

AFRICA: Atlas of Our Changing Environment



One hundred and four environmental change pair studies, largely drawn from the 36-year legacy of Landsat satellite data, for publication in a 400-page hardcover book: *Africa: Atlas of Our Changing Environment* (June 2008 release). This publication presents a survey of environmental change in all 54 African countries focusing on the past several decades.

For each country, a 2-page profile presents relevant issues and statistics. This is followed by change pair studies showing specific instances of environmental change for that country.

The majority of change pairs are Landsat imagery. Declassified Corona and Argon images, aerial photography, and high-resolution commercial satellite images are used as well. Each change pair is accompanied by a brief narrative based on literature review, data from the respective countries, UN data, and correspondence with local experts. Six of the 104 sites are shown below.

Yamba Berté Forest Reserve, Chad



Agriculture in the Yamba Berté Forest Reserve, Chad: The Yamba Berté Forest Reserve in southwestern Chad is made up of critical gallery forests, pristine woodlands, and a network of small lakes and swamps. The dense forest includes trees that can grow as tall as 35 m. The reserve is an important habitat for gazelles, monkeys, warthogs, giraffes, elephants, and the rare giant eland.

Yamba Berté is located in a zone of savanna woodland that stretches across southern Chad and supports a dense human population and most of the country's agriculture. The introduction of cotton in the 1930s and draft animals in the 1950s supported a large increase in agriculture. During the drought years (1968, 1972-1973, 1983-1984), large numbers of people migrated to the area because of its higher rainfall and the economic opportunity of its larger cities. In addition to subsistence

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cropping such as maize, millet, and sorghum, the area is ideal for growing cotton and groundnuts, which are the two primary cash crops. The 1986 image shows agriculture around Yamba Berté, including some encroachment on the reserve area. The second image, captured 15 years later, shows dramatically increased agriculture around the reserve and several areas where the reserve boundary has been breached. The high-resolution image (inset) shows the detail in one area of encroachment.

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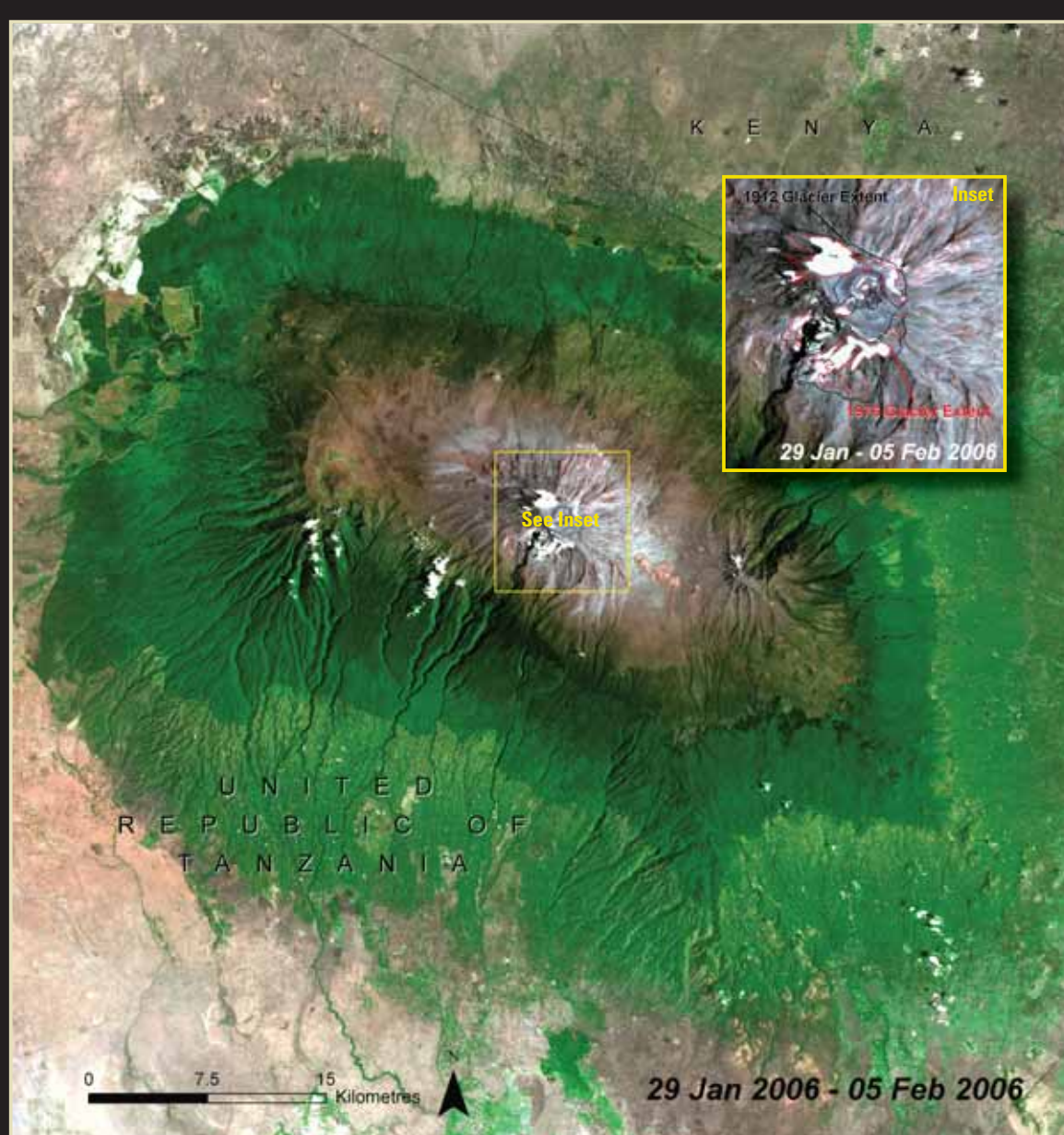
Mount Kilimanjaro, Tanzania



