

Environmental Notes & Abstracts

Las Virgenes Creek: Post-Restoration

PHOTO: SARAH WOODARD

Environmental Notes & Abstracts

Urban Coast contains summaries of submitted research and policy as well as abstracts from current literature. This section brings together innovative policy developments, environmental research, technical studies, and monitoring and project implementation to keep our readers abreast of the latest thinking about environmental issues and solutions. This collection of notes and abstracts reflects the latest developments in urban coastal research and policy and shares knowledge of how the vast array of techniques and tools available are being applied in urban coastal regions. We encourage our readers to learn more about any or all of the work highlighted in this section.

We welcome suggestions for abstracts to include in this section as well as submittals. Please direct correspondence to swoodard@waterboards.ca.gov.

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Policy

Coastal Project Management. Kamphuis, J. W. 2011. *Coastal Management*. 39(1):72-81.

Abstract

This article discusses the complex task of managing coastal projects, focusing specifically on those projects involving design and construction; management of projects that go beyond policy and analysis. Coastal design and decision-making are described and the tasks involved in managing coastal projects are defined. The article then concludes that neither coastal engineers nor coastal managers are educated for the contemporary tasks involved in managing coastal projects that involve design and construction. Possible opportunities to make changes in the practice and curricula of both coastal engineering and management are investigated, so that those complex projects can be managed adequately in the future.

Coastal Erosion as a Natural Resource Management Problem: An Economic Perspective. Landry, C. E. *Coastal Management*. 39(3):259-281.

Abstract

Natural forces render the coastal environment an evolving landscape, with the majority of coastline in the U. S. exhibiting net erosion in recent decades. This article provides an interdisciplinary introduction to economic dynamic optimization models for analyzing beach replenishment and explores differences between these theoretically based welfare economic models and typical applications of benefit-cost analysis employed by public agencies and consultants. Welfare economic models conceptualize benefits of beach area as service flows accruing to nearby residential property owners, recreational beach users, and local businesses, while the costs include pecuniary engineering expenditures, opportunity costs, as well as negative impacts on the coastal environment. Combining information on net benefits with an equation representing beach dynamics, this framework is capable of identifying the conditions under which beach replenishment is welfare-enhancing, and an optimal replenishment schedule can be derived. By congressional mandate, applications of benefit-cost analysis employed by public agencies focus attention on storm damage reduction, with limitations placed on assessment of recreational benefits. We provide an overview of empirical results and compare and contrast the two approaches.

Research and Policy Implications for Watershed Management in the Atlantic Coastal Plain. Drescher, S. R., N. L. Law, D. S. Caraco, K. M. Cappiella, J. A. Schneider, and D. J. Hirschman. 2011. *Coastal Management*. 39(3):242-258.

Abstract

Coastal plain research and policy strive to protect unique coastal habitats and natural resources while managing for stressors such as seasonal population fluxes and coastal hazards. There is a need to translate scientific findings to impact policy for effective coastal management at a watershed scale that reaches local communities. The Center for Watershed Protection (CWP) uses an Eight Tools of Watershed Protection (Eight Tools) framework for watershed planning and assessments to systematically identify opportunities for better practices and improve natural resource protection. This article uses four of the Eight Tools, which were recently adapted for the coastal plain, to demonstrate research to policy options: (1) land use planning; (2) forested riparian buffers; (3) stormwater management; and (4) non stormwater discharges—on-site wastewater discharge focus. It provides a synthesis of CWP's recent coastal plain research supplemented with additional coastal research to suggest ways where science may be more effectively integrated into policy and regulations that will protect and restore coastal resources at a watershed scale. Summarizing and presenting the science to policymakers can increase the validity and likelihood for environmental regulations that will ultimately be implemented at the local level.

Concepts and Science for Coastal Erosion Management – An Introduction to the CONSCIENCE Framework. Marchand, M., A. Sanchez-Arcilla, M. Ferreira, J. Gault, J. A. Jiménez, M. Markovic, J. Mulder, L. van Rijn, A. St nic , W. Sulisz, and J. Sutherland. 2011. *Ocean and Coastal Management*. doi:10.1016/j.ocecoaman.2011.06.005

Abstract

The main objective of the Conscience project was to develop and test concepts, guidelines and tools for the sustainable management of erosion along the European coastline, based on the best available scientific knowledge and on existing practical experience. Four concepts are potentially capable of providing the nexus between scientific knowledge and management: coastal resilience, coastal sediment cell, favourable sediment status and strategic sediment reservoir. The project has tested the use of these concepts and found that they are useful, provided that they are positioned and linked within a logical structure that we shall call the Conscience "Frame of Reference", defined in time and space and supported through data and monitoring. Practical experience in six coastal sites in Europe has shown that the use of this Frame of Reference together with these concepts can make management objectives explicit and transparent. It can therefore support the design of an appropriate, resilience based coastal erosion management practice.

Near-Term Priorities for the Science, Policy and Practice of Coastal and Marine Spatial Planning (CMSP). Halpern, B. S., J. Diamond, S. Gaines, S. Gelcich, M. Gleason, S. Jennings, S. Lester, A. Mace, L. McCook, K. McLeod, N. Napoli, K. Rawson, J. Rice, A. Rosenberg, M. Ruckelshaus, B. Saler, P. Sandifer, A. Scholz, and A. Zivian. 2012. *Marine Policy*. 36(1):198-205.

Abstract

There is currently a rare opportunity to inform emerging efforts to implement coastal and marine spatial planning (CMSP) in the United States, Europe and elsewhere around the world. In particular, the newly formed US National Ocean Council is developing a strategic action plan for CMSP over the next 18–24 months. In order to identify priority needs for significantly advancing CMSP, a group of experts in the science, policy and practice of CMSP developed recommendations for (1) process development, (2) communication and engagement efforts, (3) tradeoff and valuation analyses, and (4) decision support. Some of these priorities are supported by existing activities in the United States and elsewhere. Others have yet to be addressed and merit immediate attention.

Examining Local Coastal Zone Management Capacity in US Pacific Coastal Counties. Tang, Z. H., M. K. Lindell, C. Prater, T. Wei, and C. M. Hussey. 2011. *Coastal Management*. 39(2):105-132.

Abstract

The coastal zone has critical natural, commercial, recreational, ecological, industrial, and esthetic values for current and future generations. Thus, there are increasing pressures from population growth and coastal land development. Local coastal land use planning plays an important role in implementing the U.S. Coastal Zone Management Act (CZMA) by establishing goals and performance policies for addressing critical coastal issues. This study extends the CZMA Performance Measurement System from the national level to the local land use level by measuring coastal zone land use plan quality and political context in fifty-three Pacific coastal counties. Plan quality is measured using an evaluation protocol defined by five components and sixty-eight indicators. The results indicate a reasonable correspondence between national goals and local coastal zone land use planning goals, but a slight gap might exist between the national/state versus local levels in the overall effectiveness of coastal zone management (CZM) efforts. The results show many U.S. Pacific coastal counties lack strong coastal zone land use plans because the average plan quality score was only 22.7 out of 50 points. Although these plans set relatively clear goals and objectives, they are somewhat weaker in their factual basis, identify a limited range of the available planning tools and techniques, and establish few coordination and implementation mechanisms. The

regression analysis results indicate that CZM plan quality was not significantly related to any of the jurisdictional characteristics.

The Effectiveness of Environmental Monitoring and Enforcement: A Review of the Empirical Evidence. Gray, W. B., and J. P., Shimshack. 2011. *Review of Environmental Economics and Policy*. 5(1):3-24.

