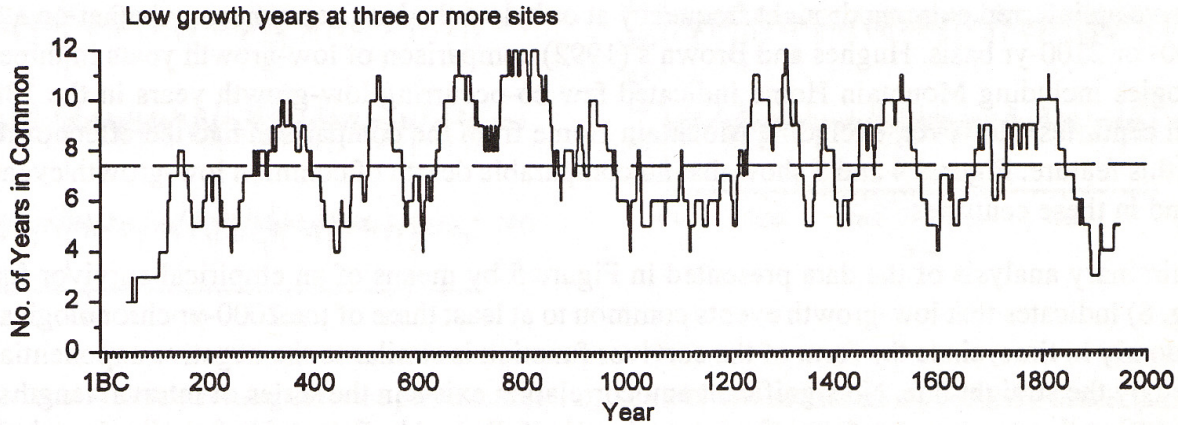

Figure S-1. Hundred-year counts of short, sharp droughts in the western Sierra Nevada, from analyses of giant sequoia tree-ring chronologies; provided by Professor Malcolm Hughes, Laboratory for Tree-Ring Research, University of Arizona, Tucson. Notice that the 20th Century has had fewer such droughts than any time in the past 2000 years.

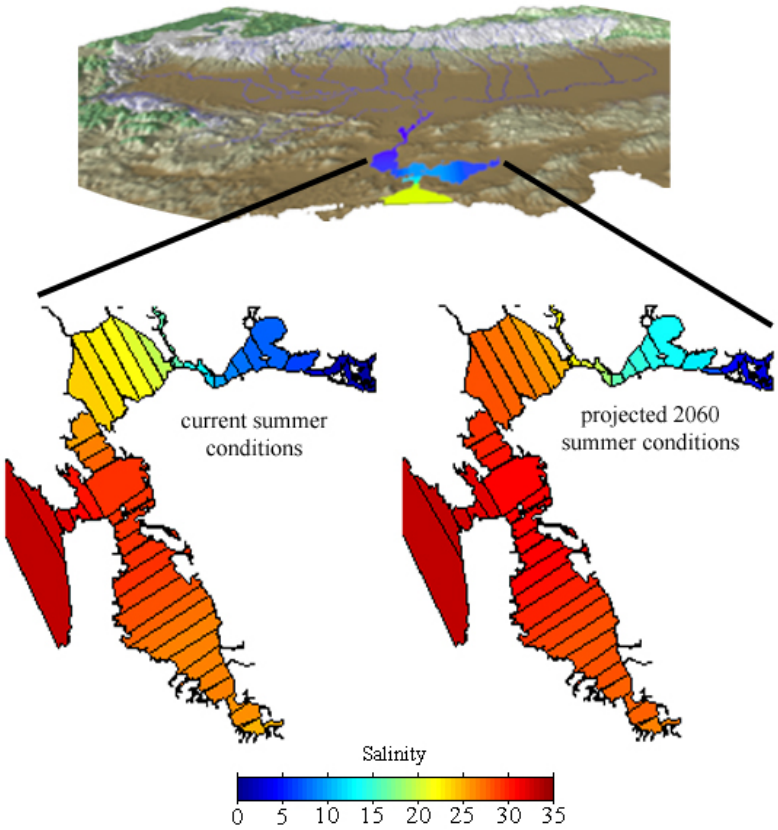

Figure S-2. Projected summer (June-August) salinity field shift for wet water-year types. The summer salinity field for wet years is projected to shift ~15 km upstream due to reduced spring-summer snowmelt runoff (see Figure 4 in the main proposal). The reduced spring-summer runoff resulting from a diminished snowpack allows seawater to intrude farther up-estuary. The salinity fields shown are for wet water-year types, in which salinity variability is the largest and the summer salt field shifts about 15 km upstream under the warmed conditions. Dry-season salinities are also projected to rise, resulting in an overall increase in the threat of adverse ecosystem impacts and degraded quality of drinking water.

