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Bird and Arthropod Communities in Fragmented Plantation Forest of Gunung Walat Education Forest (GWEF), Cibadak, Sukabumi

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PREFACE

Pusat Penelitian Lingkungan Hidup – Institut Pertanian Bogor (PPLH-IPB) [Center for Environmental Research – Institut Pertanian Bogor (CER-IPB)] was established in 1976. One of the Center's goal is to develop policies and concepts for natural resources and environmental management based on ecosystem characteristics, community participation, local community tradition, economic justice, and global environmental change.

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We are pleased to publish Dr. Yeni A. Mulyani & Dr. Noor F. Haneda's paper **Bird and Arthropod Communities in Fragmented Plantation Forest of Gunung Walat Education Forest, Cibadak, Sukabumi**, after reviewed by an expert in this field. We express our gratitude and appreciation to Ellyn K. Damayanti, Ph.D.Agr. for her invaluable contribution as editor in charge for this working paper and to Dr. Y. Aris Purwanto as the Head of Division of Research and Community Services PPLH-IPB for making it possible this working paper can be published.

Finally, we hope this publication will be valuable and beneficial for those who have interest in Indonesia's natural resource and environmental management.

December 2010,

Kukuh Murtilaksono

Director of PPLH-IPB

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Bird and Arthropod Communities in Fragmented Plantation Forest of Gunung Walat Education Forest, Cibadak, Sukabumi

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ABSTRACT

Forest loss and fragmentation is an important factors in bird community decline. Plantation forest could function as alternative habitats for birds. Different types of plantation forests might create fragments (having habitat edges between different plantation types). Habitat fragmentation could cause microclimate changes that in turn affect bird and arthropod communities. The objective of this project is to examine whether diversity and abundance of birds vary according to diferences in micro-climate, especially temperature and humidity, and arthropod abundance as birds' food resource in different locations (edge and interior) of fragments of plantation forest. The study was conducted in Copal (*Agathis lorantifolia*) and Schima (*Schima wallichii*) stands in Gunung Walat Education Forest. Monthly bird observation using point counts were done from January to June 2010. Arthropod was sampled bi-monthly to asses diversity and abundance. The result showed that the abundance of bird and arthropod were higher in the edge forest compare interior forest. A total of 44 bird species of 19 families have been identified in the four study plots, while arthropod has 5750 individual, compose of 23 Order, 266 Families and 332 morphospecies. Based on major diet, 24 bird species (54 %) were insectivores, while 12 were species that usually include insects in their regular diet. Habitat factors play important role for bird and arthropod community.

Keywords: birds, arthropods, plantation forest, edge effect

INTRODUCTION

Many studies have suggested that habitat loss and fragmentation influence bird communities (e.g. Watson , *et al.*, 2004; Castelletta , *et al.*, 2005; Barlow , *et al.*, 2006). Edge habitat created from fragmentation might influence the survival of birds through the changing of microclimate and insect availability (Şekercioğlu , *et al.*, 2002).

Different types of plantation forests create fragments (having habitat edges between different plantation types). Therefore, the objective of this project is to examine whether diversity and abundance of birds vary according to diferences in micro-climate, especially temperature and humidity, and arthropod abundance as birds' food resource in different locations (edge and interior) of fragments of plantation forest.

Efforts in bird conservation and biodiversity conservation in general need to consider many aspects. There is still very few information available on detailed bird ecology in Indonesia. Whilst natural forests are still declining, the creation of plantation forest is increasing. An improved function of plantation forest as alternative conservation area is worth seeking. By finding out the roles of plantation forest for birds, including factors affecting bird use of that habitat, we might find an alternative solution to conserve bird species.

The objectives of this study were to examine whether there is any difference in bird and arthropod diversity and abundance between different plantation types and between edge *vs.* interior habitats, and to examine whether there is any relationship between temperature, humidity, vegetation and arthropods with birds in plantation forest fragments.

METHODOLOGY

2.1. Study Sites and Plot Selection

The study was conducted in 359 ha Gunung Walat Education Forest(GWEF) (106°48'27"E - 106°50'29"E and 6°54'23"S - 6°55'35"S), located at an elevation of 460-715 m. Administratively GWEF is located in the SubDistricts of Cibadak and Cicantayan, District of Sukabumi, while based on forestry administration it is located within the Forestry Agency of Sukabumi District. Several species of conifers and broadleaves were planted in GWEF, with the dominant species being *Pinus merkusii (*114.51 ha plus few hectares in mixed plantation), *Schima wallichii* (100.59 ha plus few hectares in mixed plantation) and *Agathis lorantifolia* (41.63 ha plus few hectares in mixed plantation) (Badan Eksekutif HPGW, 2009).

