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WADING BIRDS OF THE SANDWICH HARBOUR WETLANDS, FEBRUARY, 1991

PRELIMINARY ESTIMATES AND ALTERNATIVE COUNTING METHODS

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SUMMARY

This is a summary of methods and results of the first full bird count undertaken of the entire Sandwich Harbour wetlands encompassing the northern freshwater and lagoon-side wetlands, the southern mudflats and the western sand spit from 10 to 12 February 1991. The minimum number of wading birds (charadrids, terns, pelicans, flamingos) was an estimated 195 480, and no less than 47 species were seen. The average observer bias among six counters estimating roosting tern flocks was 16% and the most "experienced" counters gave the poorest estimates. Most participants under-counted. While random sampling methods must be used in future to be put any confidence in counts of such large areas, these counts provide some of the first density estimates for wading birds (up to 7065 birds/km²) in Namibia; densities greater than those previously reported from Africa or Europe. This, and significant numbers of Red Data species, provides a basis for designating Sandwich Harbour a Ramsar wetland of major international importance.

INTRODUCTION

This first count of all Sandwich Harbour's wetland birds in February 1991, employed experienced observers immediately after the Walvis Bay (South Africa) count. As a first attempt it was seen partly as an experiment to test new ways of counting (i.e. subsampling rather than total counts), and to get a minimum estimate of all wetland-associated birds of Sandwich Harbour. A previous count was published by Underhill & Whitelaw (1977) who were unaware of the extent of the southern flats and thus bird numbers before their visit. Consequently, they admitted that their ad hoc counting methods provided low abundance estimates. Likewise, Williams (unpublished data) undertook complete counts and arrived at much smaller totals than given here.

There are several ways in which counting widely dispersed birds may be tackled: (i) a **total count** can be attempted in those areas in which birds are concentrated (e.g. roosts); (ii) **subsample**

counts of known area can be extrapolated (cautiously) to the whole are; (iii) a **mark-resighting** program can be initiated or (iv) a **variable width count**, can be undertaken in which observers count all birds visible to them and record the distance at which they are seen (to compute the area). Here we used a combination of methods **(i)** and **(ii)**.

METHODS

Covering the entire Sandwich Harbour area (14°29'E 23°23'S), described in Berry & Berry (1975) from the northern wetlands to southern mudflats was dogged by several mechanical problems. I had originally planned to lay out a grid from north to south on the mudflats and ferry counters to the southern end such that one 7 - 10 km sample count moving northwards (over a known area) would have sufficed to estimate numbers. This was not possible because of a lack of three-wheel bikes and boats.

Instead, eight counters were asked to sample across the inundated mudflats in two separate sweeps (of 2.2 and 2.6 km) while walking 200 m apart (spanning a distance of 1 km) and counting all birds to the north. Other counters simultaneously undertook total counts of concentrated flocks on the western sand spit, while a pre-count of the mudflat/main lagoon interface was undertaken by three observers because large numbers of terns were seen there 24 hours before. The previous day all birds in the 4.7 km-long northern (freshwater) wetlands were counted by three observers, and the eastern lagoon-side wetlands/shoreline of about 8.6 km was also covered by three observers. Distances on the mudflats could only be paced (by RS), while distances on the lagoon-side areas and the northern wetlands were gauged using a vehicle odometer. Peter Tarr flew and (obliquely) photographed this rapidly changing area to give us some orientation,.

Here I use the term "mudflats" to distinguish the tidal-influenced area at the southern end of the lagoon which contrast with the pure sand areas not covered by tides. On digging into the mudflats to put in marker poles, a layer of dark organic material was evident in the sandy substrate. These mudflats cover about 20 km². On 1:50 000 maps this southern area is erroneously designated "salt flats".

In counting the mudflats it became apparent that while a 200 m separation between observers was necessary for identifying the smaller waders, this distance caused almost all birds to fly either over the line of observers or be swept (with the wind) around the last observer south. In the extrapolations computed here, I took only the (one) maximum count from whole team of five observers. For example, in the count of Curlew Sandpipers, counters recorded 257, 172, 938, 580 and 5460 birds in, or flying through, their respective blocks. I took the figure 5460 birds to compute the density estimates for the entire area and ignored all other figures.

