Methylmercury TMDL & Implementation Plan for the Sacramento-San Joaquin River Delta Estuary

2006 National Monitoring Conference

Michelle Wood

Outline

- TMDL Primer
- Why a MeHg TMDL?
- The Delta MeHg TMDL

Federal Clean Water Act Section 303(d)

Requires Total Maximum Daily Loads for waterways that don’t meet WQ standards even after controlling point sources

Definition of TMDL:

The amount of a pollutant that a water body can receive and still meet water quality standards (assimilative capacity)

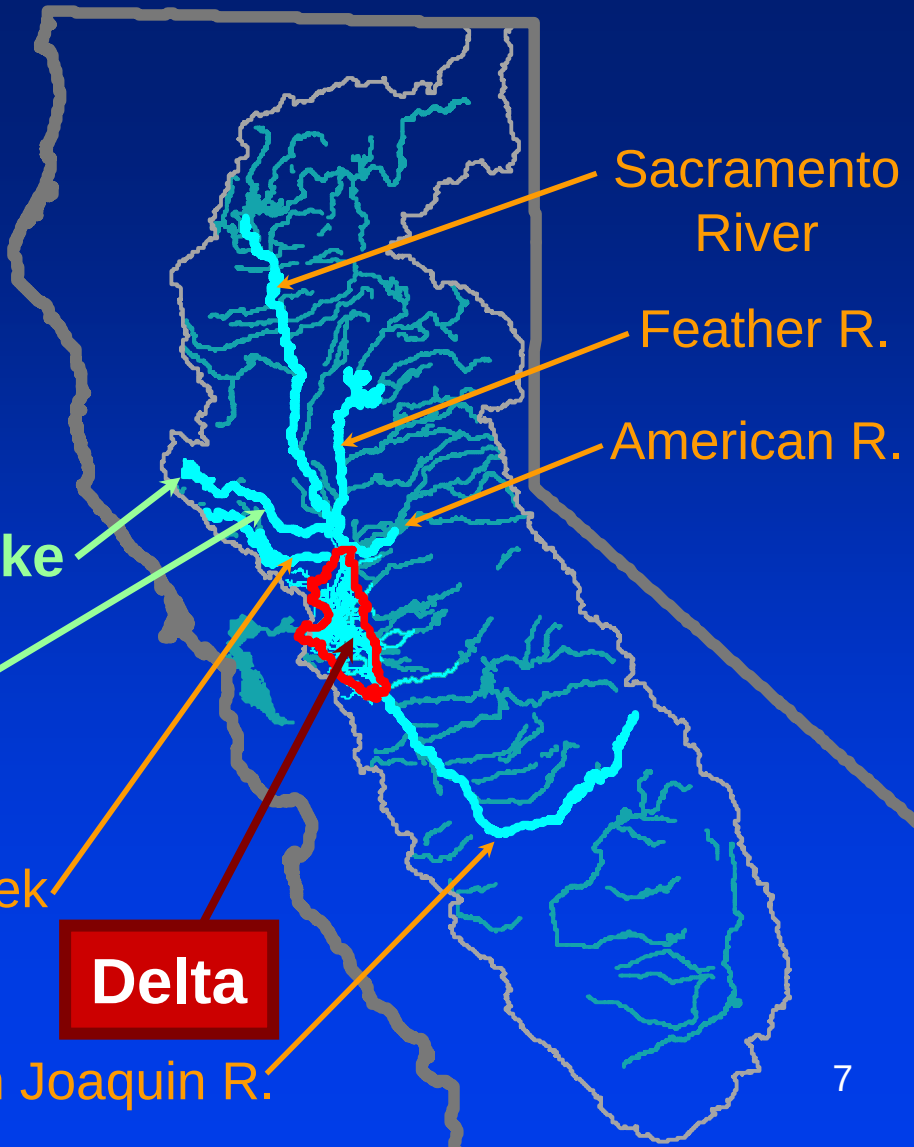
TMDL Elements

- Problem statement
- Numeric target
- Source analysis
- Linkage analysis
- Allocations

A TMDL Without Implementation: Ghost Regulation

- State Porter-Cologne Water Quality Control Act
  - Requires Regional Boards to implement TMDLs
  - TMDL implementation plans are amended into State water quality plans (“Basin Plans”)

