

Waterbird populations at the Orange River mouth from 1980–2001: a re-assessment of its Ramsar status

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The Orange River mouth (ORM), at the end of the longest river in South Africa, is one of few perennial wetlands on the arid south-west African coast. The ORM supports a large number of waterbirds, with a maximum of 20 653–26 653 individuals of 57 species being recorded in December 1985. Because of its importance for waterbirds, the ORM is recognised as a Ramsar site and an Important Bird Area. Since being designated a Ramsar site in 1991, however, the number of waterbirds has decreased (by c. 74% since the first two surveys in 1980 and 1985). During 13 surveys conducted from December 1995 to August 2001 an average of 6 873 ($\pm 1 719$ SD; $n = 6$) and 5547 ($\pm 2 039$ SD; $n = 7$) individuals were recorded during summer and winter, respectively. This decrease, in conjunction with the degradation of the c. 300ha saltmarsh resulted in the ORM being placed on the Ramsar Convention's Montreux Record in 1995. The decrease in the number of waterbirds at the ORM is mainly attributable to the absence of large numbers of Cape Cormorants (*Phalacrocorax carbo*) and non-breeding Common Terns (*Sterna hirundo*), with no breeding of the former being recorded on islands in the mouth area after 1993. The decrease in numbers of these two species may be attributed to both on- and off-site factors. During a re-evaluation of the revised Ramsar criteria, we found that the site still meets three of the four Ramsar criteria under which it was originally designated in 1991 and five of the eight new criteria. The establishment of a transboundary statutory protected area will allow for the implementation of conservation-directed management measures. We propose various management recommendations to improve the conservation of wetland birds at the ORM.

Introduction

The Orange River mouth (ORM) is the end point of one of southern Africa's largest and most important rivers. Draining into the Atlantic Ocean, the Orange River (and the mouth) is the international boundary between Namibia and South Africa and one of few perennial wetlands on the arid western coastline of southern Africa (Noli-Pearce and Williams 1991). The ORM has a variety of wetland habitats and supports a high diversity of waterbirds (Grindley 1959, Ryan and Cooper 1985, Williams 1986). It is the sixth most important southern African coastal wetland in terms of the number and diversity of birds supported (Cooper and Hockey 1981, Williams 1986, Turpie 1995, Barnes and Anderson 1998, Simmons *et al.* 1998) and consequently was designated by South Africa in 1991 (and Namibia in 1995) to the List of Wetlands of International Importance under the Ramsar Convention (see Williams 1990). The ORM met several of the standard Ramsar criteria required for designation (Williams 1990): (1) it is an example of a rare and unusual wetland type on the arid and semi-arid coastline of western southern Africa (Noli-Pearce and Williams 1991); (2) it supports an appreciable assemblage of rare and endangered bird species, 14 of which are listed in the previous South African (Brooke 1984) or draft Namibian list (Simmons *et al.* in prep). (3) at times it supports more than 20 000 waterbirds

(of 50–57 species); and (4) the ORM regularly supports (a) more than 1% of the world population of three species of waterbirds that are endemic to southern Africa (Clancey 1986), namely the Cape Cormorant (*Phalacrocorax capensis*), Hartlaub's Gull (*Larus hartlaubii*) and Damara Tern, (*Sterna balaenarum*), and (b) more than 1% of the southern African populations of six species of waterbirds, namely the Black-necked Grebe (*Podiceps nigricollis*), Lesser Flamingo (*Phoenicopterus minor*), Chestnut-banded Plover (*Charadrius pallidus*), Curlew Sandpiper (*Caladris ferruginea*), Swift Tern (*Sterna bergii*) and Caspian Tern (*Hydropogone caspia*).

During the past 3–4 decades the ORM has been subjected to significant negative anthropogenic influences, which appear to have influenced the number and diversity of waterbirds using this wetland. As a result of this decline in bird numbers, combined with the final collapse of the salt marsh component of the wetland, South Africa requested the listing of the ORM on the Montreux Record of the Ramsar Convention in 1995 (Cowan and Marneweck 1996). The Montreux Record is a register of Ramsar sites where changes in ecological character have occurred as a result of human interference, and is intended to prioritise sites for positive national and international conservation attention.

The purpose of this paper is to collate all existing water-

bird survey information (1980–2001) and provide an analysis of population trends at this wetland. Using this information, the current status of waterbird populations is re-evaluated, population trends determined, Ramsar status reviewed, and management recommendations made that will assist the long-term conservation of the ORM's waterbirds.

Study area

The Orange River is the largest and longest river in South Africa, carrying more than 20% of the total river flow in the country. The catchment of the Orange includes the whole of Lesotho and the basins of several other large rivers, including the Vaal and Fish. A large portion of the catchment (c. 600 000km²) is located inside South Africa, representing almost 47% of the country's surface area (Crowther 1988, Bremner *et al.* 1990).

The Orange River drains into the Atlantic Ocean approximately 1 335km downstream of the nearest major impoundment, Vanderkloof Dam, and 1 155km downstream of the confluence of the Orange and Vaal rivers. The ORM is situated between the mining towns of Alexander Bay (South Africa) and Oranjemund (Namibia).

Characterised by extensive, shallow and turbid waters and mudbanks, the ORM provides important habitat for waterbirds, and constitutes one of few perennial wetlands on the arid and semi-arid Atlantic coastline of the southern African subcontinent (Noli-Pearce and Williams 1991).

For the purpose of this paper, and to maintain consistency with earlier studies; e.g. Ryan and Cooper (1985) and Williams (1986), the ORM is considered to be the area between the northern and southern flood margins of the Orange River from the Sir Ernest Oppenheimer Bridge, c. 10km upstream, down to the sea (Figure 1). This covers an area of approximately 18km². The ORM is not a true estuary, as it is dominated by freshwater and has few estuarine characteristics: it is best defined as a delta-type river mouth (Day 1981). It consists of a channel system between sandbanks covered with pioneer vegetation, a tidal basin, a large *Sarcocornia* saltmarsh on the southern bank of the river mouth, the river mouth (usually only about 50m wide), and several other smaller and mainly artificial wetlands (oxidation ponds, yacht club pan).

The wetland vegetation types recognised include the island communities, which are dominated by *Scirpus littoralis*, *Phragmites australis* and *Sporobolus virginicus*, the peripheral marshland, dominated by *Sarcocornia pillansiae* and *Sporobolus virginicus*; and the *Lycium* sp. floodplain vegetation. These various wetland habitats, together with the sizeable area of sheltered shallow water and extensive mud-flats, support large numbers of various guilds of waterbirds (e.g. Grindley 1959, Ryan and Cooper 1985, Williams 1986).

The ORM has been subjected to significant human influences for at least the past 40 years, which has resulted in some of the habitats becoming severely degraded. This has almost certainly impacted on the number and diversity of waterbirds utilising the wetland. For an understanding of these impacts, some knowledge about the hydrological processes at the ORM is necessary. The state of the mouth

— either open or closed — is determined by the balance between factors that tend to block it up (sediment transport by the river and longshore currents) and factors that flush it open (outward flow of river water and the inward flow of seawater during high tides). Under natural conditions, the blocking factors would dominate when river flow is weak and the mouth would close. Water then backs up flooding the low-lying areas, particularly the saltmarsh on the southern bank. This build up continues until the sandspit is breached and a new mouth forms and the water level drops.

Prior to construction of major impoundments on the Orange River during the late 1960s and early 1970s, the Orange River displayed a distinct seasonal flow pattern characterised by high flow during the summer months and low-flow periods during winter. Regulation of the river by the Gariiep and Vanderkloof dams, in order to generate hydro-electric power and satisfy downstream demands for irrigation, has resulted in lower summer and higher winter flows. The elevated winter flow has generally been sufficient to ensure that the factors causing the mouth to close have

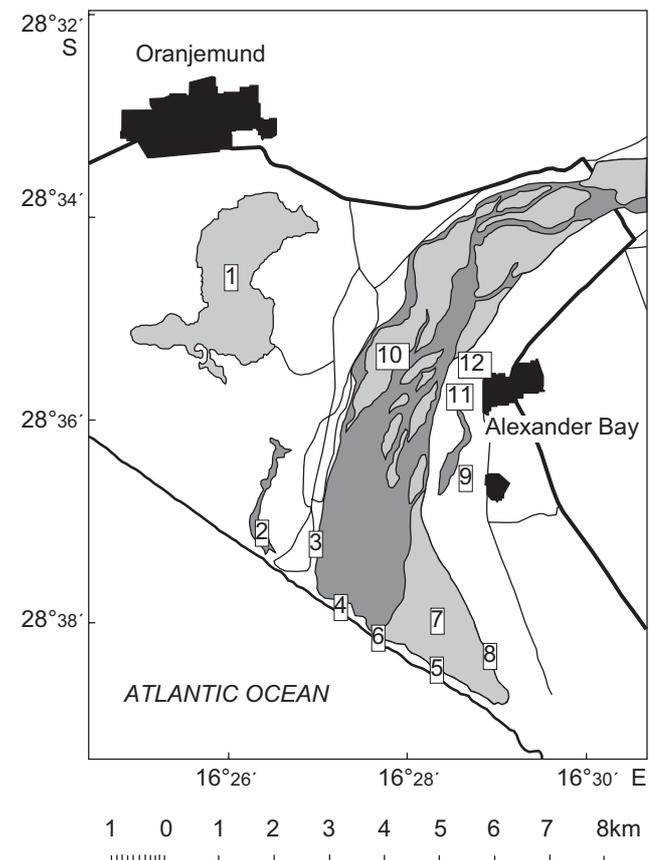


Figure 1: The Orange River mouth indicating the different areas that were surveyed during the bi-annual censuses (1 = Pink Pan, 2 = Yacht Club, 3 = Northern Bank, 4 = Namibian Beach, 5 = South African beach, 6 = Shallow wetlands at mouth, 7 = Saltmarsh, 8 = Freshwater wetlands, 9 = Oxidation ponds, 10 = River channels and islands, 11 = Lucerne fields, 12 = Lucerne fields pan)

been dominated by those keeping it open. The result is that the dynamics of the mouth are now largely artificially controlled, and closure of the mouth seldom occurs.

