Springsnail (family Hydrobiidae) Distribution and Habitat Requirements in Hydrographic Basins Potentially Affected by the Proposed Groundwater Withdrawal in Cave, Dry Lake, and Delamar Valleys

Factual Witness Report

Annalaura Averill-Murray, M.S.
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service

Introduction

Aquatic snails of the genus *Pyrgulopsis* (family Hydrobiidae) are a diverse group with approximately 130 described species and many undescribed species in North America. The Great Basin has the greatest diversity of *Pyrgulopsis* (80 species; 61%) and many locally endemic forms (Hershler and Sada 2002, p. 255). Springsnails in the western United States are also represented by 22 extant species in the genus *Tryonia* (Hershler 2001, as cited in Sada 2005, p. 1). Both *Pyrgulopsis* and *Tryonia* species (commonly referred to as springsnails) are gill-breathing, aquatic obligates throughout their life cycle (Liu et al. 2003, p. 2771; Hershler et al. 1999, p. 336) and do no inhabit springs that periodically dry (Sada and Pohlmann 2006, p. 10). Dispersal is likely constrained by their direct mode of development (lacking a free-swimming dispersal phase), their aquatic lifestyle, and the isolation of the spring systems in which these organisms are found (Hershler et al. 1999, p. 336; Liu et al. 2003, p. 2771). Thus, springsnail presence is a sign of permanent water that likely has persisted for thousands of years (Sada and Pohlmann 2006, p. 10) and this taxon is a good indicator of hydrologic condition and/or change.

Local endemism is common in springsnails (Hershler and Sada 2002, p. 255), with many of the species in the western United States restricted to a single spring, spring complex, or drainage system (Hershler 1998, p. 1; Hershler et al. 1999, p. 336; Liu et al. 2003, p. 2771). Typically only one species of *Pyrgulopsis* is found in a spring, although more species may be found in the larger spring systems (Hershler and Sada 2002, p. 255). Many of the *Pyrgulopsis* species in the west inhabit thermal (regional) springs and may be ancient in origin (Hershler and Sada 2002, p.258).

Springsnail Distribution and Status in Potentially Affected Hydrographic Basins

The Upper White River Basin, characterized by Hershler and Sada (2002, p. 269) as the Pahranagat and White River Valleys above Pahranagat Wash, contains eight species of *Pyrgulopsis*, including five species endemic to the area (Hershler and Sada 2002, p. 269). Three species of *Pyrgulopsis* in the White River Valley have very narrow distributions. The butterfield pyrg (*Pyrgulopsis lata*) and emigrant pyrg (*Pyrgulopsis gracilis*) are known from only one spring or spring complex in the middle and lower White River Valley and the White River Valley pyrg (*Pyrgulopsis sathos*) is known from five spring or spring complexes in White River Valley (Table 1). A fourth species, the Pahranagat pebblesnail (*Pyrgulopsis merriami*), is known from three springs in lower White River Valley as well as three regional springs in Pahranagat Valley. Lastly, the Hubbs pyrg

(*Pyrgulopsis hubbsi*) is endemic to Crystal and Hiko springs, two of Pahranagat Valley's large regional springs.

Two species of springsnail are known from the Hydrographic Basins (HB) that are the subject of SNWA's applications #53987-53992: the Hardy pyrg (*Pyrgulopsis marcida*) is known from an unnamed spring at Parker Station in northern Cave Valley and the flag pyrg (*Pyrgulopsis breviloba*) is known from Meloy Spring in Dry Lake Valley. Both of these species have very narrow distributions, encompassing the above-mentioned locations as well as several locations in the adjacent White River Valley (Table 1). Hershler and Sada (2002, p. 270) assert that the distribution of *P. marcida* supports earlier contentions that Cave Valley may have drained to the White River Valley prior to the late Quaternary pluvial period. Similarly, the distribution of *P. breviloba* appears to support earlier contentions that in the ancient past, Dry Lake Valley may have drained south to White River Valley via Delamar Valley.

