October 2007

Marine Science Review – 234

Ecosystems, habitats and communities

SeaWeb
Leading Voices for a Healthy Ocean

In this review:

A. Recent articles – no abstract available

Duke, N.C., Meynecke, J.O., Dittmann, S., Ellison, A.M., Anger, K., Berger, U., Cannicci, S., Diele, K., Ewel, K.C., Field, C.D., Koedam, N., Lee, S.Y., Marchand, C., Nordhaus, I., and Dahdouh-Guebas, F. **A world without mangroves?** *Science* 317(5834): 41-42, 2007.
.

B. Recent articles with abstracts

Hillier, J.K. and Watts, A.B. **Global distribution of seamounts from ship-track bathymetry data.** *Geophysical Research Letters* 34(13): art. L13304, 2007.

Notes: The distribution of submarine volcanoes, or seamounts, reflects melting within the Earth and how the magma generated ascends through the overlying lithosphere. Globally (±60° latitude), we use bathymetry data acquired along 39.5 × 10^6 km of ship tracks to find 201,055 probable seamounts, an order of magnitude more than previous counts across a wider height-range ($0.1 < h < 6.7$ km). In the North Pacific, seamounts' spatial distribution substantially reflects ridge-crest conditions, variable on timescales of 10 s of Ma and along-ridge distances of ~1,000 km, rather than intra-plate hot-spot related volcanic activity. In the Atlantic, volcano numbers decrease, somewhat counter-intuitively, towards Iceland suggesting that abundant under-ridge melt may deter the formation of isolated volcanoes. Neither previously used empirical curve (exponential or power-law) describes the true size-frequency distribution of seamounts. Nevertheless, we predict 39 ± 1 × 10^3 large seamounts ($h > 1$ km), implying that ~24,000 (60%) remain to be discovered.

Smith, L.M., DiDonato, E.M., Harwell, L.C., Nestlerode, J.A., and Summers, J.K. **The ecological condition of Gulf of Mexico resources from Perdido Key to Port St. Joe, Florida, USA: Part I. Coastal beach resources.** *Environmental Monitoring and Assessment* 128(1-3): 511-524, 2007.

Notes: Using the approach established by EPA's Environmental Monitoring and Assessment Program (EMAP), a shoreline monitoring survey was conducted in August and September 1999, encompassing the Florida Panhandle from Perdido Key, Florida to Port St. Joe, Florida. The objective of this survey was to demonstrate the use of a probabilistic survey for monitoring and estimating the condition of swimmable beach areas. Thirty stations were sampled using a probabilistic sampling design. Hydrographic data were collected in addition to samples for water chemistry. Bacterial indicators, enterococci and fecal coliforms, were enumerated from the water according to the EPA Beaches Environmental Assessment Closure and Health (BEACH) Program and Florida state guidelines. Additional criteria for site condition included the presence or absence of primary and secondary dunes, anthropogenic debris and vegetation. Based on EMAP evaluation guidelines and Florida state criteria, a baseline assessment of the condition of the Gulf of Mexico beach resources surveyed is presented.

Kuiper-Linley, M., Johnson, C.R., and Lanyon, J.M. **Effects of simulated green turtle regrazing on seagrass abundance, growth and nutritional status in Moreton Bay, south-east Queensland, Australia.** *Marine and Freshwater Research* 58(5): 492-503, 2007.

Notes: In some parts of their range, green turtles maintain grazing plots in seagrass beds by regular regrazing. The effects of simulated repeated grazing on subtropical seagrasses in Moreton Bay, Australia were investigated in a manipulative experiment over summer. Three seagrass species were subjected to two different clipping frequencies (simulating turtle cropping) and compared with unclipped controls over a 3.5-month summer period for the effects on seagrass biomass, leaf size and regrowth rates and water-soluble carbohydrate (WSC) and starch content. The order of the seagrass species' relative tolerance to simulated grazing was *Halophila ovalis* > *Zostera capricorni* > *Cymodocea serrulata*. Frequent regrazing of the green turtle's preferred seagrass, *H. ovalis*, resulted in an increase in leaf regrowth rate so that standing biomass of leaves and total plant material was maintained, suggesting an increase in productivity. Furthermore, whole-plant concentrations of WSC increased significantly in clipped *H. ovalis* plants relative to unclipped controls. In contrast, leaf biomass of the seagrass species less preferred by turtles, *Z. capricorni* and *C. serrulata*, decreased in response to repeated leaf removal relative to controls, despite maintenance of leaf regrowth rates. *C. serrulata* responded to repeated clipping with a reduction in leaf size and a decrease in rhizome WSC concentration. *Z. capricorni* also produced fewer and smaller new leaves. The ability of the preferred species, *H. ovalis*, to increase production of nutrient-rich standing crop in response to regrazing has major implications for green turtles and other seagrass grazers.

Cooper, K., Boyd, S., Aldridge, J., and Rees, H. **Cumulative impacts of aggregate extraction on seabed macro-invertebrate communities in an area off the east coast of the United Kingdom.** *Journal of Sea Research* 57(4): 288-302, 2007.

