BIRDS AND MAMMALS SURVEY ON NICKEL MINING EXPLORATION AREA OF PT WEDA BAY NICKEL AT LIMESTONE AREA OF JOHRAH MOUNTAIN, WEDA DISTRICT, CENTRAL MALUKU PROVINCE

By
Jarwadi B. Hernowo

WILDLIFE ECOLOGY AND MANAGEMENT LABORATORY
DEPARTEMENT OF FOREST RESOURCES CONSERVATION AND ECOTOURISM
FACULTY OF FORESTRY IPB
2008

BIRDS AND MAMMALS SURVEY ON NICKEL MINING EXPLORATION AREA OF PT WEDA BAY NICKEL AT LIMESTONE AREA OF JOHRAH MOUNTAIN, WEDA DISTRICT, CENTRAL MALUKU PROVINCE

By
Jarwadi B. Hernowo

INTRODUCTION

Background

PT. WEDA BAY NICKEL (WBN) is company which held on nickel mining exploration at Halmahera island. PT WBN have licensed area statement of exploration around 54 874 ha at position N 00^0 27' 00" and N 00^0 50' 00", E 127^0 52' 30" and E 128^0 08' 30" at Weda District Maluku Province. Part of the concession is limestone area. Limestone is needed for processing to neutralizing acid mining at tailing area.

PT WBN has concerned to minimize negative impact on environmental issue for developing of the project area. The WBN started with fauna survey at limestone area to collect information and data in relation to birds and mammal present at the property.

From beginning state of exploration planning, PT WBN will comply with all regulations are used in Indonesia such as the biodiversity convention regarding to the biodiversity value of the limestone area. The limestone area will be developing to support activities nickel mining.

Objective of the Study

The birds and mammals survey at the limestone area of PT WBN at Weda District Maluku Province of Halmahera Island, is to gain

1. Basic information and data are related with species diversity of bids and mammals at the limestone area
2. Local distribution and abundances of bids and mammals
3. The status of bids and mammals at site study

STUDY AREA

The nickel mining exploration area of PT. Weda Bay Nickel (WBN) is located at central eastern part of the Halmahera island at (N 00^0 27' 00" and N 00^0 50' 00", E 127^0 52' 30" and E 128^0 08' 30"). The topography of the limestone area is mostly hilly and mountainous. Very few at the property have flat area. The valley was steep and the big portion of the project area with slope more than 45 %.

The project area is dissected by numerous small streams. Some rivers flow from the project area such as Ake Doma, Ake Sake, Ake Gemaf and Ake Sagea. The drainage pattern of the rivers was dendritic. All of the rivers at WBN concession flow to the South direction and joint with Weda Bay Banda Sea.

The average annual precipitation at WBN concession area was around 3.702 mm at altitude > 9 00 m above sea level and 2.561 mm at low land area. The high precipitation at July to September. Annual average temperature was 22. ^{0} C at high altitude but at low land area around 27 ^{0} C and average humidity was around 80%.

The soil at the project area have texture chalky loamy with white red iron color at limestone area, but non karsts dominated by brown grey color. Soil physically was crumb and soil deep is sallow at karsts area but deep at non limestone area. The soil at terrain area was alluvial, brown color and the solum was deep. The soil chemists at project area were classified a fertile soil.

The exploration area was developed on current vegetation mostly low land forest. Forest type of the project area can divided such as beach forest, low land forest at hilly area. Vegetation occurs at beach forest such as *Hibiscus tilliaceus, Syzigium sp, Pandanus tectorius*, and *Terminalia catappa*. The dominant vegetation at low land forest are, *Manilkara* spp, *Syzygium* spp, *Callophylum* spp and *Garcinia* sp.

Besides, low land forest, were present several wildlife habitat type at the property such as re- growth forest, ladang, kebun and home garden. Many coconuts planted at kebun and home garden.

METHODS

Location and Time

The study was conducted at PT WBN exploration area in Weda district. At least fourteen days for get data and information related to Birds and Mammals diversity, from 22 of May to 4 of June 2008. The observations were focused at forested area of Johrah mountain karsts area and non karsts forested area from camp 10 to camp Tanjung Ulie also Tanjung Ulie to water pump. The location of sample plot is mostly covered by tropical low land forest.

