Updating and Expanding the Delta Smelt Individual-Based Model (DSIBM)

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Goal:

To update the DSIBM with new information and expand its capacity to evaluate effects of proposed water operation plans on delta smelt population dynamics

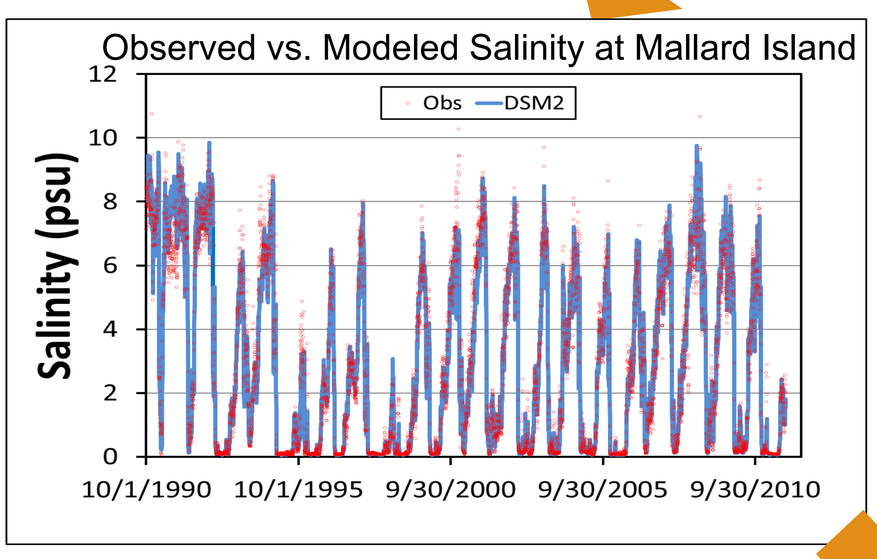
Applications:

- Food enhancement in north Delta, Suisum Marsh, and SDWSC
- Delta Smelt supplementation
- Different operational scenarios (inflows, exports, outflows)
- Increasing water temperature due to climate change
- Monte Carlo uncertainty analysis
- Optimization of restoration actions regarding benefits and costs