Notes: This study investigates whether there is any evidence of a large-scale cumulative impact on benthic macro-invertebrate communities as a result of the multiple sites of aggregate extraction located off Great Yarmouth in the southern North Sea. Forty 0.1 m^2 Hamon grab samples were collected from across the region, both within and beyond the extraction area, and analysed for macrofauna and sediment particle size distribution in order to produce a regional description of the status of the seabed environment. In addition, the data were analysed in relation to the area of seabed impacted by dredging over the period 1993-1998. Areas subject to 'direct' impacts were determined through reference to annual electronic records of dredging activity and this information was then used to model the likely extent of areas potentially subject to 'indirect' ecological and geophysical impact. Results showed the study area to be characterised by sands in the northern half of the survey area, and sandy gravels in the south. The low diversity communities found across much of the survey area were typical of mobile sandy sediments. However, stations located in the southern half and northern extreme of the survey area tended to support higher numbers of species and individuals. This may be due to marginally enhanced stability arising from the higher proportion of gravel found in samples to the south of the extraction licenses and to the presence of *Sabellaria spinulosa* reef in the north. Analysis of data in relation to areas of predicted dredging impact revealed proportionally less gravel and more sand within the 'direct' impact zone, compared to the 'indirect' impact zone. Whilst multivariate analyses of macrofaunal data did not clearly discriminate between dredging impact zones, a comparison of univariate measures revealed significantly lower numbers of species and individuals in areas which have been subject to 'direct' dredging impacts in comparison with 'reference' areas. This provides good evidence of the near-field consequences of dredging. Values of these measures in the 'indirect' zone were intermediate, although not significantly different from the 'reference' zone. We conclude that, although the dominant influence on assemblages in the region is that of sediment instability induced by tidal currents, we cannot dismiss the possibility of a subsidiary influence of dredging activity in the near vicinity of the licensed block and further investigation is warranted.

Cada, G., Ahlgrimm, J., Bahleda, M., Bigford, T., Stavrakas, S.D., Hall, D., Moursund, R., and Sale, M. **Potential impacts of hydrokinetic and wave energy conversion technologies on aquatic environments.** *Fisheries* 32(4): 174-181, 2007.

Notes: A new generation of hydropower technologies, the kinetic hydro and wave energy conversion devices, offers the possibility of generating electricity from the movements of water, without the need for dams and diversions. The Energy Policy Act of 2005 encouraged the development of these sources of renewable energy in the United States, and there is growing interest in deploying them globally. The technologies that would extract electricity from free-flowing streams, estuaries, and oceans have not been widely tested. Consequently, the U.S. Department of Energy convened a workshop to (1) identify the varieties of hydrokinetic energy and wave energy conversion devices and their stages of development, (2) identify

where these technologies can best operate, (3) identify the potential environmental issues associated with these technologies and possible mitigation measures, and (4) develop a list of research needs and/or practical solutions to address unresolved environmental issues. We review the results of that workshop, focusing on potential effects on freshwater, estuarine, and marine ecosystems, and we describe recent national and international developments.

Wulff, F., Savchuk, O.P., Sokolov, A., Humborg, C., and Morth, C.M. **Management options and effects on a marine ecosystem: Assessing the future of the Baltic.** *Ambio* 36(2-3): 243-249, 2007.

Notes: We are using the coupled models in a decision support system, Nest, to evaluate the response of the marine ecosystem to changes in external loads through various management options. The models address all the seven major marine basins and the entire drainage basin of the Baltic Sea. A series of future scenarios have been developed, in close collaboration with the Helsinki Commission, to see the possible effects of improved wastewater treatment and manure handling, phosphorus-free detergents, and less intensive land use and livestocks. Improved wastewater treatment and the use of phosphorus-free detergents in the entire region would drastically decrease phosphorus loads and improve the marine environment, particularly the occurrence of cyanobacterial blooms. However, the Baltic Sea will remain eutrophic, and to reduce other effects, a substantial reduction of nitrogen emissions must be implemented. This can only be obtained in these scenarios by drastically changing land use. In a final scenario, we have turned 50% of all agricultural lands into grasslands, together with efficient wastewater treatments and a ban of phosphorus in detergents. This scenario will substantially reduce primary production and the extension of hypoxic bottoms, increase water transparency in the most eutrophied basins, and virtually eliminate extensive cyanobacterial blooms.

Borthagaray, A. I. and Carranza, A. **Mussels as ecosystem engineers: Their contribution to species richness in a rocky littoral community.** *Acta Oecologica* 31(3): 243-250, 2007.

