

The Montane ecosystems: Characteristics and conservation

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Introduction

The purpose of this paper is:

To explain to all who love the mountains the different bands of vegetation that characterise the mountain as one climbs to the top. There may be those who see the mountains as one mass of plants species mixed in helter skelter fashion.

To explain the species adaptation to various montane ecosystem zones.

To explain the values of and threats to montane ecosystem and the measures that could conserve the rich biodiversity.

The information was compiled after a visit to several mountains in Africa. Mount Kenya, the Abadares, and Mount Marsabit all in Kenya. For the last three months I have been living on the Table Mountain in Cape Town South Africa. I have also viewed Mount Kilimanjaro bordering Kenya and Tanzania on close quarters. The following zones on Fig. 1 were observed:

Nival zone	4300 m
Alpine zone	3500 m
Health zone	3000 m
Hagenia/Hypericum zone	2800 m
Bamboo zone	2400 m
Forest (Savannah) grassland	

Figure 1. The Montane Zones

Characteristics

The soils are distinctly acidic. The humus in the soil is determined by the moistness of the mountain. The moister the mountain the more the humus. Where the soil water is close to the surface, there is more vegetation. In Mount Kenya, for example, soil water is determined by the relief, the depth and the texture of the soil. On Table Mountain, the water may not be very close to the surface and there is less vegetation.

Plants are adapted to high radiation levels and low temperatures. During sunny weather the solar radiation is intense and may cause strong surface heating on the plants. It is a very fragile ecosystem whereby plants take a long time to grow because of the low temperatures and poor soils. Some plants have morphological traits that protect them from strong radiation through reflection. These include the thick and light coloured indumentum (dense hair) covering one or both sides of the leaves, and /or bracts, peduncles, stems of plants such as *Senecio brassica*, *Hiechrysum newii* among others. These are more common in the alpine belt than the lower parts of the mountain.

Protection of plants from freezing is achieved through formation of tussocks, rosettes among other developments. Some grasses e.g. *Festuca pilgeri*, *Agrotis tryphylla* on Mount Kenya have living parts concentrated in the central part while the outer part consists of dead and decaying leaves and calm bases offering temperature insulation. During the day, the outermost part of their leaves are flat and patent while at night they bend inwards towards the centre of the leaf protecting the centre from low temperatures. Old leaves are not shed out but remain attached to the stem so as to insulate the plant against extremes of temperature change.

Another characteristic of the montane ecosystem is thin air. As one rises along the altitude, the air becomes less dense.

Montane ecosystems have to cope with high radiation, especially in form of ultra-violet radiation. This is due to clean atmosphere at high level; the intensity of incoming radiation is greater than in the lowlands. The relative amount of ultra-violet rays is higher than at sea levels. Cloudiness reduces the intensity of radiation for at least part of the day. However during a clear cloudless part of the day, insulation can have adverse affects on lifeforms and thus the need for specific adaptations.

Montane ecosystems are high rainfall areas. In Eastern Africa, rainfall coincides with the two maxima of April-May and that of November to December. On the Table Mountain, there is usually rain in summer and winter. Rainfall is higher on the lower altitudes of the mountains than on the higher altitudes. Decline in rainfall on higher altitudes is less marked on Mount Kenya as compared to Mount Kilimanjaro and the Table Mountain.

Low temperature as altitude increases is another characteristic of montane ecosystem. The mean temperature decreases by about 0.6°C per 100m increase in altitude. The most significant variation is the diurnal temperature in the Afro-Alpine zone. During the day, high temperatures are experienced due to the direct solar radiation through a clear atmosphere. During the night there is a strong long wave radiation resulting most often in night frost. This phenomenon has marked implication on species adaptations in the zone. The belt experiences rapid temperature change in a day due to changes in wind and cloudiness (Herdberg 1995).

The montane zones are illustrated by Figure 1 (above). Alpine zone is 3,500-4,350m. This is a true mountain region of high rock peaks, tarns and rugged rocky slopes. *Senecio* mass flowering occurs only once in every twenty or more years. *Lobelia* species are found in groups along wet valley bottoms. The most conspicuous inhabitant of this zone is Rock Hyrax. Occasionally elephants, leopards, jackals and buffaloes are found there, particularly in the Eastern African mountains.

The Nival zone comprises rock and ice. Slopes are usually made of bare gravel and scree left by glacier erosion. Colourful lichens are the common plant forms at this altitude. The composite *Senecio* (*Keni opytum*) occurs only a few metres from the glaciers. *Helichrysum* (*browne*) occurs on all peaks in cracks of weathered rocks. The rock hyrax is seen in the lower zone. Figure 2. below gives a comparative overview between global latitudinal biome and a tropical montane.

