BIODIVERSITY RESEARCH

Building public trust in utility right-of-way management

PLANT AND ANIMAL COMMUNITY RESPONSE

TO LONG-TERM VEGETATION MANAGEMENT PRACTICES ON RIGHTS-OF-WAY


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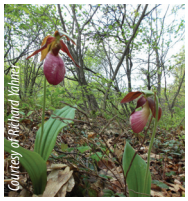
Bill Thompson US Fish and Wildlife Service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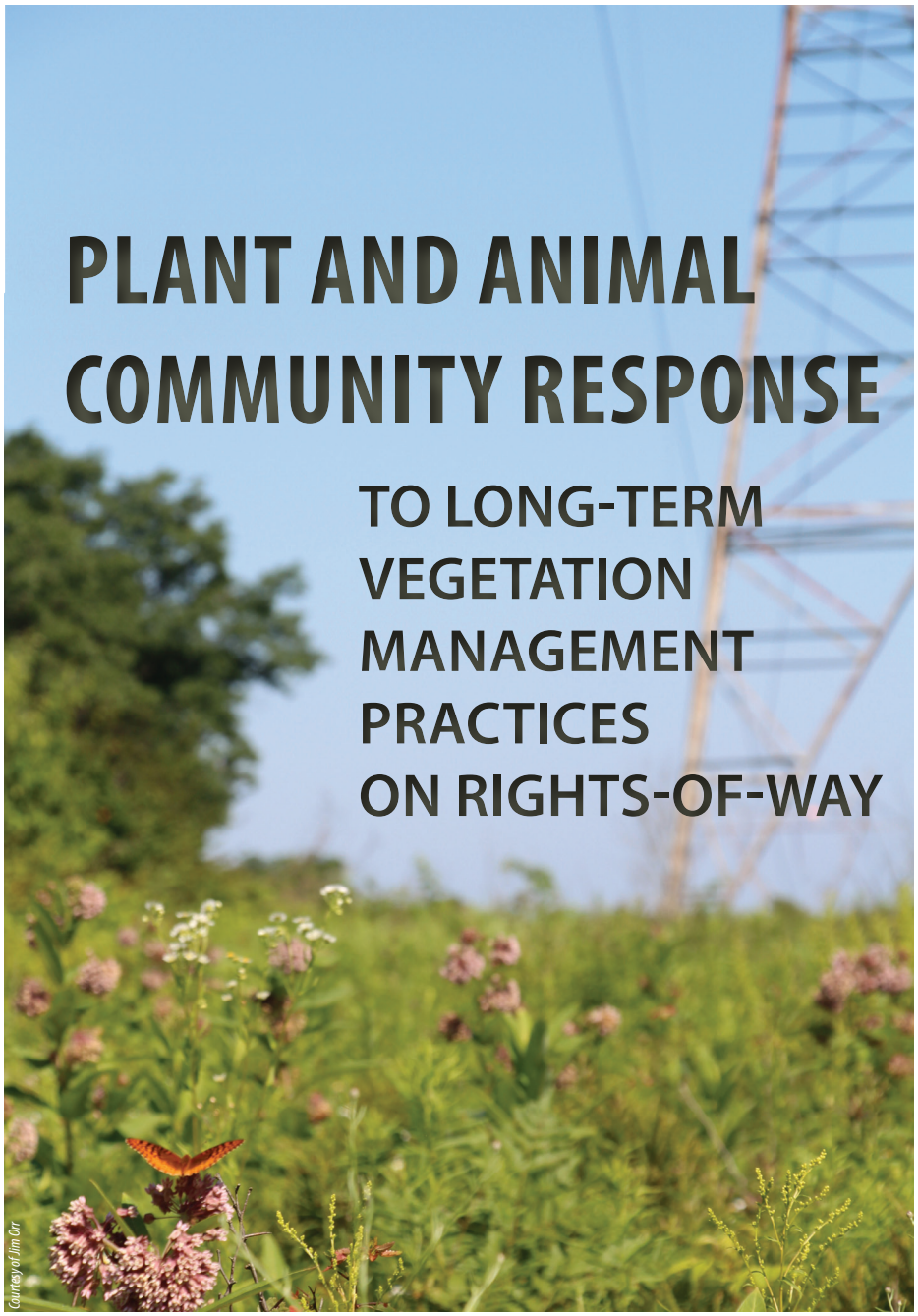
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Results of 60 years of ecological research on Pennsylvania electric transmission rights-of-way demonstrate that plant communities can be selectively managed to support reliable electric service and a diverse plant community for wildlife habitat.

