Soil chemistry adjacent to roads treated with dust control products at Squaw Creek National Wildlife Refuge

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Introduction

- The health of roadside soils determines the ecological value of roadsides for plants, invertebrates, and wildlife.
- Roadside soils can support native plant communities, filter road runoff, and provide habitat for pollinators and wildlife (*1*, *2*).
- However, roadside soils may also accumulate salts, heavy metals, and hydrocarbons, and transfer them up the food chain (e.g., *3*). Altered soil chemistry can facilitate invasion by exotic plants (*4*, *5*).
- Widespread application of chemical products for dust control may cause product residues to build up in roadside soils (*6*).
- Very few studies have attempted to track dust control products through the environment after application (*6*, *7*, *8*).

Questions

1) Can dust control products applied to unpaved roads be detected in roadside soils one year after application?
2) Are there other changes in soil chemistry associated with proximity to unpaved roads at this site?

Study site and test layout

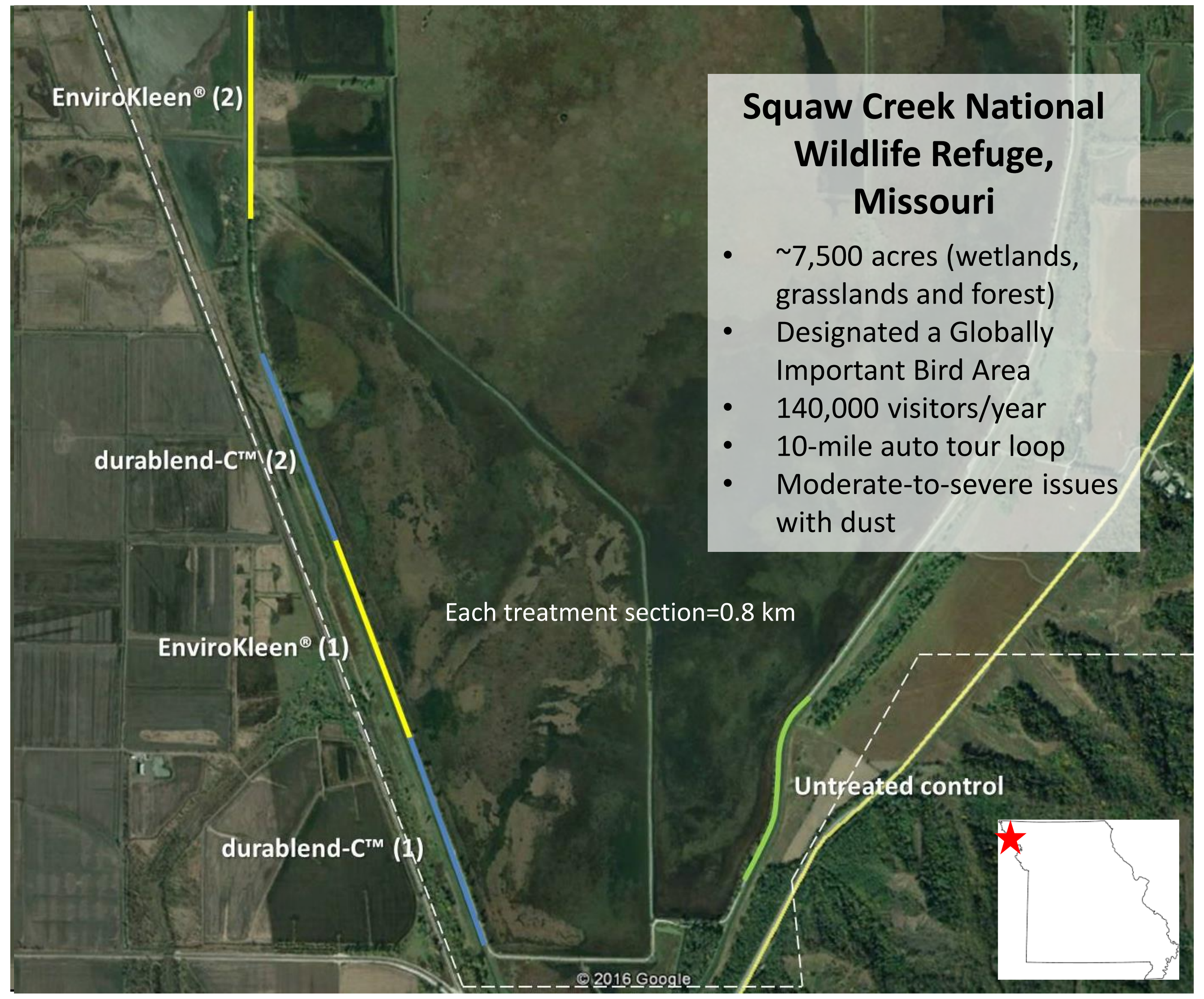
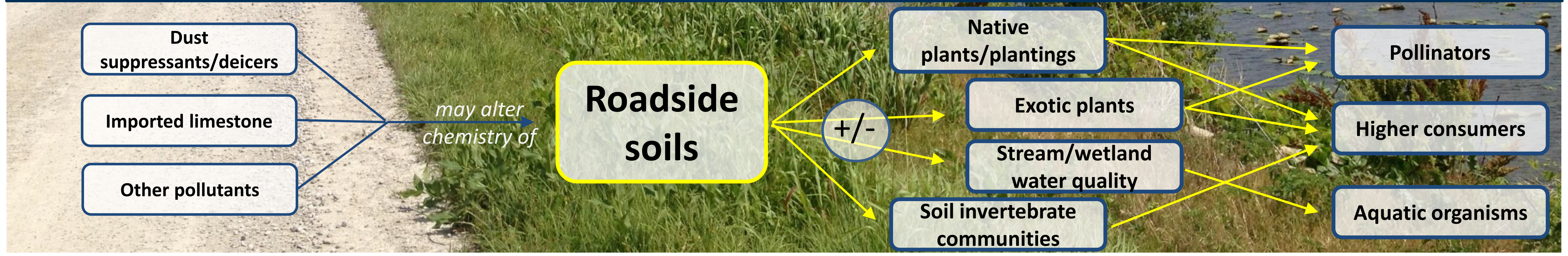


