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Bird Diversity Relative to Forest Types and Physical Factors at Tung Salang Luang National Park, Thailand

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Abstract: A survey of bird diversity was carried out at Tung Salang Luang National Park in three forest types i.e. mixed forest (seasonal evergreen forest mixed with deciduous dipterocarp forest), seasonal evergreen forest and deciduous dipterocarp forest, during March 2004 to February 2005. The point count mixed line transect methods were used for data collection. The survey found 6,697 birds in total from 140 sp., 35 families and 11 orders occurring in the mixed forest, seasonal evergreen forest and deciduous dipterocarp forest were as follows: 107, 100 and 94 sp. The quantitative bird communities have a negative correlation with climatic changes, as a result, the dynamic pattern of bird populations in the 3 habitats during a year were similar. The fewest species numbers and individual numbers were found during the rainy season and slightly high during the late rainy to early cool seasons. The highest bird populations were found during cool season. Similarity index values of birds in both mixed forest and seasonal evergreen forest were the greatest similar, while both mixed forest and deciduous dipterocarp forest were fewest less similar. The 72.6-78.3% qualitative similarity index values of bird species between study sites was done. Mixed forest had the highest Shannon diversity index 3.9507, followed by deciduous dipterocarp and seasonal evergreen forest were 3.6387 and 3.6025, respectively. The pattern observed suggest that the structure and dynamics of the Tung Salang Luang bird community are strongly liked to physical factors and habitat heterogeneity. Two particular species of bird were observed in this study: *Aviceda jerdoni* (Jerdon' Baza) and *Coracina javensis* (Javan Cuckooshrike).

Key words: Bird diversity, forest, physical factors, habitats, species

INTRODUCTION

An investigation of bird diversity was conducted at Tung Salaeng Luang National Park, Phetchabun Province, Thailand. The relationship between avian communities and environmental factors had held an important part in community ecology. It is assumed that traits of species have evolved to be adaptive to maximize evolutionary success (Adamík *et al*., 2003; Price *et al*., 1997). Base on this assumption, one may expect species-specific preferences for particular habitat type and physical factors variation as a consequence of an historical relationship between dynamic of avian communities and their environment. This is in agreement with Kotcha (2005) who found that the quantity of rainfall increases the number of birds decrease. The species of birds are significantly correlated with rainfall in January (Khobkhet, 1998; Kotcha, 2005). The patterns of bird habitat relationships have been well documented by numerous studies often revealing strong foraging preferences in some species for a particular tree species (Adamík *et al*., 2003; Kornan, 2000). This suggests that forests with high structural complexity offer bird diverse microhabitats for foraging, nesting opportunities and reduced predation (Parrish, 1995; Whelan, 2001).

The objective of this research is to find dynamic and distribution patterns of bird communities on different forest habitats and climatic change in the national park. The data has enhanced studies on the dynamic of bird communities in the areas for present and further effect investigation, which could aid in future conservation efforts.

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MATERIALS AND METHODS

Study area: Tung Salang Luang, National Park is located in lower north of Thailand. The national park office is located at approximately 16° 34′ 26.483″ north latitude and 100° 53′ 11.667″ east longitude at Nong Mae Na Subdistrict, Khao Kho District, Phetchabun Province (Fig. 1). The monitoring sites are approximately 700-860 m elevation. The total and average annual rainfalls were approximately 1805 and 150.4 mm, respectively. Average annual highest and lowest temperatures were approximately 31.8° and 17.6°C, respectively and an average annual temperature was 22.8°C.

The characteristic of the first study site is Mixed Forest (MF). It consists of seasonal evergreen forest with deciduous dipterocarp forest. The monitoring site is located approximately 16° 34′ 19.03708″ north latitude and 100° 53′ 25.76037″ east longitude . The second site is Seasonal Evergreen forest (SE) and is located at approximately 16° 36′ 12.31105″ north latitude and 100° 53′ 31.75871″ east longitude. The final study site is in Deciduous DIPTEROCARP forest (DD), located at approximately 16° 31′ 48.33861″ north latitude and 100° 51′ 25.59241″ east longitude (Fig. 1).

