



Studies of Temporal Variations of Species Diversity and Abundance of Marine Birds in Red Sea Region

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ABSTRACT

Massawas and its surrounding beaches can support a diversity of marine birds along with the Red sea, for weather seasonal, annual, and spatial factors that affect bird richness and abundance on public beaches. To do so, we conducted two years of bird surveys on the beaches. These beaches are permanent natural water bodies, and are important for bird wildlife because they are stable resources for food, water and also good ground for mating purpose. The permanent water bodies are constant and limited for its geographical areas under natural conditions. We studied the marine water birds which are both migrant and resident; its species richness and diversity were studied in Massawa and its surrounding beaches in the Red sea region. It is a good for marine food source and also near by areas for marine birds there was natural vegetation in the seasons and are less important for agricultural resources. These areas were supposed to be earlier in rich resource for different marine bird's species and may be sometimes disturbed by the seasonal sea tides and also by tourists. The study reveals that there are different species of birds as discussed below. We conclude our study that reductions in the rate of population decline of the observed species of marine bird biodiversity. To protect such species great care must be exercised either by governmental or by non-governmental agencies. Across all species we found that there are 10 marine bird species of this region and calculated there values the bird species and abundance and obtained low values indicating low bird richness and abundance, it may be due to strongly affected by seasons, natural habitat and the availability of food and are the basis for conducive environment for breeding for maintaining next generation.

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Introduction

Biodiversity is a simple contraction of biological diversity and is the total variation from the level of genes to the ecosystem. The study concerned with marine birds of Massawa and its surrounding areas and its aims the measuring of the species richness and diversity of marine birds and finally taking some protective measure. The level of diversity of organisms would not be same for the different areas and varies accordingly (Hector and Purvis, 2000). Environment will support more species in almost all taxonomic species and will modify and adjust the temperature change. Some factors such as predation, competition, spatial heterogeneity and seasonal variation will cause the species diversity and species richness and may be sometimes evolution of new species.

Shorebirds forage on marine invertebrates in the swash zone and amongst the wrack line for insects and other intertidal arthropods or its larvae's. For any particular diversity gradient, we can ask which of the factors involved and which are most important for the variation in diversity of organisms. One important factor is spatial heterogeneity. The more heterogeneous and complex the species and higher the species higher the diversity. This factor is considered both in large and small organism (Michael Huston, 1996). For instance, there is a general increase in environmental complexity as one precedes towards the tropics and in some cases the predation or by inter-specific competition will effect the variation and leading to diversity of birds (Ricklefs and Schluter, 1993). Naturally, the between habitats in relation to resource supply such as food. The

numbers of individuals of species per unit area vary widely range of organism is thus limited or varies by the kinds of available nutrients, fish eating birds were supposed to live near the water bodies and hence the species diversity and also richness of the species. However, the biotic productivity may also vary from water bodies to water bodies.

There are also other fluctuations within the single habitat according to the annual cycle. Thus the bird communities undergo great seasonal fluctuations as a result of migration between summer areas and wintering areas. For many water birds, the rhythm of climate makes it necessary to undergo regular migration (Kendeigh, 1980, Krebs, 1980). Biodiversity of birds are simply counting the number of birds, its species and its abundance and richness (Burton, 1975). Censuses and counts were given good results for the researchers. Though birds are the agricultural pests in destroying the various crops and yet some income will be gained through ecotourism (Young, 1981) and even especially in Massawa region. Hence the authors studied in these marine birds of species diversity and richness of this region and to protect the species by taking some measures.

We conducted 2 years surveys along twelve km stretches of sandy beaches to help answer the following conservation related problems such as: 1) monthly patterns in bird abundance and richness 2) differences from year to year 3) site characteristics (abundance of algal wrack, human activity, or proximity to an estuary), drive spatial variation in bird communities 4) certain shorebird species (black-bellied plover, snowy plover, willet, marbled godwit, whimbrel, sanderling) in

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2007-2010 increased or declined compared to a similar study in 1994-1997

Objectives of the Study

The objectives of the study were:

1. To determine the temporal variation in diversity and abundance of birds in Red sea region, near Massawa region.
2. To provide some basic information of marine birds for further research.

Study Area

The study area was conducted in Massawa region and is located about $16^{\circ} 25' 18.57''N$ and $39^{\circ} 39' 44.57'' E$. Massawa is situated in a low land area of Red sea region and is a part of north-east Africa. The sea is calm and the sea tides are low compared to the other seas and are a good source for fishing. Since wide variety of fishes were found and hence there will be species diversity and species richness of birds. Hence, the authors were chosen this research area.

Materials and Methods

Materials and Survey

The materials that were used to conduct the study were one set of binoculars, stationery, Global Position Systems (GPS), A textbook of Birds of Eastern Africa (Perlo, 1995) as a reference manual. The field studies were studied for a period of 24 months from January to December 2013 to 2014. Each plot of study area was visited three times to collect data on bird species – richness and abundance and the habitat and the surroundings of each study area. On each visit all the birds in the sea / beach and on the shore areas were counted while birds were passing and are recorded. Some times bird appearance will be very rare. The field studies were run during early morning and late evening since the birds were more active in these periods.

