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CHAPTER 11

RELATIONSHIP BETWEEN THE BIRD COMMUNITY AND HUMAN ACTIVITIES IN A MOUNTAINOUS AREA ADJACENT TO GUNUNG HALIMUN-SALAK NATIONAL PARK, WEST JAVA, INDONESIA

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ABSTRACT

To determine how birds in secondary habitats respond to different farming systems and human activities, we conducted research in two villages adjacent to a national park where villagers employed different farming practices in West Java, Indonesia. We first determined how the species composition of birds differed between the two villages and then identified environmental factors that influenced the species composition of birds, using a classification based on diet and foraging sites of each species. We also determined the distribution pattern of each species to assess the sensitivity of each species to habitat changes. We recorded 36, 39, and 64 species in village A, village B, and the forest, respectively. The total number of species was not significantly different between the two villages, although the species composition of birds in relation to habitat type showed different patterns. No species significantly preferred the peripheral or the core areas corresponding to proximity to the forest. Land-management practices such as fallow lands, extensive understory, or various planted tree species affected the species distribution in relationship to foraging sites. Forest edge and forest species were distributed in fuelwood plantations in village A and in tree gardens spread throughout village B. In addition, extensive management in the tree gardens in village B maintained the understory vegetation, which provided habitat for understory foragers. In village B, fallow lands as a result of swidden cultivation provided open habitat and shrub environments for species foraging in the understory and in small trees. The farming system and land-management practices differed between the two villages according to sociocultural factors such as traditional customs. Human activities have changed the secondary environment of the villages, which has affected the composition and distribution of birds.

Key Words: bird species, human activities, land management, agricultural landscape, national park.

INTRODUCTION

According to the “Threatened Birds of Asia” Red Data Book (Bird Life International 2001), Indonesia has the largest number of threatened bird species in Asia (115 species). Human activities such as logging, arable farming, shifting cultivation, and clear-cutting deleteriously affect most threatened species. Agricultural intensification, including the conversion of large areas to intensive crop cultivation, irrigation schemes, use of pesticides, and livestock grazing, cause further declines in bird species, even when they have adapted to cultivated habitats.

Agricultural landscapes remain under intensive pressure from humans. The chance of survival and persistence of bird species in this environment is closely connected with natural habitat enclaves or with adequate adaptations to environmental change (Tworek 2002). For example, artificial woodlands in agricultural environments provide substitute habitats for birds. In Mexico, small, scattered forest patches managed by indigenous people contain an important part of the original biodiversity of the area (Toledo *et al.* 1994). Similarly, multipurpose and traditionally managed agroforests have potential as buffer zones between densely populated areas and protected forest (Thiollay 1995).

Local natural environments are strictly influenced by the culture, livelihood, and farming systems of associated villages. Recently, commercialization and intensification of agriculture has triggered an expansion of arable land and changes in cropping patterns, which has caused fragmentation and degradation of remnant habitats. Such changes are considered to alter both spatial and temporal heterogeneity of habitats, and thus it is important to consider how culture, livelihood, and farming systems maintain bird habitats.

The objective of this study was to determine how birds in secondary habitats respond to different farming systems and human activities. We conducted research in two villages adjacent to a national park, where villagers practiced different farming systems. Village A engaged in rice farming with a double cropping pattern and commercial crop cultivation, whereas village B practiced traditional rice farming with a single cropping pattern and swidden cultivation. Although the activities of villagers are changing toward being more market-oriented in village A, villagers in B maintain an indigenous system following traditional customs.

Gunung Halimun-Salak National Park in West Java Province is a well-conserved montane forest on Java Island. This park harbors 244 bird species, including 32 species endemic to Java (Prawiradilaga *et al.* 2003). The national park administratively overlaps with 103 villages (Japan International Cooperation Agency 2005). More than 300 settlements are located within the park boundary, and more than 100,000 people rely on the land and resources in the park. The national park contains a mixture of land uses, including primary forests, secondary forests, tea estates, rice fields, and croplands. Villages in and around the national park practice various types of livelihood and farming systems. Some villages have experienced radical changes in lifestyles and farming systems, whereas others maintain traditional practices, following traditional customs and common law. Thus, this area was well suited to study the influence of social and historical factors of local people on birds.

