ความหลากหลายของชนิดนกในพื้นที่ภูเขาทอง อำเภอแก่งคอย จังหวัดสระบุรี

นายเลอสรรค์ วศิโนภาส

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BIRD SPECIES DIVERSITY IN PHU KHAO TONG AREA, KANG KHOI DISTRICT, SARABURI PROVINCE

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A Thesis Submitted in Partial Fulfillment of the Requirements

for the Degree of Master of Science Program in Zoology

Department of Biology

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วัตถุประสงค์หลักของการศึกษานี้คือ ศึกษาความหลากหลายของชนิดนกใน 5 ลักษณะพื้นที่ที่เป็นถิ่นที่อยู่อาศัย ได้แก่ พื้นที่ป่า อ่างเก็บน้ำ ทุ่งหญ้า แปลงเกษตร และหมู่บ้าน รวมไปถึงปัจจัยบางประการที่อาจมีผลกระทบต่อความหลากหลายของชนิดนกในพื้นที่เหล่านั้น ความหลากหลายของชนิดนกในพื้นที่ภูเขาทอง อำเภอแก่งคอย จังหวัดสระบุรี ได้เก็บข้อมูลทุกเดือน โดยวิธี point count method ตั้งแต่ มกราคม ปี พ.ศ. 2551 ถึง ธันวาคม ปี พ.ศ. 2551

ความหลากหลายของชนิดนกทั้งหมดในพื้นที่ศึกษาพบ 103 ชนิด และ จำนวนของชนิดนกในพื้นที่ทุ่งหญ้า แปลงเกษตร หมู่บ้าน อ่างเก็บน้ำ และ ป่า รอบพื้นที่ ภูเขาทอง มีค่าเท่ากับ 73, 64, 55, 46 และ 39 ชนิด ตามลำดับ และค่าดัชนีความหลากหลายของ Shannon-Weiner คือ 3.39, 3.37, 3.14, 3.06 และ 3.01 ตามลำดับ ความคล้ายคลึงของชนิดนกระหว่างสองพื้นที่ที่มีความคล้ายคลึงของชนิดนกมากที่สุดคือ แปลงเกษตรและหมู่บ้าน โดยมีดัชนีความคล้ายคลึงของ Sorensen เท่ากับ 0.78 ขณะที่ป่า และหมู่บ้าน มีความคล้ายคลึงของชนิดนกต่ำที่สุด ที่ค่าดัชนี เท่ากับ 0.47 นอกจากนั้น ปัจจัยทางชีวภาพเกี่ยวกับการรบกวนจากมนุษย์ แสดงให้เห็นความสัมพันธ์ระหว่างความหลากหลายของชนิดนก และความชุกชุมของนก (Pearson Correlation = - 0.725 (p = 0.00) และ -0.528 (p = 0.01) ตามลำดับ ในขณะเดียวกัน ปัจจัยทางกายภาพทั้งหมดที่ศึกษาในครั้งนี้ไม่มีความสัมพันธ์กับความหลากหลายของชนิด และ ความหนาแน่นของนก ที่ค่า Pearson correlation $p \geq 0.05$

เนื่องจากพื้นที่ทุ่งหญ้ามีความหลากหลายของชนิดนกสูงสุด ดังนั้นพื้นที่ทุ่งหญ้าระหว่างภูเขาจึงควรเก็บรักษาไว้ เพื่อเป็นพื้นที่เชื่อมต่อของนกในพื้นที่ ขณะเดียวกัน พื้นที่ที่ใกล้กับถนนใหญ่นั้น อาจนำมาใช้เป็นพื้นที่ก่อสร้างโครงสร้างพื้นฐานต่างๆ ปัจจุบันนี้ พื้นที่ป่าในบริเวณภูเขาทอง กำลังอยู่ในระหว่างการฟื้นฟู ดังนั้นควรรักษาสภาพให้ถูกรบกวนน้อยที่สุด

ภาควิชา: ชีววิทยา ลายมือชื่อนิสิต .....

สาขาวิชา: สัตววิทยา ลายมือชื่ออาจารย์ที่ปรึกษาวิทยานิพนธ์หลัก .....

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KEYWORDS : BIRD / DIVERSITY / DISTURBANCE

LERSON VASINOPAS : BIRD SPECIES DIVERSITY IN PHU KHAO TONG AREA KANG KHOI DISTRICT, SARABURI PROVINCE. THESIS ADVISOR: ASSOC. PROF. WINA MECKVICHAI, THESIS CO-ADVISOR : CHATCHAWAN CHAISUKUL., Ph.D., 91 pp.

The main objectives of this study were to examine bird species diversity in 5 different types which were forest, reservoir, grassland, agricultural field and residential area as well as to investigate biological and physical factors that many affect bird species in those habitats. Species diversity of birds in Phu Khao Tong area Kang Khoi District, Saraburi Province were monthly assessed by point count method from January 2008 to December 2008.

The total number of bird species in the study area is 103 species. The number of bird species for a grassland, an agricultural field, a residential area, a reservoir, and a forest around Phu Khao Tong area were 73, 64, 55, 46, and 38 species respectively, and Shonnon-Weiner diversity index were 3.39, 3.37, 3.14, 3.06, and 3.01 respectively. The most similar in bird species between two habitat types was that between the agricultural field and the residential area with a Sorensen's similarity index (S) of 0.78 while bird species in the forest and the residential are was least similar with the similarity index of 0.47. Moreover, a biological factor that showed correlations with the bird diversity and bird abundance was human disturbance (Pearson correlation = -0.725 (p = 0.00) and 0.528 (p = 0.01) respectively) while all physical factors investigated in this study did not correlate with bird diversity ($p \geq 0.05$).

Since in this study the grassland contained the highest bird diversity, the habitat type found between mountains should be preserved for bird corridor, however, those located near main road may be used for the constructions of infrastructure. At the present time forests in Phu Khao Tong area were on the process of restoration, so disturbance by human on these forests should be minimized.

Department : Biology Student's Signature

Field of Study : Zoology Advisor's Signature

Academic Year : 2009 Co-advisor's Signature

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CHAPTER I

INTRODUCTION

1.1 Background

Biodiversity is well known as one of important factors to sustain and maintain ecosystem. Currently, the biodiversity of bird in the world has been rapidly decreased due to human activities, such as land development, increase farm lands, importing various kinds of invasive species, wildlife hunting, and other expotations. Biodiversity of various groups of organisms has been studied by researchers in many countries. Several researchers selected birds as a bio-indicator for biodiversity because birds can be easily found in every habitat type. Most bird species are sensitive to human disturbance in their habitats and some wild birds have been decreased, such as Gurney's Pitta (*Pitta gurneyi*) and Sarus Crane (*Grus antigone*) which are nearly extinct from the wild because their feeding sites and breeding areas are destroyed and had been converted from forests or wetlands to be agricultural fields and residential areas (Office of Natural Resources and Environmental Policy and Planning, 1997).

In this study, Phu Khao Tong area located in Kang Khoi District, Saraburi Province was selected to be the study site because it contains variety of habitat types. At prior to this sudy their have a researcher team from the Faculty of Science, Chulalongkorn University to study bird diversity, since 2007 before the reservoir has constructed. After the reservoir was constructed, this area can be divided into five habitat types namely forest, reservoir, grassland, agricultural field, and residential area. Furthermore, it is known that different habitat types have affected on bird species, such as White-crested Laughingthrush (*Garrulax leucolophus*), Asian Fairy Bluebird (*Irena puella*), Great Hornbill (*Buceros rhinoceros*) are found only in the forest while Little Grebe (*Tachybaptus ruficollis*), Oriental Darter (*Anhinga melanogaster*), Cotton Pygmy-goose (*Nettapus coromandelianus*) are found in the reservoir as well as Indian Roller (*Coracias bengalensis*), Indochinese Bushlark (*Mirafra marionae*), and Plain Prinia (*Prinia inornata*) are commonly found in grassland while

Eurasian Tree Sparrow (*Passer montanus*), Rock Pigeon (*Columba livia*), and Common Myna (*Acridotheres tristis*) are common at residential and vicirity area.

From previous studied before reservoir constructed this area was found Brahminy Kite (*Haliastus Indus*), Pied Harrier (*Circus melanoleucos*), and Hill Myna (*Gracula religiosa*) found in the forest and grassland but after reservoir was constructed, they disappeared. At present, some birds such as Little Cormorant (*Phalacrocorax niger*), Black-winged Stilt (*Himantopus himantopus*), and Black-tailed Godwit (*Limosa limosa*) occurred to replace with those disappeared species. However, Spotted Dove (*Streptopelia chinensis*), Black Drongo (*Dicrurus macrocercus*), and Sooty-headed Bulbul (*Pycnonotus aurigaster*) are still found in both of pre and post reservoir construction.

In the former, the forest area is covered 80% of Chulalongkorn University land development project area, which also covered all mountains, namely Khao Thumsua, Phu Khao Tong, and Khao Jumpa. This forest type is mainly deciduous mixed forest which consists of various species of board lives trees, few shrubs and abundant of herbaceous plants. Some part has patches of dipterocarp forest and mixed with bamboo forest. At the center of the study area between Khao Jumpa and Phu Khao Tong, a medium size of man-made reservoir was constructed since, 2007. The grassland is located at the foot of the hill of the Phu Khao Tong, it covers 20% of this study area. This habitat type mainly consists of grasses, with some shrubs and a few small trees. The crops which they planted in this area are rice, cassavas, corns, etc. The last habitat type is residential area located on the west of the studying site that consist of houses, live stokes, and pets.

Before this land development project has start in the full scale, Chulalongkorn University had conducted the bird biodiversity studied in this area but the survey had been conducted only twice in rainy and dry seasons and had done only in two habitat types of forest and grassland but lack of biological and physical factors that may effected the bird diversity. Therefore, this study will survey covering in all habitat types which are forest, reservoir, grassland, agricultural field, and residential area and will do in more extrensive in monthly in survey in all year round. Physical factors and biological factor are also recorded in order to get more informations. This study was conducted with concurrently on going land developments.

1.2 Objectives

The objective in this thesis is to study the bird diversity in Phu Khao Tong area, Kang Khoi District, Saraburi Province.

In this study, I will investigate two major aspects:

1. To investigate bird diversity in five habitat types: forest, reservoir, grassland, agricultural field and residential area
2. To study wheather or not that biological and physical factors have effected to bird diversity

CHAPTER II

LITERATURE REVIEW

2.1 Biodiversity

There are varieties of difinitions in biodiversity in diversity but this paper will concentrate in the definition which is described by Smitinand (Smitinand, 1994) because he defends covering in all aspects as follows:

1. Species diversity

   All the species on the Earth, including single-celled bacteria as well as the species of the multicellular kingdoms (plant, fungi, and animals).

2. Genetic diviersity

   The genetic variation within species, both among geographically separate populations and among individuals within single populations.

3. Ecosystem diversity

   The different biological communities and their associations with the chemical and physical environment.

In this study, species diversity is a main point. These factors are indispensable for ecosystem. The biodiversity can be indicated using representative organism known as bioindicator.

2.2 Bird bio-indicator

There are three major characteristics of birds that are suitable for being used as a bioindicator. Birds are selective over their habitat, sensitive to disturbances, and easly to observe. These characteristics make birds the indicator of choice for many researches (Kirk and Hobson, 2001, Perkins, *et al*. 2000, Round and Treesucon, 2000.).

Habitat specificity: Each species of bird has specific habitat selection, for instance, Heron is found at the shoal, duck group can be easily found on surface of the reservoir, swilling group is found in the open area with a few trees and frugivore or foliage-gleaning insectivorous group is found around the tree trunk or shrub.

Disturbance-sensitivity: Many bird species are sensitive to the disturbances, for example: the Green Peafowl (*Parvo muticus*) (Meckvichai, 2008 and Choicahoen 2008) and the Hornbills (*Buceros* sp., *Anthracoceros* sp., *Anorrhinus* sp. and *Aceros* sp.) will move to the deep forest (Lekagul and Round, 1991).

Ease of observation: Since they can be found easily, they are the proper choice to be used as the environment indicator.

With these characteristics one can examine biodiversity of an ecosystem by surveying the birds.

2.3 Bird survey

There are varieties of bird census techniques but the suitable method in this survey is but the suitable methodin this survey is point count in line transect. In point count method, birds are observed within a radius around census points in an area of interest (Bibby *et al*., 1992). In transect method, the observation is done on a predetermined census line crossing the area.

The point count is equivalent to transect with zero length. The observer stops in each census point to observe, therefore the observer has more time to detect and identify rare birds. Point count also more flexible because census points can be either systematically or randomly defined (Bibby *et al*., 1992). Researches also show that point count is superior because more species was found (Verner and Ritter, 1985; Hutto and Pletschet, 1986; Dobkin and Rich, 1998).

Perkin proposed a variation of point count that exclude non-hunting birds that fly passing the field (Perkin, 2000). This method tries to rule out those non-habitat birds.

2.4 Bird's habitats in Thailand

Habitats are categorized by its vegetation covers. The vegetation cover is mainly determined by three factors: climate, landform, and human disturbance. There are 12 types of vegetations in Thailand (Lekagul and Round, 1991; Robson, 2000; Natbhitabhata, Lekagul, and Sanguansombat, 2007), as follows:

Deciduous forest

This forest type is originally predominant in lowland of continental Thailand. They are widely exploited and often replanted with monocultures of teck and other species. Few completely untouched tracts remain.

Dry dipterocarp forest

This forest is relatively uniform, and open forest, with a grassy understorey. It occurs on the poorest, stoniest soils. This area often rich in medium-sized arboreal birds, including woodpeckers and parakeets (smaller birds are scarcer due to the lack of middle storey and understorey foraging niches. Other species typical of this habitat include Yellow-crowned Woodpecker, White-rumped Falcon, White-browed Fantial and Common Woodshrike. Bird diversity is typically lower than in other broadleaved forest types in the region.

Mixed deciduous forest

This forest types is richer and more diverse than dry dipterocarp forest, with a greater variety of tree species in mixed association. Trees are generally taller and the forest more layered, with three main layers, including a middle storey. Bamboo is often found in this area. This is usually the result of human disturbance. The structure of bird community is similar to that found in broadleaved evergreen forest. There are representatives of most land bird families.

Broadleaved evergreen forest

This forest is relatively dense with pronounced stratification, particularly in the case of low land evergreen rain forest.

Lowland evergreen rain forest

This area is originally predominant from Thailand southwards and southeast of Thailand. Similarly to the most highly threatened forest types in the region, the bird communities in this area are very rich and diverse, with high proportion of Sundaic species in the South. The dominant families consist of woodpeckers, hornbills, barbets, trogons, babblers, cuckoos, bulbul, flowerpeckers and spiderhunters.

Evergreen forest

This forest is classified into tropical evergreen forest and dry evergreen forest. Birds in this area have high diversity, such as hornbill, bulbul, flycatcher and minivet.

Hill evergreen forest

This forest is located around 1,000 meters height from the sea level. This can be found on mountains in northern Thailand. Examples of birds in this area are Chestnut-tailed Minla (*Minla strigula*), Green-tailed Sunbird (*Aethopyga siparaja*).

Peat swamp forest

This forest is evergreen forest in swamps. Plant communities in this area have special characters, such as special root in lobes to support the tree in water.

Beach forest

This area covers all beaches, shrimp farms and salt pans. Common birds in this area include Black-winged Stilt, sea gulls and terns.

Mangrove forest

This forest is found in mud beaches and river deltas. Plant communities are durable to salt soil and have effect from flood and ebb tide. Common birds can found in this area such as kingfisher, heron and cormorant.

Farmland or agricultural field

A number of ecologicallt tolerant, decicuous forest and savanna birds can survive in intensitively cultivated farmland provided that some native trees and rough scrub or grassland remain. Some of residential birds of drier open area habitats include the Barred Buttonquail, Barred Owlet, Indian Nightjar, Coppersmith Barbet, and Sooth-headed Bulbul.

Seacoasts, islands

Intertidal mudflats are of very great importance for a host of migrat waders and terns. Many of these species winter in Thailand, but a great many also occur as passage migrants, feeding along Thailand's coasts during migration between their Siberian breedsing areas and their wintering areas in Indonesia or even Australasia. Sand beaches support small numbers of nesting Malaysian Plovers and Little Terns.

2.5 Bird diversity

The bird diversity is closely related to tree diversity. Casenave compared those diversities between edge forest and intra forest in Argentina (Casenave, *et al.*, 1998). Trees in edge forest are smaller and sparser than intra forest, but edge forest has greater tree species diversity.

As for bird, the density in edge forest is higher than those in intra forest. There is a difference of feeding behavior as shown in Table 2.1

Table 2.1 The majority of bird communities in edge forest and intra forest.

Edge forest	Intra forest
frugivores	bark insectivores
terrestrial granivores	short-flight insect-hunter
arboreal granivores	
long-flight insect-hunter	

This indicates that the bird community in edge forest differs from those in intra forest.

Chaikude compared the ecology of birds in Pynonotidae family between secondary forest and ecotone between the grassland and the topical forest in Khaoyai National Park (Chaikude, 1999) and six species of Pynonotidae were found. *Pynonotus jocosus* are usually found in grassland more than other habitat types. *P. melanicterus* are usually found

in secondary forest. *P. finlaysoni* are found in secondary forest as same as edge forest. *Criniger pallidus* are usually found in edge forest than in forest. *Hypsipetes propinquus* are usually found in forest as same as edge forest. It is obvious that most of Pynonotidae can be found in edge forest because Pynonotidae eats insect more than fruit and the larger number of insect can be found in this area.

2.6 The disturbance study

A study by Bennett indicates that human activities, such as ecotourism and outdoor recreations—would affect the birds breeding, survival, and abundance, if the activities are not controlled. Although the nesting is not directly affected, it would drop according to the decrease of breeding success. When the disturbance is reduced to the former level, the bird will return to the area. (Bennett *et al*., 2008)

In the study of Gomes found that the tolerance of frugivorous bird lives in habitat disturbance in tropical cloud forest in south Costa Rica, the frugivorous birds were selected to be model of this study because their birds facilitate forest regeneration. This study focuses on the tolerance of frugivorous birds to habitat disturbance of natural forest regeneration. During observation, bird species richness can found 33 species consist of 9 species are large frugivorous birds and there are generally tolerant to intermediate, but intolerant to high habitat disturbance (Gomes *et al*, 2008).

2.7 Preliminary survey of the site

The prior study in bird diversity before reservoir construction has constructed in 2007 (Chulalongkorn University, 2007). The result shows 38 bird species in this area while residential birds were 29 species. There are three predominant residential species of:

- Black Drongo (*Dicrurus macrocercus*)
- Streak-eared Bulbul (*Pycnonotus blanfordi*)
- Red-wattled Lapwing (*Vanellus indicus*)

There are 9 migrated species, such as Barn Swallow (*Hirundo rustica*) and Intermediate Egret (*Mesophoyx intermedia*), and etc.

CHAPTER III

METHODOLOGY

3.1 Methodology of pre-survey

The studying site was selected the area which had various kinds of habitat types. This studing area contains grassland, agricultural field, residential area, reservoir and mixed deciduous forest, only first three habitats were selected for pilot study on species diversity curve. Bird biodiversity census was conducted by point count method (Bibby *et al*, 1992). Each habitat consists of at least 10 stations and observation duration in each station was varied from 5, 10, and 15 minutes. The pilot study was repeated two times, in each station, the numbers of bird species were recorded within the radius of 50 meters excluding the birds that fly across the station (Chapman, 2004). This data were plotted between the numbers of bird species against observation time. The graph shows that the most suitable observation duration is 6 minutes according to, the value of species diversity becomes steady. Therefore, 6 minutes was an appropriate time period for observation in this studying site (Figure 3.1).

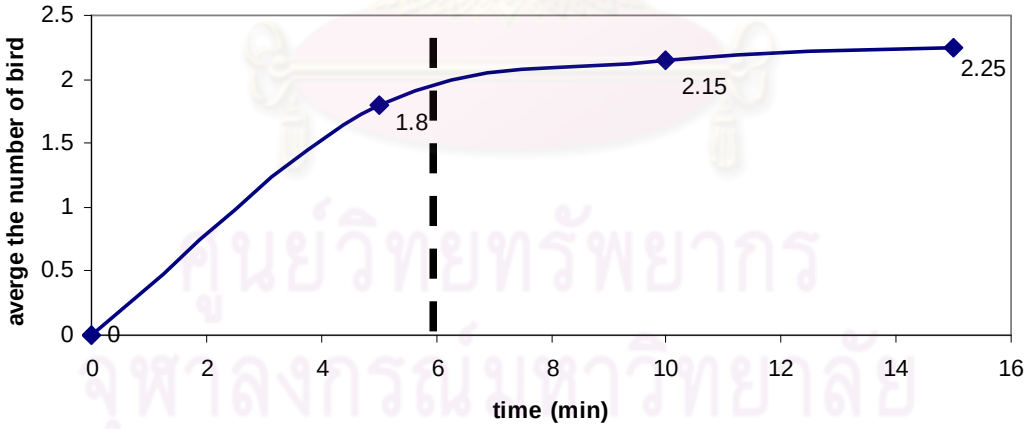

Figure 3.1 The species diversity curve is comparing between the number of bird species (number) and observation time (min).

3.2 The studying site

The studying site is at Phu Khao Tong area, located in the Kang Khoi District, Saraburi Province, in central part of Thailand. This area cover 549.12 hectare and saturated at the latitude ranging from 14°32'N to 14°30'N and the longitude of 101°0'E to 101°3'E. This area consisted of dry decidous forest on mountain range (Figure 3.2).

