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Recovery of Avian Diversity in An Abandoned Human Settlement in Western Forests of Thailand

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ABSTRACT

Avian diversity and recovery in abandoned human settlements (AHS) and dry evergreen forests (DEF) were monitored continually from 2000 to 2003, in Thung Yai Naresuan Wildlife Sanctuary, western Thailand. The monitoring objective was based on the Shannon-Wierner index (*H′*) of bird species after abandonment of the settlement areas. The line transects ran for 900 m in the AHS and continued for another 900 m in DEF, allowing for 100 meters for the edge effects. The study recorded 255 bird species. The *H′* indices in the AHS were lower than those in the DEF sites and were significantly lower ($P<0.05$) during the cool season and the summer season of 2002. Comparisons of the *H′* index in different aged (6–12 years old) sites indicated that the *H′* indices in the AHS from 6 to 10 year-old sites tended to be lower than the those in DEF sites. However, the *H′* index was greater in the 12-year old AHS than in the DEF during every rainy season, the cool season of 2002, and the summer season of 2003. The study suggested that bird diversity in protected areas showed a clear recovery pattern after abandonment of human resettlement. It is recommended to limit human disturbances as much as possible to allow for maximum avian diversity to recover.

Key words: bird, species, human disturbances, succession

INTRODUCTION

Secondary succession in tropical areas following recent human disturbances is becoming more common. This is particularly evident in regions of tropical rain forests, long valued by conservationists for their remarkable species diversity (Chinea, 2002). In Southeast Asia, as in the neotropics, central Africa and south Asia, tropical forests have been logged for timber, cleared and cultivated, exploited for non-timber natural products, submerged under reservoirs, and converted into plantations and other land uses (Johns, 1989; Raman and Sukumar, 2002).

As disturbed forests increase in protected areas of the tropics, there is a clear need to assess conservation values through studies of their vegetation and animal communities. However, Thai protected area managers lack data on how ecosystems respond following human disturbances. This research aims to provide guidelines to determine changes in bird species diversity following abandoned settlement areas and effects of seasonal changes to the bird flocks.

MATERIALS AND METHODS

Study site

The 3,200 km^2 Thung Yai Naresuan Wildlife Sanctuary is located between (longitude)

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14 ° 55′ to 15 ° 45′ North, and (latitude) 98 ° 25′ to 99 ° 05′ East. Together with the adjacent Huai Kha Kheang Wildlife Sanctuary, they constitute Thailand's Natural World Heritage Site, and form the core of the largest contiguous protected and forest complex in mainland SE Asia, known as the Western Forest Complex. The topography is mountainous with elevations ranging from 800 to 1,200 msl. The climate is subtropical, comprising summer (March -May), rainy (June-October), and cool (November- February) seasons with the average rainfall of 1,800 mm per year.The principal vegetation types are hill evergreen, dry evergreen, mixed deciduous and dry dipterocarp forests, savanna, grassland and areas of swidden agriculture. (Faculty of Forestry, 1989)

Before the forest was declared as wildlife sanctuary in 1957, indigenous hill tribes were settled in the area and converted the forests into agricultural lands. The Hmong hill tribe villagers were removed from Thung Yai Naresuan since 1987. This research focused on the 6-12 year abandoned settlements of the Hmong hill tribe.

Site selection

The rescarcher collected data of the bird flocks from four different sites in dry evergreen forests and abandoned hill tribe settlement areas located in Thung Yai Naresuan Wildlife Sanctuary. The four sites were different in abandonment time and size of the Hmong village areas. Four old Hmong hill tribe village areas were selected, namely, Ka Ngae Kee (6 years old since abandonment), Ta Su Kee (8 years old since abandonment), Thung Na Noi (10 years old since abandonment) and Huai Num Khiao (12 years old since abandonment). The elevations varied between 700 –900 msl.

Bird survey

Three permanent transects with a total length of 1.8 km were set in 4 study sites. The line transects ran for 900 m in the abandoned human settlement (AHS) and continued for another 900 m in a natural dry evergreen forest (DEF), allowing for 100 meters for the edge effects (Pattanawiboon, 1999). However, due to the small size of Huai Num Khiao, only 2 permanent transects were set. Each line was marked at 100 m intervals with aluminum tags. Surveys were conducted three times per year in every season (summer, rainy, and cool seasons) from 7.00-10.00 am and 4.00-6.00 pm in each transect for 2 consecutive days. It usually took 2-3 hours to complete the surveys in1.8 km transect. Direct observations were made by using binoculars (8X35). All birds detected by sight or sound within approximately 30 m from the transect line were recorded (Round and Brockelman, 1998). The recorded data included identified species, number of individuals, time of observation, behavior and activity, and estimated height above ground. The surveys were conducted three times a year in summer (March-May), rainy season (June-October), and cool season (November- February), starting from rainy season in 2000 to summer in 2003.