At times, when the mouth has closed, the sandspit has been artificially breached by the Alexkor and Namdeb mining companies, but as the mouth has remained open for at least the past eight years, this has not recently been necessary. With the growth of Oranjemund and Alexander Bay, agricultural lands were established within the flood plain of the river. On the southern bank a levee was built to protect these lands against flooding and a road embankment was built to provide access to the beach. This resulted in the effective isolation of wetland areas on the landward side of these obstructions from any surface flow in the mouth during minor flood events and tidal cycles. The saltmarsh has subsequently become severely degraded (Heath 2001). In order to rehabilitate the saltmarsh it will be necessary to open some of the original flood channels, annually flood the marsh in a controlled way, take steps to minimise the mine dump dust that blankets the vegetation, and possibly re-vegetate the marsh with suitable halophytic plants.

In summary, the Orange/Vaal river system is a highly disturbed ecological system, mainly because of extensive regulation and water abstraction, although occasional flooding still occurs (Swart *et al.* 1988). Floods may play an important role in changing the morphology of the ORM and establishing bird roosting and breeding islands. With increased demand for water from this system for human consumption, industrial and agricultural purposes, the ORM will however be placed under increasing stress (ORETG 1989, Noli-Peard and Williams 1991).

Methods

In this paper we present the results of all bird surveys, both published and unpublished, that have been conducted at the ORM from January 1980 to February 2001 (as well as anecdotal observations gleaned from the literature).

Since January 1994, biannual waterbird surveys of the South African and Namibian Ramsar sites have been conducted by the Namibian and Northern Cape Province of South Africa's conservation authorities. These mid-summer (late-January), late-summer (April) and mid-winter (mid- to late-July) surveys were conducted by several observers (usually 3–6 people) using X6–X10 binoculars and spotting scopes. The counts were made on foot, by motor vehicle and with the aid of an inflatable motorboat. To eliminate double-counting, the different areas were counted simultaneously during a 7–10 hour period. Counts were usually conducted from about 08h00, after the fog had lifted, until mid- to late-afternoon (between 15h00–18h00). General weather variables (temperature, wind and fog) which could influence bird abundance and distribution were recorded during each survey.

For the latter surveys (December 1995–February 2001), to determine the distribution of birds throughout the count area, the wetland was divided into nine sections, with each being counted separately (Figure 1). On the South African side these included the beach (southern side of mouth) and shallow wetlands at the mouth, the salt marsh and pan, the oxidation ponds, the 'lucerne fields pan', and the irrigated lucerne fields. On the Namibian side of the ORM, four different wetland areas were counted, namely the yacht club (salt pan), the pink pan, the beach (northern side of mouth) and the northern bank of the river. Using an inflatable motorboat,

Table 1: Number of waterbirds and waterbird species recorded at the Orange River mouth during the 20 surveys conducted between January 1980 and February 2001

Survey no.	Date of Survey	No. of Waterbirds	No. of species	Source
1	January 1980	21 512	51	Ryan and Cooper (1995)
2	December 1985	23 653	56	Williams (1986)
3	April 1986	7 562	49	Williams (1986)
4	December 1993	15 069	50	Williams (undated)
5	January 1994	15 281	46	Simmons (1994)*
6	April 1994	1 509	41	Simmons (1995)*
7	January 1995	7 538	43	Simmons (1995)*
8	December 1995	9 164	64	Underhill and Cooper (unpubl. data)
9	April 1996	6 475	56	This study
10	February 1997	4 843	55	This study
11	July 1997	5 190	52	This study
12	February 1998	5 809	56	This study
13	April 1998	2 510	51	This study
14	July 1998	4 539	52	This study
15	January 1999	7 139	60	This study
16	July 1999	5 244	50	This study
17	January 2000	5 717	52	This study
18	July 2000	9 240	51	This study
19	February 2001	8 566	56	This study
20	August 2001	5 632	48	This study

* During these three waterbird surveys only the Namibian portion of the ORM was counted, thus accounting for the lower number of birds, especially during the April 1994 survey

the river channels and islands between the bridge and the mouth were also surveyed. The counts underestimate the numbers of some species, mainly because of the inaccessibility of large areas of reedbeds on the southern bank and the difficulty in gaining access to some of the shallow river channels by boat.

Twelve surveys were conducted from April 1996 to August 2001 (Table 1). The results of these surveys were compared with the only counts conducted prior to 1993 (Ryan and Cooper 1985, Williams 1986, AJ Williams undated) as well as some published anecdotal accounts. The data from four additional surveys (AJ Williams unpublished data, Simmons 1994, 1995), prior to the initiation of our bi-annual monitoring programme, are also presented in this paper. A few other surveys conducted during the 1990s by the Ministry of Environment and Tourism, Namibia, have not been included in this paper. These surveys were not comprehensive, with mainly the Namibian side of the ORM being counted, and the number of individuals and species recorded was therefore low.

In order to determine whether more than 1% of the southern African and global populations of waterbirds occur at the ORM, we have used the maximum number of individuals of each species recorded since December 1995 (i.e. last 13 surveys). Although the Ramsar criterion 6 (Ramsar Convention Bureau 1999) states that a wetland should be considered internationally important if it *regularly* supports 1% of the population, our justification for using the maximum number of individuals is as follows: (1) only two surveys were conducted per annum and these may not have detected the population maxima for the different species, (2) in the arid western parts of southern Africa the availability of water in the ephemeral wetlands would influence the numbers of birds recorded at the ORM, and (3) our survey estimates are probably underestimates of the total populations of the different species.

Results

Numbers of waterbirds

The number of waterbirds recorded at the ORM has varied considerably since 1980 when the first comprehensive survey was conducted (Ryan and Cooper 1985) (Figure 2; Table 2). The highest number of waterbirds was recorded during the first survey, January 1980 (21 512 waterbirds; Ryan and Cooper 1985), and second survey, December 1985 (20 563–26 653 waterbirds; Williams 1986). Subsequent surveys, beginning seven years later, never recorded such high numbers. From December 1995 to August 2001 an average of 6 873 (± 1719 SD; $n = 6$) and 5 547 ($\pm 2 039$ SD; $n = 7$) waterbirds was recorded during summer and winter, respectively; less than a third of early 1980s totals.

Despite this drop in the numbers of birds present, species richness of waterbirds remained relatively constant from 1980 to 2001 (Figure 2): an average of 52 species (± 5.1 SD) was recorded. A total of 87 different waterbird species was recorded during the 20 surveys (Ryan and Cooper 1985, Williams 1986, 17 recent surveys). There are, however, records of at least another 15 waterbird species being recorded at the ORM since 1964 (Anderson, Abrahams and Rudolf in prep.). The limited seasonal variation in the species richness (Figure 2) is related to the presence of some individuals of Palaearctic migrants during the winter months. During December 1995, 64 different waterbird species were present, the maximum number of species recorded during any single survey.

Decline in number of waterbirds

A $\pm 74\%$ decline in the number of waterbirds is evident between the January 1980 and December 1985 surveys (Ryan and Cooper 1985, Williams 1986) and the 12 most recent surveys (average of 5 909 waterbirds) (Table 1). This

Table 2: Waterbirds regularly recorded at the Orange River mouth which are listed in the South African (Barnes 2000), Namibian (Barnard 1998, Simmons *et al.* in prep) and international (BirdLife International 2000) red data books

Waterbird species		South Africa	Namibia	International
Great White Pelican	<i>Pelecanus onocrotalus</i>	Near-threatened	Endangered	–
Cape Cormorant	<i>Phalacrocorax capensis</i>	Near-threatened	–	Near-threatened
Sacred Ibis	<i>Threskiornis aethiopicus</i>	–	Vulnerable	–
Glossy Ibis	<i>Plegadis falcinellus</i>	–	Vulnerable	–
Hadedda Ibis	<i>Bostrychia hagedash</i>	–	Vulnerable	–
Greater Flamingo	<i>Phoenicopterus ruber</i>	Near-threatened	Endangered	–
Lesser Flamingo	<i>Phoenicopterus minor</i>	Near-threatened	Endangered	Near-threatened
African Fish Eagle	<i>Haliaeetus vocifer</i>	–	Endangered	–
African Marsh-Harrier	<i>Circus ranivorus</i>	Vulnerable	Vulnerable	–
Chestnut-banded Plover	<i>Charadrius pallidus</i>	Near-threatened	Vulnerable	–
Hartlaub's Gull	<i>Larus hartlaubii</i>	–	Vulnerable	–
Caspian Tern	<i>Sterna caspia</i>	Near-threatened	Vulnerable	–
Swift Tern	<i>Sterna bergii</i>	–	Vulnerable	–
Damara Tern	<i>Sterna balaenarum</i>	Endangered	Endangered	Near-threatened

Additional species, which have only occasionally been recorded at the ORM (and/or which almost always forage offshore) and which are listed in the South African, Namibian and International red data books, are the following:

South Africa: Crowned Cormorant (*Phalacrocorax coronatus*), Yellow-billed Stork (*Mycteria ibis*), Cape Gannet (*Morus capensis*), White-backed Night Heron (*Gorsachius leuconotus*), White-chinned Petrel (*Procellaria aequinoctialis*), African Black Oystercatcher (*Haematopus moquini*), and African Snipe (*Gallinago nigripennis*)

Namibia: Crowned Cormorant, Yellow-billed Stork, White-backed Night Heron, Cape Gannet, and African Black Oystercatcher

International: Crowned Cormorant, Cape Gannet, White-chinned Petrel, African Black Oystercatcher

