Seasonal wetlands in Owambo and the Etosha National Park

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ABSTRACT

Wetlands in Etosha National Park and Owambo are the result of a complex endorheic drainage system and shallow basin topography. The Cuvelai drainage system which is fed by relatively high annual rainfall of the central Angolan highlands, extends into northern Namibia via a maze of shallow vegetated waterways and a few major channels which eventually drain into a primary impoundment (Lake Oponono) and a series of salt pans in Etosha N.P. The duration of wetland conditions is erratic and largely due to rainfall in the upper reaches of the system. When suitable conditions occur, vast numbers of birds, notably flamingos and pelicans, and fishes colonize ephemeral wetlands. Breeding by these and some sixty other bird species may occur sporadically, with the Etosha Pan being particularly important as the largest protected saline wetland in Africa, and one of only two regularly used mass breeding grounds for flamingos in southern Africa.

Large numbers of fish found during flood years contribute significantly to the local economy in Owambo. Despite a high degree of protection of major parts of the system in Etosha N.P., threats identified are, uncontrolled air traffic and resulting disturbance to breeding colonies of birds and the introduction of alien aquatic biota due to inter-basin water transfer. Application of sizeable amounts of DDT in Owambo has not resulted in serious deleterious effects. The value of seasonal wetlands in Etosha N.P. and Owambo centres on the biota present and aesthetic appreciation of the landscape, with the appropriate form of land use being tourism.

INTRODUCTION

Wetlands in Etosha National Park (hereafter referred to as Etosha) and Owambo are characterized by their ephemeral nature. Barren salt pans and dry water courses harbouring few life forms change suddenly into vast expanses of wetlands attracting millions of individuals of some bird and fish species. The duration of wetland conditions is largely dependent on the amount of water run-off in the upper catchment, which seems to vary from year to year. Flooding of the lower reaches of the drainage system is seldom observed and only by few people, due to the inaccessibility of the region during wet years. It is thus understandable that the majority of visitors regard the dry skeletal remains of the system as wasteland. This misconception is dangerous as it denigrates an important wildlife habitat and tourist attraction, and could be reflected in plans for developing Owambo. Any plans to alter the flood regime of the wetland system will have to be weighed against the existing benefits from the system, although some are not fully utilized at present.

Major changes to the system have already been caused by man, notably the artificial impoundment of water and the transfer of water from other basins into the Owambo-Etosha system. As long ago as the turn of the century, plans were made to channel the Cunene River into the Etosha Pan (Gessert, Schwarz, Spence in Stengel 1963), and man will no doubt in future again be tempted to tamper with the system. Seasonal wetlands in the region are internationally important as breeding habitat for birds. The Etosha Pan is particularly important, as it is possibly the largest protected saline wetland area in Africa (A.J. Williams, pers. comm.).

REGIONAL ACCOUNT

Potential wetland areas in this region are the characteristic salt pans of the Etosha Basin of the Kalahari Group (SACS 1980; Heine 1982; Momper 1982; Rust 1985). All pans are endorheic, and except for the larger ones, receive water from all directions via poorly defined drainage channels. Major channels are scarce due to the topography of the region, and even those draining into the Etosha Pan are less than 2 m deep when full (e.g. Ekuma, Oshigambo, Klein, Omathiya, Owambo: Plate 3). Salt pans are geomorphically very similar, and consist of a clayey substrate on calcrete, are shallow (<1 m), and hold water for variable periods at irregular intervals, entirely dependent on regional precipitation. Figure 1 shows the distribution of pans, and Table 1 presents the area of potential wetland in Owambo and Etosha. Only 30% of salt pans in the region occur in Etosha, but represent 86% of the total area.

TABLE 1: Number and area (km^2) of salt pans in Etosha National Park and Owambo (100 ha = 1 km^2).

