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A. Recent articles – no abstract available

Leslie, H.M., Rosenberg, A.A., and Eagle, J. **Is a new mandate needed for marine ecosystem-based management?** *Frontiers in Ecology and Environment* 6(1): 43-48, 2008.

Armsworth, P.R., Chan, K.M.A., Daily, G.C., Ehrlich, P.R., Kremen, C., Ricketts, T.H., and Sanjayan, M.A. **Ecosystem-service science and the way forward for conservation.** *Conservation Biology* 21(6): 1383-1384, 2007.

Valiela, I. and Fox, S.E. **Managing coastal wetlands.** *Science* 319(5861): 290-291, 2008.

B. Recent publications available online

FAO. 2007. **The World's Mangroves 1980 – 2005.** FAO Forestry Paper 153. FAO, Rome. 78pp.

Available at: <ftp://ftp.fao.org/docrep/fao/010/a1427e/a1427e00.pdf>

Notes: Mangroves are commonly found along sheltered coastlines in the tropics and subtropics where they fulfil important socio-economic and environmental functions. These include the provision of a large variety of wood and non-wood forest products; coastal protection against the effects of wind, waves and water currents; conservation of biological diversity, including a number of endangered mammals, reptiles, amphibians and birds; protection of coral reefs, sea-grass beds and shipping lanes against siltation; and provision of habitat, spawning grounds and nutrients for a variety of fish and shellfish, including many commercial species. High population pressure in coastal areas has, however, led to the conversion of many mangrove areas to other uses, including infrastructure, aquaculture, rice and salt production. With the preparation of this report, FAO aims to facilitate access to comprehensive information on the current and past extent of mangroves in all countries and territories in which they exist. The results obtained indicate that global mangrove area is currently about 15.2 million hectares, with the largest areas found in Asia and Africa, followed by North and Central America. An alarming 20 percent of mangrove area, or 3.6 million hectares, has been lost since 1980. More recently, the rate of net loss appears to have slowed down, reflecting an increased awareness of the value of mangrove ecosystems, but the annual rate of loss is, according to the report, still disturbingly high.

UNEP. 2007. **Deep-Sea Biodiversity and Ecosystems: A scoping report on their socio-economy, management and governance.** UNEP-WCMC Biodiversity Series No. 28. UNEP-WCMC, Cambridge, UK. 83pp.

Available at: http://www.unep-wcmc.org/resources/publications/UNEP_WCMC_bio_series/28.aspx

Notes: The objective of this report is to provide an overview of the key socio-economic, management and governance issues relating to the conservation and sustainable use of deep-sea ecosystems and biodiversity. The report highlights our current understanding of these issues and identifies topics and areas that need further investigation to close gaps in knowledge. It also explores the needs and means for interfacing research with policy with a view to contributing to the political processes regarding deep-sea and high-seas governance, which are currently ongoing in various international fora within and outside the UN system. In addition, this report provides guidance on the future direction and focus of research on environmental, socio-economic and governance aspects in relation to the deep sea.

Sale, P.F., Butler, M.J., Hooten, A.J., Kritzer, J.P., Lindeman, K.C., Sadovy de Mitcheson, Y.J., Steneck, R.S. and van Lavieren, H. 2008. *Stemming Decline of the Coastal Ocean: Rethinking Environmental Management*. UNU-INWEH, Hamilton, Canada. 42pp.

Available at: http://www.ony.unu.edu/seminars/2008/June4/UNU_StemmingDeclineLR.pdf

Notes: Current coastal management practices are ineffective and to continue them will endanger coastal economies and ecosystems that support over one half of the world's population. The trend for coastal ocean ecosystems over recent decades has been for progressive decline in the face of growing human populations, growing demand for coastal resources, and growing use of the coastal environment. Now climate change is starting to add to the pressures on the coastal environment, further stressing ecosystems there. In the following pages, we summarize the present state of management, identify the impediments limiting success, and propose steps to make the substantial improvements needed in management of the coastal ocean.

C. Recent articles with abstracts

Brauman, K.A., Daily, G.C., Duarte, T.K., and Mooney, H.A. **The nature and value of ecosystem services: An overview highlighting hydrologic services.** *Annual Review of Environment and Resources* 32: 67-98, 2007.

Notes: Ecosystem services, the benefits that people obtain from ecosystems, are a powerful lens through which to understand human relationships with the environment and to design environmental policy. The explicit inclusion of beneficiaries makes values intrinsic to ecosystem services; whether or not those values are monetized, the ecosystem services framework provides a way to assess trade-offs among alternative scenarios of resource use and land- and seascape change. We provide an overview of the ecosystem functions responsible for producing terrestrial hydrologic services and use this context to lay out a blueprint for a more general ecosystem service assessment. Other ecosystem services are addressed in our discussion of scale and trade-offs. We review valuation and policy tools useful for ecosystem service protection and provide several examples of land management using these tools. Throughout, we highlight avenues for research to advance the ecosystem services framework as an operational basis for policy decisions.

Leslie, H.M. and McLeod, K.L. **Confronting the challenges of implementing marine ecosystem-based management.** *Frontiers in Ecology and Environment* 5(10): 540-548, 2007.

