

sketch maps we examined the relationship between defoliation and the number of ignitions in the province of Ontario, Canada. Previous work in Ontario has suggested a temporary increase in flammability in budworm-killed forests but regional and seasonal variability in these relationships has not been examined. Using Poisson regression, we modelled the number of fires per 10 km pixel between 1960 and 2004 for both lightning and human caused fires on the spring and summer fire seasons. Results indicate that human caused ignitions are driven by proximity to roads and regions of high population density and defoliation does not play a role. In contrast, the number of lightning ignitions was influenced by recent SBW activity, climate, and varies significantly among ecoregions. In the context of recent increases in the extent and severity of insect outbreaks in northern forests, these results indicate the potential for increased insect-related lightning-caused fire risk that may be further exacerbated by drier and warmer conditions.

Keywords: Disturbance interactions, Regression, Insect defoliation

233. Biogeochemistry of subalpine forest soils following multiple, interacting disturbances

Authors: Wessman, Carol Wessman, University of Colorado; Kendra Morliengo-Bredlau, University of Colorado; Brian Buma, University of Colorado; Julie Hayes, University of Colorado

Offered Presentations: Disturbance 1 - Wednesday (2011-04-06): 09:40 - 10:00 - Broadway 3

Abstract: We studied disturbances, both singular and multiple, and their impact on soil properties within subalpine forest in the Rocky Mountains of northern Colorado. The Routt National Forest experienced blowdown, salvage logging and fire within a 5 year period from 1997 to 2002, leading to a spatially heterogeneous landscape of varied disturbance histories. Plots were established in green, intact forest and in areas that had experienced all disturbance combinations (blowdown, blowdown+logged, fire only, blowdown+fire and blowdown+logged+fire). Soil samples (0-10cm) were acquired in 2007-2008 and analyzed for available ammonium and nitrate, nitrification and mineralization potential, and other biogeochemical properties. Soil moisture and vegetation cover were measured monthly in 2008 and 2009. Multiple analysis of variance was used to evaluate the significance of "treatment effects" (defined as the pre-burn conditions present: blowdown, logged blowdown, and undisturbed) and "burn effect" (burned or unburned) on selected soil properties. The main effects of blowdown and logging disturbances indicated that the treatment type significantly affected the soil's total phosphorous, ammonification potential and available nitrate. Evaluation of the effects of burned versus non-burned sites showed that fire significantly affected total extractable phosphorous, bulk density, soil organic matter content, available nitrate and ammonium, and C, N, Ca and Mg content. Soil moisture and vegetation cover were also significantly affected by fire, however the extent of the effect was dependent on disturbance history. Results indicate that disturbance interactions are complex, with some (blowdown+fire) producing more dramatic impacts, while other disturbance combinations (blowdown+logging+fire) reduce the impact of the cumulative disturbance.

Keywords: Disturbance, Fire, Blowdown, Salvage logging, Subalpine forest

234. Long-distance dispersal of eastern spruce budworm in Minnesota (USA) via the atmospheric pathway

Authors: Sturtevant, Brian Sturtevant, US Forest Service; Gary Achtemeier, US Forest Service; Dean Anderson, Manaaki Whenua - Landcare Research; Joseph Charney, US Forest Service; Barry Cooke, Canadian Forest Service

Offered Presentations: Disturbance 1 - Wednesday (2011-04-06): 10:00 - 10:20 - Broadway 3

Abstract: Long-distance dispersal is thought to play an important role in synchronizing disparate populations of forest insect defoliators, but its importance relative to other factors remains unclear due to the difficulty of quantifying dispersal. In a large spatial network of spruce budworm pheromone traps in northern Minnesota and adjacent Ontario we observed a pulse in moth captures in areas where moths had not yet emerged, suggesting long-distance dispersal from phenologically advanced

areas with high population density. We applied an insect phenology model to identify sites with late phenology - due to localized cooling on the shoreline of Lake Superior - relative to "source" areas further inland where a localized population outbreak was in progress. We then coupled a high-resolution (1-km) atmospheric model with a spruce budworm adult flight behavior model to evaluate the likelihood that budworm adults emerging from the source area dispersed over 150 km to moth collection sites near the north shore of Lake Superior. Flight behavior parameters from New Brunswick, Canada, were used to parameterize the flight behavior model that interfaced with 4-dimensional output (i.e., temperature, wind speed, and precipitation) from the atmospheric model. Landings were dependent in part on the availability of suitable host, mapped using remote sensing. Results indicated that while the distance from the outbreak region to the lake shore was well within the flight capability of budworm adults, meteorological conditions limited the dates under which such immigration was possible. Our study illustrates the value of aerobiology to understand long-distance dispersal vectors for actively dispersing insect populations.