Mount Kilimanjaro: United Republic of Tanzania: Glaciers on the summit of Mount Kilimanjaro have changed in area by 80 percent since the early 20th century. While glacial retreat globally has been linked with rising air temperatures, there is evidence that the decline of Kilimanjaro's glaciers (see inset, above right), along with changes in the boundaries of vegetation zones on the mountain, may be due in large part to a trend of decreasing precipitation that began in the 1880s.

It has also been found that water from the melting of Mount Kilimanjaro's glaciers provides little, if any, water to lower elevation streams, as most ice is lost through sublimation. Water from the small amount of melting that does occur evaporates very quickly. A greater impact on the mountain's hydrology may result from increased burning under the

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drier conditions since 1880. The upper limit of the forest zone has descended significantly, as nearly 15 percent of Kilimanjaro's forest cover has been destroyed by fire since 1976. In the 1976 image above, the upper limit of the *Eriosea excelsa* forest is shown in yellow. By 2000 the upper limit had moved noticeably downlope (red line) as a result of frequent fires.

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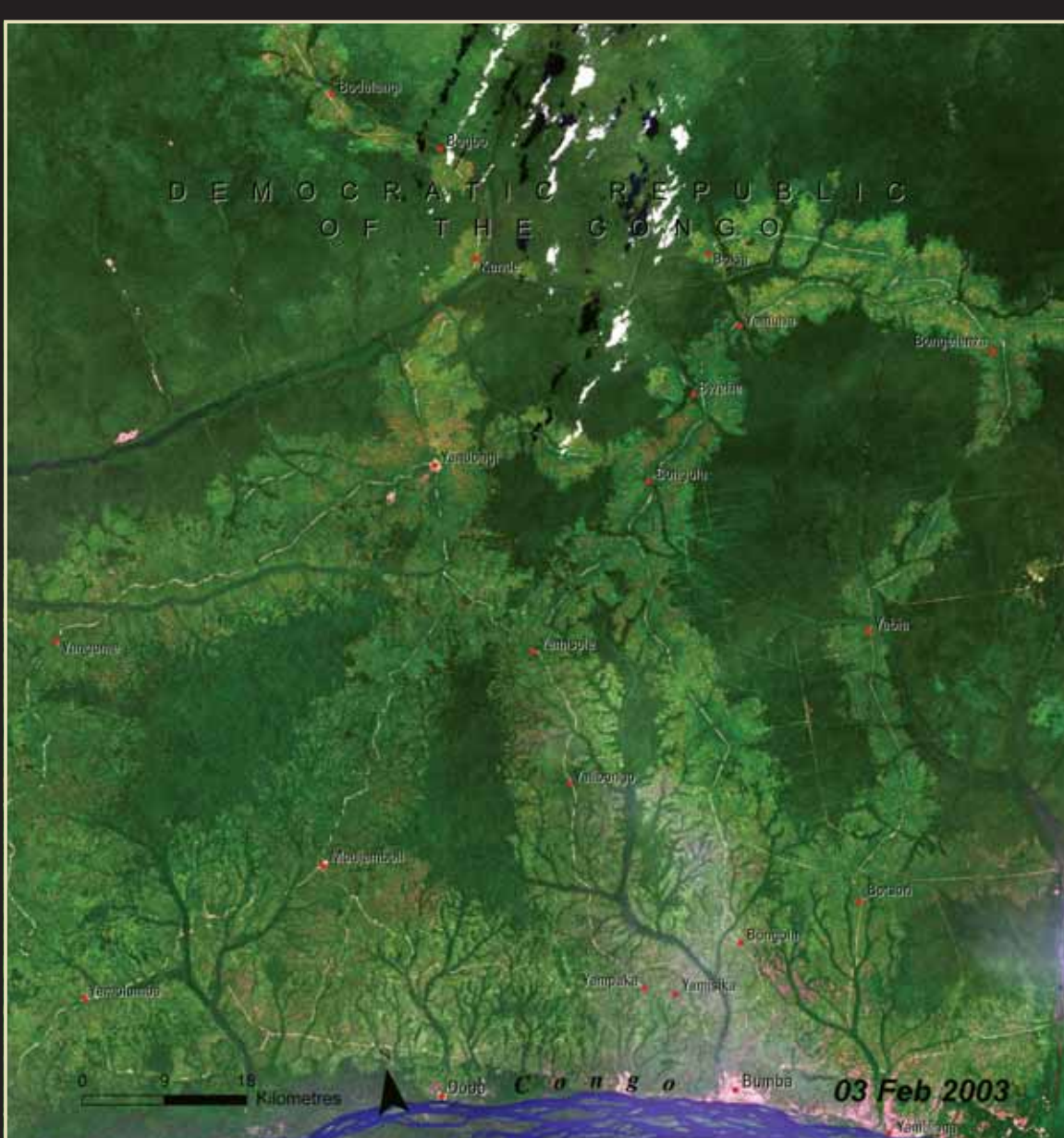
Bumba, Democratic Republic of Congo



Deforestation Surrounding Bumba, Democratic Republic of the Congo: A pattern of deforestation concentrated along the local roads in the Nord-Ubangi and Mongala provinces of the Democratic Republic of the Congo (DRC) can be seen clearly in the 1975 image as loops of light green through the otherwise dense rain forest. In the 2003 image, these deforested corridors have widened, almost to the point of joining. Most of this deforestation is the result of agricultural conversion, wood fuel collection, settlement, and artisanal logging. Networks of logging roads can also be seen within two of the patches of largely intact forest in the lower right corner.

