





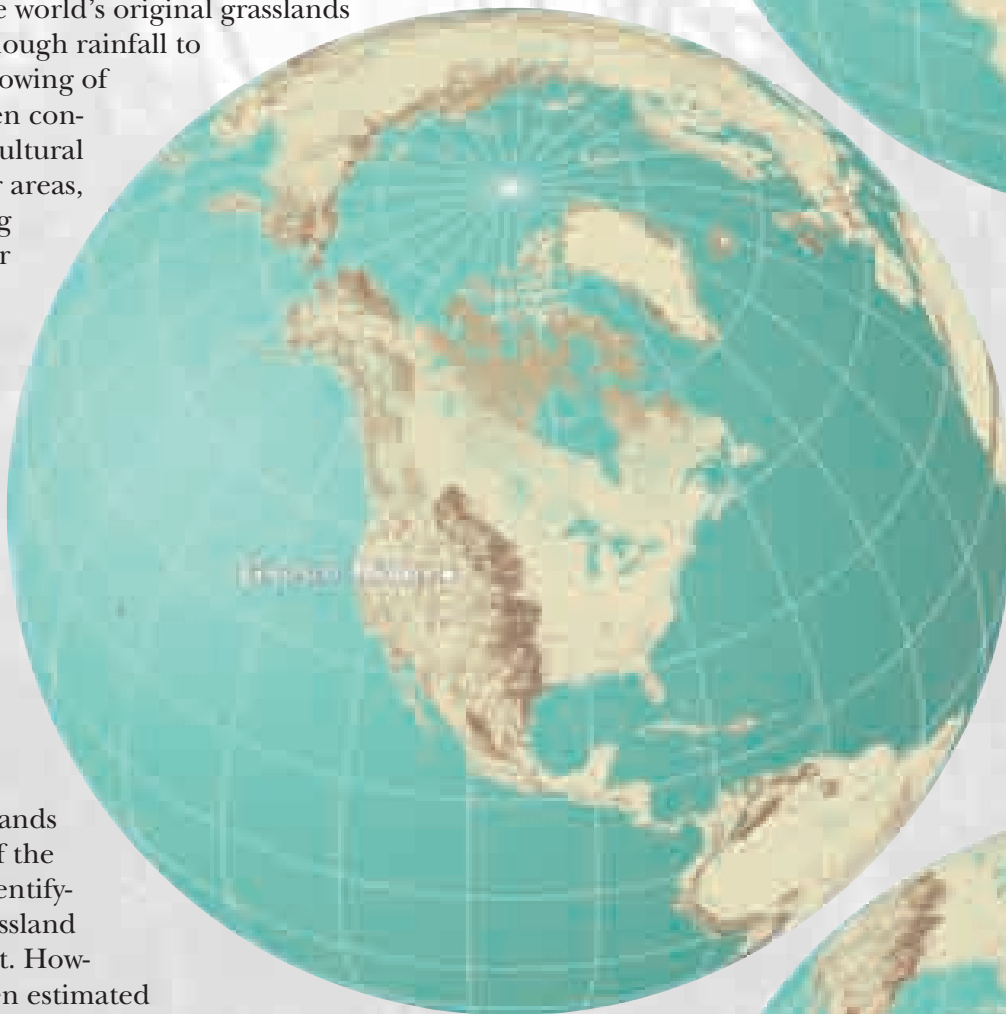
3.6 Grasslands

Grasslands cover roughly 40 per cent of the Earth's land surface. They are, as their name implies, natural landscapes where the dominant vegetation is grass. For purposes of this report shrublands are also considered grasslands. Grasslands typically receive more water than deserts, but less than forested regions. Worldwide, these ecosystems provide livelihoods for nearly 800 million people. They are also a source of forage for livestock, wildlife habitat, and a host of other resources (White et al. 2000).

Most of the world's meat comes from animals that forage on grasslands. World meat production has nearly doubled since 1975, from 116 million metric tonnes to 233 million metric tonnes in 2000 (UNEP 2002b). Grasslands and their soils store about one-third of the global stock of carbon in terrestrial ecosystems. These lands also are habitat for diverse and biologically important plants and animals.