Abstract

Regulatory punishment for pollution violations is a mainstay of nearly every industrialized nation's environmental policy. This article reviews the existing empirical evidence on the impacts of environmental monitoring and enforcement actions. We first provide context by investigating the U.S. regulatory setting. We then briefly discuss how economists think about environmental enforcement. We next consider recent empirical evidence linking regulator actions to subsequent pollution discharges and compliance behavior. Since the literature primarily studies U.S. institutions, our review focuses mainly on the effects of Environmental Protection Agency and U.S. state activities. The consistent findings from this literature review are as follows: (1) environmental monitoring and enforcement activities generate substantial specific deterrence, reducing future violations at the targeted firm; (2) environmental monitoring and enforcement activities generate substantial general deterrence, reducing future violations at facilities other than the targeted one; and (3) environmental monitoring and enforcement activities generate not only reductions in violations but also significant reductions in emissions. We conclude by discussing policy implications and identifying gaps in the current state of knowledge.

A Broad-Scale Assessment of the Risk to Coastal Seagrasses from Cumulative Threats. Grech, A., R. Coles, and H. Marsh. 2011. *Marine Policy*. 35(5):560-567.

Abstract

Informing the management of coastal marine habitats at broad spatial scales is difficult because of the costs associated with collecting and analyzing ecological data at that scale. Spatially explicit assessments of the risk to coastal marine habitats from cumulative threats provide an alternative approach by identifying sites that are exposed to multiple anthropogenic threats at broad scales. In this study, qualitative measures of vulnerability were combined with geospatial data to evaluate the risk to coastal seagrasses at the scale of the Great Barrier Reef (GBR) region (similar to 26,000 km²) of Queensland, Australia. The risk assessment outputs identified agricultural, urban and industrial runoff, and urban and port developments as the major anthropogenic activities threatening coastal seagrasses. 'Hot spots' with multiple threat exposure were all in industrial port locations and the southern two-thirds of

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the GBR. There is a distinct discontinuity in threat exposure along the GBR coast with 98% of seagrass meadows in the northern third exposed to only low levels of anthropogenic risk. The clustering of threat exposure is discussed in terms of coastal management policy. The approach outlined in this study provides management agencies a method of achieving maximum return for minimal investment in data collection at broad spatial scales by identifying sites where management intervention would be best targeted.

Using Science to Inform Controversial Issues: A Case Study from the California Ocean Science Trust. Pietri, D., S. McAfee, A. Mace, E. Knight, L. Rogers, and E. Chornesky. 2011. *Coastal Management*. 39(3):296-316.

Abstract

Connecting science and policy to promote the effective management of marine resources is a necessity and challenge acknowledged by scientists, policymakers, and stakeholders alike. As a leader on ocean issues, California has recognized the importance of integrating science into ocean and coastal management through specific policy choices. An example is the establishment of the California Ocean Science Trust (OST), a non-profit organization mandated to support management decisions with the best available science. The OST functions as a “boundary organization” bridging the often-disparate worlds of science and policy. Recently, while coordinating a scientific study on the controversial issue of decommissioning California’s offshore oil and gas platforms, the OST encountered public misconceptions about the peer review process and how it can help ensure unbiased scientific information informs policy. The OST’s experience with this study, and generally as a scientific knowledge broker, provides a practical perspective on techniques for navigating the choppy waters between science and policy. This article presents a critical reflection on the OST’s experience coordinating the platform decommissioning study, examined through the framework of boundary organizations and salience, credibility, and legitimacy. It highlights lessons-learned from the project and shares recommendations for working toward the effective integration of science and policy.

Effects of Human Trampling on Macro- and Meiofauna Communities Associated with Intertidal Algal Turfs and Implications for Management of Protected Areas on Rocky Shores (Southern California). Huff, T. M. 2011. *Marine Ecology—An Evolutionary Perspective*. 32(3):335-345.

Abstract

Human visitation to coastal rocky shore ecosystems has numerous impacts via activities such as harvesting, rock-turning, pollution, and trampling. Human trampling, in particular, has been suggested to decrease the density and

diversity of rocky shore organisms, especially large foliose algae. Inconsistent results have been seen in studies of the effects of human trampling on coralline algal turfs and the invertebrate communities (macro-and meiofauna) that inhabit them. Here, a relatively long-term manipulative trampling study based on realistic levels of human visitation was conducted in intertidal areas off Southern California dominated by coralline algal turf. Experimentally trampled plots (‘impact plots’) and control plots protected from foot traffic (‘protected control plots’) on turf-covered rocky intertidal benches were observed for 17 months in an area closed to human visitation. Control plots were also established at several other open-access sites (‘open-access control plots’) to determine whether patterns at the experimentally trampled site resembled those from sites where human visitation is allowed. Bare space increased in trampled plots as compared to pre-impact levels, but the percentage of bare rock in control plots did not change significantly. Trampled plots exhibited shifts in invertebrate community composition and significant declines in the abundances and richness of invertebrate taxa as compared to protected control plots throughout the experiment. Additionally, the trajectory of invertebrate community change through time in trampled plots was significantly different than that of both protected and open-access control plots. Nine months after trampling had ceased, the structure of the invertebrate communities from trampled plots was similar to protected control plots and bare space had decreased to pre-impact levels (ANOSIM analysis). However, trampled plots had significantly more taxa and higher Shannon diversity values than controls. These results indicate that to manage visitor impacts on rocky shore communities, ‘no-access’ zones may be as important as ‘no-take’ zones. However, the rapid recovery seen here also indicates that perhaps rotating or seasonal closures might be an effective management strategy to protect turf communities.

Managing Wastewater Effluent to Enhance Aquatic Receiving Ecosystem Productivity: A Coastal Lagoon in Western Australia. Machado, Daniel A. and J. Imberger. 2012. *Journal of Environmental Management*. 99(1):52-60.

Abstract

Large amounts of waste are generated in urban centers that if properly managed could promote ecological services. In order to promote nutrient cycling and productivity without endangering aquatic ecosystems, management of wastewater treatment and effluent discharges to receiving waters must be assessed on a case-by-case basis. We applied this premise to examine a municipal wastewater treated effluent discharge in a shallow oligotrophic coastal lagoon in Western Australia. Three-dimensional hydrodynamic-ecological modeling (ELCOM-CAEDYM) was used to assess the reaction of ecosystem for effluent quality. Two scenarios were evaluated for the summer 2000–2001 period, the actual or “current”

(conventional secondary treatment) and an “alternative” (involving substitution of biological nutrient removal by advanced treatment). The residence time of the simulated numerical domain averaged 8.4 ± 1.3 days. For the current scenario the model successfully estimated phytoplankton biomass, as chlorophyll-a concentration (Chl-a), that is within field-measured ranges and previously recorded levels. The model was able to reproduce nitrogen as the main limiting nutrient for primary production in the coastal ecosystem. Simulated surface Chl-a means were 0.26 (range 0.19–0.38) $\mu\text{g Chl-a/L}$ for the current scenario and 0.37 (range 0.19–0.67) $\mu\text{g Chl-a/L}$ for the alternative one. Comparison of the alternative scenario with field-measured Chl-a levels suggests moderate primary production increase (16–42%), within local historical variability. These results, suggest that such a scenario could be used, as part of a comprehensive wastewater management optimization strategy, to foster receiving ecosystem’s productivity and related ecological services maintaining its oligotrophic state.

Cooperation of Science and Management for Harmful Algal Blooms: Domoic Acid and the Washington Coast Razor Clam Fishery. Chadsey, Meg, V. Trainer, and T. M. Leschine. 2012. *Coastal Management*. 40(1):33-54.

