Stud. Mater. Ośr. Kult. Leśn. 13, 2014, s. 241-256

A ROLE OF FOREST AESTHETICS IN WHITE BIRCH STANDS IN CHANGING PRODUCTION ENVIRONMENT

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INTRODUCTION

Forest is an essential component of the landscape and gives us our fundamental resources for maintainability (e.g. SHIGA 1894). Among them, scenic beauty of forest is one of the most important goods in northern Japan. White birch (*Betula platyphylla* var. *japonica*) is a typical early successional tree species and is used for ornamental use, forest restoration, sap and chopstick production in northern Japan (Koike, 1995; Terazawa, 2004). In this study, we introduce an idea for managing the white birch stands in northern Japan, for maximizing their sap production for drinking and CO_2 sequestration capacity through an applicable tending method (KOIKE 2009a). While improving these functions, we state that the proposed "Postel thinning" method (von Salisch, 1902; Cook and Whelau, 2008) will potentially increase the aesthetical value of the stands.

White birches are a part of the conifer-broadleaf forest ecosystems in northern Japan, with a renewal cycle of approximately 100 years. Therefore, it is highly important to pay special attention to the species-specific growth characteristics, management practices and cultural effects, to maximize both the ecological and cultural

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value of white birch stands in the area. As shown in previous studies, a sustainable research method was applied in the present area (Terazawa, 2004). The key focus areas of this study are those specified by the tree sap harvesting versus non-harvesting methods of trees practiced within (Terazawa, 2006), high level CO_2 fixation and storage (Koike, 1993) and scenic beauty (Koike, 2009a; 2010). The aim is to work out the proper approach to maximize the potential of white birch stands when the aspects of physiological ecology, ecological services and forest management are taken into account (e.g. Hozumi et al., 1974; MEA, 2005; Shibuya, 1994), and to increase the conceptual understanding of forest aesthetics on the basis of the primary forest production.

The importance of forest aesthetics can be conceived as a part of ecosystem services, which includes provisional services, regulating services, supporting services and cultural services (fig. 1). We believe that forest can fully reach its full potential only when a holistic approach is engaged, that means all the elements of ecosystems constitute the net of dependencies, and none of them is treated separately or omitted. That includes cultural services and aesthetics.

In Japan, the concept of forest aesthetics has been greatly influenced by a forest--owner Heinrich von Salisch in Postel region, western Poland, whose work, "Forest Aesthetic" in 1885, inspired Japanese scholars to include aesthetics into Japanese forest studies. The 2nd and 3rd editions of "Forest Aesthetic" were published in 1902 and 1911, respectively (NIIJIMA and MURAYAMA 1918; Konda 1934; Shimizu et al. 2006) and the second edition was finally translated into English in 2008 (Cook and Whelau, 2008).

Von Salisch's idea of forest aesthetics was firstly introduced to Tokyo Empirical University (e.g. Tsutsui, 2009) by the Professor of Forest Politics, Zentaro Kawase, and Silviculturalist, Professor Seiroku Honda. Later, their works inspired two scholars; Alfred Möller and Wilhem Stölb, both of whom have been highly regarded in Japan (Koike et al. 2011). In their work, Möller emphasized the beauty of the most yielding fields (Yamahata, 1984) and Stölb admired Salisch's idea of the positive human activity on both productivity and beauty of forests (Sepänmaa, 2010).

Landscape aesthetics have had cultural importance in Japan already at very early stage, as the traditional forest landscapes of Arashi-yama in Kyoto, that have been famous for the natural beauty since the Hei-an period (A.D. 794-1185). However, the environment was traditionally favoured in Japan as scenery that people could admire from the distance (Konda, 1934, Koike and Koike 2012). Interest towards forest aesthetics in Japan increased during the early 1900s and the works of influential Japanese researchers, such as S. Shiga (1894), Professor Y. Niijima, J. Murayama, K. Konda, and especially Dr. T. Tamura contributed to the development of the research and the establishment of national parks in 1929 (TAMURA). Recently, the idea of forest aesthetics has expanded to the idea of "Landscape Architecture and Planning" (Ito, 1991; Ono, 2008).

