DISCUSSION

Conditions at Indian Bathtub and Hot Creek

The Indian Bathtub and Hot Creek areas have been greatly impacted in recent years. A flood in the summer of 1991 contributed much silt, sand, and gravel to Hot Creek. In particular, Indian Bathtub was reduced to less than half its size before the flood because of sediment. Available habitat in the immediate vicinity of Indian Bathtub was reduced because of this and other sedimentation events (Mladenka 1992). Furthermore, springsnail habitat has diminished considerably in recent years because of agriculture-related groundwater mining in the area (Berenbrock 1993). As a result of these changes, the Indian Bathtub population has been eliminated (Myler and Minshall 1999). Hot Creek resurfaces over 450 m from Indian Bathtub. Springsnail populations downstream of the bathtub were reduced drastically in Hot Creek (Site 1) in July 1992 (Royer and Minshall 1993), but recovered in small numbers (300-400 individuals) in June of 1999 when the fish exclosures were present. The distance from Indian Bathtub to the Bruneau River is approximately 600 m. With the maximum snail movement rate of 1 cm per minute this distance could theoretically be traveled in one day. However, movement is impeded by the fact that Hot Creek is dry 450 m downstream of Indian Bathtub and springsnail movement is slowed when moving upstream against flow.

Other habitat parameters measured at Hot Creek (Site 1) (stream temperature, discharge, periphyton chlorophyll-a and biomass, and riparian habitat quality) in 2000 remained fairly consistent with data from previous years (at least after sedimentation events in 1991 and 1992). Elimination of livestock in the area has led to a recovery of riparian vegetation over the past few years.

The recolonization of *P. bruneauensis* in 1999 in Hot Creek demonstrates this springsnail's resilience to disturbance. Since Hot Creek is a geothermally heated stream, apparently no natural aquatic predators were present historically. Therefore, springsnails probably did not evolve in the presence of significant predators and competitors. *Tilapia zilla*, an exotic fish recognizes the springsnails as a food resource both in circumstances with abundant and with limiting food supplies. Springsnails were found in a fish exclosure that was built in 1999. With the removal of the exclosure in June 2000, springsnails were once again eliminated from Hot Creek. Anthropogenic disturbances have placed this species in danger of possible extinction. The most significant threat to this species remains the reduction of available habitat as a result of extensive groundwater mining. This has caused the once plentiful rockface habitat near Hot Creek to become virtually eliminated.

Conditions at the Rockface Seeps

Springsnail size-distribution, periphyton chlorophyll-a and biomass, water temperature and chemistry are with in the range found in previous years. However, springsnail densities at Sites 2 and 3 (OS, NS) and rockface flow were among the lowest of the past decade. In particular at Site 2 (right seep), densities were such that after the rockface became dry in

September, 50 snails could not be found to conduct size distribution analysis. This is the first reporting of the right seep rockface becoming dry and an absence of springsnails. The rockface was re-wetted in October and springsnails did not recolonize.

The rockface seeps had water temperatures that were consistently lower than those in Hot Creek (Site 1) and rarely exceeded the thermal tolerance temperature (35°C) (Mladenka 1992). However site 3-OS had the highest temperatures ever recorded for the months of June through September, exceeding the thermal tolerance temperature. Temperature variations clearly affect the *P. bruneauensis* populations. Average size and growth rates were smaller, but densities were greater at the rockface seeps than found in Hot Creek during 1990-1992. The rockface sites are probably more suitable for springsnail success than Hot Creek (Varricchione and Minshall 1998) because they provide a refuge from temperature extremes, predation, and flooding events and provide better habitat for egg-laying (Myler and Minshall1999).

Although discharge measurements have only been recorded at the rockface seep sites (2, 3-OS, and 3-NS) for 30 months, it appears that there may be extensive variability, especially at Sites 1, 2 and 3-OS. The lowest discharge measurement (June-November) appears to coincide with the groundwater extraction for agriculture. Starting in 2000, measurements are only being conducted June through October. Some readings may be inconsistent because of weirs becoming clogged with sediment and vegetation. However, in 2000, weirs were cleared out before measurements were recorded. At Site 2, the weir was not collecting all of the flow for the months of September and October. The plastic tarp, which collects and directs flows to the weir needs to be replaced.

