Title: Documenting the Distributions of Native (*Rhododendron* spp., *Kalmia* spp., and *Lindera benzoin*) and Exotic Interfering (*Lonicera* spp., *Rosa multiflora*, and *Berberis thunbergii*) Shrub species in West Virginia, Ohio and Pennsylvania Forests along a Soil Fertility Gradient

Location: Monongahela, Wayne, and Allegheny National Forests of West Virginia, Ohio, and Pennsylvania

Funding Source: Base

Duration: Year 1 of a 2 year project

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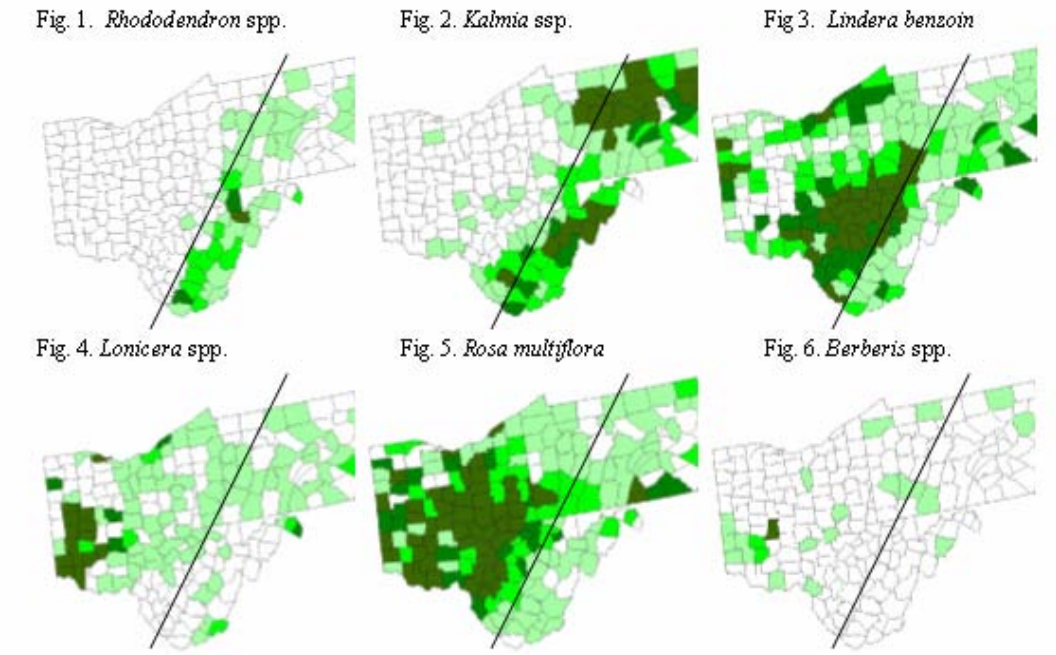
Project Objective: The objective of this project for four research plant ecologists to relate the current distribution of three native and three exotic interfering shrub species with a possible soil pH and fertility gradient. This regional gradient may then help predict local areas most likely to be affected by secondary drivers of invasion of these species, including herbivory, pathogen/insect caused canopy openings, harvesting, and fire. National forests in three States will be used as study sites because of their well-documented disturbance histories of pest outbreaks, tree harvesting and fire. The project will also help establish baseline information on the distribution of *Rhododendron* spp. and *Kalmia* spp. in the possible event of a future reduction in the abundance of these species due to *Phytophthora* spp. or other pathogens.

Justification: Analysis of Forest Inventory and Analysis (FIA**, now a part of FHM**) data reveals a northwest to southeast distribution gradient of *Rhododendron* spp., *Kalmia* spp., *Lindera benzoin*, *Lonicera* spp., *Rosa muliflora*, and *Berberis* spp. with *Rhododendron* and *Kalmia* being most abundant to the southeast and the remaining species being more abundant to the northwest (Figs. 1-6; darker counties have a greater abundance of the species). These maps also show that the exotic species may be less likely to follow an environmental gradient than the native species.



Rhododendron spp. and *Kalmia* spp. are known to prefer more acidic soils (Dirr 1998), but it is not clear if the soils in Ohio are indeed less acidic than the soils in eastern West Virginia or western Pennsylvania. Based on this data *Lindera benzoin* appears to be more similar to the three exotics in terms of a possible soil gradient than to *Rhododendron* ssp. and *Kalmia* spp..

This soil fertility gradient is most evident at the regional scale; defining regional distribution patterns of interfering or invasive shrubs may help predict where these species are most likely to become problem levels in response to more local disturbances and stresses caused by herbivory, fire, harvesting, and canopy-opening insect or pathogen infestations. This study will also differentiate these exotic species as either following a soil fertility gradient or being prevented from expansion by the dominant native shrub species; i.e., the shrub stratum is saturated.

