PREDICTION OF COVER TYPE ON RIGHTS-OF-WAY AFTER MAINTENANCE TREATMENTS

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Abstract. Plant cover occurring on electric transmission rights-of-way after commonly used maintenance treatments was studied in two Physiographic Provinces in Pennsylvania (Allegheny Mountain and Piedmont) to predict cover type development. At both locations, a tree sprout-shrub cover type developed after handcutting; a grass-forb-shrub cover type after mowing; a grass-forb cover type after mowing plus herbicide and stem-foliage sprays; a forb-grass cover type after foliage spraying; and a shrub-forb-grass cover type after selective basal spraying. Data from other studies showed that aerial spraying produced a grass-forb cover type. The plant species composition of each cover type is described for both Physiographic Provinces.

Résumé. La couverture végétale rencontrée dans la zone immédiate des lignes de transmission électrique était étudiée dans deux provinces physiographiques de Pennsylvanie (Allegheny Mountain et Piedmont) pour prédire le type de développement. Aux deux endroits, un couvert de repousses d'arbres et d'arbustes se développait après une coupe manuelle; un couvert d'herbe, de graminées et d'arbustes après un fauchage; un couvert d'herbe et de graminées après un fauchage accompagné de vaporasations d'herbicides et sur les tiges et les feuilles; un courvert d'herbe et de graminées après une vaporisation; et un couvert d'arbustes, d'herbe et de graminées après une vaporisation basal sélective. Les données provenant d'autres études montraient que la vaporisation aérienne résultait en un couvert de graminées et d'herbe. La composition des espèces de plantes pour chaque type de couvert est donnée pour chaque province physiographique.

After many years of rights-of-way (ROW) maintenance with herbicides and mechanical techniques, it is now possible to predict the pattern of vegetation development following application of common maintenance treatments. The objective of this paper, therefore, was to gather evidence from published literature and from 35 years of ROW research by the authors to make predictions for the northeastern U.S. that will enable ROW managers to apply specific maintenance techniques with a clearer understanding of their expected effects on ROW plant cover. By using this information they should be able to develop the kind of vegetation desired in any particular situation by prescribing appropriate maintenance treatments.

Literature Review

General relationships between ROW maintenance treatments and plant cover types have been indicated in a number of publications. One of the earliest reports by Egler (10) related "shrubland" to use of selective basal sprays. Egler also stated that summer foliage "blanket spraying" leaves a grasslike community composed of grasses and sedges of varied species composition lumped for convenience under "grassland."

Creation of shrub vegetation types by use of selective basal spraying was described by Niering and Goodwin (13) in the framework of plant succession for a ROW on 30 to 40 year old post-agricultural sites in Connecticut. These authors and Egler (10) recognized two general areas on ROW, namely, edges where low-growing trees can be tolerated, and a belt under the wires where low shrubby vegetation is desirable.

Repeated broadcast spraying over a number of years was observed to have created a ROW plant community of grasses, sedges, ferns, and certain herbs; and when trees were eliminated by selective spraying, shrub communities were encouraged (9).

Winter burning, mowing, and selective herbicide applications were used in Mississippi to improve game food on a ROW (3). Shrubs increased on the ROW after all treatments in this study and were becoming dominant. Prescribed burning on a ROW in New Hampshire caused an increase in grasses, sedges and forbs, and a decrease in

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shrubs, ferns, and moss (14).

In western Washington, grass-dominated ROW cover was developed by use of cultivation and heavy applications of urea nitrogen fertilizer (15). Cultivation and direct seeding of grass-legume mixtures was also used in Indiana in an effort to create a dense low plant cover on a transmission ROW which was invaded by many endemic herbaceous species, shrubs, and trees after two years (11). Similar invitation also occurred on a fescue-seeded ROW in Tennessee which was being replaced by volunteer plant communities after 6 years (1).