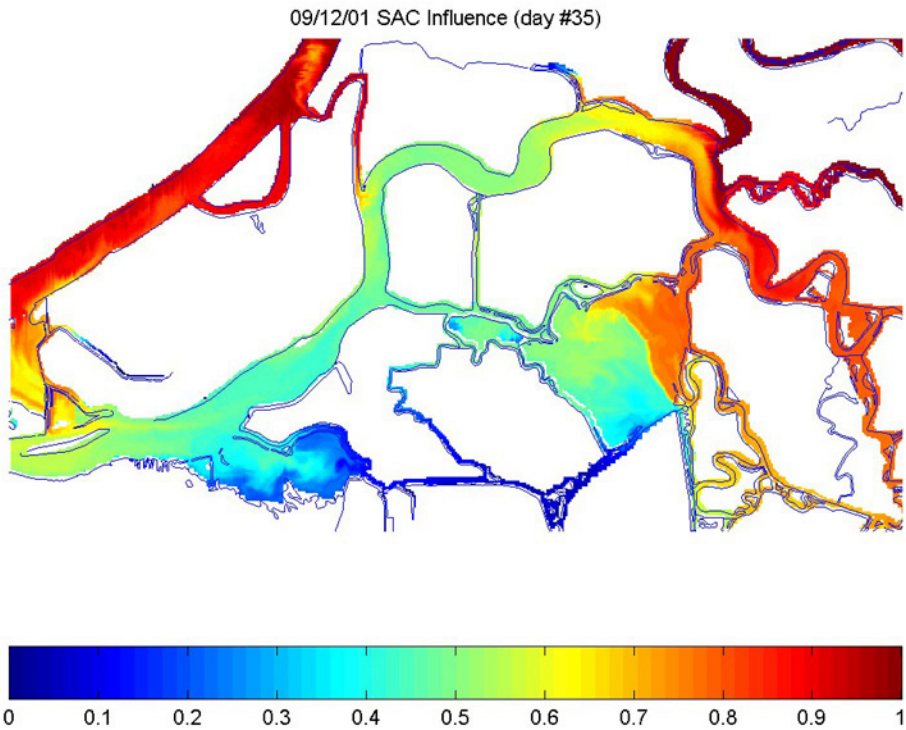

Figure S-3. Example illustrating an application of Delta TRIM to compute spatial variability of water quality in the Delta interior. In this example, color represents the proportion of water at each computational node that originated from the Sacramento River. Delta TRIM can resolve the complex two-dimensional spatial gradients characteristic of the hydrodynamically complex Delta system.

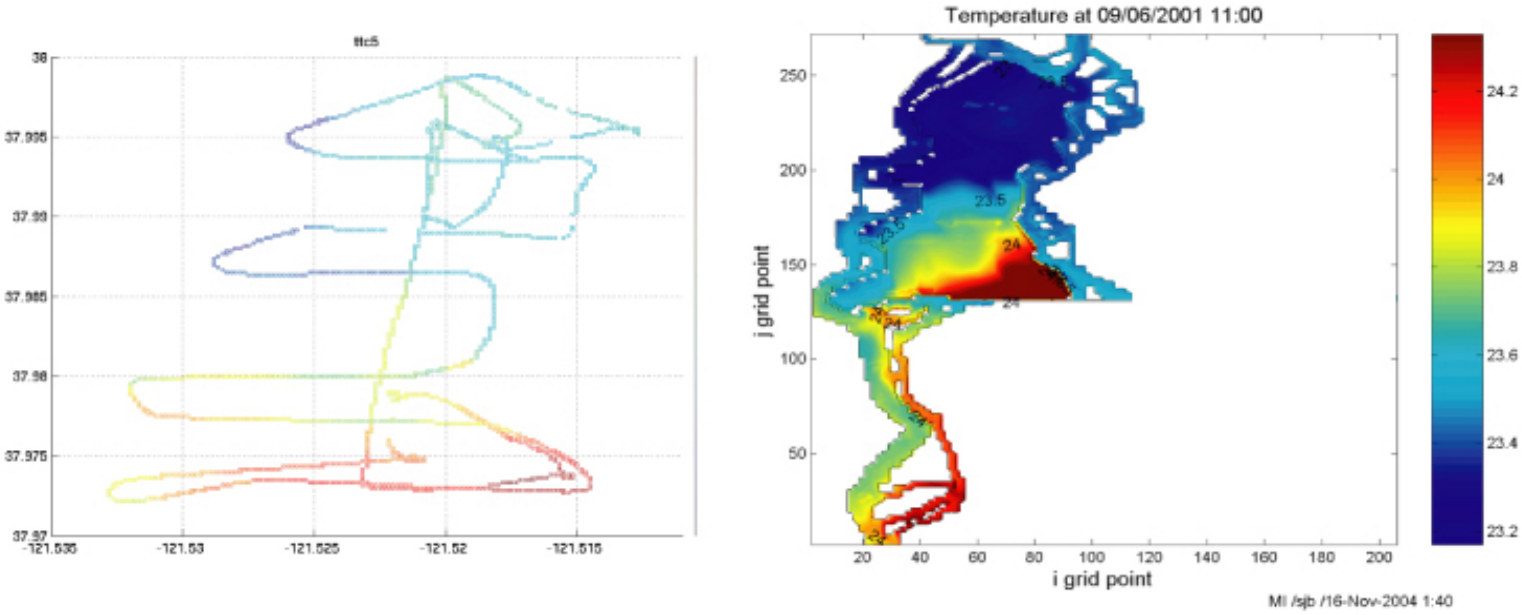

Figure S-4. Comparison of measured and modeled temperatures in Mildred Island on September 6, 2001. **Left**) Measured surface temperature. **Right**) Temperature model surface temperature results. Modeling and figures by Seungjin Baek, UC Berkeley.

