WINDSTORM AND FUEL REDUCTION EFFECTS ON GROUND BEETLES IN A SUB-BOREAL FOREST

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In July of 1999, a large windstorm known as the "Boundary Waters-Canadian Derecho" created windthrow of over 476,900 ac within Superior National Forest in northeastern Minnesota. U.S. Forest Service personnel performed two fuel reduction treatments following the storm to reduce the potential for wildfire and insect or disease outbreak: salvage logging over 2,700 ac and prescribed-burning over 2,100 ac. Objectives of this study were to look at forest sites that were undisturbed, wind-disturbed, or managed following the windstorm with a fuel reduction treatment, and determine:1) if there were differences among sites in ground beetle catches, species richness, diversity or composition; and 2) if there were differences in any these attributes among cover types.

During the summers of 2000-2003 researchers sampled ground beetles within plots of five to seven acres. Eight plots (four in aspen/birch/conifer cover type and four in jack pine cover type) were located within each of the following treatments: undisturbed, wind-disturbed, wind-disturbed-salvage logged (salvaged), and wind-disturbed-prescribed-burned (burned). Both baited and unbaited pitfall traps were used. Species richness, diversity indices, and abundances were calculated, and cluster analysis was performed across the treatments for baited and unbaited traps. Researchers caught 29,873 ground beetles consisting of 71 species in pitfall traps in cover types of aspen/birch/conifer (ABC) and jack pine (JP). Four species comprised 72% of the total number of beetles caught, with *Pterostichus melanarius*, a species introduced from Europe, being the most abundant (Table 1).

More beetles were captured in undisturbed forests than in wind-disturbed forests, suggesting that ground beetle populations in sub-boreal landscapes are negatively impacted by severe windthrow in the short term. Burned forests yielded more ground beetles than any other treatment. This may have


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MANAGEMENT IMPLICATIONS

1) Ground beetle species may be negatively impacted by severe windthrow events in the short term.

2) *Pterostichus melanarius*, an introduced ground beetle from Europe, is thought to be a generalist regarding cover type and could potentially alter successional pathways of ground beetles in this sub-boreal landscape.

3) Salvage logging or burning following windthrow resulted in greater species diversity and uniqueness of ground beetles than sites that were undisturbed or wind-disturbed with no fuel reduction treatment.

4) Treatment type (e.g., undisturbed, wind-disturbed, salvaged following windthrow, burned following windthrow) was thought to have more of an effect on ground beetle species composition than cover type (aspen/birch/conifer vs. jack pine).

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been partly driven by the presence of *P. melanarius*, which demonstrated an affinity for burned JP forests and was the most abundant species captured. This species was trapped in both cover types in all treatments and when removed from analysis, clustering patterns of ground beetle composition became more similar among cover types and among treatments. This suggests that *P. melanarius* is a cover type generalist, and its presence could alter the successional pathways of ground beetles on this landscape.

Table 1. The four most abundant ground beetle species caught over the summers of 2000-2003, altogether making up 72% of the total catch. Numbers of ground beetles caught in pitfall traps for both cover types and all four treatments are presented here.

Species	% Total Catch	Aspen/Birch/Conifer				Jack pine			
		Undisturbed	Wind-disturbed (WD)	WD-Salvaged	WD-Burned	Undisturbed	Wind-disturbed (WD)	WD-Salvaged	WD-Burned
*P. melanarius**	35%	472	56	398	2,622	224	11	832	5,561
P. adstrictus	16%	243	150	668	1,555	186	139	88	1,656
P. pensylvanicus	11%	426	181	623	168	744	317	293	257
Calathus ingratus	10%	684	326	745	330	343	138	81	619

*Introduced from Europe

Although results for baited and unbaited traps were reported separately, ground beetle species did not appear to respond to bait used in pitfall traps. For unbaited traps over all years sampled, salvaged and burned sites contained the greatest number of species and most unique species. JP salvaged sites had the highest mean diversity followed by ABC salvaged, ABC burned, JP burned, JP wind-disturbed, and ABC wind-disturbed. Undisturbed sites of JP and ABC had the lowest mean species diversity. For both cover types Simpson's diversity index was greatest in burned forests. Cluster analysis resulted in two distinct groups: ABC and JP burned forests in one group and the remaining treatments (ABC and JP undisturbed, wind-disturbed and salvaged) in a second group. For baited traps, salvaged and burned forests also had the greatest species richness and the most unique species.

In terms of abundance, there were larger ground beetle populations present within ABC forests than in JP forests overall and on a species-level scale and there were some ground beetle species found in only one or the other cover type. Species richness, however, remained similar between cover types. Within both cover types (ABC and JP) in burned forests, species composition was identical, suggesting that disturbance type had more of an effect on species composition than cover type on this landscape. These results suggest that within sub-boreal forest in northeastern Minnesota, ground beetle species may be negatively impacted by severe windthrow events in the short term, and fuel reduction treatments such as burning or salvage logging following such events can create conditions favoring a more diverse and unique community of ground beetles.

Reference

*Gandhi, K. J. K., D. W. Gilmore, S. A. Katovich, W. J. Mattson, J. C. Zasada, and S. J. Seybold. 2008. Catastrophic windstorm and fuel-reduction treatments alter ground beetle (*Coleoptera: Carabidae*) assemblages in a North American sub-boreal forest. Forest Ecology and Management 256:1104-1123*