Work accidents during cable yarding operations in Central Europe 2006 – 2014

Michal Allman¹, Martin Jankovský², Zuzana Allmanová³, Michal Ferenčík¹*, Valéria Messingerová¹, Mária Vlčková¹ and Stanimir Stoilov³

¹Department of Forest Harvesting, Logistics and Ameliorations, Faculty of Forestry, Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic. ²Department of Forestry Technologies and Construction, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 11/76, 165 21 Praha 6 – Suchdol, Czech Republic. ³University of Forestry, Department of Technologies and Mechanization of Forestry, 10, Kliment Ohridski Blvd., 1756 Sofia, Bulgaria.

Abstract

Aim of study: This study is focused on detailed analysis of accidents in yarding during the years 2006–2014. There is still not enough information about such accidents in Central Europe in the literature available.

Area of study: We collected the data on occupational accidents recorded in timber yarding from the databases of the Slovak state forest enterprise.

Material and Methods: The data on occupational accidents were recorded according to actual European Regulation, the form of the record meets the requirements of the ESAW (European Statistics on Accidents at Work) methodology. To analyze the data, we used the multiple regression and correlation analysis, contingency tables, and a $\chi^2$-test.

Main results: Almost half of the accidents were the foot injuries and the most frequent type of injury was fracture of a bone. The most hazardous operation was yarding. Most of the accidents occurred between 13:00-14:00 h (22 %). The most frequent agent causing accidents were Particles, dust, splinters, fragments, etc. (14.05 by ESAW).

Research highlights: This study informs about the most important risk factors in timber yarding, the most hazardous parts of shift, as well as the days when the most accidents occur during the week, and as such contributes to better understanding of how the accidents happen in timber yarding. The information can be subsequently used in knowledge-based improvement of safety trainings in forest enterprises.

Keywords: cable yarder; timber logging; work accident.

Introduction

Forestry covers many occupations, out of which forest harvesting is the most hazardous with the most fatal and severe accidents out of all occupations in the industry (Kawachi et al., 1994; Myers & Fosbroke, 1994; Paulozzi, 1987; Salisbury et al., 1991; Parker et al., 2002; Evanson et al., 2001). Occupational risks in forest harvesting is a combination of natural and material agents (Melemez, 2015), due to the fact that the workers carry out their jobs in a physically demanding environment, such as extreme climatic conditions, falling trees, fatigue, hazardous tools, heavy machinery, and frequently work isolated (Crowe, 1986; Slappendel et al., 1993; Peters, 1991; Foley, 1994; Gandaseca & Yoshimura, 2001; Parker et al., 2002; Lilley et al., 2002; Klun & Medved, 2007; Mitchell et al., 2001).

Mechanized non-mechanized logging is particularly difficult on steep slopes, where the risk of occupational accident is very high (Tsioras et al., 2014). Slope is an important factor when considering the optimal harvesting technology, though cable yarding is considered the most suitable technology in slopes...
steeper than 40% from the environmental point of view on one hand, and occupational safety on the other (Visser & Stämpfer, 1998). This slope is considered a threshold, beyond which it is safer and environmentally friendly to use cable yarding than using ground-based skidding technologies (Tajboš et al., 2012), as it causes less harvesting induced erosion than ground based machinery (Worell et al., 2011). Cable yarding is not a riskless technology, because mostly during mounting and dismounting the yarder, there is an increased risk of slip and fall injuries, or accidents caused by the cable, which is one of the reasons why sustainable forestry needs new set of standards in forestry operations (Tsioras et al., 2011).

Using yarders is advantageous mainly in mountainous countries, to which we place, among other countries, Slovakia, as more than 40% of its total forest area meets the above mentioned criterion on slope steepness, and should be therefore yarded with cable yarders (Messingerová et al., 2009). Despite the favorable natural conditions, cable yarding is not popular in Slovakia at the moment, as only around 7–8% of the total harvested volume is yarded. In the Slovak state forest enterprise (SFE), about 400 000 m$^3$ of timber was yarded in 2015, which is about 10–11% share of the total harvested timber in the enterprise (Lesy, 2016).

