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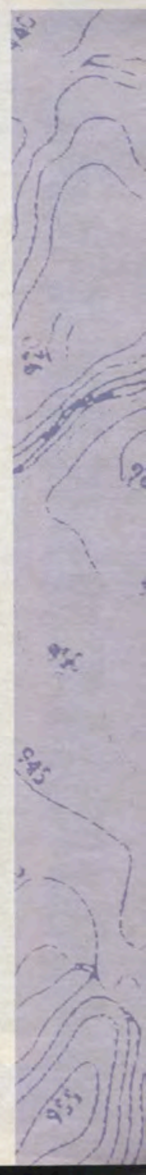
Spying on the **'sea of land'**

Following in the footsteps of earlier European explorers, Swedish scientist **Thomas Gumbricht** made use of a US spy plane to predict where the mysterious, inconsistent waters of the Okavango Delta will go next.



From the low vantage of a *mokoro* the Okavango is all reeds. Risk standing in one of these notoriously unstable craft and you'll see for miles. Make for an island and climb a termite mound, and your line of vision stretches to the horizon. But if you want to get information on the annual flooding of the Delta and the changes this brings, the only practical way is to use satellite images.

Once you've got the photos, you've got to interpret them. This means collecting data on the ground – or water in this case – to relate the colours in the images to reeds, papyrus, hippo grass, various sedges, palms, mopane, acacia and so on. Which is how a Swede was splashing about in a swamp half a world away from home. But I felt I had a connection: one of the first Europeans to explore the Okavango Delta was Charles-John Andersson, a fellow countryman.

In 1853 Andersson was following David Livingstone, who had visited Lake Ngami four years earlier – the first European to do so. When the Scottish missionary-explorer passed this way, Ngami, which is fed by the Thaoge Channel, was a huge body of water. By the time Andersson reached it four years later, it had already shrunk considerably.

Lake Ngami is typical of the Delta – an endlessly changing body of water that not only ebbs and flows with the seasons, but over time has changed direction. This inconstancy doesn't make it easy to study. Nor do the hippos.

The first time we stopped to take some measurements we had just passed a pod of them. As one of the cantankerous animals was heading for us, the motorboat driver discovered he'd dropped the gear handle. With the engine in gear it couldn't be started. Luckily, we were carrying some pliers for the GPS antenna. . . . After that we chose our measurement sites well away from hippo pools.

I was working with the Wits University Okavango Research Group to create a model for forecasting how changes in climate and human activity will affect the annual flooding of the Okavango. The project received a boost in 2000 when Nasa came to Polokwane to test its Terra satellite – the most advanced civilian satellite available – together with a civilian version of a U2 spy plane, and Professor Harold Annegarn at Wits persuaded them to photograph the Okavango.

We were the ground survey team working to tie in with the overflight. It took us a year – and several more trips – to turn the results of the surveys and the satellite and spy images into maps of the vegetation and islands of the Okavango.

That the area of flooding has changed dramatically over living memory has been proved by weather satellite images going back to 1972. We now know for sure that floods in the 1970s were larger, with a gradual decline reaching an all-time low in 1996. But since then it seems that

Beyond the Panhandle, the Okavango Delta is really an alluvial fan, formed by the waters carrying and depositing sand equally over a huge area. From space this is obvious, but from a *mokoro* it's all water, reeds and big beasts.

flooding is increasing again. The 2000 flood was large but shallow – it was fed from direct rains over the Okavango and not from waters from the Angolan highlands.

The typical flooding pattern shows the Okavango Delta is at its smallest during the summer rainy season and at its largest in the dry winter. The great ecological value of the Okavango is that the flood is at its peak when the Kalahari is at its driest.

The Okavango's waters rise in Angola and reach the entry channel to the Okavango, the Panhandle, around February each year. It takes the floodwaters a further five months to make their way through the entire swamp system, drop by painstaking drop, down to the Thamalakane River, which flows past Maun. By then waters from the outer fingers of the swamp have begun to flow back into the channels.

Topographic maps of the Okavango reveal some striking features, among them the arcs formed by the contour lines. These semicircular elevation lines have a common centre exactly where the Okavango River divides into the Thaoge and Nqoga channels – at the end of the Panhandle and the beginning of the Delta. These semicircles confirm that the Delta is an alluvial fan, an almost-flat cone formed by the waters carrying

Top right: The Delta from space at its highest inundation in September 2000, reddened by fires around Linyanti.

