

# Are horses responsible for invasive plants?

Horses have been suggested to be an important source for the introduction of non-native plant species along trails, but the data to date has largely been anecdotal. In a recently completed study—funded by an AERC research grant—horse hay, manure and hoof debris samples were collected and planted in both potting buckets and back along the horse trail to determine if they contained viable seeds from non-native species, and whether non-native seeds would germinate and establish on the trails.

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## Why are weeds a concern?

Non-native plant species pose a serious ecological and economic threat to managed and natural ecosystems. There is a great need to identify major sources for the introduction of non-native species and develop management plans to reduce or eliminate non-native species introduction.

Conservation biologists, natural resource managers, and private land owners are increasingly concerned with the invasion of non-indigenous or non-native species in natural ecosystems. Invasive plants often decrease biodiversity by replacing native plant species and other organisms that may depend on the plants, making the ecosystem “unhealthy” or susceptible to degradation.

Invasive species also have a pronounced economic impact. Weeds cost the U.S. economy \$32 billion a year by decreasing crop production by 12%, and 73% of the weeds are non-indigenous.

Trail horses have been blamed for the spread of non-native plant species. Given that non-indigenous plant species commonly occur in pastures and horses consume pasture grasses and defecate pasture grass waste, it is plausible that horses may be a source for the introduction of non-indigenous species.

## Study objectives

The objectives of the research project were to:

1. assess the importance of different mechanisms by which horses may introduce non-native plant species
2. determine if invasive species introduced by horses germinate and colonize horse trails
3. determine if horse-borne invasive species spread from trail edges into natural ecosystems
4. compare the presence and abundance of invasive plant species along horse trails to other recreation activities that may also be responsible for the spread of non-native species in natural ecosystems.

The study was conducted in five AERC endurance ride locations:

- Biltmore Estates Challenge, Asheville, North Carolina
- LBL Express, Land Between the Lakes National Recreation Area, Kentucky
- AHDRA I, Kickapoo State Park, Illinois
- Glacier Trails, South Kettle Moraine State Park, Wisconsin
- Grand Island, Hiawatha National Forest, Michigan.

Twenty rider /horse teams were selected randomly, except in the case of the Biltmore ride where 24 horses were sampled, and the Glacier Trails ride where 12 horses were sampled.

At each ride, a representative sample of hay or hay substitute was collected from each owner and the sample was sub-sampled and placed in two labeled bags. A manure sample was collected from the horse paddock, divided into two sub-samples and placed into two labeled bags. Hoof scrapings were collected from all four feet of the horse and the debris was thoroughly mixed, then divided into two sub-samples. One sub-sample of each material was transported back to Madison, Wisconsin, to determine if non-native seeds existed in the material and, if so, could they germinate in ideal conditions.

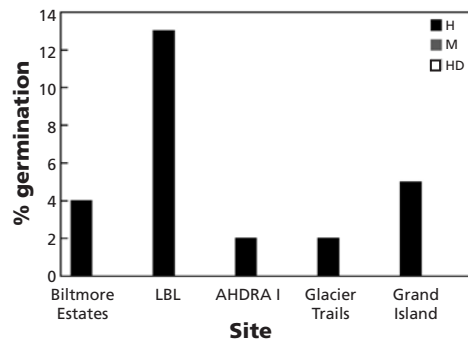
The hay, manure and hoof debris sub-sample for the common garden study was added to commercial potting soil in 15 liter plastic potting buckets at the University of Wisconsin in Madison. The potting buckets were placed outside and the soil was watered twice per week with a complete Hogland’s nutrient solution to ensure the germinating plants had adequate water and nutrients. Plants were grown to the end of August and each germinated plant was identified and classified as native or non-native.

The second sub-sample of each tissue from each horse was mixed thoroughly and placed on the trail within 24 hours of collecting the samples. Each sample was placed in a plot located every one meter along a transect at five random locations along a trail

designated for horses (see photo). At the end of the 2005 and 2006 growing season each plot was inventoried and each germinated plant was identified.

## Results

Non-native plant species only occurred in the potting buckets that contained hay samples. Non-native plants comprised 4%, 13%, 2%, 2%, and 5 % of the total plants in the pots from the Biltmore Estates, Land Between the Lakes, AHDRA I, Glacier Trails and Grand Island rides, respectively (Figure 1).



**Figure 1.** Percent of germinated plants in the pots that were non-native species. Values are based on the 26, 20, 20, 20, and 12 samples of hay, manure, and hoof debris collected at the Biltmore Estates, LBL, AHDRA I, Glacier Trails and Grand Island rides, respectively.

The germination and survivorship of plants on the trail was extremely low (Figure 2). Only one hay plot at Biltmore Estates and two hay plots at Land Between the Lakes sites contained plants, and the plants at both sites were native grasses. No plants grew in the manure and hoof debris plots. A resurvey of transects in 2006 revealed no plants were alive in any plots.

Vegetation composition of transects perpendicular to the trail was dominated by native species both along the horse trails (94%-98%) and hiking trails where horses are prohibited (93%-99%). Non-native species composition did not differ significantly between horse and hiking (non-horse) trails, and ranged from 1%-7% for hiking trails and 2%-6% for horse trails. Non-native plant species were commonly found within two meters of the trail. The results of this study demonstrates that horse hay and manure does contain seeds of non-native plant species, but native and non-native plant species rarely become established on horse trails because of the harsh environmental conditions (see "Barriers to Weed Establishment").

Results from this study may not be representative for other geographic regions in the United States, or for other types of horse activities. Additional research is needed to determine if the results from this study are representative for other regions and equine activities. There is at least one other study underway in California (<http://www.dominican.edu/dominicannews/weeds/index.html>).

## Barriers to weed establishment

It is difficult to determine whether germination or establishment was the bottleneck for plant survival in this study. Several factors may explain the extremely low germination and /or survival rate of the plants on the trail. Unlike agro-ecosystems, horse trails represent a highly disturbed system, which undoubtedly makes it difficult for plants to become established.

Environmental conditions of horse trails—lack of adequate water and light—also adversely affect plant germination and establishment. Many of the non-native weedy plants are extremely shade intolerant, and the percentage of incoming visible light reaching the soil surface averaged less than 10% at four of the five sites.

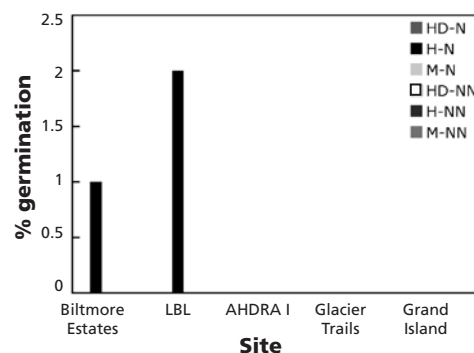
## Reducing the risk

Despite the extremely low germination and establishment rates of plants on the horse trails, the presence of non-native seed in the hay samples suggests horses pose a threat for the introduction of non-native plant species. Proper disposal of unused or spoiled hay would lessen the likelihood that seeds from non-native plants get established. Waste in the compost piles could be incinerated or allowed to decompose in a designated area. ✧

For more information about the study please contact Dr. Stith T. Gower by e-mail at [stgower@wisc.edu](mailto:stgower@wisc.edu).



A transect containing the hay, manure, and hoof debris samples collected from 20 horses participating in the Biltmore Estates Challenge endurance ride in 2005.



**Figure 2.** Percent of all (hay, manure and hoof debris) plots that contained germinated native and non-native plants. Legend is as follows: hay = H, manure = M, hoof debris = HD, native = N and non-native = NN.