

Impacts of Sea-Level Rise on National Wildlife Refuges

Considerations for Land Protection Priorities



Photo: National Oceanic and Atmospheric Administration

One of the well-documented impacts of climate change is a rise in sea levels, resulting from a combination of melting of land-based ice and the thermal expansion of the oceans. The 2007 assessment by the Intergovernmental Panel on Climate Change reports that sea levels have been rising in recent years at a rate of 1.7 mm (0.07 inches) per year¹. More recent studies predict that the rate will accelerate this century, leading to projections that sea-level rise could easily exceed 39 inches by 2100^{2,3}. For the more than 150 national wildlife refuges located in coastal areas, sea-level rise has the potential to reshape wetlands, shift habitats inland and upland, and even lead to complete inundation of refuge lands. This is a concern not just for the lands already protected as part of the National Wildlife Refuge System, but also for lands that have been prioritized for future acquisition. The U.S. Fish and Wildlife Service may not be maximizing the effectiveness of its conservation investments if it is making fee-title acquisitions or purchasing long-term easements on lands that are going to be underwater within a few decades. We utilized the Sea Level Affecting Marshes Model (SLAMM) to assess the threat to the lands within both the acquired and approved boundaries of eight coastal refuges, in order to help the Refuge System maximize the effectiveness of future land investments.



