# Differences in Visual Perception of *Abies nordmanniana* subsp. *bornmulleriana Mattf* under Snow Load

***Çiğdem SAKICI, Elif AYAN, Zeynep Pınar ÖZDİGER**
Kastamonu University, Faculty of Forestry, Department of Landscape Architecture, TURKEY
*Corresponding author: csakici@kastamonu.edu.tr

**Abstract**

This study aims at determining the visual values of solitary and group fir trees in Kastamonu city and the differences in their visual perceptions according to seasons. For this purpose selected trees in Ilgaz National Park were photographed in two different time periods (in snowy days of 2012 and in other days). Four different fir tree images were used in this study. These tree images are (i) image of a fir tree under snow load, (ii) ordinary image of a fir tree, (iii) image of a composition created by the fir trees under snow load, and (iv) ordinary image of a composition created by the fir trees. These photographs were evaluated by Kastamonu University Forestry Faculty students by using Semantic Differential Scale Technique. According to this technique ten pairs of opposing adjectives were chosen for the evaluation the visual quality of the figures. Consequently, in this study the differences in their visual perceptions according to seasons were determined. In addition, differences on perception of physical characteristics such as form, branching structure, texture, trunk, and foliage were also investigated. The respondents' socio-economic structure's effects on human perception were researched as well.

**Key Word:** Visual perception, Bornmüllerian fir, emphasis on physical characteristics

## Introduction

Bornmüllerian fir (*Abies nordmanniana* subsp. *bornmülleriana* Mattf) is one of the endemic species of Turkey. This species is distributed from Kızılırmak River to Mount Uludağ in western Black Sea region (Anşin ve Özkan, 1997). It is a natural and very decorative species. For this reason, *Abies nordmanniana* is widely used for recreational studies and preferred as Christmas tree.

This tree is evergreen and coniferous. It can grow to 30-40 m tall and its trunk diameter can expand up to 2 m. This species is a shade bearer and it has dense branches extending from the ground level (Arslan & Çelem, 2001). Its trunk is erect, tall and rounded and it has a cone-shaped crown. It has taproot root system and some lateral roots tend to spread shallowly. It grows well in airy, deep, moist soil as well as humid and cool air climate. Annular-lined up dense-leaved branches surround central and erect trunk (Figure 1). Foliage shows variety such as dark green, pearl grey or blue. Fir trees are symmetrical that means there is no need for pruning. Fir trees which are valuable landscape materials owing to all these characteristics can become striking when used single or in groups.

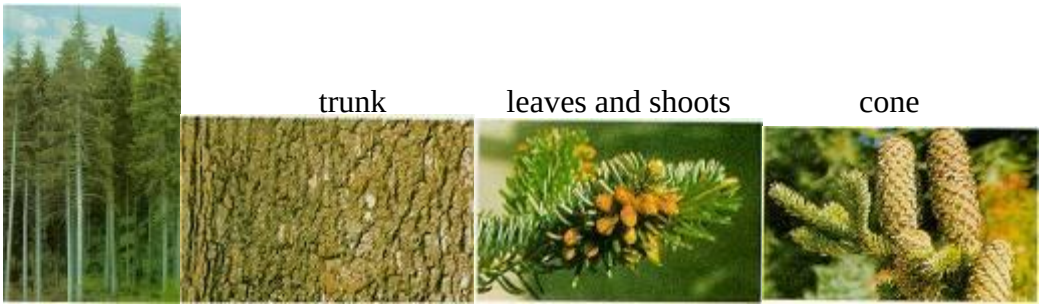


Figure 1: The Characteristic Features of Fir Tree

Fir forests cover an area of 231,655 ha in Turkey. 40 fir species exist around the world and 2 species and 5 sub-species of them (*Abies nordmanniana*, *Abies nordmanniana* subsp. *nordmanniana*, *Abies nordmanniana* subsp. *bornmülleriana*, *Abies nordmanniana* subsp. *equi-trojani*, *Abies cilicica*, *Abies cilicica* subsp. *cilicica* ve *Abies cilicica* subsp. *isaurica*) can naturally grow within the country boundaries (Anşin & Özkan,

1997). Figure 2 illustrates the distribution of fir forests around Turkey. It is known that fir species show high adaptation potential to the most part of Turkey regions except for the Aegean and Mediterranean parts.


