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Variation in the wing patches of juvenile Black-billed Magpies Pica pica hudsonia


Abstract. Variability in morphological features is one mechanism by which recognition of individuals or kin, crucial to many social interactions, can occur. Patches in the remiges of magpie wings (white patches with black tips) contain information regarding the bearer's age and sex. Juvenile wing patches of both Black-billed Pica pica hudsonia and Yellow-billed Magpies Pica nuttalli contain between 10 to 12 feathers with variable lengths of white. Our investigations examine the relationship between wing patch morphology and relatedness. We measured the black tips on the primaries of one wing on 29 fledglings from seven nests. We derived a discriminant function based on the length of black on three outer primaries that successfully assigned 75% of the birds to their natal nests (random assignment = 44% correct). We also compared the total length of black tips in the wing patches of young from 33 nests. We found less variation in the patch size within than between nests (log-transformed ANOVA F = 3.339, p < 0.01; Kruskal-Wallis H = 113.6, p < 0.01). These results suggest that familial resemblance is encoded in juvenile magpie wing patches. Family recognition may be important both to the parents, who provide protection and food for their young, as well as between siblings, who apparently know each other.

Key Words: Familial resemblance, Black-billed Magpie, Pica pica hudsonia, juvenile plumage, morphological variation

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INTRODUCTION

Recognition of kin is crucial to overcome potential costs of kin-directed behavior (Hamilton 1964). Recognizing kin may also influence mate choice behavior by optimizing the benefits of outbreeding while reducing the hazards of intense inbreeding (Batson 1983). Cues for kin recognition might be found in those sensory systems that have evolved a high degree of “importance” for particular groups of organisms. Olfactory or other chemical cues are important in insect kin recognition. Avian species, on the other hand, are acutely visual and aural organisms, evolving complex feather and vocal patterns indicative of selective pressures. Thus, we might expect familial cues to be either visual or aural in birds. As with other signals, familial cues should contain enough variability to encode for kin.

The Black-billed Magpie Pica pica hudsonia, a social, “monomorphic” corvid, has many features that allow humans to identify them regarding age and sex (Erpino 1968, data of C. H. Trost). Morphologically variable features include wing patch, facial patterns, tail length, and body size. Yearling Black-billed Magpies establish linear dominance hierarchies involving both sibs (data of C. H. Trost) and strangers (Komars 1989, Moholt and Trost 1989), suggesting the use of individual recognition and the possibility of kin recognition in
these social interactions. In this study, we examined morphological variability in the wing patch patterns for
cues of familial resemblance in juvenile Magpie siblings.

STUDY AREA AND METHODS

During the spring of 1982, C.H. Trosi banded
nestling Black-billed Magpies _Pica pica hudsonia_ at
Batiste Springs, Power County, southeastern Idaho, 
USA. Both color and metal U.S. Wildlife bands were
used to identify individual birds. During the summer
and fall of 1982, juvenile magpies were caught in either
one of two funnel traps baited with suet or dog food.
The traps were 1.5km apart and were located near the
springs. The length of the white patch and the black tip
of all primaries and the first two secondaries on the
right wing were measured on birds from known nests.

![Diagram](image.png)

Fig. 1. Separation of seven magpie families by discriminant functions
based on primaries 2, 3 and 5.

Of the 77 juveniles that were caught and measured,
29 birds from seven nests were used in the discriminant
analysis. These seven nests had a minimum of 4
recaptured siblings. Other nests had fewer siblings
recaptured (generally 1 or 2 siblings) or had siblings
with missing feather tips. The latter precluded the
measurement of damaged primaries and therefore
could not be included in the analysis. All the nests were
located linearly along Batiste Springs/Portneuf River.
Distance between the most downstream and upstream
nenest was 1.6km. We used a forward stepwise analysis
solving for the lowest Wilk's lambda in three steps. We

used SPSS Subprogram DISCRIMINANT (Update),
validation was not used due to the small number of
individuals in each group.

