
**THE BIRD DIVERSITY STUDY AT POKO
HYDROPOWER PROJECT IN PINRANG REGENCY OF
SOUTH SULAWESI PROVINCE**

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SUMMARY

Biodiversity Assessment Survey for avifauna in Poko hydropower project area in Pinrang Regency of South Sulawesi Province and Mamasa Regency of West Sulawesi Province is conducted to collect and analyze data on species abundance, diversity, and community structure as well as conservation status category. Based on the survey result, the total number of bird species identified in the study area are 77 species.

Nine station for bird observation was done to analyze, the diversity of birds has correlation with habitat types, the avifauna survey is designed in different types of habitat found in the study area. The result showed that. The highest number of bird species are found at forested area. Meanwhile the lowest bird diversity is observed in shrubs area. With regards to conservation status, from the total bird species identified, there are 10 species classified as protected by Government of Indonesia (GOI - Government Regulation 20/2018); 2 species are classified as near threatened by red list of IUCN¹; and 10 species are listed as Appendix II by CITES².

The protected birds listed in GOI regulation are 1) Sulawesi serpent eagle (*Spilornis rufipectus*), 2) Sulawesi goshawk (*Accipiter greiseiceps*), 3) Black eagle (*Ictinaetus malayensis*), 4) Small sparrowhawk (*Accipiter nanus*), 5) Brahminy kite (*Haliastur indus*), 6) Sulawesi hawk eagle (*Spizaetus lanceolatus*), 7) Spotted kestrel (*Falco moluccensis*) 8) Sulawesi scop owl (*Otus manadensis*) 9) Knobbed hornbill (*Rhyticeros cassidix*), 10) Sulawesi hornbill (*Penelopides excerhatus*) 11) crimson sunbird (*Aethopyga siparaja*)

Two bird species found at the project area are classified as near threatened bids according to IUCN Red List database such as 1) Drawf sparrow hawk (*A nanus*), 2) Sulawesi dwarf kingfisher (*Ceyx fallax*), and knobbed hornbill (*R cassidix*) as Vulnerable.

Furthermore, there are ten bird species categorized at CITES Appendix II, those are 1) Sulawesi serpent eagle (*Spilornis rufipectus*), 2) Sulawesi goshawk (*Accipiter greiseiceps*), 3) Black eagle (*Ictinaetus malayensis*), 4) Small sparrowhawk (*Accipiter nanus*), 5) Brahminy kite (*Haliastur indus*), 6) Sulawesi hawk eagle (*Spizaetus lanceolatus*), 7) Spotted kestrel (*Falco moluccensis*), Sulawesi scop owl (*Otus manadensis*), citrine lorikeet (*Trychoglossus flavoviridis*), great hanging parrot (*Loriculus stigmatus*), great billed parrot (*Tanygnathus magalorhynchos*).

Based on feeding guild analysis, the bird community observed at the study area is dominated by insectivorous birds. The dominant of bird habitat types is forested area. The location (bird observation station) will much influence by the poko hydropower project activities is area surround station 5, station 6, station 7, and station 8.

¹ IUCN: International Union for Conservation of Nature

² CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

PREFACE

PLN (Perusahaan Listrik Negara plans to develop new electricity project in Poko. The proposed project area is located in Pinrang Regency South Sulawesi Province); and Mamasa Regency West Sulawesi Province (Poko hydropower project)

In order to minimize environment impacts, performs Biodiversity Assessment Study to gather and assess data and information of bird diversity at Poko Field Development Area, . This study is carried out in several habitat types located at Poko hydropower project area and its vicinity.

The bird species has been found at the project area are 65 species. The diversity of birds has relation to habitat types. Nine station observation for bird collecting data The highest number of bird species found at the area where are covered by forested area..

Among the birds have been identified, there are 10 birds species as protected birds in Indonesia, 1 species as vulnerable also 2 species as near threatened by red list of IUCN, and 14 as Appendix II by CITES. The bird diversity varied, and it has relation with habitat types. In general the birds diversity was influenced by the existence of forest at the project area. Dominant bird at project area is insectivores' bird. Most of bird species at the study area is non forest dependent bird.

The results of Bird diversity Assessment Study at Poko hydropower project will be used as baseline to improve environmental management and monitoring program as well as to protect and conserve biological diversity

I. INTRODUCTION

1.1. Background

The avifauna diversity survey was conducted for Poko Hydropower Project in Pinrang Regency, south Sulawesi Province and Mamasa Regency, west Sulawesi Province. This survey done refers to AMDAL (Analisis Mengenai Dampak Lingkungan) refers to Indonesia Regulation and ESHIA (environmental Safety Impact Assessment) refers to World Bank requirements and others relevant international lenders standard. .

Poko hydropower project is electricity project to develop new hydropower (dam and electricity facilities) in Mamasa river facilities at Pinrang Regency, south Sulawesi Province and Mamasa Regency, west Sulawesi Province.. In relation to this planned development, Perusahaan Listrik Negara (PLN) performs Biodiversity Assessment Study to assess the bird diversity condition in and around the proposed project area to ensure that developing project implementation of mitigation planning processes aimed at reducing the effects of its activities on the environment and conserve biodiversity. The study is focused on avifauna components.

Poko hydropower field area is covered an area aroundha. The project area covered by several vegetation type such secondary mix forest, coffee and chocolate plantation, ladang, Paddy field, river bank and kampong.). Therefore, to obtain comprehensive data and information on bird diversity, the survey is designed in different habitat types occurred in the study area.

From beginning state of poko hydropower project development will ensure its compliance towards applicable regulations as governed by Government of Indonesia (GOI) related to environmental and sustainable development issues including protection and conservetaion of biodiversity.

1.2. Objectives

The avifauna survey is conducted at the poko hydropower project development and its in Pinrang Regency, south Sulawesi Province and Mamasa Regency, west Sulawesi Province. The objectives of this study include:

1. To gather basic information and data related with birds species diversity at study area.
 2. To establish data on birds abundances and community structure.
 3. To obtain and list the conservation status of birds species at study area.
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II. STUDY AREA

The Poko hydropower project area is administratively located in Pinrang Regency of South Sulawesi Province and Mamasa Regency of West Sulawesi Province; The project area is located in river side of Mamasa river at those province. The topography of the Poko hydropower project area is mountaineously with slope up 25 %.

The main area for Poko hydropower project is stream of Mamasa river. The Poko hydropower project will develop in an area with forested area, included lading, paddy field and kampoong. The vegetation observed are mostly oil forested area, pocket of corn ladang plantation, coffee plantation chocolate plantation, shrubs, open grasses, and paddy.

The Poko hydropower project area is located at elevation 6 00 to 9 00 m above see level. Annual average temperature is arroud 20 °C with average humidity around 85 %.The average annual precipitation at the project area is around mm per year . The highest precipitation occurs during December to March.

The soil at the study area has texture of sandy loamy to silty clay loamy with podsolic area, dominated by yellow and red colors. Physical soil parameter is crumb with depth categorized as not shallow. The chemical soil parameter at study area is classified as moderate soil fertility.

