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FOREST DEGRADATION AT WINTER RECREATION PLACES

SUMMARY

Studies were conducted from January 2013 to April 2014. The object of our study is pine green-moss. It is 110-140 years old. The relative density of the investigated forest plot is 0.7. The object locates in an officially recognized faunal zone of an urban forest park. The studied ski trail includes three relief elements. These are the watershed, the western slope and the foot of the slope. Ski-run has a distinctive profile by two types of skiing. The first is the movement "skating move"; the second is the movement "classical course". Once a week snowmobiles went along the ski-run: it was prepared for the competition.

We selected three typical points on each element of the relief. We have measured the snow conditions, the physical condition of the soil, litter and living ground cover at each point. The measurements were triplicated. The snow density on the ski run was 0.6 g/cm^3. This value was more one of the area outside recreation. The high density of the snow on the track stretches its melting period for 2-3 weeks. At least, the snow melts on the watershed. This provokes the processes of water erosion on sloping sections of the route. There is no litter in the center of the track. The soil freezes on the track. Field layer remains only at the edges of the track. Pine cores were measured for moisture in April 2014. The wood moisture of pines growing near the border of the track was lower than one of the pines growing away from the track. The difference was 10 %.

Keywords: winter recreation, ski-run, green moss pinery, snow density, field layer, forest litter.

INTRODUCTION

The best kind of daily rest is a sojourn of a man among tree plantations (Agal'cova, V. A., 2004; Zundel, R., 1977). The human ear has a rest from the noise of civilization (talk of clients and colleagues, sounds of news and advertising). The human look disperses on vague tree crowns. While in city conditions it focuses on the geometry of the buildings and information boards and the abundance of human faces. In the forest a human skin feels nature cool of shade instead of urban air. That is why large areas of tree plantations attract a large number of people. Those areas are named "the forest".

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If a forest is among a city, it experiences influenced enormous effect from vacationers (Agal'cova, V. A., 2004; Bol'shakov N. M., 2006; Dvinskih S.A., 2011). The territory of a forest park has to be zoned for ensuring its recreational functions. Each zone is intended for a certain kind of activity. Then each zone has to be provided with a system of actions. There are three zones. They are active recreation, walking rest and incidental rest (Agal'cova, V. A., 2004; Zundel, R., 1977). The last zone is intended for ensuring stability of the forest territory. It provides protection for the forest fauna against people, dogs and cats. Often it is called "a zone of faunistic rest". Its recreational loading should not exceed 2 people per hectare a day (Agal'cova, V. A., 2004; Yapp, G., 1977). Usually such zones allocate in places difficult to pass in the summer period.

Usually, Russian winter lasts for 5-6 months. Snow fills up marshy sites, courses of streams. Vacationers put on skis and direct deep into the forest park that was before not available to visit. Many scientists consider that the snow cover provides protection for elements of the wood (underbrush, litter, field layer). At the same time, some authors are convinced that consolidation of snow does not take place completely for the wood. But data about influence of the winter recreation on the development of forest elements did not come across to us (Bol'shakov N. M., 2006; Heinritz, G., 1975; Jirak, Z., 1975; Satchell, J. E., 1976).

MATERIAL AND METHODS

The studies were conducted since January 2013 till April 2014. The object of our study is pine green-moss. It is 110-140 years old. Relative density of investigated forest plot is 0.7. The object locates in an officially recognized faunal zone of a city forest park in Perm (Fig. 1).

Figure 1. The position of the urban forest park in Perm and the position of the research forest plot in the forest park

