ANYTHING BUT BARREN: THE SEARCH FOR PATTERNS IN THE BREEDING BIRD COMMUNITY OF THE MASSACHUSETTS PINE BARRENS

by David C. Morimoto

Several thoughts bombarded me that early morning in late May 1985, while I was standing amid a tangled sea of waist-high scrub oak, the sunlight just beginning to penetrate the patchy fog and set the pitch pines aglow. I was in Myles Standish State Forest (MSSF) in Plymouth, Massachusetts, but I felt as though I was in the middle of nowhere, lost in a wilderness. As I experienced the beauty of the coastal plain pitch pine-scrub oak forest at dawn, I was haunted by the words of Walt Whitman: "You must not be too precise or scientific about birds and trees and flowers," and I remembered Lewis Thomas' elation as he watched animals playing at the Tucson Zoo: "I wanted no part of the science of beavers and otters . . . All I asked for was their full hairy complexity." I was tempted to just stand there and wax poetic, but I realized I had work to do.

Somewhat reluctantly, I relegated those thoughts to the recesses of my mind and began to address the primary reason for my visit. I was beginning a three-year study of the breeding birds of the southeastern Massachusetts pine barrens. From the very start it was abundantly clear that the descriptive, "barrens," was inappropriate: the vegetation was alive with bird activity, and the air was full of song (see Massachusetts Audubon Society 1983, for more reasons why the adjective, barrens, is misleading).

I began this study because of my interest in the conservation of the unique pine barrens ecosystem, a love of birds, and an interest in addressing an important problem being explored by community ecologists.

The prevailing view among ornithologists of previous decades had been that competition between individuals of different species, or interspecific competition, was of primary importance in influencing the distribution and abundance of individuals. Among the strongest challenges to this view were the results of detailed studies by John Wiens and John Rotenberry conducted on the breeding birds of the sagebrush-dominated shrubsteppe of the northwestern United States (see Wiens 1984 for a review). Their research indicated that interspecific competition was probably not important. Indeed, the major assumptions of competition theory, namely that resources are limited (e.g., food, territories) and the community has as many species as it can possibly hold (referred to as "equilibrium" in ecological jargon), did not hold for the shrubsteppe bird community.

Wiens (1984) proposed that bird communities vary dramatically in the degree to which they are influenced by competition among species. Some are stable, resource-limited communities in which processes such as competition are

important. These bird communities are characterized by "tight structure." When one species changes in abundance, other species also change in a predictable way. In other words, if one species becomes scarce, its competitor species would become more abundant. Ecologists would say that these species covary in distribution and abundance.

At the other end of the spectrum are communities that inhabit unpredictable environments. These bird communities are characterized by "loose structure," with random factors (often related to severity of climate) being more important and species being distributed independently of one another in space and time. The result is that few patterns are evident in these loosely structured (nonequilibrial) communities.

The results of many other studies, such as the long-term study of the breeding birds of the northern hardwood forests by Richard Holmes and colleagues (Holmes et al. 1986), added to this changing view of biological communities. A new picture was emerging in which many factors, including not only competition, but also predation, spatial and temporal variation in food supply and quality, climatic conditions, the structure and dynamics of the surrounding landscape, events on the wintering grounds and during migration, and even evolutionary history and biogeography, were seen as relevant in determining just why certain species of birds occur in certain habitats. What is most important is that the relative influence of these many interacting factors seemed to vary from community to community.

Although the picture of bird community structure seemed to be getting more, not less complicated, some researchers soon learned that it was helpful to recognize what they called "scale" (Allen and Starr 1982; O'Neill et al. 1986). For instance, in a given year (a time scale of one season), food may be abnormally scarce and competition thus abnormally severe. However, if viewed over a hundred years (a time scale of many bird generations), competition may be far less important than, say, periodic unpredictable cold snaps that can quickly kill large numbers of birds. Scale can also apply to such things as habitat size. A small habitat may be more subject to certain events (such as cowbird parasitism) than a large habitat (small-scale area versus large-scale area). The recognition that the many factors important to birds operated at different spatial and temporal scales was important, because it meant that in order to determine the factors responsible for the complex patterns in a particular system, one must study that system at many scales (Maurer 1985; Wiens et al. 1986; Urban and Smith 1989). A given community may appear to be limited by interspecific competition at one scale but not at another.

