DEVELOPMENT OF PLANT COVER DIVERSITY ON AN ELECTRIC TRANSMISSION RIGHT-OF-WAY[1]

William C. Bramble, William R. Byrnes, and Russell J. Hutnik[2]

Abstract. -- Effects of a special right-of-way (ROW) maintenance technique on plant cover diversity was studied on an electric transmission ROW in central Pennsylvania. The important feature of this technique was a differential treatment of wire and border zones. The wire zone included the ROW area lying under the wires and the two border zones occupied the remaining ROW area on both sides. Four herbicide treatments and handcutting were applied in five replications. All trees and tall shrubs were treated in the wire zone; while trees only were treated in border zones. Pellet applications of Tordon 10K and stem-foliage sprays of Weedone 2,4-DP with Tordon 101 produced a low cover of grass-herb-fern in the wire zone and a tall shrub-low shrub-grass-herb on the borders. Summer basal of Garlon 4 and frill and squirt of Tordon RTU applications were less drastic and produced a medium shrub-herb-grass cover dominated by blackberry in the wire zone. Handcutting produced a sapling tree thicket. The borders remained practically unchanged. Deer use of the ROW remained high after treatments and a diverse deer habitat developed. The songbird population of the ROW and the dominant bird species were retained.

INTRODUCTION

The primary objective of this paper is to describe how plant cover diversity has been increased on a right-of-way through use of a specially designed maintenance method. The importance of cover type diversity has been long recognized as important to wildlife (Leopold 1937). Also, it is considered important that such diverse cover types be located in close juxtaposition so that they are available to wildlife species within their daily range.

METHODS

A new ROW maintenance technique has been developed to improve plant cover diversity (fig. 1). It consists of dividing the ROW into two zones: a wire zone consisting of the ROW area under the conductors plus a 10-foot (3 m) safety extension on each side, and two border zones which include the ROW area on both sides of the wire zone. The boundaries of these zones are not marked in the field because irregular boundaries were considered desirable as long as the wire zone was completely treated.

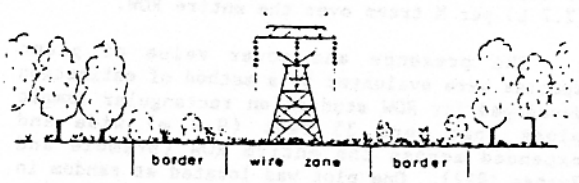

Figure 1.-- Diagram of a 230 kV transmission line divided into a wire zone and two border zones.

[1]Paper presented at the Fourth Symposium on Environmental Concerns in Rights-of-Way Management, Indianapolis, IN, October 25-28, 1987.

[2]William C. Bramble, Professor Emeritus, Purdue University, W. Lafayette, IN 47907.
William R. Byrnes, Professor and Head of Department, Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907.
Russell J. Hutnik, Professor Emeritus, School of Forest Resources, Pennsylvania State University, University Park, PA 16802.

The basic objective of the treatments was to remove all trees and tall shrubs from the wire zone and produce a plant cover of low shrubs, herbs, grass, and fern. The border zones were treated selectively to eliminate only tall-growing tree species and to retain a tall shrub-low shrub-herb-grass-fern cover.

The following combinations of treatments were applied in 1982 in five replications randomly located along the ROW. Treatment units averaged 2.5 acres (1.0 ha) in area.

1. Handcutting (control/standard) removed all trees and tall shrubs in the wire zone with slash lopped and left as it fell. The two border zones were selectively cut to remove only tall-growing tree species such as red maple (Acer rubrum), black cherry (Prunus serotina), and several oaks (Quercus spp.).

2. Summer basal spray of Garlon 4 in oil-water, consisting of Garlon 4 2 gal. (7.6 L), Cidekick 0.5 gal. (1.9 L), fuel oil 25 gal. (95 L), and water 72.5 gal. (275.5 L) to make 100 gal. (380 L) of spray solution, was applied to the bases of all trees and tall shrubs in the wire zone. Desirable shrubs or low trees such as witch-hazel (Hamamelis virginiana) and bear oak (Quercus ilicifolia) were left in the border zones where all other tree species were sprayed.

3. Selective stem-foliage spray, consisting of Weedone 2,4-DP 0.5 gal. (1.9 L), plus Amdon 101 0.5 gal. (1.9 L), plus Surfel 0.25 gal. (0.95 L), and water 98.75 gal. (372.25 L) to make 100 gal. (380 L) of spray solution, was applied to the stems and foliage of all trees and tall shrubs in the wire zone. Witch-hazel and bear oak were left in the border zones where all trees were sprayed.

