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DISTRIBUTION AND ABUNDANCE OF THE BLACK-BILLED MAGPIE (*PICA PICA*) IN NORTH AMERICA

Carl E. Bock¹ and Larry W. Lephthien¹

ABSTRACT.— Analysis of Audubon Society Christmas bird count data and certain environmental variables shows the degree to which the Black-billed Magpie is a bird of cool arid regions in North America. The abundance and distribution of this species appear to be limited by two major climatic barriers: increasing summer temperatures in the Southwest and increasing summer humidity and precipitation on the central plains.

The Black-billed Magpie (*Pica pica*) is one of the most conspicuous passerine birds on the western plains and in the Great Basin. In this paper we are concerned with what factors determine the abundance pattern and southern and eastern limits of distribution in this species. Linsdale (*in* Bent 1946:134) noted that "a rather striking relation to climate exhibited by this bird has not been clearly explained" or, specifically, that *Pica pica* in the New World seems restricted to the "cold type steppe dry climate" region characteristic of that portion of the United States north of approximately 35° latitude, west of about 100° longitude, and east of the Sierra Nevada-Cascade Range. Within this area *Pica pica* is widely distributed, breeding at most elevations up to 10,500 ft. (Ligon, 1961).

The one universal characteristic of magpie habitat is an association of thickets or riparian areas, necessary for breeding and roosting, with open meadows, grassland, or sagebrush fields suitable for its method of foraging (Linsdale, 1937; Gabrielson and Jewett, 1940; Grinnell and Miller, 1944; Jones, 1960; Erpino, 1968). Without doubt these habitat requirements explain the absence of magpies from the closed boreal forests in the north. However, this sort of habitat mosaic occurs along watercourses in the Great Plains and Southwest, so that it is not immediately apparent why this species does not occupy a larger part of the United States.

We have analyzed the winter abundance pattern of *Pica pica* using data from the annual Audubon Society Christmas bird counts. Although magpies may wander somewhat in winter (Jewett et al., 1953), the bulk of the population seems to stay within the breeding range. Christmas count data were compared with certain climatic variables taken from maps

of 50-year climatic means published by the U.S. Department of Agriculture (1941). Results provide insight into those environmental factors which directly or indirectly influence the abundance and distribution of the Black-billed Magpie.

METHODS

Each Christmas count is a standardized one-day census conducted inside a prescribed circle 15 miles in diameter. Hundreds of such counts are made annually in North America. Data gathered include the number of each species seen and the number of "party-hours" of fieldwork as a measure of census effort. Published results of the counts provide an index to continent-wide patterns of bird distribution and abundance (Bock and Lephthien, 1974; Bystrak, 1974).

Details of techniques for computerized data storage, retrieval, and analysis have been described previously (Bock and Lephthien, 1974). In this case we retrieved data from the 1969-70, 1970-71, and 1971-72 Christmas counts (2,743 individual censuses), sorted these by blocks of five degrees of latitude and longitude, and computed mean number of birds per party-hour for all counts within each block (Fig. 1). Similar maps of climatic data were constructed for all latitude-longitude blocks at least partially within the United States, adapted from the maps in the U.S. Department of Agriculture (1941).

The statistics program BMD-02R (Dixon, 1971) was used to compute stepwise regression of magpie numbers against the series of climatic variables mapped.

RESULTS

Figure 1 shows the winter abundance pattern of the Black-billed Magpie. Christ-

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Fig. 1. Winter abundance pattern of the Black-billed Magpie, based on Christmas count data. Open blocks = no birds observed; four degrees of shading represent ≥ 5.0 , 3.0-4.9, 1.0-2.9, and < 1.0 birds per party-hour, respectively.

mas count data indicate that this species is restricted to the region described by Linsdale (1937) but that it is not uniformly distributed within that area. Highest densities were found in the northern Great Basin and on the northwestern plains of Montana, Alberta, and Saskatchewan. Densities appeared lower in the southern and eastern portions of the range.

Figure 1 suggests that those same factors limiting the distribution of the Black-billed Magpie also may be influencing its abundance within that range. Table 1 shows correlation coefficients between bird abundance and various climatic factors. It is evident that magpie densities are negatively correlated with a variety of temperature and moisture variables, whether or not one includes blocks outside the range of the species.

Tables 2 and 3 show the results of stepwise multiple regression of magpies and the climatic variables listed in Table 1. When data for all latitude-longitude blocks are used, only two variables (July humidity and maximum temperature) made a meaningful contribution to the regression equation, but these accounted for 54 percent of the variation in magpie abundance. Restricting the analysis to the spe-

TABLE 1. Correlation coefficients between Black-billed Magpie abundance and certain environmental variables. Bird data are from 1969-70, 1970-71, and 1971-72 Christmas counts, grouped by blocks of latitude and longitude (see Fig. 1); environmental data are 50-year means from USDA (1941).

Variable	All blocks (n = 47)	Correlation coefficient Blocks within or adjacent to magpie range (n = 26)
\bar{X} annual temp	-.38*	-.41*
Maximum temp	-.20	-.40*
Minimum temp	-.39*	-.36
No. frost-free days	-.43*	-.51*
Annual precipitation	-.45*	-.33
Summer precipitation	-.45*	-.31
Winter precipitation	-.24	-.12
\bar{X} July humidity	-.59*	-.50*

* $p < .05$

cies' range resulted in a stepwise regression including four independent variables and accounting for 59 percent of the pattern of magpie density (Table 3). Frost-free days entered as the best predictor (negative) within the range. This, however, is simply another parameter of temperature regime. Table 3 shows that the same family of variables is involved within the species range—namely, an inverse relationship to temperature and moisture during the warm season of the year.