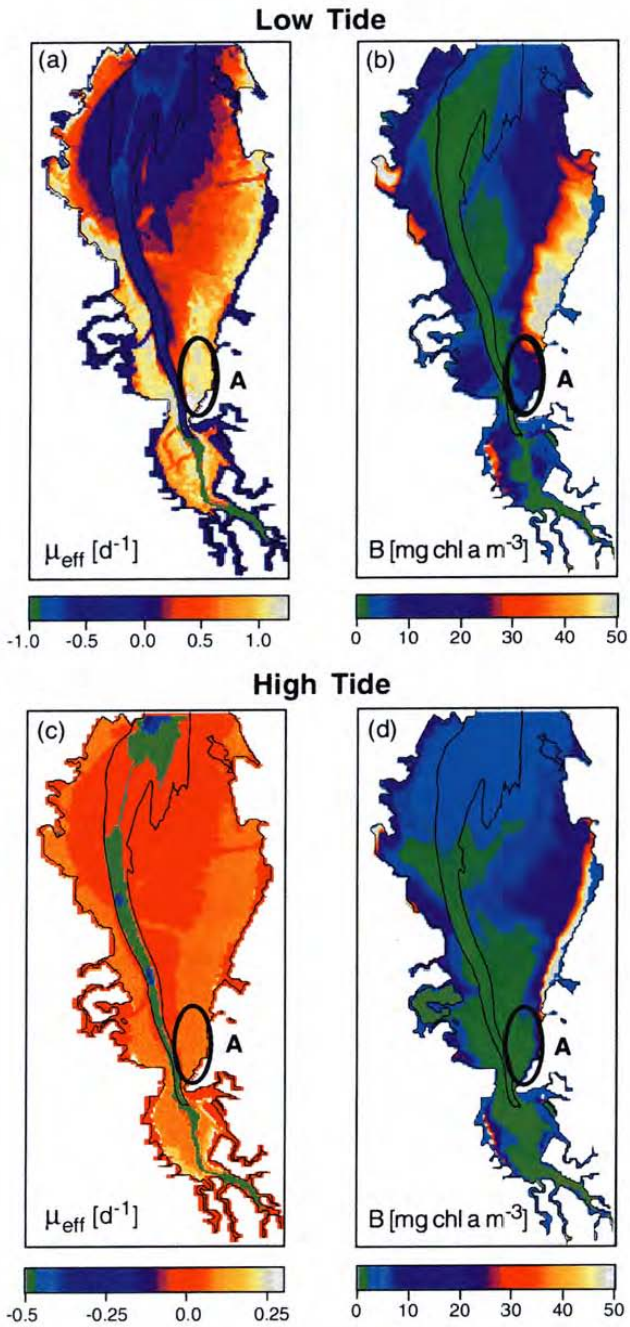

Figure S-5. Results from TRIM-BIO coupled hydrodynamic-phytoplankton model for a case where short residence time in a high-growth shoal region (circled) results in low phytoplankton biomass (Lucas et al. 1999b). Shown are: **(a)** phytoplankton effective growth rate, **(b)** phytoplankton biomass at low tide, **(c)** effective growth rate and **(d)** biomass at high tide. Associated simulations of passive particles demonstrated that particles initiated in the southeast shoal experience strong northward residual transport along the eastern shore.