RECOMMENDATIONS

To properly manage *P. bruneauensis* populations in the Bruneau River drainage, the year to year variations in population density and age-class composition of these springsnails must be well understood. Mladenka (1992), Taylor (1982), and Fritchman (1985) made significant contributions to knowledge of the biology of *P. bruneauensis*. Recent population and habitat monitoring done by Idaho State University (Myler and Minshall 1999; Varricchione and Minshall 1997, 1996, 1995a, 1995b; Varricchione et al. 1998, Royer and Minshall1993; Robinson et al. 1992) have made additional contributions. The most pressing question remaining regards the uniqueness of the springsnail populations at the different thermal streams and spring flows along the Bruneau River. Because of the different temperature regimes and the spatial separation of the populations, there is a good probability for the existence of unique gene pools and thus, different species or subspecies of the Bruneau Hot-spring springsnail at the various locations within the drainage. Experiments such as controlled growth-rate studies and population genetics studies would provide insight into whether these populations are closely related or not. This insight is needed before experiments or large-scale reintroductions in Hot Creek can be performed using *P. bruneauensis* from other locations.

A fish exclosure was built in Hot Creek and springsnails recolonized in low numbers (300-400) in 1999. The enclosure was removed in June 2000 and no springsnails have been seen since. Since *Tilapia zilla* has been shown to recognize the springsnails as a food source, we recommend that they be removed from Hot Creek. Until *Tilapia zilla* are removed from Hot Creek the exclosure should be rebuilt and suitable substrate placed inside. This will inhibit *Tilapia zilla* from feeding on the snails and large stable substrate will help recolonization of the springsnails.

The Bruneau Hot-springs Springsnail is dependent upon the thermal aquifer for its survival. The spring survey conducted in September 1998 shows that the number of thermal springs is rapidly declining (Myler and Minshall 1998). Hot Creek once came in contact and wetted several rockfaces in Indian Bathtub and adjacent areas of the Bruneau Canyon. The decrease of discharge of this stream and the increase of siltation have caused Hot Creek to lose contact with all but one rockface. Also, this is the first year that Site 2 (right seep) has been recorded as being dry with no snails. Since these rockfaces provide stable habitat for egg-laying, escaping temperature extremes, possible predation, and flood events; the current lack of this habitat may be a major reason for the lack of recolonization. Weirs should be replaced to ensure consistent monitoring of spring flows, which provides useful insight into the status of the local groundwater situation. Further studies are needed to determine the rate that springsnails could re-colonize rewetted rockfaces and the factors involved.

