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MEETINGS OF THE SECTION FOR VEGETATION RESEARCH ON 25 MARCH 1997

Changes in Tropical Montane Forest Composition Following Natural Evolution and Man-induced Disturbance, Based on Pollen Records

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Pollen records from lake sediments from tropical montane and tropical lowland forest belts show that the floral composition of these ecosystems is subject to considerable change. During glacial–interglacial transitions (some thousands of years) arboreal compositions may adapt to changing precipitation regimes causing transitions from evergreen to semi-deciduous forest and natural changes in biodiversity, which is, e.g. evidenced by pollen records of Lakes Bosumtwi (Ghana) and Barombi (Cameroon) (Maley, J., 1991, *Climatic Change*, **19**: 79–98). On long time scales, including several glacial–interglacial cycles (>200 000 years) natural adaptation of ecological requirements and migration cause important changes in the floral composition of ecosystems, causing changes in competition between floral elements (Hooghiemstra, H. & Cleef, A.M., 1995, In: Churchill, S.P. *et al.*, *Biodiversity and Conservation of Neotropical Montane Forests*, pp. 35–49, *New York Bot. Gard.*). Evidence from pollen records of anthropogenic disturbances of montane and lowland forests in the tropics is rapidly increasing. For several classical centres of civilization located in forested areas in the tropics (Inca culture in Peru, Tairona culture in Colombia, Maya culture in Guatemala, Aboriginal culture in Australia), pollen records show clear evidence of the impact of expanding and collapsing civilizations (Islebe, G.A. *et al.*, 1996, *The Holocene*, **6**: 265–271; Herrera de Turbay, L.F., 1984, *Studies on Tropical Andean Ecosystems*, **2**: pp. 531–545, Cramer, Berlin). Also evidence on the changing composition of crops in centres of civilization may be related to natural climatic change as well as to changes in farming techniques and forest degeneration (Chepstow-Lusty, A.J. *et al.*, 1996, *Antiquity*, **70**: 824–833). Growing palynological evidence shows that natural forest regeneration on century to millennial scale often involves a distinct change in the floral composition and biodiversity. Modern natural composition and biodiversity of ecosystems may be considered as a snap-shot in the course of evolution and these characteristics may be seen as variable on glacial–interglacial time scales. Human disturbance affects tropical montane and lowland forest belts selectively, affecting seriously our heritage of biodiversity.

Contribution of Non-vascular Epiphytes to the Biodiversity of Tropical Montane Forests

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One of the characteristic features of tropical montane forests is the abundance of epiphytes, especially non-vascular epiphytes (bryophytes, lichens). The relatively low air temperatures in these forests, high light levels and, especially, the availability of plentiful water due to frequent clouds and fog favour the luxuriant growth of epiphytes. By capturing large quantities of rain water epiphyte mats help to keep humidity in the forest at a high level, serve as a substrate for orchids and other plants and offer shelter to a great variety of invertebrates and micro-organisms.

Our understanding of the species richness of the bryophyte flora in neotropical montane forests is still fragmentary due to their presence in the forest canopy, requiring special techniques for access. Recent canopy work in Colombia and Costa Rica, surprisingly, has shown that the epiphyte species richness in these forests may not be very much higher than in lowland rain forests where epiphytic biomass is much smaller. Species density is usually very high, especially in bryophytes, and minimum areas for sampling are thus relatively small. Complete sampling of 4–5 trees (from base to outer canopy) may yield over 75% of the flora of a homogeneous forest stand.

Very little is known about the impact of deforestation on non-vascular epiphyte diversity. There is some evidence that the epiphyte flora of secondary forests is poorer than that of the mature forest. Moreover, shade epiphytes of the lower portions of the tree crowns and the forest understorey seem to

be more vulnerable to forest destruction than sun epiphytes which may re-establish in open woody vegetation. The capabilities of species to survive deforestation are particularly relevant for conservation of tropical montane forests and should be a priority subject for future research.

Vegetation Changes Following Human Disturbance of Mid-montane Forest in the Wau area, Papua New Guinea

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This paper examines the floristic changes that occur following human disturbance in mid-montane forest in the Wau area (7°20'S, 146°43'E, Morobe Province) in Papua New Guinea. The study was restricted to a 1600–2400 m altitudinal range on Mt Kaindi (alt. 2362 m) with disturbed forest, and Mt Missim (alt. 2877 m) with undisturbed forest. Special attention was given to the status of *Nothofagus pullei*, which is locally dominant on Mt Kaindi.

