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Hill Mynah Survival in Relation to Morphological Variations

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Abstract: The appearances of the morphological variation, especially body sizes and wattle characters of Hill Mynah population found in Thailand bring the questions if Hill Mynahs use these variations for survival through the communication in order to determine status signals within flocks and which character is the most propagated. The study was conducted both in the aviaries and in the field. The experiments in the aviaries revealed that they used body sizes and wattle characters including aggressive behavior to communicate in order to determine social status in flocks in captivity. The bigger birds were always dominant ones and gained more food. The observation in the field did not show that the bigger birds mated more than the others, but it depended on the population density of each group which inhabited in particular areas. Although the results did not indicated the specific character that propagated most, the body size and wattle variations in Hill Mynah which corresponded with aggressive behavior were used for survival in nonbreeding season. Because birds used these character variations to communicate social signals, the dominant birds approached to the resources first, obtained more food and left the flocks for mating before the others.

Key words: *Gracula religiosa*, survival

INTRODUCTION

There were several papers reporting the appearances of the morphological variation, especially body sizes and wattle characters, among Hill Mynah population found in Thailand, resulted from interbreeding between the two well-recognized subspecies *Gracula religiosa intermedia* (northern bird = N) and *G. r. religiosa* (southern bird = S)^[1-3]. The three new Hill Mynah groups (modified northern bird = MN, intermediate bird = I and modified southern bird=MS), that represent intermediate characters comprise 40% of the studied population and outnumber their northern and southern counterparts which are 36 and 24%, respectively^[4]. The degree of morphological variants tends to increase as long as the interbreeding is uninterrupted. If these three new groups are favored by natural selection through the size and wattle variants, the questions if Hill Mynahs use wattle characters which correspond with body sizes^[5] for communication in order to determine status signals within flocks and then the most evolved character will leave more offspring than the others are considered.

Animals living in flocks are likely to establish dominance hierarchies. Before hierarchy is stabilized, they use any signal such as sound, apparent body signal or aggressive behavior to determine hierarchy. In general, dominant birds gain better quality food, safer shelter, more copulation and leave more offspring than the

subordinate ones^[6-7]. Morphological variations among Hill Mynah population found in Thailand tend to continuously increase^[4]. Body sizes and yellow wattle characters that were used to classify Hill Mynahs into five groups^[3] may play a role in determining hierarchy and consequently, some birds with such specific characters will gain more advantage than the others. This study was conducted in two manners including the experiment in outdoor aviaries and the observation in the field. The experiments in outdoor aviaries would reveal whether Hill Mynahs communicate in flocks through specific body sizes and wattle characters which facilitate dominance hierarchy establishment. Meanwhile, the observation in the field would show the specific characters that succeed in pairing and reproducing. These answers will thus manifest Hill Mynah survival in relation to morphological variations.

MATERIALS AND METHODS

Experiments in outdoor aviaries: Hill Mynahs were classified into five groups : northern (N), modified northern (MN), intermediate (I), modified southern (MS) and southern (S) groups^[1,3]. Procedures of morphological measurements in these experiments followed those of previous study^[5]. Fifty Hill Mynahs, ten birds from each group, also obtained from a previous study^[2], were used again in this experiment in 2002. There were seven stages

in this experiment : stage I, observations among the same group, ten birds of each group, five groups in five aviaries; stage II, observations among five groups, two birds of each group, only the dominant and the subordinate birds from stage I, five groups in one aviary; stages III-VII, observations among five groups, two birds of each group, regardless of the ranks they used to be, or a total of ten birds in each of the five aviaries. In each stage, each bird was randomly switched to a new aviary and met new opponents. Observations were recorded at each stage.

Each outdoor aviary was $4 \times 5 \times 3 \text{ m}^3$ in dimensions with an observation chamber, $3 \times 1 \times 2 \text{ m}^3$ in dimensions, equipped with one-way glass at the Zoological Research Station, Ramkhamhaeng University, Bangna Campus, Bangkok, Thailand. Food, water, small houses and perches were provided in each aviary. Each bird was marked with a colored plastic band for identification.

