

Stormwater transport of urban and agricultural pesticides into Suisun Marsh

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Research question: Given that aquatic invertebrates are important prey for a wide variety of Suisun Marsh fishes, do winter rainstorms transport pesticides from urban and agricultural lands into the Marsh at concentrations potentially toxic to invertebrates?

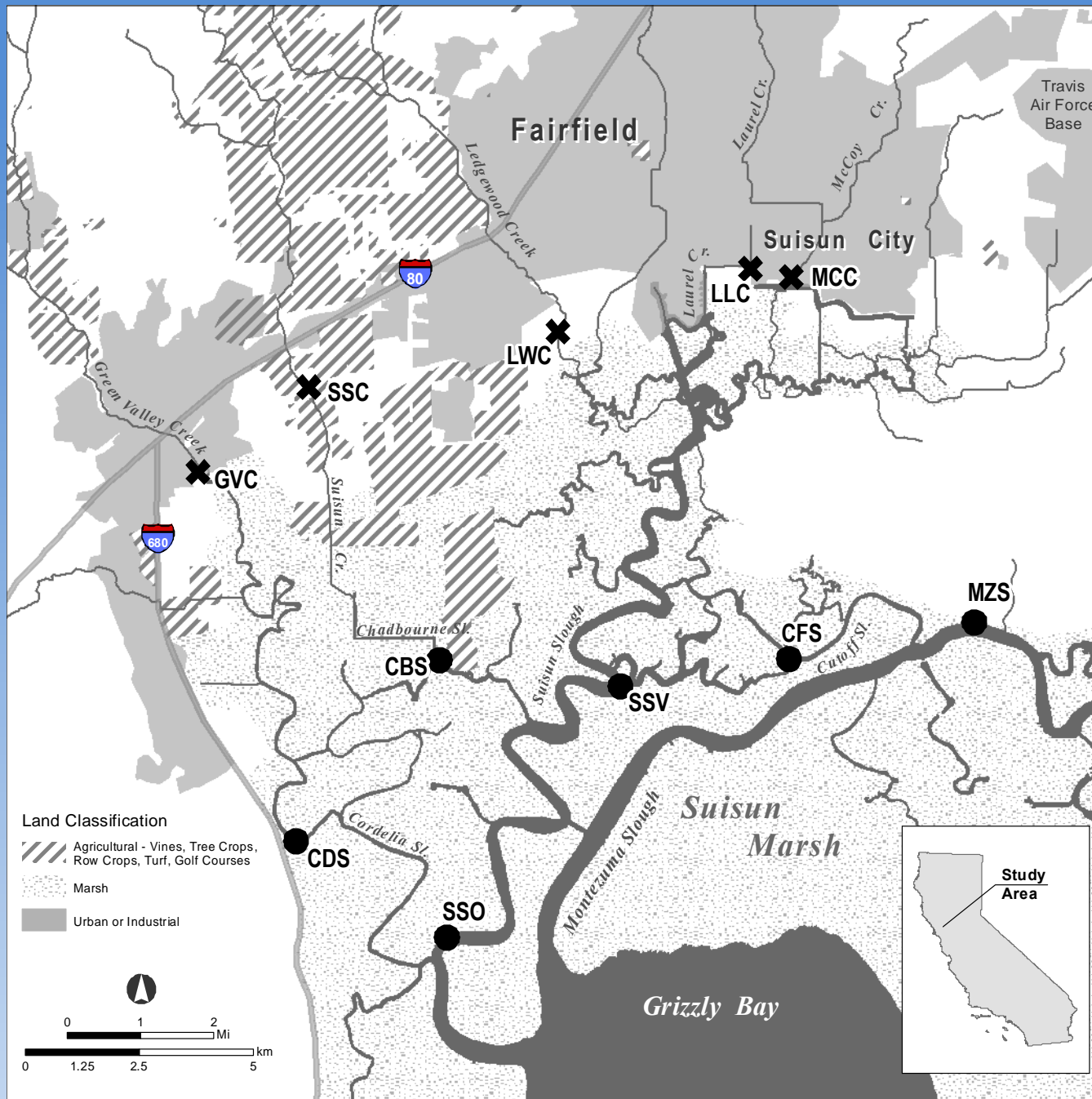
Pesticides of interest:

Pyrethroids – Well documented to be responsible for toxicity in many California waterways. Comparable amounts of ag and urban use.

