Project Title: Woundfin Stocking above the Quail Creek Diversion

Background: The Woundfin (*Plagopterus argentissimus*) has been federally listed as an endangered species since 1970 (35 FR 16047), and since their listing, Woundfin populations have continued to decline range-wide. The historical range of Woundfin includes the Virgin River and its tributaries in Utah, Arizona, and Nevada (La Rivers 1994). Presently, Woundfin have been extirpated from >85% of their historical range and remain most abundant in the upper extent of their historical range, between Pah Tempe Springs and the Washington Fields Diversion in Utah (Fridell et al. 2004, Fridell and Bennion 2019). Population declines in Woundfin, as well as other native Virgin River fishes, are attributed to a combination of factors including introduction of non-native fish species, habitat loss and alteration, and ecologically limiting factors such as low streamflow and water quality conditions (USFWS 1994, Huizinga and Fridell 2012).

The source of most of the culinary water supply for Washington County is diverted from the mainstem Virgin River at the Quail Creek Diversion (QCD), located upstream of Pah Tempe Springs, a series of more than 100 hot springs. Below Pah Tempe Springs the water quality of the Virgin River changes dramatically and is considered unfit for consumption. More specifically, Pah Tempe Springs adds approximately 11 cubic feet per second of highly mineralized water into the Virgin River, with water temperatures ranging from 38-43°C and average dissolved-solids concentration (i.e., salinity) ranging from 9,220-9,440 milligrams per liter (Gerner and Thiros 2014, Williams and Deacon 1998).

Pah Tempe Springs is also the upstream extent (historical and present) for Woundfin populations (Fridell and Bennion 2019). This distribution may suggest that Woundfin are reliant on the salinity or other water quality conditions provided by Pah Tempe Springs. A recent study initiated by the United States Geological Survey (USGS) has proposed to study the costs and benefits of removing the inflow of Pah Tempe Springs from the Virgin River (Gerner and Thiros 2014). However, it remains unknown how the removal of Pah Tempe Springs will impact downstream water quality and as a result, the subsequent survival and reproduction of Woundfin in the Virgin River. Therefore, before any projects that alter Pah Tempe Springs proceed, it is imperative to evaluate the potential impacts of altering downstream water quality on Woundfin populations.

Purpose: Based on the proposal from USGS to investigate the costs and benefits of removing the Pah Tempe Springs inflow from the Virgin River, the purpose of this research proposal is to evaluate the potential long-term ecological impacts on Woundfin populations if Pah Tempe Springs were altered or removed from the system.

Goals and Objectives: The goal of this research proposal is to provide in-situ documentation of Woundfin survival and reproduction in the absence of Pah Tempe

Springs. In order to do so, we propose to introduce hatchery reared Woundfin into the Virgin River upstream of the QCD, and to collaborate with Bozeman Fish Technology Center on a series of laboratory studies. The following questions will be addressed: 1) does Pah Tempe Springs play an important role in the survival of Woundfin?, 2) if Woundfin survive in the river reach above QCD, will they reproduce?, 3) will naturally produced Woundfin above QCD survive to age-2 or older?, and 4) could reproduction from the above QCD reach contribute to reestablishing a viable Woundfin population above the Washington Fields Diversion?

In order to gain local and State support to stock Woundfin above QCD two important considerations must be realized: 1) Woundfin stocked above the QCD would be considered surplus fish that do not contribute to the survival of Woundfin, and therefore neither the stocked Woundfin nor their progeny would be protected in the river reach above QCD under the Endangered Species Act; however, if any of the stocked fish or their progeny move below the QCD, they would be considered endangered species and be fully protected, and 2) under this designation, absolutely no change to current water management, grazing, recreation, or related activities would be required as a result of stocking Woundfin above the QCD.

Methods: Since 1998, the Utah Division of Wildlife Resources (UDWR), in cooperation with the Virgin River Resource Management and Recovery Program (VRP), has been actively managing the Virgin River within Utah to prevent the extinction of endangered Woundfin populations and other endangered and sensitive native fish species. Part of the recovery efforts for Woundfin involve maintaining broodstock and refuge populations, as well as providing production from these stocks to supplement wild populations in the Virgin River (USFWS 1994, UDNR 1999). Southwestern Native Aquatic Resources and Recovery Center (SNARRC) has maintained a refuge and broodstock population of Woundfin since the 1970s, and has attempted to produce 20,000 Woundfin for annual stocking efforts since the early 2000s.

