**Bruneau hot springsnail**
***(Pyrgulopsis bruneauensis)***

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

**Photo Credit: USFWS-SRFWO**

**U.S. Fish and Wildlife Service**
**Snake River Fish and Wildlife Office**
**Boise, Idaho**

# 5-YEAR REVIEW

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

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## 1.0 GENERAL INFORMATION

### 1.1 Reviewers

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### 1.2 Methodology used to complete the review:

In conducting this review, we utilized available commercial and scientific information regarding *Pyrgulopsis bruneauensis*, its habitat, and factors affecting the species' continued existence. This information was acquired by various means. We began by searching files at the Snake River Fish and Wildlife Office (SRFWO) (i.e. office files), that contain decades of reports from various consultants, private industries, and government agencies that worked with or for the U.S. Fish and Wildlife Service (Service) in some capacity, and shared with or reported to the Service on their actions with regard to threatened and endangered species. These reports vary greatly in utility and cover a wide range of topics from general reports on species of concern solicited by the Service, to environmental reports regarding groundwater monitoring of wells and habitat of the Bruneau hot springsnail.

Additional files were searched for all forms of information and data on *Pyrgulopsis bruneauensis*, which included conference notes, emails, and phone records. For example, we often receive useful information on a species occurrence or extirpation, biology, and life history traits while attending meetings (e.g., the Snail Conservation Plan Technical Committee). Meeting notes reflect the experience and direct observations of biologists, which might not be reported in technical reports or published literature. Similarly, biologists often create field notes from surveys conducted on various species. Such field notes can be useful and objective but rarely appear in a technical report or publication. The Service considers this information when conducting 5-year reviews of listed species.

We also searched scientific databases on the World Wide Web for published literature on *Pyrgulopsis bruneauensis* (and/or similar species), life history, habitat, and the effects of spring regulation, water pollution, and invasive species on freshwater invertebrates. These databases included Boise State University's GEOREFS, ART ABSTRACTS, BIOAG INDEX, ARTICLE FIRST, and WORLDCAT. From the technical reports regarding *P. bruneauensis*, we have extracted the relevant references cited, acquired the papers, and considered those scientific findings, which are incorporated into this 5-year review.

An informational meeting was held on October 13, 2006, with Idaho Office of Species Conservation (OSC), Idaho Department of Environmental Quality (IDEQ), the Idaho Department of Water Resources (IDWR), the Natural Resource Conservation Service (NRCS), Idaho Soil Conservation Commission (ISCC), Bruneau River Soil and Water Conservation District (BRSWCD), and three private land owners from the Bruneau area. The purpose of this meeting was to allow Federal, State, local agencies, and private landowners to provide information to the Service that should be considered in the 5-year review process. We also contacted numerous other interested parties that might have useful information for our review by telephone and/or letter. These parties included OSC, IDEQ, IDWR, Idaho Conservation Data Center (ID CDC), and the Nez Perce, Shoshone-Bannock, and Shoshone-Paiute Native American Tribes. All of the information that was gathered or provided to us by any of the means discussed above was assimilated into this 5-year review for *Pyrgulopsis bruneauensis*.

All of the information that was gathered or provided to us by any of the means discussed above was assimilated into a status review report for the Bruneau hot springsnail (Myler 2007). The draft status review was sent out for peer review to three academic professionals with expertise in general snail biology and/or familiarity with Bruneau hot springsnail habitat. Peer reviewers were given a list of questions to consider during the review process. Comments received from peer reviewers were incorporated into the status review document. A briefing, consisting of SRFWO managers and biologists, was held on April 26, 2007, to review information summarized in the status review as well as peer review comments. The SRFWO formalized a recommendation as part of the 5 year review process at that time.

### 1.3 Background:

#### 1.3.1 FR Notice citation announcing initiation of this review:

71 FR 18345–18348. Endangered and Threatened Wildlife and Plants: Initiation of 5-Year Reviews of 70 Species in Idaho, Oregon, Washington, and Hawaii, and Guam. April 11, 2006.

#### 1.3.2 Listing history

Original Listing
**FR notice:** 58 FR 5938-5946. Determination of endangered status for the Bruneau hot springsnail in SW 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 SW Idaho under the Endangered Species Act.
**Date listed:** June 17, 1998
**Entity listed:** Bruneau hot springsnail (*Pyrgulopsis bruneauensis*)
**Classification:** Endangered

*Pyrgulopsis bruneauensis* 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 *P. bruneauensis* 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, *P. bruneauensis* has remained listed as endangered (E) under the Act.

#### 1.3.3 Associated rulemakings: None

#### 1.3.4 Review History: No other reviews have been performed.

**1.3.5 Species' Recovery Priority Number at start of this 5-year review:** The Service designated a recovery priority number of 2C for *Pyrgulopsis bruneauensis*, indicating that it is a taxonomic species, subject to a high degree of threat, rated high in terms of recovery potential, and may be in conflict with construction or other development projects or other forms of economic activity.

**1.3.6 Current Recovery Plan**
**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 Bruneau hot springsnail is not a vertebrate species and 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?**

__*X*_ ***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?**

__*X*_ ***Yes***
____ ***No***

**2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery?**

__*X*_ ***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, pages 24 to 25).

*Pyrgulopsis bruneauensis* 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 geothermal habitat that *P. bruneauensis* depends on have been implemented.
   *Status*: Idaho Department of Water Resources has implemented a Groundwater Management Area status review to the Bruneau-Grand View area, but no protection of the geothermal habitat upon which *P. bruneauensis* depends has been realized. This criterion has not been met.

2. *Criterion*: Following implementation of the groundwater and habitat management activities, water levels in the geothermal aquifer (i.e., springs discharge) have shown 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 well number 03 BDC1, 03BDC2, and 04DCD1), and the number of geothermal springs and seeps have increased to approximately 165 and are well distributed within the recovery area.
   *Status*: Geothermal water levels in wells 03 BDC1, 03BDC2, and 04DCD1 average 812 m above sea level and are showing a declining trend (Myler 2007, Appendix 4). The total number of geothermal springs in 2006 was 154 (Myler 2006, pages 2-4) and have declined since the 1996 surveys (204) (Myler 2006, page 5). This criterion has not been met.

*Pyrgulopsis bruneauensis* 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 03 BDC1, 03BDC2, and 04DCD1.

   *Status*: Geothermal water levels in wells 03 BDC1, 03BDC2, and 04DCD1 average 812 m above sea level and are showing a declining trend (Myler 2007, Appendix 4). 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 2006 was 154 (Myler 2006, pages 2-4) and have declined since the 1996 surveys (Myler 2006, page 5). 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 *P. bruneauensis* (1,650 to 10,000 square meters ($m^2$)) (Rugenski and Minshall 2002).
*Status*: In 2006, there were only 66 geothermal springs that were occupied by *P. bruneauensis* out of a total of 154 springs (Myler 2006, pages 2-4). There were no geothermal springs in 2006 with high density (9,941/$m^2$ ± 4983), 4 with medium density (1,618/$m^2$ ± 693), and 62 were low density (353/$m^2$ ± 293) (Myler 2006, page 6). Given that only 4 out of 154 springs have medium to high density populations, the two-thirds threshold to meet 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. 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:

The family Hydrobiidae has a worldwide distribution that is represented in North America by approximately 285 species in 35 genera (Sada 2006, page 1). In North America, most species occupy springs, and their abundance and diversity is notably high in the Great Basin, where approximately 80 species from the genus *Pyrgulopsis* occur (Hershler and Sada 2002, page 255). Hydrobiids are dioecious (having separate sexes), and lay single oval eggs on hard substrate, vegetation, or another snail shell (Mladenka 1992, page 3). *Pyrgulopsis* is the most common genus in the family with approximately 131 described species that are considered valid, 61 percent of which occur in the Great Basin (Hershler and Sada 2002, page 255). These tiny gill-breathing springsnails are aquatic throughout their life cycle (Hershler and Sada 2002, page 255). Females from this genus are oviparous (producing egg capsules that are deposited on substrates) (Hershler and Sada 2002, page 256). *Pyrgulopsis bruneauensis* has a 1 to 1 male/female sex ratio (Mladenka 1992, page 46), and reaches sexual maturity at approximately two months (maximum size at four months) with reproduction occurring year round at suitable temperatures (20-35 degrees Celsius ($^{o}$C); 68-95 degrees Fahrenheit ($^{o}$F)) (Mladenka 1992, page 3). Male genitalia are evident by the time this species reaches a shell height of 1.4 millimeters (mm) (0.06 inches (in)), and any snail lacking male genitalia at that size or greater is considered female (Mladenka and Minshall 2001, pages 208 to 209). The egg capsules of *P. bruneauensis* are relatively small (approximately 0.3 mm (0.01 in) in diameter) (Mladenka and Minshall 2001, page 208; Mladenka 1992, page 40). After emergence, *P. bruneauensis* are transparent until they reach approximately 0.7 mm (0.28 in) when black pigmentation appears in the body tissue (Mladenka and Minshall 2001, page 208; Mladenka 1992, Page 40). Growth rates (field) ranged from

0.010 to 0.022 mm/day (0.0004 to 0.0009 in/day) (Mladenka and Minshall 2001, page 208; Mladenka 1992, page 40) while the number of juveniles per female ranged from 0 to 18.5 individuals/month (Mladenka 1992, page 45).