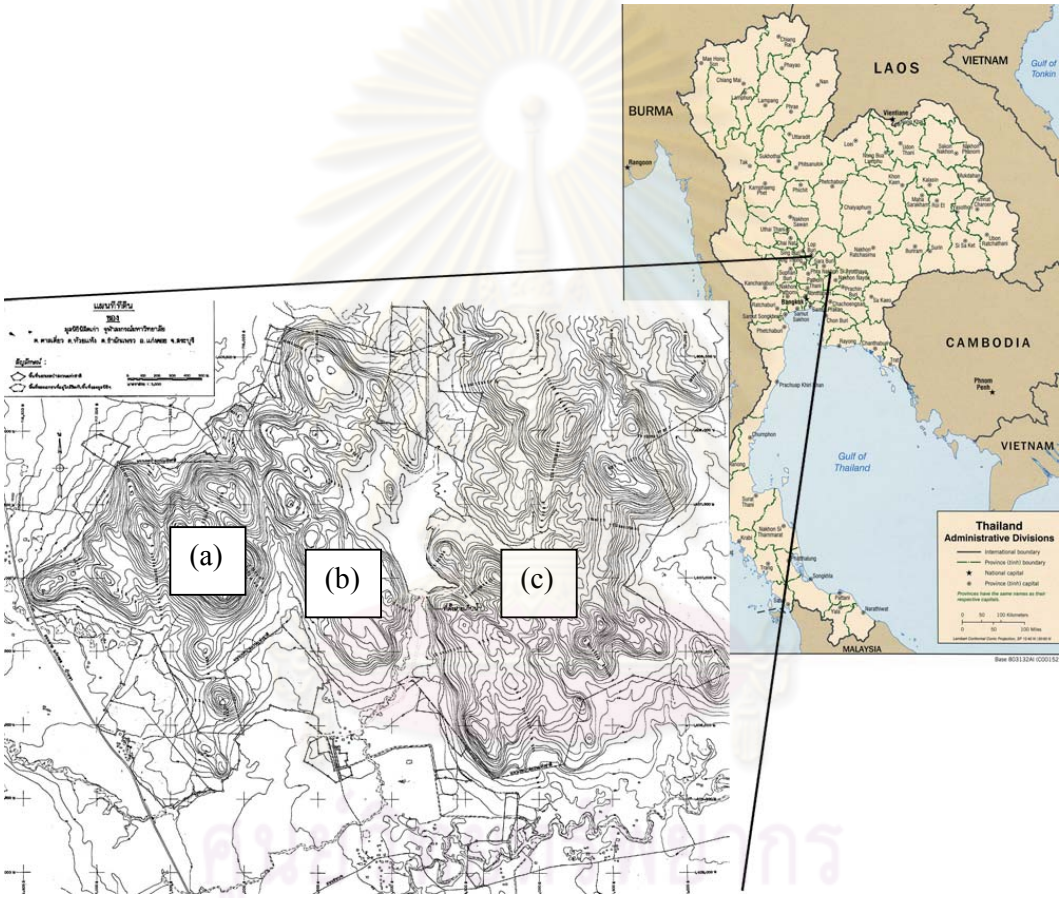

Figure 3.2 Map of Chulalongkorn University land development project in Kang Khoi District, Saraburi Province located in the central part of Thailand (a) Khao Thumsua, (b) Phu Khao Tong and (c) Khao Jumpa.

The habitat types

From previous pilot survey, it is found that the study area can be divided into 5 habitats as follows: forest, reservoir, grassland, agricultural field, and residential area (Figure 3.3). The characteristic of the forest is a mixed deciduous forest located on the hill ridge of Phu Khao Tong, Khao Jumpa, and Khao Thumsua. Reservoir is located in the central of Chulalongkorn University land development area and surrounded by Khao Jumpa and Phu Khao Tong Mountain. Along the reservoir boundary there are some patches of trees and grasses so the forest birds can move and perching at this area. The grassland consists of variety of grass species which was the majority group in this area while herbaceous plants and shrubs are the minority groups. According to the grassland is a narrow elongate area located close to the forest so some forest birds can be found in this area. Moreover, grassland is located at the south west of this studying site and also invaded until to foothill. Prior of agricultural area is grassland and later the villagers were converted into the agricultural field. They grow rice, cassava, pumpkin and corn. The last habitat type is residential area where houses of the villager are located and including a cattle barn which is located outside the Chulalongkorn University land development project area (Figure 3.3 and 3.4).

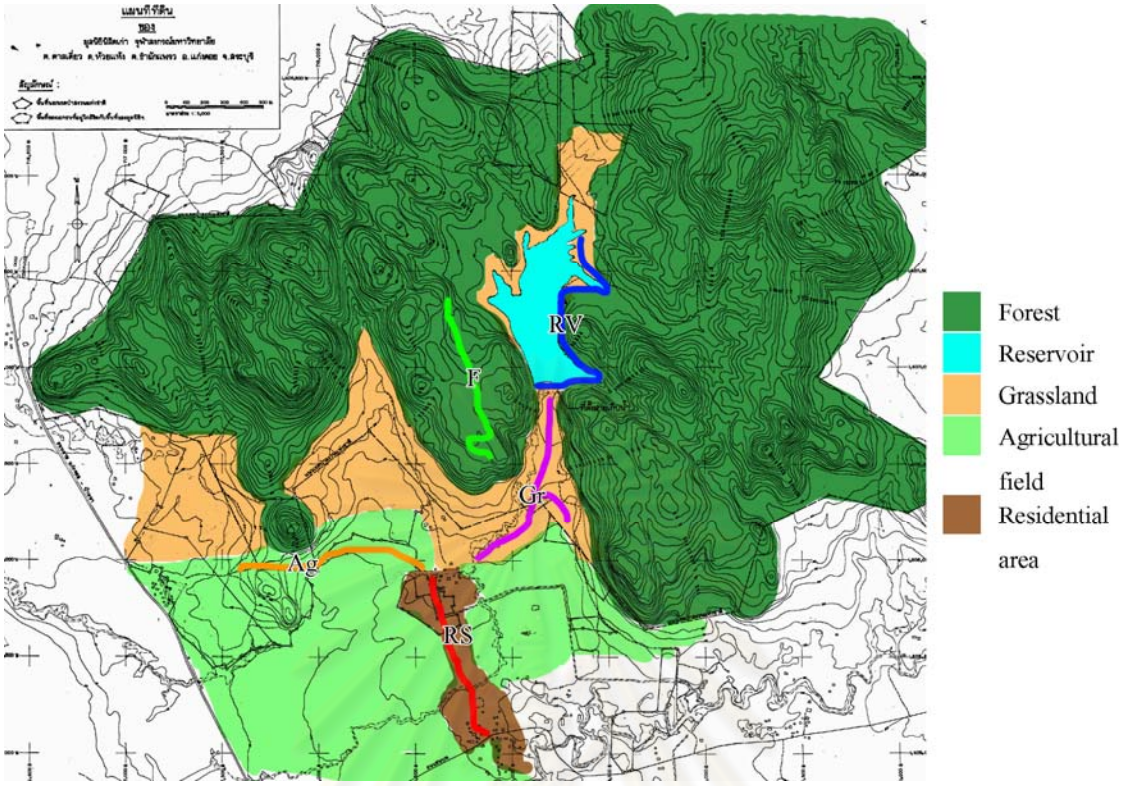

Figure 3.3 Five surveyed habitat types in Phu Khao Tong area, Kang Khoi District, Saburi Province.

Note: RV = reservoir trail, F = forest trail, Gr = grassland trail, Ag = agricultural field trail and RS = residential area trail

(a) forest

(b) reservoir

(c) grassland

(d) agricultural field

(e) residential area in study area

Figure 3.4 Five habitat types of the studying area (a) forest, (b) reservoir, (c) grassland, (d) agricultural field and (e) residential area.

3.3 The study of bird diversity

After the pilot survey has been done, 5 habitat types were visited once a month in all year. The observations were conducted two times a day during 6.00-10.00 am and 3.00-6.00 pm. Bird diversities were observed by 10x42 binoculars and bird identifications were checked by "a guide to the bird of Thailand" (Lekagul and Round, 1991.). Point count method (Bibby *et al*, 1992.) was used in these studies. The observation distant was 1 kilometer which was divided into ten stations and each station was 100 meters apart. Bird observation duration was 6 minutes per station and 3 minutes waited before next observation. Bird species, the number of birds, and sight distance (distance between the birds and the observer) were recorded within the radius of 50 meters excluding birds flying across the station. (Bibby *et al*, 1992.; Perkins, 2000; Chapman, 2004; and Meckwichai *et al*, 2005.)

Comparison of bird diversity

Bird diversities from 12 months were compared among 5 habitat types in term of species richness, bird density, Shannon-Weiner's diversity index, and Sorensen's similarity index (Kreb, 1999.). And Kruskal-Wallis test was used to test the significantly different among the bird diversities in 5 habitat types.

3.3.1 Comparison of bird feeding types

According to Kobkate (Kobkate, 1998, 1999, 2000, 2001a, and 2001b), birds were classified by feeding behaviors as follows: arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF).

The significantly different of bird species richness, bird abundance of each feeding group in each month, and bird abundance of each feeding group in dry season and rainy season were compared by Kruskal-Wallis test.

3.4 Analyzing diversity

Diversity analysis were defined by these formula.

Shannon-Wiener diversity index (H') and evenness (J)

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

p_i = the proportion number of species i divided by the total population from

n_i = the number of species i

N = total of birds

$$J = \frac{H'}{H_{max}} = \frac{H'}{\ln S}$$

J = Distributive constant

H_{max} = the highest diversity of population (when the number of all species is equal)

H' = Shannon-Wiener diversity index value

ln S = the natural logarithm of the total number of species

Sorensen's similarity index

$$S_s = \frac{2a}{2a + b + c}$$

S_s = Sorensen's similarity index

a = the number of bird species in trail A and B

b = the number of bird species that were found only in trail A but were not found in trail B

c = the number of bird species that were found only in trail B but were not found in trail A

Population density

$$D = \frac{n}{2La}$$

D = Density of animals per unit area

n = Number of animals seen on observation point

L = Total length of transect

a = The distance between the observer and the birds

3.5 Enviromental factors

3.5.1 The biological factors in this study were concentrated only on seed and fruit abundance.

Every month, the numbers of fruits and seeds were collected from 35x35 cm^2 in 10 sampling plots per habitat type and were collected all 5 habitat types, 5 meters from the left of each observation station totally 120 plots per each habitat type in all year round (Herrera, 1984).

Seeds and fruits abundance analysis

The significantly different of fruits and seeds abundance were compared between dry and rainy season by Mann-Whitney U-test. Seeds and fruits abundance were compared to bird species richness and bird diversity in specific bird feeding behavior groups. Seed abundance was compared to bird species richness and bird abundance in grainivore (G). Similarly, fruits abundance was compared to bird species richness and bird abundance in arboreal frugivore (AF) and arboreal insectivore/frugivore (AIF).

Human and livestock disturbance

During the bird observations, the activities of human and livestocks were recorded too. The number, types of disturbance and durations of activities of human and livestocks disturbances were noted. This data is recorded synchronously when birds were observed.

Human and livestock disturbance analysis

The human and livestock disturbances were classified in 5 levels.

Defining

First level is the lest disturbance when both of them have the activities in the studying area and do not make a loud noise or move with slow speed such as man walking and livestock roaming around or when they are feeding. The first level is scored one point.

Second level is defined as the low disturbance when both of them have the activities in the studing area and that do not make a loud noise such as when a car is passing. The second level is scored to two points.

Third level is defined as the medium disturbance when both of them have the activities in the studing area and make a loud noise such as when villagers turn on television or radio with high volume, car drivers are shouting or using microphone with a loud noise for advertising their goods, men repairs their house or children play football. The third level is scored to three points.

Forth level is defined as the high disturbance when they use the heavy machine which make a loud noise. The forth level is scored to four points.

Fifth level is defined as the highest disturbance when the villager cut the trees burn garbage in the studying site. The fifth level is scored to five points.

The disturbance values were analyzed by disturbance level multiplying with duration of disturbance. The significantly different of disturbance values among five habitat types were analyzed by Mann-Whitney U-test. The correlations between bird species richness as well as bird density and disturbance value were compared in each month in all year round.

From the biological factor data, the correlation between 103 bird species and biological factors were plotted by Canonical Correspondence Analysis (CCA).

3.5.2 Physical factor

In this study, humidity, temperature, and precipitation were collected as physical factors. The percentage of humidity and temperature were recorded at the time when the birds were observed by using hygrometer and thermometer. The precipitation data of rainfall in 12 months were obtained from the weather station in Kang Khoi District, Saraburi Province.

Physical factors analysis

The significantly different of physical data between dry and rainy season were analyzed by ANOVA. Moreover, the physical factor data were compared with the number of bird species richness and bird density in each habitat type in dry and rainy season. The relationship of species richness and population density with biological factors and physical factors was analyzed by Pearson Correlation. The correlation between 103 bird species and physical factors were plotted by Canonical Correspondence Analysis (CCA).

CHAPTER IV

RESULT

4.1 Bird diversity

The study of bird diversity within Phu Khao Tong area Kang Khoi District, Saraburi Province in all year round in 2008 illustrates that the total of birds species and bird number were 103 species, 5,289 individuals, respectively. All of those birds can be classified into 3 groups as follows: 77.67 % (80 species) residential birds, 20.39% (21 species) migrated birds, and 1.94% (2 species) passive migrated birds (Figure 4.1). The bird status in Thailand was classified base on a Guide to the Bird of Thailand. According to the research, it was found that 4 species were uncommon species namely Crow-billed Drongo (*Dicrurus annectans*), Australasian Bushlark (*Mirafra javanica*), Oriental Skylark (*Alanda gulgula*), and Verditer Flycatcher (*Eumyias thalassina*) whilst the rare species were not found in this studying area.

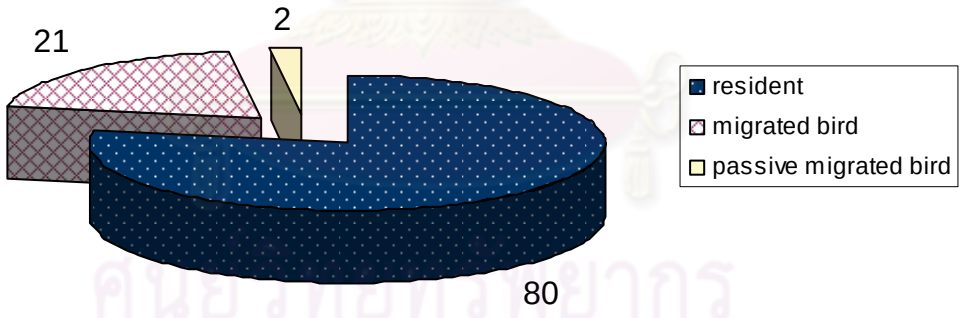

Figure 4.1 The diagram shows the number of bird species that were divided into 3 categories by migrated status in Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

Where the species richness in two succession seasons were compared, the result shows that bird species richness in dry and rainy season were not significantly different (p = 0.251; $p \leq 0.05$). Furthermore, when the bird species richness of residential bird were

compared between dry and rainy season, the result shows that these are not significantly different (p = 0.60; $p \leq 0.05$), while the migratory bird were significantly different (p = 0.01; $p \leq 0.05$).

The considerably different of bird diversity in five habitat types were analyzed by Kruskal-Wallis test; the result indicates that bird diversity has significantly different (p = 0.000). As comparing between two habitat types which were analyzed by Mann-Whitney U-test, it is found that the significantly different between forest and grassland (p = 0.000), forest and agricultural field (p = 0.000), forest and residential area (p = 0.000), reservoir and grassland (p =0.004), reservoir and residential area (p = 0.004) and reservoir and residential area (p = 0.001) have significantly different ($p \leq 0.05$) while the value between forest and reservoir (p = 0.319), grassland and agricultural field (p = 0.887), grassland and residential area (p = 0.755) and agricultural field and residential area (p = 0.478) are not significantly different ($p \geq .0.05$).

As for the population density, the average bird density was 5,818.58 individuals per km^2 per month. The majority of first three top of bird population density in Phu Khao Thong area are Eurasian Tree-Sparrow (*Passer montanus*) 13.04% (758.58 individuals per km^2 per month), Barn Swallow (*Hirundo rustica*) 4.05% (235.64 individuals per km^2 per month), and Rock Pigeon (*Columba livia*) 3.84% (223.15 individuals per km^2 per month).

From Table 4.1 in forest, the top three birds population density are Hair-crested Drongo (*Dicrurus hottentottus*) 11.23% (173.67 individuals per km^2 per month), Streak-eared Bulbul (*Pycnonotus blanfordi*) 7.7% (119.56 individuals per km^2 per month), and Asian Brown Flycatcher (*Muscicapa dauurica*) and 5.26% (81.31 individuals per km^2 per month) individual per km^2, respectively. The highest species densities (91.67%) were White-crested Laughingthrush (*Garrulux leucolophus*) and Streak-eared Bulbul (*Pycnonotus blanfordi*). Other common species (83.33%) which were Lineated Barbet (*Megalaima lineata*) while the lowest density (75%) were Greater Racket-tailed Drongo (*Dicrurus paradiseus*) and Common Tailorbird (*Orthotomus sutorius*).

In reservoir, the top three bird population densities are Barn Swallow (*Hirundo rustica*) 10.61% (227.36 individuals per km^2 per month), Asian Palm-Swift (*Cypsiurus balasiensis*) 8.69% (186.29 individuals per km^2 per month), Asian House-Martin (*Delichon dasypus*) 7.23% (155 individuals per km^2 per month). The most abundance species (100%)

was Sooty-headed Bulbul (*Pycnonotus aurigaster*). Other common species (91.67%) was Streak-eared Bulbul (*Pycnonotus blanfordi*) while the lowest density (83.33%) were Greater Racket-tailed Drongo (*Dicrurus paradiseus*), Black Drongo (*Dicrurus macrocercus*), Common Koel (*Eudynamys scolopacea*), Coppersmith Barbet (*Megalaima haemacephala*), and Pied Fantaill (*Rhipidura javanica*).

In grassland, the top three bird population density are Barn Swallow (*Hirundo rustica*) 9.67% (354.68 individuals per km^2 per month), Sooty-headed Bulbul (*Pycnonotus aurigaster*) 5.67% (207.98 individuals per km^2 per month), Streak-eared Bulbul (*Pycnonotus blanfordi*) 5.36% (196.69 individuals per km^2 per month). The most abundance species (100%) was Spotted Dove (*Streptopelia chinensis*). Other common species (91.67%) were Sooty-headed Bulbul (*Pycnonotus aurigaster*) and Pied Fantaill (*Rhipidura javanica*) while the lowest density (83.33%) were Black Drongo (*Dicrurus macrocercus*), Greater Coucal (*Centropus sinensis*), Green Bee-eater (*Merops orientalis*) and Streak-eared Bulbul (*Pycnonotus blanfordi*).

In agricultural field, the top three bird population density are Barn Swallow (*Hirundo rustica*) 7.66% (233.07 individuals per km^2 per month), Scaly-breasted Munia (*Lonchura punctulata*) 6.90 (210.04 individuals per km^2 per month), Rock Pigeon (*Columba livia*) 5.76% (175.26 individuals per km^2 per month). The most abundance species (100%) were Spotted Dove (*Streptopelia chinensis*) and Black Drongo (*Dicrurus macrocercus*). Other common species (91.67%) was Red-wattled Lapwing (*Vanellus indicus*) while the lowest density (83.33%) were Zebra Dove (*Geopelia striata*), Paddyfield Pipit (*Anthus rufulus*), Green Bee-eater (*Merops orientalis*), Rufour-winged Bushlark (*Mirafra assamica*), and Streak-eared Bulbul (*Pycnonotus blanfordi*).

In residential area, the top three bird population density are Eurasian Tree-Sparrow (*Passer montanus*) 17.79% (758.68 individuals per km^2 per month), Rock Pigeon (*Columba livia*) 6.76% (288.18 individuals per km^2 per month), Streak-eared Bulbul (*Pycnonotus blanfordi*) 4.77% (203.23 individuals per km^2 per month). The most abundance species (100%) were Zebra Dove (*Geopelia striata*) and Common Myna (*Acridotheres tristis*). Other common species (91.67%) were Spotted Dove (*Streptopelia chinensis*), White-vented Myna (*Acridotheres javanicus*), Sooty-headed Bulbul (*Pycnonotus aurigaster*) and Rock Pigeon (*Columba livia*) while the lowest density (83.33%) were Red Turtle-Dove (*Streptopelia*

tranquebarica), Ashy Wood-swallow (*Artamus fuscus*), Eurasian Tree-Sparrow (*Passer Montanus*), Common Koel (*Eudynamys scolopacea*), Streak-eared Bulbul (*Pycnonotus blanfordi*) and Streak-eared Bulbul (*Pycnonotus blanfordi*), Scarlet-backed Flowerpecker (*Dicaeum cruentatum*) and Pied Fantaill (*Rhipidura javanica*) are 83.33% of lists. And in this study, the only near threatened (IUCN) bird found was Black-tailed Godwit (*Limosa limosa*) at reservoir.

Table 4.1 Table shows bird species list CITES, IUCN, Thai status and species density in dry and rainy seasons in all year round 2008 in Phu Khao Tong area, Kang Khoi District, Saraburi Province.