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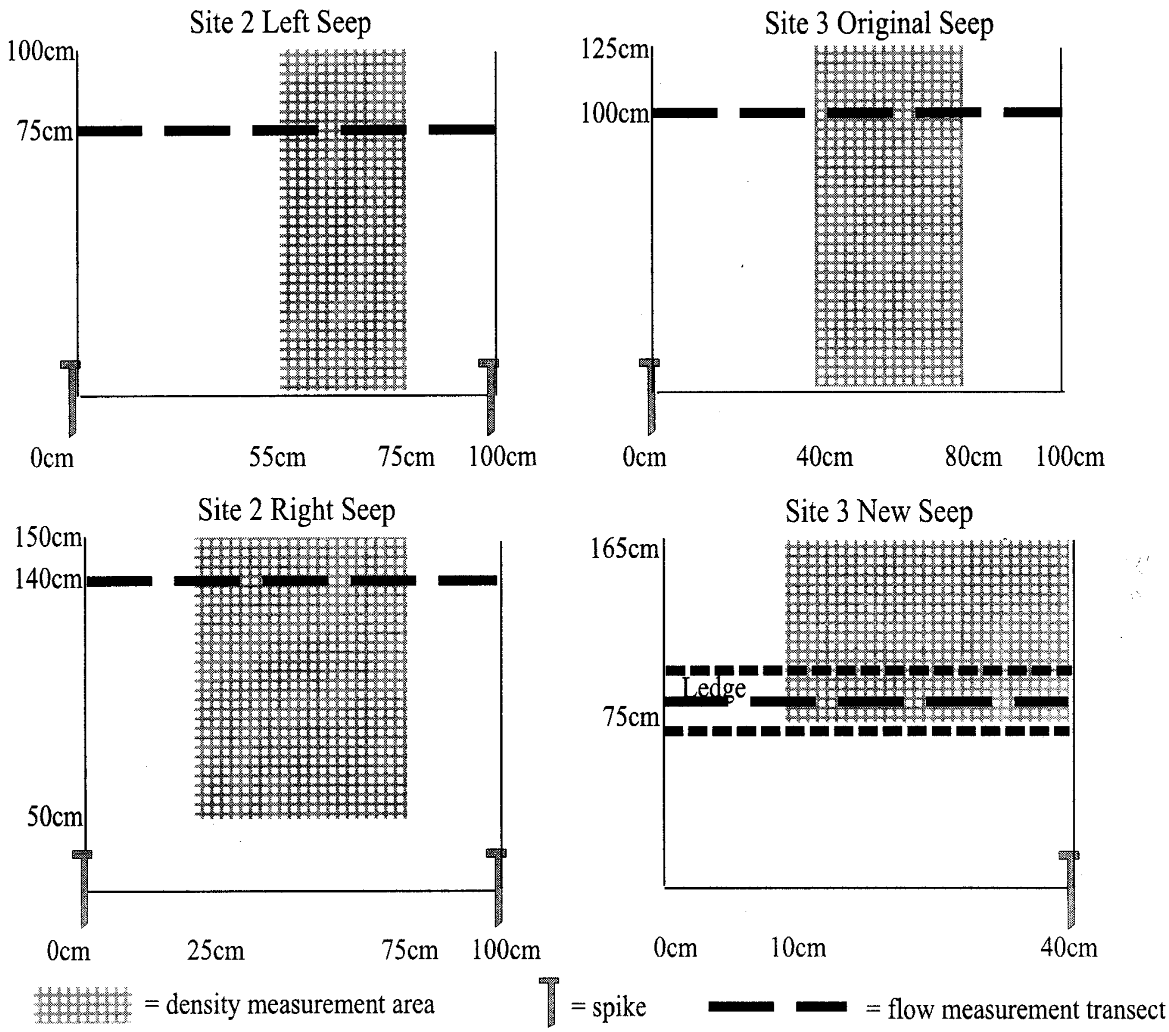

Appendix A. Springsnail density, wetted rockface, and springflow measurement locations at the rockface seeps. Maps are not drawn to scale.

A-1

Habitat Assessment, Glide/Pool Prevalence (modified after Plafkin et al., 1989).

Stream Name: ____________ Station ____________ Date ____________ Location Description ____________

Idaho Department of Health and Welfare - Division of Environmental Quality
HABITAT ASSESSMENT FIELD DATA SHEET
GLIDE/POOL PREVALENCE

HABITAT PARAMETER	CATEGORY			
	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1. Bottom substrate/ instream cover	Greater that 50% mix of rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20 ____	30-50% mix of rubble, gravel, or other stable habitat. Adequate habitat. 11-15 ____	10-30% mix of rubble, gravel, or other stable habitat. Habitat availability less than desirable. 6-10 ____	Less than 10% rubble, gravel or other stable habitat. Lack of habitat is obvious. 0-5 ____
2. Pool substrate characterization	Mixture of substrate materials with gravel and firm sand prevalent, root mats and submerged vegetation common. 16-20 ____	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present. 11-15 ____	All mud or clay or channelized with sand bottom; little or no root mat; no submerged vegetation. 6-10 ____	Hard-pan clay or bedrock; no root mat or vegetation. 0-5 ____
3. Pool variability	Even mix of deep/shallow/ large/small pools present. 16-20 ____	Majority of pools large and deep; very few shallow. 11-15 ____	Shallow pools much more prevalent than deep pools. 6-10____	Majority of pools small and shallow or pools absent. 0-5 ____
4. Canopy cover (shading)	A mixture of conditions where some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light. 16-20 ____	Covered by sparse canopy; entire water surface receiving filtered light. 11-15 ____	Completely covered by dense canopy; water surface completely shaded. OR nearly full sunlight reaching water surface. Shading limited to < 3 hours per day. 6-10 ____	Lack of canopy, full sunlight reaching water surface. 0-5 ____

B-1

Habitat Assessment, Glide/Pool Prevalence (modified after Plafkin et al., 1989).

