

DSM TN 29. Water volumes of the San Francisco Estuary in Areas Occupied by Delta Smelt

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Overview

This document describes the bathymetry of the portion of the San Francisco Estuary (SFE) where delta smelt (*Hypomesus transpacificus*) reside and related habitat volume. Bathymetric values were obtained from the updated San Francisco Bay-Delta bathymetric/topographic digital elevation model (DEM), a joint project of the U.S. Geological Survey and the California Department of Water Resources (<https://pubs.er.usgs.gov/publication/70184184>). This DEM provides depth values at a 10m² resolution in the NAVD88 datum, and all calculations herein will be in this datum.

Water areas and volumes of the SFE occupied by delta smelt are based on all contiguous water using a surface elevation referenced to the mean mean tide level (MTL) at Antioch using a value of 1.25m, and a mean ebb tide level of 0.82m (Fig. 1). Areas of contiguous water “footprints” were identified using ArcGIS approaches. To achieve specificity in discussion about habitat characteristics useful for delta smelt science and management, the delta has been stratified in two ways: spatially and by depth characteristic.

Spatial stratification- The spatial stratification divides the delta into 4 regions. A further partitioning created 33 subregions related to the Enhanced Delta Smelt Monitoring (EDSM) program (Fig. 2), and 31 subregions related to the Delta Smelt Life Cycle Model (DSLCLM) work and abundance index construction based on non-EDSM surveys (Fig. 3).

Depth stratification- The depth stratification partitions the delta based on different depth ranges (Table 1)¹. Figure 4 illustrates the how the different depth stratifications are defined when calculating stratum specific water volumes with respect to the total amount of water overall, or by region or subregion.

A set of accompanying files include

1. A text file describing the GIS procedure for identifying contiguous water, delineating boundaries of water meeting the different depth characteristics, and calculating associated water volumes.
2. A set of folders containing ArcGIS shapefile information providing the boundaries of the water areas with different depth class characteristics.
3. A set of folders containing ArcGIS shapefile information with the region and subregion boundaries.
4. Files with the volume and area information by subregion and depth stratum with reference to the MMTL and the METL at Antioch. Water volume calculations for the DSLCLM and abundance indices based on non-EDSM surveys combined the very shallow and shallow depth categories into a single depth stratum.
5. R code file for summarizing the water volume per stratum as percentages of total water volume.

¹The California Department of Fish and Wildlife has described shallow water areas, with particular reference to the delta and delta smelt, as those no deeper than 4m (Aasen 1999). The Inland Fishes of California (2002) by Peter Moyle describes shallow habitats as less than 3m deep (page 228), and Cowardin et al. (1979) classify shallow wetland habitat as areas less than 2m deep below low water (page 4).

Table 1: Depth ranges for each of the depth classes that the Delta was partitioned into. Classifications 1 and 2 are related to sampling designs of early Enhanced Delta Smelt Monitoring (EDSM) sampling efforts, while classification 3 combines conventional characterizations of estuaries and current sampling capacities, i.e. the shallowest depths that different surveys can sample in.

Depth classification	Depth range
Category 1	
Shallow	0 to 1.7m deep
Deep	Deeper than 1.7m
Category 2	
Shallow	0 to 2.4m deep
Deep	Deeper than 2.4m
Category 3	
Very shallow	0 to 1.2m deep
Shallow	Deeper than 1.2m down to 2m deep
Intermediate	Deeper than 2m down to 4m deep
Deep	Deeper than 4m down to 10m deep
Very deep	Deeper than 10m

Remarks and caveates

- MTL, MLW and MHW are values based on averages over multiple tidal cycles and are “local” tidal datums. Thus they can vary by location in the estuary, what types of tides (e.g. spring vs. neap) are used in the averaging, environmental conditions (e.g. bathymetric pressure and surface wind), how water flows in the delta are being managed (e.g. if the Delta Cross Channel is open or closed or if drought barriers are in place or not), and, for locations in the upper river channels, what amounts of outflow are occurring. Applying values from the Antioch location to different locations in the delta and irrespective of time specific conditions will incur various amounts of error. Note also that Discovery Bay has been omitted from the updated DEM compared with the DEM used in the 2012 water area and volume calculations.
- Rather than using a geographic and depth emphasis when spatially stratifying the delta, a habitat based one may be preferable (possibly nested within the spatial strata identified here). For example, rather than identifying areas of shallow water, it may be preferable to identify areas by habitat features such as how vegetated the bottom of the water column is, the influence of tides, or other species specific salient features.

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References

Aasen, Geir A. 1999. Juvenile delta smelt use of shallow-water and channel habitats in California’s Sacramento-San Joaquin Estuary. California Fish and Game 85(4):161-169.

Cowardin, Lewis M., Virginia Carter, Frances C. Golet, and Edward T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. National Oceanographic and Atmospheric Administration Office of Coastal Zone Management. Washington, D.C.

