

Occupational safety and health in Europe's forestry industry

Summary

Forests and other wooded land cover about 160 million hectares, some 35% of the European Union's land area. As well as wood, forests provide cork, Christmas trees, resins, pine nuts, medicinal plants, mushrooms and berries. They are a valuable resource, but forests are a dangerous place to work: the incidence of fatal or major injuries is higher than in many other sectors, with forest workers using chainsaws to fell trees being at particular risk. Heavy physical workloads, noise, vibration and exposure to biological hazards and chemicals also put forest workers at risk. This E-Fact outlines the dangers of working in forestry and provides information on prevention.

European forestry – an introduction

Forestry, forest based, and related industries in the EU can be broken down into: Woodworking, cork, and other forest based materials, pulp, paper and paper-board manufacturing, the paper and paper-board converting, and the printing industry. ¹ This sheet concentrates on the occupational safety and health issues in woodworking, cork and other forest-based activities.

Forestry related employment was estimated at around 3.4 million workers in 2005², and while in some states employment has fallen in the sector due to rapid mechanisation, in others such as Spain and Latvia it has gone up³. Forest ownership in Europe varies considerably. In many countries there is a high proportion of private forest: about 80% in Austria and Sweden, 72% in Denmark and Slovenia, 68% in Finland and more than 90% in Portugal⁴. In Europe as a whole half the forest is privately owned. In Finland and Sweden there is significant ownership by forest companies.

Forests and other wooded land cover about 160 million hectares, some 35% of the European Union's land area, with the enlargement of the EU in May 2004 to 25 Member States increasing the amount of forested and wooded land by 20%. Forest coverage ranges from 1.1% in Malta to 72% in Finland, with the largest forested areas in Sweden, Finland, Spain and France. The amount of forested land continues to expand, with Europe containing a great diversity of forest types. The three main forest zones in Europe are: the boreal coniferous zone forests with firs, spruces and pines; the central European forests of birches, oaks, maples and beeches; and the



Occupational safety and health in Europe's forestry industry

Mediterranean forests of eucalyptus, cork-oak, stone and maritime pine, chestnut and holm oak.

The EU-25 is the world's biggest producer of sawnwood and second largest for roundwood production with about 20% of the world's production^{5,6}. The main producers of roundwood in the EU-25 are Sweden, Finland, Germany, France and Poland. The northern countries of the EU-25 produce mainly coniferous wood, whereas the Mediterranean countries produce as much non-coniferous as coniferous wood⁷.

As well as wood, forests provide cork, Christmas trees, resins, pine nuts, medicinal plants, mushrooms and berries and other products. Cork is one of the most important non-wood forest products in the EU, with the EU producing being the largest producer, and Portugal the largest producer in the EU^{8,9}. The bark is manually harvested from cork trees with a special axe from May to August.

Pine nuts are an important crop in the Mediterranean south-west of Europe. Pine cones are often gathered by hand, using portable escalators and long wood sticks to remove those at the top of trees and from branches. Wood from the holm oak, which is also native to the Mediterranean region, is used in the manufacture of charcoal.

Christmas trees are another important product. About 7 million Christmas trees are felled each year in Denmark, Europe's leading exporter^{10,11}. Christmas tree production includes mainly fir, spruce or pine trees from plantations, as well as the harvest of individual trees from other forest areas. In many countries, Christmas tree plantations are classified as agricultural land, not as part of the forest area¹².

Accidents in the European forestry industry

Tree and forestry work is considered high-risk, with the sector having high fatal and major injury rates¹³. The self-employed, farmers, and contractors appear to be particularly at risk. The reasons for this may be that the self-employed and farmers may use forestry tools for only part of their job and so may lack experience and knowledge in the tasks, while forestry contractors have to carry out work in short periods of time, frequently changing their workplace. A lack of organisation between the host employer and the contractor may also be a contributory factor.

