

Green and Grey: Factors Affecting Perceived Protection by a Dike & Saltmarsh

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Observed Problem & Gap

- Nor'easters can cause severe precipitation, wind, storm surge, and coastal flooding due to their large size and slow movement, and they are the driving storms of shoreline change in New England. (Chen et al., 2025; Colle et al., 2008; Ginis et al., 2024; Marciano et al., 2014)
- Grey infrastructures are becoming less favorable mitigation solutions as Natural and Nature-based Features (NNBFs), which combine engineered solutions with nature-based features, emerge as alternative solutions. (Bridges et al., 2015; Kuwae & Crooks, 2021; Moreno et al., 2022)
- NNBFs provide coastal protective services and social, ecological, and economic benefits, but communities often do not perceive these benefits. (Morris et al., 2024)
- Better understanding factors affecting views on NNBFs can support and facilitate successful NNBF implementation where grey infrastructure has been established and preferred.

Research Question

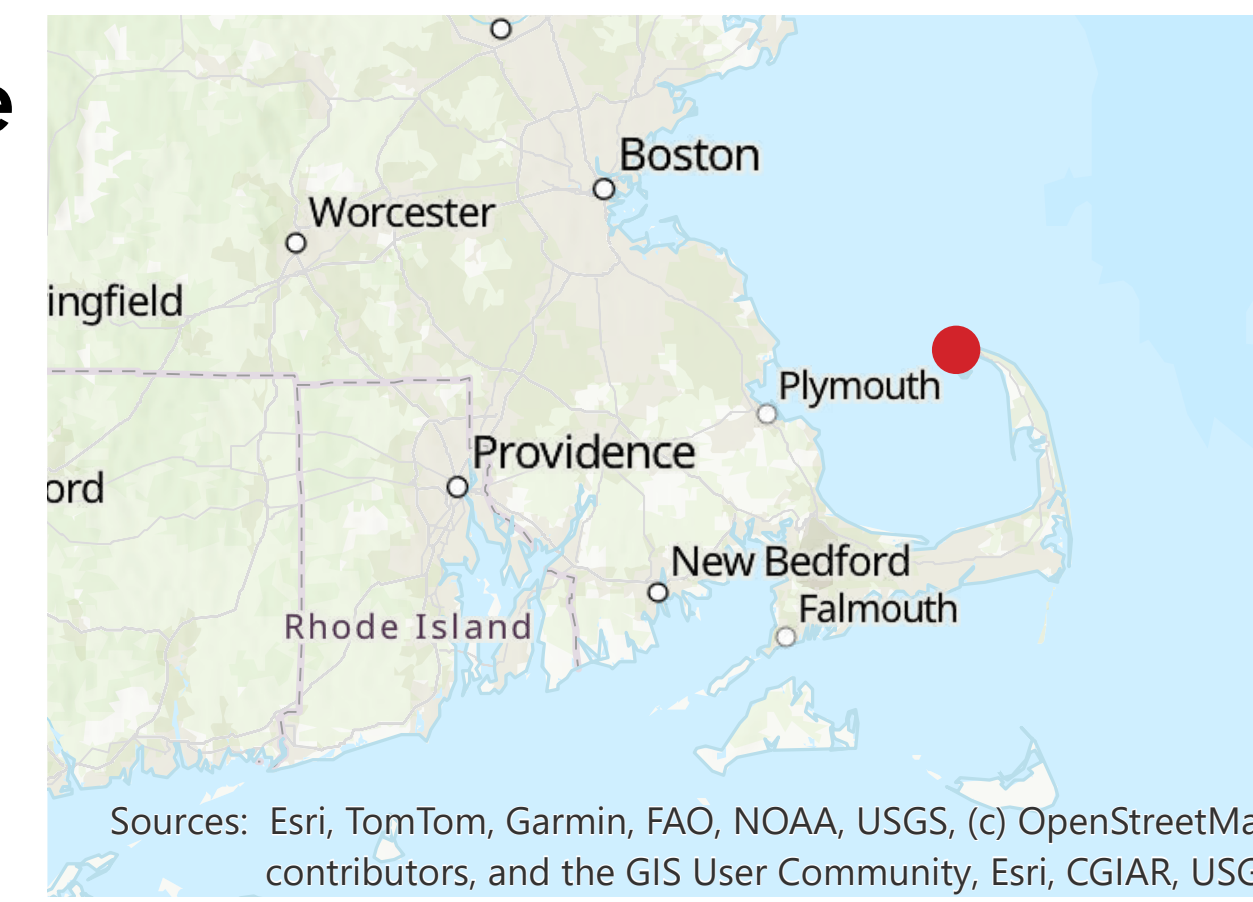
- In what ways and to what extent do the presence of grey infrastructures and NNBFs affect perceived protection from coastal storms?

