INTEGRATED VEGETATION MANAGEMENT ON AN ELECTRIC TRANSMISSION RIGHT-OF-WAY IN PENNSYLVANIA, U.S.

by Richard H. Yahner[1] and Russell J. Hutnik[2]

Abstract. Integrated vegetation management (IVM) has been used for the maintenance of vegetation along an electric utility transmission right-of-way (ROW) at the State Game Lands (SGL 33) Research and Demonstration Area, Centre County, Pennsylvania, U.S., since 1987. In addition, the wire–border zone method was implemented on the ROW in 1987. The wire–border zone method results in forb–grass–shrub cover types in wire zones and shrub cover types in border zones. The SGL 33 Research and Demonstration Area has been studied since 1953, which makes this 51-year-old project the longest continuous study documenting the effects of mechanical and herbicidal maintenance on flora and fauna along an electric transmission ROW. In this paper, our objective is to present target (undesirable) tree density and cover-type development in response to IVM prior to the most recent treatment (2000) and 2 to 3 years after treatment. Results were compared to those obtained from the late 1980s and 1990s. For all units combined (except handcut) in 1999, average target tree densities prior to treatment were 288 trees/ha (117 trees/ac) in wire zones and 759 trees/ha (307 trees/ac) in border zones. Excellent control of target tree density [62 to 124 trees/ha (25 to 50 trees/ac)] was noted in wire zones of mowing plus herbicide, stem–foliage spray, and foliage spray units; moderate control [371 to 680 trees/ha (150 to 275 trees/ac)] was observed in low-volume basal spray, high-volume basal spray units, and mowing units; and poor control (4,818 trees/ha [1,951 trees/ac]) was found in the handcut unit. In 2003, the density of target trees in all treatment units combined was 1,544 trees/ha (625 tree/ac) in wire zones and 1,594 trees/ha (645 trees/ac) in border zones. If the handcut unit was omitted from the calculations, then only 340 target trees/ha (138 trees/ac) in wire zones and 501 trees/ha (203 trees/ac) in border zones were present. IVM of a ROW is not a "tree-proof" but rather a "tree-resistant" means of reducing tree invasion. Competition with existing plants and wildlife predation on tree seeds on a ROW managed via the wire–border zone method minimized but did not eliminate tree invasion. Since 1987, IVM and the wire–border zone method of ROW maintenance has increased the time between treatment cycles, thereby reducing labor and chemical costs at the SGL 33 Research and Demonstration Area.

Key Words. Cover types; herbicides; integrated vegetation management; rights-of-way; tree control; vegetation.

Integrated vegetation management (IVM) has been used for the maintenance of vegetation along an electric utility transmission right-of-way (ROW) at the State Game Lands (SGL 33) Research and Demonstration Area, Centre County, Pennsylvania, U.S., since 1987 (Bramble and Byrnes 1996; Yahner et al. 2003). IVM involves two treatment phases: (1) use of a herbicidal spray or mechanical treatment to initially control the density of target (undesirable) tree species, i.e., those that have the potential of growing to a height that is not compatible safe ROW maintenance, and (2) development of tree-resistant plant cover types to reduce invasion of the ROW by target trees.

In addition to IVM, the wire–border zone method was implemented on the ROW in 1987 (Figure 1) (Bramble et al. 1992). The wire–border zone method results in forb–grass–shrub cover types in wire zones and shrub cover types in border zones (Bramble et al. 1990), thereby producing a ROW with economic, aesthetic, and wildlife benefits (Yahner 2003, Yahner et al. 2003).

The SGL 33 Research and Demonstration Area has been studied since 1953, which makes this 51-year-old project the longest continuous study documenting the effects of mechanical and herbicidal maintenance on flora and fauna along an electric transmission ROW. This project is invaluable from management and ecological perspectives by providing an understanding of the response of plant and animal communities within the ROW to the maintenance practices.