*Pyrgulopsis bruneauensis* is endemic to thermal springs and seeps that occur along 8 kilometers (km) (5 miles (mi)) of the Bruneau River in southwest Idaho (Figure 1). This species has a temperature tolerance between 11-35$^{o}$C (52-95$^{o}$F) (Mladenka 1992, page 85). *P. bruneauensis* is seldom found in standing or slow-moving water and was shown in the laboratory to tolerate higher current velocities than present in nature (Mladenka 1992, pages 87 and 88). This species appears to be an opportunistic grazer and seems to prefer colored algal mats, which contain higher numbers of diatoms relative to lighter algae (Mladenka 1992, page 81). A movement study performed in the laboratory showed that *P. bruneauensis* is capable of crawling 1 centimeter per minute (cm/min) (0.3 in/min) (Myler and Minshall 1998, pages 53 and 54). Additionally, this species prefers to move over wetted substrate (substrate covered with flowing water), and has a propensity to move upstream vs. downstream (Myler and Minshall 1998, pages 53 and 54). In a field substrate preference experiment, *P. bruneauensis* preferred cobbles (> 10 cm in diameter (4 in)) over gravel (2-10 mm) (0.08-0.4 in) and sand/silt (< 2 mm) (< 0.08 in) (Myler 2000a, page 26). In a field experiment where an artificial substrate (plexiglass 1 m by 1 m (39 in by 39 in)) was placed under thermal springflow near Mladenka's Site 2 (Figure 1), *P. bruneauensis* was observed to colonize at a rate of 1 snail per hour with a carrying capacity of 300 snails per square meter (snails/m$^2$) (Myler 2000a, page 42). Water temperature appears to be the predominant factor that influenced abundance at long term monitoring sites (Mladenka 1992, page 90). *P. bruneauensis* have often been observed in the geothermal spring/river interface in surveys conducted since 1998 (Myler 2004, page 8). Occurrence in this location likely facilitated individuals to optimize temperature preference. In a desiccation experiment performed in the laboratory, *P. bruneauensis* mortality occurred between 2-4 hours (Mladenka 1992, page 53), but it is unknown how this species disperses between suitable habitats under desiccated conditions. This species has been observed to drift into the Bruneau River when it is disturbed from its geothermal spring habitat (Myler 2004, page 8). Drift as a mechanism of downstream dispersal is possible for this species. However, it is assumed that since this species has no locomotion abilities in the river current, many drifting individuals that do not settle in geothermal springs will likely perish due to their strict temperature requirements. Many questions regarding the dispersal and long-term exposure to cold river water for this species remain unanswered. Although *P. bruneauensis* have been observed in the Bruneau River proper (Mladenka and Minshall 2003, pages 7 and 8), occurrences have been directly associated with geothermal upwelling on the river bottom (Myler 2004, pages 3 and 4). No evidence exists to suggest that *P. bruneauensis* is not a thermophilic species. In late summer (July to August) water temperatures in the Bruneau River are within the temperature tolerance of *P. bruneauensis*. However, we know of no surveys that have located *P. bruneauensis* in cold water or outside of geothermal upwelling zones in the Bruneau River.

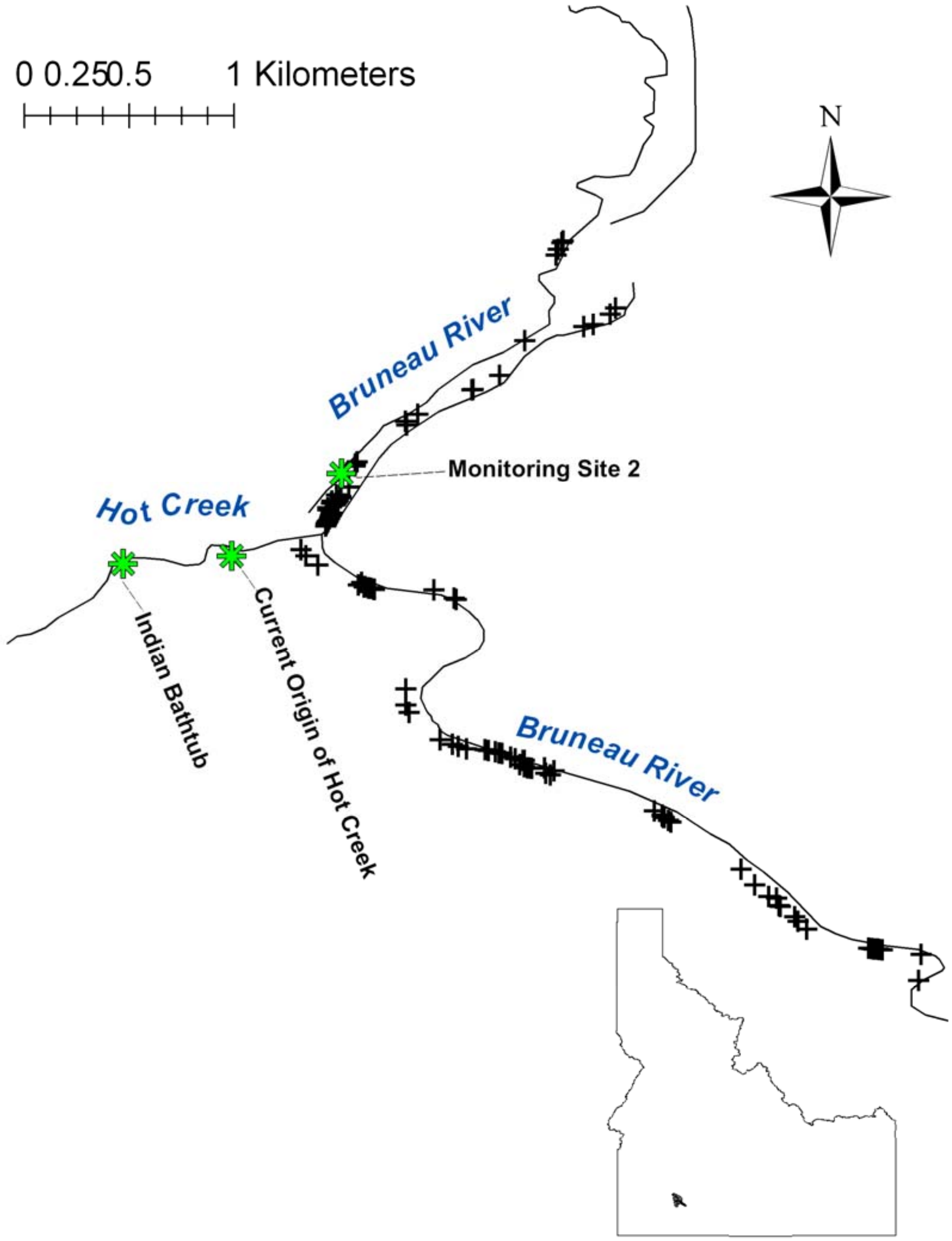



**Figure 1. Map of the geothermal springs where *Pyrgulopsis bruneauensis* resides. Survey points were generated by visiting each site and using a GPS unit to create a position. Sites of Interest: Indian Bathtub (sometimes called Hot Creek Falls) is the location where this species was first discovered; the current origin of Hot Creek is the location where Hot Creek begins to flow; and Monitoring Site 2 (=Mladenka's Site 2) is the location where Idaho State University researchers monitored this species from 1989 to 2002. The direction of flow of the Bruneau River is north.**

**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**:

The best available data concerning population size and trend was collected from the annual rangewide surveys conducted in 1991 (Mladenka 1992), 1993 (Mladenka 1993), 1996 (Mladenka and Minshall 1996), 1998 (Myler and Minshall 1998), 2000 (Myler 2000b), 2002 (Lysne 2002), 2003 (Mladenka and Minshall 2003), 2004 (Myler 2004), 2005, and 2006 (Myler 2006). These surveys enumerate the number and location of geothermal springs and assign a relative snail abundance value of absent ($0/m^2$), low ($353/m^2 \pm 293$), medium ($1{,}618/m^2 \pm 693$), or high ($9{,}941/m^2 \pm 4983$) density (Myler 2006, page 2). Myler et al. (2007, in press) analyzed population trends from 1991 to 2004 in the geothermal springs that occurred upstream of Hot Creek using total numbers of geothermal springs with and without *Pyrgulopsis bruneauensis* for each year surveyed. The results from two additional surveys (Myler 2006) conducted in 2005 and 2006 are included in this review (Figure 2). In the 15 years that rangewide surveys have been conducted, the total number of geothermal springs along the Bruneau River upstream of Hot Creek occupied by *P. bruneauensis* has declined from 146 geothermal springs in 1991 to 66 in 2006 (Figure 2, Myler 2006, pages 2 to 6). In the past 10 years, the total number of geothermal springs surveyed along the Bruneau River downstream of Hot Creek have increased from 20 in 1996, to 88 in 2006 (Figure 2; Myler 2006, pages 2 to 6) which we attribute to declining geothermal water levels and fragmentation of remaining geothermal springs sites. In other words, as the geothermal aquifer declines, geothermal springs often decrease in size and become fragmented into smaller geothermal springs and seeps. For example, what was counted as a single large spring in 1991-1993 is currently counted as multiple smaller springs and seeps with a smaller total area that represents a net decrease in habitat and species density (Figure 3). However, geothermal springs downstream of Hot Creek occupied by *P. bruneauensis* have declined from 40 in 2003, to 26 in 2006 (Figure 2; Myler 2006, pages 2 to 6).