To understand some of our counting and estimating biases more fully I asked six observers (comprised of experienced and inexperienced counters) to estimate the number of birds in a large flock of mainly Common Sterna hirundo and Arctic Terns S. paradisaea roosting about 200 m away, using either binoculars or telescope. The flock was photographed from the top of a nearby dune, and later counted from slides by projecting and marking each bird on a white screen and counting the absolute total.

RESULTS

Totals and species richness

The total count of the larger wetland species throughout the Sandwich Harbour wetlands, produced a figure of over 195 000 birds (Table 1). Just seven species comprised over 94% of this total: Greater Phoenicopterus ruber (14 536) and Lesser (15 667) Flamingos P. minor, Sanderlings Calidris alba (16 946), Little Stints C. minuta (34 667), Common/Arctic Terns (51 009) and Curlew Sandpipers Calidris ferruginea (51 709). The relative proportions of this total in each area is illuminating since it shows that the southern mudflats are by far the most important area in terms of bird abundance (holding 73%), followed by the western sandspit and dry mudflats (24%), northern (freshwater) wetlands (2%) and the lagoon-side wetlands (1%). While we had no chance to cover the southern most areas (our counts were 2-3 km and then 3-4 km from the lagoon), Hu Berry biked around the northern most limit of the flats and reported very large numbers of waders there, as dense as those areas we sampled.

Such a break down, however, de-emphasises the importance of species richness in each region. For example, the northern wetlands with the lowest abundance had the highest richness (79% of all species recorded), while the southern mudflats, with the highest abundance, held only 62% of all species recorded. Thus each wetland is important in its own right either because of total numbers of birds, or because of the species richness it supports.

Excluding several vagrants not necessarily associated with wetlands, species richness was 47 (Table 1). Inclusive of all vagrants and passerines, (Cape Wagtails Motacilla capensis, Yellow Wagtails M. flava, African Marsh Warblers Acrocephalus baeticatus, Cape Cormorants Phalacrocorax capensis and a Peregrine Falcon Falco peregrinus) species richness rose to 52.

Red data species

Of significance to this area's possible designation as a Ramsar wetland of international importance is the total number of Red data species present in the area. Table 2 shows that Great Crested Grebes, Greater and Lesser Flamingos, Chestnutbanded Plovers, Damara and Caspian Terns, Greyheaded Gulls and White

TABLE 1: Numbers of wetland birds, hours spent observing and area covered in various regions of Sandwich Bay; 11 - 12 February 1991.

Date	Observer hours	Wetland counted	Distance or km^2 covered	Number of species	Abundance
11.Feb	3.3 h	OASIS + LAGOON-SIDE WETLANDS	~8.6 km	9 29	300 1769
11.Feb	3.75 h	NORTHERN (freshwater) WETLANDS	~4.7 km	37	4172
12.Feb	2 h	MUDFLAT/LAGOON INTERFACE	2 km	17	1756
12.Feb	6 h	WESTERN SANDSPIT + SANDFLATS	~ 15 km	24 14	14255 31928
12.Feb	1.08 h	(subsample: low tide) MUDFLATS	2.2 km^2	22	(subsample)* 15,543 [141,300]
12.Feb	0.83 h	(subsample: high tide) MUDFLATS	2.6 km^2	24	(subsample)* 3,105 [23,884]
Totals	17 h	SANDWICH WETLANDS		47	195,480

*Extrapolated to the entire area (20 km^2), the mudflats held a maximum of about 141,300 wading birds, and a minumum of 23,885 waders. The first figure is more accurate since the density of birds for the high tide count was low due to excessive flooding of feeding areas.

TABLE 2: Population estimates of all Red Data-listed species present at Sandwich Harbour, February 1991.

