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ISSUES ARISING FROM CHANGES IN WATERBIRD POPULATION ESTIMATES IN COASTAL GHANA[1]

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Abstract. Reported in this paper are waterbird census data collected from four coastal wetlands in Ghana over a period of 16 mo, with extrapolations made to indicate possible changes in population trends and bird distribution in the study area. Results indicated that Ramsar sites continue to play invaluable roles in the support of waterbirds on the coast of Ghana despite the presence of waterbird species on a large number of smaller, unmanaged wetlands. On the other hand, results also indicate that waterbird populations and distributions in Ghana, as reported previously, have changed. The need for conservation action for the waterbird species in Ghana increased with respective dependency on unmanaged wetlands, with 56% of species possibly affected.
Key words: Ghana, population changes, Ramsar sites, wetland birds.

ASUNTOS RELACIONADOS CON CAMBIOS EN LAS ESTIMACIONES POBLACIONALES DE AVES ACUATICAS EN LA COSTA DE GANA

Resumen. Reportamos datos de censos de aves acuáticas colectados en cuatro zonas húmedas de Gana durante un periodo de 16 meses, así como extrapolaciones a fin de documental posibles cambios en tendencias poblacionales y distribución de aves en la zona de estudio. Los resultados indican que los sitios Ramsar continúan jugando un importante papel en la conservación de aves acuáticas en la costa de Gana a pesar de la presencia de especies en un gran número de áreas menores no manejadas. Por otro lado, los resultados también indican que las poblaciones de aves acuáticas y sus distribuciones en Gana, han cambiado desde reportes previos. La necesidad de acciones de conservación de aves acuáticas en Gana ha aumentado, especialmente en zonas húmedas no manejadas, con un 56% de las especies posiblemente afectadas.
Palabras clave: Gana, cambios poblacionales, sitios Ramsar, aves acuáticas.

INTRODUCTION

The coast of Ghana falls within the boundary of two major waterbird migration corridors: the East Atlantic and the Mediterranean flyways (Jan et al. 2004). The 550km coast has about one hundred wetlands, mainly associated with estuaries and lagoons and essentially non-tidal (Ryan 2005, Ntiamoa-Baidu 1991). The importance of coastal wetlands in Ghana as habitats for resident and migratory waterbirds has been noted previously (Ntiamoa-Baidu 1988, 1991; Ntiamoa-Baidu and Herpburn 1988; Ntiamoa-Baidu et al. 2000).

Preliminary surveys of the entire coast of

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Ghana by staff of the Ghana Game and Wildlife Department (aided by British ornithologists), in November 1985 and January 1986, indicated that 13 of ~100 wetlands held ~80% of Ghana coastal terns, 85% of waders and 95% of herons (Ntiamoa-Baidu 1991). Eight of these 13 wetlands, namely Keta Lagoon, Songor Lagoon complex, Sakumo Lagoon, Densu Delta, Muni Lagoon, Elmina Saltpans, Korle Lagoon and Esiama Beach, were considered to be of international importance to waterbirds. On the merit of their importance as waterbird habitats, the first five were designated as Ramsar sites in 1992 (Ntiamoa-Baidu and Herpburn 1988, Ntiamoa-Baidu 1991).

Despite the extent of knowledge on bird migration and wader populations worldwide, several gaps exist for West African areas, including lack of current data and the restriction of most studies to a few large sites such as Banc d' Arguin in Mauritania and the Keta Lagoon in Ghana (Piersma et al. 1990, Piersma and Ntiamoa-Baidu 1995, Ntiamoa-Baidu et al 1998, Zwart and Piersma 1990). Previous reports, i.e. Ntiamoa-Baidu (1988, 1991), Ntiamoa-Baidu and Herpburn (1988), and Ntiamoa-Baidu et al. (2000), are quickly becoming irrelevant, needing desperately to be updated with current data, particularly in the context of frequent reports of the loss of wetlands and their qualities. According to Attuquayefio and Gbogbo (2001), most non-Ramsar sites in coastal Ghana are publicly owned, unmanaged or unregulated resources. Gordon et al. (1998) reported a number of non-Ramsar wetlands such as Korle, Chemu, Teshie and Kpeshie, Fosu and Benya lagoons to be polluted and no longer supporting bird life. Indiscriminate fishing, hunting of waterbirds, sewage disposal, cutting of mangroves and farming have been identified as the major human activities contributing to this alteration of these non-Ramsar sites (Attuquayefio and Gbogbo 2001).

