NAT. HIST. BULL. SIAM SOC. 46: 43–53, 1998

DEVASTATED, DAMAGED, AND FULLY INTACT FOREST HABITATS AND THE STURNIDAE FAMILY IN A DRY LOWLAND EVERGREEN BIOME IN SOUTHEAST THAILAND

Walter A. Sontag, Jr.[1]

ABSTRACT

The aim of the study was to investigate differences in the avifauna according to different types of habitats, particularly, different levels of habitat change by degradation, in Khao Ang Rue Nai Wildlife Sanctuary. This sanctuary with its lowland evergreen forests is part of the largest block of primary forest in Southeast Thailand. Habitat use was studied in the early dry season in different environments: (I) primary forest with different degrees of human impact (i.e. Types A, B and C), (II) grassland and savannahs, and (III) areas most changed by man. Family Sturnidae (starlings) was taken as the reference group. Six species of sturnids were found. In class III habitat, *Acridotheres burmannicus, A. tristis, A. javanicus,* and *Gracupica nigricollis* were recorded; no forest-dwelling starlings were observed there. In class I habitats, *Gracula religiosa intermedia* and *Ampeliceps coronatus* were confirmed for Type A, and B, respectively, and *G. r. intermedia* also in Type C. Forest-dwelling sturnids were observed relatively frequently at Type B sites. At one Type B and one Type C site, both forest-dwelling and open country starlings were recorded. Additional observation showed that fruiting trees obviously attract rodents and pigeons as well as sturnids. Additional notes on the presence of hornbills and elephants with respective distributions (localities and habitats) are added.

INTRODUCTION

Although habitat degradation is a common phenomenon in Southeast Asia, knowledge about the effects of different levels of forest encroachment on animal populations (e.g. birds) is extremely limited. Therefore, it seemed suitable to look for possible changes in bird communities in a small geographic part where various forest types (i.e. from primeval to totally demolished) do exist near each other, as is the case in the Khao Ang Rue Nai Wildlife Sanctuary (Southeast Thailand).

In Southeast Thailand (22,400 km^2) most primary forest has been destroyed by human impact. According to KLANKAMSON & CHARUPPAT (1984), from 1973 to 1982 the forest cover declined in area by 46.8%. Today, Khao Ang Rue Nai Wildlife Sanctuary is part of the only noteworthy complex of contiguous or nearly contiguous forest areas in Southeast Thailand (ROUND, 1988). Moreover, it is the largest lowland evergreen biome of Thailand (CUBITT & STEWART-COX, 1995). It was extended to 1,030 km^2 (CUBITT & STEWART-COX, 1995) from its original size of 108 km^2 in 1977 (Wildlife Research Station, unpubl. data). The sanctuary is part of a complex of four protected areas which, in total, cover an area of about 2,000 km^2: (1) Khao Ang Rue Nai W.S., in the south separated from (2)

[1] Trubegasse 19/24, A–1030 Wien (Vienna), Austria.

Paper presented at the Second International Asian Hornbill Workshop, Bangkok, 13–15 April 1996.

Khao Chamao National Park by a narrow corridor; to the east (3) Khao Soi Dao Wildlife Sanctuary with the contiguous (4) Khao Kitchakut National Park. According to satellite imagery, the whole region may be regarded as a more-or-less continuous forest, although ROUND (1988) supposed that, altogether, possibly less than 1,000 km^2 may be covered by forest. In the north and west, Khao Ang Rue Nai Wildlife Sanctuary is surrounded by completely deforested and cultivated areas. However, on the sanctuary's boundary, buffer-zones have been established where forest may still exist outside the sanctuary proper.

Apart from some secondary scrub, grasslands, and "savannahs" (i.e. grass mixed with other low vegetation such as herbs and low scrub; single or sparse trees may occur), the sanctuary itself comprises true evergreen forest extending from the lowland up the hills of Khao Takrup in the north and Khao Ang Rue Nai in the west.

