

Vegetation Management Practices to Increase and Enhance Roadside Pollinator and Wildlife Habitat: Literature Search

July 16, 2019

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Resources searched: Transport Database, MnDOT Library Catalog, EBSCO Databases, TRB Research in Progress, Web

Summary: Results are compiled from the databases named above. The first set of results is specifically from the last 5 years and include databases outside of Transportation. The results following are slightly older.

Most Relevant Results

Title: Save The Bees and Butterflies!

Author: Remley Deirdre; Redmon Allison

Source: Public Roads. 2017/9. 81(2) n.p. (Phots.)

Publisher: Federal Highway Administration

URL: <https://www.fhwa.dot.gov/publications/publicroads/17sept/01.cfm>

Abstract: Pollinators--such as monarch butterflies, bumblebees, and other native bees--are essential to a healthy ecosystem. They transfer pollen grains that help to sustain an estimated 85 percent of the world's flowering plants, including a good portion of the world's food supply. This article discusses the work of the United States Federal Highway Administration and various state departments of transportation to manage roadside vegetation to conserve a healthy, life-sustaining habitat for insect pollinators, whose populations are dwindling due to disease, parasites, overuse of pesticides, and various other factors.

ISSN: 0033-3735

Title: Experimental rewilding enhances grassland functional composition and pollinator habitat use. **Authors:** Garrido, Pablo; Mårell, Anders; Öckinger, Erik; Skarin, Anna; Jansson, Anna; Thulin, Carl-Gustaf; Root-Bernstein, Meredith

Source: Journal of Applied Ecology. Apr2019, Vol. 56 Issue 4, p946-955. 10p. 3 Charts, 3 Graphs.

Abstract: Semi-natural grasslands are rich in biodiversity and thus important habitats for conservation, yet they are experiencing rapid declines due to agricultural intensification and abandonment. Promoting a more diverse mammalian herbivore community, including large and megaherbivores, may result in positive cascade effects for biodiversity and ecosystem functioning. Therefore, reintroducing an ecologically functional substitute of an extinct large herbivore could mitigate current biodiversity declines and foster semi-natural grassland conservation. To test this hypothesis, we set up a 3-year rewilding experiment where 12 feral horses were introduced in three 10-hectare enclosure replicates (four horses per enclosure). We used community-weighted mean plant functional traits to elucidate plant community changes induced by grazing through time. We also investigated the effects of this experimental treatment on insect pollinated plants and on pollinator habitat use. The grassland community exerted a mixed tolerance/avoidance response to grazing. This resulted in plant functional compositional changes which favoured prostrate plant species with higher specific leaf area, characteristic of ruderal communities. Plant species richness was higher in grazed compared to ungrazed areas. Butterfly and bumblebee habitat use, as well as feeding and resting activities were also higher in grazed areas. Moreover, the number of pollinators increased with plant species richness. Synthesis and applications. This study demonstrates that, to enhance the diversity of a given herbivore community with ecological replacements of extinct wild horses can have significant effects on the functional composition of grasslands. It can also mitigate plant species declines, in particular bee-dependent plants, and boost pollinator habitat use. Novel management alternatives are urgently needed to reverse the negative effect of land abandonment in

European agricultural landscapes. Thus, rewilding interventions with large mammalian herbivores may offset current biodiversity declines by maintaining important functional links between plants and pollinators in grassland ecosystems. This study demonstrates that, to enhance the diversity of a given herbivore community with ecological replacements of extinct wild horses can have significant effects on the functional composition of grasslands. It can also mitigate plant species declines, in particular bee-dependent plants, and boost pollinator habitat use. Novel management alternatives are urgently needed to reverse the negative effect of land abandonment in European agricultural landscapes. Thus, rewilding interventions with large mammalian herbivores may offset current biodiversity declines by maintaining important functional links between plants and pollinators in grassland ecosystems.

Title: Pollinator Habitat Conservation Along Roadways

Abstract. Pollinating insect populations are declining. As a result, there is increased interest in protecting pollinators along roadways. State departments of transportation (DOTs) and other transportation agencies are being encouraged by, and proactively partnering with, many right-of-way (ROW) stakeholders to establish or conserve pollinator habitat. This can result in a significant change in ROW management and will require new or updated practices for planning, designing, constructing, and maintaining habitat, as well as staff training. If widely distributed insect populations continue to decline they may be considered for listing under the Endangered Species Act. If listed, capacity improvement projects and ROW maintenance practices may have a greater potential to negatively affect or for “take” of these listed species. The purpose of this research is to share knowledge of successful practices and lessons learned from states where pollinator species have been listed, and to show how to implement integrated pollinator habitat programs. The objective of this research is to develop a guidebook for state DOTs and other ROW owners and operators to make informed decisions and implement tailored programs to maximize the potential to improve insect pollinator habitat. The guidebook should consider geographical, adjacent land use and ecological contexts, roadway characteristics and safety, and public benefits.

URL: <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4589>

Supplemental Notes: Contract to a Performing Organization has not yet been awarded.

