



Characterizing the ecological risk to the tidewater goby from pyrethroid use

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BACKGROUND

In the past three years, there have been two incidences of fish kills in the Oxnard and Port Hueneme regions of California in waters hydrologically connected to tidewater goby critical habitats. Tidewater gobies are small fish found in Californian lagoons, and were listed as endangered under the Endangered Species Act in 1994. These die-off events have been linked to high concentrations of pyrethroids, an insecticide used heavily in California and known to be toxic to aquatic organisms.



Pyrethroids

Chemical Properties

- Strong affinity for soil and other organic material
- Highly hydrophobic; low solubility in water
- Resistant to degradation

Application Rates

- In coastal California, including Ventura County, bifenthrin is the most heavily applied pyrethroid
- Since 2000, total bifenthrin applications in Ventura County have increased by an order of magnitude

Due to these chemical properties and widespread use, pyrethroids have been increasingly detected in the environment, but their ecological effects are poorly understood.

PROJECT OBJECTIVES

- Characterize pyrethroid use in coastal California
- Calculate and project pyrethroid hotspots for tidewater goby critical habitat throughout coastal California
- Recommend best management practices
- Estimate expected environmental concentrations in Ormond Lagoon



METHODS

Developed a geospatial representation of pyrethroid use at the watershed level for coastal California.

Watershed specific use of pyrethroids

Environmental modeling of pyrethroids

Estimated expected environmental concentrations of pyrethroids in Ormond Lagoon, utilizing EPA's Pesticide in Water Calculator model.

Watershed specific best management practices

Sampling in Ormond Lagoon

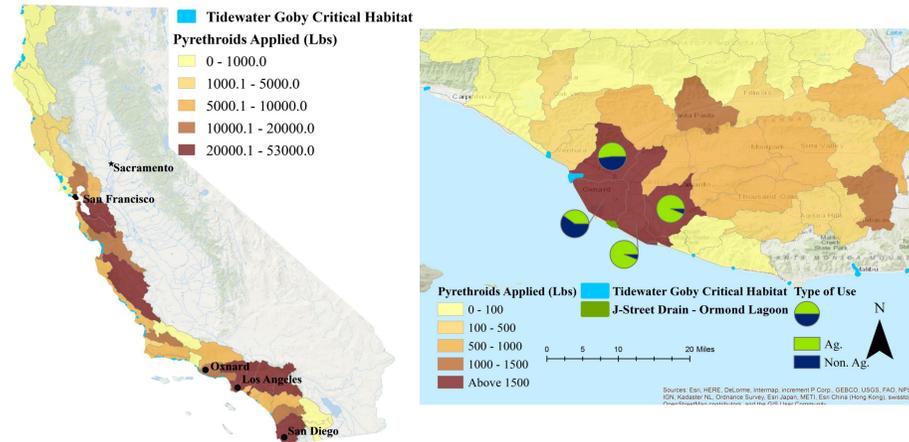
Identified best management practices to reduce ecological risk from pyrethroid application.

Collected samples to calculate current pyrethroid levels before and after precipitation events and to support modeling efforts.



RESULTS

Pyrethroid use along the coast of California



1

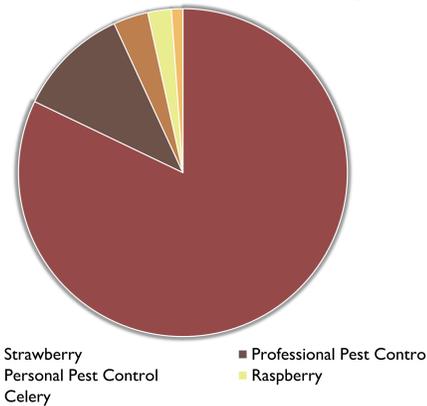
There is high spatial variability of pyrethroid use across coastal watersheds. Many areas with concentrated use (SF Bay, Salinas, LA) drain into tidewater goby critical habitat.

2

In Oxnard, the areas with the highest rates of application are concentrated nearest Ormond Lagoon. Smaller watershed units show the variability in location of use, and the type (Ag. or Non Ag.)

Environmental modeling of pyrethroids

Sources of Bifenthrin in Ormond Lagoon



3

Strawberry production and pest control applications on impervious surfaces are the largest contributors of pyrethroids to the Ormond Lagoon Watershed.

4

Current pyrethroid use is likely adversely affecting tidewater gobies. Modeled results indicate both acute direct toxicity and negative indirect effects via diminished prey abundance.

Key Findings

Environmental pyrethroid concentrations are highest during spawning

83% of acutely toxic bifenthrin concentrations occur Nov-Feb

60% of all aquatic species affected by peak permethrin concentrations

Acute LC50 of bifenthrin for *Hyaella Azteca* is exceeded on over 99% of days modeled

Sampling in Ormond Lagoon

5

- More pyrethroids were found at higher concentrations following a rain event which agree with the model results
- The highest concentrations were found downstream of strawberry agriculture
- Results indicate that personal use of pyrethroids for home and yard pest control is also a significant contributor of toxicity

Watershed specific best management practices

6

In order to reduce pyrethroid runoff into waterways across coastal California watersheds, best management practices can be implemented based on sector (urban vs. agricultural) and type (behavioral vs. structural).

	Urban	Agricultural
Behavioral	<ul style="list-style-type: none"> • Communication system • Apply earlier in dry season • Apply granules over liquid • Pyrethroid substitutes such as boric acid 	<ul style="list-style-type: none"> • Integrated Pest Management • Polyacrylamide • Pyrethroid substitutes that are less toxic to fish
Structural	<ul style="list-style-type: none"> • Bioswales • Vegetative filter strips 	<ul style="list-style-type: none"> • Sediment basins • Vegetative filter Strips



CONCLUSIONS

- Current pyrethroid use is likely adversely affecting tidewater gobies
- Sources of pyrethroid contamination across California are watershed specific
 - In Ormond Lagoon, strawberry production contributes the most pyrethroids
- In the Calleguas Watershed, which contains Ormond Lagoon, over 13,000 pounds of pyrethroids are applied annually
 - There are six other coastal California watersheds with tidewater goby critical habitat that apply even greater annual loads of pyrethroids
- More proactive pesticide management by state and federal governments is required to minimize ecological risk from pyrethroids

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FURTHER INFORMATION

More information on the project can be found at our website: <https://tidewatergoby.weebly.com/>. You can also contact us directly at gg-gogobies@bren.ucsb.edu