Most of the world's original grasslands that receive enough rainfall to support the growing of crops have been converted to agricultural lands. In other areas, irrigation using imported water or groundwater has been implemented on traditional rangeland areas (SRM n.d.). Precise measurements of area changes are difficult to come by as there is no international organization tracking grasslands and because of the difficulty in identifying what is grassland and what is not. However, it has been estimated that there were over seven million km² (three million square miles) of grassland and scrubland lost between the development of agriculture and 1982 (Mathews 1983). In addition, it is known that all croplands were developed either from forests or grasslands. In that respect, since cropland areas are expanding, it can be assumed that on the whole, grassland areas are continuing to decline. On the other hand, large areas of tropical rainforests are being cleared to provide pasture for livestock. Therefore, grasslands—at least in the form of pastures—may be expanding in some localized areas.

Worldwide, the quality of surviving grasslands is declining. This is due primarily to human-induced modifications such as agriculture, excessive or insufficient fire, livestock grazing, fragmentation, and invasive plants and animals (White et al. 2000). Invasion of the world's grasslands by woody plants is



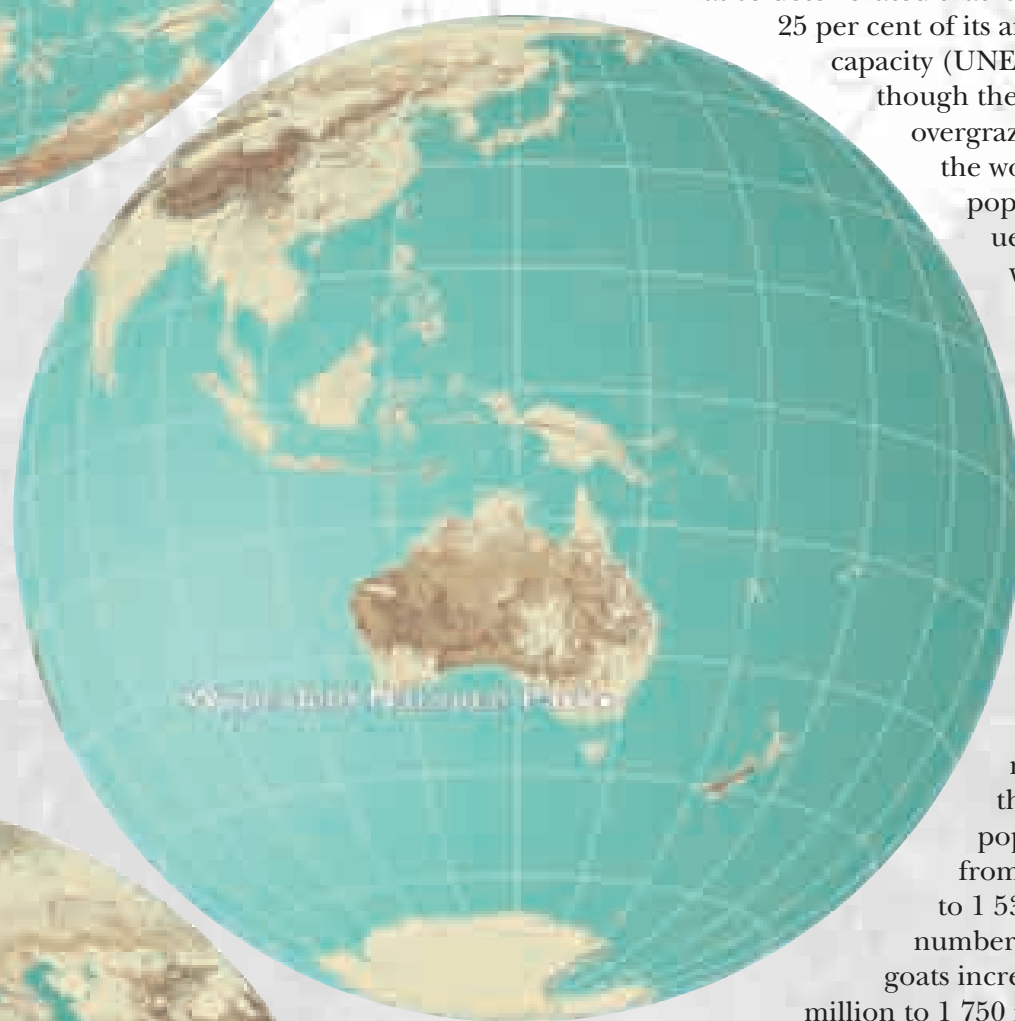
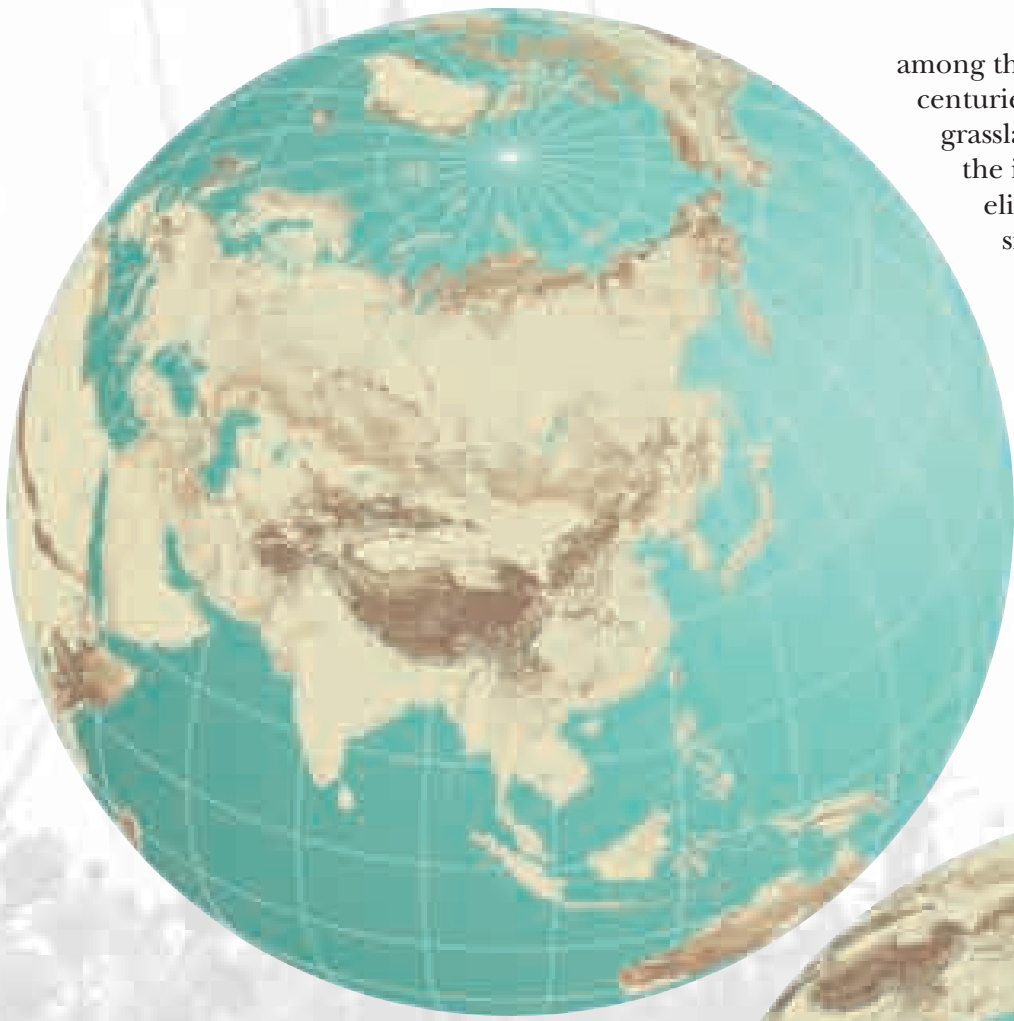
among the dominant changes in the Earth's vegetation during the last two centuries (Polley et al. 2003). Woody plants tend to displace grasses on grasslands. Invasion by woody plants traditionally has been attributed to the introduction of exotic species, overgrazing, fire suppression, and elimination of small mammals that kill woody seedlings. Fire suppression in some parts of the world is resulting in the reintroduction of woody plants into grasslands that have been controlled by fire by thousands of years. At the same time, an increase in human-made fires in other parts of the world are making it possible for grasslands to supplant forests.