Data Analysis

The simplest measure of species diversity is species richness or number of species, which is the oldest concept of species diversity. One problem with using only the number of species as a measure of diversity is that it treats rare species and common species equally; however, other and more useful concepts of species diversity are measures of heterogeneity and evenness.

Data were collected and used three measures of heterogeneity, Whittaker plots and two commonly used indices of heterogeneity, and one measure of evenness.

Whittaker Plots

The Whittaker (1965) plots is a graphic method combining species richness and abundances of the various species in a standard plot of species abundances, with log-relative abundance (y-axis) and arithmetic mean species on (x-axis). It is a visualization of community organization related to the relative abundance of the different species in the community. Another advantage of the Whittaker plot is that it could be use to study patterns shown by different communities and also it graphically reduces the magnitude of the differences in abundance.

The Shannon-Wiener Index of Diversity

It is expressed as $H = -\sum (p_i) (\log_2 p_i)$

Where H = information content of sample (bits/individual) = index of Species of Diversity

S = number of species

P_i = Proportion of total sample

Two components of diversity are combined in the Shannon-Wiener function, number of species and equitability or evenness of species, i.e. the evenness in numbers of individuals of different species. In practice, the Shannon-Wiener index, H

ranges from 1 (for low diversity) to a maximum of $(1-1/s)$, where s is the number of species.

Simpson's Measure of Evenness

For Simpson's measure of heterogeneity, maximum diversity is obtained when all abundances are equal. The maximum possible value of the reciprocal of Simpson's Index ($1/D$) is always equal to the number of species observed in the sample. This leads to a simple definition of Simpson's Index of evenness.

$$E_{1/D} = (1/D) / S$$

Where: $E_{1/D}$ = Simpson's measure of evenness

$$D = \text{Simpson's index} = \sum p_i^2$$

P_i = Proportion of species i in the community

S = Number of species in the sample

The index of evenness ranges from 0 to 1 and is relatively unaffected by the rare species in the sample.

The Whittaker plot of log abundance on the species rank is non-parametric measure as are the Shannon – Wiener function and the Simpson's index. The shape of the dominance-diversity curve may indicate which models of species abundance relations might be applied to the data.

Results

The results of marine birds of Massawa were recorded and given in the (Table). However, several bird species were common and observed in three visits. There were 19 different species with a total of 21 as observed during the three visits as shown in the table. The total number of birds may vary because of the seasonal changes and birds might be migrated and we cannot expect. The highest recorded species Common Sandpiper as observed, in the following table.

Species – abundance Relationships

In all the three observations there will be three species where the number recorded were highest as shown in the table. The trends were consistent throughout the study period and such trend was common in bird communities (Krebs, 2000).

Discussion

Human activity, including dogs, horses, and vehicles can disturb birds on beaches, and some species appear more sensitive to disturbance than others (Lafferty 2001; Glover et al. 2011). Some shorebirds feed on intertidal invertebrates, which are exposed at low tide. These birds shift their distributions according to the tides, feeding at low tide and roosting at high tide (Burger et al. 1977). Although beach topography, energy, and sand grain size can affect the type and abundance of prey (Evans and Dugan 1984),

Beaches vary considerably in width and slope, and wider beaches should have more resources per linear kilometer. Shorebirds have also been shown to be more abundant on beaches with shallow slopes, presumably because these have more food resources (Neuman et al. 2008). Shorebirds feed on insects and amphipods associated with algal wrack deposited by waves on the upper beach (Dugan et al. 2003). If such birds seek out locations near off-shore sources of algae, seasonal and climatic variation in the distribution of wrack might affect temporal patterns in bird abundance (Revell et al. 2011). Vultures and gulls feed on stranded carcasses. But some municipalities groom recreational beaches in the summer, and even low-frequency grooming reduces invertebrate biomass and carcasses (Llewellyn and Shackley 1996; Dugan et al. 2000, 2003).

Table Temporal Observation of marine birds of Massawa in the Red—sea region Species – Abundance Relationships

S. No	Common Name	Scientific Name	Abundance Observation-01	Abundance Observation-02	Abundance Observation-03	H	E1/D
1	Pink Blacked Pelican	<i>Pelicanus rufoescens</i>	3	5	2	8.53	0.026
2	Lesser Black backed gull	<i>Larus fuscus</i>	1	3	1	2.93	0.018
3	Sooty gull	<i>Larus fuscus</i>	4	1	0	3.93	0.012
4	Caspian Tern	<i>Sterna cassia</i>	1	0	2	1.53	0.067
5	Osprey	<i>Pandion haliaetus</i>	2	0	1	1.53	0.067
6	Eurasian spoonbill	<i>Platalea leucorodi</i>	1	3	2	3.83	0.012
7	Sacred Ibis	<i>Threskiornis aethiopicus</i>	4	3	6	12.42	0.013
8	Western – reef Heron	<i>Egretta gularis</i>	2	5	6	12.69	0.012
	Greater Flamingo	<i>Phoenicopterus ruber roseus</i>	3	6	5	13.81	0.011
10	Common Sandpiper	<i>Actitis hypoleucos</i>	4	5	6	15.09	0.009

