Managing Power-Line Corridor Vegetation

by James O. Luken

Abstract. Power-line corridor vegetation represents a complex resource management problem that may entail various goals and management techniques. Unfortunately, few data exist on long-term effects of many management techniques thus making it difficult to determine if goals are being met. Using data collected from northern Kentucky power-line corridors, the long-term effects of repeated cutting on woody plant communities were assessed. Results suggest that repeated cutting favors dominance by black locust (*Robinia pseudoacacia*) and white ash (*Fraxinus americana*) while other species with dramatically different shade tolerances and life histories also persist. Although repeated cutting is not a successful method of inhibiting tree regeneration, it may have some utility depending on management goals and other types of management techniques used in combination with cutting.

As land-use goals for power-line corridors become increasingly complex, so must the expertise of corridor managers expand to include previously ignored areas of the ecological sciences. There is perhaps no better illustration of this point than the complicated process of vegetation management that occurs in power-line corridors throughout forested areas of the eastern United States.

When most corridors were cut through forests during the formative years of public utilities, management goals and techniques were straightforward: maintain the vegetation in a tree-free condition and use herbicides to achieve this end. Present-day managers, however, confront a variety of issues that greatly complicate the task of vegetation management. Among these issues are stricter regulations controlling herbicide use, the existence and protection of rare and endangered species, nature preserves or critical habitats adjacent to corridors, laws protecting biological diversity, management goals to improve wildlife habitat in corridors, public concerns regarding environmental degradation, development of unique plant and animal communities due to management activities, and financial constraints that call for reductions in the costs of maintenance activities. The task of corridor management has grown well beyond simple tree-control to multi-faceted resource management.

The existence of multiple-goals for vegetation in power-line corridors necessitates several activities. First, there must be assessment of the long-term effects of management practices. Second, alternative management practices must be tested and developed to achieve different goals. Data are presented in this paper to show the long-term effects of one management practice (i.e., repeated cutting). Furthermore, the utility of frequent cutting is examined in terms of both local forest-community responses and existing management options.

During summer 1989, Cincinnati Gas and Electric Company initiated a survey of woody plant communities now occurring on their line systems in northern Kentucky. The vast majority of these power-line corridors were previously managed by repeated manual-cutting or mechanical-mowing. The objectives of this survey were to measure the composition of woody plant communities growing in the corridors, and to compare these communities with both the edges and interiors of adjacent forests. The ultimate goal of this research was to determine how past management activities have shaped present woody plant communities in corridors.

Methods

Twenty different sites were chosen for study. These sites supported vegetation where tree stems were at least five years old. At each site, woody plant communities were assessed in the corridor (typically 15 x 25 m plot), in the adjacent forest edge (10 m wide strip), and in the adjacent forest interior (10 m from the corridor). Tree stems were divided into two broad size classes for analysis: $<$ 10 cm diameter but $>$ 20 cm in height for seedlings and saplings, $\geq$ 10 cm diameter for adult trees. A full description of sampling methods is provided in another publication (9).

Results

Species Dominance. Prior to this study, line managers knew that black locust *(Robinia* *pseudoacacia*) was a problem species throughout the system. Indeed, the data showed (Table 1) that black locust is the dominant species along with white ash *(Fraxinus americana*). However, black locust and white ash were not the only important woody plants. In addition to tree species found in adjacent forests, corridors also supported large populations of early-successional trees such as tree of heaven (*Ailanthus altissima*), redbud (*Cercis canadensis*), staghorn sumac (*Rhus typhina*), smooth sumac (*Rhus glabra*), and black cherry (*Prunus serotina*). In short, management activities favored regeneration and persistence of an extremely wide range of tree species with dramatically different life histories and shade tolerances.

Density and Richness. Considering only seedlings and saplings, power-line corridors supported the highest densities of stems and the highest numbers of species when compared to adjacent forests. For example, mean (± SE) stem density (stems/ha) was 8734± 1506 in corridors, 6460± 1029 in forest edges, and 4598 ± 791 in forest interiors. Mean species richness (species/plot) was 11.8± 0.7 in corridors, 11.7± 0.8 in forest edges, and 10.4± 1.0 in forest interiors.

Tree Regeneration

Regeneration of woody plant populations in corridors under the pressure of repeated cutting will depend on the size and makeup of the propagule bank (i.e., buried roots, stems, and seeds), the movement of seeds from adjacent forests, the responses of these propagules to vegetation removal, and other habitat conditions such as slope, aspect, and competition (14). Mechanical mowing creates a myriad of microenvironments for seedling establishment and sprout growth. For example, the creation of bare spots where the blades or tires disturb the soil favors seed germination and seedling establishment of some species (14); the removal of plant parts eliminates competition and releases dormant buds of other species (6).

