SAVANNAS

I had never really believed in being able to "feel" somebody's stare on my back until I found myself standing in the middle of a southern African savanna, surrounded by a sea of grass that stretched up to the horizon in all directions. I have no problem with being alone at night in the rainforest, but African savannas, be it day or night, make me feel really vulnerable and exposed. It is not just the lions and hyenas that my imagination puts behind every bush and termite mound. It is also the inability to see what lies near my feet, potentially a thick, muscular coil of a puff adder or a spitting cobra. I had been put in a hospital by a viper in the past, and knew that a snakebite in the middle of Botswana could be the last thing that ever happened to me. The technological highlight of Rakops, the nearest town, was a crank-operated gas pump, and even that was separated from our camp by a two-hour drive on bad, sandy roads. I doubted that Rakops had a medical facility capable of administering antivenin and treating anaphylactic shock. Why then did I go there, dragging along my unsuspecting wife? The reason for my fascination with tropical savannas is the fantastic diversity of animal life in these ecosystems, much of which shows astonishing adaptations to the seasonal fires that regularly happen there.

Savannas receive less rain than tropical forests at the same latitudes, ranging from 500 to 1,500 millimeters per year. They are seasonal, with a pronounced dry season that in extreme cases can last for more than half of the year. It is often at the end of the dry season that savannas fall victim to sweeping fires. Fire is not a force usually associated with life, and yet many organisms in grasslands depend on it for their reproduction, while others have evolved ways of surviving and benefiting from it. It usually starts with a strike of lightning at the end of the dry season. As the flames turn stalks of grass into strands of wispy ash and scorch the bark of trees scattered on the plain, thick seed husks of fire-dependent plants crack from the high temperature, freeing the plant embryos to sprout as soon as the ground has cooled. Rejuvenating rains that usually follow will allow the ash covering the ground to release its mineral contents into the soil, providing new plants with nitrogen, phosphorus, and other elements they require for healthy growth. But before the plains become covered with a lush green carpet of new plant life, the once grass-covered expanse is black. A green or yellow grasshopper that miraculously survives the fire suddenly finds itself exposed, and soon falls prey to a bird. Yet only a couple of weeks later the scorched ground is alive with insects munching on sparsely scattered, juicy new blades of grass. This time, however, the grasshoppers blend perfectly into the background, thanks to a phenomenon known as fire melanism. Although the exact mechanism that causes some insects to turn black following a fire is not completely understood, physiological changes induced by differences in the humidity and perhaps also the chemical composition of the substrate cause many insects that normally display light coloration to darken following a molt. Other insects such as moths cannot change their coloration during their life, but have evolved a strategy that allows at least part of the population to survive a period when their normally cryptic coloration suddenly makes them easy to pick out. In such species, populations often display a strong color polymorphism. Some individuals have coloration that makes them disappear against the background of grass or light tree bark, but others are black or darkly colored. These dark individuals inadvertently act as a safety reserve for the species, allowing it to survive periods when many of its members are at a heightened risk of predation. This is not to imply that color polymorphism evolved for the explicit purpose of helping the species to survive—the evolutionary process has no predetermined goal. Any effects of natural selection we see in living organisms are by-products of the competition between alternate copies, or alleles, of genes found in the organisms' populations. The allele that enhances the survival of its bearer has a greater chance of being passed on to the next generation, increasing its frequency among the members of the species.

Fire is a major force that shapes the life of savanna ecosystems, stripping the soil of nonwoody vegetation,