4. Tordon 10K pellets were broadcast at a rate of 5.9 lb. picloram per acre (62.1 kg per ha) in the wire zone and applied selectively to trees at a rate of about 3 oz. (84 g) per tree in both wire zone and border zones. A 25-foot strip along each edge of the ROW was given a selective basal spray of Garlon 4 in oil-water instead of Tordon 10K to avoid potential damage from the pelleted herbicide to trees in the adjoining forest.

5. Selective frill and squirt application of Tordon RTU was applied at a rate of 0.7 gal. (2.7 L) per M trees over the entire ROW.

The presence and cover value of plant species were evaluated by a method of estimation developed for ROW studies on rectangular sample plots that were 33 feet (9.9 m) wide and extended across the entire ROW (Bramble and Byrnes 1982). One plot was located at random in each of five replications of each treatment, and was checked carefully for valid representation of the plant cover.

RESULTS

Control of Target Trees

The percent change in 1986 of target trees capable of interference with transmission on the ROW was: handcutting +3%, summer basal -72%, stem-foliage -68%, pellets -81%, and frill & squirt -41%. The average height of trees on handcutting units was 6.9 feet (2.1 m), frill & squirt 6.8 feet (2.0 m), stem-foliage 9.4 feet (2.0 m), pellets 10.2 feet (3.1 m), and summer basal 10.7 feet (3.2 m). The average height of the dominant tree canopy, trees 12 feet (3.6 m) and over, ranged from 12.9 feet (3.9 m) for handcutting to 18.8 feet (5.6 m) for stem-foliage.

A simple cost-effectiveness quotient (CEQ) developed for this study to compare the various treatments was calculated by the equation:

$$CEQ = \frac{\text{Cost/1000 stems (\$)}}{\text{Stem reduction (\%)}} \times 100$$

A low CEQ indicates a desirable cost-effectiveness (table 1).

Table 1.--Cost-effectiveness (CEQ) of treatments in 1984.

Treatment	Application cost per 1000 stems	Reduction in stem density	CEQ
	$	%	
Stem-foliage	90	73	123
Summer basal	142	71	200
Pellets	239	80	299
Frill & squirt	143	43	333
Handcutting	143	23	622

Changes in Nontarget Vegetation

Plant Cover Type Present in 1981.

A shrub-herb-grass plant community was present over the entire ROW in all treatment units in 1981, prior to treatments that were applied in 1982. This community could be divided into three layers with the following structure:

1. A tall shrub layer, 8-12 feet height, composed of witch-hazel and bear oak which together covered 11% of the ROW area.

2. A medium shrub layer, 3-8 feet height, dominated by blackberry (Rubus allegheniensis) with small amounts of sweet fern (Comptonia peregrina), which together covered 38% of the ROW area.

3. A herb layer, 3-4 feet height, which covered 47% of the ROW. Common species were bracken (Pteridium acquilinum), loosestrife (Lysimachia quadrifolia), hay-scented fern (Dennstaedtia punctilobula), vernal sedge (Carex pennsylvanica), wild sarsaparilla (Aralia nudicaulis), sheep sorrel (Rumex acetosella), panic grass (Panicum spp.), and tall meadow fescue (Festuca elatior). Poverty grass (Danthonia spicata) covered the access road. Abundant low shrubs also present in the herb layer were blueberry (Vaccinium angustifolium and V. vacillans), huckleberry (Gaylussacia baccata), dewberry (Rubus hispidus) and teaberry (Gaultheria procumbens). Together, these low shrubs covered 18% of the ROW area.

Plant Cover Types Present After Treatments.

The cover types that developed on the ROW in 1986, 4 years after treatment, varied considerably with the treatment method used (fig. 2).

The stem-foliage spray, for example, produced a new and distinctive grass-fern cover type in the wire zone that was dominated by poverty grass and hay-scented fern. Low shrubs were sparse or absent. The tall shrub-low shrub-herb-fern type formerly present in 1981 remained in the border zones and was dominated by witch-hazel and blackberry.

The pellet application also produced a new grass-herb cover type in the wire zone dominated by poverty grass, panic grass, and loosestrife. Low shrubs were sparse or absent. The border zones remained in tall shrub-low shrub-herb-fern present in 1981.

The two highly selective treatments, summer basal spray and frill & squirt, removed most of the tall shrubs from the wire zone and left the border zones in the same cover type that was present in 1981. The wire zone in these 2 cases were distinctive mostly owing to absence of the tall shrub, witch-hazel.