Figure 2. Distribution areas (www.ogm.gov.tr/english/tree/agac6.htm)

There has not been enough study dealing with the topic of Uludağ Fir yet. However, this species should be used more widely in urban and rural landscape implementations considering its industrial use and decorative feature. Therefore, the reasons for choosing fir species as study object are its common use as Christmas tree around the world and the lack of information on it. Thus, the purposes of the study are to determine the different impacts of fir tree under snow load and without snow load on peoples' perceptions and to search the characteristic features (e.g. form, branching structure, texture, tree trunk, foliage) of fir species in these two opposite situations. By this way, primarily, it would be asserted the appropriate uses on landscape implementations according to characteristic features of fir species. Subsequently, the question of how fir species can be used in summer and winter time respecting people's opinions would be answered. Lastly, the winter resemblance of fir tree providing amazing views had to be brought out.

## Material and Methods

### Study Field

This study has been done in Kastamonu. It is located in the north of Turkey, the Blacksea Region, and has an area of 13,108.1 $km^2$. Ilgaz Mountain is the highest mountainous terrain of western Black Sea Region and it exceeds with 1.875 m the Kastamonu-Çankırı road. The north side of Ilgaz Mountain has more moist and rainy climate than its south side by the reason of moist air masses coming from the Black Sea. Oak and beech are prevalent trees in hillside and as altitude increases fir and Scots pine trees dominate on the northern side. On the other hand, larch tree is the dominant species on the southern side. The study area is shown in Figure 3.

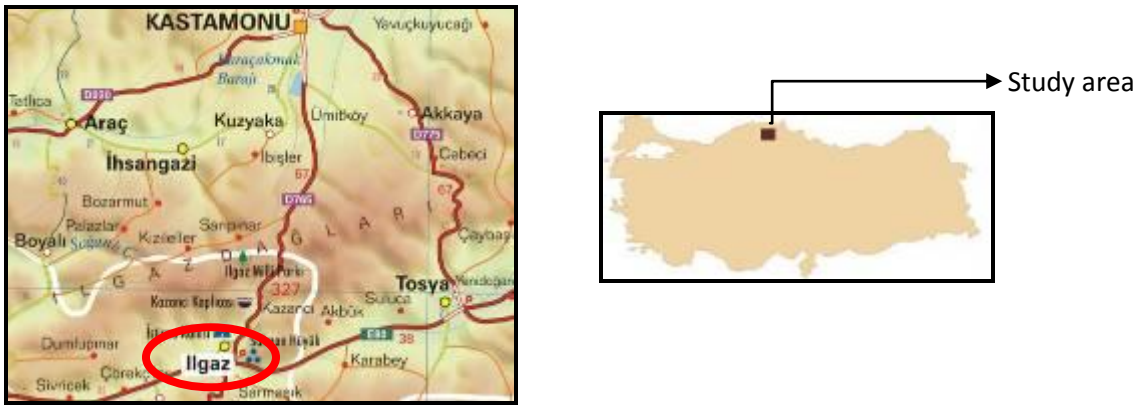


Figure 3. Study area in Kastamonu

## Figures

Bornmüllerian fir was chosen as the study material. Bornmüllerian fir is the most important tree species regarding coniferous forest landscape in Kastamonu. Pure and mixed stands with other taxa in relation to land morphology present interesting amenities.

Four different fir tree images were used in this study. These tree images are as follows: (i) ordinary image of a fir tree, (ii) image of a fir tree under snow load, (iii) ordinary image of composition created by the fir trees, and (iv) image of composition created by the fir trees under snow load (Figure 4). These four different images were taken in Ilgaz National Park. These photos were taken with a 7.2 mega pixels digital camera (EX-V7) in two different time periods (summer and winter).

