

Abstracts, in Program Order

1. **IMPACTS OF POST-FIRE GEOLOGICAL PROCESSES ON AMPHIBIAN AND FISH HABITAT IN SOUTHERN CALIFORNIA**

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Fall firestorms in southern California are becoming more common and the burn areas often now include entire watersheds. Several amphibians and fish in southern California are very rare or almost extirpated and they may have localized populations within specific watersheds. USGS has been developing a series of predictive models to predict the volume and probability of debris flows following burns as tools for reducing risk to life and property under various precipitation scenarios. We evaluate these models as they relate to amphibian and fish habitat and document the physical processes that take place following watershed burning from our recent observations. We also discuss recent data about ash from the 2007 firestorms as it potentially relates to distributional patterns observed in salamanders following the 2003 firestorms. Active management through extreme measures may be required in some instances to salvage populations until ecological resilience is restored in the southern California landscape.

2. **IMPACTS OF FIRE ON SANTA ANA SPECKLED DACE: A REDUCTION OF POPULATION AND GENETIC BIODIVERSITY IN SOUTHERN CALIFORNIA**

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Southern California is increasingly recognized as a biodiversity hotspot with high levels of endemism and population fragmentation. As such, this region is sensitive to the potential significant loss of biodiversity from impacts such as severe fire and flood. The massive Fall 2003 wildfires in southern California burned five sub-watersheds of the Santa Ana River watershed to varying degrees, ranging from 95% to 12% loss of vegetation. Extensive flooding during the 2003–2004 winter followed this fire event. The Southern California Freshwater Fauna Working Group found that the combination of fire followed by flooding caused the extirpation of Speckled Dace populations from the two streams that had the most watershed burned. Here, we report that those lost populations have not recovered and that this has resulted in a loss of biodiversity. Our genetic analysis of mtDNA sequence variation strongly suggest that Santa Ana Speckled Dace is a genetically distinct group of the more geographically widespread *Rhinichthys osculus*; and, that Santa Ana Speckled Dace have been impacted by the local extinctions of two of the five stream populations. Our more intensive investigation of genetic structure within and among Santa Ana Speckled Dace populations is still in progress, yet preliminary results suggest population structure and genetic diversity were adversely affected by the events precipitated by the 2003 wildfires resulting in a reduction of southern California biodiversity.

3. **ARTHROPOD RECOLONIZATION AFTER DISTURBANCE BY FIRE: THE IMPORTANCE OF LOCAL VS. LANDSCAPE PROCESSES**

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Natural lands are increasingly being impacted by habitat fragmentation, invasive species establishment, and altered disturbance regimes. Both the speed and direction of community succession are likely to change with these local and landscape-level changes. In order to predict how arthropod assemblages may change in light of anthropogenic pressures, we need to better understand the relative importance of these

processes. We compared arthropod communities in southern California coastal sage scrub in burned and nearby unburned sites with respect to local and landscape-scale vegetation and geography to infer whether (i) local survival and biotic interactions or (ii) immigration from the surrounding landscape is more important in organizing communities recovering after fire.

Our results indicate that ground dwelling insects were associated with local features and were shared across burning treatments. These species may recover quickly from light disturbance by surviving and reproducing and be initially, but not ultimately, resilient to the effects of fragmentation. Plant dwelling insects were associated with landscape features, but only weakly correlated with local features and not highly shared across burn treatments. Local biotic interactions (e.g., predation and competition) as well as immigration may explain their patterns of occurrence. Mobile arthropods were correlated with landscape features and were shared across sites. Habitat fragmentation and disturbance (i.e., fire) intensity should strongly affect direction and rate of community recovery by affecting both immigration and local survival of arthropods. Local changes, such as non-native grass invasion, should affect less mobile arthropods by increasing intensity of periodic fires and altering local vegetation structure.

4. A SHORT-TERM EVALUATION OF A LONG-TERM RESEARCH PROBLEM: DESERT TORTOISES, THEIR HABITATS AND FIRE

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In the Mojave Desert, tortoises (*Gopherus agassizii*) inhabit shrub communities that were invaded by Mediterranean annual grasses and carry fires that modify vegetation structure and composition. Although the immediate effect of fires on desert tortoises have been established as detrimental, it is still unknown how and if tortoises use large burned areas. We hypothesized that tortoises living near burned edges would use both burned and unburned habitats differentially for food and cover in comparison to animals living solely in burned or unburned sites. The Southern Nevada Fire Complex burned more than 32,000 acres of designated desert tortoise Critical Habitat in 2005. In 2006 we initiated a study to understand if re-seeding habitat with native plants could benefit desert tortoises, and how tortoises responded to the habitat modifications brought about by fire and restoration activities. To accelerate the recovery of food and cover plants for desert tortoises, we established monitoring plots (n=51) within this fire complex to evaluate multiple treatments (seeded burn, unseeded burned and unburned). Some establishment of seeded species occurred on most experimental sites. Simultaneously, we initiated studies to quantify desert tortoise use of burned and unburned areas in proximity to the restoration treatments by comparing the spatial distribution, movements, site fidelity, gender distribution, and condition of tortoises in burned and unburned areas.

5E. EFFECTS OF FIRE ON RODENTS IN SAGEBRUSH-JUNIPER HABITATS OF THE MOJAVE DESERT

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Fire can severely affect desert rodents, directly through mortality, and indirectly, by altering habitat and food resources. Few studies have examined changes in rodent communities following fires in North American dry deserts because fires tend to be infrequent. We investigated the effects of the 2005 Hackberry Complex Fire on rodents in sagebrush-juniper habitats at high elevations in the Mojave National Preserve. For two summers after the fire, we live-trapped rodents across the boundary between burned and unburned areas to determine how different species responded to fire. We also examined foraging in artificial seed trays during full and new moon phases to investigate potential differences in rates of granivory across the burned-unburned transition. Kangaroo rats (*Dipodomys* spp.) were the most abundant rodents remaining in burned areas (88–98% of individuals), whereas cricetid rodents (*Peromyscus* spp.) tended to be restricted to unburned vegetation. In 2006, seed removal rates were much higher on new than on full-moon nights, and decreased with distance from the unburned edge, suggesting that rodents were sensitive to predation risk in the open. However, this difference disappeared

in 2007, when seed removal rates were high (>75–95% of seeds) regardless of distance from the edge, and on both full- and new-moon nights. We speculate that rodents foraged more on risky, full-moon nights in 2007 because fewer natural seeds were available during the recent drought. Our results demonstrate the large effects of fire on rodent communities, and suggest how granivorous rodents may affect plant recovery via their foraging activity.

6. ACTIVE MANAGEMENT AIDS RECOVERY OF BURNT NATURAL LANDSCAPES

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Large tracts of open space have been acquired throughout southern California by public agencies and private organizations over the past few years. Much of this land has become critical elements in Habitat Conservation Plans (HCP). These HCP's are designed to provide high quality, functional ecosystems that preserve and promote native flora and fauna, especially listed threatened and endangered species. Unfortunately, many of these properties are degraded from decades of grazing and human impacts. In addition, much of this land was burnt in the wildfires of 2003 and 2007. HCP goals will not likely be realized if the land is not successfully restored to the natural ecosystems that previously existed. Active management of these properties is needed to get control of non-native vegetation and to encourage the growth of the native flora. However, the available literature does not provide guidance in selecting appropriate restoration practices for the particular ecosystems of southern California, especially in post-wildfire situations. Research is being conducted to compare alternative restoration practices on several sites. The primary goal is to generate scientifically based methods, tactics, and strategies that can be used by land managers within public and private organizations to guide them in restoring degraded or burnt landscapes and achieving the goals of the HCP's.

Co-investigators and cooperators for this research include; Edith Allen, UCR; Marti Witter and Christy Bingham, National Park Service; John Ekhoﬀ and Tim Dillingham, CA Department of Fish and Game; Maeve Handley and Jeremy Buegge, County of San Diego.

7. SUSTAINABLE AND FIRE-SAFE LANDSCAPES

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What are sustainable and fire-safe landscapes, and how can we find, create, and/or maintain them? In 2004, we began the Sustainable and Fire Safe (SAFE) Landscapes extension program to simultaneously improve fire preparation for wildland/urban interface (WUI) residents, AND encourage WUI residents to be better stewards of neighboring habitat. We looked at the interaction between managing landscapes to reduce the threat from fire, and the loss of native vegetation and increase in invasive vegetation. Specifically, we examined situations where the introduction of invasive plants to WUI yards and subsequent escape to wildlands might be a direct result of recommendations for fire-safe plant choices. Several invasive plants, such as invasive iceplants, myoporum, periwinkle, and ivys, are often touted as fire safe plants, with very little evidence to support this. We notified those developing and extending plant lists about the ecological impacts of invasive species and encouraged them to revise their lists. We also developed an extension publication, the 2008 SAFE Landscapes Calendar and Guidebook, that educates homeowners about invasive plants and fire-safe landscaping simultaneously (available at <http://ucanr.org/safelandscapes>). Another pressing issue affecting habitat in the WUI is brush clearance, or vegetation management beyond the landscaped areas. Currently we are working with a wide variety of stakeholders to bring clarity about the science behind fuel reduction and what is required by agencies to a specific area, the western portion of the Santa Monica Mountains in Los Angeles County.

8. CHAPARRAL DOES NOT “NEED” TO BURN: CORRECTING FIRE ECOLOGY MYTHS ABOUT MEDITERRANEAN SHRUBLANDS

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The push to return fire to natural plant communities has led to an overly broad, misapplication of the fire suppression/fuel build-up model. This is especially true for chaparral ecosystems in Southern California where anthropogenic fires have dramatically increased fire frequency leading to the extirpation of chaparral in many areas. Chaparral is continually described in media reports as “over-grown” or “unnaturally” dense and is seen by many fire and land managers as a system that “needs” to burn. Such perspectives are value laden and do not reflect sound, ecological principles. Tools designed to study fire in forested systems, such as fire severity mapping and fire behavior models, are not easily used in chaparral systems. In conjunction with misunderstanding chaparral crown-fire regimes and seeing chaparral as only a “fuel” rather than a dynamic native ecosystem, the misapplication of “forest-based” research methods can lead to inaccurate conclusions and inappropriate land use policies concerning California shrublands.

9. FIRE AS AN ECOSYSTEM PROCESS: PAST, PRESENT AND FUTURE

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A global view of potential vs actual vegetation distribution leads to the inescapable conclusion that fire is a major driver of ecosystem distribution and from the paleo-record it is apparent it has been a factor since the earliest origins of land plants. Fire-prone ecosystems are dependent on patterns of primary productivity, which provide potential fuels, coupled with climatic seasonality where droughts convert this productivity into available fuels. California’s mediterranean climate provides conditions conducive to extensive wildfires through alternating seasons of good growing conditions with extreme drought. These fire prone landscapes are home to an ever increasing human population, which creates challenges for management of these ecosystems. To understand the historical basis of this problem, and potential solutions, we need to recognize the important regional variation in fuel structure and its role in determining fire regimes. Human impact through fire suppression has been very different in montane forests than in coastal and foothill shrublands. These differences have resulted in profoundly different management dilemmas. The annual autumn Santa Ana winds in Southern California create one of the most severe fire environments in the world, and because of the high population density, it has one of the greatest fire management challenges. Historically management has focused on trying to control fires, but increasingly it is clear that changes in land planning and human infrastructure will be necessary if we are to reduce losses of property and lives. Climate has always played a dominant role in our fire regime and in order to predict future climate change impacts on fires we need to clearly understand the causal relationship between drought and wildfires and our limited capacity for altering fire behavior.

10. EFFECTS OF N DEPOSITION ON RIVERSIDEAN SAGE SCRUB

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Anthropogenic nitrogen deposition has been occurring in western Riverside County for the past half-century, and during the same time period there has been extensive vegetation-type conversion of Riversidean sage scrub to exotic annual grassland. Levels as high as 30 kg N/ha/yr occur as dry deposition from automobile emissions, with highest levels in urban northern regions and decreasing along a gradient southward. To test the impacts of elevated N on vegetation, we observed changes in vegetation along a N deposition gradient and also in N-fertilized plots at a site with relatively low N deposition. Exotic grass cover was positively related to elevated soil N along the gradient, while native shrub and forb cover and richness were negatively related to soil N. Furthermore, arbuscular mycorrhizal fungi decreased in diversity and effectivity as mutualists with increasing soil N along the gradient. Fertilization with 60 kg N/ha/yr caused an increase in biomass in exotic grass after two years, while decreases in native forb cover occurred after 11 years of fertilization. Shrub cover did not change significantly during this time period. Grass biomass of 0.5–1 T/ha in soils with elevated N may be a cause of more frequent fire, as has occurred in the Riverside area. The combination of increased grass fuel for fire, more frequent fires, and decreased effectivity of mycorrhizal fungi for native plant establishment following fire, may drive the conversion of Riversidean sage scrub to annual grassland.

11. COASTAL SAGE WATER RELATIONS AND POTENTIAL INVASIBILITY

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Soil moisture is likely a limiting resource in arid and semi-arid environments for woody shrub species. Seasonal soil moisture was assessed in a coastal sage scrub community and in two adjacent plant communities of similar soil texture. Water potential of all of the dominant woody plant species occurring in these communities were also measured seasonally. The coastal sage community had the moistest dry season soil (20%), compared to a Mojave Desert site (7%) and a chaparral site (10%). These differences in soil moisture are related to differences in precipitation (between the Mojave Desert and other two sites) and to differences in plant water use (between the coastal sage and chaparral which both receive similar precipitation). Previous work finds that 18% soil moisture is an important threshold for woody plant seedling recruitment and the coastal sage community remains above this soil moisture threshold year round. Of the three communities, the coastal sage community may therefore be particularly susceptible to invasion by woody shrub species since its soil moisture content would allow for germination and persistence of a wider range of potential invaders. This may relate to successional dynamics in areas where coastal sage scrub is replaced by chaparral vegetation over time.

12. ECOPHYSIOLOGY OF COASTAL SAGE SCRUB OF SOUTHRN CALIFORNIA

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Despite the rapidly diminishing areas of coastal sage scrub habitat in Southern California, and the fragmentation of many existing stands, there are surprisingly few data on the ecology and ecophysiology of individual coastal sage shrub species. Our study site is located in Forrestal Nature Preserve (FNP), City of Rancho Palos Verdes, which is a mixed community of plant species with different adaptive strategies, including shrubs with evergreen, sclerophyllous leaves, as well as drought-deciduous species. The study species include woody evergreens (*Rhus integrifolia*, *Baccharis pilularis*), semi evergreen shrubs (*Artemisia californica*; *Eriogonum cinerium*; *Eriogonum fasciculatum*) and drought deciduous shrubs (*Salvia leucophylla*; *Salvia mellifera*, *Encelia californica*). Seasonal patterns of midday water potential of the drought deciduous-species were highly variable, ranging from -1.5 MP during the rainy season to extremely low water potentials of -8.0 MPa in late summer. There was little fluctuation in the seasonal patterns of water potential in *Malosma laurina*. During the extreme summer drought, the minimum midday water potential reached by *Malosma laurina* was only -1.5 MPa. *Malosma laurina* an evergreen sclerophyllous shrub has a deep root system that taps ground water and thus maintains high water potentials throughout summer drought.

Our studies of comparative photosynthetic capacity have demonstrated that there is a wide range of rates between species. *Salvia leucophylla*, *Salvia mellifera* and *Encelia californica* had high photosynthetic rates ($25-28 \mu\text{mol m}^{-2} \text{s}^{-1}$), whereas evergreen species such as *Rhus integrifolia* and *Baccharis pilularis* had low rates of only $7-12 \mu\text{mol m}^{-2} \text{s}^{-1}$. Semi-evergreen species had intermediate rates of photosynthesis.

13E. DEER BROWSE AFFECTS ON POST-FIRE COASTAL SAGE REGENERATION ON SANTA CATALINA ISLAND

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Browsing by alien mule deer may reduce survival of post-fire resprouting dominant shrubs on Santa Catalina Island, and lead to vegetation type conversion from native shrubs to invasive exotic grasses and forbs. Three deer exclosures were established in a recent burn to protect *Heteromeles arbutifolia* (Rosaceae) from browse. Areas adjacent to exclosures were established for comparison. Unburned adults served as a control. We hypothesized that deer browse would negatively impact both resprout success and physiological performance. To test our hypotheses we measured plant mortality, canopy death (%), pre

-dawn water potential (Ψ_{pd}), stem elongation (mm/day), plant canopy area (m^2), maximum net carbon assimilation (A_{nmax}), photosynthetic capacity (F_v/F_m), stomatal conductance (g_s), and lignotuber starch content. Browsed resprouts had greater levels of mortality compared to non-browsed resprouts (mortality = 53% and 12%, respectively; $P = 0.05$). Stem elongation, plant canopy area and A_{nmax} for non-browsed resprouts were significantly greater compared to browsed resprouts ($P < 0.05$), but g_s was not significantly different. Pre-dawn water potentials, during the dry season (August) and in the driest year in recorded history, indicated that browsed and non-browsed plants were well hydrated ($\Psi_{pd} > -0.9$ MPa), whereas unburned plants showed water stress ($\Psi_{pd} =$). Lower values of A_{nmax} , F_v/F_m , and canopy area for browsed resprouts all point to a decreased ability to capture CO_2 , which may lead to carbon reserve depletion and ultimately starvation. Alien deer browse apparently diminishes resprout success, which is likely caused by carbon starvation and not water stress

14E. THE ROLE OF RAINFALL PULSES, RESOURCE AVAILABILITY, AND FIRE IN THE CONVERSION OF COASTAL SAGE SCRUB TO ANNUAL GRASSLAND COMMUNITIES

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Climate change models predict that in mid-latitude regions rainfall event sizes will increase and frequency will decrease. These changes in rainfall distribution may influence the success of invasive species, particularly when invaders and residents differ in their relative responses to soil moisture. The shrub-dominated coastal sage scrub (CSS) communities have declined at a rapid rate and have been converted to exotic annual grass dominated systems. As fire disturbance is increasing in frequency, the interactions between reestablishing CSS and invader species after a fire may be particularly important in this conversion process. We hypothesized that (1)CSS is more vulnerable to invasion after fire, and that (2)competitive hierarchies between invader species and reestablishing CSS would shift in response to changes in rainfall distribution. Predicted changes of larger, less frequent rainfall events should favor species like the CSS shrubs with deeper roots and greater tolerance to dry periods. Through CSS surveys, we found that sites with high fire frequencies had the greatest declines in CSS cover over the past 70 years. We also established exotic grass, CSS seedling, and competition plots in an additive design, and manipulated rainfall event size and frequency. We found that exotic grasses had a strong competitive impact on CSS seedlings in all rainfall treatments, with the strongest effect when rainfall events were more frequent. Results indicated that disturbance reduces CSS's ability to resist invasion, that exotic invaders suppress reestablishment of CSS seedlings, and that predicted changes in rainfall distribution may help to offset the trend in CSS decline.

