The Importance of Roadside Vegetation and the Need for a Vegetation Management Plan in the Commonwealth of Kentucky

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Garrard County, KY, 2012. Photo courtesy V. Holmberg

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Executive Summary

Vegetation alongside major highways and interstates has the potential to provide many benefits to society and for conservation efforts.

1. Vegetation buffers alongside roads have the potential to reduce the concentration of pollutants from vehicle emissions and noise pollution in nearby lands (e.g., native ecosystems, crops, streams, neighborhoods, and schools).
2. Vegetation stores and sequesters large amounts of carbon, providing an important service to society: carbon dioxide uptake.
3. Roadside vegetation management practices that promote natural vegetation communities may be extremely important in conserving native plant species, which in turn can provide habitat for other taxa, especially in landscapes that are highly altered and/or developed.
4. Roadside vegetation has the potential to act as a conservation corridor, providing habitat connectivity across the landscape.

   In certain locations where there is a high incidence of documented wildlife crossings, one-time funds could be raised for and spent on building wildlife crossings in these areas of elevated wildlife activity, improving safety for motor vehicle travel, and moving Kentucky to the forefront of roadside management practices and wildlife conservation efforts close to roadways. While collisions with trees alongside roads is a cause of concern for safety on our roadways, most of our recommendations for increased vegetation would occur in locations with sufficient right-of-way width so that collisions with trees would not occur or pose a potential threat to vehicle travel.
The high cost of vegetation maintenance alongside roadways in comparison to other states suggests that maintenance costs could be minimized with improvements to our roadside management.

1. Two roadside vegetation management practices commonly used across Kentucky on our interstates, parkways, and freeways are mowing and herbicide treatment for invasive species management.

2. A reduction in area mowed could provide a greater reduction in the cost of maintaining mowing along interstates, parkways, and freeways in KY.

3. Eight states have officially adopted Integrated Roadside Vegetation Management (IRVM) programs that address using innovative methods for managing roadside vegetation (Berger 2005).

   The average area managed adjacent to each mile of interstate, parkway, and freeway is 16 acres. One survey of several states demonstrated that Kentucky has the highest cost of mowing per acre per cut by contractors ($125; Berger 2005). A few states cut brush and small trees, and of those states Kentucky spent the most on hand-cutting brush and small trees ($2000 per acre per cut; Berger 2005). According to personal communications with DOT employees, many locations along these major roadways are mowed because of previous practices.

4. The primary management practice for invasive species control alongside interstates and parkways in Kentucky is applying herbicide treatments.

   The average cost of applying herbicide from 2007 to 2010 was almost $370,000 for labor, equipment, and materials (KYTC Open Records 2010). While this maintenance cost is relatively low in comparison to mowing costs in Kentucky, management practices could still be improved to reduce this cost by using other methods for invasive species control.

CONCLUSION

To develop an effective Integrated Vegetation Management Plan, Kentucky would need to engage a broad range of expertise, including government employees working on roadside vegetation management from the transportation department, professionals managing exotic and native species in vegetation communities in Kentucky, and research scientists studying roadside environments across the Commonwealth.
Introduction

Roads are an integral part of daily life for most people in the United States, providing mobility across our landscape. There are nearly 8 million km of public roads across the United States (Forman et al. 2003). While the total land area covered by roads is a small proportion compared to the total land area in the United States, the total land area ecologically affected by roads is much larger, approximately 19% of the total land area (Forman 2000). The land area adjacent to the road network (hereafter referred to as the roadside) experiences multiple impacts directly and indirectly from the road, such as pollutant inputs and invasive species spread. Since roadsides are susceptible to many potentially harmful impacts from roads, proper management of the natural habitats adjacent to roads is paramount. Roadside vegetation can be managed and used to reduce road impacts not only along the roadside, but also on adjoining landscapes by acting as a barrier to pollutant movement and by reducing the spread of invasive species.