Delta Modeling Inputs/Outputs

	Required Data	Source Historical Runs	Climate / Freshwater Demand Change runs	Physical Change/Earthquake runs	Output
Delta TRIM	Boundary stage @ Martinez	observed data at Martinez	predicted tides/UP model	observed data at Martinez for historical period	stage(x,y, t)
	Boundary flow-Sacramento R.	observed data at Freeport/or I street bridge	hydrologic model	observed data at Freeport/or I street bridge for historical period	velocity (speed/direction) (x,y,z,t)
	Boundary flow-San Joaquin R.	observed data at Vernalis	hydrologic model	observed data at Vernalis for historical period	salinity(x,y,z,t)
Model basics:					Residence time
40 sec timestep	Boundary salinity @ Martinez	observed data at Martinez	Uncles-Peterson model	observed data at Martinez for historical period	X2
50 m spatial resolution	Boundary salinity-Sacramento	observed data at Freeport/I street bridge	hydrologic model	observed data at Freeport/or I street bridge for historical period	water source composition
	Boundary salinity-San Joaquin	observed data at Vernalis	hydrologic model	observed data at Vernalis for historical period	cross-sectional flow
	Bathymetry	Base bathymetry: year 2003	Base bathymetry: year 2003	structural changes: Delta Regional Ecosystem Rest. Implem. Plan earthquake scenario: CALFED Levee System Integrity Program Plan	
	Gates/Barriers	historical operation	historical operation	historical operation	
	pump operation	historical operation	historical operation	historical operation	
	agricultural diversions/returns	historical operation	historical operation	historical operation	
Temperature Modeling	Temperature: Sacramento BC	historical data	hydrologic model	hydrologic model	temperature (x,y,z,t)
	Temperature: San Joaquin BC	historical data	hydrologic model	hydrologic model	
	Temperature: Martinez	historical data	GCM outputs projected onto historical temp data	GCM coupled with historical temperature profiles up SFBay	
	Turbulence closure (Kz)	Mellor-Yamada 2.5 turbulence in Delta TRIM	Mellor-Yamada 2.5 turbulence in Delta TRIM	Mellor-Yamada 2.5 turbulence in Delta TRIM	
	u(x,y,z,t)	Delta TRIM	Delta TRIM	Delta TRIM	
	Tair	historical data	GCM models	GCM models	
	Wind speed (U10)	historical data	GCM models	GCM models	
	Solar radiation (Qs)	historical data	GCM models	GCM models	
Phytoplankton Modeling	u(x,y,z,t)	Delta TRIM	Delta TRIM	Delta TRIM	phytoplankton biomass B(x,y,z,t)
	Turbulence closure (Kz)	Mellor-Yamada 2.5 turbulence in Delta TRIM	Mellor-Yamada 2.5 turbulence in Delta TRIM	Mellor-Yamada 2.5 turbulence in Delta TRIM	interpretation of what the B values means
	depth (H)	Delta TRIM bathymetry grid: year 2003	Delta TRIM bathymetry grid: year 2003	Delta TRIM bathymetry grid:structural changes/earthquake changes	
	water temperture Tw(w,y,z,t)	temperature model	temperature model	temperature model	
	Solar irradiation (PAR)	observed data	GCM	observed data	
	Light attenuation coefficients	observed data	Schollehamer work derive from SSC (suspended sediment conc)	Schollehamer work derive from SSC (suspended sediment concentration)	mass balance: how much exported to the Bay, grown, grazed in water column, and benthos
	Benthic grazing	field measurements (Jan Thompson)	field measurements (Jan Thompson)	field measurements and results from Benthic Section of Proposal	does primary productivity increase or decrease?
	Zooplankton grazing	field measurements (Lopez et al.)	field measurements (Lopez et al.)	field measurements (Lopez et al.)	
	Nutrients	assume replete	assume remains replete	assume remains replete	

Figure S-6. Summary of required inputs for Delta TRIM, Temperature Module and TRIM-BIO

