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DISPARITY IN BIRD COMMUNITIES OF OIL PALM (*Elaeis guineensis*) PLANTATION AND ADJACENT FOREST IN ABORLAN, PALAWAN: IMPLICATIONS TO AVIFAUNAL CONSERVATION

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ABSTRACT – Widespread plantation of oil palm replaced most of the forest bird habitats in Palawan. To compare the avifaunal communities thriving in an oil palm plantation and a forest, standard avifaunal transect walk surveys were conducted from August to November 2014 in selected oil palm plantation and its adjacent forest in Aborlan, Palawan. Bird communities were compared using attributes such as species richness, abundance, evenness, diversity index, feeding guilds and presence of endemic and conservation priority species. The study revealed that the bird community in oil palm plantation was depauperate as indicated by the low species richness, abundance and diversity index relative to the adjacent forest. The low similarity index between the bird communities highlights the disparity in bird assemblages. The number of species and individuals of frugivore, nectarivore, omnivore and insectivore birds were relatively fewer in oil palm plantation than in the forest. Moreover, the remarkably low species richness and abundance of endemic and the absence of high conservation priority birds in oil palm plantation further emphasized the threat of widespread oil palm cultivation to Palawan's avifaunal diversity. To improve the bird diversity at the landscape level, conservation and establishment of forest fragments within or near the oil palm plantations are highly recommended.

Keywords: Oil palm, avifaunal assemblage, forest, conservation

INTRODUCTION

Forest is one of the most important ecosystems in the planet. It caters myriads of life forms with astonishing biological diversity. It performs variety of ecosystem functions, and provides bountiful goods and services to the people. However, the continuously rising global population endangers the existence of the remaining forest reserves. The global deforestation rate is around 13 million hectares per year and it is mostly attributed to agricultural expansion (FAO 2010). The increasing demand for agricultural products needed by the growing global population signals that more forested lands are expected to be converted into agricultural areas in the near future. Hosonuma et al. (2012) confirmed that in developing countries, conversion of forests to commercial and subsistence agriculture use are considered important drivers of deforestation.

Agricultural expansion in Palawan is gradually creeping in the marginal uplands. Some farmers with access to capital established widespread plantations of economically promising high valued crops such as the para rubber tree (*Hevea brasiliensis*) and oil palm (*Elaeis guineensis*). Widespread

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plantations of oil palm are found in Southern Palawan. The two major companies that dominated the oil palm industry in the province are Palawan Palm and Vegetable Oil Mills Incorporated (PPVOMI) and AGUMIL Philippines Incorporated (AGPI). These companies established their own plantations and at the same time supported several cooperative and private contract growers in the municipalities of Aborlan, Narra, Sofroñio Espanola, Quezon, Rizal, Brooke's Point and Bataraza (Villanueva 2011). Oil Palm industry in Palawan is still young compared to other provinces in Mindanao. However, with the positive perspective and the support given by the Provincial Government of Palawan to this industry, it is expected to increase in the near future. Villanueva (2011) mentioned that despite the concerns on the potential impacts of oil palm production in Palawan (which is considered as the "Last Ecological Frontier"), the Provincial Government of Palawan still supports the industry by including it in the Provincial Comprehensive Development Plan of Palawan in 2005. Having this scenario, the further expansion of oil palm plantations in the near future is expected. As more contract growers participate in the industry, new areas will be opened to give way for new plantation sites. Although some of the farms were established within barren and underutilized lots, there are some farmers that plant oil palms in important wildlife habitat areas such as forest edges, secondary forest, scrublands, log out forest fragments and primary forest. These extant vegetations have very important roles in supporting the biodiversity of upland agricultural landscape. Furthermore, these regenerating forests are vital in the recovery of soil nutrients spent during the cultivation stage of swidden agriculture.

Conversion of forest to oil palm plantation has known impacts to wildlife. Past studies in Malaysia revealed that extensive cultivation of oil palm causes decline in number of beetle species (Chung et al. 2000), reduction of biomass and abundance of arthropods (Turner and Foster 2009) and reduction of species richness of ants (Bruhl and Eltz 2010). It also causes reduction in density of four species of *Anopheles* mosquitoes in Sarawak (Chang et al. 1997), reduction of restricted range and high conservation priority bird species in Southern Thailand (Aratrakorn et al. 2006), reduction of species and functional diversity of birds in Sundaland (Edwards et al. 2013) and decline in population of Sumatran Tigers, Sumatran Rhinoceros, Sumatran and Bornean Orangutans, and Asian Elephants (Brown and Jacobson 2005). These negative impacts of oil palm cultivation to biodiversity was observed in other oil palm producing countries, but the negative effects of this growing industry in the wildlife of Palawan specifically in bird communities is not yet fully understood. To shed light on this issue, this study investigated the effect of monoculture oil palm cultivation on forest bird assemblage by comparing the avifaunal communities that thrive in an oil palm plantation and its adjacent forest ecosystem in terms of species richness, abundance, evenness, diversity index, feeding guilds and presence of endemic and conservation priority birds.

METHODOLOGY

Study Area

The study area was located in the eastern part of the Municipality of Aborlan, Palawan (Figure 1). Two sites for avifaunal surveys were selected for comparison. Site 1 is an oil palm plantation. The area is dominated by matured monoculture stand of fruit bearing oil palms with minimal understory vegetation which consists of few regenerating species of grasses and broadleaf herbaceous plants that recover from herbicide application. Some densely tangled vegetation growing together with banana, papaya, bamboo and other woody vegetation form small island patches in the midst of oil palm plantation.

Site 2 is a relatively good stand of old growth secondary forest. The forest site is more than 30 years old and it was once used in swidden farming. The understory vegetation in this site is complex, its middle strata is covered with densely tangled vines, lianas and branches of much shorter trees. Sites 1 and 2 were relatively near each other, it was purposely selected to minimize the influence of geospatial distribution of birds.

