Review of the Distribution of Waterbirds in Two Tropical coastal Ramsar Lagoons in Ghana, West Africa

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Abstract

Areview of waterbirds was undertaken in two coastal Ramsar lagoons, namely the Keta and Muni Ramsar sites in Ghana, West Africa, from August 2010 to March 2012 to determine the status of diversity and abundance of key waterbired species that utilize the lagoons. A total of 20,217 of waterbirds belonging to 25 different species, 19 genera and 10 families were counted in the two lagoons. Maximum count of 19,757 contributing to 97.7% of the total counts was recorded in Keta Lagoon area while 460 contributing to 2.3% of the total count was recorded in the Muni Lagoon area. By comparison with the Save the Seashore Birds Project-Ghana (SSBP-G), which started in 1983 and ended in 1985, a total of 53,500 of waterbirds were counted in the Keta Lagoon, an indication of a 63.1% decline in waterbirds abundance. Atotal of 24 species was recorded in the Keta Lagoon and its surrounding floodplains (H'= 0.94, J'= 0.68 and d'= 2.32), whilst the Muni Lagoon recorded a lower number of species of 12 (H' = 0.82, J' = 0.76 and d' = 1.79). The Keta Lagoon recorded higher numbers of waterbirds because the Keta Lagoon is less turbid and shallow, and, therefore, waterbirds were able to stalk and easily locate their prey as compared to the Muni Lagoon, which recorded the lowest numbers possibly due to siltation and, hence, waterbirds could not locate fish fingerlings. Generally, the diversity of waterbirds utilizing both lagoons has declined over the past 27 years as compared to the results from the SSBP-G. Public awareness programmes to highlight the importance of lagoons and waterbirds as environmental indicators is recommended. This could be achieved through education and enforcement of existing wildlife laws and international conventions. In addition, conservation initiatives governing the conservation of waterbirds by the Ghana Wildlife Division of the Forestry Commission is urgently recommended.

Introduction

Ghana is on the boundary of two flyways of waterbirds, the East Atlantic Flyway and the Mediterranean Flyway (Smit & Piersma, 1989). The coastal wetlands of Ghana, therefore, receive significant numbers of waterbirds from a greater breeding range than most wetland sites in West Africa (Piersma & Ntiamoa-Baidu, 1995). At least 15 species of seabirds occur in internationally important populations in Ghana (Ntiamoa-Baidu, 1991; Ntiamoa-Baidu *et al*., 2001).

In fact, Ghana's coastal wetlands are better chartered for birds (Ntiamoa-Baidu & Grieve, 1987; Grimes, 1987; Ntiamoa-Baidu, 1991a; Ntiamoa-Baidu & Gordon, 1991; Ntiamoa-Baidu & Hollis, 1992; Van Gaalen & Van Gelderen, 1995), than those in the other countries along the Gulf of Guinea (Altenburg *et al*., 1983; Altenburg, 1987; Tye & Tye, 1987; Zwarts 1988; Schepers & Marteijn, 1993; Nicole *et al*., 1994). Their values as staging areas and wintering grounds for migratory waterbird species is also well documented (Ntiamoa-Baidu, 1993).

Eight wetland sites along the Ghanaian coast (Esiama, Elmina, Muni, Densu Floodplains, Korle, Sakumo II Lagoon,

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Songhor and Keta) qualify as internationally important wetlands on the basis of the total populations and species of waterbirds they support (Ntiamoa-Baidu, 1991a; Ntiamoa-Baidu & Gordon, 1991). In 1992, five of these sites, Muni, Densu Delta, Sakumo II Lagoon, Songhor and Keta, were proposed as Ramsar sites and received support from the Global Environment Facility (GEF) for their protection under the Ghana Coastal Wetlands Management Project (GCWMP), which was implemented by the then Wildlife Department (Piersma & Ntiamoa-Baidu, 1995).

Waterbirds serve as indicators of environmental quality by their presence, abundance and diversity. Waterbirds tend to avoid polluted water bodies since they rely on these water bodies mainly for fish fingerlings and fry, as well as worms. The higher the water quality the larger the numbers of waterbirds and *vice versa*. Hence, the abundance and diversity of waterbirds utilizing the Keta and Muni Lagoons were estimated (Piersma & Ntiamoa-Baidu, 1995; Schreiber & Burger, 2002; Ahulu, 2004; Ahulu *et al.*, 2006) based on the current water quality.

Waterbird abundance in Keta Lagoon has also declined over the years, possibly due to the hunting or trapping for game or domestic consumption by either fishers or children. This was minimized between 1985 and 1988 during the 'Save the Seashore Birds Project-Ghana (SSBP-G). The objective of this project was to change the attitude of many Ghanaians towards wildlife, especially waterbirds, through education, public awareness and training (Ntiamoa-Baidu, 1987). The main objective of this study was to determine the current distribution of waterbirds species in Keta and Muni Lagoons in comparison to the results from the SSBP-G (1988).