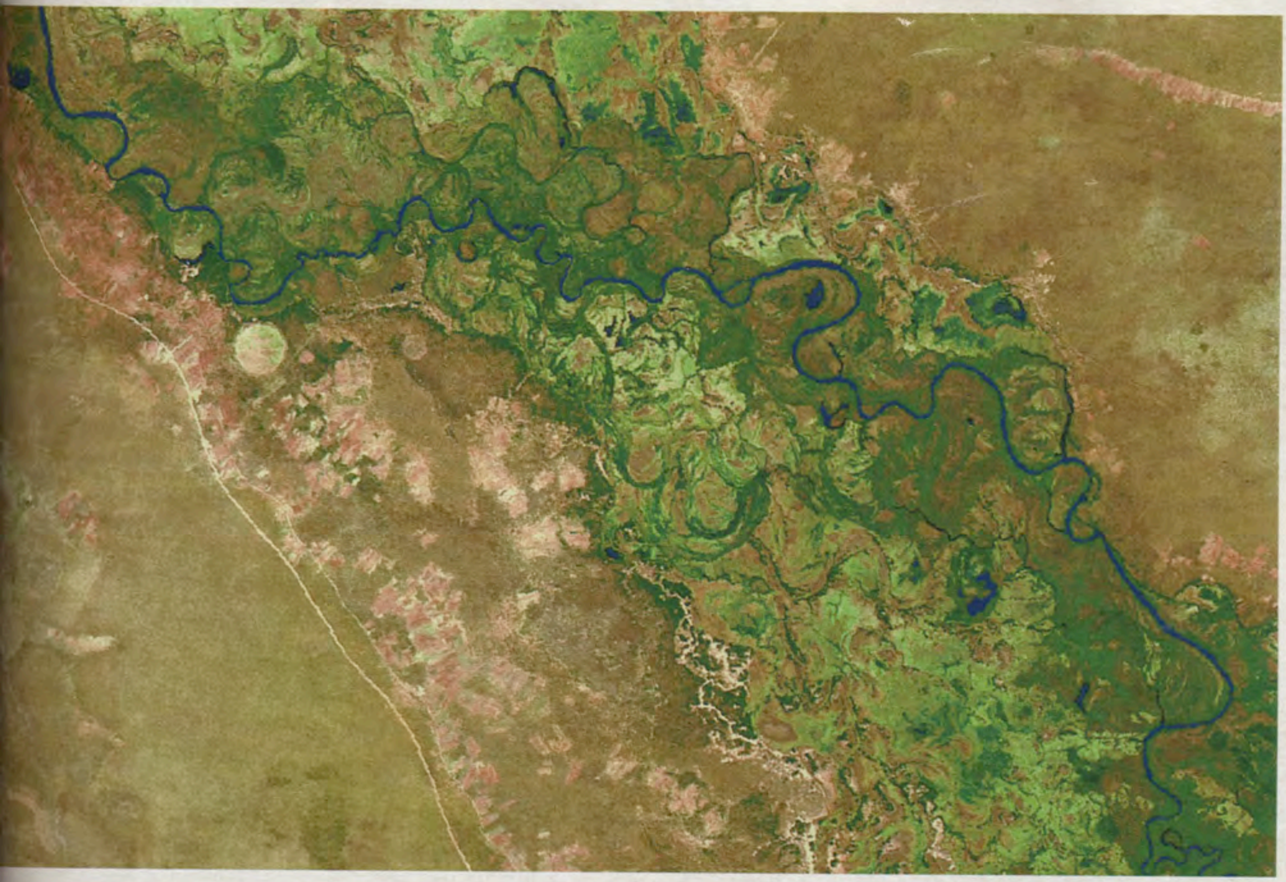
Above: The lowest inundation in the past 30 years – April 1996.

Left top and bottom: Salt islands in the permanent swamp region of the Delta below the Panhandle.

and depositing sand equally over a huge area.

Sand is what choked the Thaoge Channel and forced it to spit out its waters elsewhere – along a more easterly route into the Nqoga. According to tradition you can blame it on the hippos. Captain Stigand, who surveyed the Okavango in the early 1900s, refers to an oral history from the reign of Letsholathebe I (about 1840–1874): "The Nqoga was formed by hippo in great numbers breaking through and trampling a big hippo path through the papyrus." Now the Nqoga is also dying, and since the mid-20th century, more and more water flows into the Jao-Boro.