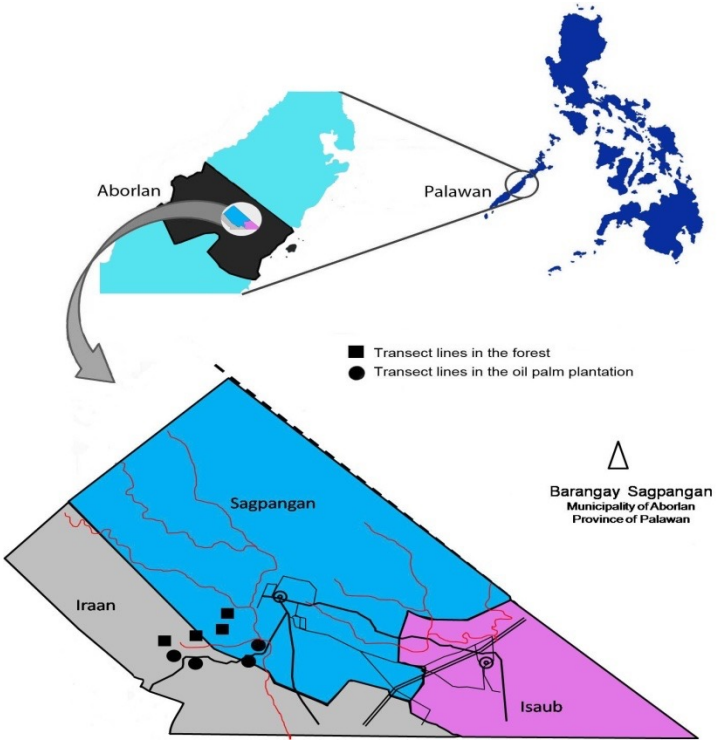

Figure 1. Map of the study area showing the location of surveyed transects in the oil palm plantation and forest sites in Iraan and Sagpangan, Aborlan, Palawan (Drawn by the author using Adobe Photoshop CS4).

Data Collection

An avifaunal survey was conducted in Site 1 (oil palm plantation) and Site 2 (forest) from August to November 2014. The study used a standard transect walk survey method (Bibby et al. 1998; Gibbons and Gregory 2006). Four 500-meter transect routes were randomly established in each site, shorter transect length was preferred in this study to fit into the irregularly shaped oil palm plantation. Using visual and auditory cues, all birds found on both sides of transect line were counted while walking slowly at a regulated pace of 1 km/hr (Dans and Gonzales 1998; Gibbons and Gregory 2006). Each observation was recorded according to the following perpendicular distance classes from the transect line (in meters): 0-10, 10-20, 20-30, 30-40 and 40-50. Bird survey was carried out in each transect route once a month for four months. This cumulatively gave a total transect distance of 8 kilometers per site. The

length of survey period was based on species discovery curve (Sutherland 2000). All bird surveys were conducted only during favorable weather condition.

Data Analysis

It was found out that beyond the 30-meter perpendicular distance from transect line, bird detection using ocular cues suddenly fall. Meanwhile, bird detection using auditory cues only showed a minor decline even beyond the 40 meter mark. To avoid bias towards more vocal species, only the birds detected from distance bands 0-10 to 20-30 on either sides of transect line were used in the data analysis. In the context of this study, bird communities were compared using Shannon's Index of diversity, species richness, abundance, evenness and feeding guilds. To support the conventional biological statistics, in depth statistical test (F ratio) was also conducted to determine if the variance in the mean number of species and mean number of individual birds found in the oil palm plantation and its adjacent forest are significant at 95% level of confidence. The test accounts both the F computed and p values in rejecting the null hypothesis. To measure the degree of similarity of bird assemblage in the study sites, Morisita's index of similarity was used. Total number of species and abundance of endemic birds and species with high conservation priority were also accounted. The noteworthy differences in avifaunal communities between forest and oil palm plantation were considered an indication of the impact of habitat change in bird assemblage.

RESULTS AND DISUSSION

A total of 78 species of birds representing 38 families were recorded in both forest and oil palm plantation. Out of the 78 species of birds detected, 55 species belonging to 28 families were recorded in the primary forest while only 40 species of the 26 families were found in the oil palm plantation (Table 1). The findings clearly revealed that the bird community in oil palm plantation has remarkably lower bird species richness relative to those found in the forest habitat. Among the 40 species of birds recorded in oil palm plantation, 23 species were open dwelling birds which are also found in neighboring open areas. It also means that out of the 55 bird species recorded in the forest, only 17 managed to thrive in the oil palm plantation (Figure 2). This result showed a massive loss of 38 species of forest dependent birds or about 69% of the total species recorded in the forest. This finding conforms to the study conducted in Southern Thailand by Aratrakorn et al. (2006), in which they mentioned that

Table 1. List of bird species recorded in oil palm and its adjacent forest in Aborlan, Palawan during August-November 2014.

Family	English Name	Scientific Name	Conservation Status (IUCN)	Level of Endemism	Feeding guild	Distribution in the Study Area	
						Oil Palm	Forest
ESTRILDIDAE	White-Bellied Munia	*Lonchura leucogastra*	Least concern	R	G	+	-
ESTRILDIDAE	Chestnut Munia	*Lonchura malacca*	Least concern	R	G	+	-
ESTRILDIDAE	Scaly-Breasted Munia	*Lonchura punctulata*	Least concern	R	G	+	-
PASSERIDAE	Eurasian Tree Sparrow	*Passer montanus*	Least concern	R	O	+	-
DICAEIDAE	Palawan Flowerpecker	*Prionochilus plateni*	Least concern	PES	O	-	+
DICAEIDAE	Pygmy Flowerpecker	*Dicaeum pygmaeum palawanorum*	Least concern	PHES	O	-	+
NECTARINIIDAE	Little Spiderhunter	*Arachnothera longirostra dilutior*	Least concern	R	N	+	+
NECTARINIIDAE	Olive-Backed Sunbird	*Nectarina jugularis*	Least concern	R	N	+	+
NECTARINIIDAE	Plain-Throated Sunbird	*Anthreptes malacensis paraguae*	Least concern	R	N	+	+
NECTARINIIDAE	Lovely Sunbird	*Aethopyga shelleyi shelleyi*	Least concern	R	N	-	+
STURNIDAE	Hill Myna	*Gracula religiosa palawanensis*	Least concern	R	F	-	+
STURNIDAE	Asian Glossy Starling	*Aplonis panayensis*	Least concern	R	O	+	-
LANIIDAE	Brown Shrike	*Lanius cristatus lucionensis*	Least concern	M	C	+	-
ARTAMIDAE	White-Breasted Wood-Swallow	*Artamus leucorynchus*	Least concern	R	I	+	-
MOTACILLIDAE	Grey Wagtail	*Motacilla cinerea*	Least concern	M	I	+	-
MONARCHIDAE	Blue Paradise-Flycatcher	*Terpsiphone cyanescens*	Near threatened	PES	I	-	+