In this paper, our objective was to present target tree density and cover-type development on the ROW at the SGL 33 Research and Demonstration Area in response to integrated vegetation management prior to the most recent treatment and 2 to 3 years after treatment. Results then

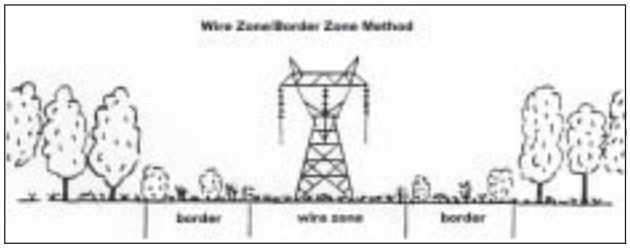

Figure 1. Diagram of a 230-kV electric transmission line, showing wire and border zones. A combination of a low-growing forb–grass–shrub cover type develops in wire zones, and a tall shrub cover type occurs in border zones. Adjacent to the border zone is mature forest.

were compared to those obtained on the ROW from the late 1980s and 1990s.

STUDY AREA AND TREATMENT METHODS

The State Game Lands 33 Research and Demonstration Area, which is located along a 230-kV transmission right-of-way (ROW) of FirstEnergy (Penelec), is in the Allegheny Mountain Region of central Pennsylvania (Yahner et al. 2003). Treatment units on the ROW are rectangular in shape, 0.8 to 1.75 ha (2 to 4.3 ac) each, and span the entire width of the ROW.

In 1987, seven treatments were applied: handcut, mowing, mowing plus herbicide, high-volume basal spray, low-volume basal spray, foliage spray, and stem–foliage spray (Bramble et al. 1991). In the handcut unit, woody vegetation was cut to a 10 cm (2.5 in.) height in wire zones, and undesirable trees were cut in border zones. In mowing units, vegetation was mowed in the entire wire zone, and a low-volume selective basal spray was applied to target trees using undiluted Weedone CB in border zones. In mowing plus herbicide units, vegetation was mowed in the entire wire zone, and a broadcast spray was applied immediately using a mix of Tordon K (0.75%), Garlon 3A (0.75%), water, and blue dye (Bullseye; 0.16% in water); a low-volume selective basal spray was applied to target trees using undiluted Weedone CB in border zones. In high-volume basal spray units, a mix of Access (Picloram + Tricolpyr; 1.5%) in fuel oil was applied to all trees and tall shrubs in wire zones, and the same spray was applied to target trees in border zones. In low-volume basal spray units, Access (12.5%) and Garlon 4 (12.5%) in Arborchem basal oil was applied to all trees and tall shrubs in wire zones and to target trees in border zones. In stem–foliage spray units, a selective stem–foliage spray of Tordon K (0.2%), Garlon 3A (0.5%), and water was applied to all trees, tall shrubs, and blackberry in wire zones, using an undiluted mix of Weedone CB (87.5%) and Garlon 4 (12.5%). Weedone CB and Garlon 4 also were applied to target trees in border zones. In foliage spray units, Accord in water was applied to the foliage of all trees and tall shrubs in wire zones, and a mix of Weedone CB and Garlon 4 was applied to target trees in border zones.

The handcut unit was treated in 1993 in the manner of the 1987 treatment. In 1996, mowing, mowing plus herbicide, low-volume basal spray, stem–foliage spray and foliage spray units were treated to deal with sparse target tree density that developed subsequent to herbicidal sprays applied in 1987. Target tree invasion was minimal because of the development of forb–grass cover type in wires zones of the ROW (Bramble et al. 1991). A low-volume basal spray was applied to all trees and tall shrubs visible above the low herbaceous vegetation in wire zones of these five treatments, using Access (20%) in Arborchem basal oil; the same low-volume basal spray was applied to target trees in border zones of these treatments. A high-volume basal spray, consisting of Access (1.5%) in kerosene, was applied in wire zones to all trees and tall shrubs visible above the herbaceous vegetation on each of the two high-volume basal (BHV) units; the same high-volume basal spray was applied to target trees in border zones.