However, Slovak forestry was a pioneer in yarding timber once, as during the 1950s and 1960s 27% of total harvested timber (1.1 million m$^3$ out of 4.1 million m$^3$) was yarded. The decline of this technology (10% in 1975, 3.5% in 1985, and 1.4% in 1998) was due to the technological advancement of the ground-based technologies in the 1970s, which enabled lower operational costs in steep terrains, as well as low regard for the environment (Lukáč et al., 2001).

In this study we focused on determining the temporal distribution of accidents in yarding, identifying the agents causing accidents, and modes of injuries, as well as identifying which groups of workers were the most prone to accidents in SFE during the years 2006–2014.

Material and methods

Slovak state forest enterprise manages 1.04 million ha (54% of the total area) of Slovak forests (Green Report Brochure, 2015). Annual cut in SFE varied between 4–5 million m$^3$, depending on the amount of incidental fellings (Green Report Brochure, 2015). Slovak state forest enterprise is divided into 32 forest districts located around the country. Harvesting and construction works that are not outsourced are supplied by the Enterprise of Forest Technique in Banská Bystrica (EFT). This enterprise harvested circa 5% of the total volume, mainly by yarders and cut-to-length technologies. The remaining volume was harvested by contractors.

In the year 2015, EFT owned and operated 20 cable yarders — three Steyr KSK 16, 11 Larix 3T, four Larix Lamako, one Larix Kombi H, one Mounty 4000. Individual yarders were operated by a crew of four people — a chainsaw worker, choker setter, yarder operator at the bottom station, and skidder operator. Work was organized into day shifts (eight hours per day, five days per week). The number of employees working with cable yarders during the years 2006–2015 gradually increased from 48 to 80 people (Table 1), following the increasing number of yarders owned by the company. The Enterprise of Forest Technique yarded more than 100 000 m$^3$ of timber and another 300 000 m$^3$ were yarded by contractors.

We collected the data on occupational accidents recorded in timber yarding from the databases of the SFE. The company records all occupational accidents according to the Regulation n. 500/2006 Coll., through which the Regulation of the European parliament and Council n. 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work was transposed into Slovak legislation. The form of the record meets the requirements of the ESAW (2013) methodology. The following information was recorded when an accidents was reported: (i) data on the injured employee (age, sex, years of practice, etc.); (ii) regional department of the EFT in which the accident occurred; (iii) date of the accident (day, month, and year of the accident); (iv) the place of the accident (Forest district); (v) the operation at which the accident occurred (yarding, felling, de-limbing, yarder maintenance, bucking, and mounting or dismounting

Table 1. The number of yarders owned by Forestry machinery branch of Slovak state forest enterprise, the number of people employed in yarding, and the volume of yarded timber in the years 2006–2015

| Year | Number of yarders | Number of employees | Volume of yarded timber (m$^3$) |
|------|-------------------|---------------------|-------------------------------|
| 2006 | 12                | 48                  | 65 963                        |
| 2007 | 14                | 56                  | 73 321                        |
| 2008 | 14                | 56                  | 74 448                        |
| 2009 | 14                | 56                  | 74 924                        |
| 2010 | 15                | 60                  | 77 608                        |
| 2011 | 16                | 64                  | 78 865                        |
| 2012 | 17                | 68                  | 83 032                        |
| 2013 | 19                | 76                  | 97 649                        |
| 2014 | 19                | 76                  | 97 635                        |
| 2015 | 20                | 80                  | 100 183                       |
the yarder); (vi) body part injured (arm, hand, leg, foot, ribs, back, shoulder, pelvis, chest, and multiple injuries); (vii) type of injury (fracture, contusion, scrape, laceration, wrench, cut, stretch, concussion, internal injury, rupture, blunt trauma, dislocation, amputation); (viii) severity of the injury (minor – up to six days sick leave; severe – more than six days sick leave; fatal); (ix) material agent (e.g. hand tools, machines, lifting equipment, vehicles, etc.); (x) mode of injury (e.g. slippage of material agent, horizontal motion of the victim, vertical motion of the victim, etc.)