Figure 1. Layout of experimental treatment sections on the southern half of the Squaw Creek auto tour loop. Refuge boundary in white.

Importance of roadside soils



Methods

Initial product applications

Two products applied to replicated sections of the Squaw Creek auto tour loop (**Fig. 1**). All road sections (including untreated control) received new surface aggregate prior to road preparation.

- **durablend-C™**—Polymer-enhanced calcium chloride from EnviroTech Services, CO. Applied as one Compact & Cap™ mixed-in application
- **EnviroKleen®**—Synthetic fluid with binder from Midwest Industrial Supply, OH. Applied as initial topical application and a maintenance dose ~10 months later

Soil sampling

- One year after initial applications
- Composite samples (10 cm depth) were taken at 1 m and 4 m from the road's edge (**Fig. 2)** along four replicated transects perpendicular to each road section
- Transects were placed on the east side of the road and in comparable habitats (vegetation, canopy cover, slope) to the greatest degree possible

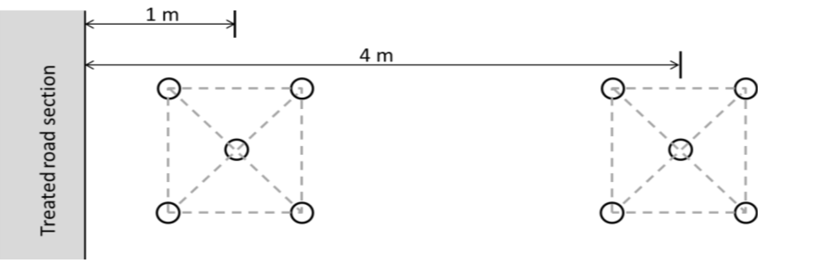


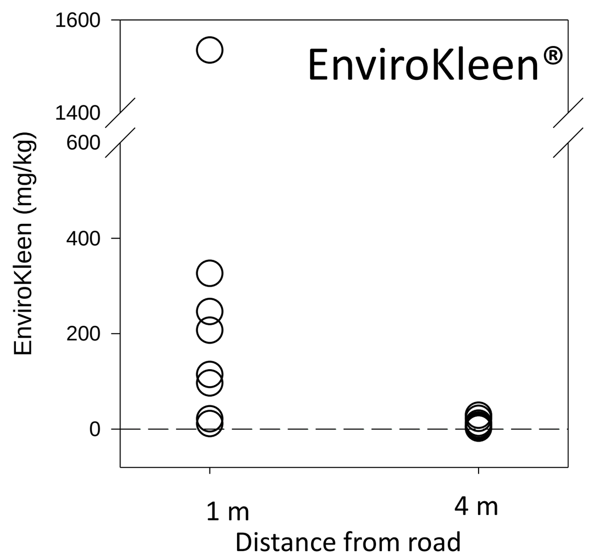
Figure 2. Detail of soil sampling locations at 1m and 4m along one roadside transect. Five subsamples (circles) were taken in a 1-m² area and combined into a composite sample for each location.

Soil analysis

