Department of Pesticide Regulation
Environmental Monitoring Branch
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STUDY 269. Surface Water and Sediment Monitoring in a Constructed Water Quality Pond in Folsom, CA, 2012-2013

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I. INTRODUCTION

The California Department of Pesticide Regulation (CDPR) Surface Water Program has been monitoring urban pesticide runoff in northern and southern California since 2008. The specific focus of Study 269 is surface water monitoring in the Sacramento area of northern California, where 24 different urban use pesticides have been detected (Table 1). The objectives of recent monitoring has been to: 1) identify the types of pesticides and their concentrations in urban runoff from selected sites in Roseville and Folsom, CA, and 2) to determine the magnitude of concentration decreases as runoff progresses through urban tributary streams and constructed water quality ponds (Ensminger 2011). Preliminary data indicate that water quality ponds have more promise than tributary streams to mitigate insecticide concentrations in urban runoff (Figure 1). For FY 2012-2013 we will further determine the effectiveness of the Folsom water quality pond in mitigating pesticide runoff. Monitoring in Roseville will be put on a six month hiatus to devote resources to this objective.

II. OBJECTIVES

For FY 2012–2013, the objectives of this Study 269 are four-fold:
1) Determine the presence and concentrations of selected pesticides in two urban storm drain outfalls which are at inlets to a water quality pond in Folsom, CA;
2) Compare the presence and concentrations of selected pesticides at the water quality pond inlet to the pesticide concentrations at a) the water quality pond outlet, and b) at the water quality pond outlet after it passes through a streamed area;
3) Determine the presence and concentrations of selected pesticides exiting from the entire neighborhood in Folsom CA;
4) Assess whether detected pesticides are at concentrations that could be potentially toxic to aquatic organisms by comparing the data to US EPA aquatic life benchmarks (US EPA 2012) or to water quality criteria (Fojut 2011a, 2011b).

III. PERSONNEL

The study will be conducted by staff from the CDPR's Environmental Monitoring Branch under the general direction of Kean S. Goh, Environmental Program Manager I (Supervisory). Key personnel are listed below:

- Project Leader: Michael Ensminger, Ph.D.
- Field Coordinator: Kevin Kelley

- Senior Scientist: Frank Spurlock, Ph.D.
- Laboratory Liaison: Sue Peoples
- Analytical Chemistry, water: Center for Analytical Chemistry, Department of Food and Agriculture (CDFA)
- Analytical Chemistry, sediment: Department of Fish and Game
- Collaborator: Lorence Oki, Ph.D., University of California at Davis, CE Associate Specialist, Landscape Horticulture, Department of Environmental Horticulture, Phone: (530) 754-4135, Email: lroki@ucdavis.edu

Please direct questions regarding this study to Michael Ensminger, Staff Environmental Scientist, at (916) 324-4186 or mensminger@cdpr.ca.gov.

IV. STUDY PLAN

Sampling will occur in Folsom, CA, located in the greater Sacramento area. Water samples will be collected at five different sites (Table 2 and Figure 2). FOL002 and FOL003 are outfalls from specific neighborhood areas and are a measure of the runoff from urban homes. FOL002 and FOL003 are inputs to a water quality pond in Folsom, CA. FOL005 is the water quality pond output and sampling at this outfall will determine the effectiveness of the water quality pond to remove pesticide concentrations from the urban runoff. FOL006 receives the water from FOL005 without any further direct inputs but is buffered by additional water quality ponds which feed into FOL006. FOL100 is at the end of the Folsom, CA neighborhood with other inputs after the water quality pond (*i.e.*, FOL006). FOL100 will measure the total output the Folsom neighborhood is contributing to the environment. Additional monitoring in Roseville CA will be conducted at selected sites for long term monitoring (Ensminger 2011).

V. SAMPLING METHODS

There will be four dry season and three rainstorm sampling events (Table 3). Water samples will be collected generally as grab samples. However, some of the storm runoff samples will be composite samples collected by automated sampling equipment. Sediment samples will also be collected quarterly (Table 4).