15. DIVERSITY PATTERNS IN CALIFORNIA SAGE SCRUB

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Plant community diversity, measured as species richness, is typically highest in the early postfire years in California sage scrub. However, this generalization is overly simplistic and the present study demonstrates that diversity is determined by a complex of temporal and spatial effects. Characteristics of the disturbance event, in this case fire severity, can alter postfire diversity, both decreasing and increasing diversity, dependent on life form. Spatial variability in resource availability is an important factor explaining patterns of diversity, and there is a complex interaction between landscape features and life form. Temporal variability in resource availability affects diversity, and the diversity peak in the immediate postfire year (or two) appears to be driven by factors different from subsequent diversity peaks. Early postfire diversity is influenced by life history specialization, illustrated by species that spend the bulk of their life cycle as a dormant seed bank, which is then triggered to germinate by fire. Resource fluctuations, in particular precipitation, may be associated with subsequent postfire diversity peaks. These later peaks in diversity comprise a flora that is compositionally different from the immediate postfire flora, and their

presence may be due to mass effects from population expansion of local populations in adjacent burned areas.

16E. CLIMATE ENVELOPE MODELING IN CALIFORNIA SAGE SCRUB: DEFINING THE BIOCLIMATIC NICHE

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Recent advances in species distribution and ecological niche modeling are proving valuable tools for ecosystem conservation and management. We used ecological niche modeling to define the bioclimatic niche, or envelope, of California sage scrub. Using point localities from georeferenced herbarium records, we model the potential distribution and bioclimatic envelopes of 13 characteristic sage scrub species based upon current climate conditions. Within sage scrub, we distinguish between three geographically based floristic elements: southern coastal species (e.g. *Encelia californica*, *Salvia apiana*), coastal-interior disjunct species (e.g. *Croton californica*, *Encelia farinosa*) and broadly distributed species (e.g. *Artemisia californica*, *Mimulus aurantiacus*). In addition, we use MAXENT, a recent maximum entropy algorithm, to model species distribution and provide climate-based regional habitat suitability maps for species and floristic groups. With applications in predicting impacts of climate and land cover change and quantifying invasive species' expansion, species distribution and ecological niche modeling hold great potential for the conservation of sage scrub in California.

17. ENVIRONMENTAL DRIVERS OF LANDSCAPE-SCALE COASTAL SAGE SCRUB CONVERSION TO EXOTIC GRASSLAND

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Type conversion of coastal sage scrub vegetation to exotic grassland is occurring at a large scale across the southern California landscape. This transformation is attributed to human-caused processes such as altered fire regimes and nitrogen deposition resulting from air pollution. To evaluate the relative importance of natural and anthropogenic environmental factors in this process we developed models predicting conversion of coastal sage scrub to non-native grassland over a 70 year period in western Riverside County. We used a vegetation map created from Wieslander surveys in the early 1930s to compare with vegetation mapped by the California Department of Fish and Game with 2001 aerial photographs to identify locations where coastal sage scrub converted to non-native grassland or remained as coastal sage scrub. We used Geographical Information Systems to assemble various environmental attributes at each sampling location including measures of topography, climate, fire regime, geology and modeled levels of nitrogen deposition. We employed an information theoretic approach to compare models with different combinations of environmental variables and to identify candidate models that best predicted conversion of coastal sage scrub to exotic grassland. We used the candidate models to identify percent slope and nitrogen deposition as important in this landscape-scale conversion process. Locations with shallower slopes and higher total nitrogen deposition were more likely to convert to exotic grassland. While fires were more frequent and larger and geology tended toward sedimentary soils at points that converted to exotic grassland, these variables did not contribute significantly to the candidate models.

18. IMPACTS OF ARGENTINE ANTS ON COMMUNITY PROCESSES IN CALIFORNIA SAGE SCRUB

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In the coastal sage scrub of southern California, dry conditions strongly limit invasion by Argentine ants (*Linepithema humile*). Where soil moisture levels are high enough, however, *L. humile* readily invades

scrub habitats and displaces a majority of native ant species. Because of the Argentine ant's intolerance of hot, dry conditions and because of its inherent dispersal limitations, native ant displacement along natural and artificial moisture gradients often resembles an edge effect, the magnitude of which is inversely proportional to the suitability of the physical environment. Control strategies for this invader might thus focus on reducing urban and agricultural run off into natural areas. The homogenization of ant communities that occurs following invasion results in additional ecological effects. Known impacts extend to animals that prey upon ants and to plants that rely on ants for seed dispersal and protection from herbivores.

19. COASTAL SAGE SCRUB RESTORATION AT AN AUDUBON CALIFORNIA SANCTUARY: A RESEARCH-BASED, NON-CHEMICAL APPROACH

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Restoration of rare coastal sage scrub habitat at Audubon California's Starr Ranch Sanctuary in southern California commences the second year of non-chemical control of the exotic herbaceous perennial, *Cynara cardunculus*, which has invaded 251 ha of native and degraded grassland stands at the 1575 ha preserve. Because analyses of aerial photoseries taken over 48 years revealed gradual coastal sage scrub colonization of grasslands, we decided to actively restore 102 ha of *C. cardunculus*-infested sites in which shrub species have begun colonization. Results from a factorial experiment established an optimum seeding rate and soil tamping technique. Restoration practices were further refined with a second experiment that showed that a combination of direct seeding and plug planting spaced over the growing season would be beneficial in our semiarid region. Non-chemical control of other exotic species in restoration sites is ongoing. Previous research demonstrated a facilitating role of small herbivorous mammals in shrub colonization of grasslands. Current research focuses on the possible role of small mammals in controlling palatable exotic species in restoration sites. Long term data collection on effects of restoration on both small mammals and birds commenced in 2004 and is beginning to indicate positive relationships. Vegetation monitoring of active and passive restoration processes in a total of 26 ha over three years showed 50–60% native shrub cover in treatment areas with baseline 0–5% native cover.

20. COUNTY OF LOS ANGELES COUNTYWIDE STORMWATER/URBAN RUNOFF PUBLIC EDUCATION PROGRAM

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The County of Los Angeles (County) developed a comprehensive public education program in compliance with the 2001 National Pollutant Discharge Elimination System Permit to inform and remind residents that their behaviors can contribute to stormwater pollution. The pollution prevention messages are circulated to County residents through a variety of media outlets including: outdoor billboards; bus tails and bus cards; radio, television, and print; movie theaters; Internet marketing; and collateral materials. We convey campaign messages through mass media and targeted businesses such as home improvement and pet stores. The County evaluates its public outreach efforts through an annual resident survey, website hits, and the number of calls received through our toll-free environmental hotline. The 1997–2006 survey results indicate a decline in the occurrence of several polluting behaviors as self-reported by survey participants.

21. PRODUCT SUBSTITUTION: DIAZINON

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Source controls, one of the two general categories of best management practices (BMPs), work by keeping potential pollutants out of stormwater while the other major category of BMPs – treatment controls work by removing potential pollutants once they are in stormwater. Most source controls are focused on physically keeping potential pollutants out of contact with rainfall and stormwater runoff

through covering, berming, or cleaning. ‘True source control’, a subset of source controls, focuses on the original source of a potential pollutant by eliminating or significantly reducing the existence of the potential pollutant, thereby negating the need to physically prevent contact with rain or runoff.

The focus of most true source control efforts to-date has been human-made products. Products are a natural for true source control because their source is clear and finite (e.g., a company, a factory). Many times it is not the product per se that is the problem but a particular form of the product or a particular ingredient in the product. This fact lends itself to an approach called product substitution in which substitute products or ingredients are developed and then promoted or required to be used. The pesticide diazinon provides a case study of how true source control can be used to reduce stormwater pollution in a quantitative and measurable way.

22. USING COMMUNITY BASED SOCIAL MARKETING TO INCREASE USED OIL RECYCLING IN LOS ANGELES

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The City of Los Angeles Stormwater Public Education Program is currently using methods of Community Based Social Marketing (CBSM) to drive the direction of its used oil recycling public education program. The program has recently revamped the “look” of the public outreach design to follow CBSM tenets of modeling and norm appeals. In addition to aesthetic design elements, Los Angeles is also employing programmatic uses of CBSM. The program is currently conducting baseline surveys in the Harbor Gateway area as part of an abandoned oil pilot program. The surveys will assess the barriers and motivators of Do-it-Yourself oil changers in order to tailor an outreach campaign that aims to curb incidences of abandoned oil. Pilot programs will be conducted throughout the City and then evaluated to measure successes and areas for improvement. The ultimate goal will be to refine the pilots in order to transition into City-wide roll out of the program.

23. ENFORCEMENT OF WATER WASTING-URBAN RUNOFF CODES & BMPS

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The City of Santa Monica Watershed Management Program contains two strategies to reduce pollution found in urban runoff. The first strategy is post-construction BMPs in building projects to control polluted runoff, whether it is runoff leaving one’s site or after it has left a site. The second strategy, and focus of this presentation, is preventing pollution from contacting runoff and reducing the production of runoff during dry weather, keeping it out of the municipal storm drain system. This strategy is a source control program. The City employs various patrols and inspections to seek out violators of the City’s two main ordinances for watershed management, the Wasting Water and Urban Runoff Pollution Mitigation ordinances. Through these two municipal codes, City staff has authority to issue fines ranging from \$250–500 for violations. However, the first strategy when enforcing these codes is to educate the public about the problems and the solutions, to work with the public to correct problems. This type of strategy offers a long-term win-win solution and recruits more of the public to participate actively in helping the City implement its Watershed Management Program.

24. CALTRANS’ USE OF AND RESEARCH ON VEGETATED BIOFILTER BMPS

K.L. Dreher^a and **M.M. Kerner^b**. ^aCalifornia Department of Transportation, Division of Environmental Analysis, Sacramento, CA, 94274; ^bCalifornia State University – Sacramento, Office of Water Programs, Sacramento, CA, 95819-6025

Caltrans has a research team dedicated to developing and improving structural and non-structural Best Management Practices (BMPs) for reducing the impact of highway runoff on receiving waters. A particularly effective and feasible category of structural BMPs that Caltrans has been implementing and researching are vegetated biofilters. Biofilters are treatment devices that incorporate vegetation to promote

the reduction of pollutants such as litter, soil particles, and metal particulates in stormwater discharge. Treatment mechanisms include filtration through vegetation, sedimentation, adsorption to soil particles, microbial processes, and infiltration. Caltrans' commonly utilizes biofiltration BMPs such as biostrips, bioswales, and wet basins to improve highway runoff quality, as their BMP Retrofit Pilot Study has shown these BMPs to be effective in cost and performance for reducing solid particles and heavy metals from highway runoff. Caltrans' Roadside Vegetated Treatment Sites (RVTS) Study assesses ways to improve implementation and effectiveness of biostrips and bioswales by evaluating how site characteristics such as roadside vegetation, slope inclinations, and soils influence treatment. Additional research is attempting to expand the Caltrans' toolbox of effective and efficient use of vegetated BMPs.

25. PERFORMANCE OF THE BALLONA FRESHWATER MARSH AS A MULTI-PURPOSE CONSTRUCTED WETLAND

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The Ballona Freshwater Marsh consists of 24 acres near Playa del Rey and Culver City, California. The Marsh is part of a 51-acre freshwater wetland under construction by Playa Vista as mitigation for development impacts. The watershed area is about 1,100 acres, of which about half consists of the Playa Vista development with water quality Best Management Practices (BMPs), and half consists of older neighborhoods without water quality BMPs. The wetland system was designed for habitat, runoff treatment, and flood management. Although the wetland as a whole is not yet complete, five years of monitoring indicate a mix of positive performance trends and challenges for maximizing habitat and water quality. Goals for bird use, vegetation structure, and species richness have been met. Comparison of water quality data to values predicted when the Marsh was designed in the 1990s show greater inputs of total suspended solids, total phosphorus, and total nitrogen than predicted, but lower concentrations of metals. Removal efficiencies depend on constituent, input concentration, and season, but at their highest levels approach 90 percent for metals such as copper and zinc that are plant nutrients. Metal and trash inputs from the portion of the watershed without water quality BMPs have been consistently higher compared to the portion of the watershed with BMPs. Management of emergent vegetation, populations of a non-native fish species, and application of a pesticide required by the local vector control agency for mosquito abatement may depress habitat values and water quality below maximum potential.

26. ENFORCEMENT OF WATER WASTING-URBAN RUNOFF CODES & BMPS MEETING THE TRASH TMDL IN THE CITY OF LOS ANGELES

Morad Sedrak. City of Los Angeles, Bureau of Sanitation, Watershed Protection Division, Los Angeles, CA, 90015

The City of Los Angeles is mandated by the Trash TMDL to reduce its trash contribution to the LA River and Ballona Creek by 10% each year for a period of ten years. The City's strategy for compliance utilizes a two-pronged approach, i.e., implementing institutional measures and installing structural trash control devices. Prior to carrying out this approach, the City completed several studies to guide its efforts for developing a cost effective implementation plan. An initial study identified three trash generation areas in the City (low, medium, high), which revealed that the high areas contributed 60% of the City's trash. Two additional studies on CB inserts and opening screen covers used by the City, concluded that their effectiveness are 100% and 86%, respectively. In July 2007, the City's catch basin inserts were certified as full capture devices by the LARWQCB. Having implemented various structural measures over the course of the past four years, the City concluded that implementation of a combination of CB inserts and opening screen covers in the high trash areas and opening screen covers at all remaining catch basins is the most feasible, practical and cost effective approach for compliance. Thus far, the City has installed 7,400 inserts and 14,300 opening screen covers.

27. SALT CREEK OZONE TREATMENT FACILITY FOR URBAN RUNOFF, DANA POINT, CALIFORNIA

Brad Fowler. P.E., Director of Public Works & Engineering Services, City of Dana Point, 33282 Golden Lantern, Dana Point, CA 92629

The City of Dana Point was determined to find an effective solution to beach impairments resulting from urban runoff at two highly-used beaches, Monarch Beach and Salt Creek County Beach *in the near term*. Even with the aggressive source control strategies that have been implemented within the urbanized watershed, including inlet filters, streetsweeping, stream restorations, over-irrigation outreach, and commercial inspections; no notable improvements were observed downstream at the beaches and ocean. The frequent beach postings and resulting potential health concerns and negative economic impacts required immediate action. The solution: the Salt Creek Ozone Treatment Facility at the bottom of Salt Creek which removes bacteria, potential viruses and a number of other pollutants commonly found in urban runoff. The state of the art facility diverts and treats 500–1,000 gpm of dry weather urban runoff. As the facility is entering its third season of operation, this presentation will cover:

- Project Effectiveness & Challenges
- To Permit or Not? The fate of the “Facility that Extracts Treats & Discharges (FETD)” - Regulatory agencies struggle as to whether treatment BMPs require discharge permits
- Taking the Next Step - Reuse Obstacles: Permitting, Funding, Brine Disposal & Water Rights
- Battling Bacteria TMDLs: “End of pipe” treatment does have its place.

28. REUSING ONE’S LOCAL WATER RESOURCES – DRY WEATHER RUNOFF REUSE THE SMURRF WAY

N. Shapiro, City of Santa Monica, Environmental Programs Division, 200 Santa Monica Pier, Suite K, Santa Monica, CA 90401

The City of Santa Monica Watershed Management Program includes a strategy to harvest and reuse both wet and dry weather runoff. Both are responsible for pollution of the Santa Monica Bay and exceedances of state health bacterial limits for water quality. As regulations have become stricter to clean up pollution found in runoff, the City decided to embark on a more sustainable watershed strategy as it planned on how to meet various runoff requirements – runoff reuse. With ongoing water supply challenges as demand rises and reliable supplies decrease, the City believes that the most sustainable strategy is to use as much of one’s local water supplies as possible and reduce dependence upon imported water supplies. Instead of treating runoff pollution and then discharging the treated runoff to the Santa Monica Bay, wasting a water resource, the City decided to adopt a sustainable strategy of water reuse. The Santa Monica Urban Runoff Recycling Facility (SMURRF) treats up to 500,000 gallons per day of dry weather runoff for reuse in landscape irrigation and indoor use. This strategy reduces the City’s dependence on imported potable water by 2–4%. The facility treats over 90% of the City’s dry weather runoff from its two main storm drains at Pico Boulevard and the Santa Monica Pier. Besides treating urban runoff, the SMURRF offers visitors a place to come and learn what urban runoff is and what solutions are available to reduce this pollution source.

29F. LIFE HISTORY OF SARGO, *ANISOTREMUS DAVIDSONII*, IN THE SOUTHERN CALIFORNIA BIGHT

M.C. Mandrup and D.J. Pondella, II. Vantuna Research Group and Department of Biology, Moore Laboratory of Zoology, Occidental College, Los Angeles, CA 90041

Sargo, *Anisotremus davidsonii*, is a common member of the rocky reef fish assemblage in the Southern California Bight, however little is known about the life history of this Haemulid. Age and growth analyses were performed on 686 individuals using otoliths. The maximum age was 23 years and the von Bertalanffy growth parameters for all individuals were $L_{\infty} = 278.47$ mm, $k = 0.224$ yr⁻¹, and $t_0 = -1.228$ yr. Growth estimates for both sexes indicated that females grew significantly larger and faster than males. Gonosomatic indices (GSI) peaked during the summer indicating that this is their spawning season with maximum GSI for males = 6.08% and females = 4.25%. Both sexes were found in all age classes with an overall male to female ratio of 56:44 that was significantly different from a 50:50 ratio ($\chi^2 = 7.0$; $p < 0.01$). GSI values and sex ratio were consistent with group spawning and sperm competition. Mean catch-per-unit-effort from 1996–2004 fluctuated temporally and spatially at 10 sites, and was significantly

correlated with sea surface temperatures ($r = 0.616$; $p = 0.006$). Catch declined from 2000–2004. Estimates for annual mortality ($A = 0.1950$) and the instantaneous coefficient of total mortality ($Z = 1.6346$) were calculated from samples collected from 2002–2004.

30M. MICROSATELLITE DNA ASSESSMENT OF MULTIPLE PATERNITY IN THE VIVIPAROUS ROCKFISH *SEBASTES MELANOPS*

K.W. Karageorge and R. Wilson, Jr. Department of Biological Sciences, California State University, Long Beach, Long Beach, CA 90840

Microsatellite DNA loci were employed in a natural population of the viviparous black rockfish, *Sebastes melanops*, to 1) quantify the incidence of multiple paternity in a sample of brooded females, 2) estimate relative paternal contributions of multiply sired broods, where evident, and 3) to characterize the genetic mating system of *S. melanops*. Brooded females ($n=15$) and samples of their progeny were assayed to determine their multi-locus genotypes, and progeny array data was then analyzed with parentage software to determine the number of (reconstructed) sires contributing to each female's brood. The total expected probability of excluding a random male in the population as being the sire of a brood was $p=0.97$. Parentage analysis revealed that 66% (10/15) of the broods were multiply sired (frequency of multiple paternity), and the mean number of sires per brood was 2.9 ($sd=0.83$), ranging from 1 to 4 sires. The relative paternal contribution was skewed in most multiply sired broods, with one male inseminating a majority of the progeny, suggesting the possibility of sperm competition in a species that exhibits prolonged sperm storage. The results provide strong genetic evidence of a promiscuous mating pattern among some female *S. melanops*, i.e., polyandry, resulting in full and half-sib relationships among brooded progeny and a polygamous genetic mating system for this economically-important nearshore rocky reef species.