Size class (km^2)	No. in Etosha N.P.	Total area in Etosha N.P. *	No. in Owambo	Total area in Owambo *	Total No.	Total area*
< 5	3	15	4	20	7	35
6-10	3	30	22	220	25	250
11-15	1	15	-	-	1	15
16-20	3	60	9	180	12	240
21-30	5	145	5	135	10	280
31-50	1	40	5	240	6	280
51-100	1	100	1	100	2	200
101-300	2	472	-	-	2	472
> 300	1	4760	-	-	1	4760
Total (%)	20 (30.3)	5637 (86.3)	46 (69.7)	895 (13.7)	66	6532

A vast number of smaller pans (there are only two larger than 100 ha i.e. Gobaub pans and Kwarikarib in Etosha) occur in the region, with a turf substrate on calcrete, and are generally not saline. Similar ephemeral impoundments occur in the form of shallow vegetated waterways (*oshanas*) grading into dry rivers (*omurambas*) with variable salinity (Omuramba Onaiso and Brakwater Omuramba in Etosha: Wellington 1938). Smaller impoundments have not been surveyed adequately, and are mostly known only from existing maps and aerial surveillance. Substrate types, depths and areas are therefore poorly known. It is not possible to estimate the area of smaller clay pans and *oshanas*, but these may occupy up to 20% of the surface area of parts of Etosha (4 000 km^2) and southern Owambo (10 000 km^2).

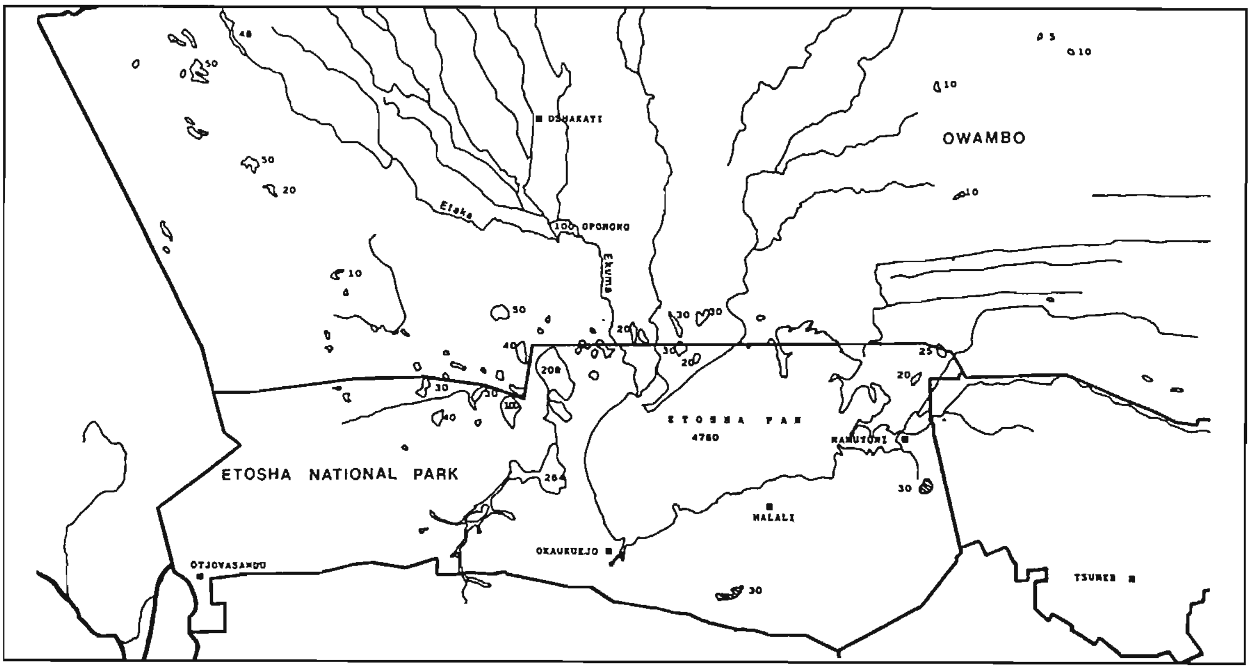

FIGURE 1: Distribution of salt pans and associated catchments greater than approximately 500 ha (5 km²) in Owambo and Etosha National Park (= salt pans, = clay pans.). Numbers indicate approximate area of some pans in km².

