

## **ASSESSMENT ON THE DIVERSITY OF BIRD FAUNA FROM THILAWA SPECIAL ECONOMIC ZONE AND IMPACTS OF THE PROJECTS IN THANLYIN TOWNSHIP, YANGON, MYANMAR**

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### **Abstracts**

This study is to assess the diversity of birds in Thilawa Special Economic Zone, outskirts of Yangon, Myanmar. The bird species diversity was investigated in the project area, Thilawa Special Economic Zone (SEZ) to assess the environmental impact of the project. The point count method was used and the data were monthly collected during June, 2015 to May 2016. The project area is 2400 hectares covering mostly paddy field with some human inhabitations. A total of 91 bird species representing 55 genera, 40 families and 8 orders were recorded from the Thilawa SEZ. Among them, 32 species from paddy field habitats, 58 species from shrubs and bushes, 32 species from wetland habitat and 55 species from scattered trees habitats were observed. They represented 61 species of terrestrial birds (51 species of resident birds and 10 species of migratory birds), and 30 species of water birds (20 species of resident birds and 10 species of migratory birds) could be categorized. 73 species (1439 individuals of birds) in cool season, 36 species (644 individuals of birds) in wet season and 50 species (733 individuals of birds) in dry season were assessed. According to abundance category, two species of abundance, two species of frequent species, nine species of uncommon and 78 rare species were examined. The birds were moderately diverse according to Shannon Index value ( $H' = 8.566$ ) with the evenness value ( $-8.577$ ). According to IUCN Redlist category, 90 species are under least concern species and only one species *Ploceus philippinus* was least concern species. Hence, the bird fauna in the project area is still diverse.

**Keywords:** Bird diversity, Impact Assessment, Special Economic Zone.

### **Introduction**

With more than 5,000 special economic zones (SEZ) across 140 economies today, the world Investment Report 2019 says SEZs perform as a new wave of industrial policy and as a response to an increasing competition for internationally mobile investments (Lynn, 2019). Accelerated foreign direct investments through new settings of special economic zones have become in recent years. The government committed to development two more SEZs worth billions of dollars namely Dawei SEZ and Kyauk Phyu SEZ: in addition to Thilawa SEZ, which is already completed and start running. The Environmental Impact Assessments (EIA) on the aspects of social, hydrological, health status and biological in which floral and fauna (fishes, herpets, birds and insects) surveys were conducted. This paper is species diversity of the birds in the project area and potential impacts of the Thilawa SEZ project on the birds (Thilawa SEZ).

An Environmental Impact Assessment (EIA) is a legal requirement in Myanmar for all development projects. It was initiated since the 2005-06, when the Htamanthi Hydropower Dam construction was implemented. After wards, EIA is playing the major roles for all projects to be legally implemented in Myanmar. In some projects, the EIA was started after initiation of the

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projects and running condition. The Thilawa SEZ was conducted the EIA assessment well before the stated of the project (Thilawa SEZ).

Creation of environmental impact assessment (EIA) system is vital to confirm socio-economic development project to environmental safety and there by ensure sustainable economic development. It helps the planning and management to take long time measures for effective management as well as environmental conservation. EIA thus ensure that the potential problem are foreseen and addressed at early stage in project planning and design. In any country, the environmental impact assessments (EIA) are inevitable conducted before project implementation. Any project usually makes more or less land cover changes that might affect negatively on the ecosystem. Actually the project is essential for the development of the country, but any project will effect more or less on the environment and sustainable ecosystem. There are also many ways of impacts, such as social impact, physical impacts, the impacts on the air and water and biological impacts that cause the air pollution and water pollution. Every aspect needs to assess the duration and magnitude of impacts. In biological study, what plant and animal species are present and what are their ecological roles in the project area first, and assess the kinds of impacts on the ecosystem. Mitigation measure during the project implementation and continue monitoring the impacts.

Birds are one of the important indicators of environmental condition, highest species numbers and bird numbers were observed in healthy environment and lowest of bird diversity in poor habitat (Krebs, 2001). Species diversity representing species richness and individual numbers of particular species can assess the condition of the habitats of any ecosystem. Myanmar is one of the highest biodiversity areas in Southeast Asia including richness in avifauna. The current classification of living birds is a hierarchical arrangement of roughly 29 orders, 187 families, over 2000 genera, and over 9,600 species. The total number of bird species today has been estimated more than 400 in the Europe, 645 in North America and 1300 in the Indian Sub-Continent comprising India, Pakistan, Bangladesh, Bhutan etc, Malaysia has 725, Singapore has 335 and Thailand has 915 (Gill, 1994).

Myanmar has about 1100 species, an estimate based on records by Ministry of Forestry and bird guidebooks of Southeast Asia and the Indian Sub-Continent (Gill, 2001). Animal distribution is mainly dependent on at least six factors; means of dispersal, habitat selection, interaction with other species, temperature, moisture, and other physical-chemical factors and the relationship between distribution and abundance (Krebs, 2001). Habitat selection in bird is partly a genetic trait although it can be modified by learning and experience. The original habitat selected by a bird is often reinforced by tenacity of individuals to their sites. Many old birds return year after the same nesting sites, even if the habitat at that sites is in deterioration. Most terrestrial environments undergo seasonal changes in habitat structure and food abundance and these changes are likely to influence diversity. Seasonal variations in the diversity of the bird species in several habitats decreased with increasing vegetation complexity (Haslem and Bennett, 2008).

Ecosystems with scattered trees occur throughout the world. Scattered trees are prominent features in many landscapes worldwide, including natural landscapes, cultural landscapes, and recently modified landscapes. The ecological importance of scattered tree is widely acknowledged in natural landscapes, but has not been sufficiently appreciated in human-modified landscapes.

Wetland habitat are commonly used by fish-eating birds, such as Egrets and Pelicans, but a lot of birds can feed together by eating different kinds of food at different levels in the water. Wetlands are often refuges for rare birds, as large mammals predators cannot easily hunt there. These habitats are also used by home to a rich variety of birds, such as Ducks, Coots, Rails, Herons and Storks. Many birds rest and feed on lakes, marshes and swamps during migration. But drainage schemes, dams, acid rain and pollution from farms and factories threaten these habitats.

Forest habitats provide birds with plenty of food and safe nesting places. A greater variety of birds live in the deciduous and eucalyptus woodland than in the dark conifer forests, because of the warmer, wetter conditions. Similar threats from habitat alteration face birds of moorland and wetland. Afforestation of moorland may diversely affect relatively common birds, such as meadow pipit and skylark, as a consequence of changes in the farming landscape. Habitat fragmentations not only reduce the area available to species but extend the amount of edge and increase the changes of population isolation. Habitat heterogeneity is also an important variable, through often a larger area is actually associated with greater habitat diversity (Jones, 1998).

The followings are the objectives for this research:

- To record the bird species and their relative abundance
- To categorize the bird status in the Thilawa SEZ project area
- To access the utilization of different habitat types
- To examine the seasonal variation and
- To calculate species diversity and its evenness

## **Materials and Methods**

### **Study area and study period**

The study area of Thilawa Special Economic Zone located in (N 16° 67' 80. 47" and E 96° 27' 24. 5") was classified into four habitat types depending on the plant species composition and water sources, (1) Paddy field habitat types, (2) shrubs and bush habitat type (3) wetland habitat type (4) and scattered trees during June 2015 to May 2016. Most of the study area was covered with paddy field, and several human habitations (villages and Buddhist moenstries) where tall and median sized pants are growing. Shrubs and bushes are covered unused land area, near vicinity of human habitations. Lakes and ponds in the study area are also filled with water throughout the year. Hmaw-iwn River is running southern to western sites of the study area.

### **Bird watching and data collection**

Bird watching was weekly conducted in the morning from 6:00 am-11:00 am and in the afternoon from 3:00 pm - 6:00 pm. Number of birds, and bird activity patterns (flying, feeding, perching, resting and single or couple or groups) and their habits were observed and noted down in field data form. Point count method was used in this study. A binoculars and digital camera power shot (5 × 50 Hs) were used for observing the plumage colours and patterns of the birds and for taking bird photographs to confirm the species for further investigation. Identifications followed after Robson (2008) and Smythies (1986).

### **Data analysis**

The recorded data were calculated into five categories, (1) habitat preference, (2) seasonal variation, (3) the status of bird species (resident birds, migratory birds, terrestrial birds, water birds), (4) abundance categories and (5) species diversity. Habitat preference was grossly assessed on the basis on the habitat types the bird species observed as habitat type (1) paddy field habitat type (2) scater trees and bushes habitat type (3) grass land habitat type and (4) water habitat type (5) wetland habitat type including lake, stream and river side. Actually, the habitat types are usually changes with seasons due to the growing plants and trees. The status of bird species were also classified as terrestrial birds and water bird, resident birds, migratory birds. The different status of bird plays and used as different feeding strategy. The abundance category indicating individual

numbers of birds of each species was followed after Kumar and Sivaperuman (2005) and was calculated as the formula mentioned below:

$$\text{Relative abundance} = \frac{\text{Total numbers of particular species}}{\text{Total species numbers}}$$

Abundance categories were determined based on index values as follows:

- |                            |                          |
|----------------------------|--------------------------|
| Rare Species = (0.1 – 2.0) | Common = (6.1- 8.0)      |
| Uncommon = (2.1 -4.0)      | Abundant = (8.1 – above) |
| Frequent = (4.1 – 6.0)     |                          |

$$\text{Dominance index} = \frac{\text{Total numbers of each species}}{\text{Total individual numbers of all species}}$$

For the assessment of diversity of bird species in the study area, Shannon index and Evenness formula were used (Stilling, 1999).

$$\text{Shannon Index} = H' = \sum P_i \ln P_i$$

Where

$$P_i = \frac{\text{No.of bird species}}{\text{Total No.of all bird species}}$$

**Identification**

Identification was followed after Robson (2008) and KyawNyuntLwin (2003) and Khin Ma MaThwin (2003), and Bird life international (2013).



Source: Google Earth2019

**Figure 1** Map of ThilawaSpecial Economic Zone of Thanlyin Township. Yangon, Myanmar

**Results and Discussion**

In the project area of Thilawa Special Economic Zone (SEZ), Thanlyin area, Yangon, Myanmar, 91 species, under 40 families of eight orders of the birds were recorded during the surveyed period. In this project area of Thilawa (SEZ), the majority was resident bird species (78%) and the minority was migratory species (22%), that represent 51 resident species and 20 species of

water birds. according to the combined data, terrestrial resident species was 51 species of birds. Among the 91 bird species, 61 species of terrestrial birds (51 resident birds, 10 species of migratory birds) and 30 species of water birds representing 20 resident birds and 10 migratory bird species were recorded. Hence the status of observed bird species from this area showed that the different ecological functioning are diverse in their habitat types (Table 1, Figure 2 and Table 2).

There were 58 species representing 440 individuals from shrub and bush habitat types. This type was the boundaries of between the paddy fields, vicinity of human habitations such as villages and monestries. In this area, no crops were planted, the plant types of small plants, bushes, shrubs and herbs grow. Their habitat was changes a little during different seasons. The insects and small grains as food and also as shelter in the hot times and also hiding places. The shrubs and bushes are small in sizes and this is main causes of small population size with higher numbers of species (Table 4). In the wetland representing lakes, ponds, streams and Hmaw-win River, 32 species including both migratory and resident species were observed. The numbers of birds was highest (1412 individuals) (Table 2). Tall trees were found in the villages, around the lakes and ponds, in which 55 bird species found. The birds were found during the day time with perching on the trees. The nests of some birds were found in this study site. Hence, this is roosting sites of the terrestrial birds. The habitat types are always changes through times and places. The birds are also changes with seasons due to their habitats supported of different kinds of foods. The weather conditions such as temperature, humidity, rain fall etc. are also found to vary with of cool season and breed in the hot season. Some migratory birds were not going back their northern parts of their home. The lowest diverse bird species was in wet season (raining season). The reason of the low numbers and low species was that the encountered rate (so call observability) was low in this season (Table 5).

According to the habitat utilization of bird species 32 bird species with 548 individual numbers of birds were examined from paddy field. Actually, this habitat types is seasonally changes, paddy plants usually grow in the wet season and it was changes after harvest time. This habitat type was changes only weather condition but also human affect. At the beginning time of growing season, the insectivorous bird species were dominately observed in this habitat type. At the ripening stage of paddy plants, the granivorous birds were dominated. This habitat type supports the bird species for food as foraging ground. Hence, this habitat type was foraging ground of both insectivorous and carnivorous birds (Table 2).

According to the abundance categories, only two species, Lesser whistling duck and Brown shrike were observed. The most important thing is rare species (78 species) and they were very small in numbers, consequently they are very vulnerable to natural selection and might be easily extinct locally. Assessment of species diversity of Shannon index was measured by two parameters, species richness and individual numbers. This index value was representing the common species and also rare species. Conclusively, the calculated value of diversity assessment, both values showed that the study area was still diverse in avifauna meaning that this environment and ecosystem were good in healthy condition. No fauna species under the IUCN Red List and Cites appendices were recorded in SEZ project area at the survey time. According to IUCN Redlist, only one species *Ploceus philippinus* was least concern species. The population of each species in the project area varied greatly from one individual number to over 1000 birds.

**Table 1 Status of the bird species recorded from Thilawa Industry Zones**

Bird status	Terrestrial birds	Water birds	Total No. of species
Resident birds	51	20	71
Migratory birds	10	10	20
Total No. of species	61	30	91

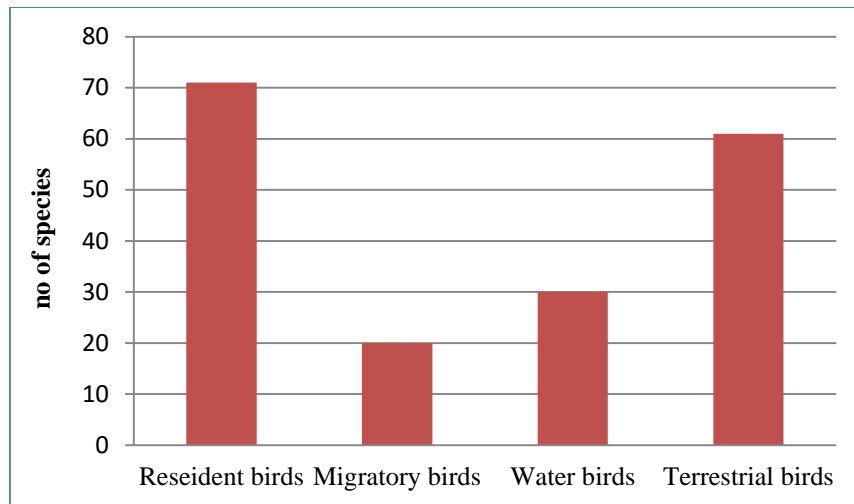


Figure 2 Number of species of different bird status collected from Thilawa SEZ project area

Table 2 Abundant categories of bird species and status of bird species

No.	Scientific Name	Common Name	Bird Status	Total No	AC	No.
1	<i>Tadornaferruginea</i>	Ruddy Shelduck	M	W	4	Rare
2	<i>Nettapuscoromandelianus</i>	Cottom Pygmy Goose	R	W	11	Rare
3	<i>Dendrocygnajavanica</i>	Lesser Whishing Duck	R	W	1030	Abun
4	<i>Tachybaptus ruficollis</i>	Little Grebe	R	W	2	Rare
5	<i>Amaurornisphoenicurus</i>	White breasted water hen	R	W	3	Rare
6	<i>Porzanafusca</i>	Ruddy breasted crake	R	W	1	Rare
7	<i>Gallinula chloropus</i>	Common Moorhen	R	W	1	Rare
8	<i>Metopidius indicus</i>	Bronze-winged Jacana	R	W	1	Rare
9	<i>Tringa tetanus</i>	Common Redshank	M	W	136	Freq
10	<i>T. nebularia</i>	Common Greenshank	M	W	2	Rare
11	<i>T. ochropus</i>	Green Sandpiper	M	W	1	Rare
12	<i>T. stagnatitits</i>	Marsh Sandpiper	M	W	4	Rare
13	<i>Actitishypoleucos</i>	Common Sandpiper	M	W	12	Rare
14	<i>Charadrius dubius</i>	Little-ringed Plover	M	W	6	Rare
15	<i>Himantopus himantopus</i>	Black-winged stilt	M	W	7	Rare
16	<i>Chlidoniasleucopterus</i>	White-winged Term	M	W	1	Rare
17	<i>Egretta garzetta</i>	Little Egret	R	W	104	Unco
18	<i>Mesophoyx intermedia</i>	Intermediate Egret	R	W	4	Rare
19	<i>Bubulcuscoromandus</i>	Cattle Egret	R	W	17	Rare
20	<i>Ardeolagrayii</i>	Indian Pond Heron	R	W	58	Unco
21	<i>Butoridesstriatus</i>	Little Heron	R	W	4	Rare
22	<i>Ardeoabacchus</i>	Chinese Pond Heron	R	W	1	Rare
23	<i>Ardeapurpurea</i>	Purple Heron	R	W	7	Rare
24	<i>A alba</i>	Great Egret	R	W	13	Rare
25	<i>A cinerea</i>	Grey Heron	R	W	4	Rare
26	<i>Nycticoraxnycticorax</i>	Black-crowned Night Heron	R	W	4	Rare
27	<i>Ixobrychus flavicollis</i>	Black Bittern	M	W	3	Rare
28	<i>I. sinensis</i>	Yellow Bittern	R	W	1	Rare
29	<i>Anastomusoscitans</i>	Asian –Open bill	R	W	4	Rare

No.	Scientific Name	Common Name	Bird Status	Total No	AC	No.
30	<i>Phalacrocorax niger</i>	Little Cormorant	R	W	31	Rare
31	<i>Tyto longimembris</i>	Grass Owl	R	T	1	Rare
32	<i>Milvus migrans</i>	Black Kite	M	T	65	Unco
33	<i>Elanus caeruleus</i>	Black shouldered kite	R	T	3	Rare
34	<i>Accipiter badius</i>	Shikra	R	T	1	Rare
35	<i>Falco tinnunculus</i>	Common Kestrel	M	T	2	Rare
36	<i>Coracias benghalensis</i>	Indian Roller	R	T	2	Rare
37	<i>Megalaimahaemancephala</i>	Coppersmith Barbet	R	T	2	Rare
38	<i>Meropsorientalis</i>	LittlegreenBeeeater	R	T	15	Rare
39	<i>M. philippinus</i>	Blue-Tailed Beeeater	R	T	5	Rare
40	<i>Alcedoatthis</i>	Common King fisher	R	T	2	Rare
41	<i>Halcyon smyrnensis</i>	White throated Kingfisher	R	T	3	Rare
42	<i>H. pileata</i>	Black copped Kingfisher	M	T	2	Rare
43	<i>Cacomantismerulinus</i>	Plaintive cuckoo	R	T	6	Rare
44	<i>Centropus sinensis</i>	Greater Coucol	R	T	147	Freq
45	<i>Cypsiurusbalasiensis</i>	Asian Palm Swift	R	T	7	Rare
46	<i>Hemiprone coronate</i>	Crested Tree Swift	R	T	1	Rare
47	<i>Iynxtorquilla</i>	Eurasian wryneck	R	T	1	Rare
48	<i>Artamusfuscus</i>	Ashy Wood Swallow	R	T	2	Rare
49	<i>Aegithinatiphia</i>	Common Iora	R	T	2	Rare
50	<i>Rhipiduraalbicollis</i>	White throated Fantail	R	T	13	Rare
51	<i>Columba livia</i>	Rock-Pigeon	R	T	67	Unco
52	<i>Streptopelia chinensis</i>	Spotted Dove	R	T	1	Rare
53	<i>S. tranquebarica</i>	Red turtle Dove	R	T	66	Unco
54	<i>Laniuscristatus</i>	Brown shrike	M	T	228	Abun
55	<i>Corvus splendens</i>	House Crow	R	T	7	Rare
56	<i>C. macrobrynchos</i>	Large -billed Crow	R	T	76	Unco
57	<i>Dicrurusmacrocerus</i>	Black Drongo	M	T	7	Rare
58	<i>Rhipiduraalbicollis</i>	White-throated Fantail	R	T	10	Rare
59	<i>Copsychussaularis</i>	Oriental magpie-Robin	R	T	8	Rare
60	<i>Saxicola Maura</i>	Eastern Stone cat	M	T	17	Rare
61	<i>S. capratastar</i>	Pied bush cat	R	T	70	Unco
62	<i>Acridotheres tristis</i>	Common Myna	R	T	47	Rare
63	<i>A. fuscus</i>	Jungle Myna	R	T	7	Rare
64	<i>A. burmannicus</i>	Vinaus breasted starling	R	T	2	Rare
65	<i>Gracupica contra</i>	Asian pied staring	R	T	1	Rare
66	<i>Sturnus malabaricus</i>	Chestnut tail Starling	R	T	1	Rare
67	<i>Alauda gulaula</i>	Oriental skylark	R	T	1	Rare
68	<i>Riparia paludicola</i>	Sand Martin	M	W	8	Rare
69	<i>Hirundorustica</i>	Barn Swallow	R	W	86	Unco
70	<i>Pycnonotuscafer</i>	Red vented Bulbul	R	W	11	Rare
71	<i>P. jocosus</i>	Red whiskered bulbul	R	T	7	Rare
72	<i>P. blafordi</i>	Streak eared bulbul	R	T	2	Rare
73	<i>Cisticola juncidis</i>	Zitting cist cola	R	T	6	Rare
74	<i>Orthotomussutorius</i>	Common tailor bird	R	T	5	Rare
75	<i>Priniainornata</i>	Plain prinia	R	T	36	Rare

No.	Scientific Name	Common Name	Bird Status	Total No	AC	No.
76	<i>P.hodgsonii</i>	Grey breasted prinia	R	T	1	Rare
77	<i>P. flaviventris</i>	Yellowbellied prinia	R	T	10	Rare
78	<i>Acrocephalusorientalis</i>	Oriental reed Warbler	R	T	15	Rare
79	<i>Phylloscopusfuscatus</i>	Dusky Warber	M	T	6	Rare
80	<i>Timaliapileata</i>	Chestnut Capped babbler	R	T	1	Rare
81	<i>Turdoidesgularis</i>	White throated babbler	R	T	1	Rare
82	<i>Chrysommasinense</i>	Yellow –eyed babbler	R	T	8	Rare
83	<i>Motacilla alba</i>	White Wagtail	M	T	86	Unco
84	<i>M. flava</i>	Yellow Wagtail	M	T	11	Rare
85	<i>Passer domesticus</i>	House Sparrow	R	T	7	Rare
86	<i>P. montanus</i>	Eurasian tree Sparrow	R	T	2	Rare
87	<i>Ploceusphilippinus</i>	Baya Weaver	R	T	6	Rare
88	<i>P.hypoxanthus</i>	Asian Golden Weaver	R	T	5	Rare
89	<i>Lonchupunctulata</i>	Scaly breasted Munia	R	T	36	Rare
90	<i>L. atricapilla</i>	Chestnut Munia	R	T	1	Rare
91	<i>L. striata</i>	White rumped Munia	R	T	10	Rare

T=terrestrial birds, W= water birds, R=Resident birds, M= Migratory Birds

**Table 3 Abundance category of birdpecies in the present study area**

Abundance categories	Abundance	Common	Frequent	Uncommon	Rare
No of species	2	-	2	9	78

**Table 4 Numbers of birds and bird speciesrecorded from different habitat types**

Current status	Paddy field	Shrubs and bushes	Wetland	Scattered trees	Total
No of species	32	58	32	55	50
No of birds	548	440	1412	416	2816

**Table 5 Seasonal variation of birds and bird species in the study area**

Birds and seasons	Cool season	Wet season	Dry season	Total
No. of species	73	36	50	50
No. of birds	1439	644	733	2816

**Table 6 Diversity index value of birds of the study area**

No.	Diversity index	Index value
1.	Shannan Weiner H' = $\sum P_i \ln P_i$	8.566E-02
2.	EvenessE = H'/S	8.557

The project area of Thilawa Special Economic Zone located at Kyauktan Township was assessed as high diversity of avifauna assessing 91 bird species including 61 terrestrial bird species (51 resident species and 10 migratory species) and 30 species of water bird species (20 resident species and 10 migratory species). In the project area, resident birds were dominant species (71 species). The most diverse species was Lesser whishing Duck *Dendrocygnajavenica* and the



second highest species was the Brown Shrike *Lanius cristatus*. They were observed in three seasons the highest numbers compare with other species. In the project area, 78 species are rare species, 9 species are uncommon, 2 frequent and 2 species are abundance categories, and no common species is not observed. According to the concept of population ecology, this may be assumed as balance ecosystem.

In the project area, four habitat types as paddy field, shrubs and bushes habitat, wetland land habitat and scattered trees habitats were utilized by the bird fauna. The species was highest in the shrubs and bushes habitat while the highest numbers of birds was observed in wetland habitat. Here, two permanent lakes, three small streams and the large Hmaw-win River were included in this habitat type. This is due to the migratory birds, they all have large number of group in each species.

According to seasonal observation, largest species numbers and populations size was examined cool season (73 species and 1439 individual numbers), while second highest was observed in dry season. The least number was observed in wet season. This is due to availability of the food source. They definitely use these habitat types for the foraging although they may use as roosting. In the survey time, the very few bird nests were observed. Conclusively, there was high bird species diversity in this area, and we can conclude this project area is suitable for the bird fauna and can good provide. After implementation on the project, the bird fauna have to move to another place due to the habitat loss.

### Conclusion

In the project, 91 bird species representing 71 resident species and 20 migratory species were recorded. According to habitat preference, highest species number was observed in shrubs and bushes habitat types, although individual numbers was highest in wetland field. The seasonal variation was examined and the highest species diversity was in cool season and lowest was in wet season. The project area of Thilawa Special Economic Zone located at Kyauktan Township was concluded as high diversity of avifauna. There was no adverse impact in this area.

### Acknowledgements

We would like to thank Dr. Nilar Aung, Pro-Rector of Yangon University, Dr. Aye Mi San, Head and Professor of Zoology Department, University of Yangon for their kind permission and NEPS International Non-Government Organisation for financial support this project assessment. The last but not least Dr. Khin Maung Swe, Retired Professor of Zoology Department, Dagon University, the Project leader of Environmental Impact Assessment (Fauna Specialist) to permit the research paper.

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