

MAN OF THE DESERT

BY QUIRIN SCHIERMEIER



Stefan Kröpelin stands near one of Chad's Ounianga lakes, an area that he helped to get listed as a World Heritage site.

Stefan Kröpelin has carved out a career where few dare to tread — in the heart of the Sahara.

Stefan Kröpelin's first research trip to the eastern Sahara was nearly his last. As a graduate student in January 1982, he travelled alone to Gilf Kebir — a remote plateau in the southwest corner of Egypt — to study sediment deposition in the steep canyons. Things didn't start well. On the first night, he found that his thin clothes and sleeping bag were no match for the freezing conditions. During the day, fierce sandstorms forced him to dig a pit for shelter and keep his eyes and mouth shut for most of the time. After a week, the driver who was scheduled to pick him up was nowhere in sight. Three days later, and running out of water, Kröpelin was just about to embark on a desperate 150-kilometre march to the nearest oasis when the jeep finally arrived.

Kröpelin, now a geologist and climate researcher at the University of Cologne in Germany, not only survived the ordeal but went on to become one of the most devoted Sahara explorers of our time. In dozens of expeditions to some of the farthest corners of the desert (see 'A career in the sand'), he has endured week-long sandstorms, suffered bouts of serious disease, including schistosomiasis, and faced heavily armed groups that roam the eastern Sahara.

But those decades of difficult field work have paid off for Kröpelin, who has made seminal discoveries about the climatic history of the Sahara that are challenging assumptions about the tipping points the world may face in a warmer future. At the same time, Kröpelin has worked to document the Sahara's cultural history and to preserve its heritage by lobbying to protect important scientific and cultural sites. "I've never ceased to be excited about the chance to investigate some of the least known parts of the desert," he says.

Siddiq Abd Algadir, president of the Sudanese Geologists' Union in Khartoum and a fellow student with Kröpelin in the 1980s, says that the German researcher has added immeasurably to Saharan science. "Much of what we now know about the geology, the environments and even the people in some of the most remote parts of the Sahara, we really owe to him and the expeditions he has led."

With his wiry build and boundless energy, Kröpelin seems much younger than his 60 years. The desks in his office are covered with parchment-coloured maps featuring vast expanses of desert. And his bookshelves sag with hundreds of volumes covering Africa's natural and cultural history, from early human

evolution and migration to the trans-Saharan trade routes that carried gold and salt between West Africa and the Mediterranean.

In the 1960s, Kröpelin's sense of adventure was sparked by reading the exploits of nineteenth-century explorers such as Heinrich Barth and Gustav Nachtigal, who were among the first Europeans to document the cultures and environment of the Sahara. Two decades later, in graduate school at the Technical University of Berlin, that early curiosity about the area became a scholarly passion as he studied its physical geography and geology.

Similar in size to Australia or the United States, the Sahara is one of the most inhospitable and least explored spots on the globe. Throughout his work there, Kröpelin has tried to amass detailed knowledge of the scientific and cultural facets of his study areas before turning out results. Researchers who have travelled with Kröpelin describe him as a circumspect, hard-driving leader, equally at home in geomorphology, archaeology, human psychology and — when necessary — motor mechanics.

MAP QUEST

Over the past few years, Kröpelin's work has helped to reveal how the Sahara transformed from a savannah more than 5,000 years ago to the desert it is today. Researchers had previously thought that the transition happened abruptly — within little more than a century — when a cyclical shift in Earth's orbit reduced the amount of sunlight in the tropics and weakened the African monsoon. This idea was championed by Peter deMenocal of Columbia University in New York, who studied a core of deep-sea sediments from the tropical Atlantic ocean and saw a rapid rise in the amount of dust blowing off the continent at the time of climatic transition¹. The sediment record agreed with models suggesting that a number of sensitive components of the planet — such as monsoon patterns, Amazon and Saharan vegetation, polar ice sheets and even the Atlantic Ocean circulation — will, under certain circumstances, flip from one stable state to another².

But Kröpelin wasn't convinced. The concept of an abrupt climate switch didn't mesh with his previous research on ancient settlements in the eastern Sahara³. "There is evidence from thousands of archaeological sites throughout the Sahara that prehistoric human settlements weren't abandoned within a few decades or so," he says. He was also piqued that deMenocal

reached his conclusion without ever setting foot in the desert, and used a single marine record to make generalizations about the entire Sahara. "The idea of catastrophically fast climate change is untenable — it can only come from someone who doesn't know the Sahara," says Kröpelin.