VI. CHEMICAL ANALYSIS

The Center for Analytical Chemistry, California Department of Food and Agriculture, Sacramento, CA (CDFA) will conduct the pesticide analysis for water samples. CDFA will analyze six different analyte groups which will include 23 pesticides (Table 5). The California Department of Fish and Game (CDFG) will conduct pesticide analyses for pyrethroids in sediments (Table 6).

VII. DATA ANALYSIS

All data generated by this project will be entered to an access database that holds weather and field information, field measurements, and laboratory analytical data. All analytical data will also be uploaded into the CDPR Surface Water Database. We will use various nonparametric and parametric statistical methods to analyze the data. The data collected from this project may be used to develop or calibrate an urban pesticide runoff model.

VIII. TIMETABLE

Field Sampling:	July 2012 – June 2013
Chemical Analysis:	July 2012 – October 2013
Draft Report:	April 2014

IX. LABORATORY BUDGET

The total cost for the CDFA chemical analyses is $140,820 (water samples; Table 3) and $9100 (sediment samples; Table 4) from CDFG. This cost includes field QC sample analysis (field blanks and field duplicates).

X. LITERATURE CITED

Ensminger, M. 2011. Study 269: Further characterization of Sacramento, California area urban neighborhoods. Addendum for Fiscal Year 2011-2012. http://cdpr.ca.gov/docs/emon/pubs/protocol/study269protocol_add.pdf. Accessed 22 June 2012.

Fojut, T. J., Palumbo, A. J., Tjeerdema, R. S. (2012a). Aquatic life water quality criteria derived via the UC Davis method: II Pyrethroid Insecticides. In R.S. Tjeerdema (Ed.), Aquatic life water quality criteria for selected pesticides (pp. 51-103). Reviews of Environmental Contamination and Toxicology 216, doi:10.1007/978-1-4614-2260-0_3

Fojut, T. J., Palumbo, A. J., Tjeerdema, R. S. (2012b). Aquatic life water quality criteria derived via the UC Davis method: III. Diuron. In R.S. Tjeerdema (Ed.), Aquatic life water quality criteria for selected pesticides (pp. 105-141). Reviews of Environmental Contamination and Toxicology 216, doi:10.1007/978-1-4614-2260-0_3

U.S. Environmental Protection Agency (2012). Office of Pesticide Programs. Aquatic life benchmarks. http://www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm. Accessed 22 June 2012.

Table 1. Pesticides detected in the Sacramento area during CDPR urban monitoring, 2008-2012.

Pesticide	Number of Detections[a]		Pesticide	Number of Detections	
	Folsom	Roseville		Folsom	Roseville
2,4-D	20	56	Fipronil desulfinyl	1	13
Bifenthrin	20	78	Fipronil sulfone	2	20
Carbaryl	2	13	Imidacloprid[b]	4	9
Chlorothalonil[b]	1	0	Lambda-cyhalothrin	0	2
Chlorpyrifos	0	1	Malathion	3	16
Cyfluthrin	2	21	MCPA	3	16
Cypermethrin	2	18	Oryzalin[c]	--	3
Diazinon	1	3	Pendimethalin[c]	--	15
Dicamba	12	50	Permethrin	1	13
Diuron	4	19	Prodiamine[c]	--	5
Fipronil	4	44	Prometon	2	3
Fipronil amide	1	1	Triclopyr	10	31

[a]Folsom, 24 sampling events at 6 sites; Roseville, 104 sampling events at 15 sites

[b]Chlorothalonil and imidacloprid added July 2011

[c]Oryzalin, pendimethalin, and prodiamine were not monitored for in Folsom and discontinued monitoring for in Roseville after May 2009.

Table 2. Sampling sites in Folsom CA.

