

# Marine Science Review - 179

## Ecosystems and habitats



### In this review:

- A. Recent articles – no abstract available
- B. Recent publications available online
- C. Recent articles with abstracts

## A. Recent articles – no abstract available

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Wells, S. and Kapos, V. **Coral reefs and mangroves: implications from the tsunami one year on.** *Oryx* 40(2): 123-124, 2006.

## B. Recent publications available online

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Gilman, E. et al. 2006. **Pacific Island Mangroves in a Changing Climate and Rising Sea.** UNEP Regional Seas Reports and Studies No. 179. United Nations Environment Programme, Regional Seas Programme, Nairobi. 58pp.

**Available at:** <http://www.unep.org/PDF//mangrove-report.pdf>

**Notes:** The central aim of this publication is to highlight the results and recommendations from a study that has assessed the capacity of Pacific Island countries and territories to determine mangrove vulnerability and adapt to mangrove responses to climate change effects. The report identifies national and regional priority needs for technical and institutional capacity-building and discusses how results from this Pacific Island study could contribute to other relevant regional and international initiatives. It also describes the status, trends and diversity of Pacific Island mangroves; the services and products derived from mangrove communities; and considerations for the development of a strategy to plan and adapt to site-specific mangrove responses to climate change effects, including the critical need for community-based approaches, integrated coastal zone management, increased mangrove resistance and resilience, and outreach activities.

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European Environment Agency. 2006. **The changing faces of Europe's coastal areas.** EEA Report No 6/2006. EEA, Copenhagen. 107pp.

**Available at:** [http://reports.eea.europa.eu/eea\\_report\\_2006\\_6/en/eea\\_report\\_6\\_2006.pdf](http://reports.eea.europa.eu/eea_report_2006_6/en/eea_report_6_2006.pdf)

**Notes:** This report provides information on the state of the environment in the coastal areas of Europe, and provides evidence of the need for a more integrated, long-term approach. Since 1995, concern about the state of Europe's coastline has led to a number of EU initiatives, which build on the concept of integrated coastal zone management (ICZM). ICZM attempts to balance the needs of development with protection of the very resources that sustain coastal economies. It also takes into account the public's concern about the deteriorating environmental, socio-economic and cultural state of the European coastline. The specific objective of this work is to contribute to the review of the Recommendation of the European Parliament and the Council concerning the implementation of Integrated Coastal Zone Management in Europe (2002/413/EC), planned by the European Commission for 2006. This review requires information on existing trends and on the effects of policies and financial instruments directed towards coastal management. The EEA intends to contribute to the review by promoting spatial analysis and enhancing the integration of relevant environmental data with related socio-economic

data to the extent current available information allows. At the same time, the report aligns itself to the wider context of ecosystems and human well-being set up by the Millennium Ecosystem Assessment (2005). By linking ecosystems and human well-being, this approach focuses in particular on 'ecosystem services', i.e. the benefits people obtain from ecosystems. Climate change and its impact on coastal zones is yet another important analytical framework that is taken into account while analysing the state of coasts. The increasing vulnerability of the coastal population and ecosystems becomes a challenge for the ICZM approach, which should achieve a reduction in these vulnerabilities through the coherent spatial organisation of coastal zones and by increasing the resilience of coastal systems.

## C. Recent articles with abstracts

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Barbier, E.B. **Natural barriers to natural disasters: replanting mangroves after the tsunami.** *Frontiers in Ecology and Environment* 4(3): 124-131, 2006.

**Notes:** The Indian Ocean tsunami disaster of December 2004 has increased interest in replanting degraded and deforested mangrove areas in Asia to improve coastal protection. Evidence from Thailand suggests that concern over mangrove deforestation by shrimp farms is an important motivation for many coastal households to participate in mangrove rehabilitation. However, successful re-establishment and management of mangroves as effective coastal barriers will require developing new institutions and policies, and must involve coastal communities in Thailand and other Indian Ocean countries in the conservation and protection of their local mangrove forests.

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Harborne, A R., Mumby, P.J., Micheli, F., Perry, C.T., Dahlgren, C.P., Holmes, K.E., and Brumbaugh, D.R. **The functional value of Caribbean coral reef, seagrass and mangrove habitats to ecosystem processes.** *Advances in Marine Biology* 50: 57-189, 2006.

**Notes:** Caribbean coral reef habitats, seagrass beds and mangroves provide important goods and services both individually and through functional linkages. A range of anthropogenic factors are threatening the ecological and economic importance of these habitats and it is vital to understand how ecosystem processes vary across seascapes. A greater understanding of processes will facilitate further insight into the effects of disturbances and assist with assessing management options. Despite the need to study processes across whole seascapes, few spatially explicit ecosystem-scale assessments exist. We review the empirical literature to examine the role of different habitat types for a range of processes. The importance of each of 10 generic habitats to each process is defined as its "functional value" (none, low, medium or high), quantitatively derived from published data wherever possible and summarised in a single figure. This summary represents the first time the importance of habitats across an entire Caribbean seascape has been assessed for a range of processes. Furthermore, we review the susceptibility of each habitat to disturbances to investigate spatial patterns that might affect functional values. Habitat types are considered at the scale discriminated by remotely-sensed imagery and we envisage that functional values can be combined with habitat maps to provide spatially explicit information on processes across ecosystems. We provide examples of mapping the functional values of habitats for populations of three commercially important species. The resulting data layers were then used to generate seascape-scale assessments of "hot spots" of functional value that might be considered priorities for conservation. We also provide an example of how the literature reviewed here can be used to parameterise a habitat-specific model investigating reef resilience under different scenarios of herbivory. Finally, we use multidimensional scaling to provide a basic analysis of the overall functional roles of different habitats. The resulting ordination suggests that each habitat has a unique suite of functional values and, potentially, a distinct role within the ecosystem. This review shows that further data are required for many habitat types and processes, particularly forereef and escarpment habitats on reefs and for seagrass beds and mangroves. Furthermore, many data were collected prior to the regional mass mortality of *Diadema* and *Acropora*, and subsequent changes to benthic communities have, in many cases, altered a habitat's functional value, hindering the use of these data for parameterising maps and models. Similarly, few data exist on how functional values change when environmental parameters, such as water clarity, are altered by natural or anthropogenic influences or the effects of a habitat's spatial context within the seascape. Despite these limitations, sufficient data are available to construct maps and models to better understand tropical marine ecosystem processes and assist more effective mitigation of threats that alter habitats and their functional values.