To clarify the effects of agricultural and social factors on bird species composition in the two villages, we first determined how the species composition of birds differed between the two villages. We then identified environmental factors that influenced the species composition of birds and determined the distribution pattern of each species to assess the sensitivity of each species to habitat changes.

METHODS

The study sites were located adjacent to the Gunung Halimun-Salak National Park in West Java Province. We compared the species composition of birds between two villages that practiced different farming systems but were located near primary forest in the national park to determine how birds in the surrounding area respond to human activities.

Village A was located ca. 1.2 km from the protected forest at the eastern side of the national park (6º45’ S, 106º34’ E; 850–920 m elevation). In 2004, the local population of village A was 1385 people in 287 households (M.K. *et al.* unpublished data). Most villagers engaged in agriculture, and in 2004, the village area covered 85 ha in paddy fields and 35 ha in other uses, including dry fields, woodlands, and hamlets (M.K. *et al.* unpublished data). Dominant land uses consisted of fuelwood plantations and cropland at the periphery, and paddy fields and grass–shrub areas in the core. Villagers cultivated rice and cassava for subsistence, and vegetables and bananas for sale.

Village B was located ca. 1.5 km from the protected forest at the southernmost edge of the national park (6º50’ S, 106º30’ E; 700–740 m elevation). In 2005, the local population of village B was 316 people in 75 households (M.K. *et al.* unpublished data), and most villagers engaged in agriculture. The forest department owns a large part of the area occupied by the village. The cultivation area consisted of 10.2 ha in paddy fields, 21.2 ha in swidden fields and woodlands, and 4 ha in hamlets (M.K. *et al.* unpublished data). Dominant land uses consisted of different-aged fallow fields resulting from the swidden cultivation, paddy fields, and woodlands at the periphery, while paddy fields and woodlands were also found in the core area. In the woodlands, various tree species grew in different layers of vegetation. Traditional laws not only confined the villagers to a single cropping pattern of rice and swidden cultivation, but also prohibited sales of rice and use of a rice mill. The influences of modern farming systems were therefore minimal in this village.

From April to September 2004, we conducted a bird survey both at the periphery and in the core areas of the two study villages to examine the effects of distance from the forest on bird species. For these comparisons, we also investigated the preserved forest following a footpath about 1.8 km in length, which was located about 50–100 m inside of the forest edge. For a representative picture of the overall species composition in all types of land use, we applied both the line census method and the point census method depending on the site. The agricultural landscape was highly heterogeneous, with a mixture of small patches of multiple land uses. We used the line census method for continuous mosaic landscapes such as the peripheral areas of both villages and the core area of village B. We used the plot census method for small and isolated land uses such as the core area of village A.

In the line census, we recorded birds found within 25 m of each side of the survey route. In the plot census, we recorded birds found within 25 m of a fixed radius of each point. We used local field guides to identify bird species (MacKinnon & Philipps 2001; Prawiradilaga *et al.* 2003).

We confined surveys to the periods between 06:00 and 12:00 and from 15:00 to 18:00 on days without rain. To reduce time-of-day effects, we reversed the order of observations in each site at each time. We recorded the species, number of individuals, sex, and behavior of all observed birds. We also documented the height at which birds were observed, substrate such as vegetation type, and foraging method. We excluded from the analysis birds that were simply passing overhead as well as several unidentified birds.

We obtained additional information from the recorded species to identify the key factors in the preference of environmental resources by birds. We broadly classified all recorded species into different categories according to habitat, diet, and foraging sites using species-specific characteristics based on MacKinnon (1991), MacKinnon and Philipps (2001), Prawiradilaga *et al.* (2003), and Thiollay (1995), as well as our own field observations.

