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Optimizing Historic Preservation under Climate Change: A Pilot Study at Cape Lookout National Seashore to Test Decision Model

Climate change poses great challenges for cultural and natural resources, particularly in coastal areas. Cultural resources in coastal parks and recreation areas are vulnerable to climate impacts including sea-level rise, flooding, storm surge, and erosion. However, research about the impacts of climate change on cultural resources and adaptation planning is generally lacking, especially for cultural resources in coastal parks and recreation areas. The National Park Service (NPS) is currently operating under policy guidance to focus climate adaptation efforts on the most vulnerable and most significant cultural heritage assets. However, no transparent process exists for assessing trade-offs between protecting the most vulnerable cultural resources and protecting the most historically valuable cultural resources under budgetary constraints. This study presents findings from a pilot study at Cape Lookout National Seashore in which the Optimal Preservation Decision Support Model (OptiPres Model) was developed and refined to (a) identify annual adaptation actions for a subset of 17 buildings located within two historic districts and (b) examine trade-offs between different actions under several budget scenarios. The objective of the OptiPres Model is to maximize total resource value (i.e., the historical significance and the use potential) while minimizing resource vulnerability (i.e., exposure and sensitivity), over a 30-year planning horizon. We used a simulated annealing algorithm, widely-used for optimization problems in the fields of operation sciences and economic management, to evaluate tradeoffs among adaptation alternatives under different fiscal constraints. Study results suggest that: 1) funding allocation thresholds may exist for national parks to maintain the historical significance and use potential of historic buildings under climate change; 2) the OptiPres Model can identify cost-efficient approaches to allocate funding to maintain the historical value of buildings vulnerable to the effects of climate change; and 3) the quantitative assessment of trade-offs among alternative adaptation actions was able to

provide sufficient generalizable guidance for decision makers to gain inference on the dynamics of their managed system. Therefore, the OptiPres Model, while not designed as a prescriptive decision tool, allows managers to learn by exploring the consequences of proposed adaptation actions. Future applications of the OptiPres Model can guide park managers and stakeholders to make cost-effective climate adaptation decisions for historical buildings and other valued resources.