Public Education – Information and Precedents: Effects of Deer Overabundance on Plant Communities

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PLSC 480: Management of Urban Forest Edges
The University of Maryland – College Park
Spring 2016

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Introduction

White-tailed deer (*Odocoileus virginianus*) are present in overwhelming numbers in urban and suburban areas. Forest fragmentation supports populations of the species, which thrives in wooded edges, and those populations drive significant changes to the local plant communities. While researchers and managers know a great deal about these interactions, the general public is not always aware of the nature and severity of the effects of deer on plants. Public desire drives how money for management is applied, so poor communication of research results can reduce the effectiveness of management efforts. Communicating the negative impacts of deer on the environment is necessary to encourage public support for management.

Effects of Deer on Plant Communities

White-tailed deer have both direct and indirect effects on plant communities that influence all layers of the forest—ground layer species, shrubs, and canopy trees. Browsing is the primary means by which deer impact the plant community. They preferentially eat certain herbaceous species, shrubs, and saplings, passing over those that are less palatable (Rooney 2001) (Hatfield and Krafft 2009) (Krafft and Hatfield 2011) (Rossell Patch and Salmons 2007). Many of the species that are negatively affected are desirable native species, such as trillium and hemlock, and the species that are not browsed gain an advantage from reduced competition. Browsing of tree seedlings and saplings causes a time-delayed change in canopy composition, decreasing regeneration of certain species.

Deer also affect plant density. Exclosure studies comparing plots with and without deer find that plant density is higher when deer are excluded from plots (Hatfield and Krafft 2009) (Krafft and Hatfield 2011) (Rossell Patch and Salmons 2007), which influences light availability. These studies also suggest that removing deer from an area will increase the species composition of the forest over time, although if seeds of once-overbrowsed species are not present in the soil and deer are not close enough disperse seeds into the area, those species might not return. Studies also confirm that overbrowsing from deer has negatively affected forest productivity and that deer can spread invasive plant species through their movements (Purcell Weldy and White 2013).

Looking at a single study can helps put these effects into context. In a ten-year study started in 1979, researchers with the U.S. Forest Service examined the relationship between deer density and management practices with the goal of maximizing timber growth (deCalesta 1994). In the eleventh year, due to increasing concerns in the field about general biodiversity, a survey of all woody species, herbaceous species, songbirds, and small mammals under each treatment was also performed.

The study found that increasing deer density had negative impacts on success of species across the board. In addition, the study found that plant species were affected differently, with ferns, grasses, striped maple, and beech—species not preferred by deer—taking over in areas where deer density is high. These effects are magnified when combined with lumber harvests, which decrease competition and allow the undesirable species, in this case the trees that are not being harvested, to flourish. Even when deer density is managed to a recommended level, researchers estimate that it will take up to ten years for woody species diversity to return to previous levels; herbaceous species that do not have adults in the area to release propagules could take several decades to recolonize an area, if they return at all.

Need for Public Education

While the effects of deer on plant communities are well-documented, there is evidence that the results of these studies are not reaching the general public.

In 2012, the Pennsylvania Game Commission commissioned a phone survey asking Pennsylvania residents their opinions on deer management. The survey had 9,212 respondents from urban and rural areas across the state. While respondents overwhelmingly supported deer management for ecological reasons, there were clear differences in opinions about the state of the current deer population. Half of respondents believed that the number of deer in their area was just right, ¼ believed it was too high, and ¼ believed it was too low. When asked about specific concerns, deer impact on habitat and other wildlife ranked low on the list, with only a 3.9 on a 10-point scale (from no concern to highly concerned). 54 percent of respondents reported that they like having deer around while 26 percent agreed, but worry about the problems deer cause. While only 8 percent of respondents were opposed to legal, regulated hunting, 57

percent were opposed to trapping and killing deer, and 40 percent were opposed to professional sharpshooters (Responsive Management 2012). All of this indicates that people are not fully aware of the serious effects of deer on plant communities. They put positive feelings about deer above lethal management practices that could be used to mitigate those effects.

Disseminating Information

Because the public can easily see the detrimental effects of overabundant deer on plant communities (Caring for Deer and Forests 2016), focusing on that damage can be a strategy to raise awareness. Various strategies can be used to disseminate this information, and each has its own strengths and weaknesses depending on communication goals.

In some cases, researchers and managers focus on placing information in the hands of stakeholders rather than the general public. For example, the authors of a U.S. Forest Service study formed a committee of people in positions of power to address management. That committee chose to adopt hunting regulations aimed at significantly reducing deer populations as a result of the study's findings (deCalesta 1994).

