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The Effects of Ground Based Skidding on Saplings during Forest Thinning Operations in Summer Season

Yaz Mevsiminde Uygulanan Orman Aralama Operasyonlarında Zemin Üzerinde Sürütmenin Fidanlar Üzerine Etkileri

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Abstract

Wood harvesting activities are one of the main activities that directly affect many elements of forest ecosystem in terms of ecological. Especially, it can be harmed during the thinning and selection cutting to the saplings that are both to the sustainability of the forest and make up the wood products of the future in silvicultural terms. In this study, damage types and grades of uncontrolled skidding on the ground to the saplings were determined. The study was carried out in harvesting units applied thinning cut with an average slope of 65% and main tree species oriental spruce [Picea orientalis L. (Link)] and eastern beech [Fagus orientalis Lipsky.]. In the scope of the study, individuals who were smaller than 10 cm in diameter around the skidding routes in the areas harvested in the summer season were examined. Diameters of the damaged saplings were measured and the damage types were determined as crushing, lean, top breaking, uprooting and side-lying. It was determined some damages to saplings as lean (25%), uprooting (21%), crushed (20%), side lying (19%) and top breaking (15%) during the skidding activities. As a result of the study, it was determined that thin-diameter seedlings are more likely to suffer side-lying damage while thick-diameter seedlings are exposed to lean and uprooting damage. Controlled skidding on a fixed or artificial route using simple machine power can be effective in reducing the damage to saplings in harvesting units with high sapling

Özet

Odun hasat faaliyetleri ekolojik açıdan orman ekosisteminin pek çok elemanına zarar veren ana faaliyetlerden birisidir. Özellikle silvikültürel açıdan, aralama ve seçme kesimleri sırasında hem ormanın sürdürülebilirliğini sağlayan hem de geleceğin ürünlerini oluşturan fidanlara zararlar verebilmektedir. Bu çalışmada, zemin üzerinde kontrolsüz sürütme faaliyetlerinin fidanlarda oluşturduğu zarar tipleri ve dereceleri belirlenmiştir. Çalışma ortalama eğimi %65 ve ana ağaç türleri doğu ladini [Picea orientalis L. (Link)] ve doğu kayını [Fagus orientalis Lipsky.] olan aralama sahalarında gerçekleştirilmiştir. Çalışma kapsamında yaz üretimi yapılan hasat birimlerinde sürütme güzergahları çevresindeki, çapı 10 cm'den küçük olan bireyler incelenmiştir. Zarar görmüş olan fidanların çapları ölçülmüş ve gördükleri zarar tipleri kırılma, devrilme, tepe kırılması, sökülme ve yan yatma olarak belirlenmiştir. Sürütme sırasında fidanların %25'inde devrilme, %21'inde sökülme, %20'sinde kırılma, %19'unda yan yatma ve %15'inde tepe kırılması zararları oluştuğu tespit edilmiştir. Çalışma sonucunda, kalın çaplı fidanlarda devrilme ve sökülme zararları tespit edilirken ince çaplı fidanlarda daha çok yan yatma zararı meydana geldiği belirlenmiştir. Fidan yoğunluğu fazla olan aralama sahalarında sabit bir güzergah üzerinde kontrollü sürütme yapılması ya da yapay bir güzergah üzerinde basit makine gücünden yararlanılarak kontrollü sürütme yapılması

density.

Keywords: Ground Based Skidding, Damage to Saplings, Residual Stand, Thinning Operations

fidanlara zararın azaltılmasında etkin olacaktır.

Anahtar kelimeler: Zemin Üzerinde Sürütme, Fidan Zararı, Kalan Meşcere, Aralama

1. INTRODUCTION

Nowadays, the increasing importance of society to the adverse effects of interventions in nature led to the idea that the environmental impacts of the activities carried out in all sectors should be determined in advance and taken measures (OECD, 1994; Yigit et al., 2002). Identifying and minimizing the damages caused by forestry activities to the forest ecosystem is of utmost importance in achieving of sustainable forest management (Unver-Okan, Gumus and Acar, 2017).