31. LONG-TERM POPULATION TRENDS OF SOUTHERN CALIFORNIA SCIAENIDS IN THE PRESENCE OF OCEANOGRAPHIC CHANGE AND POWER PLANT ONCE THROUGH COOLING

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Sciaenids comprise a substantial portion of the southern California coastal ichthyofauna. Despite their contribution to the overall abundance, little information is known about their long-term population trends, except for the heavily fished white seabass (*Atractoscion nobilis*). For the non-commercial species, such as *Seriphus politus*, *Genyonemus lineatus*, *Roncador stearnsii*, *Menticirrhus undulatus*, *Cheilotrema saturnum*, and *Umbrina roncadore* limited temporal analysis of their standing stock has been attempted, and this is limited to only *U. roncadore* and *C. saturnum*. Increasing attention to coastal fish population levels, in light of the general decline of most coastal fishes, has spurred interest into the causes of these declines. To this end, fishery independent datasets (impingement, otter trawl, scientific gillnet, and nearshore ichthyoplankton) were analyzed to evaluate these trends. From these, observed abundances were compared to oceanographic data (sea surface temperature, multivariate ENSO index, Pacific Decadal Oscillation index, etc.), annual maximum kelp canopy for the San Diego/Orange Counties coastline and Palos Verdes Peninsula, as well as cooling water flow rates at local power plants. Recruitment indices, such as annual abundance of young of the year and estimated hindcasted mortality adjusted recruitment (*S. politus*, *G. lineatus*, and *U. roncadore*), were examined against the same parameters as were observed abundances.

32E. INVESTIGATING ELK KELP'S (*PELAGOPHYCUS PORRA*), INABILITY TO INVADE POINT LOMA GIANT KELP BEDS

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The Elk Kelp, *Pelagophycus porra*, is commonly observed in deep (20–30 m) water on the outer edge of Giant Kelp, *Macrocystis pyrifera*, forests in southern California and northern Baja California, Mexico, but rarely occurs in shallower water within the giant kelp beds. *Pelagophycus* exhibits a heteromorphic life history, alternating between a macroscopic sporophyte and a microscopic gametophyte. Therefore, consideration of both life history stages allowed us to study the apparent inability of *Pelagophycus* to encroach into the more abundant Giant Kelp beds along the southern California coast. Transplanting juveniles inshore revealed that the onset of reproductive maturity occurred sooner at shallower depths with no depression in growth. Experimental removal of *Macrocystis* and the addition of *Pelagophycus* reproductive spores using sori-filled mesh bags resulted in no recruitment of *Pelagophycus* within the Giant Kelp beds. A methodological control within the *Pelagophycus* beds showed a significant difference in *Pelagophycus* recruitment within 1–2 m from sori bags as compared to natural recruitment within the site. Culture experiments were carried out in the laboratory to investigate the effects of increasing light levels on the microscopic life history stages of *Pelagophycus*. Both embryonic sporophyte and gametophyte densities dropped to zero when moved to higher levels equivalent to those found within the *Macrocystis* beds. Sensitivity of *Pelagophycus* microscopic stages was also observed when grown constantly at higher light levels. This light sensitivity of the microscopic stages is likely the major factor inhibiting *Pelagophycus* from permanently establishing within the *Macrocystis* beds.

33. AN EMERGY INPUT ANALYSIS OF SANTA MONICA BAYKEEPER'S KELP RESTORATION PROJECT

Brian Meux. Santa Monica Baykeeper, Marina del Rey, CA 90292

Santa Monica Baykeeper's Kelp Project was an answer to the large-scale degradation of giant kelp (*Macrocystis pyrifera*) forests of Santa Monica Bay, California. From 2003 to 2006, this large-scale experiment transformed a sea urchin barren into a productive and resilient kelp forest ecosystem off Escondido Beach, Malibu. Restoration success was measured by *Macrocystis* density values reaching 0.1 plants/m² and t-Test statistical analysis. Marine restoration can be expensive and difficult, and as of yet no study has linked energy inputs with the success of a kelp restoration project. This study used H.T. Odum's Emergy methodology to estimate the quantity of human and environmental Emergy inputs for direct comparison to each other and the restoration success. The human input's Empower density was found to be 4.67×10^{17} sej/ha/yr, compared to the environmental input's Empower density of 3.00×10^{18} sej/ha/yr. The Emergy Investment Ratio for the Kelp Project was 0.16 during the study period, with human inputs decreasing during the study period. Urchin relocation composed 83% of all restoration diving activities, restoring the process of urchin predation. This analysis provides insight into improving the Emergy efficiency of the kelp restoration process, including site selection, monitoring, restoration activities and design. Scientists and practitioners may integrate this method with current tools that guide ecological restoration and the assessment of kelp restoration projects.

34. SOCIAL-ECOLOGICAL INTERACTIONS IN GIANT KELP FORESTS

D.C. Reed. Marine Science Institute, University of California, Santa Barbara, CA. 93106

Most natural systems are influenced to some degree by humans, yet there has been a tendency to target relatively pristine sites when studying many ecological patterns and processes. There is growing realization that true progress in understanding the impacts of environmental change can only come about by studies that account for interactions and feedbacks between humans and the environment. Here I present a conceptual framework adopted by the US Long Term Ecological Research Network for studying social-ecological interactions, and I apply this framework to giant kelp forests in southern California. Within the context of this framework, kelp forests and humans are linked by the ecosystem services that kelp forests provide to society, and by the impairments to kelp forest structure and function that are caused either directly or indirectly by human activities. Data collected by the Santa Barbara Coastal Long Term Ecological Research project are used to illustrate direct and indirect effects among humans, environmental drivers, and kelp forest structure, function and services. Patterns observed to date indicate the need for long term data in evaluating the strength of the interactions among these factors and their underlying causes.

35. **PATTERNS OF FISH AND INVERTEBRATE ASSEMBLAGES AMONG KELP FORESTS IN SAN DIEGO**

P.E. Parnell, Integrative Oceanography Division, Scripps Institution of Oceanography, La Jolla, CA, 92093-0227

Patterns of fish and invertebrate occupancy of distinct habitats within several kelp forests off San Diego are remarkably different for many species. Why is this so? Possible reasons include, but are not limited to, (1) nonlinearities in the interaction of habitat type, quantity, and patch sizes, (2) ocean climate, and (3) fishing pressure.

36F. **MIDWATER FISH ASSEMBLAGES ASSOCIATED WITH PETROLEUM PLATFORMS ON THE SAN PEDRO SHELF: A COMPARISON WITH ADJACENT NATURAL REEFS**

C.J.B. Martin and C.G. Lowe, Department of Biological Sciences, California State University, Long Beach, CA, 90840

Recent ecological studies of petroleum platforms in the Santa Barbara Channel have indicated increased fish community parameters compared to natural adjacent reefs. These data, attributed to platforms acting as *de facto* marine reserves, have led to increased support for platform protection as "Essential Fish Habitat." However, fish communities associated with the more southern platforms on the San Pedro Shelf have remained largely unstudied. Bimonthly SCUBA-based fish surveys were conducted in the midwater regions (to a maximum depth of 31 meters) at six of the seven platforms on the San Pedro Shelf for the period of one year. Diver surveys observed 48 different species associated with platform assemblages on the San Pedro Shelf. A strong distinction was observed between the platforms close to shore (shallower than 18 meters) and those further from shore (deeper than 50 meters). Despite having several common species, the inshore platforms had greater richness while the offshore platforms had greater total density. Seasonal influences were prominent at the offshore platforms with dramatic changes attributed to pelagic baitfish species and *Chromis punctipinnis* (blacksmith) recruitment. Species assemblages were also observed to differ with depth at the offshore platforms. Comparisons are made with data from adjacent natural reefs on the San Pedro Shelf, indicating differences in species assemblages and community structure. Based on these comparisons, habitat quality of San Pedro Shelf platforms are discussed.

37. **THE NEARSHORE ROCKY-REEF FISHES OF THE SOUTHERN CALIFORNIA ISLANDS**

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Underwater surveys of nearshore rocky reef communities were conducted at 88 sites in central and southern California during summer and fall 2004 using a standardized methodology. The project, referred to as CRANE (Cooperative Research and Assessment of Nearshore Ecosystems), was a collaborative effort among scientists at six institutions. Over 225,000 fishes representing 83 distinct species from 40 families were observed at all sites combined. Rockfishes included the most species (14) of all families, followed by surfperches with ten species and sculpins with six species. A multivariate analysis identified groups of geographically-related sites that had a high degree of within-group similarity in their fish assemblages. A northern group of sites from Monterey Bay to Big Sur was characterized by blue rockfish, copper rockfish, cabezon, and striped surfperch. Sites south of Big Sur to Point Purisima formed a central mainland group, while a third group of sites at San Miguel Island and Santa Rosa Island included elements of the northern fauna in addition to greater numbers of black surfperch and kelp bass, among others. Santa Cruz Island and San Nicolas Island had a transitional fish assemblage between the northern groups and a large southern group that included sites at Anacapa Island, Santa Barbara Island, Santa Catalina Island, San Clemente Island, and the mainland from Santa Monica Bay to San Diego. Garibaldi, blacksmith, kelp bass, opaleye and sheephead characterized these southern sites.

38. OVERVIEW OF EFFORTS TO REDUCE FISHERY BYCATCH

Mark Helvey, National Marine Fisheries Service

Fishery bycatch, or fish harvested in a fishery that are neither sold nor kept for personal use, is one of the most significant issues affecting fisheries management. Bycatch, and especially the mortality of such bycatch, can have significant consequences for populations, food webs, and ecosystems. The view that bycatch should be reduced is reflected in national priorities reflecting the global view that discarded portions of fishery catches represent an unacceptable waste of natural resources. Efforts to minimize bycatch and, to the extent bycatch cannot be avoided, minimize the mortality of such bycatch, have become increasingly important priorities for fishery management over the past several years and remains a central challenge. Three primary strategies to minimize bycatch are avoidance, deterrence, and selectivity. This overview discusses these approaches and provides the context for the presentations in this symposium.

39. THE INTERNATIONAL SMART GEAR COMPETITION: INSPIRING INNOVATION BY CAPITALIZING CREATIVITY

M. Osmond, World Wildlife Fund, Palo Alto, CA 94301

WWF's International Smart Gear Competition awards cash prizes for innovative ideas to make fishing more selective. The competition is intended to inspire, reward and promote practical fishing gear designs to reduce fisheries bycatch and to encourage creative thinkers everywhere to share their ideas. The competition is open to eligible entrants from all backgrounds, and the three competitions previously held have attracted entries from around the world. Entrants have included fishermen, students, gear technologists, engineers, chemists, and inventors. An international panel made up of gear technologists, fisheries experts, seafood industry representatives, fishermen, scientists, researchers and conservationists judge the entries and select the winners. WWF then works with industry and partners to advance the winning ideas towards adoption in relevant fisheries sectors.

40. BOTTOM TRAWL PERFORMANCE IN THE CALIFORNIA HALIBUT TRAWL GROUNDS

S.P. Wertz, A.J. Frimodig, M.C. Horeczko, T.J. Mason, B.C. Owens, and M.W. Prall. State Fisheries Evaluation Project, Marine Region, California Department of Fish and Game, Los Alamitos, CA, 90720

Bottom trawling is prohibited in state waters except within the California Halibut Trawl Grounds (CHTG) located off Ventura and Santa Barbara Counties. The trawl fishery operating within the CHTG is primarily a low-volume, high-priced halibut fishery that supplies local specialty restaurants with a live product that commands a price 1.5 times greater than dead product. Commencing April 1, 2008, about 42% of the CHTG will be closed to bottom trawling unless the California Fish and Game Commission (Commission) finds the fishery minimizes bycatch, is not likely damaging seafloor habitat, is not adversely affecting ecosystem health, and is not impeding reasonable restoration of kelp, and other biogenic habitats. To provide the Commission with the best available information, the Department of Fish and Game worked collaboratively with the Southern California Trawlers Association and California Sea Grant to investigate small scale trawl gear interaction with the seafloor in situ with an underwater video camera, and conduct a bycatch study within the CHTG. Data were also analyzed from trawl logs, seafloor mapping, ROV transects, and aerial kelp canopy surveys to document the location of trawl effort intensity relative to the occurrence of kelp and other biogenic habitats. Our results showed that trawl effort occurs primarily over soft bottom with gear having minimal bottom contact. The bycatch rate per pound of retained California halibut for the CHTG was 87% lower than bycatch in the federal limited-entry trawl fishery targeting California halibut. Effects of bottom trawling on ecosystem health were beyond the scope of this study.

41. DEVELOPMENTS IN SCIENTIFIC RESEARCH ON THE USE OF MODIFIED FISHING GEAR TO REDUCE LONGLINE BYCATCH OF SEA TURTLES

Y. Swimmer and C. Boggs. NOAA Fisheries, Pacific Islands Fisheries Science Center, Honolulu, Hawaii 96822

To comply with increased concern for the welfare of our oceans, improved gear selectivity must be a priority for fisheries scientists, managers and industry alike. This talk will summarize research comparing modified fishing gear to traditional methods in pelagic longline fisheries. The ultimate goal of the work is to identify method(s) of longline fishing that effectively reduces the incidental capture of sea turtles while simultaneously maintaining the economic viability of the fishery. Summary of findings to date: 1) Replacement of J and tuna hooks with circle hooks can effectively reduce the deep ingestion of hooks by sea turtle species that tend to bite baited hooks; 2) In fisheries with bycatch of relatively large loggerhead turtles (*Caretta caretta*) or leatherback turtles (*Dermochelys coriacea*), using large sizes of circle hooks (e.g. 18/0) can substantially reduce the bycatch of both species; 3) In fisheries with bycatch of smaller turtles, using smaller size circle hooks (e.g. 16/0) can reduce capture rates of sea turtles when the circle hooks replace other hook styles with smaller widths; 4) Using fish for bait instead of squid can reduce bycatch of sea turtles in fisheries and can also offset the potential loss of swordfish from use of circle hooks. This is not a comprehensive list of effective mitigation methods, and we encourage identification of more bycatch reduction methods to be used alone or in combination with other methods to further improve fisheries selectivity in longline and other coastal or pelagic fisheries.

42. AN OVERVIEW OF FISHING GEAR AND FISHING PRACTICE MODIFICATIONS THAT HAVE RESULTED IN BYCATCH REDUCTION IN CALIFORNIA'S COMMERCIAL AND RECREATIONAL FISHERIES

Angela Louie. California Department of Fish and Game, Los Alamitos, California

Commercial and recreational fishing gear and fishing techniques have evolved over time for many reasons. Some of these changes were due to regulations designed to reduce total catch, which indirectly reduces bycatch. Other changes were intended specifically to reduce bycatch, either of prohibited species, undesirable species, or of individuals below a desired or minimum legal size. This overview will focus on non-trawl fishery gear, in particular hook-and-line, trap (both of which are used in commercial and recreational fisheries), gill net, and round haul net (both of which are used only in commercial fisheries).

43. THE ROLE OF ALLOWABLE FISHING EFFORT IN PROVIDING INCENTIVES TO INNOVATE CONSERVATION TECHNOLOGY

S.M. Stohs. NOAA Fisheries, Southwest Fisheries Science Center, La Jolla, CA 92037-1508

A key commercial fisheries management concern is upholding requirements of U.S. federal conservation laws. Such laws include the Endangered Species Act (ESA), which regulates allowable takes of threatened and endangered species, the Marine Mammal Protection Act (MMPA), which regulates interactions between commercial fisheries and marine mammals, and the Magnuson-Stevens Act (MSA), which requires sustainable management of fisheries. This paper considers the role of allowable commercial fishing effort in providing incentives for developing cleaner gear and fishing techniques coupled with more effective conservation management practices. Overly restrictive limits on allowable commercial fishing effort may prevent fishermen from achieving an economically viable level of fishing effort. In the case of highly migratory target species such as swordfish (*Xiphias gladius*) and highly migratory protected species such as leatherback turtles (*Dermochelys coriacea*), curtailment of U.S. commercial fishing effort may inadvertently outsource fisheries conservation problems to foreign fleets. Policies which promote experimentation with conservation technology subject to compliance with federal conservation mandates can potentially lead to the development of gear and fishing practices which better achieve conservation goals without eliminating the economic viability of affected fisheries. The objective is to achieve a Pareto improvement in conservation technology, providing for either an increase in economic viability at the existing level of conservation, or stricter conservation given the current level of economic viability. Such Pareto improvements can potentially offer mutual benefits to the U.S. commercial fishing industry and to the protected species which are subject to bycatch concerns.

44. CONSERVATION FISHING AGREEMENT – THE FIRST CONSERVATION EASEMENT IN THE OCEAN?

Michael Bell. The Nature Conservancy, 75 Higuera Street, Suite 200, San Luis Obispo, CA 93401.
Co Presenter: Edwin “Fast Eddie” Ewing. Commercial Fisherman, Morro Bay, CA

TNC acquired 7 federal trawl fishing permits and 4 trawl fishing vessels, as part of its conservation project that facilitated the closure and protection of 3.8 million acres of seafloor habitat from the trawl impact. One of the vessels and a permit is being used in the Conservation Fishing Agreement, a collaborative effort to explore more sustainable ways to selectively harvest flatfish species. This unprecedented lease agreement is modeled after a conservation easement on land. The agreement carries specific geographic restrictions, monitoring protocols, and terms to allow for the adaptive design of gear over time.

45. METHODOLOGIES FOR SOCIAL AND GEOGRAPHIC INTEGRATION OF MANDATORY AND VOLUNTARY BYCATCH REDUCTION TECHNOLOGY

Ana Pitchon. CSU Dominguez Hills, Department of Anthropology, Carson, CA 90747 and Karma Norman. Northwest Fisheries Science Center, Seattle, WA 98112

Within commercial fisheries, social variables are an often overlooked piece of the conservation puzzle. This is certainly true of technological fixes meant to address issues of bycatch of non-target species in fishing. Since new mitigation technologies are often specific to particular “gear communities,” the breadth of their use may be limited. For example, one complication is that fishermen often express identification with both the type of fishery in which they’re engaged (e.g. charter recreational or commercial) and the type of gear employed (e.g. trawler or long liner) and these identities can sometimes be located geographically. The NWFSC is currently developing an approach to commercial fisheries data which will address the social and geographic aspects of gear usage. While this methodology is designed to track regulatory impacts, including the imposition of tradable quota systems, such a methodology would aid in finding where technological fixes would be most readily adopted and integrated.

