CEQI PROJECTS FUNDED IN ACADEMIC YEAR 2005-06

Name	Campus	Proposal Category	Title	Abstract
Meredith Armstrong	UCSC	Graduate Student Fellowship	The Biological Origin and Possible Presence of Yessotoxin, A Newly Discovered Marine Phycotoxin in California Coastal Waters	Marine toxins are compounds produced by phytoplankton that accumulate in filter feeding organisms such as mussels and clams. These toxins have a negative impact on humans and marine organisms due to toxic shellfish ingestion. As a result, the shellfish industry is monitored for a variety of marine toxins, which cause paralytic, amnesiac and diarrheic shellfish poisoning. Yessotoxin is a newly discovered type of marine toxin that is produced by two dinoflagellates, Protoceratium reticulatum and Lingulodinium polyedrum, both of which are present along the coast of California. L. polyedrum blooms frequently in southern California and is one cause of the "red tide" events. Laboratory cultures of both L. polyedrum and P. reticulatum isolated from California coastal waters have been found to produce yessotoxin. The purpose of this proposal is to determine if yessotoxin is present in California coastal waters by testing environmental samples for yessotoxin during periods when either one or both of these species are present. Due to the potential health implications of toxin in shellfish, yessotoxin is a regularly monitored marine toxin in New Zealand, Europe and Japan. Currently, yessotoxin is not a regularly monitored toxin in the state of California (nor in the United States). This proposal will serve as an important determinant for regulators as to whether yessotoxin should be added to the list of environmental toxins that are routinely monitored throughout the state of California, as well as the nation.
Martha Burford	UCSC	Graduate Student Fellowship	Population-Genetic Analysis of Year-Class Formation in Rockfish	Several species of rockfish currently suffer from overfishing in California and remediation is required to replenish depleted stocks. Due to precipitous declines in several species, it is clear that both managers and research must focus on clarifying population dynamics and spatial connectivity of rockfish populations. All aspects of fisheries management, including ecosystem-based fisheries management tools, require knowledge of the spatial scale of genetic exchange or movement of individuals among populations and degree to which this renders stocks self-replenishing. Population genetics is one of few tools available that directly measures levels of connectivity among marine populations. My dissertation research examines genetic patterns and consequences of larval dispersal for two species of exploited rockfishes, blue and kelp rockfish, both of which inhabit nearshore rocky reefs and kelp forests along the California coast and are targeted by nearshore commercial live-fish and recreational fisheries. My goal is to characterize the effect of pelagic duration on the genetic structure of adults and of settling juveniles, and to analyze whether juveniles from different year-classes have similar patterns of genetic structure. I am using several microsatellite loci to analyze the population structure of young-of-the-year and adult rockfish. The high level of polymorphism inherent in microsatellite loci will provide a sensitive tool for finding subtle differences within and among adult samples and settling juveniles. By simultaneously describing the genetic structure of both juvenile year-classes and adult populations, this study will reveal much more about movement of larvae and constraints on reproductive output of adult populations than previous studies that have examined either larvae or adults alone. My dissertation research is designed to address critical questions on connectivity of rockfish in the coastal marine ecosystem, such that the results of this work can be directly applied to the management and conservation of exploited rockfish species.
Yiping Cao	UCSB	Graduate Student Fellowship	Interactions Between Microbial Communities and Pollutants in Salt Marsh Sediments	Salt marshes are important coastal ecosystems that alter terrestrially-derived pollutants prior to coastal water discharge. Salt marshes thus function as "buffer zones" or even "sources of contamination" by intercepting, stabilizing, removing, or rereleasing heavy metals, organic pollutants, excessive nutrients, and microbial contaminants. Salt marsh sediments are particularly important as they are the location of most of the above processing. Microbes, the most abundant and metabolic versatile resident in marsh sediments, are important biogeochemical recyclers playing central roles in processing pollutants prior to output into coastal ocean. Given microbial community composition determines microbial functionality, however, little is known about salt marsh microbial communities and, in particular, their interactions with pollutants. In this study, a southern California salt marsh with excessive nutrient (mainly nitrate) loading and suspected pesticide input from agriculture upland will be the study site. Heavy metals and persistent organic pollutants were reported in sediments from this marsh thus are included in this study. Sediment samples from the marsh are subjected to physicochemical and microbial analysis. Concentrations of the above contaminants are measured. Microbial communities are assessed by molecular community fingerprinting techniques with two focuses: the total bacterial community, and the sub-community responsible in reducing nitrate to nitrogen gas thus eliminating excessive nutrient loading. A variety of statistic tools will be utilized to evaluate relationships between the pollutants and the microbial community compositions. Interaction between pollutants and microbial communities are expected to be revealed from this study. Findings from this study will contribute to the sparse knowledge regarding relationship between microbial communities and a variety of pollutants, and facilitate understanding of the fate and transport of pollutants in coastal region. In particular, understanding and control of the major process in reducing nutrient input into coastal ocean, which is the microbial reduction of nitrate in sediments, will be greatly enhanced.

