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DUNE SANDS, OCEAN CURRENTS AND MAN: NAMIBIA'S DYNAMIC COASTLINE

John Ward and Mary Seely

Sea levels will rise over the next few decades in response to global warming from the greenhouse effect.

With roughly thirty per cent of the world's population living within a stone's throw of an ocean, coastlines and the processes shaping them should influence how we use these areas. This issue becomes crucial, considering expectations that sea levels will rise over the next few decades in response to global warming from the greenhouse effect.

Scientists predict that sea levels may rise half a metre to a metre merely from the thermal expansion of the ocean water. Consequently, coastlines as we know them today could well be modified dramatically by this change. This would be particularly noticeable on sandy shorelines such as much of the Namib coast which, in places, back onto some of the most spectacular dunefields in the world.

Sand dunes are important components of coastal systems worldwide. Not only are areas with coastal dunes of great natural beauty, they are invariably heavily used and often exploited by man. Consequently their conservation and management should receive high priority in the coastal development schemes of all countries. This message was highlighted at the international DUNES '89 conference held in Swakopmund, Namibia, during August 1989.

DUNES '89, held under the auspices of the Desert Research Foundation of Namibia – a private trust in Namibia that promotes natural science research – provided the opportunity for 140 delegates from 15 countries to discusss a variety of dune related topics. Similarities and differences between coastal dunes and desert dunes were considered from geomorphological, botanical, zoological and

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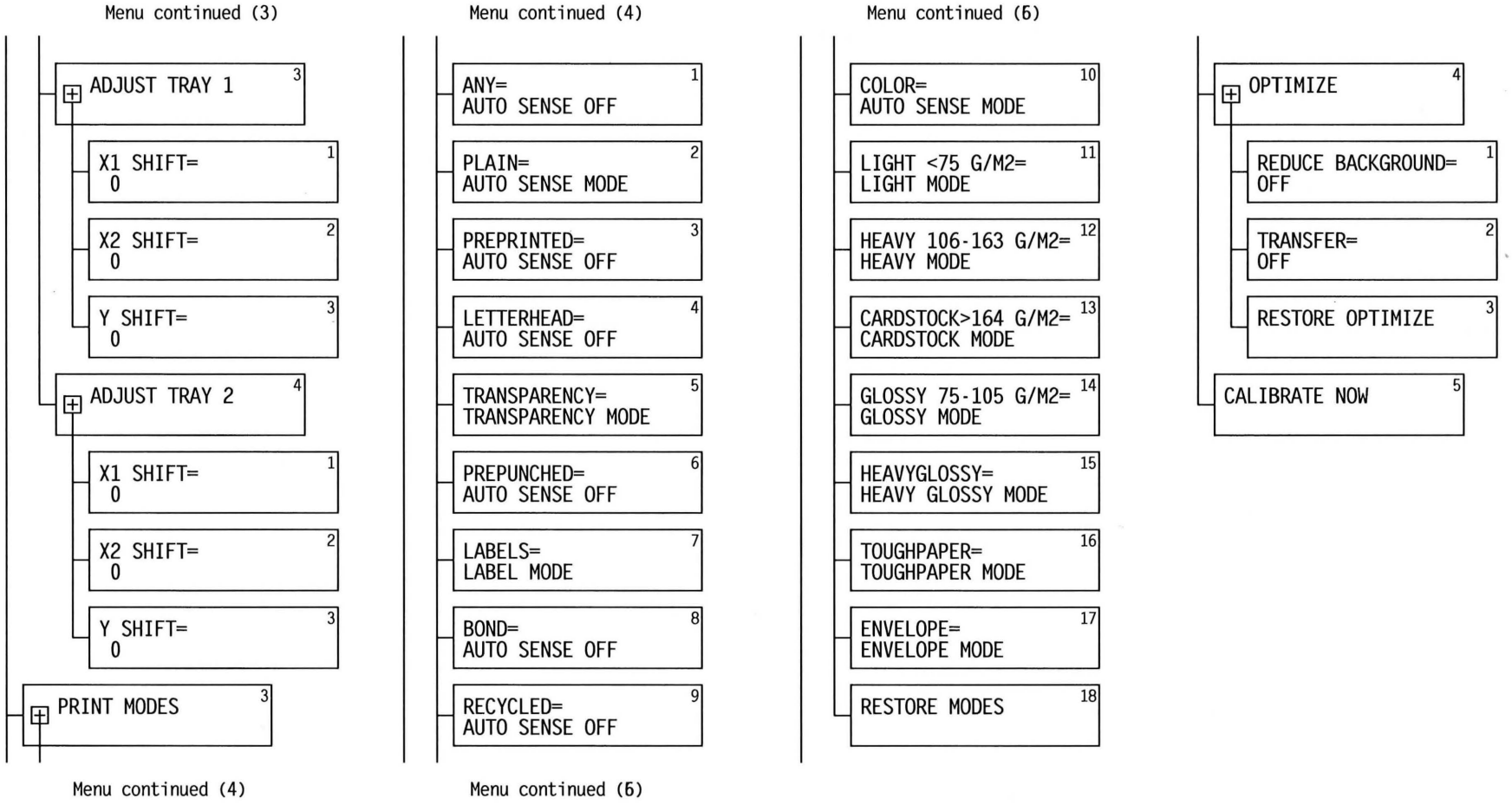

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conservation points of view.

