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The Effects of Tourists on Bird Diversity in Tourist Area Compared to Restricted Area of Seasonal Evergreen Forest at Tung Salang Luang National Park, Phetchabun Province, Thailand

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Abstract: A survey of bird similarity, diversity and density were carried out at Tung Salang Luang National Park during March 2004 - February 2005, in 3 sites of seasonal evergreen forest, one site in a restricted area (SE1) and two sites in tourist areas (SE2 and SE3). Three sites were located in the same forest structure. The point count and line transect methods were used for data collection. The results revealed the following information: 133 species, 34 families and 11 orders of birds in SE1 (102 species), SE2 (100 species) and SE3 (89 species) were observed. Seven species of birds in all sites i.e. *Criniger pallidus*, *Hypsipetes propinquus*, *Pycnonotus melanicterus*, *Irena puella*, *Garrulax leucolophus*, *Yuhina zantholeuca* and *Gracula religiosa* were the co-dominant species in this forest that will be used indicator for future investigation. Base on similarity, tourist activities may be disturbed some bird groups in tourist area such as carnivorous and omnivorous (SE2 and SE3) and nectarivorous (SE3); base on densities, carnivorous (SE3), nectarivorous (SE2 and SE3) and garnivorous (SE3) were decreased 46-78 % in tourist sites compared with restricted site (SE1). Moreover, bird diversity index in restricted area was higher value than tourist area. This phenomenon indicated that some bird groups in tourist area at the seasonal evergreen forest had negative effect correlation with human activities and similarity, diversity and density indices were a proper indicator for further impact investigation for conservation and management strategies of avifauna. Finally, this result was the first report about avifauna dynamic of Tung Salang Luang National Park.

Key words: Biodiversity, restricted area, tourist areas, seasonal evergreen forest, human disturbance, birds

INTRODUCTION

There are a number of conservation issues which currently affect protective areas and these threats may escalate if not addressed. Logging, burning and hunting are prominent effects but also tourist disturbances are a cause of some ecological problems (Sanitjan, 2000). Now a days, there are plans to develop more tourist facilities in protective areas (Groom, 1998). Tung Salang Luang National Park is comprised of variety of forest habitats and important site for birds. The park has development

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plans to allow more tourism facilities. Tourist data during March 2001-February 2006 were reported by the Protected Areas Regional Office 11 (Phitsanulok) National Park, Wildlife and Plant Conservation Department. Averages of 95,005 tourists per years come in the tourist area. The factors which influenced bird socialites are camping, burning, picnicking, photographing, bicycling, walking, noisy vehicles and other disturbing activities. It is obvious that tourism is detrimental to bird communities in the tourist areas. We forecasted that avifauna will be affected by tourist visitations. Same as in small forest fragments in the Parana State, had been affected by human activity. It led to the loss of biodiversity (Hostetler and Knowles-Yanez, 2003). It is necessary not ouly to ensure the continued security of the national park, but also the areas experiencing most serious modification by man (Ingkapatanakul, 1995). Therefore, an understanding of bird communities in the area is necessary. Now, data base of avifauna in the area have not record and with out research from scientist.

This study was conducted to know the composition of bird, species numbers, individnal numbers, feeding strategies in the seasonal evergreen forests. Co-habitat species and co-dominant species were analyzed. Furthermore, the comparisons of diversity, density and similarity values of avifauna between tourist area and restricted area are indicated how the effects of bird in restricted area. The data has enhanced studies on the dynamic of bird communities in the areas for present and further effect investigation (Reyers *et al*., 2000). The facts of this study have provided subsidies for conservation and management strategies of avifauna at Tung Salang Luang National Park.

MATERIALS AND METHODS

Tung Salang Luang, National Park, is located in the lower north of Thailand. The national park office is located at approximately 16° 34′ 26.48380″ north latitude and 100° 53′ 11.66700″ east longitude at Nong Mae Na Sub district, Khao Kho District, Phetchabun Province. The monitoring sites are approximately 700-860 m elevation. The total and average annual rainfalls were approximately 1805 and 150.4 mm, respectively. Average annnal highest and lowest temperatures were approximately 31.76 and 17.57°C, respectively and an average annnal temperature was 22.82°C.