The displacement of grasses by woody plants may also be related to the 30 per cent increase in the concentration of CO₂ in the Earth's atmosphere that has occurred over the last 200 years. Grasses use water more slowly as carbon dioxide levels increase. Consequently, grassland soil may retain water better during droughts when atmospheric carbon dioxide concentrations are high. Such an increase in soil water may indirectly promote the invasion of woody plants into grassland by enhancing the survival of shrub seedlings during droughts.

It is estimated that 73 per cent of the world's grazing land has so deteriorated that it has lost at least 25 per cent of its animal carrying capacity (UNEP 1999b). Even though the damage from overgrazing is spreading, the world's livestock population continues to grow in step with increases in the human population, and a growing demand for meat that accompanies increased wealth. As world population increased from 2 500 million in 1950 to 6 100 million in 2001, the world's cattle population grew from 720 million to 1 530 million. The number of sheep and goats increased from 1 040 million to 1 750 million.

With 180 million people worldwide now trying to make a living tending 3 300 million cattle, sheep, and goats, grasslands are under heavy pressure. As a result of overstocking and overgrazing, grasslands in much of Africa, the Middle East, Central Asia, the northern part of the Indian subcontinent, Mongolia, and much of northern China are deteriorating. While grazing was once a pastoral activity that involved people moving with their herds from place to place, it has become a far more sedentary undertaking. The result is an increase in grassland degradation near settlements and the creation of grassland landscapes perforated by bore holes.

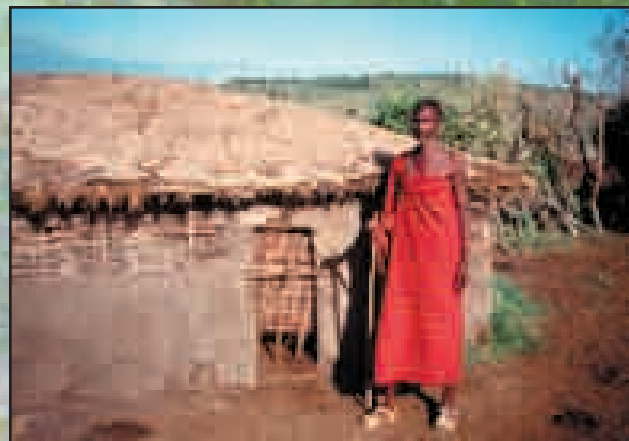
Initially, overgrazing of grasslands reduces their productivity and ultimately destroys them. Worldwide, there are now 680 million hectares (1 680 million acres) of degraded grasslands (Brown 2002). Desertification is estimated to involve 3 600 million hectares (8 896 million acres) of land—roughly 25 per cent of the world's total surface area.



Grasslands

- Dense
- Sparse

Source: Global land cover 2000 (GLC 2000)



