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Avifauna Diversity in Kangean Archipelago

## AVIFAUNA DIVERSITY IN KANGEAN ARCHIPELAGO

### KERAGAMAN BURUNG DI KEPULAUAN KANGEAN

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#### ABSTRAK

Penelitian avifauna di Kepulauan Kangean dilakukan antara 2007-2008. Tujuan dari penelitian adalah untuk mengetahui jumlah jenis dan keragaman komunitas burung di berbagai tipe habitat utama. Tiga metode yang diterapkan dalam penelitian ini yaitu observasi oportunistik, titik hitung dan penangkapan dengan jaring kabut. Setiap metode saling melengkapi untuk mendapatkan daftar jenis burung yang komprehensif. Penelitian dengan menggunakan titik hitung bertujuan untuk mengetahui keragaman komunitas burung. Sebanyak 82 spesies burung ditemukan dimana beberapa jenis terutama burung-burung bermigrasi ditemukan sebagai catatan baru. Keanekaragaman tertinggi ditemukan di habitat alami, yaitu hutan alam (28 spesies, Shannon index = 3.07), daerah terbuka (32 spesies, Shannon index = 3.18) dan bakau/ hutan pantai (34 spesies, Shannon index = 3.09). Keanekaragaman burung yang miskin di perkebunan jati dengan hanya 26 spesies (Shannon index = 2.86). Ancaman terhadap burung di Pulau Kangean sangat nyata pada burung-burung berkicau seperti kucica hutan dan tong emas. Jenis tersebut hampir tidak ditemui selama survei. Kangean memiliki jumlah jenis lebih banyak daripada yang telah diketahui sebelumnya, namun demikian perburuan dan penebangan liar menjadi ancaman serius bagi keberadaannya.

**Kata Kunci:** Kangean, keanekaragaman jenis, catatan baru, hutan alam, perkebunan jati, Shannon index.

#### ABSTRACT

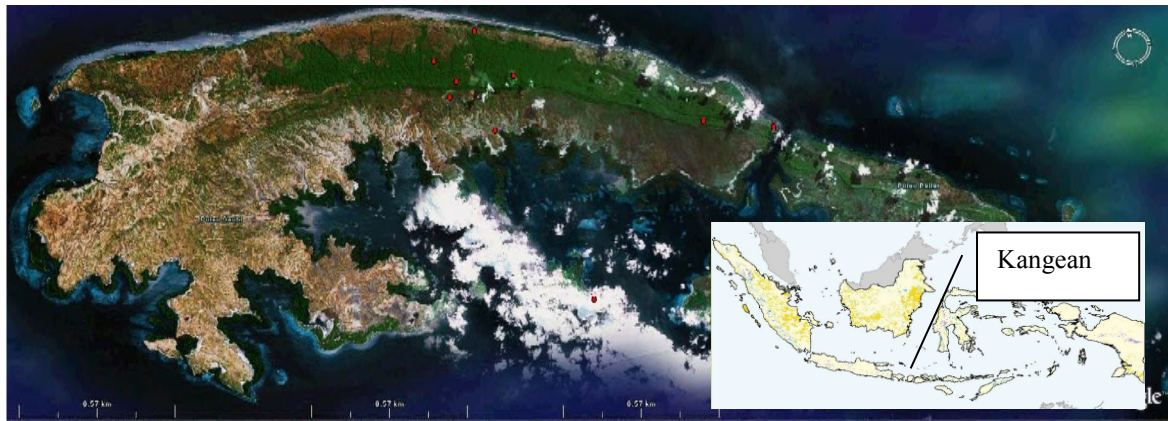
Research on the avifauna of Kangean Archipelago were conducted between 2007-2008. Objective of the studies were to obtain new data on the species numbers and community diversity at the main islands in various types of habitat. Three methods were applied i.e. opportunistic observation, point counts and mist netting. Each method would be complementary in order to get a complete list of Kangean avifauna, while point counts were intended to be used for community diversity study. A total of 82 species were recorded from which some of them especially migrating birds were new to the island. The richest diversity was found in natural habitat i.e. natural forest (28 species, Shannon index = 3.07), open area (32 species, Shannon index = 3.18) and mangrove (34 species, Shannon index = 3.09). Avian diversity was poor at teak plantation with only 26 species observed (Shannon index = 2.86). The threats to avian communities were apparent at song birds such as white-rumped shama and hill mynah. Those birds were hardly encountered during the survey. To be concluded, Kangean archipelago were richer in avifauna diversity than previously known, however hunting pressure and illegal logging might become serious threats to its existence.

**Keywords:** Kangean, diversity, new record, natural forest, teak plantation, Shannon index

#### INTRODUCTION

The Kangean Archipelago are a group of small islands situated between 115°11'-116°16'E and 6°30'-7°12'S (Fig. 1). They are approximately 120 km east of Madura and 120 km north of Bali. The archipelago consists of some 30 islands with Kangean Island as the largest at 48,700 ha. Administratively, Kangean consists of three sub-districts; those are Arjasa Sub-District on the West Kangean,

Kangayan Sub-District on the East Kangean, and Sapeken Sub-District on the eastern small islands of Kangean. Kangayan Sub-District is a newly formed district. It was just recently splitted from Arjasa Sub-District to accelerate the development of East Kangean. Meanwhile, forested area in Kangean Islands, with the exception of Saobi that is managed by PHKA, are under management of Perum Perhutani Unit II of East Java.