III. METHODS

3.1. Location of Study

The data and information related to birds diversity at Poko hydropower project is collected within two week, from 12 – 26 July 2018. The observations are focused at vegetation types occurred at the project area such as forested area, pocket of coffee and chocolate plantation with secondary mix forest, riparian forest, paddy field and ladang and kampong.

3.2. Equipment and Materials

Equipments used in this survey consists of Map of Bungin Field Development Project Area, GPS, compass, chronometer, binocular, tele-lens camera, and field guide to the birds of Wallacea (Brian J Coates, K David Bishop and Dana Gardner,).

3.3. Methods

The birds inventory was carried out by transect method combination with IPA count. Nine transect were made at Poko hydropower area (**Table 3.1**). Each transect established is 400 m length. The counting of individual numbers is based on direct visual contact or bird sound. Besides direct observation of bird species, interview with local people was done to know about the bird species existing at project area.

Table 3.1. Transects applied for Avifauna study at Poko hydropower project area

No	Transect Location	Habitat Type	Coordinate Position	
			Latitude North	Longitude East
1	Station 1	Forested area and ladang (corn plantation), chocolate plantation, open area (grass shrubs) Bakaru dam	0 ° 0 ' "	10 ° ' "
2	Station 2	Forested area and ladang (corn plantation), small stream side,	0 ° 0 ' "	10 ° ' "
3	Station 3	Forested area and ladang (corn plantation), kampong	0 ° 0 ' "	10 ° ' "
4	Station 4	Forested area (mix with forest plantation) and ladang (corn plantation), kampong	0 ° 0 ' "	10 ° ' "
5	Station 5	Forested area, river side of Mamasa, shrubs area	0 ° 0 ' "	10 ° ' "
6	Station 6	forested area (mix forest) ladang (corn	0 ° 0 ' "	10 ° ' "

		plantation) paddy field, kampoong		
7	Station 7	forested area (mix forest) ladang (corn plantation) paddy field, kampoong	0 ° 0 ' "	10 ° ' "
8	Station 8	forested area (mix forest) ladang (corn plantation) paddy field, kampoong	0 ° 0 ' "	10 ° ' "
9	Ben Mark	Forested area, cooffee plantation	0 ° 0 ' "	10 ° ' "

Sampling plot of bird survey at poko hydropower project, Pinrang dan Mamasa 9 station is presented

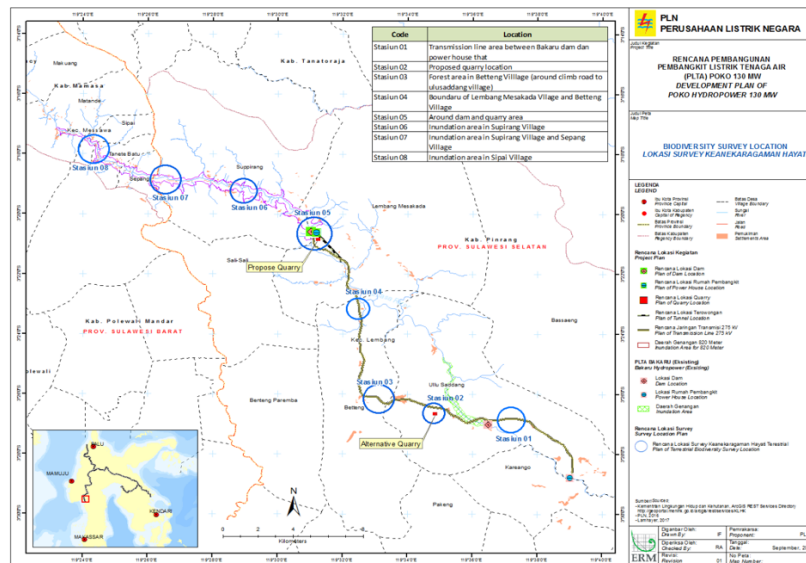


Figure 3.1. Sampling location of bird survey at poko hydropower project

3.3.1. Bird Census

Nine transects of 400 meter length are determined as sample observation. At every 100 m intervals along the transect, all bird calls or sightings are recorded over 20 minutes. This is conducted to provide a quantitative measure of species relative abundance. Bird species identified are listed during daily observation to obtain comprehensive inventory. Fewer species will be added as the total list becomes more complete.

3.3.2. Interviews

Interviews are conducted with local guides and communities to obtain more comprehensive data on bird species inventory.

3.3.3. Data analysis

Data from the bird census are used to calculate the following ecological measures:

Species Diversity Index

The Shannon index (Magurran, 1988) describes bird species diversity along the different transects:

$$H = -\sum p_i \ln p_i$$

in which p_i is the number of individuals of species divided by the total number of individuals. Species diversity is influenced by its components, Species Richness (number of species in the sample) and Evenness (also called Equitability). The following formula is used:

$$E = H/H_{\max}$$

in which $H_{\max} = -\log 1/n$ (n = number of species in the sample).

Bird Dominance Values

Bird species with numbers of individuals dominant (Helvoort, 1981) by formula

$$. D = \frac{n_i}{N} \times 100 \%$$

Where

D = Birds species dominant

n_i = Individual number of certain species

N = Total individual number

Similarity Index

The Jaccard similarity index (S) (in Mueller-Dombois and Ellenberg, 1974) shows the change in species composition among different samples (i.e. along the different transects):

$$S = \frac{c}{a+b+c}$$

in which **a** and **b** are numbers of species that is unique to samples **1** and **2** respectively, and **c** is species common to both.

Dendrogram was used for clustering analysis of bird community in each habitat at sampling site. Minitab SPSS 14 is used to help process clustering analysis.

IV RESULT AND DISCUSSION

4.1. Result

4.1.1. Bird Habitat

The habitat type of birds in Poko hydropower project is divided into several types such as: Forested area (secondary mix forest), coffee plantation, chocolate plantation, shrubs, riparian forest, ladang, mix timber plantation, paddy field and kampoong . Most of birds species found in the study area have correlation with the existing habitat.

A. Forested Area

The foreted area is one of bird habitat at Poko hydropower project (**Figure 4.1**). Most of lands around the Poko hydropower project area are surrounded by forested area. The project area most covered by the forested area. Some birds species found at this area are white necked myna (*Streptocitta albicolis*), brown cuckoo dove (*Macropygia amboinensis*), black napped fruit dove (*Ptilinopus melaspila*). sulwesi serpent eagle (*Spilornis rufipectus*), black eagle (*Ictinaetus malayensis*), knobbed hornbill (*Rythiceros cassidix*), yellow billed malkoha (*Phaenicophaeus calyorrhynchos*) brown throated sunbird (*Anthreptes malacensis*), yellow side flowerpecker (*Dicaeum aureolimbatum*)

