

Collaboration in conservation: A method for volunteer-scientist teams to monitor plant community composition long term in a private old-growth forest

Erin J. Fleming^{1,2,*}, Nelson F. Galvis^{1,2}, Bette A. Loiselle³, Julia F. Nerbonne^{2,4}

¹Whitney R. Harris World Ecology Center, University of Missouri – St. Louis
²Congregational Summer Assembly, Frankfort Michigan
³Department of Biology, University of Missouri – St. Louis
⁴Department of Fisheries Wildlife and Conservation Biology, University of Minnesota
* Corresponding Author: esida.fleming@gmail.com

Introduction

To date, most studies on the management of invasive species have been done in nature reserves or national parks. We present an example of how scientists and local communities might collaborate to develop science based management programs in private forests.

The Congregational Summer Assembly (CSA) is a mixture of common and privately owned lots within old-growth forest in Lower Michigan. The community is interested in ecological variables that should be considered when designing a long-term, ecosystem based management plan. In this base-line study we developed methods for volunteer-scientist teams to monitor:

- 1) The abundance of established invasive species
- 2) Native species abundance
- 3) Local environmental conditions
- 4) Impacts of anthropogenic disturbances on the forest community composition

Methods

In July 2009 we constructed 30 permanent plots (20 m x 20 m), within which we counted and identified to species adult and juvenile trees. We counted and identified to species herbaceous plants and tree seedlings in five 2 m x 2 m quadrats nested within each plot (Fig. 1). We measured environmental variables (% canopy, % bare soil, % woody debris and distance from road or building) in each quadrat. Quality of community composition was quantitatively measured using the floristic quality index (FQI). $FQI = (\text{mean } C) \cdot (\text{square root of } N)$. C : conservation coefficient value pre-assigned according to region (1). N: number of species per plot.



Results

Of 69 species found in plots, 9 were non-native, 3 of which were invasive. Invasive garlic mustard (*Alliaria petiolata*) and myrtle (*Vincetoxicum*) were the dominant understory species.

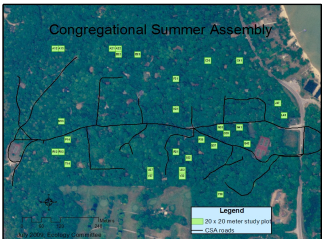


Figure 2. Map of the Congregational Summer Assembly property.

The floristic quality index value (FQI) calculated for the CSA is 30 (Table 1). FQI is unitless and is calculated using the number of species per study area; therefore, it is sensitive to the size of the sample area, as species richness (N) is influenced by area.

Table 1. Floristic Quality Index (FQI) value for the CSA and, as a general frame of reference, FQI values calculated by the Grand Traverse Regional Land Conservancy (GTRLC) at study sights surrounding the CSA.

Survey Location	Sample Area	FQI
CSA	1.2-ha	30
Parr Preserve	1.5-ha	47
Betsie Dunes	24-ha	44
Arcadia Dunes	1214-ha	59

Quality of plant community composition is lowest at the CSA study site

In study plots, we identified nine non-native or invasive plant species (Fig. 3). At least one of these was present in 59% of the quadrats (Fig. 3). Of the invasive species, only garlic mustard and myrtle were found in quadrats further than 20 m from roads and buildings (Fig. 3).

Distribution of invasive & non-native plants within quadrats relative to distance from buildings or roads

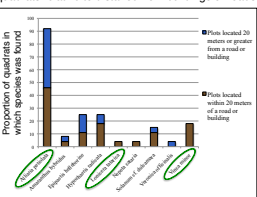


Figure 3. The occurrence of non-native plant species in quadrats (within a plot) for quadrats within 20 meters or greater than 20 meters from a road or building is shown.

Plots were ordered largely as a function of similarities in the relative abundance of red raspberry, jewel weed, ironwood, white avens and spotted touch-me-not on axis 2 (greater relative abundance of these species, note that these species were in plots with greater abundance of garlic mustard (Fig. 4).

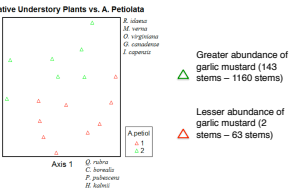


Figure 4. Results of the MDS ordination for native herbaceous species. The correlation of the axes with certain plant species are shown; the correlation reflects either axis 1 or 2 as indicated by placement of the species name on the figure.