The relative density of *Pyrgulopsis bruneauensis* upstream of Hot Creek has also changed compared to surveys of 1991, 1993, 1996, 2003, and 2004 (Myler 2006, page 6; Figure 4). In 2006, only 4 geothermal springs sites had medium densities of *P. bruneauensis* and no occupied sites had high densities of *P. bruneauensis*, compared to 33 medium and 11 high density sites (of 110 total occupied sites) located in 1996. The number of high and medium density snail sites show a decreasing trend since 1991, while the number of low density snail sites and sites without *Pyrgulopsis bruneauensis* has increased (Myler 2006, page 6; Figure 4). In the area downstream of Hot Creek, high and medium density sites have remained relatively constant, while the number of geothermal springs with low density or lacking *P. bruneauensis* have increased (Figure 4). Many of the geothermal springs and seeps that occur downstream of Hot Creek have become fragmented as a result of the declining geothermal aquifer. As geothermal springs and seeps become fragmented, *P. bruneauensis* colonies that formerly occurred in larger springs also become fragmented into smaller colonies. Although Figure 4 suggests that the number of low density and geothermal springs without *P. bruneauensis* are increasing

in trend, the reality is that remaining springs are much smaller in total area and a net decrease in overall species habitat and population density is occurring.

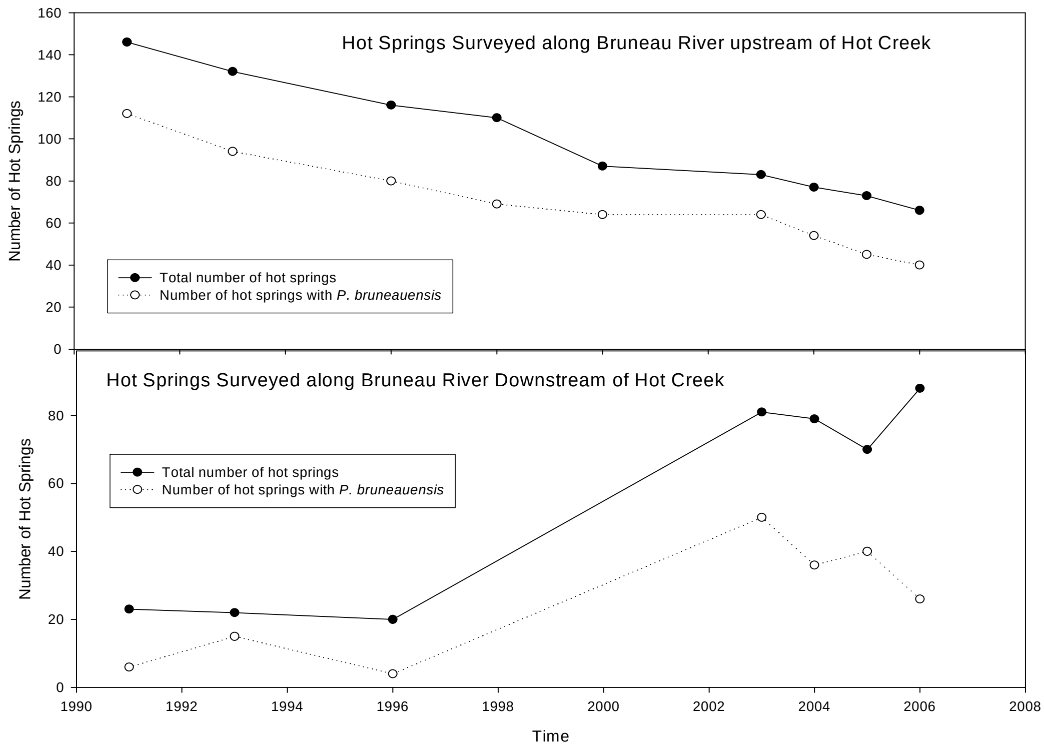



**Figure 2. Total numbers of geothermal springs and total number of geothermal springs with *P. bruneauensis* separated by Bruneau River locations upstream of Hot Creek and downstream of Hot Creek. Downstream of Hot Creek, although it appears that the number of geothermal springs is increasing, groundwater levels are actually decreasing because of large continuous geothermal springs that were counted as a single site in 1991-1996 are now fragmented with multiple discrete flows and therefore counted as multiple sites.**

**Figure 3. Downstream of Hot Creek example of decline. This large spring was formerly counted as one site and is currently counted as three sites. Mineral deposits show evidence of past thermal flows high above the current area of spring discharge.**

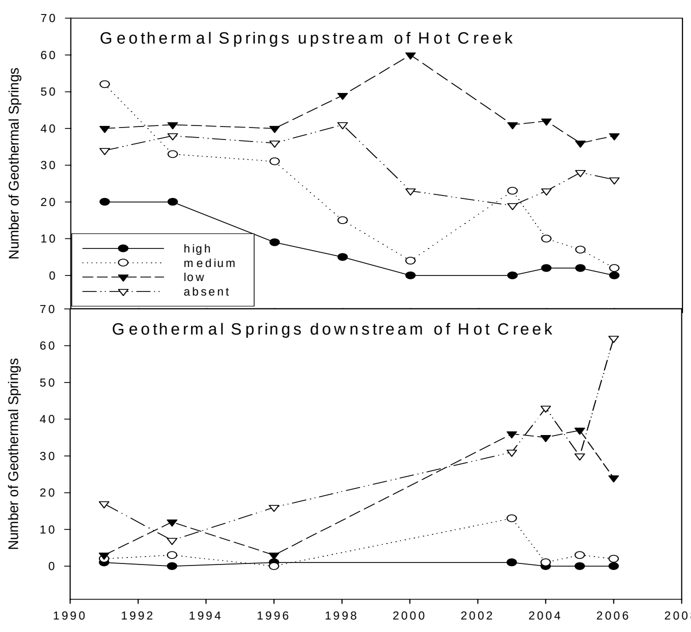



**Figure 4. Relative density of *Pyrgulopsis bruneauensis* of each surveyed geothermal spring for each year surveyed for the area upstream of Hot Creek and downstream of Hot Creek.**

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

There is no new information.

#### 2.3.1.4 Taxonomic classification or changes in nomenclature:

There is 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.):

Researchers have attempted to estimate population densities at various locations since the species was first discovered. For example, Dwight Taylor estimated approximately 1,000,000 *Pyrgulopsis bruneauensis* in the "Low Indian Bathtub Hot Spring" (a spring pool immediately downstream of Hot Creek Falls) in 1982, and as many as 60 snails per square inch (snails/in$^2$) on the wetted rockfaces surrounding the bathtub (Figure 5) (Taylor 1982, page 5). Mladenka (1992, page 49) calculated an abundance at Site 2 (Figure 7) of >100,000 snails in 1991. Mladenka (1992, page 4) and Myler (2000a, page 2) have theorized that the original population (pre-European) was not fragmented or that the geothermal springflow created connectivity among the entire range of this species, and allowed for upstream and downstream migration along much of the geothermal habitat along the Bruneau River and Hot Creek.

*Pyrgulopsis bruneauensis* currently occurs in geothermal springs on both the east and west sides of the Bruneau River with a distribution extending 4.4 km (2.73 mi) downstream of the confluence of Hot Creek and the Bruneau River, and 4.4 km (2.73 mi) upstream from the confluence of Hot Creek and the Bruneau River (Mladenka 1992, page 68). As of November 2006, Hot Creek no longer flows at the Indian Bathtub site and is completely dry. Hot Creek now begins flowing approximately 503 m (550 yards) downstream (Figure 6) (Myler 2006, page 7). Geothermal springflows associated with the rockface habitat at Mladenka's Site 2 (Figure 7) have also completely dried up and currently discharge below the rockface (Figure 7) (Myler 2006, page 7). This site supported a colony of >100,000 snails in 1992 (Mladenka 1992, page 49), but no snails were documented at this site in 2006 (Myler 2006, page 7). Mladenka (1992, page 4) estimated that the original rangewide population may have declined over 50 percent compared with population estimates made in 1991. Rangewide surveys for *P. bruneauensis* colonies (both upstream and downstream of Hot Creek) conducted in 1991, 1993, 1996, 1998, 2000, 2002, 2003, 2004, 2005, and 2006 have shown a steady decline in the number of occupied geothermal springs, with 118 geothermal springs occupied in 1991 and only 66 being occupied in 2006 (Myler 2006, page 2 to 4).