Morton, R.A., Bernier, J.C., and Barras, J.A. **Evidence of regional subsidence and associated interior wetland loss induced by hydrocarbon production, Gulf Coast region, USA.** *Environmental Geology* 50(2): 261-274, 2006.

**Notes:** Analysis of remote images, elevation surveys, stratigraphic cross-sections, and hydrocarbon production data demonstrates that extensive areas of wetland loss in the northern Gulf Coast region of the United States were associated with large-volume fluid production from mature petroleum fields. Interior wetland losses at many sites in coastal Louisiana and Texas are attributed largely to accelerated land subsidence and fault reactivation induced by decreased reservoir pressures as a result of rapid or prolonged extraction of gas, oil, and associated brines. Evidence that moderately-deep hydrocarbon production has induced land-surface subsidence and reactivated faults that intersect the surface include: (1) close temporal and spatial correlation of fluid production with surficial changes including rapid subsidence of wetland sediments near producing fields, (2) measurable offsets of shallow strata across the zones of wetland loss, (3) large reductions in subsurface pressures where subsidence rates are high, (4) coincidence of orientation and direction of displacement between surface fault traces and faults that bound the reservoirs, and (5) accelerated subsidence rates near producing fields compared to subsidence rates in surrounding areas or compared to geological rates of subsidence. Based on historical trends, subsidence rates in the Gulf Coast region near producing fields most likely will decrease in the future because most petroleum fields are nearly depleted. Alternatively, continued extraction of conventional energy resources as well as potential production of alternative energy resources (geopressured-geothermal fluids) in the Gulf Coast region could increase subsidence and land losses and also contribute to inundation of areas of higher elevation.

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Wall, L.M., Walters, L.J., Grizzle, R.E., and Sacks, P.E. **Recreational boating activity and its impact on the recruitment and survival of the oyster *Crassostrea virginica* on intertidal reefs in Mosquito Lagoon, Florida.** *Journal of Shellfish Research* 24(4): 965-973, 2005.

**Notes:** Along the east coast of central Florida in the Indian River Lagoon system, intense recreational boating activity occurs year-round, and intertidal reefs of the eastern oyster *Crassostrea virginica* (Gmelin) with dead margins (mounds of disarticulated shells) on their seaward edges are commonly found adjacent to major boating channels. These dead margins are caused, at least in part, by boat wakes and extend significantly higher above the high water line than reefs lacking dead margins (pristine reefs). To determine if these "impacted" oyster reefs alter recruitment and subsequent survival of *C. virginica*, three 8-wk field trials were run between May 2001 and April 2002 in Mosquito Lagoon. During each trial, data were also collected on total sediment loads, silt/clay fractions and relative water motion. Although recruitment did not differ between impacted and pristine reefs, juvenile survival was significantly reduced on impacted reefs. Additionally, larval recruitment and subsequent mortality were greatest during our summer trial. Total sediment loads, percent silt/clay, and relative water motion were significantly higher on impacted reefs. For these three variables, the largest values were consistently found at the bases of exposed (seaward) regions of impacted reefs. By documenting a positive relationship between reduced success of *C. virginica* and dead margins, and knowing that boat wakes contribute to the development of dead margins, we have provided the first cause and effect mechanism between intense recreational boating activity and increased oyster mortality.

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Miroshnichenko, M.L. and Bonch-Osmolovskaya, E.A. **Recent developments in the thermophilic microbiology of deep-sea hydrothermal vents.** *Extremophiles* 10(2): 85-96, 2006.

**Notes:** The diversity of thermophilic prokaryotes inhabiting deep-sea hot vents was actively studied over the last two decades. The ever growing interest is reflected in the exponentially increasing number of novel thermophilic genera described. The goal of this paper is to survey the progress in this field made in the years 2000-2005. In this period, representatives of several new taxa of hyperthermophilic archaea were obtained from deep-sea environments. Two of these isolates had phenotypic features new for this group of organisms: the presence of an outer cell membrane (the genus *Ignicoccus*) and the ability to grow anaerobically with acetate and ferric iron (the genus *Geoglobus*). Also, our knowledge on the diversity of thermophilic bacteria from deep-sea thermal environments extended significantly. The new bacterial isolates represented diverse bacterial divisions: the phylum Aquificae, the subclass Epsilonproteobacteria, the order Thermotogales, the families Thermodesulfobacteriaceae, Deferribacteraceae, and Thermaceae, and a novel bacterial phylum represented by the genus *Caldithrix*. Most of these isolates are obligate or facultative lithotrophs, oxidizing molecular hydrogen in the course of different types of anaerobic respiration or microaerobic growth. The existence and significant ecological role of some of new bacterial thermophilic isolates was initially established by molecular methods.