Notes: Many services provided by coastal and marine ecosystems are in decline. Awareness of these declines and the need to improve existing management has led to a shift toward ecosystem-based approaches to marine management and conservation, both in the US and elsewhere. Marine ecosystem-based management (EBM) involves recognizing and addressing interactions among different spatial and temporal scales, within and among ecological and social systems, and among stakeholder groups and communities interested in the health and stewardship of coastal and marine areas. We discuss some overarching principles of marine EBM and highlight key challenges facing implementation. We then recommend ways in which natural and social scientists can advance implementation of ecosystem-based approaches in the oceans by addressing key research needs, building interdisciplinary scientific capacity, and synthesizing and communicating scientific knowledge to policy makers, managers, and other stakeholders.

Kock, K.H. **Antarctic Marine Living Resources exploitation and its management in the Southern Ocean.** *Antarctic Science* 19(2): 231-238, 2007.

Notes: Man's activities have impacted on the Southern Ocean ecosystem for more than 200 years. The exploitation of Southern Ocean resources has followed the same pattern as in other parts of the World Ocean with exploitation starting at the highest trophic levels when seals and whales were taken in the 19th and 20th centuries. After serious over-exploitation of these groups attention moved down the food web to begin exploitation of fish and krill from the late 1960s onwards. The establishment of international management regimes for whales (International Whaling Convention) in 1948 and the remaining marine resources (Convention for the Conservation of Antarctic Marine Living Resources) in 1982 were based on different perceptions of management, the former only considering management by species whilst the latter adopted management at an ecosystem level. These fundamentally different approaches, together with major political interference, have resulted in very different outcomes for management. The Scientific Committee of the IWC developed a sustainable management system, the Revised Management Procedure, in the first half of the 1990s which, however, is still awaiting inclusion into an overall management regime, the Revised Management Scheme, and its acceptance by the Commission. The IWC is now paralysed by political agendas that have nothing to do with scientific management. In contrast, after an early period of slow progress, CCAMLR has improved its performance substantially from the beginning of the 1990s onwards and is now hailed worldwide for its ecosystem approach to sustainable management.

Kaiser, S., Barnes, D.K.A., and Brandt, A. **Slope and deep-sea abundance across scales: Southern Ocean isopods show how complex the deep sea can be.** *Deep Sea Research Part II: Topical Studies in Oceanography* 54(16-17): 1776-1789, 2007.

Notes: How animals are distributed in the world's largest surface environment, the deep sea, is poorly understood. The ANDEEP (ANtarctic benthic DEEP-sea biodiversity, colonisation history and recent community patterns) III cruise probed richness and abundance of one group, peracarid crustaceans (isopods, amphipods, cumaceans, tanaidaceans, mysidaceans), as a model of deep-sea fauna across Southern Ocean (SO) sites. Analysis of samples from the ANDEEP cruises reveals SO isopods to be highly abundant, rich and endemic as many other taxa in the region are known to be. Samples taken across three spatial scales include sites tens, hundreds and thousands of kilometers apart, sites stretching from the Southern Cape Basin (South Atlantic) to continental Antarctica and including depths from 1030 to 5000 m. Across these spatial scales we investigated ecological success (abundance) of peracarids at order, family, and species levels. Remarkably no significant relationship was found between abundance and spatial scale at any taxonomic level. That is, the variability in abundance at major regional scale is no different to that across just tens of kilometres. Most taxa were represented in only a few samples, but we suggest most inhabitants of the deep Weddell Sea environment to be very patchy rather than rare. Separate plots of family, genus, and species abundance by sample number revealed this to be true -- nearly all genera and species are an order of magnitude more abundant than 'background' levels in just one or two samples. Our isopod and amphipod samples reveal the Atlantic sector of the SO, one of the most dynamic and important regions influencing the global deep-sea environment, to be highly complex. Our study suggests that, at least with regard to the study taxa and area, the typical comparisons of regions that are made by ecologists miss the scale at which crucial ecological variability happens. Even without ice scours creating topographical complexity (as on the shelf) the deep Weddell Sea is clearly complex at scales smaller than that measured to date.

Norkko, A., Thrush, S.F., Cummings, V.J., Gibbs, M.M., Andrew, N.L., Norkko, J., and Schwarz, A.M. **Trophic structure of coastal Antarctic food webs associated with changes in sea ice and food supply.** *Ecology* 88(11): 2810-2820, 2007.

Notes: Predicting the dynamics of ecosystems requires an understanding of how trophic interactions respond to environmental change. In Antarctic marine ecosystems, food web dynamics are inextricably linked to sea ice conditions that affect the nature and magnitude of primary food sources available to higher trophic levels. Recent attention on the changing sea ice conditions in polar seas highlights the need to better understand how marine food webs respond to changes in such broad-scale environmental drivers. This study investigated the importance of sea ice and advected primary food sources to the structure of benthic food webs in coastal Antarctica. We compared the isotopic composition of several sea floor taxa (including primary producers and invertebrates with a variety of feeding modes) that are widely distributed in the Antarctic. We assessed shifts in the trophic role of numerically dominant benthic omnivores at five coastal Ross Sea locations. These locations vary in primary productivity and food availability, due to their different levels of sea ice cover, and proximity to

polynyas and advected primary production. The $\delta^{15}\text{N}$ signatures and isotope mixing model results for the bivalves *Laternula elliptica* and *Adamussium colbecki* and the urchin *Sterechinus neumeyeri* indicate a shift from consumption of a higher proportion of detritus at locations with more permanent sea ice in the south to more freshly produced algal material associated with proximity to ice-free water in the north and east. The detrital pathways utilized by many benthic species may act to dampen the impacts of large seasonal fluctuations in the availability of primary production. The limiting relationship between sea ice distribution and in situ primary productivity emphasizes the role of connectivity and spatial subsidies of organic matter in fueling the food web. Our results begin to provide a basis for predicting how benthic ecosystems will respond to changes in sea ice persistence and extent along environmental gradients in the high Antarctic.

