Walvis Bay, Namibia: a key wetland for waders and other coastal birds in southern Africa

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Between 1997 and 2005, the complex of wetlands at Walvis Bay, central Namibia, supported, on average, 156,000 waterbirds in summer (median of nine January surveys) and 82,000 waterbirds in winter (median of eight July surveys). This site thus supports the largest number of waders of any wetland in southern Africa. For 25 species (11 waders), maximum counts exceeded the 1% thresholds for the flyway populations; for 19 species the median counts exceeded this threshold. Eight wader species had median summer counts exceeding 1000 birds: Curlew Sandpiper (31,000), Sanderling (8,800), Little Stint (5,800), Chestnut-banded Plover (2,300, and a winter median of 5,500), White-fronted Plover (1,200 and 1,500 in winter), Pied Avocet (1,200 and 1,600 in winter), Ruddy Turnstone (1,100) and Grey Plover (1,100). Numbers of most species, with Red Knot as exception, were larger than during a survey made in 1977. The wetland is a Ramsar site and an Important Bird Area. Conservation issues include reduction of intertidal habitat, the juxtaposition with the town of Walvis Bay which is Namibia's main deep-water port, and siltation of the lagoon.

INTRODUCTION

Walvis Bay (22°59'S, 14°31'E) is a large embayment on the central Namibian coastline. It was declared a Ramsar Wetland of International Importance by Namibia in 1995. The timing of this was linked to the "Walvis Bay Enclave" being transferred from South Africa to Namibia in 1994.

The first comprehensive survey of the waterbirds at Walvis Bay was undertaken on 5 Jan 1977 (Underhill & Whitelaw 1977). Since that date Walvis Bay's significance for birds has regularly been highlighted in a series of reports and papers (e.g. Underhill & Whitelaw 1977, Whitelaw *et al*. 1978, Hockey & Bosman 1983, Williams 1987, 1988, 1997, Simmons 1997). It was identified as one of Namibia's Important Bird Areas (Simmons *et al*. 1998). In spite of being the focus of all this attention, the wetland has as yet no formal status as a protected area.

The open desert landscape and the presence of predators, mainly Black-backed Jackals *Canis mesomelas* and Kelp Gulls *Larus dominicanus*, combine to limit opportunities for ground-nesting birds to breed at Walvis Bay. This wetland therefore serves mainly as a dry-season and drought refuge for intra-African migrants and as a non-breeding area for Palearctic migrants. The objective of this paper is to document the magnitude of this role.

This paper evaluates the current status of the complex of wetlands at Walvis Bay in relation to their significance for waders (Charadrii) and other coastal birds, and is based on bi-annual surveys conducted between 1997 and 2005. A comparison is made with the 1977 survey, and the importance of Walvis Bay for waders is placed within the context of coastal wetlands in Angola, Namibia and South Africa.

STUDY AREA

The coastal and marine environments of Namibia, as relevant to this paper, are reviewed by Loutit (1991), Noli-Peard & Williams (1991), Sakko (1998), Mendelsohn *et al*. (2002) and Molley & Reinikainen (2003).

Walvis Bay is protected from the Atlantic Ocean by a narrow peninsula, terminating at Pelican Point, creating a large sheltered inlet. In its pristine state, this wetland complex would have consisted of a huge area of intertidal sand and mud. On the east side of the bay is the town of Walvis Bay, Namibia's only deep-water port. The town has 50,000 inhabitants.

Walvis Bay lies at the estuary of the Kuiseb River, a linear oasis which forms a sharp boundary between the Namib Sand Sea to the south and the gravel plain desert to the north (Huntley 1985). The source of the Kuiseb River lies in the Khomas Hochland near Windhoek, and the catchment area is 14,700 km^2. Between 1837 and 1963 this ephemeral river reached the sea 15 times (Stengel 1964), an average of once in eight years, and only twice in the subsequent 40 years (in 1997 and 2000, two exceptionally wet years in the Namibian interior (KW pers. obs)). Construction of many small dams in the upper river catchment has steadily reduced the flow and consequently the frequency with which the river reaches the sea. The water supply for the town of Walvis Bay is obtained from extraction wells in the aquifer below the bed of the Kuiseb River.