In contrast, Ramsar sites on the coast receive conservation attention including the implementation of civil works to minimise the impact of problems, the construction of trails and bird observation points, the presence of wardens to ensure general law enforcement and the prevention of bird hunting, restrictions on the use of drag nets for fishing and the institution of closed fishing seasons. Nevertheless, discrepancies also exist in the nature and quality of coastal Ramsar sites. Available records indicate that between 1992 and 2007, the total area of Densu Delta, for instance, was reduced from 58.9 km^2 to 46.2 km^2 by encroachment (Amankwah 1998, Wetland International 2007).

The evidence that physical and chemical properties of wetlands on the coast of Ghana continue to change indicate that changes in waterbird populations could occur and these need to be documented to enhance the management of wetland and waterbirds. Comprehensive waterbird studies in this area demand the commitment of huge financial and human resources that may not readily be available. Nevertheless, imprecise but useful population trends can be deduced if studies are carried out on a limited number of wetlands to be used as an index (Howe 1998). In that regard, the waterbird numbers of four coastal wetlands are reported and discussed in this paper.

METHODS

STUDY AREA

The study was carried out at four coastal wetlands in Ghana: Densu Delta and Sakumo, Mukwe and Laiwi lagoons. Densu Delta (5º31'N, 0º20'W), a Ramsar site, constitutes the lower reaches of Densu River's water course where it joins the Gulf of Guinea. It provides a significant sanctuary for resident and migratory waterbirds, having an estimated 57 species and 35,000 individual waterbirds (Grimble et al. 1998). The vegetation is dominated by *Avicennia africana, Sesuvium portulacastrum, Paspalum vaginatum, Sporobolus virginicus, Cyperus articulatus* and *Imperata cylindrica* (Oteng-Yeboah 1999). Sakumo Lagoon (5º37'N, 0º02'W), also a Ramsar site, had a cover of 13.6 km^2 in 1992 but which was reduced to 13.4 km^2 by 2007 (Amankwah 1998, Wetland International 2007). It is the third most important site for shorebirds along the coast of Ghana (Anku 2006). Its vegetation consists mainly of *Paspalum vaginatum, Sesuvium portulacastrum, Philoxerus vermicularis,* and *Typha australis* with scanty remains of Avicennia africana (Oteng-Yeboah 1999).

Mukwe Lagoon (5º36'N, 0º03W) has a total land area of 2.6 km^2. Its vegetation consists of

Avicennia africana interspersed with *Cyperus articulatus, Paspalum vaginatum* and *Azadirachta indica* (Attuquayefio and Gbogbo 2001). Laiwi Lagoon (5º42'N, 0º04'E) is 7.5 km² in extent and has *Avicennia africana, Sesuvium portulacastrum* and *Philoxerus vermicularis* as the main components of its vegetation. Mukwe and Laiwi lagoons are two of the many small non-Ramsar sites on the Ghana coast that are publicly owned. The only management at Mukwe and Laiwi lagoons is a customary regulation that forbids people from fishing on Fridays and Tuesdays, respectively.

SURVEY METHODS

The total area of each wetland was divided into sectors with the aid of natural and artificial features that serve as land marks. By walking along designated routes through each sector, the number of individuals of each waterbird species was recorded monthly between September 2008 to April 2009 and September 2009 to April 2010, which are non-breeding seasons. Counting was done in the third quarter of each month during low tide using the naked eye, binoculars (8 x 42mm) and a telescopes (zoom 20-60) mounted on tripods. To minimize the incidence of double counting, birds seen flying were not counted (Bibby et al. 2000). Data from the various sectors for each species were compiled after every counting session to obtain the total number of individuals on the various wetlands.

DATA ANALYSIS

Data were separated between Ramsar and non-Ramsar sites. The number of each waterbird species on the Ramsar and non-Ramsar sites was divided by the species total number and multiplied by 100 to obtain an estimate of Relative Abundance (RA).