In 2000, treatments on the SGL 33 Research and Demonstration Area consisted of handcut (as in 1987 and 1993) and a single herbicidal treatment (low-volume basal spray applied with backpack hand pumps) in other treatment units (Yahner et al. 2003). Because of the highly selective nature of the herbicidal treatment, the major impact was on target trees present since the 1996 treatment. The remaining vegetative cover was relatively intact and represented cover types that developed subsequent to the 1987 treatments of the ROW. The low-volume basal spray, applied to all trees and tall shrubs visible above the low wire-zone vegetation, consisted of Garlon 4 (25%) in Arborchem basal oil; the same low-volume basal spray was applied to target trees in border zones.

Vegetation Measurements

Vegetation was measured on the State Game Lands 33 Research and Demonstration Area during May–July in 1999, 2002, and 2003. We recorded all target (undesirable) trees at least 0.3 m (1 ft) in height within two permanent transect belts [each 20 m (60 ft) long × 2 m (6 ft) wide] in the wire zone and within two to four corresponding permanent transect belts [each 10 m (30 ft) long × 2 m (6 ft) wide] that extended east and west from the wire zone transects and into the adjacent border zone of each unit.

We counted only those trees rooted in a transect belt (i.e., trees rooted outside the belt with foliage extending into the belt were not counted). Based on these data, we calculated the total number of target trees per hectare in each treatment unit and zone.

We noted the maximum height (m) of target trees in both wire and border zones of each unit in the vicinity of each transect belt. We also determined plant cover types within a 5 m (16 ft) radius plot placed in the center of each transect belt in wire and border zones of each unit, using the Braun-Blanquet method for estimating abundance and sociability of major plants. From these several estimates within each treatment unit, we calculated plant cover type(s) in each unit as forb, grass, shrub, tree, or a combination of these.

RESULTS

Vegetation in 1999 Prior to Treatments in 2000

In all units combined except handcut, average target tree densities prior to treatment were 288 trees/ha (117 trees/ac) in wire zones and 759 trees/ha (307 trees/ac) in border

zones. Excellent control of target tree density [< 125 trees/ha (50 trees/ac)], however, was noted in wire zones of mowing plus herbicide, stem–foliage spray, and foliage spray units; moderate control was observed in low-volume basal spray units [371 trees/ha (150 trees/ac)], mowing [371 trees/ha (150 trees/ac)], and high-volume basal spray units [680 trees/ha (275 trees/ac)]; and poor control was found in the handcut unit [4,818 trees/ha (1,951 trees/ac)].

The control of target trees in border zones of all units combined (except handcut), which were treated with basal sprays in both 1987 and 1996, was less satisfactory than in wire zones in 1999. The density of target trees in these units averaged 759 trees/ha (307 trees/ac). Target tree density in border zones was lowest in foliage spray units [432 trees/ha (175 trees/ac)], mowing plus herbicide units [494 trees/ha (200 trees/ac)], and mowing units [556 trees/ha (225 trees/ac)]; intermediate in low-volume basal spray units [803 trees/ha (325 trees/ac)] and high-volume basal spray units [907 trees/ha (367 trees/ac)]; and highest in stem–foliage units [1,359 trees/ha (550 trees/ac)]. On the other hand, target tree density in border zones of the handcut unit was extremely high [10,635 trees/ha (4,306 trees/ac)].

Target tree heights in wire zones were not a serious problem on most units. The average maximum height in mowing plus herbicide, mowing, low-volume basal spray, stem–foliage spray, and foliage spray units was 1.3 m (4 ft) and ranged from 0.6 to 2.1 m (2 to 6.5 ft). These low maximum heights in wire zones are indicative of the value of the wire–border zone method in avoiding tree-caused outages. However, the maximum tree height in wire zones was 4.3 m (13 ft) for high-volume basal spray units and 5.2 m (16 ft) for the handcut unit. Average maximum tree heights in border zones of all units combined (excluding handcut) were comparable [5.2 m (16 ft)] to those in border zones of the handcut unit [5.3 m (16.2 ft)].

