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Maria Johansson ▪ Anders Granström ▪ Anders Malmer

Pasture burning in the heathland landscape during the dry period, February 4th 2008, at 12.10 pm. Photo Maria Johansson.

Traditional Fire Management in the Ethiopian highlands – what would happen if it ends?

- Traditional fire management has often been practiced by pastoralists to improve pasture. Authorities, however, have typically considered it destructive and hence issued burn bans.
- The Bale Mountains are a high-altitude area in Southern Ethiopia where heathland burning and free-range pasture is still practiced by local pastoralists.
- The vegetation is dominated by tree heather which may grow several metres tall, is highly flammable and burns at a high intensity.
- Repeated burning creates a mosaic landscape with stands of differing time since fire. Young stands, up to 3 years old, give the best pasture and they cannot burn due to lack of fine fuels. Therefore they act as fire breaks in the landscape, where natural fire breaks are virtually absent.
- If the traditional burning ceases the pasture quality, and also the fire breaks, would be lost in less than ten years time. Since old heather is highly flammable, this would increase the risk of large-scale, and potentially more dangerous, wildfires. The traditional fire management prevents this.

Figure 2. Highland cattle in the heathland landscape in the *Bale Mountains during the dry period. A few taller shrubs of* Erica arborea *are visible behind the cows to the left,* Erica trimera *dominates in the rest of the picture. In the foreground, white cushions of a thorny everlasting plant,* Helichrysum citrispinum*, are seen. Photo Maria Johansson.*

Burning is often necessary to create pasture. In Sweden pasture burning used to be common, but was prohibited when it came into conflict with timber interests. Centuries of pasture burning here created heathlands with a unique biodiversity, which are today threatened by reforestation.

Also in areas with Mediterranean-type climates around the world, vegetation was managed by fire to improve pasture. Fire and cattle interact with each other through their effects on vegetation (Figure 1). Now that traditional pasture and burning is decreasing in these areas, the accumulation of large fuel loads is contributing to the current wildfire problems.

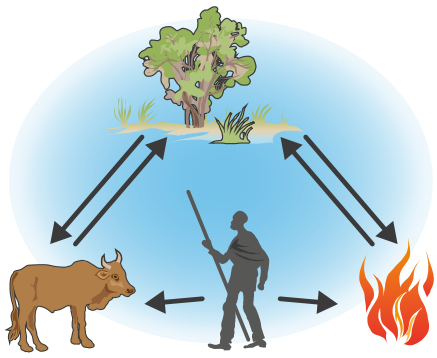

Figure 1. Interactions between fire, vegetation and large herbivores. The herbivores affect vegetation and thereby pasture quality and type of fuel available for fire. Fire affects the vegetation and thereby also pasture quality and future fuels. Man often contributes with the majority of both large herbivores and ignitions. Drawing by Gunilla Guldbrand.

Bale Mountains

The Bale Mountains is the highest part of Ethiopia's southern highlands and harbours a high biodiversity with many endemic species. It is one of few areas where traditional pasture burning still occurs. This gave us a unique opportunity to study fire ecology and traditional ecological knowledge in a living fire culture. The research objective was to understand relations between vegetation, pasture, and fire behaviour in the heathlands and forests below.

The local population are pastoralists who used to seasonally migrate between different pastures. Today, a high population growth and a more sedentary lifestyle have led to increasing competition for land. Authorities regard the present land-use as unsustainable and wish to eliminate fire. In addition, an extensive carbon storage project is being planned for the area. This might create conflict with the local people's need for pasture, and increase the risk of large-scale wildfires.

The Bale Mountains are situated approx. 7 degrees north of the Equator, at an altitude of 2 700–4 300 metres. The tropical mountain climate is characterized by a large diurnal variation in temperature, often with night-time frosts. It is moist and cold for most of the year, and burning is possible only during the short dry period which occurs between December and February. In extreme years, draught can continue into April.

The vegetation is characterized by an altitudinal zonation, mainly caused by lower temperature and higher precipitation at high altitudes. Just below the tree line (at 3 500 m) the forest is dominated by tree heather (*Erica* spp.). In the heathlands above, the same heather species are kept short and shrubby by recurrent burning (Figure 2). The whole area (both forests and heathlands) is intensively grazed by livestock, mainly cattle.

Methods

We studied the effects of fire and grazing on vegetation by constructing browsing exclosures in recently burnt as well as in older stands. Vegetation was measured over four years, and soil disturbance, sowing experiments and analysis of soil nutrients and seed bank were undertaken to explore which factors controls post-fire succession. We interviewed the local people regarding why and how they burn, and collected field data on post-fire succession, stand structure, climate, and fire behaviour.