The distance across the bay from Pelican Point to the port of Walvis Bay is *c*.10 km; the total area of the Ramsar site is *c*.9,000 ha; this excludes the deep waters of the bay and the Pelican Point peninsula. The mean tidal range at the port of

Walvis Bay is 1.42 m at spring tide and 0.62 m at neap tide; at the equinoxes, the tidal range at spring tide increases to *c*.1.9 m. Intense upwelling cells south of Walvis Bay transport nutrient-rich water to the surface. As this water is warmed and oxygenated, phytoplankton and zooplankton utilize the nutrients; by the time the northward-flowing current brings this water to the Walvis Bay region, food availability to predators higher up the food chain is maximal (Simmons 1997). The tides thus flush the bay twice daily with food-rich seawater.

Table 1. Maxima and medians of midsummer (January) and midwinter (July) surveys of waders and other waterbirds at Walvis Bay, January 1997 to January 2005. The data for 1977 are from Underhill & Whitelaw (1977). All species with a positive median in summer or in winter are included. Cormorants were not included in the 1997 survey.

Species	Summer maximum	Summer median	Winter maximum	Winter median	5 January 1977
Little Grebe *Tachybaptus ruficollis*	20	0	6	1	0
Great Crested Grebe *Podiceps cristatus*	12	3	9	0	0
Black-necked Grebe *Podiceps nigricollis*	5,634	3,020	13,129	3,668	451
Great White Pelican *Pelecanus onocrotalus*	637	340	303	146	574
White-breasted Cormorant *Phalacrocorax carbo*	458	223	593	255	–
Cape Cormorant *Phalacrocorax capensis*	10,850	4,724	4,979	2,106	–
Grey Heron *Ardea cinerea*	64	38	105	50	24
Little Egret *Egretta garzetta*	97	55	190	128	7
Cattle Egret *Bubulcus ibis*	3	2	5	3	0
Greater Flamingo *Phoenicopterus ruber roseus*	28,515	13,112	43,679	31,602	7,192
Lesser Flamingo *Phoenicopterus minor*	28,256	6,045	43,420	23,636	9,600
Egyptian Goose *Alopochen aegyptiacus*	57	12	37	16	0
Cape Teal *Anas capensis*	1,813	452	1,175	610	0
Eurasian Oystercatcher *Haematopus ostralegus*	2	1	2	1	0
African Black Oystercatcher *Haematopus moquini*	169	128	184	122	87
Black-winged Stilt *Himantopus himantopus*	448	112	768	262	0
Pied Avocet *Recurvirostra avosetta*	2,708	1,174	4,102	1,562	716
Blacksmith Lapwing *Vanellus armatus*	12	0	22	10	0
Grey Plover *Pluvialis squatarola*	2,598	1,120	1,895	362	2,438
Ringed Plover *Charadrius hiaticula*	4,545	499	68	2	179
Kittlitz's Plover *Charadrius pecuarius*	24	6	19	4	0
Three-banded Plover *Charadrius tricollaris*	19	4	19	4	0
White-fronted Plover *Charadrius marginatus*	2,277	1,215	3,108	1,516	1,093
Chestnut-banded Plover *Charadrius pallidus*	8,428	2,284	7,172	5,543	1,909
Black-tailed Godwit *Limosa limosa*	2	1	0	0	0
Bar-tailed Godwit *Limosa lapponica*	1,970	648	349	144	598
Whimbrel *Numenius phaeopus*	72	27	25	7	1
Eurasian Curlew *Numenius arquata*	75	34	34	18	0
Marsh Sandpiper *Tringa stagnatilis*	44	19	10	2	0
Common Greenshank *Tringa nebularia*	421	177	108	36	30
Terek Sandpiper *Tringa cinerea*	7	1	2	0	0
Ruddy Turnstone *Arenaria interpres*	1,883	1,129	473	306	595
Red Knot *Calidris canutus*	844	61	214	10	1,074
Sanderling *Calidris alba*	15,169	8,847	841	372	8,280
Little Stint *Calidris minuta*	11,592	5,843	726	188	598
Curlew Sandpiper *Calidris ferruginea*	44,257	30,686	18,846	5,048	9,307
Ruff *Philomachus pugnax*	434	47	276	6	1
Red-necked Phalarope *Phalaropus lobatus*	56	4	9	2	0
Unidentified waders	55,543	3,370	3,328	401	2,450
Kelp Gull *Larus dominicanus*	4,318	2,124	5,053	1,555	88
Grey-headed Gull *Larus cirrocephalus*	33	6	38	10	0
Hartlaub's Gull *Larus hartlaubii*	2,020	613	776	336	210
Black Tern *Chlidonias niger*	61,015	280	27	0	2
White-winged Black Tern *Chlidonias leucopterus*	429	108	221	0	0
Caspian Tern *Sterna caspia*	95	57	116	32	30
Common Tern *Sterna hirundo*	93,617	56,304	5,324	226	188
Damara Tern *Sterna balaenarum*	598	202	37	10	25
Swift Tern *Sterna bergii*	811	471	420	200	107
Sandwich Tern *Sterna sandvicensis*	1,807	384	200	35	138
Unidentified terns	6,270	2,727	1,221	39	0
Overall [1]	**242,920**	**155,862**	**107,233**	**81,854**	
Totals of maxima and medians [2]	**401,313**	**148,739**	**163,677**	**80,592**	**47,998**
Number of species	**48**	**46**	**47**	**43**	**29**