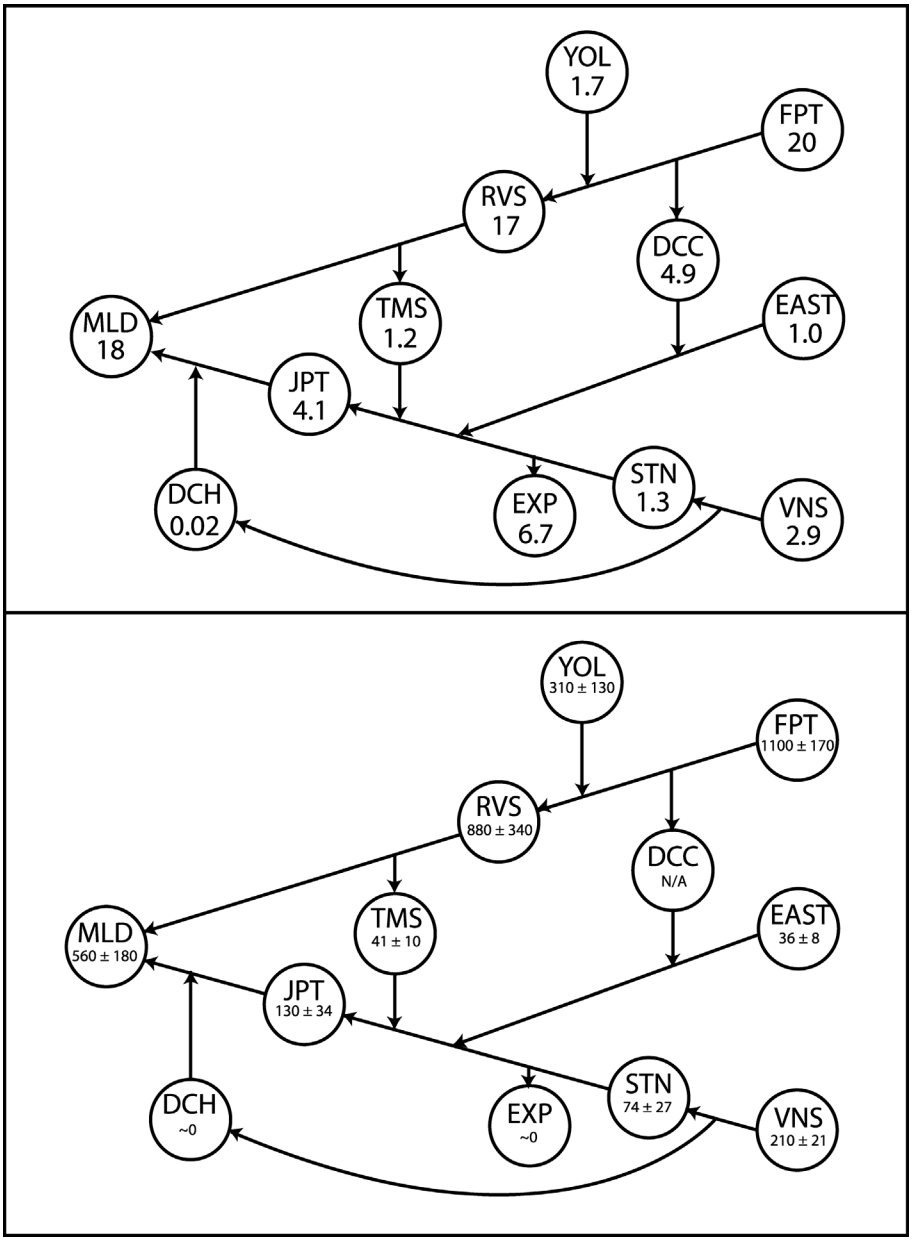

Figure S-7. Average annual Delta water (**upper**) and sediment (**lower**) budgets based on water years 1999 – 2002, except for Threemile Slough (TMS) which is based on water years 2001 and 2002 only. Annual water flux is in billion m^3 and the annual suspended-sediment flux and the estimated error are in thousand metric tons. Locations are Delta Cross Channel and Georgiana Slough (DCC), Dutch Slough (DCH), Eastside tributaries (EAST), Delta exports (EXP), Freeport (FPT), Jersey Point (JPT), Mallard Island (MAL), Rio Vista (RVS), Stockton (STN), Vernalis (VNS), and Yolo Bypass (YOL) (Wright and Schoellhamer, submitted).

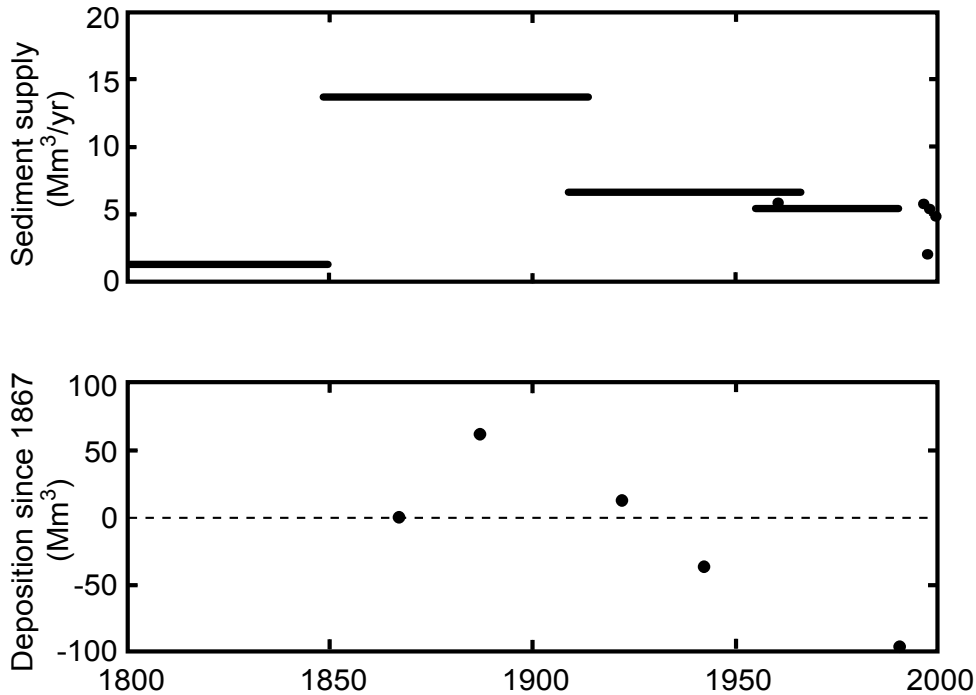

Figure S-8. **Upper:** Sediment supply to the San Francisco Bay-Delta system (Gilbert, 1917; Porterfield, 1980; Krone, 1979; OBA, 1992; Mckee et al., 2002). **Lower:** Deposition in Suisun Bay (Capiella, 1999). Sediment supply peaked during hydraulic mining in the late 1800's, and deposition in Suisun Bay greatly increased as a result. Reduced supply in post-mining years led to the erosion of deposits, and a corresponding loss of sediment in Suisun Bay. Climatic and land use changes over the next century may affect sediment supply; long-term trends of sediment supply and redistribution will control marsh accretion, mudflat stability, and channel configurations.