Amongst the causes of fatal accidents are:

- Falling trees
- Accidents with vehicles
- Accidents with work equipment



Occupational safety and health in Europe's forestry industry

Common causes of none—fatal accidents include:

- Falling trees and branches
- Slips and trips
- Accident with work equipment^{14,15}

Common types of injury received include:

- Bruises
- Sprains and strains
- Cuts and laceration
- Fractures
- Ticks and insects bites and stings

What are the risks of forestry work?

The nature of forestry work is changing in Europe, with a more mechanised wood harvesting, however much work is still carried out manually, with widespread chainsaw use.¹⁶ Manual operations include logging, limbing (debranching)ⁱ, bucking (crosscutting)ⁱⁱ and debarking. Mechanical operations include mechanical logging with tree harvesters, forwarding and removing stumps.

Forest workers who fell trees with chainsaws are perhaps exposed to the greatest risks in the industry. High-risk operations include bringing down "hung-ups", taking care of windthrow, and cleaning up after forest fires. Tree planters are also at risk from carrying heavy loads of seedlings and planting in awkward positions. Pesticides and fungicides used on seedlings are also a hazard.

Manual operations

Chainsaws are one of the most efficient, productive but dangerous portable power tools used in the forestry industry. They have the potential to cause terrible injuries. One of the biggest hazards is kickback, which happens when the chainsaw comes into contact with objects such as rocks, logs or branches. The saw abruptly kicks up and back towards the worker, who can lose control of it. The parts of the body most exposed are the head, shoulders, upper arms, hands, legs and feet. Forest workers must be trained and wear appropriate personal protective equipment.

Personal Protective Equipment

The nature of forestry work can mean that personal protective equipment (PPE) is frequently required as the hazards and risks cannot

ⁱ Limbing is the removal of the branches from either standing or downed trees

ⁱⁱ Bucking is the process of cutting the downed tree into appropriate lengths



Occupational safety and health in Europe's forestry industry

be controlled by other means. PPE is not pleasant to wear for long periods, can create additional hazards, has to be chosen correctly (making sure that it fits each worker) and workers require training in its proper use, along with somewhere to safely store the equipment.

PPE may include protective clothing for preventing cuts (e.g. from chainsaws), protective footwear, suitable gloves for the environment, materials and substances being handled, and work being done, and protective headgear, which may incorporate personal hearing protection and face protectors. Other PPE may include eye protection, leg protectors, high-visibility clothing, and respiratory protective equipment. ^{17, 18, 19}

Most deaths occur as a result of falling trees. **Felling** should be carried out professionally to safeguard the health and safety of workers. A plan should be made for each felling and a risk zone established, with other workers excluded from the danger area, and the logger retreating as soon as it moves. Workers need to be well trained.

Manual logging includes **limbing** and **bucking** trees. Falling trees often brush other trees and leave broken limbs hanging in the surrounding trees. If they come down, these overhead hazards can cause major or even fatal injuries.

Eucalyptus trees can pose particular problems. Mechanical logging operations may be easily applied to eucalyptus trees with a single trunk; however, after cutting the first trunk two or three new branches can start to grow low on the trunk, making it difficult to use a harvester to process the tree in the next cutting period. Therefore, manual cutting using a chainsaw will be needed. In southern Europe, cutting eucalyptus trees with a chainsaw is the cause of a significant number of accidents. Perhaps the most hazardous work is limbing trees from November to March using a special limbing chainsaw, which is operated by a single hand. The operation, if performed from a portable ladder or by standing on the tree is highly dangerous because trees are humid and have slippery moss during the winter. Some 90% of the accidents in cork tree harvesting occur during limbing operations compared to just 10% during bark harvesting. Injuries and open wounds, such as lacerations, cuts and contusions, are frequent, as are falls from cork trees²⁰.

