

Rapid Ecological Assessment of Forests and Associated Exotic Earthworms in the Laurentian Mixed Forest-Great Lakes Coastal Biological Network, Midwest Region, National Wildlife Refuge System, US Fish & Wildlife Service¹

FOREST COMMUNITY ANALYSIS: Rice Lake NWR

Differences in Overstory Composition Among Stands. Using relative basal area (%) by species of the 65 (66 in summary) plots sampled across 12 stands at Rice Lake NWR as part of the Rapid Ecological Assessment (Corace et al. 2011), we used a Multi-Response Permutation Procedure (MRPP) to examine if there are differences in the *overall overstory composition* among the 12 stands. MRPP is a non-parametric technique that tests the hypothesis that there is no difference between groups of entities, in this case the overstory composition of stands at Rice Lake NWR.

We conducted a MRPP using Sorenson's distance and PC-ORD (ver. 5.0) software. Prior to analysis, we transformed the data using an square root arc sin transformation as is appropriate with percentage data. Overall, there is a statistically significant difference in the overstory composition among the stands ($T = -11.997$; $A = 0.241$; $P < 0.001$). The results of the MRPP support the data as described in the SUMMARY TABLES & FIGURES document for the Rice Lake NWR that suggest differences in the overstory composition (Corace et al 2011).

Indicator Analyses. In order to predict if there are significant overstory indicator species for each stand at Rice Lake NWR, we used Indicator Species Analysis following the procedure outlined in Dufrene and Legendre (1997). We used PC-ORD (ver. 5.0) to conduct the Indicator Species Analysis using the transformed relative basal area of all species as with the MRPP analysis.

Based upon the Indicator Species Analysis, we found the following species were significant indicators ($P < 0.05$) of the following stands:

Stand	Species	Stand	Species	Stand	Species
EIG	none	NIN	none	THR	bur oak
FIVE	none	PINK	balsam fir	TWOA	red maple
FOUR	trembling aspen	RNA	tamarack; walnut	TWOB	none
H65	none	SSR	sugar maple	WD	none

Gradient Analysis. Using relative basal area by species (%) of the 65 plots sampled across the 12 different stands at Rice Lake NWR as part of the Rapid Ecological Assessment (Corace et al. 2011), we examined the distribution of overstory species across sampled stands using Non-Metric Dimensional Scaling (NMDS). NMDS is a non-parametric ordination analysis that maximizes the rank-order correlation between distances. Unlike other indirect (e.g., principal components analysis) or direct (e.g.,

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canonical correspondence analysis) ordination techniques, NMDS does not make any assumptions about the nature of the data, including assumptions about the linear relationship among variables. As a result, it is often viewed as an appropriate multivariate analysis for ecological data (McCune and Grace 2002).

Prior to the analysis, the relative basal area data by species were again transformed using an arcsin squareroot transformation. NMDS was then run using PC-ORD (ver. 5.0) software using a Sorenson distance measure. A three-dimensional solution was determined to be the most appropriate (Monte Carlo test, $n = 200$ runs).

The results of the NMDS ordination support the results outlined in the previous sections that there are distinct forest communities at Rice Lake NWR. However, the NMDS also suggests that there is high within-stand heterogeneity in overstory relative basal area as indicated by the overlap of plots representing the different stands in the NMDS ordination (Figure 1). For example, while the plots of the TWOB stand are grouped closely together and the overstory composition is characterized by balsam fir (AbBa), the other sampled plots for other stands are much more widely spaced, suggesting more variable overstory composition. Without more information it is difficult to surmise whether these differences are being driven by the environment or past land use history, or a combination of both.

Analysis Implications. These basic results confirm the summary information developed by Corace et al. (2011). Specifically, there are some unique forest communities at Rice Lake NWR, however, there is also considerable within-stand variability associated with overstory composition. These results suggest that individual stands may include different overstory communities in response to varying environmental or disturbance related factors within each stand, and as a result may need to be considered separate stands for management purposes (in forest management we typically define a stand as an area that is relatively uniform in terms of species composition and age). While overall it may appear that an effective management strategy may be to treat individual stands as separate management units, the within-stand variability may require different management recommendations and guidelines depending on management objectives. Management activities, including forest ecosystem restoration practices, would need to be tailored for each specific condition.

References:

- Corace, R.G., III, H. A. Petrillo, and L.M. Shartell. 2011. Rapid ecological assessment of forests and associated exotic earthworms in the Laurentian Mixed Forest-Great Lakes Coastal Biological Network, Midwest Region, National Wildlife Refuge System, US Fish and Wildlife Service: Summary tables and figures, Shiawassee NWR. Seney National Wildlife Refuge, Seney, MI. 16pp.
- Dufrene, M., and P. Legendre. 1997. Species assemblages and indicator species: the need for a flexible asymmetrical approach. *Ecological Monographs* 67:345-366.
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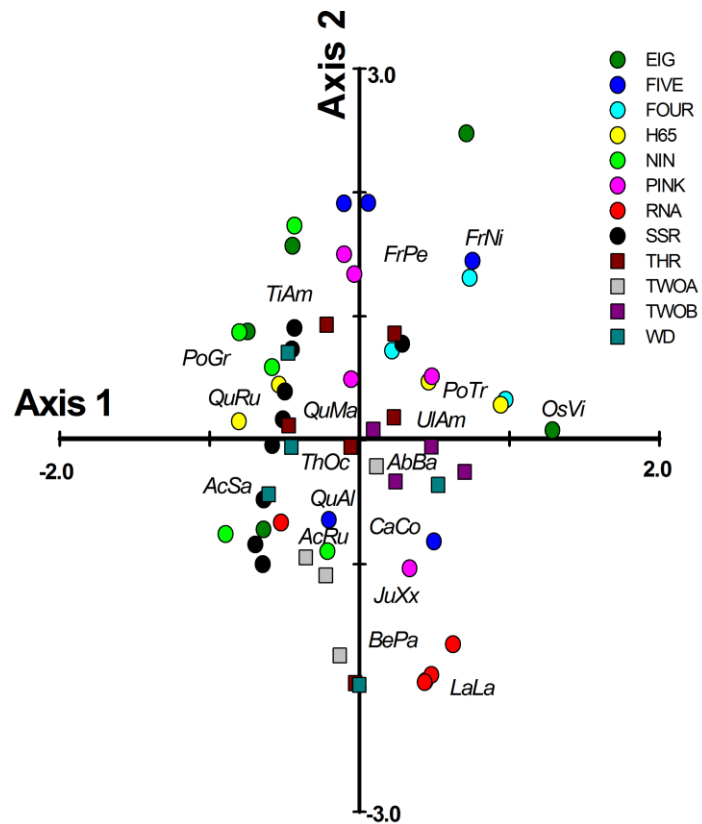


Fig. 1. NMDS ordination of overstory species based upon relative basal area for 12 stands at Rice Lake National Wildlife Refuge. Species acronyms correspond to first two letter of genus and species (e.g., QuRu = *Quercus rubra*).