Environmental Notes & Abstracts

Ballona Wetlands, Photo: Karina Johnston

The Environmental Notes and Abstracts section contains summaries of research and policy submitted to *Urban Coast*, as well as abstracts from current literature. In this section *Urban Coast* brings together innovative environmental research, technical studies, BMP or LID implementation and policy developments to keep our readers abreast of the latest developments in urban coastal research and policy. We welcome suggestions for abstracts to include in this sections as well as submittals. By submitting to *Urban Coast* you will be reaching our stakeholders and decision-makers and keeping them apprised of the latest thinking about environmental issues and solutions and helping practitioners to share knowledge of how the vast array of techniques and tools available are being applied in urban coastal regions. Please direct correspondence to sbergquist@santamonicabay.org.

Policy

Groundwater Replenishment and Watershed Restoration. Lillian Kawasaki. 2009. Water Replenishment District of Southern California.

Project Summary

The Water Replenishment District of Southern California (WRD) was created 50 years ago to restore the groundwater basins underlying the lower reaches of the Los Angeles and San Gabriel River Watersheds. The Central and West Coast Basin aquifers at the time were threatened by over-pumping on the one hand and the intrusion of seawater on the other.

Through an aggressive program of groundwater replenishment, adjudicated limitations on the amount of groundwater pumping and the construction by the Los Angeles County Flood Control District of the largest seawater barrier system in the world, the groundwater basin components of the watersheds are in better condition today than they have been since the 1930s.

The WRD experience demonstrates that watershed stewardship and groundwater replenishment are inextricably linked. Steadily over time the reliance on imported water has been replaced with local sources of supply. WRD's Water Independence Now (WIN) objective to be completely free of imported water for replenishment by 2015 is an example of the growing need to move to regional self reliance for water resources.

Local supply in the form of conservation, recycled water, stormwater capture and Low Impact Development (LID) has key advantages over imported water. It is a far more reliable and secure water source that helps reduce the export demand from the Bay Delta and Colorado River. The cost of local water supplies has proven in most cases to be far more cost effective than imported water. The energy to produce an acre-foot of advanced treated recycled water is half as much as imported water. Proven technology is available today to jointly manage surface and groundwater (conjunctive use) to optimize available groundwater storage. Within WRD's area alone, there are more than 450,000 acre-feet of available storage capacity. In recent years, 56,000 acre feet of stormwater has been captured annually for replenishment, but an estimated 260,000 acre-feet of storm flow still is lost to the ocean. Proposed groundwater storage amendments now pending before the courts demonstrate that it is possible to create a predictable framework for groundwater producers that foster groundwater storage. Coupled with a comprehensive groundwater monitoring system, management of scarce water resources can be optimized for both supply and quality.

Local groundwater supply is better for watersheds, assures a more reliable source at less cost with significantly reduced energy and carbon footprints, while reducing the demand for dwindling imported water.

Lillian Kawasaki is Division 3 Director of the Water Replenishment District of Southern California (WRD), which manages the groundwater for 4 million people in 43 cities in South LA County. Lillian also serves on the Executive Committee of the Carpe Diem: Western Water and Climate Change Project.

Water Quality Improvement Policies: Lessons Learned from the Implementation of Proposition O in Los Angeles, CA. Park, M-H, M. Stenstrom, and S. Pincetl. 2009. Environmental Management. 43:514-522.

Abstract
This article evaluates the implementation of Proposition O, a stormwater cleanup measure, in Los Angeles, California. The measure was intended to create new funding to help the city comply with the Total Maximum Daily Load requirements under the federal Clean Water Act. Funding water quality objectives through a bond measure was necessary because the city had insufficient revenues to deploy new projects in its budget. The bond initiative required a supermajority vote (two-thirds of the voters), hence the public had to be convinced that such funding both was necessary and would be effective. The bond act language included project solicitation from the public, as well as multiple benefit objectives. Accordingly, nonprofit organizations mobilized to present projects that included creating new parks, using schoolyards for flood control and groundwater recharge, and replacing parking lots with permeable surfaces, among others. Yet few, if any, of these projects were retained for funding, as the city itself also had a list of priorities and higher technical expertise in justifying them as delivering water quality improvements. Our case study of the implementation of Proposition O points to the potentially different priorities for the renovation of urban infrastructure that are held by nonprofit organizations and city agencies and the importance of structuring public processes clearly so that there are no misimpressions about funding and implementation responsibilities that can lead to disillusionment with government, especially under conditions of fiscal constraints.

Research Review of Collaborative Ecosystem-Based Management in the California Current Large Marine Ecosystem. Coleman, Kary. 2009. Coastal Management. 36(5).

Abstract
The welfare of the marine environment is threatened worldwide. In order to maintain ecosystem services management must shift from single sector to ecosystem approaches. To support this transition in marine management, this article reviews collaborative ecosystem-based management in the California Current Large Marine Ecosystem (CCLME), through an overview and comparison of three collaborations on the United States West Coast of California, Oregon, and Washington. The achievements of these collaborations are demonstrated. Networking and extending collaboration throughout the entire region is shown to be essential for environmental conservation and sustainable development in the CCLME.

Investigating the Potential Role of Visualization Techniques in Participatory Coastal Management. Jude, Simon. 2008. Coastal Management. 36(4).

Abstract
The current shift toward "soft" forms of coastal defense as means of adapting to future sea level rise requires careful communication and consultation if they are to gain widespread public acceptance. For this to be achieved then coastal managers must improve the manner in which they communicate with stakeholders and members of the public. One possible solution may be through the application of landscape visualization techniques to illustrate how new policies or management interventions may shape the coast. This article investigates the potential role of such methods in participatory coastal management. Using interviews with coastal managers, the potential application of visualization techniques in coastal management processes are explored in detail. The findings suggest that while a number of possible roles for visualization techniques exist, there is an urgent need for practical testing and evaluation of the technology in participatory decision-making processes.

Catchment-Wide Assessment of the Cost-Effectiveness of Stormwater Remediation Measures in Urban Areas. Davis, B.S. and G.F. Birch. 2009. Environmental Science and Policy. 12(2):84-91.

Abstract
The cost effectiveness of catchment-wide funding for the environmental remediation of urban waterways on the scale of a major metropolitan catchment is examined considering the typical land-use and pollutant-export characteristics of urban catchments. The evaluation is performed by comparing the effectiveness of the major stormwater treatment modes for the pollutants of concern with the proportion of pollutant export to which the measure applies. The heavy metals copper, lead, and zinc in the aqueous phase or bound to fine particulates are identified as representative of the pollutants of concern in drainage from urban catchments. The analysis suggests that these priority pollutants are predominantly (79–87%) derived from runoff from residential property and roads as disseminated urban surfaces. Analysis of a specific case of catchment-wide funding of stormwater remediation in the Sydney Harbour catchment, Australia reveals that the funding allocation cannot be expected to have achieved reductions in the loads of priority pollutants due to the types of treatment measures implemented and the sources addressed. The apportionment of funding in better accordance with the maximum potential effectiveness of stormwater treatment modes and the pollutant-export characteristics of urban catchments could thus be expected to achieve a more cost-effective result from such funding initiatives.

