Biodiversity and Threats

Hawaii is famous for encompassing a range of biotic communities, each with unique characteristics that have allowed for spectacular biotic diversification over time. Hawaii has some of the highest rates of endemism in the world, and also the greatest number of threatened and endangered species in the United States.

The increasing prevalence of invasive species in these shrubland communities, however, is shifting ecological processes and threatening native species. Many native shrubland habitats have already lost a large number of indigenous and endemic species due to human activity. Some of the most critical threats to these habitats are introduced mammals, invertebrates, plants (especially several fire- and drought-adapted species), and human land use.

Additional threats to the Hawaii Tropical Shrublands biome include overgrazing by livestock, and even seemingly benign human activity such as hiking, which can damage delicate plants and lead to erosion. Climate change impacts are still being studied. Rising sea levels are already threatening the long-term existence of some of the outlying, smaller islands here, which could spell trouble for several of the bird species that circulate among the shrublands habitats across the archipelago.

Studies have shown decreasing rainfall and increased average air temperature. However, projections of these trends into the future is an unknown. As a rule, endemic species in such variegated habitat niches are more vulnerable to climate pattern alteration than species that thrive broadly across less unique habitats. Therefore, the species adapted to Hawaii Tropical Shrublands biome niches will tend to be more at risk is the climate continues its warmer, drier trends.

Margaret J. Sporck
Christopher A. Lepczyk

Further Reading

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Highveld Grasslands

Category: Grassland, Tundra, and Human Biomes.
Geographic Location: Africa.
Summary: This diverse, high-altitude grassland is becoming increasingly degraded by urbanization, agriculture, and mining activities.

Grasslands once covered the majority of the modern-day African continent, but today a comparatively small remnant of this formerly expansive biome remains. As the African continent shifted over geologic time, grasslands were gradually converted to modern savannas that feature trees and a more tropical climate. In southern Africa, however, a small portion of the grassland biome remains. The Highveld (from Afrikaans, meaning *high field*) grassland is a remarkable ecosystem within the grassland biome. Highveld grassland is defined by high elevation; dry, cold winters; occasional snow; and the summer rainy season, when thunderstorms bring almost daily showers to the area. These features create a unique habitat for many rare species.

The Highveld grassland performs vital ecosystem functions for the human population, including storing and purifying water, a scarce resource. Despite these benefits, the Highveld Grasslands biome is being fragmented and degraded by urban expansion, agriculture, industry, and fuel demands.

The Highveld grasslands are set on a landlocked plateau in the heart of South Africa, about 3,940–5,910 feet (1,200–1,800 meters) in elevation. It is bordered by the arid Kalahari and Great Karoo Deserts to the west and southwest;

the woody, low-altitude bushveld to the north; and the Drakensberg Mountains to the east and southeast. Compared with the surrounding ecosystems, the Highveld grasslands receive greater annual rainfall, averaging 20–35 inches (500–900 millimeters), but occasionally exceeding 79 inches (2,000 millimeters) in the eastern Highveld. Some of this rain seeps into the ground and is gradually released during the dry winter.

Fire plays a natural role in maintaining the Highveld grasslands, as species that are not fire-adapted, such as many trees and shrubs, have difficulty establishing here. Frost similarly restricts the distribution of many trees and shrubs.

Biota

Grasses dominate this ecosystem, although other small herbaceous plants are common, and shrubs may be found in sheltered areas. The predominant grass species is redgrass (*Themeda triandra*). Other grasses include broom needlegrass (*Triraphis andropogonoides*), sawtooth lovegrass (*Eragrostis superba*), and many others. Hallmark shrubs include bitterkaroo (*Pentzia globosa*), as well as various woody shrubs and dwarf shrubs such as dwarf buffalothorn (*Ziziphus zeyheriana*).

Predictable patchiness of rainfall, fire regime, and frost patterns overlay a variety of soil types on the Highveld grassland. Dividing the resulting mosaic of sub-habitats into two broad categories—sweet and sour grasslands—is helpful when considering their functions and human-use histories. Due to lower rainfall and fewer frost events, sweet grasslands are palatable to grazing animals throughout the year, as they are nutritious and low in fiber.

Sour grasslands, on the other hand, are adapted to environmental conditions that favor underground nutrient storage, making the leaves of these grasses less nutritious outside the growing season. Highveld grasslands characterized by sweet grasses are threatened by overgrazing and trampling by livestock, whereas the sour grasslands tend often to be burned to encourage younger, more nutritious plant growth.