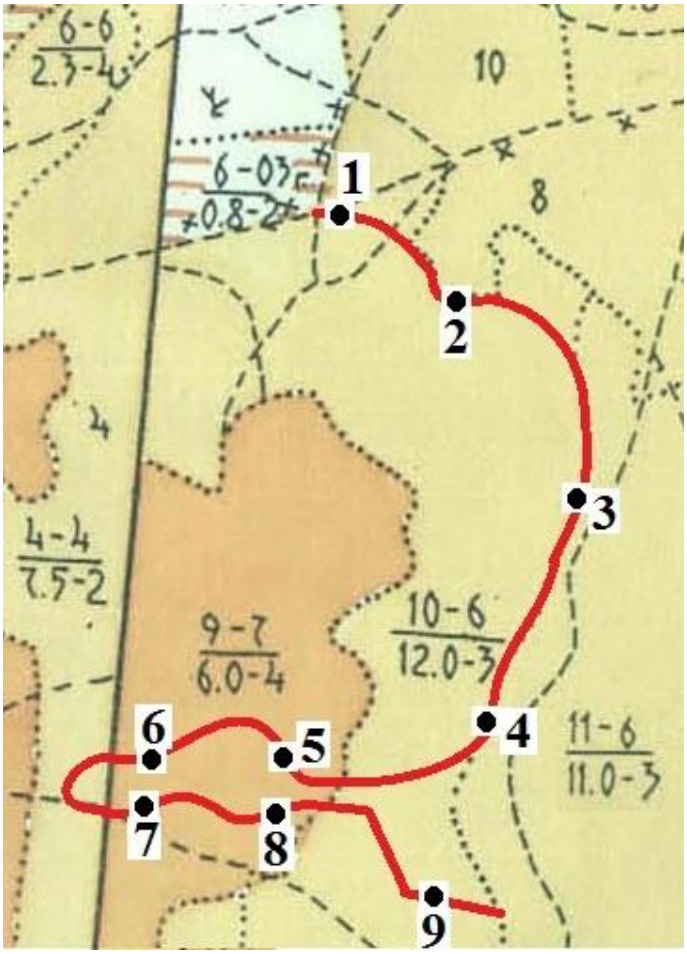

Figure 2. The position of the research points on the investigated ski-run (drawn by a red line)

The ski-run was laid on a studied site on different elements of a relief (Fig. 2). Points of carrying out researches 1, 6 and 7 are in the slope bottom. Points 2, 5 and 8 are on the western slope. Points 3, 4 and 9 are on the watershed of the wood lot.

The purpose of research is the development of forestry activities for the forest conservation in conditions of high recreational load in winter. The research program consisted of five sections. The first is the measurement of the snow depth dynamic on the ski-run and around of it. The second is the dynamic change of the soil physical properties during the growing season of the forest. The third is the measurement of the thickness of the litter. The fourth is the determination of the status of the living ground cover. The fifth is the impact assessment of winter recreation on the radial growth of pine trees.

We selected three typical points on each element of the relief. We have measured the snow conditions, the physical condition of the soil, litter and living ground cover at each point. The measurements were performed three times. The density of snow on the ski-run and around it was measured by Nekrasov's soil borer. The snow depth was measured with a metal ruler with millimetre scale. The samples were taken every week during both winters. The soil samples were taken in 10 days after the snow melts. The selected soil samples were analysed for soil moisture and soil density. The thickness of the litter was measured with a metal ruler once per summer with the selection of soil samples. The projective cover of living ground cover was measured in August 2013. Radial growth of pine was determined by cores. The core samples were selected in 10 pine trees growing on the edge of the ski-run and in 10 ones growing around ski-run in April 2014.

RESULTS AND DISCUSSION

The calculation of skiers showed that the quantity of vacationers was 143 persons an hour, although the air temperature was low – 200 C. If the weather was warmer, the number of skiers was more than 200 people an hour. The ski-run had a distinctive profile by two types of skiing. The first is the movement "skating move", the second is the movement "classical course" (Fig. 3). Once a week snowmobiles went along of ski-run. They prepared it for the competition. Such recreational loading leads to formation of various height of the snow cover (Fig. 4).

The chart in Figure 4 shows that the height of the snow cover on the ski-run has the maximum value in the centre. And it does not depend on the location of the relief. The minimum value of the snow height is observed on a slope and at the foot of the slope to the right of a classical ski-track. It is a profile site where skiers lean at ski sticks and beat out away snow. The similar phenomenon is not noticed on a watershed.