The focus of this paper is on roadside vegetation management practices alongside multi-lane, restricted-access interstates and highways across the Commonwealth of Kentucky. We focus on the management of roadside vegetation along more heavily traveled roads, since these interstates and highways have sufficient width in the right-of-way for altering management practices and these roads dissect the entire state, providing the maximum potential benefit for improvements made to our management practices. In this paper, we will address some of the safety issues related to roadside vegetation, discuss the important benefits provided by roadside vegetation, report the economic costs of current roadside management practices, and provide examples of potential improvements to our current roadside management practices. The objectives of this paper are to show that improving management of roadside vegetation in Kentucky will increase the benefits provided by roadside vegetation while reducing the cost of management practices, and that achieving effective management will require multidisciplinary cooperation.
Safety Issues Concerning Roadside Vegetation

We realize that many people may be concerned with safety issues related to the presence of vegetation, particularly trees, adjacent to major roadways. However, the right-of-way width along many of our major highways and interstates is sufficiently wide, and trees along these roads are not a direct threat to most vehicle travel. We do address a couple of safety issues that may be related to the presence of vegetation adjacent to major highways and interstates.

2.1 Wildlife collisions

Management practices that encourage vegetation growth alongside our major roadways may increase the presence of wildlife adjacent to roads. However, most of our suggestions for improvements to our vegetation management practices alongside our roads would not necessarily increase wildlife presence and several measures could be taken to counteract potential wildlife collisions. In certain locations where there is a high incidence of documented wildlife crossings, one-time funds could be raised for and spent on building wildlife crossings in these areas of elevated wildlife activity. Wildlife crossings that are included in roadway projects are often eligible for Federal transportation funds. These specially designed structures (i.e., bridges, underpasses, culverts, or tunnels) for local wildlife would not only improve safety for motor vehicle travel, but also move Kentucky to the forefront of roadside management practices and wildlife conservation efforts close to roadways.

2.2 Collisions with vegetation (particularly trees)

While collisions with trees alongside roads is a cause of concern for safety on our roadways, most of our recommendations for increased vegetation would occur in locations with sufficient right-of-way width so that collisions with trees would not occur or pose a potential threat to vehicle travel.

Benefits of Roadside Vegetation

Vegetation alongside major highways and interstates has the potential to provide many benefits to society and for conservation efforts. Forests are known to provide numerous ecosystem services, such as pollutant removal, noise reduction, carbon storage and sequestration,
and conservation of native plants and animals. Roadside vegetation can disproportionately provide these benefits by acting as a barrier to pollutant movement and by providing connectivity across the landscape for plant and animal species.

3.1 Extensive impacts from single agency management

Consistent management practices alongside major highway and interstates across the entire commonwealth are feasible, since the roadsides are managed by one entity, the Kentucky Transportation Cabinet (KYTC). Further, consistent improvements to our roadside vegetation management practices have the potential for large and positive economic and environmental impacts across the commonwealth. An estimated 22,000 acres of land is adjacent to our major highways and interstates (Bomford et al. in review), and changes in our roadside vegetation management practices would affect this land area as well as adjoining landscapes. For example, vegetation management practices that would reduce the spread of exotic invasive species may not only directly affect the presence of these species in the right-of-way area, but also reduce the extent these species spread into adjoining landscapes and potentially threaten our native ecosystems and agricultural crops.

3.2 Barrier to pollutant movement

Vegetation alongside roads may act as a barrier to pollutant movement across the landscape by removing pollutants such as carbon dioxide, nitrogen oxides, and particulate matter from the atmosphere. Vegetation buffers alongside roads have the potential to reduce the concentration of pollutants from vehicle emissions in nearby lands (e.g., ecosystems, crops, streams, neighborhoods, and schools). While vegetation buffers alongside streams typically help reduce the movement of pollutants into the stream from adjacent land-uses like urban and agricultural areas, vegetation buffers alongside roads may reduce the movement of pollutants away from the road into adjacent lands. Since motor vehicles consume a large proportion of fossil fuels, especially in cities

Photo courtesy M. Carreiro
(BTS 2004), pollutant concentrations are likely to be high close to major highways and interstates. A study conducted on forests alongside I-64, I-65, and I-71 in Jefferson County found the pollutants removed per acre were four times greater than citywide estimates for Atlanta, Chicago, Baltimore, and Brooklyn (Trammell 2010), demonstrating the importance of these forests alongside interstates in urban environments. The trees and shrubs adjacent to these interstates in Louisville removed 46.2 metric tons of pollutants with an associated monetary benefit of $231,587 (Trammell 2010). Vegetation buffers alongside major highways and interstates could be hotspots for pollutant removal and deposition across landscapes due to their higher tree density located next to a concentrated pollutant source. Roadside vegetation may provide a disproportionately large benefit to society by acting as a barrier to the movement of vehicle emissions across the landscape.