Moyle, Peter. 2002 The Inland Fishes of California. University of California Press. Berkeley, CA.

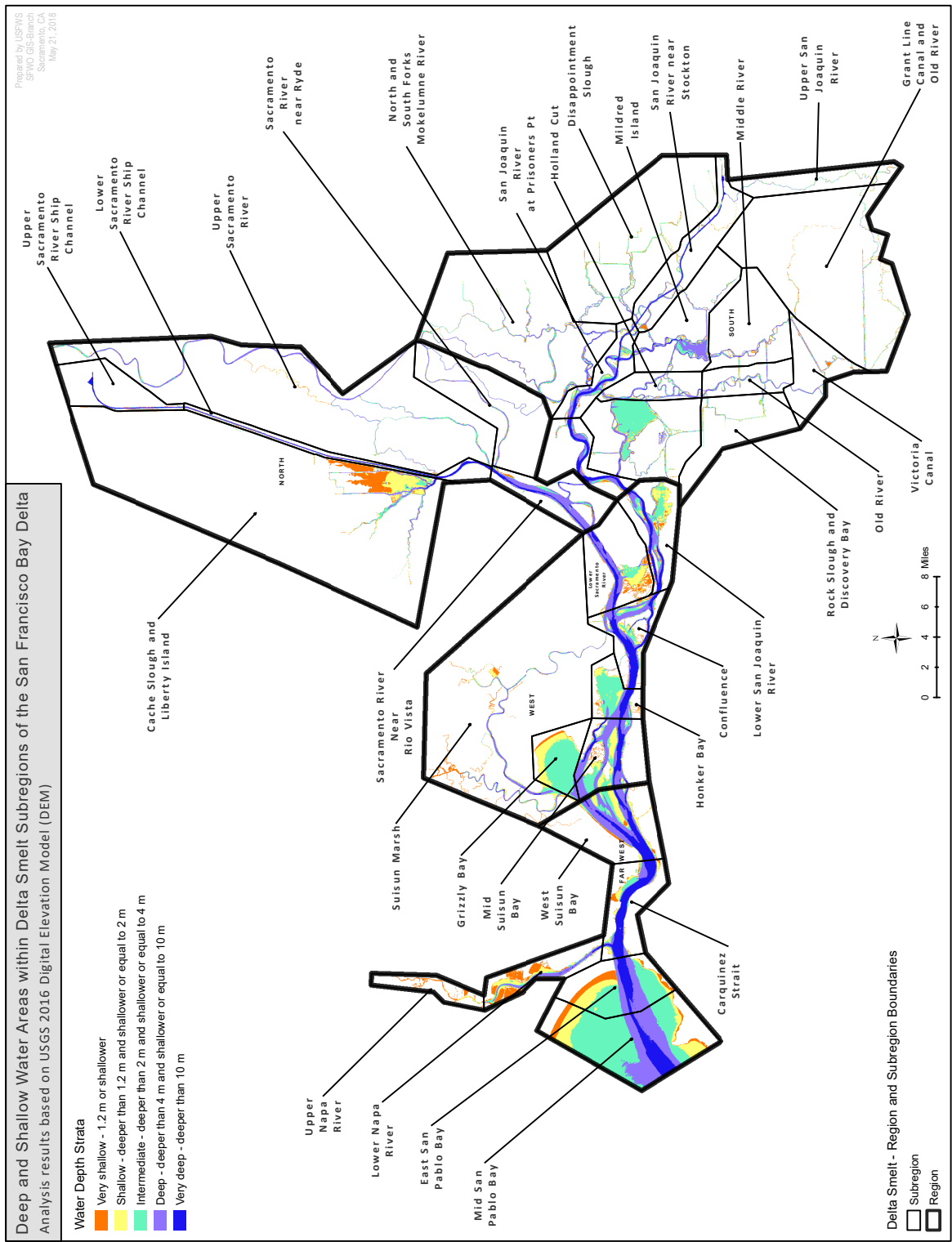


Figure 2: Region (thick lines), subregions (thin lines) with Delta water colored according to depth using the category 3 vertical depth stratum definitions.