Contract Numbers: Project 25-59

Status: Proposed

Funding Amount: 490000

Sponsor Organizations:

National Cooperative Highway Research Program

Transportation Research Board

500 Fifth Street, NW

Washington, DC 20001 United States

American Association of State Highway and Transportation Officials (AASHTO)

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Washington, DC 20001 United States

Federal Highway Administration

1200 New Jersey Avenue, SE

Washington, DC 20590 United States

Project Managers: Rogers, William C

Start Date: 2019-03-19

Expected Completion Date: --

Actual Completion Date: --

Source Agency: Transportation Research Board

500 Fifth Street, NW

Washington, DC 20001 United States

Title: Evaluate replacement of current post-construction groundcover with pollinator beneficial groundcover

Abstract. The monarch butterfly is arguably one of the most iconic and popular butterflies in North America. Its annual multigenerational migration is considered one of the most spectacular natural phenomena on the

planet. Unfortunately, estimates from the overwintering colonies in Mexico have documented a steady population decline over the past few decades and prompted a petition to list the butterfly as threatened under the Endangered Species Act. Much attention has focused on the loss of breeding habitat, with recent estimates indicating that 1.8 billion milkweed stems nationwide would be needed to return monarch populations to a more viable size. The Presidential Memorandum Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators and the resulting Pollinator Research Action Plan specifically identify roadsides as priority areas where habitat could be expanded. In response, ODOT has identified, and is currently implementing proactive strategies designed to stabilize and ultimately reverse this population collapse, including converting existing right-of-way to roadside pollinator habitats. Unfortunately, conversion requires significant site preparation to control weed pressure including at least three applications of herbicides spanning up to two calendar years. Some native wildflowers, grasses, and legumes can thrive in poor and compacted soils, are salt-tolerant, and have extensive root systems that range from 5 to 15 feet, lending themselves to being an inexpensive and ideal solution to soil erosion, slips, and slides. By directly seeding new construction projects with pollinator-beneficial wildflowers, native grasses, and legumes, ODOT could 1) Establish hundreds of acres of new pollinator habitat each year benefiting species like the monarch butterfly, the honeybee, and the rusty patched bumble bee, 2) Reduce roadside maintenance costs through mowing and herbicide reduction, and 3) Meet or exceed storm water runoff requirements by creating vegetative bio-filters. The Ohio Department of Transportation (ODOT) is seeking to create a specification to supplement, or more preferred to replace current post-construction groundcover (Kentucky bluegrass, tall and fine fescue, annual and perennial ryegrass, and the legume crown vetch) with pollinator-beneficial wildflowers, native grasses, and legumes. The objective of this research is to conduct an in-depth analysis of ODOT's current post construction groundcover and provide recommended specifications for native, pollinator beneficial groundcover that are cost effective, conservation minded, and readily available in order to update ODOT's Construction and Material Specification book. The primary objective of this research is to find Ohio native grasses and forbs that can thrive in poor and compacted soils, are highly salt tolerant, provide sediment and erosion control following ground disturbances from construction projects, filter storm water runoff, provide food and nesting habitat to pollinators which will increase their populations, and are aesthetically pleasing.

URL:

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Pages/Project_Details.aspx?View={D7C72556-2ABC-4830-BDFF-6C02603A792B}&FilterField1=State%5Fx0020%5FJob%5Fx0020%5F%5Fx0023%5F&FilterValue1=135779

Contract Numbers: 32394; 107320; 135779

Status: Active

Funding Amount: \$851,942.55

Sponsor Organizations:

Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590 United States

Managing Organizations:

Ohio Department of Transportation
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Principal Investigators: Burns, Ana

Start Date: 2018-08-29

Expected Completion Date: 2023-03-01

Source Agency: Ohio Department of Transportation
Research Program
1980 West Broad Street
Columbus, OH 43223 United States

Title: Literature review and meta-analysis of rights-of-way management for native insect pollinators with focus on application in Maine and the northeastern U.S.

Abstract. Recent declines in managed, non-native bees have heightened general awareness of the importance of the pollination services of native bees, butterflies, and other insects, with increased focus globally on enhancing pollinator conservation through habitat management. Pollinator-friendly habitat management can be a valuable tool for stemming the decline of several high-profile species, including pollinator species recently listed (Rusty-patched Bumble Bee) or under consideration for listing in the Northeast by the U.S. Endangered Species Act (Monarch butterfly, Regal Fritillary, Frosted Elfin, Yellow-banded Bumble Bee). Habitat management for pollinators and other proactive conservation measures by State Departments of Transportation and other Agencies may receive consideration by the U.S. Fish and Wildlife Service when making final species listing decisions in the coming months and years. Furthermore, habitat enhancement benefiting species of federal conservation concern, if practiced strategically, can benefit a wide diversity of other pollinator species of state and regional importance and lead to reduced costs over time. Prescriptions of land management for pollinators is complicated by the diversity of Agency management objectives, the biology of focal pollinator species and communities, the composition and structure of specific habitats available for management, and the varied effects of landscape context on outcomes of habitat manipulation. All of these factors must be considered when developing habitat management plans to enhance pollinator population persistence. Rights of way (ROWs) are managed lands that comprise a relatively small portion of Maine's landscape overall, however, they potentially have a disproportionate effect on pollinator communities as they may simultaneously fragment, connect, create, enhance, or compromise pollinator habitat. A significant body of literature is accumulating on the subject of pollinator habitat preferences and recommended management practices to support and enhance such habitats. A systematic review and quantitative summary of pollinator habitat management literature, with a focus on roadsides and ROWs, can help inform and improve pollinator conservation practices in Maine by Maine Department of Transportation (MDOT) and other regional natural resource agency partners. The research team proposes to conduct a review and meta-analysis of scientific and technical literature about land management for pollinator conservation, with a focus on roadsides and rights-of-way. This analysis approach complements a strict narrative literature review by applying objective statistical analyses to systematically assess patterns across multiple studies that explore a common research question yet with seemingly conflicting findings. The meta-analysis will be guided by these focal questions: (1) Are there specific ROW management practices that enhance pollinator abundance and diversity? (2) Are there elements of landscape context that serve to enhance (e.g., adjacent fields or wetlands) or threaten (e.g., traffic volume, road class) the success of ROW management for pollinators? (3) How do answers to these questions inform Best Management Practices for ROW habitat enhancement for pollinators? Additionally, the team will analyze survey data collected during 2017 by F. Drummond at ten managed Priority 1 roads in Maine to assess the survey results in a broader landscape context, and they will include these findings in their review.