Materials and methods

The study was undertaken in the Keta and Muni Lagoons which are feeding, breeding and wintering sites for diverse species of waterbirds belonging to some taxonomic families such as Ardeidae, Laridae, Recurvirostridae, Glareolidae and many others (Piersma & Ntiamoah-Baidu, 1995). They are Ramsar sites and also Important Bird Areas in Ghana based on the fact that these sites hold significant population of waterbirds of international importance (Ntiamoa-Baidu *et al*., 2001; Fishpool & Evans, 2001).

Site 1. Keta ramsar Lagoon

Keta Lagoon complex (Fig. 1) (5°55^2 N 0°59^2 E) lies in the far south-east of the country, west of the international frontier with Togo. The lagoon is about 140 km east-northeast of Accra, on the south-east of Ghana, West Africa (Sorensen *et al*., 2003; Armah *et al*., 1997). The lagoon is connected to the open sea through a tributary of the River Volta at Anyanui (Sorensen *et al*., 2003). It is an extensive, brackish water-body situated to the east of the Volta river estuary, with an average depth of 0.8 m and an average salinity of 1.87‰ (18.7 PSU) (Anon., 1993). As a Ramsar site, it supports over 60,000 waterbirds (Piersma & Ntiamoa-Baidu, 1995). The main occupations of the inhabitants in this area are fishing and crop farming (Ofori-Danson *et al*., 1999).

Site 2. Muni Lagoon

The Muni lagoon (05°22' N 0°40' W) is situated on the south-western part of Winneba in the Central Region of Ghana. It is part of

