

# Applying Land Cover Change Predictions to Inform Conservation Decisions

## INTRODUCTION

Anthropogenic effects on wildlife, such as habitat loss and habitat fragmentation, are leading contributors to species decline and loss of biodiversity. Of particular concern is the loss of wetland ecosystems in the Caribbean as these areas provide habitat for millions of resident and migrating birds. The ability to accurately estimate future land cover changes (for example, predicted wetland loss) would be invaluable for land and conservation managers. With this information, areas that are identified as at-risk of conversion could be prioritized based on the quantity or species of birds they support, among other factors. Using Puerto Rico as a model, this study investigates land cover change predictions and one method of how future land cover information can be applied to determine conservation priorities.

## OBJECTIVES

- 1 generate future land cover map based on observed changes
- 2 identify high priority at-risk wetlands for conservation

## RESULTS

Given: Transition potentials for each land cover combination used in the Markov Chain prediction are listed in the table at left. The automated calculations for transition potential were edited to zero if potentials were implausible (e.g., urban to forest: 0.25) and other transitions in the row were adjusted in order for each row to equal 1.

Predicted Puerto Rico land cover for the year 2021 is displayed in Figure 1 with details in Figure 4. Overall, urban and agricultural land cover is predicted to expand by 555 and 650 km<sup>2</sup>, respectively, while forested areas are predicted to decrease by 1148 km<sup>2</sup> and wetlands by 56 km<sup>2</sup> (Fig. 2.). Wetlands are expected to be primarily converted to agricultural land, followed by conversion to urban development (Fig. 3).

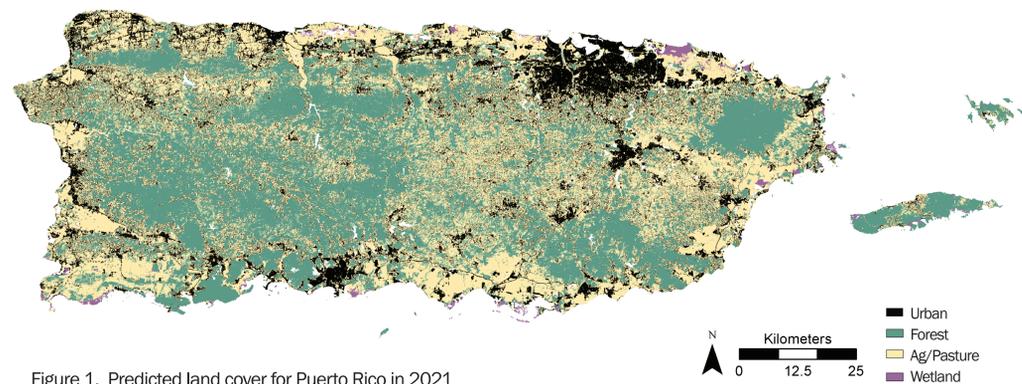


Figure 1. Predicted land cover for Puerto Rico in 2021

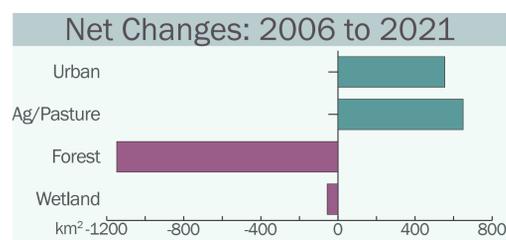


Figure 2. Predicted net changes in land cover between 2006 and 2021

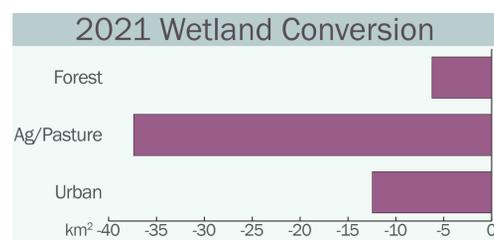


Figure 3. Contributions to predicted net loss of wetlands in 2021

Of the 125 km<sup>2</sup> of existing wetlands in 2006, only 69 km<sup>2</sup> (55%) are predicted to persist over the next 15 years. However, about 24 of the predicted 56 km<sup>2</sup> lost wetlands occur in protected natural areas which would positively contribute to persistence but was not accounted for in the model. Therefore, these wetlands were excluded in the conservation priority analysis. Wetlands predicted to disappear and occurring outside of protected areas were ranked based on estimated bird species richness (with greater richness ranked higher). Approximately 15 km<sup>2</sup> of high and medium conservation priority, and 2 km<sup>2</sup> of low conservation priority, wetlands were identified (Fig. 5.)