To analyze the data, we used the multiple regression and correlation analysis, contingency tables, and a $\chi^2$-test.

**Results**

During the observed period, 72 occupational accidents happened in the SFE. Forty-four of these accidents (62%) were minor injuries, 27 (38%) were severe injuries, and one (1%) was fatal. The total annual count of accidents was from five, in 2008, up to 11, in 2014 (Fig. 1). The mean count of accidents was nine (six minor injuries and three severe injuries). The fact that in the observed period of nine years only one fatal accident occurred shows that the crews followed the occupational safety standards thoroughly and that when the standards are kept, timber yarding is a safe technology.

The greatest count of accidents happened in the second half of the observed period, when 53% of all accidents occurred, when the total harvested volume of timber in the company, increased (Fig. 1). We studied the relationship between the number of accidents occurring, total harvested volume of timber, and the share of incidental fellings through multiple regression and correlation analysis. The analysis proved a strong relationship with the correlation coefficient of 0.79 ($p = 0.003$). Circa 63% of the variability of the number of accidents was explained through the variability of the share of incidental fellings and the annual total harvested volume of timber (Table 2). The development of the number of yarders in operation, the number of employees employed in timber yarding and the number of accidents during the observed period is also interesting. On Fig. 2 we can see the increasing number of yarders and employees and the fluctuating number of accidents on average, one accident happened to every eight employee on every second yarder.

Two thirds of the accidents were hand and foot injuries, 13% were head and neck injuries, 8% were torso injuries, 7% multiple injuries, and 6% shoulder injuries. Almost half of all accidents (33; 46%) were foot injuries, from which 15 accidents (46%) happened during yarding, nine (27%) during felling, and eight (24%) during de-limbing. During bucking, in the bucking yards, only one accident happened. Out of 15 hand injuries, seven (47%) injuries happened during felling. Head and neck injuries most commonly happened during de-limbing. The most hazardous operation was yarding, during which 30 (42%) accidents happened, followed by felling with 22 accidents (30%), and de-limbing.

![Figure 1. The number of accidents in timber yarding according to their severity during the years 2006–2014 in Slovak state forest enterprise; volumes of timber harvested in particular years; share of incidental fellings in particular years.](image-url)
with 15 accidents (21%). In other operations (repairs, maintenance, bucking, mounting and dismounting) five accidents were recorded.

The employees most frequently fractured their bones, 20 such injuries were recorded by the Slovak state forest enterprise, followed by 13 (18%) contusions, and nine (13%) of scrapes and lacerations each (Fig. 3). All of these injuries resulted from the nature of work in timber yarding, where employees work with heavy and moving loads and in difficult terrains.

Most of the accidents occurred before noon — 44, or 61% of the total count (Fig. 4). The most hazardous however, was the time between 13:01 and 14:00, when 16 (22%) accidents happened, followed by pre-noon hours between 8:01 and 9:00 with 14 (19%) accidents, and 11:01 and 12:00 with 13 (18%) of accidents. From the total count of pre-noon accidents, 25 were minor, 18 were severe, and one was fatal. In the afternoon, 19 accidents were minor and nine were severe. Despite the culmination between 13:01 and 14:00 we can conclude that working in the afternoon was less hazardous than working in the morning and pre-noon. We tested whether the working hour affected the severity of the injury, but through the χ²-test we determined that this variable has no significant effects on the severity of the injury (χ²=15.13<23.68, df=14, p=0.37).

The distribution of accidents throughout the week can be seen in Fig. 5. From the records we concluded that the most accidents (23; 32 % of the total count) occurred on Tuesday. On the other hand, least accidents (9; 14%) happened on Monday. Statistical analyses did not confirm any relationship between the day of week and the severity of injuries occurring throughout the week (χ²= 8.98<15.51, df = 8, p = 0.34).

