Bird Community Structure in Karimunjawa Islands, Central Jawa

Niarsi Merry Hemelda, Ummi Syifa Khusnuzon, & Putri Sandy Pangestu

COMATA Wildlife Study Group, Department of Biology University of Indonesia, Depok 16424, **Email**: rebirth_comata@yahoo.com

ABSTRAK

Struktur Komunitas Burung di Kepulauan Karimunjawa Jawa Tengah. Karimunjawa sebagai salah satu taman nasional yang memiliki berbagai macam tipe habitat dengan tingginya keragaman jenis burung yang ada. Penelitian kesamaan keragaman jenis burung telah dilakukan di area di hutan Legon Lele, Nyamplungan,kawasan pemukiman pedesaan Karimunjawa dan Legon Lele, kawasan kolam Cikemas dan Jatikerep, dan kawasan pantai Terusan, semua pendataan tersebut di lakukan di bulan Agustus 2009. Menggunakan metode titik telah terdata ada39 jenis burung ditemukan dikawasan tersebut. Indeks keragaman jens Shanon untuk masing-masing lokasi seperti pemukiman Legon Lele (H'=2.33), pantai Terusan (H'=2.31), kolam Jatikerep (H'=2.28), kolam Cikemas (H'=2.07), hutan Legon Lele (H'=1.81), pemukiman Karimunjawa (H'=1.75), dan hutan Nyamplungan (H'=1.65).

Kata kunci: Habitat, burung, Karimunjawa.

INTRODUCTION

Karimunjawa island is one of conservation areas in Karimunjawa National Park with high diversity of bird species. According to the previous researches, there are about 115 bird species in Karimunjawa Archipelago National Park area (Department of Forestry 2007). Karimunjawa island has many types of habitat such as settlements, forests, fishponds, and coastal area. Each habitat has unique characteristics and high diversity of bird species.

Research in bird community structure of a habitat is important to do because birds have important role as bioindicator in environmental changes. In addition, the presence of bird species is determined by the presence of particular plant species as food resource, nesting area, and refuge area (Ewusie 1990). Therefore, the community structure of bird species in an area can describe the whole condition of that community. The purpose of this study was to analyze the bird community structure including the composition, abundance, and species diversity. By analyzing the bird community structure, the indicator species from an area can be identified. Hence, the result of this study can be an evaluation data for sustainability management of Karimunjawa National Park.

MATERIALS AND METHODS

The research site was located in

Karimunjawa island, West Java (Figure 1). Karimunjawa Archipelago National Park has 5 different ecosystems, including tropical forest ecosystem and mangrove ecosystem (Department of Forestry 2007). The research site was divided into seven locations from four types of habitat. Legon lele forest and Nyamplungan forest were categorized as forest habitat, Karimunjawa village settlement and Legon Lele settlement were categorized as settlement habitat, Cikemas fishpond and Jatikerep fishpond were categorized as fishpond habitat, and Terusan coastal was categorized as coastal habitat.

Canopy covering the location is caused by the presence of trees with wide diameter. In addition, many shrubs found between the trees in the location. There are also many plants that produce fruits and seeds found in that location. A stream with slow water flow supports the water supply for trees and shrubs.

Nyamplungan forest has less density of vegetation compared with Legon Lele forest. The forest floor is covered by shrubs and canopy from the wide-diameter trees. There is also farming activity near the forest.

Legon Lele settlement is a settlement which located near the Legon Lele forest. Most of the villagers in that location occupy as rice farmers and work in rice fields near the settlement. Palm tree, *Cocos nucifera*, often found near the rice fields and Legon Lele forest. In contrast, far from the rice fields *Anacardium occidentale*, as first commodity of Karimunjawa island, found within the settlement. Beside *Cocos nucifera* and *Anacardium occidentale*, many species of plant that produce fruits and seeds also found along the settlement.

Karimunjawa village settlement is a more crowded settlement compared with Legon Lele settlement. Karimunjawa village settlement is located near the beach. Most of villagers plant some productive plants in their yards, such as *Mangifera indica, Psidium guajava,* and *Schizigium aquea*.