White River Valley likely receives subsurface flow from Cave Valley. Many springs in White River Valley, such as the Flag Springs complex and other springs listed in Table 1 that harbor springsnails, are likely supported by this regional flow (see Mayer 2007, Exhibit 501, p. 11). Similarly, there is a large discrepancy between recharge and discharge in Pahranagat Valley which is indicative of regional flow. In other words, groundwater supporting regional springs in Pahranagat Valley HB, such as Ash, Crystal and Hiko that harbor the Hubbs pyrg and other species of springsnail, is derived from outside the hydrographic basin (see Mayer 2007, Exhibit 501, p. 5).

All of the species mentioned above are considered critically imperiled at both the global and state level due to extreme rarity, imminent threats, and/or biological factors by NatureServe and the Nevada Natural Heritage Program (NNHP). There are two other species of aquatic snail found in Pahranagat Valley and/or White River Valley that are wider ranging and are not considered *critically* imperiled by the NNHP (Table 1). The grated Tryonia (*Tryonia clathrata*) is known from White River Valley, Pahranagat Valley, and the Muddy River area and is considered imperiled at both the global and state level due to rarity and/or other demonstrable factors. The Toquerville springsnail (*Pyrgulopsis kolobensis*) is a wide-ranging species whose distribution covers much of the Bonneville basin, the upper Virgin River basin, various isolated drainages in eastern Nevada, and portions of the Colorado River basin (Hershler 1998, p. 99). However, there is considerable variation in morphology across the species' range and it likely represents a species complex (Hershler and Sada 2002, p. 268).

Springsnail Habitat Requirements

Springsnails inhabit permanent, flowing waters that are highly oxygenated and relatively unpolluted (Mehlhop 1996, p. 6). They typically occur in springs, most commonly in rheocrene systems (where the spring emerges as a flowing stream) but also in limnocrenes (where the headspring forms a pool), and helocrenes (where the spring forms marshlike conditions) (Hershler 1998, p. 11). They can occur in small springs and seeps as well as large, high-discharge springs.

Springsnails require stable temperatures, water chemistry, and flow regime, characteristics typical of the headspring environment (Hershler 1998, p. 11). Thus, springsnails are often found near the spring source and decline in density downflow of the source (Hershler and Sada 2002, p. 256, Hershler 1998, p. 11). This distribution pattern is most pronounced in smaller springs (Hershler 1998, p. 11). *Pyrgulopsis* are most often found in dense mats of watercress (*Rorippa* sp.) and on other aquatic vegetation such as bladderwort (*Utricularia*), spike rush (*Eleocharis*), or tule (*Scirpus*), as well as attached to rock substrates (Hershler 1998, p. 14), and they generally feed on algae gleaned from aquatic vegetation or substrate (Mehlhop 1996, p. 6; Sada 2005, p. 3).

Pyrgulopsis species generally prefer flowing water, gravel substrate, and are found in both cold and thermal springs; *Tryonia* species prefer slow current, sandy substrate, and are always found in thermal habitats (Sada 2005, p. 3; Sada and Pohlmann 2006, p. 8). Each species of springsnail has specific preferences for substrate composition, water temperature, water depth, discharge rates/water velocity, and/or cover (Sada 2005, p. 3), and congeners appear to partition habitat based on different microhabitat preferences (Sada 2005, p. 4).

Springsnail Conservation

Most springs in the Great Basin have been altered from their natural state and are highly disturbed. Anthropogenic modifications to springs that negatively impact springsnails include, but are not limited to: diversions of the water source and modifications to the springhead; groundwater pumping; livestock grazing which removes and tramples vegetation and fouls water with excrement; recreational activities; and the introduction of exotic species such as crayfish that feed on aquatic snails (Hershler 1998, p. 14; Sada and Vinyard 2002, p. 277). Modifications to aquatic habitat, coupled with the introduction of non-native species, have caused the extirpation of 16 endemic species, subspecies, or distinct populations of fish and invertebrates within the Great Basin since the late 1800s, including 3 *Pyrgulopsis* species (Sada and Vinyard 2002; p. 277). Sada and Vinyard's (2002, p. 280) review of anthropogenic impacts to aquatic biota of the Great Basin found that all or most of the taxa that are extinct or in severe decline were narrowly distributed with few (less than five) populations, highlighting the vulnerability of these aquatic endemics to human disturbance and habitat modification.

