Distributions of Trees Along the Site Specific Micro-environmental Factors Related to the Topography of Kwangnung, Korea

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1. INTRODUCTION

The study area, the Kwangnung Experimental Forest (KEF) region is located at the west-central portion of the Korean peninsula (Figure 1), and covers 2,240ha. Elevations range about from 90m to 600m, and the highest peak is Mt. Jukyeopsan (600.6m). Kwangnung Natural Reserve Forest area is about 1,200ha, which has been protected from human activities for a long time. It mainly consists of unique old-growth forests composed of broad-leaved trees in the central cool temperate forest zone in Korea. About 796 native plant species are known to live in this area (KFRI, 1994) including many endangered species. Dominant tree species are *Quercus* spp., *Carpinus* spp., *Cornus* spp. *Acer* spp. and *Pinus densiflora* that are typical species of central cool temperate forest zone in Korea (Oh *et al.*, 2000). In this area, many ecological research programs are undergoing and registered to the International Long-Term Ecological Research network (Oh *et al.*, 2000). Micro-environments are spatially heterogeneous by topographical feature. Among the environments soil moisture and solar radiation are especially critical in ecological processes of forests. In this study, site-specific micro-environments were modeled and compared with the species abundance.

2. MATERIALS AND METHODS

2.1 Field Survey

The field survey was carried out for estimation of the species distribution along the topographically-induced microenvironments in natural forests on the KEF. Eighty of 20m×20m plots were investigated with records of the locations of the plots by marking the sample points on the 1:25,000 topographic maps (Figure 2) in 1990. At the sites, all the trees larger than 5cm in DBH were counted and their DBH were measured.

2.2 Modeling Environmental Factors Related to Topography

1) Elevation, Aspect and Slope data

The 1:25,000 scaled, 20-m-interval, topographical maps covering the whole KEF area were

digitized using the ARC/INFO GIS package. Elevation, aspect and slope data were created by the software package, as raster data-sets with a 20m×20m spatial resolution.

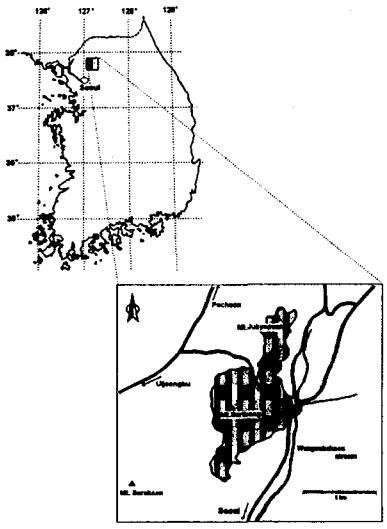

Figure 1. Location of the study area, KEF, Korea

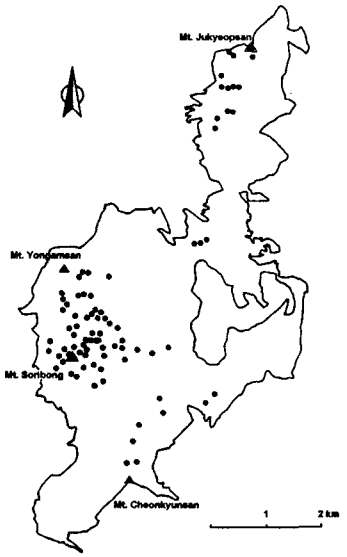

Figure 2. Site locations of field survey

2) Incident Solar Radiation

Solar radiation is the energy source for important ecological processes such as photosynthesis and evapotranspiration which control to a great extent the distribution, type and physiognomy of terrestrial vegetations. Recently, many ecological models include solar radiation as a critical environmental driver (Bonan, 1991; Running and Coughlan, 1988). Algorithm for calculation of solar radiation inputs used in this study was adopted from Nikolov and Zeller (1992), which was based on the methodology of Lui and Jordan (1960, 1963) and Klein (1977). In this approach, the calculated solar radiation on a horizontal surface outside the atmosphere is attenuated by atmospheric effects to produce the total solar radiation received on a horizontal surface at the earth's surface. This radiation is then decomposed into its direct and diffuse components which are subsequently adjusted using various tilt factors to the components of the surface of interest. Atmospheric transmittance is calculated by the function of latitude, elevation and climatic conditions of the site. Monthly average cloud cover is estimated from monthly mean temperature, mean monthly relative humidity and monthly precipitation.

3) Soil Moisture (topographic index)

TOPMODEL was developed by Beven and Kirkby (1979), based on a group of concepts which may be construed as an interface between basin topography and water flow patterns in time and space. This model utilizes a topographic index which represents a theoretical estimation of the accumulation of flow at any points. The index has the form: ln (a / tanβ), where, in a raster DTM, a = the upslope area per unit

contour length contributing flow to a pixel; tanβ= the local slope angle acting on a cell (this is taken to approximate the local hydraulic gradient under steady-state conditions) (Quinn *et al.*, 1995).

