

HERBIVOROUS INSECTS AND CLIMATE CHANGE: POTENTIAL CHANGES IN THE SPATIAL
DISTRIBUTION OF FOREST DEFOLIATOR OUTBREAKS

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The geographical ranges and spatial extent of outbreaks of herbivorous insect species are likely to shift with climatic change. We investigate potential changes in spatial distribution of outbreaks of the western spruce budworm, *Choristoneura occidentalis* Freeman, in Oregon and the gypsy moth, *Lymantria dispar* (L.), in Pennsylvania using maps of historical defoliation, climate, and forest composition in a geographic information system. Maps of defoliation frequency were assembled using historical aerial reconnaissance data. Maps of monthly means of daily temperature maxima and minima and of monthly precipitation averaged over 30 years were developed using an interpolation technique. All maps were at a spatial resolution of 2×2 km. Relationships between defoliation status and the environmental variables were modeled using a linear discriminant function. Five climatic change scenarios were investigated: an increase of 2 °C, a 2 °C increase with an increase of 0.5 mm per day in precipitation, a 2 °C increase with an equivalent decrease in precipitation, and equilibrium projections of temperature and precipitation by two general circulation models (GCMs) at doubled CO₂ levels.

With an increase in temperature alone, the projected defoliated area decreased relative to ambient conditions for the budworm and increased slightly for the gypsy moth. With an increase in temperature and precipitation, the defoliated area increased for both species. Conversely, the defoliated area decreased for both when temperature increased and precipitation decreased. Results for the GCM scenarios contrasted sharply. Using the scenario projected by the Geophysical Fluids Dynamics Laboratory (GFDL) GCM, defoliation by budworm was projected to cover Oregon completely, whereas no defoliation was projected by gypsy moth in Pennsylvania. Under the scenario projected by the Goddard Institute for Space Studies (GISS) GCM, defoliation disappeared completely for the budworm and slightly exceeded that under ambient conditions for the gypsy moth. The results are discussed in terms of potential changes in forest species composition.

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