STRUCTURE OF BEECH (*FAGUS ORIENTALIS* LIPSKY) STANDS IN ALTITUDE PROFILE OF CASPIAN FOREST IN GOLBAND REGION

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Introduction

The outbreak of environmental problems resulting from harsh interfering of human beings in the environment has caused a new attitude existed in the world urging the nations to manage their own resources in a sustainable manner. For so doing, all nations should be developed.
The world nations signing different conventions, after Rio de Janeiro conference in 1992, have tried to manage the world jungles correctly, whether through conservation or through harvesting in the manner of closed the nature, provide the necessary condition for sustainable development in the ecosystems (Moahajer, 2003).
Iran should follow the contexts of related conventions because of being a member of these conventions. This had made a great change in silviculture systems. Because of the very change, from 1996 the method of uneven-aged forestry and the related silviculture have become the guidelines for providing forestry plans. Thus, the first basic step in the correct and principle management of jungles, the usage of information related to the principles of growth, evolution, and the quality of natural structure (affected by environmental factors) is forest stand. Of course, the inharmonious interference with the situation and conditions governing the jungles in order to natural evolution continuity is much more dangerous than lack of interference in jungle affairs. (Emborg, 1996 & Korpel, 1982).

Methods

In order to achieve the goals of research, the banding method has been used. To choose the strip, at first, a spot has been selected randomly on the topography map. A strip with the direction towards the north-south having the width of 20 m was selected in two sides of the spot. The quality and quantity specifications for all trees with a diameter of 7.5 cm had been measured and registered. The survey of the changing process of altitude with an increase in distance from the lowest point of the examined strip (Fig.1) indicates that the range of height from the sea level for the strip is 135 m and 2160 m consecutively.

Results and Discussion

The site starting line of Beech is from 240 m.a.s.l which at first begins with 6.2 in hectare and finishes in 2150 m.a.s.l 82 in hectare. The most common type of beech in hectare of altitude class in this research is a main type named tree 700 m.a.s.l which are often White Beech (*Carpinus betelus*) after that up to 2160 m.a.s.l beech is dominant species and Oak (*Quercus sp)* , Maple *(Acer sp*) Alder (*Alnus sp)* are admixed tree species in determination area.

The maximum relative frequency of existed species belongs to White Beech (*Carpinus betelus*) and the maximum cut area of breast height is also related to this species. The beech tree (*Fagus orientalis* Lipsky) from the frequency point of view has the second rank in the studied strip.

The diagram of scattering number in different diameter distribution for beech trees has indicated that the amplitude of scattering of the mentioned species has been from diameter class 10 to 155 cm. The observed maximum frequency has been 11.3 trees in hectare occurred in the diameter class of 15 m. The maximum frequency for diameter class above 80 cm has been 0.8 trees in hectare. Based on the figure 2, the structure of beech jungles is an uneen-aged one.

Therefore, considering cut plan as the index of typology, the principal species of trees up to 700 m height from the sea level in the studied strip are White Beech (*Carpinus betelus*). The beech species as the dominant species (principal) appeared above the height of 700 m and the associate species of beech in the typology are White Beech (*Carpinus betelus*), Oak (*Quercus sp)* , Maple *(Acer sp*) Alder (*Alnus sp)*. Of course, the pure typology of beech has been observed only in the area of 2000 m - 2100 m altitude. Like the structure studies made in the mountainous forests of the north (Nedialkov, 1971) and the case studies made in the high altitude by different researchers has shown that the irregular uneen-aged structure for most of the altitude areas has been in the strip.

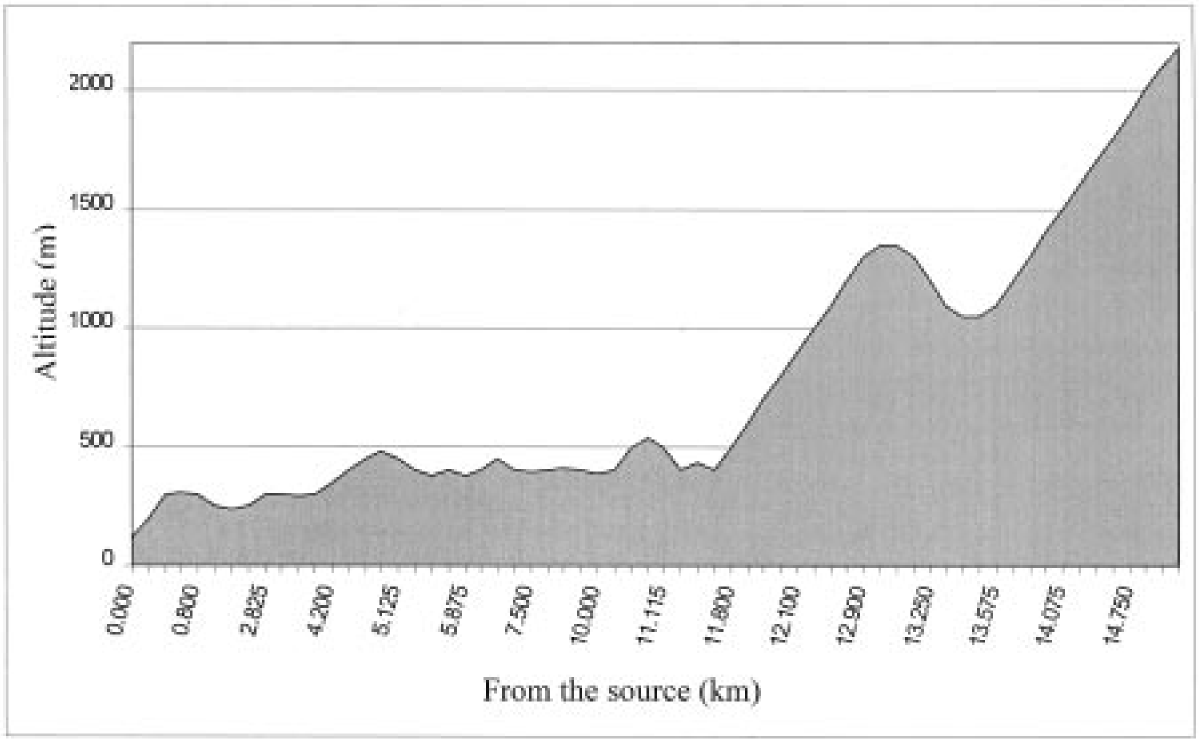

Fig.1. The process of changing the altitude with an increase from the source

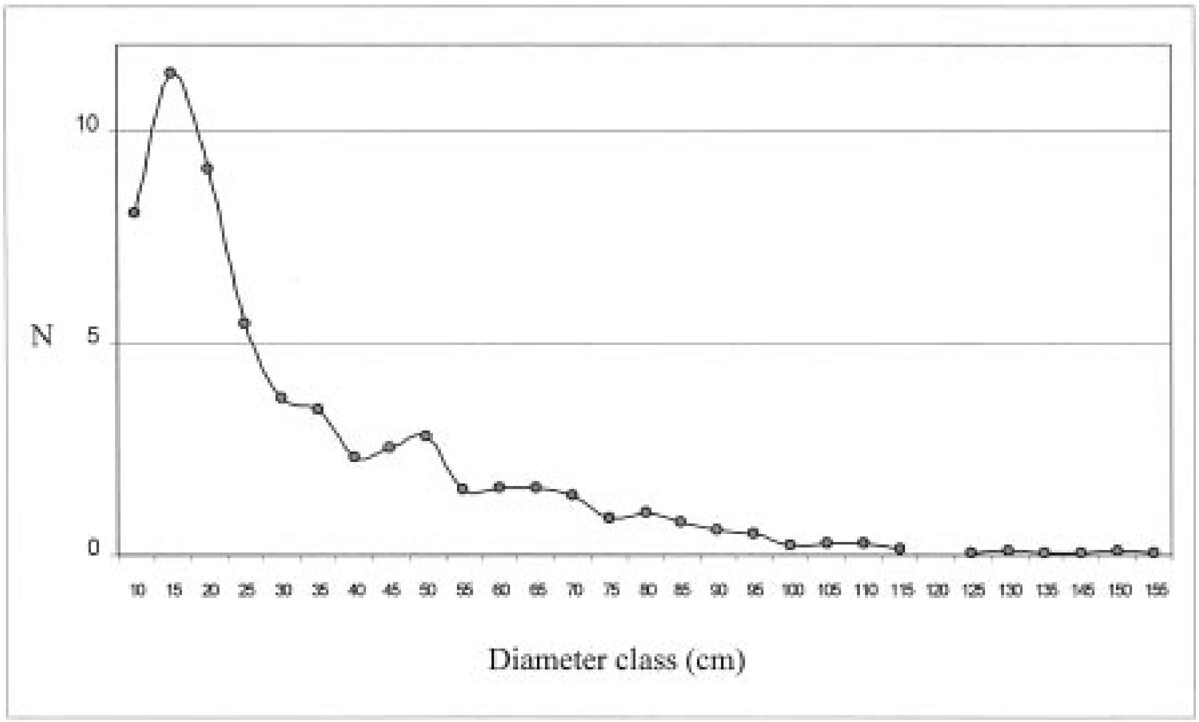

Fig.2. The frequency of the beech species in different diameter class in the studied strip

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EFFECT OF FIRE ON TREES QUALITY AND REGENERATION IN A BEECH MOUNTAIN FOREST OF IRAN

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Introduction

Natural forested landscapes are characterized by a variety of disturbance processes primarily wildfire, windthrow, insects and diseases as well as geomorphic activity such as landslides and debris or snow avalanches (John, 1992). Effects of fire on vegetation are usually the most obvious impacts of burning. Fire affects natural ecosystems by consuming plants, altering successional patterns, and changing vegetative resources such as timber, forage, and wildlife habitats (DeBano et al., 1998).Most of world's forests which exist in varied climates has experienced fire under deferent severity. Broadleaves deciduous forests have been suffering fire regimes with many decades (or less) till centuries (or more) return intervals (Sanford *et al.*, 1985). Iran has a total of 1.2 million ha temperate forest in the north where fires occur in ca. 300-400 ha annually. Despite such repeated fire occurrences, there is a few studies which has been undertaken investigating of fire effects on the forests. This study focuses on the impact of fire on deferent tree species quality and their regeneration (specially focused on beech) in Chelir forest in north of Iran.

Materials and Methods

Study area

The study area is located in Chelir, Iran (36̇ 30′ 30″ to 36̇ 32′ 30″ N latitude and 51̇ 40′ 00″ to 51̇ 41′ 30″ E longitude). It is located at an altitude of about 1100-1350 m in the tophills of Chelier's Forest, with slope between 10-30%, 30 km southeast of the Nowshahr city in Mazandaran, Iran (North of Iran). The forest type is an uneven aged mixed broadleaves trees consisting of beech (*Fagus orientalis* L.) and hornbeam (*Carpinus betulus* L.) as the dominant species, forest harvesting operation has not yet to be conducted in the area. The climate is humid temperate where mean annual precipitation is 1380 mm without any dry season, and mean temperature of hottest month is 24.6 °C and the mean temperature of coldest month is 7.5 °C. For this study, the fire event occurred in 1999 where 270 ha of forest were burned in 4 days; field data and sample collection were done 6 years later in 2005.

Sampling

Our study areas included both burned and unburned area (each study area has 100 ha) where a systematic 100 x 200 m grid sampling plan placed in E-W direction and was carried out using circular plots that each one had 1000 m^2 area. A geographical positioning system (GPS) was used to locate the centre of each plot. For collecting regeneration data, 4 microplots were conducted in each plot due to north, east, south and west respectively. Therefore, in each study area 50 plots and 200 microplots were designated for a total of 100 plots and 400 microplots for the study.

Tree species and their quality conditions related to fire (table 1) in the plots and seedling species and numbers in microplots were recorded.
We used spss 12.0.0 (2003) for processing statistical analysis on collected data.

Results and Discussion
The results showed that the forest fire didn't has the same effect on tree species in both burned and control area. those species such as beech (*Fagus orientalis* L.) and maple tree (*Acer velutinum* Bioss) which containing thin bark have been affected more in compare with the others containing thick bark like hornbeam (*Carpinus betulus* L.) and oak (*Quercus castaneifolia* C.A.Mey). the number of beech regeneration in control was significantly more than burned area while the quantity of those species regeneration such as hornbeam, cappadocian maple and Maple tree (*Acer velutinum* Bioss) were significantly higher in burned area than the other. It is concluded that the forest fire had more effect on beech quality and changed regeneration species composition in burned area that fire prevention activities should be considered as silvicultural treatments for preserving these valuable forests.

Table 1. Categorizing of tree's quality related to forest fire (Lotfi, 1999)

Code	*Tree's burned quality index*	*Description*
1	Safe	A tree without any burned or blacked signs
2	Low burned	A tree with burned or blacked signs up to 10 cm aboveground
3	Medium burned	A tree with burned or blacked signs up to 50 cm aboveground
4	High burned	A tree with burned or blacked signs more than 50 cm aboveground and the bark goes dry

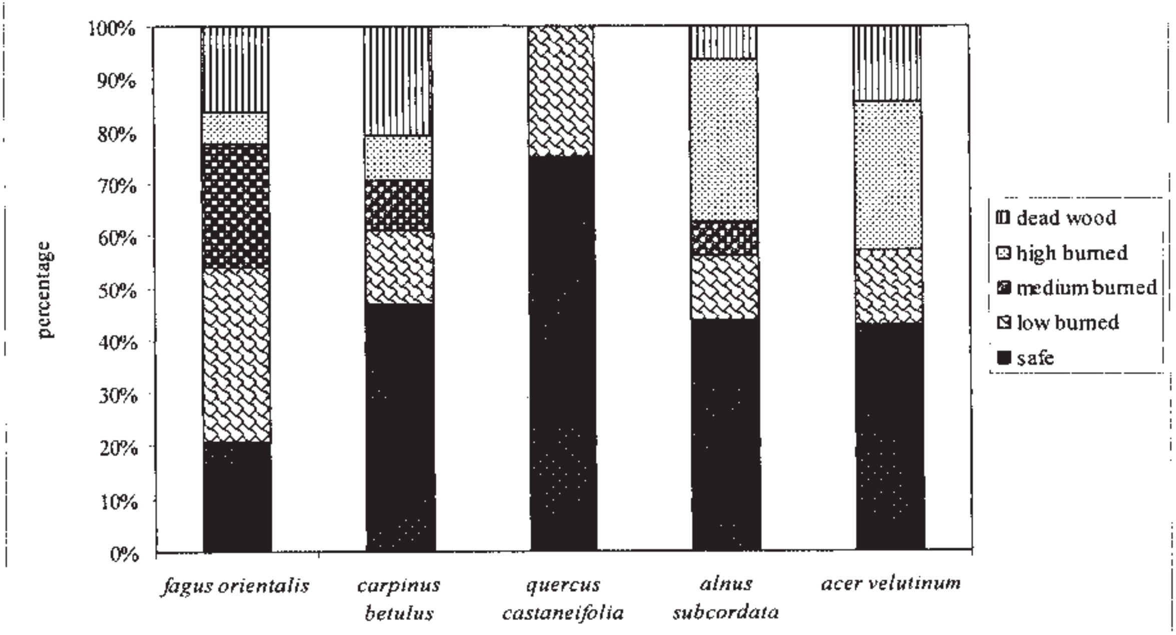
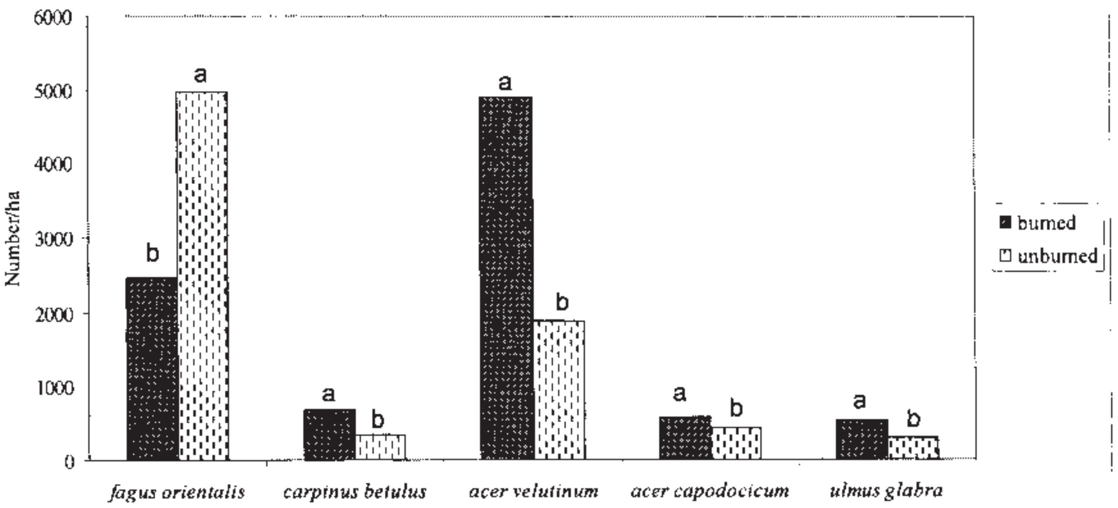


figure 1-Percentage of tree quality relating to fire in burned area

figure 2- Number per hectare of regeneration in both and unburned area



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DETERMINATION AND ANALYSIS OF ECOLOGICAL SPECIES GROUPS WITH RESPECT TO ENVIRONMENTAL FACTORS

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Introduction

Distinguishing plant associations has been at the heart of vegetation science for centuries, with a traditional focus on the distribution, composition and classification of plant communities (Kashian *et al.* 2003). In combination with analyses of communities and individual species, classifying ecological species groups is one method for discerning vegetation – environment relationships (Grabherr *et al.* 2003). Ecological species groups are groups of plants that repeatedly occur together in areas with similar combinations of site factors, and that are perceived to have similar ecological requirements or tolerances (Host and Pregitzer 1991; Barnes *et al.* 1998). While often all species of a group occur together on a site, presence of one species of a group has been interpreted to suggest that the site meets requirements of all species of that group (Kashian *et al.* 2003).

Species groups are based on the theory that evolutionary and community processes such as competition confine species to environmental complexes where they are best adapted (Host and Pregitzer 1992; Kashian *et al.* 2003). Species group research identifies environmental gradients correlated with species distributions, classifies species assemblages occupying similar environmental complexes, and relates species distributions to management-oriented variables such as tree growth (Host and Pregitzer 1991). Once species groups are developed for an area, their distribution can be used for inferring soil properties and other variables relatively difficult to measure (Meilleur *et al.* 1992).

At intermediate elevation levels (~800-1800 m a.s.l.) beech (*Fagus orientalis*) is the most important tree species and a major component of different forest communities (Mohajer 2006). They have a remarkable significance due to their diversity, productivity and economical value. The aim of the research was investigation on classifying the vegetation, recognition of ecological species groups in Fagetum communities and comparing different environmental conditions among them.

Materials and Methods

This study was done in *Carpino-Fagetum, Rusco-Fagetum, Fagetum Oriental and Alno-Fagetum* forest communities of Namkhaneh, Gorazbon and Chelir districts of Kheiroudkenar forests(in Caspian forests located in northern Iran).

Selective stratification sampling method was used to locate samples (Mueller–Dombois & Ellenberg 1974). Because of the large variability in geographical aspects in the study area, aspects were selected as sampling unit in the Fagetum communities. Therefore, one plot was sampled on each aspect in each community.

Plot size of the floristic sampling was always 400 m². Within each sample, full floristic composition of vascular plants was recorded. Cover classes (Braun-Blanquet scale, Mueller–Dombois and Ellenberg 1974) for each species was estimated separately for the herb, shrub and tree layer.

At the center of each releve, two soil samples were taken separately from 0-10 and10-30 cm layers of mineral soil at the same time as the floristic inventory.

Sand, silt and clay percentages were determined by the hydrometry method. Soil pH was determined by a pH meter. Total N was analyzed by the Kjeldahl method, Available P by colorimetry according to Bray-II method (Bray and Kurtz, 1945) Calcium carbonate by calcimetry; organic carbon by Walkley and Black method; Organic matter was obtained by multiplying C values with 1.72; exchangeable cations were extracted with ammonium acetate 1 N and analyzed by atomic spectrometry. C/N rate and base saturation were calculated. At each plot physical features of the site have been recorded (elevation, aspect, relative topographical position, percentage of slope).

Cluster analysis was used to classification of samples. (MRPP) Multi-response Permutation Procedures was used to test the hypothesis of no difference between groups in species space and also in environmental variables space. Tukey test was used to compare the environmental variables means among groups

Results and Discussion

120 samples were established and 104 species were recorded in the study area in different strata including 12 trees, 9 shrubs and 83 herbaceous species.