On 20 ROW studied in New York, herbaceous cover was found to be significantly greater on broadcast-sprayed ROW than on selectively-sprayed ROW (12). Total shrub cover and total grass cover were similar. In another study plant species that spread vegetatively were dominant on 9 ROW in New York (5). A grass-herb plant cover occupied 85% of these ROW after both aerial and ground foliar spraying, but only 39% after selective basal spraying. The dominant shrubs were blackberry, dewberry, and raspberry after all treatments: dominant forbs were aster, goldenrod, and bracken.

The plant cover of a ROW in central Pennsylvania was a bracken-sedge-loosestrife-blueberry cover type after capital clearance followed by 6 different maintenance treatments (4). This cover type persisted for 20 years but was then invaded by species typical of open areas such as goldenrod and blackberry (6).

Methods

Cover Types. The term "cover type" as used in this paper refers to a distinguishable grouping of dominant plant species that can be recognized by their life forms as tree, shrub, forb, and grass. Forb includes herbaceous plants other than grass-like plants and grass includes grasses and sedges. A cover type based on life forms should be recognizable at any season of the year and extend over sufficient area to form an important part of total ROW cover.

The recognition that each plant community consists of a definite group of life forms has led to the development of a number of ecological classifications of plant communities based on life forms (8). This is particularly valuable to the use of life forms in management situations as it does not presuppose recognition of plant species by a manager, and can be done rapidly on the ROW.

For more precise delineation of cover types, the dominant plant species must be identified to separate different plant communities having the same life forms. For example, the grass-forb cover type on one ROW studied included both a poverty grass-goldenrod community and a fescue-loosestrife community. However, the life form cover type was sufficient for management purposes as both communities were resistant to tree invasion, and furnished wildlife food and cover.

ROW Studied. The plant cover type predictions made in this paper were based mainly on current research on ROW in the Allegheny Mountain and Piedmont Physiographic Provinces in Pennsylvania. Only those ROW areas on which a typical pretreatment shrub-forb-grass cover type was present were used. The ROW sites ranged from medium dry to medium wet (mesic); wet sites (hydric) were omitted as they occurred only along drainage streams and were given special treatment by selective cutting of trees on protective zones.

Maintenance Treatments. The wire zone-border zone technique that has been developed for use in sensitive areas was used on the ROW studied (Figure 1). The differential treatments applied to the zones in 1987 are described below:

Handcutting: All trees and tall shrubs were cut to a stump height of about 4 inches on the wire zone. Tall-growing tree species, only were cut on border zones.

Mowing: Vegetation on the entire ROW wire zone was mowed to a height of about 6 inches.

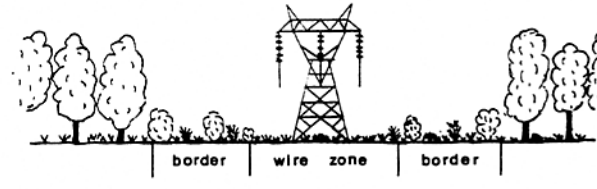

Figure 1. Diagram of a 230 kV line ROW to show (1) a wire zone that included the ROW lying under the wires plus about 10 feet on each side and (2) border zones that included the remainder of the ROW lying on each side of the wire zone. A low shrub-forb-grass cover type is shown on the wire zone with a tall shrub-forb-grass cover type on border zones.

Trees, only, were selectively treated on the border zones with a low volume basal spray of Access (12.5%) plus Garlon 4 (12.5%) in oil (75%).

Mowing plus herbicide: Vegetation on the entire wire zone was mowed to a height of about 6 inches, and the cut stubble of woody plants was sprayed immediately with a mixture of Tordon K (0.75%) plus Garlon 3A (0.75%) in water (98.5%). The border zones were treated as for "mowing" above.

Stem-foliage spray: All trees and tall shrubs on the wire zone were sprayed to wet the stems and foliage with a mixture of Tordon K (0.5%) and Garlon 3A (0.5%) in water (99%). The border zones were treated as described for border zones under "mowing."