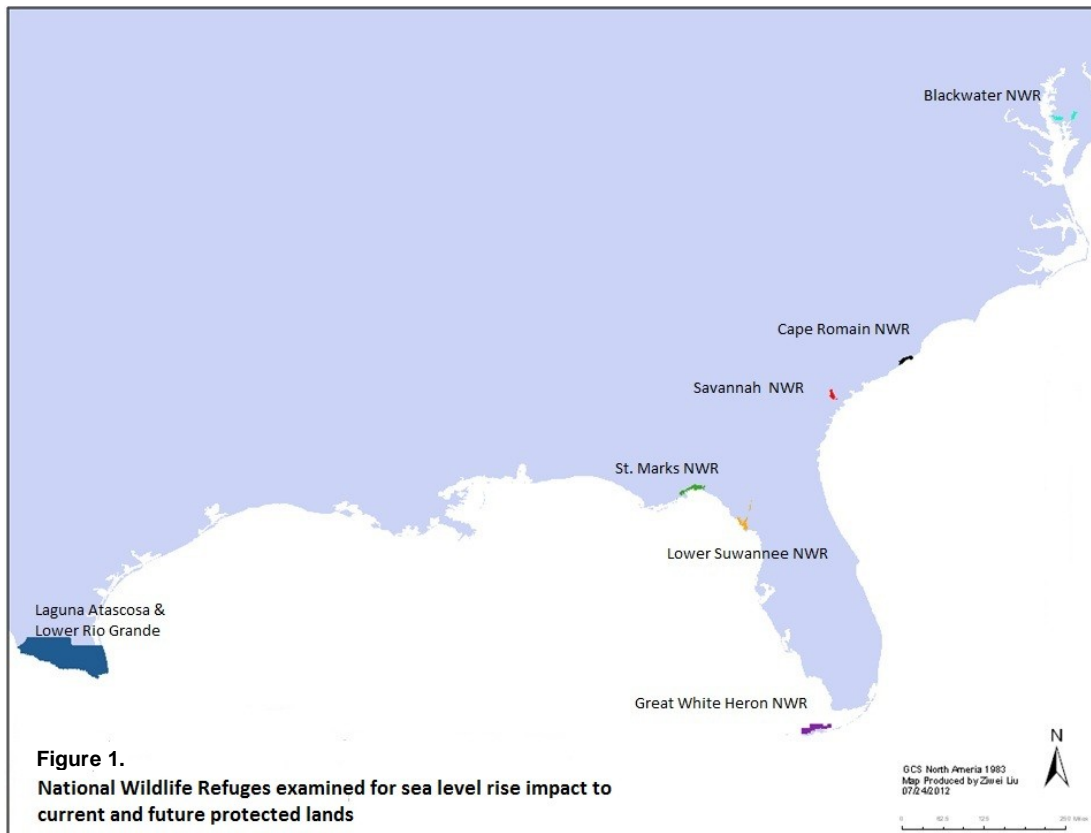
Background

The National Wildlife Refuge System, managed by the U.S. Fish and Wildlife Service (FWS), is composed of over 550 national wildlife refuges and 38 wetland management districts, totaling approximately 150 million acres of lands and waters managed primarily for wildlife conservation. Most refuges have a Land Protection Plan (LPP), which identifies priorities for new refuge land acquisition. Furthermore, in order to make the best use of its limited land protection budget, FWS annually ranks the refuges according to criteria laid out in their Land Acquisition Priority System (LAPS). LAPS outputs numerical scores for each refuge, based on four component parts: Fisheries and Aquatic Resources, Endangered and Threatened Species, Bird Conservation, and Landscape Conservation⁴. The higher the score, the higher that refuge's priority for funding acquisitions identified within its LPP. Though rising sea level is starting to impact many coastal refuges, neither LAPS nor most LPPs take it into consideration. Thus, it is possible that FWS will invest in the protection of lands that will be inundated in the future.

Methodology

To assess the sea-level rise risk to coastal refuge acquisition priorities, we overlaid SLAMM data and the approved acquisition boundary and acquired refuge boundary for coastal refuges with the highest LAPS scores. Of the top 20 LAPS-ranked refuges for fiscal year 2013, eight of these are located in coastal areas and had SLAMM data available for analysis (see Figure 1). Laguna Atascosa National Wildlife Refuge (NWR) and Lower Rio Grande Valley NWR were assessed together due to their close proximity.

We utilized the scenario of 1 m (39 inches) sea-level rise by 2100, in accordance with USGCRP's 2009 assessment.³ The output year in the maps and table below is 2075, a time period long enough to demonstrate meaningful change, while avoiding some of the uncertainties associated with projecting out to 2100. The 1 m by 2100 scenario yields a projected rise of about 70 cm (27 inches) in the year 2075.



Results

The impact of sea-level rise varies widely among the eight refuges we investigated: four of the refuges have less than 5% of their land area vulnerable, while two face potential net loss of over 40% of refuge lands by 2075, if sea level rises by one meter over the course of the century. Results for all refuges are summarized in the following table, and the four with the largest loss are profiled and mapped below.

Refuge	Percentage Net Loss of Upland and Wetland Within:		
	Area Already Acquired	Area Approved but not Acquired	Acquired + Approved Boundary
Blackwater	63.5%	31.8%	42%
Great White Heron	45.9%	41.6%	41.5%
Laguna Atascosa & Lower Rio Grande Valley	30%	19.3%	25.9%
Lower Suwannee	3.3%	5.9%	4.1%
Cape Romain	3.7%	2%	3.6%
St. Marks	1.4%	1.2%	1.3%
Savannah	0.2%	0.6%	0.4%

Blackwater NWR (Maryland)

Blackwater faces severe impacts from sea-level rise. Under the one-meter scenario, most land from the middle to the southern part of the refuge will be inundated by 2075. To reduce the impact of sea-level rise on Blackwater NWR, the refuge should focus its acquisition efforts on lands in the northern portion of the area within the approved boundary, where marsh and wetlands will be more persistent. To maximize long-term protection of marsh habitats in the vicinity, it may also be necessary for FWS to extend the approved boundary of the main part of the refuge to include areas to the north where wetlands appear likely to persist (see Figure 2).

Great White Heron NWR (Florida)

Much of the land area in the Florida Keys is less than five feet in elevation, so sea-level rise poses a substantial threat to the entire island chain. Many of the islands within the acquisition boundary of Great White Heron NWR will experience wetland loss and an overall shrinkage in area by 2075. Those areas on which marsh habitat will persist should be prioritized for acquisition. However, maps of year 2075 (Figure 3) may even underestimate the threat: under slightly higher scenarios of rise, up to three-quarters of the refuge could be under water.

Laguna Atascosa and Lower Rio Grande Valley NWRs (Texas)

These two refuges cover a patchwork of lands along the southern tip of mainland Texas and nearby Padre Island. Substantial marsh and wetland loss will occur in the coastal areas of the mainland and on the west side of Padre Island. Furthermore, very little marsh and wetland habitat will likely be created inland, compared to the amount lost, as demonstrated by the lack of dark green parcels on the map (Figure 4). Thus, managers of these refuges may need to look to the broader landscape to find and protect other areas of persistent or transitioning marsh, or risk threats to the species that depend on coastal Texas wetlands.

