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Environmental Monitoring Branch
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STUDY 269. FURTHER CHARACTERIZATION OF SACRAMENTO, CALIFORNIA AREA URBAN NEIGHBORHOODS. ADDENDUM FOR FISCAL YEAR 2011-2012

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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. Study 269 specifically deals with monitoring in the Sacramento area of northern California, where 26 different urban use pesticides have been detected (Table 1). However, two other major use urban pesticides have not been included in this work: chlorothalonil and imidacloprid (Ensminger 2010). Chlorothalonil is a broad spectrum non-systematic foliar applied fungicide. In California its major uses are on tomatoes, almonds, and for landscape maintenance. In 2009, over 80,000 lb ai (active ingredient) of chlorothalonil was applied statewide in urban areas (CDPR 2010). Chlorothalonil is moderately persistent and highly toxic to fish and aquatic invertebrates (PPDB 2011). In the Sacramento area, the highest urban use of chlorothalonil is in July, August, and September (Figure 1). Imidacloprid is a neonicotinoid insecticide used to control sucking insects, some chewing insects including termites, soil insects, and fleas on pets. In addition to its topical use on pets, imidacloprid may be applied to structures, crops, soil, and as a seed treatment (NPIC 2010). Imidacloprid is fairly water soluble and persistent, thus it has been found in ground and surface waters (Fossen 2006). Imidacloprid has low toxicity to fish but moderate to high toxicity to aquatic invertebrates (PPDB 2011). In 2009, statewide, over 30,000 lb ai of imidacloprid was applied in urban areas. Imidacloprid has been detected in over half of the water samples from Southern California during routine monitoring (R. Budd, personal communication). Sacramento area has slightly higher reported urban use than does Orange County (Figure 2).

II. OBJECTIVES

For FY 2011 – 2012, Study 269 will focus on two main objectives: 1) determine if various urban mitigation measures reduce the runoff of pesticides into mainstem receiving waters, and 2) monitor for additional pesticides not previously looked for in CDPR's urban monitoring program in northern California. A third, new objective of the study will be to determine the toxicity of some of the sampling sites to the amphipod *Hyalella azteca*. The University of California at Davis Aquatic Toxicity Lab will conduct all toxicity testing and will prepare a separate QAPP/protocol for this testing.

III. PERSONNEL

The study will be conducted by staff from the CDPR's Environmental Monitoring Branch under the general direction of Sheryl Gill, Senior Environmental Scientist. 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: Center for Analytical Chemistry, Department of Food and Agriculture (CDFA)
- Collaborator: Lorence Oki, 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, Environmental Scientist, at (916) 324-4186 or mensminger@cdpr.ca.gov.

IV. STUDY PLAN

Sampling will occur in Folsom and Roseville, CA, both located in the greater Sacramento area. During the development of newer neighborhoods in these cities several mitigation structures were developed or left intact. In Roseville, riparian buffers separate city neighborhoods from Pleasant Grove Creek. These riparian buffers mimic non-vegetative ditches, which have been shown to reduce agricultural runoff. Holding ponds and wetlands may be a better mitigation strategy (Reichenberger et al. 2007). In Folsom, these types of structures have been used to separate a community creek from urban areas. In FY 2011 – 2012, we will evaluate the efficicacy of both mitigation structures to reduce urban runoff. In Roseville, we will continue to monitor riparian buffers (Figure 3) as described in the original protocol. Sites PGC010, PGC021, and PGC022 will also be used to determine the presence of chlorothalonil and imidacloprid runoff from their respective neighborhoods. In addition, we will collect samples at downstream monitoring sites at the western edge of Roseville in Pleasant Grove Creek and in Dry Creek (Figure 4).

In Folsom, we will collect water samples at six different sites to characterize the effectiveness of a pond and wetlands to reduce pesticide runoff into a mainstem creek (Table 2 and Figure 5). FOL001 and FOL002 were sampled in Urban Study 264 and by Oki and Haver (2009); they will also be used to determine the presence of chlorothalonil and imidacloprid runoff from their respective neighborhoods. At all sites, monitoring chlorothalonil and imidacloprid will coincide with high use periods (Figures 1 and 2) as well as the first flush rainstorm of the 2012 water year.

V. SAMPLING METHODS

There will be three baseflow and three storm sampling events. Not all water samples at every sampling event will be analyzed for the same pesticides. We will make decisions on which pesticides to analyze for based on use patterns and previous detections in these two sampling areas (Tables 1, 3). Water samples will be collected generally as grab

samples. However, some of the storm runoff samples from Folsom will be composite samples collected by automated sampling equipment during the length of the storm. No sediment samples will be collected.

VI. CHEMICAL ANALYSIS

The Center for Analytical Chemistry, California Department of Food and Agriculture, Sacramento, CA (CDFA) will conduct the pesticide analysis for the study. CDFA will analyze seven different analyte groups which will include 25 pesticides (Table 4). In addition to adding chlorothalonil and imidacloprid, CDFA will analyze for pendimethalin and four synthetic auxin herbicides; carbaryl, simazine, and diuron will be dropped from the study.