The total number of species used in the analysis (frequency more than 5%) was 57. Some of the recorded species have a wide ecological and sociological range of distribution, e.g. *Asperula odorata, Euphorbia amygdaloides, Viola odorata, Hypericum androsaemum* with more than 100 records and the highest species occurrence (>80%), while *Paeonia wittmanniana Cephalanthera rubra, Lathyrus vernus* recorded in 5 sites and showed the smallest occurrence (<4%).

Four ecological species groups were recognized in Fagetum communities in the study area.

Table1 shows that what environmental variables are significantly different between groups.

Group1 is stretched over northern, west northern, east northern and western aspects, group2 is located on southern, west southern and western aspects, group3 on west northern, southern, west southern and western and group4 distributed on all aspects.

In summary, the study results showed that the distribution of ecological associated with Aspect, Clay, Total nitrogen, Organic matter, Phosphorous and exchangeable cations. There are no direct relationship between distribution of ecological groups and Elevation, slope, percentage of sand and silt, C:N ratio, pH, bulk density and porosity in the study area.

Table 1: Multiple comparison of Mean differences of different groups by Tukey Test

	Significant differences ($P<0.05$)
Group 1 *vs.* group 2	OM_2, Aspect
Group 1 *vs.* group 3	N_2, Aspect, $Clay_2$
Group 1 *vs.* group 4	CA_1, CA_2,BS_1, BS_2, K_1, P_2, Aspect
Group 2 *vs.* group 3	BS_1, K_1, OM_2
Group 2 *vs.* group 4	Aspect
Group 3 *vs.* group 4	N_1, N_2,OM_1,OM_2,CA_1,CA_2,BS_1,BS_2,K_1,P_2,$Clay_2$,Aspect

Abbreviations: OM: organic matter, N: nitrogen, CA: calcium, K: potassium,
BS: Base saturation P: phosphorous, 1: Depth 0-10, 2: Depth 10-30 cm

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EFFECT OF STAND ELEVATION AND SLOPE DIRECTION ON SEED CHARACTERISTICS OF *FAGUS ORIENTALIS*

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Introduction

Caspian forest are located from -20 to 2200 m.a.s.l. in north of Iran. The rich and beautiful stands are distributed on the northern slopes and the best stands at 900-1500 m.a.s.l (Sain et al., 1981). The basic element of each natural regeneration is seed production. Seeds make relationship between the regeneration and genetic inheritance. Transforming of heredity is done by seeds. One of the most important principals of silviculture is sustainable biologic prouduction and this would be done by natural regeneration, having completed and enough information about charactristics seed production is necessary for every forest manager. Beechnuts were collected from six high elevation beech forest of the great Smoky Mountain National Park. High elevation beechnuts were found to have a germinative capacity of 72.26% and low elevation nuts 71.12% . Naturally occuring seedlings were found growing in high elevation forests. The conclussion is that these forests posses the capacity to reproduce via seed (Tabari et al., 2007). Nine stations over 3 regions were selected at western, central, and eastern area of Mazandaran province and seeds were collected and investigated on quality of seed production. The highest precentage and germination level and also viability of seeds belong to western in 1500 m.a.s.l. The size of seed and weight of seed were larger in western. The seeds from 1500 m.a.s.l elevation have the highest germination capacity (Etemad. et al., 2004). The goal of this study was ghathering information about seed characterstics and introducing the best area for seed production.

Materials and Methods

This research was carried out in pured stands of beech in the caspian region of northern in Iran. The studied site is located in Golestan province at latitude from 36°41' to 36°45' N and longitude from 54°20' to 54°24' E. Dominant tree species was beech. This species is a most valuable wood producing species in the Caspian forest which covering 17.6 percent of the areas an represent 30 percent of the standing volume. Beech stands extend between 220 and 2160 m.a.s.l. The mean annual percipitation and mean annual temperature are 562.1 mm and 24 °c respectively. The soil type is forest brown soil. Beech seeds [*Fagus orientalis, Lipsky*] were collected the fall of 2007 from six beech stands in 3 elevation of 550, 679, 809 meters above sea level (m.a.s.l) and two main slope directions (East and West). Three trees in each stand were selected randomly with diameter higher than 70 cm. The distance between the selected trees was about 70 meters. Totally 18 trees studied in this research and all seeds were collected. After seed collection (90 seeds in each stand), seed characterestics including size of seed (seed lengh,seed width), seed wet weight, seed dry weight, seed wetness, seed viability and seed emptiness, total number of seeds for each tree were measured. Seed length and width by vernier caliper with accuracy of .01 and seed wet weight by balance with accuracy of .01 were measured. Seeds samples for wet test sited for 17 houres in aven with tempreture 105°c and then speedly were weighted. Seeds wetness were calculated by difference of between seeds wet weight and seeds dry weight. Viability was tested by tetrazolium.

Measured characteristics of seeds was analyzed by factoriel and using SPSS software. The mean of each measurement was compared in different elevation and two main slope direction.

Results

The results showed that by increasing the elevation, the length of seeds increased at first and then decreased respectively. Also the moisture content was more in eastern direction rather than western direction but the hight increases doesn't have a significant effect on avibility and generally it was more in eastern direction. The trees in the higer elevations had less empty seeds and the number of empty seeds were more in the eastern direction.

Table 1: Variance analysis of seed quantitative and qualitative characteristics between different slope directions and m.a.s.

	Seed Length	Seed Width	Wet Weight	Dry Weight	Water Content	Seed Viability	Emptiness Number Precent
Height-Slope direction	15447.893**	8993.666**	2055.782**	1959.003**	1163.160**	287.704**	33.140**
Height	19.550**	38.471**	36.979**	24.612**	39.589**	2.326^{ns}	15.434**
Slope Direction	$.601^{ns}$	40.828**	134.321**	9.905**	567.827**	18.134**	3.532^{ns}
Height * Slope Direction	$.620^{ns}$	3.328**	6.213**	15.052**	5.376**	8.849**	3.408^{ns}

^{ns} : no significant

**: significant

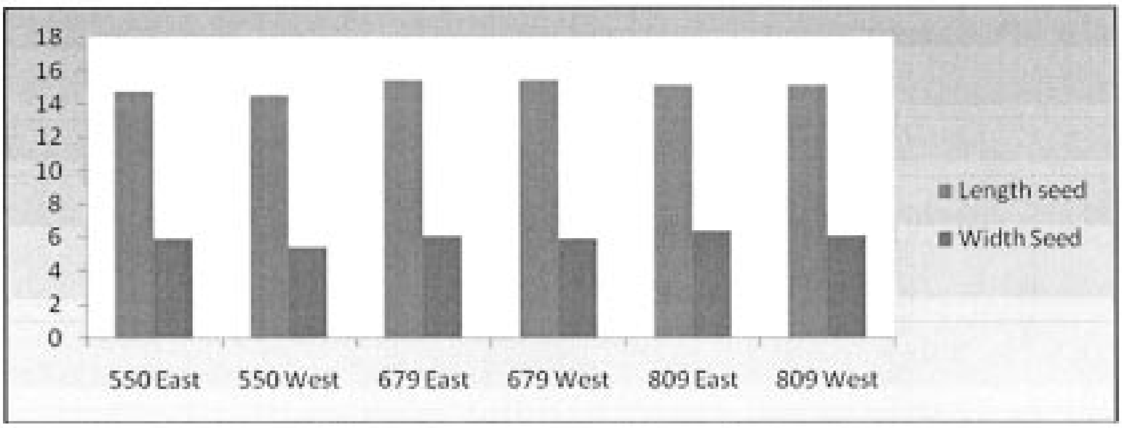

Figure 1: Comparision of seed length and width of beech in different slope directions and m.a.s.l.

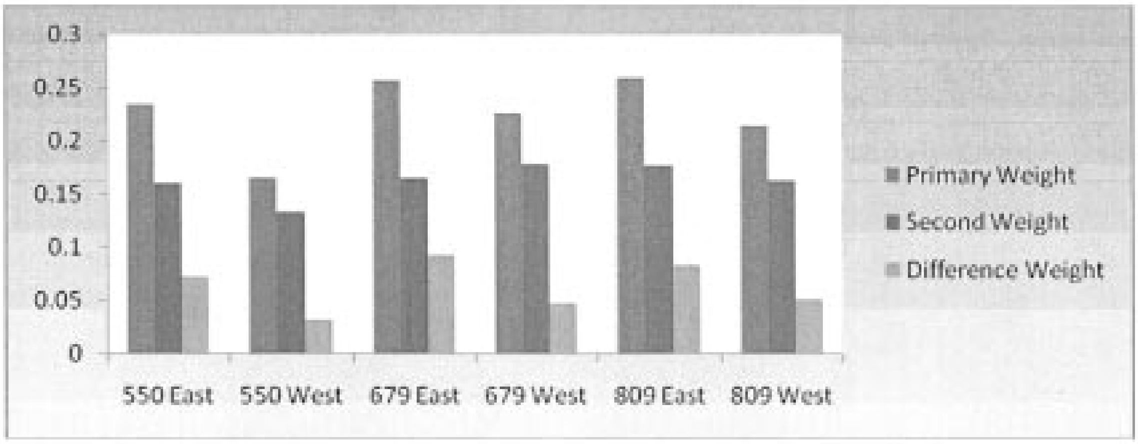

Figure2: Comparision of seed wet weight, dry weight and water content in different slope direction and m.a.s.l.

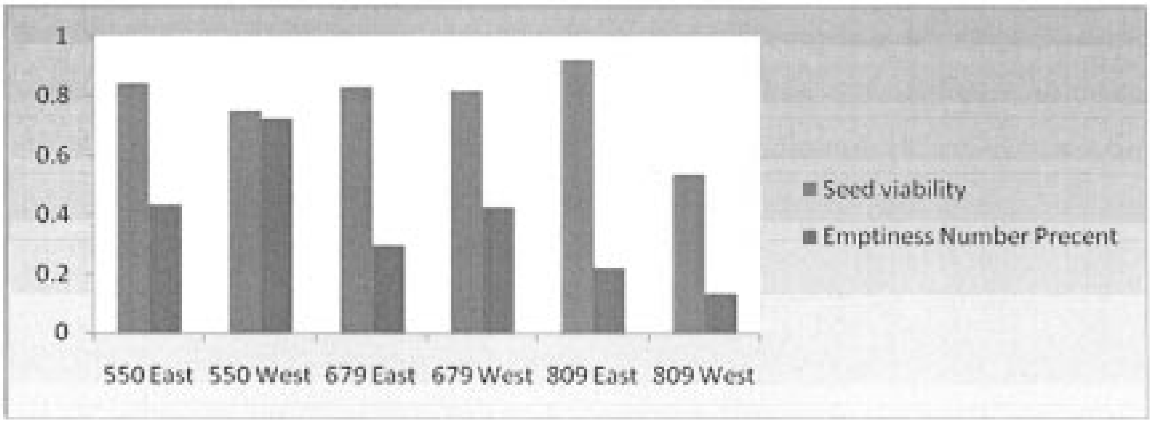

Figure 3: Comparision of seed viability and emptiness number percent in different slope direction and m.a.s.l.

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INTER- AND INTRA-YEAR VARIATION IN NONSTRUCTURAL CARBOHYDRATES CONTENT IN DIFFERENT ORGANS OF *FAGUS CRENATA* TREES AFTER THE MASTING EVENT

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Introduction

Masting is one of the attractive events, and several hypotheses were presented to interpret the significance of masting. In *resource matching hypothesis*, it is regarded that stored resources would play an important role in masting, since plants must prepare large amount of resources for reproduction events. There are some studies, in which repeated measurements of the amount of storages (mainly carbohydrates) were done during ante- and post-masting periods to assess the importance of stored resources for reproduction, but the results are contradictory (Miyazaki et al. 2002, Hoch et al. 2003, Ichie et al. 2005). Furthermore, other studies, in which some manipulations such as using a labelled carbon, girdling, or defoliation were conducted, showed that current photosynthates could afford to ripen fruits (Hasegawa et al. 2003, Hoch 2005, Hoch & Keel 2006).

At whole plant level, carbon resources are also required for growth and maintenance of non-assimilation organs during reproduction events. It is speculated that reserved carbohydrates are used for growth and maintenance of vegetative organs, when notable amount of current photosynthates are allocated to reproduction. Therefore, the level of carbohydrate storage should be associated with masting events, even if current income is sufficient for fruits ripening. Not only the contributions to the activities of the non-assimilation organs, internal stored carbohydrate also plays an important role in enhancement of stress resistance and recovery from physical damages (Kabeya et al. 2003, Myers & Kitajima 2007). Hence, the reduction in carbohydrate storage owing to a masting event may affect plant life history. It is important, therefore, to clarify the effect of masting event on the level of internal carbohydrate stores.

In deciduous trees, non-assimilation organs are regarded as perennial storage parts, but the tissue that serves as an internal store and the stored substance are species specific in tree species (Kozlowski 1992). Moreover, the level of resource storage fluctuates in time scales (daily, seasonally, or yearly) (Chapin et al. 1990). In this study, we monitored the fluctuation of carbohydrate storage levels in roots, stems, and twigs in *Fagus crenata* Blume after a masting event in 2005. The aims of this study were to: (1) elucidate how did the level of carbohydrate storage fluctuate after masting events in intra- and inter-annual time scales? (2) determine which organ is the primal storage part in *F. crenata*?

Materials and Methods

The study site was located in a beech forest on Mt. Naeba (36°51′ N, 138°46′ E, 900 m asl.). It was a masting year in 2005 for beech in this region. To measure the carbohydrate contents in twigs, stems and roots, parts of each organ were repeatedly collect from November

2005 to November 2007. Three to five trees were selected for study. Sampling was conducted once (at the start of dormancy) in 2005, whereas, it was repeated four times (at the completion of leaf development, mid summer, mid autumn, and dormancy) in 2006 and 2007. At each sampling, branchlets were collected from top of the canopy. The branchlets were separated into sections of different age classes. All branch samples were heated in a microwave oven at 600 W for 90 s in the field to denature enzymes. From each tree, one stem xylem core was sampled at breast height and one root xylem core was sampled from roots exposed soil surface. The stem and root cores were 4 and 3 cm respectively starting from the cambium. Both stem and root cores were fractionated into 1 cm sections and immediately frozen in liquid nitrogen in the field. Barks of stem and roots were removed from xylem cores but branch barks were not peeled off. All samples were dried at 70 °C to constant masses in the laboratory and ground to fine powder. Soluble sugars and starch were extracted severally according to Ono et al. (1996), then soluble sugars and glucose from starch were quantified using phenol-sulphuric acid method and glucose-oxidase method, respectively.

Results and Discussion

Seasonal fluctuation of carbohydrate storage

In each organ, both soluble sugar and starch concentrations showed the similar seasonal patterns for two years after the masting event. Concentrations of soluble sugars in twigs averaged among age classes were 2.2% ~ 5.0% and slightly increased through the growing season. Sugar concentration in stems and roots had lower levels than that in twigs. That would be mainly due to the difference in sampling components of different organs (higher fraction of phloem in twigs than in stems and roots). Distinct seasonal increase in sugar concentration was observed in stems and roots (left panel in Figure 1). The high concentrations of sugars in dormant season were thought to be for winter hardiness.

In contrast to the concentrations of soluble sugars, the concentrations of the starch in aerial parts, which was considered as a primal storage substance, increased in early growing seasons, maintained high level until autumn, and fell down at the dormancy (right panel in Figure 1). As the result, the starch concentrations of aerial parts at both the start and the end of growing seasons were almost the same for two years. Starch concentration in roots also declined at dormant seasons, but the degree was gentle. These results indicate that starch in aerial parts are hydrolysed to sugar for osmotic control (for winter hardiness) and/or transported to the root at dormant season.

Inter-annual fluctuation

The starch concentration in roots increased annually after masting. On the other hand, distinct inter-annual increase in starch concentrations was not found in aerial parts, because of the steep decline of starch concentration at the end of growing season (right panel in Figure 1). These results indicate that, in *F. crenata*, aerial parts are temporal storage organs and the root is a perennial storage organ for carbohydrates. Because the soluble sugar concentrations increased yearly in aerial parts, the concentration of total non-structural carbohydrates (starch + soluble sugars) showed inter-annual increase in all organs. This result consists with Ichie (2006), and the masting event seems to cause a shortage of the carbohydrates at whole plant level in this species. However, a moderate reproduction event, which was observed in another study site in 2007, only caused the intra-annual delay of starch storage in roots (data not shown). Therefore, reproduction may not always affect the level of long term carbohydrate storage (c.f., Hoch et al. 2003).

Conclusion

In *F. crenata*, a masting event affected the carbohydrate level in whole plant level; carbohydrate amount seemed to recover after masting event. Branchlets and stem contained larger amount of carbohydrates than roots. However, when both intra- and inter-annual fluctuation patterns of the carbohydrate storage were considered, it was suggested that aerial parts of *F. crenata* act as temporal storage spaces for carbohydrate and root was the main storage organ to prepare for long-interval events such as masting.

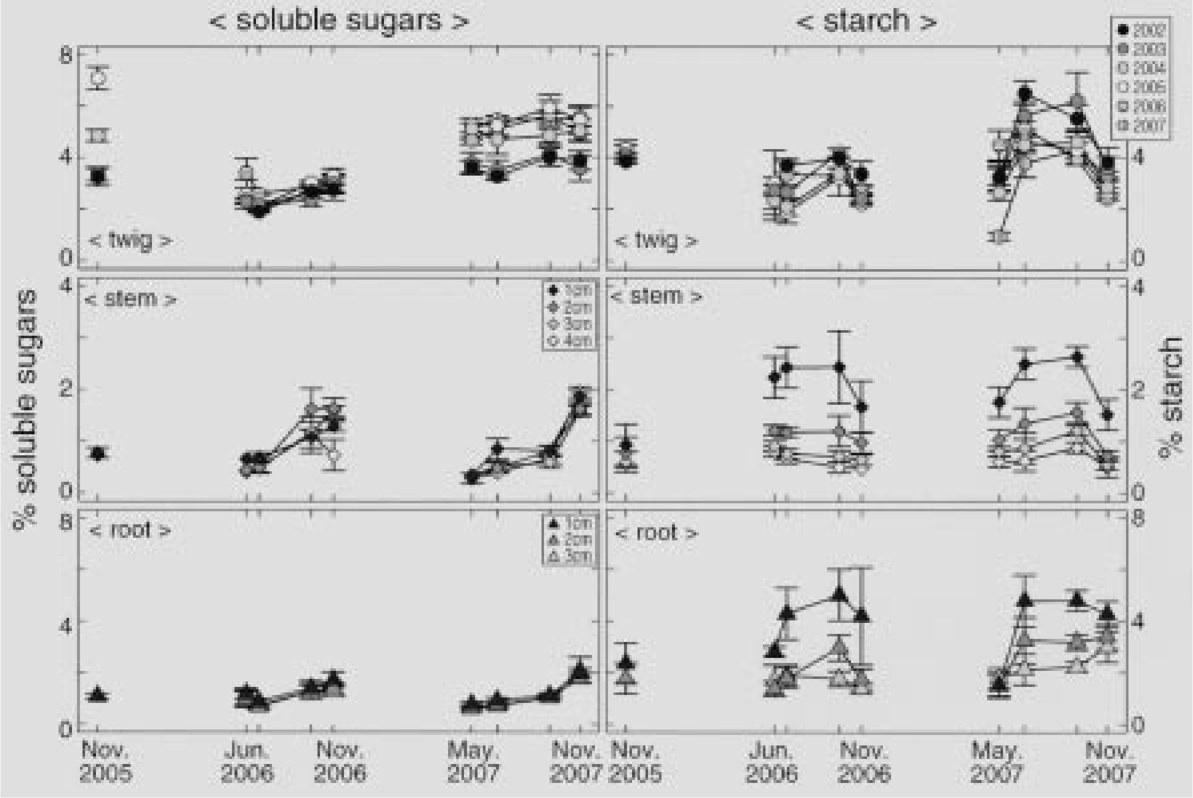

Figure 1. Soluble sugar concentration (right) and starch concentration (left) in twigs, stems, and roots of *Fagus crenata* (mean ± se). Symbols with different filled shows different elongation year (twigs) or core samples collected from different depth (stems and roots).