From his past reconnaissance work, Kröpelin knew one place in the Sahara with a climate record potentially long enough to test his ideas — a series of permanent lakes in the remote Ounianga basin in northeastern Chad, a practically rainless and notoriously insecure region bordering Libya and Sudan. French military geographers had explored the lakes in the early twentieth century but the area had since been forgotten by most foreign researchers. The lakes are fed by ancient groundwater, and their depths are layered with sediments containing climatic indicators such as pollen. Kröpelin suspected that one of the largest lakes, Lake Yoa, held a sedimentary cache thick enough to reconstruct the long-term climatic history of the region.

Working in Ounianga has its challenges. On a reconnaissance mission in 1999, Kröpelin had to persuade a superstitious local population that drilling a hole in the lake bottom would not drain the water or release the jinns and demons they feared might dwell in the ground.

After extensive preparations, he returned to the remote lake in 2003 and 2004, and pulled up a continuous 8-metre-long core of sediment from its bottom — a climate record reaching back 6,000 years. Kröpelin's analysis revealed that it took some 3,000 years — from 5,600 to 2,700 BC — for the fully vegetated savannah there to transform into a barren desert⁴.

THE GREAT DRYING

At first, some researchers questioned the dating of the core and whether it represented conditions across a broad region. But Kröpelin answered his critics⁵, and his ideas eventually gained acceptance. Today, deMenocal maintains that the western Sahara dried out quickly, but he acknowledges that the eastern part around Lake Yoa took much longer. "Stefan knows the Sahara better than any other living scientist, and the climate archive he has uncovered, while not perfect, is uniquely well-dated," he says.

The debate has intrigued climate modellers interested in potential tipping points in the Earth system, in which small perturbations cause abrupt and major changes. Kröpelin's findings imply that the most recent savannah-to-desert transition does not fit this pattern — although he leaves open the possibility of earlier tipping points in the Saharan climate.

Climate researchers are therefore eager for Kröpelin to report his analysis of a 16-metre-long core from Lake Yoa that he drilled in 2010, which he is now readying for publication. "The published record is fascinating but rather

A CAREER IN THE SAND

In 30 years of research, Stefan Kröpelin has conducted expeditions to dozens of sites in the eastern Sahara. His research has helped to reveal the humid past of what is today one of the driest spots on the planet.

● Kröpelin's research sites

■ Gilf Kebir plateau

One of the first places studied by Kröpelin, it acted as an ecological refuge long after the surrounding Sahara dried out.

■ West Nubian palaeolake

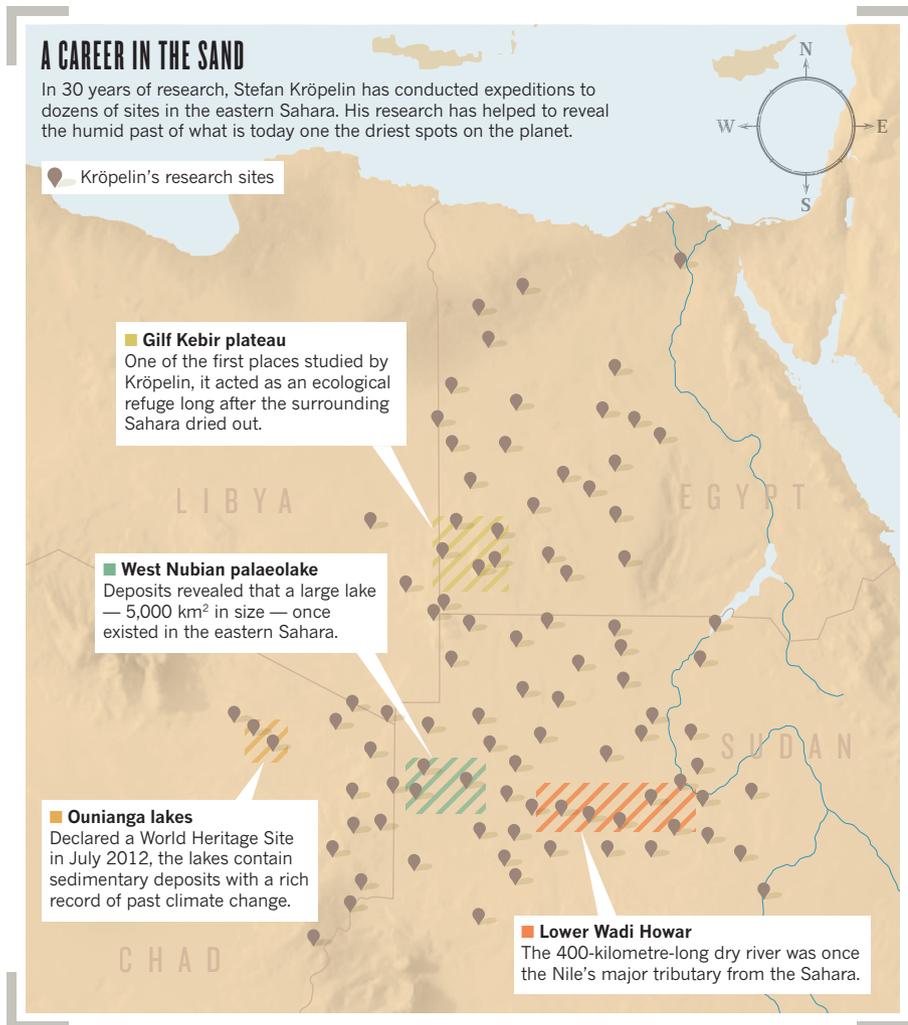
Deposits revealed that a large lake — 5,000 km² in size — once existed in the eastern Sahara.