Pines cones may be gathered by hand or by using a vibrating tool. Manual operations are frequently used to harvest pines cones in southern Europe. When pines cones are gathered by hand, workers use a portable extensive escalator and a long wood stick to remove the cones from the tops of trees and branches. Falling from trees and from portable ladders are the most



Occupational safety and health in Europe's forestry industry

common causes of accidents during cone gathering at heights of 5-15 metres.

Forest fires

Forest fires are a particular hazard in parts of Europe. About 50,000 fires burn a surface of 500,000 ha every year in Europe. Forest fires in Portugal, Spain, France, Italy and Greece break out regularly, often without obvious reason. During the forest fire season of 2000 in the southern Member States of the EU, 30 fire fighters, pilots, civilians and other volunteers involved in fire fighting lost their lives. In these five southern countries, 60,633 fires were observed from 2000-2004, burning an area covering 464,090 ha.

Clearance of windblow

Clearing windblowⁱⁱⁱ is one of the most hazardous operations in forestry. Only workers fully competent in felling, the taking down of hung-up trees, debranching and cross-cutting stems under tension should be employed to work with windblown trees.

All workers engaged in the clearance of windblow should be instructed about the high risks it entails, in particular cutting wood under tension and dealing with trees lying across each other.

The high risks of accidents in forest work mean that lone working puts the person at particular risk should they suffer an accident or injury. For this reason, lone working may be restricted in Member States (e.g. when working with chainsaws). Workers who work alone should be able to request help by radio, mobile phone or emergency call systems. The dangers in the sector may also mean that there are restrictions to the activities permitted by young workers.

Dealing with windblow

- NEVER work in windblow on your own.
- Ensure you hold the appropriate competency in windblow for the task you are undertaking.
- Do not walk or work under unstable windblown trees or root plates.
- Avoid walking along the stems or branches of windblown trees.
- Be careful when working with trees under tension and sawing roots

ⁱⁱⁱ Windblow (or windthrow) is a tree, trees, or parts of trees (windbreakage) blown down by the wind



Occupational safety and health in Europe's forestry industry

- When working in windblow with machinery, an agreed system of work and a suitable system of communication must be identified.
- Wear personal protective equipment
- When working manually with chainsaws, work only during daylight with sufficient breaks.²¹

Mechanical operations

The mechanisation of felling operations in the forest industry is increasing. With this increase has come a change in the type of accidents suffered by workers. In Poland, where the chainsaw remains the basic tool used in felling and limbing, the level of mechanisation of wood harvesting operations is relatively low. Horses and farm tractors are still often used as the basic means of extraction²². In northern European countries, such as Finland and Sweden, harvesters — machines that integrate all felling operations except debarking²³ — have replaced the chainsaw.

Accident rates in harvester operation are low, but they rise when chain-saw operators work alongside them. Mechanical operations must be planned and the safety of other persons in the working area ensured. Maintenance of harvesters is hazardous: repairs are always done under severe work pressure so slips, trips and falls are a constant risk. Uncomfortable and awkward working positions, heavy lifting, contact with hydraulic oils and hot oils under pressure and stress also pose health hazards. There are also risks in using a similar type of vehicle, known as the "feller-buncher"²⁴, for full-tree logging.

Forwarders are extraction machines that carry a load of logs off the ground. They usually have a mechanical or hydraulic crane for loading and unloading logs. Accidents with forwarders are similar to those involving tractors and other forestry machines such as skidders and tractor crawlers: overturning, penetrating, being struck by vehicles, slips and trips, falling objects, electric power lines and maintenance problems. Health hazards also include vibration and noise²⁵.

Occupational diseases and ill health in the forestry industry

Carrying out heavy physical work, and being exposed to noise, vibrations, biological and chemical hazards put forestry workers at risk of harm. Musculoskeletal disorders (MSDs) are a particular concern with the combination of carrying heavy loads and exposure to vibrations.