The "savannahs" have arisen due to human settlement and cultivation which stopped some years ago, when inhabitants were moved to areas outside the boundary of the sanctuary (Wildlife Research Station, pers. comm.). Even today, logging has not been totally prevented (pers. obs., 1995). In contrast to the reduction of the primary forest, some areas of secondary scrub or secondary forest (with low trees) have become well established. Indeed, introduced trees found there have reached remarkable sizes estimated at 12–13 m high (Site 13, see below). Furthermore, various areas are going to be systematically reforested with native trees (e.g. *Afzelia;* N. Koonkhunthod, pers. comm.).

Presently, the sanctuary encompasses habitats for many forest birds, such as three hornbill species (Oriental Pied *Anthracoceros albirostris,* Wreathed *Aceros (Rhyticeros) undulatus,* and Great Hornbill *Buceros bicornis;* ROUND, 1988). Moreover, the sanctuary is large enough to provide space for viable populations of large mammals. A self-sustaining elephant population has survived up until now, and in 1995 tiger tracks were found in the northern part of the sanctuary where Sambar Deer *Cervus unicolor* are common (D. Smith, pers. comm.). However, for preservation, management problems might arise from contrasting habitat requirements of different animal species. Conservation measures to be considered may involve reforestation with native trees, felling introduced tree species, or maintaining the current situation. In any particular case, conservationists may come into conflict with each other over which kind of habitat should receive preferential attention. Some animal species take advantage of a considerable proportion of open country; however, other species profit most from dense forests. It remains obscure to what extent secondary habitats are used by forest animal species such as hornbills. JOHNS (1987, 1988) reported on the use of primary and selectively logged rain forest by hornbills and the consequences of logging for hornbills in Malaysia. In the light of our limited knowledge on differential habitat utilization, I present the first findings from the Khao Ang Rue Nai Wildlife Sanctuary.

During my stays in the sanctuary in the early dry season, I studied the sociology, group composition, and flock size of starlings in various habitats. The starling group (Sturnidae) seemed appropriate for comparative investigations on habitat use in the sanctuary, because this bird family (1) is well represented in Khao Ang Rue Nai Wildlife Sanctuary, and (2) is found both in open and in forest habitats (LEKAGUL & ROUND, 1991). Moreover, starling species do not only occur sympatrically, but their habitats may overlap considerably (TUNHIKORN, 1990; pers. obs.). Starlings, to a high degree, inhabit open country (SONTAG, 1992), but Hill Myna *Gracula religiosa* and Golden-crested Myna *Ampeliceps coronatus,* both found in Khao Ang Rue Nai Wildlife Sanctuary, live in the forest. The habitats

studied were situated relatively close to, or even adjacent to, each other (with one area apart) and included widely divergent vegetation types, such as open deforested country, scrub and secondary forest consisting of low trees; but in this paper special emphasis was laid on areas covered by primary forest remains and partially or fully intact primary forest (Types A–C). Therefore only findings relevant to forest assessment are presented.

METHODS

The observations were made in Khao Ang Rue Nai Wildlife Sanctuary in November 1994 and December 1995; both periods were in the early dry season, which is known to be the non-breeding season for sturnids in this area. Additionally, buffer zone areas that included forest outside the sanctuary's boundary were also visited to check their condition (Fig. 1): in the west, (a) south to the main road, along the route to Khao Ang Rue Nai near the foot of the mountain, visited in 1994, and (b) directly north to the main road crossing the sanctuary, visited in 1995; in the north, on the northern slope of Khao Takrup not far from the waterfall and the temple, visited in 1995.