As valuable as the conference itself, were three field excursions that introduced some of the delegates to the wide variety of dune types and their unusual fauna and flora in the central Namib.

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The delegates were exposed to the fossil dune systems that underlie the modern dune desert. Among these were ancient, 180 million year old fossil dunes of the Gondwana desert that crop out in Damaraland, as well as the younger 20 to 50 million year old desert deposits that underlie the main Namib Sand Sea.

Significantly, the participants came from diverse backgrounds, and included academics, conservationists and industrialists. The oil and gas industry was well represented, not unexpectedly, as many of the world's hydro-carbon reserves are trapped in ancient sand dune deposits.

Although the conference was broad-based, delegates from the many disciplines found common ground in the conservation and management of dune systems, particularly those of the sensitive and usually well-populated coastal areas. Because of the low population density of Namibia, many delegates to DUNES '89, especially the 50 or so from overseas, were surprised at the comparatively heavy use to which the central Namib coast

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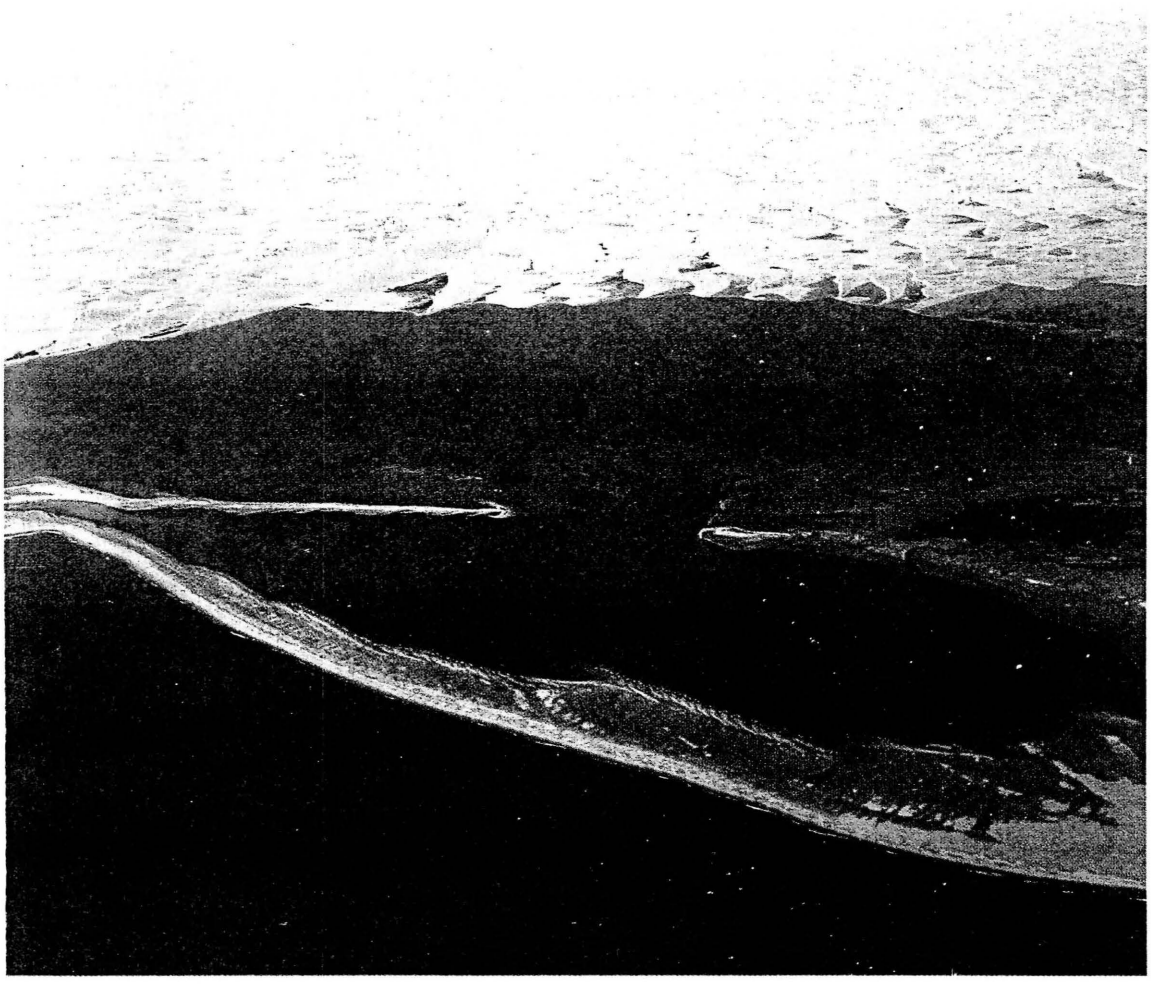