Nqoga is two metres above the Jao-Boro, and rising. The reed and papyrus surrounding the Nqoga lets water through, but the sand is left in the channel – its bed



rises by around five centimetres a year. Soon this 'aqueduct of sand' will be so high that another hippo path will divert the Okavango into the Jao-Boro instead. Then the bed of the Jao-Boro will start to rise, and a new cycle will begin. The question is where the water will go next. Nobody knows for sure, but we can make some educated guesses.

The bedrock of the Delta has two geological faults. The lower, Thamalakane fault is very obvious – all rivers coming out of the Delta bend to form the Thamalakane River flowing past Maun. The Panhandle must be a valley cut into the Kalahari sands along this fault. The Selinda Spillway is thought to be in another geological fault. If correct, the fate of the Delta is sealed: in time its waters will divert to the Zambezi.

Another likely scenario is that when the Jao-Boro starts to fail the waters will pass into the Selinda Spillway – and the Okavango Delta will dry out. But there is a third force that might save the Delta.

Information from satellite images shows that the Okavango is sagging from the sheer weight of water and sand being deposited. It's possible this internal force will save the Delta from emptying itself into the Zambezi.

HAVING NAVIGATED AROUND THE POTHOLES IN THE road from Maun to Shakawe we felt like a beer, but decided to use the last hours of sunlight for a reconnaissance of the river. As we were fairly frequent guests at Shakawe Fishing Lodge, Elaine and Barrie Pryce let us drive their boat ourselves. It was in June, with

A Landsat image of part of the Okavango Panhandle: a life-giving ribbon of water in the Kalahari thirstlands. Its very curvy or meandering route indicates a heavy load of sand that will eventually choke it, just like it did the Thaoge Channel 150 years ago.

the last flood waters still coming down from Angola.

The higher up we got in the Panhandle, the more islands and sand bars we saw. A few crocodiles were still basking in the dying sunlight. With the islands more bee-eaters and fish-eagles came our way, and we could see the occasional hippo. We turned round in time to be back before sunset, and took the small Khalithaoge Channel that forms a loop for about 10 kilometres.

The reeds and papyrus became less dense and larger stands of hippo grass allowed a wider view of the terrain. The Okavango River acts like nutrient artery with a change from papyrus and reeds to less luxuriously growth away from the main channel.

Looking at a satellite image you can clearly see the Okavango wetland is really an alluvial fan. However, on the ground it's a matrix of thousands of islands in a wetland fed by rains falling in Angola.

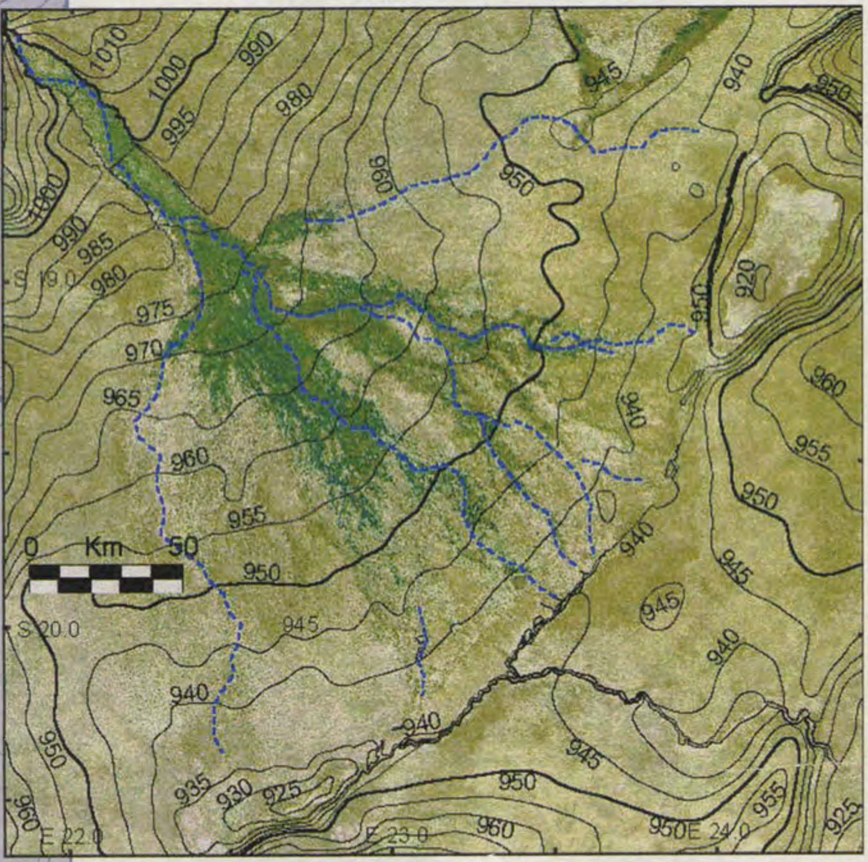
Each year more than half a million tons of sand, clay and salts flow in to the Delta. Nothing flows out. The plants, together with the hot and dry air, suck up all of the 10 to 15 million cubic kilometres of water that spill out over the Kalahari to the Okavango. The sand and the salt are left behind, redirecting the water flow and building islands. ⇨

