Community structure of shorebirds (Charadriiformes: Scolopacidae) in Percut Sei Tuan District, North Sumatra

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Abstract. A study on the community structure of sandpipers (Charadriiformes: Scolopacidae) has been conducted from February to March 2014. Scolopacidae is a large family of shorebirds inhabiting the mudflat of Percut Sei Tuan district. The site was also documented as a transitory habitat during migration in each year during September and April. The aim of this study was to obtain the community structure and population of Scolopacidae species in the area. The method used to calculate the shorebirds was the concentration count and block method to estimate the number of population. The study documented 16 species and 2573 individuals, all dispersed within three sub-sites namely Bagan Percut, Pematang Lalang, and Tanjung Rejo. The total Shannon’s diversity index ($H'$) was obtained lower (1.672) in this study than the previous report in 2012 (1.865). The species, Numenius madagascariensis was the dominant population with a number of 1,156 individuals.

1. Introduction

Scolopacidae are a large family of shorebirds with an annual migration route to maintain their population. The East Coast of North Sumatra is a transitory site for the members of Scolopacidae and is regarded as an important bird area for the Sumatra region represented by Percut Sei Tuan district located at Deli Serdang Regency, North Sumatra [1-3]. Migration is a series in life cycles for shorebirds to preserve their fitness and survivability during the food limitation and unfavored environmental condition in their original habitat.

The species in Scolopacidae travel a great distance from their breeding sites to migratory sites in order to maintain their species. Shorebirds are often referred to as shorebird or waders. In general, shorebirds can be interpreted as a group of water birds which are ecologically dependent to the coastal area to explore food and/ to breed, small- to medium-sized of beak of various shapes adapted to their prey diversity [4,5],

The common habitat for water birds are swamps, marshes, mangroves, estuaries, lakes, rice fields, rivers, dams, and coastal area as a place to forage, rest, take shelter and other daily activities. The existence of water birds in wetlands is influenced by many factors such as food resources, water quality, resting and nesting site availability and predators [6]. Based on the location of breeding, shorebirds can be divided into sedentary (non-migratory) and migratory water birds. Taxonomically, the majority species of shorebirds belong to two families, namely Charadiidae and Scolopacidae. The species are known to inhabit the mudflat area for finding their preys [2,3].
Percut Sei Tuan district has a stretch of mudflat area besides their mangrove and coastal area which has experienced a significant land conversion into agricultural land and plantations. The activity will impact on the biodiversity of shorebirds, in specific to the members of Scolopacidae. The study then aimed to monitor the population and shorebird species in this location to reflect their functionality as an important bird area in North Sumatra.

2. Materials and methods

2.1. Sampling method
This study was conducted on three sub-sites or mudflat areas of Bagan Percut, Percut Sei Tuan district, Deli Serdang Regency, North Sumatra Province, Indonesia (3°43’23.4”N, 98°47’52.5”E) from February to March 2014. The monitoring used a concentration method in the feeding ground during low tide for 2 hr, followed with a population count using block method by using a monocular.

2.2. Data analysis

2.2.1. Species identification
Members of Scolopacidae were identified using a field guide to Sumatran, Kalimantan, Java, and Bali avifauna by MacKinnon 1993 [7].

2.2.2. Ecological analysis
The diversity of shorebird species from each sub-site was determined by calculating the number of species richness (S), number of individuals (N), Shannon’s diversity index (H’), Shannon’s equitability index (E_H), and Jaccard’s similarity index [8,9]. The category based on the frequency of attendance from each species was expressed in percentage (%). A two-year study result was compared and displayed in bar chart to illustrate the difference of the number of individuals among sub-sites and dominating species.

3. Results and discussion

3.1. Diversity of Scolopacidae shorebird species
Based on an observation period from February to March 2014 in three sub-sites, I documented 16 species of migratory shorebirds within the Scolopacidae which utilized the mudflats of Percut Sei Tuan district. When compared to the previous study in 2012, a decrease number of species was observed in certain sub-sites (Table 1). The decreased species in Scolopacidae was documented from Pematang Lalang site with four missing species.

