



Assessment of Plant Species Diversity and Wildlife in Pindaya Township, Shan State, Myanmar

REDD+ Himalaya: Developing and
using experience in implementing
REDD+ in the Himalaya

Assessment of Plant Species Diversity and Wildlife in Pindaya Township, Shan State, Myanmar

REDD+ Himalayas: Developing and using experience in
implementing REDD+ in the Himalayas

Editors

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Executive Summary

Myanmar is one of the world's biodiversity hotspots; however, the diversity is rapidly decreasing because of deforestation, shifting cultivation, population growth, increased resource utilization, and similar factors. For this reason, the ongoing ICIMOD REDD+ Project started in March 2016 aiming to strengthen the capacity of the government staff as well as other relevant stakeholders and to develop instruments in preparation for REDD+ Readiness by undertaking and identifying gaps in the readiness phase. Forest Department (FD) and ICIMOD: REDD+ implementation programmes have been recognizing sustainable forest development, biodiversity conservation, social safeguard, and local livelihood enhancement. Species diversity takes a critically important role in all ecosystems. Habitat loss, forest degradation, deforestation, and land use changes are main factors for biodiversity loss. Biodiversity conservation is one of the main activities of the project, so this study is designed to record the distribution and abundance of native flora and wildlife, particularly birds and butterfly diversity.

The research activities were carried out in community forests of four villages, namely, Pwe Hla, Shar Pyar, Shouk Pin, and Nan Kone of the Pindaya Township, Taunggyi District, Southern Shan State, during December 2017 and January 2018. Plant species identification and specimen collection were carried out through forest inventory and systematic botanical studies. The project team studied flora habitat, and surveyed plants and assessed their conservation status, in the highland around the study areas. The ecological linkage between and among the plant species and a quantitative estimate of plant species diversity of the study areas were also investigated. The quantitative estimate of plant species diversity and ecological linkage between and among species are assessed by using standardized line transect method of 100 x 5 m (10 subplots of 10 x 5 m). In the plots, we recorded occurrence data for all the vascular plant species including trees, shrubs, herbs, climbers, and epiphytes.

Including those plants that were found in the study plots, a total of 278 specimens of plants, 64 species from 27 families and 41 genera, were identified in this study. The main findings of the study provide information on the distribution and abundance of native flora in the study areas. It also informs people of actions they can take on their properties to help conserve these plants. Based on overall results of the different research activities, it would help suggest appropriate means, ways and recommendations for sustainable conservation of plant species diversity of the study areas. The results of the research would contribute to updating the flora in Myanmar.

As a result, 94 bird species, 69 genera, 43 families, and 13 orders were observed in total by using transects. Among the species recorded, Green Peafowl and Javan Myna were observed to be listed under the IUCN Red List as Endangered (EN) and Vulnerable (NT), respectively, and Red-billed Blue Magpie under eBird as a sensitive species. By status, 69 residents, 21 winter visitors, 1 breeding visitor, 1 introduced species, and 2 status-unknown species were found in these study areas. Order Passeriformes has the highest species numbers, amounting to 65 species while other orders have 5 or fewer species. For butterfly species, there were 20 species, 17 genera, and 4 families in Nan Kone Community Forest area. As with other fauna surveys, we conducted interviews with key informants where, in general, one can find muntjac, porcupine, marten, jungle cat, squirrels, Siamese hare, and tortoise. Inlay Carp were recognized as endemic and endangered, and Himalayan Newts were found in Pwe Hla Lake.

Concerning biodiversity conservation, monks, village tracts, and young people are involved in protecting their community forests for a variety of purposes and also biodiversity conservation activities. Moreover, they formulate internal rules for protecting forests and animals. Most interesting, an environmental organization called Pwe Hla Environment Conservation and Development Organization performs environmental conservation activities by themselves and with the support of many organizations. Sustainable conservation cannot be done alone; it needs the whole involvement of all stakeholders. We still need to enhance the local community's awareness of environmental conservation and sustainable management through awareness raising activities and capacity building programmes. We hope that this biodiversity survey will fulfill the requirements of FD biodiversity conservation and the ICIMOD-FD REDD+ programme.

Background

Myanmar is a country situated in continental Southeast Asia, between 10° and 29° N latitude and 92° and 101° E longitude. Myanmar is rich in floral and faunal diversity, from the mangrove forests and coral reefs of the Andaman Islands in the south, to the snow-capped peaks of Mount Kakaboradzi (5,881 m), the highest mountain in Southeast Asia, in the north. Myanmar, with an area of 676,577 km², extends 936 km from east to west and 2,051 km from north to south. It shares boundaries with China in the north, and the eastern hills region. The general profile of the country rises from the sea level along the north, with Laos and Thailand to the east, and with Bangladesh and India in the west. The Andaman Sea and the Bay of Bengal edge the Myanmar coast in the south and the west. Topographically, Myanmar can be roughly divided into four parts: the western mountains, the central plains, the eastern highlands and the southern coasts. Myanmar's terrain ranges from plains in the south to the snow-capped mountains towering with the highest elevation of around 6,000 masl in the northern tip of the country near the China border.

Myanmar is drained by many river systems and most flow from the north to the south. The main rivers are Ayeyarwaddy, Thanlwin, Chindwin, and Sittaung. Myanmar typically features a tropical monsoon climate. The climate in some parts of the country, however, is locally modified by topography. In most parts of Myanmar, there are three well-defined seasons: the rainy season (mid-May to October), the cold season (November to January), and the hot season (February to mid-May). Nonetheless, the rainfall patterns and temperature distributions are quite diverse throughout the country. The coastal regions receive more than 5,000 mm of annual rainfall whereas the central part of Myanmar has an annual rainfall of less than 1,000 mm. In addition, the average highest temperature in the central region during the hot season of March and April rises to above 43.3°C while in the northern mountainous parts of the country, it is about 36°C and on the eastern Shan Plateau, it is between 29.4°C and 35°C.

As a result of the great variations in rainfall, temperature, and topography, there are many forest types in Myanmar. Tropical evergreen forests occur in many places of the highest rainfall zone, especially in the southern part of the country. Hill and moist forests are found in the eastern, northern, and western parts, where the elevation exceeds 900 m. The forest type changes into deciduous, then into dry forests towards the middle of the country as a result of low rainfall. Mangrove forests are characteristic of the coastal areas.

Myanmar is one of the world's biodiversity hotspots; however, the diversity is rapidly decreasing because of deforestation, shifting cultivation, population growth, increased resource utilization, and similar factors.

The ongoing ICIMOD REDD+ Project started in March 2016 aiming to strengthen the capacity of the government staff as well as other relevant stakeholders and to develop instruments in preparation for REDD+ Readiness by undertaking and identifying gaps in the readiness phase. FD and ICIMOD: REDD+ implementation programmes have been recognizing sustainable forest development, biodiversity conservation, social safeguard, and local livelihood enhancement.

Biodiversity conservation is one of the project activities undertaken to support REDD+ environmental safeguard. In this regard, plant diversity assessment and wildlife survey, particularly birds and butterfly, were conducted to document the current status of plant and wildlife species diversity of the study area.

Biodiversity Richness in Myanmar

Myanmar is one of the 25 biodiversity hotspots of the world (Myers, 2016, and about 42.96% of the country's total land is forested (FAO, 2018). The Himalaya in the north, coral reefs and lowland forests in the south, and extensive river systems contribute to its complex network of ecosystems and high biodiversity. According to the National Biodiversity Strategy and Action Plan (NBSAP, 2015), varied forest types of Myanmar are home to several mammals, reptiles, avifauna, amphibians, fish, and plant species (Table 1). Myanmar, therefore, represents an important biodiversity reservoir in Asia. Furthermore, Myanmar possesses numerous endemic wild flora and fauna (Table 2).

Table 1: Biodiversity richness in Myanmar

Taxonomic group	Species	Number
Species of vascular plants of gymnosperms and angiosperms		11,800
Mammals		258
Bird species		1,056
Reptiles	Snakes	153
	Lizards	87
	Turtles and tortoises	32
Amphibians	Frogs and toads	79
	Caecilians	2
	Salamander	1
Freshwater fish		310
Marine water fish		465
Medicinal plant		841
Bamboo		96
Rattan		37

Table 2: Some endemic species of Myanmar

Taxonomic group	Common name	Scientific name
Mammals	1. Golden Deer	<i>Cervus eldi thamin</i>
Birds	1. Black-browed Tit	<i>Aegithalos bonvaloti sharpie</i>
	2. Burmese Bushlark	<i>Mirafra microptera</i>
	3. White-browed Nuthatch	<i>Sitta victoriae</i>
	4. White-throated Babbler	<i>Turtoides gularis</i>
	5. Hooded Treepie	<i>Crypsirina cucullata</i>
	6. White-bellied Minivet	<i>Pericroctus erythropygius</i>
Reptiles	1. Burmese Star Tortoise	<i>Geochelone platynota</i>
	2. Rakhine Forest Turtle	<i>Heosemys depressa</i>
	3. Burmese Roofed Turtle	<i>Batagur (Kachuga) trivitta</i>
	4. Burmese Eyed Turtle	<i>Morenia ocellata</i>
	5. Burmese Frog-faced Softshell Turtle	<i>Chitra vandijki</i>
	6. Burmese Peacock Softshell Turtle	<i>Nilssononia formosa</i>
	7. Burmese Flagshell Turtle	<i>Lissemys scutata</i>
Plants	1. Black Orchid	<i>Paphiopedilum wardii</i>
	2. Thawkagyi	<i>Amherstia nobilis</i>
	3. Meadow	<i>Potentilla montisvictoriae</i>
	4. Ground Orchid	<i>Roscoea australis</i>
	5. Rhododendron	<i>Rhododendron burmanicum</i>
	6. Taung Thabye	<i>Tristania burmanica</i>
	7. Taung Tama	<i>Melia burmanica</i>
	8. Te	<i>Diospyros burmanica</i>

To date, 40 protected areas (PAs) which amount to 9,681,672.35 acres (15,127.61 square miles and 5.79% of total country area) have been established across the country for biodiversity conservation. Furthermore, 11 areas covering 3,227,547.165 acres (5,043.04 square miles, 1.94% of the total country area) have been proposed as PAs, and the gazettation process is being implemented.

Table 3 shows the number and area coverage of PAs in each state and region, and Table 4 shows the list of proposed PAs.

Table 3: List of established protected areas (PAs) in Myanmar

State/Region	Number of PAs	Total Area	
		Acres	Square miles
Kachin State	7	3,948,694.00	6,169.83
Kayin State	2	73,920.00	115.50
Chin State	2	208,474.00	325.78
Sagaing Region	5	3,711,936.37	5,799.89
Tanintharyi Region	3	482,765.73	754.32
Bago Region	2	268,538.48	419.59
Magway Region	3	116,142.91	181.48
Mandalay Region	5	112,379.14	175.59
Mon State	2	44,148.47	68.98
Rakhine State	1	433,843.20	677.88
Yangon Region	1	1,540.00	2.41
Shan State	5	245,296.45	383.27
Ayeyarwaddy Region	2	33,993.60	53.12
Total	40	9,681,672.35	15,127.61

Source: Forest Department (2018)

Table 4. List of proposed protected areas (PAs) in Myanmar

State/Region	Number of PAs	Total Area	
		Acres	Square miles
Kayah State	1	57,772.00	31.15
Chin State	4	71,692.00	76.01
Shan State	3	34,744.00	54.28
Sagaing Region	2	11,106.00	17.35
Magway Region	1	30,700.00	47.97
Total	11	206,014.00	322.79

Source: Forest Department (2018)

REDD+ in Myanmar

Myanmar is a signatory to the UNFCCC, having ratified the convention in November 1994 and signed the Kyoto Protocol in 2003. The government of Myanmar, together with many key stakeholders, is aware of the causes and potential impacts of climate change and is striving to reduce its greenhouse gas emissions and contribute to climate change mitigation.

REDD+ is a major opportunity for tropical forest conservation. Myanmar has recognized that REDD+ is an innovative concept, and Myanmar is also aware of REDD+ as a mechanism to create an incentive for developing countries to protect, better manage, and wisely use their forest resources, contributing to the global fight against climate change.

Decision 1/CP.16 taken during COP16 in Cancun requests countries to have the following elements in place for REDD+ implementation and to access results-based payments/results-based finance:

- National Strategy (NS) or Action Plan (AP)
- National Forestry Monitoring System (NFMS)
- Safeguard Information System
- Forest Reference Emission Levels (FREL) and/or Forest Reference Levels (FRL)

Given the technical and procedural complexity involved in the implementation of the REDD+ activities, Myanmar has been implementing REDD+ through three phases: readiness, implementation, and results-based actions. Figure 1 provides more details on each step of the process.

Within this context, Myanmar recognizes the following non-carbon benefits when REDD+ activities are implemented with safeguards:

- Enhancement of local livelihoods
- Increase in the value of biodiversity
- Better ecosystem services to people and environment
- More resilient ecosystems for climate change adaptation
- Improved governance, institutional setup, and policies for natural resource management at local to national levels
- Contributions to SDGs and NDC

Objectives

The objectives of the study were:

- To record the distribution and abundance of plant species and wildlife/wild animals, and
- To observe the species diversity and make the checklist of the flora in Pindaya area.

Structure of the Report

This report is composed of two components, namely, tree species diversity and wildlife (birds and butterflies) diversity. Due to the different nature of flora and fauna, different methodologies were applied to collect the data. For clarity, methodology and results of tree species diversity assessment and wildlife survey are presented separately.

Tree Species Diversity

Introduction

Myanmar is one of the biodiversity hotspots in the world; however, the diversity is rapidly decreasing because of deforestation, shifting cultivation, population growth, increased resource utilization, and similar factors. For this reason, the ongoing ICIMOD REDD+ Project started in March 2016 aiming to strengthen the capacity of the government staff as well as other relevant stakeholders and to develop instruments in preparation for REDD+ Readiness by undertaking and identifying gaps in readiness phase. FD and ICIMOD: REDD+ implementation programmes have been recognizing sustainable forest development, biodiversity conservation, social safeguard, and local livelihood enhancement. Species diversity takes a critically important role in all ecosystems. Habitat loss, forest degradation, deforestation, and land use changes are the main factors for biodiversity loss. Biodiversity conservation is one of the main activities of the project, so this study is designed to record the distribution and abundance of native flora and wildlife, particularly birds and butterfly diversity.

The research activities were carried out in community forests of four villages, namely, Pwe Hla, Shar Pyar, Shouk Pin, and Nan Kone of the Pindaya Township, Taunggyi District, Southern Shan State, during December 2017 and January 2018.

There are various approaches for the biodiversity monitoring protocol depending on the scale and scope. Biodiversity monitoring can be conducted in accordance with different levels such as landscape level, ecosystem level, species level, and genetic level. However, due to the time limitations, two approaches were proposed by Yahara et al., (2012): specimens-based approach and transect-based approach.

Materials and Methods for Tree Species Diversity Assessment

Study area

The preliminary field surveys were conducted within the surrounding areas of the Pwe Hla, Nan Kone, Shar Pyar, and Shouk Pin villages which are located in Pindaya Township, Southern Shan State (Figure 1). The geographic

Table 5: Various approaches for the biodiversity monitoring protocol (depending on the scale)

Biodiversity Level	Area of Interest	Key Priorities
Landscape Level	<ul style="list-style-type: none"> Identity, distribution, and proportions of each type of habitat, trends, and distribution of species within those habitats Landscape diversity, connectivity, and fragmentation Disturbance, energy flow, geomorphic, hydrologic process, and land-use changes 	<ul style="list-style-type: none"> Biodiversity hotspots, corridors, and connectivity Rare or threatened habitats (globally, regionally, nationally) Features of high socioeconomic and cultural importance (e.g., grazing lands, touristic landscapes, sacred areas) Climate refugia (macrorefugia and microrefugia)
Ecosystem Level	<ul style="list-style-type: none"> Richness, evenness, and diversity of communities species, and guilds Distribution of key physical and biological features Response to disturbance 	<ul style="list-style-type: none"> Rare, threatened, and critical habitats (regionally, nationally, locally) Habitats of specific importance (e.g., large, highly natural forest) Specific species community Forest cover dynamics Biomass productivity
Species Level	<ul style="list-style-type: none"> Abundance, density, and biomass of each population Population dynamics Dispersion/Migration Regeneration and growth 	<ul style="list-style-type: none"> Globally threatened species (i.e., on IUCN Red Lists) Significant populations of rare, endemic, or otherwise nationally or regionally threatened species Faunal species, specific plants
Genetic Level	<ul style="list-style-type: none"> Genetic diversity of individual organisms within a population Gene of special importance 	<ul style="list-style-type: none"> Endemic species Rare and threatened species Species with low populations Characteristic species

Source: ICIMOD. Presented at the Workshop on REDD+ and SDGs held December 2017 at the Forest Research Institute, Yezin, Myanmar.

location of the study area ranges from the north latitude 20° 47' N and 21° 06' and east longitude 96° 41' E and 96° 39' with altitudinal ranges from 1,400 to 1,490 m above sea level. Specifically, the forest inventory and wildlife/wild animal survey were conducted at the highland watershed areas of Pwe Hla Community Forest, Shar Pyar Community Forest, and Shouk Pin and Nan Kone Monastery Reserved Forest during the December 2017 and January 2018 (Figures 2, 3, and 4).

Figure 1: Location map of study area

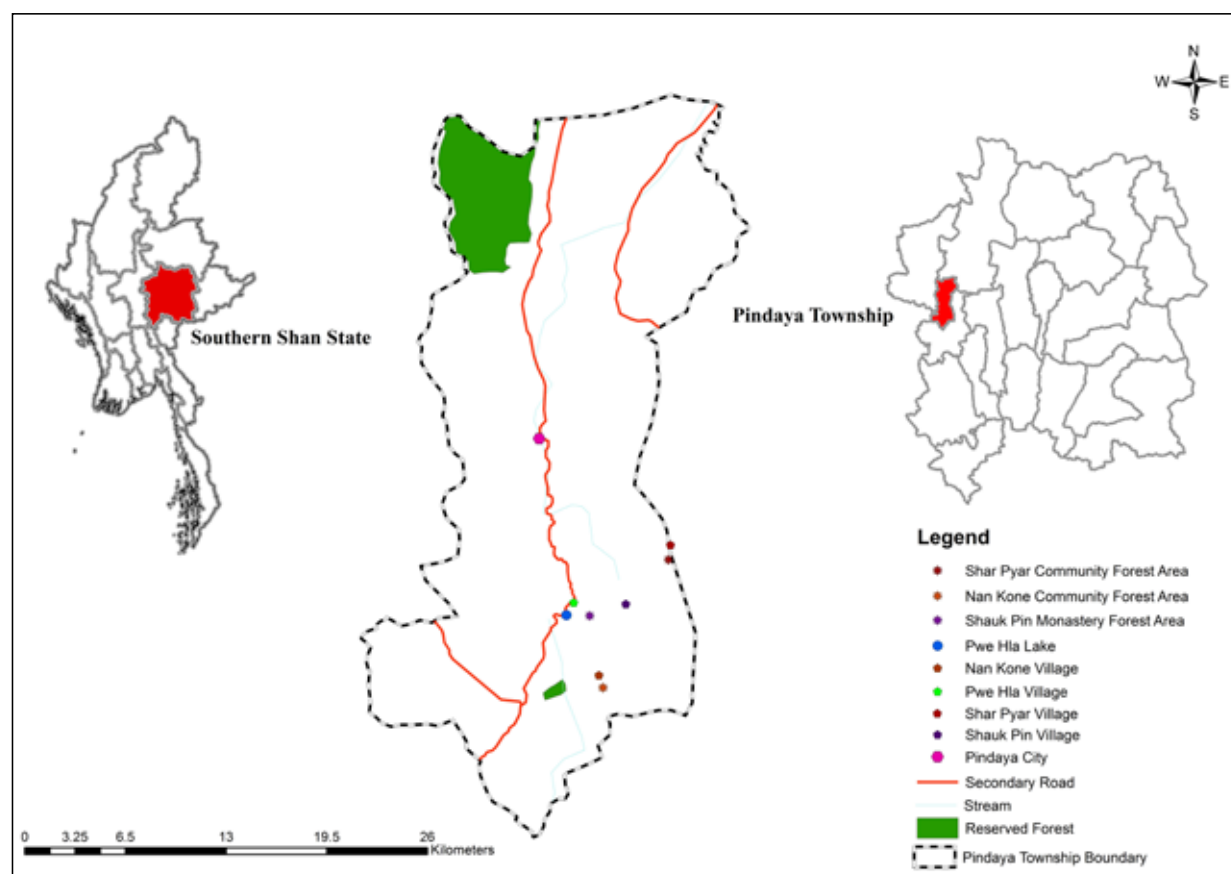


Figure 2: Shouk Pin Community Forest



Figure 3: Nan Kone Community Forest



Tree species monitoring

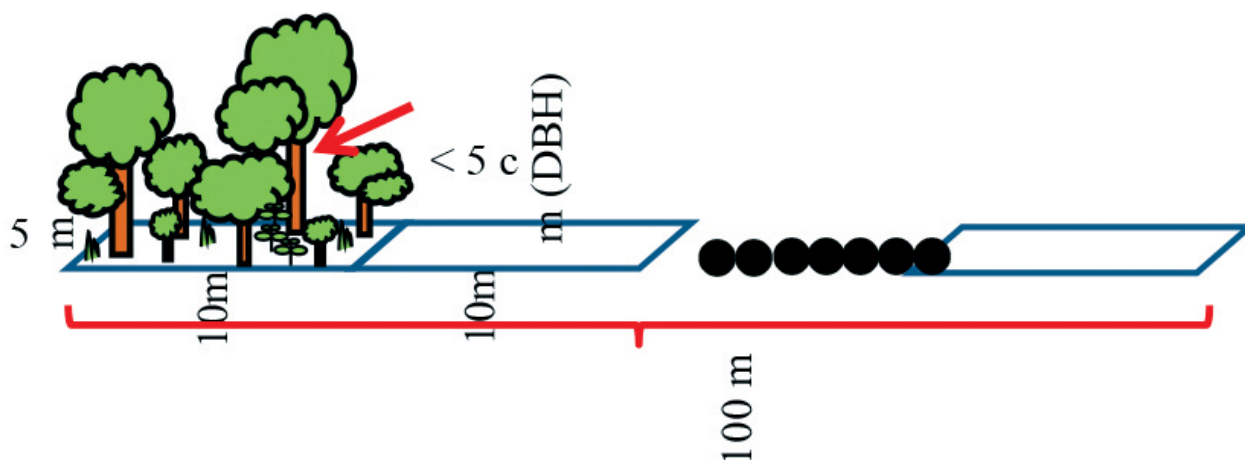
A standardized belt-transect method, a 100 m x 5 m belt transect is used as a standard unit of observation (Yahara et al., 2012). One transect is divided into 10 plots of 10 m x 5 m, and all the vascular plant species in each section are distinguished and recorded as field names because it is difficult to accurately identify them in the field to taxonomic species. All tree species greater than 5 cm in diameter at breast height (DBH) were recorded.

The plots were distributed along transects that range from 1 km to 1.6 km which were laid parallel to the slope. In total 10 transects of study areas were set up. Within each main plot, 10 small plots of 10 m x 5 m were laid, two at the corners (Figure 5).

Figure 4: Shar Pyar Community Forest



Figure 5: Layout of sample plots



Diversity analyses

Data was analyzed using MS Excel 2007. Shannon index (H'), Evenness ($E\%$) (Pielou 1969), and Simpson's index (D) (Magurran 1988) were calculated for this study:

- Simpson's Diversity Index**

$$D = \sum_{i=1}^s \frac{n_i (n_i - 1)}{N (N - 1)}$$

where,

D = Simpson's index of diversity

n_i = number of individuals of species "i" in the sample

s = number of species in the sample

N = total number of species in the sample

- Shannon Diversity Index**

$$H' = - \sum_{i=1}^s P_i \ln(P_i)$$

where,

H' = index of species diversity

S = number of species in the sample

P_i = proportion of total sample belonging to "ith" species

I = the theoretical maximum value of diversity by a given number of total species (S) found in the sample.

$$H_{\max} = \ln k$$

k = total number of species

- Evenness**

$$E(\%) = 100 \cdot H' / H_{\max}$$

where,

E = Shannon's Evenness

H' = Shannon-Wiener function

H_{\max} = Maximum possible diversity

Results and discussion

Tree species diversity

As the result of this preliminary field work and identifications of these materials collected, we have so far confirmed the presence of a total of 64 species from 27 families and 41 genera to be presented in this study (Table 6). The 10 most common species found in the study areas were Khansue (*Carissa spinarum* A. DC.), Thit Poke (*Celtis tetrandra* Roxb.),

Taw Kant Kaw (*Litsea glutinosa* (Lour.) C.B. Rob.), Taung Kular (*Sapium insigne* (Muell. Arg.) Trimen), Htinyu (*Pinus khasya* Royle ex Parl.), Karaway (*Cinnamomum* sp.), Burmese rosewood (*Dalbergia* sp.), Pone-na-yeik (*Ixora coccinea* L.), Yenin (*Pittosporum napaulensis* (DC.) Rehder & Wilson), and Thit Ma (*Cephalanthus occidentalis*).

Khansue (*Carissa spinarum* A. DC.) was the most dominant species, which represent about 10% of the total individuals, while Thit Poke (*Celtis tetrandra* Roxb.) was the second most dominant species, representing about 9% of the total individuals (Figure 6). Families that are represented by the largest number of individuals are Lauraceae, Apocynaceae, Ulmaceae, Euphorbiaceae, Rubiaceae, Rosaceae, Fabaceae, Pinaceae, Theaceae, and Myrtaceae.

The most tree species belong to Family Lauraceae (Figure 7).

Table 6: Number of families, genera, and species of tree species

Category	Family	Genera	Species
Trees*	27	41	64

* Trees with DBH \geq 5 cm

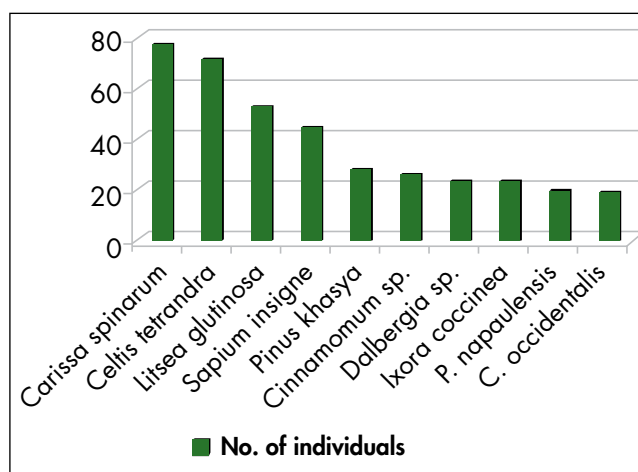
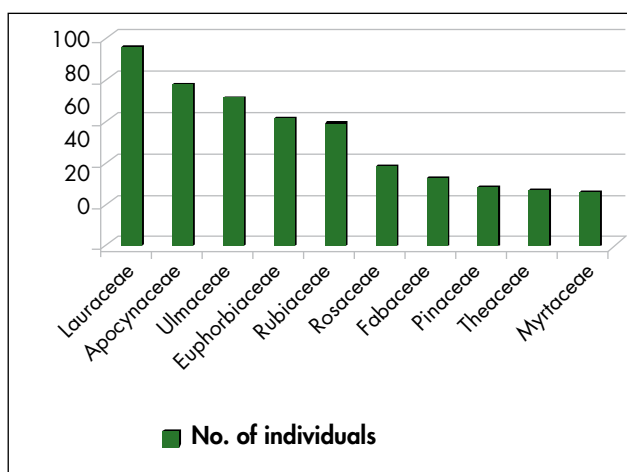
Figure 6: The ten most dominant tree species (DBH \geq 5) in the study areas

Figure 7: The ten most dominant families in the study areas



Species diversity and evenness

Species diversity is a combination of richness and evenness. Species diversity and evenness is related to the frequency of rare and common species. Species diversity expresses the degree of evenness of the mixture of species. In any ecosystem, the typical feature of species frequency distribution is that many rare species with only a few individuals are found in combination with a few species, which possess comparatively large number of individuals.

Diversity indices are a better measure of the species diversity of a forest. Species diversity is often expressed by two indices, namely, Shannon index (H') and Simpson's index (D) (Magurran 1988). Shannon diversity index places more weight on the rare species while Simpson's diversity index emphasis on the common species. It is generally accepted that both indices give appropriate measures of diversity, and provide different insights into the diversity of the forest.

In Simpson's diversity index, as the value of D increase, diversity decreases. Therefore, Simpson's diversity index is usually expressed as a reciprocal form (i.e., $1/D$ or $1-D$). Thus, the value of the index increases with increasing diversity (Magurran 1988).

The diversity index (H') of the study area was 4.78 while Evenness ($E\%$) of the area revealed nearly 20%. Simpson's diversity index in this study indicated that the areas possessed a relatively low level of diversity (Table 7).

Table 7: Parameters of tree diversity in the study areas

Total number of tree species	64
Total number of trees (≥ 5 cm DBH)	746
Number of trees (individuals)	746
Shannon Diversity Index (H')	4.779
Shannon Evenness ($E\%$)	18.628%
Simpson's Diversity Index (D)	0.039
($1 - D$)	0.96

Conclusions

The overall results of the field research activities provide appropriate means, ways and recommendations for sustainable conservation of plant species diversity of the study areas. The results of the research would contribute to updating the flora in Myanmar. Flora survey should be done in three seasons, especially winter and summer seasons, to assess their species diversity and extension on the conservation of rare and endangered species. Many new records of the species are still to be expected from the study area. Further seasonal inventories to accurately ascertain species diversity are required to obtain reliable baseline information.

We need to pay more attention to biological inventory and research to conserve biodiversity in the study areas. The first important step is to know what species naturally grow in the study areas, their character, their habitats and distribution, and how to recognize them.

Wildlife (Birds and Butterfly) Diversity

Introduction

Biodiversity is critically important for ecosystem stabilization by providing ecological functions and services. Myanmar is at the transition zone between three biogeographic regions (Sino-Himalayan region in the north, the Indochinese region in the east, and Malayan peninsular region in the south) where unique and diverse species communities are found (NBSAP 2015-2020). Myanmar is endowed with a rich diversity of habitat types arising largely from its unusual ecological diversity. More than 18,000 plant species including 61 globally threatened species, nearly 300 mammals, 1,096 birds including 45 globally threatened species, 291 reptiles, 119 amphibians, and 1,197 butterflies were recorded in Myanmar (NBSAP 2015-2020).

However, biodiversity in Myanmar has been under severe pressure due to population growth accompanied by increased resource utilization as well as the ever-increasing demand for resources from neighboring countries (Aung et al., 2004) and unsustainable land use practices and unplanned and uncoordinated development (NBSAP 2015-2020). Moreover, habitat destruction and loss are one of the major threats to biological diversity (Kareiva and Wennegren 1995; Foley et al., 2005). Nowadays, biodiversity conservation is considered a hot issue all over the world (Turner et al., 1990; Ehrlich and Wilson 1991). For conservation activities/strategies, species diversity assessment is a fundamental factor (Rubene et al., 2015).

Forest Department (FD) pays attention to biodiversity conservation through sustainable forest management, the establishment and expansion of protected areas, and improvement of awareness of local communities, and by considering payment for ecosystem services and green ecotourism practices. FD has been conducting biological surveys throughout the country by itself and also with the collaboration of many international organizations. According to NBSAP (2015-2020), regional or localized studies on biodiversity are under development. FD and ICIMOD have previously made an agreement on REDD+ Himalayas: Developing and using experience in implementing REDD+ in the Himalayas towards sustainable forest development, biodiversity conservation, social safeguard, and local livelihood enhancement. This ICIMOD-FD REDD+ programme implemented pilot survey areas in Pindaya Township, Southern Shan State of Myanmar. As one of the activities of this programme aimed at developing a biodiversity monitoring system for measuring impacts on biodiversity, biodiversity assessment was carried out not only in pilot areas — Pwe Hla Village, Nan Kone Village, and Shar Pyar Village — but also in Shouk Pin Village near the pilot areas.

The objectives of this survey are:

- To characterize fauna richness found in these study areas
- To observe the biodiversity conservation status of study areas and their altitude
- To publish a localized or regional field guidebook on biological diversity

Materials and Methods for Wildlife (Bird and Butterfly) Survey

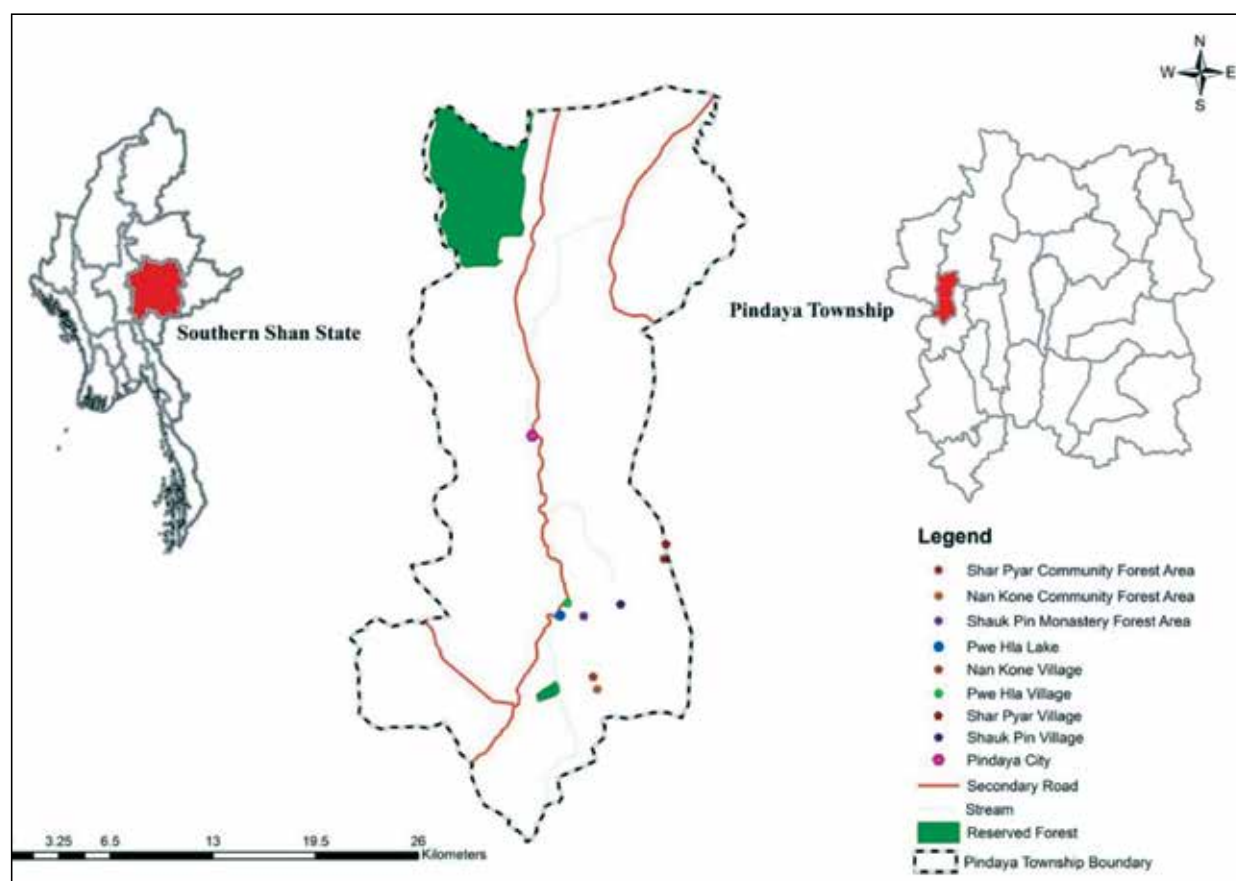
Study area

Pindaya Township is located in the Southern Shan State of Myanmar. It is one of the self-administrative zones called Danu. Biodiversity field surveys were performed in pilot areas especially in Pwe Hla Lake, Pwe Hla Village (20°50'19.94"N, 96°40'44.88"E); Nan Kone Community Forest, Nan Kone Village (20°47'50.25"N, 96°42'00.01"E); and Shar Pyar Community Forest, Shar Pyar Village (20°52'17.33"N, 96°44'16.20"E), and its surrounding area, especially Shauk Pin Monastery Forest, Shauk Pin Village (20°50'20.33"N, 96°41'31.51"E). Village landscapes are organized mosaics of paddy and crop fields, forests, and home gardens. Local communities secure their livelihood from crop cultivation, wages from employment in land-based occupations, and livestock husbandry.

Fauna survey

Due to the limited time and professional constraints, only surveys on birds and butterflies were carried out. Bird survey was conducted by transect, ranging from 115 m to 559 m. The survey was carried out for four days. The data collection was taken from 7:30 to 11:35 and 15:30 to 17:30 per day during 7-10 January 2018. All birds

Figure 8: Location map of study areas, Pindaya Township, Southern Shan State



found were recorded through the unaided eye and using a Canon PowerShot SX50 HS digital camera to take photos and sometimes through the sounds of birds. Butterfly survey was carried out by walking routes in the Nan Kone Community Forest from 13:30 to 15:30 on 9 January 2018. During the first two days of the survey, it was lightly raining, cloudy, and windy, where butterflies were rarely seen and it was a little bit difficult to watch the birds. Bird and butterfly diversities were calculated based on their occurrence during the survey. For other fauna species and biodiversity conservation status, key informant persons were interviewed to know their presence.

Secondary data collection

We collected bird data from the Pwe Hla Environment Conservation and Development Organization of Pwe Hla Village where their study areas included community forestry areas, farmlands, and residential areas in Pwe Hla Village and Nan Kone Village. They conducted a bird survey in January, March, and April 2016 for a total of 15 days. In this report, we also discussed these data as a result.

Data analysis

Data (richness of species, genera, families, and orders) were analyzed by using MS Excel 2007. Taxonomic identification of bird species followed field guide to *Birds of Myanmar* (Lwin and Thwin 2003), *New Holland Field Guide to the Birds of South-East Asia* (Robson 2008), *Biodiversity of Mt. Popa, Myanmar* (Lee et al., 2014), and *Wildlife of Southeast Asia* (Myers 2016). The status of bird species was accorded with *Birds of Myanmar* (Lwin and Thwin 2003) and *New Holland Field Guide to the Birds of South-East Asia* (Robson 2008). Butterfly identification referred to *Biodiversity of Mt. Popa, Myanmar* (Lee et al., 2014) and *Butterflies of Western Ghats* (Kasambe 2016).

Results and Discussion

Bird species

Birds are very important for the dynamics of natural and human-dominated ecosystems by providing such ecological services as provisioning, regulating, cultural, and supporting services (Sekercioglu et al., 2002;

Figure 9: **Yellow-browed Warbler (*Phylloscopus inornatus*)** observed in all study areas



Figure 10: **Ultramarine Flycatcher (*Ficedula superciliaris*)** observed in Nan Kone Community Forest Area



Sekercioglu et al., 2004). They respond to changes in habitats because of their mobility and habitat selection (Kwon et al., 2007; Wenny et al., 2011), and are used as an effective indicator for assessing biodiversity in all habitats (Chace and Walsh 2006; Yang et al., 2015).

From this survey, we found 66 species, 49 genera, 32 families, and 10 orders. Sixteen families were represented only by one species each while other families include 2 to 3 species except Muscicapidae family and Pycnonotidae family which have 10 and 5 species, respectively. There are 50 species in Order Passeriformes while other orders have 1 to 3 species. In Pwe Hla Village, Eurasian Tree-sparrow, House Sparrow, and Large-billed Crow were recorded. In Pwe Hla lake, 14 species were observed with 63 individuals. In Nan Kone Village, we found Eurasian Tree-sparrow, House Sparrow, and Japanese Tit. There were 34 species accounting for 216 counts in Nan Kone Community Forest.

From the secondary data of Pwe Hla Village, we recorded 74 species, 56 genera, 37 families, and 12 orders in community forestry areas, farmlands, and residential areas in Pwe Hla Village and Nan Kone Village. According to the primary data, 44 species, 35 genera, 27 families, and 9 orders were observed in these study areas. When we compared these primary and secondary data, all of the orders and families recorded by the field survey data were found in the secondary data except Dicaeidae, Paridae, Phylloscopidae, and Vangidae families (Tables 8 and 9). Moreover, we could add 10 bird species to these areas. They are Common Woodshrike, Dusky Warbler, Eastern Stonechat, House Sparrow, Japanese Tit, Peregrine Falcon, Scarlet-backed Flowerpecker, Ultramarine Flycatcher, Wire-tailed Swallow, and Yellow-browed Warbler.

There was an observation of Green Peafowl, which is recorded as an endangered species (BirdLife International 2017; IUCN 2017), with 3 individuals in Nan Kone Community Forest and 1 in Shauk Pin Monastery Forest. According to the secondary data and informal interviews, there are about 50-60 Green Peafowls roosting in the Nan Kone Community Forest and coming to croplands near Nan Kone Village to access food resources in the early mornings and evenings. One can also find this species in Pwe Hla Community Forest and Shauk Pin Monastery Forest area. Moreover, we observed introduced and vulnerable species (Javan Myna) (BirdLife International

Table 8: **Comparison of avifaunal orders of Pwe Hla Village and Nan Kone Village between the field survey and secondary data**

Order	No. of species (field observation)	No. of species (secondary data)
<i>Accipitriformes</i>	1	3
<i>Caprimulgiformes</i>	0	1
<i>Charadriiformes</i>	0	2
<i>Columbiformes</i>	2	5
<i>Coraciiformes</i>	1	3
<i>Cuculiformes</i>	1	4
<i>Falconiformes</i>	2	1
<i>Galliformes</i>	1	1
<i>Gruiformes</i>	0	1
<i>Passeriformes</i>	34	48
<i>Pelecaniformes</i>	1	2
<i>Piciformes</i>	1	3

Table 9: Comparison of avifaunal families of Pwe Hla Village and Nan Kone Village between the field survey and the secondary data

Family	No. of species (field observation)	No. of species (secondary data)
<i>Accipitridae</i>	1	3
<i>Aegithinidae</i>	0	1
<i>Alcedinidae</i>	1	1
<i>Ardeidae</i>	1	2
<i>Campephagidae</i>	1	1
<i>Caprimulgidae</i>	0	1
<i>Charadriidae</i>	0	1
<i>Cisticolidae</i>	1	2
<i>Columbidae</i>	2	5
<i>Coraciidae</i>	0	1
<i>Corvidae</i>	1	2
<i>Cuculidae</i>	1	4
<i>Dicaeidae</i>	1	0
<i>Dicruridae</i>	1	2
<i>Emberizidae</i>	0	1
<i>Estrildidae</i>	1	1
<i>Falconidae</i>	2	1
<i>Fringillidae</i>	1	1
<i>Hirundinidae</i>	2	1
<i>Laniidae</i>	2	3
<i>Leiothrichidae</i>	0	2
<i>Megalaimidae</i>	1	3
<i>Meropidae</i>	0	1
<i>Monarchidae</i>	0	1
<i>Motacillidae</i>	3	4
<i>Muscicapidae</i>	6	6
<i>Nectariniidae</i>	0	1
<i>Oriolidae</i>	0	1
<i>Paridae</i>	1	0
<i>Passeridae</i>	2	2
<i>Phasianidae</i>	1	1
<i>Phylloscopidae</i>	2	0
<i>Pycnonotidae</i>	4	4
<i>Rallidae</i>	0	1
<i>Rhipiduridae</i>	0	1
<i>Stenostiridae</i>	1	1
<i>Sturnidae</i>	2	6
<i>Timaliidae</i>	0	2
<i>Turnicidae</i>	0	1
<i>Vangidae</i>	1	0
<i>Zosteropidae</i>	1	2

2017; IUCN 2017) in those areas. There were 37 bird species with 148 individuals in Shauk Pin Monastery Forest area where we recorded Red-billed Blue Magpie with 4 individuals recognized as a sensitive species of Myanmar in eBird (2017), which means that this bird species faces risks including capture, targeted killing, or significant disturbance. All other recorded bird species are listed as “least concern” (IUCN 2017).

Figure 11: **Green Peafowl (*Pavo muticus*, EN)** observed in all study areas except Shar Pyar Community Forest Area



Figure 12: **Javan Myna (*Acridotheres javanicus*, introduced and VU)** sourced from Pwe Hla Environment Conservation and Development Organization



In one study of “Biological Survey Report for Pwe Hla Watershed Area” including Pwe Hla residential areas, lake, and community forestry area and Shauk Pin Monastery Forest area conducted 8-13 August 2014, 73 bird species from 14 different families were recorded (NWCD-FD 2014). In our study, we found 48 species with 27 families in Pwe Hla residential areas, Pwe Hla Community Forest area, Pwe Hla lake, and Shauk Pin Monastery Forest area. Twenty-eight species with 8 families are different from the previous study (Table 10). In Shar Pyar Village, Eurasian Tree-sparrow, House Sparrow, and Rock Pigeon were recorded. We found 26 species amounting to 95 birds in Shar Pyar Community Forest.

Table 10: **List of bird species added to Pwe Hla Village and Shauk Pin Monastery Forest Area**

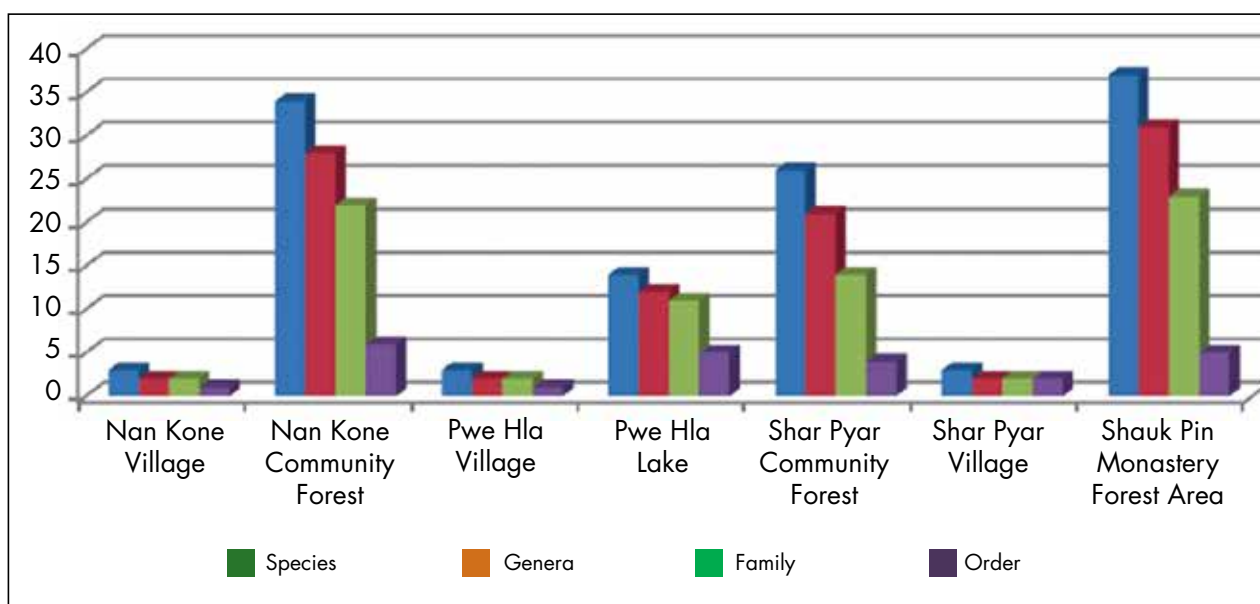
Common Name	Scientific Name	Family	Order
Common Kingfisher	<i>Alcedo atthis</i>	Alcedinidae*	Coraciiformes
Chinese Pond-heron	<i>Ardeola bacchus</i>	Ardeidae	Pelecaniformes
Indochinese Cuckooshrike	<i>Lalage polioptera</i>	Campephagidae*	Passeriformes
Long-tailed Minivet	<i>Pericrocotus ethologus</i>	Campephagidae	Passeriformes
Large-billed Crow	<i>Corvus japonensis</i>	Corvidae	Passeriformes
Red-billed Blue Magpie	<i>Urocissa erythrorhyncha</i>	Corvidae	Passeriformes
Black-headed Greenfinch	<i>Chloris ambigua</i>	Fringillidae*	Passeriformes
Barn Swallow	<i>Hirundo rustica</i>	Hirundinidae	Passeriformes
Brown Shrike	<i>Lanius cristatus</i>	Laniidae	Passeriformes
Grey-backed Shrike	<i>Lanius tephronotus</i>	Laniidae	Passeriformes
Blue-throated Barbet	<i>Psilopogon asiaticus</i>	Megalaimidae	Piciformes
Black-naped Monarch	<i>Hypothymis azurea</i>	Monarchidae*	Passeriformes
Grey Wagtail	<i>Motacilla cinerea</i>	Motacillidae*	Passeriformes
White Wagtail	<i>Motacilla alba</i>	Motacillidae	Passeriformes
Daurian Redstart	<i>Phoenicurus aureus</i>	Muscicapidae	Passeriformes
Grey Bushchat	<i>Saxicola ferreus</i>	Muscicapidae	Passeriformes
Rufous-breasted Bush-robin	<i>Tarsiger hyperythrus</i>	Muscicapidae	Passeriformes
Taiga Flycatcher	<i>Ficedula albicilla</i>	Muscicapidae	Passeriformes
Dusky Warbler	<i>Phylloscopus fuscatus</i>	Phylloscopidae*	Passeriformes
Yellow-browed Warbler	<i>Phylloscopus inornatus</i>	Phylloscopidae	Passeriformes
Black-crested Bulbul	<i>Pycnonotus flaviventris</i>	Pycnonotidae	Passeriformes
Brown-breasted Bulbul	<i>Pycnonotus sinensis</i>	Pycnonotidae	Passeriformes

Himalayan Black Bulbul	<i>Hypispetes leucocephalus</i>	Pycnonotidae	Passeriformes
White-throated Fantail	<i>Rhipidura albicollis</i>	Rhipiduridae	Passeriformes
Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	Stenostiridae*	Passeriformes
White-browed Scimitar-Babbler	<i>Pomatorhinus schisticeps</i>	Timaliidae	Passeriformes
Yellow-eyed Babbler	<i>Chrysomma sinense</i>	Timaliidae	Passeriformes
Blyth's Shrike-babbler	<i>Pteruthius aeralatus</i>	Vireonidae*	Passeriformes

Note: * means families different from the previous study

When we made a comparison between study areas, Shauk Pin Monastery Forest area occupied the highest number of species, genera, and family, followed by Nan Kone and Shar Pyar Community Forests while Nan Kone Community Forest has the largest order numbers (Figure 13).

Figure 13: Bird diversity of study areas, Pindaya Township, Southern Shan State

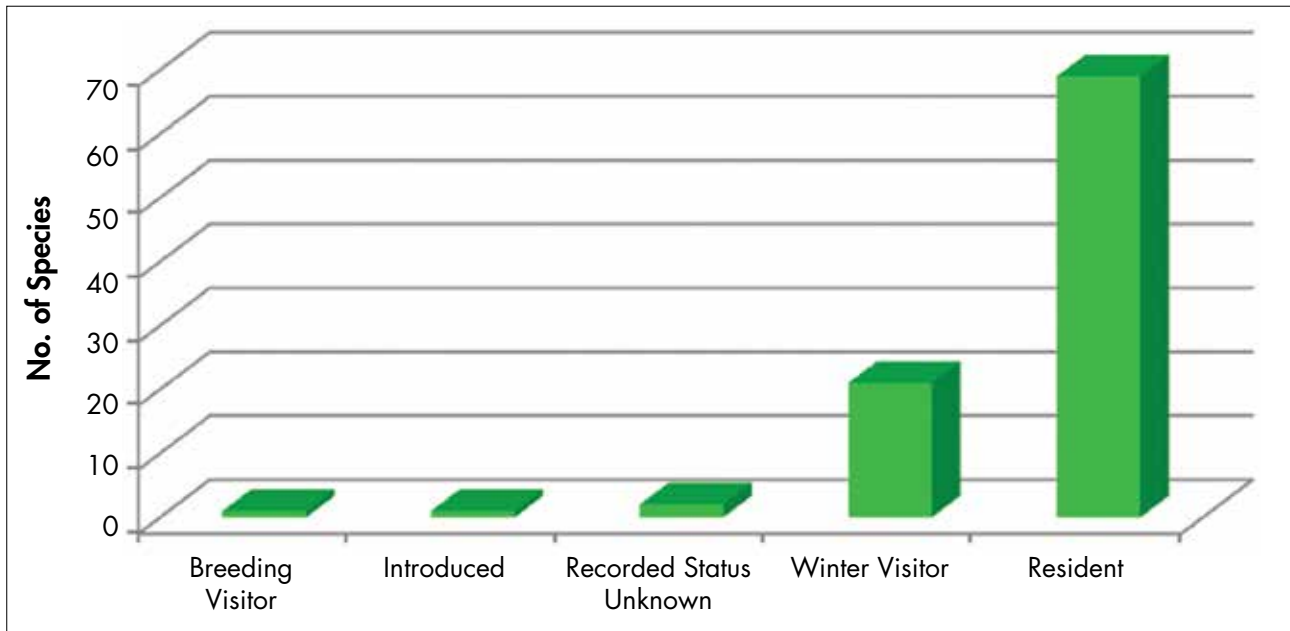


For the whole study, including the field survey and the secondary data obtained from Pwe Hla Village, we recorded 94 species, 69 genera, 43 families, and 13 orders. It was found that order Passeriformes has highest species numbers amounting to 65 species while other orders have 5 or fewer species. The detailed list of bird species observed in these study areas is described in Appendix I. In Myanmar, there are 1,096 avifaunal species including 6 endemic species and 46 Red List species (NBSAP 2015-2020). Nearly one-twelfth of the total bird species of Myanmar was found in these study areas. About 17% of the total bird species of Shan State accounting for 556 species was also covered (eBird 2017). Concerning the status of bird species in the study area, the majority of species are residents (about 73% of the total bird community) followed by winter visitors (22%) (Figure 14).

Butterfly species

Butterflies are important in plant pollination. They are also useful to determine habitat quality, because they respond to changes in habitat characteristics and follow environmental conditions due to short generation times, and are easy to collect and identify (Caldas and Robbins 2003; Mac Nally et al., 2003; Thomas 2005; Debinski et al., 2006). Myanmar is the fifth richest country in the world in terms of butterfly diversity, but there is little knowledge of butterfly survey in the region. In one study of biodiversity of Mount Popa, 70 species and 8 families were recorded. As mentioned before, a butterfly survey was performed in Nan Kone Community Forest where we observed 20 species, 17 genera, and 4 families belonging to Order Lepidoptera (Figure 15). The detailed list of butterfly species observed in Nan Kone Community Forest is described in Appendix II.

Figure 14: Characterization of residents and migrants at the species level



Other fauna species

According to the key informant interview with village heads, older peoples, and monks, we obtained information about other fauna species. In Pwe Hla Community Forest, Nan Kone Community Forest, and Shaik Pin Monastery Forest, one can find muntjac, porcupine, marten, jungle cat, squirrels, and Siamese hare. In Shar Pyar Community Forest, there are Siamese hare, squirrels, jungle cat, and yellow tortoise (*Indotestudo elongata*) which is recognized as an endangered species (IUCN 2017). In Myanmar, there are a total 26 species of turtles and tortoise including 6 endemic species. Habitat destruction, overharvesting of eggs and living bodies, and border trade pressures threaten chelonians (Platt et al, 2012). Myanmar is rich in freshwater fish species with 520 recorded species and also has 120 amphibians (NBSAP 2015-2020). In Pwe Hla lake, one can find the Himalayan Newt (*Tylototriton verrucosus*) as an amphibian and Inlay Carp (*Cyprinus intha*) as a fish species which is recognized as an endemic species to the Southern Shan State and also endangered (IUCN 2017). The village head of Pwe Hla Village said the Himalayan Newt is a flagship species of the village, attracting visitors, and one can find it during the rainy season. We should consider conserving these endangered, endemic, and flagship species because of their unique requirements.

Figure 15: Butterfly richness with different families of study areas

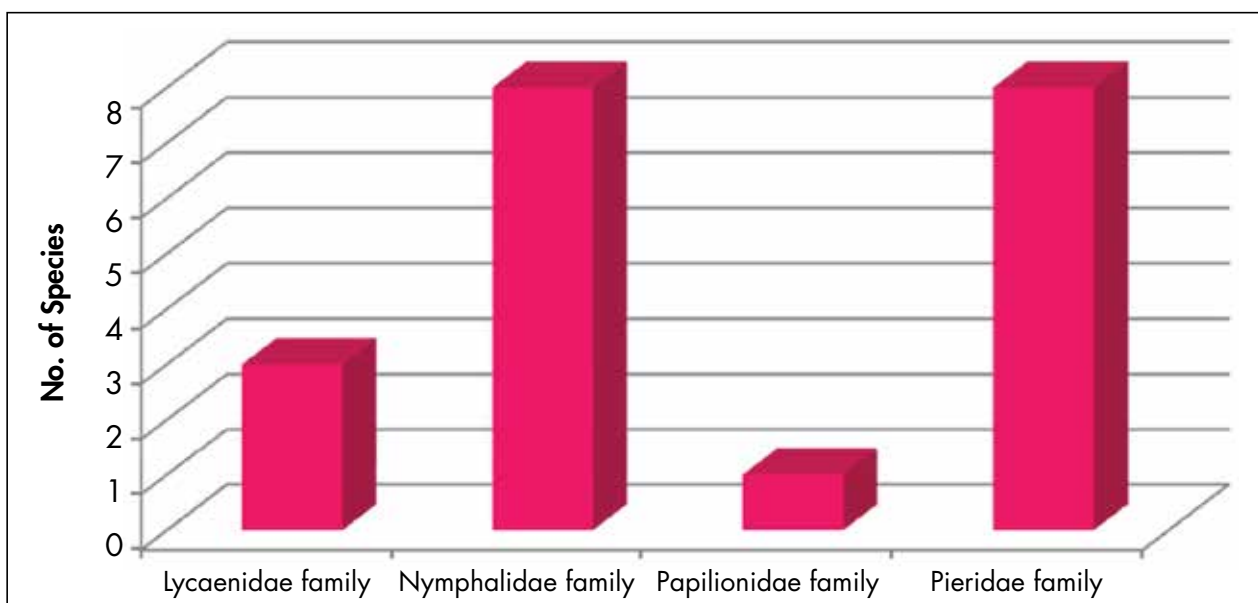


Figure 16: **Common Map (*Cyrestis thyodamas*)** found in **Nan Kone Community Forest Area**



Figure 17: **Yellow Tortoise (*Indotestudo elongata*, EN)** observed in **Shar Pyar Community Forest Area**



Photo: Mu Mu Aung, PhD, Forest Research Institute

Status of Biodiversity Conservation

As a result of the study, it was found that Pwe Hla Community Forest, Nan Kone Community Forest, and Shauk Pin Monastery Forest are maintained and protected by monks together with village tracts and the local community. They formulate internal rules for conserving the forest and protecting animals: 1) not allow cutting trees except for social affairs (donation, wedding, etc.), and 2) not allow killing and hunting animals. Moreover, they give punishment to someone who does not follow these rules: 1st infraction) remind hunters or cutters not to do such things, and 2nd infraction) inform and discuss with their village tract for their punishment. Village tracts and the local community conserve and protect Shar Pyar Community Forest for the environment greening and regulating the weather. They also develop internal rules for conserving the forest. However, they are not aware of fauna conservation in this area.

Pwe Hla Environment Conservation and Development Organization was organized in 2010 with 15 members from 6 villages (Pwe Hla, Kan Daunt, Pwint Lan, Set Kyar Kone, Shauk Pin, and Wartayar) under Pwe Hla village tract to conserve their community forest again because they faced climate changes, especially drought, and community forestry activities were not active. With the help of Forest Department and non-governmental organizations (UNDP, Mercy Corps, Myanmar Environment Rehabilitation-conservation Network (MERN), Friends Of Wildlife (FOW)), they have carried out gap planting in community forest areas and spring areas, facilitated achieving CF certificates, recorded bird diversity, and given awareness of environment and biodiversity conservation to local community and students. Now they are assessing the population of Green Peafowls and the condition of their environment for their conservation with the support of FOW.

Figure 18: **Himalayan Newt (*Tylototriton verrucosus*)** found in **Pwe Hla Lake, Pwe Hla Village**



Figure 19: **Inlay Carp (*Cyprinus intha*)** found in **Pwe Hla Lake, Pwe Hla Village**



Photos: Biological Survey Report for Pwe Hla Watershed Area of Forest Department)

Conclusion and Recommendation

This study revealed a total of 94 bird species and 20 butterfly species. These study areas are very important for biodiversity conservation because they possessed 69 resident, 21 migratory bird species, 2 endangered species (Green Peafowl and Inlay Carp), 1 vulnerable bird species (Javan Myna), and 1 sensitive bird species (Red-billed Blue Magpie). Nowadays, one in eight bird species is threatened with global extinction because of ecosystem disturbance and habitat fragmentation. Detailed studies of feeding habits and non-breeding and breeding habitats of resident species, migratory bird species, vulnerable species, and endangered species should be carried out to conserve them effectively because of their highly specific habitat requirements. Awareness raising programmes and capacity building training such as biodiversity conservation and environment and forest management for the local community, especially children and the youth, should be carried out regularly in order to enhance the involvement of the youth and children in conservation activities and balance the conservation and development. As mentioned above, this study was carried out with time and professional constraints. So this study cannot cover all aspects influencing biological diversity, especially seasonal effects. Further research should give attention to systematic inventory on biodiversity.

Constraints and Threats

Though Myanmar has been doing its best to conserve the biodiversity richness, loss of biodiversity and the habitats have been reported from the protected areas that have been established as a major conservation measure to conserve biodiversity and to reduce forest depletion. Many constraints need to be addressed immediately for achieving meaningful biodiversity conservation in Myanmar. The major constraints are:

- lack of basic physical infrastructure,
- inadequate financial resources,
- insufficient onsite personnel,
- poor technical knowledge of staff,
- lack of site-based management plans,
- weak enforcement over the control of illegal trade of wildlife and their parts,
- lack of proper environmental impact assessment for development projects,
- lack of people participation in biodiversity conservation activities, and
- lack of clearly defined land use policy.

In addition, protected areas in Myanmar are facing several threats that range from small scale to large scale. The major threats, which cause the degradation of the diverse flora and fauna of the country, are mentioned in Table 11.

Furthermore, impacts of climate change on wild flora and fauna, an introduction of alien invasive species that cause harmful impacts on native biodiversity, and threats of genetically modified organisms (GMOs) need special attention in conserving biodiversity for the long term. In order to minimize the above-mentioned threats, close cooperation and collaboration from the outside agencies are needed.

Table 11: Major threats faced by protected areas in Myanmar

Small-scale threats	No.	Large-scale threats
Hunting and wildlife trade for subsistence	1	Permanent human settlements and land reclamation
Fuelwood collection	2	Plantations
Extraction of non-wood forest products	3	Timber extraction
Grazing	4	Geological exploration by large companies
Fishing	5	Construction of dams and reservoirs
Shifting cultivation	6	Expansion of roads
Mining (gold panning)	7	Weakness of law enforcement
	8	Lack of awareness and conservation ethic
	9	Disposal of toxic chemicals into water bodies such as rivers, lakes, and seas

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Appendix I: The list of species and their respective individuals

Species	No. of individuals per sp.
<i>Carissa spinarum</i>	78
<i>Celtis tetrandra</i>	72
<i>Litsea glutinosa</i>	53
<i>Sapium insigne</i>	45
<i>Pinus khasya</i>	28
<i>Cinnamomum sp.</i>	26
<i>Dalbergia sp.</i>	24
<i>Ixora coccinea</i>	24
<i>Pittosporum napaulensis</i>	20
<i>Cephalanthus occidentalis</i>	19
<i>Cydonia cathayensis</i>	18
<i>Phoebe attenuata</i>	18
<i>Phyllanthus emblica</i>	17
<i>Helicia erratica</i>	16
<i>Lithocarpus lindleyanus</i>	16
<i>Ternstroemia japonica</i>	14
<i>Alnus nepalensis</i>	13
<i>Capparis sepiaria</i>	13
<i>Prunus macrophyllus</i>	13
<i>Anneslea fragrans</i>	12
<i>Aporosa roxburghii</i>	11
<i>Eugenia albiflora</i>	10
<i>Wendlandia glabrata</i>	10
<i>Syzygium cumini</i>	8
<i>Cydonia sp.</i>	7
<i>Gymnosporia sp.</i>	7
<i>Tupidanthus calypratus</i>	7

Species	No. of individuals per sp.
<i>Eugenia operculata</i>	6
<i>Mangifera caloneura</i>	6
<i>Glochidion hirsutum</i>	5
<i>Fraxinus griffithii</i>	4
<i>Bauhinia purpurea</i>	3
<i>Berberis asiatica</i>	3
<i>Wendlandia tinctoria</i>	3
<i>Acacia kingii</i>	2
<i>Dalbergia cultrata</i>	2
<i>Eriolaena candollei</i>	2
<i>Gardenia sootepensis</i>	2
<i>Terminalia bellirica</i>	2
<i>Antidesma ghesaembilla</i>	1
<i>Bauhinia acuminata</i>	1
<i>Buchanania latifolia</i>	1
<i>Cedrela serrata</i>	1
<i>Chonemorpha verrucosa</i>	1
<i>Cinnamomum obtusifolium</i>	1
<i>Ficus ischnopoda</i>	1
<i>Gardenia coronaria</i>	1
<i>Gardenia obtusifolia</i>	1
<i>Maytenus sp.</i>	1
<i>Pittosporum kerrii</i>	1
<i>Sideroxylon burmanicum</i>	1
<i>Syzygium oblatum</i>	1
Unknown	94
Grand Total	746

Appendix II: The list of families and their respective individuals

Family	No. of individuals
<i>Lauraceae</i>	98
<i>Apocynaceae</i>	79
<i>Ulmaceae</i>	72
<i>Euphorbiaceae</i>	62
<i>Rubiaceae</i>	60
<i>Rosaceae</i>	38
<i>Fabaceae</i>	32
<i>Pinaceae</i>	28
<i>Theaceae</i>	26
<i>Myrtaceae</i>	25
<i>Pittosporaceae</i>	21
<i>Phyllanthaceae</i>	17
<i>Fagaceae</i>	16
<i>Proteaceae</i>	16
<i>Betulaceae</i>	13
<i>Capraceae</i>	13
<i>Celastraceae</i>	8
<i>Anacardiaceae</i>	7
<i>Araliaceae</i>	7
<i>Oleaceae</i>	4
<i>Berberidaceae</i>	3
<i>Combretaceae</i>	2
<i>Malvaceae</i>	2
<i>Meliaceae</i>	1
<i>Moraceae</i>	1
<i>Sapotaceae</i>	1
Unknown	94
Grand Total	746

Appendix III: List of bird species noted in study areas, Pindaya Township, Southern Shan State

Order	Family	Genus	Species (Scientific)	Common Name	IUCN Global Threat Status
Galliformes					
	Phasianidae				
		Pavo			
			muticus	Green Peafowl	Endangered
Pelecaniformes					
	Ardeidae				
		Ardeola			
			bacchus	Chinese Pond Heron	Least Concern
		Egretta			
			garzetta	Little Egret	Least Concern
Falconiformes					
	Falconidae				
		Falco			
			peregrinus	Peregrine Falcon	Least Concern
			tinnunculus	Common Kestrel	Least Concern
Accipitriformes					
	Accipitridae				
		Elanus			
			caeruleus	Black-shouldered Kite	Least Concern
		Circus			
			melanoleucos	Pied Harrier	Least Concern
		Accipiter			
			badius	Shikra	Least Concern
		Buteo			
			buteo	Common Buzzard	Least Concern
Gruiformes					
	Rallidae				
		Gallinula			
			chloropus	Common Moorhen	Least Concern
Charadriiformes					
	Charadriidae				
		Vanellus			
			indicus	Red-wattled Lapwing	Least Concern
	Turnicidae				
		Turnix			
			suscitator	Barred Buttonquail	Least Concern
Columbiformes					
	Columbidae				
		Columba			
			livia	Rock Pigeon	Least Concern
		Streptopelia			
			orientalis	Oriental Turtle-dove	Least Concern
			tranquebarica	Red Collared Dove	Least Concern
			chinensis	Spotted Dove	Least Concern
		Treron			
			phoenicopterus	Yellow-footed Green Pigeon	Least Concern
Cuculiformes					
	Cuculidae				
		Cuculus			
			micropterus	Indian Cuckoo	Least Concern
		Cacomantis			

Order	Family	Genus	Species (Scientific)	Common Name	IUCN Global Threat Status
			merulinus	Plaintive Cuckoo	Least Concern
		Phaenicophaeus			
			tristis	Green-billed Malkoha	Least Concern
		Centropus			
			sinensis	Greater Coucal	Least Concern
Caprimulgiformes					
	Caprimulgidae				
		Caprimulgus			
			macrurus	Large-tailed Nightjar	Least Concern
Coraciiformes					
	Alcedinidae				
		Alcedo			
			atthis	Common Kingfisher	Least Concern
	Coraciidae				
		Coracias			
			benghalensis	Indian Roller	Least Concern
	Meropidae				
		Merops			
			orientalis	Little Green Bee-eater	Least Concern
Bucerotiformes					
	Upupidae				
		Upupa			
			epops	Common Hoopoe	Least Concern
Piciformes					
	Megalaimidae				
		Psilopogon			
			lineatus	Lineated Barbet	Least Concern
			asiaticus	Blue-throated Barbet	Least Concern
			haemacephala	Coppersmith Barbet	Least Concern
Passeriformes					
	Vireonidae				
		Pteruthius			
			aeralatus	Blyth's Shrike-Babbler	Least Concern
	Campephagidae				
		Lalage			
			polioptera	Indochinese Cuckooshrike	Least Concern
		Pericrocotus			
			ethologus	Long-tailed Minivet	Least Concern
	Oriolidae				
		Oriolus			
			tenuirostris	Slender-billed Oriole	Least Concern
	Vangidae				
		Tephrodornis			
			pondicerianus	Common Woodshrike	Least Concern
	Rhipiduridae				
		Rhipidura			
			albicollis	White-throated Fantail	Least Concern
	Monarchidae				
		Hypothymis			
			azurea	Black-naped Monarch	Least Concern
	Dicruridae				
		Dicrurus			
			leucophaeus	Ashy Drongo	Least Concern
			hottentottus	Hair-crested Drongo	Least Concern
	Corvidae				

Order	Family	Genus	Species (Scientific)	Common Name	IUCN Global Threat Status
		Corvus			
			japonensis	Large-billed Crow	Least Concern
		Urocissa			
			erythrorhyncha	Red-billed Blue Magpie	Least Concern
	Aegithinidae				
		Aegithina			
			tiphia	Common Iora	Least Concern
	Laniidae				
		Lanius			
			cristatus	Brown Shrike	Least Concern
			collurioides	Burmese Shrike	Least Concern
			tephronotus	Grey-backed Shrike	Least Concern
	Nectariniidae				
		Cinnyris			
			asiaticus	Purple Sunbird	Least Concern
	Dicaeidae				
		Dicaeum			
			cruentatum	Scarlet-backed Flowerpecker	Least Concern
	Estrildidae				
		Lonchura			
			punctulata	Scaly-breasted Munia	Least Concern
	Passeridae				
		Passer			
			domesticus	House Sparrow	Least Concern
			flaveolus	Plain-backed Sparrow	Least Concern
			montanus	Eurasian Tree-sparrow	Least Concern
	Motacillidae				
		Anthus			
			hodgsoni	Olive-backed Pipit	Least Concern
			richardi	Richard's Pipit	Least Concern
		Motacilla			
			alba	White Wagtail	Least Concern
			cinerea	Grey Wagtail	Least Concern
	Fringillidae				
		Chloris			
			ambigua	Black-headed Greenfinch	Least Concern
	Emberizidae				
		Melophus			
			lathamii	Crested Bunting	Least Concern
	Sturnidae				
		Acridotheres			
			cristatellus	Crested Myna	Least Concern
			javanicus	Javan Myna	Vulnerable
			albocinctus	Collared Myna	Least Concern
			tristis	Common Myna	Least Concern
			burmannicus	Vinous-breasted Starling	Least Concern
		Gracupica			
			nigricollis	Black-collared starling	Least Concern
	Muscicapidae				
		Monticola			
			solitarius	Blue Rock-thrush	Least Concern
		Copsychus			
			sauularis	Oriental Magpie-robin	Least Concern
		Calliope			
			calliope	Siberian Rubythroat	Least Concern
		Phoenicurus			
			auroreus	Daurian Redstart	Least Concern
		Saxicola			
			ferreus	Grey Bushchat	Least Concern
			maurus	Eastern Stonechat	Least Concern

Order	Family	Genus	Species (Scientific)	Common Name	IUCN Global Threat Status
			caprata	Pied Bushchat	Least Concern
		Tarsiger			
			hyperythrus	Rufous-breasted Bush-Robin	Least Concern
		Ficedula			
			superciliaris	Ultramarine Flycatcher	Least Concern
			albicilla	Taiga Flycatcher	Least Concern
		Eumyias			
			thalassinus	Verditer Flycatcher	Least Concern
	Stenostiridae				
		Culicicapa			
			ceylonensis	Gray-headed Canary-Flycatcher	Least Concern
	Paridae				
		Parus			
			minor	Japanese Tit	Least Concern
	Pycnonotidae				
		Pycnonotus			
			jocosus	Red-whiskered Bulbul	Least Concern
			cafer	Red-vented Bulbul	Least Concern
			xanthorrhous	Brown-breasted Bulbul	Least Concern
			flaviventris	Black-crested Bulbul	Least Concern
		Hypispetes			
			leucocephalus	Himalayan Black Bulbul	Least Concern
	Corvidae				
		Cecropis			
			striolata	Barn Swallow	Least Concern
	Hirundinidae				
		Hirundo			
			smithii	Wire-tailed Swallow	Least Concern
		Cecropis			
			striolata	Striated Swallow	Least Concern
	Phylloscopidae				
		Seicercus			
			tephrocephalus	Gray-crowned Warbler	Least Concern
		Phylloscopus			
			inornatus	Yellow-browed Warbler	Least Concern
			fuscatus	Dusky Warbler	Least Concern
	Leiothrichidae				
		Alcippe			
			poioicephala	Brown-cheeked Fulvetta	Least Concern
		Pterorhinus			
			sannio	White-browed Laughingthrush	Least Concern
	Zosteropidae				
		Zosterops			
			palpebrosus	Oriental White-eye	Least Concern
			japonicus	Japanese White-eye	Least Concern
	Timaliidae				
		Chrysomma			
			sinense	Yellow-eyed Babbler	Least Concern
		Pomatorhinus			
			schisticeps	White-browed Scimitar-Babbler	Least Concern
	Cisticolidae				
		Orthotomus			
			sutorius	Common Tailorbird	Least Concern
		Prinia			
			hodgsonii	Grey-breasted Prinia	Least Concern

Appendix IV: List of butterfly species noted in study areas, Pindaya Township, Southern Shan State

Order	Family	Genus	Species (Scientific)	Common Name
Lepidoptera				
	Lycaenidae			
		Catochrysops		
			panormus	Silver Forget-me-not
			strabo	Forget-me-not
	Nymphalidae			
		Argynnis		
			hyperbius	Indian Fritillary
		Cethosia		
			cyane	Leopard Lacewing
		Cyrestis		
			thyodamas	Common Map
		Junonia		
			hierta	Yellow Pansy
		Junonia		
			lemonias	Lemon Pansy
		Neptis		
			clinia	Clear Sailer
		Phalanta		
			phalantha	Common Leopard
		Vagrans		
			egista	Vagrant
	Papilionidae			
		Papilio		
			helenus	Red Helen
	Pieridae			
		Cepora		
			nadina	Lesser Gull
		Delias		
			descombesi	Red-spot Jezebel
		Delias		
			pasithoe	Red-base Jezebel
		Eurema		
			blanda	Three-spot Grass Yellow
		Ixias		
			pyrene	Yellow Orange Tip
		Pieris		
			mannii	Southern Small White
		Pontia		
			daplidice	Bath White
		Vindula		
			erota	Common Cruiser



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