Notes: Mussels are important ecosystem engineers in marine benthic systems because they aggregate into beds, thus modifying the nature and complexity of the substrate. In this study, we evaluated the contribution of mussels (*Brachidontes rodriguezii*, *Mytilus edulis platensis*, and *Perna perna*) to the benthic species richness of intertidal and shallow subtidal communities at Cerro Verde (Uruguay). We compared the richness of macro-benthic species between mussel-engineered patches and patches without mussels but dominated by algae or barnacles at a landscape scale (all samples), between tidal levels, and between sites distributed along a wave exposition gradient. Overall, we found a net increase in species richness in samples with mussels (35 species), in contrast to samples where mussels were naturally absent or scarce (27 species). The positive trend of the effect did not depend upon tidal level or wave exposition, but its magnitude varied between sites. Within sites, a significant positive effect was detected only at the protected site. Within the mussel-engineered patches, the richness of all macro-faunal groups (total, sessile and mobile) was positively correlated with mussel abundance. This evidence indicates that the mussel beds studied here were important in maintaining species richness at the landscape-level, and highlights that beds of shelled bivalves should not be neglected as conservation targets in marine benthic environments.

Smith, K.L., Robison, B.H., Helly, J.J., Kaufmann, R.S., Ruhl, H.A., Shaw, T.J., Twining, B.S., and Vernet, M. **Free-drifting icebergs: Hot spots of chemical and biological enrichment in the Weddell Sea.** *Science* 317(5837): 478-482, 2007.

Notes: The proliferation of icebergs from Antarctica over the past decade has raised questions about their potential impact on the surrounding pelagic ecosystem. Two free-drifting icebergs, 0.1 and 30.8 square kilometers in aerial surface area, and the surrounding waters were sampled in the northwest Weddell Sea during austral spring 2005. There was substantial enrichment of terrigenous material, and there were high concentrations of chlorophyll, krill, and seabirds surrounding each iceberg, extending out to a radial distance of ~ 3.7 kilometers. Extrapolating these results to all icebergs in the same size range, with the use of iceberg population estimates from satellite surveys, indicates that they similarly affect 39% of the surface ocean in this region. These results suggest that free-drifting icebergs can substantially affect the pelagic ecosystem of the Southern Ocean and can serve as areas of enhanced production and sequestration of organic carbon to the deep sea.

Rossi, F., Forster, R.M., Montserrat, F., Ponti, M., Terlizzi, A., Ysebaert, T., and Middelburg, J.J. **Human trampling as short-term disturbance on intertidal mudflats: effects on macrofauna biodiversity and population dynamics of bivalves.** *Marine Biology* 151(6): 2077-2090, 2007.

Notes: The effect of physical disturbance in the form of trampling on the benthic environment of an intertidal mudflat was investigated. Intense trampling was created as unintended side-effect by benthic ecologists during field experiments in spring and summer 2005, when a mid-shore area of 25x25 m was visited twice per month by on average five researchers for a period of 8 months. At the putatively-impacted location (I) (25x25 m) and two nearby control locations (Cs) (25x25 m each), three sites (4x4 m) were randomly selected and at each site, three plots (50x50 cm) were sampled after 18 and 40 days from the end of the disturbance. Multivariate and univariate asymmetrical analyses tested for changes in the macrofaunal assemblage, biomass of microphytobenthos and various sediment properties (grain-size, water content, NH_4 and NO_3 concentrations in the pore water) between the two control locations (Cs) and the putatively-impacted location (I). There were no detectable changes in the sediment properties and microphytobenthos biomass, but variability at small scale was observed. Microphytobenthos and NH_4 were correlated at I to the number of footprints, as estimated by the percentage cover of physical depressions. This indicated that trampling could have an impact at small scales, but more investigation is needed. Trampling, instead, clearly modified the abundance and population dynamics of the clam *Macoma balthica* (L.) and the cockle *Cerastoderma edule* (L.). There was a negative impact on adults of both species, probably because footsteps directly killed or buried the animals, provoking asphyxia. Conversely, trampling indirectly enhanced recruitment rate of *M. balthica*, while small-sized *C. edule* did not react to the trampling. It was likely that small animals could recover more quickly because trampling occurred during the growing season and there was a continuous supply of larvae and juveniles. In addition, trampling might have weakened negative adult-juvenile interactions between adult cockles and juvenile *M. balthica*, thus facilitating the recruitment. Our findings indicated that human trampling is a relevant source of disturbance for the conservation and management of mudflats. During the growing season recovery can be fast, but in the long-term it might lead towards the dominance of *M. balthica* to the cost of *C. edule*, thereby affecting ecosystem functioning.

Teixido, N., Garrabou, J., Gutt, J., and Arntz, W.E. **Iceberg disturbance and successional spatial patterns: The case of the shelf Antarctic benthic communities.** *Ecosystems* 10(1): 142-157, 2007.

