Multivariate analysis of plant communities in the Narok district, Kenya: The influence of environmental factors and human disturbance

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Abstract

Species type in 42 samples was examined using ordination analysis to establish whether the vegetation pattern displays gradation due to environmental factors, and whether the pattern was being altered by human disturbance. The analysis displayed two patterns. First, the ordination on axis 1 demonstrated vegetation gradation from xeric communities on the plains to humid forests on the highland. This pattern is explained on the basis of moisture and nutrient variations. Vegetation vectors based on species presence-absence were correlated with average rainfall, carbon, nitrogen and zinc.

The second was separation of disturbed and undisturbed forest and bushland site categories on axis 2 of the ordination space. This pattern suggests that disturbance response is interactive with moisture so that only in moist communities does a significant vegetation response to disturbance occur.

Introduction

Narok district is undergoing rapid changes in land use, with cultivation expanding significantly, challenging pastoralism and wildlife conservation. These changes are likely to affect environmental gradients and correlations relating vegetation to ecological conditions. Although previous studies (e.g. Dublin 1986; Lamprey 1984) have focused on the district, in terms of demographic and physiographic plant ecology, the relationship between vegetation and the environment is least studied and understood.

While temperature is sufficient for plant functions, rainfall and soil nutrients are limiting factors (Ogutu 1991). Consequently, vegetation is very sensitive to disturbance of these factors. This paper examines the extent to which species composition grades spatially on rainfall, soil and geographic site factors, and the impact of human disturbance on the established vegetation patterns.

The study area

Figure 1 shows the location of Narok district in Kenya. Topographically the district has highlands on the north, west and south-east, while the rest of the area is an extensive plain interrupted by scattered hills (Figure 2). It also has geographical gradients that are associated with a) altitudinal range of 2186 m (from 914 to 3100 m); b) latitudinal range of 163 km or 1.5° latitude and; c) longitudinal range of 149 km or 1.6° longitude. The influence of latitude and longitude on vegetation gradation is presumed to be minimal due to indistinct seasonality and the district's small area (18 513 km²).

Rainfall is the most important climatic variable in the study area. Its seasonality, for instance, determines agricultural potential (Karime 1990), vegetation cover and the migration of wildlife in the Serengeti-Mara ecosystem (Bourton et al. 1988; Norton-Griffiths et al., 1975; Sinclair 1979). An isohyet map for this ecosystem (Figure 3) reveals rainfall gradation due to topography, altitude and latitude. Annual rainfall decreases from about 1600 m on the top of the Mau uplands (in the north) to 508 m on the plains (in the south).
Climatic variations are associated with the Intertropical Convergence Zone (ITCZ). The movement of this zone gives the north (which is higher) an advantage over the south by having earlier rains and a late dry sequence. Thus, while most of the study area has a bimodal rainfall pattern (March-May, July-September) the south has a monomodal pattern of rainfall (November-January). Soil is another significant environmental factor which influences the vegetation of Narok district. Soils vary with differences in geology, topography and climate (Lamprey 1984; Jaetzold & Schmidt 1983). The major soil types include brown loams and red friable clays in the highlands, and red friable clays and sandy loams in the plains. Except for areas with impeded drainage, most soils are deep and well developed. Problem soils such as shallow and alkaline soils are common in the plains.

On the basis of the above paragraphs, the vegetation of Narok district has a latitudinal-altitudinal zonation which is related to increasing precipitation and decreasing temperature from the plains towards the highlands. Respective plant communities are grasslands and shrubland on the plains, bushland and wood-