Observations of dominance relationships were modified from previous studies^[8-10]. The observations

were done in the morning from 08-10 h. To heighten the bird's activity, food was removed from an aviary two hours prior to the observations. During the observation one dish of food was brought back to the aviary. The observations were focused on activities occurred at a food dish in each aviary. It was disclosed that the dominant bird was the one who supplanted, chased and pecked the others away from the food dish. Although fighting rarely occurred, the subordinate bird usually flew away when fighting happened. The number of supplanting, chasing, pecking and persisting at the fight of a particular bird to another particular one was recorded for 15 min per day for a week and used for specifying dominance hierarchy. For example, the first bird supplanted, chased, pecked and persisted at the fight with the second bird 53 times. The first bird dominated the second bird. The second bird did the same things to the third bird 48 times. Thus it was said to dominate the third bird.

Field study: The observations were carried out in 12 provinces from latitude 6° - 16° N (Fig.1) where the five Hill Mynah groups were found together^[2,11] during breeding season, January to July of 2002. The number of each of the five different Hill Mynah groups which paired were counted in order to learn which group was the most productive in these areas.

RESULTS

Morphological characteristics: Birds in the experiments in outdoor aviaries showed the differences in each character among the five groups. The northern group had straighter bill, smaller head, body and wattle, shorter wing, tail and tarsus than the other four groups. On the contrary, the southern group had the biggest bill, head, body and wattle and the longest wing, tail and tarsus (Table 1). The sizes ranged from small to large in the following order : $N < MN < I < MS < S$.

Dominance relationships among the same groups (stage I): Hill Mynahs in the same group (N or MN or I or MS or S group) showed dominance relationships indicating that birds with the biggest body, the widest and the longest yellow wattle were dominant in all aviaries (Table 2).

Dominance relationships among different groups (stages II-VII): When the dominant and the subordinate birds (second in rank) of each group in each aviary of stage I (S_4 , S_2 , MS_1 , MS_{10} , I_6 , I_7 , MN_2 , MN_8 , N_8 and N_3) were placed in the same aviary in stage II to examine the relationships between dominance and body and wattle

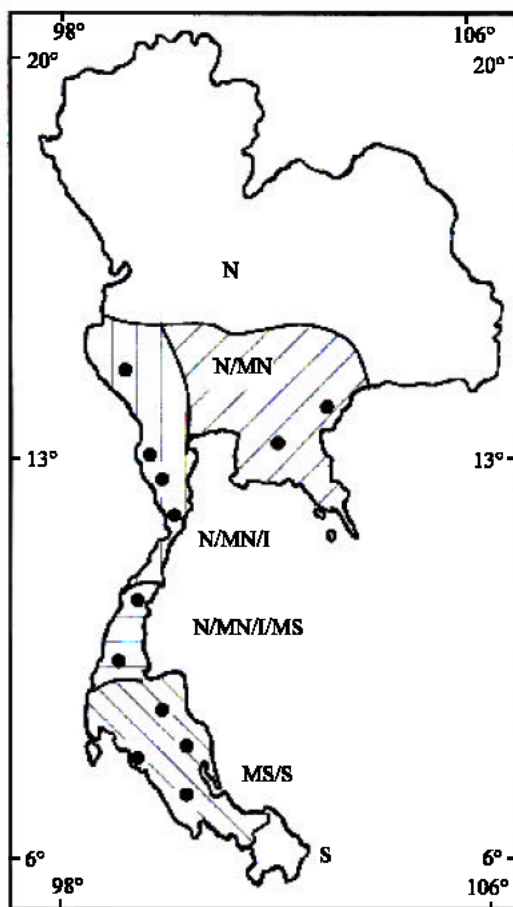


Fig. 1: Pairing study sites in 12 provinces of Thailand

Table 1: Mean and standard deviation of morphological characteristics of 50 birds from five different Hill Mynah groups in outdoor aviary experiments

Morphological characters	N	MN	I	MS	S
Head area (cm ²)	18.24±0.97	18.58±0.81	20.10±1.02	21.87±1.26	22.68±2.12
Bill cone (cm ²)	7.12±0.15	8.15±0.18	9.34±0.14	10.86±0.29	11.52±0.64
Bill curvature (degree)	6.73±1.52	6.95±1.04	7.22±0.73	8.54±1.43	9.15±1.51
Body mass (g)	190.42±14.85	201.18±13.52	232.61±17.79	241.81±10.95	283.80±17.53
Body length (cm)	18.52±0.74	19.74±0.98	21.53±0.84	21.23±0.91	23.75±1.85
Body circumference (cm)	19.09±0.72	19.31±0.83	21.16±0.74	22.20±1.43	23.07±1.28
Wing length (cm)	17.54±0.81	17.63±0.86	18.74±1.23	19.37±1.22	19.89±1.08
Tail length (cm)	8.56±0.74	7.57±0.51	8.77±0.72	7.16±0.84	8.26±0.59
Tarsus length (cm)	3.33±0.26	4.24±0.18	4.38±0.23	4.65±3.09	4.77±0.21
Anterior wattle area (cm ²)	1.03±0.27	1.32±0.27	1.38±0.19	1.46±0.62	1.55±0.08
Posterior wattle area (cm ²)	2.06±0.67	2.30±0.41	2.42±0.56	4.43±0.49	4.49±0.82
Length from anterior wattle to posterior wattle (cm)	0.30±0.05	0.34±0.05	0.33±0.04	0.39±0.05	0.43±0.06