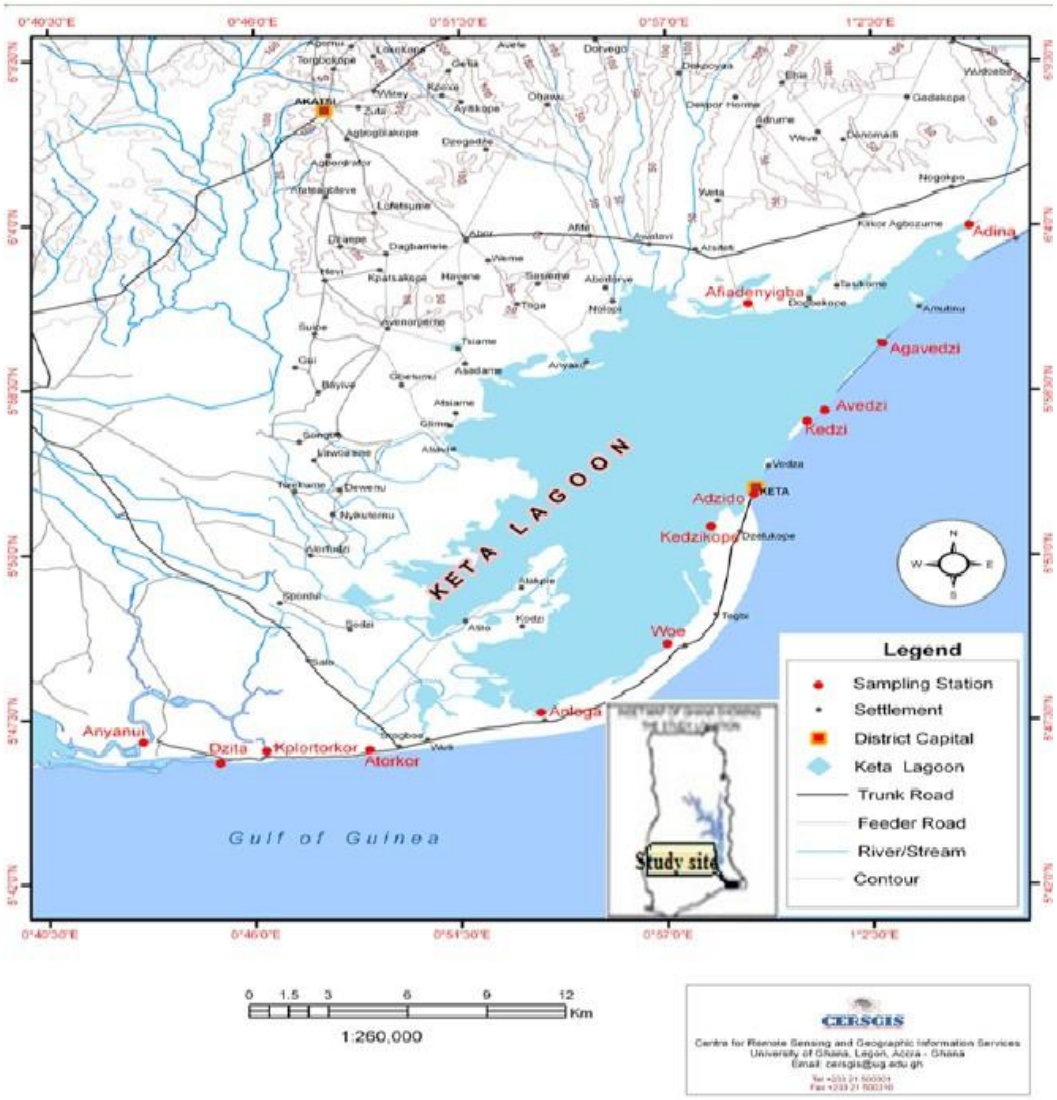

Fig. 1. Map of Ghana showing the Keta Lagoon and the sampling stations (after CERSGIS, 2010).

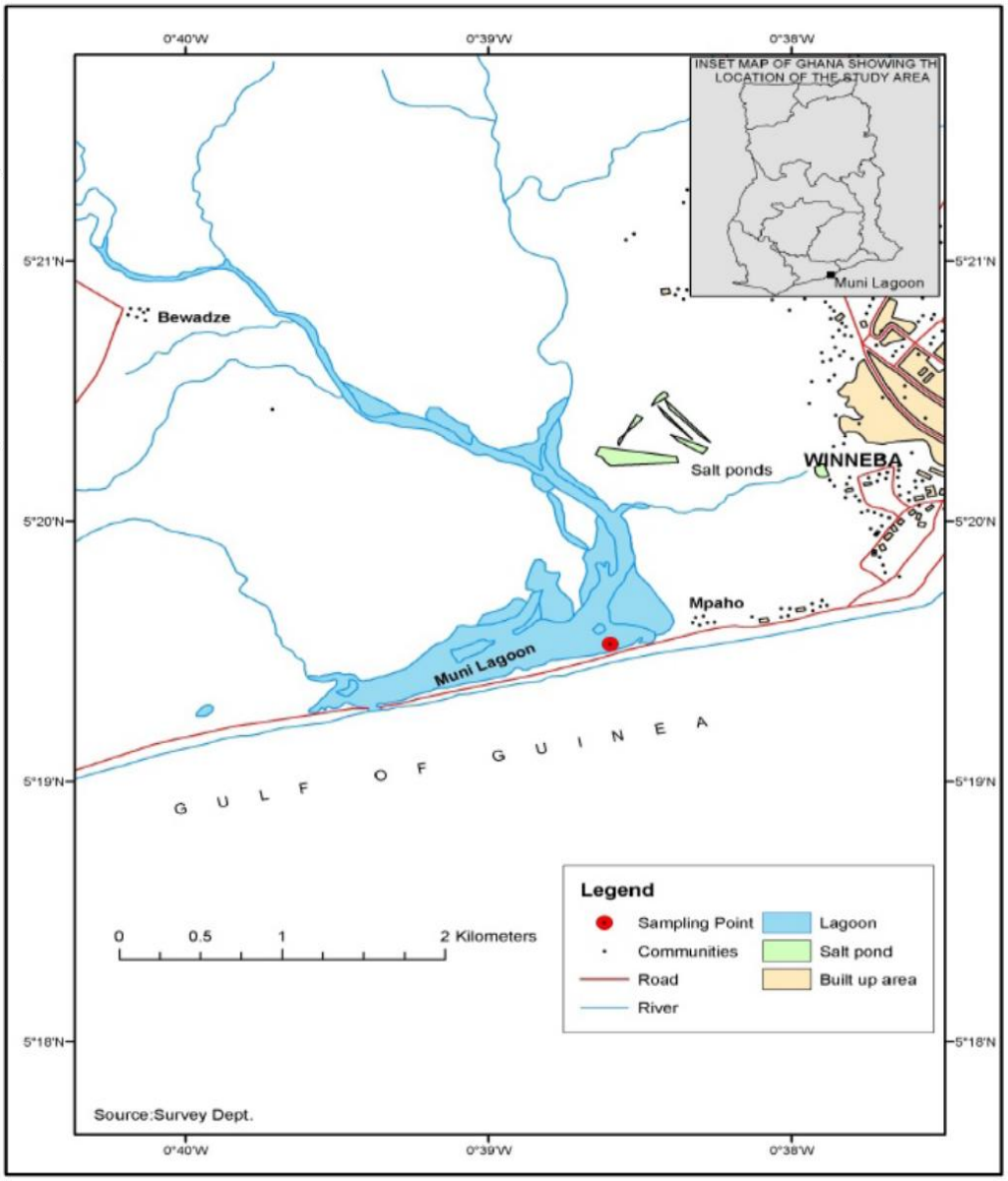

Fig. 2. Map of Ghana showing the Muni Lagoon (after Geological Survey, 2010).