Lower Suwannee NWR (Florida)

Lower Suwannee NWR faces less inundation than many coastal refuges. Marsh loss is distributed patchily across the refuge and concentrated in a small area along the river. Most of the large area for acquisition in the south part of the refuge will likely be persistent. This refuge may also benefit from expansion of its boundary to the north, where large areas of marsh are also expected to be persistent under sea-level rise (See Figure 5).

Figure 2. Blackwater National Wildlife Refuge (Maryland)

Much of the acquired area (shaded) of the refuge will be inundated, along with large parts of the southern portion of the approved boundary (red). However, marsh habitat will remain, and be created, to the north of the current

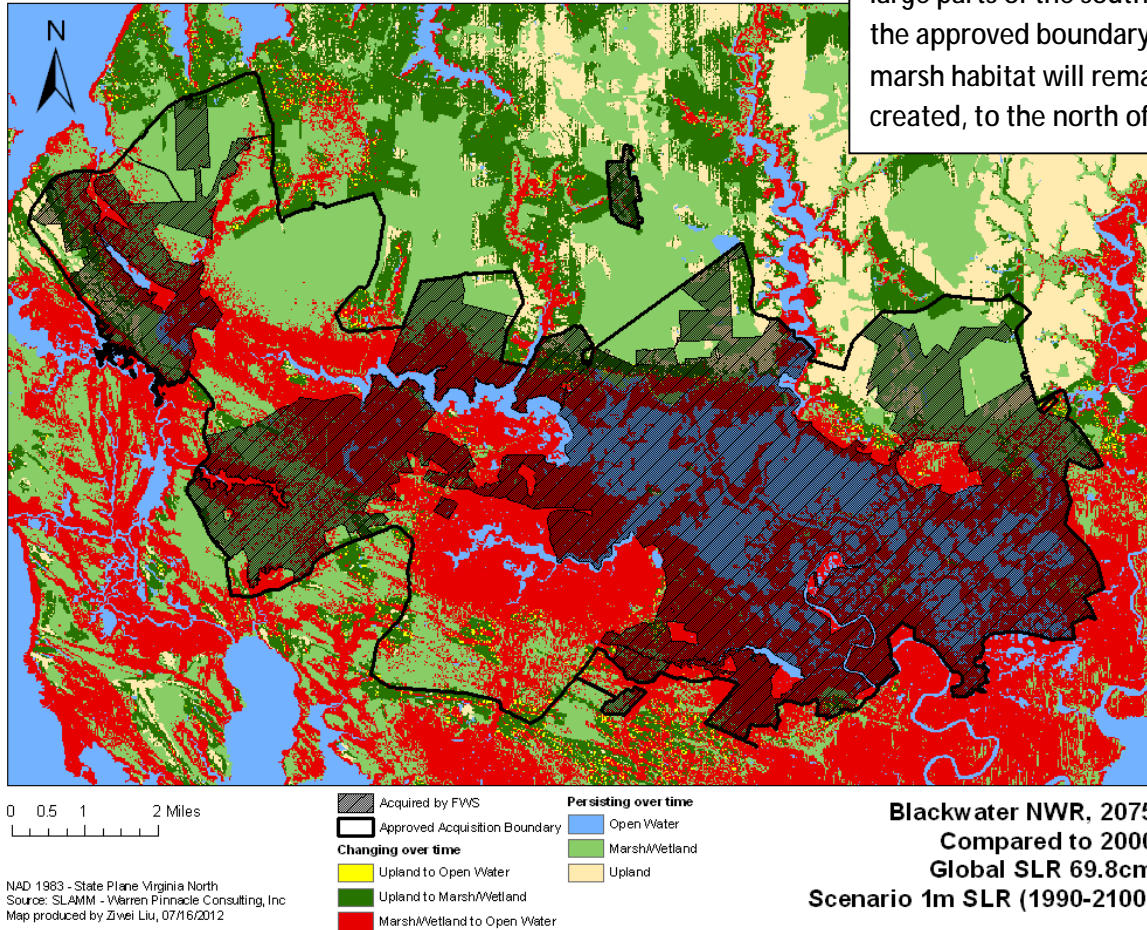
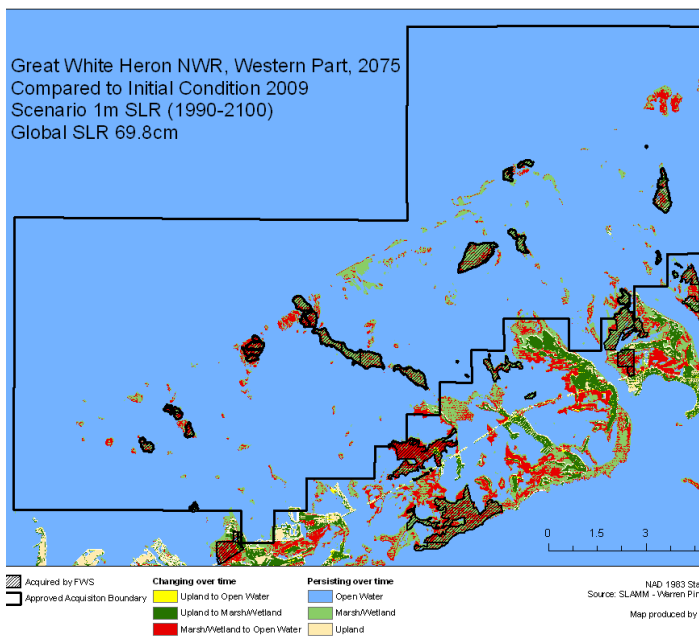