While industrial logging has had a relatively small impact in the DRC in the past, it has recently become the most extensive form of land use in Central Africa. More than half of the area visible in these images is under logging concession. The selective logging

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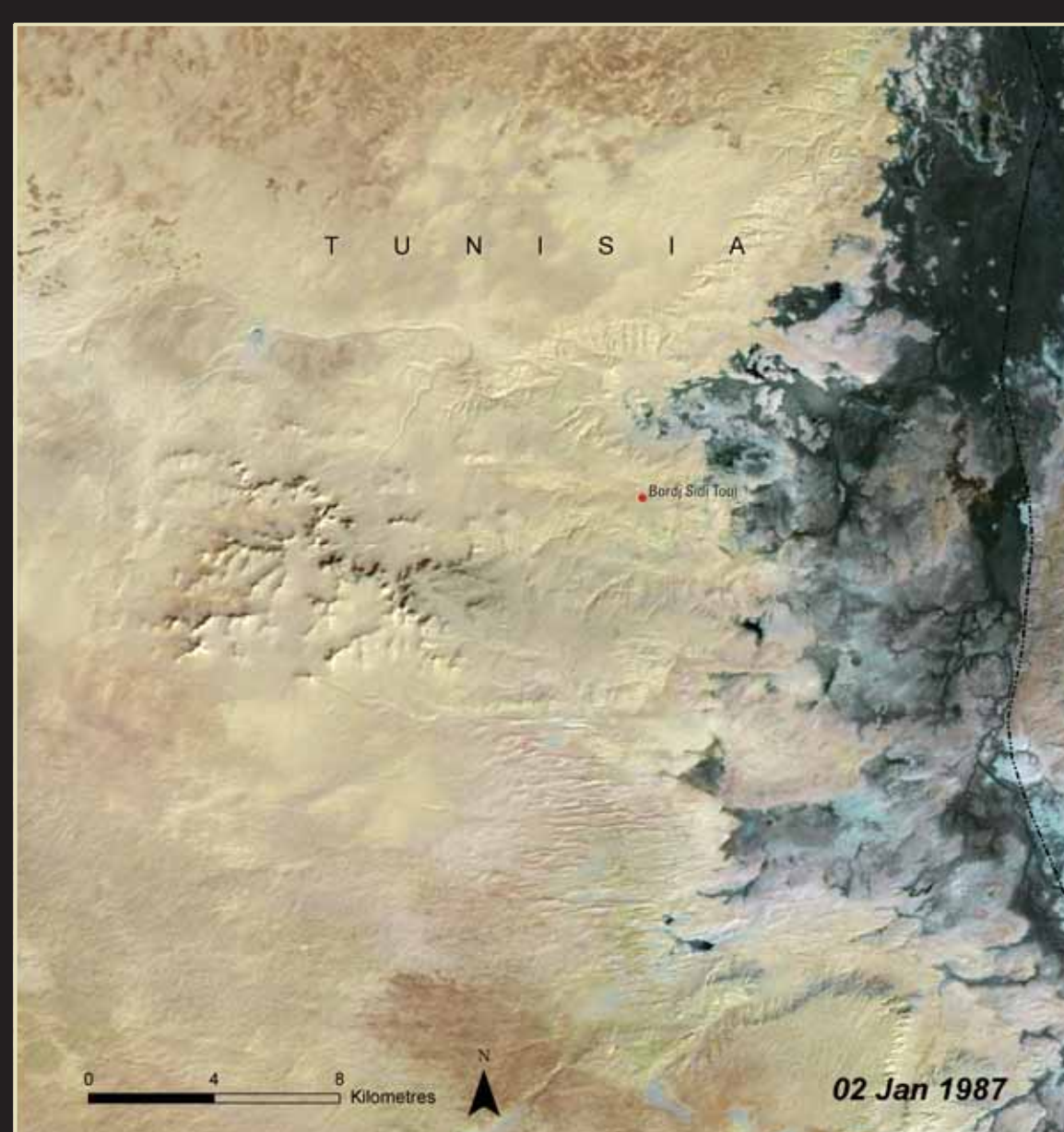


practiced by commercial logging companies has been shown to have long lasting impacts on forest composition. Logging roads have been shown to significantly increase bushmeat hunting.