Observation plots were placed only in Agathis and Schima stands to represent conifers (Agathis) and broad leaves (Schima). Pine stands were not chosen primarily due to logistic reason and its narrow corridor-like distribution. Vegetation outside the boundary is mixed species of agroforestry plantation and agricultural land. Plots were located in Schima edge (106°49'02"E - 106°49'05"E and 6°54'48"S - 6°54'50"S), Schima interior (106°49'03"E - 106°49'23"E and 6°54'46"S - 6°55'14"S), Agathis edge (106°49'22"E - 106°49'26"E and 6°55'13"S - 6°55'18"S) and Agathis interior (106°49'26"E - 106°49'29"E and 6°55'01"S - 6°55'12"S). The minimum distance between outer interior plots with edges was 100 m.

2.2. Data Collection and Analysis

Monthly observation of bird community was done by using point count with fixed radius of 30 m, and distance between points $\pm$ 100 m. Ten points, located along transect wherever possible, are observed for the duration of 15 minutes per point in each habitat type from 0530 to approximately 0900 hrs. Birds seen (using binoculars 8x42) and/or heard within the radius are recorded. Data recorded include species, number of individuals, activities and position or location of individual bird in the habitat. Bird identification and naming follow MacKinnon and Phillipps (1993).

Maximum and minimum temperature and humidity measurements were conducted using dry-wet bulb thermometer in the observation plots during bird survey period. Temperature and humidity were measured between 1130-1500 hrs. Vegetation measurement using point quadrate method was done at bird observation plots. Data recorded include vegetation density (trees and lower vegetation) and canopy cover. Vegetation analysis technique followed Soerianegara (2005).

Bi-monthly collection of arthropod was conducted by using *window trap (funnel trap*) and *yellow pan*. Window traps were set at the height of 5 m above the ground to target flying insects. *Yellow-pan traps* (size 24 x 20 x 6 cm) were placed on the forest floor for ground arthropods. Each pan was filled with detergent and sorbic acid. Five traps of each type were set in each of the 4 habitat types for 3 days. Arthropods collected were preserved in alcohol 70% to be identified and counted in the lab using morphospecies concept (Recognizable Taxonomic Units =RTU) based on the external appearance of specimens and commonly used as a surrogate for species diversity) (Strehlow, *et al.*, 2002; Abbott, *et al.*, 2002).

Species diversity, both for birds and arthropod, was calculated using the Shannon index of diversity, and evenness. Relative abundance of birds and arthropods were compared between habitats and locations using Factorial Design with two factors i.e. plantation type (Agathis and Schima) and location (interior and edge). To examine whether bird diversity and abundance are influenced by habitat components a Pearson Correlation Analysis was conducted. SPSS version 16 was used for analysis.

RESULTS AND DISCUSSION

3.1. Bird Diversity and Abundance

A total of 44 bird species of 19 families have been identified in the four study plots. Based on major diet, 24 species (54 %) were insectivores, while 12 were species that usually include insects in their regular diet. Bird diversity (H' and E) varied between months and location (Table 1). In general, bird diversity ranges from low compared to other studies in plantation. Sutopo (2008) recorded H' of 2.97 in teak plantation in East Java, while in Pine plantation located at the elevation of 200-2500 m above sea level at Gunung Ciremai, West Java, Surahman (2010) recorded H' value of 2.86.

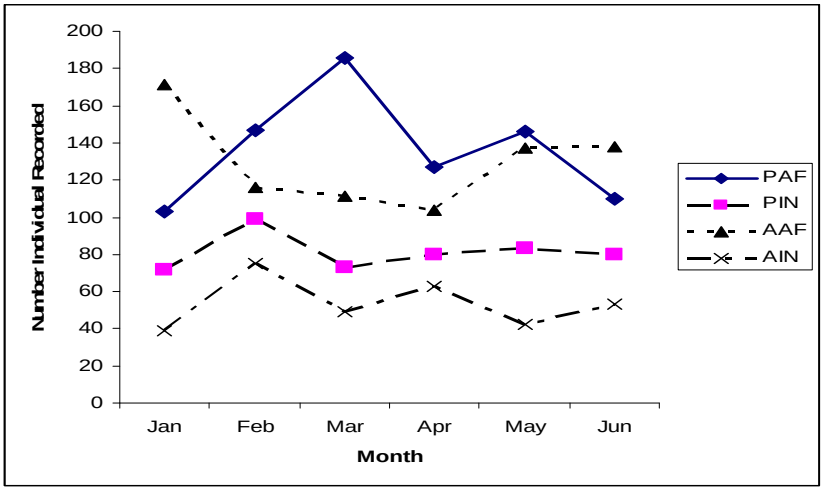
The number of records also varied between months (Figure 1). This might indicate different use of each by birds in Gunung Walat, or different activities of birds. For example, different breeding stages could influence detection. However, further study needs to be done to confirm this.

