

California Ocean Protection Council/
USC Sea Grant Research
2007-2010




University of Southern California
The Urban Ocean Program





Published 2010 by
USC Sea Grant
University of Southern California
University Park, Los Angeles, CA 90089-0373
(213) 740-1961
www.usc.edu/org/seagrant

The research reported in this document was supported by the California Ocean Protection Council, www.opc.ca.gov

This publication has been produced with support from the National Sea Grant College Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, under grant number NA10OAR4170058, and by the California Natural Resources Agency.

The views expressed herein do not necessarily reflect the views of those organizations.

Sea Grant is a unique partnership of public and private sectors, combining research, education, and outreach for public service. It is a national network of universities meeting changing environmental and economic needs of people in our coastal ocean and Great Lakes regions.

USC Sea Grant Staff

- Linda Duguay, Director
- Phyllis Grifman, Associate Director
- Lyndell Whitley, Director of Education
- Linda Chilton, Education Programs Coordinator
- James Fawcett, Marine Transportation/Seaport Specialist, Extension Leader
- Juliette Hart, Regional Research and Planning Specialist
- Charlotte Stevenson, Science Communications Specialist
- Rick Hayduk, Information Technology Specialist
- Ruth Dudas, Office Manager

Introduction



Santa Monica Beach. (Photo credit: Charlotte Stevenson)

California's Ocean Protection Council (OPC) was created in accordance with the 2004 California Ocean Protection Act (COPA) to improve the management and protection of ocean and coastal resources and ecosystems. One of the many ways the OPC achieves this purpose, is by supporting innovative research that directly informs and improves the stewardship of ocean resources through a partnership with USC Sea Grant. The research reported in this document reflects the partnership between USC and the OPC.

The mission of the California Ocean Protection Council (<http://www.opc.ca.gov>) is to ensure that California maintains healthy, resilient, and productive ocean and coastal ecosystems for the benefit of current and future generations.

Beginning in early 2007 and again in 2009 (although funding was frozen until 2010), the OPC awarded funds to USC Sea Grant to administer peer-reviewed scientific research to address specific OPC research priorities, which were included in USC Sea Grant's annual Call for Proposals. This partnership resulted in a cost-savings to both programs, which collaborated on the scientific peer review and selection of proposals.

In the first round of research solicitation in 2007, Sea Grant and the OPC were specifically seeking projects that respond to the OPC's overarching priority – an ecosystem-based approach to the management of marine systems. The most recent round of research projects were required to address or substantially contribute to improving management decisions, protection, conservation, or restoration of the State's coastal and ocean water quality, a priority issue for both the OPC and USC Sea Grant. In addition to addressing these priority issues, all of these projects were required to pertain to the particular issues characterizing the "Urban Ocean," USC Sea Grant's primary and unique focus.

USC Sea Grant is pleased to share this summary of research that it has administered on behalf of the OPC. Projects for which the research has been completed are summarized first, followed by shorter summaries of projects that were ongoing at the writing of this report.



Port of Los Angeles. (Photo credit: Jim Fawcett)

Site Fidelity And Depth Preference Of Nearshore Reef Fishes On San Pedro Shelf Offshore Petroleum Platforms

#06-043
2007 – 2009

Dr. Christopher G. Lowe, California State University, Long Beach
562-985-4918, clowe@csulb.edu

Rationale:

Many of the 27 offshore petroleum platforms found along the California coast are forecasted to end production in the next decade, heightening the debate over the possible decommissioning options. Currently, state and federal management regulations in California require complete removal of offshore petroleum platforms within one year of ceased production; however, there is growing evidence that these structures support higher abundances of economically important fish than adjacent natural reefs, and questions have arisen as to the environmental pros and cons of leaving all or part of the existing platform structures after decommissioning.

Objectives:

- Assess the site fidelity of nearshore reef fishes to petroleum platforms on the San Pedro Shelf (SPS)
- Assess the depth preference of the same species relative to environmental conditions
- Compare the site fidelity of nearshore reef fish on petroleum platforms on the SPS with site fidelity of rockfish species on petroleum platforms in the Santa Barbara Channel (SBC)

Progress/Results:

Data collection for this project ended in January 2009, and findings suggest that San Pedro Shelf platforms provide important habitat for adults of nearshore reef fishes, which is supported by findings that individuals are sheltering and foraging at platforms for extended periods of time. All four study-species—cabezon, grass rockfish, kelp rockfish, and California sheephead—displayed high rates of site fidelity to San Pedro Shelf platforms for periods up to at least 1.5 yrs. The rates of site fidelity were found to be higher than those displayed by a majority of species inhabiting platforms on the Santa Barbara Channel. Each species displayed seasonal differences in depth utilization, suggesting that individuals make vertical movements within platform habitats to meet biological demands. (continued on page 5)

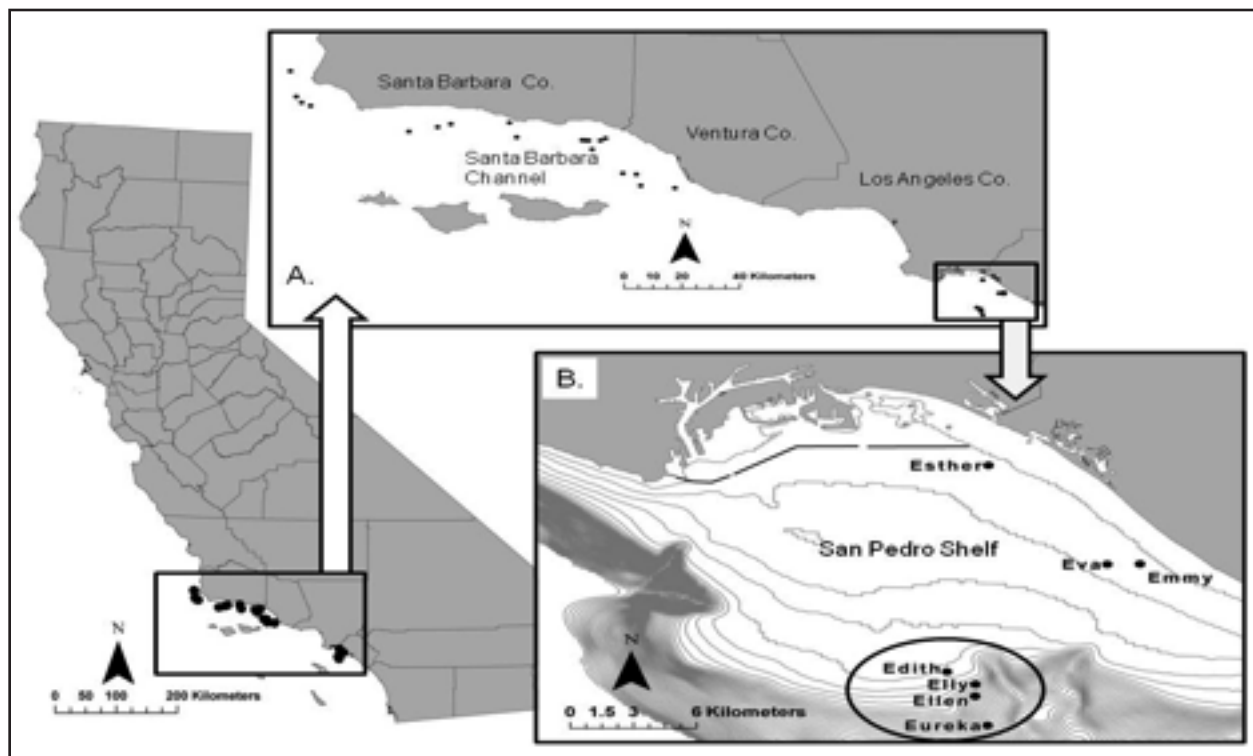
Progress/Results:

Regardless of the overall platform depth, though, the most important aspect of habitat on both platforms was shown to be the horizontal levels, with all species (with the exception of cabezon) mainly utilizing the areas within close proximity (< 3 m) to the platform's horizontal levels. During sheltering and foraging activities, species appear to utilize the tops of these levels as they would use hard seafloor while utilizing the undersides of the levels as they would reef overhangs or the kelp canopy.