Historical Data or CalSimII Data

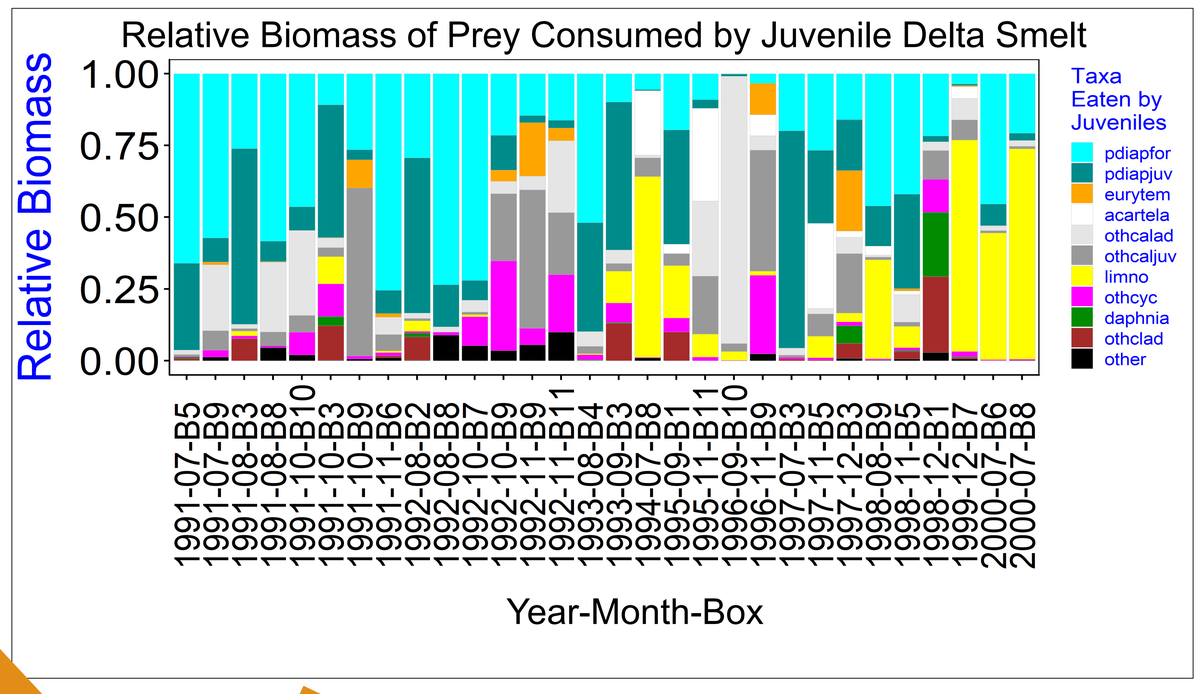
DSM2

- Hydraulics
- Salinity
- Water temp

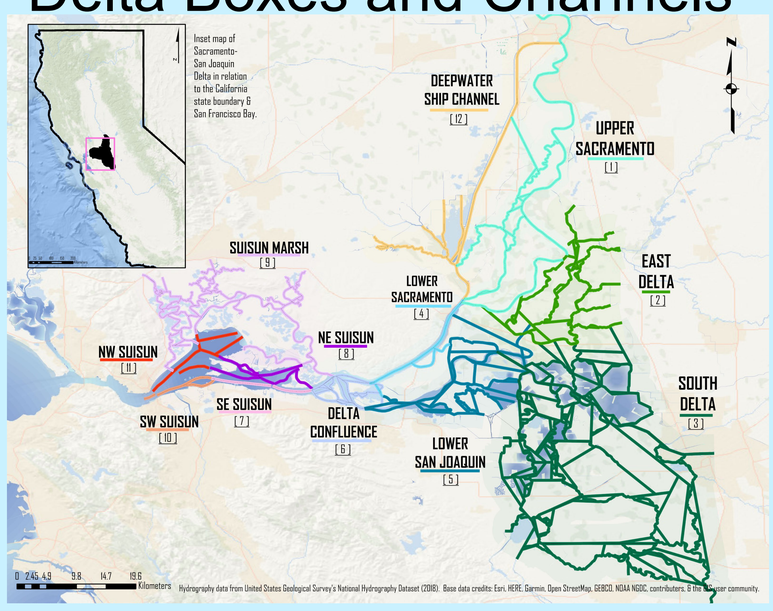


Zooplankton

- 12 groups



Delta Boxes and Channels



DSIBM Individual

- Reproduction
- Growth
- Mortality
- Movement

Population

- Distribution
- Abundance
- Growth rate
- Life-stage survival

New Data

Category	2013 DSIBM	Updated DSIBM	Improvement
Zooplankton input data	6 taxonomic groups	12 taxonomic groups	Better reflect recent delta smelt diet study results; Enable any number of prey types (12 max) to be specified by the user
Salinity and Water temperature input data	11 Box averages of measured data and interpolation	12 box averages or 521 channel averages from DSM2 simulation	Enable generating simulated data when there were no measured data
Spawning interval	14 days	30 days	Updated to reflect recent study results
Water temperature at first spawn	1-day water temperature >12 ^{o}C	4-day moving average water temperature >12 ^{o}C	Improves the simulated timing of spawning
Temperature dependent spawning	Uniform distribution of spawning temp from 12 to 20 ^{o}C for spawners	3 probability distributions available to assign temps for spawning from user-specified min (e.g.,12 ^{o}C) to user-specified max (e.g., 20 ^{o}C)	Updated to reflect recent delta smelt spawning temperature study results
Fecundity	Bennet 2005	Damon et al. 2016	Updated to reflect recent fecundity study on wild delta smelt

2013 DSIBM

- Rose, K.A., Kimmerer, W.J., Edwards, K.P. and Bennett, W.A., 2013. Individual-based modeling of delta smelt population dynamics in the upper San Francisco Estuary: I. Model description and baseline results. *Transactions of the American Fisheries Society*, *142*(5), pp.1238-1259.
- Rose, K.A., Kimmerer, W.J., Edwards, K.P. and Bennett, W.A., 2013. Individual-based modeling of Delta Smelt population dynamics in the upper San Francisco Estuary: II. Alternative baselines and good versus bad years. *Transactions of the American Fisheries Society*, *142*(5), pp.1260-1272.
- Kimmerer, W.J. and Rose, K.A., 2018. Individual-Based Modeling of Delta Smelt Population Dynamics in the Upper San Francisco Estuary III. Effects of Entrainment Mortality and Changes in Prey. *Transactions of the American Fisheries Society*, *147*(1), pp.223-243.

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