Abstract

Harmful algal blooms (HABs) may be increasing in frequency and intensity worldwide. Coastal economies suffer significant income losses when fisheries or beaches are closed to protect human health and subsistence fishing communities are at risk. Despite these hardships, managers must often conservatively close harvests across a wide area or for long periods, because they lack scientific information that would allow them to predict HAB events. The outer coast of Washington State has experienced several closures of the razor clam (*Siliqua patula*) fishery starting in 1991, due to domoic acid (DA) contamination caused by toxic blooms of the diatom *Pseudo-nitzschia*. Improved science-based management was needed to minimize the impact of DA on this fishery and the coastal communities that relied on it for income, tourism, and subsistence. The Olympic Region Harmful Algal Bloom (ORHAB) Partnership, comprised of state and tribal managers, scientists, and local stakeholders, evolved in response to this need; it has been successful in its mission. Here we examine ORHAB through the lens of the Institutional Analysis and Development framework, in order to identify key factors contributing to its success. The relevance of our findings for other ORHAB-like institutions in the Pacific Northwest and elsewhere is discussed.

Conceptualising Joint Knowledge Production in Regional Climate Change Adaptation Projects: Success Conditions and Levers for Action. Hegger, Dries, M. Lamers, A. Van Zeijl-Rozema, and C. Dieperink. 2012. *Environmental Science & Policy*. 18(1):52-65.

Abstract

Matching supply and demand for knowledge in the fields of global change and sustainability is a daunting task. Science and public policy differ in their timeframes, epistemologies, objectives, process-cycles and criteria for judging the quality of knowledge, while global change and sustainability issues involve value pluralities and large uncertainties. In literature and in practice, it is argued that joint knowledge production in projects through collaboration between (and within) science and policy serves as a means to bridge the gap between the two domains. However, an assessment framework for analysing the merits and limitations of such projects, identifying good practices and enabling adaptive management as well as social learning had not yet been developed. This paper aims to develop such a framework. We portray joint knowledge production projects as policy arrangements in which the degree of success depends on the actors involved, contents of dominant discourses, presence of rules and the availability of resources. Literature was discussed to specify these four dimensions into seven success conditions for joint knowledge production. Scholars, boundary organizations and actors in projects can use the framework for retrospective analyses of projects, providing joint knowledge production with the empirical basis it still requires. The framework can also be used for promoting reflection in action as well as for formative assessments enabling social learning.

Hydrologic Shortcomings of Conventional Urban Stormwater Management and Opportunities for Reform. Burns, Matthew J., T. D. Fletcher, C. J. Walsh, A. R. Ladson, and B. E. Hatt. 2012. *Landscape and Urban Planning*. 105(3):230-240.

Abstract

Conventional approaches to stormwater management for environmental protection fail because they do not address all of the changes to the flow regime caused by conventional stormwater drainage. In this paper, we contrasted the hydrologic effects of two conventional approaches to urban stormwater management – (a) drainage-efficiency focused and (b) pollutant-load-reduction focused – identifying their shortcomings and contrasting their hydrologic outcomes with those of a proposed alternative approach focused on restoring important elements of the natural flow regime. Under conventional approaches, both high-flow and low-flow hydrology remain perturbed. We suggest that urban stormwater management should emphasize the restoration or protection of natural hydrologic processes at small scales, with the aim of restoring natural flow regimes at larger scales downstream. We therefore suggest that, despite recent advances in managing stormwater to reduce pollutant loads and peak flow rates, a more complete approach is needed, one which includes as a goal the restoration or

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protection of ecologically important elements of the pre-development hydrograph. We propose an approach, flow-regime management, which aims as much as possible to restore and protect ecological structure and function of urban streams by retaining the pre-urban frequency of untreated storm flows, reducing the total stormwater runoff volume through evapotranspiration or harvesting, and delivering filtered flow rates to match pre-urban baseflow rates. We note, however, that the cumulative effects of urban stormwater management at smaller scales on catchment-scale hydrology are not yet fully understood.

Amounts and Distribution of Recreational Beach Expenditures in Southern California. Dwight, Ryan H., S. N. Catlin, and L. M. Fernandez. 2012. *Ocean & Coastal Management*. 59(1): 13-19.

Abstract

Visitors (n = 2455) were surveyed at fourteen southern California beaches in the summer of 2009 to measure travel expenditures associated with a recreational beach trip. The majority of beach trips were made by California residents (88%), and most traveled by motorized vehicle (90%). Mean distance traveled per beach trip was 35.0 miles; mean time at the beach was 4.0 h; and mean age of adult visitors was 34.8 years. Amounts spent on different cost categories varied; Mean direct beach expenditures spent on parking, food, shopping, lodging and rentals were \$46.09 per trip; mean fuel costs were \$8.84 per trip; and mean equipment costs (beach gear) were \$10.60 per trip. The combined Total Beach Expenditures (TBE) were \$65.53 per trip. Beaches with amenities captured greater expenditures (\$73.37 per trip) compared to beaches with less facilities (\$11.78 per trip). Southern California beaches generate over \$3.5 billion annually in beach related expenditures, and \$2.5 billion of that is spent directly at beaches. Attendance patterns determine expenditure amounts resulting in more than half of direct beach expenditures occurring at only 20% of the regions most popular beach locations. The beach specific data and results on spending patterns can be helpful for a range of agencies and beach managers when researching the most economically effective maintenance or enhancement options for different sites. The values generated also provide baseline economic activity by beach which may be useful for compensation calculations in the event of a future loss or closure of a particular beach.

Trade-offs between environmental protection and economic development in China's fisheries policy: A political analysis on the adoption and implementation of the Fisheries Law 2000. Ferraro, Gianluca and M. Brans. 2012. *Natural Resources Forum*. 36(1): 38-49.

Abstract

The Rio Declaration of 1992 called for states to integrate environmental protection in their process of development in order to achieve the ultimate goal of sustainable development (Principle 4). The paper investigates to what extent the People's Republic of China (PRC) has integrated environmental protection into her fisheries policy. The environment/development nexus is analysed in relation to the adoption and implementation of the Fisheries Law of 2000. Official documents and, more importantly, interviews conducted in several organizations at multiple levels of governance disclose a complex reality beyond the formal commitment to sustainable fisheries. Diverging interests, goals and strategies can be traced beyond formal policy documents in Beijing, Guangdong and between the Centre and the Province. Inter-organizational divergences at the central and local levels, as well as between them, hinder the pursuit of environmental protection in the development of China's fisheries sector. The paper highlights the political complexity of pursuing more responsible fisheries in the multi-actor and multi-level political-administrative system of the PRC. Here, as well as in many other developing countries, economic development constitutes the policy priority. Environmental protection often remains not only an ambitious objective but also an unperceived need.

Sustainability of Deep-Sea Fisheries. Norse, Elliott A., S. Brooke, W. W. L. Cheung, M. R. Clark, I. Ekeland, R. Froese, K. M. Gjerde, R. L. Haedrich, S. S. Heppell, T. Morato, L. E. Morgan, D. Pauly, R. Sumaila, and R. Watson. 2012. *Marine Policy*. 36(2): 307-320.

Abstract

As coastal fisheries around the world have collapsed, industrial fishing has spread seaward and deeper in pursuit of the last economically attractive concentrations of fishable biomass. For a seafood-hungry world depending on the oceans' ecosystem services, it is crucial to know whether deep-sea fisheries can be sustainable.

The deep sea is by far the largest but least productive part of the oceans, although in very limited places fish biomass can be very high. Most deep-sea fishes have life histories giving them far less population resilience/productivity than shallow-water fishes, and could be fished sustainably only at very low catch rates if population resilience were the sole consideration. But like old-growth trees and great whales, their biomass makes them tempting targets while their low productivity creates strong economic incentive to liquidate their populations rather than exploiting them sustainably (Clark's Law). Many deep-sea fisheries use bottom trawls, which often have high impacts on nontarget fishes (e.g., sharks) and invertebrates (e.g., corals), and can often proceed only because they receive massive government subsidies.

