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ARE HILL MYNAS (*GRACULA RELIGIOSA*) MORE COMMON IN DISTURBED THAN IN VIRGIN FOREST HABITATS?

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ABSTRACT

Habitat selection of Hill Mynas (*Gracula religiosa*) of the race *intermedia* was studied on five visits to Khao Ang Rue Nai Wildlife Sanctuary, southeastern Thailand. The birds tended to occur in pairs and were often found spatially clumped. Their distribution in two dry seasons was analyzed. They were recorded significantly more frequently in moderately disturbed than in fully intact primary forest. The species was confirmed in all moderately disturbed sites but not in several of the undamaged ones. On the other hand, it was found much more infrequently or not at all in greatly disturbed forest habitats and a reforested area. This study suggests that good-quality forest combined with a portion of open habitat may be highly attractive for Hill Mynas during the non-breeding season.

Key words: forest habitats, *Gracula religiosa*, habitat use, Hill Myna, Khao Ang Rue Nai Wildlife Sanctuary

INTRODUCTION

While there is a considerable amount of information on the distribution of and resource use in South Asian sturnids living in open habitat (*e.g.* ALI & RIPLEY, 1972; TUNHIKORN, 1990), such knowledge is much more limited with respect to forest-living sturnids of the region, including the Golden-crested Myna *Ampeliceps coronatus* and Hill Myna *Gracula religiosa* (*e.g.* FEARE & CRAIG, 1998). Although records of these two forest-dwelling species are reported in more comprehensive avifaunistic literature (*e.g.* EVANS *ET AL.*, 2000), detailed studies are lacking. Rough information on the distribution of both species in Thailand, particularly in protected areas, is presented by ROUND (1988). Severe threats to the Hill Myna originate from the pet trade (ROUND, 1988; ARCHAWARANON, 2003). Particularly in view of the ongoing habitat loss in the species' distributional ranges, there is a strong need for data on the role various forest types, *i.e.* virgin to differentially degraded, play for the birds.

In an earlier study, sturnids were surveyed in Khao Ang Rue Nai Wildlife Sanctuary, southeastern Thailand, in two dry seasons (SONTAG, 1998). This area is part of the largest lowland evergreen forest complex in Thailand (CUBITT & STEWART-FOX, 1995). Most of the observations were done in three forest categories defined according to human impact. Surprisingly, forest-living sturnids appeared to be more common in moderately disturbed than in unaffected forest. However, no quantitative data were available for statistical analysis.

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Special methodological problems arose from habitat classification and defining comparable sites.

More recently, I revisited Khao Ang Rue Nai Wildlife Sanctuary on three occasions (SONTAG, 1999). In the present paper the forest sites are critically re-evaluated based on all five visits and an attempt is made to quantify the proportional distribution of one of the observed species, the Hill Myna (*Gracula religiosa intermedia*), in three forest types classified according to human impacts. In addition to the data from two dry seasons (1994, 1995), some findings from the later visits are also reported where useful.

STUDY AREA

Khao Ang Rue Nai Wildlife Sanctuary is located in Chachoengsao, Chonburi, Rayong, Chanthaburi and Prachinburi Provinces in Southeast Thailand. It covers a small part of the Prachinburi floodplain and extends across the Chonburi-Chanthaburi watershed (CUBITT & STEWART-COX, 1995; ROUND, 1988). The sanctuary belongs to the largest primary forest complex in Southeast Thailand. Its topography is characterized by well-watered lowlands and several hills, such as Khao Takrup (661 m) and Khao Ang Rue Nai, the highest point in the sanctuary (777 m). Precipitation is variable according to the specific areas and is estimated to be 1,500–2,000 mm per year in most places relevant here (sources: Industrial Promotion Center Region 9; Wildlife Research Station; see also Acknowledgements). Regardless of more subtle sub-distinctions, the vegetation is generally classified as lowland evergreen forest. Extensive sections of the area consist of selectively logged semi-evergreen forest on level ground and in the vicinity of larger streams at 100–200 m elevation (ROUND, 1988). The most dominant tree is *Lagerstroemia calyculata*; the other important tree species include *Afzelia xylocarpa, Pterocarpus macrocarpus, Tetrameles nudiflora*, and *Irvingia malayana* (KITAWACHAKUL, 1998).