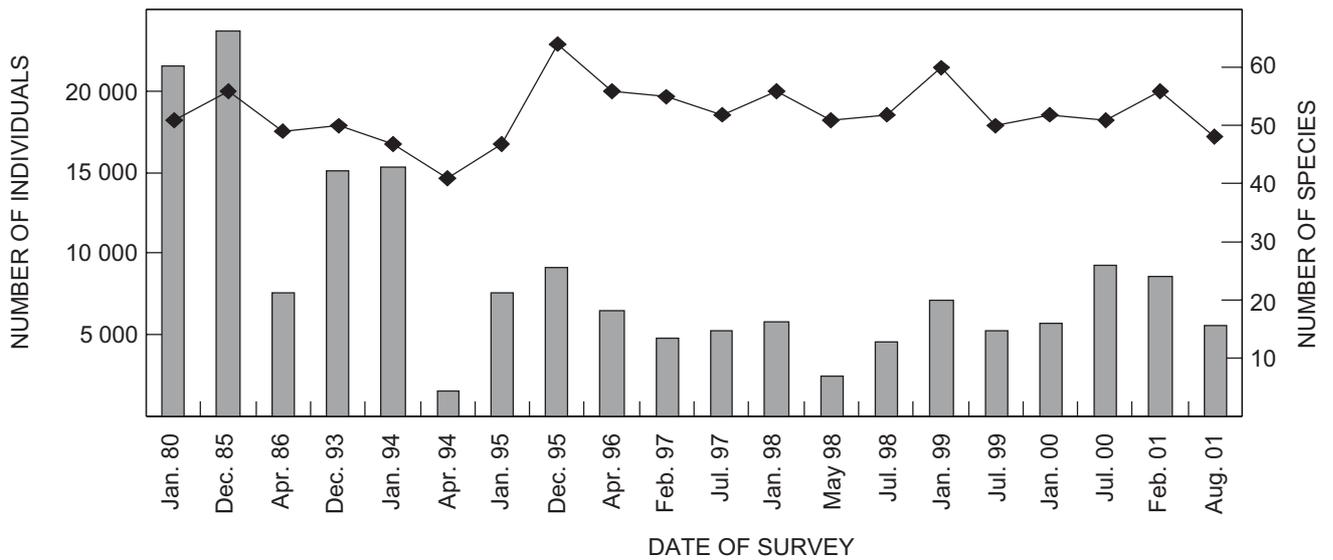


Figure 2: The numbers of waterbirds (bars) and waterbird species (diamonds) recorded at the Orange River mouth during 20 surveys from January 1980 to August 2001

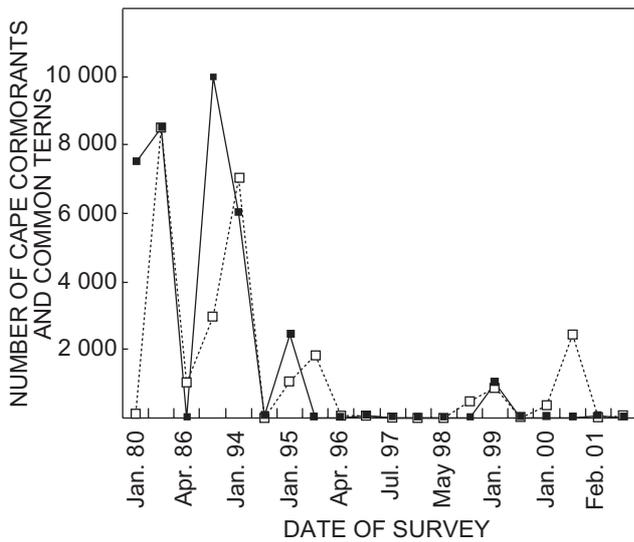


Figure 3: The numbers of Cape Cormorants (solid squares) and Common Terns (open squares) recorded at the Orange River mouth during 20 surveys from January 1980 to August 2001

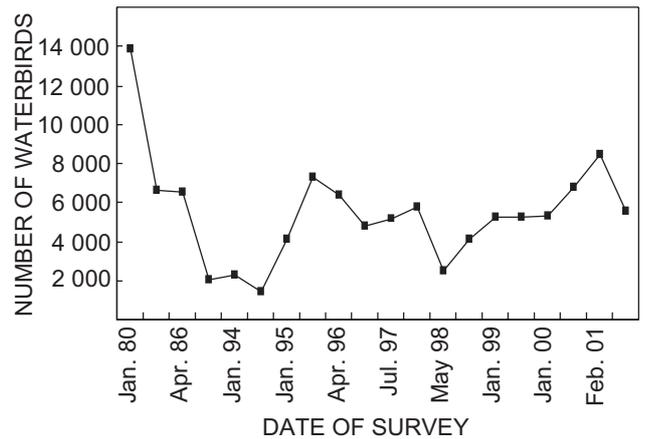


Figure 4: The numbers of waterbirds (excluding Cape Cormorant and Common Tern) recorded at the Orange River mouth during 20 surveys from January 1980 to August 2001

is primarily accounted for by the virtual absence of Cape Cormorants and Common Terns (*Sterna hirundo*) during the latter surveys (Figure 3). Cape Cormorants have declined from an average of 6 400 ($\pm 3 861$) individuals from January 1980–January 1994 to 212 (± 612) individuals during 16 surveys conducted from April 1994 to August 2001. During this same period, Common Terns have declined from an average of 3 928 ($\pm 3 678$) individuals to 425 (± 731) individuals. If these two species are excluded from the analysis, a lower appreciable decline between the 1980s (9 027.7 \pm 4 195.6) and the 1990s (4 265.3 \pm 1 853.) is evident (Figure 4)

Discussion

Previous surveys

Prior to the 1980s, knowledge about the waterbirds of the ORM was based on anecdotal accounts by several visitors to the area (e.g. Plowes 1943, Grindley 1959, Maclean 1960, Courtenay-Latimer 1963, Manry 1978). Herewith follows a brief description of their most important observations. Plowes (1943) visited the ORM in 1942 and subsequently compiled an annotated checklist for this site. Numbers of birds were not given but Cape Cormorants were apparently numerous. He stated (p 127) that, ‘They (Cape Cormorants)

were fond of sitting on either side of the mouth of the river and they would be smelt from quite a distance'. In July 1956, Grindley (1959) recorded some of the birds present at the ORM. An island in the mouth supported Kelp Gulls (*Larus dominicanus*), Hartlaub's Gulls (*Larus hartlaubii*), five species of terns, Cape and Great Cormorants (*Phalacrocorax lucidus*) and Great White Pelicans (*Pelecanus onocrotalus*). Several species were breeding. Also recorded were 39 occupied Hartlaub's Gull nests as well as many empty ones, 45 mostly unoccupied Great Cormorant nests, and evidence of an earlier Cape Cormorant breeding event, evidenced by a large number of dead young. Courtenay-Latimer (1963) recorded the birds at the ORM and surrounding area during three visits, in July 1958, August 1958 and August 1960. Her annotated checklist provides a record of all birds seen from the Holgat River (about 50km south of the Orange River) to the ORM. She only recorded small groups of Cape Cormorants (described as 'not common'; no breeding was reported). On 11 December 1976, Frost and Johnson (1977) recorded a total of 7 873 occupied Cape Cormorant nests on a sandbank in the mouth area. Cape Cormorant breeding was also recorded on islands in the estuary in December 1977, along with 150 pairs of breeding Kelp Gulls (Siegfried and Johnson 1977). Manry (1978) visited the ORM from 22–28 April 1978. His observations included 180–200 roosting Great Cormorants (no breeding was recorded) and a breeding colony of Hartlaub's Gulls on an island in the saltmarsh area. Of 62 nests inspected in this colony, 30 contained eggs. Most importantly, on 26 April 1978 c. 20 000 Cape Cormorants were counted on a sandbar offshore from the Oranjemund Golf Club. At least seven active breeding nests were recorded, and Manry ventured that 20 000+ were also roosting on another sandbar in the mouth. Roberts (1989) visited the ORM in August 1988 and made some general observations of the birds present. He recorded a mixed flock of approximately 1 000 Greater (*Phoenicopterus ruber*) and Lesser Flamingos, consisting of about 500 of each species. He suggested (p 6) that 'their attachment to a large island...and the presence of a good number of immatures, suggested the possibility of a breeding colony', which is unlikely (Anderson 2000). Greig (Simmons 1994, 1995) conducted three surveys at the ORM during 1994 and 1995. The area surveyed was largely restricted to the Namibian side of the ORM and the results are therefore not a reflection of the total number of birds present. Of interest were the following: 159 Great White Pelicans, 6 000 Cape Cormorants and 7 000 Common Terns (January 1994), 41 Cape Cormorants and no Common Terns (April 1994) and 2 406 Cape Cormorants and 1 053 Common Terns (January 1995).

The first comprehensive waterbird survey was done in January 1980 (Ryan and Cooper 1985), yielding a total of 21 512 wetland birds of 56 species (Table 1), including 7 500 Cape Cormorants. Although no evidence of breeding was recorded, it was stated that the ORM is an 'important breeding site for thousands of Cape Cormorants'. Of the 171.5km of Northern Cape coastline they counted, it was determined that the ORM supported 94% of all wetland waders encountered.

Two other comprehensive surveys were conducted by Williams (1986) in December 1985 and April 1986 (Table 1). The number of waterbirds recorded during these surveys was 20 653–26 653 (of 57 species) and 7 562 (of 50 species), respectively. During the former survey three islands supported breeding Cape Cormorants, two of which had 831 nests. Both of these accessible islets had been disturbed by humans and the breeding attempt was subsequently aborted. The three islands also supported breeding Kelp Gulls (40 nests on the two accessible islands). Grey Heron (*Ardea cinerea*), Black-headed Heron (*Ardea melanocephala*), Little Egret (*Egretta garzetta*), Cattle Egret (*Bubulcus ibis*) and Black-crowned Night Heron (*Nycticorax nycticorax*) were recorded breeding in reeds in the 'Heronry Pool' close to Alexander Bay. In April 1986, more than 2 000 Hartlaub's Gulls and 250 Swift Terns were recorded on an artificial islet in a canal on the river side of Alexander Bay. It was presumed that this was the start of a breeding event. The large number of birds recorded during the December 1985 survey (Williams 1986) can be attributed mainly to the large number of Cape Cormorants (7 000–10 000) and Common Terns (7 000–10 000). Comparable numbers of these species were considerably less during the subsequent survey in April 1996. During December 1993 Williams (undated) counted about 15 000 waterbirds of 52 species at the ORM. These comprised mainly Cape Cormorants (c. 5 000+ pairs; many of which were nesting) and Common Terns (c. 3 000 individuals), both of which were present on three islets in the mouth area.