Foliage spray: All trees and tall shrubs on the wire zone were sprayed to wet their foliage with Accord (1%) in water (99%). Border zones were treated as described for border zones under "mowing."

High volume selective basal spray: Trees and tall shrubs on the wire zone were sprayed with sufficient volume to cover the lower 18 inches of woody plant stems and to provide runoff to the root collar with Access (1.5%) in fuel oil (98.5%). Trees, only, were selectively sprayed on border zones.

Low volume basal spray: All trees and tall shrubs were sprayed to cover the lower 18 inches of stem and root collar thoroughly with Access (12.5%) plus Garlon 4 (12.5%) in Arborchem basal oil (75%). Trees, only, were treated on the border zones.

Treatments were replicated 4 times on the Allegheny Mountain ROW and 3 times on the Piedmont ROW. High volume basal spray was omitted on the Piedmont ROW because of high tree density and to avoid odor from an oil carrier at nearby homes.

Vegetation Evaluation. The vegetation cover was recorded annually for 2 years on circular sample plots that were 8.25 feet in radius on the Piedmont ROW and 16.5 feet radius on the Allegheny Mountains ROW. Three plots were placed at equal distances apart on the center line of the wire zone and 3 plots were placed in each border zone opposite wire zone plots on each treatment unit. The method of Braun-Blanquet (8) was used to estimate the cover value of each plant species found on the plots; the cover value of common species occurring off the plots were recorded on field sheets. Six broad cover value classes that are relatively simple to apply were used.

Cover value class	*Median cover value (%)*
1. Covering less than 1% of the plot area	0.1
2. Covering 1 to 10% of the plot area	5.0
3. Covering 10 to 25% of the plot area	17.5
4. Covering 25 to 50% of the plot area	37.5
5. Covering 50 to 75% of the plot area	62.5
6. Covering 75 to 100% of the plot area	87.5

Results

Definite relationships were found to exist between the plant cover types based on life form and the common ROW maintenance treatments applied in 1987 (Figures 2, 3, 4, 5 and 6). Also, these relationships were consistent between the Allegheny Mountain and Peidmont Regions in Pennsylvania. These findings were supported by earlier results reported from ROW studies in New York which included aerial spraying (5 and 12).

Of importance to ROW management was an earlier finding that the grass-forb cover types produced on the Allegheny Mountain ROW by mowing plus herbicide and stem-foliage spraying were highly resistant to tree invasion (7).

The dominant species composition (see Table 1 for scientific names) of the cover types varied between region owing to differences in such site fac-

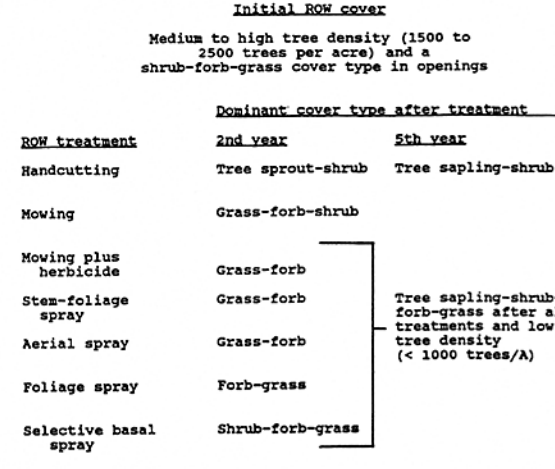

Figure 2. Model for prediction of cover types that will develop after specific maintenance treatments on mesic upland sites. Forbs include herbaceous plants, not grass-like; and grass includes grasses and sedges.

Table 1. Scientific names of plants referred to in the text and figures.