TABLE 2. Stepwise multiple regression of eight environmental variables against winter abundance of Black-billed Magpies. Based upon Christmas count data and climate variables for 47 latitude-longitude blocks in the United States (see text and Fig. 1).

Step no.	Variable entered	R*	R ² **
1	July humidity	0.59	0.35
2	Maximum temperature	0.74	0.54

R* = multiple correlation coefficient
R²** = coefficient of determination, equivalent to percent of variation in magpie abundance explained at each step

TABLE 3. Same as Table 2, except based upon 26 latitude-longitude blocks in the United States within or adjacent to Black-billed Magpie range (see Fig. 1).

Step no.	Variable entered	R	R ²
1	No. frost-free days	0.51	0.26
2	July humidity	0.71	0.51
3	Summer precipitation	0.75	0.56
4	Maximum temperature	0.77	0.59

DISCUSSION AND CONCLUSIONS

Results of this study show the degree to which the Black-billed Magpie is a bird of cool arid climates in the United States. This does not necessarily mean that magpie distribution and abundance actually are determined by climate, or even by the influence of climate on food. It could be that the species is restricted by habitat availability or by the appearance of close competitors coincidental with changes in climatic regime. We can provide no definitive answer to this dilemma, but a few considered speculations are in order, particularly as they might stimulate more research.

First, there is no clear break in suitable habitat in the United States which should limit magpie distribution, except in the West where the closed coniferous forests constitute a sharp boundary. Riparian habitat along such watercourses as the Rio Grande and the North Platte, South Platte, Arkansas, and Colorado rivers all support Black-billed Magpie populations; yet, *Pica pica* become scarce and disappear along these rivers when they reach the hot Southwest or the more humid central plains. Subtle habitat changes may occur, but it is not clear why such an opportunistic species should be limited by them.

Concerning competitors, it is obvious that *Pica pica* is replaced by the closely related *P. nuttalli* in interior California. Magpies forage opportunistically on invertebrates (especially grasshoppers), carrion, and various other items (Linsdale, 1937; Verbeek, 1973). It is very difficult to describe the foraging niche of such a species, but the Common Crow (*Corvus brachyrhynchos*) and White-necked Raven (*C. cryptoleucus*) appear generally similar in food and habitat requirements (Bent, 1946). The White-necked Raven is a bird of the Southwest. The Common Crow is distributed all across the United States, but is especially abundant in central and eastern regions (Bystrak, 1974). While these two species of *Corvus* do roughly circumscribe the range of the Black-billed Magpie, we would be reluctant to conclude, without more field evidence, that they are involved in a competitive exclusion. First, the White-necked Raven is uncommon (Bystrak, 1974) and more typical of southwestern grasslands than the actual hot desert country (Phillips et al., 1964) marking the boundary

of magpie distribution. Second, the Common Crow is, in fact, widely sympatric with the Black-billed Magpie. Linsdale (1937) reports only occasional and mild interactions between crows and magpies. Verbeek (1973) observed a number of interactions between crows and *Pica nuttalli*; however, these occurred only around the nest and may have involved a response to the crows as potential nest predators. At other seasons the two species were tolerant of each other. Finally, *Pica pica* is Holarctic in distribution and in Great Britain and Europe is sympatric with four species of *Corvus* with generally similar habitat requirements (Bannerman, 1953).

We would like to conclude by returning to the question of climate. It seems very likely that the Black-billed Magpie (and/or their invertebrate prey) cannot tolerate the extreme temperatures of a warm desert. Verbeek (1972:571) noted that *Pica nuttalli* forage in summer mainly in the morning, partly because midday heat even in California stops the activity of invertebrate prey, and partly because "this same heat severely limits the birds in their feeding." In the Old World magpies are distributed throughout Europe and into North Africa as far as the edge of the Sahara (Bannerman, 1953). In New Mexico *Pica pica* breeds only in the northern third of the state; yet in the cooler winter season birds may wander down the Rio Grande Valley considerable distances (Ligon, 1961).

While the eastern distributional limits of the Black-billed Magpie do not fit with striking physiographic or habitat changes, they do coincide with major changes in climatic regime which appear to have general avifaunal significance. For example, Salt (1952) concluded that the House Finch (*Carpodacus mexicanus*) does not breed eastward in the Great Plains because of its intolerance of high summer humidity. The eastern limits of this species are very similar to those of the magpie.

The eastward disappearance of *Pica pica* also is generally coincidental with rather steep zones of introgression between eastern and western populations of several bird species. The most familiar of these is the zone of "hybridization" between the western (*cafer*) and eastern (*auratus*) subspecies of the Common Flicker (*Colaptes auratus*), analyzed by Short (1965).

Interestingly, a third subspecies, *C. a. chrysooides*, replaces *cafer* in the Southwest, although this zone is somewhat south of the limits of magpie distribution. Johnson (1969:229) reviewed the situation in flickers and made these comments:

One of the most striking revelations that came to me upon examining Short's generalized maps of the geographic distribution of flickers in North America is the great coincidence of phenotypic change in the various forms with major climatic boundaries on the continent.

Rising (1969), in fact, studied the comparative physiologies of Northern Orioles (*Icterus galbula*) which, in the same part of the western Great Plains as the flickers, undergo marked phenotypic change. He found that the western "Bullock's Oriole" (*I. g. bullocki*) is better adapted to hot dry climate than is the eastern "Baltimore Oriole" (*I. g. galbula*).

We suggest that climatic factors related to temperature and humidity may limit the abundance and distribution of the Black-billed Magpie, either directly or by their effects upon the availability of invertebrate prey. Future research on this interesting bird could profitably include ecophysiological studies as well as more fieldwork on the relationships of this species to subtle habitat changes or the presence of competitors, especially the Common Crow.

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