Large-scale disturbance by man started in the 1920s with the discovery of rich gold deposits in the upper Edie Creek basin on the west side of Mt Kaindi. The disturbance in the research area is directly or indirectly related to mining activities, i.e. prospecting for gold, road construction and logging for firewood and timber.

A major change in floristic composition in virgin forest on Mt Missim was observed between 1800 and 2000 m, where a large group of tree species have their upper or lower limit of distribution. The altitudinal zonation is also reflected in the floristic composition of secondary forest on Mt Kaindi (Van Valkenburg, J.L.C.H. & Ketner, P., 1994, *Trop. Ecol.* **10**: 41–45).

Dominance or absence of *Nothofagus pullei* in secondary forest plots of varying age led to the hypothesis that the species is a pioneer with a long life-span. *N. pullei* does not regenerate under its own cover and dominance is dependent on the availability of seed at the moment of disturbance. As a result of its rapid growth rate it can overtop competitors. The competing species remain suppressed in the middle layer of the forest together with the primary species that establish later. There were no important floristic differences between *Nothofagus*-dominated forest and mixed mid-montane forest.

Montane forests in Papua New Guinea have been constantly subjected to natural disturbances (Johns, R.J., 1986, *Blumea* **32**: 341–371). However, the present intensity and frequency of human disturbance on Mt Kaindi may well result in the disappearance of *N. pullei*.

Accelerating Montane Forest Restoration on Abandoned Pastures in Costa Rica: the Effects of Seed Availability and Site Treatment

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Forest recovery on abandoned pastures is usually slow, especially in montane areas. A high intensity of land use often alters soil conditions negatively, eliminates advanced regeneration and possibly depletes the seed bank. Large open sites may present a barrier to seed vectors, and colonizing species have to compete for resources with the present vegetation. This raises the supposition that forest recovery on abandoned fields may be limited by the availability of seeds, and inhibited by the present vegetation. We tested this by enlarging the available pool of species, and by reducing the inhibitory effects of the present vegetation.

Research was conducted at the Ecolodge San Luis Biological Station, located on the Pacific slopes at an elevation of 1100 m in north-western Costa Rica. The study site is a small, recently abandoned pasture surrounded by secondary and primary forests. Seed availability was assessed by sampling the seed bank in secondary forest and pasture, and by recording the invasion and predation of seeds in the pasture. Furthermore, seed availability and the inhibitory effects of the present vegetation were experimentally tested in the field, by adding forest soil and/or treating the grass vegetation (mowing, tilling, applying herbicide). Our results indicate that seed availability is a major limiting factor in forest restoration on abandoned pastures, due to low tree seed densities in the seed bank, virtually no colonization by tree species, and high levels of seed predation. Furthermore, the intact grass vegetation inhibits the germination of woody species. We demonstrated that forest restoration can be artificially accelerated by: (1) enlarging the available pool of species, and (2) reducing the inhibitory effects of the present grass vegetation. Of these two factors, enlarging the available species pool has the most pronounced effect.

Montane Rain Forest in the Blue Mountains, Jamaica: Forest Stature and Edaphic Conditions

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As part of a long-term programme investigating the

causes of forest stunting on wet tropical mountains the hydrometeorology, site water balance, soil fertility status and nutrient cycling patterns of two montane rain forests of contrasting stature were studied at *c.* 1820 m in the Blue Mountains of Jamaica.

Compared to the nearby 'well-developed Mull Ridge' and 'Mor Ridge' forests, studied earlier by Tanner (1977, *J. Ecol.* 65: 883–913), the two forests represent intermediate stages in a sequence of increasingly acid humus and topsoils (pH 2.5–3.5). Forest stature ranges from 5 to 7 m in the Mor forests to 13 to 17 m in the well-developed Mull forest. Dominant species in all four forest types include *Lyonia* cf. *octandra*, *Cyrilla racemiflora*, *Clethra occidentalis*, *Chaetocarpus globosus*, *Alchornea latifolia* and *Podocarpus urbanii*, with *Lyonia* and *Clusia* cf. *havetioides* being characteristic of the Mor forest versus *Clethra*, *Podocarpus* and *Hedyosmum arborescens* of the Mull sites. Soil development in the two main forests is strikingly different. A discontinuous litter/fermentation layer plus a thin humus layer overlie deep clay soils (bedrock >3 m) in the Mull forests, whereas the shallow Mor forest soils (bedrock <=0.7 m) have a thick layer of accumulated Mor humus (<=0.5 ml). Computed long-term soil moisture patterns suggest that the Mor forest soils are subject to water stress (pF >3) after about 40 days without rainfall, versus about 130 dry days in Mull forests. Drought is therefore not a major factor determining forest stunting in the study area.