The observations were made in the sanctuary, including a buffer zone area in the north-west, in November 1994 and December 1995. Two more visits took place in 1997/1998 (December/January) and 1998 (November/December). All the four stays were in the dry season. An additional visit took place in April 1996 when the climate was hot and wet. Count data from the latter period are used here only for discussion and when specifically stated.

METHODOLOGY

Sites

The study sites were situated within approx. 13°15'–13°28'N latitude and 101°40'–101°58'E longitude. All of them were located in the lowlands except for Site 17 on a gentle slope and the steeper Site 25 in the Khao Takrup range (Fig. 1). I chose the sites randomly, although, for practical reasons, accessibility played a role in the selection process. All the analyzed plots, however, were considered to be independent, including those that were in the same area (*i.e.* Sites 8a-c, 13a-c, and 22/1–22/3). The 29 available forest sites include seven plots where former nesting-sites of forest-living mynas were known

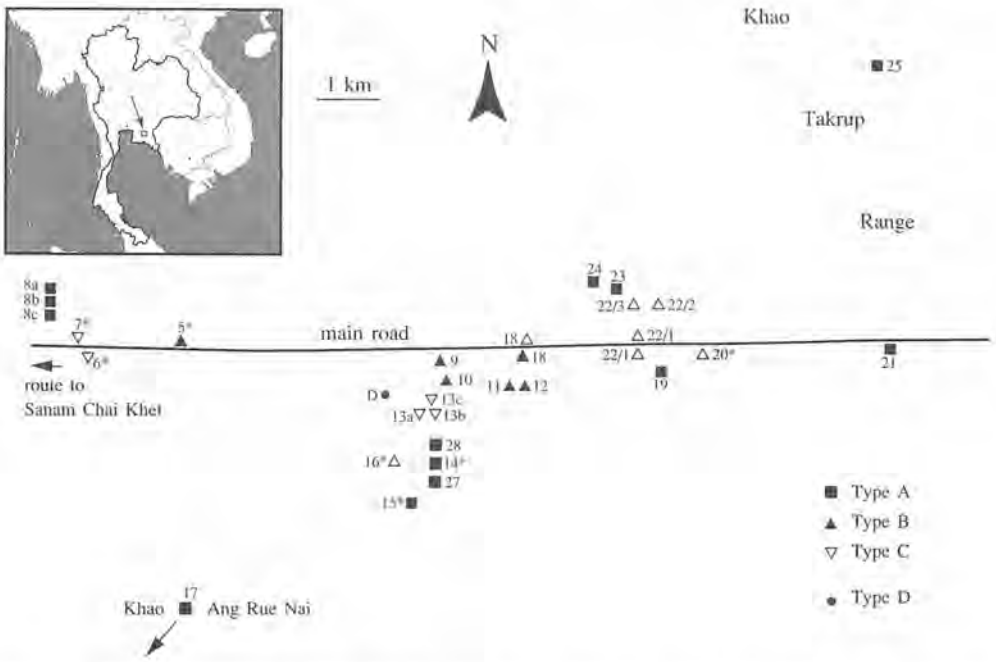

Figure 1. Study site locations in Khao Ang Rue Nai Wildlife Sanctuary. Type A-C: primary forest. Type D: reforested area. Asterisk indicates "nesting-tree site".

(*i.e.* "nesting-tree sites"; Fig. 1) (P. PONSENA, pers. comm.) but birds were not actually detected. All sites are attributed to one of several distinct habitat types according to the classification given below. As the sites other than "nesting-tree sites" were roughly comparable in size (approx. 16 ha), only these 22 sites were taken into account for the quantitative analyses.

