

Bird diversity in transition zone of Taka Bonerate, Kepulauan Selayar Biosphere Reserve, Indonesia

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Abstract. Praptiwi RA, Saab R, Setia TM, Wicaksono G, Wulandari P, Sugardjito J. 2019. Bird diversity in transition zone of Taka Bonerate, Kepulauan Selayar Biosphere Reserve, Indonesia. *Biodiversitas* 20: 820-824. Conservation management in the buffer and transition zones of Biosphere Reserves play an important role in ensuring enhanced core zone protection. Tambolongan and Polassi are two islands located in the administrative region of South Sulawesi, Indonesia, and part of the transition zone area of UNESCO's Taka Bonerate-Kepulauan Selayar (TBKS) Biosphere Reserve (BR). These two islands can be considered as some of the most populated islands in the region, containing a variety of human activities. These human activities, such as the ever expanding agriculture and the building of human habitation have put pressures toward ecosystem and species conservation in the BR. Bird are often the focus of conservation efforts, due to their roles in supporting the ecological functioning of their habitats. This study aims to provide baseline data of bird diversity in Tambolongan and Polassi that can be used as a proxy indicator of ecosystem health and input to conservation strategies within the BR area. A Visual Encounter Survey (VES) method is used to examine bird diversity index. Results from the observation recorded a total of 29 species were found in both islands, with 5 listed as protected species and 3 categorized as migratory species. The comparison between the two islands showed that the bird diversity index (H') differs only slightly ($H'_{Tambolongan}=2.98$; $H'_{Polassi}=2.71$). This study provided the initial attempt in understanding the role of habitats or land cover types, guild types and human interferences in determining the diversity of bird population - and related ecosystem health - in the area. Such knowledge is essential in providing the information necessary for sustainable management practices. This work represents the first study to inventorize avian species diversity in the transition zone of TBKS BR.

Keywords: Birds, biosphere reserve, diversity, transition zone

INTRODUCTION

Indonesia is one of the countries known as one of the biodiversity hotspots area in the world (Mittermeier 1998, Marchese 2015). Most species of wild animals still reside in forested areas, estimated to be around more than 50% of the land available in the country (Alisjahbana and Busch 2017). These areas are also home to a significant number of birds – key species in the functioning of many ecosystems. The Wallacea area, of a particular interest to bird diversity research, supports a large number of endemic bird species in the region and includes the islands of Sulawesi (where the study was performed), Lesser Sunda and Moluccas. Despite the growing number of observation discovering new species in the biodiversity hotspots of Indonesia, such areas face gradual diminishing of habitat size due land conversion to various other uses deemed more economically profitable, for instance agricultural activities and the development of residential areas (Brooks et al. 2002).

Birds as one of the most visible residents of the threatened areas hold a key role in the functioning of the ecosystem. They perform services essential for the

regulation of ecosystem health, such as seeds dispersal, pollination of tropical plants and pest control (Philpott et al. 2009, Sekercioglu 2012). When birds ingest fruits from fruit bearing trees, they would leave the seeds undigested, excreting them instead to the ground, leaving them ready for germination. Birds that consume pollen from flowering plants would carry with them pollens, transporting and inadvertently distributing the pollens into nearby flowers, causing them to be pollinated. While carnivorous birds that hunt and prey on small animals, such as rodents, would keep the population of the vermin under control, leaving the food chain structures balanced through this act of predation.

The birds inhabiting some of the islands of Indonesian archipelago have been observed to reside in some areas in two different types of habitats, the forest and agricultural land (Waltert et al. 2004, 2005). The forest habitats are under pressure from the aforementioned land use change factors (Sodhi et al. 2005). These pressure on bird habitat also put the birds at risk, as the reduction of forest cover may lead to the reduction of the chance that the bird can obtain its livelihood. However, the availability of forest patches in the land changed to agricultural uses have been

observed to still maintain adequate level of support for the existing bird species in the area (Waltert et al. 2004, 2005).

Birds may also function as a proxy indicator of the ecosystem health. Measurement of indicators such as bird diversity and guilds, structure community, population density and abundance can point out the extent of disturbances in their habitat (O'Connell et al. 2000, Tanalgo et al. 2015). Moreover, it has been observed that the species richness and composition of the birds are important parameters of a stable and functioning ecosystem (Bibi and Ali 2013). Indeed, with the growing interests on the management of ecosystem and its services, measurement of diversity and abundance of birds have been used as indicators of the quality of ecosystem services in a given area, especially as the roles they perform in the ecosystem, such as seed dispersers and predators, have been claimed to underpin the ecological functions which form the base of ecosystem services (Andersson et al. 2007).