There are only a few other published references to birds at the ORM. These are mainly checklists for a wider area (for example, Maclean 1960, Winterbottom and Courtenay-Latimer 1961) and surveys along stretches of the Orange River, usually upstream of the mouth (for example, Balme 1991, Allan and Jenkins 1993, Simmons and Allan 2002). There is also a recent reference to a Red-billed Quelea (*Quelea quelea*) breeding colony in reedbeds just upstream of the ORM, which constitutes a 300km extension of the species' southern African breeding range (Underhill 1998). Crawford *et al.* (1995) summated the surveys of Great White Pelicans that were conducted at the ORM between 1942 and 1987. Barnes (1998) and Anderson *et al.* (in prep) have recorded 187 and 253 terrestrial and waterbird species, respectively, at the ORM and areas to the south. The ORM and surrounding area supports populations of various threatened and/or range restricted terrestrial birds, including the recently described Barlow's Lark (*Certhilauda barlowi*) and Cape Long-billed Lark (*C. curvirostris*).

ORM wetland habitats used by birds

The birds use a variety of areas of the ORM, but large numbers have been recorded at islets in the river floodplain (Williams 1986), an artificial island in the oxidation ponds (Williams 1986), on the sandspit and exposed tidal sandbank (Grindley 1959, Williams 1986, this study) and the lower end of the saltmarsh (this study) (Figure 5). During six recent surveys, the largest proportion of the waterbirds was counted at two wetland areas, namely the saltmarsh (12.1–37.3% of birds counted) and north bank, adjacent islands and Namibian beach area (24.5–44.9% of birds

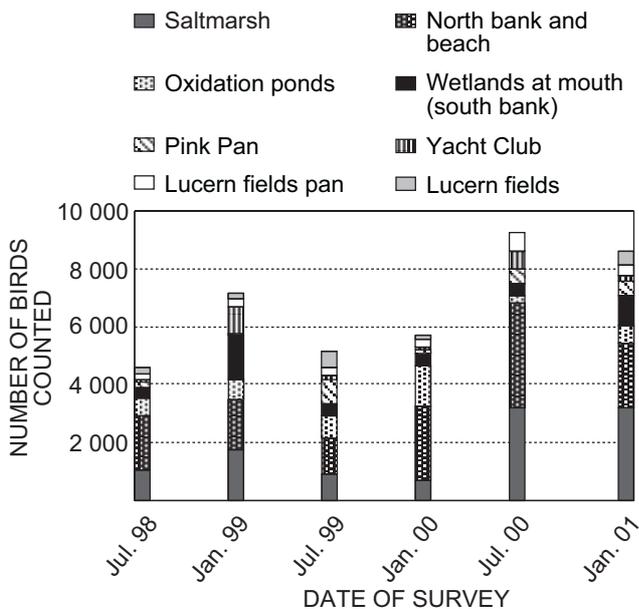


Figure 5: The number of waterbirds recorded in eight different sections of the Orange River mouth wetland during six surveys (July 1998 to January 2001)

counted) (Figure 5). During the latter six surveys the oxidation ponds supported an average of 12.0% (3.2–24.0%) of the ORM's waterbirds. Because of their accessibility, a greater proportion of this site's birds were counted relative to other ORM wetland habitats. These data refute previous suggestions that the oxidation ponds (which are located below the river's high water mark) support a significant proportion of the ORM's waterbirds. This argument has been used to favour keeping these sewerage ponds within the Ramsar area (Genis 1998). It is also apparent that some of the peripheral wetlands, such as the pink pan and yacht club, support relatively fewer birds, although this does not necessarily warrant exclusion of these habitats from the Ramsar site.

Number of waterbirds

The number of waterbirds present at the ORM is higher than would be expected (e.g. Barnes and Anderson 1998, Simmons *et al.* 1998) when one considers the general paucity at the ORM of invertebrate fauna, the food of many bird species. The depauperate invertebrate fauna has been attributed to the high turbidity and extreme fluctuations in salinity (Brown 1959). The large number of birds may be attributed to a paucity of other suitable habitat along the Namib Desert coastline between the mouths of the Cunene and Olifants Rivers. The ORM may also be an important staging area for migratory waders along the arid east Atlantic flyway (Barnes and Anderson 1998). Simmons and Allan (2002) estimated that the total number of waterbirds at the ORM exceeds the entire lower Orange River in overall abundance (31–34 birds/10km).

Recently, several studies have confirmed the importance of the ORM as waterbird habitat. Using the data of Ryan and

Cooper (1985), Turpie (1995) determined that the ORM ranked 4th (in terms of conservation status and bird abundance index), 5th (in terms of a multiple criteria index), 6th (in terms of a bird rarity index) and 7th (in terms of a bird diversity index) out of 42 estuaries in South Africa. In a recent study Turpie and co-workers (Turpie *et al.* 2002) found that the ORM ranked 7th in terms of conservation importance out of the top 50 South African estuaries.

The ORM is also recognised as one of South Africa's Important Bird Areas, mainly because of the significant populations of waterbird species which it supports (Barnes and Anderson 1998). These include two nationally threatened and four globally near-threatened waterbird species, three nationally near-threatened waterbird species, and one nationally near-threatened and several range-restricted terrestrial bird species (Barnes and Anderson 1998). This wetland is also a key component of the Sperrgebiet Important Bird Area (Simmons *et al.* 1998). A recent analysis of the austral summer and winter 1997 waterbird survey data for the ORM found that significant proportions of the regional populations of South African Shelduck (*Tadorna cana*) and Cape Shoveller (*Anas smithii*) and globally significant populations of the nominate race of Kelp Gull and Hartlaub's Gull were present during the winter months (Taylor *et al.* 1999). A flaw of the above studies (except Taylor *et al.* 1999) is that old survey data have been used in the analyses, some of which are now more than two decades old (e.g. Ryan and Cooper 1985).

The dramatic decline in the numbers of waterbirds at the ORM (Ryan and Cooper 1985, Williams 1986, this study) is accounted for by the virtual absence of Cape Cormorants and Common Terns during the recent surveys. Without the large numbers of Cape Cormorants and Common Terns, the important number of 20 000 waterbirds, one of the criteria used for the original designation of the ORM as a Ramsar site, is not attained.

Declining numbers of Cape Cormorants and Common Terns

It is important to examine why the numbers of Cape Cormorant and Common Tern have declined (Figure 3). Heath (2001) suggested that the numbers of some coastal birds, including these two species, will always be variable and that the number of birds recorded will depend on the timing of the counts. Although the Common Tern is a non-breeding, Palaearctic migrant to the coasts of southern Africa, it is present throughout the year (Williams and Underhill 1997), but its preferred feeding and roosting sites will presumably be determined by the local availability of food in the open ocean.

Heath (2001) suggested that the number of Common Terns at the ORM would depend on factors such as (1) the presence of suitable fish shoals along that section of the coast, (2) the state of the sea and winds, and (3) turbidity of adjacent coastal waters. During the 20 ORM waterbird surveys, the number of Common Terns recorded has been very variable (average of 1 343 ± 2 371 SD individuals), with more than 1 000 birds being counted on seven occasions. During the past 21 years, the maximum numbers of terns recorded were 8 500 and 7 000 individuals during December

1985 and January 1994, respectively. Although comparably large numbers of terns have not been recorded during the past six years, 2 437 roosting birds were counted during the July 2000 survey. However, regardless of the time of day/year, weather, or sea conditions, there is no evidence to suggest that the large numbers of terns originally recorded at the ORM are now present. There has also been no significant global population decline (Williams and Underhill 1997) and we believe that onsite factors have resulted in the ORM becoming less suitable for roosting birds. These include increased disturbance by humans, as well as a change in the architecture of the mouth and islands with a consequent effect on roost site availability.

Large numbers of Common Terns have recently been recorded at wetlands in Namibia, with, for example 180 000 individuals being counted at Sandwich Harbour in 2000 (compared to 10 000–30 000 previously) (RE Simmons pers. comm.). It is possible that this wetland has attracted terns away from the more marginal sites, such as the ORM.

The Cape Cormorant is endemic to southern Africa, with the bulk of the population occurring on the west coast of southern Africa (Cooper *et al.* 1982, Crawford 1997a). It is listed as 'nationally near-threatened' in the South African Red Data book (Crawford 2000) and internationally (BirdLife International 2000). The present status of this species has been attributed to disease, oiling, declining fish stocks and disturbance at their breeding sites (Crawford 1997a, 2000). At the ORM several thousand ($6\ 881 \pm 2\ 895$ SD) Cape Cormorants were recorded during five of the initial seven surveys (i.e. January 1980 to January 1995), with an average of only 90 (± 269 SD) individuals being recorded during the subsequent 13 surveys. The highest number recorded during the latter 13 surveys was 984 birds in January 1999. Although the Cape Cormorant was recorded breeding at ORM on several occasions from the 1950's (Grindley 1959) to December 1993 (Williams unpubl.), no breeding has been reported subsequently. Why then is this species no longer roosting in large numbers and breeding at the ORM?

Although the Cape Cormorant breeds mainly on offshore islands, with 92% of the South African population breeding on only six islands (Cooper *et al.* 1982, Crawford 1997a), the ORM was until recently one of the few important mainland breeding sites (Cooper *et al.* 1982). The reasons why the ORM is no longer used for roosting and breeding by this cormorant is not known, but there are several possible explanations which draw on both on- and off-site factors, including: (1) a general decline in the global (i.e. southern African) population of this species; (2) a declining food resource; (3) a change in the architecture of the river mouth which has resulted in fewer suitable roosting and breeding sites; (4) increased human disturbance; or (5) better conditions elsewhere.

