Two Salmon Walk Into A Bar...  
An Assessment of Salmon Habitat Restoration on the Feather River  
Nathan Sweem, Timothy Horner, and Whitney Thorpe, California State University, Sacramento

Introduction

- Salmon bury their eggs in the hyporheic zone underneath the surface layer of the streambed.
- Successful spawning requires appropriately sized gravel, appropriate depth and velocity, high gravel permeability, and a significant amount of dissolved oxygen (DO).
- Since the construction of dams, smaller gravel has been scoured away and hasn't been replaced by gravel from upstream.
- Gravel was added to a select channel of the Lower Feather River in order to restore this habitat.

Methods

The California Department of Water Resources added 7000 ft$^3$ of gravel to selected restoration sites on the Lower Feather River downstream from the Thermalito Diversion Dam. Spawning conditions were assessed using measurements of grain size, depth and velocity, dissolved oxygen content, and gravel permeability. Measurements collected in this project were compared to Heffernan (2013) data collected prior to gravel addition.

Results

1-A: Grain Size Before Gravel Was Added

- Median (D$_{50}$) grain size before restoration was mostly too coarse to be used by salmon for spawning, with few grains smaller than -5$\phi$ or -6$\phi$.

1-B: Grain Size After Gravel Was Added

- Median (D$_{50}$) grain size after restoration is more than twice as small, with about half of the grains between -5$\phi$ and -6$\phi$.

2-A: Depth & Velocity Before Gravel Was Added

- Before restoration, the channel consisted of a deep, low velocity pool, a shallow low velocity riffle, and an area too shallow for salmon spawning.

2-B: Depth & Velocity After Gravel Was Added

- After restoration, depth and velocity in riffle areas increased significantly, while depth in the pool decreased. Mean velocity is 2.86 ft/s, and mean depth is 1.5 ft. These values are ideal for salmon spawning.

3-A: Permeability Before Gravel Was Added (cm/hr)

- Permeability before restoration was very low in the riffles, which indicates that the area is unlikely to support healthy embryos.

3-B: Permeability After Gravel Was Added (cm/hr)

- Permeability increased dramatically, which suggests a greater chance of successful spawning in the area.

4-A: Dissolved Oxygen Before Gravel Was Added

- Before restoration, dissolved oxygen content is mostly low or not detectable due to low permeability conditions.

4-B: Dissolved Oxygen After Gravel Was Added

- After restoration, the dissolved oxygen content is much higher, with a mean more than twice what it was previously.

Conclusion

Before gravel was added, spawning conditions were predominantly characterized by gravel too coarse for salmon use, low velocity pools and very shallow riffles, little to no gravel permeability, and low dissolved oxygen content. Spawning conditions after the gravel was added consisted of gravel fine enough for salmon use, riffles of appropriate depth and velocity, greater permeability, and higher dissolved oxygen content. These conditions are ideal for salmon spawning.

References