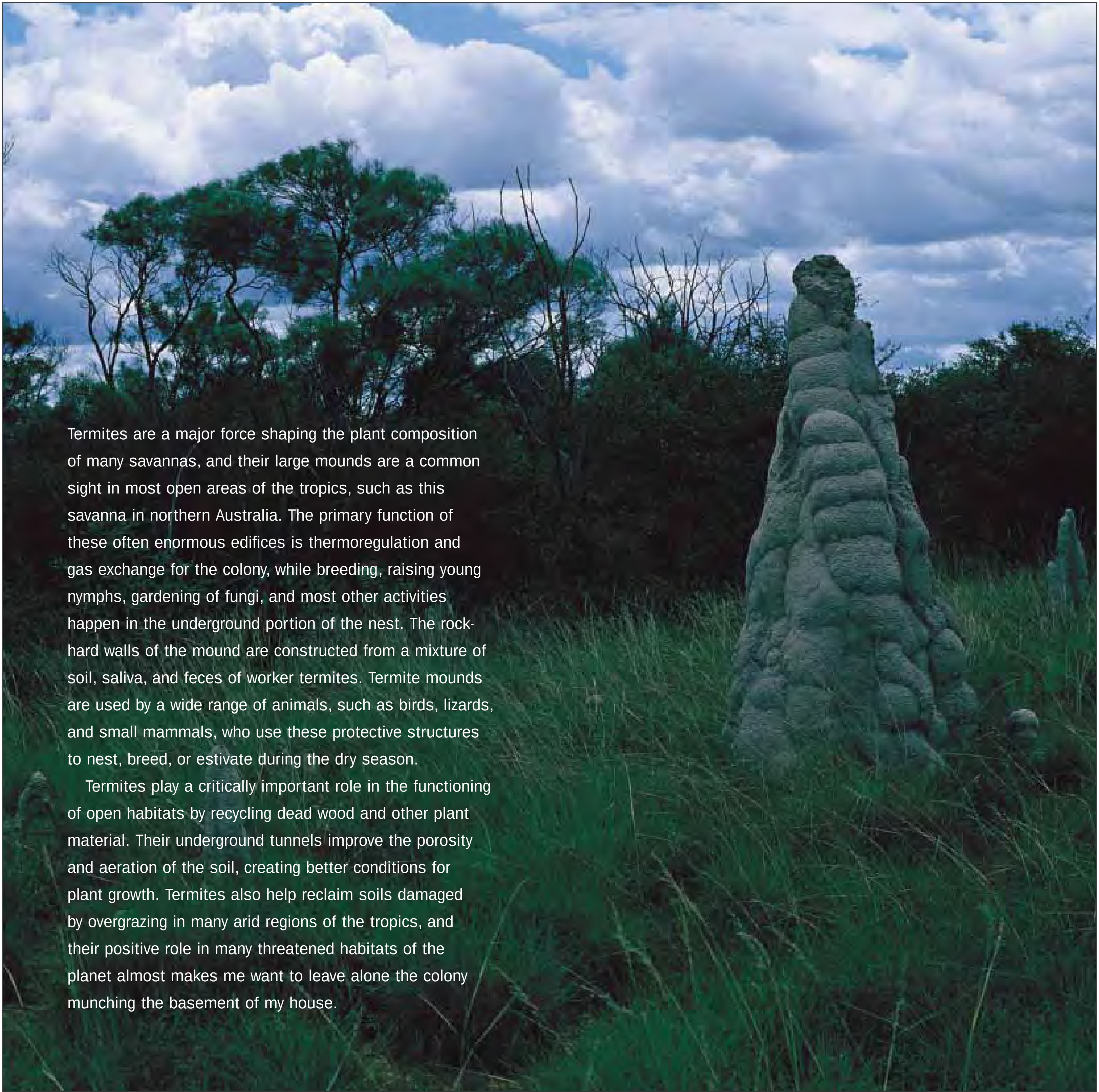
but for most of the year grasses dominate the landscape. In open savannas the grass cover is complete or very sparsely interspersed with other vegetation. But up to 75 percent of a savanna can be covered by trees and still be classified as such, although the term "parkland" is often used to describe grassy areas with a large percentage of tree coverage, especially if they occur at mid-elevations. Savanna trees such as the common African mopane *(Colophospermum mopane)* often exhibit strong fire resistance. Their bark is thick and corky, and the cells of these plants contain crystals of calcium oxalate. When the temperature of the wood during a fire reaches 370°C, this substance starts to decompose, producing copious amounts of carbon dioxide that acts as a powerful fire retardant. In addition to reducing fire damage to the tree, calcium oxalate is a natural repellent against termites and other wood-boring insects. Ironically, the fire resistance of some savanna trees is also the reason for their rapid disappearance from this habitat. Because they burn much slower than other species, such trees are sought as an ideal wood for cooking, providing hot and long-lasting fire.

Savannas, despite their relative dryness, have exceptionally high primary productivity, rivaling or even exceeding that of forest ecosystems. As a result they also show surprisingly high animal species diversity, despite being distinctly less botanically diverse than forests. Grasses, which dominate savanna ecosystems,

A balloon-winged
katydid nymph
*(Tympanophora
uvarovi)* (Australia)

One must wonder whether the similarity between the pointillist style of Australian aboriginal paintings and the color pattern found in common Australian spotted pyrgomorph grasshoppers *(Monistria)* is accidental, or a genuine case of art imitating nature. The resemblance was pointed out to me by David Rentz, an entomologist extraordinaire who knows Australian grasshoppers like no one else on the planet. Aboriginal artists have been aware of grasshoppers for thousands of years, and they are featured in some cave paintings. Leichhardt's grasshoppers, close relatives of the spotted pyrgomorph, are a part of the aboriginal mythology, considered to be children of Namarrgon—the "lightning man" responsible for violent electrical storms in northern Australia.

The reason for spotted pyrgomorphs' gaudy coloration lies in their unpalatability, acquired through a diet consisting of a wide range of toxic plants. These grasshoppers sequester and store the plants' secondary compounds and advertise this fact through the universal language of warning coloration. The combination of black and yellow effectively signals the noxious properties of an animal, and patterns based on these two colors have evolved independently in many unrelated groups.



Termites are a major force shaping the plant composition of many savannas, and their large mounds are a common sight in most open areas of the tropics, such as this savanna in northern Australia. The primary function of these often enormous edifices is thermoregulation and gas exchange for the colony, while breeding, raising young nymphs, gardening of fungi, and most other activities happen in the underground portion of the nest. The rock-hard walls of the mound are constructed from a mixture of soil, saliva, and feces of worker termites. Termite mounds are used by a wide range of animals, such as birds, lizards, and small mammals, who use these protective structures to nest, breed, or estivate during the dry season.

Termites play a critically important role in the functioning of open habitats by recycling dead wood and other plant material. Their underground tunnels improve the porosity and aeration of the soil, creating better conditions for plant growth. Termites also help reclaim soils damaged by overgrazing in many arid regions of the tropics, and their positive role in many threatened habitats of the planet almost makes me want to leave alone the colony munching the basement of my house.