

Wildlife biodiversity in plantation-working area and conservation area of PT National Sago Prima Industrial Forest in Meranti Island District, Riau Province, Indonesia

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Abstract. PT National Sago Prima has allocated about 415 Ha of their area as a biodiversity conservation area to comply with the Minister of Environment and Forestry Regulation, Number P.17/MENLHK/SETJEN/KUM.1/2/2017. Unfortunately, information availability on the diversity of wildlife in the conservation area of PT. National Sago Prima is still limited. The objective of the study is to compare the species biodiversity between conservation area and plantation working area of PT. National Sago Prima. In this study, observations were conducted on mammals, bird and herpetofauna. Data on mammals were collected using strip transect and trapping method. Data on birds were collected using transect method combined with point count, while data on herpetofauna were collected using visual encounter survey combined with transect method. Our results showed that the diversity of mammals and herpetofauna in the plantation working area were higher than in the conservation area, while the diversity of bird was higher in the conservation area compared to the plantation working area.

1. Introduction

PT National Sago Prima is one of the industrial forests under Sampoerna Agro Group, which is engaged in the forestry by producing sago. The plantation working areas was legalized through the Minister of Environment and Forestry Regulation No.77 of 2013. As outlined in the Minister of Environment and Forestry Regulation No. P.17/MENLHK/ SETJEN/ KUM.1/2/2017 on amendment to the Environment and Forestry Regulation No. P.12/MENLKH-II/2015, the holders of IUPHHK-HTI (industrial forest plantation company) shall make adjustments to the IUPHHK-HTI spatial plan, that the implementation of the Industrial Plantation Forest shall allocate part of their plantation working area as a conservation area for peat land ecosystem. PT. National Sago Prima has allocated about 415 Ha of their area as a biodiversity conservation area. The conservation area is expected to protect the biodiversity and to support the genetics flows of the wildlife within the area [1]. Until now, studies on wildlife diversity in the plantation working area and conservation area of PT. National Sago Prima is lacking. Facts on wildlife diversity would provide useful information to manage both conservation area and plantation working area [2]. Furthermore, the information would also be useful to test the hypothesis that conservation area buffers higher number of species than plantation working area. Birds [3], mammals [4], and herpetofauna [5] have specific roles on the ecosystem. Therefore, the existence of wildlife biodiversity will reflect the effectiveness of the area to its function.



2. Method

2.1 Time and location

The study was conducted in the plantation working area and conservation area of PT National Sago Prima, Meranti Island District of Riau Province from February 6th to March 19th 2017.

2.2 Data collection

Data collection on mammal species diversity was divided into direct observation using Strip Transect method and indirect observations using traps and interview. Species were identified using the field guide of Mammals of Borneo. Data of bird diversity were collected through direct observation using the combination of strip and point count method, and exploration method, while data on herpetofauna were collected using Visual Encounter Survey (VES) combined with transect design [6]. Each transect was 1 km in length. Observations on birds and mammals were done twice, in the morning (06.00 – 09.00 a.m.) and afternoon (03.00 – 06.00 p.m.), whereas observation on herpetofauna was conducted at night (07.00 – 09.00 p.m.). Observations of each taxa were repeated four times for each transect. The total number of transects were 15, which comprised of 10 transects in plantation working area (each 5 in burnt and unburnt areas) and 5 transects in conservation area.

2.3. Data analysis

2.3.1. Mammals, bird and herpetofauna diversities.

2.3.1.1 *Species richness indices (Dmg)*. The species richness was determined using the following species richness index [7]:

$$Dmg = \frac{S - 1}{\ln(N)}$$

Dmg = Species richness index

S = Number of species

ln = Natural logarithm

N = Total number of individual

2.3.1.2 *Evenness indices (E)*. This index showed the species abundance and calculated using the formula below:

$$E = \frac{H'}{\ln S}$$

E = Evenness index

S = Number of species

ln = Natural logarithm

H' = Species diversity index

2.3.2. *Similarity between plantation working area and conservation area*. Similarity was obtained using similarity index. This index justifies the relative similarity of the species compositions in both communities [8]. This index can be calculated using the formula below:

$$Is = \frac{2c}{a + b}$$

IS = Similarity index

a = Species total in the first location

b = Species total in the second location

c = Total species in both location

3. Results and discussion

Figure 1 indicated that bird taxon showed the highest richness and total number of species, whereas mammals and herpetofaunas showed much lesser numbers. The results were found to linear with the total species observed, where birds were found in a much higher number than mammals and herpetofaunas.