In 1999, shrubs and forbs dominated the cover type of all units, with the exception of the handcut unit and mowing plus herbicide units. The handcut unit was classified as a tree cover in the wire zone and a tree–shrub cover in the border zone; mowing plus herbicide units were classified as forb–grass–shrub cover type in wire zones (Yahner et al. 1999). Both wire zones and border zones of high-volume basal spray and low-volume basal spray units were considered shrub–forb cover types. Border zones of the remaining units (mowing, mowing plus herbicide, stem–foliage spray, and foliage spray) and wire zones of mowing units were shrub–forb–grass cover types. Wire zones of the latter units (stem–foliage and foliage spray) had forbs as the major cover type, with shrubs second, and, in the case of foliage spray units, grass third.

Vegetation in 2002 and 2003

The overall density of target trees in all treatment units combined averaged 1,544 trees/ha (625 trees/ac) in wire zones and 1,594 trees/ha (645 trees/ac) in border zones (Table 1). Compared to data collected in 2002, densities in 2003 represented a 40% increase from the average overall density in wire zones [1,103 trees/ha (447 trees/ac) in 2002] and a 13% decrease from the density in border zones [1,827 trees/ha (740 trees/ac) in 2002].

The overall densities of trees were influenced greatly by including the handcut unit into the calculations (Table 1). If this unit is omitted from the calculations, there were only 340 target trees/ha (138 trees/ac) in wire zones and 501 trees/ha (203 trees/ac) in border zones in 2003.

Table 1. Number of trees/ha [≥ 0.3 m (1 ft) tall] in wire zones and border zones of 13 treatment units on the State Game Lands 33 Research and Demonstration Area in wire and border zones in 2002 and 2003.

	Wire zone		Border zone	
Treatment unit/replicate	2002	2003	2002	2003
Mowing				
M-1	371	494	865	988
M-3	124	741	371	247
Average	247	618	618	618
Mowing plus herbicide				
MH-1	0	124	371	124
MH-3	0	247	618	988
Average	0	185	494	556
Stem–foliage spray				
SF-1	371	0	1,730	865
SF-2	0	124	741	247
Average	185	62	1,236	556
Foliage spray				
F-1	494	371	1,112	494
F-2	124	0	741	247
Average	309	185	927	371
Basal low volume				
BLV-1	0	0	741	371
BLV-2	371	371	618	371
Average	185	185	680	371
Basal high volume				
BHV-1	618	494	494	329
BLV-2	618	1,112	1,359	741
Average	618	803	927	535
Handcut				
HC-1	6,178	8,772	7,907	8,154
All units except HC				
Average	257	340	813	501
All units				
Overall average	1,103	1,544	1,827	1,594

Annual increases in target tree densities were expected as trees gradually invaded shrub, forb, and grass cover types. Even so, these low densities attest, in part, to the effectiveness of integrated vegetation management (IVM) for maintenance of electric utility transmission rights-of-way (Bramble and Byrnes 1996). In contrast, densities of target trees in wire zones of the handcut unit were 6,178 and 8,772 trees/ha (2,501 and 3,551 trees/ac) in 2002 and 2003, respectively, indicating out-of-control management for this treatment unit.

Densities of target trees in border zones differed somewhat from those in wire zones in 2002 and 2003 (Table 1). Within most treatment units, there was no relationship between tree densities in wire zones when compared to adjacent border zones. In 1987 and subsequent treatments, all border zones were treated with low-volume basal spray, with the exception of high-volume basal spray units (these were treated with high-volume basal spray in both 1987 and 1993) and the handcut unit. Thus, when comparing tree densities in border zones, we should not expect differences in densities among border zones of various treatment units, except when comparing to border zones of the handcut unit. If data from the handcut unit in 2003 were deleted, average target tree densities in border zones ranged from 371 to 618 trees/ha (150 and 250 trees/ac) [overall average = 501 trees/ha (203 trees/ac)], which was similar to the average of 494 trees/ha (200 trees/ac) in wire zones of low-volume and high-volume basal spray units combined. For the handcut unit in 2003, the average number of trees/ha in border zones [8,154/ha (3,301/ac)] was similar to that of wire zones [8,772/ha (3,551/ac)].

