

# SALMONICS

## Quantifying the economic benefits of river restoration for Chinook salmon on the Lower Yuba River, California



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### PROJECT INTRODUCTION



The Lower Yuba River.



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The **Yuba River** watershed once supported thriving Chinook salmon populations; however, significant human alteration beginning in the mid-1850s has caused a variety of physical and ecological impacts. During the California gold rush, hydraulic mining activities caused large volumes of sediment to be transported and deposited in the lowermost reaches of the river. The magnitude of sediment entering the Lower Yuba River motivated the construction of Englebright Dam to protect downstream settlements from flooding. In the process, the Lower Yuba River became hydrologically and ecologically disconnected from the upper watershed. These physical transformations have especially occluded or damaged much of the habitat necessary for healthy Chinook salmon populations.

While several organizations have undertaken restoration work over the past ten years on the Lower Yuba River, no projects to date have sought to quantify the economic benefits associated with river restoration. The objective of this study was to develop a framework for monetizing the benefits of river restoration to inform future management decisions.

### OUR APPROACH



#### River Health Report Card

We created a river health report card for the Lower Yuba River reaches with respect to Chinook salmon in order to understand current river conditions. We compiled data from a variety of sources, using measures of water quality, ecological conditions, and physical conditions of the river. The report card provides reach-level detail and a systematic approach for unbiased comparison of analogous river reaches.



#### What are the economic benefits of restoring the Lower Yuba River for Chinook salmon?



#### Quantifying Benefits of Restoration

We calculated the benefits associated with doubling current Chinook salmon populations, a target established by the Anadromous Fish Restoration Program. We performed these calculations under the assumption that doubling the current amount of available juvenile Chinook salmon habitat on the Lower Yuba River would lead to a doubling of the adult population. We used three economic approaches to quantifying benefits: a fishery valuation, a carbon sequestration analysis, and a hedonic property valuation.



#### Comparing Benefits to Project Costs

We compared benefits to a range of project costs associated with the amount of restoration needed to reach the doubling target. We then calculated a benefit-cost ratio using these values. Additionally, a sensitivity analysis was performed to examine how the benefit-cost ratio varies under different levels of salmon returns and under different discount rates.

### RESULTS & FINDINGS



#### River Health Report Card

The Lower Yuba is divided into eight geomorphic reaches, with Englebright being farthest upstream and Marysville being farthest downstream. Red boxes indicate scores of poor or intolerable conditions, yellow indicates tolerable conditions, and green indicates good conditions for Chinook salmon.

Parameter	Marysville	Hallwood	Daguerre Pt Dam	Dry Creek	Parks Bar	Timbuctoo	Narrows	Englebright Dam
<b>Water Quality</b>								
Summer Daily High Temp.	●	●	●	●	●	●	●	●
Summer Daily Avg. Temp.	●	●	●	●	●	●	●	●
Total Suspended Solids	●	●	●	●	●	●	●	●
Dissolved Oxygen	●	●	●	●	●	●	●	●
pH	●	●	●	●	●	●	●	●
<b>Ecological Resources</b>								
Macroinvertebrate Diversity	●	●	●	●	●	●	●	●
Riparian Vegetation	●	●	●	●	●	●	●	●
<b>Physical Conditions</b>								
Percent Pool	●	●	●	●	●	●	●	●
Percent Riffle	●	●	●	●	●	●	●	●
Pool: Riffle Ratio	●	●	●	●	●	●	●	●
Spawning Substrate Diameter	●	●	●	●	●	●	●	●

Sources: Yuba County Water Agency, USGS.



#### Quantifying Benefits of Restoration: These benefits total \$64 million when calculated into perpetuity.

We utilized three revealed preference methods to quantify the monetary benefits of restoration.

##### 1. Fishery valuation: \$5 million per year.

Since Chinook salmon spend part of their life in streams and part of their life in the ocean, the species generates value in two distinct geographic locations. Benefits from commercial and recreational fishing were accounted for, totaling \$5 million per year.

##### 2. Carbon sequestration: \$5,000 per year.

To get to our restoration goals, 510 acres of riparian vegetation would be planted. This new vegetation would sequester about 0.5 tons of carbon per acre, totaling \$5,000 per year.

##### 3. Hedonic property valuation: \$1 million.

To simulate the value of a private property being located near a restored river, an 11% increase was applied the current appraised value of homes located adjacent to the Lower Yuba River (Streiner and Loomis, 1995). These increases in property value total a one-time benefit of \$1 million.



#### Comparing Benefits to Project Costs

Restoration Project Type	Low Cost Estimate (per acre)	High Cost Estimate (per acre)
Floodplain Lowering	\$60,000 - \$90,000	\$200,000 - \$300,000
Riparian Planting	\$5,000 - \$25,000	\$30,000 - \$50,000

Source: Thomson and Pinkerton, 2008.



Source: OMB, 1992.

### PROJECT CONCLUSION

We found that river restoration for salmon habitat is economically viable if project costs are low and restoration actions successfully bring increased adult salmon returns. Doubling current Chinook salmon populations on the Lower Yuba generates \$64 million in benefits.

Quantifying benefits can be a powerful tool in the planning stages of river restoration projects. While benefit valuations are becoming more common, this type of analysis is not yet a requirement to receive state or federal restoration grants. The advantages of formal economic analysis include crystallization of costs and benefits, data gap detection, informed planning, and post-restoration examination of project success. Perhaps the most valid application of restoration benefit valuation is the comparison of benefits across competing project proposals, particularly if rival projects have significantly different cost-benefit results.

While we have taken an economic perspective for justifying river restoration, we recognize that there are benefits of a restored river that cannot be captured in strictly financial terms. However, we believe that economic valuation can provide supplemental justification in addition to environmental rationale, which will allow ecologists and river scientists to garner support for widespread river restoration.

**Doubling current Chinook salmon populations on the Lower Yuba generates \$64 million in benefits.**

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