

# Coho Salmon Limiting Factors Analysis

Location: Rock Creek, Douglas County, Oregon

Client: PacifiCorp

Restoring anadromous salmonid populations is a high priority throughout the Pacific Northwest and California. For restoration to be successful, a clear understanding of factors limiting populations is needed. Without information on limiting factors, resources may be allocated with little or no benefit to the species. The objectives of a limiting factors analysis (LFA) are to (1) develop a conceptual model that allows generation of hypotheses about potential limiting factors; (2) test hypotheses through focused field studies and quantitative population modeling; and (3) develop restoration plans based on findings.

A systematic analysis of the North Umpqua basin, Oregon indicated that, based on channel gradient and confinement, Rock Creek had by far the greatest potential for coho salmon restoration of any tributary in the basin. We developed a conceptual model for coho salmon in Rock Creek, and generated hypotheses regarding potential factors that may limit the population. We evaluated these hypotheses with focused studies, and in less than a year were able to determine likely limiting factors, and develop restoration strategies for improving conditions. Below, we summarize three studies used to evaluate factors hypothesized to limit coho production in Rock Creek, and the restoration plan that resulted from study findings.

## 1) Water temperature and summer rearing

Elevated water temperatures due to reduced riparian shading can prohibit coho rearing. Using BasinTemp®, a basin-scale predictive temperature model, we showed that maximum weekly average temperature (MWAT) in much of mainstem Rock Creek exceeds 17°C, the level tolerated by juvenile coho salmon. As a result, we selected a large tributary with suitable temperatures to evaluate other possible limiting factors in the absence of water temperature limitations.

## 2) Fine sediment input and pool filling

Fine sediment input can be a factor limiting coho survival. Infiltration of fines into redds can cause mortality during incubation by decreasing oxygen delivery and waste removal, and can physically prevent fry emergence. Pools, vital for juvenile rearing, can also be filled by fine sediment, thus decreasing juvenile carrying capacity. We measured fine sediment conditions across Rock Creek which indicated high permeability in spawning gravels and minimal pool filling, suggesting fine sediment was not likely a limiting factor. These findings suggest that

putting limited resources toward fine-sediment control would have negligible impact on increasing coho production in the basin.

## 3) Summer and winter habitat limitations

To determine if summer or winter juvenile carrying capacity was limiting coho production we conducted population estimates using snorkeling and electrofishing surveys in summer, fall, following major winter freshets, and spring. We planted wild coho eggs throughout the study reach prior to abundance surveys to ensure fully seeded conditions and account for the effects of variable adult returns or other environmental factors that could limit seeding levels.



Egg seeding of spawning gravels.

We found winter habitat was limiting and summer habitat could become limiting if winter survival was improved. Using Ripple—a GIS-based model that integrates geomorphological, aquatic habitat, and biological data to predict area-specific population size—we estimated that improving winter survival through addition of large wood has the potential to double coho production in Rock Creek.

## Conclusion

These findings led to the design and implementation of an ongoing, before-after-impact-control (BACI) experiment aimed at determining the density and configuration of wood placement that most cost-effectively maximizes coho winter survival.