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Yang, Z., Wang, H., Saito, Y., Milliman, J.D., Xu, K., Qiao, S., and Shi, G. **Dam impacts on the Changjiang (Yangtze) River sediment discharge to the sea: The past 55 years and after the Three Gorges Dam.** *Water Resources Research* 42(4): art. W04407, 2006.

**Notes:** In 5 recent years (2000 - 2004), the Changjiang (Yangtze) River has discharged past Datong (600 km from the river mouth) an average of ~ 250 million tons (mt) of sediment per year, a decrease of more than 40% since the 1950s and 1960s, whereas water discharge at Datong has increased slightly. Water and sediment discharge data from the upper, middle, and lower reaches of the river suggest that the reduction of the Changjiang sediment load has occurred in two phases between 1950 and 2002: following the closure of the Danjiangkou Reservoir on the Hanjiang tributary in 1968 and following the installation of numerous dams and water-soil conservation works in the Jialingjiang catchment after 1985. As the Three Gorges Dam (TGD) started operating in 2003, the Changjiang entered a third phase of sediment reduction with annual sediment loads at Datong < 200 mt/yr. Upon completion of the Three Gorges Dam (TGD) in 2009, the sediment load at Datong will decrease to ~ 210 mt/yr for the first 20 years, then will recover to ~ 230 mt/yr during 2030 - 2060, and will reach ~ 310 mt/yr during 2060 - 2110. From the sediment budget and sediment erosion data for the Changjiang subaqueous delta, it can be assumed that the delta will be eroded extensively during the first five decades after TGD operation and then will approach a balance during the next five decades as sediment discharging from TGD again increases.

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Speybroeck, J., Bonte, D., Courtens, W., Gheschiere, T., Grootaert, P., Maelfait, J.P., Mathys, M., Provoost, S., Sabbe, K., Stienen, E.W.M., Van Lancker, V., Vincx, M., and Degraer, S. **Beach nourishment: an ecologically sound coastal defence alternative? A review.** *Aquatic Conservation: Marine and Freshwater Ecosystems* 16(4): 419-435, 2006.

**Notes:** 1. Even though beach nourishment is generally considered as an environment-friendly option for coastal protection and beach restoration, sizeable impacts on several beach ecosystem components (microphytobenthos, vascular plants, terrestrial arthropods, marine zoobenthos and avifauna) are described in the literature, as reviewed in this paper. 2. Negative, ecosystem-component specific effects of beach nourishment dominate in the short to medium term, with the size of the impact being determined by (1) activities during the construction phase, (2) the quality and (3) the quantity of the nourishment sand, (4) the timing, place and size of project, and (5) the nourishment technique and strategy applied. Over the long term the speed and degree of ecological recovery largely depend on the physical characteristics of the beach habitat, mainly determined by (1) sediment quality and quantity, (2) the nourishment technique and strategy applied, (3) the place and the size of nourishment and (4) the physical environment prior to nourishment. 3. The limited information available on indirect and cumulative ecological effects indicates that these effects cannot be neglected in an overall impact assessment. Hence, for ecologically good practice of beach nourishment it is advised (1) to choose nourishment sands with a sediment composition comparable to that of the natural sediment, (2) to avoid short-term compaction by ploughing immediately after construction, (3) to execute the nourishment in a period of low beach use by birds and other mobile organisms, (4) to choose a number of smaller projects rather than a single large nourishment project and (5) to select the nourishment technique with respect to the local natural values. 4. In order to allow an objective, scientifically sound, ecological adjustment of future nourishments, research should aim at (1) taking into account the full sandy beach ecosystem, (2) avoiding strategic imperfections in experimental design and (3) elucidating the biological processes behind impact and recovery of all ecosystem components.

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Bujang, J.S., Zakaria, M.H., and Arshad, A. **Distribution and significance of seagrass ecosystems in Malaysia.** *Aquatic Ecosystem Health and Management* 9(2): 203-214, 2006.

**Notes:** Seagrasses are the only flowering plants (monocotyledonous Angiosperms) that have adapted themselves to living in marine and estuarine habitats, and are submerged most of the time. They are rooted in sediments on the sea bottom, with shoots appearing above the substrate. Seagrasses occurred at 78 sites scattered in the west and east coasts of Peninsular Malaysia and in Sabah and Sarawak in East Malaysia. They are usually found along the coasts growing in association with shallow inter-tidal, mangroves, coral reefs, semi-enclosed lagoons and shoals. In these habitats, seagrass beds or meadows have distinct species assemblage completely adapted to the submerged life. There are fourteen major species of seagrasses recorded in Malaysia: *Enhalus acoroides*, *Halophila beccarii*, *H. decipiens*, *H. ovalis*, *H. minor*, *H. spinulosa*, *Halodule pinifolia*, *H. uninervis*, *Cymodocea rotundata*, *C. serrulata*, *Thalassia hemprichii*, *Syringodium isoetifolium*, *Ruppia maritima* and *Thalassodendron ciliatum*. Although

seagrasses make up only a small portion of the marine ecosystem, the physical settings and their interactive community within and from outside account for their high diversity and ensure survival of an assortment of vertebrates (fish), invertebrates (shrimps, starfish, sea cucumbers, bivalves, gastropods), and seaweeds. Seagrass form the food and habitats for the vulnerable dugongs or sea cows (*Dugong dugon*), seahorses (*Hippocampus* spp.) and endangered green turtles (*Chelonia mydas*), and for other fish, and also a feeding ground for seasonal migratory birds, *Egretta garzetta*. Seagrasses provide conditions for the growth and abundance of invertebrates and fish that many local coastal communities collect and catch for their livelihood. Seagrass ecosystems are sources of food and yet they are continually threatened by human activities, causing their degradation and possible habitat loss. The purpose of this review is to give information on the significant linkages of seagrasses with the coastal inhabitants and to suggest recommendations for the protection and conservation of this important ecosystem and the associated resources.