In addition to local and logging roads, a recent study for the World Bank suggests the road from Bangui, Central African Republic, to Kisangani, DRC, be improved as part of a continental road network. The study shows that the network would increase trade on this route enormously. It also acknowledges concerns that parts of the road network that would experience the greatest increase in trade correspond to areas with the highest biodiversity.

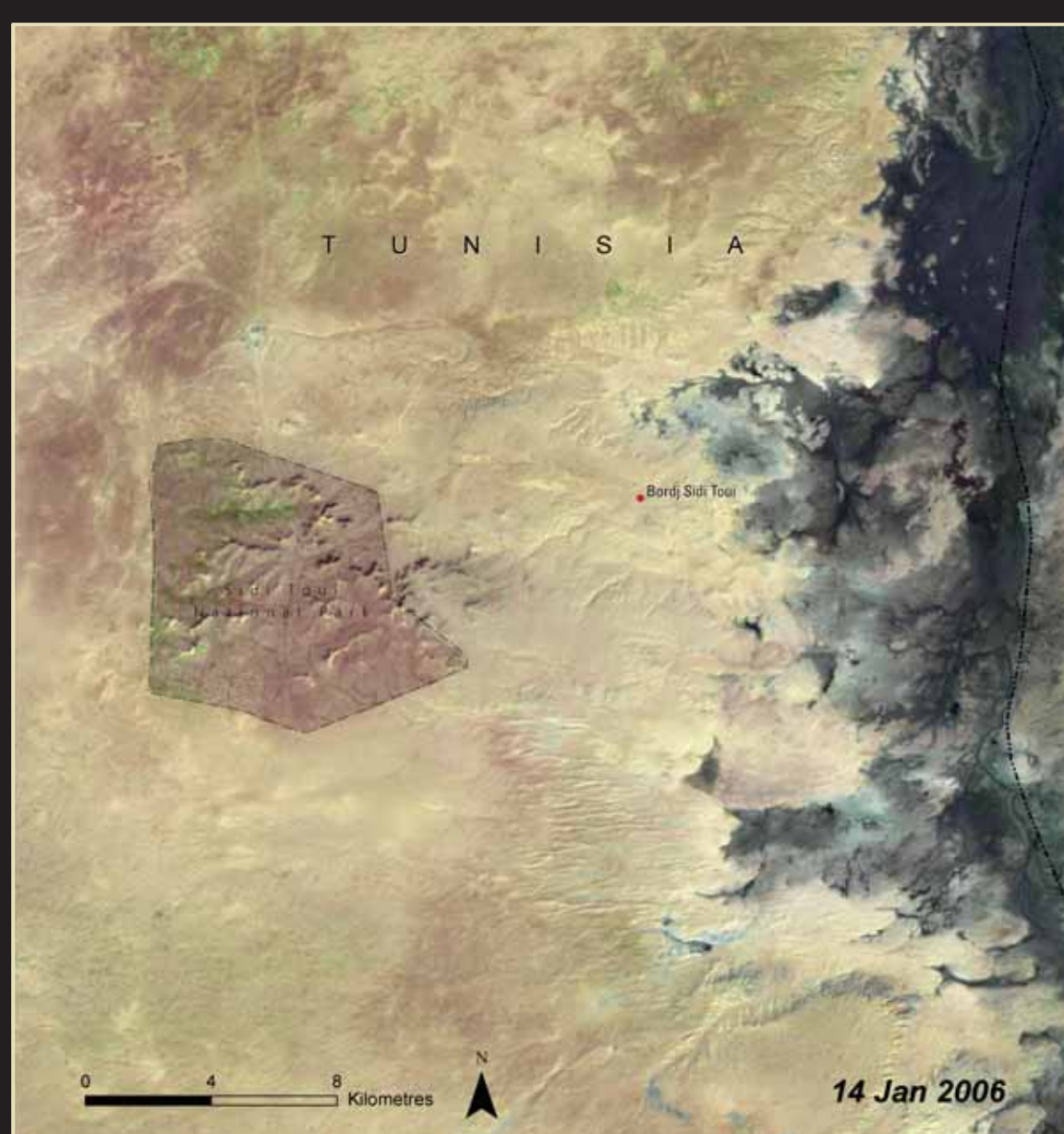
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Sidi Toui National Park, Tunisia



