Community Classification, Community Structure and Vegetation-Environmental Rlationships of Forest Vegetation In South Korea

Yong Sik Hong[1], Young Keun Lee[2], Sang Hoon Chung[2], Eung Pill Lee[1], Seung Yeon Lee[1], Eui Joo Kim[1], Kyu Tae Cho[1], Heon mo Jeong[3], Young Han You[1]

[1]Kongju National University, Life science, Gongjusi, Korea, Republic of.
[2]Forest Technology and Management Research Center, National Institute of Forest Science, Pocheonsi, Korea, Republic of.
[3]Division of Ecosystem Service and Research Planning, Gongjusi, Korea, Republic of

Forest structure has significant influences on a series of structural and functional properties of forest ecosystems. However, there were few studies to classify Korean forests horizontally and vertically and to analyze the relationships between communitys and environmental factors although their occurrence was highly correlated with ecological forest management. The purpose of this study is to develop forest management plan for forest vegetation of South Korea and to establish basic data for sustainable forest management. Data was used tree species of overstory vegetation of NFI and the importance value of tree species was calculated. environmental variables was measured and recorded in each stands. Importance value was also calculated for tree species of understory vegetation(DBH<6cm) in order to identify forest vertical structure and to predict potential natural vegetation. TWINSPAN and CCA were conducted to identify communitys and to analyze the relationships between communitys and environmental variables. TWINSPAN classified the different communitys and the 16 communitys were representative of the general forest vegetation in South Korea. CCA results revealed that altitude, slope, annual average temperature and precipitation were revealed as the environmental factors that most influenced distribution. Overall, the succession was proceeding in Korean forests. Especially, the understory vegetation of communitys dominated by Pinus densiflora, P. thunbergii and Chamaecyparis obtuse which is distributed in the lowlands is dominated by the deciduous oak such as Quercus serrata. these communitys will be replaced by the deciduous oak in the future. This study was supported by Mid-career Subsequent Researcher Program(NRF-2018R1A2B5A01021358) through NRF grant funded by the MEST.

Introduction

The National Forest Inventory of Korea began with the 1st National Forest Survey, conducted from 1972 to 1974, followed by the 2nd (1978-1980), the 3rd (1986-1992), and the 4th (1996-2005), the 5th (2006-2010) and the 6th National Forest Inventory was conducted from 2011 to 2015. The purpose of this study is to provide basic data for establishing policy for sustainable forest management practices by securing basic statistics on inland forest resources and periodically identifying changes in the 6th National Forest Resources Survey data.

Materials & Methods

1. Study area

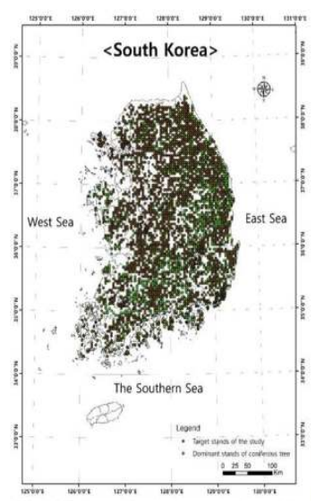

Fig. 1. The map showing investigated stands In the Korean Peninsula.

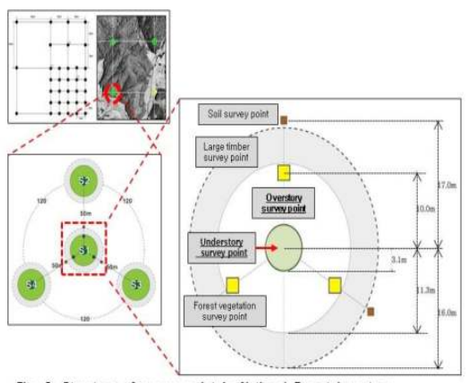

Fig. 2. Structure of survey point in National Forest Inventory.

Table 1. Area of survey point in National Forest Inventory.

Classification of survey point	Area(ha)	Radius length(m)
Overstory	0.04ha	11.3m
Understory	0.003ha	3.1m

2. Fieldwork and Data collection

Braun-Blanquet coverage value was estimated and recorded for each species in community layer of a stand. The investigated values were entered in an Excel spreadsheet(Microsoft Office 2007). And relativized which in turn were summed up to obtain importance value index(IV), relative coverage index(*RC*i, %), relative frequency index(*RF*i, %) and relative importance value index(RIV).

3. Multivariate methods

Two-way indicator species analysis(TWINSPAN) was used to classify the plant community groups based on the overstory tree spcies, while canonical correspondence analysis(CCA) was used to investigate vegetation patterns and distributions of species with regard to their environmental variables, using PC-ORD5(MiM software Co).

Environmental variables used for the CCA analysis were the altitude, slope, aspect, annual mean temperature(for about 35 years), canopy gap, initial growth period precipitation(from April to June), non-growth period precipitation(from November to March).