(i) (ii) (iii) (iv)

Figure 4. Four different fir tree images

## Evaluation of Figures

A total of 48 students (25 males; 23 females; range 20 to 27 years) of Kastamonu University, Faculty of Forestry have evaluated the photographs of fir. In snowy days of 2012 and in other days selected fir trees were photographed. Inquiries were made face to face with the respondents. Each inquiry lasted for about 20 min. Subjective assessment techniques were used for the evaluation of the studies. They examine the individual reactions to environment reactions because of the aim of measuring the interaction between the environment and

observer. In this study the 'Semantic Differential Technique' was used to measure the visual values (Osgood et al., 1975). According to this technique ten pairs of opposing adjectives were chosen for the evaluation of the figures. The adjective pairs splendour/vapidity, order/disorder, elegance/rudeness, softness/hardness, joy/sadness, peaceful/unsettling, spacious/distressing, inviting/grotty, different/usual, and flashy/ordinary were used to evaluate the visual quality of fir trees. Respondents were asked to rate each adjective pair with one of the points from the rating scale with seven points (-3, -2, -1, 0, 1, 2, 3) for each figure presented (Küller, 1979). The rating scale was changed from (-3, -2, -1, 0, 1, 2, 3) to (1, 2, 3, 4, 5, 6, 7) while the answers were interpreted by the computer for an easy evaluation. There were also questions that helped to find out the respondents' socio-economic structure such as age, gender, occupation. These respondent data's effects on human perception were researched. In addition, in this study the differences in their visual perceptions according to seasons were determined. Differences in perception of characteristics such as form, branching structure, texture, trunk, and foliage were also investigated. By looking at the image (i) in order to understand which characteristic feature is perceived first, respondents were asked to mark from 1 to 5 according to their own priorities on perception of characteristic features. Afterwards, the same process was repeated for the image (ii) in order to investigate the impact of snow load on the characteristics of fir tree.

Visual quality analysis is a method used quite commonly in many recent studies in assessing various landscape elements. Visual quality assessment method was used in the following studies to determine the 'visual value of landscape elements' such as waterscapes (Herzog, 1985), arboretum landscapes (Schroeder, 1991), rural landscape (Habron, 1998), vegetation (Purcell and Lamb, 1998), and vegetation types (Bergen et al., 1995; Tzolova, 1995; Misgav, 2000), landscape pattern (Hunziker and Kienast, 1999), roadside vejetation (Akbar et al., 2003), forests (Tahvanainen et al., 2001; Sheppard and Picard, 2006; Ribe, 2005), conservation areas and national parks (Bienabe and Hearne, 2006), rural-urban fringes (Sullivan and Lovell, 2006) and river views (Meitner, 2004). Several similar studies on visual quality assessment have been carried out in Turkey for highway corridors (Karahan, 2003), rural and urban-fringed landscapes (Kaplan et al., 2006), urban rocky habitats (Acar and Sakıcı, 2008), rural-urban landscapes (Bulut, 2006; Bulut and Yılmaz, 2008; Bulut and Yılmaz 2009) and lake landscapes (Kearney et al., 2008).

## Findings

The purposes of this study are to investigate the effects of the resemblances of fir tree(s) under snow and without snow and to search under which resemblance the characteristic features are more distinct. Primarily, solitary fir tree images (i and ii) were evaluated. The distributions of points on visual perception concepts of these two images were illustrated in Figure 5. As it is shown in the figure, both solitary fir resemblances show a positive arithmetic mean for almost each visual perception concept. However, the image of the fir tree under snow got the highest points for all adjective pairs. The ordinary image of fir species shows positive arithmetic mean in terms of splendour (1.0), order (0.9), elegance (0.6), softness (0.3), joy (0.7), peaceful (1.2), spacious (1.5), inviting (0.5) and flashily (0.3) concepts except different (-0.4). On the other hand, the snow load resemblance of fir species shows positive arithmetic mean in all cases when the visual perception concepts splendour (2.1), order (1.1), elegance (1.5), softness (1.3), joy (1.0), peaceful (1.4), spacious (1.6), inviting (1.5), different (1.0) and flashily (1.6) are evaluated (Figure5).