Guidetti, P. **Predator diversity and density affect levels of predation upon strongly interactive species in temperate rocky reefs.** *Oecologia* 154(3): 513-520, 2007.

Notes: Indirect effects of predators in the classic trophic cascade theory involve the effects of basal species (e.g. primary producers) mediated by predation upon strongly interactive consumers (e.g. grazers). The diversity and density of predators, and the way in which they interact, determine whether and how the effects of different predators on prey combine. Intraguild predation, for instance, was observed to dampen the effects of predators on prey in many ecosystems. In marine systems, species at high trophic levels are particularly susceptible to extinction (at least functionally). The loss of such species, which is mainly attributed to human activities (mostly fishing), is presently decreasing the diversity of marine predators in many areas of the world. Experimental studies that manipulate predator diversity and investigate the effects of this on strongly interactive consumers (i.e. those potentially capable of causing community-wide effects) in marine systems are scant, especially in the rocky sublittoral. I established an experiment that utilised cage enclosures to test whether the diversity and density of fish predators (two sea breams and two wrasses) would affect predation upon juvenile and adult sea urchins, the most important grazers in Mediterranean sublittoral rocky reefs. Changes in species identity (with sea breams producing major effects) and density of predators affected predation upon sea urchins more than changes in species richness *per se*. Predation upon adult sea urchins decreased in the presence of multiple predators, probably due to interference competition between sea breams and wrasses. This study suggests that factors that influence both fish predator diversity and density in Mediterranean rocky reefs (e.g. fishing and climate change) may have the potential to affect the predators' ability to control sea urchin population density, with possible repercussions for the whole benthic community structure.

Ryaczewski, R.R. and Checkley, D.M. **Influence of ocean winds on the pelagic ecosystem in upwelling regions.** *Proceedings of the National Academy of Sciences [USA]* 105(6): 1965-1970, 2008.

Notes: Upwelling of nutrient-rich, subsurface water sustains high productivity in the ocean's eastern boundary currents. These ecosystems support a rate of fish harvest nearly 100 times the global mean and account for >20% of the world's marine fish catch. Environmental variability is thought to be the major cause of the decadal-scale biomass fluctuations characteristic of fish populations in these regions, but the mechanisms relating atmospheric physics to fish production remain unexplained. Two atmospheric conditions induce different types of upwelling in these ecosystems: coastal, alongshore wind stress, resulting in rapid upwelling (with high vertical velocity, w); and wind-stress curl, resulting in slower upwelling (low w). We show that the level of wind-stress curl has increased and that production of Pacific sardine (*Sardinops sagax*) varies with wind-stress curl over the past six decades. The extent of isopycnal shoaling, nutricline depth, and chlorophyll concentration in the upper ocean also correlate positively with wind-stress curl. The size structure of plankton assemblages is related to the rate of wind-forced upwelling, and sardine feed efficiently on small plankters generated by slow upwelling. Upwelling rate is a fundamental determinant of the biological structure and production in coastal pelagic ecosystems, and future changes in the magnitude and spatial gradient of wind stress may have important and differing effects on these ecosystems. Understanding of the biological mechanisms relating fisheries production to environmental variability is essential for wise management of marine resources under a changing climate.

Schlacher, T.A., Schoeman, D.S., Dugan, J., Lastra, M., Jones, A., Scapini, F., and McLachlan, A. **Sandy beach ecosystems: key features, sampling issues, management challenges and climate change impacts.** *Marine Ecology: An Evolutionary Perspective* 29(s1): 70-90, 2008.

Notes: Escalating pressures caused by the combined effects of population growth, demographic shifts, economic development and global climate change pose unprecedented threats to sandy beach ecosystems worldwide. Conservation of beaches as functional ecosystems and protection of their unique biodiversity requires management interventions that not only mitigate threats to physical properties of sandy shores, but also include ecological dimensions. Yet, beach management remains overwhelmingly focused on engineering interventions. Here we summarise the key outcomes of several workshops, held during the 2006 Sandy Beach Ecology Symposium in Vigo, Spain, that addressed issues of climate change, beach management and sampling methodology. Because efficient communication between managers and ecologists is critical, we summarise the salient features of sandy beaches as functional ecosystems in 50 'key statements'; these provide a succinct synopsis of the main structural and functional characteristics of these highly dynamic systems. Key outcomes of the workshops include a set of recommendations on designs and methods for sampling the benthic infaunal communities of beaches, the identification of the main ecological effects caused by direct and indirect human interventions, the predicted consequence of climate change for beach ecosystems, and priority areas for future research.

