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Diversity of faunal communities in the Biodiversity Park of Ciherang, Bogor, West Java, Indonesia

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Abstract. *Gunawan H, Sugiarti, Rianti A, Sihombing VS. 2016. Diversity of faunal communities in the Biodiversity Park of Ciherang, Bogor, West Java, Indonesia. Biodiversitas 17*: *479-486.* A Biodiversity Park is a new concept for ex situ conservation in Indonesia which was first launched in 2012. The purposes of a Biodiversity Park are to conserve indigenous and threatened species of flora, provide habitat for a diversity of animals, and to provide opportunities for economic benefit, recreation, education and research. The main goal of Biodiversity Park is to increase flora and fauna diversity in the midst of human settlement and industrial precincts. This research was directed at studying the diversity of faunal communities in the Biodiversity Park of Aqua Danone Ciherang**,** Bogor, West Java, Indonesia. Line transects, walk transects, terrestrial transects and point count methods were combined to census the mammals, reptiles, amphibians and birds in the Biodiversity Park. Twenty five families of fauna were identified, consisting of 28 genera and 32 species. The Shannon diversity index for the total faunal community was 2.82. Composition of the faunal community consisted of birds (66%), reptiles (16%), mammals (12%) and amphibians (6%). This finding supports the goal that Biodiversity Park can increase flora and fauna diversity. The diversity index of 2.37 for the bird community indicates a beneficial contribution to habitat quality within an urban environment.

Keywords: Biodiversity Park, fauna, habitat, green space

INTRODUCTION

Java is the most populated island in Indonesia, with 136.45 million people or 57.44% of its total population (237.56 million) (Center Bureau of Statistic 2010). Due to the high density of human population, Java is facing two serious challenges namely, consumptive behavior leading to over-exploitation of natural resources; and limited understanding of the importance of conservation, which leads to low implementation of conservation principles in the planning and implementation of development (Whitten et al. 1996). The threat of environmental degradation and biodiversity loss comes from habitat alteration, invasive alien species, pollution, over-exploitation and climate change (Widjaja 2014). Fragmentation of the environment is also leading to local extinction of species (Morrison et al. 1992; Turner 1996; Gu et al. 2002; Henle et al. 2004; van Houtan et al. 2006; Parker et al. 2008).

The rate of biodiversity loss must be curtailed, and priority given to rehabilitation of degraded ecosystems both inside conservation areas and in surrounding human settlements (BAPPENAS 2003). Some effort has been initiated by the Government of Indonesia to protect biodiversity through in situ and ex situ conservation methods. Besides protecting the biodiversity in its natural habitat through designation of in situ conservation areas, the Government of Indonesia has also established ex situ conservation areas such as Botanical Gardens and Biodiversity Parks (Widjaja 2014).

A Biodiversity Park is a reserved area for preserving local biodiversity, especially the flora and associated fauna that act as pollinators and seed dispersal agents. The goals of Biodiversity Parks are to conserve local and threatened species of flora, develop habitat to increase faunal diversity, and provide opportunities for tourism, research, education and local wealth generation (Ministry of Environment 2012).

AQUA Danone Plant Ciherang is a producer of bottled drinking water under the management of the Aqua Danone Group. Aqua Danone Plant Ciherang has established a Biodiversity Park as part of its effort to achieve Green Company status within the Green PROPER (Performance Rating in Environmental Management) award scheme promoted by the Ministry of Environment and Forestry. To achieve a Green PROPER award as a Biodiversity Park, various activities and outputs must match with the criteria set out in PROPER assessment (Ministry of Environment 2014). One of the award criteria for a Biodiversity Park is that it must impact positively to increase the status of flora and fauna diversity in the local environment. Objective measures of diversity based on the variety and relative abundance of species are frequently used as indicators of the well-being of ecological systems (Magurran 1988; Spellerberg and Fedor 2003).