No	Common name	Specific name	Feeding group	CITES	IUCN	Thai status	Dry season					Rainy season				
							F	Rv	G	Ag	Rs	F	Rv	G	Ag	Rs
1	Chinese Francolin	*Francolinus pintadeanus*	TIGF	-	LC	CR	+	+	+	+	++	-	-	+	++	+
2	Red Junglefowl	*Gallus gallus*	TIGF	-	LC	CR	+	+	+	+	-	+	-	+	+	-
3	Lesser Whistling-Duck	*Dendrocygna javanica*	P	-	LC	CR & CW	-	+	-	+	-	-	+	-	-	+
4	Fulvous-breasted Woodpecker	*Picoides macei*	BI	-	LC	CW & UR	-	-	++	-	-	-	-	-	-	-
5	Lineated Barbet	*Megalaima lineata*	AIF	-	LC	CR	+	++	-	++	-	+	-	++	+	-
6	Coppersmith Barbet	*Megalaima haemacephala*	AIF	-	LC	VCR	+	+	++	+	+	-	+	++	+	+
7	Indian Roller	*Coracias benghalensis*	TF	-	LC	CR	-	+	++	+	+	-	-	+	++	-
8	Hoopoe	*Upupa epops*	TI	-	LC	CR	-	-	+	-	-	-	-	-	-	-
9	White-throated Kingfisher	*Halcyon smyrnensis*	P	-	LC	VCR	+	+	+	+	+	-	+	+	+	+
10	Green Bee-eater	*Merops orientalis*	SwI	-	LC	VCR	-	-	++	++	++	-	-	++	++	++
11	Chestnut-headed Bee-eater	*Merops leschenaulti*	SwI	-	LC	CR	-	-	+	-	-	-	-	+	-	-
12	Plaintive Cuckoo	*Cacomantis merulinus*	FGI	-	LC	CR	-	+	+	+	+	-	-	-	+	+
13	Green-billed Malkoha	*Phaenicophaeus chlorophaeus*	FGI	-	LC	VCW	-	-	+	-	-	+	-	-	-	-
14	Common Koel	*Eudynamys scolopacea*	FGI	-	LC	CR	+++	++	++	++	++	+	+	+	+	+
15	Greater Coucal	*Centropus sinensis*	TF	-	LC	VCR	++	++	+	+	-	+	+	++	+	-
16	Asian Palm-Swift	*Cypsiurus balasiensis*	SaI	-	LC	VCR	++	++++	+	+	++	+	++	-	+	+
17	House Swift	*Apus affinis*	SaI	-	LC	CR	-	-	-	++	-	-	-	-	-	++

No	Common name	Scientific Name	Feeding group	CITES	IUCN	Thai status	Dry season					Rainy season				
							F	Rv	G	Ag	Rs	F	Rv	G	Ag	Rs
18	Large-tailed Nightjar	*Caprimulgus macrurus*	Swl	-	LC	CR	-	-	-	-	-	+	-	-	-	-
19	Rock Pigeon	*Columba livia*	TIGF	-	LC	CR	-	-	+	+	++++	-	-	-	++++	++++
20	Spotted Dove	*Streptopelia chinensis*	TIGF	-	LC	VCR	+	++	++	++	+++	++	+	++	++	++
21	Red Turtle-Dove	*Streptopelia tranquebarica*	TIGF	-	LC	VCR	-	-	+	++	++	-	-	+	+	+
22	Zebra Dove	*Geopelia striata*	TIGF	-	LC	VCR	-	+	+	++	++	++	-	+	++	+++
23	White-breasted Waterhen	*Amaurornis phoenicurus*	P	-	LC	VCR	-	-	-	-	+	-	-	+	-	-
24	Ruddy-breasted Crake	*Porzana fusca*	P	-	LC	VCR	-	-	-	-	-	-	-	-	-	++
25	Common Moorhen	*Gallinula chloropus*	P	-	LC	CR	-	++	-	-	-	-	-	-	-	-
26	Black-tailed Godwit	*Limosa limosa*	P	-	NT	VCR	-	+	-	-	-	-	-	-	-	-
27	Black-winged Stilt	*Himantopus himantopus*	P	-	LC	VCR	-	++	-	-	-	-	-	-	-	-
28	Little Ringed Plover	*Charadrius dubius*	P	-	LC	CR	-	++	-	-	-	-	-	-	-	-
29	Red-wattled Lapwing	*Vanellus indicus*	P	-	LC	VCR	+	++	++	++	++	-	+	+++	++	++
30	Black-shouldered Kite	*Elanus caeruleus*	R	II	LC	CR	-	-	-	+	-	-	-	+	+	-
31	Crested Honey-Buzzard	*Pernis ptilorhyncus*	R	-	LC	PM, UR	-	-	-	+	-	-	-	-	-	-
32	Eastern Marsh-Harrier	*Circus spilonotus*	R	II	LC	CW	+	-	-	+	-	-	-	-	-	-
33	Shikra	*Accipiter badius*	R	II	LC	CR	-	-	+	-	-	-	-	-	-	-
34	Japanese Sparrowhawk	*Accipiter gularis*	R	II	LC	PM	+	+	+	+	-	-	-	+	-	-
35	Little Grebe	*Tachybaptus ruficollis*	P	-	LC	VCR	-	+++	-	-	-	-	-	-	-	-
36	Little Egret	*Egretta garzetta*	P	-	LC	CR & CW	-	+	+	-	++	-	+	++	++	+
37	Cattle Egret	*Bubulcus ibis*	P	-	LC	VCR	-	-	+	++	+++	-	++	+	-	++
38	Chinese Pond-Heron	*Ardeola bacchus*	P	-	LC	VCR	-	+	++	+	++	-	-	+	+	++

No	Common name	Scientific Name	Feeding group	CITES	IUCN	Thai status	Dry season					Rainy season				
							F	Rv	G	Ag	Rs	F	Rv	G	Ag	Rs
39	Javan Pond-Heron	*Ardeola speciosa*	P	-	LC	VCW	-	+	+	-	++	-	-	-	-	-
40	Little Heron	*Butorides striatus*	P	-	LC	VCW	-	-	-	-	-	-	+	-	-	-
41	Cinnamon Bittern	*Ixobrychus cinnamomeus*	P	-	LC	CR & CW	-	-	-	-	-	-	+	+	+	-
42	Asian Openbill	*Anastomus oscitans*	P	-	LC	VCW	-	-	+++	-	+++	-	-	-	+	+
43	Brown Shrike	*Lanius cristatus*	R	-	LC	UR	-	-	+	-	+	-	-	-	-	+
44	Burmese Shrike	*Lanius collurioides*	R	-	LC	VCW	-	-	-	+	-	-	-	-	-	-
45	Long-tailed Shrike	*Lanius schach*	R	-	LC	UR & CW	-	-	++	+	-	-	-	+	+	++
46	Rufous Treepie	*Dendrocitta formosae*	FGI	-	LC	CR	+	++	+		+	-	-	+	-	-
47	Racket-tailed Treepie	*Crypsirina temia*	FGI	-	LC	CR	+	-	-	-	-	-	-	+	-	-
48	Large-billed Crow	*Corvus macrorhynchos*	TF	-	LC	VCR	+	-	-	+	+	-	-	-	-	-
49	Ashy Wood-swallow	*Artamus fuscus*	IN	-	LC	CR	-	+	-	+	+	-	+	+++	-	+++
50	Pied Fantaill	*Rhipidura javanica*	SwI	-	LC	VCR	+	++	++	+	++	+	++	++	++	+
51	Ashy Drongo	*Dicrurus leucophaeus*	SwI	-	LC	CR& CW	-	-	-	+	-	-	-	-	-	-
52	Black Drongo	*Dicrurus macrocercus*	SwI	-	LC	CR	++	++	+++	+++	++++	+	++	+++	++	++
53	Crow-billed Drongo	*Dicrurus annectans*	SwI	-	LC	PM	-	-	-	-	-	-	-	+	-	-
54	Brozed Drongo	*Dicrurus aeneus*	SwI	-	LC	CR	-	-	++	-	-	-	-	-	+	-
55	Hair-crested Drongo	*Dicrurus hottentottus*	SwI	-	LC	CR& CW	++++	++	+++	++	-	++	++	++	+	+
56	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	SwI	-	LC	CR	++	+	++	-	-	+	+	+	-	-
57	Asian Paradise-flycatcher	*Terpsiphone paradisi*	SwI	-	LC	FCR& CW	+	-	-	-	-	-	-	-	-	-
58	Common Iora	*Aegithina tiphia*	FGI	-	LC	VCR	+	-	++	+	-	+	-	-	-	+
59	Blue Rock-Thrush	*Monticola solitarius*	SwI	-	LC	CW	-	-	+	-	-	-	-	-	-	-

No	Common name	Scientific Name	Feeding group	CITES	IUCN	Thai status	Dry season					Rainy season				
							F	Rv	G	Ag	Rs	F	Rv	G	Ag	Rs
60	Asian Brown Flycatcher	*Muscicapa dauurica*	SwI	-	LC	VCW & UR	++	-	+	+	-	-	-	-	-	-
61	Red-throated Flycatcher	*Ficedula parva*	SwI	-	LC	VCW	++	-	-	-	-	-	-	-	-	-
62	Verditer Flycatcher	*Eumyias thalassina*	SwI	-	LC	CR & CW	+	-	+	-	-	-	-	-	-	-
63	Siberian Rubythroat	*Luscinia calliope*	TI	-	LC	VCW	-	-	+	-	-	-	-	-	-	-
64	Oriental Magpie-Robin	*Copsychus saularis*	FGI	-	LC	VCR	+	-	-	+	++	+	+	++	-	++
65	Siberian Stonechat	*Saxicola torquata*	SwI	-	LC	VCR	-	-	+	++	++	-	-	+	+	-
66	Black-collared Starling	*Sturnus nigricollis*	TIGF	-	LC	VCR	-	-	-	-	++	-	-	-	-	-
67	Vinous-breasted Starling	*Sturnus burmannicus*	TIGF	-	LC	UR-CR	-	+	++	+	+	-	+	++	+	+
68	Common Myna	*Acridotheres tristis*	TIGF	-	LC	VCR	-	-	-	-	+++	-	-	-	++	++
69	White-vented Myna	*Acridotheres javanicus*	TIGF	-	LC	VCR	-	-	-	++	+++	-	-	-	++	+++
70	Asian House-Martin	*Delichon dasypus*	SaI	-	LC	VCR	-	+++	+	+	+	-	-	-	-	-
71	Barn Swallow	*Hirundo rustica*	SaI	-	LC	CW	++	++++	++++	++++	+++	-	+++	++	+++	++
72	Red-rumped Swallow	*Hirundo daurica*	SaI	-	LC	CW	-	+++	-	+	-	-	-	-	-	-
73	Black-crested Bulbul	*Pycnonotus melanicterus*	AIF	-	LC	CR	++	-	+	-	-	+	-	-	-	-
74	Sooty-headed Bulbul	*Pycnonotus aurigaster*	AIF	-	LC	CR	+++	+++	++++	+++	+++	++	++	+++	+++	+++
75	Yellow-vented Bulbul	*Pycnonotus goiavier*	AIF	-	LC	VCR	-	-	+	-	++	-	-	-	-	++
76	Streak-eared Bulbul	*Pycnonotus blanfordi*	AIF	-	LC	VCR	++++	+++	++++	++	++++	+	++	++	+++	++
77	Rufescent Prinia	*Prinia rufescens*	FGI	-	LC	VCR	-	+	-	-	-	-	-	-	-	-
78	Grey-breasted Prinia	*Prinia hodgsonii*	FGI	-	LC	VCR	-	-	++	-	-	-	-	++	-	-
79	Yellow-bellied Prinia	*Prinia Flaviventris*	FGI	-	LC	VCR	-	-	++	-	-	-	-	+++	-	-
80	Plain Prinia	*Prinia inornata*	FGI	-	LC	VCR	-	+	++	+	+++		+	++	++	++

No	Common name	Scientific Name	Feeding group	CITES	IUCN	Thai status	Dry season					Rainy season				
							F	Rv	G	Ag	Rs	F	Rv	G	Ag	Rs
81	Zitting Cisticola	*Cisticola juncidis*	FGI	-	LC	VCR	-	-	-	-	-	-	-	-	++	-
82	Common Tailorbird	*Orthotomus sutorius*	FGI	-	LC	VCR	+	-	++	+	+	+	-	-	-	-
83	Inornate Warbler	*Phylloscopus inornatus*	FGI	-	LC	VCW	++	-	++	++	+	-	-	-	-	-
84	White-crested Laughingthrush	*Garrulux leucolophus*	FGI	-	LC	CR	++	-	-	-	-	++	-	-	-	-
85	Lesser Necklaced Laughingthrush	*Garrulux monileger*	FGI	-	LC	CR	-	-	-	-	-	+	-		-	-
86	Puff-throated Babbler	*Pellorneum ruficeps*	TI	-	LC	VCR	+	-	++	-	++	+	-	-	-	-
87	Yellow-eyed Babbler	*Chrysoomma sinense*	FGI	-	LC	VCR	-	-	+++	-	-	-	-	++	++	-
88	Singing Bushlark	*Mirafra javanica*	TIGF	-	LC	UR	-	+	+	-	-	-	-	-	-	-
89	Oriental Skylark	*Alauda gulgula*	TIGF	-	LC	UR	-	++	-	-	-	-	-	++	-	-
90	Rufour-winged Bushlark	*Mirafra assamica*	TIGF	-	LC	UR	-	-	++	++	++	-	-	++	+++	++
91	Plain Flowerpecker	*Dicaeum concolor*	AF	-	LC	FCR	-	+	-	-	-	-	-	-	-	-
92	Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	AF	-	LC	FCR	+	+	+	++	++	+	+	++	+	+
93	Brown-throated Sunbird	*Anthreptes malacensis*	IN	-	LC	VCR	-	-	-	-	++	+	-	-	-	++
94	Olive-backed Sunbird	*Nectarinia jugularis*	IN	-	LC	VCR	++	++	+	+	+++	+	++	+	++	+
95	Purple Sunbird	*Nectarinia asiatica*	IN	-	LC	CR	-	-	-	-	-	-	-	-	+++	-
96	Paddyfield Pipit	*Anthus rufulus*	TI	-	LC	VCR & CW	-	-	++	+++	+++	-	-	++	++	-
97	Olive-backed Pipit	*Anthus hodgsoni*	TI	-	LC	CW	-	-	-	++	-	-	-	+	++	-
98	Red-throated Pipit	*Anthus cervinus*	TI	-	LC	VCW	-	-	++	-	-	-	-	-	-	-
99	Plain-backed Sparrow	*Passer flaveolus*	TIGF	-	LC	VCR	-	-	-	+	+++	-	-	-	++	++
100	Eurasian Tree-Sparrow	*Passer montanus*	TIGF	-	LC	VCR	-	-	-	-	++++	-	-	-	-	++++
101	Baya Weaver	*Ploceus philippinus*	G	-	LC	FCR	-	-	-	-	+	-	-	++	+	+++

No	Common name	Scientific Name	Feeding group	CITES	IUCN	Thai status	Dry season					Rainy season				
							F	Rv	G	Ag	Rs	F	Rv	G	Ag	Rs
102	White-rumped Munia	*Lonchura striata*	G	-	LC	VCR	-	-	++	-	-	-	-	-	+	-
103	Scaly-breasted Munia	*Lonchura punctulata*	G	-	LC	VCR	-	-	+++	-	++	-	-	+++	++++	++

F = forest Rv = reservoir G = = grassland Ag = agricultural field Rs = Residential area

+ = species density between 1-33 VCR = Very common resident CW = Common winter visitor NT = Near Threatened

++ = species density between 34-100 CR = Common resident VCW = Very common winter visitor

+++ = species density between 101-200 UR = Uncommon resident PM = Passive migrate

++++ = species density more than 200 FCR = Fairly common resident LC = Least Concern

CITES II Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

Bird species richness can be divided into 13 groups by their feeding behavior. Number of species in each group were ranging from the highest to lowest as follows: foliage-gleaning insectivore, 17species (FGI) and piscivore, 17 species (P), the biggest bird feeding group in this study area, arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF) consist of 2, 6, 1, 3, 4, 8, 16, 5, 3, 6, and 15 species, respectively (Figure 4.2).

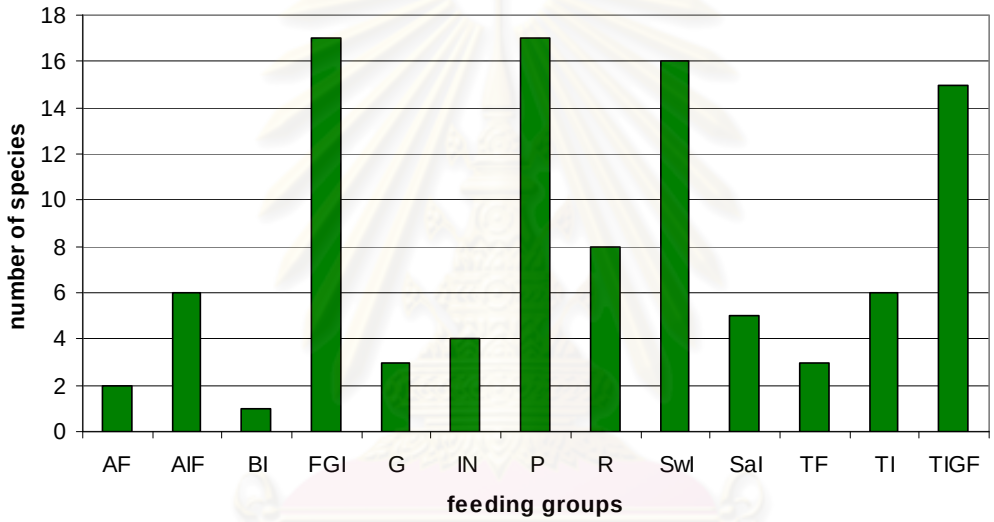

Figure 4.2 The histogram shows the number of bird species in thirteen feeding groups of all five habitat types in the studying area in 2008.

Note: arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF)

The highest bird species richness in 2008 was in grassland (73 species) while the lowest was in forest (39 species). The number of species richness in other habitat types of reservoir, agricultural field, and residential area were 46, 64, and 55 species, respectively (Figure 4.3) and the species accumulated curve in all habitat types were showed in (Figure 4.4). The different between bird species richness in five habitat types was analyzed by

Kruskal-Wallis test, the result shows no significantly different among the habitat types (p = 0.406; $p \leq 0.05$).

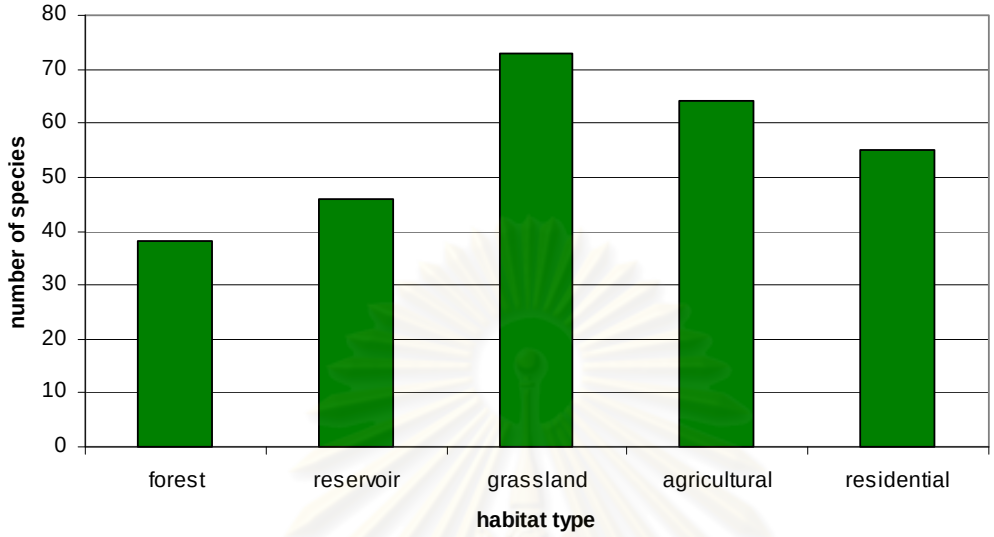

Figure 4.3 The histogram of bird species richness in five habitat types of Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

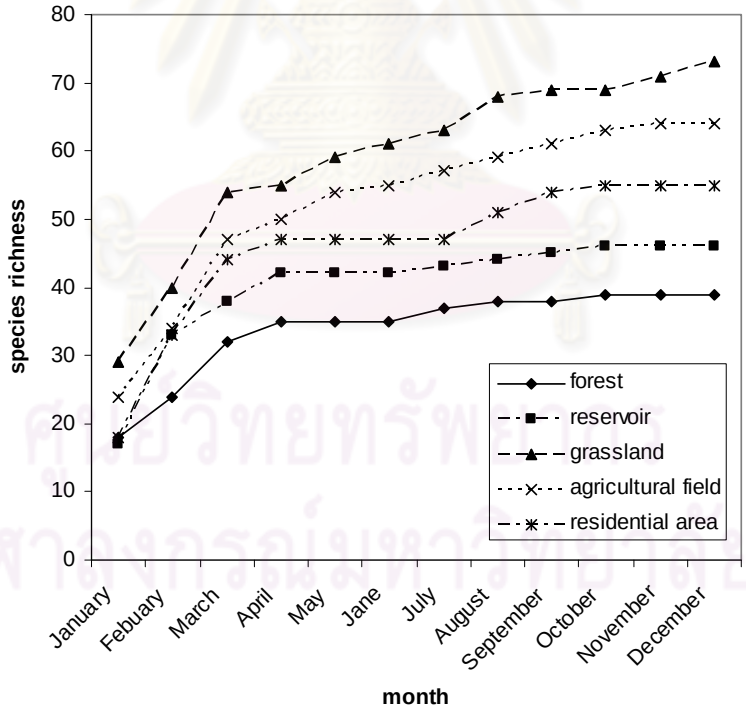

Figure 4.4 The figure shows the species accumulation curves of forest, reservoir, grassland, agricultural field and residential area at Phu Khao Tong area, Kang Khoi District, Saraburi Province from January 2008 - December 2008.

The Shannon-Weiner values in forest, reservoir, grassland, agricultural field, and residential area were 3.01, 3.06, 3.39, 3.37, and 3.14, respectively (Figure 4.5). The Shannon-Weiner value in five habitat types was no significantly different ($p = 0.406$; $p \leq 0.05$).

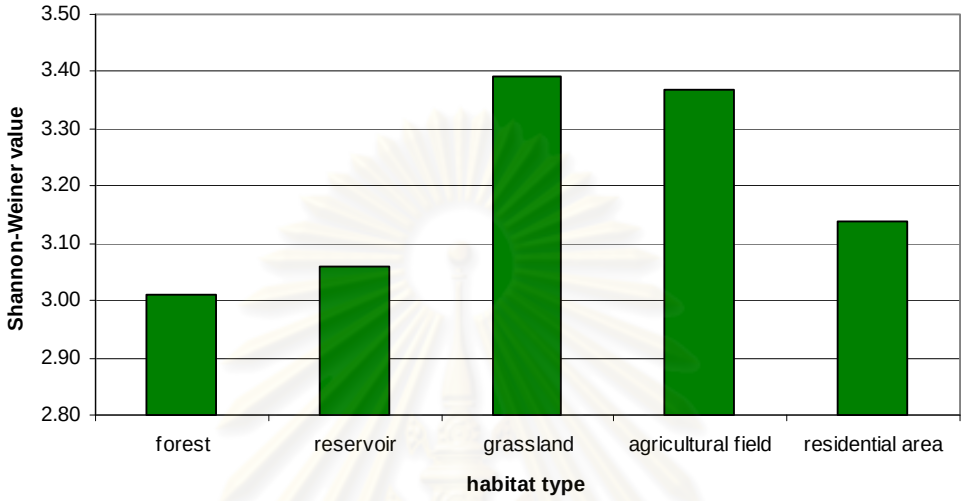

Figure 4.5 The Histogram of Shannon-Weiner index value in five habitat types in Phu Khao Thong area, Kang Khoi District, Saraburi Province in 2008.