Site	Type/Describe	No. Homes[§]	Area[§] (Acres)	Sampling Type (Matrix)	GPS Coordinates (WGS84)	
					Latitude	Longitude
FOL002	Stormdrain outfall; input into water quality pond at Brock Circle	252	58	Sediment Water	38.65030	-121.14494
FOL003	Stormdrain outfall; input into water quality pond via (lower) Marsh Hawk Dr.	91	21	Sediment Water	38.64938	-121.14494
FOL005	Outflow from FOL002 and FOL003, through water quality pond			Sediment Water	38.64969	-121.14459
FOL006	Outflow fromWillow Springs Reservoir and water quality pond (FOL005) at (lower) Marsh Hawk Dr.			Sediment Water	38.649253	-121.144276
FOL100	Receiving water at Iron Point Rd., near Buckingham Way			Water	38.64559	-121.14442

[§]Approximate number of homes and area.

Table 3. Analytical cost estimates for urban water samples collected in Study 269, FY 2012-2013, and analyzed by CDFA

Sampling Date	Analyte Screen*						Grand Total
	CT	FP/OP	IMD	PD	PX	PY-6	
Aug 1, 2012 (dry season)	6	6	6	6	6	6	
Sept 5, 2012 (dry season)	0	6	6	6	6	6	
First Flush Rain, Oct/Nov 2012	0	6	6	6	6	6	
Winter Rain, Feb 2013	0	6	6	6	6	6	
Spring Rain Mar/April 2013	0	6	6	6	6	6	
May 29, 2013 (dry season)	0	6	6	6	6	6	
June 26, 2013(dry season)	0	6	6	6	6	6	
Total Number of Chemical Analyses	6	42	42	42	42	42	
Cost per Screen	$550	$840	$600	$540	$690	$600	
Total Analyte Screen Costs	$3,300	$35,280	$25,200	$22,680	$28,980	$25,200	$140,820

*CT = chlorothalonil; FP/OP = fipronil and organophosphates (chlorpyrifos, diazinon, and malathion); IMD = imidacloprid; PD = pendimethalin; PX = synthetic auxin; PY-6 = pyrethroid

Table 4. Analytical cost estimates for urban sediment samples collected in Study 269, FY 2012-2013, and analyzed by CDFG

	Quarterly Samples	Total Samples	Cost per Sample	Total Cost
Number of Chemical Analysis	5	20	$455	$9100

Table 5. Chemical analysis of pesticides in the Northern California urban monitoring Study 269. All samples collected in water and the California Department of Food and Agriculture (CDFA) will conduct the analyses. Specific methods can be found at http://www.cdpr.ca.gov/docs/emon/pubs/em_methd_main.htm

Pesticide	Analyte Screen	Method Detection Limit (µg L^{-1})	Reporting Limit (µg L^{-1})
Fipronil	Fipronil (FP) + Organophosphate (OP)	0.004	0.05
Fipronil sulfide		0.003	0.05
Fipronil sulfone		0.005	0.05
Desulfinyl fipronil		0.003	0.05
Desulfinyl fipronil amide		0.005	0.05
Fipronil amide		0.005	0.05
Diazinon		0.0012	0.01
Chlorpyrifos		0.0079	0.01
Malathion		0.0117	0.04
Chlorothalonil	Chlorothalonil (CT)	0.0111	0.05
Imidacloprid	Imidacloprid (IMD)	0.0101	0.05
Pendimethalin	Pendimethalin (PD)	0.019	0.05
2,4-D	Synthetic Auxin (PX)	0.015	0.05
Dicamba		0.017	0.05
MCPA		0.022	0.05
Triclopyr		0.020	0.05
		Pyrethroid units in ng L^{-1}	
Bifenthrin	Pyrethroid (PY-6)	1.76	5.0
Lambda-cyhalothrin		1.15	15.0
Permethrin cis		3.52	15.0
Permethrin trans		7.68	15.0
Cyfluthrin		1.73	15.0
Cypermethrin		1.75	15.0
Fenvalerate/Esfenvalerate		1.75	15.0

Table 6. Chemical analysis of pesticides in the Northern California urban monitoring Study 269. All samples collected in sediments and the Department of Fish and Game (DFG) will conduct the analyses.