(Table 1 continued)

Family	English Name	Scientific Name	Conservation Status (IUCN)	Level of Endemism	Feeding guild	Distribution in the Study Area	
						Oil Palm	Forest
MONARCHIDAE	Black-Naped Monarch	*Hypothymis azurea*	Least concern	R	I	+	+
RHIPIDURIDAE	Pied Fantail	*Rhipidura javanica nigritorquis*	Least concern	R	I	+	-
MUSCICAPIDAE	Palawan Blue Flycatcher	*Cyornis lemprieri*	Near threatened	PES	I	-	+
MUSCICAPIDAE	Grey-Streaked Flycatcher	*Muscicapa griseisticta*	Least concern	M	I	+	+
MUSCICAPIDAE	White-Vented Shama	*Copsychus niger*	Least concern	PES	I	+	+
SYLVIIDAE	Rufous-Tailed Tailorbird	*Orthotomus sericeus*	Least concern	R	I	+	+
SYLVIIDAE	Striated Grassbird	*Megalurus palustris*	Least concern	R	I	+	-
ARDEIDAE	Little Egret	*Egretta garzetta*	Least concern	M	C	+	-
ARDEIDAE	Cattle Egret	*Bubulcus ibis*	Least concern	M	C	+	-
ARDEIDAE	Intermediate Egret	*Egretta intermedia*	Least concern	M	C	+	-
ACCIPITRIDAE	Crested Serpent-Eagle	*Spilornis cheela palawanensis*	Least concern	R	C	+	+
ACCIPITRIDAE	Changeable Hawk-Eagle	*Spizaetus cirrhatus*	Least concern	R	C	-	+
PHASIANIDAE	Red Junglefowl	*Gallus gallus*	Least concern	R	O	-	+
PHASIANIDAE	Palawan Peacock-Pheasant	*Polyplectron emphanum*	Vulnerable	PES	O	-	+
PHASIANIDAE	Blue-Breasted Quail	*Coturnix chinensis*	Least concern	R	O	+	-
TURNICIDAE	Barred Buttonquail	*Turnix suscitator haynaldi*	Least concern	R	O	+	-
RALLIDAE	White-Breasted Waterhen	*Amaurornis phoenicurus*	Least concern	R	O	+	-

(Table 1 continued)

Family	English Name	Scientific Name	Conservation Status (IUCN)	Level of Endemism	Feeding guild	Distribution in the Study Area	
						Oil Palm	Forest
COLUMBIDAE	Thick-Billed Green-Pigeon	*Treron curvirostra*	Least concern	R	F	-	+
COLUMBIDAE	Pink-Necked Green-Pigeon	*Treron vernans*	Least concern	R	F	-	+
COLUMBIDAE	Black-Chinned Fruit-Dove	*Ptilinopus leclancheri gironieri*	Least concern	R	F	-	+
COLUMBIDAE	Green Imperial-Pigeon	*Ducula aenea*	Least concern	R	F	-	+
COLUMBIDAE	Reddish Cuckoo-Dove	*Macropygia phasianella*	Least concern	R	F	-	+
COLUMBIDAE	Spotted Dove	*Streptopelia chinensis*	Least concern	R	G	+	-
COLUMBIDAE	Zebra Dove	*Geopelia striata*	Least concern	R	G	+	-
COLUMBIDAE	Common Emerald-Dove	*Chalcophaps indica*	Least concern	R	G	+	+
PSITTACIDAE	Blue-Naped Parrot	*Tanygnathus lucionensis*	Near threatened	PHES	F	-	+
PSITTACIDAE	Blue-Headed Racquet-Tail	*Prioniturus platenae*	Vulnerable	PES	F	-	+
CUCULIDAE	Plaintive Cuckoo	*Cacomantis merulinus*	Least concern	R	I	-	+
CUCULIDAE	Common Koel	*Eudynamys scolopacea*	Least concern	R	O	-	+
CUCULIDAE	Chestnut-Breasted Malkoha	*Phaenicophaeus curvirostris harringtoni*	Least concern	PHES	I	-	+
CUCULIDAE	Greater Coucal	*Centropus sinensis*	Least concern	R	I	+	-
CUCULIDAE	Lesser Coucal	*Centropus bengalensis*	Least concern	R	I	+	-
APODIDAE	Glossy Swiftlet	*Collocalia esculenta*	Least concern	R	I	+	+
APODIDAE	Brown-Backed Needletail	*Hirundapus giganteus*	Least concern	R	I	+	+
CORACIIDAE	Dollarbird	*Eurystomus orientalis*	Least concern	R	I	-	+

(Table 1 continued)

