

Science Supporting Dissolved Oxygen Objectives for Suisun Marsh

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EXECUTIVE SUMMARY

At the request of the San Francisco Bay Regional Water Quality Control Board, the potential for deriving site-specific water quality criteria for dissolved oxygen (DO) in Suisun Bay and Marsh was evaluated. Fish and invertebrate species representative of Suisun Bay and Marsh were identified from the literature and screened against currently available data on sensitivity to low levels of DO (i.e., hypoxia). It was determined that sufficient data were available for either locally-occurring species or their genus or family level surrogates to calculate values for both the acute criterion minimum concentration (CMC) and chronic criterion continuous concentration (CCC) for DO using USEPA procedures for deriving water quality criteria. The CMC is designed to protect the survival of juvenile and adult organisms under short term exposure conditions, whereas the CCC is designed to protect organisms from adverse effects on survival, growth and reproduction related to long-term (i.e., indefinite) exposure. The calculated criteria varied, depending upon which species were included, with the most sensitive species being sturgeon and salmon. Based on analysis of the available data, the criteria are shown below:

Species Represented	CMC(Mg/L)	CCC (Mg/L)
General, without Sturgeon	3.0	4.8
General, with Sturgeon	3.3	5.0
General, with Sturgeon and Salmonids	3.3	6.2

These criteria were compared with a subset of DO data collected from Suisun Marsh (summer 2010) to evaluate the extent to which there might be potential for impairment. Based on these data, DO fell below 2 mg/L on several occasions, suggesting that there was potential for acute toxicity during these events. With respect to the potential for chronic effects, DO concentrations fell below 5 mg/L on a relatively frequent basis during June and July, suggesting that growth of sensitive species could be impaired. In addition to the CMC and CCC, USEPA procedures also allow for calculating the potential adverse effects of hypoxia on the survival of early life stages of fish and invertebrates. This approach is based on a Final Recruitment Concentration (FRC) that is intended to protect the strength of a given year class (i.e., not individuals) over an extended period that encompasses multiple spawning events. While the FRC was developed for the nearshore waters of the East Coast, the underlying model is based on DO response curves and biological data for 9 species that include 7 taxa that are either: 1) present in the Marsh as introduced species; or 2) represent genus or family-level surrogates of species that are present in the Marsh. Consequently, the model is relevant to Suisun Marsh. Notably, when the subset of DO data from Suisun Marsh (i.e., summer 2010) was evaluated against the FRC, the results suggested that there was potential for adverse effects on year-class strength. Overall, given that the example dataset represents very limited spatial and temporal coverage of the Marsh, the potential for adverse effects on survival, growth and recruitment suggests that the extent of exceedances should be evaluated on a broader scale. The

calculated criteria represent what should be acceptable concentrations with respect to protecting against adverse effects of hypoxia. However, it is acknowledged that there is limited representation of local species in the data set and it may be desirable to develop and include data from additional locally relevant species in the calculation. That being said, given the breadth of taxa represented in the calculations, it is not likely that additional species would significantly alter the criteria values determined. In terms of implementing the criteria, it would be desirable to develop an assessment protocol that specifies the temporal/spatial averaging and data density necessary to make a determination of "impairment". Policy decisions on DO objectives should also take into account naturally-occurring seasonal, diurnal or tidally-influenced periods of low DO, and guidance will be needed regarding the use of DO objectives in the context of assessment, TMDLs and NPDES-permitting decisions.

Full Text:

http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/830_SuisunBay_web.pdf