Stream Name: ____________ Station ____________ Date ____________ Location Description ____________

Idaho Department of Health and Welfare - Division of Environmental Quality HABITAT ASSESSMENT FIELD DATA SHEET GLIDE/POOL PREVALENCE				
CATEGORY				
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
5. Channel alteration	Little or no enlargement of islands or point bars, add/or no channelization. 12-15 ____	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11 ____	Moderate deposition of new gravel, coarse sand on old and new bars; and/or embankments on both banks. 6-10 ____	Heavy deposits of fine material. Increased bar development; and/or extensive channelization. 0-3 ____
6. Deposition	Less than 5% of bottom affected; minor accumulation of coarse sand and pebbles as snags and submerged vegetation. 12-15 ____	5-30% affected; moderate accumulation of sand at snags and submerged vegetation. 8-11 ____	30-50% affected; major deposition of sand at snags and submerged vegetation; pools shallow, heavily silted. 4-7 ____	Channelized; mud, silt and/or sand in braided or nonbraided channels; pools almost absent due to deposition. 0-3 ____
7. Channel sinuosity	Instream channel length 3 to 4 times straight line distance. 12-15 ____	Instream channel length 2 to 3 times straight line distance. 8-11 ____	Instream channel length 1 to 2 times straight line distance. 4-7 ____	Channel straight; channelized waterway. 0-3 ____
8. Lower bank channel capacity	Overbank (lower) flows rare. Lower bank W/D ratio < 7. (Channel width divided by depth or height of lower bank.) 12-15 ____	Overbank (lower) flows occasional. W/D ratio: 8-15 8-11 ____	Overbank (lower) flows occasional. W/D ratio: 15-25. 4-7 ____	Peak flows not contained or contained through channelization. W/D ratio > 25 0-3 ____

B-2

Habitat Assessment, Glide/Pool Prevalence (modified after Plafkin et al., 1989).

Stream Name: ____________ Station ____________ Date ____________ Location Description ____________

Idaho Department of Health and Welfare - Division of Environmental Quality HABITAT ASSESSMENT FIELD DATA SHEET GLIDE/POOL PREVALENCE				
	CATEGORY			
HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
9. Upper bank stability	Upper bank stable. No evidence of erosion or bank failures. Side slopes generally < 30°. Little potential for future problems. 9-10 ____	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40° on one bank. Slight potential in extreme floods. 6-8 ____	Moderately stable. Moderate frequency and size of erosional areas. Side slopes up to 60° on some banks. High erosion potential during extreme high flow. 3-5 ____	Unstable. Many eroded areas. "Raw" areas frequent along straight sections and bends. Side slopes 60° common. 0-2 ____
10. Bank vegetation protection	Over 90% of the streambank surfaces covered by vegetation. 9-10 ____	70-89% of the streambank surfaces covered by vegetation. 6-8 ____	50-79% of the streambank surfaces covered by vegetation. 3-5 ____	Less than 50% of the streambank surfaces covered by vegetation. 0-2 ____
OR Grazing or other disruptive pressure	Vegetative disruption minimal or not efficient. Almost all potential plant biomass in present stage of development remains. 9-10 ____	Disruption evident but not affecting community vigor. Vegetative use is moderate, and at least one-half of the potential plant biomass remains. 6-8 ____	Disruption obvious; some patches of bare soil or closely cropped vegetation present. Less than one half of the potential plant biomass remains. 3-5 ____	Disruption of streambank vegetation is very high. Vegegation has been removed to 2 inches or less in average stubble height. 0-2 ____

Habitat Assessment, Glide/Pool Prevalence (modified after Plafkin et al., 1989).

Stream Name: ____________ Station ____________ Date ____________ Location Description ____________

Idaho Department of Health and Welfare - Division of Environmental Quality
HABITAT ASSESSMENT FIELD DATA SHEET
GLIDE/POOL PREVALENCE

HABITAT PARAMETER	CATEGORY			
	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
11. Streamside cover	Dominant vegetation is shrub. 9-10 ____	Dominant vegetation is of tree form. 6-8 ____	Dominant vegetation is grass or forbes. 3-5 ____	Over 50% of the stream bank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2 ____
12. Riparian vegetative zone width (least buffered side)	> 18 meters 9-10 ____	Between 12 and 18 meters. 6-8 ____	Between 6 and 12 meters. 3-5 ____	< 6 meters 0-2 ____
Column Totals	____	____	____	____
Score				