Following Thiollay (1995), we first classified all recorded species into three categories, i.e., forest species, forest edge species, and farmland species, according to their primary natural habitat, their level of association with the forest, and their tolerance to human or natural disturbances. Forest species are originally associated with primary and old secondary forest interior. Forest edge species are forest species mostly found in natural conditions along edges, in gaps (treefalls, landslides), or in the upper canopy of dense forest stands or in semi-deciduous, more open forest types. Farmland species are restricted to open woodlands, low secondary growth, grasslands, and cultivated areas. Some forest species are restricted to large, undisturbed forests, but others are more tolerant of human or natural disturbance and remain widespread in more secondary forests (Thiollay 1995).

We categorized specific diets and foraging sites to examine resource use by birds, and classified the recorded species into six diet categories: carnivores, insectivores, nectarivores, frugivores, granivores, and omnivores. Similarly, we classified species into six categories based on foraging sites: aerial, canopy (foliage and branches), understory (from low undergrowth and lower canopy), grasslands, terrestrial, and bark (including dead wood) (Thiollay 1995).

We used several statistical procedures to compare species composition and distribution of birds. For the comparison of species number and observations in each landscape element, we summed the data based on the census duration. Initially, we divided results from the plot census into isolated paddy fields, woodlands, scrubs, and dry fields into smaller units. One unit of 180 minutes consisted of a 60-minute census in each large land use (i.e., paddy fields and woodlands) and a 30-minute census in each small land use (i.e., scrubs and dry fields). Data for ten units (1800 minutes) were obtained from plot censuses in the core area of village A. The total species number of the line census was considered the cumulative species number. We compared the total species number recorded in 1440 minutes of census at the periphery area of the village to the total number recorded in 1800 minutes of census at the core area of the village. Most species were recorded when the census duration was 1440 minutes. Therefore, species observations were compared for a census duration of 1440 minutes.

We compared species distributions between the periphery area and the core area of each village, and examined the sensitivity or tolerance of each bird species to forest, forest edge, and farmland using randomization tests. The randomization test predicted whether the species distribution (i.e., presence/absence) was random or nonrandom corresponding to the distance from the forest or resource distribution at the periphery area and core area of each village (Maeda 2001; Tachibana 1997). For example, if some species were distributed randomly throughout the village, the result of the randomization test would indicate a random distribution. We considered that the tolerance of a species to other environments was high if that species was distributed randomly. In the process of the analysis, the randomization tests generalized possible abundances of each species for all recorded times. The randomization then examined the actual recorded times in each sampling plot to determine whether it differed from a theoretically possible abundance (Maeda 2001). We excluded species for which we had fewer than six records.

RESULTS

In total, we identified 94 species of birds during the study period. We recorded 36, 39, and 64 species in villages A and B and in the forest, respectively. We found no significant difference between villages A and B in total species number. Twenty-seven species (56.3% of total species in both villages) were common to both villages.

There was no significant difference in species number between the peripheral area (25 species) and the core area (26 species) in village A. Although the difference was not significant, the peripheral area of village B had more species (33 species) than the core area (28 species). Fifteen and 22 species, respectively, were common between the peripheral area and the core area in village A (41.7% of total) and village B (56.4% of total).

Villages A and B had 15 and 14 bird species, respectively, in common with the forest. In village A, 14 and eight bird species at the peripheral and the core areas, respectively, were also found in the forest. In the village B, 11 and 12 bird species observed in the core and the peripheral areas, respectively, were also found in the forest.