46E. LIFESTYLE AND QUALITY OF HEALTH FOR 19TH CENTURY POPULATIONS IN NORTH AMERICA

S. Fitz-González. California State University, Los Angeles, Department of Anthropology, Los Angeles, CA, 90032

Detailed analysis of skeletal remains may present direct evidence of the biology of past populations, providing insight into health, diet, lifestyle, and violence. Skeletal attributes that may determine the health status or quality of life of a given population are stature, dentition, bone lesions, degenerative joint disease, and trauma. This research paper attempts to glean information about the lifestyle and quality of health for nineteenth century populations in North America by analyzing and comparing published skeletal case studies. After reviewing 13 skeletal samples, patterns of health and lifestyle in the nineteenth century emerge with respect to ancestry, socioeconomic status, geographic location, and age. African-American populations, urban populations, and children reveal the most severe lifestyle and lowest quality of health. The results shed light on nineteenth century issues, such as different access to nutrition, exposure to diseases, and interpersonal violence.

47. TIDAL LOADING RATES FOR FECAL INDICATOR BACTERIA (FIB) IN THE BALLONA WETLANDS, CALIFORNIA: RESULTS OF 12- AND 24-HR SURVEYS

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Densities of fecal indicator bacteria (FIB: total coliforms, *E. coli*, enterococci) were measured in the main tidal channel of the Ballona Wetlands (Los Angeles County) to determine fluxes over varying tidal cycles to address whether or not the wetlands act as a sink or source of these bacteria. Densities of FIB and environmental parameters were measured at a single site every 1.5-hrs over one 12-hr period (2 Mar 2007)

and two 24-hr periods (12–13 Jul 2007, 2–3 Aug 2007). Parameters included current flows, replicate surface water samples (n=3) for FIB and turbidity (NTU), and measurements of depth (ft), oxygen (mg/L), temperature (C°), salinity (ppt), and pH collected every 15-min using YSI 6600 continuous recording sonde. Tidal flows (CFS) were greatest during mid flood and ebb tide periods; maximum flows after spring highs ranged from 29.0–43.9 CFS. Turbidity spikes occurred at maximum flood and ebb flows with mean peak NTU values of 14.2 (March), 6.4 (July), and 8.3 (August). FIB loading rates (MPN/m³/s) were greatest on incoming flood tides during night, then fell throughout daylight hours; total coliform loading rates fell from levels of 10⁶–10⁸ by two to three orders of magnitude, while *E. coli* and enterococci fell from levels of 10⁵–10⁷ by two to four orders of magnitude. Correlation analyses suggest that increased light intensity may be causing diminished FIB densities throughout the day light hours, while FIB density spikes of up to four orders of magnitude appeared to be associated with increased turbidities from sediments resuspended during faster mid- to low ebb flows.

48E. FORAGING ECOLOGY OF THE ELEGANT TERN IN RESPONSE TO NEW MARINE HABITAT AT THE RESTORED BOLSA CHICA ECOLOGICAL RESERVE

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The 2006 restoration of the Bolsa Chica Ecological Reserve (BCER) in Orange County, California, provides 235-ha of new marine habitat in the reserve. This expansive marine area more than doubles the total aquatic habitat of the reserve and is located immediately adjacent to nesting sites of the Elegant Tern (*Thalasseus elegans*), a California state Species of Special Concern. This tern is primarily an ocean forager, and we predicted that the species will continue to feed in the ocean despite the accessibility of the new marine habitat. Foraging habitat locations were observed during the 2007 nesting season, and will be recorded throughout the 2008 season. Of the 6,321 Elegant Terns observed returning to the nesting site with a bill load, only 174 (<3%) were associated with foraging in the new marine area. To assess the diet of this species, we identified dropped fish from the nesting areas, bill loads of adult terns returning to feed their young by direct observation, and a few regurgitations. From dietary assessment, most fish species identified can be associated as marine or as marine migrants to estuarine systems, coinciding with our foraging observations. Compared to previous years at BCER, an increase in the number of pipefish was found among the dropped fish samples, comprising ~56% of all dropped fish collected in 2007. These findings indicate that the Elegant Tern continues to be an ocean forager following the restoration, and they suggest a recent increase in pipefish recruitment in southern California.

49E. DEVELOPING *SALICORNIA VIRGINICA* AS A BIO-MONITOR FOR THE HEAVY METALS ZINC AND CADMIUM IN THE BALLONA WETLANDS

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The coastal Ballona Wetlands are a part of the highly urbanized Los Angeles watershed. Studies performed on the water quality of the channel feeding the wetlands have shown high levels of heavy metals. It is hypothesized that in a contaminated wetland the widely distributed halophyte *S. virginica* will take up heavy metals along with the salts and thus may be used as a bio-monitor for heavy metal pollution. Five replicates of stem tips and the soil immediately below each plant were collected from 16 sites throughout the Ballona Wetlands. Stem tips were also collected from plants of Huntington Beach Back Bay for comparison. The methods used included: oven drying to establish wet and dry weights for water content, flame photometry to determine sodium and potassium levels, and atomic absorption spectroscopy for zinc (flame analysis) and cadmium (graphite furnace) levels. The concentration of each metal in the plants was correlated with the concentration of metal in the soil by regression analysis. Correlations were positive and significant for both cadmium and zinc. With *S. virginica* established as a reliable bio-monitor, areas of constant elevated cadmium and zinc pollution were identified. Comparison of heavy metal levels in *S. virginica* from Ballona to those of other areas suggests that pollution may be higher in Ballona, consistent with its urban surroundings.

50E. THE EFFECTS OF AGE AND SEXUAL EXPERIENCE ON THE MATING SUCCESS OF THE MALE HOUSE CRICKET, *ACHETA DOMESTICUS*

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Age and sexual experience are factors that have rarely been studied in insects. House cricket (*Acheta domestica*) males have been studied extensively in regards to what type of acoustic signals females choose. However, acoustic signals are long-distance and are only part of the process of mate choice. During courtship, when the male is close to the female, numerous other factors could influence male success. We examined how male age and sexual experience impact mating success. We hypothesized that older males will have higher mating success than younger males and that sexually experienced males will have higher mating success than males with no experience. In the first experiment, virgin males of different ages were paired with virgin females. In the second experiment, males with varying sexual experience were paired with virgin females. Prior to this experiment, sexually mature males were placed in one of two treatments for 48 hrs with virgin females: 0 female partners or 2 female partners. After this period, the males were isolated for 48 hrs before being presented with a virgin female for observation. In each experiment, we measured the number of successful matings, duration of successful matings, number of attempted matings, and time until mating for the males. Results will be discussed in regard to mate choice in crickets and sexual selection.

51E. METAL CONCENTRATIONS IN *MACROCYSTIS PYRIFERA* BETWEEN THREE DEPTHS AT LA HARBOR AND EAGLE ROCK

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Metal pollution is a significant problem in coastal marine communities that receive urban run-off and discharges. The following study aims to establish if the concentrations of metals within the sieve tube sap (STS) of the kelp *Macrocystis pyrifera* can be used to monitor the bioavailability and origin of metals within marine ecosystems. Inductively coupled plasma mass spectroscopy was used to compare the metal concentrations of kelp STS collected from a reference site at Eagle Rock on Catalina Island and fronds collected from LA Harbor, which is known to experience significant anthropogenic inputs of metals. STS was collected from 0 m (surface), 5 m and 10 m down the length of the frond. It was hypothesized that greater concentrations of metals would be present in LA harbor and if differences between depths occurred, the highest concentrations would occur at the apex of the frond since this region contains the highest levels of photosynthetates. Zinc, barium, cesium, rubidium, vanadium, and mercury were found in significantly higher concentrations at LA Harbor while cadmium, strontium and silver were significantly elevated in the fronds from Eagle Rock. Cadmium was also found to differ significantly between depths with the highest concentrations at 5 m and 0 m at both sites. The elevated Cadmium in the kelp from Eagle rock was attributed to seasonal upwelling and the high levels of bird guano found proximal to this site.

52E. SETTLEMENT OF *OSTREA CONCHAPHILA* AS A FUNCTYION OF TIDAL HEIGHT IN A SOUTHERN CALIFORNIA

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Recent interest in restoration of *Ostrea conchaphila*, the native west coast oyster, motivates an interest in understanding factors influencing population persistence. Not only survival of adults, but also settlement of spat can affect the persistence of future generations. Processes controlling settlement dynamics of this species are of particular concern because we can exploit natural settlement of spat for seeding restoration habitat. Here, we examined the effect of tidal height on settlement rates in Newport Bay, CA using replicate stationary PVC arrays (n=4) that suspended PVC tiles at different tidal heights during two consecutive tide series. Settlement varied inversely with tidal height (Two-way ANOVA, $p < 0.0001$) and

among tide series ($p=0.02$). Results from this study also suggested that tide distance from the mudflat bottom may be more important than tidal height in determining settlement rates. Further studies will aim to tease out the relative importance of these two factors.

53E. SONG PLAYBACK EXPERIMENTS IN ANNA'S AND COSTA'S HUMMINGBIRDS

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Hummingbirds, like songbirds, learn and sing complex songs. However, it is not known if song plays a role in individual recognition in hummingbirds. The *Calypte* genus has two species: Anna's hummingbird (*Calypte anna*) which has a complex, learned song and Costa's hummingbird (*Calypte costae*) with a relatively simple song. These structural song differences may indicate differences in the use of song between these two species. Neighbor-stranger playback experiments have documented individual recognition in territorial males in many songbird species. We conducted neighbor-stranger and heterospecific playbacks to Anna's and Costa's hummingbirds during the breeding season in Anza Borrego State Park, California (2007) and currently near Palm Desert, California (2008). The playbacks consisted of four trials in random order: a neighbor song, a stranger song, the sister species' song (a heterospecific competitor) and a heterospecific non-competitor's song. The results from our first season suggest that Anna's hummingbirds respond more aggressively to conspecific than heterospecific playback. Costa's hummingbirds showed no apparent response to conspecific playback during the first season of trials, but preliminary results from this season suggest that they are responding more aggressively to conspecific playback. To date there is no strong evidence for neighbor-stranger discrimination in Anna's or Costa's hummingbirds. Data collection is being continued during the 2008 breeding season. This is the first known study examining neighbor-stranger recognition in hummingbirds.

54F. LASER ABLATION ICP-MS ANALYSIS OF PREHISTORIC AND CONTEMPORARY WHITE CROAKER (*GENYONEMEUS LINEATUS*) OTOLITHS

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Fish otoliths (ear stones) absorb metals and other elements from their surroundings as they grow throughout life. I used laser ablation inductivity coupled plasma mass spectrometry (LA-ICP-MS) to compare the ratios of trace metals and several other elements in contemporary and prehistoric otoliths from the white croaker (*Genyonemus lineatus*). The goals of this study were to determine if LA-ICP-MS of fish otoliths could be a viable method of determining changes in ocean chemistry over time, and to observe any increases in anthropogenic elements associated with modern industrial practices in the contemporary otoliths. I obtained prehistoric otoliths from an archaeological deposit dated to be 6,000 to 600 years old, near Seal Beach, California (ORA-263). Contemporary otoliths were obtained using hook and line bait fishing from the pier at Seal Beach. The growth rings of these otoliths were exposed by cutting otoliths in half that were embedded in resin. I took LA-ICP-MS readings from the center to the outer rings of the otoliths. I determined the element to Ca ratio for each element being analyzed. A two way ANOVA revealed that most of the elements were found at higher ratios in the prehistoric otoliths than in contemporaries.

55. VARIATION IN THE DEEP SEA HOLOTHURIAN *PSYCHROPOTES LONGICAUDA* AND CONFIRMATION OF THE SPECIES *PSYCHROPOTES MIRABILIS*

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The deep sea holothurian *Psychropotes longicauda* is found at depths of 1000 to 6000 meters and is cosmopolitan in distribution. It is the most widely distributed of the deep sea holothurians seen in benthic imagery. *Psychropotes longicauda* is an extremely variable species in both morphology and color. The species *Psychropotes mirabilis* was described from a single specimen from the Indian Ocean. *Psychropotes mirabilis* is very similar to *P. longicauda* with the primary difference being a two lobed dorsal appendage

while that of *P. longicauda* has a single lobe. A second specimen of *P. mirabilis* has been seen in benthic imagery of the abyssal plain of the Indian Ocean. There is a clear difference in the structure of the dorsal appendage of the *P. mirabilis* seen in the benthic imagery and those of *P. longicauda* seen in the same benthic imagery. Detection of the second *P. mirabilis* individual confirms the status of the species.

56. **ECOSYSTEM IMPLANTATION ON SATURN'S MOON TITAN BY ACCUMULATION OF INTERNAL OCEAN SATELLITE ICE DEBRIS CONTAINING ORGANISMS**

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Microbe containing ice may originate in Saturn's planetary system from the disintegration of ice satellites with internal ocean ecosystems. Icy moons with internal oceans, which previously existed in orbit around Saturn, could have been destroyed through tidal disruption by Saturn or by collision with other moons, asteroids, or comets. Also, microbe containing ice may be ejected into Saturn's E ring by the plumes of Enceladus which may have or may have had an internal ocean with an ecosystem. Water ice makes up 90% of the plume material being ejected from the south polar fractures on Enceladus. Some of the water ice crystals are deposited on the surface of Enceladus while the rest ends up in the E ring of Saturn. This ice with microbes in the Saturnian system may be accumulated by the existing moons of Saturn. There is evidence of accumulated debris in the Saturnian system by Saturn's moons Iapetus, Hyperion, Atlas and Pan. The only moon of Saturn where microbes from ice debris could survive and implant an ecosystem would be Titan. Microbes would have to make a transition from an internal water ocean ecosystem to an external hydrocarbon ocean ecosystem on Titan.

57. **TRANSIENT MACROFAUNA INVERTEBRATES IN THE CHALLENGER DEEP ECOSYSTEM OF THE MARIANAS TRENCH**

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Benthic imagery of the Challenger Deep ecosystem of the Marianas Trench at 10,900 meters may imply that species of macrofauna invertebrates are transient in the deepest ecosystem of the world's oceans. JAMSTEC imagery taken by the ROV Kaiko observed the rare presence of the pelagic amphipod *Hirondellea gigas* and a species of the holothuroid genus *Peniagone*. A species of the actinarian anthozoan genus *Galatheanthemum* is not seen in benthic imagery although it was trawled in the Marianas Trench at a depth of 10,730 meters. Macrofauna species in the Marianas Trench may be transient to the Challenger Deep ecosystem while some smaller infaunal invertebrates, such as the small holothuroid *Prototrochus brunni*, may be more permanent species of the Challenger Deep ecosystem.

58. **THE GENERATION OF QUENCHED ENCLAVES DURING MAGMA MINGLING OF MAFIC MAGMAS: EXAMPLES FROM THE SIERRA NEVADA AND THE SOUTHERN CASCADES**

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The presence of quenched mafic enclaves in igneous rocks is well documented in andesitic to rhyolitic host lavas and domes as well as in the plutonic record. These enclaves form by the mingling in the liquid state of coexisting magmas with strongly contrasting physical properties, as indicated by textural evidence such as a spherical or ellipsoidal shape with vesicular interiors, acicular groundmass minerals and/or cusped margins. Interestingly, evidence for basaltic enclaves forming in basaltic or basaltic andesite host magmas is virtually absent in the scientific literature. Of course, the fact that basaltic enclaves rarely are observed in mafic host lavas does not preclude the occurrence of basalt-basalt magma mixing, but rather underscores the importance that contrasting physical properties (i.e. viscosity) in the interacting magmas play in the formation of quenched enclaves. This study presents findings on the morphologic and petrologic characteristics of basaltic enclaves in basaltic and basaltic andesite host lavas as a means of constraining the manner in which mafic enclaves form in host magmas of similar viscosity, temperature, and composition. Here, we show that mafic enclaves in mafic hosts are typically small (<3 cm),

subrounded, composed almost entirely of plagioclase and orthopyroxene with rare clinopyroxene and olivine, and exist in close proximity to the erupting vent. Their texture and crystal morphologies are characterized by radiating and acicular plagioclase, vesicular groundmass, and fine-grained margins, consistent with a magma-mixing origin between a basaltic magma intruding into a slightly lower-temperature basaltic-andesitic reservoir.

59. TURONIAN TO CAMPANIAN LAVAS FROM SOUTHWEST PUERTO RICO AND THE TIREO GROUP OF SOUTH CENTRAL HISPANIOLA (GREATER ANTILLES ISLAND ARC): IDENTIFICATION OF AN UPPER CRETACEOUS ISLAND ARC

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Temporally equivalent Turonian to Campanian island arc strata are present in southwest Puerto Rico and in south central Hispaniola. The Puerto Rican strata occur in a northwest-trending belt that contains on the southwest flank lavas from the forearc, consisting of clinopyroxene (cpx)-plagioclase (pl)-hornblende (hb) basalts and cpx-pl-orthopyroxene (opx) high-Mg andesites, and on the northeast flank lavas from the principal volcanic axis, consisting of cpx-pl basalts. Geographic arrangement of rock types indicate the strata were produced in a northeast-dipping subduction zone. Incompatible element-enriched compositions of the Puerto Rican lavas are consistent with melting in an E-MORB-type mantle wedge source that was enriched by emplacement of the Caribbean Cretaceous mantle plume during Turonian times (91–88 Ma) immediately preceding arc volcanism. Turonian to Campanian strata from the Upper Tireo Group in south central Hispaniola include incompatible element-depleted basalts, identified as boninites, high-Nb basalts, and low-Al₂O₃, low LREE dacites and rhyolites, identified as low-pressure crustal melts. Incompatible element concentrations in the boninitic basalts, high-Nb basalts, and dacites and rhyolites are consistent with an E-MORB-type source, and with northeast-dipping subduction as in southwest Puerto Rico, suggesting a single island arc possible continuing into the Aves Ridge island arc.

60P. GRANDE SOUFRIERE HILLS VOLCANO, DOMINICA, LESSER ANTILLES

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The Grande Soufriere Hills volcano is deeply dissected, but has a distinct circular crater that opens to the east within which is a lava dome. Unconsolidated pyroclastic deposits which mantle the southeast flanks of the volcano are almost entirely block and ash flows and surges suggesting that Pelean-style eruptions, dated between 10,000 to 12,000 years, have dominated its most recent activity. On the southeastern coast at Pointe Mulâtre and extending approximately 4 km north and 2 km west, is a megabreccia of large flow-banded andesite clasts set in a semi-lithified medium-grained ash matrix. At Pointe Mulâtre this megabreccia is overlain by unconsolidated block and ash flow deposits. To the north of the megabreccia, exposures in the sea cliffs reveal a consolidated sequence of well-bedded alternating coarse and fine deposits suggesting deltaic beds, which in turn appear to be overlain by a yellow-colored relatively coarse flow deposit with an irregular upper surface, that may represent a debris avalanche deposit associated with the collapse of the eastern flank of the volcano. The uppermost deposits in the sea cliffs are a sequence of block and ash flow deposits and interbedded fluvial conglomerates equivalent to the younger flow deposits logged inland, that have given ¹⁴C ages of around 11,000 years B.P.