the Muni-Pomadze ramsar site (Koranteng *et al.*, 2000). It is a closed lagoon which occasionally opens to the sea, especially during the rainy season. Rivers Muni and Pratu feed the lagoon, but these are normally dried up except during the rainy season. The lagoon is usually 3 km^2 in extent (Ntiamoa-Baidu & Hollis, 1988) but could expand over 6 km^2 of surrounding floodplain in the rainy season. The Muni-Pomadze site encompasses an area of about 90 km^2 comprising the water shed of the Muni Lagoon. However, the lagoon and floodplains are only 114 ha. The lagoon extends about 15 km inland. Farming and fishing are the main vocation of the people. Muni Lagoon was designated a ramsar site under the Ghana Coastal Wetlands Management Project in 1999 (Ofori-Danson *et al.*, 1999). The site supports an estimated 23,000 waterbirds (www.ramsar.org). The commonest economic activities are fisheries, aquaculture and farming (Ofori-Danson *et al*., 1999).

Waterbirds abundance was estimated for three fish landing sites in Keta Lagoon, mainly Anloga, Woe and Anyanui Estuary (Fig. 1) from August 2010 to March 2012, as well as in 10 of the floodplains of the Keta Lagoon area in Atorkor, Kplortorkor, Dzita, Kedzikope, Adzido, Kedzi, Afiadenyigba, Avedzi, Agavedzi and Adina (Fig. 1) from February 2011 to February 2012. All the data from the various floodplains were pooled together because of the sparse nature of the data. Field sampling was consistently undertaken in the third week of every month from August 2010 to March 2012 for Keta lagoon, and March 2011 to March 2012 for Muni lagoon. The area of lagoon at each sampling site was considered as one unit, and the waterbird species abundance was estimated using telescopes and binoculars for viewing and counters for estimating bird counts (Granadeiro *et al.*, 2004).

Waterbirds were identified with identification keys from Austin & Austin (1973) and Barlow *et al*. (1997). The waterbirds were counted sequentially throughout the day from left to right of the investigator in order to minimize likelihood of counting the same birds which might fly to other parts of the lagoon within a maximum radius of 100 m (Granadeiro *et al*., 2004). The waterbirds species diversity indices were determined from the Shannon-Wiener (Equation 1) Diversity Index (H^1), Margalef species richness (Equation 2) index (d') and Pielou's evenness (J) (Equation 3) using PRIMER 6 Software. These are defined as:

i) $$H^1 = \frac{n \log n - \sum_{i=1}^{n} fi \log fi}{n} \quad \ldots\ldots\ldots (1)$$

(Magurran, 1988; Zar, 1974).

where n = sample size and f_i = frequency of occurrence or abundance of i^{th} individual.

ii) $$d' = \frac{(S-1)}{\ln N} \quad \ldots\ldots\ldots\ldots (2)$$

(Magurran, 1988; Zar, 1974).

where S = number of species recorded and N = total number of individuals summed over all the S species.

iii) $$J = \frac{H}{H_{max}} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

(Magurran, 1988; Zar, 1974).

where H' = Shannon-Wiener's species diversity index; and H_{max} = the maximum possible diversity.

Results

Waterbird species abundance and diversity

Table 1 shows the total number of waterbirds

TABLE 1

Species list of avifauna encountered during the study from August 2010 to March 2012

Category	*Family*	*Scientific name*	*Authority*	*Common name*	*Status (IUCN, 2012)*
Waders	Recurvirostridae	*Himantopus himantopus*	Linnaeus, 1758	Black-winged stilt	Least concern
	Scolopacidae	*Calidris alba*	Pallas, 1764	Sanderling	
		Actitis hypoleucos	Linnaeus, 1758	Common sandpiper	
		Calidris minuta	Leisler, 1812	Little Stint	
		Nemunius phaeopus	Linnaeus, 1758	Whimbrel	
		Tringa nebularia	Gunnerus, 1767	Common greenshank	
		Calidris canutus	Linnaeus, 1758	Common knot	
		Limosa limosa	Linnaeus, 1758	Black-tailed godwit	Near Threatened
	Charadriidae	*Vanellus spinosus*	Linnaeus, 1758	Spur-winged plover	Least concern
		Charadrius pecuarius	Temminck, 1823	Kittlitz's sandplover	
	Glareolidae	*Glareola pratincola*	Linnaeus, 1758	Collared pratincole	
Terns and Gulls	Laridae	*Larus marinus*	Linnaeus, 1758	Greater black-backed gull	
	Sternidae	*Sterna hirundo*	Linnaeus, 1758	Common tern	
		Chlidonias niger	Linnaeus, 1758	Black tern	
		Sterna albifrons	Pallas, 1764	Little tern	
Others	Phalacrocoracidae	*Microcarbo africanus*	Gmelin, 1789	Long-tailed cormorant	
	Ardeidae	*Egretta gularis*	Bosc, 1792	Western reef heron	
		Ardea cinerea	Linnaeus, 1758	Grey heron	
		Egretta egretta	Linnaeus, 1766	Little egret	
		Butorides striatus	Linnaeus, 1758	Striated heron	
		Egretta alba	Linnaeus, 1758	Great white egret	
		Ardea goliath	Cretzschmar, 1827	Goliath heron	
		Ardeola ralloides	Scopoli, 1769	Squacco heron	
	Cerylidae	*Ceryle rudis*	Linnaeus, 1758	Pied kingfisher	
	Anatidae	*Dendrocygna viduata*	Linnaeus, 1766	White-faced tree ducks	