A program of research is needed to determine whether faunal diversity is increasing as a result of the development of Biodiversity Parks. A quantitative census of wildlife species is a key tool used to establish a base-line description of the site, to estimate population sizes, and to monitor population changes. It also provides basic information for determining the habitat requirements of identified species, for determining if and why species have declined, and for monitoring the effects of habitat management (Sutherland 2004). The objective of this research was to study the diversity of faunal communities in the Biodiversity Park of Aqua Danone Ciherang, Bogor, West Java, Indonesia. This was to be used to provide evidence as to whether or not the implementation of the Biodiversity Park concept at this site has been effective in increasing species diversity.

MATERIALS AND METHODS

The research was conducted from July to December 2015 in the Biodiversity Park of Ciherang which is located in the industrial and sub-urban settlement environment of Ciherang Pondok Village, Sub District of Caringin, Bogor District, West Java Province, Indonesia. The Biodiversity Park of Ciherang is managed by Aqua Danone which covers 3.76 hectares allocated as open green space. Identification of fauna was based on various field guides, namely 'Guide to the Tracks of Mammals of Western Indonesia' (van Strien 1983); field guides for identification of Indonesian birds (Mackinnon 1991; MacKinnon et al. 1992); field guides for the identification of amphibians (Iskandar 2002; Kusrini 2013), and for identification of snakes (Suhono 1986; Supriatna1995). Binoculars, SLR camera with tele-lens and camera trap were used in spotting fauna.

Line transects were used to sample individual mammals detected on and to each side of the transect line, followed by other specific methods for identifying particular species. Faecal pellet investigation was used to identify mammals, particularly carnivores which use their droppings for territory marking. Observation of feeding signs was used to identify those species that leave conspicuous markings on food sources or remains. The track count method was also used to identify a variety of species. Systematic searching for signs along transects provides an indication of presence and activity (Hill et al. 2005). Camera trap were also installed in strategic sites to monitor those species of fauna that are difficult to find because of secretive or nocturnal behavior (McDonald 2004; Meek 2012).

The walk transect method was used to survey reptiles. All reptiles seen along transects were identified and recorded (Hill et al. 2005). Terrestrial transect searches were used to estimate amphibian numbers on land. Transects were searched carefully (i.e. on hands and knees) for signs of amphibians within a specified distance of the transect line (Hill et al. 2005). The point counts method was applied for the bird survey (Hill et al. 2005) with observation radius of 50 m. The result was a list of bird species and a number of records for each species (van Lavieren 1982).

Data was processed and analyzed using Microsoft Excel. Data was analyzed and interpret to provide information of Relative Abundant (RA); Relative Frequency of occurrence (RF); Important Value (IV), diversity index (H') and evenness index (E) for each community. The diversity and evenness indices were based on the Shannon formula (Ludwig and Reynolds 1988; Magurran 1988; Spellerberg and Fedor 2003). The equation for Shannon function, which uses natural logarithms (ln), is