One of the most important interventions in the forest ecosystem is wood harvesting operations. This process consists of three main stages: cutting, extraction and transportation stages. The extraction activity is the stage having the greatest ecological damage to residual stand. Wood extraction activities in Turkey is carried out largely by ground-based skidding due to the fact that the mechanization is not over-developed and about half of the forests are sloping or rough (Unver, 2008). In Turkey, 100 million logs and 300 million thin-diameter woods is moved average 500 m with ground-based skidding method to the edge of the forest road.

In some studies, it has been determined that wood harvesting activities have significant damages on saplings which provide both sustainability of forest assets and utilization of forests (Badraghi, N., 2013; Unver & Acar, 2009). Besides it might influence seedling survival and growth (Thiffault, Hannam, Paré, Titus, Hazlett, Maynard and Brais, 2011). The silvicultural intervention type, harvesting technique, the forest conditions, operational characteristic (Granhus & Fjeld, 2001) and the level of training of forest workers (FAO, 2004) has affected to damage on saplings during harvesting activities.

In terms of silvicultural interventions, the most damage to the residual trees and saplings comes into play during the thinning and selection operations (Pereira, Zweede and Asner, 2002).

Silvicultural operations aim to achieve stand-specific objectives by using silvicultural techniques. These techniques are canopy alterations to induce natural regeneration, the harvesting of mature trees and thinning. Silvicultural operations involve decisions on machinery and other equipment, techniques, work organization and human resources (FAO, 2018). It was found that the level of basal area removal was a better predictor for sapling having 0.5–2 m height damage (Surakka, Sirén, Heikkinen, and Valkonen, 2011). The damage to the seedlings was detected 15% by Whitman et al. (1997) and 30% (dbh < 5 cm) by Kuramoto et al. (2010). In addition, Siren & Surakka (2010) estimated that 1/3 of the saplings would be damaged and 1/3 of damaged saplings would die during extraction activities with traditional methods. Besides it was found that multiple residue piles after harvesting decreased seedling damage (Rahman, Viiri, Pelkonen and Khanam, 2015).

In terms of skidding technique, Hosseini et al. (2000) found that the injuries (8.7%) and fracture or dismemberment (2.3%) occurred in the saplings during ground-based-skidding by man power. Naghdi et al. (2009) determined that while skidding on the ground with animal power had damaged 13.3% to the saplings, skidding with machine power had damaged 23.3%. The ground based skidding by the winch and the tractor caused damages on the saplings by 5.9-17.9% and 11.8-17.1% respectively. It was determined that most of these damages come into the form of the death of the saplings. Tavankar et al (2012) showed that 16.9% of regenerations were damaged by logging operation. In addition, the ground based skidding to the saplings in different studies were determined, 52-56% (Vorob, Danchenko, Bekh, Panevin, and Burkov, 1994) 52% (Sikström & Glöde, 2000) and 48% (Westerberg & Berg, 1994). Bugday and Menemencioglu (2013) determined that 327 saplings were damaged during harvesting activities in the mixed stands of Scotch Pine (Pinus sylvestris L.) and Fir (Abies nordmanniana subsp. Bornmulleriana Mattf.). 16.01% of the saplings died and 35.95% of them were exposed to breakage or stem damage.

The damages of forest harvesting activities on saplings can be minimized practical planning, effective monitoring control systems and improper operational techniques (Pereira et al, 2002; Rushton, Brown and McGrath, 2003). It has been emphasized that in some studies it is not necessary to use ground based skidding technique in forests with more saplings (Virdine, Dehoop and Lanford, 1999; Tiernan, Owende, Kanali, Lyons and Ward, 2001).

In this study, it was aimed to determine the damages of uncontrolled ground based skidding activities on saplings in the sloping thinning areas.