1. *Houses on the North Dune of Henties Bay have been built in the path of an active sand stream.*
2. *Over two years the outer sand spit developed from the south in an eastward-trending arc towards the mouth of Sandwich Harbour. Sediment was transported along this sand-spit into the mouth contributing to the formation of the flood tidal delta. Moreover, an additional cut-off lagoon was formed by this sand-spit. Oblique aerial view to the southeast.*
3. *Delegates at the DUNES '89 CONFERENCE against a backdrop of coastal dunes fronting on the Swakop River.*

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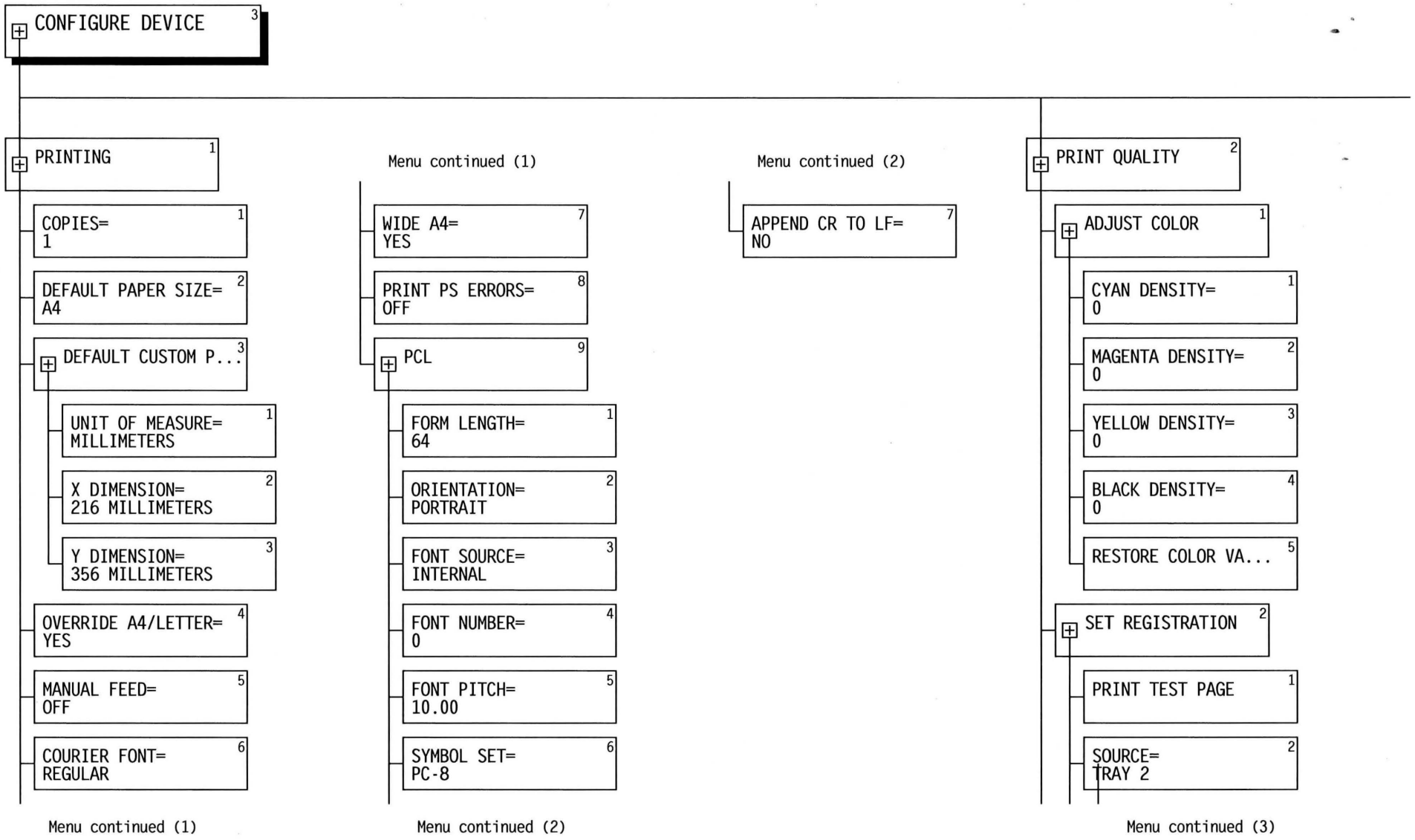

