Characterizing the ecological risk to the tidewater goby from pyrethroid use

Chester Lindley, Jia Liu, Michael Patton, Alexander Prescott, Natalie Shahbol

Advisor: Arturo Keller
Client: Jenny Marek, U.S. Fish and Wildlife Service

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 California 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.

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

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

Sampling in Ormond Lagoon

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

Watershed specific best management practices

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

RESULTS

Pyrethroid use along the coast of California

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.

Environmental modeling of pyrethroids

- Strawberry
- Personal Pest Control
- Celery
- Professional Pest Control
- Raspberry

Key Findings

- Environmental pyrethroid concentrations are highest during spawning.
- 60% of all aquatic species affected by peak permethrin concentrations.
- 83% of acutely toxic bifenthrin concentrations occur Nov-Feb.
- Acute LC50 of bifenthrin for Hyallela azteca is exceeded on over 99% of days modeled.

CONCLUSIONS

- 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.
- Current pyrethroid use is likely adversely affecting tidewater gobies.
- Sources of pyrethroid contamination across California are watershed specific.
- In Oxnard 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.

ACKNOWLEDGEMENTS

We would like to thank the following people for their guidance, support, knowledge, and resources, which were invaluable for the completion of this project:

Faculty Advisor: Arturo Keller
Client: Jenny Marek and Kendra Chen, U.S. Fish and Wildlife Service
External Advisor: Jenny Newman, Los Angeles Regional Water Quality Control Board
Donor: James S. Bowker Foundation

REFERENCES


FURTHER INFORMATION

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