The number of accidents in individual months varied from two (3% of total count) in December

### Table 2. Relationship between the number of accidents, the annual volume of harvest, and the share of incidental fellings;

|                      | Regression results |          |          |          |          |          |
|----------------------|--------------------|----------|----------|----------|----------|----------|
|                      | R= 0.79; R²=0.63   | F(2.6)=5.09 p<0.05 Standard error: 1.49 |
| N=9                  | b*                 | Standard error of b* | b        | Standard error of z b | t(6)     | p-value  |
| Intercept            | -1.150             | 0.387    | -4.440   | 1.495    | -2.970   | 0.025    |
| Volume of harvest (m³) | 0.593             | 0.387    | 0.135    | 0.088    | 1.531    | 0.177    |

Figure 2. The number of cable yarders, the number of employees and accidents during the years 2006–2014.
to 12 (17%) in June. As can be seen in Fig. 6, the number of accidents is more or less even, with extremes in February and June. Increased accident rate in February could be due to increased risk in this month — unsuitable climatic conditions, slippery terrain, etc. Similarly, climatic conditions were also the most feasible factor for increased accident rate in June, when mean outside temperatures reach 30°C. The lowest accident rate on the other hand, was recorded in December, and this was most likely caused by the winter holidays. We tested whether any differences in the severity of injuries showed in particular months, however through the χ²-test we determined there was no significant effect of the month of year on the severity of injuries sustained in an accident (χ² = 23.94<33.92, df = 22, p = 0.35).

The most frequent agent causing accidents were Particles, dust, splinters, fragments, etc. (encoded 14.05 by ESAW) (Fig. 7), which caused 26 (36% of the total count) accidents. Another 18 accidents (25%) were due surfaces at ground levels (encoded 01.02 by ESAW), followed by 15 accidents (21%) caused by loads transported by mechanical handling devices. Both mechanical hand tools for sawing (07.02) and hand tools for drilling, turning, or screwing (06.05) caused four accidents each (6% each). Numerous other material agents caused one accident each, the details can be seen on Fig. 7. As for the mode of injury, 41 accidents (57% of the total count) happened when the victims were moving, 13 (18%) happened when the material agents fell from above, six accidents (8%) happened when the victims lost control of their hand tools, and four (6%) happened due to contact with a sharp agent.

Practice is an important factor, which has fundamental effect on the frequency of accidents. Victims with less practice had accidents more frequently, 49 (68%) accidents happened to victims with less than five years of practice and another 10 accidents (14%) happened to victims with 5–10 years of practice (Fig. 8). The figure shows that the decrease of occupational accidents is exponential. The χ²-test also showed that length of practice significantly affects the severity of accidents the victims had (χ² = 27.71>5.10, df = 14, p = 0.02).

Discussion

Östereichische Bundesforste (2004) state that in the year 2003 increased frequency of occupational accidents was reported, mainly due to increased incidental fellings, which corresponds with our results. Eiwegger (2009)
reported similar results, stating that due to the increased volume of incidental fellings, more employees worked in Austrian state forests. This increase in employment changed the structure of yarder crews, which caused increased frequency of accidents occurring that year (Odenthal–Kahabka, 2005; Sonnleitner & Seebacher, 2003). Potočnik et al. (2009) and KWF (2014) report that contusions were the most frequent types of injuries, followed by dislocations, cuts, and fractures. To compare, in Austrian state forests, as well as Germany fractures constituted 9% of the total count of accidents, whereas in Slovenia it was 6%. Contusions constituted 40% of all accidents in Austria, 56% in Slovenia (Potočnik et al., 2009), and 41% in Germany (KWF, 2014). Lindroos & Burström (2010) state that fractures are the most frequent types of injuries (25% of the total count of occupational accidents), damage to teeth (23%), and dislocations (19%). According to statistics conducted by hospitals, more than one third of all patients were admitted with contusions (Lindroos & Burström, 2010). The differences between countries, and our results were caused by the differences in the technologies used in yarding.