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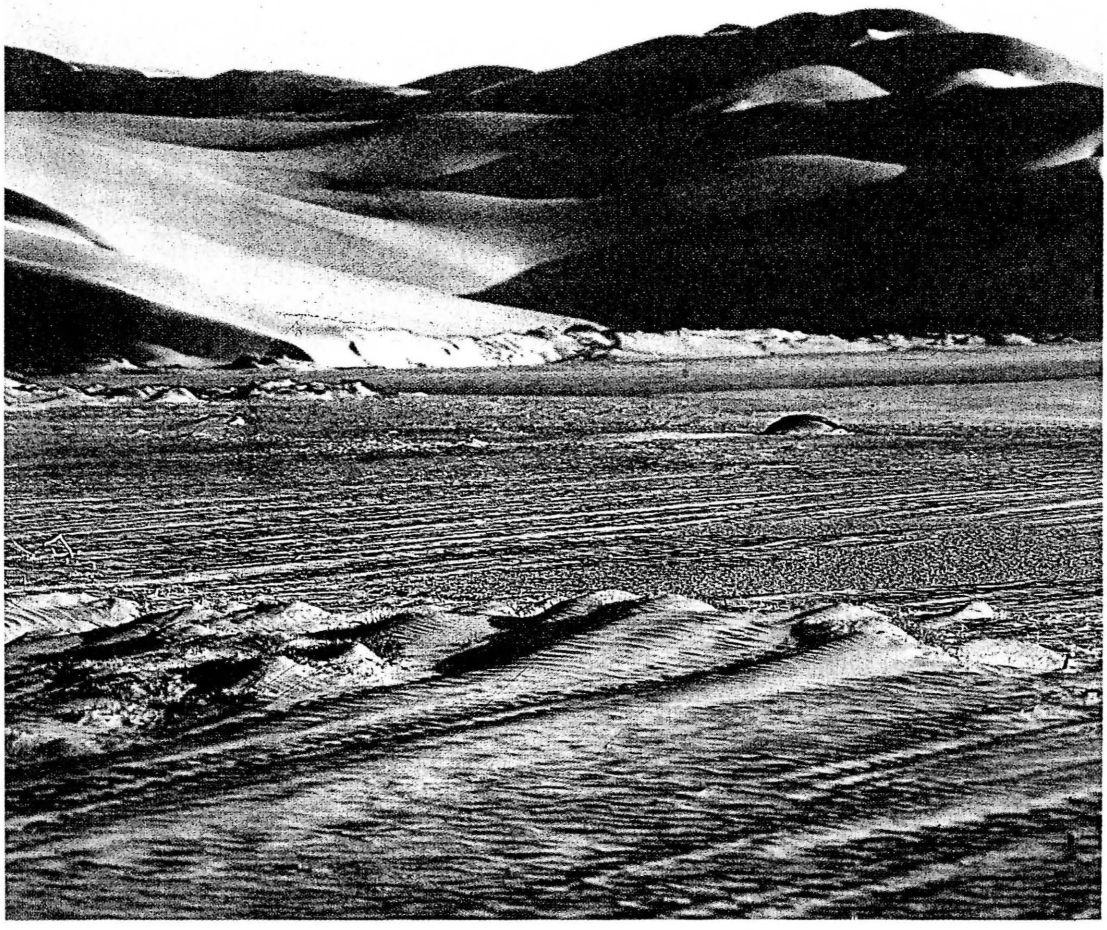
– including the dunes – is subjected. This region, stretching from Sandwich Harbour northwards to the Ugab River, is the focus for extensive recreation and residential development. An appreciation of the changes in configuration along the central Namib coast is of considerable importance, particularly when viewed in the light of experience gained elsewhere in the world.

4

This has led to the Geological Survey Department of Namibia running an observation programme to monitor changes in the coastline at selected places along the central Namib coast. Oblique and vertical aerial photographs of these areas are taken at altitudes ranging from 200 to nearly 3 000 metres. Weather permitting, the flying is undertaken around the low spring equinoctial tides when sedimentary features such as sand banks and tidal channels are best exposed. The Geological Survey is thus building up a record of the position and shape of the coast at certain localities – information that will be necessary for rational development along the central Namib coast in the future.