Clay pans and oshanas are thus estimated to cover at least 800 km² and 2 000 km² in Etosha N.P. and Owambo respectively.

DOMINANT ABIOTIC FACTORS

The hydrology of the region has been described by Stengel (1963) and van der Waal (1985a), and an account of the regional geomorphology is given by Rust (1985). The drainage basin represented in Owambo and the Etosha National Park is flanked by two major drainage systems, ie. the Cunene and Kavango, but has no direct links with these systems. A previous suggestion that the Cunene River was diverted away from the Etosha Pan by stream capture (Wellington 1938) was challenged by Rust (1985). Changes in the flood regime of the Etosha Pan from an inland lake to a barren salt pan were likely due to climatic changes.

Most of the water flooding into Owambo originates in the approximately 37 000 km² Cuvelai drainage system (Stengel 1963). The Cuvelai River arises in the highlands of central Angola, some 260 km north of the Namibia border, and forms a series of shallow waterways and swamps converging into Lake Oponono (= Lake Oussouk) via a major channel, the Etaka Omuramba (see van der Waal, this volume). Floodwaters reach Lake Oponono on average twice in three years (van der Waal 1985a), where the lake acts as a sump from which all water is lost through evaporation following major increases in salinity. "Lake" Oponono is a misnomer, as it is merely a collection of shallow (< 70 cm) pans and swamps which only form a continuous albeit ephemeral water mass during flood years (van der Waal 1985a,b).

In years of above average floods or *efundja* years, water from the Oponono complex floods into the Ekuma River, but only reach the Etosha Pan via the latter in exceptional flood years. There seems to be salinity gradient from south to north, but with local variations depending on the degree of flushing and dilution. Salinity progressively increases in the primary sump, ie, the Oponono complex, during dry spells, but flood waters reaching the Ekuma River and the Etosha Pan only turn brackish towards the end of the rainy season through evaporation and contact with previous evaporites.

The average annual rainfall of 400-500 mm in Owambo is relatively high for the country, and must contribute to the formation and maintenance of seasonal wetlands. Beyers & Katsiambirtas (1987) nevertheless found that sandy substrates and high evaporation rates lead to minimal run-off. They also found that annual variation in rainfall is less in Owambo than in other parts of Namibia, which argues against rainfall as a cause of erratic flooding of variable magnitude. Variable rainfall in the upper Cuvelai catchment, (on average > 1000 mm p.a.) is regarded as the determining factor regarding the duration and severity of floods in Owambo and the Etosha Pan (Stengel 1963).

Floodwaters also enter the Etosha Pan via its easternmost and slightly deeper tongue, known as Fischer's Pan. Virtually all waters flooding into the latter are transported by two channels, namely the Omuramba Omathiya and the Omuramba Owambo. The former drains the system of parallel vegetated dunes north-east of Fischer's Pan. The latter drains the northern aspect of the Otavi highlands north of Tsumeb. Both these areas can be regarded as part of the Etosha basin and both receive an average rainfall of 500-600 mm p.a. (van der Merwe 1983).

Fischer's Pan is flooded almost every year, but the amount of water received and the duration of wetland conditions vary from year to year (pers. obs.). Standing water in the Etosha Pan rarely occurs more than a month after initial flooding, except in years of exceptional floods when large portions of the pan might be covered in a shallow film of water until August (Berry 1972). Clay pans in Etosha may hold water for up to three months after the end of the rainy season.

