

Sublethal Effects of Contaminants Regularly Detected in the Delta: Risks to Smelt

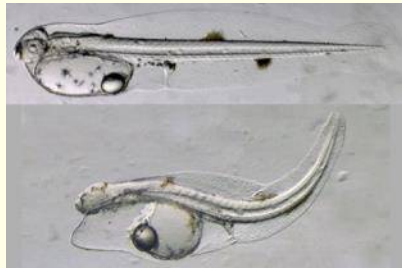


Image: John Incardona, NOAA.



Image: Bethany Decourten, UNCW.

Richard E. Connon, PhD

Assistant Professor

School of Veterinary Medicine:
Anatomy, Physiology & Cell Biology

UC DAVIS
UNIVERSITY OF CALIFORNIA



Acknowledgments

- Co-authors of State of the Bay Delta Science

Chapter 7 - Contaminant Effects on California Delta Species and Human Health:

- Stephanie Fong (SFCWA)
 - Val Connor (GEI Consultants)
 - Stephen J. Louie (CDFW)
 - Inge Werner (Eawag-EPFL)
 - Jay Davis (SFEI)
 - Lynda Smith (MWD)
- Coordinators and reviewers for their comments and contributions
 - Collaborators, postdocs, students, and other contributors to contaminant research in the Delta.

Funding:



State and Federal Contractors
Water Agency

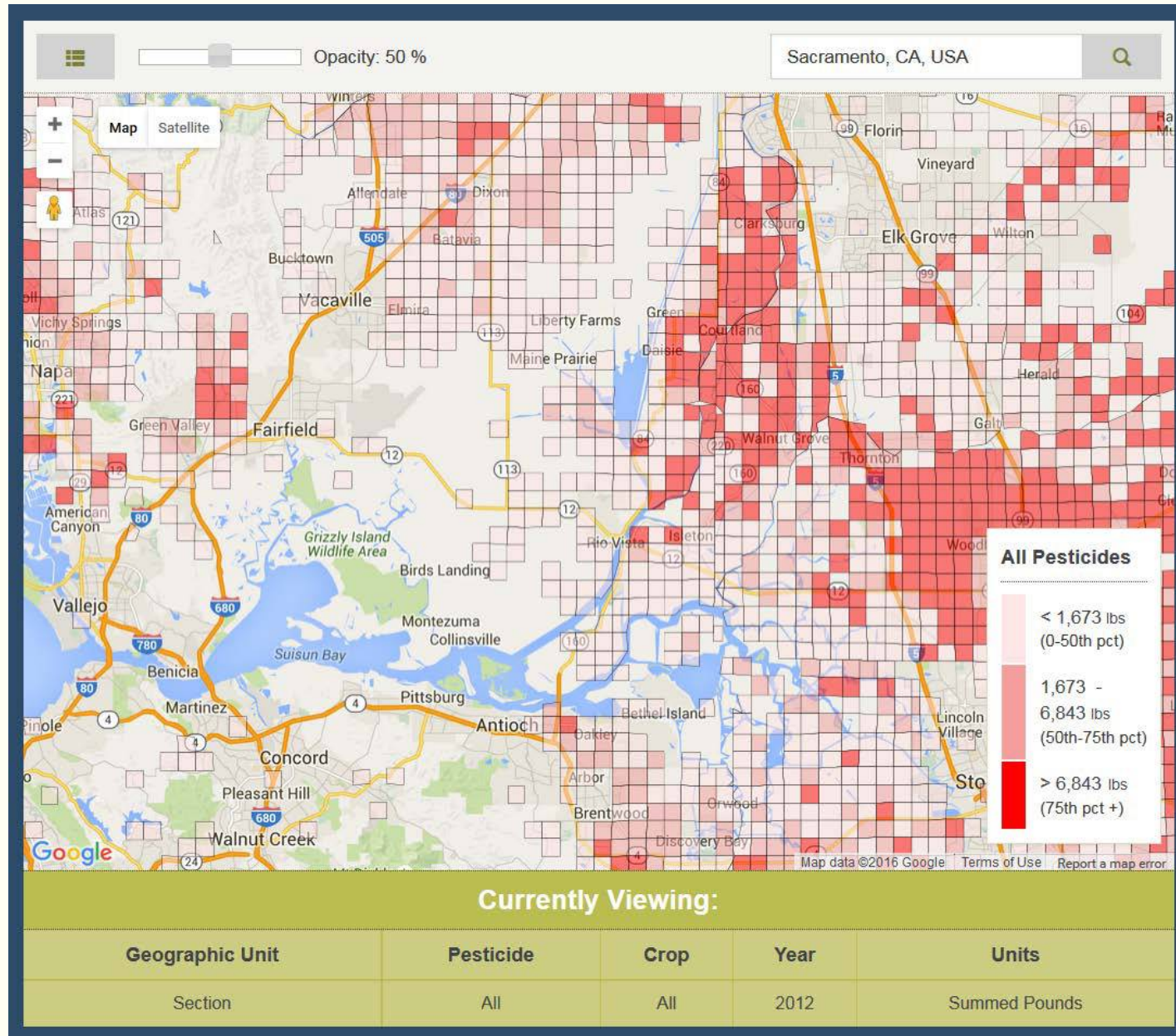


DELTA STEWARDSHIP COUNCIL
DELTA SCIENCE PROGRAM

Pesticide Application

Note: *Agricultural Pesticides only.*
Does not include direct applications to surface waters, urban and domestic use

Other contaminants:
Pharmaceuticals and personal care products (PPCPs)
Industrial chemicals
Heavy metals
Legacy contaminants
Organic compounds (e.g., PCBs, PAHs)
Nanoparticles
Plastics



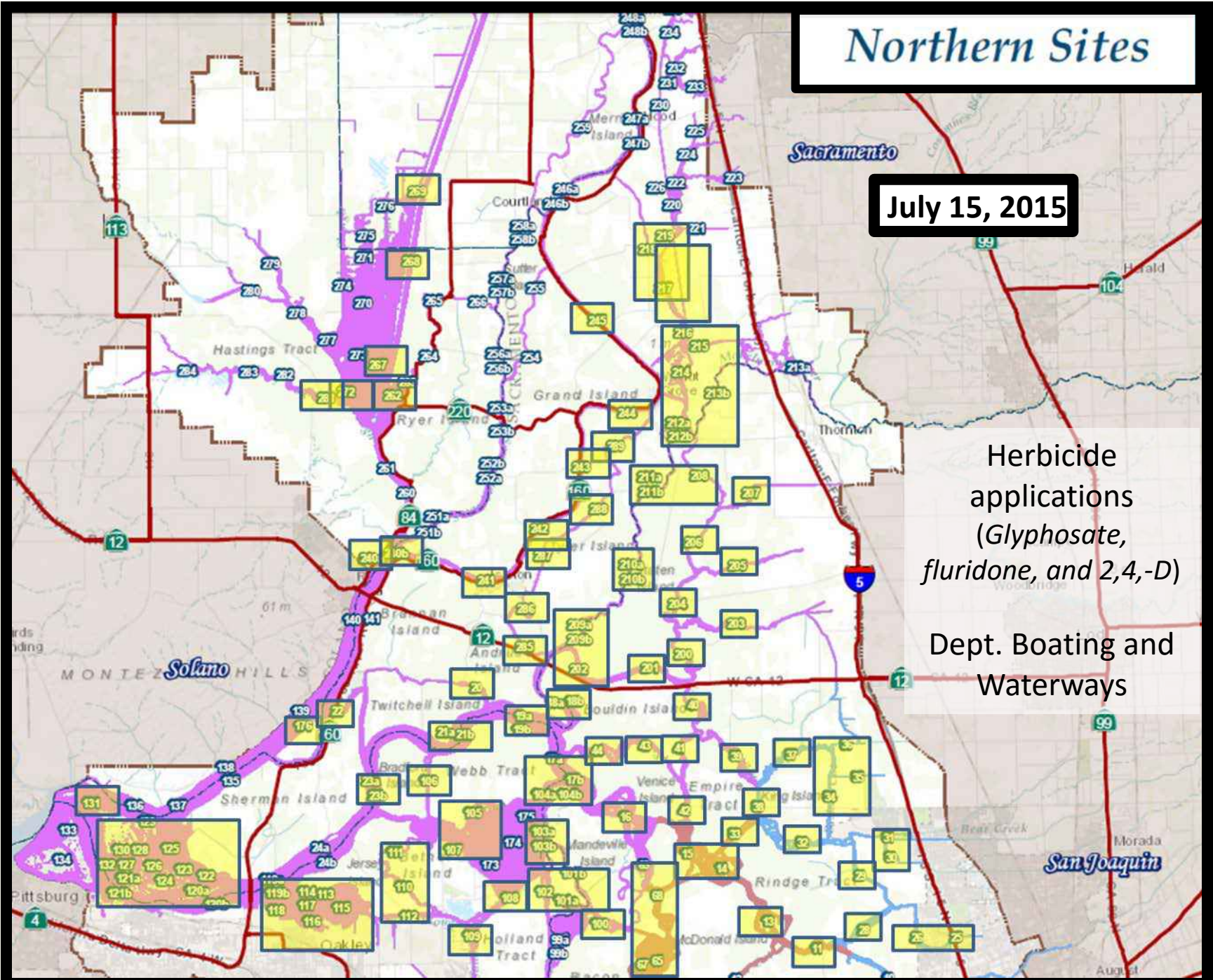
Source: http://www.cehtp.org/page/pesticides/agricultural_pesticide_use_in_california.
Department of Public Health. Accessed March 28, 2016 (latest dataset: 2012)