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Cynthia Catton	UCSD	Graduate Student Fellowship	Low-density population dynamics: Implication for conservation and management of California's coastal marine resources	Many shellfish species may be subject to population declines below a threshold density, due to an extreme reduction in fertilization success. Once this lower population limit is reached, the possibility of recovery without intervention is unlikely. The goal of my research is to develop a life-history-based matrix model that incorporates density-dependent processes influencing the populations of southern California broadcast-spawning species, and to provide stock assessments of local pink abalone (Haliotis corrugata) and wavy turban snail (Megastraea undosa) populations. The abalone populations are highly depleted, whereas the wavy turban snail populations are still near virgin-stock sizes. The model requires data on the population size, sex ratio, and nearest-neighbor distances in addition to size-specific growth, survival, and fertility. It will also utilize previous results on the probability of fertilization with increasing distance from a conspecific. I measure population abundance, growth, and survival using tag-recapture methods. Using this new model, I will assess the extinction risk for the populations with different initial population abundances, size structures, and spatial structures. This project may then be used as a template for the study of other broadcast-spawning benthic Invertebrate species, and direct the data collection and formal analysis of the population dynamics for use in regulating these fisheries. In order to increase the effectiveness and impact of this research, I formed partnerships with current abalone and Kelp forest monitoring programs at the National Marine Fisheries Service, California Department of Fish and Game, and with local commercial fishermen. By collaborating across institutions and professions, a comprehensive monitoring plan involving all of the fishery stakeholders will be developed. The results will be used to better review the recovery of abalone stocks, to develop a management plan for the wavy turban snail before the local fishery increases landings, and to analyze the effectiveness of future management and recovery schemes.
Emily Fleming	UCD	Graduate Student Fellowship	Contribution of Iron-Reducing Bacteria to Mercury Methylation in Marine Sediments	Mercury is a toxic metal that was mined in California's Coast Range and then used in the Sierra Nevada foothills for extraction of gold. Weathering of abandoned waste rock piles and mines plus erosion of contaminated river sediments continue to transport mercury into coastal sediments. Once deposited there, anaerobic microorganisms transform it into a more toxic form, methyl-mercury. This enters food chains where it bioaccumulates to concentrations that can cause impaired neurological function in a variety of higher organisms (fish, birds, humans). This toxic conversion has, in the scientific literature, been quite dogmatically attributed to activities of sulfate-reducing bacteria. Importantly, recent unpublished results from our laboratory with freshwater sediments show that iron-reducing bacteria can also convert inorganic mercury into methyl mercury and do so at rates equivalent to those of sulfate-reducing bacteria. Due to California's high concentrations of iron in coastal sediments, we propose to test the hypothesis that iron-reducing bacteria also contribute significantly to the overall production of methyl mercury in marine sediments. We will do this by exploring the linkage between methyl mercury production and the activity of iron-reducing bacteria. In mercury-contaminated marine sediments we will measure rates of methyl mercury production along with signature activities of different bacterial metabolic types, i.e. sulfate reduction and iron reduction. A second approach involves culturing evolutionarily diverse iron-reducing bacteria from contaminated marine sediments to compare (vs. sulfate-reducers) their relative abilities to methylate mercury. Understanding, based both on potential in pure cultures and activities in contaminated sediments, which bacterial types contribute significantly to mercury methylation in coastal sediments will aid in modeling of marine methyl mercury problems and in creating remediation strategies for impacted sites. This project also has implications for certain commercial fisheries that are impacted by bioaccumulation of methyl mercury.
