

## How does vegetation management affect roadside plants and invertebrates?

*Many species previously associated with meadows and pastures can now be found on roadsides instead. For traffic-safety reasons, vegetation is regularly managed along most roadsides. In the systematic review that is summarised here, we investigated how such management could be carried out to also benefit biodiversity.*

### Roadsides a potential substitute for declining grasslands

As agriculture has been modernised, the area of meadows and pastures has fallen sharply, in Sweden and elsewhere. Today only fragments of such semi-natural grasslands remain. In contrast, roadside habitats have increased in area.

Roadsides are usually mowed every year for traffic safety reasons, and sometimes plant litter is removed to favour more demanding plant species. In some cases, vegetation along roadsides is controlled by grazing or burning instead. This means that there are similarities between roadside maintenance and management of semi-natural grasslands, and many species that were previously mainly associated with such grasslands can now largely be found along the roads instead.

Recommendations for roadside management to promote conservation values are mainly based on botanical studies in meadows, pastures and similar grasslands. However, key stakeholders have emphasised the need for more targeted management recommendations based on actual roadside



Thanks to regular maintenance, many roadsides can function as refuges for threatened species. Photo: hansslegers via iStockphoto.

studies. Due to the use of road salt for de-icing, ditching and reinforcement activities, and other measures particular to the maintenance of roads and roadsides, plants are not likely to respond to management in the same way there as in other grasslands.

Therefore, we conducted a *systematic review* of how maintenance or restoration of roadsides using various forms of non-chemical vegetation removal affects the diversity of vascular plants and invertebrates. The ultimate aim of the review was to facilitate evidence-based management of roadsides to conserve or restore biodiversity.

### Results from 54 studies synthesised

The review included a total of 54 studies. Nearly all of these were conducted in Europe (29 studies) or North America (24). One study was made in South Africa, but we found no relevant studies from Asia, Australia and South America and none from tropical regions.

The vast majority of included studies (48) examined effects of mowing, whereas effects of burning were reported by seven studies. One study reported on effects of grazing and one on effects of shrub removal.

Most studies in the review were relatively short-term – 36 of them were made over a period of three years or less. The longest-term study had run for 23 years.



The red dots on the map show the locations of studies in the review.

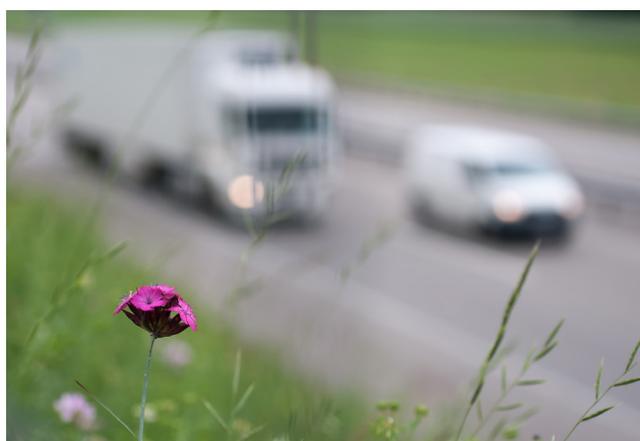
Nearly all of the included studies (51) investigated effects of roadside management on vascular plants, whereas effects on invertebrates were reported in eight studies.

Quantitative analysis of plant species richness and diversity showed that mowing effects were dependent on the interplay between mowing frequency and hay removal. There were no statistically significant overall effects of mowing vs. no mowing, frequency of mowing, timing of mowing or hay removal on plant species richness and diversity (measured as Shannon diversity index).

Nevertheless, species richness of plants was higher in roadsides mowed once or twice per year with hay removal compared to unmowed roadsides, and also higher in roadsides mowed twice compared to once per year (with or without removal of hay), whereas mowing more than twice per year did not increase species richness.

Diversity of plants was also higher in roadsides mowed twice per year, but there were not sufficiently many studies for analysing the effects of hay removal on diversity. The variability was too large to allow conclusions on the effects of early vs. late mowing on plant species richness and diversity.

Similarly, mowing frequency influenced how mowing affected abundances of functional groups of vegetation. Mowing twice instead of once per year had a significantly negative impact on the abundance (cover) of graminoids (grasses, sedges etc.), with a parallel positive trend towards higher abundance of forbs. Woody plant abundance was usually lower in mowed than in unmowed roadsides, although also with the clearest effect in roadsides mowed twice per year.



In both roadsides and semi-natural grasslands, forbs tend to be benefitted by frequent mowing. One likely reason is that such treatment usually reduces the abundance of grasses and other graminoids.

### What is a systematic review?

In this review we used a systematic approach to synthesise available evidence on the biodiversity impacts of vegetation removal along roadsides. A systematic review is characterised by meticulous planning, thorough searches for literature, objective assessments of studies, and a complete documentation of the whole review process. This approach is designed to avoid bias and increase reliability and repeatability.

### How this review was conducted

This review was initiated and financed by the Mistra Council for Evidence-Based Environmental Management (EviEM). It was conducted by a specially appointed team of researchers chaired by Regina Lindborg, professor of physical geography at Stockholm University. The project was managed by Claes Bernes, EviEM.

### EviEM

The Mistra Council for Evidence-Based Environmental Management (EviEM) strives to ensure that environmental management in Sweden is informed by the best possible scientific evidence. Through systematic reviews of relevant research, we aim to improve the basis for decisions in environmental policy. EviEM is funded by the Swedish Foundation for Strategic Environmental Research (Mistra). It is financially and politically independent.

## Implications of the findings

Based on our review we conclude that vascular plant richness is likely to increase (i) if roadsides are mowed each year, (ii) if they are mowed twice rather than once a year (this can be expected to benefit forb diversity specifically), and (iii) if hay is removed after each cutting.

However, the review also shows that there are large knowledge gaps on how management of roadsides affects diversity of vascular plants and invertebrates. First, relevant studies on invertebrates were very few. Secondly, studies on vascular plant diversity are almost exclusively focused on mowing; few studies test effects of other management options such as burning or grazing, or effects of roadside management in combination with influx of chemicals, nutrients or salt. The studies also suffer from short experimental duration, limited geographic distribution, and lack of common research protocols.

## Free access to full report

A more detailed summary of this review is available at the EviEM website ([www.eviem.se/en/](http://www.eviem.se/en/)). The full report on the review can also be downloaded there. The report has been published in the *Environmental Evidence* journal ([www.environmentalevidencejournal.org](http://www.environmentalevidencejournal.org)).