Supplemental Notes: Contract to a Performing Organization has not yet been awarded.

Status: Programmed

Funding Amount: 60000

Sponsor Organizations: Maine Department of Transportation
16 Statehouse Station
Augusta, ME 04333 United States

Start Date: 2018-03-01

Source Agency: Maine Department of Transportation
16 Statehouse Station
Augusta, ME 04333 United States

Title: Roadsides as Habitat for Pollinators: Management to Support Bees and Butterflies.

Author: Hopwood Jennifer L

Citation: Conference Title: 2013 International Conference on Ecology and Transportation (ICOET 2013). Scottsdale. Sponsored by: Federal Highway Administration. Held: 20130623-20130627. 2013. 18p(Figs., Refs., Tabs.)

Abstract: Pollination of flowering plants is an essential ecosystem service. It is estimated that 85% of flowering plants worldwide and 35% of global crop production rely on animals for pollination. Pollinators such as bees, flies, wasps, beetles, moths, and butterflies play multiple roles in food webs in addition to facilitating the reproduction of flowering plants. Fruits and seeds, the product of pollination, are an important part of the diet of many birds and mammals, and pollinators are a direct food source for other wildlife such as songbirds and even grizzly bears as well. However, research indicates that some managed and wild pollinators are in decline. Threats to pollinators affect not only pollinators themselves but also the stability of natural ecosystems and agricultural productivity. Roadsides are known to have value as habitat for plants, as well as birds, small mammals, amphibians, reptiles, ants and beetles. Roadsides can also be a refuge for pollinators, especially in landscapes substantially altered by urbanization or agriculture. Often the only semi-natural areas remaining in heavily altered landscapes, marginal habitats like roadsides can provide pollinators with places to forage for food and to nest. Pollinator habitat must include blooming flowers, which supply pollinators with protein-rich pollen and energy-providing nectar. Pollinators also require a place to nest or to lay their eggs. Butterflies and moths generally lay their eggs on or next to the host plant upon which their vegetation-eating caterpillars will feed. In contrast, bees create nests in which they leave food for their young. Many bee species dig subterranean nests in their preferred soil type, while other species nest above ground in plant stems or cavities in dead wood. Bumble bees nest within insulated cavities, under clumps of grass or in old rodent burrows. Studies demonstrate that roadsides planted with native plants support more butterflies and bees than do roadsides dominated by non-native grasses and flowers. With millions of acres of land in roadsides, managing roadsides with pollinators in mind could have a significant impact on pollinator conservation. New roadside plantings should include a diversity of native wildflowers with overlapping bloom times, to provide for pollinators throughout the growing season, including key host plants for butterflies. For example, monarch butterflies, renowned for their impressive long-distance seasonal migration, rely on milkweed species only as host plants. Monarch populations have been declining over the last fifteen years, and reduced numbers of milkweeds across the butterfly's breeding range, particularly within agricultural fields, are likely contributing to their decline. Planting milkweeds along roadsides can restore monarch breeding habitat, including along migration routes. Roadsides can be of great benefit to pollinators. Best management practices include consideration of timing and frequency of mowing, spot spraying rather than broadcast use of herbicides, and surveys to identify existing roadside habitat that provides native plant resources for wildlife. Roadside managers can develop a management strategy that addresses safety concerns while also benefiting wildlife such as pollinators.

URL: http://www.icoet.net/ICOET_2013/documents/papers/ICOET2013_Paper403C_Hopwood.pdf

Title: ODOT's Pollinator Habitat Guidelines and Recommendations

Author: Kusnier, John

URL: http://www.dot.state.oh.us/engineering/OTEC/2016%20Presentations/Wednesday/64/Lucas_64.pdf

Title: Technical Guide for Enhancing, Managing and Restoring Pollinator Habitat Along Ontario's Utility Lands

URL: <https://pollinatorpartnership.ca/assets/generalFiles/LandManagerGuide.Ontario.Corridor.FINAL.PDF>

Title: Xcel Energy Transmission: Pollinator Initiative

URL: <https://www.transmission.xcelenergy.com/pollinator-initiative>

Title: Survey of Key Monarch Habitat Areas Along Roadways in Central and North Florida.

<http://rip.trb.org/view/1377839>

Abstract: The Florida Department of Transportation in collaboration with the Florida Museum of Natural History's McGuire Center for Lepidoptera and Biodiversity at the University of Florida propose to enhance roadside management of pinewoods milkweed along Florida roadways in central and north Florida - specifically

Osceola County north to the Florida-Georgia line and west to Jackson County. Specific objectives include: (1) Identification of key milkweed populations and plant densities for *Asclepias humistrata* (primary focus), *A. tuberosa* (secondary focus) along select state and county roads within the survey area, including re-evaluation of previously surveyed areas; (2) inclusion of data in a georeferenced database with identification of high density hotspots; (3) survey of select hotspot areas for successful pod (seed) production; and (4) Following identification of hotspot areas, the project will work to develop new Florida Department of Transportation (FDOT) vegetative management practice recommendations to maximize the quality and availability of pinewoods milkweeds to support early season monarch breeding. The resulting pinewoods milkweed population "hotspots" could additionally be managed to help generate local ecotype seed production for other key habitat restoration or augmentation projects in the future.

Title: Evaluating Integrated Roadside Vegetation Management (IRVM) Techniques to Improve Pollinator Habitat.

<http://rip.trb.org/view/1440192>

Abstract: The State Highway Agency (SHA) is working to develop performance measures that comply with the June 2014 Presidential Memorandum – Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators. This is a proposed 2-year pilot study to establish and manage roadside meadows, and compare such meadows with intensively mowed and current/proposed Integrated Roadside Vegetation Management (IRVM) strategies.