The most common target tree species on the different treatment units on the ROW varied, depending on whether the units had been handcut or given a different treatment. We found oak (*Quercus*) to be the dominant genus, with white oak (*Q. alba*) being the most abundant target tree in the handcut unit (both wire and border zones), and northern red oak (*Q. rubra*) in border zones of other units. Red maple (*Acer rubrum*) was a minor component in the handcut unit, but it was an important target tree species in the other units. Black cherry (*Prunus serotina*) and chestnut oak (*Q. montana*) were abundant in wire zones but not in border zones of all units. As in previous years, we found most target trees in the handcut unit were stump sprouts that had developed following the initial line clearance and have survived subsequent handcut treatments.

In 2003, shrubs and forbs were the most important cover types in wire zones of all treatment units (Table 2). Trees were a major cover type in the handcut unit only, and grasses were a principal cover type only in one mowing plus herbicide unit (MH-1) and one basal low-volume spray unit (BLV-1). Shrubs were the most important cover type in border zones of all units, although forbs also were important in border zones.

Results were similar to those in 2002 except for an increase in grass in wire zones in 2003 (Table 2). Based on our surveys, grass was a major component of the cover type in ten (77%) of the units in 2003 but in only five (38%) of the units in 2002. Grass may have increased on the ROW from 2003 to 2002 because of plant succession, but another factor may be that vegetation was measured later in 2002 (late July) compared to 2003 (early June). In early June 2003, grass cover was fully developed but important forbs, such as hay-scented fern and goldenrod, had just emerged. If vegetation were sampled in late July, forbs perhaps would be better represented in cover types in 2003.

DISCUSSION

Integrated vegetation management of a right-of-way is not a "tree-proof" but rather a "tree-resistant" means of reducing tree invasion (Bramble et al. 1996). Competition with existing plants and wildlife predation on tree seeds on a right-of-way managed via the wire–border zone method keep tree invasion of the right-of-way to a minimum. Cover types, such as forb–grass, have held tree densities to around 300 trees/ha (121 trees/ac) or less in various treatments, such as mowing plus herbicide, stem–foliage spray, and foliage spray (Bramble et al. 1990, 1996). Thus, over the

Table 2. Cover type in wire zones and border zones of 13 treatment units at the State Game Lands 33 Research and Demonstration Area in July 2002 and June 2003. F = forb, G = grass, S = shrub, and T = tree. The symbol ">" implies a greater proportion of this cover type; the symbol "=" implies relatively similar amounts of this cover type.

	Cover type			
	Wire zone		Border zone	
Treatment/replicate unit	2002	2003	2002	2003
Mowing				
M-1	S=F	S>F>G	S>F	S>F=G
M-3	S=F>G	S>F=G	S>F>G	S>G>F
Mowing plus herbicide				
MH-1	S=G	G>S	S>F>G	S>F=G
MH-3	F>S>G	S=F>G	S>F	S>F
Stem–foliage spray				
SF-1	S=F	S=F=G	S>F>G	S>G>F
SF-2	S=F	S=F	S>G>F	S>G
Foliage spray				
F-1	S>F	S>F	S>F	S>F>G
F-2	F>S>G	F=S>G	S>F	S>F
Basal low volume				
BLV-1	S=G	S=G	S	S>G>F
BLV-2	F>S	F>G>S	S>F	S>F
Basal high volume				
BHV-1	S>F	S>F>G	S>F>T	S>F>G
BHV-2	F>S	S>F=G	S>F	S>F
Handcut				
HC-1	T>S>F	T>S	S>T	S>T>F

years since 1987, IVM and the wire–border zone method of ROW maintenance have increased the time between treatment cycles, thereby reducing labor and chemical costs for ROW maintenance (Bramble et al. 1996).