Family	English Name	Scientific Name	Conservation Status (IUCN)	Level of Endemism	Feeding guild	Distribution in the Study Area	
						Oil Palm	Forest
ALCIDINIDAE	Oriental Dwarf-Kingfisher	*Ceryx erithacus rufidorsa*	Least concern	R	C	+	+
ALCIDINIDAE	White-Collared Kingfisher	*Halcyon chloris*	Least concern	R	C	+	-
BUCEROTIDAE	Palawan Hornbill	*Anthracoceros marchei*	Vulnerable	PES	F	-	+
PICIDAE	Great Slaty Woodpecker	*Mullerripicus pulverulentus*	Vulnerable	R	I	-	+
PICIDAE	Greater Flameback	*Chrysocolaptes lucidus erythrocephalus*	Least concern	R	I	-	+
PICIDAE	Common Flameback	*Dinopium javanense everetti*	Least concern	R	I	-	+
PITTIDAE	Red-Bellied Pitta	*Pitta erythrogaster propinqua*	Least concern	R	I	-	+
PITTIDAE	Hooded Pitta	*Pitta sordida palawanensis*	Least concern	R	I	-	+
HIRUNDINIDAE	Barn Swallow	*Hirundo rustica*	Least concern	M	I	+	+
CAMPEPHAGIDAE	Bar-Bellied Cuckoo-Shrike	*Coracina striata difficilis*	Least concern	R	I	-	+
CAMPEPHAGIDAE	Pied Triller	*Lalage nigra*	Least concern	R	I	+	-
CAMPEPHAGIDAE	Small Minivet	*Pericrocotus cinnamomeus*	Least concern	R	I	-	+
CHLOROPSEIDAE	Yellow-Throated Leafbird	*Chloropsis palawanensis*	Least concern	PES	O	-	+
AEGITHINIDAE	Common Iora	*Aegithina tiphia*	Least concern	R	O	-	+
PYCNONOTIDAE	Black Headed Bulbul	*Pycnonotus atriceps*	Least concern	R	O	+	+
PYCNONOTIDAE	Olive-Winged Bulbul	*Pycnonotus plumosus cinereifrons*	Least concern	R	O	+	+
PYCNONOTIDAE	Grey-Cheeked Bulbul	*Criniger bres frater*	Least concern	R	O	-	+
DICRURIDAE	Ashy Drongo	*Dicrurus leucophaeus*	Least concern	R	I	+	+

(Table 1 continued)

Family	English Name	Scientific Name	Conservation Status (IUCN)	Level of Endemism	Feeding guild	Distribution in the Study Area	
						Oil Palm	Forest
DICRURIDAE	Spangled Drongo	*Dicrurus hottentottus palawanensis*	Least concern	R	I	-	+
ORIOLIDAE	Dark-Throated Oriole	*Oriolus xanthonotus*	Near threatened	R	O	-	+
ORIOLIDAE	Black-Naped Oriole	*Oriolus chinensis*	Least concern	R	O	-	+
IRENIDAE	Asian Fairy-Bluebird	*Irena puella tweeddalei*	Least concern	R	F	-	+
CORVIDAE	Slender-Billed Crow	*Corvus enca*	Least concern	R	O	+	-
PARIDAE	Palawan Tit	*Parus amabilis*	Near threatened	PES	O	-	+
SITTIDAE	Velvet-Fronted Nuthatch	*Sitta frontalis palawana*	Least concern	R	I	-	+
TIMALIIDAE	Ashy-Headed Babbler	*Trichastoma cinereiceps*	Least concern	PES	I	-	+
TIMALIIDAE	Striped Tit-Babbler	*Macronous gularis woodi*	Least concern	R	I	+	+

Legend:

Level of Endemism:

R - Resident species

PES - Palawan endemic species

PHES – Philippine endemic species

M – Migrant

Feeding Guild

O - Omnivore

C - Carnivore

F - Frugivore

G - Granivore

I - Insectivore

N - Nectarivore

Presence in Surveyed Sites:

(+) -Present

(-) - Absent

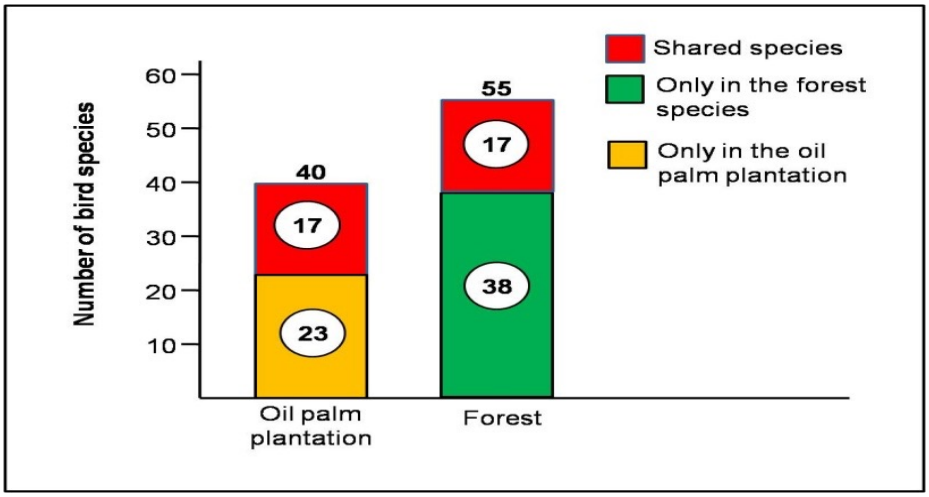

Figure 2. Number of shared and not shared species of birds observed from oil palm plantation and adjacent forest in Aborlan, Palawan

Conversion of forest to plantations such as rubber tree and oil palm may result to a 60% decline in species richness of birds.