Waders

Black-winged Stilt

Black-tailed Godwit

Terns and Gulls

Common Tern

Little Tern

Others

Great white Egret

Pied Kingfisher

Fig. 3. Some of the common waterbirds sited during the study from August 2010 to March 2012

encountered at the various sampling sites during the study period. A total of 25 species made up of 11 waders, 3 terns and one gull, and 10 other spp. of waterbirds belonging to 10 families, and 19 genera, totalling 20,217 individuals (Keta Lagoon = 19,757, Muni Lagoon = 460) were encountered (Fig. 3). Waterbirds count at the Keta Lagoon was for 97.7% and Muni Lagoon was 2.3% of the total count of waterbirds. The most common of the t axonomic families were Scolopacidae and Ardeidae. Table 2 shows the total number of waders, tern and other species in the various sampling sites. The total number of waders across the sampling sites was 4,975 with the highest number of 3,322, constituting 67% of the total recorded in Anyanui.

In Anloga, a total of 1,139 constituting 23%, followed by Muni with 219 individuals constituing 4% were recorded. In the Keta floodplains, a total of 215 waterbirds constituting 4% and the lowest of 80 individual waterbirds constituting 2% were recorded in Woe. Waders formed the second highest waterbird abundance contributing 24.6% of the total estimates of waterbirds. Terns contributed lowest (2,520) to the waterbird abundance forming 12.5% of the total number of waterbirds encountered (Table 2). The highest count of 7,639 contributing to 37.8% of the total estimate, was recorded for the long-tailed Cormorant.

In Anyanui (Fig. 4), terns were counted only in five of the sampling months starting from March 2011, with the highest number (47) counted in November 2011, which conforms to the observations of Ntiamoa-Baidu (1988) indicating that tern and wader numbers start peaking in October until late December when they start leaving to winter in Europe. In Anloga (Fig. 5) other waterbird species for example, herons and egrets which are mostly resident species (Ntiamoa-Baidu 1988) occurred in higher numbers with the peaks in August (1,934) and September (1,777) 2010. In Woe (Fig. 6), the other species such as the herons and egrets also dominated the counts. In the Keta floodplains (Fig. 7), terns and gulls dominated the counts possibly because of the fact that most of the floodplains were much shallower than the Keta Lagoon, and they could easily wade through and find fish, and also used the dry part of the lagoon as their roosting and nursery grounds (Piersma & Ntiamoa-Baidu, 1995). In Muni (Fig. 8), no terns were recorded at all during the study, possibly because they had moved to feed at sea (Atlantic Ocean) and utilized nearby wetlands as roosting and nursery grounds due to the deteriorated nature of the Muni ramsar site.

The highest number of species of 20 (species diversity of 0.98) was recorded in Anyanui, whilst Woe near Keta Lagoon and the Muni lagoon recorded the lowest number of species of 12 each (H' = 0.58 and 0.82, respectively) (Table 3). The waterbird species of the Keta floodplains were the most even (J'= 0.78) whilst those of Woe were the least even (J' = 0.54). The most species rich station was Anyanui (d' = 2.17), whilst Woe recorded the lowest in terms of species richness, d'= 1.39.

A two-tailed correlation analysis of waterbirds by stations showed no significant correlation between waterbirds species distribution (significance 2-tailed = 0.60) between the sampling sites at 0.01 level, also a one-sample T-test also showed no significance (T-value = 1.97; significance = 0.21) at 0.05 level.