Results

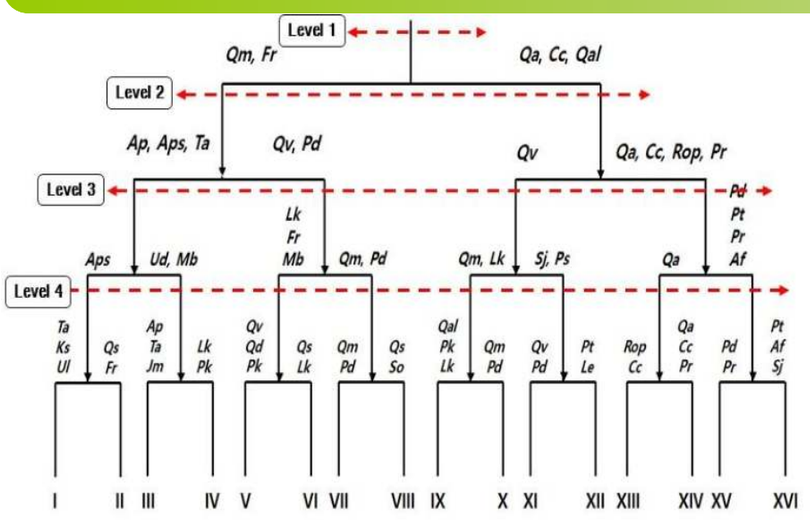

Fig. 2. Dendrogram of 2,814 stands by TWINSPAN, which is used importance value(IV) of each stands in the Korean Peninsula.

Table 2. Abbreviation of indicator species in study

Abbreviation	Species
Jm	*Juglans mandshurica*
Qal	*Quercus aliena*
Ap	*Acer pictum*
Pt	*Pinus thunbergii*
Qv	*Quercus variabilis*
Ps	*Platycarya strobilacea*
Ul	*Ulmus laciniate*
Ud	*Ulmus davidiana*
Aps	*Acer pseudosieboldianum*
Sj	*Styrax japonicus*
Qd	*Quercus dentata*
Pr	*Pinus rigida*
Fr	*Fraxinus rhynchophylla*
Cc	*Castanea crenata*
Le	*Lindera erythrocarpa*
Af	*Alnus firma*
Mb	*Morus bombycis*
Qa	*Quercus acutissima*
Pd	*Pinus densiflora*
Qm	*Quercus mongolica*
Rop	*Robinia pseudoacacia*
Ks	*Kalopanax septemlobus*
Lk	*Larix kaempferi*
Pk	*Pinus koraiensis*
Qs	*Quercus serrata*
So	*Styrax obassia*
Ta	*Tilia amurensis*

Table 3. Community name of groups which is classified by TWINSPAN in the Korean Peninsula(black boxes mean deciduous forest and red lines mean coniferous forest. Conifers were excluded because they are not useful as wood in Korea)

Group division	Names of community classification
Group I	*Quercus mongolica-Tilia amurensis* community
Group II	*Quercus mongolica-Acer pseudosieboldianum* community
Group IIII	*Quercus mongolica-Fraxinus rhynchophylla* community
~~Group IV~~	~~*Quercus mongolica-Larix kaempferi* community~~
Group V	*Quercus mongolica-Quercus variabilis* community
~~Group VI~~	~~*Larix kaempferi-Quercus mongolica* community~~
Group VII	*Quercus mongolica-Pinus densiflora* community
Group VIII	*Quercus serrata-Quercus variabilis* community
~~Group IX~~	~~*Larix kaempferi-Pinus koraiensis* community~~
Group X	*Pinus densiflora-Quercus mongolica* community
Group XI	*Pinus densiflora-Quercus variabilis* community
~~Group XII~~	~~*Pinus thunbergii-Quercus serrata* community~~
Group XIII	*Castanea crenata-Robinia pseudoacacia* community
Group XIV	*Quercus acutissima-Pinus densiflora* community
~~Group XV~~	~~*Pinus densiflora-Pinus rigida* community~~
~~Group XVI~~	~~*Pinus thunbergii-Pinus densiflora* community~~