Table 2: The orders of the dominant and the subordinate birds (second in rank in stage I) in stages III – VII

Bird ID	Stage				
	III	IV	V	VI	VII
S ₄	1	1	1	1	1
S ₂	1	1	1	1	1
MS ₁	3	1	1	1	1
MS ₁₀	1	3	1	4	1
I ₆	2	1	4	3	2
I ₇	4	3	1	4	5
MN ₂	5	1	4	5	2
MN ₈	4	1	1	3	4
N ₈	2	1	1	1	3
N ₃	2	1	4	6	3

		The Defenders									
		S ₄	S ₂	MS ₁	MS ₁₀	I ₆	N ₈	I ₇	MN ₂	MN ₈	N ₃
The Offender	S ₄	53	48	92	68	112	163	52	81	40	
	S ₂		88	57	75	36	29	61	14	12	
	MS ₁			72	48	20	8	35	31	3	
	MS ₁₀				24	77	46	8	4	11	
	I ₆					28	15	56	51	2	
	N ₈						35	9	24	6	
	I ₇							31	53	31	
	MN ₂								19	4	
	MN ₈										5
	N ₃										

Fig. 2: The frequency of supplanting, chasing, pecking, and persisting at the fight between birds in stage II. (S₄ = southern bird no.4, S₂ = southern bird no.2, MS₁ = modified southern bird no.1, MS₁₀ = modified southern bird no.10, I₆ = intermediate bird no.6, I₇ = intermediate bird no.7, MN₂ = modified northern no.2, MN₈ = modified northern no.8, N₈ = northern bird no.8, N₃ = northern bird no.3)

sizes, the southern birds were dominant, S₄ and second in rank, S₂ (Fig. 2), whereas the modified southern birds, MS₁ and MS₁₀, were the third and fourth ranks and the northern bird, N₃, that had the smallest body was the last in rank. In stages III-VII, birds were shuffled five times to five aviaries. In each switch the dominance relationships were

recorded. The observations showed that the dominant birds and the subordinate ones in stage I, resumed their ranks in stages III-VII (Table 2). The southern bird, S₂, which was subordinate to S₄ in stage II, was the dominant in stages III-VII. Meanwhile, S₄ which was the biggest bird in this study was always the dominant bird in every switch. The modified southern, intermediate, modified northern and northern groups had chances to return to their dominant status.

Pairing in the field: From study sites of 12 provinces (Fig. 1), there were four parts of the five different Hill Mynah groups' habitat combinations : N/MN; N/MN/I; N/MN/I/MS and MS/S. In the N/MN part, there were two types of paired birds (NXN and NXMN). In the N/MN/I part, there were six types of paired birds (NXN, NXMN, MNXMN, NXI, MNXI and IXI). In the N/MN/I/MS part, there were seven types of paired birds (NXMN, NXI, MNXI, IXI, NXMS, MNXMS and IXMS) and lastly, in the MS/S part, there were three types of paired birds (MSXMS, MSXS and SXS) (Table 3). In the N/MN and N/MN/I parts, northern bird (N) was the most pairing group, while in the N/MN/I/MS part, intermediate bird (I) was the most pairing group and in the MS/S part, southern bird (S) was the most pairing group (Table 4).