Furthermore, the bird similarities between each pair of habitat types were analyzed pursuance to Sorensen's similarity index. Comparing between each pair of habitat types, the outcome illustrates that agricultural field and residential area have the highest bird similarity (Sorensen's index = 0.78), while forest and residential area have the least similarity (Sorensen's index = 0.47) (Table 4.2).

	forest	reservoir	grassland	agricultural field	residential area
forest		-	-	-	-
reservoir	0.52			-	-
grassland	0.54	0.60		-	-
agricultural field	0.48	0.61	0.76		-
residential area	0.47*	0.571	0.70	0.78**	

Table 4.2 The number under the triangular are Sorensen's index when comparing in each pair of habitat types in Phu Khao Tong area Kang Khoi District Saraburi Province in 2008.

* The value of the most difference in bird species between each pair of habitat types.

** The value of the most similarity in bird species between each pair of habitat types.

When considering bird feeding groups, it is found that the species richness of FGI (9 species) and SwI (9 species) were higher than other groups while, BI and G are not found in forest area (Figure 4.6).

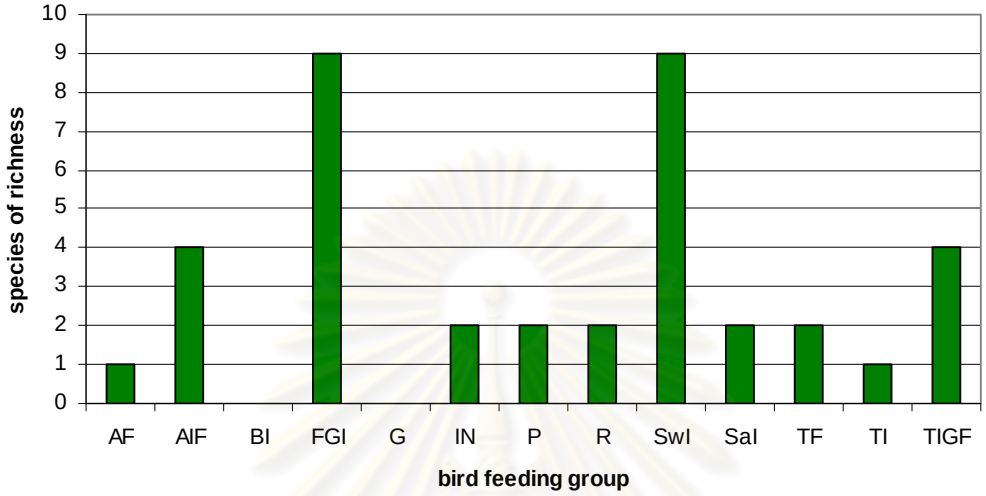

Figure 4.6 The histogram illustrates species richness base on feeding groups in forest area at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.
Note: arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF)

Species richness of bird in reservoir area indicates that P has the highest species richness (14 species) while BI, G, and TI group are absent (Figure 4.7).

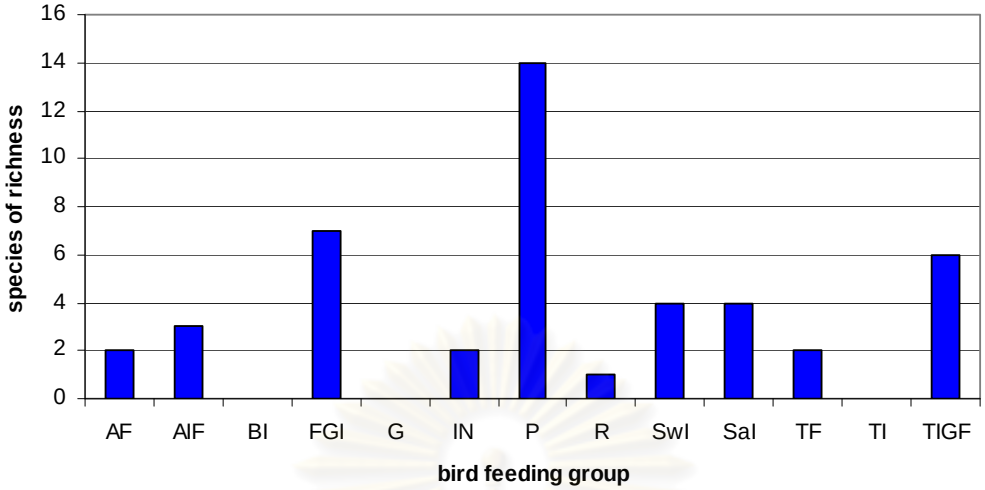

Figure 4.7 The histogram shows species richness of birds in reservoir area at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

In grassland, the FGI has the highest species richness (15 species) whilst AF and G group are the lowest (1 species) (Figure 4.8).

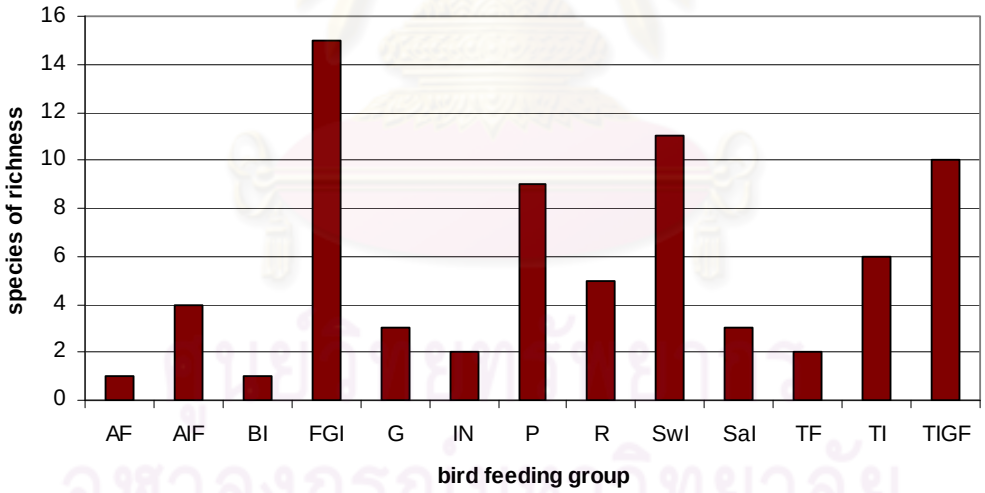

Figure 4.8 The histogram indicates species richness of birds in grassland area at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

Note of Figure 4.7 and 4.8: arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF)

Furthermore, in agricultural field the TIGF has the highest species richness (11 species) whereas BI is not found in this area (Figure 4.9).

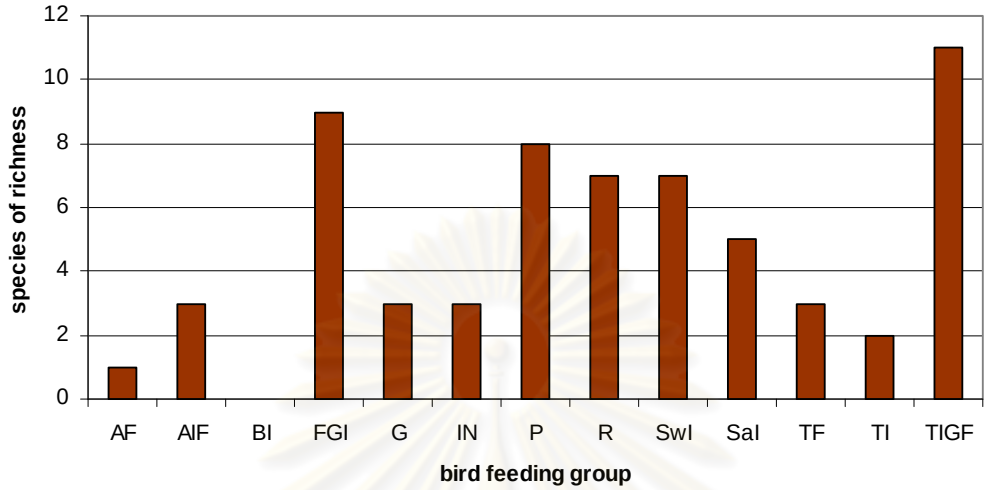

Figure 4.9 The histogram shows the species richness of birds in agricultural field area at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

Note Figure 4.7 and 4.8: arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF)

Finally, the TIGF group has highest species richness (11 species) while BI group is not found in this residential area (Figure 4.10).

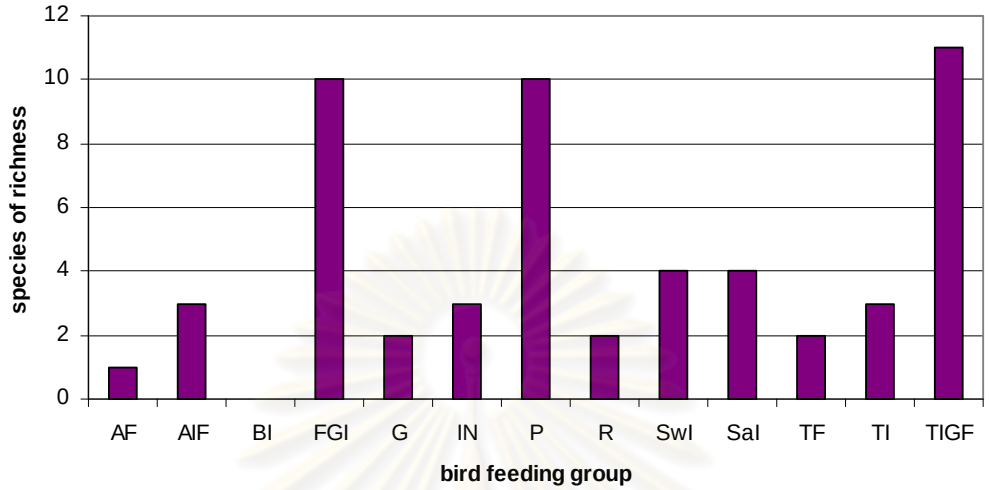

Figure 4.10 The histogram shows the species richness of birds in residental area at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

Note: arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF)

The species richness of birds in dry season (during November until April 2008) in five habitat types namely forest, reservoir, grassland, agricultural field, and residential area were 35, 42, 64, 54, and 49, respectively, whereas the species richness in rainy season (during May until October 2008), were 25, 27, 48, 46, and 43, respectively. The bird species richness of all habitat types in dry season was higher than rainy season. The highest value of species richness was found in the grassland while the lowest one was in the forest area (Figure 4.11).

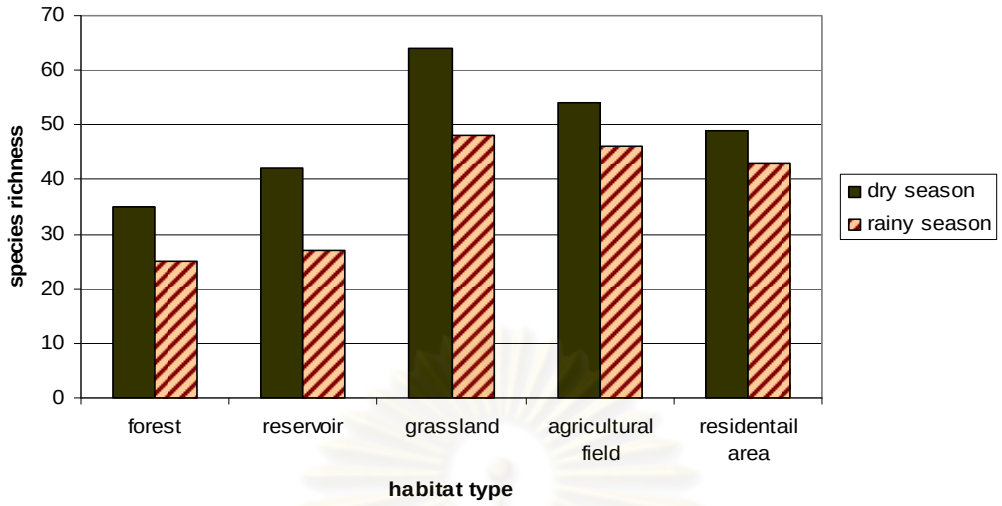

Figure 4.11 Bird species richness when compared between dry and rainy season at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

The Shannon-Weiner value from five habitat types (forest, reservoir, grassland, agricultural field, and residential area) in dry season – rainy season were 2.9-2.77, 2.96-2.87, 3.2-3.28, 3.13-3.25, and 3.1-2.93, respectively. Shannon-Weiner value in dry season, forest, reservoir, and residential area were higher than rainy season while Shannon-Weiner value of grassland and agricultural field in dry season were lower than rainy season (Figure 4.12).

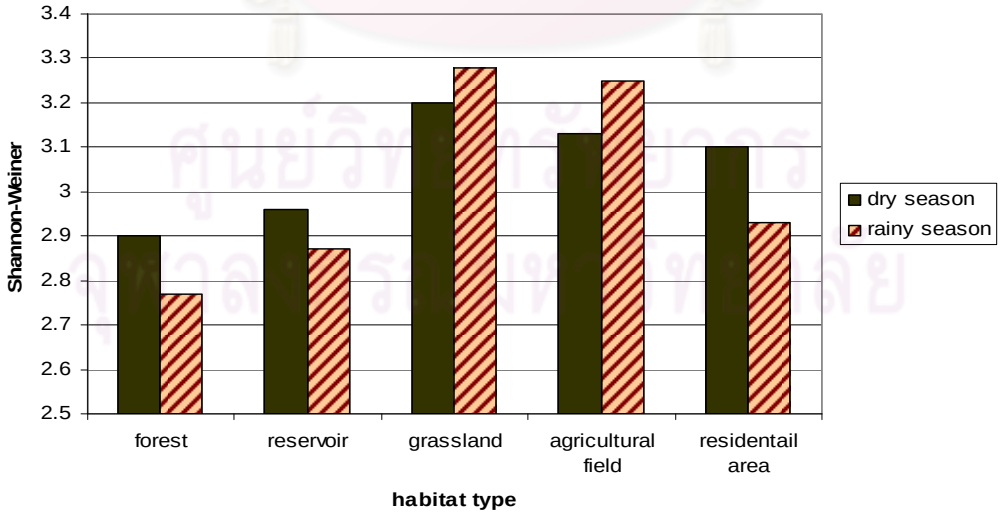

Figure 4.12 Shannon-Weiner value in five habitat types when compare between dry and rainy season at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

4.2: Biological and Physical factors

4.2.1 Biological factors

4.2.1.1 Seed abundance

Seed abundance was collected in five habitat types from January to December 2008. The average number of seed abundance in forest, reservoir, grassland, agricultural field, and residential area in all year round were 0, 6.23, 41.71, 40.29, and 31.14, number per square meter respectively. It is found that, the average seed number per square meter in grassland was the highest while seeding in the forest was absent (Figure 4.13).

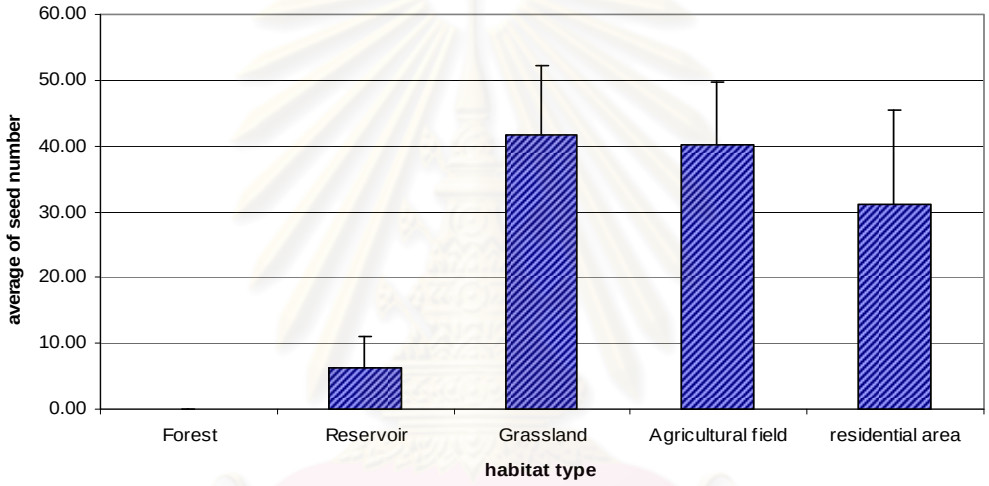

Figure 4.13 The histogram illustrates the average number of seeding in all habitat types at Phu Khao Tong area, Kang Khoi District, Saraburi Province in twelve months from January to December 2008.

Where seed abundance was applied to correlate with bird species richness and bird abundance in granivore group (G); it is found that seed abundance is not correlated ($R^2 \leq 0.5$) with bird species richness ($R^2 = 0.08$) and bird abundance ($R^2 = 0.08$).

4.2.1.2 Fruit abundance

The fruit abundance in this study was found in 3 habitat types consists of forest, grassland, and residential area whereas the fruit abundance in reservoir and agricultural

field were absent. The highest fruit abundance was in the forest (5.57) while in grassland (1.77) and residential area (0.11) were lower (Figure 4.14).

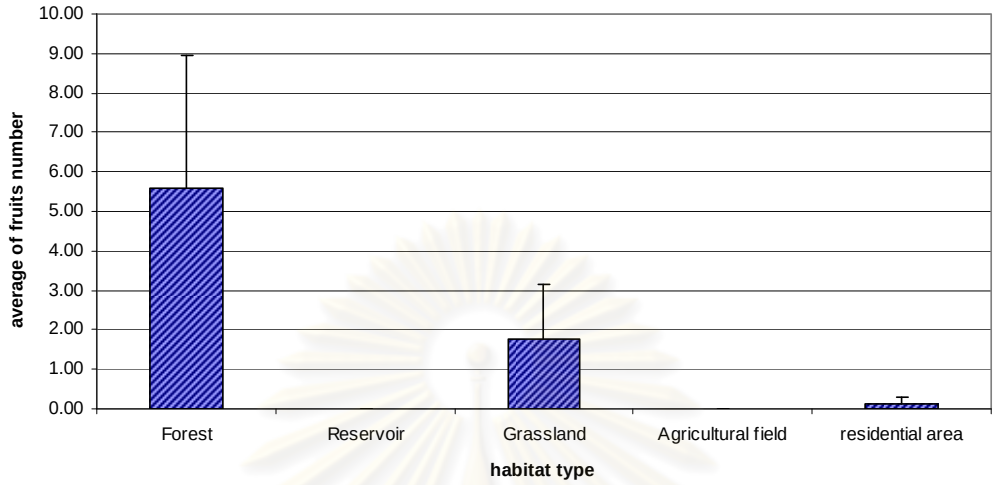

Figure 4.14 The histogram shows the average number of fruits abundance of all habitat types at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

When fruit abundance was compared to bird species richness and bird abundance of arboreal frugivore (AF) and arboreal insectivore/frugivore (AIF) groups, the result indicates that fruit abundance were not correlated ($R^2 \leq 0.05$) with bird species ($R^2 = 0.1$) richness and bird abundance ($R^2 = 0.001$).

4.2.1.3 Human disturbance

The last biological factor, which was the disturbances from human and livestocks in five habitat types, were 0.3, 16.41, 22.18, 28.98, and 46.24, respectively (Figure 4.15). The disturbance in residential area (46.24) was the highest value whereas the lowest one was in the forest (0.3). Where disturbance level was analyzed for the significantly different (p = 0.000) by Kruskal-Wallis test, the result illustrates that disturbance value in forest was significantly different from reservoir, grassland, agricultural field, and residential area (p = 0.008, 0.008, 0.000, and 0.000, respectively). In residential area, it was considerably different from reservoir, grassland, and agricultural field (p = 0.004, 0.005, and 0.045, respectively) as well.

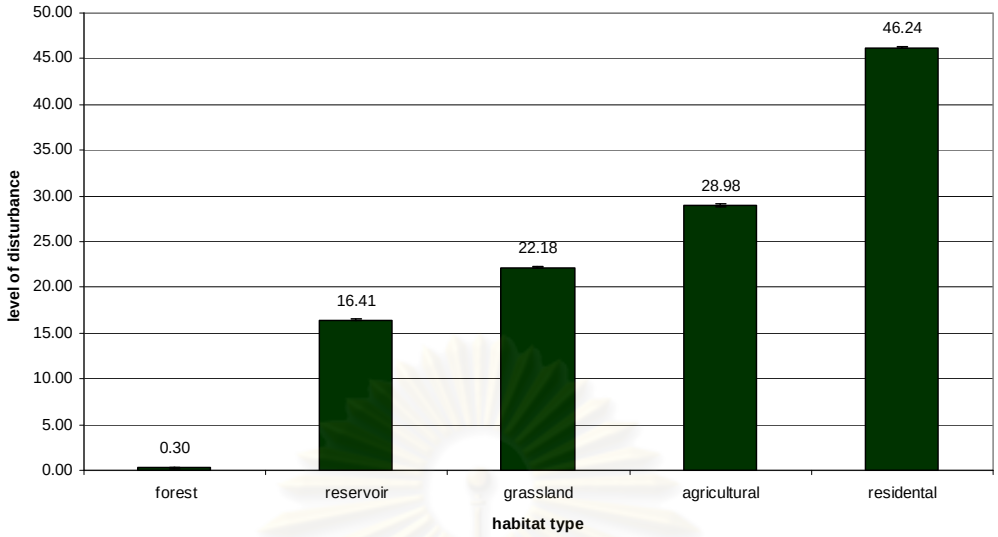

Figure 4.15 The histogram shows the level of disturbance from human and livestocks of all habitat types at Phu Khao Tong area, Kang Khoi District, Saraburi Province in 2008.

The disturbance values were analyzed by Mann-Whitney U-test and the result shows the disturbance value in forest was significantly different ($p \leq 0.05$) from reservoir (p = 0.008), grassland (p = 0.008), agricultural field (p = 0.000) and residential area (p = 0.000). Moreover, the disturbance value in residential area was significantly different ($p \leq 0.05$) from forest (p = 0.000), reservoir (p = 0.004), grassland (p = 005) and agricultural field (p = 0.045) (Table 4.3).

	Forest	Reservoir	Grassland	Agricultural field	Residential area
Forest					
Reservoir	0.008*				
Grassland	0.008*	0.843			
Agricultural field	0.000*	0.101	0.114		
Residential area	0.000*	0.004*	0.005*	0.045*	

Table 4.3 The table shows the number under the triangular are significantly different value ($p \leq 0.05$) when comparing with the disturbance value in each pair of habitat types of five habitat types at Phu Khao Thong area, Kang Khoi District, Saraburi Province in 2008.

* The value of the most difference in disturbance value between each pair of habitat types.

When applied disturbance level to correlate with bird species richness and bird abundance, the result shows that disturbance value are correlated ($R^2 \geq 0.50$) with bird species richness ($R^2 = 0.5$) but not correlated with bird abundance ($R^2 = 0.27$). As indicated below, the bird species richness has tendency to decrease where the disturbance level increases (Figure 4.16).