Birds can use habitats in addition to the sandy beach; the sandy beach can influence the bird community found there. Some species that use beaches for roosting forage primarily in estuaries (herons and egrets), along intertidal rocky shores (turnstones), or over ocean waters (pelicans, terns, cormorants). Land birds (e.g., sparrows) occur on beaches, but they are dependent on vegetation for nesting and roosting. Raptors hunt near the beach if their roosts are near the shore, and peridomestic species like pigeons associate with parks that are often near beaches. Proximity to housing (increasing crows), proximity to estuary (increasing birds), and proximity to the rocky intertidal (increasing birds) affect the types of birds seen along a mix of sandy and rocky beach (Lafferty 2001). Other studies have also found that shorebirds are more common on beach transects near estuarine feeding areas (Colwell and Sundeen, 2000; Neuman et al. 2008).

Between January to December surveys were done, and simultaneously monitored for more than two hours when the outgoing tide reached 15 feet (or less than high tide). These tidal conditions optimized the viewing opportunity of shore birds. In the first monitoring session conducted at high tide, 5 species of sea birds were observed. The total count was approximately 25 individuals of the above mentioned species were counted and in the second were 31 and the third with 35 and additional 7 unidentified shore birds. The ten *taxa* were included as per the table; Pink Backed Pelicans, Lesser Black Backed Gull, Sooty Gull, Caspian Terns, Osprey, Eurasian Spoonbill, Sacred Ibis, Western – Reef Heron, Greater Flamingo And Common Sandpiper. The number of shore birds counted on this survey was less than most followed surveys. However this survey was done during the high tide which is considered to be less and rare inn richness.

The secondary survey was done with the arrival of migratory sea birds and shore birds when the ice season begins in Europe and the where the summer season begins in the southern and northern islands of Eritrea in total 25 species were conducted during the survey this include marine birds and terrestrial birds.

Third surveys in total 28 species were recorded in addition there were 11 unidentified smaller gulls and plovers among this 28 species were visitors to the area. Some of the details as observed during the period of study:

Details of Some Species observed

Pink-backed Pelican : *Pelecanus rufescens*

The bird is common on the coasts and the islands of Eritrea. Nest is on top of mangrove (*Avicenna marina*); usually the mangrove stand is on shallow water separated few to hundreds of meters from the main island. The nest is made from mangrove branch and leaves where two white eggs lay. In the north breeding starts on September and lasts on December however in the south breeding starts on July.

Sooty Gull: *Larus hemprichii*

Few to fair number were recorded on all the islands visited. They breed in solitary or loose colony. They lay two or three eggs. Breeding biology is similar with the white-eyed gull. Breeding start on June and lasts on August.

Caspian Tern: *Sterna caspia*

The bird breeds either in solitary or in loose colony with a maximum of three to four pairs. Nest is on open bare sand usually close to the beach, which is shallow depression where two eggs laid. In the Saudi Arabian Red Sea, there were 100 and 200 breeding. Large number of breeding pairs is expected if the entire islands are surveyed on winter.

Osprey: *Pandion haliaetus*

The bird was recorded on the majority of the islands visited during the summer and winter. It is a winter breeder as per the data. The bird is a solitary breeder since it appears singly. The bird built a massive hill shaped nest composed of twinges, dried sponges and sea-weeds, pieces of vegetations and other sort of flotsam. Nest is usually on elevated ground and on top of hill or cliff and on lighthouses. During the winter survey 146 adults on 59 active nests were recorded. Breeding starts in October and stay well until February.

Eurasian Spoonbill: *Platalea leucorodia*

Nest is on top of mangrove, thick shrubs, and high halophytes and on coral out crop. Two to five white eggs are laid. On many occasions the bird had seen breeding in association with another bird, Western Reef Heron. Breeding start on May and lasts until August.

Sacred Ibis: *Threskiornis aethiopicus*

The bird is common around Massawa city and usually seen foraging on mudflats. High numbers were recorded breeding on small islands situated around Massawa.

Western Reef Heron: *Egretta gularis*

Two to four were usually seen on the majority of the islands visited. Nest is on top of mangrove, thick shrubs, and high halophytes where two or three eggs laid. On many occasions the

bird found to breed in association with spoonbill. Breeding start on May and lasts on early August.

Conclusion

Based on the above observations the following conclusions are made:

- Some of the species *Sacra Ibis*, *Western – reef heron*, *Greater flamingo*, *Pink blacked pelican* were abundant and *Sooty gull*, *Caspian tern* were less abundant.
- Based on the data and findings the less abundant species must be initiated the conservations efforts either by the governmental or by non-governmental agencies.
- Discouraging excessive tourism activities in such areas, so that we can improve its habitat.
- Preserving natural habitat for them, so that they can breed and improve its number of species.

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