provided. Aside from these minor shortcomings, the book is both useful and readable.

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Expected Effects of Climate Change on Marine Coastal Ecosystems, J.J. Beukema, W.J. Wolff, and J.J.W.M. Brouns (eds.), 1988. Dordrecht, The Netherlands: Kluwer Academic Publishers, Developments in Hydrobiology 57, 221p. ISBN 0-7923-0697-X.

Coastal ecosystems are particularly vulnerable to future climate change because they face inundation or increased salinity as well as exposure to increased levels of CO_2, UV-B radiation (due to stratospheric ozone depletion by chlorofluorocarbons), and higher temperatures. The potential consequences of these climate changes on coastal ecosystems formed the theme of a workshop held in Texel, The Netherlands, from 11 to 15 November, 1988, attended by a group of 30 scientists from 13 countries, covering the fields of biology, ecology, geology and climatology.

The Expected Effects of Climatic Change on Marine Coastal Ecosystems constitutes a collection of 23 papers, representing the proceedings of this workshop. The book begins with an overview of the causes of climate change (Hekstra), and reviews various anticipatory approaches, for example: General Circulation Models (GCM's), construction of regional scenarios, and studies of past climates as analogs (see papers by DeBoois, also Goodess and Palutikof). The book is further divided into several sections dealing with ecosystems responses to elevated carbon dioxide levels (3 papers), to temperature changes (6 papers), sea level rise (9 papers), and UV-B radiation increases (2 papers). Long utilizes mathematical models to investigate light interception and conversion efficiency in salt-marsh grasses. Field studies and geographical or historical analogs are more common anticipatory approaches. Field observations have been made on winter temperature responses of benthic animals (Beukema), thermal tolerance limits of bivalves (Wilson), salinity changes on salt-marsh zonation (Huiskes), and on accretion rates (Dijkema *et al.*). Potential consequences of UV-B radiation on aquatic coastal ecosystems are reviewed by Kramer, and on salt-marsh vegetation by Van de Staaij *et al.*

Past and present latitudinal ranges of seaweed species are utilized to project future climate responses (Van Hoek *et al.*). A similar study, but more focused on Western Europe is summarized by Breeman. A regional scenario of temperature increase equivalent to that now existing between The Netherlands and France is used to predict eventual bottom faunal changes in Holland (De Vooys).

Historical rises in sea level, both during the Holocene post-glacial transgression, and the last few centuries are explored in a series of papers. Day and Templet cite the Mississippi Delta, with its nearly 6–10 times global average sea level rise, as an analog for the future of other vulnerable coastal areas. The situation in Louisiana may be somewhat unique, because subsidence and wetlands losses have been aggravated by other anthropogenic activities, such as sediment deprivation due to construction of upstream dams, and reduction of seasonal sediment influx during floods, by dikes, canal and jetty construction. Morphological changes associated with sea level rise are detailed in papers by Christiansen and Bowman, Misdorp *et al.*, and Westerhoff and Cleveringa. Siefert presents evidence for recent sea level rise along the German Atlantic coast, and a marked increase in the tidal range in recent decades, possibly due to dredging.

The papers presented in this book are largely drawn from studies in Western Europe, particularly The Netherlands, thus possibly limiting the global applicability of the findings. While there may be a dearth of coastal data, the relevance of agricultural studies to coastal ecosystems (*e.g.*, Overdieck) may be questioned. Tables are often reduced beyond easy legibility. Typographical errors are not uncommon. Nevertheless, this series of papers present useful results that can be added to the growing literature on the potential impacts of climate change, especially in the coastal zone.

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World Atlas of Holocene Sea-Level Changes, P.A. Pirazzoli, assisted by J. Pluet, 1991. Amsterdam: Elsevier Science Publishers, B. V., Oceanography Series, 300p. ISBN 0-444-8906-6.