Considering the aforementioned factors, this paper aims to report the results of a study performed in Tambolongan and Polassi islands, South Sulawesi, that carried out measurement of bird species diversity and their guilds, linked with observation of their current habitat (land cover types). This study provides baseline data that can be used as an initial assessment towards a more thorough investigation of factors needed in a conservation management strategy in the area. Indeed, the use of bird diversity data to evaluate and prepare an ecosystem or conservation management plan has been demonstrated in other studies (Mas and Dietsch 2004). In addition, this study also serves as the first study inventorying bird species in Tambolongan and Polassi, South Sulawesi, Indonesia.

MATERIALS AND METHODS

Study area

Field observation was conducted in the month of June 2018, and took place in two islands situated in the transition zone of Taka Bonerate Kepulauan Selayar (TBKS) Biosphere Reserve (BR), those are: Tambolongan Island (6.6188 °S, 120.4098 °E) and Polassi Island (6.6741 °S, 120.4380 °E). Both islands are located in Selayar Regency, South Sulawesi, Indonesia (Figure 1). The area is a part of the designated UNESCO Biosphere Reserve site, where a combination exists between the sustainable uses of the area by human that are aligned with the conservation needs to ensure that both human and nature could thrive without jeopardizing the well-being of the other. However, despite the status of the area, comprehensive monitoring regimes that provide information for its management strategies are currently still unavailable.

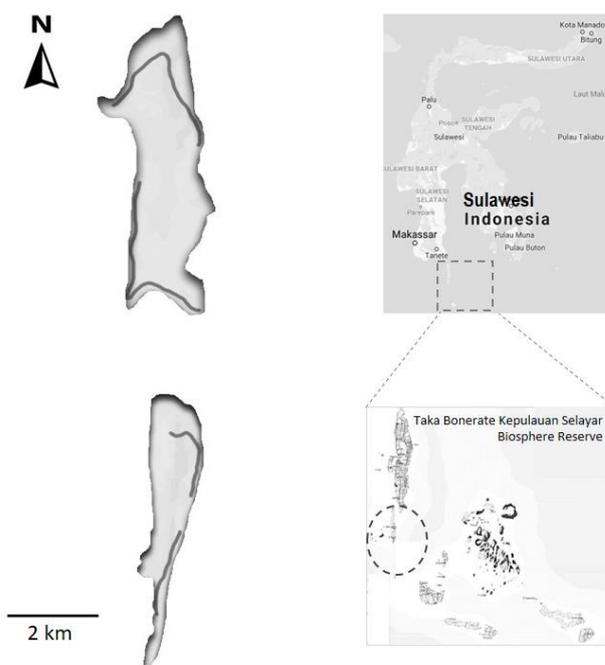


Figure 1. Sampling location and pathways (represented as grey lines) in Tambolongan (the upper island) and Polassi (the lower island), Selayar Regency, South Sulawesi, Indonesia

Procedures

Observation was conducted in two islands (Tambolongan and Polassi) for each sampling visitation. A visual encounter method (VES) was used to inventory bird species along specified observation pathways as illustrated with grey lines in figure 1. Observation pathways were selected to represent variation of terrestrial habitats on each island. Data collected for each encountered species were recorded according to local name, observation time and location, and numbers observed. In addition, photograph of each species was collected for further identification and scientific name labelling.

Data analysis

Bird species identification was performed using a reference book (van Ballen et al. 2016). The diversity index was measured using Shannon-Wiener (H' index) calculation (Spellerberg and Fedor 2003). The H' index assumes that the random sampling of each species observed sufficiently represents the majority of species in its habitat (Bibi and Ali 2013). The species richness (D index) was calculated using Menhinick index (Menhinick 1964). The evenness index for each sampling location was measured using Pielou (J') index (Pielou 1966). The evenness index is used to indicate the relative abundance of different species and evaluate the evenness of distribution among existing species (Bibi and Ali 2013). These indices have been commonly used in studies analyzing the diversity of birds and other species found living in different types of habitats and provide means to evaluate indirectly the ecosystem health (Cooleman et al. 2015; Li et al. 2017; Tanner et al. 2017; Dinesh et al. 2018; Mentil et al. 2018).

RESULTS AND DISCUSSION

Tambolongan and Polassi islands are situated southward of Sulawesi Island, Indonesia, and are parts of transition zone of Taka Bonerate Kepulauan Selayar (TBKS) biosphere reserve. Each island measures approximately 9.8 km² for Tambolongan and 3.3 km² for Polassi. Despite their relatively remote location and small terrestrial area size, each islands are home to about 1300 human inhabitants. In the past decade, the islands have seen an increase of human population of up to 20% (Indonesian Bureau of Statistics 2017). The population growth indicates that appropriate environmental management plan is necessary to ensure that it would not put pressure towards the ecosystem health in both islands.