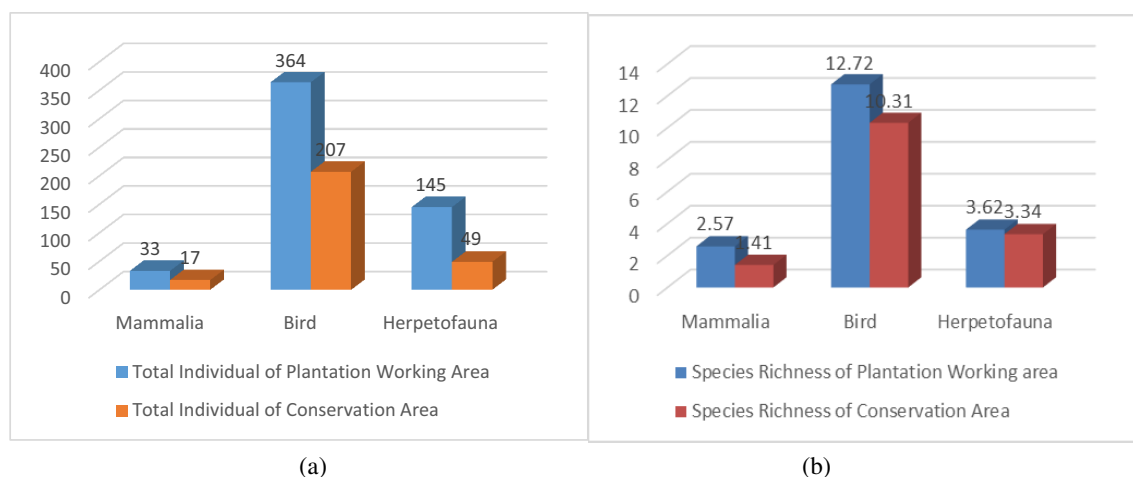


Figure 1. Total species (a) and species richness (b).

3.1 Mammals

Four species of mammals were observed in the conservation area, of which were also found within the plantation working area, in addition to another 6 species in the plantation area giving a total of 10 species in the plantation (table 2). The 4 species were plantain squirrel, the hairy-nosed otter and whitehead's spiny rat and long-tailed macaques, with long-tailed macaques (*Macaca fascicularis*) showed the highest number in both areas (10 individuals were found in conservation area and 20 individuals in plantation working area). Some species, found only in the plantation working area, were rodents. Several rat species such as Polynesian rat or Malayan field rat (*Rattus tiomanicus jalorensis*) were found on shrubs area and were rarely found under tall vegetation [9] such as the conservation area. On the other hand, *Rattus whitehead* could also be found in the secondary forest [9]. This condition becomes one of the most influencing factor of encounters. Furthermore, the higher number of rat species encountered among other mammals in the plantation working area, were associated with the higher availability of feed resources. Rats preferred rice than wheat or even molluscs and crabs [10]. Various feed sources were available within the plantation working area, such as the remains of sago harvest and the fact that it is close to settlements. Therefore, this area provides a wide range of the feeds.

On the contrary, feeds were rarely available in the conservation area. Since water is lacking inside the conservation area, the area became dry thus prevented small crabs or even molluscs to inhabit it. Therefore, only small number of mammals inhabited the conservation area. Almost all of the mammals in the conservation area were found on the edges, which is a transition area between working area and conservation area. This area has surface water supply originated from the canal. It also had thick litter on the upper side reaching up to 5 cm, which inhibit the growth of cover crops. The existence of surface water plays a great role to the animal's existence [11].

The existence of the settlement also played a significant role to food supply, especially for macaques. Essentially, the macaques consumed remains of harvested sago, which has become one of

their main feeding area. During the study period, PT. National Sago Prima had just finished its harvesting cycle, hence there were plenty of sago remains for the macaques, thus higher number of macaques were found. On the contrary, the conservation area has few feed resources, one of which is *Ficus sundaica* [12] though in small percentage [13].