The research will measure the effects of the various vegetation management strategies on the abundance and diversity of pollinator communities, and evaluate pollinator nesting and foraging opportunities under these strategies. Pollinator Best Management Practices will be developed and pollinator-friendly, affordable seed mixes, with a focus on native plants, will be identified.

Title: Establishment of Wildflower Islands to Enhance Roadsides for Pollinators Health and Aesthetics.

<http://rip.trb.org/view/1410524>

Abstract: Recently, a Presidential Memorandum was released and highlights an overarching strategy goal to restore and enhance pollinator habitat acreage through federal actions and public/private partnerships. Seeded grasslands with a high density of wildflowers on roadsides have excellent potential for providing songbird and pollinator habitat.

Wildflowers are particularly critical in providing habitat for grassland songbirds and pollinators (e.g., bees and butterflies), both of which have experienced massive declines in numbers over the last decade or more. Wildflowers are particularly important to pollinators in spring and early summer, before other food sources are available.

Effective habitat restoration must be appropriate for the desired pollinator species, affordable to establish in the short term, and self-sustaining in the long-term (Black et al. 2011). Because roadsides offer continuous swaths of vegetation, testing establishment of wildflower refuges or 2 islands in this context holds great opportunity for providing pollinator habitat. This research will evaluate whether establishment of wildflower islands on roadsides will provide better stands of wildflowers, more plant diversity, improved bee health, and greater abundance and diversity of native bee pollinators compared to roadsides where wildflowers are seeded conventionally with grasses across the entire area. The problem with the latter or conventional approach to seeding is that wildflowers may become established, but don't persist in extensively managed roadsides and it is expensive for Nebraska Department of Roads (NDOR) to seed wildflowers across entire roadsides. Establishment and management of wildflowers in islands/refuges will reduce seed costs and is hypothesized to provide better establishment and persistence of wildflower populations.

Title: Evaluating the Use of Highway Corridors by Monarch Butterflies.

<http://rip.trb.org/view/1407188>

Abstract: In response to the decline of critical pollinators, including butterflies, a presidential memorandum entitled, "Creating a Federal Strategy to Promote the Health of Honey Bees and other Pollinators," established the Pollinator Health Task Force. The U.S. Department of Transportation is a member of this task force and is

tasked with evaluating its current guidance and identifying opportunities for establishing pollinator habitat and promoting pollinator friendly practices in transportation corridors.

The monarch butterfly is found throughout the lower 48 states, Hawaii, southern Canada, and northern South America. Because of its large bright orange and black-patterned wings and its migration path spanning much of the northwestern hemisphere, its decline has been more noticeable than most other pollinators. This butterfly has experienced a 59 percent decline, based on observations when they are concentrated in overwintering grounds. Reasons for its decline: habitat and food source loss; invasive plant species that outcompete milkweed; species both native and introduced that mimic milkweed and fool the butterfly into laying eggs where the milkweed required for the larval stage does not exist; pesticide use; and illegal logging in its very limited overwintering grounds. Milkweeds, which provide food for the larval stage, are often considered “weeds” in need of eradication in agricultural settings.

Research is needed to expand on the existing body of knowledge around roadside pollinator habitat to provide a better understanding of the relationship between long-term maintenance and roadside management activities. In particular, the information will assist in evaluating potential tradeoffs between providing monarch butterfly habitat and safety concerns relative to changes in maintenance practices to maintain the habitat. The objectives of the research are to (1) provide objective answers as to whether planting native species, including the milkweeds preferred by the larval stage of the butterfly and nectar producing plants for the adult stage, along roadways contributes to sustainable or increased populations; (2) produce implementation guidelines on the minimal area of plantings needed to create effective habitat enhancement for the monarch butterfly, as well as location of plantings in the roadside topography, and whether planting too close to the roadway may increase butterfly mortality through strikes by vehicles or mowing plants when larvae are present in clear zones; and (3) provide information to state departments of transportation about the impacts of transportation on and benefits and drawbacks of planting milkweed and nectar providing plantings for the butterfly.

Title: Evaluating the Suitability of Roadway Corridors for Use by Monarch Butterflies.

<http://rip.trb.org/view/1459512>

Abstract: In response to the decline of critical pollinators, including butterflies, a presidential memorandum entitled, “Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators,” established the Pollinator Health Task Force, of which the U.S. Department of Transportation is a member. The monarch butterfly is found throughout the lower 48 states, Hawaii, southern Canada, and northern South America. Because of its large bright orange and black-patterned wings and its migration path spanning much of the northwestern hemisphere, its decline has been more noticeable than most other pollinators. This butterfly has experienced a precipitous population decline. Thus, it is under review by the U.S. Fish and Wildlife Service for listing as a threatened species (a decision is anticipated by June 30, 2019). The reasons for its decline listed in scientific and popular science literature include: habitat and food source loss, invasive plant species that outcompete milkweed, pesticide use, and illegal logging in its very limited overwintering grounds. There is a need to study the relationship between roadside habitat and the various life stages of monarch butterflies as one of the proactive conservation strategies for the species.

The objective of this research is to develop and validate a methodology for transportation practitioners to determine if roadway corridors are sources or sinks (beneficial or detrimental) to the monarch butterfly and how to maximize the beneficial aspects and minimize the detrimental impacts. The methodology should address a broad range of variables related to the project objective such as, but not limited to, the following: (1) Accounting for the differences and similarities between the eastern and western monarch butterfly populations, and migratory and non-migratory populations; (2) Analyzing mortality rates related to roadsides; (3) Considering traffic volume, speed, right-of-way width, and roadway width; (4) Assigning functional values for different roadside vegetation types; (5) Evaluating the effects of adjacent land use and habitat; (6) Considering roadway right-of-way maintenance practices (e.g., mowing, salt, burning, timing, pesticides); and (7) Considering environmental variables (e.g., climate, precipitation, elevation and aspect).