Northern Sites

July 15, 2015

Herbicide applications
(Glyphosate,
fluridone, and 2,4,-D)

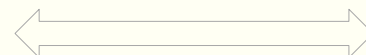
Dept. Boating and
Waterways





DELTA-SPECIFIC STUDIES	General Stress Response	Detoxification / Sequestration	Immune System	Osmoregulation	Nervous system	Muscular system	Tissue effects / Histopathology	Low Nutritional Status	Necrosis / Apoptosis	Growth	Development	Deformities	Endocrine Disruption	Altered Sex Ratio	Behavior
Pyrethroid pesticides	*	*	*	*	*	*			*	*	*				*
Organophosphate pesticides															
Phenylpyrazole (Fipronil)															
Pharmaceuticals and Personal Care Products	*		*	*	*	*					*				*
Metals and Metalloids					*	*			*	*	*				*
Persistent Organic Pollutants		*					*			*	*				
Ammonium	*		*			*			*		*				*
Microcystin	*						*	*	*	*					
Delta Water Samples (Laboratory)	*	*	*		*	*	*		*	*	*		*		*
Delta Water Samples (<i>In-situ</i> , field collected fish)		*		*	*		*	*	*	*		*	*	*	

Physiological Relevance



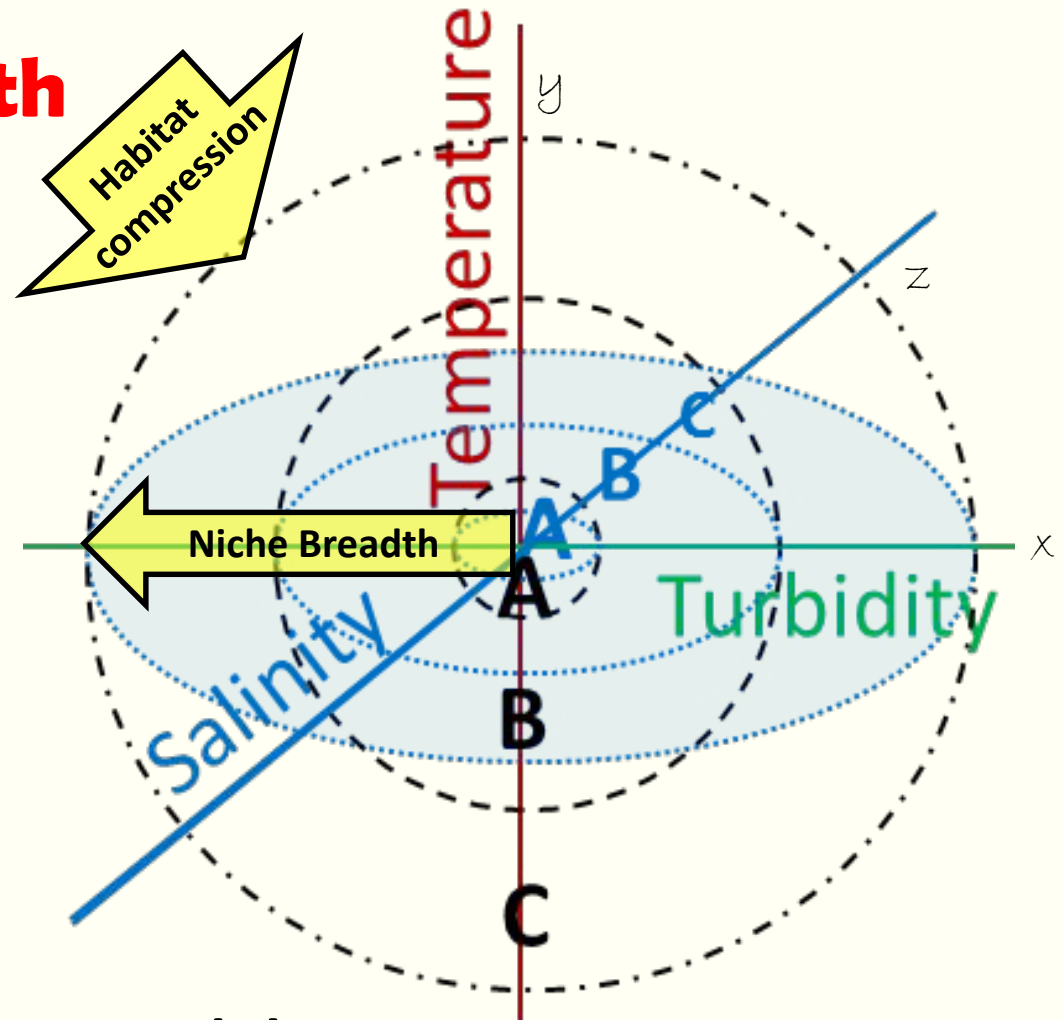