The Pennsylvania State Game Lands 33 (SGL33) research project in central Pennsylvania began in 1953 in response to public concern—particularly from hunters—about the impact of vegetation management practices on wildlife habitat within electric transmission rights-of-way. Today, SGL33 is the site of the longest continuous study measuring the effects of herbicides and mechanical vegetation management practices on plant diversity, wildlife habitat, and wildlife use within a right-of-way. Similar studies have been conducted at a companion site, Green Lane Research and Demonstration Area (GLR&D), in southeastern Pennsylvania since 1987. Both projects provide invaluable information for understanding the response of plants and animals to vegetation management on rights-of-way.

THE ORIGINAL RESEARCH OBJECTIVES OF THE PROJECT REMAIN THE SAME TODAY

1. Compare the effectiveness of commonly used vegetation management practices on controlling trees incompatible[1] with management objectives for right-of-way function;
2. Developing tree-resistant plant cover types; and
3. Determine the effect of vegetation management practices on wildlife habitat and select wildlife species of high public interest.

[1] In this document the term 'incompatible' vegetation indicates tall-growing trees that are not compatible with management objectives for right-of-way function.

MANAGEMENT PRACTICES

WITHIN RIGHT-OF-WAY STUDY AREAS

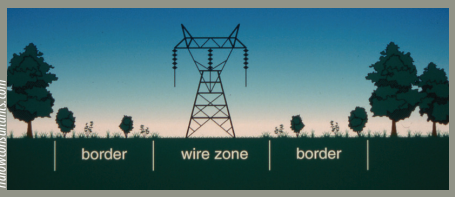
Treatment units within the SGL33 right-of-way project area historically included hand-cutting, herbicides, and mowing alone or in combination with herbicides applied across the entire width of the right-of-way. Although herbicides and application methods varied over the years as new products and techniques became available, specific treatment units (whether mowing, hand-cutting, or herbicides) have remained consistent since 1953.

INTEGRATED VEGETATION MANAGEMENT ON TRANSMISSION RIGHTS OF WAY INVOLVES TWO PHASES:

1. Using herbicides and/or mechanical treatments to initially control undesirable trees incompatible with management objectives for right-of-way function.
2. Developing a tree-resistant plant cover type to reduce reinvasion of tall-statured trees such as white oak (*Quercus alba*) or red maple (*Acer rubrum*).

A brief description of integrated vegetation management treatments are shown in Table 1. A more detailed treatment history is available at www.brambleandbyrnes.com.

WIRE ZONE-BORDER ZONE METHOD



Since the mid-1980s, the wire zone–border zone integrated vegetation management approach has been applied at SGL33 and GLR&D sites. With this approach, the zone located directly under transmission lines (wire zone) is managed for a plant community of grass, forbs and low shrubs to minimize reinvasion of tall-statured trees and shrubs that could interfere with power lines. The 'wire zone' adjoins a narrow 'border zone' of low- to medium-sized shrubs where the right-of-way meets the natural forest.

TABLE 1. INTEGRATED VEGETATION MANAGEMENT PRACTICES applied on State Game Lands 33 (SGL33) and Green Lane Research and Demonstration Area (GLR&D). *Photos courtesy Kristin Wild.*

1 Mowing+Cut Stubble Treatment
WIRE ZONE

Mechanical equipment is used to cut and mulch vegetation leaving only cut stubble behind. Following mechanical cutting and typically before woody vegetation re-sprouts, a diluted herbicide mixture of selective broadleaf residual herbicides is applied to cut stems and soil of the treatment area. This treatment relies on the stems and roots of incompatible woody plants absorbing herbicides and providing long-term woody plant control. Herbaceous plants and grasses colonize the treatment area within months of application.