Figure 3. Great White Heron NWR (Florida)



Many islands will suffer substantial loss of land area, while others retain marsh habitat.

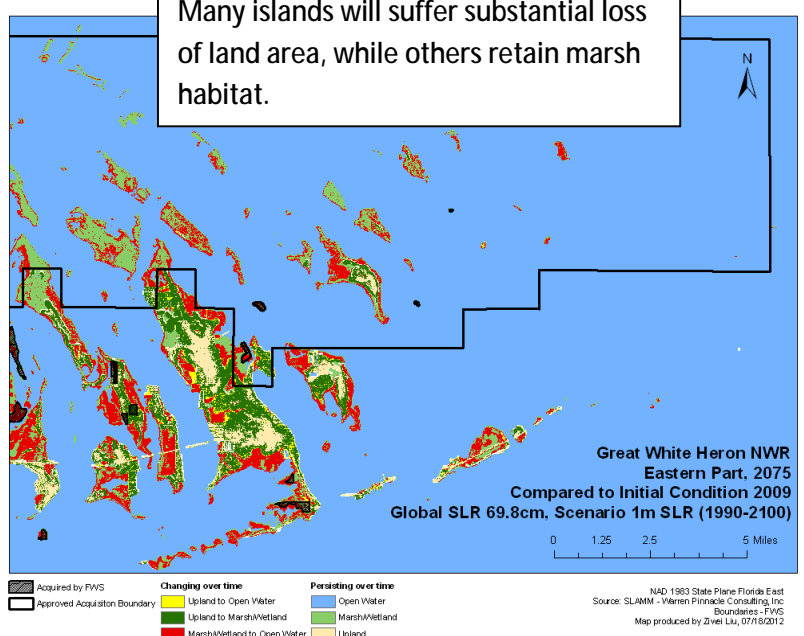
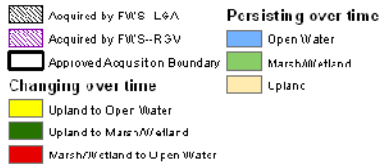


Figure 4. Laguna Atascosa and Lower Rio Grande Valley National Wildlife Refuges



Laguna Atascosa & Lower Rio Grande Valley NWR, 2075
 Compared to Initial Condition 1994, Global SLR 69.8cm
 Scenario 1m SLR (1990-2100)

NAD 1983 State Plane Texas South
 Source: SLAMM - Warren Pinnacle Consulting, Inc
 Map produced by Zhwei Liu, 07/17/2012