Notes: High-latitude, shelf Antarctic benthic communities are highly diversified and structured, dominated by benthic suspension feeders, and are subject to major natural disturbances. This study focuses on spatial patterns of the Antarctic benthos emphasizing the succession process after iceberg disturbance. For this purpose, underwater photographs (1 m^2 each) from the southeastern Weddell Sea shelf (< 300 m depth) were analyzed using techniques from the field of landscape ecology. Here, we examine measurements of spatial patterns (landscape indices) to describe changes in structural patterns along successional stages on these Antarctic benthic communities. We show a gradual separation from the early to older stages of succession based on sessile benthic cover area, size, shape, diversity, and interspersion and juxtaposition indices. Conceptually, the results describe a gradient from samples belonging to first stages of recovery with low cover area, low complexity of patch shape, small patch size, low diversity and patches poorly interspersed to samples from later stages with higher values of these indices. Cover area was the best predictor of recovery. We conclude that a variety of factors affect the observed successional sequences of Antarctic shelf benthic communities after iceberg disturbance, including the existence and dispersal abilities of propagules, growth rates, and competition between species. Overall, changes in the magnitude, frequency, and duration of disturbance regimes and alterations of ecosystem resilience pose major challenges for conservation of Antarctic benthos.

Bianchi, C.N. **Biodiversity issues for the forthcoming tropical Mediterranean Sea.** *Hydrobiologia* 580: 7-21, 2007.

Notes: Present-day Mediterranean marine biodiversity is undergoing rapid alteration. Because of the increased occurrence of warm water biota, it has been said that the Mediterranean is under a process of 'tropicalization'. This paper analyses the main patterns of the Mediterranean Sea tropicalization and considers briefly its extent and consequences. As happened during previous interglacial phases of the Quaternary, Atlantic water, entering via the Straits of Gibraltar, carries into the Mediterranean species that are prevalently of (sub)tropical affinity. On the other side of the basin, Red Sea species penetrate through the Suez Canal, a phenomenon called lessepsian migration from the name of F. De Lesseps, the French engineer who promoted the cutting of the Canal. Also the many exotic species introduced by humans voluntarily or involuntarily are nearly always typical of warm waters. Climate change combines with Atlantic influx, lessepsian migration and the introduction of exotic species by humans to the establishment of tropical marine biota in the Mediterranean Sea. Present-day warming

ultimately favours the spread of warmwater species through direct and indirect effects, and especially by changing water circulation. It is impossible at present to foresee to what extent the exuberance of warm-water species will affect the trophic web and the functioning of marine ecosystems in the Mediterranean Sea of tomorrow. While Mediterranean Sea communities are modifying their pattern of species composition, they do not seem to be acquiring a more marked tropical physiognomy: Mediterranean coastal marine ecosystems are still dominated by frondose algae (even if the species that are gaining ascendancy are of tropical origin) and not by corals as is normal in tropical seas.

Hector, A. and Bagchi, R. **Biodiversity and ecosystem multifunctionality.** *Nature* 448(7150): 188-190, 2007.

Notes: Biodiversity loss can affect ecosystem functions and services. Individual ecosystem functions generally show a positive asymptotic relationship with increasing biodiversity, suggesting that some species are redundant. However, ecosystems are managed and conserved for multiple functions, which may require greater biodiversity. Here we present an analysis of published data from grassland biodiversity experiments, and show that ecosystem multifunctionality does require greater numbers of species. We analysed each ecosystem function alone to identify species with desirable effects. We then calculated the number of species with positive effects for all possible combinations of functions. Our results show appreciable differences in the sets of species influencing different ecosystem functions, with average proportional overlap of about 0.2 to 0.5. Consequently, as more ecosystem processes were included in our analysis, more species were found to affect overall functioning. Specifically, for all of the analysed experiments, there was a positive saturating relationship between the number of ecosystem processes considered and the number of species influencing overall functioning. We conclude that because different species often influence different functions, studies focusing on individual processes in isolation will underestimate levels of biodiversity required to maintain multifunctional ecosystems.

Daskalov, G.M., Grishin, A.N., Rodionov, S., and Mihneva, V. **Trophic cascades triggered by overfishing reveal possible mechanisms of ecosystem regime shifts.** *Proceedings of the National Academy of Sciences [USA]* 104(25): 10518-10523, 2007.

Notes: Large-scale transitions between alternative states in ecosystems are known as regime shifts. Once described as healthy and dominated by various marine predators, the Black Sea ecosystem by the late 20th century had experienced anthropogenic impacts such as heavy fishing, cultural eutrophication, and invasions by alien species. We studied changes related to these "natural experiments" to reveal the mechanisms of regime shifts. Two major shifts were detected, the first related to a depletion of marine predators and the second to an outburst of the alien comb jelly *Mnemiopsis leidyi*; both shifts were triggered by intense fishing resulting in system-wide trophic cascades. The complex nature of ecosystem responses to human activities calls for more elaborate approaches than currently provided by traditional environmental and fisheries management. This implies challenging existing practices and implementing explanatory models of ecosystem interactions that can better reconcile conservation and ecosystem management ideals.

Graham, M.H., Kinlan, B.P., Druehl, L.D., Garske, L.E., and Banks, S. **Deep-water kelp refugia as potential hotspots of tropical marine diversity and productivity.** *Proceedings of the National Academy of Sciences [USA]* 104(42): 16576-16580, 2007.