**Figure 1.** Map showing location of Kangean Archipelago and major study sites (red dots).

Geographically, Kangean Island is a rugged island with hilly contour especially at the central ridge. The western half of the north coast is bordered by sandy beach, while the eastern half and part of the southern section are bordered by vast area of mudflat and fringed by a coral reef. Kangean has a climate of tropical monsoon forest (de Jongh et al. 1982, Silvius & Taufik 1989). The central part of Kangean Island, which is situated at the hilly area, is covered by a tropical forest in which decorated by *Canarium vulgare*, *Schleicheria oleosa*, *Grewia eriocarpa*, and *Kleinhovia hospital* among others. Whereas the surrounding area on flat terrain the vegetation are replaced by huge area of teak plantation. The southern part of P. Kangean is covered by mangrove forest dominated by *Rhizophora sp.*, *Brugueira sp.*, *Ceriop tagal*, *Avecenia sp.*, *Sonneratia acida* and *Calophyllum inophyllum* (Silvius & Taufik 1989, Syukri 2000).

The bird communities in Kangean islands have been studied since 1892. A total of 113 species are present from which 11 subspecies are recognized as endemic (Irham & Marakarmah 2009, Hartert 1902, Vordermann 1893, Hoogerwerf 1954 & Hoogerwerf 1962, Dickin-

son 2003). This communities reflect the depauperated condition from those of birds in Java; meanwhile there was only a single species of Wallacean origin present on the island which was Orange-footed Scrubfowl. Kangean show just a little less proportion of endemic species in comparison to Java endemic; by which Kangean has 9% and Java has 11% of endemics birds (Irham & Marakarmah 2009, Sukmantorodkk. 2007). Therefore by having endemic species regardless its subspecies status the islands hold significant value and is warranted as Secondary Area of Restricted-Range Species by BirdLife (BirdLife International 2003).

Birds communities in Kangean face greater threats than continental communities. The forest cover have changed rapidly over years. Kangean and Sepanjang, the two biggest islands, lost around 26 – 28 km<sup>2</sup> its natural forest due to expansion of agricultural land and teak plantation. In addition, illegal logging that targeted not only teak but also forest timber was rampant as during the periods of November-December 2010 as many as 4000 trunks of teak and other forest species were transported out of the island every day (tempointeractive 2010).

As an island population, they are prone

to extinction due to their smaller range of habitat therefore susceptible to have greater impact from any catastrophic event, habitat alteration and destruction, forest fragmentation, hunting and invasive species (Rodriguez & Cunha 2012). There are evidences of that where islands species immediately extinct after environmental changes from both natural or anthropogenic cause (Blackburn *et al.* 2004, Morrison *et al.* 2011). In addition, the legal standing of forest protection is very limited to protected forest except in Saobi Island where some of area is protected as nature reserve.

In order to conserve Kangean avifauna, proper management should be planned and carried out by the local authorities. Some basic data would be needed to support conservation plan. Therefore, the objective of this study is to provide data on Kangean avifauna, specifically: (1) the current condition of avifauna diversity; and (2) community diversity between habitat types. By utilizing those data, hopefully the local authority can set up conservation priority that can be synchronized with the target of the production forest.

## RESEARCH METHODS

### Study Sites

I visited the islands four times during 2007-2008. I went to Kangean in March-April 2007 and August-September 2007; then I continued to Sepanjang in June-July 2008 and Paliat in December 2008. General inventories were made during all visits, however, systematic study of avian diversity was conducted only in Kangean Island during 2007 period.

Avian diversity studies were carried out

at five main sites. Three study sites were located at the central ridge of Kangean i.e. G. Talangkobeto (S 06°55.341' - E 115°32.385', natural forest), G. Ngeteng-Tembayangan (S 06°52.496' - E 115°25.028', natural forest) and G. Moncong (S 06°52.673' - E 115°26.833', natural forest). The other sites were located at the lower elevation i.e. Tembayangan (S 06°52.942' - E 115°24.737', teak forest), Kaletek-Aingkokap (S 06°51.701' - E 115°24.481', natural forest), Jukong-jukong (S 06°50.996' - E 115°25.938', teak forest), Patapan (S 06°55.981' - E 115°34.536', open area and mangrove/beach forest), and Cangkramaan (S 06°54.292' - E 115°25.906', open area and mangrove/beach forest).

### Data acquisition

I applied three methods in order to obtain a comprehensive bird list i.e. opportunistic surveys, point count and mist-netting (Bibby *et al.* 1998, Allen *et al.* 2006). Most fieldwork was carried out opportunistically to allow as many species as possible to be found. I searched for birds in a range of terrestrial habitat following main roads, tracks, and forest trails across the area. Upon an encounter with birds, the following data were collected i.e. species, number of individuals, habitat type, behavior, and location. If possible, birds calls were recorded and photographed were taken. Birds calls or sound were useful to identified unseen birds.

In order to get more information on recent situation of bird communities, local people also were interviewed and shown pictures of birds. Fieldworks started at 05.30 – 18.00 everyday. For bird identification, I refer to MacKinnon (1997) and Sonobe & Usui (1993).

I followed Dickinson (2003) for English and scientific names of birds.

As for quantitative avifauna community comparison study, I surveyed birds collated from point observation in different habitats (Bibby et al. 1998, Allen et al. 2006). These methods were carried three days in each location altogether with mistnetting. Sampling sites for diversity studies were chosen based on vegetation characteristic that categorized as natural forest, teak forest, mangrove and open area. Natural forest is defined as the interior forest that dominated by wild plants or trees and it received less influence done by human activities. Teak forest is a forested area in which teak timber is planted and managed by human. Mangrove forest is natural forest along coastal area. Beach forest is included in this category. Open area is a habitat dominated by shrubs or bushes and it cover both natural grassland and artificial environment such as paddy field and fish ponds.