Thus,

$$RA_R = \frac{N_R \times 100}{N_R + N_{NR}}, \text{ and}$$

$$RA_{RN} = \frac{N_{NR} \times 100}{N_R + N_{NR}},$$

where RA_R = relative abundance of species *i* on the Ramsar sites, N_R = total number of species *i* on the Ramsar sites, N_{NR} = total number of species *i* on the non-Ramsar sites and RA_{NR} = relative abundance of species *i* on the non-Ramsar sites. On the basis that the Ghana coast has ~100 wetlands of which five are managed as Ramsar sites, the number of waterbirds of each species that the five Ramsar sites might support was extrapolated from the number counted on the two Ramsar sites, given that

$$E_R = \frac{5\, N_R}{2}$$

where E_R = the extrapolated number of waterbirds of species *i* that the 5 Ramsar sites in coastal Ghana might support.

Similarly, the number of waterbirds of each species that the 95 non-Ramsar sites might support was extrapolated from the number of waterbirds on the two non-Ramsar sites surveyed, such that

$$E_{NR} = \frac{95\, N_{NR}}{2},$$

where E_{NR} = the extrapolated number of waterbirds of species *i* of the 95 non-Ramsar sites. The number of non-Ramsar sites needed to support the equivalence of E_R (W_{NR}) was calculated for each species of waterbird given that

$$W_{NR} = E_R \,/\, (N_{NR} \div 2).$$

The percentage bird representation on the Ramsar sites (E_{BR}), signifying the number of birds on the Ramsar sites as a fraction of the total number of birds on Ghana's coastal wetlands, was calculated for each species. Thus,

$$E_{BR} = \frac{E_R \times 100.}{E_R + E_{NR}}$$

On the basis of W_{NR} and E_{BR}, the waterbirds were put into 6 categories as follows:

Category 1. Species found solely on the Ramsar sites whose E_{BR} was 100% and W_{NR} was undetermined.

Category 2. Species for which the total number of non-Ramsar wetlands needed to support the bird equivalence E_R is greater than the numbers that exist on the coast. Thus calculated W_{NR} is >95.

Category 3. Species for which the total number of non-Ramsar wetlands needed to support the bird equivalence E_R was lying between 51% and 100% of the total number of non-Ramsar wetlands on the coast. Thus W_{NR} lies between 48 and 95.

Category 4. Species for which the total number of non-Ramsar wetlands needed to support the bird equivalence E_R lies between 21% and 50% of

the total number of non-Ramsar wetlands on the coast. Thus W_{NR} lies between 20 and 47.

Category 5. Species for which the total number of non-Ramsar small-scale wetlands needed to support the bird equivalence E_R lies between 1% and 20% of the total number of non-Ramsar wetlands existing on the coast. Thus W_{NR} lies between 1 and 19.

Category 6. Species found solely on the non-Ramsar sites whose EBR were 0% and their WNR is undetermined.

RESULTS

A total of 48 species of waterbirds were recorded over the 16-mo period of study (see Table 1). Excepting Wood Sandpiper, Black Heron, White-fronted Plover, Common Moorhen, Senegal Thick-knee and Greater Painted Snipe, which had an RA_{RN} >50%, all other species had R_{AR} >50% indicating general species preference for the Ramsar sites. However, as many as 36 species of waterbirds, representing 75% of the total number of species, had an E_{NR} greater than their E_R (Table 2). Subsequently these 36 species had an E_{BR} <50% leaving only 25% of the waterbird species to have E_{BR} of 50% or greater.

Analysis of the values for W_{NR} and E_{BR} further indicated that waterbird species, namely African Skimmer, African Spoonbill, Ruff, Bar-tailed Godwit and Little Bittern, constituting 10.4% of species, occurred solely on the Ramsar sites (Table 2). These five species fall under Category 1 of the set criteria. The numbers of individuals among Category 1 species (Table 1), as well as the numbers extrapolated for the five Ramsar sites (Table 2), were generally low.

In addition, waterbird species occurring within the range of Roseate and Royal terns fell within Category 2 (Table 2). These Category 2 species represented 12.5% of the total number of species; they needed 100 to 885 non-Ramsar small-scaled wetlands to hold the equivalent of bird numbers occurring on the five managed wetlands. Thus these species are well represented on the Ramsar sites, with prevalence ranging from 90.3% for Roseate Terns to 51.4% for Royal Terns.

Species within the range of Black-tailed Godwit and White-back Night Heron, representing 16.6% of species, fell within Category 3 (Table 2). These species need 48 to 95 non-Ramsar small-scale wetlands to support equivalent numbers estimated for the five Ramsar sites. Between 50.1% and 36% of their numbers occurred on the Ramsar sites. Similarly, bird species falling within Category 4 had between 16.3% and 32.7% of their population on the Ramsar sites. Category 4 species include those within the range of Collared Pratincole and Spotted Redshank (Table 2). They constituted 25% of the bird species and needed 20 to 47 non-Ramsar wetlands to support numbers equivalent to those on the five Ramsar sites.