Reflecting Ecological Criteria in Laws Supporting the Baja to Bering Sea Marine Protected Areas Network Case Study. Vásárhelyia, Charlotte and Vernon G. Thomas. 2008. Environmental Science and Policy. 11(5):394-407.

Abstract
Canadian and US marine conservation law, and other related law, was analyzed to determine if it reflected ecological criteria needed to implement connectivity among marine protected areas of the northeast Pacific in the proposed trilateral Baja to Bering Sea (B2B) initiative. The analysis included both nations' federal laws and those of California, Oregon, Washington, Alaska, and British Columbia. While legal provisions exist already to implement marine protected areas for varying reasons, there is little capacity in most laws to create connectivity among them for conservation purposes. Only California's legislation contained explicit provisions for all the criteria. Other federal, state, and provincial laws, while containing provisions for species at risk and vulnerable habitats, generally lacked explicit provisions for the vital criteria, size of area, migratory patterns, and recruitment patterns. Implementation, future management, and protection of the proposed B2B marine network would be facilitated by amendment of both Canadian and US laws. Some of the ecological criteria are already implied implicitly or vaguely, but they need to be made explicit in the amended law. The legislative model of California could serve as a template for amending the laws of other jurisdictions in the B2B venture.

More Than Information: What Coastal Managers Need to Plan for Climate Change. Tribbia, J. and S.C. Moser. 2008. Environmental Science and Policy. 11(4):315-328.

Abstract
Climate change and sea-level rise (SLR) increasingly threaten the world's coastlines, managers at local, regional, state, and federal levels will need to plan and implement adaptation measures to cope with these impacts in order to continue to protect the economic, social, and environmental security of the state and of local communities.

In this paper, we explore the information needs of California coastal managers as they begin confronting the growing risks from climate change. Through this case study we examine the challenges managers face presently, what information they use to perform their responsibilities, what additional information and other knowledge resources they may need to begin planning for climate change. We place our study into the broader context of the study of how science can best support policy-makers and resource managers as they begin to plan and prepare for adaptation to climate change.

Based on extensive interview and survey research in the state, we find that managers prefer certain types of information and information sources and would benefit from various learning opportunities (in addition to that information) to make better use of available global change information. Coastal managers are concerned about climate change and willing to address it in their work, but require financial and technical assistance from other agencies at the state and federal level to do so. The study illustrates the strong need for boundary organizations to serve various intermediary functions between science and practice, especially in the context of adaptation to global climate change impacts.

Conceptual Issues in Designing a Policy to Phase Out Metal-Based Antifouling Paints on Recreational Boats in San Diego Bay . Carsona, Richard T., Maria Damonb, Leigh T. Johnson and Jamie A. Gonzalezc 2009. Journal of Environmental Management. 90(8):2460-2468.

Abstract
In marine areas throughout the world where recreational boats are densely located, concentrations of copper in the water are being found to be in excess of government standards, due to the hull coatings used on these boats. Copper-based hull coatings are intended to be antifouling in that they retard the growth of algae, barnacles and tubeworms; but alternatives exist that can eliminate the harm that copper contamination does to marine organisms. A variety of policy options are available to mandate or provide economic incentives to switch to these less harmful alternatives. This paper puts forth a conceptual framework for thinking about how to design and evaluate alternative policies to transition to nontoxic boat hulls, drawing from the authors' experience designing a policy for use in San Diego Bay. Many of the issues raised are broadly applicable to environmental problems where the solution involves a large-scale replacement of durable consumer goods.

A Dynamic Analysis of the Wetland Mitigation Process and its Effects on No Net Loss Policy. Todd Bendor. 2009. Landscape and Urban Planning. 89(1-2):17-27.

Abstract
Since 1980, U.S. regulations have required compensatory mitigation for wetland losses, often through wetland creation or restoration. In 1987, the National Wetlands Policy Forum recommended that federal policy should aim to achieve overall "no net loss" of the country's remaining wetland acreage and function. Controversy has surrounded recent reports that laud the achievement of no net loss while citing the virtual elimination of certain types of wetland losses in certain areas. However, little discussion in this debate has centered on the dynamic nature of wetland loss and restoration. Evidence has shown that temporal lags in wetland restoration can temporarily reduce wetland function and impose high costs on society. This paper analyzes wetland loss and compensation as dynamic processes that include temporal lags prevalent in various mitigation techniques. Here, a system dynamics model of the mitigation process is used to explore wetland alteration and mitigation data collected between 1993 and 2004 for the Chicago, IL region. This model includes vital factors associated with mitigation policy, including mitigation failure rates, varying mitigation ratios, and the temporal lags and head starts inherent in mitigation banking, permittee responsible mitigation, and in-lieu fee mitigation programs. Results demonstrate that

delays in initiating and completing restoration activities mean that frequent, temporary wetland losses can easily contribute to a consistent and considerable net functional loss over time. I conclude by discussing methods for minimizing net temporary losses and reducing wetland restoration lag costs.

Pollution

Water Resources Action Plan (WRAP). 2009. Port of Los Angeles and Port of Long Beach.

Project Summary
The Ports of Los Angeles and Long Beach, the two largest container ports in North America, face water quality issues that include not only stormwater runoff from port lands, but also the on-water activities of industrial harbors, legacy sediment contamination, and inputs from intensely developed urban watershed areas upstream. Recognizing the advantages of addressing these issues on a harbor-wide basis, the two ports worked cooperatively to develop a joint plan for managing water and sediment quality in the entire port complex. This was undertaken with input from U.S. EPA, the Regional Water Quality Control Board, and a public stakeholder process. The WRAP's driving forces are: 1) the need to achieve the ports' mission of protecting and improving water and sediment quality, and 2) the imminent promulgation of Total Maximum Daily Loads (TMDLs) for harbor waters. Much of the harbor area is designated as impaired under Clean Water Act Section 303(d); because the listings are driven by sediment contamination, rather than elevated pollutant concentrations in the water, the WRAP addresses sediment issues as well as water quality. The WRAP's purpose is to put into place the programs and mechanisms through which the ports will achieve the goals and targets that will be established by upcoming TMDLs and to comply with the stormwater permits.

The WRAP identifies the key issues in the port complex; identifies control measures to address those issues; and assembles existing, as well as proposed, water and sediment programs into those measures. Eight control measures address the various types of activities and sources on port-owned land, including construction, operations, litter control, and new development. Three measures address on-water activities, including structures and vessels. Two measures address sediment quality issues, including guidance for routine dredging and management of sediment hotspots. Finally, one control measure commits the ports to working with watershed stakeholders in order to reduce pollutant inputs from sources outside port jurisdiction. The WRAP describes the implementation tools available to the ports (lease and tariff provisions, incentives, and port-sponsored initiatives) and establishes a schedule for implementing the control measures. A key aspect of the WRAP is its dynamic nature: the WRAP will be revisited periodically in order to add detail and to add or modify measures where appropriate. Accordingly, as TMDLs and the corresponding permits are promulgated, the WRAP will respond rapidly by incorporating numerical goals for pollution reduction without a massive program development effort.