## METHODS

### LANDCOVER PREDICTION

Two land cover rasters (1991 and 2006) for Puerto Rico were obtained and modified in order for both to contain the same four land cover categories. The ArcGIS extension Land Change Modeler (Clark Labs) was used for prediction analysis. A raster layer reflecting the natural log of the distance to existing urban land cover served as a driver variable for land cover change. Transition potentials for all land cover change combinations were determined by the neural network model Multi-layer Perceptron and predictions for future change were estimated by Markov Chain.

### CONSERVATION PRIORITY ANALYSIS

Three layers were utilized to determine high priority at-risk wetlands: predicted wetland loss from the previous analysis, existing protected natural areas and estimated bird species richness. Layers were reclassified, scaled and weighted (25%, 25% and 50%, respectively) and the weighted overlay tool was used to generate conservation priorities.

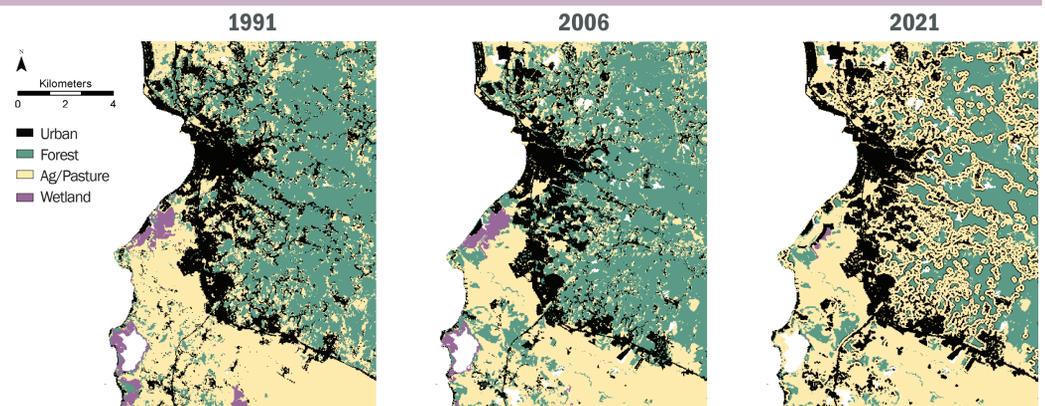


Figure 4. Detail of land use change surrounding the city of Mayaguez on the western coast of Puerto Rico. Known changes occur between 1991 and 2006; Markov Chain prediction depicted in 2021. Note urban and agricultural expansion and a decrease in wetlands and forests.

## CONSERVATION PRIORITY ANALYSIS FOR AT-RISK WETLANDS

Wetlands are recommended for conservation based on the following:

- 1 Predicted to disappear by 2021
- 2 Occur outside of protected natural areas
- 3 Support high estimated bird species richness



Figure 5. Priority wetland conservation areas (high=red, medium=orange, low=blue) for the island of Puerto Rico with detail on the south western coast.

## CONCLUSIONS

Land cover change prediction analysis of Puerto Rico revealed a trend of increased urbanization and agricultural land use and a decrease in existing forests and wetlands. As of 2006, there were 125 km<sup>2</sup> of wetlands- one of the most bird species rich habitat types. Of this area, 56 km<sup>2</sup> are predicted to disappear by 2021. A conservation priority analysis was conducted which identified 15 km<sup>2</sup> of high priority at-risk wetlands across the island to recommend for protection. Limitations to this study include the potential for error in the analysis. For example, standardizing raster pixel size, reducing the variety of land cover types, using different driver variables, editing the transition matrix, and reclassifying and weighting species richness all have the potential to introduce error.

### Data: