TITLE: Evaluating Environmental and Disturbance Conditions Associated with Invasive Plants Using the Allegheny National Forest FHM Intensive Plot Data

LOCATION: Morgantown, WV
DURATION: Year 1 of 2-year project
FUNDING SOURCE: Base
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PROJECT OBJECTIVES:

1. Compare species abundances and distribution of native tree, sapling, seedling, shrub, vine, and herbaceous species to the abundances and distribution of invasive exotic and native species (e.g., ferns).
2. Evaluate the abundance and distribution of exotic and native invasive plant species by forest type and age.
3. Evaluate the distribution of invasive plant species using physiographic data.
4. Evaluate the distribution of invasive plant species using defoliation events and indicators of disturbance.
5. Evaluate the abundance and distribution of invasive plant species using landscape features.
6. Determine change over time of the presence or absence (and, where possible, abundance) of invasive plant species and if an increase or decrease can be attributed to a disturbance or environmental event or forest type stability.
7. Develop a forest health indicator of potential invasion using the results of 1-6 and test this indicator using other FHM plot data from the state.

JUSTIFICATION: The Allegheny National Forest (ANF) FHM detection monitoring data have not been evaluated in terms of plant species abundance and distribution patterns or the relationship of these species patterns to environmental and disturbance conditions. These analyses will enable us to propose a forest health indicator of potential invasion by exotic and native invasive or interfering plant species from which predictions about forest health and invasion can be made for less intensively measured sites.

DESCRIPTION:

a. Background: The ANF, established in 1923, is located on the unglaciated portion of the Allegheny Plateau in northwestern Pennsylvania. The ANF area is approximately 740,500 acres, with about 227,500 acres of this in private land inholdings. While the original forest was composed primarily of eastern hemlock and American beech, the current forest is dominated by hardwoods, including black cherry and red maple. The early 19th century even-aged timber harvests, increases in white-tailed deer population, and insect defoliations events may explain the change in forest composition. There is a documented lack of tree regeneration, which has been attributed to a fern-dominated understory. Exotic invasive species are present in several of the FHM plots and may exacerbate this current regeneration problem (Morin et al., 2004, draft report).

The intensified network of FHM plots consists of 173 plots, with one plot about every 3,000 acres. These were established in 1998 and have been surveyed at least once annually through 2004, with re-measurements of 60% of the plots in 2003 and 2004 (Moore, pers. com.). Data are available for further analysis through 2003 (and possibly 2004). Available biological data include tree, sapling, seedling, shrub, vine and herbaceous species information. Environmental data collected include soil moisture content, soil texture, soil nutrient composition, soil pH, litter cover and depth, slope aspect, slope inclination, slope position, and elevation. Potential disturbance indicators include plot age, crown dieback, crown density, crown ratio, foliage transparency, standing dead trees, down woody materials, and lichen abundance by species (Morin et al., 2004, draft report).

The FHM plots have been categorized into forest types by using the percent of live basal area of each species, with 25% and 24% in the mixed upland hardwood and Allegheny hardwood types, respectively (Morin et al., 2004, draft report). The plots have also been categorized into Land Type Associations and Ecological Land Types, a classification system based on physiographic and plant species data and this information is available (Moore, pers. com.).

Approximately 86% of the ANF has been defoliated at least once since 1985. Gypsy moth defoliation occurred primarily in the mid-1980s while other defoliations, such as that caused by the cherry scallopshell moth and elm spanworm, occurred more recently. Data on timing and extent of defoliation events and associated severe droughts are available for use. These data also include information on the killing front and extent of beech bark disease in the ANF (Morin, pers. com.).

Landscape features of interest include distance to road (or percent road coverage), distance to stream (or percent stream coverage), and distance to open land (private and/or publicly owned). These data are available from digital topographic maps (Morin and Moore, pers. com.).

b. Methods: Methods are described by objective (numbered 1-7).