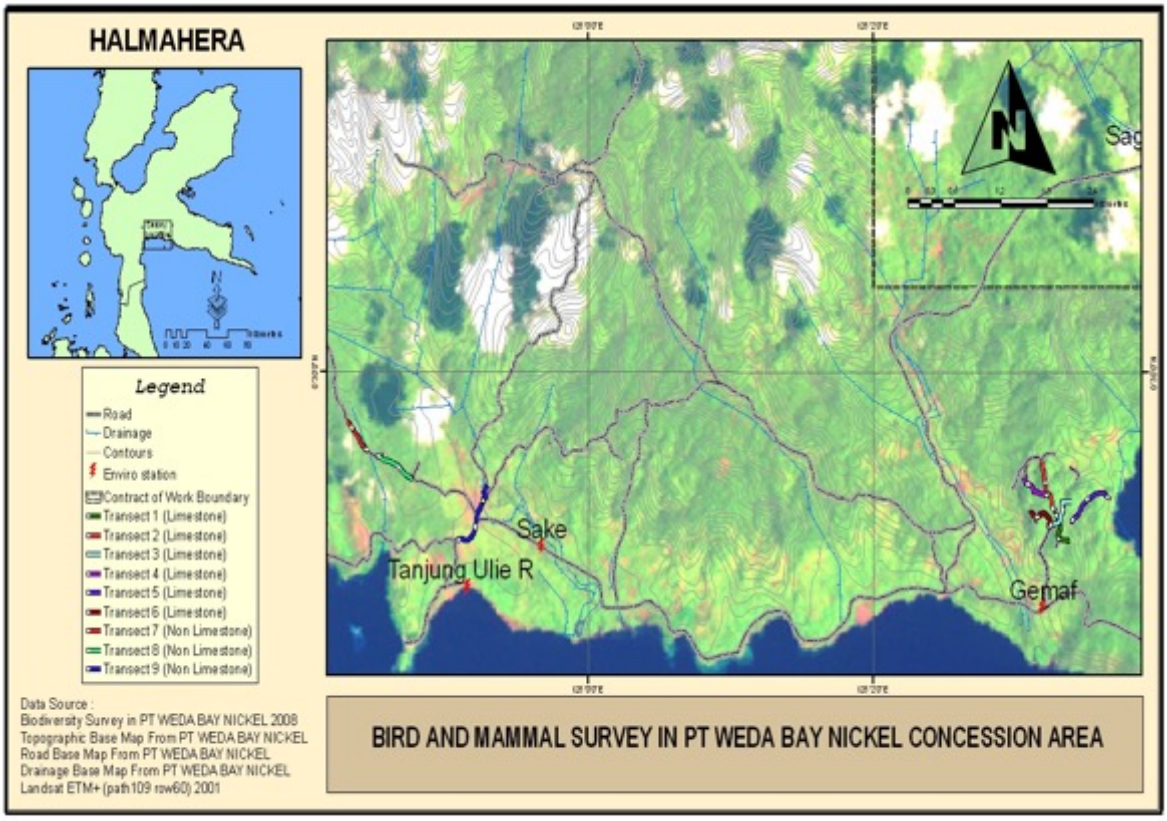

Figure 1. Transect of bird and mammals survey at PT WBN concession area.

Sample plot was selected at two block area at Johrah mountain karsts area and non karsts area surrounding camp 10 to Tanjung Ulie. The position of sample plot was recorded at table 1.

Table 1. Position of Transect at PT WBN concession area (karsts and non karsts)

No	Transect	Coordinate Position	
		Latitude North	Longitude East
	Karsts Area		
1	Limestone camp- GZ 11 **(LIM 1)**	00° 32' 45.7"	128° 01' 26.5"
2	GZ 11 + 400 m to Helipad 2 direction **(LIM 2)**	00° 34' 13.2"	128° 00' 52.2"
3	Cross Section 1 to GZ 13 **(LIM 3)**	00° 34' 43.3"	128° 59' 22.0"
4	Cross Section Helipad 2 to left + 400 m **(LIM 4)**	00° 35' 51.9"	128° 59' 00.8"
5	GZ 11 to Sagea Lake **(LIM 5)**	00° 36' 32.1"	128° 02' 03.0"
6	Cross Section 1 to left + 400 m **(LIM 6)**	00° 34' 01.4"	128° 59' 00.8"
	Non Karsts Area		
7	Camp 10 + 400 m to Camp Tj Ulie **(Non Karst 1)**	00° 36' 39.2"	127° 02' 35.1"
8	Cross Section Water pump + 400m to Camp 10 **(Non Karst 2)**	00° 37' 06.7"	127° 02' 13.2"
9	Cross Section Tj Ulie + 400m to Water Pump **(Non Karst 3)**	00° 37' 21.2"	127° 02' 46.7"

Equipment and Materials

Tools were used in this survey: Map of WBN Karsts concession area and surrounding area, GPS, compass, chronometer, binocular, tele-lens camera, and field guide to the birds of Wallacea (Coat B J and Bishop K D,1997), bat mist net and cage trap for rat.

Methods

The birds and mammals inventory was carried out by transect method combination with IPA count for birds. Seven transect were made at Johrah mountain karsts area and three transect at non karsts area surrounding camp 10. The each transect is 400 m length. The counting of individual numbers was based on direct visual contact or the animal track. Besides direct observation to wild animal, interview with local people was done to know about fauna occur at project area.

Besides direct and indirect observation, cage trap for rat (20 piece) and 1 mist net, also were used to help on identification which the animal are difficult to get by direct contact.

Bird Census

Seven transects of 400 meter length in each, has been laid out the low land forest of karsts area at Johrah Mountain and three transect at non karsts forest area from camp 10 to Tanjung Ulie camp. At 100 m intervals along each transect, all bird calls or sightings within 100 m from the observer were recorded over 20 minute periods. This provided a quantitative measure of the relative abundance of species. Daily species lists have been prepared as an indication of the comprehensiveness of the inventory: fewer species will be added as the total list becomes more complete.

Interviews

Semi-structured interviews with local guides/inhabitants provided information to make more completely the data.

Data analysis

Data from the bird censuses were used to calculate the following ecological measures:

Species Diversity Index

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

$$\mathbf{H = -\Sigma\ p_i\ ln\ p_i}$$

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 was used:

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

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

Similarity indices

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

$$\mathbf{S = c\ /\ a+b+c}$$

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

Dendrogram was used for analysis clustering bird's community in each habitat at sampling site. Minitab SPSS 14 was used on help process clustering analysis.

RESULTS AND DISCUSSION

RESULTS

Birds and Mammals Habitat

The habitat type of birds and mammals has been developed at PT WBN concession area, such as beach forest, mangrove, lowland forest at limestone area and non limestone, and secondary growth forest, kebun and ladang. Most of birds and mammals species, which are found in the project area, it have correlated with occurred of the forest.

Beach forest was dominated by vegetation such as, *Hibiscus tilliaceus*, *Terminalia cattapa*, and *Pandanus sp*. These forests occurred at long cost at southern part camp Tanjung Ulie, which it was direct bordered with Weda bay and it width is between 25 – 100 m. Bids species can be found at that habitat type such as; beach kingfisher and sacred kingfisher. Mangrove limited distributed at long cost of Weda bay with width around 20 – 50 m.

Lowland forest is largest habitat type at concession area in limestone hill area and alluvial soil (non karts). Vegetation dominant at limestone area *Manilkara sp, Syzygium sp,* and *Myristica sp*, but vegetation at alluvial soil dominated by *Calophyllum sp, Garcinia sp* and *Syzygium* sp. The wildlife were found at the habitat type at least 60 species of bird and.. mammals species.

