SFCWA State and Federal Contractors Water Agency

FACT SHEET

Effect of insecticides and herbicides of concern to the Cache Slough Complex upon primary and secondary producers (15-14)

Deliverables: Deliverables will be a study plan, quarterly, and final reports describing the study and results; one presentation at a local or national science conference, one presentation to SFCWA representatives, designees and staff, and at least one publication.

Status: Preparing of mesocosm tanks for field experiment in progress, as well as literature research on pesticides selected for this study. Also, meeting with SFCWA project manager to discuss details of the study scheduled for mid-November.

Primary Investigator: Richard E. Connon (PI), Sharon P. Lawler (Co-PI)	**Recipient Organization:** UC Davis
Project Cost: 165,005 (including 20% indirect costs)	**SFCWA Funding:** 165,005

Partners: Thomas Young, Department of Civil and Environmental Engineering, University of California, Davis

Introduction

A number of pesticides, including a growing number of herbicides, have been repetitively detected within the main Cache Slough Complex (CSC) watershed and its tributaries, as well as throughout the Bay-Delta system; frequently detected herbicides include diuron and hexazinone, and the diuron degradates 3,4-dichloroaniline and N-(3,4-dichlorophenyl)-N'-methylurea (DCPMU) (Orlando et al, 2013). Commonly detected insecticides include the pyrethroids bifenthrin and lambda-cyhalothrin, and the organophosphate chlorpyrifos; these have been determined to enter the CSC via Ulatis Creek and Lindsey Slough (Weston et al., 2013), and are highly toxic to aquatic invertebrates (e.g., Lawler et al. 2007, Weston et al, 2013, Hasenbein et al, submitted) and fish (e.g., Lawler et al. 2003, Beggel et al, 2011, Brander et al, 2012, 2013). These insecticides and herbicides, either singly, or in concert, have the potential to affect the food sources of larval fish within this important fish nursery system.

Current and planned restoration projects aim at increasing primary and secondary productivity to supply energy to the pelagic food-webs supporting threatened and endangered fish species such as delta smelt and winter run chinook salmon. It is therefore essential to understand the level of impact that contaminants pose on fish food production.

Standard toxicity assessments have relied on the assessment of the active ingredients of common use pesticide formulations. Our research has highlighted that metabolized compounds (metabolites) and pesticide formulations (so called "inert ingredients") can be more toxic than their active ingredients (Beggel et al, 2010, see also Mesnage et al. 2014).

This project aims to investigate the effect of single and mixture pesticide exposures, at concentrations measured within the Bay

-Delta, on both primary and secondary production, incorporating population growth rates, and community structure assessments. We will use a combination of laboratory studies and long-term field based mesocosms, and conduct exposures of co-occurring pesticides on seasonally relevant species.

Objective

The overall purpose of this project is to determine the level of impact of pesticide mixtures, including both herbicides and insecticides commonly found in the Bay-Delta, on both primary and secondary production. A secondary goal is to quantify differences in impact levels between active ingredients and commercial formulations. Our objectives are thus to evaluate the toxicity of both formulations and active ingredients of common herbicides and insecticides; including degradates, at concentrations that are present in the Bay-Delta, on both single species of phytoplankton and aquatic invertebrates, as well as on invertebrate communities.

Results

We will answer the following research questions:

1. What are the effects of herbicides upon invertebrate survival and reproduction, population growth rates, and communities due to indirect (food quality and quantity) toxicity?
2. How do binary mixtures of insecticides and herbicides directly and indirectly affect invertebrate communities?
3. What are the differences in toxicities between formulations and active ingredients of commonly used insecticides and herbicides?

Conclusions

1. We will gain new information on effects on nutrients and low-food chain organisms in the CSC following short-term and long-term pesticide exposures.
2. Sublethal and lethal responses of fish prey species will be used to determine effects of pesticides on communities in the main CSC watershed and its tributaries.

Relevance

This study addresses issues of primary concern within the CSC and the Bay-Delta System. It investigates effects, besides nutrient source and quality, focusing on inhibitors of phytoplankton (herbicides) and invertebrate (insecticides) population growth, and community structure; studies which will be conducted under controlled laboratory conditions and supported, or validated, within field based mesocosms.

Next Steps

Study results will be used to interpret continuous monitoring data in Delta habitats and will give more information on effects on nutrients and low-food chain organisms in the Delta. Information on sublethal and lethal impacts of contaminants on fish prey species will inform decision-making and protect fish species utilizing the CSC as a habitat.