Trees	
Black cherry	*Prunus serotina*
Oaks	*Quercus* spp.
Red maple	*Acer rubrum*
Tulip poplar	*Liriodendron tulipifera*
White ash	*Fraxinus americana*
Shrubs	
Bear oak	*Quercus ilicifolia*
Blackberry	*Rubus allegheniensis*
Black haw	*Viburnum prunifolium*
Blueberry	*Vaccinium angustifolium*
	Vaccinium vacillans
Dewberry	*Rubus hispidus*
Gray dogwood	*Cornus paniculata*
Huckleberry	*Gaylussacia baccata*
Japanese honeysuckle	*Lonicera Japonica*
Raspberry	*Rubus idaeus*
Sweetfern	*Comptonia peregrina*
Witchhazel	*Hamamelis virginiana*
Forbs	
Bracken	*Pteridium acquilinum*
Cinquefoil	*Potentilla* spp.
Goldenrod	*Solidago* spp.
Hayscented fern	*Dennstaedtia punctilobula*
Loosestrife	*Lysimachia quadrifolia*
Mullein	*Verbascum Thaspus*
Sheep sorrel	*Rumex Acetosella*
Strawberry	*Fragaria virginiana*
Grasses and Sedges	
Broomsedge	*Andropogon virginicus*
Foxtail grass	*Setaria Faberii*
Meadow fescus	*Festuca elatior*
Panic grass	*Panicum* spp.
	Panicum latifolia
	Panicum dichotomiflorum
Poverty grass	*Dantonia spicata*
Vernal sedge	*Carex pennsylvanica*

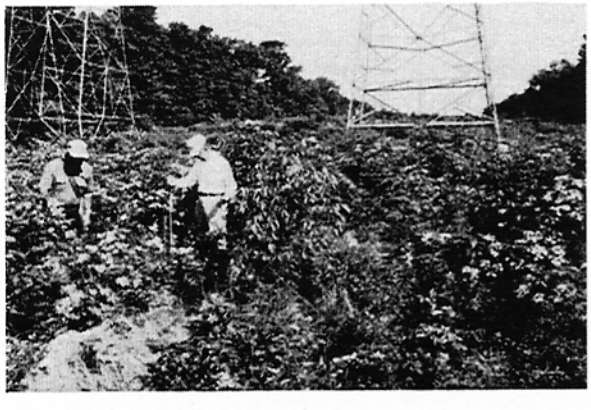

Figure 3. Tree sprout-shrub type in May 1990 dominated by white ash that developed after handcutting in 1987 on the Piedmont ROW. Blackberry was the dominant shrub.

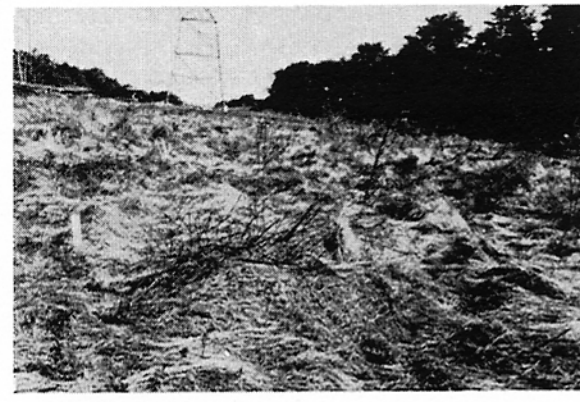

Figure 4. Grass-forb cover type in May 1990 dominated by fall panic grass, broomsedge and goldenrod that developed after mowing plus herbicide applied in 1987 on the Piedmont ROW.

Figure 5. Forb-grass cover type in May 1990 dominated by goldenrod, cinquefoil and fall panic grass that developed after a foliage spray applied in 1987 on the Piedmont ROW.

Figure 6. Shrub-forb-grass cover type in May 1990 that developed after a selective basal spray applied in 1987 on the Piedmont ROW.

Table 2. Characteristic species of cover types developed in 1989 on mesic ROW in the Allegheny Mountain and Piedmont Physiographic Provinces after maintenance treatments. Cover % is shown only for characteristic life forms, dead vegetation, and open spaces between plants.

