

## Conclusions

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.



The Lower Yuba River. Source: SYRCL

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.

## Acknowledgements

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# SALMONICS

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

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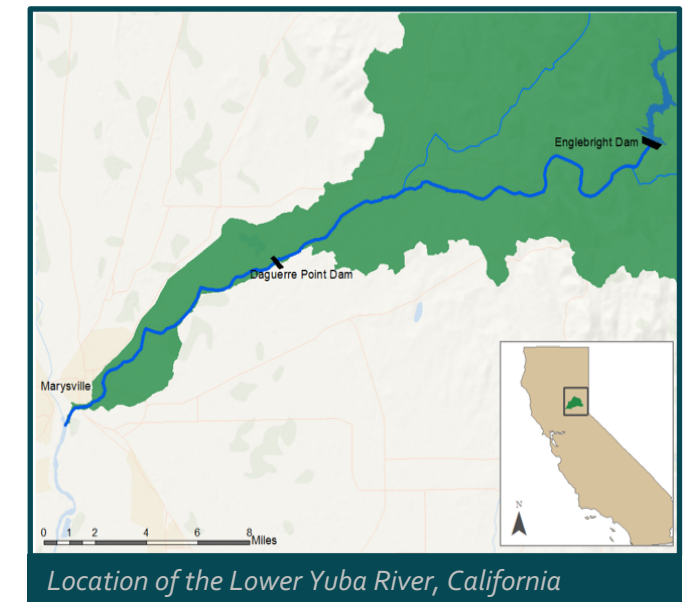
<http://yuba2016.wixsite.com/yubariverrenovation>

Project Brief, Spring 2017

## Introduction

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.



Location of the Lower Yuba River, California



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

## 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. In the figure below, red circles indicate poor conditions, yellow indicates fair conditions, and green indicates good conditions for Chinook salmon. The Lower Yuba is divided into eight geomorphic reaches, with Englebright being farthest upstream. There is no reach on the Lower Yuba River that receives favorable scores across all parameters, indicating the need for river-scale restoration in order to improve 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.

**Target for restoration:  
Double the current Chinook salmon population**

## Costs of Restoration

We selected floodplain lowering and riparian planting as restoration strategies required to double Chinook salmon populations in the Lower Yuba River. The juvenile life stage of Chinook salmon was identified as the limiting life stage, floodplain restoration has the greatest opportunity to improve this limiting life stage. There are 510 acres of juvenile habitat on the Lower Yuba River and therefore an additional 510 acres of floodplain habitat would be need to be restored. Below are the costs of restoration per acre.

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.

## Quantifying the Benefits of Restoration

We utilized three revealed preference methods to quantify the monetary benefits of restoration. These benefit measures were summed and calculated into perpetuity.



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

Chinook salmon spend part of their life in streams and part of their life in the ocean, therefore the species generates value in two distinct geographic locations. Benefits from both commercial and recreational fishing were considered.



### 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.



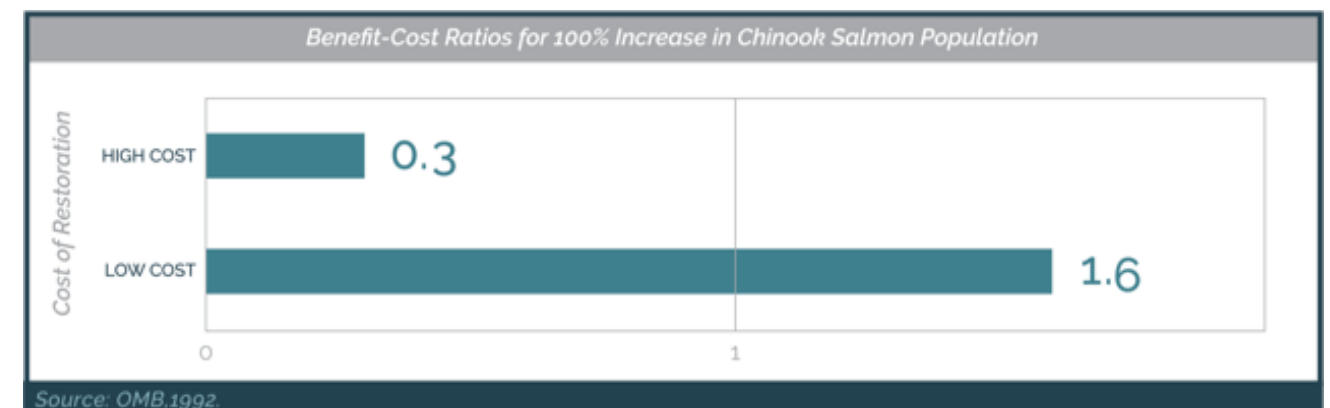
### 3 Hedonic property value: \$1 million

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

**Doubling the current Chinook salmon population results in benefits totaling \$64 million.**

## Comparing Costs and Benefits

Costs are incurred in the first 3 years. Benefits begin accruing in year 4 and were calculated into perpetuity. A 7% discount rate was used. We utilized the benefit-cost ratio to determine the economic viability of restoration projects. **A benefit-cost ratio greater than 1 indicates that a project's benefits outweigh its costs, meaning the project is economically favorable.** Under low costs of restoration, the benefit-cost ratio of restoring the Lower Yuba River exceeds 1. Under high costs, the benefit-cost ratio is far less than 1.



Source: OMB, 1992.