Secondary re-growth forest occurred in the project area near Tanjung Ulie. Those forest have simple structure only one layer canopy. The dominant fauna species were found at the plantation area are bird's species. In this habitat type were found 25 bird species.

Kebun and ladang are wildlife habitat type occurred close to human settlement. The habitat has simple strata only have one storey. Some species of wildlife present at the forest, but the dominant is bird species.

Species Abundance

Base on direct observation and as well as interviews, species richness of wildlife/fauna in the project area is categories as medium level, but significant on number of bird species. Total species of wildlife were found 8 species of mammals, and 64 birds species.

Table 2. Wildlife/Fauna species recorded at concession area of PT WBN

Wildlife (Fauna)	Found at Low Land Forest of	Found at Low Land Forest	Found at Beach	Found at Secondary	Found at Kebun and

	Limestone Area at Johrah Mountain (Species)	Non Limestone of to Camp 10 (Species)	Forest and Mangrove (Species)	Re-Growth (species)	Ladang (Species)
Birds	43	28	32	34	15
Mammals	5	6	6	2	1

Birds

Among the wildlife species can be found at the concession area, birds are abundant at the number of species. The total birds species found at the property are listed at table 3. The number birds protected species were found at the project area is 19 species such as little egret (*Egretta garzetta*), cattle egret (*Bubulcus ibis*) brahminy kite (*Haliastur indus*), moluccan goshawk (*Accipiter henicogrammus*), meyer goshawk (*Accipiter meyerianus*), gurney eagle (*Aquila gurneyi*), oriental hobby (*Falco severus*), dusky scrubfowl (*Megapodius freycinet*), electus parrot (*Eclectus roratus*), common paradise kingfisher (*Tanysiptera galatea*), blue and white kingfisher (*Halcyon diops*) beach kingfisher (*Halcyon saurophaga*), sacred kingfisher (*Halcyon sancta*), azure kingfisher (*Alcedo azurea*), blyths hornbill (*Rhyticeros plicatus*), paradise crow (*Lycocorax pyrrhopterus*), wallace standardwing (*Semioptera wallacei*), dusky myzomela (*Myzomela obscura*), and olive backed sunbird (*Nectarinia jugularis*).

Figure 2. Moluccan goshawk (*Accipiter henicogramus*) at limestone area

Table 3. Bids species were found at PT WBN concession area

Family Species	Local Name	Common Name	Found and Frequency	Status
Ardeidae				
1. *Egretta garzetta**	Kuntul Kecil	Little Egret	+5Rr,	P
2..*Bubulcus ibis**	Kuntul Kerbau	Cattle Egret	+5Rr,	P
Accipitridae				
1. *Haliastur indus**	Elang Bondol	Brahminy Kite	+1Rr,+2Rr,+3Rr,+4Rr,	P
2. *Accipiter henicogrammus**	Elang Alap Halmahera	Moluccan Goshawk	+1Rr,	P
3. *Accipiter meyerianus**	Elang Alap Meyer	Meyers Goshawk	+1Vr,+3Vr,	P
4. *Aquila gurneyi**	Rajawali Kuskus	Gurneys Eagle	+1Vr	P
Falconidae				
1.*Falco severus**	Alap Alap macan	Oriental hobby	+5Rr	P
Anatidae				
1. *Tadorna radja*	Umukia Raja	White headed Shelduck	+4Rr,+5Rr	NP
Megapodidae				
1. *Megapodius freycinet**	Gosong Kelam	Dusky Scrubfowl	+1Rr,+2Rr,	P
Columbidae				
1. *Streptopelia chinensis*	Tekukur	Spotted Dove	+5Rr	NP
2.*Macropygia amboinensis*	Uncal Ambon	Slender-billed Cuckoo-Dove	+1Fr,+2Rr,+3Rr,+4Rr	NP
3.*Chalcophaps indica*	Delimukan	Emerald-Dove	+1Rr,+2Rr,+3Rr,+4Rr	NP
4. *Ptilinopus bernsteinii*	Walik dada Merah	Scarlet-breasted Fruit-Dove	+1Fr,+2Fr,+3Rr,+4Rr,	NP
5. *Ptilinopus monacha*	Walik Topi Biru	Blue-capped Fruit- Dove	+1Fr,+2Fr,+4Rr,	NP
6. *Ptilinopus hyogastra*	Walik Kepala Kelabu	Grey-headed Fruit- Dove	+1Rr,+2Rr,+3Rr,+4Rr,	NP
7. *Ptilinopus superbus*	Walik Raja	Superb Fruit-Dove	+1Rr,+2Rr,+4Rr	NP
8. *Ducula perspicillata*	Pergam Mata putih	White-eye Imperial Pigeon	+1Rr,+2Rr,+3Rr	NP
9. *Ducula basilica*	Pergam Boke	Cinnamon-bellied Imperial Pigeon	+1Fr,+2Fr,+3Rr,+4Rr,	NP
10. *Ducula bicolor*	Pergam Laut	Pied Imperial Pigeon	+1Rr,+3Rr,+4Rr	NP
Psittacidae				
1.*Eos squamata*	Nuri Kalung ungu	Violet –Necked Lory	+2Rr,+4Rr,	NP
2.*Trichoglosus haematodus*	Perkici Pelangi	Rainbow Lorikeet	+1Rr,	NP
3.*Charmosyna placentis*	Perkici Dagu Merah	Red Flanked Lorikeet	+2Rr,+4Rr	NP
4.*Cacatua alba*	Kakatua Putih	White Cockatoo	+1Rr,+2Rr,+4Rr,	NP
5. *Eclectus roratus**	Nuri Bayan	Eclectus Parrot	+1Fr,+2Rr,+3Rr,+4Fr,+5Rr	P
6. *Geoffroyus geoffroyi*	Nuri Pipi Merah	Red-Cheeked Parrot	+1Fr,+2Fr,+3Fr,+4Fr,+5Rr	NP
7.*Tanygnathus megalorhynchos*	Betet-Kelapa Paruh besar	Great –billed Parrot	+1Rr,	NP
8. *Alisterus amboinensis*	Nuri Raja Ambon	Moluccan King Parrot	+1Rr,	NP
9. *Loriculus amabilis*	Serndit Maluku	Moluccan Hanging Parrot	+1Rr,+2Rr,+3Rr,+4Rr,	NP
Cuculidae				
1. *Cacomantis variolosus*	Wik-wik Rimba	Brush Cuckoo	+1Rr,	NP
2. *Centropus goliath*	Bubut Goliat	Goliath Coucal	+1Fr,+2Rr,+3Rr,+4Rr,	NP
Apodidae				
1. *Collocalia esculenta*	Walet Sapi	Glossy Swiftlet	+4Fr,+5Rr	NP
2. *Collocalia vanikorensis*	Walet Polos	Uniform Swiftlet	+1Fr,+2Fr,+3Rr,+4Fr,+5Rr	NP
Alcediniidae				
1. *Tanysiptera galatea**	Cekakak Pita	Common Paradise Kingfisher	+3Vr,	P
2. *Halcyon diops**	Cekakak Biru Putih	Blue and White Kingfisher	+3Rr,+4Rr,+5Rr	P
3. *Halcyon saurophaga**	Cekakak Pantai	Beach Kingfisher	+3Rr,	P
4. *Halcyon sancta**	Cekakak Suci	Sacred Kingfisher	+3Rr,	P
5. *Alcedo azurea**	Raja udang Biru langit	Azure Kingfisher	?1Rr,+3Rr,	P
Meropidae				
1. *Merops ornatus*	Kirik-kirik Australia	Rainbow Bee-Eater	+1Vr,	NP
Coraciidae				
1. *Eurystomus azurea*	Tiong Lampu ungu	Purple Dollarbird	+3Rr	NP
Bucerotidae				
1. *Rhyticeros plicatus**	Julang Irian	Blyths Hornbill	+1Fr,+2Fr,+4Rr	P
Hirundinidae				
1. *Hirundo tahitica*	Layang Batu	Pacific Swallow	+3Rr,+4Rr	NP
Campephagidae				
1. *Coracina atriceps*	Kepudang Sungu Maluku	Moluccan Cuckoo Shrike	+1Fr,	NP
2. *Coracina parvula*	Kepudang Sungu Halmahera	Halmahera Cuckoo Shrike	+1Rr,	NP
3. *Coracina papuensis*	Kepudang Sungu Kartula	White billied Cuckoo Shrike	+3Rr,+5Rr	NP
4. *Lalage azurea*	Kapasan Halmahera	Rufous bellied Triller	+1Fr,+2Fr,+4Fr,	NP
Pycnonotidae				
1. *Ixos affinis*	Brinji Emas	Golden Bulbul	+1Fr,+2Fr,+3Rr,+4Fr,	NP
Dicruridae				