Additionally, the spring systems in which these species are found are typically isolated and separated from other surface waters by large expanses of dry land. This isolation coupled with low vagility may exacerbate the vulnerability of species or local populations to extirpation. Recent mitochondrial DNA analysis of wider ranging *Pyrgulopsis* species (e.g., *P. micrococcus*) indicated multiple, genetically distinct and geographically restricted populations consistent with the presumably limited dispersal ability of springsnails (Liu et al. 2003, p. 2779). However, recent dispersal among hydrographically isolated areas has likely occurred in some instances, potentially by transport on the feet or plumage of migratory waterbirds (Liu et al. 2003, p. 2780). Examination of *P. kolobensis*, which is a wide-ranging species of western Utah and eastern Nevada, including the White River Valley, may result in the identification of previously undescribed species (Liu et al. 2003, p. 2780).

In 1998, the U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, National Park Service, U.S. Forest Service, Smithsonian Institution, and The Nature Conservancy signed a Memorandum of Understanding (MOU) that formally recognized the importance of conserving the springsnail fauna of the Great Basin. The MOU is currently outdated, but the importance of springsnail conservation continues to be recognized by the participating parties.

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Table 1. Springsnail species known from project basins (Cave, Dry Lake, and Delamar valleys) and adjacent, down-gradient basins (Pahranagat and White River valleys).

Common Name	Scientific Name	Species Range[1]	Status/Rank[2]
Flag pyrg	*Pyrgulopsis breviloba*	Known from Meloy Spring in Dry Lake Valley and the Flag Springs complex in White River Valley	G1S1
Emigrant pyrg	*Pyrgulopsis gracilis*	Known from the Emigrant Springs complex in White River Valley; endemic to Upper White River Basin[3]	G1S1
Hubbs pyrg	*Pyrgulopsis hubbsi*	Known from Crystal and Hiko Springs in Pahranagat Valley; endemic to Upper White River Basin	G1S1
Toquerville pyrg	*Pyrgulopsis kolobensis*	Wide ranging species known from much of the Bonneville basin, the upper Virgin River basin, various isolated drainages in eastern Nevada, and portions of the Colorado River basin; known from Butterfield Springs in White River Valley	Not ranked
Butterfield pyrg	*Pyrgulopsis lata*	Known from Butterfield Springs in White River Valley; endemic to Upper White River Basin	
Hardy pyrg	*Pyrgulopsis marcida*	Known from an unnamed spring at Parker Station in Cave Valley; known from Ruppes Boghole, the Emigrant Springs complex, Hardy, Butterfield, and Silver Springs in White River Valley	G1S1
Pahranagat pebblesnail	*Pyrgulopsis merriami*	Known from Moorman, Hot Creek, and Moon River Springs in White River Valley and Ash, Crystal, and Hiko Springs in Pahranagat Valley; endemic to upper White River Basin	G1S1
White River Valley pyrg	*Pyrgulopsis sathos*	Known from Flag, Lund, Preston Big, Arnoldson, and Camp Springs in White River Valley; endemic to Upper White River Basin	G1S1
Grated Tryonia	*Tryonia clathrata*	Known from Moorman and Hot Creek Springs in White River Valley; Ash Spring in Pahranagat Valley; and Moapa Valley (Muddy River)	G2S2

[1]Distribution based on Nevada Natural Heritage Program database records.

[2]Ranking based on NatureServe and Nevada Natural Heritage Program designations:

G = Global rank indicator, based on worldwide distribution at the species level; S = State rank indicator, based on distribution within the state at the lowest taxonomic level

1 = critically imperiled due to extreme rarity, imminent threats, and/or biological factors

2 = imperiled due to rarity and/or other demonstrable factors

[3]Upper White River Basin includes Pahranagat and White River Valleys above Pahranagat Wash (Hershler and Sada 2002).