Apart from differences in acidity, principal chemical contrasts between the Mor and Mull litter are (much) higher extractable base cations and aluminium (including amorphous forms) in the Mull. Ammonium amounts are similar, although total nitrogen levels are higher in the Mor. These differences disappear in the topsoil, except for magnesium, nitrogen and ammonium (remain constant or increase), and sodium and aluminium (for which the trend is reversed). Mineralization and nitrification rates in the Mull soils are three times those found in the Mor soils whereas concentrations of polyphenols in fresh Mor litter are approximately twice those in Mull litter.

Nutrient inputs from rainfall, throughfall and cloud water far exceed corresponding rates of uptake by trees. Nutrient limitation alone thus cannot explain a reduction in forest productivity; an alternative factor must therefore be at work. The temporary immobilization of nitrogen by polyphenols (Northup *et al.*, 1995, *Plant Soil* 171: 225–262) and their capacity to reduce aluminium toxicity may stimulate trees to increase foliar polyphenol levels, for which the ecological cost will be a limitation in growth. The contrasts in forest stature are tentatively explained in terms of differences in soil acidity and aluminium levels, inducing different foliar concentrations of polyphenols, affecting in turn the breakdown of litter, the release of nitrogen and the detoxification of excess aluminium.

Plant Reproduction and Pollination in a Tropical Montane Forest in Costa Rica

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Knowledge of reproductive ecology is essential in conservation and management of the fragile tropical montane forest ecosystem. Reproductive investment, reproductive success (fruit and seed set), mating systems and pollination modes were studied in eight subcanopy species at two montane forest sites at 2350 and 2500–2600 m altitude in the Cordillera de Talamanca. Fruit set ranged from 8% to over 40% in the six species with few (1–5) seeds per fruit, while fruit set in the two species (*Deppea grandiflora* and *Leandra subseriata*) with many (>100) seeds per fruit was 90–96%. Of the fruits that became ripe, seed set—the fraction of ovules developed per fruit—was 79% in *Leandra subseriata*, and 55% in *Zanthoxylum melanostictum*. For four species it was possible to assess the mating system. As far as early fruit set was concerned, all four species studied showed some degree of self-compatibility. By far the most numerous pollinator was the bumblebee species *Bombus ephippiatus*. Individual workers of this species visited on average at least eight plant species on a single foraging trip, as could be seen in their pollen loads. Pollinator sharing may lead to strong competition for pollination among plant species, and may cause low rates of fertilization due to insufficient visits and clogging of the stigma with foreign pollen. Visitation rates differed 60-fold between plant species. Predispersal seed herbivory put a heavy toll on reproductive output in several species: between 20% and 55% of the seeds were lost to arthropod seed eaters. Low reproductive investment in most of the species, combined with a low to moderate reproductive success and a high rate of seed herbivory, leads to a very low output of viable seeds. This low seed availability is likely to be limiting for forest regeneration.

Seed Dispersal by Birds and Successional Change in a Costa Rican Montane Oak Forest

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The role of frugivorous birds in seed dispersal is more important in the tropics than in temperate regions. Simultaneously, the key role they may play in forest recovery in disturbed vegetation is greater in the tropical montane zone than in tropical lowland rain forest areas. In pasture lands, isolated remnant forest trees may function as protection for frugivorous birds, as perching places, for food, or as 'stepping stones'. Thus, these trees may act as nuclei of succession following forest clearing and abandonment.

In order to get a better understanding of montane cloud forest recovery following clearing, and the role of frugivorous birds during the recovery process, we studied frugiverous bird species, their diets, behaviour, distribution, diversity and habitat preferences in a tropical montane oak-dominated cloud forest area in the Costa Rican Los Santos Forest Reserve. Avian key seed dispersers were identified and classified according to different traits. Implications for restoration of neotropical montane cloud forests depending on seed dispersal by birds were formulated.

During both the dry and wet season a total of 34 frugivorous bird species were observed in nine plots distributed over three plant communities (mature forest, successional forest and pastureland with isolated trees), being 45.3% of the total amount of avian species known from the area. Twenty of these species (58.8%) were observed foraging on at least one fruiting tree species. A comparison of frugivorous bird species compositions showed no significant differences in similarity within and between plant communities, with the exception of similarity found within pasturelands. Plant community preference was assessed for 18 frugivorous bird species, nine of which showed no significant plant community preference and three of which appeared significantly less often in either successional forest or pastureland. From the birds' perspective the plots belonging to three plant communities can be reclustered into two habitats, a closed forest and an open successional habitat. Only seven of 34 bird species act as key seed dispersal agents, as they frequently cross the forest edge between closed mature and open, successional habitats.