In the spring of 1994 and 1995, a similar study was
carried out at McCammon, Idaho, about 40km
southeast of the previous study. All the remiges with
white patches were measured before the young
fledged. At fledging, the feathers were not developed
enough to measure the entire length of the white areas
and hence only the lengths of the black tips were
measured. We compared the lengths of the black tips
from all the 10-12 feathers in the wing patch of 183
young magpies from 33 nests. We then did an analysis
of variance on log transformed data. In addition, we
ran a Kruskal-Wallis test on the untransformed data for
a non-parametric comparison.

RESULTS

For the data collected from Batiste Springs, two
functions significantly separated family units. These
functions were derived from black tips located in the
interior portions of the wings (tips of primaries 2, 3,
and 5). In function 1, black tips on primaries 5 and 3
contributed heavily, while all three variables
contributed approximately equally in function 2. Both
functions correlated fairly well with the set of dummy
variables representing the nests (squared canonical
correlations were 0.757 and 0.686 respectively),
indicating an ability to discriminate among the nests.
Thus, the discriminant version of the omnibus F was
significant (Wilk's lambda = 0.0572, χ² = 65.81), and
derivation of the functions was justified. After the
second function was derived, Wilk's lambda increased
to 0.749, and the chi-square values were no longer
significant.

Classification by the functions was very successful.
If randomly classified without regard to wing patch
patterns, on average 14.3% of the nestlings would be
correctly placed in their original nest. Using the
discriminant functions, 75% of the sibs were correctly
classified into their appropriate families (Tab. 1).
However, errors did occur. In Nest 824, sibs were
essentially classified randomly, i.e., the discriminant
functions failed to recognize 75% of the members of
this family as different from other families. While two of the misclassified juveniles were placed into nests located close to Nest 824, the third juvenile was misclassified into a nest located more than 1 km downstream. While the two functions separate most of families well, siblings from Nest 824 are scattered throughout (Fig. 1).

For the McCammon data, a comparison of the wing patch sizes (black tips) from all the young from 33 nests showed significantly less variation in the patch sizes within than between nests (ANOVA: F_{32,150} = 8.34, p < 0.001; KRUSKAL-WALLIS: H_{32} = 113.61, p < 0.001). However, we have noted that a few of the young within nests have highly variable wing patches. Nevertheless, low within-nest variability of the patch sizes is the general rule.

Table 1. Classification of juvenile Black-billed Magpies from 7 nests by discriminant functions based on primaries 2, 3, and 5.

<table>
<thead>
<tr>
<th>Nest no.</th>
<th>n. of sibs.</th>
<th>Predicted nest membership</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>217 757 763 824 877 954</td>
</tr>
<tr>
<td>217</td>
<td>4</td>
<td>3 4 1 1 2 1 1</td>
</tr>
<tr>
<td>757</td>
<td>4</td>
<td>3 4 1 1 2 1 1</td>
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<tr>
<td>763</td>
<td>4</td>
<td>3 4 1 1 2 1 1</td>
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<tr>
<td>806</td>
<td>5</td>
<td>3 4 1 1 2 1 1</td>
</tr>
<tr>
<td>824</td>
<td>4</td>
<td>3 4 1 1 2 1 1</td>
</tr>
<tr>
<td>877</td>
<td>4</td>
<td>3 4 1 1 2 1 1</td>
</tr>
<tr>
<td>954</td>
<td>4</td>
<td>3 4 1 1 2 1 1</td>
</tr>
<tr>
<td>Downstream order</td>
<td></td>
<td>5 6 2 4 1 7 3</td>
</tr>
</tbody>
</table>

DISCUSSION

We found that Black-billed Magpies in Southeastern Idaho have wing patches that vary according to familial membership. Inner feathers of the primaries contain familial resemblance information. Our discriminant analysis limited the number of feathers to three, and yet more than 75% of the siblings were correctly classified back to their original family. One nest was poorly classified. Misclassification was more likely due to the low number of feathers used in the discriminant analysis (centroids were located close together, and thus more information was needed to separate these families) rather than biological phenomenon such as extra-pair copulations. In fact, when we used more feathers in a less stringent analysis, we found even more successful separation among families.