A survey of bird diversity was conducted at Tung Salang Luang National Park, Phetchabun Province, Thailand during March 2004 - February 2005. The forest at all 3 study sites is seasonal evergreen forest i.e., SE1, SE2 and SE3. The restricted site, SE1 is located approximately 16°37′ 59.11593″ north latitude and 100° 54 ′ 23.44744″ east longitude. The tourist sites, SE2 and SE3 are located approximately 16° 36′ 12.31105″ north latitude and 100° 53′ 31.75871″ east longitude and 16° 34′ 0.05670″ north latitude and 100° 50′ 55.38545″ east longitude, respectively (Fig. 1).

Three sampling sites and transect lines were established. Ten sampling plots (80×80 m) were systematically fixed on transect lines, 20 m between each plot long.

The point count and line transect methods were used for data collection (Ralph *et al*., 1997) and was done once a month at 3 periods, 0700-1000, 1100-1400 and 1500-1800 h for a year. At each the ten plots at each field site, ten minutes per plots (monitoring zone) and five minutes between plot (stop zone), were used for sampling.

The monitoring of the bird populations were included species and numbers. Prismatic binoculars, telescope, camera set were used for observation. Identification is based on species description and identification manuals (Lekagul and Round, 1991).

Analyses of all collected data were made to calculate similarity, diversity abundance, frequency and density indices. The calculated indices were used to compare species composition and variations of bird populations in all study sites.

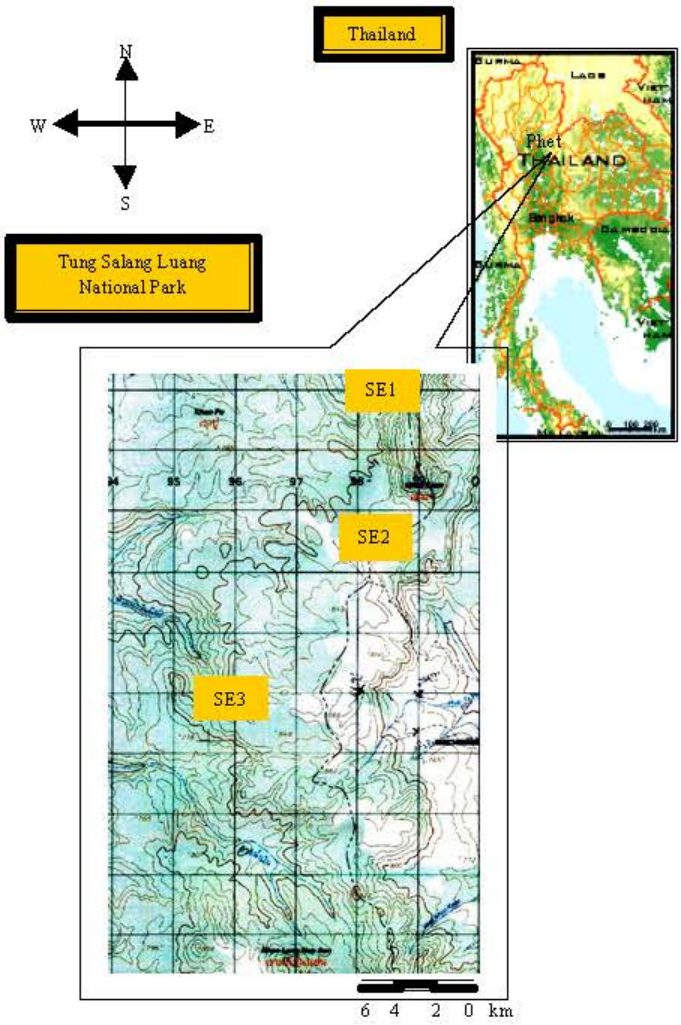


Fig. 1: Location of study sites SE1, SE2 and SE3 in Tung Salang Luang, National Park Scale 1:5000, (UTM 47Q, Royal Thai Survey Department)