1. *Dicrurus bracteatus*	Srigunting Lencana	Spangled Drongo	+1Rr,+2Rr,+4Rr,	NP
Oriolidae				
1. *Oriolus phaeochromus*	Kepodang Halmahera	Dusky Oriole	+1Rr	NP
Corvidae				
1. *Corvus validus*	Gagak Halmahera	Long billed Crow	+1Rr,+3Rr,+4Rr,+5Rr	NP
2. *Lycocorax pyrrhopterus**	Gagak Cendrawasih	Paradise Crow	+2Rr,+3Rr,+4Rr,	P
Paradisaeidae				
1. *Semioptera wallacei**	Bidadari Halmahera	Wallace s Standardwing	+1Vr	P
Muscicapidae				
1.*Monarcha trivirgatus*	Kehicap Kacamata	Spectacled Monarch	+1Fr,+2Fr,+3Fr,+4Rr,	NP
2. *Piezorhynchus alecto*	Sikatan Kilap	Shining Flycatcher	+4Vr,	NP
3. *Rhipidura leucophris*	Kipasan Kebun	Willie Wagtail	+1Rr,+3Fr,+4Rr,+5Fr	NP
Pachycephalidae				
1. *Pachycephala pectoralis*	Kancilan Emas	Common Golden Whistler	+3Rr,+4Rr,	NP
2. *Pachycephala griseonota*	Kancilan Tunawarna	Drab Whistler	+1Rr,+2Rr,+3Rr,+4Rr,	NP
Sturnidae				
1. *Aplonis mysolensis*	Perling Maluku	Mollucan Starling	+5Rr	NP
Meliphagidae				
1.*Melitograis gilolensis*	Cikukua Halmahera	White Streaked Friarbird	+1Rr,	NP
2.*Myzomela obscura**	Myzomela remang	Dusky Myzomela	+1Rr,,+3Rr,+4Rr,	P
Nectariniidae				
1. *Nectarinia aspasia**	Br Madu Hitam	Black Sunbird	+1Fr,+2Fr,+3Fr,+4Rr,+5Fr	P
2. *Nectarinia jugularis**	Br Madu Sriganti	Olive backed Sunbird	+3Rr,+4Rr,+5Rr	P
Dicaeidae				
1. *Dicaeum erythrothorax*	Cabe dada Api	Flame breasted Flowerpecker	+1Rr,+2Rr,+3Rr,+4Rr,	NP
Zosteropidae				
1. *Zosterops atriceps*	Kacamata Halmahera	Cream-throated White Eyes	+1Rr,+2Rr,+4Rr,+5Rr	NP
Ploceidae				
1. *Lonchura molucca*	Bondol Maluku	Mollucan Munia	+4Rr,+5Rr	NP

Legend :

1. Low land Forest at limestone of Johrah mountain
2. Low land Forest at non limestone area
3. Beach and Mangrove Forest
4. Secondary Growth Forest
5. Kebun and Home garden

