

Zoogeography of Various Hill Mynah Phenotypes in Thailand

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Abstract: A study on external characteristics of 749 live Hill Mynahs throughout Thailand classified morphological variants into five groups including two known subspecies and three new groups: northern, modified northern, intermediate, modified southern and southern. Zoogeography of these variations was studied by mapping the locations where each group inhabited related with body mass in order to understand the occurrence of three new Hill Mynah groups. The results showed that there were only northern group inhabited between 18° and 20°30' N and only southern group inhabited between 5°30' and 8° N. Three new Hill Mynah groups were found between 8° and 16° N: with northern group between 9° and 16°N and with southern group between 8° and 9°N. Combination studied of Hill Mynah groups and body mass showed the gradual shift of body mass diffusion in particular areas from north and south to the middle of the country. The relative patterns of phenotypic variation may result from introgressive interbreeding between two original subspecies in a contact zone.

Key words: *Gracula religiosa*, Hill Mynah, morphological variation, zoogeography

Introduction

Among ten subspecies of Hill Mynah, *Gracula religiosa*, in the world, two subspecies were found in Thailand, *G. r. intermedia* and *G. r. religiosa* (Peters, 1962; Lekagul and Round, 1991). A previous study on external characteristics of 749 live Hill Mynahs throughout Thailand classified morphological variants into five groups, including two known subspecies and three new groups. The first group was recognized subspecies, *G. r. intermedia*, named group N (northern), had the continuous yellow connection

line between the anterior and posterior wattles. The second group, named group MN (modified northern), had the yellow connection line approximately 90% of the length between the anterior and posterior wattles. The third group named group I (intermediate) had the yellow connection line half way between the anterior and posterior wattles. The fourth group, named group MS (modified southern), had the yellow connection line approximately 10% of the length between the anterior and posterior wattles. The last group, named group S (southern) was recognized subspecies *G. r. religiosa*, had no yellow connection line between the anterior and posterior wattles (Archawaranon and Wongwasana, 1998). The averages of most characteristics: head area, bill cone, bill curvature, posterior wattle length, body mass, body length, body circumference, wing length and tarsus length, increased toward the south (Archawaranon and Mevatee, 2002). Especially, body size and body mass were remarkably different among five groups (Fig. 1). The northern birds were smaller than the southern birds. Meanwhile the three new groups were bigger than the northern race but smaller than the southern race. Zoogeography of each Hill Mynah groups in Thailand was examined by mapping the locations where each group inhabited in the nature related with body mass which was the most considerable character to represent the morphological variants in this study. The distribution pattern of these variable phenotypes was studied in order to understand how and where the variation of morphology of Hill Mynahs in Thailand have occurred in the wild.

Materials and Methods

Study areas: From 1994 to 1998, 33 localities were surveyed (Fig. 2) in Thailand between 5°30' and 20°30'N to study the distribution of morphological variation within Hill Mynah population in the wild. Hill Mynah is sedentary, completely arboreal bird living in forest: evergreen, dry or hill evergreen, pine, mixed deciduous and deciduous dipterocarp.

Distribution of Hill Mynah groups: During nonbreeding season from August to December, Hill Mynahs stay in flocks of approximately 4–25 birds and searched was made for them by following their easily recognized calls, especially at food tree or rooting trees. High blinds were constructed for observation. Observations were made by two people simultaneously between 08:00–11:00 and 15:00–18:00 at feeding areas and 11:00–15:00 at rooting sites. Wattle characteristics were identified in order to classify groups of Hill Mynah according to the length of yellow connection line between the anterior and posterior wattles. In each locality, observations were made at 8 to 12 sites and repeated twice in each site by the same observers.

Body mass measurement: Although the best measure of overall body size is total mass (Rising and Somers, 1989), reliable information on mass is difficult to obtain. Data on mass are