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VARIATIONS IN NITROGEN CONTENT IN DIFFERENT ORGANS OF *FAGUS CRENATA* TREES AFTER THE MASTING EVENT

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Introduction

Mast seeding or masting, i.e. synchronous, but highly variable among-year seed production by plant populations, is characteristic of many species globally, including tropical trees, temperate forest trees, and temperate herbs (Kelly 1994). The resource allocation mechanism is one of the most common hypotheses used to explain masting event (Kelly and Sork 2002). According to this hypothesis which has been tested by several models assuming carbohydrate to be the main limiting internal resource (Isagi et al. 1997), trees take several years to recovery from the large expenditure of internal resources required to produce seeds in a mast year. However, recent studies have demonstrated that carbohydrate contents of fruit are more dependent on current-year photosynthates than on internal stores of carbohydrates (Hoch et al. 2003, Hoch 2005), indicating that resources other than carbohydrate may also relate to masting event. A major candidate for such a limiting resource is nitrogen (*N*), for the following reasons. Leaf photosynthesis is closely correlated to leaf *N* because of the large proportion of leaf *N* in the photosynthetic machinery (Evans 1989) and the limited amounts of available *N* in soils of most regions (Niinemets et al. 2001). In addition, early season leaf growth after bud burst is more dependent on *N* supplied by remobilization from internal stores than on *N* uptake by roots (Grassi et al. 2002, Frak et al. 2006, Millard et al. 2006). Furthermore, large, mature trees rely more than small, juvenile trees on the remobilization of stored *N* for their growth each spring (Millard 1996). These results imply that *N* may be the internal resource that impedes masting event. In our previous study, we evaluated the effects of masting on nitrogen content and dry mass of winter buds in Japanese beech (*Fagus crenata* Blume) (Han et al. 2008). Here, we measured the seasonal variations in *N* in leaves, branches, stem and roots after the masting event of 2005. The main objectives of this study were to: (1) evaluate the influence of masting on *N* concentration in various organs and (2) determine which organ serves as the main internal store for nitrogen.

Materials and Methods

Study site

The study area was located in the Naeba Mountains in southern Niigata Prefecture, Japan (36°51' N, 138°46' E, 900 m asl.), where *F. crenata* forests are found over an altitudinal range from 550 to 1500 m. The bedrock is predominantly andesite and basalt, on which moderately water-retentive brown forest soil has formed. During the period 1979–2006, the mean annual precipitation and temperature were 2,225 mm and 11.5 °C, respectively, at a nearby meteorological station (36°56' N, 138°49' E, 340m asl., Japanese Bureau of Meteorology). The stand age was about 83, with tree density of 1190 trees ha^{-1}, tree height of 17.2-22.8 m, and diameter at breast height of 20.50-38.10 cm in the full masting year of 2005.

Sampling and nitrogen analysis from branch, stem and root

Samplings were conducted from three to five trees that fully fruited in 2005 at the following date: the end of May (end of spring flush), middle of July (mature leaves with maximum photosynthetic capacity), late September (before leaf senescence) and earlier November (after leaf fall).

Two branches were sampled from the upper parts of each tree crown. In each case the branching system representing the previous five years of growth was retained and branches were separated into sections of different age classes. All branch samples were heated in a microwave oven at 600 W for 90 s in the field to denature enzymes. From each tree, one stem xylem core was sampled at breast height and one root xylem core was sampled from roots exposed soil surface. The stem and root cores were 4 and 3 cm respectively starting from the cambium. Both stem and root cores were fractionated into 1 cm sections and immediately frozen in liquid nitrogen in the field. Barks of stem and roots were removed from xylem cores but branch barks were not peeled off.

All samples were dried at 70 °C to constant masses in the laboratory and ground to fine powder. Nitrogen concentration was determined using a gas chromatograph (GC-8A, Shimadzu, Kyoto, Japan) after combustion with circulating O_2 by an NC analyzer (Sumigraph NC-900, SCAS, Osaka, Japan).

Results and Discussion

Leaves: Compared with the mean *N* value in September of masting year 2005, *N* in leaves decreased in the same period of the following non-masting years of 2006 and 2007 (Fig. 1a). Similar decreases were also found in both dry mass and area per single leaf (data not shown). Together with the reduction of annual leaf litter caused by masting (Han et al. 2008), these results indicate a significant effect of masting on leaf quantity and quality and thus the current-year photosynthates that is the main source for fruits (Hoch et al. 2003).

Branches: Nitrogen concentration in twigs of all age classes exhibited the same pattern of seasonal fluctuation except in current-year shoots (Figs. 1a and 1b). The level of *N* increased in autumn that is caused by either resorption from senescent leaves or/and N uptake by roots (Fig. 1b). The level of *N* in all age classes decreased during the spring flush in comparison with its respective values of the same twigs during dormancy of previous year, indicating remobilization of stored *N* to spring shoot flush and leaf growth (Grassi et al. 2002, Frak et al. 2006, Millard et al. 2006). The level of *N* during tree dormancy was lower in 2006 than in 2007, indicating re-charge of stored pool of N in branches after masting events.

Stems: Nitrogen concentration in stem woods was higher in the cambium-containing section than in other xylem woods, but the level of *N* had less seasonal and inter-annual variations in all sampled depths (Fig. 1c). This result suggests that stem contributes less to N remobilization and does not serve as a storage organ of N in *F. crenata*.

Roots: Nitrogen concentration in roots was higher in the cambium-containing section than in other xylem woods, but the level of *N* had less seasonal and inter-annual variations in all sampled depths (Fig. 1d). This trend was the same as in stems, although *N* concentration in roots was higher than in stems. Roots, the same as stems, may also contribute less to N remobilization.

Conclusion: In *F crenata*, a typic masting species, masting events affected the nitrogen concentration in branches but less in stems and roots. Branches serves as the main store organ for *N* remobilization and this store pool reduced by masting events.

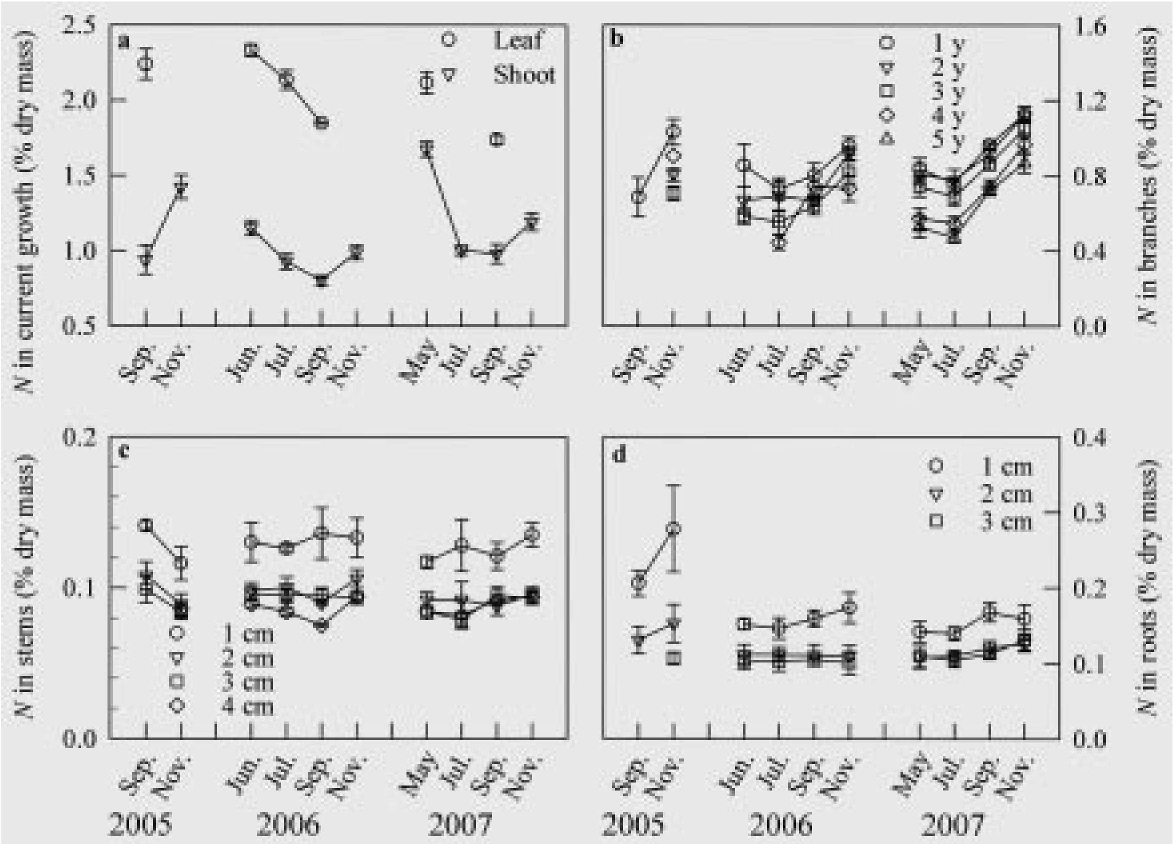

Figure 1: Nitrogen concentration (*N*) in (a) leaves and current-year shoots, (b) twigs of different age classes, (c) stems and (d) roots of each centimeter sections starting from the cambium. Values shown are means ± SE estimated from individual-averaged data.

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EFFECTS OF WEATHER CONDITIONS ON MAST SEEDING IN *FAGUS CRENATA* IN NORTHERN JAPAN

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Introduction

Fagus crenata Blume, which dominates the cool temperate forests of Japan, is one of the more extreme examples of mast-seeding plants. This species produces large seed crops at 5- to 7-year intervals (Hiroki and Matsubara 1995) and synchronizes the fluctuation of reproduction over tens of kilometers (Yasaka et al. 2003, Suzuki et al. 2005). Several recent studies have proposed both evolutionary advantages and mechanisms of mast seeding in *F. crenata* (Shibata et al. 2002, Yasaka et al. 2003, Kon et al. 2005a, b). Based on 13 years of time series data collected from southwestern Hokkaido, Japan, Kon et al. (2005a) suggested that *F. crenata* gains major benefits from predator satiation. The same research group also suggested that such fluctuations in reproduction were caused by internal resource dynamics and weather cues and that the cessation of reproduction, resulting in a decline in predator populations at a large spatial scale, is triggered by minimum temperatures in the spring (late April to mid-May) in the year preceding flowering (Kon et al. 2005b). Therefore, the response to weather cues may have evolved to cope with seed-predatory insects over extended periods of time and to facilitate reproductive success (Kon et al. 2005b).

In contrast to these hypotheses, Suzuki et al. (2005) proposed that higher temperature from mid-June to late July may explain mast seeding of *F. crenata* in the Tohoku district of Japan. In addition, for some other *Fagus* species, temperature and/or precipitation in early summer have a stimulating effect on flower induction (Piovesan and Adams 2001, Övergaard et al. 2007). Therefore, the reproductive mechanism in *F. crenata* might be different between the forests in southwestern Hokkaido and the forests located more to the south.

We reanalyzed data obtained over 31 years (1976–2006) in the Tohoku district of Japan to determine the weather conditions that induce cessation of reproduction, resulting in mast seeding in *F. crenata*.

Materials and Methods

Seed crop series from 1976–1992 (Hiroki and Matsubara 1995) and 1989–2006 (Forestry and Forest Products Research Institute, FFPRI; http://ss.ffpri.affrc.go.jp/labs/tanedas/tanedas-flash.html) were used for the analyses. For the time series 1976–1992 (Hiroki and Matsubara 1995), mast years were considered to be those with a ratio of sound seeds greater than 50%. For the time series 1989–2006 (data from FFPRI), mast years were determined by the first ranking of "good crop" in the categorization of fruiting. Based on these criteria, mast years occurred in 1976, 1984, 1990, 1995, 2000, and 2005 in the southern part of the Tohoku district.

To assess the effects of weather on mast seeding of *F. crenata*, we analyzed the mean minimum daily temperatures from late April to mid-May and the mean maximum daily temperatures in July for 1 and 2 years preceding a mast year (except 1976). Daily meteorological data recorded for 1979–2005 at the Washikura station (37° 40′ N, 140° 15′ E, 1,220 m a.s.l.) of the Japan Meteorological Agency were used for the analysis.

Results and Discussion

Temperature from late April to mid-May: The occurrence of mast years was related to the minimum temperature in the spring (late April to mid-May) 2 years preceding mast seeding (Table 1, Fig. 1). Although the mean minimum temperature in the spring 2 years preceding mast seeding was not higher than that in the spring 1 year preceding mast seeding (*t*-test, NS, $P = 0.60$) , in two (1984 and 2000) of five mast years, higher values than normal temperatures occurred in late April to mid-May. This result supports the hypothesis that higher minimum temperatures in the spring of the year before flowering inhibit flower induction in *F. crenata* (Kon et al. 2005b; Kon and Noda 2007).

A low temperature cue to initiate flowering appears to be important in trees and has been correlated with seed production in several species (Norton and Kelly 1988). For example, mass flowering in dipterocarps is triggered by low temperatures at night (Ashton et al. 1988, Numata et al. 2003). High temperatures at night may inhibit flower induction, whereas low temperatures may enhance flower induction.

Temperature in July: The occurrence of mast years was also related to the maximum temperature in July 2 years before mast seeding (Table 1, Fig. 1). Significant differences in the maximum temperatures were observed in July between 1 and 2 years before mast seeding occurred (*t*-test, $P = 0.04$). Three (1990, 1995 and 2005) of the five mast years were characterized by considerably lower temperature in July 2 years before mast seeding. This result showed that a cool summer caused the cessation of reproduction.

Generally, reproductive output is limited by resource availability. In a resource budget model describing mast seeding behavior, it has been proposed that resources stored at the development of a flower bud are a dominant factor leading to annual variation in flowering (Masaka and Maguchi 2001).

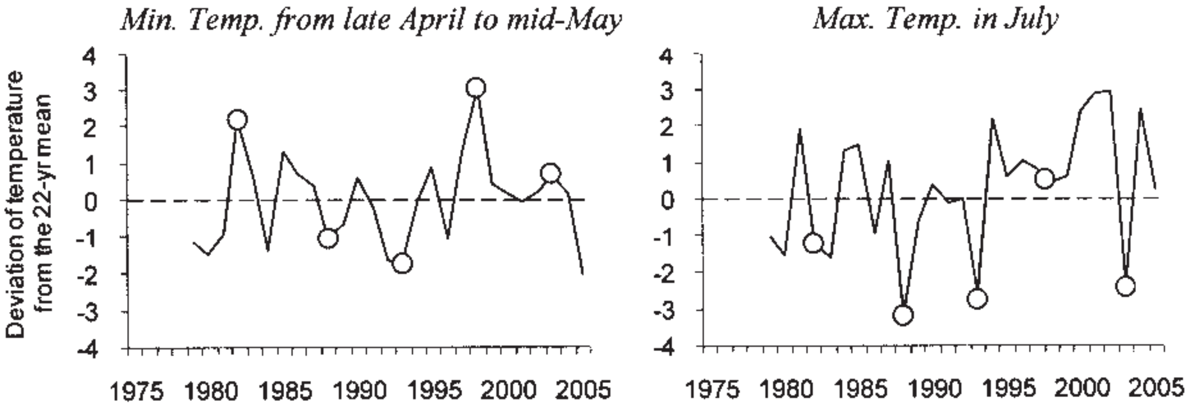
Higher temperatures in July of the preceding year did not explain the occurrence of mast seeding. There may be a mass flower induction the year following a year with cessation of flowering even without the occurrence of a warm summer. Because beech trees may build up carbohydrate resources during the cessation of reproduction, a high reproductive success can be achieved in the following year.

These results are consistent with two hypotheses that focus on low temperatures in spring (Kon et al. 2005b, Kon and Noda 2007) and high temperatures in early summer (Övergaard et al. 2007). This suggests that weather and resources are clearly involved in mast seeding.

Table 1: Deviations from the 22-year (1979–2000) mean of the mean minimum daily temperatures from late April to mid-May and the mean maximum daily temperature in July for 1 and 2 years preceding a mast year.

	Min. temp. from late April to mid-May		Max. temp. in July	
Mast year	year-1	year-2	year-1	year-2
1984	0.63	2.20	-1.57	-1.23
1990	-0.67	-1.07	-0.60	-3.17
1995	-0.03	-1.77	2.20	-2.60
2000	0.43	3.10	0.63	0.43
2005	0.20	0.67	2.50	-2.33
Mean	0.11	0.63	0.63	-1.78

Figure 1: Annual variation in temperatures from 1979 to 2005 at the Washikura station. White symbols represent the two years preceding a mast year.



Min. Temp. from late April to mid-May

Max. Temp. in July

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A MODEL FOR EPIPHYTE COLONIZATION OF BEECH STANDS

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We will present a model for the colonization of forest stands for a set of epiphytic species that are confined to *Fagus sylvatica*. This includes testing a new method for developing simulation models for metapopulations in changing landscapes that utilize data on only the distribution pattern of the species among its dynamic habitat patches. We use data on the occurrence of a set of focal species collected in two types of beech stands: all old stands that constitute dispersal sources, and younger stands to become colonized. We used the Bayesian approach to fit the model, because it allows us to estimate missing observations, here the year of colonization. The approach also provides the full probability distribution of the parameters, which reflects the natural variability and uncertainty. These probability distributions will be used in simulations with the model. Colonization is modelled as a function of connectivity to old source stands, stand variables and environmental variables.

ESTIMATING CAVITY TREE DENSITY IN BEECH FORESTS OF SOUTHERN HOKKAIDO, JAPAN

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Introduction

Cavity trees provide important habitat elements for a variety of species, and the density of these trees may be an indicator of habitat quality. Accordingly, foresters have actively managed cavity tree stands in decades, and there have been many studies of cavity abundance and distribution. The key factors influencing cavity abundance are forest age, tree size and tree species composition (Fan et al. 2003, Holloway et al. 2007). Generally, DBH (diameter at breast height) and tree species composition data are readily available for many forests, whereas information on cavity trees is scarce. The objective of this study was to develop a method for estimating cavity tree density from DBH and tree species composition data.

Materials and Methods

We recorded DBH, species identity, and presence of cavities for all trees ≥10 cm DBH in 107 plots (25 × 25 m) in nine deciduous second-growth or old-growth stands. *Fagus crenata* Blume and *Acer mono* Maxim., are the predominant species. Other species included *Quercus crispula* Blume, *Ulmus davidiana* var. *japonica* Nakai, *Tilia japonica* Simonkai, *Betula platyphylla* var. *japonica* Hara, and *Betula ermanii* Cham. Cavities were defined as those with openings of at least 2.5 cm in the smallest dimension (excluding those that had been excavated by woodpeckers). No judgment was made as to whether a particular hole was of sufficient depth or quality to provide a functional cavity for animal use.

To analyze the probability of a tree having a cavity, we divided the data (71 of 107 plots data was used) into 7 sets by tree species or groups (1:*F. crenata*, 2:*A. mono*, 3:*Q. crispula*, 4:*T. japonica*, 5:*Betula spp.*, 6:other species, and 7:snag) and used a logistic regression with DBH as the only independent variable in each data set, to compare trees with cavities (1) and those without (0). Subsequently, we calculated the probability (y - dependent variable) of all recorded trees from the logistic regression equation and then summed the probabilities of all trees in each plot. We considered this summed value to be an estimator of cavity tree number in each plot.

To examine this method on a scale larger than plot level (i.e., > 1ha), we randomly sampled 10 of 36 adjoining plots (one plot: 25 × 25 m, total (36 plots): 150 × 150 m) in the Utasai beech forest and compared the mean estimated and actual cavity tree density in the 10 sampled plots to the actual cavity tree density in 36 plots. This trial comparison was repeated 100 times.

Results and Discussion

The probability of a tree having a cavity differed significantly by tree species and DBH. Cavities were most likely to be present in *A. mono*, and least likely in *Q. crispula*. The likelihood of cavity presence increased sharply with larger diameters. The DBH at which the probability reached 0.5 was 42, 56, and 86 cm for *A. mono*, *F. crenata*, and *Q. crispula*, respectively (Table 1). The age of *F. crenata* with a 56 cm DBH is about 230 yr (Kitamura et al., 2007).

Estimated number of cavity trees and actual number of cavity trees were weakly proportionally correlated ($y = 1.006\ x - 0.12$, $R^2 = 0.321$) at the plot level. Some studies have shown that DBH and tree species are strong predictors of cavity presence (Holloway et al. 2007), and that stand level attributes (slope percent, slope position, and aspect) have little association with cavity presence (Fan et al. 2003). Nevertheless, Lindenmayer et al. (1991) demonstrated in their study that stand level attributes were significant explanatory variables for cavity tree number. Thus, the low coefficient of determination in this study may be partially explained by stand level attributes.

The actual cavity tree density in the Utasai beech forest (mean density of 36 plots) was 47.6 ha^{-1}. In 68 of 100 trial comparisons, the mean estimated density in 10 sampled plots was within ±15% (40.5- 54.7 cavity trees ha^{-1}) of the actual cavity tree density in 36 plots. In further trial comparisons (67 of 100 trials), the mean of actual density (i.e., not estimated density) in 10 sampled plots was within ±15% of the actual cavity tree density in 36 plots. Thus, the accuracy of our method using DBH and tree species composition data as predictors provided estimates closely similar to ground-truthing counts of actual cavity density. Accordingly, we consider our method sufficiently effective for management of cavity tree abundance. Application of the results of this study should be incorporated into forest growth models for estimating future densities of cavity trees.

