UNIVERSITY OF CALIFORNIA
RIVERSIDE

Assessing Sediment Quality using Biomarkers in Various Flatfish Species off the Coast of Southern California

A Thesis submitted in partial satisfaction
of the requirements for the degree of

Master of Science

in

Soil and Water Sciences

by

Luke Aaron Roy

August 2002

Thesis Committee:
Dr. Daniel Schlenk, Chairperson
Dr. Michael Anderson
Dr. Paul Ziemann
Dr. Jeffrey L Armstrong

ABSTRACT OF THE THESIS

Assessing Sediment Quality using Biomarkers in Various Flatfish Species off the Coast of Southern California

by

Luke Aaron Roy

Master of Science, Graduate Program in Soil and Water Sciences
University of California, Riverside, August, 2002
Dr. Daniel Schlenk, Chairperson

The primary objective of this study involves the assessment of sediment quality, using feral flatfish species, with the ultimate goal of promoting a healthy and sustainable coastal marine ecosystem. Due to the complexity of assessing sediment quality across the wide variety of organisms found in coastal marine habitats, assessments will be conducted by investigating the individual and population level responses of three species of flatfish commonly found in southern California coastal waters. These include hornyhead turbot (*Pleuronichthys verticalis*), English sole (*Pleuronectes vetulus*), and bigmouth sole (*Hippoglossina stomata*). The specific ecologies and life histories of these benthic organisms allow for an accurate depiction of exposure and effects due to contaminated sediments. Biochemical markers have been widely used to assess the exposure and effects of polyaromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in marine organisms.

This study sought to assess sediment quality by means of separate field and laboratory investigations. The field study evaluated biochemical endpoints as well as

population and community metrics to explore possible detrimental effects in three species of flatfish. The biomarkers employed in this study included Cytochrome P-450 (CYP1A) expression, DNA damage, biliary fluorescent aromatic compounds (FACs), liver histopathology, and vitellogenin expression. Biochemical endpoints were compared to sediment chemistry, fish tissue chemistry, and population and community endpoints. The laboratory investigation evaluated the biochemical dose-response of hornyhead turbot exposed to different sediment PAH exposure regimes utilizing a re-circulating exposure system. CYP1A expression, DNA damage, and biliary FACs were compared to sediment PAH chemistry to determine chemical levels capable of illiciting a significant response. Results suggest that levels of sediment PAHs and PCBs in Southern California coastal waters are not high enough to cause population-level effects in the flatfish examined. A dose-responsive relationship was observed with increasing sediment PAH concentrations and DNA damage in hornyhead turbot. These sediment PAH concentrations are higher than field values surrounding the Orange County municipal outfall, which normally range several orders of magnitude lower.

Acknowledgements

I would first like to extend my appreciation to my major professor, Dr. Daniel Schlenk. Many doors and opportunities have opened for me throughout my tenure at UC Riverside thanks to your efforts and support. Working under your direction has made me a more creative and well-rounded scientist. I will definitely miss our philosophical discussions of SEC football and Southern nomenclature. Roll Tide!

I wish to extend my gratitude to Dr. Jeff Armstrong and the Orange County Sanitation District for allowing our participation in their field studies. I am also deeply indebted to Steve Bay and the Southern California Coastal Water Research Project for allowing us the use of their facilities and time. Thanks to Scott Steinert for all of the laughs in the field. Thanks to Bjarte Furnes, Rickey Kim, and Jeanne Kuhajek for your friendship and technical advice in the lab. Thanks also the other members of my committee, Dr. Michael Anderson and Dr. Paul Ziemann.

It is difficult to address all of the individuals who contributed to my general interest in the sciences and who have supported me in my endeavors over the years. I am indebted to my former undergraduate advisor and mentor, Dr. Paul Blanchard, for kindling my interest in the fields of fish ecology and toxicology. Thanks to Susan for the love and encouragement throughout these last two years. I also extend my appreciation to my family for their continuous support and belief in me. Last, but certainly not least, thanks God, for placing in me an interest to study, understand, and protect that which You created. As I close one chapter of my life and open yet another, my eyes focus on You for guidance and wisdom.