Grass Rockfish (*Sebastes rastrelliger*). (Photo credit: Bonnie Rodgers)

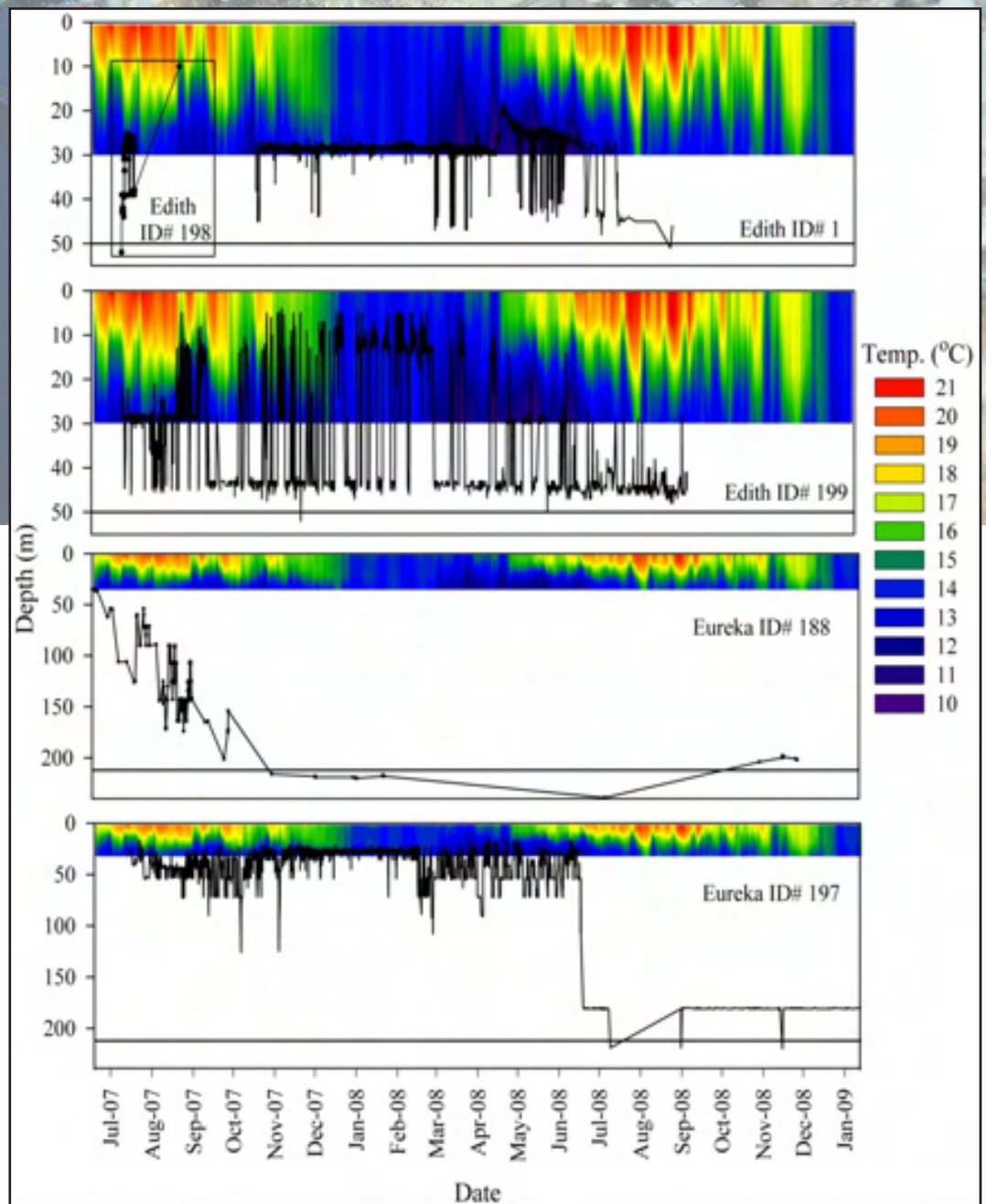
The first (shallowest) horizontal level on platform Edith (15 m) and platform Eureka (17 m) was found to be the most utilized aspect of habitat by grass rockfish, kelp rockfish, and sheephead, as well being used by all study species during their known spawning periods. These findings are the first to describe the fine-scale site fidelity, vertical movements, and habitat utilization of economically important species inhabiting California petroleum platforms.



A.) Distribution of all 27 California petroleum platforms (black points). B.) Platforms on the San Pedro Shelf, including study platforms Edith, Ellen, Elly, and Eureka (encircled). (Image courtesy of C. Lowe)

“Data from this research is being used to evaluate the ecological importance of petroleum platforms as fisheries habitat and will be important in determining the most appropriate decommissioning option to meet conservation goals in California.”

-Dr. Chris Lowe



Time series depth plots (black line) of cabezon individuals on platform Edith and Eureka overlying water temperature (°C) profiles (color gradient) measured from 5-30 m depths. Temperature (°C) is coded by color with red indicating warmer water and purple indicating colder water (see legend). Horizontal black lines at 50 and 212 m represent the bottom depth of platform Edith and Eureka, respectively. (Image courtesy of C. Lowe)



Left: Male California Sheephead (*Semicossyphus pulcher*) (Photo credit: Bob Wahlers)



Right: Grass Rockfish (*Sebastes rastrelliger*). (Photo credit: Bonnie Rodgers)

Student:

Carlos Mireles

Master's Thesis:

Mireles, C. May 2010. Site Fidelity and Depth Utilization of Nearshore Reef Fish on Offshore San Pedro Shelf Petroleum Platforms. Masters of Science Thesis. California State University, Long Beach. 102 p.

Professional scientific presentations:

Lowe, C.G., K.M. Anthony, and C. Mireles. (July 2009). Site fidelity, homing and movements of fishes associated with offshore platforms in southern California. Ann. Mtg. Amer. Soc. of Ichthy. & Herp. Portland, OR.

Mireles, C. and C. G. Lowe. (July, 2009). Petroleum Platforms as Fisheries Habitat: Using Acoustic Telemetry to Investigate How Shallow Occurring Nearshore Reef Species Utilize Deep Offshore Petroleum Platforms in Southern California. Joint Meeting of Ichthyologist and Herpetologists. Portland, Oregon

Lowe, C.G., K.M. Anthony, E.T. Jarvis, L.F. Bellquist, M.S. Love. (May 2009). Site fidelity patterns of groundfishes associated with platforms in the Santa Barbara Channel. Ann. Mtg. Southern California Academy of Sciences, Palos Verdes, CA.

Martin, C.J.B., B.J. Allen, and C.G. Lowe. (May 2009). San Pedro Shelf platforms fish assemblages and relations to habitat quality. Ann. Mtg. Southern California Academy of Sciences, Palos Verdes, CA.

Mireles, C. and C. G. Lowe. (May, 2009). The Site Fidelity and Depth Distribution of Shallow Nearshore Reef Species Inhabiting Offshore Petroleum Platforms on the San Pedro Shelf. Southern California Academy of Sciences. Palos Verdes, California

Mireles, C. and C. G. Lowe. (November, 2008). Site Fidelity and Vertical Movement of Nearshore Reef Fishes on San Pedro Offshore Petroleum Platforms. Western Society of Naturalists Annual Meeting. Vancouver, British Columbia

Martin, C.J.B. and C.G. Lowe. (May 2008). Midwater fish assemblages associated with petroleum platforms on the San Pedro Shelf: A comparison with adjacent natural reefs. Ann. Mtg. Southern California Academy of Sciences. Dominguez Hills, CA. *Best student paper – American Inst. of Fisheries Research Biologists Award.

Publications:

Lowe CG, Anthony KM, Jarvis ET, Bellquist LF, Love MS. 2009. Site fidelity and movement patterns of groundfish associated with offshore petroleum platforms in the Santa Barbara Channel. Marine Coastal Fisheries: Dynamics, Management & Ecosystem Sciences 1:71-89.

Martin CJB, Lowe CG. 2010. Assemblage structure of fishes at offshore petroleum platforms on the San Pedro Shelf, southern California. Marine Coastal Fisheries: Dynamics, Management & Ecosystem Sciences 2:180-194.