Fipronil – A phenylpyrazole insecticide with growing use over past decade, and recent data indicating toxicity common in urban streams. Degrades even more toxic than parent compound. Entirely urban sources; no agricultural use in California.

Chlorpyrifos – An organophosphate insecticide occasionally linked to aquatic toxicity. Largely agricultural sources; negligible urban use.

Imidacloprid – An emerging neonicotinamide insecticide with little aquatic monitoring data. Primarily agricultural, but some urban uses.



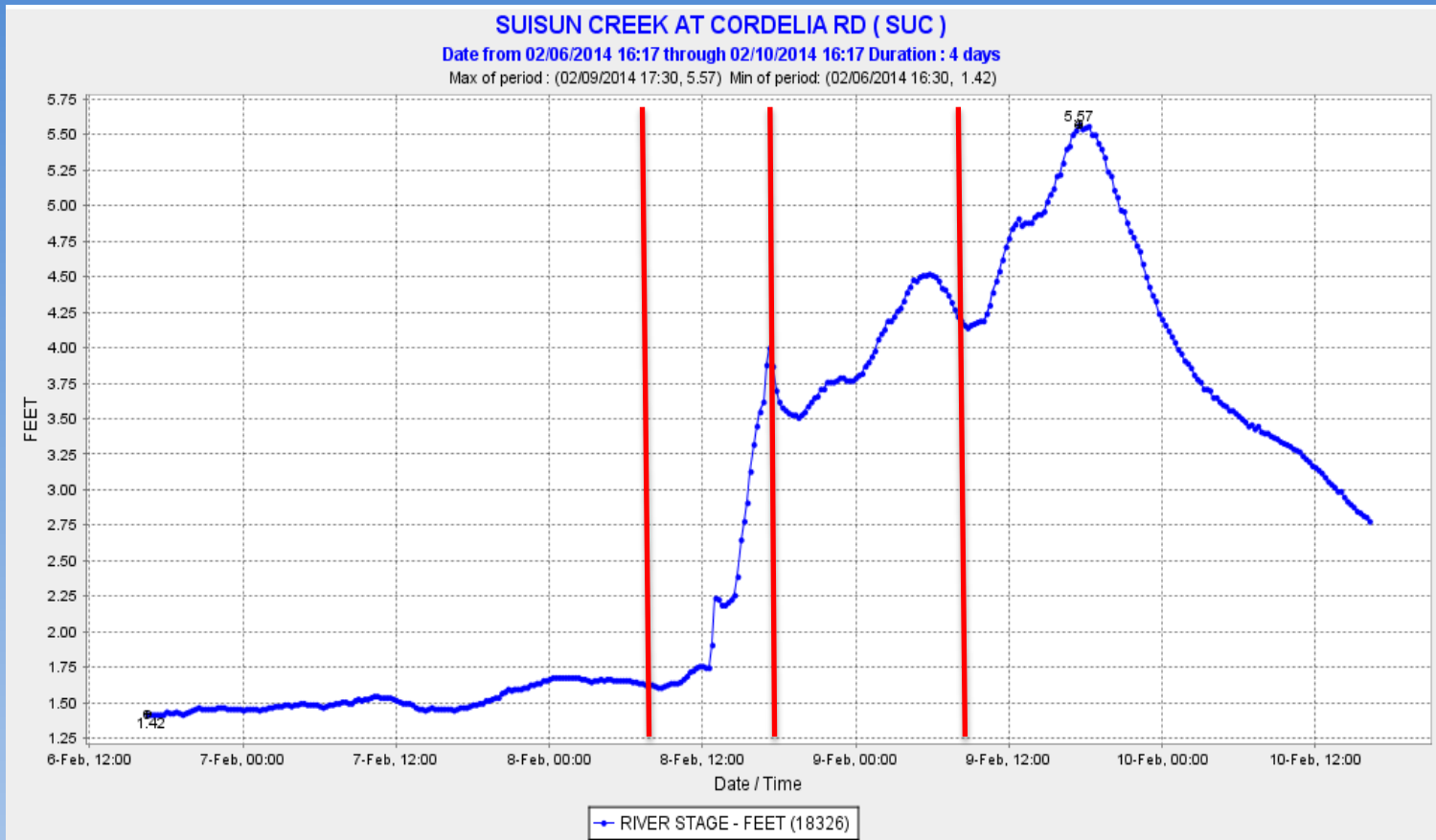


Figure 2. River stage throughout the storm event at the SSC sampling site on Suisun Creek. Vertical lines indicate the times of sampling at the site. From http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=SUC

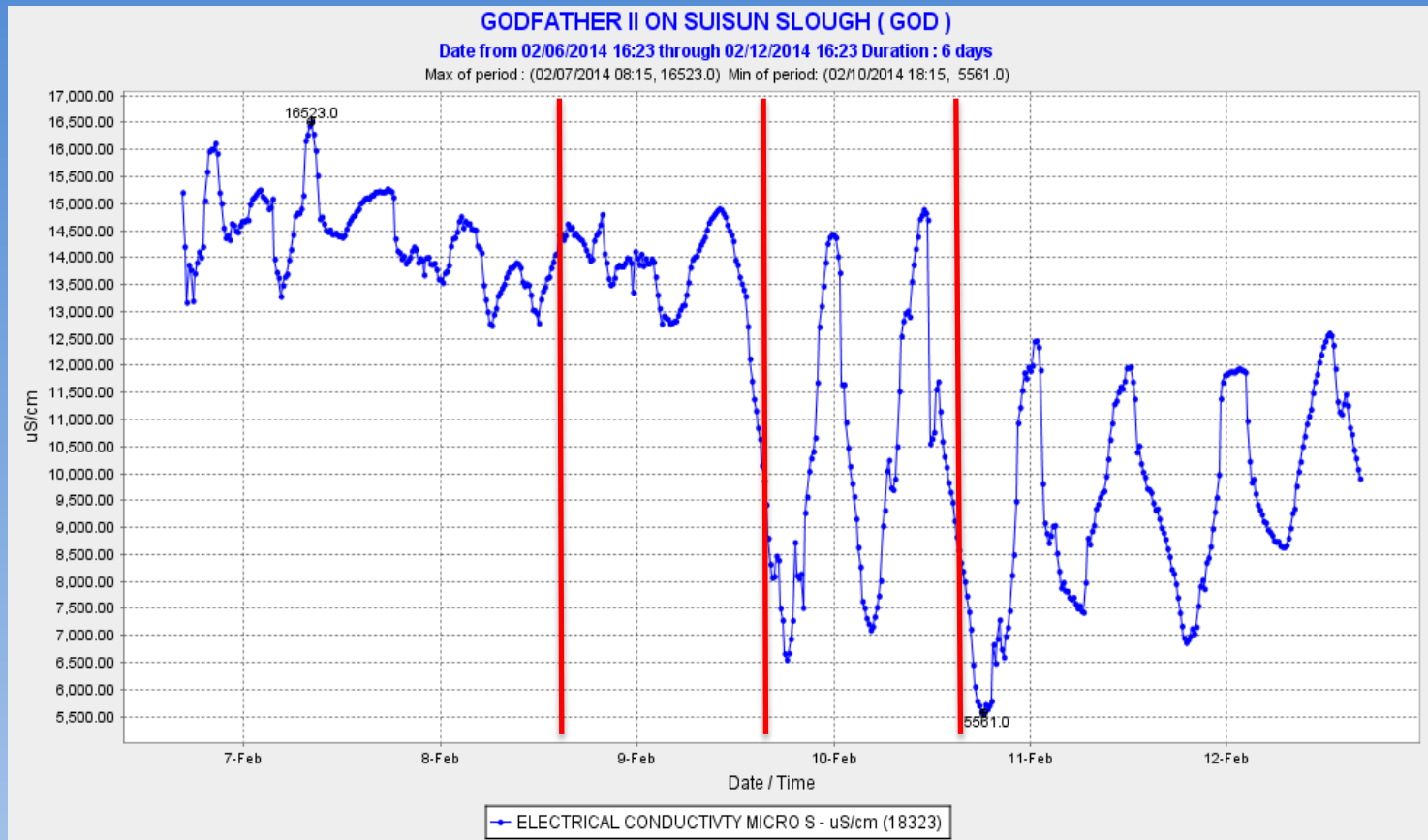
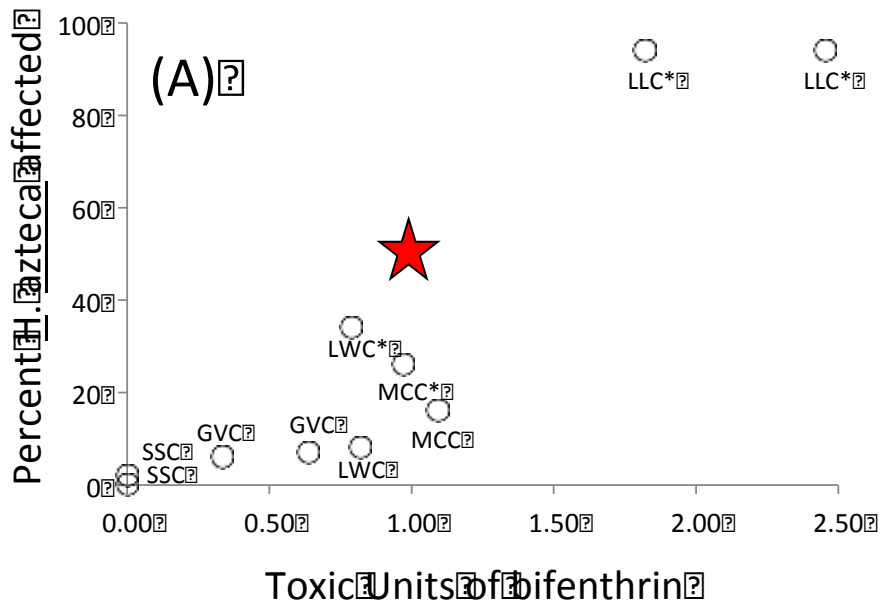