Cikemas fishpond is a fishpond area that had been abandoned. Sedimentation process occurred in that fishpond so that the fishpond became narrower. Many shrubs that produce small seeds like *Penicetum* sp. grow surrounding the fishpond.Many *Anacardium occidentale* trees were also foundnear the fish pond.

Jatikerep fishpond is an active and well-managed fishpond. Near the fishpond, many fruit-producing trees can be easily found. In contrast, just a small cluster of shrubs can be found because the fishpond owner cut it.

Terusan coastal is located between Karimunjawa island and Kemujan island. Mangrove ecosystem with high density of mangrove vegetation is found in that area. The mangrove trees produce fruits and their root system supply refuge areas for small crustacean, fish, and gastropods.

Point count method is used for collecting data. The observer is standing and observe during certain time and identify the bird species both visually and vocally (Bibby *et. al*.1992). According to Bibby *et.al*. 1992, point count method can be used to explain bird community condition based on the habitat type. Point samples

were determined by route in the seven locations. From one point to the nearest point took 150 m distance for closed habitat (forest, settlement, and fishpond area), but 250 m distance for opened habitat (coastal area). Each point took 10 minutes duration for collecting the data. Data collections was carried out for 3 days from 07.00 WIB until 10.00 WIB and continued at 16.30 WIB until 18.00 WIB. Following Aynalem & Bekele (2008), in that time, the activities of birds were prominent. Data collections included species and total individuals of birds that could be identified visually and vocally. Field guide books were used to identify birds visually (MacKinnon *et. al*., 1992). Other equipments that used for collecting data were Bushnell 10 x 50 binoculars, Kowa TSH-601 20x zoom monocular, and Nikon Coolpix L14 digital camera.

The data that had been collected was analyzed for determining species richness, species diversity, and habitat similarity. Species richness is defined as total bird species that had been met in a habitat. Shannon-Wiener Index (H') was used to evaluate bird species diversity in each habitat. Evenness Index was used to explain evenness of total individual of each bird species in one habitat and according to Balen (1986), Evenness Index of undisturbed habitat is about 0.80-0.87.

Similarity between locations was analyzed using Sorensen Similarity Index. The result was described in a dendrogram using MVSP (Multivariate Variable Statistical Package) Version 3.13n. The index then was analyzed using UPGMA (Unweighted Pair Group Multivariate Analysis) cluster for measuring the habitat similarity.

RESULTS

A total of 39 bird species from 19 families was observed in seven locations during the 3 days observation, 2 species of them are endemic in Java Island (Table 1). They are *Dicaeum trochilleum* (Sparrman, 1789) dan *Lonchura leucogastroides* (Horsfield &

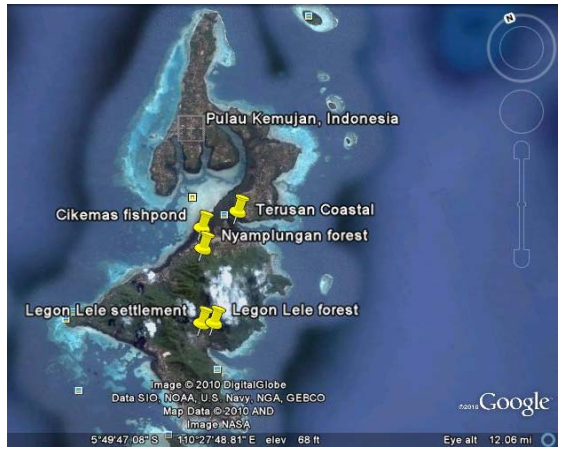

Figure 1. Karimunjawa island.