The Effects Of Urban Stormwater Runoff On Phytoplankton Dynamics In Santa Monica Bay

Grant #06-043
FY 2007 – 2009

Rebecca Shipe, Ph.D.
University of California, Los Angeles
310-794-4903, rshipe@ucla.edu

Objectives:

- Characterize the physical and chemical environment of urban stormwater runoff plumes
- Quantify the effects of runoff from Ballona and Malibu Creeks on phytoplankton biomass, community composition, size structure, and primary productivity in Santa Monica Bay
- Place a special focus on the factors causing blooms and the factors causing shifts in community composition to having a greater abundance of potentially harmful phytoplankton species



Santa Monica Beach
(Photo credit: Charlotte Stevenson)

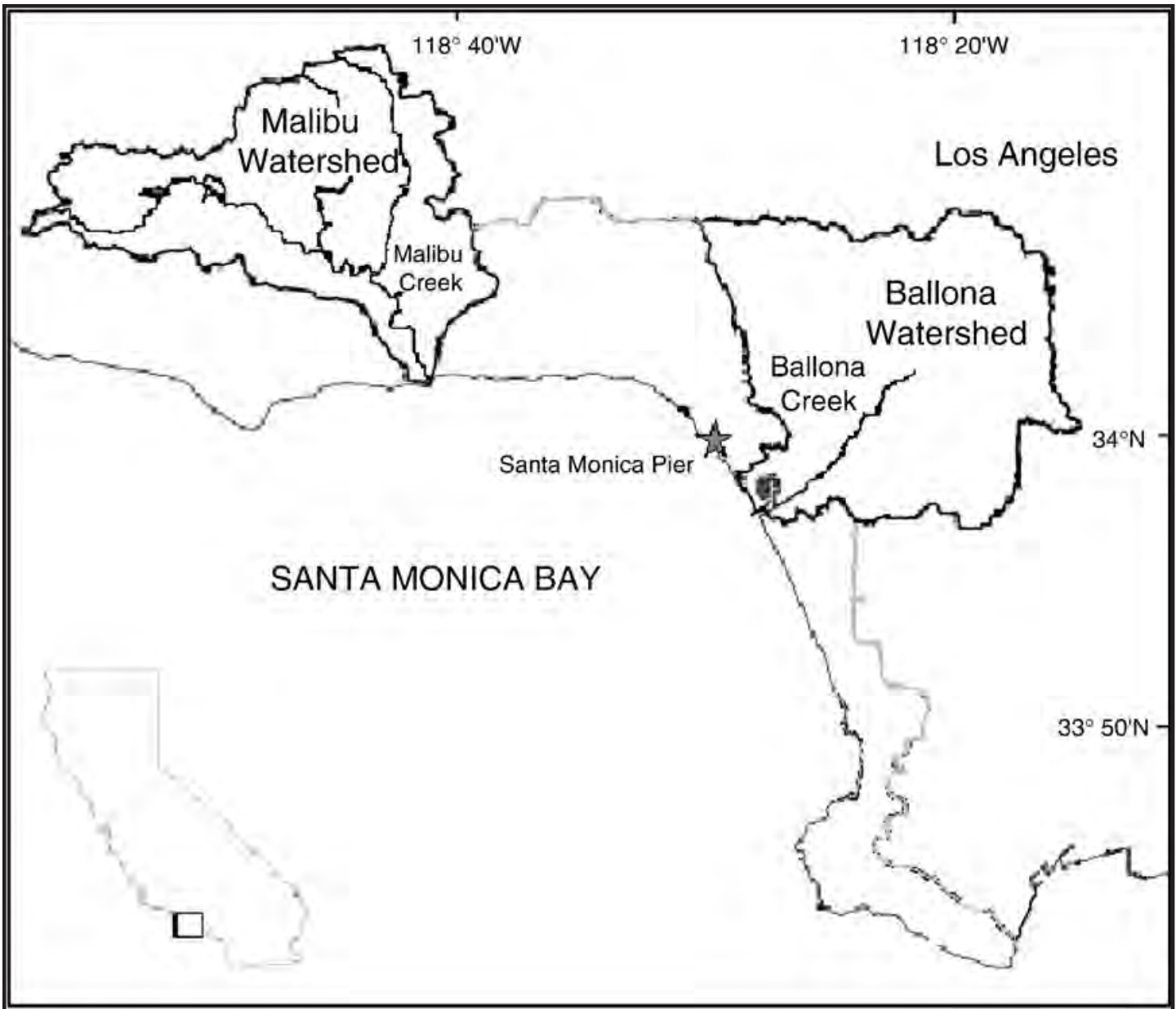
Rationale:

Nonpoint source water runoff became the primary source of anthropogenic contamination (human pathogens, organic matter, inorganic nutrients) of coastal water bodies following the regulation of point source (from a pipe) run-off in the 1970's. Most studies to date have focused on human pathogens and ignored the ecosystem effects of increased input of organic matter and nutrients, particularly on primary producers (phytoplankton), the base and the fuel of the entire marine food chain.

This study is the first to track changes in phytoplankton dynamics within stormwater plumes in the Southern California Bight. This project offers insight into the effects on ecosystem structure and function of increased stormwater runoff due to urbanization. This study begins to provide local managers with predictive relationships between the characteristics and behavior of stormwater plumes and phytoplankton responses in the Bay.

Progress/Results:

Dr. Shipe and her team investigated the plumes following four precipitation events between April 2007 and January 2008, ranging in magnitude from 1 to 9 cm of rain. These stormwater plumes persisted in Santa Monica Bay for 2-5 days over spatial scales of up to 15 km after each event. Data collected in this study included surface salinity, temperature and chlorophyll fluorescence, measurements of inorganic nutrients, phytoplankton biomass, and cell identification and enumeration. The stormwater plumes were generally characterized by higher concentrations of dissolved nitrogen, colored dissolved organic matter, and higher light attenuation due to the fact that the light had more trouble making it through the 'cloudier' water of the plume. (Continued on page 10)