A survey of bird diversity was conducted at Tung Salang Luang National Park, Phetchabun Province,

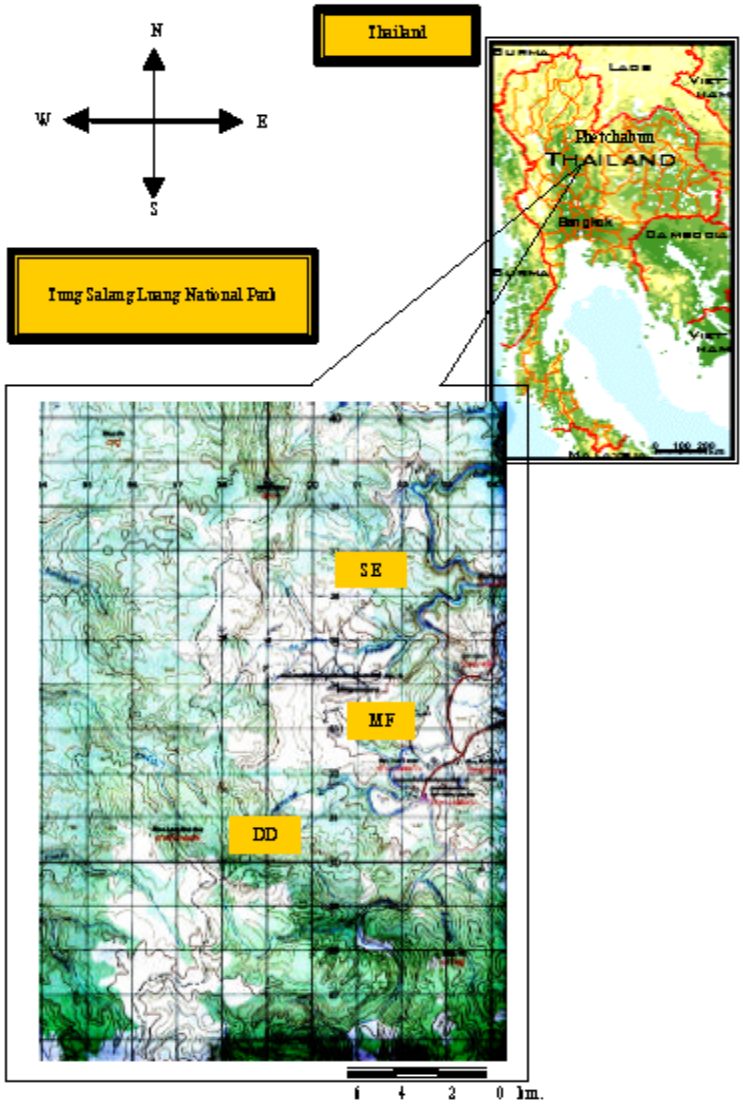


Fig. 1: Location of study sites MF, SE and DD in Tung Salang Luang, national park. Scale 1:5000, (UTM 47Q, royal Thai survey department)

Thailand during March 2004 to February 2005. Ten sampling plots (80 × 80 m per plot) were systematically fixed on transect lines, with 20 between each plot, in each forest type.

Point count and line transect methods were used for data collection (Ralph *et al*., 1997) and was done once a month at 3 period 7:00-10:00, 11:00 14:00 and 15:00-18:00 h for a year. For 10 min each of the ten plots (monitoring zone) and 5 min between plot (stop zone) were used for sampling.

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

Analysis of all data collected was made to calculate similarity and diversity indices. The calculated indices were used to compare species composition and variation of bird populations in all habitat types.

RESULTS

A total of 6,697 birds as belonging to 140 species, 35 families and 11 orders were observed (Table 1). One hundred and fifteen species (78%) were found to be residential birds, whereas 25 species (22%) were migratory birds. Most of the bird communities were found in Mixed Forest (MF) with 2,271 birds of 107 species. Two thousand four hundred and fourteen birds of 100 species and 2,012 birds of 94 species were found in Seasonal Evergreen forest (SE) and Deciduous Dipterocarp forest (DD), respectively. Only 17 species were recorded from mixed forest. 12 species were found in only seasonal evergreen forest and 13 species only in deciduous dipterocarp forest. There were 64 species found in all 3 habitats.