The combination of very low target population productivity, nonselective fishing gear, economics that favor population liquidation and a very weak regulatory regime makes deep-sea fisheries unsustainable with very few exceptions. Rather, deep-sea fisheries more closely resemble mining operations that serially eliminate fishable populations and move on.

Instead of mining fish from the least-suitable places on Earth, an ecologically and economically preferable strategy would be rebuilding and sustainably fishing resilient populations in the most suitable places, namely shallower and more productive marine ecosystems that are closer to markets.

Pollution

Effects of the Pharmaceuticals Gemfibrozil and Diclofenac on the Marine Mussel (Mytilus spp.) and Their Comparison with Standardized Toxicity Tests. Schmidt, W., K. O'Rourke, R. Hernan, and B. Quinn. 2011. *Marine Pollution Bulletin*. 62(7):1389-1395.

Abstract

Human pharmaceuticals, like the lipid lowering agent gemfibrozil and the non-steroidal anti-inflammatory drug diclofenac are causing environmental concern. In this study, the marine mussel (*Mytilus* spp.) was exposed by injection to environmentally relevant and elevated (1 µg/L and 1000 µg/L) concentrations of both compounds and biomarker expression was observed. Gemfibrozil exposure induced biomarkers of stress (glutathione S-transferase and metallothionein) at both concentrations 24 h and 96 h after exposure, respectively. Biomarkers of damage (lipid peroxidation (LPO) and DNA damage) were significantly affected, as well as the biomarker for reproduction, alkali-labile phosphate assay, indicating the potential oxidative stress and endocrine disrupting effect of gemfibrozil. Diclofenac significantly induced LPO after 96 h indicating tissue damage. Additionally standard toxicity tests using the marine species *Vibrio fischeri*, *Skeletonema costatum* and *Tisbe battagliai* showed differences in sensitivity to both drugs in the mg/L range. Results indicate a suite of tests should be used to give accurate information for regulation.

Seabirds and Chronic Oil Pollution: Self-cleaning Properties of Gulls, Laridae, as Revealed from Colouring Sightings. Camphuysen, K. 2011. *Marine Pollution Bulletin*. 62(3):514-519.

Abstract

Mystery oil spills off the Dutch coast affected colonial, adult Lesser Black-backed Gulls prior to and within the breeding season. From colour-ringed individuals, it was demonstrated that most oiled birds survived and were clean within a few

weeks and often bred successfully. Further evidence of self-cleaning properties of Larus-gulls is provided from a long-term colour-ringing project (1984–2009). In total 46 birds were reported 'oiled', two died, but the majority cleaned itself and survived for up to 20 years after being oiled. From colouring data and 30 years of beached bird surveys (1980–2010) it is demonstrated that the effects of chronic oil pollution is larger in winter than in summer; a reflection of seasonal differences in exposure and environmental conditions. The self-cleaning properties of gulls are such that long-term survival is not necessarily jeopardised and even in a breeding season, not all is lost in case of a spill.

Disruption of Sema3A Expression Causes Abnormal Neural Projection in Heavy Oil Exposed Japanese Flounder Larvae. Kawaguchi, M., J. Y. Song, K. Irie, Y. Murakami, K. Nakayama, and S. I. Kitamura. 2011. *Marine Pollution Bulletin*. 63(5-12):356-361.

Abstract

It has been well known that oil spills cause serious problems in the aquatic organisms. In particular, some species of teleosts, which develop on the sea surface thought to be affected by heavy oil (HO). During the embryogenesis, the nervous system is constructed. Therefore, it is important to study the toxicological effects of HO on the developing neurons. We exposed HO to eggs of Japanese flounder (*Paralichthys olivaceus*) and investigated the neural disorder. In larvae exposed by HO at the concentration of 8.75 mg/L, the facial and lateral line nerves partially entered into the incorrect region and the bundle was defasciculated. Furthermore, in the HO-exposed larvae, Sema3A, a kind of axon guidance molecule, was broadly expressed in second pharyngeal arch, a target region of facial nerve. Taken together, we suggested the possibility that the abnormal expression of Sema3A affected by HO exposure causes disruption of facial nerve scaffolding.

Marine Meiobenthic and Nematode Community Structure in Victoria Harbour, Hong Kong upon Recovery from Sewage Pollution. Liu, X. S., W. Z. Xu, S. G. Cheung, and P. K. S. Shin. 2011. *Marine Pollution Bulletin*. 63(5-12):318-325.

Abstract

Sediment quality, meiofaunal and nematode communities were monitored across six time points at two inside-harbour and three outside-harbour sites over a three-year period in Victoria Harbour, Hong Kong, after the implementation of a sewage treatment project. Twenty-one meiofaunal groups comprising mainly free-living nematodes and harpacticoid copepods and 188 species of free-living nematodes were identified. The outside-harbour area had a more diverse and significantly different nematode community structure as compared to that in the inside-harbour area. Such spatial

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difference was highly correlated with the total Kjeldahl nitrogen content of the sediments. Over the study period, there was no significant improvement in sediment quality within the harbour. However, in the last sampling time, an increase in meiofaunal abundance and a closer similarity in nematode composition between one of the inside- and outside-harbour sites suggested signs of recovery of the meiofauna as a response to abatement of sewage pollution.

Temporal Distributions of Anthropogenic Al, Zn and Pb in Hong Kong Porites Coral During the Last Two Centuries.

Wang, B. S., N. F. Goodkin, N. Angeline, A. D. Switzer, C. F. You, and K. Huguen. 2011. *Marine Pollution Bulletin*. 63(5-12):508-515.

Abstract

A 182-year long record of trace metal concentrations of aluminum, zinc and lead was reconstructed from a massive *Porites* coral skeleton from southeastern Hong Kong to evaluate the impacts of anthropogenic activity on the marine environment. Zn/Ca and Pb/Ca ratios fluctuate synchronously from the early 19th century to the present, indicating that the marine environment has been anthropogenically influenced since industrialization. Additionally, land reclamation, mining, and ship building activities are recorded by elevated Al/Ca ratios from 1900 to 1950. The coral record indicates that high levels of Zn, Pb and Al occur coincidentally with local wars, and may have contributed to partial colony mortality. Pb/Ca does not correlate well with hemispheric proxy records after 1950, indicating that coastal corals may be recording local rather than hemispheric contamination. Pb/Ca levels in Hong Kong, Guangdong and Hainan corals imply a continuous supply of Pb-based contamination to southern China not reflected in hemispheric signals.

Occurrence and Toxicity of Three Classes of Insecticides in Water and Sediment in Two Southern California Coastal Watersheds.

Delgado-Moreno, L., K. Lin, R. Veiga-Nascimento, and J. Gan. 2011. *Journal of Agricultural and Food Chemistry*. 59(17):9448-9456.

Abstract

The occurrence of chlorpyrifos, diazinon, pyrethroids, and fipronil was investigated in two watersheds along the southern California coast. Paired surface water and sediment samples were collected under dry and wet (after significant rain events) weather conditions. Insecticide concentrations in water and sediment were higher following rain events than during the dry season. Chlorpyrifos was the most frequently detected compound (>88%). Pyrethroids were detected in 74 and 100% of the water and sediment samples, respectively, with bifenthrin detected most frequently. Trans-permethrin was detected at the highest concentration followed by bifenthrin. Bifenthrin and trans-permethrin water

concentrations were significantly correlated ($P < 0.01$) with the suspended solid level, suggesting transport facilitated by suspended particles. In 80% of the wet season samples with 100% of *Ceriodaphnia dubia* mortality, chlorpyrifos concentrations were $>100 \text{ ng L}^{-1}$. Sediment pyrethroid levels ($0.5\text{-}1100 \text{ ng g}^{-1}$) were frequently higher than the respective *Hyalella azteca* LC(50) values, with bifenthrin as the primary contributor of *H. azteca* toxicity.