Figure 3. Conductivity throughout the storm event near the SSO sampling site near the mouth of Suisun Slough. SSO was only sampled once (on Feb. 10), so the vertical lines indicate the times of sampling at site SSV, the other site on Suisun Slough. From http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=GOD

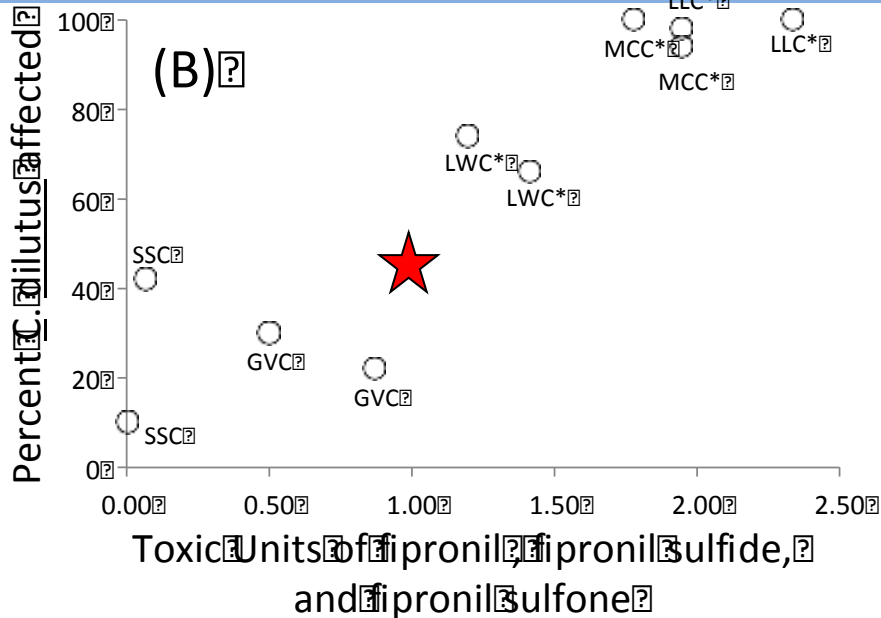
Exceedances of benchmarks (one half lowest EC50 or LC50 in lit.)