Acknowledgment

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Table 1: The status of each species (groups) and the DBH at which the probability of cavity presence reached 0.5 calculated from the logistic regression equation.

Species (groups)	*Betula spp.*	*F. crenata*	*Q. crispula*	*A. mono*	*T. japonica*	Other species	snag
n	206	582	214	290	124	446	130
Mean DBH (cm)	28.2	33.9	37.5	21.6	32.7	26.5	19.6
Max. DBH (cm)	76.8	109.5	129.5	71	93.2	123.8	108
N. of cavity trees	43	120	27	37	37	65	24
DBH, p = 0.5 (cm)	54	56	86	42	48	not reached	72

THE USE OF FOLIAR CHEMISTRY TO INDICATE VITALITY IN SWEDISH BEECH (*FAGUS SYLVATICA*)

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Introduction

Beech (*Fagus sylvatica* L.) has its northern distribution limit in southern Sweden and is one of the major tree species, of importance in sustainable forest management and landscape ecology, in the very south of Sweden. However, tree vitality and forest condition of beech and other deciduous species, e.g. pedunculate oak (*Quercus robur* L.) and sessile oak (*Q. petraea* (Matt.) Liebl.) have deteriorated during the last decades (Sonesson and Anderson, 2001). Foliar chemistry has been identified as a useful tool in large scale monitoring of forest condition and air pollution effects on forests, e.g. ICP Forests and the European Commission. A number of Swedish studies have indicated low levels of foliar nutrients in beech and oak as compared to the ranges suggested for Europe by ICP Forests (Balsberg-Påhlsson, 1992; Hagen-Thorn et al., 2004; Schlyter et al., 2002; Sonesson, 2000; Stefan et al., 1997). This discrepancy can be interpreted as nutrient deficiency, alternatively as an imbalance due to environmental factors. The low levels of foliar nutrients in Swedish beech might arise from differences in soil conditions, provenances or to the fact that the species has the northern limit through Scandinavia.

The object of the present study is to analyse the variation in foliar chemistry of beech in Sweden using available data. Frequency graphs based on nutrient concentrations and ratios of certain elements to N are compared with European data, and the ranges on foliar chemistry suggested by ICP Forests.

Materials and Methods

The Swedish foliar chemistry database covers all available data on mature beech from the last decades, i.e. from forest monitoring and research projects, from published results as well as ongoing projects (Balsberg-Påhlsson, 1992, Hagen-Thorn et al., 2003; Nihlgård et al., 2000, Schlyter et al., 2000; Sonesson, 2000, Sonesson and Stjernquist pers. com.). All samples have been collected in August in accordance with the ICP Forests guidelines for sampling and analysis (Manual part IV). The European database is compiled from scientific studies in 12 countries (Sweden not included) during the same period and follows the European monitoring standards as well. The Swedish and continental European nutrient variation of foliar concentration and foliar nutrient ratios to N were calculated from the data bases and are given as frequency spans. The variation in the European dataset was tested with and without the Level I values included. The results are compared with the classification adopted by the participants of the 3rd Expert Panel meeting in Vienna 1995, see Table 1, (Stefan et al., 1997).

Results and Discussion

Beech stands in Sweden have low foliar element concentration compared to European stands (Fig.1 and 2). The results show that:

- The Swedish spans on foliar concentration of N, P, K, Mg, Cu and Zn are narrower than the European spans. There are, however, no differences at the lower end of the frequency graph. It is noteworthy that high foliar concentrations are persistently not represented in the Swedish beech stand data.
- Nearly half of the continental European beech sites have foliar values of N, Mg and Ca in the highest *class* of the ICP Forest European classification system. The corresponding figure for Sweden is 5-10%. Among the Swedish beech sites, 40% have very low K concentrations.

The major part of the foliar samples collected in the Swedish beech and oak investigations represent local provenances growing on podzols and dystric cambisols. These soils have low pH and a low base saturation, only 24% of the stands have a base saturation in the 20-30 cm above 20% (Sonesson and Anderson, 2001). This condition is due to the fact that most Swedish forests are located on poor till soils and many, further more, affected by leaching of base cations from the root zone owing to soil acidification (Sverdrup and Stjernquist, 2002). Deficiency levels and target values for sustainable forestry, defined as nutrient ratios to N, may, therefore, be lower than the main European thresholds.

The Swedish nutrient ratios to N reflect low but in general balanced nutrient conditions. The only exceptions being Ca/N and Mg/N which show a more narrow span, and lower ratios, than that present in the continental European data (Fig.2). In spite of the nitrogen accumulation in the soil, and soil acidification due to deposition of air pollutants, the growth of beech and oak is sustainable under the current forest management conditions.

European nutrient standards for monitoring sustainable forestry should not be uncritically applied for Sweden. For operative use for monitoring beech vitality in Sweden there is, depending on element, a need for regional adjustments of the nutrient concentrations and ratios.

Figure 1. Frequency graphs of the foliar concentration of N and P in Swedish and European beech and oak stands.

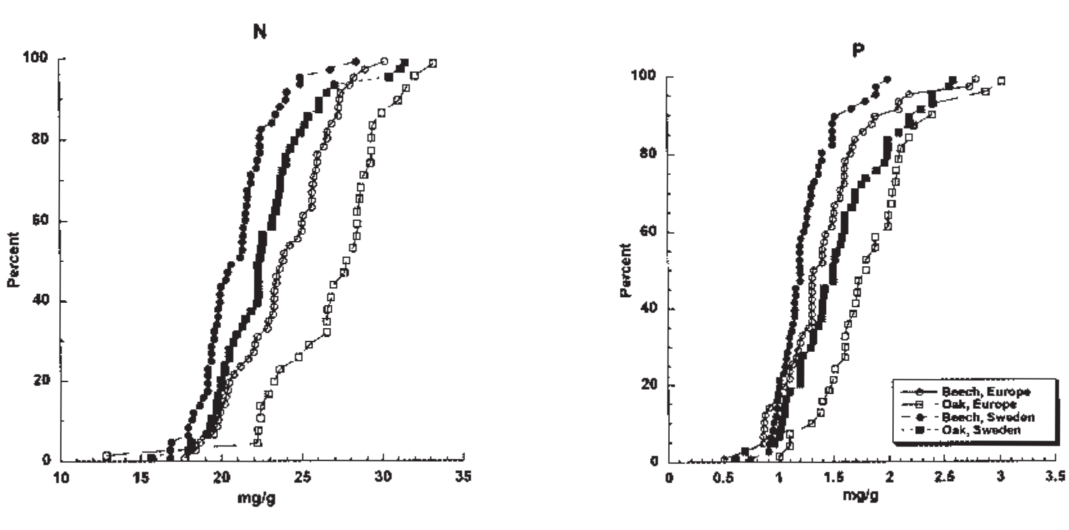

Figure 2. Frequency graphs of the foliar concentration of Ca and the foliar ratio of Ca to N in Swedish and European beech and oak stands.

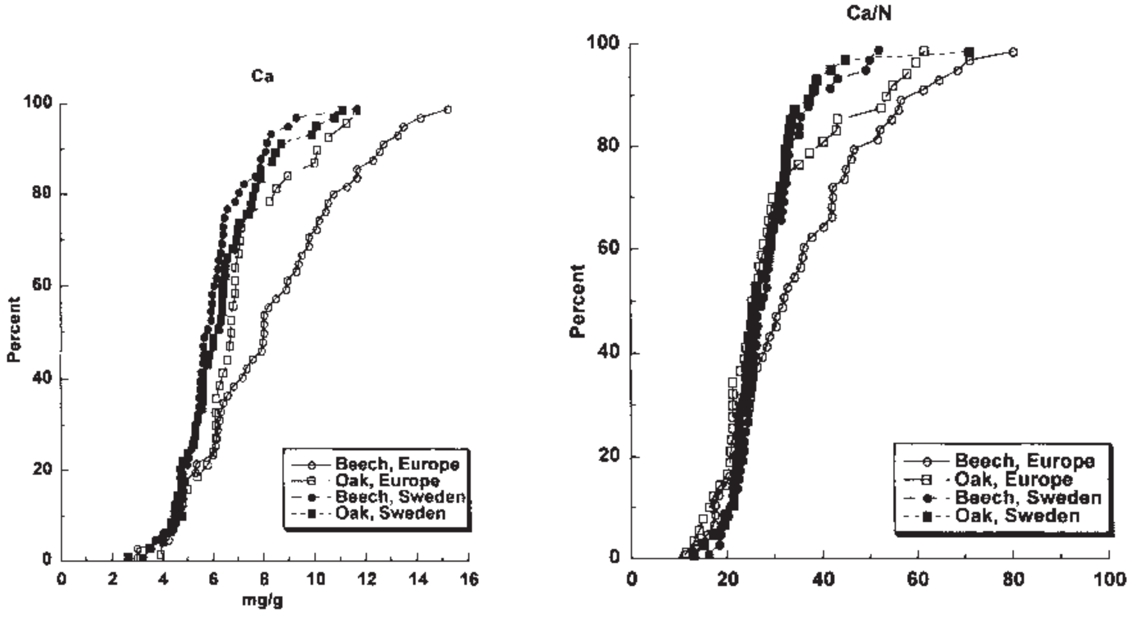

Table 1. The classification values for the evaluation at European level of beech (Stefan el al. 1997).

	Class 1	Class 2	Class 3
N, mg g^{-1}	<18	18-25	>25
Ca, mg g^{-1}	<4	4-8	>8
K, mg g^{-1}	<5	5-10	>10
Mg, mg g^{-1}	<1	1-1.5	>1.5
P, mg g^{-1}	<1	1-1.7	>1.7

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STRESS DIAGNOSIS OF BEECH TREE BY GENOMIC ECOPHYSIOLOGY - A PERSPECTIVE

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Introduction

Stress diagnosis for tree, which is assessment of the environment-growth relationship under complex stress conditions in forest, is important for planning forest management. Forest ecophysiologist has traditionally studied to understand the mechanism of physiological response of trees to environmental changes and looked for useful indicator of stress diagnosis. Although there is numerous insight of the ecophysiology, it is still difficult to simultaneously evaluate physiological status and the environmental factor critically determining the physiological status in forest trees, i.e. the relation of cause and effect in the growth. Thus, the method of stress diagnosis by using ecophysiological techunique is still poor.

Current genomic biology has advanced the better understanding of the molecular mechanism of plant growth in response to environmental stresses, i.e. from reception of environmental stimulation to regulation of morphological and physiological characteristics, by using the analysis of gene expression pattern resulted from mRNA quantification, called transcriptome analysis, in model plants in laboratory. Full length enriched expression sequence tags (FL-ESTs) provides the information of structure and function of genome conprehensivelly. Microarray technique becomes powerful tool to measure the expression of numerous genes at the same time. These are accelerating to screen and understand the various stress-specific gene-expression-pattern regulating morphological and physiological characteristics (Seki et al. 2003). The result of transcriptome analysis must include available gene-expression-pattern to use as indicator of stress diagnosis. Therefore, author hypothesizes that the technique of genomic biology has pottential to become useful method of stress diagnosis for forest trees, if this techunique can apply to ecophysiology of forest tree. At present, the genomic biology has intensibly studied for model plants in laboratory, however the investigation on the performace of transcription in the field-growing plants, which I call "genomic ecophysiology", is poorly carried out.

Here I show that genomic ecophysiology is a promising approach to develop stress diagnosis for forest trees based on current studies on genomics and gene expression for Siebold's beech (*Fagus crenata* Blume) as the following aspects. First, high quality full-length enriched cDNA library was created for the field-growing *F. crenata* leaves and the ESTs resulted that almost of gene expressing in *F. crenata* leaves in field was consistent with the already-known gene in model plants in laboratory. Second, control genes for quantitative RT-PCR were selected. Third, *rbc*S (ribulose-1, 5- bisphosphate carboxylase/oxigenase small subunit gene, a key enzyme of CO_2 assimilation in photosynthesis) and *ACS* (1-aminocyclopropane-1-carboxylate (ACC) synthase gene, a key enzyme of ethylene biosynthesis) genes represented senescence-dependent gene expression pattern in leaf from differing in tree vigor canopy in *F. crenata*, suggesting they are candidate of available indicator for the timing of leaf senescence and tree vigor.

Materials and Methods

cDNA library and ESTs analysis: The studied tree was located in a natural *F. crenata* forest in Kuromatsunai, Hokkaido Island, northern Japan. The plant samples were bud in just before bud break and leaves in whole growing season from the flushing to senescence, 13 times in total. The collected leaves in the three deferent stages of development (May), mature (July) and senescence (September) were subjected to the stress treatments of dehydration, high temperature, chilling, and H_2O_2, NaCl treatments. For dehydration treatment, the collected leaves desiccated in plastic bag with silica-gel under dim light and actual temperature (around 10-20°C). For heating and chilling treatments, leaves were put in plastic tube and incubated in 34°C water and crashed-ice. For H_2O_2 and NaCl treatment, leaves were soaked in 50 ml of aqueous solution of 400 mM NaCl and 200 mM H_2O_2. A 2 mg of total RNA mixture derived from all extracted samples was used for the preparation of poly(A)+RNA. Poly(A)+RNA was isolated, and then the resultant poly (A)+ RNA was used for the construction of the normalized and full-length enriched cDNA library. 5'-end one-pass sequencing of FcFL (*F. crenata* full length) clones was conducted, and functional annotation and functional classification of the Fc FL ESTs were analyzed.

Control genes for quantitative RT-PCR: The quantification of mRNA was used by quantitative real-time reverse transcription polymerase chain reaction (qRT-PCR) technique. For accurate quantification of mRNA transcripts level by qRT-PCR technique, the internal reference gene, which mRNA transcript keeps stable mRNA transcript independently on development and stresses, is needed. We evaluated the stability of candidate reference gene mRNA transcript level to seasonal change and various abiotic stresses; remove of leaf, dry, heat, chilling, hydrogen peroxide, by using GeNome software (Vandesompele et al. Genomebiology, 2002). The gene of aprt (adenine phosphoribosyltransferase), ef1α (elongation factor-1 alpha), EIF1A (putative translation initiation factor eIF-1A-like), GAPDH (Glyceraldehyde-3-phosphate dehydrogenase), TUA (tubulin alpha-2/alpha-4 chain), UBC (Ubiquitin conjugationg enzyme) were examined.

Seasonal changes of rbcS and ACS mRNAs in leaves: The sample trees were located in Kuromatsunai. The apparently vigorous and weakening *F. crenata* trees were investigated (n = 6 in total). The sample size was approximately 6 - 22m. Light saturated photosynthesis rate and mRNA level for *rbs*S and *ACS* genes in leaves were seasonally measured.

Results and Discussion

Full length enriched cDNA library: A normalized and full-length enriched cDNA library of *F. crenata* was generated from field-growing leaves of mature tree crown, from in spring bud to senescence and subjected to environmental stress treatments of dehydration, high salinity, chilling, heat, abscisic acid (ABA), H_2O_2. The pilot analyzes of this cDNA library showed high quality as follows, (1) the average size of inserted clone was 2.00 kbp (n = 96), (2) the percentage of insert was 100% (n = 96), (3) redundancy of gene was 0% (n = 85) and (4) the percentage of full-length cDNA was 100% (n = 10). Therefore, high quality cDNA library was created.

Expression sequence tags (ESTs): There were 3,574 clones (98%) which could be annotated as putative gene with threshold of over 50 % sequence maching, indicating that gene expressing in *F. crenata* leaves in the filed conditions was a mostly consistent with known genes previously studied in model plants. The estimated functions of the genes in the ESTs were numerous, such as photosynthesis, stress tolerance, physiological regulation like hormones, stress-specific-transcriptional factor, which were expected to be useful as genomic indicator for aging, functional acclimation and the critical environments affecting their functional changes. It was concluded that the *F. crenata* ESTs would make it possible to analyze transcriptional performance in *F. crenata* forest tree indicating the response of physiological and morphological characteristics in field. As perspective in near future, this challenge would lead that transcriptome would become powerful methodology for help ecophysiology.

Control genes for quantitative RT-PCR: The ef1α and EIF1A were selected as reference genes for seasonal change, removal of leaf, dry, heat, hydrogen peroxide treatments. As well as, the ef1α and UBC were selected for dry stress, and the aprt and GAPDH were selected for chilling stress, nevertheless the ef1α and EIF1A resulted relatively stable expression. The normalization factor was dependent on the season and the abiotic stress factors. The normalization factor ranged from 0.4 to 2.5. These results indicated that the normalization is important procedure in the quantification of mRNA transcript level for each gene by RT-PCR technique. Our results showed that ef1α and EIF1A were relatively universally available reference gene of *F. crenata* leave from the different season and stresses.

Photosynthesis and gene expression in senescence: In all of trees, the *rbc*S transcript level decreased with aging in seasonal change. The *ACS* transcript level increased in the autumn. The decrease of the *rbc*S transcript level and decrease of the photosynthesis rate were accompanied by increase of *ACS* transcript level. The timing of decreases in the photosynthesis rate and *rbc*S transcript level was earlier in weakening trees than vigorous trees. As well as, the timing of increase in the *ACS* transcript level was earlier in weakening trees than vigorous trees. Thus, *rbc*S and *ACS* gene expression patterns could indicate the timing of leaf senescence and tree vigor.

Concluding remarks: Author demonstrated that the methodology of genomic biology for model plants in laboratory could be applied to *F. crenata* in forest and transcriptome analysis was a promising approach for stress diagnosis. Consequently, the genomic ecophysiology on beech tree must contribute stress diagnosis. Our study is only standing the start point of genomic ecophysiology for *F. crenata*. To realize this methodology of stress diagnosis by transcriptome analysis, numerous studies on genomic ecophysiology is needed.

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LOCALIZATION OF CHEMICAL DEFENSIVE MATERIALS IN LEAVES OF BEECH (*FAGUS CRENATA*) GROWING AT VARIOUS ENVIRONMENTAL CONDITIONS

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Introduction

Forest trees have some defensive traits against herbivore attack. One of them is chemical defense, and broad-leaved tree species include chemical defensive materials, mainly polyphenols in their leaves. Some investigations showed that polyohenols in leaves of forest trees act as chemical defense against herbivores (e.g., Feeny 1970, Matsuki et al. 2004).

Polyphenols are secondary metabolites biosynthesized from photosynthates. Because both growth and defense require photosynthates, trees do not always invest enough photosynthates for their defense against herbivores. According to optimal defense (OD) theory, defensive materials are strategically concentrated in certain regions within a plant to maximize fitness of the plant (McKey 1974, Stamp 2003). Therefore, it is predicted that polyphenols are localized in leaves, in particular, in some organs such as palisade parenchyma and epidermis to protect the photosynthetic organs. However, little information is available about localization of chemical defensive materials including polyphenols in leaves of forest trees.

Beech (*Fagus crenata*) is one of the main broad-leaved tree species in the cool temperate zone of Japan. It has been reported that many herbivores attack beech trees (e.g. Kamata and Igarashi 1996) and that there are both spatial and temporal variations for leaf herbivores within a canopy (Yamasaki and Kikuzawa 2003). However, herbivore attack changes according to the ontogenetic change in beech from seedlings to adult trees.

The objective of this study was to clarify the localization of polyphenols in leaves of beech seedlings, saplings and adult trees. We expected that in various development stages beech trees localize polyphenols in leaves to reduce herbivore attack.

Materials and Methods

We collected the leaves of adult trees, saplings and seedlings of Siebold's beech (*Fagus crenata*) as follows: adult trees were about 50 years-old in the Hiyama Experimental Forest (HEF) of Hokkaido University and both sun and shade leaves were collected. Saplings were 2 years-old planted in the yard of the HEF lodging facility. Current-year seedlings were rooted in the Soebetsu-beech forest of Kuromatsunai-cho. All samples were collected in July 2005.

To observe the localization of defense chemicals, leaves were fixed in 4% glutaraldehyde and then embedded with epoxy resin. Sections of 1 μm were cut using an ultra microtome and observed under a light microscope (Axioskop2 Plus, Carl Zeiss, Jena, Germany) and an ultraviolet (UV) microphotometer (MPM-80, Carl Zeiss, Jena, Germany).

Results

In adult trees, sun leaves were thicker than shade leaves, and mesophyll tissue, in particular, palisade parenchyma were developed (Fig.1a). Polyphenols, such as tannin, were distributed in epidermal cells and palisade parenchyma. On the other hand, shade leaves had poor mesophyll tissues and polyphenols were localized in only epidermal cells (Fig.1b). Cuticle of upper epidermis was developed well in sun leaves.

Leaves of Siebold's beech saplings showed the same result as leaves of adult trees.
In seedlings, both cotyledons and foliage leaves were investigated. In cotyledons, polyphenols were mainly localized in the epidermis of both adaxial and abaxial sides (Fig.2a & b). In foliage leaves, polyphenols were distributed in palisade cells (Fig.2c).