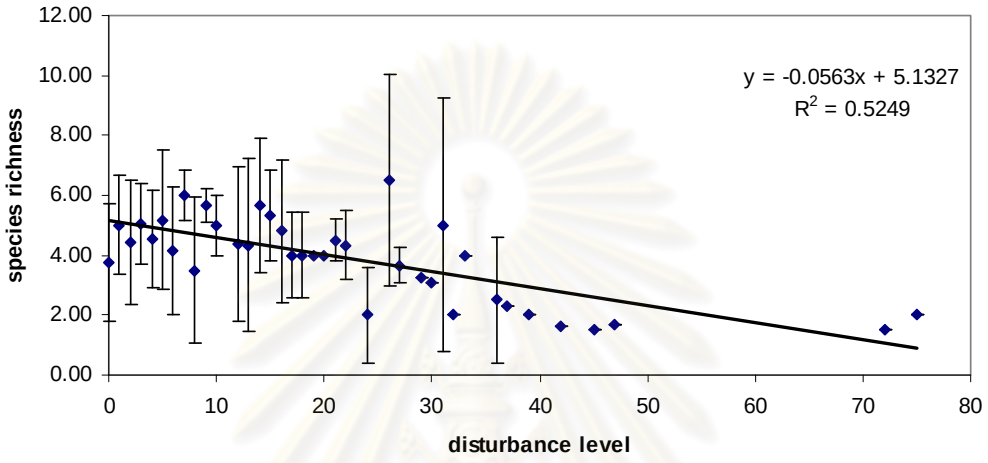

Figure 4.16 The histogram shows the level of disturbance from human and livestocks and bird species richness in 5 habitat types in 12 months in Phu Khao Tong area, Kang Khoi District, Saraburi Province 2008.

From my observation, Cattle Egrets (*Bubulcus ibis*), Common Mynas (*Acridotheres tristis*) and White-vented Mynas (*Acridotheres javanicus*) are found close to livestock in this study area but when applied the disturbance from livestocks with birds abundance, the result indicates that they are not correlated ($R^2 \leq 0.05$) with these birds abundance ($R^2 = 0.02$).

Furthermore, the relationship between bird species and biological factors were applied by Canonical Correspondence Analysis (CCA); the correlation between bird species and biological factors can be explained by CCA. The accumulation of all axes is 91.8%. However, the best axes for interpretation are the first and second axe which is 80.4%. And the multidimensional scaling plot shows codes of bird species, habitats, and all biological factors. And the scaling codes of bird species and bird scientific names for each species are described in Appendix A, table 3.

The bird species from all sampling point in forest were plotted into two dimensional spaces while there were scattered across the 1 and 2 quadrants (Figure 4.16). Some of birds depend on fruit abundance, such as Black-crested Bulbul (AIF 03) (*Pycnonotus melanicterus*), Hair-crested Drongo (SwI 04) (*Dicrurus hottentottus*), Asian Brown Flycatcher (SwI 10) (*Muscicapa dauurica*), Lineated Barbet (AIF 01) (*Megalaima lineata*), and White-crested Laughingthrush (FGI 08) (*Garrulux leucolophus*). When they were plotted in CCA graph, they are closer to the factor line. However, the bird species in grassland and agricultural field sampling plots were spread around the central in four quadrants and they do not depend on seed and fruit abundance. The majority of bird species in residential area were plotted in the quadrate 4 which indicates that birds species are related to disturbance value from human and livestock. On the one hand, some of these species, i.e. Eurasian Tree-Sparrow (TIGF 08) (*Passer montanus*), Vinous-breasted Starling (TIGF 11) (*Sturnus burmannicus*), Ashy Wood-swallow (N 01) (*Artamus fuscus*), Common Myna (TIGF 04) (*Acridotheres tristis*), White-vented Myna (TIGF 05) (*Acridotheres javanicus*), Plain-backed Sparrow (TIGF 07) (*Passer flaveolus*), Rock Pigeon (TIGF 15) (*Columba livia*), are not sensitive to the lower disturbance value. On the other hand, most of the birds species are not endured in high disturbance value, such as Black-crested Bulbul (AIF 03) (*Pycnonotus melanicterus*), Inornate Warbler (FGI 01) (*Phylloscopus inornatus*), Common Tailorbird (FGI 02) (*Orthotomus sutorius*), Lesser Necklaced Laughingthrush (FGI 07) (*Garrulux monileger*), White-crested Laughingthrush (FGI 08) (*Garrulux leucolophus*), Green-billed Malkoha (FGI 15) (*Phaenicophaeus chlorophaeus*), Asian Brown Flycatcher (SwI 10) (*Muscicapa dauurica*), and Large-tailed Nightjar (SwI 14) (*Caprimulgus macrurus)* (Figure 4.17).

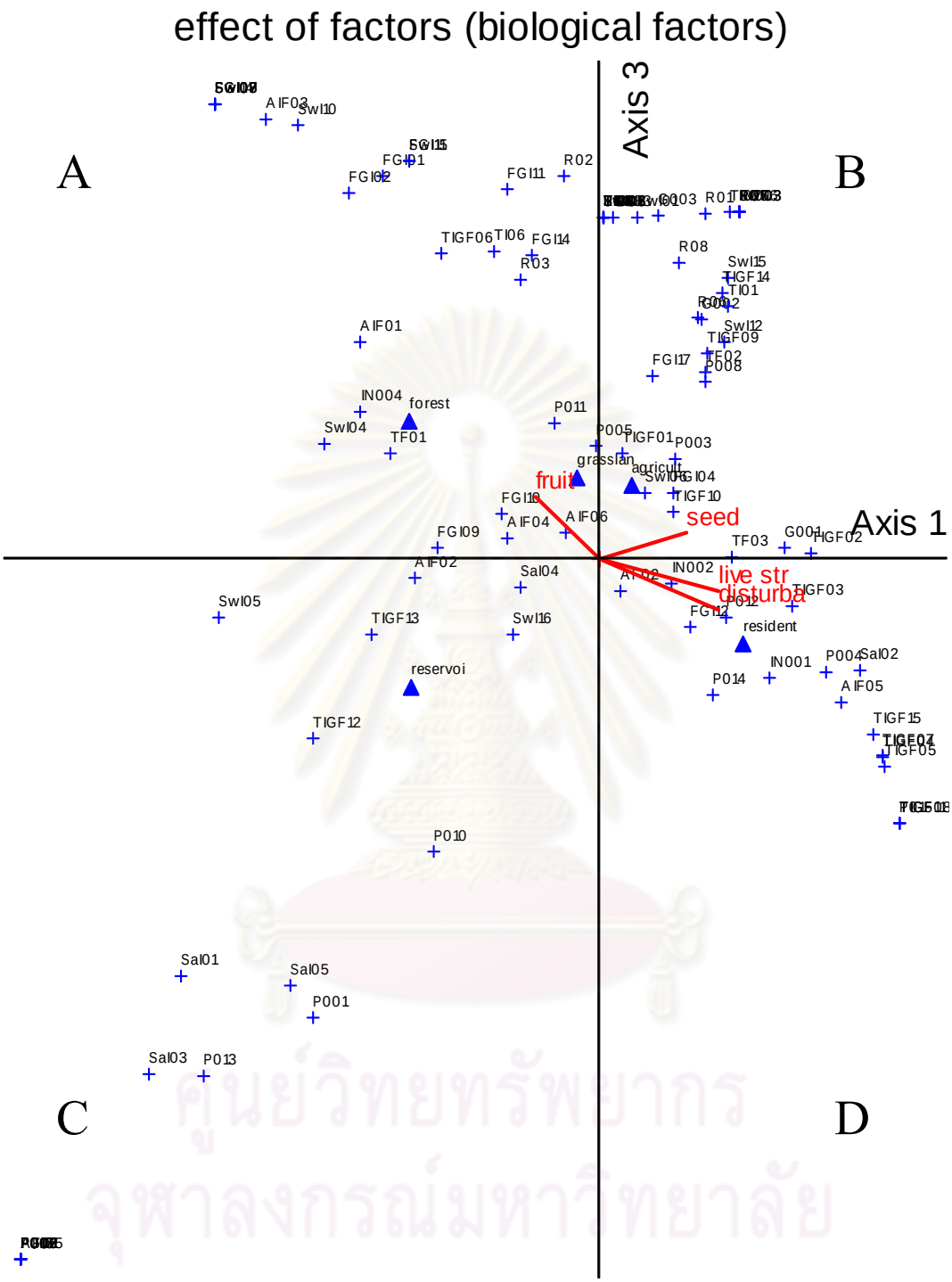

Figure 4.17 Figure shows Canonical Correspondence Analysis (CCA) of biological factors in five habitat types and in all year round in Phu Khao Tong area, Kang Khoi District, Saraburi Province.

4.2.2 Physical factors

The average temperature in all year round in 2008 within this area was 29.18 degree Celsius and the temperature in each month from January to December were 31.65, 28.22, 30.77, 29.09, 28.46, 29.66, 29.96, 26.90, 30.37,31.10, 26.29, and 27.65, respectively (Figure 4.17). The percentage of humidity was calculated from Thermometer hygrometer (Brannan thermometers), during January to March and October to December humidity was less than 70% while April to September the humidity was higher than 70 %. The percentages of humidity in each month from January to December 2008 were 60, 55, 65, 78, 96, 85, 85, 92, 72, 66, 55, and 63, respectively (Figure 4.17). The precipitations collected from the office of weather station branch of Kang Khoi District Saraburi Province from January to December 2008 were 0.0, 0.0, 110.2, 148.2, 270.0, 158.6, 114.6, 106.7, 1,451.2, 272.0, 15.8, and 0.0, respectively. The numbers of raining days in each month from January to December were 0, 0, 6, 7, 10, 9, 12, 17, 16, 11, 3, and 0, respectively (Figure 4.18).

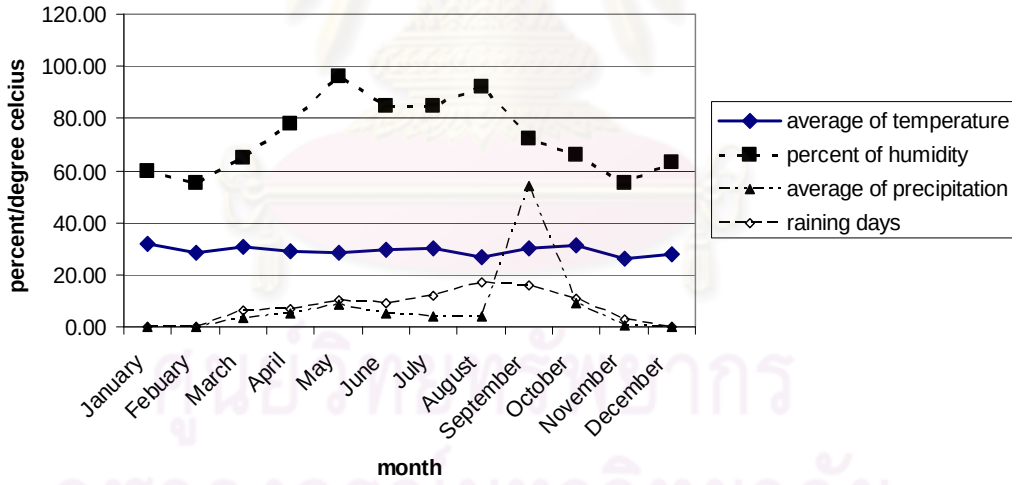

Figure 4.18 The histogram of average temperature, percentage of humidity, average of precipitation and raining days in all year round 2008 at Phu Khao Tong area, Kang Khoi District, Saraburi Province.

When applied the average temperature to correlate with bird species richness and bird abundance, the result shows that temperature is not correlated ($R^2 \leq 0.50$) with bird species richness ($R^2 = 0.02$) and bird abundance ($R^2 = 0.01$). Moreover, percentage of humidity when applied to correlate with species richness and bird abundance, the result shows that the percentage of humidity does not correlate ($R^2 \leq 0.50$) with bird species richness ($R^2 = 0.25$) but correlate with bird abundance ($R^2 = 0.52$) (Figure 4.19).

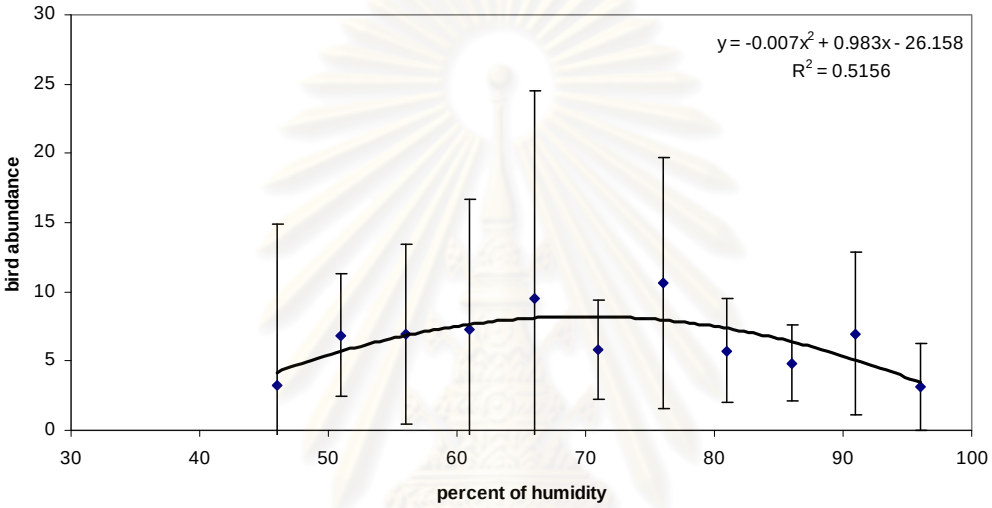

Figure 4.19 The histogram shows the correlation between bird abundance and percentage of humidity ($R^2 = 0.52$).

Moreover, when the average precipitation were applied to correlate with bird species richness and bird abundance, the result illustrates that the precipitation does not correlate ($R^2 \leq 0.50$) with bird species richness ($R^2 = 0.06$) and bird abundance ($R^2 = 0.13$). And when applied the number of raining day to correlate with bird species richness and bird abundance, it shows that raining day does not correlated ($R^2 \leq 0.50$) with bird species richness ($R^2 = 0.13$) and bird abundance ($R^2 = 0.08$) as well.

Furthermore, the relationship between bird species and biological factors were applied by Canonical Correspondence Analysis (CCA). The percentage accumulation of all axes that shows the correlation between bird species and all of biological factors was 79.9% and the percentage variables were show in axes 1 and axes 3 at 65% (Figure 4.20). The multidimensional scaling plot was shows bird species (abbrieviation in coded), habitats, and

all physical factors. The abbrieviation of bird feeding group and bird scientific names were listed in at table 3 in Appendix.

The bird species in the forest were plotted into the two dimensional space appeared scattered across the quadrant A and related with percentage of humidity (Figure 4.20). Birds which are related to percentage of humidity in quadrate A are Hair-crested Drongo (SwI 04) (*Dicrurus hottentottus*), Greater Racket-tailed Drongo (SwI 05) (*Dicrurus paradiseus*) and Greater Coucal (TF 01) (*Centropus sinensis*). However, most of bird species in grassland and agricultural field and some of bird species in residential area were plotted around the central of four quadrants which they do not relate to temperature and percentage of humidity. The majority of bird species in residential area was plotted in the quadrate D, these show the tendency related to temperature, such as Cattle Egret (P 14) (*Bubulcus ibis*), Red Turtle-Dove (TIGF 02) (*Streptopelia tranquebarica*) and House Swift (SaI 02) (*Apus affinis*).

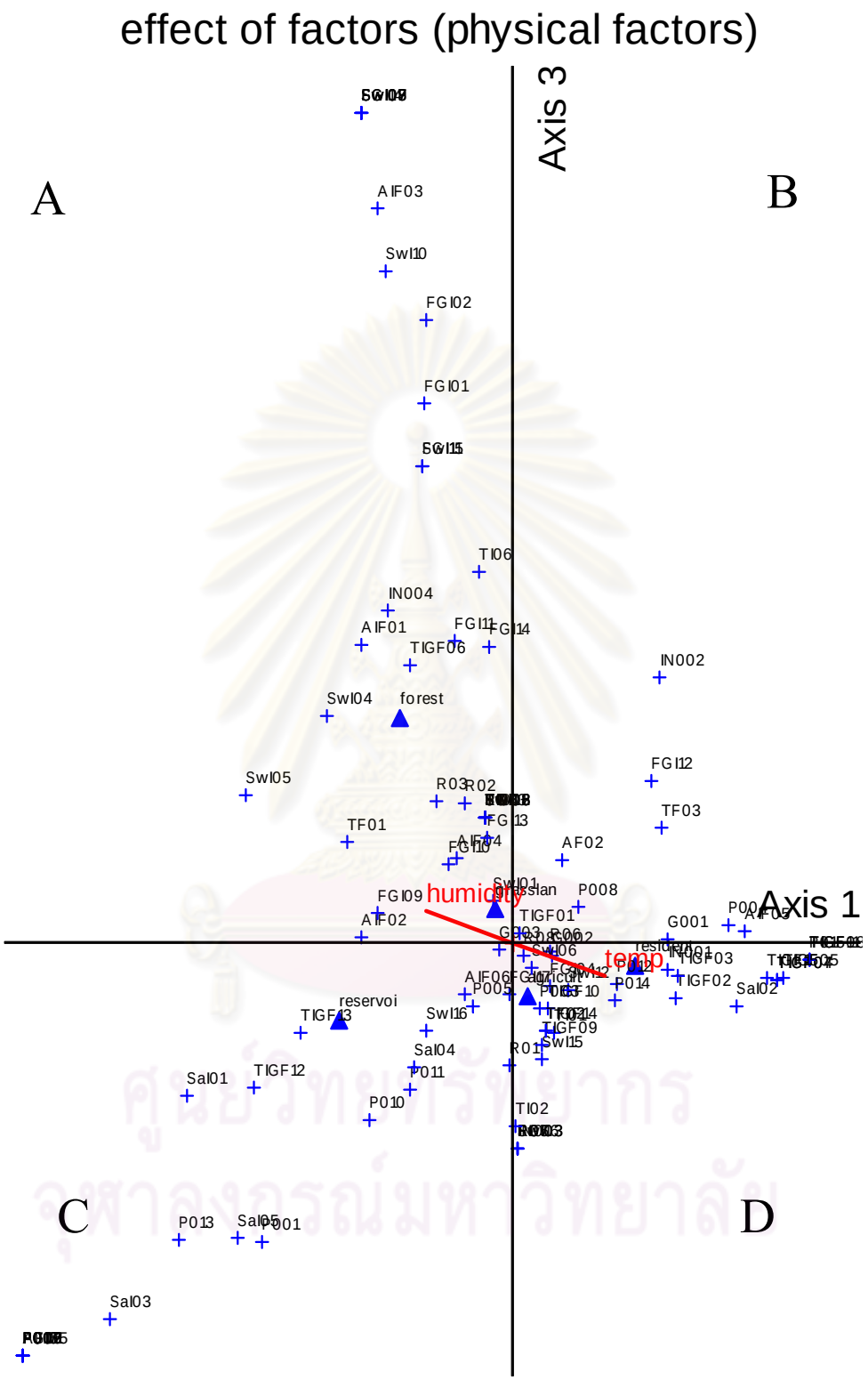

Figure 4.20 The figure shows Canonical Correspondence Analysis of physical factors in five habitat types in all year round in Phu Khao Thong area, Kang Khoi District, Saraburi Province.

In this study, Purple Sunbird (*Nectarinia asiatica*) was found in agricultural field that was a new distribution record of this species (Figure 4.21).

Figure 4.21 Purple Sunbird (*Nectarinia asiatica*) was found in agricultural field of studying site (a) and the drawing illustration (b) from A guide to the birds of Thailand (Lekagul and Round, 1991).

CHAPTER V

DISCUSSION

The bird diversity in Phu Khao Tong area Kang Khoi District, Saraburi Province in one year round was 103 species. The species richness in Phu Khao Thong area is higher than species richness in the 4 city parks, 21-29 species (Soonthornsarathool, 1999), and comparable to the species richness in Khao Wang Khamen, Sai-Yok district, Kanchanaburi Province, 118 species (Uttaruk, 2002). It is attributed to the habitat diversity, size of habitats and surrounding area. The study area consists of various habitat types when compare with the city parks (Gajaseni, 2001). The size of study area is larger than city parks. The study site is located near to Khao Yai National Park. Since some birds may have feeding or nesting activities overlapping in the study area as Khao Yai National Park. Although habitat diversity in study area is higher than Khao Wang Khamen but this area is recovering secondary forest while Khao Wang Khamen is primary forest and the size of study area is smaller than Khao Wang Khamen. Moreover, Khao Wang Khamen is located between Sai Yok National Park and Erawan National Park. Since some birds from 2 national parks may have feeding or nesting activities in Khao Wang Khamen area.

Since the species accumulation curve of five habitats is relatively steady, it can be further interpreted that the bird diversity in the studying area is most likely to be stable. Hence, this result can satisfactorily represent the bird diversity in such area (Round, Gale and Brockelman 2006.).

Bird species composition in forest were most differed from the other habitat types (Sorensen's similarity index 0.47-0.52) while bird species composition in grassland, agricultural field and residential area were similar (Sorensen's similarity index 0.70-0.78). Because forest is the most distinct area since such area has high density of tree, no permanent water resource and low human disturbance. Bird species that were specific in forest were 5 species, such as Asian Paradise-flycatcher (*Terpsiphone paradisi*), Lesser Necklaced Laughingthrush (*Garrulux monileger*) and White-crested Laughingthrush (*Garrulux leucolophus*). These birds are sensitive to disturbance (Kobkete, 2001a) and the forest has the lowest disturbance. Furthermore, comparing with other habitat types, the

grassland, agricultural field and residential area have the most similar bird species because the habitat compositions of grassland, agricultural field and residential area have some similar habitat characteristics, such as human disturbance, crops, and permanent water recourses.