Figure References

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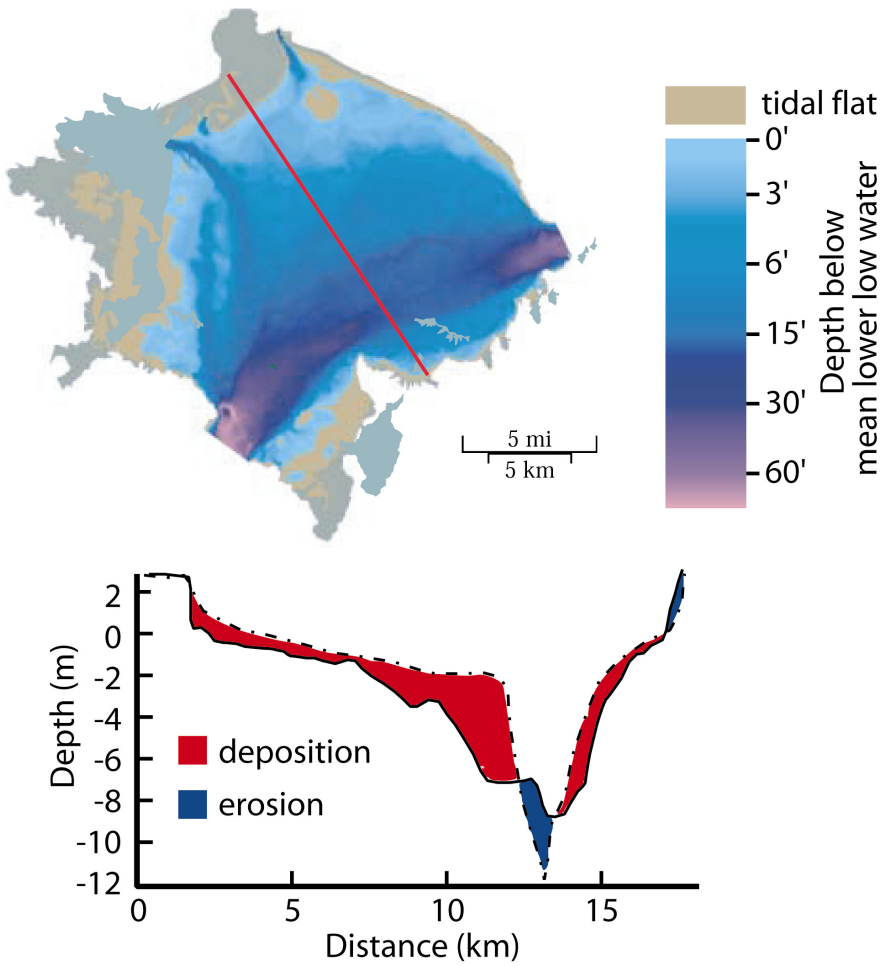

Figure S-9. Bathymetry of San Pablo Bay in 1856 (**upper**), and cross-section of bathymetric change from 1856 – 1983 (**lower**). Cross-section spans from marsh to mudflat to channel; deposition occurred in mudflats and channel-adjacent areas, but the channel deepened substantially (Jaffe et al., 1998). These changes are due to sediment supply, redistribution, and export. Changes in long-term supply will modulate distributions of marsh, mudflat and channel, and therefore affect habitat availability for endemic species.