61P. A STUDY OF GEOTHERMAL SPRINGS IN NORTHERN DOMINICA

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The geochemistry of two groups of geothermal springs located in the north of Dominica, Lesser Antilles were studied over a four year period. One group, the Penville Cold Soufriere, is located in the summit

region of the potentially active Morne aux Diaboles volcano, the other group, which comprises both submarine and subaerial springs, is located in the vicinity of Portsmouth, the second largest town on the island, and on the flanks of Morne Diablotins, a second potentially active volcano. The chemistry of these springs was compared to "reference standards" composed of average seawater, seawater from Prince Rupert Bay (adjacent to Portsmouth), a fresh water pool in the center of the island and rainwater. A group of 21 elements in the hot springs consistently showed greater than two-orders of magnitude difference to the "reference standards". When these elements are plotted on chemical variation diagrams the springs and the reference standards form two trends, one composed of the submarine springs and the seawater compositions and the other the subaerial springs and the freshwater compositions. For many elements these two trends intersected at a point that is interpreted to represent the original composition of the geothermal waters before dilution with either seawater or meteoric water. Oxygen and hydrogen isotopic compositions also suggest for many springs a mixing of a magmatic source with either meteoric water or seawater.

62. GEOLOGICAL EVOLUTION OF DOMINICA, LESSER ANTILLES

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The geology of the Dominica can be divided into 4 units: Miocene; Pliocene; 'Older Pleistocene'; 'Younger Pleistocene'-Recent. The Miocene rocks are only exposed along the east coast. Separated from the Miocene by a major unconformity are a number of eroded stratovolcanoes of Pliocene age often composed of pillow lavas and submarine volcanic breccias, overlain by subaerial lava flows interbedded with pyroclastic deposits. The centers of Morne aux Diaboles and Morne Diablotins are confined to the N of the island and are characterized by the presence of Pelean domes and associated aprons of block and ash flow deposits. Around 1 Ma activity switched from the N to the S, where six major volcanoes, (Morne Trois Pitons, Wotten Waven/Micotrin, Watt Mountain, Grand Soufriere Hills, Morne Anglais, and Morne Plat Pays) developed. Activity also continued in a reduced manner at the two northern centers. Within the last 100,000 years, 3 major periods of Plinian activity produced extensive subaerial and submarine pumiceous deposits. These eruptions, each of which is estimated to have produced tens of km³ of pyroclastic material are associated with Morne Diablotins, and the calderas of Morne Trois Pitons and Wotten Waven/Micotrin. Morne Plat Pays in the SW corner of the island has also been subjected to at least 3 sector collapses during the past 300,000 years. Recent eruptive activity have been associated with centers within the sector collapse and the Watten Waven caldera.

63E. GENETIC VARIATION AND SYSTEMATIC DIVERSITY IN THE AMPHIPOD GENUS *CYAMUS*, USING MITOCHONDRIAL AND NUCLEAR GENE SEQUENCE ANALYSIS

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Taxonomy of cyamids, amphipod ectoparasites found on cetaceans, has been problematic and confusing. The most abundant genus *Cyamus* is considered to comprise 12–13 species, according to a recent taxonomic revision (Haney, unpublished), but molecular data are needed to support these conclusions. The present study will analyze the phylogeny of the genus based on DNA sequence analysis of mitochondrial cytochrome c oxidase I (CO1) and the 16S and 28S nuclear rRNA. *Cyamus* will be analyzed and the resulting phylogenetic tree(s) will be compared with previous taxonomic hypotheses. The goal is to generate a molecular phylogeny and resolve relationships within the genera *Cyamus*. In the future, the phylogeny obtained here may contribute to other studies such as divergence time analysis, which may clarify cyamid diversification in relation to host species. Cyamid phylogeny offers another look into whale history, which is especially useful because whales have comparatively little intraspecific variation in molecular markers.

64. GENETIC CONFIRMATION OF HYBRIDIZATION BETWEEN *CATOSTOMUS FUMEIVENTRIS* AND *CATOSTOMUS SANTAANAE* (CYPRINIFORMES: CATOSTOMIDAE) IN THE SANTA CLARA DRAINAGE

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The presence of morphological intermediates has suggested that *Catostomus fumeiventris* and *C.santaanae* hybridize in the Santa Clara drainage where both were introduced many decades ago. We used starch gel electrophoresis of codominant gene products to confirm the genetic interaction between these two species of fishes. Both F₁ and F₂ generations of hybrids were identified, but both parental species still maintained their genetic integrity. Of 160 specimens obtained from Sespe Creek north of Fillmore CA on 15 May 2006, 125 were genetically identified as *C. santaanae*, 11 as *C. fumeiventris*, 10 as F₁ hybrids and 14 as F₂ hybrids. The F₂ hybrids appeared to be the progeny of F₁ × F₁ crosses or backcrosses to *C. santaanae*.

65E. OBSERVING THE EFFECTS BIOFILMS, PLANTS AND SEDIMENTS HAVE ON CONCENTRATIONS OF NITRATE AND PHOSPHATE IN WATER SUPPLIES

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The focus of this investigation is the use of artificial wetlands and local biofilms to reduce phosphate and nitrate pollutants from a contaminated water supply. Biofilms, plants and sediments that have been historically exposed to high levels of nitrate and phosphate contamination were collected and placed in a manufactured environment that mimicked a wetland but allowed for control of input, output and flow rates. Different combinations of treatments were tested and several different flow rates to examine the effects of each aspect and find the optimal combination for removing the targeted pollutants. The tests produced variable results for the concentrations of nitrate. There was a consistent pattern of phosphate reduction through the entire test.

66. COYOTE AND FOX ON THE PALOS VERDES PENINSULA

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The Palos Verdes Peninsula Land Conservancy has an on-going study of coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and gray fox (*Urocyon cinereoargenteus*) on the Palos Verdes Peninsula. It is a collaborative effort, involving high school and college students who gain biological survey experience as well as credit for school research. Additionally, this project enables the Conservancy to satisfy a monitoring requirement for the Palos Verdes Nature Preserve's Natural Communities Conservation Plan (NCCP). This study was initiated to determine major and minor movement corridors of these three species. Each participant selected a specific location to regularly survey for scat and tracks. The predominant observation was scat, which can be used to distinguish coyote from fox. Tracks are unique for each species, but were rarely observed. When found, tracks were measured and photographed. Data were collated, normalized to adjust for variation in survey frequencies, and mapped to illustrate location and number of observations for the six-month period from November 2007 through April 2008. As expected, areas having better quality habitat were more frequently visited. Conversely areas surrounded by higher density housing had lower visitation rates. Patterns of scat deposition show a preference for level ground with coyotes favoring trail junctions and fox using trail sides within 50 m of trail junctions. Most interesting is that all locations are heavily used by hikers, runners, and domestic dogs illustrating the tolerance for urban life that these animals have developed

67E. ABOVE AND BELOWGROUND FEEDBACKS FOLLOWING EXOTIC PLANT INVASION AND RESTORATION OF COASTAL SAGE SCRUB OF SOUTHERN CALIFORNIA

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The invasion of exotic plants into coastal sage scrub has increased displacement of rare and endangered species, fire hazard due to their higher density and flammable biomass, and an alteration of important above and belowground processes that promote healthy ecosystem function and species diversity. In order to understand the impact exotics have on these processes and the potential for restoration after invasion, research must address changes in both the above and below ground processes being altered. Historically restoration efforts focused on aboveground native vegetation with less emphasis on the soil system. Few studies have looked at restoration of invaded soil. Therefore, it is not known if soils and their processes recover from exotic plant invasions once the invaders have been removed and native plants restored. This work examines how the presence of exotic plant species changes soil characteristics, how these changes may be maintaining the presence of exotics by negatively affecting native species and whether these changes are reversible through vegetation restoration and exotic plant removal. Three hypotheses are being tested: (1) the presence of exotic plant species changes the characteristics of the soils beneath them. (2) If exotics are controlled and natives restored, soil characteristics will return to pre-invaded conditions. (3) Changes in soil due to the presence of exotic species have negative impacts on native species grown in invaded soil.

68E. THE EFFECTS OF NITROGEN ADDITION AT DIFFERENT STAGES OF DECOMPOSITION

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Many fungi and bacteria decompose organic material faster under nitrogen enrichment. However, microbial activity may be negatively affected if levels of nitrogen are exceptionally high for prolonged periods. We compared N effects on decomposition of fresh litter, old litter, and older, more-decomposed litter (i.e., "light fraction"). We hypothesized that as N addition rates increase, decomposition of fresh litter and old litter will increase to a maximum value, and ultimately decrease. We expect decomposition rates of light fraction to decrease initially and eventually level off. To test our hypothesis, we constructed a microcosm experiment with litter collected in 2007 from a California grassland. Litter was incubated for 90 days under four levels of N addition. Respiration of carbon dioxide was collected as an indicator of decomposer activity. We also measured the carbon and N content of the litter to determine if N responses are related to C:N ratios. Typically, C:N ratios of litter strongly control decomposition rates, and we expect that N additions will essentially shift these ratios. Different substrates decomposed at different rates ($P < 0.0001$) and responded differently to N ($P = 0.016$). Decomposition of light fraction increased approximately 20% as nitrogen levels increased ($P = 0.031$). As for old litter, there was no effect of nitrogen on decomposition. The decomposition rate of new litter declined by 30% at the lowest level of nitrogen addition but increased to control levels at higher rates of nitrogen ($P = 0.0042$). Our data suggest that effects of nitrogen addition vary depending on stage of decomposition.

69. PROTOCOLS FOR *HALIOTIS RUFESCENS* EGG CRYOPRESERVATION AND *IN VITRO* FERTILIZATION (YEAR 2)

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Gamete cryopreservation can play an important role in conservation strategies for at-risk abalone species. Objectives of this study were to continue investigating red abalone egg cryopreservation protocols by determining whether eggs which exhibit normal phenotypes after thawing could be successfully fertilized with live sperm, and by evaluating propylene glycol (PG) as an alternative cryoprotectant agent (CPA) to dimethyl sulfoxide (DMSO).

After induced spawning and egg collection, eggs were frozen using cooled or uncooled DMSO or PG at 8 and 16 mins stepwise cooling at 14, ≤ 4 , -40 degrees C, before plunging into liquid nitrogen. 26 stepwise thawing protocols (5 mins at -40 , ≤ 4 , 14 degrees C with 1.25 g or 2.5 g non-permeating sucrose/80 ml

water) and 20 *in vitro* fertilization tests were conducted. Protocols using PG at 8 or 16 mins stepwise cooling and stepwise thawing with 1.25 g sucrose, yielded 90% to 100% (8 mins) and 75% to 80% (16 mins) intact round eggs with clear chorion. PG protocols using 2.5 g sucrose during thawing yielded less than 10% such eggs. DMSO stepwise cooling (8 and 16 mins) and stepwise thawing (1.25 g or 2.5 g sucrose) protocols yielded 10% to 25% intact round eggs displaying little or missing chorion. Sperm orientation towards eggs during *in vitro* fertilization attempts occurred only in PG trials. No cell division occurred. PG appears to be the more effective CPA, as chemical signaling between sperm and eggs, with release of egg chemoattractant (L- tryptophan), remained bioactive after cryopreservation. CPA toxicity, ice crystallization or other factors may have caused egg damage and prevented fertilization. Further research will involve refining protocols.

70E. THE EFFECTS OF DISTURBANCE OF BIOLOGICAL SOIL CRUSTS ON THE GERMINATION OF EXOTIC PLANTS IN COASTAL SAGE SCRUB

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Invasion by nonnative species is shifting the composition of coastal sage scrub (CSS) plant communities in southern California from native perennial shrubland to exotic annual grassland. Disturbance of the soil, and especially, biological soil crusts (BSCs), is known to increase germination of exotic plants. These crusts, which are a fragile aggregation of cyanobacteria, fungi, green algae, lichen, and moss, occupy the soil surface, and perform key ecosystem functions in both high and low abiotic stress environments, including CSS. Using a field and greenhouse experiment, I tested the hypothesis that disturbance of BSC increases germination of exotic plants in CSS plant communities. At Whiting Ranch Wilderness Park in Lake Forest, California, 21 paired plots were established and mean germination of exotic and native plants was compared between control subplots containing intact BSC and disturbed subplots. In the greenhouse experiment, BSC cores were removed from Whiting Ranch and half were disturbed. Seeds of native and exotic plant species were placed in the BSC cores, watered for 8 weeks, and then observed daily to determine emergence (n=6). In the field, disturbance of BSC significantly increased mean exotic germination and mean germination of native species was higher in undisturbed BSC. In the greenhouse, percent emergence was higher in disturbed BSC cores for all species and mean day of emergence was species specific. These results will assist land managers to better manage and preserve CSS communities by including BSC as an ecological factor affecting exotic plant invasions and a component of overall ecosystem health.

71E. ETHYLENE, TEMPERATURE, AND LIGHT EFFECTS ON THE GERMINATION OF THE SAND VERBENA, *ABRONIA MARITIMA* S. WATSON

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Abronia maritima S. Watson is a sand verbena native to coastal dunes of Southern California and Mexico. Germination percentages of *Abronia* species in the laboratory are low. This research aims to develop techniques of germinating *A. maritima* for restoration of dune vegetation, and to elucidate environmental factors resulting in germination. Germination studies were performed under controlled conditions, using various temperatures, with or without the addition of ethylene (supplied as ethephon), which has been shown to overcome dormancy. Anthocarps were removed from achenes for all trials. A dose response experiment showed that imbibition of achenes in $100 \mu \text{mol l}^{-1}$ ethephon optimized both germination rate and percentage. At constant temperatures and $100 \mu \text{mol l}^{-1}$ ethephon, germination was optimal at 20°C, and decreased above 35°C and below 15°C. Across the same range of constant temperatures, little to no germination occurred for achenes imbibed in water and kept in the light. Furthermore, neither cold nor warm stratification significantly increased germination in the absence of ethephon. However, achenes showed increased germination under alternating temperatures (15/35°C for 12/12 h) from 26% in the light, to 58% in the dark without ethephon. These results suggest *A. maritima* is negatively photoblastic, but may not germinate if buried too deeply or in areas where shading reduces soil temperature variation. Temperatures of sandy substrates in habitats typical for *A. maritima* are being

continuously monitored using data loggers. Additional experiments are testing the effects of burial depth and the role of sand in stimulating germination.

72E. EFFECTS OF SMALL-SCALE DISTURBANCE ON SEED BANK SPECIES IN A COASTAL SAGE SCRUB COMMUNITY

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California Coastal Sage Scrub (CSS) is a biologically diverse community in a Mediterranean environment. Species have adapted to germinate, survive and reproduce in an environment prone to seismic activity, drought and periodic fire and thus the Coastal Sage Scrub shows resilience to large-scale disturbance. Such large-scale disturbance events are believed to be required for long-term maintenance of a healthy CSS community, but there is evidence to suggest that disturbances that occur between larger events play a significant role in the persistence of CSS. These smaller-scale events may include soil disturbances, litter disturbances, and canopy disturbances that result from animal activity, stochastic events, or anthropogenic causes. This study observed the effects of small-scale disturbances on the seed bank species at the Voorhis Ecological Reserve. I determined the impact of soil, litter and canopy disturbances on germination and survival of focal seed bank species and considered possible implications for the role of small-scale disturbance in maintaining Coastal Sage Scrub communities in Southern California. Preliminary analyses indicated that very few native species were recruited and non-native annuals persisted longer in a drought year across all disturbance treatments. Additionally, *Centaurea melitensis* and *Hirschfeldia incana* successfully germinated and persisted to flowering in an extremely dry year. The results of this study may be significant in understanding the implications of small and large-scale disturbances on the persistence of viable CSS communities.

73E. EFFECTS OF LIGHT AND COLUMN HEIGHT ON DIEL VERTICAL MIGRATION OF THE MARINE GASTROPOD *KELLETTIA KELLETTII*

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Marine veliger *Kellettia kellettii* larvae exhibit diel vertical migratory (DVM) behavior; larvae ascend at night and are demersal during the day. DVM behavior has strong implications for larval dispersal outcomes. We investigated how light and vessel height influenced DVM behavior and whether DVM patterns in the lab were similar to those in the field. We hypothesized that DVM behavior would be light-initiated and would not be affected by column height, and that field surface densities of *K. kellettii* larvae would be higher at 2400 h than at 1200 h. We placed 100 larvae in replicate cultures (n = 4) under two different light treatments, natural (16:8) and a dark-only photoperiod (0:24), and two different column treatments (15 and 125 cm). Vertical positions in the column were recorded every 4 h for 24 h. Surface plankton tows (n=3) were conducted at 1200 h and 2400 h of the coast of Palos Verdes, CA. Column height and the interaction between photoperiod and time were significant (3-way full-factorial ANOVA for photoperiod, column height and time). Cultures in shorter columns had significantly greater proportions of demersal larvae. During daytime, natural photoperiod treatments had higher proportions of demersal larvae than dark-only treatments. Plankton tows revealed significantly higher densities of total veligers (2-sided F-test, n=3) and similar trends for *K. kellettii* (T-test, n=3) at the surface at 2400 h compared to 1200 h. Unraveling DVM behavior in *K. kellettii* larvae can aid in understanding distributional patterns of adults.

74E. PLANT ABSORPTION OF THE CHEMICAL POLLUTANTS NITRATE AND AMMONIA

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In Hahamongna Watershed Park (Pasadena, CA.) chemical pollutants from the runoff from equestrian centers have been implicated in contamination of the surface and possibly ground water supplies. We

tested the effect of local native plants on the concentrations of pollutants from the effluent of local stables. We isolated several species of plants and tested them separately to make recommendations on using them for possible bioremediation. The main pollutants from the effluent were nitrate and ammonia and cattails (*Typha latifolia*) had the most prominent effect reducing the targeted pollutants. We suggest designing the landscape around the equestrian outfalls to maximize contact between the effluent and plants that remove nitrate and ammonia.

75. USING HISTORICAL TAGGING DATA (1962–1971) TO ANALYZE THE SPAWNING RELATED MOVEMENTS OF BARRED SAND BASS, *PARALABRAX NEBULIFER* (SERRANIDAE) IN SOUTHERN CALIFORNIA

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Southern California recreational fishers target barred sand bass, *Paralabrax nebulifer*, during the summer months when the fish form large spawning aggregations. Despite its popularity as a sportfish, very little information is known regarding the spawning-related movements of barred sand bass. However, from 1962–1971, biologists with the California Department of Fish and Game tagged over 4,000 barred sand bass within the Southern California Bight. Tagging primarily occurred on historical spawning grounds during spawning season (Apr. to Oct.), except for those fish tagged year-round in Newport Harbor. Our objectives were to examine these historical data for trends in 1) residence times on spawning grounds, 2) movement to non-spawning season residences, and 3) spawning site fidelity. Of the tagged barred sand bass, 749 were recaptured within a maximum of 1,211 days at liberty. Recaptures within a spawning season showed an approximate residence time of two months at the tagging location. The farthest recapture distance was 66 km. Recapture distances during non-spawning season were variable, suggesting that the proximity to non-spawning season residences may vary greatly by individual fish regardless of the locality of their spawning ground. Annual seasonal patterns in recapture locations from Huntington Flats (a summer season tagging location) and Newport Harbor (a winter season tagging location), strongly suggest both spawning and non-spawning season site fidelity. Although obvious caveats exist within tag and recapture studies, these data are valuable for future studies on finer scale spawning-related movements of barred sand bass.