Bird diversity in forest have the same number as in reservoir area but when comparing between bird feeding behavior groups, they are deferent. Birds which live in the forest are foliage-gleaning insectivore (FGI) and Sweeping insectivore (SwI), while the study of Uttaruk in 2002 at Khao Wang Khamen, Amphoe Sai-Yok, Changwat Kanchanaburi showed that the majority of bird feeding groups in forest was arboreal frugivore (AF). It is attributable to the majority of plant community in the study forest is dry fruit trees, such as family Asclepiadaceae, Bombaceae, Leguminosae, Lythraceae; it lacks of fruit trees, such as *Ficus altissma* and *Gewia eriocarpus* that are major food for frugivous birds (Chulalongkorn, 2007; and Uttaruk, 2002).

Babblers (Timaliidae) are generally good indicators of diversities because they are shot-winged forms with rather limited dispersal capabilities. The large and low disturbed forests are rich in Babblers and four species of Babbler were found in study area, namely Yellow-eyed Babbler (*Chrysomma sinense*), Puff-throated Babbler (*Pellorneum ruficeps*), Lesser Necklaced Laughingthrush (*Garrulux monileger*) and White-crested Laughingthrush (*Garrulux leucolophus*). According to, the number of Babbler show that the diversity in the study area is low when compared with the number of Babblers in other studies. For example, 13 species of Babblers were found in Kaeng Krachan National park among 364 bird species (Nabhitabhata, 2000), ten species of Babblers were found in Sakaerat forest among 223 bird species (Waengsothorn and Muangkham, 2005) and 11 species of Babblers were recorded in Krung Chi among 81 bird species (Round, Gale and Brocklman, 2006). This result may be caused by the fact that the Shannon-Weiner of the forest in Phu Khao Thong area had lower bird diversity (Shannon-Weiner = 3.01) than Khao Wang Khamen (Shannon-Weiner = 3.99). from this study bird diversity in forest (3.01) was lower than in the grassland (3.39), the agricultural field (3.37) and the residential area (3.14) but most studies found that bird diversity in the forest are higher than grassland, agricultural field and residential area (Round and Treesucon 2000.; Sodhi, N.S., 2002; Sandstrom, et al 2006.; Soh, Sodhi and Lim 2006.). Because of forest in the study area was recovering

secondary forest area, Shannon-Weiner diversity index in the forest area in this study differs from mature forest in the other studies and surrounding forest in this study was disturbed by human activities.

The reservoir was a specific feeding site of some birds species, such as Little Grebe (*Tachybaptus ruficollis*), Black-winged Stilt (*Himantopus himantopus*), and Common Moorhen (*Gallinula chloropus*) due to availability of several fish species and other food that were not found in other habitat. Moreover, some birds that live in forest can found in this area because the reservoir was surrounded by the forest.

When compare bird species richness between dry (January to April) and rainy (May to October) season, species richness between 2 seasons differed in reservoir because the important factor may be the increasing of feeding area, such as sand banks, while in rainy season, the sand banks (sand bank is important feeding area for wading birds. (Pandey, 1993) were disappear. Thus wading bird, such as Black-winged Stilt (*Himantopus himantopus*), Black-tailed Godwit (*Limosa limosa*) and Little Ringed Plover (*Charadrius dubius*) disappeared. The sandbank area could not be found even in the next dry season (November and December 2008).

Moreover, after the dam was constructed since 2007, piscivore has increased from 4 species of Chinese Pond-Heron (*Ardeola bacchus*), Intermediate Egret (*Egratta intermedia*), Little Egret (*Egratta garzetta*) and Red-wattled Lapwing (*Vanellus indicus*) (Chulalongkorn, 2007) to 14 species, such as Lesser Whistling-Duck (*Dendrocygna javanica*), Little Grebe (*Tachybaptus ruficollis*), Red-wattled Lapwing (*Vanellus indicus*), White-throated Kingfisher (*Halcyon smyrnensis*) and Black-winged Stilt (*Himantopus himantopus*). The increasing of water birds after the building of the reservoir was similar to the study of Pandey in India 1993. The shallow habitat below the outfall of the reservoir is important to ducks, grebes as well as waders. The shallow on the margins of the reservoir is the important feeding area for a large population density of ducks and some long-legged waders. The sandy bank strewn with small boulders near the reservoir margin are used by other water birds.

In grassland and agricultural field, bird species found only in the grassland 10 species, such as Red-throated Pipit (*Anthus cervinus*), Japanese Sparrowhawk (*Accipiter gularis*) and Blue Rock-Thrush (*Monticola solitarius*) can be found in the grassland and 5 species found in agricultural field, such as Crested Honey-Buzzard (*Pernis ptilorhyncus*),

Ashy Drongo (*Dicrurus leucophaeus*) and Purple Sunbird (*Nectarinia asiatica*). Both of these habitat types are found the majority of bird in feeding group of foliage-gleaning insectivore and terrestrial insectivore/granivore/frugivore group. Because both areas are open area and contain few large trees, although these will be good of food resource for insectivorous birds.

However, the number of species in foliage-gleaning insectivore group in the grassland is higher than the agricultural field since the grassland consists of more plant species which possibly high diversity of insect species. In contrary, number of bird species in piscivore and terrestrial insectivore/granivore/frugivore groups in the agricultural field was higher than the grassland. The reason why the piscivorous birds were found in majority groups because in this area has permanent water resource which is the important food resource for piscivorous birds. Moreover, the reason why the terrestrial insectivore/granivore/frugivore was found in majority groups because agricultural field locates close to the residential area, thus, bird can fly from residential area to this area. Human and live stock disturbance, such as the grazing cattle are also factors that cause some bird species, such as Common Myna (*Acridotheres tristis*), White-vented Myna (*Acridotheres javanicus*) and Plain-backed Sparrow (*Passer flaveolus*), to come into the agricultural field to feed on insects associated on the cattle.

During this study, grassland was violently disturbed by the activity of road construction, lending from the main road directly to the dam and this area are also preparing for helicopter landing field. So, shrubs, weed and grasses were cleared and soil was pressed in January 2008. And in July 2008, the workers have construction the artesian well and roads were repaired in September 2008. All of these disturbances and habitat change caused habitat at grassland areas become a bare land. The noise from machines working and dispersion of dust are spreading covered the grassland, there were negative effected to bird species richness, such as Sooty-headed Bulbul (*Pycnonotus aurigaster*) and Plain Prinia (*Prinia inornata*). Bird abundance was decreasing during the work of machines while the number of Plain Prinia (*Prinia inornata*) in residential area is increasing.

In agricultural field, the majority bird feeding group i.e. terrestrial insectivore/granivore/frugivore (TIGF) (11 species) and foliage-gleaning insectivore (FGI) (9 species) because this habitat is open area and has few large trees. And from villager

interview found that during the study period, the villagers never use pesticides in agricultural field therefore the majority of bird food abundance in this area will be insects that related with richness of bird species in terrestrial insectivore/granivore/frugivore (TIGF) and foliage-gleaning insectivore (FGI) groups that higher than other groups. Raptors species (7 species) were found in agricultural field, that higher than forest (2 species), reservoir (1 species), grassland (5 species) and residential area (2 species). This area has lot of small vertebrates and plenty insects which are the food resources for hunting preys in this habitat (Kasorndorkbua, 2008).

In the residential area, there are three specific bird species for example Eurasian Tree-Sparrow (*Passer Montanus*) that could be found in such area. As the reasons that Eurasian Tree-Sparrow (*Passer montanus*), which was classified into terrestrial insectivore/granivore/frugivore group, is good at habituating to human activities, good at adapting to feed various foods and their nesting habit had been changed from nesting in narrow space between rocks to nest in crack of walls or groove under roofs, this bird therefore can easily live near the human residences.

Bird species in residential area is the most similar to agricultural field because the residential area has similar habitat as in agricultural field, such as crops or rice fields. The terrestrial insectivore/granivore/frugivore (TIGF) was the highest species richness due to this area has food waste from human. Thus, omnivores birds that resistant to low disturbance can live in this habitat, such as Common Myna (*Acridotheres tristis*), White-vented Myna (*Acridotheres javanicus*) and Rock Pigeon (*Columba livia*).

In the residential area, nests of Baya Weaver (*Ploceus philippinus*) and Scaly-breasted Munia (*Lonchura punctulata*) can be found although such area has a little food for these birds. Nevertheless, they still selected to nest in this habitat since there are big and high trees that suit for nesting. Contrary to grassland and agricultural field, they have few numbers of large trees. Many bird species selected large trees for nesting because the large trees are good to avoid facing with many predators. While in forest have a lot of trees for bird nesting but in forest has few of nesting materials. Since residential area should be good choose for these birds to nesting. Moreover, the number of predators in residential area were lower than agricultural filed and grassland. According to the study of Marshall in

2003, they found birds decided to nest in the residential area for the number of raptors was lower than higher area although there was less food supply.

Bird species richness in all habitats was comparison between seasons. Dry season is higher than rainy seasons because birds immigrated into the study area and they emigrated in the rainy season (Lekagul and Round, 1991). Shannon-Weiner of all habitat types is found that grassland and agricultural field in rainy season are higher than dry season. Therefore, Shannon-Weiner includes the number of birds; hence, the number of birds in grassland and agricultural field in dry season is lower than rainy season may be cause by seed abundance of grassland and agricultural field in dry season (8.6 and 9 seed per square meter) are higher than rainy season (5.9 and 5.1 seed per square meter).

From my research, fruit and seed abundance are not correlated to species richness and abundance because the effect of disturbance from human activity on birds species richness and abundance is higher than effect of fruit and seed abundance. It is similar to the study of Francel (Francel, 2000) and Codaccioni (Codaccioni, 2008).

From my observation, many bird species in the grassland were disappeared during road construction (disturbance level 5). After the disturbance had been stopped, until the next two month, some birds, such as Greater Coucal (*Centropus sinensis*) were found in this area. Moreover, some birds could not be found in the study field during the disturbance but in the next month they could be found in low number and then increased in the next month.

From this study, I found the new distribution recorded of Purple Sunbird (*Nectarinia asiatica*) in the central of Thailand while Lekagul and Round (Lekagul and Round, 1991) ever found in northern, northern–east and western of Thailand. According to the description of Purple Sunbird in A Guide to the Bird of Thailand, this species is found in dipterocarp forest, beach forest, and agricultural field. Therefore, it is possible that such species can be found in this area.

And from this study, the physical factors are not correlated with bird species richness and bird abundance because the physical factors were similar in every habitat types. Thus the effects of physical factors were not significantly different in every habitat types.

CHAPTER VI

CONCLUSIONS

6.1 Conclusions

1. Bird species diversity in grassland is the highest (73 species) and bird species diversity in forest is the lowest (38 species).
2. In each habitat type, the highest bird feeding group are foliage-gleaning insectivore (FGI) (17 species) and piscivore (P) (17 species). The relatively higher group is sweeping insectivore (SwI) (16 species).
3. Shannon-Weiner diversity in grassland is the highest (4.89) and the lowest is forest (4.34).
4. When comparing bird species between two habitat types, habitats with the most similarity is between agricultural field and residential area; while habitats with the least similarity is between forest and residential area.
5. The majority of bird feeding group in each habitat types were
   a. Forest is FGI and SwI (9 species).
   b. Reservoir is P (14 species).
   c. Grassland is FGI (15 species).
   d. Agricultural field is TIGF (11 species).
   e. Residential area is TIGF (11 species).
6. Disturbance has negative affect with both bird diversity and bird abundance (p = 0.000, p = 0.01, respectively).On the other hand, fruits and seeds abundance are not related to bird diversity and bird abundance.
7. Percent of humidity is significantly related to bird abundance (R^2 = 0.52) while other physical factors are not related to bird diversity and abundance.

6.2 Recommendations

1. During disturbance period, refuge area with similar in habitat characteristics to the disturbed area should be provided, since bird from the disturbed area can return to the area from the refuge after 2 months.
2. The grassland between forests should be protected because the birds between 2 forests can fly together while the area that close to rural road should be constructed area because this area has few large trees and far from recovering secondary forest.
3. Grassland covers 20% of study area and has bird species richness higher than any other habitat types; hence, this area should be preserved by avoiding the construction or keeping some of grassland that connected with the other similar locations to sustain bird diversity.
4. In the study area, forest is recovering and consists of small and medium trees. The forest should be protected without disturbance to allow natural succession to proceed in order to keep species and age diversities of trees as food source, refuge and nesting site of birds.
5. In reservoir area, sand banks should be created near a reservoir shore. Moreover, aquatic plants, such as water lilies, water mimosa, water lettuce, camphor tree, false loose, and water morning glory should be planted near the shore in order to provide habitats for wading birds.
6. Since insectivorous birds were the most common species in the study area and bio-control against, the correlation between species richness and abundance of insectivorous birds and of the insects they feed on should be studied.

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APPENDIX

Appendix A

Table A-1 Table shows bird diversity in Chulalongkorn University land development project Kang Khoi District, Saraburi Province before reservoir constructed.

Note: A = all part of Thailand, N = Northern, NE = North East, C = Central, E = East, S = Southern, VCR = very common resident, CR = common resident, UR = uncommon resident, CWV = very common winter visitor, WV = winter visitor

Common name	Scientific name	Distribution	Thai status
ยางกรอกพันธุ์จีน	*Ardeola bacchus*	A	CWV
นกยางโทนน้อย	*Egratta tntermedia*	N NE C S	CWV
นกยางเปีย	*Egretta garzetta*	A	WV
เหยี่ยวแดง	*Haliastur indus*	C	CR
เหยี่ยวผึ้ง	*Pernis ptilorhyncus*	N NE C S	UR
เหยี่ยวรุ้ง	*Spilornis cheela*	N W C S	CR
เหยี่ยวด่างดำขาว	*Cicus melanoleucos*	N NE W E C	VCR
เหยี่ยวเคสเตรล	*Falco tinnunculeucos*	N E C	CWV
ไก่ป่า	*Gallus gallus*	A	VCR
นกกระทาทุ่ง	*Francolinus pintadeanus*	N W C	CR
นกกระแตแต้แว็ด	*Vanellus indicus*	N W E C S	VCR
นกเขาใหญ่	*Streptopelia chinensis*	A	CR
นกเขาชวา	*Geopelia striata*	C S	CR
นกอีวาบตั๊กแตน	*Cacomantis merulinus*	A	CR
นกกระปูดใหญ่	*Centropus sinensis*	W E C S	CR
นกกาเหว่า	*Eudynamys scolopacea*	A	VCR
นกตะขาบทุ่ง	*Coracias benghalensis*	A	VCR
นกโพระดกธรรมดา	*Megalaima lineate*	N W E C S	CR
นกโพระดกหน้าผากดำ	*Megalaima australis*	N W C S	VCR
นกตีทอง	*Megalaima haemacephala*	A	VCR
นกแอ่นตาล	*Cypsiurus balasiensis*	A	CWV
นกนางแอ่นบ้าน	*Hirundo rustica*	N NE C S	CWV
นกเด้าดินสวน	*Anthus hodgsoni*	A	WV

นกปรอดหัวโขน	*Pycnonotus jocosus*	C	CR
นกปรอดสวน	*Pycnonotus blanfordi*	N W C S	CR
นกปรอดหัวสีเขม่า	*Pycnonotus aurigaster*	N NE C S	CR
นกแซงแซวหางปลา	*Dicrurus macrocercus*	N NE W E C	VCR
นกแซงแซวหงอนขน	*Dicrurus hottentottus*	N E C	CWV
นกแซงแซวหางบ่วงใหญ่	*Dicrurus paradiseus*	A	VCR
นกจาบดินอกลาย	*Pellorneum ruficeps*	N W C	CR
นกกระรางหัวหงอก	*Garrulux leucolophus*	N W E C S	VCR
นกกระจิ๊ดธรรมดา	*Phylloscopus inornatus*	A	VCR
นกกระจิบธรรมดา	*Orthotomus sutorius*	C S	CR
นกกางเขนดง	*Copsychus malabaricus*	A	VCR
นกขุนทอง	*Gracula religiosa*	W E C S	CR
นกกินปลีอกเหลือง	*Nectarinia jugularis*	A	VCR
นกสีชมพูสวน	*Dicaeum cruentatum*	A	VCR
นกกระติ๊ดตะโพกขาว	*Lonchura striata*	A	VCR

Table A-2 Plant diversity in Chulalongkorn University land development project Kang Khoi District, Saraburi Province.

Note: F: Fern; CF Clam Fern; TerO: Terrestrial Orchid; T: Tree; ST: Small Tree; S: Shrub; H: Herb; C: Clam; Sc: Scandent; ScS: Scandent Shrub; abundance: * = Very low, ** = Low, *** = Medium and **** = high

Common name	Scientific name	Habit	abundance
Selaginellaceae			
หญ้าร้องไห้	*Selaginella helferi* Warb.	F	++
Schizaeaceae			
กระฉอด	*Lygodium flexuosum* (L.) Sw.	CF	+
Cycadaceae			
-	*Cycas* sp	S	++++
Anacardiaceae			
กุ๊ก, อ้อยช้าง	*Lannea coromandelica* (Houtt.) Merr.	T	+++
-	*Spondias* sp.	T	++
Annonaceae			

หางรอก	*Miliusa velutina* (Dunal) Hook.f. & Thomson	T	+++
Apocynaceae			
โมกใหญ่	*Holarrhena pubescens* Wall. ex G.Don	T	++++
โมกใบบาง	*Wrightia lecomtei* Pitard	T	++
Asclepiadaceae			
-	*Gymnema* sp.	C	+++
-	*Marsdenia lachostoma* Bentham	H	++
-	*Marsdenia tenacissima* (Roxb.) Moon	C	++++
อ้อยแสนสวน	*Myriopteron extensum* (Wight) K.Schum	C	++++
เถาประสงค์	*Streptocaulon juventas* (Lour.) Merr.	C	++++
อบเชยเถา	*Zygostelma Benthami* Baill.	C	+++
Bignoniaceae			
แคหางด่าง	*Makhamia stipulate* Seem.	T	+++
แคทราย	*Stereospermum neuranthum* Kurz	T	++
Bombacaceae			
งิ้วดอกขาว	*Bombax anceps* Pierre	T	+++
งิ้วบ้าน	*Bombax ceiba* L.	T	++
งิ้วป่าดอกแดง	*Bombax insigne* Wall.	T	+++
Boraginaceae			
ก้อม	*Ehretia laevis* R.Br.	ST	+
Burseraceae			
ตะคร้ำ	*Garuga pinnata* Roxb.	T	++
Celastraceae			
มะดูก	*Siphonodon celastrineus* Griff.	T	+
Connaraceae			
คำรอก	*Ellipanthus tomentosus* Kurz.	S/ST	++
Convolvulaceae			
ใบต่างเหรียญ	*Evolvulus nummularius* (L.) L.	H	++++
Euphorbiaceae			
เปล้าใหญ่	*Croton roxburghii* N.P.Balakr.	ST	+++
Flacourtiaceae			
ตะขบป่า	*Flacourtia indica* (Burm.f.) Merr.	ST	++++
Labiatae			
ชะรักป่า	*Clerodendrum serratum* (L.) Moon	S	+

ทองแมว	*Gmelina elliptica* Sm.	ScS	+
ตีนนก	*Vitex* sp.	T	++
Leguminasae-Caesalpininoideae			
ราชพฤกษ์	*Cassia fistula* L.	T	+++
อะราง	*Peltophorum dasyrachis* (Miq.) Kurz	T	+++
Leguminsae-Papilionoideae			
ทองเครือ	*Butea superba* Roxb.	C	+++
-	*Dalbergia* sp1	T	+
-	*Dalbergia* sp2	T	++
ทองเดือนห้า	*Erythrina stricta* Roxb.	T	++++
Lythraceae			
อินทนิลบก	*Lagerstroemia macrocarpa* Wall.	T	++
Malpighiaceae			
โนรา	*Hiptage benghalensis* (L.) Kurz	ScS	++
Menispermaceae			
-	*Tinospora* sp.	C	++
Moraceae			
ข่อย	*Streblus asper* Lour.	T	++
Ochnaceae			
ตาลเหลือง	*Ochna integrerrima* (Lour.) Merr.	S/ST	+
Olacaceae			
น้ำใจใคร่	*Olax psittacorum* (Willd.) Vahl	Sc	++++
Orchidaceae			
อึ่งเปาะ	*Geodorum attenuatum* Griff.	TerO	++++
-	*Geoforum* sp.	TerO	+++
Rubiaceae			
คำมอกหลวง	*Gardenia sootepensis* Hutch.	ST	++
-	*Ixora* sp.	ST	++
ยอป่า	*Morinda coreia* Ham.	T	++
ตดหมูตดหมา	*Paederia* sp.	C	+++
Simaroubaceae			
สีฟันคนทา	*Harrisonia perforate* (Blanco) Merr.	ScS	++++
Sterculiaceae			
ปอคาว	*Firmiana pallens* (Wall. ex King) Steam	T	++++
ปอบิด	*Helicteres isora* L.	S	+++

ดีงู	*Helicteres lanceolata* A.DC. var. lanceolata	S	+++
Strychnaceae			
แสลงใจ	*Strychnos nux-vomica* L.	T	++
Tiliaceae			
เลียง	*Berrya mollis* wall.	T	++++
Zingiberaceae			
-	*Curcuma* sp.	H	+++
-	*Kaempferia* sp.	H	+++
-	*Zingiber* sp.	H	+++

Table A-3 Table shows codes, common name, and scientific name of birds in Chulalongkorn University land development project Kang Khoi District, Saraburi Province.