Recently, the Japanese people have raised up voices that forest areas should be developed for recreational and educational purposes (e.g. Tsutsui, 2009). More people living in urban areas want to enjoy forest landscapes, and as a result, many recreational scenic forest areas have been created. There are several forests of recreational use,

such as Akazawa forest dominated by Hinoki cypress in central Japan and Nopporo Showa-no-mori (=forest) park with primeval stands in Hokkaido. Among them, we admire the forests, although disturbed after fires and landslides, mainly composed of white birch. Birch forests of Kaida-kogen (high) in Nagano Prefecture, central Japan (Kaida-Kogen (=high) resort) and in Bifuka-twon of Hokkaido Island (Terazawa, 2004; 2006). This development brought out the idea of "forest-scape.": forest is a part of landscape and there is a focus on the relationship between a standpoint of observers and targeted forest scenery (Hori et al., 1997; Oku et al., 2007), which will be discussed further in this article. Enhancing the interest in forest aesthetics also involves the aspirations to maximize the potential of all ecosystem services, including cultural services. Von Salisch's work concentrated on creating a beautiful and productive forest by introducing several different tending methods, including "Postel thinning." In this study, we introduce the potential of his "Postel thinning" method, namely intensive thinning but not marked such method (Salisch 1902 via Cook Jr. and Wehrau2008) on some dominant and most sub-dominant individuals, to create birch forests that will have both larger sap production and CO_2 fixation capacity, as well as potentially an increased aesthetic value, due to the improved visibility. In general, we recognize von Salisch's idea that commercial, ecological and aesthetical aspects are not contradictory one from each other, and that well designed forest management can increase both the aesthetic and economic value of forests (Cook and Wehlau, 2008). We also recognize the importance of multifaceted discussion on the value of aesthetics in landscape and the forest management (Kimmins, 1999; Panagopoulus, 2009).

First, we begin with introducing the special characteristics of tree sap production and CO_2 fixation capacity in white birches, and later we show how their potential could be maximized by using von Salisch's "Postel thinning" method, along with potentially increasing the area's aesthetic value throughout these management activities.

TREE SAP PRODUCTION

The wood structure of white birch is classified as a diffuse and porous, with a tree sap flowing mostly through the sapwood region. Tree sap production in white birches is known to be greater in individuals with a large crown (Terazawa, 2004; 2006). Studies have shown a strong correlation between sapwood area of the stem and the amount of leaves in all birch species (see fig. 2) (Shinozaki et al., 1964a; b; Waring et al., 1977; 1982). An exception to this is a Monarch birch (*Betula maximowicziana*: local name is Makaba, having large proportion of heart wood against sapwood) which has low sap production, but instead produces very high quality "Makaba" wood for furniture markets (Koike and Watanabe, 2009).

An individual white birch with a large sapwood area can be recognized at a very early stage, by its large crown, which has branches at a lower angle of the stem (Takahashi, 1971). During the growing season, we can trace the dead branches on the stem (fig. 3), which form a "handlebar kaizer-mustache-shape" (i.e. tuft) (Kano,

1987). This type of individual is called a "plus tree," and as it is in an auto-self pruned state, it produces a high quality timber.

In order to increase sap production in white birch, we should favour a tending methods that enable large crown growth which also protects the stem. This is indicative, as mentioned above, where fallen branches form a "plus tree" shape. Management methods used should therefore enhance growth of the crown in order to increase sap production in white birch stands. However, the management needs are distinctively different when aiming to reach high CO_2 fixation capacity.