Interestingly, two species viz. *Aviceda jerdoni* (Jerdon' Baza) and *Coracina javensis* (Javan Cuckooshrike) were seen in the study area. The former

Table 1: List of bird species found in three habitats MF = Mixed Forest, SE = Seasonal Evergreen forest and DD = Deciduous Dipterocarp forest; R = Resident, W = Winter visitor, P = Passage migrant (Lekagul and Round, 1991; Treesucon and Round, 1989)

				Habitats		
Orders	Families	Species	Status	MF	SE	DD
Falconiformes	Accipitridae	*Aviceda jerdoni*	W	-	+	-
		Aviceda leuphotes	W	+	+	+
		Accipiter badius	R	-	-	+
		Spilornis cheela	R	+	-	-
Galliformes	Phasianidae	*Lophura diardi*	R	-	+	-
		Gallus gallus	R	+	+	+
		Arborophila rufogularis	R	+	-	-
		Francolinus pintadeanus	R	+	-	+
Gruiformes	Turnicidae	*Turnix tanki*	R	-	-	+
Columbiformes	Columbidae	*Treron curvirostra*	R	+	+	+
		Ducula badia	R	+	+	+
		Macropygia ruficeps	R	+	+	+
		Streptopelia orientalis	R	+	+	+
		Streptopelia tranquebarica	R	-	-	+
		Streptopelia chinensis	R	+	-	+
		Chalcophaps indica	R	+	+	+
Psittaciformes	Psittacidae	*Psittacula alexandri*	R	-	+	-
		Loriculus vernalis	R	+	+	+
Cuculiniformes	Cuculidae	*Cuculus sparveriodes*	R	+	+	-
		chrysococcyx maculatus	W	+	-	-
		Chrysococcyx xanthorhynchus	R	+	-	-
		Surniculus lugubris	R	+	+	+
		Phaenicophaeus tritis	R	+	+	+
		Centropus sinensis	R	+	-	-
Strigiformes	Strigiformes	*Glaucidium brodiei*	R	-	+	+
Trogoniformes	Trogonidae	*Harpactes oreskios*	R	+	+	-
		Harpactes erythrocephalus	R	+	+	-
Coraciiformes	Alcedinidae	*Lacedo pulchella*	R	-	+	-
	Meropidae	*Merops leschenaulti*	R	+	-	-
		Nyctyornis athertoni	R	+	+	-
	Coraciidae	*Coracias benghalensis*	R	+	-	+
		Eurystomus orientailis	R	+	+	-
	Upupidae	*Upupa epops*	R	-	-	+
	Bucerotidae	*Anthracoceros albirostris*	R	+	+	+
Piciformes	Capitonidae,	*Megalaima virens*	R	+	+	+
	Megalaimidae	*Megalaima lineata*	R	+	-	-
		Megalaima asiatica	R	+	+	+
		Megalaima incognita	R	+	+	+