Coastal Pollution Limits Pelagic Larval Dispersal.

Puritz, J. B. and R. J. Toonen. 2011. *Nature Communications*. 2,226.

Abstract

The ecological impact of large coastal human populations on marine ecosystems remains relatively unknown. Here, we examine the population structure of *Patiria miniata*, the bat star, and correlate genetic distances with a model based on flow rates and proximity to *P. miniata* populations for the four major stormwater runoff and wastewater effluent sources of the Southern California Bight. We show that overall genetic connectivity is high (F_{ST} similar to 0.005); however, multivariate analyses show that genetic structure is highly correlated with anthropogenic inputs. The best models included both stormwater and wastewater variables and explained between 26.55 and 93.69% of the observed structure. Additionally, regressions between allelic richness and distance to sources show that populations near anthropogenic pollution have reduced genetic diversity. Our results indicate that anthropogenic runoff and effluent are acting as barriers to larval dispersal, effectively isolating a high gene flow species that is virtually free of direct human impact.

Impact of Urbanization and Agriculture on the Occurrence of Bacterial Pathogens and Stx Genes in Coastal Waterbodies of Central California.

Walters, S. P., A. L. Thebo, and A. B. Boehm. 2011. *Water Research*. 45(4):1752-1762.

Abstract

Fecal pollution enters coastal waters through multiple routes, many of which originate from land-based activities: Runoff from pervious and impervious land surfaces transports pollutants from land to sea and can cause impairment of coastal ocean waters. To understand how land use practices and water characteristics influence concentrations of fecal indicator bacteria (FIB) and pathogens in natural waters, fourteen coastal streams, rivers, and tidal lagoons, surrounded by variable land use and animal densities, were sampled every six weeks over two years (2008 & 2009). Fecal indicator bacteria (FIB; *Escherichia coli* and *Enterococci*) and *Salmonella* concentrations, the occurrence of *Bacteroidales* human, ruminant, and pig-specific fecal markers, *E. coli* O157:H7, and Shiga toxin (stx) genes present

in *E. coli*, were measured. In addition, environmental and climatic variables (e.g., temperature, salinity, rainfall), as well as human and livestock population densities and land cover were quantified. Concentrations of FIB and Salmonella were correlated with each other, but the occurrence of host-specific Bacteroidales markers did not correlate with FIB or pathogens. FIB and Salmonella concentrations, as well as the occurrence of *E. coli* harboring *stx* genes, were positively associated with the fraction of the surrounding sub-watershed that was urban, while the occurrence of *E. coli* O157:H7 was positively associated with the agricultural fraction. FIB and Salmonella concentrations were negatively correlated to salinity and temperature, and positively correlated to rainfall. Areal loading rates of FIB, Salmonella and *E. coli* O157:H7 to the coastal ocean were calculated for stream and river sites and varied with land cover, salinity, temperature, and rainfall. Results suggest that FIB and pathogen concentrations are influenced, in part, by their flux from the land, which is exacerbated during rainfall; once waterborne, bacterial persistence is affected by water temperature and salinity.

Terrestrial Sources Homogenize Bacterial Water Quality During Rainfall in Two Urbanized Watersheds in Santa Barbara, CA. Sercu, B., L. C. Van De Werfhorst, J. L. S. Murray, and P. A. Holden. 2011. *Microbial Ecology*. 62(3):574-583.

Abstract

Microbiological contamination from runoff is a human health concern in urbanized coastal environments, but the contamination sources are often unknown. This study quantified fecal indicator bacteria and compared the distributions of human-specific genetic markers and bacterial community composition during dry and wet weather in urban creeks draining two neighboring watersheds in Santa Barbara, CA. In a prior study conducted during exclusively dry weather, the creeks were contaminated with human waste as indicated by elevated numbers of the human-specific Bacteroidales marker HF183 (Sercu et al. in *Environ Sci Technol* 43:293-298, 2009). During the storm, fecal indicator bacterial numbers and loads increased orders of magnitude above dry weather conditions. Moreover, bacterial community composition drastically changed during rainfall and differed from dry weather flow by (1) increased bacterial diversity, (2) reduced spatial heterogeneity within and between watersheds, and (3) clone library sequences more related to terrestrial than freshwater taxa. Finally, the spatial patterns of human-associated genetic markers (HF183 and *Methanobrevibacter smithii* nifH gene) changed during wet weather, and the contribution of surface soils to *M. smithii* nifH gene detection was suspected. The increased fecal indicator bacteria numbers during wet weather were likely associated with terrestrial sources, instead of human waste sources that dominated during dry weather flow.

Elevated Ammonium Concentrations from Wastewater Discharge Depress Primary Productivity in the Sacramento River and the Northern San Francisco Estuary. Parker, Alexander E., R. C. Dugdale, and F. P. Wilkerson. 2012. *Marine Pollution Bulletin*. 64(3):574-586.

Abstract

Primary production in the Northern San Francisco Estuary (SFE) has been declining despite heavy loading of anthropogenic nutrients. The inorganic nitrogen (N) loading comes primarily from municipal wastewater treatment plant (WTP) discharge as ammonium (NH₄). This study investigated the consequences for river and estuarine phytoplankton of the daily discharge of 15 metric tons NH₄-N into the Sacramento River that feeds the SFE. Consistent patterns of nutrients and phytoplankton responses were observed during two 150-km transects made in spring 2009. Phytoplankton N productivity shifted from NO₃ use upstream of the WTP to productivity based entirely upon NH₄ downstream. Phytoplankton NH₄ uptake declined downstream of the WTP as NH₄ concentrations increased, suggesting NH₄ inhibition. The reduced total N uptake downstream of the WTP was accompanied by a 60% decline in primary production. These findings indicate that increased anthropogenic NH₄ may decrease estuarine primary production and increase export of NH₄ to the coastal ocean.

Linking Chemical Contamination to Biological Effects in Coastal Pollution Monitoring. Beiras, Ricardo, I. Durán, S. Parra, M. B. Urrutia, V. Besada, J. Bellas, L. Viñas, P. Sánchez-Marín, A. González-Quijano, and M. A. Franco, et al. 2012. *Ecotoxicology*. 21(1):9-17.

Abstract

To establish the connection between pollutant levels and their harmful effects on living resources, coastal monitoring programmes have incorporated biological tools, such as the scope for growth (SFG) in marine mussels and benthic macrofauna community indices. Although the relation between oxygen-depleting anthropogenic inputs and the alteration of benthic communities is well described, the effects of chemical pollutants are unknown because they are not expected to favour any particular taxa. In this study, the combined efforts of five research teams involved in the investigative monitoring of marine pollution allowed the generation of a multiyear data set for Ría de Vigo (NW Iberian Peninsula). Multivariate analysis of these data allowed the identification of the chemical-matrix combinations responsible for most of the variability among sites and the construction of a chemical pollution index (CPI) that significantly ($P < 0.01$) correlated with biological effects at both the individual and the community levels. We report a consistent reduction in the physiological fitness of local populations of mussels as chemical pollution increases. The energy balance was more sensitive to pollution than individual physiological rates, but

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the reduction in the SFG was primarily due to significantly decreased clearance rates. We also found a decrease in benthic macrofauna diversity as chemical pollution increases. This diversity reduction resulted not from altered evenness, as the classic paradigm might suggest, but from a loss of species richness.

