

Sea level rise and potential change in coastal bird habitat: the case of New Jersey, USA

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Introduction

The consequences of global climate change are expected to intensify in the 21st century and beyond resulting in accelerating rates of sea level rise. The effects will include coastal inundation and flooding of shorelines, barrier islands and low-lying mainland areas. This will cause changes in coastal bird habitat, including reductions and alternations in wetlands, and inter-tidal and beach areas. This study provides an illustration of the effects of sea level rise on four globally important bird areas in New Jersey, USA and attempts to gauge the ability of these areas to support bird species at current population levels.



Methods

Study locations

Four globally important bird areas on the New Jersey coast were selected for the study based on criteria formulated by the American Bird Conservancy (Chipley et al., 2003). The bird areas include: 1) Sandy Hook; 2) Edwin B. Forsythe National Wildlife Refuge; 3) Cape May National Wildlife Refuge and Cape May Wetlands; 4) Fortescue and Egg Island Wildlife Management Areas.

Sea level rise projections

Based on tide-gauge data the rate of relative sea level rise for New Jersey during the 20th century is estimated to be 3.53 mm/yr. The probability of projected changes in sea level rise for the New Jersey was calculated by applying the methodology of Titus and Narayanan (1995). The sea level rise parameters selected for analysis include **61 and 134 cm**. The 61 cm parameter approximates a high end projection for 2050 and median projection for 2100. The 134 cm parameter represents the high end projection for 2100 and median projection for 2200. The parameters are consistent with IPCC sea level rise approximations and provide a precautionary best estimate appropriate for management and planning (Church et al., 2001).

Modeling coastal change

Sea level rise was modeled based on 7.5 m digital elevation models with 10 m horizontal resolution.

The models utilize elevation data which represents a static depiction based on land elevation at a given time. The models are unable to depict future shoreline positions and do not consider land subsidence, erosion, accretion and other natural adaptation. Nor do they incorporate human measures such as sea walls or beach nourishment projects. Despite these limitations the models provide an indicative illustration of sea level rise on the New Jersey coast.

Results

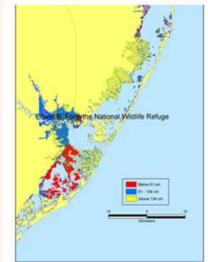
Coastal inundation

Estimated extent of coastal inundation given projected sea level rise. Portions of land area lying below 61 cm and 134 cm parameters is likely to be inundated.

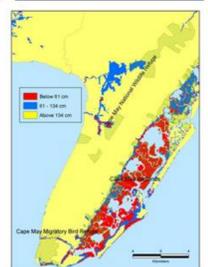
Sandy Hook



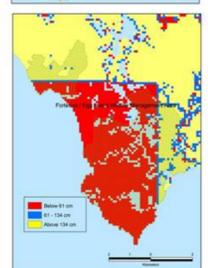
Edwin B. Forsythe National Wildlife Refuge



Cape May National Wildlife Refuge and Cape May Wetlands

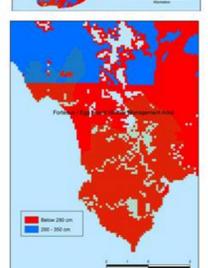
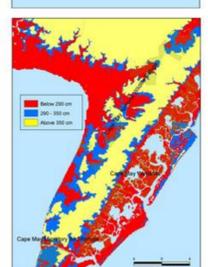
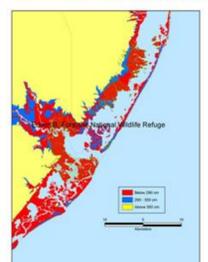


Fortescue and Egg Island Wildlife Management Areas



Coastal flooding

Estimated extent of coastal flooding given projected sea level rise. Portions of land area lying below 2.90 m and 3.50 m parameters is likely to be susceptible to episodic flooding.



New Jersey's coastal bird habitat

The New Jersey coast, particularly the four globally important bird areas identified in this study, sustains large concentrations of breeding, migrating and wintering bird species, including shorebirds, seabirds, waterfowl, and wading birds. Portions of the bird areas lie along the Atlantic flyway and serves as a vital stopover site for millions of shorebirds. This migratory bird stopover coincides with the spawning period for the world's largest population of horseshoe crabs. The migratory birds feed on the horseshoe crab eggs as a principle food source.

Results

Bird areas of New Jersey	Total land area (km ²)	Percentage of total land area coastal wetlands	Percentage of total land area susceptible to inundation	Percentage of total land area susceptible to episodic flooding	Percentage of coastal wetlands susceptible to inundation	Percentage of beach areas susceptible to inundation
Sandy Hook	8 km ²	41%	1-4%	40-43%	1-3%	2-8%
Forsythe NWR	162 km ²	> 90%	20-50%	85-95%	19-48%	60-70%
Cape May	90 km ²	> 80%	40-50%	76-90%	38-49%	3-5%
Fortescue and Egg Island	41 km ²	> 95%	72-75%	85-100%	68-73%	85-90%

Conclusions

This study has provided an illustration of the potential effects of future sea level rise on coastal bird habitat in New Jersey, USA based on sea level rise projections and elevation models. The results show that the extent of coastal inundation and flooding will have detectable impacts on three of the four globally important bird areas – Edwin B. Forsythe National Wildlife Refuge, Cape May National Wildlife Refuge and Cape May Wetlands, and Fortescue and Egg Island Wildlife Management Areas.

Changes in finite and productive coastal habitat due to inundation and flooding will limit the ability of these areas to support large concentrations of bird species and populations. Even more vulnerable are coast dependent bird species which are considered threatened, endangered, or currently decreasing in population. These species, due to their restricted distributions, small population sizes, specialized habitats and density-dependent behavior, are highly susceptible even to small changes in sea level rise and unable to adapt.

It is uncertain whether the bird areas will be able to naturally adapt to rising sea levels and to what extent coastal development will impede this process. Furthermore, it is difficult to ascertain precise predictions as to how decreases in feeding, breeding, roosting and nesting areas will shape particular bird responses. Nevertheless, it is probable that major reductions in coastal habitat will translate into reduced species density and population declines.

Literature cited

Chipley, R.M. et al., 2003. *The American Bird Conservancy Guide to the 500 Most Important Bird Areas in the United States*. Random House, New York.
 Titus J.G. and Narayanan, V.K., 1995. *The Probability of Sea Level Rise*. U.S. Environmental Protection Agency (EPA 230-R-95-008), Washington DC.
 Church, J.A. et al., 2001. *Climate Change 2001, the Scientific Basis*. Cambridge University Press, Cambridge. Pp. 639-693.

Acknowledgements

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Further information:

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 Also see my talk in Session 4: Coastal Management - Tuesday, November 15, 2005 - 10:45-12:15.