Orders	Families	Species	Status	Habitats		
				MF	SE	DD
		Megalaima australis	R	+	+	+
		Megalaima haemacephala	R	+	+	-
	Picidae	*Picumnus innominatus*	R	-	+	-
		Chrysocolaptes lucidus	R	+	+	+
		Dinopium javanense	R	+	+	+
		Picus canus	R	-	-	+
		Picus flavinucha	R	+	+	+
		Picus chlorolophus	R	+	+	+
		Celeus brachyurus	R	-	+	+
		Blythipicus rubiginosus	R	+	+	+
		Muelleripicus pulverulentus	R	+	+	+
		Dryocopus javensis	R	+	-	-
		Meiglyptes jugularis	R	+	+	+
		Hemicicus canente	R	+	+	+
		Picoides canicapillus	R	+	+	+
Passeriformes	Euryliamidae	*Corydon sumatranus*	R	+	+	-
		Serilophus lunatus	R		+	-
		Psarisomus dalhouiae	R	+	+	-
	Pittidae	*Pitta oatesi*	R	-	-	+
	Motacillidae	*Anthus hodgsoni*	W	+	-	-
		Dendronanthus indicus	W	-	+	-
	Campephagidae	*Tephrodornis virgatus*	R	+	+	+
		Tephrodornis pondicerianus	R	-	+	-
		Coracina macei	R	+	+	+
		Coracina javensis	R	+	-	+
		Coracina polioptera	R	-	+	+
		Coracina melaschista	R	+	+	+
		Pericrocotus divaricatus	W	-	+	+
		Pericrocotus roseus	W	+	-	-
		Pericrocotus flammeus	R	+	+	+
	Chloropseidae	*Aegithina tiphia*	R	+	+	+
		Chloropsis aurifrons	R	+	+	+
		Chloropsis cochinchinensis	R	+	+	+
	Pycnonotidae	*Pycnonotus atriceps*	R	+	+	+
		Pycnonotus melanicterus	R	+	+	+
		Pynonotus aurigaster	R	+	-	+
		Pynonotus finlaysoni	R	+	-	-
		Criniger pallidus	R	+	+	+
		Hypsipetes propinquus	R	+	+	+
		Hypsipetes flavala	R	+	+	-
		Hypsipetes madagascariensis	R	+	-	-
	Dicruridae	*Dicrurus leucophaeus*	R	+	+	+
		Dicrurus aeneus	R	+	+	+
		Dicrurus remifer	R	+	-	+
		Dicrurus hottentottus	R	+	+	+
		Dicrurus paradiseus	R	+	+	+
	Oriolidae	*Oliolus xanthonotus*	W	+	+	+
		Oriolus tenuirostris	W	-	+	-
	Irenidae	*Irena puella*	R	+	+	+
		Cissa chinensis	R	+	+	+
		Dendrocita vagabunda	R	-	+	+
	Paridae	*Melanochlora sultanea*	R	+	+	-
	Sittidae	*Sitta frotalis*	R	+	+	+
	Timaliidae	*Macronous gularis*	R	+	+	+
		Chrysomma sinense	R	-	-	+
		Garrulax leucolophus	R	+	+	+
		Garrulax monileger	R	-	+	-
		Garrulax pectoralis	R	+	+	+
	Timaliidae	*Alcippe poioicephala*	R	-	+	-
		Yuhina zantholeuca	R	+	+	+
	Sylviidae	*Seicercus burkii*	W	-	+	+
		Phylloscopus subaffinis	W	-	+	+
		Phylloscopus schwarzi	W	+	+	+
		Phylloscopus borealis	P	+	-	+
		Phylloscopus plumbeitarsus	W	-	-	+
		Phylloscopus reguloides	W	-	-	+
		Phylloscopus inornatus	W	+	+	+

Orders	Families	Species	Status	Habitats MF	SE	DD
		Cisticola exilis	R	-	-	+
		Prinia hodgsonii	R	-	-	+
		Prinia rufescens	R	+	+	+
		Prinia polychroa	R	-	-	+
		Orthotomus sutorius	R	+	+	-
		Orthotomus atrogularis	R	+	+	+
	Turdidae	*Copsychus malabaricus*	R	+	+	+
		Monticola gularis	W	-	-	+
		Monticola solitarius	W	+	-	-
		Myiophoneus caeruleus	R	-	+	-
		Turdus obscurus	W	+	+	-
	Muscicapidae	*Muscicapa sibirica*	W	+	-	-
		Muscicapa dauurica	W	+	-	+
		Muscicapa williamsoni	P	-	-	+
		Ficedula parva	W	+	+	+
		Ficedula westermanni	R	+	+	+
		Culicicapa ceylonensis	R	+	+	+
		Eumyias thalassina	R	+	+	+
		Cyornis banyumas	R	+	+	+
	Monachidae	*Hypothymis azurea*	R	+	+	+
		Terpsiphone paradisi	R	+	-	-
	Sturnidae	*Ampeliceps coronatus*	R	+	+	-
		Gracula religiosa	R	+	+	+
	Nectariniidae	*Anthreptes singalensis*	R	+	-	-
		Hypogramma hypogrammicum	R	+	+	+
		Nectarinia jugularis	R	+	-	+
		Aethopyga saturata	R	+	+	+
		Arachnothera longirostra	R	+	+	-
		Arachnothera magna	R	+	+	-
	Dicaeidae	*Dicaeum agile*	R	+	+	-
		Dicaeum cruentatum	R	+	-	-
	Zosteropidae	*Zosterops Erythropleurus*	W	+	+	+
		Zosterops japonicus	W	+	+	-
	Estrildidae	*Lonchura striata*	R	+	+	+
		Lonchura punctulata	R	+	+	+