Table 1. Comparison of the number of individuals of mammals found in the plantation working area and conservation area.

No	English name	Scientific Name	Number of Individual	
			Plantation working area	Conservation Area
1	Javan chevrotain	<i>Tragulus javanicus</i>	1	0
2	Bornean bearded pig	<i>Sus barbatus</i>	1	0
3	Long-tailed macaque	<i>Macaca fascicularis</i>	21	10
4	Sumatran surili	<i>Presbytis melalophos</i>	1	0
5	Plaintain squirrel	<i>Callosciurus notatus</i>	2	5
6	Polynesian rat	<i>Rattus exculans</i>	1	0
7	Whitehead's spiny rat	<i>Maxomys whiteheadi</i>	1	2
8	Malayan field rat	<i>Rattus tiomanicus jalorensis</i>	2	0
9	Asian house rat	<i>Rattus tanezumi</i>	1	0
10	The hairy-nosed otter	<i>Lutra sumatrana</i>	2	1
Total species			10	4
Total individuals			33	18

3.2. Bird

The number of birds species found in plantation working area (81 species) was lower than in conservation area (97 species), although the number of individuals found in the plantation working area was higher. The highest number of individuals in both areas showed different species. Olive-winged bulbul has the highest number of individuals in the working area, while thick-billed green pigeon has the highest number of individuals in the conservation area. Almost all of the species encountered in the conservation area were also found in the working area. Species that were specific of the conservation area included ferruginous babbler, black-headed bulbul, black-naped monarch, crested goshawk and some other species, while those specific of the plantation working area were scaly-breasted munia, purple heron, yellow-vented bulbul and some other species (table 2). The presence of birds species that were found only in the working area, were related to the characteristic of their feeding palatability [14].

The presence of thick-billed green pigeon with the highest number of individuals in the conservation area, was associated with its feeding characteristics. Pigeon is a phytophagous bird, meaning it eats plants including undergrowth [15]. Besides, pigeons eat figs and use other *Ficus* sp. as the figs' substitutes [15]. Thick-billed Green Pigeon was found in a big number within the conservation area due to the *Ficus* sp. which was also found in the conservation area [12], in which this vegetation is one of their diet. The number of this species found in the conservation area was higher than in the working area.

Table 2. Bird species found in the conservation area and plantation working area.

No	English Name	Scientific Name	Location	
			Plantation working area	Conservation area
1	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	+	+
2	Asian Drongo-Cuckoo	<i>Surniculus lugubris</i>		+
3	Asian Glossy Starling	<i>Aplonis panayensis</i>	+	+
4	Asian Red-eyed Bulbul	<i>Pycnonotus brunneus</i>		+
5	Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	+	+
6	Bar-bellied Cuckoo shrike	<i>Coraci nastriata</i>		+
7	Barn Owl	<i>Tyto alba</i>	+	+
8	Barn Swallow	<i>Hirundo rustica</i>	+	+
9	Black Eagle	<i>Ictinaetus malayensis</i>	+	+
10	Black-headed Bulbul	<i>Pycnonotus atriceps</i>		+
11	Black-naped Monarch	<i>Hypothymis azurea</i>		+
12	Black-naped Oriole	<i>Oriolus chinensis</i>	+	
13	Black-thighed Falconet	<i>Microhierax fringillarius</i>	+	+
14	Black-winged Flycatcher-shrike	<i>Hemipus hirundinaceus</i>		+
15	Black-winged Kite	<i>Elanus caeruleus</i>	+	+
16	Blue-eared Kingfisher	<i>Alcedo meninting</i>	+	
17	Blue-rumped Parrot	<i>Psittinus cyanurus</i>	+	+
18	Blue-tailed Bee-eater	<i>Merops philippinus</i>	+	+
19	Brahminy Kite	<i>Haliaeetus turindus</i>	+	+
20	Bronzed Drongo	<i>Dicrurus aeneus</i>		+
21	Brown Barbet	<i>Calorhampus fuliginosus</i>		+
22	Brown Shrike	<i>Lanius cristatus</i>	+	+
23	Brown-throated Barbet	<i>Megalaima corvina</i>		+
24	Brown-throated Sunbird	<i>Anthreptes malacensis</i>	+	+
25	Buff-necked Woodpecker	<i>Meiglyptes tukki</i>		+
26	Buff-rumped Woodpecker	<i>Meiglyptes tristis</i>		+
27	Cattle Egret	<i>Bubulcus ibis</i>	+	
28	Chestnut-bellied Malkoha	<i>Phaenicophaeus sumatranus</i>	+	+
		<i>Phaenicophaeus</i>		
29	Chestnut-breasted Malkoha	<i>curvirostris</i>	+	+
30	Chestnut-rumped Babbler	<i>Stachyris maculata</i>	+	+
31	Chestnut-winged Cuckoo	<i>Clamator colomandus</i>	+	
32	Collared Scops Owl	<i>Otus lempiji</i>		+
33	Common Goldenback	<i>Dinopium javanense</i>	+	+
34	Common Hill Myna	<i>Gracula religiosa</i>	+	+
35	Common Iora	<i>Aegithina tiphia</i>	+	+
36	Cream-vented Bulbul	<i>Pycnonotus simplex</i>	+	+
37	Crested Goshawk	<i>Accipiter trivirgatus</i>		+
38	Crested Serpent Eagle	<i>Spilornis cheela</i>	+	+
39	Crimson SunBird	<i>Aethopyga siparaja</i>	+	+
40	Dark-necked Tailor Bird	<i>Orthotomus atrogularis</i>	+	+