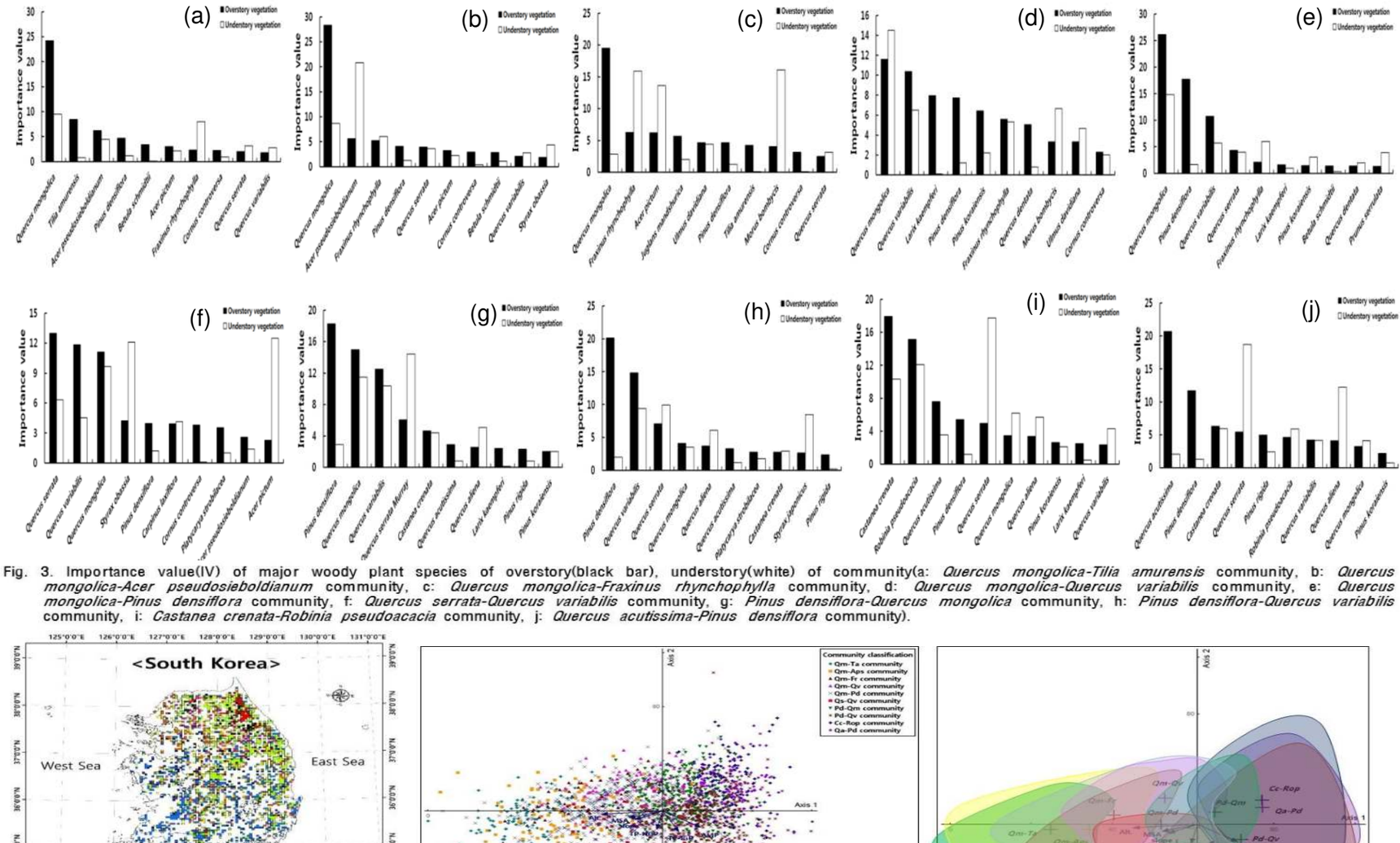

Fig. 3. Importance value(IV) of major woody plant species of overstory(black bar), understory(white) of community(a: *Quercus mongolica-Tilia amurensis* community, b: *Quercus mongolica-Acer pseudosieboldianum* community, c: *Quercus mongolica-Fraxinus rhynchophylla* community, d: *Quercus mongolica-Quercus variabilis* community, e: *Quercus mongolica-Pinus densiflora* community, f: *Quercus serrata-Quercus variabilis* community, g: *Pinus densiflora-Quercus mongolica* community, h: *Pinus densiflora-Quercus variabilis* community, i: *Castanea crenata-Robinia pseudoacacia* community, j: *Quercus acutissima-Pinus densiflora* community).

Fig.4. Map showing plant communities divided by TWINSPAN in inland area of Korea.

Fig. 5. CCA ordination biplot of importance value and 14 environmental variables in 2,291 stands which are classified by community classification. The arrows on graph mean significant environmental variables(r^2>20%) which are influencing on stands.

Fig. 6. CCA ordination biplot of centroid value of community classification according to major 5 environmental variables. The colored cross are centroid values of each community classification and the colored polygons are distribution range of stands of each community classification.

Summary

- Two-way indicator species analysis(TWINSPAN) of tree species resulted in sixteen ecologically distinct community types along different plant species variables.
- CCA results of grouped community reveal that five environmental variables, i.e. Altitude, Non-growth period precipitation, Initial growth period precipitation, Annual mean temperature, Slope, have a strong influence on distribution of stands and herb species There was no change in number of leaf and specific leaf area according to global warming.
- The location environments of *Pinus densiflora-Castanea crenata* community, *Pinus densiflora-Pinus rigida* community, *Pinus thunbergii-Quercus serrata* community, *Castanea crenata-Robinia pseudoacacia* community and *Quercus acutissima-Pinus densiflora* community which are lowland forest are similar and understory vegetation of the communities is dominated by *Quercus serrata*, so it will be changed by *Quercus serrata* forests.