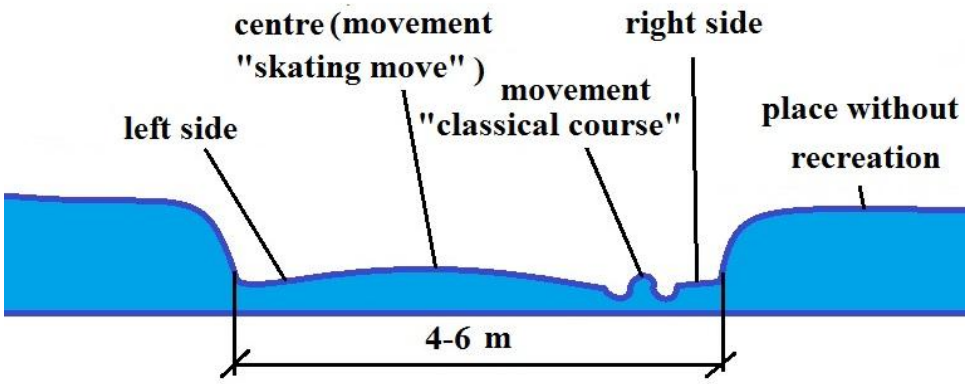

Figure 3. The distinctive profile of ski-run

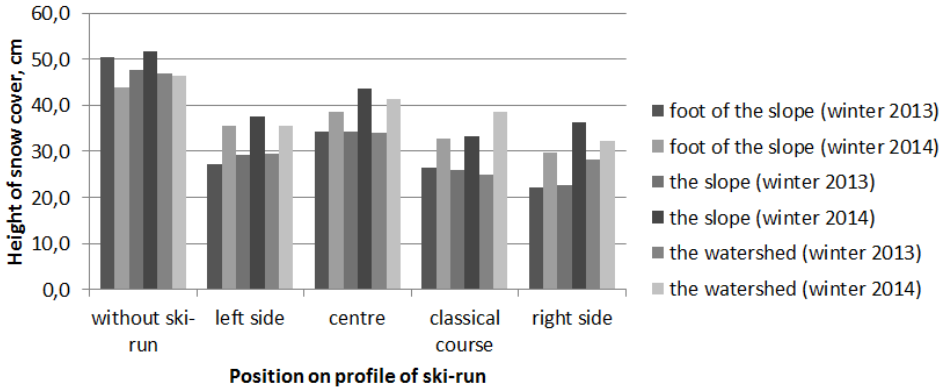

Figure 4.The height of the snow cover on the profile of the ski-run (February)

As we expected, the ski-run snow density had greater values than one on a site off the recreation. The maximum density was revealed in the ski-run centre for two years of the monitoring. It reached the value of 0.5 g/cm3 by the period of maximum snow accumulation (February). By the end of April the value of the snow density reached 0.6 g/cm3 for both years. On a site out of the recreation the maximum value of the snow density was 0.3 g/cm3. The high density of the snow on the ski-run stretches its melting period for 2-3 weeks. At the last turn snow thaws on the watershed (Fig. 6).

It provokes processes of water erosion of the soil on slope sites of the ski-run. The water flows downhill and washes away fallen-down needles and leaves. Therefore, the forest litter practically disappears in the centre of a ski-run on a slope and at the foot of the slope (Fig. 7). While the thin layer of the litter remains on a watershed part of the ski-run.

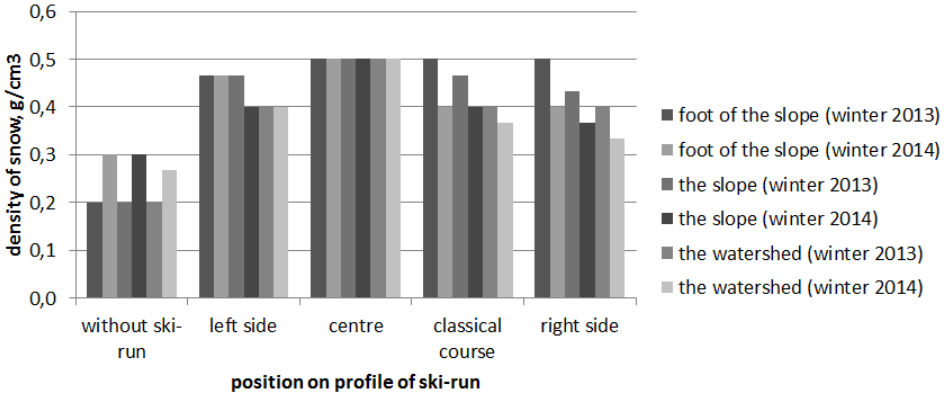

Figure 5. The density of snow cover on the profile of ski-run (February)

The soil freezes through under the condensed snow. Then it slowly gets warm. The effect of the soil freezing has impact for 5 meters out of the ski-run

(Fig. 7). That effect detains the vegetation of the living ground cover (Fig. 8). Grassy plants start developing for 2-3 weeks later.

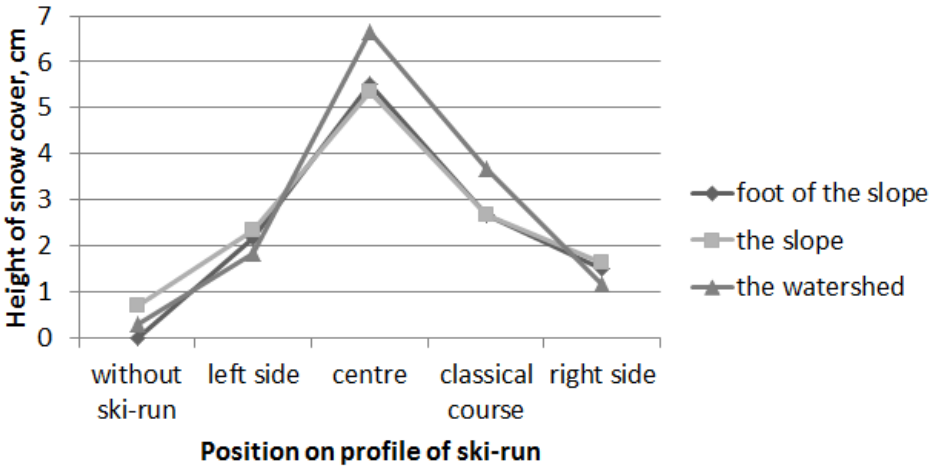

Figure 6. The height of snow cover on the profile of ski-run (April, 2013)