DOMINANT BIOTIC FACTORS

The duration and amount of water in pans and oshanas are unpredictable, with consequently marked fluctuations in the diversity of biota associated with impoundments. Intra-african migrant birds and one palearctic migrant (white stork *Ciconia ciconia*) opportunistically visit impoundments, but only seven migrants commonly breed on salt pans, and one, the painted snipe *Rostratula benghalensis*: Table 2, breeds on clay pans (Sauer & Rocher 1966; Berry 1972; Berry et al. 1973; Berry &

Berry 1976; unpubl. departmental records; pers. obs.). At least 25 and 15 nomadic-cum-resident species breed on or near salt and clay pans respectively. Seasonal wetlands also provide suitable breeding opportunities for a further two migrants and 18 residents, but actual breeding by these species has not been recorded. Sixty species of birds, mostly waterbirds, might therefore sporadically breed on seasonal wetlands in the region.

TABLE 2: Breeding birds associated with seasonal wetlands (Records of breeding from unpublished departmental records and pers.obs.)

Substrate	Migrant	Nomadic-Resident
Salt	greater flamingo	greyheaded gull
	lesser flamingo	saddlebilled stork
	white pelican *	grey heron *
	sacred ibis *	blackheaded heron
	glossy ibis *	avocet
	African spoonbill*	blackwinged stilt
	banded martin	dabchick
		redknobbed coot **
		lesser moorhen
		Egyptian goose
		maccoa duck
		yellowbilled duck
		Cape teal
		whitefaced duck
		southern pochard
		blacknecked grebe
		blacksmith plover
		chestnutbanded plover
		threebanded plover
		Kittlitz's plover
		crowned crane
		blue crane
		ostrich
		reed cormorant*
		whiskered tern
Clay	painted snipe	avocet
		blackwinged stilt
		dabchick **
		Egyptian goose **
		spurwing goose
		African shellduck
		whitefaced cuck
		redbilled teal **
		knobbilled duck
		Cape teal
		moorhen
		blacksmith plover **
		threebanded plover **
		Kittlitz's plover
		blue crane

* Species also breed in less saline water such as Lake Oponono
** Species also breed in other waters, including perennial springs

Breeding of migrants suspected:[1] dwarf bittern, openbilled stork

Breeding of nomadic-resident birds suspected:[1] darter, purple heron, great white egret, little egret, yellowbilled egret, black egret, cattle egret, greenbacked heron, blackcrowned night heron, little bittern, fulvous duck, whitebacked duck, black crake, Baillon's crake, whitefronted plover, wattled plover, Ethiopion snipe, Cape wagtail.

[1] C. Brown (pers.comm.) (Private Bag 13306, Windhoek 9000)

The Etosha Pan is the only known, regularly used, mass breeding ground for flamingos in southern Africa. Berry (1971) recorded 1,05 x 10^6 flamingos on the Etosha Pan (predominantly lesser flamingos *Phoenicopterus minor*) of which at least 10% bred. Breeding seems to coincide with regional rainfall of greater than 500 mm p.a. and seven breeding episodes have occurred since 1956 (Berry 1972; pers. obs.).

Large numbers of young fish migrate from the upper perennial sections of the Cuvelai River during floods and rapidly colonize the maze of shallow waterways and large impoundments created by flooding. Local people utilize this bounty, and in one survey up to 4 200 kg of fish were caught in a 30 km section in central Owambo in one day, during an *efundja* flood (van der Waal, this volume). The total harvest is unknown, but it is a significant contribution to the local economy and diet (van der Waal 1985a, b this volume). All fish eventually die as floods recede, except in some artificial impoundments and this is one instance where total exploitation of fish stocks can be done every year without any harm to the system. Although *efundja* floods occur twice in three years, large numbers of fish are apparently only found once in three years.

The number of fish species (n) found in the system increases from the Etosha Pan (5) northwards to the Oponono complex (7), *oshanas* in the Cuvelai system (12) and artificial impoundments and canals (21-36) (Berry et al. 1973; van der Waal 1985a,b this volume). Fish species occurring in the Etosha Pan and Oponono complex are mostly euryhaline, with typical freshwater species occurring further upstream in the Cuvelai system. Fourteen fish species from the Cunene system have been introduced to the Cuvelai system via inter-basin water transfer, but these introductions were apparently short-lived. Some of the Cunene system species have nevertheless, colonised perennial artificial impoundments from where the upper sections of the Cuvelai may be invaded (van der Waal, this volume). No further information is available on the dependence of other vertebrates on wetlands in the region, other than opportunistic drinking and feeding by a large variety of species equally at home elsewhere.