Central Valley Mercury TMDLs

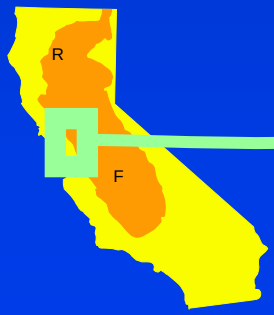


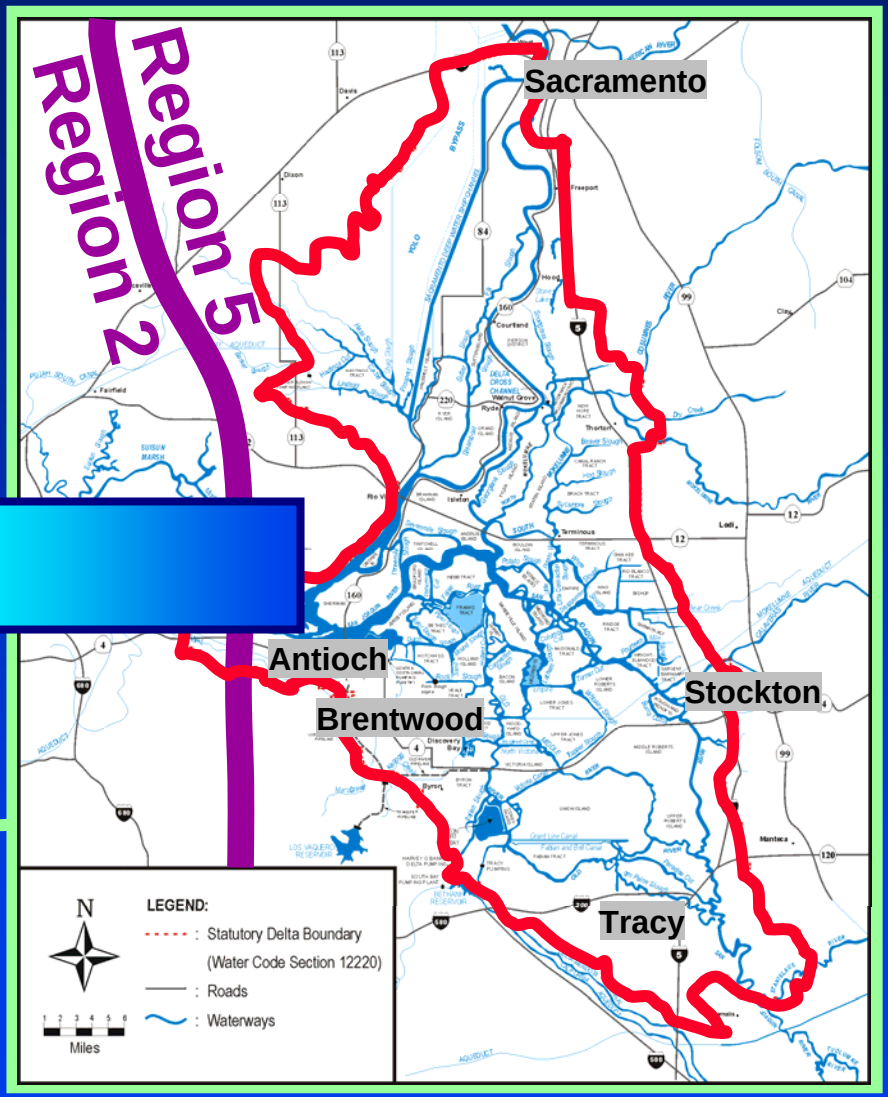
The Delta

>1100 mi waterways
Drains ~1/3 of CA

San Francisco Bay

Reduce
Central Valley
Mercury Outflows by
110 Kg/yr

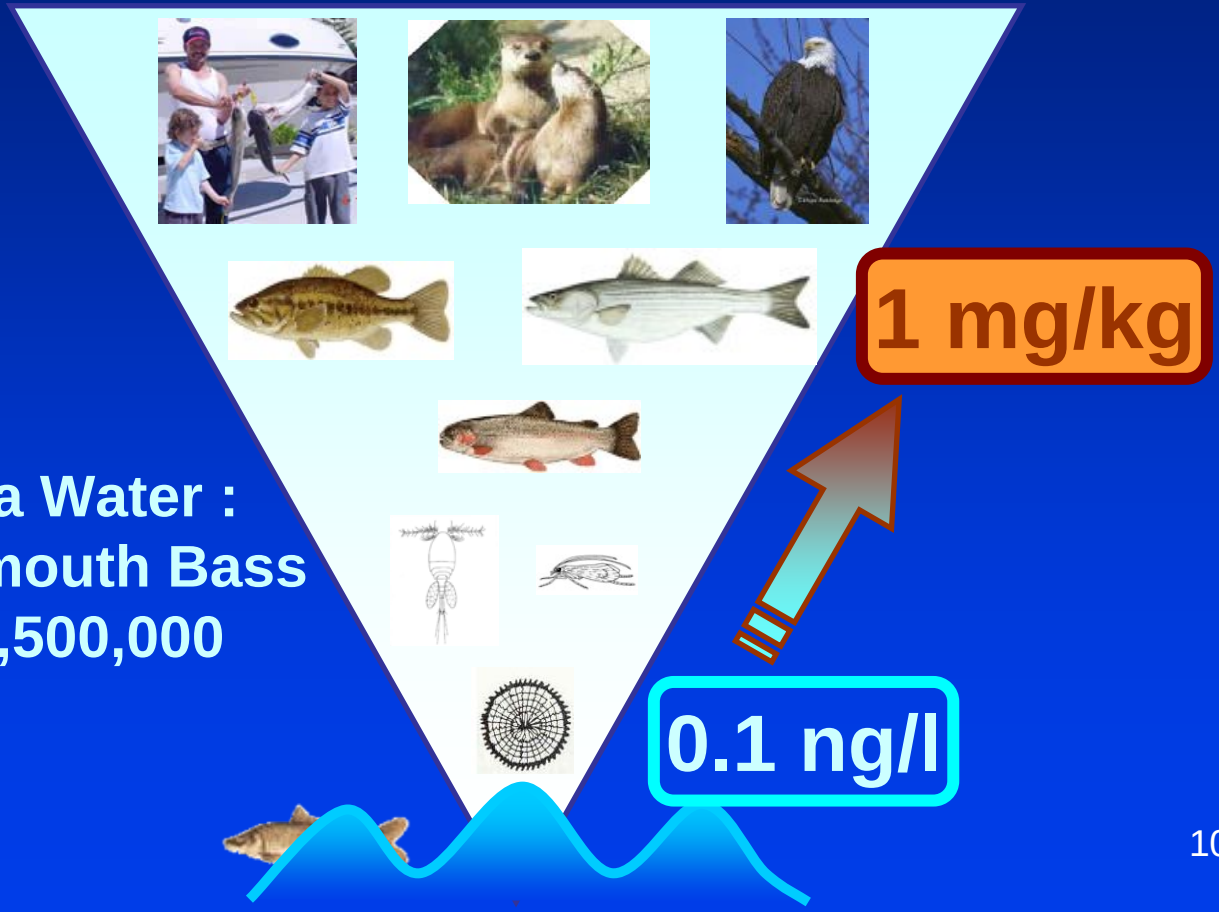




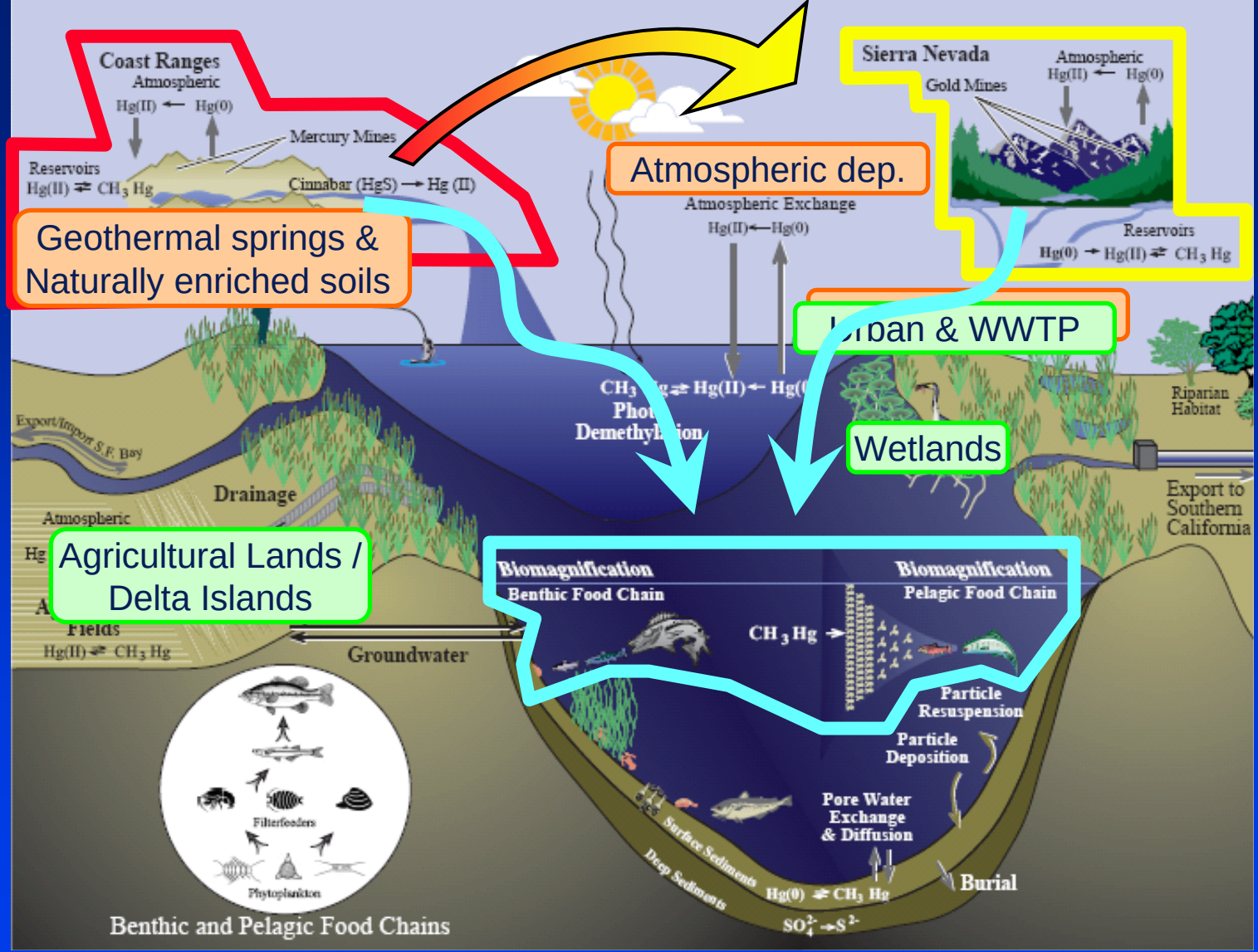
Methylmercury

- Most toxic form of mercury (a potent neurotoxicant)
- Sulfate-reducing bacteria convert mercury to MeHg
- >90% mercury in top trophic level fish is MeHg
- Exposure to MeHg is through consumption of fish & shellfish

MeHg Bioaccumulates…



Delta Water :
Largemouth Bass
1: 6,500,000


Coast Ranges
Atmospheric
Hg(II) ← Hg(0)
Mercury Mines
Reservoirs
Hg(II) ⇄ CH3 Hg
Cinnabar (HgS) → Hg (II)
Geothermal springs & Naturally enriched soils
Atmospheric dep.
Atmospheric Exchange
Hg(II)←Hg(0)
Sierra Nevada
Gold Mines
Atmospheric
Hg(II) ← Hg(0)
Reservoirs
Hg(0) → Hg(II) ⇄ CH3 Hg
Urban & WWTP
Wetlands
Export/Import S.F. Bay
Drainage
Atmospheric
Agricultural Lands / Delta Islands
Fields
Hg(II) ⇄ CH3 Hg
Groundwater
Riparian Habitat
Export to Southern California
Biomagnification
Benthic Food Chain
Biomagnification
Pelagic Food Chain
CH3 Hg
Particle Resuspension
Particle Deposition
Pore Water Exchange & Diffusion
Surface Sediments
Deep Sediments
Hg(0) ⇄ CH3 Hg
SO4 2- → S 2-
Burial
Filterfeeders
Phytoplankton
Benthic and Pelagic Food Chains

Concerns about Focusing Control Program on Only Inorganic Hg

- Millions of kilograms released to waterways by historic mining
- Much remains in channels & may be untreatable
- Necessitate reliance on natural erosion as a reduction strategy
- May take centuries to wash the mercury from the waterways

Interrupt the Methylation Cycle

- Identify sources of MeHg
  - Reduce methylation, and/or
  - Reduce mercury sources that supply the methylation sources
- Shorten time to see fish tissue improvements from <u>centuries</u> to <u>decades</u>