Bio-Remediation Treatment Study to Control the Algae and Odor Problems at the Oxford Retention Basin in Marina Del Rey, California. 2009. The Los County Flood Control District.

Project Summary
The Los Angeles County Flood Control District has initiated a bio-remediation treatment study to control the algae and odor problems at the Oxford Retention Basin in Marina Del Rey. Bio-remediation takes advantage of naturally occurring microbes which act symbiotically to out-compete the algae for nutrients in the basin. The project is a one year pilot study which began in the Summer of 2009. The first phase of the study was completed on August 24, 2009. The work consisted of the analysis of three pre-treatment water quality samples for 33 different constituents and five water treatments to introduce the microbes into the basin. Initial observation of algae quantity, color, and thickness indicate that the treatments are beginning to produce results; however, more time is needed to allow the microbe colonies to build and slow the rate of algae growth.

In addition, to controlling algae and odor the Los Angeles County Flood Control District is conducting a Sediment and Water Quality Analysis for Oxford Retention Basin and is proposing to remove excess sediment to restore capacity, and ultimately constructing a wetland feature that will improve the overall water quality within the basin."

Pilot- and Bench-Scale Testing of Faecal Indicator Bacteria Survival in Marine Beach Sand Near Point Sources. Mika, K.B., G. Imamura, C. Chang, V. Conway, G. Fernandez, J.F. Griffith, R.A. Kampalath, C.M. Lee, C-C. Lin, R. Moreno, S. Thompson, R.L. Whitman and J.A. Jay. 2009. Journal of Apllied Microbiology. 107:72-84.

Abstract
Aim: Factors affecting faecal indicator bacteria (FIB) and pathogen survival/persistence in sand remain largely unstudied. This work elucidates how biological and physical factors affect die-off in beach sand following sewage spills.

Methods and Results: Solar disinfection with mechanical mixing was pilot-tested as a disinfection procedure after a large sewage spill in Los Angeles. Effects of solar exposure, mechanical mixing, predation and/or competition, season, and moisture were tested at bench scale. First-order decay constants for *Escherichia coli* ranged between -0.23 and -1.02 per day, and for *enterococci* between -0.5 and -1.0 per day. Desiccation was a dominant factor for E. coli but not enterococci inactivation. Effects of season were investigated through a comparison of experimental results from winter, spring, and fall.

Conclusions: Moisture was the dominant factor controlling E. coli inactivation kinetics. Initial microbial community and sand

temperature were also important factors. Mechanical mixing, common in beach grooming, did not consistently reduce bacterial levels.

Significance and Impact of the Study: Inactivation rates are mainly dependent on moisture and high sand temperature. Chlorination was an effective disinfection treatment in sand microcosms inoculated with raw influent.

Natural Catchments as Sources of Background Levels of Stormwater Metals, Nutrients, and Solids. Yoon, V.K., E.D. Stein. 2008. Journal of Environmental Engineering. 134:961-973.

Abstract
A key challenge in managing water quality and meeting compliance standards is accounting for both the anthropogenic and natural contributions of a range of water quality constituents. This study quantified levels of solids, metals, and nutrients in storm-water runoff from 18 sites across 11 watersheds representing a range of natural conditions in southern California. Constituent concentration and flux were measured over the course of a variety of storms in order to investigate temporal and spatial patterns in constituent levels, and to identify the most important environmental attributes affecting background water quality. Metals and nutrient concentrations from the natural catchments were typically one to two orders of magnitude lower than those from developed catchments. In contrast, total suspended solids levels were comparable to those found in urban storm water from Los Angeles. Geologic setting had the greatest effect on constituent levels at natural sites. Unlike urban systems, natural catchments do no appear to exhibit a first flush phenomenon, with a substantial portion of the constituent load occurring later in the storm. Ratios of particulate to dissolved metals concentrations changed considerably over the course of storms suggesting that bioavailability of constituents from natural areas may vary over storm duration.

Watershed and Land Use-Based Sources of Trace Metals in Urban Stormwater. Tiefenthaler, L.L., E.D. Stein and K.C. Schiff. 2008. Environmental Toxicology and Chemistry. 27:277-287.

Abstract
Trace metal contributions in urban storm water are of concern to environmental managers because of their potential impacts on ambient receiving waters. The mechanisms and processes that influence temporal and spatial patterns of trace metal loading in urban storm water, however, are not well understood. The goals of the present study were to quantify trace metal event mean concentration (EMC), flux, and mass loading associated with storm water runoff from representative land uses; to compare EMC, flux, and mass loading associated with storm water runoff from urban (developed) and nonurban (undeveloped) watersheds; and to investigate within-storm and within-season factors that affect trace metal concentration and flux. To achieve these goals, trace metal concentrations were measured in 315 samples over 11 storm events in five southern California, USA, watersheds representing eight different land use types during the 2000 through 2005 storm seasons. In addition, 377 runoff samples were collected from 12 mass emission sites (end of watershed) during 15 different storm events. Mean flux at land use sites ranged from 24 to 1,238, 0.1 to 1,272, and 6 to 33,189 g/km2 for total copper, total lead, and total zinc, respectively. Storm water runoff from industrial land use sites contained higher EMCs and generated greater flux of trace metals than other land use types. For all storms sampled, the highest metal concentrations occurred during the early phases of storm water runoff, with peak concentrations usually preceding peak flow. Early season storms produced significantly higher metal flux compared with late season storms at both mass emission and land use sites.

Evaluating the Potential Efficacy of Mercury Total Maximum Daily Loads on Aqueous Methylmercury Levels in Coastal Watersheds. Rothenberg, S.E., R. Ambrose and J.A. Jay. 2008. Environmental Science and Technology. 42(15):5400-5406.

Abstract
Of the 780 U.S. EPA approved mercury total maximum daily loads (TMDLs), most specify a reduction in total mercury (HgT) loads to reduce methylmercury levels in fish tissue, assuming a 1:1 correspondence. However, mercury methylation is more complex, and therefore, proposed load reductions may not be adequate. Using multiple regression with microlevel and macrolevel variables, the potential efficacy of mercury TMDLs on decreasing aqueous methylmercury levels was investigated in four coastal watersheds: Mugu Lagoon (CA), San Francisco Bay Estuary, Long Island Sound, and south Florida. HgT and methylmercury levels were positively correlated in all watersheds except in Long Island Sound, where spatial differences explained over 40% of the variability in methylmercury levels. A mercury TMDL would be least effective in Long Island Sound due to spatial heterogeneity but most effective in south Florida, where the ratio between aqueous HgT and methylmercury levels was close to 1 and the 95% confidence interval was narrow, indicating a probable reduction in aqueous methylmercury levels if HgT loads were reduced.