The numbers of point of observation for each habitat category were as followed 25 for natural forest, 20 for teak forest, 15 for open area and 15 for beach/mangrove. The observation was made at 25 m radius circular station in 10 m. The distance between stations was around 200 m apart.

### **Analysis**

Bird diversity was analyzed only based on the data obtained from point counts. Data from mistnetting were used together with opportunistic observations as annotated species checklist.

For evaluating bird species richness and completeness of point counts, non-parametric species richness estimators (ACE, ICE, Chao1, Chao2, Jack1, Jack2, Bootstrap) and curve models (MMRuns, MMMeans) were used (Colwell 2005). To quantify index of diversity and similarity index, Shannon and Jaccard index was applied respectively (Krebs 1989, Colwell 2005).

Comparison of avian communities between habitat types was examined by ANOSIM (Oksanen *et al.* 2015). All data were checked whether or not they departed significantly from a normal distribution. If the data was not normally distributed, it was transformed to approach a normal distribution more closely (Sokal & Rohlf 1995). Statistical analysis conducted with SPSS software (SPSS Inc. 2002). The abundance of birds was taken as the maximum number of individual of a species present in each habitat types during the three observations periods (Nur *et al.* 1999). To quantify index of diversity and similarity index, Shannon-Wiener and Jaccard index was applied respectively (Krebs 1989).

## **RESULTS AND DISCUSSION**

### **Species account**

I recorded as many as 82 species from Kangean Archipelago (Appendix 1). General information on that finding had been published in Irham & Marakarmah 2009. Hereafter, specific informations were presented. Of those records, some species were newly recorded for the island of Kangean such as Arctic Leaf-Warbler (*Phylloscopus borealis*),

Changeable Hawk-Eagle (*Spizaetus cirrhatus*), Oriental Honey-buzzard (*Pernis ptilorhynchos*) and Eastern Marsh-Harrier (*Circus spilonotus*). All subspecies endemic to Kangean such as Red-breasted Parakeet (*Psittacula alexandri kangeanensis*), Javan Frogmouth (*Batrachostomus javensis longicaudatus*), Greater Goldenback (*Chrysocolaptes lucidus kangeanensis*) and Green-billed Malkoha (*Rhopodytes tristis kangeansis*) were also observed. A bird from Wallacean area, Orange-Footed Scrubfowl (*Megapodius reinwardt*), was seen in Saobi. Scrubfowl is known to be absent from Kangean, however a mound like structure was found near Talangkobeto. According to local helper the mound was likely an abandon scrubfowl nest.

I presented comprehensive information on species that has been documented in Kangean Archipelago having special interest from an ornithological perspective and conservation. I marked species that bear conservation status such as Indonesian protected species, IUCN and CITES appendices.

## NON-PASSERIFORMES

### CICONIIDAE

#### ***Leptoptilos javanicus* Lesser Adjutant**

Vulnerable, Protected by Indonesian Law

This species was known from Paliat Island only based on observation report by Nurwatha (1996). Some information on the presence of this bird was also given by locals.

### THRESKIORNITHIDAE

#### ***Plegadis falcinellus* Glossy Ibis**

Protected by Indonesian Law

Only one specimen is available which was collected by Hoogerwerf in September 29, 1954 in Kalisangka, Kangean Island. Judging from habitat deterioration on that place, I presumed that local population was expatriated or moved to another site within the islands.

### ACCIPITRIDAE

#### ***Pandion haliaeetus* Osprey**

Appendix II CITES, Protected by Indonesian Law

All Osprey observed throughout fieldworks were presumed to be resident birds instead of migrants from boreal regions. Moreover, pair consists of an adult and juvenile Osprey was observed on the coastal and mangrove area of Saobi Island, Sepanjang Island, and southern Kangean.

#### ***Elanus caeruleus* Black-winged Kite**

Appendix II CITES, Protected by Indonesian Law

Two specimens were collected by Hoogerwerf in 1954 at Bujutan, North-western Kangean. However, they presence were not mentioned by Nijman (2004). None of the individuals were observed in Kangean Island. Five individuals were recorded in Sepanjang and three individuals were seen in Paliat. They were observed while hunting and perching on the open land. They were frequently seen in pairs.

***Haliaeetus leucogaster* White-bellied Sea-eagle**

Appendix II CITES, Protected by Indonesian Law

Several individual including sub-adults were recorded in southern Kangean, and all visited island. They were observed a long the coastal area of the islands.

***Haliastur indus* Brahminy Kite**

Appendix II CITES, Protected by Indonesian Law

They were the most common bird of preys in Kangean Archipelago. They were frequently observed as single bird and a flock of five to seven individuals. During these fieldworks, all flocks were consisting of adults and sub-adults. Brahminy Kites were observed almost in all parts of the island not only on the mangrove and coastal area where they usually went hunting but also at natural forest on the central ridge of the island.

***Spizaetus cirrhatus* Changeable Hawk-eagle**

Appendix II CITES, Protected by Indonesian Law

On Java or other continental islands, Changeable Hawk-eagle inhabits primary or secondary forest and hunts for preys on various type of habitats. They are mostly seen around mountainous area, they frequently fly to lower altitude. It is known as vocal raptors due to frequent calls and shrieks during fly or perch. They have never been recorded on the small islands especially around Java Sea (Nijman 2004). To date population of Sime-

uleu Island ( West of Sumatra) and Lesser Sundas are the only island population in Indonesia (Dickinson 2003).

Call was heard during morning observation on 27 August 2007 at natural forest of G. Ngeteng, Tembayangan. A short recording was made for several seconds. A few minutes later, from forest opening, about a half km from the place where calls were heard, I got one sighting of an adult Changeable Hawk-Eagle soaring over forest canopy.