Outline

- TMDL Primer
- Why a MeHg TMDL?
- **The Delta MeHg TMDL**

MeHg TMDL Elements

- **Numeric target** (a.k.a. WQO)
- Source analysis
- **Linkage analysis**
- Implementation plan with Allocations
- **Monitoring and evaluation**

Numeric Target

- Protect humans and wildlife
- Main factor: fish consumption rates
- There are many options…

Alternative Targets for Human Protection

Objective (catfish & bass, mg/kg)	Safe Consumption Amounts for Humans & Implications
0.58	• **One** 8 oz. meal every 2 weeks of a **mixture** of fish (USEPA default criterion of 0.3ppm) • Does not protect fish-eating wildlife • Delta anglers eat mostly catfish & bass
0.24	• One 8 oz. meal of a mixture of fish every week • Protects fish-eating wildlife & sport anglers
0.16	• One 8 oz. meal of bass/catfish per week
0.05	• Four 8 oz. meals every week of bass/catfish • Protects anglers who catch local fish as primary source of protein

Wildlife Targets

Food Group / Species	TLFG Target	Large TL4 Fish
TL4 Fish (150-500 mm)		
Bald eagle	0.31	0.31
TL3 Fish (150-500 mm)		
Bald eagle	0.11	0.35
TL4 Fish (150-350 mm)		
Osprey	0.26	0.33
River otter	0.36	0.45
TL3 Fish (150-350 mm)		
Western grebe	0.08	0.29
Common merganser	0.09	0.34
Osprey	0.09	0.34
TL3 Fish (50-150 mm)		
Kingfisher	0.05	0.63
Mink	0.08	0.91
River otter	0.04	0.50
Double-crested cormorant	0.09	0.98
TL3 (<50 mm)		
California least tern	0.03	0.36
Western snowy plover	0.10	1.20

Recommended Targets

- **Large TL4 Fish: 0.24 ppm**
  - Humans: ***Key Policy Question***
  - Protects piscivorous wildlife species
- **Small TL3 Fish: 0.03 ppm**
  - Protects wildlife consuming small fish where there are no big fish to monitor

MeHg Linkage

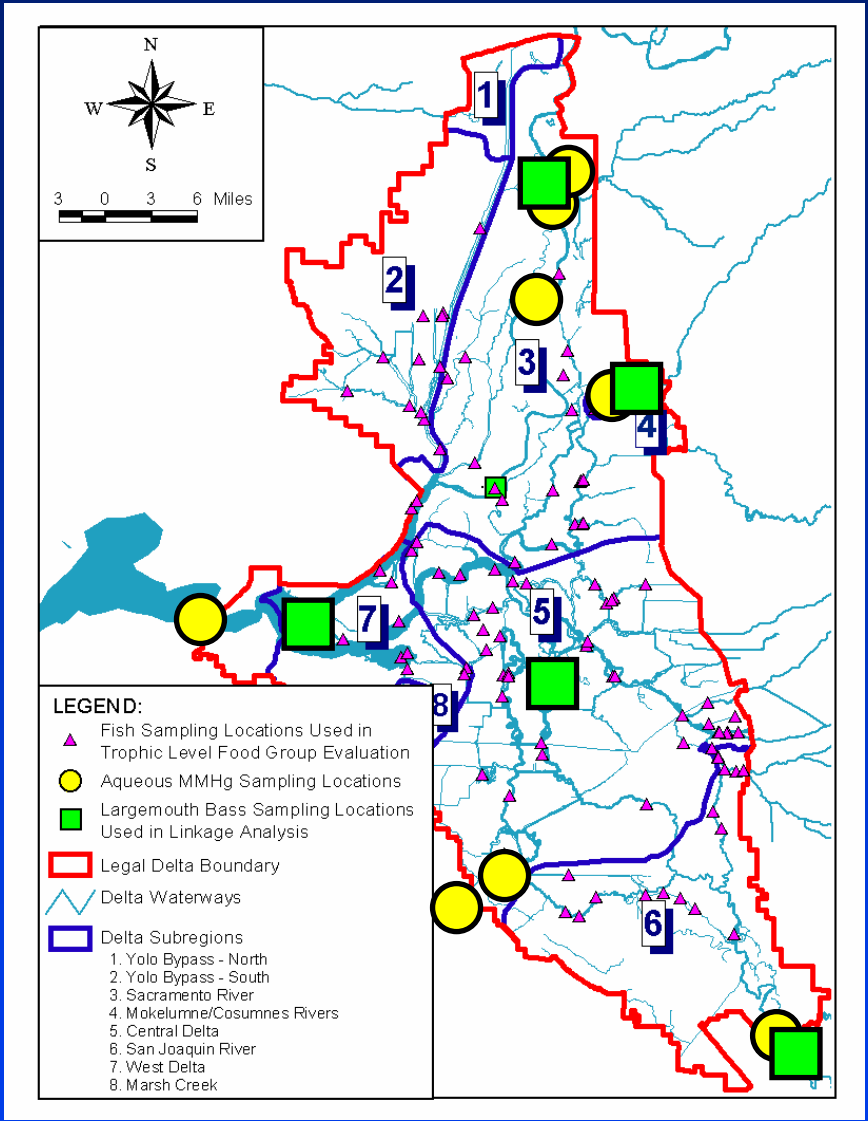
- Links targets to sources using the Delta-specific mathematical relationship between water and fish MeHg concentrations
- Determines a MeHg goal for ambient water