Currently, the geothermal spring habitats upon which *Pyrgulopsis bruneauensis* depends are declining in number and several formerly large geothermal springs sites are becoming fragmented into smaller, isolated sites as the geothermal aquifer levels

**Figure 5. Historic photograph of Hot Creek Falls (Indian Bathtub) circa 1900.**

**Figure 6. Photograph of the Indian Bathtub site in 2004. Over 2/3 of the total depth at Indian Bathtub (as shown in Figure 5) has been filled with sediment due to the loss of historic springflows that formerly flushed away deposited sediments.**

**Figure 7. Mladenka's Study Site 2, photo from 1998 on left and photo from 2004 on right. Note loss of wetted rock surface that formerly provided suitable occupied habitat.**

continue to decline (Myler 2006, page 4). Thermal Infrared (TIR) images of the recovery area were collected by aircraft in November 2005 and showed 1,079 $m^2$ of geothermal spring/seep habitat >14°C (57°F) upstream of Hot Creek. Downstream of Hot Creek (including Hot Creek), the measured geothermal habitat >14°C (57°F) measured 5,024 $m^2$ and is attributed to a few very large springs. However, approximately 1,600 $m^2$ of this downstream habitat had water temperatures that exceed *P. bruneauensis*' maximum temperature tolerance of 35°C (95°F). In addition, at least two large geothermal springs have been detected that discharge underneath the Bruneau River as geothermal upwelling zones that are occupied by *P. bruneauensis* (Myler 2004, pages 3 and 4). In 2004, the average water temperature in one thermal upwelling zone was 24.7°C (76.4°F) (Myler 2004, page 4). In 2006, only two major geothermal upwelling zones are known as compared to 66 occupied geothermal springs and seeps (Myler 2006, pages 2-4). As groundwater levels continue to decline, *P. bruneauensis*' remaining geothermal spring habitat flowing into the Bruneau River will continue to decline in number, and will become more fragmented. At some time in the future, the thermal upwelling zones in the Bruneau River may become more important in providing *P. bruneauensis* habitat, but will also be affected by the declining geothermal aquifer and will likely follow the same decline as the geothermal springs. While *P. bruneauensis* has been found in recent surveys in these upwelling zones, we currently lack information on how these habitats are being used by this species. Further research in these geothermal upwelling areas and how *P. bruneauensis* uses them is currently planned for the future by the Service. We do know that various non-native fishes (i.e. *Tilapia zilli* and *Gambusia affinis*) observed in laboratory studies (Myler and Minshall 1998a, page 53) feed upon *P. bruneauensis*, and also utilize parts of the Bruneau River that are influenced by geothermal water (Mladenka

and Minshall 1993, page 7; Myler 2004, page 7). In addition, *P. bruneauensis* in this habitat may be subject to increased scouring and removal from naturally occurring high runoff events in the Bruneau River.

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

*Pyrgulopsis bruneauensis* is endemic to a series of geothermal springs that discharge along 8 km (5 mi) of the Bruneau River in southwest Idaho. The geographic range of this species 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 extending hundreds of feet directly adjacent to the river channel. This area is only accessible by foot (walking up the river channel from the confluence of Hot Creek); or by floating by raft or kayak through > 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 an unconfined floodplain. Property and the geothermal springs along the Bruneau River downstream of Hot Creek are privately owned, with alfalfa hay fields and livestock pastures characterizing the landscape. Although *P. bruneauensis'* distribution extends 4 km (2.5 mi) downstream of the confluence of Hot Creek, the recovery area designated by the Plan only extends about 2 km (1.2 mi) because of the private property issues in this lower part of the range. 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 river into two canals which are then used for irrigation. The area downstream of Hot Creek is characterized by diversions and canals, hay fields, and areas with livestock that have access to the geothermal springs that contain *P. bruneauensis*.

#### 2.3.1.7 Other: Groundwater history and status

In the early 1900s, the Bruneau River was used to irrigate about 4,200 acres (ac) (1,700 hectares (ha)) in the lower Bruneau River Valley and about 6,000 ac (2,428 ha) in the Grand View area (Figure 8) (Berenbrock 1993, page 26). The Bruneau-Grand View area has an arid climate with an average annual precipitation on valley floors <25 cm (10 in) (Berenbrock 1993, page 4). The arid climate and low river flows in late summer proved to be inadequate for the needs of irrigators (Piper 1924, page 35 as used in Berenbrock 1993, page 26), and Piper (1924, page 35) recommended the use of groundwater as a supplemental supply for irrigation in the Bruneau-Grand View area (Berenbrock 1993, page 26). The geothermal aquifer that underlies the Bruneau-Grand View area is the largest geothermal aquifer in Idaho (Mink and Lockwood 1995, page 3). The first irrigation wells were drilled in 1896 and by 1925 there were about 100 irrigation wells (Figures 9 and 10). In 1945, no appreciable amount of land in the study area was being irrigated with groundwater; but by 1966 about 13,000 ac (5,261 ha) were irrigated with groundwater, and by 1980 about 20,000 ac (8,094 ha) were irrigated with

groundwater (Goodell 1986 as used in Berenbrock 1993, page 29). Location of irrigation wells relative to Indian Bathtub Spring and the year that wells were drilled are shown in Figure 9. The cumulative number of irrigation wells increased dramatically from 1954 to 1978 (Figure 10) (Berenbrock 1993, page 29). During 1954-1978, a dramatic increase in well discharge was observed which is attributed to the addition of large capacity pumps (Figure 11) (Berenbrock 1993, page 29). The majority of this pumping for irrigation since the 1940s occurred in Little and Sugar Valleys (Figures 9 and 11) (Berenbrock 1993, page 28).

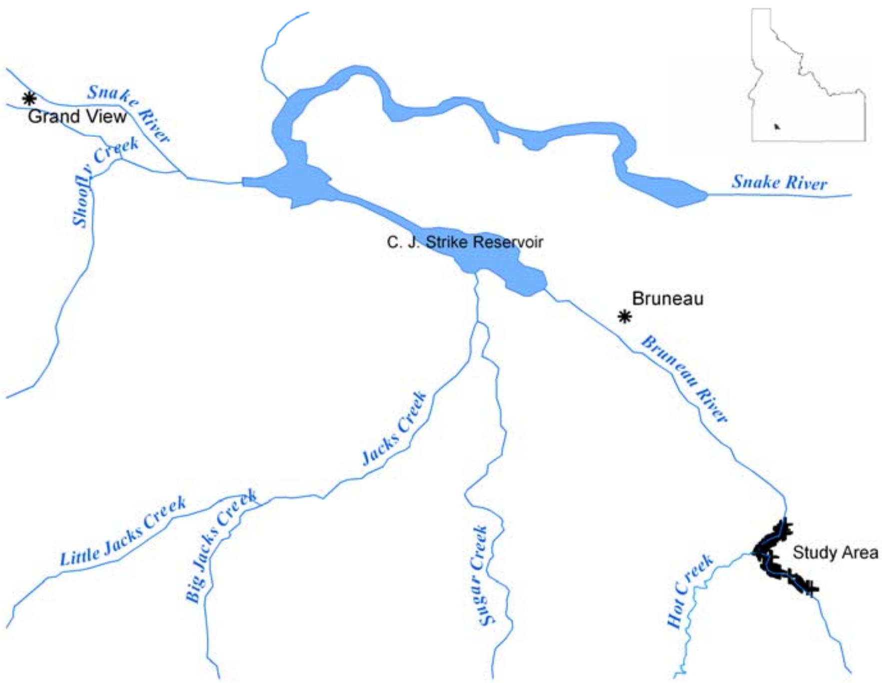



**Figure 8. Map of Bruneau-Grand View area along the Snake River. A majority of the agricultural groundwater withdrawal from the geothermal aquifer occurs in the Little Jacks Creek and Sugar Creek drainages, not in the Bruneau River drainage.**

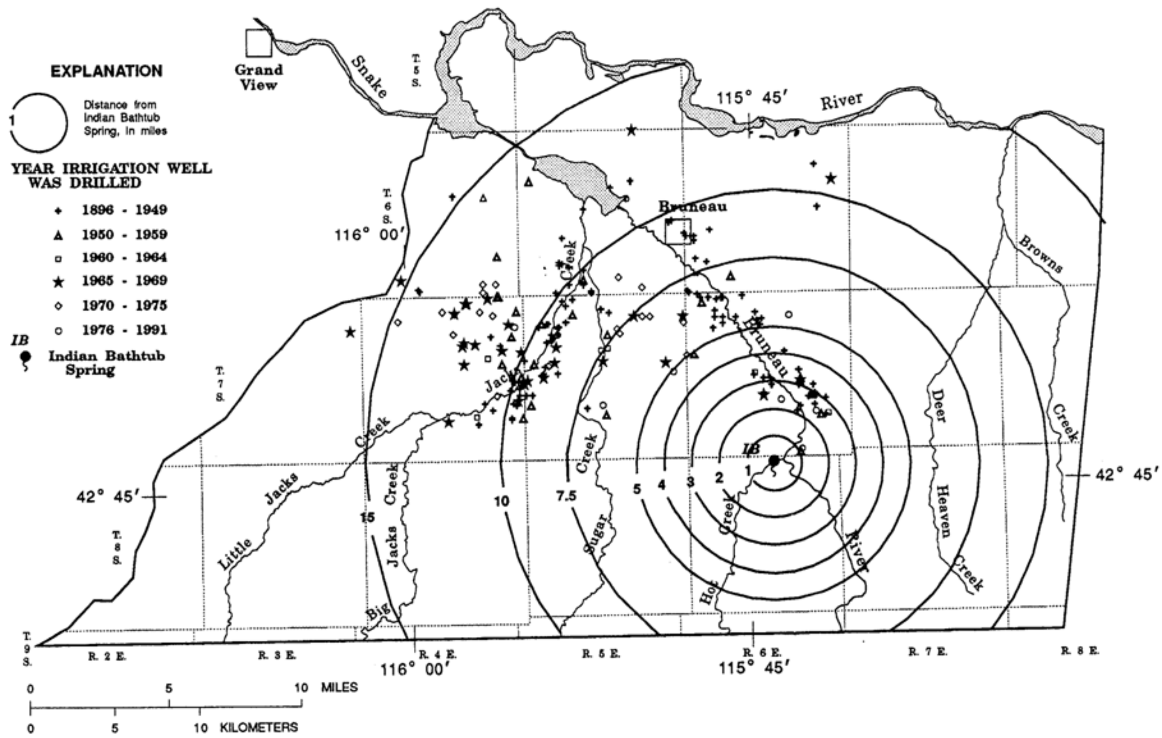



Figure 9. Location of irrigation wells in the Bruneau, Sugar, and Little valleys and year drilled (from Berenbrock 1993).