The proportion of birds that fell within Category 5 constituted 31% of species. Category 5 comprises species within the range of Common Redshank and Senegal Thick-knee (Table 2). These species need between 1 and 19 non-Ramsar wetlands to support numbers equivalent to those of the five Ramsar sites. Between 0.7% and 16% of the total occurrence of species in Category 5 was estimated to be on Ramsar sites. Only one species, *Rostratulla benghalensis* (2.1% of species), fell within Category 6.

DISCUSSION

The selection of wetlands for consideration as Ramsar sites in Ghana was based mainly on the merits of the wetlands as waterbird habitats. The fact that 87.5% of the waterbird species recorded R_{AR} >50%, once again, highlighted the importance of Sakumo and Densu Delta Ramsar sites in the support of waterbirds. This, therefore, confirmed that Ramsar sites play invaluable roles in the support of waterbirds on the coast of Ghana. Most non-Ramsar sites on the Ghana coast are small relative to the Ramsar sites. The observation that only 12.5% of species have their RA_{NR} greater than their R_{AR}, therefore, supports the report of Peterjohn and Sauer (1997) that wetlands that are small play a minimal role in the support of waterbird species in this area.

On the other hand, given that coastal Ghana has a large number of small-sized but unmanaged wetlands that are non-Ramsar sites, comparison of the values of E_R and E_{NR} indicates that the dependency of waterbird species on the non-Ramsar sites is ecologically important. The E_{NR} values for 39 species were greater that their E_R, rendering ~81% of the species to score E_{BR}

TABLE 1. Data on waterbird counts on four coastal Wetlands in Ghana .

Species Name	Common Name	Maximum number recorded at any one time				Species Abundance (%)		Total number of birds
		Densu Delta	Sakumo Lagoon	Mukwe Lagoon	Laiwi Lagoon	Non-Ramsar site	Ramsar site	
Actitis hypoleucos	Common Sandpiper	57	15	116	45	74.9	25.1	1313
Actophilornis africanus	Jacana	10	80	46	0	37.4	62.6	321
Ardea cinerea	Grey Heron	306	157	2	65	7.7	2.3	2875
Ardea pururea	Purple Heron	2	5	1	0	4.5	95.5	44
Ardeola ralloides	Squacco Heron	76	24	9	0	12.8	87.2	374
Arenaria interpres	Ruddy Turnstone	42	30	23	40	34	66	409
Burhinus senegalensis	Senegal Thick-knee	0	8	6	5	88.6	11.4	70
Butorides straitus	Green-back Heron	12	2	8	5	47.1	52.9	102
Calidris alba	Sanderling	831	458	32	376	27	73	6863
Calidris ferruginea	Curlew Sandpiper	3294	1673	40	696	19.3	80.7	18447
Calidris minuta	Little Stint	890	247	14	200	14.6	85.4	8363
Charadrius hiaticula	Common Ringed Plover	1860	904	125	1071	24.7	75.3	23263
Charadrius marginatus	White-fronted Plover	3	5	0	31	76.2	23.8	126
Charadrius pecuarius	Kettliz's Plover	25	83	2	64	23.6	76.4	853
Clidonias niger	Black Tern	4959	172	0	280	5.6	94.4	17931
Dendrocygna viduata	White-faced Whistling Duck	9	425	0	16	0.7	99.3	2340
Egretta alba	Great White Egret	240	184	3	18	5.9	94.1	2182
Egretta ardesiaca	Black Heron	186	36	0	0	63.9	36.1	654
Egretta garzetta	Little Egret	1170	603	29	368	12.5	87.5	15696
Egretta gularis	Western Reef Heron	420	300	6	59	6.9	93.1	5716
Egretta intermedia	Yellow billed Egret	23	30	8	1	11.3	88.7	238
Gallinula chloropus	Common Moorhen	6	9	9	3	66.7	33.3	93
Glareola pratincola	Collared Pratincole	206	380	58	75	9.8	90.2	3411
Gorsachius leuconotus	White-back Night Heron	2	13	3	0	8.6	91.4	35
Himantopus himantopus	Black-winged Stilt	1230	1031	118	263	15.6	84.4	14614
Ixobrychus minutus	Little Bittern	2	1	0	0	0	100	8
Limosa lapponica	Bar-tailed Godwit	7	4	1	6	60	40	60
Limosa limosa	Black-tailed Godwit	0	187	0	31	5	95	622
Numenius arquata	Eurasian Curlew	55	2	0	8	19.1	80.9	131
Numenius phaeopus	Whimbrel	200	20	15	68	25	75	1302

TABLE 1. Continued .