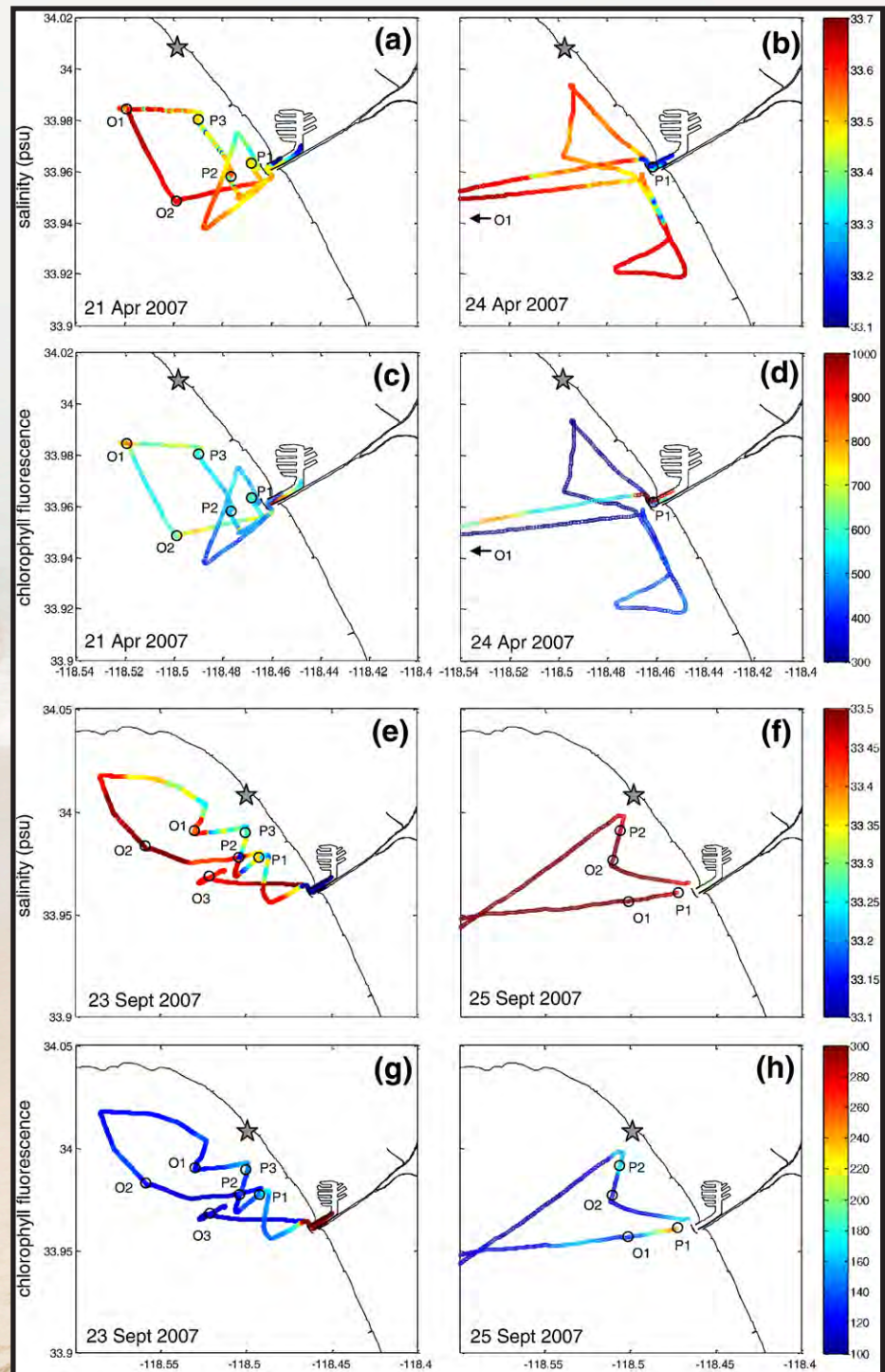


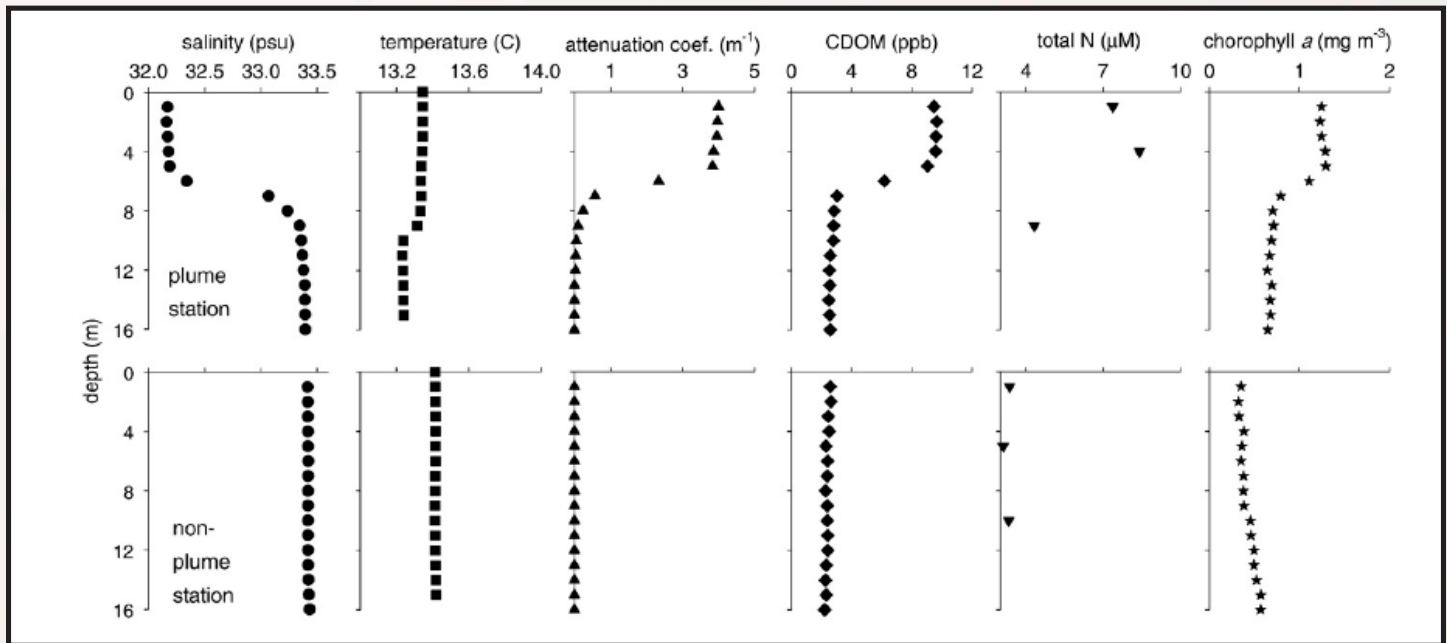
Santa Monica Bay and Ballona and Malibu watersheds. (Courtesy of R. Shipe)

Progress/Results:

There was a direct correlation between the size and residence time of the plume in the bay and the effects on the local phytoplankton community. These rain events and their resulting plumes caused increases in primary productivity and phytoplankton biomass, especially diatom biomass. This study showed that stormwater runoff does indeed alter the physical, chemical and biological properties of the coastal water column for at least several days after rain events. In cases of larger rain events where rainfall was continuous over several days or resulted in more than 5 cm of rain, there was the greatest potential for alterations of ecological processes in the Santa Monica Bay.

Salinity (top) and chlorophyll a fluorescence (bottom) recorded underway on during April and September 2007 in Santa Monica Bay. The scales of the figure axes are identical among individual sampling days within each month. Plume ('P') and non-plume (outside, 'O') stations are numerically labeled in the order that they were occupied and the Santa Monica Pier is marked with a star. On April 24, the location of one non-plume station is outside of the figure. (Courtesy of Corcoran et al. 2010)





Representative vertical profiles of measured parameters in a plume (top) and non-plume station (bottom). (Image courtesy of Corcoran et al. 2010)

Cooperating Organizations

USC
NASA

Students

Kristen Reifel, USC
Alina Corcoran, UCLA

Publications

Corcoran, A.A., Reifel, K. M., Jones, B. H. and Shipe, R. F. (2010) Spatiotemporal development of physical, chemical and biological characteristics of stormwater plumes in Santa Monica Bay, California (USA) *Journal of Sea Research*, 63:129-142.

Corcoran, A. A. and Shipe, R. F. (in prep.), Inshore-offshore and vertical patterns of phytoplankton biomass and community composition in Santa Monica Bay, CA (USA), in preparation for *Marine Ecology Progress Series*.

Proteomics To Develop Relevant Phenotypic Biomarkers Of Environmental Impacts In Wild Marine Fishes Of Southern California

Grant #06-043
2008 – 2010

Kevin M. Kelley, Ph.D.

California State University, Long Beach
kmkelley@csulb.edu, 562-985-4294

Andrew Mason, Ph.D.

California State University, Long Beach
zedmason@csulb.edu, (562) 985-5266

Jeffrey Armstrong, Ph.D.

Orange County Sanitation District Ocean Monitoring Division
jarmstrong@ocsd.com, (714) 593-7455

Objectives:

- Determine protein expression profiles or “fingerprints” for fish from known contaminated and control locations
- Help lead to better identification of pollutants and the mechanisms by which they impact marine wildlife and ecosystems, which in turn can help state resource managers and regulators reduce the sources of contamination that negatively affect wildlife



Field collection of fish onboard M/V Nerissa with staff from the Orange County Sanitation Ocean Monitoring Division. Sea Grant Trainee, Claire Wagonner (2nd from left) and Co-P.I. Dr. Jeffrey Armstrong (4th from left). (Image courtesy of K. Kelley)

Rationale:

Previous research has shown that anthropogenic chemicals in the marine environment have caused endocrine and physiological disruption, such as changes to reproductive and metabolic characteristics and changes in growth; Changes like these have a strong potential to threaten survival in a variety of different species residing in coastal California, including flatfish, surfperch and sculpin. Most all studies to date that have monitored these types of impacts to fish have used single or a limited set of biomarkers. This project is developing more powerful diagnostic tools using protein expression profiles, or “fingerprints,” that will enhance assessment and understanding of environmental effects in marine organisms.