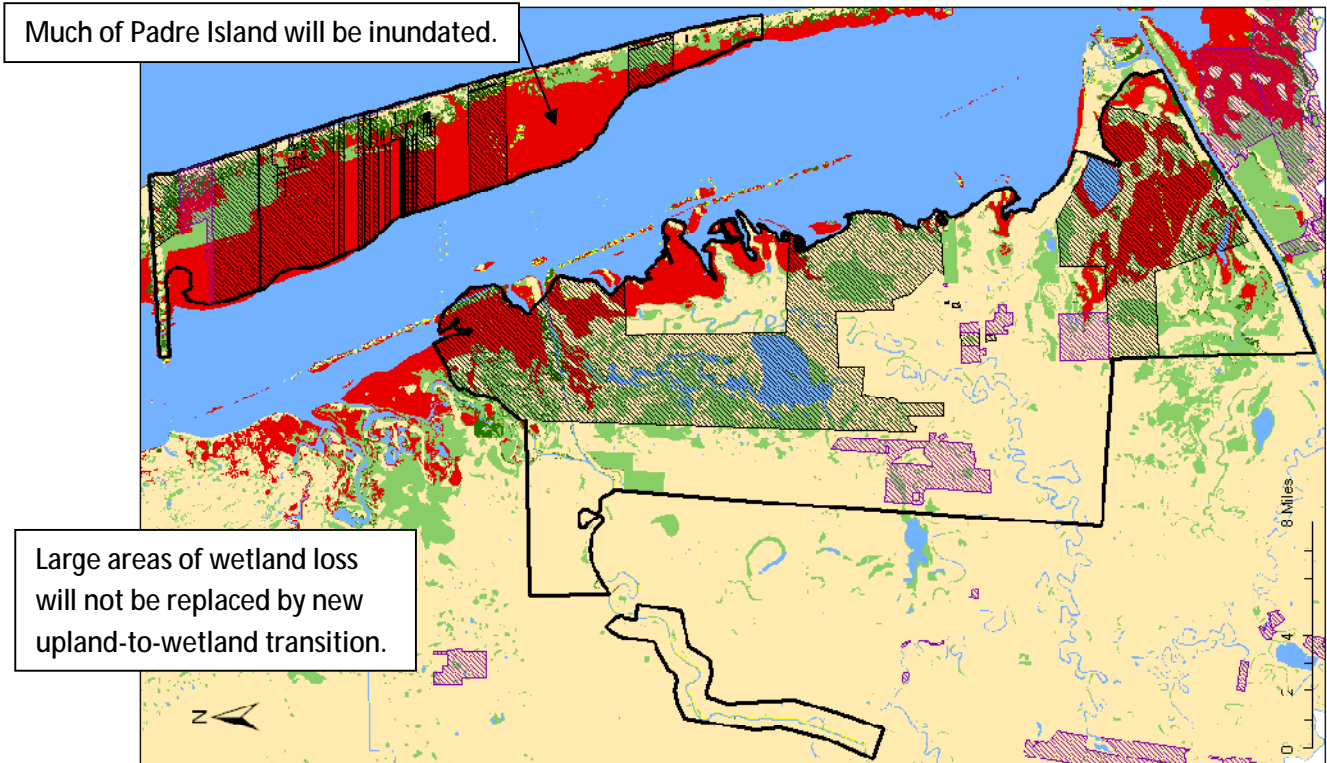
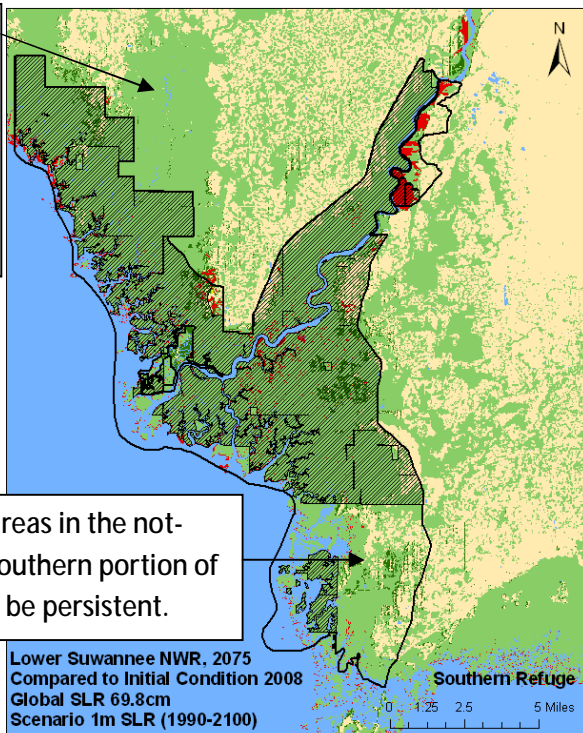