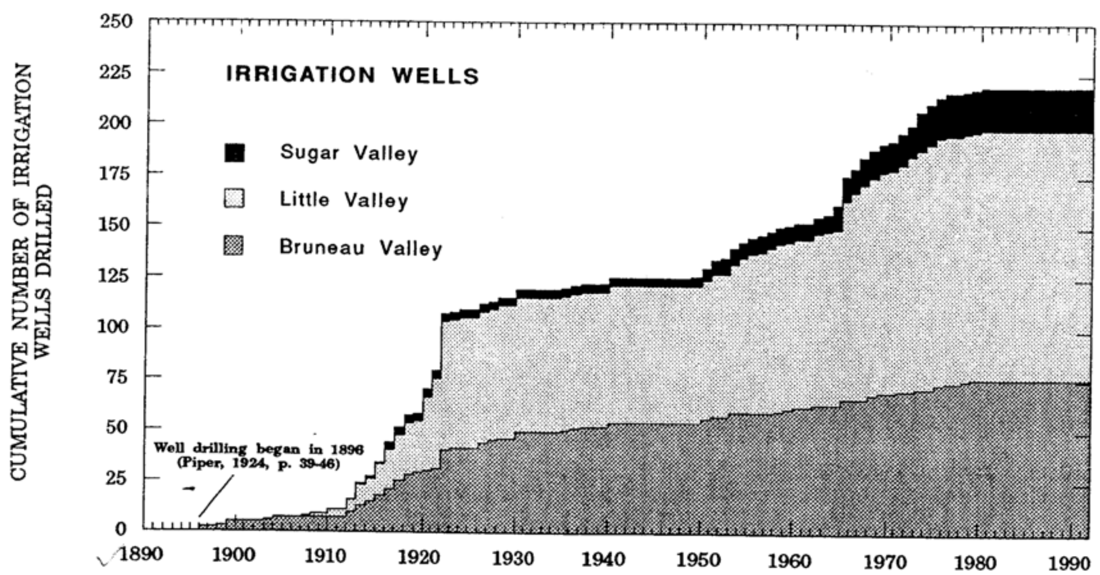



Figure 10. Cumulative number of irrigation wells drilled for the Bruneau, Sugar, and Little valleys (from Berenbrock 1993).

Figure 11- A

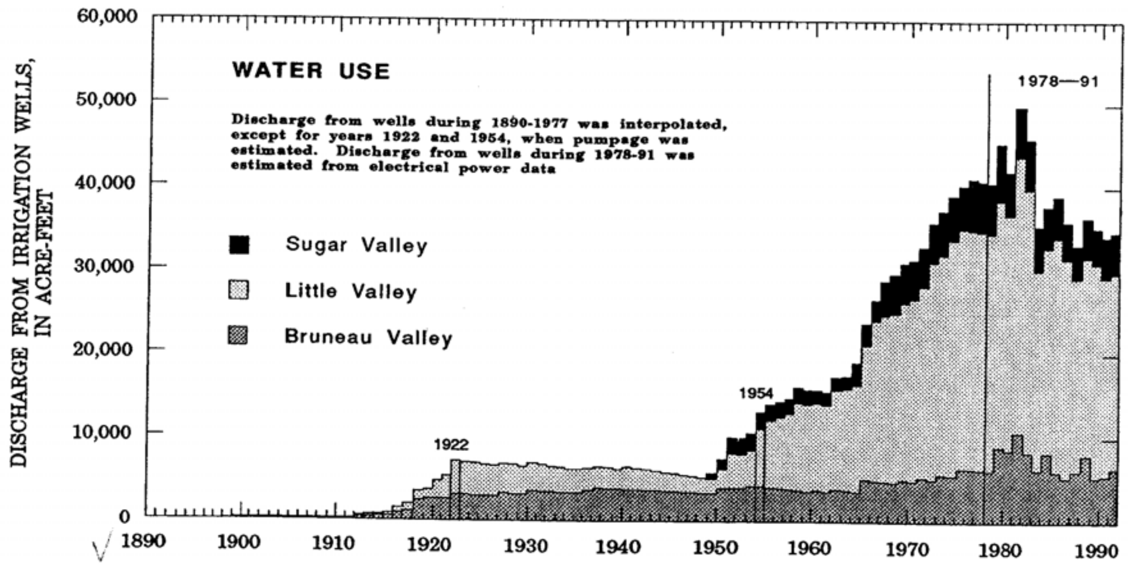
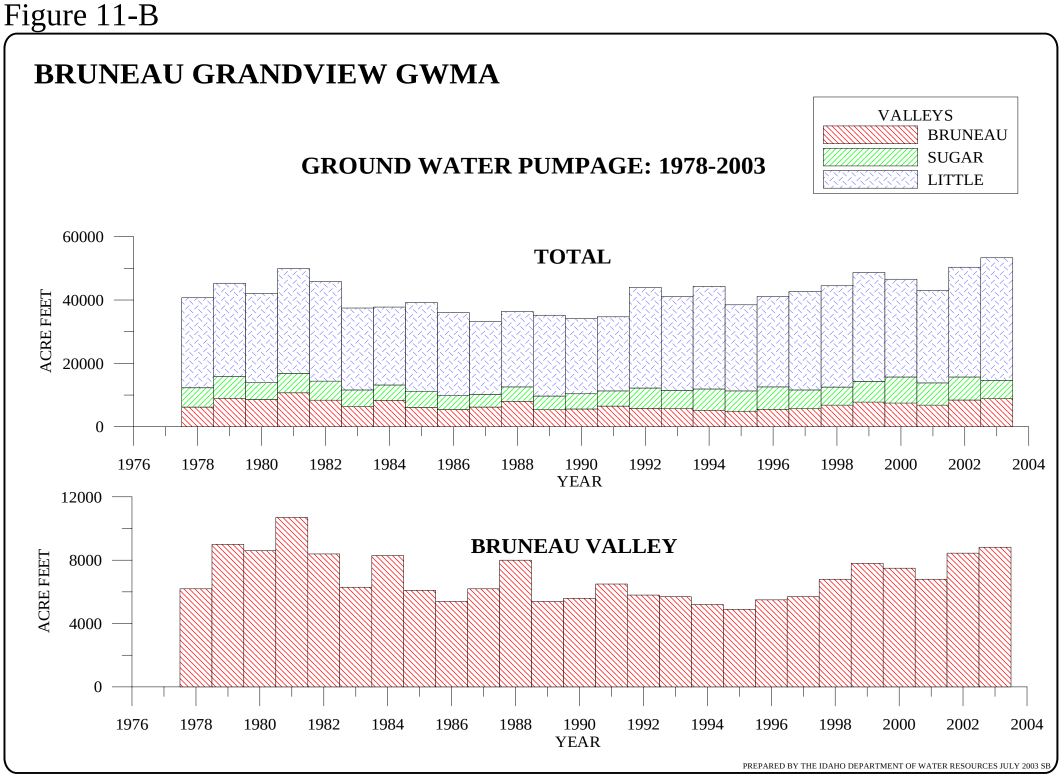



Figure 11-B




ATTACHMENT #2

**Figure 11. A) Discharge from irrigation wells from the Bruneau, Sugar and Little valleys from 1890 to 1991 (from Berenbrock 1993) and B) Discharge from irrigation wells from the Bruneau, Sugar and Little valleys from 1977 to 2003 (from USGS in litt. 2004).**

In 1987, the Service entered a cooperative agreement with the U.S. Geological Survey (USGS) to develop and implement a groundwater study of the Bruneau area that focused on the hydrology of the regional geothermal aquifer and geothermal springs (Berenbrock 1993, page 2). This study updated hydrologic information in the area, implemented groundwater and geothermal spring monitoring, described recharge, discharge, and hydraulic head in the study area, and determined the effects of discharge from wells on hydraulic head and geothermal spring flows (Berenbrock 1993, page 2). Eight test wells were drilled into the geothermal aquifer near Hot Creek to monitor groundwater level in the geothermal aquifer.