MeHg Sampling Locations Used in Linkage

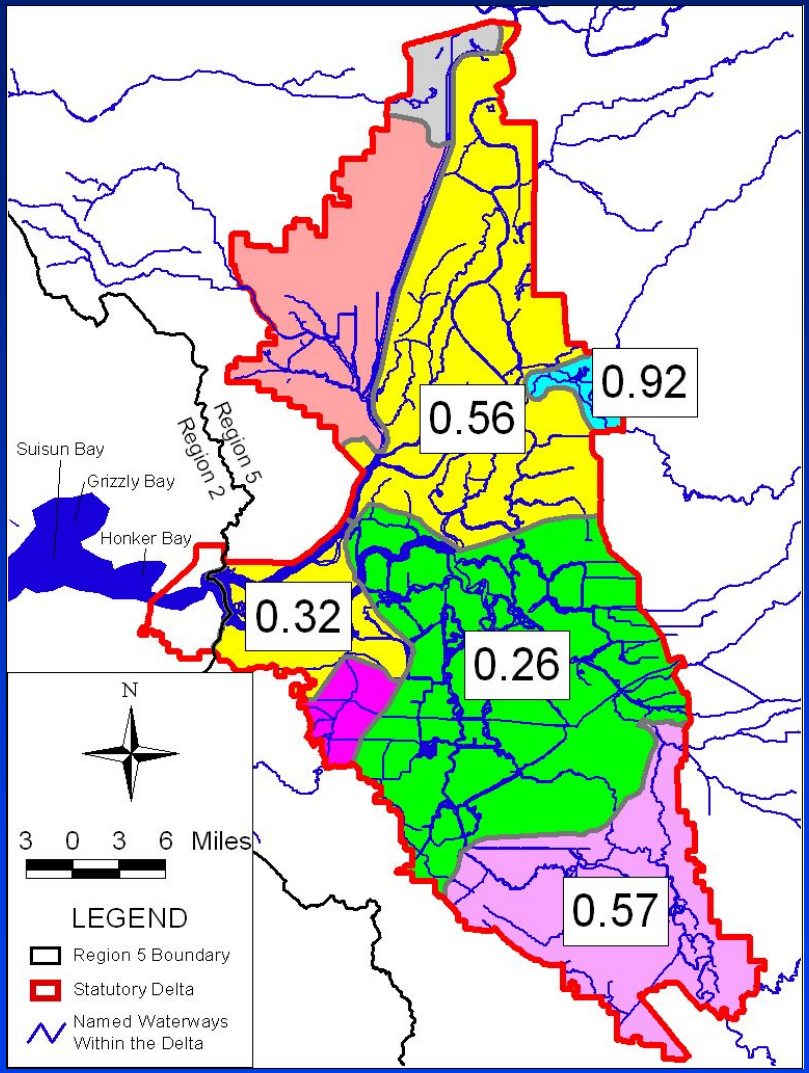
TL4 Fish – ▲

LMB – ■

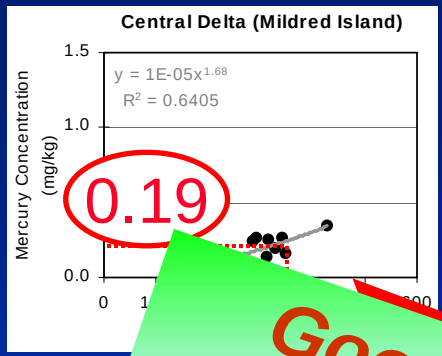
Water – ●

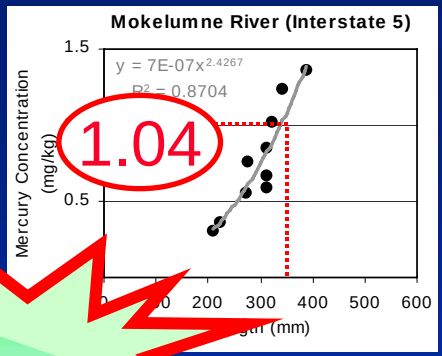


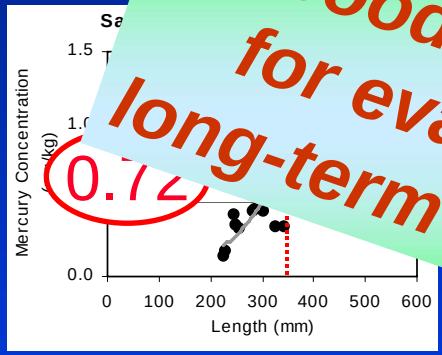
Weighted Average MeHg Levels in TL4 Fish (mg/kg)

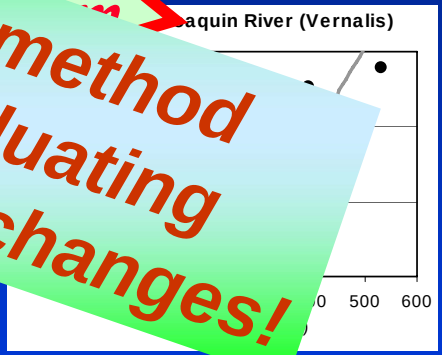


Large-mouth Bass Length vs. MeHg Conc.