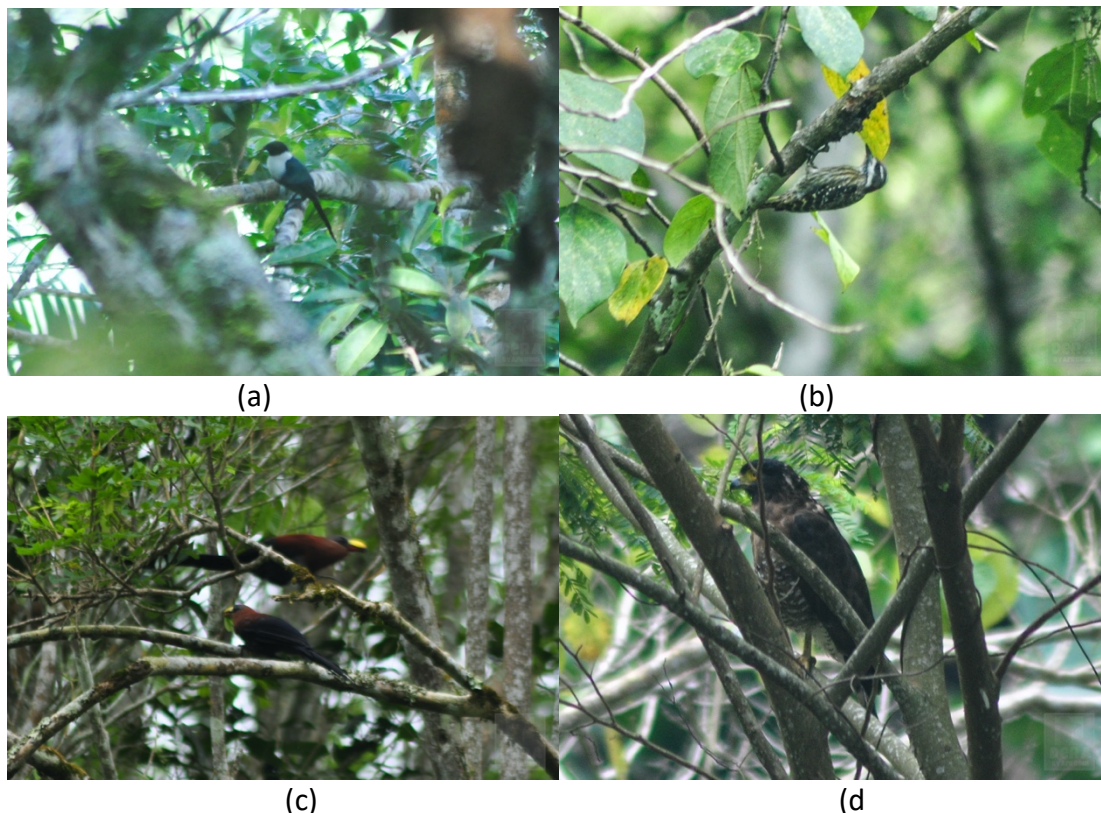


Figure 4.1 . White necked Myna (*Streptocitta albicolis*) (a) Sulawesi woodpecker (*Dendrocopos temminkii*) (c) yellow billed malkoha (*Phaenicophaeus calyorrhynchos*) and (d) sulawesi serpent eagle (*Spilornis rufipectus*) in forested area

B. Small stream, Corn Plantation

Corn plantation as one of habitat types for bird species of Poko hydropower project area. Corn is planted vegetation in ladang (**Figure 4.2**). Besides corn plantation, other habitat type is small stream left and right side of stream vegetations that grow several vegetation. The birds species occurred at this habitat types such as White collared kingfisher (*Halcyon chloris*), and blue eraed kingfisher (*Alcedo meninting*).

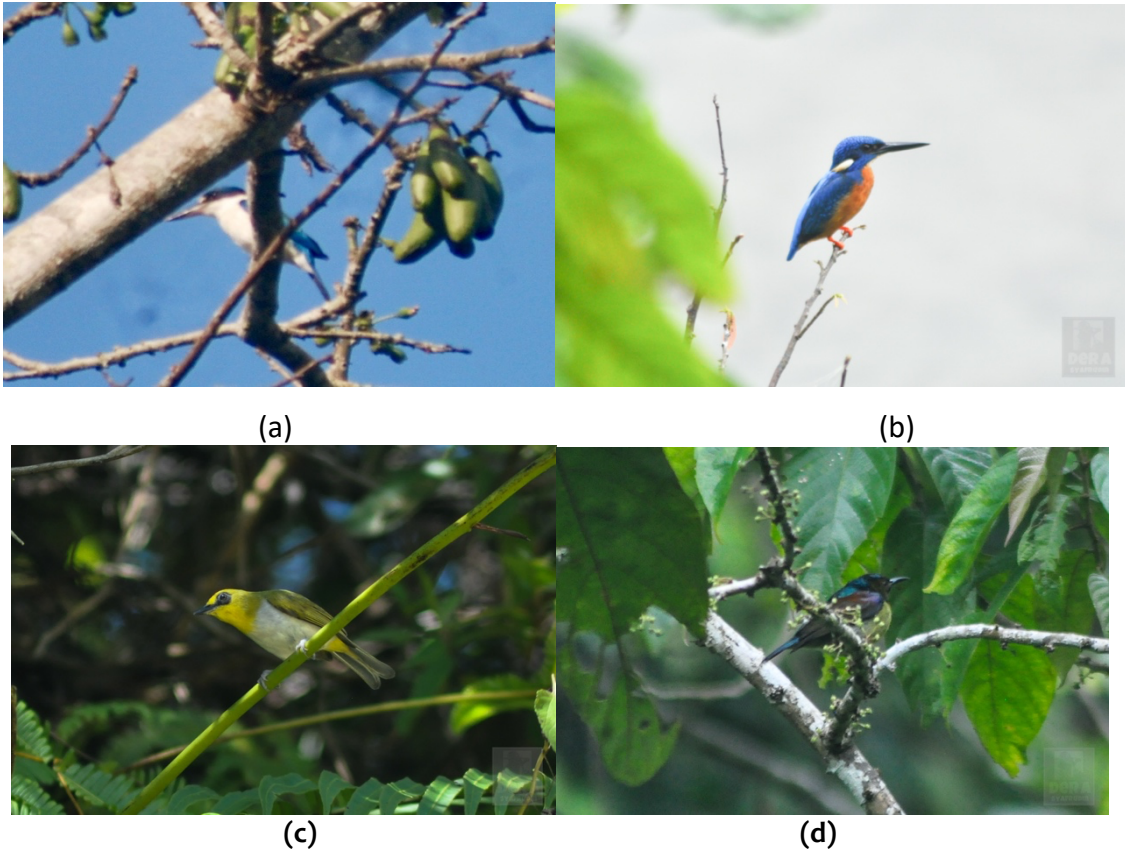


Figure 4.2. White collared kingfisher (*Halcyon chloris*) (a) blue eared kingfisher (*Alcedo meninting*) (b) black ring white eye (*Zosterops anomalus*) (c) and brown throated sunbird (*Anthreptes malacensis*) found in Small stream where are surrounded by corn plantation

C. Forest plantation, Coffee plantation and chocolate plantation

Forest plantation, coffee plantation and chocolate plantation as birds habitat types is found at the hydropower project area (**Figure 4.3**). The bird occurred at this area such as crimson sunbird (*Aethopyga siparaja*), black sunbird (*Nectarinia aspasia*), and grey side flowe pecker (*Dicaeum celebicum*).