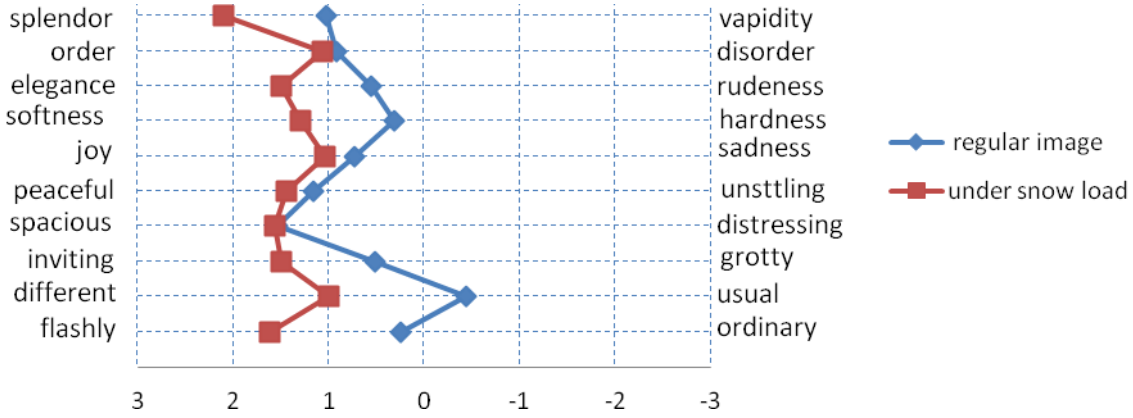


Figure 5. The distributions of points on visual perception concepts of solitary fir tree resemblances under snow and without snow.

On the other hand, the distributions of points on visual perception concepts of the images composed by the fir trees (iii and iv) were assessed in Figure 6. As one can see, both images show positive arithmetic mean for almost each visual perception concept. According to these data, the snow load image got the highest point for each adjective pair similar to Figure 5. The ordinary image of a composition created by the fir trees has a positive arithmetic mean in terms of splendour (1.2), order (1.4), elegance (1.1), softness (0.9), joy (1.0), peaceful (1.5), spacious (1.4), inviting (1.3), different (0.2) and flashily (0.6) concepts. Similarly, the image of a composition created by the fir trees under snow load has positive arithmetic mean according to splendour (2.1), order (1.3), elegance (1.7), softness (1.6), joy (1.7), peaceful (1.8), spacious (1.7), inviting (2.0), different (1.4) and flashily (2.1) concepts (Figure 6).

Moreover in this study, in order to determine the distinctive characteristic features of the fir tree under snow and without snow, respondents were asked to evaluate the characteristic features from most distinct one to less distinct one by giving points from 1 to 5. In this way the distinct characteristic features of fir tree under snow and without snow were deduced. The frequency and alignment values of characteristic features of fir tree under snow load and ordinary fir tree are separately shown in Table 1.

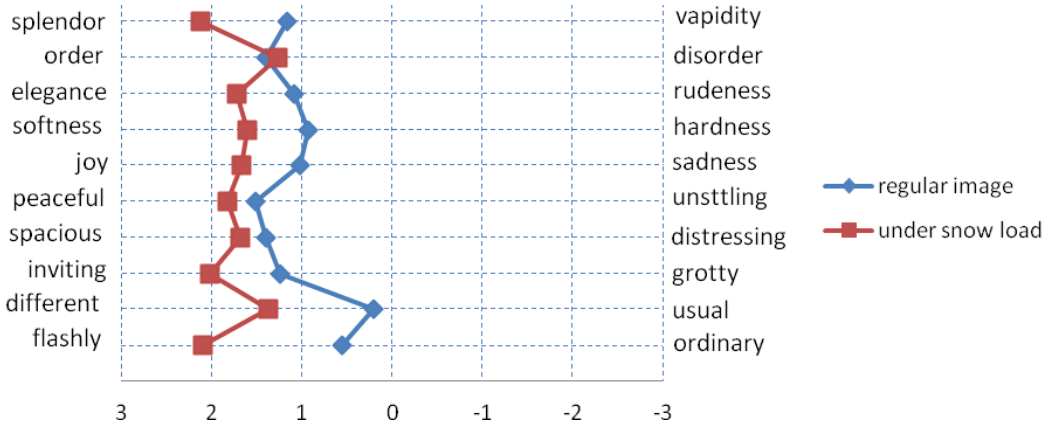


Figure 6. The distributions of points on visual perception concepts of the images composed by the fir trees under snow and without snow

According to the data of ordinary resemblance, respectively branching structure, form, trunk, foliage and texture are perceived. In contrast, form, branching structure, texture, trunk and foliage are perceived when the snow load resemblance is

assessed. Paired Samples t test was implemented to determine the statistical differences between the two resemblances. Characteristic features (except foliage) of two resemblances have shown statistically meaningful differences when the comparisons of form, branching structure, texture, trunk and foliage are examined ($p<0.05$). There is no statistical difference for the foliage perception priority of two resemblances ($p>0.05$).