CO_2 FIXATION CAPACITY

Forests are expected to absorb and store atmospheric CO_2 within the next few decades at least (IGBP, 1998). The CO_2 fixation capacity of forest ecosystems consist of the photosynthetic assimilation capacity of the trees and the soil respiration from the forest floor. If we are aiming to increase CO_2 fixation capacity of a forest stand, the tree density of the stand should be increased. This is rather difficult to apply for a birch tree stands because of their high demand for light (Koike 1988). However, a tree with a narrow crown can grow at a higher density because incidental light can enter deeper into part of the crown and the forest canopy, similarly to grass-type species (Monsi und Saeki, 1953). Moreover, we can easily identify the individuals by the branch traces on the stem: it is shaped like the Japanese or Chinese character for "8" (Takahashi, 1971; Koike, 2009b). This type of white birch rarely sheds its branches through natural auto-self pruning, and we call them a "minus tree" because the branch trace usually is larger and is difficult not to become a stem wound (Takahashi, 1971; Kano, 1987).

Furthermore, we can use the stem of birch for plywood and flooring, as in the case for Monarch birch and mountain birch (*Betula ermanii*) and decorative trees, as in the case of white birch (see fig. 4). With these methods of wood utilization, fixed CO_2 will be stored in wood for long period of time, ultimately contributing to the reduction of atmospheric CO_2 concentration. Some questions remain: how can we improve birch forests with different types of tending methods? And, how can we enjoy the forest scenery as a part of the whole landscape?

TENDING METHODS

In birch stands, it is difficult to target on a high levels of both tree sap production and CO_2 fixation due to the species' high light demands (Koike, 1988). Therefore, we should pay special attention to the growing size of the crown. If we aim for a large amount of tree sap, we should select individuals with branch traces on the stem shaped like a handlebar (Kaizer) mustache, but if we hope to increase CO_2 fixation capacity per area, we should select individuals with smaller crowns and branch traces shaped like the Japanese character "8," which allows us to create a high density birch stand.

Von Salisch in 1902 proposed a special thinning method, called "Postel thinning" (Salisch, 1902; Cook and Wehlau, 2008); This method is characterized by an intense selective-cutting, which increases the amount of sunlight reaching to the forest floor and accelerates the decomposition of both the litter-fall and the ground vegetation. Within this method, the trees in a stand are classified as very dominant (1st trees), intermediate (2nd trees) and suppressed (3rd tree) individuals. The 2nd trees are cut mainly in addition to some of the 1st trees, what aims on growth acceleration of the resembling trees and also a ground vegetation for animals or future games, all to maintain forest productivity.

As described above, the Postel thinning method provides enough space for larger tree crown, which leads to increase tree sap production. Also, the method establishes birch stands with a sufficient sunlight amount, leading to larger stems development and increased biomass production (Hozumi et al., 1974; Shibuya, 1992; 1994) as well as enhanced CO_2 storage capacity.

RELATION TO FOREST AESTHETICS

Both von Salisch and Möller (proposed a sustainable forest management) stated that the creation of bright spaces and regeneration sites by an intensive thinning in the forest would create an impression on people, the joy that lies in nature's beauty (Möller, 1922; Salisch, 1902; KOIKE 2009a). Similar results have been received across Finland, Norway and Sweden, within various studies concentrating on the public preferences in forest structures (Gundersen et al., 2008). Specific studies made in Finland on public forest preferences also confirm that both locals and tourists alike enjoy natural-looking forests with sufficient ground vegetation, but still maintaining high visibility for active forest management (Karjalainen et al., 2010).

Recently, in Japan people have started to enjoy more forest-related activities and there has been more interest to protect forest areas for educational reasons. A comparative study on Russian and Japanese forest preferences indicated that today's Japanese tend to see forests as subjective, practical places that provide people with recreational trails (Ueda et al., 2012). Therefore, the scenery, brightness of the forest and a good visibility on trails were highly important. Recreational preferences were especially strong in Sapporo, Hokkaido (Ueda et al., 2012). As these results indicated, the Japanese idea of forest aesthetics has changed from a distant beautiful scenery to a more active and recreational place, where the forest is also seen from within. However, these studies have also shown that despite the changing perception of forests, forest management and forest aesthetics are still valued highly.