6

Preliminary results reveal a number of dynamic processes interacting to shape the coastline of the central Namib. The principal factors are the southwesterly winds – which drive the powerful northward-directed longshore drift, the northeasterly berg winds, the sediment supply, and the orientation of the coastline. Several case studies outlined here show how these processes operate in the central Namib.



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4. *An oblique view of of the Namib Desert south of Swakopmund taken from an altitude of 300 kilometres with a hand-held camera out of a spacecraft.*
5. *A beach is forming rapidly today where salt marsh prevailed 13 years ago.*
6. *An oblique aerial view of the flood tidal delta in Walvis Bay lagoon with sand bars and tidal channels well exposed at low equinoctial tide.*
7. *Holiday flats on ancient dunes at Mdhloti Beach, Natal coast.*
8. *An oblique aerial view of the Mole at Swakopmund. Note the wave pattern in response to the southwesterly wind.*
9. *Steve Fryberger, USA-based oil consultant, explaining dune processes to DUNES '89 excursion participants at a fossil dune locality in Damaraland.*
10. *During strong northeasterly winds dune sand accumulates rapidly around, and on, buildings and walls.*

An unusual situation where the northeasterly berg wind, in contrast to the more frequent southwesterly wind, influences dune sand movement and coastal erosion is illustrated clearly at the town of Henties Bay. This small coastal resort 70 kilometres north of Swakopmund has developed rapidly in the last few years. This boom has seen a proliferation of houses on both North Dune and South Dune – the two residential areas on either side of an old course of the Omaruru River.

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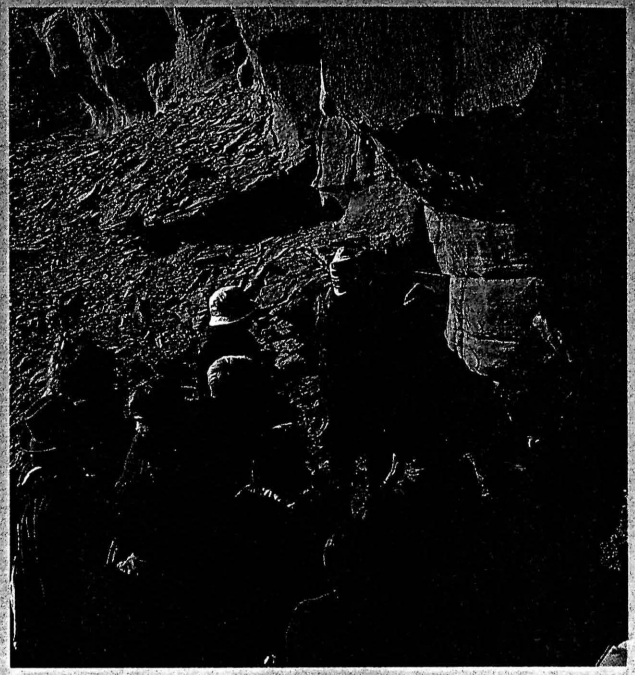

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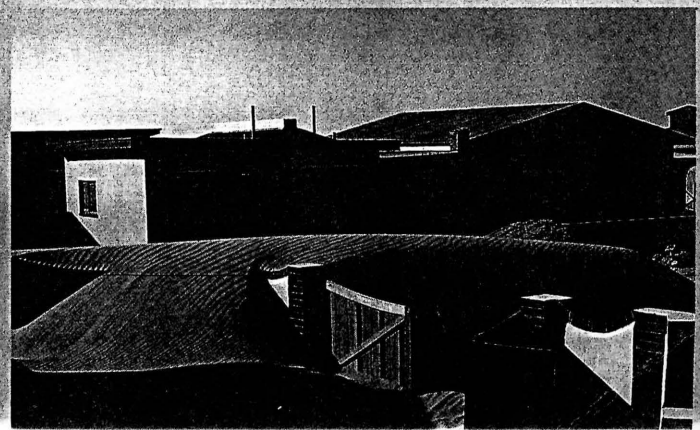
On the North Dune, houses have been erected, unwittingly, at Henties Bay. Under These accumulations of sand cause considerable incovenience to the North Dune residents, collapsing garden walls and even roofs. Although this appears to be a costly nuisance, this mobile dune sand actually plays an important role in stabilizing the potentially erodable coast starvation. To prevent this coastal erosion, the accumulations of dune sand around the houses should be dumped over the sea-facing cliff to simulate, as closely as possible, the natural process.