The global Cape Cormorant population numbered 247 000 pairs during the period 1977–1981 (Cooper *et al.* 1982). During the next few years the population plummeted to 59 667 pairs in 1985/1986 and 72 511 pairs in 1992/1993 (Crawford and Dyer 1995, Crawford 1999). This decline and subsequent fluctuation in cormorant numbers is related to an overall decline in Cape Anchovy (*Engraulis capensis*), an important food item, as well as fluctuations in the availability of

these fish (Crawford and Dyer 1995, Crawford 1997a, 1999, 2000, Schwartzlose *et al.* 1999). There have also been recent dramatic decreases in the populations of African Penguins (*Spheniscus demersus*) (Cordes *et al.* 1999) and Cape Gannets in southern Namibia, thought to be food related and there has probably been a regional scarcity of fish over the past few years (Crawford pers. comm.). The Cape Cormorants and Common Terns used the ORM for roosting and breeding purposes, probably foraging almost exclusively at sea, thus their numbers were not influenced by ORM food supply.

Although the drastic decline in the global population of the Cape Cormorant in the early 1980s may be partly responsible for the present absence of this species from the ORM, it should be noted that even after the decline, such as in December 1993 and January 1994, large numbers (c. 10 000 individuals) were still using the mouth. A decline in the Cape Cormorant breeding population in the early 1990s was probably related to an outbreak of avian cholera (*Pasteurella multocida*) which resulted in the death of 14 000 birds (Crawford *et al.* 1992, Crawford and Dyer 1995).

It is conceivable that the 1988 Orange River flood, the largest since 1976 (Swart *et al.* 1988, Morant and O'Callaghan 1990), destroyed the sandspits and islands which were used by Cape Cormorants for roosting and breeding and that subsequent river flow dynamics have not enabled suitable breeding and roosting habitat to be recreated (Barnes and Anderson 1998). Morant and O'Callaghan (1990) mentioned the presence of Cape Cormorants before, during and after the flood, but no mention was made of a loss of roosting/breeding sites. During the flood, Swart *et al.* (1988) observed cormorants roosting on a sandbank (remnant of the spit) to the north of the mouth. Subsequent to the flood, in December 1993 and January 1995, 10,000 and 2 406 cormorants respectively were counted, with breeding activity being noted during the former survey (these birds were using three islets in the flooded mouth). This implies that roosting and nesting sites have been available after 1988, at least until 1995. An aerial photograph taken in December 1983 by Marine and Coastal Management (South Africa) of a sandy island in the mouth area clearly shows the presence of large numbers of breeding and roosting Cape Cormorants. Although this large sandy island apparently no longer exists (and may have been destroyed during the 1988 flood), it has also been our impression during visits to the ORM from 1995–2001 that other breeding habitats, namely small, grassy islets in the mouth area, still remain.

The Cape Cormorant is sensitive to human disturbance (Cooper *et al.* 1982, Crawford 1997a) and increased human and other activities on these islets may be responsible for the observed lack of breeding. During 1985 at least 831 pairs aborted their breeding attempt after people disturbed the birds on the islands (Williams 1986). Cattle also graze illegally in the Ramsar site (K van Zyl pers. comm.). It is not known whether mammalian predators, such as black-backed jackals (*Canis mesomelas*), brown hyaenas (*Hyaena brunnea*) and domestic dogs (*Canis familiaris*), can gain access to these islands.

It is possible that the ORM Cape Cormorants have moved to more favourable roosting and breeding places

elsewhere in southern Africa. In Namibia Cape Cormorant numbers are increasing and they have begun breeding on islands at Sandwich Harbour, with more than 30 000 birds regularly being counted (RE Simmons pers. comm.). It is therefore likely that this species is being drawn away from more marginal sites, such as the ORM and Cape Cross in Namibia.

The absence of breeding Cape Cormorants and the desertion of the breeding colonies is then probably the result of a combination of factors, but particularly the global decline of the population of this species and human interference at the roosting and breeding sites.

Population trends of other waterbird species

Several other waterbird species that were particularly numerous in January 1980 (Ryan and Cooper 1985) have not subsequently attained their original numbers. These include Black-necked Grebe, Great Cormorant and Redknobbed Coot (*Fulica cristata*). Several waders too have shown this pattern, with lower numbers of Common Ringed Plover (*Charadrius hiaticula*), Chestnut-banded Plover, Common Greenshank (*Tringa nebularia*), Little Stint (*Calidris minuta*), Ruff (*Philomachus pugnax*) and Pied Avocet (*Recurvirostra avosetta*) being recorded during the subsequent 19 surveys. The reason for this is unclear, but it could be related to the deterioration of the saltmarsh and the corresponding decrease in available mud-flat habitat for many of these species. Subsequent to 1980 there has, however, not been a significant decline in the numbers of the three main wader groups (Figure 6).

There is no evidence that the numbers of the other important bird species cited by Williams (1986) (Hartlaub's Gull, Damara Tern, Black-necked Grebe, Lesser Flamingo,

Chestnut-banded Plover, Curlew Sandpiper, Swift Tern and Caspian Tern) have declined. In particular, the species which would use the saltmarsh (Lesser Flamingo, Chestnut-banded Plover and Curlew Sandpiper) have not shown significant declines. There have in fact been recent increases in the number of Curlew Sandpiper, a species that makes use of the saltmarsh and mudflats. These data suggest that the collapse of the saltmarsh wetland has not significantly affected the overall waterbird numbers. It should not be concluded that the rehabilitation of the saltmarsh would have little impact on the bird population, as the saltmarsh may be important for the functioning of the greater ORM wetland and may thus influence other habitats favoured by birds (Heath 2001). Another consideration is that with the now permanently open river mouth and the resultant tidal influence, extensive areas of shallow mud-flats favoured by wading birds has been maintained.

During the 20 waterbird surveys, 12 different waterfowl species (ducks and geese) have been recorded, with from 7–10 different species being recorded during a specific count (Figure 7). Since January 1995, there has been an increase in the numbers of ducks and geese utilising the ORM (Figure 7). There are two possible reasons for this observation: (1) an increase in the area under irrigated agriculture, such as at Beauvallon (K van Zyl pers. comm.) and, (2) a halt in the hunting of these birds within the ORM and surrounding area (P Laubscher pers. comm.). What is noticeable too, is the seasonal change in usage of the ORM by ducks and geese. Fewer waterfowl are present during the winter months, the time of year in this winter-rainfall area when they probably disperse to smaller, ephemeral wetlands.

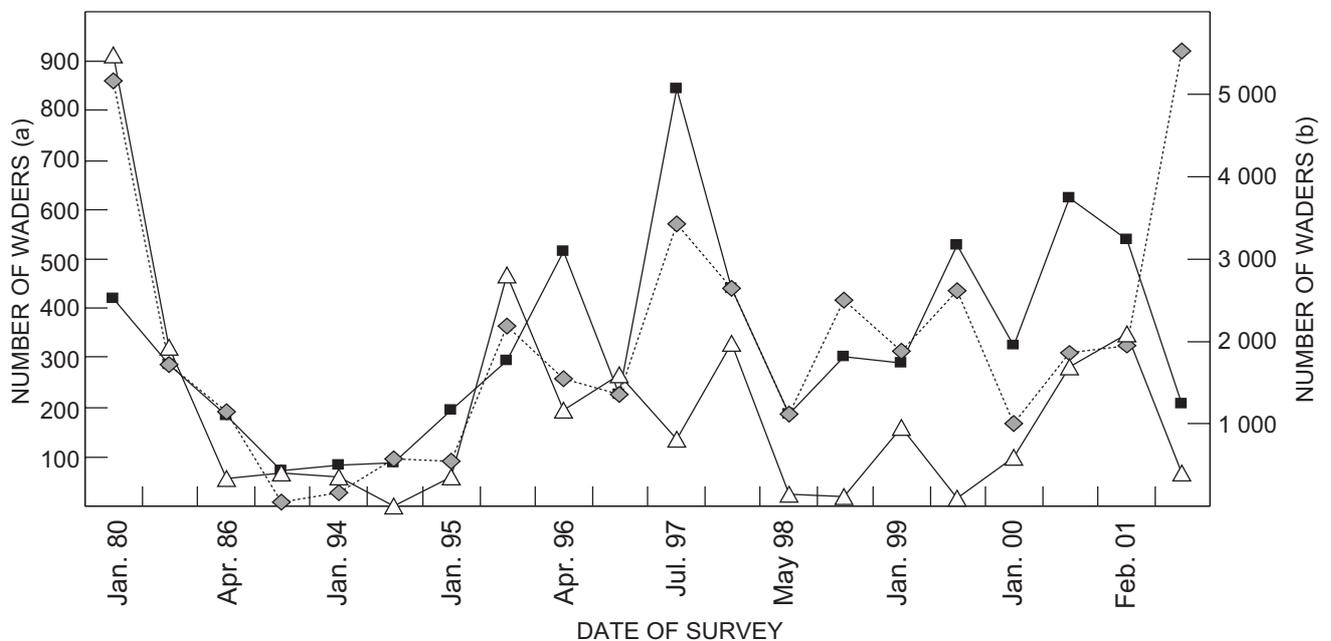


Figure 6: The numbers of waders (a = resident and intra-African migrant, b = Palaeartic) recorded at the Orange River mouth during 20 surveys from January 1980 to August 2001 (resident waders = squares, Palaeartic migrants = triangles, intra-African migrants = diamonds)