Number of birds differ significantly between location in the forest fragment, with higher number was observed in edge habitats ($P<0.05$). However, this difference was not observed between plantation types (Table 2).

Table 1. Bird diversity indices in four study plots

Month	Diversity Index (H')				Evenness (E)			
	PAF	PIN	AAF	AIN	PAF	PIN	AAF	AIN
Jan	2.18	2.70	2.15	1.61	0.74	0.84	0.73	0.59
Feb	2.46	2.42	1.90	2.59	0.79	0.82	0.69	0.90
Mar	2.56	2.34	2.43	2.27	0.80	0.83	0.82	0.82
Apr	2.33	2.35	2.35	2.29	0.82	0.87	0.83	0.87
May	2.30	2.10	1.97	2.20	0.68	0.76	0.70	0.79
Jun	1.89	1.96	2.16	2.07	0.68	0.76	0.78	0.76

Notes: PAF=edge habitat of Schima, PIN=interior habitat of Schima, AAF=edge habitat of Agathis, AIN=interior habitat of Agathis



Notes: Abbreviation as in Table 1

Figure 1. Monthly variation of bird abundance in four study plots

Table 2. The response variable for number of birds to forest habitat and location

Factors	Mean ± sd
Plantation type	
Agathis	91.50 ± 3.72 a
Schima	108.83 ± 6.67 a
Location	
Edge	133.00 ± 4.89 a
Interior	67.33 ± 4.50 b

Note: The same letter within factor indicates no significant difference ($p<0.05$) among forest habitats based on LSD test

Correlation analysis showed that bird diversity and number are positively correlated with number of arthropod ($r=0.52$, $p<0.06$) and understorey vegetation ($r=0.98$, $p<0.07$). McShea and Rappole (2000) found that an increase in understorey density had increased the abundance of most bird species found in their study sites. Hagar , ***et al.***, (2007) found that understorey vegetation support prey species for insectivorus shrub species.

3.2. Arthropod Communities

A total of 5750 individual Arthropod were collected from Gunung Walat Education Forest, composed of 23 Order, 266 Families and 332 morphospecies (Table 3). Results obtained from using the yellow-pan traps and window trap showed that Collembola, Diptera, and Hymenoptera were the abundant orders in all forest habitats. This was apparently due to the thickness of litter and low abundance of spider (Araneae). The relatively high abundance of understorey vegetation in edge habitat will produce numerous litters. A thicker litter will maintain higher soil moisture content during the dry season and influence densities and diversity of Collembola. A clear negative correlation between Collembola and spider densities was observed in some experiments (Kajak, 1997; Lawrence and Wise, 2000). Other taxa, such as Diptera and Hymenoptera had similar abundance pattern with Collembola. Between location, Hymenoptera and Diptera had higher abundance in the edge habitat compare to interior habitat.

In general, arthropod abundance was significantly higher in the edhe habitat than in the interior (Table 4). This may be due to the denser canopy and understorey plant. Higher abundance and diversity in the habitat indicated that this insect group could utilize these habitats. Hymenoptera visited edge forest for collecting food because in this habitat had a lot of flowering shrub. For foraging, Hymenoptera might have adapted to the open area and high temperature but for reproduction they still need low temperature, high humidity and dense understorey plants.

The richness index was higher in the Agathis edge compared to those in other forest habitat. However, the Shannon-Wiener estimate of diversity index of the Agathis interior was higher. Interior forest has higher evenness index compared to edge habitat.

Table 3. Number of Arthropod taxa in different forest habitat in Gunung Walat Education Forest (GWEF)

Taxa	Forest Habitat				Total GWEF
	AAF	AIN	PAF	PIN	
Order	15	19	15	17	23
Family	126	110	91	117	266
Morphospecies	167	135	110	162	332
Individual	1378	920	2080	1372	5750

Table 4. The response variable number of Arthropods to forest habitat and location

Factors	Mean ± sd
Plantation type	
Schima	431.50 ± 159.68 a
Agathis	287.25 ± 82.29 a
Location	
Edge	432.25 ± 115.49 a
Interior	286.50 ± 78.23 b

Note: The same letter within factor indicates no significant difference ($p<0.05$) among forest habitats based on LSD test

This indicated that some Arthropods were more adapted to edge habitat and that gap positively affects the Arthropod communities in the GWEF. The edge habitat seemed to have less canopy cover allowing more vegetation to grow which provides plenty of food for the Arthropods, particularly insect (Cappuccino, *et al.*, 1998; Shahabuddin, *et al.*, 2000; Idris & Nor-Zaneedarwarty, 2000).

This study suggests that the arthropod species diversity in interior forest is not necessarily high as generally claimed (La Salle, 1993). In addition, the species of arthropods in this edge habitat are most probably the area-insensitive species that favor disturbed habitat (Smith and Smith, 1996).