Another important observation worth noticing was the presence of many bird species found only in oil palm plantation and not in the forest. This observation revealed that bird species assemblage will most likely change when forested areas were converted into plantations. Seemingly, the concurrent loss of forest bird species was apparently replaced with new species of birds that are not normal inhabitants of the forest. Some of these species are Asian Glossy Starling (*Aplonis panayensis*), Zebra dove (*Geopelia striata*), Slender–Billed Crow (*Corvus enca*), White-Collared Kingfisher (*Halcyon chloris*), Barred Buttonquail (*Turnix suscitator haynaldi*) and Cattle Egret (*Bubulcus ibis*).These birds are normally living in open habitats such as grassland, agricultural lots, settlement areas and young regenerating forests. Most of these birds are generalist species that can thrive in wide variety of habitats and can make use of diverse resources for food and nesting materials. Additionally, these birds are also good in thriving across fragmented and degraded habitats. The very few number of bird species shared between oil palm plantation and forest site and the presence of so many new colonizing species in plantation clearly exposed the big difference in species composition between the avifaunal communities compared. This observation was supported by the very low Morisita's index of community similarity (0.23) between the avifaunal communities in the forest and in the oil palm plantation.

Despite the presence of open dwelling species, the species richness in oil palm plantation (40) is 27% lower than the species richness in the forest (55) (Table 2). The mean number of species in the forest (17.38) is relatively higher than the mean number of species recorded in oil palm plantation (10.13). The difference is statistically significant ($F_{1,15} = 2.65$, $p < .05$) (Table 3).

Table 2. Bird community attributes in oil palm plantation and adjacent forest in Aborlan, Palawan

Bird Community Attributes	Oil Palm Plantation	Forest
Number of Represented Families	26	28
Species Richness	40	55
Abundance (all recorded species)	193	363
Diversity Index (Shannon-Wiener Index)	1.55	1.65
Evenness	0.968	0.946

Similar to species richness, the abundance of birds in oil palm plantation (193) was found to be relatively lower compared to those found in the forest (363). The mean number of individuals in the forest (22.69) is also relatively higher than the mean number of individuals recorded in oil palm plantation (12.13). The difference is also statistically significant ($F_{1,15} = 2.49$, $p < .05$) (Table 4). Additionally, more than half of the total number of individual birds recorded in oil palm plantation was contributed by open dwelling species. This depauperate status of bird community was similarly observed in other monoculture plantations such as banana and cacao monoculture plantations (Harvey and Gonzalez Villalobos 2007). One of the possible explanations to the low species richness and abundance of birds in oil palm plantation was the absence of the dense and diverse forest vegetation. The vegetation structure and the emergent properties that come with it provide food, hiding places, nesting materials, and other resources vital to the survival of forest dwelling avifauna and other wildlife species as well. Shankar Raman et al. (1998) disclosed that the vegetation attributes in a given area had influence in the assemblage of birds. They also mentioned that species richness, abundance and diversity of birds increased following the vegetation recovery in abandoned swidden fallows.

Furthermore, they also stressed that the similarity of bird communities in a developing fallow and the forest is positively correlated to similarity in physiognomic and floristic attributes. This highlights the importance of good quality vegetation with desirable floral attributes in supporting the forest-dependent avifaunal species.

The monoculture oil palm plantation apparently was a totally different kind of environment. The area was not as dimly shaded as in the forest, forest litters were absent, fruiting trees in the canopy layer and in the middle strata were also absent and the species of ground flora was also different. These changes in ambient environmental characteristics as well as changes in biological components might as well be the reason of species recruitment from the more open mixed agricultural landscape. Avifaunal species recruitment in farm lands was also observed by Martin and Blackburn (2010), they reported that species richness in the primary forest was relatively higher than a disturbed secondary forest. However, they also observed that a much disturbed farm land had the highest species richness but the bird assemblage was significantly different compared to the forest sites.

Table 4. Result of F-Test for variance of mean number of individual birds between oil palm plantation and forest.

	Oil Palm plantation	Forest
Mean	12.13	22.69
Variance	19.05	7.70
Observations	16	16
df	15	15
F	2.475	
P(F<=f) one-tail	0.045	
F Critical one-tail	2.403	

Significant at 0.05 level

The bird community in oil palm plantation had slightly higher evenness value (0.97) compared to forest bird community (0.95). This indicated that even though bird community in oil palm plantation had lower species richness and abundance and largely composed of open dwelling species, the distribution of individual birds in different species was a bit more evenly than that of the forest bird community. Despite of a more even distribution of individual birds to respective species in oil palm bird community, the Shannon-Wiener diversity index of avifaunal community in the forest (H'=1.65) was still relatively higher compared to those found in oil palm plantation (H'=1.55) because of the very high difference in species richness.

The number of species (Figure 3) and abundance (Figure 4) of frugivore, insectivore, nectarivore, and omnivore birds were relatively higher in the forest than in the oil palm plantation.

The presence of more frugivore birds in the forest appears to be coherent to the findings of other studies (Thiollay 1995; Shankar Raman et al. 1998). The difference in feeding guilds between oil palm and adjacent forest specifically on frugivore and insectivore species could be due to the reduced tree height, canopy foliage volume, vertical diversity of the vegetation structure, floristic richness, and associated variety of food resources (Thiollay 1995). The presence of more fruiting vegetation, more insects and more flowers that produce nectar in the forest provides more opportunities to frugivore, insectivore, nectarivore, and omnivore birds to survive in the forest than in oil palm plantation. Meanwhile, the proliferation of many species of grain producing plants in the plantation and open areas possibly caused the thriving of more species and individuals of granivore birds. The presence of several species of egrets in oil palm plantation contributes to the increased presence of carnivores in the plantation. In general, the feeding guild of forest bird community will suffer a potential decline if a forest will be converted into oil palm plantations.