Microbial Water Quality Before and After the Repair of a Failing Onsite Wastewater Treatment System adjacent to Coastal Waters. Conn, K. E., M. Y. Habteselassie, A. D. Blackwood, and R. T. Noble. 2012. *Journal of Applied Microbiology*. 112(1):214-224.

Abstract

Aims: The objective was to assess the impacts of repairing a failing onsite wastewater treatment system (OWTS, i.e., septic system) as related to coastal microbial water quality.

Methods and Results: Wastewater, groundwater and surface water were monitored for environmental parameters, faecal indicator bacteria (total coliforms, *Escherichia coli*, enterococci) and the viral tracer MS2 before and after repairing a failing OWTS. MS2 results using plaque enumeration and quantitative reverse transcriptase polymerase chain reaction (qRT-PCR) often agreed, but inhibition limited the qRT-PCR assay sensitivity. Prerepair, MS2 persisted in groundwater and was detected in the nearby creek; postrepair, it was not detected. In groundwater, total coliform concentrations were lower and *E. coli* was not detected, while enterococci concentrations were similar to prerepair levels. *E. coli* and enterococci surface water concentrations were elevated both before and after the repair.

Conclusions: Repairing the failing OWTS improved groundwater microbial water quality, although persistence of bacteria in surface water suggests that the OWTS was not the singular faecal contributor to adjacent coastal waters. A suite of tracers is needed to fully assess OWTS performance in treating microbial contaminants and related impacts on receiving waters. Molecular methods like qRT-PCR have potential but require optimization.

Significance and Impact of Study: This is the first before and after study of a failing OWTS and provides guidance on selection of microbial tracers and methods.

Diurnal Variation in Enterococcus Species Composition in Polluted Ocean Water and a Potential Role for the Enterococcal Carotenoid in Protection against Photoinactivation. Maraccini, Peter A., D. M. Ferguson, and A. B. Boehm. 2012. *Applied and Environmental Microbiology*. 78(2):305-310.

Abstract

Enterococcus species composition was determined each hour for 72 h at a polluted marine beach in Avalon, Santa

Catalina Island, CA. Species composition during the day was significantly different from that at night, based on an analysis of similarity. Enterococcus faecium and E. faecalis were more prevalent at night than during the day, while E. hirae and other Enterococcus species were more prevalent during the day than the night. Enterococcus spp. containing a yellow pigment were more common during the day than the night, suggesting that the pigmented phenotype may offer a competitive advantage under sunlit conditions. A laboratory microcosm experiment established that the pigmented E. casseliflavus isolate and a pigmented E. faecalis isolate recovered from the field site decay slower than a nonpigmented E. faecalis isolate in a solar simulator in simulated, clear seawater. This further supports the idea that the yellow carotenoid pigment in Enterococcus provides protection under sunlit conditions. The findings are in accordance with previous work with other carotenoid-containing nonphotosynthetic and photosynthetic bacteria that suggests that the carotenoid is able to quench reactive oxygen species capable of causing photoinactivation and photostress. The results suggest that using enterococcal species composition as a microbial source tracking tool may be hindered by the differential environmental persistence of pigmented and nonpigmented enterococci.

Monitoring

An Innovative Statistical Approach for Analysing Non-continuous Variables in Environmental Monitoring: Assessing Temporal Trends of TBT Pollution. Santos, J. A., S. Galante-Oliveira, and C. Barroso. 2011. *Journal of Environmental Monitoring*. 13(3):673-680.

Abstract

The current work presents an innovative statistical approach to model ordinal variables in environmental monitoring studies. An ordinal variable has values that can only be compared as “less”, “equal” or “greater” and it is not possible to have information about the size of the difference between two particular values. The example of ordinal variable under this study is the vas deferens sequence (VDS) used in imposex (superimposition of male sexual characters onto prosobranch females) field assessment programmes for monitoring tributyltin (TBT) pollution. The statistical methodology presented here is the ordered logit regression model. It assumes that the VDS is an ordinal variable whose values match up a process of imposex development that can be considered continuous in both biological and statistical senses and can be described by a latent non-observable continuous variable. This model was applied to the case study of *Nucella lapillus* imposex monitoring surveys conducted in the Portuguese coast between 2003 and 2008 to evaluate the temporal evolution of TBT pollution in this country. In order to produce more reliable conclusions, the proposed model includes covariates that may influence the

imposex response besides TBT (e.g. the shell size). The model also provides an analysis of the environmental risk associated to TBT pollution by estimating the probability of the occurrence of females with VDS ≥ 2 in each year, according to OSPAR criteria. We consider that the proposed application of this statistical methodology has a great potential in environmental monitoring whenever there is the need to model variables that can only be assessed through an ordinal scale of values.

Assessment of Heavy Metal Pollution From a Fe-smelting Plant in Urban River Sediments Using Environmental Magnetic and Geochemical Methods. Zhang, C., Q. Qiao, J. D. A. Piper, and B. Huang. 2011. *Environmental Pollution*. 159(10):3057-3070.

Abstract

Environmental magnetic proxies provide a rapid means of assessing the degree of industrial heavy metal pollution in soils and sediments. To test the efficiency of magnetic methods for detecting contaminants from a Fe-smelting plant in Loudi City, Hunan Province (China) we investigated river sediments from Lianshui River. Both magnetic and non-magnetic (microscopic, chemical and statistical) methods were used to characterize these sediments. Anthropogenic heavy metals coexist with coarse-grained magnetic spherules. It can be demonstrated that the Pollution Load Index of industrial heavy metals (Fe, V, Cr, Mo, Zn, Pb, Cd, Cu) and the logarithm of saturation isothermal remanent magnetization, a proxy for magnetic concentration, are significantly correlated. The distribution heavy metal pollution in the Lianshui River is controlled by surface water transport and deposition. Our findings demonstrate that magnetic methods have a useful and practical application for detecting and mapping pollution in and around modern industrial cities.

Applying a Regional Coastal Wetland Monitoring Framework to Refine and Report on Wildlife and Habitat Delisting Criteria in the Bay of Quinte Area of Concern. Macecek, D., and G. P. Grabas. 2011. *Aquatic Ecosystem Health & Management*. 14(1):94-103.

Abstract

In most Canadian Areas of Concern, fish and wildlife populations and their habitats (i.e. Beneficial Use Impairments 3 and 14) have been listed as impaired. While much work has addressed other Beneficial Use Impairments, there has often been a lack of specific

data and methodologies for evaluating fish and wildlife populations and their habitats. This article presents a methodology for refining delisting criteria for wildlife and habitat Beneficial Use Impairments in the Bay of Quinte Area of Concern using indices of condition in a coastal wetland monitoring framework. Data have been collected to provide information on loss of fish and wildlife habitat (water quality and submerged aquatic vegetation and aquatic macroinvertebrate communities) and degradation of fish and wildlife populations (fish, amphibian and breeding bird communities). Three potential models for delisting are presented using the submerged aquatic vegetation community data as an example. For all coastal wetland attributes considered through the framework, Bay of Quinte coastal wetlands were generally in better condition than other Canadian sites along the Lake Ontario shoreline.

Characterizing the Effects of Two Storms on the Coastal Waters of O'ahu, Hawai'i, Using Data from the Pacific Islands Ocean Observing System. Tomlinson, M. S., E. H. De Carlo, M. A. McManus, G. Pawlak, G. F. Steward, F. J. Sansone, O. D. Nigro, R. E. Timmerman, J. Patterson, S. Jaramillo, and C. E. Ostrander. 2011. *Oceanography*. 24(2):182-199.