Improved pasture

Interview results revealed that the pastoralists had three main objectives for burning the heathlands: 1) to improve pasture; 2) to reduce the abundance of a toxic caterpillar ("*Bokata*", Figure 3) and 3) to reduce loss of cattle to predators such as hyena and leopard (since their chances to hide are smaller in recently burnt areas). The informants were well aware of critical relations between fuel structure, weather, and fire behaviour, showing an intimate knowledge of fire as a management tool.

The forest below the tree line had a low fire potential because of a lack of surface fuels and an elevated canopy (Figure 4d). Good surface fuels are a prerequisite for fire. Even after four years of cattle exclusion there were no combustible surface fuels in the forest. The field layer consisted of a carpet of green herbs which did not cure even during extreme draught.

In contrast, the heathland is highly flammable as soon as the shrubs reach one metre in height. The heathlands are sustained by a man-made fire regime of high-intensity fires with an average fire-return-interval of about ten years. The burning results in a mosaic landscape with patches of stands of varying age (time since last fire) (Figure 4 a-c). After each fire, the heather produce new shoots from subterranean lignotubers (Figure 5) and grows into tall shrubs in a few years, despite being browsed. Annual net accumulation of biomass was approximately 3.8 tonnes per hectare. Young stands (1–3 years) have a large proportion of a short-grazed grass sward between the shrubs (Figure 4a). According to the interviews, these stands provide the best pasture. The cows can reach the young heather shoots and grasses and herbs are abundant. At the same time, these young stands cannot burn due to lack of fine fuels and a discontinuous fuel bed.

Figure 4. Tree heather stands in different post-fire successional stages: a) two years after fire b) five years c) eleven years, with plenty of fine dead fuels in the shrub layer d) approx. 50 years after fire, with the canopy separated from the hard-grazed field layer. Photo Maria Johansson, except c Anders Granström.

The necessity of burning

Since the young stands cannot burn, the heather cannot be eliminated by too frequent fires. As the shrubs grow taller and denser, fuel quantity and quality increases dramatically, and ten year old stands burn with high intensity (Figure 6). Because the landscape is full of young unburnable stands, acting as firebreaks, fires can be controlled.

Cattle exclusion had a relatively small effect on fuel development. Cattle browsing, however, had a dramatic effect on the competitive balance between the two co-dominant shrubs *Erica trimera* and *E. arborea*, where the latter was favoured because it was less browsed. The humus layer was usually too moist to burn, and vegetative regeneration dominated after both fire and mechanical disturbance, in spite of the presence of a large and diverse seed bank. Deep smouldering in the humus layer, which had killed a few lignotubers, was however observed after severe drought. The most important nitrogen-fixating vascular plants in the system are procumbent leguminous herbs which are abundant only in young stands. If grazing and burning would cease, it is likely that productivity would decrease due to nitrogen limitation.

The results showed that fire prevention is not a viable option for the heathland. It would deteriorate pasture quality and it is also unlikely that long-term

*Figure 3. "*Bokata*", a moth caterpillar. It is covered by urticating hairs which cause respiratory and skin disease in the cattle. Photo Maria Johansson.*

Figure 5. Lignotuber of Erica trimera *from which new shoots arise after each fire. Photo Anders Granström.*

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Figure 6. Heathland fire on February 4th, 2008 at 12.40 pm. The longest flames are approx. 8 meters long. The burning Erica *shrubs are about 2 metres tall. The lower shrubs in the foreground are approx. 1 metre tall. Photo Maria Johansson.*

fire elimination would be successful, since large tracts of highly flammable vegetation would soon develop. To successfully preserve these ecosystems, and the livelihoods of the pastoralists, we recommend that the authorities develop a joint management plan, together with the local people, allowing burning, but with defined prescriptions concerning fire intervals and fire weather.

Keywords

Afro-alpine heathlands, pasture burning, fuel succession, *Erica arborea*, *Erica trimera*, pastoralists, selective grazing, traditional ecological knowledge.

Read more

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Authors

MARIA JOHANSSON
PhD, Department of Forest Ecology and Management, SLU, SE-901 83 Umeå
Maria.Johansson@slu.se

ANDERS GRANSTRÖM
Senior lecturer, Department of Forest Ecology and Management, SLU, SE-901 83 Umeå
Anders.Granstrom@slu.se

ANDERS MALMER
Professor, Department of Forest Ecology and Management, SLU, SE-901 83 Umeå
Anders.Malmer@slu.se

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