From call and sighting, I estimated there were probably two individuals of Changeable Hawk-Eagle present at G. Ngeteng-Tembayangan because the first calls detected was typically begging calls of juvenile while another individual sought was an adult. This was the only encountered with Changeable Hawk-eagle.

***Falco moluccensis* Spotted Kestrel**

Appendix II CITES, Protected by Indonesian Law

Spotted Kestrel is rather common in Kangean. Locals know them as the fast flier. Most of the time, they were seen in pairs in all parts of the island but coastal and mangrove forest.

***Pernis ptilorhyncus* Oriental Honey-buzzard**

Appendix II CITES, Protected by Indonesian Law, Migrant

A single individual was first detected fly along the coast of eastern Kangean. Clear observations were obtained at the neighbour-

ing island, Paliat, on the next subsequent days. A single individual of Oriental Honey-buzzard was observed soaring above teak forest that mix with paddy field in the morning around 10.00 and it being mobbed by Hair-crested Drongo. Another individual was recorded in the morning, perched on tree at natural forest of western Paliat. Again, because of the drongos it flew away. It was clearly seen that this bird used Kangean as wintering ground.

***Circus spilonotus* Eastern Marsh-harrier**

Appendix II CITES, Protected by Indonesian Law, Migrant

A flock of eight individuals was observed fly low on the coastal area of western Kangean. They arrived from south-west and toward making a landfall flew off to north-eastern direction.

ANATIDAE

***Anas gibberifrons* Sunda Teal**

Sunda Teal has a widespread distribution in Indonesia except Maluku and Papua. They were usually encountered in a pair or in a flock of three to seven individuals as observed in Patapan, East Kangean. The numbers could be up to 15 when they gathered on large mudflat such as one in Paliat. During this study, it seemed that they had a clear preference for mudflat area around mangrove forest.

***Anas superciliosa* Pacific Black Duck**

All previous observers recorded the presence of this species was recorded by Har-

tert from East of Kangean and three specimens were collected by Hoogerwerf at Bujutan (Hoogerwerf 1962). None was observed during this researches.

***Dendrocygna arcuata* Wandering Whistling Duck**

Two pairs were recorded, once at the mudflat of Patapan and another at Paliat, mixed with a group of Sunda Teal. Hoogerwerf collected two specimens from Saebus and Sepanjang Island (Hoogerwerf 1962).

MEGAPODIDAE

***Megapodius reinwardt* Orange-footed Megapode**

Protected by Indonesian Law

Kangean is the only one extended range within Javan realm of this Wallacean form. The biggest population is found in Saobi and Sepanjang Island. Saobi, which is only 430 ha, has the highest density of megapode's mound. On that small island, Orange-footed Megapode confined only at the south-eastern beach forest; and the only remaining forest of the island. Due to that fact, Saobi was declared as protected area. I encountered five individuals during a day visit to Saobi.

Sepanjang, the second biggest island, is also the main distribution of Orange-footed Megapode. They present almost at all area although the main population is restricted to the natural forest and teak forest at the eastern flank of the island. Encountered with this species was almost happen every day in Sepanjang although rather difficult to see due to

their shy behaviour. While they could forage for food not only limited to natural forest but also to teak forest, they still have their mound built around natural forest. Their mounds in Sepanjang were sparse with the distance around 50 m in average between mounds.

The main island, Kangean, is not known for being occupied by Orange-footed Megapode. The hypothesis regarding the absence of Orange-footed Scrubfowl in Kangean was due to the occurrence of large predator in bigger island (Decker 1989). However, an abandoned mound was found on the way to G. Talangkobeto, central ridge of Kangean Island.

#### PHASIANIDAE

##### ***Gallus varius* Green Junglefowl**

There is only one species of junglefowl in Kangean which is Green Junglefowl and, unlike its relative Red Junglefowl (Nishibori *et al.* 2006), it is free from natural hybridisation. Male Green Junglefowl from Kangean is very popular and the best stock for being bred with domestic hen to produce Bekisar breed. Green Junglefowl from Java mainland and Bali will not give offspring as good as Kangean despite of their same taxonomical status. This is interesting fact due to particular genetic traits that might be absent in Java and Bali population.

At present study, I only saw once a group of Green Junglefowl consists of one adult male, four female and the other three unidentified sexes. They were foraging on the paddy fields southern Tembayan village.

Based on the information from local, the population of Green Junglefowl were decreasing steadily due to over harvesting.

#### CHARADRIIDAE

##### ***Charadrius javanicus* Javan Plover**

Migratory

There are five species of Charadrius have been recorded in Kangean Archipelago. And all species have specimens' representatives collected by Hoogerwerf. Javan Plover was previously not recorded. This is the first information on the extended distribution of Javan Plover outside the mainland Java.

#### SCOLOPACIDAE

##### ***Numenius phaeopus* Whimbrel**

Migratory

They are frequently seen and easily recognized by their long bill and loud calls. Whimbrels were presented mostly around coastal and mangrove forest during migratory season and took tall trees as their roosting site. They were recorded as a flock from which could consist up to 30 individuals. Towards the end of wintering season, several individuals stayed longer and were still being seen until July.

##### ***Esacus neglectus* Beach Thick-knee**

Near Threatened, Protected by Indonesian Law

No single specimen was observed during fieldwork. The only records were from Hartert (1902) by which collected two individuals from east of Kangean island.



## COLUMBIDAE

### ***Streptopelia bitorquata* Island Collared Dove**

There is only one record provide by Nurwatha et al. (1996). None were observed during present study. I believed that the dove observed by Nurwatha was not origin to Kangean and probably caged birds that made a way to escape.

### ***Caloenas nicobarica* Nicobar Pigeon**

Near Threatened, Appendix I CITES, Protected by Indonesian Law.