RESULTS

In total of 7418 birds as belonging to 133 species, 34 families and 11 orders were observed. One hundred and fifteen species (84%) were found to be residential birds, whereas 18 species (16%) were migratory birds. Bird communities in SE1 had about 2472 birds of 102 species (Fig. 2). Two thousand four hundred and fourteen birds of 100 species and 2,532 birds of 89 species were found in SE2 and SE3, respectively. Only 20 species were recorded only in SE1. Fifteen species were only found in SE2 and 7 species only in SE3. The 65 co-habitat species (bird species were found in all 3 study sites), among those listed, were identification. Seven co-dominant species were selected among 65 co-habitat species. They were identified by based on the highest index values of frequency, density and abundance. Top 7 dominant species in all 3 study

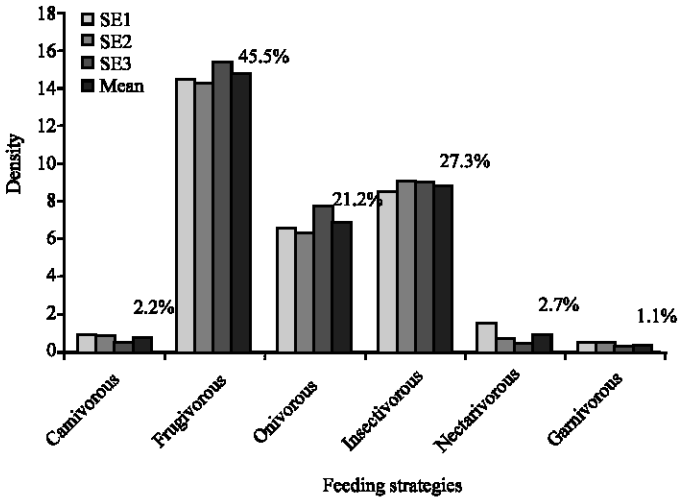


Fig. 2: Comparisons bird densities related to feeding strategies in the restricted site (SE1) and tourist sites (SE2) and (SE3)

Table 1: Matrix of similarity by the Sorensen index of bird species in the restricted site (SE1) and tourist sites (SE2 and SE3)