[1] The overall maximum and median of the actual counts in summer and winter.
[2] The sum of the maximum and median counts of each species given in this table.

Fig. 1. Aerial photograph of Walvis Bay and environs from the south looking northwards (the distance between Pelican Point and Walvis Bay town is about 10 km). (Photo: Mark van Aardt, courtesy of Walvis Bay Salt Refiners.)

There are four main waterbird habitats within the Walvis Bay wetland complex: the sandy shoreline, intertidal mudflats, shallow sheltered water, and constructed saltpans (Fig. 1).

The western shore, ending at Pelican Point, is sandy and has been subject to little anthropogenic change, but is geomorphically dynamic. Longshore deposition of sediment along this section of coastline has resulted in this sandspit peninsula extending northwards by 17 m y^{-1} on average over the past 200 years (Hughes *et al*. 1992) and by 25 m y^{-1} since 2000 (KW pers. obs). The sea broke through the peninsula during gales in March 1997, and again in 2000. The inner (eastern) shore of the peninsula is currently a sandy beach six to seven km long, and the intertidal area has increased to a width of up to 800 m.

The Walvis Bay Lagoon, a sheltered inlet from the bay, is *c*.7 km long and *c*.300 m wide at the mouth (Fig. 1). The maximum depth of the lagoon at the mouth at low tide is *c*.2.5 m, but is gradually becoming less because the lagoon is silting up (see Discussion). The substrate of the central and southern sections of the lagoon consists of extremely fine muddy sediments.

The southern and eastern boundaries of the lagoon area have been radically modified by the development of saltpans and associated building of roads. The attractions of constructing saltpans at Walvis Bay are its position on the edge of the Namib Desert (average annual precipitation less than 15 mm and high evaporation rates) and the vast expanses of sheltered flat landscapes close to sea-level. Construction of the saltpans commenced in 1963, and the most recent expansion was in 2000; the total area is currently *c*.4,400 ha (KW pers. obs). Within the saltpans, there is no diurnal fluctuation in water levels. Fluctuations in water levels within a pan are relatively small; there is great variation in salinity between pans as the water is pumped from one evaporation pan to the next. The saltpans provide a qualitatively different habitat for waterbirds; most saltpans were constructed over sebka, a dry salty habitat with minimal avian value, consisting of areas flooded only at the highest equinox spring tides. However, some saltpans replaced mudflats so there has been a loss of intertidal area.

