Damages inflicted to remaining trees, soil and regeneration in single - tree selection cuttings in mixed (coniferous and beech) stands from mountainous areas of Romania

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Abstract:
Research was conducted in mixed coniferous and beech stands located in Braşov mountainous area during single – tree harvesting. This paper presents data regarding the damages inflicted to the remaining trees, regeneration and soil during skidding operations.

Keywords: damages, ecosystem protection, single – tree selection cuttings

1 Introduction

Single - tree selection is advisable to be applied in natural forests, uneven and relative uneven aged. It is the most intensive harvesting method of the forest and it is characterised by the following:

- maintain constant size and structure of current growth in volume;
- forest possibility is harvested with continuity;
- provide a continuous and effective natural regeneration in relation with ecological and economical demands;
- maintaining genetic diversity and preserve the natural genetic fund particularly valuable from the mountain forest massifs.

Logging in case of single - tree selection is more difficult and more expensive. Cuttings takes place on larger areas than other harvesting methods and the volume harvested per hectare is lower than in case of cuttings made in even aged stands. The equipments used must be supple in order to produce minimum damages to the remaining trees, seedling and soil.

In this paper are analyzes the influence of forest logging to the remaining trees, seedling and soil in mixed beech and coniferous stands located in the mountains of the Curvature Carpathians in which were applied single - tree selection cuttings.

2 Place of research. Method of research

The research was conducted in stands located in Postavaru Massif, Management Unit No. V Noua in which were made cuttings for regeneration (Figure 1). Table 1 presents the general conditions of the compartments where the researches were made.

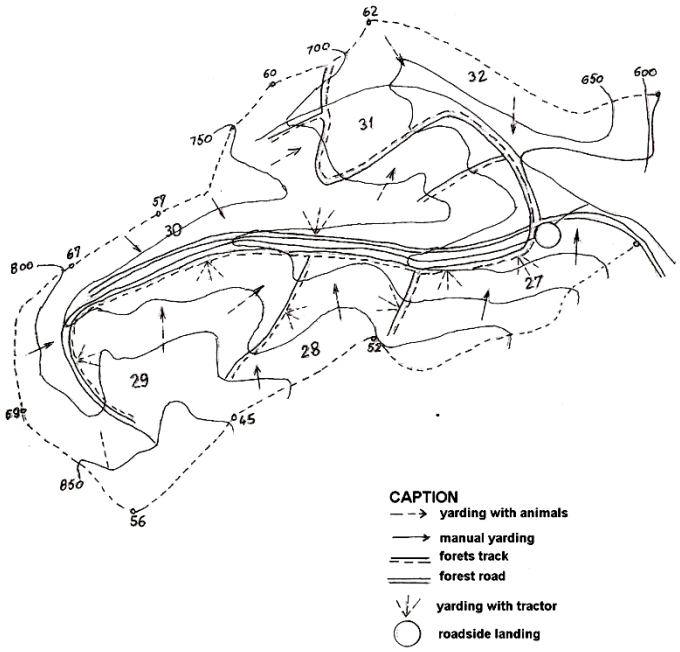

Figure 1: Layout for wood skidding in compartments 27 -32

Table 1: General conditions of the compartments

Current number	Compartment	Surface [ha]	Forest site characteristics				Stand characteristics				
			Altitude [m]	Exposition	Declivity [degree]	Forest site type	Composition	Age [years]	Site class /Stand density	Volume [m^3]	Forest type
0	1	2	3	4	5	6	7	8	9	11	12
1	27	13.00	630 910	N	27	3333	6Br4Fa	140	II/0.6	385	2211
2	28	18.10	670 880	NE	25	3333	6Br4Fa	125	II/0.7	357	2211
3	29	17.80	770 870	SE	20	3332	6Br4Fa	135	III/0.7	376	2212
4	30	14.90	630 770	S	20	3332	5Br5Fa	90	III/0.8	300	2212
5	31	21.90	610 770	N	20	3332	6Fa2Br2Mo	70	III/0.8	336	2212
6	32	13.80	600 720	E	35	3332	2Br6Fa2Mo	70	III/0.7	271	2212

*Br – Fir; Fa – beech; Mo – spruce.

Objectives followed in the present research were:

- establishing the logging technologies based on geomorphological features of land, stand structure and intensity of interventions;
- knowledge of the nature and intensity of damages caused by timber harvesting on remaining trees, soil and seedling

For establishing the damages made to the remaining trees after logging, trees inventories were realized on square surfaces having 20m side, placed along the hauling tracks and near the skidding tracks (forest tracks).

