What is the Estuary’s Pulse?

Bruce Herbold USEPA
Freshwater Flow ($m^3/s$)

Day of Water Year

Dry Years

Wet Years

Wet Years:
- 1983
- 1977
- 1998
- 1991
- 1995
- 1992
- 1982
- 1990
- 1958
- 1994
- (1997)

Dry Years:
- 1982
- 1990
- 1958
- 1994
- (1997)
Most fishes follow salinities

Cumulative Percent

Salinity

Delta smelt
Shiner perch
Thr. shad
Am. shad
Striped bass
Chinook salmon
YF goby
Starry flounder
Longfin smelt
Staghorn sculpin
Splittail
Marine species

Kimmerer 2004
What chemically changes?

Nutrients
Contaminants
Organic matter
Sediment

Loadings
Concentrations
& Residence Times

FLOW
FISH ABUNDANCE

TOP-DOWN

LOSS

PARENTS

Prior Fish Abundance

FISH ABUNDANCE

FOOD

BOTTOM-UP

PHYSICAL & CHEMICAL FISH HABITAT

HOME
FISH ABUNDANCE

PHYSICAL & CHEMICAL FISH HABITAT

Temperature
Turbidity
Salinity
Nutrients
Contaminants
Disease
Toxic algae
Monthly Ammonia Loads in the Sacramento River at Hood and in Effluent from the Sacramento Regional WWTP

Sources: A. Mueller-Solger, DWR; A. Jassby, in press SFEWS
Widespread, sporadic blooms of *Microcystis*

August 2007 Levels: 1.3 million cells/mL

*Microcystis* grows well on ammonia! (Diatoms don’t)

Core Habitat of Delta Smelt

Source: Peggy Lehman (DWR)
Diatoms
Pelagic fish
Natives thrive
Resists invasions

Clams
Jellyfish
Edge & benthic fish
Microcystis
Aquatic Weeds

Little    Ammonia    Lots
Low      Contaminants    High
Highly variable    Flow    Low and Constant
Low    “Harvest”    High
Lots    Phosphorus    Limited
Cool    Temperature    Warm
High    Turbidity    Low
X2 and the SF Bay Delta Estuary

DeLio (2011) adapted from Jassby et al. (1995)
X2 and the Low Salinity Zone

Source of X2 maps is Delta Modeling Associates
Geometry, habitat, and flows have changed.
Monthly Unimpaired X2 (km)

Courtesy of Dr. Anke Mueller-Solger, Using Jassby et al. 1995 Monthly Equation

Westward LSZ:
Mar-May 42-80 km

Eastward LSZ: Aug-Oct 62-92 km

Unimpaired (Monthly Median 1921-2003)
Daily X2 (km) After Channelization 1930-1944

Unimpaired (Monthly Median 1921-2003)
Daily X2 (km) After Dams 1951-1967

Unimpaired (Monthly Median 1921-2003)
Daily X2 (km) Substantial Delta Diversions 1978-1999

Unimpaired (Monthly Median 1921-2003)
Daily X2 (km) After D-1641, 2000 and POD
Before Shasta Dam (1930-1944)

Before SWP Exports (1951-1967)

Substantial Delta Diversions (1978-1999)

After D-1641, 2000, & POD
FLaSH
BIG Disclaimer:

Many graphs and data and their interpretation in this presentation are PRELIMINARY and subject to change!!!

Many thanks to everyone who provided data and graphs – all errors in display and interpretation are mine, not theirs.

Results are PRELIMINARY & subject to change!
Average Fall Outflow (cfs)

- W
- AN
- BN
- D
- C

Sep-Oct 2011
Some Fish Abundance Indices Improved in 2011

**Delta Smelt**

ESA Listed since 1993

Highest since 2001

Graphs: DFG

Results are PRELIMINARY & subject to change!

**Longfin Smelt**

CESA Listed since 2009

2012: ESA Candidate Species

Highest since 2006
Delta smelt indices increased throughout 2011

**Spring: Larval Delta Smelt Index (20 mm)**

- Highest since 2006

**Summer: Juvenile Delta Smelt Index (TNS)**

- Highest since 2004

**Fall: Subadult Delta Smelt Index (FMWT)**

- Highest since 2001

Results are PRELIMINARY & subject to change!
Was the fall 2011 phytoplankton bloom unusual?

Fall Blooms common in Suisun/West Delta before 1987

Data: EMP, USGS-Polaris, DFG “NZ”, Graph: A. Mueller-Solger, DSC

Results are PRELIMINARY & subject to change!
Was the fall 2011 phytoplankton bloom unusual?

Fall blooms only west of Carquinez, except 2011

“Depression” Date

Fall Blooms common in Suisun/West Delta before 1987

Results are PRELIMINARY & subject to change.
Zooplankton Biomass (2)

High total zooplankton biomass in LSZ in fall 2011

Results are PRELIMINARY & subject to change!

Data: IEP EMP
Graph: A. Hennessy, DFG
Delta smelt grew well in 2011

Data and Graphs:
J. Hobbs, UC Davis

Results are PRELIMINARY & subject to change!
Results are PRELIMINARY & subject to change!
How much water do fish need?