Mo = Molusca eater
I = insectivorous

\+ = found at sampling area
++ = found at sampling site with abundance
\- = not found at sampling site
? = not found at sampling site but most probably found
Hs = Honey sucker
Sf = Seed feeder
C = carnivore

NP = Non Protected species
P = Protected species
Sol = Solitary
O = omnivores
Fs = Fish eater

Fr = frequently found
Rr = rarely found
Vr = Very rare
E = Endemic
H = Herbivorous
F = Fruit feeder

Twenty one endemic bird species were found at the project area such as moluccan goshawk (*Accipiter henicogrammus*), Scarlet breasted fruit dove (*Ptilinopus bernsteinii*), blue capped fruit dove (*Ptilinopus monacha*), grey headed fruit dove (*Ptilinopus hyogastra*) cinnamon bellied imperial pigeon (*Ducula basilica*) white cockatoo (*Cacatua alba*), moluccan hanging parrot (*Loriculus amabilis*), goliath coucal (*Centropus goliath*), blue and white kingfisher (*Halcyon diops*), purple dollarbirds (*Eurystomus azurea*), moluccan cuckoo shrike (*Coracina atriceps*), halmahera cuckoo shrike (*Coracina parvula*), rufous bellied triller (*Lalage azurea*), golden bulbul (*Ixos affinis*), dusky oriole (*Oriolus phaeochromus*), long bill crow (*Corvus validus*), paradise crow (*Lycocorax pyrrhopterus*), wallace standardwing (*Semioptera wallacei*), white streaked friarbird (*Melitograis gilolensis*), flame breasted flowerpecker (*Dicaeum erythrothorax*) and cream throated white eyes (*Zosterops atriceps*).

Figure 3. *Lalage azurea* is one of endemic birds at Wallacean

Figure 4. *Ixos affinis* is dominant bird at sample area and endemic birds at Wallacean

Bird Structure

The bird's structure communities at project area can be derived from trophic level or bird guild structure. The bird guild at limestone area of Johrah mountain and non limestone area were recorded at table 5. Insectivores bird is dominant species at both sample area.

Table 4. Birds guild at sample area of limestone area of Johrah mountain and non Limestone area.

No	Guild	Limestone Area	Non Limestone Area
1	Insectivores	20	24
2	Frugivores	20	20
3	Seed feeder	0	2
4	Fischivores	1	5
5	Carnivores	4	1
6	Honey sucker	3	3
7	Omnivores	1	2

Figure 5. *Geofroyus geoffroyii* is one of birds dominant at the project area

Dominancy

There are 15 dominant of bird species occur at the project area such as golden bulbul (*Ixos affinis*), black sunbird (*Nectarinia aspasia*) blyth's hornbill (*Rhyticeros plycatus*), spangled drongo (*Dicrurus brachteatus*), cinnamon bellied imperial pigeon (*Ducula basilica*), red checked parrot (*Geoffroyus geoffroyii*), uniform swiftlet (*Collocalia vanikorensis*), scarlet breasted fruit dove (*Ptilinopus bersteinii*), eclectus parrot (*Eclectus roratus*), flame breasted flowerpecker (*Dicaeum erythrothorax*), goliath coucal (*Centropus goliath*) drab whistler (*Pachycephala griseonota*), white cockatoo (*Cacatua alba*), moluccan hanging parrot (*Loriculus amabilis*) and grey headed fruit dove (*Ptilinopus hyogastra*).

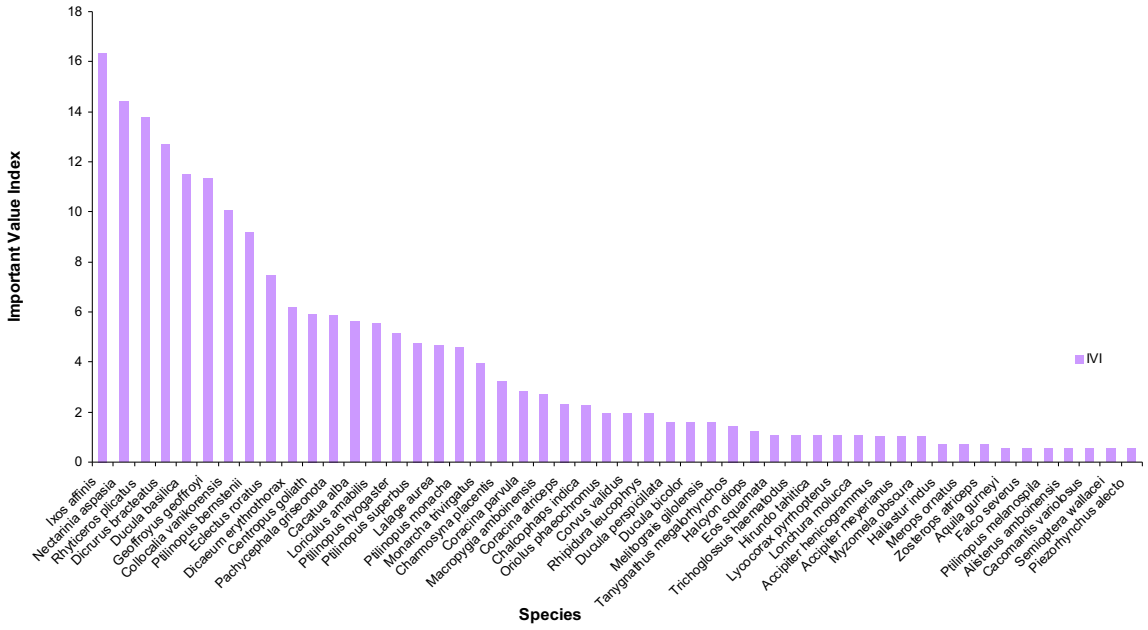

Figure 6. Relation between important value index of bird species and individual number at the project area

Figure 7. Blyth`s hornbill (*Rhyticeros plicatus*) at Non karst forest

Bird Species Diversity

The bird species diversity at the sample area shown that diversity index is varied, but at limestone area resulted the lowest index was transect LIM 2 and the highest was transect LIM 1 (table 5). The important factor influenced to the bird diversity is habitat condition. The diversity of habitat is main factor to support availability of food resources, cover, shelter and nesting area for live of bird.