$$H' = -\sum pi \ln pi$$

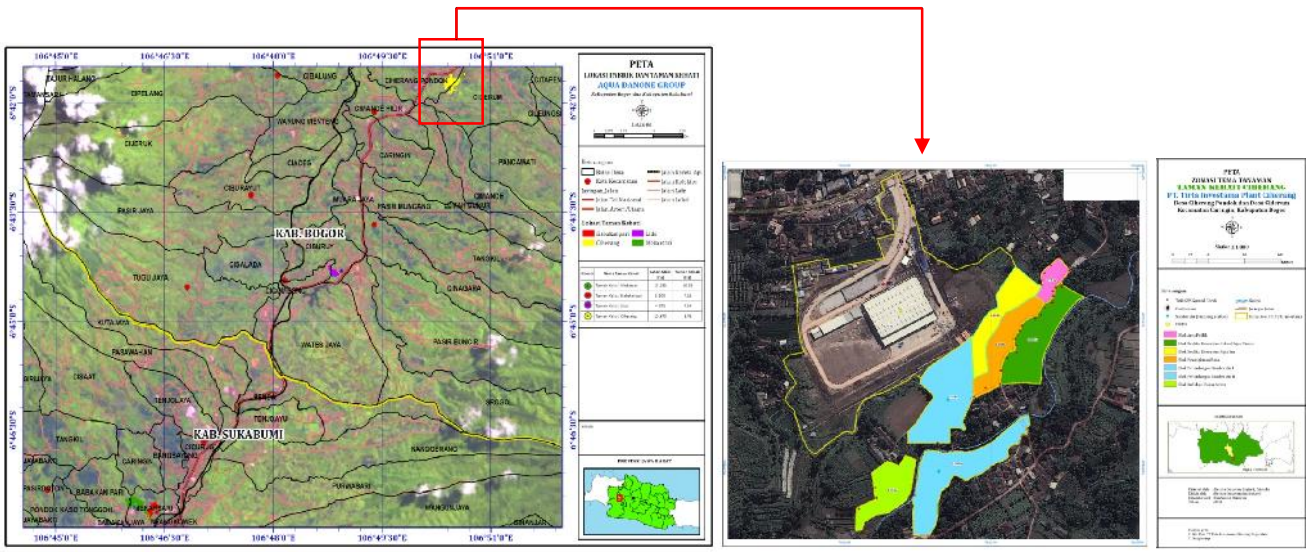

Figure 1. Research location at Ciherang Pondok Village, Sub District of Caringin, Bogor District, West Java Province, Indonesia

Where, *pi* is the proportion of individuals found in the i^{th} species which is estimated as ni/N. The formula of evenness index (E) used in this research is

$$E = \frac{H'}{lnS}$$

Where, S is number of species.

Relative abundance (RA) was determined by using formula (Zakaria et al. 2009):

$$RA\ (\%) = \frac{n}{N} x100\%$$

Where, *n* is number of particular recorded animal and *N* is total recorded animal. In the same way, we get formula for Relative Frequency of occurrence (RF) as follow:

$$RF = \frac{f}{F} x100\%$$

Where, *f* is frequency of detection of particular recorded animal and *F* is total recorded animal. Important value is a sum of relative abundant and relative frequency of occurrence.

Fauna was listed and categorized according to the IUCN Red List status (i.e. LC = Least Concern; NT = Near Threatened; NE = Not Evaluated) (IUCN-WCU 2001) and Government Protection status (i.e. L=Protected; TL=Unprotected) (Ministry of Forestry 1999). Birds were also categorized according to feeding guilds (i.e. carnivorous, nectarivorous, granivorous, frugivorous, and insectivorous) (Wiafe and Nutsuakor 2012; Edison et al. 2016).

RESULTS AND DISCUSSION

The diversity of faunal communities

A serial survey of fauna at the Biodiversity Park of Aqua Danone Ciherang found 25 families consisting of 28 genera and 32 species. For comparison, at the similar type of vegetation in Biodiversity Park of Aqua Danone Babakan Pari, West Java with 4.15 hectares area only found 22 species of fauna consisted of four mammalian, four herpetofauna and 14 avifauna (Gunawan and Sugiarti 2015a). Both of biodiversity parks are located in the midst of industrial and human settlement environment. The diversity index for the total fauna community at Biodiversity Park of Aqua Danone Ciherang was 2.82, higher than Biodiversity Park of Aqua Danone Babakan Pari (2.62). Other research at Biodiversity Park of Aqua Danone Lido with 4.34 hectares area found 21 species with diversity index of 2.58 (Gunawan and Sugiarti 2015b). In general, the Biodiversity Park of Aqua Danone Ciherang is more succeed in providing habitat for animal life.

Bird community was dominant which comprised 66% (21 species) of the total number of faunal species (32) in the Biodiversity Park. Avifauna had the highest diversity index (2.37), followed by reptiles (1.52) and mammals (1.28) and the lowest was for amphibians (0.56). In general, the Biodiversity Park has provided habitats for many species of fauna, including mammals, reptiles, amphibians and bird. Diversity in the species of plants occurring in the Biodiversity Park of Aqua Danone Ciherang creates habitats which provide a variety of feed types, nesting trees, foraging trees and shelter for fauna.

Most of the fauna in Biodiversity Park of Aqua Danone Ciherang are listed as Least Concern in IUCN Red list; three species are listed as Not Evaluated and one species is listed as Near Threatened. Sixteen percent of the species recorded are protected by law due to their rarity and threatened status. This means that the Biodiversity Park represents an oasis of biodiversity in a marginal environment of dense human settlement and industry.