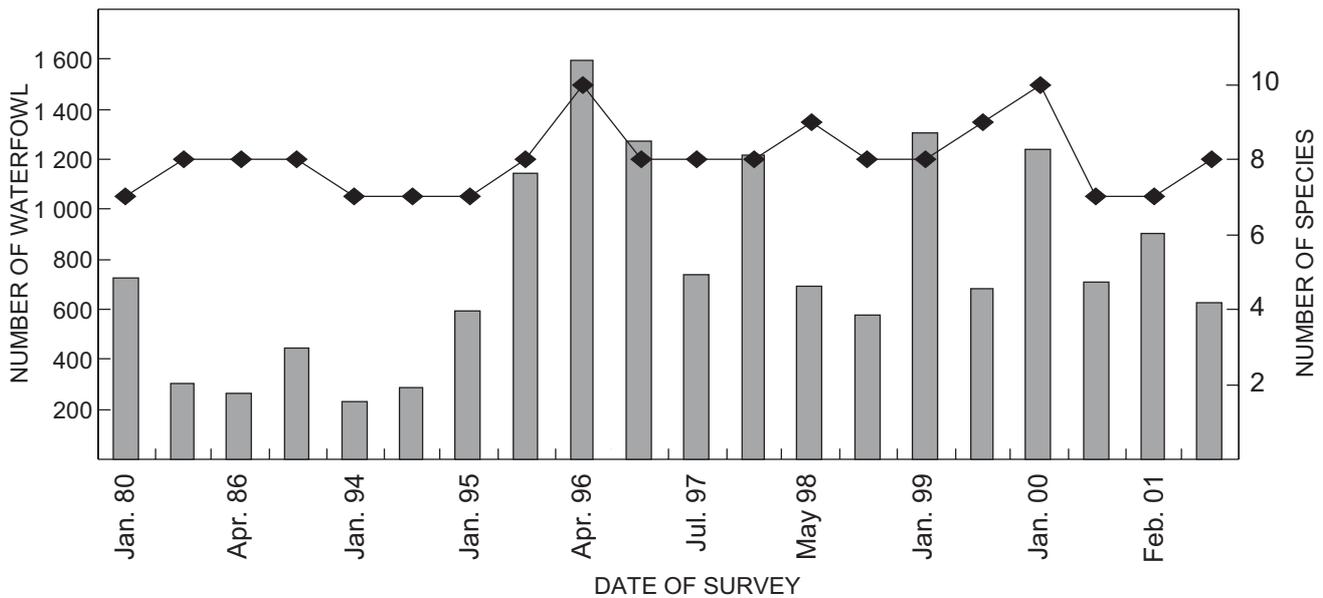


Figure 7: The total number of waterfowl (ducks and geese) and number of species recorded at the Orange River mouth during 20 surveys from January 1980 to August 2001

Table 3: The maximum number of birds recorded during 13 surveys since December 1995, estimated southern African and global populations for these species, and the proportion of these populations which occur at the Orange River mouth. Species which meet the 1% global population threshold are indicated with an asterisk

Species	No. of birds	Southern African population	Proportion of SA population	Global Population	Proportion of global population
Black-necked Grebe	125	>10 000 ¹	<1.3%	145 000 ⁵	>0.09%
Great White Pelican	473	12 000 ^{2,3}	3.9%	>150 000 ⁵	<0.30%
Cape Cormorant*	984	145 022 ⁶	1.4%	145 022 ⁶	1.40%
Lesser Flamingo	1 031	40 000–60 000 ⁷	1.7–2.6%	2 000 000–6 000 000 ⁵	<0.05%
Greater Flamingo	700	47 427–55 000 ^{7,10}	1.3–1.5%	800 000 ^{3,4}	<0.09%
South African Shelduck*	516	42 000 ⁵	1.2%	42 000 ⁵	1.20%
Cape Shoveller*	373	20 000–50 000 ⁵	0.7–1.9%	20 000–50 000 ⁵	0.7–1.90%
Chestnut-banded Plover	97	11 192 ^{11,12,21}	0.9%	12 792 ^{11,12,21}	0.80%
Pied Avocet	891	10 000–20 000 ¹³	4.5–8.9%	132 000–337 000 ¹³	0.3–0.70%
Curlew Sandpiper	1 666	74 600–149 200 ¹⁴	1.1–2.2%	1 000 000 ⁵	0.17%
Kelp Gull*	1 098	>22 000 ¹⁵	5.0%	>22 000 ¹⁵	5.00%
Hartlaub's Gull*	707	>30 000 ¹⁶	2.4%	>30 000 ¹⁶	2.40%
Caspian Tern	165	1 500 ¹⁷	11%	53 480–164 480 ⁵	0.1–0.30%
Swift Tern*	344	6 000 ^{18,19}	5.7%	15 000 ⁵	2.30%
Damara Tern*	58	13 500 ^{20,22}	0.4%	13 500 ^{20,22}	0.40%

Source: ¹ Underhill *et al.* (1991), ² Urban (1984), ³ Del Hoyo *et al.* (1992), ⁴ Kahl (1975), ⁵ Rose and Scott (1997), ⁶ Crawford (1999), ⁷ Simmons (1996, 1997), ⁸ Williams and Velásquez (1997), ⁹ Brown *et al.* (1982), ¹⁰ Dodman and Taylor (1995), ¹¹ Tree (1997a), ¹² Underhill *et al.* (1999), ¹³ Tree (1997b), ¹⁴ Underhill (1997), ¹⁵ Crawford *et al.* (1982), ¹⁶ Williams *et al.* (1990), ¹⁷ Cooper *et al.* (1992), ¹⁸ Crawford (1997b), ¹⁹ Cooper *et al.* (1990), ²⁰ Underhill (2000), ²¹ Simmons (2000), ²² Simmons *et al.* (1998)

Status of Red Data species

One of the criteria originally used to designate the ORM as a Ramsar site was that it supported an appreciable assemblage of rare and endangered bird species, 14 of which are listed in either the South African (Brooke 1984) and Namibian (Barnard 1998, Simmons *et al.* in prep.) Red Data books. The South African Red Data book has subsequently been revised, using the new IUCN criteria (Barnes 2000). Using these new criteria, the ORM now supports 21 Red Data species, 14 regularly occurring and an additional seven

occasionally occurring species (as listed in either Barnes (2000), Barnard (1998), Simmons *et al.* (in prep.) or BirdLife International (2000) (Table 2)).

Does the ORM still meet the Ramsar criteria?

This assessment of recent survey data has shown that the ORM still meets three of the four Ramsar criteria under which it was originally designated in 1991, and which are listed above. In particular, the ORM continues to support more than 1% of the southern African and global populations

of all the waterbird species listed by Williams (1990) under criterion 4 (Table 3). The site no longer regularly supports in excess of 20 000 waterbirds, primarily as a result of the decline in the numbers of Cape Cormorant and Common Tern, and thus presently does not meet criterion 3. The criteria for identifying Wetlands of International Importance have recently been rationalised (Ramsar Convention Bureau 1999) to a list of eight criteria based on wetland types, species and ecological communities, waterbirds and fish. Of these revised criteria, the ORM currently complies with the following:

Criterion 1: The wetland contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographical region.

The Succulent Karoo Biome, including the southern African west coast, is characterised by a lack of large perennial wetland systems. The ORM is one of the largest perennial and coastal wetlands in a climatic region characterised by average annual precipitation of less than 50mm per annum and evaporation rates of 2 450mm per annum. The nearest wetlands holding significant waterbird habitat are the Olifants River mouth, some 400km to the south, and Sandwich Harbour approximately 500km to the north.

Criterion 2: ORM supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

The ORM supports 14 regularly occurring and an additional seven occasionally occurring bird species listed in the South African (Barnes 2000), Namibian (Barnard 1998, Simmons *et al.* in prep) and international (BirdLife International 2000) Red Data books. The ORM supports two freshwater fish species appearing on the IUCN Red Data List (Hilton-Taylor 2000), both of which are endemic to the Orange River system — Largemouth Yellowfish (*Barbus kimberleyensis*) and Namaqua Barb (*B. hospes*) (Benade 1993, Seaman and Van As 1998). Several other freshwater fishes, endemic to the Orange River system, occur at the ORM, including Smallmouth Yellowfish (*B. aeneus*) and Orange River Mudfish (*Labeo capensis*). The marine White Steenbras (*Lithognathus lithognathus*), which is listed in the IUCN Red Data List, also occurs at the ORM.

Criterion 3: ORM supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographical region.

The ORM supports several animal species that would otherwise not have been present in this arid region. These include many waterbird species (such as Great White Pelican) and mammals, such as the Straw-coloured Fruit Bat (*Eidolon helvum*) and the Cape Clawless Otter (*Aonyx capensis*). Desert-dwelling Gemsbok (*Oryx gazella*) and Common Ostriches (*Struthio camelus*) are dependent on vegetation on the ORM floodplain during dry periods in the Sperrgebiet interior. The Orange River is a linear oasis through this arid region and may act as an important migration corridor or conduit for many species (Simmons and Allan 2002).

Criterion 4: ORM supports plant and/or animal species at critical stages in their life-cycles, or provides refuge during adverse conditions.

The ORM is probably an important staging area for several Palaearctic migrants (such as Curlew Sandpiper, Little Stint and Common Ringed Plover) and intra-African migrant and nomadic waterbird species (such as Damara Tern, Pied Avocet and Lesser Flamingo). It is also a breeding area for several waterbird species, including White-fronted Plover (*Charadrius marginatus*), Pied Avocet, Caspian Tern and Hartlaub's Gull, and roosting site for marine-feeding terns and cormorants.

Criterion 6: ORM supports 1% of the individuals in a population of one species or subspecies of waterbird.

The ORM supports more than 1% of the southern African population of 15 species and more than 1% of the global population of seven waterbird species (Table 3).