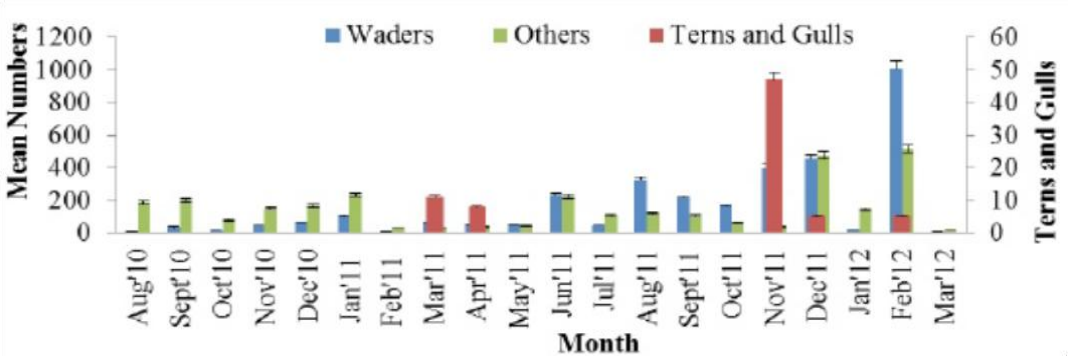

Fig. 4. Abundance and distribution of waterbirds at Anyanui located on the Keta lagoon

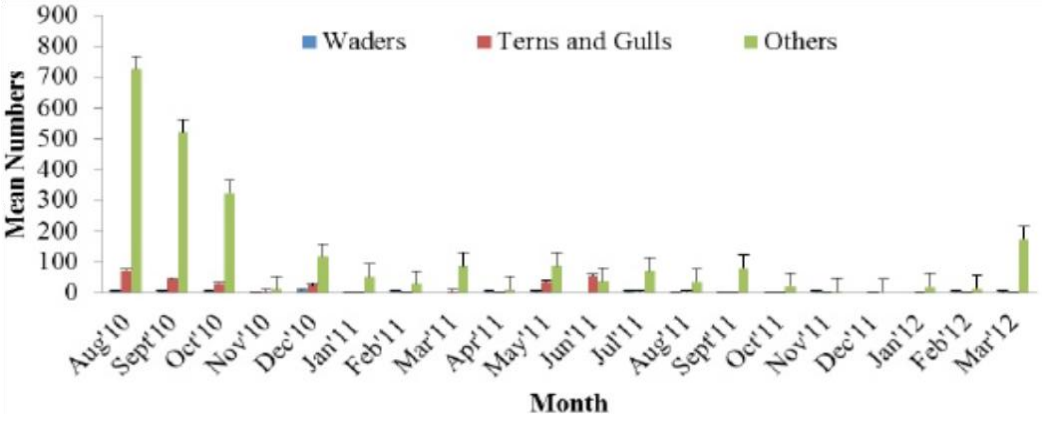

Fig. 5. Abundance and distribution of waterbirds at Anloga located on the Keta lagoon

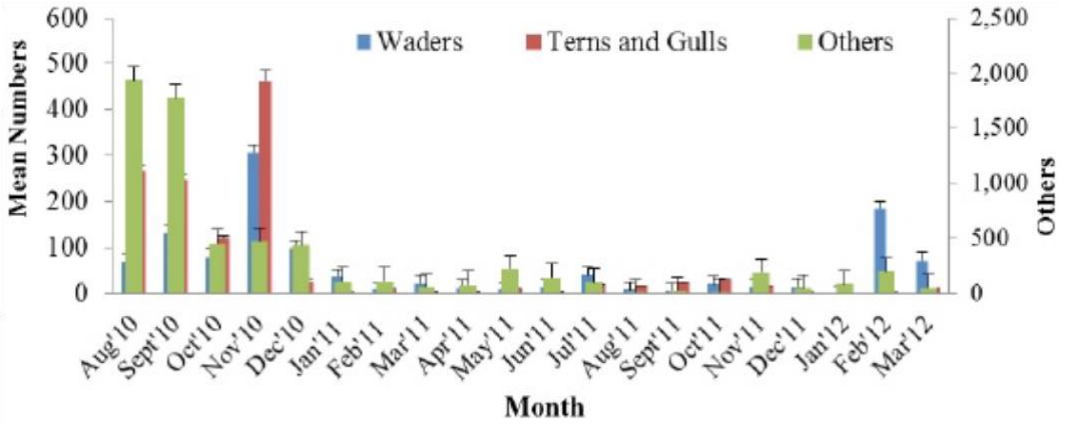

Fig. 6. Abundance and distribution of waterbirds at Woe located on the Keta Lagoon