1. Further species identifications and verifications will be conducted and relative importance values for each species will be calculated using all available vegetation parameters (cover, density, and/or frequency) for each given year. Species patterns of associations will first be analyzed within forest stratum type (tree, sapling, seedling, shrubs and vines, and herbs) and then among strata. Species will also be grouped into mutually exclusive categories, including exotic, invasive exotic, native, and invasive native. A separate set of mutually exclusive categories will be composed of shade-tolerant, shade-intolerant, and intermediate species. A final grouping will look at particular species of interest, including *Berberis thunbergii* (Japanese barberry), *Rosa multiflora* (multiflora rose), *Dennstaedtia punctilobula* (hayscented fern), *Thelypteris noveboracensis* (New York fern), *Quercus* sp. (oaks), and *Viburnum alnifolium* (hobble bush). Analyses will be conducted using detrended correspondence analysis (PCORD v. 4) and correspondence analysis (PCORD v. 4 and SAS v. 8). Year to year differences will require use of repeated measures mixed model or multivariate procedures (SAS v. 8).

2. Plots will be categorized by forest type and age (both within each forest type and as a sole variable) and analyzed using exotic and native invasive species as separate dependent variables in a multi-response permutation procedure (PCORD v. 4) and/or in a mixed model procedure (SAS v. 8). This analysis will also be conducted for other species of interest and categories (listed in objective 1).

3. Presence/absence data of the exotic and native invasive species will be compared with environmental variables using logistic regression (SAS v. 8). Abundance measures will be analyzed using canonical correspondence analysis (PCORD v. 4 and SAS v. 8).

4. Similar analyses will be conducted as in objective 3 except using disturbance variables and indicators. Once the most important environmental and disturbance variables are defined separately, these will be combined so that degree of importance of environmental to disturbance factors can be determined.

5. Similar analyses will be conducted as in objective 3 except using landscape variables. These will also be combined with the most important environmental and disturbance variables to determine degree of importance.

6. Stability of forest types and strata within forest types will be determined using similarity indices (Sorensen for presence/absence data and Squared Euclidean Distance for abundance data), comparing year to year change in species composition (for re-measured plots). One-way ANOVAs will be conducted to determine significant differences in stability among forest types and among strata within forest types. A rating of stability will then be determined and compared with presence/absence and abundance data of exotic and native species by forest type and strata. This analysis will also be conducted for other species of interest and categories (listed in objective 1).

7. The most important variables determined by objectives 1-6 will then be used to formulate an index of invasion. This index will be tested using data from FHM plots located within Pennsylvania. These data are available for use (Twardus and Morin, pers. com.).

c. Products: We plan to present the results at the National Forest Health and Monitoring meeting in 2006. We also hope to present some of the results at the International Vegetation Science symposium and the Ecological Society of America meetings (both in 2006). We envision publishing the findings in at least 2 peer-reviewed papers.

d. Schedule of Activities: Each objective should take approximately 3 months to complete using 10% of the principal investigator's time each year. This allows 3 months for paper and presentation preparation.

e. Progress/Accomplishments: Not relevant.

Budget Justification: The intern will help with further species identifications and verifications. She/he will also help summarize importance values for each species and organize data for other analyses. Travel funds are needed for travel to the National FHM meeting (second year only) and for approximately three cooperator meetings each year. Total requested amount is $19,200.

Costs:

	Item	**Requested FHM EM Funding**	**Other Source Funding**	**Source**
Year 1				
Administration	Salary (1 intern for 3 months)	7,200	6,100	NE Research Station, RWU 4557
	Overhead	None	None	
	Travel	1,800	None	
Procurements	Contracting	None		
	Equipment	None	None	
	Supplies	None	None	
Year 1 Total		**9,000**	**6,100**	
Year 2				
Administration	Salary (1 intern for 3 months)	7,200	6,100	NE Research Station, RWU 4557
	Overhead	None	None	
	Travel	3,000	None	
Procurements	Contracting	None	None	
	Equipment	None	None	
	Travel	None	None	
Year 2 Total		**10,200**	**6,100**	
Total Requested		**19,200**	**12,200**	