Discussion

Our results showed that there was variation of polyphenol distribution in the leaves of Seibold's beech at various development stages. In adult trees, polyphenols were localized in both epidermis and palisade parenchyma in sun leaves, but in only epidermis in shade leaves (Fig.1). Yamasaki and Kikuzawa (2003) showed that concentrations of total phenolics and condensed tannin in leaves were higher under high light intensity. Although we did not conduct quantitative analysis of polyphenols in leaves, our results by histochemical analyses would support their chemical analyses.

Distribution of polyphenols in leaves of Siebold's beech at various developmental stages revealed that higher light intensity induced more distribution of polyphenols. Abundance of mesophyll tissues might affect their photosynthetic ability, leading to distribution of polyphenols in both epidermis and palisade parenchyma. On the other hand, shade leaves in adult trees, cotyledons and foliage leaves of seedlings grown in forest floor showed the distribution of polyphenols in only epidermis tissues (Fig.1b & Fig.2). Mckey (1974) reviewed that some defensive chemicals, such as alkaloid, accumulated in the epidermis of leaves and stem of various plants. Defensive chemicals, i.e. polyphenols, accumulated in epidermis of leaves in our study would have a role in defense against herbivores.

Our results in this study indicate the possibility that polyphenols would be localized in leaves to protect the important parts of leaves in accordance with OD theory. We need more investigations on localization of polyphenols against herbivores in forest trees.

Acknowledgements

We thank the financial support in part by JSPS (Grant-in-aid) (18658060, 19380089, 20380083).

-- Histochemical photos----------------------------------

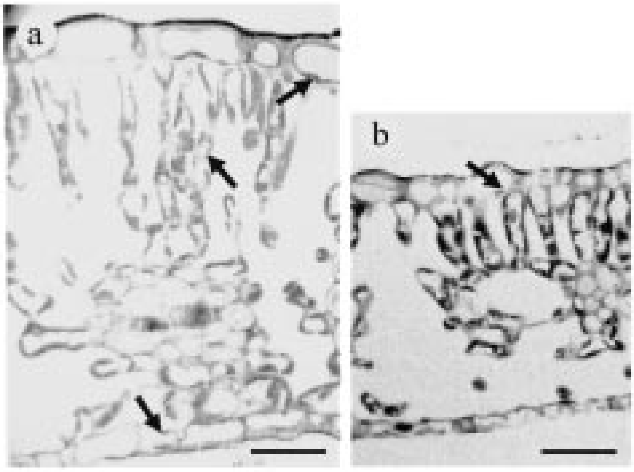

Figure1. distribution of polyphenols in adult leaves of Siebold's beech. a; sun leaves, b; shade leaves. Arrows show phenolic materials. Scale bars = 25 μ m.

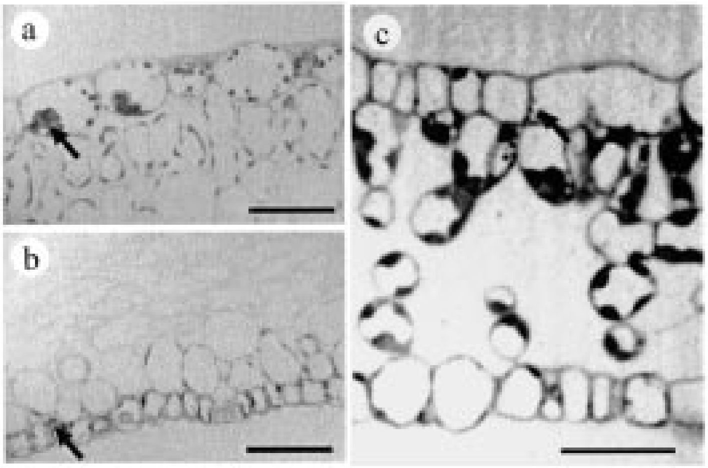

Figure2. distribution of polyphenols in cotyledon and foliage leaves of Siebold's beech seedlings. a; adaxial side of cotyledon, , b;abaxial side of cotyledon, c; foliage leaves of seedlings. Arrows show phenolic materials. Scale bars =50 μ m (a, b) and 25 μ m (c).

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PATHOGENICITY OF TWO FUNGI ISOLATED FROM THE DECAYED SEEDS OF *FAGUS CRENATA* IN JAPAN

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To clarify the seed pathogen causing the decay of *Fagus crenata* seeds in Japan, we isolated the fungi from decayed seeds collected from a natural beech forest in northern Japan and performed an inoculation test with the isolated fungi. Two fungi, *Rhizoctonia* sp. and *Cylindrocarpon* sp., were frequently isolated from the decayed seeds. These 2 fungi decayed the seed tissue in the inoculation test and were reisolated from the decayed tissue. These 2 fungi were also isolated from decayed seeds collected from several *F. crenata* forests in northern Japan. These results suggest that the two fungi are pathogenic to *F. crenata* seeds in beech forests in northern Japan. Frequency of seed decay caused by these fungi was high in litter layer; however, it was low on mineral soil, concrete pavement and wood tips. This suggests that *F. crenata* seeds may be infected with these fungi mainly in litter layer.

A STUDY ON YOUNG BEECH TREE RELEASE IN UNEVEN-AGED STANDS

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Introduction

In uneven-aged stands, foresters often focus on the change in quality and vigour of a few young trees per hectare called "future trees" (7.5cm≤dbh<17.5cm). A central issue is to determine whether a thinning at a given time would be profitable for these trees. For seedlings and saplings, many studies have shown that diameter growth is closely related to light availability (Coates and Burton 1999 ; Wright et al. 1998 ; Pacala et al. 1994). For these small development stages, relevant indicators of vigour, such as the living crown ratio (Messier and Nikinmaa 2000 ; Poorter and Werger 1999), the plagiotropy of branches (Cao 2001 ; Cao and Okhubo 1998), the slenderness (Peters, 1997), and the crown projection area (Ricard et al. 2003 ; Poorter and Werger, 1999; Sterck et al. 1999), already exist. Nevertheless, light availability for trees appears difficult to evaluate in uneven-aged stands and the validity of the indicators has not yet been clearly assessed for later developmental stages. Finally, most studies do not take into account the quality features of the trees (epicormic shoots, straightness). Actually, current decisions are very often empirical.

In 2006 the French Forest Service (ONF) and the National Research Institute of Agronomy (INRA) began a study in several uneven-aged mixed stands (i) to define morphotypes of small beech trees for the northern part of France and (ii) to release these morphotypes by local thinning to determine their potential reactivity. Here, we present the methodology used to build morphotypes and to release trees in the experiments.

Building morphotypes

We selected 832 trees (7.5cm≤dbh<17.5cm) located in 11 uneven-aged in the northern part of France. These managed forests (two private forests and nine public forests) are dominated by oak (*Quecus petraea*, *Quercus robur*) and beech (*Fagus sylvatica*) species. Common ash, hornbeam, silver birch, silver fir, trembling aspen and wild service species are also present but to a lesser extent. An important set of measurements were taken on each selected tree: girth, height, height of the first four living branches (also angles of the branches), crown base height, number of epicormic shoots and branches (4m), straightness (4m), crown projection area, number of forks, height of the first fork. Data were studied through ACP (Ward distance method) and hierarchical classification analysis using SPAD software to define homogeneous morphotypes (with raw and calculated variables). We determined eight morphotypes according to four main variables (figure 1): living crown ratio (indicator of vigour), relative length between the first living branch and the crown base height (called the under-crown ratio, an indicator of an on-going self-pruning), the presence of epicormic branches in the first 4m bole height (indicator of a past stress), and the relative height of the first fork (indicator of a past vigour). Some allometric relationships were also built using non-linear models (see fig 2.).

Tree release: exemple of the Grand-Poiremont private forest (Franche-Comté)

In the Grand Poiremont mixed oak-beech forest, eight to ten trees per morphotype were selected on a 12 ha plot (a total of 74 trees). The next step consisted in setting up permanent plots centered on selected trees. The radius of the plots is constant and equals 12 meters which is consistent with other studies dealing with competition in complex stands (Canham et al. 2004). In plots, all the azimuths and distances of competitive trees (dbh>7.5cm) were measured. Poles smaller than 7.5cm and bigger than 2.5cm in diameter were just counted. Competitive trees were then ranked according to a competitive index, i.e. the ratio between their diameter at breast height and their distance to the selected tree (Canham et al. 2004; Zhao et al. 2006). This competitive index has the advantage of being mathematically simple and easy to use in the field. However, its major drawback is to give too much importance to large trees. We then defined the following simple rules to determine competitive trees to be cut in half of the plots (other plots are kept as controls): (i) the three or four most competitive trees according to the competition index based on diameters and distances and (ii) all the trees with diameter inferior to 32,5cm but whose crown overlaps the crown of the selected tree.

The following additional measurements were taken on each selected tree: a count of all epicormic buds, shoots and branches (4m), the straightness of the trunk using a tacheometer. Moreover, we performed terrestrial laser scanner images near selected trees in order to better characterise their environment and their branchiness.

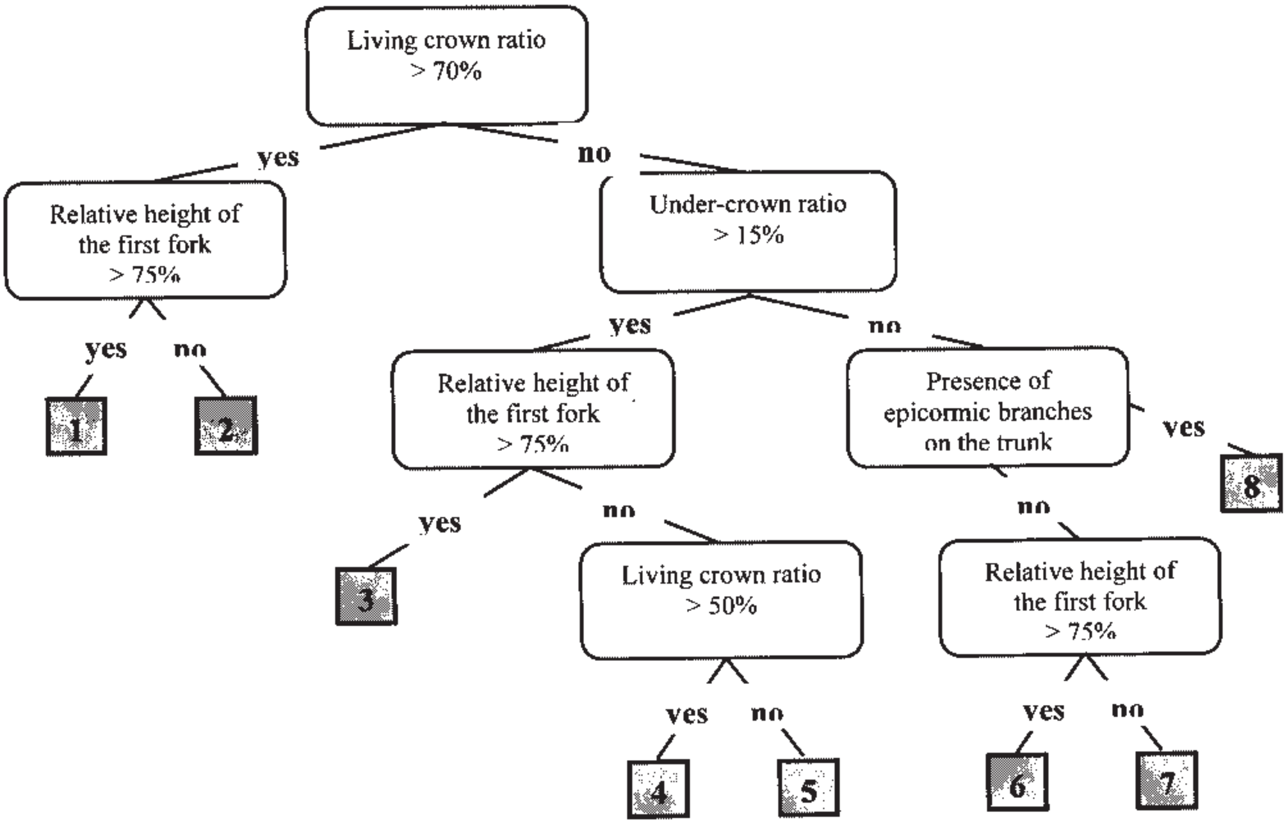

Figure 1: morphotypes of small beech trees (7.5cm<dbh<17.5cm) in 11 uneven-aged forests in the northern part of France

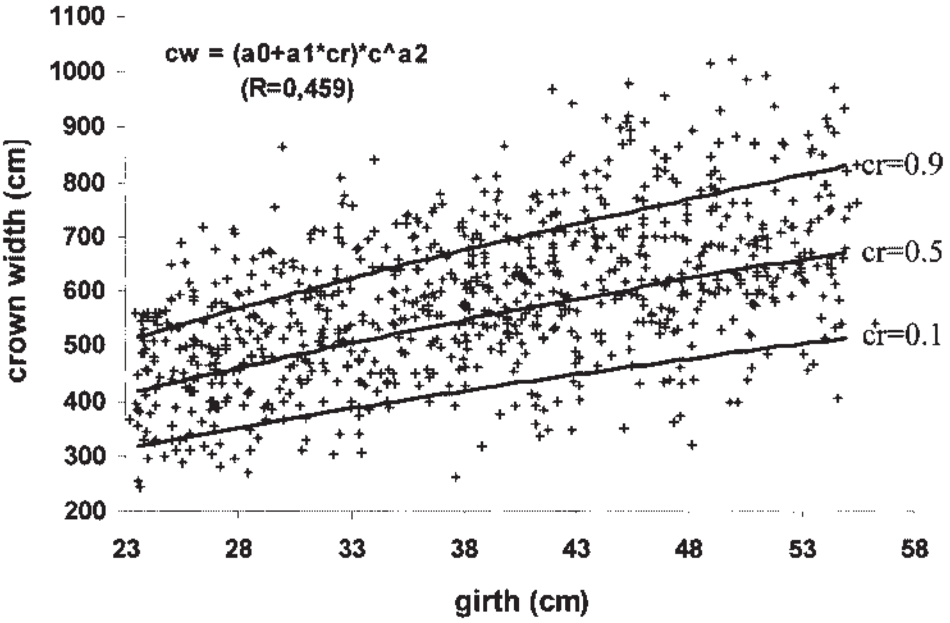

Figure 2 : relationship between crown width (cw), girth (c)and living crown ratio (cr).

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GROWTH RESPONSE OF BEECH (*FAGUS CRENATA*) SEEDLINGS TO LIGHT GRADIENTS NEAR EDGE IN A BEECH SECONDARY FOREST

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Introduction

Beech forms seedling banks in natural forests because of its high shade tolerance (Nakashizuka 1983). Forest edge is located between open space and canopy closure, of which light condition varies gradually into inside forest. The light intensity near forest edge changes due to latitude, aspect and inclination (Messier 1996). If favorable range for maintaining beech seedling bank is demonstrated in forest edge, seedlings can be maintaied with nursery plant size for several years.

Japanese forest has high density of forest roads and, threfore, has a lot of forest edges along them. We can utilize the forest edges for nursery site under controling light condition naturally.

The aim of this study is 1) to investigate the effects of the aspect of forest edge and the distance from a forest edge on light gradients and growth of beech seedlings, 2) to demonstrate the favorable range for beech nursery site in beech secondary forest.

Materials and Methods

Study was conducted at two secondary beech forests in Niigata, central Japan. Two hundreds and forty one seedlings of two-year-old were dug out from four forest edges into inside the forests within 25 meter in differnt four aspects. The seedlings were measured for stem length and dry weights(W) of their roots, stems and leaves. T/R ratio ($(W_{\mathrm{stem}}+W_{\mathrm{leaf}})\ W_{\mathrm{root}}^{-1}$)and C/F ratio ($W_{\mathrm{stem}}\ W_{\mathrm{leaf}}^{-1}$) were calculated from those weights. More than seven hemispherical photographs were taken along the sampling sites. Light intensities, namely relative photosynthetic photon flux density (RPPFD) were measured with WINPHOT (National Herbarium Nederland).

Spearman correlation coefficients were used to determine the significance of an association between the distance and stem length on each aspect. On stem length, T/R ratio and C/F ratio, overall differences between the aspect groups were determined by one-way ANOVA and post-hoc multiple comparisons were made by using Tukey's and Games-Howell test.

Results and Discussion

RPPFD decreased markedly approximately to five meter points from forest edge in each aspect, whereas over five meter points into inside the forest similar values of RPPFD were shown in common with every aspects (Fig.1). From 5 to 20 meter from the edges, statistically significant ($P<0.05$) correlations were not observed between stem length and RPPFD, and also between stem length and the distance from the edges on every aspects(Fig.2). This means that distance from forest edge and light intensity don't have marked effects on the height growth of two years old beech seedlings within the range.

Growth funtions of all seedlings sampled in each aspect showed that seedlings growing in north edge have unique growth characteristic in comparison with other aspects. The average stem length and C/F ratio of the seedlings in the north aspect was significantly highest (Fig.3).

The average stem length of east, west and south aspects were significantly small, and the average T/R ratio on west was significantly high (Fig.3). These showed that significant differences of characteristic are not observed among the seedlings in east, south and north but in west.

Seedlings sampled from north aspect edge have good growth characteristics although a little direct sun light arrive into there.

Some possible reason could be shown followings.

1) Diffuse light is more important than direct sun light for beech seedlings (Messier 1996).
2) Soil water is more usuful for early spring growth in beech seedlings because evaporation of snow by solar radiation is slow on north aspect.
3) Air humidity is high and more dew remains on the soil surface.

These light and water condition at the north aspect edge would be usuful for shade tolerance of beech seedlings. These effective environmental quality, therefore, contributes to be formed seedling banks.

Conclusion

We demonstrated that beech seedlings were kept constant range of stem lengths within the distance of 5 to 20 meter from the edge and the aspect of edge have significant effects on growth function. North aspect edge is suitable to control seedling heigher with good growth form. The edges toward east and south would be controled their growth lower also with good growth form. These seedlings are maintained as suitable nursery size in the forest edge.

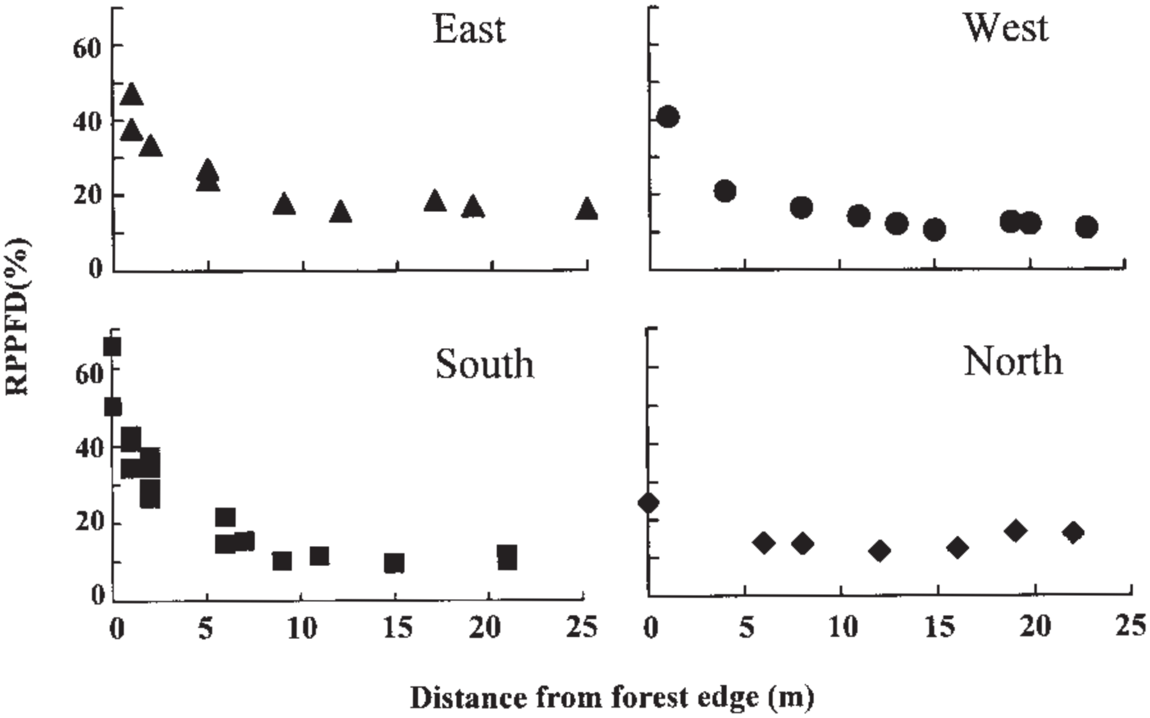

Figure 1: Changing patterns of RPPFD on the distance from forest edge in the four different aspects of forest edges.