Woodworking tools may expose workers to **vibration** that could result in hand-arm vibration and vibration induced "white finger" syndrome²⁶. Chainsaws may put workers at particular risk. Whole-body vibration, from working with large forest machines such as harvesters, all-terrain vehicles



Occupational safety and health in Europe's forestry industry

and forwarders, is uncomfortable and tiring for the operator and can cause serious harm over time²⁷. The combined exposure of workers to vibration and muscular work, and to awkward postures is a matter of concern²⁸

Risks increase when proper damping techniques are not applied, machines are not maintained, tools are not alternated and workers use a vibrating tool or vehicle for long periods without a break. Workers should receive training on the hazards of working with vibrating tools or vehicles²⁹ and the relevant preventive measures.

Carrying **heavy loads**³⁰ over extended periods of time, such as during the harvesting or transporting of timber may increase the risk of MSDs in forestry workers, particularly if the pace of work is too high, or the workers have not been trained in good working practices.

High **noise** levels can cause permanent hearing loss. Common sources of noise in the forestry industry include all-terrain vehicles, stump grinders, wood chippers chainsaws and peeling machines.

Pesticides are used in forests and forest nurseries to control fungi, insects and rodents. The treatment of saplings or planting of treated saplings exposes workers to risks. These risks can be managed if the work is planned and workers well trained³¹. Workers working with pesticides should be protected so they do not inhale or absorb chemicals through the skin. The safety data sheet for each pesticide contains information about risks and protective measures. The measures required for protecting workers is set out in national legislation following a common hierarchy of control measures, and may include the use of personal protective equipment (PPE) and respiratory protective equipment (RPE). Other **dangerous substances** that may affect the health of forestry workers include fertilisers, colourants for marking trees and timber and exhaust gases from chainsaws.

Outdoor workers, especially in agriculture and forestry, may be exposed to biological hazards^{32, 33} from contact with animals, plants, bacteria or viruses. Plant and wood products, such as wood, bark, sawdust and pollen and insects, may also cause allergic reactions. In the Mediterranean countries, contact with the pine processionary caterpillar (*Thaumetopoea pityocampa*), which attacks pine and cedar forests, can cause an allergic skin reaction, eye problems and problems with the respiratory tract.

Infections and diseases transmitted by animals are a significant biological hazard. The most common carriers (vectors) in Europe are ticks, carrying the bacteria that causes Lyme disease (borreliosis) and flavivirus that can lead to encephalitis³⁴, and small rodents can transmit Leptospirosis (Weil's disease).



Occupational safety and health in Europe's forestry industry

In most cases, indirect transmission occurs from contact with *Leptospira*-contaminated water or soil.

The protection of workers from biological hazards should be considered in their employer's risk assessment, and prevention should follow the established hierarchy of control. PPE may be required, along with routine body checks to guard against ticks. Access to clean, fresh water for washing should also be provided.

European Legislation for the forestry sector

European Directives exist that establish minimum occupational safety and health standards; these directives are transposed into national legislation in every Member States. The most important is Council Directive 89/391/EEC³⁵ of 12 June 1989 ("the framework directive") on the introduction of measures to encourage improvements in the safety and health of workers at work sets general duties on employers and workers, establishes a hierarchy of control, and requires employers to undertake a risk assessment.

The main points of the directive are that the employer has to:

- ensure that an assessment is made of the risks to the safety and health of workers
- take the necessary preventive measures
- ensure that the workers and/or their representatives receive the necessary information, in particular on safety and health risks, preventive measures, first aid and fire fighting
- ensure that each worker receives adequate and job-specific safety and health training
- consult workers and/or their representatives and allow them to take part in discussions on all questions relating to safety and health at work.

Each worker also has to take care, as far as possible, of his/her own safety and health and to make correct use of machinery, tools, dangerous substances and personal protective equipment. The improvement of workers' safety, hygiene and health at work is an objective that cannot be subordinated to purely economic considerations.

The framework directive is supplemented by individual "daughter" directives covering specific health and safety issues. Some of the most relevant are listed at the end of this document.