2. MATERIAL AND METHODS

The research area considered in this work is located Maçka District of Trabzon in northeastern part of Turkey, between 39º 37' 0,6"-39º 45' 00" east latitudes according to Greenwich and 40º 48' 42"- 40º 52' 00" north longitudes according to Equator. The eastern spruce [Picea orientalis (L.) Link.] and eastern beech [Fagus orientalis Lipsky.] are the dominated species in addition to limited coverage of Rhododendron [Rhododendron tulipifera and Rhododendron ponticum]. The region has an average value of annual temperature of 14 ºC and 731.6 mm precipitation. The highest rainfall takes place during April-May and October-December (Anonymous, 2002).

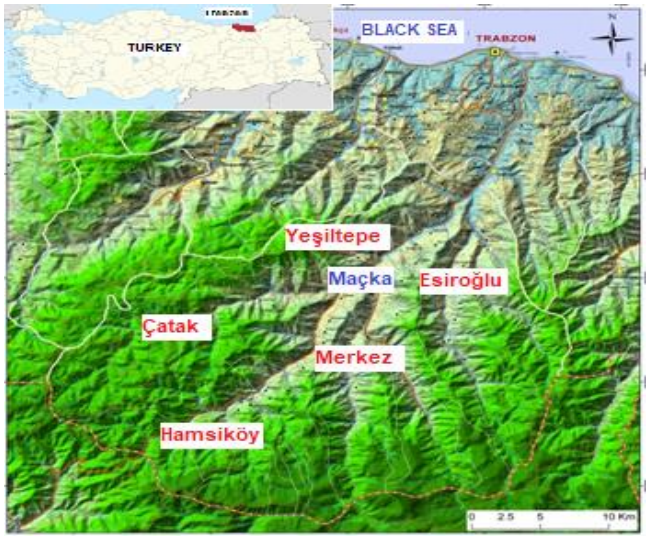

Figure 1. Overview of the study area

The study areas were selected from the harvesting units harvested in summer season in Yesiltepe, Hamsikoy and Esiroglu districts of Trabzon-Macka (Figure 1). The average slope, area and volume of the harvesting units were 65%, 22.5 ha and 21.24 m^3 / ha respectively.

In the scope of the study, all trees having smaller than 10 cm in diameter were accepted as saplings. All the saplings around the skidding routes were examined to assess the damages of the uncontrolled ground-based skidding. The diameters of the damaged saplings were measured with a caliper and the damages on the seedlings occurred as crushed, uprooted, uprooted, side-lying, broken top and lean (Acar & Unver, 2004). These damage types defined as (Figure 2a,2b).

- Crushed; breakage of saplings near the middle of the body,
- Uprooted; the roots of the saplings lose contact with the soil and their vitality,
- Side-lying; seedlings lying on the ground without being cut off from the ground,
- Broken top; break of the tops or top buds of the saplings,
- Lean; leaning of saplings around trees or seedlings continuing to contact the land

SPSS package program (SPSS Inc. Chicago, IL, USA) was used to evaluate the statistical relationship between the data obtained after the measurements.

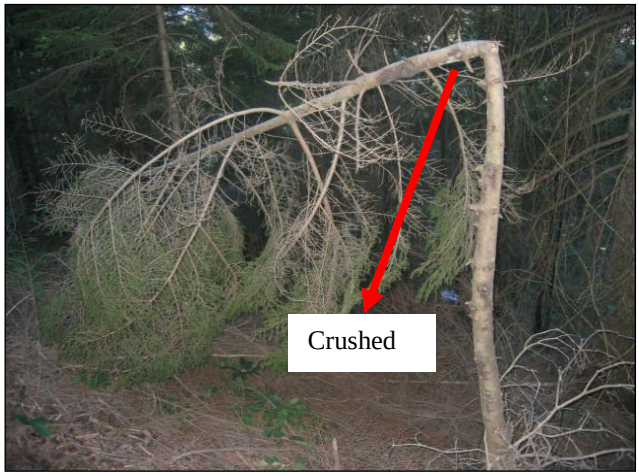

Figure 2a. Damage types surveyed in saplings (Unver, 2008).