Julie Standish	UCSB	Graduate Student Fellowship	Defining the Extent of Larval Exchange Among Kelp Rockfish (Sebastes atrovirens) Populations Using Otolith Microchemistry	The extent to which populations are connected through larval dispersal remains one of the fundamental unresolved issues in marine ecology. Larval connectivity among marine populations has far-reaching consequences for understanding population dynamics and the structure of marine communities, as well as the management of exploited species. Despite its importance, the level of connectivity among marine populations remains poorly understood. Currently, explicit information regarding the sources and destination of larvae remains unknown for any marine species with pelagic larvae, which is necessary both for the development of effective management strategies and the design and placement of marine protected areas. Given the small size of fish and invertebrate larvae, determining the dispersal pathways larvae travel has been a very challenging task. Recent developments in the use of elemental signatures contained within the calcified structures and hard parts of fishes have shown great promise as a means of reconstructing the past histories of individual fish. My proposed research uses the variation in otolith chemistry of a nearshore rockfish species (Sebastes atrovirens) to evaluate larval exchange and determine potential limitations to dispersal along the coast of California. The effective management of marine populations depends on information regarding the level of movement of larvae among populations. By examining the exchange of individuals among locations and the dispersal patterns along the coast of California, this study will generate valuable information for the effective management of nearshore fisheries and conservation.

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Steve Gaines	UCSB	Multicampus Research	Population Connectivity of Coastal Fishery Species Across the California-Mexico International Border	This project focuses on understanding the interconnections between populations of fishery species on either side of the international border with Mexico. Despite the fact that California is moving quickly toward promoting sustainable harvest through ecosystem-based management approaches in its own waters, there has been little consideration of the role of other regions in supplying individuals. Fish and invertebrates do not recognize international borders. Past research suggests that many southern California species peak in abundance south of the Mexican border, and indirect evidence suggests that ocean currents may cause a significant number of marine communities in California to depend on larval re-seeding from Baja, Mexico. Without consideration of the role of cross-border connectivity, the State of California's efforts to create sustainable harvests will be misinformed and likely unsuccessful. In order to understand the extent of larval exchange between California and Mexico, we will use new advances in genetic technology on a suite of model species to determine the rates and direction of gene flow across the international border, the spatial scales of larval dispersal along the coastline, and, when possible, the source locations of individuals recruiting to populations in California. Synthesis of these results will enable us to test and quantify the hypothesized dependence of California on breeding populations in Mexico for new recruits. Our research covers a broad taxonomic assemblage of five fish and invertebrate fishery species having similar biogeographic and life history traits that suggest population connectivity across the international border. These species also represent a host of other sub-tropically associated species in California, thereby extending the implications of our results to cover a wide array of species of economic and conservation importance to California.
Hunter Lenihan	UCSB	Multicampus Research	Community-based Collaborative Fishery Research: Assessing Fishery Impacts of California Marine Reserves	Marine reserves provide a promising alternative to conventional, single-species fishery management that bares a history of biological and economic failure. While reserves ensure ecosystem benefits, such as biodiversity and habitat conservation, ecological theories of how reserves enhance fishery production are supported by relatively little empirical data. Consequently, there is strong resistance to reserves within the fishing community. The research addressed here proposes an adaptive learning process based on scientific inquiry that will lead to more informed policy decisions regarding reserves as fishery management tools. Specifically, we propose to (1) examine whether spill-over of the CA spiny lobster (Panulirus interruptus) influences yield (catch-per-unit-effort); (2) initiate a monitoring program that exploits reserves to generate lobster population data for advancing stock assessments; (3) map the habitat, biological, and fishery economic properties of an ecosystem containing reserves to create the template for ecosystem-based management; and (4) use the information gained from steps 1-3 to develop dynamical decision-theoretic models that will guide adaptive fishery management and promote learning in management.