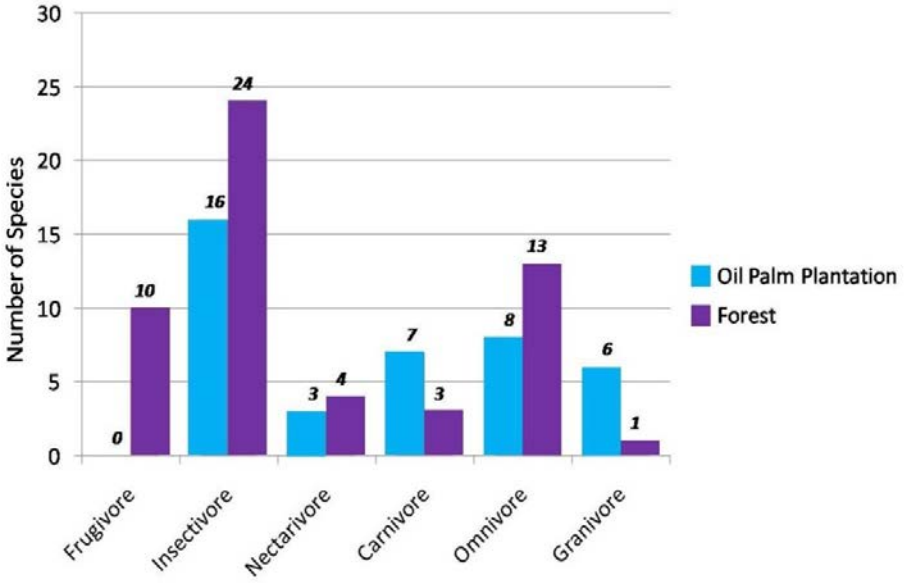

Figure 3. Number of species of each bird feeding guild in oil palm plantation and adjacent forest in Aborlan, Palawan

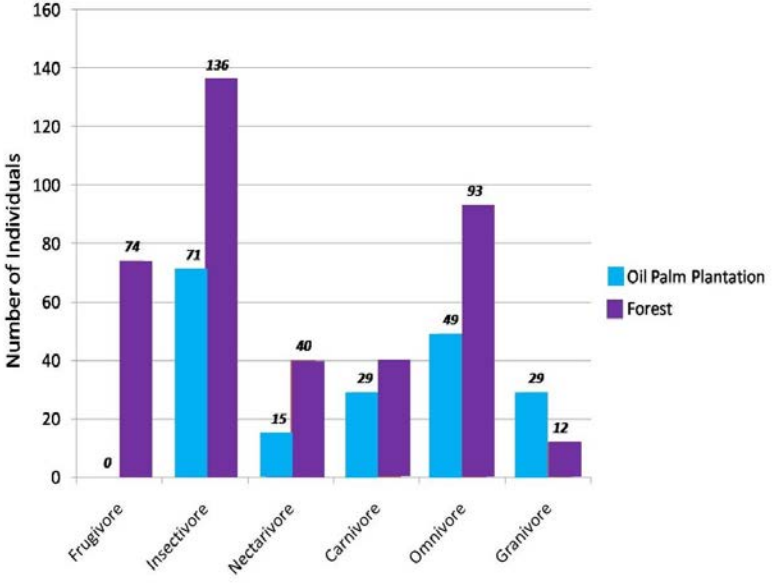

Figure 4. Number of individuals of each bird feeding guild in oil palm plantation and adjacent forest in Aborlan, Palawan.

The two most commonly represented bird species found in the forest habitat were both members of the family Decaeidae, the Palawan Flowerpecker (*Prionochilus plateni*) a Palawan endemic species and Pygmy Flowerpecker (*Dicaeum pygmaeum palawanorum*) a Philippine endemic species with Palawan endemic race. On the other hand, the two most commonly represented bird species found in the oil palm plantation were Asian Glossy Starling (*Aplonis panayensis*) and Zebra Dove (*Geopelia striata*). These two non-endemic open habitat dwellers also have wider range of distribution. It was also observed that Palawan endemic bird species prefer to live in forest habitat and do not thrive well in oil palm plantation. Out of the ten Palawan endemic bird species recorded in the forest, only one, the White-Vented Shama (*Copsychus niger*) was also recorded in the oil palm plantation and all the three Philippine endemic bird species recorded in the study sites were recorded only in the forest (Figure 5). No new Palawan endemic species from other habitats was observed in oil palm plantation. Furthermore, the abundance of Palawan endemic species also followed a similar pattern of falloff. It was observed that out of the 89 individual Palawan endemic birds recorded in the forest, only five individual birds belonging to White-Vented Shama (*Copsychus niger*) was recorded in the oil palm plantation (Figure 6). This bird was the only Palawan endemic species recorded out of the forest site.

Altogether, Palawan endemic bird species appear to be strongly dependent on forest environment and forest resources. Wijesinghe and Brooke (2005) subscribed to this idea by reporting that forest dwelling endemic species of birds have difficulties in thriving to modified landscapes.

All birds with high conservation priority were also observed to be highly vulnerable to conversion of forest to oil palm plantation. Using the International Union for the Conservation of Nature (IUCN) Red List of Threatened Wildlife Species 2014 as reference, 34 individual birds belonging to five near-threatened species and 22 individual birds belonging to four vulnerable species were recorded only in the forest site. In addition, three out of the five recorded near-threatened species, the Palawan Tit (*Parus amabilis*), Palawan Blue Flycatcher (*Cyornis lemprieri*) and Blue Paradise-Flycatcher (*Terpsiphone cyanescens*) were also restricted range Palawan endemic species. Moreover, three out of four recorded vulnerable bird species, the Palawan Peacock-Pheasant (*Polyplectron emphanum*), Blue-Headed Racquet-Tail (*Prioniturus platenae*) and Palawan Hornbill (*Anthracoceros marchei*) were also restricted range Palawan endemic species.

In general, the findings obviously showed that the avifaunal community attributes such as species richness, abundance and diversity in oil palm plantation were relatively lower than in the forest (Table 2). The survey results which divulged significant differences between the mean species number ($F_{1,15} = 2.65$, $p < .05$) and mean number of individuals ($F_{1,15} = 2.49$, $p < .05$) of bird communities of the oil palm plantation and its adjacent forest give a clear picture of what will happen to the forest bird community as more forest habitats are converted into monoculture oil palm plantations in the future. Moreover, these changes in the bird community when forest is converted to oil palm plantation were further aggravated by the colonization of open dwelling generalist species. The settling in of new species might somehow contribute in improving the species richness as well as the overall diversity in the plantations, but it has very little or no importance in the perspective of conserving the more sensitive and specialist forest bird species.