It was in this unfolding climate of ecological inquiry that I began my study of the pine barrens bird community. I sought to relate patterns of bird occurrence to patterns of habitat variation. I hoped to learn whether the bird community is more or less tightly structured, and whether the birds seem to be

responding more or less independently of one another and to factors such as habitat variation.

I established eight plots, each ranging in area from seven to nine hectares, in the southeastern Massachusetts pine barrens (five in Plymouth: three in MSSF, one in Plymouth County Wildlands Trust's West Shore Preserve, and one on nearby private land; and three on Cape Cod: one in Bourne near Otis Air Force Base and two on municipal land in Mashpee). These sites represented an array of post-fire successional stages, having been burned from fewer than five to more than thirty years previous to the onset of my study (see also Kerlinger 1984). I mapped territories of breeding birds and surveyed vegetation on each plot for three years. I then performed several complex statistical analyses on the large volume of data collected. My statistical tests facilitated the detection and interpretation of the major patterns in the bird communities.

Bird Patterns. Rufous-sided Towhees, Common Yellowthroats, and Prairie Warblers were the three most numerous and widespread of the thirty-one breeding bird species detected (Table 1). When I searched statistically for patterns, I did find some relatively well-defined ones, most of which were consistent with what was known of the birds' habitat affinities. For instance, Prairie Warblers, Field Sparrows, Gray Catbirds, and House Wrens, all birds of shrubby habitats, were strongly correlated with each other across the eight study sites. If I knew the abundance of catbirds, I could pretty well predict the abundance of Field Sparrows. In contrast, many other species, including towhees and yellowthroats, were only weakly associated with other species. So, while some small groups of species did seem related in their abundance patterns, there were also many species that were distributed independently of one another. In no case did I need to invoke interspecific competition as an explanation for any of the patterns I detected. In fact, very few negative associations (six of forty-two significant correlations) were evident, and each of these could be explained by habitat preferences alone (see also Finch 1991).

Vegetation Patterns. My analyses of vegetation uncovered strong patterns of variation in both structure and composition across study sites. Large changes occurred from open habitats with few trees to those with numerous tall pitch pines, from habitats with few oak trees to those with relatively high coverage of black oak and white oak (particularly on one Mashpee site), and from those with low coverage of shrubs (scrub oak, sheep laurel, blueberry, black huckleberry) and herbs to those with relatively high shrub and herb coverage. The eight study sites exhibited considerable variation in vegetation, and this variation largely reflected the gradient in post-fire successional stages. Were the birds responding to this variation, and if so, were they responding independently of one another, with no apparent influence by other species?

Bird-Vegetation Patterns. When I statistically compared bird abundances with the major patterns in vegetation, I found a mixed bag. Roughly two-thirds