Conclusions

The CSA forest appears to be under stress from anthropogenic disturbance and encroaching invasive species. It is thought that plant communities in the 1800s, before human-caused environmental degradation, would have been similar to habitats today that have FQI values greater than 45 (3). FQI values calculated for the CSA in 2009 can be compared with those measured in later years to track qualitative changes, and evaluate whether the plant community composition in the CSA forest improves over time with management.

Garlic mustard is the most widespread and aggressive invasive species established at the CSA. Where myrtle is well established it comprises up to 87% of the species community in one quadrat. Results indicate that red raspberry, spring forget-me-not, ironwood, white avens and jewel weed are more commonly found in areas with high abundance of garlic mustard. These native species may be facilitated by garlic mustard and / or may have similar environmental preferences.

Allelopathic inhibition from garlic mustard may affect root growth in tree seedlings and shading of tree seedlings by myrtle cover can suppress seedling recruitment (4). The invasion of myrtle could eventually prevent the growth of seedlings to the extent that there are no replacements of canopy trees (4).

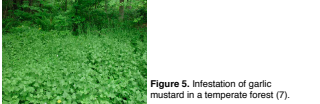


Figure 5. Infection of garlic mustard in a temperate forest (7).

A volunteer-based monitoring program for early detection of "founder" populations of invasive species could be an effective way to control harmful species (5, 6). In 2010 the CSA is conducting a rapid assessment survey to identify and eradicate early invaders. In addition to honeysuckle, they have identified 3 other key invasive species.

Many of the non-native species at the CSA are used as ornamental plants for landscaping. In particular, myrtle (*V. minor*) is used as ground cover around buildings. Education is needed to increase awareness of the impact of invasive species and decrease the spread of invasive species by people living in the area.

Long-term monitoring is ongoing at the CSA to identify invasive species. Restoration of areas that have been disrupted by established invasive species has begun. This study provides a template for collaboration between scientists and communities interested in developing science-based management programs that promote the conservation of native biodiversity.

Literature cited

(1) Herman, K. D., L. A. Masters, A. A. Reznicek, G. S. Wilhelm, W. Brodovich, K. P. Gardiner. 2001. Floristic Quality Assessment with wetland categories and examples of computer applications for the state of Michigan. Michigan Department of Natural Resources, Wildlife Division.
(2) Gartland, A. pers. comm. Grand Traverse Regional Land Conservancy, Preserve Program Manager. Contact: gartland@GTRLC.org.
(3) Swink, F. and Wilhelm, G. 1994. "Plants of the Chicago Region." IAS, Chicago.
(4) Dancy, A. J. and Burkart, M. C. 2002. Allelopathic potential of Vincetoxicum minor, and invasive exotic plant in west Michigan forest. Beta Biological Society 73: 127-132.

(5) Lodge, D. M., S. Williams, H. J. MacIsaac, K. R. Hayes, B. Leung, S. Richardson, R. N. Mack, P.B. Moyle, M. Smith and D. A. Andow. 2006. Biological invasions: recommendations for its policy and management. Ecological Applications 16:2035-2054.
(6) Maxwell, B. D., E. Lehnhoff, L. J. Rew. 2009. The rationale for monitoring invasive plant populations as a crucial step for management. Invasive Plant Science and Management 2:1-9.
(7) Mehnhoff, L. J., J. A. Silander, Jr., S. A. Leicht, E. S. Mosher and N. M. Tabak. 2003. INANE: Invasive Plant Atlas of New England. Department of Ecology & Evolutionary Biology, University of Connecticut, Storrs, CT, USA. URL: <http://www.inane.org>.

Acknowledgments

This research was supported by a grant from the Benzie Audubon Club. Funds and logistical support were provided from the Congregational Summer Assembly and the CSA Ecology Committee, Linda Fried, the University of Missouri and the Whitney R. Harris World Ecology Center to J. Nerbonne, E. Fleming, and N. Galvis. We thank the peer discussion group at the University of Missouri-St. Louis and especially J. Blake, E. Miller, J. Gonzalo, K. Bauman, M. Villegas and F. Blendinger.

For further information

Please contact: erin.fleming@gmail.com, or nerbonne@umn.edu.
More information on this and related projects can be obtained at: <http://summersassembly.org/csa/csaorg/csaorg/>.