Note: Note: arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF)

Code	**ชื่อไทย**	Common name	Scientific name
AF01	กาฝากสีเรียบ	Plain Flowerpecker	*Dicaeum concolor*
AF02	สีชมพูสวน	Scarlet-backed Flowerpecker	*Dicaeum cruentatum*
AIF01	โพระดกธรรมดา	Lineated Barbet	*Megalaima lineata*
AIF02	ตีทอง	Coppersmith Barbet	*Megalaima haemacephala*
AIF03	ปรอดเหลืองหัวจุก	Black-crested Bulbul	*Pycnonotus melanicterus*
AIF04	ปรอดสวน	Streak-eared Bulbul	*Pycnonotus blanfordi*
AIF05	ปรอดหน้านวล	Yellow-vented Bulbul	*Pycnonotus goiavier*
AIF06	ปรอดหัวสีเขม่า	Sooty-headed Bulbul	*Pycnonotus aurigaster*
BI01	หัวขวานด่างอกลายจุด	Fulvous-breasted Woodpecker	*Picoides macei*
FGI01	กระจิ๊ดธรรมดา	Inornate Warbler	*Phylloscopus inornatus*
FGI02	กระจิบธรรมดา	Common Tailorbird	*Orthotomus sutorius*
FGI03	กระจิบหญ้าท้องเหลือง	Yellow-bellied Prinia	*Prinia Flaviventris*
FGI04	กระจิบหญ้าสีเรียบ	Plain Prinia	*Prinia inornata*
FGI05	กระจิบหญ้าสีข้างแดง	Rufescent Prinia	*Prinia rufescens*
FGI06	กระจิบหญ้าอกเทา	Grey-breasted Prinia	*Prinia hodgsonii*
FGI07	กระรางสร้อยคอเล็ก	Lesser Necklaced Laughingthrush	*Garrulux monileger*

FGI08	กระรางหัวหงอก	White-crested Laughingthrush	*Garrulux leucolophus*
FGI09	กะลิงเขียด	Rufous Treepie	*Dendrocitta formosae*
FGI10	กาเหว่า	Common Koel	*Eudynamys scolopacea*
FGI11	กาแวน	Racket-tailed Treepie	*Crypsirina temia*
FGI12	กางเขนบ้าน	Oriental Magpie-Robin	*Copsychus saularis*
FGI13	กินแมลงตาเหลือง	Yellow-eyed Babbler	*Chrysoomma sinense*
FGI14	ขมิ้นน้อยธรรมดา	Common Iora	*Aegithina tiphia*
FGI15	บั้งรอกใหญ่	Green-billed Malkoha	*Phaenicophaeus chlorophaeus*
FGI16	ยอดข้าวหางแพนลาย	Zitting Cisticola	*Cisticola juncidis*
FGI17	อีวาปต๊ักแตน	Plaintive Cuckoo	*Cacomantis merulinus*
G01	กระจาบธรรมดา	Baya Weaver	*Ploceus philippinus*
G02	กระติ๊ดขี้หมู	Scaly-breasted Munia	*Lonchura punctulata*
G03	กระติ๊ดตะโพกขาว	White-rumped Munia	*Lonchura striata*
IN01	แอ่นพง	Ashy Wood-swallow	*Artamus fuscus*
IN02	กินปลีคอสีน้ำตาล	Brown-throated Sunbird	*Anthreptes malacensis*
IN03	กินปลีดำม่วง	Purple Sunbird	*Nectarinia asiatica*
IN04	กินปลีอกเหลือง	Olive-backed Sunbird	*Nectarinia jugularis*
P01	เป็ดแดง	Lesser Whistling-Duck	*Dendrocygna javanica*
P02	เป็ดผีเล็ก	Little Grebe	*Tachybaptus ruficollis*
P03	กระแตแต๊แว๊ด	Red-wattled Lapwing	*Vanellus indicus*
P04	กวัก	White-breasted Waterhen	*Amaurornis phoenicurus*
P05	กะเต็นอกขาว	White-throated Kingfisher	*Halcyon smyrnensis*
P06	ตีนเทียน	Black-winged Stilt	*Himantopus himantopus*
P07	ปากแอ่นหางดำ	Black-tailed Godwit	*Limosa limosa*
P08	ปากห่าง	Asian Openbill	*Anastomus oscitans*
P09	ยางเขียว	Little Heron	*Butorides striatus*
P10	ยางเปีย	Little Egret	*Egretta garzetta*
P11	ยางไฟธรรมดา	Cinnamon Bittern	*Ixobrychus cinnamomeus*
P12	ยางกรอกพันธุ์จีน	Chinese Pond-Heron	*Ardeola bacchus*
P13	ยางกรอกพันธุ์ชวา	Javan Pond-Heron	*Ardeola speciosa*
P14	ยางควาย	Cattle Egret	*Bubulcus ibis*
P15	หนูแดง	Ruddy-breasted Crake	*Porzana fusca*
P16	หัวโตเล็กขาเหลือง	Little Ringed Plover	*Charadrius dubius*
P17	อีล้ำ	Common Moorhen	*Gallinula chloropus*

R01	เหยี่ยวขาว	Black-shouldered Kite	*Elanus caeruleus*
R02	เหยี่ยวทุ่งพันธุ์เอเชีย	Eastern Marsh-Harrier	*Circus spilonotus*
R03	เหยี่ยวนกเขาชิครา	Shikra	*Accipiter badius*
R04	เหยี่ยวนกเขาพันธุ์ญี่ปุ่น	Japanese Sparrowhawk	*Accipiter gularis*
R05	เหยี่ยวผึ้ง	Crested Honey-Buzzard	*Pernis ptilorhyncus*
R06	อีเสือสีน้ำตาล	Brown Shrike	*Lanius cristatus*
R07	อีเสือหลังแดง	Burmese Shrike	*Lanius collurioides*
R08	อีเสือหัวดำ	Long-tailed Shrike	*Lanius schach*
Sal01	แอ่นตาล	Asian Palm-Swift	*Cypsiurus balasiensis*
Sal02	แอ่นบ้าน	House Swift	*Apus affinis*
Sal03	นางแอ่นตะโพกแดง	Red-rumped Swallow	*Hirundo daurica*
Sal04	นางแอ่นบ้าน	Barn Swallow	*Hirundo rustica*
Sal05	นางแอ่นมาตินพันธุ์เอเชียใต้	Asian House-Martin	*Delichon dasypus*
Swl01	แซงแซวเล็กเหลือบ	Brozed Drongo	*Dicrurus aeneus*
Swl02	แซงแซวปากกา	Crow-billed Drongo	*Dicrurus annectans*
Swl03	แซงแซวสีเทา	Ashy Drongo	*Dicrurus leucophaeus*
Swl04	แซงแซวหงอนขน	Hair-crested Drongo	*Dicrurus hottentottus*
Swl05	แซงแซวหางบ่วงใหญ่	Greater Racket-tailed Drongo	*Dicrurus paradiseus*
Swl06	แซงแซวหางปลา	Black Drongo	*Dicrurus macrocercus*
Swl07	แซวสวรรค์	Asian Paradise-flycatcher	*Terpsiphone paradisi*
Swl08	กระเบื้องผา	Blue Rock-Thrush	*Monticola solitarius*
Swl09	จับแมลงคอแดง	Red-throated Flycatcher	*Ficedula parva*
Swl10	จับแมลงสีน้ำตาล	Asian Brown Flycatcher	*Muscicapa dauurica*
Swl11	จับแมลงสีฟ้า	Verditer Flycatcher	*Eumyias thalassina*
Swl12	จาบคาเล็ก	Green Bee-eater	*Merops orientalis*
Swl13	จาบคาหัวสีส้ม	Chestnut-headed Bee-eater	*Merops leschenaulti*
Swl14	ตบยุงหางยาว	Large-tailed Nightjar	*Caprimulgus macrurus*
Swl15	ยอดหญ้าหัวดำ	Stonechat	*Saxicola torquata*
Swl16	อีแพรดแถบอกดำ	Pied Fantaill	*Rhipidura javanica*
TF01	กระปูดใหญ่	Greater Coucal	*Centropus sinensis*
TF02	ตะขาบทุ่ง	Indian Roller	*Coracias benghalensis*
TF03	อีกา	Large-billed Crow	*Corvus macrorhynchos*
TI01	เด้าดินทุ่งเล็ก	Paddyfield Pipit	*Anthus rufulus*
TI02	เด้าดินสวน	Olive-backed Pipit	*Anthus hodgsoni*
TI03	เด้าดินอกแดง	Red-throated Pipit	*Anthus cervinus*

TI04	กระรางหัวขวาน	Hoopoe	*Upupa epops*
TI05	คอทับทิม	Siberian Rubythroat	*Luscinia calliope*
TI06	จาบดินอกลาย	Puff-throated Babbler	*Pellorneum ruficeps*
TIGF01	เขาใหญ่	Spotted Dove	*Streptopelia chinensis*
TIGF02	เขาไฟ	Red Turtle-Dove	*Streptopelia tranquebarica*
TIGF03	เขาชวา	Zebra Dove	*Geopelia striata*
TIGF04	เอี้ยงสาริกา	Common Myna	*Acridotheres tristis*
TIGF05	เอี้ยงหงอน	White-vented Myna	*Acridotheres javanicus*
TIGF06	ไก่ป่า	Red Junglefowl	*Gallus gallus*
TIGF07	กระจอกตาล	Plain-backed Sparrow	*Passer flaveolus*
TIGF08	กระจอกบ้าน	Eurasian Tree-Sparrow	*Passer montanus*
TIGF09	กระทาทุ่ง	Chinese Francolin	*Francolinus pintadeanus*
TIGF10	กิ้งโครงคอดำ	Black-collared Starling	*Sturnus nigricollis*
TIGF11	กิ้งโครงหัวสีนวล	Vinous-breasted Starling	*Sturnus burmannicus*
TIGF12	จาบฝนเสียงใส	Singing Bushlark	*Mirafra javanica*
TIGF13	จาบฝนเสียงสวรรค์	Oriental Skylark	*Alauda gulgula*
TIGF14	จาบฝนปีกแดง	Rufour-winged Bushlark	*Mirafra assamica*
TIGF15	พิราบป่า	Rock Pigeon	*Columba livia*

Table A-4 Table shows bird species list, population density (individual per km^2) in dry and rainy seasons in all year round 2008 in Phu Khao Tong area, Kang Khoi District, Saraburi Province.

No	Common Name	Scientific Name	Feeding group	Dry season					Rainy season				
				F	Rv	G	Ag	Rs	F	Rv	G	Ag	Rs
1	Chinese Francolin	*Francolinus pintadeanus*	TIGF	20.00	20.00	20.00	25.00	85.71	0.00	0.00	16.67	77.50	20.00
2	Red Junglefowl	*Gallus gallus*	TIGF	16.67	10.00	15.00	10.00	0.00	10.00	0.00	10.00	10.00	0.00
3	Lesser Whistling-Duck	*Dendrocygna javanica*	P	0.00	20.00	0.00	20.00	0.00	0.00	11.67	0.00	0.00	30.00
4	Fulvous-breasted Woodpecker	*Dendrocopos macei*	BI	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Lineated Barbet	*Megalaima lineata*	AIF	24.00	40.00	37.50	40.00	0.00	22.00	0.00	90.36	10.00	0.00
6	Coppersmith Barbet	*Megalaima haemacephala*	AIF	24.20	12.50	33.33	16.67	10.00	0.00	23.33	33.33	10.00	13.33
7	Indian Roller	*Coracias benghalensis*	TF	0.00	10.00	44.29	28.06	20.69	0.00	0.00	15.10	33.51	0.00
8	Hoopoe	*Upupa epops*	TI	0.00	0.00	12.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	White-throated Kingfisher	*Halcyon smyrnensis*	P	16.67	16.67	20.48	18.57	17.07	0.00	10.56	13.57	30.00	13.89
10	Green Bee-eater	*Merops orientalis*	SwI	0.00	0.00	50.91	71.20	39.16	0.00	0.00	45.08	40.99	34.46
11	Chestnut-headed Bee-eater	*Merops leschenaulti*	SwI	0.00	0.00	13.51	0.00	0.00	0.00	0.00	24.19	0.00	0.00
12	Plaintive Cuckoo	*Cacomantis merulinus*	FGI	0.00	10.00	31.10	20.00	26.67	0.00	0.00	0.00	19.26	11.90
13	Green-billed Malkoha	*Phaenicophaeus chlorophaeus*	FGI	0.00	0.00	10.00	0.00	0.00	20.00	0.00	0.00	0.00	0.00
14	Common Koel	*Eudynamys scolopacea*	FGI	101.25	48.00	54.22	93.33	67.08	15.00	22.00	10.00	20.00	18.00
15	Greater Coucal	*Centropus sinensis*	TF	33.33	40.00	32.81	18.83	0.00	26.00	20.48	52.85	13.27	0.00
16	Asian Palm-Swift	*Cypsiurus balasiensis*	SaI	59.64	246.90	16.67	10.00	72.78	20.00	65.00	0.00	16.10	20.38
17	House Swift	*Apus affinis*	SaI	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	46.76
18	Large-tailed Nightjar	*Caprimulgus macrurus*	SwI	0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00
19	Rock Pigeon	*Columba livia*	TIGF	0.00	0.00	32.62	20.00	365.24	0.00	0.00	0.00	252.90	223.96

No	Common Name	Scientific Name	Feeding group	Dry season					Rainy season				
				F	Rv	F	Rv	F	Rv	F	Rv	F	Rv
20	Spotted Dove	*Streptopelia chinensis*	TIGF	29.33	38.08	70.31	80.93	152.30	40.00	21.10	51.46	92.16	55.20
21	Red Turtle-Dove	*Streptopelia tranquebarica*	TIGF	0.00	0.00	29.17	37.64	89.13	0.00	0.00	17.56	10.08	24.08
22	Zebra Dove	*Geopelia striata*	TIGF	0.00	10.56	20.00	53.84	97.83	36.67	0.00	10.81	36.23	121.67
23	White-breasted Waterhen	*Amaurornis phoenicurus*	P	0.00	0.00	0.00	0.00	17.14	0.00	0.00	15.15	0.00	0.00
24	Ruddy-breasted Crake	*Porzana fusca*	P	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.67
25	Common Moorhen	*Gallinula chloropus*	P	0.00	43.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Black-tailed Godwit	*Limosa limosa*	P	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	Black-winged Stilt	*Himantopus himantopus*	P	0.00	88.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	Little Ringed Plover	*Charadrius dubius*	P	0.00	43.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	Red-wattled Lapwing	*Vanellus indicus*	P	10.00	65.77	62.10	61.73	89.50	0.00	20.00	103.02	70.55	53.83
30	Black-shouldered Kite	*Elanus caeruleus*	R	0.00	0.00	0.00	11.11	0.00	0.00	0.00	10.00	10.93	0.00
31	Crested Honey-Buzzard	*Pernis ptilorhyncus*	R	0.00	0.00	0.00	7.50	0.00	0.00	0.00	0.00	0.00	0.00
32	Eastern Marsh-Harrier	*Circus spilonotus*	R	14.29	0.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00
33	Japanese Sparrowhawk	*Accipiter gularis*	R	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	Shikra	*Accipiter badius*	R	20.00	10.00	30.00	10.00	0.00	0.00	0.00	14.29	0.00	0.00
35	Little Grebe	*Tachybaptus ruficollis*	P	0.00	124.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	Little Egret	*Egretta garzetta*	P	0.00	26.22	22.73	0.00	50.00	0.00	16.42	39.33	45.45	21.36
37	Cattle Egret	*Bubulcus ibis*	P	0.00	0.00	30.54	51.39	183.08	0.00	67.14	17.60	0.00	67.82
38	Chinese Pond-Heron	*Ardeola bacchus*	P	0.00	11.77	39.72	28.15	38.92	0.00	0.00	18.76	10.00	94.18
39	Javan Pond-Heron	*Ardeola speciosa*	P	0.00	31.22	16.67	0.00	33.33	0.00	0.00	0.00	0.00	0.00
40	Little Heron	*Butorides striatus*	P	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
41	Cinnamon Bittern	*Ixobrychus cinnamomeus*	P	0.00	0.00	0.00	0.00	0.00	0.00	2.27	6.67	29.25	0.00

No	Common Name	Scientific Name	Feeding group	Dry season					Rainy season				
				F	Rv	F	Rv	F	Rv	F	Rv	F	Rv
42	Asian Openbill	*Anastomus oscitans*	P	0.00	0.00	116.67	0.00	181.25	0.00	0.00	0.00	26.02	29.60
43	Brown Shrike	*Lanius cristatus*	R	0.00	0.00	29.07	23.69	22.92	0.00	0.00	0.00	0.00	10.00
44	Burmese Shrike	*Lanius collurioides*	R	0.00	0.00	0.00	14.58	0.00	0.00	0.00	0.00	0.00	0.00
45	Long-tailed Shrike	*Lanius schach*	R	0.00	0.00	34.17	10.56	0.00	0.00	0.00	30.59	13.92	10.64
46	Rufous Treepie	*Dendrocitta formosae*	FGI	16.67	34.29	21.28	0.00	31.25	0.00	0.00	17.96	0.00	0.00
47	Racket-tailed Treepie	*Crypsirina temia*	FGI	16.67	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00
48	Large-billed Crow	*Corvus macrorhynchos*	TF	10.00	0.00	0.00	16.67	12.14	0.00	0.00	0.00	0.00	0.00
49	Ashy Wood-swallow	*Artamus fuscus*	IN	0.00	30.00	0.00	23.06	28.33	0.00	20.00	112.57	0.00	115.82
50	Pied Fantaill	*Rhipidura javanica*	SwI	14.29	47.92	51.58	23.28	42.67	10.00	38.52	76.98	83.67	61.86
51	Ashy Drongo	*Dicrurus leucophaeus*	SwI	0.00	0.00	0.00	12.50	0.00	0.00	0.00	0.00	0.00	0.00
52	Black Drongo	*Dicrurus macrocercus*	SwI	66.42	38.21	126.70	119.42	232.97	15.64	42.74	140.99	74.60	47.92
53	Crow-billed Drongo	*Dicrurus annectans*	SwI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00
54	Brozed Drongo	*Dicrurus aeneus*	SwI	0.00	0.00	42.22	0.00	0.00	0.00	0.00	0.00	10.64	0.00
55	Hair-crested Drongo	*Dicrurus hottentottus*	SwI	232.31	97.34	116.34	35.48	0.00	75.93	46.17	70.33	10.00	23.81
56	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	SwI	34.82	25.33	45.00	0.00	0.00	27.91	19.03	10.00	0.00	0.00
57	Asian Paradise-flycatcher	*Terpsiphone paradisi*	SwI	14.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	Common Iora	*Aegithina tiphia*	FGI	20.00	0.00	41.59	25.00	0.00	10.00	0.00	0.00	0.00	27.24
59	Blue Rock-Thrush	*Monticola solitarius*	SwI	0.00	0.00	16.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	Asian Brown Flycatcher	*Muscicapa dauurica*	SwI	81.31	0.00	20.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00
61	Red-throated Flycatcher	*Ficedula parva*	SwI	70.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62	Verditer Flycatcher	*Eumyias thalassina*	SwI	25.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63	Siberian Rubythroat	*Luscinia calliope*	TI	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

No	Common Name	Scientific Name	Feeding group	Dry season					Rainy season				
				F	Rv	F	Rv	F	Rv	F	Rv	F	Rv
64	Oriental Magpie-Robin	*Copsychus saularis*	FGI	30.00	0.00	0.00	25.00	43.94	30.00	20.00	35.71	0.00	45.70
65	Siberian Stonechat	*Saxicola torquata*	SwI	0.00	0.00	17.72	46.12	39.39	0.00	0.00	15.63	26.67	0.00
66	Vinous-breasted Starling	*Sturnus burmannicus*	TIGF	0.00	0.00	0.00	0.00	33.33	0.00	0.00	0.00	0.00	0.00
67	Black-collared Starling	*Sturnus nigricollis*	TIGF	0.00	10.00	33.33	21.11	29.79	0.00	20.00	54.11	22.22	20.00
68	Common Myna	*Acridotheres tristis*	TIGF	0.00	0.00	0.00	0.00	169.25	0.00	0.00	0.00	50.02	88.54
69	White-vented Myna	*Acridotheres javanicus*	TIGF	0.00	0.00	0.00	70.00	144.63	0.00	0.00	0.00	71.43	133.40
70	Asian House-Martin	*Delichon dasypus*	SaI	0.00	155.00	25.00	20.00	17.14	0.00	0.00	0.00	0.00	0.00
71	Barn Swallow	*Hirundo rustica*	SaI	55.00	361.04	415.19	274.96	167.08	0.00	110.00	52.14	163.25	64.16
72	Red-rumped Swallow	*Hirundo daurica*	SaI	0.00	105.83	0.00	15.56	0.00	0.00	0.00	0.00	0.00	0.00
73	Black-crested Bulbul	*Pycnonotus melanicterus*	AIF	75.63	0.00	20.00	0.00	0.00	20.31	0.00	0.00	0.00	0.00
74	Sooty-headed Bulbul	*Pycnonotus aurigaster*	AIF	106.98	112.51	233.92	165.67	134.85	39.41	98.05	176.85	177.80	184.77
75	Yellow-vented Bulbul	*Pycnonotus goiavier*	AIF	0.00	0.00	27.78	0.00	36.67	0.00	0.00	0.00	0.00	37.04
76	Streak-eared Bulbul	*Pycnonotus blanfordi*	AIF	240.55	114.11	295.47	56.12	341.13	18.91	63.61	97.91	106.06	65.33
77	Rufescent Prinia	*Prinia rufescens*	FGI	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	Grey-breasted Prinia	*Prinia hodgsonii*	FGI	0.00	0.00	50.00	0.00	0.00	0.00	0.00	45.45	0.00	0.00
79	Yellow-bellied Prinia	*Prinia Flaviventris*	FGI	0.00	0.00	44.64	0.00	0.00	0.00	0.00	101.01	0.00	0.00
80	Plain Prinia	*Prinia inornata*	FGI	0.00	32.81	54.17	27.50	135.40	0.00	23.81	97.35	74.45	43.15
81	Zitting Cisticola	*Cisticola juncidis*	FGI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	71.43	0.00
82	Common Tailorbird	*Orthotomus sutorius*	FGI	17.78	0.00	33.33	25.00	15.00	26.00	0.00	0.00	0.00	0.00
83	Inornate Warbler	*Phylloscopus inornatus*	FGI	75.01	0.00	35.79	45.45	12.50	0.00	0.00	0.00	0.00	0.00
84	White-crested Laughingthrush	*Garrulux leucolophus*	FGI	72.95	0.00	0.00	0.00	0.00	52.08	0.00	0.00	0.00	0.00
85	Lesser Necklaced Laughingthrush	*Garrulux monileger*	FGI	0.00	0.00	0.00	0.00	0.00	16.13	0.00	0.00	0.00	0.00

