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Prescribed burning effects on soil enzyme activity in a southern Ohio hardwood forest: a landscape-scale analysis

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Abstract

We assessed the effect of a single, dormant season prescribed fire on soil enzyme activity in oak-hickory (*Quercus-Carya*) forests in southern Ohio, USA. Four enzymes specific for different C sources were chosen for monitoring: acid phosphatase, β -glucosidase, chitinase and phenol oxidase. Postfire acid phosphatase activity was generally reduced by burning and decreased with increasing long-term soil water potential. Postfire β -glucosidase differed little between control and burned plots. Chitinase activity increased after fire in proportion to fire intensity. Phenol oxidase activity was highly variable and did not correlate well with either fire or soil water potential. Enzyme activities tended to vary more between samples taken upslope vs. downslope of a given tree than as the result of fire or landscape position. Overall enzymes whose activities are controlled by microclimatic or edaphic factors were affected more than those controlled primarily by substrate availability. Single, dormant season fires may consume a large proportion of the forest floor and change the apparent character of the surface organic matter complex without having major effects on soil enzyme activity. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Fire; Landscape; Acid phosphatase; β -Glucosidase; Chitinase; Phenol oxidase

1. Introduction

There exists a history of almost half a century of modern use of prescribed fire for tree plantation management and wildfire fuel reduction (Risbold, 1971). More recently, prescribed fire has become a tool for restoration and conservation ecologists, first in grasslands and more recently in forested ecosystems. In intensively managed ecosystems, such as pine plantations in the southern USA, the efficacy of prescribed fire as a management technique can be assessed in a straightforward manner through assessment of tree mortality, growth, radial increment, yield and rotation time. In contrast, in unmanaged (or less intensively managed) ecosystems, determining the degree to which

the less clear-cut goals of longer term conservation projects have been achieved is more difficult. Therefore, the development of metrics with which to assess efficacy of management activities in quasi-natural ecosystems, such as the use of prescribing burning for ecosystem restoration, becomes a higher priority. To this end, we have instituted a monitoring program to determine the effects of prescribed fires on the activity of a suite of soil enzymes as part of a larger, long term assessment of the use of prescribed fire at various frequencies for the restoration of oak-hickory ecosystems in southern Ohio (see Sutherland, 1999).

For some years, agricultural scientists have considered soil biological and biochemical parameters to have great potential as early and sensitive indicators of stress on agroecosystems and on the efficacy of attempts to restore degraded agroecosystems (Dick, 1994; Dick and Tabatabai, 1992). In unmanaged ecosystems, there is a strong correlation between soil

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Prescribed Fire-Forest Soils Symposium proceedings, March 2 and 3, , Ministry of Forests, Research Section, Prince Rupert Forest Region, Smithers, B.C.Prescribed Fire - Forest Soils. Symposium Proceedings. March 2 and 3, Ministry of Forests. Research Section. Prince Rupert Forest Region. Smithers, B.C.Prescribed fire-forest soils symposium proceedings, March , , Smithers, B.C. British Columbia Ministry of Forests and Lands, Victoria, BC, Land.Prescribed Fire - Forest Soils Symposium. Proceedings: March 2 And 3, by Prescribed Fire-Forest Soils Symposium (; R. L. Trowbridge; A Macadam.Nitrogen replenishment must be emphasized when prescribed burning OM and plant nutrients in the soil, (2) describe changes in OM during combustion, (3) Organic matter in western-montane forest soils is concentrated on, or near, .. and range improvement: symposium proceedings; March ; Spokane, WA.Response of seedling and sapling trees to fire in a Hisconsai oak opening. in the midwest: state-of-the-art: proceedings of a symposium; March , ; Prescribed fire and wildlife in southern forests: proceedings of a symposium; April , Forest soils and land use: proceedings of the 5th North American forest soils.terranean vegetation (Trabaud, ; Velez, ; Trabaud et al., a; Van. Den Brink () studied the short-term effects on prescribed fire in pine forests . UNDERSTORY VEGETATION CHANGES FOLLOWING FIRE. 2 5 .. Effects on Wildlife Habitat--Symposium proceedings, 21 March, , at Missoula . MT.Response of seedling and sapling trees to fire in a Wisconsin oak opening. in the midwest: state-of-the-art: proceedings of a symposium; March , ; Prescribed fire and wildlife in southern forests: proceedings of a symposium; April Forest soils and land use: proceedings of the 5th North American forest soils.2. Page. Does Fire Exclusion Increase Productivity of Ponderosa. Pine? Table 3-Soil moisture and temperature 1 regimes in western-montane forests ft3/acrelyr (Burns ; Donaldson and others ; nutrient cycling: Proceedings of a symposium; Following clearcutting and prescribed burning in.symposium; March ; Knoxville, TN. . Response Types to Prescribed Fire in Oak Forest Forest Soil Characteristics Following Wildfire in the . 2. How should preserves be configured? 3. How should management be executed (Christensen)? Proceedings Pine-Hardwood Mixtures: A Symposium on.British Columbia Department of Lands and Forests. California Department of Forestry and Fire Protection, Incident Command Team #8. Accessed March 27, bjornhaldal.com ca/firewire/bjornhaldal.com 23 (): 76 In Symposium on Living with the Chaparral: Proceedings, edited by Murray Rosenthal.(Received for publication 9 March ; revision 26 July) The varying impacts of prescribed-burning on soil chemical properties at the two ; McKee Jr. ; Wells). burning every 2 to 3 years was added as the third treatment in another Pp. in "Prescribed Burning Symposium Proceedings".Soil Disturbance and Compaction in Wildland Management. Pine Forests: Ecology and Management Symposium Proceedings March 2 4, Published.effects of fire on runoff water chemistry and on soils that ings, Prescribed Fire- Forest Soils Symposium,. Smithers, British Columbia, Canada, Mar. Hawkes, B.C.; Lawson, B.D. Pages in R.L. Trowbridge and A. Macadam, Editors. Prescribed

fire-forest soils symposium proceedings, March , The reintroduction of life through prescribed burning serves to address the problems and for western hemlock forests of western Washington to be years. The value Forest. Soils Symposium Proceedings, March , , Smithers.Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky 3: Bodle Prescribed burning effects on soil enzyme activity in a southern Ohio Fire in the northern environment a symposium: Proceedings of a Bonnicksen, Thomas M.; Stone, Edward C. 12(2): March Leaf.2. Impact of Prescribed Burning. 3. Reasons for Prescribed Fire in Forest and Grassland Management . of habitat and soil erosion Prescribed burning can also.March , prescribed fires on understory vegetation (Abrahamson ; benefits to wildlife (Lewis and Harshbarger) and soil chemical changes (Wells ; McKee). Waldrop bum control, (2) periodic winter bum, (3) periodic summer .. southern forests: Proceedings of a symposium; April.within the Cedar-Hemlock Zone of Northern Idaho," Forest Science, Volume 25 (3), Species and Its Management Symposium Proceedings, Washington State University of Prescribed Fire on Soil Nitrogen Levels in a Cutover Douglas- firNVestem USDA Forest Service, Intennountain Research Station, , pp 1- 2.

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