Handcutting produced different plant cover when tree thickets developed mainly from sprouts of cut trees in both wire and border zones. However, as tall shrubs were cut in the wire zone but not in the border zones, witch-hazel and bear oak were more prominent on the borders.

Of special interest in relation to wildlife habitat was the total shrub cover of at least 45% that was left on the ROW after all treatments. Although shrubs were practically eliminated in the wire zone by the drastic pellet applications, both the common tall shrub (witch-hazel) and low shrubs (blackberry, blueberry, and dewberry) were retained in the border zones to leave a 45% shrub cover on the ROW.

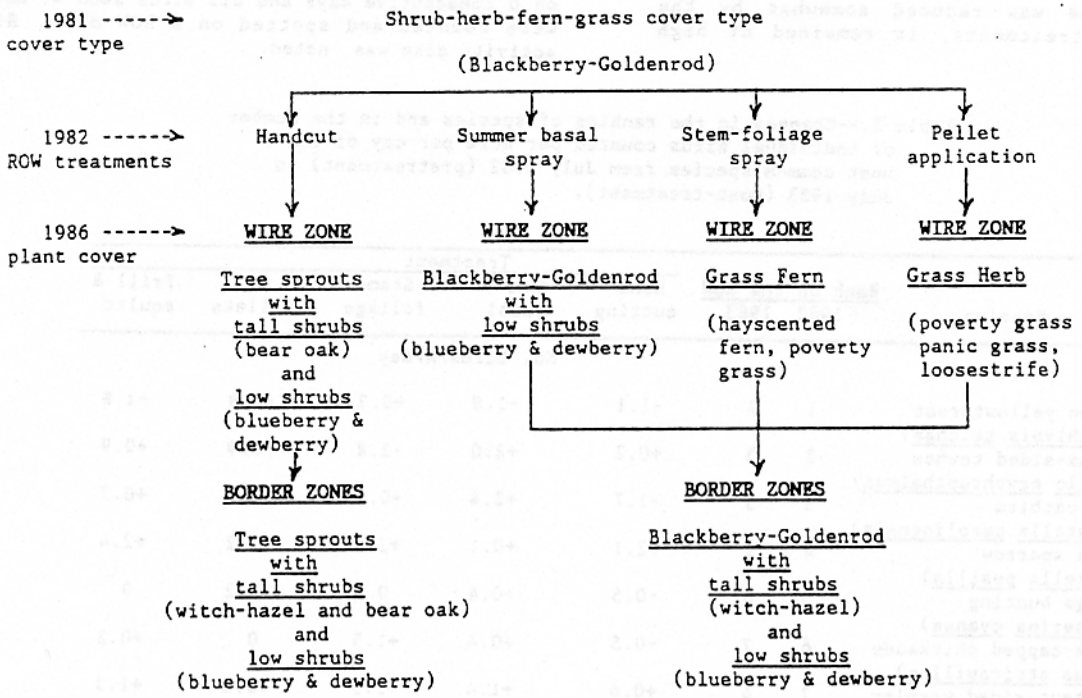

Figure 2.--Plant cover type development on the ROW after differential treatment of wire and border zones.

Effects on Wildlife

Effects of the "wire-border zone method" on wildlife was evaluated through studies on white-tailed deer (Odocoileus virginiana), a common large mammal of the forest area, and on the pretreatment bird population (Bramble and Byrnes 1985, 1986).

Presence of deer using the ROW and the adjoining forest was determined by means of a pellet group count method that has been thoroughly studied (Eberhart and Van Etten 1956) and was tested in previous ROW studies (Bramble and Byrnes 1982).

Data from this technique indicated that deer used all of the ROW treatment units in 1982 (pretreatment) and in 1983 and 1984 (post-treatment); and that use actually increased after treatments (fig. 3). Use of the adjoining forest fell off in 1983 but regained its 1982 value in 1984. Deer used the ROW for feeding, bedding down, and as escape cover.

Deer habitat quality was evaluated before and after treatment using a method that involved 7 vegetation conditions considered important to white-tailed deer (Bramble and Byrnes 1985). These included food plant abundance and diversity, low plant cover, and tall shrub cover as direct factors; and external shrub borders, interspersion of cover types, and stage in plant succession as indirect factors. Although total habitat value was reduced somewhat by the maintenance treatments, it remained of high value.