Additionally, a reforested site was checked. This plot was deemed as an appropriate control site because (1) other songbirds were seen here, (2) according to P. PONSENA (pers. comm.), Hill Mynas approached the semi-reforested area situated nearby, and (3) Hill Mynas have been reported from environments drastically changed by humans (ALI & RIPLEY, 1972).

Sampling

The aim of this investigation was to record all Hill Mynas present in the sites as completely as possible in order to gain a reliable measure for the relative abundance of the species in different habitat types. The study does not, however, attempt to determine exact overall densities. Thus, special consideration was given to the comprehensiveness of the surveillance of the respective sites. For this purpose, a combination of line transects and point counts was applied covering walking distances of approximately 500 m (range c. 400–1,000 m). As total visual overview usually was not possible, acoustic evidence was

crucial except for larger groups (*i.e.* flock size > 6 individuals). Hence, only in Site 22/1 did visual cues play the key role. Due to the restricted sizes of the plots the counting distance was clearly less than the detection distance in all habitat types. Birds more than 200 m away were excluded from counting. Sites were visited on one to four days (Area 22: four times on three days and a partial visit on another day). Counting time was c. 30–40 minutes per site (exception: Site 17 — roughly 60 min for 1,000 m). Thus, the same amount of effort was applied at all sites. The time spent in Sites 27 and 28 (no birds found) situated in an extended forest area was shorter. These data, however, were included because adjoining, much larger forest parts of similar quality were visited directly before and afterwards and no birds were detected there either.

Additional confidence in the results was provided by observations made at the sites before and/or after the proper counting sessions whenever possible. For the difficult Site 23, useful information from the later stays was also taken into account.

As suggested by direct observations and confirmed on later visits, two individuals usually occur at/close to a specific sound source, even if only one of the birds may be detected. Such records were therefore taken as representing two individuals, except for one case in which definitely only one individual was documented. On a few occasions it was not possible to determine the number of birds with certainty due to poor visibility. Hence, two different types of data are presented: confirmed records, *i.e.* minimum individual numbers, and estimated numbers.

Independent of all parameters including site, habitat type and observation periods, in total, between 67 to 128 individual Hill Mynas were recorded. The wide range between minimum and maximum numbers was largely due to flocking birds observed in an area on one day under difficult viewing conditions.

Habitat Classification

Four habitats are differentiated here according to human impact. Three of them are primary forest habitats (Types A, B, and C, respectively); they could be qualitatively distinguished by sight. The reforested control site was designated Type D.

Type A: fully intact primary forest; undamaged pristine, dense vegetation with large trees; no logged area or (in some cases) few limited forest patches or strips damaged by man, such as paths and selectively removed trees (see also below).

Type B: moderately disturbed primary forest; largely dense, original vegetation with high trees; however, extended patches of logged or otherwise damaged vegetation or clearings; up to 50% of the area damaged or logged.

Type C: severely devastated habitat; much open area, "savannah-like"; a few isolated or scattered large trees or tree-remnants are left and the surrounding forest edge is usually present; introduced trees may occur; less than 20% of the area covered by original forest.

Type D: reforested area containing few tree species (such as Caesalpiniaceae; *Leucaena leucocephala*, Mimosaceae); estimated tree heights 7 m.

The present habitat classification partially differs from the initial scheme (SONTAG, 1998). Originally, the attributes had been based on the change of a forest section by humans regardless of the actual consequences of human activity (considering the main road *per se* as neutral, where applicable). For instance, Sites 8a, 8b, 8c situated in a buffer zone were characterized by very large trees, much dense vegetation and extended patches

of a Type A character despite some former human encroachment. This forest part now appeared undisturbed by humans, and the presence of a well-established wild elephant population suggested that the area was successfully protected. Thus, it is appropriate to attribute Type A quality to those sites in this investigation.

In total, 13 forest sites were assessed to be Type A habitats, 11 Type B, and 5 Type C. Excluding the "nesting-tree sites", 11 sites were Type A, 8 Type B, and 3 Type C.