Data analysis

The Shanon-Wiener diversity index (H') and standard deviation were calculated using the Species Diversity and Richness II for Windows (Pisces Conservation Ltd, 2001). Statistical comparisons of bird diversity indices between the abandoned areas and dry evergreen forests were made by Mann-Whitney's U-test. All statistical tests were two-tailed and the significance level was set at $P < 0.05$. Means were given ±1 SD.

To investigate how abandoned times affected bird communities, simple linear regression was used to examine bird diversity index distribution corresponded with abandoned times (Raman, 2001).

RESULTS

Bird diversity

Two hundred forty-five bird species were recorded during this study. These were composed

of 52 migratory and 193 resident bird species from all seasons, 214 species from an AHS and 192 species from DEF. The H' index in the AHS (3.891) was significantly lower ($P<0.05$) than in the DEF (4.091) sites. Across all transects, 21% of all migrant species (44 spp.) and 79% of all resident species (170 spp.) were detected in the abandoned human settlements and 16% of migrant species (31 spp.) and 84% of resident species (161 spp.) were found in dry evergreen forest.

The majority of species restricted to one habitat were resident birds (68% from AHS, i.e., 32 spp. and 61% from DEF, i.e., 19 spp.). Resident species restricted to AHS habitat type included white-rumped munia, scaly-breasted munia, chestnut-tailed starling, and red-rumped swallow. Common migratory species restricted to DEF were rosy minivet, ashy minivet, black-naped oriole, eyebrowed thrush, and white-tailed leaf warbler.

Seasonal changes in bird species diversity

The cumulative number of bird species varied from 109-149 from year 2000 to 2003. The highest (149) and lowest (109) numbers of species were found in the rainy season of 2002 and in the cool season of 2000, respectively. The number of bird species was highest during the cool season; and, the H' indices changed from 3.758 in the rainy season of 2001 to 3.973 in the cool season of 2000. The seasonal trend indicated that both indicators (bird species numbers and H' index) decreased during the rainy season of each year. In general, the number of bird species and H' index increased to the highest level during the cool season but decreased in the summer and rainy season.

Comparison of Shanon-Wierner index between an abandoned human settlement and a dry evergreen forest

The H' index for each season between the AHS and DEF is shown in Figures 1. The H' indices in the AHS were lower than in the DEF sites, and were significantly lower (Mann-Whitney's U-test, n=11, $P<0.05$) during the cool and summer season of 2002. There were no seasonal effects on diversity index in the AHS and DEF, similar to the seasonal changes that this study indicated. H' index in the AHS and DEF areas dropped in the rainy season each year. In general, H' index increased to their highest levels during the cool season but decreased in the summer and rainy seasons, except during the cool season of 2001 and summer season of 2002.

Comparisons of the H' index in different aged (6–12 years old) sites indicated that the H' index tended to be lower in the 6-10 year old AHS than in the DEF sites. However, the H' index was greater in the 12-year old AHS, than in the DEF in every rainy season, in the cool season of 2002,

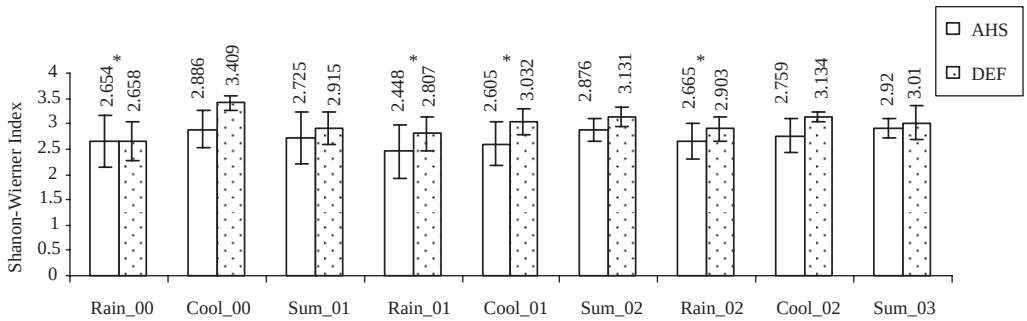

Figure 1 Shanon-Wierner index(H′) (mean ± 1 SD) of bird diversity between the AHS and DEF in the Thung Yai Naresuan Wildlife Sanctuary from the rainy season 2000 to summer season 2003 with *denote $P<0.05$.

and in the summer season of 2003.