Description:

a. Background: Soil fertility gradients have typically been viewed as unimportant compared to soil moisture gradients, topography, or local disturbances when defining vegetation distribution (Gauch and Stone 1979; Ulrey 2002). *Rhododendron* spp. have been documented as increasing in cover, at least locally (e.g., 15% cover in 1976 and 32% cover in 1995 in the Coweeta Basin; Dobbs 1995). Several exotic shrubs, including *Lonicera maackii*, *L. morrowii*, *Rosa multiflora*, and *Berberis thunbergii* have been increasing in cover in the mid-Atlantic region over the last decade (Huebner 2003). If distribution of these plants along a soil fertility gradient can be documented, our ability to predict spread potential of local populations in response to local disturbances improves. Likewise, our ability to predict regional spread of these species improves as the soil fertility gradient changes in response to global climate change or acid deposition.

b. Methods: Five 1 km transects will be randomly located along an east-west bearing within each of three National Forests. Along each transect, a 100 m^2 plot will be placed every 100 m in forested areas (of which age may vary), totaling ten 100 m^2 plots (each mapped using GPS) per transact or 150 plots for the entire study. The transect will be extended in length such that non-forested (i.e., roads, old fields) along the transect are excluded. Forest stand history will be determined from the National Forests' records. Four 10 m^2 plots will be nested within each of the 100 m^2 plots and cover of all shrub species will be estimated. **Canopy and subcanopy trees**

will be tallied from each plot center using a 10-factor wedge prism. Four soil cores of the upper B horizon will be taken from each of the cardinal directions just outside each of the 10 m^2 plots. Soil samples will be mixed and combined by 100 m^2 plot such that a total of 10 mixed soil samples will be collected per transect or 150 soil samples across all National Forest study sites. Elevation, slope, aspect, relative position from nearest ridge and/or stream valley, and canopy opening (using hemispherical photography) data will be taken at the center of each 100 m^2 plot. Soils will be analyzed by the University of Maine Analytical Lab for pH, acidity, total C/N, NH_4Cl, Ca, K, Mg, P, Na, Fe, Mn and NO_3. Additional samples will be taken from one 100 m^2 plot per transect (selected after a preliminary analysis of the original combined soils data) in which the soils are not combined (16 x 10 total samples), in order to compare variation of soil fertility at the local scale with that at that regional scale. Finally, 10 additional 100 m^2 plots per state will be established in locations of known *Kalmia* spp. and *Rosa multiflora* populations within forested sites from which 16 mixed soil samples will be collected and analyzed. The same light and topography data will also be taken from these 30 plots. **Precipation data (from**

NOAA climatological data; for a moisture gradient comparison) will be evaluated across each transect.

c. Products: At least one peer-reviewed publication will be produced in addition to presentations at the Ecological Society of America Meetings and the FHM Annual Working Group Meeting in 2008. We also hope to present at the MidAtlantic Chapter of the American Rhododendron Society in 2008.

d. Schedule of Activities:

FY 2007 May-Sept. Collect vegetation data and soil samples.
Sept-Nov. Prepare soil samples.
Nov-April. Analyze soil samples and begin analysis of overall data.

FY 2008 May-Sept. Collect more intense soil samples from randomly selected 100 m^2 plots to compare local variation to regional variation; collect vegetation data and soil samples from 30 plots with known populations of *Kalmia* spp. and *Rosa multiflora*.
Sept-Nov. Prepare soil samples.
Nov-April. Analyze soil samples and complete analysis of overall data.

Costs:

	Item	Requested FHM EM Funding	Other-Source Funding	Source
Year 2007				
Administration	Salary (2 GS 4/5 Technicians for 4 months)	$4000	$8000 (technician) $26,000 (10% of 4 scientists' time)	NRS budget
	Overhead	0	0	
	Travel	$4200	0	
Procurements	Soil Analysis Contract	$4500	0	
	Equipment (2 additional soil cores; collection bags)	$550	$700 (existing soil core, tapes, compasses etc.)	NRS budget
Total for 2007		$13,250	$34,700	
Year 2008	Salary (2 GS 4/5 Technicians for 4 months)	$4000	$8000 $26,000	NRS budget
	Overhead	0	0	
	Travel	$6000	0	
Procurements	Soil Analysis Contract	$5400	0	
	Equipment	0	0	
Total for 2008		$15,400	$34,000	
Total Requested		**$28,650**	$68,700	

Literature Cited:

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Dobbs, M.M. 1995. Spatial and temporal distribution of the evergreen understory in the southern Appalachians, Master Thesis, University of Georgia, Athens, GA.

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