The following observations were made in each sample plot: the total number of standing trees and the total number of harvested trees were countered. For the remaining trees were established the species; the damages type and their dimensions were recorded and also the DBH for each tree was measured.

The damaged trees were classified in accordance with the damage type and gravity in small, mild and strong damaged using the Petrescu method (1974), respectively:

- small scars, with the width less than 25% of the trunk circumference;
- mild scars, which affect between 25 and 50% of trunk circumference;
- big scars, which affect more than 50% of the trunk circumference.

Damages to the soil were evaluated based on measurements made over some traverse placed on the contour line and along the skidding tracks. The damages to the soil were appreciate taking into account the following classification: low damaged surfaces where the litter was disarranged or removed; moderately damaged surfaces where up to 50% from the A layer (the humus layer) was removed; strongly damaged surfaces where the A layer was removed between 50 and 100%; very strongly damaged surfaces, where the A layer was completely removed and ditches were made.

Damages on seedling were assessed by inventories carried out in areas with a radius of $1m^2$, placed on the entire logging surface.

3 Results

3.1. Damages to the remaining trees

For logging were used different technological solutions, especially for skidding, in accordance with the field conditions. The logging method was trunk and mast because animal yarding and hauling impose to cross – cut the trees and cleaning the branches. In each sample plot and compartments were made several measurements resulting an average of damaged trees. For slopes with declivity less than 40%, yarding was made with animals and for more than 40% with cant hook.

Were adopted the following skidding solutions:

- forwarding and “first skidding” was made in several stages with animals, by hauling and with the winches mounted on tractors and skidders;
- for yarding was use mainly the tractor, but also the animals;
- tractor tracks and animal tracks were placed usually on valleys, avoiding the line of highest declivity.

Analysing the obtained data the following conclusions can be draw:

- the low damaged trees has the biggest share. Thus, from the total group, the average number of low damaged in an area of $400m^2$ trees was 1.13 (Figure 1), for moderately damaged trees was 0.17 (Figure 2) and 0.13 trees were strongly damaged (Figure 3) – the number of low damaged trees increase with the distance due to the increased number of trees collected by the sector.
- the number of moderate and strong damaged trees being very low, can not reveal a direct correlation with the yarding distance. It can be considered that, statistically, the concerned trees are rare events and they should be harvested in the further;
- strongly damaged trees includes especially tiny trees, broken during skidding.

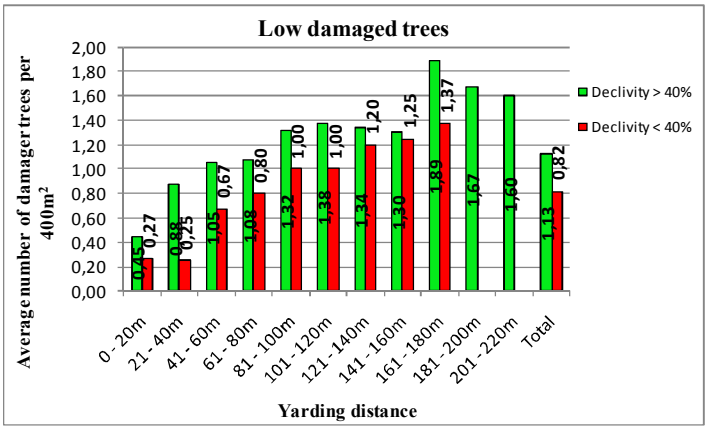

Figure 2: Situation of low damaged trees after yarding for declivity <40% and >40%

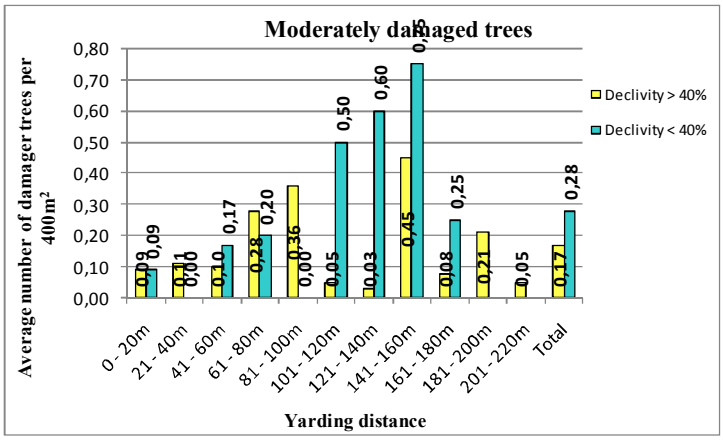

Figure 3: Situation of moderately damaged trees after yarding for declivity <40% and >40