Habitat Regeneration: Sidi Toui National Park, Tunisia: The semi-arid Sahelian grassland and scrub of southern Tunisia has been profoundly altered by human activities during the last century. Located on the northern fringe of the Sahara Desert, this ecosystem is susceptible to erosion and desertification brought on by droughts, overgrazing, and agriculture. In 1993, Sidi Toui National Park was established. Within the bounds of this protected area, natural vegetation began to return. The 1987 image shows the barren condition of the region before the park was created. In the 2006 image the outline of the park, which is protected from the effects of grazing cattle, contrasts markedly with the surrounding landscape. Protection substantially increased the vegetation density and species diversity, particularly of the grasses.

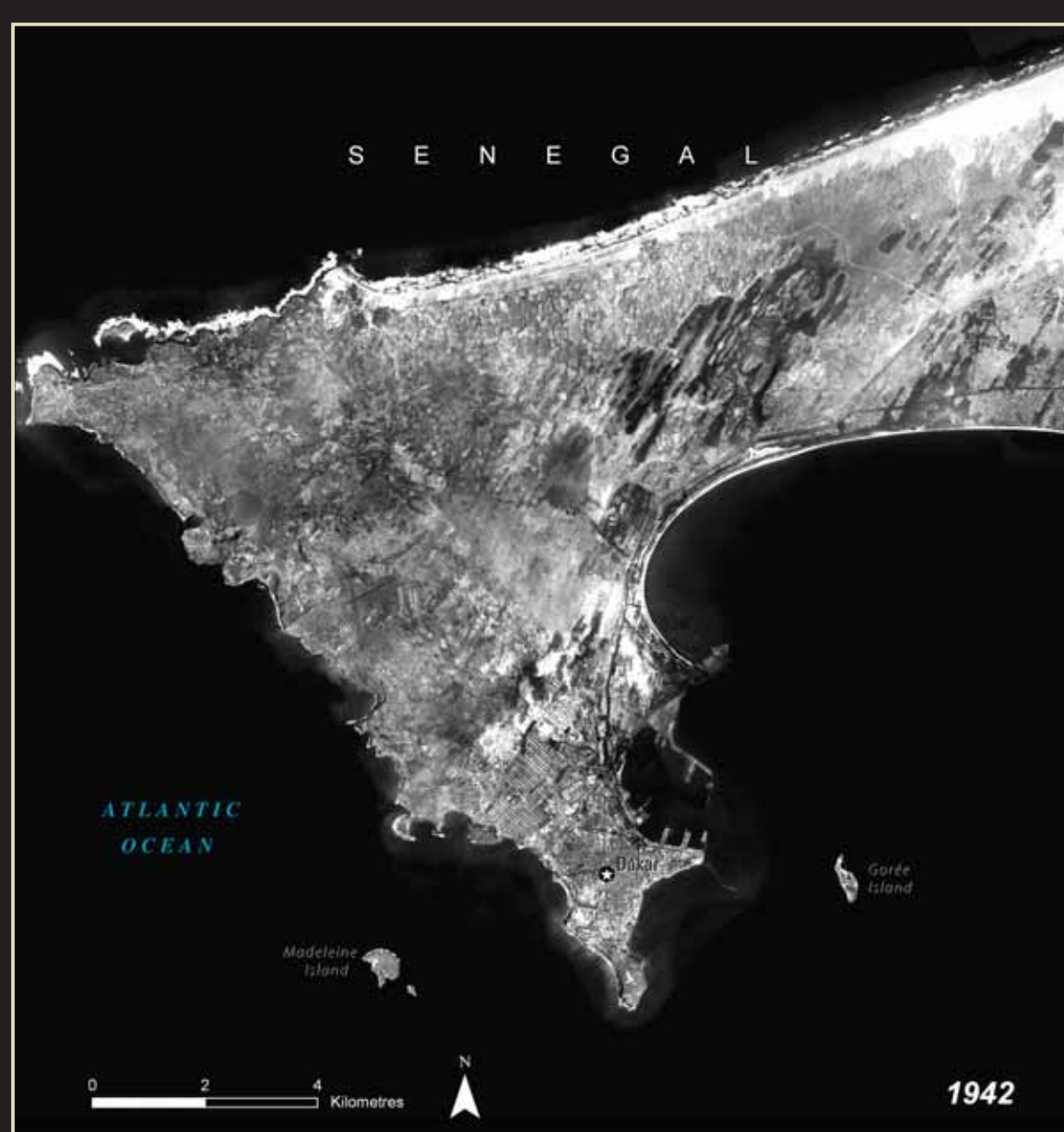
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The Scimitar-horned oryx (Oryx dammah) and five other species of gazelles and antelope native to this area had been brought to near extinction by lack of habitat and overhunting throughout the 20th century. Classified as critically endangered in 1996, a small population of Scimitar-horned oryx was introduced into Sidi Toui Park in 1999. If the population inside the park thrives, it may enable future reintroductions of Scimitar-horned oryx elsewhere. Sidi Toui also provides habitat for several native species of antelope and a variety of bird species.