Two ornithochorous tree taxa are identified as important fruit trees for several bird species: the small-seeded *Fuchsia paniculata* and the large-seeded *Ocotea* spp. The first species grows mainly in secondary vegetation, the latter in closed, dense mature oak forest. Next to *F. paniculata*, *Freziera candicans* appeared to be the fruiting species visited by the largest number of foraging bird species. The presence of isolated ornithochorous tree species in open successional plant communities is an important factor for attracting birds from mature forests and accelerates the process of forest restoration. Therefore, reforestation of pasturelands with the above-mentioned three arboreal taxa is highly recommended.

MEETING OF THE SECTION FOR VEGETATION SCIENCE ON 14 MAY 1997

Lycaena dispar subsp. *batava* in relation to Vegetations with *Rumex hydrolapathum*

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During recent years the Dutch Butterfly Foundation has received fewer records of the endemic large copper (*Lycaena dispar* subsp. *batava*) than usual. The butterfly population seems to decrease, especially in a part of the Wieden. The Dutch Butterfly Foundation has made a rescue-plan to prevent the species from extinction. This research is part of the rescue-plan.

In the literature some hypotheses are given on the causes of the decline of the large copper: (i) due to acidification, the food quality of the host plant (great waterdock, *Rumex hydrolapathum*) is reduced or (ii) because of vegetation succession the optimal habitat for the large copper is disappearing. In this study, these hypotheses were tested by analysing the vegetation surrounding the great waterdock in plots on two sites: the Wieden and the Weerribben (last big population of the large copper). Eggs or caterpillars on plants were scored within each plot.

The great waterdock plants on which the large copper lay eggs are usually situated in vegetation indicative of acid and nutrient poor situations. The disappearance of the large copper is therefore not attributable to the acidifying conditions.

Large differences in vegetation composition were found between both sites. The plots in the Weerribben showed characteristics of waterside and rich fenn vegetation and the plots in the Wieden of ruderal and hayfield vegetation. In the plots in the Weerribben the moss layer is clearly more abundant than in the Wieden and mostly consisting of *Sphagnum* species. There seems to be a large difference between the cutting management of both sites. In the Wieden most of the fields are cut quite early in summer, while many parts of the Weerribben are cut later, even in autumn. Due to the late cutting in the Weerribben an open vegetation has developed. In the Wieden, much of the reed (*Phragmites australis*) has

disappeared because of the early cutting. Restoration of vegetation more favourable for the large copper is possible, but this requires the restart of the succession. In both the Weerribben and the Wieden this proved to be difficult, possibly due to the bad water quality.

Changes in Species Composition of Reedbelts along Eutrophic Waters

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Phragmites australis (Cav.) Trin. ex Steudel forms monospecific stands at permanently flooded sites on shorelines along eutrophic waters. Where watertables are regulated tall forbs such as *Epilobium hirsutum* L. and *Urtica dioica* L. are dominant above the waterline and a zone where interstitial marsh species accompany *P. australis* is absent. In 1993, a research project was started to find out which management measures may be applied to enhance the abundance of interstitial marsh species without favouring the tall forbs.

Field surveys in the Northern Delta area showed a negative correlation between aboveground biomass of *P. australis* and species richness. The standing biomass, a measure of vigour of *P. australis*, was negatively correlated with the amount of organic matter in the soil. This observation confirms experimental evidence on possible detrimental effects of organic matter accumulation on reed performance (Armstrong *et al.*, 1996, *New Phytol.* 133: 399–414). Reduced vigour of *P. australis* may lead to the establishment of tall forb species, whose expansion will lead to a loss of reed dominance.

In order to predict when decreased vigour of *P. australis* leads to either increased species richness or to expansion of tall forbs, representatives of both species groups were compared concerning their response to manageable environmental factors. All species had highest germination on soils at field capacity and failed to germinate when being submerged or waterlogged. Seedlings of both groups showed similar patterns of growth when waterlogged or when waterlogged in combination with shading. *E. hirsutum*, however, was hampered in rhizome production when waterlogged or flooded, whereas rhizome formation of *Mentha aquatica*, a representative of the interstitial marsh species, was only (slightly) decreased when flooded.