Motor vehicles also produce significant noise pollution along our major highways and interstates. Vegetation buffers can also reduce this pollution in our environment. Studies on the ability of vegetation to reduce vehicle noise have shown that the benefit of noise reduction is improved when the vegetation buffer is closer to the source of the noise (i.e., highway) (Anderson et al. 1984, Harris & Cohn 1985, Heisler 1977). Thus, vegetation buffers, especially those consisting of trees, should be closer to highways and interstates to provide the maximum benefit in noise reduction.

3.3 Carbon storage and sequestration

Vegetation, especially trees, store and sequester large amounts of carbon, providing an important service to society: carbon dioxide uptake. Roadside forests have the potential to store and sequester substantially more carbon due to the greater leaf area of the tree community. Due to greater tree density, Trammell (2010) demonstrated how forests adjacent to urban interstates in Louisville stored seven times more carbon compared to citywide estimates in New York City, Philadelphia, and San Francisco. Trees adjacent to I-64, I-65, and I-71 in Louisville stored over 40,000 metric tons of carbon and sequestered annually over 2200 metric tons of carbon (Trammell 2010). Thus, the potential for roadside vegetation, especially trees, to store and sequester carbon is substantial. The Federal Highway Administration has recognized the potential importance for highway rights-of-way to sequester carbon by starting the Carbon
Sequestration Pilot Program (CSPP) in 2008 with the purpose of determining the potential of State DOT’s to reduce carbon emissions and to create revenue by altering vegetation management practices in the right-of-way (FHWA 2010). Furthermore, the federal government has recognized the possibility of managing the roadside for carbon storage and sequestration. Trammell (2010) documented the great potential for roadside forests in Kentucky to store and sequester carbon.

One aspect of carbon acquisition by ecosystems that is not commonly considered is the carbon storage and sequestration potential belowground, or in the soil. However, soils represent a large potential sink for carbon in our environment, and the average forest in the U.S. stores a higher proportion of carbon in the soil than in aboveground vegetation (Birdsey & Heath 1995). While soils have a high potential to provide carbon storage and sequestration, roadside soils are subjected to many disturbances, primarily highway construction activities and management practices, that greatly alter the soil profile and the soil carbon storage potential (Trammell et al. 2011, Trammell & Carreiro 2012). Improvements to our roadside management practices both during and after construction (e.g., eliminate planting exotic invasive species, reduce soil excavation) would greatly improve the ability of soils to store and sequester carbon, as well as providing an enhanced substrate for plant growth (Trammell 2010).

3.4 Biodiversity

It is well known that roads can facilitate the movement of plants and animals across the landscape. Thus, management of the roadside environment is vital for improving conservation across the commonwealth. Roads can spread exotic invasive plant species to protected areas in the U.S. (e.g., Gelbard & Belnap 2003, Watkins et al. 2003) and other countries (e.g., Canada: Hansen & Clevenger 2005). This potential spread of exotic invasive species alongside roads can have significant detrimental impacts on our state nature preserves, crops, and other native ecosystems. While roadside managers are currently removing and or reducing exotic invasive plant species along our roads in Kentucky, improvements to management practices in addition to greater resources for this effort could greatly improve our biodiversity status in Kentucky. Roadside forests dominated by an exotic invasive species in Louisville had fewer tree seedlings and lower total species diversity (Trammell & Carreiro 2011). One potential suggestion to
combat exotic invasive species in our roadside environments would be to provide management resources for exotic invasive plant species that are known to have devastating impacts on ecosystems, and where ecosystem health has been shown to respond to one-time removals (or minimal repeat visits) of these species. This would provide maximum benefits from management efforts with little extra effort or resources.