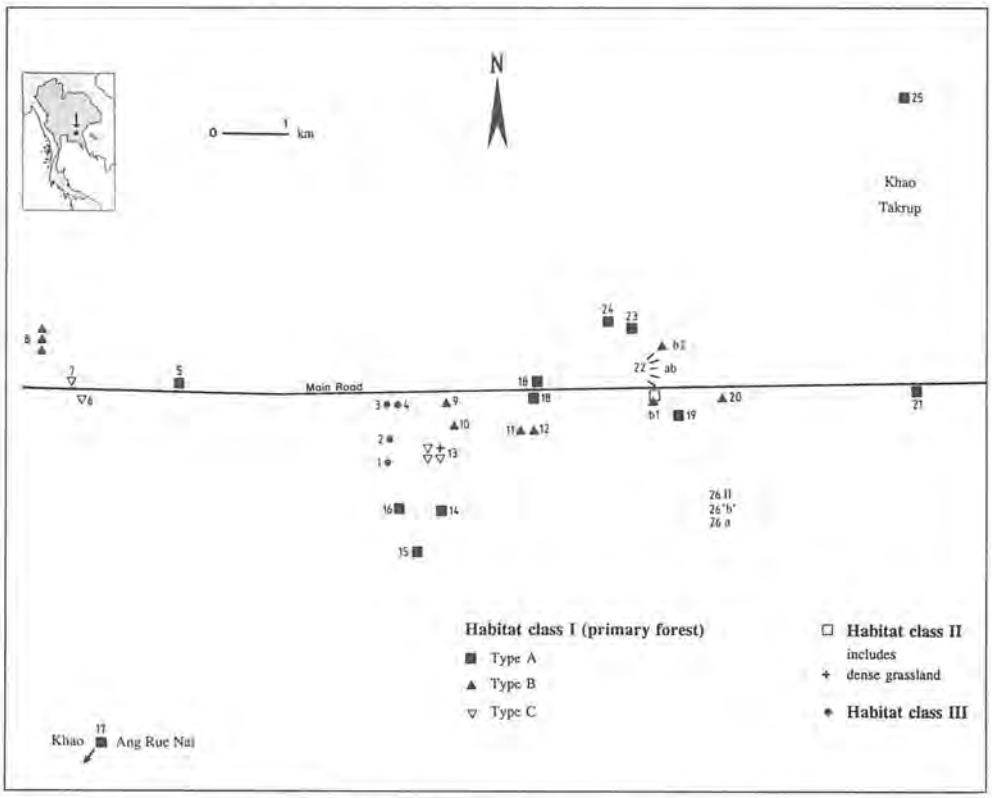

Figure 1. Observation sites in Khao Ang Rue Nai Wildlife Sanctuary. For descriptions of the study areas, see Table 1. Locations on the map were estimated as exactly as possible and given as marks when possible (26a–c , only rough orientation possible; Table 3). Scale: approx. 1 km.

Table 1. Descriptions of habitat classes and types present within the control sites (Class I, Type AñC) and study sites (Classes II and III) in 1994 and 1995. Extended site numbers (i.e. 22ab) indicate specific subsites. Site 26 is excluded because of methodological differences from the other sites (see Table 3). * Site 22ab contained habitat of Class/Types I/A, I/B and II, but was classified in this study as type I/B because the proportion of virgin forest present was found to be minimal.

Habitat Class	Habitat Type	Description	Sites in which habitat was present 1994	Sites in which habitat was present 1995
I	A	Primary forest virgin or relatively intact, including intact patches along the main road.	5, 14, 15, 16, 17, 21, 22ab*	18, 19, 23, 24 25, 22ab*
	B	Primary forest disturbed by humans to a certain degree (i.e. moderately damaged), but with dense vegetation and tall trees. Includes forest edges adjoining grasslands.	20, 22ab*, 22b1, 22b2	8, 9, 10, 11, 12, 22ab*, 22b1
	C	Devastated (i.e. drastically damaged) primary forest and resulting remnants	6, 7, 13	13
II		Grasslands and savannahs with monotonous vegetation without stratification. If present, trees occur sparsely or singly.	22ab*, subsite of 13	22ab*, subsite of 13
III		Agricultural land or secondary forest, including areas at the Wildlife Research Station with several aviaries surrounded by a rivulet, a tree plantation (saplings), secondary forest (trees approximately 9 m tall), a cut meadow, and areas of dense bushy scrub with a few tall trees.	-	1, 2, 3, 4