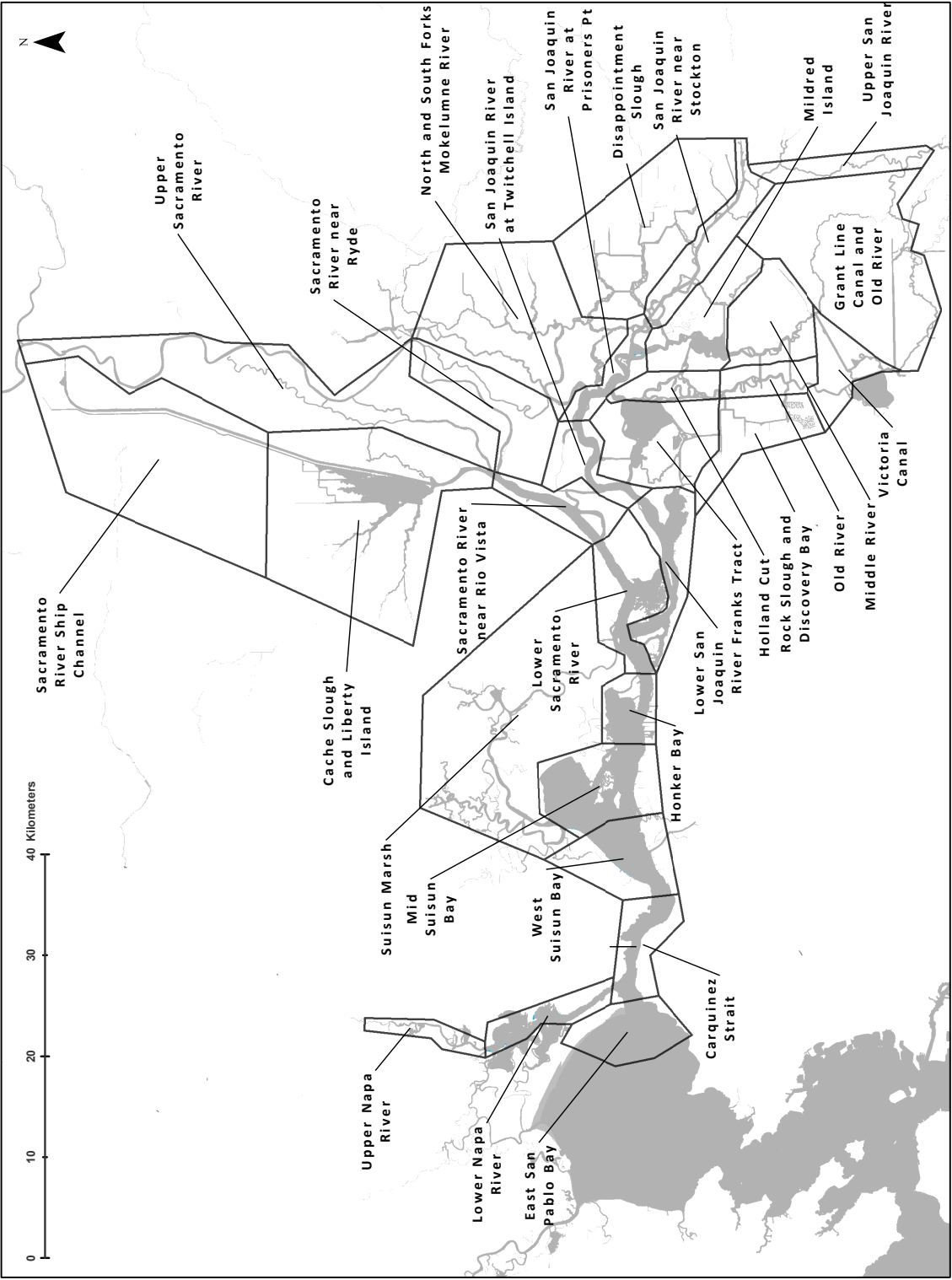


Figure 3: Subregion boundaries used for summarizing water volumes for DSLCM and non-EDSM survey indice construction.

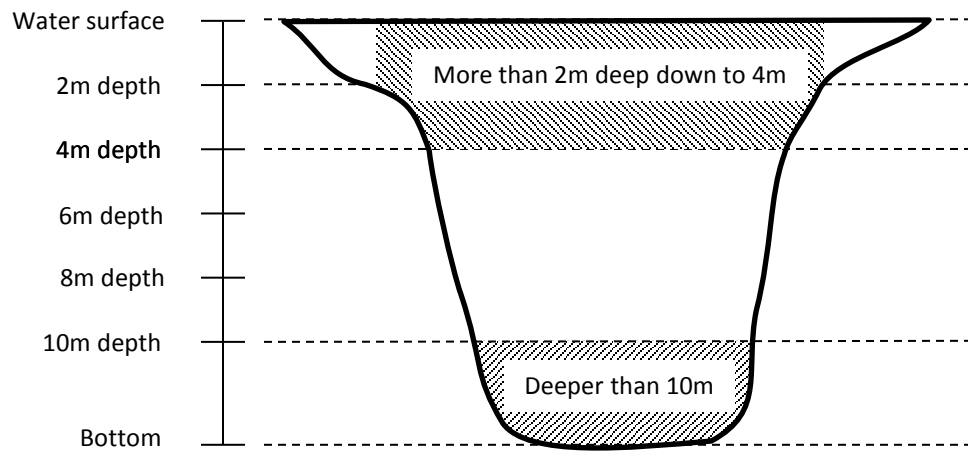


Figure 4: Sketch of two different area and depth strata. The top shaded area illustrates the portion of the water column deeper than 2m down to 4m deep, and the bottom shaded area illustrates the portion of the water column deeper than 10m down to the bottom.