Nutrient Transport Through a Vegetative Filter Strip with Subsurface Drainage. Bhattarai, Rabin, Prasanta Kumar Kalita and Mita Kanu Patel. 2009. Journal of Environmental Management. 90(5):1868-1876.

Abstract
The transport of nutrients and soil sediments in runoff has been recognized as a noteworthy environmental issue. Vegetative Filter Strips (VFS) have been used as one of the best management practices (BMPs) for retaining nutrients and sediments from surface runoff, thus preventing the pollutants from reaching receiving waters. However, the effectiveness of a VFS when combined with a subsurface drainage system has not been investigated previously. This study was undertaken to monitor the retention and transport of nutrients within a VFS

that had a subsurface drainage system installed at a depth of 1.2 m below the soil surface. Nutrient concentrations of NO3-N (Nitrate Nitrogen), PO4– (Orthophosphorus), and TP (Total Phosphorus) were measured in surface water samples (entering and leaving the VFS), and subsurface outflow. Soil samples were collected and analyzed for plant available Phosphorus (Bray P1) and NO3-N concentrations. Results showed that PO4–, NO3-N, and TP concentrations decreased in surface flow through the VFS. Many surface outflow water samples from the VFS showed concentration reductions of as much as 75% for PO4– and 70% for TP. For subsurface outflow water samples through the drainage system, concentrations of PO4– and TP decreased but NO3-N concentrations increased in comparison to concentrations in surface inflow samples. Soil samples that were collected from various depths in the VFS showed a minimal buildup of nutrients in the top soil profile but indicated a gradual buildup of nutrients at the depth of the subsurface drain. Results demonstrate that although a VFS can be very effective in reducing runoff and nutrients from surface flow, the presence of a subsurface drain underneath the VFS may not be environmentally beneficial. Such a combination may increase NO3-N transport from the VFS, thus invalidating the purpose of the BMP.

Bacteria Load Estimator Spreadsheet Tool for Modeling Spatial Escherichia coli Loads to an Urban Bayou. Petersen, Christina M., Hanadi S. Rifai and Ronald Stein. 2009. Journal of Environmental Engineering. 135:203.

Abstract
The model developed in this paper, the bacteria loading estimator spreadsheet tool (BLEST), was designed as an easy to use indicator bacteria model that can overcome the shortcomings of many of the simpler total maximum daily load (TMDL) modeling approaches by integrating spatial variation into load estimates. BLEST was applied to the Buffalo Bayou watershed in Houston, Texas and incorporated loading from point and nonpoint sources, such as wastewater treatment plants, sanitary sewer overflows, septic systems, storm sewer leaks, runoff, bed sediment resuspension, and direct deposition. The dry weather Escherichia coli load in Buffalo Bayou was estimated using BLEST to be 244 billion MPN/day and would require an overall 48% reduction to meet the contact recreation standard, while wet weather loads would need to be reduced by 99.7%. Dry weather loads were primarily caused by animal direct deposition, septic systems and discharges from storm sewers under dry weather conditions, while wet weather loads were mostly attributable to runoff and resuspension from sediment. Unlike most simple TMDL load allocation strategies, BLEST can be used to evaluate spatially variable load reduction strategies. For example, septic system load reductions implemented in less than 10% of the subwatersheds resulted in a decrease in bayou loading of more than 20%.

Predictive Modeling of Storm-Water Runoff Quantity and Quality for a Large Urban Watershed. Ha, Simon J. and Michael K. Stenstrom. 2008. Journal of Environmental Engineering. 134:703.

Abstract
A predictive model for storm-water runoff was implemented on a GIS platform based on the unit area loading method and Browne's empirical relation for soil characteristics for the Upper Ballona Creek Watershed in Los Angeles. The heterogeneity of the watershed was quantified by dividing it into many small subareas and applying lumped parameters for each. Characterization of total pollutant load by land-use types to total loads was achieved through zeroth-order regularization and limited memory Broyden–Fletcher–Goldfarb–Shanno bound constrained optimization techniques. Relative form was used in the objective function to compensate for strong contributions of high magnitude variables. Model predictions showed reasonable agreement with pollutant loadings, using Zn as an example, measured at the mass emission site at watershed mouth. The predicted runoff volumes using the developed quantity model were in good agreement with the data and had R2 of 0.86. The RMS error of the quality model was 9 kg, which is low compared to the mean discharge of 77 kg/event.

Methods Applied in Studies of Benthic Marine Debris. Spengler, Angela and Monica F. Costa. 2008. Marine Pollution Bulletin. 56(2):226-230.

Abstract
The ocean floor is one of the main accumulation sites of marine debris. The study of this kind of debris still lags behind that of shorelines. It is necessary to identify the methods used to evaluate this debris and how the results are presented and interpreted. From the available literature on benthic marine debris (26 studies), six sampling methods were registered: bottom trawl net, sonar, submersible, snorkeling, scuba diving and manta tow. The most frequent method used was bottom trawl net, followed by the three methods of diving. The majority of the debris was classified according to their former use and the results usually expressed as items per unity of area. To facilitate comparisons of the contamination levels among sites and regions some standardization requirements are suggested.

Discriminating Sources of PCB Contamination in Fish on the Coastal Shelf Off San Diego, California (USA). Parnella, P. Ed, Ami K. Groceb,, Timothy D. Stebbins and Paul K. Dayton. 2008. Marine Pollution Bulletin. 56(12):1992-2002.

Abstract
Management of coastal ecosystems necessitates the evaluation of pollutant loading based on adequate source discrimination. Monitoring of sediments and fish on the shelf off San Diego has shown that some areas on the shelf are contaminated with polychlorinated biphenyls (PCBs). Here, we present an analysis of PCB contamination in fish on the shelf off San Diego designed to discriminate possible sources. The analysis was

complicated by the variability of species available for analysis across the shelf, variable affinities of PCBs among species, and non-detects in the data. We utilized survival regression analysis to account for these complications. We also examined spatial patterns of PCBs in bay and offshore sediments and reviewed more than 20 years of influent and effluent data for local wastewater treatment facilities. We conclude that most PCB contamination in shelf sediments and fish is due to the ongoing practice of dumping contaminated sediments dredged from San Diego Bay.

Monitoring

Heal the Bay End of Summer Beach Report Card. 2009. Heal the Bay.

Project Summary
Heal the Bay's End of Summer Beach Report Card provides beachgoers with essential water quality information by grading nearly 460 monitoring locations from Humboldt County through San Diego County from Memorial Day to Labor Day 2009.

The Beach Report Card is based on the routine monitoring of beaches conducted by local health agencies and dischargers. Water samples are analyzed for bacteria that indicate pollution from numerous sources, including fecal waste. The better the grade a beach receives, the lower the risk of illness to ocean users. The report is not designed to measure the amount of trash or toxins found at beaches. The Beach Report Card would not be possible without the cooperation of all of the shoreline monitoring agencies in the state.