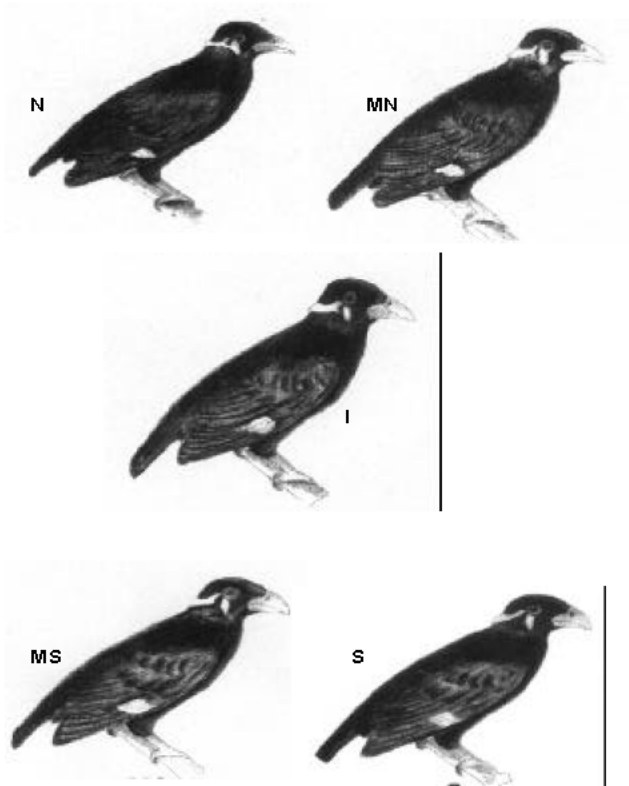


Fig. 1: The static display pose of hill Mynah, *Gracula religiosa*. Wattle feature, bill curvature and body size are remarkably different among them. (N=Northern, *G.r. intermedia*, MN= Modified northern, I = Intermediate, MS = Modified southern and S = Southern, *G.r. religiosa*)

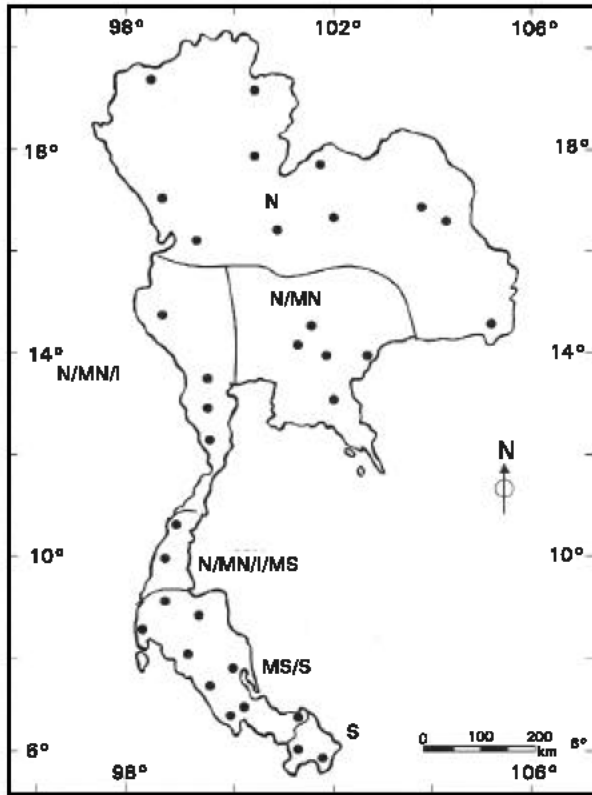


Fig. 2: Six parts of Thailand divided according to the habitats of five different Hill Mynah groups (● = 33 study sites)

sometimes unsatisfactory because of seasonal and diet-related variability (Niles, 1973). In this study, seasonal variation on body mass was concerned by studying during only nonbreeding season of each year. Variability of diets which effected directly on body mass was accomplished by trapping birds for body mass measurement at roosting sites during 11:00 – 15:00, assumed that they were all resting after each meal and before next meal (Archawaranon, 1994). Only adult birds (>1 years) were studied by examining the yellow wattles. Young birds normally have pink and pale wattle. Body mass was obtained by weighting. Birds were released at the original places after the measurement was done twice by two people. According to the body mass of 749 live Hill Mynahs, the weight was classified into five categories: SS < 185 g; S = 185 – 215 g; M = 216 – 245 g; L = 246 – 275 g and LL > 275 g.

Results

Distribution of Hill Mynah groups: From 33 localities, birds of northern group (N) were found between 9° and 20°30'N, southern group (S) were found between 5°30' and 9°N, three new Hill Mynah groups (MN, I, MS) were found between 6° and 16°N. The N group was also found with three new groups in the 9° and 16°N latitudinal range. Three subdivisions of this range were recognized. In the east of 12° and 16°N, the N group was found with MN group. In the west of 11° and 16°N, the N, MN and I groups coexisted. Upper south (9° and 11°N) was a complex zone of four groups: N, MN, I and MS. From about 6° and 9°N both MS and S groups were found together while only S group inhabited in the latitudes 5°30' and 6°N.

Body mass variation: Body mass was not determined by sexes. Based on sign test there were no significant morphological