The decline of most bird feeding guilds and the increase of some due to the recruitment of open dwelling species generally make the existing feeding guild in oil palm plantation different from the forest. These changes may alter the ecosystem functions of such guilds and affect the overall health of the ecosystem in many ways at the landscape level, but this remains to be further investigated. It was also revealed that the restricted range Palawan endemic species as well as the species with high conservation priority were vulnerable to habitat alteration resulting from the conversion of forest to oil palm

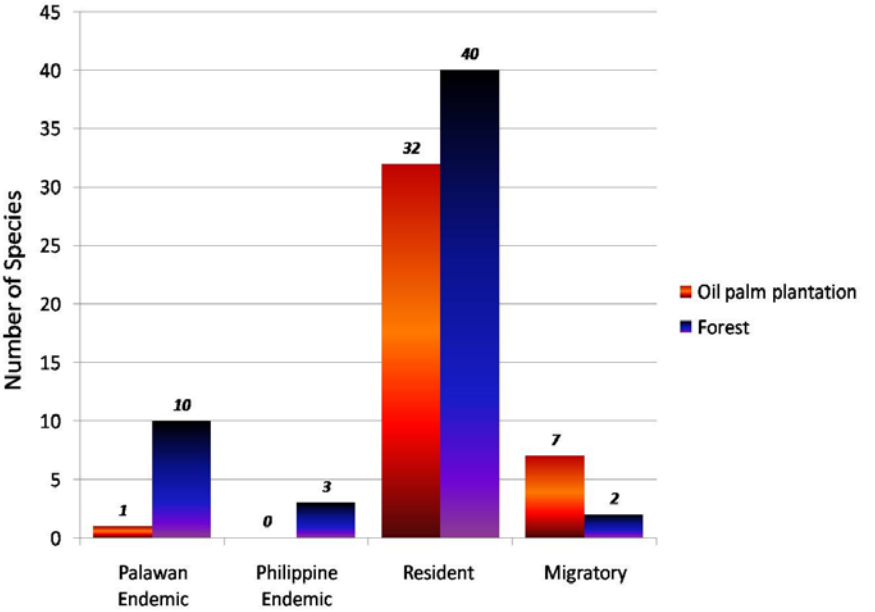

Figure 5. Relative number of endemic and non endemic species of birds in oil palm plantation and adjacent forest

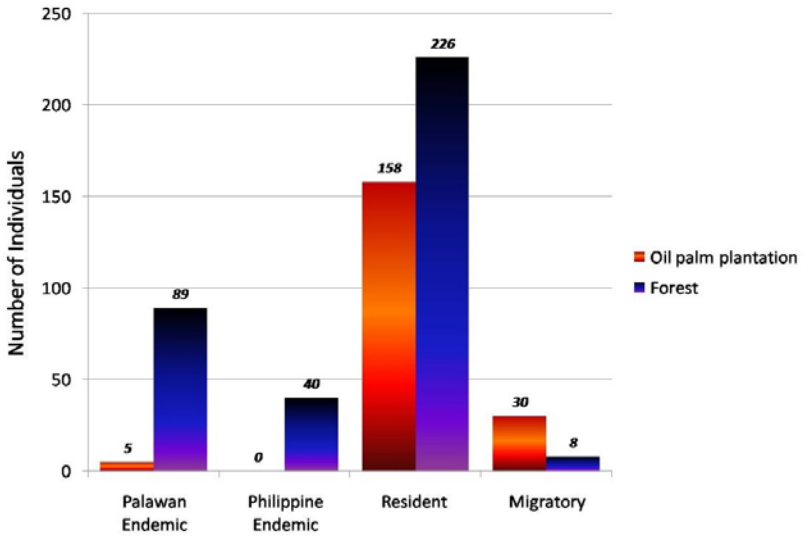

Figure 6. Relative abundance of endemic and non endemic birds in oil palm plantation and adjacent forest

plantation. More importantly, majority of these affected near-threatened and vulnerable species were also restricted range Palawan endemic species. This calls for urgent conservation measures focusing on forest habitat protection, conservation and enhancement. Moreover, forest conversion to oil palm plantation and other agricultural use must also be stopped.

The future prospects of expanding the oil palm plantations in Palawan and the possibility of promoting widespread production of other monoculture crops in the future such as rubber tree, cacao, coffee and tree plantations may result to further conversion of more of the province's remaining stand of forest. Moreover, the recent trend of migration of people in the upland areas in search of productive areas for cultivation will most likely contribute in the forest resource utilization and might eventually lead to further forest habitat degradation. Combining all these anthropogenic activities may later on result to forest fragmentation in the upland and total elimination of native forest in the lowland. These series of events will be detrimental to the survival of forest-dependent bird species specifically those restricted range Palawan endemic species. These birds are found only in Palawan and nowhere else in the world and becoming extinct here in the province means they are gone forever.

CONCLUSIONS AND RECOMMENDATIONS

The avifaunal community recorded in oil palm plantation is apparently lower in species richness, abundance, and diversity as compared to avifaunal community recorded in the forest. The paucity of bird species shared by oil palm plantation and forest sites is an indication that very few species of birds that thrive in the forest are able to adjust and thrive in the monoculture oil palm plantation. The considerably high abundance and species richness of open dwelling bird species recorded in the oil palm plantation demonstrate that habitat changes brought by converting forest to oil palm plantation do not only cause decline in forest bird abundance and richness but also encourage settling in of open dwelling birds which are mostly, if not all, generalist species. The difference in the structure of bird feeding guilds between oil palm plantation and forest might as well alter the ecosystem functions that may potentially undermine the ecosystem's health at the landscape level. Furthermore, the decline in abundance and richness of Palawan endemic bird species and the absence of all high conservation priority bird species in oil palm plantation further highlight the negative impact of oil palm plantations in Palawan's fragile avifaunal diversity.