(a)

(b)

Figure 4.3. crimson sunbird (*Aethopyga siparaja*) (a) black sunbird (*Nectarinia aspasias*) found in coffe plantation and chocolate plantation

D. Secondary Growth, open area

This habitat types are observed around ladang at the project area (**Figure 4.4**). Dominant vegetation observed such as *ficus sp*, *Trema orientalis*, and *other pioneer species*. Birds species found at this habitat types are lesser coucal (*Centropus bengalensis*), scaly breasted munia (*Lonchura punctulata*), golden headed cisticola (*Cisticola exilis*).



(a)

(b)

Figure 4.4. golden headed cisticola (*Cisticola exilis*) (a) scaly breasted munia (*Lonchura punctulata*) (b) in secondary growth habitat

E. Riparian/River side area, paddy field

Riparian ferers to areas adjacent to a water body, including lakes, river and ponds. While in the study area, this habitat types is located at the river bank sides inhabited by vegetations (**Figure 4.5**). Riparian habitats that are observed include river bank of Mamasa River, also paddy field in station 6, 7 and 8. The bird found at this habitat types are white breasted waterhen (*Amaurornis phoenicurus*), javan pound heron (*Ardeola speciosa*), and cattle egret (*Bubulcus ibis*)

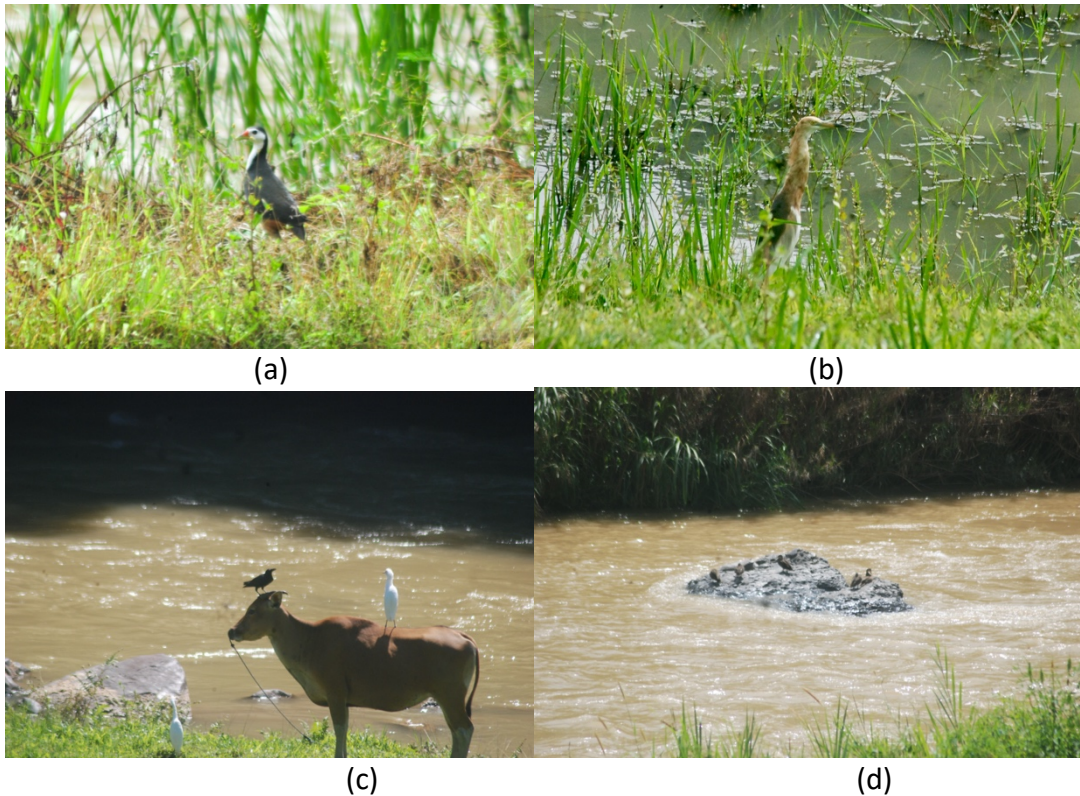


Figure 4.5. White breasted waterhen (*Amaurornis phoenicurus*) (a) javan pond heron (*Ardeola speciosa*) (b) cattle egret (*Bubulcus ibis*) (c) pacific black duck (*Anas superciliosa*) (d) in Riparian/river bank birdhabitat type

F. Kampong surrounded Forest

There are several kampongs included at the study area. In general the kampong was surrounded by forested area. The kampong is also *as birds habitat type*. The bird species found at this habitat types such are slender bill crow (*Corvus enca*), olive backed sunbird (*Nectarinia jugularis*), Brown throated sunbird (*Anthreptes malacensis*) and Asian glossy starling (*Aplonis panayensis*)



Figure 4.6. slender bill crow (*Corvus enca*) (a) olive backed sunbird (*Nectarinia jugularis*) (b)

4.1.2. Species Abundance, Diversity and Evenness

Base on direct observation and interviews, species richness of bird in the poko hydropower project area is significant on number of bird species related to the habitat types. Total species of bird was found 65 birds species and 34 family (**Table 4.1**).