Figure 8. White Cuckatoo (*Cacatua alba*) at bordered secondary forest

Table 5. Birds diversity index of sample transect at PT. WBN concession area

No.	Transect	Species Number	H'	E
1	LIM 1	26	2.9085	0.8927
2	LIM 2	15	2.4330	0.8984
3	LIM 3	21	2.7500	0.9033
4	LIM 4	18	2.7224	0.9419
5	LIM 5	20	2.8286	0.9442
6	LIM 6	16	2.4862	0.8967
7	Non Karst 1	17	2.6835	0.9471
8	Non Karst 2	15	2.4322	0.8981
9	Non Karst 3	26	3.0126	0.9247

legend: H' = diversity index E = equitabilty index

Similarity of Bird Community

The similarity of birds community at sample area of PT WBN concession area shown at figure.. Birds community clustering at sample area divided into 3 cluster, there are **cluster 1** is LIM 1 – LIM 4 – LIM 3 and LIM 2 (similarity around 62.5 %), **cluster 2** is Non Karsts 1– Non Karsts 2 – LIM 6 and LIM 5(similarity around 50.48 %), **cluster 3** is Non Karsts 3. Linkage between clusters is cluster 1- cluster 2 (similarity around 45.30%) than cluster1-2 linkage to cluster 3 (similarity around 33.62 %).

Figure 9. Cinnamon green imperial pigeon (*Ducula basilica*) as common birds at sample plot

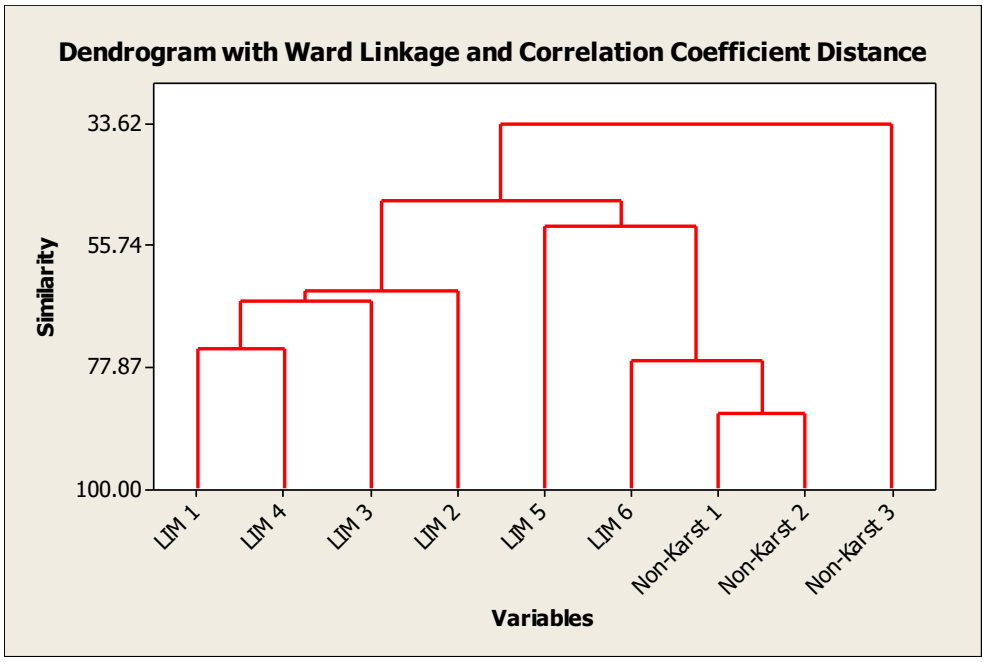

Figure 10. Dendrogram bird community at sample area of PT WBN

Figure 11. Moluccan king parrot (*Alisterus amboinensis*) as rare parrot at sample plot

Mammals

Very few mammals species can be found PT WBN concession area, only 8 species as occur at the properties as recorded at table 6. The mammals species which are found at sample plot base on direct and indirect observation.

Figure 12. Raffrays sheath- tailed Bat (*Emballonura raffrayana*) found at limestone area

Table 6. Mammals species were recorded at PT WBN concession area

Family Species	Local Name	Common Name	Found and Frequency	Status	Doc
Phalangeridae 1. *Phalanger ornatus**	Kuskus	Ornate Cuscus	? 1Vr, ? 2Vr, + 5Vr	P	Iw, F
Emballonuridae 1. *Emballonura raffrayana*	Kelelawar ekor Trubus raffray	Raffrays Sheath tail-Bat	+1Rr, + 2Rr, +3Rr,	NP	I
Hipposideridae 1. *Aselliscus tricuspidatus* 3. *Hipposideros cervinus*	Kelalawar Barong Kelelawar Barong Rusa	Trident Hourseshoe-Bat Fawn Hourseshoe-Bat	+1Rr, + 2Rr, +3Rr +1Rr, + 2Rr, +3Rr	NP NP	I I
Muridae 1.. *Rattus exculans*	Tikus Ladang	Polynesia Rat	?1Vr, ? 2Rr, +3Rr, +4Rr,+5Rr	NP	Iw, F, S
Viveriidae 1. *Viverra tangalunga*	Musang tenggalong	Malay civet	+1Rr, + 2Rr, +3Rr	NP	DO, C,
Cervidae 1.*Cervus timorensis**	Rusa	Timor Deer	?1Rr, + 2Rr,	P	Fp, H
Suidae 1. *Sus scrofa*	Babi hutan	Common Wild boar	+1Rr,+ 2Rr,+3Rr,+4Rr	NP	Fp, H