- For the synthetic fluid EnviroKleen®**,** a unique signature was detected by gas chromatography/mass spectrometry (GC/MS)
- Analysis required development of a method for two-phase extraction (hexane/dicholoromethane), followed by GC/MS to look for specific ions characteristic of EnviroKleen®
- Only soils adjacent to EnviroKleen® or untreated sections were analyzed for EnviroKleen®
- For the calcium choride-based durablend-C™, soil conductivity was used as an indicator
- All samples analyzed for pH, conductivity, NO_3-N, P, K, Ca, Mg, Na, and S by Texas A&M Extension AgriLife
- Analysis of variance was used to examine the effect of road treatment and distance from road's edge on soil conductivity and calcium. Bonferroni corrections were applied for multiple comparisons

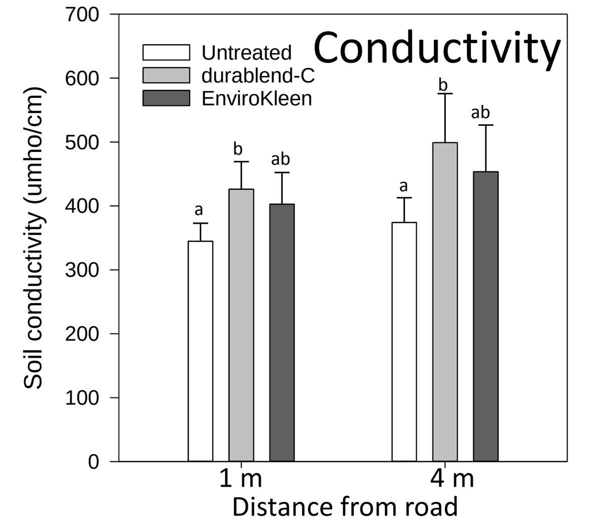
Preliminary results

Figure 3. EnviroKleen® residues detected in individual soil samples adjacent to EnviroKleen®-treated road sections. Note break in y-axis.



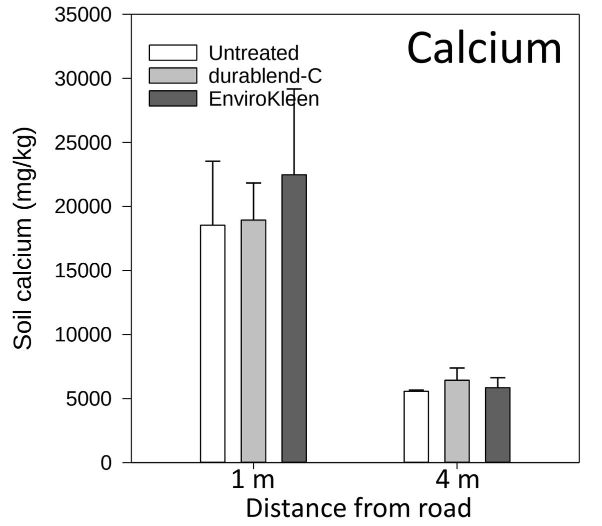
- EnviroKleen® concentrations ranged from 12 to 1535 mg/kg at 1 m from the road's edge, and from 1 to 22 mg/kg at 4 m (**Fig. 3**)
- EnviroKleen® was not detected in soils adjacent to untreated road sections

Figure 4. Conductivity of soils adjacent to untreated and treated road sections. Bars are means (n= 4-8) ± standard deviation. Different letters indicate significant differences (*P<0.05*) among treatments at a given distance.