RESOURCE EVALUATION

As explained elsewhere in this edition, wetlands in the region were rated in terms of resource and system values, as part of an attempt to formulate a national wetland conservation strategy. Table 3 presents this evaluation as based on the limited information available on wetlands of the Etosha-Owambo region. Animal components of wetland systems, as well as direct exploitation of the system by humans for aesthetic and socio-economic reasons account for the highest values (Table 3).

TABLE 3: Qualitative evaluation of regional wetlands in Owambo and Etosha National Park in terms of resource and systems values (H = high value, M = medium, L = low, ? = unknown).

	Salt Pans Etosha Pan	*Salt Pans* Smaller pans	Oponono complex	*Oshana* complex	Major channels	Clay pans
Resource values						
Water	L	L	L	L	L	L
Soil	L	L	L	L	L	L
Salt	M	M	L	L	L	L
Animals	H	H	H	H	H	H
Plants	L	L	L	L	L	L
Peat	L	L	L	L	L	L
Endangered species	H	H	H	?	?	?
System Values						
Flood attenuation	M	M	M	M	L	M
Aquifer recharge	H	M	M	M	M	L
Water quality modifier	H(-) *	H(-)	H(-)	?	M(-)	?
Aesthetics	H	H	H	H	H	H
Social attributes	H	H	H	H	H	H
Atmospheric modifier	?	?	?	?	?	?

* reduces quality substantially through salination

CONSERVATION PROBLEMS

Limited extraction of salt occurs on Saltpans No. 1 and 2 (Otjivalundu, north of Etosha), which was the reason given for the deproclamation of approximately 1500 km² of Etosha N. P. in the 1970's. Mudstone and stromatolite deposits were previously exploited on the Etosha Pan near Namutoni, but are presently protected in terms of the Masterplan for Etosha (1987). Previous interference with drainage of pans in Etosha (Charl Marais Dam; Brakwater Dam) have been corrected and further interference is prohibited. No major threats from development exist in Etosha, except injudicious scarring of pan surfaces by vehicles, which might promote wind erosion by destruction of salt crusts, and minor effects on drainage by existing roads.

Major omurambas and pans in Owambo are used as dry season access routes, including heavy military vehicles. Potentially valuable vertebrate fossil deposits in Karroo outcrops exposed in e.g. the Ekuma River in Etosha might be progressively destroyed. No detailed paleontological survey has yet been done in the area, despite requests to this effect.

Disturbance caused by commercial fishing ventures at Lake Oponono may harm breeding attempts by pelicans and other species (Berry et al. 1973), but the overall development of a fisheries industry based on semi-permanent impoundments might benefit pelicans and other birds in the region. A far more serious threat to breeding birds exists through the increasing air traffic in the region. Three landing strips on the southern edge of the Etosha Pan service the three tourist camps on Etosha, and the Etosha Pan is on the major routes between the population centres in Owambo and elsewhere in the country. In the "Regulations relating to Nature Conservation" (Government Notice 240 of 1976), regulation 25A(2) prohibits any aircraft flying at an altitude of less than 1000 m a.g.l. over a game reserve, unless for the purpose of legal landings and take-offs. This regulation is virtually impossible to enforce and is widely ignored. The most serious effects of low-flying aircraft is the disturbance of breeding flamingos leading to desertion of nests (Berry 1972). This happens at the time when the Etosha Pan is flooded and thus also most attractive to persons in aircraft.