The importance of rivers supplying sediment to the coast, albeit at irregular intervals, to counteract beach erosion is demonstrated at



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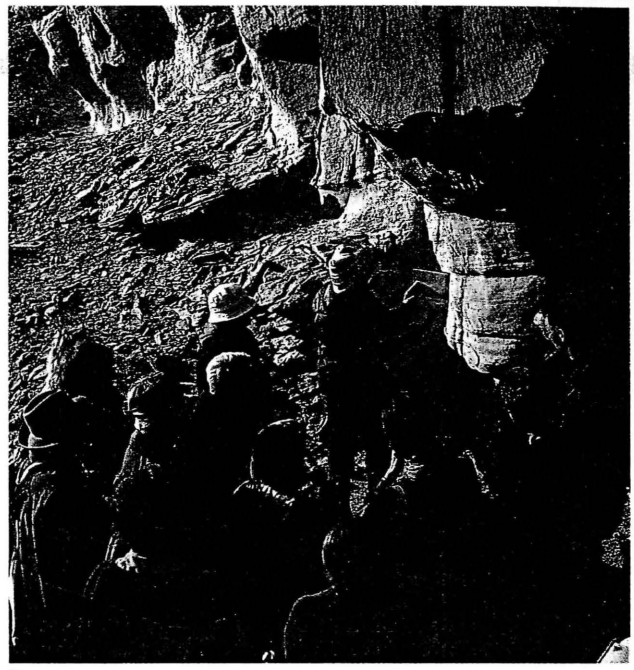

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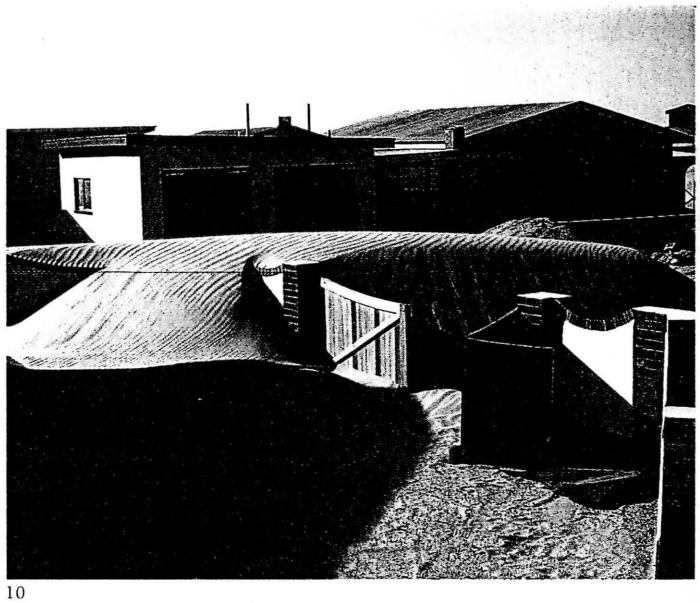
On the North Dune, houses have been erected, unwittingly, in the path of wind-blown sand. This path, or sand stream is active on those occasions when the northeasterly berg wind blows – mainly in the winter months. During these northeasterlies, river-deposited sand is blown viciously out of the course of the lower Omaruru, across the gravel plains and into the northern part of Henties Bay. Where obstacles – such as houses and walls are in the path of the moving sand, dunes build up. These accumulations of sand cause considerable incovenience to the North Dune residents, collapsing garden walls and even roofs. Although this appears to be a costly nuisance, this mobile dune sand actually plays an important role in stabilizing the potentially erodable coast at Henties Bay. Under normal circumstances, that is without houses to obstruct sand movement – this Omaruru-derived sediment would blow over the sea-facing cliff forming a dune drape that protects this cliff from wave undercutting. Thus the shoreline at Henties Bay, which has been apparently stable for at least the last 40 years, may well retreat because of sand starvation. To prevent this coastal erosion, the accumulations of dune sand around the houses should be dumped over the sea-facing cliff to simulate, as closely as possible, the natural process.

The importance of rivers supplying sediment to the coast, albeit at irregular intervals, to counteract beach erosion is demonstrated at Swakopmund. The small embayment formed behind the Mole in Swakopmund is a popular tourist beach. The erosive power of the longshore drift, under the influence of the southwesterly wind, is enhanced on the northern side of any solid promontory



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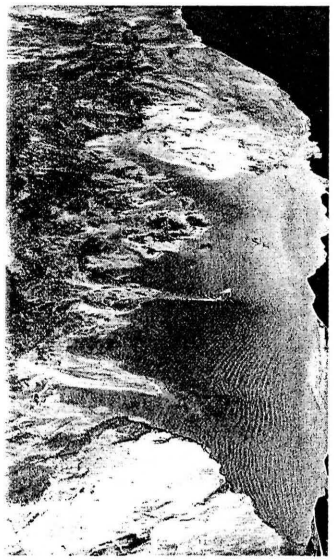

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4. *An oblique view of of the Namib Desert south of Swakopmund taken from an altitude of 300 kilometres with a hand-held camera out of a spacecraft.*
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projecting into the sea. The beach at the Mole is therefore constantly undergoing erosion, except when there is an excess of sediment entrained by the longshore drift. Under these conditions, deposition occurs in such embayments and the beach builds seawards. This occurs when the Swakop River floods strongly into the sea and a large sand bank is formed off the mouth, which happened in 1985.