Species Name	Common Name	Maximum number recorded at any one time				Species Abundance (%)		Total number of birds
		Densu Delta	Sakumo Lagoon	Mukwe Lagoon	Laiwi Lagoon	Non-Ramsar site	Ramsar site	
Phalacrocorax africanus	Long-tailed Cormorant	1562	56	5	36	1.2	98.8	7765
Philomachus pugnax	Ruff	0	71	0	0	0	100	455
Platalea alba	African Spoonbill	0	11	0	0	0	100	61
Pluvialis squatarola	Grey Plover	142	77	22	69	30	70	1830
Rostratulla benghalensis	Greater Painted Snipe	0	0	2	0	100	0	5
Rynchops flavirostris	African Skimmer	128	0	0	0	0	100	320
Sterna albifrons	Little Tern	714	614	0	92	6.3	93.7	3408
Sterna dougallii	Roseate Tern	1742	24	0	8	0.6	99.4	2314
Sterna hirundo	Common Tern	5869	696	0	1488	7	93	35653
Sterna maxima	Royal Tern	4076	350	0	219	4.7	95.3	11773
Sterna sandvicensis	Sandwich Tern	3783	323	0	81	0.9	99.1	22629
Tringa erythropus	Spotted Redshank	206	450	0	289	20	80	3466
Tringa glareola	Wood Sandpiper	29	44	210	1	81	19	1663
Tringa nebularia	Greenshank	715	718	45	796	27.2	72.8	13597
Tringa stagnatilis	Marsh sandpiper	206	64	15	18	17.4	82.6	442
Tringa tetanus	Common Redshank	10	13	3	3	21.2	78.8	146
Vanellus senegallus	Wattled Plover	35	54	10	8	18.6	81.4	355
Vanellus spinosus	Spur-winged Plover	58	138	20	71	17.4	82.6	1375

TABLE 2: Estimated waterbird numbers for Ghana's coastal wetlands based on counts on two Ramsar and two non-Ramsar sites.

Cat	Name	Extrapolated number of of waterbirds on the 5 Ramsar wetlands (E_R)	Extrapolated number on the 95 non-Ramsar wetlands (E_{NR})	Extrapolated number of non-Ramsar wetlands holding equivalent numbers of waterbirds extrapolated for the 5 Ramsar sites (W_{NR})	Percentage bird representation on the Ramar sites (E_{BR})
I	African Skimmer	575	0	-	100%
	African Spoonbill	152	0	-	100%
	Ruff	1137.5	0	-	100%
	Bar-tailed Godwit	25	0	-	100%
	Little Bittern	20	0	-	100%
2	Roseate Tern	5752.5	617.5	885	90.30%
	White-faced Whistling Duck	5810	760	726.3	88.40%
	Sandwich Tern	56087.5	9215.0	578	85.90%
	Long-tailed Cormorant	19180	4417.50	412	81.30%
	Purple Heron	105	95	105	52.50%
	Royal Tern	28035	26552.5	100	51.40%
3	Black-tailed Godwit	1477.5	1472.5	95	50.10%
	Black Tern	42325.00	47547.50	85	47.10%
	Great White Egret	5132.5	6127.5	80	45.60%
	Little Tern	7985	10165	75	43.9%
	Western Reef Heron	13305	18715	68	41.60%
	Common Tern	82877.5	118845.0	66	41.10%
	Grey Heron	6632.5	10545	60	36.60%
	White-back Night Heron	80	142.5	53	36%
4	Collared Pratincole	7692.5	15865	46	32.70%
	Yellow billed Egret	527.5	1282.5	39	29.10%
	Little Egret	34327.5	93337.50	40	26.90%
	Squacco Heron	815	2280	34	26.30%
	Little Stint	17860	57902.5	29	23.60%
	Black-winged Stilt	30827.50	108442.5	27	22.10%
	Spur-winged Plover	2840	11352.5	24	20%
	Marsh sandpiper	912.5	3657.5	24	20.00%
	Wattled Plover	722.5	3135	22	18.70%
	Eurasian Curlew	265	1187.5	21	18.20%
	Curlew Sandpiper	37222.50	169005	20	18%
	Spotted Redshank	6935	32870	20	17.4%
5	Common Redshank	287.5	1472.5	19	16.30%
	Kettliz's Plover	1630	9547.5	16	14.60%
	Common Ringed Plover	43775	273267.5	15	13.80%
	Whimbrel	2442.5	15437.5	15	13.70%
	Sanderling	12530	87922.5	14	12.50%
	Greenshank	24745	175702.5	13	12.30%
	Grey Plover	3205	26077.5	12	10.90%
	Ruddy Turnstone	675	6602.5	10	9.30%
	Jacana	502.5	5700	8	8.10%
	Green-back Heron	135	2280	5.6	5.60%
	Black Heron	590	19855	3	2.90%
	Common Moorhen	77.5	2945	2.5	2.50%
	Common Sandpiper	825	46692.5	2	1.70%
	White-fronted Plover	75	4560	2	1.60%
	Wood Sandpiper	790	63982.5	1	1.20%
	Senegal Thick-knee	20	2945	1	0.70%
6	Greater Painted Snipe	-	278	-	0%