The Biodiversity Park has also demonstrated its significant role for carnivores such as Javan mongoose (*Herpestes javanicus javanicus* É. Geoffroy Saint-Hilaire) and common palm civet (*Paradoxurus hermaphroditus* Pallas) which are now becoming difficult to be found. Javan mongoose is a carnivore which controls populations of pest like rat (*Rattus rattus* Linnaeus). Common palm civet is a species of carnivore that mostly feeds on fruits and seeds of many trees, palms and rattans, such as *Vitex glabrata* R.Br, *Coffea arabica* L, *Pinanga kuhlii* Blume and *Pinanga javana* Blume; so this species is an important agent of seed dispersal (Thohari and Santoso 1996; Gregory and van Strien 2010; Chakravarthy and Ratnam 2015).

The monitor lizard (*Varanus salvator* Laurent) and snake species (*Rhabdophis subminiatus* Schlegel) are predatory animals which live in the Biodiversity Park. These species have a role as controllers of their prey populations in its ecosystem. Monitor lizard is carnivorous and scavenger (Kulabtong and Mahaprom 2015), it has an extremely broad diet and will scavenge food left over from residents (Uyeda 2009). As scavenger, monitor lizard has important role in cleaning the environment from potential pests and diseases arising from dead carcasses. On the other side, monitor lizard is also facing threat from hunting for food, medicine and leather.

Other reptiles (i.e. *Bronchocela jubata* Duméril and Bibron, *Draco volans* Linnaeus, and *Eutropis multifasciata* Kuhl), as well as amphibians (i.e. *Hylarana chalconota* Schlegel and *Duttaphrynus melanostictus* Schneider) have important roles in ecosystems. Manned forest lizard (*Bronchocela jubata)* preys on butterflies, moths, dragonflies, flies and other small insects. Common gliding lizard (*Draco volans*) feeds mainly on ants, and possibly termites (McGuire and Kiew 2001). Common sun skink (*Eutropis multifasciata)* specializes on spiders, insect larvae, snails, grasshoppers and crickets (Ngo et al. 2015).

The role of amphibians in ecosystems is their contribution to supporting services. Amphibians can affect ecosystem structure through soil burrowing and aquatic bioturbation and ecosystem functions such as decomposition and nutrient cycling through waste excretion and indirectly through predatory changes in the food web. They also can control primary production in aquatic ecosystems through direct consumption and nutrient cycling (Hocking and Babbitt 2014).

The existence of carnivorous and insectivorous species in an ecosystem suggests the possibility of maintaining a harmonious food chain. Scavengers play an important role in the ecosystem by consuming the dead animal and plant material. This imply that the presence of scavengers has also tends to keep the ecosystem healthy. Based on these facts, the Biodiversity Park has successfully provided a habitat for some carnivorous species and insectivorous reptiles and amphibians.

Structure and composition of bird community

Avifauna plays an important link of food chain in ecological unit of nature. Hence, it is very important to know their diversity, migratory status, population size, distribution pattern and conservation status (Jeevan et al, 2013). There were 15 family of birds found in Aqua Danone Ciherang Biodiversity Park, consisting of 17 genera and 21 species. Twenty species are listed as Least Concern (LC) status in the Red list of IUCN; one species is listed as Near Threatened (NT). Referring to the Government Regulation No. 7/1999, there are five species which are protected by law and the rest are unprotected. The Shannon diversity index of the bird community in Aqua Danone Ciherang Biodiversity Park is 2.37 with an evenness index of 0.78.