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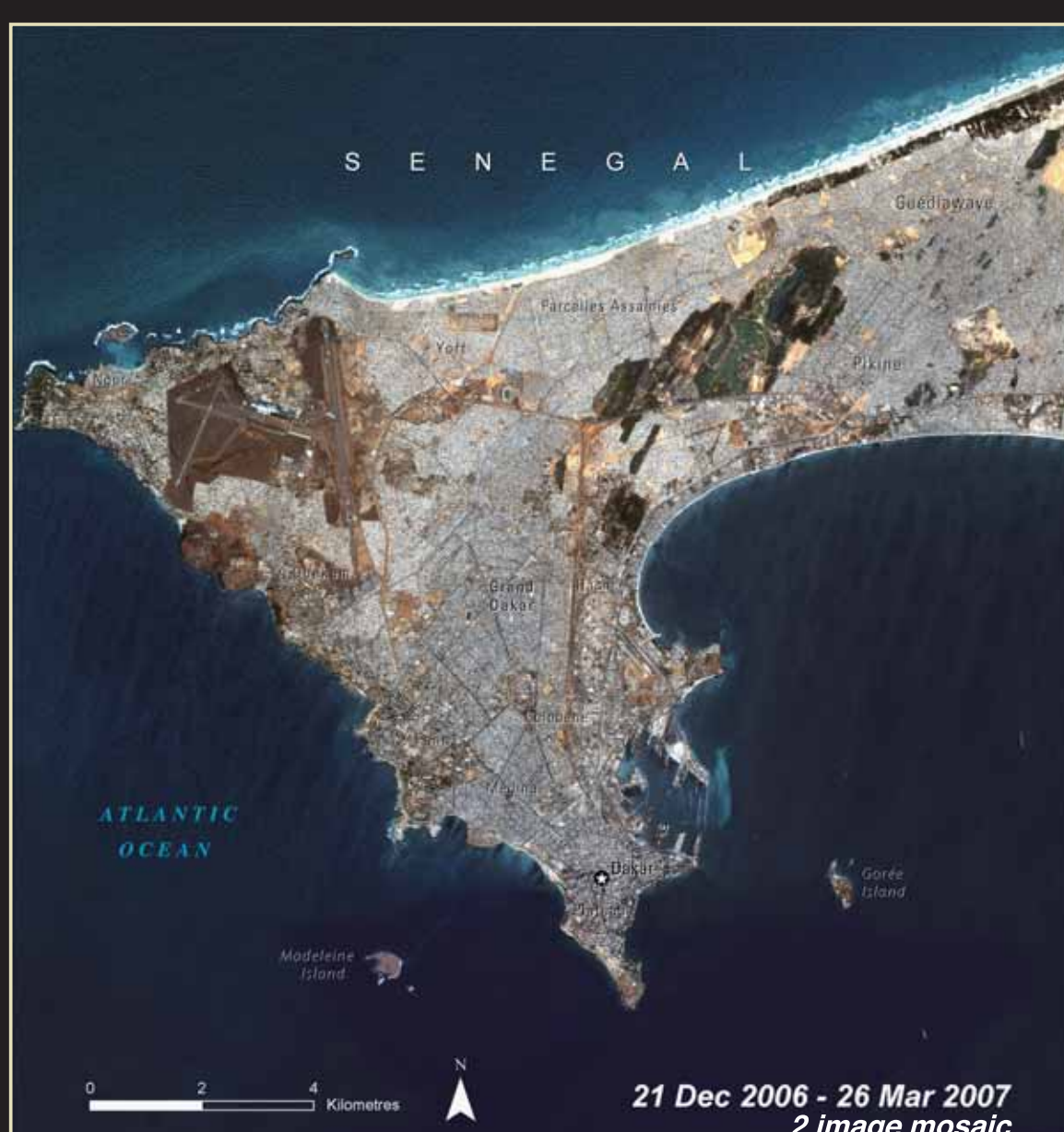
Dakar, Senegal