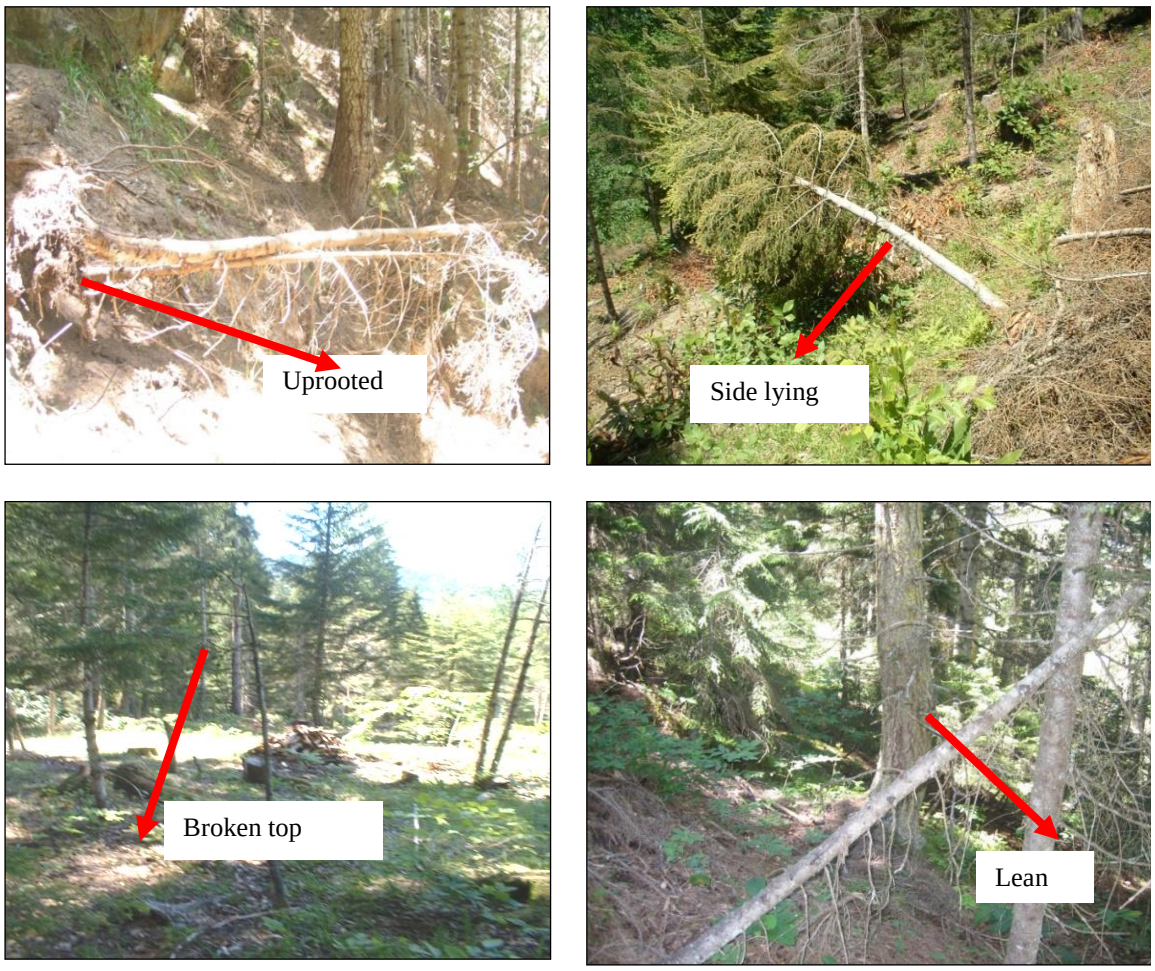

Figure 2. Damage types surveyed in saplings (Unver, 2008).