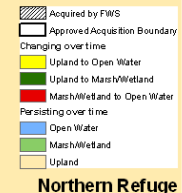
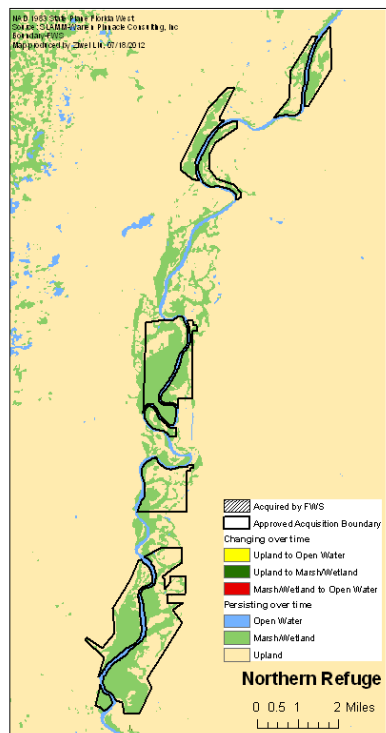
Figure 5. Lower Suwannee National Wildlife Refuge

Extending the refuge boundary north would allow protection of large areas of persistent wetland.

Most habitat areas in the not-yet-acquired southern portion of the refuge will be persistent.



Lower Suwannee NWR, 2075
 Compared to Initial Condition 2008
 Global SLR 69.8cm
 Scenario 1m SLR (1990-2100)



Conclusions and Recommendations

Sea-level rise impact will not be felt equally among coastal refuges. Lower Suwannee NWR, for instance, will have very little loss of wetlands or uplands. Some refuges, like Blackwater, will likely face inundation but have newly created areas nearby. Others, like Laguna Atascosa NWR, will face wetlands loss that may not be readily replaced. And refuges whose land area consists mainly of low-lying islands, like in the Florida Keys, may run out of land entirely.

In order to maximize the effectiveness of conservation investments in future acquisitions for coastal wildlife refuges, we offer the following recommendations:

- Individual refuges should prioritize acquisition of parcels that are less vulnerable to sea-level rise, unless there is an immediate conservation need that justifies protecting a vulnerable parcel, or when FWS determines a parcel is important to allow for marsh habitats to transition or shift inland as sea levels rise.
- When immediate protection of a vulnerable parcel is needed, FWS should consider alternatives to land purchase, such as short-term, long-term, or rolling easements.
- FWS should amend approved refuge boundaries as appropriate to maximize long-term conservation benefits in the face of sea-level rise.
- LAPS should include maintenance of conservation value over time and long-term parcel vulnerability in its scoring system to help best allocate conservation dollars.
- Refuges should maintain GIS data of individual parcels of potential acquisitions within the approved boundary to facilitate analysis and management decisions.
- These recommendations should be applied not only to acquisitions using funding from the Land and Water Conservation Fund (LWCF), which LAPS informs, but also other sources, chief among them the Migratory Bird Conservation Fund.

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For more detailed analysis, including additional refuges and scenarios, please visit www.defenders.org/climate-change.

¹ IPCC, 2007. Climate Change 2007 - The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the IPCC. Cambridge: Cambridge University Press. ISBN 978 0521 88009-1.

² Rahmstorf, S. (2007). "A semi-Empirical Approach to Projecting Future Sea-Level Rise" *Science*, 315(5810), 368-370.

³ Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

⁴ Fiscal Year 2013 Land Acquisition Priority System ("LAPS") list, United States Department of the Interior, Fish and Wildlife Service, May 26, 2011.