Regarding the distribution of occupational accidents throughout the day, Tsioras et al. (2014) reported results similar to ours. However, they found that most accidents occur between 10:00 and 10:59 and 11:00 to 11:59. Bentley et al. (2005); Wetmann (2005); Fischer (1991); Stadlmann (1991) state that most workers work most intensively between 10:00 to 12:00. Bentley et al. (2002); Kirk (1996); Parker & Ashby (2005) state that fatigue of workers in this period increases, due to depleting the energy the workers received from breakfast begins to deplete and dehydration often occurs. Camino–Lopéz et
al. (2011) state that the accident rate is connected with food intake. In our case, the most accidents happened between 13:01 and 14:00, whereas Tsioras et al. (2014) report culmination of frequency of accidents an hour later — between 14:00 and 14:59.

Tsioras et al. (2014) state that the most, almost one quarter, accidents happen on Monday and thereafter the accident rate decreases steadily until Sunday. Wetmann (2005) and Fischer (1991) state that Monday and Tuesday are the days when most accidents occur, which corresponds with our results. The authors state that the frequency of accidents on Friday was less than half of the frequency on any other day. Tsioras et al. (2011) report similar results. Jacke (1989) states that the increased number of accidents on Monday can be attributed to the change of occupations after the weekend (e.g. yarder operator can work as chainsaw worker the next week, etc.), he attributes higher accident rate on Wednesday to fatigue in the middle of the work week, and the decrease of accident rate at the end of the week to the fact that most workers work more than eight hours per day from Monday to Thursday and a shorter shift on Friday.

The most frequent mode of injury was that the victims fell or slipped. This result corresponds with the findings of Tsioras et al. (2014), who state that 36 % of accidents were falls or slips, followed by accidents caused by the material agent falling (23 %). These types of accidents are common in forestry, as reported by Driscoll et al. (1999). Falling material agents are a broad term, the agents can vary from small particles to whole stems of trees during yarding (Brodie & Ibrahim, 2010).

Conclusions

In this study we focused on the analysis of accidents occurring during timber yarding in Central Europe. Compared to other studies, the accident rate in particular years varied significantly, and the total accident count depended on the volume of harvested timber and share of incidental fellings in SFR. This study informs about the most important risk factors in timber yarding, the most hazardous parts of shift, as well as the days when the most accidents occur during the week, and as such contributes to better understanding of how the accidents happen in timber yarding. The information can be subsequently used in knowledge-based improvement of safety trainings in forest enterprises.

Acknowledgements

We would like to thank to Miroslav Slotta, director of Enterprise of Forest Technique in Banská Bystrica and to Ján Sokol from the same enterprise, who helped us with gathering the data for the research.

References

Bentley TA, Parker RJ, Ashby L, Moore DJ, Tappin DC, 2002. The role of the New Zealand forest industry injury surveillance system in a strategic ergonomics, safety and health research programme. Appl Ergon 33(5): 395–403. https://doi.org/10.1016/S0003-6870(02)00037-6

Bentley T, Parke R, Ashby L, 2005. Understanding felling safety in the New Zealand forest industry. Appl Ergon 36(2): 165–175. https://doi.org/10.1016/j.apergo.2004.10.009

Brodie LR, Ibrahim JE, 2010. Fatal injury in tree felling and related activities, Victoria, Australia 1992–2007. Injury Prev 16(1): 53–56. https://doi.org/10.1136/isp.2009.021683

Camino-Lopez MA, Fontanea I, Gonzalez-Alcantara OJ, Ritzel DO, 2011. The special severity of occupational accidents in the afternoon: ‘The lunch effect’. Accid Anal Prev 43(3): 1104–1116. https://doi.org/10.1016/j. aap.2010.12.019

Crowe MP, 1986. Hardwood logging accidents and countermeasures for their reduction. Aust Forest 49: 44-55. https://doi.org/10.1080/00049158.1986.10674462

Driscoll T, Healey S, Hendrie L, Mandryk J, Mitchell R, 1999. Work-related traumatic fatalities involving timber activities in Australia, 1989–1992. Epidemiology Unit, National Occupational Health and Safety Commission, Canberra, Australia.