Unsworth, R.K.F., DeLeon, P.S., Garrard, S.L., Jompa, J., Smith, D.J., and Bell, J.J. **High connectivity of Indo-Pacific seagrass fish assemblages with mangrove and coral reef habitats.** *Marine Ecology Progress Series* 353: 213-224, 2008.

Notes: Marine ecosystems throughout the Indo-Pacific region are highly threatened by anthropogenic stressors, yet the faunal interaction between different component habitats remains poorly understood. This information is vital as stress on one interconnected habitat may have cascade effects on other habitats. The present study focused on the impact of inter-habitat connectivity on seagrass fish assemblages, specifically between seagrass, mangrove and reef habitats. Fish were sampled using a seine net within 3 seagrass habitats (seagrass near to reef, seagrass near to reef and mangrove, and seagrass near to mangrove) within eastern Indonesia. Visual surveys were also conducted within mangrove habitats. Fish abundance and species richness in seagrass beds in close proximity to mangroves was at least twice that found in seagrass beds that were distant from mangrove habitat. The trophic structures of seagrass fish assemblages change from being dominated by predators and omnivores close to the reef, to assemblages high in planktivores and herbivores close to mangroves. We found that mangroves enhance the fish assemblages of nearby seagrass beds probably by increasing the availability of shelter and food provision. This study indicates that Indo-Pacific seagrass beds play an important fish nursery role, which is influenced by the availability of nearby reef and mangrove habitats. Our research supports the need for ecosystem-level management of shallow water tropical habitats, but also suggests that successful management requires local-level knowledge of habitat interactions to successfully enhance or conserve fish assemblages.

Duarte, C.M., Dennison, W.C., Orth, R.J.W., and Carruthers, T.J.B. **The charisma of coastal ecosystems: Addressing the imbalance.** *Estuaries and Coasts* 31(2): 233-238, 2008.

Notes: Coastal ecosystems including coral reefs, mangrove forests, seagrass meadows, and salt marshes are being lost at alarming rates, and increased scientific understanding of causes has failed to stem these losses. Coastal habitats receive contrasting research effort, with 60% of all of the published research carried out on coral reefs, compared to 11-14% of the records for each of salt marshes, mangrove forests, and seagrass meadows. In addition, these highly connected and interdependent coastal ecosystems receive widely contrasting media attention that is disproportional to their scientific attention. Seagrass ecosystems receive the least attention in the media (1.3% of the media reports) with greater attention on salt marshes (6.5%), considerably more attention on mangroves (20%), and a dominant focus on coral reefs, which are the subject of three in every four media reports on coastal ecosystems (72.5%). There are approximately tenfold lower reports on seagrass meadows in the media for every scientific paper published (ten), than the 130-150 media reports per scientific paper for mangroves and coral reefs. The lack of public awareness of losses of less charismatic ecosystems results in the continuation of detrimental practices and therefore contributes to continued declines of coastal ecosystems. More effective communication of scientific knowledge about these uncharismatic but ecologically important coastal habitats is required. Effective use of formal (e.g., school curricula, media) and informal (e.g., web) education avenues and an effective partnership between scientists and media communicators are essential to raise public awareness of issues, concerns, and solutions within coastal ecosystems. Only increased public understanding can ultimately inform and motivate effective management of these ecologically important coastal ecosystems.

Coleman, J.M., Huh, O.K., and Braud, D. **Wetland loss in world deltas.** *Journal of Coastal Research* 24(1A): 1-14, 2008.

Notes: Geologic and geomorphic data on 42 world deltas were compiled for a NASA-sponsored research project. Satellite images from 14 of these deltas (Danube, Ganges, Brahmaputra, Indus, Mahanadi, Mangoky, McKenzie, Mississippi, Niger, Nile, Shatt el Arab, Volga, Huang He [Yellow], Yukon, and Zambezi) were analyzed for delta plain wetland loss caused by natural causes and conversion of wetlands for agricultural and industrial use. These analyses indicated that a total of 15,845 km² of wetlands have been irreversibly lost during the past 14 years and the average rate of loss is 95 km²/y. If a similar trend is present in the other deltas, a total wetland loss in the delta plains of the 42 deltas would be on the order 364,000 km² over the past 15 to 20 years.

Van Dolah, R.F., Riekerk, G.H.M., Bergquist, D.C., Felber, J., Chestnut, D.E., and Holland, A.F. **Estuarine habitat quality reflects urbanization at large spatial scales in South Carolina's coastal zone.** *The Science of the Total Environment* 390(1): 142-154, 2008.

