Dispersal of Honey Locust (Gleditsia triacanthos) Seeds by White-tailed Deer

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The seminal International Primer for Ecological Restoration lists the integration of a habitat within its larger ecological landscape as a necessary attribute of a restored ecosystem (Society for Ecological Restoration 2004). Most plant species maintain this integration and connectivity through dispersal of seeds. Specifically, long-distance dispersal is a critical explanatory factor of plant metapopulation dynamics, colonization, and invasion (Cain et al. 2000). A plant species' ability to reach favorable habitats often relies on long-distance dispersal events (Clark et al. 1998). Restored habitats are no exception to this generalization. Historically, long-distance dispersal mechanisms have been viewed as difficult or impossible to study. However, recently both genetic approaches, such as parentage analysis (Cain et al. 2000), and field-based approaches, such as sampling deer feces for viable seeds (Myers et al. 2004), have provided an increased understanding for the long-distance dispersal of plant species, and can potentially inform restoration efforts in the attempt to maintain plant habitat connectivity.

Anthropogenic changes at a landscape-wide scale, such as climate change and habitat fragmentation, may significantly shift the potential niche, and correspondingly the distribution, of many plant species. The current increase in global temperatures will make new habitats suitable, while simultaneously making some current habitats unsuitable (Gray and Hamman 2013). These changes will also likely affect animal-mediated dispersal. Landscape-wide changes can alter animal movement patterns, causing a shift (either an increase or decrease) in propagule rain received by sites (Hampe 2011). In light of these changes, a more robust understanding of basic plant dispersal mechanisms must be developed in order to predict how the ability of species to colonize suitable habitat, including target areas for restoration, will change.

A potentially important long-distance dispersal vector for plants in North America is the white-tailed deer (Odocoileus virginianus). As generalist herbivores, deer disperse many vascular species (Eycott et al. 2007), some of which are invasive (Williams 2003, Myers et al. 2004). Changes in climate, deer density, and habitat fragmentation can affect daily movement and migration patterns in deer (Nixon et al. 1991, Brinkman et al. 2005), and could in turn impact the dispersal of many plant species.

One native species that may rely on dispersal by deer is honey locust (Gleditsia triacanthos). Honey locust is a woody species native to the central United States, west of the Appalachian Mountains and east of Texas and South Dakota. It thrives in riparian habitats and is commonly cultivated for use as an ornamental, a windbreak, and a dietary supplement for livestock (Blair 1990, Wilson 1991). Fruits are produced from mid-September to mid-October, but continue to dehisce throughout the winter (Blair 1990). This phenology of honey locust may make it an attractive food for deer. Livestock, specifically cattle and sheep, are known to readily consume these fruits (Wilson 1991), but there is currently no evidence in the literature that supports the assertion that seeds are dispersed by deer (Blair 1990). Here, I provide the first direct evidence that deer disperse honey locust seeds by endozoochory.

This project grew out of a pilot study testing the relative efficacy of two methods for determining seed viability of the invasive shrub, Amur honeysuckle (Lonicera maackii). Deer fecal pellets were collected from December 2012 to January 2013 at the Miami University Ecology Research Center (ERC) in Butler County, Ohio. The ERC is a 69 hectare mosaic of secondary forests, agricultural plots, old fields, and mowed areas. An aerial survey in the vicinity of ERC estimated winter deer density to be 3.9 deer/km².
was conducted outside of the native range of honey locust. A year-group was used in this study.

Over 1 km, and rarely over 3 km. My finding that deer Trillium grandiflorum) seeds can disperse white trillium (Trillium grandiflorum) that deer daily movement patterns and gut retention times) that deer distances, given Vellend et al.'s (2003) projection (using e.g. Vellend et al. 2003). This is not entirely surprising, since this study in which case strategies such as seeding or planting may be preferred. While the impacts of deer ultimately must be reduced in order to achieve some restoration goals, it is becoming apparent that deer remain a necessary biotic component to maintaining landscape connectivity.

I report here only seedlings germinating out of deer pellet groups potted intact, since seeds other than Amur honeysuckle found in the washed pellets were not examined. Pellets collected in December and January were cold stratified at 5°C for five and two weeks, respectively, before being planted on sterile vermiculite, then maintained in a greenhouse at 24°C during the day and 15°C at night for 15 weeks. Seedling emergence was recorded weekly.

A total of seven honey locust seedlings germinated from the 29 pellet groups. These emerged from six of the groups (21%). The number of seedlings germinating is likely a conservative result, since only half of each collected pellet group was used in this study.

This study provides the first known evidence of honey locust dispersal by deer found in the literature. A year-round investigation of deer endozoochory in New York forests did not find viable honey locust seeds in deer pellets, despite finding 15 other species of woody plants (Myers et al. 2004). This is not entirely surprising, since this study was conducted outside of the native range of honey locust.

It is likely that deer disperse honey locust seeds over long distances, given Vellend et al.'s (2003) projection (using daily movement patterns and gut retention times) that deer can disperse white trillium (Trillium grandiflorum) seeds over 1 km, and rarely over 3 km. My finding that deer disperse honey locust, combined with the high abundance of deer in eastern North America, suggests that this tree species is not dispersal-limited. As a result, honey locust should be able to maintain disjunct populations in restored systems through dispersal, while tracking suitable habitat as climate changes, better than species that lack long-distance dispersal mechanisms (Gray and Hamman 2013). These results also inform management in Argentina, where honey locust is invasive (de Viana and Colombo Speroni 2003) and efforts to predict the spread of this invasion should include movement and gut retention times for herbivores (e.g. Vellend et al. 2003).

These findings demonstrate the complex effects deer have on plant communities. Deer are often the dominant herbivore in deciduous forests of the eastern United States, and can severely reduce native plant abundance and diversity through extensive browsing. They can also act as dispersal vectors of invasive plant species (Myers et al. 2004). In aggregate, these effects suggest that in order to sustain forest landscapes, the ecological impacts of deer populations must be mitigated (Abrams and Johnson 2012). Many methods currently used in restoring species composition focus on deer exclosure (Côté et al. 2004). However, this might restrict the ability of deer to act as dispersal vectors for native species facing increasingly fragmented habitat and changing climate. Recent discussions suggest that restoration ecology should place a greater emphasis on habitat connectivity and permeability (Shackleford et al. 2013), in which case strategies such as seeding or planting may be preferred. While the impacts of deer ultimately must be reduced in order to achieve some restoration goals, it is becoming apparent that deer remain a necessary biotic component to maintaining landscape connectivity.

References