76E. POST-FIRE PLANT SUCCESSION AT TUCKER WILDLIFE SANCTUARY IN MODJESKA CANYON, CALIFORNIA

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We observed succession of a chaparral plant community following the October 2007 Santiago Fire. The study site was a burned south-facing hillside at Tucker Wildlife Sanctuary (Modjeska Canyon, CA) that included four microhabitats: ridge, open slope, canopy-covered slope, and drainage. Each microhabitat consisted of five, one-meter square plots, haphazardly spaced, that were photographed monthly starting in January 2008. Plant abundance, species richness, and percent cover were measured from photographs of each plot to assess differences in post-fire recovery across microhabitats. Preliminary analyses show an increase in vegetative cover in all plots due to resprouts or recruitment of seedlings. We observed the greatest percent cover in the canopy-covered slope microhabitat. The other three microhabitats exhibited variability in percent cover, however, such cover was uniformly low. These observations suggest that soil nutrient content and propagule presence was greater in the canopy-covered slope microhabitat.

77E. QUESTION REALITY: QUALITATIVE INTERPRETATIONS OF UNIVERSAL SCALING LAWS IN BIOLOGY-ECOLOGY-EVOLUTION

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There have been recent breakthroughs in discovering mathematical scaling laws in biology and ecology by a small team of scientists (West, Brown, Enquist, et alia). Though there has been extensive data crunching and mathematical exploration of the transcendence of these scaling patterns across multitudes of biological systems, there has been little philosophical, scientific, and artistic investigation of the qualitative meanings of these laws, and their implications for restructuring/re-organizing the entire way how we understand biological reality. Primarily, these mathematical principles provide the license to apply spacetime reasoning and a constructionist approach—the mental organizing tools of geology and film—into the overarching discipline of biology. This poster will touch on the main themes and applications of scaling laws to qualitative re-structuring of ecological systems on planet Earth at multiple scales: from deep to present times, from non-human to human systems, and even to providing implications in the realm of constructing and managing human-environmental systems for short- and long-term sustainability. The products of this poster will be submitted to the international STAGE script competition at UC Santa Barbara, a contest involving artistic, creative story-telling for science and technology, such as to communicate academic ideas to wider audiences.

78P. PALEO GROUNDWATER CHEMISTRY RECORD FROM FAULT ZONE BANDED CALCITE, MOUNTAIN PASS MINE, CA

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Geochemical, stable isotope, and field evidence suggest that the Celebration and Friendship Fault Zones have long been deep, active conduits for fluid flow. The upper portion of each fault is wide and porous and serves as a conduit for modern precipitation. Early in the development of the fault zone, the upper reaches were receiving meteoric fluids that probably drained from the east and contained significant Ca, Mg, and HCO₃ from the Goodsprings Dolomite. Later, as erosion changed local drainage patterns and exposed the Mtn. Pass Carbonate, the vein records influx of meteoric fluids that contain increasing amounts of atmospheric carbon, Ba, and Sr as well as REE's. The concentrations of these elements were quite elevated, as evidenced by their precipitation as unique phases and as substitution within calcite. Early in vein formation, fluids within upper reaches of the fault zone were as warm as 29°C, probably due to oxidation of local sulfides or volcanic activity. Later calcite records low temperatures approximately equal to ambient temperatures. Progressively deeper sections of the faults show thinner and less rhythmic banding, reflecting a fluid source less subjected to seasonal variation and water table fluctuation. Calcite becomes more dominant and Ba, Sr, and REE's decrease in abundance. The early period of elevated groundwater and vadose zone water temperatures would have accelerated the rate of dissolution of these elements at that time. Concentrations of most of these elements in groundwater appear to have decreased over time as they precipitated within the fault veins.

79E. EFFECTS OF ANTHROPOGENIC WATER INPUTS ON ARGENTINE ANT INVASION IN RIPARIAN AREAS OF SOUTHERN ORANGE COUNTY

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In arid and semi-arid ecosystems of southern California, urban runoff disrupts natural water flows, modifying natural communities downstream. We examined the effects of anthropogenic runoff on the invasion of riparian habitats in southern California by the Argentine ant, *Linepithema humile*. We placed pitfall traps along creeks at Starr Ranch Audubon Sanctuary, Orange County, to describe ant communities at 14 sites along seasonal creeks altered to varying degrees by inputs from the nearby Dove Canyon (DC) housing development. We hypothesized that abundance of Argentine ants would be highest during the rainy "wet" season but would decrease during the "dry" season and with the gradual elimination of anthropogenic water inputs that will result from recent improvements in the DC water control system. Our dry-season surveys in 2007 indicated that sites invaded by Argentine ants generally had a lower diversity of native ants, and lower abundance of other ground-foraging arthropods. Analyses of wet-season sampling in 2007–08 showed a decrease in activity of both Argentine and native ants, as well as reduced species richness of native ants. The overall decrease in ant abundance and diversity probably

reflects seasonal changes in aboveground activity. To date, no new sites have been invaded by Argentine ants, and we expect that the elimination of dry-season anthropogenic run-off in summer 2008 will reduce Argentine ant numbers over time. Our study addresses whether eliminating non-natural water sources substantially reduces Argentine ant invasion and aids in the restoration of native ant communities.

80E. BIOLOGICAL DIVERSITY STUDY OF ARTHROPODS OF SELECTED SITES IN THE HAHAMONGHA WATERSHED PARK, PASADENA, CA

Alice Okumura, student participant, Pasadena City College, Pasadena, California

The purpose of this study was to investigate and determine one parameter of the ecological status of the Hahamongha watershed in Pasadena, California, by studying arthropod diversity. We estimated the robustness of the watershed environment and its potential for recovery from regular disturbance to horse use, specially horse manure. Sites were chosen and tested because of the impact horse stable runoff from rainfall could have on arthropod diversity, as opposed to the less disturbed areas of the Coastal Sage Scrub (CSS). Data was collected by setting pit traps for three days between rainfall events. Spring 2008 data collection and analyses supplement initial data found in Fall 2007. Studies found that each site has fauna that are similar in diversity according to Simpson's Index (0.8077 and 0.7919) and Paired 2-sample Student T-test, ($p < 0.05$). In general, it appears that the more disturbed areas foster a larger quantity of arthropods than the less disturbed CSS. This discovery suggests that rainfall and disturbance may allow for a greater diversity of arthropods along the waste stream, indicating that in terms of ecosystem stability, food webs may still be intact. This work increases our understanding of the relationship that can exist between recreational use of our natural areas and the conservation of these same areas. This coexistence warrants further study and dialogue.

81E. EFFECTS OF DOUBLE ALGAL BIOFILM FILTRATION ON NITROGEN SATURATED WATER

Mark Ortega, UCLA and Pasadena City College

Currently the issue of water runoff due to agriculture and domestic livestock waste has led the scientific community to focus more attention to the problem of nutrient load management. Both domestically and internationally it has been noted that groundwater is eventually affected, which leads to contamination of an otherwise fresh water source. Nitrogen saturation is the main contaminant in this process. If there was a natural way of cycling this water and reducing or neutralizing the nitrogen, the degree of contamination would decrease allowing for the preservation of a vital fresh water source. There has been substantial evidence proving that algal biofilm has the ability to reduce nitrogen in a fresh water source. An analysis of the effects of a two step algal biofilm filtration might lead to a more efficient way to manage nutrient load. Potentially becoming part of a multi-step filtration process that could effectively reduce contamination.

82E. GENETIC DIVERSITY ANALYSIS OF THE CALIFORNIA INVASIVE CHAMELEON GOBY (*TRIDENTIGER TRIGONOCEPHALUS*); EXPLORATON OF A GENETIC BOTTLENECK WITH COMMENTS ON AN *IN SITU* RISE IN POPULATION

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The chameleon goby, *Tridentiger trigonocephalus*, became prevalent on the California coast from its native Asian population in the 1960s. Recent invasions allow an investigation of potential founder effects, which can be detected by a decline in genetic diversity (bottleneck) in a population out of mutation-drift equilibrium. This study tested the hypothesis that the invasive population of *T. trigonocephalus* in San Francisco Bay California is exhibiting a genetic bottleneck, and has spread by an *in situ* rise in population size as opposed to receiving constant replenishment. Mitochondrial DNA (mtDNA) control region of *T. trigonocephalus* specimens collected from San Francisco Bay were sequenced, and tested for a reduction in genetic diversity. Genetic diversity of *T. trigonocephalus* was compared to a known bottlenecked invasive goby, *Acanthogobius flavimanus*, to determine if a decline in genetic diversity was exhibited by *T.*

trigonocephalus, signifying a founder effect. Examination of 14 samples indicated *T. trigonocephalus* mtDNA is no more variable than *A. flavimanus* with an average sequence divergence of <1% demonstrating a genetic bottleneck. 11 haplotypes with 9 singletons were discovered, suggesting that *T. trigonocephalus* may be receiving on-going immigration in San Francisco Bay. Knowledge of whether this is a self-sustaining invasive population or one from constant replenishment is important when analyzing the impact of a local marine ecosystem invasion.

83E. GENETIC VARIABILITY WITHIN THE SANTA ANA WOOLLY STAR, *ERIASTRUM DENSIFOLIUM* SSP. *SANCTORUM*: REANALYSIS SEVENTEEN YEARS LATER

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The Santa Ana River Woolly Star, *Eriastrum densifolium* ssp. *sanctorum*, is a federally endangered perennial shrub located in San Bernardino County, CA. Its habitat along the Santa Ana River floodplain has been degraded by development, recreational activities, and the building of the Seven Oaks Dam, rendering geographically isolated metapopulations lacking the seasonal flooding that is evolutionarily important to the development of the plant. In a previous study conducted in 1991, the promising genetic health of the plant was determined using isozyme electrophoresis, which provides measures of heterozygosity, gene flow, genetic assimilation, and therefore the future viability of a species. This project will reanalyze the population genetics of the Woolly Star 17 years later for any changes, using the same methodology as in 1991. Knowledge of genetic variability and any variation from random mating can then be implemented into future management decisions.

84P. SELENIUM STRATIFICATION AND MIXING DYNAMICS OF UPPER NEWPORT BAY, CALIFORNIA

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The Upper Newport Bay Ecological Reserve (UNBER) was founded in 1975 and is one of the few remaining estuaries in Southern California. The water in the estuary is moderately saline to brackish due to the changes from the twice-daily ebb and flow of the tide and fresh water discharge from San Diego Creek. The estuary is an important habitat to approximately 200 species of birds, including several endangered species. California Department of Fish and Game manages the UNBER and is concerned that the bay may have high concentrations of selenium which has been found to cause adverse health effects in wildlife. Water samples were collected at the top and bottom of the water column at six fixed stations located throughout the bay. Additionally, depth profiles of dissolved oxygen, salinity, pH, and temperature were collected at each of the stations. Mass balance calculations based on conservative anions indicate that both top and bottom waters of the bay are dominated by marine waters with the exception of rain events, which resulted in the water column becoming increasingly stratified. Selenium levels in terrestrial waters averaged 6 ug/L, becoming increasingly dilute with distance from the mouth of San Diego Creek. Marine selenium levels were found to be negligible (≤ 1 ug/L). Nitrate levels average 20 mg/L in terrestrial waters and 2.84 mg/L in marine waters, exhibiting a negative correlation with respect to distance from the mouth of the creek. High selenium levels observed in the upper portion of the bay are of concern due to potential toxicity to wildlife.

85. MICROFLUIDIC IMAGE CYTOMETRY TO DETECT PI3K PATHWAY MARKERS IN BRAIN CANCER

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Although a new generation of anticancer drugs targets molecular pathways, cancer treatment still remains inefficient and is in need of further development. Macro-scaled imaging modalities rely on reductions of tumor size to determine the effectiveness of drug treatment. However, this process takes a few months to see noticeable change. Even though patients have similar tumors, they respond differently

to treatment because of their unique molecular signature. In order to quickly assess the efficacy of drug treatment and analyze the different molecular profiles, the Microfluidic Image Cytometry was utilized.

The Microfluidic Image Cytometry platform allows for single cell level detection and analysis to compare protein expressions in a cell population's response to drug treatment. Experiments were conducted using the immunocytochemistry method of antibody specific staining. U87 cells, brain cancer cells, were fixated and expression levels were detected inside a PDMS microfluidic chip. Fluorescence dyes were attached to the antibodies to target the PI3K pathway markers in brain cancer: EGFR, EGFRvIII, PTEN, and pS6.

Optimum conditions were determined by measuring fluorescence intensity levels using Metamorph. Optimum antibody concentrations for detection of EGFRvIII, PTEN, and pS6 were established: 0.5 ug/mL, 5 ug/mL, and 4.5 ug/mL respectively. The U87 cells then underwent rapamycin drug treatment for brain cancer and pS6 levels served as readout to measure the effective concentrations, 2 nM to 20 nM, needed in order to inhibit the PI3K pathway.

The Microfluidic Image Cytometry is an effective and quick method for real-time analysis of cancer treatment response. This system will bring cancer treatment to a new age of development because of its small sample volume, large scale analysis, and single cell precision.

86E. A COMPARISON OF EMBOLISM AND EMBOLISM REPAIR IN TWO SALVIA SPECIES

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Salvia mellifera and *Salvia apiana* are two co-occurring shrub species found in coastal sage scrub vegetation in southern California. The Mediterranean climate of this region normally supplies water only during winter and spring, leaving perennial plants to survive the long, hot and dry summer season. Previous research on water relations and the geographical and topographical distribution of the two species suggests that *S. apiana* may be the more drought resistant species. In contrast, the much larger leaf sizes of *S. apiana* and the wood anatomy of the two species, especially the larger-diameter vessels and the absence of vasicentric tracheids of *S. apiana* suggest that it is less drought resistant than *S. mellifera*. The goal of this study was to compare plant water relations during the spring growing season and summer dry season. The following measurements were conducted on co-existing plants of both species: degrees of stem segmentation and hydraulic integration, the amount of embolisms in the plants' hydraulic systems, root vulnerability to embolism formation, specific hydraulic stem conductivities, predawn and mid-day xylem water potentials, and leaf stomatal conductances. Initial results suggests that *S. mellifera* stems and leaves are less-prone to dieback during the dry season and possess more drought adaptations than those of *S. apiana*, which, however, may have a better ability to survive severe summer drought by strongly reducing its canopy to a few basal leaves and stems.

87E. THE LIGHT'S ON BUT NOBODY'S HOME: NEGATIVE PHOTOTACTIC RESPONSE OF *KELLETIA KELLETII* LARVAE TO LIGHT INTENSITY AND WAVELENGTH

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Many marine invertebrate larvae control their vertical position in the water column, potentially influencing dispersal outcomes. Previous laboratory studies with marine gastropod *Kelletia kelletii* larvae revealed that this species exhibits diel vertical migration (DVM) that is partially controlled by light. We explored light intensity and wavelength as potential cues initiating downward swimming and verified that DVM occurs in the field with plankton tows. We varied full-spectrum light intensity ranging from 99–2.5 PAR (mmol-m⁻²-s⁻¹) in six replicate 10 cm diameter by 125 cm tall columns each containing 100 one-week old dark-adapted larvae and determined their vertical positions after 2 hrs light exposure. As light intensity decreased, significantly fewer larvae descended (ANOVA, p<0.0001). At 2.5 PAR the percent larvae at the top of columns was similar to that in the dark control (p<0.05). The effect of wavelength was tested by comparing blue/green light (450–550 nm) at 15 PAR to full spectrum light (380–740 nm) of equivalent intensity. Percent larvae at the surface exposed to blue/green light was not significantly different from larvae exposed to full spectrum light (ANOVA, p=0.8676). Surface plankton tows (n=5) were

conducted at 1200 h and 2400 h off the coast of Palos Verdes, CA to examine whether laboratory findings were consistent with field vertical distributions of larvae. We found that there were significantly more larvae at the surface at 2400 hr versus 1200 hr (T-test, $p=0.0008$). Findings from this study will help develop mathematical models of larval distributions aimed at estimating dispersal outcomes.

88. PREDICTING LUNG CANCER RELAPSE USING LEVELS OF 2881 PROTEINS

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A major problem with diagnosing cancer and other gene-related cases is that there is so much data to sift through. Even though scientists have been able to measure each of the approximately 25,000 genes in the human genome, they have no way of identifying patterns associated with gene-caused illnesses because simple identification of single genes is not enough to discover interactions between genes. Even if the searchers were able to specify a range of genes that could possibly contain genes related to the searched-for disease, the potential for combinations between the genes would still generate a large search area. This study attempts to search through a bank of genes to find certain genes that are associated with lung cancer relapse. 2881 genes from 39 patients are analyzed by computer algorithms such as J48, IBI, and NaïveBayes. Two genes were found to be significant. The importance of pattern finding and the significance of the two genes are talked about, as well as the importance of computers in aiding the search for causes of sicknesses related to genes.

89. COMPARISON BETWEEN ALCOHOLIC AND NONALCOHOLIC LIVER USING CT PHANTOM CALIBRATION

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The objective is to engineer a noninvasive methodology for precisely determining the volume, mass, and density of the liver. The secondary goal is to apply this method to obtain accurate measurements of nonalcoholic livers compared to alcoholic livers (patients who consume 1 to 3 drinks per day). Previous techniques for finding organ measurements relied on autopsy and blood tests to detect liver disease.

This study innovates a medical imaging method that focuses on the use of Computed Tomography (CT) and Phantom calibration, which creates a standard for evaluating the fluctuations on the scanner and electric current. Anonymous CT scans with full-body Phantom for 60 non-alcohol consuming patients and 35 alcohol-consuming patients were obtained from the CT scanner database. Image results were analyzed using a software program called Reformat. Histograms and two sample t-tests were created for statistical analysis.

The data revealed that both consistency and accuracy were achieved using the Phantom calibration and the differences in averages between normal and alcoholic measurements were successfully determined. Results indicate that alcoholic livers are larger in volume compared to nonalcoholic livers and the fat content is also higher in the alcoholic group. No significant difference in density was found. In regards to other measurements, alcohol consuming patients demonstrate a higher ratio for liver mass, volume index, and mass index.

It was concluded that Phantom calibration in CT scans produced more accurate results than autopsy or CT alone. This information can be utilized as a guideline to detect abnormalities in volume and volume fat of the liver, which can be the first signs of alcohol related disease such as cirrhosis and fatty liver. The contributions of this project may be utilized in assisting doctors in making treatment decisions for patients with liver disease.