While the methodology should be directly applicable to most situations, it should also outline decision-making processes and criteria that would assist transportation practitioners in identifying flexible solutions. Ultimately, the methodology should allow users to select and prioritize the most advantageous locations for

butterfly habitat enhancement on a landscape scale (i.e., how large do habitat patches need to be and are there considerations of the amount of habitat adjacent to the roadways that would make selections of particular roadside locations more beneficial than others?).

Title: Integrating Roadside Vegetation and Erosion Control.

Author: Kuennen Tom

Citation: Better Roads. 2013/3. 83(3) pp 25-33(Figs., Photos.)

Abstract: Vegetation management is an important part of integrated roadside management programs. Vegetation control helps highway safety. If left unchecked, weeds and other plants can overrun signage and damage infrastructure. Proper care of roadside vegetation can protect and encourage wildlife and enhance the aesthetic qualities of the highway. A number of states have introduced vegetation management into their integrated roadside management programs. In Washington state, the unwanted vegetation is eliminated and desirable is cultivated. The prevention of weed overgrowth and regularly monitoring conditions are essential parts of the program. It is hoped that with proper management, the roadside vegetation will eventually become self-sustaining. Massachusetts' vegetation management plan provides a safe, unobstructed roadway. The plan has identified priorities for vegetation control and implemented them. Nebraska's plan is focused on encouraging natives plants for a sustainable roadside. The plan includes information about regional ecosystems across the state, for each type of landscape. Iowa's vegetation management program, which was established in 1988, focuses on improving vegetation with the goal of sustainability. Minnesota is developing an integrated plan that includes management of roadsides for the benefit of wildlife. In addition to the control of vegetation, drainage is an important part of roadside management. Poor drainage systems can cause the deterioration of pavement and other parts of roadway infrastructure.

<http://www.equipmentworld.com/integrating-roadside-vegetation-and-erosion-control/>

Title: Roadsides and Vegetation.

Author: Forman Richard T T

Citation: Conference Title: 2001 International Conference on Ecology and Transportation (ICOET 2001).

Location: Keystone. Held: 20010924-20010928. 2001. pp 7-8(Refs.)

Abstract: A huge area, equal to 100,000 football fields in every state of the U. S., is devoted to roadsides. Most travelers see nothing there...a boring void. Yet looking closely reveals a set of plants different from those in adjacent land. Vegetation zonation across the roadside, together with patches scattered over it, is conspicuous. And like a movie film, the sequence of vegetation along the road often changes markedly. Despite these distinctive patterns, ecologists see more problems than benefits. Indeed, roadsides represent an enormous opportunity for new thinking and approaches by the transportation community, science and society. Road construction normally is a process of moving, homogenizing, molding and smoothing earth to produce a safe, efficient and hydrologically stable road. Roadsides begin without their inherent natural heterogeneity. Soil, vegetation, and animal communities thus become relatively monotonous and impoverished. The earth forms...including road shoulder, ditch, outer roadside, cutbank and fillslope...are somewhat novel habitats in the landscape, especially with traffic effects superimposed on them. Soil erosion and its control mechanisms are a major issue, and establishing natural plant communities on roadsides remains a challenge. At least two dozen chemical constituents of pollutants emanate from road systems and probably have significant ecological effects (FHWA 1996). Four-fifths of the chemicals come from vehicles, with a wide variety of sources: oil, grease, hydraulic fluids, engine and parts wear, metal plating and rust, tire wear, brake lining wear, and fuel and exhaust. Non-vehicular sources include sanding and de-icing agents, roadbed and road surface wear, and herbicide and pesticide use. Pollutant levels in road runoff often correlate poorly with traffic volume, though several pollutants seem to correlate with traffic volume during storms. With a high diversity of pollutants and sources, mitigation or best-management-practice solutions for pollutants in road runoff are difficult. The total diversity of roadside plants along a road tends to be quite high, largely because of the many non- native species added (Harper-Lore 1999). In contrast, plant diversity is often low at a specific spot or site. The spread of non-natives along roads is favored by ditching, road salt, vehicle transport, vehicle-caused wind, and habitat homogenization in road construction. Native rare species

are present in roadsides though little studied. Rock outcrops, bridges, culverts, other concrete structures (with calcareous conditions), and blocked- drainage spots may provide microhabitats for rare species. In intensively altered landscapes such as for agriculture, roadsides may harbor some of the rare species and natural communities remaining, and thus be of considerable conservation interest. Although roadsides often contain numerous non-native species, and non- natives invade ranchland, cultivated land, parkland and natural areas, little is known about how important roadsides are in these invasions. Road-shoulder vegetation subject to vehicle disturbance, numerous pollutants and road maintenance differs sharply from ditch vegetation with much more water and sediments. Ditch vegetation differs in turn from the outer- roadside plant community with usually well-drained soil, less vehicular and maintenance disturbance, and more intense influence of adjacent land. Disturbance-induced early successional stages may be of conservation importance in areas of mature vegetation. Roadside natural strips (road reserves) in intensive agricultural landscapes of Australia are an impressive example of protecting relatively natural communities along roads. Creating roadsides as a mosaic strip, e.g., of successional communities, rare-species habitats, shrubland, savanna and forest for carbon sequestration and/or wood products, could contribute to many of society's goals. Maintenance, mowing and management occur in countless combinations, with highly diverse ecological effects (Aanen et al. 1991). For instance, vegetation can be mowed at different times and different frequencies, as well as in alternating strips of varying size, located either along the road or laterally across the roadside. Wildflower patches may be planted, tree saplings maintained or removed, wildlife encouraged or discouraged, wet spots protected or drained, and so forth. In effect, the nature of roadsides is strongly determined by road managers and workers. The ecology of visual quality is especially important in the many miles of roadsides along which the average American spends several hours a week. In the U. S. the perception of high-visual-quality roadsides has gradually changed from neatness to an increasing emphasis on beautification, followed by ecological conditions, and more recently cultural dimensions including a sense of place. The consequent ecological changes in roadsides are equally diverse. Ecological characteristics such as biodiversity, wildlife movement, vegetation type, erosion, water flows and water quality of high-visual-quality roadsides usually differs sharply from those of low-visual-quality roadsides. In conclusion, the huge area devoted to roadsides offers few ecological benefits, but with new approaches, nature's heterogeneity and richness could be reestablished, and roadsides could provide many resources and uses to society. Chemical pollutants from road systems are highly diverse, suggesting the absence of a "magic bullet" and the need for diverse solutions. The abundance of rare species in roadsides and the roles of non-native species remain little known. Finally, maintenance, mowing and management offer an enormous opportunity to enhance both roadsides and the landscapes surrounding us.