Moore, 1858). According to UU No. 5/ 1990 about Natural Resources Conservation, several of 39 bird species are protected by government, namely: *Egretta sacra* (J. F. Gmelin, 1789); *Numenius arquata* (Linnaeus, 1758); *Halcyon chloris* Boddaert, 1783; *Cinnyris jugularis* (Linnaeus, 1766); *Pernis ptilorhynchus* (Temminck, 1821); *Haliaeetus leucogaster* (Gmelin, 1788); *Numenius minutus* Gould, 1841; dan *Numenius madagascariensis* (Linnaeus, 1766). According to IUCN Redlist (2009), *Numenius arquata* and *Ducula rosacea* are listed as Near Threatened species.

Species diversity of birds in seven habitats successively from the highest are Terusan coastal (17 species), Legon Lele settlement (15 species), Cikemas fishpond (14 species), Jatikerep fishpond (12 species), Legon Lele forest (9 species), Karimunjawa village settlement (8 species), and Nyamplungan forest (7 species). Jatikerep fishpond has the highest value of Evenness Index (J), 0.92, whereas Cikemas fishpond has the lowest one, 0.78.

Species of bird which has the highest values of relative species abundance (Pi) in Legon Lele forest, Legon Lele settlement, Cikemas fishpond, Nyamplungan forest, Karimunjawa village settlement, and Terusan coastal successively *Orthotomus ruficeps* (Lesson, 1830) (Pi=0.2766); *Lonchura leucogastroides* (Pi=0.2381); *Lonchura punctulata* (Linnaeus, 1758) (Pi=0.3443); *Pycnonotus goiavier* (Scopoli, 1786) (Pi=0.4211); *Pycnonotus goiavier* (Pi=0.3281), and *Numenius arquata* (Linnaeus, 1758). In Jatikerep fishpond, there are 3 species that have high value of relative species abundance (Pi=0.1667), namely *Halcyon chloris* Boddaert, 1783; *Zosterops palpebrosus* (Temminck, 1821); and *Lonchura leucogastroides*.

Diversity of bird species in each location was analyzed using Shannon-Wiener diversity index. The locations that have the highest values of bird species diversity index (H') successively are Legon Lele settlement (H'=2.33),

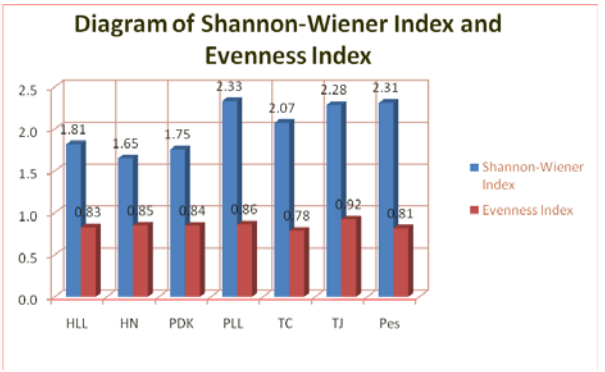

Figure 3. Value of Shannon-Wiener Index and Evenness Index in seven locations.

Table 1. Species relative Abundance in Karimunjawa Island.

Families and Species	Abundance (Pi)						
	HLL	**HN**	**PDK**	**PLL**	**TC**	**TJ**	**PT**
Scolopidae							
Actitis hypoleucos	0	0	0	0	0	0.033	0.032
Heteroscelus brevipes	0	0	0	0	0	0	0.016
Numenius madagascariensis	0	0	0	0	0	0	0.048
Numenius minutes	0	0	0	0	0	0	0.016
Numenius arquata	0	0	0	0	0	0	0.242
Tringa tetanus	0	0	0	0	0	0	0.016
Anatidae							
Anas gibberifrons	0	0	0	0	0	0	0.032
Sturnidae							
Acridotheres javanicus	0.021	0	0	0	0	0	0
Acanthizidae							
Gerygone sulphurea	0	0	0	0	0	0.033	0.016
Ploceidae							
Passer montanus	0	0	0.047	0	0	0	0
Estrildidae							
Lonchura punctulata	0	0	0	0	0.344	0	0
Lonchura leucogastroides		0.105		0.238		0.167	
Artamidae							
Artamus leucorynchus	0	0	0	0.048	0	0	0.032
Pycnonotidae							
Pycnonotus goiavier	0.255	0.421	0.328	0.214	0.066	0.1	0
Pycnonotus aurigaster	0	0	0	0.024	0	0	0
Dicaeidae							
Dicaeum trochilleum	0	0	0.219	0	0.033	0.067	0
Sylviidae							
Orthotomus ruficeps	0.277	0.158	0	0.048	0.033	0	0
Orthotomus sutorius	0.064	0	0	0	0.016	0	0
Muscicapidae							
Muscicapa dauurica	0	0.053	0	0	0	0	0
Muscicapa sibirica	0	0	0	0	0	0.1	0
Nectariniidae							
Anthreptes malacensis	0	0		0.024	0	0	0
Cinnyris jugularis	0	0	0.141	0	0.033	0.067	0
Zosteropidae							
Zosterops palpebrosus	0.106	0.158	0.156	0.071	0.213	0.167	0.016
Zosterops chloris	0	0	0	0.095	0	0	0
Rallidae							
Amaurornis phoenicurus	0.043	0	0	0.048	0	0	0