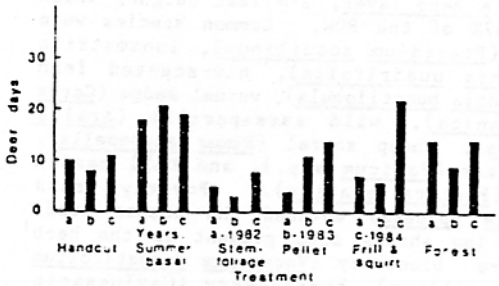

Figure 3.--Deer days per acre on ROW treatment units and in the adjoining forest in 1982 (pretreatment) and in 1983 and 1984 (post-treatment).

$$\text{Deer days} = \frac{\text{number fecal groups per acre}}{\text{13 fecal group depositions per day}}$$

The effect of the "wire-border zone method" was further evaluated by means of bird censuses taken on the ROW and in the adjoining forest before and after treatments were applied (Bramble and Byrnes 1986). The belt transect census method was adjusted so as to use the entire width of the ROW and the length of a treatment unit as a transect. The census units averaged 2.5 acres (1 ha) in area. Two units of each treatment and similar areas in the adjoining forest were censused in July 1982 (pretreatment) and in July 1983 (post-treatment). Each census was repeated on 6 consecutive days and all birds seen or heard were counted and spotted on a ROW map. Bird activity also was noted.

Table 2.--Changes in the ranking of species and in the number of individual birds counted per acre per day of the 7 most common species from July 1982 (pretreatment) to July 1983 (post-treatment).

Species	Rank on the ROW 1982	Rank on the ROW 1983	Treatment: Hand-cutting	Summer basal	Stem-foliage	Pellets	Frill & squirt
			No. birds/A/day				
Common yellowthroat (Geothlypis trichas)	1	2	-1.1	-1.8	+0.3	-0.9	-1.8
Rufous-sided towhee (Pipilo erythropthalmus)	2	3	+0.2	+2.0	-2.8	-0.9	+0.9
Gray catbird (Dumatella carolinensis)	3	5	-1.7	+2.4	+0.1	-0.7	+0.7
Field sparrow (Spizella pusilla)	4	1	+2.1	+0.1	+2.7	+2.2	+2.4
Indigo bunting (Passerina cyanea)	5	6	-0.5	+0.6	0	+0.2	0
Black-capped chickadee (Parus atricapillus)	6	7	-0.5	+0.4	+1.5	0	+0.3
Chestnut-sided warbler (Dendroica pensylvanica)	7	4	+0.6	+1.4	+1.3	+0.5	+1.3

The number of individual birds counted per acre per day averaged 2.5 on the ROW in July 1982 (pretreatment) and 1.2 in the adjoining forest. And the number increased in July 1983 to 2.8 on the ROW and 1.6 in the forest. There was no significant difference between treatments in 1982 or 1983.

Some important changes occurred, however, in bird species dominance on the ROW from 1982 to 1983 (table 2). Of the 7 most common species, field sparrow moved from number 4 in abundance ranking on the ROW to number 1, and chestnut-sided warbler moved from 7th to 4th place. Although the other 5 common species all decreased in ranking, none dropped from the first 7.

ACKNOWLEDGEMENTS

Cooperators in this project were Asplundh Tree Expert Company, Dow Chemical Company, Pennsylvania Electric Company (GPU), Pennsylvania Game Commission, and Union Carbide Agricultural Products Company.

LITERATURE CITED

Bramble, W. C. and W. R. Byrnes. 1982. Development of wildlife food and cover on an electric transmission right-of-way maintained by herbicides: a 30-year report. Purdue Univ. Agric. Expt. Sta. Res. Bull. 974. 24 p.

Bramble, W. C., W. R. Byrnes, and R. J. Hutnik. 1985. Effects of a special technique for right-of-way maintenance on deer habitat. Jour. Arbor. 11(9):278-284.

Bramble, W. C. and W. R. Byrnes. 1986. Effects of special right-of-way maintenance on an avian population. Jour. Arbor. 12(9):219-226.

Eberhart, L. and R. C. Van Etten. 1956. Evaluation of the pellet group count as a deer census method. J. Wildl. Manage. 20:70-74.

Johnston, P. A. and W. C. Bramble. 1979. Vegetation distribution associated with right -of-way habitats in New York. Proc. 2nd Symp. on Environ. Concerns in Rights-of-Way Manage. Elec. Power Res. Inst., Palo Alto, CA. p. 44-1 to 44-15.

Leopold, A. D. 1937. Game Management. Scribner's, N.Y. 481 p.

Niering, W. A. and R. H. Goodwin. 1974. Creation of relatively stable shrublands with herbicides: arresting succession on rights-of-way and pastureland. Ecology 55:784-795.