Title: The Establishment Success of Native Versus Non-Native Herbaceous Seed Mixes on a Revegetated Roadside in Central Texas.

Author: Tinsley M Jeannine; Simmons Mark T; Windhager Steve

Citation: Conference 2007 International Conference on Ecology and Transportation (ICOET 2007).

Location: Little Rock. Sponsored by: Federal Highway Administration. Held: 20070520-20070525. 2007. pp 220-228(Figs., Refs., Tabs.)

Abstract: Revegetation is an essential component of roadside and building site construction and improvement. In the southern United States non-native grass species are frequently included in revegetation seed mixes used by highway authorities. Non-native species are frequently selected for aggressive growth characteristics, however these same traits also render them potentially invasive, and subsequently hazardous to, adjacent plant communities. Although the use of pure native seed mixes have been rejected in the past due to perceived inferior establishment characteristics, there have been few comparative quantitative field studies that justify this belief. The establishment characteristics of three seed mixes: one containing non-native species and two with native grass and forb species only, were compared in a randomized-block design along a Texas roadside following spring and summer sowing. After 60 days following the spring sowing, the two native-only seed mixes demonstrated 180% and 560% ($F=10.18$; $P<0.0001$) higher seed densities than the recommended native/non-native mix. The summer sowing results were similar with seedling densities 180% and 330% ($F=9.20$; $P<0.01$) greater than the standard non-native

seeding. Although an aggressive colonizer from vegetative tissue such as stolons and rhizomes, the non-native Bermudagrass (*Cynodon dactylon*) has a lower than expected establishment rate thought to be due to high water demand during the first weeks following sowing. Given the invasive characteristics of this common component of many recommended revegetation seed mixes, these results call into question the widespread recommended use of Bermudagrass for such projects. These data indicate that examination of suites of early- and late-successional native species can provide a highly effective mix for revegetation projects. Furthermore, this reduces the potential for negative ecological consequences and provides added benefits associated with wholly native plant communities.

Title: Not Just a Pretty Face: Roadside Vegetation Plays Practical, Safety and Economic Roles.

Author: Barbaccia Tina Grady

Citation: Better Roads. 2009/5. 79(5) pp 8-10, 12, 14(3 Photos.)

Abstract: This article describes a novel roadside vegetation management program that saves money, reduces maintenance, reduces carbon emissions, and returns unused areas of right-of-ways to the way they looked a few hundred years ago. The project, known as the Hoosier Roadside Heritage Program and undertaken by the Indiana Department of Transportation and a private group called Save the Dunes, involves planting wildflower seeds native to the area along U.S. 12. Not only does it restore natural habitat, but it cuts down on mowing costs. The article describes how the project was managed, what worked and what didn't. It notes that the Indiana DOT's LaPorte County grows its own seeds for the flowers it plants along the road at three seed sites. The article also describes a similar partnership between the Mississippi Department of Transportation and the Mississippi State University.

Title: INTEGRATED ROADSIDE VEGETATION: POLICIES FOR PLANTING AND MANAGEMENT (STUDY RECOMMENDATION).

Author: Summary Report prepared by the Alternative Roadside Vegetation Steering Committee, authorized by the Iowa Legislature.

Abstract: The Alternative Roadside Vegetation Steering Committee was established by the Iowa Legislature to study and make recommendations and roadside management policies and laws. The Legislature's purpose was to preserve and enhance the biology, environment, and stability of the roadsides, the safety of the motorists, and to preserve and enhance the aesthetic features of the roadsides, in a cost effective manner. Part of their definition of roadside vegetation management notes that, for the general public welfare, vegetation for Iowa's roadsides is preserved, planted and maintained to be safe, visually interesting, ecologically integrated and useful for many purposes. This report presents a summary of the study recommendations.

Title: BETTER LOOKING ROADSIDES.

Citation: Better Roads. 1973/6. 43(6) p. 16-7

Abstract: THE PENNSYLVANIA DEPARTMENT OF TRANSPORTATION LANDSCAPE MANAGEMENT TEAM HAS MOVED IN SEVEN MAJOR AREAS TO IMPROVE OPERATIONAL CONTROL OF ITS ROADSIDES. THESE AREAS ARE: (1) USE OF CROWNVETCH HAS CUT MOWING COSTS, REQUIRES LITTLE MAINTENANCE, AND IS VALUABLE IN EROSION CONTROL; (2) USE OF HERBICIDES; (3) USE OF A BASAL SPRAY PROGRAM; (4) SELECTIVE MOWING; (5) CONSIDERATION OF ALL LANDSCAPE DETAILS IN THE HIGHWAY PLANNING PROCESS; (6) USE OF UREAFORM FERTILIZER; AND (7) DEMONSTRATION PROJECTS TO CONVINCING THE PUBLIC OF THE VALUE OF THE USE OF THE LATEST TOOLS INCLUDING HERBICIDES.