Mountain		
Arctic	Tundra (heather)	
Temperate	Conifer Woodland	
		Deciduous Woodland
		Forest
Tropical	Savannah	

Figure 2. Global Latitudinal Biome and Tropical Montane ecosystem. (apologies to the author from the Mountain Forum - the graphic part of this figure did not reproduce on our web site)

Values of the Mountain Ecosystem

Mountains form some of the most important water catchment areas. Mineral water, which is considered safe universally, is obtained mainly from mountain ecosystems. As unique ecosystems, montane ecosystems have fragile and very

rare plant and animal species e.g. the giant *Senecio* which flowers every 20 years. They provide breeding ground for fish such as trout whose eggs require very low temperatures (10-14°C) before they hatch. The forests are a source of construction materials e.g. bamboo, mahogany among others. The montane ecosystem is a habitat for certain animals which are not found elsewhere.

In lower montane forests (between 2,100-2,400m), the tree species include camphor (*Ocotea usmbarensis*), cedar (*Juniperus procera*), Olive (*Olea africana*) and *Podocarpus* spp. The animals in this region include the giant forest hog, tree hyrax, white tailed mongoose, elephant, leopard, buffalo, sykes monkey among others.

Bamboo Zone (2,400-2,800) is the home for giant grass bamboo (*Arundinalia alpina*) which grows as thick forest attaining heights of 12-15 metres. Interspersed are numerous flowering herbs. The *Hargenia/Hypericum* zone (2850-3000m) has forests with patches of bamboo thickets and open glades. Dominant trees include Rosewood (*Hagenia abyssinica*), Giant St. Johns Wort (*Hypericum keniensis*), and *Lobelia*. The trees are hung with long strands of lichen, ferns, *Sphagnum* mosses and orchids. As one goes up the mountain, there is occurrence of plants that resemble the temperate ferns.

The Heath Zone (3,000-3,500m) is an open moorland of smooth tussock (*Deschampsia flexuosa*) and tussock grasses (*Eeleusina jaegri*) grasses mixed with other plants varying according to altitude. Giant Herb such as giant *Senecio*, *Lobelia*, giant groundsel and fields for flowers make this zone particularly attractive.

Apart from the flora and fauna the montane ecosystems have numerous waterfalls which can be used to generate electricity. They are truly wonderful areas for recreation as there are several learning resources and delightful scenery.

Threats to the Montane Ecosystem

The montane ecosystem is threatened by several factors. There is the threat from human activities such as by mountain climbers. Climbing tracks form erosion gullies and hikers' feet trample on vegetation which has taken many years to grow. Mountain climbers are careless with cans, packaging materials, soap and other forms of human waste. These non-biodegradable waste products bring chemical pollution and if animals feed on them they cause clogging of their alimentary canals and they can die. Waste is also unaesthetic.

Commercial overutilisation of trees in the lower forest zones is a great threat to biodiversity. Replanting indigenous trees with fast growing coniferous trees as has been done on the Table Mountain is not as beautiful as the natural trees. Wild life is very rare on the Table Mountain as there is not much of natural vegetation. Lighting the mountain at night for the beautiful scenery for tourists may bring money to the Cape Town but does not encourage the development of fauna on Table Mountain.

Global warming is another threat to the montane ecosystems. Snowlines are receding and eventually there may be a melting of the glaciers which will lead to drying up of rivers which feed from them.

Human settlement and activities constitute the biggest threat to the mountain ecosystem. Building of such towns such as Cape Town right inside the mountain and transporting people by cable car to the peak has eroded the Table Mountain and driven the flora and fauna as far away as possible. Human settlements and land use patterns especially for Eastern African mountains bring about such threats as fire which when carelessly handled destroys a lot of biodiversity.

Conservation

Attempts at conservation of montane ecosystem ought to be multifaceted, and involving several sectors. Since human activities are the greatest threat, there should be a way of controlling their encroachment. Hikers should be issued rules of what they can do and cannot do as they visit the montane ecosystems. Such rules should be enforced with huge fines which will pay for surveillance of mountain resources.

Gazetting montane ecosystem will be useful in prohibiting excess overutilisation of forest resources. Religious beliefs and traditions which protect the environment could be given value by being enforced by the law. Communities who live by the mountains should benefit from the marketing of the mountain resources so as to make them enthusiastic custodians of mountain resources. Cultural centres could be organised by building of museums and forest homes to cater for tourist and boost the incomes of mountain communities.

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Notes to readers

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