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Brooks, R.A., Purdy, C.N., Bell, S.S., and Sulak, K.J. **The benthic community of the eastern US continental shelf: A literature synopsis of benthic faunal resources.** *Continental Shelf Research* 26(6): 804-818, 2006.

**Notes:** The existing scientific literature on offshore benthic assemblages (OBA) residing along the US East and Gulf of Mexico continental shelf was reviewed. Identification was made of any associations between the dominant OBA and particular sediment types and/or bathymetry. Of special interest was the evaluation of reported effects of sand dredge/mining activities on the dominant OBA and recognition of data deficiencies. One hundred and twenty-two references were selected and classified as to type of study with pertinent results extracted. Polychaetes were predominantly cited as the principal infaunal taxa present in studies from both the Gulf of Mexico and US Atlantic coast. Specifically, *Prionospio cristata*, *Nephtys incisa*, *N. picta*, and *Spiophanes bombyx* were consistently identified as a common part of the benthic community structure. Surveys from the East Coast indicated a greater diversity of dominant taxa not reported for the Gulf of Mexico than vice-versa. Robust animal-sediment or animal-depth relationships were not readily available. From the few studies available, it appears that general "recovery" from anthropogenic disturbance by benthic assemblages on the continental shelf occurs within three months to 2.5 years. Presently, it is difficult to draw conclusions about approximate benthic faunal recovery times following anthropogenic activities such as sand mining and/or disposal operations because of the paucity of studies.

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Campbell, S.J., McKenzie, L.J., and Kerville, S.P. **Photosynthetic responses of seven tropical seagrasses to elevated seawater temperature.** *Journal of Experimental Marine Biology and Ecology* 330(2): 455-468, 2006.

**Notes:** This study uses chlorophyll *a* fluorescence to examine the effect of environmentally relevant (1-4 h) exposures of thermal stress (35-45°C) on seagrass photosynthetic yield in seven tropical species of seagrasses. Acute response of each tropical seagrass species to thermal stress was characterised, and the capacity of each species to tolerate and recover from thermal stress was assessed. Two fundamental characteristics of heat stress were observed. The first effect was a decrease in photosynthetic yield (F-v/ F) characterised by reductions in F and F-m'. The dramatic decline in F/F-m' ratio, due to chronic inhibition of photosynthesis, indicates an intolerance of *Halophila ovalis*, *Zostera capricorni* and *Syringodium isoetifolium* to ecologically relevant exposures of thermal stress and structural alterations to the PhotoSystem II (PSII) reaction centres. The decline in F-m' represents heat-induced photoinhibition related to closure of PSII reaction centres and chloroplast dysfunction. The key finding was that *Cymodocea rotundata*, *Cymodocea serrulata*, *Halodule uninervis* and *Thalassia hemprichii* were more tolerant to thermal stress than *H. ovalis*, *Z. capricorni* and *S. isoetifolium*. After 3 days of 4 h temperature treatments ranging from 25 to 40°C, *C. rotundata*, *C. serrulata* and *H. uninervis* demonstrated a wide tolerance to temperature with no detrimental effect on F-v/F-m' qN or qP responses. These three species are restricted to subtropical and tropical waters and their tolerance to seawater temperatures 25 to 40°C is likely to be an adaptive response to high temperatures commonly occurring at low tides and peak solar irradiance. The results of temperature experiments suggest that the photosynthetic condition of all seagrass species tested are likely to suffer irreparable effects from short-term or episodic changes in seawater temperatures as high as 40-45°C. Acute stress responses of seagrasses to elevated seawater temperatures are consistent with observed reductions in above-ground biomass during a recent El Nino event.

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Milbrandt, E.C. and Tinsley, M.N. **The role of saltwort (*Batis maritima* L.) in regeneration of degraded mangrove forests.** *Hydrobiologia* 568: 369-377, 2006.

**Notes:** While saltwort (*Batis maritima* L.) is common in the fringe mangrove forests of southwest Florida, its role in regeneration of degraded mangrove communities is not known. Given the potential encroachment and subsequent degradation of mangrove communities by sea-level rise, it is important to quantify the effect of early-colonizing vegetation to early mangrove seedling survival. A greater number of mangrove seedlings were observed in existing *B. maritima* patches compared to surrounding mudflats. A planting experiment was designed to determine whether *B. maritima* was responsible for the observed pattern. Black mangrove (*Avicennia germinans* L.) seedlings, raised in a nursery, were planted in previously established *B. maritima* patches and on mudflats with and without nursery-raised *B. maritima*. There was significantly lower mortality of *A. germinans* seedlings when planted in existing *B. maritima* patches (69%), compared to seedlings planted on the mudflats (93%), demonstrating that existing *B. maritima* improved *A. germinans* seedling survival. Nursery-raised *B. maritima* had lower mortality on open mudflats (28%), suggesting that it can tolerate conditions, which make it an early colonizer of newly available habitats. The primary mechanism proposed for improving seedling success is a slight increase in elevation provided by the dense root network of established *B. maritima*. These findings have implications for scientists and managers anticipating the response of mangroves to sea-level rise.