Nicobar Pigeon is a breeding resident and it has a widespread distribution in Indonesia especially on the small islands. Mr. Prillwitz collected two male specimens from east Kangean. Local people in Kangean Island was not very familiar with this birds but on the other islands they knew it well. According to people in Sepanjang, this bird had not been seen for quite some times.

I did not observe any living specimen but I found bones of leg tied on trap that could be belong to Nicobar Pigeon due to its size and features. Moreover, Nicobar Pigeon has unique behaviour while eating fruits by cleaning the area of foraging. I noticed there were several spots that had been used by them in Sepanjang. The fact that I failed to observed them due to its low numbers and cryptic.

## PSITTACIDAE

### ***Psittacula alexandri* Red-breasted Parakeet**

Appendix II CITES

It is the only parrot inhabits Kangean Archipelago. They present all over the area

except Sepanjang Island. Kangean Red-Breasted Parakeet was firstly described as a distinct population from other islands by Hoogerwerf (1962) (Sudaryanti *et al.* 2006).

Red-Breasted Parakeet was frequently seen in natural forest and teak forest. They could be found also around villages, especially those directly adjacent to teak forest or natural forest. The availability of big tree stands were probably one of the prerequisites habitat components for Red-Breasted Parakeet to dwell as it reflected on their absences in open and mangrove forest.

Red-Breasted Parakeet was usually found in a flock of three to ten individuals. They would form larger flock to raid corn field at the harvesting season. Even so, locals did not put special counter measurements to repel them. The population of Red-Breasted Parakeet in Kangean was rather secured than its other Psittacidae in Indonesia. There were no direct persecutions observed on this species because locals prefer other species such as Zebra Dove and Hill Myna to be caught and sold in Java.

## CUCULIDAE

### ***Rhopodytes tristis* Green-Billed Malkoha**

The global distribution of Green-Billed Malkoha is from India to South-East Asia. In Indonesia, its distribution is disjunct as they occurred only in Sumatra and Kangean, while this species is altogether absent from Java. Kangean population was separable from Sumatran population based on the larger size, especially on bill and wing, and

coloration on the head (Vorderman 1893). In Sumatra, they were commonly present in hill forest at the elevation of 500-1500 m and in Kangean it was said to be common (MacKinnon 1998). Two individual were observed in this study. One individual was seen on teak forest in Tembayangan. Another was caught by children in Patapan, east Kangean. This malkoha is absent from Sepanjang Island.

#### ***Centropus sinensis* Greater Coucal**

There are two form of Greater Coucal in Kangean Archipelago. First is 'normal' color with black body and reddish brown color on the wing, this form resembled to those in Java. Second is having grayish, beige or creamy buff, varying much in tinge, especially on the under parts, instead of black.

Greater Coucal was common species all around island of Kangean. Normal Greater Coucal (dark form) was more common than its light form. I observed three individual of Light Greater Coucal in open area and teak forest at Kangean Island and one individual in Paliat.

#### ***Centropus bengalensis* Lesser Coucal**

Three specimens were collected by Hoogerwerf from Kangean Archipelago. All of them are immature; two males and a female. He recognized them as the same population as those in Celebes and Lesser Sundas, known as *C.b. sarasinorum* due to their larger size than Java and Bali population.

I did not encounter any individual of Lesser Coucal in all islands. If this species is

present in Kangean, it should be easy to observe since they are highly vocal and have habitat preferences as same as Greater Coucal.

#### PODARGIDAE

##### ***Batrachostomus javensis* Javan Frogmouth**

Javan Frogmouth was firstly described by Hoogerwerf upon specimens from Sepanjang Island (Hoogerwerf 1962). An individual of Javan Frogmouth was mistnetted at mangrove in Patapan. No other individual of Javan Frogmouth were observed or mistnetted on the next subsequent surveys. Its distribution apparently restricted in southern Kangean and nearby islands.

#### PICIDAE

##### ***Picus vittatus* Laced Woodpecker**

Once, this species was considered to be separated entity from that Javan and Bali population (Vorderman 1893). With the addition specimen from Bali, the diagnostic characters described by Vorderman were considered not enough to separate Kangean population from Java (Mees 1996).

Laced Woodpeckers were frequently observed in natural forest and teak forest. They sometimes flew down to the nearby village. While this species were seen in various habitat types, microhabitat or the substrates where they forage upon are typical. Like other woodpecker, the availability of big and old trees is prerequisites. When they were seen at teak forest or village, they always forage on the old trees but teak.

***Chryocoplptes lucidus kangeanensis* Greater Goldenback**

Greater Goldenback is one of the endemic birds in Kangean. It is less common than Laced Woodpecker. They foraged mainly on the old tree, dead or sick trees and snags that were more abundant in natural forest. Therefore, most of the encountered with Greater Goldenback were taken place in natural forest. However, their distribution was not restricted to natural forest; they sometimes venture downhill to forage in teak forest if big and old non-teak trees were available. Greater Goldenback and Laced Woodpecker are present only in Kangean, Paliat and nearby islands but absent in Sepanjang Island.

**PASSERIFORMES**

**STURNIDAE**

***Gracula religiosa* Hill Myna**

Hill Myna is one of the most after sough birds in Kangean. They have economic value as pet birds. The ability to mimic human vocals makes Hill Myna popular among birds lover. Kangean Hill Myna is being included into *religiosa* race together with other continental races of Sumatra, Java and Borneo (Hoogerwerf 1963). Nevertheless, vocalization of Kangean bird has different characters compare to those in Kalimantan or Sumatra. Unfortunately, I did not manage to get clear calls recording. To get clear taxonomical status of Kangean population, detailed study in molecular and vocalization may be a promising opportunity for future research.