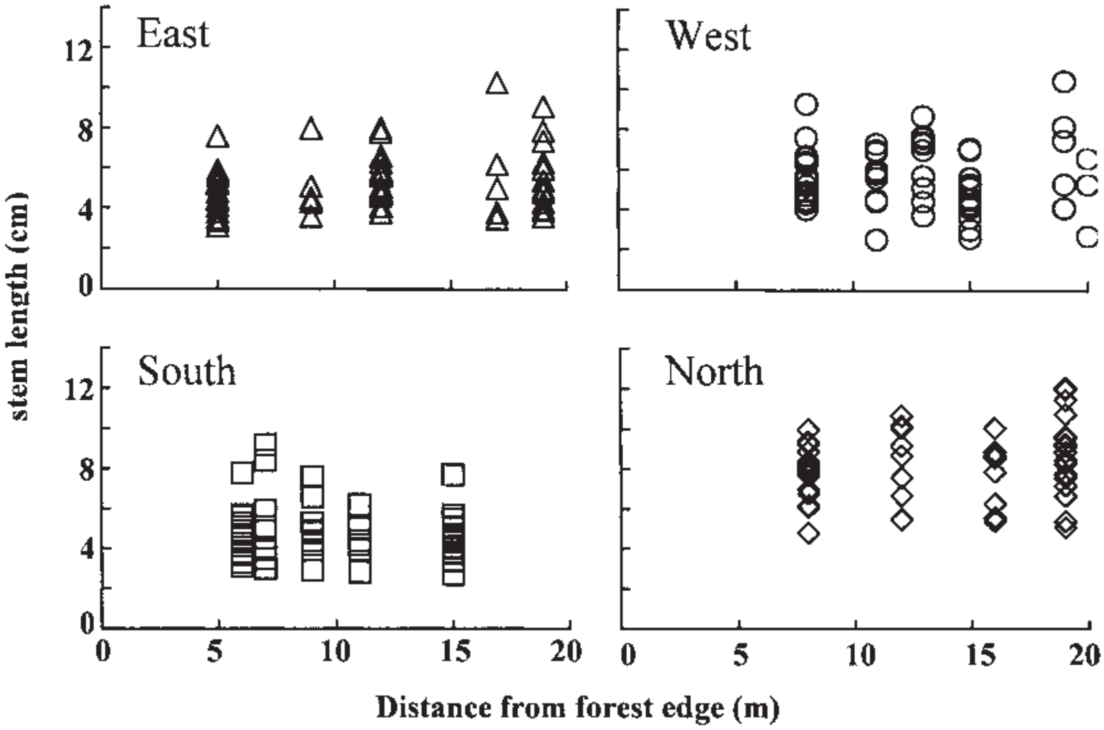

Figure 2: Changing patterns of stem length on the distance from forest edge in the four different aspects of forest edges.

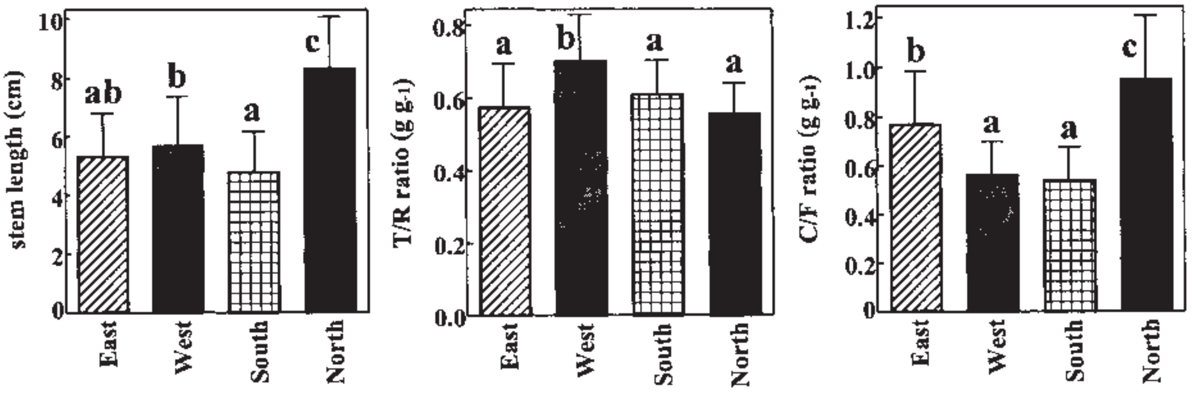

Figure 3: Difference of growth funtions of all seedlings sampled in each aspect were determined by one-way ANOVA on stem length, T/R ratio and C/F ratio.

Post-hoc multiple comparisons were made by using Tukey's and Games-Howell test.

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SUSTAINABLE FOREST MANAGEMENT BY INTRODUCING BEECH (*FAGUS SYLVATICA* L.) INTO SPRUCE MONOCULTURES (*PICEA ABIES* (L.) KARST.)

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Introduction

Most of the mountainous areas in Germany are covered with monocultures of spruce. Reintroduction of broadleaved species, mostly European beech, is of interest in order to increase the potential of a multiple use of future forests. Two issues are covered by different studies: Rising biodiversity by more complex habitat structures and supplying highly-valuable beech wood sustainably.

Materials and Methods

Approximately 80% of areas in Hochharz National Park (51°44‘57“N, 10°28‘32“E, 600-650 m a.s.l.) consisting of Norway spruce (*Picea abies*) and proportion of deciduous trees comprehends only 20%. Eight old European beech (*Fagus sylvatica*) trees were used for regeneration measurements to get information about spatial distribution of beech regeneration as a result of zoochore seed dispersal. Therefore all positions for saplings and regenerated plants were measured with laser technology (LEHDA-GEO) up to distances of 150 m around seed trees.

Model

For modelling spatial distribution of beech regeneration we used the statistical tool 'WALDSTAT' developed by Näther and Wälder (2003). The Log-normal function was utilised as density function after Batschelet (1981) for calculating spatial distribution of beech regeneration (see Figure 1). This function is defined by parameters μ and σ. The ratio between real and reference dbh (dbh_{ref}) is integrated into the function as parameter β. As dbh_{ref} for further calculations the mean dbh of European beech trees at study site ($dbh_{\bar{x}} = dbh_{ref} = 0.63$ m) was used. The distance from old beech tree is defined by r to a point of known regeneration density with Cartesian coordinates x and y. Between predominantly barochorous and zoochorous dispersal mechanisms we defined a boundary of 20 m from seed source. Estimations for 'Long-Distance Dispersal' (LDD, Cain et al. 2000) were done by calculating ratio of Log-normal distribution integral functions.

Results and Discussion

The results of estimation with 'WaldStat' show for distributions predominantly caused by zoochory (> 20 m) that regeneration density decreases relatively fast until distances of 80 m from source.

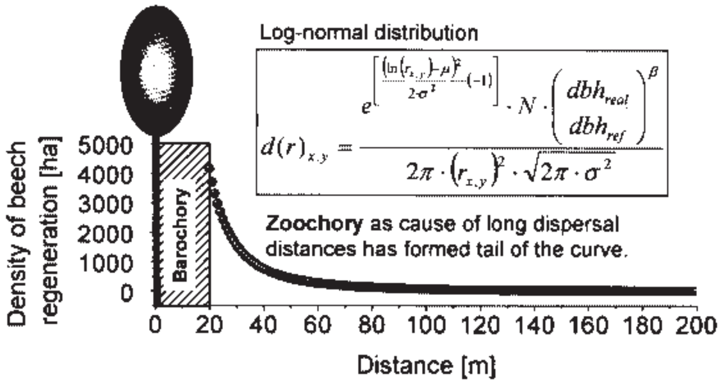

Figure 1: Distance dependent results of regeneration density estimated with Log-normal distribution

Furthermore run of the curve follows the abscissa almost parallel. Therefore as one result we can see from LDD modelling (Table 1) that in distances of 240 m only 5 regenerated beeches can be found per hectare. From this it follows that in a circle of 200 m around seed source 98% of natural regenerated beeches are located.

Table 1: Estimated absolute and relative densities of regenerated beeches with regard to different distances from source

distance from source [m]	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**
number of regenerated plants [ha]	1536	269	91	42	22	13	9	5
relative proportion [%]	46.7	83.2	91.9	95.3	96.9	97.9	98.4	98.8

This small proportion of regenerated beeches, which is located in distances far away from seed source, was established without necessity of anthropogenic input. Connecting results with main objectives of management strategies in national park systems of Germany old beeches can be seen as initial sources for establishing spatial networks of beeches covering large areas (Wagner, 2007).

Materials and Methods

On sites in Northrhine-Westphalia, Germany, (51° 25' N; 8° 15' E; 350-550 m.a.s.l., mean precipitation per year 1000 mm, mean temperature per year 6 °C) mature spruce stands underplanted with beech trees aged 15-20 years and no precommercial thinnings have been selected. In stands with regeneration of homogeneous density, rectangular plots have been established; inhomogeneously stocked ones have been investigated by a systematic circular plot design with a grid of 6 x 8m. Shelter density above each young tree has been rated in 3 categories, growing space has been derived from the amount of beeches per plot and ranged from 0.8 till 3 m^2 per plant, sociological classes (1-5), stem forms (a-not sweeped, b-slightly sweeped, c-heavily sweeped) and crown forms (1-monocorm type, 2-branched monocorm, 3-steeply branched, 4-forked, 5-completely deformed) have been also assessed. Target tree quality has been merged into 4 categories: "very good" coded 1 (1a, 2a, 1b, 2b), "good" coded 2 (1c, 2c, 3a, 3b), "forked" coded 3 (4a, 4b) and "insufficient" coded 4 (5a, 5b, 5c, 4c, 3c) (Leonhardt & Wagner 2006).

Model

In order to describe relations between target tree quality, shelter density, spacing (main effects), proportion of upper sociological classes per covariate pattern (confounder), the odds of a tree of belonging to a certain outcome (Y=1) has been modelled. Because of the categorical dependent variable, binary logistic regressions have been performed for consecutive splits q4_123, q34_12 and q234_1 with backward elimination methods (O'Connell (2006); Hosmer & Lemeshow (2000)).
From these single regressions, validity and proportionality in the odds have been assessed in order to check if assumptions for a proportional odds model (equation 1) are met.

[1] $P(Y \leq j \mid X) = EXP(\hat{}\alpha_j - \hat{}\beta X)/(1+ EXP(\hat{}\alpha_j - \hat{}\beta X))$

Results and Discussion

Out of N=991 beeches, 715 target trees have been selected representing the upper sociological classes and showing no damage. Backward elimination revealed that the 2-way-interaction shelter*spacing and the proportion of upper sociological classes per covariate pattern were not significant. Binary models were valid an showed parallel odds. Results for the proportional odds model are presented in figure 2; parameters were all significant with p=0.000:

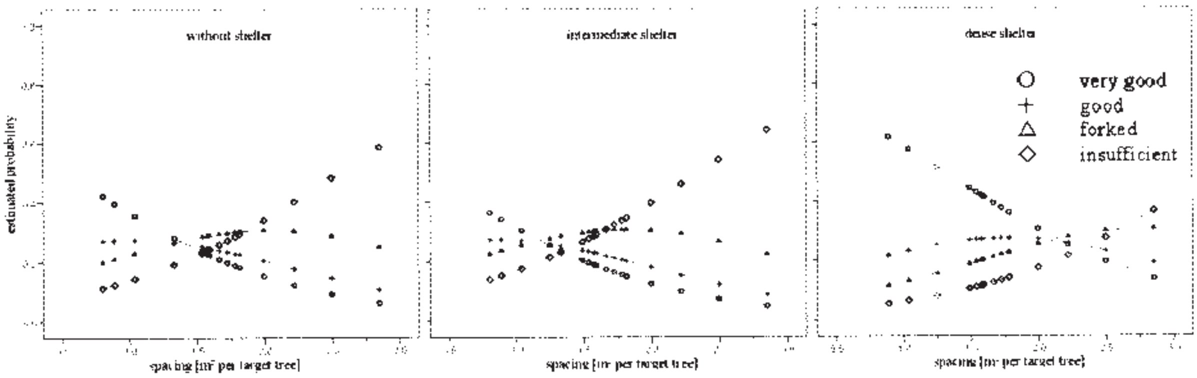

Figure 2: estimated probability of quality classes with intercept thresholds $\alpha1=1.52$, $\alpha2=2.65$, $\alpha3=3.91$ for $\hat{}\beta = 0.9 * shelt1 + 1.14 * shelt2 + 1.18 * spac$

For beeches without or with an intermediate shelter, at a maximum value of 1.5 m² growing space corresponding to 6,600 plants ha^{-1}, it is more likely for a young beech tree to show a good quality. Under dense shelter conditions, approx. 2.2 m² or 4,500 plants ha^{-1} are needed at minimum in order to produce trees of a good quality. Moreover, the probability proportion of such well-formed beeches does most increase with regeneration density at high shelter density conditions.

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VARIATIONS OF WOODY SPECIES DIVERSITY AFTER SINGLE SELECTION METHOD PERFORMANCE

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Introduction

Modern silvicultural practices stress forest management that combines timber harvesting and biodiversity preservation (Mitchell *et al.*, 2002). Traditional even-aged silvicultural approaches usually lead to homogeneous forests (Mitchell *et al.*, 2002), while it is assumed that natural disturbances create heterogeneity, influencing the variety and diversity of forest species (Palik *et al.*,2002). Management that mirrors natural disturbances is being recommended to sustain biodiversity (Harvey *et al.*, 2002). This type of management can increase heterogeneity in forested areas (Klinka *et al.*, 1985), leading to an array of different environmental situations, even in initially homogeneous areas, which in turn will bring changes in vegetation.

Hyrcanian vegetation zone is a green belt stretching over the northern slopes of Alborz mountain ranges and covers the southern coasts of Caspian Sea. *Fagus orientalis* and *Carpinus betulus* stands are the most abundant in these forests (Sagheb-Talebi, 2004) and have been managed in a sustainable, low impact way by single selection silvicultural system in the last decade (Mohajer, 2005). This allows for natural regeneration and mimics the opening of small- to medium-size gaps by natural small-scale disturbances, including tree fall. Gap creation affects the species diversity of the forest, and the plant species found in the gaps vary according to the size and quality of the gaps (Nakashizuka, 1989; Abe *et al.*, 1995).

The object of the study was to explore the effect of single selection silvicultural system on woody species diversity in the mixed forests of *Fagus orientalis* and *Carpinus betulus.*

Materials and Methods

This study was being carried out in a part of Janbesara district in Guilan province (located in northern Iran) with total area ca. 650 ha between 500 to 900 meters altitude. The average annual rainfall is 1542 mm, the annual mean temperature is 15.7c, the average maximum temperature in the hottest month (July) is 30.3c and the coldest month (January, February) is 2.5c during a year. The soil type of district consists of brown acidic, brown forest, humus and psoudoglay which have average drain situation. The study area is covered by natural deciduous hardwood forests which *Fagus orientalis* and *Carpinus betulus* are the main species. These forests had been under single selection silvicultural method during 1993-2003 (Forest, range and Watershed management Organization of Iran, 2003).

The study area was sampled by randomized-systematic method with 200×150 network dimensions in the first and last year of the 10-year period (1993-2003). At each sample, Shrubs and trees species were recorded in circle shape plots with 1000 m^2.

Species richness was calculated as the average number of species per sample. Shannon and Simpson indices were applied to quantify diversity and equitability of samples of different recognized communities.

T test was used to test whether there were significant differences in the species richness, diversity and evenness indices in both sampling.

Results and Discussion

As shown in figure1, Species Richness (A) ,Shannon evenness(B), Shannon Diversity(C) and Simpson diversity(D) indices of woody species in the mixed forests of *Fagus orientalis* and *Carpinus betulus* a little bit increased after single selection performance but the differences were not significantly different($P<0.01$). Sebastia *et al.* (2005) showed that the plant diversity in managed forests by selection silvicultural treatment were more diverse than pristine forests. Species composition showed the greatest difference 4–5 years after even-age and uneven-age harvests (Metzger and Schultz, 1984). Inappropriate forest management has caused a destruction of most of the forest stands, and, sometimes, even the destruction of their habitats (Kwiatkowska, 1994).Successive changes in the vegetation following clear cutting have been also reported in many forests (Malik *et* al., 1997). The effects of the shelterwood logging system on species diversity are relatively weaker than with other forms of management, such as clear cutting and plantations (Nagaike *et al.,* 1999). In summary, our results suggest that low impact management by single selection system mimicking natural disturbances enhances or preserves plant diversity in Caspian mixed forests.

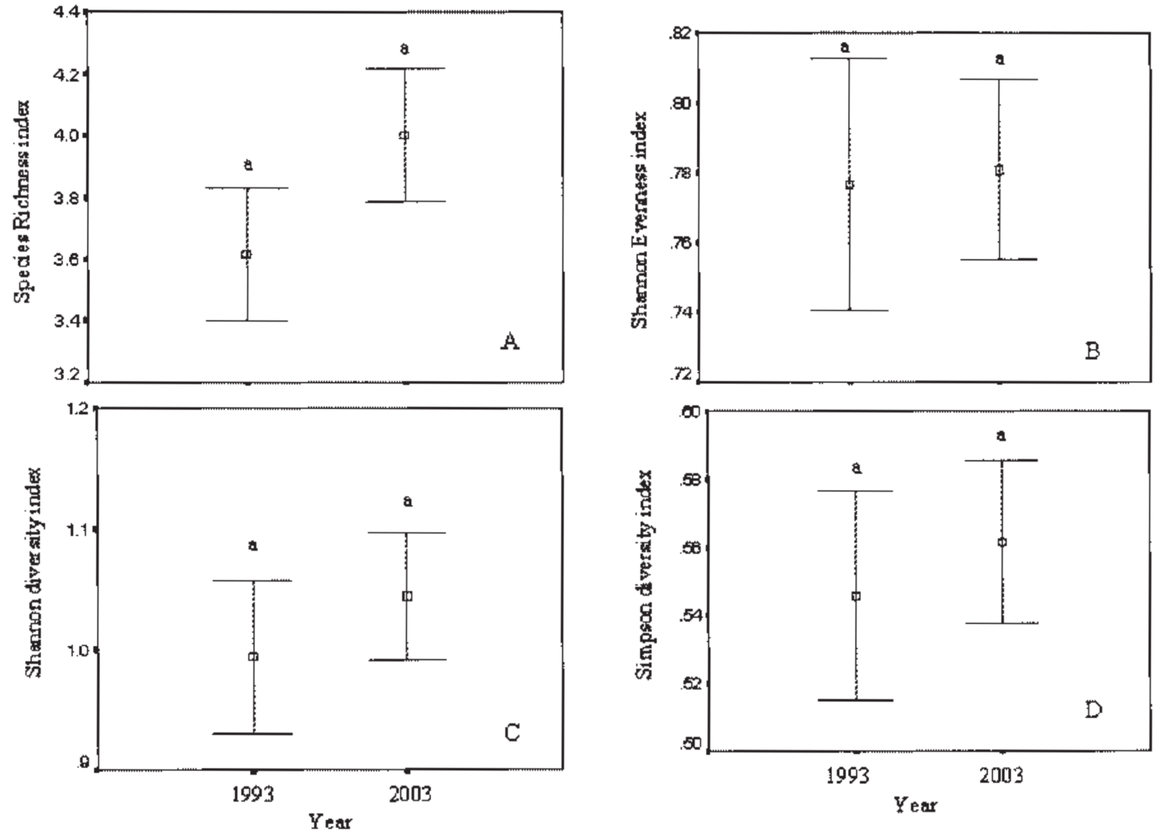

Figure1: Mean and interval of Species Richness (A), Shannon evenness(B), Shannon Diversity (C) and Simpson diversity (D) indices in 1993 and 2003. Significant differences are depicted by different letter.

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INVESTIGATION ON STRUCTURE OF PURE AND MIXED ORIENTAL BEECH STANDS OF NORTHERN IRAN

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Introduction

Frequency distribution (tree number, basal area ...) is the representative of many important information about forest situation and environmental factors. These factors are reflected by forest structure, has several usage in forest management, silviculture and determining how to treat forest stands. The structure as a variable is described by frequency data of tree number, basal area, etc. Mixed and pure beech stands (*Fagus orientals* Lipsky) of the Caspian region cover 17.5 percent of surface and 30 percent of volume in northern forests of Iran. Group selection system has been introduced for application in these uneven-aged high forests (Sagheb-Talebi and Schuetz, 2002, Marvie Mohajer, 2005). In order to use the selection system successfully, a close survey of the structure and growth conditions is absolutely essential (Schuetz, 1997). According to the studies of Leibundgut (1993) and Korpel (1995) in Slovakian virgin natural beech forests believed for investigation of forest structure, to need 3-6 plots and every plot with 0.5 -1 ha area. Fallah (2000) recommended in his studies on natural beech forests of northern Iran, that sample plots with an area of 0.75 ha could be sufficient to study stand structure.