3. RESULTS AND DISCUSSION

The average thinning ratio of harvesting units is calculated 0.70. This value showed that early low thinning applied in the study areas according to the thinning ratio classes (Alder, 1980). In the study, after the harvesting activities, all the saplings along the skidding routes were examined. A total of 464 damaged saplings were detected in the harvesting units and the percentage distribution of the damage types on the saplings was calculated (Figure 3).

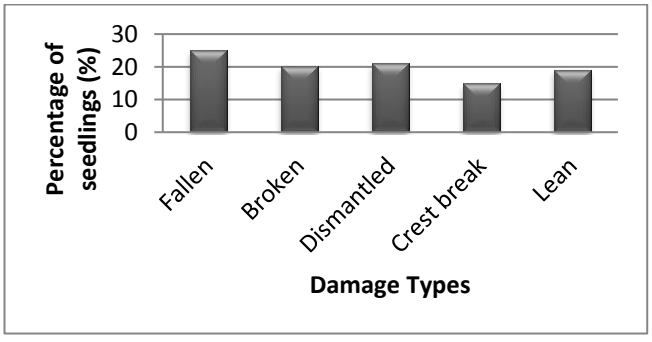

Figure 3. Proportional distribution of damage types in saplings

As seen in Figure 3, it was determined that the most common damage types were the lean (25%) and uprooting (22%) and the least frequent damage type was the broken top (15%). It was observed that about 2/3 of the broken saplings and all of the uprooted saplings had been lost their vitality. Similarly, Bugday and Menemencioglu (2013) determined that 327 saplings were damaged during harvesting activities in the mixed stands of Scotch Pine (Pinus sylvestris L.) and Fir (Abies nordmanniana subsp. Bornmulleriana Mattf.). 16.01% of the saplings died and 35.95% of them were exposed to breakage or stem damage.

Newton and Cole (2006) found that nearly 40% of all the seedlings were damaged. In addition, it has been determined that serious damages were happened such as the damage of the crushed, broken top and lean on 16% of the seedlings.

As a result of the Kruskal Wallis test, it was determined that there was a difference of 95% confidence level ($P < 0.05$) between the damage

types and the diameter of the damaged saplings (Figure 4).

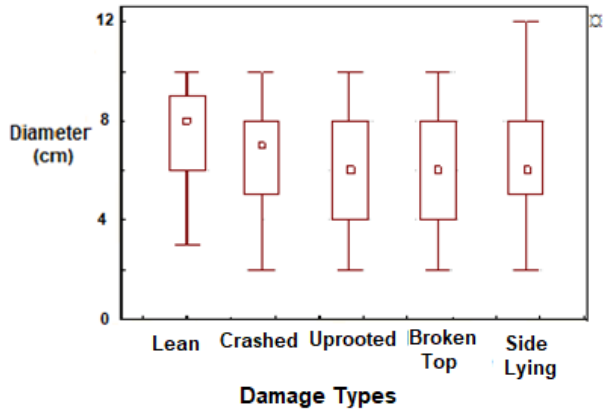

Figure 4. Relationship between damage type and sapling diameter

As seen in Figure 4, it was determined that thin-diameter seedlings are more likely to suffer side-lying damage while thick-diameter seedlings are exposed to lean and uprooting damages. This situation may arise because the thin seedlings are more flexible. Similarly, it was emphasized that small-sized saplings were more resistant to harvesting damages than large ones in some studies (Eliasson, Lageson & Valinger, 2003).

4. CONCLUTIONS

As a result of the statistical evaluations, it was determined that damage types on the saplings had varied depending on the diameter of the saplings. Thick saplings have suffered more severe damages than thin saplings and thin saplings were able to save themselves in a shorter time.