Water quality data collected at California beaches this past summer showed that this was one of the cleanest summers on record. Southern California's third summer of drought likely contributed to the third consecutive year of excellent overall summer grades. Despite a few problem areas, statewide water quality was very good (and slightly better than last summer) with 92% A and B grades. There were only 37 locations (8%) throughout the state that received fair-to-poor water quality grades (10 Cs, 5 Ds and 22 Fs).

Overall, Los Angeles beach water quality grades were good and moderately improved from last year. Santa Monica Bay beaches showed a significant improvement from last summer with far more beaches receiving A or B grades. Overall, Santa Monica Bay beaches fared better than last summer, with 60 (91%) of 66 monitoring locations receiving A or B grades compared to 86% last year.

One of Santa Monica Bay's most polluted beaches is the Santa Monica Pier. This historic landmark, attracting over 3 million tourists each year, has been plagued by poor water quality for many years. In 2006, a study was conducted to determine the source of the chronic bacteria issues experienced on the south side of the pier. Consultants to Santa Monica determined that a stormdrain rehabilitation project was required to alleviate these water quality problems. The City completed the stormdrain project before Memorial Day 2009. Santa Monica is continuing work with UCLA and Heal the Bay to determine additional pollution sources and potential maintenance modifications.

The full End of Summer Beach Report Card can be found at www.healthebay.org/brc

Ecosystem Response to Regulatory and Management Actions: The Southern California Experience in Long-Term Monitoring. E.D. Stein and D.B. Cadien. 2009. Marine Pollution Bulletin. 59:91-100.

Abstract
Billions of dollars have been invested over the past 35 years in reducing pollutant emissions to coastal environments. Evaluation of the effectiveness of this investment is hampered by the lack of long-term consistent data. A rare opportunity exists in southern California to evaluate the effectiveness of management actions by analyzing long-term monitoring of effluent, sediment, benthos, and fish and comparing this trend data to periodic regional surveys of environmental condition. In this paper, we ask the question "have improvements in effluent quality in response to environmental regulation translated into improvements in the receiving environment?" Results indicate that management actions directed at reducing mass emissions from wastewater treatment plants (POTWs) have resulted in substantial improvement in aquatic communities. However, the magnitude and timing of response varies by indicator suggesting that use of multiple assessment endpoints is necessary to adequately interpret trends. Reductions in the effect of POTW effluent have allowed managers to shift resources to address other contaminant sources such as stormwater and resuspension of legacy pollutants.

The Extent and Magnitude of Sediment Contamination in the Southern California Bight. Maruya, K.A. and K. Schiff. 2009. The Geological Society of America Special Paper. 454:399-412.

Abstract
More than 30 million dollars are expended annually to assess environmental quality of the Southern California Bight, yet only 5% of the Bight area is surveyed on an ongoing basis. Because decision makers lacked the data to make regional assessments of ecosystem condition, multiple stakeholders collaborated to create a Southern California Bight Regional Monitoring Program. The third survey in this program was conducted in 2003. A primary goal of this regional monitoring program was to determine the extent and magnitude of sediment contamination in the Southern California Bight, and to compare these assessments among several different habitats. A stratified random design was selected to provide unbiased areal assessments of environmental condition; 359 surficial sediments were collected, representing 12 different habitats that extend from shallow embayments and estuaries to deep offshore basins. Each sample was analyzed for grain size, total organic carbon and nitrogen (TOC/TN), 15 trace metals, and a suite of

persistent organic constituents (total dichloro-diphenyltrichloroethane [DDT], total polychlorinated biphenyl [PCB], and total polynuclear aromatic hydrocarbon [PAH]). The greatest accumulated mass of these constituents (76% on average; range 70% to 87%) was located at depths >200 m, which was proportional to its relatively large area (67% of entire Southern California Bight). The greatest sediment concentrations of trace metals, total PAH, and total PCB were observed in embayments (e.g., marinas, estuaries draining urbanized watersheds, and industrialized port facilities). These shallow habitats also contained a disproportionately high mass of contaminants relative to their area. Despite the relatively widespread anthropogenic enrichment of Southern California Bight sediments, only 1% of the Southern California Bight was at a moderate to high risk of adverse biological effects based on empirically derived sediment quality guidelines. Risk, however, was not evenly distributed throughout the Southern California Bight. The greatest risk of adverse biological effects was found in sediments of marinas, Los Angeles estuaries, and large publicly owned treatment works (POTWs); these were the only habitats for which the mean effects range-median quotient (ERMQ) exceeded 0.5. The least risk was observed in sediments associated with the Channel Islands and small POTWs, for which all sites were considered to be at low risk of adverse biological effects.

Effects of Post-Fire Runoff on Surface Water Quality: Development of a Southern California Regional Monitoring Program with Management Questions and Implementation Recommendations. Stein, E.D. and J. Brown. 2009. Technical Report 598. Southern California Coastal Water Research Project. Costa Mesa, CA.

Executive Summary

Periodic wildfires are a natural component of southern California's forest and scrubland and essential to maintaining overall ecological health of these systems. However, the frequency and intensity of wildfires has increased in association with human activities in and near natural forest and foothill areas. The effects of fire on hydrologic response and sediment loads in southern California have been noted for over 80 years, yet no coordinated monitoring of water quality following fires currently occurs. The lack of coordinated monitoring is particularly problematic in southern California because watersheds affected by fire often drain to waterbodies that support sensitive resources or that have been designated as impaired under Section 303(d) of the Clean Water Act, often for the same constituents found in post-fire runoff. Consequently, the contribution of metals, nutrients, and organic contaminants from post-fire runoff to receiving waters is poorly understood in terms of both the magnitude and persistence of potential effects.

The lack of a coordinated post-fire monitoring program results from several factors. First, there is no procedure for post-fire water quality monitoring that identifies a standard set of constituents and monitoring protocols appropriate for assessing water quality following fires. Second, resources are often scarce following fires making it difficult for various entities to coordinate. Third, there is no regional entity responsible for coordinating post-fire sampling, compiling the resultant data, and disseminating the information back to mangers at the local and regional levels. Fourth, because fires occur unexpectedly, there is often insufficient available funding for conducting post-fire sampling.

This document describes a regional post-fire water quality monitoring program. The goal of the program is to help address the current information gaps by providing agreed upon regional post-fire water quality sampling procedures, including an implementation plan and a funding strategy. This plan was developed by a team of technical experts, stormwater managers, and regulators from academia, government, and the private sector. The plan provides a ready "off-the-shelf" response plan that can be quickly implemented after fires.

The post-fire monitoring program is organized around three priority management questions:

How does post-fire runoff affect contaminant flux?

What is the effect of post-fire runoff on downstream receiving waters?

What are the factors that influence how long post-fire runoff effects persist?

Status of Perennial Estuarine Wetlands in the State of California. Sutula, M., J.N. Collins, A. Wiskind, C. Roberts, C. Solek, S. Pearce, R. Clark, A.E. Fetscher, C. Grosso, K. O'Connor, A. Robinson, C. Clark, K. Rey, S. Morrissette, A. Eicher, R. Pasquinelli, M. May and K. Ritter. 2008. Final report to the Surface Water Ambient Monitoring Program, State Water Resources Control Board. Technical Report 571. Southern California Coastal Water Research Project. Costa Mesa, CA.