Two changes may have occurred in the plant community from 1990 to 2003. First, in 1990, sassafras (*Sassafras albidum*) was one of the most common trees on the ROW (Bramble et al. 1990), yet this species was uncommon in 2003. Second, shrub cover on three treatments (mowing plus herbicide, stem–foliage spray, and foliage spray) was virtually absent in 1990 (Bramble et al. 1996). Shrubs (particularly blueberry [*Vaccinium* spp.]) were relatively abundant on these units in 2003, with no pronounced increase in the density of undesirable trees. These are two examples of a dynamic plant community existing on the ROW, in terms of changes in species composition and abundance.

In summary, the plant community present on the State Game Lands 33 Research and Demonstration Area has remained relatively stable over the years since the onset of IVM and the wire–border zone method of ROW maintenance. The result has been an excellent demonstration of how ROW maintenance can have multiple benefits to utility companies and wildlife (e.g., Yahner 2004).

LITERATURE CITED

Bramble, W.C., and W.R. Byrnes. 1996. Integrated vegetation management of an electric utility right-of-way ecosystem. Down to Earth 51(1):29–34.

Bramble, W.C., R.H. Yahner, and W.R. Byrnes. 1992. Breeding bird population changes following right-of-way maintenance treatment. J. Arboric. 18:23–32.

Bramble, W.C., W.R. Byrnes, R.J. Hutnik, and S.A. Liscinsky. 1991. Prediction of cover type on rights-of-way after maintenance treatments. J. Arboric. 17:38–43.

———. 1996. Interference factors responsible for resistance of forb–grass cover types to tree invasion on an electric right-of-way. J. Arboric. 22:99–105.

Bramble, W.C., W.R. Byrnes, R.J. Hutnik, S.A. Liscinsky, and R.H. Yahner. 1990. Gamelands 33 Research Project. Annual Report to Cooperators. 30 pp.

Yahner, R.H. 2004. Wildlife response to over 50 years of vegetation maintenance on a Pennsylvania right-of-way. J. Arboric. 30:123–126.

Yahner, R.H., R.J. Hutnik, and S.A. Liscinsky. 2003. State Game Lands 33 Research and Demonstration Project: 51 Years of Continuous Study. Annual Report to Cooperators. 38 pp.

Yahner, R.H., W.C. Bramble, W.R. Byrnes, R.J. Hutnik, and S.A. Liscinsky. 1999. State Game Lands 33 Research Project. Annual Report to Cooperators. 29 pp.

Acknowledgments. Cooperators were Asplundh Tree Expert Tree Company, Dow AgroSciences, FirstEnergy (Penelec), and Pennsylvania Game Commission. We would like to dedicate this manuscript to W.C. Bramble and S.A. Liscinsky, who both passed away in 2003.

[1,2]School of Forest Resources*
The Pennsylvania State University
University Park, PA, U.S. 16802