According to the classifications based on diets and foraging sites, insectivores and nectarivores showed different patterns between the peripheral area and the core area of each village. At the peripheral area of village A, we recorded more insectivores that foraged in the canopy (16%, 4 of 25 species) than species that foraged in grass and shrubs (8%, 2 of 25 species) and understory (8%, 2 of 25 species). In contrast, in the core area of village A, we found fewer insectivores that foraged in the canopy (3.8%, 1 of 26 species) than species that foraged in grass and shrubs (15.4%, 4 of 26 species) and understory (23.1%, 6 of 26 species). At the periphery of village B, insectivores that foraged in the canopy, grass and shrubs, and understory showed the same proportions (15.2%, 5 of 33 species for each category). At the core area of village B, insectivores that foraged in the canopy (10.7%, 3 of 28 species) and the understory (17.9%, 5 of 28 species) were more abundant than insectivores that foraged in grass and shrubs (3.6%, 1 of 28 species). We recorded more nectarivores at the peripheral area of village A (16%, 4 of 25 species) than in the core area (7.7%, 2 of 26 species). In contrast, we recorded more nectarivores in the core area of village B (17.9%, 5 of 28 species) than in the periphery (9.1%, 3 of 33 species). Nectarivores that foraged in the canopy were not found at the periphery of village B. Species numbers of granivores, frugivores, omnivores, and carnivores showed similar patterns between the two villages. In the forest, insectivores (76.6%, 49 of 64 species) comprised the dominant species, consisting of foragers in the canopy (25%, 16 of 64 species), understory (20.3%, 13 of 64 species), ground (12.5%, 8 of 64 species), and others (18.8%, 12 of 64 species).

We determined the distribution of each species using randomization tests. No species significantly preferred the peripheral or the core areas corresponding to the proximity to the forest (Table 1). First, most forest edge species (3 of 4 species) preferred the peripheral area of village A. In village B, forest edge species showed no preference for the peripheral areas, since tree gardens provided similar habitats throughout the village. Second, most farmland species (10 of 11 species) preferred the core area of village A and/or the peripheral area of village B. These species mainly used open habitats, e.g., paddy fields and/or grassland. Although the peripheral area of village B was located at the forest edge, most species that preferred this area were farmland species. Third, forest species (3 of 4 species) preferred the core area of village B, but not the peripheral area.

DISCUSSION

Our first objective was to determine how the species composition of birds differed between the two villages. The total number of species did not significantly differ between the villages, although the species compositions of birds in relation to habitat types showed different patterns. In village A, fuelwood plantations at the periphery provided a woody environment for forest and forest edge species. Paddy fields and grassy shrubs in the core area of village A provided open habitats for farmland species.

In village B, tree gardens were evenly distributed throughout the village and provided woody environments for forest and forest edge species. Even portions of the tree gardens that spread to the core area of village B were used by birds. In addition, planted trees around paddy fields were also used by forest and forest edge species in the core area. The swidden fields provided open habitats for farmland species at the peripheral areas despite their proximity to the forest.

The differences in species composition indicate that the layout of land uses was an important factor that determined bird species composition, whereas the distance from the forest was not an essential factor at our study sites. In particular, the case of village B showed that the woody environments provide habitats for forest and forest edge species even when these environments are located in the core area of a village.

Our second aim was to determine environmental factors that influenced species distribution of birds, using a classification based on diet and foraging sites of each species. We found that insectivores showed distinctive distribution patterns, and identified two groups of insectivores: one preferred both the canopy and the understory, and the other preferred grassy shrubs and understory habitats, but not the canopy. The former group showed a distribution pattern similar to omnivores and nectarivores, and used fuelwood plantations at the periphery of village A and tree gardens in village B. According to Thiollay (1995), small frugivores, foliage insectivores, and nectarivores are often associated with gaps. This indicates that human efforts to manage diverse tree species in the tree gardens provided habitats for bird species associated with gaps and forest edges. The latter group mainly foraged in grassy shrubs and was recorded in fallow lands and swidden fields at the peripheral area. In general, insectivores were less sensitive to differences between gaps and intact forest (Levey 1988). Our study showed that different land-management practices such as fallow lands, extensive understory, or various planted tree species affect the distribution of species related to foraging sites.