Data Analysis

The frequencies of recorded Hill Mynas per site were compared (a) between all three primary habitat types A, B, C (Kruskal-Wallis test) and (b) solely between A and B (Mann-Whitney U test), which by far were the most frequent habitat types. SPSS software (version 7.5 for Windows) was used.

RESULTS

Hill Mynas occurred in all primary forest types studied (Table 1), whereas no individuals were found in the reforested Type D habitat.

An overall comparison between the primary forest types, including the underrepresented Type C sites (*i.e.* devastated habitats), clearly revealed significant frequency differences for both the minimum individual numbers and the estimated numbers (Kruskal-Wallis tests: Chi-Square = 8.894, p = 0.012, and Chi-Square = 7.842, p = 0.020, respectively; df = 2, $N_1 = 11$, $N_2 = 8$, $N_3 = 3$). The same was true for the respective comparisons between Type A and B sites alone (two-tailed U tests: z = –2.637, p = 0.008, and z = –2.382, p = 0.017, respectively). Frequencies in Type B habitat were clearly higher compared to the fully intact sites (Type A). The minimum Hill Myna records and estimated numbers differed

Table 1. Recorded frequencies of Hill Mynas in three primary forest types (excluding "nesting-tree sites") defined according to human impact. Minimum individual numbers and estimated record numbers (related to 16 hectares, *i.e.* individual site size) are given (see text).

	Type A	Type B	Type C
Number of sites (n)	11	8	3
Sites with birds present	7	8	1
Number of birds:			
Minimum individual numbers			
range	0–2	1–16	0–2
median	2	4	0
Est. record numbers			
range	0–4	1–24	0–2
median	2	4	0

only slightly. The values of both categories deviated for only one Type A and B site. Strikingly, no Hill Mynas were found in 4 of 11 Type A sites, whereas in all Type B sites individuals were recorded.

The considerable variation of individual numbers among the sites (Table 1) has three explanations. First, Hill Mynas, if present, tended to occur in pairs and not as single birds. Only once was a single, flying bird documented. In a second case, a conspecific was probably nearby or only briefly separated. Second, pairs were often distributed in a spatially clumped manner, especially apparent in Type B habitats. Third, a patchy distribution pattern was caused by flocking birds. In one case, possibly up to 40 Hill Mynas may have aggregated. In this instance, at least one rich feeding resource, a large fruit-bearing *Lagerstroemia* tree with fruiting *Ficus* around it, was available.

The most heavily used sites were Type B 22–1 to 22–3 with tall trees but a lot of open habitat in the centre (clearing). Hill Mynas were also very common in this area on the three later visits.

Pairwise statistical analyses between Type C habitat and each of the other two primary forest habitat types are less indicative because the number of available C sites was very low. Nevertheless, the single comparison between Type B (much utilized) and C showed a significant difference in individual frequencies (two-tailed U test: $z = -2.084$, $p = 0.037$ for both minimum and estimated record numbers). Recorded bird numbers at both A and C sites were too small to statistically compare the two habitat types. Only one pair of Hill Mynas was actually confirmed in Type C habitat.

DISCUSSION AND CONCLUSION

Although Hill Mynas occurred in all three primary forest types, they were found in significant numbers only in Type A and B habitats. Both habitat types were characterized by many large trees, such as *Lagerstroemia*, which are highly attractive for this arboreal species (pers. obs.) and used for nesting (P. PONSENA & C. KAPASUWAN, unpubl. report; ARCHAWARANON, 2003). The birds were, however, reported distinctly more often from Type B than Type A forest. Remarkably, Hill Mynas intensively utilized a buffer zone section (including Type A Sites 8a, 8b, 8c), where limited logging had formerly taken place, but whose overall aspect was that of an open to moderately dense Type A forest. Even the Golden-crested Myna was observed here. In contrast, no Hill Mynas were found in a steep valley characterized by dense, fully intact vegetation and very high trees in the north of the sanctuary (est. 300–400 m alt.). Likewise, on a trip to Khao Yai National Park (November 1998), no Hill Mynas were discovered in a similar habitat, a steep-sided valley (est. 550 m alt.). Note, however, that Hill Myna records from mountainous areas are inconsistent. In another part of Southeast Thailand (Khao Soi Dao Wildlife Sanctuary), Hill Mynas were observed in such forest in December 1998 (pers. obs.). For the same race (*intermedia*), BERTRAM (1970: 90) classifies ravines and steep slopes as typical Hill Myna habitat in Assam. On Khao Ang Rue Nai, Hill Mynas are common at least on the lower third of the mountain (see below). There may be a difference between races. In South Thailand, the southern race *religiosa* appears to be restricted to level lowland (ROUND, 1988). In India and Sri Lanka, populations (and races) differ in altitudinal distribution (compiled by BERTRAM, 1970).

