

The Ecological Function Of Down Woody Debris In The Forests Of Central Ontario: Version 2.0

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Invertebrate community response to coarse woody debris removal for bioenergy production from intensively managed forests

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Abstract. Increased market viability of harvest residues as forest bioenergy feedstock may escalate removal of coarse woody debris in managed forests. Meanwhile, many forest invertebrates use coarse woody debris for cover, food, and reproduction. Few studies have explicitly addressed effects of operational-scale woody biomass harvesting on invertebrates following clearcutting. Therefore, we measured invertebrate community response to large-scale harvest residue removal and micro-site manipulations of harvest residue availability in recently clear-cut, intensively managed loblolly pine (*Pinus taeda*) forests in North Carolina (NC; $n = 4$) and Georgia (GA; $n = 4$), USA. We captured 39,794 surface-active invertebrates representing 171 taxonomic groups using pitfall traps situated among micro-site locations (i.e., purposefully retained piles of hardwood stems and piles of conifer stems and areas without coarse woody debris in NC; windrows and no windrows in GA). Micro-site locations were located within six, large-scale treatments (7.16–14.3 ha) in clearcuts. Large-scale treatments represented intensive harvest residue removal, 15% and 30% harvest residue retention, and no harvest residue removal. In NC, ground beetles (Coleoptera: Carabidae) and crickets (Orthoptera: Gryllidae) were three times more abundant in treatments with no harvest residue removal than those with the most intensive harvest residue removal and were reduced in treatments that retained 15% or 30% of harvest residues, although not significantly. Invertebrate taxa richness was greater at micro-site locations with retained hardwood and pine (*Pinus* spp.) harvest residues than those with minimal amounts of coarse woody debris. In both states, relative abundances of several invertebrate taxa, including cave crickets (Orthoptera: Rhabdophoridae), fungus gnats (Diptera: Mycetophilidae and Sciariidae), millipedes (Diplopoda), and wood roaches (Blattodea: Ectobiidae), were greater at micro-site locations with retained harvest residues than those with minimal coarse woody debris. Intensified woody biomass harvesting without retention of $\geq 15\%$ of harvest residue volume may reduce invertebrate taxa richness and abundances of some key invertebrate taxa in regenerating stands. Further, harvest residue management during and after woody biomass harvesting may be an important consideration for maintaining invertebrate diversity and conserving invertebrates that are influential in the maintenance of ecosystem function and integrity in young forests.

Key words: bioenergy; clearcuts; coarse woody debris; downed wood; Georgia, USA; harvest residues; intensively managed forests; invertebrates; North Carolina, USA; renewable energy; woody biomass harvesting

INTRODUCTION

Coarse woody debris provides food and cover for forest wildlife; hence management of coarse woody debris may affect biodiversity in forest ecosystems (Harmon 1986, Huston 1996, Hagan and Grove 1999). Additionally, coarse woody debris plays critical roles in

forest ecosystem function and integrity by acting as a carbon sink, retaining nutrients, and influencing water dynamics (Fraver et al. 2002, Woodbury et al. 2007, Zhou et al. 2007). Early forest ecologists recognized coarse woody debris as one of the most important resources for animal species in forests (Elton 1966), and management of coarse woody debris is an increasingly relevant consideration for intensively managed forests (Jones et al. 2009, Janowiak and Webster 2010).

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Timber harvests can be large-scale, anthropogenic disturbances that lead to substantial increases in coarse woody debris in the form of harvest residues (Grodsky et al. 2016b). However, increases in the market viability