Maasai tribesman from Maasai Mara National Park
Credit: H. Gyde Lund/UNEP

29 Jul 1975



GRASSLANDS

NAROK, KENYA

The Narok District, located in southwestern Kenya, is one of eighteen districts in the country's Rift Valley Province. The primary inhabitants of the district, the Maasai, have traditionally been nomadic pastoralists. However, conversion of portions of their grazing and hunting grounds into national parks and game re-



serves, including Mara (Maasai Mara Game Reserve), Serengeti, and Tsavo, has posed a challenge to their way of life. Diminishing income from cattle raising and tourism activities has led to the conversion of Narok's fertile soils into productive agricultural lands. With World Bank estimates of US\$0.75 per annum per hectare for cattle, US\$5.5 for tourism and US\$218.75 for farming, the tendency for grasslands conversion into to agricultural fields seems only logical

to many. By 1987, more than 27 000 hectares (66 718 acres) of land had been leased to farmers, an increase from 18 000 hectares (44 478 acres) in 1973. These two images reveal the changes that have taken place in the Narok grasslands area over the past three decades. In the 1975 image, agricultural expansion is just beginning, while the 2000 image shows the degree to which farmlands have expanded.



23 Nov 1979



GRASSLANDS

PEANUT BASIN, SENEGAL

While much of West Africa is experiencing loss of woodland and forest cover from expanding cultivation, Senegal's major agricultural region—the Peanut Basin—is witnessing the opposite: agricultural lands are being abandoned, and replaced with tree-dotted savannas. This pair of Landsat images shows the



30 June 1983

16 November 1995

Credit: Gray Tappan/UNEP/USGS

This photo pair shows the same landscape at a 12-year interval (1983 and 1995). The view is typical of many areas in Senegal where cropland is being abandoned in favor of fallow and grazing lands. Note the regeneration of the natural woody vegetation in the background.