The aim of this study was to determine the natural structure in pure and mixed oriental beech stands in order to select suitable silviculture system.

Materials and Methods

Typical examples of pure and mixed oriental beech (*Fagus orientalis* Lipsky) forests were selected in the Mazandaran Province of northern Iran, Neka-Zalemroud region. In order to study the structure of beech stands, two main sample plots, each covering 4 ha, were laid out in pure and mixed natural beech stands at each site. These were then divided into two division (2 ha), into four subdivisions (1 ha), into eight plots (0.5 ha) and into sixteen subplots (0.25 ha).The stadied sample plots were located between 1080 and 1220 m.a.s.l., with north and northwest direction and 11 to 25% of slope gradient. All standing trees with a diamater at breast hight (d.b.h) more than 7.5cm recorded, and height and canopy measurements were taken to allow the vertical and horizontal profiles of the stands. The pure beech stand was composed of 91 percent beech and 9 percent other broadleaved trees, whereas the mixed stand was consisted of 70 percent beech and 30 percent other broadleaved species. Stand data in each main plot (pure and mixed) is presented in table1. Data analysis was carried out by using of SPSS and Excel soft wares.

Results and Discussion

The results showed that in both stands of the sample 0.25 and 0.5 ha plots, the distribution of sample number per diameter class was heterogeneous but the general view of the curves showed an even-aged structure (Fig.1-a, b).

However, at a larger scale, 1 ha plots and above, showed an uneven-aged pattern and irregular distribution of trees (Fig.1-c). In the 2 ha sample plots, the frequency distribution of stem numbers displayed a noticeably uneven-aged structure (Fig.1-d). This was due to the fact that several even-aged groups of trees existed beside each other. The same trend was observed in the 4 ha sample plos. To examine the structure of the stands, data from the 1 ha plots were used. The results showed that the stem number and basal area per hectare, and consequently the volume of the mixed stand were higher than in the pure stand. In the pure stand, the total basal area was 31.8 m^2, while in the mixed stand it was 41 m^2 (Table 1). Beech accounted for more than 80 percent of basal area and volume of the pure stand, whereas the proportion of basal area and volume of beech in the mixed stand was slightly more than 50 percent. The percentage of number of stems and tree volume for different tree sizes is shown in Table 2. The percentage of number of stems per hectare for large timber in the pure and mixed stands was only 32 per cent and 17 per cent, respectively; this accounted for 86.6 per cent and 69.4 per cent of the total volume per hectare (Table 2). In oder words, larger timer made up more than two thirds of total volume. Results indicated that some sample plots showed regular even–aged structure in 0.25 ha. With increasing of study area, the structure changes to uneven-aged. Further more, our investigation showed that the least area that irregular uneven–aged structure coud be recognized is 0.5 ha area at mixed beech stand, whereas this structure could be more observed in one ha area at pure beech stands.

Table 1: Quantitative characteristics of studied pure and mixed beech stands (data from 1 ha plot)

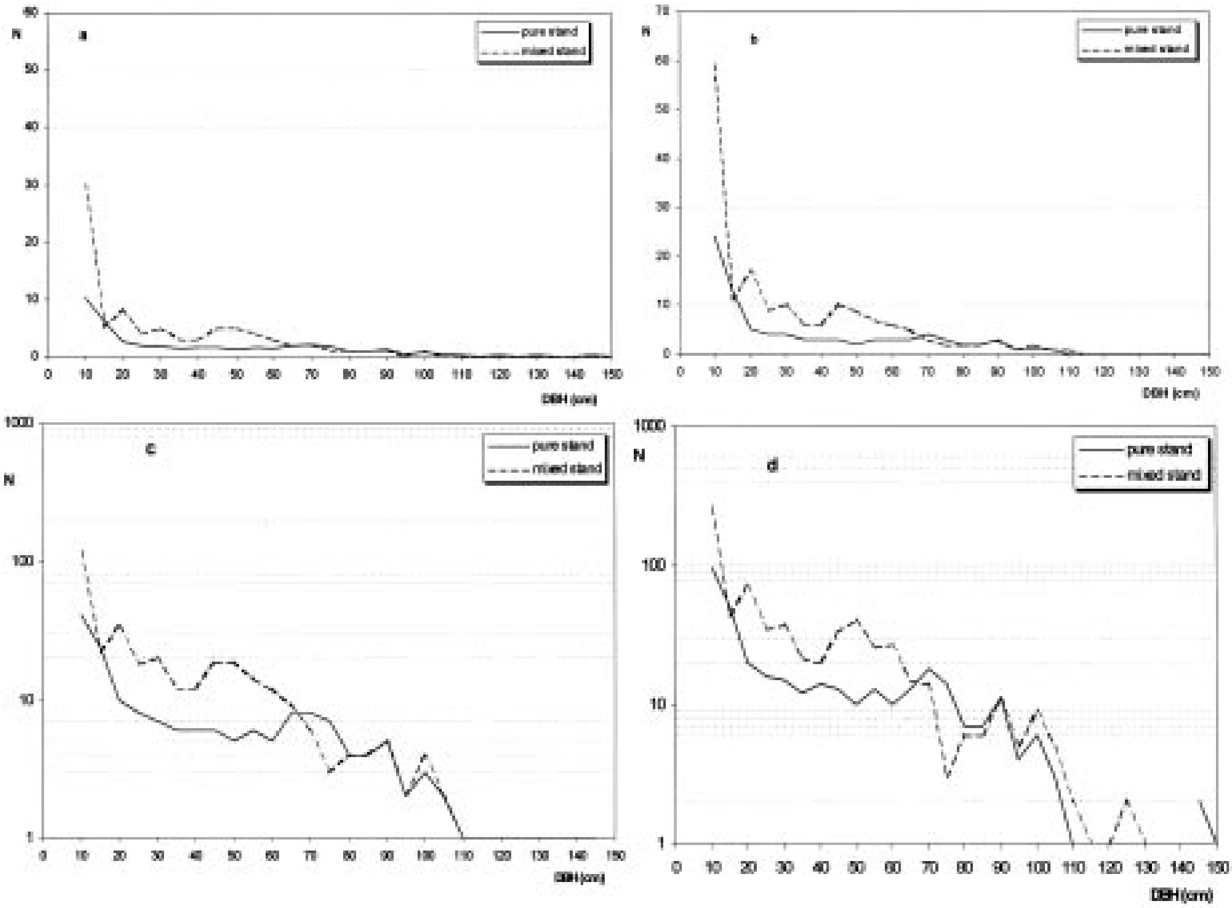
Stand	N/ha	Basal area (m^2/ha)					Volume (m^3/ha)				
		Beech		Other spp.			Beech		Other spp.		
		B.a*	(%)	B.a*	(%)	Total	Vol.+	(%)	Vol.+	(%)	Total
Pure	167	26.9	84.6	4.9	15.4	31.8	406.5	84.2	77.1	15.8	483.6
Mixed	336	21.6	52.7	19.4	47.3	41.0	316.6	52.5	286.5	47.5	603.1

* B.a = basal area
$^+$ vol. = volume.

Table 2: Frequency of stem number (n) and tree volume (m^3) for different timber sizes in the studied stands (data from 1 ha plot)

	Timber size (pure stand)				Timber size (mixed stand)			
	Small < 30 cm	Medium 35-50 cm	Large > 55 cm	Total	Small < 30 cm	Medium 35-50 cm	Large > 55 cm	Total
Number	89.0	24.0	54.0	167	220.0	59.0	57.0	336
Percent (%)	53.3	14.4	32.3	100	65.5	17.5	17.0	100
Volume	20.2	44.5	418.9	483.6	59.2	125.3	418.6	603.1
Percent (%)	4.2	9.2	86.6	100	9.8	20.8	69.4	100

Figure 1: Frequency distribution of stems in (a) 0.25 ha, (b) 0.5 ha, (c) 1 ha and (d) 2 ha in the studied pure and mixed beech stands.



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EFECTS OF LANDSLIDE ON COMMUNITY STRUCTURE IN A JAPANESE BEECH FOREST

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Introduction

In forest communities, natural disturbance has an important role in determining the structure, dynamics and species diversity. Although there are a variety of disturbances, research on natural disturbance in temperate forests has concentrated mostly on the occurrence of tree fall gaps and their effects on the plant community. Relatively fewer studies have been conducted to reveal the effects of large disturbance, particularly for landslides (Veblen and Ashton 1978; Guariguata1990; Dalling and Tanner 1995).

In the large area of beech dominated forests in north temperate region of Japan, landslide occurrences may be relatively common on forested slope due to particular geometric and climatic factors. Interactions among shallow, heavy-textured soils, weak rock types, and highly dissected topography with steep slopes generate landslide-prone zones over the large area (Guariguata1990; Geertsema and Pojar 2007).

The objective of the present study is to reveal the effects of landslide on the forest community structure in an old-growth beech dominated forest. We compared the species composition, size structure and demographic parameters (recruitment, mortality and growth rate) of dominant tree species between a landslide stand and an adjacent control stand.

Methods

Study site

The study was carried out in an old-growth forest (780 m in altitude) of Ippitsu Reserves area on Mt. Kunimi (38° 49' 2N, 140° 45' E and 718 m in altitude) in Miyagi Prefecture, northeastern Japan. There is little evidence of human disturbance in the study area. We set a 1-ha permanent plot (100 m × 100 m), which include both a landslide stand (0.29ha) and a stable (control) stand (0.71ha).

Field data

To obtain data for demographic variables and spatial distribution for all the trees, shrubs and vines, all stems with DBH $\geq$ 3 cm were marked and the location were determined in August 1994, and censuses of the DBH of all the surviving stems and newly recruited stems with DBH $\geq$ 3 cm was repeated in August 1999. All recorded deaths were classified into standing dead, uprooting and disappearing.

The species observed in this study plot were classified to early- or late-succesional status according to Seiwa and Kikuzawa (1991, 1996).

Results

Species composition

The proportion of the species of early- vs. late -successional status was not different between control (early:15.4% vs. late: 84.6%) and landslide stand (early: 18.2% vs. late: 81.8%).

Basal area

In control stand, basal area (m^2ha^{-1}) was greatest in *Fagus crenata*, and decreased in the order, *Quercus mongolica* var. *grosseserrata, Castanea crenata*, and the three dominant species occupied 72.2 % of the total basal area. In landslide stand, basal area was greatest in *Q. m. grosseserrata*, and decreased in the order, *Carpinus laxifolia, C. crenata, F. crenata*, and the four dominant species occupied 76.0 % of the total basal area. In each of the three late-successional species, *F. crenata, Acer mono* and *Aescurus turbinata*, the proportion of the basal area to total basal area was lower in landslide than control stands, whereas the reverse was true for two early-successional species, *C. laxiflora* and *Alnus hirsuta.*

Size structure

Tree density (DBH $\geq$ 3cm) was greater in landslide (1704 ha^{-1}) than control stand (1276 ha^{-1}). When comparing the frequency distribution of DBH, greater number of individuals was observed in small size classes (DBH < 33cm) but not in large size classes (DBH $\geq$33 cm) in landslide compared to control stand. In particular, largest individuals (DBH $\geq$ 48 cm) were very few in landslide stand. In two early-successional species, *C. laxiflora* and *A. hirsuta,* the density was greater in landslide than control in most of the size classes (Kolmogolv-Smirnov test, $P<0.05$), whereas most of the late-successional species showed very few individuals in large size classes in landslide compared to control stand.

Causes of death

In control stand, mortality rate was highest in the smallest size class of DBH, and decreased with increasing the DBH. In contrast, the mortality rate increased with increasing the DBH in landslide stand. In both stands, standing dead was largest proportion of the dead trees during 5 years studied. Second largest was stem breakage and uprooting in control and landslide stands, respectively. In land slide stand, proportion of dead trees caused by uprooting increased with increasing the DBH, suggesting that landslide continuously kills the trees probably due to the cutting of the main roots.

Discussion

This study clearly showed that landslide strongly reduced the relative abundance of the dominant late-succesional tree, *F. crenata*, but increased the abundance of early-successional species, *C. laxiflora* and *Alnus hirsuta*. In landslide stand, large mass movement would remove the trees, particularly for large individuals of several late-successional tree species. Such great disturbance in both canopy and soil levels, therefore, may promote the establishment of small-seeded early-successional species.

In Japanese beech forests, relative abundance of *F. crenata* is usually very high, and the juveniles succeedingly regenerated even under canopy of other late-successional tree species (Tomita et al. 2002; Tomita and Seiwa 2004). The results of this study strongly suggest that landslide is one of the most important and effective disturbances in changing community structure in beech dominated forests in Japan.

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EFFECT OF MANAGEMENT ON FOREST CARBON BUDGET: A MODELLING STUDY ON VIRGIN AND MANAGED SLOVENIAN BEECH STANDS

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Introduction

Forest ecosystems play a dominant role in controlling terrestrial carbon sinks (Janssens et al., 2003). In order to predict more accurately the response of the carbon balance of forest ecosystems to atmospheric and climate change, the effect of management needs to be more clearly understood. Thornton et al. (2002) had analysed the effects of disturbance history on carbon budgets in evergreen needle-leaf forests. Their results suggested that there was a consistent pattern of early carbon source followed by strong and gradually diminishing sink during recovery from a major disturbance.

Carbon stocking in virgin forests were few investigated in temperate climate (Knohl et al., 2003). In their review, Hyvönen et al. (2007) found that unmanaged stands were either close to neutral or weak carbon sinks. Hollinger et al. (1994) used the eddy-correlation technique to investigate the exchange of CO_2 between an undisturbed old-growth forest and the atmosphere. But they neither gave annual estimate of fluxes nor assess of carbon stocks in soil or wood. More recently, Knohl et al., (2003), found that a virgin beech forest was a large carbon sink over 2 years, with 494 $g_C m^{-2}$ per year in 2000 and 490$g_C m^{-2}$ per year in 2001.

One way to study the effects of management on carbon fluxes is to compare carbon fluxes by modelling or eddy flux measurements on several sites following various management modes or other types of disturbance (Thornton et al., 2002). Another solution is to use process based models and simulates the effect of various modes of thinning (Loustau et al., 2005). The purpose of this study was to compare two beech ecosystems in similar conditions but with different management modes (old unmanaged forest and a managed forest) using both measurements and modelling. The first objective was to assess by the comparison of the two sites the effect of management both on stock and carbon fluxes. The second objective was to provide an estimation of the carbon fluxes in a virgin forest, which are few studied in European countries.

Material and Methods

The sites

The virgin and managed silver-fir–beech forests investigated are located in the northern part of the Dinaric Alps in SE Slovenia (45°20N, 14°30E, 860–890 m). The bedrock is Cretaceous limestone and the soil generally shallow (leptosolic). The climate of the region is typical of Dinaric mountains, with annual precipitation up to 1,500 mm and a mean annual air temperature of 8.4°C. The Rajhenavski Rog virgin forest was officially declared as a virgin forest in the first forest management plan of the area in 1894, but is more precisely defined as a secondary virgin forest.

CASTANEA model and measurements

CASTANEA is a physiological process-based model simulating the carbon and the water balance in forest stands. The canopy is assumed to be homogeneous horizontally and is vertically subdivided into a variable number of layers (i.e. multi-layer canopy model). The main simulated output variables are the canopy photosynthesis, maintenance and growth respiration, growth of organs, soil heterotrophic respiration, transpiration, and evapotranspiration.

The radiation extinction and diffusion are based on the SAIL model. Half-hourly rates of gross canopy photosynthesis are calculated based on Farquhar et al. (1980) coupled with a stomatal conductance model of Ball et al. (1987). Maintenance respiration depends on temperature and nitrogen content of the various organs (Ryan, 1991), while growth respiration depends on biochemical composition of organs. After subtraction of maintenance respiration requirements, the remaining assimilates are allocated to the growth of various plant tissues using a priority rule, which varies with the season. The heterotrophic respiration is calculated using a Soil Organic Carbon (SOC) model (Epron et al., 2001) derived from CENTURY (Parton et al., 1987). Phenological stages (budburst, end of leaf growth, and start of leaf yellowing) and leaf growth depend on degree days (i.e. heat amount accumulated). The big-leaf Penman-Monteith equation is used to calculate both transpiration (Tr) and evaporation (EP). The soil water balance is calculated using a bucket model with three layers. During water stress periods, the slope of the relationship between leaf assimilation and stomata conductance (g_1) is assumed to decrease. Complete description and validation of the model were given in Dufrêne et al. (2005).

In the two sites, in 2005 and 2006, measurements of soil extractable water, leaf photosynthesis, and stand carbon biomass (soil and aboveground) were used to calibrate the model. Soil water content, soil respiration and tree ring increment were used to validate the model.

Results and Discussion

The model was applied from 1997 to 2006 to estimate the various carbon fluxes in the two ecosystems: canopy photosynthesis, autotrophic and heterotrophic respirations, wood growth and Net Ecosystem Exchange. The CASTANEA model reproduced the soil water dynamics in 2005 and 2006 both in managed and virgin forest. Stand growth simulated in managed and virgin forest, were compared to tree ring increment measured in the managed forest from 1997 to 2006 (Fig. 1). The canopy photosynthesis was found globally high compared to others studies, respectively 2040 g_C m^{-2} y^{-1} in the virgin forest and 1960 g_C m^{-2} y^{-1} in the managed forest. The higher photosynthesis in the virgin forest (Fig. 2) was counterbalanced by a much higher heterotrophic respiration (+14%), due to higher soil carbon content and a higher wood respiration (+11%) caused by the regeneration. The result is that the managed forest showed a higher stock (+2%: 56 vs 55 t_C m^{-2}), but a lower flux of carbon (-60%: 132 vs 211 g_C m^{-2} y^{-1}).

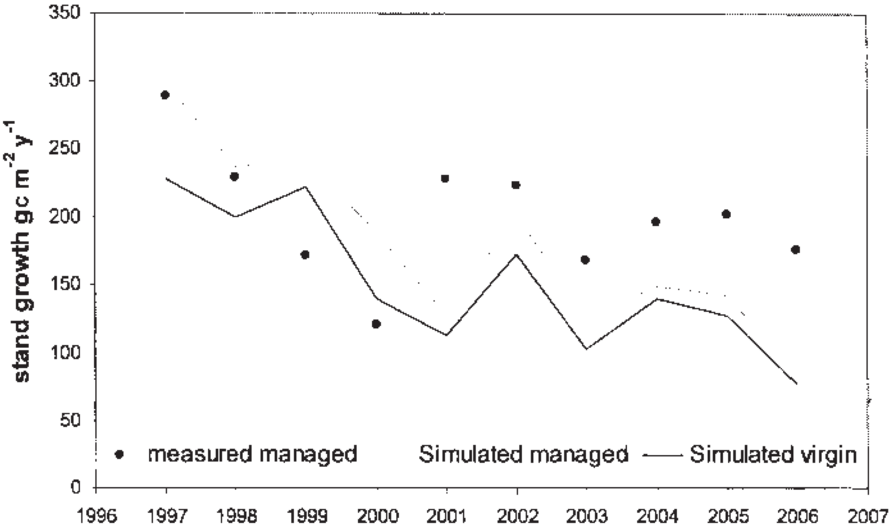

Figure 1: Stand growth from 1997 to 2006 measured from tree ring increment and simulated by CASTANEA in managed forest and simulated in virgin forest.

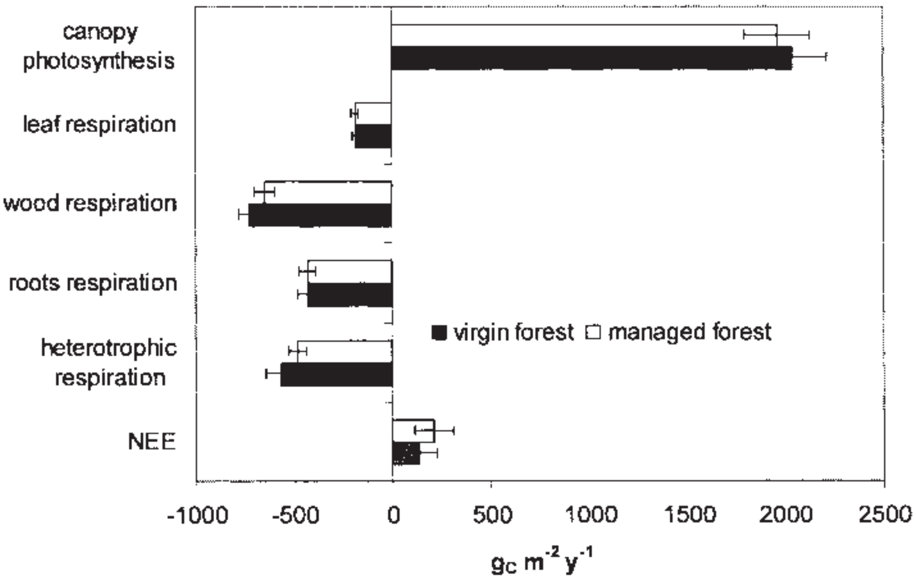

Figure 2: Summarize of average annual carbon fluxes simulated by CASTANEA from 1997 to 2006 in virgin and managed forests.

