

SIDEBAR 2

Luoma et al 2015

The Delta: A “Wicked” Problem

- If the problem were just about allocating flows, it might be solvable.
- Add in the complexity of moving water through a hydrologically and hydrodynamically complex Delta and it becomes complicated.
- Add the uncertainty of ecological responses and the institutional complexity of many actors with many visions and the problem becomes *wicked* (Dryzek et al. 2013).
- Then add the ever-changing water supply and ecological and economic contexts within which decisions must be made, and the problem becomes *devilishly wicked*.

Contaminant and Project effects in the Bay-Delta

Samuel N Luoma
Institute of the Environment
University of California, Davis

Most important stressors.... related to the projects

“We can’t attribute the restructuring of the biological community to a single factor,”
(Cloern, in *Estuaries Newsletter* 1990s);

...federal efforts to protect endangered fish are “scientifically justified” but ...
“problems facing delta smelt and chinook salmon are not entirely caused by thirsty
farms south of the estuary.”... (National Academies of Science, 2012)

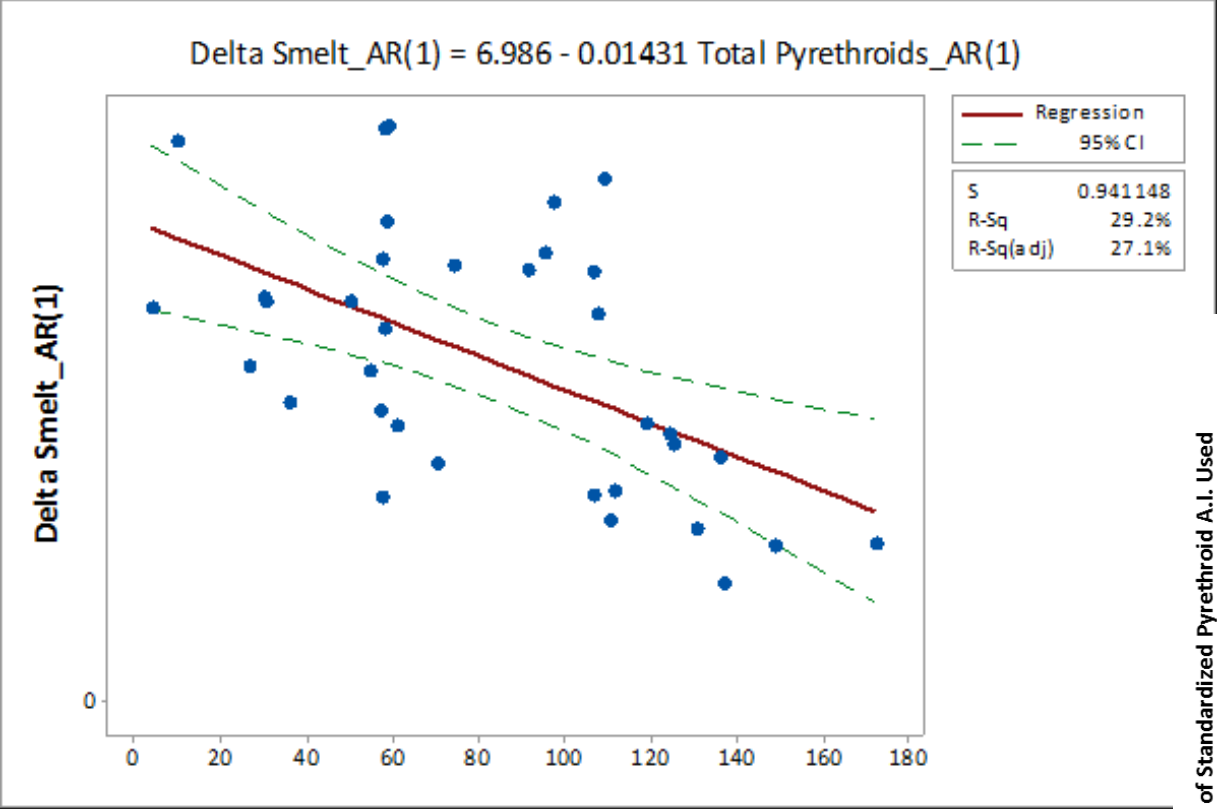
“The proximate causes...are interactions of multiple factors that have altered habitat,
making it increasingly unsuitable (for native species). None of these factors by
themselves have caused the severe decline”...(Moyle et al 2016)

“Complex, wicked problems like the Delta rarely yield to the simplistic solutions
directed at only one dimension of the problem” ...”The San Luis Drain was a multi-
million dollar "stranded investment" that resulted from a poorly understood, simplistic
engineering “solution” to a complex problem with many dimensions.” (Luoma et al 2015).