Changes in Species Composition

Repeated cutting of the vegetation in these power-line corridors has affected plant communities in three major ways: those species capable of rapid stem growth from root or stem buds are favored, e.g., black locust and white ash); those species that require high light and soil disturbance for seed germination and seedling establishment are favored, e.g., black locust, staghorn sumac, redbud, yellow poplar (*Liriodendron tulipifera*), and tree of heaven; and, shade tolerant species are not favored, e.g., sugar maple (*Acer saccharum*) and hackberry (*Celtis occidentalis*). These results contrast with previous research showing that deciduous forests of Kentucky regenerate largely unchanged in community composition when cut once (11), but are consistent with other studies showing an increase in black locust (1), white ash (12) and black cherry (15) when cutting or human disturbance is frequent. In short, as repeated human-generated disturbance replaces natural disturbance (i.e., fire, wind, and pathogens), tree species are favored that can persist under this new disturbance regimen (13).

Management Recommendations

If the long-term goal of vegetation management on power-line corridors is to gradually reduce woody plant populations, then management techniques must be chosen carefully to achieve this goal. A number of researchers have suggested that selective herbicide application, where tree density is low to medium, is one solution to the problem of tree regeneration (2,5,6). However, I suggest several other approaches that electric utilities might consider before, during, and after mechanical mowing and manual cutting are used as management techniques.

1. If new corridors are planned or are under construction in patchy landscapes, site these so that they avoid forest patches (10). Higher costs during construction may be recovered quickly in the future as the task of plant-community management is borne by landowners, farmers, and livestock.

2. Assess the wildlife-habitat and plant-habitat suitability of plant communities created by frequent cutting (2,3,4). The abundance of accessible browse, the incidence of fruit- and seed-bearing plants, and the use of corridors as animal migration routes may suggest that frequent cutting is

actually more suitable for creating wildlife habitat than for inhibiting tree populations. Moreover, frequent cutting may create suitable habitats for the growth and maintenance of rare or endangered plant species. In a multiple-goal plan for corridors, benefits (e.g., public relations, greater wildlife populations, mitigation of habitat loss) must be balanced against costs of frequent cutting.

3. Experimentally examine the response of plant communities when cutting time, height, and frequency are varied in combination with herbicide use (7). To efficiently kill entire plant systems,

Table 1. Percent frequencies and mean importance values of tree species found in northern Kentucky power-line corridors (C), forest edges (E), and forest interiors (I). Twenty separate sites were sampled.

	Stems < 10 cm diam.						Stems ≥ 10 cm diam.			
	Frequency[1]			Importance[2]			Frequen cy		Importance	
Species	C	E	I	C	E	I	E	I	E	I
Acer negundo	75	55	30	4	4	3	5	10	1	*
Acer saccharum	75	85	90	4	24	31	65	65	15	14
Aesculus glabra	10	40	50	*	2	2	5	10	*	1
Ailanthus altissima	5	20	25	7	1	1	20	15	2	2
Asimina triloba	15	25	30	2	2	5	-	-	-	-
Carpinus caroliniana	10	15	5	*	*	*	-	-	-	-
Carya cordiformis	50	60	45	*	2	*	5	5	*	*
Carya glabra	5	15	10	*	*	*	-	-	-	-
Carya laciniosa	5	5	5	*	*	*	5	5	*	*
Carya ovata	5	10	-	*	*	-	-	10	-	1
Carya tomentosa	-	10	-	-	*	-	5	-	*	-
Celtis occidentalis	40	70	80	2	11	16	40	65	11	11
Cercis canadensis	55	55	35	7	4	4	15	20	2	2
Cornis florida	15	30	35	*	6	6	20	10	1	1
Cornis racemosa	55	25	30	3	1	*	-	-	-	-
Crataegus spp	-	10	5	-	1	*	-	-	-	-
Fagus grandifolia	5	10	15	*	*	*	5	10	*	1
Fraxinus americana	95	80	75	18	10	13	65	95	21	28
Fraxinus quadrangulata	15	10	-	*	*	-	-	-	-	-
Gleditsis triacanthos	-	-	-	-	-	-	5	10	*	*
Juniperus virginiana	15	10	15	2	*	*	5	-	*	-
Juglans nigra	60	20	25	2	*	1	-	15	-	1
Liriodendron tulipifera	25	25	10	6	2	1	15	15	4	6
Morus rubra	20	20	20	*	*	*	-	20	-	1
Ostrya virginiana	5	20	15	*	*	*	-	-	-	-
Platanus occidentalis	15	5	-	*	*	-	10	5	1	*
Prunus americana	20	5	5	*	*	*	5	5	*	*
Prunus serotiana	85	85	60	4	3	1	15	35	2	4
Quercus alba	5	5	5	*	*	*	10	5	1	1
Quercus muehlenbergii	25	50	35	*	3	2	30	35	5	4
Quercus rubra	45	50	45	1	2	*	35	25	11	6
Rhus glabra	30	15	-	4	*	-	-	-	-	-
Rhus typhina	35	10	5	5	5	*	-	-	-	-
Robenia pseudoacacia	60	35	20	20	2	*	45	10	7	3
Sassafras albidum	25	45	30	2	4	2	5	15	8	*
Tilia americiana	10	10	15	*	*	*	5	5	*	*
Ulmus rubra	70	80	75	4	8	6	55	70	9	7

1. Frequency--percentage of pltos where this species was found.
2. Importance--(relative density + relative basal area) /2.
3. *--Mean importance < 1.

cutting should be timed so that the maximum amount of carbohydrate manufactured during the current growing season is removed before translocation to belowground structures. For many trees the optimum time to cut for carbohydrate removal is late summer. Follow this with herbicide application in the following spring when physiological activity of trees is maximum.