Table 4.1. The species of bird found in the poko hydropower project area

No	Family and Species	Name	Local name	Common Name	Information
1	Ardeidae 1. <i>Ardea purpurea</i> 2. <i>Ardeola speciosa</i> 3. <i>Bubulcus ibis</i>	Cangak merah Blekok Kuntul Kerbau	Korong	Purple Heron Javan Pond Heron Cattle Egret	St 1,7,8 St 6,7,8 St 6,7,8
2	Accipitridae 1. <i>Haliaeetus indus</i> 2. <i>Spilornis rufipectus</i> 3. <i>Accipter griceiceps</i> 4. <i>Accipter nanus</i> 5. <i>Ictinaetus malayensis</i> 6. <i>Spizaetus lanceolatus</i>	Elang Bondol Elang Ular Sulawesi Elang Alap Kepala Kelabu Elang Alap Kecil Elang Hitam Elang Sulawesi	Lakan Sikko	Brahminy Kite Sulawesi Serpent Eagle Sulawesi Goshawk Small Sparrowhawk Black Eagle Sulawesi Hawk Eagle	St 1,2,3,4,5,6,7,8 St 1,2,3, 5,6 8, E St 2, E St 1, E St 2, 4,5,6, 8 BM St 1,2, 3, 6, BM, E
3	Falconidae 1. <i>Falco moluccensis</i>	Alap-alap Sapi		Spotted Kestrel	St 6
4	Anatidae 1. <i>Anas superciliosa</i>	Itik Gunung	Undan	Pacific Black Duck	St Mamasa 1,6,7,8
5	Phasianidae 1. <i>Gallus gallus</i>	Ayam Hutan	Kala	Red Jungle Fowl	St 1,2,3,4,5,6,7,8,BM
6	Turnicidae 1. <i>Turnix maculosa</i> 2. <i>Turnix susciator</i>	Gemak Totol Gemak Loreng		Red Backed Butongquail Barred Butongquail	St 2 St 2,3,6,7,8
7	Rallidae 1. <i>Amaurornis phoenicurus</i>	Kareo	Kararuak	White breasted Water Hen	St 6,7,8
8	Columbidae 1. <i>Turacoena manadensis</i> 2. <i>Macropygia amboinensis</i> 3. <i>Ptilinopus melanospila</i> 4. <i>Streptopelia chinensis</i>	Merpati Hitam Sulawesi Uncal Ambon Walik Kembang Tekukur	Cat Pili Buku buku	White Face Dove Brown Cuckoo Dove Black Naped Friutdove Spotted Dove	St 1,2,3, 6, 8 BM,E St,1,2,3,4,5,6,7,8 St,1,2,8 BM St 6
9	Psittacidae 1. <i>Trichoglossus flavoviridis</i> 2. <i>Tanygnathus megalorhynchos</i> 3. <i>Loriculus stigmatus</i>	Perkici kuning hijau Betet kelapa paruh besar Serindit Sulawesi		Citrine lorikeet Great Bill Parrot Great Hanging Parrot	St 3,7,8 BM,E St, 6,7,8 BM BM,E
10	Cuculidae 1. <i>Cacomantis merulinus</i> 2. <i>Cacomantis sepulclaris</i> 3. <i>Surniculus lugubris</i> 4. <i>Phaenicophaeus calyrorhynchos</i> 5. <i>Centropus bengalensis</i>	Wikwik Kelabu Wikwik uncuing Kedasi Hitam Kadalan Sulawesi Bubut Alang	Sareseh Kalukung	Plaintive Cuckoo Rusti breated Cuckoo Drongo Cuckoo Yellow Billed Malkoha Lssser Coucal	St 6 St 1 St 5,7 St 1,2,3,4,5,6,7,8 BM, St,1,2,3,4,5,6,7,8 BM
11	Strigidae 1. <i>Otus manadensis</i>	Celepuk Sulawesi		Sulawesi Scop Owl	St 1, 3 E
12	Caprimulgidae 1. <i>Eurostopodus macrotis</i>	Taktarau Hutan		Great eared NightJar	St 5
13	Apodidae 1. <i>Collocalia esculenta</i> 2. <i>Collocalia fusciphaga</i>	Walet Sapi Walet Sarang Putih	Sariti	Glossy Swiftlet Edible Nest Swiftlet	St,1,2,3,4,5,6,7,8 BM St,1,2,3, 5,6,7,8 BM
14	Hemiprocnidae 1. <i>Hemiprocne longipenis</i>	Tapekong Jambul		Grey Rumped Treeswift	St 1,2,3,4,7
15	Alcedinidae 1. <i>Alcedo meninting</i> 2. <i>Ceyx fallax</i> 3. <i>Cittura cyanotis</i> 4. <i>Halcyon chloris</i>	Raja udang Meninting Raja udang Merah Raja udang pipi ungu Cekaka Sungai	Sekeng	Blue Eared Kingfisher Sulawesi dwarf Kingfisher Lilac Kingfisher Collared Kingfisher	St,1,2,3,5,6,7,8 BM St 2, E St 1, E St,1,2,3,4,5,6,7,8 BM
16	Bucerotidae	Julang Sulawesi	Alo	Knobbed Hornbill	St,1,2,3,4, BM E

	1. <i>Rhyticeros cassidix</i>				
17	Picidae 1. <i>Dendrocopus temminckii</i> 2. <i>Mullerpicus fulvus</i>	Caladi Sulawesi Pelatuk Kelabu Sulawesi		Sulawesi Woodpecker Ashy Woodpecker	St 1, 5, E St BM, E
18	Pittidae 1. <i>Pitta erythrogaster</i>	Paok Mopo		Red bellied Pita	St 4
19	Hirundinidae 1. <i>Hirundo tahitica</i>	Layang Batu	Celeng celeng	Pacific Swallow	St,1,2,3,4,5,6,7,8 BM
20	Campephagidae 1. <i>Coracina temminckii</i>	Kepodang Sungu Biru		Caerulean Cuckoo Shrike	St 1 BM,E
21	Pycnonotidae 1. <i>Pycnonotus aurigaster</i>	Cucak Kutilang		Scooty Headed Bulbul	St 1,4,5,6,7
22	Timaliidae 1. <i>Trichastoma celebence</i>	Pelanduk Sulawesi		Sulawesi Babbler	St,1,2,3, 5, 7,8 BM E
23	Sylviidae 1. <i>Cisticola excilis</i>	Cici Merah		Golden Head Cisticola	St BM, 7,8
24	Muscicapidae 1. <i>Muscicapa griseisticta</i>	Sikatan Burik		Grey Stricket Flycatcher	St 5
25	Acanthizidae 1. <i>Gerygone sulphurea</i>	Remetuk Laut		Golden-bellied Gerygone	St 1,3,4,5,6,7,8 BM
26	Dicaeidae 1. <i>Dicaeum aureolimbatum</i> 2. <i>Dicaeum nehrkorni</i> 3. <i>Dicaeum celebicum</i>	Cabai Panggul-kuning Cabai Sulawesi Cabai panggul kelabu		Yellow-sided Flowerpecker Crimson-crowned Flowerpecker Grey sided Flowerpecker	St,1,2,3,4,5,6,7,8 BM St 1 E St,1,2,3,4,5,6,7,8 BM
27	Nectariniidae 1. <i>Anthreptes malacensis</i> 2. <i>Nectarinia jugularis</i> 3. <i>Nectarinia aspasia</i> 4. <i>Aethopyga siparaja</i>	Burungmadu Kelapa Burungmadu Sriganti Burungmadu Hitam Burungmadu Sepah-raja	Cui Dabu	Brown-throated Sunbird Olive-backed Sunbird Black Sunbird Crimson Sunbird	St,1,2,3,4,5, 7,8 BM St,1,2,3,4,5,6,7,8 BM St,1,2,3,4 BM St,1,2,3, 6, 8 BM
28	Zosteropidae 1. <i>Zosterops anomalus</i> 2. <i>Zosterops chloris</i>	Kacamata Makasar Kacamata laut	Cui Belek Sirere	Black-ringed White-eye Lemmon Bellied White-eye	St,1,2,3,4,5,6,7,8 BM, St,1,2,3,4,5,6,7,8 BM
29	Estrildidae 1. <i>Lonchura punctulata</i> 2. <i>Lonchura malacca</i>	Bondol Peking Bondol Rawa	Dongi-dongi	Scaly-breasted Munia Black headed Munia	St, 2, 5,6,7,8 St, 6,7,8
30	Ploceidae 1. <i>Passer montanus</i>	Burunggereja Erasia		Eurasian Tree Sparrow	St 1,3,4,5,7,8
31	Sturnidae 1. <i>Aplonis panayensis</i> 2. <i>Streptocitta albicolis</i>	Perling Kumbang Blibong Pendeta	Kurik Kurik	Asian Glossy Starling White-necked Myna	St,1,2,3,4,5,6,7,8 BM St 3, BM,E
32	Dicruridae 1. <i>Dicrurus hottentottus</i>	Srigunting Jambul-rambut	Cicipang	Hair-crested Drongo	St,1,2,3,4,5,6,7,8 BM
33	Artamidae 1. <i>Artamus leucorhynchus</i>	Kekep Babi		White-breasted Woodswallow	St 1, 2, 3,
34	Corvidae 1. <i>Corvus enca</i> 2. <i>Corvus typicus</i>	Gagak Hutan Gagak Sulawesi	Kakaok	Slender-billed Crow Pipin Crow	St 1,3,4,6,7,8 St BM,E

Legend

St = Station 1, 2, 3,.....8 = Number of station BM + Ben Mark station E = Endemic

The species birds diversity is categorized as medium to high level of diversity index. The evenness index is included to good level. Species abundance, bird diversity and the evenness are significant in relation with forested area.