As observed in the field studies performed in these islands, both have experienced some degree of environmental pressures. One of the most apparent of these pressures is the destruction of marine habitats (coral reefs) in the area due to unsustainable fishing practices, such as the use of bombs and tranquilizers. The destruction is mainly the result of the lack of alternatives for the human population in the islands in earning their livelihoods. Nonetheless, recent trends have seen growing number of local population converting to land based livelihoods, mainly from agricultures. This shift has actually resulted in the conversion of previously pristine habitats in the islands into fields, used for more economically productive purposes. It is thus may be deemed important to monitor environmental health in the area to prevent the situation from escalating unsustainably.

One of the key indicators of environmental pressures is bird diversity. Birds often perform key roles in the functioning of their ecosystem habitats, such as seed dispersal and predation of pest (Philpott et al. 2009, Sekercioglu 2012). As such, measurement of indexes related to bird species existing in the areas can provide information on the state of ecosystem health to ensure that local management of resources can be performed sustainably. Based on this consideration, this study surveyed the types of birds that can be found in each island and attempted the analysis of their community structures.

Field sampling showed that there were a total of 29 bird species from 21 family found in the two islands (Table 1). Out of the 29 species observed, 3 species were identified as migratory birds, those are: *Charadrius alexandrinus*, *Charadrius peronei* and *Numenius phaeopus*. In addition to this, 5 bird species are listed as protected species under ministerial decree No. 92 year 2018 (published by Indonesian Ministry of Environment and Forestry), those are: *N. phaeopus*, *Haliaeetus leucogaster*, *Pandion haliaetus*, *Megapodius reinwardt* and *Rhipidura Javanica*. One of the protected bird species, (*M. reinwardt*), was observed to be occasionally hunted and consumed by the local community. Such condition has to be addressed in the environmental management strategy of the islands, for instance through public education to induce changes in public attitude by raising awareness towards the unsustainability of the practice.

Comparison of the two islands revealed that higher number of species was observed in Tambolongan (27 species) than Polassi (20 species) (Table 1). This may be attributed to its larger terrestrial area and more types of habitat. Tambolongan has at least 5 key categories of habitats, consisting of beach forest, agricultural land, savannah, mangrove forest and residential area. With the exception of mangrove forest, all other four key habitats exist in Polassi.

Although the direct measurement of the number of species seems to indicate that Tambolongan supports a more varied population of birds, the analysis of community structure indexes (diversity, richness and evenness) showed that both islands differ only slightly (Table 2). The calculation of the diversity indexes in the area revealed that Tambolongan island ($H' = 2.98$) harbors a marginally more diverse bird population than Polasi island ($H' = 2.71$). Similarly, the higher value of species richness observed for Tambolongan ($D = 2.46$) than Polassi ($D = 2.01$) suggests that this island supports richer types of bird. These similarities between the two islands may be attributed to their proximity that might cause birds to easily circumnavigate the distance between both islands. Such situation renders the difference between habitat sizes in the two islands may be less of an influencing factor in determining the diversity, as both islands seem capable of supporting an almost similar quality of bird community. As observed in other studies, bird diversity and richness in a similarly conditioned environment are seem to be more influenced by their guilds than by their habitat characteristics (Kim et al. 2007, Smith et al. 2018). In other words, the availability of food sources may be the key factor directly influencing the structure of the bird community.

Nonetheless, the analysis on guild types of the observed birds also show that the two islands share similar traits. As illustrated in figure 2, both islands are inhabited by birds that feed mainly on insects. The dominance of the insectivore bird population may reflect the habitat situation in both islands that have seen clearances due to conversions to agricultural lands. Despite the fact that such process removes land covers from the areas, the agricultural crops that replace them could also provide food for insects, sustaining their population (Benton et al. 2002, Smith et al. 2018). The other two feed types (seed and fish) signify the original condition of the now partially beach-forested islands with large areas of agricultural land and surrounded by sea on its sides, which supply both seeds and fish to the foraging bird population.

Table 2. Index of bird community structure in Tambolongan and Polassi.