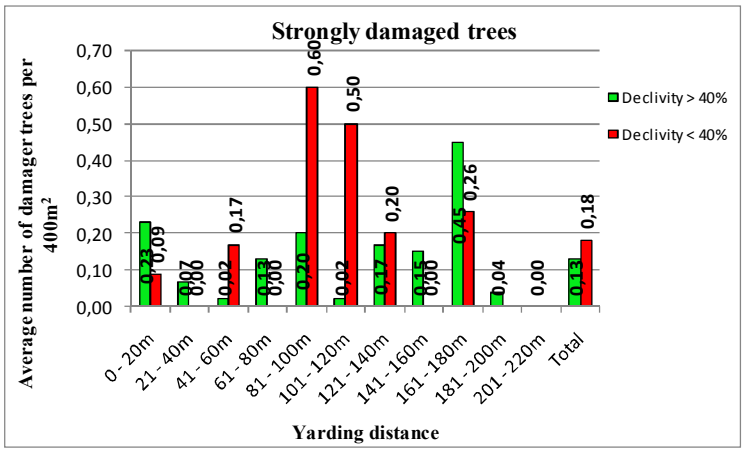

Figure 4: Situation of strongly damaged trees after yarding for declivity <40% and >40

Differentiate analysis of the damages made to the trees located on the edge of animal and tractor tracks, shows that here they are maximum in these cases (Table 2 and Figure 5). Thus in case of tracks for animal forwarding, the share of damaged trees is 43%, from which over 10% are moderately and strongly damaged.

Trees located near the tractor tracks suffered the most important damages, namely (Table 2):

- In relatively uneven - aged stands (compartment 27 – 30), more rare, the share of damaged trees increase to 57% of trees, from which 20% are medium and strongly damaged trees.
- In younger and even – aged stands (compartments 31 and 32), with thinner trees, but densely, the tractor load being greater, the share of damages increase to 68% from number of trees and for moderately and strongly damaged trees to 45 – 50%.

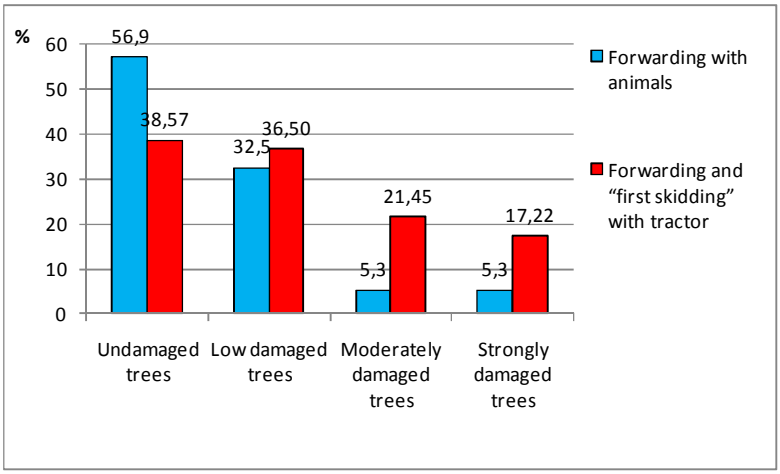

Figure 5: The intensity (in %) of the damages produced to the standing trees in accordance with the logging technology

Table 2: The intensity (in %) of the damages produced to the standing trees according to logging technology

Type of damage	Species	Forwarding with animals	Forwarding and "first skidding" with tractor	
			Compartments 27 - 30	Compartments 31 - 32
		No. of trees [%]	No. of trees [%]	No. of trees [%]
0	1	2	3	4
Undamaged trees	Br	61.7	38.2	27.2
	Fa	52.3	48.5	34.6
	Total	**56.9**	**43.1**	**32.3**
Low damaged trees	Br	28.2	41.8	22.5
	Fa	36.6	32.7	21.9
	Total	**32.5**	**37.4**	**22.1**
Moderately damaged trees	Br	4.7	10.9	29.7
	Fa	5.9	9.9	24.3
	Total	**5.3**	**10.4**	**26.1**
Strongly damaged trees	Br	5.4	9.1	20.6
	Fa	5.2	8.9	19.2
	Total	**5.3**	**9.1**	**19.9**

*Br – Fir; Fa – beech;

3.2. Damages made to the soil

From the total area of harvested stands, about 20% (approx. 20ha) suffered changes after logging works. From this area, on 65% were made unessential changes, respectively litter disarrangement or removal of this and the remaining 35% was degraded more or less. In the considered compartments, the surface in which the soil suffered changes varies between wide limits (Figure 6).