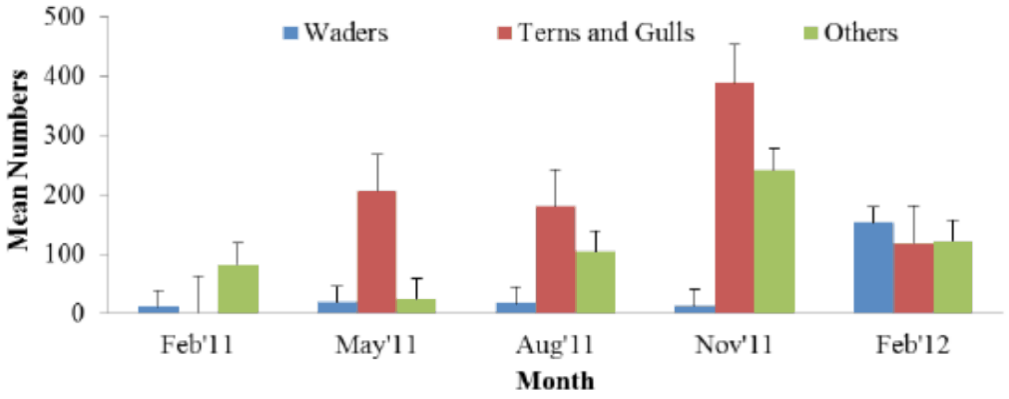

Fig. 7. Abundance and distribution of waterbirds at the Keta floodplains

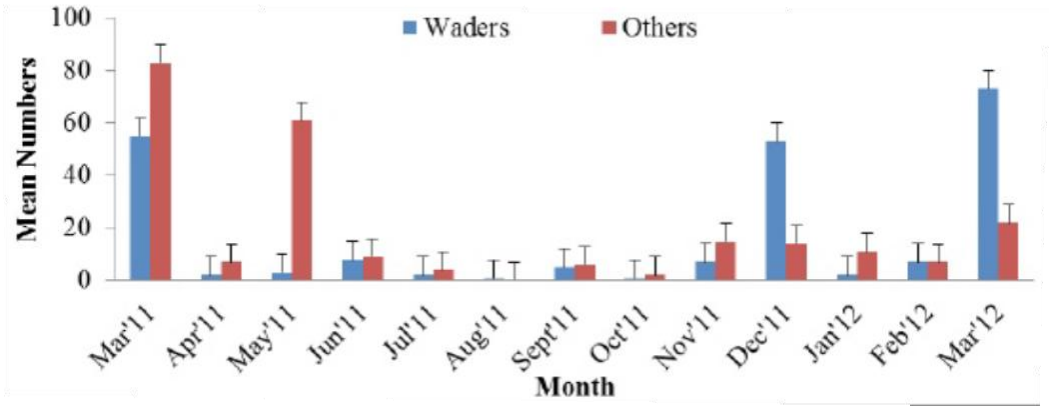

Fig. 8. Abundance and distribution of waterbirds at Muni Lagoon.

Discussion

During the "Save the Seashore Birds Project", 40 species of waders and 11 species of terns were recorded across the various wetlands and ramsar sites including Keta and Muni Lagoons. The Keta Lagoon at that time recorded a total of over 53,500 waterbirds (40,000 waders, 5,000 terns and 8,500 herons and egrets) (SSBP-G 1988). Comparing these to the waterbird counts in the Keta Lagoon during the study, shows that there has been a massive overall decline of 63.1% (waders by 87.6%; terns by 49.6 % and heron and egrets by 56.7%) in waterbird abundance and species diversity over a period of 20 years. Subsequently, from July 1998 to July 2000, a total of 185,643 waterbirds belonging to over 48 species and 10,292 waterbirds belonging to 23 species were recorded in Keta and Muni Lagoons, respectively.

Waterbird populations are a good

TABLE 2
Counts of waterbirds by stations during the study from August 2010 to March 2012

Category	*Common name*	*Keta lagoon*					*Total lagoon*	*Percent composition*	*SSBP-G (1988)*
		Anyanui	*Anloga*	*Woe*	**Floodplains*	***Muni*			
Waders	Black-winged stilt	1443	469	19	0	47	4,975	24.6	40,000 (74.8%)
	Sanderling	218	277	0	39	90			
	Common sandpiper	609	348	36	18	7			
	Little Stint	40	0	0	2	14			
	Whimbrel	778	0	13	0	12			
	Greenshank	144	0	6	146	0			
	Spur-winged plover	33	45	6	2	0			
	Kittlitz's sandplover	45	0	0	0	0			
	Black-tailed godwit	12	0	0	0	0			
	Collared pratincole	0	0	0	8	48			
	Common knot	0	0	0	0	1			
Gulls and Terns	Common tern	76	737	165	557	0	2,520	12.5	5,000 (9.3%)
	Black tern	0	21	0	51	0			
	Little tern	0	517	110	204	0			
	Greater black-backed gull	0	0	0	82	0			
Others	Long-tailed cormorant	1014	4635	1733	252	5	12,722	62.9	8,500^ (15.9%)
	Western reef heron	355	434	277	163	16			
	Grey heron	20	13	0	0	1			
	Little egret	540	890	320	123	154			
	Green-backed heron	10	5	0	0	0			
	Great white egret	57	267	26	0	0			
	Goliath heron	6	1	0	0	0			
	Squacco heron	3	2	0	0	0			
	Pied kingfisher	851	269	58	37	65			
	White-faced tree ducks	120	0	0	0	0			
	Total	6,374	8,930	2,769	1,689	460	20,217	100	
	% Composition	31.5	44.2	13.7	8.4	2.2			

