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Species Diversity of a Stratified Hornbeam Community in Kwangneung Forest

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光陵山林에 있어서 서나무群集의 層에 따른 種多樣性에 關한 硏究

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ABSTRACT

The herb, shrub, understory and canopy strata, which arbitrarily delineated by size classes, were sampled separately. The former one were sampled by the pin-point quadrat method. And remaining three by size quadrats, diversity ($H=-\sum Pi \log Pi$) of of each stratum was estimated for each set of census data. Species diversity within a stratum was independent of sample plot size above a minimum cumulative area. Diversity based on plotless and plot samples could be determined by the same equation, and by pooling the data needed to estimate diversity of each stratum.

Key words: Hornbeam community, Kwangneung forest, Pin-point quadrat method, Species diversity

INTRODUCTION

The concept of diversity is particularly important because it is commonly considered an attribute of a natural or organized community(Hairston, 1964). Diversity has been said to increase in a successional sequence to a maximum at climax, the enhance community stability, and to relate to community productivity, integration, evolution, niche structure and competition(McIntosh, 1967; Krebs, 1985; Colinvaux, 1986; Ehrlich and Roughgarden, 1987).

Species diversity is expressed as the number of species per some unit area, and species equitability or the apportionment of indivisuals among the species. Any of these may be influenced by body size and the spare occupied.

Most plant communities are constructed from individuals which vary greatly in size. This is particularly true of most forest communities where two to four strata may be recognizable. Stratified communities are usually sampled by strata using a combination of sample plot sizes. Often several sampling methods are employed. If a community is to be sampled by strata through the use of different plot sizes and sample methods, two questions rise as to whether species diversity is independent of sample plot size or sample method or not, and whether samples of the different strata can be pooled to estimate the diversity of the community or not(Monk *et al.*, 1969).

The purpose of this paper is to solve those two questions in a stratified hornbeam (*Carpinus laxiflora*) community in Kwangnung forest.

METHODS

Twenty 400m^2 sample plots was established in a hornbeam community in Kwangnung forest, Korea, in Summer, 1975 and 1995.

A complete census was made on all species in each plot. During the summer of 1975 the community was devided and sampled in the following manner :

1) the canopy(Stems≥10cmDBH) and understory(Stems≥2.5cm<10cmDBH) sampled in twenty 20 by 20m quadrats.
2) the shrub layer(Woody stems≥30cm high and<25cm DBH) sampled in twenty five 4 by 4m quadrats.
3) herb layer(Woody stems<30cm high plus all herbaceous nindividuals) sampled in one hundred pin point quadrats. Although these size classes tend to be arbitrarily, they in general conform to those commonly employed in forest sampling.

Estimate of species diversity of the four strata in the community were determined by Shannon-Wiener function,

$$H=-\sum_{i=1}^{s}\frac{Ni}{N}\log\frac{Ni}{N}=-\sum Pi\log Pi$$

where H is Shannon index of species diversity. N is the density per plot, s is the number of species in the plot, Ni is the density contribution of the ith species, and Pi is the number of individuals of one species devided by the total number of all individuals in the sample.

RESULTS

Curves showing the relationship between diversity indices and the number of sample plots for four strata are given in Figure 1. Sufficient species of canopy were found in the each sample unit to produce long asymptote provided a high degree of confidence in the adequacy of sample size. With the possible exception of undersoty, shrub and herb diver-

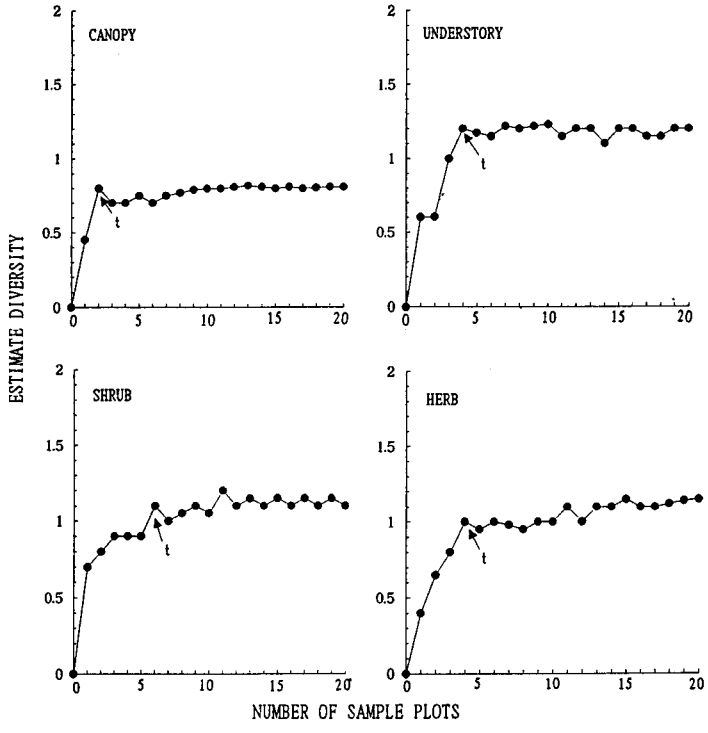

Fig. 1. Estimated diversity of four strata of a hornbeam community in Kwangnung forests. The curves for the canopy and understory represent 400m^2 plots. The plot size for the shrub layer was 16m^2. The sample method of herbaceous layer was 16m^2. The sample method of herbaceous layer was pinpoint quadrat. The approximate threshold of asymtote is designated by "t".