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CURRENT STATE OF EUROPEAN BEECH (*FAGUS SYLVATICA* L.) GENE-POOL IN THE CZECH REPUBLIC

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Introduction

Current state of European beech (*Fagus sylvatica* L.) gene-pool in the Czech Republic is presented in this paper. There are mentioned information about this species both horizontal and vertical occurrence, together with information about its actual representation in forest stands, plant communities, including information concerning site conditions. Information about current status of this species forestry research and other specific information are included, too.

European beech distribution in the Czech Republic

European beech is distributed nearly around all the Czech Republic area, with centre in mesophyticum and oreophyticum. Just small distribution of European beech is registered in thermophyticum, hereat in the regions having been utilised for agriculture this species is missing. European beech is the most important broadleaved species in the Czech Republic, from economical point of view. Its occurrence is registered ca from 300 m to 1 000 metres above sea level, mainly from supracollinus level to mountainous level, rarely on northern slopes especially on limestone in collinus level. According to BURIÁNEK (2004), centre of European beech occurrence is referred to be in beech forest vegetation level, where this species had composed pure stands, in the past. In lower localities, where European beech composes mixtures with oak, this species growths mostly in northern slopes or on inversion sites with higher soil humidity. European beech is not growing in floodplain forests. As for higher elevations, there European beech growths in mixture stands with Norway spruce and with silver fir, eventually.

Characteristics and forest management

European beech wood used to often be characterized by false heart. Therefore, this is possible to obtain valuable assortments just from higher parts of stem, remaining parts used to be processed to be used as firewood or cellulose (ÚRADNÍČEK et al. 2001).

In the Czech Republic, as for current legislative rules, there is valid Forest Law No. 289/1995 Sb. in its full version, together with all its executive decrees, market with forest tree species reproductive material is modified by Law No. 149/2003 Sb. in its full version, together with its executive decree No. 139/2004 Sb.

As for current state of forest tree species reproductive sources in the Czech Republic, there have been registered following reproductive material sources to 15. 12. 2006 (MUSIL et al. 2006):

Category of European beech reproductive material identified sources = 18 094,16 ha,

Category of European beech reproductive material selected sources – certified stands of phenotype class A = 3 317,68 ha,

Category of European beech reproductive material selected sources – certified stands of phenotype class B = 13 433 ha,

Category of European beech reproductive material qualified sources – 278 elite trees (clones), Category of European beech reproductive material qualified sources – 8 seed orchards.

European beech gene pool preservation and conservation

As for treatments aimed to European beech valuable gene pool preservation and conservation, there have been certified 106 European beech genetic conservation units, in the Czech Republic, until current time.

In the Czech Republic, European beech composition has decreased from original 40.2% to current 6.7%, in consequence of forest management in last 200 years (*Report about forest state and management of the Czech Republic in 2006*). However, within forest stands a regeneration European beech composition increase, which is also reflected in higher portion of this species in species composition (Tab. 1). Mean age of beech forest stands has also grown (71 years in 2006), which implies total aging of European beech population in the Czech Republic. Concerning future supposed increasing of European beech in the Czech Republic forests (as perspective 18%), it is evident that it will be necessary pay attention to another artificial regeneration of this species, in the course of its increased natural regeneration utilization, as well. Origin of reproductive material to be used in frame of European beech artificial regeneration will have to meet requirements of all connected valid national and international legislative rules about reproductive material zoning (NOVOTNÝ 2006).

Table. 1 – European beech composition in the Czech Republic forest stands

	1950	1970	1980	1990	2000	2006
%	4.5	5.0	5.3	5.4	6.0	6.7
ha	102 243	129 158	135 988	140 130	154 791	174 858

Report about forest state and management of the Czech Republic in 2006.

Forest research

During 35 years of European beech provenance research in the Czech Republic, it has already been succeeded numerous valuable findings concerning height growth characteristics of various origin partial populations in various site conditions of research provenance plots, having been established and examined, till now. These research provenance plots are of long-term character, when importance and consideration of obtained results used to be higher, in connection with research plots age increasing.

As for current research projects presenting background for both current and another possibilities for realization of research aimed to solution of European beech problems in the Czech Republic, FGMRI Jíloviště-Strnady, Department of Forest Tree Biology and Breeding, has been solving the national research project QF4025 "Applications of the results of the European beech (*Fagus sylvatica* L.) genetically conditioned variability verifying for the gene resources protection and reproduction and for this species increasing in the forest stands of the Czech Republic" financed by the Ministry of Agriculture of the Czech Republic through the National Agency for Agricultural Research. This project solution started in 1st February 2004 and finished in 31st December 2007.

The main purpose of the project was the realization of breeding measures, directed to the protection and reproduction of European beech gene resources and the contribution to creation of the presuppositions for the saving and increasing of this species proportion in the Czech Republic forest stands. The provenance plots series 1972, 1984, 1995 and 1998 evaluation provides the next information about the beech variability, mainly about viability and about the production potential of individual beech populations. This acquires will be used to streamlining of seed harvesting from the certified forest stands and for the seed zoning purposes. The positively verified partial populations have been used as the material source for the auto vegetative propagation with the aim of the set of trees specially grown for taking of cuttings establishing. The most actual findings from provenance research of European beech are mentioned e.g. in reports of ŠINDELÁŘ (2005), NOVOTNÝ (2006), NOVOTNÝ et al. (2007). Another possibility for continuation and extension of research activities aimed to solution of European beech problems in the Czech Republic represent current activities of beginning international research project COST Action E52 "Evaluation of Beech Genetic Resources for Sustainable Forestry".

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GROWTH OF THE COEFFICIENT FOR NET WOOD MATERIAL UTILIZATION IN OUR COUNTRY, NECESSITY FOR FORESTS CONSERVATION

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Introduction

The survey of gross details productivity from beech logs has a special importance, because it has to do with rational utilization of wood, reduction of damages, technological wastes as well as further increase of wood usage coefficient (Aranda, I.; Gil, L.; Pardos, J.A 2000).

Today in our country, there are different enterprises that produce gross details from the beech tree (Dimoshi, S.; Rjepaj, B. 1971). These details are produced with different size both in length and in wideness.

Gross details have two production qualities (Kalo, M.; Marjani, Dh. 1983):

- the first quality includes only the white wood of beech tree, without, red heart wood of beech, knot, gaps and cracks, rot and worm holes.
- the second quality includes white wood of beech tree and red heart wood of beech, without knot, gaps and cracks, rot and worm holes.

Based on that the sale price of beech gross details in humid state will be designated:

- The first quality about 400 $/m^3
- The second quality about 340 $/m^3

Except that mentioned above, the aim of the study of gross details productivity from beech logs stands as following:

- To show the disadvantages that exists in the technology of production, which have a negative impact on gross details productivity.
- To be inspected, factors of the productivity of sawed material depends on, as well as the factor of gross details productivity, their impact measure, and this factor to be improved in order to provide high yields.
- The wastes that result from sawing of sawed material in gross details, to be decreased

Material and Methods

For the designation of gross details productivity from beech trees, the following measurements are conducted: log measurements, measure of sawed material from trees, gross details measure, furring measure, piece measure, sawdust measure and final balance.

The measure of trees was conducted with a special care, especially in designation of tree medium diameter. We did four measurements to a tree, two of them vertical and we have taken their average in the thick head. During the measurement, it has been taken into account that the place designated to this purpose, must be without defects, and with the measurement results, it has been removed the husk from the husky trees. The measurements were conducted in five different days in October 2004.

The measurement of sawed material which results from trees was broke into pieces, where the length, wideness and thickness measures were recorded

Desks from bans saw were produced non-equipped, semi-equipped, and equipped with thickening 55mm. The wideness of non-equipped and semi-equipped desks was designated as an average of the amount of two sides measured between the lengths without counting the bark.

Detail were produced with the same wideness 65mm, whereas the length of produced details was 550mm, 800mm, 850mm, 900mm, 950mm and 1000mm, as larger market requests.

For the designation of ship volume and other wastes from log sawing, the weighing method was used.

Results and Discussion

In the company Sanida gross details productivity is 33.95% low.

This is related to the following factors:

- Supply with raw material is desirable.
- Log protection is not done with any method
- The processing accuracy in machinery is desirable; especially the accuracy of log sawing in desks is low.
- Logs are cut in different diameters.
- The pressure given to the tines of sawmill is higher than recommended from 0.6-0.7mm and it should be 0.3-0.4mm.

For the improvement of gross details productivity from logs and sawed material these methods must be followed:

- Supply with beech log according to the standards.
- To be created the conditions for log protection.
- Logs must be separated in diametric category and its sawing must be done according to cutting models.
- Cutting model with beech logs should take into account that the defects to be included in a very limited number of desks.
- Pressure must be in accordance with standards.

Conclusions

From the analyses done to gross details and measurements performed, it comes to the following conclusions:

- The mid gross details productivity from sawmill beech logs is low.
- In Sanida company is 33.95%, whereas the medium specific consume is 2.94m^3 logs for 1m^3 gross details.
- Logs with larger diameter gives a productivity from 2% higher gross details than those with smaller diameter.
- Logs shall be sawed without sectioning in diametric groups which would impact the specific consume and gross details productivity.
- It must be created the conditions for preservation of logs, protecting them from harm of mushrooms and insects.
- To be provided the bases of supply with beech logs with a good quality, without decays and wormholes, without cracks, without declination and without any damages.
- To be careful with logs delivery, by performing accuracy measures of their diameters.
- To have a special care in maintaining the cutting means, through sharpening, tension, in order to reduce loses of gross details.

From the view of gross details productivity results that 66.05% of logs turn to wastes, such as ships, furring, different pieces and sawdust. A part of these wastes should be processed in order to produce gross details for other destination, for instance: chair components. This is because of the fact that ships and furring comprise the best part of the wood (bruise), which is much required in the market. The usage of these wastes in gross details with other destination and with measure, section and length lower than those of scales, would increase the details productivity from logs.

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LATITUDINAL DIFFERENT IMPACTS OF DIFFERENT FEEDING TYPES OF HERBIVORE INSECTS ON BEECH CANOPIES

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Introduction

Herbivory is generally reported to be higher in the tropics than at temperate latitudes (Coley and Barone 1996). Coley and co-authors suggest that the more favorable climatic conditions in the tropics throughout the year allow insect herbivores to feed constantly, compared to temperate latitudes. However, this generalization is based on literature compilations that used variety of methodologies and plant species. To assess leaf herbivory along a latitudinal gradient, we should use standardized methods for comparison from north to south in order to reduce many of the confounding effects.

In Japan, it has been recognized in *Fagus crenata* that there is a geographic cline in which leaf size gradually decreases from north to south populations (Hagiwara 1977). Some of leaf traits are thought to determine various herbivore characteristics such as feeding preference, performance, and diversity (Feeny 1970). For example, carbon-based secondary metabolites (e.g. condensed tannin and total phenolics) are considered to work as an inhibitor of digestion for herbivores (Rhoades and Cates 1976). Tougher leaves are better physical defended against herbivores (Coley 1983). In contrast, nitrogen is the basic structure material and high nitrogen in leaves means better food value for herbivores (Schoonhoven et al. 1998). Therefore, we expect that latitudinal difference in herbivory would occur due to difference in leaf traits. To determine different impacts of different feeding types of herbivore insects (chewers, miners, and gallers) along a latitudinal gradient, our census conducted two standardized methods (direct observation using scaffolding systems and canopy knockdown) in the south and north sites of Japan.

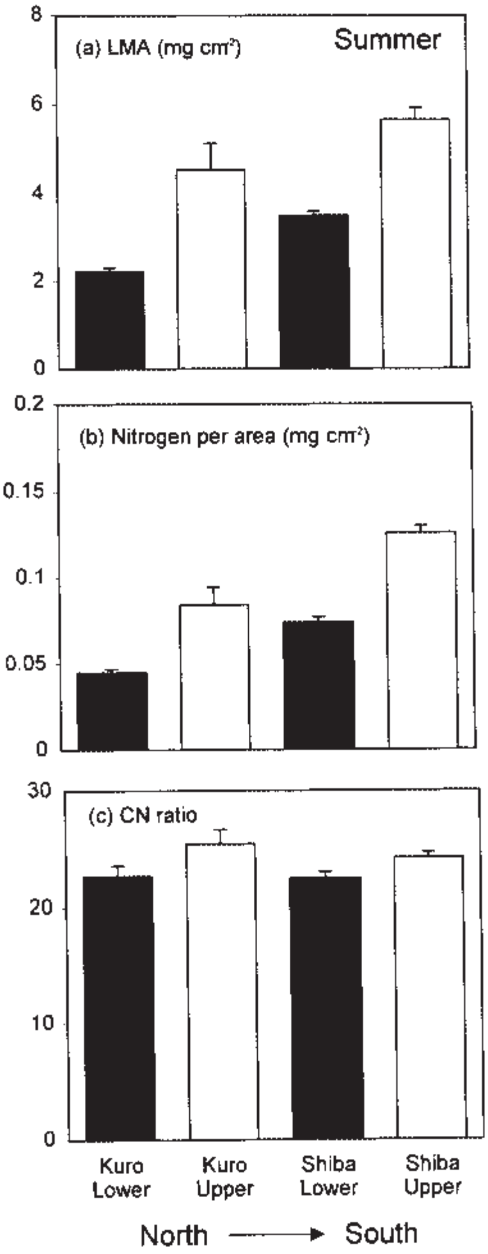

Fig. 1 (a) LMA, (b) nitrogen, and (c) CN ratio of leaves on lower and upper canopies at north and south sites in summer. Mean and SE are presented.

Materials and Methods

In 2005, scaffolding systems (length = 6m, width = 6m, height = 12-18m), constructed by steel pipes and steps at Kuromatsunai (42 39'N, north site) and Shiba (32 28'N, south site). These systems were built around trees of *Fagus crenata* to gain access to the canopy. We can gain access to seven and four canopy trees at south and north sites, respectively.

In 2007, we randomly selected from five to ten branches on each different part (upper and lower parts) within a canopy on each tree. To assess the variation in leaf traits that may be associated with herbivores, we sampled a leaf having least herbivory (less than 10% leaf loss) on each branch. We measured mean leaf mass per area (LMA), concentration of nitrogen, and CN ratio in leaves. The carbon-nutrient (CNB) hypothesis suggests that the increase in CN ratio means the increase in carbon-based secondary metabolites (Bryant et al. 1983). Also, we directly observed three major feeding types of herbivore insects: one externally feeding types (chewing herbivory) and two internal (miners and gallers). We assessed such feeding types from each different part (upper and lower parts) within a canopy. These censuses for leaf traits and herbivory conducted in May (spring) and August (summer) at south and north sites.

In 2008, to determine latitudinal difference in chewer abundance on beech canopy, we conducted canopy knockdown in May (spring) and September (summer) at the above sites. On each site, we sprayed with pyrethrum-water solution using a fogger at two plots. Fallen arthropods were collected using 20 collecting trays (80 mm diam.).

Results and Discussion

Leaf traits: Not only leaf size but also other leaf traits changed with latitude. In spring, LMA and CN ratio increased but nitrogen content decreased from north to south. However, there were small differences between north and south. In summer, LMA and nitrogen content increased from north to south (Fig. 1). These LMA and nitrogen content in summer had larger differences between north and south than those in spring. This result implies that the latitudinal difference in leaf traits become greater with the approaching to summer. However, CN ratio did not changed with latitude.

Insect herbivory: Different feeding types of herbivore insects have different responses to latitude. In spring, miner and galler density increased from north to south although these densities were very small. On the other hand, in summer, chewing herbivory decreased but gall density increased from north to south (Fig. 2). The differences between north and south were greater in summer than those in spring. However, miner density did not changed with latitude.

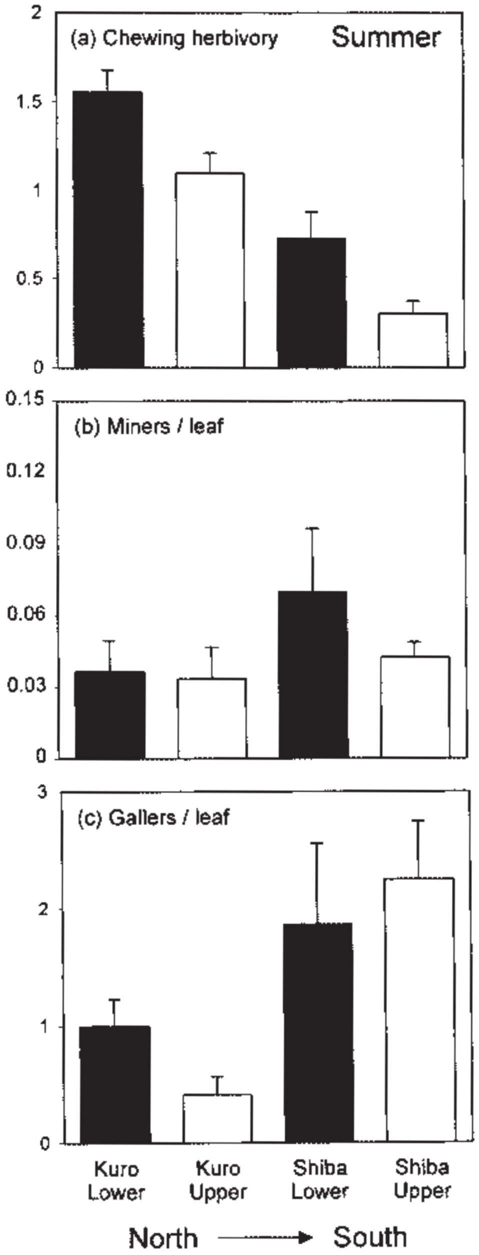

Fig. 2 (a) Chewing herbivory, (b) miner density, and (c) galler density of leaves on lower and upper canopies at north and south sites in summer. Mean and SE are presented.

Relationship between leaf traits and herbivory: We analyzed the relationships between leaf traits and herbivory. We used data sets, which were significant differences between north and south. LMA and nitrogen content in summer were negatively correlated with chewing herbivory in summer. In spite of marginal significant, LMA in spring was positively correlated with gall density in summer. These results imply that leaf traits are more likely to influence chewing herbivory and gall density.

Chewer abundance: Because of two replicates (two plots) on each site, we did not conduct statistical analysis in chewer abundance. However, chewer abundance apparently decreased from north (plot 1 = 50 individuals, plot 2 = 19) to south (plot 1 = 11, plot 2 = 8) in summer although there was no latitudinal difference in spring.

Latitudinal difference in galler density supports the Coley and co-authors' generalization, which suggests that herbviory rates are higher in tropical forests than in temperate ones (Coley and Barone 1996). However, chewing herbivory was opposite to this generalization. These different responses of different feeding types to latitude are more likely to be explained by latitudinal differences in leaf traits. There was a positive correlation between LMA in spring and gall density in summer. This implies that adults of gall-makers selected thicker leaves when they oviposited immediately after leaf flushing probably because greater mesophyll is suitable for their larvae to make galls inside the leaves. In addition, herbivore insects typically have a narrow host range in the tropics (Coley and Barone 1996). This may also explain the increased galler density at south because most of galler species are specialist herbivores. On the other hand, there was a negative correlation between LMA and chewing herbivory in summer. This implies that increased physical defense of leaves decreased chewing herbivory. Nitrogen is generally the basic structure material and is positively correlated with herbivory (Schoonhoven et al. 1998). However, there was a negative correlation between nitrogen content and chewing herbivory in summer. Slanshy and Scriber (1985) suggest that herbivore insects should increase consumption rate to compensate for reducing the nitrogen concentration. This compensation is also likely to explain latitudinal difference in chewing herbivory.

In general, the abundance increases towards lower latitudes (Gaston and Blackburn 2000). However, not only chewing herbivory but also chewer abundance in summer decreased from north to south. This latitudinal difference in chewer abundance implies that leaf traits have a great potential to determine chewer abundance.

In conclusion, we demonstrated that latitudinal different impacts of different feeding types occur probably due to latitudinal difference in leaf traits. To understand latitudinal difference in associated herbivores in detail, future studies should explore relative importance of environmental and genetic effects to latitudinal differences in leaf traits.

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