Keywords: *Choristoneura fumiferana*, Long-distance dispersal, Aerobiology, Agent-based modeling, Minnesota

235. Multiple disturbances in a subalpine forest, impact on resilience mechanisms, and implications for ecosystem recovery

Authors: Buma, Brian Buma, University of Colorado; Carol Wessman, University of Colorado

Offered Presentations: Disturbance 1 - Wednesday (2011-04-06): 10:20 - 10:40 - Broadway 3

Abstract: Multiple disturbances, or compounded perturbations, potentially cause ecological surprises and rapid shifts in land cover and are thus an important topic of study. Actual landscape-scale study systems, however, are rare and often not ideal. In Colorado, a 1997 blowdown (~10,000 ha) coupled with a 2002 wildfire (~12,500 ha) created a mosaic of disturbance magnitudes and interactions in a subalpine forest composed of Engelmann spruce, subalpine fir, and lodgepole pine. Salvage logging (~800 acres) from 1998 - 2001 functions as a de facto experimental treatment (reducing blowdown magnitude prior to the fire). By investigating the ecosystem response along a gradient of disturbance magnitudes and histories, disturbance interaction phenomena (e.g. novel conditions) and cumulative severity can be assessed. It appears the interaction of high-magnitude blowdown and fire overcame the resilience of the subalpine coniferous ecosystem through specific and novel ways. Lodgepole typically recovers post-fire through cone serotiny, whereas spruce and fir rely on dispersal from residuals. The combination of severe blowdown and fire significantly increased both the burn times (consuming serotinous cones) and the distance to lower magnitude fire areas (increasing required seed dispersal distances), resulting in significantly less conifer recruitment than fire-only treatments ($p < 0.05$). Salvage logging partially ameliorated the disturbance severity, likely by reducing coarse woody debris levels prior to the fire. Thus these interactions created, in effect, a novel disturbance. Disturbance interactions can overwhelm ecosystem resilience mechanisms, reduce recovery rates, increase future landscape heterogeneity, and potentially push the ecosystem onto different successional trajectories.

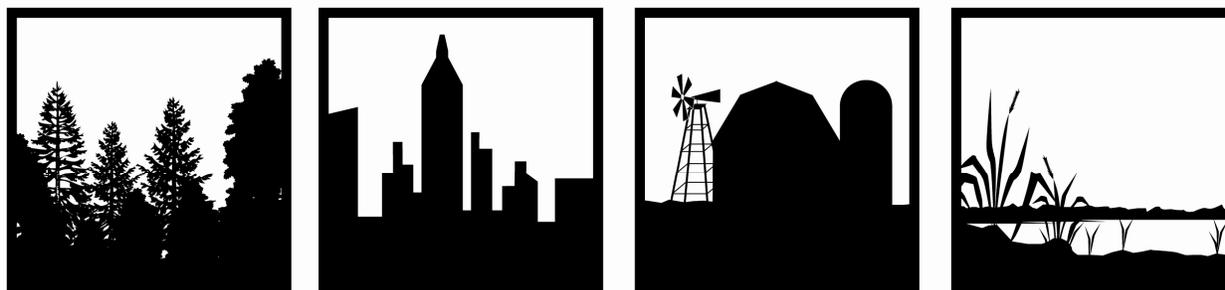
Keywords: Disturbance, Forest, Fire, Resilience, Compounding perturbation

236. Simulating Southern Appalachian forest landscape change: Effects of herbivory by Southern Pine Beetle

Authors: Zeng, Szu-Hung Chen, Texas A&M University; Charles Lafon, Texas A&M University; David Cairns, Texas A&M University; Andrew Birt, Texas A&M University; Robert Coulson, Texas A&M University

Offered Presentations: Disturbance 1 - Wednesday (2011-04-06): 10:40 - 11:00 - Broadway 3

Abstract: The outbreaks of Southern Pine Beetle (SPB) (*Dendroctonus frontalis*) are major disturbances to Southern Appalachian forest. Large events of this disturbance can significantly change composition and structure of forest landscape by setting off successional dynamics



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