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Dittel, A.I., Epifanio, C.E., and Fogel, M.L. **Trophic relationships of juvenile blue crabs (*Callinectes sapidus*) in estuarine habitats.** *Hydrobiologia* 568: 379-390, 2006.

**Notes:** Salt marshes and shallow-water macroalgal beds are known to provide nursery habitat for many species of fish and invertebrates. The role of these habitats as refuge from predation is well established, but the degree to which indigenous primary production within the nursery provides food for growth and development of estuarine species remains unresolved. In this study, we tested the hypothesis that juvenile blue crabs depend on indigenous primary production, directly or indirectly, during their entire stay within the nursery. To test this hypothesis, we conducted isotopic studies and stomach content analyses of juveniles from habitats near the mouth of Delaware Bay and from an adjacent lagoonal estuary (ca. 39.5°N, 75.1°W). Primary producers, marsh detritus, various life-history stages of blue crabs and potential prey species were sampled in the main estuary and in an adjacent marsh during the summer and early fall of two consecutive years. Newly settled juveniles (< 15 mm carapace width) from the marsh were about 1.8% lighter in carbon (-17.2%) relative to larger juveniles from the marsh (15-30 mm carapace width) and appeared to have retained a carbon isotopic signature indicative of the phytoplankton-based food web associated with larval stages. However, the signature of juveniles changed as a function of size. Large juveniles and crabs > 60 mm were enriched in dC-13 (-14.7 +/- 0.1%) compared to small crabs, suggesting a gradual shift in diet from a planktonic to a detritus-based food web with increasing size. As with crabs from Delaware Bay, the dC-13 signature of juvenile crabs sampled from macroalgal beds in the lagoonal estuary (Rehoboth Bay) changed as a function of size. Also, dC-13 ratios of crabs varied among the various species of macroalgae. The dN-15 composition of primary producers in the marsh and main estuary also was reflected in the delta N-15 values of crabs and other benthic consumers in the respective habitats. Results of stomach-content analysis in this study were consistent with isotope data. Observed changes in prey preferences were related to changes in size of juvenile crabs and also differed among habitats. Gut content analyses of the three size classes of juveniles in macroalgal beds from Rehoboth Bay indicated that the crabs depend heavily on various amphipod species that occur on the seaweeds. These amphipods graze directly on the macroalgae and are among the most abundant invertebrates in the macroalgal beds. This implies a direct trophic relationship between the juvenile crabs and the macroalgae. In summary, our study provides strong evidence that the value of nursery areas such as salt marshes and macroalgal beds goes beyond that of providing refuge from predation, and that species using these nurseries (e.g. juvenile blue crabs) are ultimately dependent on primary production originating in benthic plants indigenous to the nursery.

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Halpern, B.S., Cottenie, K., and Broitman, B.R. **Strong top-down control in southern California kelp forest ecosystems.** *Science* 312(5777): 1230-1232, 2006.

**Notes:** Global-scale changes in anthropogenic nutrient input into marine ecosystems via terrestrial runoff, coupled with widespread predator removal via fishing, have created greater urgency for understanding the relative role of top-down versus bottom-up control of food web dynamics. Yet recent large-scale studies of community regulation in marine ecosystems have shown dramatically different results that leave this issue largely unresolved. We combined a multiyear, large-scale data set of species abundances for 46 species in kelp forests from the California Channel Islands with satellite-derived primary production and found that top-down control explains 7- to 10-fold more of the variance in abundance of bottom and mid-trophic levels than does bottom-up control. This top-down control was propagated via a variety of species-level direct and indirect

responses to predator abundance. Management of top-down influences such as fishing may be more important in coastal marine ecosystems, particularly in kelp forest systems, than is commonly thought.

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Lotze, H.K., Lenihan, H.S., Bourque, B.J., Bradbury, R.H., Cooke, R.G., Kay, M.C., Kidwell, S.M., Kirby, M.X., Peterson, C.H., and Jackson, J.B.C. **Depletion, degradation, and recovery potential of estuaries and coastal seas.** *Science* 312(5781): 1806-1809, 2006.

**Notes:** Estuarine and coastal transformation is as old as civilization yet has dramatically accelerated over the past 150 to 300 years. Reconstructed time lines, causes, and consequences of change in 12 once diverse and productive estuaries and coastal seas worldwide show similar patterns: Human impacts have depleted >90% of formerly important species, destroyed >65% of seagrass and wetland habitat, degraded water quality, and accelerated species invasions. Twentieth-century conservation efforts achieved partial recovery of upper trophic levels but have so far failed to restore former ecosystem structure and function. Our results provide detailed historical baselines and quantitative targets for ecosystem-based management and marine conservation.

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Thampanya, U., Vermaat, J.E., Sinsakul, S., and Panapitukkul, N. **Coastal erosion and mangrove progradation of Southern Thailand.** *Estuarine, Coastal and Shelf Science* 68(1-2): 75-85, 2006.