Eiwegger A, 2009. Arbeitssicherheit bei der Seilrückung – Auswertung von Arbeitsunfällen (Work safety during cable yarding – Evaluation of Accidents). Diplomarbeit am Institut für Forsttechnik (Diploma thesis at the Institute of Forest Engineering). Universität für Bodenkultur, Wien, 57 pp.

Evanson T, Parker R, Ashby L, Bentley T, 2001. Analysis of lost time injuries—2000 logging (accident reporting scheme statistics).COHFE Rep. 2(6): 2001.s

ESAW, 2013. http://ec.europa.eu/eurostat/documents/3859598/592681/KS-RA-12-102-EN.PDF

Fischer M, 1991. Unfallursachenforschung als Grundlage für die Unfallverhütung (cause analysis of accidents as basis for accident prevention). Diplomarbeit am Institut für Forsttechnik. Universität für Bodenkultur, Wien, 38 pp.

Foley G, 1994. Forestry logging and log sawmilling industries:occupational health and safety performance overview, Australia 1991–92. J. Occupational Health Safety—Australia New Zealand 10 (5): 467–474.

Gandaseca S, Yoshimura T, 2001. Occupational Safety, Health and Living Conditions of Forestry Workers in Indonesia. J For Res 6: 281–285. https://doi.org/10.1007/BF02762469

Green Report, 2015. http://www.mpsr.sk/index.php?navID =123&id=9795

Jacke H, 1989. Die Unfallhäufigkeit im Wochenverlauf (accident frequency along the week days). Allgemeine Forst Zeitschrift 48(6): 1276–1281.
Kawachi I, Marshall SW, Cryer PC, Wright D, Slappendel C, Laird I, 1994. Work-related injury among forest workers in New Zealand. J. Occupational Safety Health—Australia New Zealand 10: 213–223.

Kirk P, 1996. Reducing the impact of fatigue on forest workers. Liro Report 21(3).

Klun J, Medved M, 2007. Fatal accidents in forestry in some European countries. Croatian J For Eng 28: 55–63.

KWF, 2014. Unfallstatistik 1999–2014 (Accident Statistics 1999–2014). Available on http://www.kwf-online.de/index.php/wissenstransfer/unfallstatistik/352-zeitreihen-dieraender?highlight=WyJ1bmZhbGxzGF0aXNoaWsiXQ==.

Lilley R, Feyer AM, Kirk P, Gander P, 2002. A survey of forest workers in New Zealand – Do hours of work, rest, and recovery play a role in accidents and injury? J Saf Res 33: 53–71. https://doi.org/10.1016/S0022-4375(02)00003-8

Lindroos O, Burstrom L, 2010. Accident rates and types among self-employed private forest owners. Accident Analysis Prevention 42(6): 1729–1735. https://doi.org/10.1016/j.aap.2010.04.013

Lesy SR, 2016. Available on http://www.lesy.sk/files/lesnik2013/lesnik10_13-web.pdf.

Lukáč T, Štollman V, Messingerová V, 2001. Forest cableways (Lanovky v lesnictve). Vydal : Ústav pre výchovu a vzdelávanie pracovníkov LVH SR, Zvolen 2001.

Mitchell R, Driscoll T, Healey S, Mandryk J, Hendrie L, Hull B, 2001. Fatal injuries in Forestry and logging work in Australia, 1999 to 1992. J Occupat Health Safety – Australia New Zealand 17(6): 567-577.