Title: Best practices handbook for roadside vegetation management

Author: Johnson, Ann M. Contributing author, John D. Krenz ; edited by Fran Howard.

Call Number: Mn/DOT Library Main Collection - MNDOT TE178 .J64 2008

Title: Roadsides for wildlife [videorecording] : integrating wildlife in your roadside vegetation management

Author: Minnesota Department of Transportation.

Call Number: Mn/DOT Library DVD TE177 .R625 2008

Title: Proceedings: The International Conference on Ecology & Transportation (ICOET)

URL: <http://www.icoet.net/links.asp>

Title: Roadside Vegetation Management of Invasive Plants to Benefit Biodiversity and MDOT Management Programs.

<http://rip.trb.org/view/1396107>

Abstract: Non-native invasive plants readily colonize habitat edges such as transportation corridors where sunlight, soil disturbance, and competitive advantage provide prime conditions for establishment and spread by seed or rhizome. Along roadways, invasive plants create thick infestations that can be difficult to manage, are expensive and time consuming to eradicate or control, and can cause infrastructural damage and safety hazards for motorists, management crews. For example certain invasive plants can block road signs and site lines, encroach on travel lanes, clog drainages or culverts, increase risk of fire, and even push up through pavement (Perron 2008). Furthermore invasive plants degrade wildlife habitat, clog waterways, cause economic loss, impact agriculture, and alter ecosystem services such as pollination by outcompeting and displacing native plants. It has been estimated that invasive plants cause an estimated \$120 billion/year in damage and economic losses in the U.S. (Pimental et al. 2004), and invasives are considered to be the second largest cause of biodiversity loss in the U.S.

Roadside vegetation management techniques such as mowing, cutting, and herbicides are regularly employed to control invasive plants, but baseline information on the species and abundance of native (non-invasive) plants on treatment sites is lacking. Furthermore restoration and revegetation of treated sites, both to prevent re-establishment of non-native plants and to control erosion, is costly, complicated and often yields disappointing results with available seed mixes, potentially facilitating the re-invasion of non-natives. The re-establishment of desirable species of native forbs and graminoids as a component of roadside vegetation management requires a better understanding of what native species are already present on a treated site (and could promote natural regeneration). Similarly the control and prevention of infestations of invasive species requires an understanding of the species, its habit (e.g aggressiveness), and a proactive approach that emphasizes identification, early detection, and appropriate management.

In addition while roadside vegetation management is already conducted with sensitivity towards environmental resources such as rare species, wetlands, aquatic resources, and wildlife, management techniques that favor the establishment of native plants can provide habitat suitable for pollinator species such as the Monarch butterfly – part of a suite of insects that have seen population declines due in part to the spread of invasive plants (Hopwood 2010).

Objectives are as follows: (1) Conduct landscape analysis to identify priority field survey areas, focusing on sections of the Maine Interstate that intersect with rare or exemplary wetland communities, and/or public lands and Priority 1 Corridors that intersect with Focus Areas of Statewide Ecological Significance; (2) Conduct Baseline Inventory for vegetation at selected sites, to identify and map native and non-native plants (Year 1 and 2); (3) Conduct Baseline inventory for pollinator species at a subset of surveyed sites, based on an established protocol (Year 2); (4) Create Management Recommendations for the control of invasive plants and revegetation with native species for selected sites; and (5) Incorporate knowledge about species invasiveness and threat to transportation corridors in to Management Recommendations.

Title: Literature Review: Pollinator Habitat Enhancement and Best Management Practices in Highway Rights-of-Way

Authors: Hopwood, Jennifer; Black, Scott Hoffman; Lee-Mäder, Eric; Charlap, Alexandra; Preston, Robert; Mozumder, Kailash; Fleury, Scott

Abstract. The objective of this literature review is to establish a foundation for the development of best management practices (BMPs) for pollinator habitat protection and enhancement in highway right-of-ways (ROWs) that will be described in two subsequent reports: (1) a high-level technical report for Federal Highway

Administration (FHWA) and State Departments of Transportation (DOTs) program and policy staff; and (2) a detailed BMP guidance document for field applications by State DOT field staff and contractors. This document represents a first step in an effort to provide practicable BMPs that FHWA can offer transportation agencies to develop pollinator programs in their jurisdictions and enhance these programs where they already exist. This document does not include the FHWA BMPs, which are still under development.

URL: https://www.environment.fhwa.dot.gov/ecosystems/documents/pollinators_BMPs_in_highway_ROW.pdf

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Pagination: 68p

Publication Date: 2015-05-00

Title: Pollinators and Roadsides: Best Management Practices for Managers and Decision Makers

Authors: Hopwood, Jennifer; Black, Scott Hoffman; Fleury, Scott

Abstract. Concerns about the declines of managed honey bees and wild native pollinators, such as monarch butterflies, have focused attention on the importance of habitat restoration and management in the conservation of pollinators and the ecosystem services they provide. Roadsides form one of the most extensive networks of linear habitats on earth, and in the United States, roadside rights-of-way managed by State departments of transportation (DOTs) cover an estimated 17 million acres. This document provides best management practices for managing roadside vegetation to reduce impacts to pollinators. This includes implementing roadside plantings that provide functions, including erosion control and motorist safety, while also benefiting pollinators. The authors also outline challenges to implementation identified by State DOTs and roadside restoration experts, and discuss potential opportunities to overcome these challenges. Additionally, case studies are included from across the United States. The Xerces Society for Invertebrate Conservation and ICF International staff performed a thorough literature review of peer-reviewed and technical material and conducted interviews with State DOTs and roadside restoration experts who work with DOTs. The literature review included a comprehensive treatment of the status of pollinators, causes of decline, potential mitigation efforts, habitat restoration and management for pollinators, and applications to highway rights-of-way. The interviews provided documentation of existing roadside vegetation management practices, including information on the current State of the practice in roadside vegetation management as relates to pollinators. The interviews also provided feedback about the feasibility of implementing roadside vegetation management strategies that can benefit pollinators, highlighting both successes and challenges in improving pollinator habitat.