Executive Summary

Section 305(b) of the Federal Clean Water Act (CWA) requires each state submit biennial reports describing the health of its surface water, including wetlands, to the USEPA. This document reports on the health of California's perennial, saline estuarine wetlands.

Estuaries are partially enclosed bodies of water along the coast where freshwater runoff meets and mixes with salt water from the ocean. Based on the draft definition of wetlands for California, an estuarine wetland is an area within an estuary that is exposed at low tide and covered with rooted vegetation.

The health of the state's estuarine wetlands is estimated from a statewide survey of the distribution, abundance, and ambient condition of estuarine wetlands. The survey had three components: 1) landscape profile; 2) probability-based assessment of ambient condition; and 3) assessment of selected estuarine wetland restoration and mitigation projects. The results help answer four fundamental management questions: 1) where are the State's estuarine wetlands and how abundant are they; 2) what is the ambient condition of estuarine wetlands statewide and how does their condition vary by region; 3) what are the

major stressors and how do they vary among coastal regions; and 4) what is the condition of permitted restoration projects relative to ambient condition. This fourth question demonstrates how data could be used to evaluate policies and programs affecting the distribution, abundance, and condition of estuarine wetlands.

The landscape profile described the distribution and abundance of the State's estuarine wetlands relative to other estuarine habitats and explored the underlying causes through a detailed examination of trends in San Francisco Estuary. A probability-based survey was used to assess the ambient condition of saline, perennial estuarine wetlands. The statewide ambient survey involved 120 sites allocated equally among four regions: North Coast, San Francisco Estuary, Central Coast, and South Coast. An additional 30 sites were allocated to South Coast to test for a difference between large and small estuaries. The field survey was conducted in the Fall of 2007. The statewide ambient survey in turn served as a regional frame of reference for project assessments.

Extent and Magnitude of Copper Contamination in Marinas of the San Diego region, California, USA. Schiff, K. and J Brown, D Diehl, D Greenstein. 2007. Marine Pollution Bulletin. 54:322-328.

Abstract
Marinas are areas of special water quality concern because of the potential for pollutant accumulation within their protected waters. Perhaps the largest contaminant source to marinas is antifouling paints that leach copper to prevent the growth of encrusting organisms on vessel bottoms. Very little monitoring of marinas is typically conducted despite the potential environmental risk, particularly in the San Diego region of California, USA where as many as 17,000 recreational vessels are berthed. The objective of this study was twofold: (1) determine the extent and magnitude of dissolved copper concentrations in marinas throughout the San Diego region, and (2) determine if elevated copper concentrations in marinas of the San Diego region are resulting in adverse biological impacts. A probabilistic study design was used to sample water column copper concentrations and toxicity (using *Mytilus galloprovincialis*) at 30 stations. Results indicated that exceedence of state water quality objectives was widespread (86% of marina area), but that toxicity was much less prevalent (21% of marina area). Toxicity identification evaluations (TIEs) conducted at the most toxic sites indicated that toxicity was largely due to trace metals, most likely copper. Toxicity was reduced using TIE treatments that chelated trace metals such as cation exchange column, ethylenediaminetetraacetic acid (EDTA), and sodium thiosulfate (STS). Moreover, increasing dissolved copper concentrations correlated with increasing toxicity and these copper concentrations were high enough to account for virtually all of the observed toxicity.

Design of Storm Water Monitoring Programs. Lee, H, X. Swamikannu, D. Radulescu, S-J Kim and M.K. Stenstrom. 2007. Water Research. 41(18):4186-4196.

Abstract
Stormwater runoff is now the leading source of water pollution in the United States, and stormwater monitoring programs have only recently been developed. This paper evaluates several stormwater monitoring programs to identify ways of increasing the likelihood of identification of high-risk dischargers and increasing data reliability for assisting in the development of total maximum daily loads. No relationship was found between various types of industrial activity or land use and water quality data. Stormwater data collected with grab samples has much greater pollutant concentration variability than in potable water or wastewater monitoring programs. Industrial land use is an important source of metals. For grab samples, sampling time during the storm event will affect results. Data from California, which has distinct dry periods, showed a seasonal first flush, whereas data from areas with more uniform rainfall throughout the year did not show a seasonal first flush. Selecting a subset of sites from each monitored category using a flow-weighted composite sampler is an alternative strategy, and may result in lower overall cost with improved accuracy and variability in mass emissions, but may not be less successful in identifying high-risk dischargers.

Calibration and Evaluation of Five Indicators of Benthic Community Condition in Two California Bay and Estuary Habitats. Ranasinghe, J.A., S.B. Weisberg, R.W. Smith, D.E. Montagne, B. Thompson, J.M. Oakden, D.D. Huff and K.J. Ritter. 2009. Marine Pollution Bulletin. 59(1-3):5-13.

Abstract
Many types of indices have been developed to assess benthic invertebrate community condition, but there have been few studies evaluating the relative performance of different index approaches. Here we calibrate and compare the performance of five indices: the Benthic Response Index (BRI), Benthic Quality Index (BQI), Relative Benthic Index (RBI), River Invertebrate Prediction and Classification System (RIVPACS), and the Index of Biotic Integrity (IBI). We also examine whether index performance improves when the different indices, which rely on measurement of different properties, are used in combination. The five indices were calibrated for two geographies using 238 samples from southern California marine bays and 125 samples from polyhaline San Francisco Bay. Index performance was evaluated by comparing index assessments of 35 sites to the best professional judgment of nine benthic experts. None of the individual indices performed as well as the average expert in ranking sample condition or evaluating whether benthic assemblages exhibited evidence of disturbance. However, several index combinations outperformed the average expert. When results from both habitats were combined, two four-index combinations and a three-index combination performed best. However, performance differences among several combinations

were small enough that factors such as logistics can also become a consideration in index selection.

Die Off and Current Status of Southern Steelhead Trout (*Oncorhynchus mykiss*) in Malibu Creek, Los Angeles County, USA. Dagit, Rosi, Stevie Adams and Sabrina Drill. 2009. Bulletin, Southern California Academy of Sciences. 108(1):1-15.

Abstract
A die-off of native and exotic fish and invertebrate species, including the endangered southern steelhead trout (*Oncorhynchus mykiss*) was observed in Malibu Creek, Los Angeles County, during the summer and fall of 2006. Death was preceded by a period of illness during which trout in particular exhibited a noticeable yellow coloration. Physical, chemical and biological variables, including temperature, dissolved oxygen, a variety of chemical contaminants, presence of toxin producing algae, and direct pathology were examined but results remain inconclusive. The first day of a 12-day high temperature event occurred on the same date yellow trout were first observed. This sustained event is different from shorter term temperature spikes recorded in other years. Recovery monitoring documented recolonization by all exotic fish species and crayfish, but limited numbers of southern steelhead trout in 2007. Surveys in summer 2008 documented a record number of anadromous adults (five silvery fish over 50 cm total length) and young of the year (over 2,200 under 10 cm).