Species	Areas in which observed*	Abundance
Podiceps cristatus (Great crested Grebe)	NFW	2
Sterna balaenarum (Damara Tern)	NFW, ELW SMF, WSS	117
Hydroprogne caspia (Caspian Tern)	NFW, ELW SMF, WSS	93
Phoenicopterus ruber (Greater Flamingo)	NFW, ELW SMF, WSS	14,536
Phoenicopterus minor (Lesser Flamingo)	NFW, ELW SMF, WSS	15,667
Charadrius pallidus (Chestnut banded Plover)	SMF	1,109
Pelecanus onocrotalus (Great White Pelican)	NFW, ELW SMF, WSS	215
Larus novaehollandiae (Grey headed Gull)	ELW, WSS	3

* Northern freshwater wetlands = NFW
Eastern lagoon-side wetlands = ELW
Southern mudflats = SMF
Western sandspit = WSS

Pelicans (species binomials in Table 2), were represented, varying from very large to very small numbers. Worthy of note was the number of Chestnutbanded Plovers (1109) recorded on the mudflats. Other interesting records were six European Oystercatchers Haematopus ostralegus seen on the lagoon-side counts (4) and in the northern wetlands (2).

Wader density estimates

The two transects of known area give some of the first density estimates available for wading birds in Namibia. Our two transects of 2.2 and 2.6 km² showed that the minimum number of birds present during low, but rising tide conditions, was 7065 individuals/km², all of which were feeding (i.e. no roosts). On the high tide, when most mud had been inundated to a depth of about 10 cm, the density dropped to 1230 individuals/km². These counts are considerably higher than others reported from central and southern Africa and Europe (reviewed in Spearpoint et al. 1988, Zwarts et al. 1990).

The bulk of this population (expressed as birds/km²) comprised: Curlew Sandpipers (2482 - 483 birds/km²); Little Stints (1732 - 67); Sanderlings (805 - 345); Greater Flamingos (677 - 223); Lesser Flamingos (745 - 27) and Common/Arctic Terns (231 - 1).

Observer biases

Six observers differed widely in their estimates of a roosting flock of 2069 Common and Arctic Terns: the average error was 16% from the known total, varying from 28% for some of the most experienced counters to 3% for some of the least experienced (Table 3)! All observers other than RS under-counted. If these biases are true estimates of our counting biases (particularly for the large tern flocks on the western sandspit) then terns numbers would rise from 51 009 to over 59 000 birds.

Breeding and "freshwater" birds

While Sandwich Harbour held huge numbers of birds, very few breeding birds were found. At least four Little Egret Egretta garzetta nests with feathered chicks were present in the Phragmites reeds surrounding the semi-freshwater wetland known as the Oasis, south of the Eagle wreck. One or two Grey Heron Ardea cinerea nests were active in the palms, 500 m south of the Nature Conservation hut, while one immature Black-crowned Night Heron Nycticorax nycticorax was seen at the first pool in the northern wetlands. As noted by Berry & Berry (1975), the Red-knobbed Coot Fulica cristata has continued to decline: their 1972 count revealed 65 birds (down from 570 in 1970), while this 1991 count revealed just 11 birds. Undoubtably, the narrowing of the

northern wetlands from about 1 km in the early 1970s to less than 300 m in the early 1990s has contributed to the decrease in freshwater birds in this region. This decrease is highlighted in all comparisons shown in Table 4 for "freshwater" birds. The only species apparently gained in the twenty-year interval between counts is the Black-crowned Night Heron, which was reported as vagrant by Berry & Berry (1975).

TABLE 3 : Counting biases of six observers estimating the flock size of roosting Common and Arctic Terns. The correct figure was calculated from photographs taken simultaneously. Observers Williams to Curtis counted all terns, whereas RS counted a sub-section of 1002 terns.

Observer	Estimate	Aid	% Error from known total
Williams	1710	Telescope	- 17%
Ward	1500	Telescope	- 28%
Malan	1500	Telescope	- 28%
Wearne	2000	Binoculars	- 3%
Curtis	2000	Binoculars	- 3%
[Simmons	1190	Binoculars	+ 16%]
PHOTOGRAPH	2069 ± 20	500 mm lens	$\bar{x}$ = 16%

Table 4: Decreases in freshwater-associated wetland birds of Sandwich Harbour in the twenty-year period between 1970-1972 (Berry & Berry 1975) and 1991 (this count). Species not listed here which otherwise fall into the "freshwater" category were not seen in 1991.