Abstract

Pathogens (and other contaminants) associated with urban storm water runoff plumes have long been recognized as adversely affecting the water quality of the coastal ocean. An understanding of the temporal and spatial characteristics of stormwater plumes is a critical first step in protecting the health of people who recreate in coastal waters. Until recently, characterization of stormwater plumes was limited to expensive vessel-based sampling and satellites, which cannot always provide imagery of the nearshore areas, particularly during storms. With the advent of coastal ocean observing systems with their fixed sensor platforms and autonomous underwater vehicles, we have begun to better understand the temporal and spatial characteristics of stormwater plumes in the coastal ocean. The Pacific Islands Ocean Observing System (PacIOOS) provides continuous environmental monitoring of island coastal waters throughout the Pacific Ocean. This network of new ocean-based monitoring stations enabled the authors to study the effects of two storms on coastal water quality. We find that storm runoff from even a relatively small, partially urbanized watershed can profoundly affect the surface waters of the coastal ocean for days to weeks, both inshore and up to hundreds of meters offshore. Even in these coastal waters exposed to the open ocean, the lower salinities and higher turbidity values indicative

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of stormwater plumes lingered for nearly two days along the southern coast of O'ahu, Hawai'i.

Chemical Contamination Baseline in the Western Basin of the Mediterranean Sea Based on Transplanted Mussels.

Andral, B., F. Galgani, C. Tomasino, M. Bouchoucha, C. Blottiere, A. Scarpato, J. Benedicto, S. Deudero, M. Calvo, A. Cento, S. Benbrahim, M. Boulahdid, C. Sammari. 2011. *Archives of Environmental Contamination and Toxicology*. 61(2):261-271.

Abstract

The MYTILOS project aimed at drawing up a preliminary report on coastal chemical contamination at the scale of the Western Mediterranean (continental coasts of the Balearic Islands, Sicily, Sardinia, Corsica and Maghreb) based on a transplanted mussels methodology validated along the French coasts since 1996 by Ifremer and the Rhne M, diterran, e & Corsica water board. MYTILOS is backed up by the INTERREG III B/MEDOC programme, the PNUE/PAM-MEDPOL and Rhne M, diterran, e & Corsica water board. Three cruises (2004, 2005, 2006) have taken place to assess the first state of chemical contamination along the Western Mediterranean shores with the same methodology. Approximately 120 days were spent at sea deploying and retrieving 123 mussel bags. The results obtained for all studied contaminants were equivalent to those obtained along the French coast according the RINBIO network. These similarities relate to both the highest measured levels and background levels throughout the 123 stations. The areas of greatest impact were mainly urban and industrial centers and the outlets of major rivers, with a far higher midsea impact on the dilution of organic compounds than on metals. Metal levels measured in midsea zones were found to be similar to those in natural shellfish populations living along the coast. On a global scale we can observe that the contaminants levels in the Mediterranean Sea are in the same range as in other areas worldwide. Overall, the research demonstrates the reliability of this methodology for marine pollution monitoring, especially in the Mediterranean Sea.

Restoration

Differences in Relative Predation Vulnerability Between Native and Non-native Oyster Larvae and the Influence on Restoration Planning in an Estuarine Ecosystem. Fulford, R. S., D. L. Breitburg, and M. Luckenbach. 2011. *Estuaries and Coasts*. 34(3):618-629.

Abstract

The costs and benefits of non-native introductions as a restoration tool should be estimated prior to any action

to prevent both undesirable consequences and waste of restoration resources. The suggested introduction of non-native oyster species, *Crassostrea ariakensis*, into Chesapeake Bay, USA, provides a good example in which the survival of non-native oysters may differ from that of native oysters, *Crassostrea virginica*, during the larval stage. Experiments were conducted to compare the predation vulnerability of native and non-native oyster larvae to different predator types (visual vs. non-visual, benthic vs. pelagic). The results suggest that the non-native larvae are more vulnerable to visual and non-visual pelagic predators. Although vulnerability was similar for larvae exposed to benthic non-visual predators, the consumption of one non-native strain was higher than the consumption of native *C. virginica* larvae. When vulnerability data are combined with predator feeding rates, the predation mortality for non-native larvae in the wild can be much higher than for native larvae. Small changes in larval mortality rates can yield large changes in total larval delivery to the reef for settlement, so these differences among species may contribute to differences in settlement success. These results provide an example of how a comprehensive examination of the perceived benefits of non-native introductions into complex ecosystems can provide important information to inform management decisions.

Restoration of Isolated and Small Coastal Sand Dunes on the Rocky Coast of Northern Spain. Gallego-Fernandez, J. B., I. A. Sanchez, and C. Ley. 2011. *Ecological Engineering*. 37(11):1822-1832.

Abstract

The coastal dunes of the Basque Country have suffered a significant anthropic process of regional-scale destruction and fragmentation. This has led to the loss of seven, and endangerment of 14, of the 37 species of plants recognized as exclusive to these dunes. In response to this situation, the restoration of one of the lost dune systems, the Laida Dune, began in 2002 with the installation of sand trapping devices and the plantation of two dune-building species of plants. This study shows the results of a program that monitored the process of natural colonization of plant species in the restored dune over a period of seven years, until the loss of the dune by the action of storms in 2008. The results show that the vegetation dynamics in the restored dune followed a process of primary succession, with a progressive increase in species number, coverage and heterogeneity. The establishment of species was driven by the strong environmental gradient present perpendicular to the coastline. The results indicate that natural colonization in this coastal sector is now possible due to the large number of dune species present, and in spite of the isolation of the restored dune system and the loss and fragmentation of the dune habitats in the region. Over the seven years, 42 plant species became established on the dune, of which 18 were dune-exclusive species, representing

62.1% of the total number of species of the same type in the region. Five of these species are considered to be rare or threatened. Comparison with reference data allowed the evaluation of the trajectory of the plant community assembly. The results indicate that the highest similarity to a reference dune system was to the one located closest to the restored dune.

Artificial Modifications of the Coast in Response to the Deepwater Horizon Oil Spill: Quick Solutions or Long-term Liabilities? Martinez, M. L., R. A. Feagin, K. M. Yeager, J. Day, R. Costanza, J. A. Harris, R. J. Hobbs, J. López-Portillo, I. J. Walker, E. Higgs, P. Moreno-Casasola, J. Sheinbaum, and A. Yáñez-Arancibia. 2011. *Frontiers in Ecology and the Environment*. E-view.

Abstract

The Deepwater Horizon oil spill threatened many coastal ecosystems in the Gulf of Mexico during the spring and summer of 2010. Mitigation strategies included the construction of barrier sand berms, the restriction or blocking of inlets, and the diversion of freshwater from the riverbeds to the coastal marshes and into the ocean, in order to flush away the oil, on the premise that these measures could reduce the quantity of oil reaching sensitive coastal environments, such as wetlands or estuaries. These projects result in changes to the ecosystems that they were intended to protect. Long-term impacts include alterations of the hydrological and ecological characteristics of estuaries, changes in sediment transport along the coastal barrier islands, the loss of sand resources, and adverse impacts to benthic and pelagic organisms. Although there are no easy solutions for minimizing the impacts of the Deepwater Horizon disaster on coastal ecosystems, we recommend that federal, state, and local agencies return to the strategic use of long-term restoration plans for this region.

The Willapa Bay Oyster Reserves in Washington State: Fishery Collapse, Creating a Sustainable Replacement, and the Potential for Habitat Conservation and Restoration. Dumbauld, B. R., B. E. Kauffman, A. C. Trimble, and J. L. Ruesink. 2011. *Journal of Shellfish Research*. 30(1):71-83.