Melemez K, 2015. Risk factor analysis of fatal forest harvesting accidents: A case study in Turkey. Safety Sci 79 (2015) 369–378. https://doi.org/10.1016/j.ssci.2015.07.004

Messingerová V, Stanovský M, Ferencik M, Kovičík P, 2009. Technological Planning in Cableway Terrains in Slovakia. In Proceedings of 42nd International Symposium on Forestry Mechanization-FORMEC. Pp. 307-315.

Myers JR, Fosbroke DE, 1994. Logging fatalities in the United States by region, cause of death and other factors - 1980 through 1988. J Safety Res 25, 97-105. https://doi.org/10.1016/0022-4375(94)90021-3

Odenthal-Kahabka J, 2005. Hadreichung Sturmschadens-bewältigung. Hrsg. Landesforstverwaltung Baden-Württemberg und Landesforsten Rheinland-Pfalz. Österreichische Bundesforste, 2004. Nachhaltigkeitsbericht zum Geschäftsjahr 2004 (Sustainability Report for the Year 2004).

Parker R, Bentley T, Ashby L, 2002. Forestry applications of human factors research. In: Brien, T.G., Charlton, S.G. (Eds.), Handbook of Human Factors Testing and Evaluation, second ed. Lawrence Erlbaum Associates, Hillsdale NJ.

Parker R, Ashby L, 2005. Chainsaw related injuries. COHFE Report 6(1). Centre for Human Factors and Ergonomics, Rotorua, New Zealand.

PauloZZI LJ, 1987. Fatal logging injuries in Washington State, 1977 to 1983. J Occupat Medic 29: 103-108.

Peters PA, 1991. Chainsaw felling fatal accidents. Trans. Am. Soc. Agric. Eng. 34, 2600–2608. https://doi.org/10.101301/2013.31912

Potocnik I, Pentek T, Poje A, 2009. Severity analysis of accidents in forest operations. Croatian J Forest Engin 30(2): 171–184.

Regulation No. 500/2006 on registration of accidents at work (Vyhľáska MPSV aR č. 500/2006 Z.z., ktorou sa ustanovuje vzor záznamu o registrovanom pracovnom úraze).

Salisbury DA, Brubaker R, Hertzman C, Loeb GR, 1991. Fatalities among British Columbia railers and buckers. Can J Public Health 82: 32-37.

Slappendel C, Laird I, Kawachi I, Marshall S, Cryer C, 1993. Factors affecting work-related injury among forestry workers: A review. J Safety Res 24: 19-32. https://doi.org/10.1016/0022-4375(93)90048-R

Sonntleitner G, Seebacher D, 2003. Unfallverhütung bei der Aufarbeitung von Sturmschadholz (Accident protection during processing of windthrown wood). BFW Praxis Information 1: 6-8.

Stadlmann H, 1991. Motorsägen – Unfallanalyse 1990/91 (Chainsaws – Analysis of Accidents 1990/91). SVB, Wien, 16 pp.

Tajboš J, Slugeň J, Iľčík Š, 2012. Description of the cableway Mouny 4000. Manag companies. ISSN 1338-4104. 2(1): 66-69.

Tsioras PA, Rottensteiner Ch, Stampfer K, 2011. Analysis of Accidents During Cable Yarding Operations in Austria 1998 – 2008 Croat J Forest Eng 32(2011): 2.

Tsioras PA, Rottensteiner Ch, Stampfer K, 2014. Wood harvesting accidents in the Austrian State Forest Enterprise 2000 – 2009. Safety Sci 62(2014): 400–408. https://doi.org/10.1016/j.ssci.2013.09.016

Visser R, Stampfer K, 1998. Cable extraction of harvester felled thinnings: An Austrian case study. J forest Engin 9(1): 39-46.

Wettmann O, 2005. Berufsunfalle in Forstbetrieben 2003 (Occupational Accidents in Forest Enterprises for the Year 2003). SUVA, Luzern. 26 pp.

Worrell WC, Bolding MC, Aust WM, 2011. «Potential soil erosion following skyline yarding versus tracked skidding on bladed skid trails in the Appalachian region of Virginia.» South J App Forestry 35(3): 131-135.