For practical reasons, the study sites (Table 1, Fig. 1) were partially selected due to accessibility. They consisted of one particular habitat type or could be subdivided into subsites with distinct habitat types according to the classification given below. Further consideration was given as to whether the surveillance of the respective sites could be comprehensive, as visual overview was not thoroughly possible in the forest. Therefore, acoustic cues played an important role for recording, and the size of the observation unit was limited by the certainty of auditory perceptibility within the whole observation area for a given observation period. The sizes of sites were kept as consistent as possible, although some variation in size inevitably resulted from specific local conditions (Sites 17 and 25). The study sites varied in area from 2–50 ha according to the openness or density of their habitats. In order to avoid overlooking records, checks were made in the sites

before and/or after the observation periods. Where possible, checks were also made in the marginal areas of the observation sites. Study sites were repeatedly visited in order to (a) monitor the use or non-use of a given site by sturnids, (b) get enough information for a particular habitat type (as in the case of Type C sites; Table 1) and (c) obtain as much data as possible from a richly structured area. Some sites with known nesting-trees of Hill Myna and Golden-crested Myna were also checked (Table 2).

In 1994, a standard observation schedule was developed and strictly applied on subsequent visits in 1995. The standard observational procedure was to record species and numbers of individuals present at the beginning (time = 0 min.), middle (time = 5 min.) and end (time = 10 min.) of 10-minute sessions. Once sighted, the birds were observed continuously for as long as they remained in visual or auditory contact, for periods up to 1 hour. In addition, excursions were made outside of the study sites and, in parts of the extensive Sites 17 and 25, for opportunistic recordings and important information on the potential distribution of the birds.

Habitat Classification

Three general habitat classes were distinguished as follows (for details see Table 1).

I. Primary forest:
   Type A (intact forest)
   Type B (damaged)
   Type C (devastated)
II. Grasslands and savannahs
III. Vegetation resulting completely from drastic changes due to human activities

Except for the control sites (class II: one subsite of Sites 13 and 26; class III: Sites 1–4), all the other sites included primary forest Types A, B, and C (Table 1). Eleven sites were attributable to Type A (two of them occupying large areas on Khao Takrup, and Khao Ang Rue Nai, three situated along the main road, and one adjoining the main road on one edge). Seven sites were characterised by habitat Type B inclusive of three subsites neighbouring in Site 8, and in Site 22. Three sites were classified as habitat Type C, including three subsites of Site 13 adjacent to each other. Using an alternative principle of classification, 16 out of 19 sites (20 out of 25 subsites) under full observation were made up of habitat Types A and B, primary forest. Site 22 was very heterogeneous with respect to habitat type, i.e. I/A, I/B, and II (e.g. class II confining subsite 22b1; Fig. 1); according to the large portions of forest contour lines and Type B habitat, its subsites could, however, be treated as Type B (Table 1).

Species Observed

The species observed during this study can generally be attributed to two habitat categories, open country or forest (KING ET AL., 1975; LEKAGUL & ROUND, 1991; SONTAG, 1992). Common Myna *Acridotheres tristis,* White-vented Myna *Acridotheres javanicus,* Black-collared Starling *Gracupica nigricollis,* and Vinous-breasted Starling *Acridotheres*

Table 2. Observations of starlings in various habitats. Study sites 1-4 (Class III in 1995) served as basic standards of comparison with the primary forest (Types I/A, I/B and I/C); thus observations at each of the sites 1-4 were summarised and not listed in detail. For details of Site 22, see Table 1 and Fig. 1. CM = Common Myna, WM = White-vented Myna, BS = Black-collared Starling, VS = Vinous-breasted Starling, HM = Hill Myna, GM = Golden-crested Myna. + = confirmed present, number unknown, ++ = confirmed present and abundant, ~ = confirmed present, number estimated, - = not present. * information confirmed by Pongsak Ponsena (pers. comm.)

