ABSTRACT OF THE THESIS

Structural dynamics of early old-field succession

on the New Jersey Piedmont:

a comparative approach.

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Major objectives were to describe the structural dynamics of early old-field succession on the New Jersey Piedmont and to test the ability of spatial sequence data to represent temporal changes.

Ten agricultural fields at the William L. Hutcheson Memorial Forest, East Millstone, New Jersey, were abandoned in pairs at two-year intervals beginning in 1957. Fields were abandoned following the harvest of annual crops, the harvest of perennial crops, and autumn or spring cultivation. Species cover data were recorded each summer from 48 permanent one-m^2 quadrats in each field through 1976. In 1976, five additional fields, ranging from 2 to 16 years in age, were examined as a spatial sequence study of succession.

In the spatial sequence study, total vegetation cover increased through year 10 and then decreased slightly. Among the temporal sequence fields, cover varied widely year to year. Multiple regression, using age of field and seasonal rainfall, accounted for more than 50% of the cover variation in only three fields.

Diversity (H'), in the spatial sequence study, increased rapidly at first, then slowly. Among the temporal sequence fields, H' fluctuated widely during the first decade; however, it appeared to become

more stable in later years. Regression analysis of H' as a quadratic function of age was effective in describing the trends in only four fields.

In the temporal sequence fields, the initial ratios of the four life form categories (annual, biennial, perennial herb, and woody), both in species numbers and cover, were strongly influenced by the final crop type and the mode of abandonment. Short-term trends during later years were influenced by the particular species compositions of each field. However, by the tenth year, ratios were nearly the same in all the fields.

The relative roles of native and introduced species varied widely among the temporal sequence fields. During the early years, the relative roles as determined from species cover were often the reverse of those determined from species numbers.

In the spatial sequence study, the rate of turnover decreased rapidly and then stabilized. While a number of the temporal sequence fields also displayed quadratic components in their turnover responses, the resultant equations were different.

Members of field pairs receiving similar treatment, and/or in close proximity, displayed greater similarity of species composition initially and/or a greater increase in similarity with time. One pair, separated by a stream, achieved only 40% similarity by the seventeenth year, while another pair, with its members adjacent, achieved 82% similarity by the eleventh year. When non-paired fields were compared at the same age, it was found that none achieved more than 55% similarity, regardless of physical proximity.

The lack of similarity in species composition provided an explanation for the differences in those community parameters discussed. Of the more than 275 species recorded, only 41 achieved dominance (≥10% cover) at least once, and only 8 achieved dominance in at least five fields. Well-dispersed species established large populations earlier in fields abandoned later in the study. The final crop, weather, previous land-use history, buried seed population, interspecific competition (including allelopathy), intraspecific competition (including autotoxicity), the proximity of seed sources, seed dispersal mechanisms, and chance were cited as some of the putative factors influencing the distribution and development of individual species-populations.

It was demonstrated that, through the influence of individual species-populations upon community parameters, successions in individual fields on the New Jersey Piedmont are sufficiently distinctive that spatial sequence data provide inadequate representations of temporal events. It is suggested that subsequent research in early old-field succession be concentrated at the individual species-population level rather than on parameters at the community level.