**Corresponding author: Richard H. Yahner*

Résume. La gestion intégrée de la végétation a été utilisée pour le contrôle de la végétation dans une emprise de ligne électrique de transport sur l'aire de démonstration et de recherche no 33 de State Game Lands dans le comté de Centre en Pennsylvanie, et ce depuis 1987. De plus, la méthode «°sous les fils vs. bordure de l'emprise°» a été implantée dans cette emprise en 1987. Cette méthode a produit un couvert mélangé de graminées, d'herbacées et d'arbustes dans la zone sous les fils, et un couvert arbustif dans la zone en bordure de l'emprise. Cette aire de démonstration et de recherche a été étudiée depuis 1953, ce qui fait de ce projet de recherche continu vieux de 51 ans le plus long en documentation sur les effets de l'entretien mécanique et chimique sur la flore et la faune au sien d'une emprise de ligne électrique de transport. Dans cet article, notre objectif est de présenter la densité en arbres cibles (arbres indésirables...) et le développement du couvert-type en réponse à la gestion intégrée de la gestion par rapport au plus récent traitement effectué (année 2000) ainsi que 2 et 3 années par après. Les résultats ont été comparés à ceux obtenus à la fin des années '80 et dans les années '90. Pour toutes les unités combinées – à l'exception de la coupe manuelle – en 1999, la densité moyenne en arbres cibles avant le traitement était de 288 arbres/ha dans la zone sous les fils, et de 759 arbres/ha dans la zone en bordure de l'emprise. Un excellent contrôle de la densité en arbres indésirables (62 à 124 arbres arbres/ha) a été observé dans la zone sous les fils, et ce dans les unités traitées par fauchage avec herbicide, par vaporisation sur les feuilles et les tiges, ou par vaporisation foliaire; un contrôle modéré (371 à 680 arbres/ha) a été observé dans les unités traitées par vaporisation basale en faible quantité, par vaporisation basale en forte quantité ou par fauchage; un mauvais contrôle (4818 arbres/ha) a été observé dans l'unité traitée par coupe manuelle. En 2003, la densité en arbres indésirables dans toutes les unités de traitements combinées était de 1544 arbres/ha dans la zone sous les fils et de 1594 arbres/ha dans

la zone en bordure de l'emprise. Si l'unité traitée par coupe manuelle était omise des calculs, alors seulement 340 arbres indésirables/ha étaient présents dans la zone sous les fils et 501 arbres/ha dans la zone en bordure de l'emprise. La gestion intégrée de la végétation dans les emprises de lignes électriques de transport n'est pas une méthode à l'épreuve des arbres mais plutôt une méthode de résistance pour diminuer l'invasion par les arbres. La compétition avec les végétaux existants et la prédation par la faune sauvage sur les semis d'arbres dans une emprise de ligne de transport sous gestion via la méthode «ºsous les fils vs. bordure de l'empriseº» permet de minimiser mais non d'éliminer l'invasion par les arbres. Depuis 1987, la gestion intégrée de la végétation et la méthode «ºsous les fils vs. bordure de l'empriseº» pour l'entretien de l'emprise de la ligne de transport a permis d'augmenter le délai entre deux interventions cycliques, ce qui a permis de diminuer le travail et les coûts en produits chimiques dans cette aire de recherche et de démonstration.