Notes: Classic marine ecological paradigms view kelp forests as inherently temperate-boreal phenomena replaced by coral reefs in tropical waters. These paradigms hinge on the notion that tropical surface waters are too warm and nutrient-depleted to support kelp productivity and survival. We present a synthetic oceanographic and ecophysiological model that accurately identifies all known kelp populations and, by using the same criteria, predicts the existence of >23,500 km^2 unexplored submerged (30- to 200-m depth) tropical kelp habitats. Predicted tropical kelp habitats were most probable in regions where bathymetry and upwelling resulted in mixed-layer shoaling above the depth of minimum annual irradiance dose for kelp survival. Using model predictions, we discovered extensive new deep-water *Eisenia galapagensis* populations in the Galápagos that increased in abundance with increasing depth to >60 m, complete with cold-water flora and fauna of temperate affinities. The predictability of deep-water kelp habitat and the discovery of expansive deep-water Galápagos kelp forests validate the extent of deep-water tropical kelp refugia, with potential implications for regional productivity and biodiversity, tropical food web ecology, and understanding of the resilience of tropical marine systems to climate change.

Jagtap, T.G. and Nagle, V.L. **Response and adaptability of mangrove habitats from the Indian subcontinent to changing climate.** *Ambio* 36(4): 328-334, 2007.

Notes: Mangroves, a predominant coastal habitat in the tropics, are constantly threatened by various anthropogenic pressures that are deteriorating the mangroves to a great extent. Global emissions of greenhouse gases are likely to raise the world temperature and the sea level at the rate of 0.3°C and 6 mm 10 y^{-1} by the year 2100. Mangrove habitats would be more vulnerable to climatic changes and resultant sea level rise (SLR) because of their unique location at the interface of the sea. By altering ecobiological processes, the intertidal and supratidal zones may extend further inland, resulting in changes in the existing ecological setup. The limitation of the landward margin would cause vertical rise, resulting in water-logging and ultimately killing the mangroves and dependent biota. The present document describes mangrove habitats and related issues from the Indian subcontinent in the context of climate variations and SLR, and recommends integrated long-term monitoring.

An, S. Q., Li, H.B., Guan, B.H., Zhou, C.F., Wang, Z.S., Deng, Z.F., Zhi, Y.B., Liu, Y.H., Xu, C., Fang, S.B., Jiang, J.H., and Li, H.L. **China's natural wetlands: Past problems, current status, and future challenges.** *Ambio* 36(4): 335-342, 2007.

Notes: Natural wetlands, occupying 3.8% of China's land and providing 54.9% of ecosystem services, are unevenly distributed among eight wetland regions. Natural wetlands in China suffered great loss and degradation (e.g., 23.0% freshwater swamps, 51.2% costal wetlands) because of the wetland reclamation during China's long history of civilization, and the population pressure and the misguided policies over the last 50 years. Recently, with an improved understanding that healthy wetland ecosystems play a vital role in her sustainable economic development, China started major efforts in wetland conservation, as signified by the policy to return reclaimed croplands to wetlands, the funding of billions of dollars to restore degraded wetlands, and the national plan to place 90% of natural wetlands under protection by 2030. This paper describes the current status of the natural wetlands in China, reviews past problems, and discusses current efforts and future challenges in protecting China's natural wetlands.

Schlacher, T.A., Thompson, L., and Price, S. **Vehicles *versus* conservation of invertebrates on sandy beaches: mortalities inflicted by off-road vehicles on ghost crabs.** *Marine Ecology* 28(3): 354-367, 2007.

Notes: Sandy beaches face increasing anthropogenic pressures, with vehicle traffic being ecologically highly harmful. Ghost crabs (Fam. Ocypodidae) are conspicuous on many beaches, and they have been used as a bio-monitoring tool to measure the ecological responses to human disturbance. However, the mechanisms causing declines in crab numbers are unknown, yet conservation must target the actual impact mechanisms. Therefore, we quantified the magnitude and mechanisms of off-road vehicle (ORV) impacts on ghost crabs, addressing three key questions: (i) Does abundance of ghost crabs respond to traffic intensity?; (ii) Can burrows protect crabs from vehicles? and (iii) Can mortalities caused by vehicles contribute to population declines? ORV-impacts were measured on North Stradbroke Island (Australia) for *Ocypode cordimanus* and *Ocypode ceratophthalma*. Crab densities were significantly lower in areas subjected to heavy beach traffic, suggesting direct crushing by vehicles. Burrows only partially protect crabs against cars: all individuals buried shallow (5cm) are killed by 10 vehicle passes. Mortality declines with depth of burrows, but remains considerable (10-30% killed) at 20cm and only those crabs buried at least 30cm are not killed by ORVs: these 'deep-living' crabs represent about half of the population. After crabs emerge at dusk they are killed in large numbers on the beach surface. A single vehicle can crush up to 0.75% of the intertidal population. While conservation measures should primarily regulate night traffic, our results also emphasise that the fossorial life habits of sandy beach animals cannot off-set the impacts caused by ORVs.

