

INVASION OF A PARTIALLY CUT OAK STAND BY HAYSCENTED FERN

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Abstract: Hardwood forests in Pennsylvania frequently develop a dense understory of hayscented fern (*Dennstaedtia punctilobula* (Michx.) Moore)) following partial overstory removal. Seedlings of desirable hardwood species are unable to develop in these understories. A study was conducted in a central Pennsylvania mixed oak stand to determine how hayscented fern becomes established following partial cutting.

Hayscented fern is capable of reproducing both sexually through the production of spores and asexually through the extension of a perennial rhizome. While rhizome extension and transportation by logging equipment have traditionally been considered the primary mechanisms of fern reproduction and invasion, these processes can also be the result of development from spores. Spores are disseminated throughout late summer and early fall and can emerge within days after release or during the following spring when soil conditions are favorable. Rhizomes grow and fronds are produced throughout the growing season. Individuals are capable of reproducing sexually three years after development from spores.

The study area is a 100-year-old stand dominated by northern red oak (*Quercus rubra* L.), black oak (*Quercus velutina* Lam.), yellow-poplar (*Liriodendron tulipifera* L.), and red maple (*Acer rubrum* L.) located on state forest lands 7 miles south of State College, PA. The site occupies a lower slope position and has a southeasterly aspect. Soils range from poorly to well drained. The stand received an improvement shelterwood cut during the spring of 1989 in which the basal area was reduced to 80 sq. ft. per acre. The stand contained a few isolated clumps of hayscented fern before logging. A previously partially cut stand adjacent to the study area contained dense fern understories.

Hayscented ferns arising from spores were observed in the study area during the spring one year after cutting. Both gametophytes and sporophytes were noted. These individuals are characterized by a dense clumping of small fronds generally less than 4 inches tall. A small rhizome (< 0.5 inches long) was usually present. These newly developing ferns appeared to be restricted to areas with high soil moisture usually growing from moss patches. Sexually

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reproduced ferns were most commonly associated with microsites produced by logging-related soil disturbance; where mineral soil was exposed through intensive log skidding and on the uphill banks of skid roads where high soil moisture is maintained by subsurface drainage. Ferns also grow frequently at the base of rocks or fallen logs where water runoff is concentrated and high soil moisture is maintained. We have occasionally observed spore origin ferns in microsites not associated with logging disturbance. These include soil mounds resulting from windthrown trees and wet areas associated with seeps. In contrast, new ferns have not been observed on well-drained mineral soil, areas with thick litter cover or on compacted skid roads. Dense shade does not appear to limit fern development under these conditions. Instead, shaded conditions may favor the growth of young ferns by maintaining high soil moisture.

Based on the findings of this study, sexual reproduction is the primary mode by which hayscented ferns invade previously fern free areas. Once these individuals become established, asexual reproduction through rhizome extension becomes the primary means of reproduction. Reducing the impact of log skidding on wet sites would also help prevent sexual reproduction of hayscented ferns. The herbicide sulfometuron (Oust®) effectively controlled hayscented fern spore emergence in a greenhouse study and may also prevent the development of spore origin ferns if applied following timber harvesting.

MICROCOPPICE: A NEW STRATEGY FOR RED OAK CLONAL PROPAGATION

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Abstract: The great demand for red oak (*Quercus rubra* L.) has forced plant propagators to consider viable methods of mass clonal propagation for the species. A process called 'microcoppicing' is presently being developed to help meet such needs. The advantage of this technique is that it proposes to work with oak's natural growth characteristics. The 'microcoppice' hypothesis capitalizes on the well-known ability of oak to form epicormic shoots. This concept should be capable of providing a large number of plants without being overly hampered by oak's episodic growth tendencies. This theory is being developed by utilizing seedlings, stump sprouts, and grafted scions from mature plants. Plant material will be disinfected, cultured on an agar-based media, and rooted *in vitro*. The plants will then be put through an *in vitro* coppicing phase, thus producing a multiplication effect. The derived microshoots will then be rooted *ex vitro*. After acclimation, it is believed that the plants could again go through a coppicing series for further multiplication. This process should be capable of producing a large quantity of plants from mature stock, a goal that has eluded plant propagators working with oak species.

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