URL:

https://www.environment.fhwa.dot.gov/ecosystems/Pollinators_Roadsides/BMPs_pollinators_roadslides.pdf

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Pagination: 96p

Publication Date: 2016-01-00

Title: Roadside Revegetation: An Integrated Approach to Establishing Native Plants and Pollinator Habitat

Abstract. Native plants are a foundation of ecological function, affecting soil conservation, wildlife habitat, plant communities, invasive species, and water quality. Establishing locally-adapted, self-sustaining plant communities can also support transportation goals for safety and efficiency. Past obstacles to establishing native plant communities on roadsides have been technical, informational, and organizational. Effective strategies and practical techniques for revegetating the disturbed conditions with limited resources must be made available to practitioners. Multiple disciplines including engineering, soil science, ecology, botany, and wildlife science must work cooperatively and not in isolation. Roadsides play an important role in the conservation of declining wild pollinators and in supporting the health of managed pollinators. Throughout the revegetation process, practitioners and designers can enhance roadsides to benefit pollinators. This report offers an integrated approach to facilitate the successful establishment of native plants and pollinator habitats along roadsides and other areas of disturbance associated with road modifications. It guides readers through a comprehensive process of: 1) initiating, 2) planning, 3) implementing, and 4) monitoring a roadside revegetation project with native plants and pollinator habitat.

URL: http://www.nativer revegetation.org/pdf/RoadsideReveg_PollinatorHabitat_DRAFTv1-1_sept2016.pdf

Edition: Draft Version 1.1

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Pagination: 534p

Publication Date: 2016-09-00

Title: Monitoring and Habitat Assessment of Declining Bumble Bees in Twin Cities Metro Roadsides

Abstract. This research has four objectives. First, we will sample bumble bees in roadside areas at 30 survey locations systematically distributed throughout the Twin Cities metro area in an effort to detect the area occupied by *B. affinis* and other declining bumble bees and assess their use of roadside habitat. Sampling will be rapid and broad-scale giving relative abundances of bumble bee species, rather than estimates of absolute population sizes. Recent *B. affinis* sightings will be used to prioritize survey locations. Second, we will estimate population sizes of bumble bee species at eight of the 30 locations using a mark-recapture approach. This technique provides a more robust population size estimate. These sites will be chosen based on proximity to recent records of *B. affinis*. Third, we will compare rapid assessment and mark-recapture methods to develop a long-term monitoring protocol to be incorporated into the Minnesota Bumble Bee Survey and inform national bumble bee survey efforts (managed by Co-PI Evans). Fourth, we will characterize floral communities, land-use type and roadside management practices at survey locations. We will then examine whether these characteristics are related to variation in bumble bee population size and species composition. Results of this study can be used to guide roadside management to promote conservation of declining bumble bee species. As keystone species, bumble bees benefit many other organisms through their role as major pollinators. This includes not only flowering plants but other organisms such as birds that benefit from seed production. Further, bumble bees are among the most effective crop pollinators and are critical to the health of urban agroecosystems.

Project Contract Numbers: 1003325 WO#30

Status: Active

Funding Amount: 111,264.00

Sponsor Organizations:

Minnesota Department of Transportation

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Notice Date: --

Start Date: 2017-06-29

Expected Completion Date: 2019-08-31

Source Agency: Minnesota Department of Transportation
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Least Relevant Results

Title: The effects of mowing on roadside biodiversity (Niiton vaikutus tienpientareiden niittyelioston monimuotoisuuteen (NIINI)).

Author: SAARINEN,K; JANTUNEN,J; VALTONEN,A

Citation: TIEHALLINNON SELVITYKSIA, FINNRA REPORTS. 2006. 3200985(9/2006) pp46p(70 Refs.)

URL: <http://alk.tiehallinto.fi/julkaisut/pdf/3200985-v-niini.pdf>

Title: Effects of a Modified Mowing Regime in NYSDOT ROWs on Pollinators and Vegetation

Abstract. Recently, roadside rights-of-way have been proposed as habitat for pollinating insect conservation, such as in the US federal pollinator plan focused on monarch butterflies. However, whether highway roadsides are an effective site of biological conservation of monarchs or other pollinating insects has yet to be rigorously tested. Moreover, the as of yet limited research of road impacts on invertebrates indicates that roads may be harmful. Some research drawing comparisons to roadside rights-of-way was done in grasslands that simulate the vegetation, but not actually located along roads. Yet other research does not use realistic management scenarios. For example, the federal pollinator plan presumes state departments of transportation will till roadsides and transplant milkweed seedlings – yet an analysis found that this would require an estimated billion milkweed seeds and be very costly. As such, there is a critical need to understand how cost-neutral or other less expensive methods of modifying roadside management practices could potentially serve to promote pollinator habitat and pollinator conservation, and whether these modifications would not also promote the proliferation of invasive and noxious species. The objectives of this research are: Research Objective 1: Determine if and how insect abundance, diversity, and function vary in highway rights-of-way managed under control (current NYSDOT mowing management practices, NYSDOT Vegetation Mowing Policy TMI 14-10) and experimental (modified mowing regime of mowing every two years after a plant-killing frost) conditions. Research Objective 2: Determine if and how noxious and invasive terrestrial plant abundance, regeneration, and rate of spread vary under the control and experimental conditions.

URL: <http://www.utrc2.org/research/projects/effects-modified-mowing-regime>

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