Conservation problems

During the mid-1980s, the ORM was '...little disturbed at present; access is strictly controlled by mining companies and human disturbance is limited to angling at the mouth and some recreational activities along the north bank. However, further development of the land around the estuary and its adjoining pans should not be allowed' (Ryan and Cooper 1985). The situation is very different today. There are several major ecological problems at the ORM, several of which are related to the Orange River's altered flow regime, manifested through lower summer flows, higher winter flows and buffering of small and medium floods (see ORETG 1989). This has had direct and indirect effects on the waterbird habitats at the ORM. Elevated winter flows, which generally prevent the mouth from closing, a general decrease in summer flow and the buffering of small to medium floods have resulted in only occasional flooding of the saltmarsh, resulting in a further deterioration of this habitat. Mining and other human activities have also contributed to the deterioration of the saltmarsh, including the construction of levees and a road to the beach and the coating of vegetation with wind-blown sediments from adjacent mine dumps (Burns 1994). Other factors which have probably impacted the birds at the ORM include (1) recreational activities (fishing, off-road vehicles on the beach) at or in the vicinity of sensitive breeding and roosting sites (see above), (2) disturbance by aircraft (Velasquez 1996), (3) disturbance by cattle and possibly by feral cats and dogs, (4) the hunting of ducks and geese within the Ramsar site and (5) the possible hybridisation of Yellow-billed Ducks (*Anas undulata*) with alien Mallards (*Anas platyrhynchos*). It is also likely that the current flow regime has prevented the formation of suitable sand bars in the mouth, which would have been used as roosting and breeding sites by cormorants and terns.

Management recommendations

The listing of the ORM on the Montreux Record obligates the relevant conservation authorities in South Africa to put measures in place, where possible, to restore and maintain the site's ecological character. In the case of the ORM, this translates to the rehabilitation of the saltmarsh and a possible recovery in the numbers of certain species of waterbirds utilising this habitat and other components of the ORM wetland. Various measures can be implemented to improve the

situation for waterbirds at the ORM, including:

1. Influencing decision-makers to amend the operating rules of dams, especially Vanderkloof, in order to simulate historical flow regimes, especially the sustained low winter flows required to close the mouth. The concept of the Ecological Reserve — that quantity, quality and timing of flow required to sustain aquatic ecosystem functioning — has been entrenched in South Africa's National Water Act (Act 36 of 1998). Although much work has been done towards determining this Reserve for the ORM (Venter and Van Veelen 1996), it has yet to be implemented. A closer resemblance of future flow regimes at ORM to historical patterns will result in the occasional flooding of the saltmarsh, opening and closing of the mouth and establishment of a larger area of mud-flats, all of which will result in additional feeding habitats for birds.
2. Undertake hydrological and botanical studies to determine the feasibility of rehabilitating the saltmarsh and methods required to restore this habitat (this may require opening old river/flood channels, creating additional openings in the road embankment, and re-vegetation).
3. Until there has been an improvement in the ecological status of the ORM, it should remain on the Montreux Record.
4. Determine the locality of key waterbird breeding and roosting areas, especially for Damara Tern, Caspian Tern, Hartlaub's Gull and Cape Cormorants, and prohibit human and livestock access to these areas.
5. Restrict or prohibit illegal activities, including the hunting of waterfowl in the Ramsar site and impose restrictions on aircraft flying over the ORM.
6. Continue bi-annual monitoring of the ORM waterbird population and begin monthly monitoring of key species, such as Great White Pelican, flamingos, and Caspian and Damara Terns. These counts should also be coupled with aerial photography (in order to relate the dynamics of the mouth architecture to bird numbers).
7. Where feasible create artificial roosting and breeding sites for certain bird species, such as Great White Pelican, terns and cormorants, to encourage their return to former numbers.

It is anticipated that, if the ORM receives statutory protection from the Northern Cape and Namibian conservation authorities (Heath 2001), the situation will improve for the wetland's waterbirds and it will remain a wetland of international importance.

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References

- Allan DG and Jenkins AR** 1993. A count of waterbirds along a section of the lower Orange River. *Bontebok* 8: 33–34
- Anderson MD** 2000. The status of flamingos in the Northern Cape Province, South Africa. *Ostrich* 71: 431–434
- Balme A** 1991. Birds along the Orange River. *Birding in SA* 43(2): 37
- Barnard P** (ed) 1998. *Biological Diversity in Namibia: A Country Study*. Namibian National Biodiversity Task Force, Windhoek, Namibia, 332 pp
- Barnes KN** 1998. An assessment of birdwatching-based tourism at the Orange River mouth wetlands and associated Alexkor property, northern Namaqualand. Ornithological Consultants Research Report No. 1. Ornithological Consultants, Cape Town, South Africa
- Barnes KN** 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa
- Barnes KN and Anderson MD** 1998. Important bird areas of the Northern Cape. In: Barnes KN (ed) *The Important Bird Areas of Southern Africa*. pp 103–122. BirdLife South Africa, Johannesburg, South Africa
- Benade C** 1993. *Studies on Fish Populations in the Regulated Orange River System Within the Borders of the Cape Province*. MSc Thesis, University of the Orange Free State, Bloemfontein, South Africa
- BirdLife International** 2000. *Threatened Birds of the World*. Lynx Edicions and BirdLife International, Barcelona and Cambridge
- Bremner JM, Rogers J and Willis JP** 1990. Sedimentological aspects of the 1988 Orange River floods. *Transactions of the Royal Society of South Africa* 47: 247–294
- Brooke RK** 1984. *South African Red Data Book — Birds*. South African National Scientific Programmes Report. 97. Council for Scientific and Industrial Research, Pretoria, South Africa
- Brown AC** 1959. The ecology of South African estuaries Part IX: notes on the estuary of the Orange River. *Transactions of the Royal Society of South Africa* 35: 463–473
- Brown LH, Urban EK and Newman K** 1982. *The Birds of Africa*, Vol. 1. Academic Press, London
- Burns M** 1994. Alexkor environmental management programme report: Vol. 3. Council for Scientific and Industrial Research, Report Number EMAS-C 94037(3), Stellenbosch, South Africa
- Clancey PA** 1986. Endemicity in southern African avifauna. *Durban Museum Novitates* 13: 245–284
- Cooper J, Brooke RK, Cyrus DP, Martin AP, Taylor RH and Williams AJ** 1992. Distribution, population size and conservation of Caspian Tern *Sterna caspia* in southern Africa. *Ostrich* 63: 58–67
- Cooper J, Brooke RK, Shelton PA and Crawford RJM** 1982. Distribution, population size and conservation of the Cape Cormorant *Phalacrocorax capensis*. *Fish Bulletin of South Africa* 16: 121–143
- Cooper J, Crawford RJM, Suter W and Williams AJ** 1990. Distribution, population size and conservation of the Swift Tern *Sterna bergii* in southern Africa. *Ostrich* 61: 56–65
- Cooper J and Hockey PAR** 1981. The atlas and site register of South African coastal birds, Part 2 — the atlas. Percy FitzPatrick Institute of African Ornithology Unpublished report, University of Cape Town, Cape Town, South Africa
- Cordes I, Crawford RJM, Williams AJ and Dyer BM** 1999. Decrease of African Penguins at the Possession Island group 1956–1995. *Marine Ornithology* 27: 129–138
- Courtenay-Latimer M** 1963. Birds of the state alluvial diamond diggings from Holgat to the Orange River mouth. *Annals of Cape Province Museums* 3: 44–56