+ = Present, _ = Absent, = Migratory birds

Table 2: Matrix of similarity by Sorensen's index of bird speciies in the 3 habitats

	MF	SE	DD
MF			
SE	78.3		
DD	72.6	73.2	

specie is a cool season visitor with few records, it evidenced in SE. The latter species is a rare resident with a new provincial record, they evidenced in MF and DD.

Similarity using Sorensen's index in all forest habitats were analyzed using similar comparisons between habitat types. The highest similarity index was found in both MF and SE forest, with 78.3% which differed from pair of DD and SE forests followed by both MF and DD, with 73.2 and 72.6%, respectively (Table 2).

Diversity by the Shannon-Wiener diversity index (Magurran, 1988) in all habitats was analyzed. The highest diversity index was found in MF giving with 3.95067^{a}, which was significantly different from DD and SE, which had 3.63872^{b} and 3.60254^{b}, respectively ($p<0.05$).

Variation of bird populations during 12 month: Quantitative dynamic patterns of bird populations in all habitats during the study period appeared similar. The fewest species numbers and individual numbers were found during June to September (rainy season) and greatly increased during October to December (early cool season). The highest populations and bird species were recorded during December to January (cool-dry season, Fig. 2 and 3). The numbers of individual and species of birds at each seasons were significantly different ($\alpha = 0.05$).

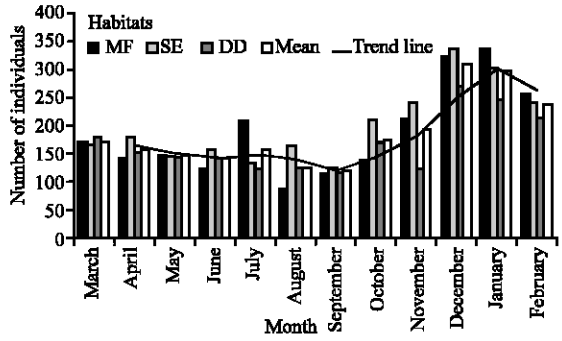


Fig. 2: Number of individuals in three habitats

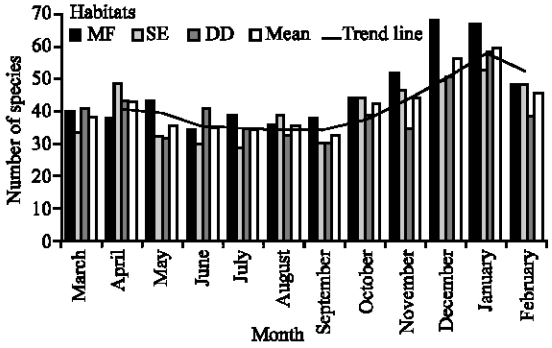
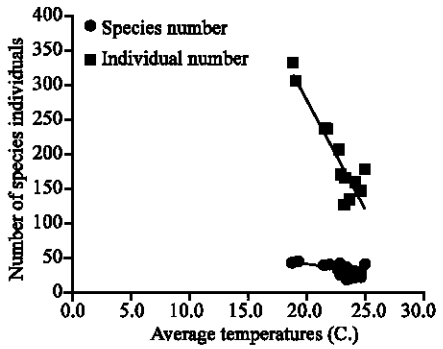
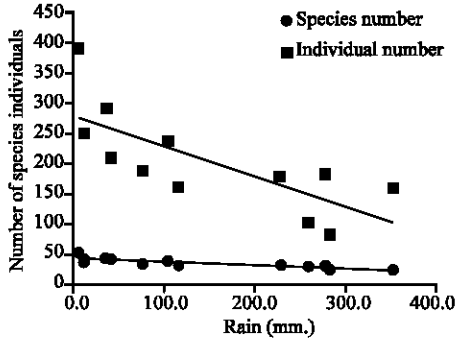