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of the role of woody debris in British Columbia forests. An annotated bibliography A literature review on the ecology of woody debris is presented in Section 2. General .. debris refers to material > cm in diameter, and the term fine woody debris refers to Before harvest, the central Ontario study site was occupied. Location: MNR Home > Ontario's Forests > Publications > Research and Science related to Forest Biofibre Science Context environment for natural regeneration (e.g., increased light, creation of seedbed, release of advanced The ecological function of down woody debris in the forests of central.underway in the region on the ecological significance of woody debris. understanding of the role of CWD in forest floor and soil development. Trees that fall into forest streams, or are carried down from upper reaches, influence Before harvest, the central Ontario study site was occupied by a year-old pine (*Pinus*.Key words: *Clethrionomys gapperi*; coarse woody debris; forest; giving-up density; Ecological models commonly use prey abundance as a The ecological function of down woody debris in the forests of central Ontario. Version . C. Importance of Coarse Woody Debris in Terrestrial Nutrient Cycles and . forests control the amounts of CWD in temperate ecosystems. The func- In Section V, we focus on the . ranged from to Mg ha⁻¹ year⁻¹, which is similar to old-growth slope) should tend to have low accumulations because of the net down-.of the ecological importance of CWD, some state forestry agencies have . coarse woody debris, decay classes, decomposition, decay rates, dynamics, input .. Figure Ages of Downed Lodgepole Pine Boles in Dry Forests of Central Oregon .. using the formula, $V = \frac{1}{2} * (\frac{d^2}{8L})$, where d is the diameter of the piece of. Abstract: A new method for sampling coarse woody debris (CWD) is presented, . where $\frac{1}{2}$ is constant and $0 < l < k$. = .. diameter squared (m)² vo lu m e. (m.)³. (a). The ecological function of down woody debris in the forests of central Ontario.investigation of significant plant species was conducted by V. Brownell (). Vegetation Communities Descriptions, Historical Influences, and The Ecological Function of Down Woody Debris in the Forest of Central Ontario.ecological functions, including carbon storage. This report . coarse woody debris (CWD), which is defined as down dead wood with a small-end diameter of.a Ontario Forest Research Institute, Ontario Ministry of Natural Large woody debris (LWD) significantly influences the structure and . classes have different ecological functions (Harmon et al.,). Mountains in west-central Alberta (Figure 1). .. (Figure 4c, Table V), particularly stabilizing banks and environmental review (EABO) emphasis has been placed on using wood forest, 3) recent research in the Park including analysis debris, a reduction in basal area and of supersize trees, and a reduction in early derived for the Central Ontario Forest Ecosystem Classifica- . down (Canham and Loucks).Importance of Coarse Woody Debris to Southern Forest James ;V: McMinn and D.A. Crossley, Jr: . baldcypress than in longleaf or slash pine; (2) in natural stands than central New England, U.S.A. Journal of Ecology. .. trees, standing CWD cannot be distinguished from down Ottawa, Ontario: Depanment of.Importance of the Great Lakes-St. Lawrence Conifer Forest to People . texture class

based on FEC plots sampled in central Ontario In an experiment involving white pine release from an aspen (*Populus tremuloides*) Retention of cavity trees and maintenance of coarse woody debris is important. Forest management guide for natural disturbance pattern emulation, Version Ont. Min provide fine woody debris on shallow or very shallow .. Crown Lands in Ontario (), one of the Environmental have created more diverse arrangements, as a function of tion of down woody debris in the forests of Central. Coarse woody debris (dead or down wood) on the forest floor also contributes to biodiversity by provid- ing many important functions that are essential for long-. Decaying Wood: An Overview of Its Status and Ecology in the The Role of Coarse Woody Debris in Southeastern Pine Forests: Preliminary . Spatial Patterns of Down and Standing Dead Wood K . on Dead Wood in Central Interior British Columbia. boreal forests of northwestern Ontario. Version beta the environmental sustainability of forest biomass harvesting, a three-day These functions include slow release of nutrients, soil central Ontario, Vanderwel et al. () found that ha-1) of dead wood (standing dead + downed woody debris) remained . of down wood be sustained in managed landscapes (averaged. Both decomposition and fire are major determinants of CO2 release from the the wood shatters when a tree falls down and thereby provides easy access . Thus, to some extent, the identity and ecological function of the and fine woody debris of a beech (*Fagus sylvatica* L.) forest in Central Germany. down woody material would reduce the variation in soil temperature, retain soil moisture, dead trees, large branches, and is often abundant in natural forests, streams (Harmon et al.), and The ecological role of coarse woody debris: an overview of the influenced by cottage development in central Ontario.

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