values <80%. This indicates that the numbers and distribution of waterbirds in Ghana, as reported by Ntiamoa-Baidu (1991), might have changed.

Additional evidence for change is provided by the relativities between reported maximum number of species counted for the entire coast of Ghana ((Ntiamoa-Baidu et al. 2001) and those reported in this study. For instance, the maximum number of Common Sandpipers reported at any one time along the entire coast of Ghana (Ntiamoa-Baidu et al. 2001) was 385, while in this study the maximum count in Mukwe Lagoon was 116 (Table 1). Similarly, only 8 Spur-winged Plovers were reported as a maximum count in the survey of the entire coast of Ghana (Ntiamoa-Baidu et al. 2001), but the present study recorded a maximum 138 in Sakumo lagoon. It is important to know that the preliminary surveys of Ntiamoa-Baidu (1991) were based on snap-shot events and that there is a possibility, therefore, that they might not be a true reflection of real trends in the populations of waterbirds along the coast of Ghana.

One deficiency associated with this extrapolation is the fact that the Ramsar sites, as well as the non-Ramsar sites that were not involved in this study, might not be of the same sizes nor qualities as those used for this study. Although this might render the comparisons imprecise, they can be justified on the basis that existing inequalities in the size and characteristics of the Ramsar sites equally exist in the non-Ramsar sites. For instance, although Keta-Lagoon complex is the largest Ramsar site in Ghana, and was not involved in the study, there are also non-Ramsar sites such as Esiama Beach that are far larger than Laiwi and Mukwe lagoons and were also not involved in the study. Making useful deductions from these extrapolations is further strengthened by the fact that Sakumo Lagoon has been rated the third most important site for shorebirds on the coast of Ghana (Anku 2006), while peak waterbird counts at Densu Delta (35,000) were reported to be more than half the peak count of 55,000 at Keta Lagoon complex (Grimble et al. 1998).

The numbers of waterbird species that fall into the individual categories have conservation significance. The criteria used indicate that the attention a species deserves increases with the category number allocated. Although Category 1 indicates the rarity of species, the species involved receive little direct conservation attention because all are located on Ramsar sites, where they enjoy the benefits of management. Similarly, Category 2 birds, though represented on the non-Ramsar sites, can also be considered to require little direct conservation attention. The number of non-Ramsar sites needed to support the equivalent number of Category 2 species on the Ramsar sites is generally larger than exist on the coast. This means that the Category 2 species are well represented on the Ramsar sites and that their current populations would not be significantly affected with the nevertheless continuous destruction of unmanaged coastal wetlands on the coasts.

The need for conservation action begins to increase with Category 3 through to Category 6 but the later, fortunately, involves only one species. Of particular importance are the birds that fall into Categories 4 and 5, which collectively constitute 56% of species. Two-thirds or more of the total population of these species use unmanaged, non-Ramsar sites implying that only a third actually use the Ramsar sites. The total number of non-Ramsar wetlands needed to support the bird equivalence on the Ramsar sites for these two categories generally remains a small fraction of the total number of non-Ramsar sites on the coast. Thus the risk of wetland loss through pollution and resource misuse would be consequential for species in these two categories.

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