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## Balancing salmon populations, aquatic biodiversity, and water resource needs during drought in coastal California

### *Principal Investigators:*

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## Project Summary

One of the most pressing challenges in the 21st century will be to balance societal needs for freshwater with the maintenance of aquatic biodiversity in the face of climate change. Water withdrawals and climate change pose especially grave threats to stream biodiversity in arid regions, like the western US. How much water is needed to sustain biodiversity is an open question. Such knowledge gaps hamper our ability to design and evaluate the ecological benefits of innovative water conservation projects that strive to balance competing demands for freshwater. The CIWR seed funds are contributing to the development of a research program to identify flow thresholds for sustaining biodiversity during drought, which will be a major step towards providing managers and policy makers with flow targets to support aquatic biodiversity through seasonal and multi-year drought.

Our efforts to date have involved several reconnaissance trips to our focal watershed (the Pine Gulch Creek basin in Marin County) to identify potential study sites. Following these trips, we selected 15 study reaches in the basin in summer 2014, including 8 reaches on tributaries (all with intermittent flow) and 7 sites on the mainstem of Pine Gulch Creek (all with perennial flow). In fall 2014, we deployed flow-state (wet/dry) and temperature remote data loggers at all eight tributary study reaches and at two perennial study reaches on the mainstem of Pine Gulch Creek. These flow-state sensors are the latest technology for measuring flow-state in small, intermittent streams. During summer 2015, we will begin our field campaign to characterize the biotic communities throughout the Pine Gulch Basin (including at the aforementioned 15 reaches) while also recording a suite of abiotic characters. Our aim is to collect abiotic and biotic data throughout the watershed, from the smallest intermittent tributaries to the mainstem of Pine Gulch Creek.

Such a field campaign requires a large survey team, and we have leveraged the CIWR funds to secure additional funding to support the continuation of this project, including a Smith Postdoctoral Fellowship to Dr. Michael Bogan, who is leading the field effort. Once the biological data is in hand, we plan to use a recently developed statistical approach (CART regression) to identify flow thresholds for sustaining aquatic biodiversity, including imperiled salmonids, during drought.

During this time period, we have also been advancing related work using data collected from the John West Fork, an intermittent stream that flows into Olema Creek in Marin County. One product from this work is a newly accepted paper (Bogan et al. In Press) describing the incredible aquatic biodiversity found in small coastal intermittent streams. As an example, from the John West Fork alone, we have documented four vertebrate species (including two imperiled salmonid fishes) and >160 aquatic invertebrate taxa.

Our sampling program thus focuses both on raising the awareness of the biodiversity value of small intermittent streams and working towards approaches for balancing societal and ecosystem demands for freshwater to conserve biodiversity through drought.

### Publications from prior projects

Bogan, Michael T., Jason L. Hwan, and Stephanie M. Carlson. In Press. High aquatic biodiversity in an intermittent coastal headwater stream at Golden Gate National Recreation Area, California. Northwest Science 89: xxx-xxx.