No	English Name	Scientific Name	Location	
			Plantation working area	Conservation area
41	Eurasian Tree Sparrow	<i>Passer montanus</i>	+	+
42	Ferruginous Babbler	<i>Trichas tomabicolor</i>		+
43	Flame-fronted Barbet	<i>Megalaima armillaris</i>	+	+
44	Fulvous-breasted Woodpecker	<i>Dendrocopus macei</i>	+	+
45	Glossy Swiftlet	<i>Collocalia culenta</i>	+	+
46	Great Hornbill	<i>Buceros bicornis</i>		+
47	Great Tit	<i>Parus major</i>	+	+
48	Greater Racquet-tailed Drongo	<i>Dicrurus paradiseus</i>	+	+
49	Green Imperial Pigeon	<i>Ducula aenea</i>	+	+
50	Grey Heron	<i>Ardea cinerea</i>	+	+
51	Grey Wagtail	<i>Motacilla cinerea</i>	+	+
52	Grey-and-buff Woodpecker	<i>Hemicircus concretus</i>		+
53	Grey-rumped Treeswift	<i>Hemiprocne longipennis</i>	+	+
54	Hill Prinia	<i>Prinia atrogularis</i>		
55	Indigo Flycatcher	<i>Eumyias indigo</i>		+
56	Japanese Paradise-flycatcher	<i>Terpsiphoneatro caudata</i>		+
57	Javan munia	<i>Lonchura leucogastroides</i>	+	+
58	King Quail	<i>Coturnix chinensis</i>	+	
59	Large Hawk-cuckoo	<i>Cuculuss parverioides</i>	+	
60	Large-billed Crow	<i>Corvus macrorhynchos</i>	+	+
61	Lesser Coucal	<i>Centropus bengalensis</i>	+	
62	Little Egret	<i>Egretta garzetta</i>	+	
63	Little Pied Flycatcher	<i>Ficedula westermanni</i>	+	+
64	Long-tailed Parakeet	<i>Psitacula longicauda</i>	+	+
65	Long-tailed Shrike	<i>Lanius schach</i>	+	+
66	Mangrove Blue Flycatcher	<i>Cyornis rufigastrea</i>	+	+
67	Mangrove Whistler	<i>Pachycephala grisola</i>		+
68	New Zealand Pipit	<i>Anthusnovaes elandiae</i>	+	+
69	Olive-backed SunBird	<i>Cinnyris jugularis</i>	+	+
70	Olive-backed Tailor Bird	<i>Orthotomus sepium</i>	+	+
71	Olive-winged Bulbul	<i>Pycnonotus plumosus</i>	+	+
72	Orange-bellied Flowerpecker	<i>Dicaeum trigonostigma</i>	+	+
73	Oriental DollarBird	<i>Eurystomus orientalis</i>	+	+
74	Oriental Magpie-robin	<i>Copsychus saularis</i>	+	+
75	Oriental Pied Hornbill	<i>Anthraceroceros albirostris</i>	+	+
76	Pacific Swallow	<i>Hirundo tahitica</i>	+	+
77	Pied Fantail	<i>Rhipidura javanica</i>	+	+
78	Pink-necked Green Pigeon	<i>Treron vernans</i>	+	+
79	Plain SunBird	<i>Anthreptes implex</i>	+	+
80	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	+	+
81	Purple Heron	<i>Ardea purpurea</i>	+	
82	Purple-naped SunBird	<i>Hypogramma hypogrammicum</i>		+