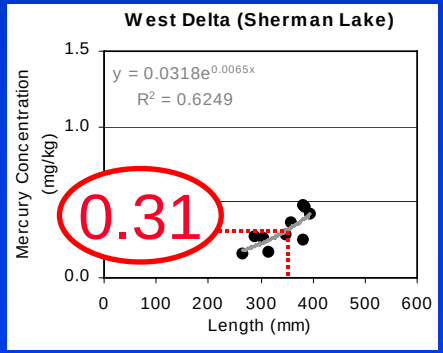




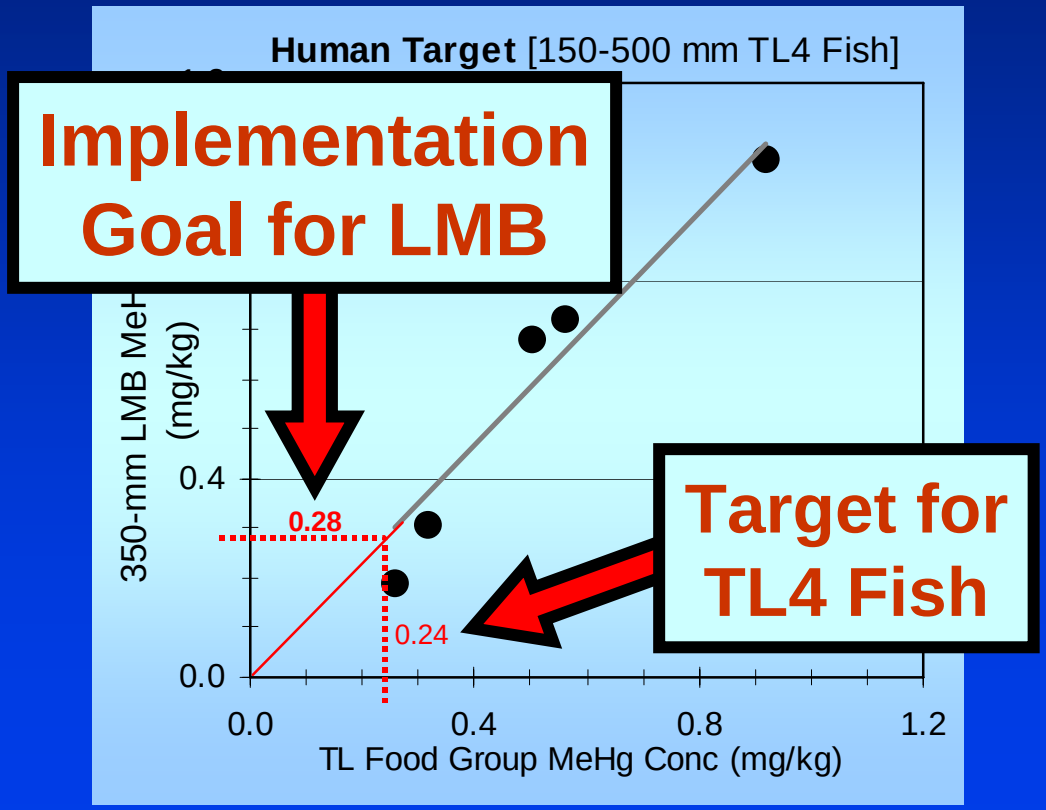




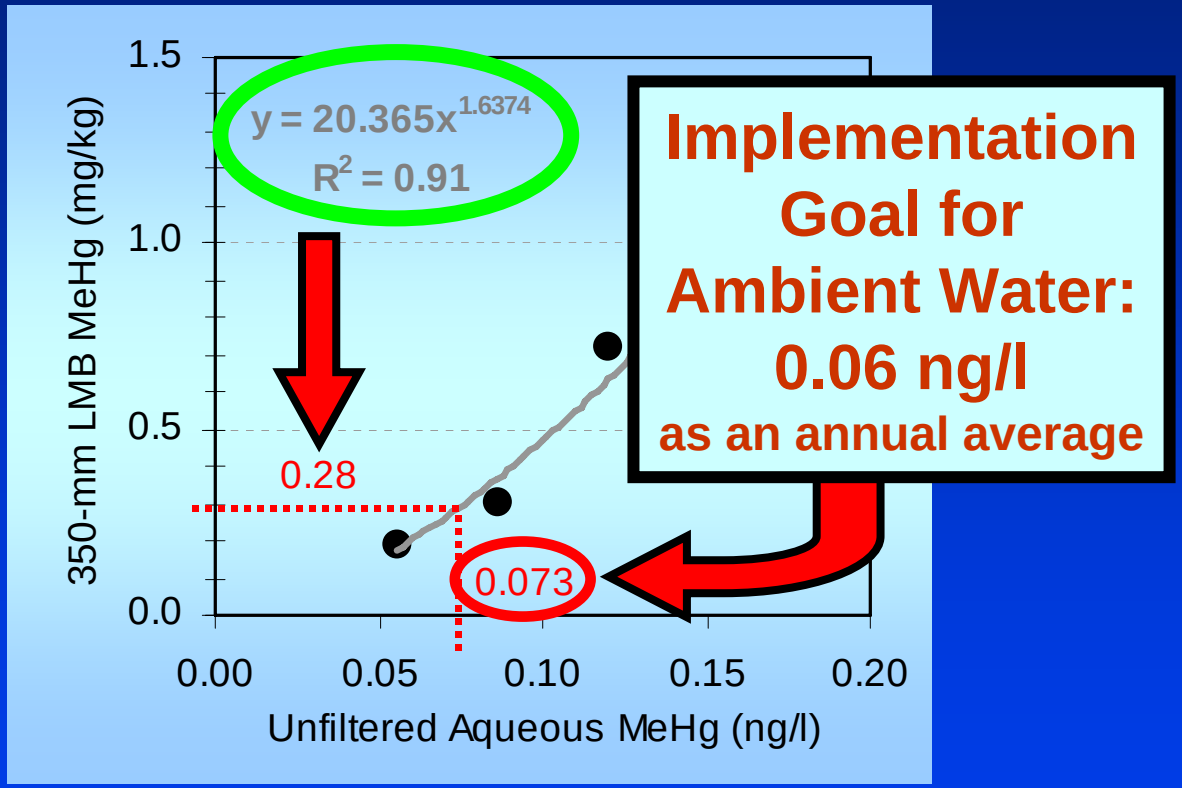
Good method for evaluating long-term changes!