Because of the disparity in bird assemblage in oil palm plantation and adjacent forest, it is recommended that the establishment of oil palm plantations must be carefully planned and should be restricted to marginal and underutilized areas only. Establishment and enhancement of interconnected forest fragments near monoculture oil palm plantations are also recommended to improve the avifaunal diversity at landscape level.

Secondary forests, specifically those used as swidden fallows, must be spared from converting into oil palm plantation. These forest fragments are very important components of the traditional swidden farming system as practiced by the indigenous tribes in Palawan. Using these regenerating forest fragments in oil palm plantation will restrict the normal shifting movements of swidden farmers in the marginal uplands.

Additional researches on the impact of widespread cultivation of oil palm and other monoculture crops on other wildlife species must also be conducted.

Continued expansion of oil palm plantations in the remaining tracts of forests in the marginal uplands threatens not only the wildlife but also the ecosystem functions, the goods and the services provided by these creatures as well. If taken into account, the economic benefits that can be derived from these ecosystem functions could be many folds as compared to the economic gains in oil palm plantations. One of the policy suggestions that are doable in Palawan setting is implementing a certification program for all oil palm contract growers. The process of certification will include evaluation of lands that will be converted into plantations and the extent of land allotted for expansion. The responsibility of the farmer to maintain, enhance or establish forest fragments within or adjacent to plantations must also be included in the agreement. Imposing environmental fee to oil palm growers and processors is another policy option. This is to generate revenue that can be used in the conservation, enhancement and reforestation of watershed areas near the plantations. Relevant forestry laws must be strictly enforced against violators who establish oil palm plantation on forested areas.

REFERENCES

Aratrakorn, A., Thunhikorn, S., and Donald, P. F. (2006). Changes in bird communities following conversion of lowland forest to oil palm and rubber plantations in Southern Thailand. Bird Conservation International 16, 71-82.

Bibby, C., Jones M., and Marsden, S. (1998). Expedition field techniques: bird surveys. Expedition Advisory Centre. Royal Geographical Society. London. p 137.

Brown, E., and Jacobson, M. (2005). Cruel oil: how palm oil harms health, rainforest and wildlife. Center for Science in the Public Interest, Washington, D.C., USA. Retrieved from <http://www.cspinet.org/palmoilreport/PalmOilReport.pdf> on June 10, 2015

Bruhl, C. A., and Eltz, T. (2010). Fuelling the biodiversity crisis: species loss of ground-dwelling forest ants in oil palm plantations in Sabah, Malaysia (Borneo). Biodiversity Conservation 19(2), 519-529.

Chang, M. S., Hii, J., Buttner, P., and Mansoor, F. (1997). Changes in abundance and behavior of vector mosquitoes induced by land use during the development of an oil palm plantation in Sarawak. Transactions of the Royal Society of Tropical Medicine and Hygiene 91(4), 382–386.

Chung, A. Y. C., Eggleton, P., Speight, M. R., Hammond, P. M., and Chey, V. K. (2000). The diversity of beetle assemblage in different habitat types in Sabah, Malaysia. Bulletin of Entomological Research 90(6), 475-496.

Dans, A.T.L., and Gonzalez, J.C.T. (1998). Birds and mammals of fragmented forest along Anahawin River, Mt. Iglit-Baco National Park, Mindoro Island Philippines. Sylvatrop: The Technical Journal of Philippine Ecosystems and Natural Resources 8(1&2), 43-61.

Edwards, F. A., Edwards, D. P., Hamer, K. C., and Davies, R. G. (2013). Impacts of logging and conversion of rainforest to oil palm on the functional diversity of birds in Sundaland. Ibis 155(2), 313-326.

Food and Agriculture Organization of the United Nations. (2010). Global forest resources assessment 2010: Main report. Food and Agriculture Organization of the United Nations (FAO) Forestry Papers. 16

Gibbons, D. W., and Gregory, R. D. (2006). Birds. In: Sutherland, W. (ed). Ecological Census Techniques: A Handbook. 2nd edition. Cambridge University Press, United Kingdom. P308-344.

Harvey, C. and Gonzalez Villalobos, J. A. (2007). Agroforestry systems conserve species-rich but modified assemblages of tropical birds and bats. Biodiversity Conservation 16, 2257-2292.

Hosonuma, N., Herold, M., De Sy, V., De Fries, R. S., Brockhaus, M., Verchot, L., Angelsen, A., and Romijn, E. (2012). An assessment of deforestation and forest degradation drivers in developing countries. Environmental Research Letters 7(4), 4009.

Martin, T., and Blackburn, G. (2010). Impacts of tropical forest disturbance upon avifauna on a small island with high endemism: Implications for conservation. Conservation and Society 8(2), 127-139.

Shankar Raman, T., Rawat, G., and Johnsingh, J. (1998). Recovery of tropical rainforest avifauna in relation to vegetation succession following shifting cultivation in Mizoram, North-East India. Journal of Applied Ecology 35(2), 214-231.

Sutherland, W. L. (2000). The conservation handbook research, management and policy. Blackwell Publishing. United Kingdom. p 278.

Thiollay, J. M. (1995). The role of traditional agroforests in the conservation of rain forest bird diversity in Sumatra. Conservation Biology 9(2), 335-353.

Turner, E. C. and Foster, W. A. (2009). The impact of forest conversion to oil palm on arthropod abundance and biomass in Sabah, Malaysia. Journal of Tropical Ecology 25, 23-30.

Villanueva, J. (2011). Oil palm expansions in the Philippines analysis of land rights, environment and food security issues. Editors: Colchester, M. and Chao, S. 2011. Oil Palm Expansion in South East Asia: Trends and Implications for Local Communities and Indigenous People. 1st Edition. Forest Peoples Programme. England and Perkumpulan Sawit Watch. Indonesia. pp 110-216.

Wijesinghe, M. and Brooke, M. (2005). Impact of habitat disturbance on the distribution of endemic species of small mammals and birds in a Tropical Rain Forest in Sri Lanka. Journal of Tropical Ecology 21(6), 661-668.

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