Applications

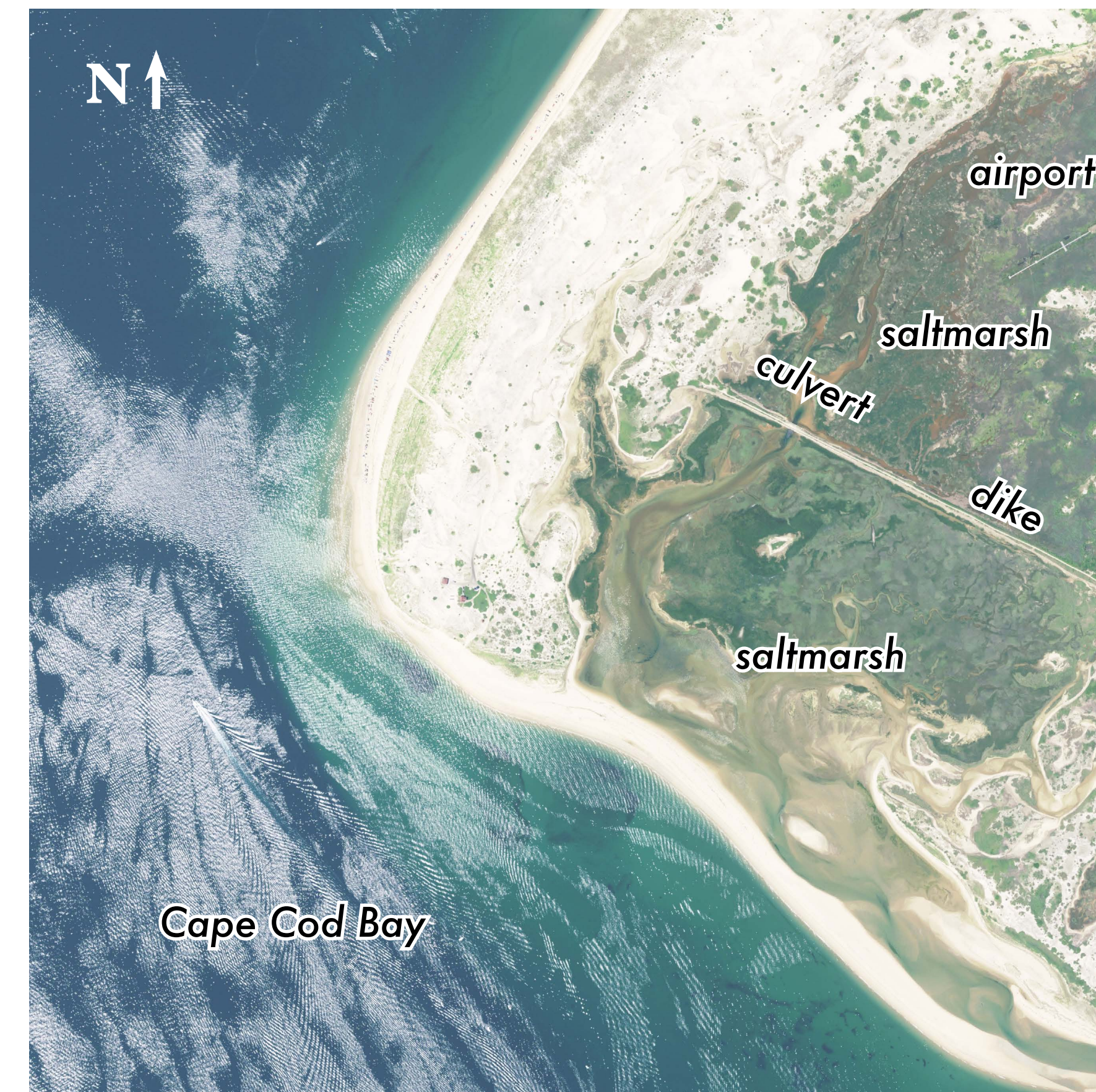
1. Contribute to theoretical understanding of the factors that affect perceptions of protection from coastal storms.
2. Integrate findings into the manner in which NNBFs are discussed with vulnerable communities.
3. Provide the National Park Service at Cape Cod National Seashore with social considerations for the management planning of Hatches Harbor resources.

Case Study Site

- Hatches Harbor (HH) within Cape Cod National Seashore adjacent to Provincetown, Massachusetts.
- Co-location of a saltmarsh (NNBF) and a dike (grey infrastructure) in the same social and environmental context, protecting the Provincetown Municipal Airport.
- Construction of the dike in 1930 blocked tidal exchange between the Cape Cod Bay and the saltmarsh, degrading the natural ecosystem. (Portnoy et al., 2003)
- The airport was constructed in the 1940s in the floodplain with the dike as flood protection. (Portnoy et al., 2003)
- The dike was already in poor condition when a culvert was opened in the late 1990s to restore the health of the saltmarsh. (Portnoy et al., 2003)
- The Provincetown Municipal Airport is valued today for its contribution to Provincetown's tourism-driven economy.
- The National Park Service will come to manage the airport and its land when the current 40-year special lease agreement lapses.



The red dot indicates location of Hatches Harbor and Provincetown on Cape Cod.