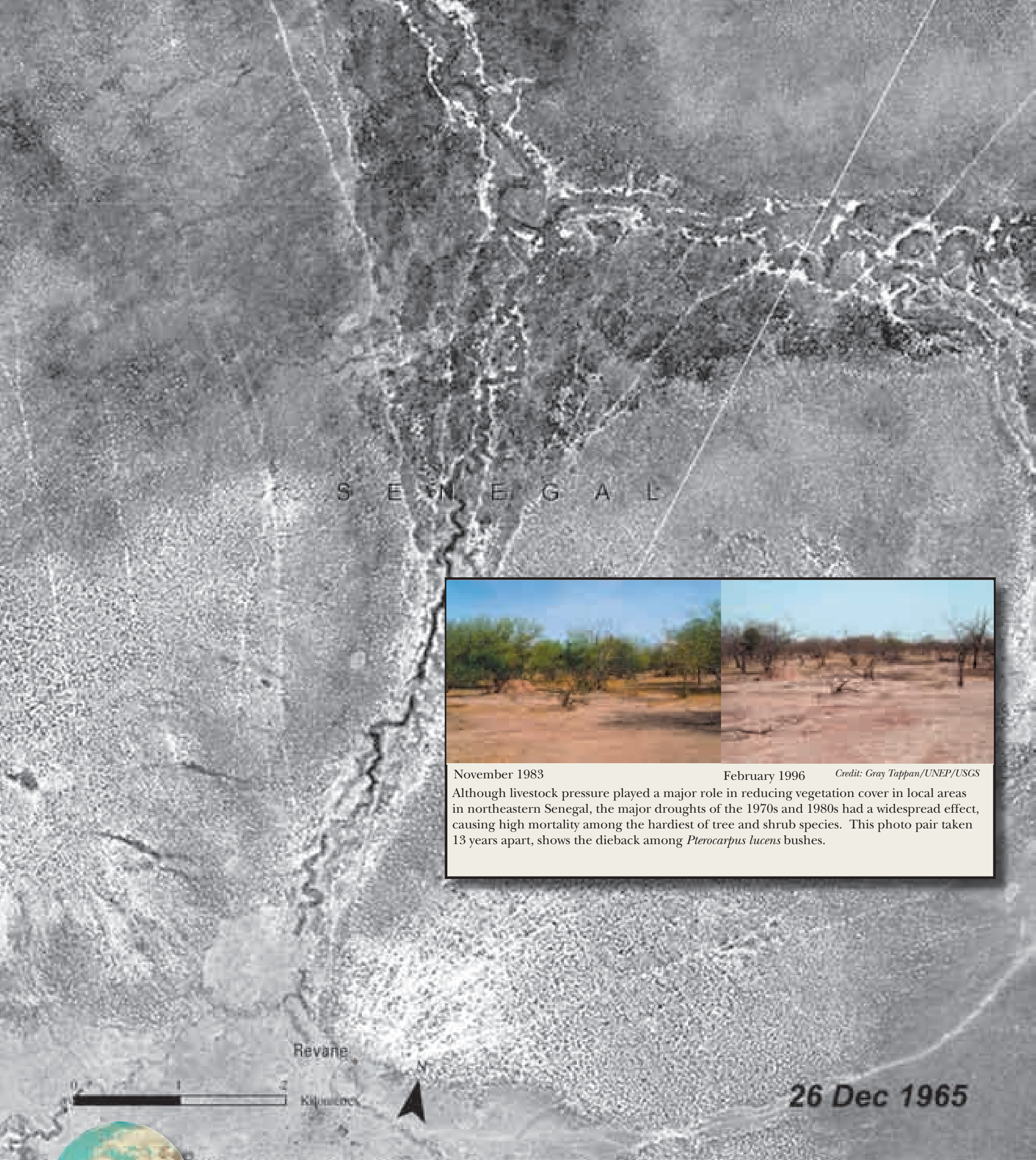
0 5 10 Kilometers



4 Nov 1999

growing patchwork of savannas (greenish patches) where peanut and millet crops once prevailed. This phenomenon is not the result of a planned land management program. Rather, it stems from recent trends in out-migration. The drop in world market prices for peanuts, drought, and the removal of government agricultural subsidies have made it difficult for farmers in the region to continue to farm. Since the 1980s, many have left in search of new

livelihoods in Senegal's urban areas, including Darou-Mousty (upper right), and the major centers of Touba and Dakar (not shown) as well as abroad. Those who have stayed are enjoying the benefits of a revived rotational fallow system, large tracts of grazing land for a growing livestock economy, and diversification into other cash crops. Hundreds of villages can be seen scattered throughout this region (dark spots).



November 1983

February 1996

Credit: Gray Tappan/UNEP/USGS

Although livestock pressure played a major role in reducing vegetation cover in local areas in northeastern Senegal, the major droughts of the 1970s and 1980s had a widespread effect, causing high mortality among the hardiest of tree and shrub species. This photo pair taken 13 years apart, shows the dieback among *Pterocarpus lucens* bushes.



GRASSLANDS

REVANE, SENEGAL

The impact of drought and over-grazing on the woody vegetation of Senegal's northeastern plateau is evident both on the ground and from space. On the left, one of the earliest satellite photographs ever taken of northern Senegal (Corona, 26 December 1965) shows



ancient valleys cutting through gravelly plateaus, with extensive bushland vegetation. In the late 1950s, a borehole was drilled deep into the underlying aquifer at Revane, providing water in the dry season for livestock of the region's semi-nomadic pastoralists, the Fulani. By 1965, the early stages of landscape degradation (bright areas) around Revane are visible, a result of

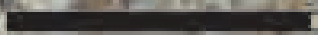
heavy livestock concentrations. By 1999, this badland phenomenon, exacerbated by years of drought, had spread extensively along the shallow valley slopes, leaving barren, unproductive surfaces (smooth, bright patches). A firebreak runs diagonally across the image from Revane to the northeast.

U N I T E D
S T A T E S

Wyoming



Credit: Gary Kramer/UNEP/NRCS



Kilometres



2 Jul 1989



GRASSLANDS

UPPER GREEN RIVER, UNITED STATES

The Upper Green River Basin (UGRB) is western Wyoming's sagebrush steppe, a landscape punctuated by ribbons of wildlife habitat, stunning vistas, and important cultural sites. The basin serves as the winter home of large herds of pronghorn antelope and mule deer,