Until the late 1970's, Holocene sea-level studies were directed towards establishing a single universal eustatic sea-level curve, representing the addition of glacial melt-water to the earth's oceans. This search generated three distinct schools of thought: (1) an oscillatory pattern of sea-level change (the Fairbridge curve), (2) a steady rise to ~ 4,000–5,000 years BP, remaining constant thereafter (Godwin *et al.*), and (3) a smooth but gradually decreasing rate of rise, especially within the last 4,000 years (the Shepard curve). These contrasting viewpoints stimulated further research, leading to the International Geological Correlation Program, IGCP Project 61, headed by A.L. Bloom, IGCP Project 200 (sea-level correlation and applications), led by P.A. Pirazzoli, 1983–1987, and IGCP Project 274 (Quaternary Coastal Evolution, 1988–1992), led by O. Van de Plassche.

A major outcome has been the realization of the futility of finding a single Holocene sea-level curve. Holocene sea-level records are the product of several processes, which include glacio-eustasy, glacio-isostasy, neo-tectonism, and sediment loading and compaction, particularly near major deltas. In addition, climate changes, such as shifts in the general atmospheric circulation, which regulate storminess, hence wind stress, wave climate and ocean dynamics, also affect the mean sea level position. At any given locality, mean sea-level is determined by a combination of these factors, the relative importance of which varies from place to place. While it is generally difficult to isolate these contributing factors, considerable progress has been made toward filtering out glacio-isostatic movements, using rheological models, such as those developed by Clark *et al.*, Peltier, and Lambeck, in the 1980's.

In *The World Atlas of Holocene Sea-Level Changes* Pirazzoli has collated worldwide data, largely generated from the above-mentioned international programs, thus updating the earlier *Atlas of Sea-Level Curves*, by A.L. Bloom (1977). The present "World Atlas" clearly illustrates the diversity of sea-level curves from numerous localities on different continents. The "World Atlas" is organized into four sections. Part 1, the Introduction, reviews previous research, outlines causes of sea-level changes, the nature of sea-level indicators, and sources of errors in the data. Part 2, the main body of the "Atlas," portrays the large spatial variability of sea level, in a series of 77 regional plates, each containing 4 to 20 relative sea-level curves, drawn to the same scale, for quick visual inspection. Each plate also has a small index map and author references. Around 100 sea-level curves derived from geophysical models, are shown with curves drawn from field studies. In addition, modern tide-gauge data are also presented for comparisons with longer-term trends. The accompanying text briefly discusses the geological context and other relevant information. Numerous photographs illustrate a variety of paleosea-level indicators. Part 3 (Conclusions) summarizes the geographical coverage, indicates data gaps, and proposes suggestions for future research. Part 4 lists a bibliography with over 750 entries. Geographical and author indices are also provided.

The "Atlas" is a thorough and very useful compendium of existing data and, given the extensive bibliography, a good starting point for future research. A simple superposition of curves provides a quick overview of regional differences due to neotectonics or glacio-isostasy. Grouping several curves together from the same general area also gives some indication of relative consistency. However, the curves, assembled from so many sources, utilizing a variety of analytical techniques, vary widely in their precision, and in reference to a common datum. The precision is occasionally suggested by uncertainty bands, less commonly by error boxes. Clearly, some wildly fluctuating sea-level curves (several 10's meters in 1,000–2,000 years; see for example, Plates 13, 26, 27, 33, 34, 42, and especially Plate 56, curve B) need to be carefully re-examined. While many of these come from tectonically active regions, others such as Plate 13 (East Baltic) or Plate 56, curve B (Argentina) are from relatively stable areas. Even well-studied areas, such as the eastern United States, show a broad spread in sea-level curves (Plates 60, 61, 64). Curves derived from field studies closely match those from geophysical models in some instances (*e.g.*, Plates 43, 57), but diverge significantly in others (Plates 61, 62). (Note: the ages on the field-derived sea-level curves are in radiocarbon years BP; those on the geophysical model curves are in sidereal or calendar years. This may introduce some discrepancy between the two sets of curves, but probably not to the extent observed). These mismatches point to the need for further refinements in both the data base and the geophysical models.