Species	1970-72	1991
Great crested Grebe	4 - 40	2
Dabchick (*Podiceps ruficollis*)	14*	5
Black crowned Night Heron	2	11
Grey Heron	30 - 50	37
Little Egret	103	15
Egyptian Goose (*Alopochen aegyptiacus*)	10 - 30	3
South African Shellduck (*Tadorna cana*)	>5	4
Cape Shovellor (*Anas smithii*)	30 - 40	6
Cape Teal (*Anas capensis*)	300 - 500	265
Maccoa Duck (*Oxyura punctata*)	80	22
Purple Gallinule (*Porphyrio porphyrio*)	6	1

* Where a single figure is given this is the maximum seen in 1970-1972.

DISCUSSION

Abundance comparisons and sources of error

In comparison with previous attempts to (total) count Sandwich Bay's wetland birds the figures reported here are very high. Underhill & Whitelaw (1977), for example, estimated a total wader and non-wader population of 52 481 birds, in December-January, although they admitted their total was conservative because they had not extrapolated the southern mudflats count to the total area. Neither did they count the western sandspit, a region that yielded almost one quarter of all birds counted in this census (Table 1).

Extrapolation from subsampling (as opposed to truly random sampling) is always fraught with unknowns. Potential biases include the effect of tides (and feeding behaviour of waders) and counting errors among observers (Table 3). Nevertheless, both can be controlled by careful planning. The largest errors are likely to be the extrapolations from subsamples which may not be representative of the entire area. However, I have two reasons to believe that birds were at least as dense in other blocks on the southern mudflats. Firstly, while counting, the southernmost observer noted as many, or more, birds in the sector south of him as were counted within the sampled sector. Secondly, Hu Berry reported, on traversing the southern limit of the tidal reach by bike, that huge numbers of waders were present, and estimated some 50 000 birds. These factors, and the finding that experienced observers generally under-count (Table 3), suggest that our counts are in the correct order of magnitude, and certainly higher than the tens of thousands estimated by Underhill & Whitelaw (1977).

Are these high abundance figures representative of the region, or are they due to an excess influx of waders at this time of year? According to the finding of Spearpoint et al. (1988) numbers of southern African shorebirds, particularly palaearctic migrants in summer (December through February) are very stable with little movement between summering areas. Tony Williams's (personal communication) experience with Walvis Bay bird numbers supports this supposition.

Density estimates

The usual method of counting shorebirds is that of counting birds per kilometre (Underhill & Whitelaw 1977, Ryan et al. 1984, Tarr & Tarr 1987). While these are useful indices among linearly-aligned species, these and total counts are known to give poor comparative results (Spearpoint et al. 1988), thus density estimates are preferable for long term assessments of trends.

My wetland bird density estimates, for which the methods were less prone to error, also point to the conclusion that Sandwich Harbour is indeed an exceptional area, holding densities of wetland species almost four times higher than previous counts anywhere in southern Africa. For example, Spearpoint et al. (1988), with some of the most comprehensive counts available for southern Africa, reported densities of 1570 birds/km² for the Port Elizabeth area, 1470 birds/km² (Langebaan Lagoon, south western Cape), and 1290 birds/km² for the Swartskop river Estuary (Port Elizabeth). Sandwich Bay density counts, by contrast, varied from 7065 to 1230 birds/km². Some species differences were apparent in the densities of Curlew Sandpipers (2482 birds/km² at Sandwich versus 133 birds/km² at Cape Recife) and Little Stints (1732 versus 146). However, Turnstones (78 versus 433) and Sanderling (805 versus 433) density estimates were more compatible between the two areas. Since density estimates cited by Spearpoint et al. (1988) and Zwarts (1988) were all considerably lower than this, Sandwich Bay may be among the most productive shorebird regions in the world.

In sheer numbers, however, Sandwich Harbour's wetlands pale into insignificance relative to the two million waders present on the tidal flats of the Banc D'Arguin, in coastal Mauritania (Zwarts & Piersma 1990) - a system fed by the cold water Canary current. Possible reasons for the Sandwich Bay productivity, such as the Benguela upwelling providing a rich nutrient soup for a large invertebrate fauna, is under investigated by Barbara Curtis, Curator of aquatic invertebrates at the State Museum of Namibia.