The geothermal water is present in pore spaces of sedimentary rock and in vesicles, fractures, and rubbles zones of volcanic rock (Berenbrock 1993, page 13). Generally, the geothermal groundwater flows northward from areas of recharge along the Owyhee and Jarbidge Mountains through the volcanic rocks and into the sedimentary rock aquifer where the springs discharge (Young and Lewis 1982, page J17). The highly fractured nature of volcanic rocks in the study area allows groundwater to be readily transmitted both vertically and horizontally (Berenbrock 1993, page 39). The age of the groundwater (carbon isotope analysis) in the geothermal aquifer is 18,000 to 25,000 years old (Young and Lewis 1982, page J17; Berenbrock 1993, page 13). There is an unconfined coldwater aquifer that occurs above the geothermal aquifer. This coldwater aquifer is thin (<30 m (100 ft) thick) with a small spatial extent (confined to alluvium along stream channels of the Bruneau River) (Berenbrock 1993, page 13). Recharge to the coldwater aquifer occurs from infiltration of precipitation, streamflow, and applied irrigation water (Berenbrock 1993, page 13). In the eight test wells that were drilled near Hot Creek, only geothermal water was encountered, suggesting that the coldwater aquifer occurs downstream in the area where the valley is less geologically confined. Mink and Lockwood (1995, pages 5 and 6) believed that geothermal water is leaking from partially cased wells from the geothermal aquifer into the coldwater aquifer. This could potentially change the hydraulic pressure and possibly the water temperature of the geothermal springs. Only one deep well was logged in their determination of cross-flow potential and the volume of leakage could not be determined. A complete understanding of the hydrologic relationship between the geothermal aquifer and the coldwater aquifer remains unknown.

Beginning in 1990, groundwater levels have been measured from eight wells near the confluence of the Bruneau River and Hot Creek by USGS, IDWR, and Service personnel. At four of these wells, groundwater levels were converted to elevation above sea level, and then averaged (Figure 12). Average groundwater elevation has declined from 1991 to 2005 (Figure 12) (Myler et al 2007, in press). The recovery plan for the Bruneau hot springsnail stated that a geothermal aquifer elevation level of 815 m (2,674 ft) is necessary for delisting (USFWS 2002). The geothermal groundwater elevation has been below 815 m (2,674 ft) since 1991 and is currently showing a declining trend (Figure 12). In addition, the number of geothermal springs upstream of Hot Creek has declined from 146 springs in 1991 to 66 in 2006 (Figure 2) (Myler 2006, pages 2 to 6). Downstream of Hot Creek, although it appears that the number of geothermal springs is increasing, groundwater levels are actually decreasing because large geothermal springs

that were counted as single sites in 1991-1996 are now fragmented with multiple discrete flows and therefore are counted as multiple sites (Figures 2 and 3). New springs are emerging, rather, formerly large springs have become fragmented into small multiple springs and seeps (Figure 3). The rate of decline in the number of geothermal springs upstream of Hot Creek from 1991 to 2004 appears to be approximately five geothermal springs/year (Myler et al. 2007, in press). Groundwater levels in geothermal wells in the Bruneau-Grand View area are currently being monitored by the IDWR and the Service. Water levels in geothermal wells in the vicinity of Indian Bathtub have declined in the past 18 years (Myler 2007, Appendix 4, page 1). Although this geothermal aquifer also extends into the Sugar and Little valleys, monitored water levels in these wells have generally remained stable (Myler 2007, Appendix 4, page 2).

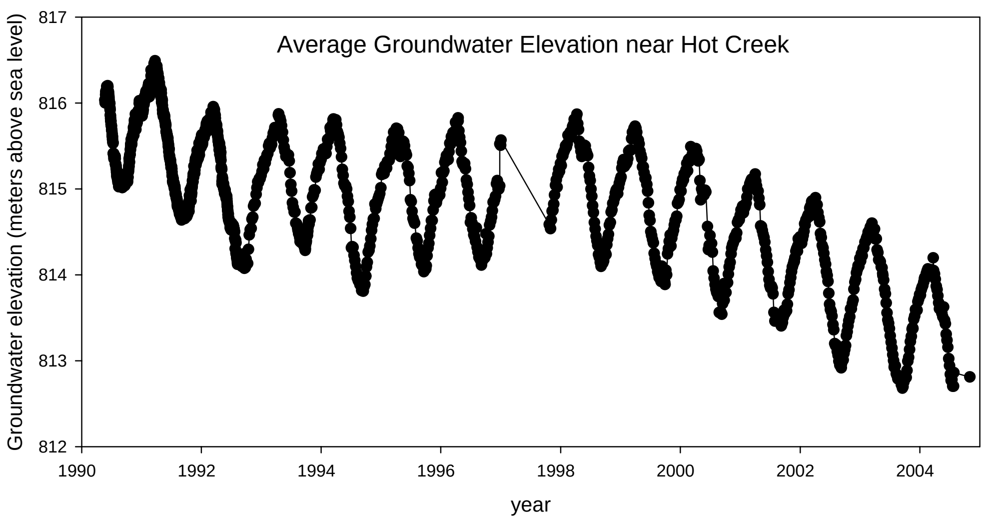



**Figure 12. Average groundwater elevation measured at four groundwater wells located near Hot Creek. Oscillations over time correspond to the irrigators turning off and on the pumps for the irrigation season (from Myler et al. 2007, in press).**

Analysis of data indicates that the decline in geothermal springs upstream of Hot Creek with and without *Pyrgulopsis bruneauensis* is directly related to the decline in the geothermal aquifer (Figure 13) (Myler et al. 2007, in press). Downstream of Hot Creek, the increase in the total number of geothermal springs since 1996 is an artifact of habitat fragmentation due to the decline in the geothermal aquifer (Myler 2006, page 4). Large continuous wetted rockfaces, which formerly provided suitable *P. bruneauensis* habitat in earlier surveys (1991-1996) were previously counted as single sites. Since that time, many of these sites have been fragmented into separate geothermal springs separated by over 1 m distance. Therefore, these sites have been counted as multiple and separate geothermal springs (Myler 2006, page 4). This represents a continuing trend in habitat and population fragmentation as declining geothermal spring discharges result in the dewatering of suitable substrates previously inundated by geothermal spring waters; what were larger, continuous *P. bruneauensis* colonies have become smaller, fragmented colonies.

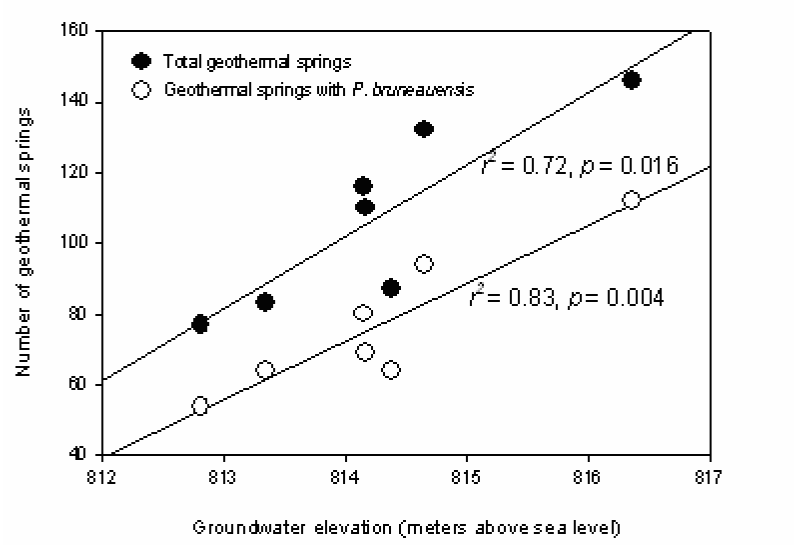



**Figure 13. Number of geothermal springs upstream of Hot Creek with and without *Pyrgulopsis bruneauensis* as they relate through simple linear regression to groundwater elevation (Modified from Myler et al., in press 2007).**

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

According to Section 4(c)(2) of the Act, the Secretary of Interior shall conduct a status review every five years of species that are listed as threatened or endangered under the Act in accordance with section 4(a) and (b). The Secretary shall make a determination on the basis of the best scientific and commercial data available after conducting a review of the status of the species and after taking into account those efforts being made by the State to protect such species within any area under its jurisdiction [section 4(b)]. As part of this review, we will determine whether this species shall continue to be listed as endangered (or threatened species) based on a five factor analysis [section 4 (a)(1)] that addresses: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) over-utilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence.

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

The geothermal spring habitats where *Pyrgulopsis bruneauensis* resides have been impacted by habitat modification and curtailment. What has been assumed to be historically abundant flowing, geothermal spring environments where *P. bruneauensis* evolved have been reduced in number and area by groundwater withdrawal for agricultural purposes. Specific threats as they relate to *P. bruneauensis* are assessed in Myler 2007, Appendix 3.

