Introduction
Fire and defoliation are the two primary agents of mortality in the New Jersey Pine Barrens. Gypsy moth is a major defoliator throughout the northern hemisphere. It is estimated that gypsy moth in the US are currently infesting only 23% of the land area that they could potentially occupy, and will likely spread to all of the hardwood forest in the US and Canada. Gypsy moth first appeared in forests in New Jersey in 1966. Since then, three major defoliation events have occurred; 1972 (260,000 acres), 1981 (798,000 acres) and 1990 (431,000 acres). Early detection of defoliation in 2007 shows a near doubling of area defoliated since 2006. The New Jersey Pine Barrens (NJPB) is the largest remaining relatively undisturbed population of pitch pine (Pinus rigida) and white pine (Pinus strobus) in the northern hemisphere. The upland forests of the NJPB are a mix of early successional pine species and late successional oak species. Oak species act as the primary food source for gypsy moth defoliation, fire, and climate. We have encountered a range of disturbance events at our eddy covariance flux sites that measure net ecosystem exchange of carbon at three sites in the NJPB, which monitors the ecological impacts of transient disturbances such as gypsy moth defoliation, fire, and climate. We have encountered a range of disturbance events at our eddy covariance flux sites that measure net ecosystem exchange of carbon including disturbances such as partial defoliation, complete defoliation, and fire. Each disturbance site has at least one year of flux and plot data collected prior to disturbance to act as a control. We have established a multi-tiered network of field sites that have been collecting data since 2005 to look at defoliation and wildfire effects on forest health (i.e. mortality) and nutrient dynamics. The Silas Little and Cedar Bridge sites have been collected in prior years at our research sites. Data collected at these sites includes tree mortality, crown dieback, and a set of measurements required to estimate carbon pools in these forest stands. We will simulate the effects of gypsy moth defoliation and fire on ecosystem health, defined in terms of 1) carbon storage, 2) forest productivity, 3) tree mortality, and 4) changes in species composition. Preliminary Modeling Results: Comparison to flux tower measurements taken before and after defoliation
Comparison of flux tower and simulated net ecosystem exchange of carbon at three sites in the New Jersey Pine Barrens. The LANDIS-II model was calibrated to the Silas Little site (a) and then run without further tuning at the Cedar Bridge (b) and Fort Dix (c) sites. Differences at Cedar Bridge and Fort Dix in 2006 and 2007 and at Silas Little in 2007 are largely due to fire or insect disturbances not yet captured in the simulations.

Model Parameterization, Calibration, and Development
We will use a combination of field measurements, FDM defoliation monitoring data, and New Jersey Department of Environmental Protection (NJ DEP) data to parameterize and calibrate the LANDIS-II model. The model has been partially parameterized for New Jersey fire disturbances by Scheller et al. 2008. Climate change scenarios will be simulated using data from the Hadley GEMII model, and multiple emissions scenarios presented in the recent Fourth Assessment Report from the IPCC. The modeling component of this project using LANDIS-II makes use, primarily, of three model extensions or modules: the Dynamic Fire System (DFS) extension, the Biomass Succession Extension (BSE) and an insect defoliation extension. Parameterization of the DFS and a version of the Biomass Succession extension are complete, however the insect defoliation extension is underway in order to ensure realistic simulations of fire growth and fire effects on tree communities and nutrient dynamics.

Summary and Next Steps
The LANDIS-II model is being calibrated and parameterized for New Jersey. Preliminary model comparisons to flux tower data for undisturbed years show very close correlation. Differences are largely due to fire or insect disturbances not yet captured in the simulations. We anticipate the completion of model calibration of the dynamic fire system extension for LANDIS-II and implementing simulations of climate change effects on fire regimes and carbon cycling in the NJPB by approximately the end of the first year of the project. The field mortality survey and canopy foliar analysis were not part of the original proposal but added to this study to understand the process of forest decline with insect defoliation.

Projected Schedule for Project Year 2
The second year of the project will be focused on incorporating insect defoliation and the new biomass succession extensions into the modeling framework. We anticipate that by the end of the second year simulations of both defoliation and fire effects on forest health (i.e. mortality) and nutrient dynamics under control and climate change scenarios will be completed as originally proposed. A set of simulations will be used to represent potential future management scenarios including proposed changes in management of defoliation, fire, and management for carbon sequestration.

Acknowledgments

Contact: John Hom, USDA Forest Service, 11 Campus Blvd, Ste. 200, Newtown Square, PA 19073. 610-557-4097, jhom@fs.fed.us