Table 4.2 Number of birds species, diversity and evenness in observation station of the poko hydropower project area

No	Observation Area	Species Number	Diversity Index (H')	Evenness Index E
1	Stasiun 1	40	3.43	0.92
2	Stasiun 2	34	3.20	0.91
3	Stasiun 3	34	3.25	0.92
4	Stasiun 4	25	2.95	0.92
5	Stasiun 5	30	3.13	0.92
6	Stasiun 6	35	3.31	0.93
7	Stasiun 7	36	3.27	0.91
8	Stasiun 8	35	3.33	0.92
9	Ben mark	33	3.25	0.94

4.1.3. Bird Status

The total birds species found at the property are listed at **Table 4.2**. The number birds species protected by GOI found at the study area is 10 species, they are 1) Sulawesi serpent eagle (*Spilornis rufipectus*), 2) Sulawesi goshawk (*Accipiter greiseiceps*), 3) Black eagle (*Ictinaetus malayensis*), 4) Small sparrowhawk (*Accipiter nanus*), 5) Brahminy kite (*Haliastur indus*), 6) Sulawesi hawk eagle (*Spizaetus lanceolatus*), 7) Spotted kestrel (*Falco moluccensis*) 8) Sulawesi scop owl (*Otus manadensis*) 9) Knobbed hornbill (*Rhyticeros cassidix*), 10) crimson sunbird (*Aethopyga siparaja*)

Other birds species are recorded as migratory birds from northern hemisphere not found during the inventory at the study area. The endemic bird found in project area are Sulawesi serpent eagle (*S rufipectus*), Sulawesi goshawk (*A greiseiceps*), Dwarf sparrowhawk (*A nanus*), Sulawesi hawk eagle (*S lanceolatus*), white faced dove (*Turacoena manadensis*), citrine lorikeet (*Trycoglossus flavoviridis*), great hanging parrot (*Loriculus stigmatus*), yellow billed malkoha (*P calyrorhynchos*), Sulawesi scop owl (*O manadensis*), Sulawesi dwarf kingfisher (*Ceyx fallax*), Lilac kingfisher (*Cytura cyanotis*), Knobbed hornbill (*R cassidix*), ashy woodpecker (*Mulleripicus fulvus*), Sulawesi pygmy woodpecker (*Dendropus temminckii*), caerulean cuckoo shrike (*Coracina temminckii*), yellow sided flowerpecker (*Dicaeum aerolimbatum*), crimson crowned flowerpecker (*Dicaeum nehrkorni*), grey sided flowerpecker (*Dicaeum celebicum*), black ring white eye (*Zosterops anomalus*). White necked myna (*Streptocitta albigolis*), piping crow (*Corvus typicus*)

Two bird species found at the project area are classified as near threatened birds according to IUCN Red List database such as 1) Dwarf sparrow hawk (*A nanus*), 2) Sulawesi dwarf kingfisher (*Ceyx fallax*), and knobbed hornbill (*R cassidix*) as Vulnerable.

Furthermore, there are ten bird species categorized at CITES Appendix II, those are 1) Sulawesi serpent eagle (*Spilornis rufipectus*), 2) Sulawesi goshawk (*Accipiter greiseiceps*), 3) Black eagle (*Ictinaetus malayensis*), 4) Small sparrowhawk (*Accipiter nanus*), 5) Brahminy kite (*Haliastur indus*), 6) Sulawesi hawk eagle (*Spizaetus lanceolatus*), 7) Spotted kestrel (*Falco moluccensis*), Sulawesi scop owl (*Otus manadensis*), citrine lorikeet (*Trycoglossus flavoviridis*), great hanging parrot (*Loriculus stigmatus*), great billed parrot (*Tanygnathus magalorhynchos*)



(a)



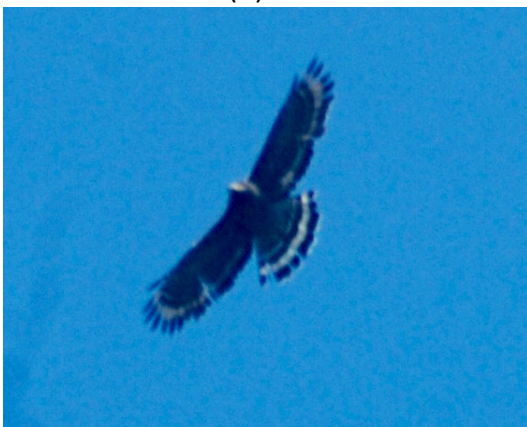
(b)



(c)



(d)



(e)



(f)



(g)

Figure 4.9. Black eagle (*Ictinaetus malayensis*) (a) Sulawesi goshawk (*Accipiter greiseiceps*) (b) Brahminy kite (*Haliastur indus*) (c) Sulawesi hawk eagle (*Spizaetus lanceolatus*) (d) Sulawesi serpent eagle (*Spilornis rufipectus*), Spotted kestrel (*Falco moluccensis*) drawf sparrow hawk (*Accipiter nanus*) are protected by GOI and listed in CITES Appendix

4.1.4. Bird Structure

The bird structure communities at study area can be indicated from the trophic level or bird feeding guild. The bird feeding guild at Poko hydropower project area is recorded at **Figure 4.11**. Insectivores bird is dominant species observed at whole station observation.