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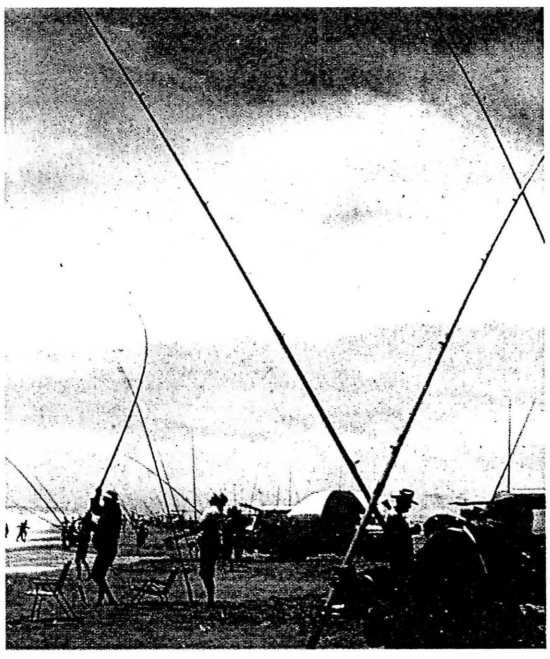
Wave action reworks this river-deposited sediment, the bulk of which is caught up in the longshore drift and deposited in the Mole some 7-8 months later thereby replenishing the beach sand. This, however, is only a temporary phenomenon and continued erosion, without further replenishment, causes the beach to retreat again. This dynamic interplay of coastal processes and sediment input from the hinterland can seriously affect the size and also the tourist potential of Swakopmund's beaches.

The most spectacular example of dynamic coastal processes acting along the Namib coast can be seen at Sandwich Harbour, a natural lagoon 40 kilometres south of Walvis Bay. This 10 kilometres long lagoon was used by whalers and other ships from the late 1700's until the 1930's. Intermittently during this period, as in the late 1950's and early 1960's, the mouth of the lagoon was closed by a sand spit. However, for the last two decades the mouth has been open and the lagoon has changed dramatically. The south end of the lagoon, which is 6-8 metres deep, has been largely cut off from the northern part by a plug of marine-deposited sand in the form of a flood tidal delta. This subaqueous body of sand is fed from the longshore drift that would normally carry sand northward along the central Namib coast from the Kleine Lange Wand.



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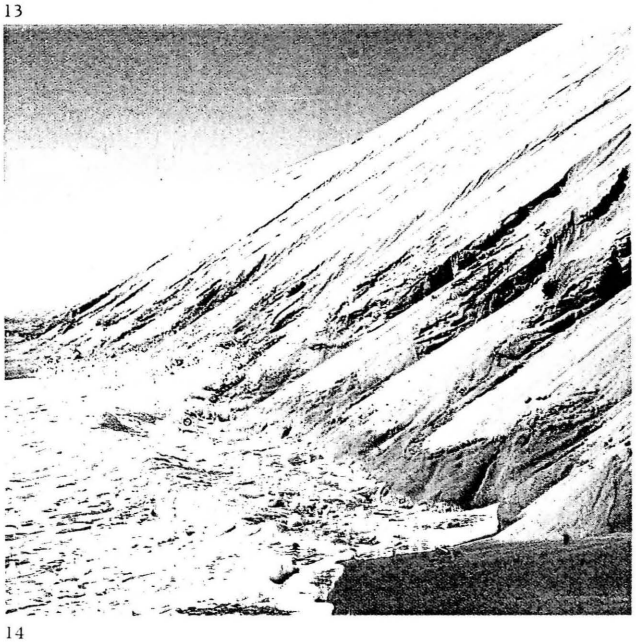

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11. *Large transverse dunes flanking Sandwich lagoon on the central Namib coast.*
12. *Much of the central Namib coast is heavily used for recreation.*
13. *Marine-cut cliffs in ancient Augab delta deposits.*
14. *Sea lapping the cliff cut in ancient Omeruru River delta deposit – Henties Bay.*
15. *A high-altitude oblique aerial view of Sandwich Harbour.*
16. *Compare this oblique aerial view of the northern end of Sandwich Harbour taken in January 1979 with the next one taken in March 1989. Note the considerable landward migration of the beach barrier bar in ten years which has eliminated the number of open pools and a large proportion of the vegetated salt marsh. View to the north; arrows indicate the same open pool that has persisted for the past 10 years.*