Legend :
1. Low land Forest at limestone of Johrah mountain + = found at sampling area NP = Non Protected species Fr = frequently found

2. Low land Forest at non limestone area
3. Beach and Mangrove Forest
4. Secondary Growth Forest
5. Kebun and Home garden
Mo = Molusca eater
I = insectivorous
F = Fruit feeder

++ = found at sampling site with abundance
- = not found at sampling site
? = not found at sampling site but most probably found
Hs = Honey sucker
Sf = Seed feeder
C = carnivore
I = insectivorous

P = Protected species
Sol = Solitary
O = omnivores
Fs = Fish eater

Rr = rarely found
Vr = Very rare
E = Endemic
H = Herbivorous
F = Fruit feeder

Figure 13. Trident Hourseshoe-Bat (*Aselliscus tricuspidatus*)

Figure 14. Fawn Hourseshoe-Bat (*Hipposideros cervinus*)

DISCUSSION

Bird

The diversity of bids species is quite high compare to mammals. Wallacea is area which are contain many birds endemic. Twenty one endemic bird species occur at WBN concession area (around 30 %) of total birds which are found at the property. One of factors which have influenced to endemic bird species is isolation area.

Number species of birds do not significant different between limestone area and non limestone area.

The protected birds species are quite high at PT WBN concession area (around 28 %) and total number species of bird can be found at the concession area. Most of the bird's species are having relation to forest habitat. Base on birds diversity, protected bird and endemic birds species at the project area are high, the concession owner should be consider to having plan for conserve those birds.

Mammal

Mammals' species diversity at limestone area of PT WBN concession area is low. At limestone area were found 5 species. Those number species of mammal's species are quite easy found at limestone area is bat and wildboard.

Total number species of mammals can be found at the concession area around .. % of total mammal's species at Halmahera. The number species of mammals at limestone area not significant different with non limestone area. Several mammals species which are found at sample plot probably introduce species like, timore deer, and malay civet

CONCLUSIONS & RECOMMENDATIONS

1. The wildlife species has been found at the project area .. species of mammals and 64 birds species. The diversity of birds was categorized medium, but significant high at endemic bird species.

2. Among the wildlife has been identified, 2 species of mammals, and 19 birds species as protected species in Indonesia.

3. If the mining project will be developing at the project area should be considered to the protected species and endemic species at limestone area.

REFERENCES

BirdLife International (2001). *Threatened Birds of Asia: the BirdLife International Red Data Book*, Cambridge, UK: BirdLife International

Coated B.J and Bishop K.D 1997. A Guide To The Bird : Birds Of Wallacea, Sulawesi, The Moluccas, Lesser Sunda Island, Indonesia. Dove Publications. Dai Nippon Co Ltd. Hongkong.

Flannery, T (1995). Mammals of the South West Pacific and Moluccan Islands. Reed Books, Sydney.

_____ (1995). Mammals of New Guinea. Revised and Updated. Reed Books, Singapore

Magurran, A.E. (1988). *Ecological diversity and its measurement*. London & Sydney, Croom Helm.

Monk, K. A., Y. De Fretes & G. Reksodiharjo-Lilley (1977) The Ecology of Nusa Tenggara and Maluku. Periplus Editions (HK) Ltd.

Mueller-Dombois, D. & H. Ellenberg (1974). *Aims and methods of vegetation ecology*. New York etc, Wiley.

Noerdjito, M & I Maryanto (2001). Jenis-Jenis Hayati yang Dilindungi Perundang-undangan Indonesia. Balitbang Zoologi & The Nature conservancy. Cibinong Bogor.

Suyanto, A. (2001). Kelelawar Di Indonesia. PusLitbang Biologi-LIPI. Bogor

Suyanto, A., M. Yoneda, I. Maryanto, Maharadatunkamsi & J. Sugardjito (1998). Checklist of the Mammals of Indonesia. LIPI-JICA Joint Project for Biodiversity Conservation in Indonesia. Bogor.

White C.M.N and Bruce M.D 1997. The Birds Of Wallacea, Sulawesi, The Moluccas, Lesser Sunda Island, Indonesia.An Annotated Check-List. British Ornithologists Union. Henry Ling Ltd. Dorset

APPENDIX

Appendix ... Selected Species List

In the following account species are listed that have a globally threatened status: vulnerable and near-threatened (BirdLife International 2001) also endemic species.

Cattle Egret *Bubulcus ibis*
Global status Near-threatened (Birdlife International 2001). Field notes – Single a male bird observed at kebun Kelapa, kandang Sapi

Little Egret *Egretta garzetta*
Global status Near-threatened (Birdlife International 2001). Field notes – one group of bird (6 birds) at kebun Kelapa, kandang Sapi searching food.

Brachminy Kite *Haliastur indus*
Global status – Vulnerable (BirdLife International 2001). Field notes – Frequent single bird saw fly uphill of limestone area and non limestone low land forest.

Molluccan Goshwk *Accipiter henicogrammus*
Global status – Vulnerable (BirdLife International 2001). Endemic species to Wallacean Field notes – pair bird perch at top of trees at limestone area and single bird saw fly uphill forest on……..

Meyers Goshawk *Accipiter meyerianus*
Global status – Vulnerable (BirdLife International 2001).Field notes – single bird saw fly uphill of limestone area and beach forest

Gurneys Eagle *Aquila gurney*
Global status – Vulnerable (BirdLife International 2001). Field notes – single birds fly uphill limestone area. On 30 May 2008

Oriental Hobby *Falco severus*
Global status – Vulnerable (BirdLife International 2001). Field notes – single birds perch on top dead tree at secondary re-growth forest. On 2 June 2008 closed to Tanjung Ulie Camp.

White headed Shelduck *Tadorna radjah*
Global status – Near-threatened (BirdLife International 2001). Field notes – Two bird sitting on branch of tree at river bank of Kandang Sapi on 25 May 2008.