TL4 Fish WQO & 350 mm LMB Hg Goal



350 mm LMB MeHg Goal & Average Annual Water MeHg Goal



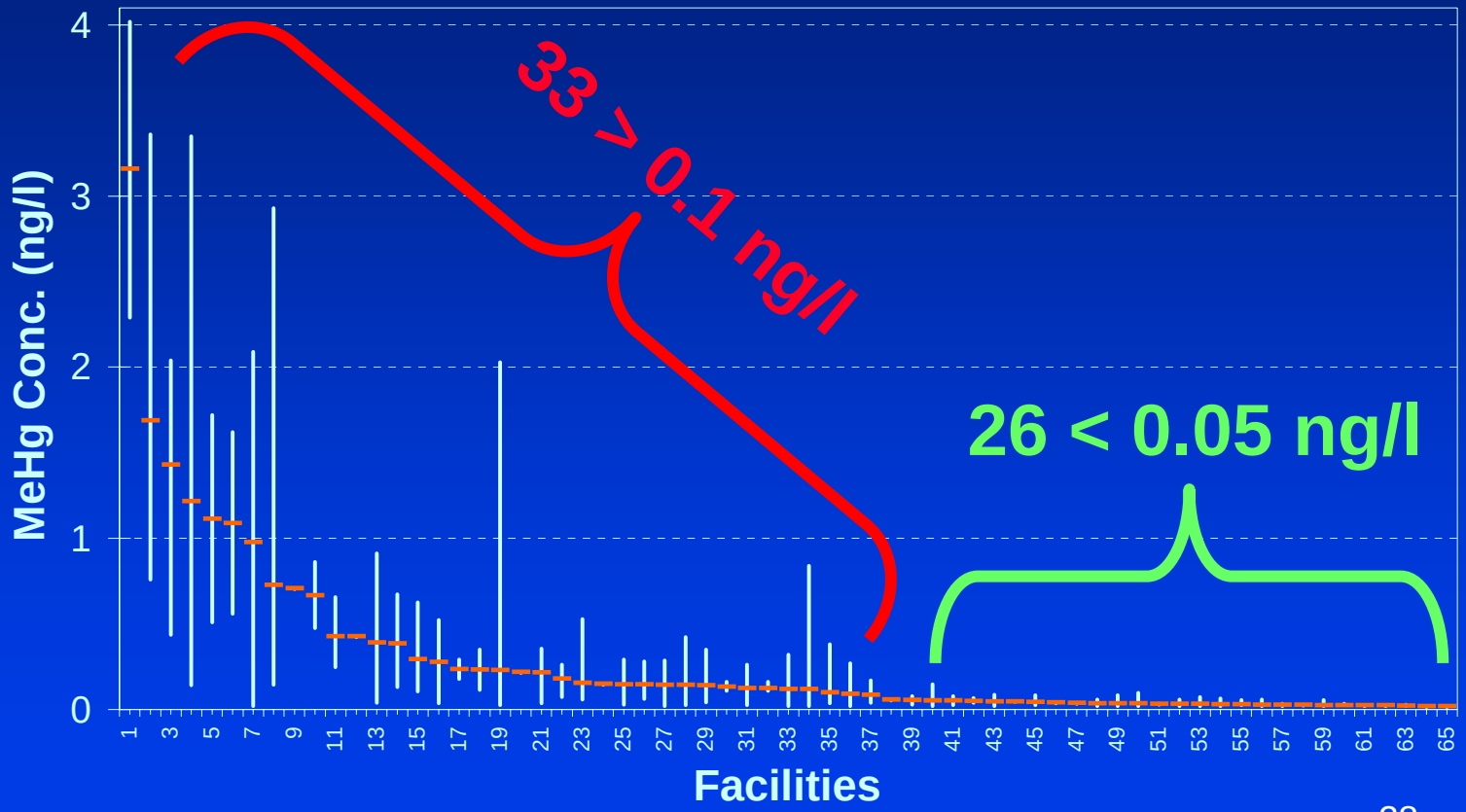
Recommended Control Program

1. Control MeHg sources
2. Control TotHg sources
3. Reduce MeHg exposure to the fish eating public

5-Year Study Period:

- Conduct **<u>studies to characterize & control</u>** existing MeHg & Hg concentrations and loads
- ***GOALS*:**
  - Address uncertainty in load estimates
  - Develop technically & economically feasible controls

Preliminary Municipal WWTP MeHg Monitoring Results



Mercury Offset Program

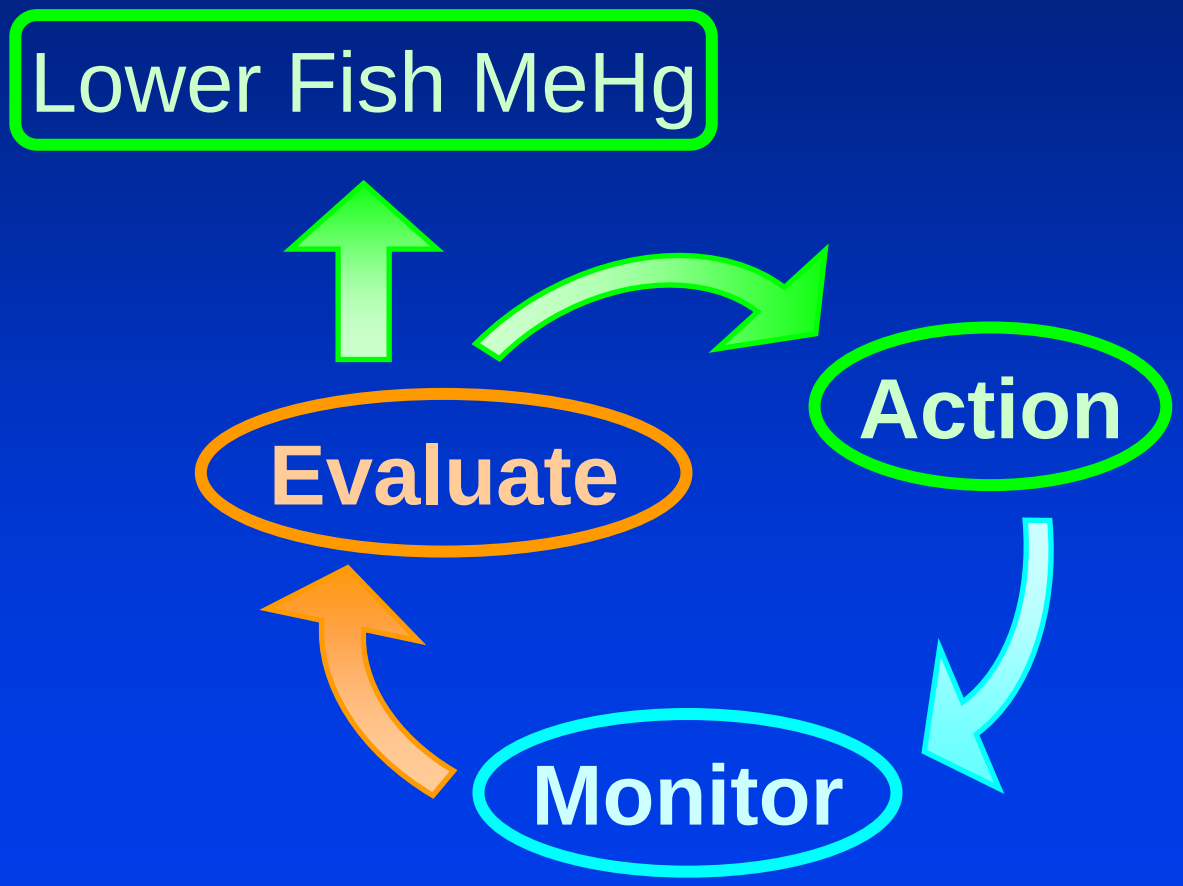
Enable beneficial projects
to proceed even if
on-site mercury controls
are not feasible

Timeline

- **<u>Within 30 years</u>**:
  If implement MeHg controls,
  achieve measurable reductions in fish tissue mercury

- **<u>100+ years</u>**:
  Fully achieve WQO

Adaptive Implementation



Next Steps

- Report for scientific peer review
- Release draft BPA staff report
- Board Hearing in Fall/Winter 2006