Urbanization of Cap Vert Peninsula: Dakar, Senegal: Like many West African cities, Senegal's capital city of Dakar has grown dramatically over the past several decades. Growth is expected to continue. While birth rates have begun to decline, they will account for much of Dakar's expansion. In addition, Dakar experienced a large rural-to-urban migration beginning in the 1960s, when Senegal suffered from declining precipitation and periods of extreme drought. By 2005, Senegal's urban population exceeded its rural population. By 2030, two-thirds of the country's population is expected to be urban.

Roughly half of Senegal's urban population lives in the greater Dakar metropolitan area. Urban population growth has turned the Cap Vert Peninsula into a sprawling metropolis, where settlements reach far over inland and onto the prime farmland

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that has historically supported the city. Pikine, initially begun as a resettlement of urban slum dwellers 15 km east of Dakar, has grown to over 1 million people. Its location in the fertile Niayes region displaced large areas of urban and peri-urban agriculture that once provided livelihoods for a substantial portion of the population.

In the aerial photo mosaic from 1942, Dakar is concentrated at the southern tip of the peninsula, with only the airport and a few scattered roads and settlements to the north. The 2006/2007 image shows only a portion of the greater Dakar area, which currently stretches another 14 km to the city of Rufisque (not shown).

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Baban Rafi Forest, Niger



Forest Degradation: Baban Rafi Forest, Niger: Along the southern border of Niger in the Department of Maradi, population has increased by roughly 400 percent over the past 40 years. The area under agriculture in the department as a whole grew by 26 percent between 1975 and 1996. In the south of the district, this expansion of population and agriculture has meant the loss of a large portion of the Baban Rafi Forest. The remaining woodlands are being degraded by overexploitation of wood fuel and nonwood forest products.

Baban Rafi Forest is the most significant area of woodland in the Maradi Department. Located at the southern extreme of the Sahel, it has areas of both savannah and Sahelian vegetation. In the savannah areas, the balance of trees, grasses, and shrubs varies. The wooded areas are dominated by just four species of trees—*Guiera senegalensis*, *Combretum microcarpum*,

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This May 2007 QuickBird image shows detail at the interface between the remaining savannah woodland and the area's expanding agriculture.

Combretum microcarpum, and *Acacia macracantha*—likely as a result of selective exploitation and some combination of drought and disease. These satellite images show the loss of a significant fraction of the natural landscape (darker green areas of Baban Rafi Forest) to agriculture between 1976 and 2007. The intensity of demand for agricultural land has also led to near-continuous use of farmland in the area, with shortened or no fallow period for it to recover fertility. Continuing population growth will put further demands on this already dramatically changed landscape.

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