2 High Volume Foliar Treatment
WIRE ZONE

A diluted herbicide solution is applied to the foliage of target vegetation using hydraulic equipment. This treatment uses a large volume of water per acre (usually 100 + gallons) and is applied on sites where incompatible vegetation is very dense and tall. Selective herbicides are used which maintain the grasses while incompatible trees and shrubs are treated. Herbicide application may be broadcast on larger areas or applied as a spot treatment on smaller areas.

3 Ultra Low Volume Treatment
WIRE ZONE

This application method allows for selective treatment of target vegetation without impacting surrounding desirable plant species. This treatment uses the Thinvert application system whereby selected herbicides are mixed with an oil based material and applied using a unique nozzle design. This method of application results in less total volume of solution applied per acre (typically 5 gallons per acre or less). Best suited for vegetation under eight feet tall.

4 Low Volume Basal Bark Treatment
WIRE & BORDER ZONE

Herbicides are applied to individual target plants to selectively control trees and shrubs up to 6 inches in diameter without harming surrounding vegetation. This treatment uses an oil based herbicide and carrier. The mixture is applied to the entire circumference of the stem from the ground to a height of about 12 to 15 inches.

5 Mowing Treatment
WIRE*/BORDER ZONE
*Mowing only

Mechanical equipment is used to cut and mulch vegetation from the site. This method is non-selective and is typically used to reclaim an area from tall, dense brush. The root system of mowed vegetation is not affected which frequently results in dense thickets of re-sprouted brush in areas where brush existed prior to mowing.

6 Hand cutting Treatment

This technique involves individually cutting target vegetation usually with a chainsaw. All or part of the above-ground portion of the incompatible vegetation is cut. The root system of the incompatible vegetation is not affected which frequently results in dense thickets of re-sprouted brush.

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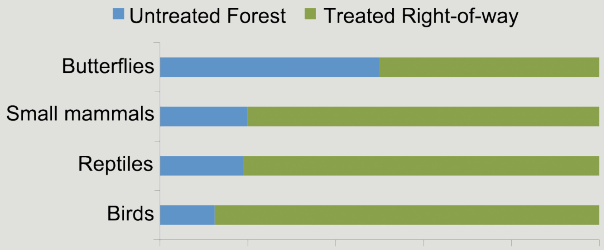
KEY RESEARCH FINDINGS

PLANT AND ANIMAL RESPONSE TO RIGHT-OF-WAY TREATMENTS

Researchers began documenting game species such as white-tailed deer and eastern cottontails on treated SGL33 sites in the 1950s, and continue to monitor and measure plant and animal biodiversity within both study areas. From 1982 to the present, there has been a concerted effort to examine wildlife usage of rights-of-way through a series of studies focusing on songbirds, large and small mammals, butterflies, amphibians and reptiles (Figure 1). Key findings from these studies are described below.

FIGURE 1. RELATIVE SPECIES RICHNESS
of native bird, reptile, small mammal, and butterfly populations in a variety of right-of-way treatments compared to the adjacent mature forest.




Courtesy of Richard Yahner

PLANT COMMUNITY

KEY FINDINGS

1. Plant communities can be changed with the use of an appropriate herbicide and application method. (2, 3, 6, 18, 20, 24, 25, 26, 27, 34)
2. Vegetation management practices that include the use of selective herbicides result in diverse vegetation that provides forage and habitat for wildlife on rights-of-way. (2, 14, 18, 20)
3. Plant communities can be created that inhibit tree establishment, thereby reducing maintenance costs for utility companies and mitigating the potential for power outage. (5)

TABLE 2. EXAMPLES OF VEGETATION COMPATIBLE WITH WILDLIFE within the wire zone and border zone of the electric transmission right of way in State Game Lands 33 Project Area.