VII. DATA ANALYSIS

All data generated by this project will be entered to a central database that holds all data including weather and field information, field measurements, and laboratory analytical data. 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 2011 – June 2012
Chemical Analysis:	July 2011 – October 2012
Draft Report:	April 2013

IX. LABORATORY BUDGET

The total cost for the CDFA chemical analyses is $143,475. This cost includes QC sample analysis (field blanks and field duplicates) (Table 3).

X. LITERATURE CITED

CDPR 2010. California Department of Pesticide Regulation's Pesticide Information Portal, Pesticide Use Report (PUR) data. http://www.cdpr.ca.gov/docs/pur/purmain.htm. Accessed 9 June 2011.

Ensminger, M. 2010. Study 269: Further characterization of a Sacramento, California area urban neighborhood. Accessed at http://cdpr.ca.gov/docs/emon/pubs/protocol.htm?filter=surfwater on 15 July 2011.

Pesticide Properties Database (PPDB). 2011. Accessed at http://eu-footprint.org/ppdb.html on 9 June 2011.

Fossen, M. 2006. Environmental fate of Imidacloprid. Accessed at http://cdpr.ca.gov/docs/emon/pubs/fatememo/Imidclprdfate2.pdf on 9 June 2011.

NPIC. 2010. Imidacloprid: Technical data sheet. Accessed at http://npic.orst.edu/factsheets/imidacloprid.pdf on 9 June 2011.

Oki, L. and D. Haver. 2009. Monitoring pesticides in runoff in Northern and Southern California neighborhoods. http://www.cdpr.ca.gov/docs/emon/surfwtr/presentations.htm. Accessed 12 July 2011.

Reichenberger, S., M. Bach, A. Skitschak, and H-G. Frede. Mitigation strategies to reduce pesticide inputs into ground- and surface water and their effectiveness; A review. 2007. Sci of the Total Environ 384:1-35.

Table 1. Pesticides detected in Sacramento area during CDPR urban monitoring, 2008 – 2011.

Pesticide	Number of Detections	Pesticide	Number of Detections
2,4-D	55	Fipronil amide	8
Aldicarb	2	Fipronil sulfide	8
Bifenthrin	61	Fipronil sulfone	20
Carbaryl	11	Lambda-cyhalothrin	1
Chlorpyrifos	1	Malathion	17
Cyfluthrin	11	MCPA	18
Cypermethrin	13	Oryzalin	3
Desulfinyl fipronil	21	Pendimethalin	15
Desulfinyl fipronil amide	2	Permethrin cis	4
Diazinon	5	Permethrin trans	5
Dicamba	44	Prodiamine	5
Diuron	24	Prometon	6
Fipronil	41	Triclopyr	13

Table 2. Sampling sites in Folsom CA.

Site	Type/Describe	No. Homes[§]	Area[§] (Acres)	GPS Coordinates (WGS84)	
				Latitude	Longitude
FOL001	Stormdrain outfall; input into pond from (upper) Marsh Hawk Dr.	163	37	38.65567	-121.144001
FOL002	Stormdrain outfall; input into wetland at Brock Circle	252	58	38.65030	-121.14494
FOL003	Stormdrain outfall; input into wetland via (lower) Marsh Hawk Dr.	91	21	38.64938	-121.14494
FOL004	Outflow from pond and FOL001			38.652111	-121.143899
FOL005	Outflow from FOL002 and FOL003, through wetland			38.64969	-121.14459
FOL006	Outflow from pond (FOL004) and wetland (FOL005) at (lower) Marsh Hawk Dr.			38.649253	-121.144276

[§]Approximate number of homes and area.

Table 3. Analytical cost estimates for urban samples collected in Study 269, FY 2011-2012.

Sampling Date	Analyte Screen							Grand Total
	CT	FP	IMD	OP (short)	PD	PX	PY-6	
Aug 1 and 2, 2011	10	13	10	0	0	13	13	
Sept 20, 2011	8	0	8	0	0	0	0	
First Flush Rain (Oct/Nov) 2011	8	13	8	13	0	13	13	
Winter Rain 2012	0	10	6	10	10	10	10	
Spring Rain 2012	0	10	5	10	10	10	10	
June 28, 2012	0	10	0	0	0	10	10	
Total Number of Chemical Analysis	26	56	37	33	20	56	56	
Cost per Screen	$550	$450	$500	$500	$450	$575	$500	
Total Analyte Screen Costs	$14,300	$25,200	$18,500	$16,500	$9,000	$32,200	$28,000	$143,700**

*CT = Chlorothalonil; FP = fipronil; IMD = Imidacloprid; OP = Organophosphate; PD = Pendimethalin; PX = Synthetic auxin; PY-6 = Pyrethroid.