The eastern side of the bay, north of the lagoon, consists of the port and town of Walvis Bay (Fig. 1). The port and southern suburbs are constructed on reclaimed intertidal flats. The construction of the road along the eastern edge of the lagoon from the town to the saltpans during the early 1970s resulted in extensive loss of habitat previously inundated at every high tide, not only spring high tide.

METHODS

Waders and other coastal birds were counted in nine midsummer (January) and eight midwinter (July) surveys between January 1997 and January 2005. In each survey, the area was covered by eight experienced observers and about 25 assistants over two consecutive days. The resulting data form part of Namibia's biodiversity monitoring programme (Robertson *et al*. 2001), and are contributed to the Namibian submission to the African Waterbird Census of Wetlands International (e.g. Dodman & Diagana 2003).

RESULTS

Table 1 (which includes scientific names) gives maximum and median counts for 48 species in midsummer and midwinter which occurred on more than half the surveys, and therefore have a positive median, in at least one of the two seasons. Table 2 lists 15 vagrant and rare species which were recorded during the surveys, but for which both the midsummer and midwinter medians were zero.

The largest number of birds counted was 242,920, in Jan. 2004 (midsummer), and the medians of the midsummer and the midwinter counts were 155,862 and 81,854 respectively (Table 1). The most abundant wader was Curlew Sandpiper, for which the midsummer median count was 31,000, and the maximum count was 44,000 (Table 1). Seven other wader species had midsummer medians in excess of 1,000: Sanderling (8,800), Little Stint (5,800), Chestnut-banded Plover (2,300), White-fronted Plover (1,200), Pied Avocet (1,200), Ruddy Turnstone (1,100) and Grey Plover (1,100) (Table 1).

In midwinter, four wader species had median counts in excess of 1,000: Chestnut-banded Plover (5,500), Curlew Sandpiper (5,000), Pied Avocet (1,600) and White-fronted Plover (1,500).

Of the remaining waterbirds, five species had midsummer or midwinter medians in excess of 1,000 (Table 1). Common Terns were abundant in midsummer (maximum of 94,000 in midsummer 2005, and a median of 56,000). Both Greater and Lesser Flamingos were abundant in both midsummer and midwinter, with larger numbers in winter (maxima 44,000 and 43,000, medians 32,000 and 24,000, respectively). Black-necked Grebes had a maximum count of 13,000 in July 2004, midsummer and midwinter medians 3,000 and 3,700 respectively. Cape Cormorants were more abundant in midsummer (median 4,700) than in midwinter (median 2,100). An exceptional count of 61,000 Black Terns was made in January 2004.

DISCUSSION

Global significance of Walvis Bay

For 25 species, 11 of which are waders, counts over the study period were larger than 1% of the flyway population, as documented by Wetlands International (2002) (Table 3). For 19 species, including eight waders, the median counts exceeded the 1% threshold (Table 3).

The most impressive single entry in Table 3 shows that the median number of Chestnut-banded Plovers in winter represents half the estimated total population of the southern African subspecies. These plovers leave coastal wetlands to breed inland during the summer rainy season, mainly on ephemeral saline pans in Namibia and Botswana, with the Etosha Pan and the Makgadikgadi Pan probably key breeding sites (Tree 1997, Simmons 2000, Underhill 2000). They use Walvis Bay as a dry season refuge; sometimes the rains fail for several consecutive years, and Walvis Bay then becomes a drought refuge. Other species which breed inland and use Walvis Bay as a dry season and drought refuge are Greater Flamingo (winter median 42% of flyway population), Lesser Flamingo (32%), Black-necked Grebe (24%,) and Pied Avocet (8%). The cues used by these species to locate ephemeral wetlands when they hold water are discussed by Simmons *et al*. (1999).