Two arguments might be raised against the interpretation that Type B habitat is more attractive for Hill Mynas than virgin forest (Type A). First, sample sizes are rather small. Both minimum individual numbers and estimated numbers, however, indicated significant differences. Second, one could argue that it might be more difficult to detect Hill Mynas in dense Type A forest. Accordingly, the result would rather reflect the distribution of records than the actual occurrence of the birds. As counterarguments, Hill Mynas can be localized by ear relatively easily and counting distances were less than possible detection distances. The case of Sites 22–1 to 22–3 also clearly demonstrates that open habitat (clearing with recently planted tree saplings) and its surrounding forest sections can strongly attract pairs as well as flocks (cf. SONTAG, 1998). The combination of available fruit trees and relatively large scanning space for the birds to avoid predation (see ROBINETTE & HA, 2001: 448) might have contributed to this preference. Finally, accumulations of numerous individuals were spotted at another Type B site in the sanctuary in the dry season in 1998. According to ALI & RIPLEY (1972), small flocks occur at the edge of closed forest or in cultivation clearings with sparse sprinkling of standing trees in the non-breeding season. In my study area, Hill Myna records were clearly underrepresented in Type C habitats (*i.e.* devastated forest), especially when considering that (a) in this environment birds were relatively easy to see and (b) much better forest, inhabited by Hill Mynas, was situated nearby. If site numbers, especially of Type C, had been larger, then the minor use of Type C habitat might have been statistically significant (Type A vs. C) or more markedly significant than shown here (Type B vs. C). That no sightings were made in the reforested area with trees measuring less than 10 m high (Type D) is in line with the observed "trend" in Type C habitat.

The observations provide evidence for patchy habitat utilization. This becomes even clearer when forest areas qualitatively surveyed outside the proper study sites are also taken into account. The fruit production of trees (*i.e.* non-fruiting, fruiting, different stages of ripeness) might be much more important for Hill Mynas than the structural difference between Type A forest and high quality B forest (*cf.* ALI & RIPLEY, 1972: 192), at least in the dry season when there is no need for breeding-sites. BERTRAM (1970: 84) points out that large-scale or long-distance migrations probably do not occur, but that regular seasonal movements and altitudinal changes in range are known, probably dependent on changing food supplies and the availability of nesting-sites. The flocks observed in the sanctuary outside the breeding season also suggest that the distribution of individuals varies with the time of year. Two findings from April 1996 would fit with potential changes in local distribution. At that time, precipitation was high in the sanctuary. During a short visit, Hill Mynas were spotted several times on Khao Ang Rue Nai mountain, which supports a large virgin forest area. The distribution of these records was clearly uneven. Furthermore, close to the park station at the foot of the mountain were four neighboring trees containing cavities that had been used by Hill Mynas as nesting-sites. This additionally suggests that Hill Mynas do not necessarily avoid the proximity of humans.

In conclusion, Hill Mynas utilized moderately disturbed more than fully intact primary forest habitats in the northern part of Khao Ang Rue Nai Wildlife Sanctuary outside the breeding season. Habitat choice in other places and the role of different forest types (*e.g.*, open vs. dense; moderately damaged vs. virgin) for this sturnid in the breeding season require further research.

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