Journal of Coastal Research | 10 | 4 | 987-989 | Fort Lauderdale, Florida | Fall 1994

SPECIAL THEMATIC SECTION

Sea-Level Rise and the Fate of Tidal Wetlands

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PREFACE

Tidal wetlands provide numerous ecological functions and protect urban areas from saltwater intrusion and storm surge. Because these areas occur at the land-sea interface they are strongly influenced by changing sea-level elevation. Hence, it is of interest to quantify the effects of sea-level rise anticipated to accompany global climate change into the next century.

In this issue of the *Journal of Coastal Research* seven articles have been compiled, each of which address the effects of sea-level rise on a wide variety of Holocene tidal wetlands (Figure 1). In all cases, coastal wetland response to sea-level rise will reflect an interaction between the rate of sea-level rise and substrate accretion. In addition to quantifying salt marsh, mangrove, and coastal forest response to sea-level rise, the collection of articles provides an excellent list of references on the subject (Table 1).

Predicting the effects of future sea-level rise on wetlands can be facilitated by quantifying their evolution under past sea-level regimes. In the study by GEHRELS (1994), foraminiferal analyses are used to construct long-term trends (10^2 to 10^3 yr) in middle to late Holocene sea-level change for eastern Maine. Gehrels demonstrates that fossilized assemblages of salt-marsh foraminifera are more precise indicators of local sea-level than salt marsh plants because their vertical range is smaller and less variable (± 15 cm). From this information, Gehrels generates a tightly constrained relative sea-level chronology for Machiasport, Maine.

Vertical accretion rates can vary significantly both spatially and temporally in marshes. This potential variation complicates the assessment of a marsh's ability to keep pace with sea-level rise and is the subject of the paper by KEARNEY *et al.* (1994). They examine the potential for spatial and temporal variability in vertical accretion rates in a large stable estuarine marsh on Maryland's lower Eastern Shore (Chesapeake Bay). It is shown that vertical accretion rates can vary significantly, not only between depositional environments, but even between apparently identical sites within the same depositional environment. Moreover, there is a considerable range in the rates of vertical accretion at any individual site if different time-scales are considered. Both factors complicate the determination of a marsh's ability to keep pace with sea-level rise.

Although it is widely accepted that vertical accretion deficits versus local sea-level rise are the underlying cause of rapidly submerging marshes, accretionary processes in coastal marshes are complex and not fully understood (KEARNEY *et al.*, 1994). DELAUNE *et al.* (1994) present a study initiated to test the hypothesis that plant mortality and peat collapse caused Mississippi River deltaic marsh surface elevations to decrease and hence caused pond initiation and wetland loss. According to these authors, increased submergence in sediment deficient environments stress plant communities and reduce plant productivity, the source of soil organic matter that directly determines vertical accretion. After several decades of inadequate vertical accretion, a critical point is reached in the accretionary process in which plant mortality and peat collapse occurs.

DOWNS *et al.* (1994) present the first quantitative analysis of both perimeter and interior land loss for Bloodsworth Island, one of the large marsh islands in the Chesapeake Bay, between 1849 and