	SE1	SE2	SE3
SE1			
SE2	74.3		
SE3	75.4	79.4	

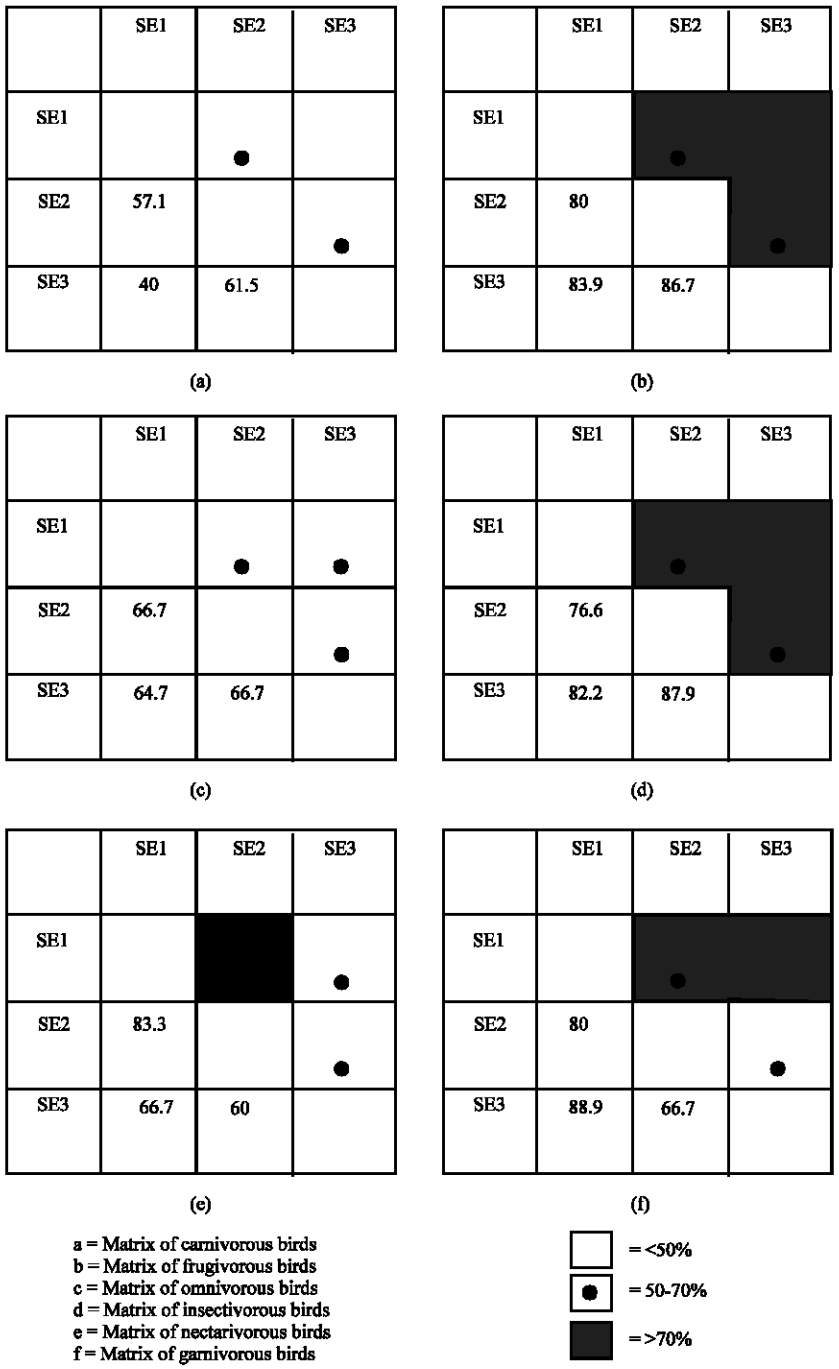
sites were similar viz. *Criniger pallidus*, *Hypsipetes propinquus*, *Pycnonotus melanicterus*, *Irena puella*, *Garrulax leucolophus*, *Yuhina zantholeuca* and *Gracula religiosa*.

More than 70% similarity index of avifauna between all 3 study sites were represented greater similar. The percentages of bird similarity in tourist areas were nearly the same similar in the restricted area at 74.3-75.4%. The highest similarity index value was found in both tourist areas at 79.4% (Table 1).

Bird similarities were classified according their feeding strategies in 6 groups viz. carnivorous, frugivorous, omnivorous, insectivorous, nectarivorous and garnivorous birds. Carnivorous and omnivorous species in SE2 and SE3 and nectarivorous ones in SE3 were less similar than 70% compare to same feeding strategies group in SE1 (Table 2a, c, e). Whereas, there were frugivorous, insectivorous and garnivorous in SE2 and SE3 and nectarivorous in SE2 were more similar than 70% compare to same feeding strategies group in SE1 (Table 2b, d, e, f)

The highest Shannon diversity index value found was found 3.62^{a} in SE1, followed by 3.60^{a} in SE2 and 3.44^{b} in SE3. The SE1 was not significantly different diversity from SE2, but the both sites were significantly different from SE3 by Duncan's Multiple Range Test (Table 3).

Table 2: Matrix of similarity of bird species by the Sorensen index to divide from feeding strategies groups in the restricted site (SE1) and tourist sites (SE2 and SE3)



The relative average of bird densities in all study sites was 32.2 individuals/ha. They were separated 6 groups from feeding strategies. The highest density index was found 45.5% in frugivorous giving with 15 individuals/ha, followed by 27.3% in insectivorous, 21.2% in