*= sampled quarterly from February 2011 to February 2012; **= sampled monthly from March 2011 to March 2012; ^ only herons and egrets

TABLE 3
Diversity Indices of Avifauna at the various sites

Diversity indices lagoon	*Anyanui*	*Keta Lagoon Anloga*	*Woe*	*Floodplains*	*Muni*
N	6374	8930	2769	1684	460
S	20	16	12	14	12
H'	0.98	0.76	0.58	0.89	0.82
J'	0.76	0.63	0.54	0.78	0.76
d'	2.17	1.65	1.39	1.75	1.79

S = species; N=number; H'=Shannon Wiener diversity index; J'=Pielou's species evenness; d'= Margalef species richness index.

indicator of overall environmental sustainability. Many estuaries and lagoons experience widely varying conditions of salinity, wide variations in other physico-chemical parameters such as *p*H, electrical conductivity, ammonium, nitrates and phosphates, and also a wide variety of plant and animal densities. Much of this is mediated by water movement over relatively short time scales (Koranteng *et al*. 2000). This highly unstable l imnological environment seemed to occur in the Muni Lagoon, which was mostly dried up during the study period except for rainy seasons. Siltation had taken over the major part of the lagoon, and fish could barely survive in it, therefore, accounting for the very low numbers of waterbirds, since they could barely find food, mainly juvenile fish (Ahulu, 2008) to eat. This, therefore, could possibly necessitate the migration of waterbirds to nearby lagoons, streams and estuaries or to the sea to feed (Piersma & Ntiamoa-Baidu, 1995; Ntiamoa-Baidu *et al*., 2001).

In terms of conservation status, most of all the waterbirds encountered in the study were in the "least concern" (LC) category (IUCN, 2010), except for the Black-tailed Godwit which falls within the "near threatended" (NT) category, which means that it is likely to become threatened in the near future. The Long-tailed Cormorant was the most abundant species encountered across the sampling sites except for Muni Lagoon. This could be possibly due to the fact that certain conditions at the time permitted their occurrence in large numbers. These waterbirds, in the absence of diving to feed, prefer to stand on stilts or brush parks erected in the water to dry up or rest (Ahulu, 2004). All the sampling sites except Muni Lagoon had 'acadja' sticks erected in the water. Moreover, Muni Lagoon was almost dried up unlike the Keta Lagoon, and, therefore, not a habitable lagoon for the Long-tailed Cormorant due to their mode of feeding.

The number and diversity of waterbirds a wetland can accommodate depends on the size of the wetland itself, the health condition of the wetland (good water and sediment quality), the availability of food, and human and other anthropogenic interferences (Schreiber & Burger, 2002; Piersma & Ntiamoa-Baidu, 1995). In terms of size, Keta Lagoon is the largest (Nyame, 2003) and, therefore, has more food available for the waterbirds. The major causes of the decline

are the very poor water (Lamptey *et al.*, 2013) and sediment quality (Lamptey, 2014) and the various anthropogenic effects. Also the very low numbers of waterbirds in Woe was as a result of the unfriendly nature of the site for wading for the waterbirds (mainly waders) since that part of the lagoon was always full, and there were no mangrove stands for roosting (Ntiamoa-Baidu & Grieve, 1987; Piersma & Ntiamoa-Baidu, 1995).

Most of the floodplains had dried up during the dry season, and, therefore, recorded no waterbirds at all, hence, waterbirds were recorded only during the wet season when there was flooding. In addition, most of the floodplains had very high water salinity (Lamptey *et al.*, 2013), which were intolerable to fish, and, therefore, rendered these floodplains unhabitable to waterbirds since they could not find food. Other anthropogenic possible causes of decline in waterbird abundance were due to the fact that some parts of the lagoon and floodplains had been converted into refuse dump sites, sites for defaecation, bathing, washing and dumping of wastewater. If these activities are not curtailed, they pose impediments to the achievement of the Millennium Development Goal 7 which states "Ensure environmental sustainability".

Other factors that could possibly be associated with the decline in waterbirds species diversity and abundance in the sampling sites could be changes in water levels and general ecology of the wetlands. In Keta area, the sea defence project could impact negatively on the hydrological regimes and, hence, the various ecosystems such as mangrove forests, which serve as breeding and roosting grounds for the waterbirds.

It is recommended that continuous community-based education is conducted throughout the various coastal towns to uplift the public awareness on the importance of waterbirds in our wetlands. This would help curb the trapping of waterbirds and the destruction of Important Bird Areas through illegal development of settlement and industrialization. Other anthropogenic activities such as dumping of refuse, discharging of untreated wastewater and defaecating into the lagoons should also be abolished.

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