Schiaparelli, S., Castellano, M., Povero, P., Sartoni, G., and Cattaneo-Vietti, R. **A benthic mucilage event in North-Western Mediterranean Sea and its possible relationships with the summer 2003 European heatwave: short term effects on littoral rocky assemblages.** *Marine Ecology* 28(3): 341-353, 2007.

Notes: In this contribution we document an anomalous mucilage growth which occurred in June 2003 along the rocky cliffs of the Portofino Promontory (Ligurian Sea, NW Mediterranean Sea), and we describe its dynamics and its negative effects on many benthic taxa. The zooxanthellate scleractinian *Cladocora caespitosa* underwent 'bleaching' and about 40% of biomass of the

erect algae was detached by mucilage 'lianas' created and strengthened by bottom currents. The 2003 event differed from any other previously occurred in the northern Tyrrhenian Sea, in that the mucilage aggregates were formed by the free-living form of the Phaeophyceae *Acinetospora crinita* (Harvey) Kornmann, a not usually dominant species in mucilage aggregates from the north Tyrrhenian Sea. The damage suffered by the benthic organisms living in this area was curtailed by a severe storm, occurred in July, which removed the mucilage to deeper depths, preventing irreversible damages. Only slow growing, perennant organisms, such as corallinales or scleractinians, were seriously affected, but a survey carried out 1 year later, in June 2004, allowed to appreciate a complete recovery of those organisms. This anomalous mucilage event occurred in coincidence of the 2003 European heatwave, and the anomalous temperature increase of seawater has to be regarded as the major contributing event that led to the mucilage outbreak.

Jaffe, B.E., Smith, R.E., and Foxgrover, A.C. **Anthropogenic influence on sedimentation and intertidal mudflat change in San Pablo Bay, California: 1856-1983.** *Estuarine, Coastal and Shelf Science* 73(1-2): 175-187, 2007.

Notes: Analysis of a series of historical bathymetric surveys has revealed large changes in morphology and sedimentation from 1856 to 1983 in San Pablo Bay, California. In 1856, the morphology of the bay was complex, with a broad main channel, a major side channel connecting to the Petaluma River, and an ebb-tidal delta crossing shallow parts of the bay. In 1983, its morphology was simpler because all channels except the main channel had filled with sediment and erosion had planed the shallows creating a uniform gently sloping surface. The timing and patterns of geomorphic change and deposition and erosion of sediment were influenced by human activities that altered sediment delivery from rivers. From 1856 to 1887, high sediment delivery (14.1 x 106 m^3/yr) to San Francisco Bay during the hydraulic gold-mining period in the Sierra Nevada resulted in net deposition of 259 $\pm$ 14 x 10^6 m^3 in San Pablo Bay. This rapid deposition filled channels and increased intertidal mudflat area by 60% (37.4 $\pm$ 3.4 to 60.6 $\pm$ 6.2 km^2). From 1951 to 1983, 23 $\pm$ 3 x 10^6 m^3 of sediment was eroded from San Pablo Bay as sediment delivery from the Sacramento and San Joaquin Rivers decreased to 2.8 x 10^6 m^3/yr because of damming of rivers, riverbank protection, and altered land use. Interfidal mudflat area in 1983 was 31.8 $\pm$ 3.9 km, similar to that in 1856. Intertidal mudflat distribution in 1983, however, was fairly uniform whereas most of the intertidal mudflats were in the western part of San Pablo Bay in 1856. Sediment delivery, through its affect on shallow parts of the bay, was determined to be a primary control on intertidal mudflat area. San Pablo Bay has been greatly affected by human activities and will likely continue to erode in the near term in response to a diminished sediment delivery from rivers.

Bos, A.R., Bouma, T.J., de Kort, G.L.J., and van Katwijk, M.M. **Ecosystem engineering by annual intertidal seagrass beds: Sediment accretion and modification.** *Estuarine, Coastal and Shelf Science* 74(1-2): 344-348, 2007.

Notes: Seagrasses are generally known as ecosystem engineers, as they reduce flow velocities in their canopies. In perennial subtidal meadows, this usually leads to increased net sedimentation rates and reduction of the grain size. The present study aims to describe the contribution of annual seagrass populations to these processes and elucidate the temporal dynamics. Sediment accretion and grain size modification were experimentally tested by transplanting seedlings of an annual intertidal eelgrass population to an unvegetated tidal flat. Within the planting units (79 shoots m^{-2}) 4.7 mm of sediment accreted, whereas in the most dense parts of these units (199 shoots m^{-2}) accretion amounted to 7.1 mm. The silt fraction (<63 μm) increased and the sand fraction (63-500 μm) decreased in the eelgrass beds, which provides evidence that higher silt content in seagrass beds is the result and not the cause of seagrass presence. Annual intertidal eelgrass beds significantly contribute to the immobilisation of sediment during the growing season with its magnitude depending on canopy density. During winter, the accumulated sediments were released again and could even induce additional erosion. Possible consequences of these sediment dynamics for the larger scale functioning of estuarine ecosystems are discussed.