Relationship between the Shanon-Wierner index (*H'*) and years since abandonment

The pattern of diversity since abandonment of AHS (6-12 years) indicated a positive correlation between the *H'* index and years since the abandonment (Figure 2).

DISCUSSION AND RECOMMENDATION

Studies of relationships between wildlife and plant succession have mostly concentrated on birds because of their ability to fly from place to place in long distances and also because they are very sensitive to seasonal and habitat changes (Raman *et al*., 1998; Andrade and Rubio-Torgen, 1994; Welford, 2000; Raman, 2001; Raman and Sukumar, 2002). In this study, bird species diversity was first strongly influenced by seasons followed by land use patterns. Shannon-Wierner indices were highest during the cool and lowest in rainy seasons.

In general, in the tropics, seasonal factors mainly affect changes in bird diversity because migratory birds move from northern regions to the tropics, particularly insectivore birds (e.g. warbler 13 spp. and flycatcher 5spp.) during the cool season (from December to late of February), and are absent from these areas during late summer and rainy season (April to October). The results of this study reflected the same trend reported by Ohno and Ishida (1997) which concluded that the diversity of bird communities was significantly higher in natural forests than in plantations. In contrast, Knok and Corlett (2000) concluded that bird species diversity in forest plantations differed insignificantly when compared with secondary forests, but differed in species composition. Also, Welford (2000) indicated that the number of bird species recorded in each successively older abandoned pasture increased but only half of the species recorded in undisturbed forests were recorded in mature pastures.

Bird communities are frequently used for conservation assessment and monitoring. Many studies in tropical rain forest regions showed that forest plantations, logged forests and secondary forests generally harboured fewer bird species and have altered community composition as compared to primary forest (Johns, 1989; Raman and Sukumar, 2002). However, relationships between degrees of habitat alteration and changes in bird communities were not precisely understood. The observed effects may be a non-linear function of disturbance intensity (Johns, 1986, 1989) with the degree of changes in bird community structures and compositions being strongly related to the magnitude of alteration of rain forest vegetation structures and floristic compositions (Raman and Sukumar, 2002). Within the community, individual bird species differed in response and susceptibility to habitat alteration. Habitat changes particularly affected rare and restricted-range birds, rainforest

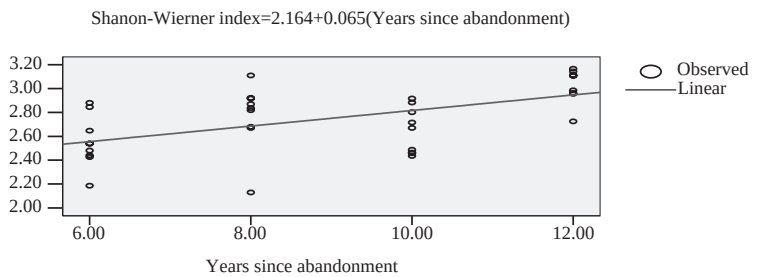

Figure 2 Relationship between Shanon-Wierner index and years since abandonment ($R^2 = 0.297$, $P = 0.011$).

habitat specialists, and altitudinal migrants (Raman, 2001). Other factors influencing susceptibility included body size, fecundity, diet-guild and foraging stratum (Thiollay, 1999). Few studies addressed avian use of abandoned former pastures (Andrade and Rubio-Torgler,1994). Johns (1989) compared the avifauna of undisturbed tropical forest, slightly logged forest, secondary growth and crop fields. He concluded that many species were found in most habitat types although similarity decreased by increasing disturbance intensity between early secondary growth and undisturbed.

This study agreed with studies by Raman *et al*. (1998) and Dunn (2004). All studies produced positive correlation with fallow age in shifting cultivations and concluded that bird species richness, abundance and diversity increased rapidly and asymptotically during successive paralleling vegetation recovery. Non-linear relationships implied that fallow periods, less than a threshold of 25 years for birds, and about 50-75 years for woody plants, were likely to cause substantial community alteration.

The results strongly support earlier studies (Raman *et al*., 1998; Raman, 2001; Raman and Sukumar, 2002) and underscored the need to protect mature and primary forests to conserve a source of unique diversity.

The study also suggests that the bird diversity shows a clear recovery pattern after the abandonment of human settlement. It can, therefore, be concluded that for ecological restoration, especially in the protected areas, it is important to limit human disturbances as much as possible to allow maximum avian diversity to recover. However, to speed up the recovery process of birds, trees, especially native pioneer species, must be planted in the abadoned settlement areas in order to create an environment suitable for birds in primary forests.

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