

# **Optimal management controls for maximizing the recovery of an endangered fish species**

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**Abstract:** A computationally-expensive individual-based model (IBM) was used to simulate the population decline of delta smelt during 1995 to 2005 in the Upper San Francisco Estuary. We approximated the IBM's output with a spatially-explicit matrix projection model. By applying optimal control theory to the matrix model, we determined cost-effective management actions involving redirected movement and improved habitat (affecting mortality and growth) that would maximize long-term population growth during this period of decline.