Cerco, C.F. and Noel, M.R. **Can oyster restoration reverse cultural eutrophication in Chesapeake Bay?** *Estuaries and Coasts* 30(2): 331-343, 2007.

Notes: We investigated the hypothesis that effects of cultural eutrophication can be reversed through natural resource restoration via addition of an oyster module to a predictive eutrophication model. We explored the potential effects of native oyster restoration on dissolved oxygen (DO), chlorophyll, light attenuation, and submerged aquatic vegetation (SAV) in eutrophic Chesapeake Bay. A tenfold increase in existing oyster biomass is projected to reduce system-wide summer surface

chlorophyll by approximately 1 mg m^{-3}, increase summer-average deep-water DO by 0.25 g m^{-3}, add 2100 kg C (20%) to summer SAV biomass, and remove 30,000 kg d^{-1} nitrogen through enhanced denitrification. The influence of oyster restoration on deep extensive pelagic waters is limited. Oyster restoration is recommended as a supplement to nutrient load reduction, not as a substitute.

Heck, K.L. and Valentine, J.F. **The primacy of top-down effects in shallow benthic ecosystems.** *Estuaries and Coasts* 30(3): 371-381, 2007.

Notes: Individual scientists, scientific organizations, and government agencies have all concluded that eutrophication is among the most detrimental of all human activities in coastal ecosystems; very large amounts of funding have been earmarked to study the negative consequences of nutrient pollution. Most studies of eutrophication have been conducted long after the numbers and diversity of larger marine consumers were dramatically reduced by centuries of intense harvesting. It is now understood that these once abundant predators played pivotal roles in regulating ecosystem structure and function, and that the widespread overharvesting of large consumers can trigger indirect effects that alter species compositions in ways that are very similar to those reported to result from eutrophication. All of this suggests that we should reevaluate whether the many negative effects attributed to eutrophication are actually a result of nutrient additions or whether they may be the result of the indirect effects of dramatically altered coastal food webs. In this essay, we review experimental assessments of the degree to which changes in consumer abundances have indirectly altered the structure of benthic ecosystems in coastal waters, and on the relative importance of top-down and bottom-up effects on coral reefs, rocky shores, and seagrass meadows. We find that the evidence clearly indicates that indirect consumer effects are the primary drivers of coastal benthic ecosystem structure and function.

King, R.S., Deluca, W.V., Whigham, D.F., and Marra, P.P. **Threshold effects of coastal urbanization on *Phragmites australis* (common reed) abundance and foliar nitrogen in Chesapeake Bay.** *Estuaries and Coasts* 30(3): 469-481, 2007.

Notes: The invasion of North American tidal marshes by *Phragmites australis*, or common reed, is a large-scale ecological problem that has been primarily studied at small spatial scales. Previous local-scale studies have provided evidence that the expansion of *Phragmites* is facilitated by disturbance and increased nitrogen (N) associated with agricultural and urban-suburban (developed) land uses along wetland-upland borders. We tested the generality of previous findings across a larger spatial scale and wider range of environmental conditions in Chesapeake Bay, the largest estuarine ecosystem in the USA. We sampled 90 tidal wetlands nested within 30 distinct subestuarine watersheds and examined the relationship between land use and *Phragmites* abundance and foliar N, an indicator of nitrogen availability. We estimated land use adjacent to wetland borders and within subestuary watersheds and explored the importance of spatial proximity by weighting land use by its distance from the wetland border or subestuary shoreline, respectively. Regression tree and changepoint analyses revealed that *Phragmites* abundance sharply increased in almost every wetland where development adjacent to borders exceeded 15%. Where development was < 15% but natural land cover at the near the subestuary shoreline was low (< ~ 35%), *Phragmites* was abundant, suggesting that wetlands in highly modified watersheds also were susceptible to invasion, regardless of land use adjacent to wetlands. *Phragmites* foliar N was markedly elevated in watersheds with > 14-22% shoreline development, the same level of development that corresponded to high levels of invasion. Our results suggest that development near wetlands is at least partially responsible for patterns of invasion across Chesapeake Bay. Larger-scale phenomena, such as nitrogen pollution at the watershed-subestuary scale, also may be facilitating invasion. Urbanization near coastlines appears to play an important role in the invasion success of *Phragmites* in coastal wetlands of Chesapeake Bay and probably much of eastern North America.

Fulford, R.S., Breitburg, D.L., Newell, R.I.E., Kemp, W.M., and Luckenbach, M. **Effects of oyster population restoration strategies on phytoplankton biomass in Chesapeake Bay: a flexible modeling approach.** *Marine Ecology Progress Series* 336: 43-61, 2007.