The Highveld is home to a diverse fauna community, many of which are endangered. These include straw-colored fruit bats, the African rock python (*Python sebae*), and the blue crane (*Anthropoides paradiseus*), South Africa's national bird. Reptiles such as pythons, monitors, and Nile crocodiles are common within the biome. An endemic (exists nowhere else on Earth) reptile found in the Highveld is the giant girdled lizard (*Cordylus giganteus*). Major mammals found in the area include the brown hyena, leopard, African civet, mountain zebra, and honey badger.

Effects of Human Activity

Agriculture on the Highveld grasslands began in the 13th century, and remains a dominant activity. Maize is the most important commercial crop, but wheat, sorghum, and sunflowers are also cultivated to a lesser extent. Due to its intensive use, the Highveld Grasslands biome suffers broadly from erosion and soil degradation.

To salvage exhausted soil, farmed land is often permanently converted to pasture. However, this land-use strategy is less effective in these grasslands than in some other parts of the world, as the native soil here is rarely resilient enough for this transition. After intensive agriculture, the Highveld soil structure is physically altered; microbial communities are irreversibly changed, which make restoration efforts in this ecosystem more difficult.

Urbanization and an increasing need for energy are threatening the remaining Highveld grasslands. The Gauteng province (a part of the former Transvaal), the most densely populated region of South Africa, is situated within the Highveld grasslands. Almost three-quarters of the South African population receives electricity from the Highveld's many power-generation plants, and demand continues to increase. The Highveld plateau possesses gold and shallow coal deposits, both of which are extensively mined. The coal-mining industry practices ecosystem rehabilitation, although success is limited because revegetation is especially slow as organic matter is easily depleted here.

Human activity has also reduced the effectiveness of the Highveld grasslands as a source of water and natural water purification. Though the Highveld receives and stores a signifi-

cant amount of rain, plantations of exotic trees draw large amounts of water from the ground. Because these trees are ultimately harvested and exported, valuable water is being permanently removed from the region. Peat harvesting also negatively affects ecosystem function, by impairing the biome's capacity to purify water. Peat forms slowly over time, and acts as a sponge to remove pollutants from runoff—but it is rapidly being removed from this ecosystem.

Ongoing climate change has the potential to remove even more water from the Highveld grasslands, as average annual rainfall will decrease, according to some predictive models. Grasslands would retreat across some parts of the plateau in such a scenario, as arid conditions would overtake groundwater recharge rates. Such a development would combine with the human impacts of continued mining and more intensive agricultural activity to raise the stress level of habitat and species here. The increasing human population is ultimately a vector that could lead to widespread negative tipping points when combined with the effects of global warming here.

Conservation Efforts

Currently, less than 2 percent of all South Africa's grasslands are officially conserved. The Highveld grasslands are home to several threatened endemic species. The sungazer lizard (*Cordylus giganteus*) and the robust golden mole (*Amblysomus robustus*), for example, are both jeopardized by habitat degradation. The Highveld Grasslands biome has also been identified as an ecosystem at high risk of biological invasion.

Plateau-wide conservation organizations like the South African Grasslands Programme, and community-driven initiatives like the recently proposed Highveld National Park, are steps toward conserving this unique ecosystem and its long-term benefits to human residents. New models put forth by such groups identify several key areas within the Highveld grasslands that, if protected, would be highly effective in preserving the ecosystem's functions and ecological diversity.

Lindsey Noele Swierk

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Himalayan Alpine Shrub and Meadows, Eastern

Category: Grassland, Tundra, and Human Biomes.
Geographic Location: Asia.
Summary: The Eastern Himalayan Alpine Shrub and Meadows biome features spectacular flora that developed between the snowfields and treelines; it is threatened by changes in land use and climate.

The Eastern Himalayan Alpine Shrub and Meadows biome lies between the treeline and snowline, spreading across parts of India, Nepal, Bhutan, and Myanmar. As one proceeds to higher elevations, tree life is abruptly replaced by a magnificent combination of shrubs and meadows, before reaching the permanent snow-covered areas.

Separated from the western part of the Himalaya Mountains range by the Kali Gandaki River, the eastern altitudinal belt holds an area of outstanding biodiversity and high endemism (home to species found nowhere else on Earth). In fact, the Eastern Himalayas Alpine Shrub and Meadows are home to more than 7,000 species of plants, three times more than the rest of the Himalayas, making it perhaps the most important alpine area in the world, and an obvious conservation priority.