Habitat		Observation	Site	Starling species observed					
Class	Type	type	number	CM	WM	BS	VS	HM	GM
1994									
I	A	Direct obs.	17	-	-	-	-	2	-
		Nest tree*	5, 14, 15, 16	-	-	-	-	4	2
		Sound/call	19, 21	-	-	-	-	+	-
		Seen flying	-	-	-	-	-	-	-
I	B	Direct obs.	22b2	-	-	-	-	2	-
		Nest tree*	20	-	-	-	-	2 or >2	-
		Sound/call	22	?	-	?	?	2-4	-
		Seen flying	-	-	-	-	-	-	-
I	C	Direct obs.	13	-	-	-	+	-	-
		Nest tree*	6, 7	-	-	-	-	2	-
		Sound/call	13	-	-	+	-	-	-
		Seen flying		-	-	-	-	-	-
1995									
I	A	Direct obs.	18, 23	-	-	-	-	+	2
		Nest tree*	-	-	-	-	-	-	-
		Sound/call	19, 24	-	-	-	-	+	-
		Seen flying	-	-	-	-	-	-	-
I	B	Direct obs.	8, 9, 10, 12, 22ab, 22b1	-	-	+	~ 40+2	16-18+ ~15-40 (Site 22)	2+~ 20 (Site 22)
		Nest tree*	-	-	-	-		-	- -
		Sound/call	8, 9, 12, 22ab	-	-	+	-	9	-
		Seen flying	8, 11, 22ab	-	-	-	-	4	-
I	C	Direct obs.	13	-	-	-	-	6	-
		Nest tree*		-	-	-	-	-	-
		Sound/call		-	-	-	-	-	-
		Seen flying		-	-	-	-	-	-
II			1, 2, 3, 4	++	2	++	++	-	-

burmannicus were found in open habitat, whereas Hill Myna and Golden-crested Myna were found in the forest.

RESULTS

Observations of sturnids in each habitat type are presented in Table 2. In the class III study sites (Sites 1–4), none of the forest-dwelling sturnids were observed. No starlings were observed in the low forest (Site 2). At Site 1, Common Mynas, Vinous-breasted, and Black-collared Starlings were found very often; only once two White-vented Mynas visited the area for a brief period in the evening. This was the only record obtained in this study for the presence of this species in the sanctuary. Throughout the entire study period, neither Hill Myna nor Golden-crested Myna was observed at Site 1, although a number of Hill Mynas were kept in a spacious aviary complex (both in 1994 and in 1995), and plenty of trees were growing or had been newly planted throughout the area. But it should be stressed that no *Eucalyptus* trees were noted in this region (Sites 1–4).

In the primary forest, individuals of the *Sturnus-Acridotheres*-group (SONTAG, 1992) were observed only at Sites 13 and 22 (Table 2). In Site 13, a devastated area, three sturnid species were identified: Vinous-breasted Starling (in small numbers, 1994), Black-collared Starling (heard, 1994) and Hill Myna (1995). Hence, the forest-dwelling Hill Myna and the open country Vinous-breasted and Black-collared Starlings (LEKAGUL & ROUND, 1991) were never seen there simultaneously. Surprisingly, two Hill Mynas (presumably a pair) seemed to utilise the area extensively.

In 1995 at Site 22, many (>20 individuals) of the Vinous-breasted Starlings and Hill Mynas, as well as a remarkable number (>15 individuals) of the Golden-crested Mynas were seen almost simultaneously. Smaller numbers of Black-collared Starlings were also observed gathered with Vinous-breasted Starlings in a big, densely leafed tree, in the centre of the southern clearing. Two Vinous-breasted Starlings remained perched in a low tree in the savannah area in subsite 22ab, the only clear evidence of the use of habitat class II in this study.

The results from the excursions (Table 3) support the above finding that species of the *Sturnus-Acridotheres*-group (SONTAG, 1992) made use of primary forest habitats to a lesser extent. On these excursions, no sturnids at all were recorded, even in class II habitat.

Hill Mynas and Golden-crested Mynas were found to be distributed more widely in the primary forest habitats than the other starlings living in the sanctuary. Evidence of trees with nest cavities used by these species provided additional data (Table 2).

It should be stressed that observations were made outside the breeding season, and therefore, only casual data can be presented in relation to nest sites. However, nest sites were recorded in all primary forest types, at four different Type A sites, one Type B site and two Type C sites. Nest cavities tended to be in very large trees (ARCHAWARANON, 1994; pers. obs.).