While many questions can be ad-

ressed concerning its status, the present situation is not promising. During two times visits in Kangean, I only saw two individuals of Hill Myna. Its distribution seemed restricted to natural forest. Its rarity was due to hunting and illegal logging.

**MUSCICAPIDAE**

***Copsychus malabaricus nigricauda* White-rumped Shama**

Hoogerwerf (1962) noted that White-rumped Shama were recorded and collected at western part of Kangean, which nowadays transformed greatly into urban and agricultural areas; and Paliat. Kangean forms differed from the other population by having almost totally black tail with few white on the tip of outer feathers, rufous-orange underparts without chestnut tone (Collar 2017). This species was detected by song once at the eastern part of Tembayan forest. It was even rarer than Hill Myna. Paliat population was not detected. Kangean population was predicted to be extinct due to over harvesting for song birds.

**CAMPEPHAGIDE**

***Coracina striata vordermani* Bar-bellied Cuckooshrike**

*Coracina striata vordermani* were collected on Sepanjang, Paliat and Batuputih, Central Kangean (Hoogerwerf 1962). None of individuals were detected.

**TIMALIIDAE**

***Mixornis prillwitzii* Kangean Tit-babbler**

The taxonomic status of Kangean Tit-

**Table 1.** Evaluating bird species richness across habitat types using non-parametric estimator.

<b>Estimator</b>	<b>Natural</b>	<b>Teak</b>	<b>Open</b>	<b>Mangrove</b>
<b>Observed species richness</b>	<b>28</b>	<b>26</b>	<b>32</b>	<b>34</b>
<b>ACE</b>	30	29	32	38.15
<b>ICE</b>	29.7	28.05	38.69	48.62
<b>Chao1</b>	28.33	26.5	32	38.99
<b>Chao2</b>	32.5	26.64	35.43	40.74
<b>Jack1</b>	31	29	38	43.33
<b>Jack2</b>	33	29	40	46.67
<b>Bootstrap</b>	29.28	27.65	34.89	38.44
<b>MMRuns</b>	29.17	29.95	38.24	47.11
<b>MMMeans</b>	29.19	29.34	37.96	46.17
<b>Mean estimated species richness</b>	30.24	28.35	36.36	43.14
<b>Percentage of total estimated species detected by observations</b>	92.59	91.72	88.02	78.82
<b>Shannon Index of Species Richness</b>	<b>3.07</b>	<b>2.86</b>	<b>3.18</b>	<b>3.09</b>

babbler has been re-instated to full species by del Hoyo and Collar (2017). Unlike the others passerine endemics, Kangean Tit-babbler was fairly common in open area, agricultural area and teak forest. They were observed in natural forest. Therefore, they occupied wide range habitat except for mangrove area.

### **Bird Communities across Habitat Types**

A total of 60 species of birds out of 82 species were observed during point count surveys. Most of the observation among habitat types gave indication that the systematic survey was relatively complete of which 80% - 90% of bird's species recorded closed to the expected richness (Table 1). The observed species richness showed that highest diversity was found in Mangrove habitat while the lowest diversity was counted in teak forest. All the estimators also confirmed the observed richness of which the highest diversity was the highest in mangrove followed by open are,

natural forest and the least diverse was in teak forest.

From this analysis, the open area and mangrove forest, while they were not sampled as many as natural and teak forest, exhibited the highest diversity of birds compare that of forest birds. Some of the estimators for open area and mangrove even predicted much higher numbers of species that occur on both habitat than estimators for forest communities.

Shared species were varied between habitat types (Table 2). The biggest numbers of shared species were shown between natural forest and teak forest. It was followed by teak forest to open area and open area to mangrove. The lowest shared species was found between natural forest and mangrove forest. ANOSIM test showed that the community between habitat types were differed significantly ( $R = 93\%$ ,  $p < 0.05$ ); except between open area and mangrove ( $p = 0.09$ ).

The interior forest community such as

members of Family Columbidae, Picidae, Oriole and Drongo that were pre-dominantly natural forest dweller could expand their ranges onto teak forest and used as secondary habitat. The pool data showed that there were only several species did not occur in teak forest such as *Copsychus malabaricus*, *Pachycephala grisola* and *Coracina striata*. However, some species tend to have lower abundance in teak forest than natural forest such as *Picus vittatus*, *Chrysocolaptes lucidus*, *Macronus flavicollis*, *Ducula aenea*, *Duculua bicolor* and *Macropygia emiliana*.

Bird communities in mangrove habitat were the most different from all types. It shared some of species with (young) teak forest and open area, specifically for members of Family Ardeidae such as *Ardeola speciosa*, *Bubulcus ibis* and *Egretta* sp. The occurrence some of the water birds and other species that more commonly associate with mangrove and open habitat were due to plantation management. Those species usually were found in young teak forest instead of the old growth. Shorebirds and seabirds were exclusively bound to mangrove habitat. This area also used as stop over for some of migratory shore birds. Therefore, as a form of natural habitat,

**Table 2.** Shared species between habitat types. (1.0 indicates all species are in common; 0 indicates no species are shared).

Habitat Types	Habitat Types	Jaccard Classic
Natural Forest	Teak Forest	0.50
Natural Forest	Open Area	0.25
Natural Forest	Mangrove	0.19
Teak Forest	Open Area	0.41
Teak Forest	Mangrove	0.30
Open Area	Mangrove	0.40

mangrove is important habitat to maintain diversity especially for water birds. In addition, mangrove is not only important for birds but also as a complex ecosystem due to its ability to provide many function such as fish feeding ground and natural barrier from land erosion.