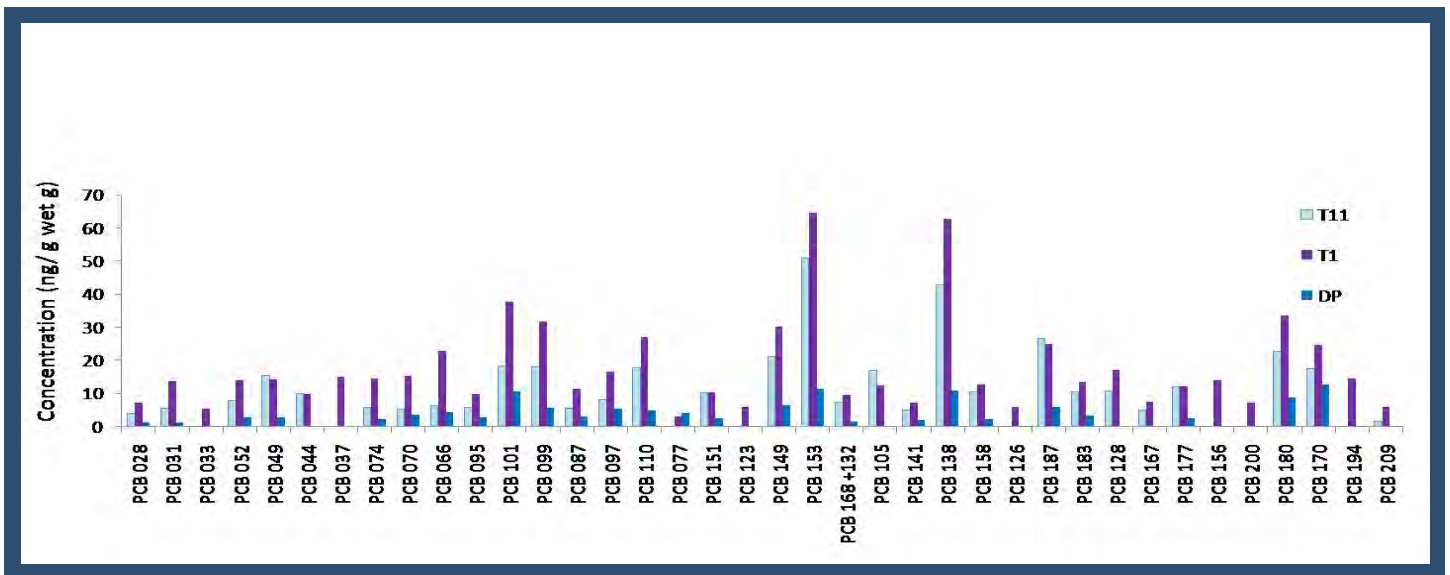
Progress/Results:

Blood plasma and liver samples were collected from English sole in 2008 and 2009 at the Orange County Sanitation District (OCSD) outfall location offshore of Huntington Beach, CA, at the OCSD reference (“far-field”) location offshore of Bolsa Chica, CA, and from an Environmental Protection Agency reference location offshore of Dana Point, CA. Plasma samples were analyzed by radioimmunoassay procedures to determine concentrations of four different hormones known to be part of the stress response. Fish livers were also sampled and analyzed for organic contaminant concentrations.

Animals from the different study sites exhibit distinct patterns of tissue-accumulated contaminants. The successful measurements of contaminant concentrations within individual fish livers, and the range of concentrations among the different contaminants observed, enabling a statistical evaluation of the degree to which each contaminant measured in the fish may be related to endocrine alterations and other phenotypic changes (e.g., “fingerprints” or protein expression profiles). (continued on page 14)



Blood plasma sample being taken from an English Sole offshore of Huntington Beach, CA. (Image courtesy of K. Kelley)



Liver concentrations of polychlorinated biphenyl (PCB) congeners (indicated across x-axis) in English sole from the Orange County Sanitation District outfall location (T1) and far-field (T11) monitoring stations and Dana Point (DP) sampled in August 2009. The outfall location (T1) is associated with higher PCB exposures in fish as compared with sites T11 and DP. (Image courtesy of K. Kelley)

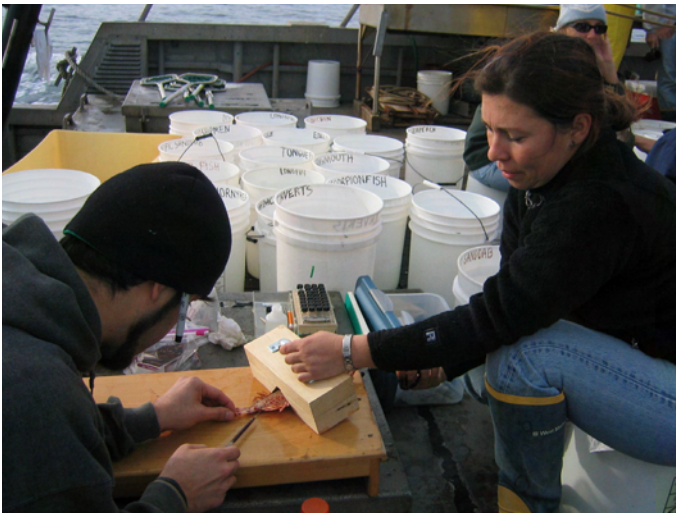
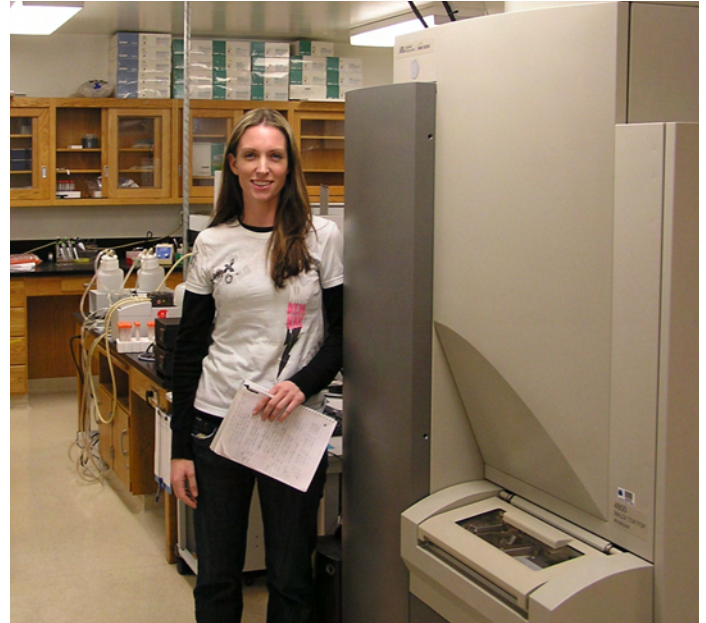
Progress/Results:

The results to date clearly indicate that different classes of contaminants are significantly correlated with different kinds of endocrine disruption. Thus far, a number of proteins representing distinct, important physiological and cellular roles in the animals have been identified. Overall, the findings are providing novel insights into the potential endocrine disruptive effects of existing environmental contaminants to which resident fish are exposed. The concordance with another of Dr. Kelley's studies of San Francisco Bay fish—which also links different types of endocrine system impacts with distinct chemical classes—provides some confidence that important candidate endocrine-disrupting chemicals in the southern California Bight may be emerging from this study.

This work is ongoing, and researchers plan to identify more than 50 different expressed proteins. Upon completion of the last phase of the study through summer 2010, the study group will provide detailed, novel insight into the physiological condition of the southern California English sole, in addition to identifying specific environmental contaminants as candidate causative agents in endocrine and phenotypic impacts in the fish. Identification of these contaminants is the first step towards helping managers reduce the sources of the contamination.



English sole (left) and California halibut (right).
(Images courtesy of K. Kelley)



Dr. Julianne Kalman, Jesus Reyes, and Dr. Kevin Kelley collecting fish samples (top left); Sea Grant Trainee Claire Waggoner next to MALDI TOF/TOF instrument used in analysis (top right); Dr. Julianne Kalman and Jesus Reyes collecting flatfish (bottom right). (Images courtesy of K. Kelley)

Cooperating Organizations

Orange County Sanitation District

Student

Claire Waggoner

Presentations

- International Congress on the Biology of Fish (Portland, OR, July 2008)
- Society for Environmental Toxicology and Chemistry (SETAC) North America (Tampa, FL, November 2008)
- Southern California SETAC Annual Meeting (Dana Point, CA, May 2008)
- 20th (Oakland, CA, January 2008) and 21st (Los Angeles, CA, January 2009) Annual CSU Biotechnology Symposium
- CALFED Science Conference (Sacramento, CA, October, 2008)
- California Water Environment Association Annual Meeting (Monterey, CA, March, 2009)
- SETAC North America (New Orleans, LA, November 2009)
- Society for Integrative and Comparative Biology (SICB) Annual Meeting (Seattle, WA, January 2010)
- World Aquaculture 2010 Annual Meeting (San Diego, CA, March 2010)

Distributions, Abundances And Feeding Interactions With Native Consumers of Non-Indigenous Seaweeds On Urban Southern California Shores

Grant #06-043
2008 – 2010

Steven N. Murray, Ph.D.

California State University, Fullerton,
smurray@fullerton.edu, (714) 278-7291

Jayson R. Smith, Ph.D.