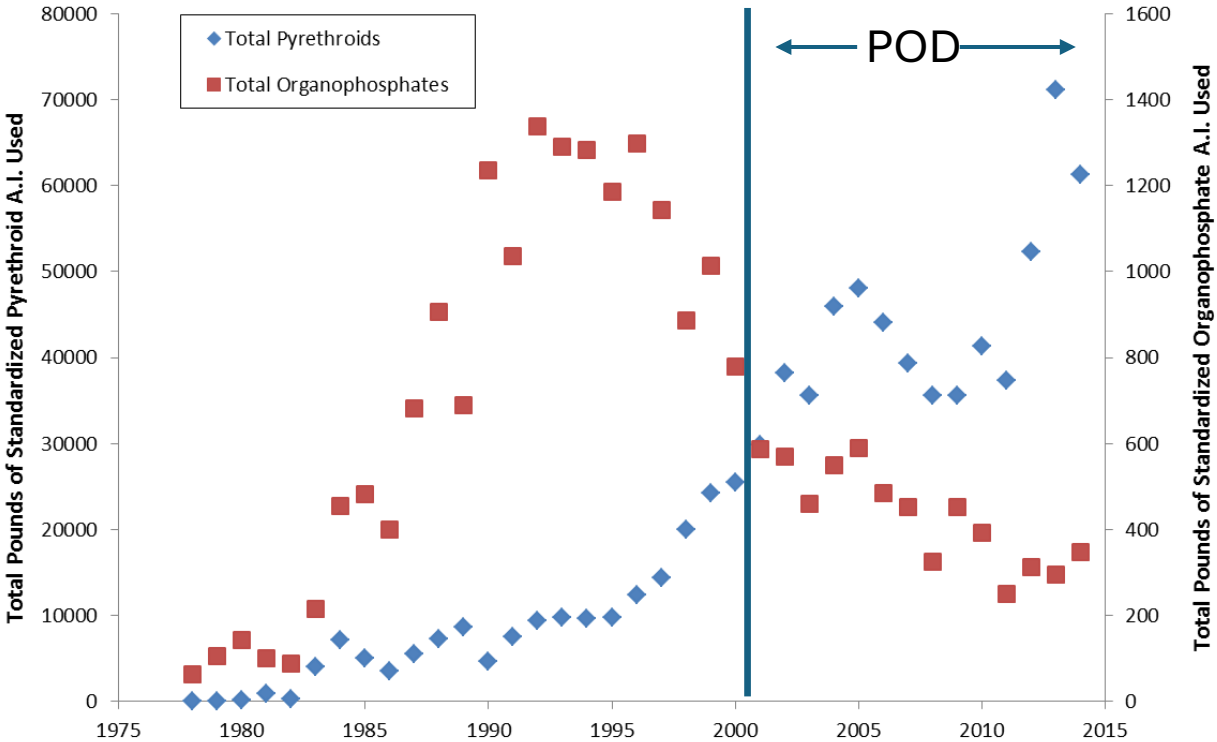
CONTAMINANTS IN THE DELTA AND SAN FRANCISCO BAY

- **LEGACIES**: ***MERCURY*** from historic mining sources contaminates food webs. Organic chemicals in sediments: ***DDT AND ITS BREAKDOWN PRODUCTS***, and ***POLYCHLORINATED BIPHENYLS (PCBS)***. ***PAHs and Pb*** near urban areas and legacy industries
 - Progress: Incrementally reduced hotspots in SF Bay...recoveries documented
 - Erosion of bed sediments exposes buried legacies
- **SELENIUM** from Central Valley irrigation drainage and Bay refineries
 - *Linked to projects = Land transformation...irrigation drainage west SJR.. remove drainage from the valley?...Kesterson Nat'l Wildlife Refuge...Progress = control Se inputs to SJR, but reservoir waiting in the valley...Substitute SJR water for Sacto water*
- **PHARMACEUTICALS, FLAME RETARDANTS, AND PERSONAL CARE PRODUCTS**
 - ***Hot spots: Waste treatment facilities; Disrupt endocrine systems; predators***
- **MULTIPLE, CHANGING PESTICIDES** from agriculture and urban uses
 - Hot spots; Population recruitment and survival; simplify benthic communities; Delta smelt
- **NUTRIENTS**
 - Turbidity; Stimulate nuisance or toxic algal blooms and water weeds;

Delta Smelt population index as a function of Pyrethroid insecticide use



Pyrethroid use in the counties of the Delta



Figures from Fong et al, 2016

CONCLUSION: POINTS FOR FUTURE MANAGEMENT

Simple, one-dimensional solutions do not exist.

Mgt. should evolve, and is to some degree, beyond questions that focus on the projects and on ranking most important stressors.

Wicked problem: recognize the value of an incremental, flexible approach to multi-faceted ecosystem mgt...

This requires that we be positive about the progress we have made and realistic about the challenges that lie ahead.

The greatest impediment: a deficit of trust/communication among factions.

Collaboration and cooperation are slow and sometimes frustrating, but are a necessary part of a path toward timely, effective, sustainable management.