TREES AND TALL SHRUBS (border zone)
Witchhazel, *Hammamelis virginiana*
Bear oak, *Quercus ilicifolia*

LOW-GROWING SHRUBS (both zones)
Sweet fern, *Comptonia peregrina*
Blueberry, *Vaccinium* spp
Blackberry, *Rubus allegheniensis*

FORBS AND GRASS (both zones)
Rough goldenrod, *Solidago rugosa*
Narrow-leaf goldenrod, *Euthamia graminifolia*
Bracken fern, *Pteridium aquilinum*
Hay-scented fern, *Dennstaedtia punctilobula*
Whorled loosestrife, *Lysimachia quadrifolia*
Poverty grass, *Danthonia spicata*

When a transmission right-of-way is initially cleared, a short-term decrease in total vegetative cover occurs. Following tree canopy removal, plants that tolerate high levels of sunlight increase in dominance, and tree seeds present in the soil germinate and grow. Thus, follow-up management is necessary to maintain a low-growing plant community to optimize safe and reliable transmission of electricity.

Data collected from SGL33 and GLR&D sites indicate that herbicide treatments to remove incompatible species (e.g., tall-statured trees) produce a distinct change in the plant community. Post-treatment vegetative cover ranges from grasses, to herbicide-tolerant wildflowers, shrubs and small trees. These new plant communities are relatively stable and have diversity that equals or exceeds non-treated areas.

The data also shows that right-of-way vegetation managers can predict cover types and develop the kind of vegetation desired in a particular situation by prescribing appropriate maintenance. Management units that were treated with herbicides alone or in combination with mowing had fewer incompatible trees per acre within the wire zone compared to units with mowing alone or hand-cutting treatments (Table 3). The diverse plant community created within the right-of-way as the result of vegetation management practices (Table 1) produces a variety of native species important for wildlife food and cover (Table 2 and Table 4).

TABLE 3. NUMBER OF INCOMPATIBLE TREES
remaining per acre under various integrated vegetation management practices on the State Game Lands 33 Project Area.

Treatment	Number of Incompatible Trees
1. Mowing+Cut Stubble	<100
2. High Volume Foliar	<100
3. Ultra Low Volume	<100
4. Low Volume Basal Bark	300
5. Mowing	600
6. Hand cutting	1,150

TABLE 4. NUMBER OF PLANT SPECIES PRESENT
in the wire and border zones with various integrated vegetation management practices on State Game Lands 33 Project Area.

Treatment	Wire Zone	Border Zone	Both Zones
1. Mowing+Cut Stubble	39	40	54
2. High Volume Foliar	41	40	49
3. Ultra Low Volume	33	35	44
4. Low Volume Basal Bark	34	28	46
5. Mowing	31	34	40
6. Hand cutting	35	41	47
All treatment units combined	95	110	125


Courtesy of Richard Yahner

BIRD POPULATION AND NESTING STUDIES

KEY FINDINGS

1. Vegetation management treatments provide valuable habitat for spring and summer bird populations. (8, 9, 10, 11, 15, 16, 31)
2. Bird abundance is about sevenfold higher within the treated right-of-way compared to the adjacent forest. (8, 9, 17)
3. The number of bird species is 33 percent greater on herbicide treated units compared to those that were mechanically treated. (28, 29)
4. The diversity of native plant species on the right-of-way provide a variety of nest sites for different bird species that depend on early successional habitat for breeding. (11, 21, 30)
5. Within the right-of-way, nearly four times as many birds were observed in the shrubby border zones as in the wire zones. Hence, the border zone is a very important habitat, with its combination of shrubs and a mix of herbaceous and tree species. (10, 28, 29)

Bird populations have been extensively studied on the SGL33 right-of-way since 1982. Over 40 bird species have been noted on the right-of-way, with the most common being those that nest in brushy or grassy vegetation created by integrated vegetation management practices. Bird populations proved to be more plentiful in the treated right-of-way than adjacent forest, including herbicide-treated units, especially those with basal and foliar methods of application. In areas treated with herbicides, there were 712 birds observed per day per 100 acres, compared to 552 birds on areas mechanically maintained. Forty-four different species of birds were counted in 2000 through 2001 on the right-of-way compared to 39 in 1987 through 1988.