Fig. 3: Number of species in the three habitats





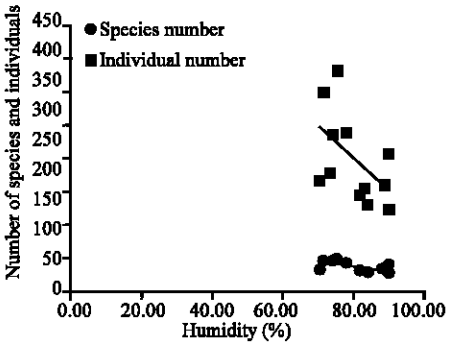
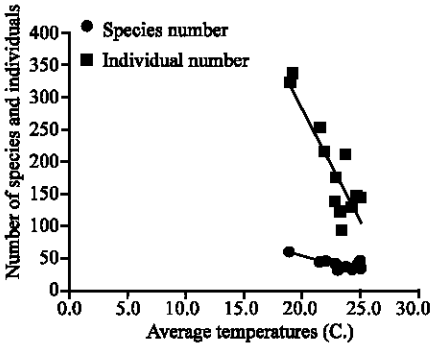
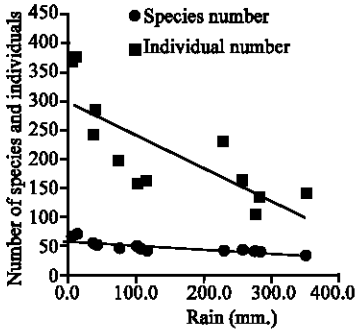


Fig. 4: Relationships between avian communities and physical factors of SE





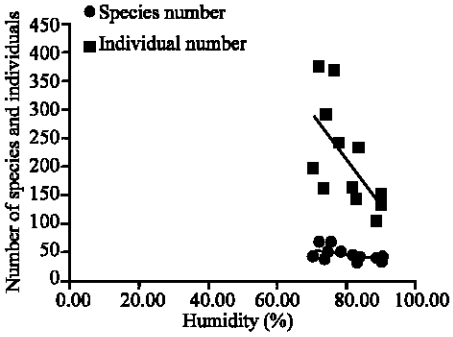


Fig. 5: Relationships between avian communities and physical factors of MF

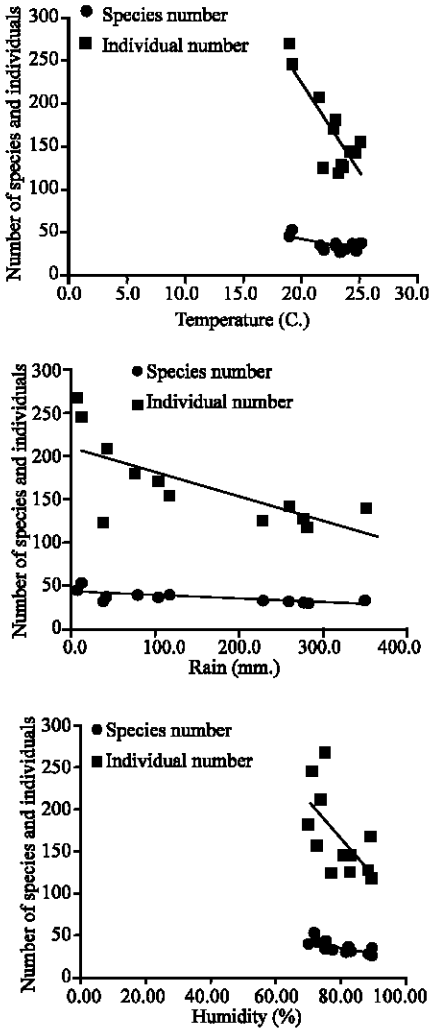


Fig. 6: Relationships between avian communities and physical factors of DD

Trend of relationship between dynamic pattern of avian communities and physical factor viz. temperature, rain and humidity at each study sites were almost same. The total number of bird species and individual numbers in all study sites were decrease during temperature, rain and humidity increase (Fig. 4-6).

