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# Landscape patterns and forest island interactions

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## LANDSCAPE PATTERNS AND FOREST ISLAND INTERACTIONS

On March 18, the Field Station welcomed faculty and graduate students involved in the Landscape Pattern Analysis project. This study has both theoretical and practical objectives. The theoretical problems are concerned with island biogeography as outlined by Robert MacArthur and E. O. Wilson were discussed in the Spring 1975 Field Station Bulletin. These questions relate principally to how island size and distance from neighboring islands affect species composition and extinction, i.e., affect the diversity of island communities. These theoretical questions are being approached in a series of studies undertaken jointly by scientists at the Oak Ridge National Laboratory, Rutgers University, The University of Wisconsin—Milwaukee and the University of Wisconsin—Madison.

Practical applications of the project concern the preservation of landscape diversity. How large a park do we need to retain the original forest composition? What are the effects of island size on bird diversity? Do seeds move from forest island to forest island in an agricultural or urban matrix? Are they carried by birds, by animals, by wind? Does the diversity of the landscape influence its ability to regenerate itself, for example, if forest islands are eliminated or reduced drastically in number or size and are separated by large distances, will seed be available to begin the successional process in an abandoned field? What is the function of the hedgerow forest and the interstitial forests of the urban complex?

En route to the Field Station brief visits were made to two sites studied by the UWM group. Meekwon Park represents a vigorous and relatively young stand which suffered from past grazing but with little effect upon the composition of the tree and shrub populations. A nearby island, Coleway Woods, another relatively young stand, also shows evidence of earlier disturbance. However, the most striking change is the rapid and drastic alteration of species composition as a result of ground water pumped from the neighboring gravel pit. Water flows through the eastern portion of the woods and accumulates in a pond at the south edge. This new and artificial stream superimposed on the upland forest appears to be causing a change to a lowland community.

The group also visited the Field Station beech-maple forest to observe firsthand the heavy damage and drastic disturbance caused by the severe ice storm of March 1-5, 1976.

Each of the four working groups reported their progress of the past year. This review served as background for the April program review and outlined the areas in which future effort would be concentrated.

Work in and around Milwaukee was described by James Levenson and Paul Matthiae. They outlined the methods and basic findings of the study of 45 southern-mesic forest stands in the metropolitan Milwaukee area.

Richard Forman, Rutgers University, discussed his study of the relationship of island size and shape to plant and bird diversity. He indicated that in stands of approximately 2 hectares (about 5 acres) species diversity began to decline with a 4:1 ratio in length to width. In contrast, in several 7.5 hectare stands (about 19 acres), diversity was not effected until the stand reached a length to width ratio of about 8:1.

David Sharpe, Southern Illinois University, discussed the use of the wind-rose model to examine seed dispersal. Windrose data are readily available and only seed fall velocities were needed. The critical parameters of seed dispersal by wind include wind direction, wind speed, height of seed source and seed fall velocity. These factors must be related to seasonality of wind and phenology of seed shed. Carter Johnson, Oak Ridge National Laboratory, noted that the distance between islands was a critical factor. He expressed interest in animal movement of seed and in the receptivity of the site to seed.

Ted Stiles, Rutgers, noted the importance of matrix quality in seed transfer. For example, the rate at which seed would move across a sidewalk versus the rate across grass may differ greatly. The probability of establishment and the probability of transfer, need to be examined. He suggested calculating backwards from the stand model to the seed rain required for establishment. Instead of emphasizing elimination of species one could instead examine stand development. Robert Burgess, Oak Ridge National Laboratory, noted that there was considerable published information on seed production and distribution and that an intensive search would be justified.

Jack Ranney, University of Tennessee, worked with artificial patterns. He stated that if over 10 or 20% of the landscape was covered by forest the pattern was difficult to quantify. Patterns within patterns emerged depending upon scale.

Alan Ek, UW-Madison, reported on the forest growth models. The model, FOREST, has been modified and expanded so that a plot of trees can be "grown" through time in even or uneven aged stands, with single or mixed species. Data are now available for 11 species giving height, diameter relationships, and other

growth factors. The model can be used to project island forests forward in time to see what might happen to species, whether they increase or decrease and to determine the effects of management techniques.

John Tyburski, UW—Madison, reported on his analysis of the Wisconsin test site, an area of some 200 wooded stands including 17 studied by UWM. These stands have been grouped into 6 species categories, 5 density classes, and 3 height classes. Each stand has been categorized and its size determined from color infrared aerial photographs taken at 6000 feet. Field checks on the ground indicate an error in classification of only 16 percent. Tyburski also noted that the length (area) of fence rows per unit area may serve as an index of matrix quality.

Joe Chang, UW—Madison, reported on his progress with the spatial autocorrelation technique for landscape analysis in two townships north of Milwaukee.

The meeting continued Friday morning, March 19 at the Kenwood Conference Center during which time 1976-77 plans for the project were discussed. Burgess suggested that it was essential to document landscape turnover time. For example, in 1920 Foreman's area in New Jersey was 66% agricultural land. Now it is only 33% farm land with 33% in woods and another 33% in urban development. Burgess also suggested that in examining the landscape, other forest types as well as non-forest components deserve consideration.

Stiles recommended that the islands be considered as resource patches and that the theoretical bases of transfer rate, receptivity and matrix quality should receive further work. As Stiles noted, when modeling, one may look at the general picture, or be precise about the measurements or examine the reality of the situation. However, one cannot get a model which will optimize all three items.

The meeting concluded with a discussion of possible seed movement by animals and birds and how best to determine rates of movement if indeed it occurs.

Free sharing of information and the discussion of mutual problems made the meeting particularly valuable. Similar results in New Jersey and Wisconsin are most encouraging indicating that the same general principles apply in different parts of the eastern deciduous forest. Interaction between plant and animal ecologists, modelers, and others with diverse training produced many useful ideas. A selection of those ideas will be tested during the following season. The basic question in reference to pattern concerns the survival of these biotic islands and their effect on the surrounding matrix. The findings should have wide application.

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Participants in the Landscape Pattern conference included:

Martyn Dibben	Milwaukee Public Museum
David Dralle	
Robert Burgess	Oak Ridge National Laboratory
Carter Johnson	
Kent Schrieber	
Jack Ranney	ORNL and University Tenn.
Richard Forman	Rutgers University
Theodore Stiles	
Alan Ek	UW–Madison
Joseph Chang	
Ronald Oliveira	
John Tyburski	
Linda Hoehne	UW–Milwaukee
Dennis Gustafson	
James Levenson	
Paul Matthiae	
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