Table 1 (continued)

Families and Species	Abundance (Pi)						
	HLL	HN	PDK	PLL	TC	TJ	PT
Apodidae							
Apus pacificus	0.021	0	0	0	0	0	0
Collocalia linchi	0	0	0.031	0.024	0.016	0.033	0.048
Alcedinidae							
Halcyon chloris	0	0	0.063	0.024	0.082	0.167	0.145
Ardeidae							
Egretta sacra	0	0	0	0.024	0	0.033	0.226
Ardea cinerea	0	0	0	0	0.016	0	0
Butorides striatus	0	0	0	0	0.016	0	0.048
Ixobrychus cinnamomeus	0	0	0	0	0	0.033	0
Columbidae							
Ptilinopus melanospila	0.021	0	0	0	0	0	0
Ducula aenea	0.191	0.053	0.016	0.071	0.082	0	0
Ducula rosacea	0	0	0	0.024	0	0	0.032
Ducula bicolor	0	0	0	0	0.033	0	0
Chalcophaps indica	0	0	0	0	0.016	0	0
Accipitridae							
Haliaeetus leucogaster	0	0.053	0	0.024	0	0	0.016
Pernis ptilorhynchus	0	0	0				0.016

Notes: HLL: Legon Lele forest; HN: Nyamplungan forest; PDK: Karimunjawa island village settlement; PLL: Legon Lele settlement; TC: Cikemas fishpond; TJ: Jatikerep fishpond; Pes: Terusan Coastal.

Terusan coastal (H'=2.31), Jatikerep fishpond (H'=2.28), Cikemas fishpond (H'=2.07), Legon Lele forest (H'=1.81), Karimunjawa village settlement (H'=1.75), and Nyamplungan forest (H'=1.65). Based on observation, Legon Lele settlement is a not-so-crowded settlement with wide area of rice fields.

DISCUSSION

The research site was divided into four type of habitat, namely forest, fishpond, settlement, and coastal area. We divided 3 types of habitat (forest, fishpond, and settlement) into two locations each habitat, but only one location for coastal habitat. Based on the result from Sorensen Similarity Index, the seven locations are grouped into 3 main groups. Group A consists of Legon Lele settlement, Nyamplungan forest, and Legon Lele forest. Group B consists of Jatikerep fishpond, Cikemas fishpond, and Karimunjawa village settlement. Group C only consists of Terusan coastal. Locations which are in same group share many similarities and might be have simi-

lar environmental condition. In addition, the state of the locations where is near each other, so there is no barrier that hamper the bird movement from one location to another (Cox & Moore 2005).

In group A, Legon Lele settlement, Nyamplungan forest, and Legon Lele forest are in same group because they share same food resources for birds. Legon Lele settlement and Nyamplungan forest has the highest value of Sorensen Similarity Index (Ss=0.545) in this group. That may be caused both locations are located near the rice fields whereas no rice field in Legon Lele forest.