- Soil conductivity was slightly elevated in soils adjacent to road sections treated with durablend-C™ relative to untreated at both distances (**Fig. 4**)
- Soil conductivity did not differ between 1 m and 4 m samples for a given product

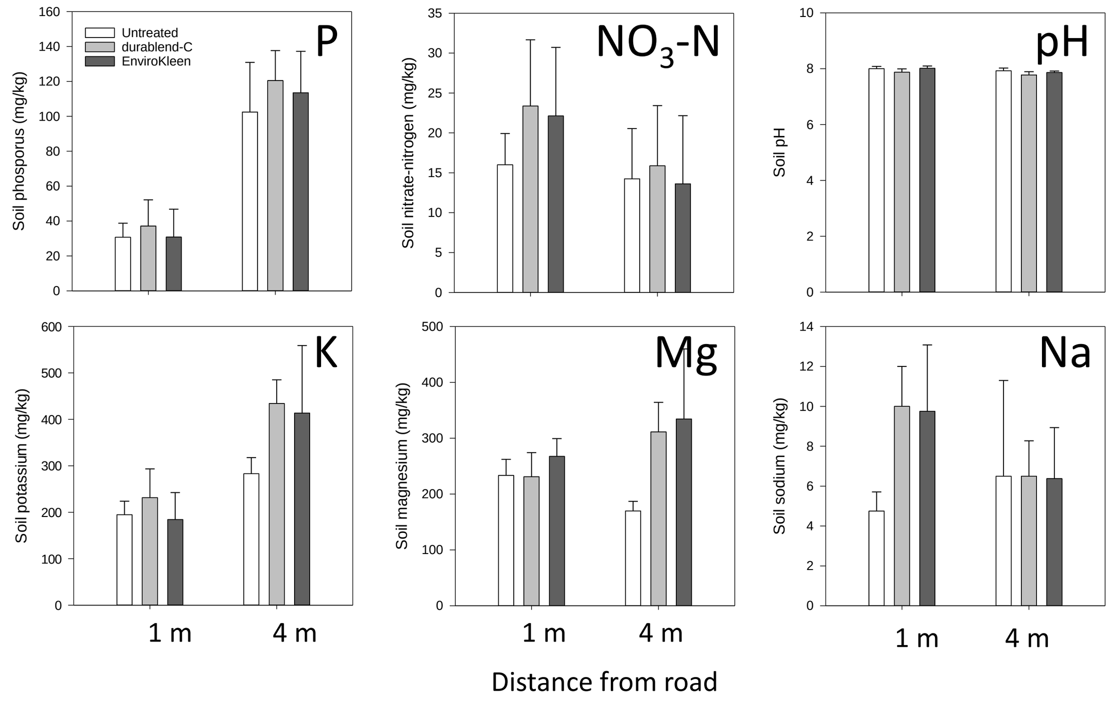
Figure 5. Calcium concentrations in soils adjacent to untreated and treated road sections. Bars are means (n= 4-8) ± standard deviation.



- Calcium concentrations were high (up to 30,000 mg/kg) in soils adjacent to any road section at 1 m (**Fig. 5**)
- Mean calcium was more than three times higher at 1 m than at 4 m from the road's edge (*P<0.01*)

Preliminary results—continued

Figure 6. Additional results from analyses of soils adjacent to untreated and treated road sections. Bars are means (n=4-8) ± standard deviation.



Conclusions

- **This study is the first to detect and quantify EnviroKleen®, a synthetic fluid dust control product, in roadside soils.**
- **Soil conductivity was marginally elevated in soils adjacent to roads treated with durablend-C™, a calcium chloride-based product.**
- **Dramatic changes in soil chemistry (elevated calcium) at 1 m were likely driven by dust deposition from the limestone road surface.**
- **At least in some cases, proximity to the road itself may be a more important influence on roadside soil chemistry than treatment with dust control products (pattern seen for P and K, as well as calcium).**
- **Understanding the environmental transport and fate of products after application is key for predicting the risk of harm to plants, soil invertebrates, or wildlife.**

Literature cited

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