4. Explore biological control of tree populations. On some corridors in northern Kentucky, cottontail rabbits appear to kill many black locust stems each year due to bark girdling. Further data are required to determine size classes of stems most vulnerable to girdling. Cutting could be used to hold stems in the most vulnerable stage of development. Moreover, in some areas domestic animals have been used to inhibit or hold in-check woody plant populations (8).

Conclusions

Although frequent cutting does not inhibit tree regeneration, it does have profound effects on the structure and composition of woody plant communities in power-line corridors. If a management goal calls for the maintenance of vegetation with high stem density and high species richness, then repeated cutting is well-suited to this goal. On the other hand, if line managers seek to develop tree-free vegetation then frequent cutting alone should not be used. As an alternative management approach, frequent cutting might be used to decrease the vigor of plant systems, to allow more efficient use of herbicides, and to make trees more accessible to browsing animals.

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Résumé. En utilisant les données recueillies des corridors de lignes électriques du Kentucky du Nord. les effets à long terme de coupes répétées sur les groupements de plantes ligneuses furent établis. Les résultats suggèrent que la coupe répétée favorise la dominance du robinier faux-acacia ou faux acacia (*Robinia pseudoacacia*) et de frêne blanc (*Fraxinus americana*), tandis que les autres espèces, avec des tolérances à l'ombre et des chronologies dramatiquement différentes, persistent aussi. Bien que la coupe à répétition n'est pas une méthode couronnée de succès quant au freinage de la régénération en arbres, elle peut comporter une certaine utilité dépendant des objectifs d'aménagement et des autres types de techniques d'aménagement employés en association avec la coupe.

Zusammenfassung: Mit eingesammelten Daten von Nord-Kentucky Starkstromleitung Korridoren wurden die langfristigen Wirkungen von wiederholteten Auslaubungen bei Holzpflanzen-Gesellschaften beobachtet. Die Resultate deuten an, dass die wiederholteten Auslaubungen, dem *Robinia pseudoacacia* und *Fraxinus americana* begünstigen, während andere Arten mit höchst unterschiedlichen Schattentoleranzen und Lebensgeschichten auch fortbestehen. Obwohl wiederholtete Auslaubung keine erfolgreiche Methode von der Hemmung Baumwiedererzeugung ist, darf es etwas Nützlichkeit haben, abhängend von den Verwaltungszielen und anderen Verwaltungsanwendungen, die in Verbindung mit Auslaubung verwendet sind.

COMPARISON OF TRUNK INJECTED AND SOIL APPLIED MACRONUTRIENTS

by E. Thomas Smiley, Bruce R. Fraedrich, Donald C. Booth

Abstract. Macronutrients (N,P,K,) deficient willow oaks (*Quercus phellos*) grown in parking lot islands were fertilized by trunk or soil injection. Foliar nitrogen levels improved significantly in soil fertilized trees. Foliar color improved most in the soil fertilized trees and not at all in the controls.

Fertilization of shade trees is a common arboricultural practice which improves tree growth (5,6). In areas with limited space for root development, such as along streets, parking lots and sidewalks, many arborists contend that trunk injection of macronutrients is more effective than soil application. Trunk injections is effective for microelements (3,4) nevertheless, no experimental data have been published for macronutrient (N,P,K) deficiencies and, thus, it is viewed more skeptically (7). This study was conducted to determine if trunk injection is more effective than soil application of macronutrients in areas of limited root space.

Methods

Twenty five willow oaks (*Quercus phellos*) established in parking lot islands of the Springs Recreation Complex in Ft. Mill, South Carolina were exhibiting general chlorosis symptoms and had foliar nutrient levels lower than optimum thus were considered to be macronutrient deficient. Trees were paired for size and chlorosis rating prior to randomly assigning treatments. The trees had an average diameter (dbh) of 9.3 inches and average height of 37 feet. The turf area within the dripline not covered by pavement and available for soil fertilization ranged from 63 to 1118 square feet (17-100% of the area within the dripline). The average area available was 443 square feet and 63% of the dripline area.

A 0.4-0.6-0.6 (NPK) soluble fertilizer marketed as Mauget Stemix Hi-Vol (Table 1) was injected at the product labeled rate on July 18, 1989 and April 24, 1990. Leaves were fully expanded at the time of each treatment. Feeder tubes and capsules were applied within four inches of the soil line according to manufacturers instructions.

A 28-9-9 suspension grade slow release fertilizer (Table 1) was injected eight inches below the soil surface in holes spaced three feet apart within the dripline on July 18, 1989. The application rate was equal to 5.6 pounds of nitrogen per 1000 square feet. Only turf covered areas were fertilized, no adjustment was made for paved surface within the dripline. Control trees were not treated.

Foliar samples were collected from the south