Zusammenfassung. Für die Pflege entlang der SGL 33 Demonstrations- und Forschungsfläche in Center County, Pennsylvania, wurde seit 1987 ein integriertes Pflanzenschutzkonzept (IPS) verwendet. Außerdem wurde die Draht-/Grenzzonenmethode seit 1987 innerhalb des Überlandleitungskorridors verwendet. Die Draht-/Grenzzonenmethode führt zu Grasbewuchs unterhalb der Drähte und Buschbewuchs in den Grenzbereichen. Die SGL 33 Demonstrations- und Forschungsfläche ist seit 1953 Thema von Forschungen und daher mit seinen fast 51 Jahren das älteste ununterbrochene Forschungsobjekt, das die Wirkungen mechanischer und chemischer Pflanzenkontrolle mit ihren Auswirkungen auf Fauna und Flora entlang einer Überlandleitung dokumentiert. In dieser Studie ist es unser Ziel, die Bewuchsdichte unerwünschter Bäume und den Bedeckungstyp in Antwort auf IPS gegenüber den letzten Behandlungen im Jahr 2000 und 2-3 Jahre nach der Behandlung. Die Ergebnisse wurden verglichen mit denen aus den späten 80gern und 90ger Jahren. Für alle Behandlungen zusammengenommen (mit Ausnahme des manuellen Rückschnitts) war die durchschnittliche Baumdichte vor der Behandlung in der Drahtzone 288 Bäume/h und in der Grenzzone 759 Bäume/h. Eine hervorragende Kontrolle der Zielbaumdichte von 62-124 Bäume/ha in Drahtzonen mit mechanischem Einsatz plus Herbizidbekämpfung, Stamm- und Laubbehandlung bzw. nur Laubbehandlung. Eine moderate Kontrolle, 371-680 Bäume/ha, ergab sich bei niedrig dosiertem Bodenspray, hochdosiertem Bodenspray und Mähen und eine arme Kontrolle, 4,818 Bäume/ha ergab sich bei rein mechanisch gepflegten Einheiten. In 2003 betrug die Dichte der Zielbäume alle zusammengenommen 1,544 Bäume/ha in Drahtzonen und 1,594 Bäume/ha in Grenzzonen. Wenn die manuell gepflegte Einheit aus der Berechnung herausgenommen würde, dann gäbe es nur 340 Bäume/ha in der Drahtzone und 501 Bäume/ha in der Grenzzone. IGS in einem solchen Terrain ist keine absolute Lösung, aber sie reduziert die Anzahl der invasierten Bäume. Die Konkurrenz zwischen einheimischer Fauna und Flora mit eingeschleppten Arten unter einer solchen Leitung unter Draht-/Grenzzonen-Management reduziert zwar aber eliminiert nicht sämtliche eingedrungenen Pflanzen. Seit 1987 wächst der Zeitraum von Behandlungszyklen des Pflanzenschutzkonzepts der Überlandleitung, und reduziert dadurch die Kosten für Arbeit und Chemikalien in der SGL 33 Demonstrations- und Forschungsfläche.

Resumen. El Manejo Integrado de la Vegetación (MIV) ha sido empleado para el mantenimiento de la vegetación a lo largo de las líneas de transmisión en el derecho de vía (ROW) en las áreas de demostración e investigación del Estado Game (SGL 33), Condado Central, Pennsylvania desde 1987. Además, el método de la zona alambrada de frontera fue implementado en el ROW en 1987. Este método de frontera resulta en tipos de cobertura de arbustos-pastos en zonas alambradas y zonas de arbustos en zonas de frontera. El área de demostración e investigación SGL 33 ha sido estudiada desde 1953, lo cual hace de este viejo proyecto de 51 años el más largo y continuo estudio documentado sobre los efectos del mantenimiento mecánico y con herbicidas de la flora y fauna a lo largo de líneas de transmisión. En este reporte, nuestro objetivo es presentar la densidad de árboles y el tipo de cobertura desarrollado en respuesta al MIV después del tratamiento más reciente (2000) y 2-3 años después. Los resultados fueron comparados a los obtenidos en los 80s y 90s. Para todas la unidades combinadas (excepto corta manuales) en 1999, el promedio de densidad fue 288 árboles/ha (117 árboles/acre) en zonas alambradas y 759 árboles/ha (307 árboles/ac) en zonas de frontera. Se observó un excelente control de la densidad de árboles (62-124 árboles/ha [25-50 árboles/ac) en zonas con alambre controladas con máquinas cegadoras más herbicidas y aspersión del follaje. Se observó control moderado (371-680 árboles/ha [150-275 árboles (ac]) en unidades de aspersión de bajo volumen basal, aspersión alta y de máquinas; y control pobre (4,818 árboles/ha [1,951 árboles/ac]) en unidades cortadas manualmente. En 2003 la densidad de árboles en todas las unidades de tratamiento combinadas fue 1,544 árboles/ha (625 árboles/ac) en zonas con alambre y 501 árboles/ha (203 árboles/ac) en zonas de frontera. El MIV en un ROW no es a "prueba de árboles" sino más bien un medio "resistente a los árboles" para reducir la invasión de los mismos. Desde 1987, el MIV y el método de zonas alambradas de mantenimiento del ROW han aumentado el tiempo entre ciclos de tratamiento, reduciendo el trabajo y los costos de químicos en el área de demostración e investigación.