

# Losses of Sacramento River Chinook Salmon and Delta Smelt to Entrainment in Water Diversions in the Sacramento-San Joaquin Delta

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## ABSTRACT

Pumping at the water export facilities in the southern Sacramento-San Joaquin Delta kills fish at and near the associated fish-salvage facilities. Correlative analyses of salvage counts with population indices have failed to provide quantitative estimates of the magnitude of this mortality. I estimated the proportional losses of Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*) and delta smelt (*Hypomesus transpacificus*) to place these losses in a population context. The estimate for salmon was based on recoveries of tagged smolts released in the upper Sacramento River basin, and recovered at the fish-salvage facilities in the south Delta and in a trawling program in the western Delta. The proportion of fish salvaged increased with export flow, with a mean value around 10% at the highest export flows recorded. Mortality was around 10% if pre-salvage losses were about 80%, but this value is nearly unconstrained. Losses of adult delta smelt in winter and young delta smelt in spring were estimated from salvage data (adults) corrected for estimated pre-salvage survival, or from trawl data in the southern Delta (young). These losses were divided by population size and accumulated over the respective seasons. Losses of adult delta smelt were 1–50% (medi-

an 15%), although the highest value may have been biased upward. Daily losses of larvae and juveniles were 0–8%, and seasonal losses accumulated were 0–25% (median 13%). The effect of these losses on population abundance was obscured by subsequent 50-fold variability in survival from summer to fall.

## KEYWORDS

Chinook salmon *Oncorhynchus tshawytscha*, delta smelt *Hypomesus transpacificus*, diversions, population ecology

## SUGGESTED CITATION

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## INTRODUCTION

One of the greatest challenges facing resource managers is assessing the effectiveness of their actions in influencing ecosystems or biological populations. This difficulty arises from three sources: 1) weak or