Restoration

Alien Invasions, Ecological Restoration in Cities and the Loss of Ecological Memory. Schaefer, Valentin. 2009. Restoration Ecology. 17(2):171-176.

Abstract
After a community or ecosystem is lost, it may leave behind an ecological memory. The site history, soil properties, spores, seeds, stem fragments, mycorrhizae, species, populations, and other remnants may influence the composition of the replacement community or ecosystem to varying degrees. The remnants may also hold the site to a trajectory that has implications for ecological restoration. This is true in urban situations in particular where repeated disturbance has masked the history of the site. The ecological memory remaining may be insufficient for a site to heal itself; restoration activities are required to direct the future of the site. Conversely, in light of climate change and other rapidly changing environments, the existing ecological memory may be poorly suited to the new conditions and restoration projects need to create new and perhaps novel ecosystems. The loss of ecological memory facilitates the establishment of foreign invasive species. These invasives may eventually create a new stability domain with its own ecological memory and degree of resilience. To be successful, invasive species control must address both internal within patch memory of invasives and external between patch memory. Further research is necessary to document and conserve ecological memory for ecological restoration in response to future ecosystem changes.

A Method for Evaluating Outcomes of Restoration When No Reference Sites Exist. Brewer, J. Stephen and Timothy Menze. 2009. Restoration Ecology. 17(1):4-11.

Abstract
Ecological restoration typically seeks to shift species composition toward that of existing reference sites. Yet, comparing the assemblages in restored and reference habitats assumes that similarity to the reference habitat is the optimal outcome of restoration and does not provide a perspective on regionally rare off-site species. When no such reference assemblages of species exist, an accurate assessment of the habitat affinities of species is crucial. We present a method for using a species by habitat data matrix generated by biodiversity surveys to evaluate community responses to habitat restoration treatments. Habitats within the region are rated on their community similarity to a hypothetical restored habitat, other habitats of conservation concern, and disturbed habitats. Similarity scores are reinserted into the species by habitat matrix to produce indicator (I) scores for each species in relation to these habitats. We apply this procedure to an open woodland restoration project in north Mississippi (U.S.A.) by evaluating initial plant community responses to restoration. Results showed a substantial increase in open woodland indicators, a modest decrease in generalists historically restricted to floodplain forests, and no significant change in disturbance indicators as a group. These responses can be interpreted as a desirable outcome, regardless of whether species composition approaches that of reference sites. The broader value of this approach is that it provides a flexible and objective means of predicting and evaluating the outcome of restoration projects involving any group of species in any region, provided there is a biodiversity database that includes habitat and location information.

The Restoration of Fishing Services and the Conveyance of risk information in the Southern California Bight. Breffle, William S. and Kristen K. Maroney. 2009. Marine Policy. 33(4): 561-570.

Abstract
Southern California's marine areas are heavily contaminated with dichloro-diphenyl-trichloroethane (DDT) and polychlorinated-biphenyls (PCBs), and fish consumption advisories (FCAs) have been issued throughout the region. Between 2002 and 2003, the Montrose Angler Survey, a large-scale survey of subsistence anglers, was developed and implemented on site in Orange and Los Angeles counties. This survey was intended to assist natural resource trustees in the development of restoration programs that will address injuries to natural resources and restore lost economic services for anglers, but the data were never fully analyzed. The trustees have shown a clear preference for ecological restoration programs that may take years to improve fishing services. In contrast, this analysis, which includes a random-parameter fishing site choice model, demonstrates that simple, inexpensive programs such as better signage to

warn of FCAs and transportation to clean sites have the potential to yield substantial benefits quickly. This paper also focuses on how different ethnic minority groups are affected by FCAs, and determines how best to communicate risk information and change fishing behavior through outreach programs.

Ballona Wetlands Restoration: Planning for Sea Level Rise. Garrity, Nicholas J., Jeremy P. Lowe and Jeffrey Haltiner. 2009. Phillip Williams & Associates.

Project Summary

The Ballona Wetlands Restoration seeks to restore and enhance diverse wetland habitats within the 600 acres owned by the State of California. Philip Williams & Associates and the Santa Monica Bay Restoration Commission have led the preparation of a restoration feasibility report for the California State Coastal Conservancy (www.ballonarestoration.org). One planning consideration is to accommodate recent projections of sea level rise, per the Conservancy's Climate Change Policy (June 2009).

Fine sediment from the Ballona Creek watershed and the ocean is limited; accretion rates are expected to be low and the restored wetlands may not keep pace with sea level. Inundation frequency will increase with rising tide levels, and vegetated wetland may convert to mudflat, and upland may convert to wetland, in the process of "transgression."

The restoration alternatives developed restore initially large areas of upland and upland-transition habitats that are expected to convert to wetlands as sea level rises. Long gradually sloping transitions (approximately 100:1 to 300:1) would be graded from mudflat to upland habitat elevations. Figure 1 shows a conceptual cross-section of the restored grade and expected habitat types for today and the end of the 21st century. As sea level rises, the broad areas of high marsh, transition zone, and upland habitats may be converted to a mix of mudflat, low marsh, and mid marsh. Upland acreage would decrease over time, mudflat and low marsh area would increase, and mid marsh would stay roughly constant. Restored upland and transition habitats are expected to provide interim habitat benefits, act as high tide refugia, and serve as buffers from human activity. Restoring upland habitats also avoid the cost of grading these areas to intertidal elevations.

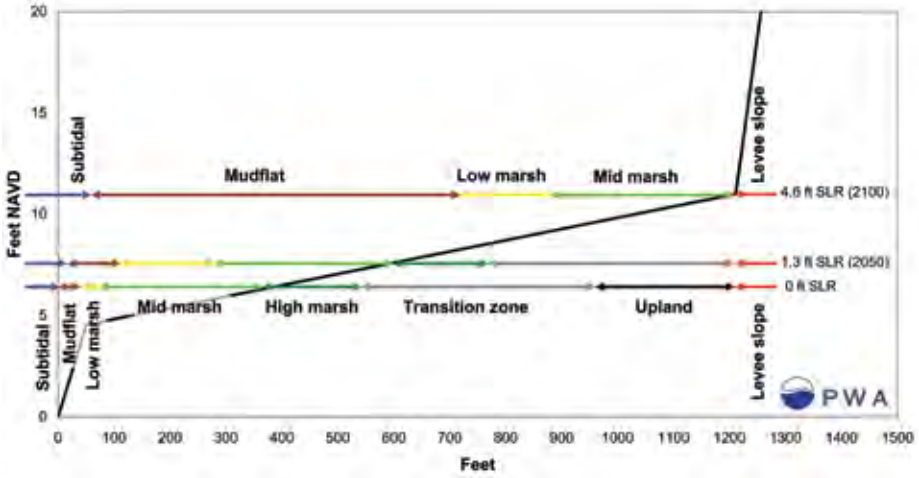

Figure 1. Conceptual Cross-section Showing Habitat Transgression with Sea Level Rise

The Nature of Urban Soils and Their Role in Ecological Restoration in Cities. Pavao-Zuckerman, Mitchell A.. 2008. Restoration Ecology. 16(4):642-649.