Table 1. Diversity of fauna in the Biodiversity Park of Aqua Danone Ciherang at Ciherang Pondok Village, Sub District of Caringin, Bogor District, West Java Province, Indonesia

Classes	Family	Genus	Species	Diversity Index	Evenness Index
Mammal	4	4	4	1.28	0.92
Reptile	4	5	5	1.52	0.94
Amphibian	2	2	2	0.56	0.81
Aves	15	17	21	2.37	0.78
Total community	25	28	32	2.82	0.81

Table 2. List of fauna in the Biodiversity Park of Aqua Danone Ciherang at Ciherang Pondok Village, Sub District of Caringin, Bogor District, West Java Province, Indonesia

Local Name	Latin Name	Family	Status	RF	RA	IV
Mammal						
Garangan jawa	*Herpestes javanicus javanicus* (É. Geoffroy Saint-Hilaire, 1818)	Herpestidae	LC/TL	2.56	1.35	3.92
Bajing kelapa	*Callosciurus notatus* (Boddaert, 1785)	Sciuridae	LC/TL	1.28	2.70	3.98
Musang luwak	*Paradoxurus hermaphroditus* (Pallas, 1777)	Viverridae	LC/TL	3.85	2.03	5.87
Tikus	*Rattus rattus* (Linnaeus, 1758)	Muridae	NE/TL	1.28	0.68	1.96
Reptile						
Biawak	*Varanus salvator* (Laurenti, 1768)	Varanidae	LC/TL	1.28	0.68	1.96
Bunglon	*Bronchocela jubata* (Duméril and Bibron, 1837)	Agamidae	LC/TL	2.56	2.03	4.59
Cecak terbang (haphap)	*Draco volans* (Linnaeus, 1758)	Agamidae	NE/TL	2.56	1.35	3.92
Kadal kebun	*Eutropis multifasciata* (Kuhl, 1820)	Scincidae	NE/TL	5.13	2.70	7.83
Ular picung	*Rhabdophis subminiatus* (Schlegel, 1837)	Colubridae	LC/TL	2.56	1.35	3.92
Amphibians						
Kongkang kolam	*Hylarana chalconota* (Schlegel, 1837)	Ranidae	LC/TL	1.28	0.68	1.96
Katak buduk	*Duttaphrynus melanostictus* (Schneider, 1799)	Bufonidae	LC/TL	3.85	2.03	5.87
Aves						
Walet sapi	*Collocalia esculenta* (Linnaeus, 1758)	Apodidae	LC/TL	7.69	12.84	20.53
Walet linchi	*Collocalia linchi* (Horsfield and Moore, 1854)	Apodidae	LC/TL	10.26	17.57	27.82
Tekukur	*Spilopelia chinensis* (Scopoli, 1768)	Columbidae	LC/TL	2.56	2.03	4.59
Madu kuning	*Cinnyris jugularis* (Linnaeus, 1766)	Nectariniidae	LC/L	2.56	1.35	3.92
Burung gereja	*Passer montanus* (Linnaeus, 1758)	Passeridae	LC/TL	2.56	4.73	7.29
Rajaudang jawa	*Halcyon cyanoventris* (Vieillot, 1818)	Halcyonidae	LC/L	3.85	2.03	5.87
Meninting	*Alcedo meninting* (Horsfield, 1821)	Alcedinidae	LC/L	1.28	0.68	1.96
Bondol jawa	*Lonchura leucogastroides* (Horsfield and Moore, 1856)	Estrildidae	LC/TL	8.97	20.95	29.92
Wiwik lurik	*Cacomantis sonneratii* (Latham, 1790)	Cuculidae	LC/TL	2.56	1.35	3.92
Wiwik uncuing	*Cacomantis sepulcralis* (S. Muller, 1843)	Cuculidae	LC/TL	2.56	1.35	3.92
Cinenen pisang	*Orthotomus sutorius* (Pennant, 1769)	Cisticolidae	LC/TL	3.85	2.70	6.55
Cipoh	*Aegithina tiphia* (Linnaeus, 1758)	Aegithinidae	LC/TL	3.85	2.03	5.87
Cucak kuning	*Pycnonotus melanicterus* (Gmelin, 1789)	Pycnonotidae	LC/TL	1.28	0.68	1.96
Cerucuk	*Pycnonotus goiavier (*Scopoli, 1786)	Pycnonotidae	LC/TL	1.28	1.35	2.63
Kutilang	*Pycnonotus aurigaster* (Vieillot, 1818)	Pycnonotidae	LC/TL	3.85	3.38	7.22
Kacamata jawa	*Zosterops flavus* (Horsfield, 1821)	Zosteropidae	NT/TL	2.56	1.35	3.92
Kacamatan biasa	*Zosterops palpebrosus* (Temminck, *1824)*	Zosteropidae	LC/TL	1.28	1.35	2.63
Alap-alap kecil	*Microhierax fringillarius* (Drapiez, *1824)*	Falconidae	LC/L	1.28	0.68	1.96
Burung cabe	*Dicaeum agile* (Tickell, 1833)	Dicaeidae	LC/TL	3.85	2.03	5.87
Puyuh tegalan	*Turnix sylvaticus* (Desfontaines, 1789)	Turnicidae	LC/TL	1.28	0.68	1.96
Cekakak sungai	*Todiramphus chloris* (Boddaert, 1783)	Halcyonidae	LC/L	2.56	1.35	3.92
			Total	100.00	100.00	200.00