In the Panhandle the Okavango is a beautifully meandering river, like a giant serpent, held in place by dense stands of papyrus and reeds. If you go by boat and look carefully you can see that the river channel is lined by hippo grass (*Vossia cuspidata*). Especially in the inner curves of the meanders ('point bars') where the erosive power of the water is less and water flow slows down. A slower water velocity reduces the water's capacity to transport sand, so the sand accumulates on the point bars.

Simultaneously, the accelerated velocity around the outer curve causes the water to pick up more material and scour away the reed and papyrus. The channel expands its loop, perhaps a metre a year. Finally the channel takes a shortcut across the loop and forms an oxbow lake.

Back at Shakawe Fishing Lodge we could finally enjoy the beer, and wash the dust off ourselves. We sat late that evening finishing a variety of bottles of red wine, telling stories of scientific truths, speculating about the future of the Okavango and lying about the fish we'd caught. We could hear a Pels fishing owl calling hauntingly from a sausage tree as we stumbled towards our tents.

The next morning we set off southward to the Filipo – a 25-kilometre side channel of the Okavango that is growing larger each year. In a few years it will be the main channel. On the way we passed a stretch where the Okavango flows past a 10-metre high sand wall, which shows the position of the geological fault. This is also a famous nesting place for bee-eaters.



We found a suitable island for lunch, and went exploring after finishing sandwiches with sardines, cheese and tomato. The side fronting the Okavango channel was densely covered with wild date palms (Phoenix reclinata) and sycamore figs (*Ficus sycamorus*), followed by African Ebony (*Diospyros mespiliformis*) and sausage trees (*Kigelia africana*). The back side was grass-covered around a small bare salt surface. Evidence of hippos grazing and *Homo sapiens* camping was obvious.

Nature is never random. The many islands in the top of the Panhandle are there because that is where most of the sand coming from up river settles. Hippo grass anchors itself to the point bars of the channel, because of the lower water velocity, and sand accumulates there. During floods sand bars build up, and when the water recedes these become islands. That's why islands form along the inner curves of the meanders, forming gentle arcs called 'scroll bars'.

LOOKING AGAIN AT THE SATELLITE IMAGES, YOU CAN can easily see the old lakeshore of Lake Ngami, the Mababe Depression and Makgadikgadi Pans. But when you're driving (or boating) through these areas it's hard to see anything but the endless horizon and the heat mirages at midday.

Driving north from Maun, starting up the Thamalakane to Sherobe, it's best to set off really early so you can cross the Mababe Depression and its infamous sand ridge before the sand gets hot enough to heat the ground into a sand trap. At Savuti the route forks: left to Selinda and Linyanti and right to Chobe.

On the ground only the western shore of the old Lake Mababe is visible as the Magikwe sand ridge. What you cannot perceive is that it is 15 metres higher than the southern 'shore', over a distance of 80 kilometres. The tilting, however, is not towards the Linyanti River but the Okavango Delta.

This idea is supported by the fact that the old Makgadikdagi lake shore is bent in a V shape, with the low apex coinciding with the centre line of the Delta.

So maybe this internal force of the Delta will save the Okavango from being deflected into the Zambezi – or at least it might postpone it. Whatever the outcome, be sure to see the last Eden of Africa while you still have time.

■ Next month: Thomas Gumbricht considers the contradictory mix of salt and water.

This topographic map of the Delta shows the small elevation changes from the Panhandle to where the fingers of water disappear into the desert sands, and its fan formation.