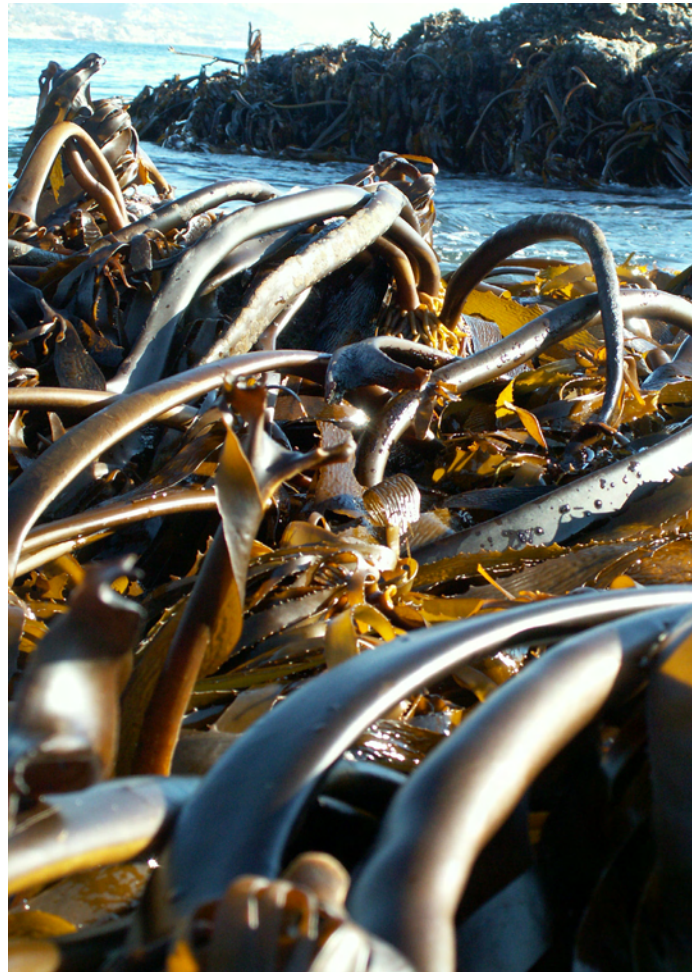
California State University, Fullerton
jsmith@fullerton.edu, (657) 278-4233

Objectives:

- Asses the distributions of NIS seaweeds on urban southern California shores
- Asses the changes in the abundances of NIS and other seaweeds and invertebrates at sites characterized by different levels of disturbance
- Assess which consumer and producer species are associated with these seaweeds.

Rationale:

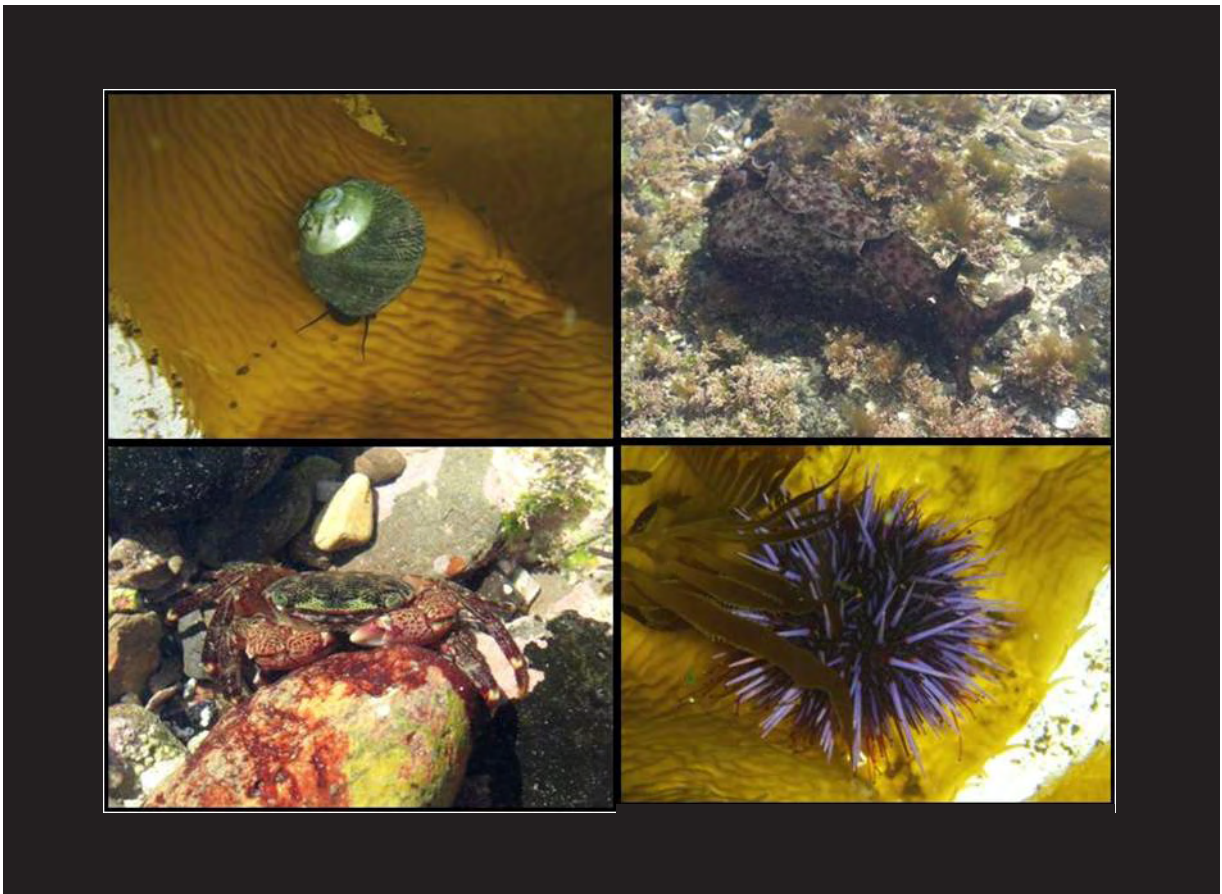
The increasing presence of non-indigenous species of seaweeds in native macroalgal assemblages poses a worldwide threat to coastal ecosystems. The current global estimate of NIS of seaweeds is 277 species and coastal regions are among the most heavily invaded of all habitats. However, despite the increasing presence of non-indigenous species of seaweeds, their ecological roles in coastal ecosystems are not well understood. In particular, little is known about how established non-indigenous species of seaweeds fit into trophic dynamics of coastal habitats. Ultimately, this research will improve understanding of the distributions of currently established non-indigenous species of seaweeds and their roles as food for consumers on urban southern California shores, giving coastal managers the ability to develop and implement effective ecosystem-based management strategies.



Eisenia arborea. (Photo courtesy of Jayson Smith)

Progress/Results:

A series of single-food consumption rate experiments were conducted in 2007-2008 to test whether macroalgal consumers (the sea hare *Aplysia californica*, the snail *Chlorostoma aureotincta*, the crab *Pachygrapsus crassipes*, and the urchin *Strongylocentrotus purpuratus*) eat indigenous or native seaweeds at faster rates than non-native seaweeds. The non-indigenous seaweeds used in this study are local introductions that have established populations in southern California coastal waters for various lengths of time: the brown alga *Sargassum muticum* has been established for more than 25 years, the red alga *Caulacanthus ustulatus* and kelp *Undaria pinnatifida* appeared approximately 10 years ago, and the brown alga *Sargassum horneri* was more recently (< 5 years) introduced. Closely-related and/or morphologically similar native seaweeds were used for comparison purposes. No clear pattern in consumption rates was observed between the native and non-native seaweeds within a group. (continued on page 18)



