

Co-occurring Groups of Wintering Birds in the Lowlands of Southern California

RICHARD A. BRADLEY¹ AND DAVID W. BRADLEY²

¹Department of Biology, University of New Mexico, Albuquerque, New Mexico 87131 USA, and

²Data Processing and Information Systems, California State University,
Long Beach, Long Beach, California 90848 USA

It is a commonly observed phenomenon in the Los Angeles basin of southern California that certain winters are characterized by the occurrence of relatively large numbers of boreal and montane birds. Some species that winter regularly in the basin occur in abnormally high numbers. Other species are found in this area only in exceptional winters.

To test for groupings among wintering bird populations in southern California, we analyzed patterns of correlation between species across 20 yr (1960–1979), using data from the National Audubon Society's annual Christmas Bird Count. Our purpose was to determine whether or not birds defined as belonging to a group fluctuate in abundance in concordance with other members of the same group.

We assumed that the Christmas Bird Count is a realistic index of relative abundance but perhaps not an accurate measure of population density. All census values were converted to birds per 10 party-hours. Five Los Angeles basin counts were chosen for consistency of data collection over the 20 yr analyzed: Los Angeles, Pasadena, San Bernardino Valley, Orange County coastal, and Orange County northeastern. A second assumption of our analysis was that fluctuations in abundance are similar enough throughout the region that we were justified in lumping data from the five different counts. To test for such consistency, we applied Kendall's coefficient

of concordance to the 13 most common species across all counts. Of the 13 species tested, nine showed statistically significant concordance; hence, we believe that we are justified in lumping the data from the five counts in all subsequent analyses.

The structure of the co-occurrence patterns was assessed by partitioning species into groups according to four different criteria: (1) ecological information about foraging method, foraging site, and food preference; (2) a subset of the ecological criteria based only on foraging site; (3) migratory habits and winter status in southern California; and (4) taxonomic allocation by family (Table 1).

Before estimating the degree of co-occurrence between species, skewness in the distributions was reduced by applying a logarithmic transformation: $\ln(1 + b)$ where b = birds per 10 party-hours. Pearson correlations of abundance patterns across the 20-yr time span were then calculated for each pair of species.

We used a randomization test (Sokal and Rohlf 1969) to estimate the probability that the observed within-group correlations could have arisen by chance. For each criterion structure, species were randomly assigned to groups under the restriction that the number and size of groups should exactly match the pattern for the criterion being tested. Thus, for the migratory habits criterion, there were four groups

TABLE 1. Group assignments by species. Each species was evaluated with respect to the four criteria. Species with the same number were placed in the same group for that criterion.

Species	Ecological	Foraging	Migratory	Taxonomic
Northern Flicker (<i>Colaptes auratus</i>)	1	3	1	1
Mountain Chickadee (<i>Parus gambeli</i>)	2	1	4	2
White-breasted Nuthatch (<i>Sitta carolinensis</i>)	5	1	4	3
Red-breasted Nuthatch (<i>Sitta canadensis</i>)	5	1	4	3
Pygmy Nuthatch (<i>Sitta pygmaea</i>)	5	1	4	3
Brown Creeper (<i>Certhia americana</i>)	2	1	4	4
American Robin (<i>Turdus migratorius</i>)	3	3	2	5
Varied Thrush (<i>Ixoreus naevius</i>)	4	2	4	5
Hermit Thrush (<i>Catharus guttatus</i>)	4	2	2	5
Golden-crowned Kinglet (<i>Regulus satrapa</i>)	2	1	3	6
Ruby-crowned Kinglet (<i>Regulus calendula</i>)	2	1	2	6
Cedar Waxwing (<i>Bombycilla cedrorum</i>)	3	1	2	7
Purple Finch (<i>Carpodacus purpureus</i>)	6	3	3	8
Cassin's Finch (<i>Carpodacus cassinii</i>)	6	3	4	8
House Finch (<i>Carpodacus mexicanus</i>)	6	3	1	8
Pine Siskin (<i>Carduelis pinus</i>)	6	1	4	8
Red Crossbill (<i>Loxia curvirostra</i>)	5	1	4	8
Dark-eyed Junco (<i>Junco hyemalis</i>)	6	3	2	8
Fox Sparrow (<i>Passerella iliaca</i>)	4	2	3	8