No	Common Name	Scientific Name	Feeding group	Dry season					Rainy season				
				F	Rv	F	Rv	F	Rv	F	Rv	F	Rv
86	Puff-throated Babbler	*Pellorneum ruficeps*	TI	20.00	0.00	86.11	0.00	50.00	20.00	0.00	0.00	0.00	0.00
87	Yellow-eyed Babbler	*Chrysoomma sinense*	FGI	0.00	0.00	102.78	0.00	0.00	0.00	0.00	41.91	38.46	0.00
88	Singing Bushlark	*Mirafra javanica*	TIGF	0.00	16.67	16.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
89	Oriental Skylark	*Alauda gulgula*	TIGF	0.00	50.00	0.00	0.00	0.00	0.00	0.00	91.91	0.00	0.00
90	Rufour-winged Bushlark	*Mirafra assamica*	TIGF	0.00	0.00	50.56	38.78	51.31	0.00	0.00	52.28	160.98	41.14
91	Plain Flowerpecker	*Dicaeum concolor*	AF	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
92	Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	AF	16.67	10.00	10.00	33.89	37.61	26.90	20.00	53.33	21.67	23.69
93	Brown-throated Sunbird	*Anthreptes malacensis*	IN	0.00	0.00	0.00	0.00	50.00	10.00	0.00	0.00	0.00	55.56
94	Olive-backed Sunbird	*Nectarinia jugularis*	IN	95.57	43.29	10.00	29.17	118.06	30.00	33.89	29.41	36.49	32.15
95	Purple Sunbird	*Nectarinia asiatica*	IN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	116.65	0.00
96	Paddyfield Pipit	*Anthus rufulus*	TI	0.00	0.00	70.44	104.48	143.75	0.00	0.00	40.04	98.13	0.00
97	Olive-backed Pipit	*Anthus hodgsoni*	TI	0.00	0.00	0.00	38.89	0.00	0.00	0.00	23.81	55.99	0.00
98	Red-throated Pipit	*Anthus cervinus*	TI	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99	Plain-backed Sparrow	*Passer flaveolus*	TIGF	0.00	0.00	0.00	25.00	178.59	0.00	0.00	0.00	47.76	71.09
100	Eurasian Tree-Sparrow	*Passer Montanus*	TIGF	0.00	0.00	0.00	0.00	716.94	0.00	0.00	0.00	0.00	786.50
101	Baya Weaver	*Ploceus philippinus*	G	0.00	0.00	0.00	0.00	16.67	0.00	0.00	47.58	21.82	112.55
102	White-rumped Munia	*Lonchura striata*	G	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	29.41	0.00
103	Scaly-breasted Munia	*Lonchura punctulata*	G	0.00	0.00	150.00	0.00	70.81	0.00	0.00	169.40	210.04	67.27

Note: F = forest Rv = reservoir G = = grassland Ag = agricultural field Rs = Residential area

arboreal frugivore (AF), arboreal insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestrial faunivore (TF), terrestrial insectivore (TI), and terrestrial insectivore/granivore/frugivore (TIGF)

Figure A-1 Lesser Whistling Duck

(*Dendrocygna javanica*)

Figure A-2 Fulvous-breasted Woodpecker

(*Dendrocopos macei*)

Figure A-3 Lineated Barbet

(*Megalaima lineata*)

Figure A-4 Coppersmith Barbet

(*Megalaima haemacephala*)

Figure A-5 Indian Roller

(*Coracias benghalensis*)

Figure A-6 Common Hoopoe

(*Upupa epops*)

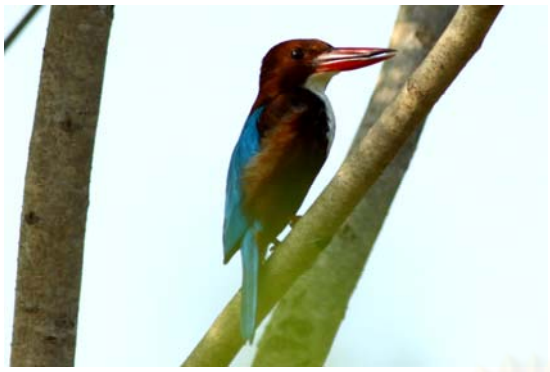

Figure A-7 White-throated Kingfisher

(*Halcyon smyrnensis*)

Figure A-8 Green Bee-eater

(*Merops orientalis*)

Figure A-9 Chestnut-headed Bee-eater

(*Merops leschenaulti*)

Figure A-10 Green-billed Malkoha

(*Phaenicophaeus chlorophaeus*)

Figure A-11 Common Koel

(*Eudynamys scolopacea*)

Figure A-12 Asian Palm-Swift

(*Cypsiurus balasiensis*)

Figure A-13 Spotted Dove

(*Streptopelia chinensis*)

Figure A-14 Zebra Dove

(*Geopelia striata*)

Figure A-15 Black-winged Stilt

(*Himantopus himantopus*)

Figure A-16 Red-wattled Lapwing

(*Vanellus indicus*)

Figure A-17 Crested Honey-Buzzard

(*Pernis ptilorhyncus*)

Figure A-18 Little Egret

(*Egretta garzetta*)

Figure A-19 Chinese Pond-Heron

(*Ardeola bacchus*)

Figure A-20 Asian Openbill

(*Anastomus oscitans*)

Figure A-21 Brown Shrike

(*Lanius cristatus*)

Figure A-22 Burmese Shrike

(*Lanius collurioides*)

Figure A-23 Long-tailed Shrike

(*Lanius schach*)

Figure A-24 Rufous Treepie

(*Dendrocitta formosae*)

Figure A-25 Large-billed Crow

(*Corvus macrorhynchos*)

Figure A-26 Pied Fantaill

(*Rhipidura javanica*)

Figure A-27 Ashy Drongo

(*Dicrurus leucophaeus*)

Figure A-28 Black Drongo

(*Dicrurus macrocercus*)

Figure A-29 Greater Racket-tailed Drongo

(*Dicrurus paradiseus*)

Figure A-30 Common Iora

(*Aegithina tiphia*)

Figure A-31 Asian Brown Flycatcher

(*Muscicapa dauurica*)

Figure A-32 Red-throated Flycatcher

(*Ficedula parva*)

Figure A-33 Verditer Flycatcher

(*Eumyias thalassina*)

Figure A-34 Oriental Magpie-Robin

(*Copsychus saularis*)

Figure A-35 Siberian Stonechat

(*Saxicola torquata*)

Figure A-36 Black-collared Starling

(*Sturnus nigricollis*)

Figure A-37 Common Myna

(*Acridotheres tristis*)

Figure A-38 White-vented Myna

(*Acridotheres javanicus*)

Figure A-39 Black-crested Bulbul

(*Pycnonotus melanicterus*)

Figure A-40 Sooty-headed Bulbul

(*Pycnonotus aurigaster*)

Figure A-41 Yellow-vented Bulbul

(*Pycnonotus goiavier*)

Figure A-42 Streak-eared Bulbul

(*Pycnonotus blanfordi*)

Figure A-43 Yellow-bellied Prinia

(*Prinia Flaviventris*)

Figure A-44 Plain Prinia

(*Prinia inornata*)

Figure A-45 Common Tailorbird

(*Orthotomus sutorius*)

Figure A-46 Inornate Warbler

(*Phylloscopus inornatus*)

Figure A-47 White-crested Laughingthrush

(*Garrulux leucolophus*)

Figure A-48 Lesser Necklaced Laughingthrush

(*Garrulux monileger*)

Figure A-49 Puff-throated Babbler

(*Pellorneum ruficeps*)

Figure A-50 Yellow-eyed Babbler

(*Chrysoomma sinense*)

Figure A-51 Rufour-winged Bushlark

(*Mirafra assamica*)

Figure A-52 Scarlet-backed Flowerpecker

(*Dicaeum cruentatum*)

Figure A-53 Brown-throated Sunbird

(*Anthreptes malacensis*)

Figure A-54 Olive-backed Sunbird

(*Nectarinia jugularis*)

Figure A-55 Purple Sunbird

(*Nectarinia asiatica*)

Figure A-56 Paddyfield Pipit

(*Anthus rufulus*)

Figure A-57 Olive-backed Pipit

(*Anthus hodgsoni*)

Figure A-58 Plain-backed Sparrow

(*Passer flaveolus*)

Figure A-59 Baya Weaver

(*Ploceus philippinus*)

Figure A-60 Scaly-breasted Munia

(*Lonchura punctulata*)

Appendix B

BIRD SPECIES DIVERSITY IN PHU KHAO THONG AREA IN KHANG KHOI DISTRICT, SARABURI PROVINCE

By Mr. Lerson Vasinopas

Advisor: Assoc. Prof Wina Meckvichai

Co-Advisor: Dr. ChatChawan Chaisuekul

3 August 2008 at 1.00-3.00 pm.

Room 121, Biology 1 building, faculty of science, Chulalongkorn University

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Abstract

Bird diversity was compared between five habitats of a land development area in Phu Khao Thong area in Khang Khoi District, Saraburi Province Thailand. The five habitats, characterized by plant species and physical factors, were forest, reservoir, grassland, agricultural field and residential area. We conducted a point count method (Bibby *et al*., 1992) for a total of 12 months (January to December 2008). Birds were observed in 6 minutes per station, which was 100 m. apart, and 10 stations per habitat. Habitat and season affected bird diversity. We found the total bird species at 100 species in every habitat. 57 species were found in dry and rainy season. 33 species were found in dry season only (January-April), while we found 10 species in rainy season only (May-July). The total species of birds in 8 months (January to August) were 37, 51, 65, 60, and 51 and Shannon-Wiener index in 8 month (January to August) were 4.22, 4.51, 4.86, 4.95, and 4.42 in the forest, reservoir, grassland, agricultural field and residential area, respectively. From Soresence's index, two areas that their bird diversities were the most different were forest and residential area at 0.477 and bird diversities were the most similarity were agriculture field and residential area at 0.764.

Key word: Diversity, habitat, disturb

Reference

Bibby, J., Neil D., B., David, A. H. Bird Census Techniques, 1992.

ความหลากหลายชนิดนก ในพื้นที่รอบภูเขาทอง อำเภอแก่งคอย จังหวัดสระบุรี ภายหลังการสร้างอ่างเก็บน้ำ

BIRD SPECIES DIVERSITY IN PHU KHAO TONG AREA KHANG KHOI DISTRICT, SARABURI PROVINCE AFTER RESERVOIR CONSTRUCTION

เลอสรรค์ วศิโนภาส, ชัชวาล ใจซื่อกุล และ วีณา เมฆวิชัย

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บทคัดย่อ: การศึกษาความหลากหลายชนิดนกในพื้นที่ภูเขาทอง อำเภอแก่งคอย สระบุรี ในปี 2551 รวม 12 เดือน พบนกทั้งหมด 103 ชนิด เป็นนกประจำถิ่น 80 ชนิด นกอพยพ 21 ชนิด และนกอพยพผ่าน 2 ชนิด จากการแบ่งกลุ่มนกจากพฤติกรรมการกินอาหารที่พบชนิดนกมากที่สุด 4 กลุ่ม คือ นกกินสัตว์น้ำ นกกินแมลงตามใบไม้ นกร่อนกินแมลงระยะใกล้ และนกกินแมลง เมล็ดพืช และผลไม้ ตามลำดับ หลังการสร้างอ่างเก็บน้ำมีจำนวนชนิดสูงขึ้น 13 จาก 14 กลุ่ม นอกจากนั้นพบพื้นที่กระจายพันธุ์เพิ่มของนกกินปลีดำม่วง (*Nectarinia asiatica*) ซึ่งไม่มีรายงานการกระจายพันธุ์ในภาคกลาง และจำนวนชนิดนกที่เปลี่ยนแปลงไปหลังจากการสร้างอ่างเก็บน้ำนั้น แสดงให้เห็นว่า การเปลี่ยนแปลงแหล่งอาศัยของนกโดยการสร้างอ่างเก็บน้ำอาจเป็นสาเหตุหนึ่งที่มีผลต่อจำนวนชนิดนกที่พบในพื้นที่

Abstract: Bird species diversity in Phu Khao Tong area Khang Khoi District, Saraburi Province, had been studied for 12 months in 2008 after a reservoir had been constructed in this area for 1 year. The total numbers of bird species were 103 species consisting of 80 residential birds, 21 migrated birds and 2 passive migrated birds. From feeding behavior, the highest species richness was found in 4 groups ranking from piscivore to foliage-gleaning insectivore to sweeping insectivore and to terrestrial insectivore/granivore/frugivore, respectively. The species richness of 13 from 14 groups by feeding behavior in post-reservoir construction in this study was higher than pre-reservoir construction from a study in 2005. Moreover, we found a new record of Purple Sunbird (*Nectarinia asiatica)* which had never been previously reported in central Thailand. The disturbance of human activity, such as reservoir construction, may be one of the effects that alter bird diversity.

Introduction: Phu Khao Thong area was previously a national reserve forest and currently undergoes a development under Chulalongkorn University initiative. Majority of the area is

secondary forest mixing between deciduous forest and deciduous dipterocarp forest (Chulalongkorn, 2007). The area covers 549.12 hectare in Khang Khoi District, Saraburi Province, central Thailand adjacent to Khao Yai National park. The Phu Khao Thong area has many native bird species and is on migratory route of birds (Chulalongkorn, 2007). In 2007, a reservoir, approximately 10^7 m^3, was constructed in the area. However, the effect of reservoir construction on bird diversity in this area was unknown. Therefore, we studied the bird diversity in post-reservoir construction comparing to the data from 2005 in pre-reservoir construction in the Phu Khao Thong area.

Methodology: Bird diversity in the Phu Khao Thong area was surveyed monthly in 2008 using point count method. In each one of five routes, birds were observed in 6 min at each of ten stations with 100 m apart along 1 km. Birds were identified to species using A guide to the bird of Thailand (Lekagul and Round 1991). Then, birds were categorized into 3 residential status which are residential, migratory, and passive migratory birds (Lekagul and Round 1991), and 14 feeding behaviors, which are arboreal frugivore (AF), insectivore/frugivore (AIF), bark-gleaning insectivore (BI), foliage-gleaning insectivore (FGI), grainivore (G), insectivore/nectarivore (IN), piscivore (P), raptor (R), sweeping insectivore (SwI), sallying insectivore (SaI), terrestial fauniore (TF), arborel terrestrial insectivore (TI) and terrestrial insectivore/granivore/frugivore (TIGF) (Kobkate, 1998). The bird diversity in post-reservoir construction was compared with the data from 2005 (Chulalongkorn, 2007) in pre-reservoir construction which birds were observed 4 times over a year.

Results discussions and conclusions: The total numbers of bird species were 103 species consisting of 80 residential birds, 21 migrated birds and 2 passive migrated birds [Figure 1]. The top three residential birds by density were Eurasian Tree Sparrow (*Passer montanus*), Sooty-headed Bulbul (*Pycnonotus aurigaster*), Black Drongo (*Dicrurus macrocercus*), respectively. The top three migratory birds by density were Barn Swallow (*Hirundo rustica*), Asian House Martin (*Delichon dasypus*) and Yellow-browed Warbler (*Phylloscopus inornatus*), respectively. The only two passive migrated birds were Japanese Sparrowhawk (*Accipiter gularis*), Crow-billed Drongo (*Dicrurus annectans*).

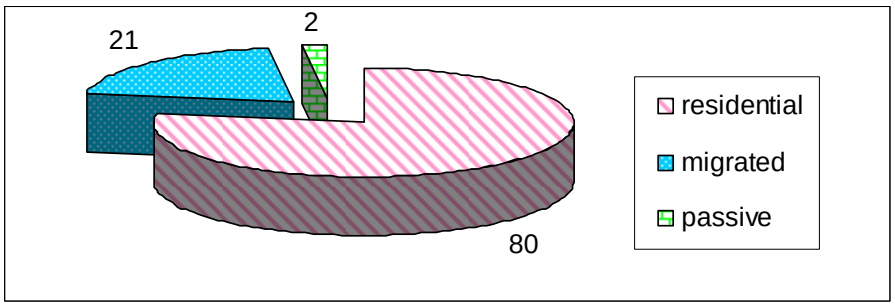

Figure 1 Number of bird species in each residential status in the Phu Khao Thong area surveyed monthly in 2008 using point count method.

The highest species richness was found in 4 groups ranking from piscivore to foliage-gleaning insectivore to sweeping insectivore and to terrestrial insectivore/granivore/frugivore, respectively (Kobkate, 1998, Kobkate, 1999, Kobkate, 2000, Kobkate, 2001a, Kobkate, 2001b, Uttaruk, 2002.) [Figure. 2]. The prominent species of the above 4 groups were piscivore such as Heron species (*Ardeola spp.*), foliage-gleaning insectivore such as Prinia species (*Prinia spp.*), sweeping insectivore such as Black Drongo (*Dicrurus macrocercus*), and terrestrial insectivore/granivore/frugivore such as Eurasian Tree Sparrow (*Passer montanus*).

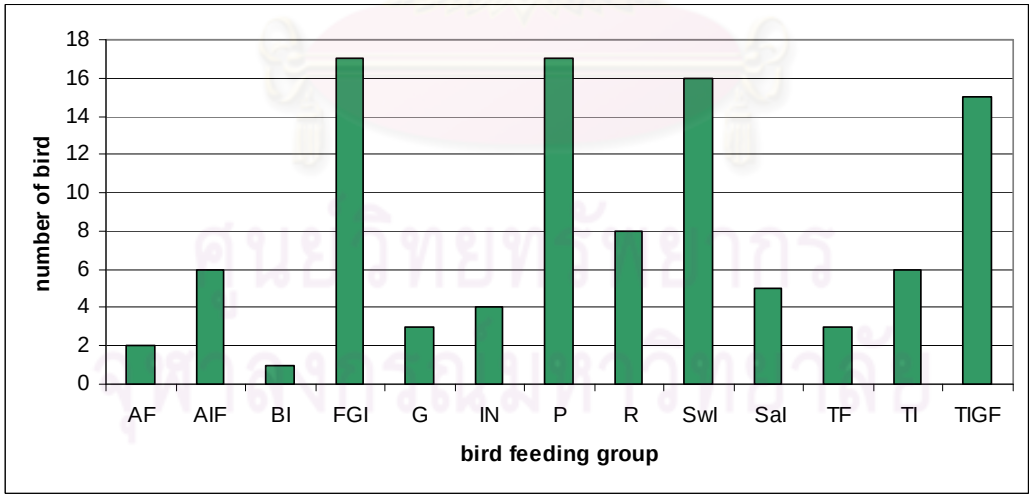

Figure 2 Number of bird species in each feeding group in the Phu Khao Thong area surveyed monthly in 2008 using point count method.

Comparing to the data from 2005 (38 species in pre-reservoir construction), more bird species were found in 2008 (103 species in post-reservoir construction). Every group by feeding behavior except arborel insectivore/frugivore was increasing, particularly foliage-gleaning insectivore, piscivore, sweeping insectivore and terrestial insectivore/granivore/frugivore [Figure 3].

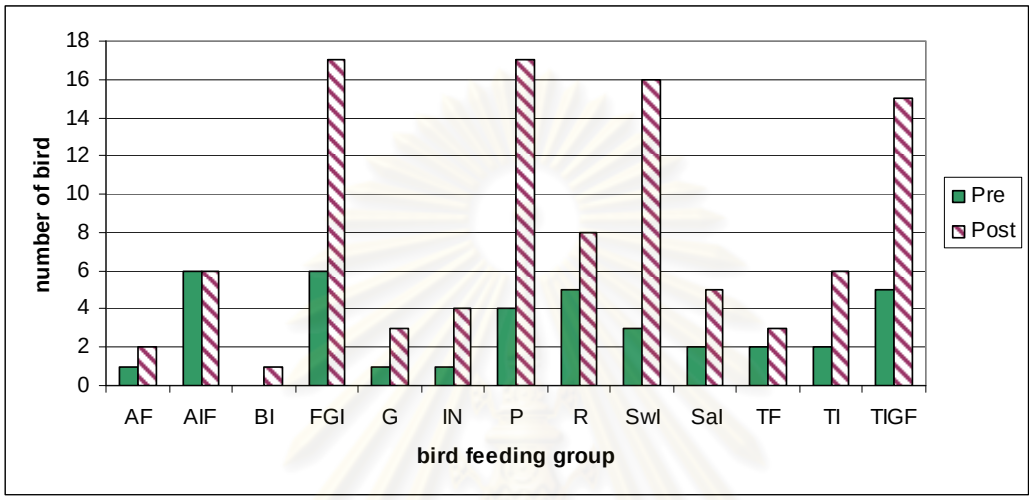

Figure 3 Comparison between number of bird species in each feeding group in pre- (2005) and post- (2008) reservoir construction in the Phu Khao Thong area.

Moreover, we found a new record of Purple Sunbird (*Nectarinia asiatica*) which had never been previously reported in central Thailand [Figure 4].

Figure 4 left Purple Sunbird (*Nectarinia asiatica*) in Phu Khao Thong area and right drawing of Purple Sunbird (*Nectarinia asiatica*) (Lekagul, B. and Round, P.D.,1991.)

From this study, we found more bird species in post-reservoir construction than pre-reservoir construction, partially due to increasing of habitat for piscivore feeding in reservoir

and sweeping insectivore feeding off insect along the shore of the reservoir. However, higher species richness may be caused by more extensive observation in 2008 than in 2005, such as Fulvous-breasted Woodpecker (*Dendrocopos macei*) (BI), and Bushlark spp. (*Mirafra spp.*) (TIGF) [Figure 4]

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BIOGRAPHY

Lerson Vasinopas was born on February 12, 1984, graduated in high school level from Chulalongkorn University Demonstration School, Bangkok in 2001. In 2005, he graduated in the Bachelors Degree in Biology from the faculty of Science, Chulalongkorn University and majoring Biology. Then, he continued in Master Degree of Science, Chulalongkorn University. During the Master Degree education, received research support scholarship from the Research Program on Conservation and Utilization of Biodiversity and the Center of Excellence in Biodiversity, Faculty of Science, Chulalongkorn University (CEB_M_47_2008) and partially supported by CU.GRADUATE SCHOOL THESIS GRANT, Chulalongkorn University.

Accomplishments & Activities

1. Vasinopas, L. Oral presentation in titled Bird species diversity in Phu Khao Thong area in Khang Khoi, Saraburi province, at Biological Science Graduated Congress National University of Singapore 13th, Singapore during December, 15-17, 2008.
2. Vasinopas L. Oral presentation in titled Bird species diversity in Phu Khao Thong area Kang Khoi district, Saraburi province, at The 35th Congress on Science and Technology of Thailand (STT35), at The Tide Resort Chonburi, Thailand during October, 15-17, 2009.
3. Vasinopas, L. Bird in civilization aspect. Meckvichai, W. (ed) Instruction manual of Green Peafowl conservation for yuth. Department of Biology, Faculty of Science, Chulalongkorn University. (in Thai), 2008.
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5. Teacher assistant of Assoc. Prof. Wina Meckvichai for the classes of Vertebrate (2008), Ornithology, Bird watching and Conservation and Basic Anatomy, Assoc. Prof. Naiyana Chaiyabud for the class of Comparative Anatomy and Assoc. Prof. Wichase Khonsue for class of vertebrate (2009) and Herpetology in department of Biology, Faculty of Science Chulalongkorn University, during 2008-2009.