Notes: Land cover patterns were evaluated in 29 estuarine watersheds of South Carolina to determine relationships between urban/suburban development and estuarine habitat quality. Principal components analysis and Pearson product moment correlation analyses were used to examine the relationships between ten land cover categories and selected measures of nutrient or bacterial enrichment in the water column and contaminant enrichment in sediments. These analyses indicated strong relationships between land cover categories representing upland development and a composite measure of 24 inorganic and organic contaminants using the Effect Range Median-Quotient (ERM-Q). Similar relationships also were observed for the summed concentrations of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and metals. Data obtained from tidal creeks generally showed stronger correlations between urban/suburban land use and pesticides and metals compared to data obtained from larger open water habitats. Correlations between PAH concentrations and the urban/suburban land cover categories were similar between creek and open water habitats. PCB concentrations generally showed very little relationship to any of the land cover categories. Measures of nutrient enrichment, which included total Kjeldahl nitrogen (TKN), nitrate-nitrite, phosphorus, chlorophyll-*a*, and total organic carbon, were generally not significantly correlated with any land cover categories, whereas fecal coliform bacteria were significantly and positively correlated with the urban/suburban land cover categories and negatively correlated with the non-urban land cover categories. Fecal coliform correlations were stronger using data from the open water sites than from the tidal creek sites. Both ERM-Q and fecal coliform concentrations were much greater and more pervasive in watersheds with relatively high (> 50%) urban/suburban cover compared to watersheds with low (< 30%) urban/suburban cover. These analyses support the hypotheses that estuarine habitat quality reflects upland development patterns at large spatial scales, and that upland urbanization can result in increased risk of biological degradation and reduced safe human use of South Carolina's coastal resources.

Barnes, C. and McFadden, K.W. **Marine ecosystem approaches to management: challenges and lessons in the United States.** *Marine Policy* 32(3): 387-392, 2008.

Notes: This study examined how the United States' largest marine resource management agency, the National Oceanic and Atmospheric Administration (NOAA), has begun to change its management strategy away from traditional marine resource management approaches towards an Ecosystem Approach to Management (EAM). Surveys were conducted with 57 NOAA scientists and resource managers in nine NOAA programs in 8 different geographic regions across the United States in 2005. A qualitative analysis examined the attitudes and experiences of participants with respect to implementing EAM and identified four major challenges to enhancing cooperation and understanding of EAM. We conclude with recommendations for concrete initiatives that future efforts in EAM that any management agency can undertake to facilitate further ecosystem management opportunities.

Tallis, H., Ferdana, Z., and Gray, E. **Linking terrestrial and marine conservation planning and threats analysis.** *Conservation Biology* 22(1): 120-130, 2008.

Notes: The existence of the Gulf of Mexico dead zone makes it clear that marine ecosystems can be damaged by terrestrial inputs. Marine and terrestrial conservation planning need to be aligned in an explicit fashion to fully represent threats to marine systems. To integrate conservation planning for terrestrial and marine systems, we used a novel threats assessment that included 5 cross-system threats in a site-prioritization exercise for the Pacific Northwest coast ecoregion (U.S.A.). Cross-system threats are actions or features in one ecological realm that have effects on species in another realm. We considered bulkheads and other forms of shoreline hardening threats to terrestrial systems and roads, logging, agriculture, and urban areas threats to marine systems. We used 2 proxies of freshwater influence on marine environments, validated against a mechanistic model and field observations, to propagate land-based threats into marine sites. We evaluated the influence of cross-system threats on conservation priorities by comparing MARXAN outputs for 3 scenarios that identified terrestrial and marine priorities simultaneously: (1) no threats, (2) single-system threats, and (3) single- and cross-system threats. Including cross-system threats changed the threat landscape dramatically. As a result the best plan that included only single-system threats identified 323 sites (161,500 ha) at risk from cross-system threats. Including these threats changed the location of best sites. By comparing the best and sum solutions of the single- and cross-system scenarios, we identified areas ideal for preservation or restoration through integrated management. Our findings lend quantitative support to the call for explicitly integrated decision making and management action in terrestrial and marine ecosystems

Ban, N. and Alder, J. **How wild is the ocean? Assessing the intensity of anthropogenic marine activities in British Columbia, Canada.** *Aquatic Conservation: Marine and Freshwater Ecosystems* 18(1): 55-85, 2008.

Notes: 1. The intensity of marine activities in the exclusive economic zone (EEZ) of British Columbia, Canada, was quantified. 2. Humans use the ocean for a multitude of purposes, many of which have a direct impact on marine life and habitat. Yet such uses are seldom assessed in an integrated fashion. 3. Using a GIS approach, spatial information for 39 marine activities was mapped, including commercial and recreational fishing areas, transportation and infrastructure uses, and terrestrial activities along the coast of British Columbia. 4. A relative scale was used to rank both the impact of marine activities and the extent of stressors beyond the location of occurrence. Limited information on the latter led to the application of three ranges of buffer distances to the data (0-1 km, 0-5 km, and 0-25 km). 5. The most conservative estimate (≤ 1 km buffers) indicates at least 83% of the continental shelf and slope of British Columbia is currently being used by humans. The largest buffer assumption shows 98% of the continental shelf and slope being affected by stressors from anthropogenic activities. 6. This analysis provides a baseline for assessing future changes in the state of British Columbia's marine environment, and could assist in identifying areas of conservation potential.

FitzGerald, D.M., Fenster, M.S., Argow, B.A., and Buynevich, I.V. **Coastal impacts due to sea-level rise.** *Annual Review of Earth and Planetary Sciences* 36: 601-647, 2008.

Notes: The Intergovernmental Panel on Climate Change (2007) recently estimated that global sea level will rise from 0.18 to 0.59 m by the end of this century. Rising sea level not only inundates low-lying coastal regions but also contributes to the redistribution of sediment along sandy coasts. Over the long term, sea-level rise (SLR) causes barrier islands to migrate landward while conserving mass through offshore and onshore sediment transport. Under these conditions, coastal systems adjust to SLR dynamically while maintaining a characteristic geometry that is unique to a particular coast. Coastal marshes are susceptible to accelerated SLR because their vertical accretion rates are limited and they may drown. As marshes convert to open water, tidal exchange through inlets increases, which leads to sand sequestration in tidal deltas and erosion of adjacent barrier shorelines.

