

Special Study Proposal: Imidacloprid in Ambient Bay Water

Summary: Imidacloprid is a widely used neonicotinoid insecticide. Recent RMP-funded monitoring of 24-hour composite samples of influent and effluent from eight Bay wastewater treatment plants (WWTPs) found levels in discharged effluent that exceed an established aquatic toxicity threshold. Imidacloprid has been intermittently detected in Bay Area creeks at levels above this threshold. The proposed study would screen ambient water samples from San Francisco Bay to determine whether levels of imidacloprid, common imidacloprid degradates, and other neonicotinoid pesticides approved for use in California exceed aquatic toxicity thresholds. Findings are essential to appropriate classification of imidacloprid and other neonicotinoids within the RMP’s tiered risk framework for contaminants of emerging concern (CECs), and may influence ongoing efforts within the California Department of Pesticide Regulation aimed at reducing environmental contamination and ecological impacts of current use pesticides.

Estimated Cost: \$40,110

Oversight Group: ECWG

Proposed by: Rebecca Sutton and Jennifer Sun (SF EI)

PROPOSED DELIVERABLES AND TIMELINE

Deliverable	Due Date
Task 1. Project Management (manage subcontracts, track budgets)	2017
Task 2. Develop detailed sampling plan	Spring 2017
Task 3. Field Sampling	Summer 2017
Task 4. Lab analysis	Fall 2017
Task 5. QA/QC and data management	Winter 2017
Task 6. Draft fact sheet	3/31/2018
Task 7. Final fact sheet	6/30/2018

Background

Imidacloprid, a common neonicotinoid insecticide with many urban uses, has recently been identified as highly toxic to aquatic organisms (Morrissey et al. 2015). Chronic toxicity data indicate that mayflies, chironomids, and mysids can experience long-term effects like immobilization at concentrations <100 ng/L (Morrissey et al. 2015). A recent European Union evaluation of imidacloprid toxicity data (EC 2015) has established a predicted no effect concentration (PNEC) of 4.8 ng/L based on impacts to mayfly nymphs (Roessink et al. 2013). A PNEC specific to the marine or estuarine environment has not been established;

the freshwater PNEC is recommended as the most relevant and protective existing toxicity threshold.

In response to these concerns, the RMP funded a 2016 Special Study, now nearing completion, to assess imidacloprid levels in influent and effluent from Bay Area wastewater treatment plants (Sadaria et al., in prep). Imidacloprid was detected in all samples, with influent levels in the range 58-310 ng/L and effluent levels in the range 84-310 ng/L. Levels in discharged effluent were as much as 60 times greater than the PNEC of 4.8 ng/L. Imidacloprid has also been detected in urban creeks in the Bay Area at levels that exceed this toxicity threshold (Weston et al. 2015).

As both stormwater and wastewater in the Bay Area have been found to contain levels of imidacloprid exceeding a protective aquatic toxicity threshold, monitoring of ambient Bay waters is now recommended. Should dilution and other relevant environmental processes prove insufficient to reduce the levels of imidacloprid below the PNEC of 4.8 ng/L, it may be considered appropriate to classify this widely used pesticide as a Moderate Concern (Tier III) emerging contaminant in San Francisco Bay via the RMP CEC Risk and Management Action Framework (Sutton et al. 2013; Sutton and Sedlak 2015). Common imidacloprid degradates, as well as other neonicotinoid pesticides approved for use in California, will also be monitored as part of this study.

Study Objectives and Applicable RMP Management Questions

This study will provide data essential to determining the placement of imidacloprid and other neonicotinoids in the RMP’s tiered risk framework, which guides monitoring and management actions on emerging contaminants in San Francisco Bay (Sutton et al. 2013; Sutton and Sedlak 2015). Existing data on imidacloprid in stormwater and wastewater suggest this pesticide in particular is a priority target for monitoring in Bay water. Management questions to be addressed by this study are the same as those of the overall RMP program, as shown in Table 1.

Table 1. Study objectives and questions relevant to RMP management questions.

