Effects of Green Space on Storm Impacts and Recovery

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Highlights

Spatial mapping can highlight the areas where natural and nature-based features (NNBF) provided the greatest benefit. Higher wind speeds and storm surges are widely recognized to increase property damages, whereas nearby environments can either mitigate or worsen storm impacts. Our spatial modeling of household survey data after Hurricane Michael hit Florida in October 2018, alongside land-use and other environmental data, revealed specific places where NNBF potentially provided the greatest benefit.

Overall, having more surrounding green space, rather than a more built environment, predicted higher probability of home and mental recovery. We found that residents surrounded by high proportions of green space had the highest probability of reporting that they had fully recovered, whereas residents mostly surrounded by built environments had the lowest.

OVERVIEW

Living along the coast is appealing to many people, but it involves constant risks and costs associated with high hazard exposures. Both the social and environmental context of coastal communities shape the impacts of hazards on these communities. For instance, many attributes of local to regional landscapes, such as elevation, shoreline types, density of houses, natural and nature-based features (NNBF), and other surrounding conditions, affect disaster outcomes. However, much less is known about how these diverse factors affect post-disaster recovery. We integrated our household survey data following Hurricane Michael with land-use/land-cover data and used geospatial mapping and regression-based predictive modeling to assess the relative influences of 'green-to-built' landscapes on the recovery of coastal homes and the mental recovery of coastal residents. 'Green-to-built' describes a continuum of situations ranging from living in a home completely surrounded by green space to living in a home completely surrounded by built or developed areas.

RESEARCH OBJECTIVES

1. Understand how 'green-to-built' environments influence recovery from the storm.
2. Identify specific areas where green environments, or NNBF, provided potential benefits of storm buffering or improved recovery.

METHODS

We collected geospatial data on damage and recovery for homes, physical health, and mental health through a household survey deployed about one year after Hurricane Michael. We merged this data with land cover and land-use data from Florida's Fish and Wildlife Commission to characterize the proportion of surrounding green space or built environment for each survey respondent. We produced bivariate maps to spatially analyze patterns of recovery, damage, and the surrounding environments. We also used ordinal logistic regressions to assess overall relationships among survey respondents' surrounding environments and reported recovery.

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FINDINGS

Our geospatial mapping visualized patterns of high damage (shown in Figure 1 as blue or red) throughout the three-county region. Wind speed was the most powerful predictor of damage. However, home and mental recovery were more spatially variable, with higher than expected recovery in several areas that had high levels of green space. All areas with high home damage that also had high recovery status had 60% or more green space surrounding the residents (Figure 1). In addition, at local scales (up to 328 feet around a home), the ratio of surrounding built versus green space was a key predictor of recovery, with higher green space predicting higher probability of property and psychological recovery (Figure 2).

Recovery from a major hurricane is a complicated process that can take many years. Our study unravels some of this complexity by revealing connections between recovery and surrounding landscapes. In the context of disaster recovery, as well as planning for future disasters, our study demonstrates the importance of considering green spaces and natural and nature-based features as part of a holistic portfolio of investments for promoting resilient coastal communities.

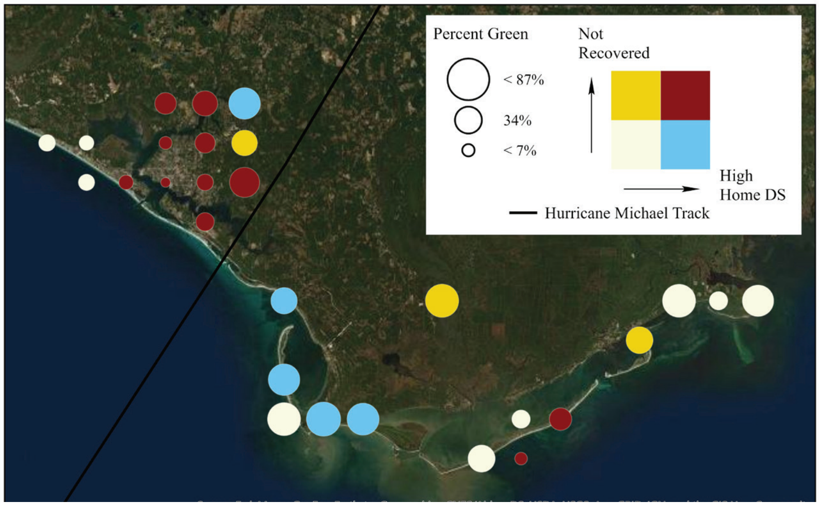

Figure 1. Bivariate map summarizing residents' home damage, recovery, and 1 km of surrounding green space, all averaged by a 10-km grid. Circles are colored by the connection between recovery and damage, then sized by the amount of surrounding green space. Red dots are grids that, on average, have high home damage and are not recovered, and blue dots are grids that have high home damage and are recovered. White dots are grids that, on average, have low home damage and are recovered, and yellow dots are grids that have low home damage and are not recovered.

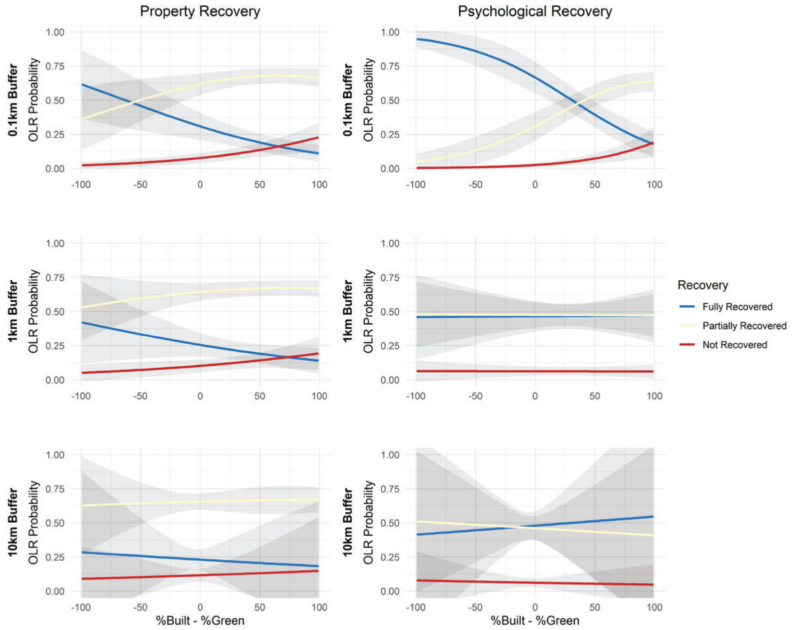

Figure 2. The probability of a respondent reporting a recovery state for property recovery and psychological recovery, given the ordinal logistic regression (OLR) models run prior. Each buffer (0.1km, 1km, and 10km) of land cover is tested creating three models for each type of recovery. The probability (y-axis) for each level of recovery is plotted by the respective %Built - %Green buffer around the respondent (x-axis). Each probability curve is colored for the corresponding recovery being predicted. The standard error of the probabilities are plotted along the curves by the grey area. The variable of %Built - %Green was significant for the 0.1km buffer model in both recovery models.