Future counts

More than anything, this census taught us a great deal about the problems of sampling birds which are spread over vast featureless mudflats. One lesson was that bird densities must be sampled throughout the mudflat area and preferably on a random basis. The next count will, therefore, be one based on 200 m x 200 m randomly chosen blocks which will be pre-planned and censused without disturbing feeding birds. Such a grid, with about 20 blocks to sample should take two observers no longer than 3 hours to count, and numbers can be compared to allow for observer errors. Afterwards, two observers can census the western sandspit, preferably by three-wheeler bikes. I expect that such counts will verify that Sandwich Harbour wetlands hold over 100 000 wetland birds. If so, its significance as southern Africa's most important coastal wetland will be confirmed.

ACKNOWLEDGEMENTS

I am most grateful to each observer who helped with this census-cum-experimental feasibility study. Particular thanks go to Keith and Gail Wearne who cheerfully ferried counters too and fro, to Hu Berry for providing a sandworthy bike and Francois Malan for his

mechanical expertise when even that bike thought better of the ordeal. Peter Tarr kindly photographed the area, using aviation fuel kindly donated by Shell Namibia. For the counters Chris Brown, Barbara Curtis, Francois & Linda Malan, Kevin Roberts, Roger Swart, David Ward, Jane Waterman and Tony Williams I am grateful for their staying power and patience under some trying times. I hope their reward, like mine, was a chance to walk among 100 000 waders and flamingos in this vast wetland arena.

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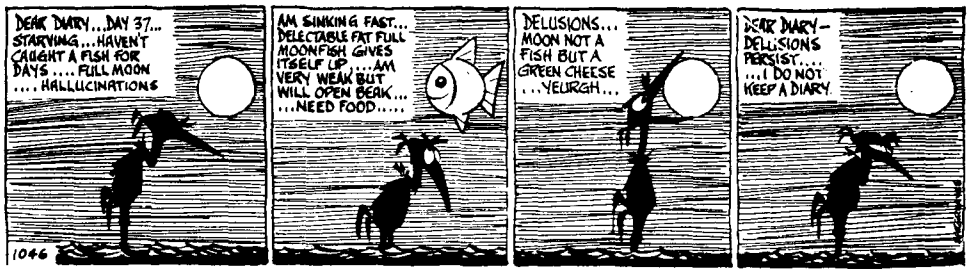

ADDENDUM

In July of the same year, I revisited the mudflats with a small team comprising David Ward, Mareck Hyrwniack and Gerd Rossler. Our aim was to lay out a grid as described above and accurately guage the size of the mudflats. We were considerably aided by some first-world technology in the form of a device known as a Global Positioning System (GPS). This little black box attached to an aerial resembling a bicycle pump is capable of determining ones position anywhere on the earth's surface to **within 10 metres.** This allowed us to accurately guage distances, lay out a complete 200 x 200 m grid and determine that the tidal portion of the mudflats is about 16 km^2 and not 20 km^2 as estimated in February. Moreover, we found that the distances paced in February underestimated the areas surveyed for birds (2.2 and 2.6 km^2) by about 5%.

Therefore, the new estimates for the February bird densities on the southern flats is 7 791 birds/km^2 (low tide) up from 7 065, and 1 361 birds/km^2 (high tide) up from 1 230.

Extrapolating to the entire tidal-influenced mudflats (now 16 km^2, not 20 km^2) the new totals give a grand total of **178 836 birds.** These totals are thus 16 644 birds down from the totals above.

On this second visit in July (as part of the IWRB count) we found impressive numbers of Chestnut banded Plovers (2 394) and "commic" terns (2 080), about 9 500 Flamingos and a few (11) over-wintering Damara Terns. Breeding by Grey Herons and Little Egrets was in full swing with about 18 and 10 active nests respectively.

The most astonishing finding was that a new, completely enclosed lagoon has formed outside the conservation hut, allowing (southerly) access to the hut without touching water. Moreover, half the fence at the northern end of the freshwater section had been washed away as the sea has cut into the beach some 60 m. The system is both dynamic and complex - and may require a helicopter for our next survey.

Special thanks is due to Mareck for skillfully manouvering us through some large Atlantic swells, to Gerd for providing the means to find our plots with his GPS and particularly to Dave for making the plot marking so easy.

Rob Simmons (27.7.91)