■ Ounianga lakes

Declared a World Heritage Site in July 2012, the lakes contain sedimentary deposits with a rich record of past climate change.

■ Lower Wadi Howar

The 400-kilometre-long dry river was once the Nile's major tributary from the Sahara.



short,” says Martin Claussen, a climate modeller at the Max Planck Institute for Meteorology in Hamburg, Germany, who is exploring ways to predict fast climate-vegetation transitions⁶. “The complete 12,000-year record should help us get a better sense of how rapidly the system might be capable of switching from one state to another and what the transition period may look like.”

The results from Lake Yoa crown a long list of discoveries that Kröpelin has made in the region. In one of his earliest major finds, Kröpelin established that the dry valley known as Wadi Howar, which sits in an extremely arid part of northern Sudan, was once one of Africa's largest rivers and a tributary to the Nile⁷. This extinct river flowed from about 9,500–4,500 years ago and supported a rich savannah that was home to a host of animals, including antelopes, giraffes, zebras and elephants.

Kröpelin's extended trips through the Sahara, which typically last two months, have sometimes placed him in difficult situations. During one expedition to northern Sudan in 1995, he was chased for several days across the desert by a truck. When the pursuers caught him, they turned out to be

Sudanese forces who thought they were following outlaws smuggling weapons or people. The soldiers were nearly out of fuel from their chase, so Kröpelin gave them a share of the expedition's diesel supplies and they enjoyed a friendly meal together. The excavations carried out on that trip revealed how prehistoric humans settled there during the Sahara's humid phase and then disappeared as the climate dried out³.

Another experience in 2005 was more troubling. One night, the sound of heavy gunfire terrified a team that Kröpelin had led to Erdi Ma, an uninhabited and largely unexplored tableland in the northwest corner of Chad. The next morning they learned that Darfur rebels had massacred 20 Sudanese soldiers not far from the expedition's campsite.

Sometimes, nature is the biggest enemy. On the way to Lake Yoa in April 2010, Kröpelin and his team got caught in a dust storm fiercer than any he had seen in 30 years. For more than a week visibility dropped to two metres. Under non-stop bombardment, the researchers' bodies and vehicles became electrically charged and each touch caused painful electric shocks. Refilling the trucks from metal gas canisters was Russian roulette, as large sparks

shot around the filler necks. “Back home, it took weeks until I could open my car again without inhibition,” Kröpelin says.

Through his expeditions, Kröpelin has developed relationships with many of the regional governments, and he has helped to advise officials in Egypt, Libya and Chad on the impact of mining, oil drilling and tourism. He has campaigned for and won protection for two environmentally and culturally unique regions that he explored — Wadi Howar and Gilf Kebir.

For the past 13 years, Kröpelin has also lobbied to protect the Ounianga lakes — an effort that involved hundreds of meetings with ministers in Chad and international agencies and officials. That work paid off in July, when the region was declared a world heritage site by UNESCO (the United Nations Educational, Scientific and Cultural Organization).

Researchers wonder what will happen when Kröpelin retires, leaving a major hole in Saharan studies. “He has taken risks few researchers would be happy to take any more,” says deMenocal.

The risks in the region have grown lately because of rebel activity and recurring armed conflict in places including Darfur, Libya, Mali and Chad. But despite some anxious moments over the years, Kröpelin considers that the risk of getting robbed, kidnapped or killed is smaller in the Sahara than in sections of London or New York City.

“In the desert there is an air of fellowship with whoever crosses your way,” he says. “Encounters with nomads, rebels and more shady folks can be scary, but I've always managed, somehow, to talk us out of even the most delicate incidents.”

For now, Kröpelin shows no signs of slowing down. He plans to return to the Sahara in November for a celebration of the UNESCO decision and to do some geological field work. Next year, he will search for traces of prehistoric writing and trading, and will explore a mysterious crater in Jebel Uweinat, the tallest mountain in the eastern Sahara. Gone are the days of foolhardy solo trips, but not the deep love for the land. “Under the vast desert skies, your whole existence takes on a different meaning,” he says. “I'd like to return for as long as I can.” ■

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