- Cowan GI and Marneweck GC** 1996. South African National Report to the Ramsar Convention 1996. Department of Environmental Affairs and Tourism, Pretoria, South Africa
- Crawford RJM** 1997a. Cape Cormorant *Phalacrocorax capensis*. In: Harrison JA, Allan DG, Underhill LG, Herremans M, Tree AJ, Parker V and Brown CJ (eds) The Atlas of Southern African Birds, Vol. 1: Non-passerines. pp 32–33. BirdLife South Africa, Johannesburg, South Africa
- Crawford RJM** 1997b. Swift Tern *Sterna bergii*. In: Harrison JA, Allan DG, Underhill LG, Herremans M, Tree AJ, Parker V and Brown CJ (eds) The Atlas of Southern African Birds, Vol 1: Non-passerines. pp 470–471. BirdLife South Africa, Johannesburg, South Africa
- Crawford RJM** 1999. Seabird responses to long-term changes of prey resources off southern Africa. In: Adams L and Slotow R (eds) Proceedings of 22nd International Ornithological Congress. BirdLife South Africa, Johannesburg, South Africa
- Crawford RJM** 2000. Cape Cormorant *Phalacrocorax capensis*. In: Barnes KN (ed) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. pp 32–33. BirdLife South Africa, Johannesburg, South Africa
- Crawford RJM, Allwright DM and Hejl CW** 1992. High mortality of Cape Cormorants (*Phalacrocorax capensis*) off western South Africa in 1991 caused by *Pasteurella multocida*. Colonial Waterbirds 15(2): 236–238
- Crawford RJM, Cooper J and Dyer BM** 1995. Conservation of an increasing population of Great White Pelicans *Pelecanus onocrotalus* in South Africa's Western Cape. South African Journal of Marine Science 15: 33–42
- Crawford RJM, Cooper J and Shelton PA** 1982. Distribution, population size, breeding and conservation of the Kelp Gull in southern Africa. Ostrich 53: 164–177
- Crawford RJM and Dyer BM** 1995. Responses by four seabird species to a fluctuating availability of Cape Anchovy *Engraulis capensis* off South Africa. Ibis 137: 329–339
- Crowth J** 1988. Basic physical geography/hydro data for 'estuaries' of the western Cape (CW1-32). NRIO Data Report D8802. Council for Scientific and Industrial Research, Stellenbosch, South Africa
- Day JH** 1981. Summaries of current knowledge of 43 estuaries in southern Africa. In: Day JH (ed) Estuarine Ecology with Particular Reference to Southern Africa. pp 251–329. AA Balkema, Cape Town, South Africa
- Del Hoyo J, Elliot A and Sargatal J** (eds) 1992. Handbook of the Birds of the World, Vol. 1. Lynx Edicions, Barcelona
- Dodman T and Taylor V** 1995. African Waterfowl Census 1995. International Waterfowl and Wetlands Research Bureau, Slimbridge, United Kingdom
- Frost P and Johnson P** 1977. Seabirds on the Diamond Coast, South West Africa, December 1976. Cormorant 2: 3–4
- Genis O** 1998. Die Voorkoms van 'n Riooldamstelsel in die Oranjeriviermond Ramsarveiland — Bate of Las? MSc in Environmental Management Thesis, University of the Orange Free State, Bloemfontein, South Africa
- Grindley JR** 1959. Birds of the Orange River estuary. Ostrich 30: 127–129
- Heath R** 2001. Orange River mouth development plan. Pulles Howard and De Lange, Unpublished Report, Auckland Park, South Africa
- Hilton-Taylor C** 2000. 2000 IUCN Red List of Threatened species. International Union for Conservation of Nature and Natural Resources, Gland, Switzerland and Cambridge, United Kingdom
- Kahl MP** 1975. Distribution and numbers — a summary. In: Kean J, Düplax-Hall N (eds) Flamingos. pp 93–102. TAD Poyser, Berkhamsted
- Maclean GL** 1960. Records from southern South-West Africa. Ostrich 31: 49–63
- Manry DE** 1978. Some seabird observations from the Orange River estuary, South Africa/South West Africa. Cormorant 5: 17–18
- Morant PD and O'Callaghan M** 1990. Some observations on the impact of the March 1988 flood on the biota of the Orange River mouth. Transactions of the Royal Society of South Africa 47: 295–305
- National Water Act** (1988) Act No. 36 of 1988. Government Gazette No. 19182, South Africa, 201pp
- Noli-Peard KR and Williams AJ** 1991. Wetlands of the Namib coast. Madoqua 17: 147–153
- Orange River Environmental Task Group** 1989. Orange River Ecology. Assessment of environmental water requirement for the Orange River mouth. Report on Orange River Environmental Workshop Oranjemund 1989. Bruinette Kruger Stoffberg Inc Consulting Engineers, Pretoria, South Africa
- Plowes DCH** 1943. Bird-life at the Orange River mouth. Ostrich 14: 123–138
- Ramsar Convention Bureau**. 1999. Information Sheet on Ramsar Wetlands (RIS). Ramsar Convention Bureau, Gland, Switzerland
- Roberts L** 1989. Birds at Alexander Bay. Promerops 189: 6–7
- Rose PM and Scott DA** 1997. Waterfowl population estimates. 2nd edn. Wetlands International Publication 44. Wageningen, The Netherlands
- Ryan PG and Cooper J** 1985. Waders (Charadrii) and other coastal birds of the northwestern Cape Province, South Africa. Bontebok 4: 1–8
- Schwartzlose RA, Alheit J, Bakun A, Baumgartner TR, Cloete R, Crawford RJM, Fletcher WJ, Green-Ruiz Y, Hagen E, Kawasaki T, Lluch-Belda D, Lluch-Cota SE, MacCall AD, Matsuura Y, Nevarez-Martinez MO, Parrish RH, Roy C, Shust KV, Ward MN and Zuzunaga JZ** 1999. Worldwide large-scale fluctuations of sardine and anchovy populations. South African Journal of Marine Science 21: 289–347
- Seaman MT and Van As JG** 1998. The environmental status of the Orange River mouth as reflected by the fish community. Water Research Commission Report 505/1/98, Pretoria, South Africa
- Siegfried WR and Johnson P** 1977. The Damara Tern and other seabirds on the Diamond Coast, South West Africa, December 1977. Cormorant 3: 13
- Simmons RE** 1994. Namibia/Namibie. In: Taylor V and Rose P (eds) African Waterfowl Census 1994. The International Waterfowl and Wetlands Research Bureau, Slimbridge, United Kingdom
- Simmons RE** 1995. Namibia/Namibie. In: Taylor V and Dodman T (eds) African Waterfowl Census 1995. The International Waterfowl and Wetlands Research Bureau, Slimbridge, United Kingdom
- Simmons RE** 1996. Population declines, viable breeding areas, and management options for flamingos in southern Africa. Conservation Biology 10: 504–514
- Simmons RE** 1997. Southern Africa's Lesser Flamingos — a summary. In: Howard G (ed) Proceedings of East African Flamingo Workshop. International Union for Conservation of Nature and Natural Resources, Nairobi, Kenya
- Simmons RE** 2000. What is the world population of the Chesnutbanded Plover? Bird Numbers 9: 45
- Simmons RE and Allan DG** 2002. The Orange River avifauna: abundance, richness and comparisons. Ostrich 73(3&4): 92–99
- Simmons RE, Boix-Hinzen C, Barnes KN, Jarvis AM and Robertson A** 1998. Important Bird Areas of Namibia. In: Barnes KN (ed) The Important Bird Areas of Southern Africa. pp 295–332. BirdLife South Africa, Johannesburg, South Africa
- Simmons RE, Brown CJ and Williams AJ** (in prep). Birds to watch in Namibia: a red list. National Biodiversity Programme, Ministry of Environment and Tourism, Namibia

- Simmons RE, Cordes I and Braby R** 1998. Latitudinal trends, population size and habitat preferences of the Damara Tern *Sterna balaenarum* on Namibia's desert coast. *Ibis* 140: 439–445
- Swart DH, Morant PD, Möller JP, Crowley JB and De Wet A** 1988. A record of events at the Orange river mouth during the March 1988 flood. *South African Journal of Science* 84: 881–889
- Taylor PB, Navarro RA, Wren-Sargent M, Harrison JA and Kieswetter SL** 1999. TOTAL CWAC Report: Coordinated Waterbird Counts in South Africa, 1992–1997. Avian Demography Unit, University of Cape Town. Cape Town, South Africa
- Tree AJ** 1997a. Chestnutbanded Plover *Charadrius pallidus*. In: Harrison JA, Allan DG, Underhill LG, Herremans M, Tree AJ, Parker V and Brown CJ (eds) *The Atlas of Southern African Birds*, Vol. 1: Non-passerines. pp 380–381. BirdLife South Africa, Johannesburg, South Africa
- Tree AJ** 1997b. Avocet *Recurvirostra avosetta*. In: Harrison JA, Allan DG, Underhill LG, Herremans M, Tree AJ, Parker V and Brown CJ (eds) *The Atlas of Southern African Birds*, Vol. 1: Non-passerines. pp 434–435. BirdLife South Africa, Johannesburg, South Africa
- Turpie JK** 1995. Prioritizing South African estuaries for conservation: a practical example using waterbirds. *Biological Conservation* 74: 175–185
- Turpie JK, Adams JB, Joubert A, Harrison TD, Colloty BM, Maree RC, Whitfield AK, Wooldridge TH, Lamberth SJ, Taljaard S and Van Niekerk L** 2002. Assessment of the conservation priority status of South African estuaries for use in management and water allocation. *Water SA* 28: 191–205
- Underhill LG** 1997. Curlew Sandpiper *Calidris ferruginea*. In: Harrison JA, Allan DG, Underhill LG, Herremans M, Tree AJ, Parker V and Brown CJ (eds) *The Atlas of Southern African Birds*, Vol. 1: Non-passerines. pp 418–419. BirdLife South Africa, Johannesburg, South Africa
- Underhill LG** 1998. Redbilled Queleas breeding at the Orange River estuary. *Bird Numbers* 7(2): 23
- Underhill LG** 2000. Damara Tern. *Sterna balaenarum*. In: Barnes KN (ed) *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa, Johannesburg, South Africa
- Underhill LG, Oatley TB, and Harrison JA** 1991. The role of large-scale data collection projects in the study of southern African birds. *Ostrich* 62: 124–148
- Underhill LG, Tree AJ, Oschadleus HD and Parker V** 1999. Review of Ring Recoveries of Waterbirds in Southern Africa. Avian Demography Unit, University of Cape Town, Cape Town, South Africa
- Urban EK** 1984. Time of egg-laying and number of nesting Great White Pelicans at Lake Shala, Ethiopia, and elsewhere in Africa. In: Ledger J (ed) *Proceedings of the 5th Pan-African Ornithological Congress*. pp 809–823. Southern African Ornithological Society, Johannesburg, South Africa
- Velasquez C** 1996. Effects of aircraft on waterbirds on the Orange River estuary. Specialist study No. 14. Environmental Evaluation Unit Report No. 1196/158. Deep Sea Mining Environmental Impact Report, Debmarine, South Africa
- Venter A and Van Veelen M** 1996. Refinement of the Instream Flow Requirements for the Orange River and Orange River Mouth. Department of Water Affairs and Forestry Unpublished Report, Pretoria, South Africa
- Williams AJ** undated. Namib Coast seabird and wetland census — November/December 1993. Cape Nature Conservation Unpublished Report, Cape Town, South Africa
- Williams AJ** 1986. Wetland birds at the Orange River mouth and their conservation significance. *Bontebok* 5: 17–23.
- Williams AJ** 1990. Orange River Mouth Wetland. Directory of Wetlands of International Importance Data Sheet. Department of Environmental Affairs and Tourism Unpublished Report, Pretoria, South Africa
- Williams AJ, Steele WK, Cooper J and Crawford RJM** 1990. Distribution, population size and conservation of the Hartlaub's Gull *Larus hartlaubii*. *Ostrich* 61: 66–76
- Williams AJ and Underhill LG** 1997. Common Tern *Sterna hirundo*. In: Harrison JA, Allan DG, Underhill LG, Herremans M, Tree AJ, Parker V and Brown CJ (eds) *The Atlas of Southern African Birds*, Vol. 1: Non-passerines. pp 57–59. BirdLife South Africa, Johannesburg, South Africa
- Williams AJ and Velásquez C** 1997. Lesser Flamingo *Phoeniconaias minor*. In: Harrison JA, Allan DG, Underhill LG, Herremans M, Tree AJ, Parker V and Brown CJ (eds) *The Atlas of Southern African Birds*, Vol. 1: Non-passerines. pp 114–115. BirdLife South Africa, Johannesburg, South Africa
- Winterbottom JM and Courtenay-Latimer M** 1961. A list of the birds of Little Namaqualand. *South African Avifauna Series* 1: 1–46