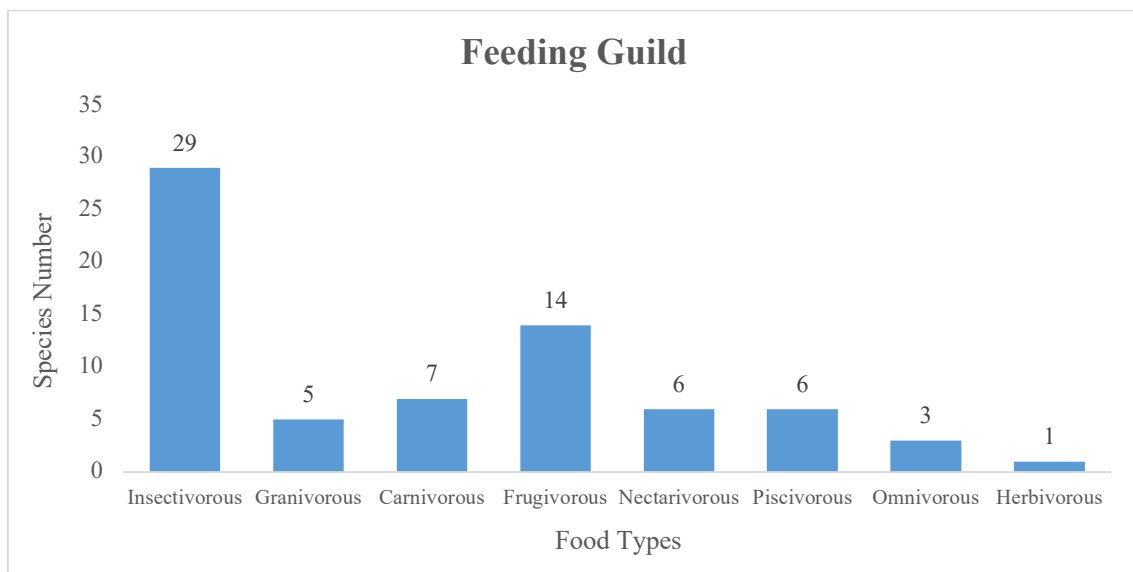


Figure 4.11. Chart of bird feeding guild at Poko

4.1.5. Bird Dominancy

There are 14 dominant of bird species occurred at the project area such as 1) Glossy swiftlet (*Collocalia esculenta*), 2) Asian glossy starling (*Aplonis panayensis*), 3) Pasific swallow (*Hirundo tahitica*), 4) Balck ring white eye (*Zosterops anomalus*), 5) scaly breated munia (*Lonchura punctulata*), 6) yellow sided flowerpecker (*Dicaeum areolimbatum*), 7) olive backed sunbird (*Nectarinia jugularis*) 8) Eurasian tree sparrow (*Passer montanus*), 9) lemon belied white eye (*Zosterops chloris*), 10) Slender bill crow (*Corvus enca*), 11) edible nest swiftlet (*Collocalia fusciphaga*), 12) grey rumped tree swift (*Hemiprocne longipennis*), 13) grey sided flowerpecker

(*Dicaeum celebicum*) and brown throated sunbird (*Anthreptes malacensis*). Correlation between importance value index (IVI) of bird species and individual number at the study area is presented at **Figure 4.13**.

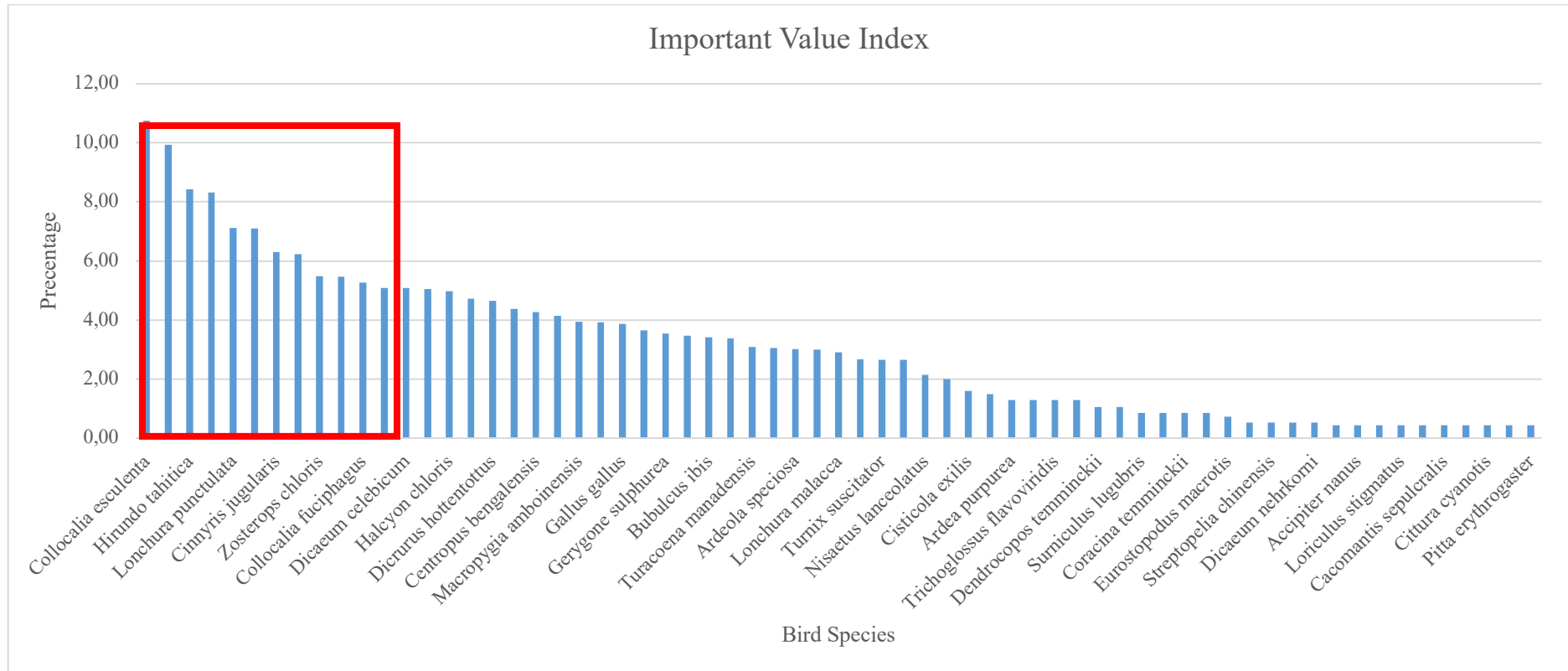


Figure 4.13. Correlation between importance value index of bird species and individual number at the project area

4.1.7. Similarity of Bird Community

The similarity of birds community at sample area determined in Poko hydropower project area is presented at **Figure 4.14**. Birds community clustering at sample area is divided into 8 cluster as follows:

1. **Cluster 1** is ST 7- ST8 (similarity around 80.50 %)
2. **Cluster 2** is ST4- ST5 (similarity approximately 78.81 %),
3. **Cluster 3** is ST2 - ST3 (similarity approximately 78,81 %)
4. **Cluster 4** is cluster 1 linkage to ST 6 (similarity around 75.40 %)
5. **Cluster 5** is cluster 3 linkage to ST 1 (similarity approximately 75.40%)
6. **Cluster 6** is cluster 5 linkage to benchmark (similarity around 62.50%),
7. **Cluster 7** is cluster 2 linkage to cluster 6 (similarity approximately 59.00%) than
8. **Cluster 8** is cluster 4 linkage to cluster 7 (similarity around 35.73 %).

