

PS/SS: Assessing the Impacts of Periodic Dredging on Benthic Habitat Quality

Estimated Cost: \$150,000 (\$50,000 RMP; \$100,000 from America's Cup)

Oversight Group: Exposure and Effects Work Group

Proposed by: The LTMS Agencies: USACE (Rob Lawrence), USEPA (Brian Ross), BCDC (Brenda Goeden) and SFBRWQCB (Beth Christian) and National Marine Fisheries Service (Korie Schaeffer)

Background

The benthic communities of the San Francisco Bay and Estuary are fundamental components of foraging habitat for many fish species. However, there is a lack of scientific information specific to the Bay Estuary about the degree of benthic community disruption caused by periodic maintenance dredging, about rates of benthic community recolonization and recovery following dredging, and about effects on fish foraging success or quality. For this reason it is difficult for the regulatory and resource agencies who manage dredging projects and fishery habitat to determine whether and when any actions to enhance or restore benthic communities following dredging may be necessary or warranted. The National Marine Fisheries Service and the LTMS agencies agreed that initial efforts to address this issue via a benthic disturbance study in Central San Francisco Bay was one of the highest priorities under the 2011 Programmatic Essential Fish Habitat Agreement.

Study Objective and Applicable RMP Management Question.

The objective of this effort is to assess the quality of benthic assemblages from a fish forage standpoint, in areas that are periodically dredged in Central San Francisco Bay compared to non-dredged areas. This study would address the following RMP management question (MQ):

MQ1. Are chemical concentrations (*or activities*) in the Estuary at levels of potential concern and are associated impacts likely?

- What potential for impacts on humans and aquatic life exists due to contaminants (*or activities*) in the Estuary ecosystem?

In specific, this study evaluates the impacts of dredging on aquatic life in the Estuary and will address the following question.

- Is the quality of benthic habitat for fish foraging lesser in areas that are dredged at a frequency of annually or once every 2-3 years than in areas that are undredged, as determined by the structure and function of the benthic invertebrate assemblage?

Approach

A phased study approach will be conducted, using a pilot study to inform the full study design. This proposal details the pilot study and larger study design. In the first phase, the senior project lead will oversee compilation and evaluation of information regarding fish feeding and benthic invertebrate assemblages in San Francisco from published literature and unpublished data. Included in the literature review would be a review of existing benthic assessments conducted in the Bay (e.g., RMP SQO and NOAA WEMAP assessments). Benthic assessment results for dredged and undisturbed sites would be reviewed and presented. Literature would be reviewed by the project lead with oversight from experts knowledgeable in study design, benthic ecology and statistical analysis. The focus of the literature review will address the following questions: *What are target fish eating in central San Francisco Bay? Are there seasonal differences in prey items and invertebrate assemblages? Yearly differences? Can invertebrate species be grouped into functional groups with regards to fish prey resources?* A list of relevant fish species is included in an Appendix A.

In the second phase, a field study will be designed to evaluate differences between treatment and control samples in terms of value of habitat for fish foraging (e.g., biomass, functional group). In addition, metrics will be developed for evaluating difference between treatment and control samples in terms of value of habitat for fish foraging (e.g., biomass, functional group). The field study and invertebrate metrics will be designed based on the literature review, and in consultation with a statistician such as Jim Carter (US Geological Survey, USGS) and benthic experts such as Jan Thompson and Francis Parchaso (USGS). The field study design will include sampling of multiple undredged and dredged sites within shallow (<12 ft MLLW) areas of Central San Francisco Bay. Dredged locations should be chosen based on frequency and last date of dredging. The LTMS agencies will provide guidance on appropriate dredged locations.

In the third phase, a pilot study will be implemented as part of the RMP sediment cruise or additional cruises in 2014. These pilot samples will be collected for initial identification of benthic communities, and to evaluate study design and sample size developed during phase two for a possible larger field study in the future. For example: *Do sample locations adequately characterize dredged and undredged conditions in Central San Francisco Bay? Does the study design include a large enough sample size to account for variability of the invertebrate community and allow for adequate statistical power of analyses?* Samples will be sorted by RMP laboratories (such as Moss Landing Marine Labs) to assure consistency with RMP benthic work. The assemblage assessments from each site will be evaluated using a rigorous statistical analysis. The project lead will write the draft report, which will be circulated among LTMS and NOAA Fisheries staff for review and comment. The project lead will finalize the report.

Agencies and project lead would pursue additional funding to complete a larger field study in the future, based on findings in the project report.

Budget

Approximately a third of the funding for this project is requested from the RMP (\$50,000); the remaining portion will be leveraged from funds available from Corps (via Port of San Francisco America's cup permit) (\$100,000).

Literature review	
Study design including statistical design	
Fieldwork and benthic assessments	
Data formatting and analysis	\$
Draft report	\$
Final report	\$
Total	\$150,000

Appendix A

Fish species of concern for this study include those managed by a federal Fishery Management Plan (FMP) pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (e.g., Pacific Groundfish FMP, Coastal Pelagic FMP, and Pacific Salmon FMP) or those listed under either the federal Endangered Species Act or California Endangered Species Act, and that frequent San Francisco Bay and are benthic feeders. Specifically:

- Leopard Shark (*Triakis semifasciata*)
- Big Skate (*Raja binoculata*)
- English Sole (*Parophrys vetulus*)
- Starry Flounder (*Platichthys stellatus*)
- Brown Rockfish (*Sebastes auriculatus*)
- Green sturgeon (*Acipenser medirostris*)
- Northern Anchovy (*Engraulis mordax*)
- Longfin Smelt (*Spirinchus thaleichthys*)
- Pacific Sardine (*Sardinops sagax*)

Also of interest, due to contributions to state fisheries:

- Dungeness crab (*Cancer magister*)
- California halibut (*Paralichthys californicus*)
- White sturgeon (*Acipenser transmontanus*)

There may be additional species that feed on benthic invertebrates and are prey to those species listed above (e.g., gobies?).