It was concluded that for an increase in species richness accumulation of soil organic matter is required. A second requirement is an alternating cycle of drawdowns (germination) and flooding (suppression of tall forbs) by allowing natural fluctuations of the watertable.

Research on Succession in Calcareous Dune Slacks

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To study the mechanisms of primary succession in dune slacks we developed a relatively simple model and tested this model with an experiment in mesocosms. We assumed that the fraction of nitrogen lost by leaching will decrease with an increasing organic matter content and that species capable of radial oxygen loss (ROL) can delay succession by stimulating the degradation of organic matter.

Our model simulates the succession in wet calcareous dune slacks and describes the fluxes of nutrients between soil, plant and organic matter. The model revealed that *Schoenus nigricans*, capable of ROL, can delay succession towards *Calamagrostis epigejos*-dominated stands.

The experiment consisted of a factorial block design with four species and four treatments. The four dune slack species included two species from early successional stages (*S. nigricans* and *Samolus valerandi*), capable of ROL and two species from a later successional stage (*C. epigejos* and *Carex nigra*). The four treatments were bare soil, only plants, only organic matter and finally both plants and organic matter. The plants grew in mesocosms with a constant flow of artificial ground water. During the experiment we measured nitrate and ammonium (using an autoanalyser), and oxygen, redox potential and sulphide (using needle electrodes). Furthermore we counted sulphate reducing and colourless sulphur bacteria (most probable number) at the end of the experiment in the *C. epigejos* treatments.

The experiment started in July and ended in beginning of October. An equilibrium state was not reached within this period. It is, therefore, not possible to estimate adequately the fraction of leached nitrogen predicted by the model, and for that reason our hypotheses could not be tested. An experiment of several years in larger mesocosm will be needed to reach an equilibrium state.

Nevertheless, the experimental design used is very useful to investigate more concrete processes such as the effects of microbial mats on plant growth in early succession. From the bacterial counts and the fact that much nitrogen is lost, probably due to denitrification, it seems that micro-organisms play an important role in early succession of wet dune slacks.

Structural Changes in the Fen Woodland 'De Suikerpot' 1970–1995

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'De Suikerpot' is located 5 km west of Hilversum (Noord Holland). It lies in the transition zone between the push moraine 'het Gooi' (east) and the fen carr area of the river 'Vecht' (west). Recent vegetation is a fen woodland stocking on a floating peat body. Up to 1995 12 relevés were made each year from eight permanent plots, established in 1970, following the Braun–Blanquet approach. A varying number of photos in the plots was made to compare structural developments and three aerial photos (1970, 1981 and 1995) were analysed for changes in dominance of woody species.

In the plots with earlier successional stages a *Salix*-dominated shrub- and treelayer is found. It shows changes mainly in the shrublayer. In the photoseries no individuals can be retrieved from one picture to the next.

Most plots (4) have an *Alnus*-dominated treelayer and a weakly developed shrublayer. Individual trees are discernible within the photoseries, because changes are slower than in the *Salix*-dominated plots.

In two plots of older successional stages there is a clear floristic and structural difference from the other plots. The thinner treelayer is dominated by *Betula*, shrub- and herblayer are hardly developed and a high cover of *Sphagnum* species is found in the mosslayer. During the 25 years of observation there have only been a few changes in structure.

Floristic composition allows a classification into five groups belonging to three subassociations of different associations. These three floristic groups correspond with the three groups of similar structure.

Aerial photos show differences in distribution of woody species. *Salix* decreases from 1970 to 1995. In 1995 there are only small areas on the margins, mixed with *Alnus*. *Alnus* increases from 1970 until 1995. *Betula*-dominated areas increased strongly in the first period, while the second period showed stagnation.