There are several factors that influence the addition and reduction of species found in these 3 sub-sites, including environmental factors, especially climate which are completely different between the region of origins of migratory birds and the region of transitory sites or migration location. Other factors were largely determined by the characteristics of each region which is spatially unique such as, duration and period of tides, water level, seasonal patterns, food availability (sediment texture and properties), wetland area, wetland connectivity and safety [2].

The results of the study [3] found that in February, an increase in the number of migratory shorebird species compared to other months was thought to be related to seasonal patterns, food availability, ease of foraging and supporting environmental conditions. February was thought to be the preferred month for migratory shorebirds to meet their food requirements. This situation is supported by other research results [10] that the composition and abundance of shorebird species at a location was strongly affected by seasonal patterns. Fluctuation in seasonal patterns greatly impact on the species locomotion and migration. Furthermore, the richness and dynamics of bird species in an area was affected by immigration, extinction and the uniqueness of a habitat [11].
Table 1. Species composition of Scolopacidae from three sub-sites in Percut Sei Tuan

| No | Species              | Site I | Site II | Site III | Site I | Site II | Site III |
|----|----------------------|--------|---------|----------|--------|---------|----------|
| 1  | Arenaria interpres   | -      | -       | √        | -      | -       | √        |
| 2  | Calidris alba        | -      | -       | -        | -      | -       | √        |
| 3  | C. ferruginea        | √      | -       | √        | -      | -       | √        |
| 4  | C. tenuirostris      | √      | -       | √        | -      | -       | √        |
| 5  | Limicola falcinellus | -      | √       | √        | -      | -       | √        |
| 6  | Limnodromus semipalmatus | - | -      | √        | -      | -       | √        |
| 7  | Limosa lapponica      | √      | √       | √        | -      | -       | √        |
| 8  | L. limosa            | √      | √       | √        | -      | -       | √        |
| 9  | N. arquata           | √      | √       | √        | -      | -       | -        |
| 10 | N. madagascariensis  | √      | -       | -        | √      | -       | √        |
| 11 | N. phaeopus          | -      | √       | √        | -      | -       | √        |
| 12 | Tringa cinerea       | √      | √       | -        | √      | -       | -        |
| 13 | Tringa hypoleucos    | √      | √       | √        | -      | -       | -        |
| 14 | Tringa nebularia     | -      | √       | √        | -      | -       | -        |
| 15 | Tringa stagnatilis   | √      | √       | √        | √      | -       | -        |
| 16 | Tringa tetanus       | √      | √       | -        | -      | -       | -        |

Site I: Tanjung Rejo, Site II: Pematang Lalang, Site III: Bagan Percut

3.2. Diversity and equitability index

The results of the analysis showed a decrease in the Shannon’s diversity index (1.672) of the community in the Scolopacidae at the study site when compared with the results of the study in 2012 (1.865). This decrease in diversity was differently documented as in Tanjung Rejo (Table 2). The lower diversity was due to the dominance of some species. The shorebird species which dominated the three sub-sites were namely three members of Numenius and one member of Tringa (Figure 1). The diversity index value is influenced by species richness and individual abundance. External factors that are thought to affect species richness and the abundance of individuals in Percut Chart including dispersal and seasonality. Wealth of species is characteristics of diversity that are influenced by external factors (immigration, migration and dispersal) and local factors (competition, predation) [12].