In regards to direct observations, Hill Mynas appeared to be seen more frequently in 1995 than in 1994 (Table 2 and Discussion). Also, Golden-crested Mynas were recorded as abundant in 1995, even though there were no direct observations of this species in 1994.

Hill Mynas were most frequently seen in pairs (Table 4). Only on two occasions was an individual bird seen. Relying on acoustic cues often made it difficult to judge from a

Table 3. Long distance, one day excursions on which no sturnids were found. The standard observational methodology was not applied. Estimated maximum distance from the respective starting points is given.

Route	Maximum distance	Specific sites included	Year
Passing through the region of sites 22-24-22, north of the main road	2 km	23, 24	1994
South of the main road	1.5 km	20	1994
South of the main road	5 km	20 26a (Type A) 26'b' (Type A or B) 26II (Class II)	1995

Table 4. Frequency distribution of number of Hill Mynas recorded per observation in Khao Ang Rue Wildlife Sanctuary. *The five extra records arise from unidentifiable sturnids which may have been either Hill or Golden-crested Mynas.

	No. of individuals directly observed			No. of individuals observed by sound only
	1	2	>2	
Frequency of sightings	2	16–17	3(Site 22)	11–13 (18*)

distance whether one or more individuals produced the sounds, and whether they were alone at a given site or accompanied by a conspecific bird. This data indicates a marked difference from open country starlings which are gregarious and often seen in flocks (SONTAG, 1992) (Table 2).

Obviously, Site 22 (with large clearings on both sides of the main road and extensive primary forest surroundings) served as a stronghold for Hill and Golden-crested Mynas. The birds only made use of the true forest parts; they were never seen in the large trees remaining in the clearings. Both species were found there in flocks. Pied Hornbills were also frequently seen at this site.

According to the data, Type B habitats were more densely inhabited by the "forest-dwelling" sturnids than dense, virgin forest (Tables 1 and 2). On the northern slope of Khao Takrup (northern peak = 525 m a.s.l.), the virgin evergreen forest (altitude < 500 m a.s.l.) is characterised by a well developed main canopy and large emergent trees; no sturnids were seen or heard at this site. However, in forest Type B habitats, Hill Mynas were found relatively frequently. It is noteworthy that this finding even held true for the sanctuary's buffer-zone on the western boundary, north to the main road where the original

habitats of the adjoining area have been completely changed by man. It has already been alluded that the poorly forested Site 13 (Type C) was part of the range of Hill Mynas.

Strictly speaking, the above findings are related to the early dry season. However, arbours, actually used as nest trees by forest dwelling mynas (P. Ponsena, pers. comm.), provided clues to species' habitat selection in the breeding season. Nest trees were recorded in all kinds of primary lowland forest including Type C, and nest trees in Type A situated near the main road may also be considered as indicators of selecting (or tolerating?) breeding habitats that encompass or share in clearings and often are anthropogeneously changed, as it is a characteristic of forest Type B.

Although the significance of fruiting trees could not be quantified, it became obvious that very large fruit-bearing trees, three *Ficus* (at Sites 10, 22b1, 23), were highly attractive for sturnids, and for pigeons and rodents as well. At Site 22b1 a *Lagerstroemia* tree being strangled by a *Ficus* specimen (both of them with fruit) turned out to be exactly the place where flocks of Vinous-breasted Starlings and Hill Mynas, and at least a few Golden-crested Mynas were recorded.

An Additional Faunistic Note

There was considerable evidence for elephants in both years (footprints, droppings and calls). They used grasslands (class II) and all kinds of forest habitats. In 1995, at least one herd, including a calf (born in November; N. Koonkhunthod, pers. comm.), lived in the region around the headquarters; many footprints were found throughout the region of Sites 9–13. Fresh footprints were seen beside the main road very near Site 4 and a bull attended the area around the old Wildlife Research Station (Site 2). In Site 8 (buffer zone), on the sanctuary's boundary, fresh droppings and many footprints were found.

