangered Species Act. Federal Register 63:32981–32996.

U.S. Fish and Wildlife Service (USFWS). 2002. Recovery plan for the Bruneau hot springsnail (*Pyrgulopsis bruneauensis*). Region 1, Portland, Oregon. 52pp.

U.S. Fish and Wildlife Service (USFWS). 2007. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 5-year review and evaluation. Boise, Idaho. 33pp.

U.S. Fish and Wildlife Service (USFWS). 2007. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2007 range-wide surveys. Boise, Idaho. 12pp.

U.S. Fish and Wildlife Service (USFWS). 2010. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2009 range-wide surveys. Boise, Idaho. 19pp.

U.S. Fish and Wildlife Service (USFWS). 2011. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2010 range-wide surveys. Boise, Idaho. 25pp.

U.S. Fish and Wildlife Service (USFWS). 2012. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2011 range-wide surveys. Boise, Idaho. 23pp.

U.S. Fish and Wildlife Service (USFWS). 2013. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2012 range-wide surveys. Boise, Idaho. 21pp.

U.S. Fish and Wildlife Service (USFWS). 2014. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2013 range-wide surveys. Boise, Idaho. 21pp.

U.S. Fish and Wildlife Service (USFWS). 2014. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2014 limited surveys. Boise, Idaho. 14pp.

U.S. Fish and Wildlife Service (USFWS). 2016a. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2015 range-wide surveys. Boise, Idaho. 17pp.

U.S. Fish and Wildlife Service (USFWS). 2016b. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2016 range-wide surveys. Boise, Idaho. 17pp.

U.S. Fish and Wildlife Service (USFWS). 2017. Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) 2017 range-wide surveys. Boise, Idaho. 15pp.

In Litt. References:

Idaho State Department of Agriculture (ISDA). 2010. Idaho Hydrilla Final Report 2010.

U.S. Fish and Wildlife Service (USFWS), *in litt.* 2017a. Presentation by Dave Hopper (USFWS) to the Bruneau River Soil and Water Conservation District on threats to the Bruneau hot springsnail. 2017.

U.S. Fish and Wildlife Service (USFWS), *in litt.* 2017b. Photograph taken by Greg Burak (USFWS) of a recreational bathing area constructed where a geothermal spring enters the Bruneau River. November 2, 2017.

U.S. Fish and Wildlife Service (USFWS), *in litt.* 2018. Well elevation readings derived from Idaho Department of Water Resources data. Word document and associated Excel files. Boise, Idaho.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Bruneau hot springsnail*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

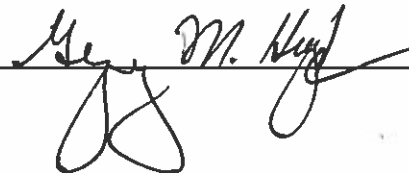
- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: N/A

Review Conducted By: Kristin Lohr, Greg Burak, and Dave Hopper

FIELD OFFICE APPROVAL:

State Supervisor, Idaho Fish and Wildlife Office

Approve  Date 9/25/18