Table 1. Effect of plot size and sample method on estimeted diversity in the canopy, understory, shrub and herbaceous layers of a hornbeam community in Kwangnung forests

Statistic	Canopy	Under story	plots of 4m×4m	pinepoint quadrats
	plots of 20m×20m	plots of 20m×20m	plots of 4m×4m	pinepoint quadrats
Estimated diversity···	0.8087	1.1577	1.1396	1.2917
Number of sample plots	20	20	25	100
Number of species in cumulatie samples···	13	24	48	48
Number of individuals in cumulative samples···	299	270	907	596

sity based on 400m^2, 16m^2 and pin point quardrats, estimated diversity reached a plateau well befoe all sample data had been pooled. Low shrubs and herbs usually featured high

diversities and curves stabilized with a few samples.

Furthermore, diversity of the shrub was estimated from six pooled sample plots, diversities of the undersotry and herb were determined by pooling four sample plots, and diversity of the canopy was calculated by two polled sample plots.

The number of 400m² 16m², or pinpoint quadrat samles needed to estimate diversity varied with sample size and sample method(Fig. 1 and Table 1).

The actual area sampled varied greatly with sample plot size and method. There is difference between estimated diversities of the canopy and understory derived from the 400m² plots.

Diversity among the four strata was lowest in the canopy and increased in the shrub, understory and herbaceous layer, respectively(Table 1). A companying the increase in diversity from the canopy to the herbaceous layer was not an increase in the cumulative number of species and individuals.

Diversity of the hornbeam community(Table 2) was estimated by pooling the species and individuals in the cumulative 400m², 16m² and pinpoint quadrats used to estimate diversity in each of the four strata in the community(Table 1).

Table 2. Community diversity estimated from the species and individuals in the cumulative 400m², 16m² and pinpoint quadrats data given in Table 1

Statistic	Sample
Estimated community diversity……	1.4767
Number of species in cumulative sample……	82
Number of individuals in cumulative sample……	1,929

DISCUSSIONS

Species diversity(Lloyd & Ghelardi, 1964 ; McIntosh, 1967, Berger, & Parker, 1970, Oh, 1975) in the community studied is independent of sample plot size or sample method (Fig. 1), provided a sufficient number of samples are pooled. The number of samples necessary to estimate diversity may vary as a function of the area of each individual sample. As sample plot size increases, fewer samples are required to estimate diversity until the universe is included. In communities where species tend to be clumped, such as the secondary hornbeam community used in this study, a larger area may have to be included in the cumulative sample before diversity reaches an asymptotic equilibrium, i.e. in the case of the canopy, where only two 400m² plots were needed. Eventhough diversity may be independent of sample size, it is clear from the variability in diversity values given in Table 1 for different sample plots and method that those values are, only

estimates of an unknown diversity of the canopy and understor (Monk *et al.*, 1969). Stratified communities with different sized individuals present several problems in estimating species diversity. The first problem is the delineation of the strata. In the temperate deciduous forest of Korea, canopy, understory, shurb and herbaceous layers of vascular plants are commonly recognized. Although each layer is more or less distinct, transgrassives of higher layers often exist in intermediate positions with result being imperfect stratification. In this study, each stratum was arbitrarily defined by size class.

A second problem is the expediency of using different sized sample plots to census the different strata. However, since diversity appears to be independent of sample plot size, the main problem is not one of estimating diversity of a given stratum but rather how the samples of different strata are to be pooled to estimate diversity of the community.

The diversity of the multi-stratal terrestrial communities can be determined by pooling all the data used to estimate diversity of each stratum. If this is done, potential canopy species may be sampled in each layer, understory species in three layer, shrub species in two and herb species in one.

The data collected from the twenty 400m^2 plots should be a good representative sample of individuals 2.5cm DBH in the hornbeam community of the present study. Close agreement(0.748) is obtained when the species diversity from the 10 canopy 400m^2 plots(Table 1) are pooled.

적 요

各層의 標本은 크기에 따라 草本層, 灌木層, 底木層, 高木層에서 각각 抽出하였다. 이 中 草木層은 點方形區, 樹木層에서는 크기 方形區를 使用하였다.

各層의 多樣性 指數는 Shannon과 Wiener Function($H=-\sum Pi \log Pi$)을 이용하여 算出하였다.

各層의 種多樣性 標集區의 크기에 따른 最少累積 面積에서 獨立的이었다.

方形區法과 無方形區法에 依한 多樣性은 同一한 式으로 구할 수 있으며, 群落의 種多樣性은 各層의 多樣性을 測定한 資料를 連合하여 決定할 수 있다.

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