The presentation of the plots is not always as clear as possible, thus interfering with rapid visual comparisons. Too many curves are often crowded on one plate, sometimes from widely separated areas (*e.g.*, Plate 42 Taiwan-Micronesia; Plate 30, the Indian Ocean-Africa; Plate 54, Western U.S. down to Tierra del Fuego). In other cases, curves seem to be grouped by overall shape, rather than geographic proximity (Plate 13, curve C; or Plate 23, curves and F and G). Some occasional errors occur (for example, Fig. 2-5 comes after Figs. 2-6 and 2–7).

Pirazzoli makes clear the limitations of the extant sea level data in pointing out the uneven geographical coverage (Table 3.1), and the large range in precision in collection and dating techniques. In the Introduction, Pirazzoli expresses the need for digitized sea-level data bases with more complete documentation of analytical techniques, and error margins. He cites some examples of existing data banks, such as the "Paleogeodesy" data base, compiled by the late W.S. Newman, the U.K. data base of Shennan, and others being assembled at the University of Lund, Sweden, and the Geophysical Institute of Kiel, Germany. In the conclusions, Pirazzoli furthermore recommends additional studies from data-deficient regions of the Southern Hemisphere. The creation of a truly global sea-level data base, with uniform standards and quality control, will represent a major advance in Holocene sea level research, and will become an indispensable tool in studies of crustal isostatic movements, neo-tectonic activity and paleoclimate change.

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Ecology of Sandy Shores, A.C. Brown and A. McLachlan, 1990. Amsterdam-Oxford. New York-Tokyo: Elsevier, 328p. ISBN 0-444-88661-3.

Two South African authors (respectively, universities of Cape Town and Elizabeth Port) have collaborated to present us with this unusual book. Another surprising element is they are both zoologists. So many biologists in the late 20th Century have been seduced by the charms of genetic research and non-field-related activities that ecology has reverted almost entirely to botanists, geomorphologists and physical geographers. Neveretheless, our two zoologists have done a superb job of presenting the whole field in a well balanced way.

In reviewing a book, this particular writer has a rule of thumb: after a quick glance at the Table of Contents (4p., about 150 entries: good!), he turns to the Index (about 300 entries: O.K.!), and References (about 600: excellent!). So we are starting out on the right foot. Brown's own citations are mainly zoological but include ecological papers and oil-pollution results. McLachlan's are rather similar but more ecological and he (with T. Erasmus) edited a collective volume on "Sandy Beaches as Ecosystems" (The Hague: W. Junk Publ., 1983). He has also contributed to the *Journal of Coastal Research.*

To convey some idea of the book's scope and emphasis, the 13 chapters will be touched on, one by one. Each is identified by author's initials, some of them jointly. Chapter 1, an Introduction, spells out the book's objective: "to present a more balanced and integrated account of sandy-shore ecology than has previously been possible", with every component from surf-zone to dune considered as part of a single system, including management of that system. In a quotation from a 1942 paper these unique landforms are described biologically as "great digestive and incubating systems", which are hardly the words that the average geomorphologist would use to describe them, although undoubtedly true. It is salutary to get a different perspective!

Next, Chapter 2, gives us the Physical Environment (34p.), with a brief petrographic treatment of sand granulometry, Stokes Law, Phi units and porosity, going on to waves, refraction, shoaling, beach types, bars, rips, and exposure rating. The geologist misses any mention of either physical or biogenic structures. How does the paleoecologist recognize a "fossil" beach? And distinguish it from an eolianite? The South African coast is richly endowed with these informative features.

Chapter 3 provides space for the Beach Flora (10p.), which is understandably scant. In contrast, Chapters 4 through 8 (137p.) treat invertebrate faunas, their adaptations, communities, with appropriate attention to the rhythms forced by seasonal, circadian and tidal changes. Birds and other non-marine vertebrates are touched on in Chapter 9 (8p.).

One of the most interesting chapters, to this reviewer, is Chapter 10, Sandy Beach Ecosystems (29p.) with the food chains and energy flow. Chapter 11 gives timely attention to Pollution (15p.).

The Dunes (Chapter 12, 25p.) receive deserved