To improve forest scenic beauty with birch species in Northern Japan, we should employ forest-scape (Hori et al., 1997; Oku et al., 2008), together with Postel thinning. The idea of forest-scape is to regulate the relationship between the position of the view point and the landscape of forests (fig. 6). Similar suggestions come from Finland, where studies on forest preferences show that people react more positively on forest cutting and management, as long as an attractive landscape is maintained when considered from the strategic point-of-view. The importance of respecting dif-

ferent contour lines was found strongly highlighted in remote landscapes and shorelines, with a goal of maintaining a harmonized landscape as much as possible (Karjalainen et al., 1999).

Forest aesthetics also strongly grants benefits of increased tourism that well-managed recreational areas attract. This creates a notable opportunity to learn from the interactions between people and ecosystems, and what is more important, to better manage and develop an understanding of both ecosystem services and cultural services as a whole (Daniel et al., 2012). In Japan, it has become rare to see white birch stands in traditional rural forested regions such as SATOYAMA (Takeuchi et al., 2002: SATOCHI-SATOYAMA 2009). Also, areas with a natural white birch stands have lost their productivity due to insufficient management tending practices and decreased wood harvesting due to increased use of fossil fuels in Japan (Koike and Sakagami, 1985). Attention should be paid to the use and management of birch forests as they still remain highly important, not only because of an increased sapwood and CO_2 fixation, but for tourism as well. The area of Kaida-kogen (=high) in Nagano Prefecture, central Japan (fig. 7), exemplify a popular recreational area that attracts locals and tourists alike.

Various studies have requested that landscapes and landscape aesthetics should be seen as goods amongst other benefits that forests create and that increased aesthetics value potentially increases a public interest towards environmental protection (Okazaki 1970, Hettinger, 2007). Despite the relation, there is still a lack of studies or established research methods of public acceptance nor preferences in forest management (Panagopoulus, 2009).

The existence of white birch stands is considered to of a special beauty for people living in urban areas located in the lowlands. Therefore, the attention should be paid to keep forests healthy and to highlight a vital role they play in the landscape.

CONCLUSIONS

The principal idea of forest aesthetics is to create a beautiful forest with intensive tending to maximize the income they bring; The result of the former will be functionally, a well-developed forest ecosystem (von Salisch 1902; Cook and Wehlau 2008). Naturally regenerated white birch stands are used in this forest practice, with selection based on the dead branch traces on the stem, preferably either for CO_2 fixation or tree sap production. Moreover, there is an opportunity of cutting white birches for ornamental purposes or leaving them as they are for their decorative properties. Finally, an intensive thinning of Monarch birch and letting Mountain birch to naturally become an element of a mixed forests structure is recommended.

ACKNOWLEDGMENTS

Financial support for this work is in part by the grant-in-aid for Japan Society of Promotion of Science (Basic type B) and the short term exchange program of

students of Hokkaido University, Japan. We also would like to thank Prof. Emeritus Seigo Ito (Shinshu University), chair of the Institute of Forest Aesthetics & Planning, for his continuous guidance and encouragement in the consideration of Forest Aesthetic and Forest Scenic Planning. We are grateful to Dr. Yasuhiro Koyama for offering us a picture of white birch stand at Kaida-kogen (high).

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Summary

Forest aesthetics, introduced in old-Germany in the early 20th Century, considers forest tending and forest management methods by means of maximizing the yield of ecosystem services. Focus areas herein are the birch stands in northern Japan. Tree sap production from white birch (*Betula platyphylla* var. *japonica*) trees as well as fixation and storage capacity of $CO_2$are expect to be maximized, as a part of a regulation service. In fact, the stem of white birch has a relatively greater value in wood density (0.60~0.65) as compared with some conifers, or poplar or magnolia