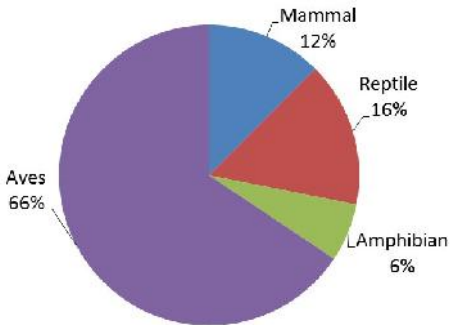

Figure 2. Composition of faunal diversity in Biodiversity Park of Ciherang

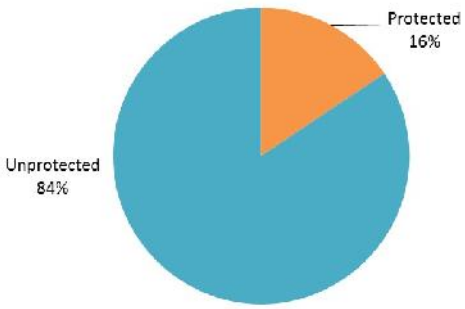

Figure 4. Protection status of fauna in Biodiversity Park of Ciherang

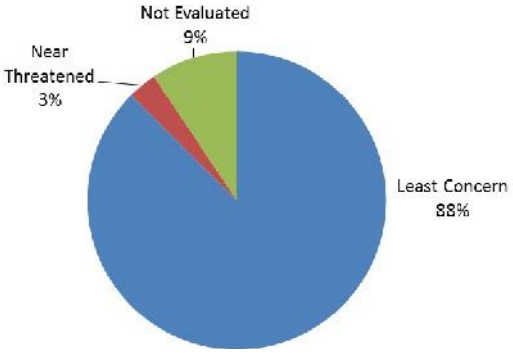

Figure 3. Red List status of fauna in Biodiversity Park of Ciherang

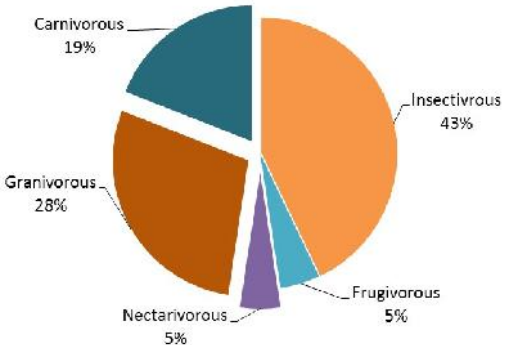

Figure 5. Composition of feeding guilds of the bird community in Biodiversity Park of Ciherang