Among the Palearctic migrant waders, Walvis Bay is particularly important for Curlew Sandpipers and Sanderlings (summer medians 9% and 7% of flyway populations respectively) (Table 3). For Curlew Sandpiper, even the winter median exceeds the 1% threshold. As at other major non-breeding wetlands for this species in southern Africa, most first-year birds do not migrate, providing evidence of the boom or bust breeding productivity of this species, which are driven by the Siberian lemming cycles (Underhill 1987b, Summers & Underhill 1987).

Table 2. Waterbird species recorded in six or fewer of the 17 biannual surveys at Walvis Bay, 1997–2005.

Species	No. of surveys	Maximum count	Date(s) of maximum count
Crowned Cormorant *Phalacrocorax coronatus*	2	5	January 2004
Black Heron *Egretta ardesiaca*	3	2	January 2000, July 2004, January 2005
Cape Shoveler *Anas smithii*	4	62	January 2004
Osprey *Pandion haliaetus*	3	1	January 1998, January 2000, January 2005
Mongolian Plover *Charadrius mongolus*	2	1	January 1998, January 2000
Caspian Plover *Charadrius asiaticus*	1	1	January 1998
Large Sandplover *Charadrius leschenaultii*	2	1	January & July 2000
Broad-billed Sandpiper *Limicola falcinellus*	1	1	January 2001
Common Sandpiper *Tringa hypoleucos*	6	19	January 1999
Common Redshank *Tringa totanus*	6	4	January 2002
Grey Phalarope *Phalaropus fulicarius*	1	4	January 2002
Wattled Plover *Vanellus senegallus*	1	1	July 1998
Franklin's Gull *Larus pipixcan*	2	3	January 2000
Black-headed Gull *Larus ridibundus*	2	1	July 1999, January 2000
Gull-billed Tern *Gelochelidon nilotica*	1	1	July 2004

Table 3. Waterbird species for which maximum and median numbers at Walvis Bay exceed 1% of the flyway population (the 1% thresholds) as defined in Wetlands International (2002). The percentages of the appropriate flyway populations are given. Values less than 1% are not shown.

Species	1% threshold	Summer maximum	Summer median	Winter maximum	Winter median
Black-necked Grebe	150	38%	20%	88%	24%
Great White Pelican	200	3.2%	1.8%	1.5%	
White-breasted Cormorant	120	3.8%	1.9%	4.9%	1.9%
Cape Cormorant	2,200	4.9%	2.1%	2.3%	
Greater Flamingo	750	38%	17%	58%	42%
Lesser Flamingo	600	47%	10%	72%	32%
Cape Teal	1,750	1.0%			
African Black Oystercatcher	55	3.1%	2.3%	3.3%	2.2%
Black-winged Stilt	230	1.9%		3.3%	1.1%
Pied Avocet	190	14%	6.2%	22%	8.2%
Grey Plover	2,500	1.0%			
Ringed Plover	1,900	2.4%			
White-fronted Plover	180	13%	6.8%	17%	8.4%
Chestnut-banded Plover	110	77%	21%	65%	50%
Ruddy Turnstone	1,000	1.9%	1.1%		
Sanderling	1,200	13%	7.4%		
Little Stint	10,000	1.2%			
Curlew Sandpiper	3,300	13%	9.3%	5.7%	1.5%
Kelp Gull	700	6.2%	3.0%	7.2%	2.2%
Hartlaub's Gull	300	6.7%	2.0%	2.6%	3.1%
Black Tern	4,000	15%			
Caspian Tern	15	6.3%	3.8%	7.7%	2.1%
Swift Tern	200	4.1%	1.6%	2.1%	1.0%
Sandwich Tern	1,700	1.1%			
Common Tern	6,400	15%	8.8%		

Walvis Bay lies north of the normal breeding range of the African Black Oystercatcher, which lies between southern Namibia and the Eastern Cape, South Africa. Nevertheless, 2–3% of the global population of the species is present here throughout the year (Table 3). These have been shown to be young birds, up to about three years old (Hockey *et al*. 2003). The Walvis Bay wetland is an important nursery area for the species; fledglings arrive within a few months of leaving the territories of their parents. They return to their natal areas at age two to three years. This is thought to be a strategy whereby conflict between adults and juveniles is reduced (Hockey *et al*. 2003).