Directives are transposed into national legislation by Member States, which may also have their own specific legislation. It is important to ensure that you are aware of the legislation applicable in your own country.



Occupational safety and health in Europe's forestry industry

Risk assessment step by step

The legal requirement for risk assessment applies to all employers. The guiding principles that should be considered throughout the risk assessment process^{iv} can be broken down into a series of steps:

Step 1. Identifying hazards and those at risk

Looking for those things at work that have the potential to cause harm, and identifying workers who may be exposed to the hazards.

Step 2. Evaluating and prioritising risks

Estimating the existing risks (their severity, their probability) and prioritising them in order of importance. It is essential that the work to be done to eliminate or prevent risks is prioritised.

Step 3. Deciding on preventive action

Identifying the appropriate measures to eliminate or control the risks.

Step 4. Taking action

Putting in place the preventive and protective measures through a prioritisation plan (most probably all the problems cannot be resolved immediately) and specifying who does what and when, when a task is to be completed and the means allocated to implement the measures.

Step 5. Monitoring and reviewing

The assessment should be reviewed at regular intervals to ensure it remains up to date. It has to be revised whenever significant changes occur in the organisation or as a result of the findings of an accident or "near miss"^v investigation.

^{iv} Whether the risk assessment process in your country is divided into more or fewer steps, or even if some of the five steps are different, the guiding principles should be the same

^v A near miss is an unplanned event that did not result in injury, illness, or damage - but had the potential to do so.



Occupational safety and health in Europe's forestry industry

Planning and organising work

The high-risk nature of forestry work means that planning and organization is required to prevent risks to workers. The ILO notes that such planning and organization should be based on a forest management plan, which should indicate:

- what type of work is necessary;
- the objectives of the operation;
- the location of the designated worksites;
- the time schedule for specific operations;
- specifications for products or other outputs;
- specifications for working methods to be used;
- the person responsible for carrying out and supervising the operations;
- a contingency plan in the event of bad weather or problems with equipment.³⁶

Annex: Relevant legislation

- Council Directive 89/391/EEC of 12 June 1989 ("the framework directive") on the introduction of measures to encourage improvements in the safety and health of workers at work
- Council Directive 89/655/EEC of 30 November 1989 concerning the minimum safety and health requirements for the use of work equipment by workers at work (second individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
- Council Directive 89/656/EEC of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace
- Council Directive 90/269/EEC of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers (fourth individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
- Council Directive 2003/10/EC of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise) (Seventeenth individual directive within the meaning of Article 16(1) of Directive 89/391/EEC)
- Council Directive of 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration) (sixteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)
- Council Directive 2000/54/EC of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work (seventh individual directive within the meaning of Article 16(1) of Directive 89/391/EEC)
- Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents



Occupational safety and health in Europe's forestry industry

at work (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC),

- Machinery Directive 89/392/EEC (Amended 98/37/EEC) concerning the construction of forest equipment
- Council Directive 89/654/EEC of 30 November 1989 concerning the minimum safety and health requirements for the workplace

Annex: Relevant standards

Existing standards, such as ISO and CEN standards, give detailed technical information concerning forest equipment to prevent accidents. These include:

- ISO 11806:1997 Agricultural and forestry machinery – portable, handheld, combustion engine driven brush cutters and grass trimmers – safety
- ISO 11850:1996 Machinery for forestry – self-propelled machinery – safety
- ISO 3789-4:1988 Tractors, machinery for agriculture and forestry – technical means for ensuring safety – part 4: forestry winches
- ISO 3463:1989 Wheeled tractors for agriculture and forestry – protective structures – dynamic test method and acceptance conditions
- ISO 4254-1:2005 Agricultural machinery – safety – part 1: general requirements
- ISO 4254-5:1992 Tractors and machinery for agriculture and forestry – technical means for ensuring safety – part 5: power-driven soil-working equipment
- ISO 11850:2003 Machinery for forestry – self-propelled machinery – safety requirements
- ISO 11681-1:2004 Machinery for forestry – portable chainsaw safety requirements and testing – part 1: chainsaws for forest service
- ISO 11681-2:2006 Machinery for forestry -- portable chain-saw safety requirements and testing – part 2: chainsaws for tree service
- ISO 9412: 1991 Portable chainsaws – automatic chain brake and cutting equipment – operator's safety test
- ISO 11805 Manually portable forest machinery – chainsaws for tree service – safety requirements and testing
- EN 608:1994 Agricultural and forestry machinery – portable chainsaws – safety