Environmental impact assessment (EIA) reports should be prepared before harvesting activities for harvesting units and the extraction technique with the least environmental damage should be selected especially in environmentally sensitive areas.

It may be appropriate to make wood harvesting in winter season in the forests where the length of the seedlings is longer than the thickness of the snow layer. If the length of the saplings is longer, it is preferable to use a controlled skidding on an artificial route method or aerial methods so that the top buds of the saplings are not damaged. A comprehensive study should be carried out to compare the effects of ground-based skidding on the seedlings in the summer and winter seasons.

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REFERENCES

Acar, H. H. & Unver, S., (2004). Determination of the harmful effects of wooden raw materials regarding technical and environmental aspects and recommendations for the solution. Journal of Bartın Forestry Faculty, 6, 6, 165-173.

Alder, D., (1980). Forest volume estimation and yield prediction vol. 2-yield prediction. Food and agriculture organization of the United Nations (FAO). ISBN 92-5-100923-6. Rome.

Anonymous, (2002). Climate datum relating to Trabzon. The report of Trabzon Meteorology General Director, Trabzon, Turkey.

Badraghi, N., (2013). Productivity, cost and environmental damage of four logging methods in forestry of Northern Iran (Doctorate Thesis). Dresden University Faculty of Environmental Sciences, 77p.

Bugday, E. & Menemencioglu, K., (2013). Forest harvesting damages to residual trees and saplings in mixed forests (A case study: Ilgaz Forests, Turkey). Proceedings of International Caucasian Forestry Symposium (pp. 265-270), Artvin, Turkey.

Eliasson, L., Lageson, H. & Valinger, E., (2003). Influence of sapling height and temperature on damage to advance regeneration. For. Ecol. Manage. 175, 217 – 222

Food and Agriculture Organization of the United Nations (FAO), (2018). Silviculture in natural forests. Sustainable forest management (SFM) toolbox. http://www.fao.org/sustainable-forest-management/toolbox/modules/silviculture-in-natural-forests

Food and Agriculture Organization of the United Nations (FAO), (2004). Reduced impact logging in tropical forests - literature synthesis, analysis and prototype statistical framework. Forest Harvesting and Engineering, Forestry Department - Working Paper 1, Rome.

Franklin, J. F., Berg, D. R., Thornburgh, D. A. & Tappeiner, J. C., (1997). Alternative silvicultural

approaches to timber harvesting: variable retention harvest systems. In: Kohm, K. A. & Franklin, J. F. (Eds.), Creating a forestry for the 21st century, Island Press, Washington, DC, 111-139.

Granhus, A. & Fjeld, D., (2001). Spatial distribution of injuries to Norway spruce advance growth after selection harvesting. Canadian Journal of Forest Research, 31, 1903-1913.

Hosseini, S. M., Madjnonian, B. & Nieuwenhuis, M., (2000). Damage to natural regeneration in the Hyrcanian Forests of Iran: a comparison of two typical timber extraction operations. Journal of Forest Engineering, 11, 2-8.

Kuramoto, S., Sasaki, S., Abe, S. & Ishibashi, S., (2010). Post-harvest damage and subsequent survival following selection harvesting of small understory trees in a mixed conifer–hardwood forest in Hokkaido Island, Northern Japan. Proceedings of FORMEC 2010 Forest Engineering: Meeting the needs of the society and the environment (pp. 1-4). Padova, Italy.

Naghdi, R., Bagheri, I., Taheri, K. & Akef, M., (2009). Residual stand damage during cut to length harvesting method in Shafaroud Forest of Guilan Province. Journal of Environmental Sciences, 60, 931–947.

Newton, M. & Cole, E. C., (2006). Harvesting impacts on understory regeneration in two-storied Douglas fir stands. West. J. Appl. For., 21, 14–18.

Organisation for Economic Co-operation and Development (OECD), (1994). Environmental impact assessment of roads. Report of OECD scientific expert group, Paris, 186 p.

