BOOK REVIEW

The Rising Sea

THE SEA IS RISING! THE SEA IS RISING! Not to be confused with "The sky is falling! The sky is falling!" Poor Chicken Little panicked, but Orrin Pilkey and Rob Young, authors of *The Rising Sea*, take a calm, pragmatic approach to explain sea-level rise. Recognized for his public service by marine, geological, and chemical societies, Pilkey is professor emeritus of earth sciences and founder and director emeritus of the Program for the Study of Developed Shorelines, Nicholas School of the Environment, Duke University, Durham, North Carolina. Young is a nationally recognized expert on wetland ecosystems and coastal environments and is a professor in the Department of Geosciences and Natural Resources at Western Carolina University, Cullowhee, North Carolina. He also serves as director of the Program for the Study of Developed Shorelines. Pilkey and Young "chose to write this book because [they] believe the public needs to have a clear guide to the critical but basic facts about sea level rise and its implications, in order to make intelligent decisions" (p. xii). The final chapter of the book provides recommendations for the societal decisions the authors believe need to be made to begin to address sea-level rise. Decision makers include private citizens, coastal managers, scientists, community planners, national and international government officials, and groups that can provide financial incentives for relocating infrastructure away from the coasts after storm events.

From the authors' perspective—a combined 65 years of studying marine and coastal processes—the effects of global warming are all around us: Venice is drowning. The Netherlands is walled off from the sea. The United States spends hundreds of millions of dollars each year managing beaches that are eroding. From their coastal point of view, there is no need to calculate global temperatures to prove planet Earth is warming, nor is it necessary to argue that the Northern Hemisphere winter of 2007–2008 was the coldest since 2001 (to justify inactivity in the face of climate change). The evidence is clear enough, and *The Rising Sea* provides example after example of the physical outcomes of sea-level rise, many of which are occurring in the National Park System. Consider the following:

Cape Lookout National Seashore. In 1899, Diamond City, North Carolina, was one of the largest towns on the Outer Banks. The now-immersed city is located within the boundary of the national seashore. At the turn of the 19th century, the shoreline was eroding and the protective high dunes began to disappear, probably as a result of sea-level rise. However, a series of storms leading up to and including the nail-in-the-coffin Great Hurricane of 1899 ended this working community of whalers. According to *The Rising Sea*, "today most of the house sites are well out to sea on the continental shelf, the high dunes used by whale spotters [to 'look out'] are completely gone, and the shoreline is retreating at 10 feet (3.0 m) or more per year" (p. 135).

Bering Land Bridge National Preserve. Preserving a long history of sea-level rise, Bering Land Bridge and other Arctic preserves operate "in tandem with greatly increased storm impacts because of longer periods of ice-free conditions on the ocean and melting of beach permafrost" (p. 129). The book pays special attention to the trials and tribulations of the citizens of Shishmaref, whose village and livelihood are threatened by global warming, sea-level rise, and severe beach erosion.

Cape Hatteras National Seashore. Shoreline erosion resulting from sea-level rise on both sides of the barrier-island chain is narrowing the width of the long, low islands off the coast of North Carolina. In 2005 the U.S. Geological Survey published an open-file report about sea-level rise impacts at Cape Hatteras National Seashore (Pendleton et al. 2005). Scientists expect that during a storm of sufficient duration and intensity, many new inlets will open up in the barrier, resulting in the isolation of the eight small tourist villages within the national seashore (Pilkey and Young 2009). The owners of threatened homes and businesses in these oceanfront villages at Cape Hatteras have requested beach nourishment to buffer their properties from the ocean's erosive forces. The National Park Service assisted with the guidance document for this process (Brunner and Beavers 2005).

Everglades National Park. As sea level rises, salt water will intrude on this vast Florida marsh ecosystem, profoundly changing the flora and fauna. The multibillion-dollar restoration that is under way considers a 1-foot (0.3 m) rise over the next century. However, the authors question what "restoration" will mean in the long term because a 3-foot (0.9 m) sea-level rise is likely for this area.

Of particular interest to resource managers may be Chapter 6, "The Living Coasts." The coastal and marine systems highlighted (i.e., coastal wetlands, marshes, mangroves, and corals) in this chapter are facing a future that is truly unprecedented. Throughout geologic history, these systems have migrated back and forth along with changing sea level. Now, as a result of human activities, coastal wetlands and coral reefs have to respond to changes in ocean volume and attendant shoreline movement while responding to anthropogenic changes in the physical environment. Pointing to the sad realization that our coastal towns, cities, and developments leave no room for the future migration of these systems, the authors ask, "When our coastal cities and towns become threatened by rising sea level, will we give these natural ecosystems high enough priority to assure their survival?"

Another notable discussion in the book is about the Intergovernmental Panel on Climate Change (IPCC) 2007 report, the fourth United Nations–supported assessment of global change. Many researchers, including those in the National Park Service, quote the IPCC prediction of sea-level rise given in this report, and the media now widely accepts that the predicted sea-level rise will be between 7 and 23 inches (18 and 58 cm) by the end of the 21st century. However, the authors point out that this range does not include critical, perhaps catastrophic, increases due to ice sheet melting. According to the IPCC, "models used to date do not include uncertainties in climate–carbon cycle feedback nor do they include the full effects of changes in ice sheet flow, because a basis in published literature is lacking" (IPCC 2007; specifically Summary for Policymakers, p. 14). The 2,500-member IPCC committee chose to include only the causes of sea-level rise that could be predicted with mathematical models; these causes are thermal expansion (increase in ocean volume due to warming) and the melting of the world's mountain glaciers. *The Rising Sea* discusses glaciers and their potential impacts on the rising sea, including the retreating glaciers in Glacier National Park (Montana) and the mountain glaciers in Alaska, such as those in Glacier Bay National Park and Preserve. According to the authors, however, the so-called 800-pound gorilla is the West Antarctic ice sheet. Various investigators have made projections that include ice sheet melting: Rahmstorf et al. (2007) estimate 1.6 to 4.6 feet (0.5 to 1.4 m) in sea-level rise by 2100; Pfeffer et al. (2008) predict slightly less than 3 feet (0.9 m) to a maximum of 6.5 feet (2 m) by the end of the century. Pilkey and Young recommend a "cautious and conservative approach" to coastal management and planning that assumes that ice sheet disintegration will continue and accelerate. For planning purposes, the authors suggest a 7-foot (2 m) rise by the year 2100.

As the sea rises, these authors remain unafraid of getting their feet wet, and they encourage others to do the same. They urge environmental consultants who model erosion rates to venture away from their computers to look at the sediments they are modeling, and engineers who predict shoreline erosion to wade knee-deep in the surf zone in order to provide meaningful estimates to constituents. Applying geologic common sense, Pilkey and Young show that the challenge, difficulty, and even inability to forecast global warming do not mean that global warming is not happening. They show that field data are the most reliable measures of global change, and these data present a compelling case for concern.

References

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