Ruckelshaus, M., Klinger, T., Knowlton, N., and Demaster, D.R. **Marine ecosystem-based management in practice: Scientific, and governance challenges.** *BioScience* 58(1): 53-63, 2008.

Notes: Ecosystem-based management (EBM) in the ocean is a relatively new approach, and existing applications are evolving from more traditional management of portions of ecosystems. Because comprehensive examples of EBM in the marine environment do not yet exist, we first summarize EBM principles that emerge from the fisheries and marine social and ecological literature. We then apply those principles to four cases in which large parts of marine ecosystems are, being managed, and ask how including additional components of an EBM approach might improve the prospects for those

ecosystems, The case studies provide examples of how additional elements of EBM approaches, if applied, could improve ecosystem function. In particular, two promising next steps for applying EBM are to identify management objectives for the ecosystem, including natural and human goals, and to ensure that the governance structure matches with the scale over which ecosystem elements are measured and managed

Osterblom, H., Hansson, S., Larsson, U., Hjerne, O., Wulff, F., Elmgren, R., and Folke, C. **Human-induced trophic cascades and ecological regime shifts in the Baltic Sea.** *Ecosystems* 10(6): 877-889, 2007.

Notes: The ecosystems of coastal and enclosed seas are under increasing anthropogenic pressure worldwide, with Chesapeake Bay, the Gulf of Mexico and the Black and Baltic Seas as well known examples. We use an ecosystem model (Ecopath with Ecosim, EwE) to show that reduced top-down control (seal predation) and increased bottom-up forcing (eutrophication) can largely explain the historical dynamics of the main fish stocks (cod, herring and sprat) in the Baltic Sea between 1900 and 1980. Based on these results and the historical fish stock development we identify two major ecological transitions. A shift from seal to cod domination was caused by a virtual elimination of marine mammals followed by a shift from an oligotrophic to a eutrophic state. A third shift from cod to clupeid domination in the late 1980s has previously been explained by overfishing of cod and climatic changes. We propose that the shift from an oligotrophic to a eutrophic state represents a true regime shift with a stabilizing mechanism for a hysteresis phenomenon. There are also mechanisms that could stabilize the shift from a cod to clupeid dominated ecosystem, but there are no indications that the ecosystem has been pushed that far yet. We argue that the shifts in the Baltic Sea are a consequence of human impacts, although variations in climate may have influenced their timing, magnitude and persistence.

van derHeide, T., van Nes, E.H., Geerling, G.W., Smolders, A.J.P., Bouma, T.J., and van Katwijk, M.M. **Positive feedbacks in seagrass ecosystems: Implications for success in conservation and restoration.** *Ecosystems* 10(8): 1311-1322, 2007.

Notes: Seagrasses are threatened by human activity in many locations around the world. Their decline is often characterized by sudden ecosystem collapse from a vegetated to a bare state. In the 1930s, such a dramatic event happened in the Dutch Wadden Sea. Before the shift, large seagrass beds (*Zostera marina*) were present in this area. After the construction of a large dam and an incidence of the "wasting disease" in the early 1930s, these meadows became virtually extinct and never recovered despite restoration attempts. We investigated whether this shift could be explained as a critical transition between alternative stable states, and whether the lack of recovery could be due to the high resilience of the new turbid state. We analyzed the depth distribution of the historical meadows, a long-term dataset of key factors determining turbidity and a minimal model based on these data. Results demonstrate that recovery was impossible because turbidity related to suspended sediment was too high, probably because turbidity was no longer reduced by seagrass itself. Model simulations on the positive feedback suggest indeed the robust occurrence of alternative stable states and a high resilience of the current turbid state. As positive feedbacks are common in seagrasses, our findings may explain both the worldwide observed collapses and the low success rate of restoration attempts of seagrass habitats. Therefore, appreciation of ecosystem resilience may be crucial in seagrass ecosystem management.

Barbier, E.B., Koch, E.W., Silliman, B.R., Hacker, S.D., Wolanski, E., Primavera, J., Granek, E. F., Polasky, S., Aswani, S., Cramer, L.A., Stoms, D.M., Kennedy, C.J., Bael, D., Kappel, C.V., Perillo, G.M.E., and Reed, D.J. **Coastal ecosystem-based management with nonlinear ecological functions and values.** *Science* 319(5861): 321-323, 2008.

Notes: A common assumption is that ecosystem services respond linearly to changes in habitat size. This assumption leads frequently to an "all or none" choice of either preserving coastal habitats or converting them to human use. However, our survey of wave attenuation data from field studies of mangroves, salt marshes, seagrass beds, nearshore coral reefs, and sand dunes reveals that these relationships are rarely linear. By incorporating nonlinear wave attenuation in estimating coastal protection values of mangroves in Thailand, we show that the optimal land use option may instead be the integration of development and conservation consistent with ecosystem-based management goals. This result suggests that reconciling competing demands on coastal habitats should not always result in stark preservation-versus-conversion choices.

Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., Dagrosa, C., Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S., Madin, E.M.P., Perry, M.T., Selig, E.R., Spalding, M., Steneck, R., and Watson, R. **A global map of human impact on marine ecosystems.** *Science* 319(5865): 948-952, 2008.

Notes: The management and conservation of the world's oceans require synthesis of spatial data on the distribution and intensity of human activities and the overlap of their impacts on marine ecosystems. We developed an ecosystem-specific, multiscale spatial model to synthesize 17 global data sets of anthropogenic drivers of ecological change for 20 marine ecosystems. Our analysis indicates that no area is unaffected by human influence and that a large fraction (41%) is strongly affected by multiple drivers. However, large areas of relatively little human impact remain, particularly near the poles. The analytical process and resulting maps provide flexible tools for regional and global efforts to allocate conservation resources; to implement ecosystem-based management; and to inform marine spatial planning, education, and basic research.

Alongi, D.M. **Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change.** *Estuarine, Coastal and Shelf Science* 76(1): 1-13, 2008.

Notes: This review assesses the degree of resilience of mangrove forests to large, infrequent disturbance (tsunamis) and their role in coastal protection, and to chronic disturbance events (climate change) and the future of mangroves in the face of global change. From a geological perspective, mangroves come and go at considerable speed with the current distribution of forests a legacy of the Holocene, having undergone almost chronic disturbance as it result of fluctuations in sea-level. Mangroves have demonstrated considerable resilience over timescales commensurate with shoreline evolution. This notion is supported by evidence that soil accretion rates in mangrove forests are currently keeping pace with mean sea-level rise. Further support for their resilience comes from patterns of recovery from natural disturbances (storms, hurricanes) which coupled with key life history traits, suggest pioneer-phase characteristics. Stand composition and forest structure are the result of a complex interplay of physiological tolerances and competitive interactions leading to a mosaic of interrupted or arrested succession sequences, in response to physical/chemical gradients and landform changes. The extent to which some or all of these factors come into play depends on the frequency, intensity, size, and duration of the disturbance. Mangroves may in certain circumstances offer limited protection from tsunamis; some models using realistic forest variables suggest significant reduction in tsunami wave flow pressure for forests at least 100 m in width. The magnitude of energy absorption strongly depends on tree density, stem and root diameter, shore slope, bathymetry, spectral characteristics of incident waves, and tidal stage upon entering the forest. The ultimate disturbance, climate change, may lead to a maximum global loss of 10-15% of mangrove forest, but must be considered of secondary importance compared with current average annual rates of 1-2% deforestation. A large reservoir of below-ground nutrients, rapid rates of nutrient flux and microbial decomposition, complex and highly efficient biotic controls, self-design and redundancy of keystone species, and numerous feedbacks, all contribute to mangrove resilience to various types of disturbance.

Gonzalez-Correa, J.M., Torquemada, Y.F., and Lizaso, J.L.S. **Long-term effect of beach replenishment on natural recovery of shallow *Posidonia oceanica* meadows.** *Estuarine, Coastal and Shelf Science* 76(4): 834-844, 2008.

Notes: The recovery capacity of shallow *Posidonia oceanica* meadows degraded by beach replenishment eighteen years before was assessed in two impacted meadows and compared with other two undisturbed localities. Inside each locality, we selected randomly three sites separated by 500-1000 m. At site level we study the vitality of *P. oceanica* meadow assessing the vegetative growth, leaf characteristics, and non-structural carbohydrates of the plants. Additionally, at locality level, silt-clay fraction, organic matter, pH and light intensity incident on the sea bottom were measured to evaluate the environmental conditions. Covering of *P. oceanica* was significantly lower at the impacted localities while amount of dead "matte" was higher. Leaf production of horizontal rhizomes (14.6 ± 1.11 vs 19.47 ± 1.45 leaves y^{-1}), net total rhizomes recruitment (2.33 ± 0.17 vs 4.3 ± 0.33 branches y^{-1}) and starch concentration (43.625 ± 0.67 vs 54.45 ± 0.74 mg per g of rhizome) at impacted meadows were significantly lower than controls. Leaf features, epiphytes biomass, colonization, elongation and horizontal and vertical rhizome production did not show significant differences. Sediments at impacted localities contained higher silt-clay fraction and higher organic matter load while pH was lower. Light intensity on the sea bottom measured at all localities was over the minimum light requirements estimated for *P. oceanica*. Our results show that the press impact produced by beach replenishment was enduring in the time slowing natural recovery by 45%. This impact may be related with changes in the sediment features.

McClain, C.R. **Seamounts: identity crisis or split personality?** *Journal of Biogeography* 34(12): 2001-2008, 2007.

Notes: At present, researchers propose that over 14,000 seamounts exist and, like their terrestrial analogues, function like islands. In addition, seamounts are described as oases, biodiversity hotspots, and lush coral/sponge gardens. Here I discuss the extent to which these tenets regarding seamounts may be inappropriate, suffer from a lack of support, and be over-generalizations of a broad range of environmental types encountered on seamounts. Ultimately, for seamount science to progress, we need to challenge our conventional wisdom on these habitats and the extent to which all seamounts function in a similar manner.