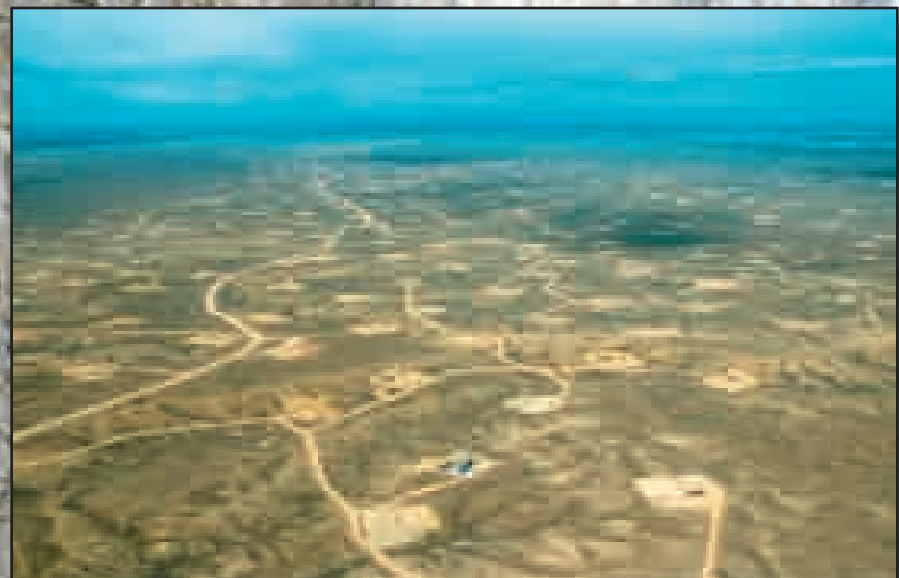
U N I T E D
S T A T E S

Wyoming

0 10 20 Kilometers



4 Aug 2004



Credit: Peter Aengst/UNEP/The Wilderness Society, LightHawk, and SkyTruth

This aerial photograph shows the vast network of roads and well pads that make up a portion of the Jonah natural gas field, located in Wyoming's Upper Green River basin, 21 km (35 miles) south of the town of Pinedale. This recently drilled gas field is not coal bed methane, but shows similar high density drilling (in this case it is for gas in a "tight sands" reservoir).

which migrate into the area from the highlands of Grand Teton and Yellowstone National Parks.

With its extraordinary reserves of oil and natural gas, the UGRB has become a focal point for the oil and gas industry. Over 3 000 wells (black dots in the center of the 2004 image) have been approved in the UGRB and development is occurring at a rapid rate—one that exceeds the Bureau of

Land Management's "reasonably foreseeable development" plan by more than 300 per cent. The environmental impacts of this rapidly escalating oil and natural gas development are not clear, and conservationists are pressing for measures that will help safeguard the region's wildlife and air and water resources.



Murrayville

Wyperfeld National park

Lake Hinton

Rainbow

Lake Hinton Marsh

Jepant

A U S T R A L I A

Bunns Springs

Yanac

Victoria

South Australia

Nhill

Katva

Bardostown

03 Jul 1973



GRASSLANDS WYPERFELD NATIONAL PARK, AUSTRALIA

Wyperfeld National Park in Australia's southeastern state of Victoria consists of some 3 000 km² (1 158 square miles) of dry, native scrubland—classic Australian "bush." Wyperfeld lies in the flood plain of the Murray River, sandwiched between wet, coastal forests and the country's arid interior. The park has water only



when the river overflows its banks. Much of the park's vegetation is mallee, a type of shrubland dominated by several sparse, tall varieties of eucalyptus. Over 450 species of plants, 200 species of birds, and a variety of mammals and reptiles live within the park.

Fires set by people have been used to maintain the Australian bush for thousands of years. Fires also occur naturally and occur in the park and sur-

rounding area nearly every year, leaving huge fire scars on the landscape that are easily seen in satellite images (light green areas). Remote sensing is used to document the extent of burn areas, and to help land managers plan controlled burns that help maintain the native vegetation and habitat for native wildlife. Wyperfeld staff currently set fuel-reduction fires along the park's edges but fight all accidental fires.