Table 2. Species richness (S), number of individuals (N), Shannon’s diversity index (H'), and Shannon’s equitability (E_H) of Scolopacidae community in Percut Sei Tuan

|       | Site I | Site II | Site III | Site I | Site II | Site III | Total |
|-------|--------|---------|----------|--------|---------|----------|-------|
| S     | 10     | 9       | 11       | 11     | 6       | 12       | 15    |
| N     | 669    | 1246    | 1067     | 1467   | 80      | 1026     | 2982  |
| H'    | 1.814  | 1.187   | 1.671    | 1.150  | 1.460   | 1.545    | 1.865 |
| E_H   | 0.788  | 0.54    | 0.697    | 0.48   | 0.815   | 0.622    | 0.689 |

Figure 1. Categorization of Scolopacidae species in Percut Sei Tuan
The results also showed a decrease in the number of migratory shorebirds found in three locations or sub-sites compared to previous studies (Table 2). The location with the highest number of species was found in Bagan Percut while the lowest was found in Pematang Lalang (Figure 2). In figure 2, it can be seen that there was a decrease in the number of species in Pematang Lalang while the other two sub-sites had additional Scolopacidae species.

![Figure 2. Comparison on the number of species between year 2012 and 2014 in Percut Sei Tuan](image)

The largest decline in the number of species documented in four species namely *Limosa lapponica*, *L. limosa*, *Numenius arquata*, and *N. phaeopus*, whereas *N. madagascariensis* experienced an increase in the number of species. (Figure 3). The adaptive traits from each species to deal with unfavored environmental conditions and reproductive capacity were thought to be the cause of the decline and increase in migratory bird species found at the study site.

![Figure 3. Comparison on the number of individuals of highly documented species between year 2012 and 2014 in Percut Sei Tuan](image)
The documentation of newly reported species in other locations was caused by external factors, such as environmental conditions, food and safety factors. Factors influencing the density of an animal population included food and prey availability, nesting and shelter site condition, disease incidences, parasites infestation, predation and competition [13]. Other important factors are tidal condition, water level, and sediment quality. Percut Sei Tuan mudflats have a sequential tidal occurrence, in which high tides occurred for about two to three hours which largely determined the availability of space and sufficient time for shorebirds to search for food.

Further ecological analysis including the measurement of physico-chemical conditions from each site may be approached to obtain the precise limiting factor on the species richness and gradual increase/decrease of Scolopacidae population in the future. In addition, this study results were consistent with the previous study [14]. Distribution, number and composition of water birds found in an area was strongly influenced by water levels, fluctuations in water level, vegetation, salinity, topography, food type, ease of obtaining food, size of wetlands and connectivity of wetlands [6].

3.3. Similarity of community among sub-sites
Bagan Percut and Pematang Lalang has almost the same species richness, with a similarity index ($E_H$) of 0.538 for Tanjung Rejo and $E_H$ of 0.5 for Pematang Lalang. In percentage, more than 50% of total Scolopacidae species found in this study was contributed from these sub-sites while Bagan Percut was regarded as a site for a combination of species found in Tanjung Rejo and Pematang Lalang (Table 3). Based on the analysis of the similarity of shorebird species found in the three locations, it was known that there were species only found in one location. This can be seen from the different $E_H$ index between Tanjung Rejo and Bagan Percut. This data also showed that each region was so unique that certain species selected it with distinct ecological requirements. In addition to the members of Scolopacidae, other genera of shorebirds may be monitored intensively since the mudflat area has been regarded as an important bird area to numerous migratory water birds [15,16].

|                | Tanjung Rejo | Pematang Lalang | Bagan Percut |
|----------------|--------------|-----------------|--------------|
| Tanjung Rejo   | 0.500        | 0.500           | 0.400        |
| Pematang Lalang| 0.500        | 0.538           | 0.538        |
| Bagan Percut   | 0.400        | 0.538           | 0.538        |

4. Conclusions
The structure of the shorebird community of the Scolopacidae Family includes: distribution, number and composition of species are strongly influenced by habitat characteristics including water level, food, tidal length, tidal time, water level, temperature (climate and environment), extent of mud, spatial connectivity and security. Diversity of Scolopacidae species was recorded for 16 species in Percut Sei Tuan mudflats.

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