Ecological Relevance

Toxicity varies with habitat and physiological condition

∴

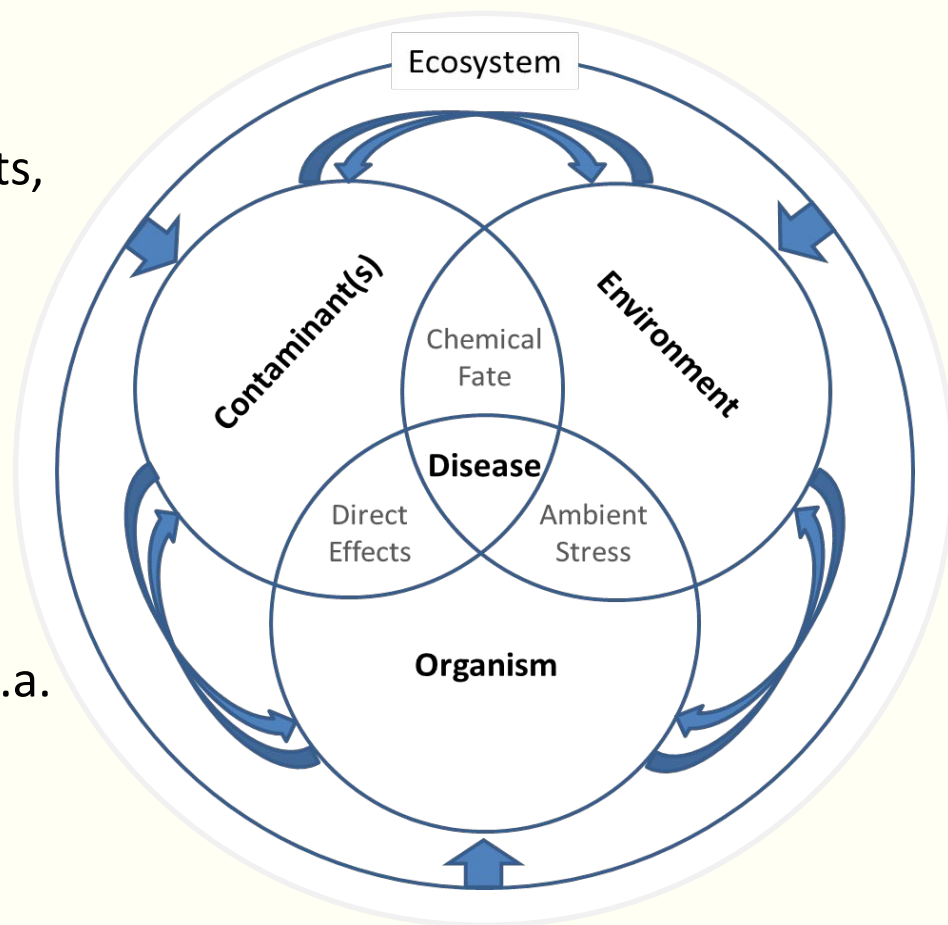
Optimal niche (A) = less sensitive

Less optimum environment (C) = more sensitive



Contaminant-Environment-Organism Interactions

- Direct effects (+metabolites, solvents, formulations, herbicides)
- Indirect effects (e.g., via food web)
- Organismal interaction (e.g., disease/predation)
- Habitat modification
- Climate change
- Physicochemical parameters (a.k.a. water quality)



What does this mean?

Contaminants impact organisms at multiple levels of biological organization

Environmentally relevant concentrations can and do lead to developmental, behavioral, and reproductive effects

Organisms are exposed to contaminant mixtures, rather than to single chemicals

Mitigation of chemical and sediment runoff can be achieved through best management practices

It is delusional to assume that contaminants play a minor role in the decline of delta species



Sublethal effects can, and do lead to mortality