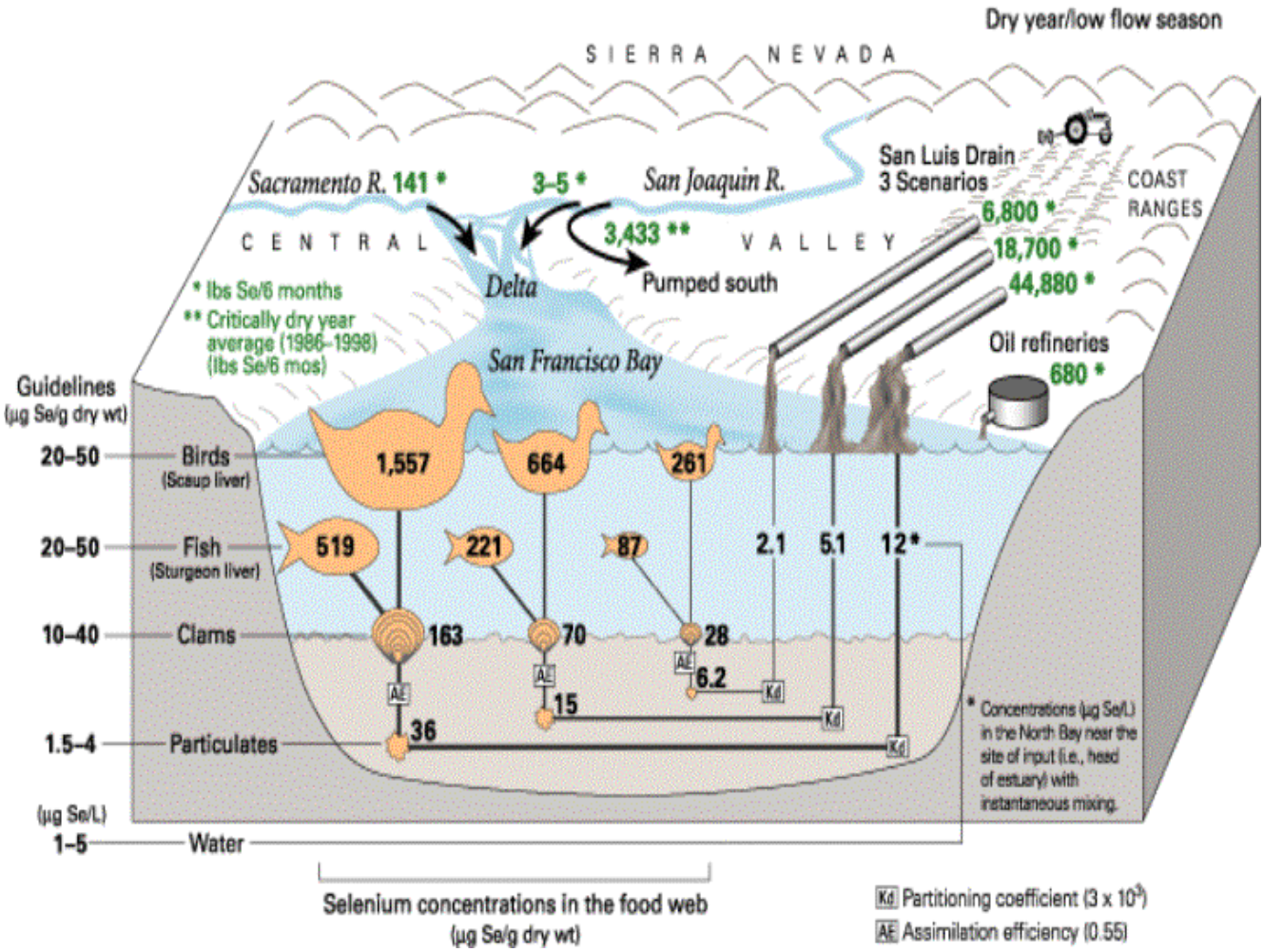

Figure S-10. Fate of selenium in San Francisco Bay under 3 loading scenarios from a hypothetical San Luis Drain. Forecasts of partitioning and concentration in water, sediment, invertebrates, and predators were developed from model calculations based upon existing conditions in the Bay.