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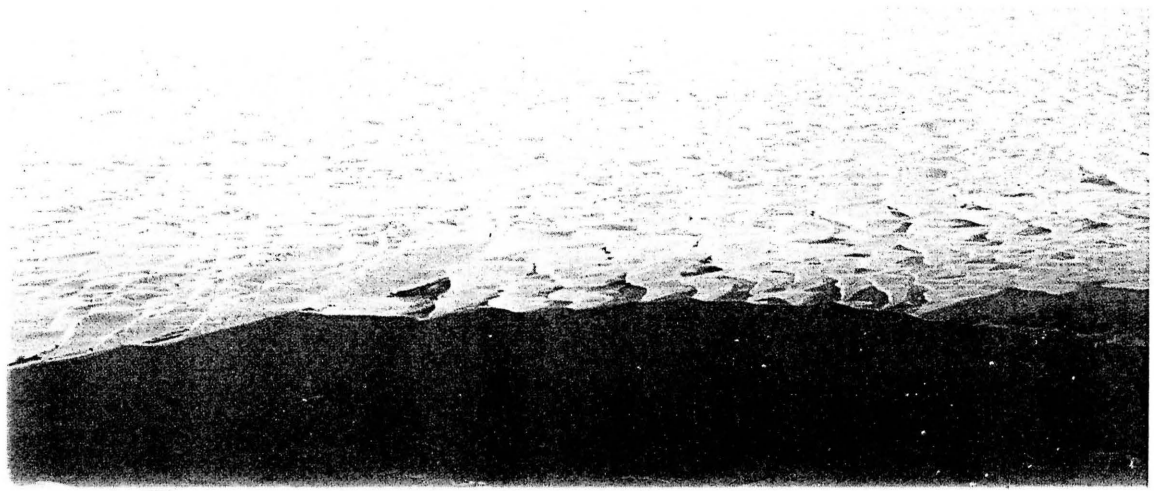

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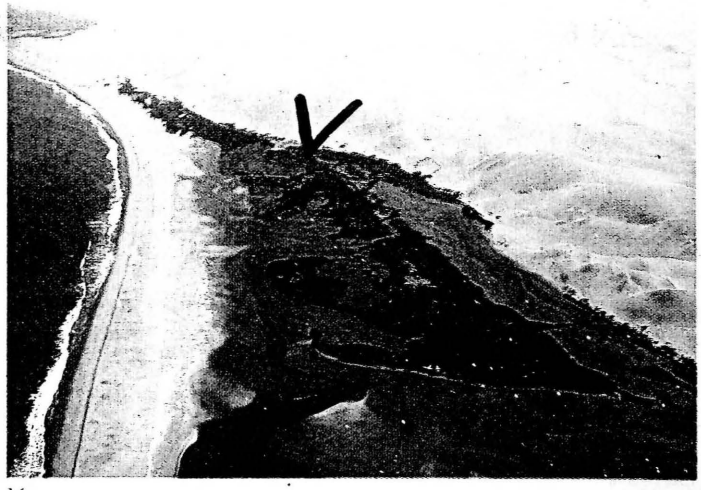
In recent years, the enlarged mouth of Sandwich Harbour appears to have caused a diversion of the usual northward movement of the sediment, facilitating deposition into the southern part of the lagoon. Consequently, the northern sand-spit has been starved of sand, causing this beach barrier to move rapidly landwards. This beach bar has moved 400 metres eastwards in the last decade, eliminating vegetated salt marsh and open fresh-to-brack-water pools in the northern part of the lagoon. At the present rate of movement, the renowned bird habitat of northern Sandwich Harbour could change to a hostile beach within the next few years. These changes could well be part of the natural processes operating on an extremely sandy part of the central Namib coast, but any further rise in sea level could reduce Sandwich Harbour to a mere fraction of its former glory.

It is long-term monitoring programmes, such as the one operating along the central Namib coast that will contribute significantly to a better understanding of our dynamic environment. This information can help predict more accurately the consequences of any changes wrought by global-scale processes – such as the greenhouse warming – that are expected over the next few decades. Conferences such as DUNES '89, with their international and interdisciplinary approach can enable local scientific information to be appreciated fully in the global context.

17. *An oblique aerial view looking north into the northern end of Sandwich Harbour, March 1989.*
18. *The flood tidal delta forms a plug into the southern end of Sandwich lagoon effectively cutting off that sector from the north. View to the west with the ends of the southern spits visible at the top of the picture.*



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