Pereira, R. J., Zweede, J. C. & Asner, G. P., (2002). Forest canopy damage and recovery in reduced impact and conventional logging in Eastern Para, Brazil. Forest Ecology and Management, 168, 77-89.

Rahman, A., Viiri, H., Pelkonen, P. & Khanam T. (2015). Have stump piles any effect on the pine weevil (Hylobius abietis L.) incidence and seedling damage?. Global Ecol Conserv., 3, 424–432.

Rushton, T., Brown, S. & McGrath, T., (2003). Impact of tree length versus short-wood harvesting systems on natural regeneration. Forest Research Report 70. Nova Scotia Department of Natural Resources.

Sikström, U. & Glöde, D., (2000). Damage to Picea abies regeneration after final cutting of shelterwood with single- and double-grip harvester systems. Scandinavian Journal of Forest Research, 15, 274-283.

Siren, M. & Surakka, H., (2010). Sapling damage in mechanized selection cuttings. Proceedings of FORMEC 2010 Forest engineering: Meeting the Needs of the Society and the Environment (pp. 1-8), Padova, Italy.

Surakka, H., Sirén, M., Heikkinen, J. & Valkonen, S. (2011). Damage to saplings in mechanized selection cutting in uneven-aged Norway spruce stands. Scandinavian Journal of Forest Research, 26, 232–244.

Tavankar, F., Majnounian, B. & Bonyad, A. E., (2012). Felling and winching damages to natural regeneration in the Hyrcanian Forests of Iran. International Journal of Agronomy and Plant Production, 3, 300–305.

Thiffault, E., Hannam, K. D., Paré, D., Titus, B. D., Hazlett, P.W., Maynard, D. G. & Brais, S. (2011). Effects of forest biomass harvesting on soil productivity in boreal and temperate forests – a review. Environ Rev., 19, 278–309.

Tiernan, D., Owende, P. M. O., Kanali, C. L., Lyons, J. & Ward, S. M., (2001). Selection and operation of cable systems on sensitive forest sites. ECOWOOD project deliverable D2 (Work package No. 1), quality of life and management of living resources contract, 100.

Unver S. (2008). Determining environmental and quantitative effects of human power based ground skidding and the damage prediction model (Doctorate Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 233655).

Unver, S. & Acar, H.H., (2009), Evaluation of residual tree damage in sloping areas due to harvesting operations by manually. Austrian Journal of Forest Science, 126, 3, 119-132.

Unver-Okan, S., Gumus, S. & Acar, H.H., (2017). Assessment of wood harvesting activities in terms of sustainable forest management. Proceedings of International forestry and

environmental symposium (IFES) (pp. 231). Trabzon, Turkey.

Virdine, C. G., Dehoop, C. & Lanford, B. L., (1999). Assessment of site and stand disturbance from cut-to-length harvesting. Proceedings of 10th Biennial Southern Silvicultural Research Conference (288-292). Shreveport, Louisiana.

Vorob, V. N., Danchenko, A. M., Bekh, I. A., Panevin, V. S. & Burkov, V. P., (1994). Is it possible to preserve advance growth when using harvesters? Lesnoe Khozyaistvo, 6, 33-34.

Westerberg, D., (1995). Profitable Forestry methods-maintaining biodiversity as an integral part of Swedish Forestry, In: Bamsey, C.R. (Ed), Innovative silviculture systems in Boreal Forests, Clear Lake Ltd., Edmonton, Alberta, Canada, 61-65.

Whitman, A., Brokaw, N. & Hagan, J., (1997). Forest damage caused by selection logging of mahogany in Northern Belize. Forest Ecology and Management, 92, 87-96.

Yigit, N., Colak, E., Ketenoglu, O., Kurt, L., Sozen, M., Hamzaoglu, E., Karatas, A. & Özkurt, Ş., (2002). Environmental impact assessment "EIA", Ankara, ISBN 975-96176-1-7, 592p.