DISCUSSION

Dominance relationships within the same group indicated that among the birds that had the same type of yellow wattles but different body sizes, the bigger ones were dominant and actually showed more aggressive behavior. These dominant birds had bigger sizes of all characters than other birds in the same groups. However, when the dominant and the subordinate birds (second in rank) of each aviary in stage I were kept in same aviary in stage II, the relationships between dominance and size characters were clearly seen. Two southern birds dominated the four other groups in the same aviary. They showed more aggressive behavior than the other eight

Table 3: Percentages of pairing in four parts of Thailand where more than one group of Hill Mynahs inhabit

Habitat of Hill Mynah groups	n(Pairs)	% Pairing											
		N x N	N x MN	MN x MN	N x I	MN x I	I x I	N x MS	MN x MS	I x MS	MS x MS	MS x S	S x S
N / MN	11	63.64 (7)	36.36 (4)										
N / MN / I	28	25.00 (7)	35.72 (10)	10.71 (3)	14.29 (4)	3.57 (1)	10.71 (3)						
N / MN / I / MS	13		15.38 (2)		15.38 (2)	7.69 (1)	23.1 (3)	15.38 (2)	7.69 (1)	15.38 (2)			
MS / S	27										25.93 (7)	33.33 (9)	40.74 (11)

Table 4: Percentages of each group of Hill Mynah that had paired in each part of Thailand

Habitat of Hill Mynah groups	N	MN	I	MS	S
N / MN	81.82 (18)	18.18 (4)			
N / MN / I	50.00 (28)	30.36 (17)	19.64 (11)		
N / MN / I / MS	23.08 (6)	15.38 (4)	42.31 (11)	19.23 (5)	
MS / S				42.59 (23)	57.4 (31)

Table 5: Percentages of birds of each group counted in ten days in four parts of Thailand where more than one group of Hill Mynahs inhabit^[4]

Habitat of Hill Mynah groups	N	MN	I	MS	S
N / MN	61.60	38.40			
N / MN / I	36.84	33.14	30.02		
N / MN / I / MS	16.48	24.59	34.73	24.20	
MS / S				48.71	51.29

birds. Both of them had bigger sizes of characters than the rest. Moreover, the switches in stages III to VII revealed that birds that used to be dominant birds in stage I resumed to their dominant ranks in stages III-VII. These results showed that in captivity, sizes of body and wattle played an important role in accessing a social status.

There were many reports about prior-residence effect on the dominance hierarchy establishment in White-throated sparrows (*Zonotrichia albicollis*) and Dark-eyed juncos (*Junco hyemalis*)^[12-14]. In this study, prior-residence effect was eliminated by switching each bird to a new and unfamiliar aviary. No prior residence effect appeared in the results. Factors of size and aggressive interactions directly influenced dominance in captivity.

However, the observations in the field showed the opposite results. In the N/MN part, modified northern birds should have paired more than northern ones. Similarly, in the N/MN/I part, intermediate birds should have paired more than the two other groups. But in both parts of Thailand, the northern group was the one that paired most. In the N/MN/I/MS part, modified southern birds were not the group that paired most but the intermediate group was. However, these results corresponded to the number or density of each group that inhabited in those particular areas. In the N/MN and

N/MN/I parts northern birds outnumbered the other groups^[4]. Whereas, in the N/MN/I/MS part, intermediate birds were more numerous than the three other groups (Table 5). Anyhow, during nonbreeding season in which Hill Mynahs foraged in flocks, birds that were bigger in sizes than the others in the flock, regardless of the group to which they belonged, were always the leaders in flying, perching, approaching to food and chasing other birds away from the fruit branches^[4]. Although the aggressive interactions in the field were not so many as in aviaries, because the access to food resource was not limited only at one dish as in an aviary and there were fruits available on many tree branches, the chasing of subordinate birds by dominant ones from tree branches were often noticed. The observations in the field did not indicate that Hill Mynahs used any specific characters for reproductive success during breeding season. Nevertheless the dominant birds disappeared from flocks first to join their mates while the smaller ones stayed in flocks together until late breeding season^[15].

Dominance hierarchy establishments in captivity and in the field were not always the same^[16]. There might have been more than status signal contributing to the determination of reproductive success such as individual physiological basis, resources and most of all the population number of each group inhabited in particular areas. Although Hill mynahs did not use morphological variations directly to indicate the survival through the most evolved character, they used them as social signals in flocks during nonbreeding season in order to approach to the food, then get more food and mate before the others. The wattle character variations were not the only factor which caused the dominance because they always corresponded with body size variations^[5]. The southern birds, that were apparently dominant were the biggest birds of all and also the most aggressive ones^[17]. Therefore, body size and wattle character variations as well as aggressive interactions were used to determine the dominance relationships, indirectly the chance of survival, at least during nonbreeding season.

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