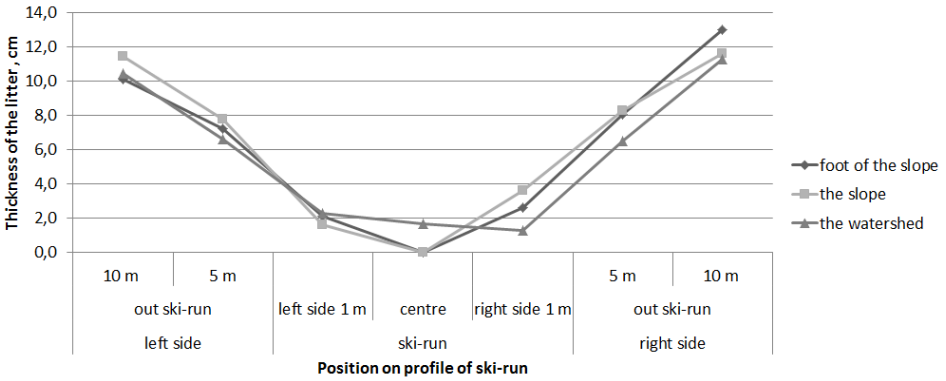

Figure 7. The thickness of the litter

The living ground cover on a site out of the recreation is presented by green mosses (Pleurozium schreberi, Polýtrichum commúne), cowberries (Vaccinium vitisidaea L.), bilberries (Vaccinium myrtillus L.), wood small reed (Calamagrostis epigeios Roth.). Bifoliate bead-ruby (*Majanthemum bifolium* L.) woodland strawberry (*Fragaria vesca* L.), wood sorrel (Oxalis acetosella L.), stone bramble (Rubus saxatilis L.) are seldom. The meadow grass (Poa annua L.) develops only on a place of the ski-run. Meadow grass is developed poorly. It is not able to protect the slope from the drain during the spring and summer period. Flowing-down water washes away fallen-down needles, foliage and the soil, baring roots of trees.

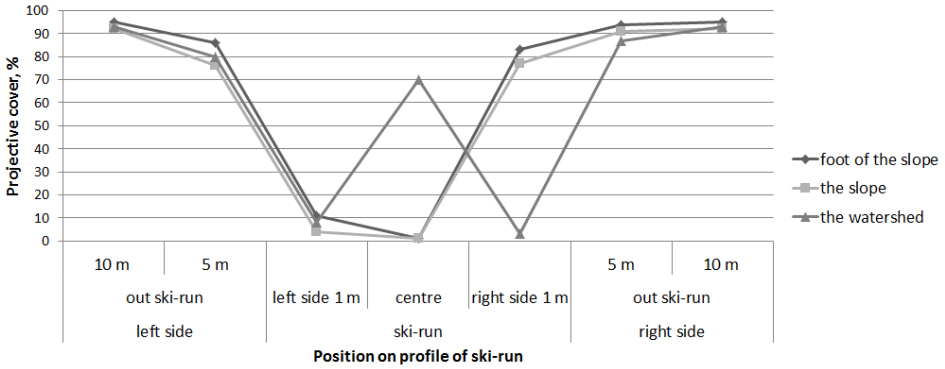

Figure 8. The projective cover of the living ground cover

We believe that the winter recreation directly affects the forest situated on the slope. At the watershed and at the slope foot, the winter recreation prevents the restoration of live ground vegetation previously destroyed by the human activities. So, we found the areas with live ground vegetation destroyed by fire trucks during fire-fighting in the forest in 1992. Those areas were successfully overgrown when there was no ski-run.

Pine cores were measured for moisture in April 2014. The wood moisture of pines growing near the border of the track was lower than one of the pines growing away from the track. The difference was 10 %.

CONCLUSIONS

1. The ski-run snow density is more than one on a site out of the recreation by 1.5-2 times. The high density of the snow on the ski-run stretches its melting period for 2-3 weeks. In the last turn snow thaws on a watershed.

2. Thawing on the watershed snow washes away the forest litter on a slope and at the foot of slope. The phenomenon of washout continues all warm period by rains. The thickness of the forest litter on the ski-run fluctuates from 0 to 4 cm. It is less than the thickness of the litter on a site out of the ski-run by 2-4 times.

3. Dense snow promotes frost penetration in the soil. The living ground cover on the ski-run starts developing later and does not protect the soil from erosive processes. We noted the decrease of the litter thickness for 30-35 % in the natural wood at the distance of 5 meters aside from the ski-run.

4. The living ground cover on the ski-run is presented by the meadow grass. The living ground cover remains typical for the green-moss pinery on a site out of a recreation.

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