No	English Name	Scientific Name	Location	
			Plantation working area	Conservation area
83	Purple-throated sunbird	<i>Nectarinia sperata</i>	+	+
84	Red-naped Trogon	<i>Harpactes kasumba</i>		+
85	Red-wattled Lapwing	<i>Vanellus indicus</i>	+	
86	Ruby-cheeked Sunbird	<i>Nectarinia calcostetha</i>	+	+
87	Rufous backed Kingfisher	<i>Ceyx rufidorsa</i>		+
88	Rufous Piculet	<i>Sasia abnormis</i>		+
89	Rufous-fronted Babbler	<i>Stachyris rufifrons</i>	+	+
90	Rufous-tailed Tailor Bird	<i>Orthotomus sericeus</i>	+	+
91	Savanna Nightjar	<i>Caprimulgus affinis</i>	+	+
92	Scaly-breasted Munia	<i>Lonchura punctulata</i>	+	
93	Scaly-crowned Babbler	<i>Malacopteron cinereum</i>		+
94	Slender-billed Crow	<i>Corvus enca</i>	+	+
95	Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	+	
96	Spotted Dove	<i>Streptopelia chinensis</i>	+	+
97	Sunda Minivet	<i>Pericrocotus miniatus</i>		+
98	Thick-billed Green Pigeon	<i>Treron curvirostra</i>	+	+
99	Tiger Shrike	<i>Lanius tigrinus</i>		+
100	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>		+
101	Whiskered Treeswift	<i>Hemiprocne comata</i>	+	+
102	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	+	+
103	White-breasted Wood swallow	<i>Artamus leucorhynchus</i>	+	+
104	White-headed Munia	<i>Lonchur amaja</i>	+	+
105	White-rumped Munia	<i>Lonchura striata</i>	+	+
106	White-throated Kingfisher	<i>Halcyons myrnenis</i>	+	+
107	Wrinkled Hornbill	<i>Aceros corrugatus</i>	+	
108	Yellow-bellied Prinia	<i>Prinia flaviventris</i>	+	+
109	Yellow-browed Warbler	<i>Phylloscopus inornatus</i>		+
110	Yellow-rumped Flycatcher	<i>Ficedula zanthopygia</i>	+	+
111	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	+	+
Species Total			81	97
Individual Total			364	207

*+: Found on the location

3.3. Herpetofauna

The herpetofauna existence is strongly influenced by temperature conditions, humidity and weather, especially for frogs [16], due to the herpetofauna's body temperature, which fluctuates following its environmental condition as found in other poikilotherm-ectotherm animals [17]. The daily temperature of the conservation area was approximately 21 – 22°C and was relatively constant due to the dense canopy cover. However, there were almost no available surface water along the observation transects except along the second transect, lying in the 6th and 8th divisions, although this source of water was just a small puddle due to the rain, which can be lost anytime. Therefore, the number of herpetofauna that could be observed were less than those encountered in the plantation working area. This caused specific species to be found only in certain areas.