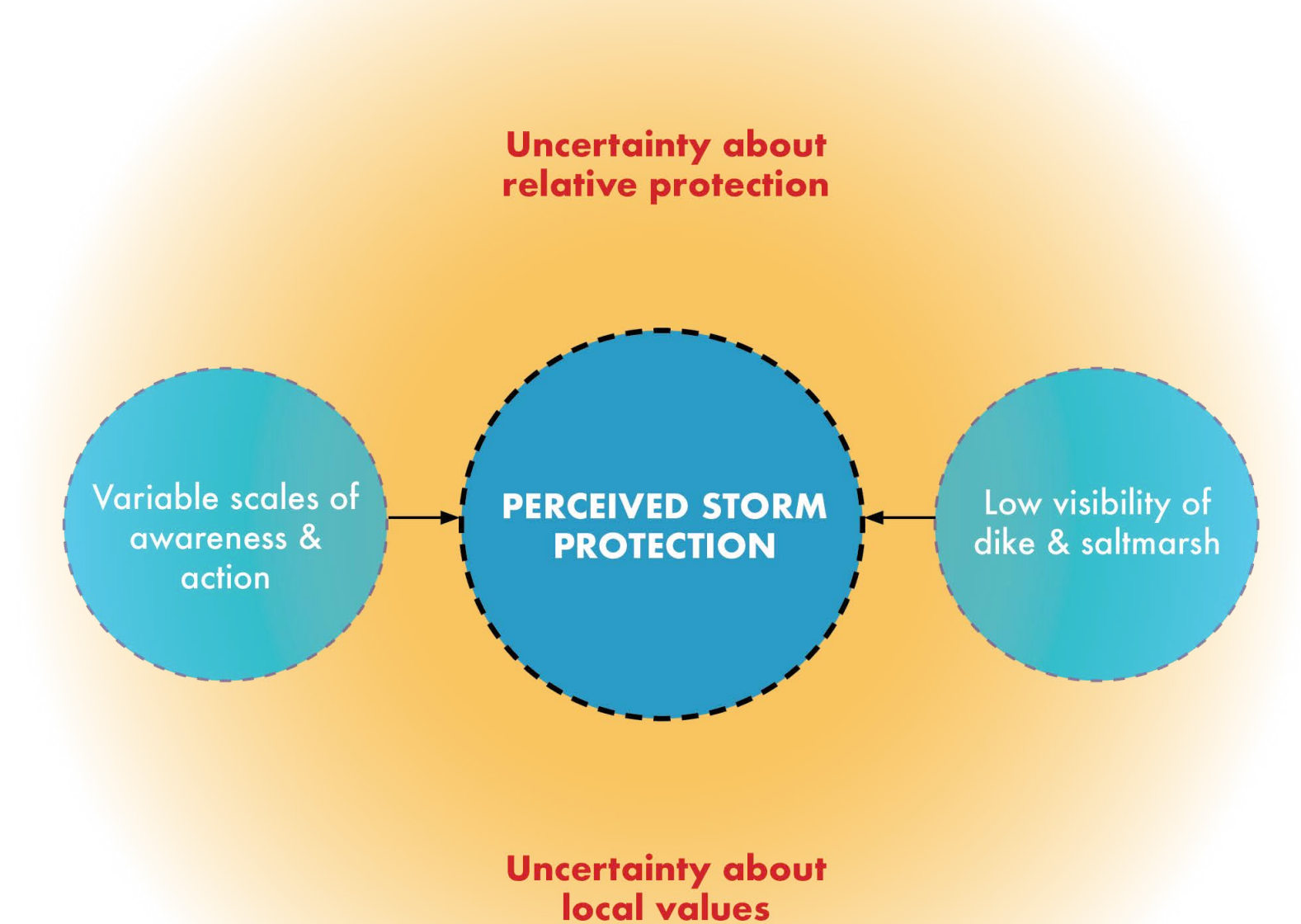
The locations of the dike, saltmarsh, and airport within Hatches Harbor. Visualized by Peter Stempel.

Methods

- Qualitative exploratory geographic intensive case study.
- IRB #: STUDY00029170.
- 60-minute-long semi-structured interviews.
- N = 24 purposively sampled, including 12 government officials and 12 local interest holders.
- Key themes addressed in interviews:
 1. Experience with coastal storms and climate change.
 2. Use of Hatches Harbor.
 3. Interaction/knowledge with/about the Provincetown Municipal Airport.
 4. Views of the dike and saltmarsh.
 5. Opinions on future management decisions.
- Inductive, iterative thematic analysis of interview data using NVivo to develop a grounded theory addressing the research question.

Themes from Development Interviews

- Lack of infrastructure in HH leads to passive recreational use of the natural area and low awareness of the dike's and saltmarsh's protective function.
- Individual/group awareness of the dike and saltmarsh is idiosyncratic.
- Protective action in the Cape Cod region varies in scale and is influenced by its single-access road.
- There is uncertainty regarding how locals value the three pieces of infrastructure and the relative protection provided by the dike vs. the saltmarsh due to modeling constraints.



Conceptual diagram of themes from development interviews.

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