Management Question	Study Objective	Example Information Application
1) Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?	Compare measured concentrations to toxicity thresholds.	Do findings suggest individual neonicotinoids should be classified as moderate concern, low concern, or possible concern emerging contaminant within the RMP’s tiered risk framework? Do data indicate a need for management actions?
2) What are the concentrations and masses of contaminants in the Estuary and its segments? 2.1 Are there particular regions of concern?	Compare levels in different embayments.	Do specific embayments or regions appear to have greater levels of contamination?
3) What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary? 3.1. Which sources, pathways, etc. contribute most to impacts?	<i>(Previous RMP Special Study directly addresses this management question for imidacloprid.)</i>	
4) Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased? 4.1. What are the effects of management actions on concentrations and mass?		
5) What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?	Review results alongside available projections of use and potential control actions under consideration by state and federal pesticide agencies.	Which anticipated changes or actions are likely to have the greatest impact on neonicotinoid pollution? Are additional/different actions needed?

This monitoring effort would most directly address question 1, determining whether contaminant levels exceed a toxicity threshold. Inferences regarding regional or future pollution patterns could involve interpretation of the data within the context of regional use data and potential changes in use or regulation of this pesticide, all of which may play a role in addressing questions 2 and 5.

In addition, the study will address the established emerging contaminants priority question: What emerging contaminants have the potential to adversely impact beneficial uses of the Bay? The RMP Tiered Risk and Management Action Framework does not include a specific classification for imidacloprid; findings should allow this pesticide to be listed as either a moderate concern (Tier III), low concern (Tier II), or possible concern (Tier I) for San Francisco Bay.

Approach

Ambient Bay Water Sampling

Bay water sample collection will take place in the summer of 2017 as part of the RMP's regular Status and Trends water monitoring cruise. Grab samples of ambient Bay water (1 L, amber glass, 7 day hold time) will be collected at all 22 Bay sites. Two field replicates and a field blank will also be collected.

Analytical Methods

Samples will be analyzed by AXYS Analytical or a comparable laboratory. Per sample analytical costs are estimated to be ~\$550 for AXYS.

AXYS Analytical is currently developing a new method to measure imidacloprid, common degradates including imidacloprid urea, and other neonicotinoid pesticides (e.g., acetamiprid, clothianidin, dinotefuran, nitenpyram, thiacloprid, thiamethoxam, imidaclothiz) in (total) water using a high performance liquid chromatograph coupled to a triple quadrupole mass spectrometer (HPLC-MS/MS). The expected instrument detection limit for imidacloprid is expected to be ≤ 2 ng/L, less than half the 4.8 ng/L PNEC (Roessink et al. 2013).

Budget

The following budget represents estimated costs for this proposed special study (Table 3). Efforts and costs can be scaled back by reducing the number of sites sampled.

Table 3. Proposed Budget.

Expense	Estimated Hours	Estimated Cost
Labor		
Project Staff	138	20,500
Senior Management Review	6	960
Project Management		0*
Contract Management		0*
Data Technical Services		2,500
GIS Services		300
Creative Services		750
IT Services		0
Communications		0
Operations		0
Subcontracts		
Name of contractor		
AXYS or comparable lab		13,750
Direct Costs		
Equipment		0
Travel		0
Printing		150
Shipping		1,200
Other		0
Grand Total		40,110

*services included in the base RMP funding

Budget Justification

Field Costs

Field costs are minimized through sample collection during the RMP's 2017 Status and Trends water sampling cruise.

Laboratory Costs

Analytical costs per sample are estimated to be ~\$550. For 25 samples, including two field replicates and a field blank, the total analytical costs will be \$13,750.

Data Management Costs

Standard data management procedures and costs will be used for this project. Final quality assured data will be uploaded to CEDEN and will be publicly accessible through CD3 (cd3.sfei.org).

Reporting

Results will be provided to the RMP committees in the form of a draft report by 1/31/18, which will be reviewed by ECWG and the TRC. Comments will be incorporated into the final report published by 4/30/18.

References

EC (European Commission). 2015. Directive 98/8/EC concerning the placing of biocidal products on the market; Imidacloprid; Product-type 18 (Insecticides, Acaricides and Products to control other Arthropods). Standing Committee on Biocidal Products.

Morrissey, C.A., Mineau, P., Devries, J.H., Sanchez-Bayo, F., Liess, M., Cavallaro, M.C., Liber, K., 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: a review. *Environ Int* 74, 291-303.

Roessink, I., Merga, L.B., Zweers, H.J., Van den Brink, P.J., 2013. The neonicotinoid imidacloprid shows high chronic toxicity to mayfly nymphs. *Environ Toxicol Chem* 32, 1096-1100.

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