In the same way, the Pennsylvania Game Commission, responsible for managing all game species in that state, also formed a committee, open to any interested stakeholders, to advise the Commission on management practices (Pennsylvania Game Commission 2010). Because this committee is open, anyone with substantial connection to deer management concerns can join, disseminating results to potential participants in a way that maximizes the committee's reach and effectiveness.

As part of their communication with stakeholders, the Pennsylvania Game Commission makes scientific studies available on their website so that potential committee members can familiarize themselves with the status of deer and deer impacts in the state. The website information is also available to the general public, but if people are not concerned with the effects of deer, they are unlikely to come across it. The people most likely to access websites like the Pennsylvania Game Commission's are hunters and others with a vested interest in how deer are being managed. In

some cases, those users also have a preexisting bias, favoring practices that maintain population numbers and allow that removal to occur annually (Moyer Shissler and Latham 2016).

Materials released through platforms like The Nature Conservancy's blog are most likely to be accessed by readers who have an interest in the environment, and might already be familiar with the problems caused by deer overpopulation. Most of the reliable information available detailing how deer impact plant communities is published in scientific journals expensive to access and not easily understood by readers without a scientific background.

Placing information in the hands of the general public is a challenge, and it seems as though the easiest method for doing so is through fact sheets. However, researchers at Cornell University advise managers that a personal connection to the issue is necessary for educational materials to be effective (Decker Raik and Siemer 2004); simply providing fact sheets is not enough.

Stakeholders like hunters have a natural interest in the effects of deer on the ecosystem if only because those effects drive management, but as evidenced in the Pennsylvania phone survey, the average community member tends to favor high levels of deer and to be unaware of the problems they cause, particularly if the problems are unrelated to human property (Responsive Management 2012). If the goal is to guide community members to be aware of and concerned about the effects of deer on plant communities, strategies should include a connection to the plant communities around their homes.

Communicating to the General Public

A brochure released by the Pennsylvania Department of Conservation and Natural Resources (Pennsylvania Department of Conservation and Natural Resources 2012) adopts a strategy that makes that local connection. Its pictures illustrate the differences between a healthy forest and a forest affected by deer, which allows casual observers to evaluate the effects of deer in forests near their property. The brochure also includes information about the necessity of lethal management practices to preserve plant communities, encouraging individuals opposed to killing deer to reconsider their views.

A fact sheet released by the New York State Department of Environmental Conservation (Stegemann Gawalt and Herec 2002), focused more on deer biology than their effect on plants, is a gentler option, advising readers to use damage control methods—non-lethal strategies like firecrackers or spray repellents to drive off deer or curb their browsing. Pairing presentation of information about the effects of deer on plant communities with management strategies that individuals can use mitigate damage could be an effective way to encourage engagement with the problem. However, those management strategies should be appropriate for the area. In a suburban residential area, fencing and repellant would often be safer choices than firecrackers.

Dissemination strategies that allow the public to manually explore the effects of deer on the environment could also be a way to personally connect the public to the issues. An online activity developed by researchers at the University of Georgia, Penn State, and the U.S. Forest Service and hosted on their website, Caring for Deer and Forests, allows users to examine the results low, medium, and high levels of deer impact. Manipulation provides different illustrations of the forest, and users can choose layers of the forest to focus on. The module breaks down forest illustrations into understory, forest canopy, browse line definition, stump spouts, and, in the case of low deer impact, saplings. This module includes a great deal of information about the effects of deer on plant communities delivered concisely in a visual, interactive way that allows direct comparison of situations. Active engagement lets people unfamiliar with forests regularly visualize the problem and relate to it. But again, the problem is connecting the public with these resources. The module featured on the Caring for Deer and Forests website is not likely to be found by individuals unless they already have interest in the effects of deer or are doing research.

Involvement with schools and informal education events can also make the public aware of deer effects on plant communities. The Missouri Department of Conservation uses events to connect the public with nature, including a mix of indoor events like lectures and activity tables, and outdoor events like fishing trips with a conservation theme. Both types of events are venues to provide the public with important information, and designing events that get the public into forested areas in their community could help them make personal connections with forest health.

Getting information on the effects of deer on plant communities to the general public and helping them feel personally connected to the issue are both critical steps, but they do not guarantee that individuals will actively help or change their behavior. Providing a list of actions that they can personally take can guide efforts to change behavior.

The New York State Department of Environmental Conservation's fact sheet suggests damage control methods that people can use to manage deer on their property (Stegemann Gawalt and Herec 2002). The Pennsylvania Game Commission asks people to stop feeding deer, an action that attracts the animals to residential areas. A fact sheet from the Ecosystem Management Project (Moyer Shissler and Latham 2016) provides readers with contact information for their local representatives and governor so they can share opinions on how deer have affected their forests and how deer should be managed.