Comparison with 1977 survey

The survey made on 5 Jan 1977 located many fewer waterbirds than were found during 1997–2005 (Table 1). It was undertaken as part of an expedition to the central Namibian coast by the Western Cape Wader Study Group, guided by Charles Clinning, the ornithologist in the Department of Nature Conservation of the then South West African Administration (Underhill & Whitelaw 1977, Whitelaw *et al*. 1978). The participants were experienced waterbird counters and there is no reason to believe that they underestimated the numbers. Cormorants were excluded from the 1977 survey.

The increases between the counts for most species in midsummer 1977 and the medians for midsummer 1997–2005 are substantial (Table 1). The total number of waterbirds increased from 48,000 in 1977 to 154,000, the sum of the medians for the period 1997–2005, a three-fold increase. Excluding Common Terns, which formed 36% of the sum of the medians for the study period, the number of waterbirds doubled. The total number of Palearctic migrant waders also doubled from about 26,000 in 1977 to 53,000, the sum of the medians for 1997–2005. For the Palearctic migrants, the key differences were increases in Curlew Sandpipers, from 9,300 in 1977 to a 31,000 median for 1997–2005 and in Little Stints, from 600 to 6,000.

There was a large decrease in Red Knots, from 1,100 to 61. Even within the nine-year study period, there was a strong decrease; with numbers dropping from 658 and 844 respectively in the first two years to only six and four in the last two years (KW unpubl. data). A similar pattern has occurred at Langebaan Lagoon in the Western Cape, where the midsummer median was 2,808 during 1975–1986, 838 during 1992–1997, and only 374 during 1998–2005 (Underhill 1987a, Taylor *et al*. 1999, Western Cape Wader Study Group unpubl. data).

Increases in the numbers of African-breeding species, such as Blacknecked Grebes, Greater and Lesser Flamingos, Cape Teal, Black-winged Stilt, Avocet and Chestnut-banded Plover, can, at least in part, be attributed to the creation of hypersaline habitats at saltpans. These saltpans probably enable larger numbers of these species to survive the bottlenecks caused by long periods of drought.

Comparison with numbers of waders at southern African wetlands

Tye (1987) identified likely sites for waders along the Atlantic Ocean coast of Africa by examining maritime charts. From Gabon southwards, he located only 13 sites, of which Walvis Bay was one. In the intervening years remarkably little data have become available for these wetlands, apart from those in Namibia and South Africa, with limited data for Angola in recent years (Table 4). The figures in Table 4 are based, as far as data are available, on surveys made sub-

Table 4. Numbers of waders in the austral midsummer at some of the larger coastal wetlands of Angola, Namibia and South Africa, and the Banc d'Arguin, Mauritania. The values are the sum of the maximum counts for each species in the reference(s), and have not been attained on a single survey. Most of the surveys were made subsequent to 1990.