We showed that the distribution of bird species is related to the distribution of resources, such as foraging sites, but not to the distance from forests. The distribution of resources is strongly associated with human activities. For example, forest edge and forest species were distributed in fuelwood plantations in village A and tree gardens throughout village B. Extensive management of the fuelwood plantation maintained the understory vegetation, which provided suitable habitats for omnivores and insectivores. Although tree gardens were distributed throughout village B, different distributions of bird species were found between the core and the peripheral areas in village B. If the tree gardens at the core and the peripheral areas were equally suitable, forest species should be distributed randomly in village B. However, three nectarivores preferred the core area of village B. One possible explanation for the observed pattern is the difference in the species composition of the tree gardens. Villagers planted tree crops that require frequent care such as sugar palm (*Arenga pinnata*) and clove trees (*Syzygium sp*.). These tree crops were more abundant at the core area of village B (M. K. *et al*. unpublished data), and nectarivores utilized these trees for foraging. In addition, extensive management in the tree gardens of village B maintained the understory vegetation, which provided habitat for understory foragers. In contrast, tree gardens in the core area of village A were small and isolated. Because the understory of the tree garden in village A was used for planting crops with intensive management, few species of birds used the tree garden in village A. Because villagers in B were obligated to conduct swidden cultivation, fallow lands provided open habitat and shrub environments for species foraging in the understory and in small trees.

We found that the farming system and land-management practices influenced the composition and distribution of birds in the villages adjacent to the national park. The farming system and land management differed in each village according to sociocultural factors such as traditional customs. The activities of villagers have changed the secondary environment of the villages, which affected the composition and distribution of birds. We suggest that further studies on sociocultural factors will contribute to maintaining the sustainability and management of environments in and around the national park.

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Table 1. Distribution of bird occurrence (n) on landscape element types in two villages adjacent to Gunung Halimun-Salak National Park, West Java, Indonesia. The *p*-value represents the probability that species occur ≥n times at each site assuming random use

Scientific names	Occurrence (n times)				*p*-value				Diet	F.S	G.H.
	AP	AC	BP	BC	AP	AC	BP	BC			
Todiramphus chloris	11	0	14	11	< 0.001	ns	ns	ns	CA	U	II
Dicaeum trigonostigma	29	9	14	21	< 0.001	ns	ns	ns	OM	C	II
Zosterops palpebrosus	29	25	15	38	ns	ns	ns	< 0.01	OM	C	I
Cacomantis sepulcralis	6	0			< 0.05	ns			IN	C	II
Lanius schach	2	25	13	0	ns	< 0.001	< 0.001	ns	IN	G	III
Pycnonotus aurigaster	7	24	28	15	ns	< 0.01	< 0.05	ns	OM	G	III
Lonchura leucogastroides	6	29	7	6	ns	< 0.001	ns	ns	GR	G	III
Megalurus palustris	0	13			ns	< 0.001			IN	G	III
Timalia pileata	1	15			ns	< 0.001			IN	U	III
Lonchura punctulata	0	7			ns	< 0.01			GR	G	III
Halcyon cyanoventris	2	11			ns	< 0.05			CA	U	III
Centropus bengalensis	0	5			ns	< 0.05			IN	G	III
Pycnonotus goiavier			16	1			< 0.001	ns	OM	U	III
Ducula badia			10	1			< 0.01	ns	FR	C	I
Prinia familiaris	37	44	41	24	ns	ns	< 0.05	ns	IN	G	III
Aegithina tiphia			1	20			ns	< 0.001	OM	C	II
Nectarinia jugularis			3	16			ns	< 0.01	NE	U	III
Aethopyga mystacalis			0	7			ns	< 0.01	NE	C	I
Arachnothera longirostra			2	10			ns	< 0.05	NE	U	I

Sampling sites are; A-P = peripheral area of village A, A-C = core area of village A, B-P = peripheral area of village B, B-C = core area of village B. Diet are; CA = carnivores, IN = insectivores, NE = nectarivores, FR = frugivores, GR = granivores, OM = omnivores. Foraging sites are; C = tree crown, G = grass shrubs in open areas, T = terrestrial, U = understory. General habitats are I = primary forests interior, II = forest gaps and edges, III = little wooded and cultivated areas.