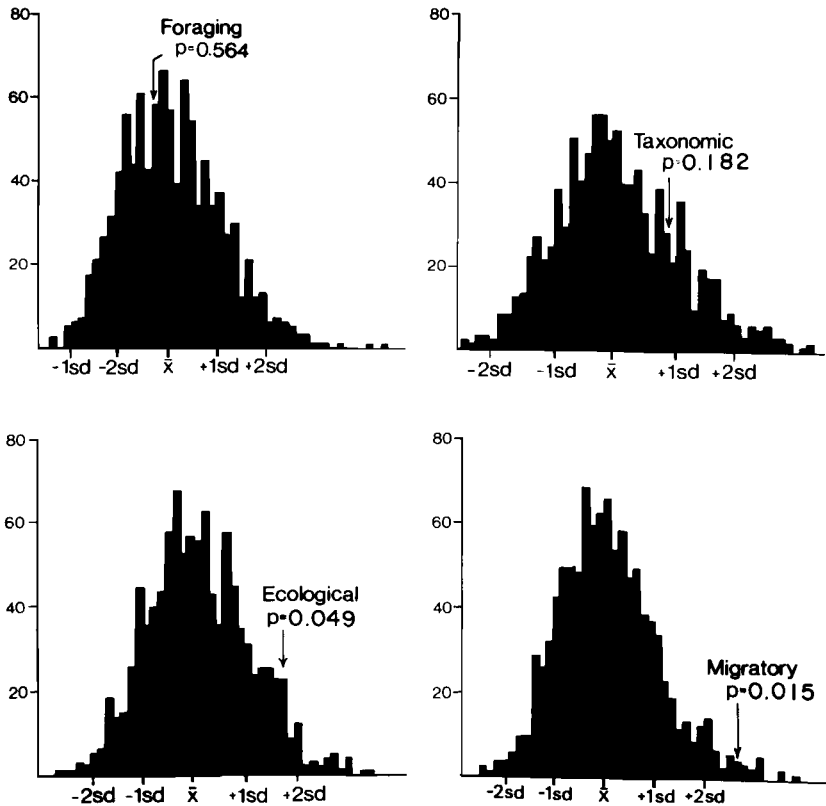


Fig. 1. The results of the randomization test for significance of the group structures. The arrow is positioned at the point in the distribution of random trials where the real mean within-group association score would fit. The area under the tail outside of this point corresponds to the exact probability value for this position.

with 2, 5, 3, and 9 species. For the migratory habits test, 1,000 mean within-group similarities (all with four groups of 2, 5, 3, and 9 species) were calculated, and they form the null distribution against which we tested the real within-group score. The statistic used to test co-occurrence within groups was the mean within-group association score. The association scores were obtained from the correlations between species by applying Fisher's inverse hyperbolic tangent transformation (Sokal and Rohlf 1969). The position of the observed within-group mean along the randomization distribution yields the estimated significance level. We employed 1,000 trials to generate each randomization distribution.

Two of the 19 species included in the analysis are consistent winter residents, and their inclusion tests for the reality of the boreal/montane bird invasion phenomenon. As expected, these two species (Northern Flicker¹ and House Finch) showed no gen-

eral pattern of correlation with the invasive species. The House Finch showed a significant negative correlation with the Ruby-crowned Kinglet ($r = -0.49$, $P < 0.05$). This was the only statistically significant negative relationship detected in our analyses and might well be (considering the number of correlations tested) a chance result. The median of the 136 correlations among the 17 migratory species was +0.22 (80% of the correlations were positive). If there were many spurious correlations (sampling artifacts), several should have been negative. The prevalence of strong positive correlations reinforces our confidence in the reality of the "boreal/montane year" phenomenon.