In group B, Jatikerep fishpond, Cikemas fishpond, and Karimunjawa village settlement are in same group because they are relatively opened habitat with less density of vegetations compared with group A. In addition, they also share same vegetation of fruit-producing plants. Cikemas fishpond and Karimunjawa village settlement have the highest value of Sorensen Similarity Index (Ss=0.636).

Group C, Terusan coastal, is significantly different from other groups. Terusan coastal has unique ecosystem, namely mangrove ecosystem. Species of birds that found in Terusan coastal are also different from other locations. Most of birds that found in there were shorebirds and some of them were migrant birds. Terusan coastal is also the richest area of bird species diversity.

Cikemas fishpond has the lowest value of Evenness Index (J) because the location is rich of species diversity but the abundance of each bird species is uneven. According to Waite (2000), if a habitat or community has less species diversity and each species is distributed unevenly, the value of H' will be low, conversely.

Cikemas fishpond and Legon Lele settlement share the highest value of Sorensen Similarity Index (Ss=0.636) (Fig. 3). It may be caused the two locations have similar vegetations such as palm trees and other fruit-producing trees so that it is possible for same species of birds which have same food resources found in both locations. Terusan coastal and Legon Lele forest share the lowest value of Sorensen Similarity Index (Ss=0.154) because they have different ecosystems and vegetations so the species of birds found in both locations are different too.

Based on the result, species of bird

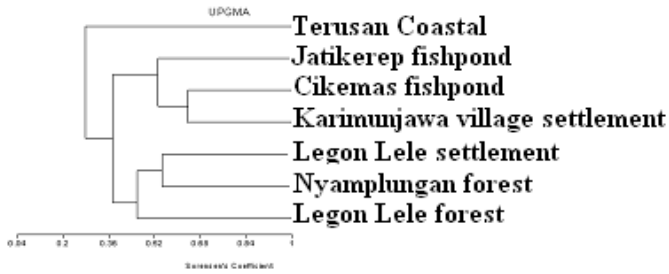

Figure 3. Dendrogram of Sorensen Similarity Index

that has the highest value of relative species abundance is different in each location. There are several factors that influence the relative abundance of bird species, such as historical process of that area (speciation and dispersal), climate and climate changes, topography, biotic components (primary productivity), and competition (Huggert 1995).

The highest value of relative abundance in Legon Lele settlement might be caused of the diversity of food resources in that location compared with other locations. Rice fields supply microhabitats and food resources for several species of birds, such as Amaurornis phoenicurus (Pennant 1769). Rice field areas, shrubs, and trees near the settlement provide food resources, such as fruits, seeds, nectars, insects, small crustaceans, and fish. Therefore, guilds of bird that were found such as nectarinivores, piscivores, insectivores, frugivore, and graminivores.

Result from Evenness Index shows that the values of Evenness Index in seven locations are above 0.8. Value of Evenness Index of Undisturbed habitat according to Balen (1986) is about 0.80-0.87. Based on that theory, it can be concluded that the seven locations are relatively undisturbed.

Two of 39 bird species that observed in seven locations were new record species that have not recorded in Karimunjawa 2007. They are *Numenius arquata* and *Pycnonotus aurigaster. N. arquata* is a migrant bird, migrating in winter from North Erasia to the south, Indonesia and Australia (MacKinnon 2000). The category of migrant birds refers to bird species that migrate from the North of Earth to the South in the winter (Sukmantoro *et.al*. 2007). Winter in Erasia is supposed to be in August until October and the data collection time, August 2009, coincided perfectly with the migration of *N. arguata. Pycnonotus aurigaster* is a common bird that can be found everywhere, but it is new record in Karimunjawa and it may be an introduction species that released by the villagers.

CONCLUSION

Result of this research in Karimunjawa island shows that a total of 39 bird species was observed in seven locations. Legon Lele settlement has the highest value of Shannon-Wiener Diversity Index (H'=2.33). Cikemas fishpond and Legon Lele settlement has the highest value of Sorensen Similarity Index (Ss=0.636). The activities of villager in those locations do not disturb the diversity of bird species significantly.

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