Locality	Number of waders	References
Banc d'Arguin, Mauritania	2,350,000	Hagemeijer *et al*. 2004
Luanda Bay, Angola	"1,000s"	P.G. Ryan pers. comm.
Baia dos Tigros, Angola	2,050	A. Sakko, R.E. Simmons pers. comm., Dodman & Diagana 2003
Cunene River estuary, Angola/Namibia	5,197	Simmons *et al*. 1993, Anderson *et al*. 2001
Cape Cross Lagoons, Namibia	3,120	Williams 1991
Mile 4 Saltworks, Swakopmund	3,077	Underhill & Whitelaw 1977
Walvis Bay Lagoon, Namibia	153,599	Table 1
Sandwich Harbour, Namibia	120,000	R. Braby, R.E. Simmons pers.comm.
Lüderitz, Namibia	1,407	Hockey 1982
Orange River estuary, Namibia/Northern Cape, South Africa	4,183	CWAC unpubl. data, M.D. Anderson
Olifants River estuary, Western Cape (WC)	1,451	Taylor *et al*. 1999
Rocherpan, WC	2,281	Taylor *et al*. 1999
Berg River estuary, WC	11,614	Taylor *et al*. 1999
Langebaan Lagoon, WC	38,901	Taylor *et al*. 1999
Rietvlei, Cape Town, WC	6,130	Taylor *et al*. 1999
Strandfontein Sewage Works, Cape Town, WC	3,004	Taylor *et al*. 1999
De Hoop Vlei, WC	2,654	Taylor *et al*. 1999
Voëlvlei, Mossel Bay, WC	12,021	Taylor *et al*. 1999
Knysna Lagoon, WC	5,005	Taylor *et al*. 1999
Kabeljous River estuary, Eastern Cape	2,016	Taylor *et al*. 1999
Swartkops River estuary (including Chatty, Bar None and Redhouse Saltworks), Eastern Cape	14,730	Taylor *et al*. 1999
Durban Bayhead, KwaZulu-Natal (KZN)	1,323	Allan *et al*. 1999
Richards Bay (including Thulazihleka Pan), KZN	3,190	Taylor *et al*. 1999
Lake St Lucia, KZN	9,594	Taylor *et al*. 1999

sequent to 1990; these totals are, in general, smaller than estimates based on surveys made in the 1970s and 1980s (LGU unpubl. data). Walvis Bay is clearly the most important wetland for waders at the southern end of the East Atlantic Flyway.

Sandwich Harbour, 55 km to the south of Walvis Bay, is second in importance to Walvis Bay as a wader resort in southern Africa (Table 4). The third most important wetland for waders in southern Africa is Langebaan Lagoon, which has 25% of the numbers at Walvis Bay. To the north of Walvis Bay, the nearest estuary is that of the Kunene River, 700 km away on the border between Namibia and Angola; but this has only 125 ha of intertidal sand- and mudflats (Simmons *et al.* 1993, 1998, Anderson *et al*. 2001). The the Baie dos Tigros in southern Angola. Numbers of shorebirds at this wetland are unknown, but are thought to be in the tens of thousands (J. Paterson *in litt*.); the value in Table 4 was based on counts on the mainland shore only. Along this stretch of desert coastline, the only other significant wetlands north of Walvis Bay are saltpans near Swakopmund and saline lagoons near Cape Cross (Table 4). To the south of the Walvis Bay and Sandwich Harbour, wetlands of some significance for waders are Lüderitzbucht and the estuaries of the Orange and Berg Rivers (Table 4).

Walvis Bay holds only 6.5% of the number of waders estimated to occur at Banc d'Arguin, Mauritania, which is the most important wetland on the East Atlantic Flyway and supports up to 30% of the Flyway wader population (Hagemeijer *et al*. 2004). However, the densities at the two wetlands are comparable; 40 waders ha^{-1} at the Banc d'Arguin and 50 waders ha^{-1} at Walvis Bay (Simmons 1997, Hagemeijer *et al*. 2004). Both wetlands are adjacent to upwelling cells (Simmons 1997).

Conservation issues

Of all anthropogenic impacts, the reduction of intertidal habitat poses the main ongoing threat to the waterbirds at Walvis Bay. This has happened in three main ways: the construction of the saltpans over previously intertidal habitat; the construction of roads, and the reclamation of land for the port and suburbs of Walvis Bay.

Most of the area occupied by saltpans would be sebka, dry salt-encrusted sand. The pans provide permanent water of almost constant depth. However some of saltpans represent loss of intertidal habitat. The shallow evaporation ponds, with a salinity gradient from seawater to hypersaline, support large numbers of a suite of waterbirds, mainly African species which use them as non-breeding refuges (e.g. Black-necked Grebe, Great White Pelican, White-breasted Cormorant, Grey Heron, Little Egret, Greater and Lesser Flamingo, Cape Teal, Black-winged Stilt, Pied Avocet, White-fronted and Chestnut-banded Plover, Kelp and Hartlaub's Gull and Caspian Tern – almost all of which increased in numbers between 1977 and 1997–2005 (Table 1)). Given the flatness of the landscape (the town of Walvis Bay and the area bordering the lagoon lie less than 1 m above sea-level (Hughes *et al.* 1992)), further extensions to the saltpans could readily and economically continue to be constructed in areas which never or seldom get inundated at spring high tides. In this way, they would have no impact on intertidal areas, and would create additional waterbird habitat.