Abstract

Current and predicted trends indicate that an increasing proportion of the world's population is living in urban and suburban places. The nature of the urban environment becomes an important factor if we are concerned with the restoration and preservation of biodiversity and ecosystems in and around cities. This article highlights the varied impacts of cities on soils and their implications for restoration planning and expectations of restoration "success." Urban soils exist in different historical and formational trajectories than their local nonurbanized counterparts due to direct anthropogenic disturbance and indirect environmental impacts from urbanization. Therefore, urban soils often exhibit altered physical, chemical, and biological characteristics in comparison to local nonurbanized soils. Several unique features of urban soils and urban ecosystems pose particular issues for ecological restoration or the improvement of degraded soil conditions in cities. The creation of novel soil types, conditions that promote invasion by non-natives, the strong influence of past land use on soil properties, and the presence of strong interactions and alternative stable states set up unique difficulties for the restoration of urban soils. Soils in urban restorations are a medium that can be deliberately manipulated to improve site conditions or in the monitoring of soil conditions as indices of ecosystem status. Including an explicit role for strong manipulations of soils in urban ecosystems changes how we approach baselines, management, and reference conditions in urban ecological restoration. With an understanding of urban soil ecological knowledge, we can guide aspects of urban ecological restoration toward successful outcomes.

Rehabilitation of Stream Ecosystem Functions through the Reintroduction of Coarse Particulate Organic Matter. Aldridge, Kane T., Justin D. Brookes and George G. Ganf. 2009. Restoration Ecology. 17(1):97-106.

Abstract
In streams, coarse particulate organic matter (CPOM) acts as a substrate for microbial activity, which promotes nutrient retention. However, in urban areas, increased peak flows within streams lead to decreased retention of CPOM. The aim of this study was to investigate whether the reintroduction of CPOM, in the form of leaf litter, into a degraded urban stream would increase biofilm activity and phosphorus retention, two ecosystem functions that reflect the integrity of the ecosystem. Stream metabolism and nutrient retention were assessed in treated (T) and control (C) channels of the Torrens River Catchment, South Australia, before and after CPOM addition. Gross primary production and community respiration (CR) were measured as oxygen production and consumption within benthic chambers. Phosphorus retention was measured through a series of short-term filterable reactive phosphorus (FRP) addition experiments. Before CPOM addition, there were no differences in CR, but C retained 6.8% more FRP than T. After CPOM addition, CR was greater in T than in C (572 and 276 mg O2·m–2·day–1, respectively), and T retained 7.7% more FRP than C. The increase in FRP retention in T compared to C was attributed to phosphorus limitation of the CPOM and increased demand for phosphorus of the attached microbial heterotrophic community. The reintroduction of CPOM into degraded streams will be an important step in the restoration of stream metabolism and nutrient retention. Maintenance of CPOM may be achieved through restoration of riparian vegetation, a reduction in the increased peak flows, and rehabilitation of stream morphology.

Seed Dispersal and Seedling Emergence in a Created and a Natural Salt Marsh on the Gulf of Mexico Coast in Southwest Louisiana, U.S.A. Elsey-Quirk, Tracy, Beth A. Middleton, and C. Edward Proffitt. 2009. Restoration Ecology.17(3):422-432.

Abstract
Early regeneration dynamics related to seed dispersal and seedling emergence can contribute to differences in species composition among a created and a natural salt marsh. The objectives of this study were to determine (1) whether aquatic and aerial seed dispersal differed in low and high elevations within a created marsh and a natural marsh and (2) whether seedling emergence was influenced by marsh, the presence of openings in the vegetation, and seed availability along the northern Gulf of Mexico coast. Aerial seed traps captured a greater quantity of seeds than aquatic traps. Several factors influenced aquatic and aerial seed dispersal in a created and a natural salt marsh, including distance from the marsh edge, cover of existing vegetation, and water depth. The natural marsh had a high seed density of *Spartina alterniflora* and *Distichlis spicata*, the low-elevation created marsh had a high seed density of *S. alterniflora*, and the high-elevation created marsh had a high seed density of *Aster subulatus* and *Iva frutescens*. The presence of adult plants and water depth above the marsh surface influenced seed density. In the natural marsh, openings in vegetation increased seedling emergence for all species, whereas in the low-elevation created marsh, *S. alterniflora* had higher seedling density under a canopy of vegetation. According to the early regeneration dynamics, the future vegetation in areas of the low-elevation created marsh may become similar to that in the natural marsh. In the high-elevation created marsh, vegetation may be upland fringe habitat dominated by high-elevation marsh shrubs and annual herbaceous species.

Effects of Stream Restoration on Denitrification in an Urbanizing Watershed. Kaushal, Sujay S., Peter M. Groffman, Paul M. Mayer, Elise Striz and Arthur J. Gold. 2008. Ecological Applications. 18(3):789-804.

Abstract
Increased delivery of nitrogen due to urbanization and stream ecosystem degradation is contributing to eutrophication in coastal regions of the eastern United States. We tested whether geomorphic restoration involving hydrologic "reconnection" of a stream to its floodplain could increase rates of denitrification at the riparian-zone–stream interface of an urban stream in Baltimore, Maryland. Rates of denitrification measured using in situ 15N tracer additions were spatially variable across sites and years and ranged from undetectable to >200 μg N·(kg sediment)–1·d–1. Mean rates of denitrification were significantly greater in the restored reach of the stream at 77.4 ± 12.6 μg N·kg–1·d–1 (mean ± SE) as compared to the unrestored reach at 34.8 ± 8.0 μg N·kg–1·d–1. Concentrations of nitrate-N in groundwater and stream water in the restored reach were also significantly lower than in the unrestored reach, but this may have also been associated with differences in sources and hydrologic flow paths. Riparian areas with low, hydrologically "connected" streambanks designed to promote flooding and dissipation of erosive force for storm water management had substantially higher rates of denitrification than restored high "nonconnected" banks and both unrestored low and high banks. Coupled measurements of hyporheic groundwater flow and in situ denitrification rates indicated that up to 1.16 mg NO3--N could be removed per liter of groundwater flow through one cubic meter of sediment at the riparian-zone–stream interface over a mean residence time of 4.97 d in the unrestored reach, and estimates of mass removal of nitrate-N in the restored reach were also considerable. Mass removal of nitrate-N appeared to be strongly influenced by hydrologic residence time in unrestored and restored reaches. Our results suggest that stream restoration designed to "reconnect" stream channels with floodplains can increase denitrification rates, that there can be substantial variability in the efficacy of stream restoration designs, and that more work is necessary to elucidate which designs can be effective in conjunction with watershed strategies to reduce nitrate-N sources to streams.