Dusky Scrubfowl *Megapodius freycinet*
Global status – Vurnerable (BirdLife International 2001). Field notes – One old nesting site laid on forest floor limestone area near Helipad 2.

Slender billed Cuckoo-Dove *Macropygia amboinensis*
Global status –Not common. Field notes – not frequent bird found at sample plot.

Scarlet Breasted Fruit Dove *Ptilinopus bernsteini*
Global status – Endemic to Wallacea. Field notes – frequent a single bird found at sample plot in concession area.

Blue Capped Fruit Dove *Ptilinopus monacha*
Global status – Endemic to Wallacea. Field notes – not frequent a single bird found at sample plot in limestone area.

Grey Headed Fruit Dove *Ptilinopus hyogastra*
Global status – Endemic to Wallacea. Field notes – frequent a single bird found at sample plot in limestone area

Superb Fruit Dove *Ptilinopus superbus*
Global status – Not common. Field notes – not frequent bird found at sample plot.

White Eyes Imperial Pigeon *Ducula perspicillata*
Global status – Global status – Not common. Field notes – rare bird found at sample plot.

Cinnamon Bellied Imperial Pigeon *Ducula basilica*
Global status – Endemic to Wallacea. Field notes –common, widespread all forest at limestone area and limestone area

Violet Necked Lory *Eos squamata*
Global status - Near-threatened (BirdLife International 2001). Field notes – uncommon one group (4 birds) flying over the re-growth secondary forest.

White Cuckatoo *Cacatua alba*
Global status - Vulnerable (BirdLife International 2001), Endemic to Wallacea. Field notes –frequent a single birds flying over and perch at tree on limestone area and one birds catch by camera at secondary re-growth forest.

Eclectus Parrot *Electus roratus*
Global status - Vulnerable (BirdLife International 2001). Field notes –frequent a single birds flying over and perch at tree on limestone area and a male birds catch by camera at limestone forest.

White Cuckatoo *Cacatua alba*
Global status - Vulnerable (BirdLife International 2001), Endemic to Wallacea. Field notes –frequent a single birds flying over and perch at tree on limestone area and one birds catch by camera at secondary re-growth forest

Red Cheeked Parrot *Geoffroyus geoffroyi*
Global status – Commonest bird for family of Psittacidae found at sample area. Field notes – very frequent bird found at limestone area

Moluccan King Parrot *Alisterus amboinensis*
Global status – Rare bird found at sample area. Field notes – twice bird found at limestone area on 26 and 31 of May 2008

Moluccan Hanging Parrot *Loriculus amabilis*
Global status – Endemic to Wallacea. Field notes – Not frequent bird found at limestone area.

Goliath Coucal *Centropus goliath*
Global status – Endemic to Wallacea. Field notes – common bird at limestone area

Common Paradise Kingfisher *Tanysiptera galatea*
Global status –Rare bird found at sample area. Field notes – Rare bird, a single bird seen fly over pound near Tanjung Uli on 31 May 2008 .

Beach Kingfisher *Halcyon saurophaga*
Global status – Common bird. Field notes –common bird at beach of Weda bay, frequent a single bird perch at tree in beach forest.

Blue and White Kingfisher *Halcyon diops*
Global status – Endemic to Wallacea. Field notes – not uncommon bird, a single bird perch at tree in secondary re-growth forest

Purple Dollar Bird *Eurostomus azurea*
Global status –Endemic to Wallacea. Field notes – uncommon, found at beach forest, Tanjung Uli camp.

Blyth`s Hornbill *Rhyticeros plicatus*
Global status – Near-threatened (BirdLife International 2001). Common bird. Field notes – Common bird, Very frequent found at sample area, widespread all over lowland forest, at limestone and non limestone area.

Moluccan Cuckoo Shrike *Coracina atriceps*
Global status – Endemic to Wallacea. Field notes –common bird, pair or a single bird perch at tree in lowland forest limestone area.

Halmahera Cuckoo Shrike *Coracina atriceps*
Global status – Endemic to Wallacea. Field notes –not common bird, pair bird perch at tree in lowland forest limestone area.

Rufous Bellied Triller *Lalage azurea*
Global status - Endemic to Wallacea. Field notes – common, Widespread at lowland forest at limestone area and non limestone area.

Golden Bulbul *Ixos affinis*
Global status – Endemic to Wallacea. Field notes – common, Widespread at lowland forest at limestone area and non limestone area.

Spangled Drongo *Dicrurus bracteatus*
Global status – Not uncommon bird. Field notes- common, widespread at lowland forest at limestone area and non limestone area.

Dusky Oriole *Oriolus phaeochromus*
Global status – Endemic to Wallacea. Field notes – Rare bird, found pair bird perch at ficus trees at lowland forest of limestone area on 29 May 2008.

Long Bill Crow *Corvus validus*
Global status – Endemic to Wallacea. Field notes – not uncommon bird, found at kebun, beach forest, and lowland forest at limestone area.

Paradise Crow *Lycocorax pyrropterus*
Global status – Endemic to Wallacea. Field notes – not uncommon bird, found at re-growth secondary forest, beach forest, and lowland forest.

Wallace`s Standardwing *Semioptera wallacei*
Global status – Vulnerable (BirdLife International 2001). Endemic to Wallacea. Field notes – very rare species in the project area. Found a female bird at lowland forest limestone area on 29 May 2008.

White Streaked Friarbird *Melitograis gilolensis*
Global status – Endemic to Wallacea. Field notes – not common bird, found at re-growth secondary forest, and lowland forest limestone area

Flame-breasted Flowerpecker *Dicaeum erythrothorax*
Global status – Endemic to Wallacea. Field notes – Common bird, widespread in the project area, frquent found at lowland forest limestone area

Cream Throated White Eyes *Zosterops atriceps*
Global status – Endemic to Wallacea. Field notes – Not common bird, found at re-growth secondary forest, and lowland forest limestone area