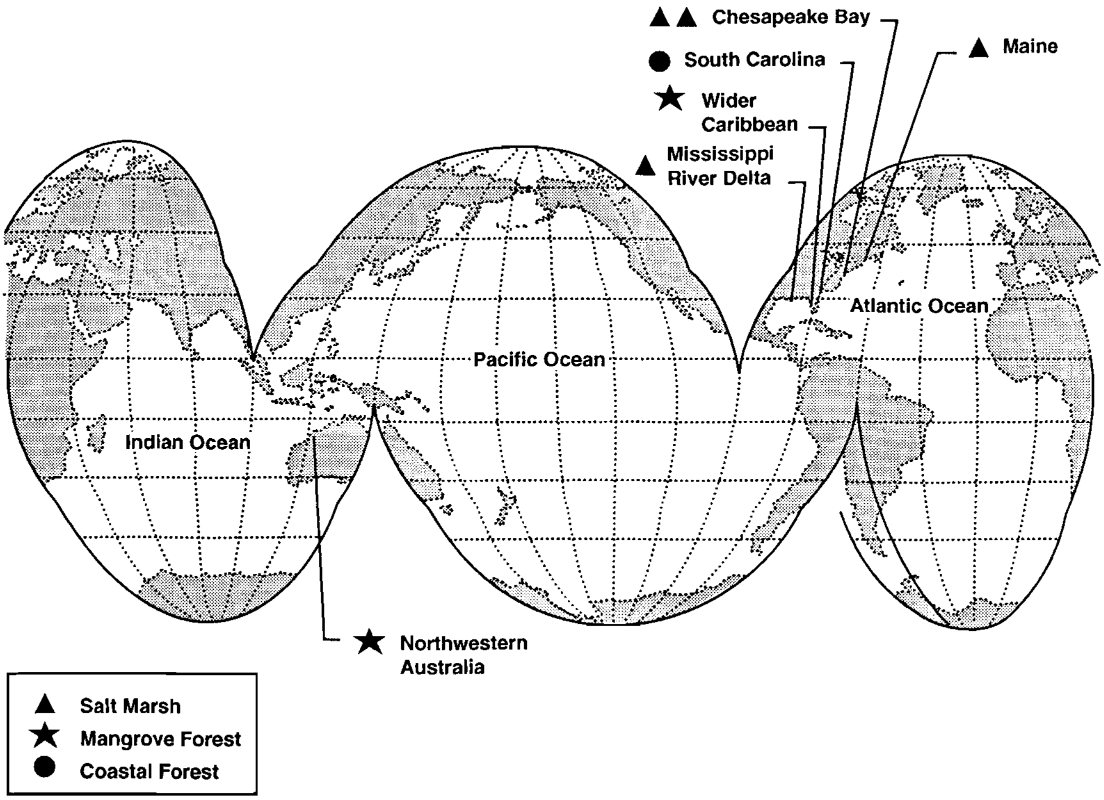

Figure 1. Map illustrating location and type of tidal wetland investigated in the seven papers compiled herein. Each paper addresses the effects of sea-level rise on the sustainability and persistence of tidal wetlands into the next century.

1992. These losses can be attributed to an accretion deficit in which relative sea-level rise is faster than vertical accretion of the marshes. This study confirms a picture of regional wetland loss in the Chesapeake Bay area, driven by high rates of relative sea-level rise.

Salt marshes are not the only coastal ecosystem potentially affected by rising sea-level. In the southeastern United States, many coastal forested wetlands are being subjected to increased levels of flooding and salinity as a result of subsidence and sea-level rise. In the paper by CONNER (1994), these effects are quantified using baldcypress (*Taxodium distichum* (L.) Rich.) and Chinese tallow (*Sapium sebiferm* (L.) Roxb.). Baldcypress is an indigenous species which currently dominates forested wetlands of the southeast United States, while Chinese tallow is an exotic species becoming increasingly more common in these areas.

Table 1. *Summary of references contained within the seven papers addressing the effects of sea-level rise on tidal wetlands.*

	Keyword			
Year	Mangrove	Salt Marsh	Sea Level	Total
Pre-1990	20	55	31	195
1990 to present	8	13	26	72
Total	28	68	57	267

SEMENIUK's paper (1994) develops the potential impact of sea-level rise on mangrove systems of northwestern Australia. Semeniuk notes that most predictions of the effect of sea-level rise on mangrove forests have been based upon low energy, low gradient carbonate or peat forests with little terrigenous sediment input and uncomplicated floristics, vegetation physiognomy and structure. These small scale studies present a simple model of coastal retreat in response to sea-level rise. However, at a larger scale, Semeniuk argues that coasts are heterogenous and therefore the response of mangroves to a sea-level rise will not be simple and uniform. Rather, it will be varied and dependent on the species involved, the type of terrain the sea is rising onto, concomitant geomorphic changes, and the rate of sea-level rise. Case studies are presented to illustrate this point.

Finally, PARKINSON *et al.* (1994) review mangrove forest peat accretion data obtained from carbonate settings of the Wider Caribbean Region and evaluate the fate of these forests based upon current global eustatic sea-level rise projections. They note that historical peat accretion rates are more than double the rates calculated using long-term methods, a discrepancy also observed in salt marshes (KEARNEY *et al.*, 1994). Their conceptual model predicts stable conditions only if the lowest rate of sea-level rise is realized and then only if the historical rate of peat accretion continues. However, they note that anticipated global sea-level rise is not likely to lead to a catastrophic disruption of the world's mangrove forests as areas with abundant allochthonous sediment supply (*e.g.*, fluvial and deltaic settings) will continue to act as forest refuges, as they have during previous Quaternary sea-level fluctuations.

These seven papers represent a continuing effort to improve our understanding of the potential effects of sea-level rise on tidal wetlands. These coastal ecosystems are extremely complex, and it is clear that much more information will be required before the effects of global climate change and concomitant sea-level rise on the world's tidal wetlands will be clearly understood.

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