3. RESULTS AND DISCUSSSION

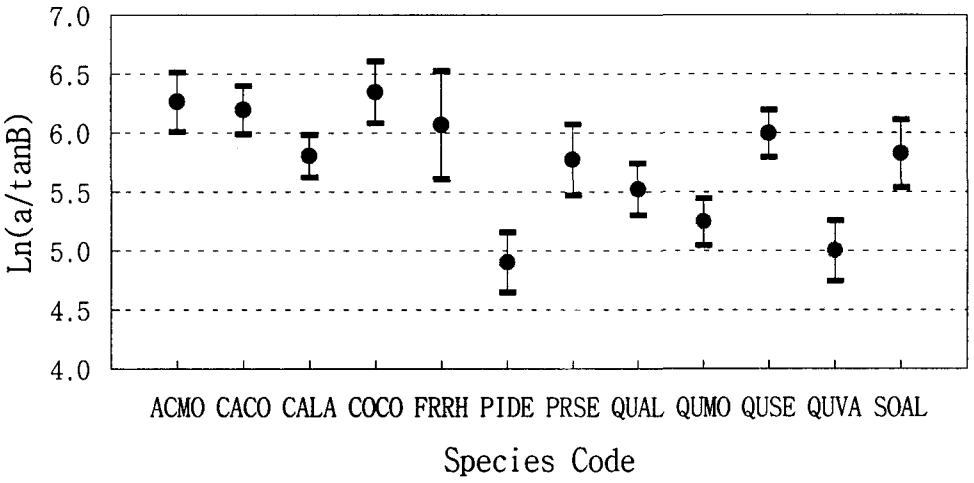

Figure 1. Species distribution ranges along the gradient of annual incident solar radiation in the KEF region. Distribution ranges indicate standard deviations (ecological amplitude), the abundance data were weighted by basal area. Species codes of ACMO is *Acer mono*, CACO *Carpinus cordata*, CALA *Carpinus laxiflora*, FRRH *Fraxinus rhynchophylla*, PIDE *Pinus densiflora*, PRSE *Prunus sargentii*, QUAL *Quercus aliena*, QUMO *Quercus mongolica*, QUSE *Quercus serrata*, QUVA *Quercus variabilis*, and SOAL *Sorbus aliena*.

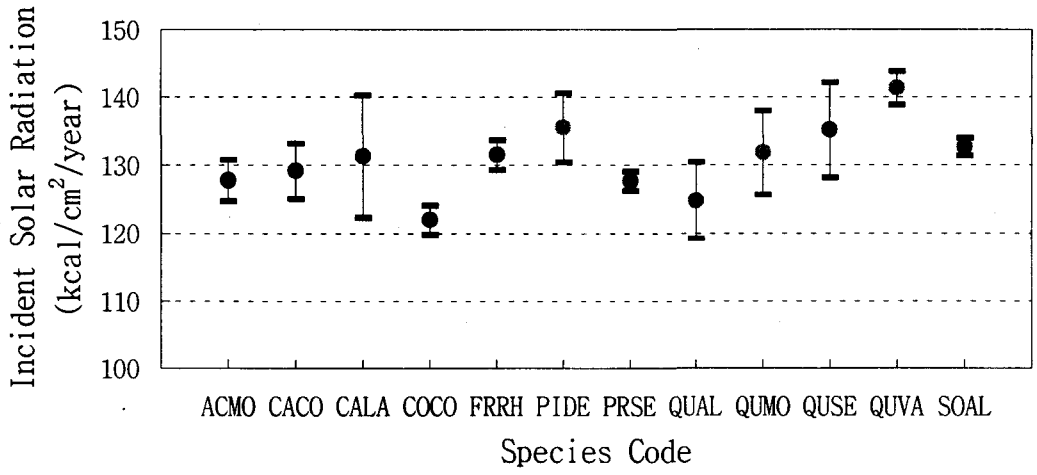

Figure 2. Species distribution ranges along the gradient of annual incident solar radiation in the KEF region. Distribution ranges indicate standard deviations (ecological amplitude), the abundance data were weighted by basal area.

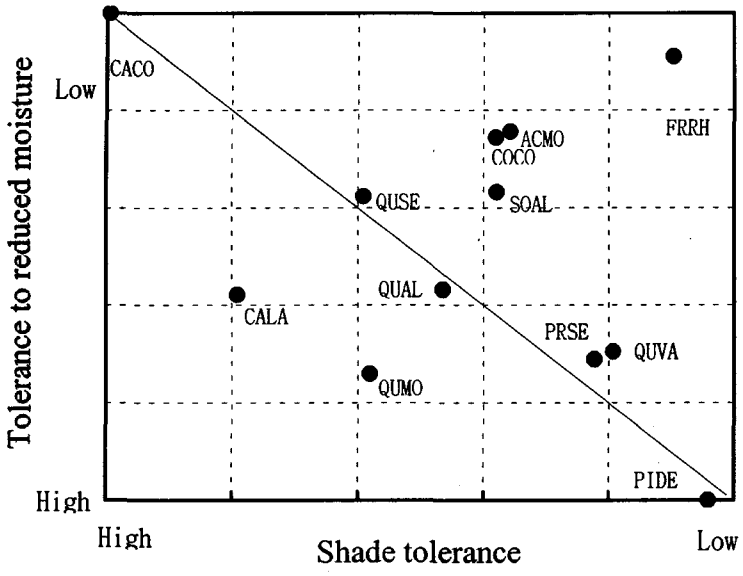

Figure 3. Life-history strategies of the 12 tree species in the KEF region. Their hypothesis assumes that there will be no species locating at the lower part from the diagonal line because of the physiological limitation. *Quercus mongolica* and *Carpinus laxiflora* showed exceptions.

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