The effects of current-use, sediment-bound pesticides on a coastal marine system

Principal Investigator

Donald P. Weston
Department of Integrative Biology
University of California
3060 Valley Life Sciences Bldg.
Berkeley, CA 94720-3140
Phone: 510-665-3421
Fax: 510-665-6729
E-mail: dweston@berkeley.edu

Executive Summary

There are abundant data that pyrethroid insecticides, widely used in both agricultural and urban settings, are accumulating in river and stream sediments of California at concentrations acutely toxic to aquatic life. There are also many other strongly sediment-associated pesticides that are heavily used in agriculture, yet for which there are no data on their environmental distribution and no information on their toxicity to sediment-dwelling organisms. In the region of Monterey Bay, there are several rivers and creeks that carry very large amounts of sediments in to the coastal waters of the Monterey Bay National Marine Sanctuary. There are many reasons to believe that these sediments contain hydrophobic pesticides, potentially at concentrations toxic to aquatic life. Our own monitoring has shown extensive urban and agricultural-derived toxicity in the creeks of Salinas, and regional monitoring by an agriculture-associated group has reported about 80% of their sediment samples to be toxic to standard testing species. We are finding suspended sediment concentrations in runoff from Salinas lettuce fields far above those we are observing in Central Valley locations. Finally, other investigators have reported sediment toxicity and pyrethroids as a potential contributing factor in the Salinas River and other coastal rivers. Yet despite the obvious reasons for concern, there are no data on pyrethroid or other hydrophobic current-use pesticides in any open ocean environment in the U.S. Monterey Bay provides an ideal opportunity to study pesticide distribution and effects on coastal systems, not only because of the numerous rivers that discharge sediment to the Bay, but because of the special significance of the Monterey Bay National Marine Sanctuary, and the presence of a nearshore submarine canyon that provides a direct route of transport of pesticide-contaminated sediments to the deep ocean.

The proposed research will assess whether current-use, sediment-associated pesticides are reaching shelf sediments, if they are entering Monterey Canyon (a deep ocean environment), and if pesticide contributions from individual rivers can be differentiated. Sediment samples will be collected in depositional areas of Monterey Bay, with particularly intensive sampling off the mouths of the major rivers. Sediments will be analyzed for pyrethroid insecticides, as well as several other hydrophobic pesticides that have not been included in any monitoring program in

California, but for which we are now developing analytical methods. Suspended sediments obtained from the major rivers through an independent monitoring program will be analyzed for these same pesticides. With the pesticide signature of these river-specific suspended sediment samples, and pesticide use data provided by the California Department of Pesticide Regulation, we expect to identify distinguishing characteristics of the pesticides originating from these rivers to better delineate their zones of influence in shelf sediments and better describe sediment transport patterns. Benthic invertebrates will be collected on the shelf of Monterey Bay, and species distributions interpreted in light of the data gathered on pesticide concentrations in the sediment, particularly as they may affect crustaceans in the benthic community.

The proposed research will make several unique contributions. First, there have been very few studies on the effects of agricultural pesticides on coastal communities. Most pesticide studies have focused on riverine or lacustrine systems, but in our study area sediment of agricultural origin is discharged to the coastal zone. Secondly, this work would provide data on environmental distribution and toxicity of pyrethroid pesticides. Despite their wide use in agriculture and urban settings, there have been remarkably few assessments of their concentrations in the environment and no data from open ocean areas. Also, as part of a new initiative we will begin studying many other widely used hydrophobic pesticides which have been ignored by most monitoring programs. Finally, this study would be of considerable value to those making management decisions. Our preliminary work in the city of Salinas and other monitoring in the area has shown hydrophobic pesticides to be at acutely toxic concentrations in the sediments of rivers and streams surrounding Monterey Bay. If these sediments are reaching the protected waters of the Sanctuary while retaining toxic concentrations of these compounds, our findings could have a significant impact on the management policies in the Monterey Bay National Marine Sanctuary. State-wide policy changes by the Regional Water Quality Control Boards have prompted California agriculture to conduct studies of agricultural best management practices to provide growers a means to mitigate impacts. A better definition of the pesticides of concern and the extent of their effects on coastal communities, as our research would provide, would serve as valuable guidance to these efforts. Lastly, the California Department of Pesticide Regulation (DPR) has recently announced that pyrethroids are entering a process known as re-evaluation and any data on pyrethroids gathered over the next few years will be extremely valuable to DPR in this re-evaluation process, and could be pivotal to determining pyrethroid use practices in California for years to come.