Habitat Curtailment

*Groundwater Withdrawal and Springflow Reduction*

Groundwater withdrawal for irrigation has resulted in a decline of the geothermal aquifer underlying the Bruneau, Sugar, and Little valleys in north-central Owyhee County, Idaho which threatens *Pyrgulopsis bruneauensis* through the reduction or loss of geothermal habitat. Increased agricultural use of groundwater since the mid-1960s has resulted in a steady decrease in local water table levels (Figure 11). Mineral deposits high on the basalt cliffs provide some evidence of once higher water levels (Myler 2000a, page 2). It appears that thermal springs were so plentiful that *P. bruneauensis*, within its historic range along Hot Creek and the Bruneau River, were able to migrate and colonize new locations or re-colonize former areas. Within the historical limits set by the elevation of surfacing hot water, the original population probably was not confined to isolated springs (Myler 2000a, page 2). The total number of geothermal springs along the Bruneau River upstream of Hot Creek (with and without *P. bruneauensis*) declined from 1991 to 2006 (Figure 2; Myler 2006, pages 2 to 6) and there are currently fewer high and low snail density sites with *P. bruneauensis* compared to 1991 (Myler 2006, page 6; Figure 4). Data from wells that monitor the geothermal aquifer near Indian Bathtub demonstrate that groundwater withdrawal for agriculture has had the most noticeable impact to the geothermal aquifer in that area (Myler 2007, Appendix 4, page 1). By contrast, some monitoring wells located further from Indian Bathtub do not show such declines (Myler 2007, Appendix 4, page 2). It is possible that because the geothermal aquifer is a confined pressure related system, certain wells in the immediate vicinity might cause a cone of depression or change the pressure equilibrium of the aquifer system. As with any aquifer, many questions remain regarding the dynamics of aquifer withdrawal and recharge, but geothermal spring/seep habitat on which *P. bruneauensis* depends is declining as well as the geothermal aquifer levels near Indian Bathtub (Figure 2) (Myler 2007, Appendix 4). Because the water table has dropped dramatically, much of the geothermal spring habitat previously inhabited by *P. bruneauensis* is dry, resulting in a reduction in number of habitats, habitat area, and isolation of colonies.

A conceptual model developed by the USGS in 1982 estimated that 29,000 acre feet (acft) of groundwater per year is recharged into the geothermal aquifer in the Jarbidge and Owyhee Mountains (Young and Lewis 1982, page J17; Berenbrock 1993, page 5). The USGS also estimated groundwater extraction from this same aquifer using pump electricity usage in the Bruneau area (Bruneau, Sugar and Little valleys) at more than 50,000 acft of groundwater in 2003 (USGS in litt. 2004, pages 1 and 2). Given these estimates, the geothermal aquifer has a deficit relative to recharge of approximately 20,000 acft/year. The 1998, Notice of Determination noted that water withdrawals have generally declined over the past 15 to 20 years due to cropland retired from agricultural production through participation in the Conservation Reserve Program (CRP) (USFWS 1998). However in the late 1990s, all CRP contracts in the Bruneau-Grand View area have expired and have not been renewed (Steve Ulrich, pers comm. 2006). Thus, any groundwater savings previously realized under the CRP is no longer occurring. In addition, the expiration of CRP contracts in the Bruneau-Grand View area has led to increased irrigated agricultural land use (Duane Lafayette, pers comm. 2006), and

increased geothermal groundwater pumping and withdrawal (Figure 11) (USGS, in litt. 2004, pages 1 and 2), resulting in decreases in the elevation of the geothermal aquifer. In 2003, water withdrawals from wells through pump irrigation were at their highest recorded level, more than 50,000 acft/year (Figure 11) (USGS in litt 2004, pages 1 and 2). Decreases in the geothermal aquifer have been monitored and documented in the eight monitoring wells located near Indian Bathtub (Myler 2007, Appendix 4).

The two largest *Pyrgulopsis bruneauensis* colonies (Hot Creek and Mladenka's Site 2; Figure 1) previously known from earlier reports (Taylor 1982, page 5; Mladenka 1992, page 49) have been extirpated. Discharge from many of the geothermal springs along the Bruneau River is difficult to measure, therefore, the decline of the geothermal springflows is difficult to quantify. Photo points have been used for many of the surveys and definite reductions in geothermal spring discharges are easily observed from 1991 and 1993 surveys to present. Geothermal spring sites that have gone dry such as Indian Bathtub, Mladenka's Site 2, and Site U4E, demonstrate the drastic reduction in the geothermal aquifer at different locations (Figures 5, 6, 7, and 14). These sites are briefly discussed below.

As previously stated, in Hot Creek, approximately 1,000,000 *Pyrgulopsis bruneauensis* were estimated to occur in the "Low Indian Bathtub Hot Spring" in 1982, with as many as 60 snails/in$^2$ observed on the wetted rockfaces surrounding Indian Bathtub (Figure 5) (Taylor 1982, page 5). Indian Bathtub (Figure 6), which is located at the base of Hot Creek Falls, was reduced to less than one-half its size by a major sediment deposition event in 1991 (Figure 6) (Varricchione et al. 1997, page 58). Field experiments performed by Myler (2000a, page 26) in experimental exclosures placed in Hot Creek have shown that *P. bruneauensis* prefers large cobbles (> 10 cm diameter (4 in)) over gravel (2-10 mm (0.08-0.4 in)), and sand/silt (< 2 mm (< 0.08 in)). Trench analysis performed in Hot Creek in 1997, showed that larger substrate has been buried by finer gravel, sand, and silt (< 10 mm) (4 in) (Varricchione et al. 1997, page 46). Another flood event occurred in Hot Creek in July 1992 which drastically reduced *P. bruneauensis* from Hot Creek by filling much of the Indian Bathtub area with sediment (Royer and Minshall 1993, page 1), and by 1997, the population had been totally extirpated (Varricchione et al. 1997, page 58). Currently, Hot Creek discharges 503 m (550 yards) downstream of Indian Bathtub (Myler 2006, page 7).


**Figure 2. Series of photographs from Site U4E located along the Bruneau River upstream of Hot Creek. This site once provided excellent geothermal habitat that supported high densities of *Pyrgulopsis bruneauensis*. Photos were taken in 1993 (left) and 2000 (right). Arrow shows point of reference for each photo.**

At Mladenka's Site 2 abundant thermal springwater once flowed down rock cliffs and created habitat for >100,000 *Pyrgulopsis bruneauensis* (Figure 7) (Mladenka 1992, page 49). This site currently is dry except for seasonal flow that discharges from the base of the cliff (Figure 7) (Myler 2006, Page 4). Site U4E also supported high densities of *P. bruneauensis* in 1991 and discharged one cubic foot per second (cfs) of geothermal water (Mladenka 1992, page 71). In 1993, site U4E still supported a high density of *P. bruneauensis*, but geothermal discharge had declined to a trickle (Figure 14). In 1996, Site U4E only discharged geothermal water below the surface of the Bruneau River; and by 2000, the geothermal water at this location was gone and *P. bruneauensis* were absent (Figure 14) (Myler 2000, page 12).

*Livestock grazing*

Prior to 1998, livestock grazing was considered a threat factor that impacted some geothermal spring habitats where *Pyrgulopsis bruneauensis* occurred near Hot Creek. In the 1990s, the BLM constructed fences to exclude livestock grazing in this area, and presently, cattle are excluded 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 defense against instream erosion. Indian Bathtub has not noticeably changed since it was filled with sediment in 1992. Presently, livestock grazing is considered a low ranking threat factor to *P. bruneauensis* colonies and the

geothermal habitats it occupies in Hot Creek or along the Bruneau River upstream of Hot Creek. Recent surveys in 2004-2006 of geothermal springs and seep habitats along the Bruneau River downstream of Hot Creek document trampling by livestock and streambeds that are embedded in fine sediment (Myler 2004, pages 7 and 8; Myler 2006, page 8). If the current declining trend of the geothermal aquifer continues and more geothermal spring habitats go dry upstream of Hot Creek, the importance of the habitat along the Bruneau River downstream of Hot Creek will become important to the long-term survival of *P. bruneauensis*.

*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 take nearly all of the flowing water from the Bruneau River and send it to two canals to be used for irrigation in the lower Bruneau Valley. It is not known how *Pyrgulopsis bruneauensis* disperses between geothermal springs; however, they have been observed to drift into the Bruneau River when disturbed (Myler 2006, page 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*

The original 1993 listing stated that recreational access also impacts habitats of *Pyrgulopsis bruneauensis* along the Bruneau River (USFWS 1993). This activity continues to occur at one geothermal spring where small dams have been constructed to form thermal pools for bathing. The 1998, Notice of Determination determined that recreational use of thermal springs was not a significant threat to *P. bruneauensis* or its geothermal spring habitat (USFWS 1998). Presently, only one known geothermal spring in the recovery area is used by recreational bathers, but is above the thermal maximum of 35 $^{o}$C (95 $^{o}$F), that *P. bruneauensis* can tolerate. Therefore, recreational use of the geothermal springs and seeps is considered a low ranking threat to *P. bruneauensis*. However, with the declining geothermal aquifer other bathing pools may be constructed in occupied *P. bruneauensis* habitat.

#### 2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

The data indicate that overutilization of this species is not a threat to the continued existence of *Pyrgulopsis bruneauensis*. There is no known commercial or recreational use of the species, and collection for scientific or educational purposes is subject to permitting by the Service and therefore highly controlled. Future permits for collecting *P. bruneauensis* will likely be contingent upon more detailed collection and reporting requirements to facilitate improved species occurrence and distribution information.

#### 2.3.2.3 Disease or predation:

There is currently no information regarding the threat of disease to the continued existence of *Pyrgulopsis bruneauensis*. We believe that disease is not likely to affect the species unless an unknown pathogen is transmitted to *P. bruneauensis*.