¹ European Commission DG Agriculture *Main characteristics of the EU forest sector* web page at http://ec.europa.eu/agriculture/fore/characteristics/index_en.htm#book2

² European Commission SCADPlus summary of legislation *EU Forest strategy (2005)* <http://europa.eu/scadplus/leg/en/lvb/l60040.htm> accessed January 2008 also see



Occupational safety and health in Europe's forestry industry

European Commission COM(2005) 84 final *Communication from the Commission to the Council and the European Parliament Reporting on the implementation of the EU Forestry Strategy* {SEC(2005) 333} 2005 http://eur-lex.europa.eu/LexUriServ/site/en/com/2005/com2005_0084en01.pdf

³ Ministerial Conference on the Protection of Forests in Europe: *State of Europe's Forests 2003 The MCPFE Report on Sustainable Forest Management in Europe*, <http://www.mcpfe.org/publications/pdf> accessed January 2008

⁴ United Nations Economic Commission for Europe (UNECE) Press release 2005 *Europe's forest increasing, says the most detailed and comprehensive assessment ever of the world's forests* For Global Forest Resources Assessment 2005 by the Food and Agriculture Organisation (FAO) http://www.unece.org/press/pr2005/05tim_p08e.htm and <http://www.fao.org/forestry/site/fra2005/en/> Accessed January 2008

⁵ Zanata Y, *Roundwood production in EU-25 – EU-25 and the world 2006* Statistics in focus Agriculture and fisheries Nr. 8, 4 pp..

⁶ Mäki-Simola E, Panagopoulos K, *The production of wood and forest industry products in EU-25 2005*, Statistics in focus Agriculture and fisheries Nr. 44, 4 pp.

⁷ Zanata Y, *Roundwood production in EU-25 – EU-25 and the world 2006* Statistics in focus Agriculture and fisheries Nr. 8, 4 pp.

⁸ European Commission DG Agriculture *Main characteristics of the EU forest sector* web page at http://ec.europa.eu/agriculture/fore/characteristics/index_en.htm#book2, accessed January 2008

⁹ Andreas Voth *2003 Technological and Institutional Innovations for Sustainable Rural Development - Sustainable Cork Production in Changing Mediterranean Agroforestry System* http://www.tropentag.de/2003/abstracts/links/Voth_IG1UI0uy.pdf

¹⁰ Koch, N. E., *Danish Forests* Denmark portal <http://denmark.dk>

¹¹ Kucklick, C., Schauer M., *Fachinformationen zu Weihnachtsbäumen 2004*, http://www.weihnachtsbaeume.de/PDF/01_Fachinformationen_zu_Weihnachtsbaeum_en.pdf

¹² Ministerial Conference on the Protection of Forests in Europe: *State of Europe's Forests 2003 The MCPFE Report on Sustainable Forest Management in Europe*

¹³ Blombäck, P., Poschen, P. Lövgren, M. (ILO), *Employment Trends and Prospects in the European Forest Sector 2003* Geneva Timber and Forest Discussion Papers, United Nations.

¹⁴ Comision Nacional De Seguridad Y Salud En El Trabajo, Grupo De Trabajo Sector Agrario: *Trabajos Forestales España*, Junio 2006.