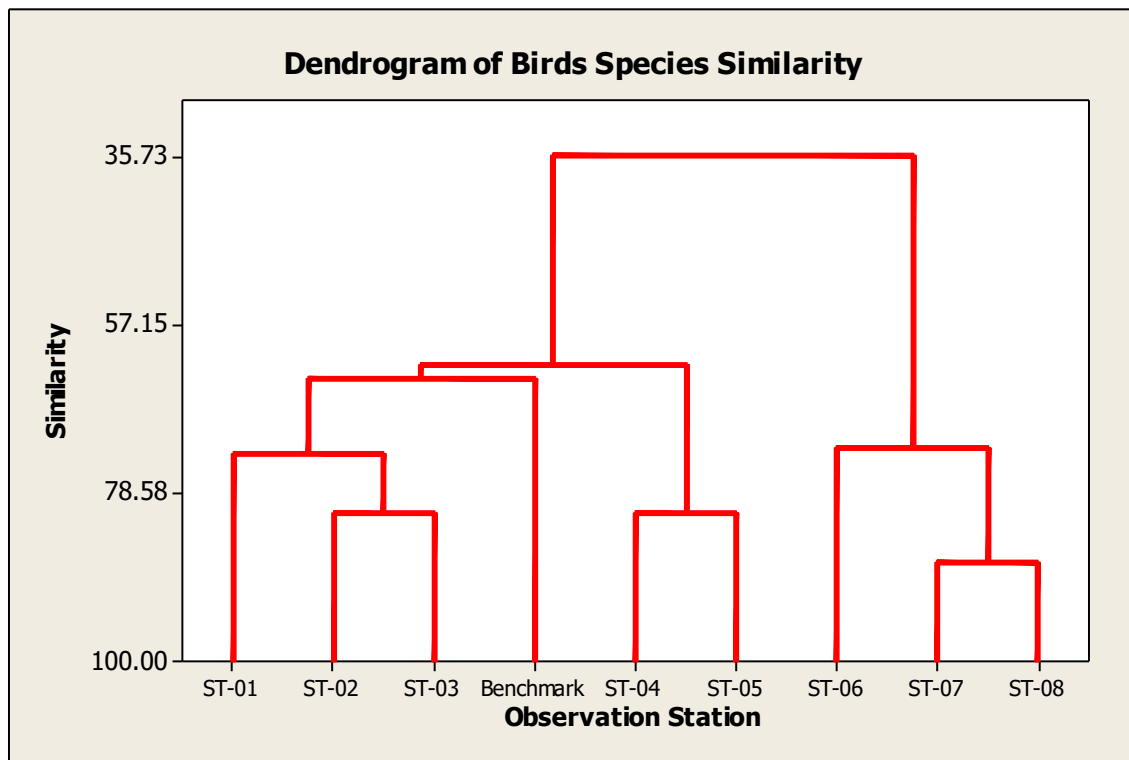


Figure 4.14. Dendrogram bird community at sample area at Poko hydropower project area

The cluster illustrated relationship between habitat type with bird communities. In general the cluster 6 (ST2,ST3 and ST1) showed that forested habitat influenced to bids communities, but for cluster 4 paddy field habitat type influenced to bids communities at Station 6, 7 and 8.

4.2. Discussion

4.2.1. Habitat Types and Diversity

Poko hydropower project area have varied habitat types. The habitat types have significant difference on species number of bird. But in general forested area much influenced to bird communities. Base on the analysis, it can be divided into two groups; habitat types possessing low species number of birds and habitat types possessing moderate number of birds species.

The bird habitat types that have low number of birds species are shrubs/open area, plantation area a, and secondary growth degraded forest. These habitats types have around 10-13 number of bird species. Meanwhile, habitat types such as forested area (natural and plantation area are classified as types that posses moderate number of bird species with total species number found around 23 – 33 species. This phenomenon is similar to birds diversity, which also has close correlation with habitat types condition. The highest bird diversity is observed in mixture forested habitat types. It seems that occurred forested area significantly influenced species abundance. The birds diversity will increase if the habitat type composed with forest vegetation

4.2.2. Conservation Status

The number of protected bird species observed at hydropower area are quite high (around 15.38 % of total bird species found at the project area). Among birds species found at Poko hydropower project area, 10 species are classified as protected species by GOI regulation (Permen LHK 20/2018). From those birds species identified (65 species), they are also categorized as Near Threatened (NT) base don Red List Database of IUCN (2009) such as such as 1) Drawf sparrow hawk (*A nanus*), 2) Sulawesi dwarf kingfisher (*Ceyx fallax*), and knobbed hornbill (*R cassidix*) as Vulnerable. Furthermore, some species are also listed in Appendix II CITES such as 1) Sulawesi serpent eagle (*Spilornis rufipectus*), 2) Sulawesi goshawk (*Accipiter greiseiceps*), 3) Black eagle (*Ictinaetus malayensis*), 4) Small sparrowhawk (*Accipiter nanus*), 5) Brahminy kite (*Haliastur indus*), 6) Sulawesi hawk eagle (*Spizaetus lanceolatus*), 7) Spotted kestrel (*Falco moluccensis*), Sulawesi scop owl (*Otus manadensis*), citrine lorikeet (*Trycoglossus flavoviridis*), great hanging parrot (*Loriculus stigmatus*), great billed parrot (*Tanygnathus magalorhynchos*). .

4.2.3. Feeding Guild and Dominancy

Most of the bird species observed at Poko hydropower project area are categorized as insectivores bird (approximately 46.20 %) and frugivores bird (around 21.54 %). The dominant bird species found at Poko hydropower project area are such as 1) Glossy swiftlet (*Collocalia esculenta*), 2) Asian glossy starling (*Aplonis panayensis*), 3) Pasific swallow (*Hirundo tahitica*), 4) Balck ring white eye (*Zosterops anomalus*), 5) scaly breated munia (*Lonchura punctulata*), 6) yellow sided flowerpecker (*Dicaeum areolimbatum*), 7) olive backed sunbird (*Nectarinia jugularis*) 8) Eurasian tree sparrow (*Passer montanus*), 9) lemon belied white eye (*Zosterops chloris*), 10) Slender bill crow (*Corvus enca*), 11) edible nest swiftlet (*Collocalia fusciphaga*), 12) grey rumped tree swift (*Hemiprocne longipennis*), 13) grey sided flowerpecker (*Dicaeum celebicum*) and brown throated sunbird (*Anthreptes malacensis*).

4.2.4. Similarity Communities

From dendrogram analysis, it shows that bird community at Poko hydropower project area have 8 clusters based on similarity index to bird habitat types. The birds community of cluster1, cluster 2, and cluster 3 have similarity of > 80 %, it seems that communities quite similar in species. Because of species bird at that cluster mostly forest dependent birds It is also concluded that bird community is composed by birds that adapts to forest. In the future bird communities at Poko hydropower development project will not much change to forest dependent birds.

V. CONCLUSION AND RECOMENDATION

1. The total bird species found at the Poko hydropower project area are 65 species. Among them, 10 birds species are classified as protected by Government of Indonesia (GOI) regulation; 2 species are listed as near threatened based on the Red List Database of IUCN; and 14 species are listed in Appendix II by CITES.
 2. The bird diversity observed is varied that has correlation with habitat types. In general the birds diversity is influenced by the forested covered area at the Poko hydropower area.
 3. based on feeding guild analysis, the dominant bird at project area is insectivores bird. In addition, the most of bird species observed at the study area is categorized forest dependent bird.
 4. In order to develop Poko hydropower area, the data and information of bird diversity can be used as baseline data to be considered for maintaining environmental condition at the project area.
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