Berry (1972) found average levels of the insecticides DDT (and metabolites DDE, DDD) of 0.3 ppm, dieldrin 0.03 ppm and BHC (αßδ), 0.03 ppm in flamingo eggs from the Etosha Pan. He records that 120 tons of DDT were used by health officials in Owambo to combat malaria vectors in 1971. Berry et al. (1973) found average levels of DDT:0,665 ppm, dieldrin: 0.1 ppm, BHC:0.057 ppm in pelican eggs from the same area, which demonstrates the concentration of insecticidal residues progressively up in the food chain. Far lower levels of pollutants were found in soil collected between the Oponono complex and Etosha Pan during a recent study (C.J. Brown, pers. comm.) and it seems that the levels recorded by Berry (1972) and Berry et al. (1973) in eggs resulted from contamination elsewhere in Africa. Berry (1972) mentions that Lake Nakuru in Kenya has previously been implicated in insecticidal residues in flamingos. Despite the large amounts of residual insecticides recently applied in Owambo (approximately 500 000 dwellings were sprayed using 30 000 - 50 000 kg of a 75% solution of DDT per year from 1985 - 1988; C.J. Brown, pers. comm.), small amounts are flushed down to the lower reaches of the drainage system. Low gradients, minimal run-off due to sandy substrates, and comparatively gentle flooding might account for this, but surface temperature and exposure to ultra-violet light on salt pans could enhance the denaturization and vaporization of DDT in particular (C.J. Brown, pers. comm.)

Transfer of water from the Cunene to the Cuvelai system has already resulted in the introduction of fish species formerly not present in the latter system. The implications of inter-basin water transfers are far-reaching and further investigation might well show additional deleterious effects (Petitjean & Davies 1988). An urgent study is required to confirm the presence of alien species in the Cuvelai system, particularly the upper perennial reaches. Van der Waal (1985a, b, this volume) also reported the presence of *Oreochromis mossambicus* in *oshanas* near Oshakati in Owambo, possibly as the result of inadvertent releases from a commercial fish production unit. This species is renowned for its propensity to hybridize with closely allied species such as *O. andersonii*. An urgent survey is required to determine the distribution of *O. mossambicus* in Owambo and the Cunene system.

DISCUSSION

Some 86% of the saline pan wetland area in the entire region has been afforded the highest degree of protection in Etosha. The Masterplan of this park prohibits vehicular traffic on all pans (except two routes) except for research purposes, and any interference with the drainage systems associated with salt pans. It is unlikely that further development in Owambo should directly affect saline pans, except agricultural and urban pollution, which should be monitored. Lake Oponono (and the northern edge of the Etosha Pan outside the park in Owambo), however, forms an integral part of the hydrology of the region with the other major waterways and pans in Etosha.

It has been formally recommended that some measure of conservation status be given to the area immediately north of the Etosha Pan (Bigalke 1964; Berry 1980; Lindeque 1988) as the area is used by migratory ungulates from Etosha. Any such conservation measure would further protect the major omurambas and the Oponono complex. This issue should be raised again in view of possible political changes in the region.

The regulation prohibiting low-flying aircraft has been shown through experience to be worthless. Additional measures are called for, including a public awareness campaign aimed at military and scheduled air carriers, but particularly at private aircraft operators. Similar steps have to be taken to prevent disturbance at breeding sites outside game reserves, such as the Oponono complex, when mass breeding by one of the sporadically breeding bird species occurs.

The value of seasonal wetlands in Etosha and Owambo centres, on the biota present and aesthetic appreciation of the landscape. The most beneficial long-term form of exploitation of these wetlands by man seems to be tourism, as already practised in Etosha. Some bird species, specifically those that add massive tourism appeal to the wetlands, are sensitive to disturbance and require protective measures. Visits to breeding colonies of birds on the Etosha Pan should never be contemplated as a tourist attraction, and even monitoring work by staff has to be strictly controlled.

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Plate 3(a). The salt-encrusted Ekuma River, the main northern feeder of the Etosha Pan. The pools may remain year-round, but flow only occurs in high rainfall years. © M. Lindeque. See Lindeque & Archibald, this volume.

Plate 3(b). Wetland vegetation remains year round in the Hoarusib River valley. Like other west coast rivers in Namibia, dune sand constantly threatens to engulf such rivers. © R. Simmons. See Loutit, this volume.