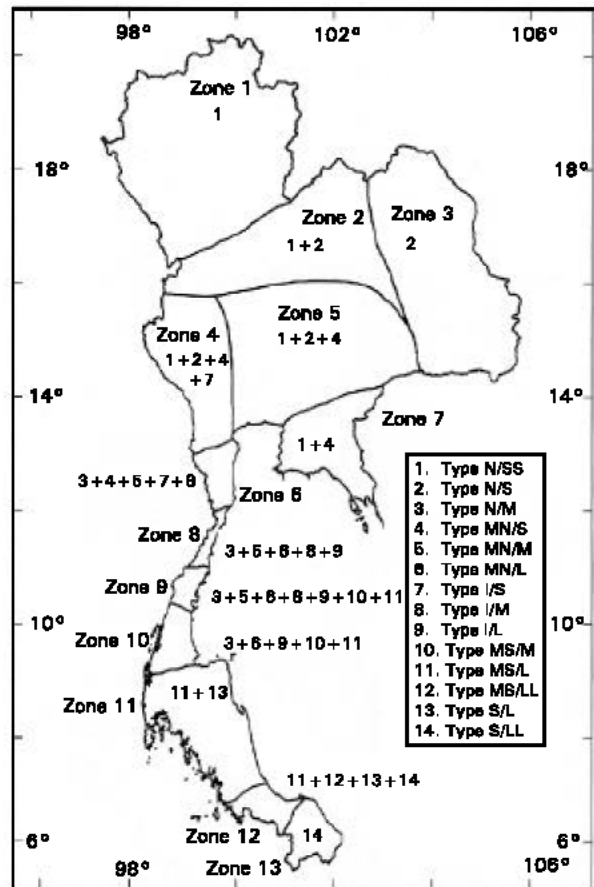


Fig. 3: Body mass variation within various Hill Mynah phenotypes in different areas of Thailand

Table 1: Category of Hill Mynah groups and body mass

Types	Groups	Size	Body mass (g)
1. N/SS	N	SS	< 185
2. N/S	N	S	185-215
3. N/M	N	M	216-245
4. MN/S	MN	S	185-215
5. MN/M	MN	M	216-245
6. MN/L	MN	L	246-275
7. I/S	I	S	185-215
8. I/M	I	M	216-245
9. I/L	I	L	246-275
10. MS/M	MS	M	216-245
11. MS/L	MS	L	246-275
12. MS/LL	MS	LL	> 275
14. S/L	S	L	246-275
15. S/LL	S	LL	> 275

differences between sexes in each locality (Archawaranon and Techatraisak, 2002 unpublished). Therefore, the sexes were pooled for further analysis. When the combination between Hill Mynah groups and body mass were made, 14 types of assortative combinations were established (Table 1). N group fell into three of the size categories: SS, S and M. In MN and I groups, there were S, M and L sizes, whereas MS group had M, L and LL sizes. S group had only two sizes, L and LL. Thailand was consequently divided into 13 zones to represent the distribution of different combinations of Hill Mynah groups and body mass (Fig. 3). In the further north (zone 1), northeast (zone 3) and further south (zone 13), only one type of Hill Mynah was found in each zone: type 1

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N/SS, type 2 N/S and type 14 S/LL, respectively. The greatest variety in combinations of Hill Mynah groups and body mass occurred in the middle of the country, zone 9, seven different combinations of groups and mass categories occurred. The second most variety were in zone 6, 8 and 10, five different combinations occurred. Zone 4 and 12 had four different combinations. While zone 5 had three different combinations. Two different combinations occurred in zone 2, 7 and 11.

Discussion

Geographic character variation has been detected in many bird species (Johnston and Salender, 1964; Zink, 1989; Beniter-Diaz, 1993; Tvedt *et al.*, 1994). Body size varied positively with latitude (Johnston, 1994) which reflected adaptation to environmental variation such as climate (James, 1970; Blem, 1981; Aldrich and James 1991; Martin, 1991; Kratter, 1993). However, study of the reflection of morphological variation to climate variation in this species provided counter-evidence to Bergmann's rule, that body size tended to increase in colder and drier climates. Hill Mynahs in the south with humid climates had larger body than birds in the north (Archawaranon and Techatraisak, 2002).

From this study, the variety of intermediate characters, especially body size, occurred in the middle part of the country where three new Hill Mynah groups were found. Meanwhile, at the edge of the country (zone 1, 3, 13), only one specific type was found in each zone. Zone 1 was the place where the smallest northern Hill Mynah group inhabited whereas zone 13 was the place where the largest southern Hill Mynah groups inhabited. The area of intergradation was the place where the variety of character combinations had shown. It was the gradual shift of body mass diffusion in particular areas from north and south to the middle of the country. For instance, birds of both type 1 in zone 1 and type 2 in zone 3 were found in zone 2. Birds of zone 2 (type 1 + 2) and zone 7 (type 1 + 4) were found in zone 5 where was between zone 2 and zone 7. Zone 9, which the most different combinations of groups and body mass categories occurred, was between zone 8 and 10. Birds of both in zone 8 and 10 were found in zone 9.

In Thailand the ranges of two widespread subspecies meet. *G. r. intermedia* occurs from India and southern China southward to central Thailand; *G. r. religiosa* occurs from southern Thailand southward through Malaysia and Indonesia. These two subspecies are not reproductively isolated (Archawaranon, 1994). Where two subspecies meet, intermediate or hybrid populations may combine the characters of both subspecies (Mayr and Ashlock, 1991). Therefore, one of possible causes of size variation in this species is neutral character diffusion for population in contact with each other (Johnston, 1994). It is likely that the transitions in yellow wattle characteristic and body mass occur across an intergrade zone between two subspecies of Hill Mynahs (*G. r. intermedia*, *G. r. religiosa*). The relative patterns of change of these characters across the subspecific contact zone suggest that morphological variation in Hill Mynahs may result from introgressive interbreeding between two original subspecies.

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