(0.40). Positively, white birch forest stands have a scenic value. Therefore, introducing the forest-scape idea, may contribute to enhancement of their cultural service. We present criteria for selecting individual trees for tree sap production. It should be a young individual (about 20 years old) tree having a large and well-developed crown. We can indentify this type of tree by traces of stem dead branches. Its shape resembles "Kaiser's mustache." In addition, the ideal forest stand of white birch for tree sap production should have well-developed understory vegetation (but not *Sasa* sp.) on fertile mesic soils. It is also necessary to take into consideration the fact that the white birch is a typical light demanding species and needs space for getting enough light energy. However, if we expect maximum CO_2 fixation of white birch stands per unit area, the stand should have a high stand density with sharp angles of stem branches. The criteria for selecting an individual with the potential for maximum CO_2 are branches traces in a shape of the Japanese character for the number 8. In conclusion, the forest management practices described above can shape white birch forest stands for different purposes. Nevertheless, whatever the demands, the forest aesthetics along with the proper thinning shall serve well.

Key words: forest aesthetics, postel thinning, von Salisch, white birch, trace of branch, stand density, sapwood, CO_2 fixation, forest-scape

ROLA ESTETYKI LASU W DRZEWOSTANACH BRZOZY BIAŁEJ WRAZ ZE ZMIENIAJĄCYM SIĘ ŚRODOWISKIEM PRODUKCYJNYM

Streszczenie

Estetyka lasu, zapoczątkowana w Niemczech na początku XX wieku, uważa pielęgnację lasów i metody zarządzania nimi za drogę do osiągnięcia największej wydajności ról ekosystemu leśnego. Uwagę skoncentrowano tu na brzozie w północnej Japonii. Produkcja soku drzewnego z białej brzozy (*Betula platyphylla* var. *Japonica*), jak i przewidywane zwiększanie wiązania (pochłaniania) CO^2 są częścią roli regulacyjnej tego ekosystemu. Kłoda brzozy białej ma stosunkowo większą gęstość (0,60 ~ 0,65) w porównaniu z niektórymi gatunkami drzew iglastych, topolą i magnolią (0,40). Drzewostany brzozy białej mają wyjątkową wartość krajobrazową. Dlatego wprowadzenie ideii „forest-scape" może zwiększyć funkcję kulturową lasu. Przedstawiamy kryteria wyboru pojedynczych drzew do produkcji soku drzewnego. Powinno być ono młode (około 20 lat) i mieć dużą, dobrze rozwiniętą koronę. Możemy zidentyfikować tego typu drzewa poprzez kształt obumarłych gałęzi – przypomina „wąsy Kaisera". Brzoza biała jest gatunkiem światłożądnym i potrzebuje przestrzeni do zdobywania energii słonecznej. Poza tym idealny drzewostan brzozy białej z przeznaczeniem na produkcję soku brzozowego powinien mieć dobrze rozwinięty podszyt (ale nie *Sasa* sp.) na żyznych, wilgotnych glebach. Trzeba też uwzględnić fakt, że brzoza biała jest typowym gatunkiem światłożądnym i potrzebuje przestrzeni, aby uzyskać wystarczająco dużo energii świetlnej. Jeśli natomiast oczekujemy od drzewostanów brzozowych maksymalnego wiązania CO_2 na jednostkę powierzchni,

powinny one mieć wysoki współczynnik zagęszczenia. Kryterium selekcji osobników o potencjalnej największej zdolności wiązania CO_2 jest kształt martwych gałęzi, przypominający znak japońskiej liczby osiem [achi /\]. Podsumowując, opisane praktyki gospodarki leśnej mogą kształtować drzewostany brzozowe dla różnych celów. Estetyka lasu wraz z odpowiednimi czyszczeniami powinny dobrze przysłużyć się wszelkim tym potrzebom.

Słowa kluczowe: estetyka lasu, trzebież postolińska, von Salisch, brzoza biała, cień gałęzi, gęstość drzewostanu, sok drzewny, wiązanie CO_2, krajobraz leśny