Table 3: List of bird species found during this study

				Study sites		
Orders	Families	Species	FS	SE1	SE2	SE3
Falconiformes	Accipitridae	*Aviceda jerdoni*	C	-	+	-
		Aviceda leuphotes	C	+	+	+
		Accipiter virgatus	C	+	-	-
		Falco severus	C	-	-	+
Galliformes	Phasianidae	*Lophura nycthemera*	O	-	-	+
		Lophura diardi	O	+	+	+
		Gallus gallus	O	+	+	+
		Polyplectron bicalcaratum	O	+	-	-
		Arborophila rufogularis	O	+	-	+
Columbiformes	Columbidae	*Treron curvirostra*	F	+	+	+
		Ducula badia	F	+	+	+
		Macropygia unchall	G	+	-	+
		Macropygia ruficeps	G	+	+	+
		Streptopelia orientalis	G	+	+	+
		Chalcophaps indica	G	+	+	+
Psittaciformes	Psittacidae	*Psittacula ale-andri*	F	-	+	-
		Loriculus vernalis	F	+	+	+
Cuculiniformes	Cuculidae	*Cuculus sparveriodes*	C	-	+	+
		Surniculus lugubris	O	-	+	+
		Phaenicophaeus tritis	I	+	+	+
		Centropus sinensis	C	+	-	-
Strigiformes	Strigiformes	*Glaucidium brodiei*	C	+	+	+
		Glaucidium cuculoides	C	-	-	+
Caprimulgiformes	Caprimulgidae	*Caprimulgus* sp.	I	+	-	-
Trogoniformes	Trogonidae	*Harpactes oreskios*	I	+	+	+
		Harpactes erythrocephalus	I	+	+	+
Coraciiformes	Alcedinidae	*Lacedo pulchella*	C	+	+	-
	Meropidae	*Merops leschenaulti*	I	+	-	-
		Nyctyornis athertoni	I	+	+	+
	Coraciidae	*Coracias benghalensis*	I	-	-	+
		Eurystomus orientailis	I	-	+	+
Piciformes	Bucerotidae	*Anthracoceros albirostris*	F	+	+	+
	Capitonidae	*Megalaima virens*	F	+	+	+
		Megalaima asiatica	F	+	+	+
		Megalaima incognita	F	+	+	+
		Megalaima australis	F	+	+	+
		Megalaima haemacephala	F	-	+	-
	Picidae	*Picumnus innominatus*	I	+	+	+
		Sasia ochracea	I	+	-	-
		Chrysocolaptes lucidus	I	+	+	+
		Dinopium javanense	I	+	+	+
		Picus canus	I	-	-	+
		Picus flavinucha	I	-	+	+
		Picus chlorolophus	I	+	+	+
		Celeus brachyurus	I	-	+	+
		Blythipicus rubiginosus	I	+	+	+
		Mulleripicus pulverulentus	I	-	+	+
		Meiglyptes jugularis	I	+	+	+
		Hemicicus canente	I	+	+	-
		Picoides canicapillus	I	+	+	+
Passeriformes	Euryliamidae	*Corydon sumatranus*	I	-	+	+
		Serilophus lunatus	I	+	+	+
		Psarisomus dalhouiae	I	+	+	+
	Pittidae	*Pitta oatesi*	I	+	-	+
	Motacillidae	*Dendronanthus indicus*	I	-	+	
	Campephagidae	*Tephrodornis virgatus*	I	-	+	+
		Tephrodornis pondicerianus	I	-	+	-