**Notes:** Approximately 60% of the southern Thai coastline used to be occupied by mangroves according to the first mangrove forest assessment in 1961. During the past three decades, these mangrove areas have been reduced to about 50% with less than 10% left on the east coast. Coastal erosion and accretion occur irregularly along the coast but an intensification of erosion has been noticed during the past decade. This study assessed the relationship between mangrove presence and changes in coastal area. Mangrove colonization rates were assessed using in situ transects and remote sensing time series. Both methods led to comparable estimates ranging between 5 and 40 m y<sup>-1</sup>. Quantitative data on changes of coastal segments along southern Thai coastlines as well as available possible factors responsible for these changes were compiled. Overall, net erosion prevailed (1.3 +/- 0.4 m y<sup>-1</sup>). The Gulf of Thailand coastline in the East of the country was found to be most dynamic: change occurred along more coastal segments than in the West (43% vs. 16%). Rates of erosion and accretion were also higher, 3.6 versus 2.9 m y<sup>-1</sup> and 2.6 versus 1.5 m y<sup>-1</sup>, respectively. Total area losses accounted for 0.91 km<sup>2</sup> y<sup>-1</sup> for the Gulf coast and 0.25 km<sup>2</sup> y<sup>-1</sup> for the West. Coasts with and without mangroves behaved differently: in the presence of mangroves less erosion was observed whilst expansion occurred at particular coastal types with mangrove existence, i.e. river mouths and sheltered bays. Possible underlying causes were examined using multivariate analysis. Eroded areas were found to increase with increased area of shrimp farms, increased fetch to the prevailing monsoon, and when dams reduced riverine inputs. Notably, however, in areas where erosion prevailed, the presence of mangroves reduced these erosion rates. Mangrove loss was found to be higher in the presence of shrimp farms and in areas where mangrove forests used to be extensive in the past.

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Bostrom, C., Jackson, E.L., and Simenstad, C.A. **Seagrass landscapes and their effects on associated fauna: A review.** *Estuarine, Coastal and Shelf Science* 68(3-4): 383-403, 2006.

**Notes:** Seagrasses comprise some of the most heterogeneous landscape structures of shallow-water estuarine/marine ecosystems in the world. However, while knowledge at the molecular, organism, patch and community scale is pervasive, understanding of seagrass landscape ecology is more fragmentary and has not been synthesized. The growth and recruitment dynamics of seagrasses as well as man-made and/or natural disturbances create complex spatial configurations of seagrass over broad (metres to kilometres) spatial scales. Hence, it is important to identify mechanisms maintaining and/or threatening the diversity-promoting function of seagrass meadows and to understand their effects on benthic populations and communities. Although landscape ecology has recently become more integrated into seagrass research, our understanding of animal responses to variability in seagrass landscape structure is still fragmentary. By reviewing the literature to date, this paper evaluates studies on seagrass landscape ecology, testing the general null hypothesis that concepts developed in terrestrial settings can be generalized across landscapes, and (a) presenting definitions and terms used in seagrass landscape ecology, (b) reviewing geographical patterns of seagrass landscape studies to identify possible key regions and target species, (c) evaluating different methodological approaches, (d) describing the spatial and temporal scales used to describe organism responses to seagrass landscape structure, and (e) placing seagrass landscapes into an applied context.

Ericson, J.P., Vörösmarty, C.J., Dingman, S.L., Ward, L.G., and Meybeck, M. **Effective sea-level rise and deltas: Causes of change and human dimension implications.** *Global and Planetary Change* 50(1-2): 63-82, 2006.

**Notes:** An assessment is made of contemporary effective sea-level rise (ESLR) for a sample of 40 deltas distributed worldwide. For any delta, ESLR is a net rate, defined by the combination of eustatic sea-level rise, the natural gross rate of fluvial sediment deposition and subsidence, and accelerated subsidence due to groundwater and hydrocarbon extraction. ESLR is estimated under present conditions using a digital data set of delta boundaries and a simple model of delta dynamics. The deltas in this study represent all major climate zones, levels of population density, and degrees of economic development. Collectively, the sampled deltas serve as the endpoint for river basins draining 30% of the Earth's landmass, and 42% of global terrestrial runoff. Nearly 300 million people inhabit these deltas. For the contemporary baseline, ESLR estimates range from 0.5 to 12.5 mm yr<sup>-1</sup>. Decreased accretion of fluvial sediment resulting from upstream siltation of artificial impoundments and consumptive losses of runoff from irrigation are the primary determinants of ESLR in nearly 70% of the deltas. Approximately 20% of the deltas show accelerated subsidence, while only 12% show eustatic sea-level rise as the predominant effect. Extrapolating contemporary rates of ESLR through 2050 reveals that 8.7 million people and 28,000 km<sup>2</sup> of deltaic area in the sample set of deltas could suffer from enhanced inundation and increased coastal erosion. The population and area inundated rise significantly when considering increased flood risk due to storm surge. This study finds that direct anthropogenic effects determine ESLR in the majority of deltas studied, with a relatively less important role for eustatic sea-level rise. Serious challenges to human occupancy of deltaic regions worldwide are thus conveyed by factors which to date have been studied less comprehensively than the climate change-sea-level rise question.

Restrepo, J.D., Zapata, P., Díaz, J.M., Garzón-Ferreira, J., and García, C.B. **Fluvial fluxes into the Caribbean Sea and their impact on coastal ecosystems: The Magdalena River, Colombia.** *Global and Planetary Change* 50(1-2): 33-49, 2006.