The road from the town of Walvis Bay to the saltpans runs along the eastern and southern sides of the lagoon. It reduced the area flooded at high tides. This loss was partially mitigated by the construction of culverts under this road; however, these have silted up and are no longer effective. They require maintenance.

Further wetland reclamation for suburbs and port development should cease, or at least balanced by the rehabilitation of equivalent areas of lost intertidal habitat. It is particularly critical that the narrow mouth of the lagoon should not be subjected to further reclamation, because this reduces the flush out of the lagoon.

Walvis Bay has a large fishing industry. In the past, the waste associated with fish processing was discharged into the bay; an incident in which thousands of Cape Cormorants were killed at Walvis as a result of pollution with fish oil was described by Berry (1976). Port operations at Walvis Bay potentially generate pollutants typical of this activity (petrochemicals and other toxic compounds, ore dust and heavy metals, cargo packaging materials, especially plastics and styrofoam, and galley waste). The juxtaposition of the port and fish factories and the bird-rich mudflats means that there is no margin of error in the event of a pollutant spill, especially if this occurs on an incoming tide (Sakko 1998, pp. 206–207). The Port Authority has an environmental committee, of which KH is a member, and pollution problems have diminished.

The ongoing necessity to dredge a channel to maintain Walvis Bay as a deep-water port causes a major disturbance to the substrate of the mouth of the lagoon (Hughes *et al*. 1992). The spoil has, at times, been deposited near the entrance to the lagoon. Suction dredgers are used, and since 1999 the spoil has been placed on barges and dumped offshore, 1 km west of Pelican Point; provided this practice is continued, this operation will not impact the waterbirds of the lagoon.

In the long-term, siltation poses the major long-term natural threat to the existence of the lagoon (Hughes *et al*. 1992; Ward 1997 and references therein). There are two sources of sediments. First, wind blown (aeolian) sand is carried by the prevailing southwesterly winds from the dunes of the adjoining Namib Sand Sea. The placement of saltpans along the southern and western shorelines of the lagoon, the directions from which the prevailing winds arrive, provides a 'trap' for a fraction of this wind-blown sand. Second, the prevailing winds generate an inshore current which transports two million m^3 of sediment northwards past Pelican Point annually. Of this, 50,000–200,000 $m^3\ y^{-1}$ is estimated to enter Walvis Bay.

Disturbance, including tourism and ecotourism, reduces the ability of birds to utilize the wetland fully. The disturbance caused by birdwatchers and other tourist activities (angling, yachting, canoeing, cetacean viewing, off-road vehicles, quad bikes, etc) can be reduced by the zoning of habitats and restricting the activities that can be undertaken in each zone. Birdwatcher disturbance can be reduced by the strategic construction of hides from which birds can be viewed at close quarters with minimal impact on their activities. Some forms of disturbance have no justification whatsoever; for example, regulations regarding height restrictions of overflying aircraft should be strictly enforced. Low flights over the lagoon to enable tourists to take photographs of flamingos put to flight represent an unacceptable use of this resource.

The vast numbers and diversity of waterbirds of Walvis Bay, in their spectacular desert setting, combine to provide a powerful tourist attraction. Well-managed, this represents a sustainable use for this wetland, and a source of employment for local communities.

Promulgation of the Walvis Bay wetland complex as a protected area is long overdue. The year 2005 represents the 10th anniversary of its declaration as a Ramsar wetland. It is also the seventh year since its recognition as one of BirdLife International's Important Bird Areas (Simmons *et al*. 1998), a status that indicates its global significance for bird conservation. Consideration should be given to extending the boundaries of the Ramsar site, at least to include the Pelican Point peninsula (Fig. 1).

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