Table 1

Breeding Birds Recorded in the Southeastern Massachusetts Pine Barrens 1985-1987

Species	% Surveys (N=24) Occurring On	Density Range Where Occurring (territories/ha)
Rufous-sided Towhee	100	1.19-3.13
Common Yellowthroat	100	1.20-2.64
Prairie Warbler	100	0.29-2.46
Brown-headed Cowbird	100	0.26-1.02
Black-capped Chickadee	100	0.07-0.83
Pine Warbler	96	0.12-0.70
American Goldfinch	92	0.04-1.15
Black-and-white Warbler	83	0.07-0.91
Gray Catbird	75	0.05-0.53
House Wren	71	0.04-0.58
Field Sparrow	67	0.14-0.43
Hermit Thrush	67	0.07-0.35
Northern Flicker	58	0.06-0.20
Blue Jay	54	0.07-0.14
Tree Swallow	46	0.05-0.43
Nashville Warbler	46	0.04-0.40
Cedar Waxwing	46	0.03-0.14
American Robin	33	0.03-0.14
Black-billed Cuckoo	25	0.07-0.14
Northern Bobwhite	25	0.04-0.07
Ruffed Grouse	21	0.05-0.14
Eastern Wood-Pewee	21	0.04-0.24
Chestnut-sided Warbler	17	0.11-0.29
Eastern Kingbird	17	0.14
Mourning Dove	17	0.05-0.14
Eastern Bluebird	12	0.14
Brown Thrasher	12	0.07-0.14
Hairy Woodpecker	12	0.07
Northern Mockingbird	8	0.04-0.05
Downy Woodpecker	8	0.14
House Finch	8	0.04-0.14

of the species exhibited statistically significant habitat associations, although some were difficult to interpret, probably due to small population sizes of certain species. These results began to give me the sense that the pine barrens bird community did, indeed, exhibit some patterns, but nonetheless, the two most widespread and abundant species (towhees and yellowthroats), among others, exhibited no or just a few weak associations.

I concluded that the bird community was not as "loosely structured" as that of the shrubsteppe (which was marked by an extreme lack of pattern), a

conclusion supported by the results of my analyses of temporal variation. Bird densities and species composition on study plots were unchanged from one year to the next, despite significant annual differences in vegetation caused by a late frost and gypsy moth outbreak in 1985. Birds stayed on their territories despite these disturbances, so that although habitat associations were different between 1985 and the next two years, all birds exhibited similar shifts between years, giving rise to the appearance of stability over the three years of the study.

The patterns detected in these initial analyses suggested that while some species seemed to be responding similarly to habitat variation, many other species were distributed independently of one another and had only weak habitat associations. That this system exhibited stronger patterns than the shrubsteppe system can be explained in part by the fact that there was more marked habitat variation (caused by the different fire histories of the eight sites) encompassed in my study than in the shrubsteppe study (shrubsteppe habitat was relatively homogeneous among study plots), and at least some of the birds were responding to this variation. In addition, it seems likely that this system is less physically harsh and experiences fewer unpredictable environmental perturbations than the shrubsteppe system. In the shrubsteppe, severe climatic events tend to keep population numbers low, so the habitat is never really saturated with birds, and habitat associations and distributional patterns among bird species of the shrubsteppe are therefore weak at best and quite inconsistent from year to year.

That interspecific competition was not needed to explain any of the patterns uncovered does not suggest that it is absent in the pine barrens. It may simply occur at smaller or larger scales and not be evident at the among-plot scale investigated here. One might have to look very carefully at habitat associations within plots, or at patterns of reproductive success or foraging behavior in sites varying in species composition and abundance.

The analyses related here were only preliminary, and many questions remained, particularly with respect to the species for which few relationships were detected. Were these species responding in ways such that patterns were not evident at the scale used in my study? Would the effects of interspecific competition become evident in an analysis of the foraging behavior of individuals? In a future article I will relate the results of more refined analyses of the three most abundant species in an attempt to address these questions. I will also look at community-wide patterns and discuss the implications of the results of this study for conservation and management.

I often think back to the first day of my study, and the same thoughts I had that morning furtively creep back into my mind, tempting me to give up my scientific pursuit in favor of a more wholly Zen-oriented existence. But too many questions need to be explored, and too many secrets remain to be told about the world in which we live. It is our nature to care and dare to be "too

precise or scientific about birds and trees and flowers." Indeed, our knowledge of them is necessary for our own survival. And although we are met with dazzling complexity and uncertainty, we must strive, as Melvin Konner says, "with all our stumbling, and in the midst of our dreadful confusion," to seek the answers if we are to survive to experience fully the wonders of nature.

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