**Notes:** The Magdalena, a world-class river, in the top ten in terms of sediment load 150 MT/yr, is the largest river discharging directly into the Caribbean Sea. Data on water discharge, sediment load, and dissolved load of the Magdalena River is presented as an initial interpretation of coastal ecosystems changes in relation to water discharge and sediment load from the Magdalena. During the 1972-1998 yr-period, the Magdalena River has delivered approximately 4022 MT of sediment to the Caribbean coast. The river reflects high inter-annual variability and delivers large portions of its fluvial discharge and sediment loads in short periods of time. The analysis of annual deviations from the 27-yr mean sediment load indicates that 59% of the total sediment load variability of the Magdalena at Calamar could be attributed to flashy peak events. Further analyses of sediment load anomalies suggest that there was a high discharge period in the Magdalena River between 1985 and 1995 and another one in the Canal del Dique between 1985 and 1992. These increasing trends in sediment load coincide with the overall decline of live coral cover around the Rosario Islands, a 145 km<sup>2</sup> coral reef complex in the Caribbean Sea that constitutes a marine protected area. The comparison of live coral: algae ratios for the 1983-2004 yr-period, also indicates that there has been an associated increase in the percentage of algae cover (i.e., Grande Island 1983=5%, 2004=59%). Other analyses show that nearly 850 ha of seagrass existing in the Cartagena Bay in the 1930s, only 76 ha remained in 2001, which is less than 8% of the original cover. There has been a mix of multiple stressors (natural and anthropogenic; local, regional and global; temporal and chronic) affecting the coastal ecosystems in the area, but the effect of the Magdalena River runoff has been constant and very prolonged (several decades). The impacts of heavy sediment loads and freshwater discharges from the Canal del Dique to Cartagena Bay have greatly contributed to the partial disappearance of coral formations and also to a considerable reduction in abundance of seagrass beds in the bay and neighboring areas.

Duffy, J.E. **Biodiversity and the functioning of seagrass ecosystems.** *Marine Ecology Progress Series* 311: 233-250, 2006.

**Notes:** Biodiversity at multiple levels - genotypes within species, species within functional groups, habitats within a landscape - enhances productivity, resource use, and stability of seagrass ecosystems. Several themes emerge from a review of the mostly indirect evidence and the few experiments that explicitly manipulated diversity in seagrass systems. First, because many seagrass communities are dominated by 1 or a few plant species, genetic and phenotypic diversity within such foundation species has important influences on ecosystem productivity and stability. Second, in seagrass beds and many other aquatic systems, consumer control is strong, extinction is biased toward large body size and high trophic levels, and thus human

impacts are often mediated by interactions of changing 'vertical diversity' (food chain length) with changing 'horizontal diversity' (heterogeneity within trophic levels). Third, the openness of marine systems means that ecosystem structure and processes often depend on interactions among habitats within a landscape (landscape diversity). There is clear evidence from seagrass systems that advection of resources and active movement of consumers among adjacent habitats influence nutrient fluxes, trophic transfer, fishery production, and species diversity. Future investigations of biodiversity effects on processes within seagrass and other aquatic ecosystems would benefit from broadening the concept of biodiversity to encompass the hierarchy of genetic through landscape diversity, focusing on links between diversity and trophic interactions, and on links between regional diversity, local diversity, and ecosystem processes. Maintaining biodiversity and biocomplexity of seagrass and other coastal ecosystems has important conservation and management implications.

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Dahlgren, C.P., Kellison, G.T., Adams, A.J., Gillanders, B.M., Kendall, M.S., Layman, C.A., Ley, J.A., Nagelkerken, I., and Serafy, J.E. **Marine nurseries and effective juvenile habitats: concepts and applications.** *Marine Ecology Progress Series* 312: 291-295, 2006.

**Notes:** Much recent attention has been focused on juvenile fish and invertebrate habitat use, particularly defining and identifying marine nurseries. The most significant advancement in this area has been the development of a standardized framework for assessing the relative importance of juvenile habitats and classifying the most productive as nurseries. Within this framework, a marine nursery is defined as a juvenile habitat for a particular species that contributes a greater than average number of individuals to the adult population on a per-unit-area basis, as compared to other habitats used by juveniles. While the nursery definition and framework provides a powerful approach to identifying habitats for conservation and restoration efforts, it can omit habitats that have a small per-unit-area contribution to adult populations, but may be essential for sustaining adult populations. Here we build on the nursery concept by developing a framework for evaluating juvenile habitats based on their overall contribution to adult populations, and introduce the concept of Effective Juvenile Habitat (EJH) to refer to habitats that make a greater than average overall contribution to adult populations.

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Weishar, L.L., Teal, J.M., and Hinkle, R. **Designing large-scale wetland restoration for Delaware Bay.** *Ecological Engineering* 25(3): 231-239, 2005.

**Notes:** Perimeter dikes around Delaware Bay salt marshes, many installed more than 50 years ago, have reduced marsh plain elevations, obliterated tidal channels, reduced *Spartina alterniflora* and increased *Phragmites australis*. Restoration goals included a salt marsh ecosystem dominated by *S. alterniflora* with significant areas of *Spartina patens* and to increase the detrital production and contribution of these areas to the marsh/estuary food web and to provide refuge, feeding habitat, and nursery grounds for various estuarine fish. The first step in the design process was to obtain consensus among regulators, ecologists, engineers, and the public as to marsh structure and function. Second was to reach agreement on the essential sedimentary and hydrodynamic characteristics needed to achieve the desired ecosystem. Third was to develop a two-dimensional hydrodynamic numerical model to design marsh channels that would not erode, would have typical channel cross-sections, and would have a hydro-period on the marsh plain to allow growth of the desired species. The process for design that met the restoration goals and was acceptable to the regulatory agencies and the public was complex. We discuss the social/political and the scientific/engineering steps used to reach a final design acceptable to all involved parties.

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Teal, J.M. and Weishar, L. **Ecological engineering, adaptive management, and restoration management in Delaware Bay salt marsh restoration.** *Ecological Engineering* 25(3): 304-314, 2005.