DISCUSSION AND CONCLUSION

The Khao Ang Rue Nai Wildlife Sanctuary consists of both original primary forest and areas affected, or even totally changed, by man, thus showing tremendous encroachment. Infringements continue to some extent. Apart from human impact, it appeared that the natural vegetation of some parts was affected by the elephant population due to their locally high density.

In the bird family studied, open country sturnids of the *Sturnus-Acridotheres*-group (comprising Vinous-breasted Starling, Common Myna, White-vented Myna, and Black-collared Starling) and forest-dwelling sturnids (Hill Myna and Golden-crested Myna) showed minor overlapping in habitat use. All habitat types that consisted completely or partially of primary forest elements were utilised by forest-dwelling sturnids, whereas in environments totally shaped by anthropogenic influence no Hill or Golden-crested Mynas were ever found. Although the studies were made during limited periods outside the breeding season, there is strong evidence that all primary forest types (i.e. Types A–C) are used by these sturnids both in and outside the breeding season. A prominent fact was that forest Type B, which had previously suffered considerable encroachment was highly attractive for both species. Many individuals remained in this habitat for extended periods and may even

have a preference (possibly seasonal or temporary) for it. This finding may indicate a preference of Hill and Golden-crested Mynas for some portion of open vegetation and/or less closed forest in their environment. An additional factor may be the presence of fruiting trees in such habitats. In the breeding season, nest sites available may be influential as well. ARCHAWARANON (1994) stated that "for the predator constraint" Hill Mynas breed in trees higher than 30 m and isolated from other trees. However, I observed a pair of Hill Mynas perching near a cavity (apparently appropriate for nesting) in a large *Lagerstroemia* tree inside the forest (Type B), in which case Archawaranon's argument may not hold true.

There is no satisfactory explanation for the considerable differences in observation frequencies between November 1994 and December 1995. Methodological reasons might have been (in part) responsible for the impression of an increase in individual numbers and density, for example, the better knowledge of the region. Another parameter that may possibly account for differences in the detection frequency or detectability of Hill Mynas between both years is time of day; for instance, in one case a number of individuals were recorded in an area where none had been perceived earlier on the same day. However, the example of Site 13 (with primary forest Type C) in which extensive investigations were conducted in both years indicates an actual rise in Hill Myna numbers. On the other hand, it cannot absolutely be excluded either that the precise time within the season may have influenced data collection. The distribution of fruiting trees might have played a role. Overall, soil condition was somewhat drier during the observation period in 1995 than in 1994 (which may indicate more specifically defined phases of the season); however, there was some rainfall during the visit in 1995, but not in 1994. A change in individual numbers over the past years may be a plausible explanation as former human residents were recently settled outside the sanctuary. Thus, direct persecution pressure has been reduced and recovery of vegetation is taking place. A change in vegetation cover could easily be established in the area of the Wildlife Research Station where trees planted recently had distinctly grown within 13 months.

Regular records of forest-dwelling starlings in encroached habitats also suggest that primary forests which have been interfered with might regain a noteworthy part of their potential as homes to former resident species, but only if protection is actually provided in the present. Several observations, in addition to those of the sturnids, indicate that other forest species presently not thought to occur in the study area are potential members of the local avifauna, and may return to such protected forest habitats. In April 1996, Oriental Pied Hornbills were seen at two different localities in the same region, and a single female Wreathed Hornbill was seen flying over a clearing next to Site 13. According to N. Koonkhuntod (pers. comm.), this species had not been observed in that region before (which may in fact mean ëin a long time').

ACKNOWLEDGMENTS

In the field, I was assisted by Susanne Sontag. I thank Mr. Pongsak Ponsena for information on breeding sites of Hill and Golden-crested Mynas. I am indebted to Dr. Rose Samuel for improving the readability of the manuscript. I am specially grateful to

Dr. Schwann Tunhikorn, Mr. Sawai Wanghongsa, Mr. Narong Koonkhunthod, and Mr. Pongsak Ponsena for supporting my research in the Sanctuary.

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