¹⁵ Kuratorium für Waldarbeit und Forsttechnik e.V., *Verletzungsursachen Waldarbeiter Staatswald 2004* Unfallstatistik, http://www.kwf-online.de/deutsch/mensch/unfall/unfall_index.htm

¹⁶ Blombäck P, *Improving occupational safety and health: the International Labour Organization's contribution* FAO corporate document repository.

¹⁷ Korhonen E, ILO encyclopaedia *Personal Protective Equipment* <http://www.ilo.org/encyclopedia/?doc&nd=857200390&nh=0>

¹⁸ Landwirtschaftliche Berufsgenossenschaft, Waldarbeit 2002 *Aktuelles zu Sicherheit und Gesundheitsschutz* pp. 64.



Occupational safety and health in Europe's forestry industry

- ¹⁹ NYCOSH *Personal Protective Equipment Occupational Safety and Health Training and Education. Program – factsheet* 2006
http://www.nycosh.org/workplace_hazards/PPE-1999.html
- ²⁰ ANSUB: Associação de produtores Florestais do Vale do Sado. Interview in 20 October 2006.
- ²¹ Adapted from HSE *chainsaw clearance of windblow guidance* 2003, modified
- ²² Jodlowski K *Forests and Forest Contractors in Poland* 1998 Food and Agriculture Organisation <http://www.fao.org/DOCREP/004/X4009E/X4009E12.htm#ch10>
- ²³ Axelsson S-A, *The Mechanization of Logging Operations in Sweden and its Effect on Occupational Safety and Health* 1998, International journal of Forest Engineering, volume 9 number 2
<http://www.lib.unb.ca/Texts/JFE/bin/get4.cgi?directory=July98/&filename=axelsson.html#8>
- ²⁴ Wikipedia http://en.wikipedia.org/wiki/Cruncher_bunchers
- ²⁵ Dykskra D, Poschen P, *Wood harvesting* 1999 ILO encyclopaedia
- ²⁶ Neitzel R, Yost M, *Tasked-Based Assessment of Occupational Vibration and Noise Exposures in Forestry Workers* 2001
http://staff.washington.edu/rneitzel/vib_document.pdf
- ²⁷ Almqvist, R., Gellerstedt, S., Tobish, R. *Ergonomic checklist for forest machines* 2006 European Commission, handbook, second edition,
<http://www2.spm.slu.se/ergowood>
- ²⁸ European Agency for Safety and Health at Work *Expert forecast on emerging physical risks related to occupational safety and health* 2005 ISBN 92-9191-165-8
- ²⁹ OSHA *Health hazards: vibration*
http://www.osha.gov/SLTC/etools/woodworking/health_vibration.html *
- ³⁰ Chapman L, Meyers J, National Agricultural Safety Database *Ergonomics and Musculoskeletal Injuries in Agriculture: Recognizing and Preventing the Industry's Most Widespread Health and Safety Problem*
<http://www.cdc.gov/NASD/docs/d001701-d001800/d001771/d001771.html>
- ³¹ Swedish work environment authority *Safe work with treated forest saplings and when treating after planting*
<http://www.av.se/dokument/publikationer/Broschyrrer/stormfalltdskog/Engelska.pdf>
- ³² INRS *La forêt et ses maux: de l'arbre à l'homme* 2002 XXVII^e Symposium national de médecine agricole 22. juin 2001, Tours, dmt notes de congrès
- ³³ Noraud P. *Forstarbeit heute*, (2004), *Internationales Kolloquium Prävention in der Land- und Forstwirtschaft* 31 August – 02 September 2004.
- ³⁴ European Agency for Safety and Health at Work *Expert forecast on emerging biological risks related to occupational safety and health* 2007 ISBN 92-9191-130-5
- ³⁵ Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work,
http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31989L0391&model=guichett
- ³⁶ International Labour Organization *Safety and health in forestry work: An ILO code of practice* 1998
<http://www.ilo.ch/public/english/protection/safework/cops/english/download/e981284.pdf>