Properly maintained vegetation within a right-of-way benefits many bird species, especially those adapted to brushy, early successional habitats. In the northeastern United States, populations of bird species using early successional vegetation as a group are declining faster than other groups such as forest or wetland birds. Therefore, a properly managed right-of-way is key to the conservation of birds such as the chestnut-sided warbler (*Dendroica pensylvanica*) or eastern towhee (*Pipilo erythrophthalmus*) that require early successional habitat.

The nesting ecology study conducted from 1991 to 1992 showed an increased survival for birds raising young in a well-managed right-of-way. Overall, the nesting success along the right-of-way is 66 percent, which is higher than success reported in other studies of songbirds (approximately 50 percent), including those conducted in managed forest stands (clear-cuts) in central Pennsylvania. Six different native plant species—including blackberry, witch hazel, mountain laurel, blueberry, hay-scented fern, and poverty grass—provided a variety of nest sites within the right-of-way for different bird species that depend on this linear, early successional habitat for breeding.


Courtesy of Richard

REPTILES AND AMPHIBIANS

KEY FINDINGS

1. Plant diversity and cover type within the right-of-way provided preferred habitat for most reptiles (snakes) and amphibians (salamanders). (23, 24)
2. With exception of the red-backed salamander (*Plethodon cinereus*), amphibians and reptiles were more common within the right-of-way compared to the adjacent forest. (23,24)
3. Reptiles and amphibians were more prevalent on herbicide treated units compared to hand-cutting units. (23, 24)
4. Properly maintained right-of-way is not a barrier to movement of reptiles and amphibians. (personal communication Carolyn Mahan)

Forest-management practices, such as clear-cutting, can have negative impacts on some species of amphibians and reptiles. A two-year research study of amphibian and reptile populations on SGL33 and GLR&D sites concluded that the right-of-way contained a diverse assemblage of these species. Depending on the location, eight to nine different species were recorded on the right-of-way versus only two recorded in the adjacent forest. The most common species were red-backed salamander (*Plethodon cinereus*), Jefferson salamanders (*Ambystoma jeffersonianum*), northern redbelly snake (*Storeria occipitomaculata occipitomaculata*), and northern ringneck snake (*Diadophis punctatus edwardsii*). Border zones were valuable habitat to salamanders, whereas wire zones were used most often by snakes. The right-of-way contains a much more diverse community of reptiles and amphibians than the adjacent forest and provides an acceptable habitat for these important species of wildlife.

S Hilleland, US Fish and WildlifeService, public-domain-image.org

SMALL MAMMAL POPULATIONS

KEY FINDINGS

1. Small mammals contribute to the diversity of wildlife within a right-of-way. [7, 32, 33]
2. Small mammal population and diversity is greater within the treated right-of-way than the adjacent forest. [7, 32]
3. Cover types that benefit small mammals can be predicted through the implementation of specific right-of-way maintenance techniques. [6]
4. Small mammals use a diversity of cover types from grass to shrub that result from integrated vegetation management on the right-of-way. [7, 32, 33]
5. Small mammals are important in reducing tree reinvasion by feeding on tree seeds and seedlings. [7, 32]

Small mammals are important components of any ecosystem, including rights-of-way. From an ecological perspective, small mammals serve as prey for predators and are major links in the food chain.

A two-year study was conducted on SGL33 to determine relative abundance and species richness (number of species) of small mammals on the right-of-way compared to the adjacent forest. Results of the study showed that eight species of small mammals were noted on the right-of-way compared to only two in the adjacent forest. Five species of mice [whitefooted mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), red-backed vole (*Clethrionomys gapperi*), woodland jumping mouse (*Napaeozapus insignis*), and meadow jumping mouse (*Zapus hudsonius*)], two shrew species [short-tailed (*Blarina brevicauda*) and masked (*Sorex cinereus*)], and a short-tailed weasel (*Mustela erminea*) occurred on the right-of-way.