The most efficient method to evaluate if Woundfin are dependent on Pah Tempe Springs is to introduce hatchery reared Woundfin provided by SNARRC into the Virgin River above QCD, and to monitor the stocked population for survival and reproduction (Fridell and Bennion 2019). There have been a variety of theories suggesting Pah Tempe Springs is important to Woundfin survival; for example, Woundfin are very susceptible to "Ich" (*Ichthyophthirius multifiliis*) and local water quality provided by Pah Tempe Springs is thought to play a significant role in reducing fish vulnerability to this parasite. However, laboratory studies alone are not adequate to address the remaining questions. This field study will correspond to concurrent laboratory studies conducted by the U.S. Fish and Wildlife Service's Bozeman Fish Technology Center.

All Woundfin would be provided by SNARRC and marked with Visible Implant Elastomer (VIE) tags unique to Woundfin stocked above the QCD. Stocking methods would follow protocols established for the Virgin River below the QCD (Fridell et al. 2006, Fridell and Bennion 2019) and stocking site(s) will be prioritized based on suitable Woundfin habitat (e.g., sand/runs).

Proposed monitoring would be conducted over a 10-year period to allow for natural variability in environmental conditions (i.e., water year and discharge regimes), hatchery production, and cyclical fluctuations in fish populations. Population monitoring would consist of monthly Population Response Station (PRS) sampling at the Grafton station located above QCD. A complete description of PRS methods can be found in Bennion and Fridell (2019). Additional sampling above QCD will also be conducted to detect survival, reproduction, and distribution of stocked populations. The use of unique VIE tags will also enable UDWR to monitor the potential for dispersal below the QCD.

Temperature probes will be added in stocked reaches and salinity samples will be collected during PRS sampling in order to correlate Woundfin survival and reproduction to environmental variables upstream of the QCD.

Project Work/Task Description and Schedule:

- Annual stocking plans will be coordinated through the Virgin River Program and Virgin River Fishes Recovery Team. It is anticipated that Woundfin will be stocked annually for up to five years.
- Annual surplus production of Woundfin from SNARRC will be stocked in the Virgin River above QCD in spring.
- The presence of VIE tagged fish will be monitored throughout the year using PRS and distributional sampling for up to 10 years.
- An annual report summarizing Woundfin stocking, subsequent recaptures, fish length histograms, and presence of young Woundfin (i.e., reproduction), along with any recommendations will be completed in February of each year.

Recommendations/Results:

Results will be summarized annually and recommendations for future years will be developed in consultation with the Virgin River Program Technical Team and Virgin River Fishes Recovery Team.

References:

- Bennion, M.R.M. and R.A. Fridell. 2019. Virgin River fishes population response stations data summary, 2018. Utah Division of Wildlife Resources Publication Number 19-09. 25 pp.
- Fridell, R.A. and M.R.M. Bennion. 2019. The distribution, life history, status, population demographics, and management of Woundfin (Plagopterus argentissimus) and Virgin River Chub (Gila seminuda), Virgin River, Utah. Utah Division of Wildlife Resources Publication Number 19-11. 76 pp.
- Fridell, R.A., D.W. Kite, and J.A. Moore. 2006. Woundfin stocking and dispersal monitoring on the Virgin River, Utah, 2005. Utah Division of Wildlife Resources Publication 06-19. 29pp.
- Fridell, R.A., M.A. Schijf, and M.K. Morvilius. 2004. Virgin River fish distribution between the Washington Fields Diversion and Pah Tempe, 2003. 35 pp.
- Gerner, S.J. and S.A. Thiros, eds. 2014. Hydrosalinity studies of the Virgin River, Dixie Hot Springs, and Littlefield Springs, Utah, Arizona, and Nevada: U.S. Geological Survey Scientific Investigations Report 2014-5093, <u>http://dx.doi.org/10.3133/sir20145093</u>. 47 pp.
- Huizinga, M. and R.A. Fridell. 2012. Trends in the native fish assemblage and identification of temperature and flow limiting factors in the Virgin River between Pah Tempe hot springs and the Washington Fields Diversion 2002-2010. Utah Division of Wildlife Resources Publication number 11-35. 147 pp.
- La Rivers, I. 1994. Fishes and fisheries of Nevada. University of Nevada Press, Reno. 782 pp.
- Utah Department of Natural Resources (UDNR). 1999. Program document for the proposed Virgin River Resource Management and Recovery Program. Publication Number 98-18. 27pp.
- USFWS. 1994. Virgin River Fishes Recovery Plan. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 45pp.
- Williams, C.D. and J.E. Deacon. 1998. Recommendations for a Comprehensive Virgin River Watershed and Native Fishes Conservation Program. Pacific Rivers Council. 53pp.