This research showed that natural forest hold important role to maintain bird's diversity over monoculture plantation. Study by Fujita *et al.* (2015) demonstrated that land use change has substantially affected species richness, community composition and feeding guild patterns of peatland avifauna in Sumatera. The peatland natural forest sustained the highest species richness, especially for forest dependent birds, and  $\beta$ -diversity compare to monoculture acacia plantation in which generalist species were commonly present. Other studies showed that birds richness and capture rates of understory birds were lower in plantation than in natural forest, again, it was accounted for forest dependent species (Zou *et al.* 2014). Therefore, in Kangean islands, poor subset of interior forest birds in teak plantation gave the tendency of low value of teak forest to maintain bird's diversity.

However, since teak plantation was managed it was consist of many blocks with different sizes and ages. Those matrix in the monocultures plantation provided additional microhabitat such as shrubs that could be attractive to birds. Some of the water birds and small granivores birds were commonly seen in young teak plantation, adding the diversity to this habitat. Therefore, managed plantation with different types of stands structures and mixed with native tree species could affect

bird's community structures (Fujita *et al.* 2014., Zou *et al.* 2014). Furthermore, mixed tree plantation with native tree species used either as main trees or shade trees might promote bird species richness and composition comparable to undisturbed or natural forest (Zou *et al.* 2014, Subashinge *et al.* 2014).

Birds conservation in Kangean needed to focus on natural habitat *i.e.* natural forest and mangrove. Teak plantation and open area as part of managed habitat should be threatened carefully as not to expand so much in reducing the area of natural forest. In addition, shifting harvesting time of teak stand in which already been practice has created mosaic that beneficial to diversity. Moreover, those habitats might have the function of maintaining birds diversity on some degree.

Nevertheless, the survival of the bird in Kangean especially forest bird was threatened by habitat degradation, particularly illegal logging and birds hunting. Illegal logging was imminent in Kangean. The targeted woods were not only teak timber which had high economic values but also trees from natural forest. In the long run, if natural forest was kept unprotected from illegal logging, it would influence some species which have specific niche such as woodpeckers or species that dependent on the fruiting trees will be at risk because the loss of older trees. The habitat alteration and forest fragmentation would push process of extinction even faster for island endemic as it lack of mechanism of recolonization in the secondary growth from nearby forest fragments (Wolfe *et al.* 2015)

Hunting pressure may give larger impacts on the declining numbers of some species in Kangean. The popular birds targeted by hunter are song birds notably, *Gracula religiosa*, *Copsychus malabaricus* and *Lanius schach*. Those birds were detected either only once or none at all. The demand of song birds was very high so it was expected that those birds which were very rare at the time of field-work became extinct nowadays. Those particular three species were included in top 28 the most threatened song birds in Southeast Asia and particular conservation action was on going (Lee *et al.* 2016).

## CONCLUSION

The study revealed new information on the bird's diversity and community in Kangean Islands. The additional data on particularly water birds and migratory birds expanded the list of Kangean birds onto 113 species. The bird richness and community composition showed that natural forest hold important role to maintain interior forest communities over teak plantation; while the importance of mangrove habitat in Kangean became clearer as the stop over for migratory birds. However, this study also demonstrated the process of diminishing diversity especially for forest birds as many of species became rarer and eventually missing from observation such as song birds species. Conservation strategy should be taken to prevent local extinction in Kangean islands, focusing onto some objectives *i.e.* plantation management that include natural forest conservation, effective law

enforcement to prevent illegal logging both in teak plantation and natural forest, and controlling illegal birds poaching.

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### APPENDIX 1. List of Kangean Birds

No	Family	Species	Previous records	2007-2008
1	<b>Ardeidae</b>	<i>Ardea sumatrana</i>	√	√
2		<i>Ardea purpurea</i>	√	√
3		<i>Bubulcus ibis</i>	√	√
4		<i>Ardeola speciosa</i>	√	√
5		<i>Butorides striata</i>	√	√
6		<i>Nycticorax nycticorax</i>	√	
7		<i>Egretta sacra</i>	√	√
8		<i>Egretta garzeta</i>	√	√
9		<i>Egretta intermedia</i>	√	√
10		<i>Ixobrychus cinnamomeus</i>	√	
11	<b>Ciconiidae</b>	<i>Leptoptilos javanicus</i>	√	
12	<b>Threskiornithidae</b>	<i>Plegadis falcinellus</i>	√	
13	<b>Accipitridae</b>	<i>Pandion haliaeetus</i>	√	√
14		<i>Elanus caeruleus</i>	√	√
15		<i>Pernis ptilorhynchus</i>		√
16		<i>Haliaeetus leucogaster</i>	√	√
17		<i>Haliastur indus</i>	√	√
18		<i>Circus spilonotus</i>		√
19		<i>Spizaetus cirrhatus</i>		√
20	<b>Falconidae</b>	<i>Falco moluccensis</i>	√	√
21	<b>Fregatidae</b>	<i>Fregata ariel</i>	√	√
22		<i>Fregata minor</i>		√
23	<b>Anatidae</b>	<i>Dendrocygna javanica</i>	√	√
24		<i>Dendrocygna arcuata</i>	√	√
25		<i>Anas gibberifrons</i>	√	√
26		<i>Anas superciliosa</i>	√	
27	<b>Megapodidae</b>	<i>Megapodius reinwardt</i>	√	√
28	<b>Phasianidae</b>	<i>Gallus varius</i>	√	√
29	<b>Rallidae</b>	<i>Amaurornis phoenicurus</i>	√	√
30		<i>Poliolimnas cinerea</i>	√	
31		<i>Gallinula chloropus</i>	√	
32		<i>Porphyrio porphyrio</i>	√	
33	<b>Charadriidae</b>	<i>Pluvialis fulva</i>	√	
34		<i>Charadrius javanicus</i>	√	√
35		<i>Charadrius dubius</i>	√	
36		<i>Charadrius peronii</i>	√	
37		<i>Charadrius leschenaultii</i>	√	
38		<i>Charadrius veredus</i>	√	
39	<b>Scolopacidae</b>	<i>Numenius phaeopus</i>	√	√
40		<i>Limosa sp.</i>		√