**Notes:** Salt hay marshes were diked and farmed for over 50 years, reducing marsh plain elevations, obliterating many tidal channels, keeping fish out of the marsh, and encouraging invasion of *Phragmites*. Restoration involved setting restoration goals, careful planning, recreating major tidal channels, and opening the dikes. Ecological engineering, allowing nature to self-design, was used to create the smaller tidal channels, re-introduce fish, and adjust the elevation of the marsh plain and revegetate it. Adaptive management, specified in regulatory requirements, was used to monitor the restoration to ensure that design goals were met. Adaptive management and restoration management, less constrained by regulatory requirements but an equally intense process, were carried out by a small team of ecologists, engineers, and regulators. Ecological engineering, adaptive

management, and restoration management were used to restore the structure and function of degraded salt marshes and were essential to the success of the Delaware Bay wetland restorations.

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Erwin, R.M., Cahoon, D.R., Prosser, D.J., Sanders, G.M., and Hensel, P. **Surface elevation dynamics in vegetated *Spartina* marshes versus unvegetated tidal ponds along the mid-Atlantic coast, USA, with implications to waterbirds.** *Estuaries and Coasts* 29(1): 96-106, 2006.

**Notes:** Mid Atlantic coastal salt marshes contain a matrix of vegetation diversified by tidal pools, pannes, and creeks, providing habitats of varying importance to many species of breeding, migrating, and wintering waterbirds. We hypothesized that changes in marsh elevation were not sufficient to keep pace with those of sea level in both vegetated and unvegetated *Spartina alterniflora* sites at a number of mid lagoon marsh areas along the Atlantic Coast. We also predicted that northern areas would suffer less of a deficit than would southern sites. Beginning in August 1998, we installed surface elevation tables at study sites on Cape Cod, Massachusetts, southern New Jersey, and two locations along Virginia's eastern shore. We compared these elevation changes over the 4-4.5 yr record with the long-term (> 50 yr) tidal records for each locale. We also collected data on waterbird use of these sites during all seasons of the year, based on ground surveys and replicated surveys from observation platforms. Three patterns of marsh elevation change were found. At Nauset Marsh, Cape Cod, the *Spartina* marsh surface tracked the pond surface, both keeping pace with regional sea-level rise rates. In New Jersey, the ponds are becoming deeper while marsh surface elevation remains unchanged from the initial reading. This may result in a submergence of the marsh in the future, assuming sea-level rise continues at current rates. Ponds at both Virginia sites are filling in, while marsh surface elevation rates do not seem to be keeping pace with local sea-level rise. An additional finding at all sites was that subsidence in the vegetated marsh surfaces was less than in unvegetated areas, reflecting the importance of the root mat in stabilizing sediments. The implications to migratory waterbirds are significant. Submergence of much of the lagoonal marsh area in Virginia and New Jersey over the next century could have major negative (i.e., flooding) effects on nesting populations of marsh-dependent seaside sparrows *Ammodramus maritimus*, saltmarsh sharp-tailed sparrows *Ammodramus caudacutus*, black rails *Laterallus jamaicensis*, clapper rails *Rallus longirostris*, Forster's terns *Sterna forsteri*, common terns *Sterna hirundo*, and gull-billed terns *Sterna nilotica*. Although short-term inundation of many lagoonal marshes may benefit some open-water feeding ducks, geese, and swans during winter, the long-term ecosystem effects may be detrimental, as wildlife resources will be lost or displaced. With the reduction in area of emergent marsh, estuarine secondary productivity and biotic diversity will also be reduced.

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Rice, C.A. **Effects of shoreline modification on a northern Puget Sound beach: Microclimate and embryo mortality in surf smelt (*Hypomesus pretiosus*).** *Estuaries and Coasts* 29(1): 63-71, 2006.

**Notes:** Human alteration of Puget Sound shorelines is extensive yet its ecological consequences are largely undocumented. This study evaluates differences between natural and heavily modified beaches in terms of microclimate and one aspect of biological condition. Electronic data loggers were placed at a tidal height of approximately 3.7 m (12 ft) above mean lower low water during July 16-20, 2001, to monitor light intensity, substrate and air temperatures, and humidity. Substrate samples were collected at the end of the monitoring period to evaluate condition and density of eggs from surf smelt (*Hypomesus pretiosus*), a forage fish species that spawns on gravel-sand beaches in the upper intertidal zone. The modified beach had significantly higher daily mean light intensity, air temperature, and substrate temperature, and significantly lower daily mean relative humidity. Particularly striking were the differences in substrate temperature, which, on the natural beach, ranged from 12.1°C to 18.2°C (mean = 14.1°C) and on the modified beach ranged from 14.4°C to 29.4°C (mean = 18.8°C). In addition to these different means and more extreme values, microclimate conditions on the modified beach were more variable, indicative of a less buffered environment. The proportion of smelt eggs containing live embryos on the altered beach was approximately half that of the natural beach.

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Harris, L.A., Duarte, C.M., and Nixon, S.W. **Allometric laws and prediction in estuarine and coastal ecology.** *Estuaries and Coasts* 29(2): 340-344, 2006.

**Notes:** A theoretical and quantitative framework of first principles would benefit estuarine and coastal ecologists in search of predictions to enhance our understanding and management of marine resources. The Metabolic Theory of Ecology describes a

possible unifying theory for ecology, including mechanistically derived equations that predict scaling exponents observed in empirical, allometric relationships from individuals to ecosystems. The controversy surrounding this theory should stimulate our exploration of its potential use in the coastal realm, where questions specific to an applied science may suggest new refinements and derivations, contributing to the overall progress of ecology.

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