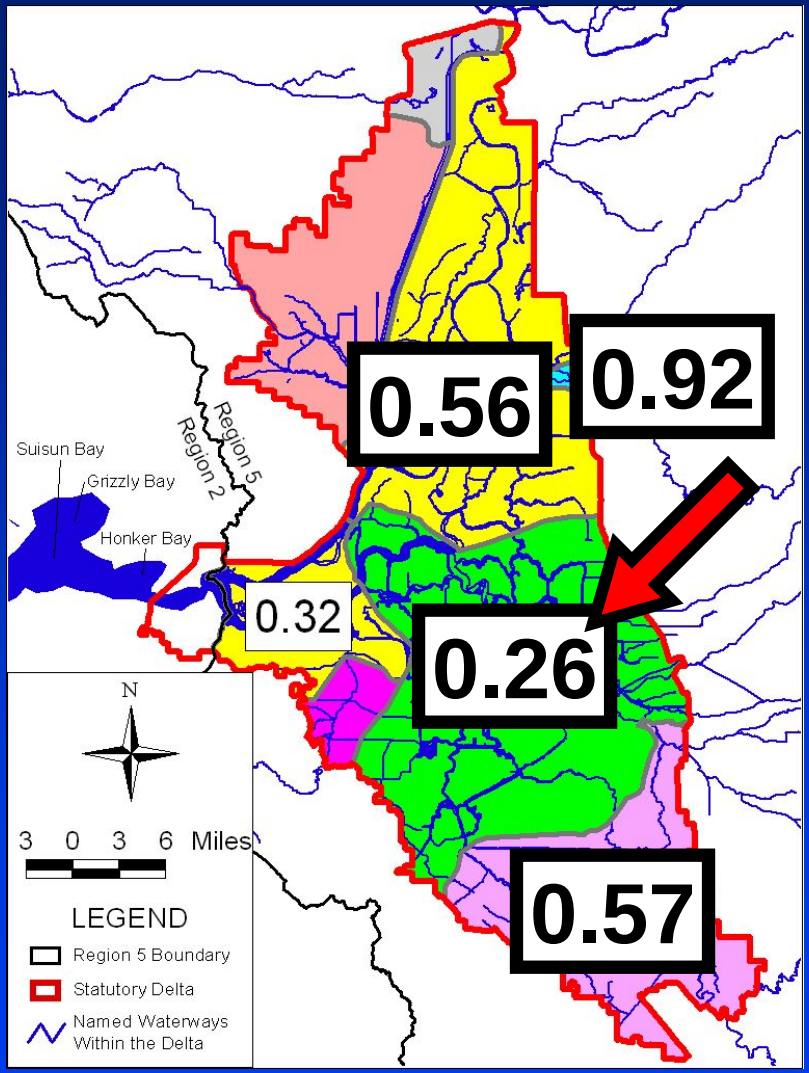
Acknowledgments

Data, Methods & Ideas

SFEI, UCDavis, SRWP, CMP
SF Water Board staff,
DHS, OEHHA, DFG,
Moss Landing Marine Laboratories,
USGS, USFWS
CALFED Mercury Program

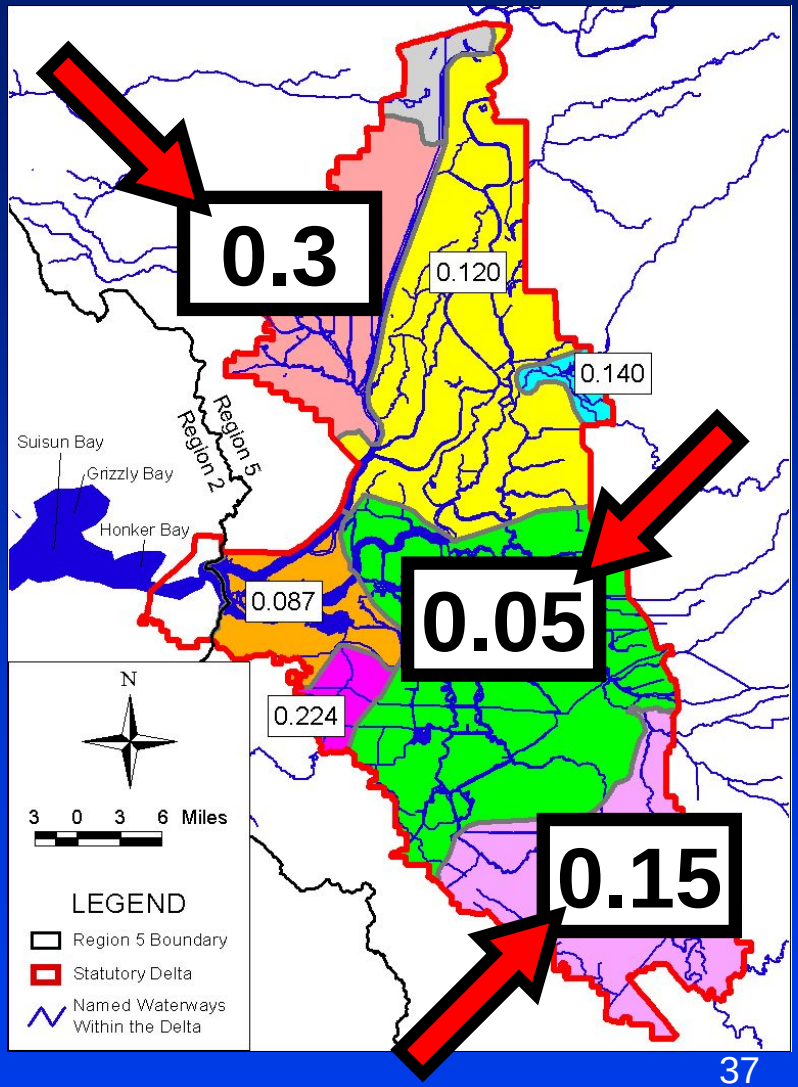
Questions & Discussion

Weighted Average MeHg Levels in TL4 Fish (mg/kg)



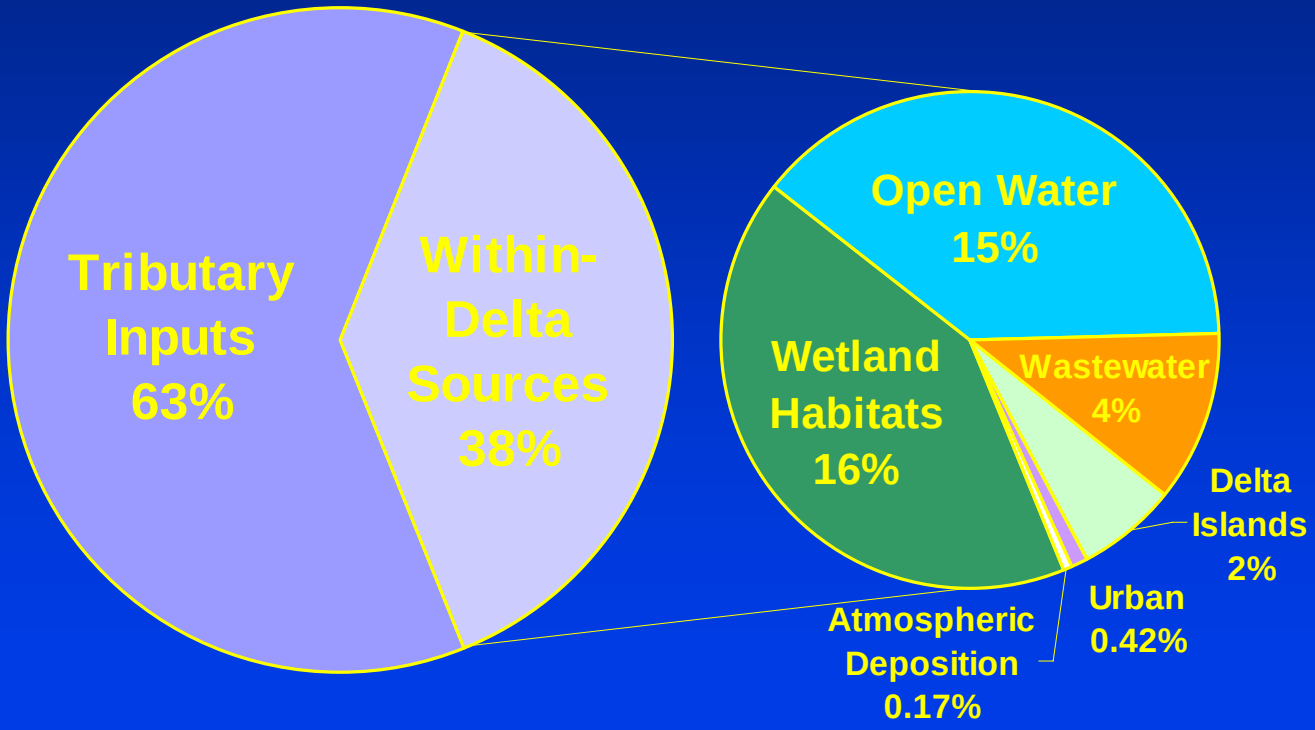
Average Annual Ambient MeHg Levels in Water