Pesticide	Method Detection Limit (ng g^{-1} dry wt)	Reporting Limit (ng g^{-1} dry wt)
Bifenthrin	0.5	1
Cyfluthrin	2	4
Cypermethrin	2	4
Deltamethrin	2	4
Esfenvalerate/Fenvalerate	1	2
Fenpropathrin	2	4
Lambda cyhalothrin	1	2
Permethrin, cis	4	8
Permethrin, trans	4	8

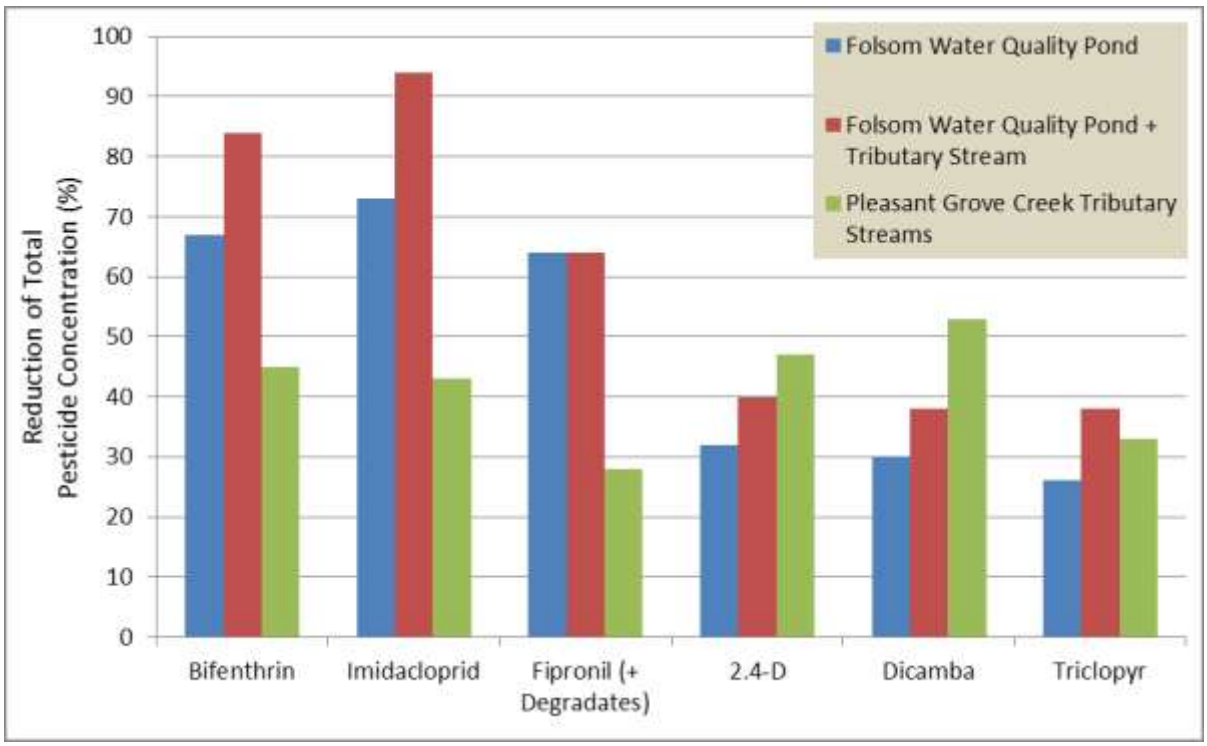

Figure 1. Comparison of the effectiveness of tributary streams in Roseville, CA to the constructed water quality pond in Folsom, CA in removing pesticide concentrations from urban runoff.

Figure 2. The five sampling sites in Folsom CA. Drainage area for FOL002 (F2) and FOL003 (F3) are outlined in same color as the marker.