Table 3: Continued

Orders	Families	Species	FS	Study sites SE1	SE2	SE3
		Coracina macei	I	+	+	+
		Coracina polioptera	I	-	+	+
		Coracina melaschista	I	+	+	+
		Pericrocotus divaricatus	I	+	+	+
		Pericrocotus flammeus	I	+	+	+
	Chloropseidae	*Aegithina tiphia*	I	-	+	-
		Chloropsis aurifrons	F	-	+	-
		Chloropsis cochinchinensis	F	+	+	+
	Pycnonotidae	*Pycnonotus atriceps*	F	+	+	-
		Pycnonotus melanicterus	F	+	+	+
		Pycnonotus jocosus	F	+	-	-
		Pynonotus finlaysoni	F	+	-	-
		Criniger pallidus	F	+	+	+
		Hypsipetes propinquus	F	+	+	+
		Hypsipetes mcclellandii	F	+	-	-
		Hypsipetes flavala	F	+	+	+
		Hypsipetes madagascariensis	F	+	-	-
	Dicruridae	*Dicrurus leucophaeus*	I	+	+	+
		Dicrurus aeneus	I	+	+	+
		Dicrurus remifer	I	+	-	+
		Dicrurus hottentottus	N	+	+	+
		Dicrurus paradiseus	I	+	+	+
	Oriolidae	*Oliolus anthonotus*	O	+	+	+
		Oriolus tenuirostris	O	-	+	-
	Irenidae	*Irena puella*	O	+	+	+
		Cissa chinensis	O	+	+	+
		Dendrocita vagabunda	O	-	+	+
	Paridae	*Melanochlora sultanea*	O	+	+	+
		Sitta frotalis	I	+	+	+
	Timaliidae	*Pomatorhinus hypoleucos*	C	-	-	+
		Pomatorhinus schisticeps	C	+	-	-
		Napothera brevicaudata	C	+	-	-
		Macronous gularis	C	+	+	+
		Garrula leucolophus	O	+	+	+
		Garrula monileger	O	-	+	-
		Garrula pectoralis	O	+	+	+
		Garrula chinensis	O	+	-	-
	Timaliidae	*Alcippe poioicephala*	I	+	+	+
		Yuhina zantholeuca	I	+	+	+
	Sylviidae	*Seicercus burkii*	I	+	+	+
		Phylloscopus subaffinis	I	+	+	+
		Phylloscopus schwarzi	I	-	+	-
		Phylloscopus borealis	I	+	-	-
		Phylloscopus ricketti	I	+	-	-
		Phylloscopus inornatus	I	+	+	+
		Prinia rufescens	O	-	+	-
		Orthotomus sutorius	O	+	+	-
		Orthotomus atrogularis	O	+	+	+
		Copsychus malabaricus	I	+	+	+
		Monticola solitarius	O	-	+	-
		Turdus obscurus	O	-	+	-
		Muscicapa sibirica	I	+	-	-
	Muscicapidae	*Ficedula parva*	I	+	+	+
		Ficedula westermanni	I	+	+	+
		Culicicapa ceylonensis	I	+	+	+
		Eumyias thalassina	I	+	+	+
		Cyornis banyumas	I	+	+	+
		Hypothymis azurea	I	+	+	+

Table 3: Continued

Orders	Families	Species	PS	Study sites SE1	SE2	SE3
	Monachidae	*Terpsiphone paradisi*	I	+	-	+
		Ampeliceps coronatus	O	+	+	-
	Sturnidae	*Gracula religiosa*	O	+	+	+
		Anthreptes malacensis	N	-	-	+
	Nectariniidae	*Anthreptes singalensis*	N	+	-	+
		Hypogramma hypogrammicum	N	+	+	-
		Nectarinia jugularis	N	+	-	-
		Aethopyga saturata	N	+	+	+
		Arachnothera longirostra	N	+	+	-
		Arachnothera magna	N	+	+	+
		Dicaeum agile	O	+	+	-
	Dicaeidae	*Dicaeum Chrysorrheum*	O	+	-	-
		Dicaeum concolor	O	+	-	-
		Dicaeum cruentatum	O	+	-	-
		Zosterops Erythropleurus	O	-	+	-
	Zosteropidae	*Zosterops japonicus*	O	+	+	-
		Lonchura striata	G	-	+	-
	Estrildidae	*Lonchura punctulata*	G	+	+	-

SE1 = Seasonal evergreen forest 1 inrestricted area, SE2 = Seasonal evergreen forest 2 in tourist area, SE3 = Seasonal Evergreen forest 3 in tourist area; FS = Feeding Strategy, C = Carnivorous, F = Frugivorous, O = Omnivorous, I = Insectivorous, N = Nectarivorous, G = Garnivorous. (Lekagul and Round, 1991; Treesucon and Round, 1989), + = Present, - = Absent, = Migratory birds

omnivorous, 2.7% in nectarivorous, 2.2% in carnivorous and 1.1% in garnivorous, which had 9, 7, 1, 0.7 and 0.3 individuals/ha, respectively. Relative density of carnivorous birds in SE3, nectarivorous birds in SE2 and SE3 and garnivorous birds in SE3 of tourist area were lower density interval values than 46-78% compare to same feeding strategy group in SE1 and average density values. While density values of frugivorous, omnivorous and insectivorous in all 3 sites were nearly the same similar (Fig. 2).

