GGNRA's Vulnerability to Sea-Level Rise

Sea levels are predicted to rise 13-20 feet over the next 100 years as a result of global warming, inundating low-lying islands and threatening coastal cities and harbors world-wide (J. Overpeck, B. Otto-Bliesner, G. Miller, D. Muhs, R. Alley, and J. Kiehl 2006). While this forecast has shocking global implications, it raises equally serious concern for many U.S. national parks.

The U.S. Geological Survey (USGS), in cooperation with NPS, completed an assessment in 2005 of GGNRA's vulnerability to sea-level rise using a tool called the Coastal Vulnerability Index (CVI). The CVI provides insight into the relative potential of coastal change due to future sea-level rise.

The CVI allows six variables (geomorphology, shoreline change, regional coastal slope, relative sea-level rise, mean significant wave height, and mean tidal range) to be related in a quantifiable manner that expresses the relative vulnerability of the coast to physical changes due to future sea-level rise. The CVI highlights those regions where the physical effects of sea-level rise might be the greatest.

The most influential variables in the CVI are geomorphology, coastal slope, and mean significant wave height; therefore, they may be considered the dominant factors controlling how GGNRA will evolve as sea level rises.

While climate change data reflect long-term increases in sea levels, there may be specific sites within GGNRA that could be more vulnerable to rising sea levels even within the lifespan of this GMP, particularly if the melting of the polar ice caps increases more rapidly than expected.

The colored shoreline depicted in Figure 1 represents the relative coastal vulnerability index (CVI) determined from the six variables. The very high vulnerability shoreline is generally located along sandy beaches where significant wave heights are highest and regional coastal slope is shallow, including sites like Ocean Beach, Fort Mason, Land's End, and Fort Funston. The lower vulnerability shoreline is located along rock cliffs mostly along the northern part of GGNRA where wave heights are lower and coastal slope is steep.

Figure 1

Of the 59 miles evaluated at GGNRA, 50%were classified as either having high (26%) or very high (24%) vulnerability, with another 26% classified as having moderate vulnerability (Pendleton, Thieler and Williams 2005). This information

raises serious concern since the most vulnerable shorelines are located on the southern peninsula where the largest concentration of humans and built facilities exist. This area also includes heavily visited beaches including Ocean Beach, China Beach, and Baker Beach.

This information should have a profound influence on coastal park planning and management strategies. In particular, GGNRA can use this information for park facilities planning, assessing threats to existing infrastructure and cultural resources, and crafting long-term strategies to manage natural resources.

GGNRA should recognize the impacts of sea-level rise and work proactively to address them. This includes keeping up with new and ongoing research on climate change; considering the relocation of park infrastructure where possible; and adopting a “managed retreat” policy in areas where it is practical. The park should also work to prioritize their assets and develop plans to protect important facilities. Developing thresholds for various management actions is one possible approach.

Citations

Jonathan T. Overpeck, Bette L. Otto-Bliesner, Gifford H. Miller, Daniel R. Muhs, Richard B. Alley, Jeffrey T. Kiehl m. 2006. Paleoclimatic Evidence for Future Ice-Sheet Instability and Rapid Sea-Level Rise. *Science* 24 March 2006: Vol. 311. no. 5768, pp. 1747 – 1750.

Pendleton, Thieler and Williams. 2005. Coastal vulnerability assessment of Golden Gate National Recreation Area to sea-level rise. U.S. Geological Survey Open File Report 2005-1058.