Inspection of the correlation data yields a number of interesting results. There are a few strong correlations that make good intuitive ecological sense. One example is the high correlation between Golden-crowned Kinglet and Ruby-crowned Kinglet ($r = 0.61$, $P < 0.01$). Another example that seems logical is the correlation between American Robin and Cedar Waxwing ($r = 0.50$, $P < 0.05$). These two species

¹ Scientific names of bird species are given in Table 1.

commonly occur in winter in large flocks that exploit similar patchy resources, for example locally abundant Toyon berry (*Heteromeles arbutifolia*) crops. Unlike the above pairs, some other pairs of significantly covarying species show no obvious ecological relationships. Examples of such pairs are the Cedar Waxwing with Dark-eyed Junco or the Hermit Thrush with Purple Finch. In fact, close study of the correlation matrix shows that about half of the significant relationships are between ecologically rather dissimilar species pairs.

The results of the randomization procedure for testing the "significance" of the various group structures are presented in Fig. 1. The most "realistic" ecological group structure, which incorporated information about diet and microhabitat association, was significant ($P = 0.049$). The simple foraging-site grouping and the rather arbitrary taxonomic structure did a poor job of combining concordant species. The simple migratory-habit group structure was highly significant ($P = 0.015$). This latter result probably reflects the overall "boreal/montane bird year" phenomenon.

If these results verify the existence of a boreal/montane bird invasion phenomenon, what does that pattern mean? One possible explanation for the pattern is that the fluctuations represent actual changes in boreal/montane bird populations. Perhaps years with excellent summer recruitment are followed by a widespread occurrence of these species in the lowlands of southern California during winter. This could explain why ecologically similar species tend to covary. Alternatively, co-occurrence patterns might result from similar responses to local food or weather

conditions. If the distribution of wintering density varies across the range of these species, certain years may be characterized by high densities in the Los Angeles basin. Such years need not be years with high recruitment but could represent years of locally favorable food supplies or weather conditions (or unfavorable conditions elsewhere). Identifying the relative influence of each factor on local population densities would require a broader scale analysis. Such a study should consider recruitment success, migratory pathways, and winter population densities across the entire range of the species in question.

We thank Carl Bock, Charles Collins, Glen Ford, Kimball Garrett, Terry Root, John Rotenberry, Cliff Crawford, Aida Parkinson, John Wiens, Bruce Woodward, Jared Verner, and an anonymous reviewer for reading an earlier draft of the manuscript and making many helpful suggestions. Special thanks are due Dennis Heinemann and Beatrice Van Horne for reading the manuscript, as well as for assisting in the initial computer analysis at New Mexico. Computing time was provided by the University of New Mexico Computer Center and the Data Processing and Information Systems Department at California State University, Long Beach. We also thank all of the tireless volunteers who annually contribute to the Christmas Bird Count effort.

LITERATURE CITED

SOKAL, R. R., & F. J. ROHLF. 1969. *Biometry*. San Francisco, W. H. Freeman and Co.

Received 10 June 1982, accepted 1 November 1982.

Chaffinch Imitates Canary Song Elements and Aspects of Organization

P. J. B. SLATER

School of Biology, University of Sussex, Brighton BN1 9QG, United Kingdom

The learning of certain aspects of song between bird species is a well-known phenomenon, and species vary from those that regularly imitate the sounds of many others to those in which inter-specific mimicry is rare or unknown. In cases in which the range of sounds normally copied is restricted, it is of great interest to discover the nature of the constraints that limit this learning. Marler (1976) suggested that young birds are born with a template and will only learn sounds that match its features. If this analogy is accurate, it is particularly interesting to know just what form the restrictions imposed by this template take and how they operate to ensure that most birds usually sing only the song typical of their

own species. Examples of cross-species copying in cases in which copying is unusual, such as the one reported here, may shed light on this problem and help us to understand the processes involved in song learning.

In May 1982, I heard a song coming from a cage containing British birds at London Zoo and recognized it to be that of a Canary (*Serinus canaria*), although it was very brief for that species. I was surprised to find that the singer was a Chaffinch (*Fringilla coelebs*). This species is not noted for its mimetic ability, although an individual singing Greenfinch (*Carduelis chloris*) song in the wild has been reported (Conrads 1977), and Thorpe (1958) trained one to sing