Response of a Forest Ecosystem after a Decrease in Nitrogen Input

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Due to a chronically high ammonium input many Dutch forests suffer from nitrogen stress and have become nitrogen saturated. In a field experiment in a Scots pine (*Pinus sylvestris* L.) stand at Ysselsteyn in The Netherlands, atmospheric input of nitrogen was reduced to pre-industrial levels to assess reversibility of nitrogen stress. Starting in 1989, throughfall water was intercepted by means of a transport roof and replaced by simulated, clean water, i.e. ambient throughfall precipitation with natural concentrations of nitrogen and sulphur. Below the roof two plots were designed to receive either clean water (roof-clean: 5 kg N ha^{-1} $year^{-1}$) or ambient throughfall (roof-control: 40 kg N ha^{-1} $year^{-1}$). Outside the roof a second control plot was established (ambient control: 60 kg N ha^{-1} $year^{-1}$) to assess roof effects. Within 1 year after the start of the experiment the sulphur and nitrogen concentrations in the upper soil layers of the roof-clean plot strongly decreased, as did the fluxes of these elements through the soil profile. The trees have reacted after a lag-phase of 3 years: the potassium and magnesium concentrations in the needles have increased and the nutritional balance to nitrogen improved. Arginine (as a sink for N) proved to be a good indicator of nitrogen stress: the high arginine concentration in the needles in the roof-clean plot decreased, which was the first sign of recovery. The trees responded to the roof-clean treatment with a growth improvement (DBH + 40%). The aboveground biomass of the nitrophilous bramble and fern vegetation has decreased, although there were no signs of a recovery of the natural understorey. Furthermore, a recolonization and increase in the number of mycorrhizal fungi was found in the roof-clean plot. In conclusion: the ecosystem has reacted positively upon a decrease in nitrogen input, although it may still take several years before it meets our requirements.

Grasslands in Europe and New Zealand

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Leaving aside the intensively managed cultural grassland, grasslands can be divided into natural and semi-natural categories. The greater part of the natural grasslands in Europe are zonal, bound to climates where woodland development is not possible. There, grassland is the climax of the vegetation succession. In eastern Europe and Asia, extensive grassland (steppe) areas developed in the past because the climate is too dry for woodland. A co-evolution of large herbivores and grassland plants took place and grazing became a necessary factor of the grassland ecosystem. This becomes evident when grazing (or mowing as a substitute) stops. Then the biodiversity of the steppe drops strongly, as was the case in an experiment in the Alyokhin Central Chernozem Reserve in the Streletsk steppe near Kursk (Russia).

In most places in western Europe, woodland is

the climax vegetation and natural grasslands are restricted to coastal and mountainous areas. The vast majority of the grasslands until about 1950 were semi-natural and originated from woodlands cut and burnt by man, followed by cattle, horse and sheep grazing. Due to the long period of development, the variation in habitat and the migration of grassland species from natural grasslands, a great variety of semi-natural types developed. They form a habitat for many plant and animal species. Also for semi-natural grasslands, grazing or mowing is a necessary factor for their survival.

In New Zealand, climatically allied to western Europe, the situation is different. Originally, mammals were absent and natural grasslands, mainly occurring in mountainous areas, are too vulnerable to grazing. Therefore, introduction of sheep-grazing in the 19th century by European colonists led to a severe threat and local disappearance of these natural grasslands. Both natural grasslands and natural woodlands have been transformed by man and sheep into semi-natural (and also cultural) grasslands. Their species diversity is very low and consists of common European grassland species introduced by man. Only very few native species are present; most New Zealand grassland species are not grazing-resistant. Because of the isolation, there is no spontaneous migration of grassland species to New Zealand. Therefore, in the long term, the semi-natural grassland will remain very poor in species.

Traditional Savanna Burning in Contemporary Africa

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In African savannas fire is a recurring phenomenon. Although natural fires do occur (i.e. lightning), the majority are of anthropogenic origin, most being lit by pastoralists who use fire as a tool to increase the amount and quality of grazer forage.

Several effects of fire can enhance the quality and quantity of grazer forage. First of all fire can increase the area of grazing land by preventing tree regeneration. Secondly, by burning unpalatable species fire can enhance the abundance of preferred species. Finally pastoralists burn vegetation at the end of the dry season to obtain a post-fire regrowth in the rain season. This regrowth is of high nutritive value to grazers and is more accessible, since fire removes old and dead vegetation providing the grazer with a green lawn.

However, the manner in which fire affects grazer forage depends on post-fire rainfall. When fire is followed by a rain season of below-average rainfall, effects of fire on grazer forage quantity are detrimental. Lack of cover in burned areas causes soil to dry up more quickly than unburned vegetation, resulting in death of perennial grasses which offer the majority of grazer forage. In this situation occurring regrowth mainly consists of non-palatable herbs. Since rainfall is erratic in the African savannas, pastoralists take the risk of ending with a negative effect of fire on grazer forage.

If this occurred in the past, pastoralists moved away to areas where resources were still available. At present, however, the grazing area for pastoralism has decreased significantly due to increase in human population and livestock numbers and increased surface area for crop production. Thus the negative effects of fire in years of drought can no longer be evaded. This situation, combined with extensive grazing pressure in African savannas, suggests that traditional burning by pastoralists is not a tool to be used in the contemporary situation.