Table 1. The values of frequency and alignment of characteristic features of fir tree

| Semb. | Ch. Features | Num. of People | Point | Num. of People | Point | Num. of People | Point | Num. of People | Point | Num. of People | Point | Σ | Alignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ordinary Resemb. | Form | 13 | 5 | 11 | 4 | 9 | 3 | 11 | 2 | 4 | 1 | 162 | 2. |
| | **Branching Structure** | 20 | 5 | 15 | 4 | 8 | 3 | 2 | 2 | 3 | 1 | 189 | **1.** |
| | Texture | 5 | 5 | 4 | 4 | 4 | 3 | 9 | 2 | 26 | 1 | 97 | 5. |
| | Trunk | 5 | 5 | 8 | 4 | 17 | 3 | 13 | 2 | 5 | 1 | 139 | 3. |
| | Foliage | 5 | 5 | 10 | 4 | 10 | 3 | 13 | 2 | 10 | 1 | 131 | 4. |
| Snow Load Resemb. | **Form** | 27 | 5 | 11 | 4 | 2 | 3 | 5 | 2 | 3 | 1 | 198 | **1.** |
| | Branching Structure | 9 | 5 | 15 | 4 | 13 | 3 | 5 | 2 | 6 | 1 | 160 | 2. |
| | Texture | 6 | 5 | 6 | 4 | 9 | 3 | 15 | 2 | 12 | 1 | 123 | 4. |
| | Trunk | 1 | 5 | 6 | 4 | 10 | 3 | 16 | 2 | 15 | 1 | 106 | 5. |
| | Foliage | 5 | 5 | 11 | 4 | 14 | 3 | 6 | 2 | 12 | 1 | 135 | 3. |

Σ= Number of People x Point

## Conclusions and Recommendations

This study, in which the effects of visual perception of fir species under snow load and without snow and the differences amongst characteristic features of fir tree under snow load were searched, found out that fir species can easily be used in landscape implementations even in winter. Furthermore, it was determined that snow load resemblance of fir species got higher points than its ordinary resemblance. There is a big difference between the two resemblances in terms of splendour, elegance, softness, inviting, different and flashily concepts. Also, similar results were found for the composition of fir species' two different resemblances.

Moreover, the positive effects of snow load on the perception of the characteristic features of fir species were determined in terms of statistics. As a result of analysis, in the ordinary resemblance of fir tree respectively branching structure, form, trunk, foliage and lastly texture was perceived. In contrast, in the snow load resemblance of fir tree primarily form, then respectively branching structure, foliage, texture and trunk were perceived.

Nowadays, fir species are rarely used in landscape implementations although they have aesthetic beauty and are one of Turkey's native tree species. This study allows for a more conscious way when using fir species in the landscape implementations in the process of planting design. As a result, in the landscape implementations snow load resemblance of fir species should also be preferred as a design object.

### References

Akbar, K.F., Hale, W.G.H. and Headley, A.D. 2003. Assessment of scenic beauty of the roadside vegetation in northern England. Landscape and Urban Plann. 63:139-144.

Ansin, R., Özkan, Z.C. 1997. Tohumlu Bitkiler (Spermatophyta) Odunsu Taksonlar, Karadeniz Teknik Üniversitesi Orman Fakültesi. Trabzon.

Arslan, M., Çelem, H. 2001. Ankara'nın Egzotik Ağaç ve Çalıları, Tübitak, Türkiye Tarımsal Araştırma Projesi Yayınları, TOGTAGTARP- 2125, Ankara.

Bergen, S.D., Ulbricht, C.A., Fridley, J.L. and Ganter, M.A. 1995. The validity of computer generated graphic images of forest landscapes. Journal of Environmental Psych. 15:135-146.