DISCUSSION

In this study, a total of 10 orders, 35 families and 140 species were found, which is roughly 15% of the total number of the bird species in Thailand were found. Presently birds have been discovered in Thailand 970 species, 90 families and 19 orders. There are specialist species (species which occur in a specific or a single habitat) with 17 species in mixed forest, 12 species in seasonal evergreen forest and 13 species in deciduous dipterocarp forest. Sixty-four generalist species live in all habitats. The pattern observed suggest that the structure and dynamics of the Tung Salang Luang bird community are strongly liked to physical factors and habitat heterogeneity.

It can be seen that physical factors has correlation with dynamic patterns of Tung Salang Luang bird communities throughout the year. Individual and species number of birds has a negative correlation with temperature, rain and humidity values. The highest values of three physical factors were recorded in rainy season and lowest in cool-dry season. As a result, species and individual numbers of birds in the area were found decrease in the rainy season during June to September and increase in cool-dry season during December to January. This is in agreement with Kotcha (2005) who studied bird diversity in Salween Wildlife Sactuary, Mae Hong Son Province. He found that if quantity of rainfall increases the number of birds decrease. The species of birds were significantly correlated with rainfall. Khobkhet (1998) reported that the highest species number and individual number of bird is in January at Bung Borapet Non-hunting Area, Nakornsawan Province, Thailand.

In all forest habitats, Sorensen similarity indices were analyzed to find similarity of bird communities between forest types. The highest similarity index was found in both mixed forest and seasonal evergreen forest, which differed from result both seasonal evergreen forest and deciduous dipterocarp forest, followed by both mixed forest and deciduous dipterocarp forest, respectively. Similarities of birds between habitats were related to habitat quality. The patterns of bird habitats had relationships to forests with high structural complexity offer birds diverse microhabitats for foraging, nesting opportunities and reduced predation (Kornan, 2000; Parrish, 1995; Whelan, 2001). Walson and Round (1992) stated that if threats or disturbance occur in habitats that are less similar to one another habitat, birds can not survive, as no suitable alternative habitats are present. For example, when either mixed forest or seasonal evergreen forest is disturbed, birds migrate between the two habitats instead of migrating to different habitats.

The 72.6-78.3% qualitative similarity index values of bird species between study sites was done. The proportions and composition of bird communities in mixed forest had the highest Shannon-Wiener diversity index (Magurran, 1988). We suspect that the mixed forest has higher biodiversity, because the forest there is a mixture between seasonal evergreen forest and deciduous dipterocarp forest, thus, the species composition of bird in both habitats were higher combined together. This

resulted in the highest bird diversity index. Figueira *et al.* (2006) point out the importance of environment heterogeneity to fauna: different landscape units may function as dispersion corridors, stepping- stones, refuges and feeding sites. It maybe shows the importance of environment heterogeneity in determining species diversity in the Pantanal.

Although the seasonal evergreen forest was the richest in individual numbers, the diversity index was the lowest values. Evergreen forest is still an excellent habitat. That is, the structure can be measured by length, width and height. Resource partitioning is a strategy the animals use to survive (Kotcha, 2005). However, several species require specific resources, habitat type and/or specific environmental conditions. Therefore, it can provide abundant resources for some bird species. The proportion of bird relative to species numbers and individual numbers were higher different than those in other habitats. Thus, bird populations in the seasonal evergreen forest were not evenness. This resulted in a lower diversity index.

Two particular species of bird were found in this area. Firstly *Aviceda jerdoni* (Jerdon Baza) is a migrant bird in cool season with few records (Lekagul and Round, 1991). Secondly *Coracina javensis* (Javan Cuckooshrike) were not recorded in A Guide to the Birds of Thailand manual (Lekagul and Round, 1991). While, Supparatvikorn and Klaichinda (2000) reported in Birds of Thailand book (Thai book manual). It is scientifically accepted as a subspecies *(C.j. larutensis)* of the Javan Cuckooshrike of Java and Bali. Although, the Javan Cuckooshrike is a common bird in the Main Range of West Malaysia, it can sometimes be found in the extreme south of Thailand. This species is a rainforest inhabitant but can be seen at forest edges. At Tung Salang Luang National Park, Javan Cuckooshrike can be seen in the mixed forest (deciduous dipterocarp zone) and deciduous dipterocarp forest. Their nesting site and incubation nests were also found. We speculate that they are rare residents and new record of the provincial part.

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