DISCUSSION

A total of 11 orders, 34 families and 133 species were indicative. Roughly 14% of all bird species, 38.9% families and 57.9% orders of Thailand were found at the 3 study sites. The birds of Thailand now include 970 species, 90 families and 19 orders. Our work represents that lists of bird species in seasonal evergreen forest of the area were higher quantitative than in evergreen forest at other protective areas. Eighty-eight species of birds were found in evergreen forest of Salween Wildlife Sanctuary, Mae Hong Son Province (Kotcha, 2005). Ecological data viz. taxonomic data, specie numbers, individual numbers, co-habitat species and co-dominant species were represented the composition characteristic of birds in the seasonal evergreen forest habitats at the area. According to Marco and Alan (2005), bird community in an urban area of Southeast Brazil showed clearly that each habitat had its own characteristics with regard to avifauna composition. The data will be used indicator for future investigation.

The 65 species, among those listed, were co-habitat species. Seven species among 65 co- habitat species were co-dominant species. The characteristics of co-dominant species should include the following factors: residential species, co-habitat species, frequency occurrence and high individual numbers. The co-dominant species were identified by using the highest frequency, density and abundance values (Ludwing and Renolds, 1998; Pettingill, 1970). We forecasted that if avian communities will be greater affected by tourist visitations than present. Some co-habitat species will be affected with a less or loss from the area before co-dominant species. Same as in small forest

fragments in the Parana State, had been affected by human activity. It led to the loss of biodiversity (Hostetler and Knowles-Yanez, 2003). This fact suggested that the presences of co-dominant species and co-habitat species are indicator of effect level in the areas. Thus, presence and absence data of co-habitat and co-dominant species had enhanced studies for further effect investigation.

An analysis bird effect was analyzed from base on the index values of similarity, diversity and density in tourist area compare to restricted area. The 74.3-79.4% qualitative similarity index values of bird species between study sites was done. The appearance results seemed to be equal. Nevertheless some of feeding strategies groups viz. carnivorous and omnivorous birds in both SE2 and SE3 and nectarivorous birds in SE3 were effected more than the other group, because similarity index values less than 70%, compared to same feeding strategies groups in SE1. Same results of densities relative to carnivorous (SE3), nectarivorous (SE2 and SE3) and garnivorous (SE3) groups decreased 46-78 % in tourist sites compared to feeding strategies groups in restricted site (SE1). This result suggested that tourist activities maybe disturbed some bird groups in tourist area. According to Martinez-Abrain *et al*. (2002) reported that high tourist presence coincides with a loss of breeding pairs in at Foradada-lobo and that low tourist presence coincide with an increase in the number of pairs at Ferrera in Eleonora's Falcon. Similar results were also found by Gutzwiller *et al*. (1997) about normal behaviors of birds viz. singing, feeding, reproductive and social behavior were altered by low levels of human intrusion. It led to the loss of biodiversity (Hostetler and Knowles-Yanez, 2003). This agrees with Heil *et al*. (2007) concerning avian responses to tourism in the biogeographically isolated Cordoba Mountain, Argentina. They discovered that bird communities, relative species richness, species diversity and density values were lower in on-trail transects compared to off-trail transects. These researchers suggest that human disturbance may be involved in the responses found in different avian communities. Conform to the calculated result of bird in tourist areas (SE2 and SE3) had lower Shannon-Wiener diversity indices (Magurran, 1988) than restricted area.

The collected data was a first report about avifauna dynamic of Tung Salang Luang National Park. The highlight of research was represented; at present, some bird groups in the seasonal evergreen forest had negative effect correlation with human activities on the national park management condition. The facts shall be used indicator for further impact investigation and to lead into preservation and management strategies of avifauna at Tung Salang Luang National Park.

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