Giri, C., Zhu, Z., Tieszen, L.L., Singh, A., Gillette, S., and Kelmelis, J.A. **Mangrove forest distributions and dynamics (1975-2005) of the tsunami-affected region of Asia.** *Journal of Biogeography* 35(3): 519-528, 2008.

Notes: *Aim* We aimed to estimate the present extent of tsunami-affected mangrove forests and determine the rates and causes of deforestation from 1975 to 2005. *Location* Our study region covers the tsunami-affected coastal areas of Indonesia, Malaysia, Thailand, Burma (Myanmar), Bangladesh, India and Sri Lanka in Asia. *Methods* We interpreted time-series Landsat data using a hybrid supervised and unsupervised classification approach. Landsat data were geometrically corrected to an accuracy of plus-or-minus half a pixel, an accuracy necessary for change analysis. Each image was normalized for solar irradiance by converting digital number values to the top-of-the atmosphere reflectance. Ground truth data and existing maps and data bases were used to select training samples and also for iterative labelling. We used a post-classification change detection approach. Results were validated with the help of local experts and/or high-resolution commercial satellite data. *Results* The region lost 12% of its mangrove forests from 1975 to 2005, to a present extent of c. 1,670,000 ha. Rates and causes of deforestation varied both spatially and temporally. Annual deforestation was highest in Burma (c. 1%) and lowest in Sri Lanka (0.1%). In contrast, mangrove forests in India and Bangladesh remained unchanged or gained a small percentage. Net deforestation peaked at 137,000 ha during 1990-2000, increasing from 97,000 ha during 1975-90, and declining to 14,000 ha during 2000-05. The major causes of deforestation were agricultural expansion (81%), aquaculture (12%) and urban development (2%). *Main conclusions* We assessed and monitored mangrove forests in the tsunami-affected region of Asia using the historical archive of Landsat data. We also measured the rates of change and determined possible causes. The results of our study can be used to better understand the role of mangrove forests in saving lives and property from natural disasters such as the Indian Ocean tsunami, and to identify possible areas for conservation, restoration and rehabilitation

Ellison, A.M. **Managing mangroves with benthic biodiversity in mind: Moving beyond roving banditry.** *Journal of Sea Research* 59(1-2): 2-15, 2008.

Notes: This review addresses mangrove management activities in the broader context of the diversity of the mangrove benthos. Goals for mangrove ecosystem management include silviculture, aquaculture, or 'ecosystem services' such as coastal protection. Silvicultural management of mangroves generally neglects the benthos, although benthic invertebrates may affect tree establishment and growth, and community composition of benthic invertebrates may be a reliable indicator of the state of managed mangrove forests. Similarly, mangrove aquaculture focuses on particular species with little attention paid either to impacts on other trophic levels or to feedbacks with the trees. Exploitation of mangrove-associated prawns, crabs, and molluscs has a total economic value >US \$4 billion per year. These aquaculture operations still rely on wild-collected stock; world-wide patterns of exploitation fit the well-known process of 'roving banditry', where mobile agents move from location to location, rapidly exploiting and depleting local resources before moving on to other, as-yet unprotected grounds. Collection of brood stock and fishing for other external inputs required by aquaculture (e.g., 'trash fish') removes intermediate trophic levels from marine food webs, may destabilize them, and lead to secondary extinctions of higher-order predators. Increased attention being paid to the role of mangroves in coastal protection following the 2004 Indian Ocean tsunami provides an opportunity to reassess the relative merits of management focused on short-term economic gains. Managing for ecosystem services may ultimately preserve benthic biodiversity in mangrove ecosystems.

Notes: Macrobenthic assemblages are relatively poorly known compared to other components of the mangrove ecosystem. Tropical mangroves support macrobenthic biodiversity resources yet to be properly documented and interpreted. Some methodological challenges, such as the generally high spatial heterogeneity and complexity of the habitat, evidently reduce sampling efficiency and accuracy, while also leaving some microhabitats under-sampled. Macrobenthic assemblage structure seems to be influenced by local environmental conditions, such as hydroperiod, organic matter availability and sediment characteristics. Brachyurans, gastropods and oligochaetes dominate in the sediment, with the former two groups also common on hard surfaces provided by tree trunks, while insects and arachnids inhabit the canopy. Traditionally, studies of mangrove macrobenthos have focused on assemblage structure or the biology of individual species, but more complex inter-specific interactions and the inter-relationship between habitat and the biota are recently being addressed. Brachyuran crabs are the best-studied macrobenthos group, but many issues about their role in mangrove ecosystem dynamics are still controversial. Despite many species of mangrove macrobenthos being referred to as 'trophic dead ends', most serve as important links between recalcitrant mangrove organic matter and estuarine secondary production, through feeding excursion by mobile nekton during the high tide, and macrobenthos-mediated processing and exportation of organic matter. A significant difference in the standing crop biomass of forests between the Indo-west-Pacific (IWP) and Atlantic-east-Pacific (AEP) mangroves may be related to the difference in species richness of mangrove as well as macrobenthos diversity in the two bioregions. Such differences in assemblage structure may also result in different ecosystem functioning, but the nature of the links is, however, yet to be explored. There is also a strong need for evaluating mangrove macrobenthos assemblages as a component of the connected biotic resources in the land-sea continuum, rather than as an isolated faunal group.