Location	No. of Species	No. of Family	H'	D	J'
Tambolongan	27	20	2.98	2.46	0.90
Polassi	20	16	2.71	2.01	0.90

Table 1. Diversity of birds observed in Tambolongan and Polassi, South Sulawesi, Indonesia

Family	Species	Island		No. of individuals
		Tambolongan	Polassi	
Accipitridae	<i>Haliaeetus leucogaster</i>	+	+	3
Pandionidae	<i>Pandion haliaetus</i>	+	-	2
Alcenidae	<i>Halcyon chloris</i>	+	+	6
	<i>Halcyon sancta</i>	+	-	2
Apopidae	<i>Collocalia esculenta</i>	+	+	19
Ardeidae	<i>Ardea purpurea</i>	+	-	2
	<i>Butorides striata</i>	-	+	1
	<i>Egretta sacra</i>	+	+	5
Artamidae	<i>Artamus leucorhynchus</i>	+	+	11
Campephagidae	<i>Lalage sueurii</i>	+	+	8
Charadriidae	<i>Charadrius alexandrinus</i>	+	-	4
	<i>Charadrius peronii</i>	+	-	2
Columbidae	<i>Ducula aenea</i>	+	+	15
	<i>Streptopelia chinensis</i>	+	+	7
	<i>Treron vernans</i>	+	+	6
Estrildidae	<i>Lonchura molucca</i>	+	+	8
	<i>Lonchura pallida</i>	+	+	14
Hirundinidae	<i>Hirundo tahitica</i>	+	+	11
Megapodiidae	<i>Megapodius reinwardt</i>	+	+	2
Meropidae	<i>Merops ornatus</i>	+	-	2
	<i>Merops philippinus</i>	+	-	1
Muscicapidae	<i>Cyornis rufigastra</i>	+	+	3
Nectariniidae	<i>Cinnyris teysmanni</i>	+	+	18
Oriolidae	<i>Oriolus chinensis</i>	+	+	27
Passeridae	<i>Passer montanus</i>	+	+	14
Phasianidae	<i>Coturnix chinensis</i>	-	+	1
Rhipiduridae	<i>Rhipidura javanica</i>	+	-	1
Scolopacidae	<i>Numenius phaeopus</i>	+	-	1
Zosteropidae	<i>Zosterops chloris</i>	+	+	25
Total	29	27	20	221

Note: + : Present in the area

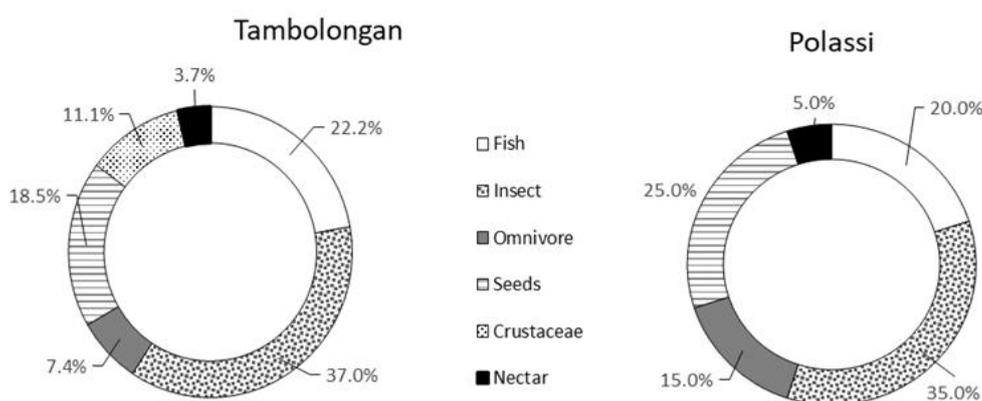


Figure 2. Percentage share of bird guild types in Tambolongan and Polassi, South Sulawesi, Indonesia

This study performed analysis on bird community structures found in the islands of Tambolongan and Polassi. It was found that both islands share similar bird community traits, as evident in the indexes calculated for the purpose of evaluating its diversity and the guilds composition. It

also appears that the similarity in community traits seems to be more influenced by the guild characteristics than the sizes of the land area of both islands, which has one island (Tambolongan) measured almost three times larger than the other (Polassi).

The present environmental conditions of the islands can be considered to experience some degree of pressures from human population growth and land conversion. However, the data discussed can be deemed to provide only the initial snapshot of ecosystem health through proxy measurement of current bird diversity condition in both islands. As such, further studies are required to ascertain whether the ecosystem health in both islands is still in good condition or already threatened by the pressures. These studies should be designed to monitor the bird population across time and to relate the indexes to various pertinent variables such as land use change, habitat types and the changes of the guild profile across time. The data collected should then be able to track changes across space and time, rendering them usable in evaluating environmental changes and their effects on ecosystem health in both islands. Such studies would act as preliminary preparation for a consistent in-situ monitoring regime, which would be needed for the appropriate management of interests between those of development and conservation, befitting the status of the site as a Biosphere Reserve. Moreover, as has been commented in another study (Yoccoz et al. 2001), the monitoring program should be supported by clear management goals that pinpoint on the way that the gathered data would be used to realize the aforementioned management objective.

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