While it is important to manage our roadside environments in locations where roads traverse nature preserves or other pristine ecosystems, roadside management in highly modified landscapes, such as urban environments or agricultural landscapes, is also vital for conservation in Kentucky since these roadside environments can conserve local natural ecosystems and act as a refuge for local plant and animal species (Saunders and Hobbs 1991). The intent to manage roadside environments for the conservation of plant and animal species in highly modified landscapes has occurred in other countries, resulting in the preservation of many native species. For example, Australia has managed the roadside environment throughout agricultural landscapes for the preservation of native species, such as terrestrial ant and beetles (Major et al. 1999) and an arboreal marsupial (van der Ree & Bennett 2003). Roadside environments along highly modified landscapes in the United Kingdom preserved butterfly and burnet populations (Munguira & Thomas 1992). Roadside vegetation management practices that promote natural vegetation communities may be extremely important in conserving native plant species, which in turn can provide habitat for other taxa and connect habitats across the landscape, especially in landscapes that are highly altered and/or developed. Management practices that encourage the conservation of our native plant and animal species also facilitate the ability of the roadside environment to serve as a corridor for the movement of plant and animal species across the landscape. Roadside vegetation has the potential to act as a conservation corridor, providing habitat connectivity across the landscape.
Economic costs of current roadside management practices

Two roadside vegetation management practices commonly used across Kentucky on our interstates, parkways, and freeways are mowing and herbicide treatment for invasive species management. The average area managed adjacent to each mile of interstate, parkway, and freeway is 16 acres and equates to at least 200 to 220 feet on either side of the roadway (Bomford et al., in review). The total cost of mowing in 2008 was over $5 million (KYTC Open Records 2010). The number of mowing cycles was reduced from five in 2008 to four in 2009, yet the total cost of mowing was still high at approximately $4.4 million in 2009 (KYTC Open Records 2010). According to personal communications with department of transportation employees, many locations along these major roadways are mowed because of previous practices. A reduction in area mowed could provide a greater reduction in the cost of maintaining mowing along interstates, parkways, and freeways in Kentucky. Roadside vegetation management practices should reduce total mowing area, in addition to the already instituted reduction in the number of mowing cycles to conserve additional maintenance costs.

The primary management practice for invasive species control alongside interstates and parkways in Kentucky is applying herbicide treatments. The average cost of applying herbicide from 2007 to 2010 was almost $370,000 for labor, equipment, and materials (KYTC Open Records 2010). While this maintenance cost is relatively low in comparison to mowing costs in Kentucky, management practices could still be improved to reduce this cost by using other methods for invasive species control.

Roadside managers across our country recognize the need to modernize our management of vegetation communities adjacent to our roads, and eight states have officially adopted Integrated Roadside Vegetation Management (IRVM) programs that address using innovative methods for managing roadside vegetation (Berger 2005). One survey of several states demonstrated that Kentucky has the highest cost of mowing per acre per cut by contractors ($125; Berger 2005). A few states cut brush and small trees, and of those states Kentucky spent the most on hand-cutting brush and small trees ($2000 per acre per cut; Berger 2005). The high cost of vegetation maintenance alongside our roadways in comparison to other states suggests that maintenance costs could be minimized with improvements to our roadside management.
Other states that have successfully implemented Integrated Roadside Vegetation Management plans; Kentucky should consider something similar.

**Conclusions**

Roadside vegetation is extremely important for providing ecosystem services to society (e.g., carbon storage) and for enabling ecosystem connectivity for plant and animal movement across the landscape. Management practices that remove exotic species, promote native species, and maintain healthy plant communities are vital for conservation in Kentucky. The current costs and practices of our roadside management in Kentucky need examining, and Kentucky needs an Integrated Management Plan to maximize the benefits of roadside vegetation.

To develop an effective Integrated Management plan, Kentucky would need to engage representatives from a broad range of expertise and authority, including government employees working on roadside vegetation management from the transportation department, professionals managing exotic and native species in vegetation communities in Kentucky, and research scientists studying roadside environments across the commonwealth. This combination of experts would understand the complex issues surrounding the proper management of roadside environments and the potential issues with modifying current practices.
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