Distinctive wing patterns are common in many species, and behaviors have co-evolved to advertise these patterns, particularly relating to age and sex (e.g., Yellow-billed Magpies, Verbeek 1972; and Northern Mockingbirds Mimus polyglottos, Hailman 1960). Familial resemblance in birds has generally not been examined in great detail. Burley and Bartels (1990) found that male sibling Zebra Finches Taeniopygia guttata were very similar in eye and throat stripes, but not similar in breast band width and bill coloration. Similarity was enough for human observers to correctly classify 89 percent of the birds into the right sibling group. Human observation also noted differences between family groups of magpies. Trost noted, while banding nestling birds, that family members were more similar than non-nestmates, particularly regarding the amount of black on the wings. This pattern was emphasized when an occasional chick would seem markedly different from its nestmates. Markedly different nestmates may be the result of extra-pair copulations (Birkhead 1979, Buttrun 1983), or between-nest egg movement (Trost and Webb 1986). However, a study by Parrott (1997) showed that while Magpie family groups are more similar within than between groups, DNA analysis did not support the idea that markedly different nestmates were the result of extra-pair copulations.

Juvenile Magpies establish dominance hierarchies in flocks during the late summer and fall. Some adults join these flocks. During this time, juveniles undergo a complete body molt, but retain the primaries, secondaries, and tail feathers. The patch patterns of distal primaries contain information on age (Erpino 1968) and sex (data of C. H. Trost). Our study indicates that familial resemblance information is contained in the black tips located on proximal primaries. Parrott's (1997) study of European Pica indicate similar patterns. All of these patterns may be important in identifying individuals who engage in self-aggrandizement (Moholt and Trost 1989) and other dangerous exploits that correlate with higher social positions in dominance hierarchies.

Whenever potential cues exist involving possible kin-directed behavior, the question of kin selection
through altruism (e.g., helpers-at-the-nest, nepotism) arise. While cooperative feeding by non-parents has been observed, this is a relatively rare phenomenon and probably related to low mate availability (Buitron 1988). The degree of nepotism is unknown. Since juvenile flocks not only roost through territories of adults, but contain adults as well, a potential exists for nepotism with alarm calls.

Wing patch patterns might act as a spacing mechanism in the dispersion of siblings. Moholt and Trost (1989) suggest that relatedness within foraging juvenile flocks may be very low. Eden (1989) found that dispersal in Magpies is related to dominance status: those with higher status stayed, and those with lower (including females) left. Distance traveled might be controlled by the proximity of other siblings versus the inherent tendency toward philopatry. If breeding is limited particularly to a dominant sibling, then moving to a neighboring flock may increase one’s fitness. If a magpie cannot get a nest because of the presence of a dominant sibling, then it cannot breed. Moving creates the potential for breeding at an earlier date, thus raising the individual fitness of the one who can recognize a superior kin. However, recognizing a sibling does not necessarily mean recognizing kin. Juvenile magpies may only be recognizing siblings as individuals, not kin.

REFERENCES


niejszą zmienność wielkość plan wewnątrz lęgów niż pomiędzy lęgami (t-ANOVA f = 8,339, p < 0,001; Kruskal-Wallis H = 113,6; p < 0,001). Wyniki sugerują, że rodzinne podobieństwo jest zakodowane na wzorach w skrzydłach młodych strok. Rozpoznawanie się osobników w obrębie rodziny może być ważne zarówno dla rodziców, którzy zapewniają swoim młodym pokarm i ochronę, jak również dla rodzeństwa, które może łatwiej się wzajemnie rozpoznawać.

(tłum. A.K.)