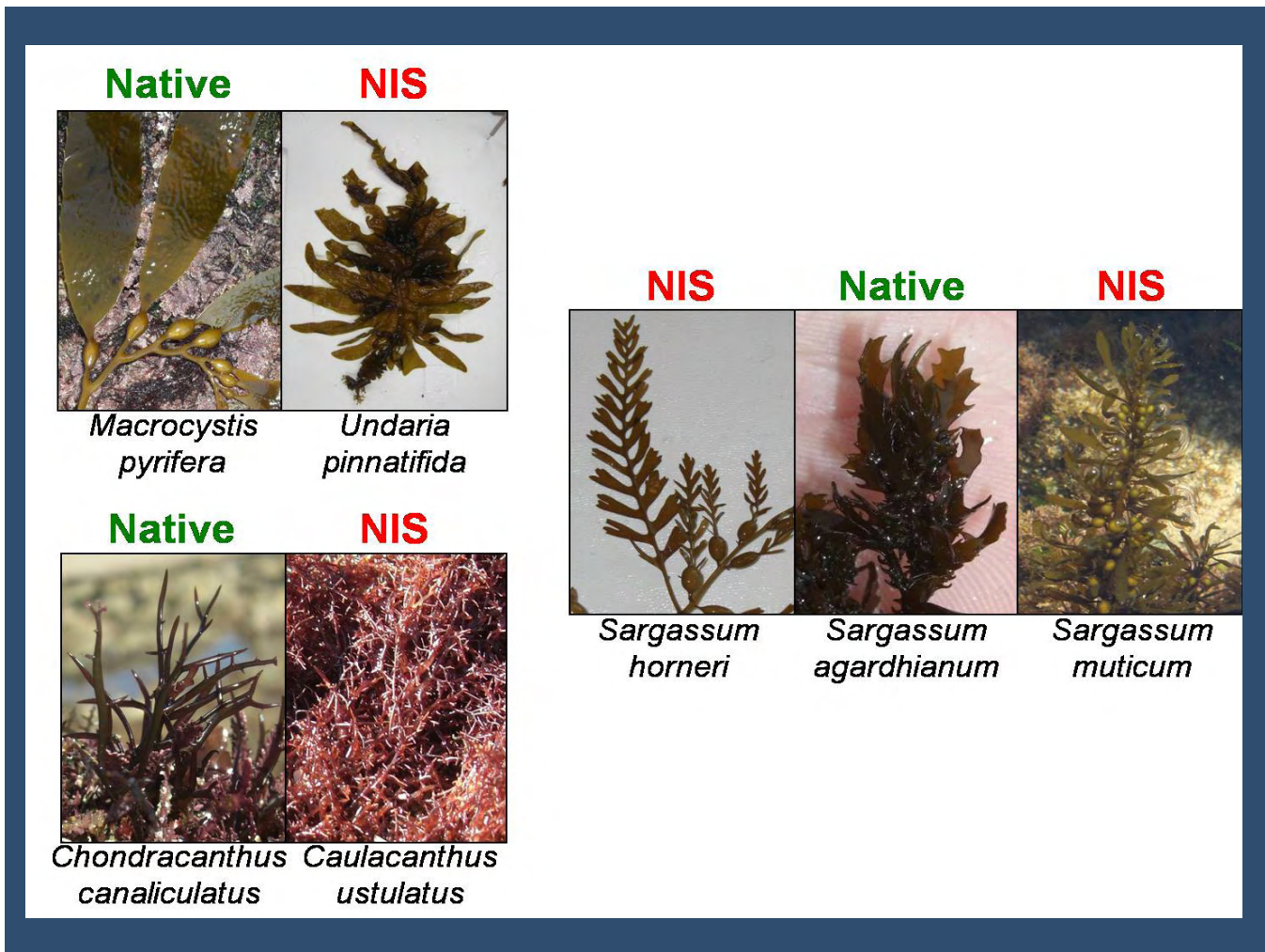
Native macro-algal consumers used in feeding trials including (clockwise from top left): the snail *Chlorostoma aureotincta*, the sea hare *Aplysia californica*, the crab *Pachygrapsus crassipes*, and the urchin *Strongylocentrotus purpuratus*.

Progress/Results:

A series of two-choice feeding experiments were conducted in 2007-2009 to determine if when given a choice, macroalgal consumers will feed preferentially on native seaweeds over non-indigenous species of seaweeds. Results indicate that native consumers tend to prefer native over non-native seaweeds when they are offered palatable species but patterns were not consistent among all seaweed pairs and herbivore taxa. Additional testing is in progress.



Students sampling and collecting specimens in the field. (Images courtesy of Jayson Smith)



Paired native and non-indigenous (NIS) seaweed species offered to macro-algal consumers in single food consumption rate trials and two-choice preference trials. (Image courtesy of S. Murray)

Students:

Sean Vogt
Carla Navarro

Masters Thesis:

Navarro, C.N. 2009. Feeding rates of native herbivores on introduced and non-native seaweeds. California State University, Fullerton. MS Thesis.

Presentations:

Vogt, S. C., Smith, J. R., and Murray, S. N. 2010. Do native macro-invertebrates consume native over non-native seaweeds? Northwest Algal Symposium, Whidbey Island, Washington.



Students sampling and collecting specimens in the field. (Images courtesy of Jayson Smith)

Murray, S. N, Navarro, C. A., Vogt, S. C., and Smith, J. R. 2010. Feeding responses of native macro-invertebrates to non-indigenous seaweeds. International Seaweed Symposium, Ensenada, Mexico.

Vogt, S.C., Pereira, R.C., Smith, J.R., Feeding Preferences of Native Invertebrate Consumers for Native and Non-Native Seaweeds in Brazilian Waters. International Seaweed Symposium, Ensenada, Mexico.

Smith, J. R., Murray, S.N., Fong, P., and Ambrose, R. F. 2009. Urban ecology: a southern California rocky intertidal perspective. Eastern Connecticut State University, Department of Biology.

Smith, J. R., Murray, S.N., Fong, P., and Ambrose, R. F. 2009. Urban ecology: a southern California rocky intertidal perspective. COSEE (Centers for Ocean Sciences Education Excellence), Dana Point, CA.

Smith, J. R., Murray, S.N., Fong, P., and Ambrose, R. F. Urban ecology: a southern California rocky intertidal perspective. SUNY Stony Brook Southampton, School of Marine and Atmospheric Sciences.

Smith, J. R., Murray, S.N., Fong, P., and Ambrose, R. F. 2009. Urban ecology: a southern California rocky intertidal perspective. California State University, Fullerton, Department of Biological Science.

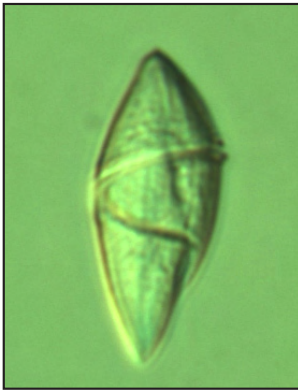
Smith, J. R., Murray, S.N., Fong, P., and Ambrose, R. F. 2009. Coastal ecology in the face urbanization and environmental change. University of Alaska Southeast, Department of Marine Biology.

Impacts of Algal Toxin on Species Composition of Coastal Plankton Communities

Grant #09-022
February 2010- January 2012

Astrid Schnezter, Ph.D. University of Southern California
astrids@usc.edu, (213) 740-3675

Dave A. Caron, Ph.D. University of Southern California
dcaron@usc.edu, (213) 740-0203



Dinoflagellate.
(Image courtesy
of D. Caron)

Objectives:

- Investigate the role of phytoplankton-derived toxins in the emergence of local algal blooms
- Specifically, investigate whether the production of saxitoxin by the dinoflagellate, *Alexandrium catenella*, and brevetoxin by the dinoflagellate, *Chattonella marina*, provides a competitive advantage for these phytoplankton species by inhibition of growth in other phytoplankton

Rationale:

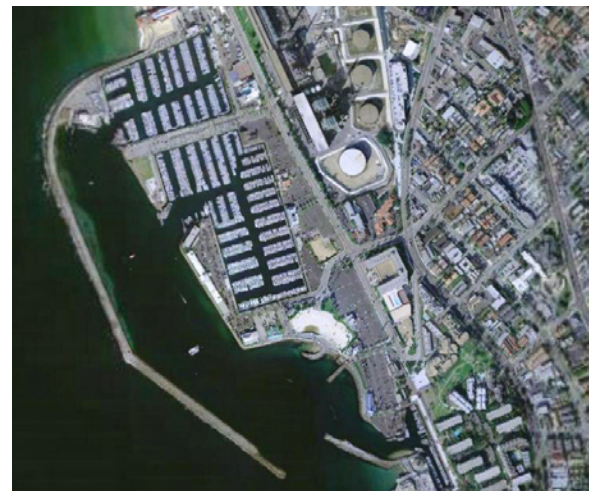
Understanding the factors that drive the initiation, progression and the demise of harmful algal blooms (HABs) is a complicated and challenging task, but this knowledge is critical in light of increasing reports on coastal bloom events, and our increased awareness of adverse impacts of these blooms on marine communities and human health. To investigate the anatomy of a harmful (toxic) algal bloom requires information on physical, chemical and biological parameters and the tools to determine attributes such as species composition, species abundance and toxin concentrations. This proposed project will build on the existing infrastructure to follow environmental conditions in near-real time and will have the tools and expertise to apply cutting-edge molecular and immunological techniques to obtain the needed data. The ongoing collaborative relationship with the City of Redondo Beach—which is increasingly faced with a severe environmental issue (HABs and fish kills) in King Harbor—will be of tremendous advantage. King Harbor is not unique in having to deal with severe HAB events, and we hope that a better understanding of whether toxic bloom-forming algae have a competitive advantage will aid evaluation of algal bloom events in other coastal environments.