(ng/l)



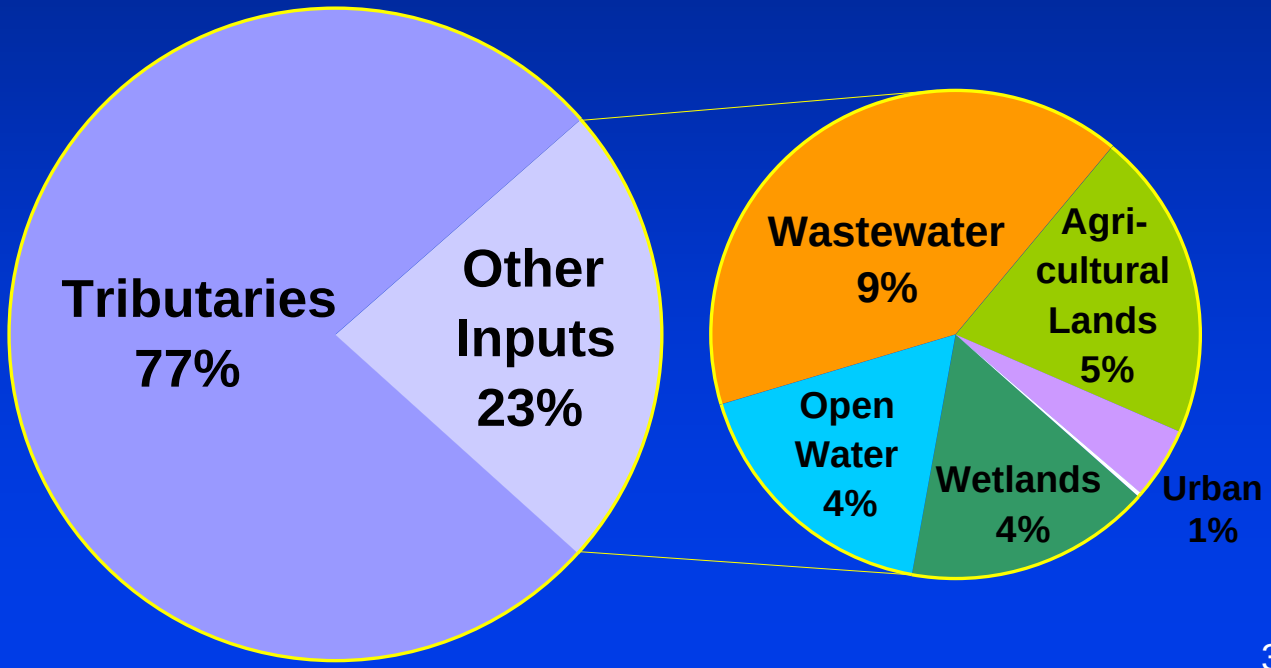
Delta MeHg Sources

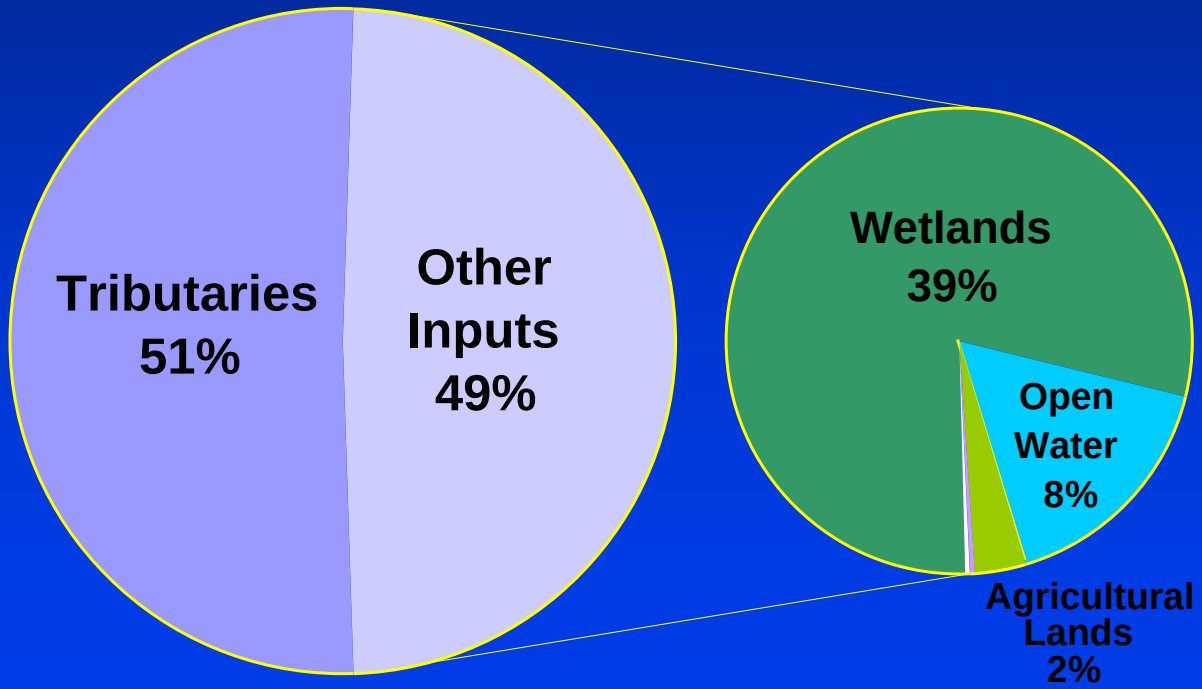
Average Annual Loads



San Joaquin Subregion MethyIlmercury Sources

Total Loading: ~478 g/yr



Yolo Bypass Subregion Methylmercury Sources

Total Loading: ~1,000 g/yr