Abstract

Oysters have been an important resource in Washington state since the mid 1800s and are intimately associated with recent history of the Willapa Bay estuary, just as they have defined social culture around much larger U.S. east coast systems. The Willapa Bay oyster reserves were set aside in 1890 to preserve stocks of the native oyster *Ostrea lurida* in this estuary, but these stocks were overfished and replaced with the introduced Pacific oyster *Crassostrea gigas* during the late 1920s. Pacific oysters have spawned

and set naturally in this estuary on a fairly regular basis since that time, and have formed the basis of a sustainable fishery established on state oyster reserves. The fishery is managed as an annual sale of oysters to private aquaculture interests. Oysters are harvested mostly by hand from intertidal tracts, usually moved to better growing areas closer to the estuary mouth, and shell is required to be returned to the reserves to perpetuate the fishery. Although oyster harvest for human consumption will remain an important social management goal, these bivalves have been shown to provide a suite of other ecosystem functions and services. A survey of the reserves suggests that they represent 11.2% of the intertidal habitat in Willapa Bay and cover substantial subtidal areas as well. A comparison with historical maps suggests that most of the low intertidal area in the reserves formerly populated by native oysters is now covered primarily with eelgrass (*Zostera marina*), which potentially serves as important habitat for numerous other organisms, including juvenile salmon, Dungeness crab, and migratory waterfowl like black Brant. Native oysters can still potentially be restored to some of these areas, but the value of both introduced oysters and eelgrass as habitat and ecosystem engineers also deserves attention, and the reserves provide an excellent place to elucidate the role of these additional conservation targets at the landscape scale.

Characteristics, Restoration, and Enhancement of Southern California Lagoons. Elwany, M. H. S. 2011. *Journal of Coastal Research*. 59:246-255.

Abstract

The successful enhancement and restoration of coastal lagoons requires a comprehensive understanding of the physical and biological conditions in each lagoon and the processes that influence the lagoon's performance. Since lagoons differ substantially from one location to another, the problems that affect lagoon performance differ as well. Coastal lagoons in Southern California tend to be small with surface areas of a few hundred hectares or less and mean water depths of less than 2m. Careful monitoring studies of lagoons, together with historical reviews and data from previous studies, enable wetland scientists to recommend successful, cost-effective, environmentally sound plans for enhancement and restoration of Southern California lagoons.

Recent understanding of the settings and physical processes controlling lagoon performance will enable us to produce improved schemes to enhance these systems. Usually the biological performance of a wetland depends on improvement of the physical parameters, such as tidal flushing, water quality, freshwater flow reduction, and channel and basin sedimentation. Other factors that should be taken into consideration are the impacts of the wetland on adjacent beaches, the response of the wetland to dry and wet periods, any possible or expected future climate changes, and biodiversity management. This paper discusses cases of environmental impacts on selected Southern California lagoons, together with proposed or existing projects to reduce or mitigate these impacts.

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Optimal Restoration: Accounting for Space, Time and Uncertainty. Wilson, K. A., M. Lulow, J. Burger, Y. C. Fang, C. Anderson, D. Olson, M. O'Connell, and M. F. McBride. 2011. *Journal of Applied Ecology*. 48(3):715-725.

Abstract

1. In general, conservation seeks to prevent further habitat loss but in many cases there is a need to reverse habitat degradation. Restoration of habitat is necessary to achieve biodiversity conservation goals but often it is a costly and time-intensive process. Prioritization of where and when habitat is restored can help to ensure the cost-effective delivery of desired outcomes.

2. We develop a restoration prioritization decision support tool to identify the combination of restoration sites and the schedule for their implementation most likely to deliver the greatest utility for a fixed budget and operational constraints. We use a case study to apply our prioritization approach in order to illustrate the data that can be employed to parameterise the analysis and the outputs that are able to inform restoration planning. We compare restoration schedules under alternative utility functions to demonstrate trade-offs associated with different objectives, assumptions and preferences for particular outcomes.

3. Our prioritization approach is spatially and temporally explicit and accounts for the costs and benefits of restoration, the likelihood of restoration success, the probability of stochastic events, feedbacks, time lags and spatial connectivity.

4. Through collaboration with restoration practitioners we derive quantitative and spatially explicit data on each site requiring restoration. We determine the relative priority for restoring each site and develop a restoration schedule over 20 years.

5. Our results showed that after 20 years a little over a half of the sites requiring restoration are likely to be successfully restored, while the total expenditure at our site will be c. US\$13 center dot 7 million - almost the entire budget of \$14 million.

6. Synthesis and applications. Our restoration prioritization approach provides a schedule for where and when restoration should occur, and also provides operational guidance and support for cost-effective restoration planning such as informing the likely total cost of restoration.

Uprooting and Burial of Invasive Alien Plants: A New Tool in Coastal Restoration? Kollman, J., K. Brink-Jensen, S. I. Frandsen, and M. K. Hansen. 2011. *Restoration Ecology*. 19(3):371-378.

Abstract

Invasive alien plants are a problem for conservation management, and control of these species can be combined with habitat restoration. Subsoil burial of uprooted plants is a new method of mechanical control, which might be suitable in disturbed habitats. The method

was tested in *Rosa rugosa* (Japanese Rose), an invasive shrub in north-western Europe with negative effects on coastal biodiversity. Two months after uprooting and burial in dunes of north-eastern Denmark, 89% of the 58 shrubs resprouted from roots and rhizomes; on average 41 resprouts per shrub. Resprout density was twice as high at former shrub margins compared with the center; resprouts were taller and originated from more superficial soil layers at the margin than in the center. Resprouting was negatively correlated with fragment depth, and no resprouts were observed from greater than 15 cm depth. The number of resprouts increased with fragment dry mass (0.5-168.5 g). After 18 months with harrowing the species was still resprouting, flowering, and fruiting, albeit with no difference between shrub margin and center. Resprouts were taller (26 cm) and coverage was higher (0-4%) after two compared with three times harrowing, whereas no difference was found in cover of native dune species (1-5%). The results show that even small fragments of *R. rugosa* resprout, and that resprouting persists despite repeated harrowing. Thus, careful subsoil burial of all fragments is necessary, special attention should be paid to the shrub margin, and follow-up treatments are needed. The effectiveness of the burial method is discussed for restoration of coastal dunes.

The Influence of Time on the Soil Seed Bank and Vegetation across a Landscape-Scale Wetland Restoration Project. Stroh, Peter A., F. M. R. Hughes, T. H. Sparks, and J. O. Mountford. 2012. *Restoration Ecology*. 20(1):103-112.

Abstract

Wicken Fen National Nature Reserve (NNR) in Cambridgeshire, U. K. is a wetland of international importance isolated in a landscape dominated by arable farming. The prospect of species extinctions within the NNR led to the creation of the Wicken Fen Vision, an ambitious project that will eventually expand the reserve boundary by the purchase and restoration of c. 50 km² of arable land. We sampled three fields from each of three distinct age-categories of restoration land (5, 15, and 60 years post-arable), and three fields within the adjacent, undrained NNR, to determine (1) differences in seed bank composition across age-categories, (2) relationships between restoration age, the seed bank and standing vegetation, and (3) changes in species traits across age-categories. Historic arable management contributed to an apparent "vertical mixing" effect in the seed bank of the youngest two age-categories, with associated and significant differences in species functional traits across the study area. Almost all plants associated with NNR vegetation were absent from restoration area seed banks and standing vegetation. Seed bank species common to all ages-categories exhibited a bias toward moderate to high Ellenberg F (moisture) values, persistent seed banks, and lateral vegetative spread. Relatively short (c. 6 years) periods of drainage and plowing impact heavily upon seed bank diversity and soils, resulting in a lack of pre-drainage vegetation, even after decades of subsequent restoration adjacent to intact, species-rich habitat. However, the seed banks of highly degraded fields can contribute toward the creation of novel wetland vegetation assemblages over time and under suitable environmental conditions.