continued

No	Family	Species	Previous records	2007-2008
41		<i>Tringa totanus</i>	√	
42		<i>Tringa nebularia</i>	√	√
43		<i>Tringa glareola</i>	√	√
44		<i>Actitis hypoleucos</i>	√	√
45		<i>Heteroscelus brevipes</i>	√	√
46		<i>Calidris ruficollis</i>	√	
47		<i>Calidris subminuta</i>	√	
48	<b>Burhinidae</b>	<i>Esacus magnirostris</i>	√	
49	<b>Galeolidae</b>	<i>Siltia isabella</i>	√	
50	<b>Laridae</b>	<i>Sterna sumatrana</i>	√	√
51		<i>Sterna albifrons</i>	√	√
52		<i>Sterna bergii</i>	√	√
53		<i>Sterna bengalensis</i>	√	
54	<b>Columbidae</b>	<i>Treron griseicauda</i>	√	√
55		<i>Treron vernans</i>	√	√
56		<i>Ducula aenea</i>	√	√
57		<i>Ducula rosacea</i>	√	
58		<i>Ducula bicolor</i>	√	√
59		<i>Macropygia emiliana</i>	√	√
60		<i>Ptilinopus melanospila</i>	√	√
61		<i>Streptopelia chinensis</i>	√	√
62		<i>Streptopelia bitorquata</i>	√	
63		<i>Geopelia striata</i>	√	√
64		<i>Chalcopaps indica</i>	√	√
65		<i>Caloenas nicobarica</i>	√	√
66	<b>Psittacidae</b>	<i>Psittacula alexandri</i>	√	√
67	<b>Cuculidae</b>	<i>Chrysococcyx basalis</i>	√	
68		<i>Rhopodytes tristis</i>	√	√
69		<i>Centropus sinensis</i>	√	√
70		<i>Centropus bengalensis</i>	√	
71		<i>Eudynamys scolopaceus</i>	√	√
72	<b>Tytonidae</b>	<i>Tyto alba</i>	√	√
73	<b>Strigidae</b>	<i>Otus lempiji</i>	√	√
74	<b>Podargidae</b>	<i>Batrachostomus javensis</i>	√	√
75	<b>Apodidae</b>	<i>Collocalia fuciphagus</i>	√	√
76		<i>Collocalia linchi</i>	√	√
77		<i>Cypsiurus balasiensis</i>	√	
78	<b>Hemiprocnidae</b>	<i>Hemiprogne longipennis</i>	√	√
79	<b>Alcedinidae</b>	<i>Alcedo meninting</i>	√	
80		<i>Alcedo coerulescens</i>	√	√

continued

No	Family	Species	Previous records	2007-2008
81		<i>Ceyx rufidorsa</i>	√	
82		<i>Halcyon chloris</i>	√	√
83		<i>Halcyon sancta</i>	√	√
84	<b>Meropidae</b>	<i>Merops philippinus</i>	√	√
85		<i>Merops leschenaulti</i>	√	
86		<i>Merops ornatus</i>	√	√
87	<b>Picidae</b>	<i>Picus vittatus</i>	√	√
88		<i>Chrysocolaptes lucidus</i>	√	√
89	<b>Hirundinidae</b>	<i>Hirundo tahitica</i>	√	√
90		<i>Hirundo rustica</i>		√
91	<b>Motacillidae</b>	<i>Motacilla flava</i>	√	
92	<b>Campephagidae</b>	<i>Coracina striata</i>	√	√
93		<i>Lalage sueurii</i>	√	
94	<b>Pycnonotidae</b>	<i>Pycnonotus goiavier</i>	√	√
95	<b>Laniidae</b>	<i>Lanius schach</i>	√	
96	<b>Turdidae</b>	<i>Copsychus malabaricus</i>	√	√
97	<b>Timaliidae</b>	<i>Macronous flavicollis</i>	√	√
98	<b>Sylviidae</b>	<i>Cisticola juncidis</i>	√	√
99		<i>Orthotomus ruficeps</i>	√	√
100		<i>Phylloscopus borealis</i>		√
101	<b>Dicaeidae</b>	<i>Dicaeum trochileum</i>	√	√
102	<b>Nectariniidae</b>	<i>Anthreptes malaccensis</i>	√	√
103		<i>Cinnyris jugularis</i>	√	√
104	<b>Zosteropidae</b>	<i>Zosterpos chloris</i>	√	
105	<b>Estrildidae</b>	<i>Lonchura punctulata</i>	√	√
106		<i>Lonchura molucca</i>	√	√
107		<i>Padda oryzivora</i>	√	√
108	<b>Phacycephalidae</b>	<i>Pachycephala grisola</i>	√	√
109	<b>Sturnidae</b>	<i>Gracula religiosa</i>	√	√
110	<b>Oriolidae</b>	<i>Oriolus chinensis</i>	√	√
111	<b>Dicruridae</b>	<i>Dicrurus hottentottus</i>	√	√
112	<b>Artamidae</b>	<i>Artamus leucorhynchus</i>	√	√
113	<b>Corvidae</b>	<i>Corvus macrorhynchos</i>	√	√

Notes: previous records were accumulated from list of Hartert (1902), Hoogerwer (1954) and Nurwatha(1999).