**Budgeting costs paid by CDPR.

Table 4. Chemical analysis of pesticides in the Northern California urban monitoring Study 269. All samples collected in water. 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)	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
Chlorothalonil	Chlorothalonil (CT)	0.0111	0.05
Imidacloprid	Imidacloprid (IMD)	0.0101	0.05
Pendimethalin	Pendimethalin (PD)	0.019	0.05
Diazinon	Organophos-phate (OP) short	0.0012	0.01
Chlorpyrifos		0.0079	0.01
Malathion		0.0117	0.04
Methidathion		0.0111	0.05
Dimethoate		0.0079	0.04
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

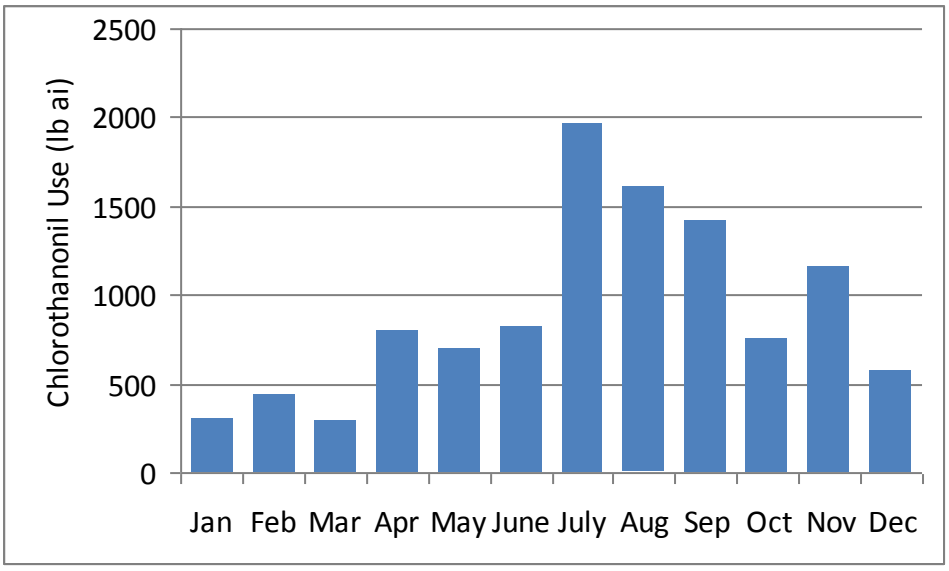

Figure 1. Chlorothalonil urban use in Placer and Sacramento and Counties, 2008 – 2009 (CDPR 2010). Data from CDPR Pesticide Use Report (CDPR 2010).

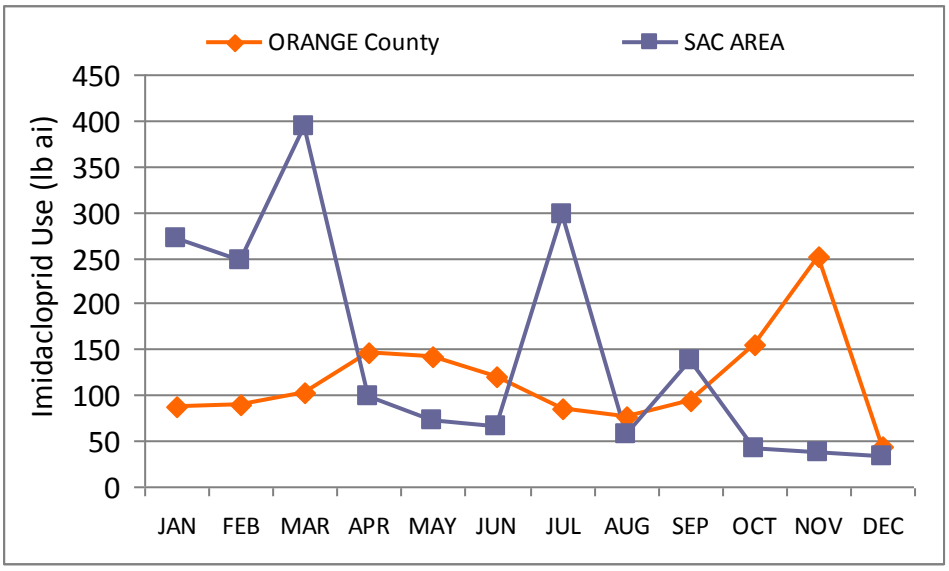

Figure 2. Imidacloprid urban use in Orange County and in the greater Sacramento area (average of 2008 – 2009; CDPR 2010).

Figure 3. Riparian buffer monitoring sites in Roseville, CA.

Figure 4. Sampling sites in Roseville, CA (PGC010, PGC015, PGC021, PGC022, PGC025, PGC060, DRY100).

Figure 5. Sampling sites in Folsom CA. FOL001, FOL002, and FOL003 are storm drain outfalls (with drainage area outlined in same color as marker), FOL004 is outfall from Marsh Hawk pond, FOL005 is outfall from wetland, and FOL006 is outfall from both the pond and wetland.