Moderately and strongly degraded area, where the humus horizon was partially or totally removed, usually contains parts where the yarding was realised with animals or by hauling. Strongly degraded area generally includes hauling trails and forwarding tracks with tractor or with animals.

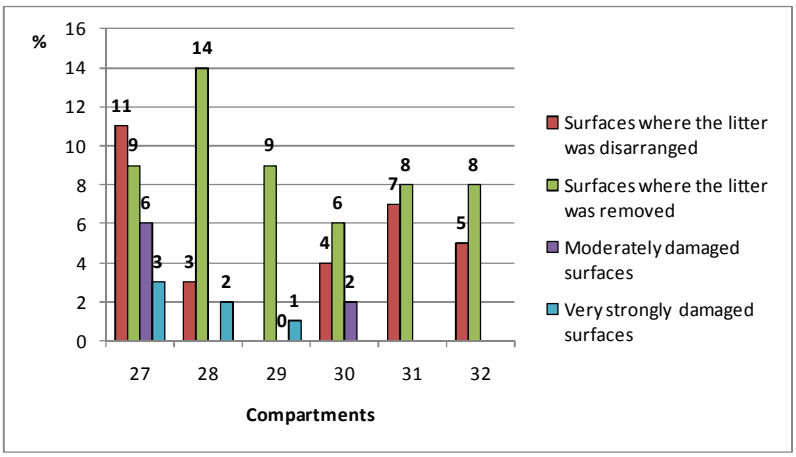

Figure 6: Damages done to the soil

3.3. Damage to regeneration

Regarding the damages done to the seedlings, in Figure 7 it can be seen that the highest numbers of damaged seedlings were in plots 27 and 31, but there was no correlation between the type of damage and logging technology.

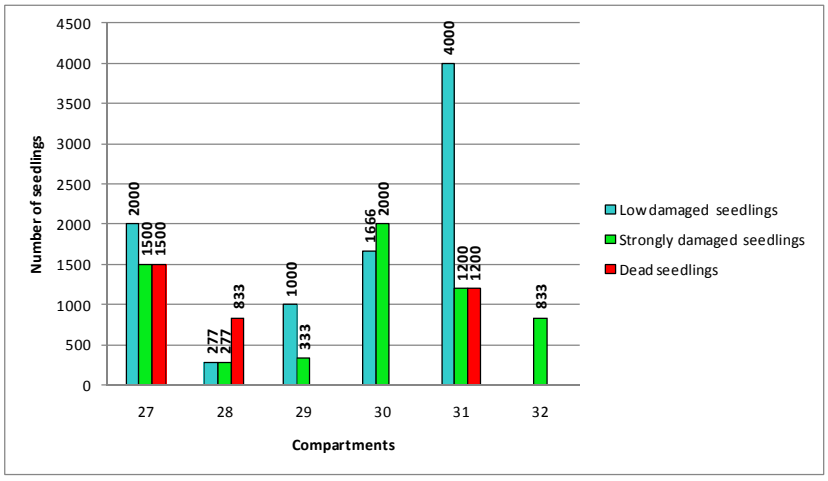

Figure 7: Damages made to the seedlings

4 Conclusions

Regarding the damaged trees, the general conclusion is that the level of damages made to the standing trees varied directly proportional with the skidding distance, but also with relief characteristics, skidding means, volume and weight of the load. At animal yarding, the correlation took into account only the low damaged trees, the moderately and strongly damages being considered rare events which do not affect the quality of the remaining stand. Instead, at tractor skidding, the share of moderately and strongly damaged trees increase significantly. This should be considered at logging control, which must be made by surveying the entire length of skidding line.

The relative great differences regarding the changes made to the soil in different compartments is predominantly due by the work way and this was determined primarily by the interventions intensity, the average volume of trees, terrain characteristics a.s.o.

Regarding the logging technology, to reduce the damages it is necessary that in case of "first skidding" with animals and especially for tractor forwarding to limit the load size, to avoid the minimum radius of curves, to use specially or makeshift means for marginal trees protection, to limit the length of tractor roads inside the forest, to avoid the logging in the period with very wet soil a.s.o.

The estimation of damages made to the standing trees, seedlings and soil has a double significance: establishing some rational limits of some inevitable damages with no serious consequences for the future evolution of the forest and improving the existing technology or even to design appropriate work processes, more adequate to the forest management requirements.

5 References

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