	★	★	
	Urban Creeks	Mixed creeks	Agric. Creek
★ Bifenthrin (Hyalella EC50=3.3 ng/L)	6 of 6 (max 9.9 ng/L)	4 of 6 (max 4.4 ng/L)	0 of 3
★ Fipronil (Chironomus EC50= 33 ng/L)	5 of 6 (max 27 ng/L)	0 of 6	0 of 3
Fipronil sulfide (Chironomus EC50=9.9 ng/L)	1 of 6 (max 8.4 ng/L)	0 of 6	0 of 3
★ Fipronil sulfone (Chironomus EC50=7.7 ng/L)	6 of 6 (max 11.9 ng/L)	4 of 6 (max 7.3 ng/L)	0 of 3
Chlorpyrifos (Deleatidium LC50=50 ng/L)	0 of 6	0 of 6	0 of 3
Imidacloprid (Epeorus LC50=650 ng/L)	2 of 6 (max 1462 ng/L)	0 of 4	0 of 2

Urban creeks = Laurel and McCoy; Mixed creeks= Ledgewood and Green Valley; Agricultural creek = Suisun



Concentrations of fipronil, its degradates, chlorpyrifos, and imidacloprid all far below effect levels for *Hyalella*.



Concentrations pyrethroids, chlorpyrifos, and imidacloprid all far below effect levels for *Chironomus*.

In the Marsh sloughs...

- Bifenthrin and chlorpyrifos undetectable at <1 ng/L. (Imidacloprid not measured)
- Fipronil or its degradates found in 90% of slough samples, but usually <2 ng/L, never exceeding 8 ng/L.
- No toxicity to *Hyalella* in any sample (too saline to test with *Chironomus*).
- Dilution alone can explain much of the “improvement”. Estimates based on conductivity, as a proxy for salinity, suggest the slough samples were, on average, about half S.F. Bay water.

Conclusions

- The primary creeks draining Fairfield-Suisun City (McCoy, Laurel, LedgeWood) contain the pyrethroid bifenthrin, fipronil, and fipronil degradates at acutely toxic concentrations after rains.
- Toxicity to *Hyalella* and *Chironomus* was demonstrated, and other species may be at risk.
- Insecticide concentrations downstream of Fairfield are comparable to our data from urban creeks in many Bay area and Sacramento area cities.
- The creeks draining less-populous Cordelia and surrounding agricultural lands (Green Valley, Suisun) had lower insecticide concentrations and showed no toxicity.
- Dilution, degradation, and adsorption reduce insecticide concentrations in the sloughs to undetectable levels (bifenthrin, chlorpyrifos), or below those likely to be acutely toxic (fipronil and degradates).

Limitations

1. We focused on winter rains, and did not address agricultural pesticide use during the growing season.
2. Toxicity in the creeks could have implications to food availability for Suisun Marsh fishes if export of food organisms from the freshwater reaches to the sloughs.
3. Fipronil concentrations in the sloughs on the threshold of sublethal toxicity to the most sensitive freshwater species known (*Chironomus*). However, there are minimal data on toxicity of fipronil or degradates to brackish and marine species.
4. Focus was on lethality and paralysis to the test species. Did not address more subtle impacts (e.g. genotoxicity).