90. TRADITIONAL AGROFORESTRY SYSTEMS IN THE SOCONUSCO REGION OF CHIAPAS, MEXICO

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Across the humid tropics worldwide, indigenous or traditional peoples have adopted a number of similar ecological practices often referred to as “traditional agroforestry systems.” Research shows that indigenous populations manage tropical forests and influence the kinds, numbers, and distributions of forest species, creating “forest gardens.” They also rely on home or kitchen gardens, the diverse, multistoried gardens adjacent to houses where a wide variety of edible foods, condiments, medicinal plants, and other useful plants are grown. A third element of these agroforestry systems is swidden agriculture, of which an important element is “managed fallows” in which the successional process that follows cultivation is carefully managed to increase the presence of desirable species. In this paper I review what we are learning about traditional agroforestry systems in a region of Mexico that has not previously been a focus of study.

91. LAND MANAGEMENT IN COASTAL CHIAPAS

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In this paper we describe traditional swidden agricultural practices in the Soconusco region of Chiapas, Mexico. Ethnoecological work done by Dr. Janine Gasco in the community of Barrio Santa Cecelia has shown an intimate relationship between local people and the increasing pressures placed upon their limited resources. Land management has become a critical issue due to an increasing population and shift from traditional milpa farming to short term cattle ranching favored by those seeking quick financial reward. Recent data provided by local residents during field work, that was carried out as part of an Ethnoecology Field Methods course, has projected that this will not be a sustainable way of life in the near future given population increases and scarce availability of usable land. Traditional milpa farming cycles the land between usable and fallow periods allowing the soil to regenerate, creating a sustainable system. Our research shows that traditional swidden techniques fully utilize all available areas within a highly organized community structure. We have now begun to better understand the annual swidden agricultural cycle, and we discuss how this system can be sustainable and productive.

92. PANELA PRODUCTION IN MESOAMERICA

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The production of *panela* (unrefined sugar) in Mesoamerica is a vital element in traditional rural cultures, and is an economic commodity that involves community cooperation. Panela is a sugar product derived from sugar cane. Despite being an introduced plant from Spain, sugar cane has become a traditional dietary element in Mesoamerica. Contrary to its refined sugar counterpart, panela is unrefined sugar. In this paper I will look at the traditional panela production process in Mexico. The case study presented was observed in a rural town in Chiapas in the winter of 2008 during an ethnobotanical field study class with Anthropologist, Dr. Janine Gasco. I will first present the economic viability of the small-scale production of panela versus the factory produced refined sugar. I will then discuss health consequences for the community comparing the consumption of refined sugar to panela. The main focus of this paper will be on the production process of panela from the cut sugar cane stalk to the marketable end product. The discussion will focus on the use of pre-industrial production techniques that rely mainly on hand-made tools and draft animal produced power. The last aspect of the paper will be on the social implication. Since panela production is a cooperative effort, it relies on communal involvement which is often based on reciprocity, which in turn strengthens social ties.

93. THE PROEYCTO ARQUEOLOGICO TUMBES: AN OVERVIEW TO THE RESEARCH PROJECT

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The Department of Tumbes in far northern Peru is one of the archaeologically least-known regions in Andean South America. Beginning in 1996 the Proyecto Arqueológico Tumbes is a multi-phase, binacional project dedicated to basic archaeological research into the region. An initial program of archaeological survey and reconnaissance (1996) led to field inspections of specific sites (2000). In 2003 a limited archaeological testing program was conducted, followed by extensive excavations at four sites in 2006 and 2007. While analysis is still on-going, we now know that the prehistory of Tumbes extends back to at least 4500 BC, that long-distance exchange in obsidian occurred by 1200–800 BC, and that the construction of modest public architecture occurred by 1000–800 BC. Excavations at other, much later archaeological sites has documented the Inka presence in the region and the impacts of the Inka Empire on the Tumbes region. This presentation briefly summarizes the fieldwork and major findings of the Proyecto Arqueológico Tumbes.

94. THE 2007 FIELD SEASON OF PROYECTO ARQUEOLOGICO TUMBES

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This paper reviews fieldwork conducted for the Proyecto Arqueologico Tumbes, an archaeological field project directed by Jerry Moore (CSU-DH). From mid June to early August 2007, the authors served as research assistants on what was the first comprehensive archaeological study in this region of Peru. The study focuses on the origins of monumental public architecture in northern Peru. Archaeologists use these data to develop theories describing the lifestyle and social organization of the culture at the time of a building's construction. Our role in this research was to supervise excavations at one of the three mounds located at this site, where we were responsible for multiple operational activities. In this paper we will describe these activities in further detail, and conclude with their role in the overall project, as well as explain several of the future objectives on this work.

95. PREHISTORIC DIACHRONIC VARIATION IN MOLLUSCAN ASSEMBLAGES AND PALEOCLIMATIC DISRUPTIONS IN FAR NORTHERN PERU

J.D. Moore and J. Lewis. California State University, Dominguez Hills, Dept. of Anthropology, Carson, CA 90747

Recent (2006 and 2007) archaeological investigations in the Department of Tumbes in far northern Peru have documented significant changes through time in molluscan assemblages from two archaeological sites, El Porvenir and Ulna de Gatos. Dating to the Archaic and Formative periods, materials from the sites range in antiquity from ca. 4700–4500 BC until 1900 BC. Based on the analysis of shellfish species in the assemblages, there were major shifts in the species exploited—in particular a dramatic decrease in *Ostrea columbensis*. Archaeologists working in adjacent areas of southern Ecuador have noticed similar shifts in the molluscan species and proposed a hypothesis linking these shifts to the effects of El Niño/Southern Oscillation events in destroying habitats suitable for oyster populations. Sedimentary cores obtained by Moy et al (2002) from Laguna Pallacocha in the southern Ecuadorian highlands provide and alternative source of data on the intensity and frequency in prehistoric ENSO events. The ENSO reconstruction, however, fails to account for the shifts in the molluscan assemblages in the prehistoric sites from Tumbes, suggesting the need to consider alternative explanations of these changes in archaeofaunal assemblages.

96. JOSHUA TREE (*YUCCA BREVIFOLIA*) MORTALITY AND RESPROUTING FOLLOWING THE 2005 HACKBERRY COMPLEX FIRES IN THE MOJAVE DESERT

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The 2005 Hackberry Complex Fires burned through two of five study sites that were part of a long-term investigation of growth and flowering patterns in *Yucca brevifolia* along an elevational gradient in the Mojave Desert. Individual trees, chosen to reflect the overall size structure of the populations, were tagged

and branch number was recorded annually to approximate growth. Thus mortality due to fire, and post-fire resprouting could be correlated with size and growth rates of individuals. Mortality approximated 93% of trees at the 1450 m site and 100% at the 1545 m site. Trees dead prior to the fire burned completely and were not in evidence after the fire. The few trees that survived at the 1450 m site were shorter than average and showed average growth over the preceding 18 years. By contrast, at a site with unmarked trees chosen for comparison because of lower fire mortality (65%), the trees that survived were 20% taller ($P < 0.05$). Increased tree height and a low stature under-story of grasses by comparison to shrubs apparently reduced the spread of fire to the tree crowns. Fire-induced resprouting occurred for 20 and 25% of the individuals in the 1450 and 1545 m sites, respectively. Only 4% of trees in a comparable unburnt site showed new sprouts. The 18-year growth rates for resprouting trees were almost twice the average at both sites. Sprouting was most abundant on the warmer, south sides of the trunks.

97E. INFLUENCE OF ANTHROPOGENIC NOISE ON SONG STRUCTURE IN *CALYPTE* HUMMINGBIRDS

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Urbanization causes an increase in anthropogenic noise, e.g. from traffic and power lines. This increased noise may be a problem in habitats where animals depend on sound transmission for survival and reproduction. Songbirds have been shown to raise the frequency of their song above ambient noise, but it is not known how non-songbirds (non-Passerines) respond to this challenge. Increased anthropogenic noise may decrease the reproductive success of male hummingbirds, as they use song to defend their feeding and breeding territories and to attract potential mates. We recorded songs of male Anna's and Costa's hummingbirds (*Calypte anna* and *Calypte costae*, respectively) during the breeding season in Anza Borrego, CA (San Diego and Imperial Counties) in the summer of 2007. We used spectrogram software to analyze and determine whether they alter song parameters (frequency, amplitude, and duration) in response to increased ambient noise. We also studied possible behavioral changes in the presence of sources of intermittent noise, such as cars. Song analysis suggests that Anna's hummingbird produced shorter and less complex songs in the presence of constant noise, while Costa's hummingbird sang less often in high noise conditions. There was no change in frequency or amplitude of song in high noise conditions. Preliminary data may suggest that *Calypte* hummingbirds rely on visual displays for mate attraction and territory defense because they sing less often. Further analysis of song and behavior, as well as additional song collections, are planned for subsequent breeding seasons.

98E. ARE LOOKS DECEIVING? SHOULD TWO NEARLY IDENTICAL CHITONS REALLY BELONG IN DIFFERENT SUBGENERA?

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Two chiton (Mollusca: Polyplacophora) species, *Ischnochiton (Ischnochiton) boninensis* and *Ischnochiton (Haploplax) comptus*, live together under the same seashore rocks near Tokyo, Japan. They apparently differ only in whether their girdle scales are ribbed or smooth, respectively. These numerous overlapping scales ornament the girdle surrounding the chiton's eight shell plates like a coat of armor. The scale differences are the sole basis for separating these otherwise indistinguishable species. The extent of similarities implies these might either be very closely related species or perhaps even variation within a single polymorphic species. However, those with smooth scales are currently classified in *Haploplax*, a separate subgenus from those with ribbed scales. The 12 other, mostly Australian, members of *Haploplax* also have smooth girdle scales. We used mitochondrial 16S ribosomal DNA sequence comparison to test whether Japanese chitons with different scale morphology belong to a single species, closely related species, or only distantly related but convergent species. Preliminary DNA comparisons of members of both subgenera from Japan and Australia indicate that chitons with different scale morphology represent sister species that co-occur and together are more distantly related to Australian members of both subgenera. Our evidence implies that the ribs have been lost independently in Australia and Japan, and

should not be used as the sole basis for separating members of *Ischnochiton* into different subgenera. Our results also lead to further questions about how these closely related species speciated initially, whether they hybridize, and how they now coexist with such a similar habitat and geographic range.

99E. EVIDENCE FOR 'CONTEXTUAL DECISION HIERARCHIES' IN THE HERMIT CRAB, PAGURUS SAMUELIS

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Shell and food acquisition behaviors of the hermit crab, *Pagurus samuelis*, were examined in response to cues of shell and food availability. In a preliminary experiment, motivation for acquisition behavior was tested by offering food and shells concurrently. We found that 85.0% of starved hermit crabs ignored tactile cues of shell availability, while 100% of shell-less hermit crabs ignored chemical cues of food availability, demonstrating that current motivation can be the trigger that initiates specific behaviors. When hermit crabs were both starved and shell-less, 77.5% inserted into shells and 17.5% fed. In the two experiments that followed, tactile, visual, and chemical cues were presented in a factorial manner and time was measured between initial contact and either inhabitation of a shell or initiation of feeding. We considered the time difference between initial contact and subsequent behavior to be a measure of hermit crab 'decision time'. In the shell acquisition task, treatments that included tactile cues elicited significantly shorter decision times than treatments without tactile cues. In contrast to the findings of the shell acquisition task, we found that in the food acquisition task, treatments that included chemical cues elicited significantly shorter decision times than those without chemical cues. Even though primary cues elicited the shortest decision time in each of these tasks, in the absence of the primary cue, secondary cues may still be used to make appropriate decisions, albeit with significantly longer decision times. Therefore we propose that hermit crabs sort environmental information in 'Contextual Decision Hierarchies' in order to make accurate and efficient behavioral choices.

100. EFFECTS OF VARIATION IN PREDATOR DENSITY ON GROWTH AND SURVIVAL OF THE TEMPERATE REEF FISH *LYTHRYPNUS DALLI*

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Predators can play a key role in driving dynamics of prey populations, yet the influence of natural variation in predator density on prey populations of temperate reef fishes is not well known. We used field experiments at 3 sites that varied in predator density to test whether predator density affected the mortality rate, growth rate, or the strength of density-dependence in these rates of the bluebanded goby (*Lythrypnus dalli*) at Santa Catalina Island, CA. The density of populations of adult *L. dalli* was manipulated on small artificial reefs. Densities of one major predator, the kelp bass (*Paralabrax clathratus*), were significantly higher at the site within a marine protected area than at the other two sites; but another predator, the rock wrasse (*Halichoeres semicinctus*), tended to be more abundant at the two non-MPA sites. Survivorship of *L. dalli* was density-dependent at all three sites, but the strength of this density dependence was not related to the density of predators. The density-independent mortality rate was, however, significantly different among sites, although not related to predator density. Growth rates of *L. dalli* were not density-dependent but differed significantly among sites, and there was some evidence that predator density affected the growth of prey. This study suggests that the influences of predator density on the dynamics of temperate reef fish populations are likely to be complex and may be obscured by correlated differences in habitat and interactions among different species of predators.

101. PHYLOGEOGRAPHIC ANALYSIS OF THE FIDDLER CRAB *UCA PRINCEPS* IN THE GULF OF CALIFORNIA AND OUTER COAST OF BAJA CALIFORNIA

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The fiddler crab *Uca princeps* is widely distributed along the eastern Pacific coast of the Americas, from Southern California to Peru. The previously described *U. monilifera* is now recognized as a subspecies of *U. princeps*, and it is found in the northern Gulf of California where freshwater input from the Colorado River is substantial. We sampled *U. p. princeps* and *U. p. monilifera* along the outer coast of Baja California and the Gulf of California. Although color is not mentioned in formal description of *U. p. monilifera*, crabs obtained from the northern Gulf of California were blue in color, strikingly different from orange individuals of *U. p. princeps* obtained from all other study areas. We conducted phylogeographic analysis using a 657 bp fragment of the mitochondrial cytochrome *c* oxidase subunit I (COI). Despite the high dispersal potential of this species' planktonic larvae, mtDNA sequences displayed exceptionally distinctive genetic structure in the northernmost Gulf of California. However, little phylogeographic structure was found throughout the rest of the Gulf and along the outer coast of Baja California, indicating high levels of gene flow across coastal distances of 1500 km or more. These results are consistent with the subspecies status of *U. p. monilifera*. Further investigation will be conducted using AFLPs or nuclear DNA sequences to examine whether *U. p. monilifera* is a distinct taxon endemic to the northern Gulf.

102P. MOBILITY OF SELENIUM AND NITRATE ALONG A SHALLOW GROUNDWATER FLOWPATH, ORANGE COUNTY, CALIFORNIA

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High levels of selenium in the shallow groundwaters of the San Diego Creek watershed coincide with the boundaries of the historic "Swamp of the Frogs," which was drained in the late 19th century. Springs oriented along a shallow groundwater flowpath were sampled for standard inorganic parameters, selenium speciation, Fe, Mn, Mo, and V. Select springs were also analyzed for stable isotopes ($\delta^{34}\text{S}$ -[SO₄²⁻], $\delta^{15}\text{N}$ -[NO₃⁻], $\delta^{18}\text{O}$ -[NO₃⁻], and $\delta^{82/76}\text{Se}$). These data reveal present-day controls on the mobility of selenium. These waters can be divided into two groups: the relatively more dilute upstream springs (~2500 mg/L TDS) and the more saline downstream springs (~4200 mg/L TDS). Along the "dilute" portion of the flowpath, Fe and Mn are non-detectable; NO₃⁻ is the dominant form of N (~14 mg/L NO₃⁻-N, NH₃-N at or below detection limit of 0.01 mg/L); Se increases steadily from 50 µg/L to 228 µg/L where selenate makes up over 98% total dissolved Se; and $\delta^{34}\text{S}$ -[SO₄²⁻] becomes isotopically lighter by 1‰. These data are consistent with an oxidizing environment. Along the more saline portion of the flowpath, dissolved Mn increases to 70 mg/L; NO₃⁻-N concentrations drop to 2.7 mg/L while NH₃-N increase to 0.04 mg/L; Se drops to ~70 µg/L where selenite makes up over 10% of total dissolved Se; and $\delta^{34}\text{S}$ -[SO₄²⁻] becomes isotopically lighter by ~3‰ from up-gradient values. These data are consistent with intermediate redox conditions. We expect $\delta^{15}\text{N}$ -[NO₃⁻], $\delta^{18}\text{O}$ -[NO₃⁻], and $\delta^{82/76}\text{Se}$ to grow isotopically heavier along the "saline" portion of the flowpath. This pattern would be consistent with denitrification and selenium reduction.

103F. GENETIC SEPARATION FOR THE OUTER SOUTHERN CALIFORNIA CHANNEL ISLANDS? MICROSATELLITE DATA FROM KELP BASS (*PARALABRAX CLATHRATUS*)

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Kelp bass (*Paralabrax clathratus*) populations are believed to be genetically homogenous in the eastern Southern California Bight (SCB). However, previous studies suggest that the interface between the California Current to the west and the California Counter-Current to the east differentiates allele frequencies in the eastern and western SCB. To test this hypothesis, adult kelp bass were sampled at San Nicolas (SNI) and Santa Catalina (SCAI) islands and genotyped at three polymorphic microsatellite loci. Preliminary analysis of 35 SNI and 33 SCAI specimens at the AV6 and AV15 loci shows significant ($F_{ST}=0.01298$, 95% CI: 0.00901) allele frequency differences. Average heterozygosity at SCAI ($H_O=0.96154$) was higher than SNI ($H_O=0.84375$), with one locus (AV6) failing to meet Hardy-Weinberg equilibrium in SNI samples. This suggests a discontinuity in genetic connectivity between the

eastern and western SCB at its latitudinal center with a reduction in genetic diversity at SNI, indicating less diverse source populations in the western SCB. Future work will expand the sample size, number of loci and analysis methods, collect recruiting juveniles, and add Santa Barbara Island as an intermediate collection site.

104. IDENTIFYING MACHINE LEARNING ALGORITHMS THAT POSSESS HIGH PREDICTIVE ACCURACIES FOR MULTIPLE TYPES OF CANCER

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A major problem with predicting and diagnosing cancer and other gene-related cases is that there is so much data to sift through. Even though scientists have been able to measure each of the approximately 25,000 genes in the human genome, they have no way of identifying patterns associated with gene-caused illnesses. Even if the search were narrowed down to a relatively small range of genes, for example 2,881, which *potentially* could contain the genes that cause such an illness, the potential for interactions between the genes would still generate a large search area. This study attempts to find a machine learning algorithm that will work accurately in identifying key genes related with many types of cancer. Many data sets were analyzed using the same algorithms, ZeroR, OneR, J48, IB1, IBk, and NaïveBayes in order to compare the predictive accuracy of each algorithm. Each algorithm differed in the patterns they were designed to find and in the ways that they searched for those patterns. One algorithm was found to be effective in identifying patterns in multiple sets of cancer data, and its results were confirmed by an increase in accuracy of the other algorithms when only the selected genes were analyzed. The importance of computers in gene related disease identification and analysis, as well as the future of medical research, are discussed. Identification of these diagnostic genes by machine learning algorithms provides potential causative genes that would help in the search for a cure to a gene-related disease.