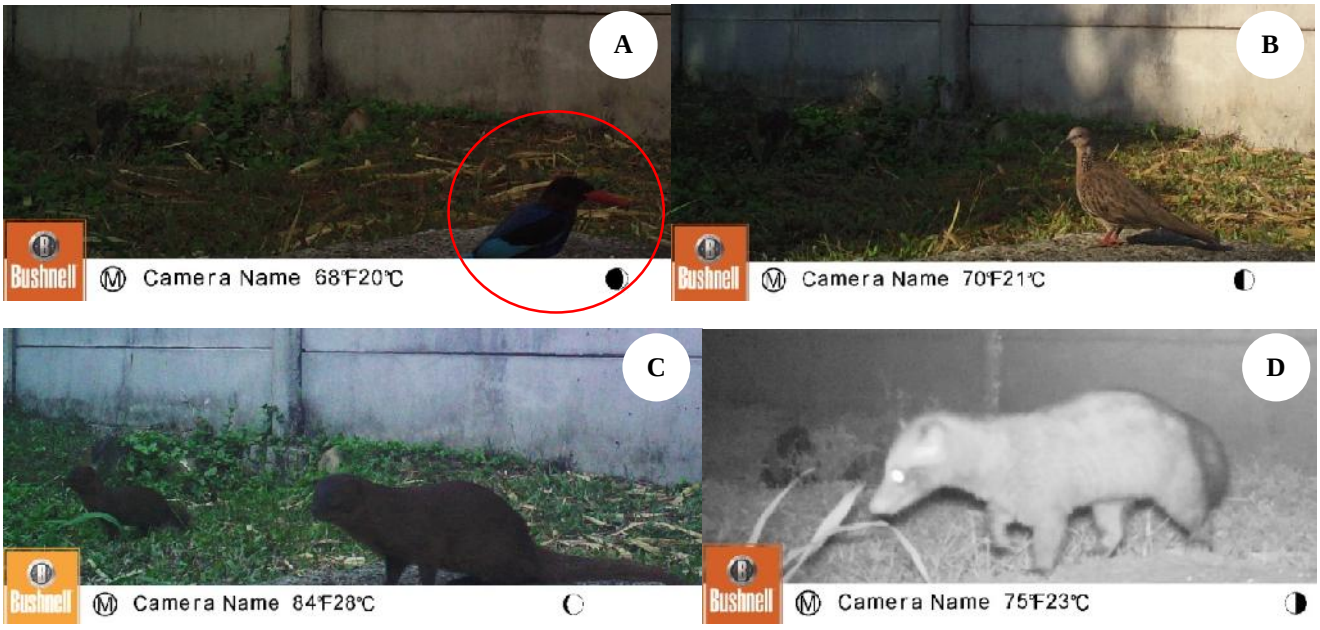

Figure 6. Some fauna species which have been caught on camera traps at the Biodiversity Park of Ciherang. A. *Halcyon cyanoventris* Vieillot, B. *Spilopelia chinensis* Scopoli, C. *Herpestes javanicus javanicus* É. Geoffroy Saint-Hilaire, D. *Paradoxurus hermaphroditus* Pallas

These indices are relatively high for a habitat situated in the middle of human populations and an industrial environment. For comparison, the diversity index of bird community in Biodiversity Park of Aqua Danon Lido is 1.92 (Gunawan and Sugiarti 2015b) and in Aqua Danone Mekarsari Biodiversity park is 2.22 (Gunawan and Sugiarti 2015c).

In accordance with feeding guilds, the insectivorous birds are dominant (42%) in the Biodiversity Park of Aqua Danone Ciherang (Figure 5). This fact means that the area is most suitable for insectivorous birds. At the initial stage of the vegetation succession, the dominant habitat is usually open shrub and grass land, dominated by young trees with not much flowering or fruit production. Open land with shrubs and grasses is a suitable habitat for many species of insects such as grasshoppers, butterflies, moths, and dragonflies, as well as spiders. Insectivorous birds that feed on harmful insects and other pests in agro-ecosystems are beneficial to agriculturists (Rajashekara and Venkaesha 2014). Insectivorous birds act as important biological control agents of insect pests in agriculture, floriculture, horticulture and forests (Thakur et al. 2010).

Granivorous birds are also abundant (28%), but most of the granivorous birds feed on small seeds of wild shrubs and on ferns, which are still available in the Biodiversity Park. The impact of granivorous birds on any ecosystem can be viewed from different points but the best known impact of granivorous birds is an economical one. Granivorous birds in fact cause some damage to cultivated plants and, therefore, to primary production (Turcek 2010). On the other side, granivorous birds, especially the small sized species, will probably be the only free-living, surviving birds on cultivated land and in an environment dominated by man in the next centuries, then the importance of these birds is even more evident (Turcek 2010).