Notes: Cultural eutrophication in estuaries and other coastal systems has increased over the last 50 yr. Some recently proposed strategies to reverse this trend have included the restoration of bivalve suspension feeders as an ecological tool for reducing phytoplankton biomass. The ecological benefits accruing from such bivalve restoration will be dependent on the characteristics of the estuary, as well as how restoration is implemented. We developed a filtration model to estimate the effect

of bivalve restoration on the rate of phytoplankton removal over a range of spatial and temporal scales and used it to compare alternate restoration strategies for the eastern oyster *Crassostrea virginica* in Chesapeake Bay, USA. Model results suggested that currently accepted restoration goals for oysters in the bay are unlikely to result in significant bay-wide reductions in phytoplankton biomass. This is partially due to low current biomass targets for oyster restoration, but also important are several spatial and temporal mismatches between oyster and phytoplankton biomass that may limit the ecological benefit of oyster restoration. Our model did predict important increases in phytoplankton removal by oysters at the tributary scale, and this effect was dependent on where oyster restoration was achieved and whether restoration and management plans affected the size distribution of oysters. Our findings suggest that the ecological benefit of restoring bivalve populations are variable, and a comparative model analysis of restoration plans in particular systems can be highly beneficial to maximizing the benefit-to-cost ratio of restoration efforts intended to reduce the negative effects of cultural eutrophication.

Murdoch, T.J.T., Glasspool, A.F., Outerbridge, M., Ward, J., Manuel, S., Gray, J., Nash, A., Coates, K.A., Pitt, J., Fourqurean, J.W., Barnes, P.A., Vierros, M., Holzer, K., and Smith, S.R. **Large-scale decline in offshore seagrass meadows in Bermuda.** *Marine Ecology Progress Series* 339: 123-130, 2007.

Notes: Bermuda is an isolated 5560 ha chain of limestone islands on a 150 000 ha seamount located near 32ºN, 64ºW. Meadows of tropical and subtropical seagrasses, dominated by *Thalassia testudinum* and *Syringodium filiforme*, are found from inshore bays out to the inner edge of the rim reef that encircles the platform. Fine-scale computerized mapping and subsequent broad-scaled field assessment of seagrass meadows in Bermuda show that (1) meadows representing nearly one-quarter of the territory's total seagrass area in 1997 had declined by 2004, (2) net loss of seagrass meadows occurred at rim reef and lagoonal locations that are far-removed from anthropogenic disturbances, (3) the decline appears to have been in progress as early as 1996, and (4) both *T. testudinum* and *S. filiforme* meadows declined. Nearly 2100 ha of meadows were visible in a 1997 geo-referenced mosaic of aerial photographs of the Bermuda platform. In 2004, 22 meadows that represented about 475 of the 900 ha of offshore seagrass identified in 1997 and earlier were absent or in obvious decline. The size and location of inshore and nearshore meadows, which are exposed to intense anthropogenic stresses and physical damage, varied over the same 7 yr but their total area has either remained unchanged or even increased. Processes contributing to the decline in offshore meadows have yet to be determined, but may include herbivory by juvenile green turtles and parrot-fishes and below-normal productivity owing to a winter cold-water event correlated with a change in the North Atlantic Oscillation (NAO) in 1996. The potential consequences to Bermuda of the loss of nearly 500 ha of critical marine habitat are of extreme concern.

Schlacher, T.A., Schlacher-Hoenlinger, M.A., Williams, A., Althaus, F., Hooper, J.N.A., and Kloser, R. **Richness and distribution of sponge megabenthos in continental margin canyons off southeastern Australia.** *Marine Ecology Progress Series* 340: 73-88, 2007.

Notes: Submarine canyons are spectacular topographical features that intersect the continental margins of the world's oceans. Canyons comprise unique habitats in terms of complexity, instability, material processing, and hydrodynamics, and they may support diverse assemblages of larger epibenthos. Yet, quantitative data on the biodiversity of the megabenthos in canyons are scant. Consequently, we quantified the diversity of sponges (a key and dominant group of the megabenthos) in 5 canyons located on the continental margin off southeastern Australia at depths from 114 to 612 m. The canyons harboured a rich sponge fauna, with a total of 165 species, belonging to 65 genera, 41 families, 10 orders, and 2 classes in 14 sled samples. Species richness declined with depth, but was positively linked to spatial heterogeneity of bottom types. Areas comprised of a broader range of bottom types (e.g. mixed rocky and sandy/muddy bottoms) contained more species than areas with more uniform substratum properties. Spatial patterns of the sponge assemblages were characterized by (1) high species turnover both between sites in individual canyons and between different canyons, and (2) low levels of site occupancy of the component species, with most species recorded from single canyons only. Variations in depth, substratum type and topographic relief resulted in heterogeneous environmental conditions of benthic habitats in canyons that corresponded to changes in the assemblage structure of sponges. A broad comparison with other abrupt topographical features in the bathyal zone of the region suggests that canyon assemblages may rival the diversity of sponges on seamounts. Site-to-site variation in diversity and species composition within individual canyons suggests that biological patterns may be finer-grained than the spatial scale of conventional geomorphological units. Consequently, from a perspective of conservation planning, a single or a few canyons are unlikely to accurately represent the regional faunal diversity, because of the strong biotic separation of communities between canyons and the limited distributional ranges of the component species.