105. PROTEASE INHIBITORS IN AUGMENT TEMOZOLOMIDE-BASED TREATMENT FOR MALIGNANT GLIOMAS

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The use of HIV protease inhibitors in conjunction with temozolomide (TMZ) based chemotherapy for patients with malignant gliomas has never been attempted before. Protease inhibitors, which were approved by FDA on May 1999,¹ are orally administered, and are generally very safe and well tolerated by patients. Protease inhibitors have been previously demonstrated to have anti-tumor, anti-angiogenesis, and anti-invasive properties in Kaposi's sarcoma. In addition, recent data have indicated that the protease inhibitors have radio-sensitizing and chemo-sensitization properties as well. First of all, in this experiment, we propose to demonstrate via *in-vitro* models (glioma cell lines and cell cultures) that protease inhibitors may have a synergistic effect in inducing cytotoxicity during combination treatment with temozolomide-based chemotherapy. The best type of protease inhibitor and the ideal dosage will also be determined *in-vitro*. Second, we will apply the same conditions to an *in-vivo* nude mice subcutaneous and intracranial glioma model. If the hypotheses and goals of this research are realized, adding a protease inhibitor to the default temozolomide-based chemotherapy may be done more easily and safely, something that will hopefully reduce the malignant gliomas from a fatal disease to a less severe chronic illness. *VB Pai and MC Nahata Nelfinavir mesylate: a protease inhibitor The Annals of Pharmacotherapy: Vol. 33, No. 3, pp. 325-339.*

106. REGULATION OF ALDEHYDE OXIDASE 4 (AOX4) GENE BY THE GRAINYHEAD-LIKE EPITHELIAL TRANSACTIVATOR (GET1) TRANSCRIPTION FACTOR

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Skin acts as a barrier preventing toxic substances from entering and disrupting internal homeostasis. There are several skin disorders and hereditary diseases associated with a defective skin barrier. Previous work done in the Andersen laboratory has shown that *Get1*, a transcriptional factor, regulates the terminal differentiation program in the epidermis. *Get1*-deleted mice die prenatally due to neural tube closure defects and exhibit defective terminal differentiation of the epidermis. Expression analysis of backskin RNA from wild type and *Get1*-deleted mice at different stages of embryonic development as well as from different epithelia, identified the Aldehyde oxidase 4 (*Aox4*) gene as one of the most significantly downregulated in the *Get1*-deleted mice. Members of the Aldehyde oxidase gene family have shown to be important in the retinoic acid pathway which plays an important role in the differentiation of keratinocytes. To investigate whether *Get1* directly regulates *Aox4*, 1 kb and 2 kb regions upstream of the transcription start site were cloned into the pGL3 luciferase reporter vector. Measurements of the luciferase activity of these recombinant vectors in response to *Get1* can assist in evaluating whether *Get1* directly binds to the promoter region. This work paves the way to further test the hypothesis that *Aox4* is directly regulated by *Get1*.

107. CARBOHYDRATE-BASED EXPERIMENTAL THERAPEUTICS FOR CANCER, HIV/AIDS AND OTHER DISEASES

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Science has recently seen a fascinating, new area of research: carbohydrate-based experimental therapeutics for cancer, HIV/AIDS, and other diseases. A model system of washed yeast (*Saccharomyces cerevisiae*) that possessed mannose-rich cell surfaces and washed concanavalin A (Con A) derivatized agarose beads that preferentially bind to glycans containing mannose/glucose residues was used. This is a model system that can be used, for example, in the development of drugs that may prevent AIDS infection. This is the case because the AIDS virus, HIV, like yeast, has cell surface mannose residues, and human cells to which HIV binds have receptors for mannose, like the Con A beads. Using the system, different concentrations of two sugars, alpha methyl mannose and D-melezitose, were tested over a 30 minute time course, assaying how much yeast remained bound to the beads at 10 minute intervals with and without sugar at each sugar concentration tested. The highest sugar concentration (25 mM) tested was most effective in causing dissociation of the yeast from the beads and the 50/50 mixture of the 2 sugars was less effective than the single sugars in causing dissociation at the lower concentrations (less than 25 mM). The results suggest that careful attention should be paid to sugar concentration and incubation times in experiments using lectin derivatized beads in molecular purification protocols and in the development of carbohydrate-based drugs and diagnostic tests. In the second and third experiments of the project, which were preliminary experiments aimed at perfecting the yeast and Con A bead model system, conditions for the storage of the Con A beads were tested and, like sugars, salts at various concentrations were tested for their ability to cause dissociation of yeast from the Con A beads.

108. TO SPECIATE OR NOT TO SPECIATE?: POPULATION STRUCTURE OF *HAMINOEA VESICULA* (OPISTHOBRANCHIA: HAMINOEIDAE) IN THE NORTHEAST PACIFIC

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Two separate populations of *Haminoea vesicula* (Gould, 1855) are assessed based on complete specimens and shells collected primarily in British Columbia, Canada and Southern California, United States with the purpose of determining whether a speciation event for this species is justified.

Specimens are compared using morphological and genetic characteristics. Evaluation of diagnostically reliable features including the external morphology, radulae, and gizzard plates through SEM photomicrographs, camera lucida, and digital photography revealed consistent differences that support a divergence between the two populations which may culminate in speciation. The shell morphology and male copulatory organs present no variations. Mitochondrial genetic markers (partial 16S fragments) offer

promising additional data to test morphological differences. Protocols for DNA extraction and sequencing of long-term preserved tissue are used to compare the two populations.

With the presented data it is clear that the two populations show steady variation typical for a process of divergence. However, further investigation and corroboration of differences is needed before sufficient evidence is compiled to support the establishment of a new name for the northern population. Determination of the population structure of *H. vesicula* or the possibility of the existence of a second, cryptic species in the northern part of the range is of the utmost importance in further understanding the biology of this species. This knowledge will contribute to understanding the influence of environmental change on this species through factors such as global warming.

109. SURVEY OF THE PLEISTOCENE *CAMELIDAE* MATERIAL OF RALPH B. CLARK REGIONAL PARK INTERPRETIVE CENTER, ORANGE COUNTY, CA

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A faunal list of the Pleistocene camel species at R.B. Clark Regional Park Interpretive Center (RCIC) was recorded. The Clark Park specimens were compared with other specimens in order to verify and clarify previous identifications. A total of 23 specimens were analyzed and were identified to approximate identifications. Three specimens were identified as part of the camel family or *Camelidae*. Seven were identified as *Camelops*, and eleven were identified as *Camelops hesternus*. One specimen was identified as *Hemiauchenia* and one was removed from the camel specimens. The material at RCIC is fairly diversified. The *Camelops hesternus* specimens of RCIC were compared with those of *Camelops hesternus* in the La Brea tar pit collection, since La Brea has mostly *Camelops hesternus*. The specimens were then photographed to provide further information about the morphological similarities.

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111. EVOLUTIONARY CHANGES IN THE DIGESTIVE TRACT OF THE PARASITIC CATFISHES (TRICHOMYCTERIDAE)

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Many species of the widespread Neotropical catfish family Trichomycteridae are known for their parasitic habits of feeding on blood, scales and mucus of other fishes, while other species of the family are more generalized predators on insects. One species of the parasitic group, *Pareiodon microps*, has reverted back to a predatory habit of feeding on fish flesh. The entire parasitic species group has a straight gut, losing the stomach and looping structure found in other species. These were found also to have reduced intestinal walls and villi. *P. microps* is found to have redeveloped a strong intestinal wall, as well as intestinal villi, and developed an enlarged rectum. The internal structure of the *P. microps* gut is more complex compared to other members of the family.

112. MODELING THE TOXIC EFFECTS OF SILVER NANOPARTICLES UNDER VARYING ENVIRONMENTAL CONDITIONS

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Although 25 percent of the nanotechnology consumer market contains silver nanoparticles, the obscurity of these associated environmental risks necessitates the development of a reproducible assay to

quantify the toxicity of nanosilver. Phase I of this investigation conducted preliminary experiments in order to determine the optimum conditions for the bacterial toxicity assay. In Phase II, the development of a high throughput method quantified the toxicity, redefined as the percentage of cells that died in excess to its natural death, based on ratios of the fluorescence of live to dead cells. This novel technique established a positive logarithmic association between the various concentrations of nanosilver and its resultant toxicity on model environmental bacteria, *Pseudomonas putida* and *Bacillus subtilis*; as concentration increases, toxicity increases at a logarithmic rate. In Phase III, a practical application of a silver nanoparticle water filtration system revealed the passage of nanosilver through a 1-micron filter into the filtered waters. This may, in turn, come into indirect or direct contact of the environment and continue to induce toxic effects in the environmental surroundings. This investigation not only showed that a nanosilver concentration as low as 1-micromolar can induce approximately 50% death of surrogate environmental bacteria, but it also revealed the potential risks of consumer products that contain silver nanoparticles. This investigation took steps toward understanding and quantifying the potential environmental consequences of nanotechnology.

113. CHEMOTHERAPY AND THE UNFOLDED PROTEIN RESPONSE

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The unfolded protein response (UPR) is an essential cellular survival tool that counteracts the detrimental effects of outside stresses such as hypoxia and nutrient deprivation by allowing the proper folding of polypeptides within the endoplasmic reticulum. The UPR has been shown to be involved both in carcinogenesis and in the response of cancer cells to chemotherapy, yet little is known regarding the specific effects of chemotherapy on the UPR. We sought to investigate the relationship between the UPR and certain chemotherapeutic drugs, mainly Paclitaxal (Taxol[®]), a drug commonly used in the treatment of breast and ovarian cancers, and Gemcitabine (Gemzar[®]), a drug used widely in the treatment of pancreatic cancer. We utilized HT1080 fibrosarcoma cells that were stably transfected with luciferase reporters of different arms of the UPR and exposed each cell line to both Paclitaxal and Gemcitabine. Our results indicate that Paclitaxal but not Gemcitabine specifically activates the IRE1 arm of the UPR. A second, parallel arm of the UPR which is regulated by the activation of the ATF4 protein was not stimulated by Paclitaxal. Interestingly, a survival assay showed that Paclitaxal did little to kill HT1080 fibrosarcoma cells in culture, whereas Gemcitabine was toxic. The activation of the UPR by Paclitaxal may explain in part the ability of HT1080 cells to survive exposure which would otherwise be lethal, and suggests that inhibitors of the UPR, currently under development, may provide a means to increase efficacy of certain chemotherapies.

114. THE ROLE OF THE GET1 TRANSACTIVATOR IN THE REGULATION OF EPITHELIAL BARRIER STRUCTURE AND FUNCTION IN BLADDER EPITHELIUM

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The Grainyhead-like epithelial transactivator (Get1) is a transcriptional regulator linked to epithelial differentiation in the bladder. Uroplakin 2 is an essential bladder structure protein found to be lacking in Get1 knockout mice. The purpose of this experiment was to investigate the particular interaction between Get1 and Uroplakin 2 (Upk2). A prospective Get1 binding site was identified upstream of the Upk2 gene, ligated into a pGL3 luciferase assay expression vector, and transfected into a human keratinocyte cell line. Luciferase assay results indicated that the tested binding site did show up regulation in the presence of Get1, supporting the hypothesis that the tested Get1 binding site was the actual connection between the presence of Get1 and Upk2.

115. THE EL SEGUNDO BLUE BUTTERFLY RETURNS TO SOUTH BAY BEACHES

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In a case of “if you plant it, they will come”, the endangered El Segundo blue butterfly (*Euphilotes battoides allyni*) quickly exploited new habitat at beach bluffs in the south bay portion of Santa Monica Bay. Historically large populations of this butterfly inhabited its namesake El Segundo dunes until the habitat was largely built over, particularly during the post-World War II boom. The butterfly was listed as endangered in 1976, with limited populations in existence, largely cut-off from each other. Then, in 2001, the Beach Bluffs Restoration Project was formed, an ad hoc committee comprised of various citizens, governmental agencies, and non-profit organizations having the common goal of restoring native dune and bluff habitat along the south bay beaches. Although the planned habitat could support the El Segundo blue butterfly, plans were solely focused on restoring native habitat with butterfly reintroduction plans set on the back burner. Starting as a demonstration project in Redondo Beach, the effort utilized a multi-component approach that included educational, volunteerism, work experience, and infrastructure improvement programs. The SEA Lab, a Los Angeles Conservation Corps program, spearheaded the on-site effort, improving their restoration abilities and expanding to Dockweiler and Manhattan Beaches. All the while, reintroduction of the butterfly was left for sometime in the future. However, nature had her own educational component in store. By travelling much further than previously thought possible, we learned the El Segundo blue butterfly had occupied new habitat at the Redondo Beach and Dockweiler Beach sites in June 2007.

116. EFFECTS OF VARYING ZINC CONCENTRATIONS ON BIOLUMINESCENCE IN *CYPRIDINA HILGENDORFII*

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This study determined the effect of varying zinc concentration on the bioluminescence of *Cypridina hilgendorffii*, a marine shrimp. The results were compared to my previous year's project that determined the effect of phosphate on this crustacean. The result of the present experiment may be used to find the concentration of a common water pollutant, the metal zinc.

Preserved *Cypridina* were introduced into zinc sulfate solutions in concentrations of 0.05 g/100 mL, 0.1 g/100 mL and 0.15 g/100 mL. The Control Group solution was undosed distilled water. 0.05 g of ground *Cypridina* and 2 mL of zinc solution were placed in a cuvette. Four trials were done per concentration. Digital photographs were taken in a darkroom, exposing the film at 10, 15 and 20 seconds.

The results were quantified using AnalySIS software. The program calculated the percentage of the picture that was black. This percentage was subtracted from 100% to determine the percentage of the rest of the picture, which was light in the white-to-blue spectrum. This light frequency was determined for each picture.

With increased concentrations of zinc sulfate, the light frequency also increased. These results contrasted with the results from the previous year's study, where sodium phosphate caused a diminishment of light. Future research can be done to discover why zinc enhanced the bioluminescent reaction while phosphate hindered it. Several possible explanations are presented. With the significant effect on the amount of light being emitted, it is apparent that *Cypridina* can be used as a bioluminescent indicator for water quality.

117. THE ECOLOGY OF COYOTES ON THE PALOS VERDES PENINSULA

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Coyotes were believed to have re-colonized the Palos Verdes Peninsula in the mid-1990's. Their presence has generated controversy as local residents have called for coyotes' removal on the claim that coyotes have preyed upon their cats. However, no one has documented where the coyotes are, their abundance on the Peninsula, or how their activity is affected by environmental factors. We report results of a two-year field study to identify the areas of the Peninsula inhabited by coyotes, determine key aspects of their diet, and document the effect of the lunar cycle on their activity. We used public sightings to identify canyons used by coyotes, then collected scat and monitored gypsum track stations to verify their presence. Scats

were examined to identify evidence of cat remains. We also monitored tracks in one canyon intensively over a 3-month period to examine the effects of moonlight on coyote activity. This intensive study included a motion sensor game camera and a shorter supplementary study in another canyon previously determined to be frequented by coyotes. We found evidence of coyotes in many areas of the Peninsula and determined that they do prey on cats as well as native prey and berries. Coyote activity did not appear to be affected by moonlight. We also found that mesopredators such as foxes and raccoons were scarce during periods of coyote activity. We hope that information from this project will be used to help find solutions to the controversy over coyotes in Palos Verdes.

118. GENETIC COMPONENT IN MINIATURE SIZE MUTATION OF THE ENDANGERED PALOS VERDES BLUE BUTTERFLY

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The endangered Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*) is twice the size of the silvery blue butterfly (*G. lygdamus*). The Palos Verdes blue butterfly (PVB), which is reared in captivity, faces a genetic bottleneck that may increase the chances it becoming miniaturized. Avoiding this bottleneck is critical for insuring against the extinction of lycaenid *Glaucopsyche lygdamus palosverdesensis* (Palos Verdes blue butterfly). Captive PVBs with body sizes less than or equal to half the size of a regular adult butterfly were identified as “tiny”. The tiny butterflies are approximately the same size as the silvery blue butterfly. Tiny and normal-sized butterflies were placed separately in multiple plant boxes, where mating and ovipositioning occurred. The rate of tiny butterflies was determined for 48 different genelines. The tiny population was not distributed normally and was tested by the non-parametric Mann-Whitney Rank Sum to determine the presence of tiny clustering within the population. Overall, four gene lines showed a propensity to harbor a higher rate for the expression of the tiny characteristic. Researchers will monitor mating of the butterflies belonging to gene lines with the tiny characteristic to insure the health of the captive PVB population. Future studies will examine the relationship between the matriarch’s age at the time of ovipositioning, the average weight of the resulting pupae, success levels of different types of food, and possible substitute light sources to the expression of the tiny characteristic.

119. STUDY ON THE TRUNCATION OF CONVEX SYMMETRICAL POLYHEDRA

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Truncations of convex symmetrical polyhedra were investigated. Truncation planes were created at each vertex such that the plane was perpendicular to the line from the center of the polyhedron to the vertex. These planes were pushed into the polyhedron with respect to a parameter and truncated the polyhedron. A computer algebra routine was created in order to automate this process and produce a new polyhedron with simply input of an original polyhedron and the parameter of truncation. Three types of truncation were encountered with respect to the depth of the cut. The first, a shallow truncation, was a truncation in which the truncations planes only interacted with the original polyhedron and not each other. This type of truncation related to a parameter value such that the cut was very shallow. A deep truncation occurred when the truncation planes began to interact with each other as well as with the old polyhedron. The final truncation, a dual truncation, occurred when only the truncation planes were interacting with each other to produce the new polyhedron. This point became a point of stability because any parameter value that cut further into the polyhedron would only scale the outcome of the dual truncation, which is the polyhedron’s dual.

120. ACHIEVING NUTRIENT REDUCTIONS IN THE NEWPORT BAY WATERSHED – A CASE HISTORY

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Since 1998, the County of Orange has been implementing and managing a Nutrient TMDL for the Newport Bay watershed. This TMDL was developed due to large algal blooms that were common in Newport Bay during the 1980's and early 1990's. Excessive nitrogen loading to Newport Bay was determined to be the most likely cause of the algal blooms. Key point and non-point sources have been identified. BMPs have been implemented for major point source discharges and a regional BMP has been implemented to mitigate urban runoff. Over the past several years, monitoring data have shown that total inorganic nitrogen concentrations and total nitrogen loads to Newport Bay have been steadily decreasing. In addition, algal biomass in Newport Bay has also significantly been reduced and the green algae species *Ulva* (indicative of nutrient pollution) has been mostly replaced by *Ceramium*, a non-nuisance brown algae.

The remaining challenge for the watershed is to develop management strategies for the impact of nitrogen laden groundwater that passively seeps into the surface waters. During very wet years, such as 2005, groundwater can have a major impact on algal blooms in the bay. This non-point source is being addressed through a large stakeholder group, the Nitrogen and Selenium Management Program (NSMP). The NSMP is looking at the sources, loads, and treatment options for nitrogen on a watershed scale. The ultimate goal of the program is to develop management strategies that will attain nitrogen related water quality standards and protect the beneficial uses of Newport Bay.