There were only 14 species of herpetofauna found in the conservation area which is lesser than herpetofauna found in the working area. There was 19 species found in the plantation working area with a total of 48 and 145 individuals respectively (table 4). In addition, few species only inhabited one area, such as *Fejervarya cancrivora* (Asian brackish frog) found only in plantation working area. Asian brackish frog naturally lives in the watery area [16]. The presence of this frog in the plantation working area was supported by the area's habitat condition, which was mostly flooded with water. On the contrary, water sources were rarely found within the conservation area, thus tent to be dry. Certain species found in the conservation area showed a very big gap of individual number if compared to the plantation working area, such as the Common tree frog (*Polypedates leucomystax*). This species was found in both areas due to its ability to adapt in extreme condition [18]. The litters, which were covered by water tent to provide additional moisture to the amphibians to carry out their vital activities such as food hunting, breeding season or even as places for their eggs [19].

Table 3. Herpetofauna found in the *plantation working area* and conservation area.

No	English Name	Scientific Name	Number of individual	
			Plantation working area	Conservation area
1	Sumatra toad	<i>Ingerophrynus quadriporcatus</i>	2	0
2	Asian brackish frog	<i>Fejervarya cancrivora</i>	14	0
3	Copper-cheeked frog	<i>Hylarana raniceps</i>	12	12
4	Baram river frog	<i>Hylarana baramica</i>	14	15
5	Collett's Whipping Frog	<i>Polypedates colletti</i>	1	1
6	Common tree frog	<i>Polypedates leucomystax</i>	42	3
7	Flying dragon	<i>Draco sp.</i>	1	0
8	Painted bronzeback	<i>Dendrelaphis pictus</i>	5	0
9	Striped bronzeback	<i>Dendrelaphis caudolineatus</i>	2	1
10	Barred tree snake	<i>Chrysopele apelas</i>	2	1
11	Javan bent-toed gecko	<i>Cyrtodactylus marmoratus</i>	7	8
12	Common house gecko	<i>Hemidactylus frenatus</i>	20	1
13	Masked water snake	<i>Homalopsis buccata</i>	4	1
14	East Indian Brown Mabuya	<i>Eutropis multifasciata</i>	8	1
15	Reticulated phyton	<i>Malayopython reticulatus</i>	2	1
16	Common water monitor	<i>Varanus salvator</i>	5	1
17	Wagler's pit viper	<i>Tropidolaemus wagleri</i>	1	1
18	Red-headed krait	<i>Bungarus flaviceps</i>	2	0
19	South asian box turtle	<i>Cuora amboinensis</i>	1	1
Number of species			19	14
Number of individuals			145	49

4. Species evenness

The evenness of species can be determine by the evenness index. The value of the index indicates the difference in the number of species or species abundance in that location [20]. Such differences showed that every species has an important role and contributes to the ecological process within the area [21]. Figure 2 showed that all taxa in both areas were spread evenly, although each varies. Mammals showed a higher evenness index in conservation area than the working area. Nevertheless, there were only a few species that were found on every transects.

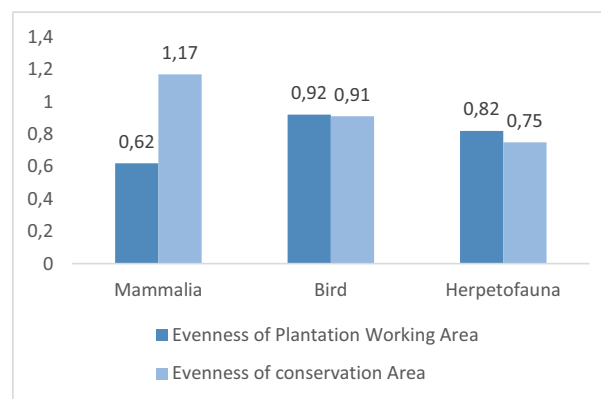


Figure 2. The evenness of each taxa in the plantation working area and conservation area.

The bird evenness value is slightly differ in both locations, 0.92 and 0.91 in the working area and conservation area respectively, indicating that birds spread evenly in both areas, even though there were some species that were found within one area only. Similarly, herpetofauna showed different evenness values between the two areas, with greater species number in the plantation working area. In contrast to the other two taxa, mammals showed an even distribution only within the conservation area (table 1).