Carnivorous birds represented 19% of the bird community in the Biodiversity Park of Aqua Danone Ciherang. Carnivorous birds feed on other fauna including small mammals, birds, reptiles, fishes, etc. All carnivorous birds are protected by law due to their role as predators in the food chain of ecosystems (Ministry of Forestry 1999).

Nectarivorous birds are also protected due to their role as pollination agents of flowering plants (Ministry of Forestry 1999). Interactions between honeyeaters and flora may have important ecological consequences for native forest communities. Drastic reduction in the abundance and diversity of honeyeaters may be limiting the regenerative capacity of a wide range of native flowering species (Anderson 2003).

Spilopelia chinensis Scopoli is the only frugivorous bird (i.e. feeding purely on fruits) in the Biodiversity Park of Aqua Danone Ciherang. *Ficus benjamina* L. is the main source of food for *Spilopelia chinensis.* Most of the plants in the Biodiversity Park are not producing fruits yet, so the carrying capacity of the habitat for supporting frugivorous birds is still limited. Frugivorous birds play important role as seed dispersal agent in an ecosystem. Frugivore seed dispersal is a common phenomenon in many ecosystems (Wutherich et al. 2001)

Cinnyris jugularis Linnaeus is the only nectarivorous bird in Aqua Danone Ciherang Biodiversity Park. This species mainly feeds on *Heliconia psittacorum* L.f. which is available in the Biodiversity Park. In the Biodiversity Park of Aqua Danone Ciherang, there are some flowering plants such as *Spathodea campanulata* P.Beauv, *Delonix regia* (Hook.) Raf, *Calliandra tetragona* (Willd.) Benth, *Erythrina crista-galli* L, *Bauhinia purpurea* L, and *Heliconia psittacorum* L.f.

Monitoring the bird community is important because birds can be used as indicators of environmental changes (Furness et al. 1994). Birds have been proposed, assessed or used as indicator species for a range of environmental parameters, including biodiversity and species richness; environmental contamination by pollutants; the condition of ecosystems; ecosystem responses to disturbances and processes including urban expansion; replacement of endemic ecosystems with plantations and habitat restoration programs (Chambers 2008).

Bird numbers and diversity indices can be used as indicators in monitoring pollutants and radionuclide contamination. Birds also can be used as indicators of change in water quality and change in marine prey stocks (Furness et al. 1994) and of course good indicators of wetland status and change (Mistry et al. 2008). Birds are also good Indicators of the Effects of Climate Change (Lemoine et al. 2007).Birds have advantages as indicators due to their easiness to identification, their classification and systematics are well established, so there is a little risk of monitoring being confounded by uncertainties regarding the identities of, or relationship between the species being studied (Furness et al. 1994).

Birds in most cases are good indicators of general change in the quality and quantity of habitat (Furness et al. 1994) including forests (Canterbury et al. 2000) and urban areas or mosaics (Jedicke 2000). Hence, birds are good indicator for ecosystem restoration program (Fredrick et al. 2009). The fact that bird populations and communities change as habitats are altered can be a basic indicator for the monitoring and evaluation of Biodiversity Parks. When diversity of birds increases, we can conclude that the Biodiversity Park has improved in its quality of bird habitat, which means that the quality of the ecosystem is getting better. This means that Biodiversity Park which located in the midst of agriculture land can provide ecosystem services such as pest control, pollination and soil fertility (Power 2010).

In conclusion, faunal diversity in the Biodiversity Park of Aqua Danone Ciherang is 2.82. There were found 25 families of fauna consisting of 28 genera and 32 species. Birds were dominant representing 66% of the total number of faunal species identified; reptiles were 16% of the total, mammals 12% and amphibians 6% of the total. The Biodiversity Park has successfully provided habitat for all tropic levels of the food chain i.e. herbivores, carnivores, omnivores and scavengers. The existence of birds in the Biodiversity Park indicates that there is improvement of habitat.

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