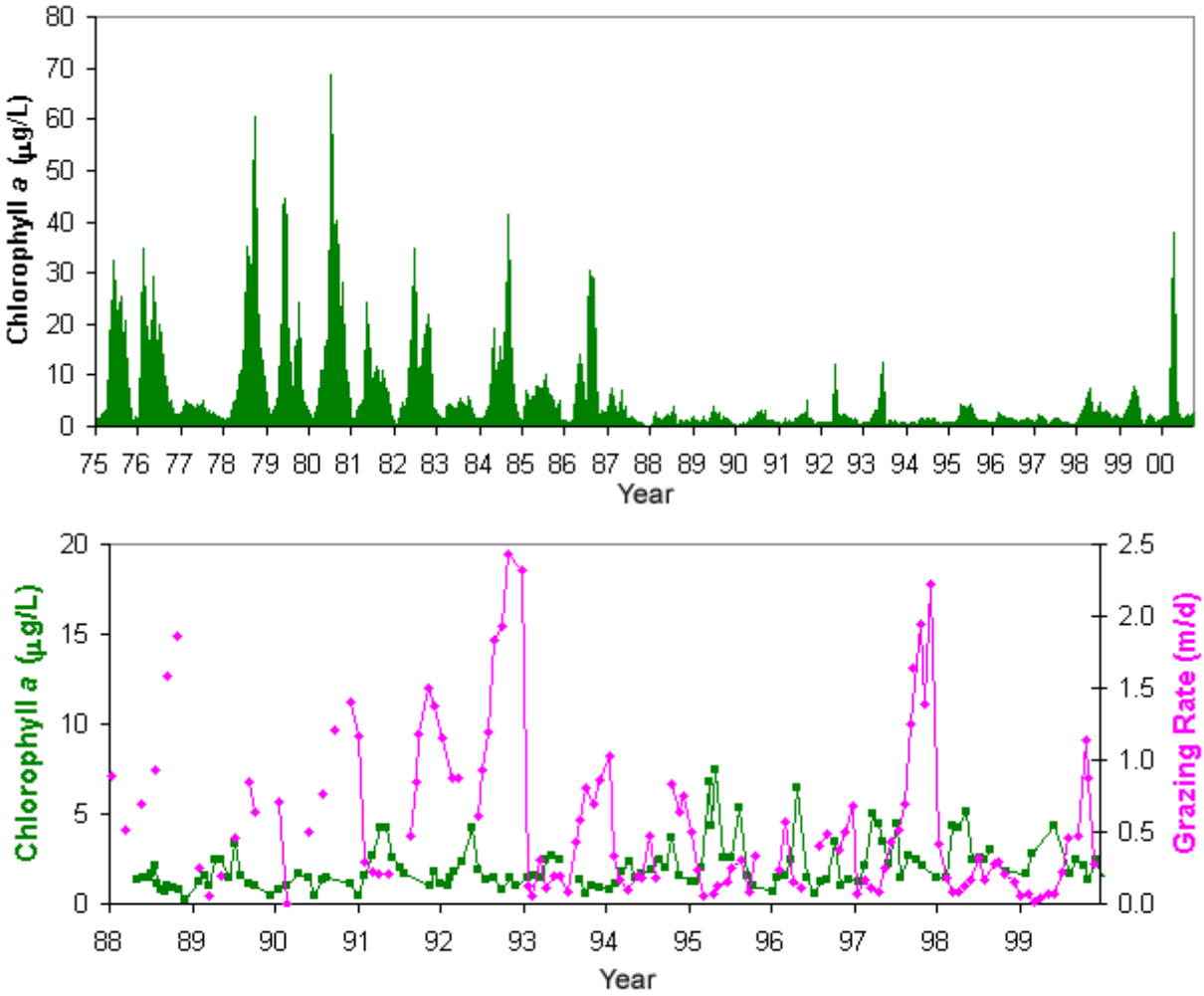

Figure S-11. **Top:** Phytoplankton biomass from 1975 through 2000 showing elimination of phytoplankton blooms from Suisun Bay, beginning in 1987. **Bottom:** Grazing rates of *P. amurensis* and concurrent chlorophyll *a* concentrations in Grizzly Bay showing small blooms occurring only during periods when grazing rates are low.

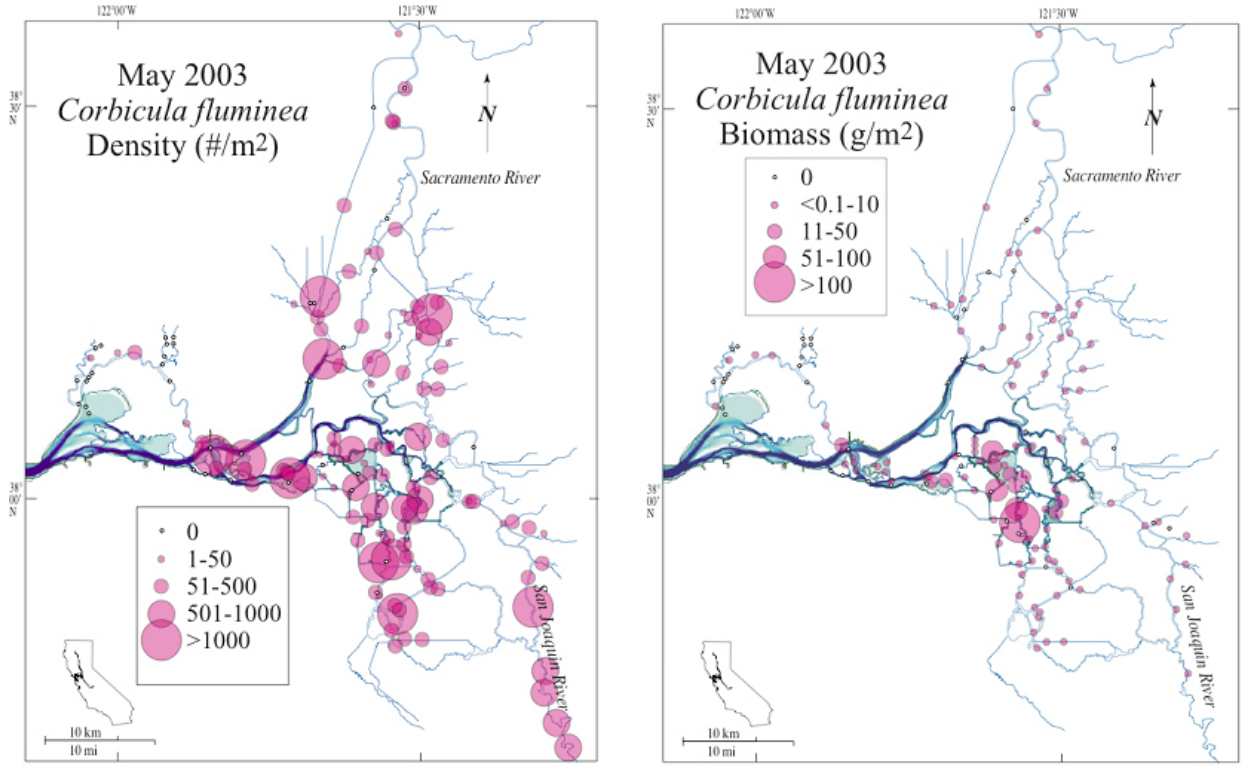

Figure S-12. Corbicula is widely distributed in the SFBD but as seen in the second panel the biomass of the animals is low in much of the system. Subsequent samples in October 2003 confirmed these findings, showing that mature individuals of *Corbicula* occur only in the central and SW delta. Preliminary hypothesis for this distribution pattern is that *Corbicula's* metabolic rate is sufficiently low during maximum outflow that adult animals are not retained in the areas with fast-moving currents.