			Allegheny Mountain		Piedmont	
Treatment 1987	*Cover type 1989*	*Life form*	*Cover % or trees/acre*	*Characteristic species*	*Cover % or trees/acre*	*Characteristic species*
Handcutting	*Tree sprout-shrub*	*Tree sprouts*	*2500/A*	*black cherry red maple msc. oaks*	*2240/A*	*White ash tulip poplar red maple*
		Shrubs	*58%*	*blueberry bear oak witchhazel*	*29%*	*blackberry raspberry black haw*
		Forbs	*22%*	*goldenrod hayscented fern sheep sorrel*	*12%*	*cinquefoil goldenrod strawberry*
		Grass	*6%*	*poverty grass vernal sedge*	*18%*	*panic grass broomsedge*
Mowing	*Grass-forb-shrub*	*Grass*	*29%*	*poverty grass meadow fescue panic grass*	*15%*	*panic grass foxtail grass*
		Forbs	*32%*	*goldenrod hayscented fern bracken*	*16%*	*goldenrod cinquefoil*
		Shrubs	*29%*	*dewberry blackberry blueberry*	*30%*	*blackberry gray dogwood black haw*
Mowing plus herbicide	*Grass-forb*	*Grass*	*35%*	*poverty grass meadow fescue panic grass*	*65%*	*panic grass broomsedge foxtail grass*
		Forbs	*30%*	*goldenrod hayscented fern bracken*	*2%*	*goldenrod mullein*
Stem-foliage spray	*Grass-forb*	*Grass*	*35%*	*poverty grass meadow fescue panic grass*	*27%*	*panic grass foxtail grass*
		Forbs	*37%*	*goldenrod hayscented fern bracken*	*17%*	*goldenrod mullein cinquefoil*
Foliage spray	*Forb-grass*	*Forbs*	*33%*	*sheep sorrel goldenrod hayscented fern*	*30%*	*goldenrod mullein strawberry*
		Grass	*25%*	*poverty grass panic grass vernal sedge*	*7%*	*broomsedge foxtail grass*
Selective basal spray	*Shrub-forb-grass*	*Shrubs*	*53%*	*blueberry dewberry huckleberry*	*16%*	*black haw blackberry gray dogwood*
		Forbs	*26%*	*hayscented fern goldenrod sheep sorrel*	*14%*	*goldenrod cinquefoil*
		Grass	*4%*	*poverty grass meadow fescue panic grass vernal sedge*	*29%*	*panic grass msc. grass*

tors as plant species present, climate, edaphic conditions, physiographic conditions, and biotic conditions including man (Table 2). These included the presence of blueberry, a shrub highly resistant to tree invasion, in the Allegheny Mountain Region, and the presence of Japanese honeysuckle and common cinquefoil as shrub and forb species, respectively, in the Piedmont. However, important consistencies also occurred, such as the presence of goldenrod and blackberry as dominant species in both regions. Poverty grass and meadow fescue were the dominant grass species in the Allegheny Mountain, while fall panic grass and foxtail grass were dominant in the Piedmont.

Discussion

Management can be defined as the act of controlling or directing a course of action to achieve a desired objective. Primarily, the objective in ROW management is to prevent vegetation from interfering with electric transmission. Now that environmental impacts have also become an important objective, and cover type development resulting from ROW treatments can be predicted for the northeastern United States, the objective can be more specific. The manager can select those ROW treatments that will produce a cover type which will provide adequate wildlife food and cover. Or, a treatment can be selected that will produce a cover type that is highly resistant to tree invasion.

An example of the use of cover type prediction has been the selection of ROW maintenance treatments by a utility division forester that were accepted as favorable to wild turkey habitat on a ROW that traversed a National Wildlife Refuge in Pennsylvania (2). This consisted of a mowed-plus-herbicide treatment of the wire zone to produce a grass-forb cover type, and selective basal spraying of the border zones to produce a shrub-forb-grass cover type. The treatments were applied in 1987, and the predicted cover types were obtained.

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