Biénabe, E. and Hearne, R.R. 2006. Public preferences for biodiversity conservation and scenic beauty within a framework of environmental services payments. Forest Policy and Econ. 9 (4):335-348.

Bulut, Z. 2006. The Evaluation of Recreational Tourism Potential of Kemaliye (Erzincan) and Nearby within an Alternative Tourism Framework. Ph.D. thesis, Graduate College of Atatürk University, Erzurum.

Bulut, Z. and Yilmaz, H. 2008. Determination of landscape beauties through visual quality assessment method: A case study for Kemaliye (Erzincan/Turkey). Environmental Monitoring and Assess. 141(1-3): 121-129.

Bulut, Z. and Yilmaz, H. 2009. Determination of waterscape beauties through visual quality assessment method. Environmental Monitoring and Assessment 154:459-468.

Habron, D. 1998. Visual perception of wild land in Scotland. Landscape and Urban Plan. 42 (1):45-56.

Herzog, T.R. 1985. A cognitive analysis of preference for waterscapes. Journal of Experimental Psych. **9**:27-43.

Hunziker, M. and Kienast, F. 1999. Potential impacts of changing agricultural activities on scenic beauty - A prototypical technique for automated rapid assessment. Landscape Ecol. 14 (2):161-176.

Kaplan, A., Taşkın, T. and Önenç, A. 2006. Assessing the visual quality of rural and urban-fringed landscapes surrounding livestock farms. Biosystems Engin. 95 (3):437-448.

Acar, C. and Sakıcı, Ç. 2008. Assessing landscape perception of urban rocky habitats. Building and Environ. 43 (6):1153-1170.

Karahan, F. 2003. Landscape Planning of Erzurum-Rize Highway Corridor and Its Opportunity for Usability as Landscape View Road. Ph.D. dissertation, Graduate College of Atatürk University, Erzurum.

Kearney, A.R., Bradley, G.A., Petrich, C.H., Kaplan, R., Kaplan, S. and Simpson-Colebank, D. 2008. Public perception as support for scenic quality regulation in a nationally treasured landscape. Landscape and Urban Plan. **87**(2):117-128.

Küller, R., 1979. Semantic Evaluation of Perceived Environment, Man Environment Systems, 9(67).

Meitner, M.J. 2004. Scenic beauty of river views in the Grand Canyon: Relating perceptual judgments to location. Landscape and Urban Plan. 68:3-13.

Misgav, A. 2000. Visual preference of the public for vegetation groups in Israel. Landscape and Urban Plan. 48:143-159.

Osgood C.E., May W.H., Miron M.S., 1975. Cross-cultural universals of affective meaning. Urbana: University of Illinois Press

Purcell, A.T. and Lamb, R.J. 1998. Preference and naturalness: An ecological approach. Landscape and Urban Plan. 42 (1):57-66.

Ribe, R.G. 2005. Aesthetic perceptions of green-tree retention harvests in vista views: The interaction of cut level, retention pattern and harvest shape. Landscape and Urban Plan. 73 (4):277-293.

Schroeder, H.W. 1991. Preference and meaning of arboretum landscapes: Combining quantitative and qualitative data. Journal of Environmental Psych. 11 (3):231-248.

Sheppard, S. and Picard, P. 2006. Visual-quality impacts of forest pest activity at the landscape level: A synthesis of published knowledge and research needs. Landscape and Urban Plan. 77 (4):321-342.

Sullivan, W.C. and Lovell, S.T. 2006. Improving the visual quality of commercial development at the rural-urban fringe. Landscape and Urban Plan. 77 (1-2):152-166.

Şevik, H., 2011. Dallanma Karakterleri Bakımından Noel Ağacı Üretimine Uygun Uludağ Göknarı Popülasyonlarının Belirlenmesi, Kastamonu Üniversitesi, Orman Fakültesi Dergisi, 11(1): 102-107.

Tahvanainen, L., Tyrväinen, L., Ihalainen, M., Vuorela, N. and Kolehmainen, O. 2001. Forest management and public perceptions visual versus verbal information. Landscape and Urban Plan. 53 (1-4): 53-70.

Tzolova, G.V. 1995. An experiment in greenway analysis and assessment: the Danube River. Landscape and Urban Plan. 33 (1-3):283-294.