The findings of this study and a companion study conclude that specific treatments on the right-of-way produce cover types that benefit small mammals compared to the adjacent forest cover type. In addition, small mammals use a diversity of cover types found on the right-of-way from grass to shrub. Evidently, the right-of-way serves as a large forest clearing, which provides habitat for forest species (e.g., white-footed mouse and woodland jumping mouse) in border zones and habitat for early successional species (e.g., meadow vole and meadow jumping mouse) in wire zones.

Ken Holmes, US Fish and Wildlife Service

BUTTERFLIES

KEY FINDINGS

1. Flowering herbaceous plants (forbs/wildflowers) occurring within the right-of-way provide excellent habitat for butterflies. [12, 13]
2. With the exception of hand-cutting, all herbicide and mowing plus herbicide treatments provided habitat for a diverse butterfly community within the right-of-way. [12, 13]
3. The use herbicides on the right-of-way did not have a detrimental impact on butterfly species or total number of butterflies. [12, 13]

Butterflies are important indicators of environmental changes and are barometers of a healthy ecosystem. They are valuable pollinators to many wildflowers and are a food source for songbirds, small mammals, and other wildlife. Habitat loss has caused some butterfly populations to decline nationally.

A two-year study on the SGL33 and a companion study on GLR&D sites compared butterfly populations on hand-cutting units versus herbicide-treated units. Results show that the same or slightly more butterfly species occurred on the right-of-way than in the adjacent forest, and were more common in herbicide-treated units than on hand-cutting units. Common native butterfly species included aphrodite fritillary (*Speyeris aphrodite*), little wood satyr (*Megistocymela*), monarch (*Danaus plexippus*), spicebush swallowtail (*Papilio troilus*), eastern tiger swallowtail (*P. glaucus*), and the exotic European skipper (*Thymelicus lineola*).

A major factor affecting the abundance and diversity of butterflies on the right-way was the presence and use of flowering plants as nectar (food) sources during the growing season. The use of herbicides as part of integrated vegetation management practices promoted a rich wildflower community and habitat that supports a diverse butterfly community on the right-of-way.

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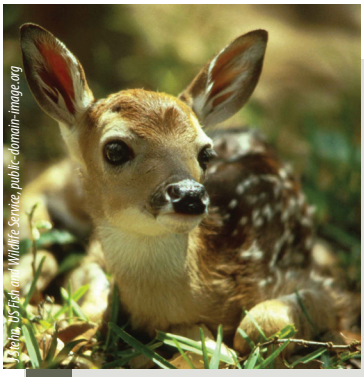
More detailed information about long-term studies at State Game Lands 33 and Green Lane Research and Demonstration Area is available at **www.brambleandbyrnes.com.**



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DEER POPULATIONS

KEY FINDINGS

1. Integrated vegetation management treatments within the right of way caused a shift in vegetation, but suitability of the habitat for deer remained high. [1, 4, 19]
2. Deer use of woody plants was greater in the adjoining forest compared to the right-of-way where more herbaceous vegetation was browsed. [4]
3. Deer use in the right of way was 48 percent greater than in the adjacent forest. [2]
4. Deer can have a positive impact on a right-of-way by browsing on incompatible trees in wire and border zones, and by providing aesthetic value to a right-of-way. [22]

White-tailed deer (*Odocoileus virginiana*) habitat and its use were evaluated on the SGL33 right-of-way before and after vegetation management treatments and compared to the adjoining forest. Deer presence increased post-treatment on the right-of-way between 1982 (treatment year) to 1984 (post-treatment). The right-of-way continued to provide desirable habitat for deer following herbicide treatment.

Long-term studies conducted on SGL33 and GLR&D sites have shown economic, aesthetic and wildlife habitat benefits associated with integrated vegetation management practices on transmission line rights-of-way. This information is critical to help right-of-way managers implement proper vegetation management practices that meet needs of their industry, the public, and wildlife. Future research will be shaped based on the needs of the utility industry to address conservation issues, new vegetation management techniques, and concerns generated by the public and scientific community.

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