The effects of deer on plant communities are significant, and in some cases, extreme. Mitigation of these effects will only be possible if the general public is educated about the impacts of high deer populations to the point where they support management efforts and will direct funding to restoring the damaged ecosystems.

There are many strategies for education, and each community must decide which is right for them. However, using multiple approaches would cover more bases than choosing just one, so if there are resources available, using a combination of printed resources, community events, school outreach, and electronic activities would provide the greatest opportunity to connect with a large number of residents. Whichever strategy or strategies are used, framing the problem as being connected to individuals, as opposed to some far-off issue in natural spaces, is critical to shifting mindsets and taking the first steps to effecting change.

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Appendix

The two worksheets that follow are examples of educational approaches for elementary and high school students

How Do White-Tailed Deer Change the Woods?

You have probably seen white-tailed deer around where you live—in parks, in your neighborhood, even in your backyard. Deer like to live in forest edges because they can see danger coming and have somewhere safe to hide, so the little patches of woods in the suburbs are perfect for them. Too many deer can cause problems for the forest, though: each deer has to eat a lot of plants to survive, and large numbers of deer can cause major changes to the community of plants in the woods.

Here are some facts about forests and deer to get you started:
- Forests have layers of plants: plants on the ground, shrubs, and trees in the canopy
- Forests change over time—for example, some plants become more common or rare, and small trees grow into big ones
- Some kinds of plants taste better to deer than others
- Deer can only eat as far up as their necks can reach

Using this information, make predictions for the following questions:

How do you think large numbers of deer will affect the plants on the ground?

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The shrubs?

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The trees?

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Now observe the forest in your neighborhood. Use the space below to write down anything you see that

supports your predictions. Is there anything you see that makes you rethink what you wrote above?

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Talk with a partner about the observations both of you made. Working together, draw two pictures in the space below: what you think woods would look like with only a few deer, and what you think woods would look like with a lot of deer.

Imagine you are a scientist studying how deer change plant communities in forests. If you were able to monitor this one patch of woods for a long period of time, what data would you want to collect to answer your question? How could you collect it?

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Effects of White-Tailed Deer on Forest Plant Communities

White-tailed deer are becoming increasingly common in urban and suburban areas. Deer prefer to live in forest edges—they can see predators coming and take cover if need be—so fragmentation of wooded spaces in urban areas has created a wealth of habitat for them. With increasing deer numbers comes increased foraging, and the resultant change in plant communities is significant.

The following activity will have you make predictions about the effects of deer on plant communities based on your current knowledge of forest ecosystems, observe a woodland patch in your own neighborhood to refine your predictions, and design an experiment to test the hypotheses you develop.

Part I: Predictions

1) Predict how you think deer browsing will affect the plants in different layers of the forest—herbaceous ground-layer vegetation, shrubs, and canopy trees. Consider both short-term and long-term effects. What would you expect to physically see in the forest if these predictions are true?

2) Draw a picture in the space below depicting what you predict two different forests, one with few deer and one with an overabundance of deer, would look like.

3) What biotic and abiotic factors do you think would be different on the edge of a forest patch versus in its interior?

Part II: Observations
Observe a forest fragment in your neighborhood and answer the following questions:

1) Describe the fragment. Is it round? Long? Wide? How much of it would you consider forest "edge" versus "interior?" Is there water nearby? What does the area around the fragment look like? How far is the fragment from human structures?

2) What specific observations of the plant community do you make that support or refute your earlier predictions?

3) Does it seem as though certain species of plants are thriving? Suffering? Why do you think that might be? (You do not need to be able to identify the plants to answer.)

Part III: Experimental Design
Imagine you are a scientist studying the effects of deer overabundance on forest plant communities.

1) Given your preliminary observations, develop a hypothesis to test with your experiment.

2) What is/are your independent variable(s)? Your dependent variable(s)?

3) Design an experiment to test your hypothesis. Describe plots or transects you set up, their locations, any structures you create, and how you will collect your data. Sketches are encouraged. Keep in mind:

- Replication – One comparison might not give good results; repeating your experiment increases accuracy.
- Randomization – Placing plots and assigning treatments randomly helps reduce bias.
- Confounding variables – Be aware of any variables other than the ones you are studying that might influence your results. You can control for some of them in your experimental design. Any that you cannot manually control for you can account for later in your statistical analysis.

Part IV: Conclusions

1) What are some methods you can think of to manage deer populations, both in urban and rural areas? How might management techniques be influenced by nearby human land use?

2) Did you realize anything new about deer effects in your neighborhood while completing this activity?