Cooperating Organizations:

Center for Embedded Networked Sensing, NSF based program
City of Redondo Beach

Students:

Erica Seubert



King Harbor, Redondo Beach, CA. (Image courtesy of Google Maps)

The Copper Problem in California Marinas

Grant #09-013
February, 2009-January, 2011

James W. Moffett, Ph.D.
University of Southern California
jmoffett@usc.edu, (213) 740-5626



Mytilus mussels. (Photo credit: Jayson Smith)

Objectives:

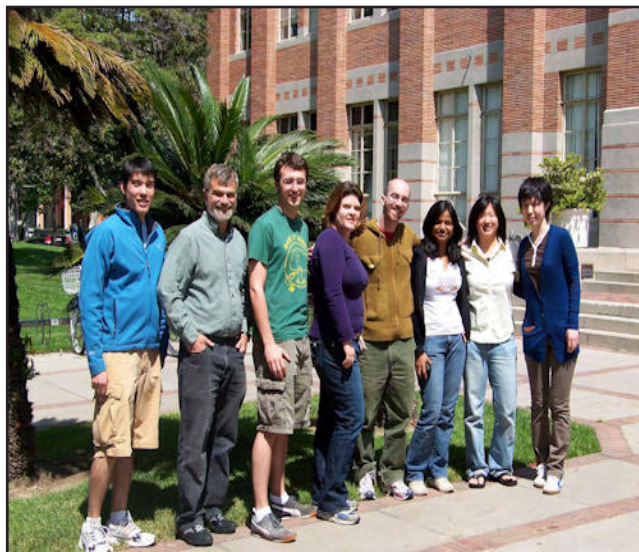
- A molecular-level understanding of copper in marinas, focusing on both the rates and mechanism of copper mobilization from paints, its solution chemistry, and how this may differ among marinas
- Do organic matter and copper interact significantly in marinas, and is this likely to lead to significant variability in the bioavailability of copper? Could this explain the variability in toxicity testing results amongst marinas in the state?
- Are there simple relationships between parameters like salinity and dissolved organic matter concentration that regulators can use to predict copper contamination in marinas?
- Could salinity-accelerated dissolution of copper contribute to the higher levels of copper in saltwater versus freshwater marinas?

Rationale:

The California Department of Pesticide Regulation has determined that copper (Cu) poses a serious threat to water quality in marinas in the state. Their recent survey showed that in saline & brackish water areas, 15 of 17 marinas exceeded EPA chronic toxicity standards (3.1 ppb). Ten of those 15 marinas also exceeded acute toxicity standards (4.8 ppb). This is a huge problem with costly and politically challenging issues. The main source of copper in these areas is from boat antifouling paints. On December 4, 2007, the Department of Pesticide Regulation announced plans to pursue reevaluation of copper regulation based on these findings. The relationship between toxicity and copper concentration is complicated by the presence of substances in the water that bind copper and detoxify it. As a result, toxicity studies using the copper sensitive blue mussel, *Mytilus* sp., are often carried out.

This research will provide a sound chemical database that managers can use to assess the threat posed by copper in these marinas, and they may reveal how copper behaves differently in marinas spanning the wide range of salinities found in California.

Student:
Jeremy Jacquot



Dr. Moffet and lab.

Environmental Endocrine Disruption in Urban Ocean Fish Mechanisms, Causes, Wider Impacts

Grant #09-013
February, 2010-January, 2012

Kevin M. Kelley, Ph.D.
California State University, Long Beach
562-985-4294, kmkelley@csulb.edu

Objectives:

- To what extent are existing contaminants—many with continuing inflows into the environment—impacting the biota?

Rationale:

It is well documented that many California coastal environments are contaminated, such as industrialized and developed shorelines, ports and marinas, and in regions around wastewater treatment plant outfalls. This project will utilize the well-documented, impacted populations of English Sole and California Scorpionfish in Orange County, which will be compared with populations at sites where similar evidence of endocrine disruption is not observed.

This study is directly relevant to State and regional environmental managers, as they work toward effective ecological-based management, which has traditionally developed water quality objectives based on concentrations of contaminants alone. There is a critical need for scientifically based understanding of impacts of water quality on wildlife in the urban ocean habitats of coastal California, and the proposed project directly addresses this need. There is also relevance to non-marine settings, given the highly conserved nature of endocrine systems and the specific nature by which endocrine disrupting chemicals typically act.

The scientific work will be used as a foundation to build a wider public outreach and education effort, in a partnership with the Cabrillo Marine Aquarium, San Pedro, CA. A public exhibit at the Aquarium will be constructed and used to educate about polluting chemicals, habitat degradation, and concepts of endocrine disruption, biomarkers, sentinel species in environmental work, and making connections between the field and laboratory.

Cooperating Organizations:
Orange County Sanitation District
Cabrillo Marine Aquarium

Students:
Dwight Causey



Students in the ship laboratory. (Image courtesy of Kevin Kelley)

Quantifying Contaminants of Emerging Concern in Urban Watersheds Using Bivalves and Passive Samplers

Grant #09-022
February 2010-May 2013

Keith Maruya, Ph.D.
Southern California Coastal Water Research Project
(714) 755-3214, keithm@sccwrp.org

Rachel Adams, Ph.D.
Loyola Marymount University,
(310) 338-5186, radams@lmu.edu



Mytilus mussel bed, Orange County, CA. (Photo credit: Jayson Smith.)

Rationale:

Recently, the National Oceanic and Atmospheric Administration's (NOAA) National Status & Trends Mussel Watch Program has re-dedicated itself to serve as an early warning system for contaminants of emerging concern in the coastal zone. As part of this effort, the Southern California Coastal Water Research Project (SCCWRP) and other coastal environmental quality agencies have partnered with NOAA to expand the list of routinely monitored chemicals to include several high priority contaminants of emerging concern using California as the backdrop.

Currently, the low-level determination of waterborne contaminants of emerging concern is a costly and time-consuming endeavor that requires pre-concentration of large volumes of sample water. Passive sampling devices will complement the use of bivalves and other sessile "watchdog" organisms in determining occurrence and as a surrogate for biological exposure in situ. Scientists, water quality and marine resource managers will be able to utilize these data in providing baseline conditions and in identifying sources and their relative contribution of contaminants of emerging concern to the larger "Urban Ocean".

Cooperating Organizations:
NOAA Mussel Watch Program

Students:
Abigail Joyce; Mallory Pirogovsky

Objectives:

Passive sampling devices (PSDs) are slowly but surely gaining acceptance as cost-effective alternatives to conventional water quality measurement tools for quantifying ultra-low levels of toxic contaminants like constituents/contaminants of emerging concern (or CECs). This project will answer these questions:

1. What classes of contaminants of emerging concern are amenable to measurement using passive sampling devices?
2. What classes of contaminants of emerging concern are detectable in bivalves collected near urban population centers across California or the United States?
3. Can the sorption of target contaminants of emerging concern by passive sampling devices be predicted using mathematical models?
4. How do water concentrations of target contaminants of emerging concern measured by passive sampling devices compare to accumulation by bivalves?
5. What are the primary sources of target contaminants of emerging concern into the coastal urban ocean?



University of Southern California
The Urban Ocean Program



Photo Credits:

- p.1 Cover Shot: Santa Monica Beach (Charlotte Stevenson)
- p. 2 Santa Monica Beach (Charlotte Stevenson)
- p. 4, Platforms Ellen and Elly (Carlos Mireles)
- p. 5, Oil platform ecosystem (Bob Wahlers)
- p.16, Eisenia arboria bed (Jayson Smith)
- p.24 Back Cover: Oil Platform Ecosystem (Bob Wahlers)