CONCLUSION

There are differences in abundance and diversity of birds and arthropods in different location of forest fragment (edge *vs.* interior habitat), with higher abundance and number of bird species recorded in edge habitat. Significant correlation was found between the number of birds, arthropods, understorey plants and canopy cover.

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REFERENCES

Abbott, I., Burbidge, T., Strehlow, K., Mellican, A. and Wills, A. 2002. Logging and burning impacts on cockroaches, crickets and grasshoppers and spiders in Jarrah Forest, Western Australia. *Forest Ecology and Management*, *174*, 383-399.

Badan Eksekutif HPGW. 2009. Rencana Pengembangan Periode 2009 – 2013. Bogor: Hutan Pendidikan Gunung Walat, Fakultas Kehutanan IPB

Barlow, J., Peres, C.A., Henriques, L. M. P., Stouffer, P. C., and Wunderle, J. M. 2006. The responses of understorey birds to forest fragmentation, logging and wildfires: An Amazonian synthesis. *Biological Conservation*, *128*, 182-1923

Castelletta, M., Thiollay, J-M., and Sodhi, N. S. 2005. The effects of extreme forest fragmentation on the bird community of Singapore Island. *Biological Conservation*, *121*, 135-155

Cappuccino, N., Lavertu, D., Bergeron, Y., and Regniere, J. 1998. Spruce budworm impact, abundance and parasitism rate in a patchy landscape. *Oecologia*, *114*, 236-242.

Hagar, J.C., Dugger, K. M., and Starkey, E. E. 2007. Arthropod prey of Wilson's warblers in the understory of Douglas-Fir Forest. *Wilson Journal of Ornithology*, *119*, 533-546

Idris, A.B. and Nor-Zaneedarwarty, N. 2000. The abundance and diversity of Braconidae in different habitats of Peninsular Malaysia. Journal of Bioscience 11: 41-77.Kajak, A. 1997. Effects of epigeic macroarthropods on grass litter decomposition in mown meadow. *Agriculture*, *Ecosystems and Environment*, *64*, 53-63

Kajak, A. 1997. Effects of epigeic macroarthropods on grass litter decomposition in mown meadow. *Agriculture*, *Ecosystem*, *and Environment*, *64*, 53-63.

La Salle, J. 1993. Parasitic Hymenoptera, biological control and biodiversity. In J. La Salle & I.D. Gauld (Eds.) Hymenoptera and Biodiversity (pp.197-216). London, UK: CAB International.

Lawrence, K. and Wise, D. 2000. Spider predation on forest-floor Collembola and evidence for indirect effects on decomposition. *Pedobiologia*, *44*, 33-39.

MacKinnon, J. and Phillipps, K. 1993. A Field guide to the birds of Borneo, Sumatra, Java and Bali. New York, NY: Oxford University Press.

McShea, W.J. and Rappole, J.H. 2000. Managing diversity and abundance of breeding bird populations through manipulation of deer populations. *Conservation Biology*, *14*, 1161-1170.

Şekercioğlu, C.H., Ehrlich, P.R., Daily, G. C., Aygen, D., Goehring, D., and Sandi, R. F. 2002. Disappearance of insectivorous birds from tropical forest fragments. *PNAS*, *99*, 263-267.

Shahabuddin, G., Herzner, G.A., Aponte, C., and Gomez, M. 2000. Persistence of a frugivorous butterfly species in Venezuelan for fragments: The role of movement and habitat quality. *Biodiversity and Conservation*, *9*, 1623-1641.

Smith, R.L. and Smith, T. M. 1996. Ecology and field biology. New York, NY: Harper Collins College Publisher.

Strehlow, K., Bradley, J.S., Davis, J., and Friend, G. R. 2002. Short term impacts of logging on invertebrate communities in jarrah forests in south-west Western Australia. *Forest Ecology and Management*, *162*, 165-184.

Soerianegara, I. 2005. *Ekologi Hutan Indonesia*. Fakultas Kehutanan IPB.

Surahman, M. 2010. Keanekaragaman dan Kelimpahan Burung pada Berbagai Tipe Habitat di Taman Nasional Gunung Ciremai. (Master Thesis Sekolah Pasca Sarjana Institut Pertanian Bogor)

Sutopo. 2008. Keanekaragaman Jenis Burung pada Beberapa Tipe Habitat di Areal Hutan Lindung KPH Madiun Perum Perhutani Unit II Jawa Timur. (Undergraduate Thesis Departemen Konservasi Sumberdaya Hutan dan Ekowisata Fakultas Kehutanan Institut Pertanian Bogor).

Watson, J. E. M., Whittaker, R. J., and Dawson, T. P. 2004. Habitat structure and proximity to forest edge affect the distribution of forest-dependent birds in tropical coastal forest of southeastern Madagascar. *Biological Conservation*, *120*, 311-327.