Each species has their own ecological roles. One example is the hairy-nosed otter, which has a role as an ecosystem engineer [22]. Otters cut woods to construct dams, which would modify the dynamic structure of the riparian zone. In addition, such activities affected the carried materials, thus affecting the nutrition composition, which were distributed to plants or other animals [23]. Evenness values were affected by the environmental conditions, as well as the location preference of the animal, thus affecting the number of species that were observed. Conservation area has a dense canopy cover and vegetation which were relatively very high. The main water resource came from the canals surrounding the conservation area. Canopy cover, temperature, density of undergrowth, depths of litters, and litters cover could affect the differences in species richness and composition, especially on herpetofauna [24], since its occurrence cannot be separated from temperature and environment [12]. Moreover, lack of available food sources within the conservation area, reduces the chance of encountering the species.

5. Species composition

The similarity indices values showed that more than 50% of the animals with the same species, occurred in both locations (figure 3). A community is said to be similar if the similarity index approached 1 [8]. The similarity index of birds between the working area and conservation area were 0.78 or 78% (figure 3). It is proportional to the number of species found in both areas, *i.e.* 68 species. Birds tent to have the abilities to adapt to various habitats [25] and some were also easily adapted to paddy field, forest or even settlement [26]. Likewise, herpetofauna also showed a high similarity of species in both locations, with similarity that was slightly higher than bird, *i.e.*, 0.85 or 85% (figure 3), suggesting that both areas shared similar species compositions, 14 out of 19 species. Similar to birds, some herpetofauna species were easily adapted, such as the common tree frog and Asian brackish frog which can adapt easily to the extreme conditions [18] thus that occurred in both locations, although there was a big gap in the number of individual abundance (table 3).

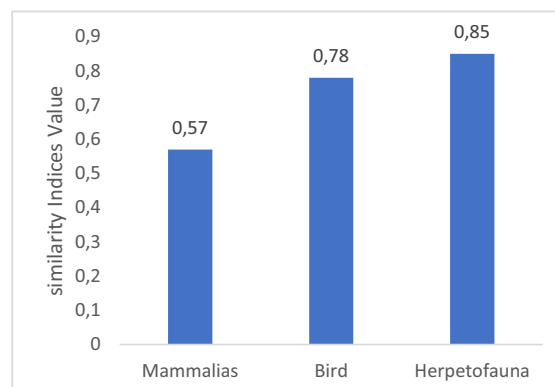


Figure 3. Similarities indices of taxa between plantation working area and conservation area.

In contrast, mammals showed the smallest value of similarity, only 0.57 or 57% species that were found in both areas (figure 3). Only 4 of the same species were found in both areas (table 1). Furthermore, only 4 species from the total of 10 species were found in both locations, due to lack of food availability and habitat compatibilities [27]. These results suggested that the allocated conservation area has not fully play its role. Therefore, the managerial should also give more attention and foster through species enrichment, herbivore feeds as well as the protective plants for carnivores. Thus, the wildlife animals which are living in the plantation working area would feel more comfortable being in the working area.

6. Conclusions

The diversities of mammals and herpetofauna in the plantation working area was higher than conservation area, while bird diversity in the plantation working area was lower than conservation area. These were indicated by the higher species richness in the plantation working area than conservation area (Plantation working area: Mammals= 3.62; Bird= 12.72; Herpetofauna= 3.62; Conservation area: Mammals= 1.41; Bird= 10.31; Herpetofauna= 3.34). Meanwhile, the evenness value of mammals in the plantation working area was lower than the conservation area (Plantation working area= 0.62; conservation area= 1.17), and higher for bird and herpetofauna in the working area (Plantation working area: Bird= 0.92; Herpetofauna= 0.82; the conservation area: Bird= 0.91; Herpetofauna= 0.75). While the Species composition in both areas were similar as the indices values were more than 0.5 (Mammals= 0.57; Bird= 0.78; Herpetofauna= 0.85). Furthermore, the total individuals in the plantation working area were higher than the conservation area (Plantation working area: Mammals= 33 individuals; Bird= 364 individuals; Herpetofauna= 145 individuals; Conservation area: Mammals= 18 individuals; Bird= 207 individuals; Herpetofauna= 49 individuals).

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