Introduced populations of redbelly Tilapia (*Tilapia zilli*), and mosquito fish (*Gambusia affinis*) thrive in Hot Creek and in the geothermal springs that discharge into the Bruneau River throughout the entire range of *Pyrgulopsis bruneauensis* (Mladenka and Minshall 1993, page 7; Myler 2004, page 7). *T. zilli* is an omnivorous feeder (i.e. detritus, algae, invertebrates, and fish) and *G. affinis* also is known for a broad feeding preference (i.e. diatoms and other algae, crustaceans, and invertebrates) (Myler 2000a, page 11). A fish gut content analysis conducted on *T. zilli* and *G. affinis* collected from Hot Creek in 1995 did not find *P. bruneauensis* in stomachs (Varricchione and Minshall 1995b, page 1). However, an extensive survey conducted for *P. bruneauensis* from the origin of Hot Creek to the confluence with the Bruneau River in 1998, did not find *P. bruneauensis* (Myler and Minshall 1998a, page 47), which suggests that the snails were not present to be eaten when the fish gut analysis was conducted in 1995.

Recent laboratory studies suggest that *Tilapia zilli* will use *Pyrgulopsis bruneauensis* as a food source. A laboratory fish feeding experiment was conducted in 1998 (Myler and Minshall 1998a) where *T. zilli* were captured from Hot Creek and placed in two aquaria. In the first aquarium, *T. zilli* were fed aquarium fish food, and in the second fish were starved for 48 hours (Myler and Minshall 1998a, page 14). Twenty *P. bruneauensis* were then added into each aquarium and within two hours, all 40 snails had been consumed in both aquaria (Myler and Minshall 1998a, page 53). A stomach analysis performed following this study revealed no *P. bruneauensis* in the stomachs of *T. zilli* (Myler and Minshall 1998a, page 53), which indicates that shells are broken down by mastication, stomach acids, or rapid digestive processes. In 1999, a controlled fish feeding experiment was performed in enclosures in Hot Creek with *T. zilli* and *P. bruneauensis* (Myler 2000a, pages 11 to 17). All *P. bruneauensis* were absent within five days (Myler 2000a, page 26). A stomach analysis performed following this study revealed no *P. bruneauensis* in the stomachs of *T. zilli* (Myler 2000a, page 26). Since *T. zilli* occur in the geothermal springs along the Bruneau River and in Hot Creek (Mladenka and Minshall 1993, page 7; Myler 2004, page 7) they likely threaten the continued existence of *P. bruneauensis* through predation. In addition, Mladenka observed *G. affinis* to eat *P. bruneauensis* in the laboratory (Mladenka peer review comments). As madicolous habitat goes dry (e.g. Indian Bathtub, Mladenka's Site 2, and Site U4E) *P. bruneauensis* are in direct contact with these exotic fish and therefore are more susceptible to predation as the geothermal water levels continue to decline.

#### 2.3.2.4 Inadequacy of existing regulatory mechanisms:

The IDWR regulates water development in the Bruneau-Grand View area. The Bruneau-Grand View area was declared a Ground-Water Management Area in 1982 by IDWR due to increases and projected increases in groundwater withdrawal, and declines

in spring flows from the geothermal aquifer system (Harrington and Bendixen 1999, page 29). Present management and regulations that govern water use affecting the geothermal aquifer have not been adequate in reversing the continuing declining trend of the geothermal aquifer upon which *Pyrgulopsis bruneauensis* depends.

The U.S. Department of Agriculture's Farm Service Agency (USDA-FSA) administers the CRP which is designed to protect wildlife and wildlife habitat by creating incentives for landowners to voluntarily retire agricultural lands. Payments to landowners enrolled in the CRP have fallen to approximately $38 per acre which has led to reduced participation in the once popular program. Currently, all CRP contracts in the Bruneau-Grand View Management area have expired (Steve Ulrich, Pers comm. 2006) and lands previously enrolled in the CRP are being used for alfalfa and corn production (Duane Lafayette, Pers. comm. 2006). A new USDA program, the Conservation Reserve Enhancement Program (CREP) is being proposed by the FSA. Under CREP, payments to landowners in Idaho would be approximately $125 per acre, with a 10 to 15 year minimum enrollment for irrigated land only (Mackey in litt. 2004, pages 1 to 5). The goal of the program is to retire 100,000 acres of agricultural land in Idaho and stop groundwater pumping from the Eastern Snake River Plain aquifer. However, these conservation efforts will not benefit *Pyrgulopsis bruneauensis* because CREP only applies to lands within the Snake River Plain Aquifer, and not the Bruneau/Grand View aquifer that feeds the geothermal springs that this species depends upon.

The IDEQ is responsible for managing point and non-point sources of pollution into waterbodies of the State. These sources contribute to a stream's inclusion in the EPA's list of impaired water bodies pursuant to section 303(d) of the Clean Water Act. Additionally, IDEQ under authority of the State Nutrient Management Act, coordinates efforts to identify and quantify contributing sources of pollutants (including nutrient and sediment loading) into Idaho watersheds areas using a Total Maximum Daily Load (TMDL) approach (Lay 2000, pages 4 to 32). The TMDL approach is used to develop pollution control strategies in waterbodies that are currently not meeting water quality standards through several of the following programs: State Agricultural Water Quality Program, Clean Water Act section 401 Certification, BLM land management plans, the State Water Plan, and local ordinances. Currently the Bruneau River is under a TMDL which includes nutrients, total suspended solids, and temperature (Lay 2000, pages 4 to 32). Although the Bruneau TMDL does not address groundwater, by addressing surface water pollutants, it may indirectly improve/conserve groundwater quality.

#### 2.3.2.5 Other natural or manmade factors affecting its continued existence:

Invasive species may affect the continued existence of *Pyrgulopsis bruneauensis* in Idaho. The most notable examples in the range of *P. bruneauensis* are the aquarium variety Tilapia (*Tilapia zilli*) and mosquito fish (*Gambusia affinis*). This specific *Tilapia* is only utilized as an aquarium species and is not the same species used in aquaculture. SEE **Section 2.3.2.3 Disease or Predation** for detailed discussion.

### 2.4 Synthesis

Although much new information has been generated since the time of listing, review of the data demonstrate continued threats and substantial reduction in the number and total habitat area of geothermal springs and seeps upon which *Pyrgulopsis bruneauensis* depends. The 2002 recovery plan for *P. bruneauensis* detailed objective measurable criteria for delisting: 1) 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 03 BDC1, 03BDC2, and 04DCD1; 2) the geothermal springs number more than 200 in October, and are well distributed throughout the recovery area; and 3) greater than two-thirds of available geothermal springs (approximately 131 geothermal springs) are occupied. Current water levels in the above mentioned wells measure 812 m and show a declining trend. In the 15 years that rangewide surveys have been conducted, the total number of geothermal springs along the Bruneau River upstream of Hot Creek occupied by *P. bruneauensis* has declined from 146 geothermal springs in 1991 to 66 in 2006. Geothermal springs downstream of Hot Creek occupied by *P. bruneauensis* have declined from 40 in 2003, to 26 in 2006. In 2006, only four geothermal springs sites had medium densities of *P. bruneauensis* and no occupied sites had high densities of *P. bruneauensis,* compared to 33 medium and 11 high density sites located in 1996. The numbers of high and medium density snail sites show a decreasing trend since 1991, while the number of low density snail sites and sites without *P. bruneauensis* has increased.

Irrigated land use for agriculture has increased because CRP contracts have expired in the Bruneau-Grand View management area. At least three locations: Indian Bathtub, Site 2, and Site U4E that once supported high densities of *Pyrgulopsis bruneauensis* have become dewatered and their colonies extirpated. The protected geothermal habitat along the Bruneau River upstream of Hot Creek is declining and existing colonies in this area are becoming more and more fragmented and isolated. As the geothermal aquifer continues to decline, the habitats downstream of Hot Creek become more important to the long-term survival of this species. Additional threats to the geothermal habitat downstream of Hot Creek include: livestock grazing, surface water diversion, and recreation.

Threats identified at the time of listing in 1998 still remain. The major threat to this species is the continued decline of the geothermal aquifer resulting in a decrease in suitable geothermal spring habitat for *Pyrgulopsis bruneauensis*. We recommend that no change in the listing status be made to *P. bruneauensis* and that it 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*
**__X_ No change is needed**

### 3.2 New Recovery Priority Number:

**No change is needed.**

## 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

We recommend that dialogue continue between the Service, State and local governments, and private land owners to inform them of the severity of declining habitat that the Bruneau hot springsnail is currently facing. We recommend purchasing lands and/or water rights nearest the recovery area to slow and eliminate the declining level of the geothermal aquifer. Any actions taken should involve the Service, State, and local land owners.

## 5.0 REFERENCES

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

**Current Classification**: ___Endangered______________

**Recommendation resulting from the 5-Year Review**:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X__ No change needed

**Appropriate Listing/Reclassification Priority Number, if applicable**:__NA___

**Review Conducted By**:__Cary Myler_______________________________

______________________________ Date 5-22-07
**Field Supervisor, Fish and Wildlife Service**

Approve ______________________________ Date 6/24/07
**Regional Director, Fish and Wildlife Service**